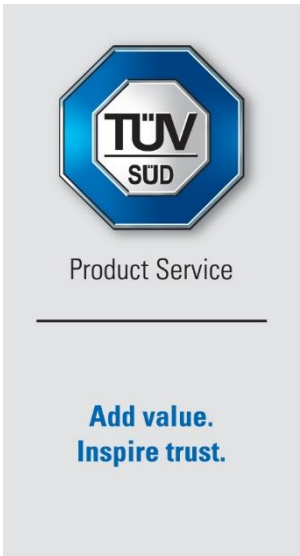


Report on the FCC and IC Testing of the
Marquardt
Model: UK1
In accordance with FCC 47 CFR Part 15 C
and ISED RSS-247 and ISED RSS-GEN

Prepared for: Marquardt GmbH
Schloßstr. 16
78604 Rietheim-Weilheim
Germany

FCC ID: IYZUK1
IC: 2701A-UK1



COMMERCIAL-IN-CONFIDENCE

Date: 2024-12-09
Document Number: TR-713338219-03 | Revision 2

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Martin Steindl	2024-12-09	<i>Steindl Martin</i> SIGN-ID 997141
Authorised Signatory	Matthias Stumpe	2024-12-09	<i>Stumpe</i> SIGN-ID 997145

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

Engineering Statement:

This measurement shown in this report were made in accordance with the procedures described on test pages.
All reported testing was carried out on a sample equipment to demonstrate limited compliance with with FCC 47 CFR Part 15 C and ISED RSS-247 and RSS-GEN.
The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Martin Steindl	2024-12-09	<i>Steindl Martin</i> SIGN-ID 997142

Laboratory Accreditation DAkKS Reg. No. D-PL-11321-11-02 DAkKS Reg. No. D-PL-11321-11-03	Laboratory recognition Registration No. BNetzA-CAB-16/21-15	Industry Canada test site registration 3050A-2
--	--	---

Executive Statement:

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15 C:2023 and ISED RSS-247:2023 and RSS-GEN:2019 + Amd1:2019 + Amd2:2021

DISCLAIMER AND COPYRIGHT

This non-binding report has been prepared by TÜV SÜD Product Service with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD Product Service. No part of this document may be reproduced without the prior written approval of TÜV SÜD Product Service. © 2024 TÜV SÜD Product Service.

Trade Register Munich
HRB 85742
VAT ID No. DE129484267
Information pursuant to Section 2(1)
DL-InfoV (Germany) at
www.tuvsud.com/imprint

Managing Directors:
Walter Reithmaier (Sprecher / CEO)
Patrick van Welij

Phone: +49 (0) 9421 56 82-0
Fax: +49 (0) 9421 56 82-199
www.tuvsud.com

TÜV SÜD Product Service GmbH
Äußere Frühlingsstraße 45
94315 Straubing
Germany



Content

1	Report Summary.....	2
1.1	Modification Report.....	2
1.2	Introduction	2
1.3	Brief Summary of Results.....	3
1.4	Product Information	4
1.5	Test Configuration	4
1.6	Modes of Operation	5
1.7	Deviations from Standard	5
1.8	EUT Modifications Record	5
1.9	Test Location	6
2	Test Details.....	7
2.1	Antenna requirement	7
2.2	Emission Bandwidth	8
2.3	Output Power.....	25
2.4	Power Spectral Density	34
2.5	Frequency Band Edge	43
2.6	Spurious emissions	49
2.7	Temperature Stability	76
3	Measurement Uncertainty	91
Annex A: Photographs of Test Setup		3 pages
Annex B: External Photos of EUT		1 page



1 Report Summary

1.1 Modification Report

Alternations and additions of this report will be issued to the holders of each copy in the form of a complete document.

Revision	Description of changes	Date of Issue
0	First Issue	2024-11-14
1	Added Hardware- and Software-Versions in section 1.1. Added calculation of antenna gain in section 2.1.	2024-11-27
2	Added information for detector, resolution and video bandwidth for plots generated by EMC32 on test system TS8997. Added radiated emission protocols for middle and highest channels and band edge requirement. Removed obsolete ISED references in sections 2.5.5 and 2.6.5.	2024-12-09

Table 1: Report of Modifications

1.2 Introduction

Applicant	Marquardt GmbH Schloßstr. 16 78604 Rietheim-Weilheim Germany
Manufacturer	Marquardt GmbH
Model Number(s)	UK1
Serial Number(s)	Conducted sample: 2624000072726007 Radiated sample: 2624000072726004
Hardware Version(s)	585172012-02
Software Version(s)	2.4
Number of Samples Tested	2
Test Specification(s) / Issue / Date	FCC 47 CFR Part 15 C : 2023 ISED RSS-247, Issue 2 : 2023 ISED RSS-GEN, Issue 5, Amd. 1 : 2019 + Amd.2:2021
Test Plan/Issue/Date	N/A
Order Number	6200690437-U35
Date	2024-05-15
Date of Receipt of EUT	2024-10-22
Start of Test	2024-10-22
Finish of Test	2024-10-29
Name of Engineer(s)	M. Steindl, A. Deese
Related Document(s)	ANSI C63.4: 2014 ANSI C63.10: 2013 FCC 47 CFR Part 2 J : 2023 KDB 558074 D01 V05R02



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15 C is shown below.

Section	Specification Clause	Test Description	Result
2.1	15.203, 15.247(b)	Antenna requirement	Pass
2.2	15.247(a)(2)	Emission Bandwidth	Pass
2.3	15.247(b)(3)	Output Power	Pass
2.4	15.247(e)	Power Spectral Density	Pass
2.5	15.247(d)	Frequency Band Edge	Pass
2.6	15.247(d), 15.205, 15.209	Spurious Emissions	Pass
---	15.207	Conducted Emissions on Mains Terminals	Not applicable

Table 2: Results according to FCC 47 CFR Part 15 C

A brief summary of the tests carried out in accordance with ISED RSS-247 and ISED RSS-GEN is shown below.

Section	Specification Clause	Test Description	Result
2.2	5.2 a.	Emission Bandwidth	Pass
2.3	5.4 d.	Output Power	Pass
2.4	5.2 b.	Power Spectral Density	Pass
2.5	5.5	Frequency Band Edge	Pass
2.6	5.5	Spurious Emissions	Pass

Table 3: Results according to ISED RSS-247

Section	Specification Clause	Test Description	Result
2.2	6.7	Emission Bandwidth	Pass
2.6	8.9, 8.10	Spurious Emissions	Pass
2.7	8.11	Frequency Stability	Pass
---	8.8	Conducted Emissions on Mains Terminals	Not applicable

Table 4: Results according to RSS-Gen

1.4 Product Information

1.4.1 Technical Description

Frequency Band: 2400.0 MHz to 2483.5 MHz
Frequency Range: 2402 MHz to 2480 MHz

Supply Voltage: 3.0 V lithium battery
Supply Frequency: 0 Hz

1.4.2 Labeling of EUT



1.5 Test Configuration

The applicant provided two test samples, one for radiated emission tests with attached antenna and one conducted sample with temporary antenna connector.
The operation modes were configured with a Rohde & Schwarz CMW500.



1.6 Modes of Operation

Tests were performed on lowest channel 37 (2402 MHz), middle channel 19 (2440 MHz) and highest channel 39 (2480 MHz).

1 Mbps:

Modulation scheme: 1 Msym/s; Data Rate: 1 Mb/s, Payload: 255 bytes, Pattern: PRBS9

2 Mbps:

Modulation scheme: 1 Msym/s; Data Rate: 2 Mb/s, Payload: 255 bytes, Pattern: PRBS9

Mode Long Range S2:

Modulation scheme: 1 Msym/s; Data Rate: 500 kb/s, Payload: 255 bytes, Pattern: PRBS9

Mode Long Range S8:

Modulation scheme: 1 Msym/s; Data Rate: 125 kb/s, Payload: 255 bytes, Pattern: PRBS9

1.7 Deviations from Standard

No deviations from standard.

1.8 EUT Modifications Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer	Not Applicable	Not Applicable

Table 5



Product Service

1.9 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing test laboratory:

Test Name	Name of Engineer(s)
Antenna requirement	M. Steindl
Emission Bandwidth	M. Steindl
Output Power	M. Steindl
Power Spectral Density	M. Steindl
Frequency Band Edge	M. Steindl
Spurious Emissions	M. Steindl, A. Deese
Frequency Stability	M. Steindl

Office Address:

Äußere Frühlingstraße 45
94315 Straubing
Germany



2 Test Details

2.1 Antenna requirement

2.1.1 Specification Reference

FCC 47 CFR Part 15 C, Clauses 15.203, 15.247(b)

2.1.2 Equipment under Test and Modification State

UK1; S/N 2624000072726007; Modification state 0

2.1.3 Specification Limits

FCC 47 CFR 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some fields disturbance sensors, or to other intentional radiators which must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits are not exceeded.

FCC 47 CFR 15.247(b)

Except for point-to-point operation and multiple directional beams, if the transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2.1.4 Test Results

The EUT consists of internal PCB antennas.

Antenna Gain: -0.15 dBi

The antenna gain was calculated based on the test results of sections 2.3 and 2.6. The EIRP was calculated acc. to ANSI C63.10, section 12.7.3.

$$\text{Antenna Gain} = \text{EIRP} - P_{\text{cond}}$$

$$\text{EIRP} = E + 20 \log_{10}(d(m)) - 104.77 \text{ dB}$$

$$\text{Antenna Gain} = 97.3 \text{ dB}\mu\text{V/m} + 20 \log_{10}(1) - 104.77 \text{ dB} = -0.15 \text{ dBi.}$$



2.2 Emission Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.247(a)(2)
ISED RSS-247, Clause 5.2 a.
ISED RSS-Gen, Clause 6.7

2.2.2 Equipment under Test and Modification State

UK1; S/N 2624000072726007; Modification state 0

2.2.3 Date of Test

2024-10-23

2.2.4 Environmental Conditions

Ambient Temperature	23 °C
Relative Humidity	52 %

2.2.5 Specification Limits

For systems using digital modulation techniques, operating in the 902 MHz – 928 MHz, 2400 MHz – 2483.5 MHz and/or 5725 MHz – 5850 MHz bands, the minimum 6 dB bandwidth shall be at least 500 kHz

ISED RSS-GEN:

The occupied (99 %) bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSS.

2.2.6 Test Method

The test was performed according to ANSI C63.10, clauses 6.9.3 and 11.8.1

The test was performed using an automated software (EMC32) with the following settings:

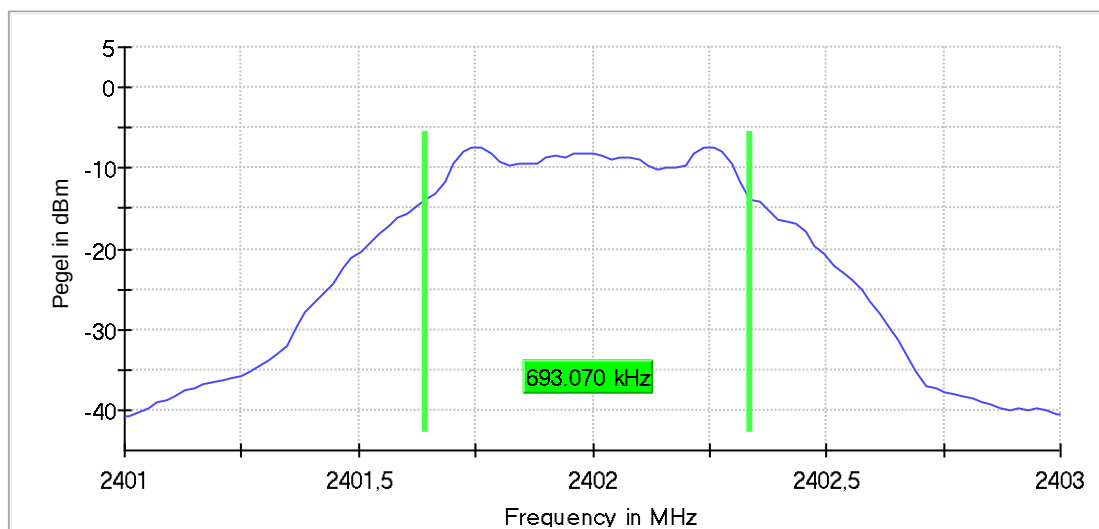
Test:	6 dB bandwidth	99 % bandwidth
Resolution Bandwidth:	100 kHz	10 kHz
Video Bandwidth:	300 kHz	30 kHz
Detector:	Positive peak	Positive peak

2.2.7 Test Results

Mode	Frequency Channel	6 dB Bandwidth	Limit	Band Edge Left	Band Edge Right
1 Mbps	2402 MHz	693.070 kHz	> 500 kHz	2401.643564 MHz	2402.336634 MHz
1 Mbps	2440 MHz	693.070 kHz	> 500 kHz	2439.643563 MHz	2440.336634 MHz
1 Mbps	2480 MHz	693.070 kHz	> 500 kHz	2479.643564 MHz	2480.336634 MHz

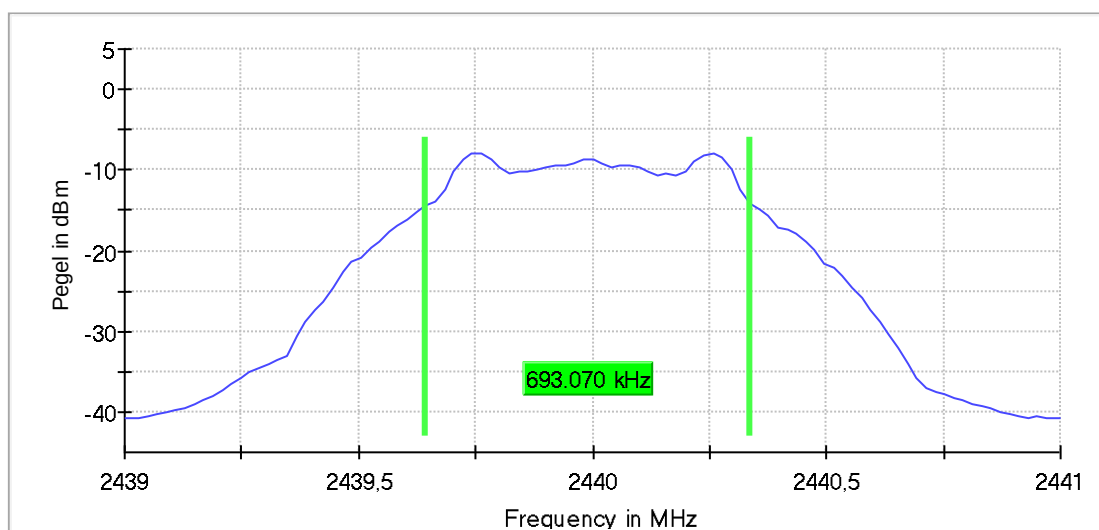
Table 6: 6 dB bandwidth, 1 Mbps

6 dB Bandwidth

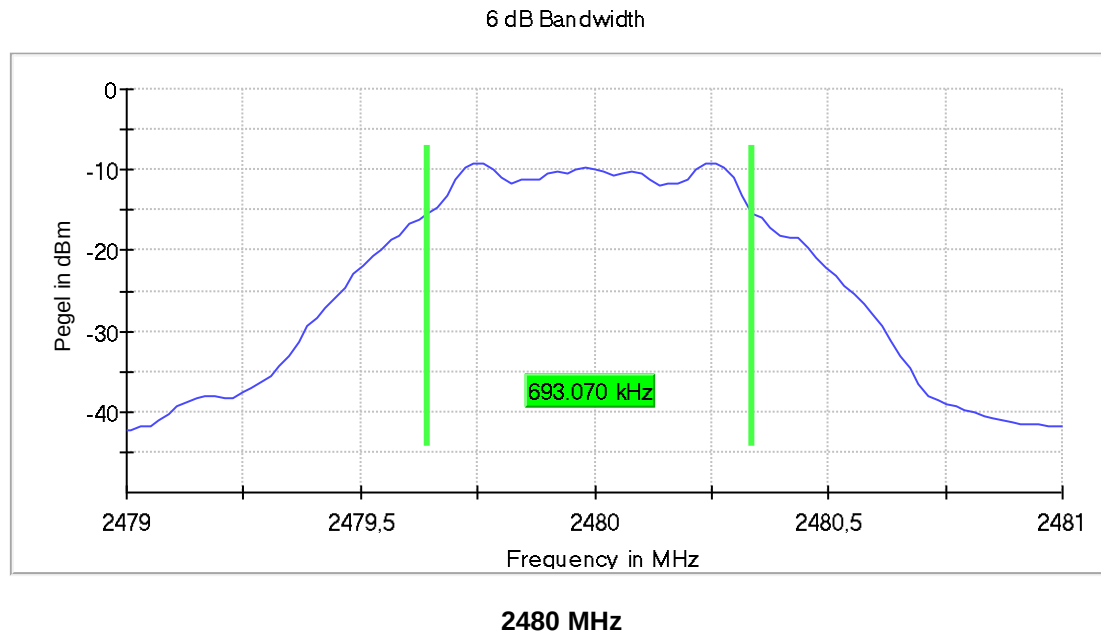


2402 MHz

6 dB Bandwidth



2440 MHz

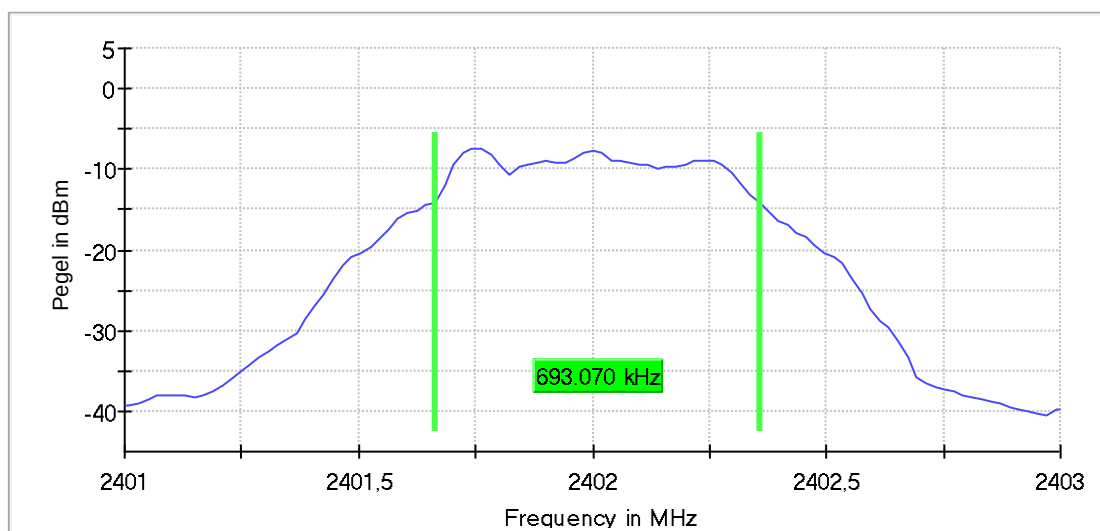




Mode	Frequency Channel	6 dB Bandwidth	Limit	Band Edge Left	Band Edge Right
Long Range S2	2402 MHz	693.070 kHz	> 500 kHz	2401.663366 MHz	2402.356436 MHz
Long Range S2	2440 MHz	693.070 kHz	> 500 kHz	2439.66336 MHz	2440.356436 MHz
Long Range S2	2480 MHz	693.070 kHz	> 500 kHz	2479.663366 MHz	2480.356436 MHz

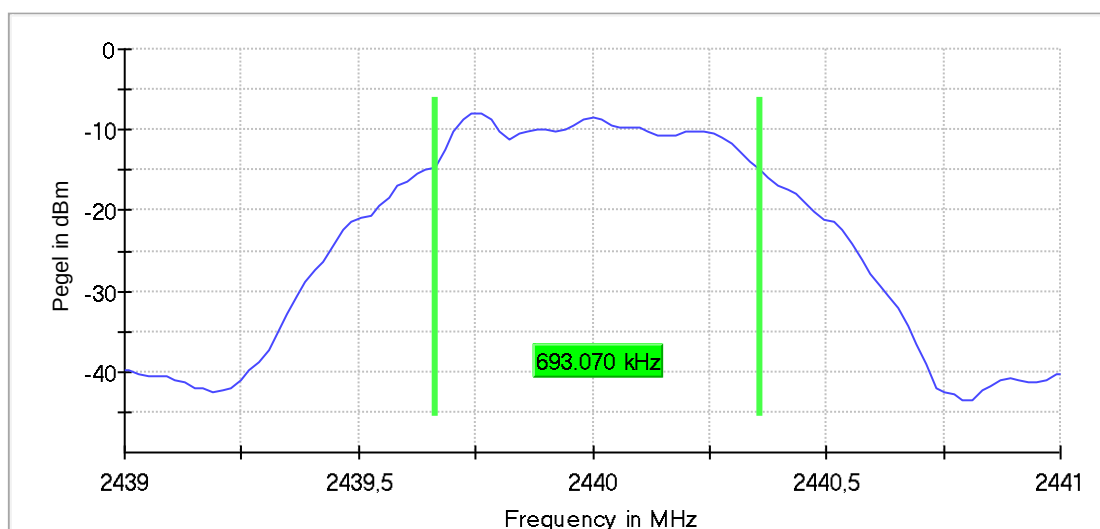
Table 7: 6 dB bandwidth, Long Range, S2

6 dB Bandwidth



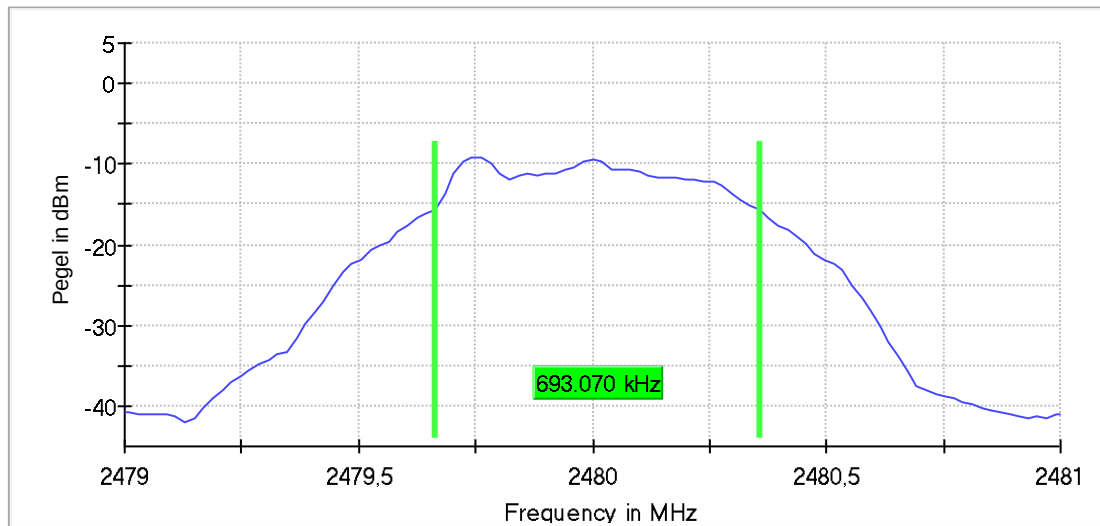
2402 MHz

6 dB Bandwidth



2440 MHz

6 dB Bandwidth



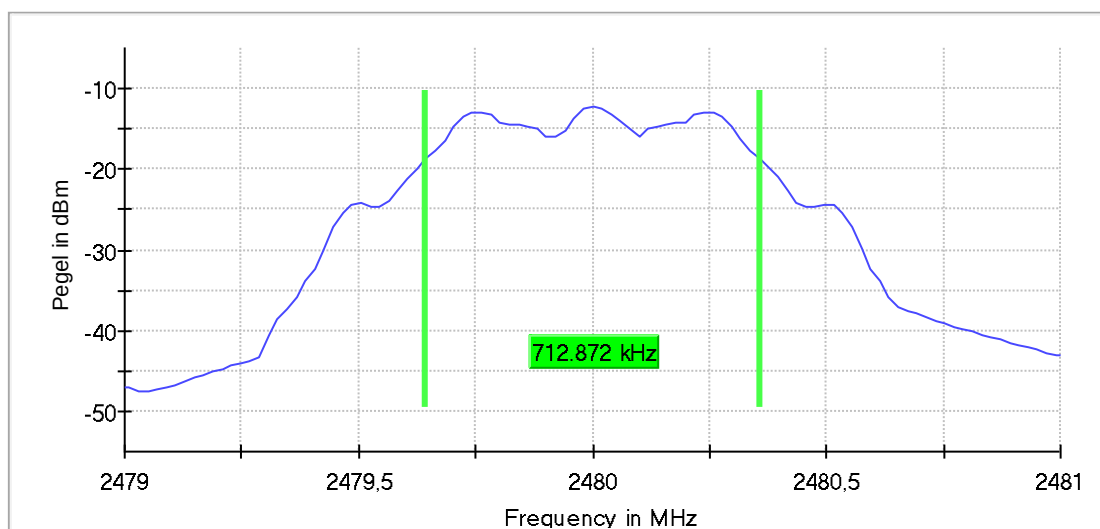
2480 MHz



Mode	Frequency Channel	6 dB Bandwidth	Limit	Band Edge Left	Band Edge Right
Long Range S8	2402 MHz	712.872 kHz	> 500 kHz	2401.643564 MHz	2402.356436 MHz
Long Range S8	2440 MHz	712.872 kHz	> 500 kHz	2439.643564 MHz	2440.356436 MHz
Long Range S8	2480 MHz	712.872 kHz	> 500 kHz	2479.643564 MHz	2480.356436 MHz

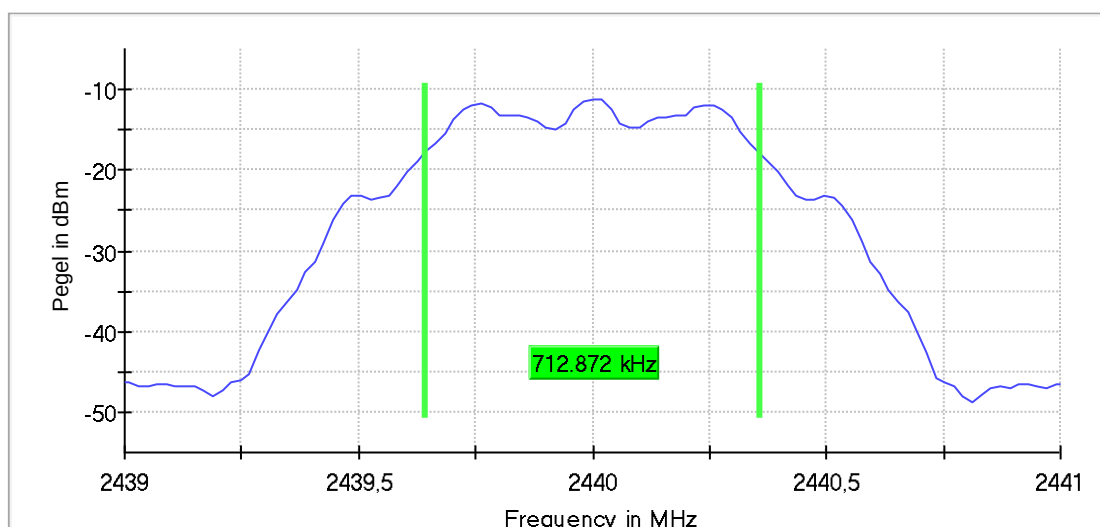
Table 8: 6 dB bandwidth, Long Range S8

6 dB Bandwidth

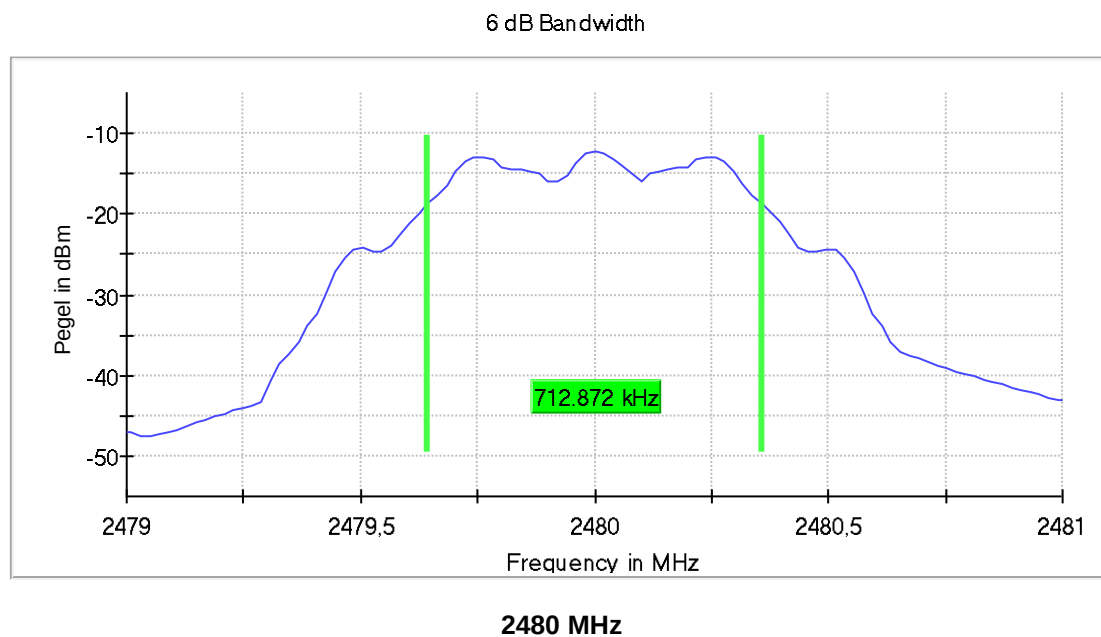


2402 MHz

6 dB Bandwidth



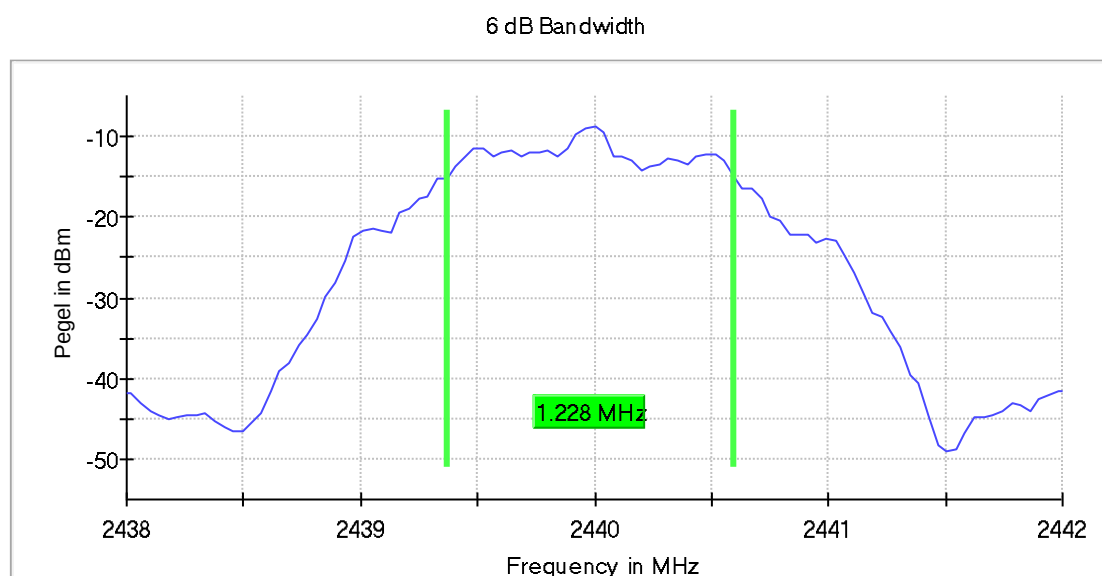
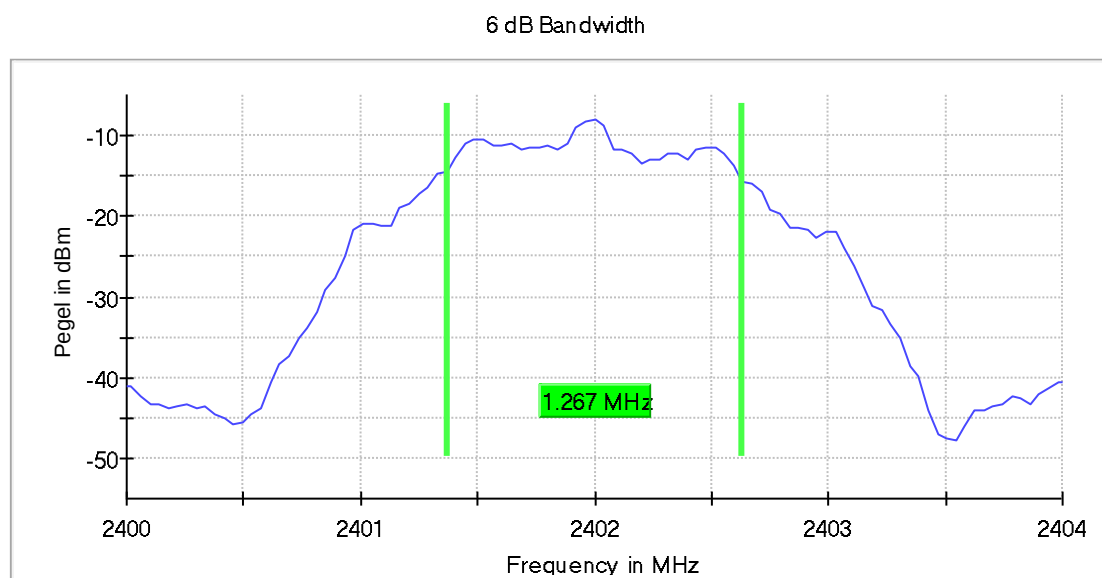
2440 MHz

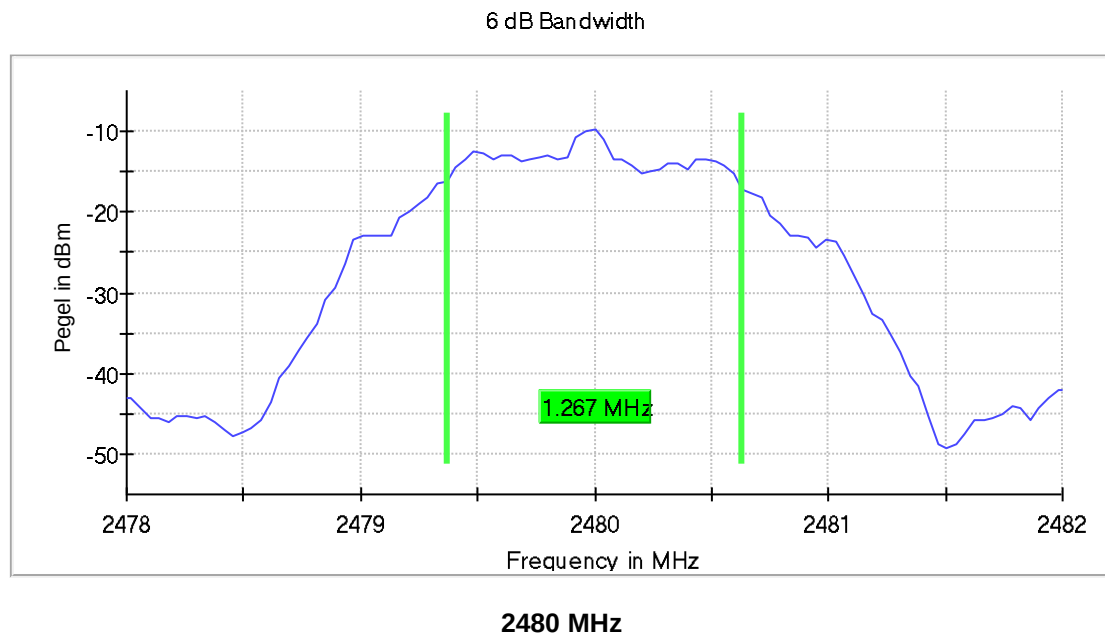




Mode	Frequency Channel	6 dB Bandwidth	Limit	Band Edge Left	Band Edge Right
2 Mbps	2402 MHz	1.267326 MHz	> 500 kHz	2401.366337 MHz	2402.633663 MHz
2 Mbps	2440 MHz	1.227722 MHz	> 500 kHz	2439.366337 MHz	2440.594059 MHz
2 Mbps	2480 MHz	1.2677326 MHz	> 500 kHz	2479.366337 MHz	2480.633663 MHz

Table 9: 6 dB bandwidth, 2 Mbps



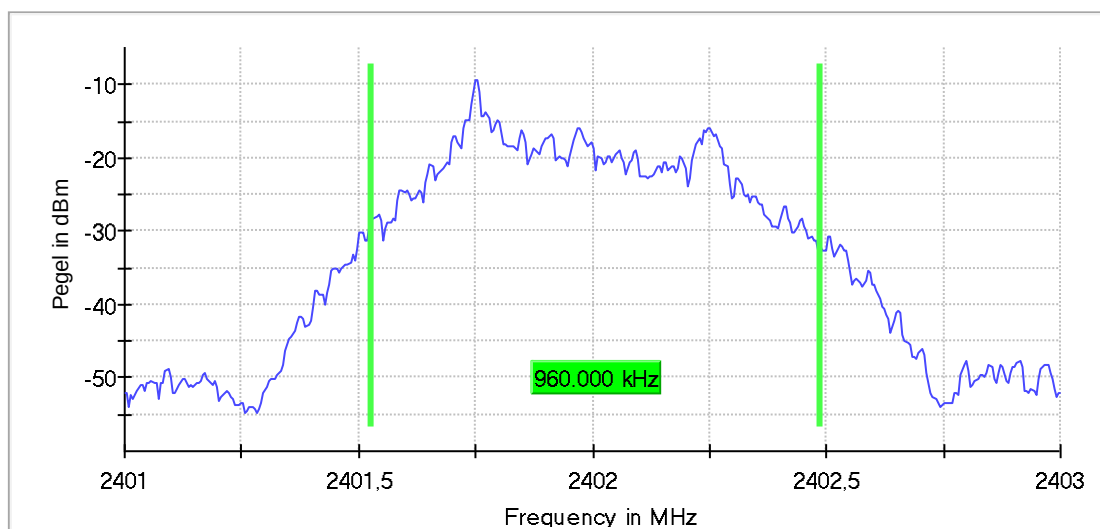




Mode	Frequency Channel	99% Bandwidth	Band Edge Left	Band Edge Right
1 Mbps	2402 MHz	960.000 kHz	2401.527500 MHz	2402.487500 MHz
1 Mbps	2440 MHz	960.000 kHz	2439.527500 MHz	2440.487500 MHz
1 Mbps	2480 MHz	960.000 kHz	2479.527500 MHz	2480.487500 MHz

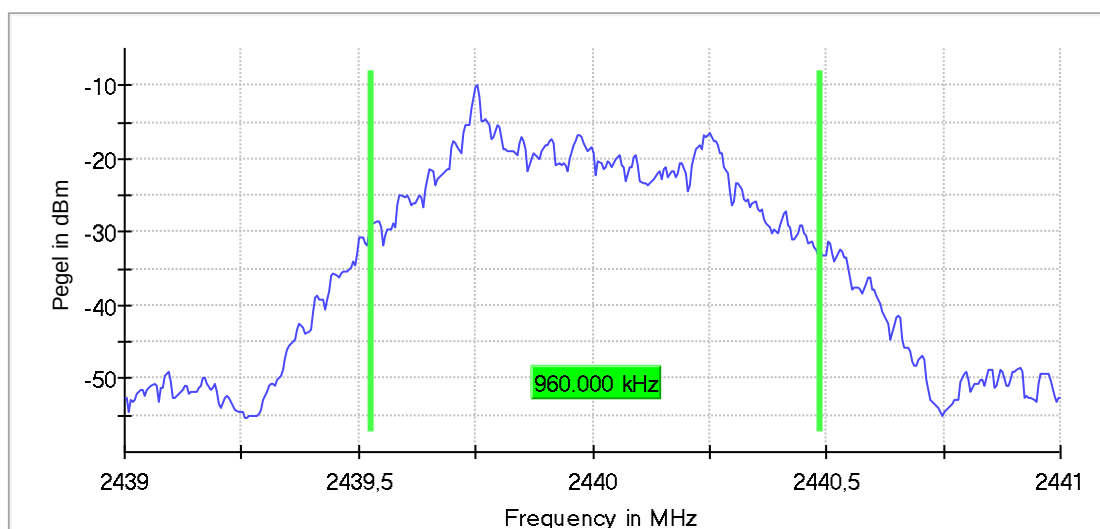
Table 10: 99% bandwidth, 1 Mbps

99 % Bandwidth

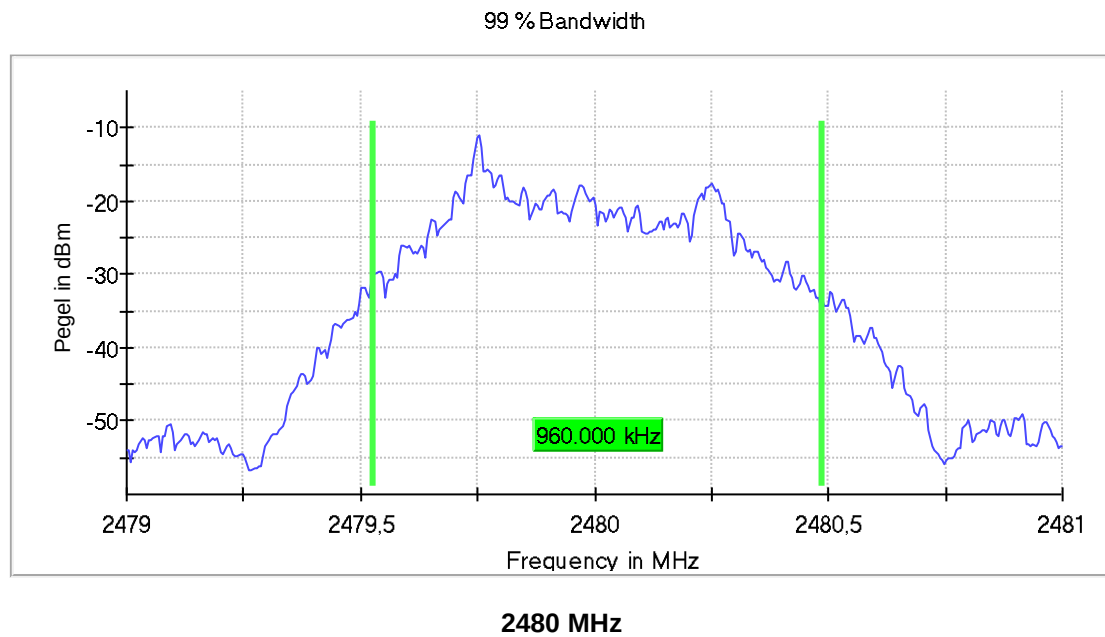


2402 MHz

99 % Bandwidth



2440 MHz

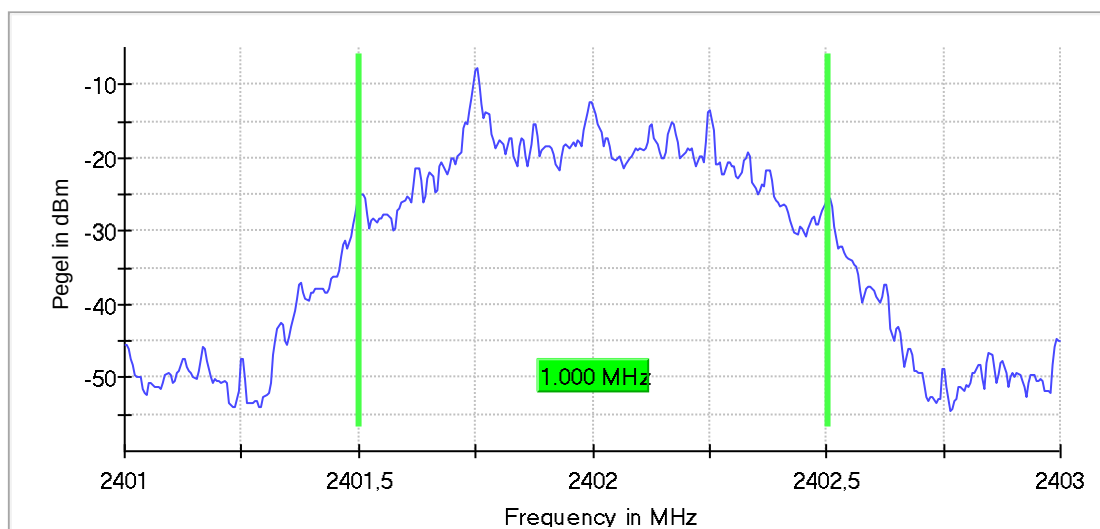




Mode	Frequency Channel	99% Bandwidth	Band Edge Left	Band Edge Right
Long Range S2	2402 MHz	1.000000 MHz	2401.502500 MHz	2402.502500 MHz
Long Range S2	2440 MHz	1.000000 MHz	2439.502500 MHz	2440.502500 MHz
Long Range S2	2480 MHz	1.000000 MHz	2479.502500 MHz	2480.502500 MHz

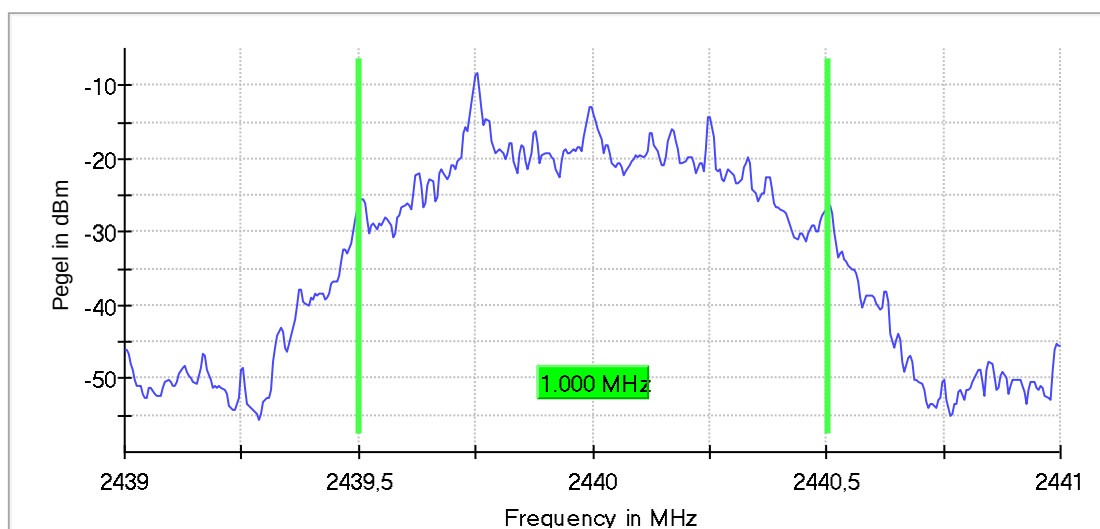
Table 11: 99% bandwidth, Long Range S2

99 % Bandwidth

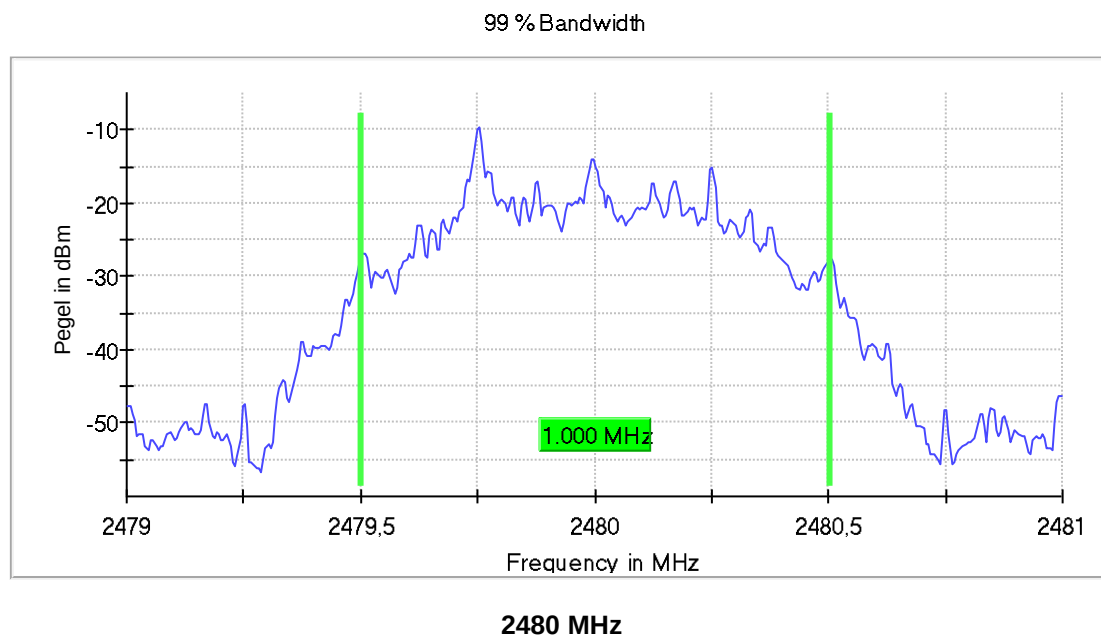


2402 MHz

99 % Bandwidth



2440 MHz

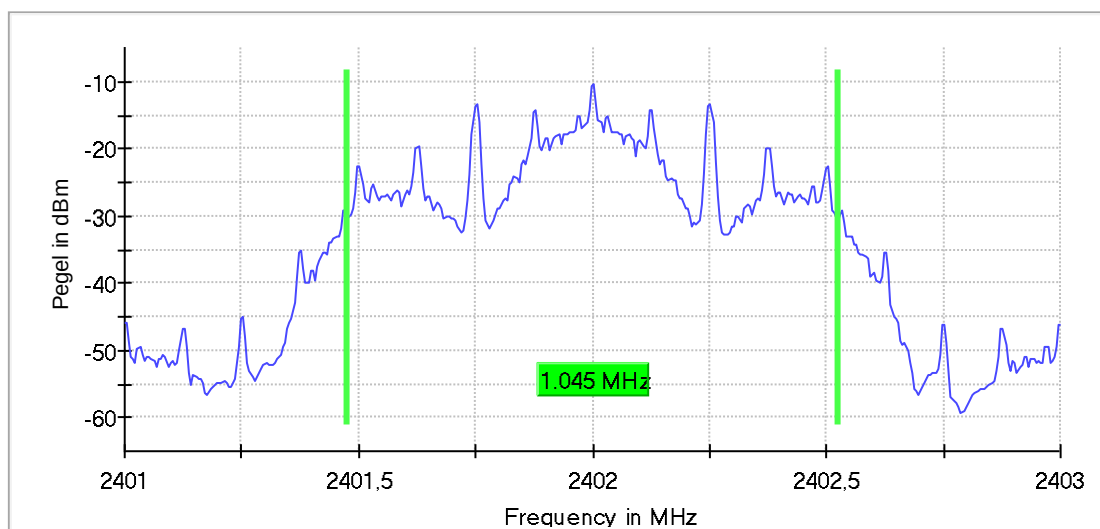




Mode	Frequency Channel	99% Bandwidth	Band Edge Left	Band Edge Right
Long Range S8	2402 MHz	1.045000 MHz	2401.477500 MHz	2402.522500 MHz
Long Range S8	2440 MHz	1.045000 MHz	2439.477500 MHz	2440.522500 MHz
Long Range S8	2480 MHz	1.050000 MHz	2479.477500 MHz	2480.527500 MHz

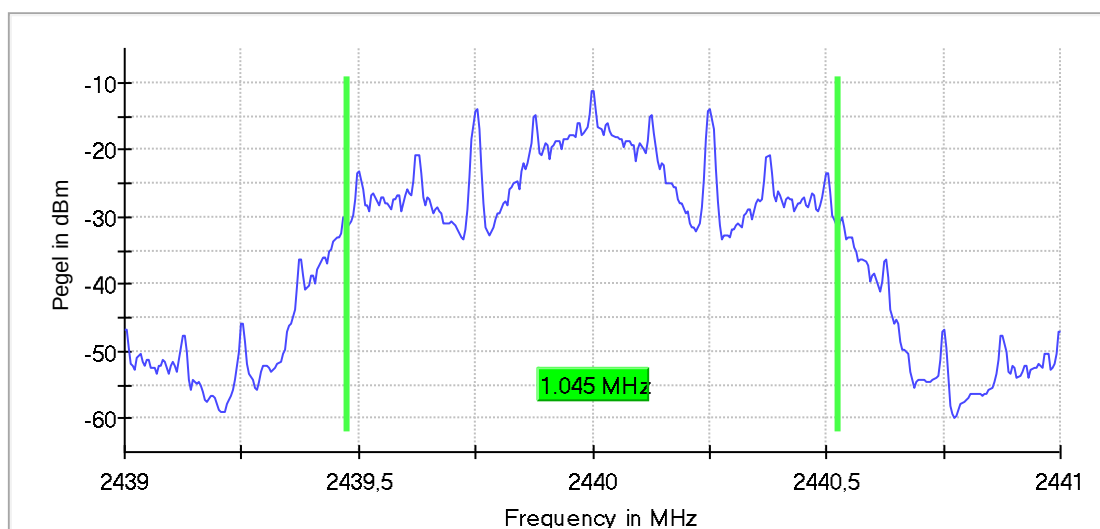
Table 12: 99% bandwidth, Long Range S8

99 % Bandwidth

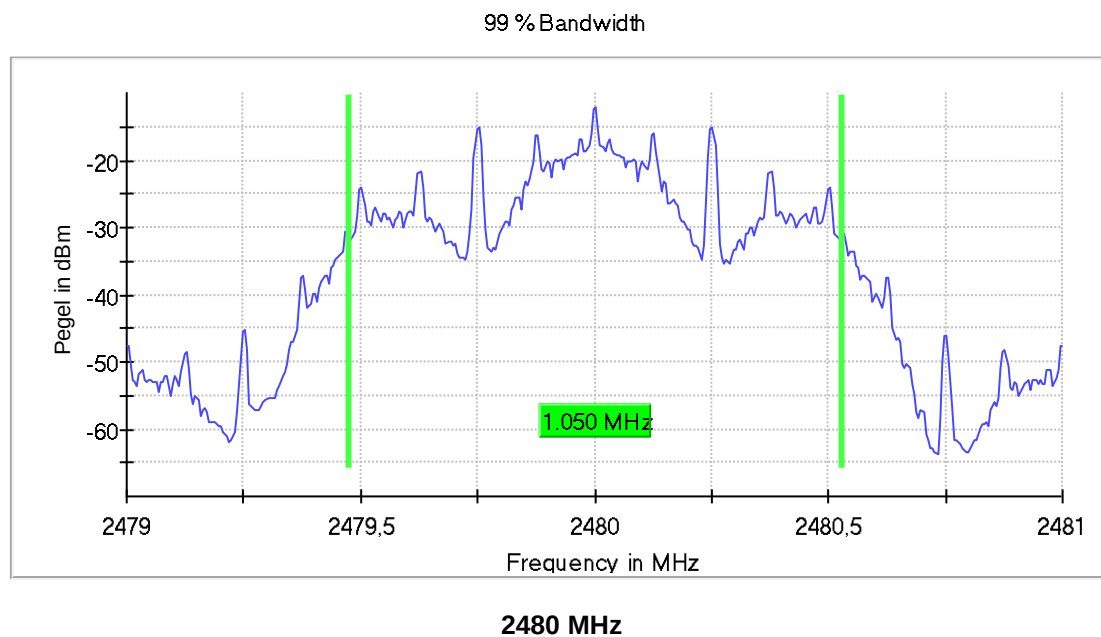


2402 MHz

99 % Bandwidth



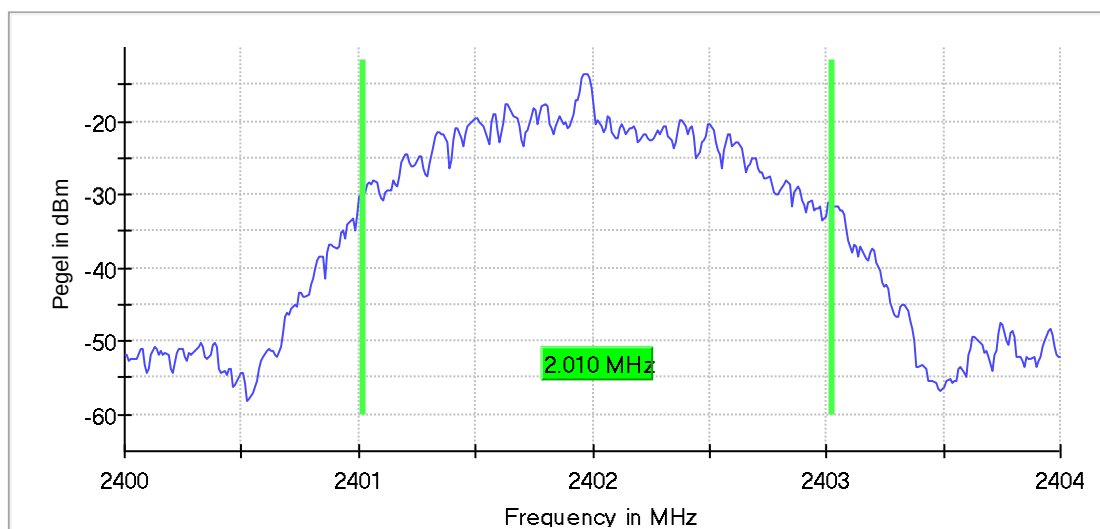
2440 MHz



Mode	Frequency Channel	99% Bandwidth	Band Edge Left	Band Edge Right
2 Mbps	2402 MHz	2.01000 MHz	2401.015000 MHz	2403.025000 MHz
2 Mbps	2440 MHz	2.01000 MHz	2439.015000 MHz	2441.025000 MHz
2 Mbps	2480 MHz	1.900000 MHz	2479.055000 MHz	2480.955000 MHz

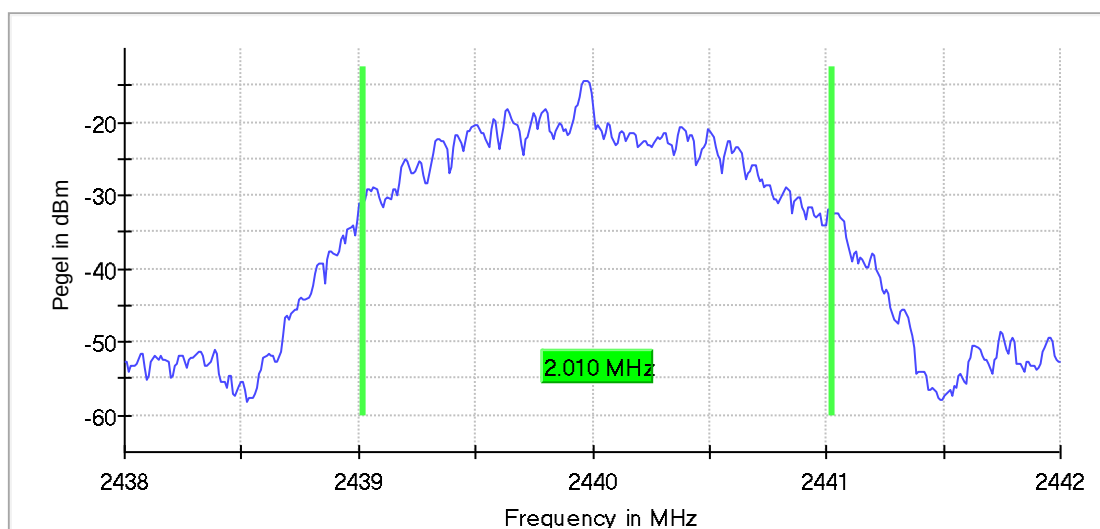
Table 13: 99% bandwidth, 2 Mbps

99 % Bandwidth

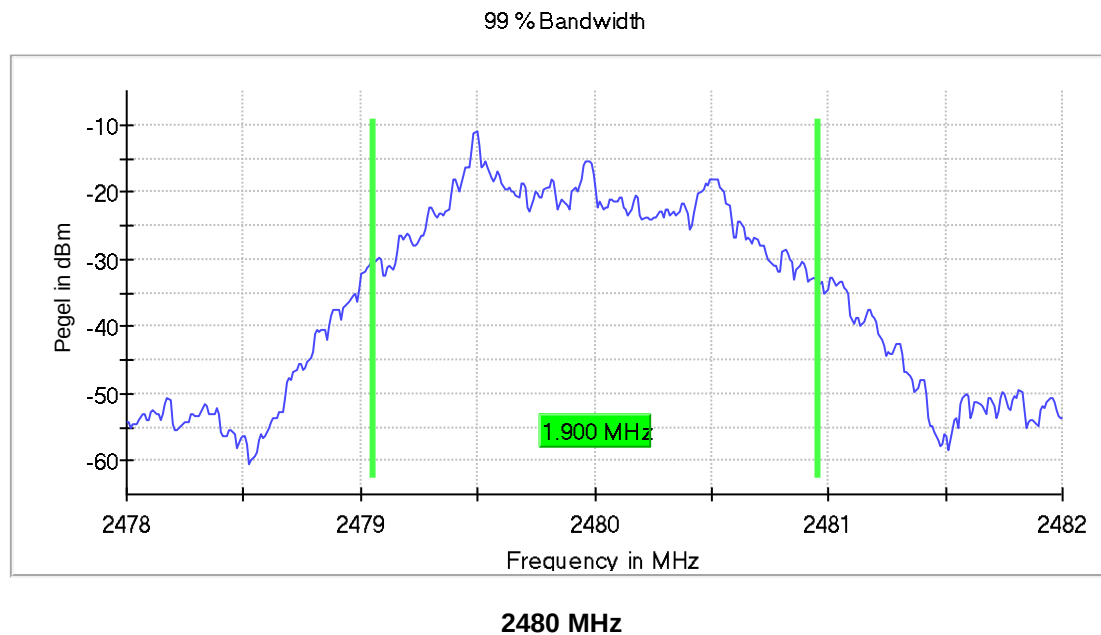


2402 MHz

99 % Bandwidth



2440 MHz



2.2.8 Test Location and Test Equipment

The test was carried out in Radio Test Laboratory

Instrument	Manufacturer	Type No	TE No	Calibra- tion Pe- riod (months)	Calibration Due
Switching device	Rohde & Schwarz	OSP120 for TS8997	20248	36	2026-07-31
Signal and spectrum analysator	Rohde & Schwarz	FS40	20219	24	2026-03-31
EMC measurement software	Rohde & Schwarz	EMC32 TS8997 – V10.60.00	44381	---	---

Table 14



2.3 Output Power

2.3.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.247(b)(3)
ISED RSS-247, Clause 5.4 d.

2.3.2 Equipment under Test and Modification State

UK1; S/N 2624000072726007; Modification state 0

2.3.3 Date of Test

2024-10-23

2.3.4 Environmental Conditions

Ambient Temperature	23 °C
Relative Humidity	52 %

2.3.5 Specification Limits

The maximum conducted output power shall not exceed 1 W (30 dBm).
The e.i.r.p. shall not exceed 4 W (36 dBm).

2.3.6 Test Method

The test was performed according to ANSI C63.10, section 11.9

The test was performed using an automated software (EMC32) with the following settings:

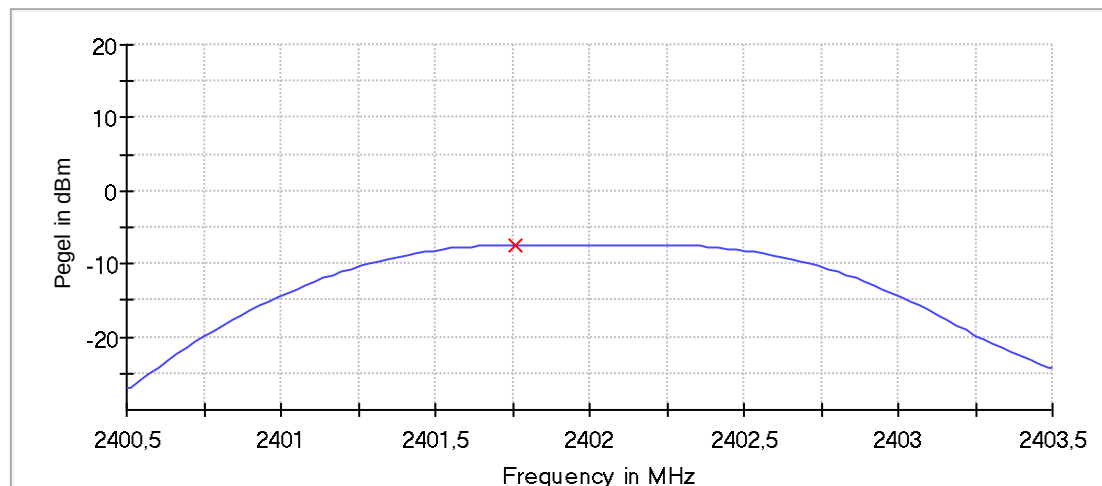
Mode:	1 Mps	Long Range S2	Long Range S8	2 Mps
Resolution Bandwidth:	1 MHz	1 MHz	1 MHz	2 MHz
Video Bandwidth:	3 MHz	3 MHz	3 MHz	10 MHz
Detector:	Positive peak	Positive peak	Positive peak	Positive peak

2.3.7 Test Results

Mode	Frequency Channel	Detector	Conducted Output Power	Limit
1 Mbps	2402 MHz	PK	-7.4 dBm	≤ 30.0 dBm
1 Mbps	2440 MHz	PK	-8.0 dBm	≤ 30.0 dBm
1 Mbps	2480 MHz	PK	-9.1 dBm	≤ 30.0 dBm

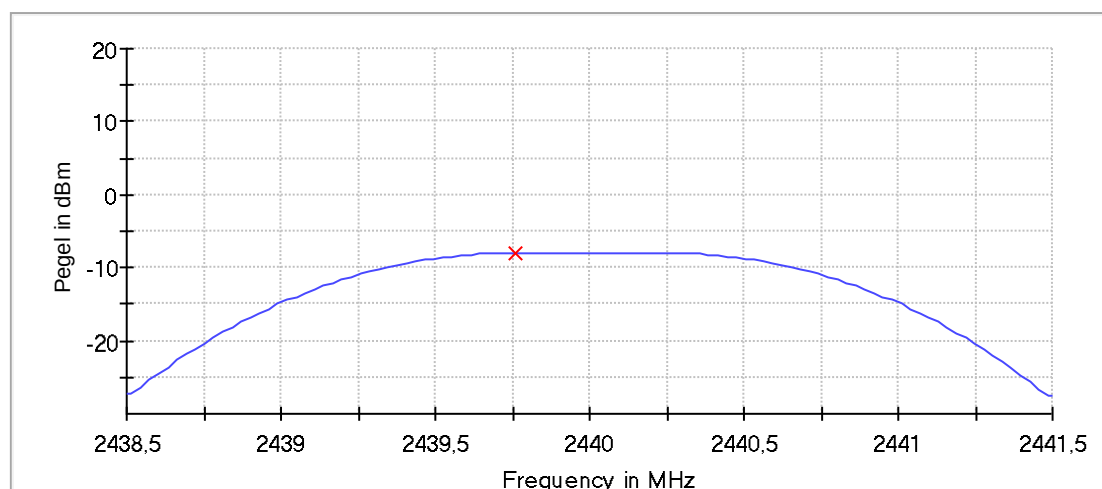
Table 15: Conducted Output Power; 1 Mbps

Peak Power



2402 MHz

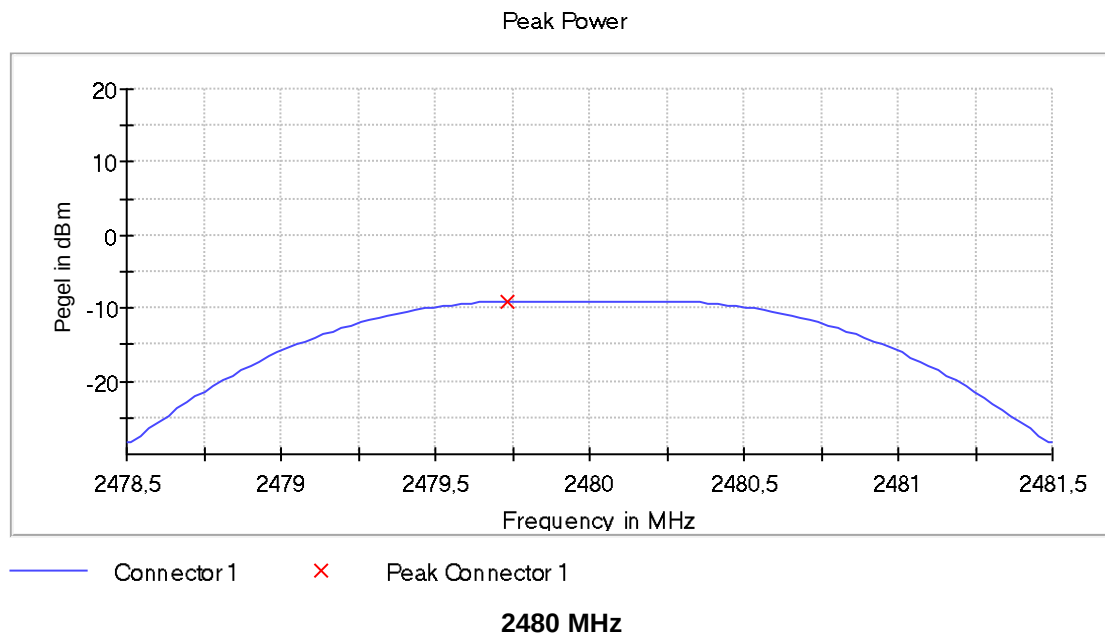
Peak Power



2440 MHz



Product Service

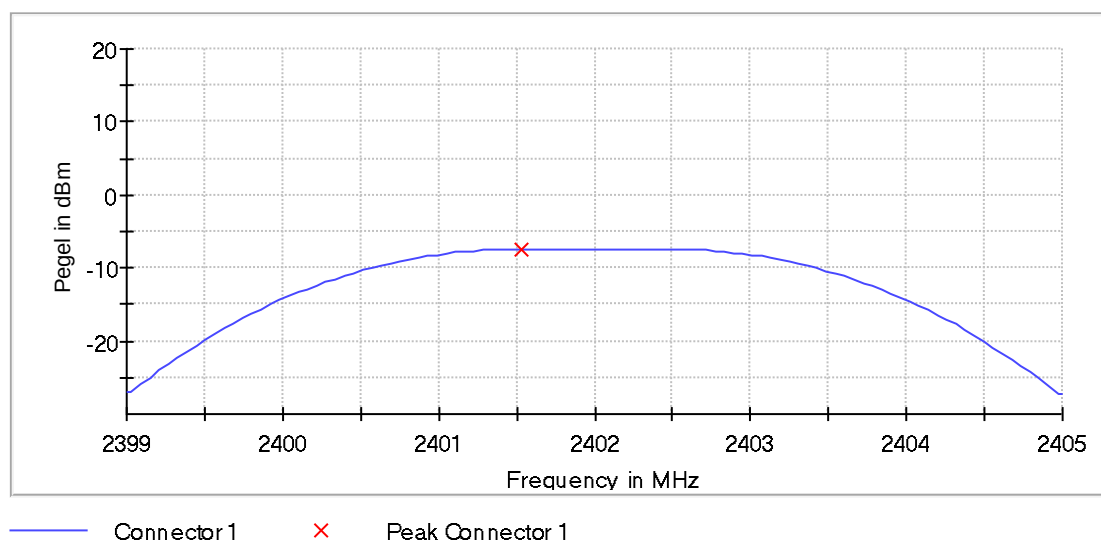




Mode	Frequency Channel	Detector	Conducted Output Power	Limit
Long Range S2	2402 MHz	PK	-7.4 dBm	≤ 30.0 dBm
Long Range S2	2440 MHz	PK	-8.0 dBm	≤ 30.0 dBm
Long Range S2	2480 MHz	PK	-9.1 dBm	≤ 30.0 dBm

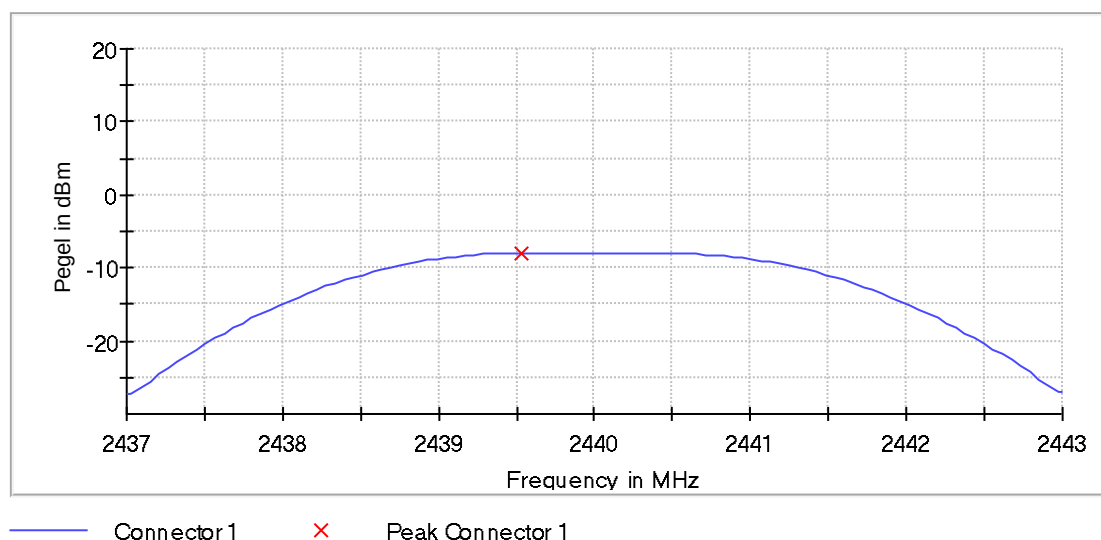
Table 16: Conducted Output Power; Long Range S2

Peak Power



2402 MHz

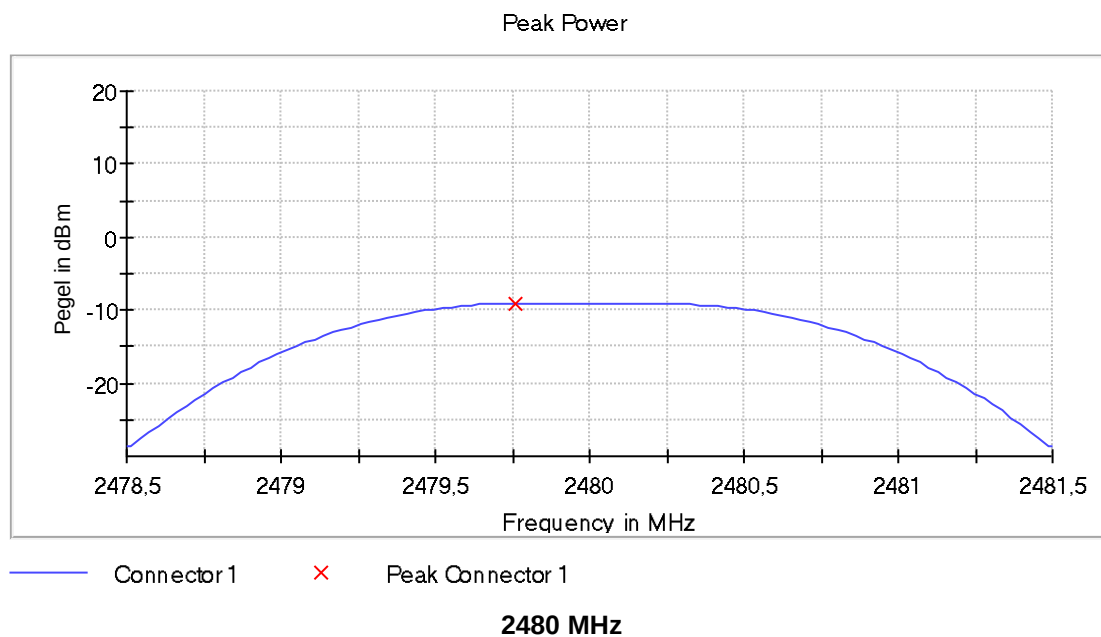
Peak Power



2440 MHz



Product Service

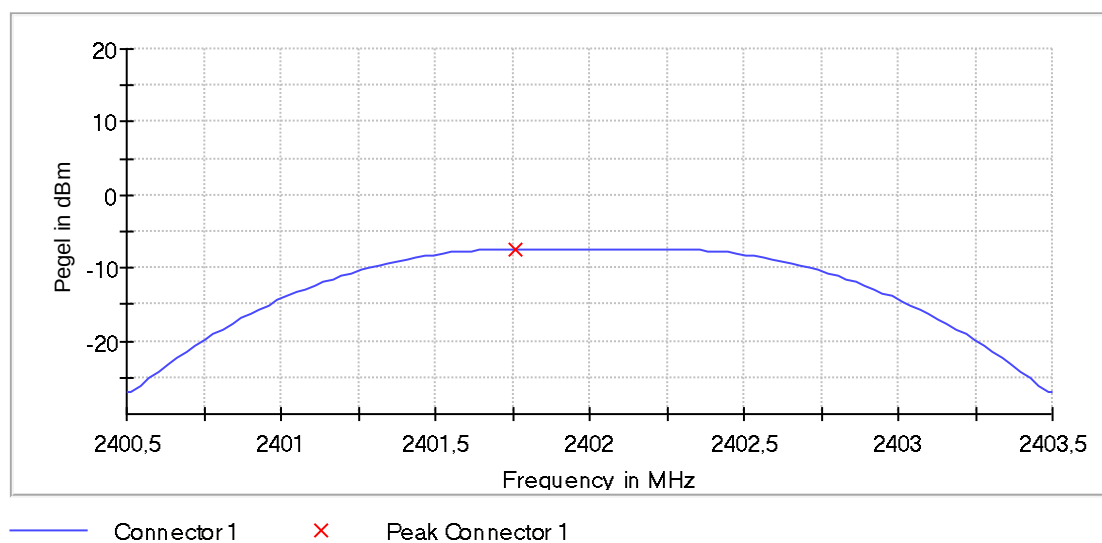




Mode	Frequency Channel	Detector	Conducted Output Power	Limit
Long Range S8	2402 MHz	PK	-7.4 dBm	≤ 30.0 dBm
Long Range S8	2440 MHz	PK	-8.0 dBm	≤ 30.0 dBm
Long Range S8	2480 MHz	PK	-9.1 dBm	≤ 30.0 dBm

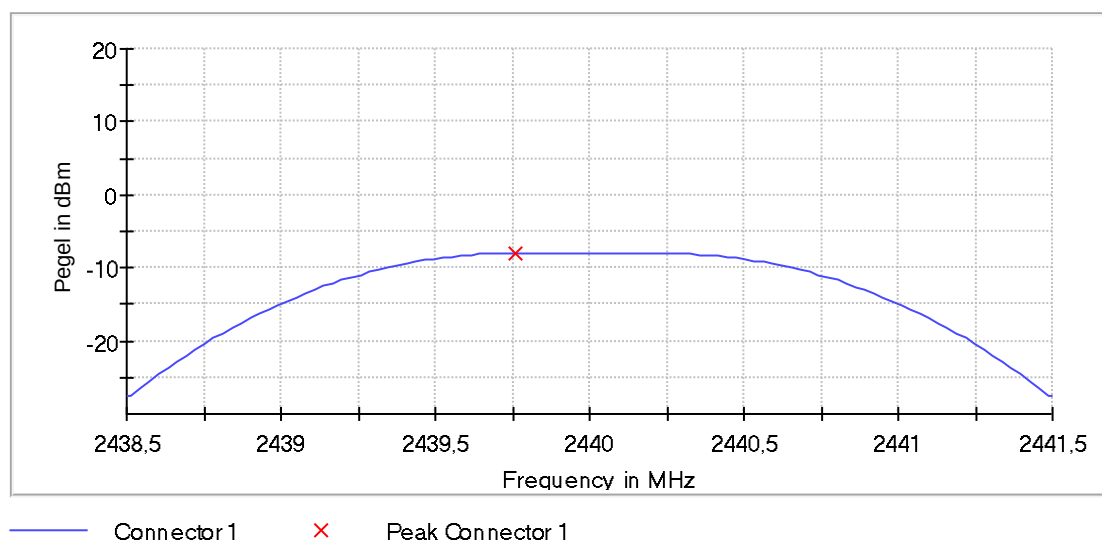
Table 17: Conducted Output Power; Long Range S8

Peak Power



2402 MHz

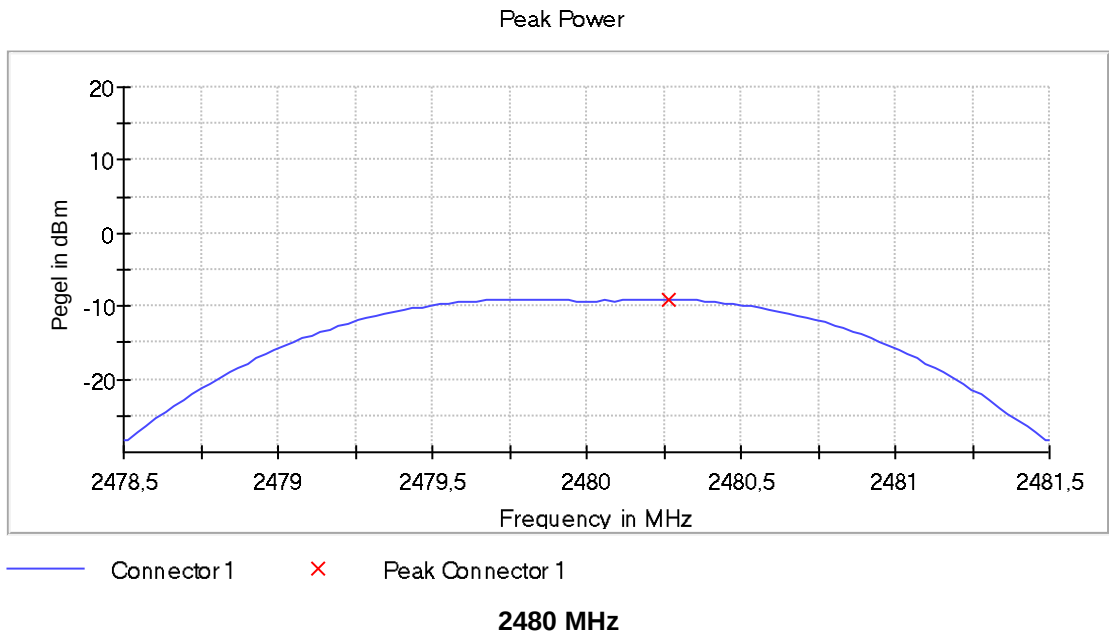
Peak Power



2440 MHz



Product Service

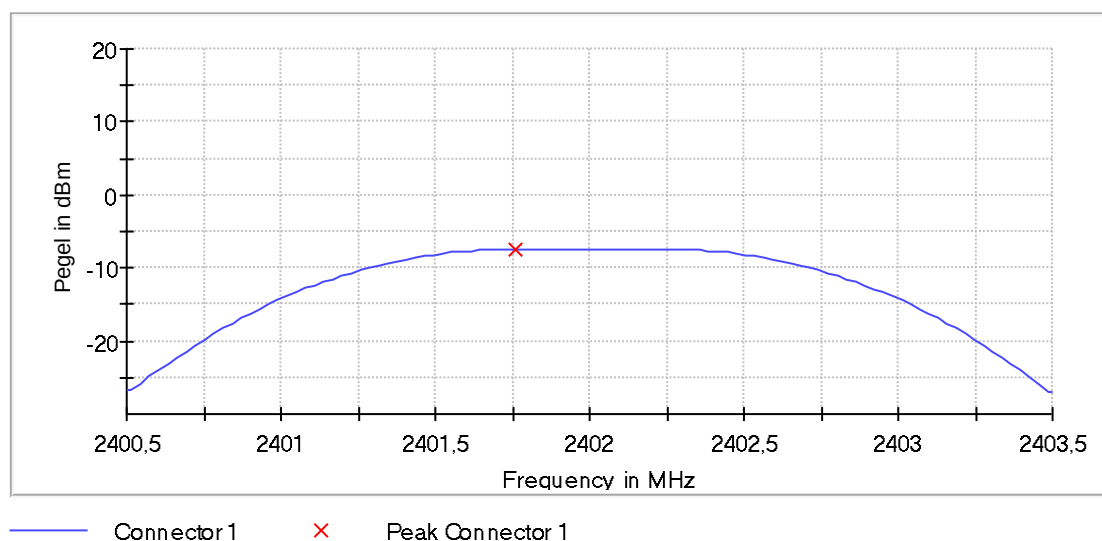




Mode	Frequency Channel	Detector	Conducted Output Power	Limit
2 Mbps	2402 MHz	PK	-7.4 dBm	≤ 30.0 dBm
2 Mbps	2440 MHz	PK	-8.0 dBm	≤ 30.0 dBm
2 Mbps	2480 MHz	PK	-9.1 dBm	≤ 30.0 dBm

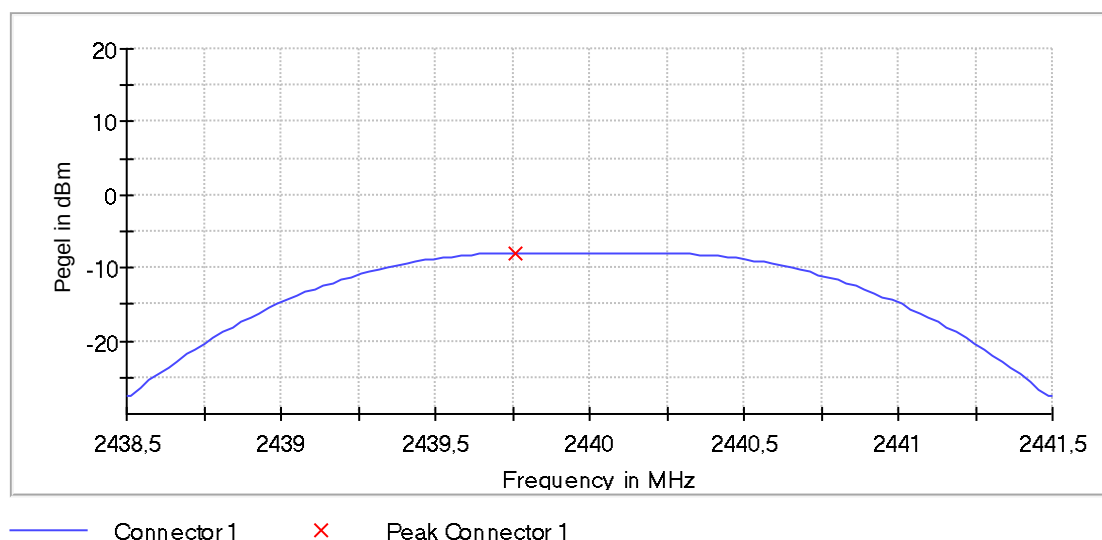
Table 18: Conducted Output Power; 2 Mbps

Peak Power

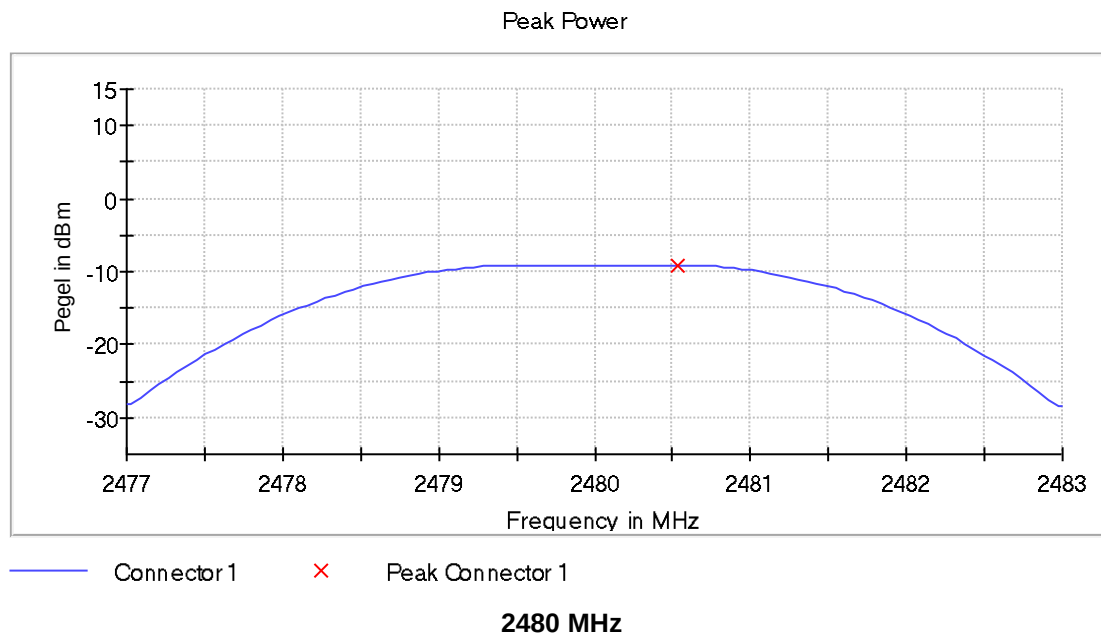


2402 MHz

Peak Power



2440 MHz



2.3.8 Test Location and Test Equipment

The test was carried out in Radio Test Laboratory

<i>Instrument</i>	<i>Manufacturer</i>	<i>Type No</i>	<i>TE No</i>	<i>Calibra- tion Pe- riod (months)</i>	<i>Calibration Due</i>
Switching device	Rohde & Schwarz	OSP120 for TS8997	20248	36	2026-07-31
Signal and spectrum analysator	Rohde & Schwarz	FS40	20219	24	2026-03-31
EMC measurement software	Rohde & Schwarz	EMC32 TS8997 – V10.60.00	44381	---	---

Table 19



2.4 Power Spectral Density

2.4.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.247(e)
ISED RSS-247, Clause 5.2 b.

2.4.2 Equipment under Test and Modification State

UK1; S/N 2624000072726007; Modification state 0

2.4.3 Date of Test

2024-10-23

2.4.4 Environmental Conditions

Ambient Temperature	23 °C
Relative Humidity	52 %

2.4.5 Specification Limits

FCC 47 CFR, section 15.257(e)
ISED RSS-247, Clause 5.2.(b)

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

The same method (detector) of determining the conducted output power shall be used to determine the power spectral density.

2.4.6 Test Method

The test was performed according to ANSI C63.10, section 11.10

The test was performed using an automated software (EMC32) with the following settings:

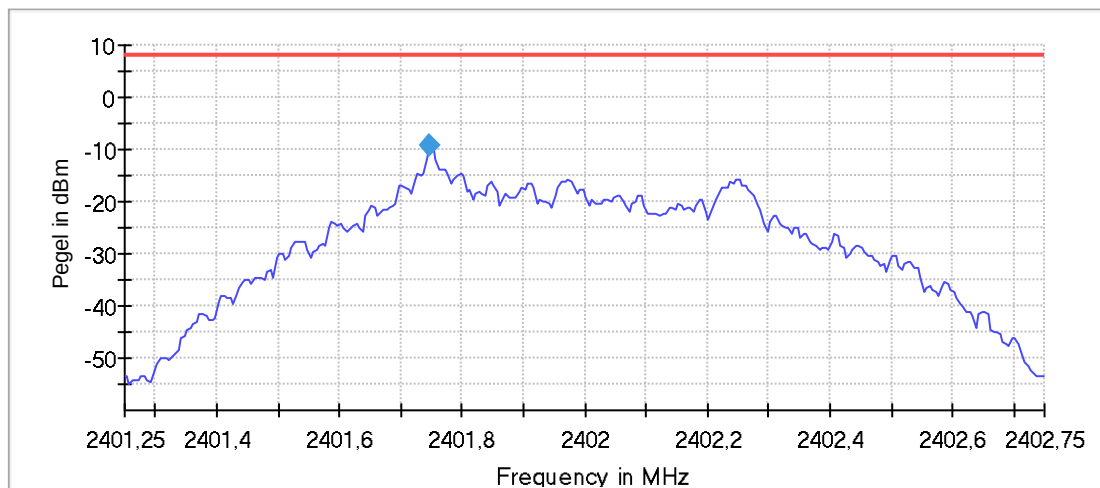
Resolution Bandwidth:	10 kHz
Video Bandwidth:	30 kHz
Detector:	Positive peak

2.4.7 Test Results

Mode	Frequency Channel	Detector	Spectral Power Density	Limit
1 Mbps	2402 MHz	PK	-9.124 dBm	≤ 8.0 dBm
1 Mbps	2440 MHz	PK	-9.752 dBm	≤ 8.0 dBm
1 Mbps	2480 MHz	PK	-10.813 dBm	≤ 8.0 dBm

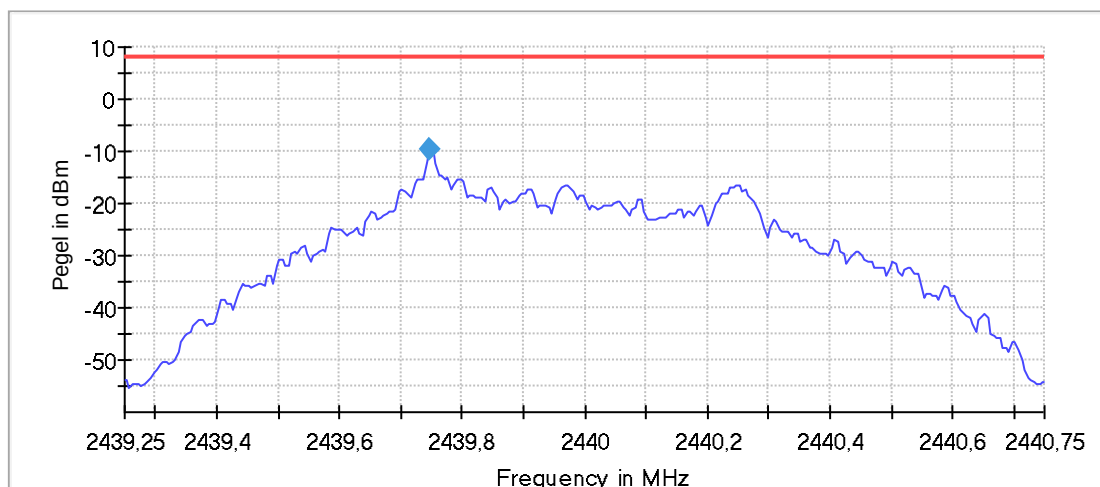
Table 20: Spectral Power Density, 1 Mbps

Peak Power Spectral Density



— Limit — Sum Level ◆ PSD
2402 MHz

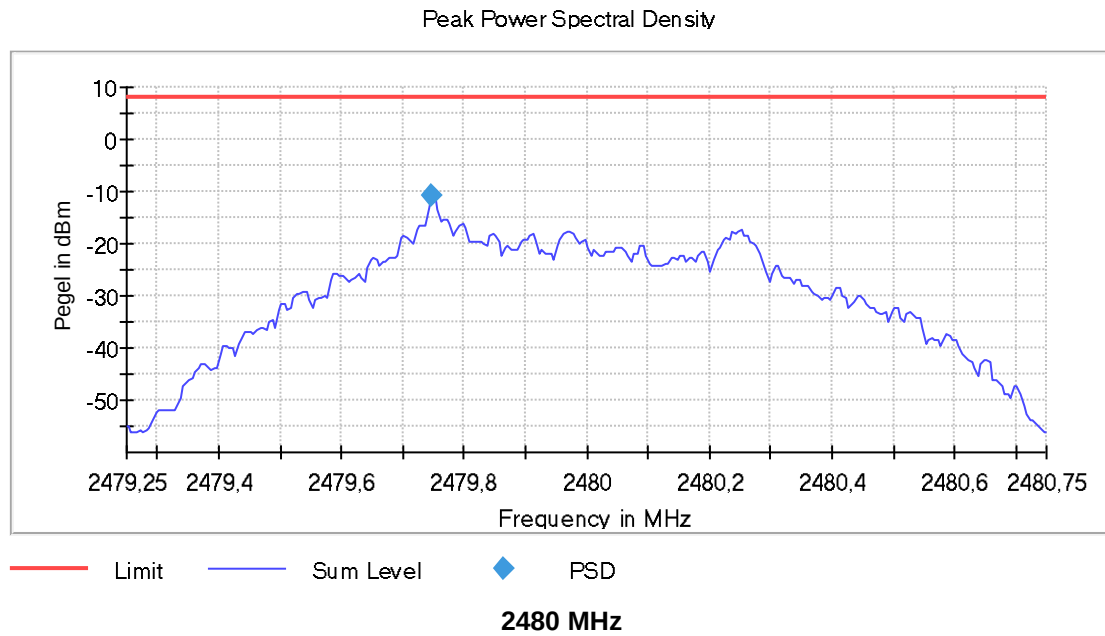
Peak Power Spectral Density



— Limit — Sum Level ◆ PSD
2440 MHz



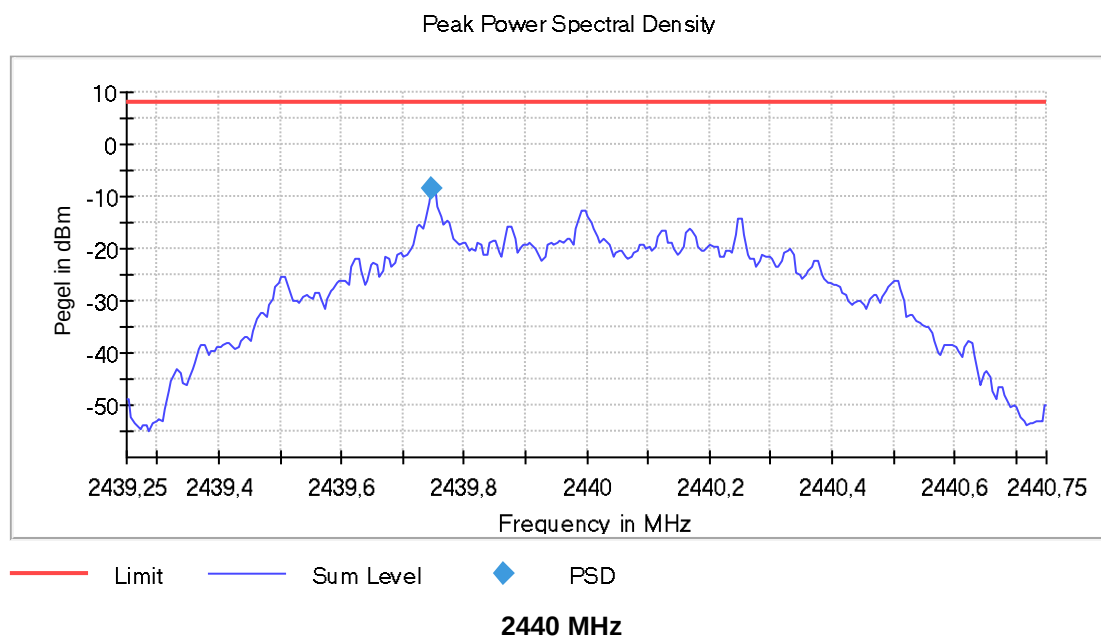
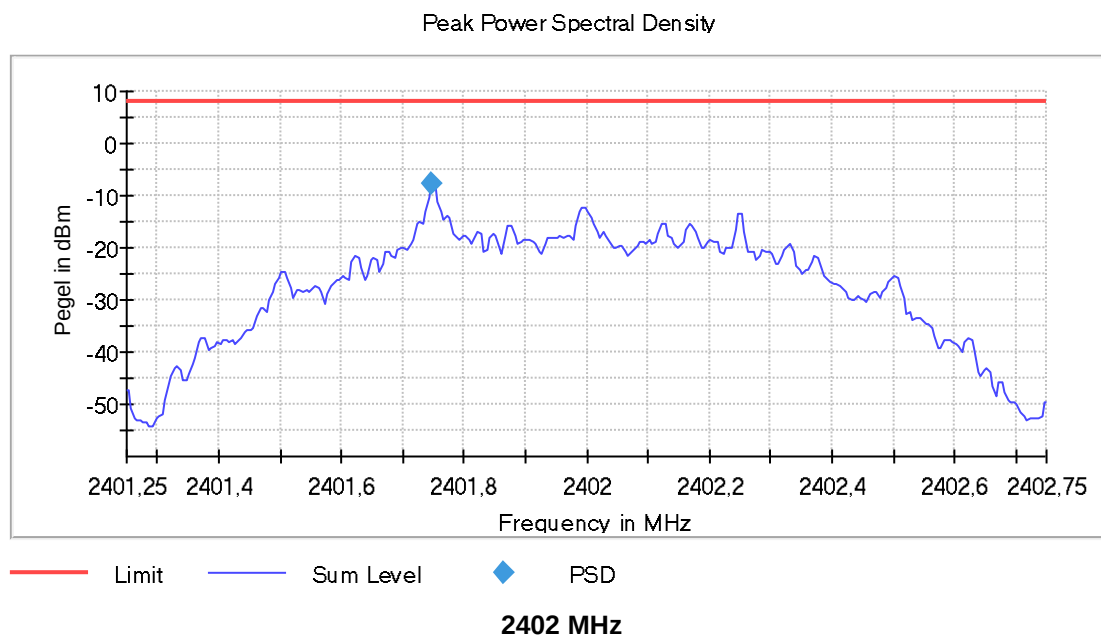
Product Service

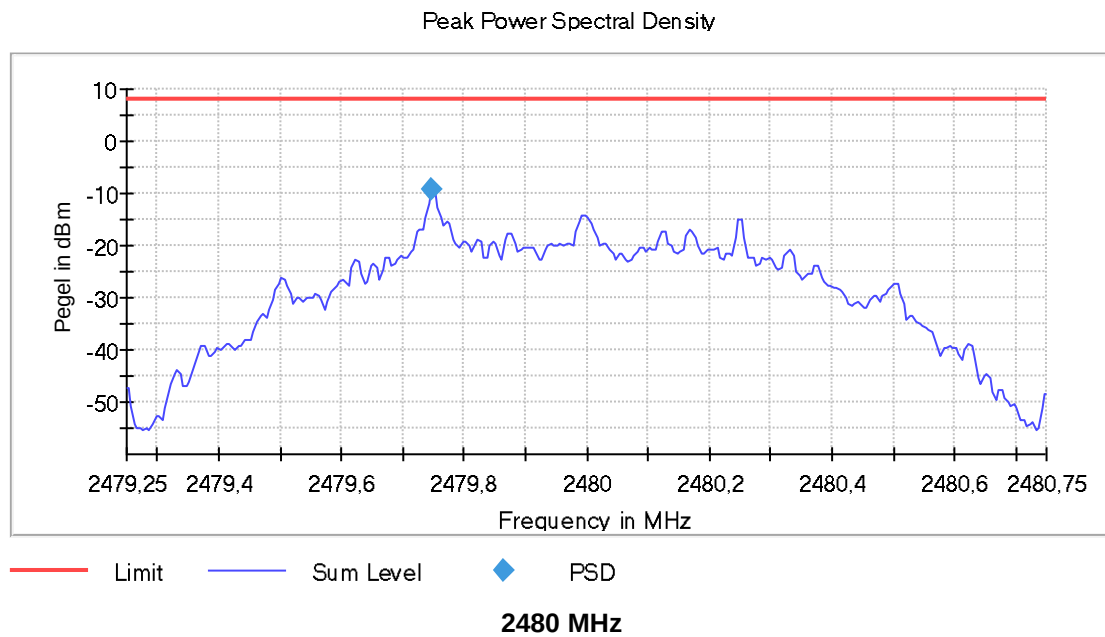




Mode	Frequency Channel	Detector	Spectral Power Density	Limit
Long Range S2	2402 MHz	PK	-7.616 dBm	≤ 8.0 dBm
Long Range S2	2440 MHz	PK	-8.297 dBm	≤ 8.0 dBm
Long Range S2	2480 MHz	PK	-9.383 dBm	≤ 8.0 dBm

Table 21: Spectral Power Density, Long Range S2



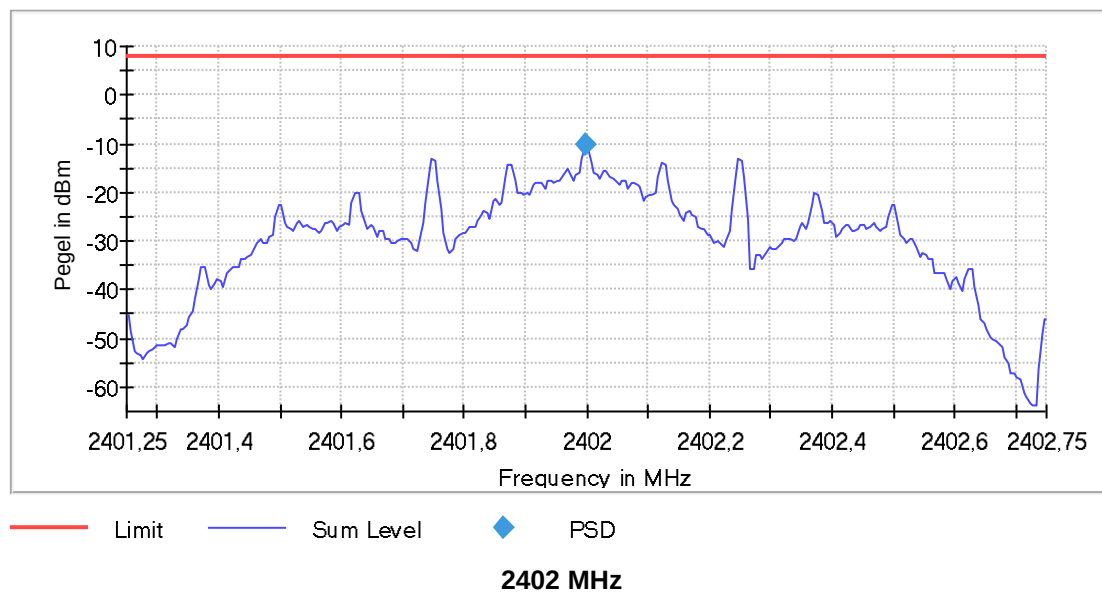




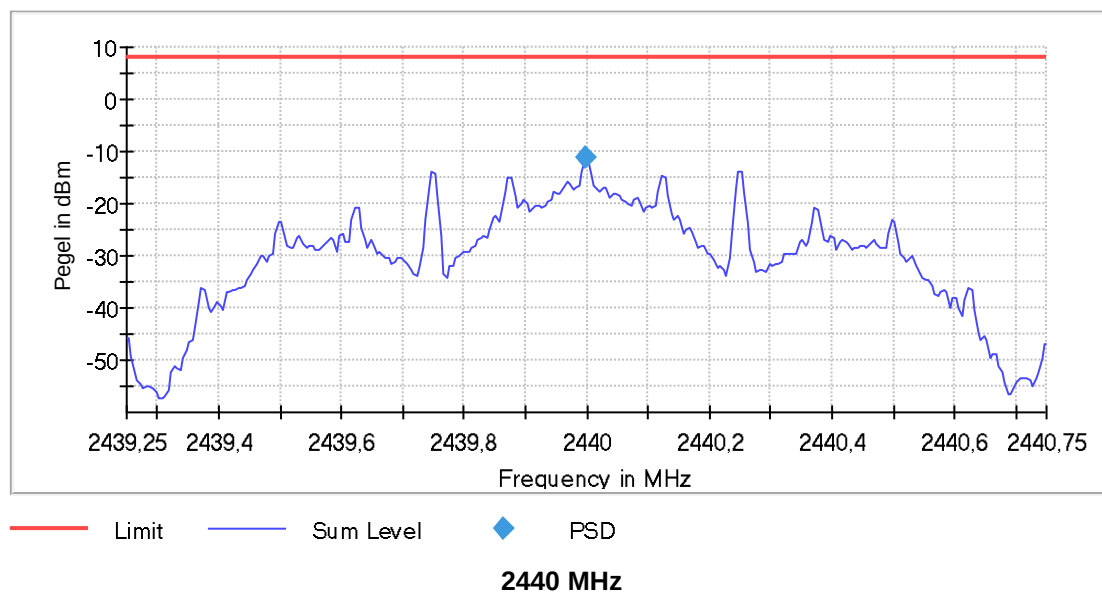
Mode	Frequency Channel	Detector	Spectral Power Density	Limit
Long Range S8	2402 MHz	PK	-10.306 dBm	≤ 8.0 dBm
Long Range S8	2440 MHz	PK	-11.056 dBm	≤ 8.0 dBm
Long Range S8	2480 MHz	PK	-12.112 dBm	≤ 8.0 dBm

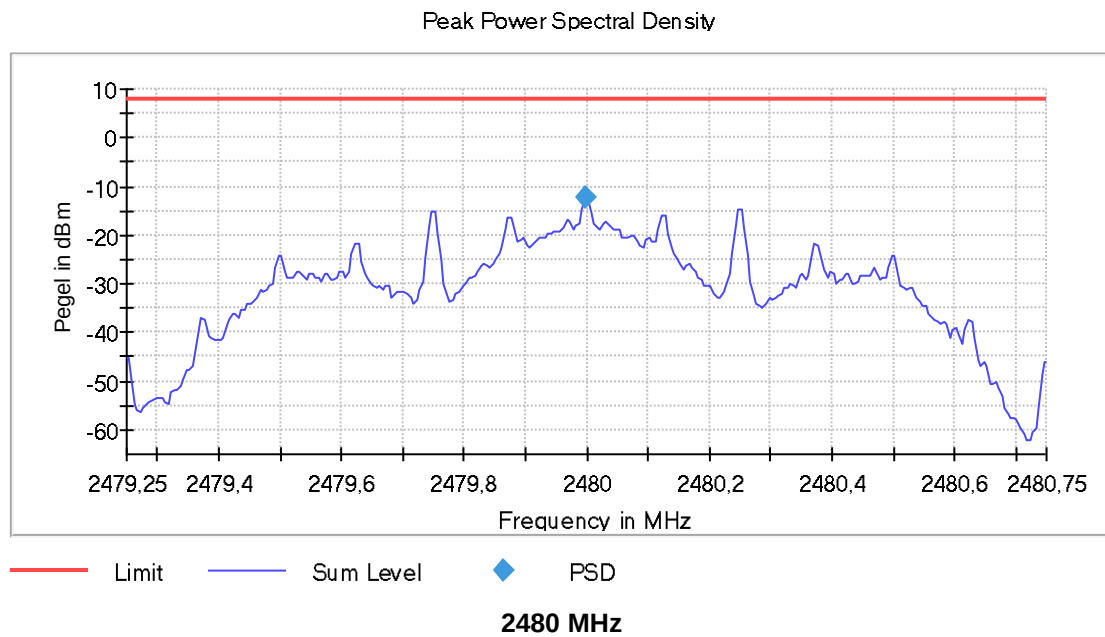
Table 22: Spectral Power Density, Long Range S8

Peak Power Spectral Density



Peak Power Spectral Density



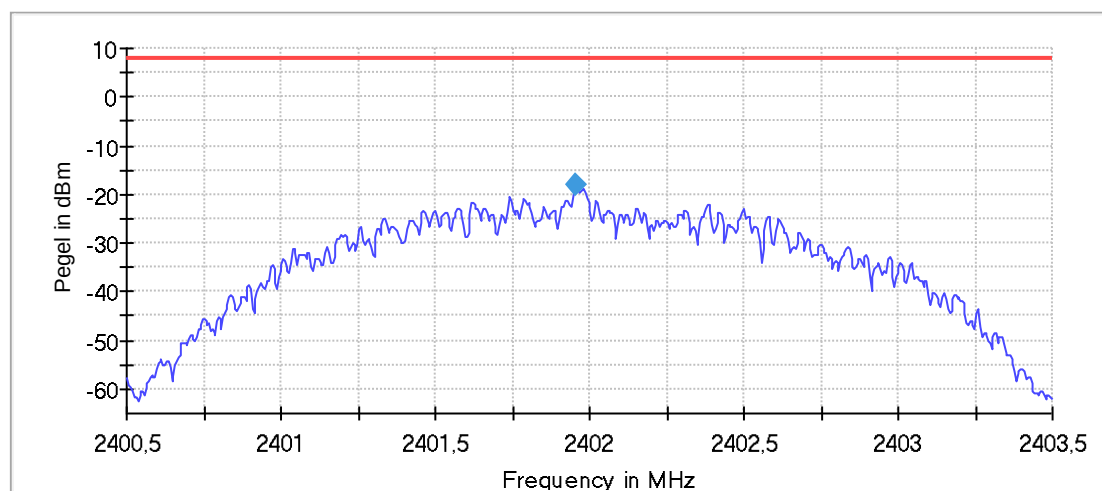




Mode	Frequency Channel	Detector	Spectral Power Density	Limit
2 Mbps	2402 MHz	PK	-17.961 dBm	≤ 8.0 dBm
2 Mbps	2440 MHz	PK	-18.667 dBm	≤ 8.0 dBm
2 Mbps	2480 MHz	PK	-19.634 dBm	≤ 8.0 dBm

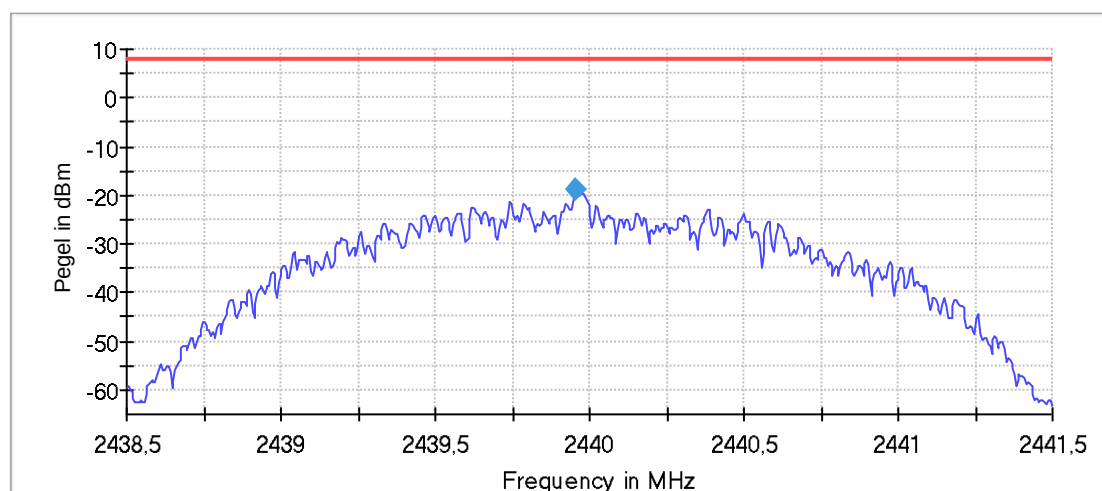
Table 23: Spectral Power Density, 2 Mbps

Peak Power Spectral Density

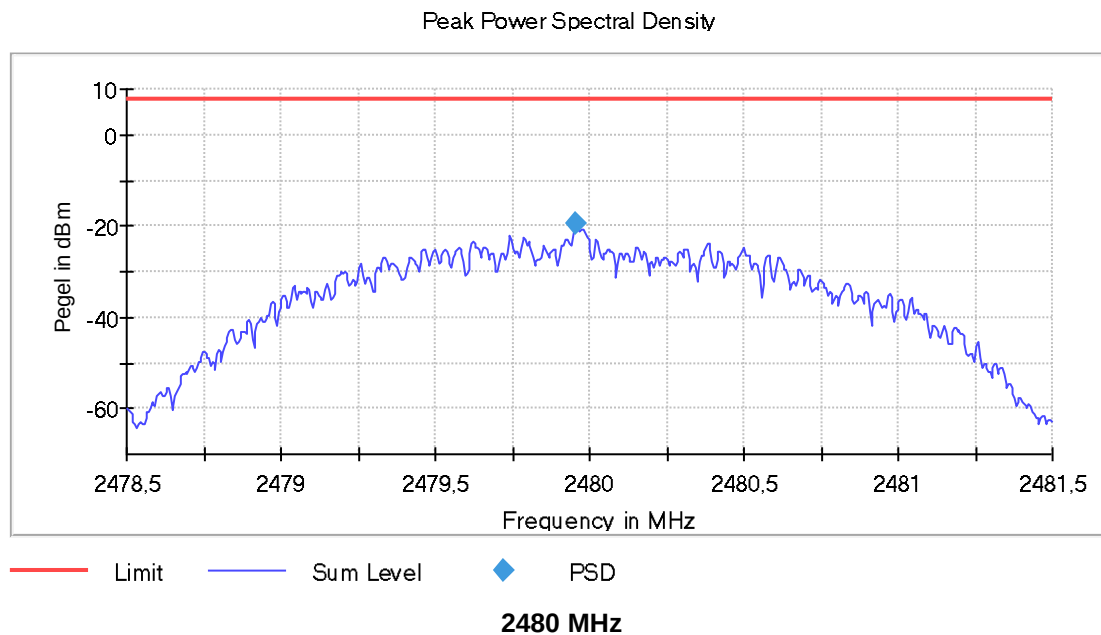


— Limit — Sum Level ◆ PSD
2402 MHz

Peak Power Spectral Density



— Limit — Sum Level ◆ PSD
2440 MHz



2.4.8 Test Location and Test Equipment

The test was carried out in Radio Test Laboratory

<i>Instrument</i>	<i>Manufacturer</i>	<i>Type No</i>	<i>TE No</i>	<i>Calibration Period (months)</i>	<i>Calibration Due</i>
Switching device	Rohde & Schwarz	OSP120 for TS8997	20248	36	2026-07-31
Signal and spectrum analysator	Rohde & Schwarz	FS40	20219	24	2026-03-31
EMC measurement software	Rohde & Schwarz	EMC32 TS8997 – V10.60.00	44381	---	---

Table 24



2.5 Frequency Band Edge

2.5.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.247(d)
ISED RSS-247, Clause 5.5

2.5.2 Equipment under Test and Modification State

UK1; S/N 2624000072726007; Modification state 0

2.5.3 Date of Test

2024-10-23

2.5.4 Environmental Conditions

Ambient Temperature	23 °C
Relative Humidity	52 %

2.5.5 Specification Limits

In any 100 kHz bandwidth outside the frequency band in which the device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either conducted or radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits is not required.

In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.



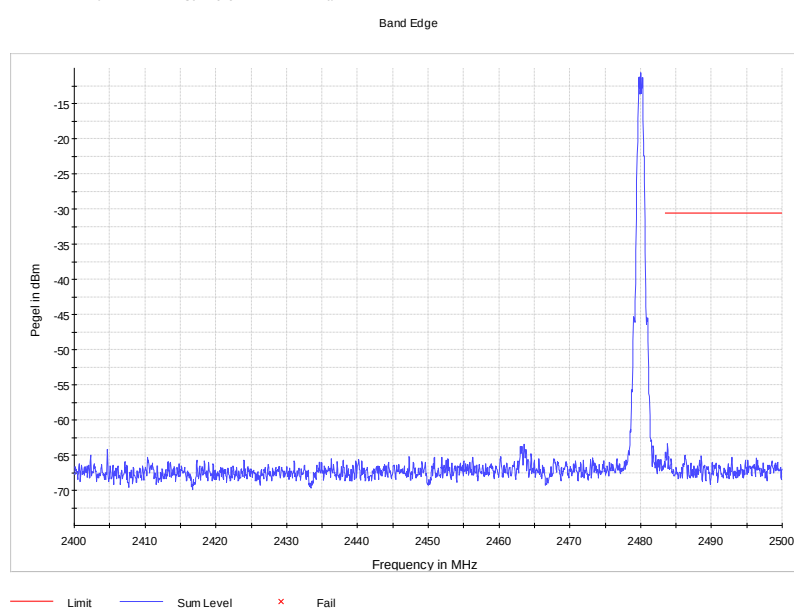
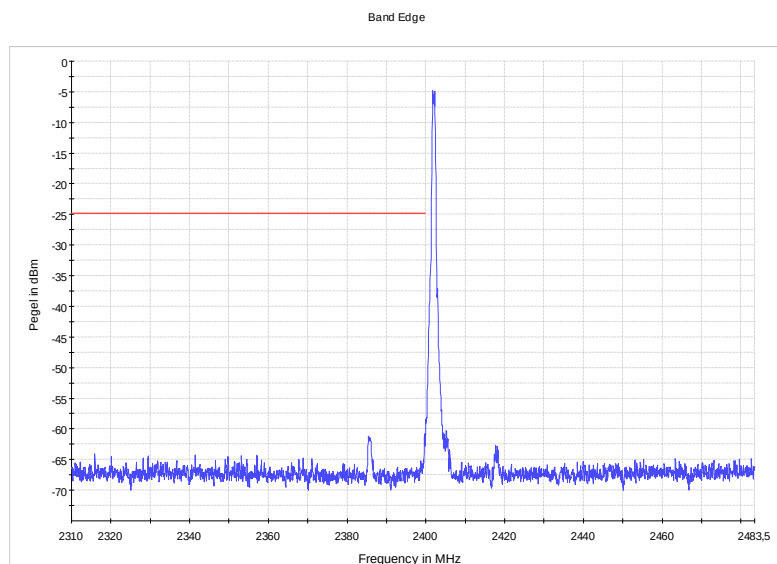
2.5.6 Test Method

The test was performed according to ANSI C63.10, sections 11.11

The test was performed using an automated software (EMC32) with the following settings:

Resolution Bandwidth: 100 kHz
Video Bandwidth: 300 kHz
Detector: Positive peak

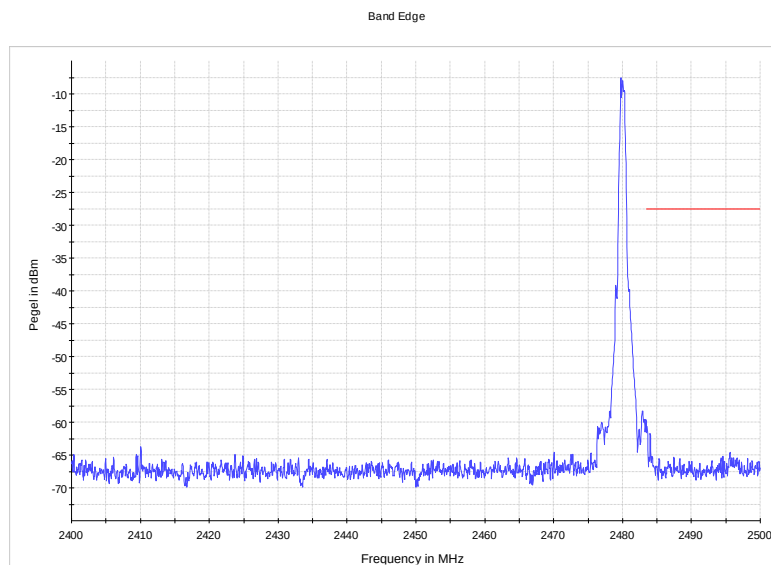
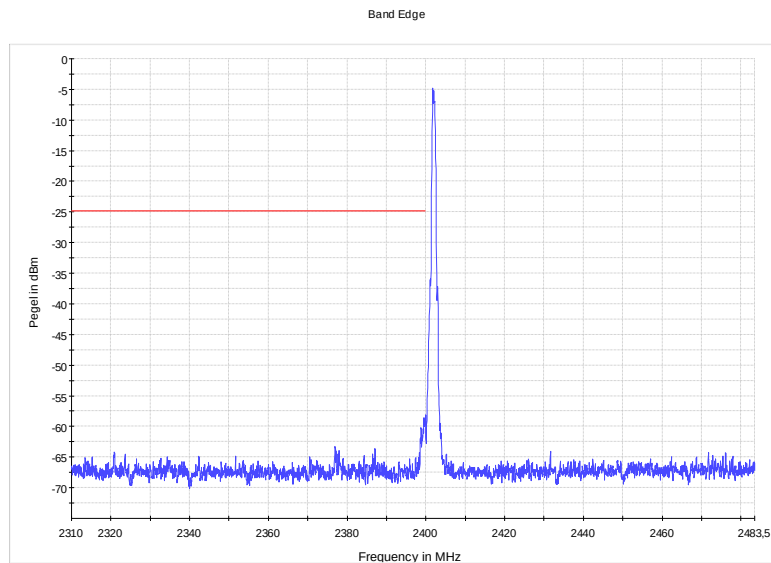
2.5.7 Test Results



1 Mbps



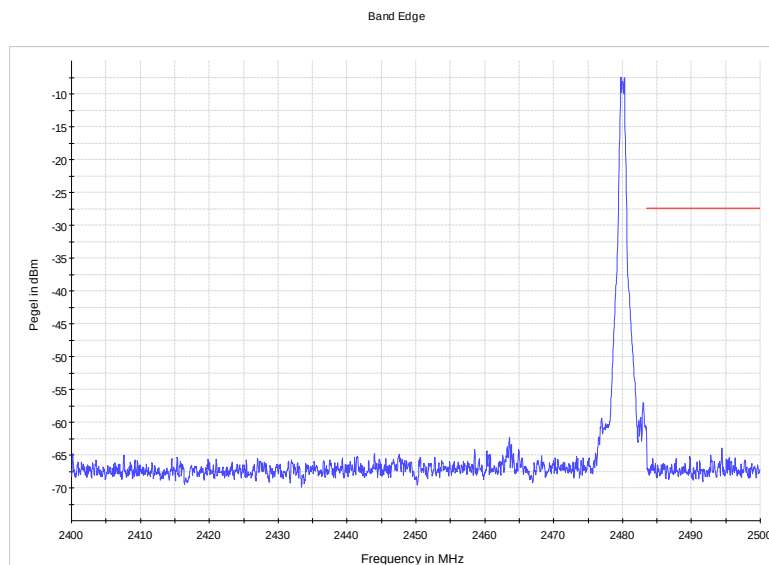
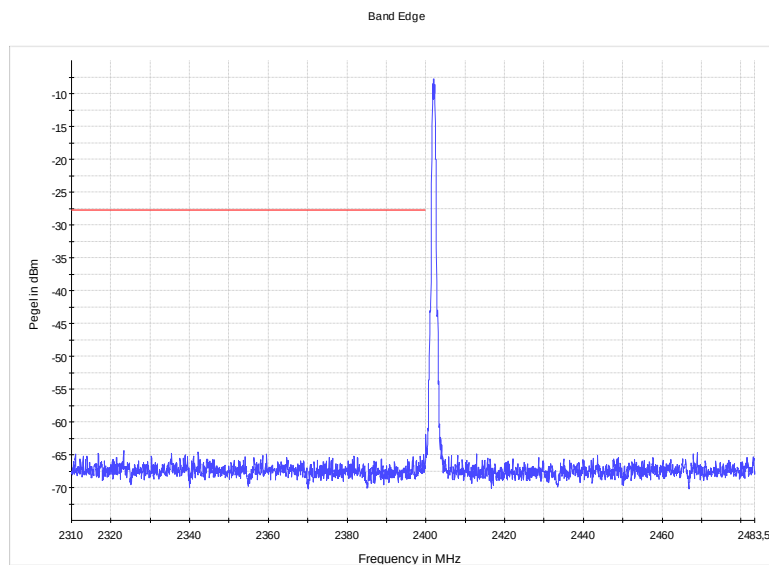
Product Service



Long Range S2



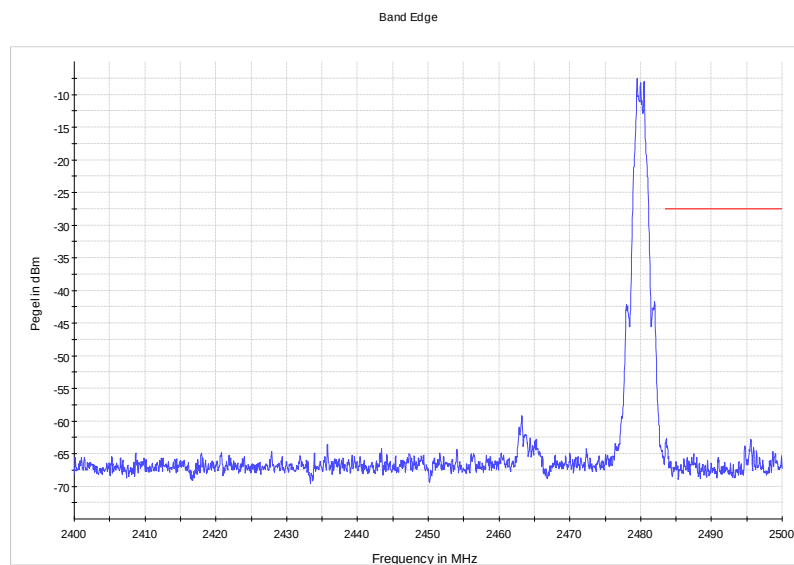
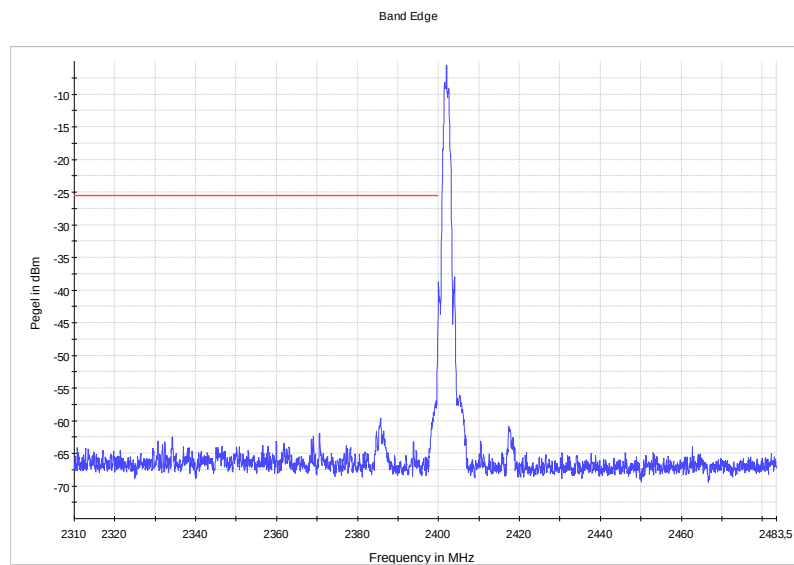
Product Service



Long Range S8



Product Service



2 Mbps



2.5.8 Test Location and Test Equipment

The test was carried out in Radio Test Laboratory

<i>Instrument</i>	<i>Manufacturer</i>	<i>Type No</i>	<i>TE No</i>	<i>Calibra- tion Pe- riod (months)</i>	<i>Calibration Due</i>
Switching device	Rohde & Schwarz	OSP120 for TS8997	20248	36	2026-07-31
Signal and spectrum analysator	Rohde & Schwarz	FS40	20219	24	2026-03-31
EMC measurement software	Rohde & Schwarz	EMC32 TS8997 – V10.60.00	44381	---	---

Table 25



2.6 Spurious emissions

2.6.1 Specification Reference

FCC 47 CFR Part 15 C, Clause 15.205, 15.209, 15.247(d)
ISED RSS-247, Clause 5.5
ISED RSS-Gen, Clauses 8.9 and 8.10

2.6.2 Equipment under Test and Modification State

UK1; S/N 2624000072726007; Modification state 0
UK1; S/N 2624000072726007; Modification state 0

2.6.3 Date of Test

2024-10-30, 2024-12-06 to 2024-12-09

2.6.4 Environmental Conditions

Ambient Temperature	23 °C
Relative Humidity	52 %

2.6.5 Specification Limits

In any 100 kHz bandwidth outside the frequency band in which the device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either conducted or radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits is not required.

In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.



General radiated emission limits:					
Frequency Range (MHz)	Test distance (m)	Field strength		Field strength	
		($\mu\text{A}/\text{m}$)	($\text{dB}\mu\text{A}/\text{m}$)	($\mu\text{V}/\text{m}$)	($\text{dB}\mu\text{V}/\text{m}$)
0.009 – 0.49	300	$6.37 / f$	$20*\lg(6.37 / f)$	$2400 / f$	$20*\lg(2400 / f)$
0.49 – 1.705	30	$63.7 / f$	$20*\lg(63.7 / f)$	$24000 / f$	$20*\lg(24000 / f)$
1.705 – 30	30	0.08	$20*\lg(0.08 / f)$	30	$20*\lg(30 / f)$
30 – 88	3	---	--	100	40
88 – 216	3	--	--	150	43.5
126 – 960	3	--	--	200	46
above 960	3	--	--	500	54

Note 1: f in kHz

Table 26 General radiated emission limits

At frequencies at or above 30 MHz, measurements may be performed at distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 m, unless it can be further demonstrated that measurements at a distance of 30 m or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempts should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

2.6.6 Test Method

The test was performed according to ANSI C63.10, sections 11.11 and 11.12

Prescans are performed in six positions of the EUT to get the full spectrum of emission caused by the EUT with the measuring antenna raised and lowered from 1 m to 4 m with vertical and horizontal polarisation to find the combination of table position, antenna height and antenna polarisation for the maximum emission levels.

Data reduction is applied to these results to select those levels having less margin than 10 dB or exceeding the limit using subranges and limited number of maximums.

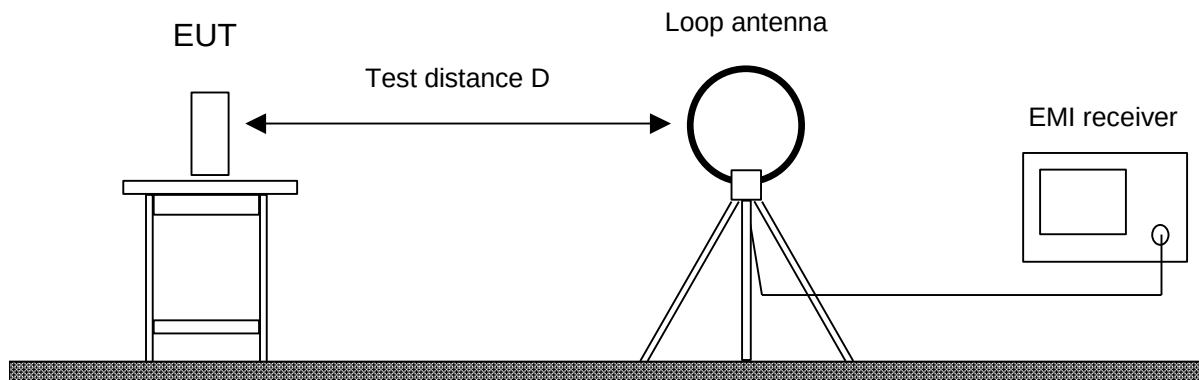
Further maximisation for adjusting the maximum position is following.

Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

The conducted test was performed using an automated software (EMC32) with the following settings:

Resolution Bandwidth:	100 kHz
Video Bandwidth:	300 kHz
Detector:	Positive peak

2.6.6.1 Frequency range 9 kHz – 30 MHz

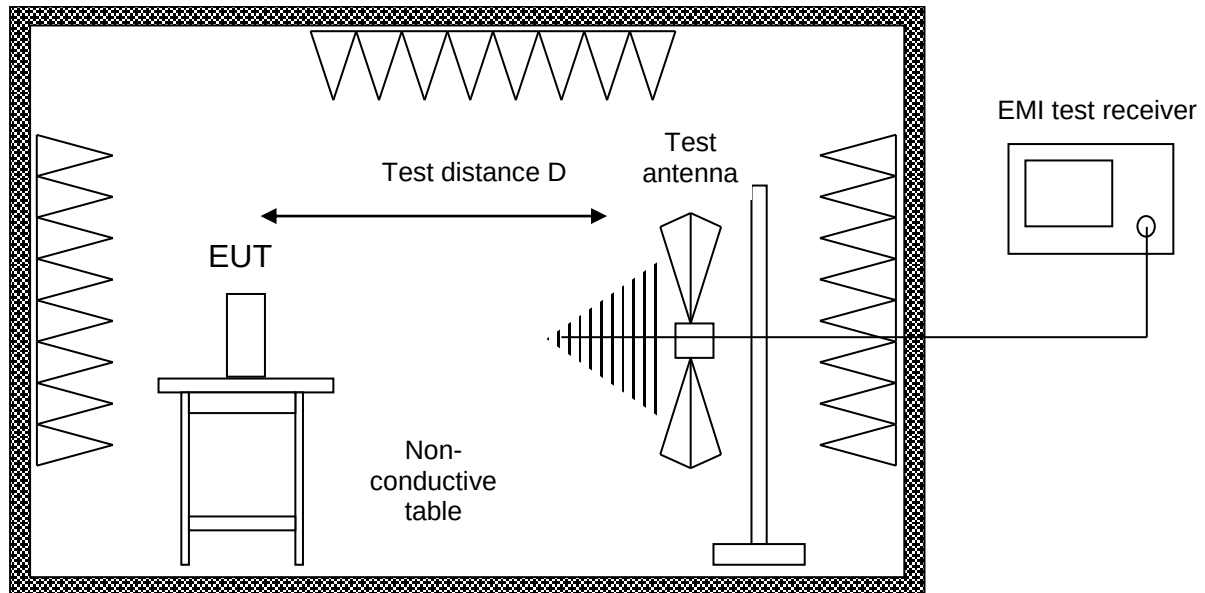


The EUT was placed on a non-conductive table, 0.8 m above the ground.

Radiated emissions in the frequency 9 kHz – 30 MHz is measured within a semi-anechoic room with an active loop antenna with the measurement detector set to peak. In addition in the frequency range 9 kHz to 490 kHz also an average detector was used. The measurement bandwidth of the receiver was set to 300 Hz in the frequency range 9 kHz to 150 kHz and 10 kHz in the frequency range 150 kHz to 30 MHz. Prescans were performed in six positions of the EUT.

For final measurements the detector was set to CISPR quasi-peak and in addition to CISPR average in the frequency range 9 kHz to 490 kHz with a resolution bandwidth 200 Hz in the frequency range 9 kHz to 150 kHz and 9 kHz in the frequency range 150 kHz to 30 MHz. Final tests were performed immediately after a final frequency and zoom (for drifting disturbances) and maximum adjustment.

2.6.6.2 Frequency range 30 MHz – 1 GHz



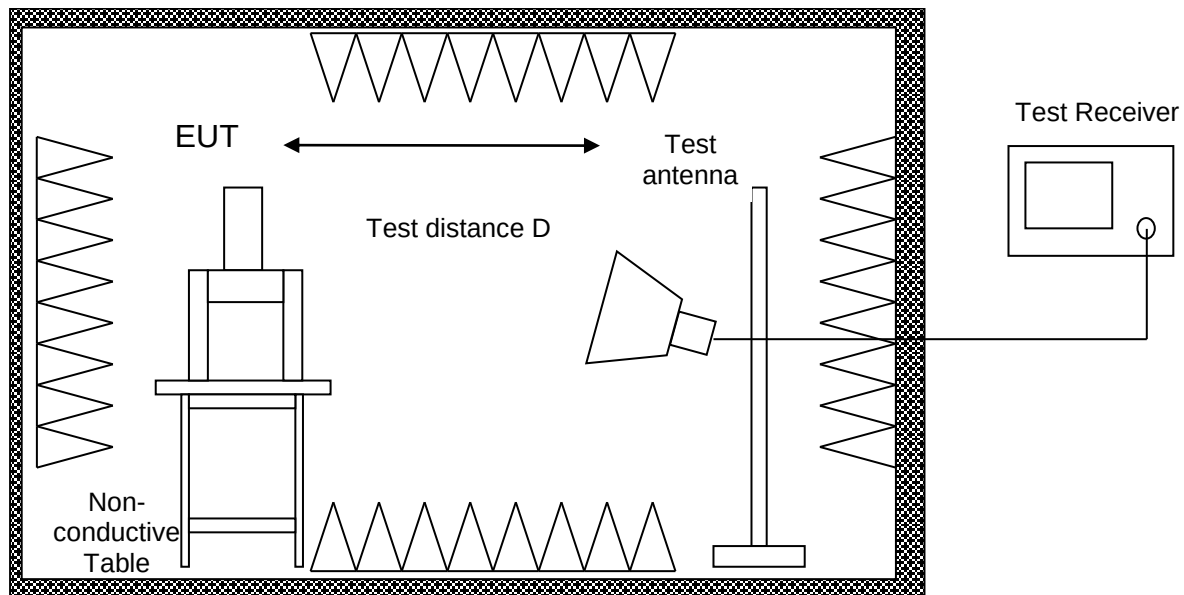
Alternate test site (semi anechoic room)

The EUT was placed on a non-conductive table, 0.8 m above the ground plane. Radiated emissions in the frequency range 30 MHz – 1 GHz are measured within a semi-anechoic room with a groundplane complying with the NSA requirements of ANSI C63.4. for alternative test sites. A linear polarised logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used.

For prescan tests the test receiver is set to peak-detector with a bandwidth of 120 kHz.

With the measurement bandwidth of the test receiver set to 120 kHz CISPR quasi-peak detector is selected for final measurements following immediately after a final frequency zoom (for drifting disturbances) and maximum adjustment.

2.6.6.3 Frequency range above 1 GHz



Fully anechoic room

The EUT was placed on a non-conductive table, 1.5 m above the ground plane

Radiated emission tests above 1 GHz are performed in a fully anechoic room with the S_{VSWR} requirements of ANSI C63.4. Measurements are performed both in the horizontal and vertical planes of polarisation using a test receiver with the detector function set to peak and average and the resolution bandwidth set to 1 MHz. Testing above 1 GHz is performed with horn antennas with the EUT in boresight of the antenna.

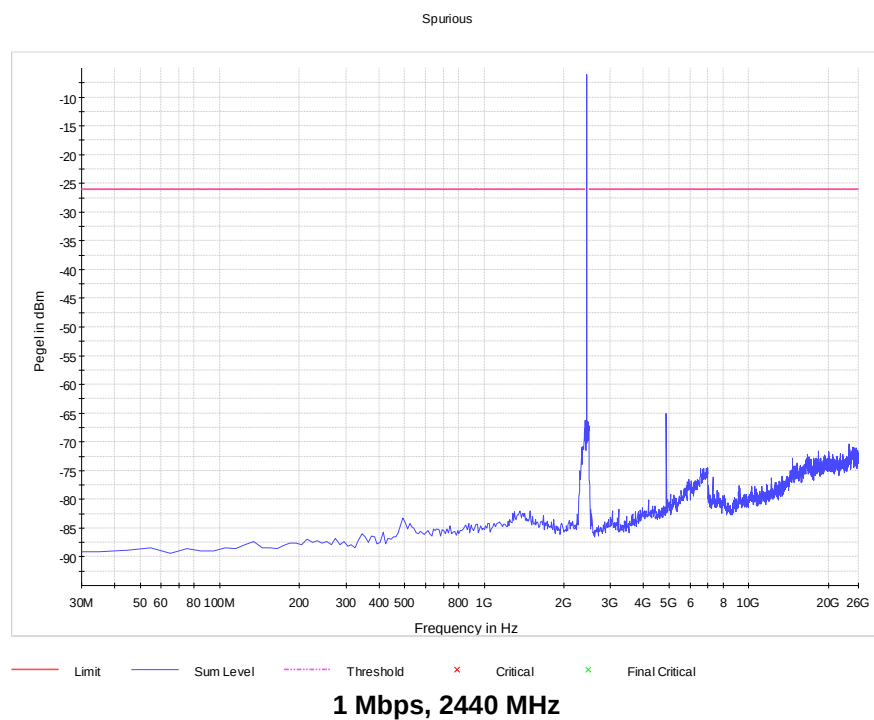
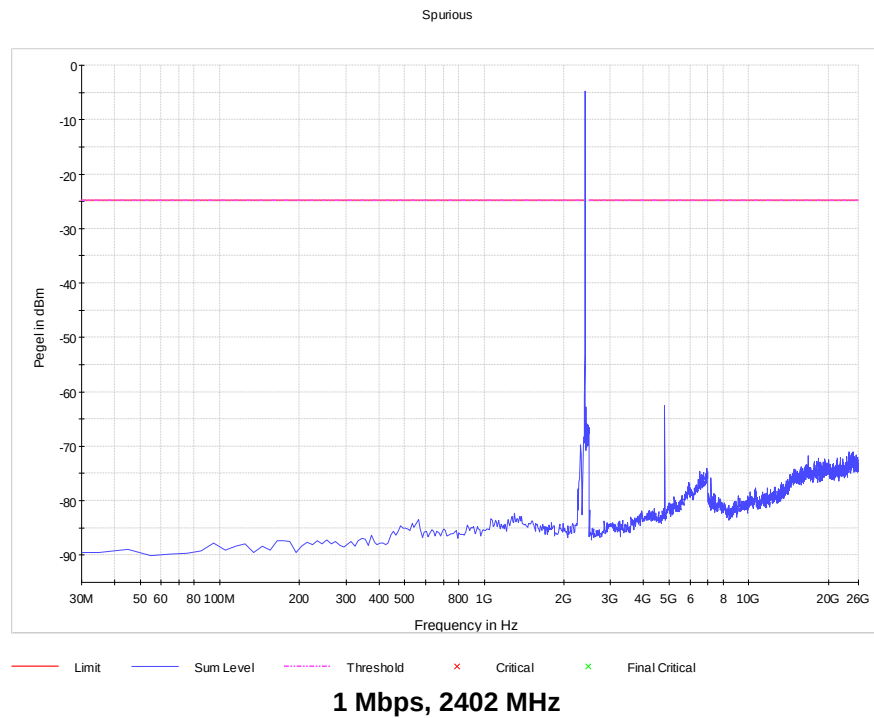
For prescan tests the test receiver is set to peak- and average-detector with a bandwidth of 1 MHz.

With the measurement bandwidth of the test receiver set to 1 MHz and peak- and CISPR average-detector is selected for final measurements following immediately after a final frequency zoom (for drifting disturbances) and maximum adjustment.



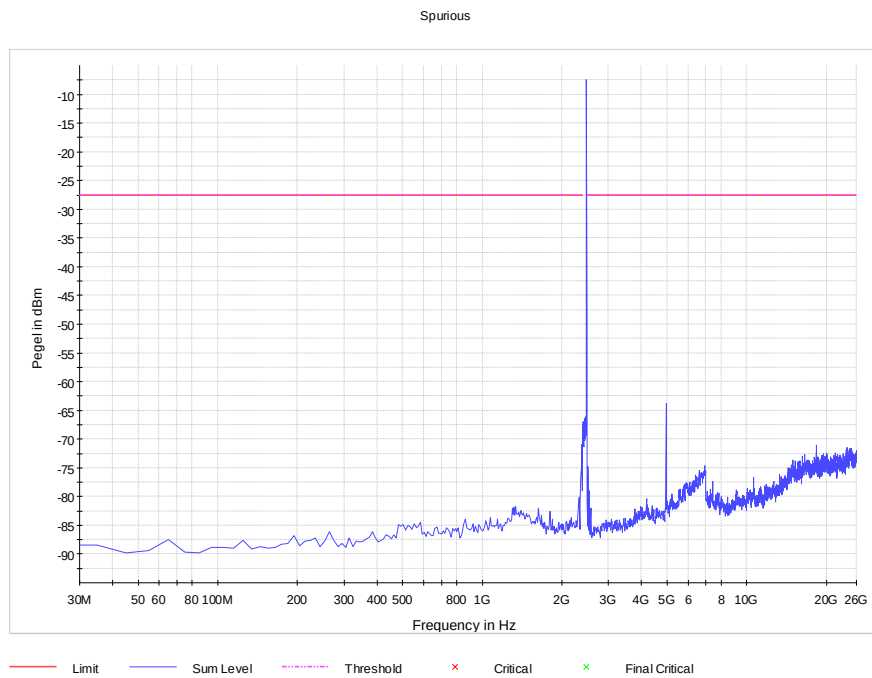
2.6.7 Test Results

2.6.7.1 Conducted measurements

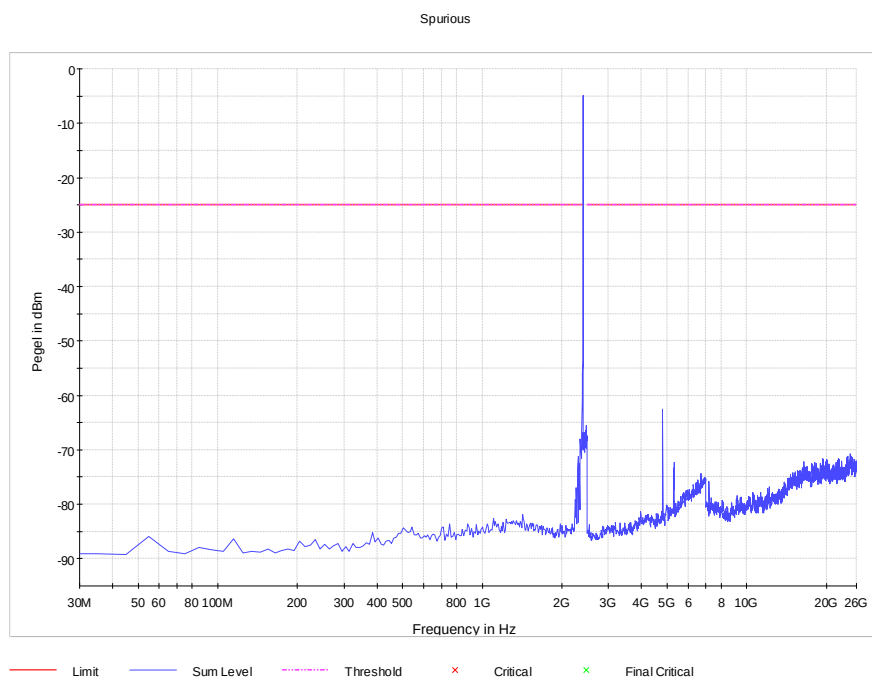




Product Service



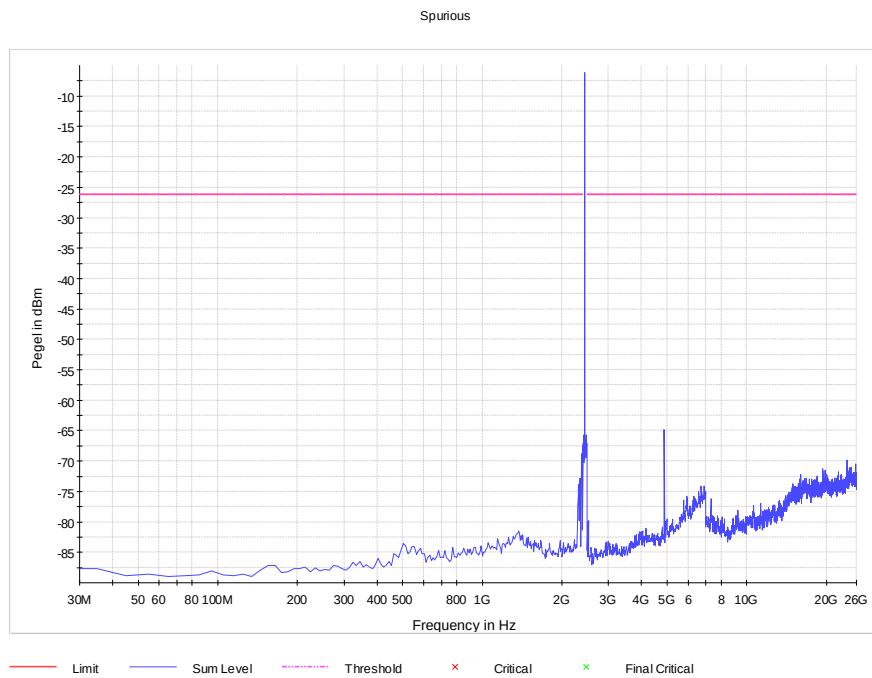
1 Mbps, 2480 MHz



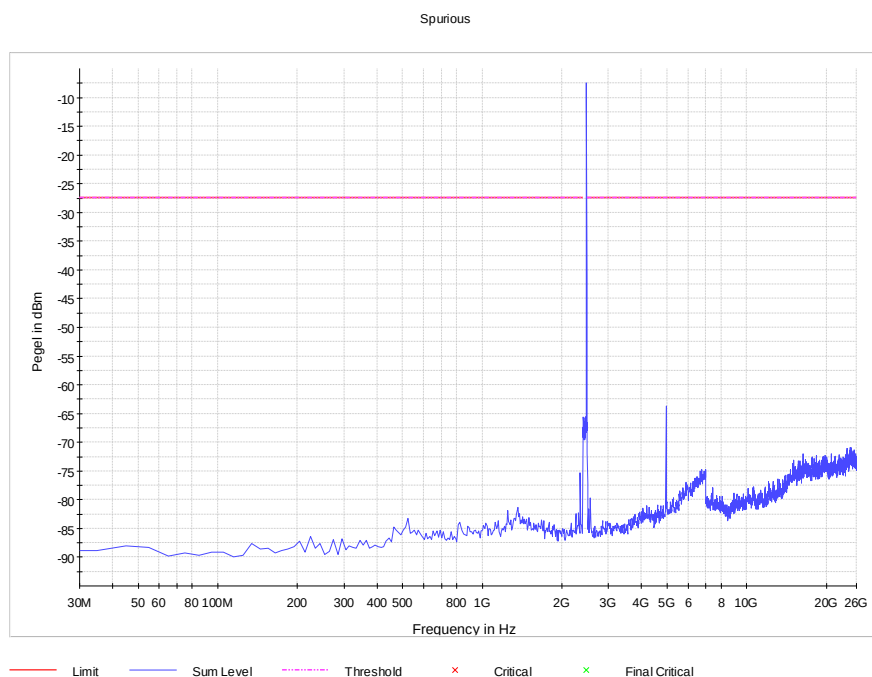
Long Range S2, 2402 MHz



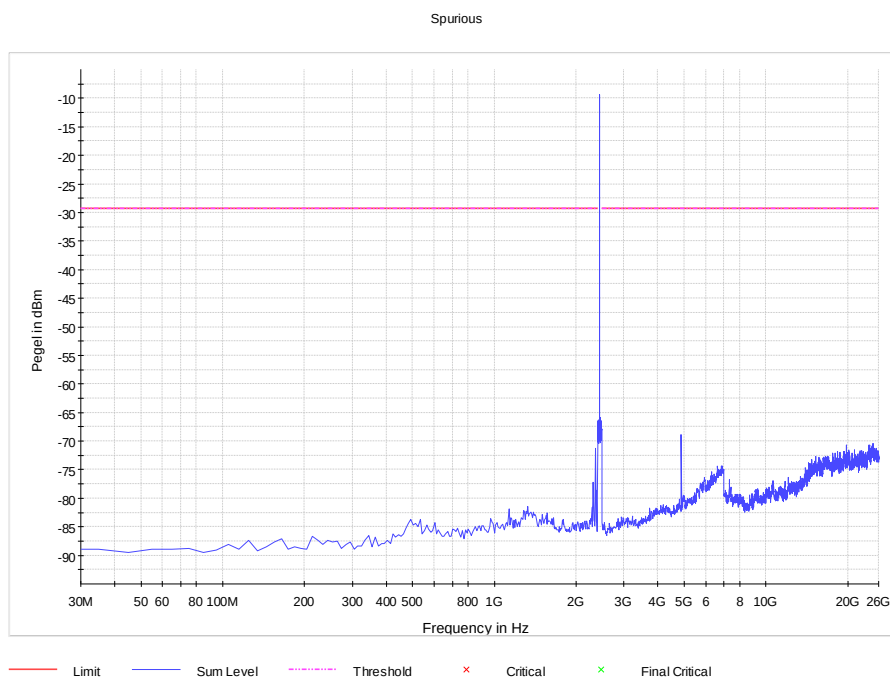
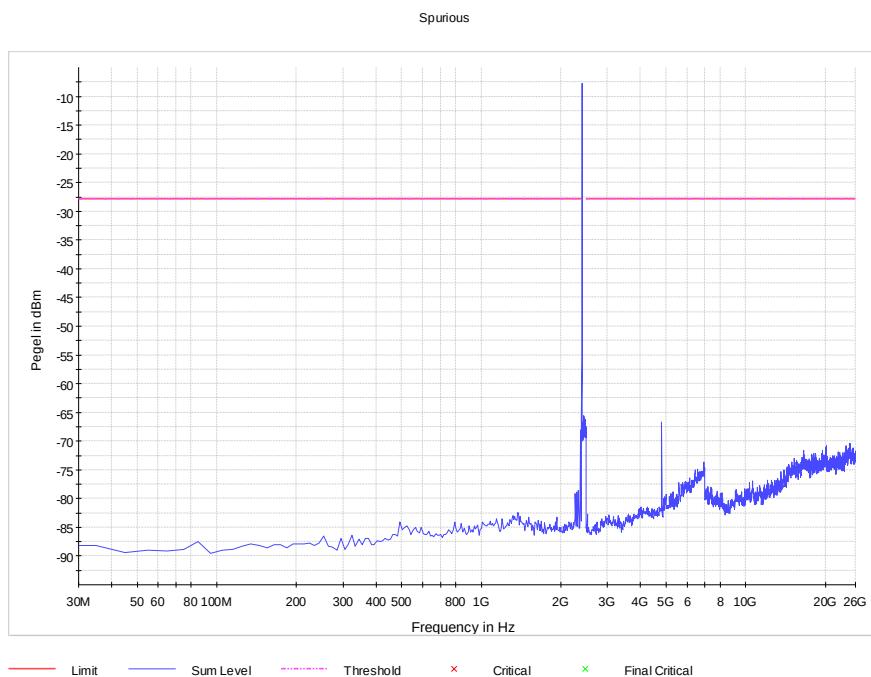
Product Service

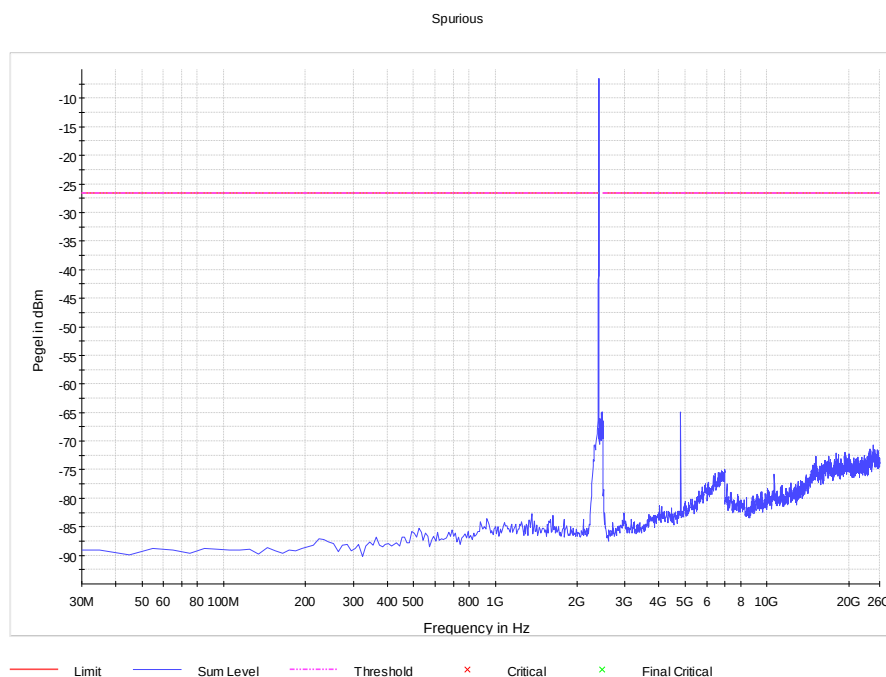
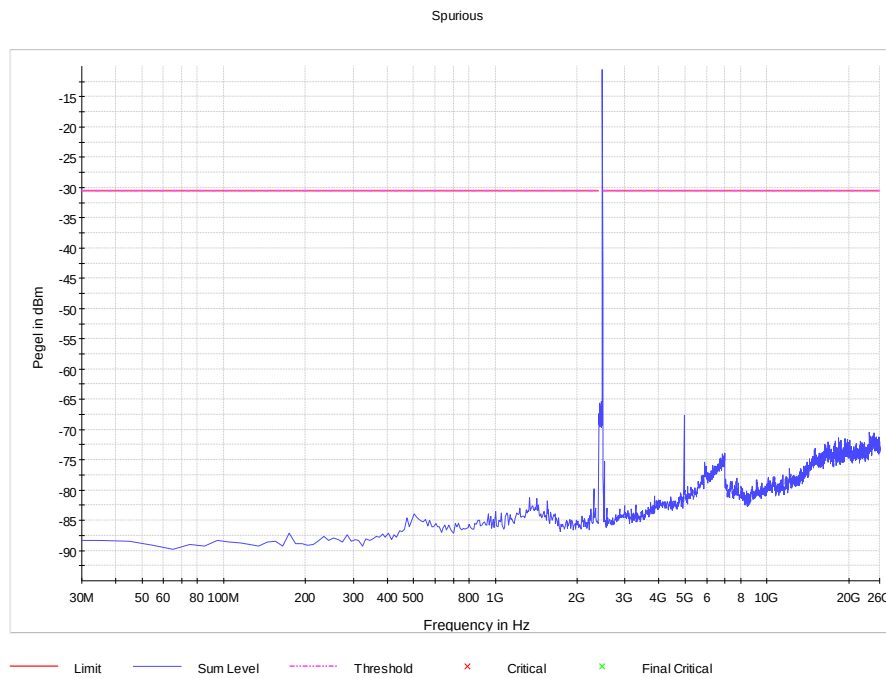


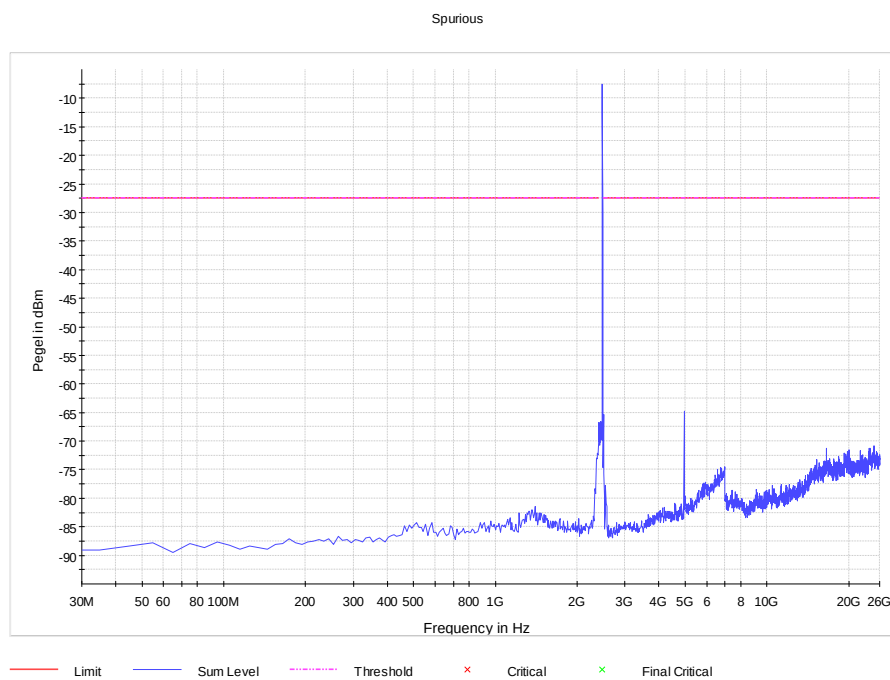
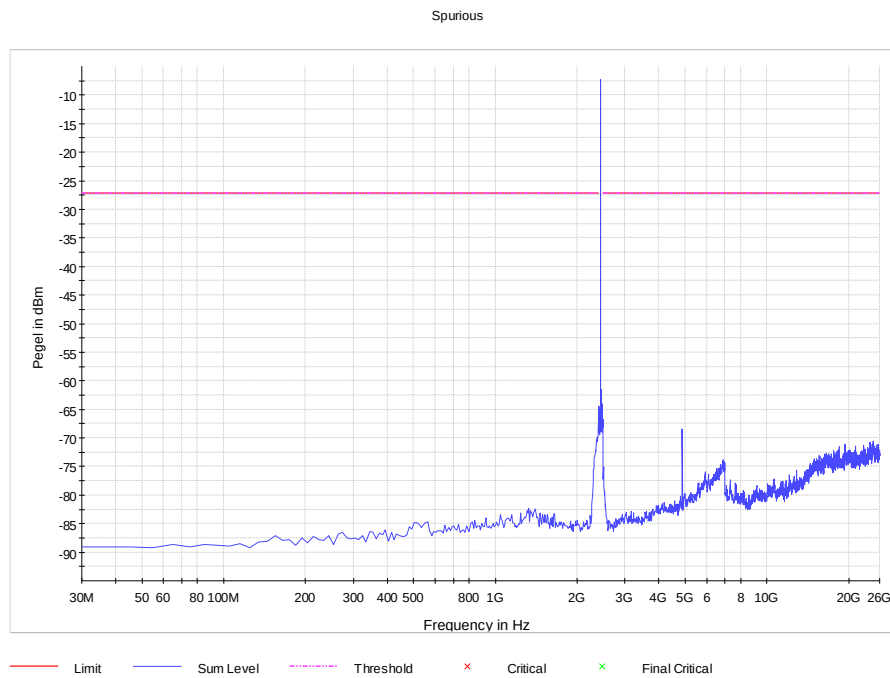
Long Range S2, 2440 MHz



Long Range S2, 2480 MHz









2.6.7.2 Radiated Emissions

Frequency range	Limit applied	IF-BW	Detector(s)	Test distance
9 – 150 kHz	§ 15.209	200 Hz	QP / CAV	3 m
150 kHz – 30 MHz	§ 15.209	9 kHz	QP / CAV	3 m
30 MHz – 1 GHz	§ 15.209	120 kHz	QP	3 m
1 – 18 GHz	§ 15.209	1 MHz	PK+ / CAV	1 m
18 – 26 GHz	§ 15.209	1 MHz	PK+ / CAV	3 m

Table 27

Sample calculation:

$$\text{Final Value (dB}\mu\text{V/m)} = \text{Reading Value (dB}\mu\text{V)} + (\text{Cable attenuation (dB)} + \text{Antenna Transducer (dB(1/m)))}$$

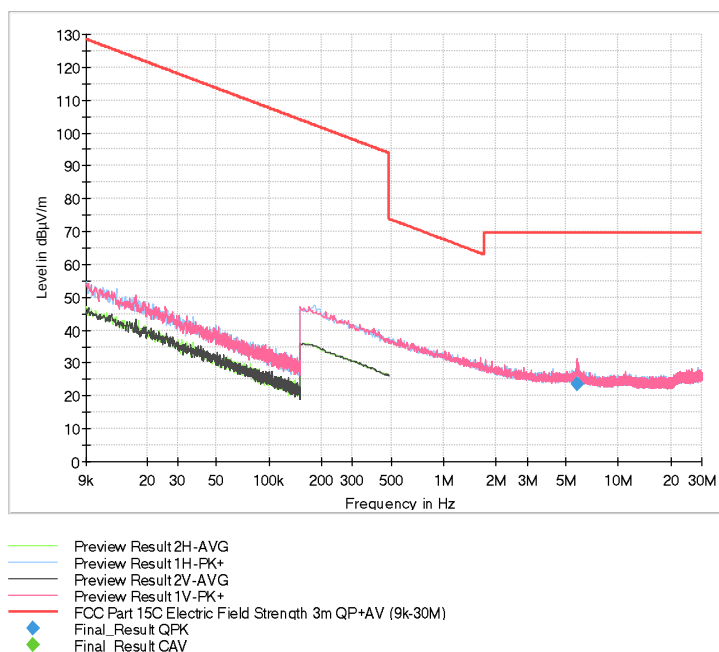
Additional correction of limit in the frequency range 9 – 490 kHz (300 m to 3 m): +80.0 dB

Additional correction of limit in the frequency range 490 kHz – 30 MHz (30 m to 3 m): +40.0 dB

Additional correction of limit in the frequency ranges above 1 GHz (3 m to 1 m): +9.54 dB

Final measurements were performed for mode Long Range S2.

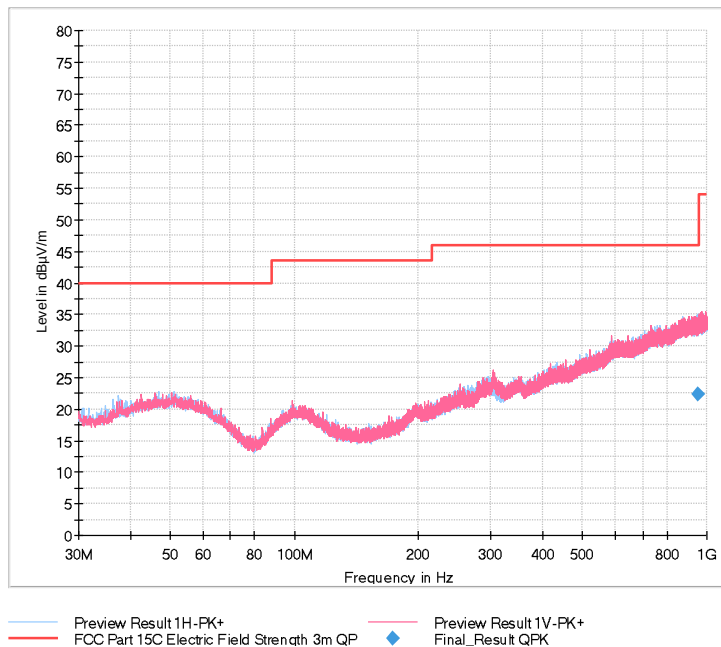
Lowest Channel:



Frequency MHz	QuasiPeak dBμV/m	CAverage dBμV/m	Limit dBμV/m	Margin dB	Meas. Time ms	Band- width kHz	Height cm	Pol	Azi- muth deg	Corr. dB/m
5.809000	23.63	---	69.54	45.91	1000.0	9.000	100.0	V	124.0	19.4



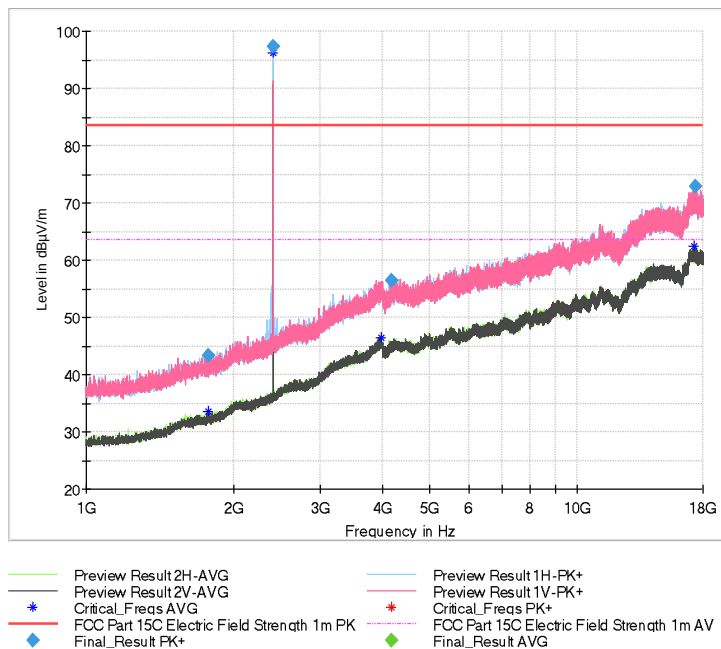
Product Service



Frequency MHz	QuasiPeak dBμV/m	Limit dBμV/m	Margin dB	Meas. Time ms	Band- width kHz	Height cm	Pol	Azi- muth deg	Corr. dB/m
954.030000	22.39	46.02	23.63	1000.0	120.000	209.0	H	-146.0	32.2

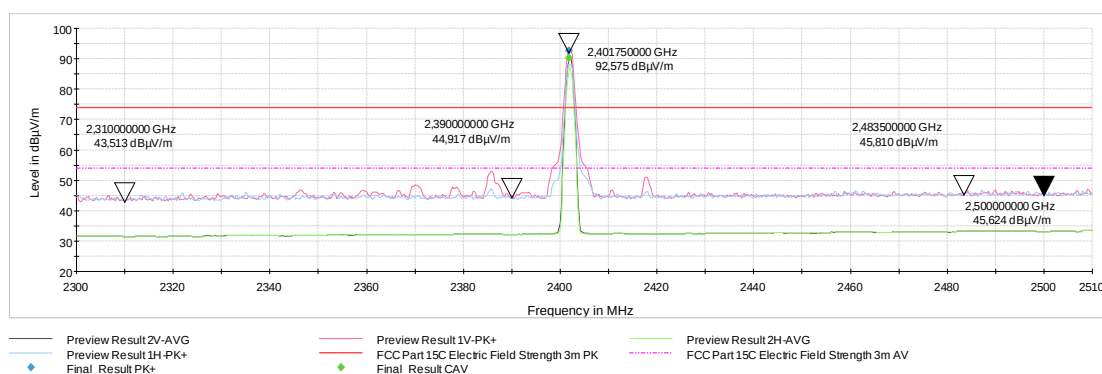


Product Service



Frequency MHz	MaxPeak dBμV/m	Limit dBμV/m	Marg- in dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azi- muth deg	Corr. dB/m
1776.500000	43.43	83.50	40.07	1000.0	1000.000	200.0	V	-150.0	31.9
2402.000000	97.30	---	---	1000.0	1000.000	100.0	H	-30.0	34.7
4190.000000	56.43	83.50	27.07	1000.0	1000.000	300.0	V	-150.0	41.5
17331.000000	72.94	83.50	10.56	1000.0	1000.000	100.0	V	-150.0	57.4

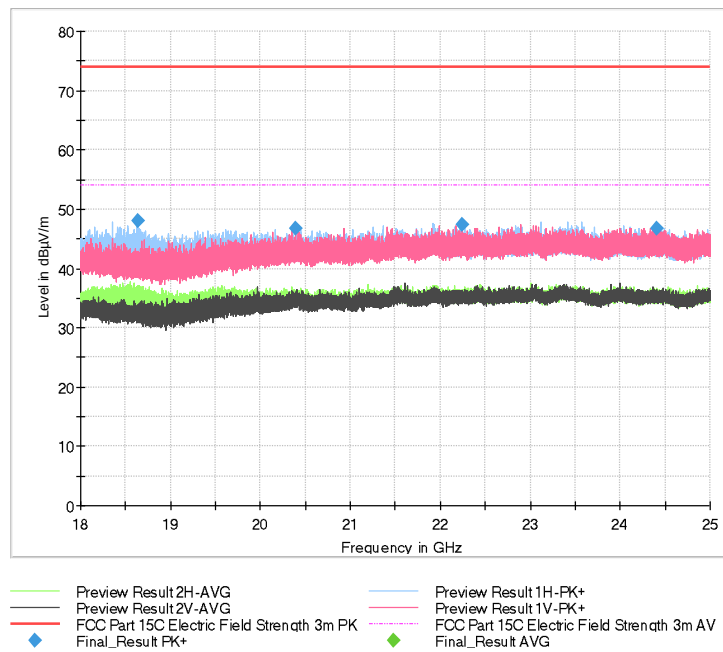
*: Carrier emission – not evaluated as spurious emission



Band Edge Requirement – Modulation: Long Range: S8



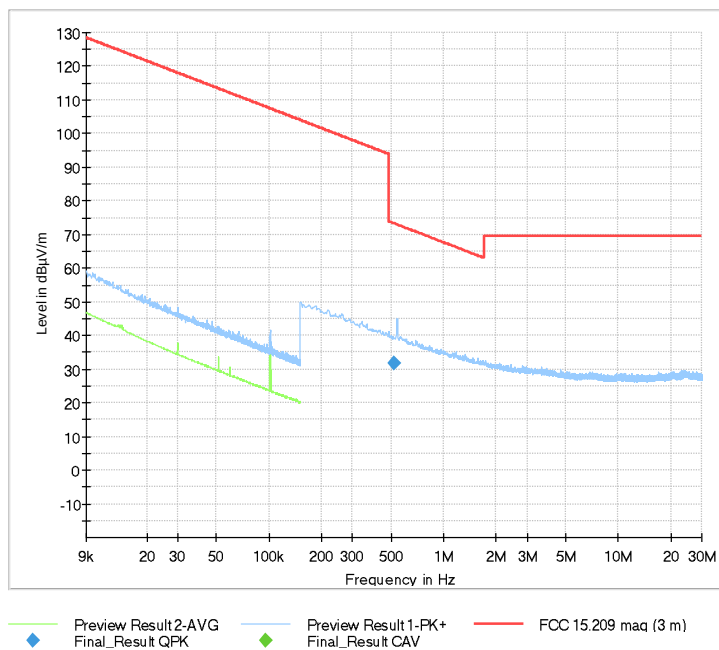
Product Service



Frequency MHz	MaxPeak dBμV/m	Limit dBμV/m	Mar- gin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azi- muth deg	Corr. dB/m
18642.600000	48.00	73.98	25.98	1000.0	1000.000	150.0	H	-150.0	11.5
20389.955556	46.81	73.98	27.17	1000.0	1000.000	150.0	H	-90.0	12.5
22243.400000	47.41	73.98	26.57	1000.0	1000.000	150.0	H	-150.0	13.3
24399.555556	46.80	73.98	27.18	1000.0	1000.000	200.0	V	150.0	14.4



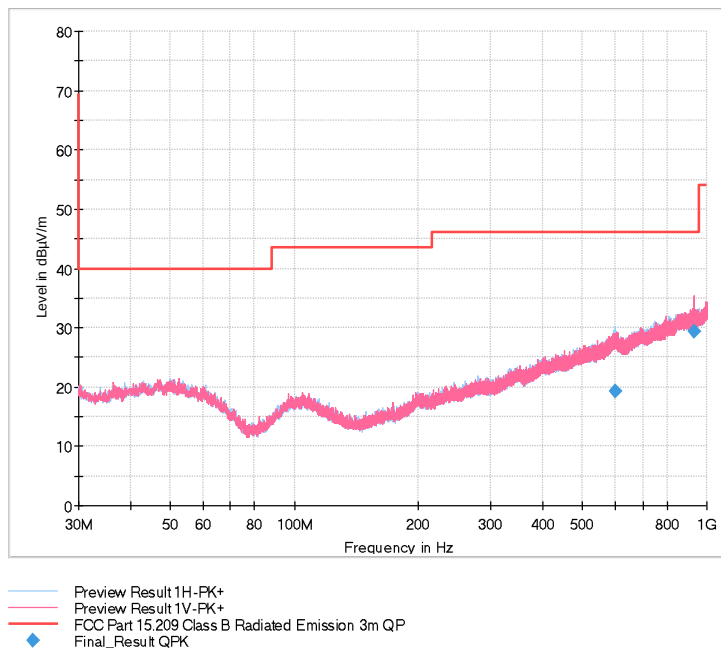
Middle Channel:



Frequency MHz	QuasiPeak dBµV/m	CAverage dBµV/m	Limit dBµV/m	Margin dB	Meas. Time ms	Band- width kHz	Pol	Azi- muth deg	Corr. dB
0.519000	31.72	---	73.30	41.58	1000.0	9.000	V	-198.0	19.7



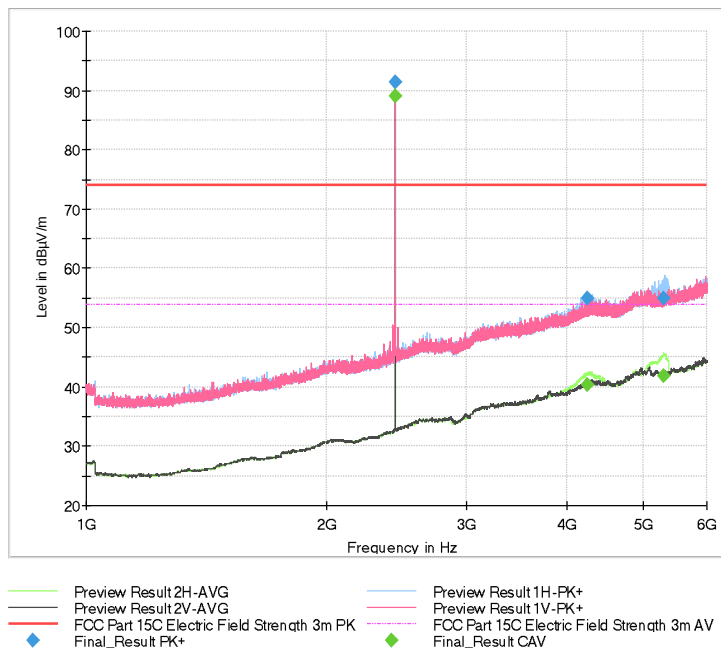
Product Service



Frequency MHz	QuasiPeak dBμV/m	Limit dBμV/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg	Corr. dB/m
598.890000	19.41	46.02	26.61	1000.0	120.000	373.0	H	115.0	26.0
934.380000	29.36	46.02	16.66	1000.0	120.000	131.0	V	87.0	30.0

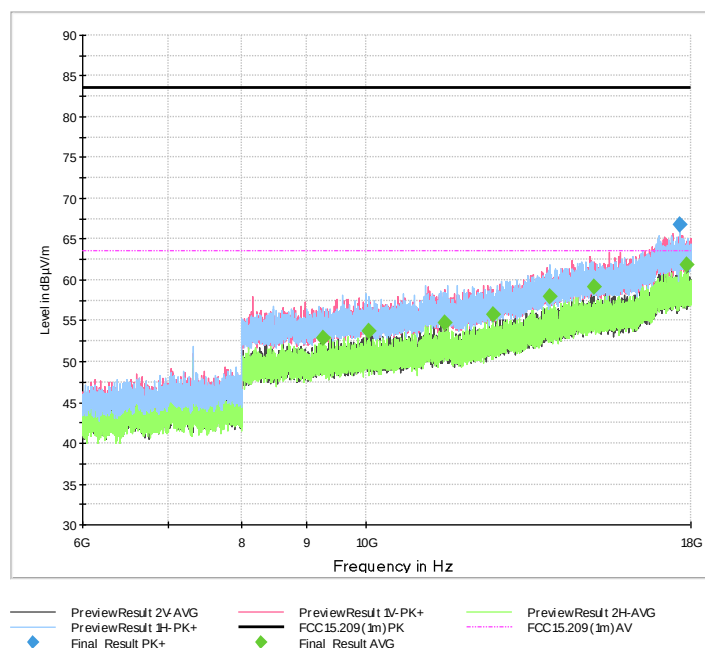


Product Service



Frequency MHz	Max-Peak dBµV/m	CAverage dBµV/m	Limit dBµV/m	Mar- gin dB	Meas. Time ms	Band- width kHz	Height cm	Pol	Azi- muth deg	Corr. dB/m
2439.750000	---	88.97	---	*	1000	1000	150.0	V	-55.0	34.9
2439.750000	91.50	---	---	*	1000	1000	150.0	V	-55.0	34.9
4249.500000	55.00	---	73.98	18.97	1000	1000	150.0	H	136.0	41.8
4249.500000	---	40.45	53.98	13.53	1000	1000	150.0	H	136.0	41.8
5302.500000	54.92	---	73.98	19.06	1000	1000	150.0	H	125.0	42.6
5302.500000	---	41.93	53.98	12.05	1000	1000	150.0	H	136.0	42.6

*: Carrier emission – not evaluated as spurious emission



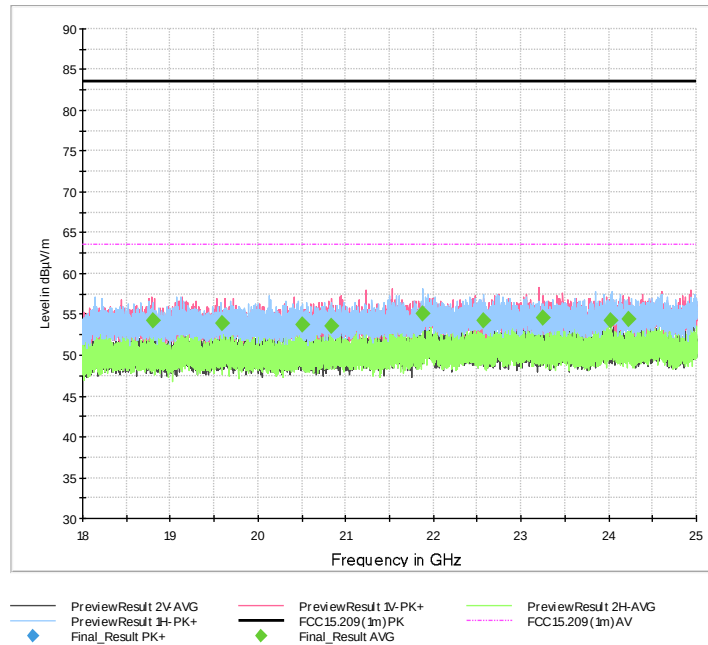


Product Service

<i>Frequency</i> <i>MHz</i>	<i>Max- Peak</i> <i>dBμV/m</i>	<i>Aver- age</i> <i>dBμV/m</i>	<i>Limit</i> <i>dBμV/m</i>	<i>Mar- gin</i> <i>dB</i>	<i>Meas. Time</i> <i>ms</i>	<i>Band- width</i> <i>kHz</i>	<i>Height</i> <i>cm</i>	<i>Pol</i>	<i>Azi- muth</i> <i>deg</i>	<i>Corr.</i> <i>dB</i>
9255.500000	---	52.93	63.50	10.57	2.5	1000.000	150.0	H	294.0	42.8
10049.500000	---	53.69	63.50	9.81	2.5	1000.000	150.0	H	156.0	43.2
11531.000000	---	54.77	63.50	8.73	2.5	1000.000	150.0	V	5.0	44.0
12586.500000	---	55.72	63.50	7.78	2.5	1000.000	150.0	H	172.0	44.7
13945.500000	---	58.00	63.50	5.50	2.5	1000.000	150.0	H	163.0	46.6
15114.500000	---	59.09	63.50	4.41	2.5	1000.000	150.0	V	15.0	47.9
17635.500000	66.86	---	83.50	16.64	2.5	1000.000	150.0	H	221.0	50.9
17851.500000	---	61.88	63.50	1.62	2.5	1000.000	150.0	V	158.0	51.0



Product Service

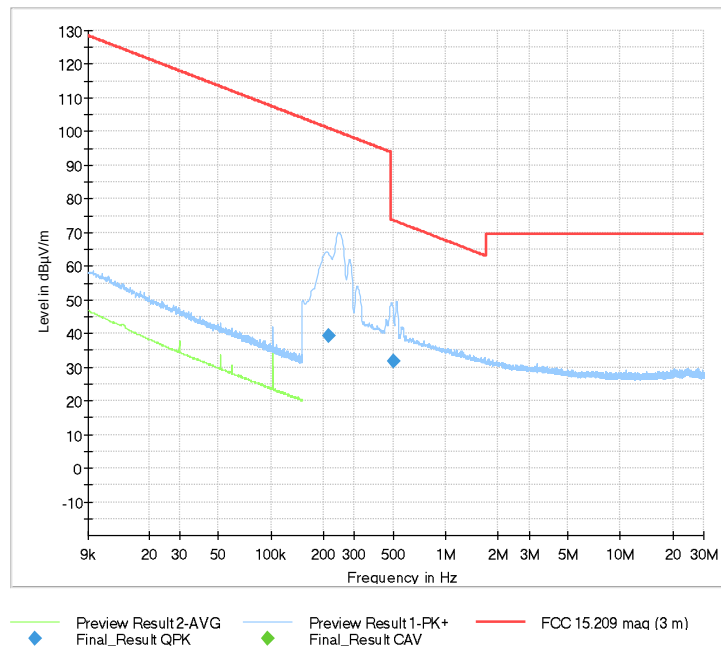


Frequency MHz	Max- Peak dBµV/m	Aver- age dBµV/m	Limit dBµV/m	Mar- gin dB	Meas. Time ms	Band- width kHz	Height cm	Pol	Azi- muth deg	Corr. dB/m
18811.611111	---	54.26	63.50	9.24	2.5	1000.000	150.0	V	84.0	42
19599.888889	---	53.96	63.50	9.54	2.5	1000.000	150.0	H	100.0	42
20509.111111	---	53.76	63.50	9.74	2.5	1000.000	150.0	H	342.0	42
20845.500000	---	53.57	63.50	9.93	2.5	1000.000	150.0	H	184.0	42
21871.000000	---	55.06	63.50	8.44	2.5	1000.000	150.0	H	1.0	42
22575.277778	---	54.31	63.50	9.19	2.5	1000.000	150.0	V	321.0	43
23248.444444	---	54.56	63.50	8.94	2.5	1000.000	150.0	V	170.0	43
24025.055556	---	54.32	63.50	9.18	2.5	1000.000	150.0	V	0.0	43
24220.666667	---	54.39	63.50	9.11	2.5	1000.000	150.0	H	305.0	43



Product Service

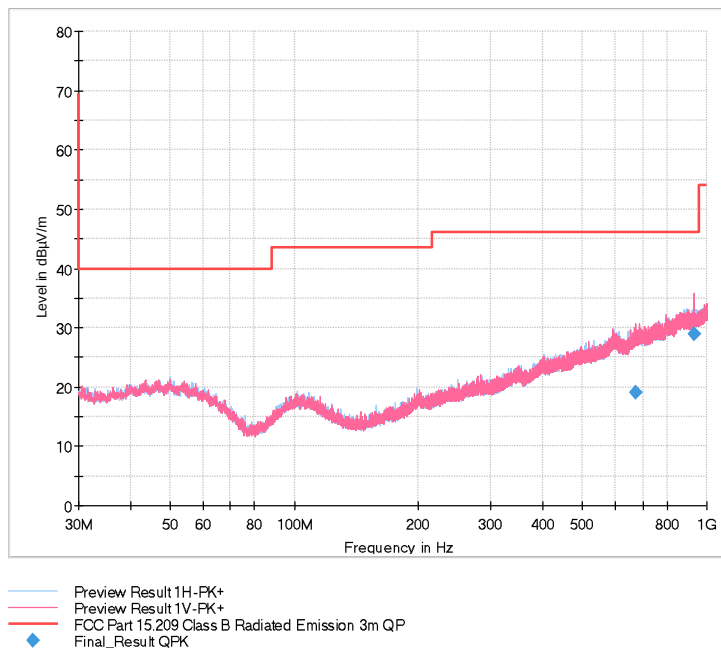
Highest Channel:



Fre- quency MHz	Qua- siPeak dBµV/m	CAver- age dBµV/m	Limit dBµV/m	Mar- gin dB	Meas. Time ms	Band- width kHz	Pol	Azi- muth deg	Corr. dB/m
0.215250	39.31	---	100.94	61.63	1000.0	9.000	H	94.0	19.8
0.498750	31.84	---	73.65	41.81	1000.0	9.000	H	158.0	19.7



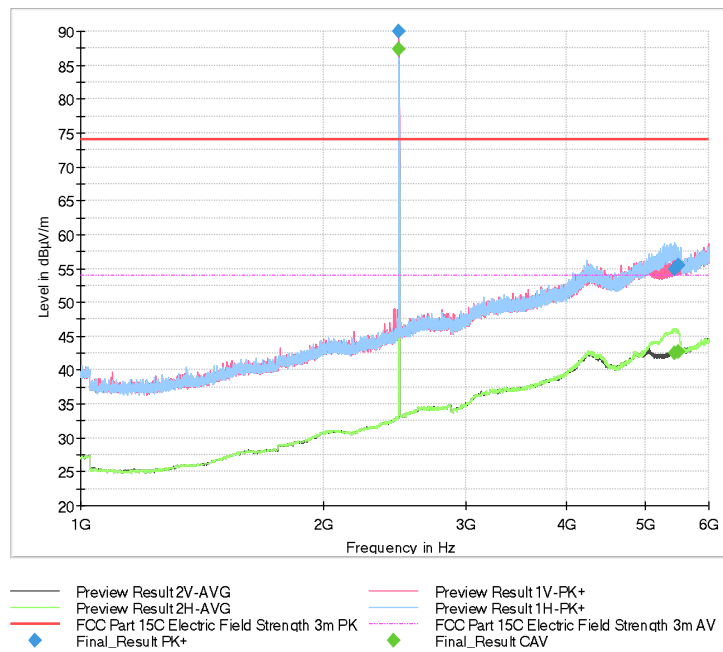
Product Service



Frequency MHz	QuasiPeak dBμV/m	Limit dBμV/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg	Corr. dB/m
673.680000	19.14	46.02	26.88	1000.0	120.000	103.0	V	112.0	26.9
934.350000	28.94	46.02	17.08	1000.0	120.000	394.0	V	-107.0	30.0



Product Service

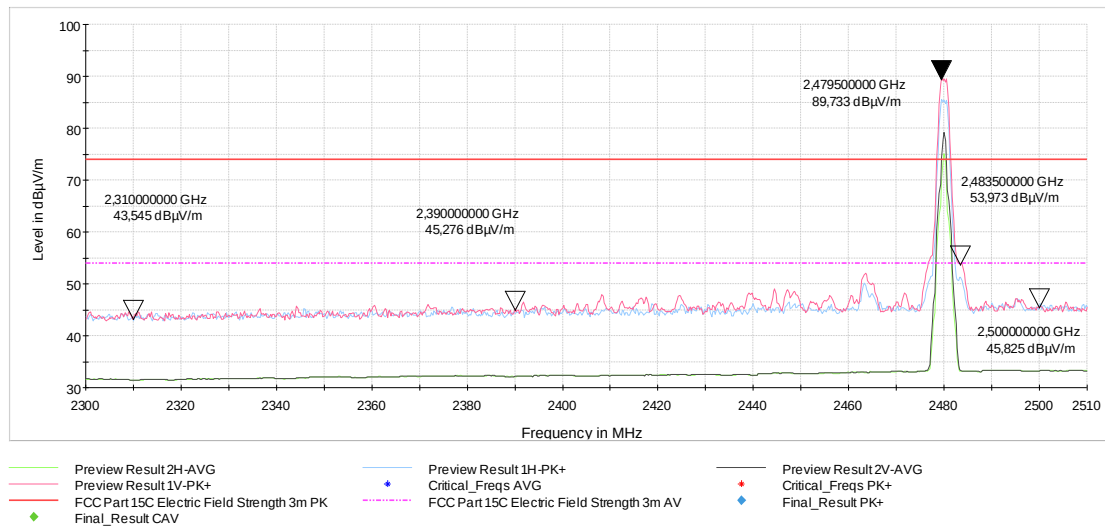


Frequency MHz	Max- Peak dBµV/m	CAver- age dBµV/m	Limit dBµV/m	Mar- gin dB	Meas. Time ms	Band- width kHz	Height cm	Pol	Azi- muth deg	Corr. dB
2479.750000	---	87.40	--- *	---	1000.0	1000.000	150.0	V	-55.0	35.2
2479.750000	89.95	---	--- *	---	1000.0	1000.000	150.0	V	-55.0	35.2
5448.500000	54.96	---	73.98	19.02	1000.0	1000.000	150.0	H	-60.0	43.0
5448.500000	---	42.56	53.98	11.42	1000.0	1000.000	150.0	H	-60.0	43.0
5494.750000	55.41	---	73.98	18.57	1000.0	1000.000	150.0	H	-45.0	43.1
5494.750000	---	42.68	53.98	11.30	1000.0	1000.000	150.0	H	-45.0	43.1

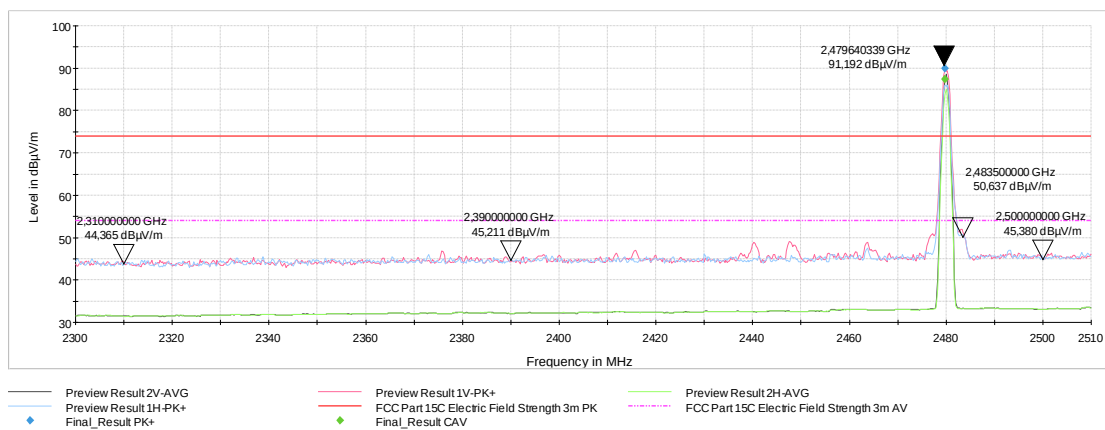
*: Carrier emission – not evaluated as spurious emission



Product Service



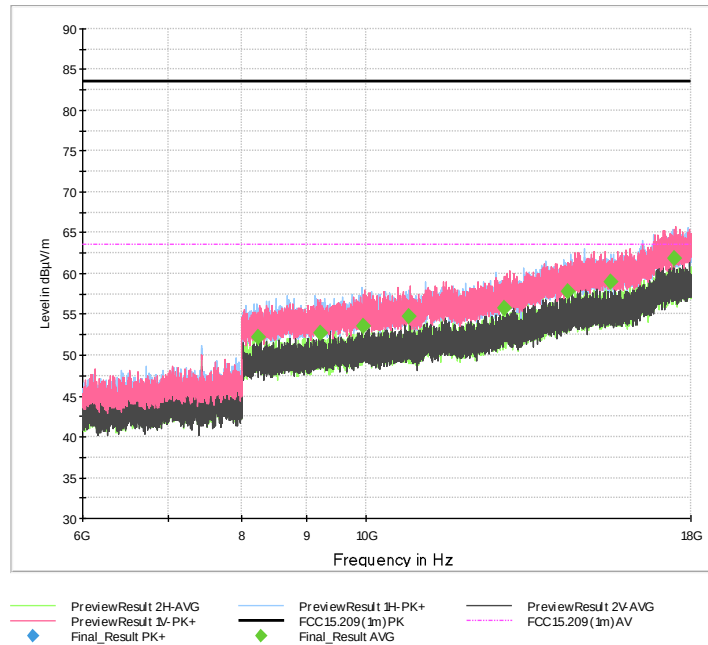
Band Edge Requirement – Modulation: Long Range: 2 Mbps



Band Edge Requirement – Modulation: Long Range: S8



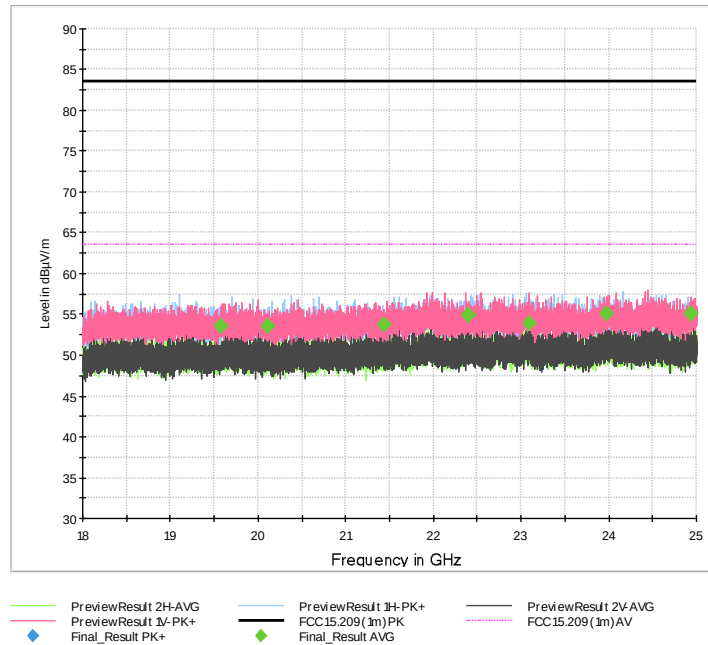
Product Service



Frequency MHz	Max- Peak dBµV/m	Aver- age dBµV/m	Limit dBµV/m	Mar- gin dB	Meas. Time ms	Band- width kHz	Height cm	Pol	Azi- muth deg	Corr. dB/m
8244.500000	---	52.13	63.50	11.37	2.5	1000.000	150.0	H	76.0	42
9219.500000	---	52.66	63.50	10.84	2.5	1000.000	150.0	H	69.0	43
9966.000000	---	53.53	63.50	9.97	2.5	1000.000	150.0	H	286.0	43
10823.500000	---	54.80	63.50	8.70	2.5	1000.000	150.0	H	105.0	44
12858.000000	---	55.73	63.50	7.77	2.5	1000.000	150.0	H	4.0	45
14430.500000	---	57.87	63.50	5.63	2.5	1000.000	150.0	V	53.0	47
15562.000000	---	58.99	63.50	4.51	2.5	1000.000	150.0	H	85.0	48
17464.000000	---	61.89	63.50	1.61	2.5	1000.000	150.0	V	252.0	51



Product Service



Frequency MHz	Max- Peak dBµV/m	Average dBµV/m	Limit dBµV/m	Mar- gin dB	Meas. Time ms	Band- width kHz	Height cm	Pol	Azi- muth deg	Corr. dB
19569.944444	---	53.53	63.50	9.97	2.5	1000.000	150.0	H	141.0	42.1
20110.111111	---	53.63	63.50	9.87	2.5	1000.000	150.0	H	336.0	42.2
21443.222222	---	53.69	63.50	9.81	2.5	1000.000	150.0	V	233.0	42.2
22393.277778	---	54.84	63.50	8.66	2.5	1000.000	150.0	H	211.0	42.6
22393.277778	---	54.84	63.50	8.66	2.5	1000.000	150.0	H	211.0	42.6
23097.555556	---	53.94	63.50	9.56	2.5	1000.000	150.0	V	90.0	42.7
23980.333333	---	55.00	63.50	8.50	2.5	1000.000	150.0	V	42.0	42.8
24936.222222	---	55.00	63.50	8.50	2.5	1000.000	150.0	V	182.0	42.8
24936.222222	---	55.00	63.50	8.50	2.5	1000.000	150.0	V	182.0	42.8



2.6.8 Test Location and Test Equipment

The conducted test was carried out in Radio Test Laboratory

<i>Instrument</i>	<i>Manufacturer</i>	<i>Type No</i>	<i>TE No</i>	<i>Calibration Period (months)</i>	<i>Calibration Due</i>
Switching device	Rohde & Schwarz	OSP120 for TS8997	20248	36	2026-07-31
Signal and spectrum analyser	Rohde & Schwarz	FS40	20219	24	2026-03-31
EMC measurement software	Rohde & Schwarz	EMC32 TS8997 – V10.60.00	44381	---	---

Table 28

The radiated test was carried out in semi anechoic room, Cabin No. 3

<i>Instrument</i>	<i>Manufacturer</i>	<i>Type No</i>	<i>TE No</i>	<i>Calibration Period (months)</i>	<i>Calibration Due</i>
EMI test receiver	Rohde & Schwarz	ESR7	61814	12	2025-06-30
Signal and spectrum analyser	Rohde & Schwarz	FSV40	20219	24	2026-03-31
TRILOG broadband antenna	Schwarzbeck	VULB 9163	19691	36	2027-04-30
Horn antenna with preamplifier	Rohde & Schwarz	LB-180400H-KF + TS-LNA1840	43661	24	2025-01-17
EMC measurement software	Rohde & Schwarz	EMC32 Emission – V11.50	44376		
Semi anechoic room	Frankonia	Cabin No. 3	56331		

Table 29



2.7 Temperature Stability

2.7.1 Specification Reference

ISED RSS-Gen, Clause 6.11, 8.11

2.7.2 Equipment under Test and Modification State

UK1; S/N 2624000072726007; Modification state 0

2.7.3 Date of Test

2024-10-28

2.7.4 Environmental Conditions

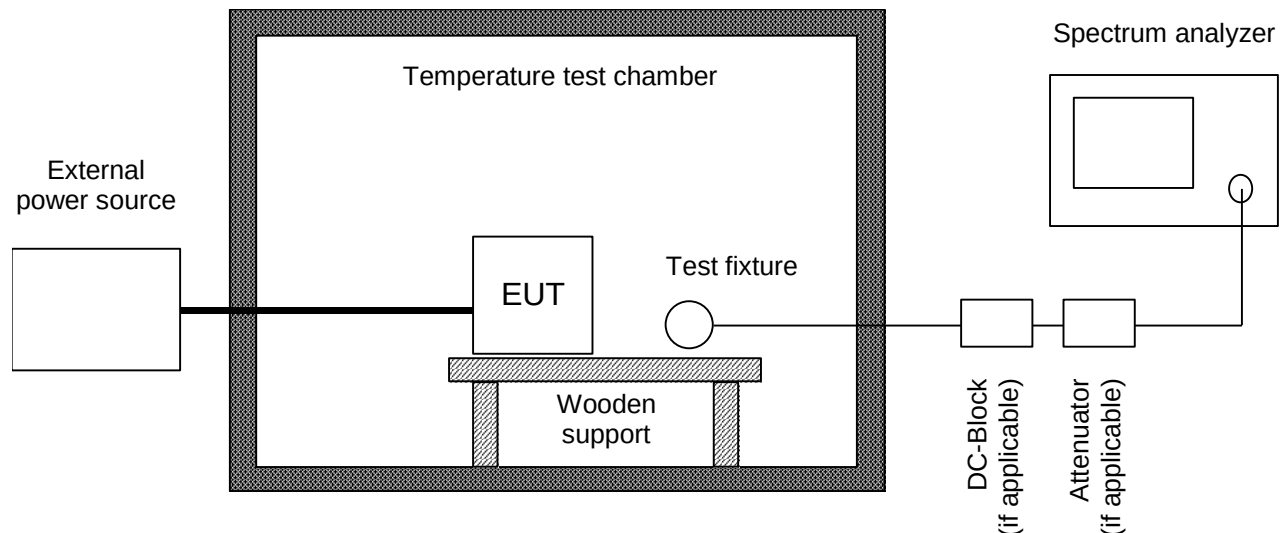
Ambient Temperature	23 °C
Relative Humidity	50 %

2.7.5 Specification Limits

If the stability of the license-exempt radio apparatus is not specified in the applicable RSS, the fundamental emissions of the radio apparatus should be kept within at least the central 80 % of its permitted operating frequency band in order to minimize the possibility of out-of-band operation. In addition, its occupied bandwidth shall be entirely outside the restricted bands and the prohibited TV bands of 85 MHz – 72 MHz, 76 MHz – 88 MHz, 174 MHz – 216 MHz, and 470 MHz – 602 MHz, unless otherwise indicated.

2.7.6 Test Method

The test was performed according to ANSI C63.10, section 6.8.



The frequency tolerance of the carrier signal is measured over a temperature variation of -20°C to $+50^{\circ}\text{C}$ at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20°C . Temperature and voltage range may vary if the manufacturer states another temperature or voltage range.

If the EUT provides an antenna connector the spectrum analyzer is connected to this port. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as a DC block and appropriate (50 Ω) attenuators. In case where the EUT does not provide an antenna connector or a test fixture is used.

For battery operated equipment, the test is performed using a new battery. Alternatively, an external supply voltage can be used and is at least set to:

- The maximum battery voltage as delivered by a new battery or 115 % of the battery nominal voltage;
- The battery nominal voltage
- 85 % of the battery nominal voltage
- The battery operating end point voltage which shall be specified by the equipment manufacturer.

The EUT is operating providing an unmodulated carrier for frequency error tests. The peak detector of the spectrum analyzer is selected and resolution as well as video bandwidth are set to values appropriate to shape of the spectrum of the EUT. The frequency counter mode of the spectrum analyzer is used to maximize the accuracy of the measured frequency tolerance.

If an unmodulated carrier is not available a significant and stable point of the spectrum is selected and the span is reduced to a value that delivers an accuracy which shall be better than 1 % of the maximum frequency tolerance allowed for the carrier signal. This method may be performed as long as the margin to the frequency tolerance is larger than the uncertainty of the measured frequency tolerance.

The test was performed using an automated software (EMC32) with the following settings:

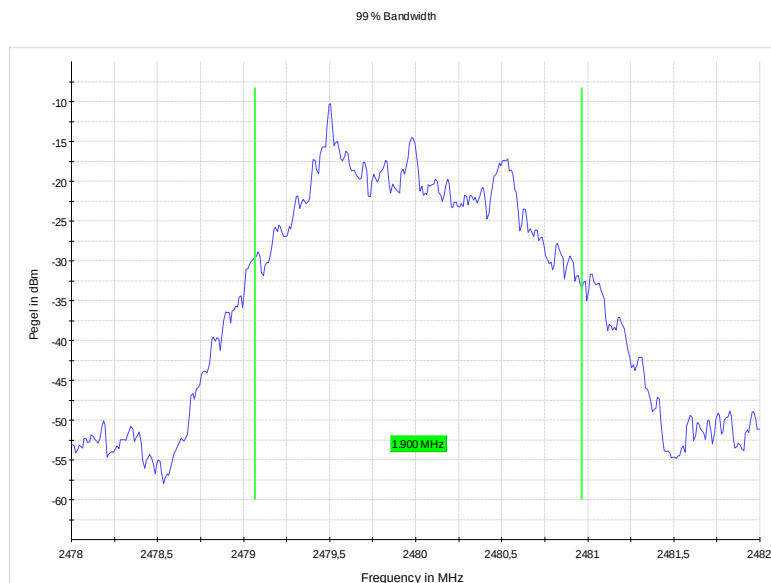
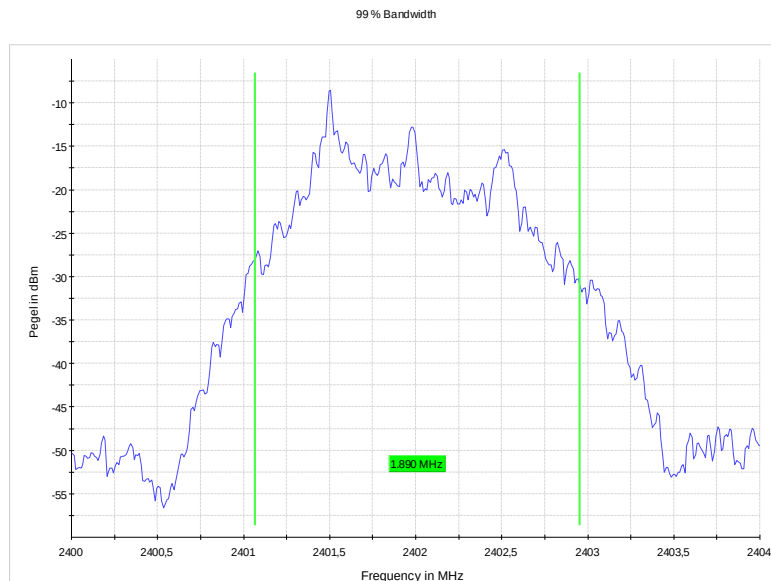
Resolution Bandwidth: 10 kHz
Video Bandwidth: 30 kHz
Detector: Positive peak



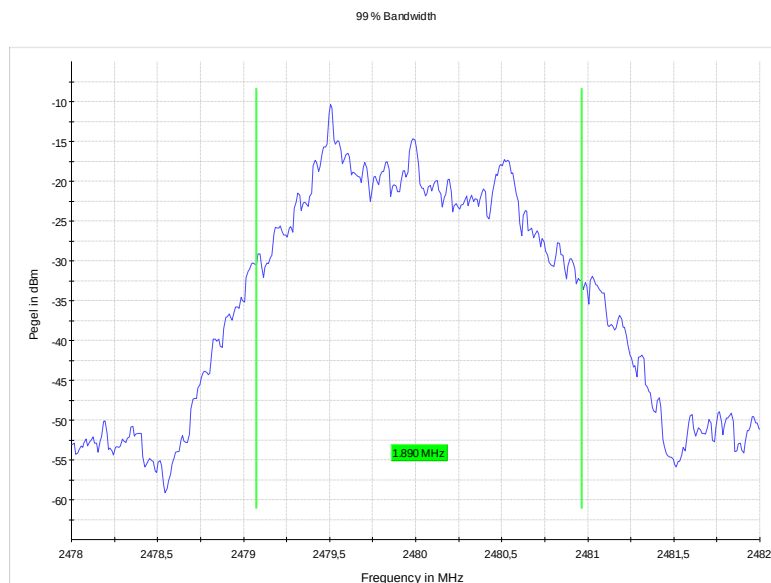
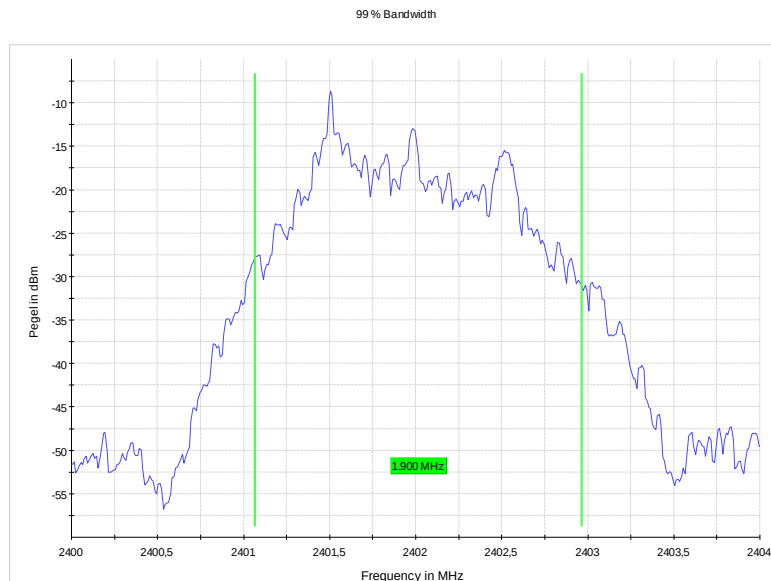
2.7.7 Test Results

<i>Temperature</i>	<i>Supply Voltage</i>	<i>Band Edge left</i>	<i>Band Edge Right</i>	<i>Middle frequency</i>	<i>Deviation</i>
-20 °C	3.0 V	2401.065 MHz	2480.965 MHz	2441.015 MHz	30 kHz
-10 °C	3.0 V	2401.065 MHz	2480.965 MHz	2441.015 MHz	30 kHz
0 °C	3.0 V	2401.065 MHz	2480.975 MHz	2441.020 MHz	35 kHz
10 °C	3.0 V	2401.065 MHz	2480.975 MHz	2441.020 MHz	35 kHz
20 °C	2.5 V	2401.055 MHz	2480.955 MHz	2441.005 MHz	20 kHz
20 °C	3.0 V	2401.015 MHz	2480.955 MHz	2440.985 MHz	0 kHz
30 °C	3.0 V	2401.055 MHz	2480.965 MHz	2441.010 MHz	25 kHz
40 °C	3.0 V	2401.045 MHz	2480.945 MHz	2440.995 MHz	10 kHz
50 °C	3.0 V	2401.035 MHz	2480.935 MHz	2440.985 MHz	0 kHz
60 °C	3.0 V	2401.035 MHz	2480.935 MHz	2440.985 MHz	0 kHz
65 °C	3.0 V	2401.005 MHz	2480.885 MHz	2440.945 MHz	-40 kHz

Table 30



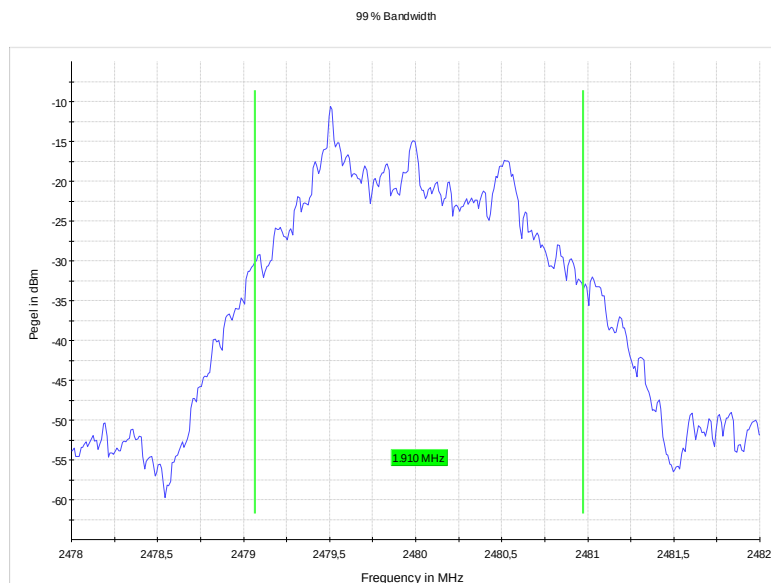
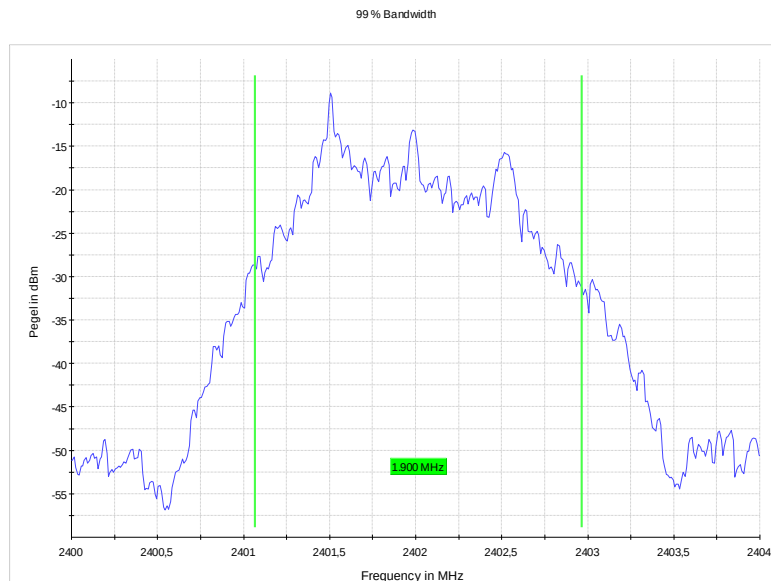
3.0 V, -20 °C



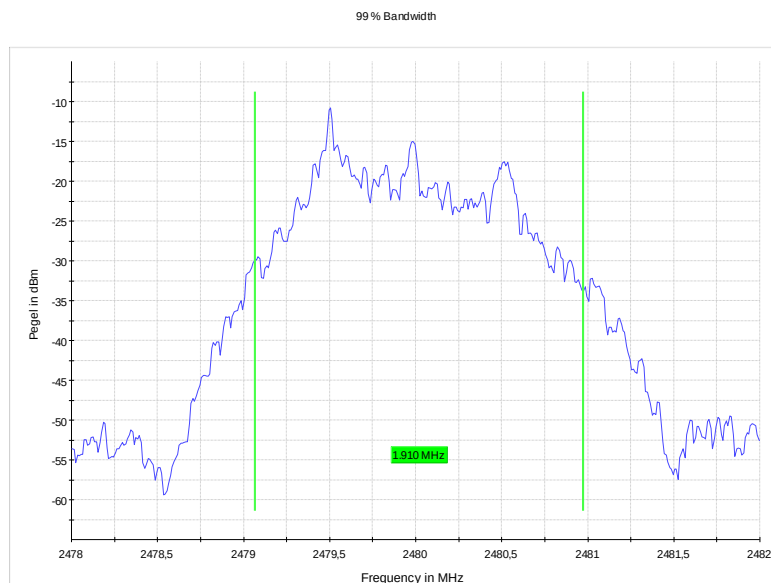
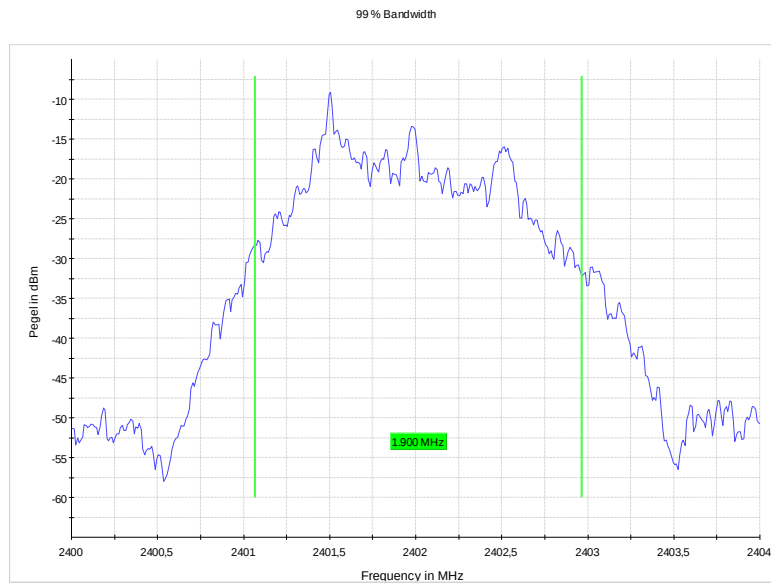
3.0 V, -10 °C



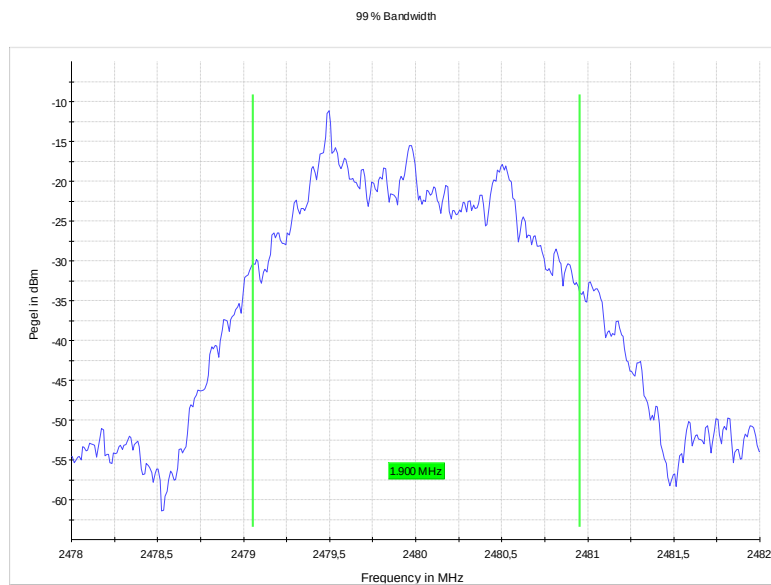
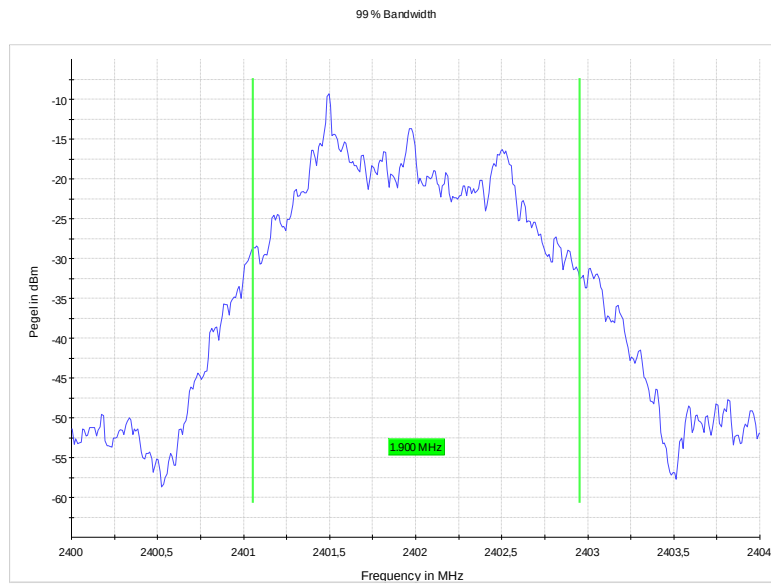
Product Service



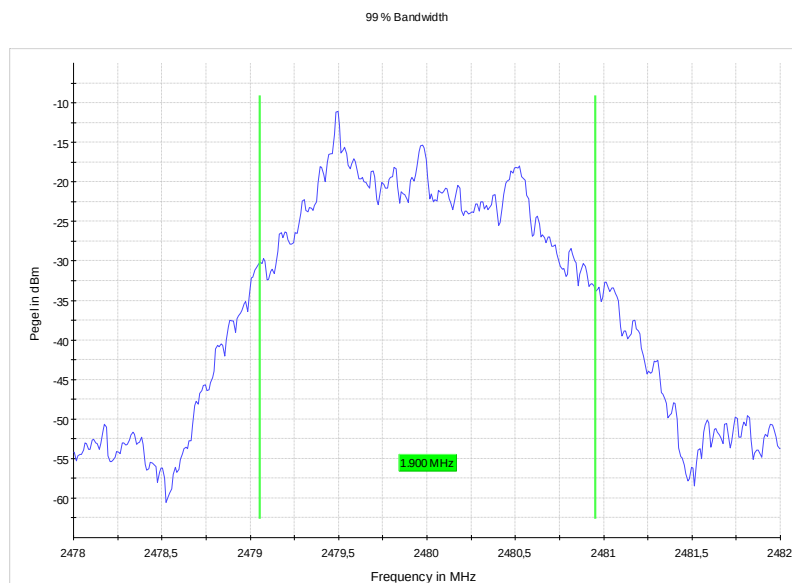
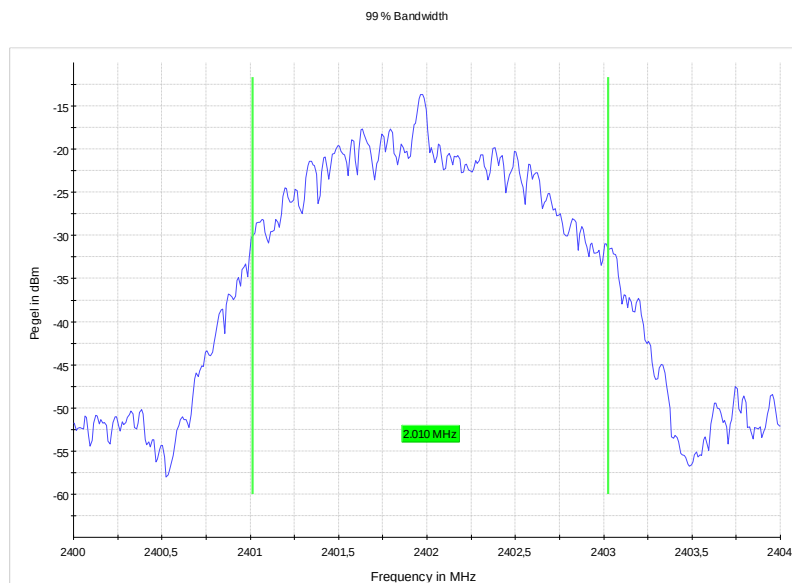
3.0 V, 0 °C



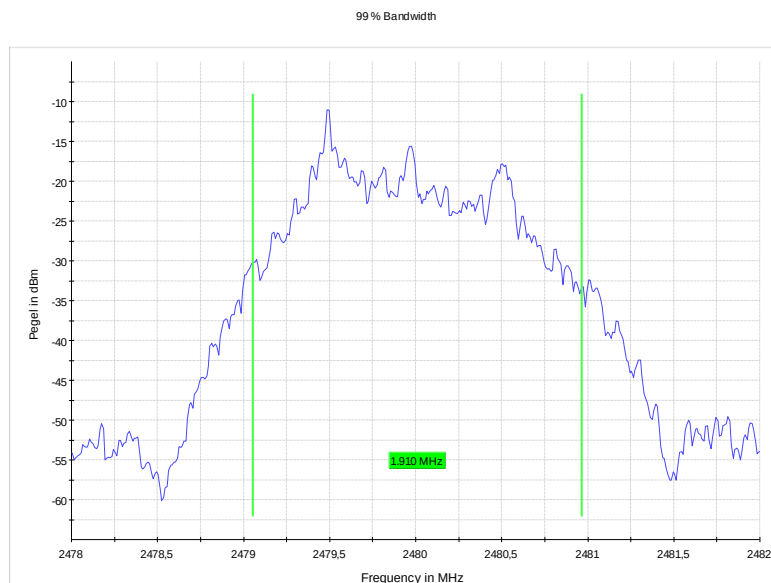
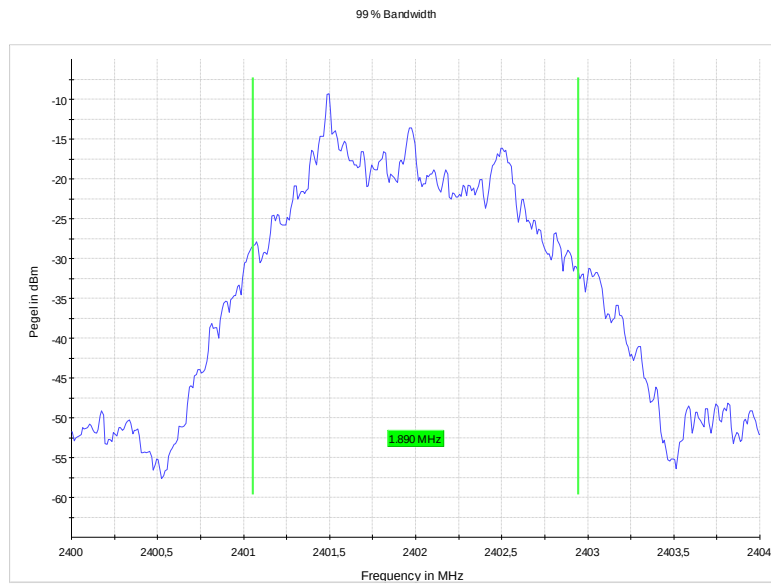
3.0 V, 10 °C



2.5 V, 20 °C



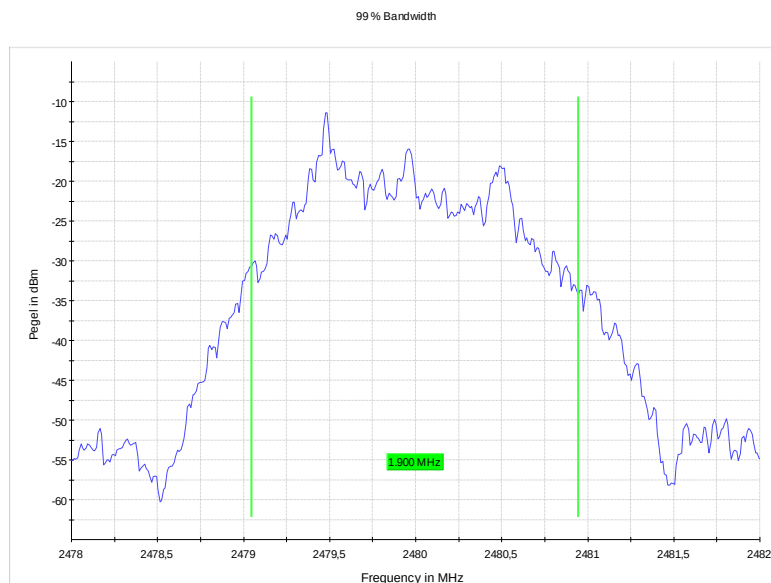
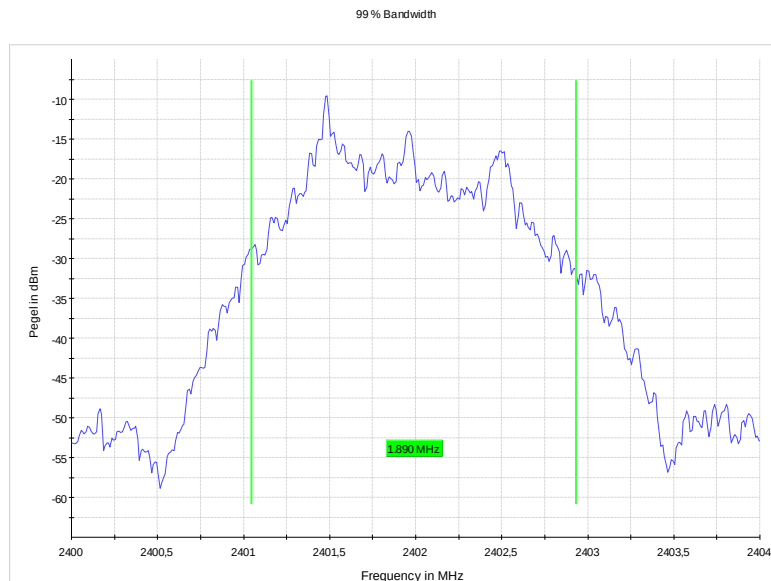
3.0 V, 20 °C



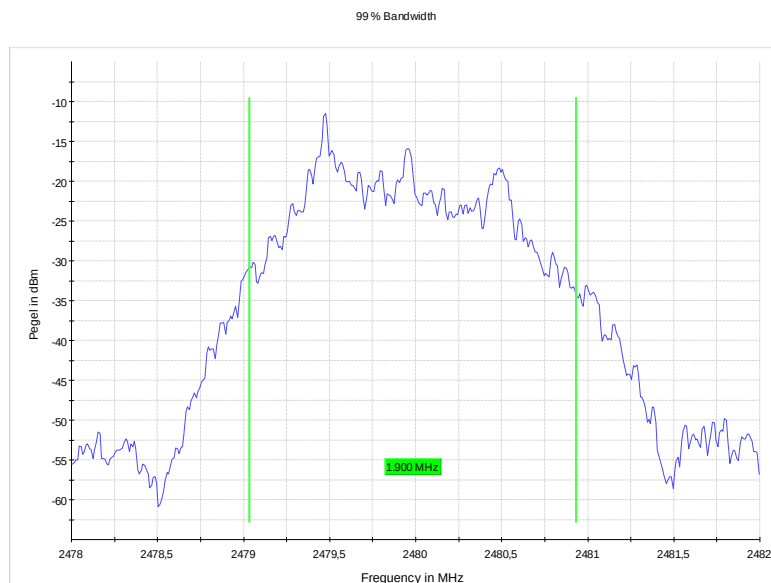
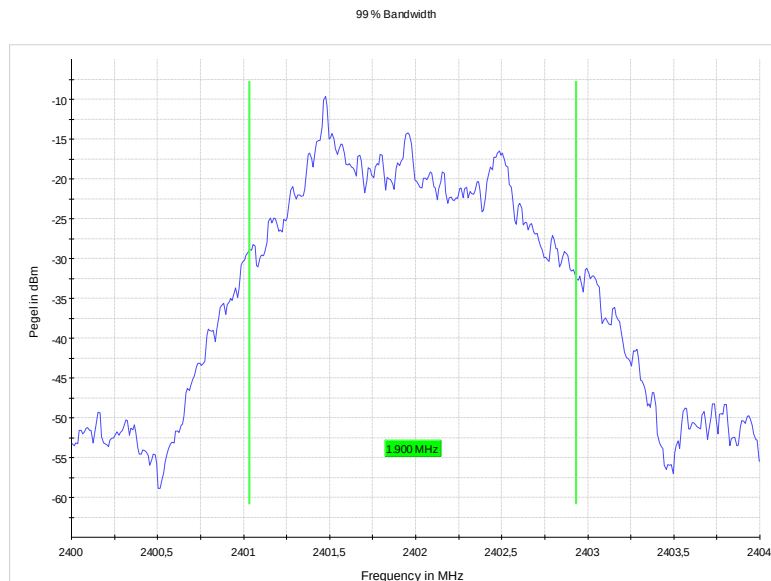
3.0 V, 30 °C



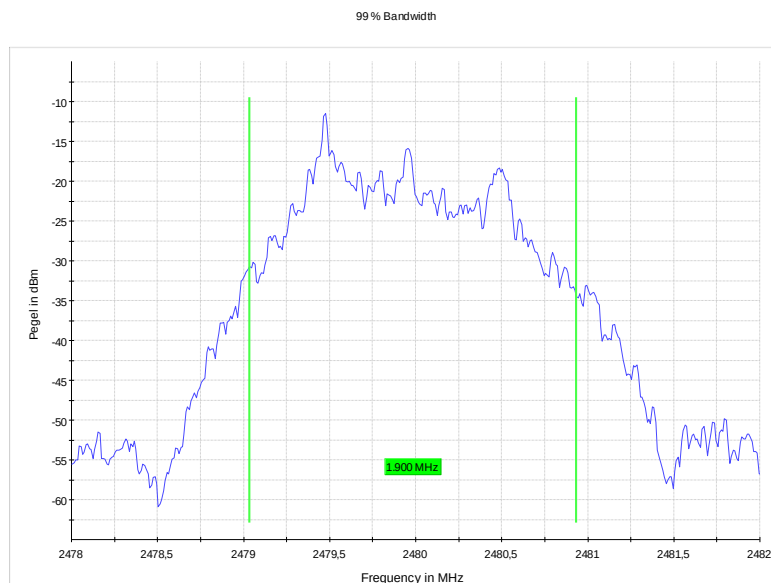
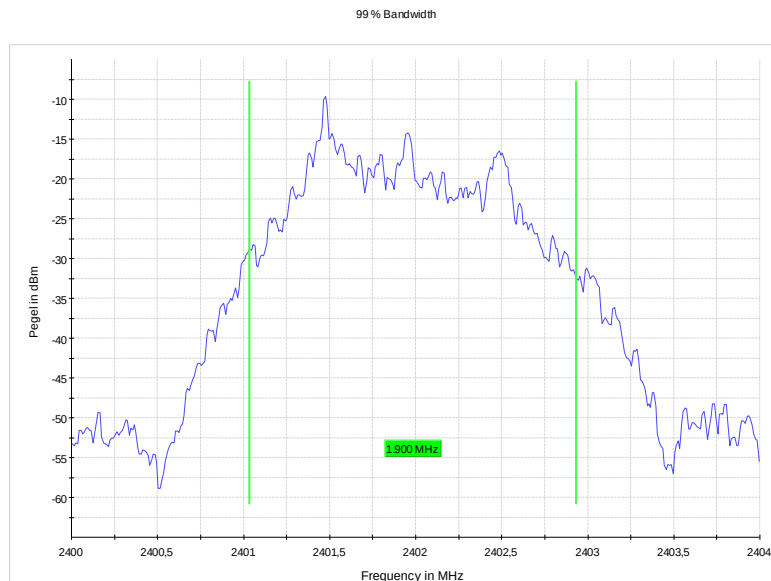
Product Service



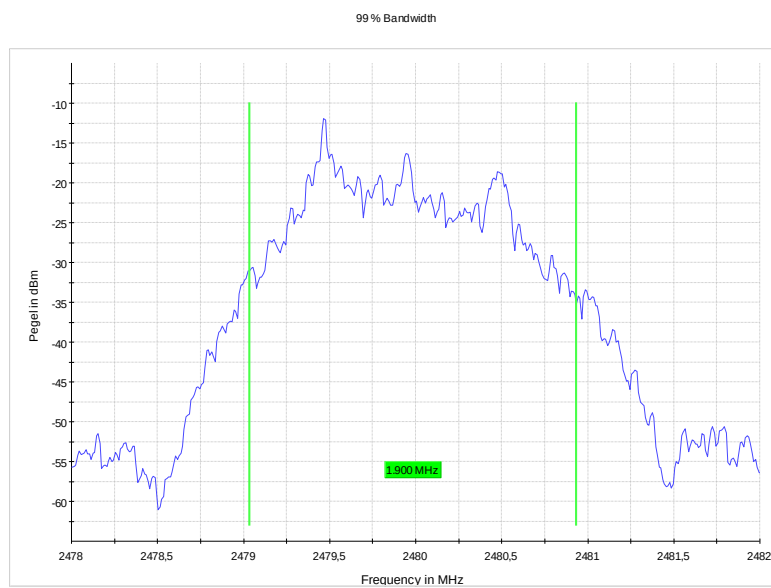
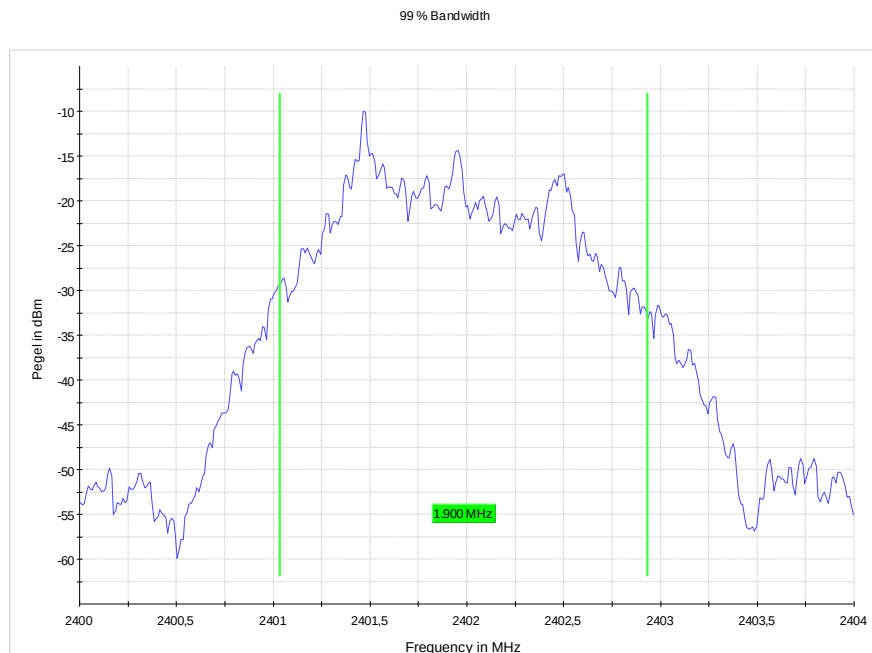
3.0 V, 40 °C



3.0 V, 50 °C



3.0 V, 60 °C



3.0 V, 65 °C

2.7.8 Test Location and Test Equipment

The test was carried out in Radio Test Laboratory



Product Service

<i>Instrument</i>	<i>Manufacturer</i>	<i>Type No</i>	<i>TE No</i>	<i>Calibration Period (months)</i>	<i>Calibration Due</i>
Switching device	Rohde & Schwarz	OSP120 for TS8997	20248	36	2026-07-31
Signal and spectrum analyser	Rohde & Schwarz	FS40	20219	24	2026-03-31
Climatic test chamber	ESPEC	PL-4J	38958	24	2025-01-31
EMC measurement software	Rohde & Schwarz	EMC32 TS8997 – V10.60.00	44381	---	---

Table 31



3 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

<i>Radio Interference Emission Testing</i>		
<i>Test Name</i>	<i>kp</i>	<i>Expanded Uncertainty</i>
Conducted Voltage Emission		
9 kHz to 150 kHz (50Ω/50μH AMN)	2	± 3.8 dB
150 kHz to 30 MHz (50Ω/50μH AMN)	2	± 3.4 dB
100 kHz to 200 MHz (50Ω/5μH AMN)	2	± 3.6 dB
Discontinuous Conducted Emission		
9 kHz to 150 kHz (50Ω/50μH AMN)	2	± 3.8 dB
150 kHz to 30 MHz (50Ω/50μH AMN)	2	± 3.4 dB
Conducted Current Emission		
9 kHz to 200 MHz	2	± 3.5 dB
Magnetic Fieldstrength		
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB
Radiated Emission		
30 MHz to 300 MHz	2	± 4.9 dB
300 MHz to 1 GHz	2	± 5.0 dB
1 GHz to 6 GHz	2	± 4.6 dB
Test distance 10 m		
30 MHz to 300 MHz	2	± 4.9 dB
300 MHz to 1 GHz	2	± 4.9 dB
The expanded uncertainty reported according to CISPR16-4-2: 2011 + A1 + A2 + Cor1 is based on a standard uncertainty multiplied by a coverage factor of $k_p = 2$, providing a level of confidence of $p = 95.45\%$		

Table 32 Measurement uncertainty based on CISPR 16-4-2



<i>Radio Interference Emission Testing</i>		
<i>Test Name</i>	<i>kp</i>	<i>Expanded Uncertainty</i>
Occupied Bandwidth	2	± 5 %
Conducted Power		
9 kHz ≤ f < 30 MHz	2	± 1.0 dB
30 MHz ≤ f < 1 GHz	2	± 1.5 dB
1 GHz ≤ f ≤ 40 GHz	2	± 2.5 dB
1 MS/s power sensor (TS8997)	2	± 1.5 dB
Occupied Bandwidth	2	± 5 %
Power Spectral Density	2	± 3.0 dB
Radiated Power		
25 MHz – 6 GHz	1.96	±4.4 dB
1 GHz – 18 GHz	1.96	±4.7 dB
18 GHz – 40 GHz	1.96	±4.9 dB
40 GHz – 325 GHz	1.96	±6.1 dB
Conducted Spurious Emissions	2	± 3.0 dB
Radiated Spurious Emissions	2	± 6.0 dB
Voltage		
DC	2	± 1.0 %
AC	2	± 2.0 %
Time (automatic)	2	± 5 %
Frequency	2	± 10 ⁻⁷
The expanded uncertainty reported according to ETSI TR 100 028:2001 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%		

Table 33 Measurement uncertainty based on ETSI TR 100 028

The measurement uncertainty in the laboratory is less than or equal to the maximum measurement uncertainty according to CISPR16-4-2: 2011 + A1 + A2 + Cor1 (U_{CISPR}) and as specified in the test report below. This normative regulation means that the measured value is also the value to be assessed in relation to the limit value.



Test Name	Expanded Uncertainty
Occupied Bandwidth	±5 %
Conducted Power	
9 kHz ≤ f < 30 MHz	±1.0 dB
30 MHz ≤ f < 1 GHz	±1.5 dB
1 GHz ≤ f ≤ 40 GHz	±2.5 dB
1 MS/s power sensor (2.4 / 5 GHz band)	±1.5 dB
Power Spectral Density	±3.0 dB
Radiated Power	
25 MHz – 26.5 GHz	±6.0 dB
26.5 GHz – 66 GHz	±8.0 dB
40 GHz – 325 GHz	±10.0 dB
Conducted Spurious Emissions	±3.0 dB
Radiated Field Strength 9 kHz – 40 GHz	±6.0 dB
Voltage	
DC	± 1.0 %
AC	± 2.0 %
Time (automatic)	± 5 %
Frequency	± 10 ⁻⁷

Table 34 Decision Rule: Maximum allowed measurement uncertainty

END OF TEST REPORT