

Test Report

Test report no.: 21116598-25034-1

Date of issue: 2022-12-20

Test result: The test item - **passed** - and **complies** with below listed standards.

Applicant

Nova Products GmbH

Manufacturer

Nova Products GmbH

Test Item

NOVA H1

RF-Spectrum Testing according to:

FCC 47 CFR Part 15

Radio Frequency Devices (Subpart C)

RSS-247, Issue 2 (2017-02)

Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen, Issue 5 (2018-04)

General Requirements for Compliance of Radio Apparatus

Tested by
(name, function, signature)

Karsten Gerald
Lab Manager RF


signature

Approved by
(name, function, signature)

Andreas Bender
Deputy Managing Director


signature

Applicant and Test item details

Applicant	Nova Products GmbH Thierschstr. 11 80538, München, Germany Phone: (phone number) Fax: (fax number)
Manufacturer	Nova Products GmbH Thierschstr. 11 80538, München, Germany
Test item description	Audio Earrings
Model/Type reference	NOVA H1
Standard specific information	
FCC ID	2A9NCNOVAH1
IC	29765-NOVAH1
HMN	N/A
PMN	H1 Audio Earrings
HVIN	NOVA H1
FVIN	N/A
Frequency	2.4 GHz ISM band (2400 – 2483.5 MHz)
Technology	Bluetooth Classic - Basic Data Rate (BDR) & Enhanced Data Rate (EDR)
Antenna	wire antenna
Power supply	3.6 V DC rechargeable lithium-ion button cell
Temperature range	0 °C – +45 °C

Disclaimer and Notes

The content of this test report relates to the mentioned test sample(s) only.
Without a written permit of IBL-Lab GmbH, this test report shall not be reproduced, except in full.

The last valid version is available at TAMSys®.

Copyright ©: All rights reserved by IBL-Lab GmbH

Within this test report, a ☒ point / ☐ comma is used as a decimal separator.
If otherwise, a detailed note is added adjoined to its use.

IBL-Lab GmbH does not take test samples. The samples used for testing are provided by the applicant.

Decision rule:

Decision rule based on simple acceptance without guard bands, binary statement, based on mutually agreed uncertainty tolerances with expansion factor k=2 according to ILAC-G8:09/2019

1 TABLE OF CONTENTS

1	TABLE OF CONTENTS	3
2	GENERAL INFORMATION	4
2.1	Administrative details	4
2.2	Possible test case verdicts	4
2.3	Observations	5
2.4	Opinions and interpretations	5
2.5	Revision history	5
2.6	Further documents	5
3	ENVIRONMENTAL & TEST CONDITIONS	6
3.1	Environmental conditions	6
3.2	Normal and extreme test conditions	6
4	TEST STANDARDS AND REFERENCES	6
5	EQUIPMENT UNDER TEST (EUT)	7
5.1	Product Description	7
5.2	Test Item Description	7
5.3	Technical Data of Equipment	7
5.4	Additional Information	8
5.5	Test modes	8
6	SUMMARY OF TEST RESULTS	9
7	TEST RESULTS	10
7.1	Carrier frequency separation	10
7.2	Number of frequency hopping channels	29
7.3	Time of channel occupancy	36
7.4	Emission bandwidth 20 dB	56
7.5	Occupied Bandwidth (99% OBW)	75
7.6	RF Output Power (Conducted Peak Power)	94
7.7	Antenna Gain, Peak E.I.R.P.	106
7.8	Band Edge Compliance (BEC), conducted	107
7.9	Band Edge Compliance (BEC), radiated	121
7.10	Conducted Spurious Emissions (CSE)	125
7.11	Radiated Spurious Emissions (RSE)	145
8	TEST SETUP DESCRIPTION	206
8.1	Semi Anechoic Chamber with Ground Plane	207
8.2	Fully Anechoic Chamber	209
8.3	Radiated measurements > 18 GHz	211
8.4	Conducted measurements WLAN test system R&S TS 8997	212
9	MEASUREMENT UNCERTAINTIES	213
Annex A	EUT Photographs, EUT #0 (conducted sample) external	214
Annex B	EUT Photographs, EUT #1 (natural pearl), external	215
Annex C	EUT Photographs, EUT #2 (artificial pearl) external	219
Annex D	EUT Photographs, internal	223
Annex E	Test Setup Photographs	226

2 GENERAL INFORMATION

2.1 Administrative details

Testing laboratory	IBL-Lab GmbH Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: www.ib-lenhardt.de E-Mail: info@ib-lenhardt.de
Accreditation	The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025:2018. Scope of testing and registration number: - Electronics, EMC, Radio D-PL-21375-01-01 - Electromagnetic Compatibility and Telecommunication (FCC requirements) Testing Laboratory Designation Number D-PL-21375-01-02 DE0024 - Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards D-PL-21375-01-03 27156 Testing Laboratory CAB Identifier DE0020 Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the ILAC Mutual Recognition Arrangement
Testing location	IBL-Lab GmbH Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	2022-08-25
Start – End of tests	2022-09-07 – 2022-10-14

2.2 Possible test case verdicts

Test sample meets the requirements	P (PASS)
Test sample does not meet the requirements	F (FAIL)
Test case does not apply to the test sample	N/A (Not applicable)
Test case not performed	N/P (Not performed)

2.3 Observations

No additional observations other than the reported observations within this test report have been made.

2.4 Opinions and interpretations

No appropriate opinions or interpretations according ISO/IEC 17025:2017 clause 7.8.7 are within this test report.

2.5 Revision history

-0 Initial Version

-1 Revision: changes 1/3

FCC ID, IC ID, PMN, HVIN added

2.6 Further documents

List of further applicable documents belonging to the present test report:

– no additional documents –

3 ENVIRONMENTAL & TEST CONDITIONS

3.1 Environmental conditions

Temperature	20°C ± 5°C
Relative humidity	25-75 % r.H.
Barometric Pressure	860-1060 mbar
Power supply	230 V / 50 Hz

3.2 Normal and extreme test conditions

	minimum	nominal	maximum
Temperature	-/-	20 °C	-/-
Relative humidity	-/-	45 % r.h.	-/-
Power supply	-/-	3.6 V DC	-/-

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
FCC 47 CFR Part 15	Radio Frequency Devices (Subpart C)
RSS-247, Issue 2 (2017-02)	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen, Issue 5 (2018-04)	General Requirements for Compliance of Radio Apparatus

Reference	Description
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
558074 D01 15.247 Meas Guide v05r02	Guidance for compliance measurements on digital transmission systems, frequency hopping spread spectrum systems and hybrid system devices operating under section 15.247 of the FCC rules

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product Description

Audio Earrings

*: as declared by applicant

5.2 Test Item Description

Model name*	NOVA H1
Serial number*	EUT #0 (conducted): 0822-00004 EUT #1 (natural pearl): 0822-00002 EUT #2 (artificial pearl): 0822-00003
PCB identifier*	EUT #0 (conducted): 8C1F64BD6006 EUT #1, Earring 2: 8C1F64BD6002 EUT #1, Earring 3: 8C1F64BD6003 EUT #2, Earring 4: 8C1F64BD6004 EUT #2, Earring 5: 8C1F64BD6005
Hardware status*	V1
Software status*	V1

*: as declared by applicant

5.3 Technical Data of Equipment

Operational frequency band*	2.4 GHz ISM band (2400 – 2483.5 MHz)
Modulation type*	GFSK, Pi /4-DQPSK, 8DPSK
Data rate*	1 Mbps, 2 Mbps, 3 Mbps
Number of channels*	79
Channel bandwidth*	1 MHz
Channel spacing*	1 MHz
Antenna*	wire antenna
Antenna gain*	-1.0 dBi
Rated RF Output Power*	< 100 mW (20 dBm)
Power supply*	3.6 V DC rechargeable lithium-ion button cell
Temperature range*	0 °C – +45 °C

*: as declared by applicant

5.4 Additional Information

Model differences	EUT #1 is equipped with a natural pearl (full testing performed). EUT #2 is equipped with an artificial pearl (Spurious testing only).
Ancillaries tested with	none
Additional equipment used for testing	Radio Communication Tester - CMW270

5.5 Test modes

Mode 1	GFSK, 1 Mbps
Mode 2	PS / 4-DQPSK, 2 Mbps
Mode 3	8DPSK, 3 Mbps
Low Channel	CH0 = 2402 MHz
Mid Channel	CH39 = 2441 MHz
High Channel	CH78 = 2480 MHz

6 SUMMARY OF TEST RESULTS

Test specification
FCC 47 CFR Part 15 RSS-247, Issue 2 (2017-02) / RSS-Gen, Issue 5 (2018-04)

Clause	Requirement / Test Case	Result - Remark	Verdict
15.247(a)(1) RSS-247, 5.1 (b)	Carrier frequency separation	KDB 558074, clause: 9	- PASS -
15.247(a)(1)(iii), (g) RSS-247, 5.1 (d)	Number of frequency hopping channels	KDB 558074, clause: 9	- PASS -
15.247(a)(1)(iii) RSS-247, 5.1 (d)	Time of channel occupancy	KDB 558074, clause: 9	- PASS -
§15.247(a)(1) RSS-247, 5.1 (a)	Minimum emission bandwidth 6dB, emission bandwidth 20 dB	KDB 558074, clause: 2.2	- PASS -
RSS Gen, 6.7	Occupied channel bandwidth (99%)	-/-	- PASS -
§15.247(b)(1) RSS-247, 5.4 (b)	RF output power (conducted peak power)	KDB 558074, clause: 9	- PASS -
§15.247(b)(4) RSS-247, 5.4 (b)	Antenna gain, Peak E.I.R.P.	-/-	- PASS -
§15.247(d) RSS-247, 5.5	Band edge compliance (BEC), conducted	KDB 558074, clause: 9	- PASS -
§15.247(d) RSS-247, 5.5	Band edge compliance (BEC), radiated	KDB 558074, clause: 9	- PASS -
§15.247(d) RSS-247, 5.5	Conducted spurious emissions (CSE)	KDB 558074, clause: 9	- PASS -
15.247(d) / §15.209 RSS-247, 5.5 / RSS-Gen, 8.9	Radiated spurious emissions (RSE)	-/-	- PASS -
§15.207 RSS-Gen, 8.8	AC conducted emissions	EUT is battery powered	- N/A -

Comments and observations

Following pages show requirements and references of FCC Part 15.247, ANSI C63.10 and KDB 558074 only. Same tests are also applicable and valid for RSS-247, with clauses given in table above.

7 TEST RESULTS

7.1 Carrier frequency separation

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum frequency value.

Limit

§15.247 (a)(1), RSS-247, 5.1 (b)

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 procedure

ANSI C63.10, 7.8.2

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

- a) Span: Wide enough to capture the peaks of two adjacent channels.
- b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- c) Video (or average) bandwidth (VBW) $\geq$ RBW.
- d) Sweep: No faster than coupled (auto) time.
- e) Detector function: Peak.
- f) Trace: Max-hold.
- g) Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

Compliance of an EUT with the appropriate regulatory limit shall be determined. A spectral plot of the data shall be included in the test report.

Where the device shares the same channel plan (carrier frequencies and number of channels) across multiple data rates or modulation schemes then the carrier separation need only be measured for one of those modulation schemes or data rates.

Test setup: 8.4 with conducted test sample (see section 5.2)

Test Results

EUT Mode	Carrier frequency separation			Limit [MHz]
	low channel [MHz]	mid channel [MHz]	high channel [MHz]	
Mode 1	1.010	1.010	1.010	≥ 0.620
Mode 2	1.010	0.9802	0.9802	≥ 0.877
Mode 3	1.010	1.010	1.010	≥ 0.847

Comment:

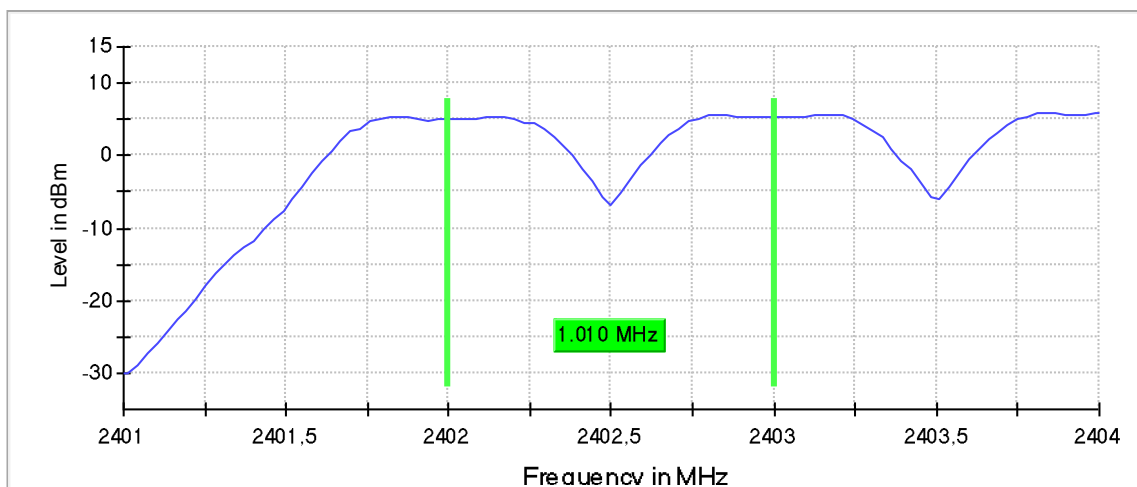
Verdict

- PASS -

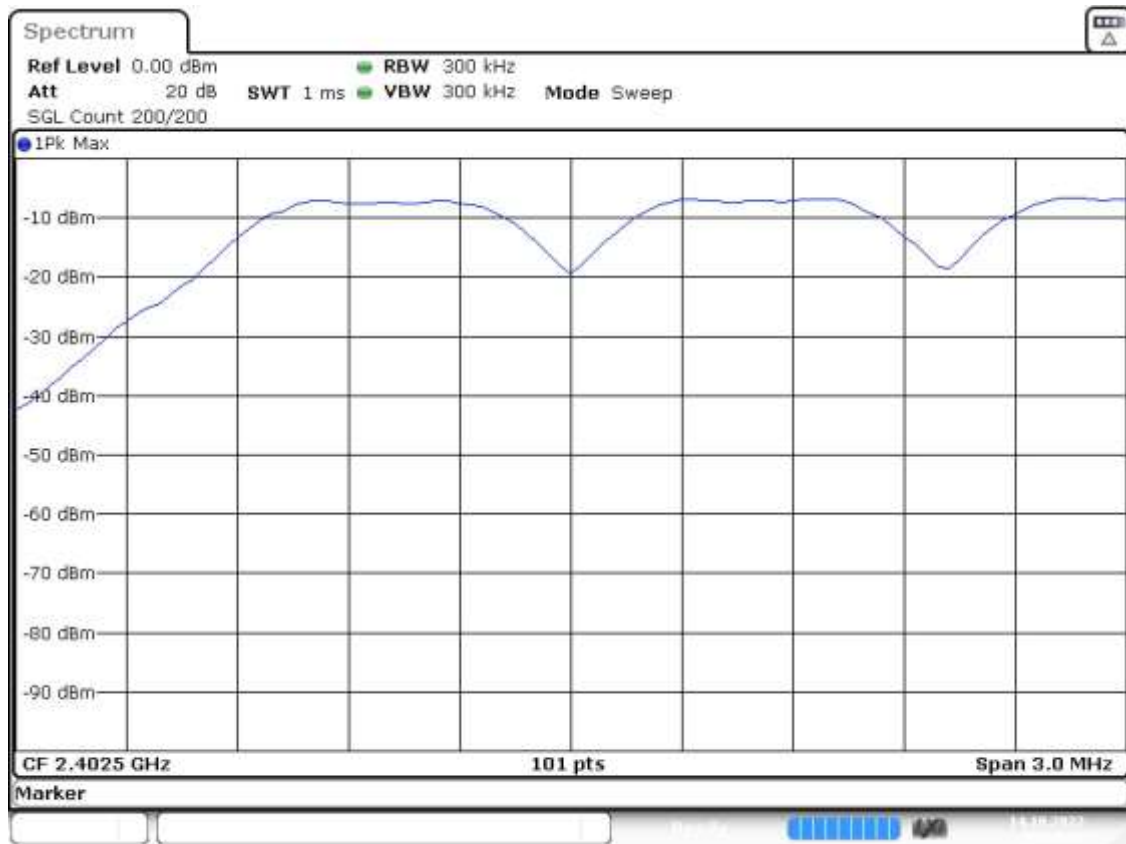
see next plots

Plot 1: EUT #0, Carrier Frequency Separation, Mode 1, low channel

CFS



DUT Frequency (MHz)	Frequency Separation (MHz)	Limit Min (MHz)	Limit Max (MHz)	Center Frequency low Channel (MHz)	Center Frequency high Channel (MHz)
2402.000000	1.009900	0.620000	---	2401.995050	2403.004950



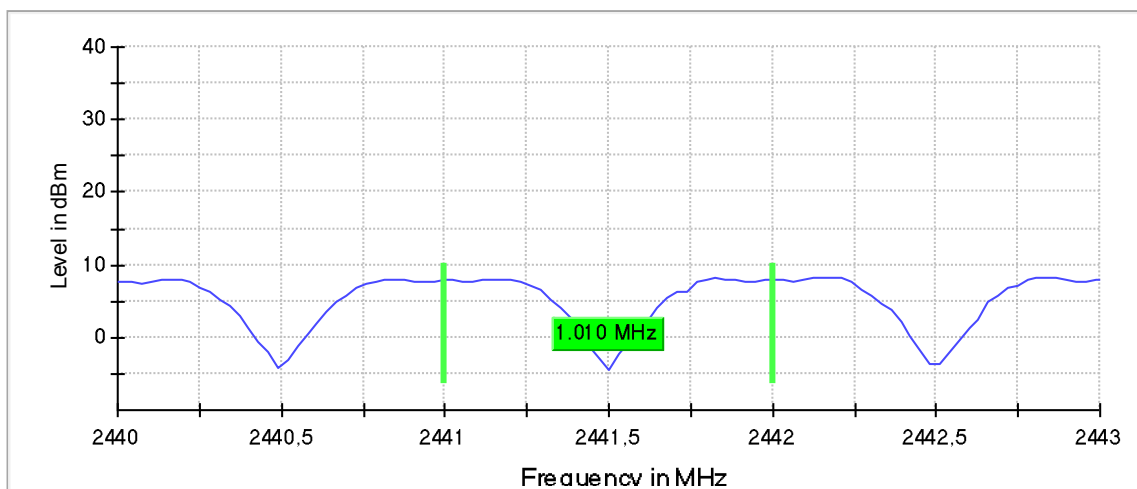
Date: 14.OCT.2022 15:22:52

Measurement

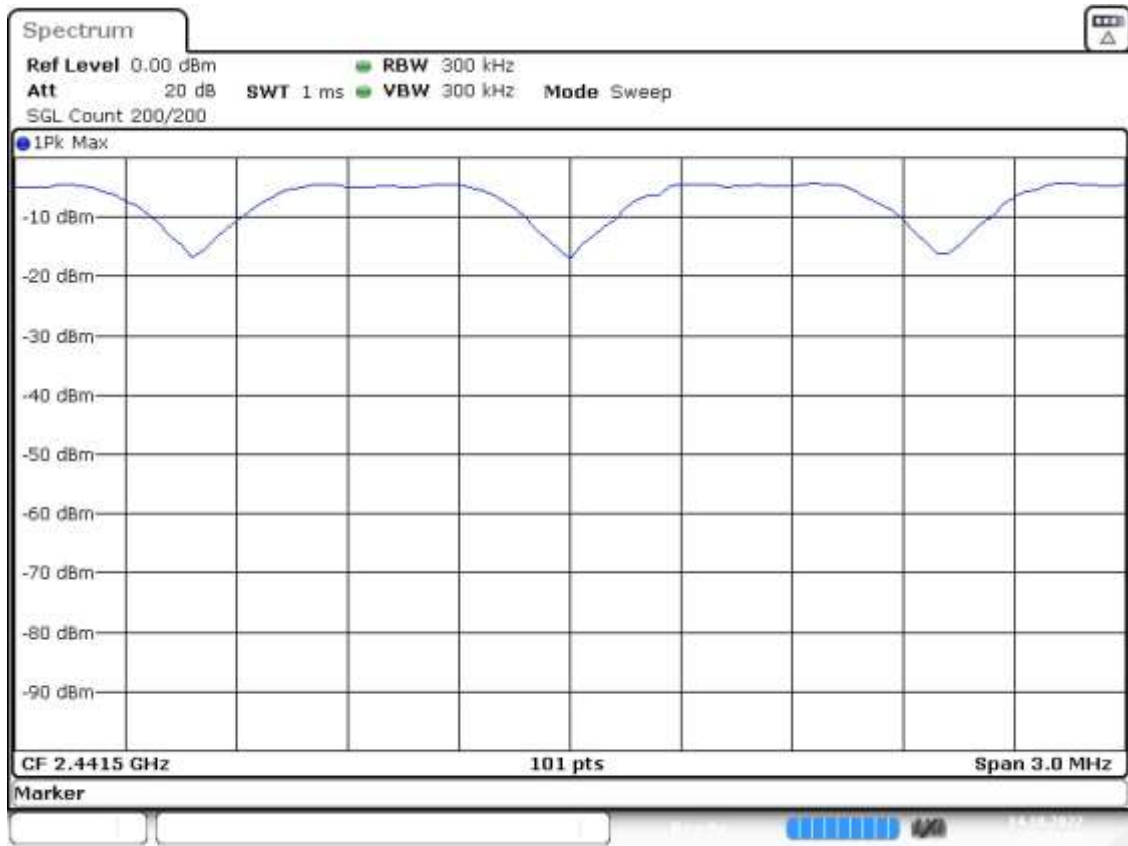
Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40400 GHz	2.40400 GHz
Span	3.000 MHz	3.000 MHz
RBW	300.000 kHz	≤ 300.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	101	~ 10
SweepTime	1.000 ms	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	23 / max. 150	max. 150
Stable	10 / 10	10
Max Stable Difference	0.00 dB	0.50 dB

Plot 2: EUT #0, Carrier Frequency Separation, Mode 1, mid channel

CFS



DUT Frequency (MHz)	Frequency Separation (MHz)	Limit Min (MHz)	Limit Max (MHz)	Center Frequency low Channel (MHz)	Center Frequency high Channel (MHz)
2441.000000	1.009900	0.620000	---	2440.995050	2442.004950

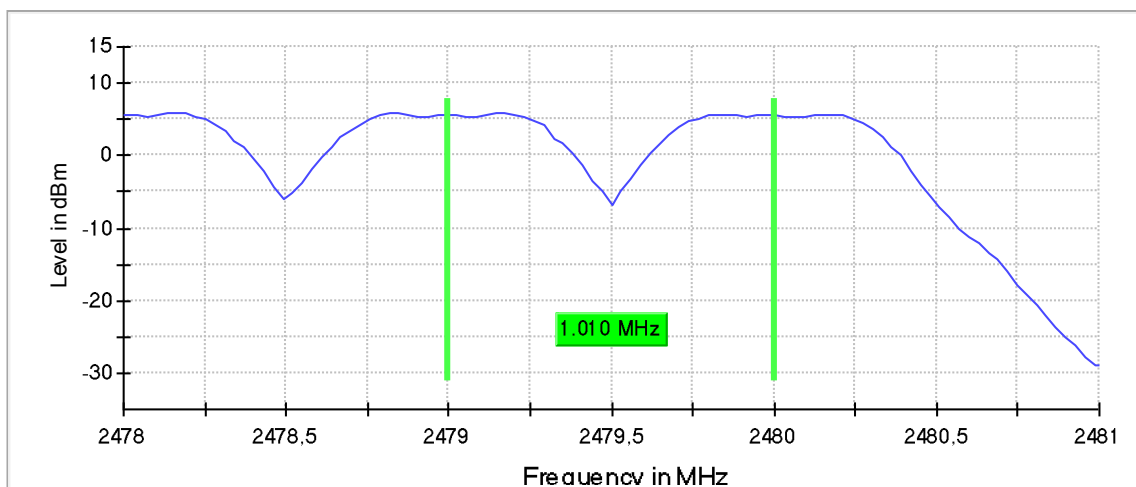


Date: 14.OCT.2022 15:23:03

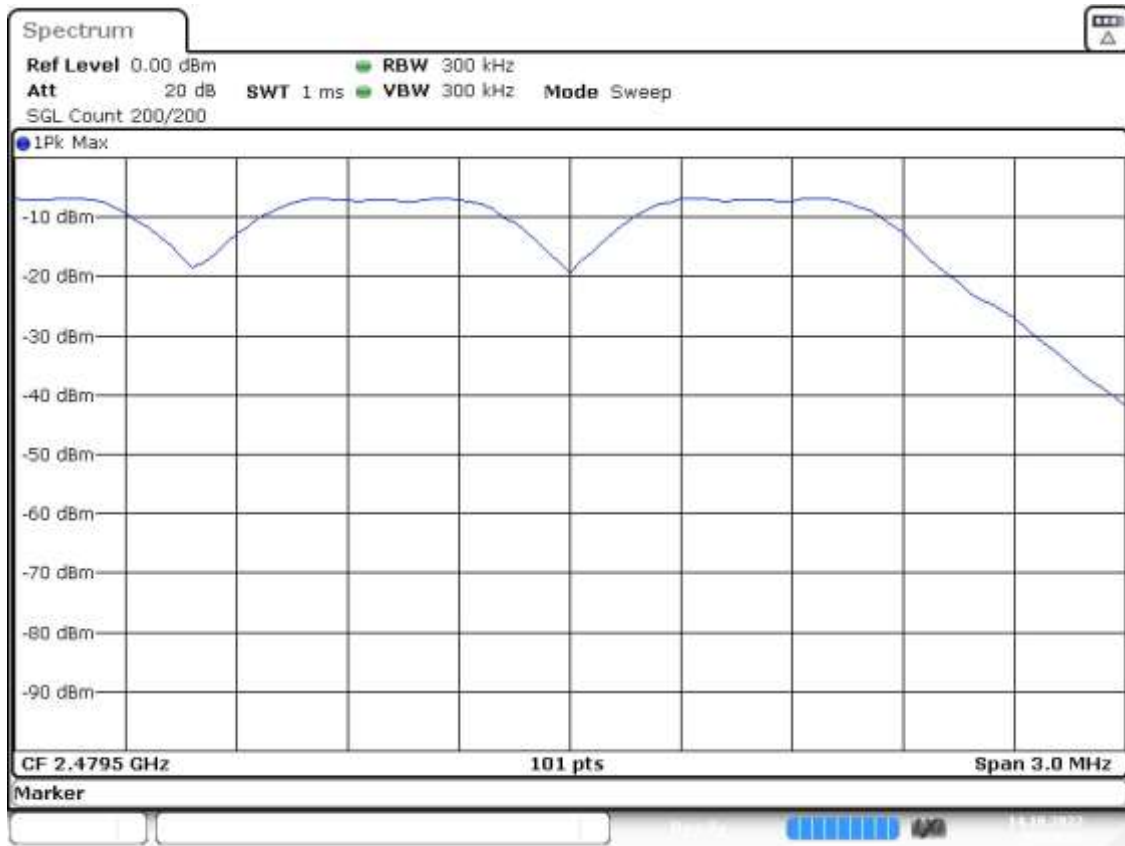
Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.44000 GHz	2.44000 GHz
Stop Frequency	2.44300 GHz	2.44300 GHz
Span	3.000 MHz	3.000 MHz
RBW	300.000 kHz	≤ 300.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	101	~ 10
Sweeptime	1.000 ms	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	12 / max. 150	max. 150
Stable	10 / 10	10
Max Stable Difference	0.00 dB	0.50 dB

Plot 3: EUT #0, Carrier Frequency Separation, Mode 1, high channel
CFS



DUT Frequency (MHz)	Frequency Separation (MHz)	Limit Min (MHz)	Limit Max (MHz)	Center Frequency low Channel (MHz)	Center Frequency high Channel (MHz)
2480.000000	1.009900	0.616667	---	2478.995050	2480.004950

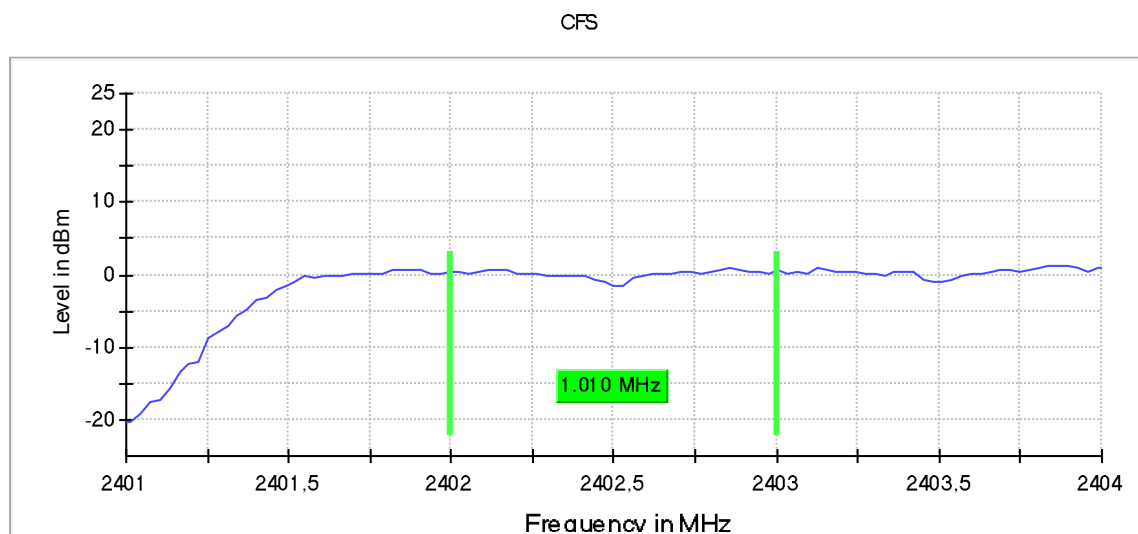


Date: 14.OCT.2022 15:23:25

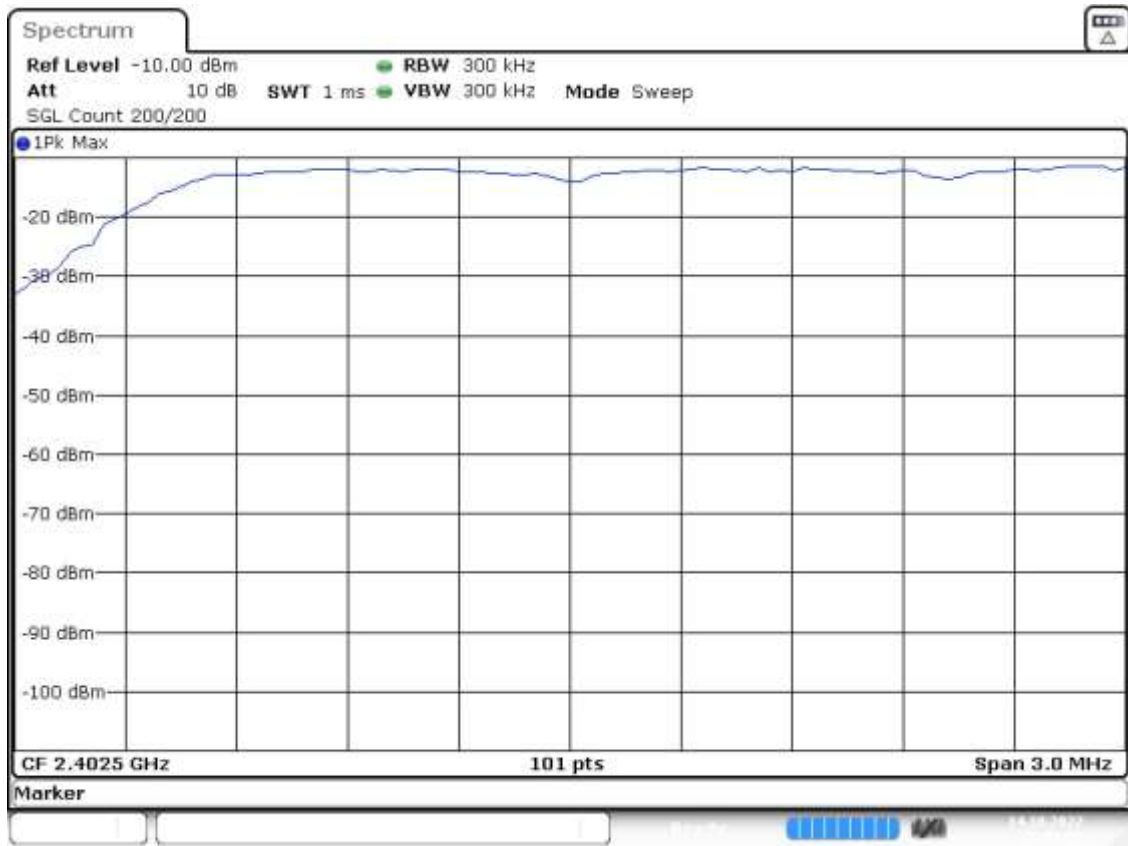
Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47800 GHz	2.47800 GHz
Stop Frequency	2.48100 GHz	2.48100 GHz
Span	3.000 MHz	3.000 MHz
RBW	300.000 kHz	≤ 300.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	101	~ 10
SweepTime	1.000 ms	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	Sweep
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	33 / max. 150	max. 150
Stable	10 / 10	10
Max Stable Difference	0.00 dB	0.50 dB

Plot 4: EUT #0, Carrier Frequency Separation, Mode 2, low channel



DUT Frequency (MHz)	Frequency Separation (MHz)	Limit Min (MHz)	Limit Max (MHz)	Center Frequency low Channel (MHz)	Center Frequency high Channel (MHz)
2402.000000	1.009900	0.863333	---	2401.995050	2403.004950

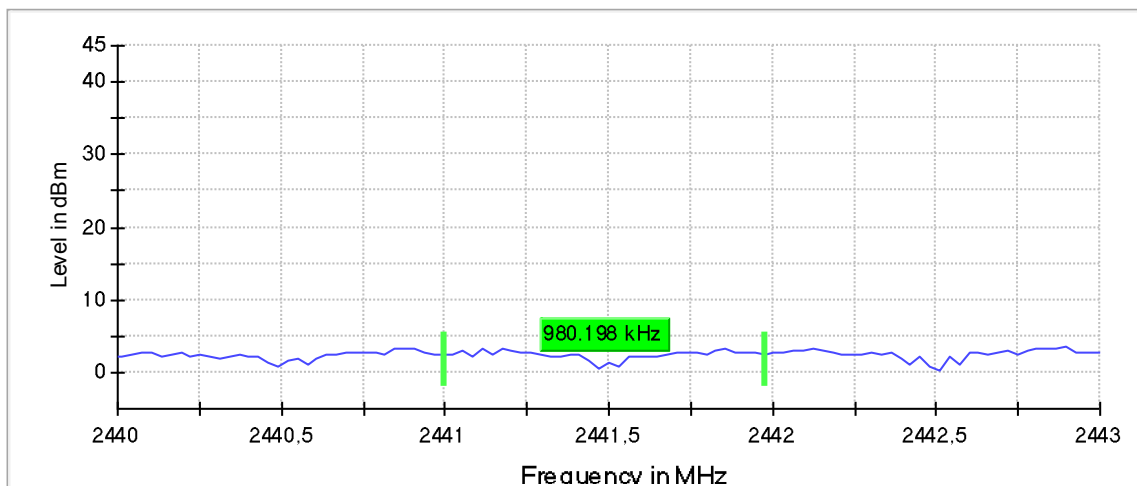


Date: 14.OCT.2022 15:56:20

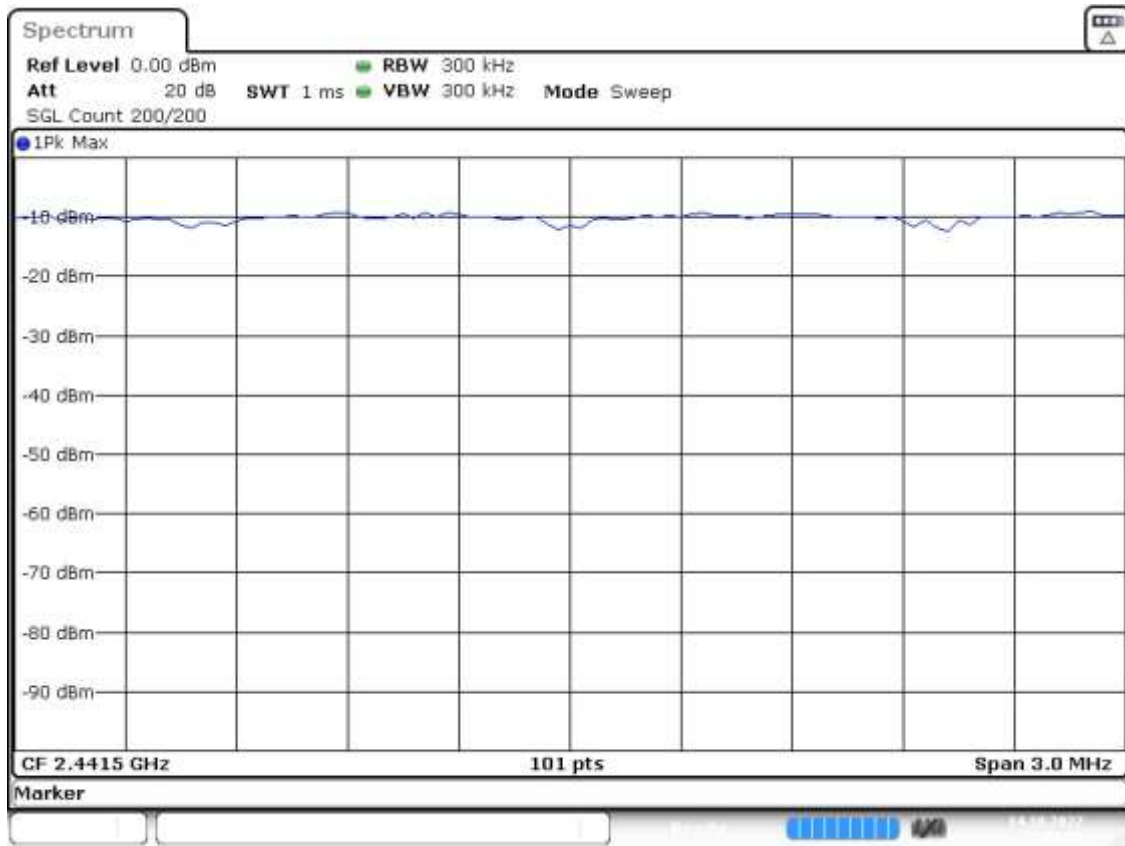
Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40400 GHz	2.40400 GHz
Span	3.000 MHz	3.000 MHz
RBW	300.000 kHz	<= 300.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	101	~ 10
Sweeptime	1.000 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	38 / max. 150	max. 150
Stable	10 / 10	10
Max Stable Difference	0.18 dB	0.50 dB

Plot 5: EUT #0, Carrier Frequency Separation, Mode 2, mid channel*
CFS



DUT Frequency (MHz)	Frequency Separation (MHz)	Limit Min (MHz)	Limit Max (MHz)	Center Frequency low Channel (MHz)	Center Frequency high Channel (MHz)
2441.000000	0.980198	0.866667	---	2440.995050	2441.975248

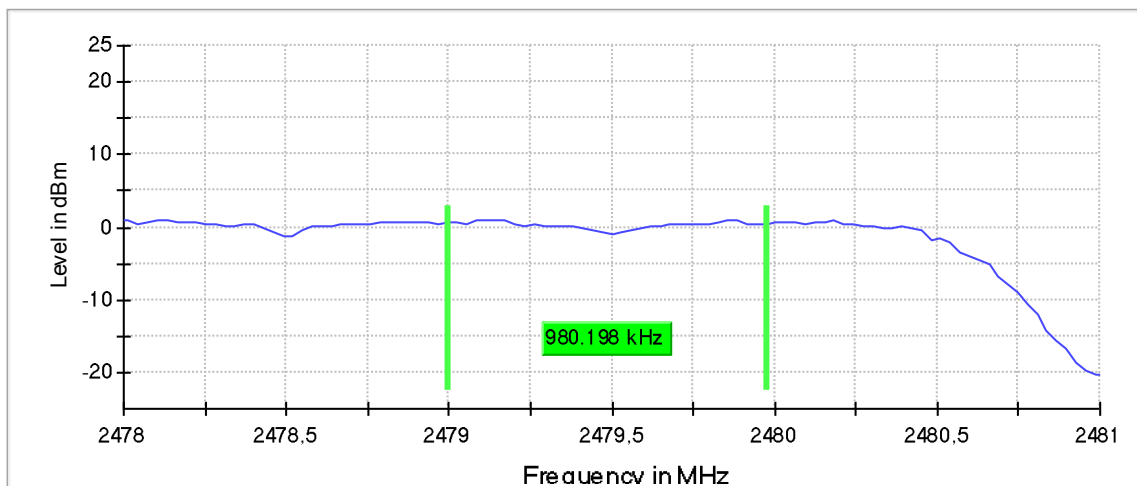


Date: 14.OCT.2022 15:58:30

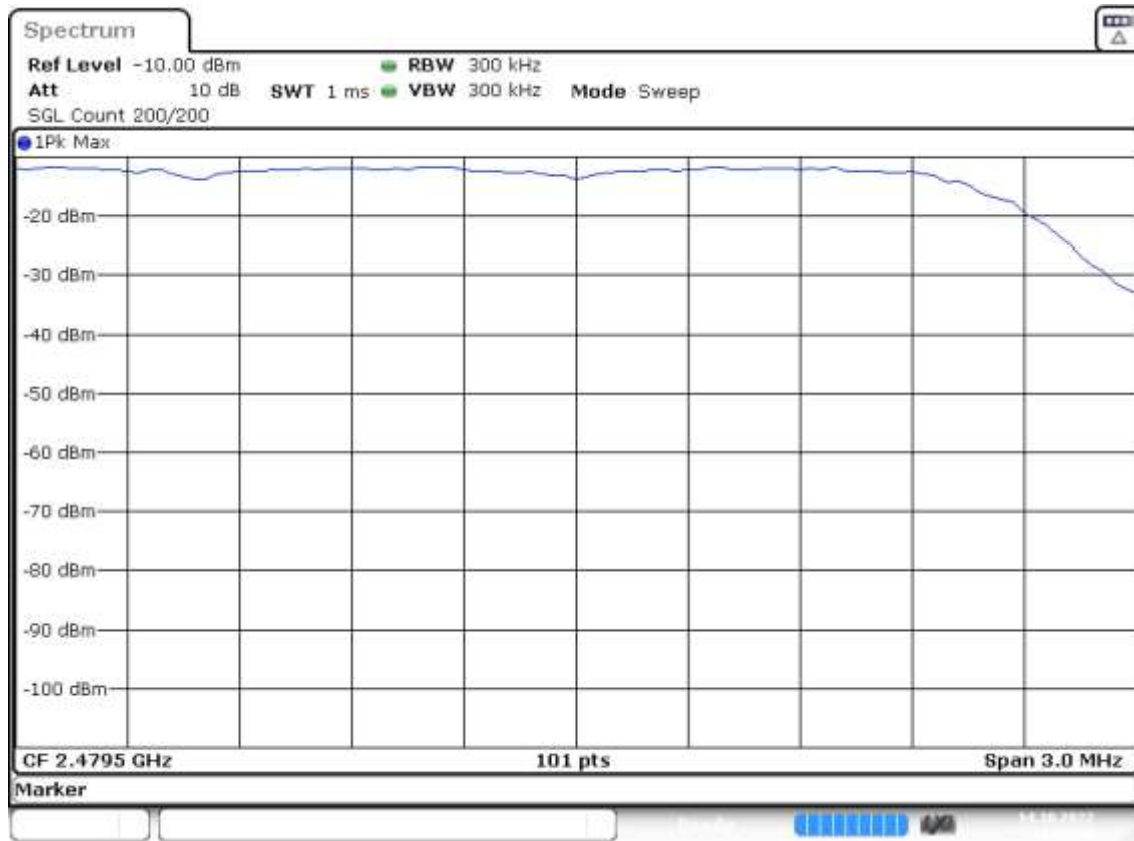
Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.44000 GHz	2.44000 GHz
Stop Frequency	2.44300 GHz	2.44300 GHz
Span	3.000 MHz	3.000 MHz
RBW	300.000 kHz	<= 300.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	101	~ 10
Sweeptime	1.000 ms	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	12 / max. 150	max. 150
Stable	10 / 10	10
Max Stable Difference	0.00 dB	0.50 dB

Plot 6: EUT #0, Carrier Frequency Separation, Mode 2, high channel
CFS



DUT Frequency (MHz)	Frequency Separation (MHz)	Limit Min (MHz)	Limit Max (MHz)	Center Frequency low Channel (MHz)	Center Frequency high Channel (MHz)
2480.000000	0.980198	0.863333	---	2478.995050	2479.975248



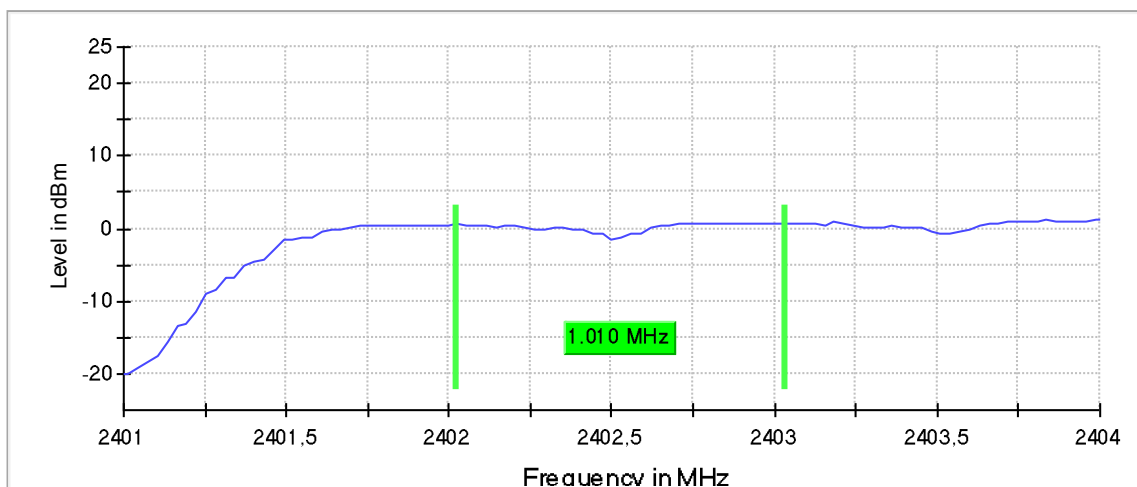
Date: 14.OCT.2022 15:57:25

Measurement

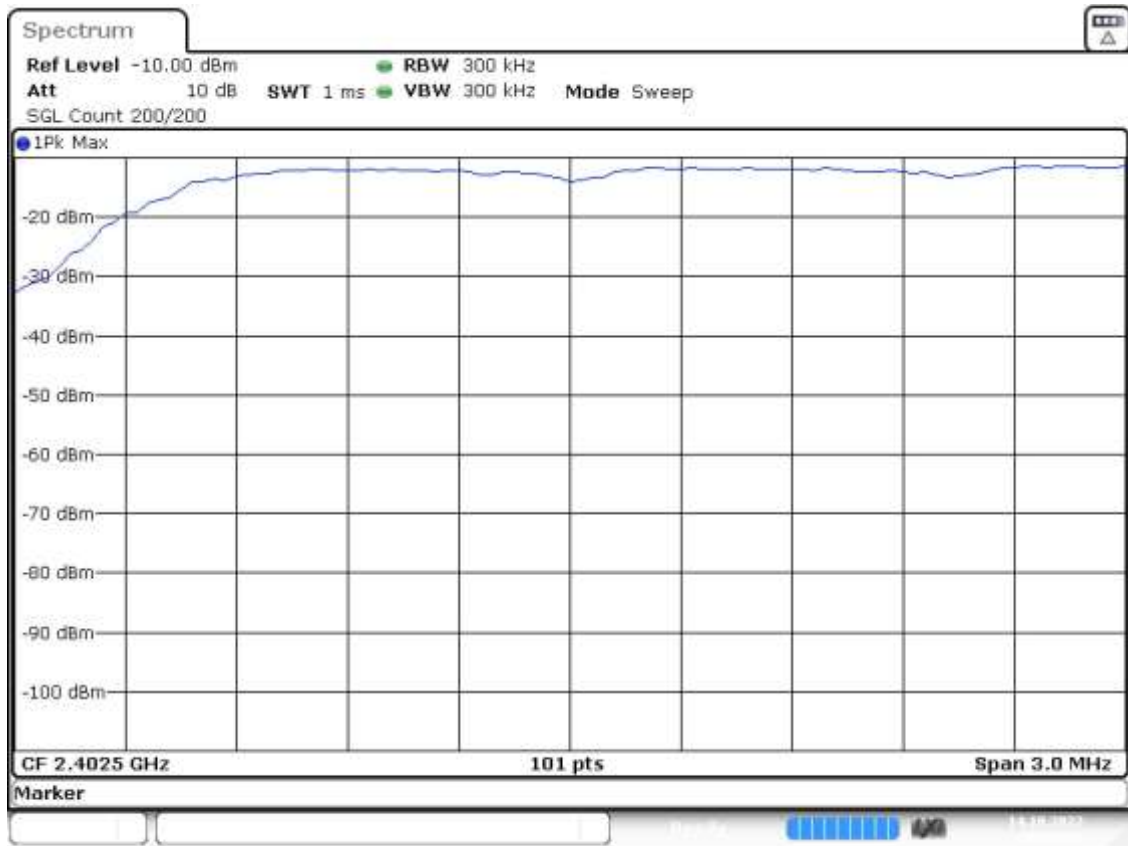
Setting	Instrument Value	Target Value
Start Frequency	2.47800 GHz	2.47800 GHz
Stop Frequency	2.48100 GHz	2.48100 GHz
Span	3.000 MHz	3.000 MHz
RBW	300.000 kHz	≤ 300.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	101	~ 10
SweepTime	1.000 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	43 / max. 150	max. 150
Stable	10 / 10	10
Max Stable Difference	0.00 dB	0.50 dB

Plot 7: EUT #0, Carrier Frequency Separation, Mode 3, low channel

CFS



DUT Frequency (MHz)	Frequency Separation (MHz)	Limit Min (MHz)	Limit Max (MHz)	Center Frequency low Channel (MHz)	Center Frequency high Channel (MHz)
2402.000000	1.009901	0.860000	---	2402.024752	2403.034653



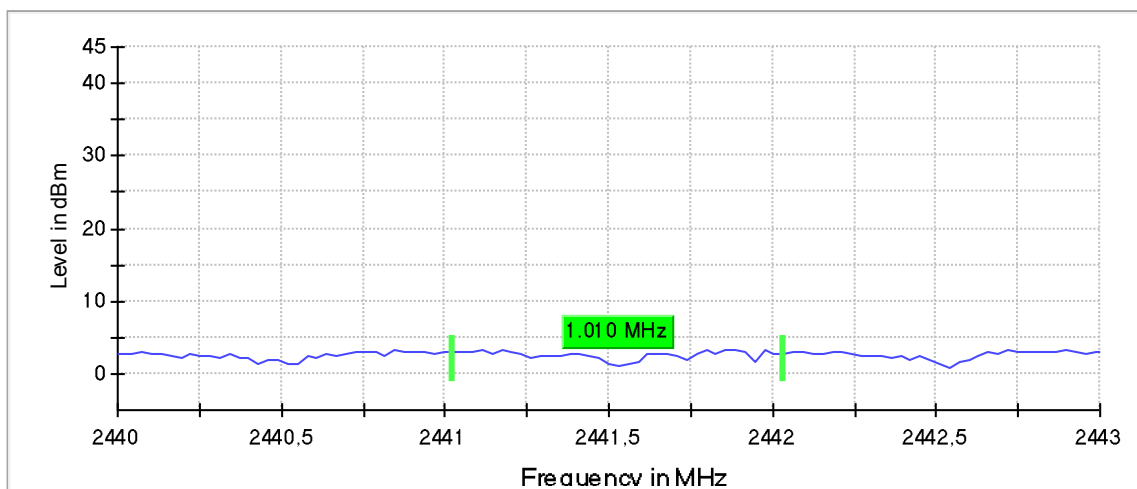
Date: 14.OCT.2022 16:41:54

Measurement

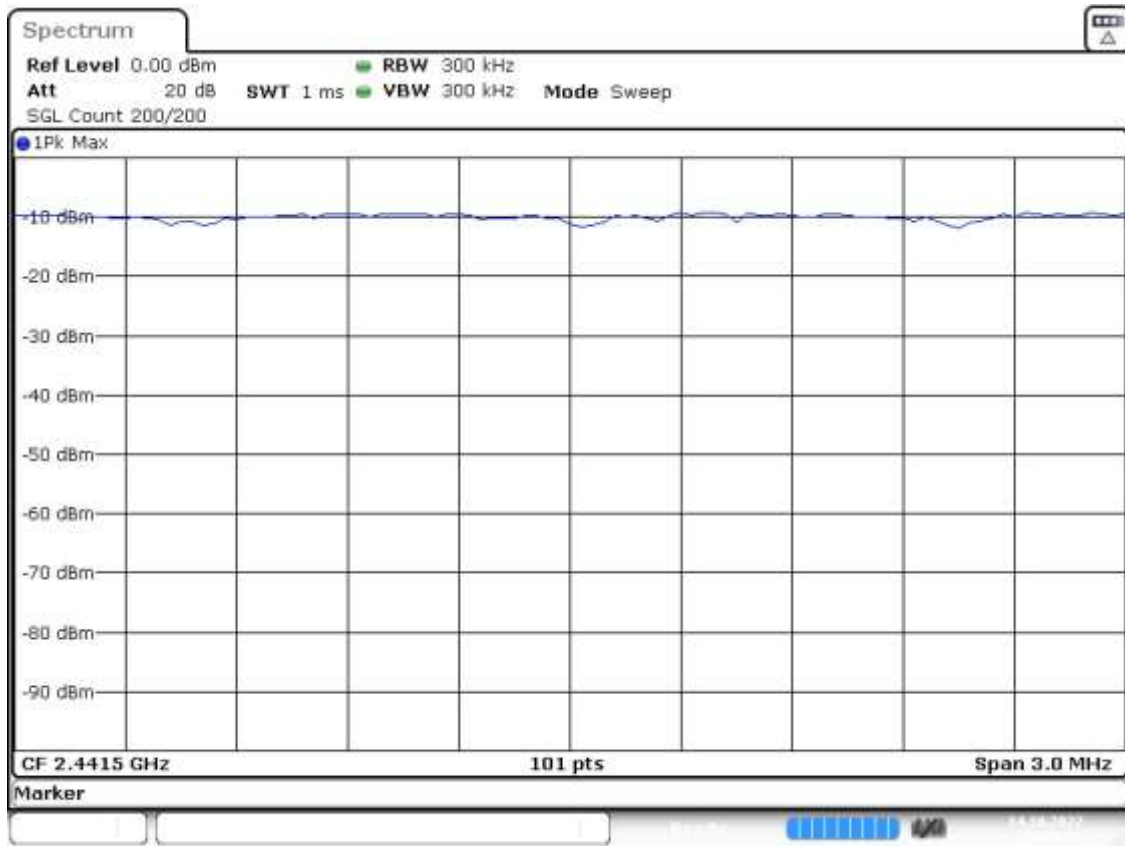
Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40400 GHz	2.40400 GHz
Span	3.000 MHz	3.000 MHz
RBW	300.000 kHz	<= 300.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	101	~ 10
Sweeptime	1.000 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	37 / max. 150	max. 150
Stable	10 / 10	10
Max Stable Difference	0.27 dB	0.50 dB

Plot 8: EUT #0, Carrier Frequency Separation, Mode 3, mid channel*

CFS



DUT Frequency (MHz)	Frequency Separation (MHz)	Limit Min (MHz)	Limit Max (MHz)	Center Frequency low Channel (MHz)	Center Frequency high Channel (MHz)
2441.000000	1.009901	0.850000	---	2441.024752	2442.034653

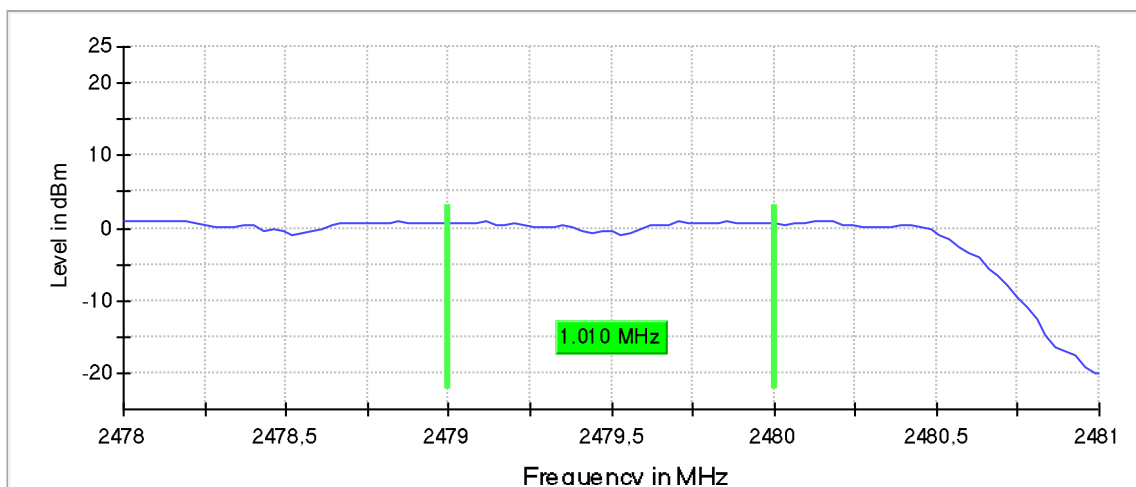


Date: 14.OCT.2022 16:42:07

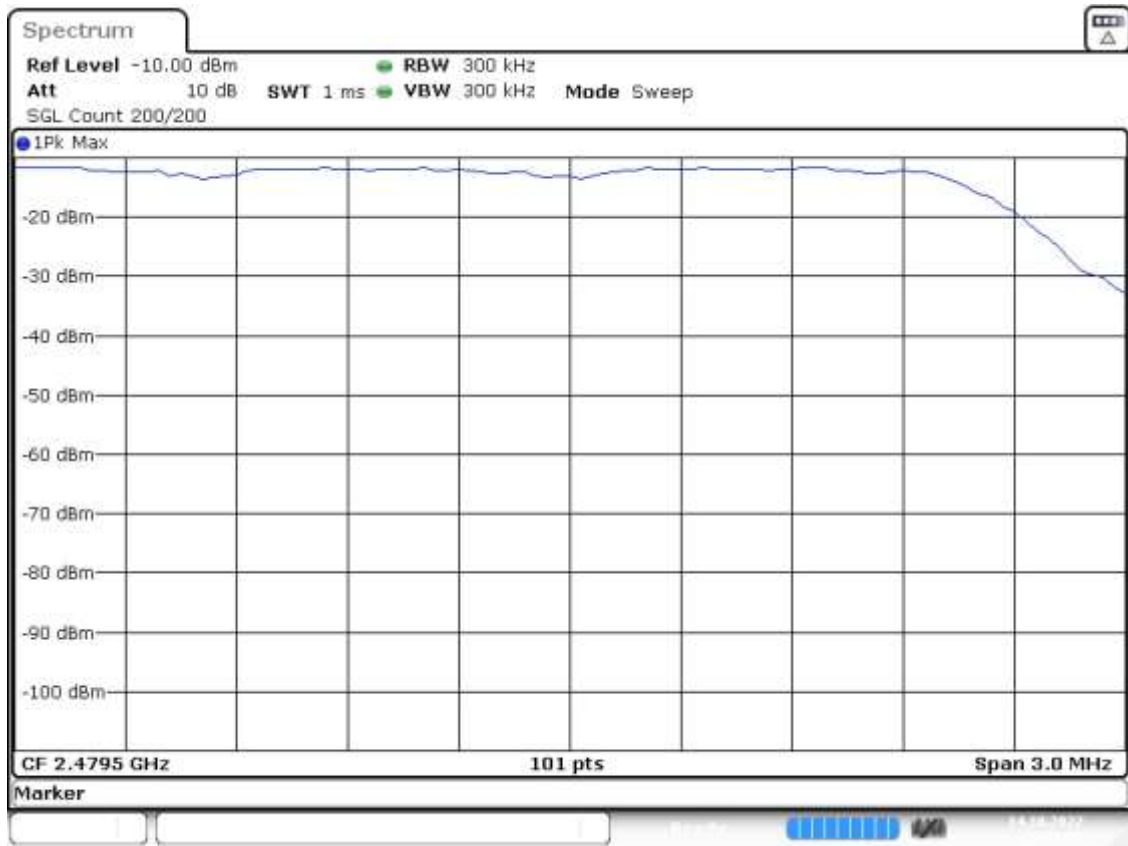
Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.44000 GHz	2.44000 GHz
Stop Frequency	2.44300 GHz	2.44300 GHz
Span	3.000 MHz	3.000 MHz
RBW	300.000 kHz	<= 300.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	101	~ 10
SweepTime	1.000 ms	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	15 / max. 150	max. 150
Stable	10 / 10	10
Max Stable Difference	0.00 dB	0.50 dB

Plot 9: EUT #0, Carrier Frequency Separation, Mode 3, high channel
CFS



DUT Frequency (MHz)	Frequency Separation (MHz)	Limit Min (MHz)	Limit Max (MHz)	Center Frequency low Channel (MHz)	Center Frequency high Channel (MHz)
2480.000000	1.009900	0.850000	---	2478.995050	2480.004950



Date: 14.OCT.2022 16:46:55

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47800 GHz	2.47800 GHz
Stop Frequency	2.48100 GHz	2.48100 GHz
Span	3.000 MHz	3.000 MHz
RBW	300.000 kHz	<= 300.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	101	~ 10
SweepTime	1.000 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	51 / max. 150	max. 150
Stable	10 / 10	10
Max Stable Difference	0.00 dB	0.50 dB

7.2 Number of frequency hopping channels

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

Frequency hopping systems shall have a minimum number of hopping channels.

Limit

§15.247 (a)(1)(iii), RSS-247, 5.1 (d)

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

RSS-247, 5.1 (d)

Test procedure

ANSI C63.10, 7.8.3

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

- a) Span: The frequency band of operation. Depending on the number of channels the device supports, it could be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- c) VBW $\geq$ RBW.
- d) Sweep: No faster than coupled (auto) time.
- e) Detector function: Peak.
- f) Trace: Max-hold.
- g) Allow the trace to stabilize.

It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies.

Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A spectral plot of the data shall be included in the test report.

Where the device shares the same channel plan (carrier frequencies and number of channels) across multiple data rates or modulation schemes then the number of channels need only be measured for one of those modulation schemes or data rates.

Test setup: 8.4 with conducted test sample (see section 5.2)

Test Results

EUT Mode	Number of frequency hopping channels			Result
	Channels	Limit min	Limit max	
Mode 1	79	15	-	≥ 15
Mode 2	87	15	-	≥ 15
Mode 3	83	15	-	≥ 15

Comment:

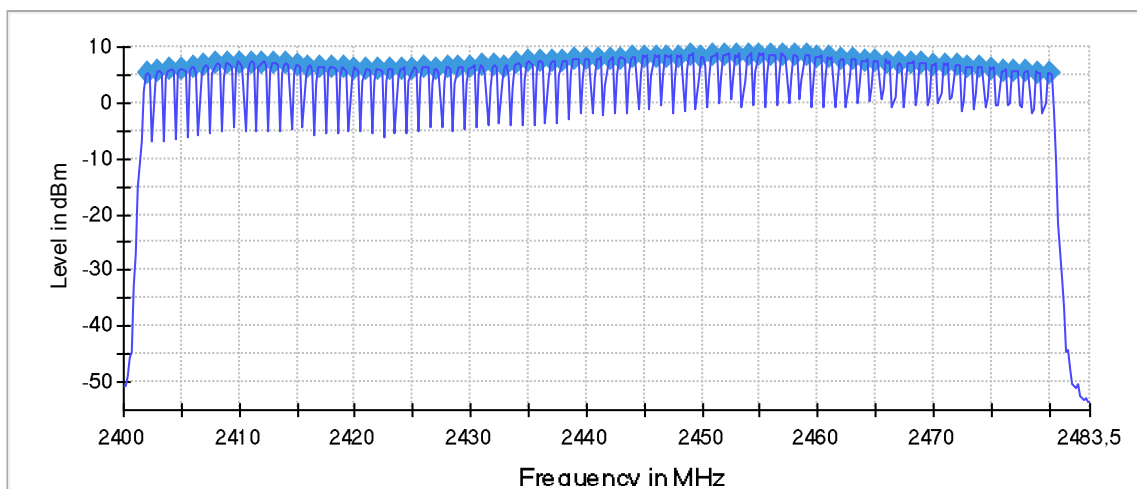
Verdict

- PASS -

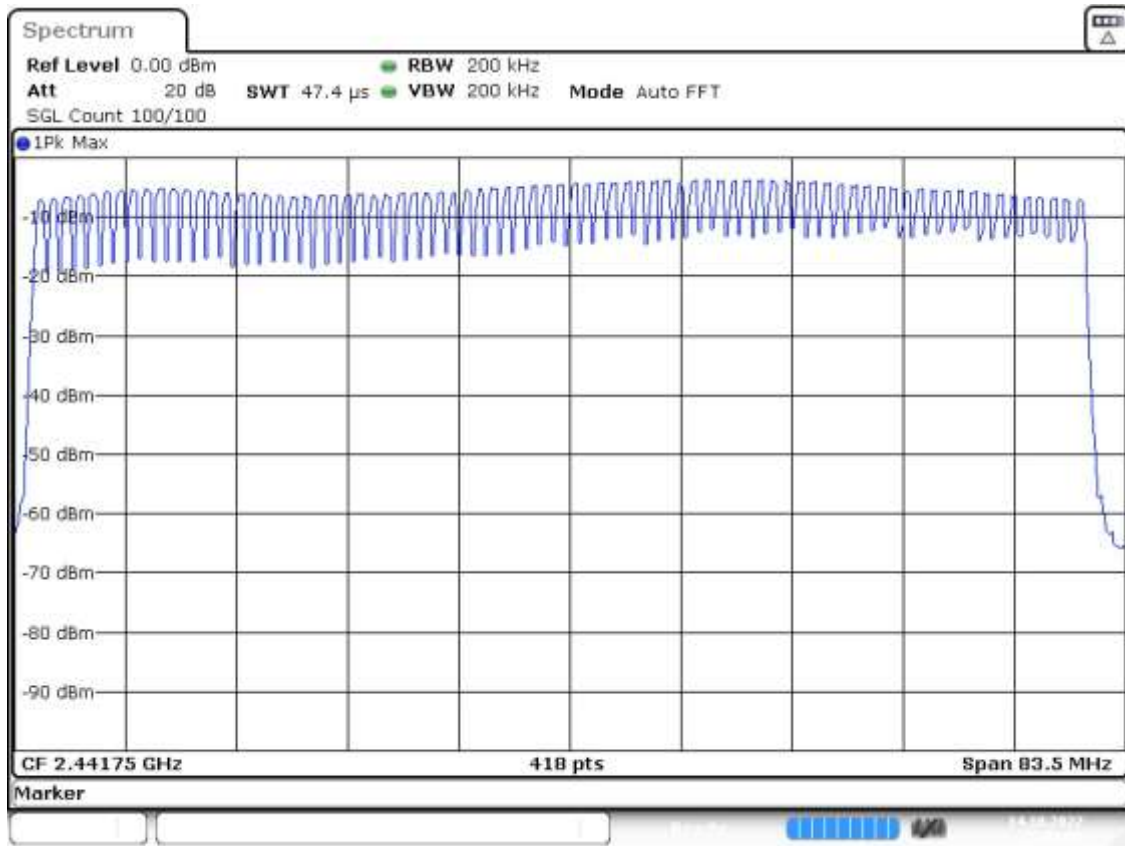
see next plots

Plot 10: EUT #0, Mode 1, Hopping Frequencies

Sequence



Channels	Limit Min	Limit Max	Result
79	15	---	PASS



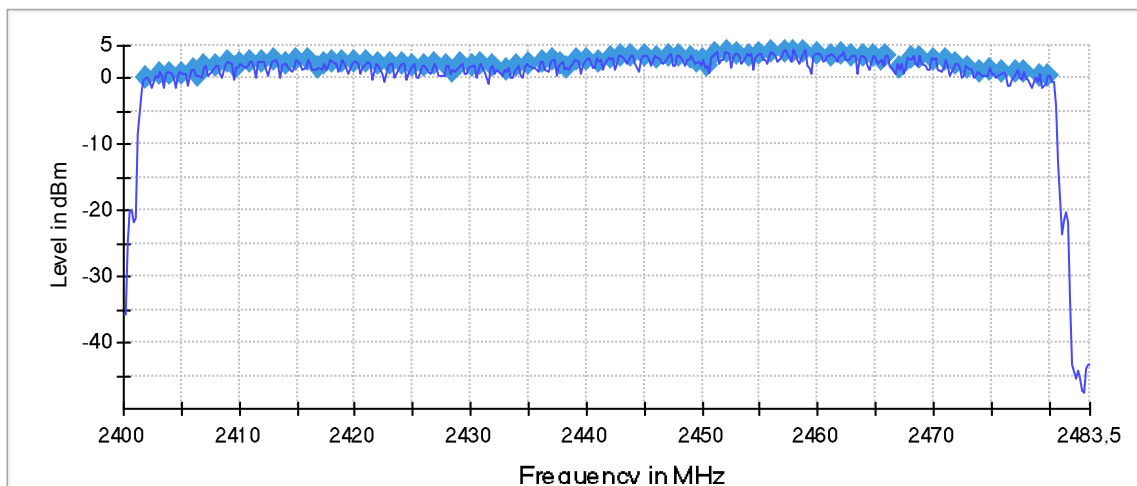
Date: 14.OCT.2022 15:01:09

Measurement

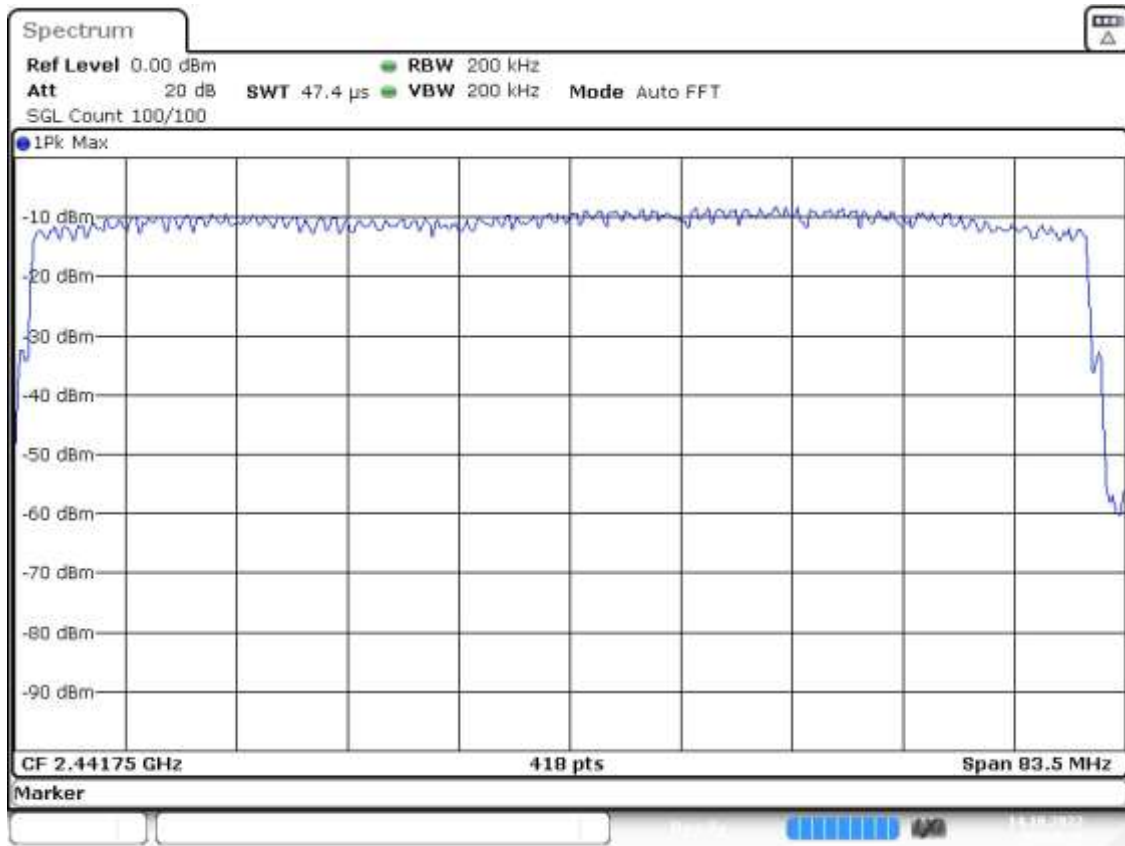
Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	200.000 kHz	≤ 299.000 kHz
VBW	200.000 kHz	≥ 200.000 kHz
SweepPoints	418	~ 418
SweepTime	47.405 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	79 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.06 dB	0.50 dB

Plot 11: EUT #0, Mode 2, Hopping Frequencies

Sequence



Channels	Limit Min	Limit Max	Result
87	15	---	PASS

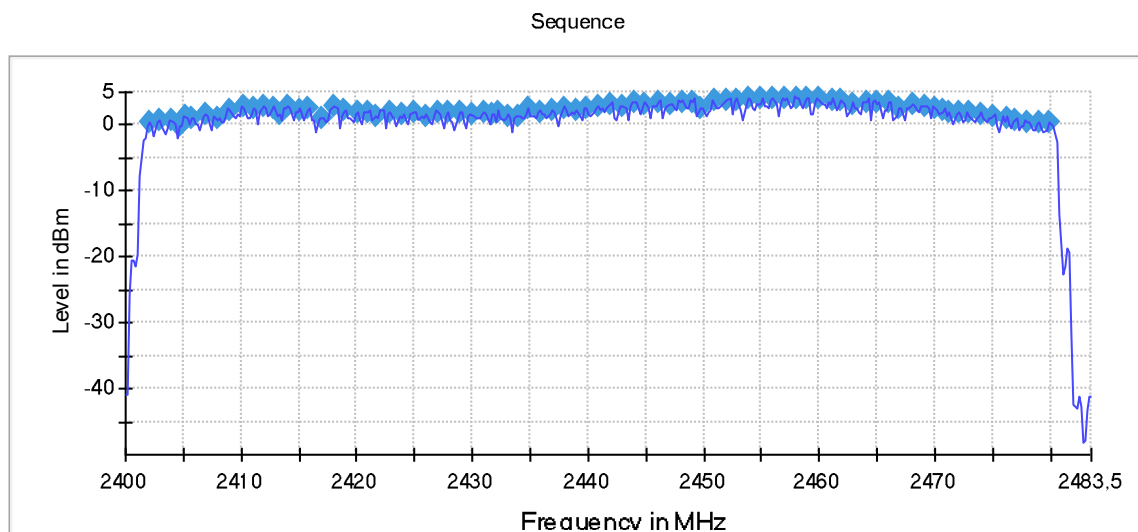


Date: 14.OCT.2022 15:31:14

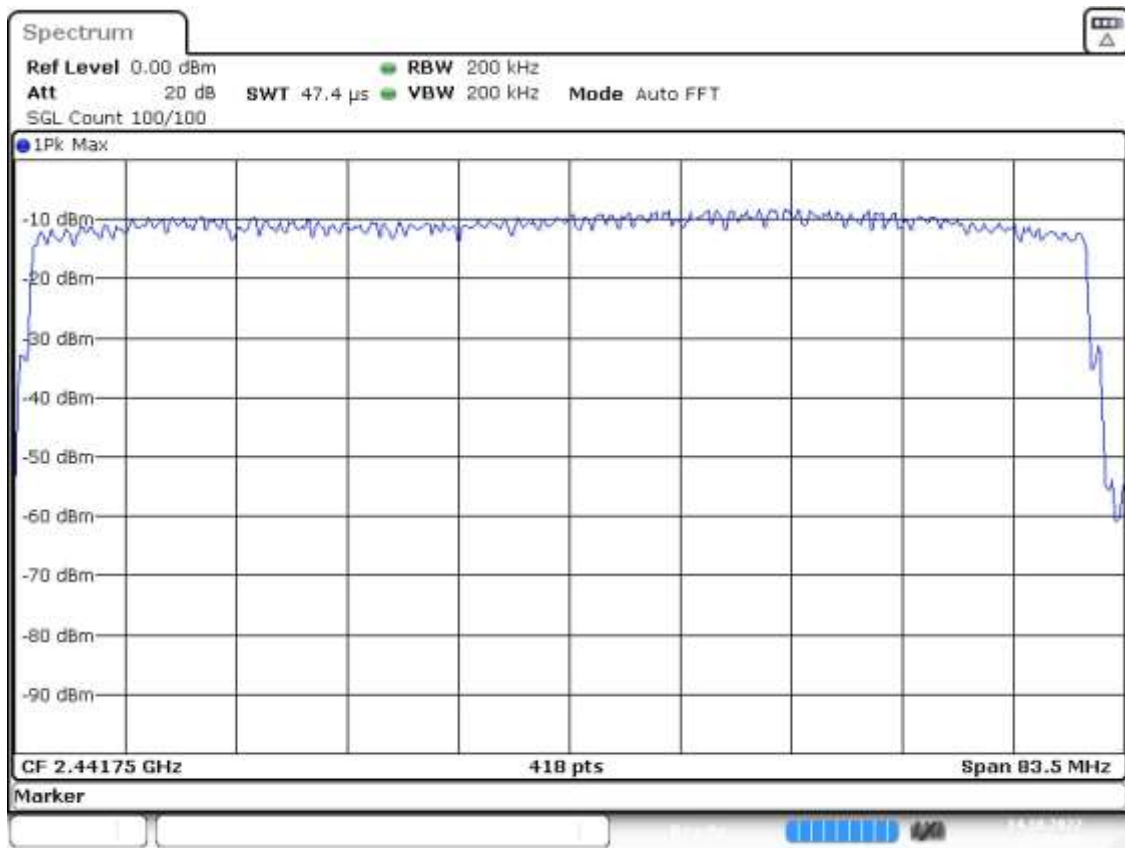
Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	200.000 kHz	≤ 299.000 kHz
VBW	200.000 kHz	≥ 200.000 kHz
SweepPoints	418	~ 418
Sweeptime	47.405 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	97 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.40 dB	0.50 dB

Plot 12: EUT #0, Mode 3, Hopping Frequencies



Channels	Limit Min	Limit Max	Result
83	15	---	PASS



Date: 14.OCT.2022 16:05:24

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	200.000 kHz	≤ 299.000 kHz
VBW	200.000 kHz	≥ 200.000 kHz
SweepPoints	418	~ 418
SweepTime	47.405 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	85 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

7.3 Time of channel occupancy

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

The dwell time per hop on a channel is the time from the start of the first transmission to the end of the last transmission for that hop. If the device has a single transmission per hop then the dwell time is the duration of that transmission. If the device has a multiple transmissions per hop then the dwell time is measured from the start of the first transmission to the end of the last transmission.

The time of occupancy is the total time that the device dwells on a channel over an observation period specified in the regulatory requirement. To determine the time of occupancy the spectrum analyzer will be configured to measure both the dwell time per hop and the number of times the device transmits on a specific channel in a given period.

Limit

§15.247 (a)(1)(iii), RSS-247, 5.1 (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test procedure

ANSI C63.10, 7.8.4

The EUT shall have its hopping function enabled. Compliance with the requirements shall be made with the minimum and with the maximum number of channels enabled. If the dwell time per channel does not vary with the number of channels then compliance with the requirements may be based on the minimum number of channels. If the device supports different dwell times per channel (example Bluetooth devices can dwell on a channel for 1, 3 or 5 time slots) then measurements can be limited to the longest dwell time with the minimum number of channels.

Use the following spectrum analyzer settings to determine the dwell time per hop:

- Span: Zero span, centered on a hopping channel.
- RBW shall be $\leq$ channel spacing and where possible RBW should be set $\gg 1 / T$, where T is the expected transmission time per hop.
- Sweep time: Set so that the start of the first transmission and end of the last transmission for the hop are clearly captured. Setting the sweep time to be slightly longer than the hopping period per channel (hopping period = $1/\text{hopping rate}$) should achieve this.
- Use a video trigger, where possible with a trigger delay, so that the start of the transmission is clearly observed. The trigger level might need adjustment to reduce the chance of triggering when the system hops on an adjacent channel.
- Detector function: Peak.
- Trace: Clear-write, single sweep.
- Place markers at the start of the first transmission on the channel and at the end of the last transmission.

The dwell time per hop is the time between these two markers.

To determine the number of hops on a channel in the regulatory observation period repeat the measurement using a longer sweep time. When the device uses a single hopping sequence the period of measurement should be sufficient to capture at least 2 hops. When the device uses a dynamic hopping sequence, or the sequence varies, the period of measurement may need to capture multiple hops to better determine the average time of occupancy. Count the number of hops on the channel across the sweep time.

The average number of hops on the same channel within the regulatory observation period is calculated from the number of hops on the channel divided by the spectrum analyzer sweep time multiplied by the regulatory observation period. For example, if three hops are counted with an analyzer sweep time of 500 ms and the regulatory observation period is 10 s, then the number of hops in that ten seconds is $3 / 0.5 \times 10$, or 60 hops. The average time of occupancy is calculated by multiplying the dwell time per hop by the number of hops in the observation period.

Where the device shares the same hopping algorithms (dwell time, channel selection) across multiple data rates or modulation schemes then the time of occupancy need only be measured for one of those modulation

schemes or data rates. If the dwell time value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in dwell time.

Test setup: 8.4 with conducted test sample (see section 5.2)

Test Results

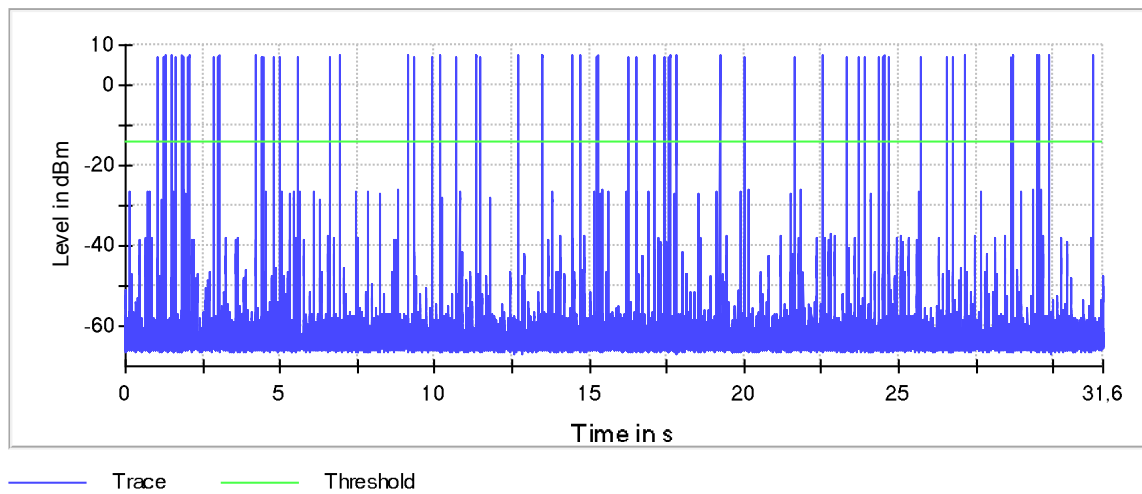
EUT Mode	Average time of occupancy			Limit [ms]
	low channel [ms]	mid channel [ms]	high channel [ms]	
Mode 1	159.44	134.68	179.75	≤ 400
Mode 2	138.67	147.95	126.76	≤ 400
Mode 3	138.35	129.93	167.78	≤ 400

Comment: ---

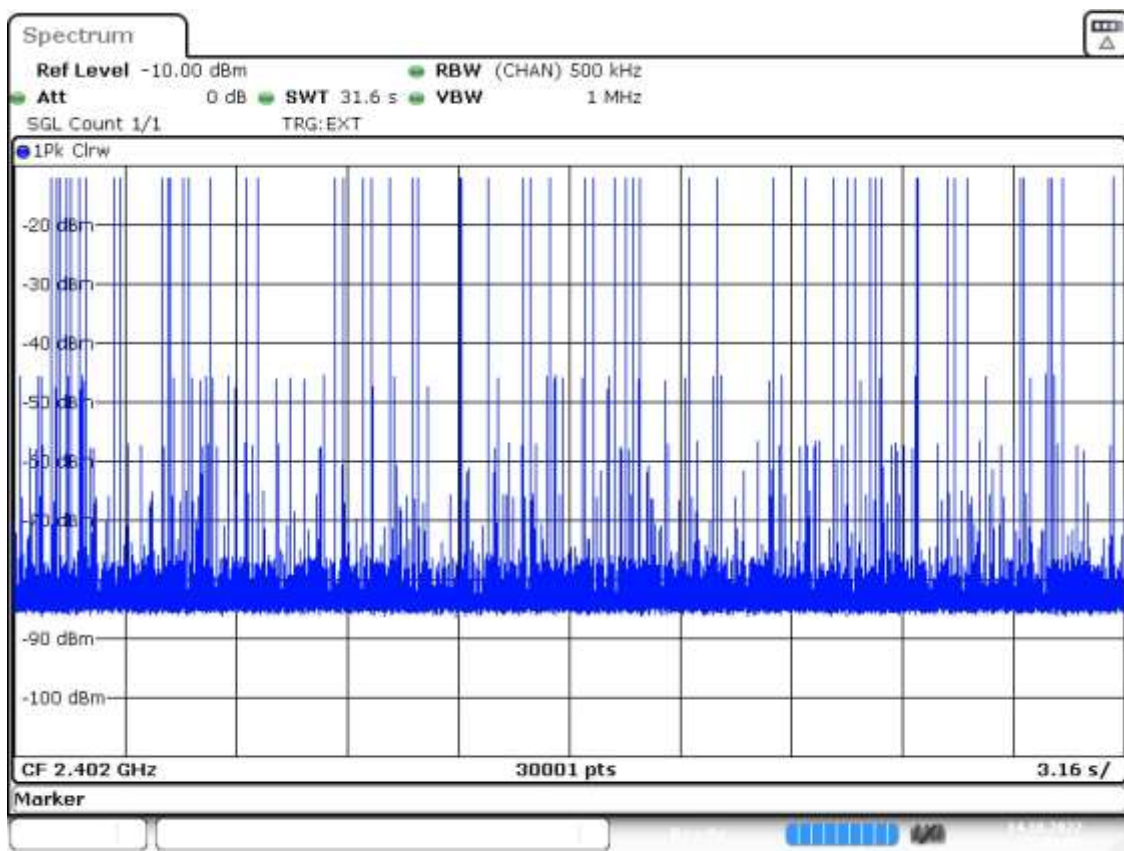
Verdict	- PASS -	<i>see next plots</i>
----------------	-----------------	-----------------------

Plot 13: EUT #0, Mode 1, Time of Channel Occupancy, low channel

Time of Channel Occupancy



DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Threshold (dBm)
2402.000000	PASS	54	159.440	-14.0



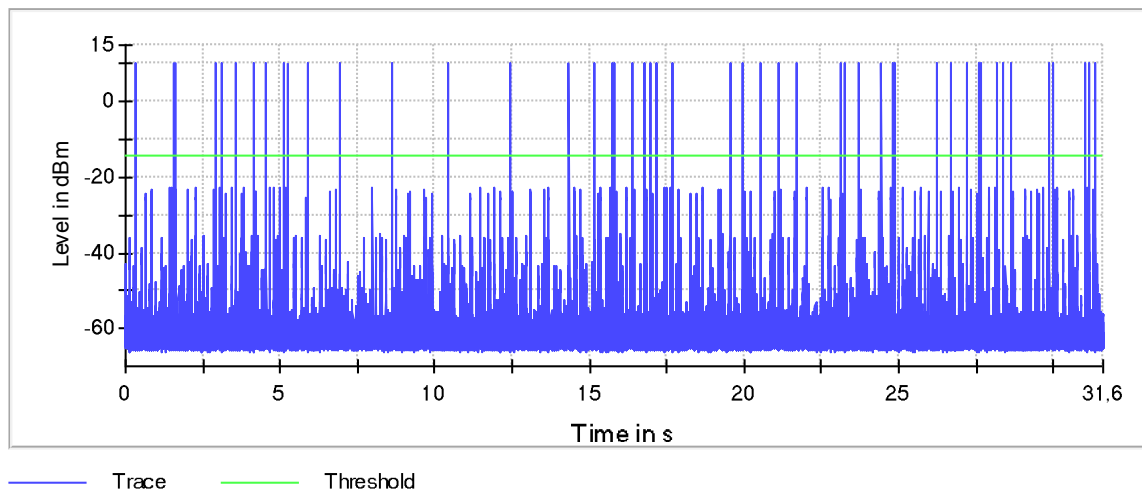
Date: 14.OCT.2022 15:02:09

Measurement

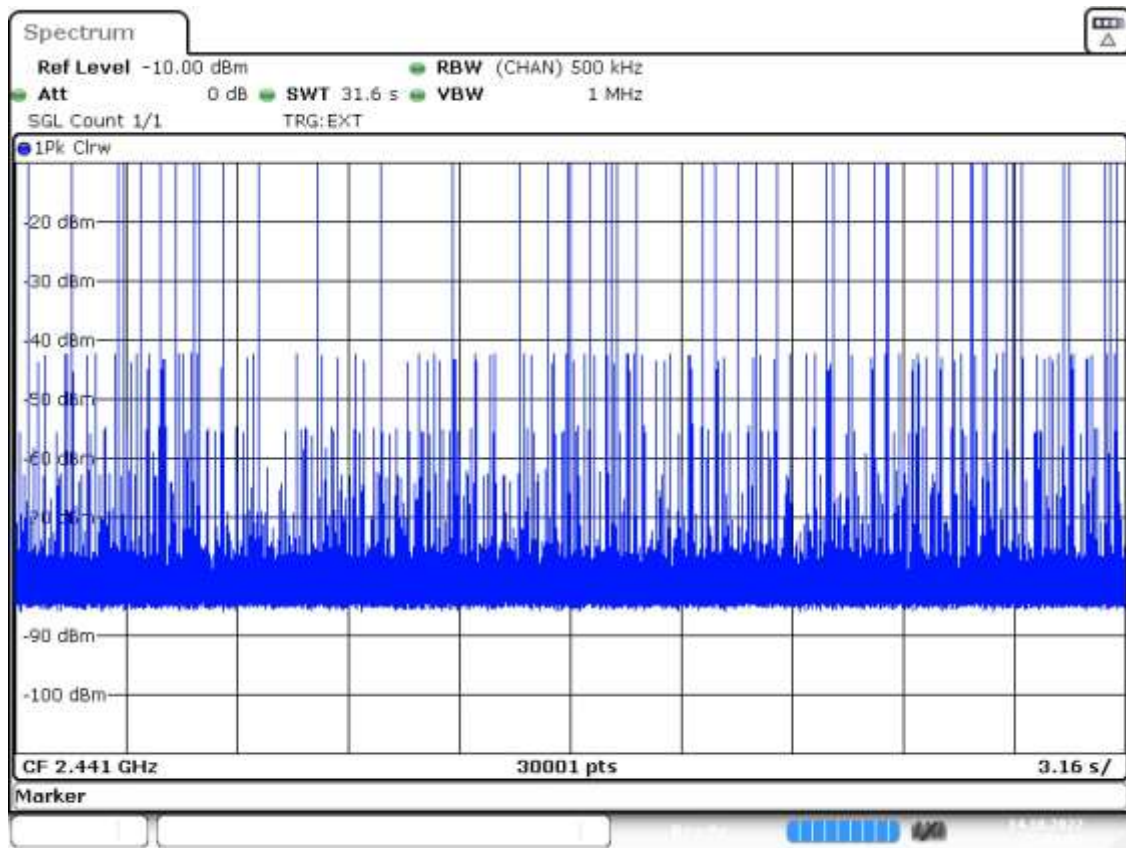
Setting	Instrument Value	Target Value
Center Frequency	2.40200 GHz	2.40200 GHz
Span	ZeroSpan	ZeroSpan
RBW	500.000 kHz	~ 500.000 kHz
VBW	1.000 MHz	~ 1.500 MHz
SweepPoints	30001	~ 30001
SweepTime	31.600 s	31.600 s
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	0.000 dB	0.000 dB
Detector	MaxPeak	MaxPeak
SweepCount	1	1
Filter	Channel	Channel
Trace Mode	Clear Write	Clear Write
Sweeptype	Sweep	AUTO
Preamp	off	off
Trigger	External	External
Trigger Offset	0.000 s	0.000 s

Plot 14: EUT #0, Mode 1, Time of Channel Occupancy, mid channel

Time of Channel Occupancy



DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Threshold (dBm)
2441.000000	PASS	46	134.680	-14.0



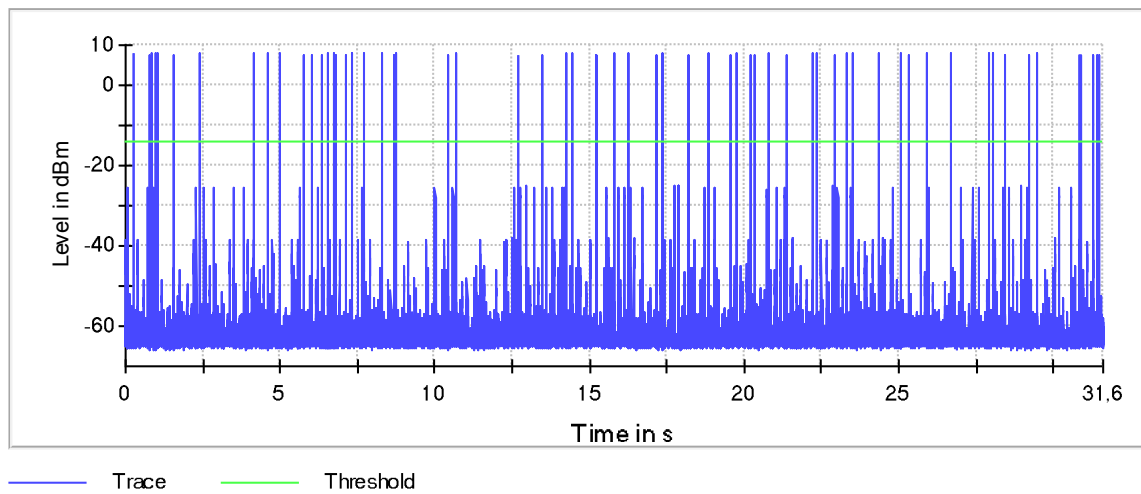
Date: 14.OCT.2022 15:03:15

Measurement

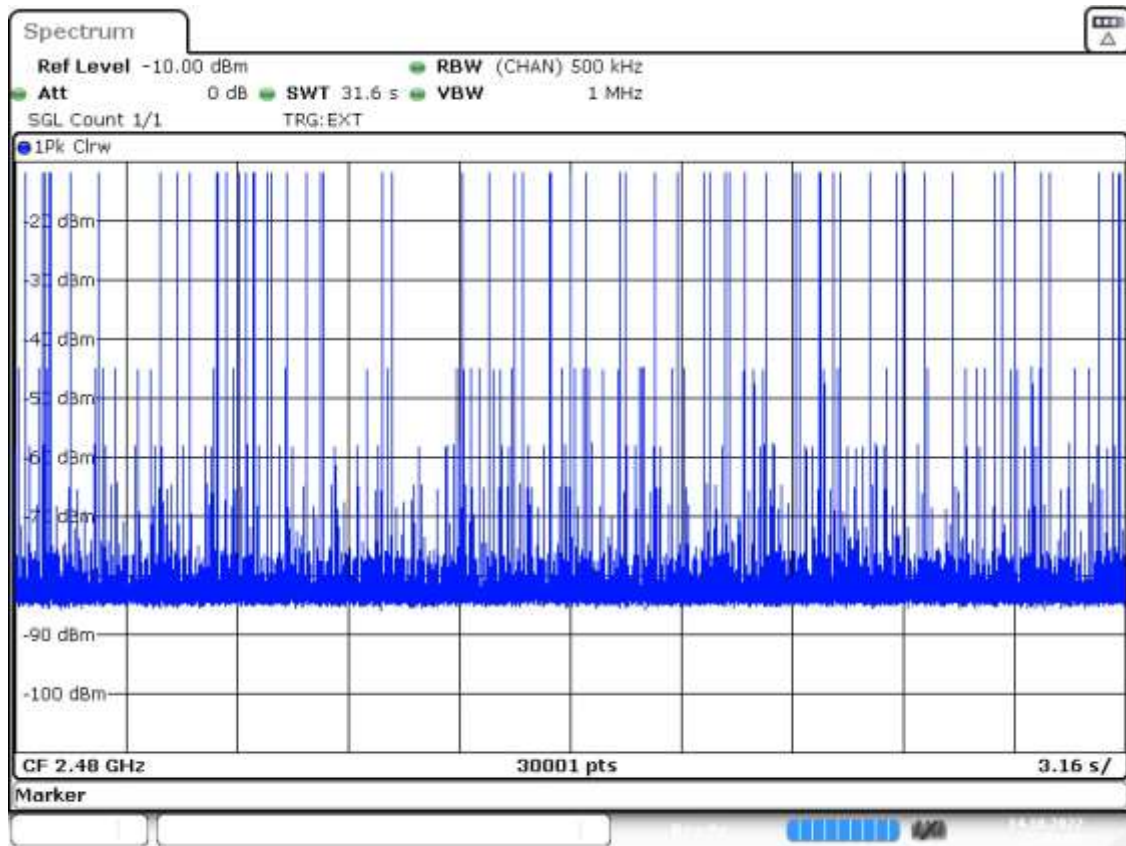
Setting	Instrument Value	Target Value
Center Frequency	2.44100 GHz	2.44100 GHz
Span	ZeroSpan	ZeroSpan
RBW	500.000 kHz	~ 500.000 kHz
VBW	1.000 MHz	~ 1.500 MHz
SweepPoints	30001	~ 30001
SweepTime	31.600 s	31.600 s
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	0.000 dB	0.000 dB
Detector	MaxPeak	MaxPeak
SweepCount	1	1
Filter	Channel	Channel
Trace Mode	Clear Write	Clear Write
SweepType	Sweep	AUTO
Preamp	off	off
Trigger	External	External
Trigger Offset	0.000 s	0.000 s

Plot 15: EUT #0, Mode 1, Time of Channel Occupancy, high channel

Time of Channel Occupancy



DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Threshold (dBm)
2480.000000	PASS	61	179.750	-14.0



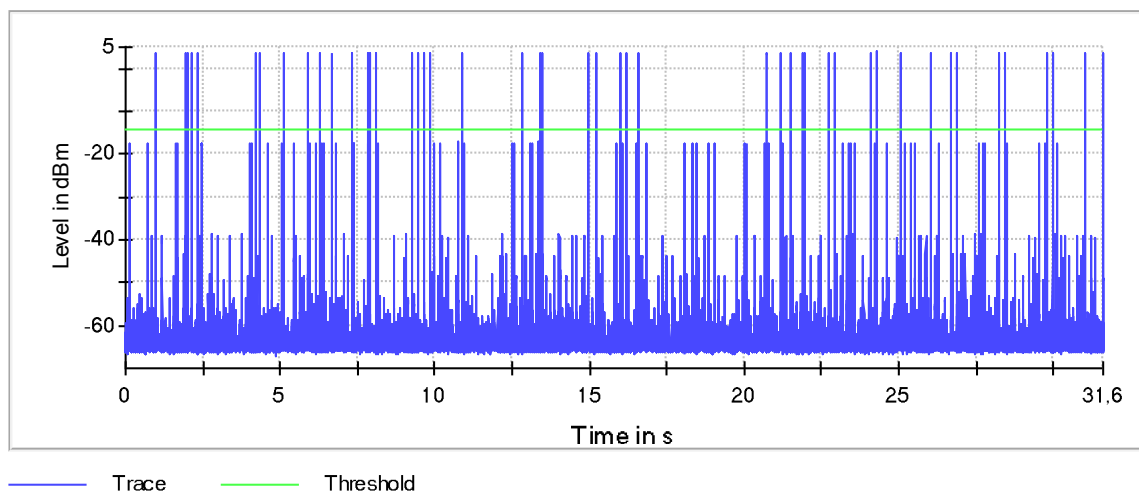
Date: 14.OCT.2022 15:04:21

Measurement

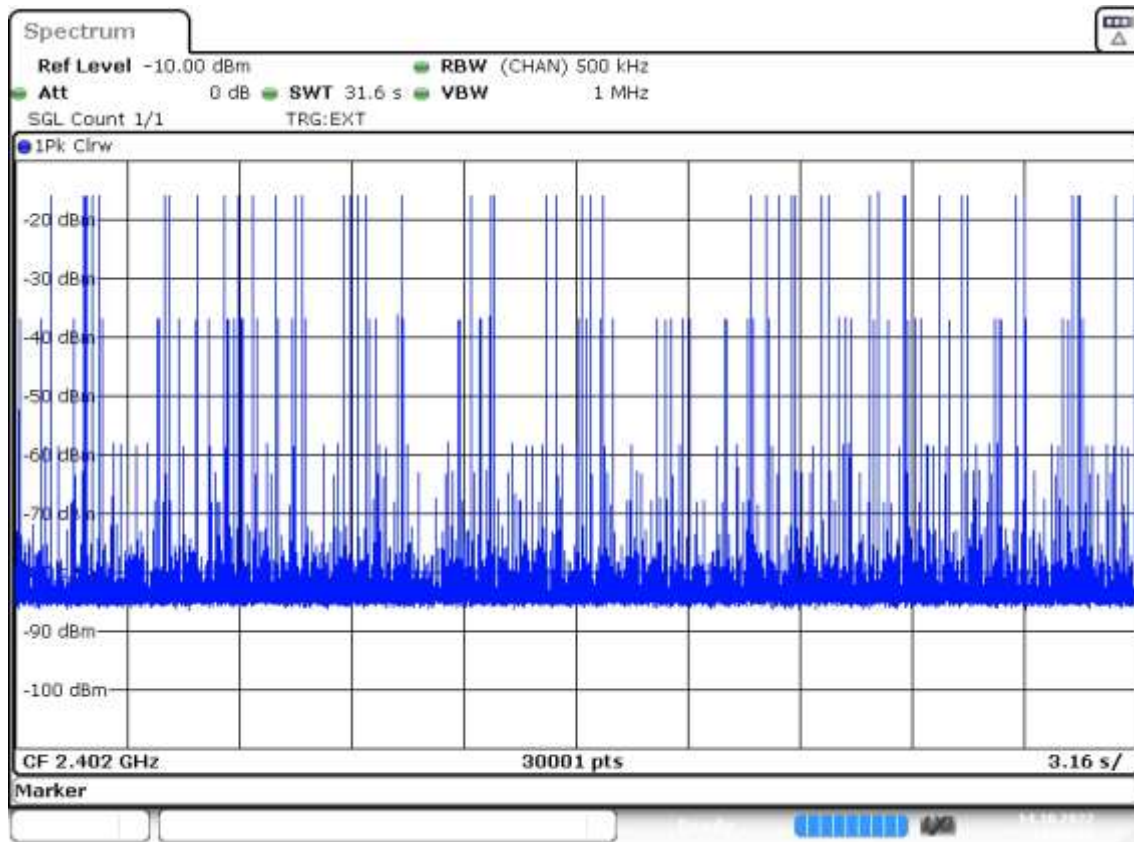
Setting	Instrument Value	Target Value
Center Frequency	2.48000 GHz	2.48000 GHz
Span	ZeroSpan	ZeroSpan
RBW	500.000 kHz	~ 500.000 kHz
VBW	1.000 MHz	~ 1.500 MHz
SweepPoints	30001	~ 30001
SweepTime	31.600 s	31.600 s
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	0.000 dB	0.000 dB
Detector	MaxPeak	MaxPeak
SweepCount	1	1
Filter	Channel	Channel
Trace Mode	Clear Write	Clear Write
SweepType	Sweep	AUTO
Preamp	off	off
Trigger	External	External
Trigger Offset	0.000 s	0.000 s

Plot 16: EUT #0, Mode 2, Time of Channel Occupancy, low channel

Time of Channel Occupancy



DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Threshold (dBm)
2402.000000	PASS	47	138.670	-14.0



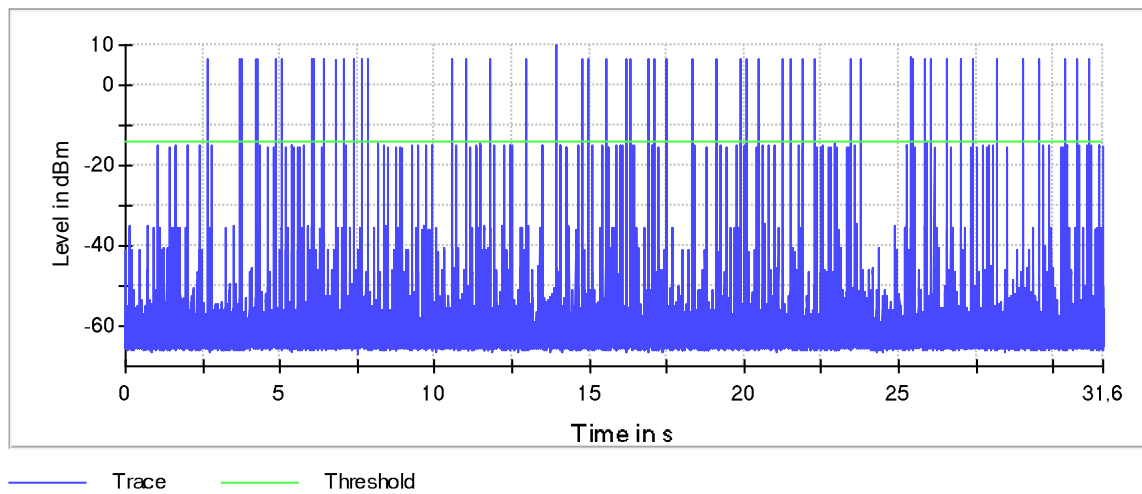
Date: 14.OCT.2022 15:32:14

Measurement

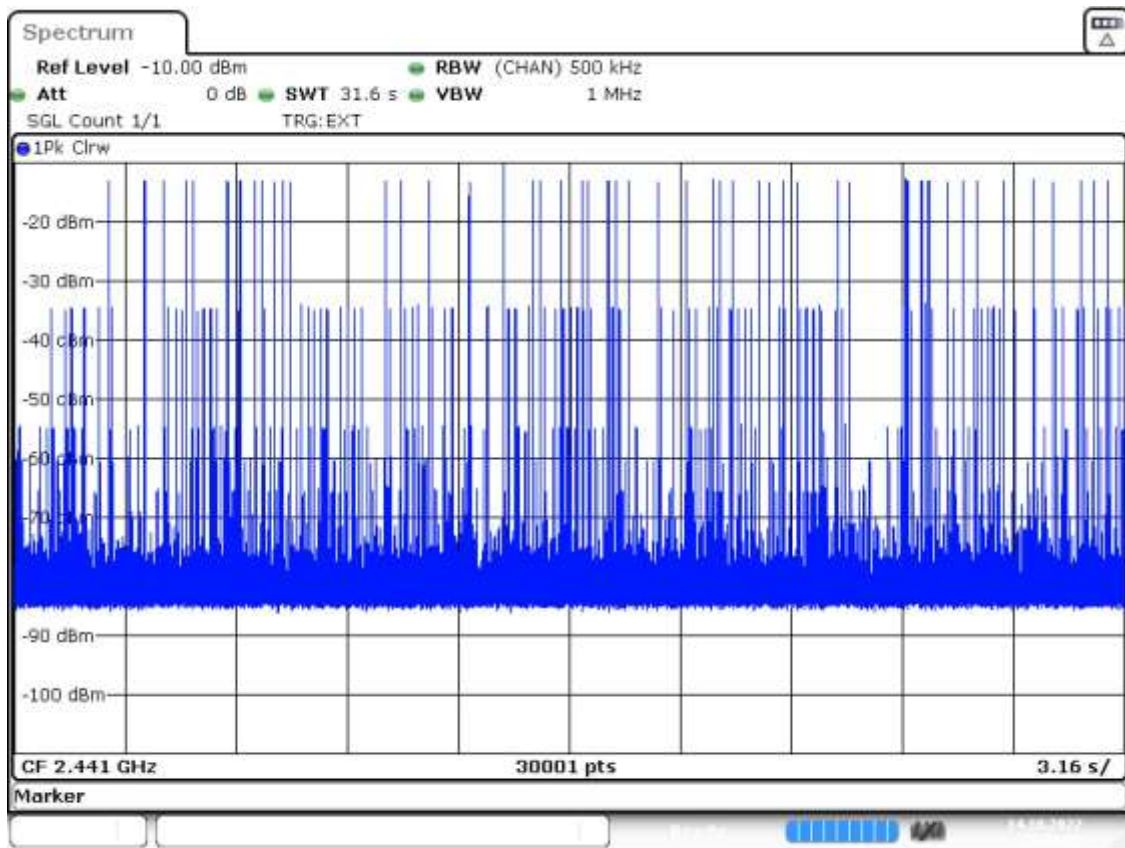
Setting	Instrument Value	Target Value
Center Frequency	2.40200 GHz	2.40200 GHz
Span	ZeroSpan	ZeroSpan
RBW	500.000 kHz	~ 500.000 kHz
VBW	1.000 MHz	~ 1.500 MHz
SweepPoints	30001	~ 30001
SweepTime	31.600 s	31.600 s
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	0.000 dB	0.000 dB
Detector	MaxPeak	MaxPeak
SweepCount	1	1
Filter	Channel	Channel
Trace Mode	Clear Write	Clear Write
SweepType	Sweep	AUTO
Preamp	off	off
Trigger	External	External
Trigger Offset	0.000 s	0.000 s

Plot 17: EUT #0, Mode 2, Time of Channel Occupancy, mid channel

Time of Channel Occupancy



DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Threshold (dBm)
2441.000000	PASS	51	147.950	-14.0



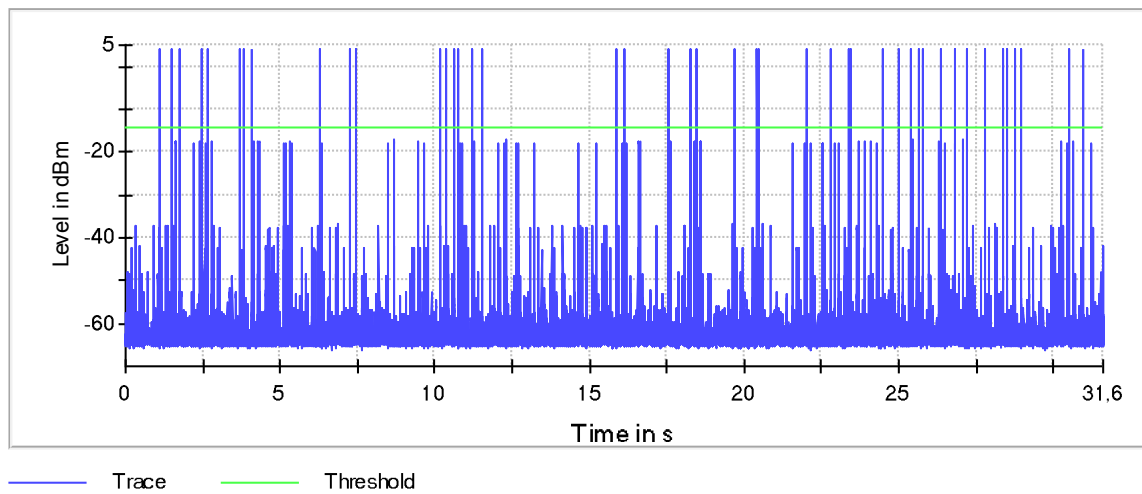
Date: 14.OCT.2022 15:33:20

Measurement

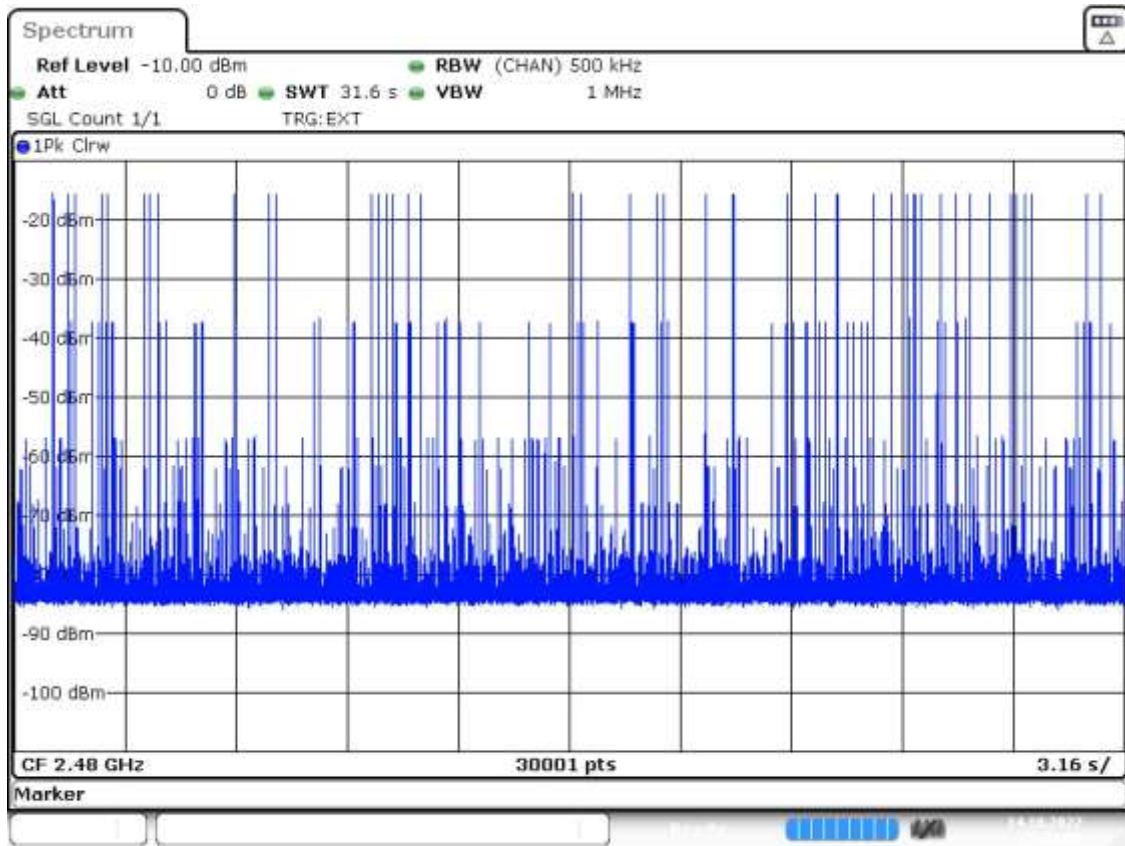
Setting	Instrument Value	Target Value
Center Frequency	2.44100 GHz	2.44100 GHz
Span	ZeroSpan	ZeroSpan
RBW	500.000 kHz	~ 500.000 kHz
VBW	1.000 MHz	~ 1.500 MHz
SweepPoints	30001	~ 30001
SweepTime	31.600 s	31.600 s
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	0.000 dB	0.000 dB
Detector	MaxPeak	MaxPeak
SweepCount	1	1
Filter	Channel	Channel
Trace Mode	Clear Write	Clear Write
SweepType	Sweep	AUTO
Preamp	off	off
Trigger	External	External
Trigger Offset	0.000 s	0.000 s

Plot 18: EUT #0, Mode 2, Time of Channel Occupancy, high channel

Time of Channel Occupancy



DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Threshold (dBm)
2480.000000	PASS	43	126.760	-14.0



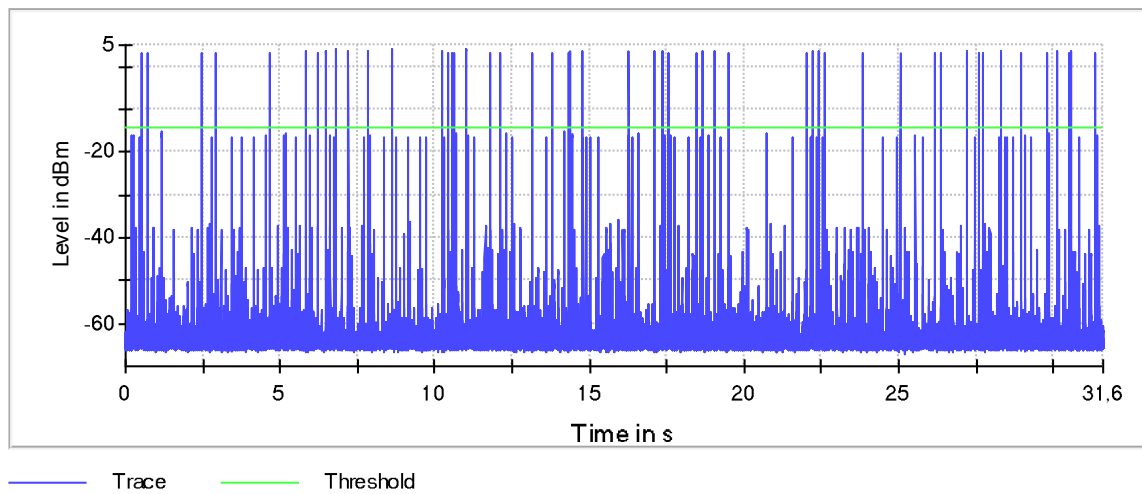
Date: 14.OCT.2022 15:37:24

Measurement

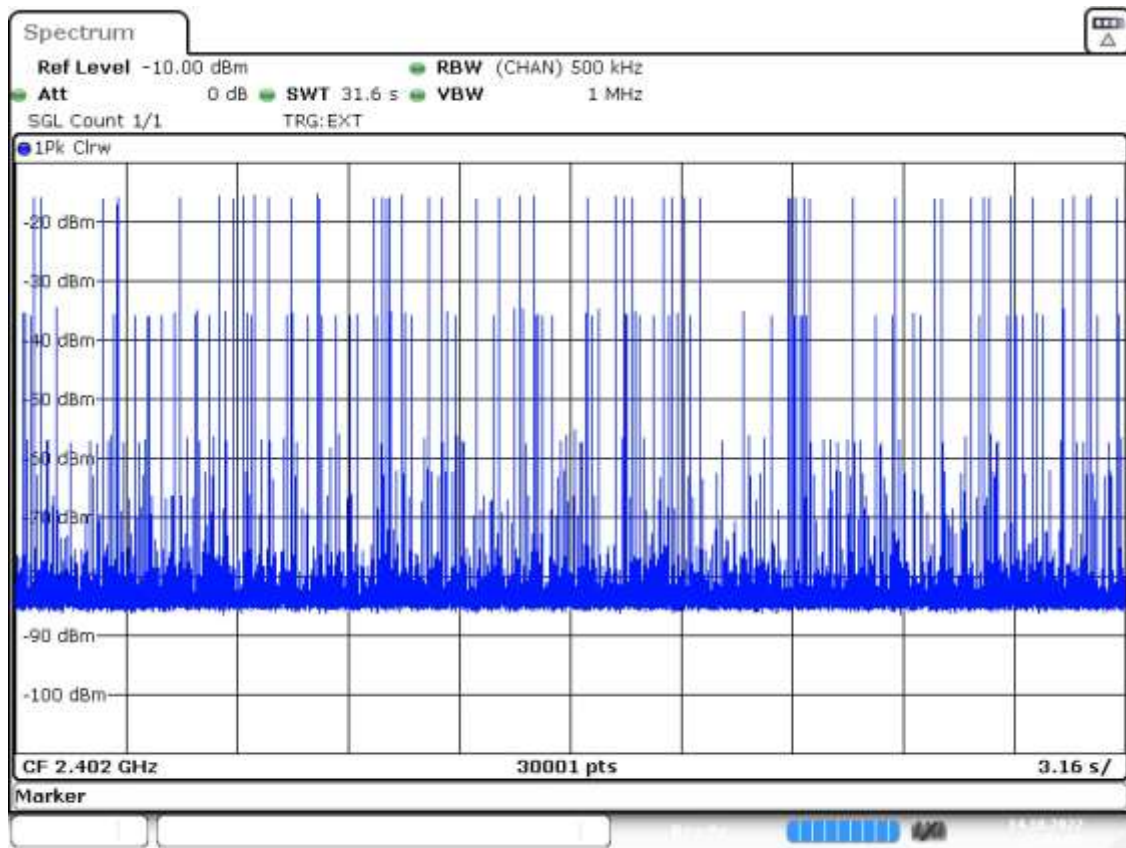
Setting	Instrument Value	Target Value
Center Frequency	2.48000 GHz	2.48000 GHz
Span	ZeroSpan	ZeroSpan
RBW	500.000 kHz	~ 500.000 kHz
VBW	1.000 MHz	~ 1.500 MHz
SweepPoints	30001	~ 30001
Sweeptime	31.600 s	31.600 s
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	0.000 dB	0.000 dB
Detector	MaxPeak	MaxPeak
SweepCount	1	1
Filter	Channel	Channel
Trace Mode	Clear Write	Clear Write
SweepType	Sweep	AUTO
Preamp	off	off
Trigger	External	External
Trigger Offset	0.000 s	0.000 s

Plot 19: EUT #0, Mode 3, Time of Channel Occupancy, low channel

Time of Channel Occupancy



DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Threshold (dBm)
2402.000000	PASS	48	138.350	-14.0



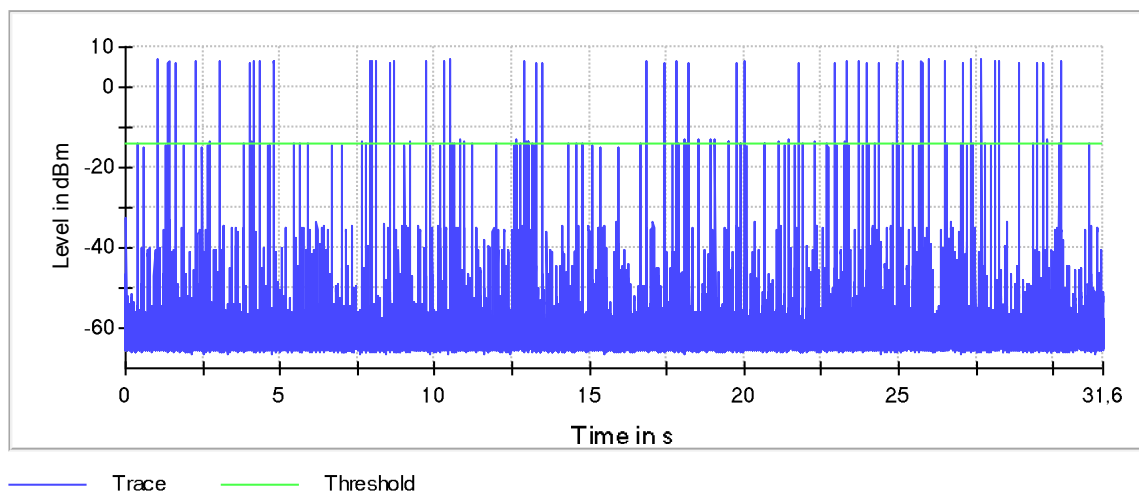
Date: 14.OCT.2022 16:06:24

Measurement

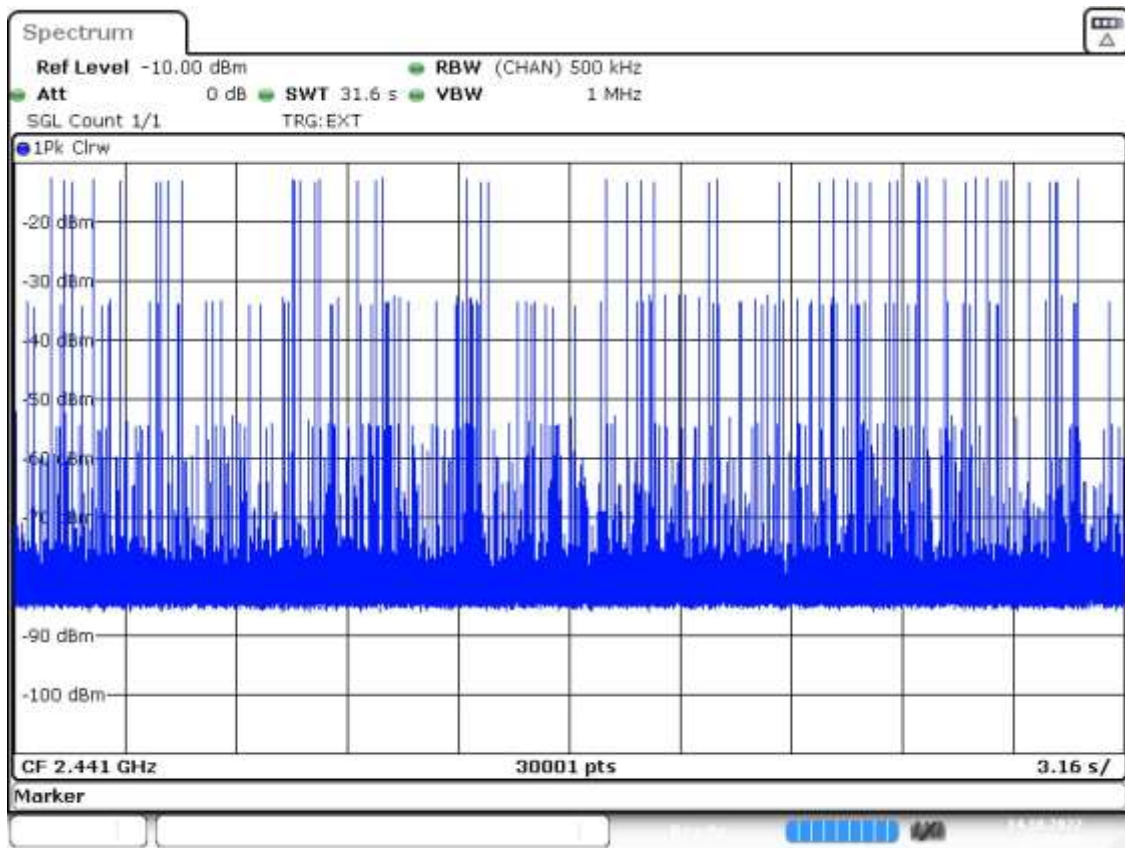
Setting	Instrument Value	Target Value
Center Frequency	2.40200 GHz	2.40200 GHz
Span	ZeroSpan	ZeroSpan
RBW	500.000 kHz	~ 500.000 kHz
VBW	1.000 MHz	~ 1.500 MHz
SweepPoints	30001	~ 30001
SweepTime	31.600 s	31.600 s
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	0.000 dB	0.000 dB
Detector	MaxPeak	MaxPeak
SweepCount	1	1
Filter	Channel	Channel
Trace Mode	Clear Write	Clear Write
Sweeptype	Sweep	AUTO
Preamp	off	off
Trigger	External	External
Trigger Offset	0.000 s	0.000 s

Plot 20: EUT #0, Mode 3, Time of Channel Occupancy, mid channel

Time of Channel Occupancy



DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Threshold (dBm)
2441.000000	PASS	47	129.930	-14.0



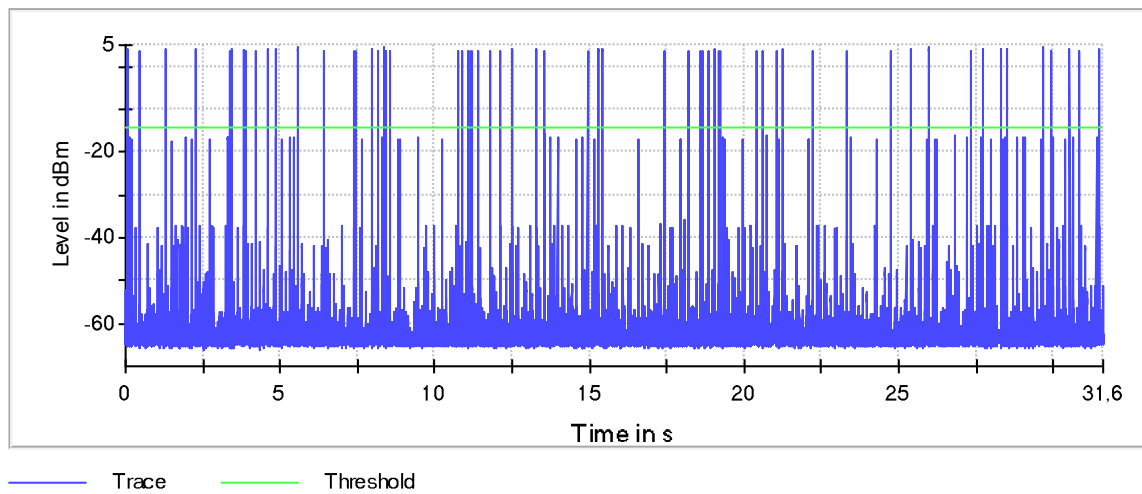
Date: 14.OCT.2022 16:07:29

Measurement

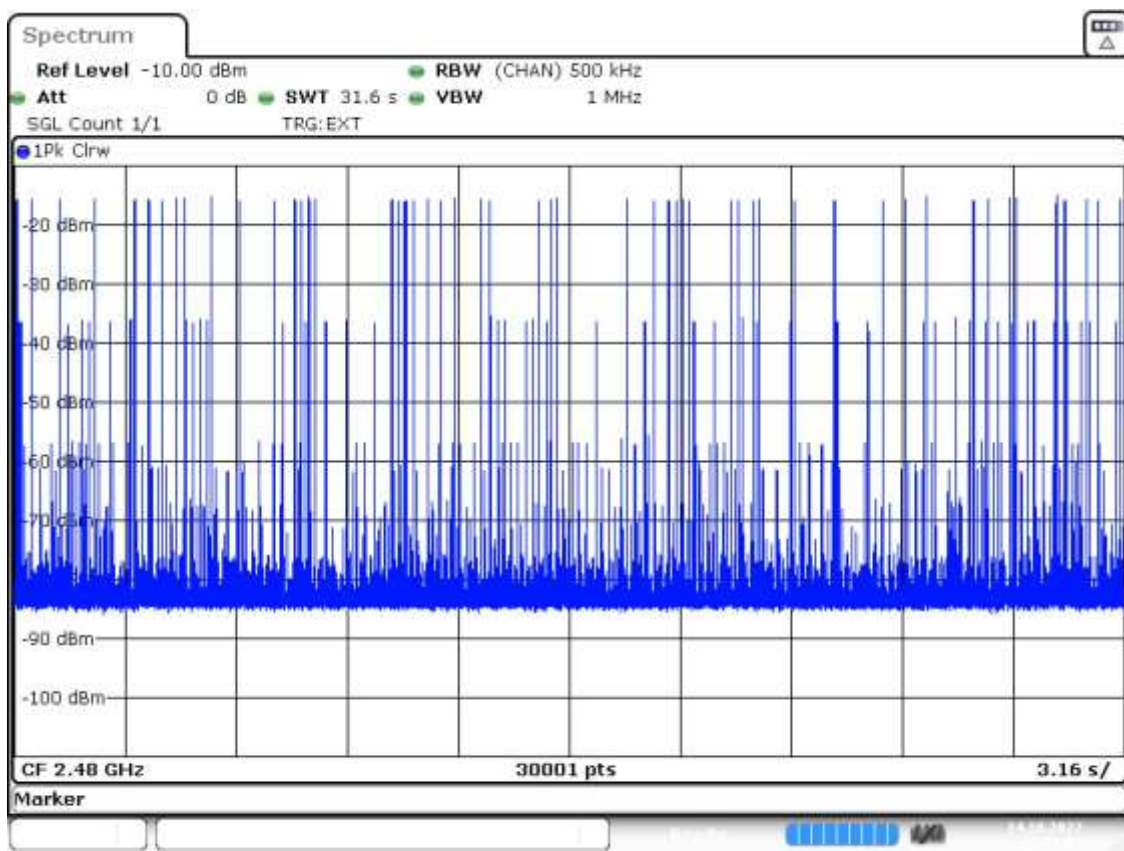
Setting	Instrument Value	Target Value
Center Frequency	2.44100 GHz	2.44100 GHz
Span	ZeroSpan	ZeroSpan
RBW	500.000 kHz	~ 500.000 kHz
VBW	1.000 MHz	~ 1.500 MHz
SweepPoints	30001	~ 30001
SweepTime	31.600 s	31.600 s
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	0.000 dB	0.000 dB
Detector	MaxPeak	MaxPeak
SweepCount	1	1
Filter	Channel	Channel
Trace Mode	Clear Write	Clear Write
SweepType	Sweep	AUTO
Preamp	off	off
Trigger	External	External
Trigger Offset	0.000 s	0.000 s

Plot 21: EUT #0, Mode 3, Time of Channel Occupancy, high channel

Time of Channel Occupancy



DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Threshold (dBm)
2480.000000	PASS	58	167.780	-14.0



Date: 14.OCT.2022 16:08:35

Measurement

Setting	Instrument Value	Target Value
Center Frequency	2.48000 GHz	2.48000 GHz
Span	ZeroSpan	ZeroSpan
RBW	500.000 kHz	~ 500.000 kHz
VBW	1.000 MHz	~ 1.500 MHz
SweepPoints	30001	~ 30001
Sweeptime	31.600 s	31.600 s
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	0.000 dB	0.000 dB
Detector	MaxPeak	MaxPeak
SweepCount	1	1
Filter	Channel	Channel
Trace Mode	Clear Write	Clear Write
SweepType	Sweep	AUTO
Preamp	off	off
Trigger	External	External
Trigger Offset	0.000 s	0.000 s

7.4 Emission bandwidth 20 dB

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

The 20 dB Emission Bandwidth is defined as the frequency width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

Limit

No limit defined

Test procedure

ANSI C63.10, 7.8

The steps are as follows:

- Set RBW = 100 kHz (6 dB bandwidth measurement) or 10 kHz (20 dB bandwidth measurement)
 - Set the VBW $\geq [3 \times \text{RBW}]$.
 - Detector = peak.
 - Trace mode = max hold.
 - Sweep = auto couple.
 - Allow the trace to stabilize.
 - Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB/ 20 dB relative to the maximum level measured in the fundamental emission.
- The automatic bandwidth measurement capability of an instrument may be employed using the 6 dB / 20 dB bandwidth mode.

Test setup: 8.4 with conducted test sample (see section 5.2)

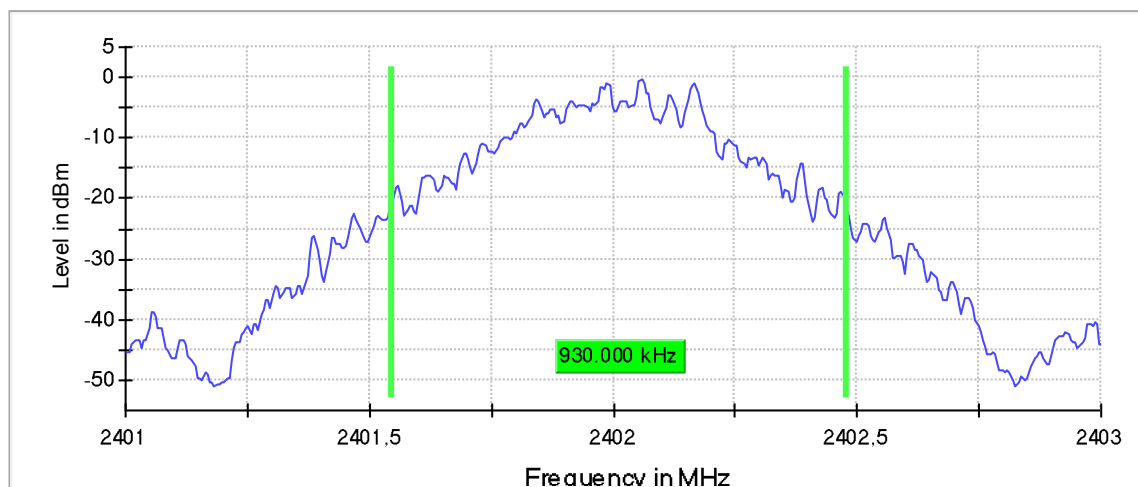
EUT Mode	Emission bandwidth 20 dB			Limit [kHz]
	low channel [kHz]	mid channel [kHz]	high channel [kHz]	
Mode 1	930	930	925	--
Mode 2	1295.0	1300.0	1295.0	--
Mode 3	1290.0	1275.0	1275.0	--

Comment:	---
-----------------	-----

Verdict	- PASS -	see next plots
----------------	----------	----------------

EUT #0, Plot 22: Mode 1, Emission Bandwidth 20 dB, low channel

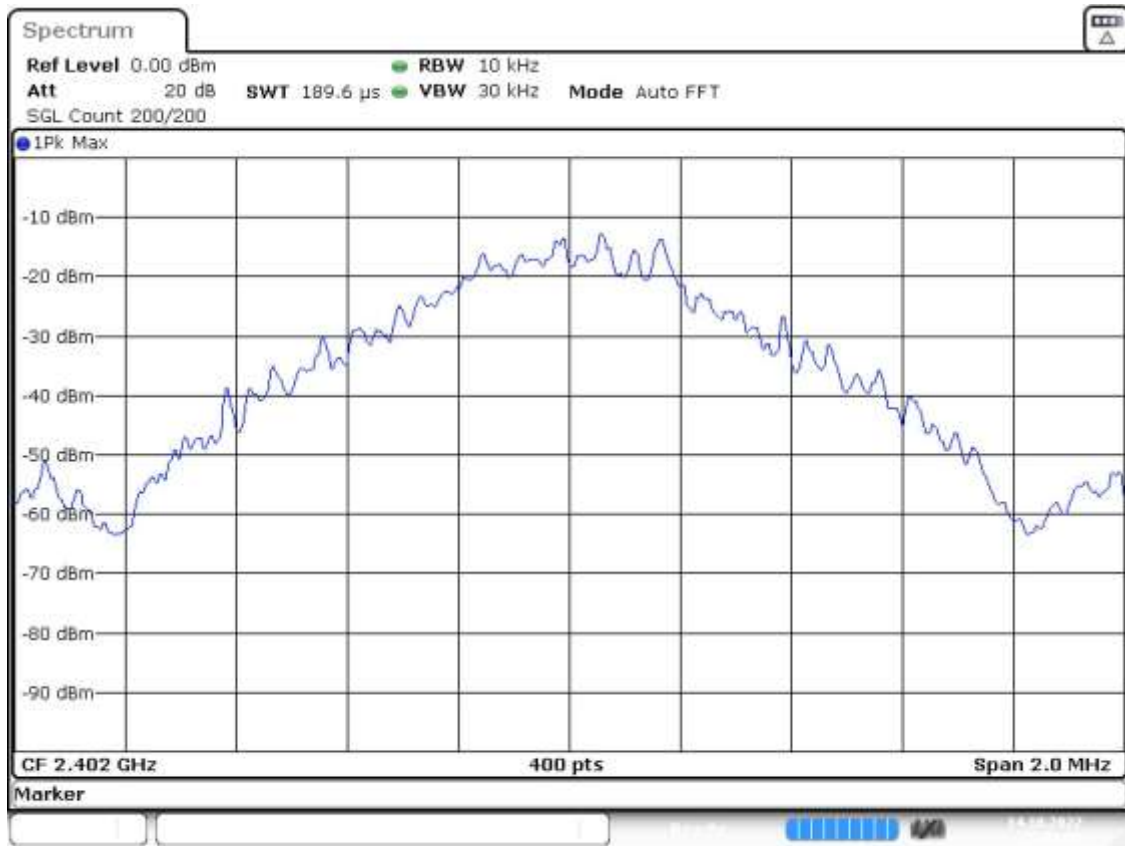
20 dB Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	0.930000	---	---	2401.547500	2402.477500

(continuation of the "20 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2402.000000	-0.2	PASS



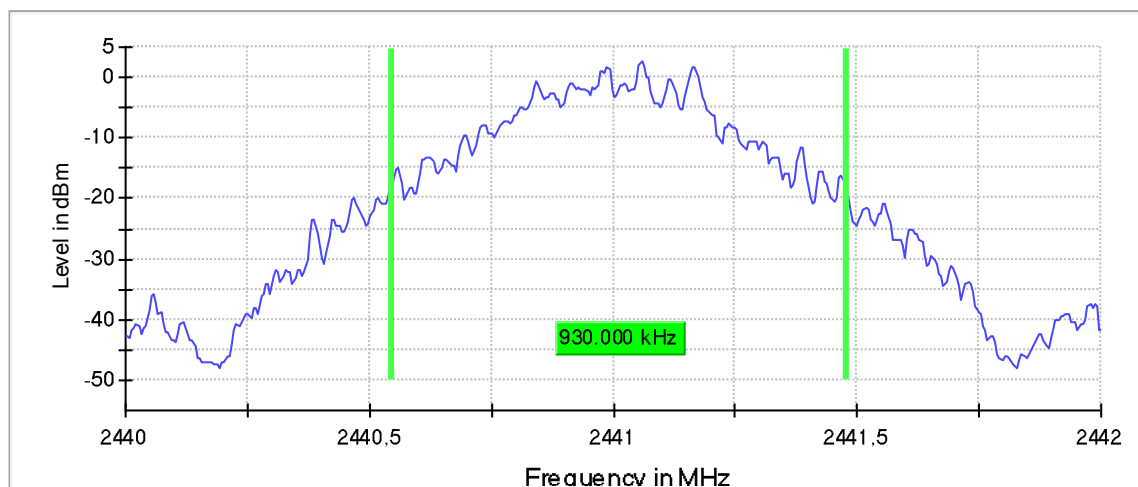
Date: 14.OCT.2022 15:04:52

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	14 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.10 dB	0.50 dB

Plot 23: EUT #0, Mode 1, Emission Bandwidth 20 dB, mid channel

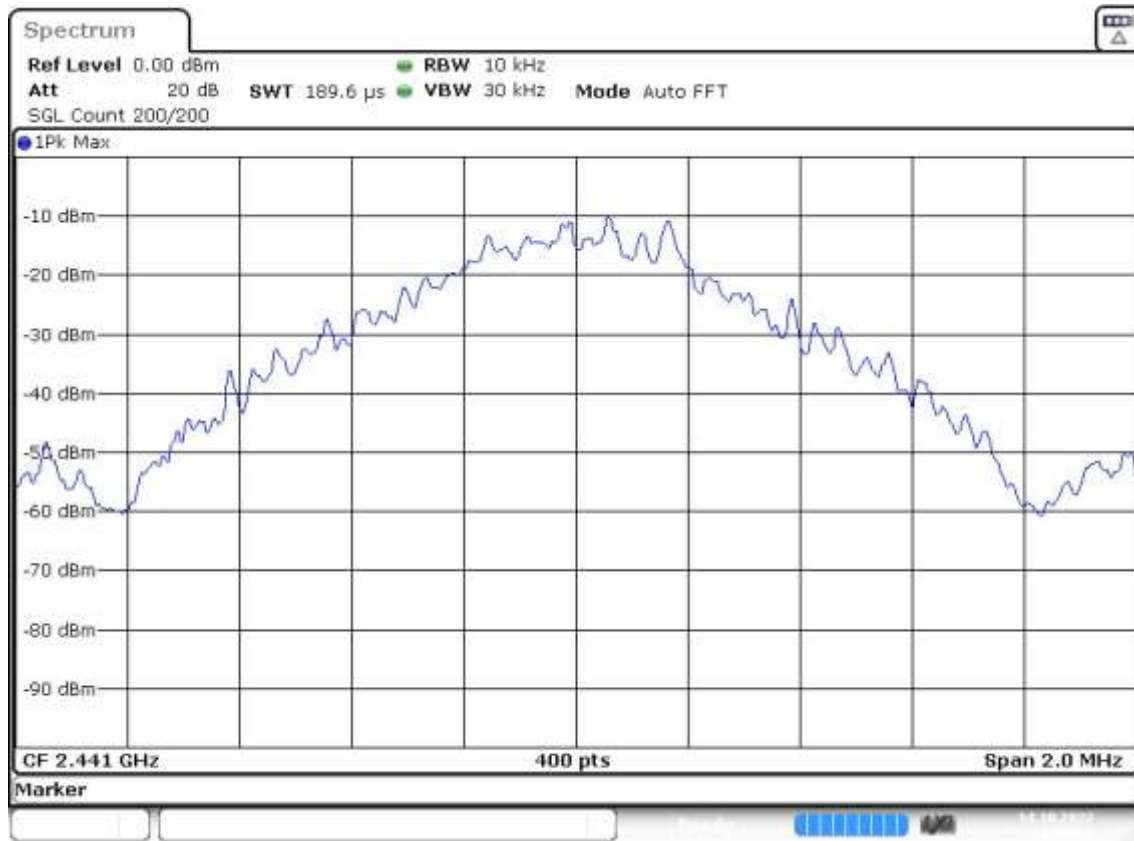
20 dB Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2441.000000	0.930000	---	---	2440.547500	2441.477500

(continuation of the "20 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2441.000000	2.5	PASS



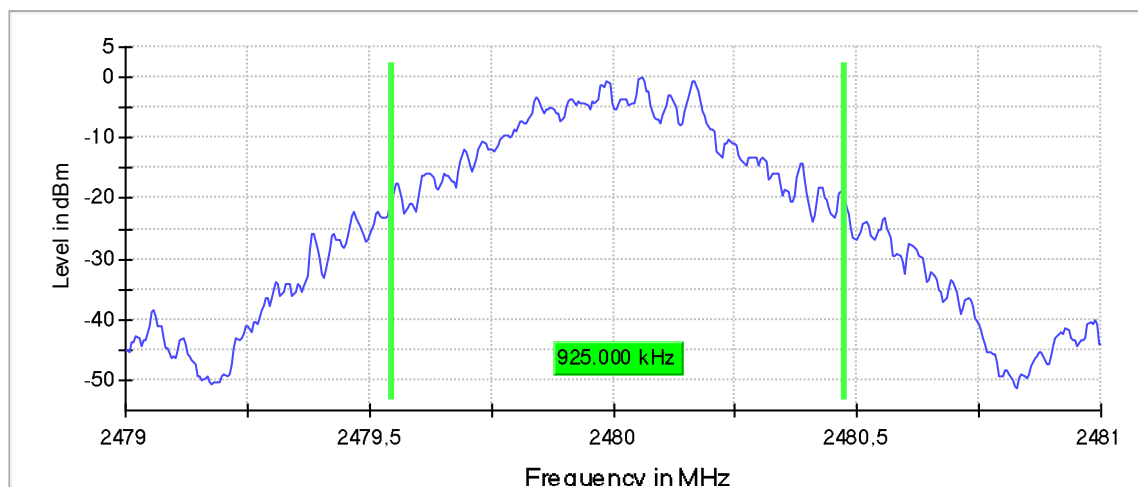
Date: 14.OCT.2022 15:09:30

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.44000 GHz	2.44000 GHz
Stop Frequency	2.44200 GHz	2.44200 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	15 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.04 dB	0.50 dB

Plot 24: EUT #0, Mode 1, Emission Bandwidth 20 dB, high channel

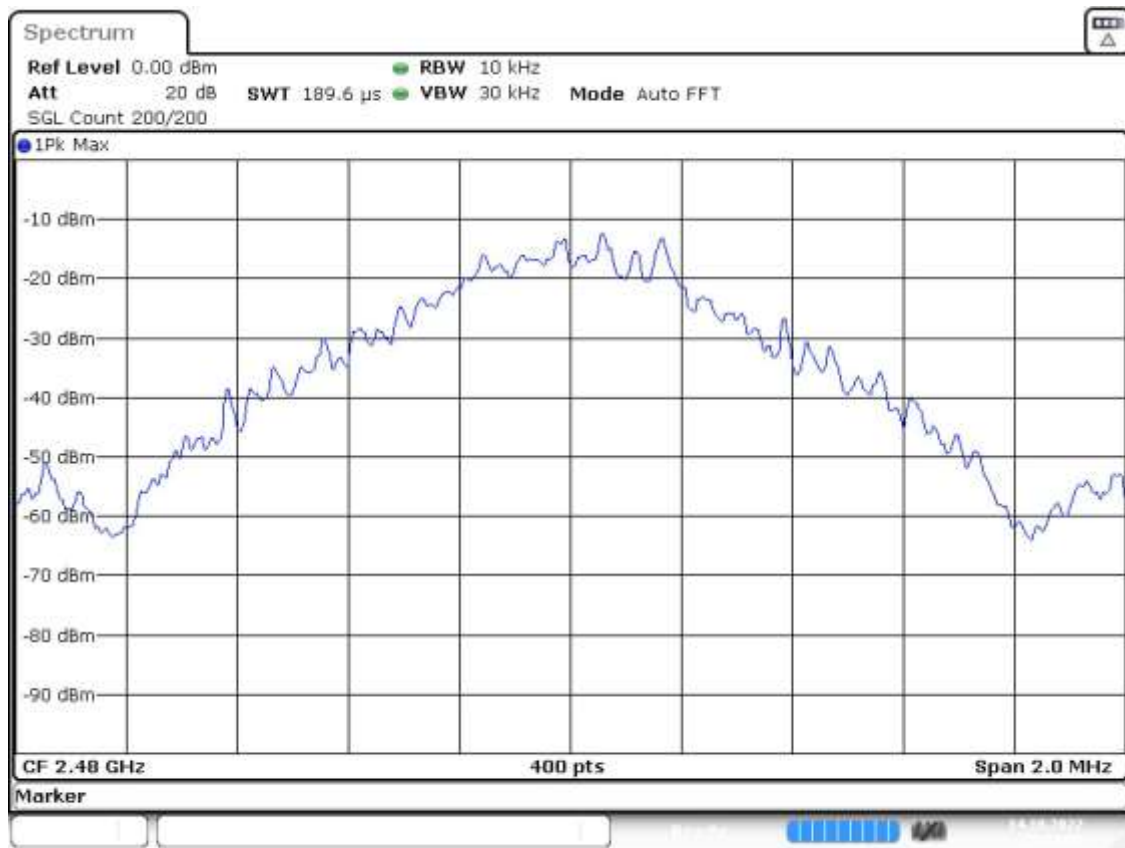
20 dB Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2480.000000	0.925000	---	---	2479.547500	2480.472500

(continuation of the "20 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2480.000000	0.2	PASS



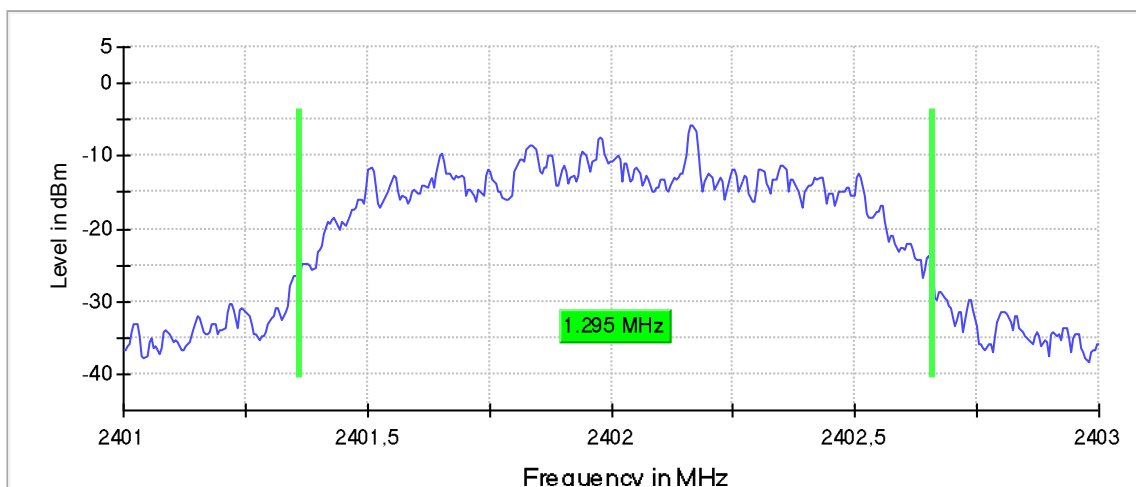
Date: 14.OCT.2022 15:14:19

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47900 GHz	2.47900 GHz
Stop Frequency	2.48100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	>= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	9 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.13 dB	0.50 dB

Plot 25: EUT #0, Mode 2, Emission Bandwidth 20 dB, low channel

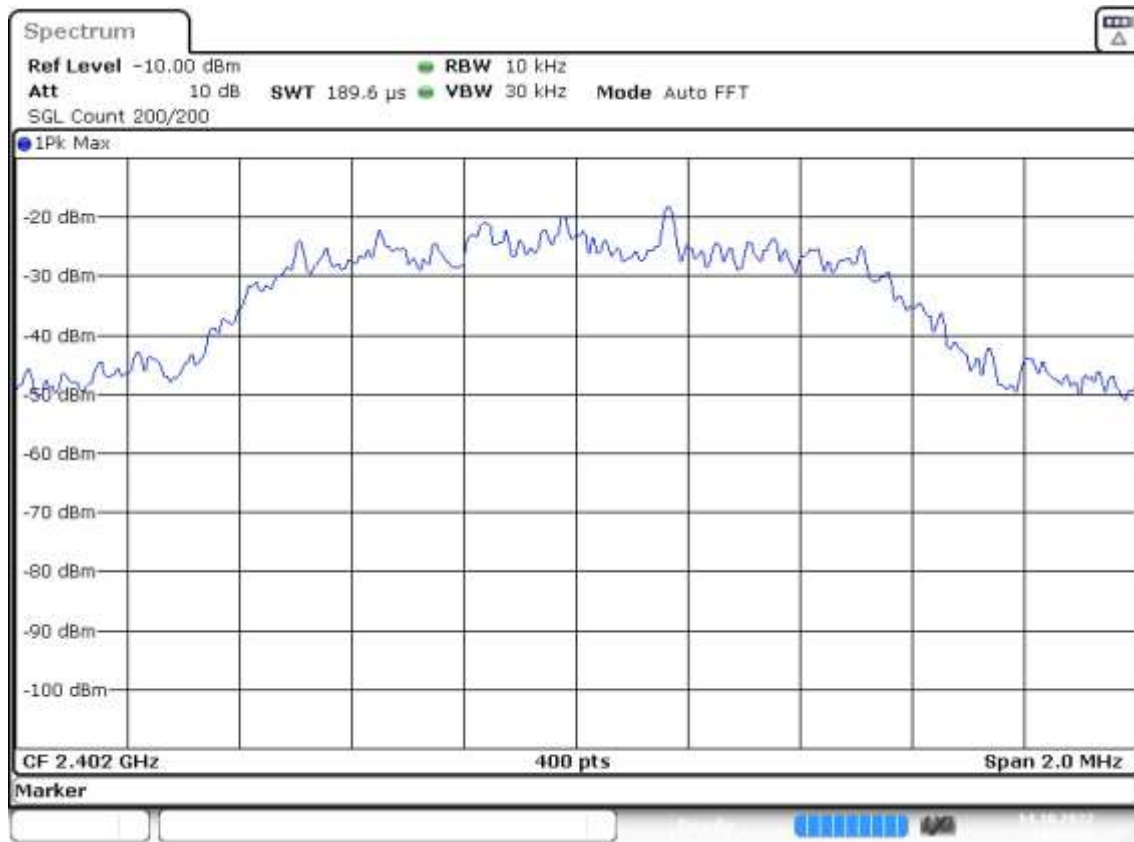
20 dB Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	1.295000	---	---	2401.362500	2402.657500

(continuation of the "20 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2402.000000	-5.7	PASS



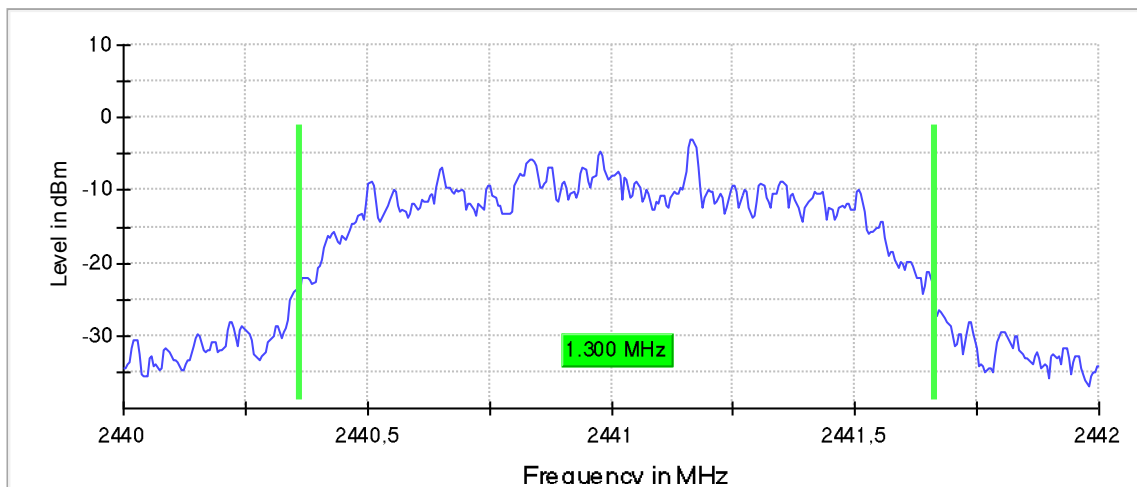
Date: 14.OCT.2022 15:37:54

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	13 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.02 dB	0.50 dB

Plot 26: EUT #0, Mode 2, Emission Bandwidth 20 dB, mid channel

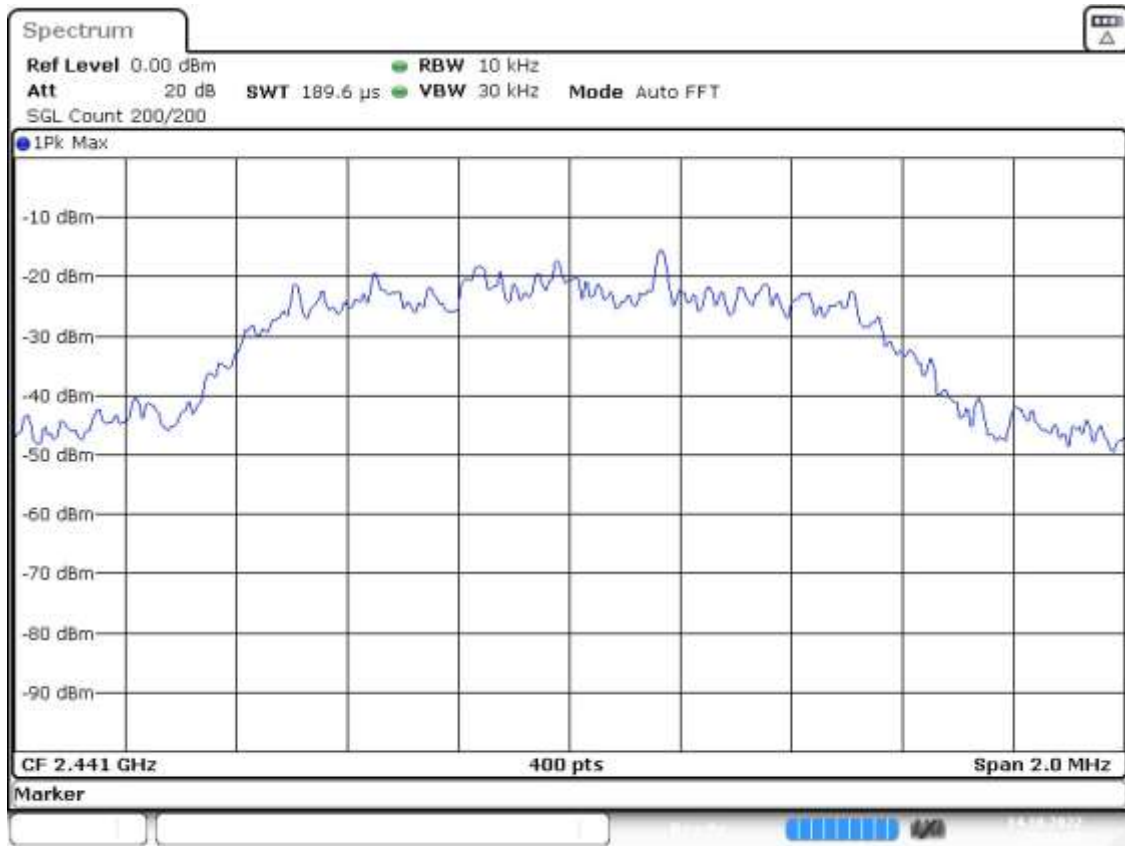
20 dB Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2441.000000	1.300000	---	---	2440.362500	2441.662500

(continuation of the "20 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2441.000000	-3.0	PASS



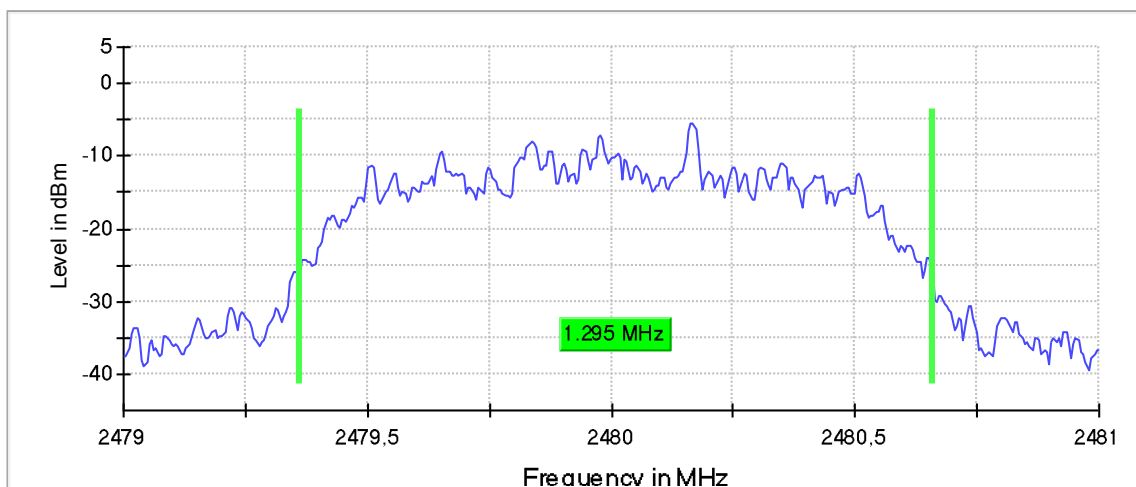
Date: 14.OCT.2022 15:42:17

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.44000 GHz	2.44000 GHz
Stop Frequency	2.44200 GHz	2.44200 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
Sweeptime	189.648 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	14 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.09 dB	0.50 dB

Plot 27: EUT #0, Mode 2, Emission Bandwidth 20 dB, high channel

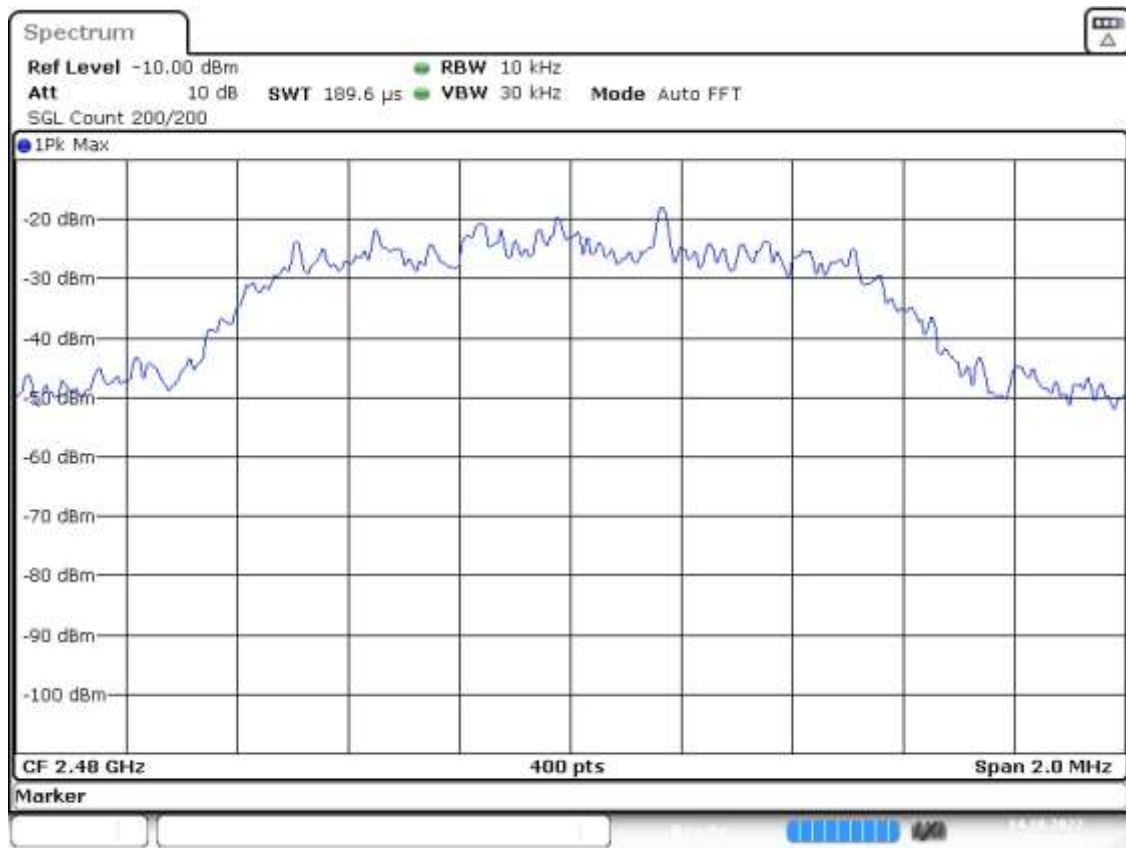
20 dB Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2480.000000	1.295000	---	---	2479.362500	2480.657500

(continuation of the "20 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2480.000000	-5.5	PASS



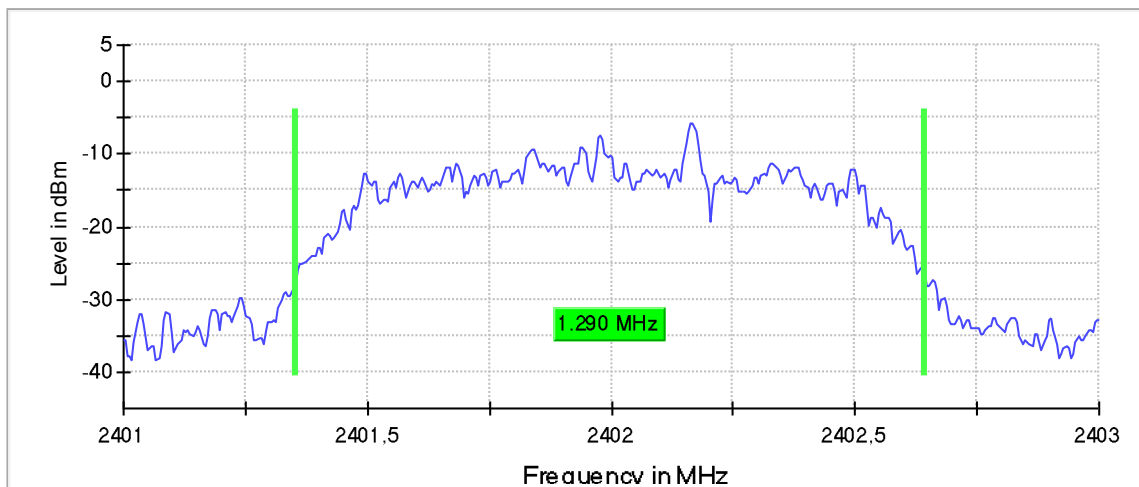
Date: 14.OCT.2022 15:46:31

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47900 GHz	2.47900 GHz
Stop Frequency	2.48100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	10 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.31 dB	0.50 dB

Plot 28: EUT #0, Mode 3, Emission Bandwidth 20 dB, low channel

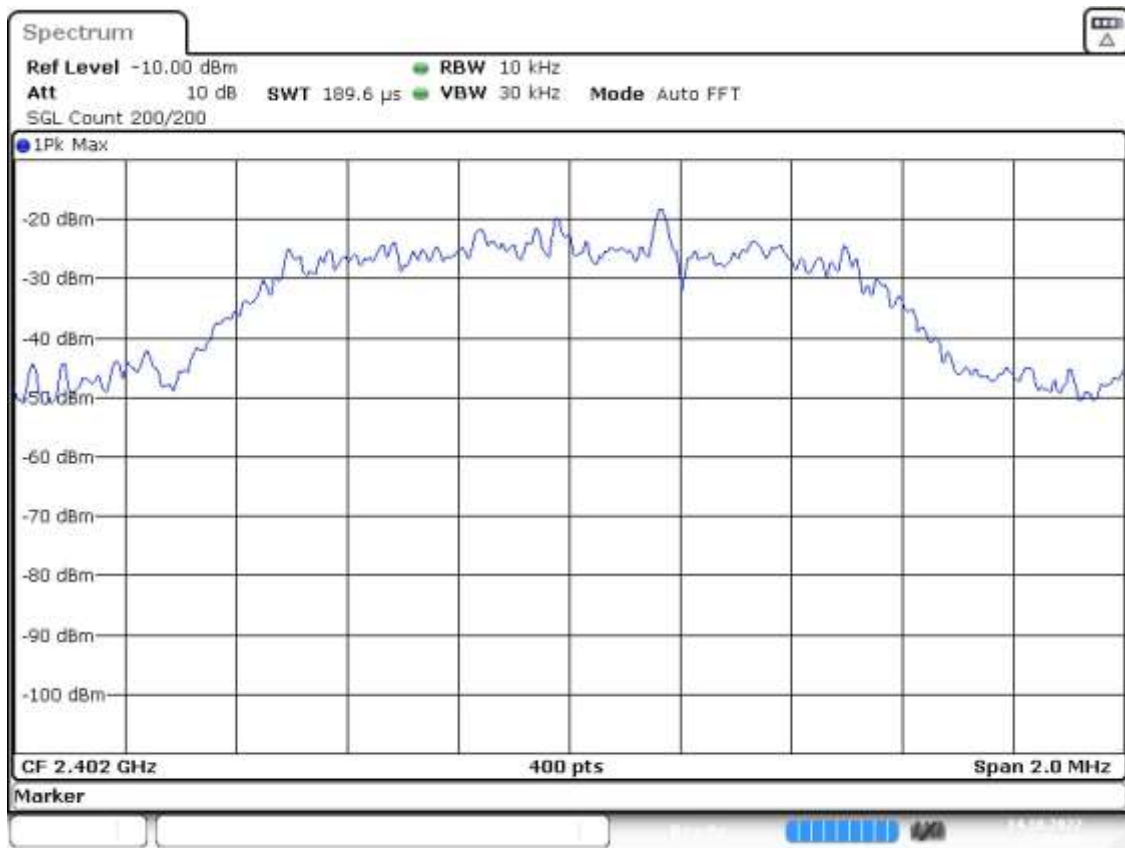
20 dB Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	1.290000	---	---	2401.352500	2402.642500

(continuation of the "20 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2402.000000	-5.8	PASS



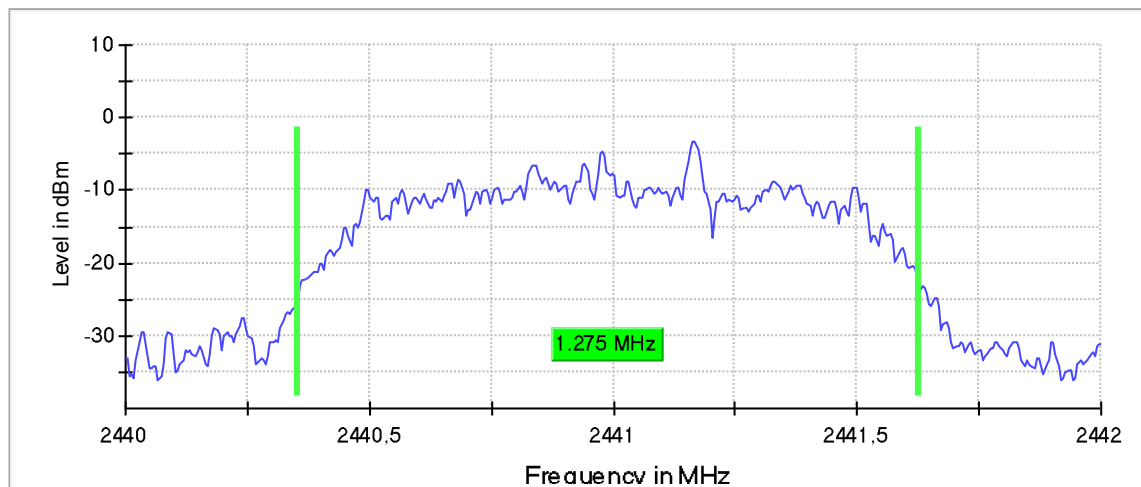
Date: 14.OCT.2022 16:09:05

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
Sweeptime	189.648 μ s	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	14 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.42 dB	0.50 dB

Plot 29: EUT #0, Mode 3, Emission Bandwidth 20 dB, mid channel

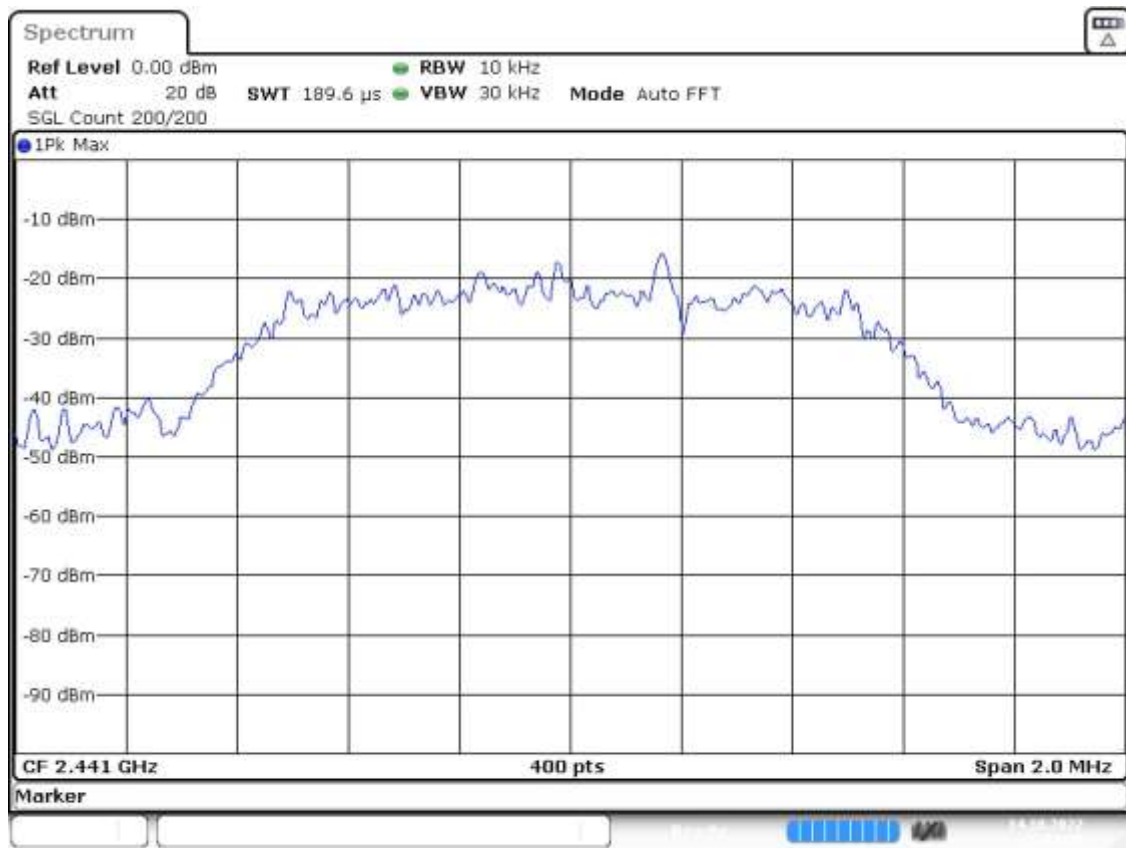
20 dB Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2441.000000	1.275000	---	---	2440.352500	2441.627500

(continuation of the "20 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2441.000000	-3.2	PASS



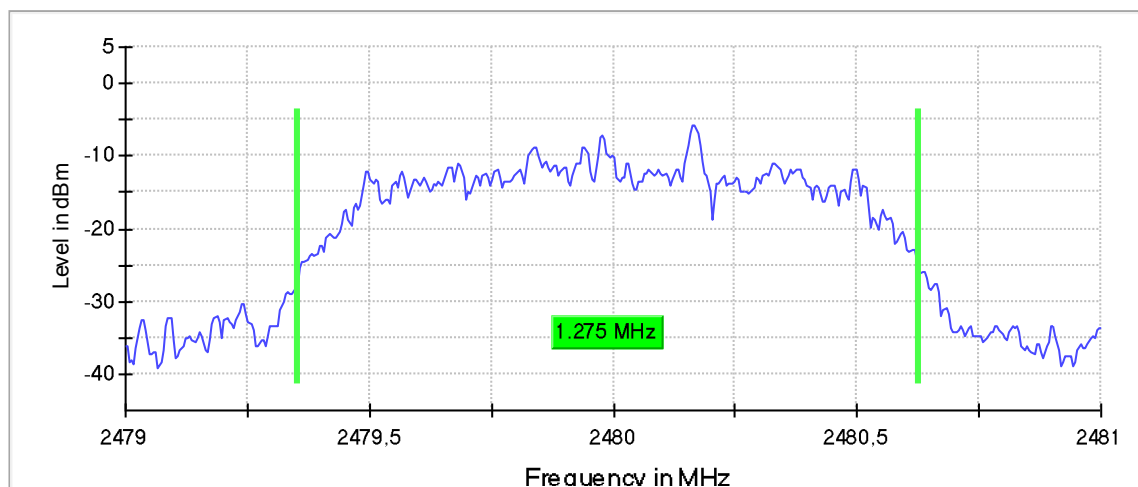
Date: 14.OCT.2022 16:13:48

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.44000 GHz	2.44000 GHz
Stop Frequency	2.44200 GHz	2.44200 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	>= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	11 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.01 dB	0.50 dB

Plot 30: EUT #0, Mode 3, Emission Bandwidth 20 dB, high channel

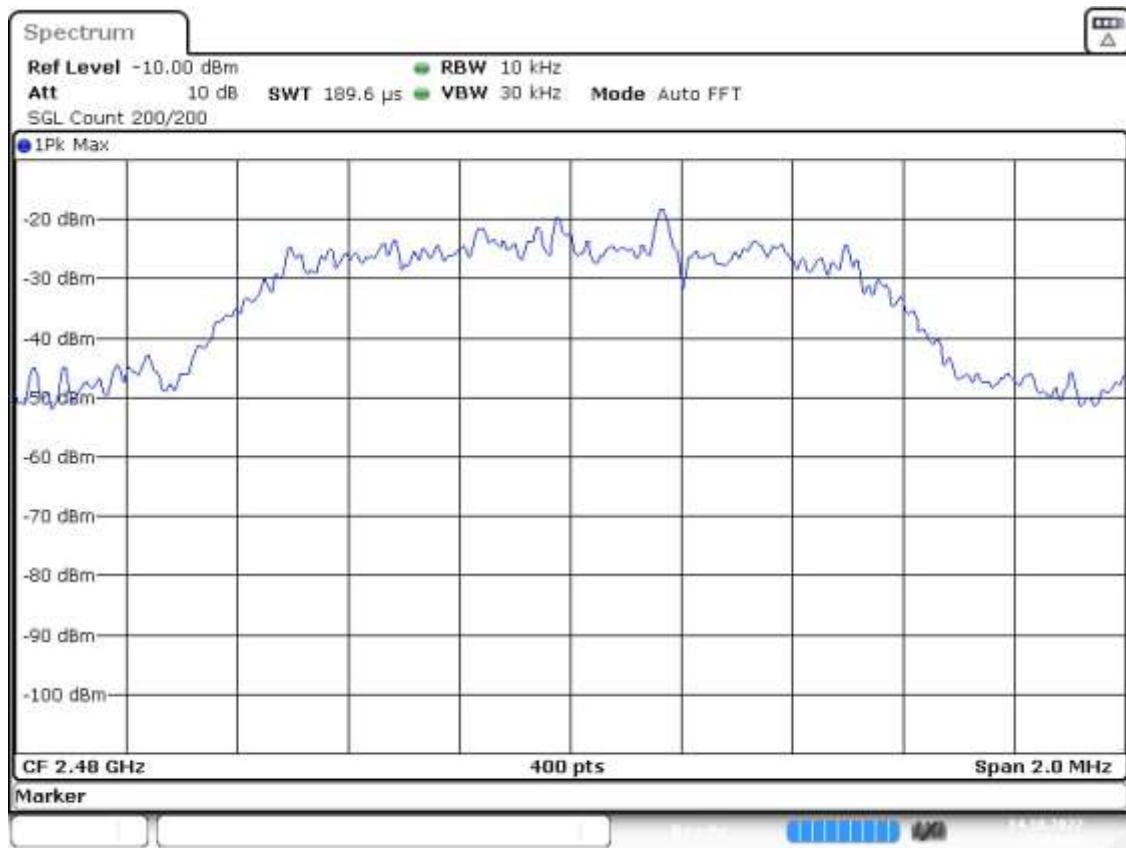
20 dB Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2480.000000	1.275000	---	---	2479.352500	2480.627500

(continuation of the "20 dB Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Max Level (dBm)	Result
2480.000000	-5.7	PASS



Date: 14.OCT.2022 16:18:26

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47900 GHz	2.47900 GHz
Stop Frequency	2.48100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	200	200
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	9 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.09 dB	0.50 dB

7.5 Occupied Bandwidth (99% OBW)

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

The Occupied Channel Bandwidth is the bandwidth that contains 99 % of the power of the signal (RSS-Gen).

Limit

No limit defined.

Test procedure

ANSI C63.10, 7.8

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

- The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
- Step a) through step c) might require iteration to adjust within the specified range.
- Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Test setup: 8.4 with conducted test sample (see section 5.2)

Test Results

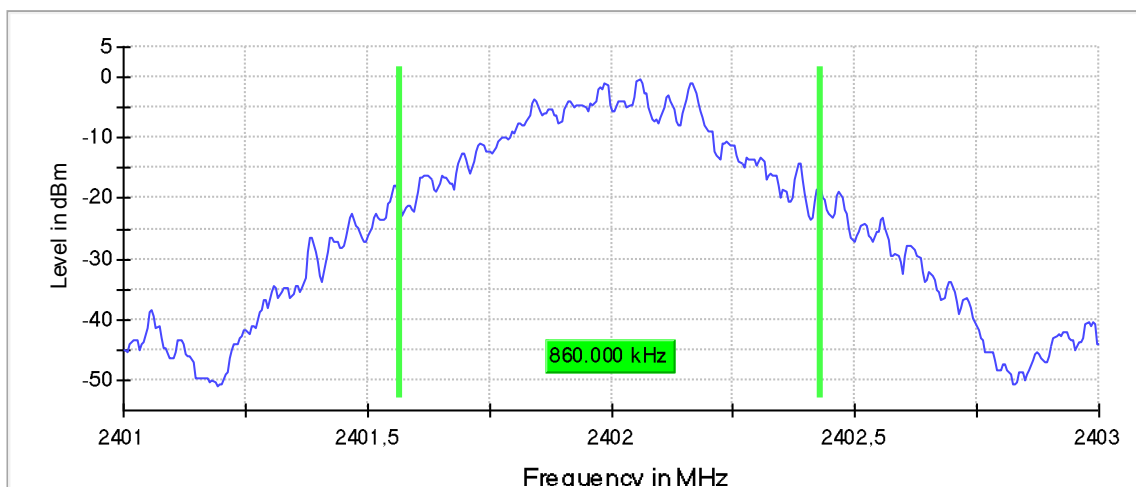
EUT Mode	Occupied Bandwidth (99%)		
	low channel [kHz]	mid channel [kHz]	high channel [kHz]
Mode 1	860	860	860
Mode 2	1220.0	1210.0	1205.0
Mode 3	1215.0	1210.0	1210.0

Comment:

Verdict	- PASS -	<i>see next plots</i>
----------------	-----------------	-----------------------

Plot 31: EUT #0, Mode 1, 99% Occupied Bandwidth, low channel

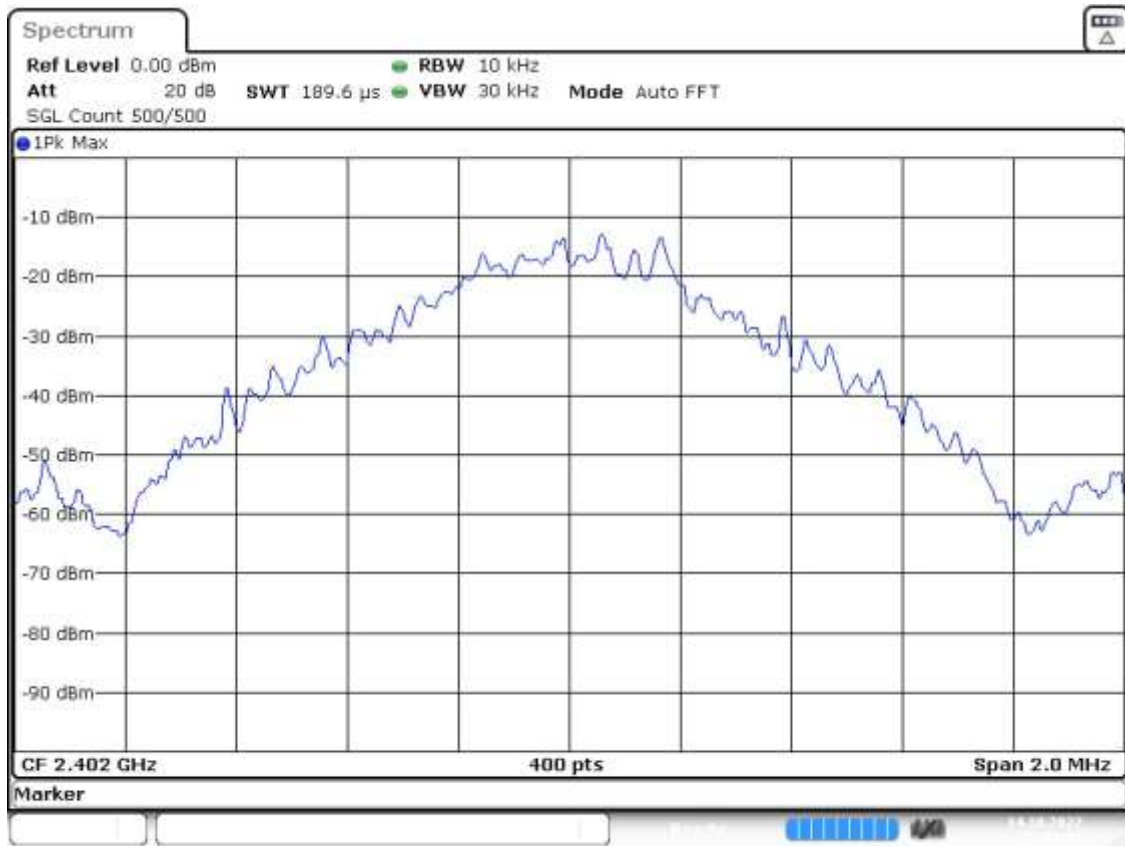
99 % Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	0.860000	---	---	2401.567500	2402.427500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2402.000000	PASS



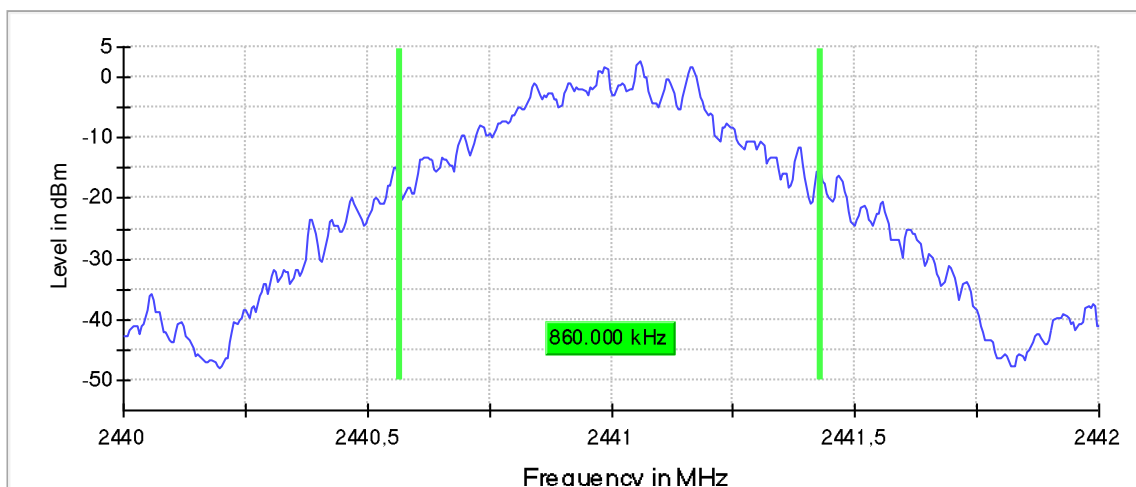
Date: 14.OCT.2022 15:05:35

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
Sweptime	189.648 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	500	500
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	8 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.08 dB	0.30 dB

Plot 32: EUT #0, Mode 1, 99% Occupied Bandwidth, mid channel

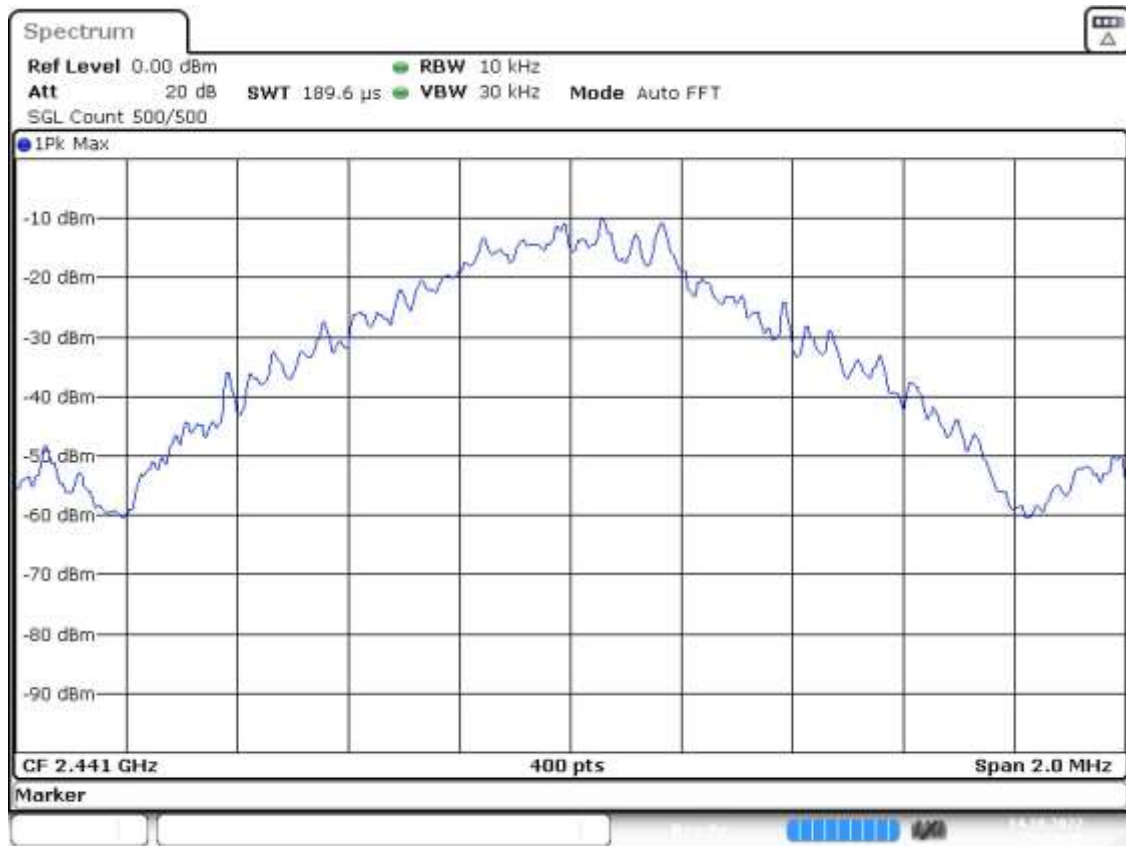
99 % Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2441.000000	0.860000	---	---	2440.567500	2441.427500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2441.000000	PASS



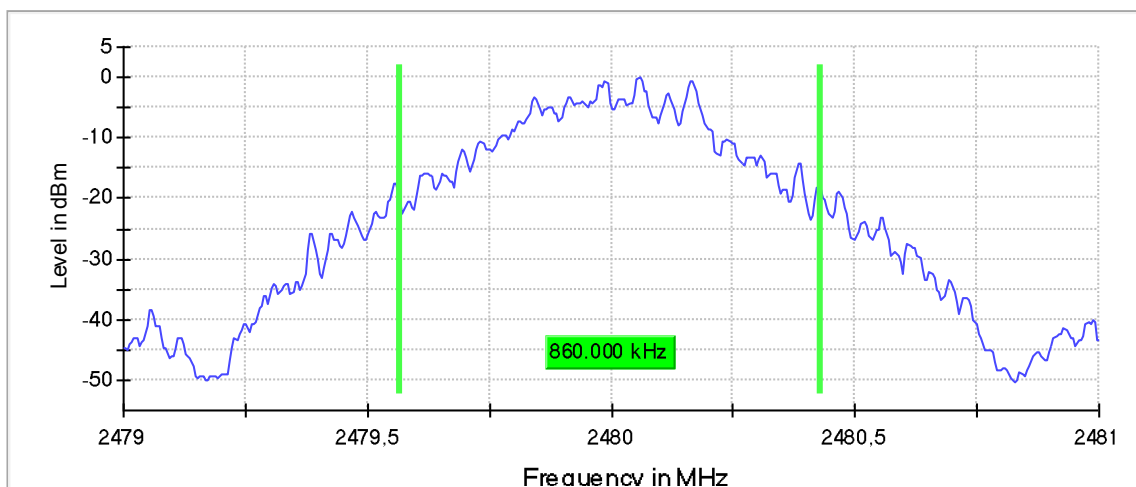
Date: 14.OCT.2022 15:10:15

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.44000 GHz	2.44000 GHz
Stop Frequency	2.44200 GHz	2.44200 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	500	500
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	10 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.10 dB	0.30 dB

Plot 33: EUT #0, Mode 1, 99% Occupied Bandwidth, high channel

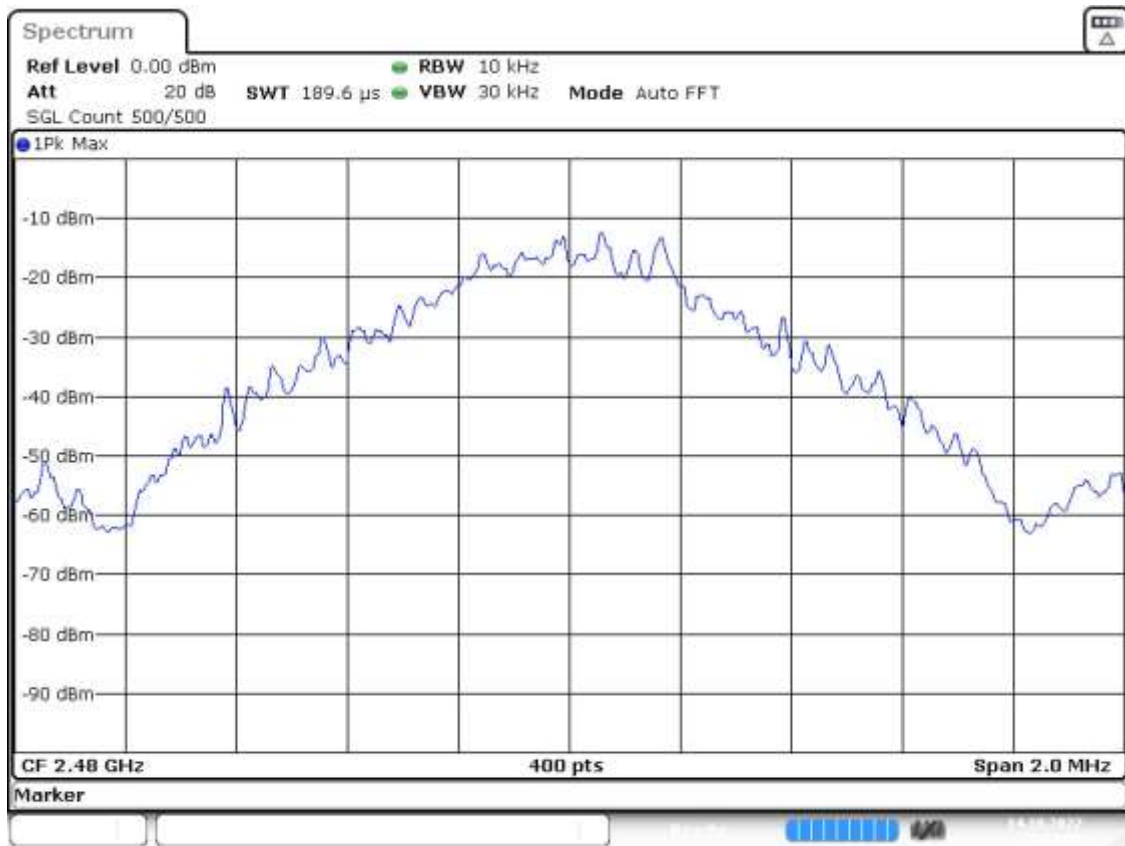
99 % Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2480.000000	0.860000	---	---	2479.567500	2480.427500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2480.000000	PASS



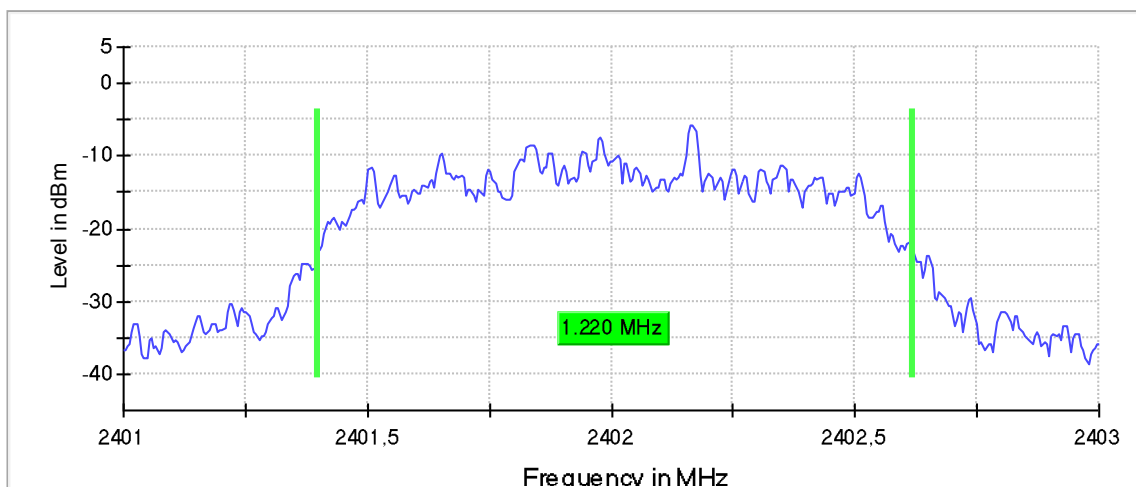
Date: 14.OCT.2022 15:15:02

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47900 GHz	2.47900 GHz
Stop Frequency	2.48100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	500	500
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	9 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.11 dB	0.30 dB

Plot 34: EUT #0, Mode 2, 99% Occupied Bandwidth, low channel

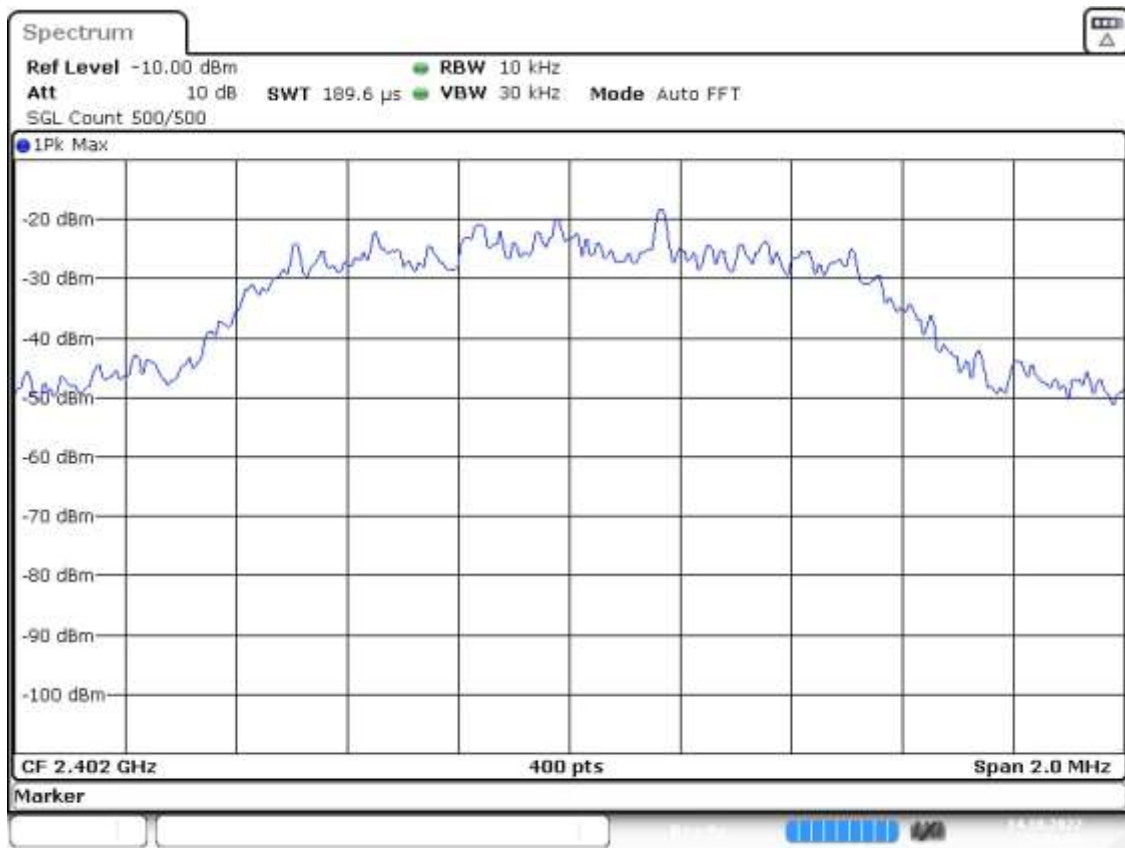
99 % Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	1.220000	---	---	2401.397500	2402.617500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2402.000000	PASS



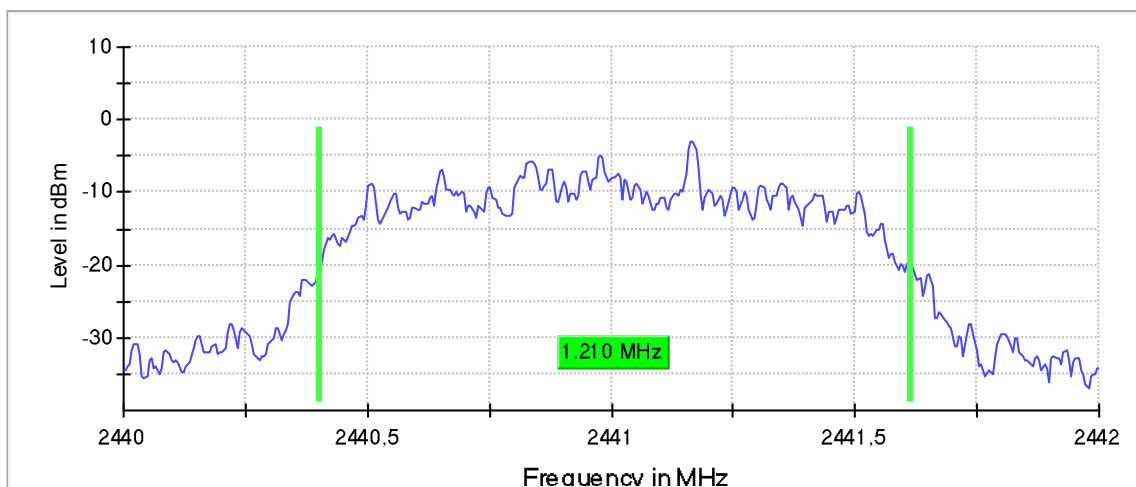
Date: 14.OCT.2022 15:38:36

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	500	500
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	6 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.09 dB	0.30 dB

Plot 35: EUT #0, Mode 2, 99% Occupied Bandwidth, mid channel

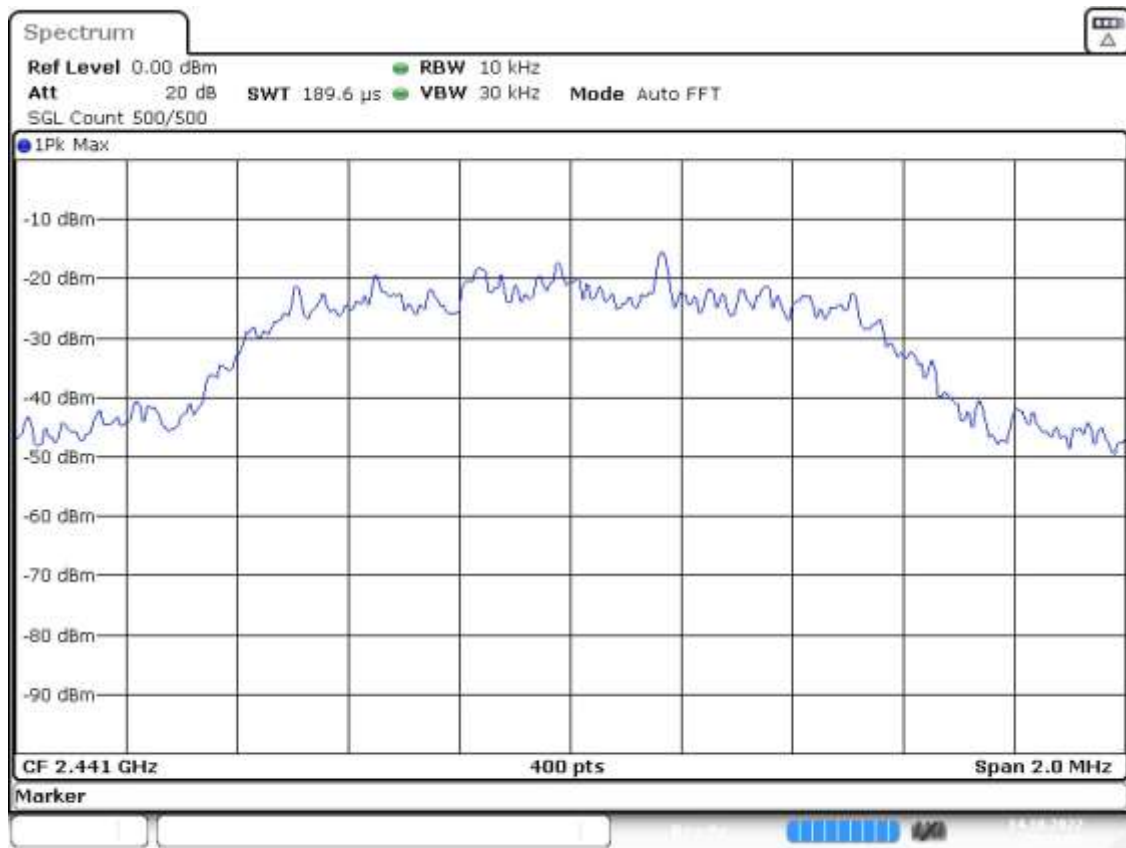
99 % Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2441.000000	1.210000	---	---	2440.402500	2441.612500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2441.000000	PASS



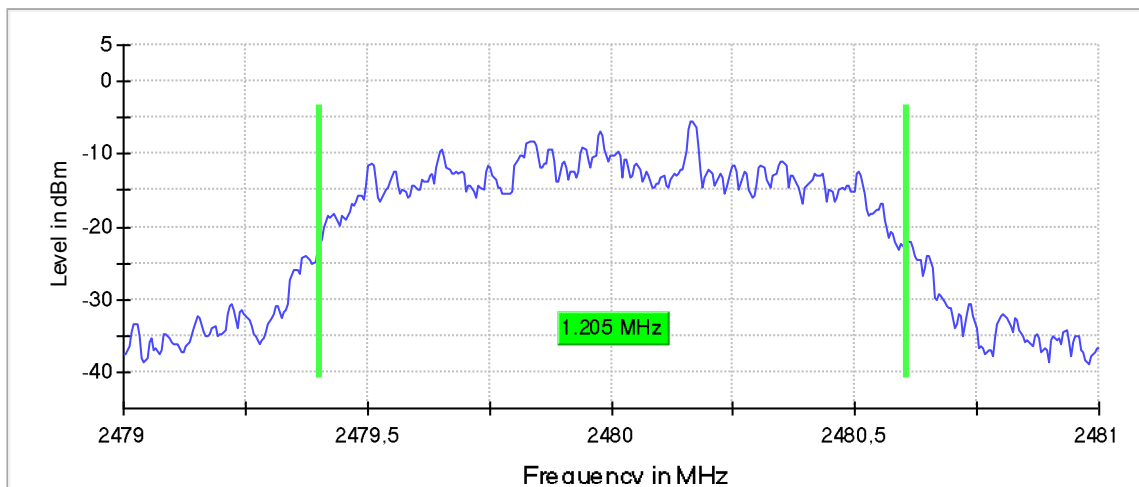
Date: 14.OCT.2022 15:42:59

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.44000 GHz	2.44000 GHz
Stop Frequency	2.44200 GHz	2.44200 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
Sweeptime	189.648 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	500	500
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	6 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.11 dB	0.30 dB

Plot 36: EUT #0, Mode 2, 99% Occupied Bandwidth, high channel

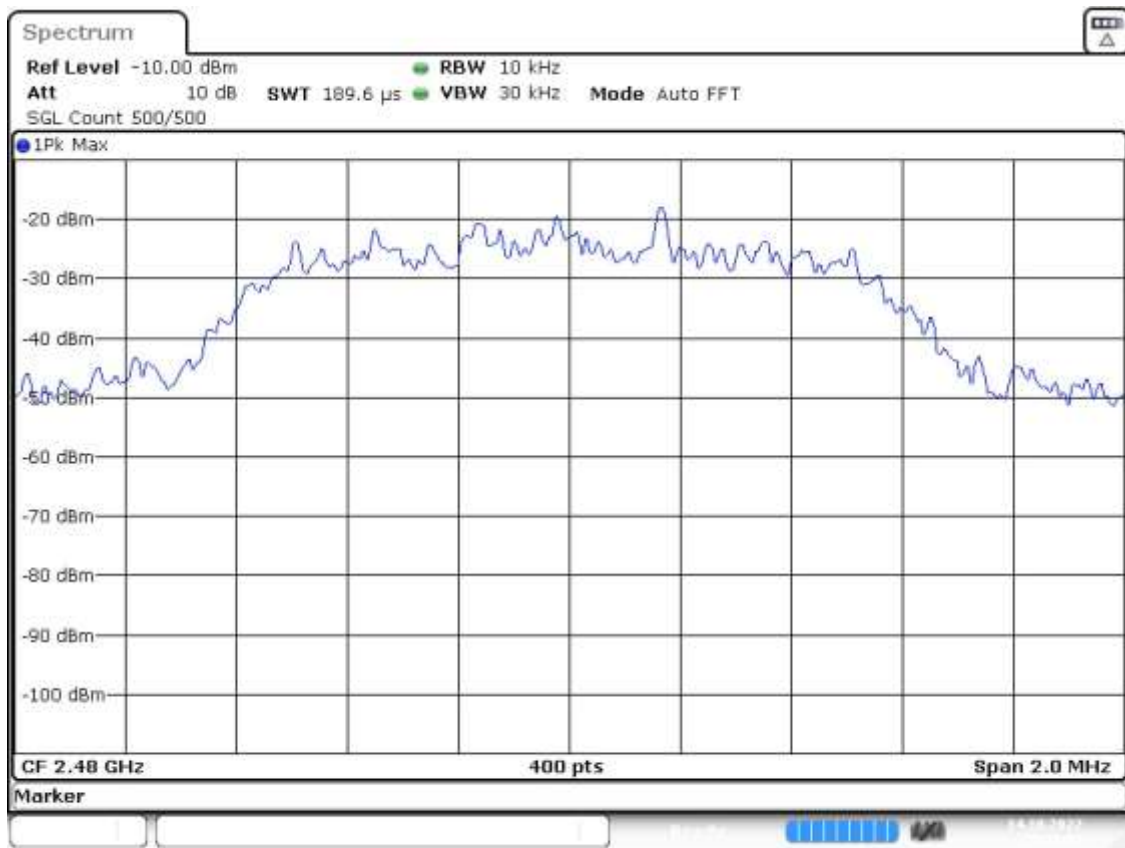
99 % Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2480.000000	1.205000	---	---	2479.402500	2480.607500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2480.000000	PASS



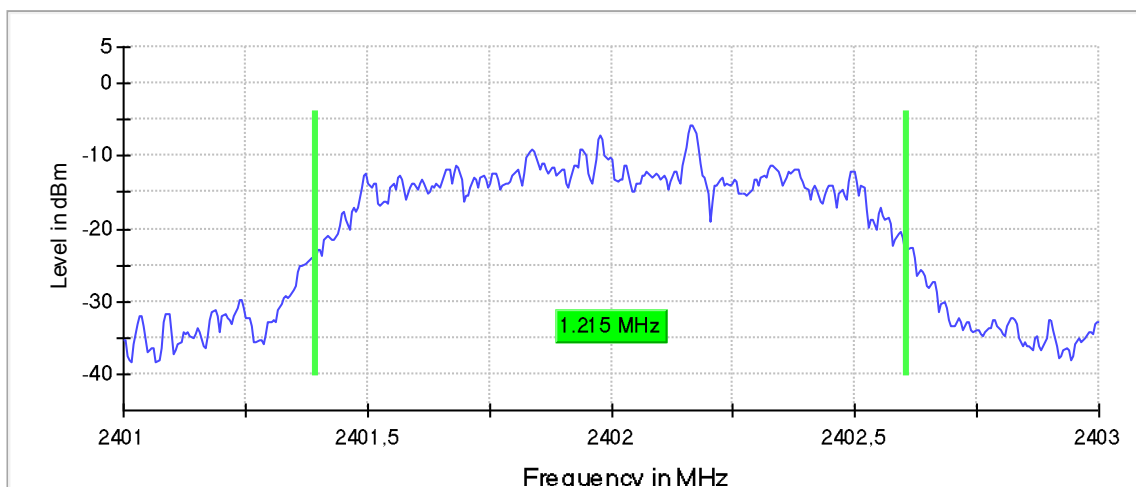
Date: 14.OCT.2022 15:47:14

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47900 GHz	2.47900 GHz
Stop Frequency	2.48100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	500	500
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	8 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.10 dB	0.30 dB

Plot 37: EUT #0, Mode 3, 99% Occupied Bandwidth, low channel

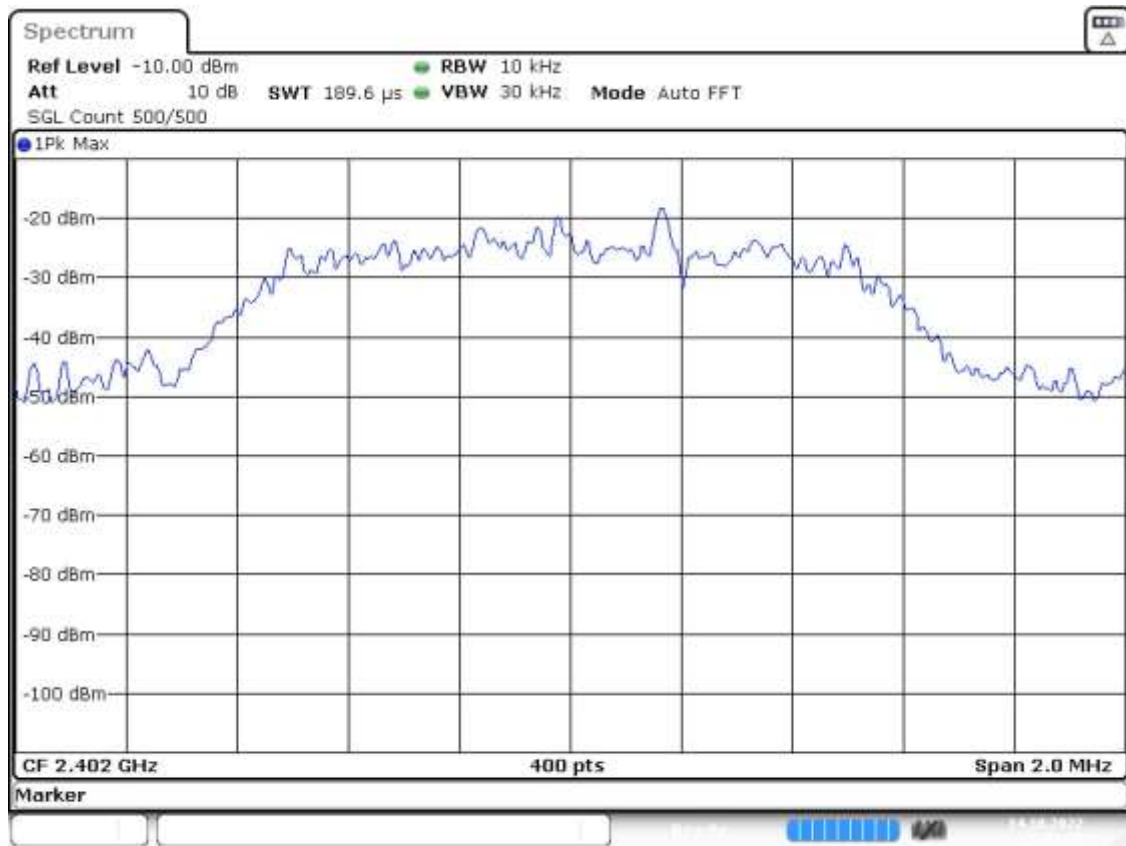
99 % Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	1.215000	---	---	2401.392500	2402.607500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2402.000000	PASS



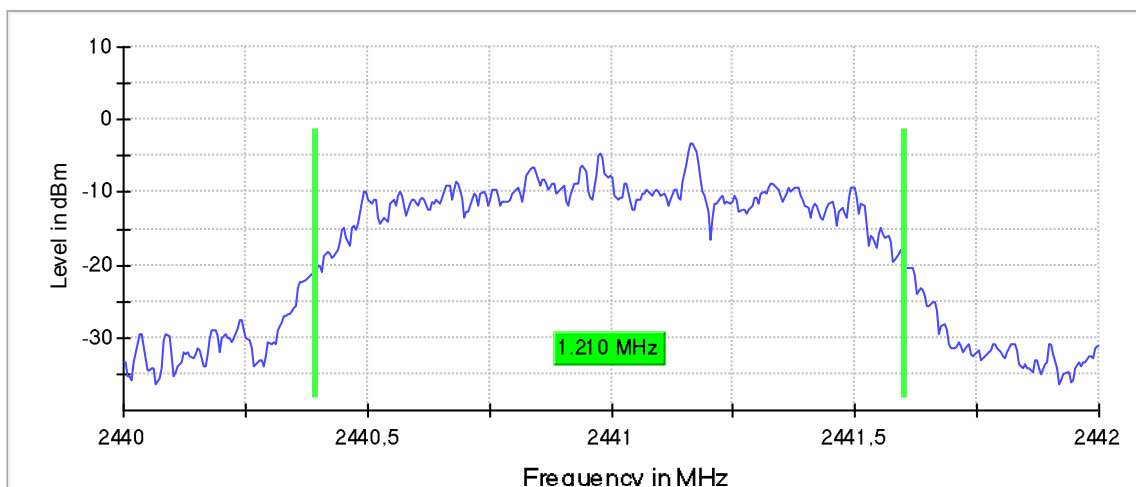
Date: 14.OCT.2022 16:09:48

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	500	500
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	8 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.13 dB	0.30 dB

Plot 38: EUT #0, Mode 3, 99% Occupied Bandwidth, mid channel

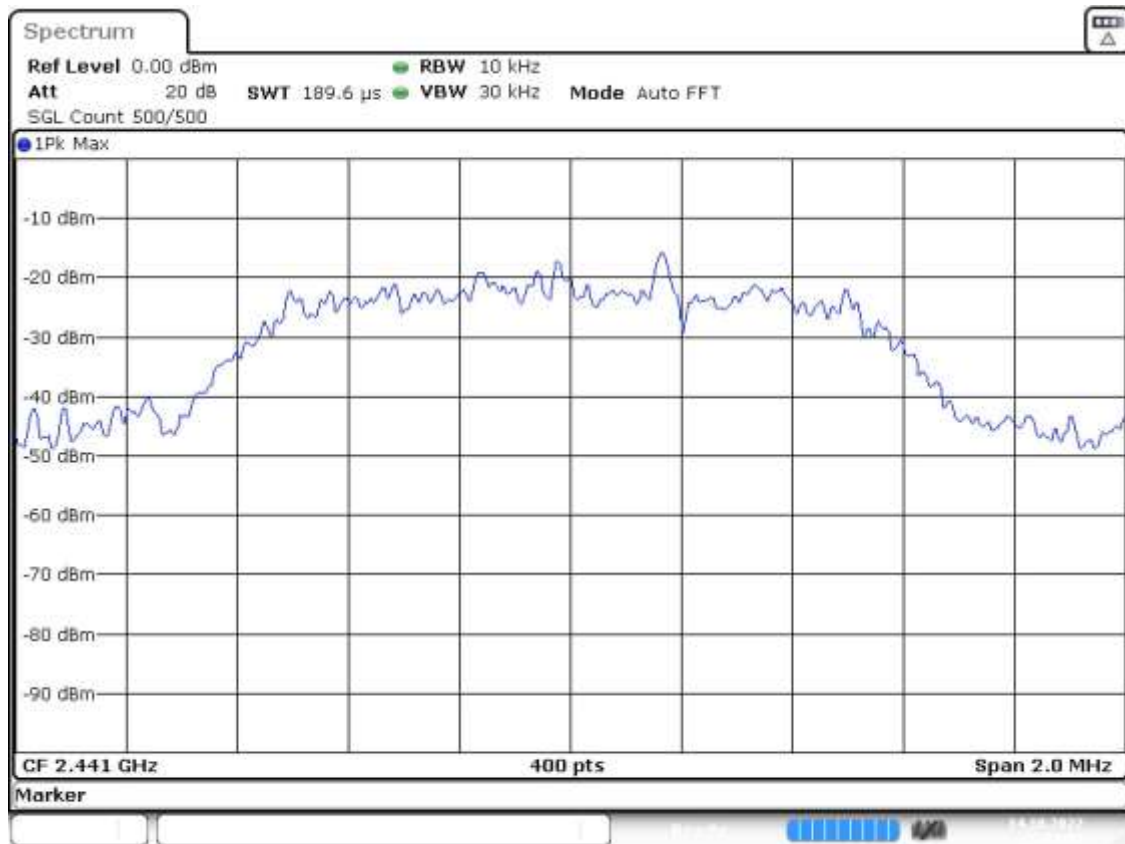
99 % Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2441.000000	1.210000	---	---	2440.392500	2441.602500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2441.000000	PASS



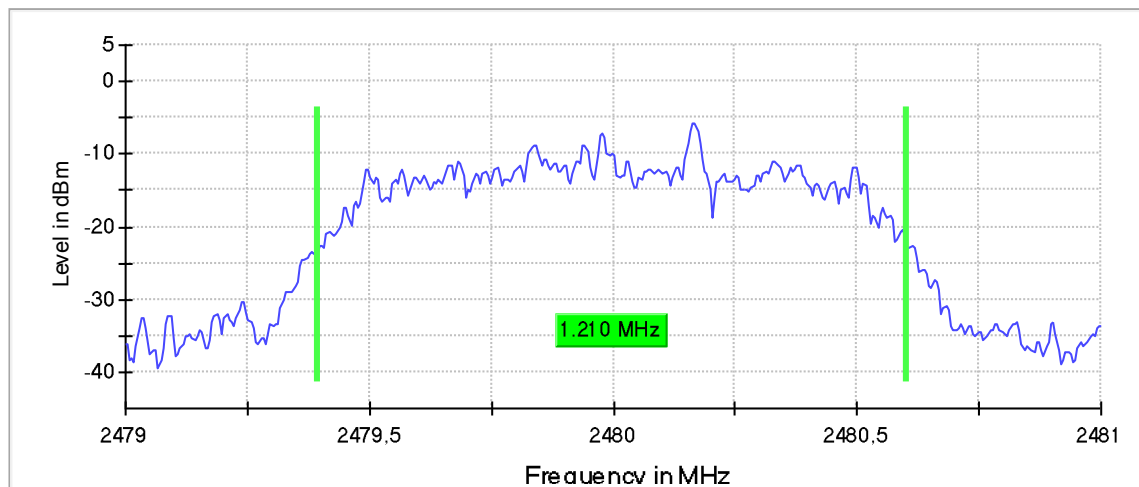
Date: 14.OCT.2022 16:14:34

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.44000 GHz	2.44000 GHz
Stop Frequency	2.44200 GHz	2.44200 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	500	500
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	8 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.04 dB	0.30 dB

Plot 39: EUT #0, Mode 3, 99% Occupied Bandwidth, high channel

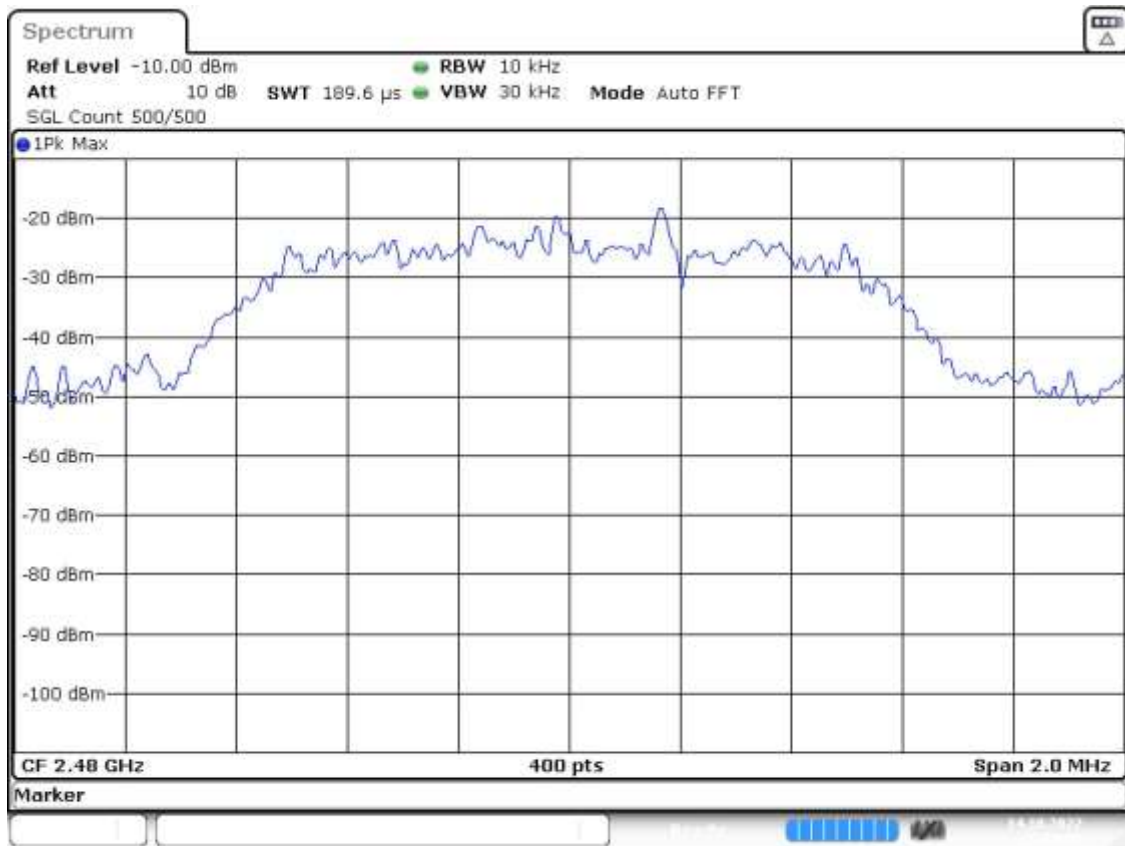
99 % Bandwidth



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2480.000000	1.210000	---	---	2479.392500	2480.602500

(continuation of the "99 % Bandwidth" table from column 6 ...)

DUT Frequency (MHz)	Result
2480.000000	PASS



Date: 14.OCT.2022 16:19:09

Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47900 GHz	2.47900 GHz
Stop Frequency	2.48100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	≥ 10.000 kHz
VBW	30.000 kHz	≥ 30.000 kHz
SweepPoints	400	~ 400
SweepTime	189.648 μ s	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	500	500
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	6 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.06 dB	0.30 dB

7.6 RF Output Power (Conducted Peak Power)

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

The RF Output Power is defined as the conducted peak output power.

Limit

§15.247

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

RSS-247, 5.4 (b)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

Test procedure

ANSI C63.10, 7.8.5

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

a) Use the following spectrum analyzer settings:

- 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- 2) RBW > 20 dB bandwidth of the emission being measured.
- 3) VBW >= RBW.
- 4) Sweep: Auto.
- 5) Detector function: Peak.
- 6) Trace: Max hold.

b) Allow trace to stabilize.

c) Use the marker-to-peak function to set the marker to the peak of the emission.

d) The indicated level is the peak output power, after any corrections for external attenuators and cables.

e) A plot of the test results and setup description shall be included in the test report.

ANSI C63.10, 11.9.2.3.2

Method AVGPM-G is a measurement using a gated RF average power meter.

Alternatively, measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Because the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

Gate triggering can be implemented in such a way that the sweep of the instrument is only active during the burst period of the device. Any Gate triggering shall be performed on the full power portion of the pulses and care must be taken to ensure that static portions of the pulse are not included in the measurement (ensuring that the trace is averaged over the entire symbol range). All Gate triggered measurements shall be accompanied by a Gate setup plot in the test report.

Test setup: 8.4 with conducted test sample (see section 5.2)

Test Results – Peak Power acc. ANSI C63-10, 7.8.5

EUT Mode	RF Output Power (Conducted Peak Power)			Limit [dBm]
	low channel [dBm]	mid channel [dBm]	high channel [dBm]	
Mode 1	5.6	8.1	5.8	≤ 30
Mode 2	4.5	7.0	4.2	≤ 30
Mode 3	4.6	7.8	5.1	≤ 30

Test Results – Average Power - AVGPM-G method acc. ANSI C63-10, 11.9.2.3.2

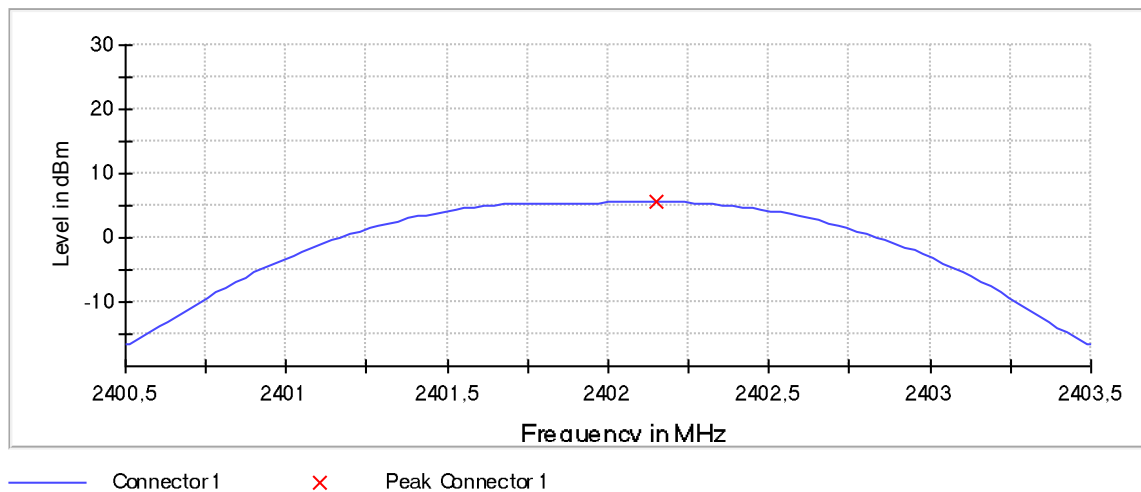
EUT Mode	RF Output Power (Conducted Peak Power)			Limit [dBm]
	low channel [dBm]	mid channel [dBm]	high channel [dBm]	
Mode 1	5.9	8.7	6.3	≤ 30
Mode 2	1.2	4.0	1.6	≤ 30
Mode 3	1.2	4.0	1.6	≤ 30

Comment:	---
-----------------	-----

Verdict	- PASS -	<i>see next plots</i>
----------------	-----------------	-----------------------

Plot 40: EUT #0, Mode 1, RF Peak Output Power, low channel

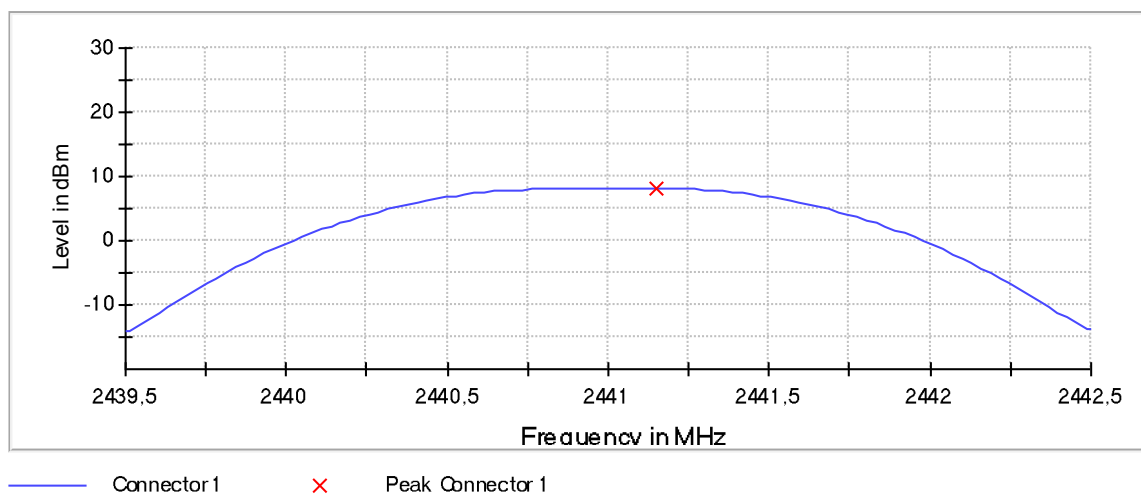
Peak Power



DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2402.000000	5.6	21.0	PASS

Plot 41: EUT #0, Mode 1, RF Peak Output Power, mid channel

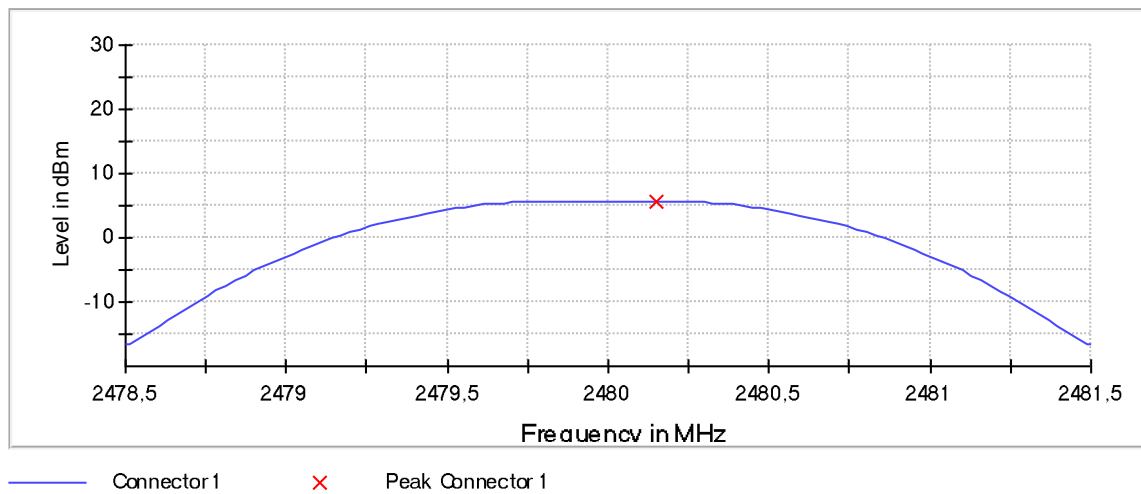
Peak Power



DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2441.000000	8.1	21.0	PASS

Plot 42: EUT #0, Mode 1, RF Peak Output Power, high channel

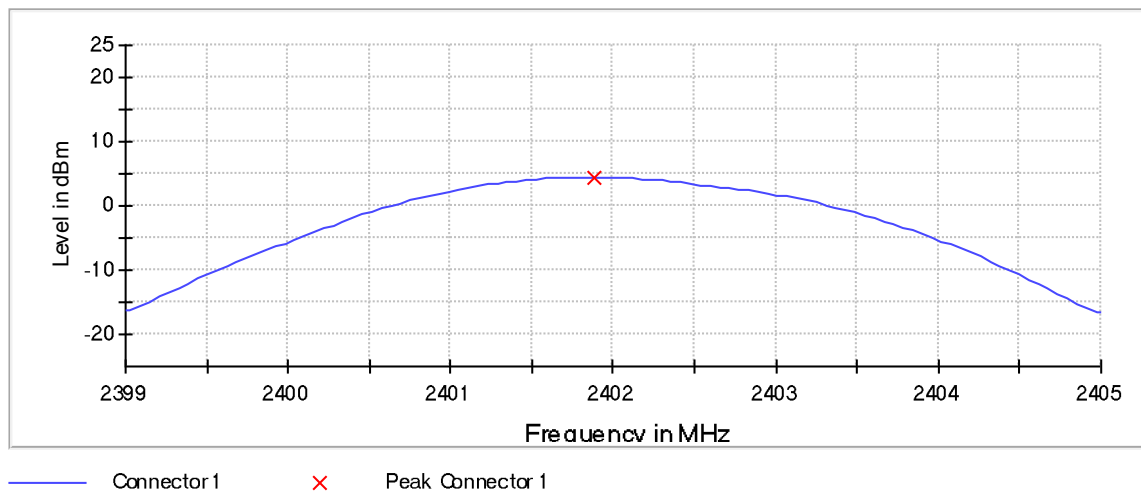
Peak Power



DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2480.000000	5.8	21.0	PASS

Plot 43: EUT #0, Mode 2, RF Peak Output Power, low channel

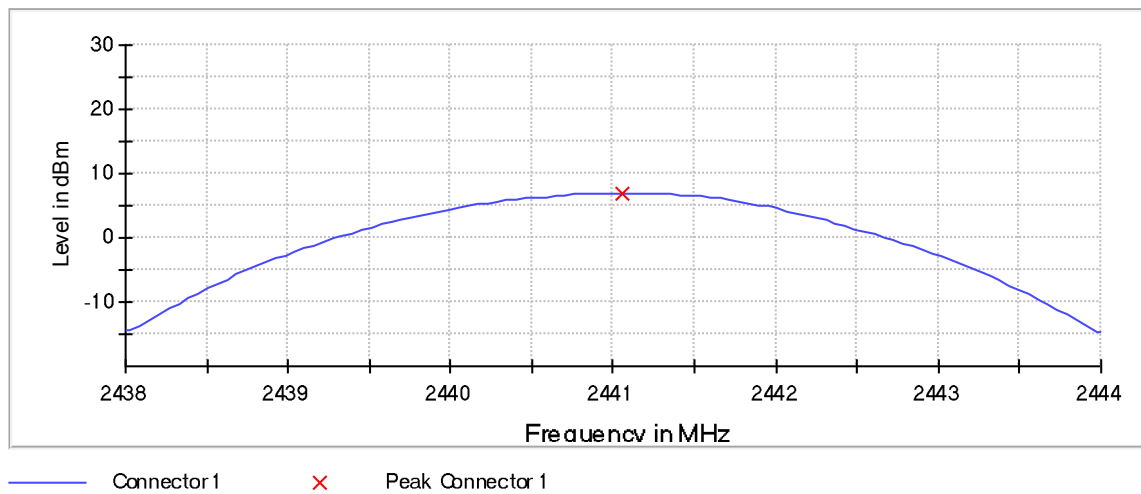
Peak Power



DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2402.000000	4.5	21.0	PASS

Plot 44: EUT #0, Mode 2, RF Peak Output Power, mid channel

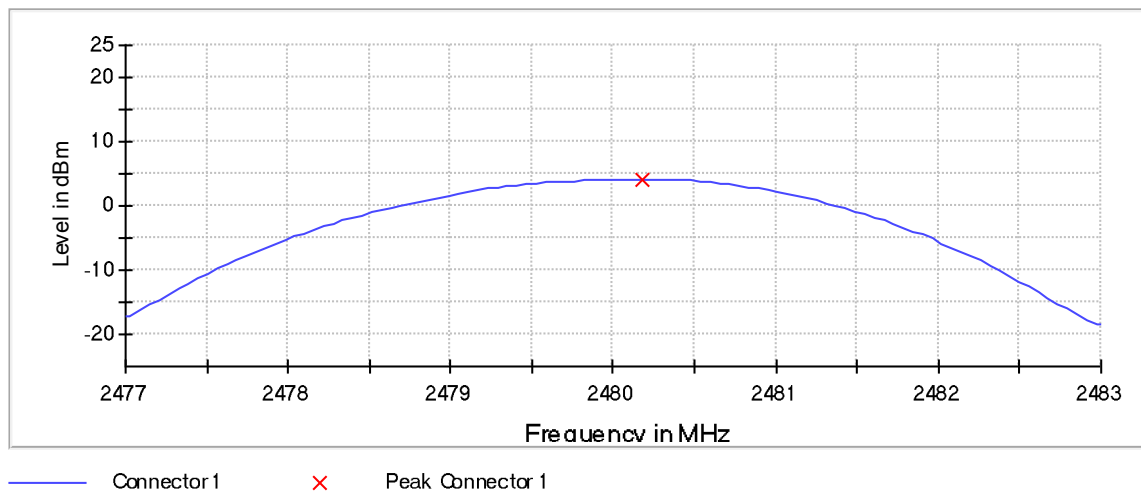
Peak Power



DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2441.000000	7.0	21.0	PASS

Plot 45: EUT #0, Mode 2, RF Peak Output Power, high channel

Peak Power



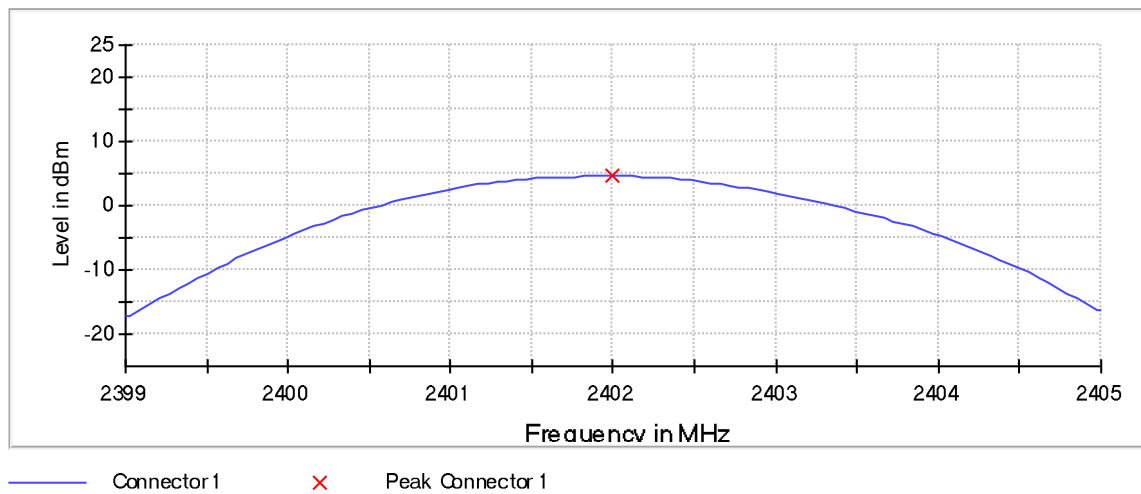
DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2480.000000	4.2	21.0	PASS

TR no.: 21116598-25034-1

2022-12-20

Plot 46: EUT #0, Mode 3, RF Peak Output Power, low channel

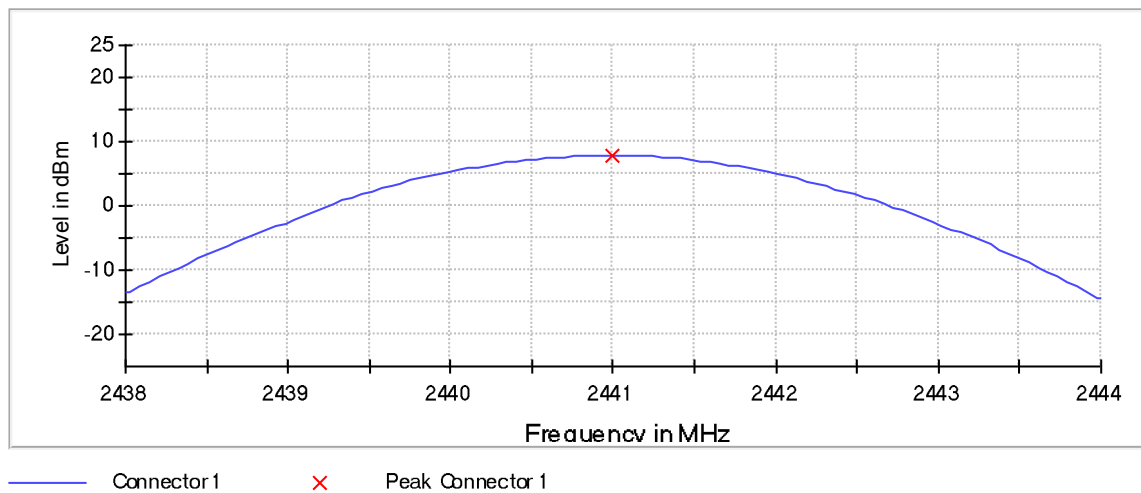
Peak Power



DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2402.000000	4.6	21.0	PASS

Plot 47: EUT #0, Mode 3, RF Peak Output Power, mid channel

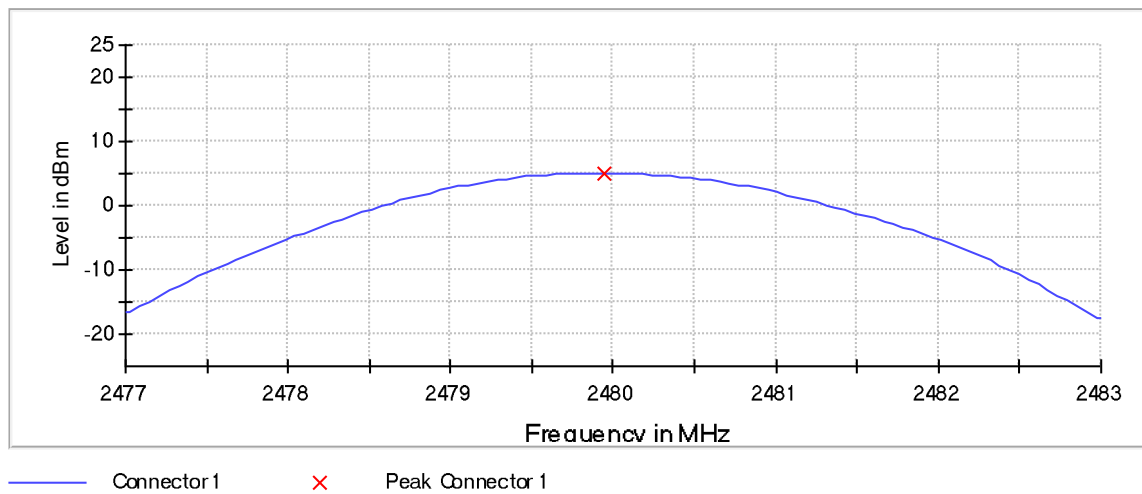
Peak Power



DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2441.000000	7.8	21.0	PASS

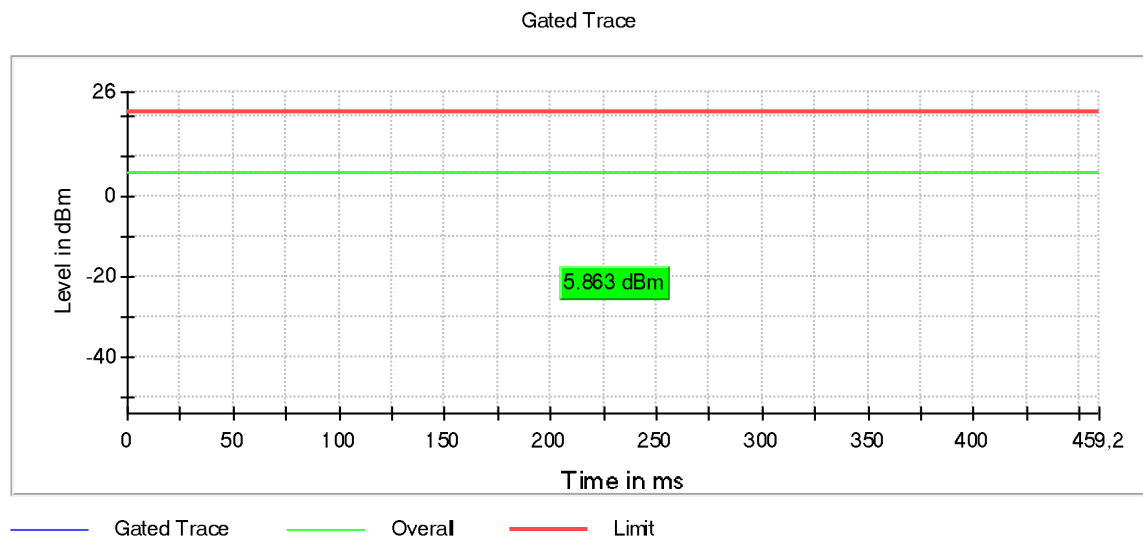
Plot 48: EUT #0, Mode 3, RF Peak Output Power, high channel

Peak Power



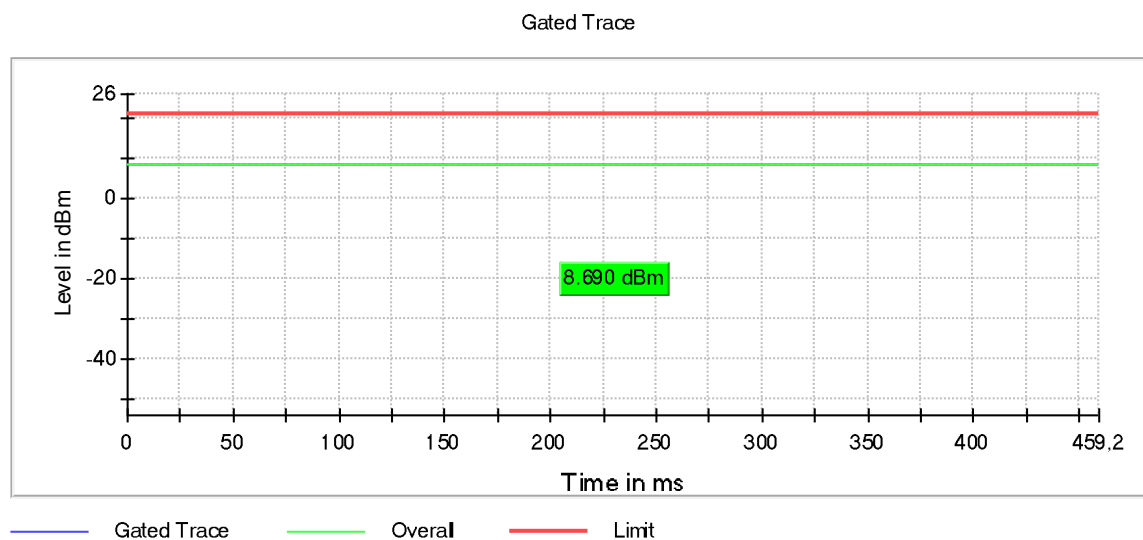
DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2480.000000	5.1	21.0	PASS

Plot 49: EUT #0, Mode 1, AVGPM-G Gated Average Power Measurement, low channel



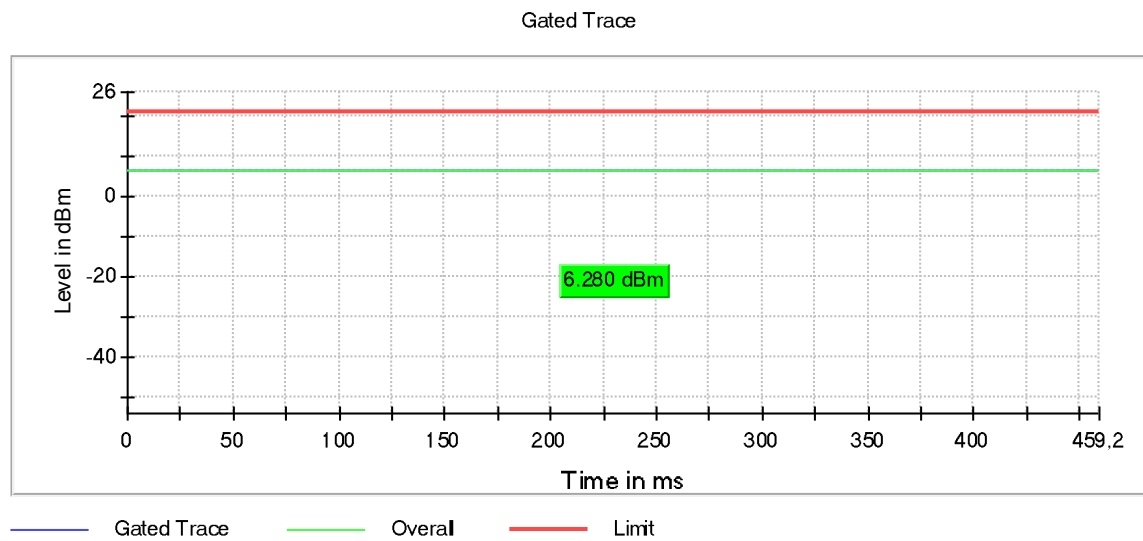
DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2402.000000	5.9	21.0	5.9	46.226	PASS

Plot 50: EUT #0, Mode 1, AVGPM-G Gated Average Power Measurement, mid channel



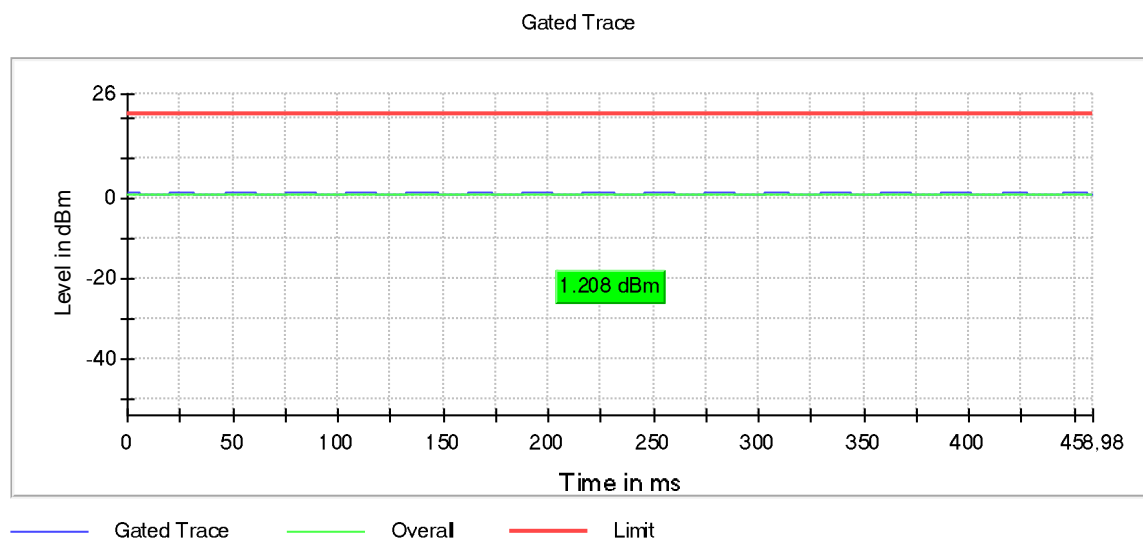
DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2441.000000	8.7	21.0	8.7	46.226	PASS

Plot 51: EUT #0, Mode 1, AVGPm-G Gated Average Power Measurement, high channel



DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2480.000000	6.3	21.0	6.3	46.226	PASS

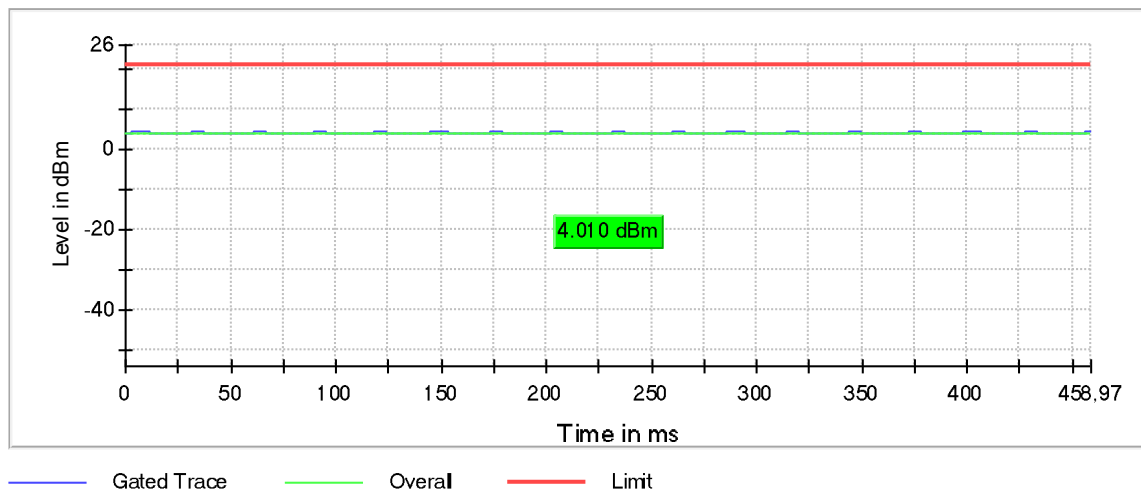
Plot 52: EUT #0, Mode 2, AVGPm-G Gated Average Power Measurement, low channel



DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2402.000000	1.2	21.0	1.2	46.203	PASS

Plot 53: EUT #0, Mode 2, AVGPm-G Gated Average Power Measurement, mid channel

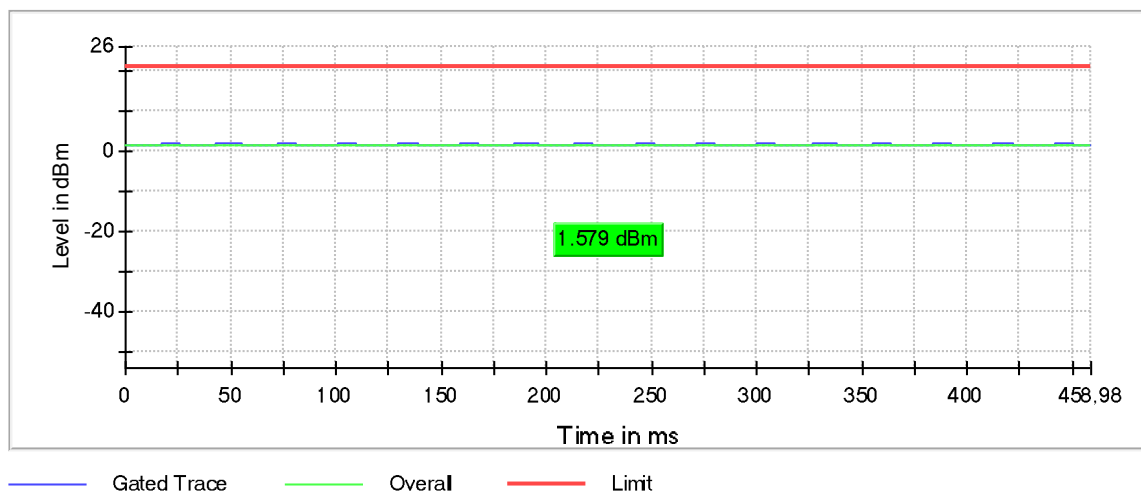
Gated Trace



DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2441.000000	4.0	21.0	4.0	46.203	PASS

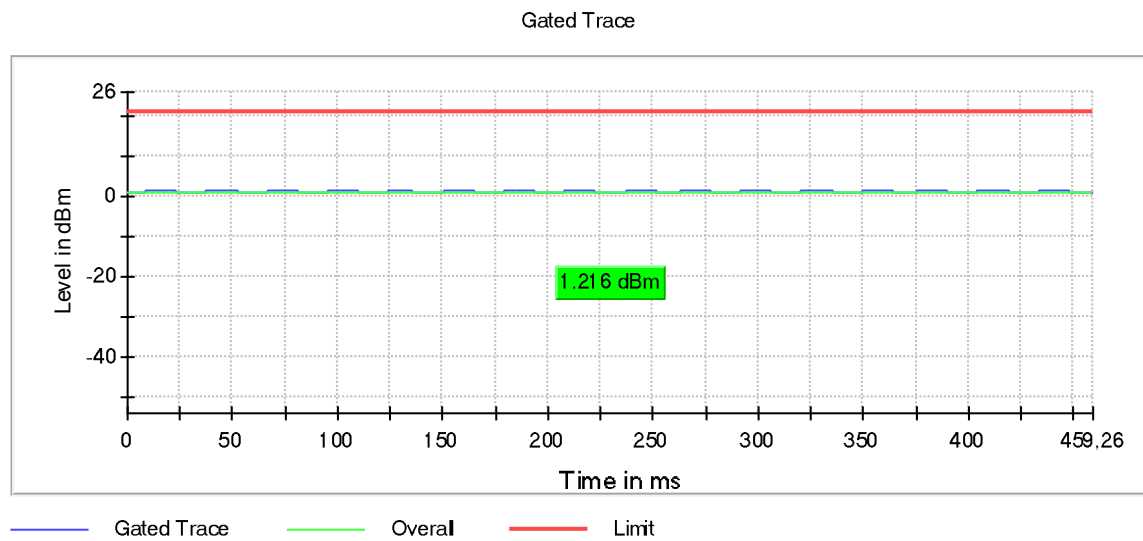
Plot 54: EUT #0, Mode 2, AVGPm-G Gated Average Power Measurement, high channel

Gated Trace



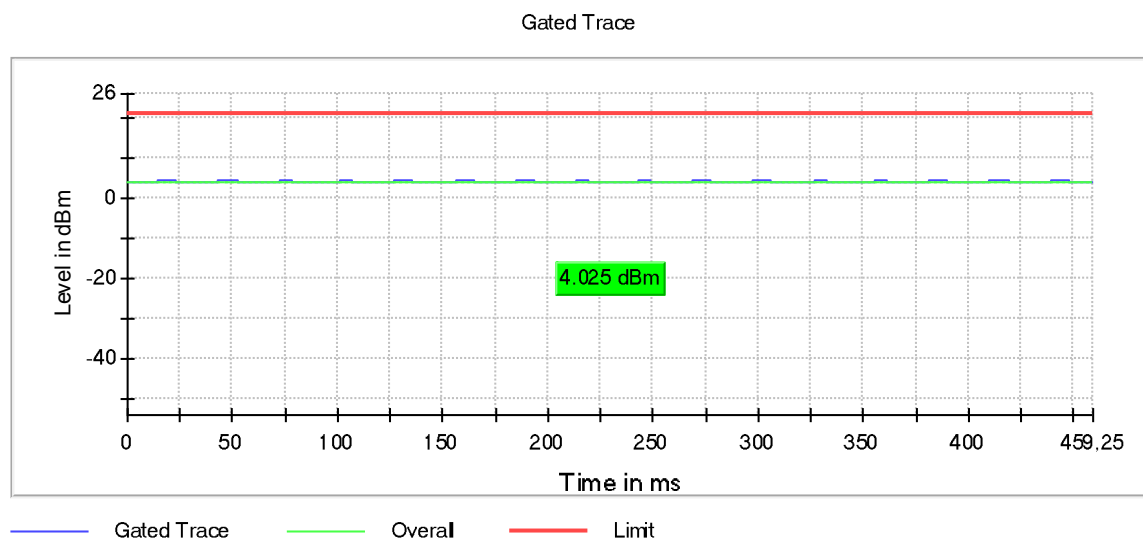
DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2480.000000	1.6	21.0	1.6	46.204	PASS

Plot 55: EUT #0, Mode 3, AVGP-M-G Gated Average Power Measurement, low channel



DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2402.000000	1.2	21.0	1.2	46.232	PASS

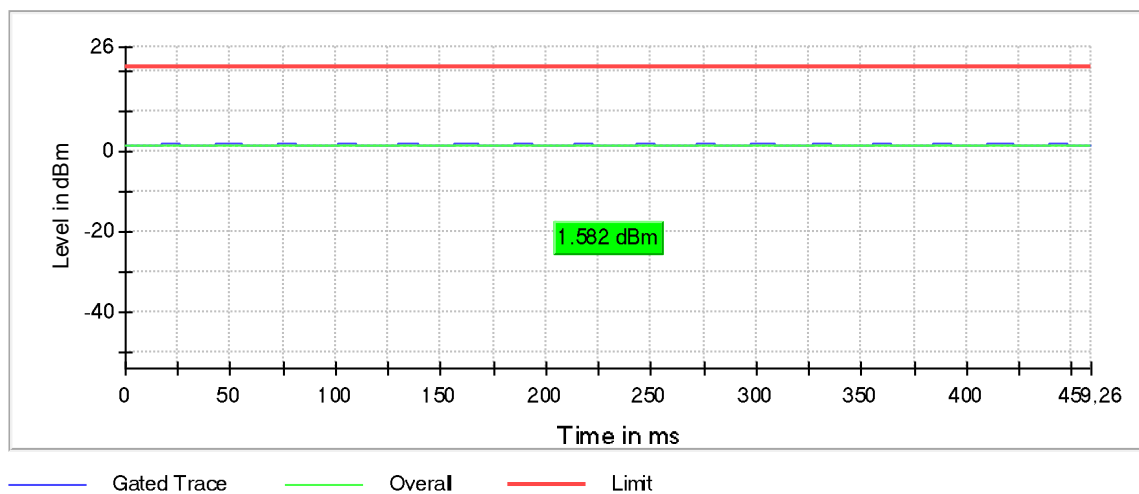
Plot 56: EUT #0, Mode 3, AVGP-M-G Gated Average Power Measurement, mid channel



DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2441.000000	4.0	21.0	4.0	46.231	PASS

Plot 57: EUT #0, Mode 3, AVGPM-G Gated Average Power Measurement, high channel

Gated Trace



DUT Frequency (MHz)	Gated RMS (dBm)	Limit Max (dBm)	Gated EIRP (dBm)	DutyCycle (%)	Result
2480.000000	1.6	21.0	1.6	46.232	PASS

7.7 Antenna Gain, Peak E.I.R.P.

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

The antenna gain is defined as the difference between radiated peak power (Peak EIRP) subtracted by the conducted peak power of the module, given in dBi.

Limit

§15.247

(b)(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

RSS-247, 5.4 (b)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

Test setup: 8.4 with conducted test sample (see section 5.2)

Test Results

Mode 1	low channel	mid channel	high channel	Limit
Radiated peak power [dBm] ¹⁾	4.6	7.1	4.8	≤ 36
Antenna gain [dBi] ²⁾	-1.0	-1.0	-1.0	≤ 6
Mode 2	low channel	mid channel	high channel	Limit
Radiated peak power [dBm] ¹⁾	3.5	6.0	3.2	≤ 36
Antenna gain [dBi] ²⁾	-1.0	-1.0	-1.0	≤ 6
Mode 3	low channel	mid channel	high channel	Limit
Radiated peak power [dBm] ¹⁾	3.6	6.8	4.1	≤ 36
Antenna gain [dBi] ²⁾	-1.0	-1.0	-1.0	≤ 6

1) peak power is calculated based on measurement results of section 7.6 (conducted peak power) and antenna gain as given by manufacturer

2) see section 5.3

Comment:

Verdict

- PASS -

7.8 Band Edge Compliance (BEC), conducted

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

Emissions within a restricted band and within 2 MHz of an authorized band edge may be measured using either the marker-delta method (ANSI C63.10, 6.10.6) or the integration method (ANSI C63.20, 11.13.3), provided that the DTS bandwidth (or EBW) edge falls within 2 MHz of the band edge. Otherwise, all unwanted emissions measurements shall be performed using the standard methods.

Limits

§15.247, RSS-247, 5.5

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in §15.209(a) is not required.

Test procedure

ANSI C63.10, 11.11

Reference level measurement:

Establish a reference level by using the following procedure:

- Set instrument center frequency to DTS channel center frequency.
 - Set the span to ≥ 1.5 times the DTS bandwidth.
 - Set the RBW = 100 kHz.
 - Set the VBW $\geq [3 \times \text{RBW}]$.
 - Detector = peak.
 - Sweep time = auto couple.
 - Trace mode = max hold.
 - Allow trace to fully stabilize.
 - Use the peak marker function to determine the maximum PSD level.
- Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Emission level measurement:

Establish an emission level by using the following procedure:

- Set the center frequency and span to encompass frequency range to be measured.
- Set the RBW = 100 kHz.
- Set the VBW $\geq [3 \times \text{RBW}]$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements as specified (≥ 20 dBc).

The marker-delta method, as described in ANSI C63.10, 6.10.6 can be used to perform measurements of the radiated unwanted emissions level at the band-edges provided that the 99 % OBW of the fundamental emission is within 2 MHz of the authorized band edge.

Test setup: 8.4 with conducted test sample (see section 5.2)

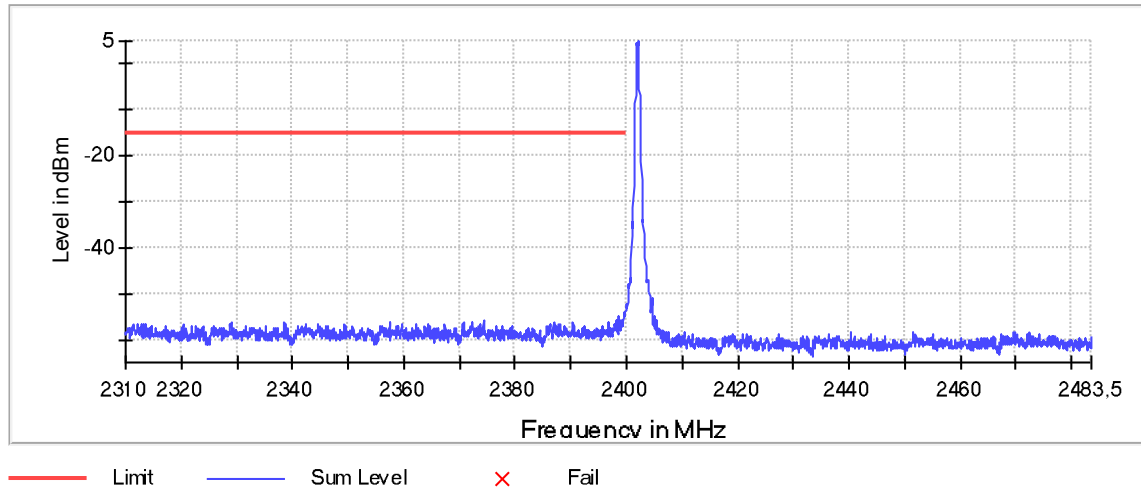
Test results			
BEC	low channel [dBc]	high channel [dBc]	Limit [dBc]
Mode 1	> 50	> 55	≥ 20
Mode 2	> 50	> 55	≥ 20
Mode 3	> 50	> 55	≥ 20

Comment:	---
----------	-----

Verdict	- PASS -	see next plots
---------	----------	----------------

Plot 58: EUT #0, Mode 1, BEC, low channel

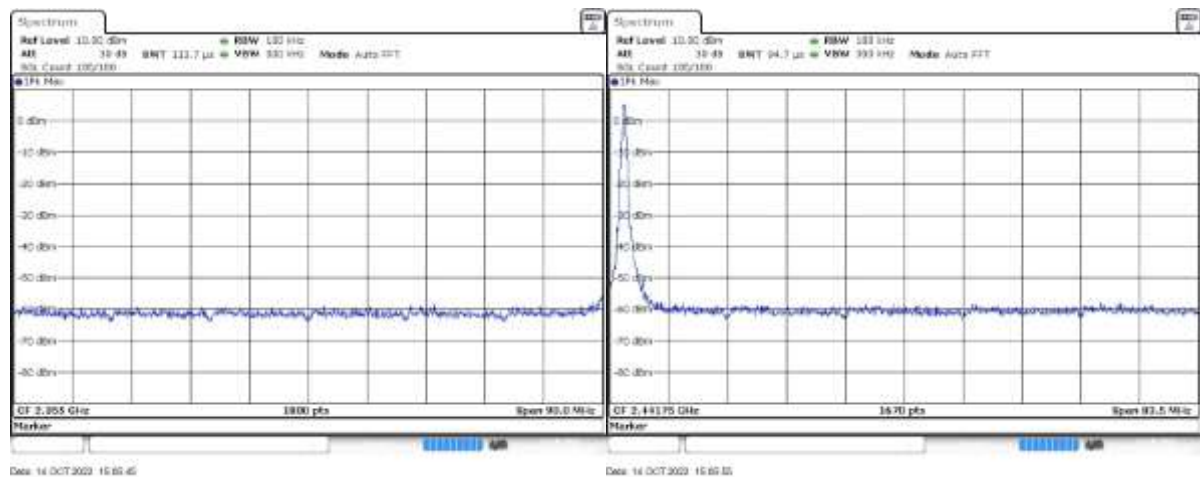
Band Edge



DUT Frequency (MHz)	Result
2402.000000	PASS

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.975000	-52.2	37.2	-15.0	PASS
2399.925000	-52.5	37.5	-15.0	PASS
2399.875000	-52.9	37.9	-15.0	PASS
2399.825000	-53.7	38.6	-15.0	PASS
2399.775000	-53.9	38.8	-15.0	PASS
2399.625000	-53.9	38.9	-15.0	PASS
2399.675000	-54.1	39.1	-15.0	PASS
2399.575000	-54.4	39.4	-15.0	PASS
2399.525000	-54.7	39.7	-15.0	PASS
2399.725000	-54.8	39.8	-15.0	PASS
2398.475000	-55.0	40.0	-15.0	PASS
2398.525000	-55.0	40.0	-15.0	PASS
2399.475000	-55.1	40.1	-15.0	PASS
2399.175000	-55.6	40.6	-15.0	PASS
2399.275000	-55.7	40.6	-15.0	PASS



Measurement 1

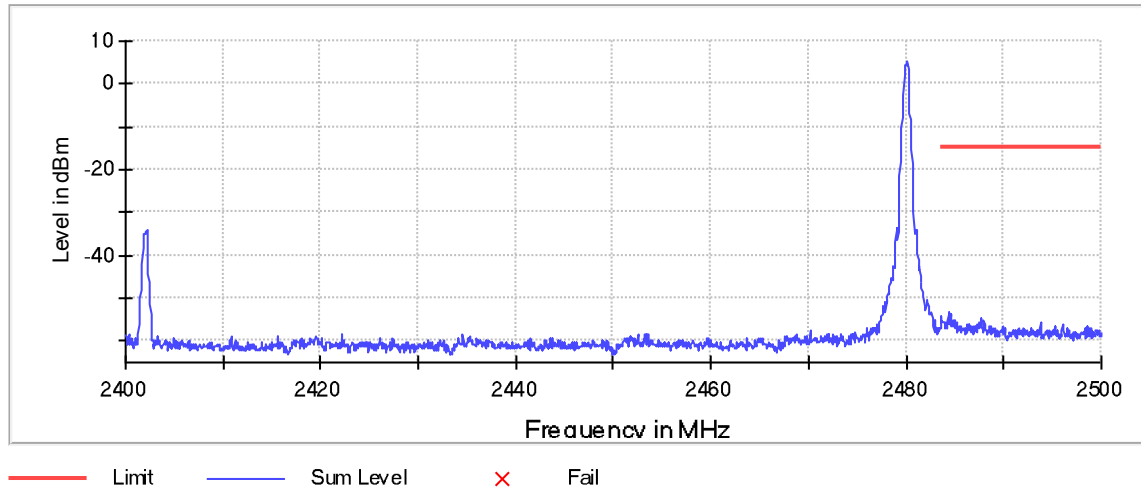
Setting	Instrument Value	Target Value
Start Frequency	2.31000 GHz	2.31000 GHz
Stop Frequency	2.40000 GHz	2.40000 GHz
Span	90.000 MHz	90.000 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1800	~ 1800
Sweptime	113.672 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Measurement 2

Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
Sweptime	94.727 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	7 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.20 dB	0.50 dB

Plot 59: EUT #0, Mode 1, BEC, high channel

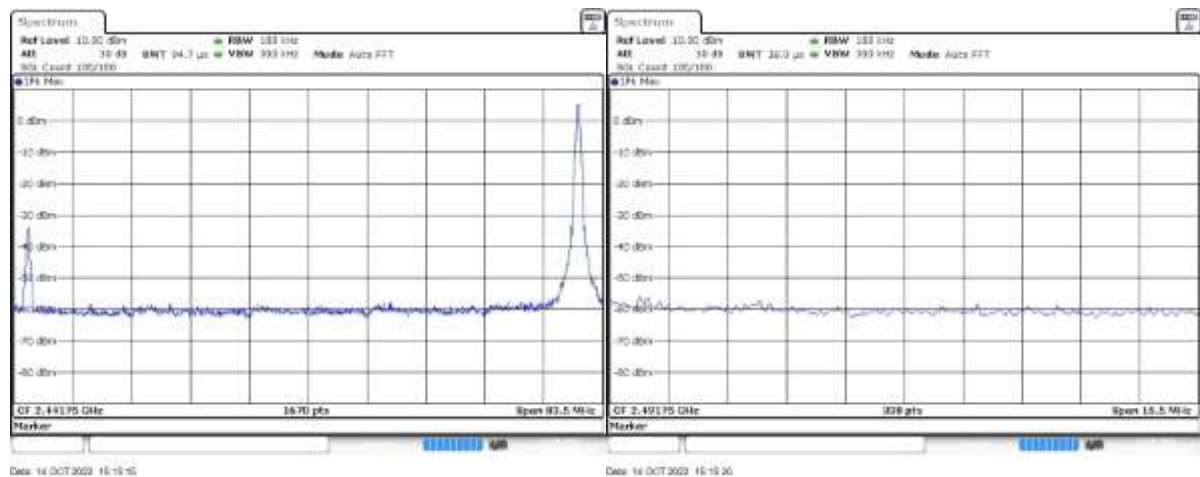
Band Edge



DUT Frequency (MHz)	Result
2480.000000	PASS

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2484.375000	-53.3	38.5	-14.8	PASS
2484.575000	-53.6	38.8	-14.8	PASS
2484.325000	-53.7	38.9	-14.8	PASS
2484.625000	-53.9	39.1	-14.8	PASS
2484.525000	-54.1	39.3	-14.8	PASS
2483.525000	-54.4	39.6	-14.8	PASS
2483.575000	-54.6	39.7	-14.8	PASS
2487.675000	-54.6	39.8	-14.8	PASS
2484.425000	-54.6	39.8	-14.8	PASS
2487.725000	-54.8	40.0	-14.8	PASS
2484.925000	-55.0	40.2	-14.8	PASS
2484.875000	-55.1	40.3	-14.8	PASS
2483.675000	-55.2	40.4	-14.8	PASS
2487.975000	-55.3	40.5	-14.8	PASS
2483.925000	-55.4	40.6	-14.8	PASS



Measurement 1

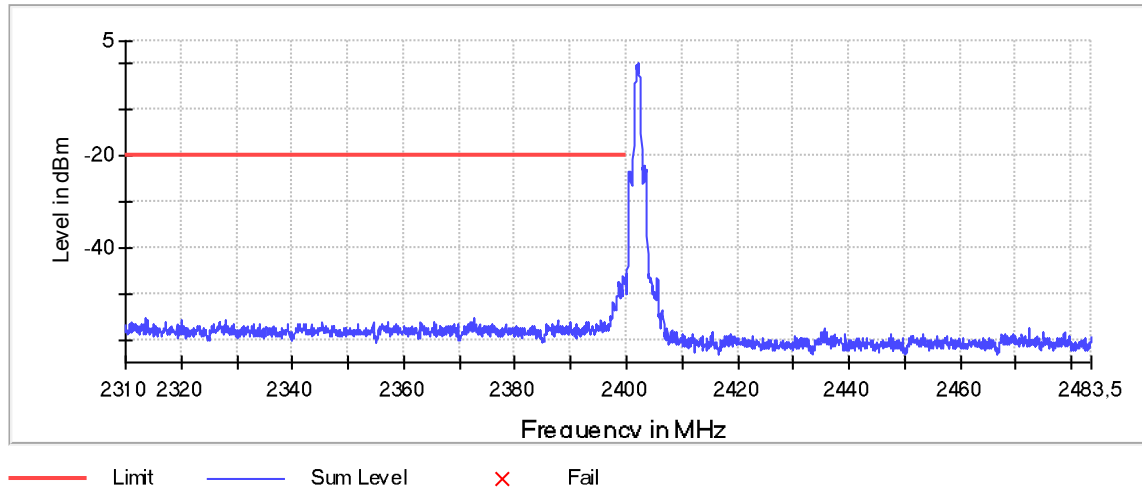
Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
Sweeptime	94.727 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	8 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.03 dB	0.50 dB

Measurement 2

Setting	Instrument Value	Target Value
Start Frequency	2.48350 GHz	2.48350 GHz
Stop Frequency	2.50000 GHz	2.50000 GHz
Span	16.500 MHz	16.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	330	~ 330
Sweeptime	18.945 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 60: EUT #0, Mode 2, BEC, low channel

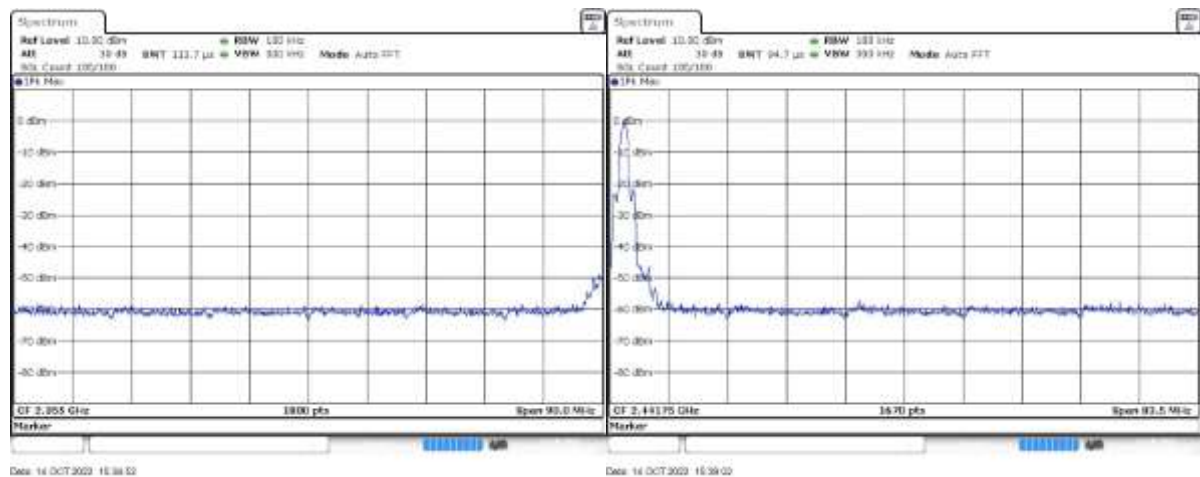
Band Edge



DUT Frequency (MHz)	Result
2402.000000	PASS

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.975000	-45.8	25.9	-19.8	PASS
2399.375000	-46.0	26.2	-19.8	PASS
2399.425000	-46.1	26.3	-19.8	PASS
2399.475000	-46.5	26.7	-19.8	PASS
2399.675000	-46.6	26.7	-19.8	PASS
2399.525000	-46.6	26.8	-19.8	PASS
2399.625000	-46.7	26.9	-19.8	PASS
2399.325000	-47.2	27.4	-19.8	PASS
2399.725000	-47.4	27.5	-19.8	PASS
2398.525000	-47.4	27.5	-19.8	PASS
2399.875000	-47.5	27.6	-19.8	PASS
2399.575000	-47.5	27.6	-19.8	PASS
2398.725000	-47.6	27.8	-19.8	PASS
2398.575000	-47.6	27.8	-19.8	PASS
2399.825000	-47.6	27.8	-19.8	PASS



Measurement 1

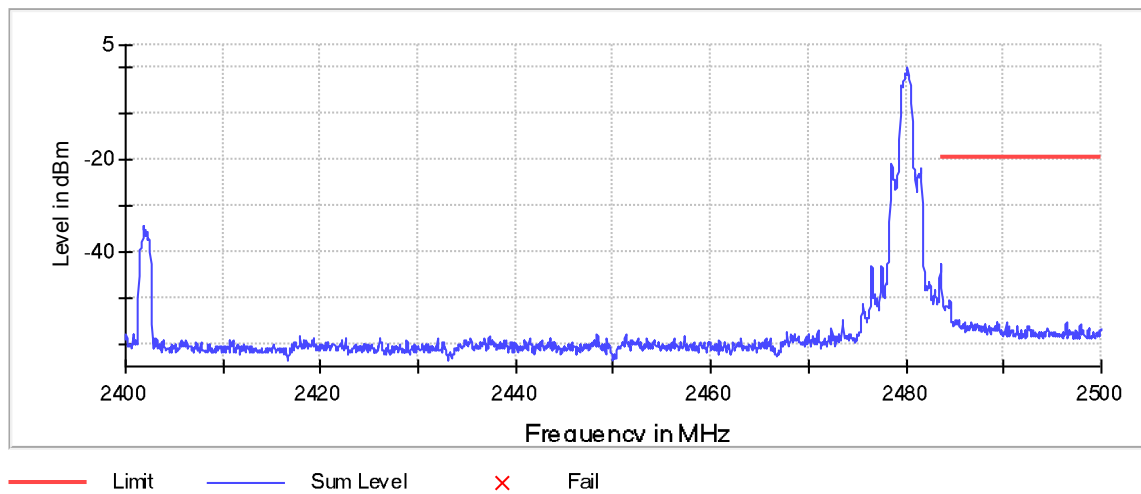
Setting	Instrument Value	Target Value
Start Frequency	2.31000 GHz	2.31000 GHz
Stop Frequency	2.40000 GHz	2.40000 GHz
Span	90.000 MHz	90.000 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1800	~ 1800
Sweeptime	113.672 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	10 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Measurement 2

Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
Sweeptime	94.727 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	7 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.20 dB	0.50 dB

Plot 61: EUT #0, Mode 2, BEC, high channel

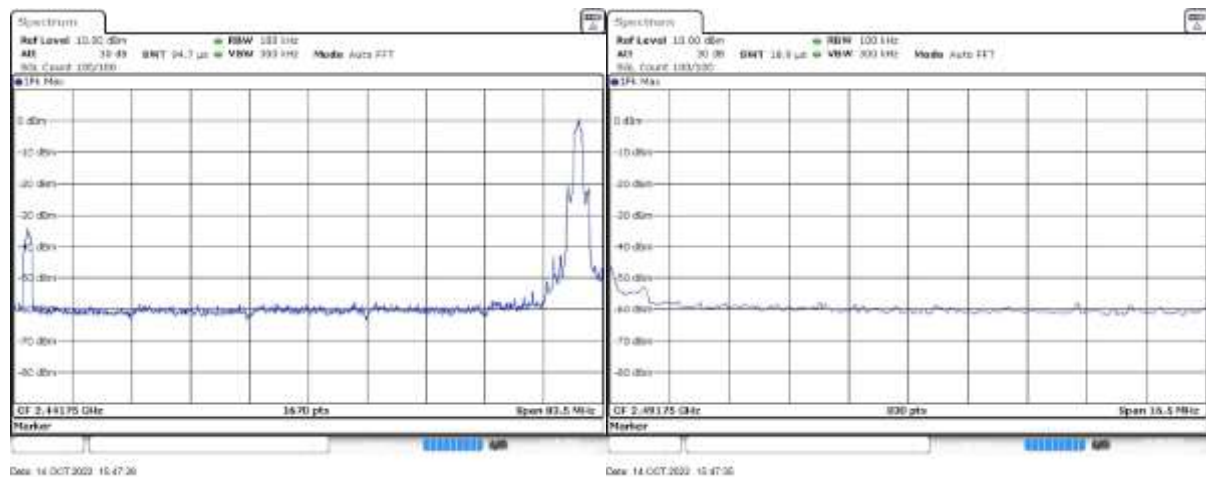
Band Edge



DUT Frequency (MHz)	Result
2480.000000	PASS

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.525000	-42.8	23.2	-19.6	PASS
2483.575000	-44.4	24.8	-19.6	PASS
2483.625000	-47.1	27.5	-19.6	PASS
2483.675000	-48.1	28.5	-19.6	PASS
2484.425000	-50.4	30.8	-19.6	PASS
2484.475000	-50.5	30.9	-19.6	PASS
2483.725000	-50.7	31.1	-19.6	PASS
2484.375000	-50.9	31.3	-19.6	PASS
2484.525000	-51.1	31.5	-19.6	PASS
2483.775000	-51.8	32.2	-19.6	PASS
2484.175000	-51.8	32.2	-19.6	PASS
2483.875000	-51.8	32.2	-19.6	PASS
2484.225000	-51.9	32.3	-19.6	PASS
2483.825000	-51.9	32.3	-19.6	PASS
2484.075000	-52.0	32.4	-19.6	PASS



Measurement 1

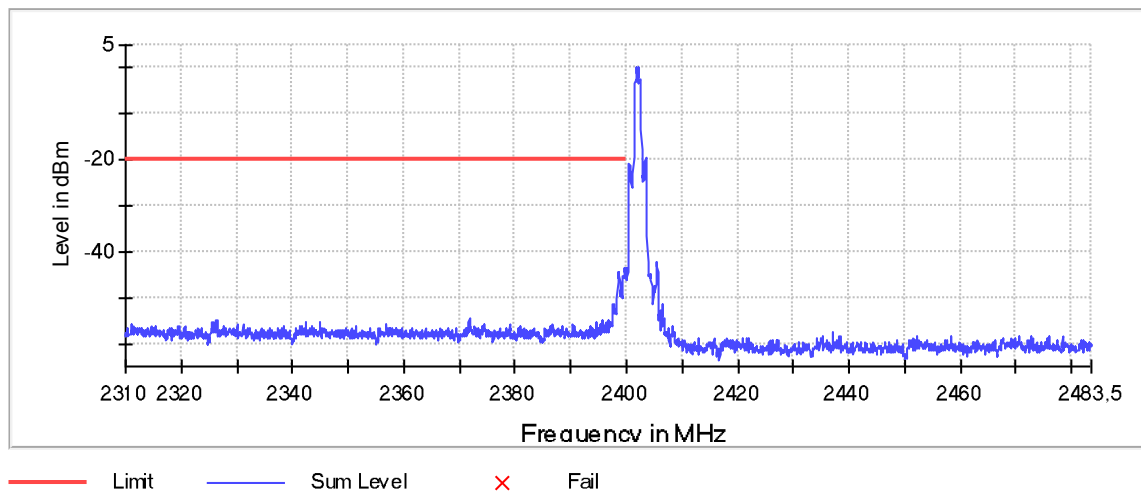
Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
Sweptime	94.727 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	10 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.06 dB	0.50 dB

Measurement 2

Setting	Instrument Value	Target Value
Start Frequency	2.48350 GHz	2.48350 GHz
Stop Frequency	2.50000 GHz	2.50000 GHz
Span	16.500 MHz	16.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	330	~ 330
Sweptime	18.945 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	8 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 62: EUT #0, Mode 3, BEC, low channel

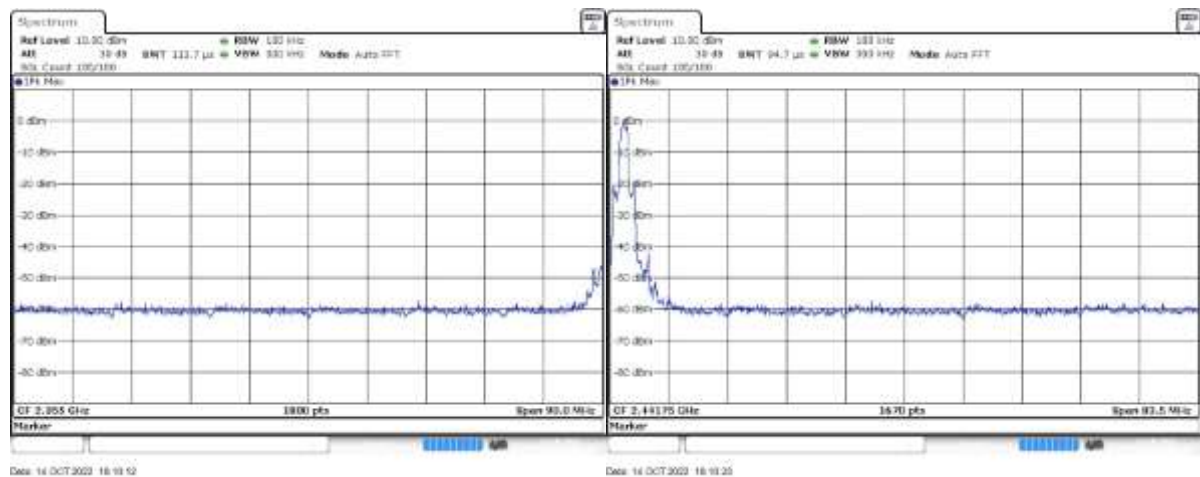
Band Edge



DUT Frequency (MHz)	Result
2402.000000	PASS

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.875000	-43.4	23.6	-19.8	PASS
2399.975000	-43.5	23.7	-19.8	PASS
2399.825000	-43.6	23.8	-19.8	PASS
2399.675000	-43.8	24.0	-19.8	PASS
2399.925000	-43.9	24.1	-19.8	PASS
2399.725000	-43.9	24.1	-19.8	PASS
2398.675000	-44.3	24.5	-19.8	PASS
2399.775000	-44.3	24.5	-19.8	PASS
2399.625000	-44.4	24.5	-19.8	PASS
2398.475000	-44.4	24.5	-19.8	PASS
2398.525000	-44.4	24.6	-19.8	PASS
2398.725000	-44.7	24.9	-19.8	PASS
2398.625000	-45.0	25.1	-19.8	PASS
2399.475000	-45.2	25.3	-19.8	PASS
2398.425000	-45.3	25.5	-19.8	PASS



Measurement 1

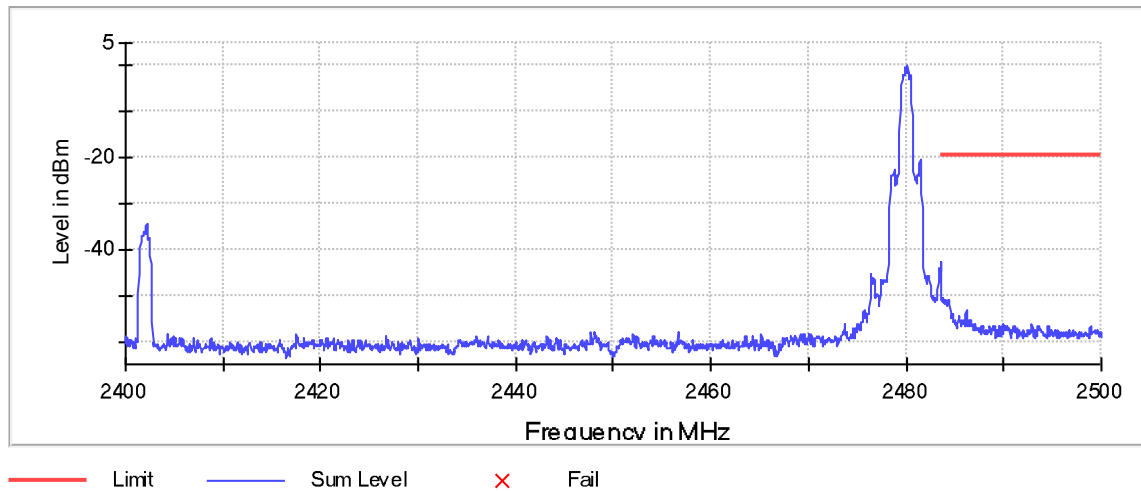
Setting	Instrument Value	Target Value
Start Frequency	2.31000 GHz	2.31000 GHz
Stop Frequency	2.40000 GHz	2.40000 GHz
Span	90.000 MHz	90.000 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1800	~ 1800
Sweeptime	113.672 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	18 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Measurement 2

Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
Sweeptime	94.727 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	8 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.37 dB	0.50 dB

Plot 63: EUT #0, Mode 3, BEC, high channel

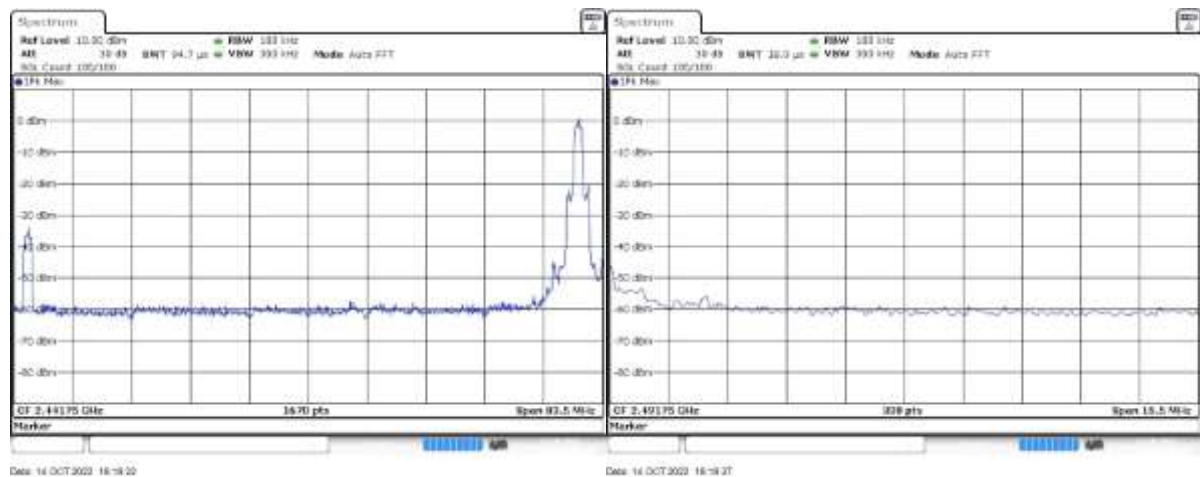
Band Edge



DUT Frequency (MHz)	Result
2480.000000	PASS

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.525000	-42.9	23.3	-19.6	PASS
2483.575000	-43.9	24.3	-19.6	PASS
2483.625000	-46.9	27.3	-19.6	PASS
2483.775000	-50.4	30.8	-19.6	PASS
2484.375000	-50.9	31.3	-19.6	PASS
2484.425000	-50.9	31.3	-19.6	PASS
2483.675000	-51.0	31.4	-19.6	PASS
2484.025000	-51.1	31.5	-19.6	PASS
2484.125000	-51.1	31.5	-19.6	PASS
2483.825000	-51.2	31.6	-19.6	PASS
2484.325000	-51.3	31.7	-19.6	PASS
2483.725000	-51.3	31.7	-19.6	PASS
2483.875000	-51.4	31.8	-19.6	PASS
2484.075000	-51.4	31.8	-19.6	PASS
2484.175000	-51.6	32.0	-19.6	PASS



Measurement 1

Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
Sweeptime	94.727 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	8 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.34 dB	0.50 dB

Measurement 2

Setting	Instrument Value	Target Value
Start Frequency	2.48350 GHz	2.48350 GHz
Stop Frequency	2.50000 GHz	2.50000 GHz
Span	16.500 MHz	16.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	330	~ 330
Sweeptime	18.945 µs	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	5 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

7.9 Band Edge Compliance (BEC), radiated

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

Emissions within a restricted band and within 2 MHz of an authorized band edge may be measured using either the marker-delta method (ANSI C63.10, 6.10.6) or the integration method (ANSI C63.20, 11.13.3), provided that the DTS bandwidth (or EBW) edge falls within 2 MHz of the band edge. Otherwise, all unwanted emissions measurements shall be performed using the standard methods.

Limits

§15.247, RSS-247, 5.5

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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)).

Test procedure

The marker-delta method as described in ANSI C63.10, 6.10.6 or the integration method as described in ANSI C63.10, 11.13.3 can be used to perform measurements of the unwanted emissions level at the band edges.

Test setup: 8.2 with radiated sample (see 5.2)

Test results

BEC	low channel AVG / Peak [dμV/m @3m]	high channel AVG / Peak [dμV/m @3m]	Limit AVG / Peak [dμV/m @3m]
Mode 1	≤ 40 AVG / ≤ 55 PK	≤ 40 AVG / ≤ 55 PK	≤ 54 AVG / ≤ 74 PK
Mode 2	≤ 40 AVG / ≤ 55 PK	≤ 40 AVG / ≤ 55 PK	≤ 54 AVG / ≤ 74 PK
Mode 3	≤ 40 AVG / ≤ 55 PK	≤ 40 AVG / ≤ 55 PK	≤ 54 AVG / ≤ 74 PK

Comment:

Verdict

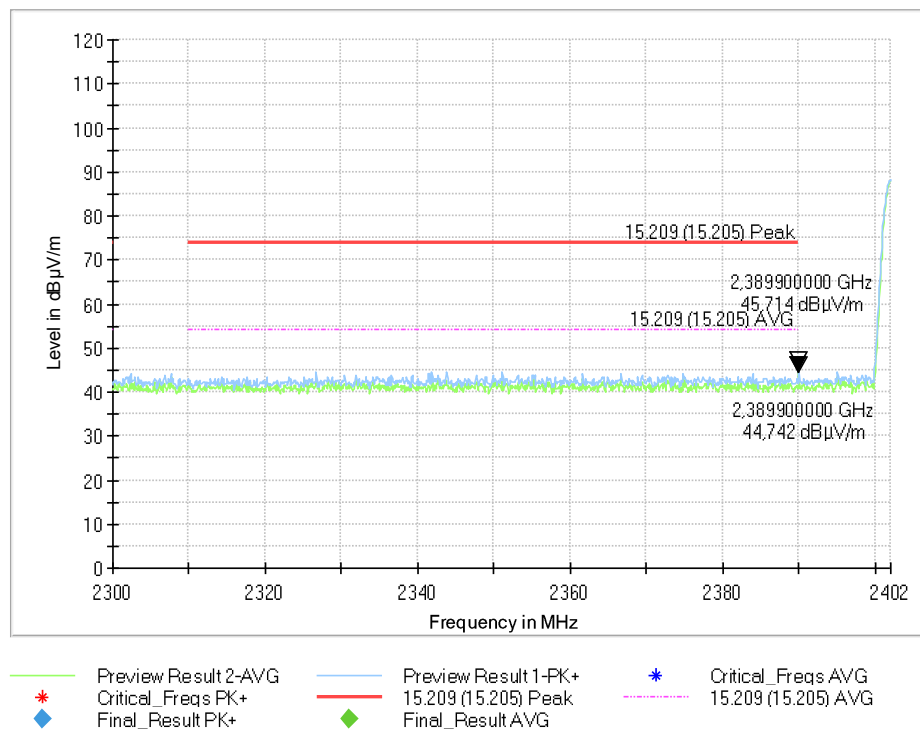
- PASS -

*see next plots**

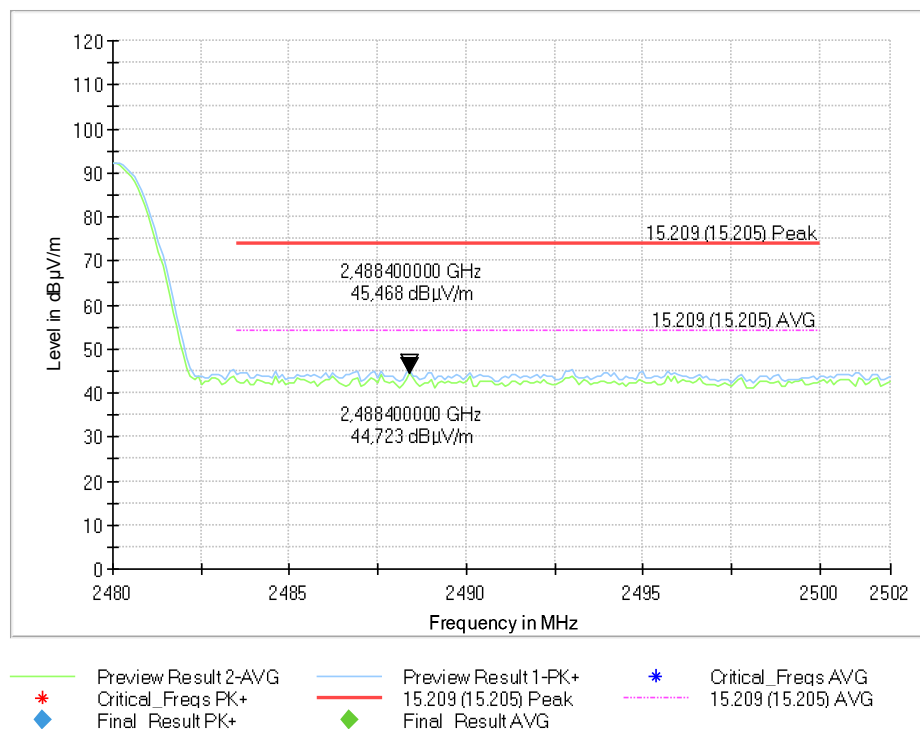
* description of traces for radiated Bend Edge Compliance (BEC) measurements:

 positive Peak (Max Hold) trace
 average Peak (Max Hold) trace

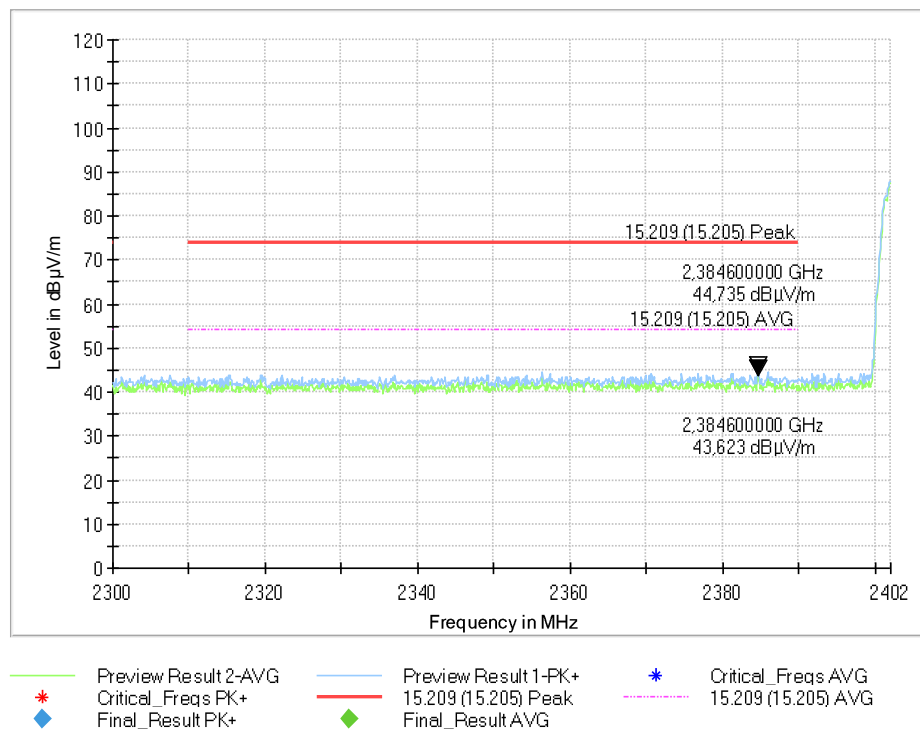
Plot 64: EUT #1, Mode 1, BEC, low channel, 2402 MHz



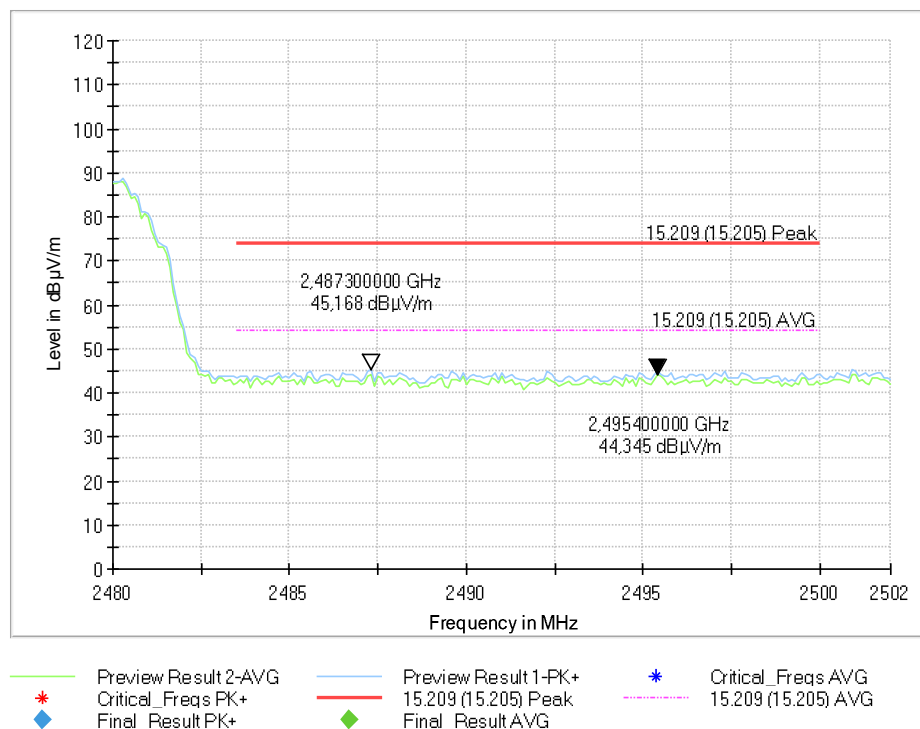
Plot 65: EUT #1, Mode 1, BEC, high channel, 2480 MHz



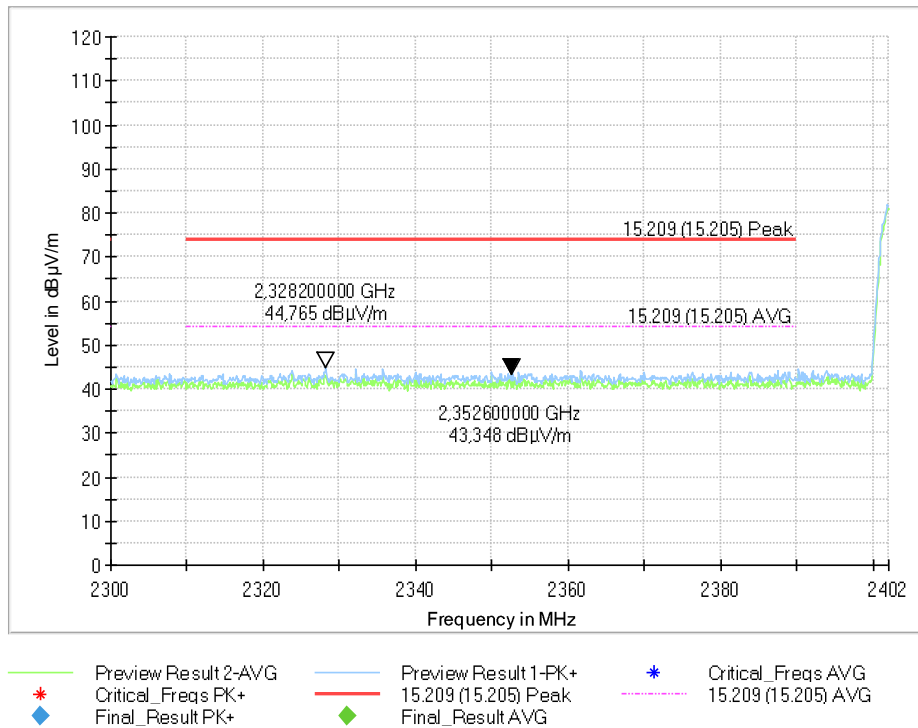
Plot 66: EUT #1, Mode 2, BEC, low channel, 2402 MHz



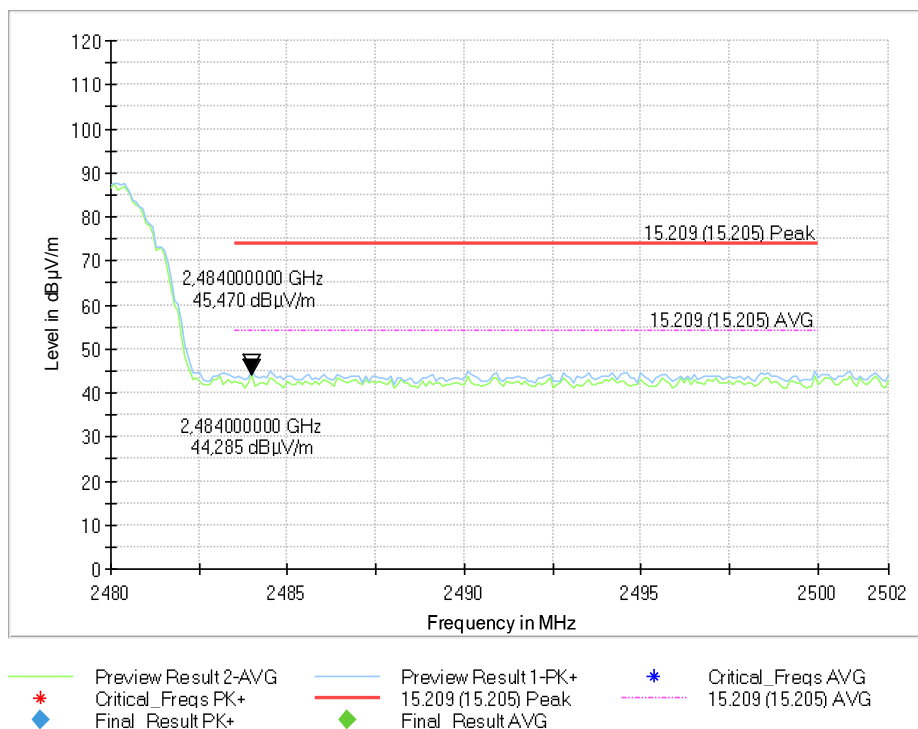
Plot 67: EUT #1, Mode 2, BEC, high channel, 2480 MHz



Plot 68: EUT #1, Mode 3, BEC, low channel, 2402 MHz



Plot 69: EUT #1, Mode 3, BEC, high channel, 2480 MHz



7.10 Conducted Spurious Emissions (CSE)

Applicability

This requirement applies to all types of FHS equipment operating in the 2400 – 2483.5 MHz band.

Description

Spurious emission / unwanted emissions are emission on a frequency or frequencies which are outside the authorized band and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products.

Limits

§15.247, RSS-247, 5.5

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in §15.209(a) is not required.

Test procedure

ANSI C63.10, 11.11

Reference level measurement:

Establish a reference level by using the following procedure:

- Set instrument center frequency to DTS channel center frequency.
 - Set the span to ≥ 1.5 times the DTS bandwidth.
 - Set the RBW = 100 kHz.
 - Set the VBW $\geq [3 \times \text{RBW}]$.
 - Detector = peak.
 - Sweep time = auto couple.
 - Trace mode = max hold.
 - Allow trace to fully stabilize.
 - Use the peak marker function to determine the maximum PSD level.
- Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Emission level measurement:

Establish an emission level by using the following procedure:

- Set the center frequency and span to encompass frequency range to be measured.
- Set the RBW = 100 kHz.
- Set the VBW $\geq [3 \times \text{RBW}]$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements as specified (≥ 20 dBc).

The marker-delta method, as described in ANSI C63.10, 6.10.6 can be used to perform measurements of the radiated unwanted emissions level at the band-edges provided that the 99 % OBW of the fundamental emission is within 2 MHz of the authorized band edge.

Test setup: 8.4 with conducted sample (see 5.2)

Test results					
EUT Mode / Channel	Frequency [MHz]	Peak/RMS Detector	Level [dBm]	Limit [dBm]	Verdict
Mode 1	(see plots)	MaxPeak	(see plots)*	(see plots)	- passed -
Mode 2	(see plots)	MaxPeak	(see plots)*	(see plots)	- passed -
Mode 3	(see plots)	MaxPeak	(see plots)*	(see plots)	- passed -

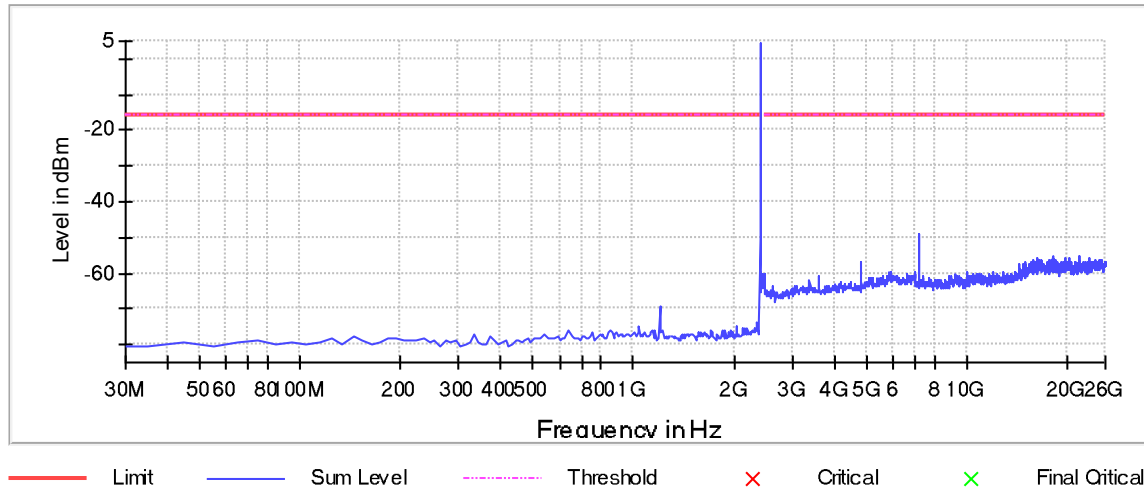
* all detected peaks are more than 6 dB below the limit

Comment:	---
-----------------	-----

Verdict	- PASS -	see next plots
----------------	-----------------	----------------

Plot 70: EUT #0, Mode 1, CSE, low channel

Spurious



Result

DUT Frequency (MHz)	Result
2402.000000	PASS

Final measurements

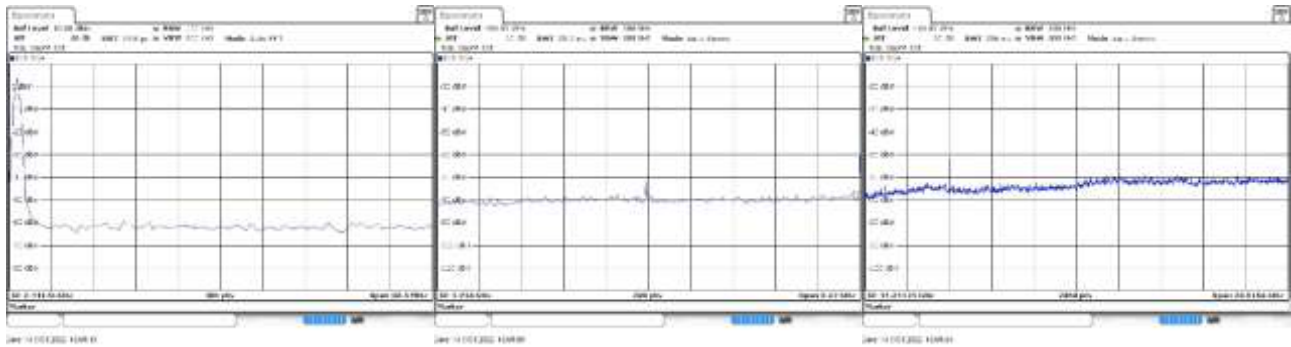
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
7205.789099	-48.9	33.2	-15.7
2395.021008	-50.4	34.7	-15.7
18029.575542	-55.1	39.4	-15.7
21857.378134	-55.4	39.6	-15.7
18059.558330	-55.7	40.0	-15.7
19778.571504	-55.7	40.0	-15.7
23146.638015	-55.7	40.0	-15.7
16270.585317	-55.8	40.1	-15.7
20378.227263	-56.0	40.3	-15.7
18009.587017	-56.0	40.3	-15.7
18399.363260	-56.2	40.4	-15.7
18049.564067	-56.2	40.5	-15.7
16630.378772	-56.4	40.6	-15.7
18339.397684	-56.4	40.7	-15.7
21867.372397	-56.4	40.7	-15.7

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1

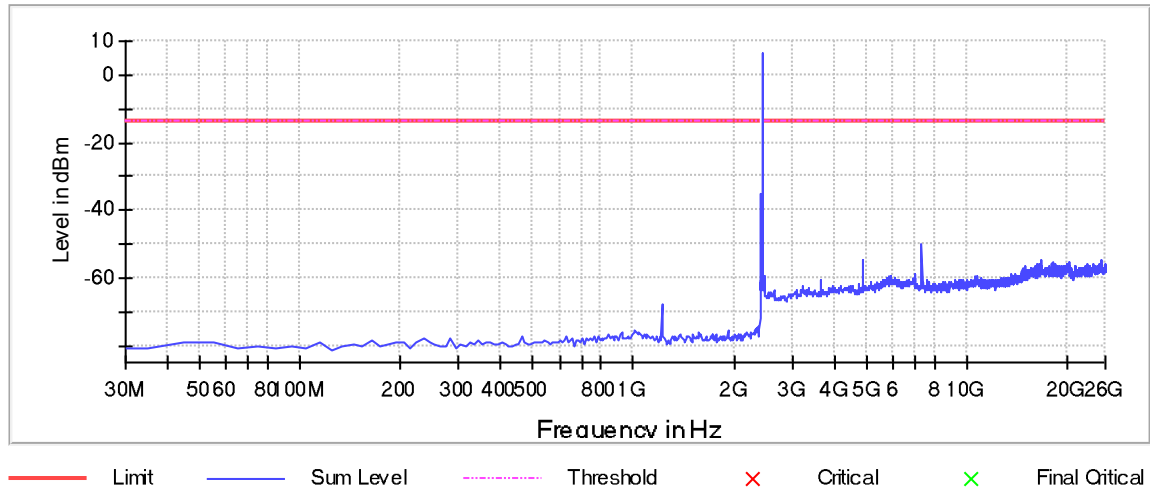


Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	≤ 100.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	238	~ 238
SweepTime	23.700 ms	AUTO
Reference Level	-20.000 dBm	-30.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	6 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 71: EUT #0, Mode 1, CSE, mid channel

Spurious



Result

DUT Frequency (MHz)	Result
2441.000000	PASS

Final measurements

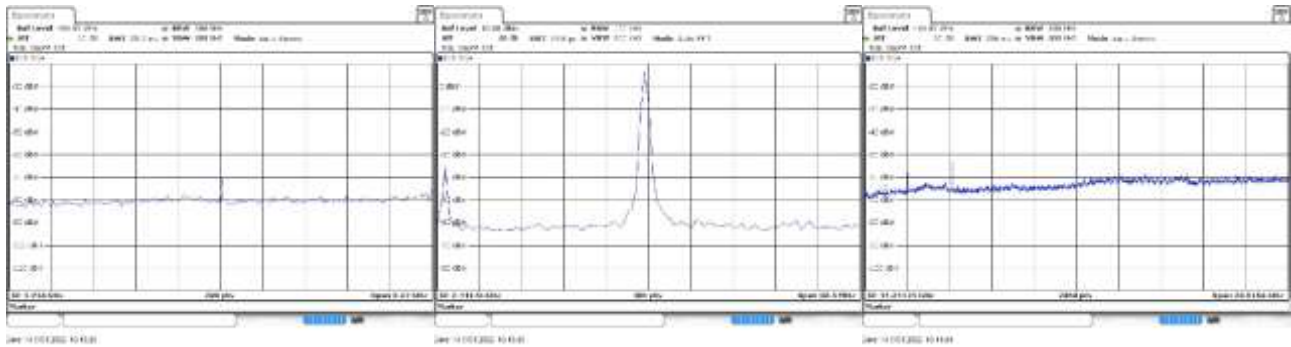
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
7325.720251	-50.2	36.3	-13.8
16650.367297	-54.8	41.0	-13.8
25315.393009	-54.8	41.0	-13.8
4887.120166	-54.8	41.0	-13.8
20378.227263	-55.2	41.3	-13.8
18039.569805	-55.2	41.4	-13.8
4877.125903	-55.2	41.4	-13.8
18029.575542	-55.3	41.5	-13.8
18049.564067	-55.6	41.8	-13.8
23076.678177	-55.7	41.8	-13.8
23786.270824	-55.8	41.9	-13.8
20008.439545	-55.8	42.0	-13.8
20358.238738	-55.9	42.0	-13.8
18069.552592	-56.0	42.1	-13.8
20048.416596	-56.0	42.2	-13.8

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1

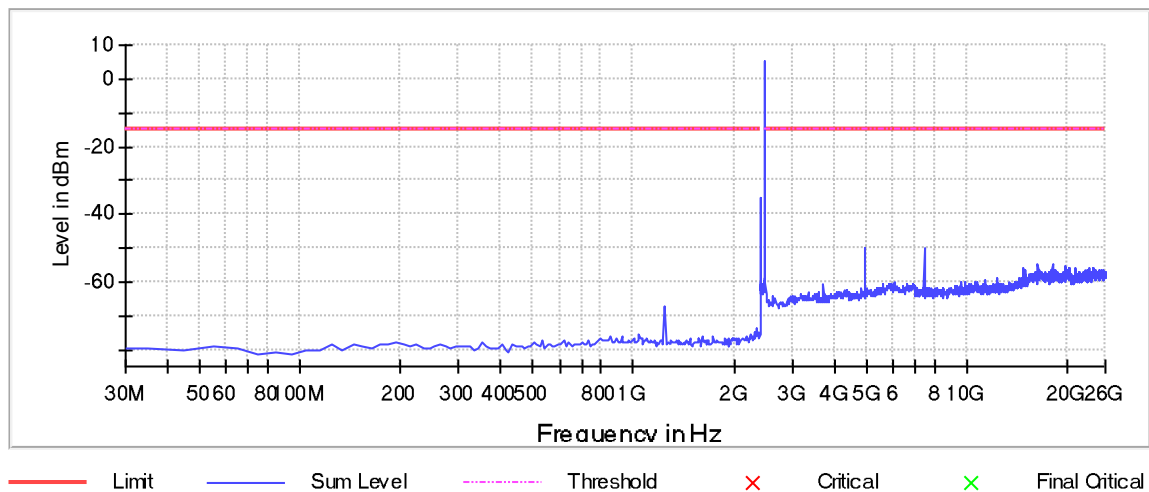


Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	≤ 100.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	238	~ 238
SweepTime	23.700 ms	AUTO
Reference Level	-20.000 dBm	-30.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 72: EUT #0, Mode 1, CSE, high channel

Spurious



Result

DUT Frequency (MHz)	Result
2480.000000	PASS

Final measurements

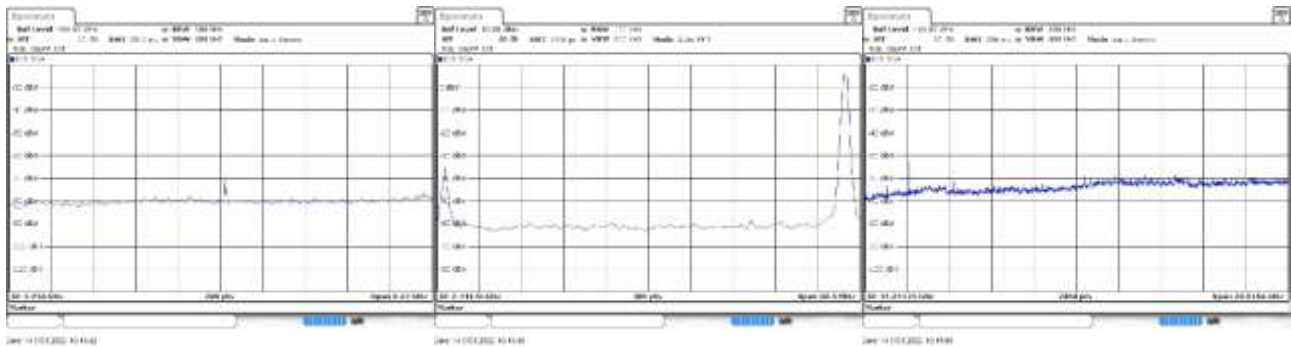
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
7435.657140	-49.8	35.0	-14.8
4957.080004	-50.0	35.2	-14.8
18029.575542	-54.7	39.9	-14.8
16350.539418	-54.9	40.1	-14.8
19688.623141	-55.4	40.6	-14.8
18039.569805	-55.5	40.7	-14.8
23166.626541	-55.6	40.9	-14.8
19728.600191	-55.6	40.9	-14.8
20398.215788	-55.8	41.0	-14.8
14701.486082	-55.9	41.1	-14.8
20348.244475	-55.9	41.1	-14.8
21127.796961	-56.0	41.3	-14.8
20368.233000	-56.1	41.3	-14.8
23866.224926	-56.1	41.4	-14.8
23826.247875	-56.2	41.4	-14.8

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1

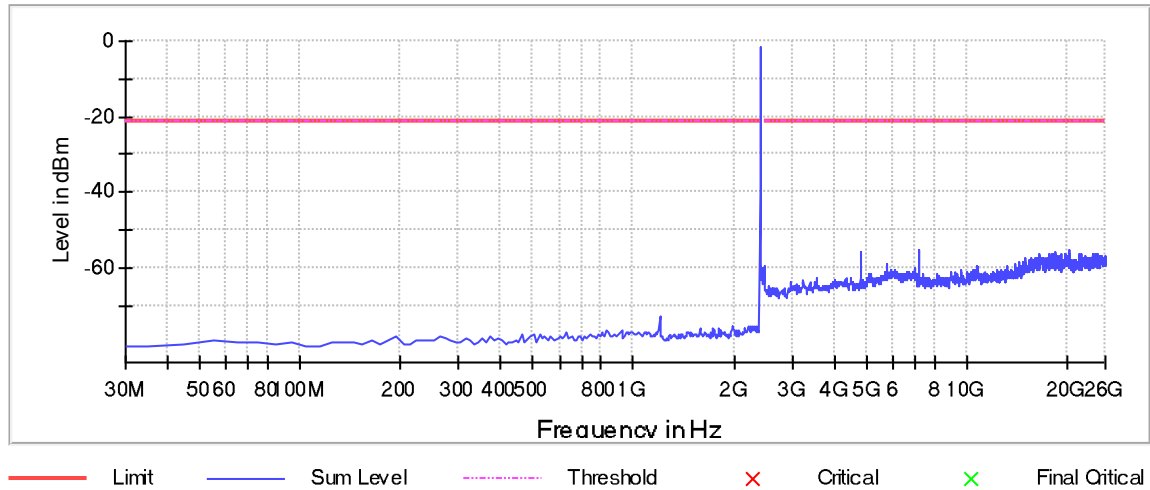


Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	≤ 100.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	238	~ 238
Sweptime	23.700 ms	AUTO
Reference Level	-20.000 dBm	-30.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	5 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 73: EUT #0, Mode 2, CSE, low channel

Spurious



Result

DUT Frequency (MHz)	Result
2402.000000	PASS

Final measurements

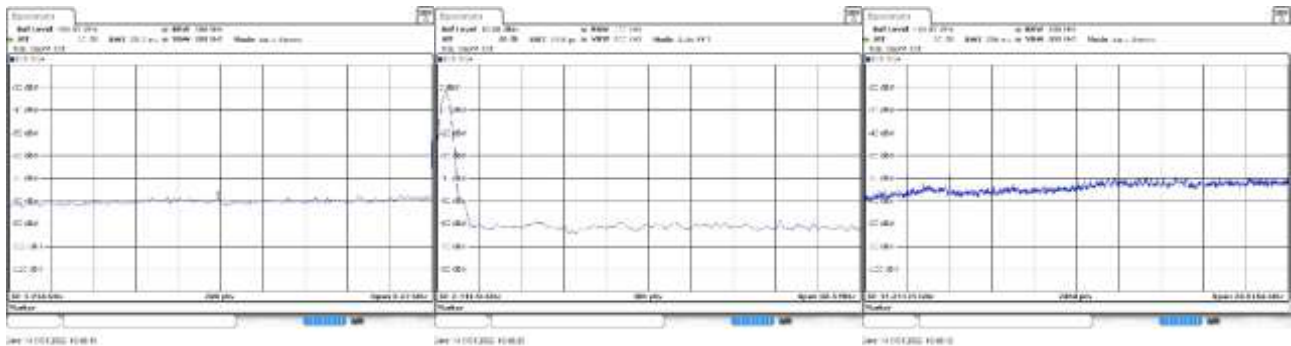
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2395.021008	-38.6	17.2	-21.4
7205.789099	-55.3	33.9	-21.4
20398.215788	-55.4	34.0	-21.4
4807.166065	-55.9	34.5	-21.4
18339.397684	-55.9	34.5	-21.4
20338.250212	-56.1	34.7	-21.4
23836.242138	-56.2	34.8	-21.4
19748.588717	-56.2	34.8	-21.4
19678.628878	-56.3	34.9	-21.4
20278.284637	-56.3	34.9	-21.4
22137.217488	-56.4	35.0	-21.4
18029.575542	-56.4	35.0	-21.4
23766.282299	-56.4	35.0	-21.4
16390.516468	-56.4	35.0	-21.4
20328.255950	-56.4	35.0	-21.4

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1

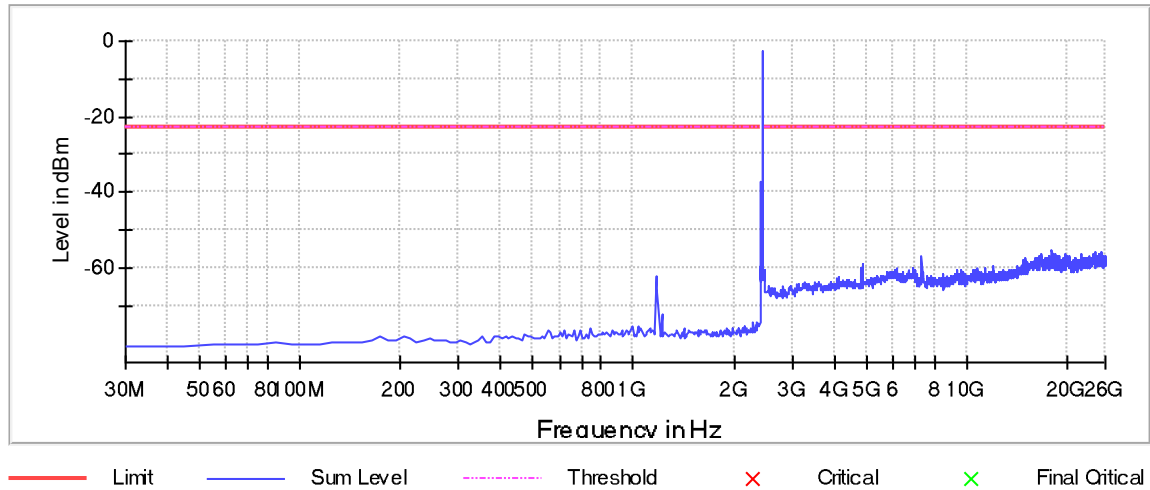


Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	≤ 100.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	238	~ 238
SweepTime	23.700 ms	AUTO
Reference Level	-20.000 dBm	-30.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	6 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 74: EUT #0, Mode 2, CSE, mid channel

Spurious



Result

DUT Frequency (MHz)	Result
2441.000000	PASS

Final measurements

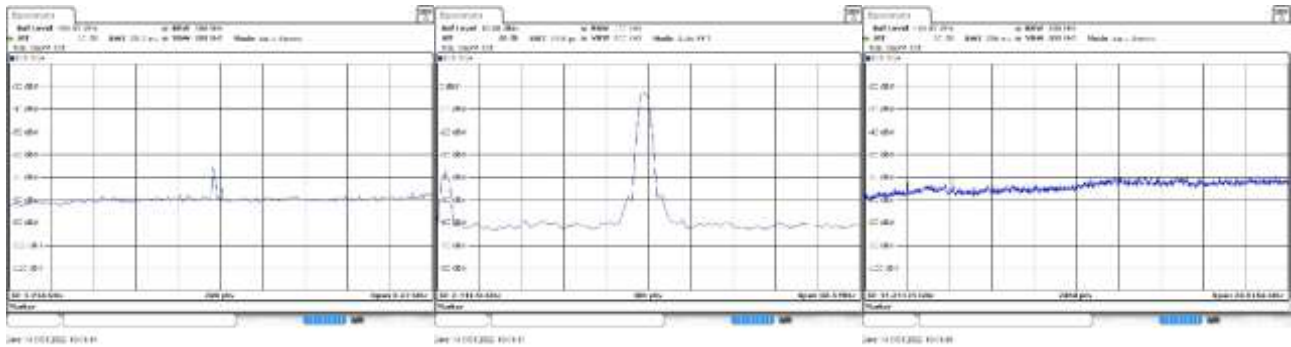
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
18019.581279	-55.5	32.8	-22.6
25295.404484	-55.8	33.2	-22.6
24226.018381	-55.9	33.2	-22.6
24905.628241	-56.3	33.6	-22.6
23866.224926	-56.3	33.7	-22.6
25095.519231	-56.3	33.7	-22.6
19788.565767	-56.4	33.8	-22.6
18359.386209	-56.4	33.8	-22.6
16700.338610	-56.4	33.8	-22.6
25275.415958	-56.4	33.8	-22.6
22117.228963	-56.4	33.8	-22.6
18039.569805	-56.5	33.8	-22.6
18029.575542	-56.6	34.0	-22.6
18349.391946	-56.6	34.0	-22.6
16420.499256	-56.7	34.1	-22.6

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1

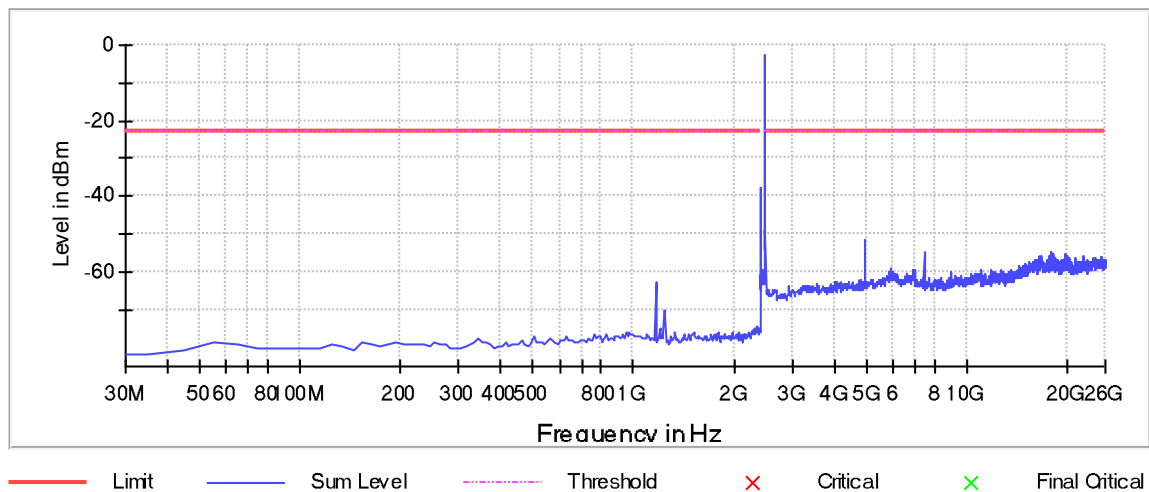


Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	238	~ 238
Sweeptime	23.700 ms	AUTO
Reference Level	-20.000 dBm	-30.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	9 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 75: EUT #0, Mode 2, CSE, high channel

Spurious



Result

DUT Frequency (MHz)	Result
2480.000000	PASS

Final measurements

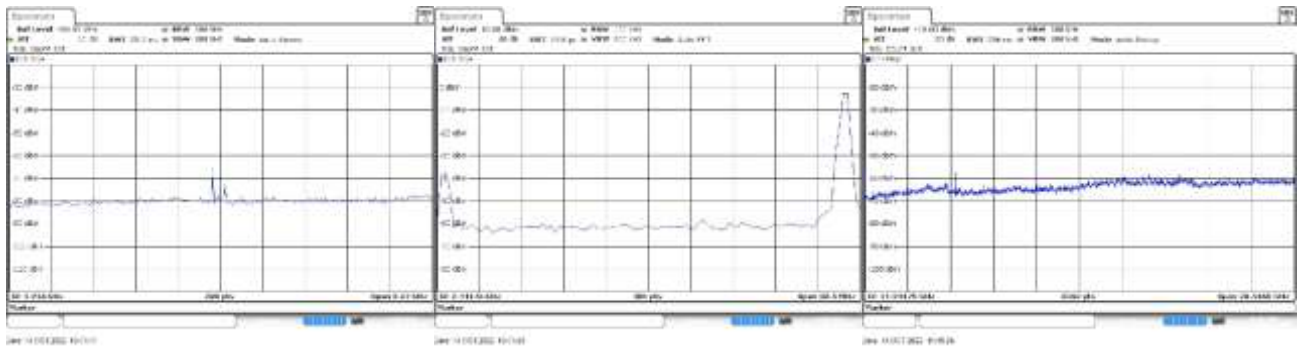
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2488.497131	-48.8	25.9	-22.9
4957.080004	-51.6	28.7	-22.9
7435.657140	-54.6	31.7	-22.9
18009.587017	-54.8	32.0	-22.9
19688.623141	-55.1	32.2	-22.9
18069.552592	-55.5	32.6	-22.9
18049.564067	-55.6	32.7	-22.9
16720.327136	-55.7	32.8	-22.9
18019.581279	-55.9	33.0	-22.9
17709.759137	-55.9	33.0	-22.9
19718.605929	-55.9	33.0	-22.9
18029.575542	-55.9	33.0	-22.9
18059.558330	-56.0	33.1	-22.9
25305.398746	-56.0	33.1	-22.9
16580.407459	-56.0	33.1	-22.9

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1

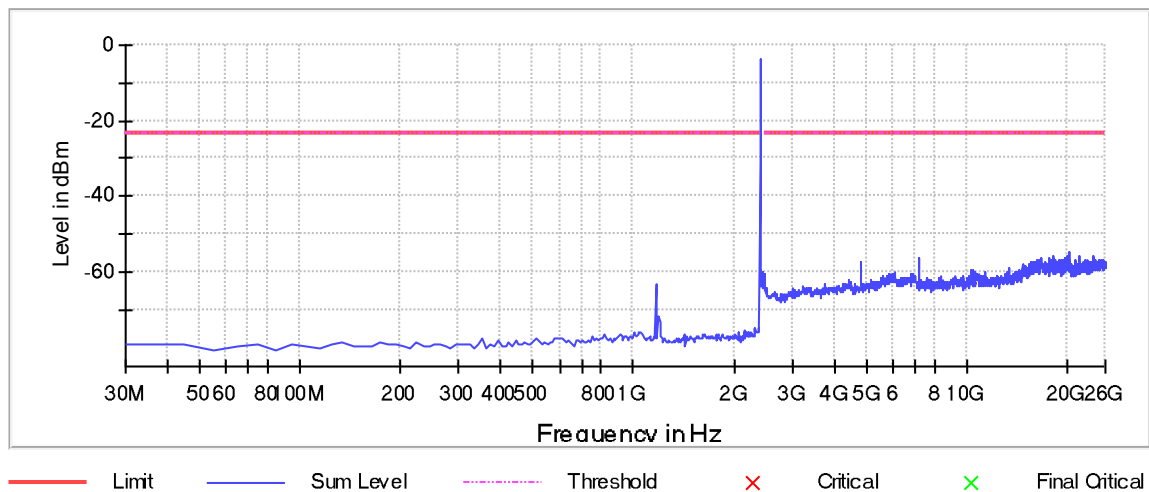


Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	≤ 100.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	238	~ 238
SweepTime	23.700 ms	AUTO
Reference Level	-20.000 dBm	-30.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	6 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 76: EUT #0, Mode 3, CSE, low channel

Spurious



Result

DUT Frequency (MHz)	Result
2402.000000	PASS

Final measurements

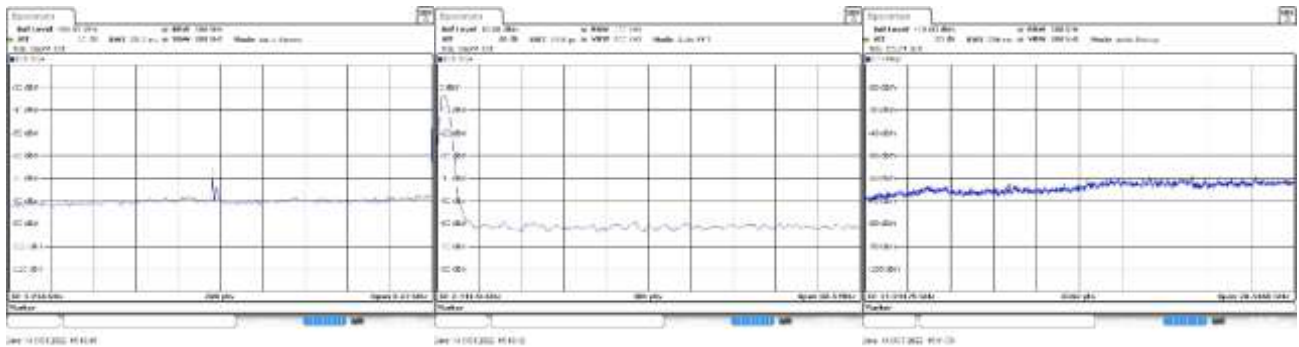
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2395.021008	-30.7	7.2	-23.5
20398.215788	-54.9	31.4	-23.5
23866.224926	-55.6	32.1	-23.5
20038.422333	-55.7	32.2	-23.5
21817.401084	-55.9	32.4	-23.5
18069.552592	-55.9	32.4	-23.5
20388.221526	-56.1	32.6	-23.5
18049.564067	-56.2	32.6	-23.5
16600.395984	-56.3	32.8	-23.5
23836.242138	-56.4	32.9	-23.5
7205.789099	-56.5	33.0	-23.5
18039.569805	-56.5	33.0	-23.5
19718.605929	-56.5	33.0	-23.5
17729.747663	-56.5	33.0	-23.5
19798.560030	-56.5	33.0	-23.5

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1

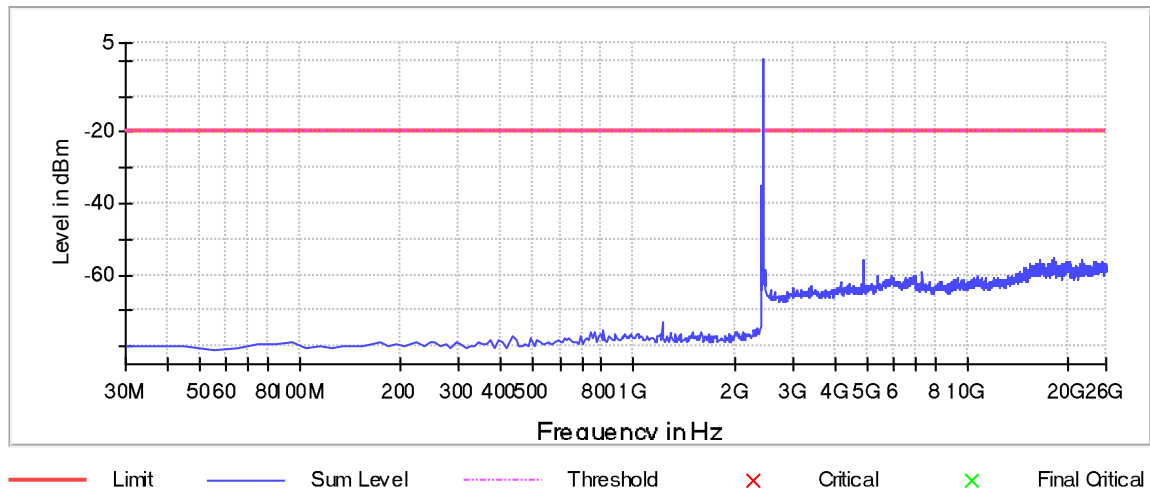


Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	≤ 100.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	238	~ 238
SweepTime	23.700 ms	AUTO
Reference Level	-20.000 dBm	-30.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	6 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 77: EUT #0, Mode 3, CSE, mid channel

Spurious



Result

DUT Frequency (MHz)	Result
2441.000000	PASS

Final measurements

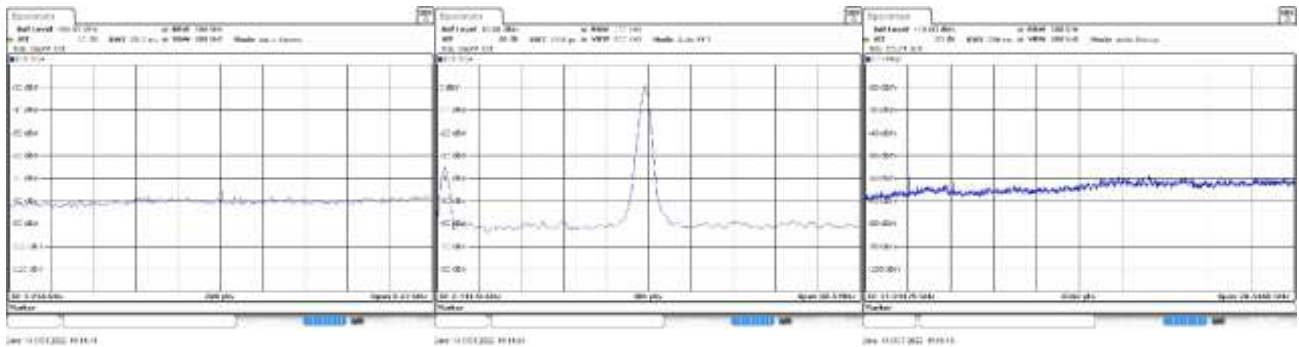
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
18049.564067	-55.4	35.8	-19.5
18069.552592	-55.5	36.0	-19.5
16390.516468	-55.8	36.3	-19.5
18039.569805	-55.9	36.3	-19.5
18019.581279	-55.9	36.3	-19.5
21957.320761	-55.9	36.4	-19.5
4877.125903	-55.9	36.4	-19.5
20028.428071	-56.1	36.5	-19.5
18369.380472	-56.2	36.6	-19.5
20358.238738	-56.2	36.7	-19.5
17999.592754	-56.2	36.7	-19.5
23946.179027	-56.4	36.8	-19.5
19748.588717	-56.5	36.9	-19.5
25405.341373	-56.5	37.0	-19.5
25375.358585	-56.5	37.0	-19.5

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1

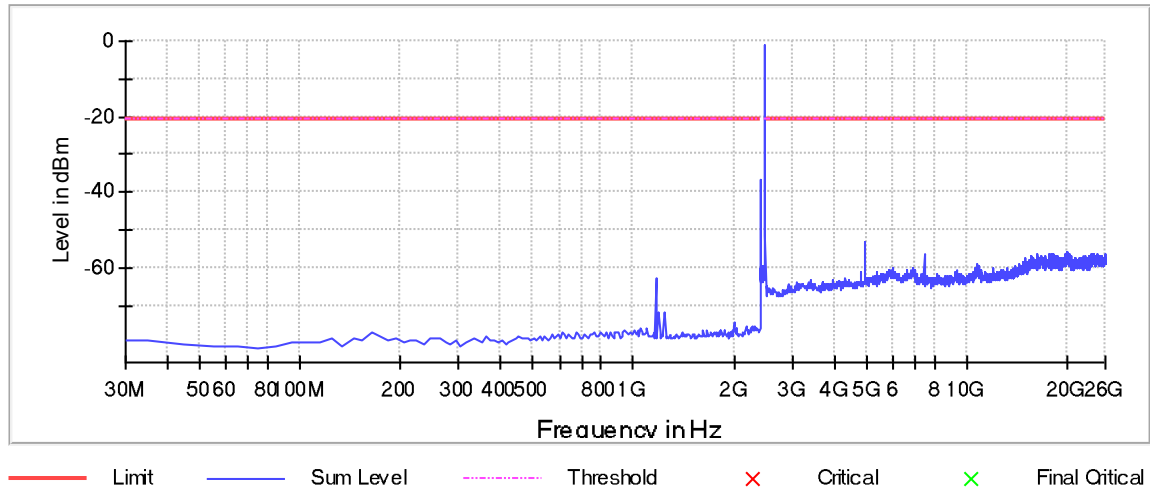


Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	≤ 100.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	238	~ 238
Sweeptime	23.700 ms	AUTO
Reference Level	-20.000 dBm	-30.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Plot 78: EUT #0, Mode 3, CSE, high channel

Spurious



Result

DUT Frequency (MHz)	Result
2480.000000	PASS

Final measurements

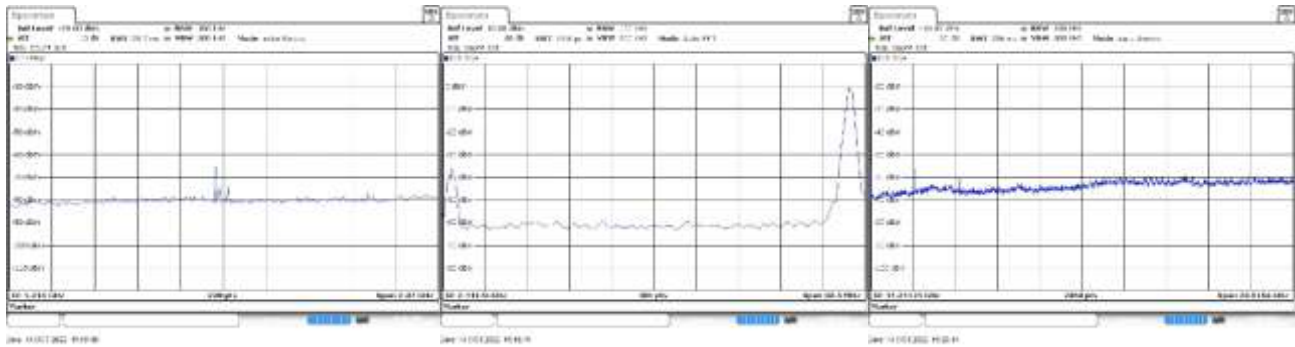
Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
---	---	---	---	---	---

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2488.497131	-51.3	30.4	-20.9
4957.080004	-53.3	32.4	-20.9
19888.508394	-56.0	35.1	-20.9
19998.445283	-56.0	35.1	-20.9
20398.215788	-56.1	35.2	-20.9
23816.253612	-56.1	35.2	-20.9
23526.419996	-56.1	35.2	-20.9
20378.227263	-56.1	35.2	-20.9
16320.556630	-56.2	35.3	-20.9
18069.552592	-56.2	35.3	-20.9
23936.184764	-56.3	35.3	-20.9
20048.416596	-56.3	35.4	-20.9
18049.564067	-56.3	35.4	-20.9
7435.657140	-56.4	35.4	-20.9
17809.701764	-56.4	35.5	-20.9

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
30.000000	2400.000000	1	1
2400.000000	2483.500000	1	1
2483.500000	26000.000000	1	1



Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	≤ 100.000 kHz
VBW	300.000 kHz	≥ 300.000 kHz
SweepPoints	238	~ 238
SweepTime	23.700 ms	AUTO
Reference Level	-20.000 dBm	-30.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	3	3
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	6 / max. 40	max. 40
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

7.11 Radiated Spurious Emissions (RSE)

Applicability

This requirement applies to all types of DTS equipment.

Description

Spurious emission / unwanted emissions are emission on a frequency or frequencies which are outside the authorized band and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products. Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation.

Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or 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, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, 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)).

Frequency [MHz]	Field Strength [$\mu\text{V/m}$] / [dB $\mu\text{V/m}$]	Measurement distance [m]
0.009 – 0.490	2400/F[kHz]	300
0.490 – 1.705	24000/F[kHz]	30
1.705 – 30.0	30.0 / 29.5	30
30 – 88	100 / 40.0	3
88 – 216	150 / 43.5	3
216 – 960	200 / 46.0	3
960 – 40 000	500 / 54.0	3

Note

Radiated Spurious Emissions (RSE) are performed for low / mid / high channel and modulation with the highest output power (worst case). In case of spurious other modulations are spot-checked.

Test setup: 8.1 & 8.2

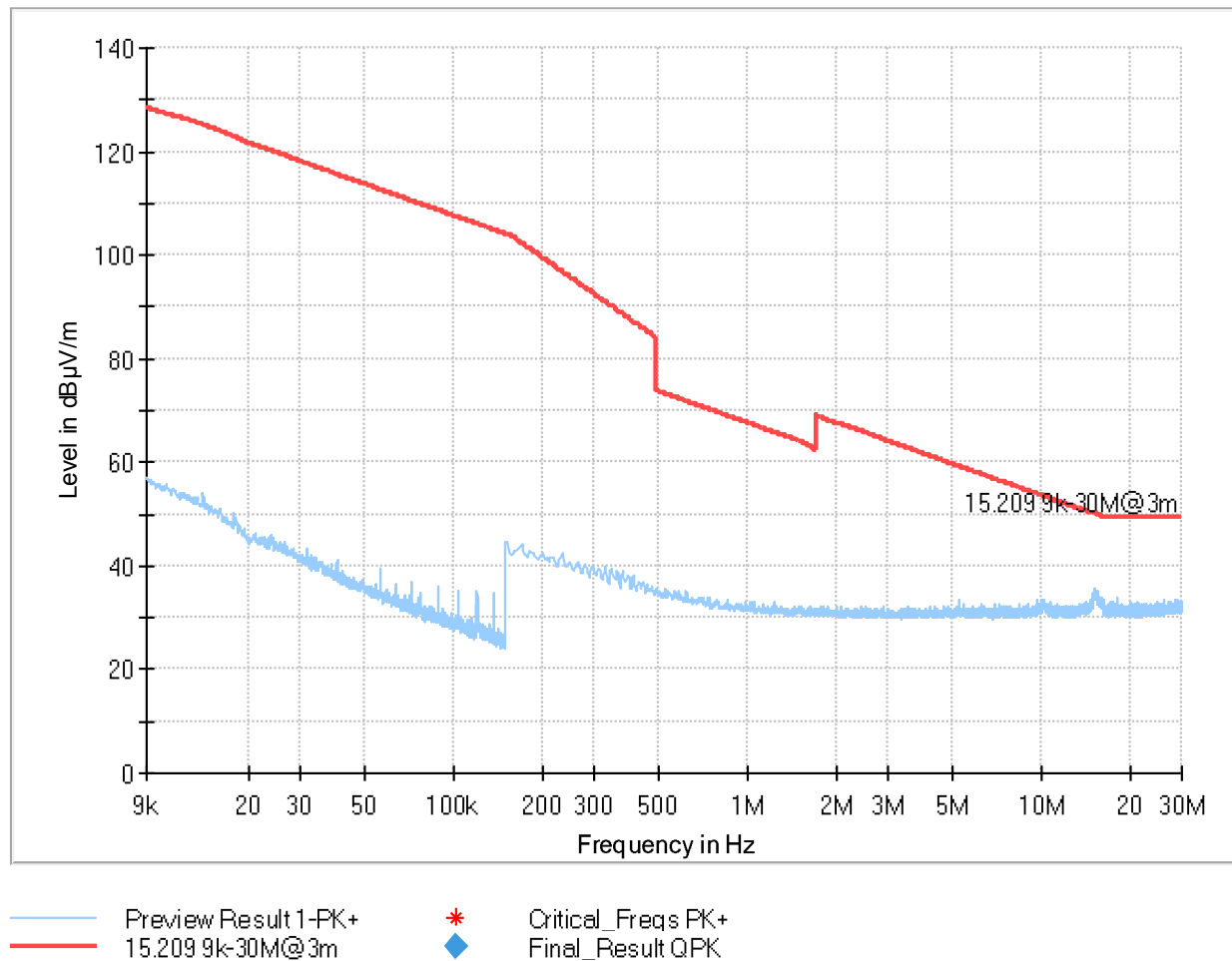
Test results

EUT Mode / Channel	Frequency [MHz]	Peak/RMS Detector	Level [dBm]	Limit [dBm]	Verdict
Mode 1	(see plots)	MaxPeak	(see plots)	(see plots)	- passed -
Mode 2	(see plots)	MaxPeak	(see plots)	(see plots)	- passed -
Mode 3	(see plots)	MaxPeak	(see plots)	(see plots)	- passed -

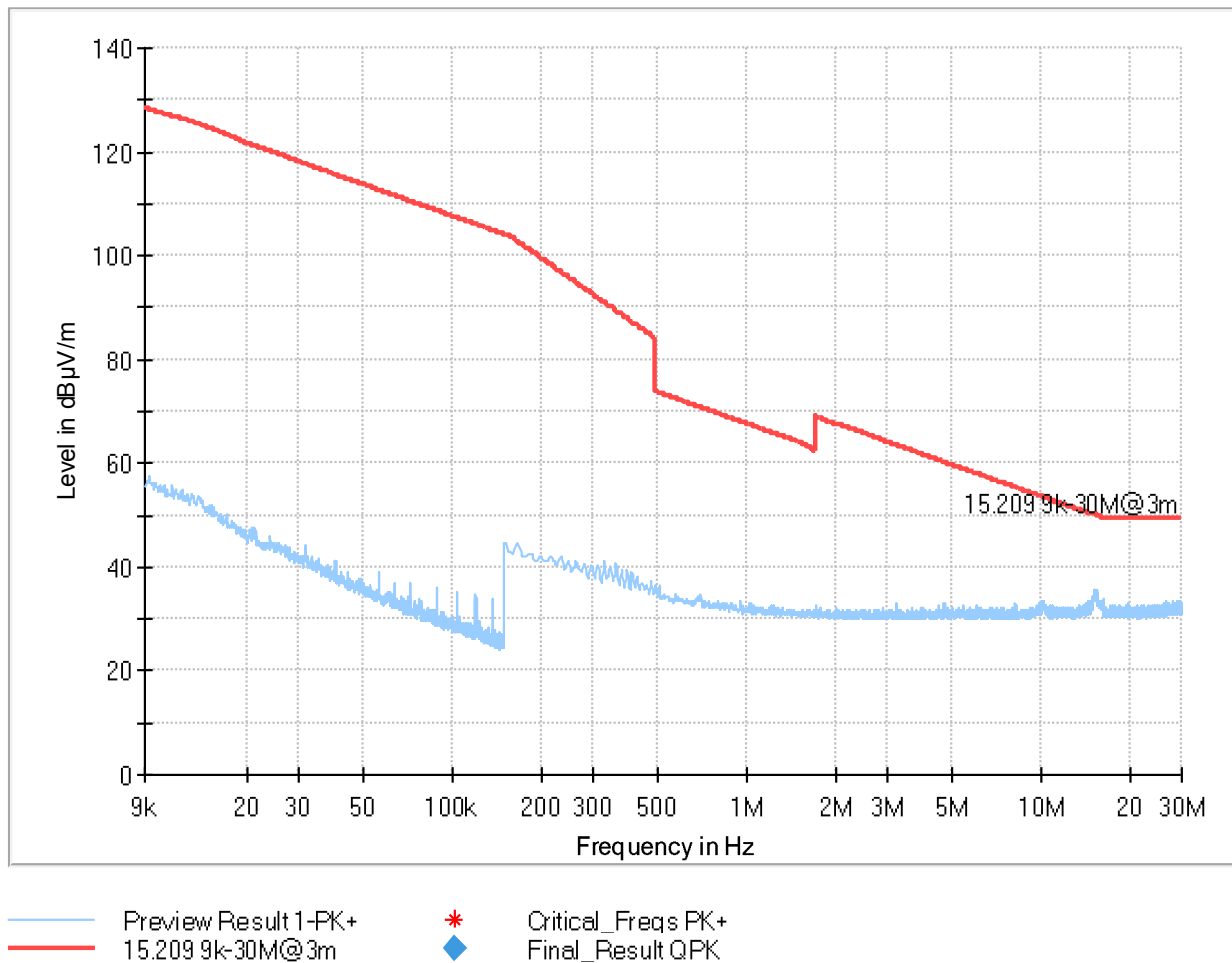
* all detected peaks are more than 6 dB below the limit

Comment:

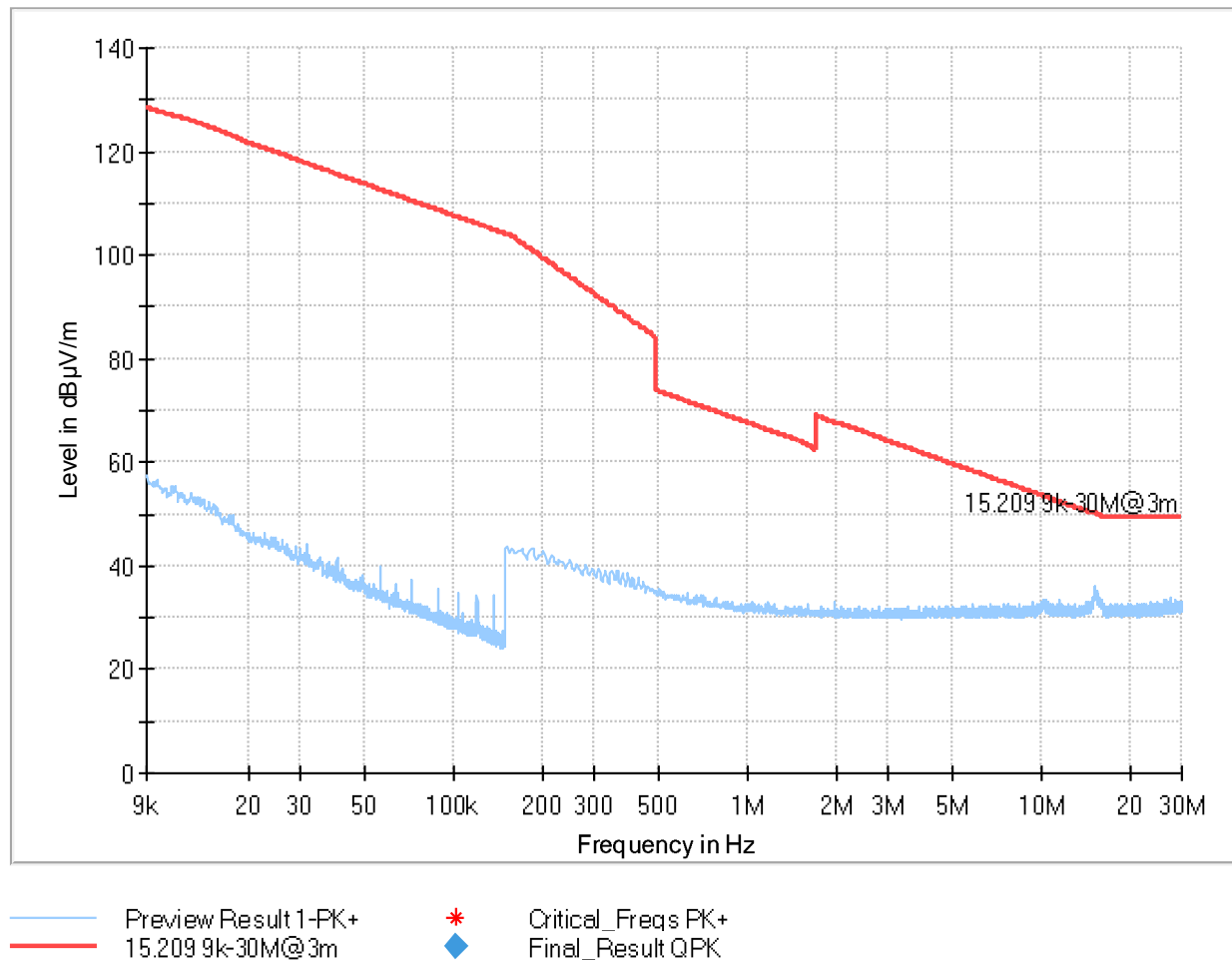
Plot 79: EUT #1, Mode 1, RSE 9 kHz – 30 MHz, low channel, loop antenna



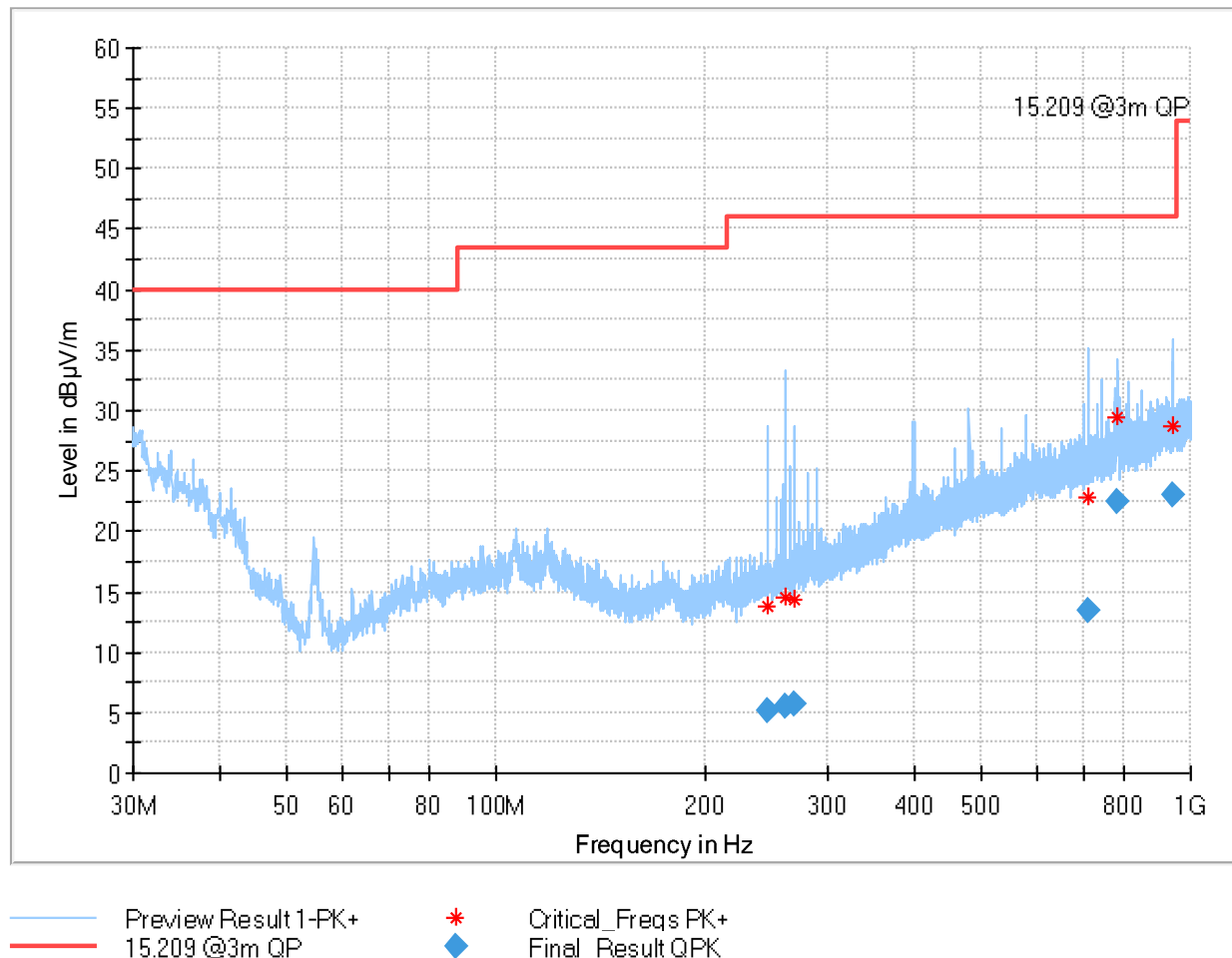
Plot 80: EUT #1, Mode 1, RSE 9 kHz – 30 MHz, mid channel, loop antenna



Plot 81: EUT #1, Mode 1, RSE 9 kHz – 30 MHz, high channel, loop antenna



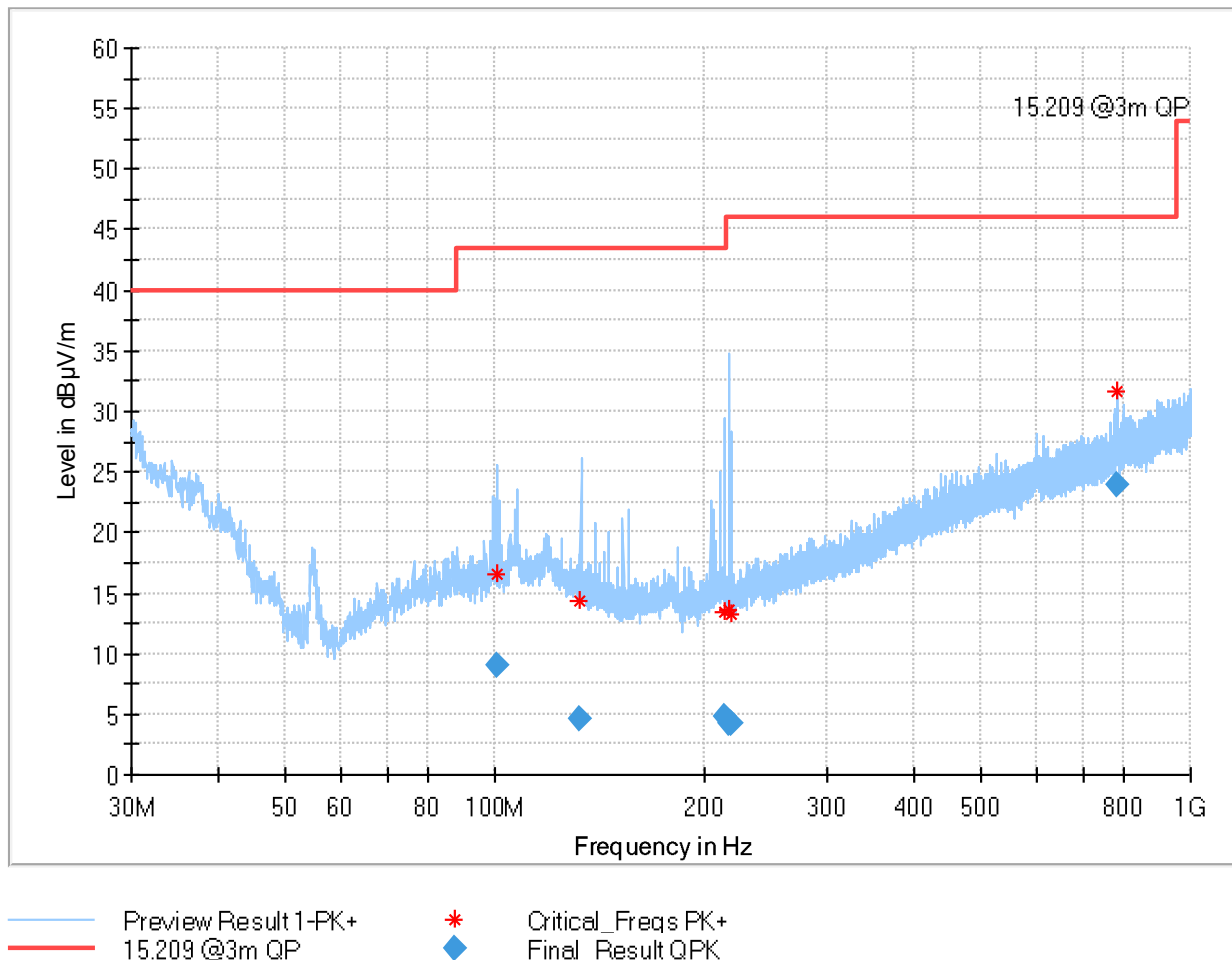
Plot 82: EUT #1, Mode 1, RSE 30 MHz – 1 GHz, low channel, horizontal / vertical polarisation



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
246.761500	5.10	46.00	40.90	100.0	120.000	133.0	H	-13.0
261.593500	5.57	46.00	40.43	100.0	120.000	142.0	H	79.0
268.997500	5.65	46.00	40.35	100.0	120.000	142.0	H	103.0
714.564500	13.43	46.00	32.57	100.0	120.000	205.0	H	277.0
783.017000	22.37	46.00	23.63	100.0	120.000	117.0	H	196.0
943.350500	23.09	46.00	22.91	100.0	120.000	205.0	H	91.0

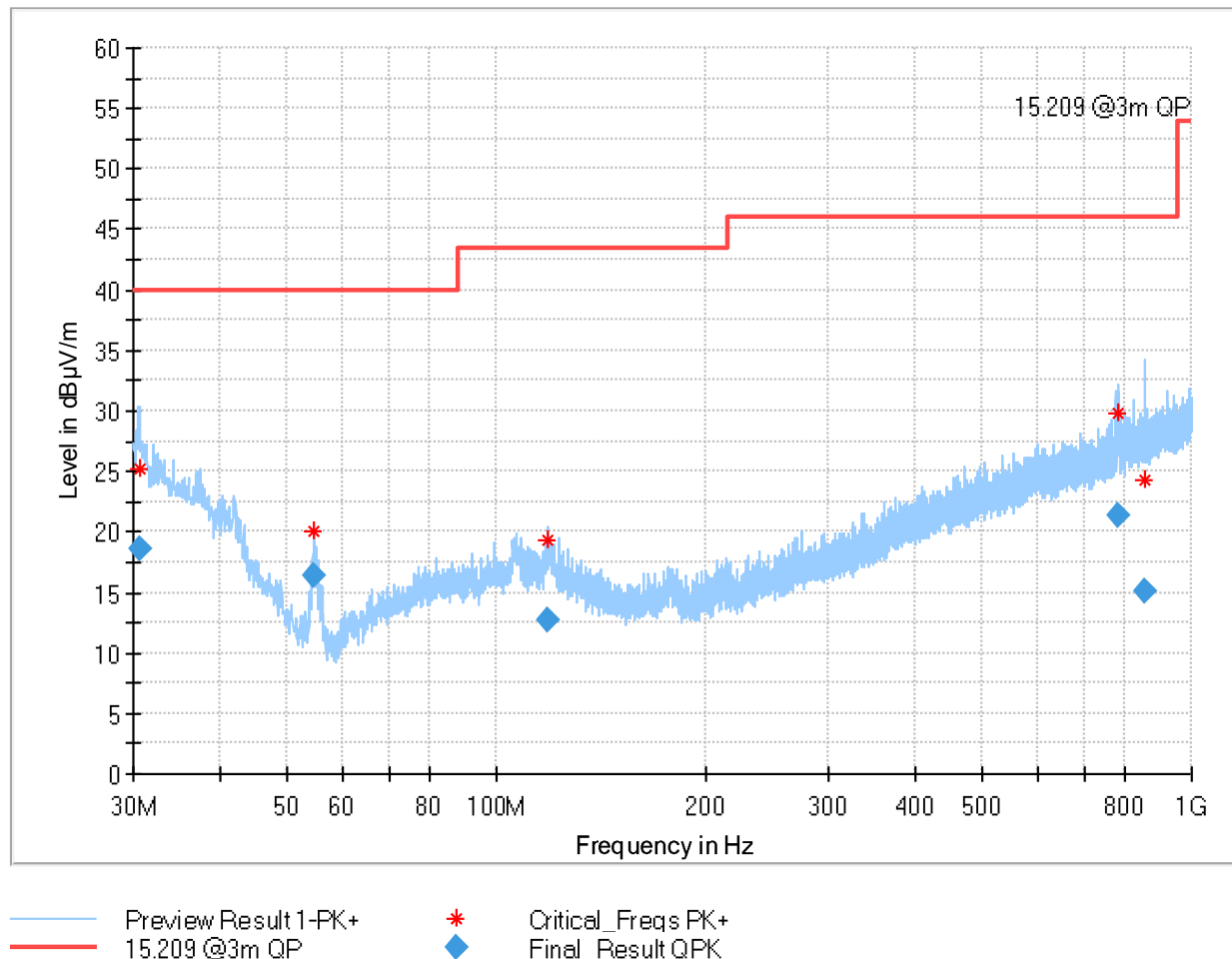
Plot 83: EUT #1, Mode 1, RSE 30 MHz – 1 GHz, mid channel, horizontal / vertical polarisation



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
100.592500	9.04	43.50	34.46	100.0	120.000	241.0	H	231.0
132.518500	4.62	43.50	38.88	100.0	120.000	350.0	H	294.0
214.226500	4.72	43.50	38.78	100.0	120.000	250.0	V	290.0
216.810500	4.23	46.00	41.77	100.0	120.000	350.0	V	303.0
218.318000	4.15	46.00	41.85	100.0	120.000	268.0	V	333.0
782.811000	23.86	46.00	22.14	100.0	120.000	314.0	H	100.0

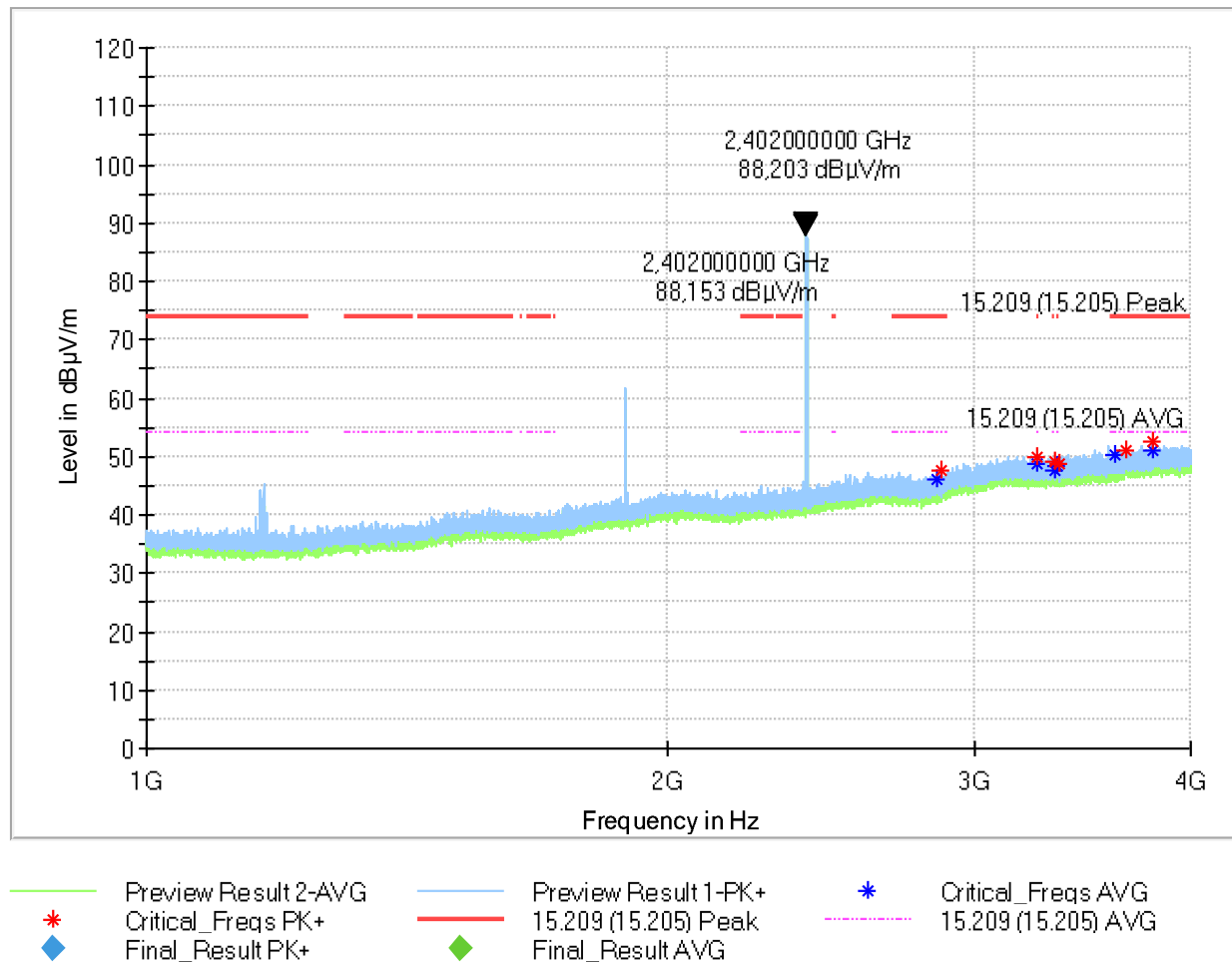
Plot 84: EUT #1, Mode 1, RSE 30 MHz – 1 GHz, high channel, horizontal / vertical polarisation



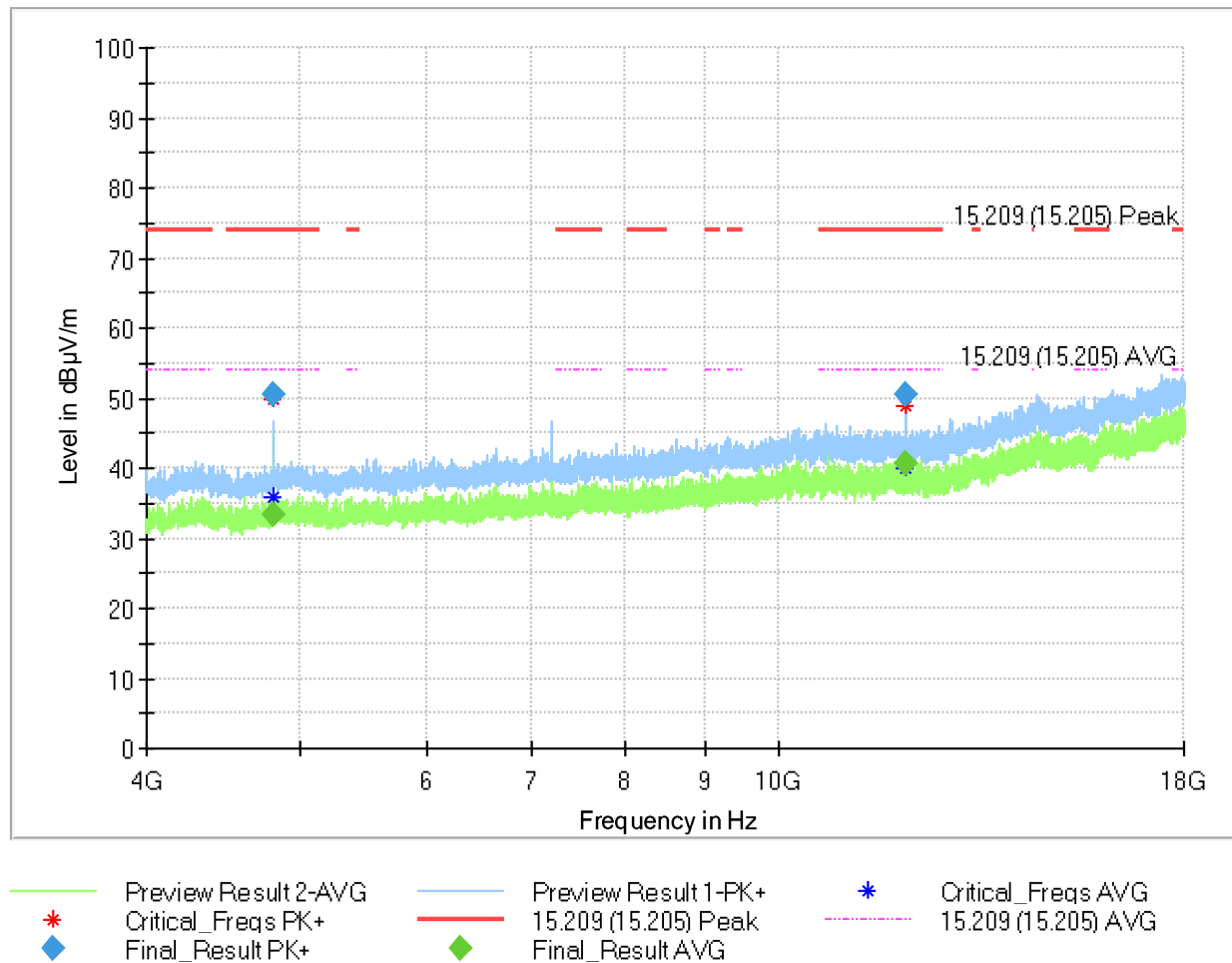
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.607000	18.57	40.00	21.43	100.0	120.000	125.0	H	181.0
54.711500	16.33	40.00	23.67	100.0	120.000	150.0	V	177.0
118.376000	12.65	43.50	30.85	100.0	120.000	186.0	V	2.0
781.354500	21.37	46.00	24.63	100.0	120.000	286.0	V	66.0
859.231000	15.03	46.00	30.97	100.0	120.000	142.0	V	356.0

Plot 85: EUT #1, Mode 1, RSE 1 GHz – 4 GHz, low channel, horizontal / vertical polarisation



Plot 86: EUT #1, Mode 1, RSE 4 GHz – 18 GHz, low channel, horizontal / vertical polarisation



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4803.969444	---	33.47	54.00	20.53	100.0	1000.000	150.0	V
4804.344444	50.44	---	74.00	23.56	100.0	1000.000	150.0	V
12009.105556	50.46	---	74.00	23.54	100.0	1000.000	150.0	V
12009.480556	---	40.75	54.00	13.25	100.0	1000.000	150.0	V