DAkkS Deutsche Akkreditierungsstelle D-PL-21375-01-00

LENHARDT WORLDWIDE | TESTING | CERTIFICATION

Bundesnetzagentur BNetzA-CAB-21/21-21

Test Report

Test report no.: 25031202-45432-0
Date of issue: 2025-10-20

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

Applicant
Raspberry Pi LTD

Manufacturer
Raspberry Pi LTD

Test Item
Raspberry Pi Compute Module 0

RF-Spectrum Testing according to:

FCC 47 CFR Part 15
Radio Frequency Devices – Subpart C
§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz

RSS-247, Issue 4 (2025-07)
Digital Transmission Systems, Frequency Hopping Systems and Licence-Exempt Local Area Network Devices in 902-928 MHz, 2400-2483.5 MHz, 5150-5350 MHz, and 5470-5895 MHz bands

RSS-Gen, Issue 5 (2018-04) & A1 (2019-03) & A2 (2021-02)
General Requirements for Compliance of Radio Apparatus

Tested by (name, function, signature)	*Karsten Geraldy* *Lab Manager RF*	signature
Approved by (name, function, signature)	*Andreas Bender* *Deputy Managing Director*	signature

Applicant and Test item details	
Applicant	Raspberry Pi LTD 194 Cambridge Science Park, Milton Road CB4 0AB, Cambridge, United Kingdom Fon: +44 (0) 1223 322 633
Manufacturer	Raspberry Pi LTD 194 Cambridge Science Park, Milton Road CB4 0AB, Cambridge, United Kingdom
Test item description	Single board computer module design for embedded computing applications.
Model/Type reference	Raspberry Pi Compute Module 0
Standard specific information	
FCC ID	2ABCB-RPICM0
IC	20953-RPICM0
HMN	N/A
PMN	CM0
HVIN	CM0
FVIN	N/A
Technology	Bluetooth Basic Data Rate (BDR), Enhanced Data Rate (EDR)
Frequency	2.4 GHz ISM band (2400 – 2483.5 MHz)
Antenna	external antenna
Power supply	5.0 V – 5.1 V DC
Temperature range	-20 °C – +50 °C

Disclaimer and Notes

The content of this report relates to the mentioned test sample(s) only.
IBL-Lab GmbH does not take samples. The samples used for testing are provided by the applicant.
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Within this test report, a ☒ point / ☐ comma is used as a decimal separator.
If otherwise, a detailed note is added adjected to its use.

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

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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: https://ib-lenhardt.com/ E-Mail: info@ib-lenhardt.com
Accreditation / Designation	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: • Attachment to the accreditation certificate D-PL-21375-01-00 ○ Electronics ○ Electromagnetic Compatibility ○ Radio ○ Electromagnetic Compatibility and Telecommunication (FCC requirements) ○ Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards ○ Automotive EMC Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the ILAC Mutual Recognition Arrangement. • Designations ○ FCC Testing Laboratory Designation Number DE0024 ○ ISED ISED Company Number 27156 Testing Laboratory CAB Identifier DE0020 ○ Kraftfahrt-Bundesamt KBA-P 00120-23
Testing location	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	2025-06-26
Start – End of tests	2025-07-22 – 2025-10-08

2.2 Possible test case verdicts

Test sample meets the requirements	P (PASS) – the measured value is below the acceptance limit, AL = TL
Test sample does not meet the requirements	F (FAIL) – the measured value is above the acceptance limit, AL = TL
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 Document history

-0 Initial Version

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 of test laboratory

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

3.2 Normal and extreme test conditions

	minimum	nominal	maximum
Temperature	-20 °C	20 °C	+50°C
Relative humidity	-/-	45 % r.h.	-/-
Power supply	5.0 V DC	5.1 V DC	5.1 V DC

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
FCC 47 CFR Part 15	Radio Frequency Devices – Subpart C § 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz
RSS-247, Issue 4 (2025-07)	Digital Transmission Systems, Frequency Hopping Systems and Licence-Exempt Local Area Network Devices in 902-928 MHz, 2400-2483.5 MHz, 5150-5350 MHz, and 5470-5895 MHz bands
RSS-Gen, Issue 5 (2018-04) & A1 (2019-03) & A2 (2021-02)	General Requirements for Compliance of Radio Apparatus

Reference	Description
ANSI C63.4-2014 / A1-2017	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 (2014-06-13) + A1 (2017-09-15)
ANSI C63.10-2020 / Cor1-2023 / A1-2024 / A1-2024 (errata)	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (2020-09-10) + Cor1 (2023-04-10) + A1 (2024-08-08) + Errata A1 (2024-11-18)
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

Single board computer module design for embedded computing applications.

*: as declared by applicant

5.2 Test Item Description

Model name*	Raspberry Pi Compute Module 0
Serial number*	conducted sample: #1 radiated sample: #3
Hardware status*	v1
Software status*	v1

*: as declared by applicant; please see Annex A, B for EUT photographs.

5.3 Technical Data of Equipment

Technology*	Bluetooth Basic Data Rate (BDR), Enhanced Data Rate (EDR)
Operational frequency band*	2.4 GHz ISM band (2400 – 2483.5 MHz)
Operational carrier frequency*	2402 – 2480 MHz
Modulation type*	FHSS – GFSK, π/4-DQPSK, 8DPSK
Data rate*	1 Mbps, 2 Mbps, 3 Mbps
Number of channels*	79
Channel bandwidth*	1 MHz
Channel spacing*	1 MHz
Antenna*	external antenna
Antenna gain*	3.7 dBi
Power supply*	5.0 V – 5.1 V DC
Temperature range*	-20 °C – +50 °C

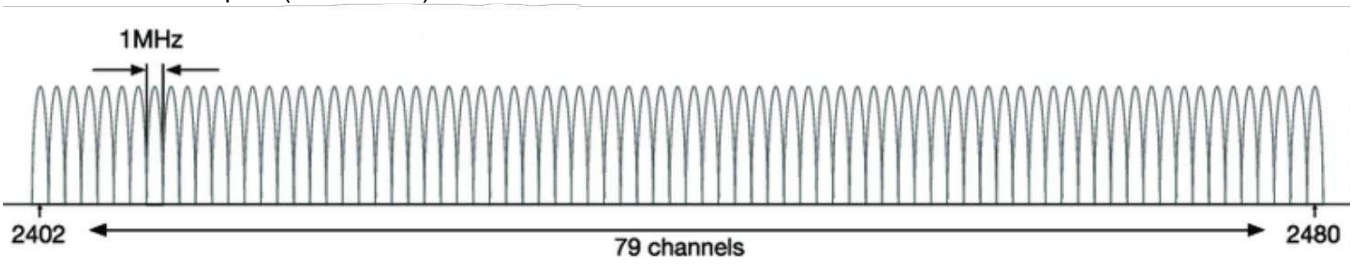
*: as declared by applicant

5.4 Additional Information

Model differences	– none –
Ancillaries tested with	– none –
Additional equipment used for testing	tp-link Archer AX1800 Dual Band Wi-Fi 6 Router and Raspberry Pi 500+ with test tool / test script

5.5 Test modes	
OP 1	1-DH5: GFSK, 1 Mbps
OP 2	2-DH5: π/4-DQPSK, 2 Mbps
OP 3	3-DH5: 8DPSK, 3 Mbps
Low Channel	CH00: 2402 MHz
Mid Channel	CH39: 2441 MHz
High Channel	CH78: 2480 MHz

Bluetooth channel plan (informative):



6 SUMMARY OF TEST RESULTS

Test specification
FCC 47 CFR Part 15 RSS-247, Issue 4 (2025-07) / RSS-Gen, Issue 5 (2018-04) & A1 (2019-03) & A2 (2021-02)

Clause	Requirement / Test Case	Result - Remark	Result	Verdict
15.247 (a)(1) RSS-247, 6.2.3.1a)	Carrier frequency separation	KDB 558074, clause: 9	≥ 980 kHz	**- PASS -**
15.247 (a)(1)(iii) RSS-247, 6.2.3.1b)	Number of frequency hopping channels	KDB 558074, clause: 9	79	**- PASS -**
15.247 (a)(1)(iii) RSS-247, 6.2.3.1b)	Time of channel occupancy	KDB 558074, clause: 9	≤ 210 ms	**- PASS -**
15.247 (a)(1) RSS-247, 6.2.1 a)	20 dB bandwidth	KDB 558074, clause: 2.2	≤ 1330 kHz	**- PASS -**
RSS Gen, 6.7	Occupied bandwidth (99%)	-/-	≤ 1215 kHz	**- PASS -**
15.247 (b)(1) RSS-247, 6.2.3.2	RF output power (conducted peak power)	KDB 558074, clause: 9	6.2 dBm	**- PASS -**
§15.247(b)(4) RSS-247, 6.2.3.2.c)	Antenna gain, Peak EIRP	-/-	3.7 dBi 9.9 dBm	**- PASS -**
15.247 (d) RSS-247, 6.6	Band edge compliance (BEC), conducted	KDB 558074, clause: 9	< limit	**- PASS -**
15.247 (d) RSS-247, 6.6	Band edge compliance (BEC), radiated	KDB 558074, clause: 9	< limit	**- PASS -**
15.247 (d) RSS-247, 6.6	Conducted spurious emissions (CSE)	KDB 558074, clause: 9	< limit	**- PASS -**
15.247(d) / §15.209 RSS-247, 6.6 / RSS-Gen, 8.9	Radiated spurious emissions (RSE)	-/-	< limit	**- PASS -**
§15.207 RSS-Gen, 8.8	AC conducted emissions	EUT is battery powered	< limit	**- PASS -**

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)
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.

RSS-247, 6.2.3.1 a)
FHS operating in the band 2400-2483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W.

Test procedure
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) ≥ $^1/_{10}$ 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.

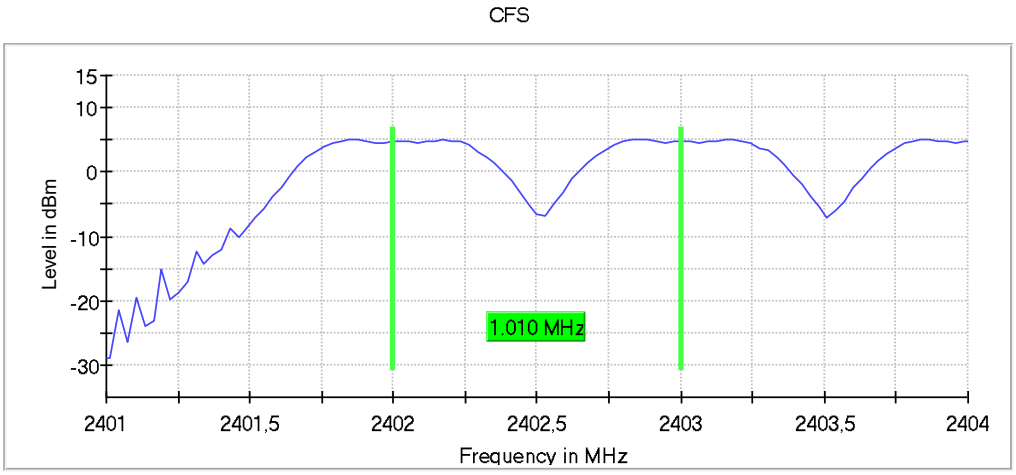
Test setup: 8.4 with conducted test sample in hopping mode (see section 5.2)

Test Results

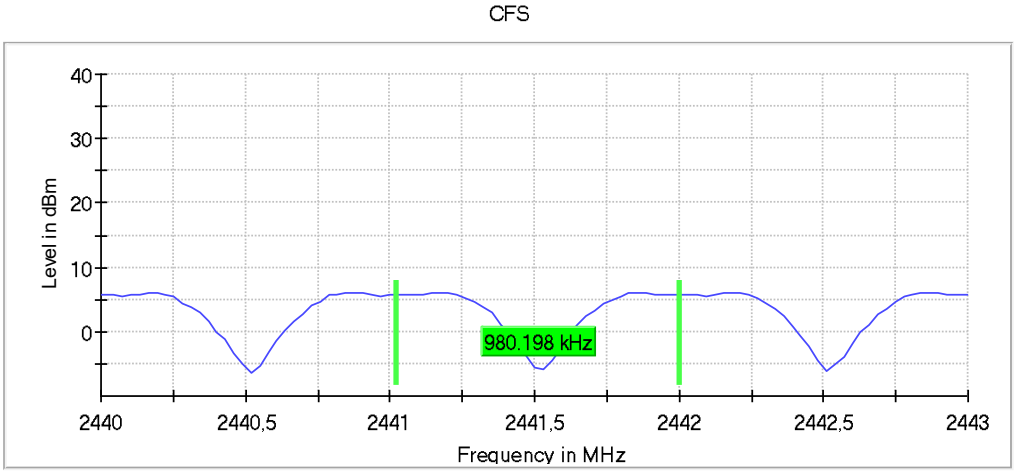
EUT Mode	Carrier frequency separation			Limit
	low channel [kHz]	mid channel [kHz]	high channel [kHz]	
OP 1	1010	980.2	980.2	≥ $^2/_3$ of 20 dB BW

Verdict	- PASS -	see next plots

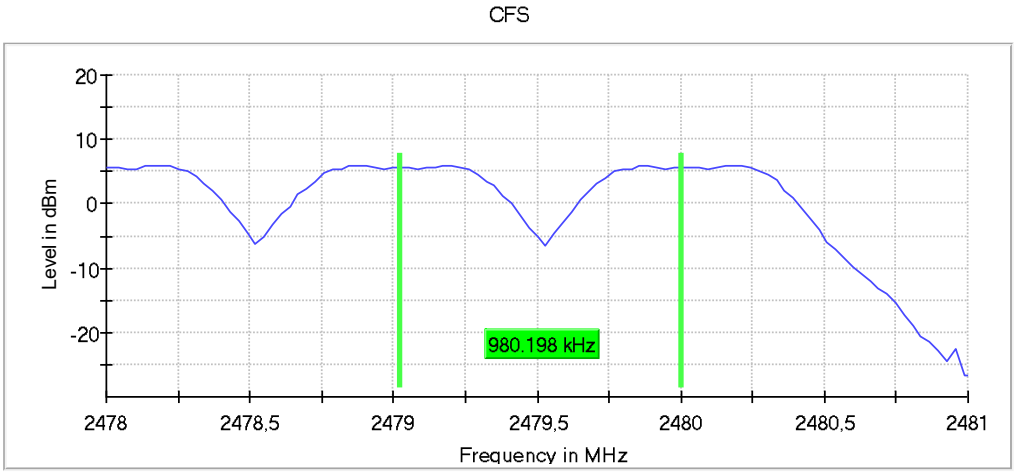
Plot 1: Carrier Frequency Separation, OP 1, low channel



Plot 2: Carrier Frequency Separation, OP 1, mid channel



Plot 3: Carrier Frequency Separation, OP 1, high channel



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

RSS-247, 6.2.3.1 b)
FHS operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 s within a period of 0.4 s, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

Test procedure
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 ≥ 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 in hopping mode (see section 5.2)

Test Results

EUT Mode	Number of frequency hopping channels			Result
	Channels	Limit min	Limit max	
OP 1	79	15	-	≥ 15

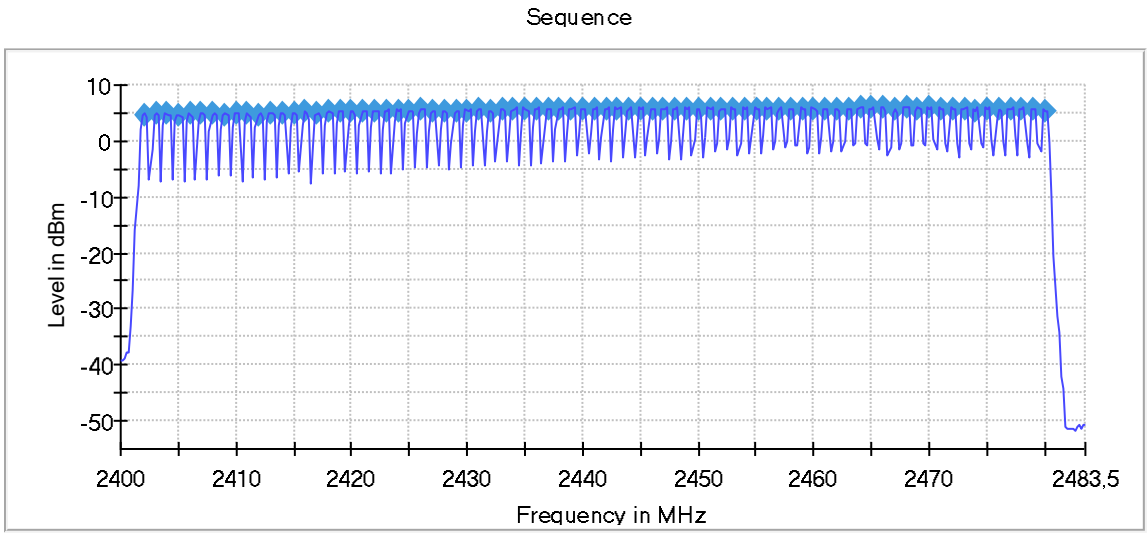
Comment:	---

Verdict	- PASS -	see next plots

Plot 4: No. of Hopping Frequencies, OP 1

Channels

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



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

RSS-247, 6.2.3.1 b)
FHS operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 s within a period of 0.4 s, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping 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 than 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:
a) Span: Zero span, centered on a hopping channel.
b) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected transmission time per hop.
c) 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/hopping rate) should achieve this.
d) 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.
e) Detector function: Peak.
f) Trace: Clear-write, single sweep.
g) 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 × 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 in hopping mode (see section 5.2)

Test Results

EUT Mode	Average time of occupancy			Limit [ms]
	low channel [ms]	mid channel [ms]	high channel [ms]	
OP 1	176.4	188.0	179.4	≤ 400
OP 2	162.9	174.4	197.1	≤ 400
OP 3	177.7	186.7	**209.6**	≤ 400

Comment:	---

Verdict	**- PASS -**	see next plots

Plot 5: Time of Channel Occupancy, OP 1, low channel

Result

DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Limit Max (ms)	Limit Min (ms)	Threshold (dBm)
2402.000000	PASS	61	176.410	400.000	0.000	-10.0

Periode

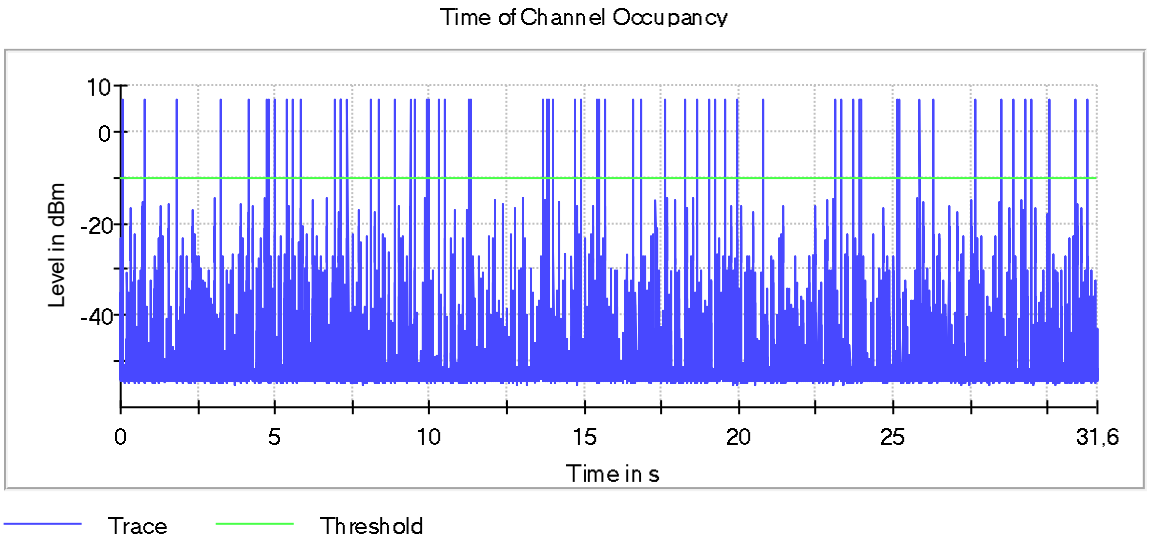
Min (ms)	Max (ms)	Mean (ms)
34.990	2334.960	519.865

Transmit Time per Hop

Min (ms)	Max (ms)	Mean (ms)
2.890	2.900	2.892

DwellTime

Min (ms)	Max (ms)	Mean (ms)
2.890	2.900	2.892



Plot 6: Time of Channel Occupancy, OP 1, mid channel

Result

DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Limit Max (ms)	Limit Min (ms)	Threshold (dBm)
2441.000000	PASS	65	188.010	400.000	0.000	-10.0

Periode

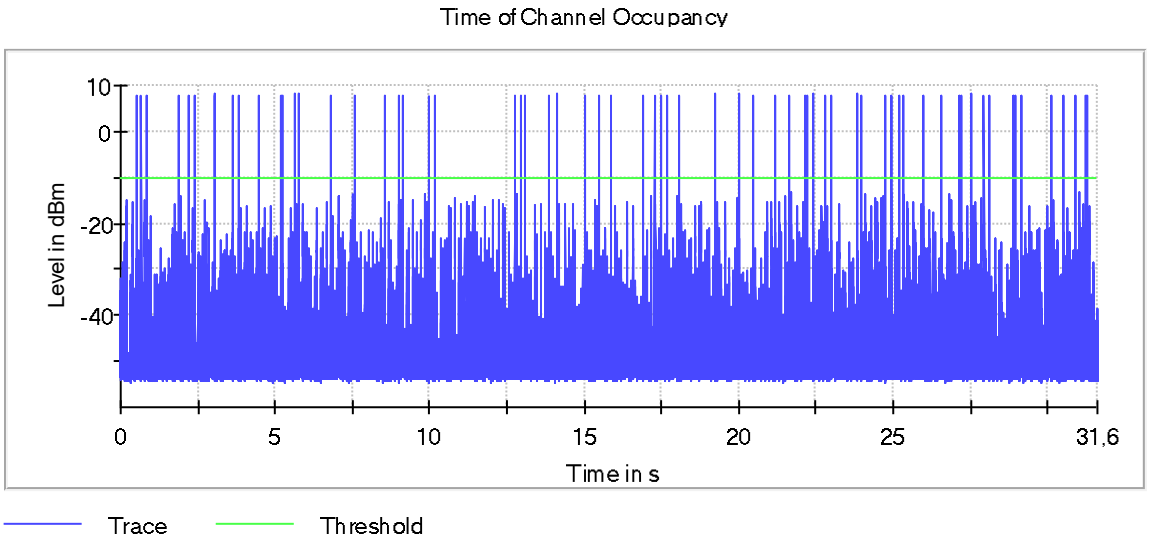
Min (ms)	Max (ms)	Mean (ms)
22.500	2558.700	480.459

Transmit Time per Hop

Min (ms)	Max (ms)	Mean (ms)
2.890	2.900	2.892

DwellTime

Min (ms)	Max (ms)	Mean (ms)
2.890	2.900	2.892



Plot 7: Time of Channel Occupancy, OP 1, high channel

Result

DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Limit Max (ms)	Limit Min (ms)	Threshold (dBm)
2480.000000	PASS	62	179.350	400.000	0.000	-10.0

Periode

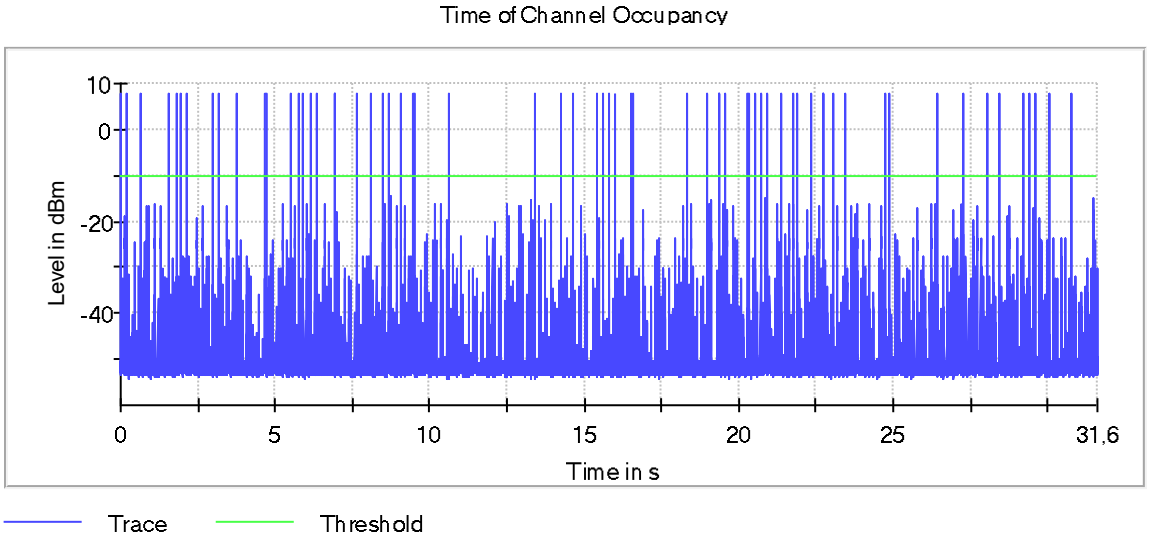
Min (ms)	Max (ms)	Mean (ms)
33.750	2799.940	504.211

Transmit Time per Hop

Min (ms)	Max (ms)	Mean (ms)
2.890	2.900	2.893

DwellTime

Min (ms)	Max (ms)	Mean (ms)
2.890	2.900	2.893



Plot 8: Time of Channel Occupancy, OP 2, low channel

Result

DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Limit Max (ms)	Limit Min (ms)	Threshold (dBm)
2402.000000	PASS	57	162.890	400.000	0.000	-10.0

Periode

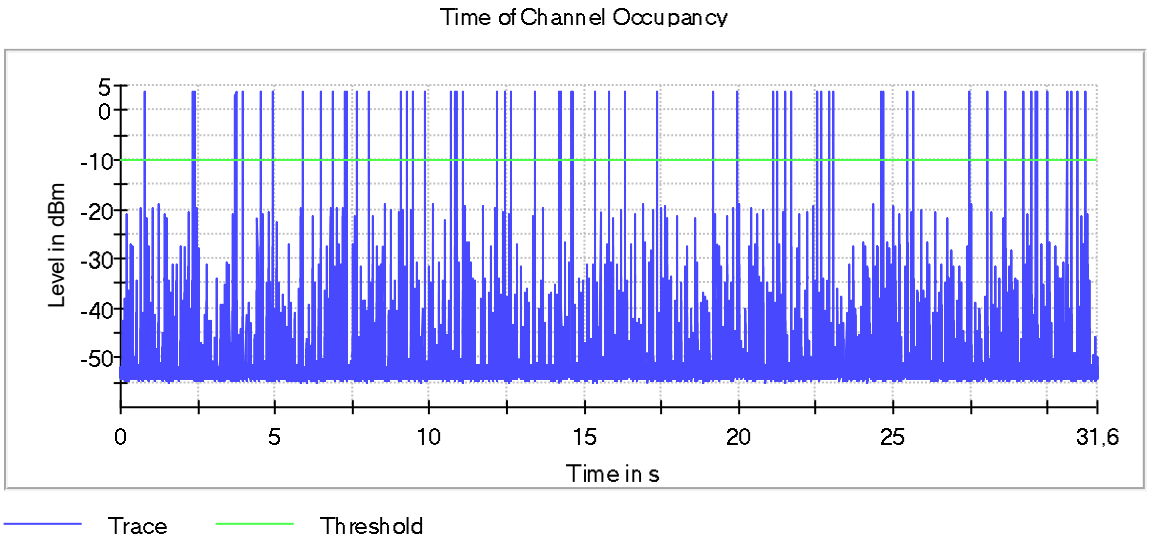
Min (ms)	Max (ms)	Mean (ms)
38.750	1824.960	543.359

Transmit Time per Hop

Min (ms)	Max (ms)	Mean (ms)
2.810	2.890	2.858

DwellTime

Min (ms)	Max (ms)	Mean (ms)
2.890	2.900	2.893



Plot 9: Time of Channel Occupancy, OP 2, mid channel

Result

DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Limit Max (ms)	Limit Min (ms)	Threshold (dBm)
2441.000000	PASS	61	174.400	400.000	0.000	-10.0

Periode

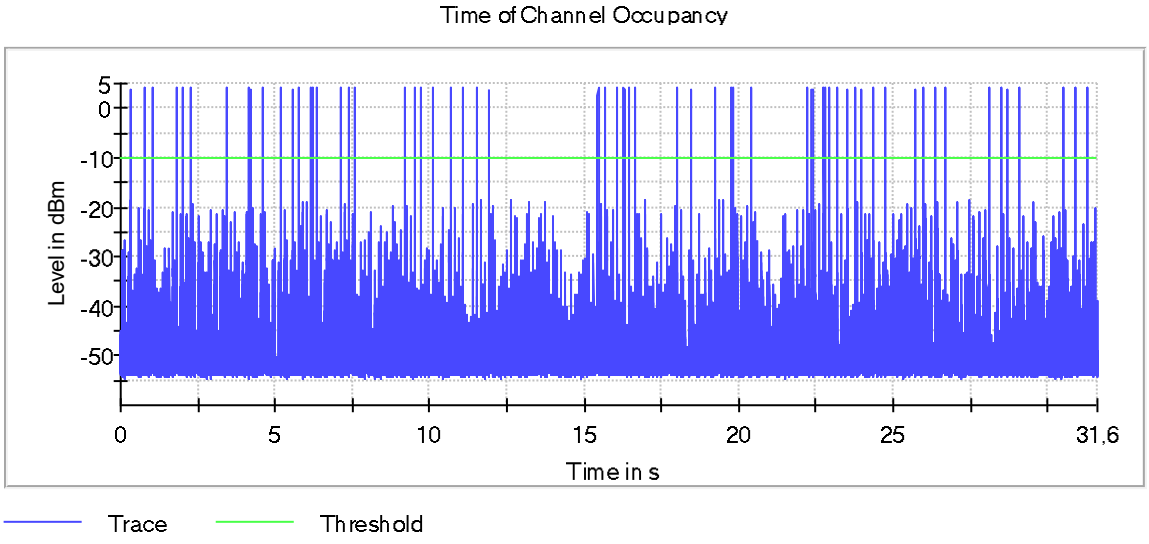
Min (ms)	Max (ms)	Mean (ms)
38.750	3514.930	516.073

Transmit Time per Hop

Min (ms)	Max (ms)	Mean (ms)
2.810	2.890	2.859

DwellTime

Min (ms)	Max (ms)	Mean (ms)
2.890	2.900	2.894



Plot 10: Time of Channel Occupancy, OP 2, high channel

Result

DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Limit Max (ms)	Limit Min (ms)	Threshold (dBm)
2480.000000	PASS	68	197.110	400.000	0.000	-10.0

Periode

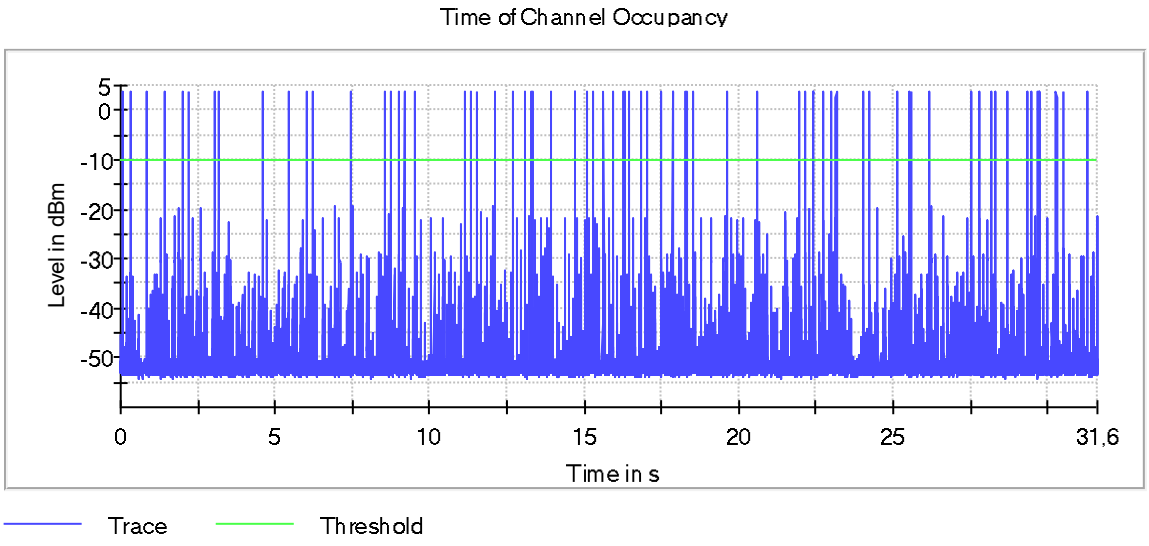
Min (ms)	Max (ms)	Mean (ms)
22.500	1604.970	465.942

Transmit Time per Hop

Min (ms)	Max (ms)	Mean (ms)
2.810	5.720	2.899

DwellTime

Min (ms)	Max (ms)	Mean (ms)
2.890	6.650	2.949



Plot 11: Time of Channel Occupancy, OP 3, low channel

Result

DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Limit Max (ms)	Limit Min (ms)	Threshold (dBm)
2402.000000	PASS	62	177.720	400.000	0.000	-10.0

Periode

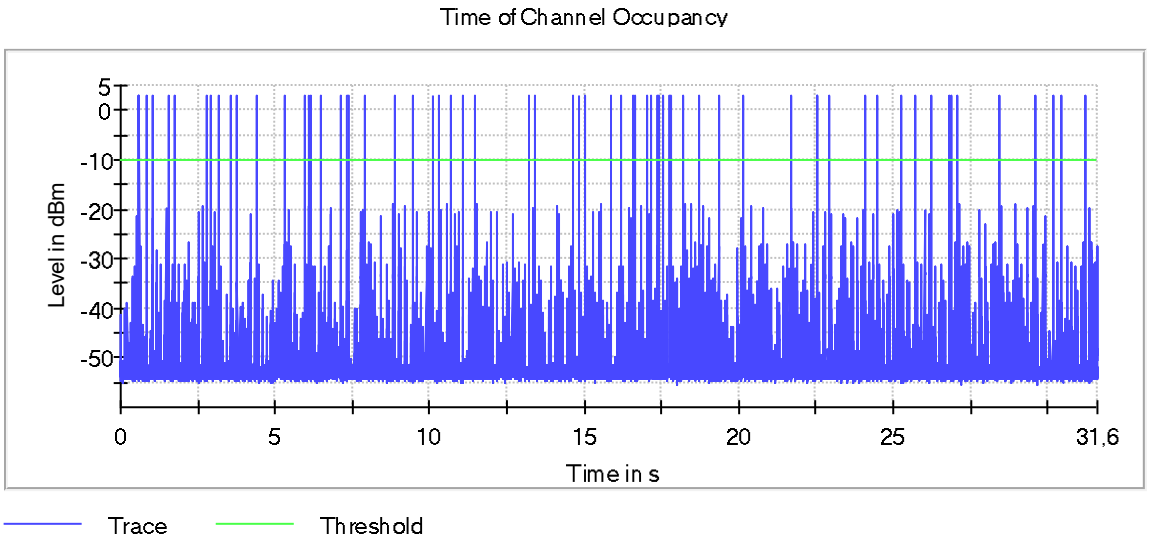
Min (ms)	Max (ms)	Mean (ms)
31.250	1739.970	502.449

Transmit Time per Hop

Min (ms)	Max (ms)	Mean (ms)
2.840	2.890	2.866

DwellTime

Min (ms)	Max (ms)	Mean (ms)
2.890	2.900	2.896



Plot 12: Time of Channel Occupancy, OP 3, mid channel

Result

DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Limit Max (ms)	Limit Min (ms)	Threshold (dBm)
2441.000000	PASS	65	186.670	400.000	0.000	-10.0

Periode

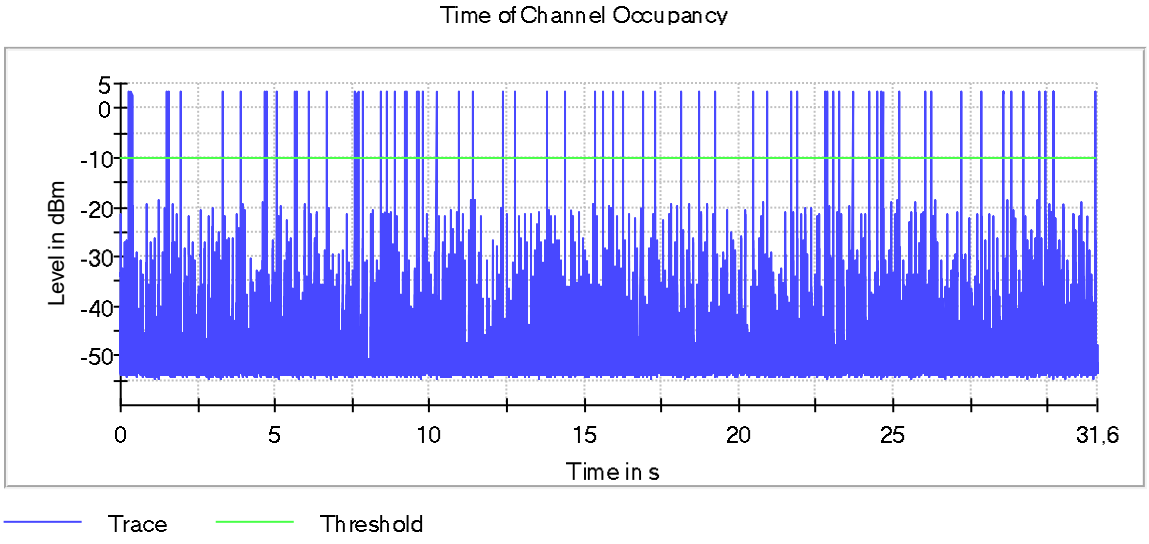
Min (ms)	Max (ms)	Mean (ms)
31.250	1366.220	488.447

Transmit Time per Hop

Min (ms)	Max (ms)	Mean (ms)
2.840	2.890	2.872

DwellTime

Min (ms)	Max (ms)	Mean (ms)
2.890	2.900	2.896



Plot 13: Time of Channel Occupancy, OP 3, high channel

Result

DUT Frequency (MHz)	Result	Number of Hops	Average time of occupancy (ms)	Limit Max (ms)	Limit Min (ms)	Threshold (dBm)
2480.000000	PASS	73	209.570	400.000	0.000	-10.0

Periode

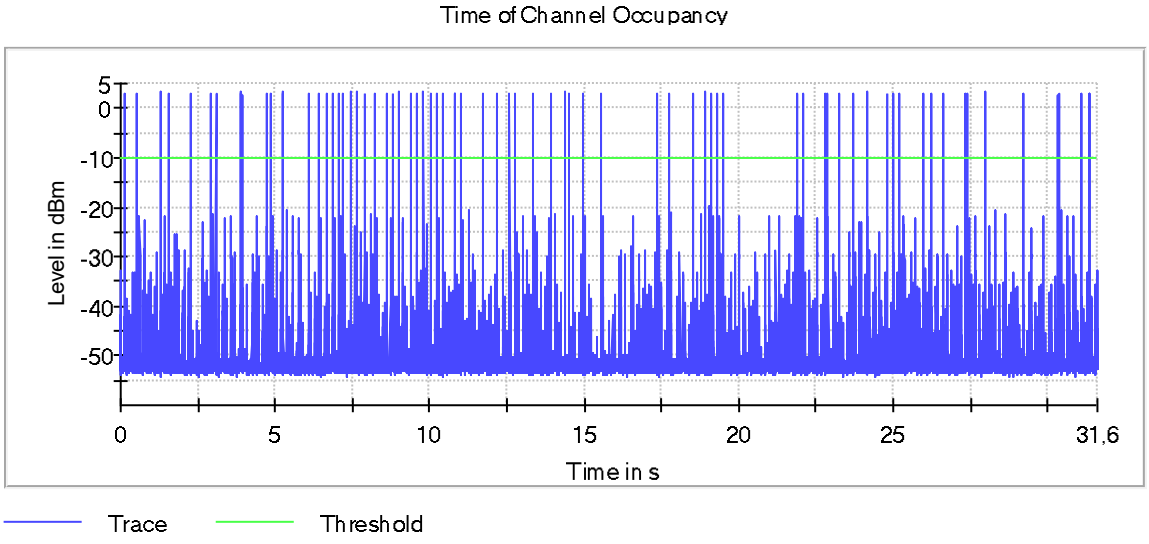
Min (ms)	Max (ms)	Mean (ms)
22.500	2368.700	433.880

Transmit Time per Hop

Min (ms)	Max (ms)	Mean (ms)
2.830	2.890	2.871

DwellTime

Min (ms)	Max (ms)	Mean (ms)
2.890	2.900	2.896



7.4 20 dB bandwidth

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 tow 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 C63.10a-2024, 6.9.1 General requirements

The minimum resolution bandwidth shall be set according to the frequency range as follows:

Frequency range	Resolution Bandwidth
9 kHz – 30 MHz	0.1 kHz
30 MHz – 1000 MHz	1 kHz
Above 1000 MHz	10 kHz

At the frequency range boundaries, the smaller resolution bandwidth shall be used.

ANSI C63.10, 6.9.2 Occupied bandwidth-relative measurement procedure

The following procedure shall be used for measuring the 6 dB BW, 20 dB BW, and 26 dB BW:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be at least three times RBW, unless otherwise specified by the applicable requirement.

c) 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 4.1.6.2.

d) Steps a) through c) might require iteration to adjust within the specified tolerances.

e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target "−xx dB down" requirement; that is, if the requirement calls for measuring the −20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.

f) Set detection mode to peak and trace mode to max-hold.

g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

h) Determine the "−xx dB down amplitude" using [(reference value) - xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.

i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).

j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the "−xx dB down amplitude" determined in step h). If a marker is below this "−xx dB down amplitude" value, then it shall be as close as possible to this value. The dBc bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the "−xx dB down amplitude" determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

k) The dBc bandwidth shall be reported by providing spectral 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).

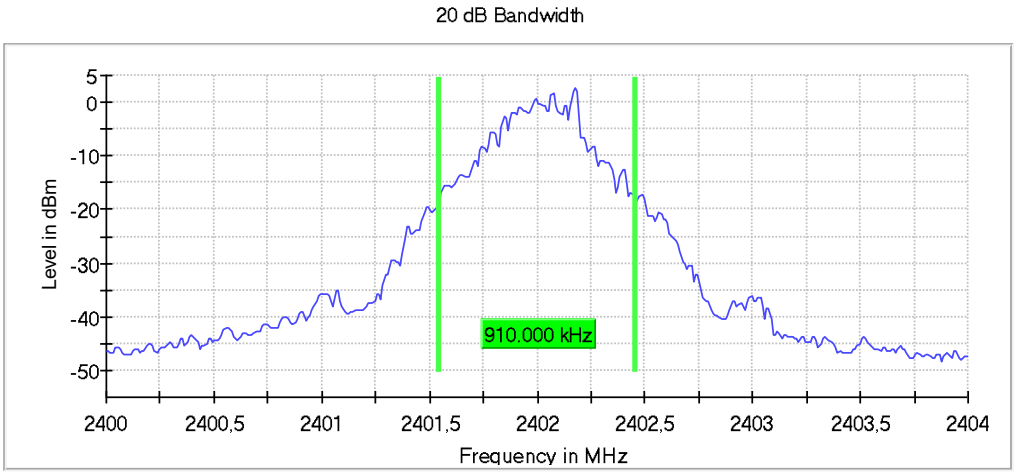
Test setup: 8.4 with conducted test sample in test mode (see section 5.2)
Test Results

EUT Mode	20 dB bandwidth		
	low channel [kHz]	mid channel [kHz]	high channel [kHz]
OP 1	910	900	900
OP 2	1325	**1330**	1325
OP 3	1315	1315	1305

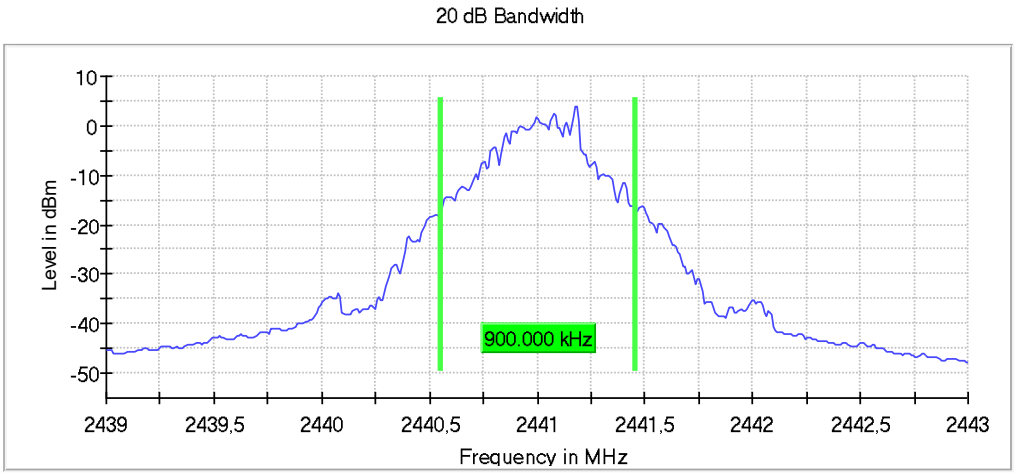
Comment:	---

Verdict	**- PASS -**	see next plots

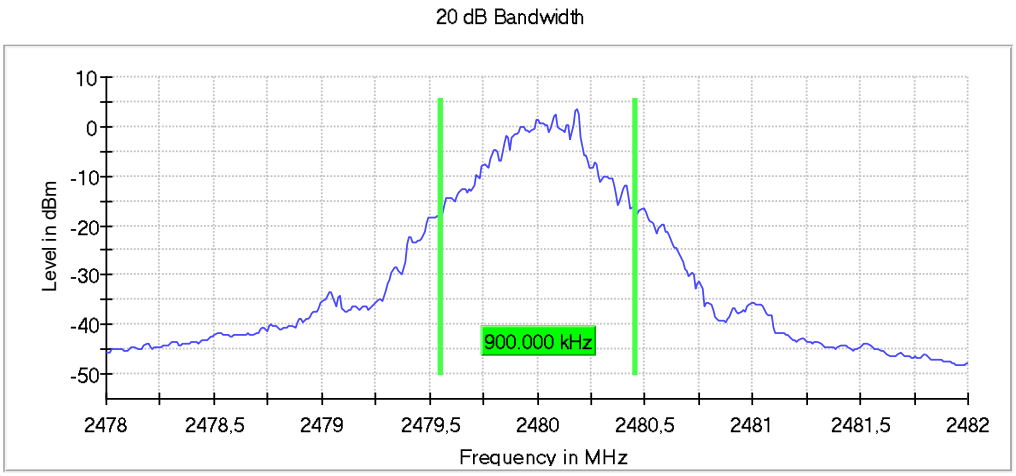
Plot 14: 20 dB bandwidth, OP 1, low channel



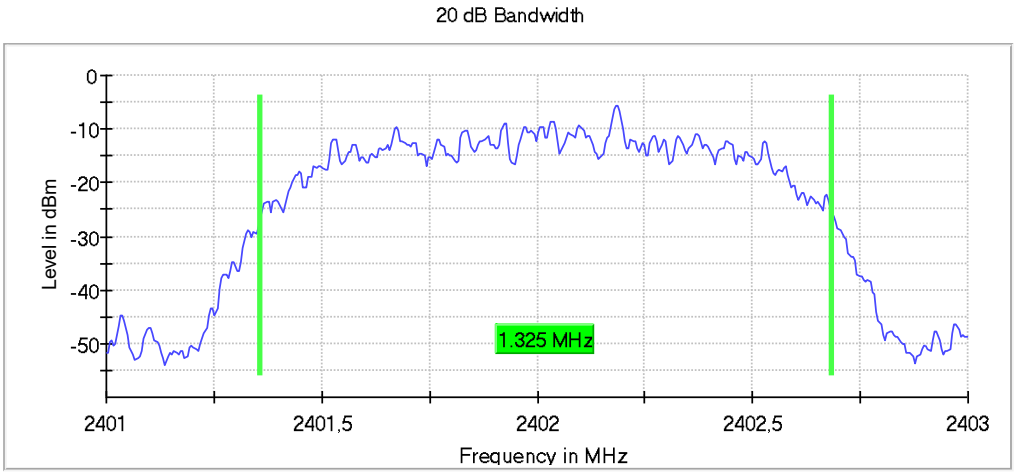
Plot 15: 20 dB bandwidth, OP 1, mid channel



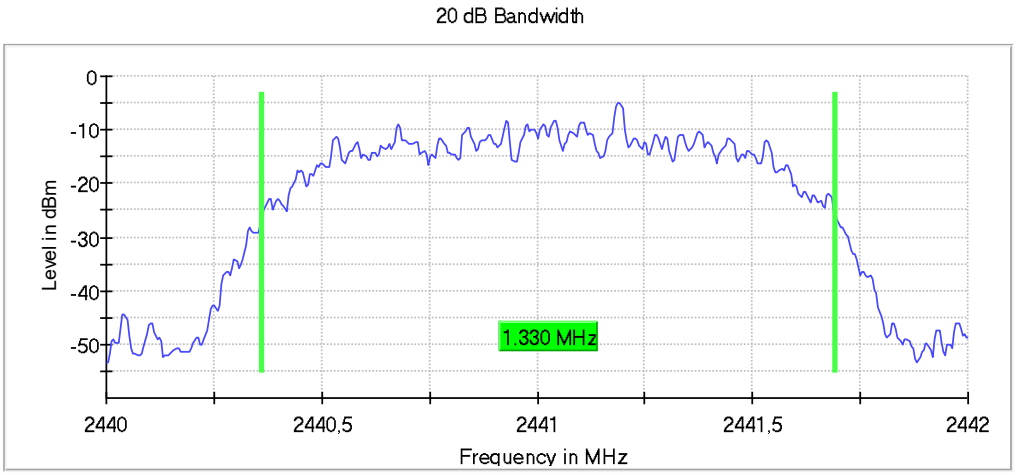
Plot 16: 20 dB bandwidth, OP 1, high channel



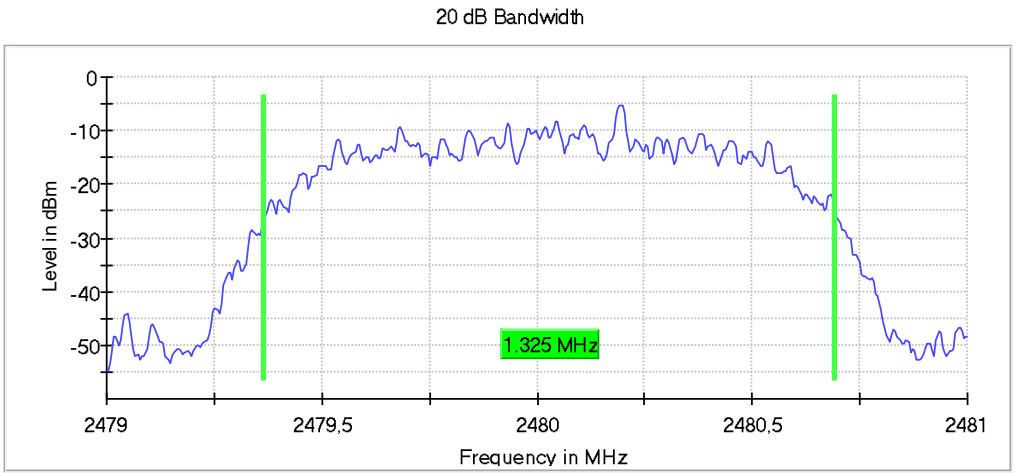
Plot 17: 20 dB bandwidth, OP 2, low channel



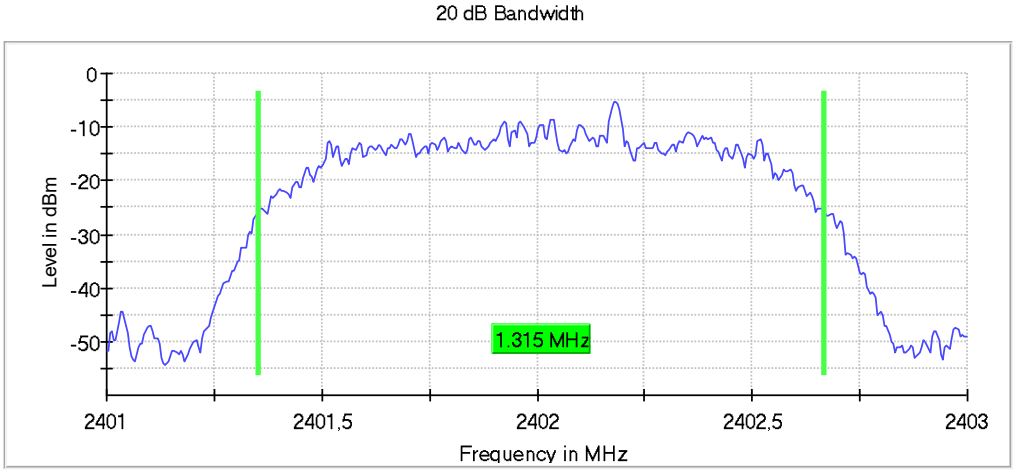
Plot 18: 20 dB bandwidth, OP 2, mid channel



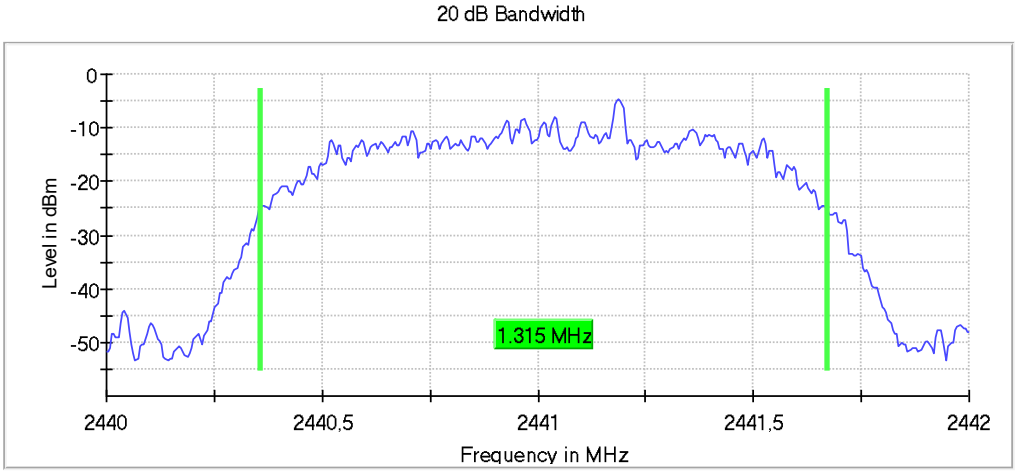
Plot 19: 20 dB bandwidth, OP 2, high channel



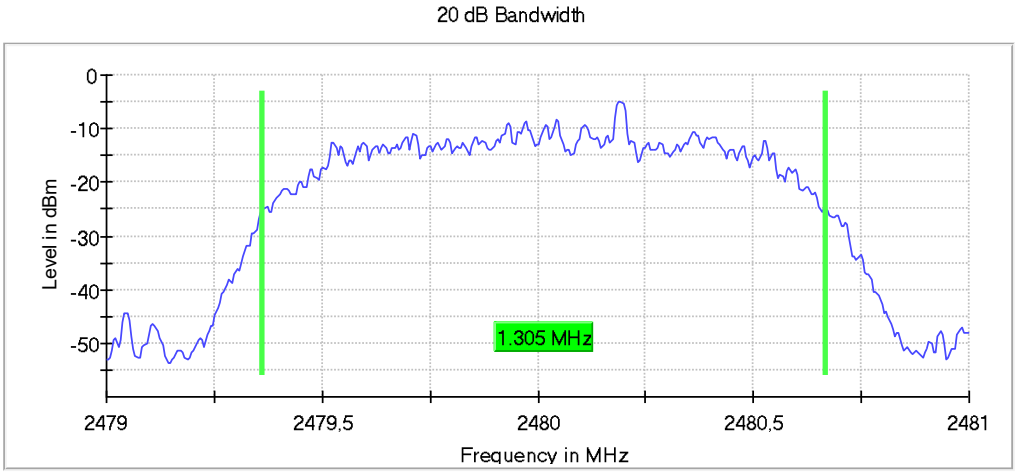
Plot 20: 20 dB bandwidth, OP 3, low channel



Plot 21: 20 dB bandwidth, OP 3, mid channel



Plot 22: 20 dB bandwidth, OP 3, high channel



7.5 Occupied Bandwidth (99%)

Applicability
This requirement applies to all types of equipment.

Description
RSS-Gen, 6.7
The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

Limit
No limit defined.

Test procedure
ANSI C63.10a-2024, 6.9.1 General requirements
The minimum resolution bandwidth shall be set according to the frequency range as follows:

Frequency range	Resolution Bandwidth
9 kHz – 30 MHz	0.1 kHz
30 MHz – 1000 MHz	1 kHz
Above 1000 MHz	10 kHz

At the frequency range boundaries, the smaller resolution bandwidth shall be used.

ANSI C63.10, 6.9.3 Occupied bandwidth-power bandwidth (99%) measurement procedure
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:
a) 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.
b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, without going below the values in 6.9.1 and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
c) 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.
d) Step a) through step c) might require iteration to adjust within the specified range.
e) 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.
f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
g) 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.
h) 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).

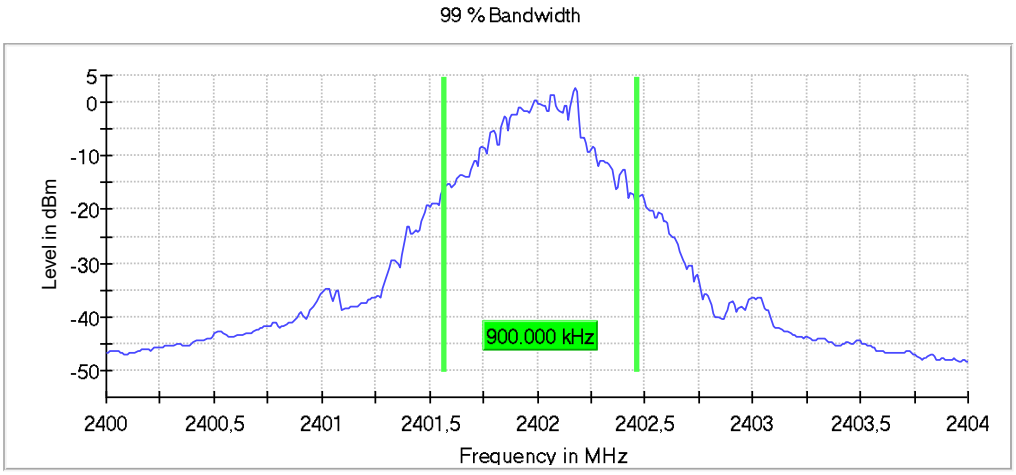
Test setup: 8.4 with conducted test sample in test mode (see section 5.2)

Test Results			
EUT Mode	**Occupied Bandwidth (99%)**		
	low channel [kHz]	**mid channel [kHz]**	**high channel [kHz]**
OP 1	900	910	900
OP 2	1205	1210	**1215**
OP 3	**1215**	**1215**	1210

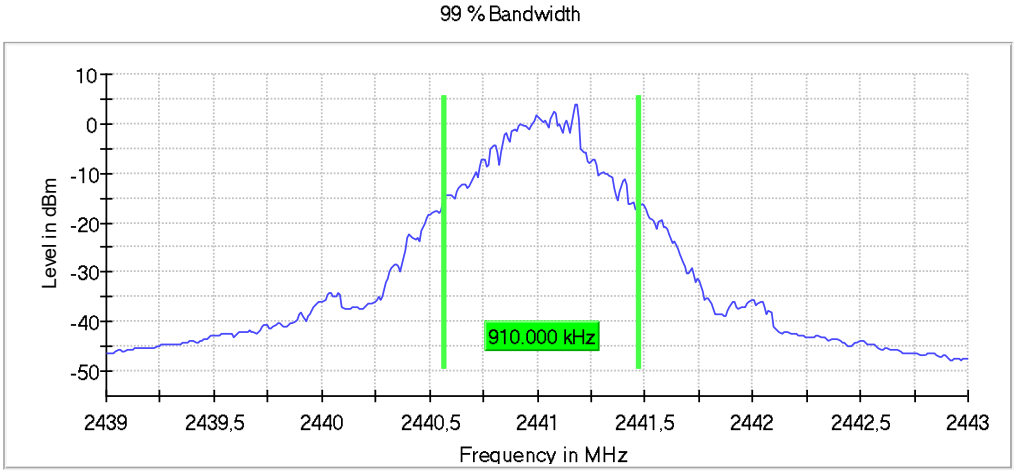
Comment:	---

Verdict	**- PASS -**	see next plots

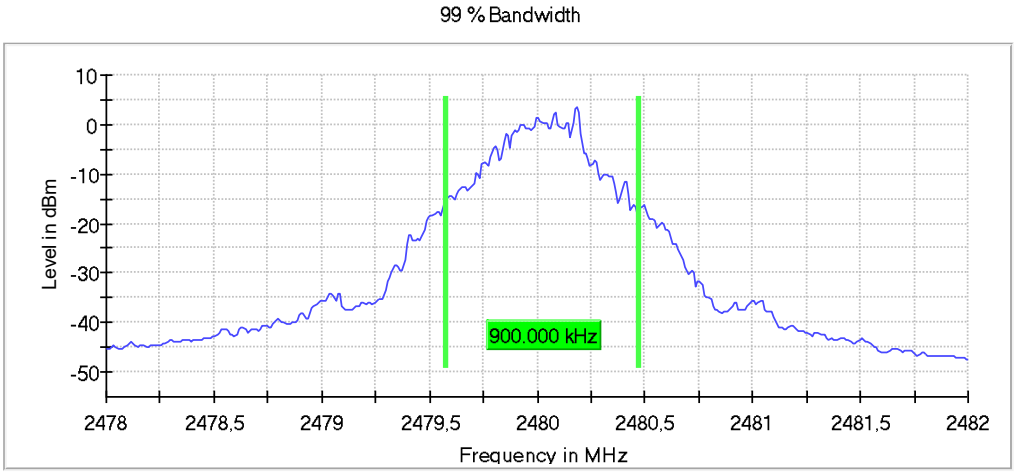
Plot 23: Occupied Bandwidth (99%), OP 1 low channel



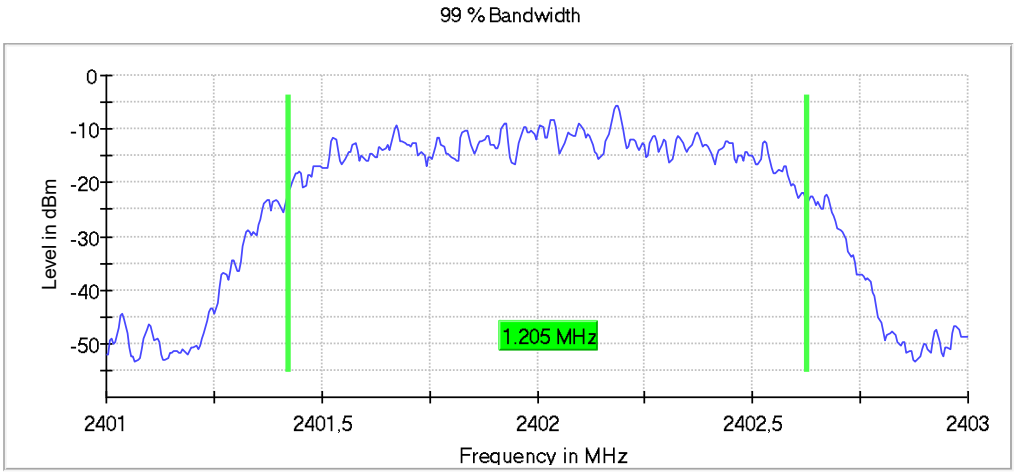
Plot 24: Occupied Bandwidth (99%), OP 1 mid channel



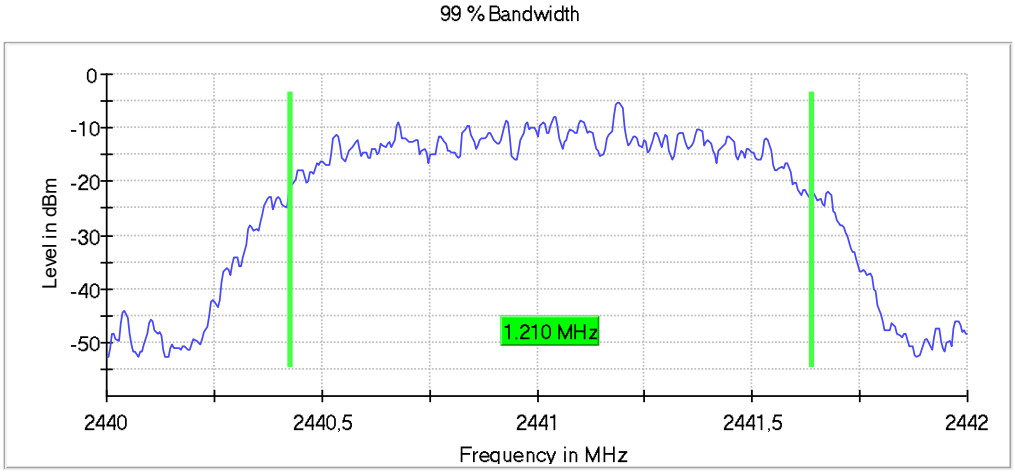
Plot 25: Occupied Bandwidth (99%), OP 1 high channel



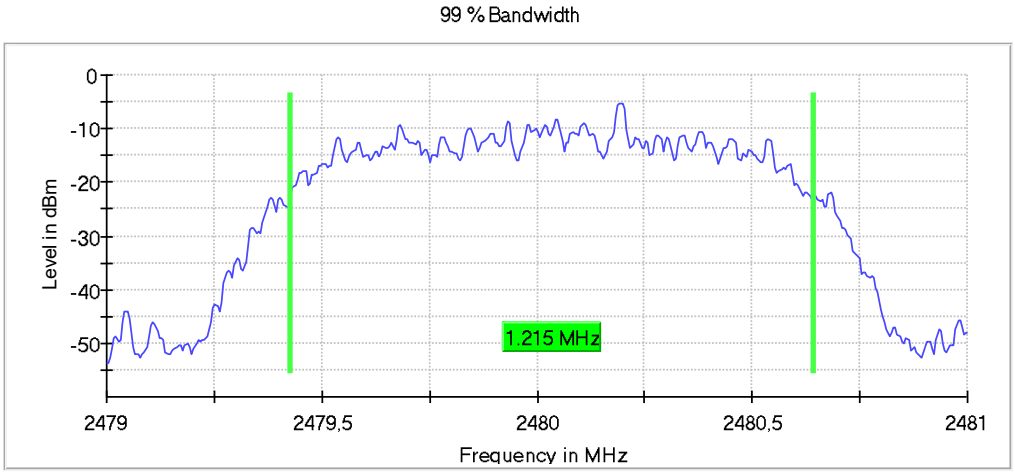
Plot 26: Occupied Bandwidth (99%), OP 2 low channel



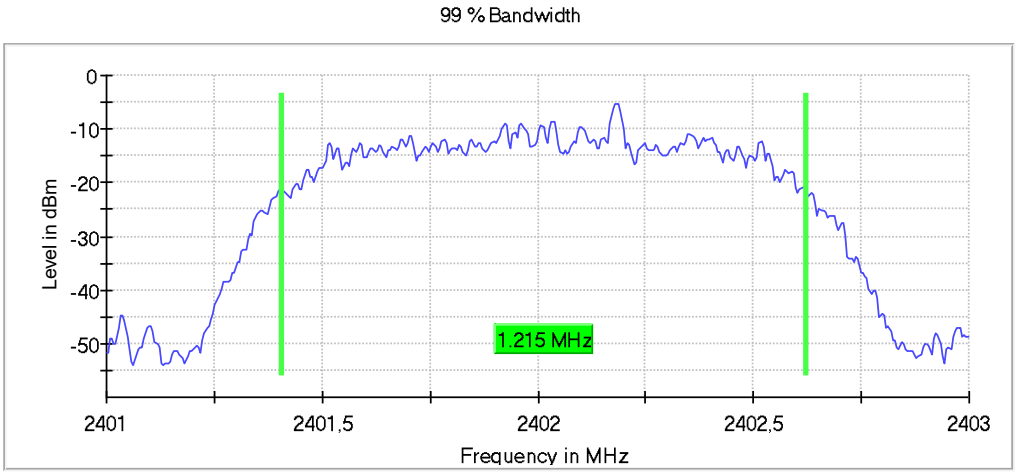
Plot 27: Occupied Bandwidth (99%), OP 2 mid channel



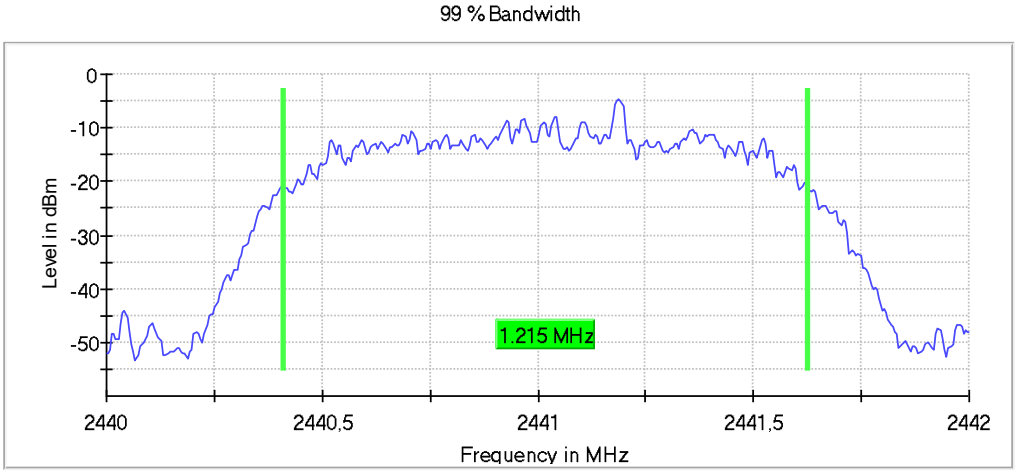
Plot 28: Occupied Bandwidth (99%), OP 2 high channel



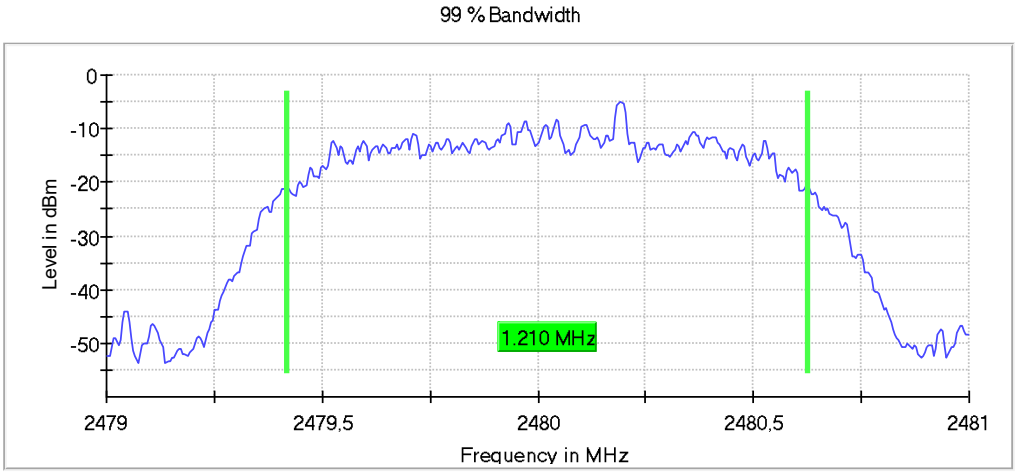
Plot 29: Occupied Bandwidth (99%), OP 3 low channel



Plot 30: Occupied Bandwidth (99%), OP 3 mid channel



Plot 31: Occupied Bandwidth (99%), OP 3 high channel



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, 6.2.3.2
The following transmitter output power and e.i.r.p. requirements shall apply:

a. if the hopset uses 75 or more hopping channels, the maximum peak conducted output power shall not exceed 1.0 W.
b. if the hopset uses less than 75 hopping channels the maximum peak conducted output power shall not exceed 0.125 W.
c. the e.i.r.p. shall not exceed 4 W, except as provided in sections 6.5 a) and b).

Test procedure
ANSI C63.10, 7.8.5
7.8.5 Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices
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.
Frequency hopping shall be disabled for this test. Use the following spectrum analyzer settings:
a) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
b) RBW > 20 dB bandwidth of the emission being measured.
c) VBW ≥ RBW.
d) Sweep: No faster than coupled (auto) time.
e) Detector function: Peak.
f) Trace: Max-hold.
g) Allow trace to stabilize.
h) Use the marker-to-peak function to set the marker to the peak of the emission.
i) The indicated level is the peak output power, after any corrections for external attenuators and cables.
j) A spectral plot of the test results and setup description shall be included in the test report.
NOTE—A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.

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

Test Results – Peak Power acc. to ANSI C63-10, 7.8.5				
EUT Mode	**RF Output Power (conducted peak power) [dBm]**			**Limit [dBm]**
	low channel	**mid channel**	**high channel**	
OP 1	5.1	**6.2**	5.9	30
OP 2	3.2	3.5	3.3	30
OP 3	3.3	4.1	3.2	30

Comment:	---

Verdict	**- PASS -**	---

7.7 Antenna Gain, Peak EIRP

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, 6.2.3.2 c)
The e.i.r.p. shall not exceed 4 W, except as provided in section 6.5 a) and b).

Test Results

Antenna type	low channel [dBi]	mid channel [dBi]	high channel [dBi]	Limit [dBi]
external antenna	3.7 dBi	3.7 dBi	3.7 dBi	6

Antenna type	Peak EIRP [dBm]	Limit [dBm]
external antenna	9.9	36

Note: - for antenna details see section 5.3
- peak EIRP is calcualated based on MAX(conducted peak power) and MAX(antenna gain) as worst case

Comment:	Antenna gain as declared by applicant.

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

On each operating frequency measured, band-edge emissions shall be reported by providing spectral plots of the measuring instrument display. The axes, the scale units per division, and the limit shall be clearly labeled in the test report.

Limits

§15.247

(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)).

RSS-247, 6.6

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum device, digitally modulated device, or hybrid system 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 the desired power – based on either an RF conducted or a 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 under section 6.3.2, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test procedure

See ANSI C63.10, 6.10.4 Authorized-band band-edge measurements (relative method)

These procedures are applicable for determining compliance at authorized band edges where the requirements are expressed as a value relative to the in-band signal level.

For devices that support frequency hopping, this test sequence shall be performed twice: once with the hopping function turned OFF and then repeated with the hopping function turned ON.

Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).

Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normal mode of operation” as specified in 6.10.3.

Perform the test as follows:

1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products that fall outside of the authorized band of operation. ANSI C63.10, 7.8.7.2: the analyzer screen shall clearly show compliance with the requirement within 10 MHz of the allocated band-edge.
2) Reference level: As required to keep the signal from exceeding the maximum instrument 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 4.1.6.2.
3) Attenuation: Auto (at least 10 dB preferred).
4) Sweep time: No faster than coupled (auto) time.
5) Resolution bandwidth: 100 kHz.
6) Video bandwidth: 300 kHz.
7) Detector: Peak.

8) Trace: Max-hold. Allow the trace to stabilize. For the test with the hopping function turned ON, this can take several minutes to achieve a reasonable probability of intercepting any emissions due to oscillator overshoot. Repeat above steps for every applicable modulation and the highest frequency channel.
Test setup: 8.4 with conducted test sample in hopping mode and test mode (see section 5.2)
Test results

BEC	low channel [dBc]	high channel [dBc]	Limit [dBc]
OP 1	> 60	> 60	≥ 20
OP 2	> 55	> 55	≥ 20
OP 3	> 55	> 55	≥ 20

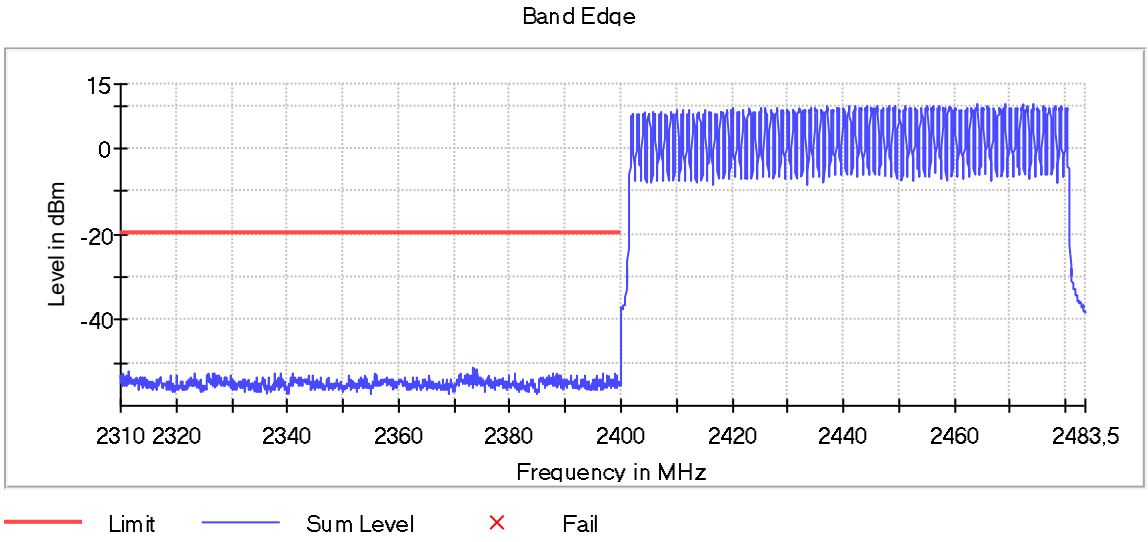
Comment:	---

Verdict	**- PASS -**	see next plots

Plot 32: BEC, OP 1, hopping mode, lower band edge

Measurements

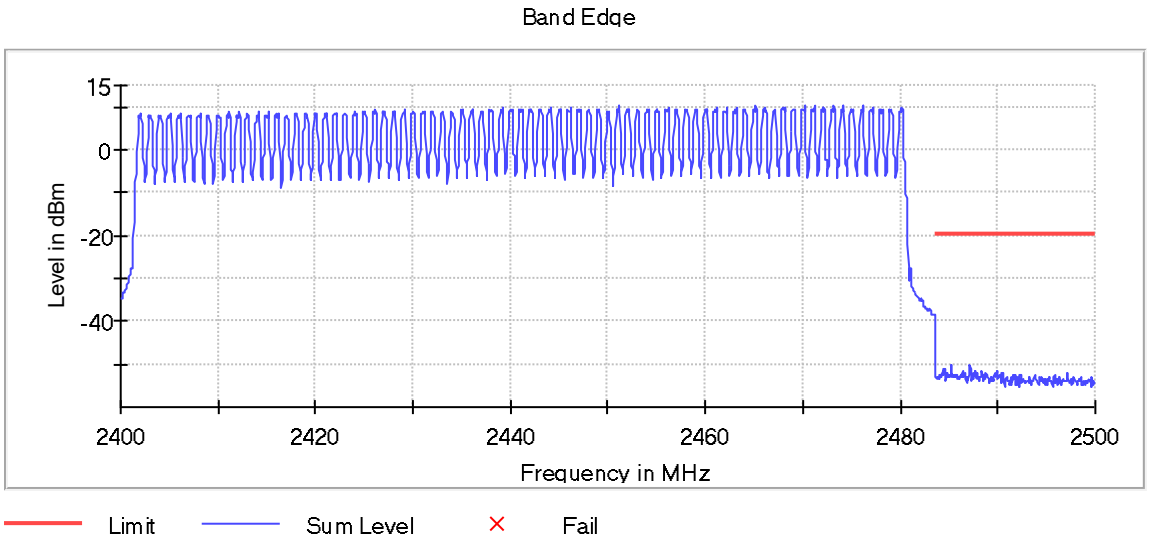
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2373.525000	-51.2	31.4	-19.8	PASS
2373.475000	-51.3	31.6	-19.8	PASS
2374.175000	-51.6	31.9	-19.8	PASS
2373.575000	-51.7	32.0	-19.8	PASS
2311.375000	-52.1	32.3	-19.8	PASS
2374.225000	-52.1	32.3	-19.8	PASS
2311.325000	-52.1	32.4	-19.8	PASS
2310.525000	-52.3	32.5	-19.8	PASS
2396.675000	-52.3	32.6	-19.8	PASS
2396.725000	-52.3	32.6	-19.8	PASS
2310.475000	-52.3	32.6	-19.8	PASS
2371.025000	-52.4	32.6	-19.8	PASS
2338.925000	-52.4	32.6	-19.8	PASS
2326.725000	-52.4	32.7	-19.8	PASS
2326.775000	-52.5	32.7	-19.8	PASS



Plot 33: BEC, OP 1, hopping mode, upper band edge

Measurements

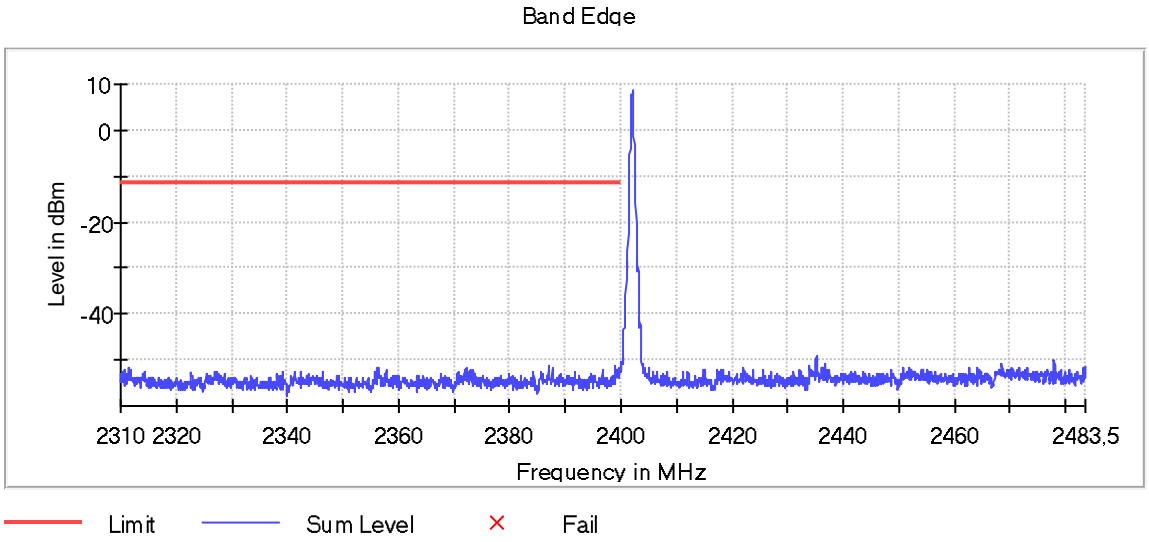
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2485.225000	-50.2	30.4	-19.7	PASS
2485.175000	-50.2	30.5	-19.7	PASS
2487.125000	-50.3	30.6	-19.7	PASS
2487.175000	-50.9	31.1	-19.7	PASS
2484.525000	-51.0	31.3	-19.7	PASS
2487.075000	-51.0	31.3	-19.7	PASS
2484.475000	-51.1	31.4	-19.7	PASS
2484.375000	-51.5	31.7	-19.7	PASS
2487.675000	-51.5	31.8	-19.7	PASS
2484.575000	-51.5	31.8	-19.7	PASS
2486.375000	-51.6	31.8	-19.7	PASS
2489.925000	-51.7	31.9	-19.7	PASS
2484.325000	-51.7	31.9	-19.7	PASS
2488.375000	-51.7	32.0	-19.7	PASS
2486.425000	-51.7	32.0	-19.7	PASS



Plot 34: BEC, OP 1, test mode, low channel

Measurements

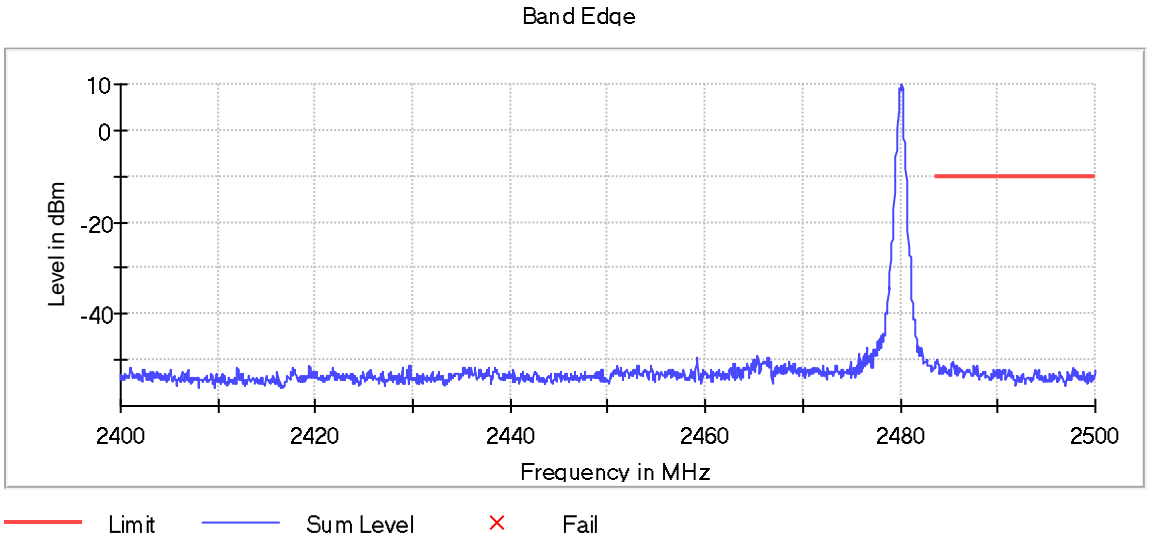
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.875000	-50.2	38.8	-11.4	PASS
2399.975000	-50.8	39.4	-11.4	PASS
2386.925000	-51.4	40.0	-11.4	PASS
2399.025000	-51.5	40.0	-11.4	PASS
2311.525000	-51.6	40.1	-11.4	PASS
2356.275000	-51.6	40.1	-11.4	PASS
2387.625000	-51.6	40.2	-11.4	PASS
2399.075000	-51.6	40.2	-11.4	PASS
2356.225000	-51.7	40.2	-11.4	PASS
2311.475000	-51.7	40.3	-11.4	PASS
2399.475000	-51.8	40.3	-11.4	PASS
2372.175000	-51.8	40.4	-11.4	PASS
2372.125000	-51.8	40.4	-11.4	PASS
2399.525000	-51.8	40.4	-11.4	PASS
2399.825000	-51.8	40.4	-11.4	PASS



Plot 35: BEC, OP 1, test mode, high channel

Measurements

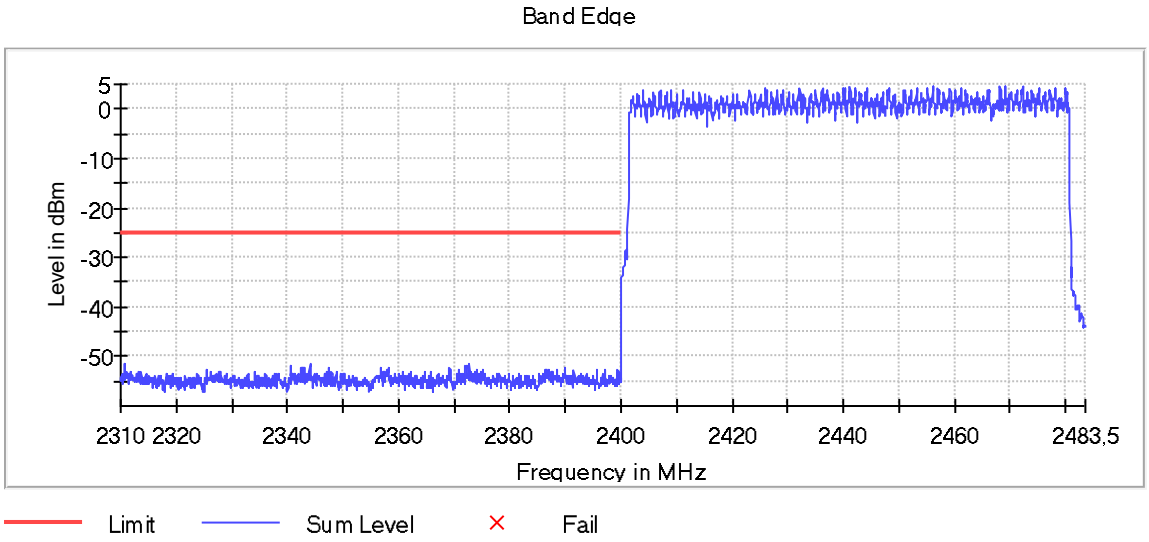
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.775000	-50.0	39.9	-10.1	PASS
2483.825000	-50.0	39.9	-10.1	PASS
2483.675000	-50.2	40.1	-10.1	PASS
2483.625000	-50.3	40.1	-10.1	PASS
2485.325000	-50.3	40.2	-10.1	PASS
2483.875000	-50.4	40.3	-10.1	PASS
2485.275000	-50.6	40.5	-10.1	PASS
2485.425000	-51.0	40.8	-10.1	PASS
2483.725000	-51.0	40.9	-10.1	PASS
2483.925000	-51.1	41.0	-10.1	PASS
2485.375000	-51.1	41.0	-10.1	PASS
2483.575000	-51.2	41.0	-10.1	PASS
2485.475000	-51.2	41.1	-10.1	PASS
2487.925000	-51.3	41.1	-10.1	PASS
2485.725000	-51.3	41.2	-10.1	PASS



Plot 36: BEC, OP 2, hopping mode, lower band edge

Measurements

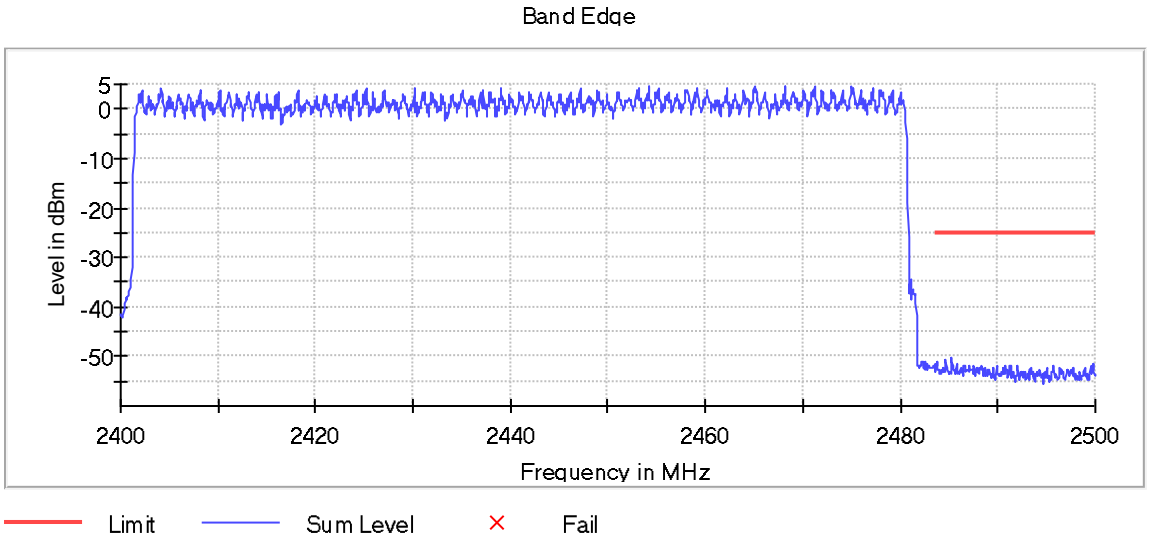
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2372.725000	-51.3	26.1	-25.2	PASS
2372.775000	-51.4	26.1	-25.2	PASS
2344.075000	-51.5	26.3	-25.2	PASS
2344.025000	-51.6	26.4	-25.2	PASS
2310.775000	-51.6	26.4	-25.2	PASS
2310.725000	-51.6	26.4	-25.2	PASS
2372.225000	-51.8	26.5	-25.2	PASS
2340.575000	-51.8	26.6	-25.2	PASS
2372.175000	-51.8	26.6	-25.2	PASS
2372.075000	-52.0	26.8	-25.2	PASS
2342.625000	-52.2	27.0	-25.2	PASS
2342.925000	-52.2	27.0	-25.2	PASS
2340.525000	-52.3	27.1	-25.2	PASS
2342.575000	-52.3	27.1	-25.2	PASS
2356.775000	-52.4	27.2	-25.2	PASS



Plot 37: BEC, OP 2, hopping mode, upper band edge

Measurements

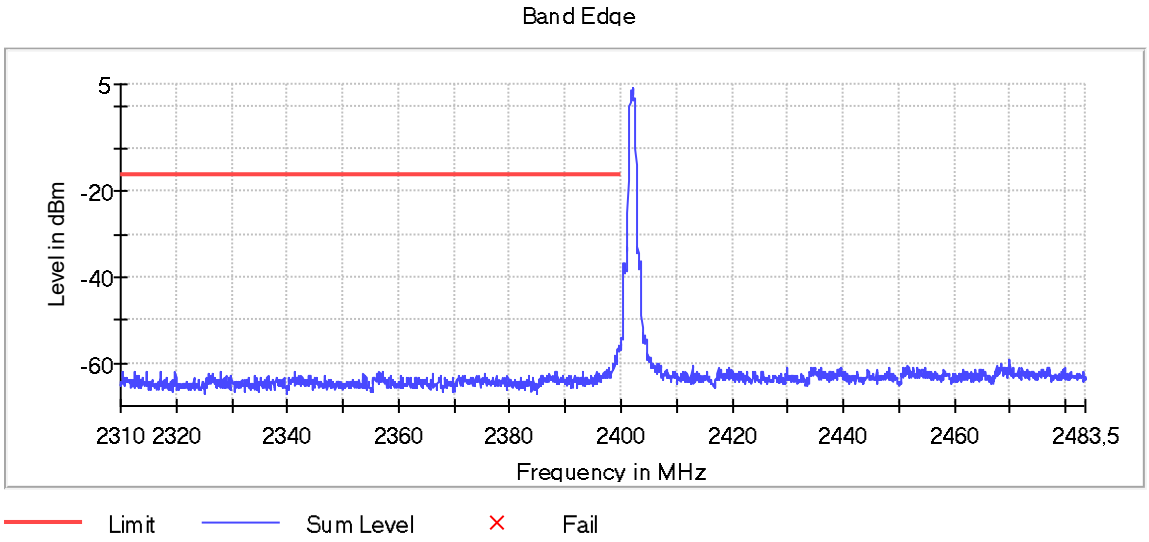
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2485.225000	-50.4	25.2	-25.2	PASS
2485.175000	-50.5	25.3	-25.2	PASS
2484.625000	-50.8	25.6	-25.2	PASS
2484.675000	-51.0	25.8	-25.2	PASS
2485.275000	-51.0	25.8	-25.2	PASS
2483.825000	-51.2	26.0	-25.2	PASS
2484.575000	-51.2	26.0	-25.2	PASS
2485.825000	-51.3	26.1	-25.2	PASS
2483.775000	-51.3	26.1	-25.2	PASS
2499.775000	-51.5	26.2	-25.2	PASS
2483.675000	-51.5	26.3	-25.2	PASS
2485.775000	-51.5	26.3	-25.2	PASS
2499.825000	-51.6	26.3	-25.2	PASS
2487.575000	-51.7	26.5	-25.2	PASS
2491.225000	-51.8	26.6	-25.2	PASS



Plot 38: BEC, OP 2, test mode, low channel

Measurements

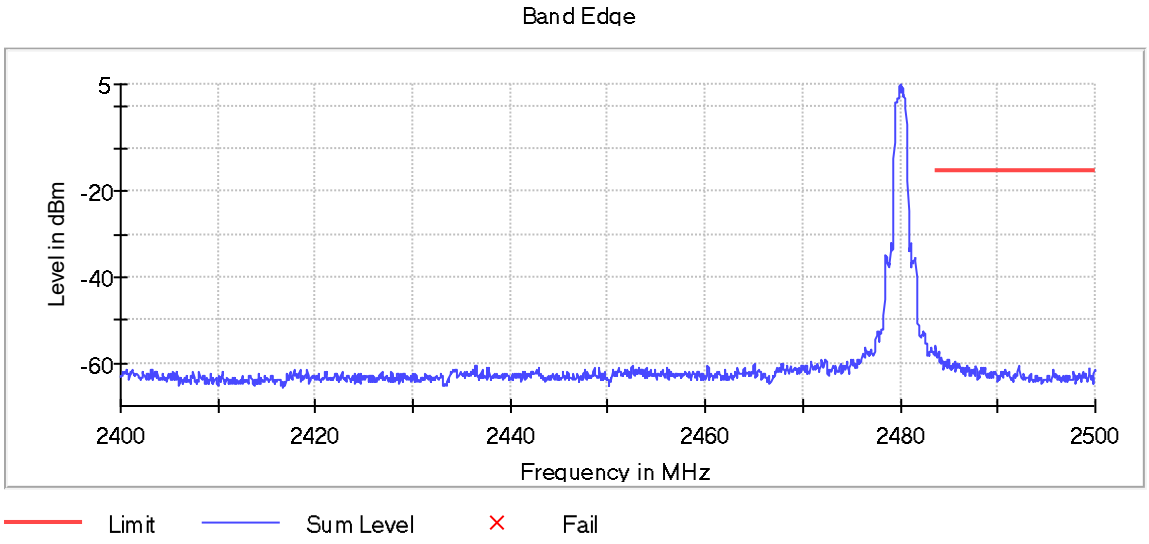
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.875000	-55.7	39.8	-15.9	PASS
2399.725000	-55.7	39.8	-15.9	PASS
2399.675000	-55.8	39.9	-15.9	PASS
2399.925000	-55.8	40.0	-15.9	PASS
2399.575000	-56.0	40.1	-15.9	PASS
2399.625000	-56.0	40.2	-15.9	PASS
2399.525000	-56.1	40.2	-15.9	PASS
2399.825000	-56.2	40.3	-15.9	PASS
2399.475000	-56.2	40.3	-15.9	PASS
2399.425000	-56.7	40.9	-15.9	PASS
2399.975000	-56.7	40.9	-15.9	PASS
2399.775000	-57.5	41.6	-15.9	PASS
2399.025000	-58.2	42.4	-15.9	PASS
2399.075000	-58.6	42.7	-15.9	PASS
2399.275000	-59.1	43.2	-15.9	PASS



Plot 39: BEC, OP 2, test mode, high channel

Measurements

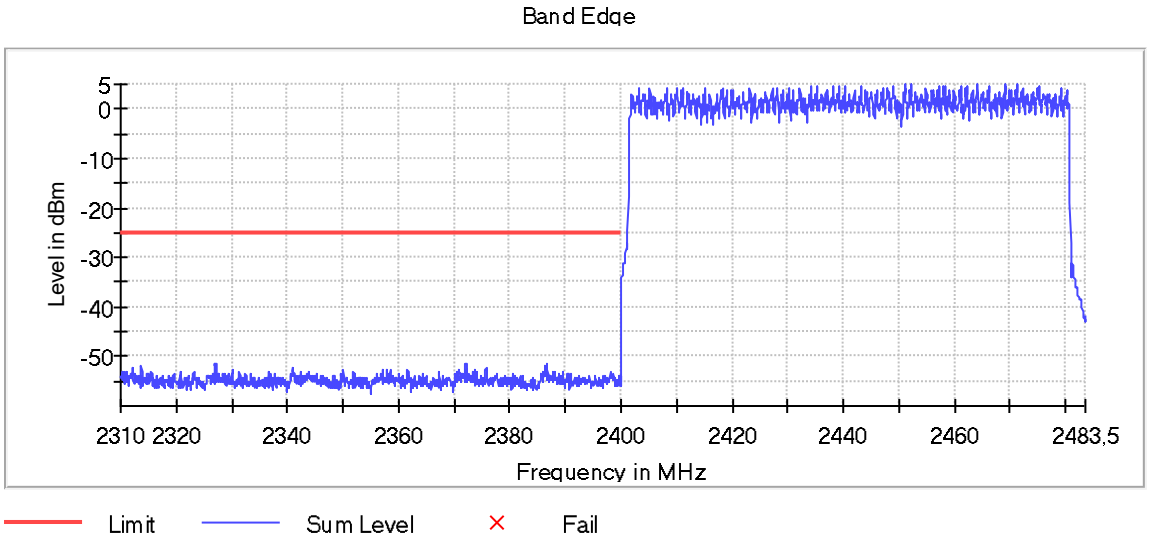
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.625000	-56.0	40.9	-15.1	PASS
2483.675000	-56.2	41.1	-15.1	PASS
2483.525000	-57.3	42.2	-15.1	PASS
2483.975000	-57.4	42.3	-15.1	PASS
2483.925000	-57.8	42.7	-15.1	PASS
2483.575000	-57.8	42.7	-15.1	PASS
2483.825000	-57.9	42.8	-15.1	PASS
2483.875000	-57.9	42.8	-15.1	PASS
2483.775000	-58.4	43.3	-15.1	PASS
2484.025000	-58.6	43.5	-15.1	PASS
2484.175000	-58.7	43.6	-15.1	PASS
2483.725000	-58.8	43.7	-15.1	PASS
2484.225000	-58.9	43.8	-15.1	PASS
2484.275000	-59.3	44.2	-15.1	PASS
2484.875000	-59.4	44.3	-15.1	PASS



Plot 40: BEC, OP 3, hopping mode, lower band edge

Measurements

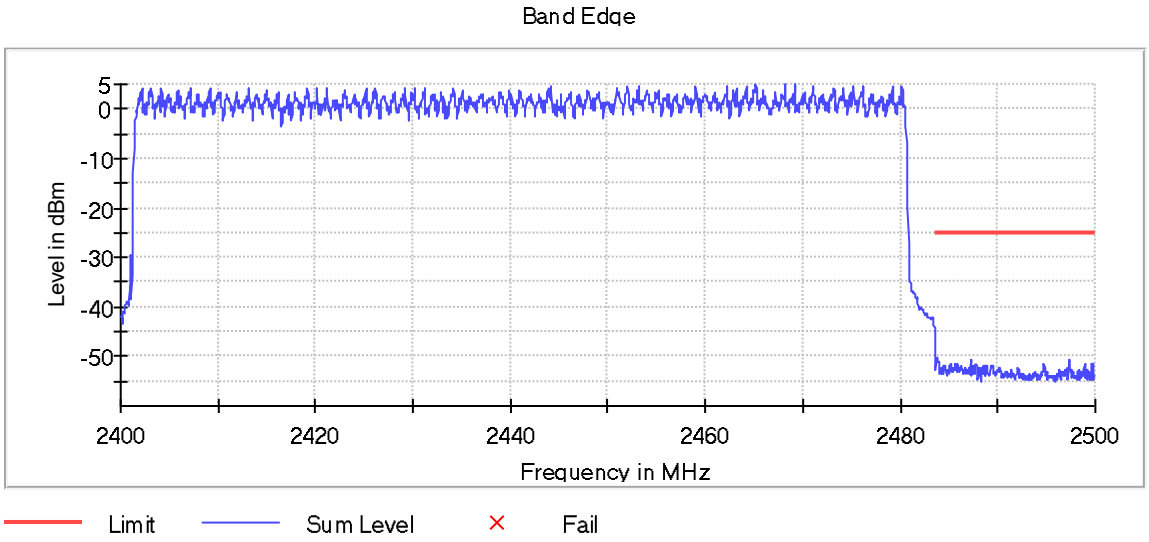
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2327.075000	-51.4	26.3	-25.1	PASS
2372.075000	-51.4	26.3	-25.1	PASS
2372.125000	-51.4	26.3	-25.1	PASS
2327.125000	-51.5	26.4	-25.1	PASS
2326.975000	-51.5	26.4	-25.1	PASS
2386.775000	-51.7	26.6	-25.1	PASS
2386.725000	-51.8	26.8	-25.1	PASS
2327.025000	-51.9	26.8	-25.1	PASS
2386.275000	-51.9	26.8	-25.1	PASS
2386.225000	-51.9	26.8	-25.1	PASS
2313.725000	-51.9	26.9	-25.1	PASS
2326.925000	-51.9	26.9	-25.1	PASS
2313.775000	-52.0	26.9	-25.1	PASS
2375.725000	-52.1	27.0	-25.1	PASS
2340.875000	-52.4	27.3	-25.1	PASS



Plot 41: BEC, OP 3, hopping mode, upper band edge

Measurements

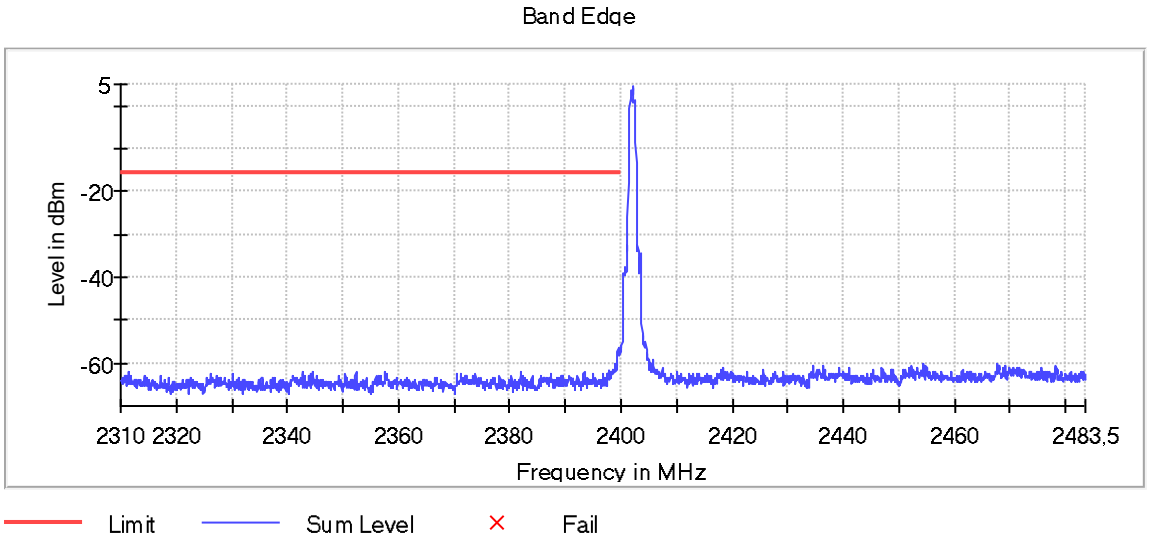
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.775000	-50.3	25.3	-25.1	PASS
2483.825000	-50.7	25.6	-25.1	PASS
2487.225000	-50.8	25.7	-25.1	PASS
2497.325000	-50.8	25.7	-25.1	PASS
2483.725000	-50.9	25.8	-25.1	PASS
2497.375000	-50.9	25.8	-25.1	PASS
2483.875000	-51.0	26.0	-25.1	PASS
2483.925000	-51.1	26.1	-25.1	PASS
2487.175000	-51.2	26.1	-25.1	PASS
2487.775000	-51.4	26.3	-25.1	PASS
2485.625000	-51.4	26.3	-25.1	PASS
2485.925000	-51.4	26.4	-25.1	PASS
2485.125000	-51.6	26.5	-25.1	PASS
2499.725000	-51.6	26.5	-25.1	PASS
2487.725000	-51.6	26.5	-25.1	PASS



Plot 42: BEC, OP 3, test mode, low channel

Measurements

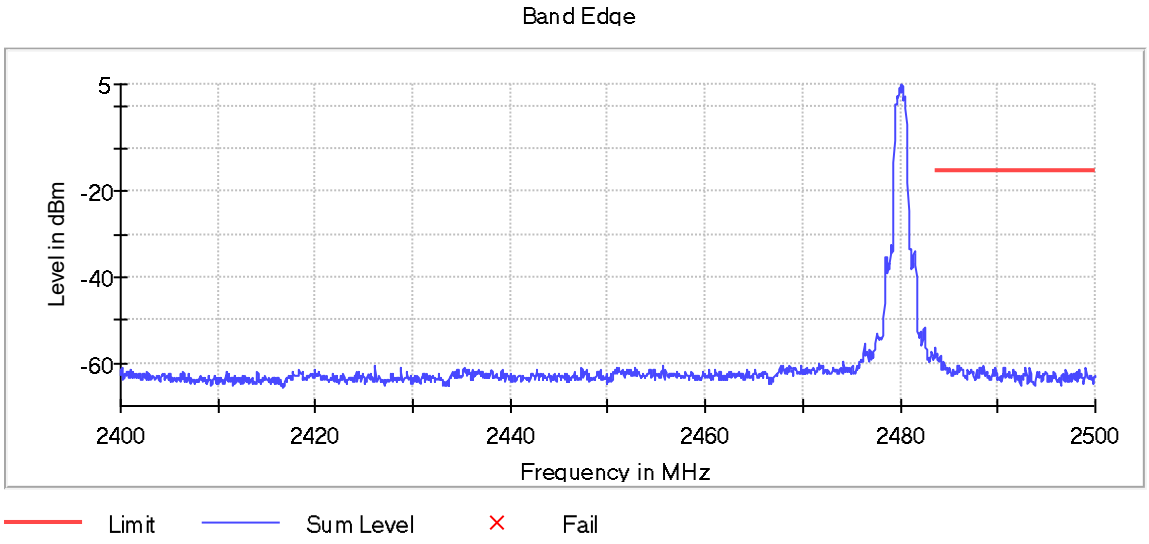
Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.975000	-56.0	40.3	-15.6	PASS
2399.475000	-56.3	40.7	-15.6	PASS
2399.925000	-56.4	40.8	-15.6	PASS
2399.625000	-56.6	41.0	-15.6	PASS
2399.675000	-56.7	41.0	-15.6	PASS
2399.525000	-56.8	41.1	-15.6	PASS
2399.575000	-57.4	41.8	-15.6	PASS
2399.425000	-57.5	41.9	-15.6	PASS
2399.875000	-57.6	41.9	-15.6	PASS
2399.825000	-57.6	41.9	-15.6	PASS
2399.725000	-58.1	42.5	-15.6	PASS
2399.775000	-58.3	42.7	-15.6	PASS
2399.275000	-59.5	43.9	-15.6	PASS
2399.325000	-59.8	44.2	-15.6	PASS
2399.225000	-59.9	44.3	-15.6	PASS



Plot 43: BEC, OP 3, test mode, high channel

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.525000	-56.5	41.5	-15.1	PASS
2483.575000	-57.7	42.6	-15.1	PASS
2483.775000	-57.9	42.9	-15.1	PASS
2483.625000	-58.1	43.1	-15.1	PASS
2483.725000	-58.1	43.1	-15.1	PASS
2483.825000	-58.1	43.1	-15.1	PASS
2484.125000	-58.4	43.3	-15.1	PASS
2483.675000	-58.5	43.4	-15.1	PASS
2484.025000	-58.5	43.5	-15.1	PASS
2484.075000	-58.5	43.5	-15.1	PASS
2483.975000	-58.6	43.5	-15.1	PASS
2483.875000	-59.4	44.3	-15.1	PASS
2483.925000	-59.8	44.8	-15.1	PASS
2484.175000	-59.9	44.8	-15.1	PASS
2484.475000	-59.9	44.9	-15.1	PASS



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

On each operating frequency measured, band-edge emissions shall be reported by providing spectral plots of the measuring instrument display. The axes, the scale units per division, and the limit shall be clearly labeled in the test report

Limits

§15.247

(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)).

RSS-247, 6.6

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum device, digitally modulated device, or hybrid system 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 the desired power – based on either an RF conducted or a 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 under section 6.3.2, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test procedure

ANSI C63.10, 6.10.5 Restricted-band band-edge measurements

For frequency hopping systems, the hopping shall be turned OFF during this test.

Set the unlicensed wireless device to the lowest frequency channel.

Set the unlicensed wireless device to operate at maximum output power and 100% duty cycle, or equivalent “normal mode of operation” as specified in 6.10.3.

Perform the test as follows:

1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products that fall outside of the authorized band of operation.
2) Reference level offset: Adjusted for gains and losses of measurement antenna factor, preamp gain and cable loss, so as to indicate field strength, in units of dBµV/m at 3 m, directly on the instrument display.
3) Reference level: As required to keep the signal from exceeding the maximum spectrum analyzer 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 4.1.6.2.
4) Attenuation: Auto (at least 10 dB preferred).
5) Sweep time: No faster than coupled (auto) time.
6) Resolution bandwidth: 1 MHz
7) Video bandwidth: 3 × RBW
8) Detector (unless specified otherwise): Peak and average above 1 GHz
9) Trace: Max-hold for final measurement.

Allow the trace to stabilize.

Repeat above steps for the highest frequency channel.

Test setup: 8.2 with radiated sample in test mode (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]**
OP 1	≤ 41 AVG / ≤ 55 PK	≤ 41 AVG / ≤ 55 PK	≤ 54 AVG / ≤ 74 PK

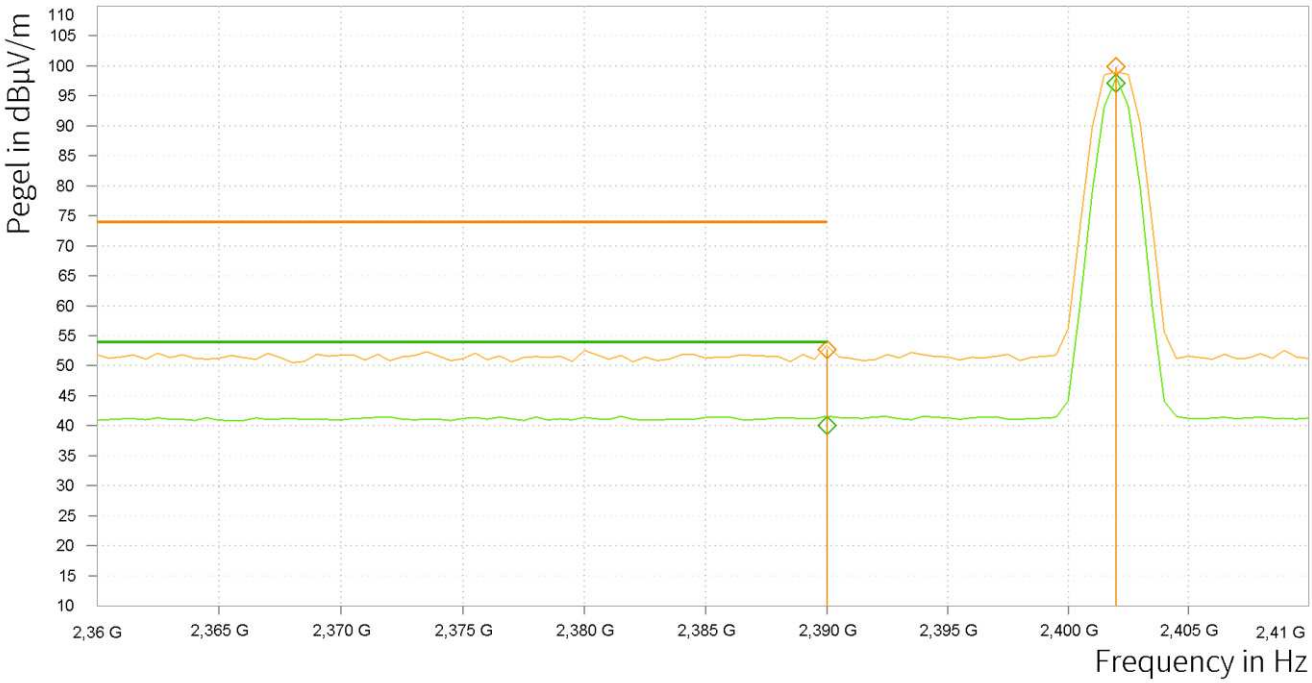
Comment:	---

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

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

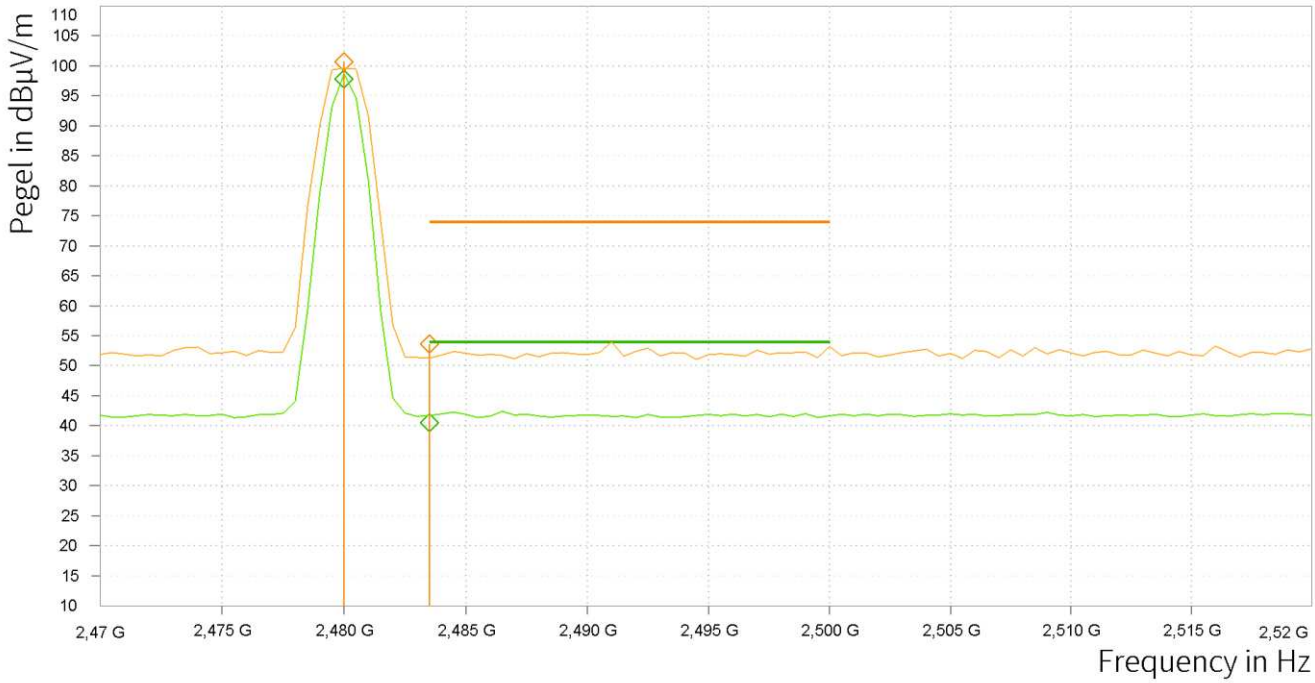
Pos-Peak (Max Hold) trace
Average (Max Hold) trace

Plot 44: BEC, OP 1, low channel



Rg	Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Polarization	Elevation [deg]	Azimuth [deg]	Meas. BW [kHz]
1	2.390,000	52,75	74,00	21,25	40,04	54,00	13,96	28,92	H	104,9	129	1.000,000
1	2.402,000	99,87			97,07			28,96	H	8,8	159,6	1.000,000

Plot 45: BEC, OP 1, high channel



Rg	Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Polarization	Elevation [deg]	Azimuth [deg]	Meas. BW [kHz]
1	2.480,000	100,68			97,84			29,34	H	-15	281	1.000,000
1	2.483,500	53,65	74,00	20,35	40,51	54,00	13,49	29,36	V	98,7	98,1	1.000,000

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

(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)).

RSS-247, 6.6

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum device, digitally modulated device, or hybrid system 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 the desired power – based on either an RF conducted or a 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 under section 6.3.2, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test procedure

ANSI C63.10, 7.8.7 Conducted spurious emissions test methodology

7.8.7.1 General considerations

To demonstrate compliance with the relative out-of-band emissions requirements conducted spurious emissions shall be measured for the transmit frequencies, per 5.5 and 5.6, and at the maximum transmit powers. Frequency hopping shall be disabled for this test with the exception of measurements at the allocated band-edges which shall be repeated with hopping enabled.

Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer. The frequency range of testing shall span 30 MHz to 10 times the operating frequency and this may be done in a single sweep or, to aid resolution, across a number of sweeps. The resolution bandwidth shall be 100 kHz, video bandwidth 300 kHz, and a coupled sweep time with a peak detector.

The limit is based on the highest in-band level across all channels measured using the same instrument settings (resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector). To help clearly demonstrate compliance a display line may be set at the required offset (typically 20 dB) below the highest in-band level. Where the highest in-band level is not clearly identified in the out-of-band measurements a separate spectral plot showing the in-band level shall be provided.

When conducted measurements cannot be made (for example a device with integrated, non-removable antenna) radiated measurements shall be used. The reference level for determining the limit shall be established by maximizing the field strength from the highest power channel and measuring using the resolution and video bandwidth settings and peak detector as described above. The field strength limit for spurious emissions outside of restricted-bands shall then be set at the required offset (typically 20 dB) below the highest in-band level. Radiated measurements will follow the standards measurement procedures described in Clause 6 with the

exception that the resolution bandwidth shall be 100 kHz, video bandwidth 300 kHz, and a coupled sweep time with a peak detector. Note that use of wider measurement bandwidths are acceptable for measuring the spurious emissions provided that the peak detector is used and that the measured value of spurious emissions are compared to the highest in-band level measured with the 100 kHz / 300 kHz bandwidth settings to determine compliance.

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

Test results

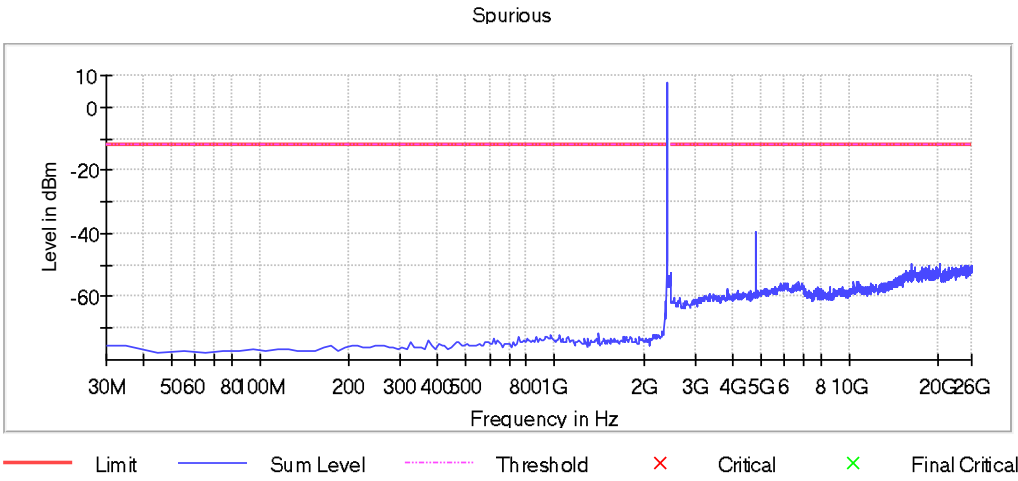
EUT Mode / Channel	Frequency [MHz]	Peak/RMS Detector	Level [dBm]	Limit [dBm]	Verdict
OP 1	(see plots)	MaxPeak	(see plots)*	(see plots)	- passed -
OP 2	(see plots)	MaxPeak	(see plots)*	(see plots)	- passed -
OP 3	(see plots)	MaxPeak	(see plots)*	(see plots)	- passed -

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

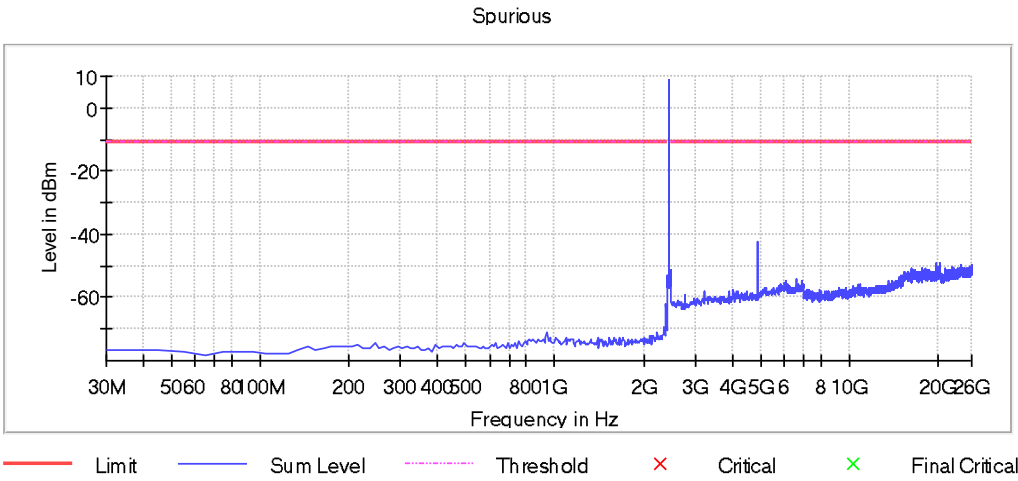
Comment:	---

Verdict	**- PASS -**	see next plots

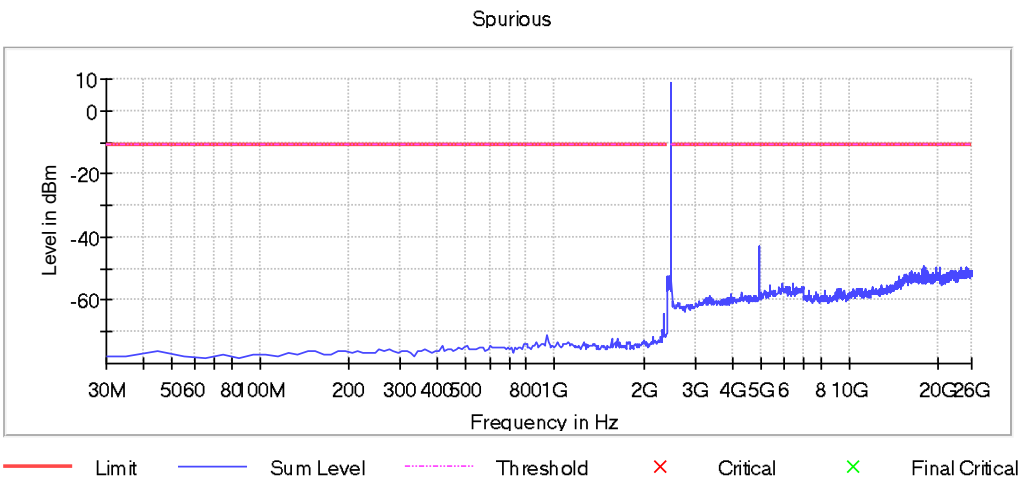
Plot 46: CSE, OP 1, low channel



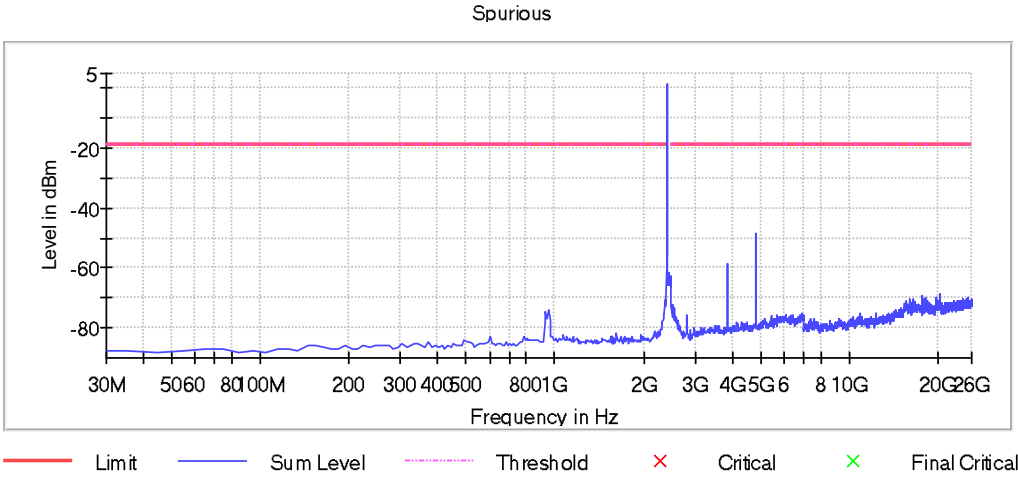
Plot 47: CSE, OP 1, mid channel



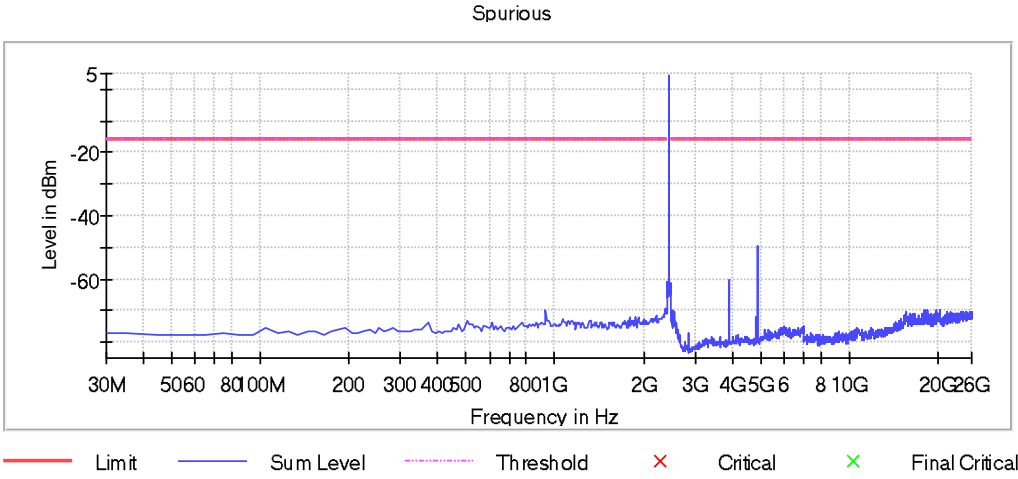
Plot 48: CSE, OP 1, high channel



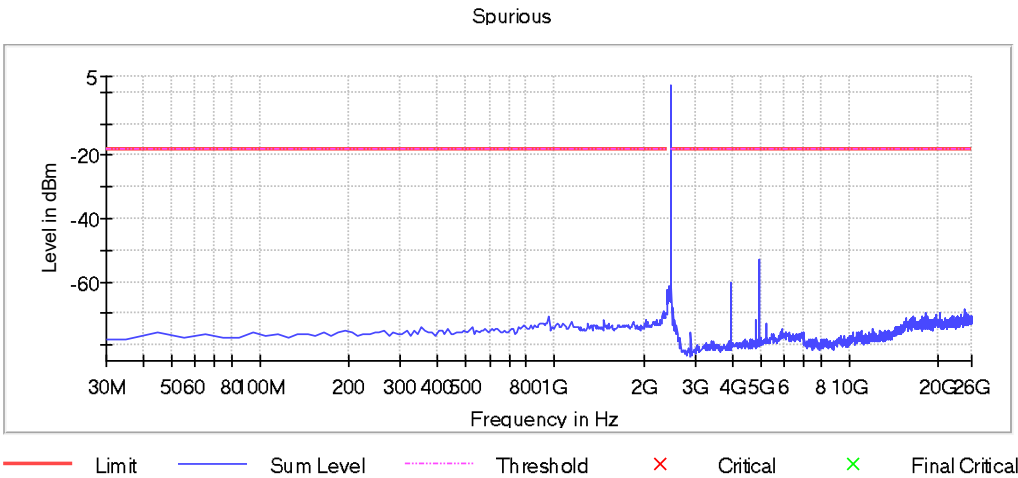
Plot 49: CSE, OP 2, low channel



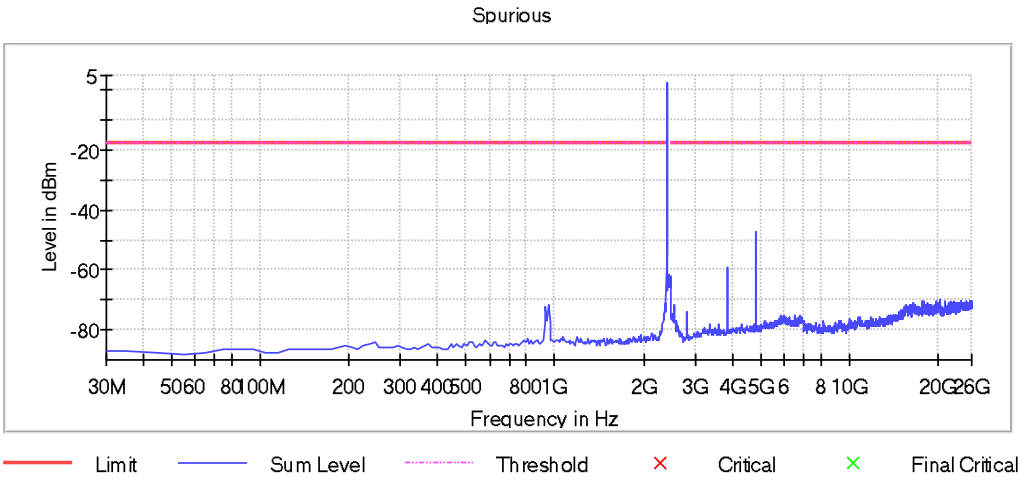
Plot 50: CSE, OP 2, mid channel



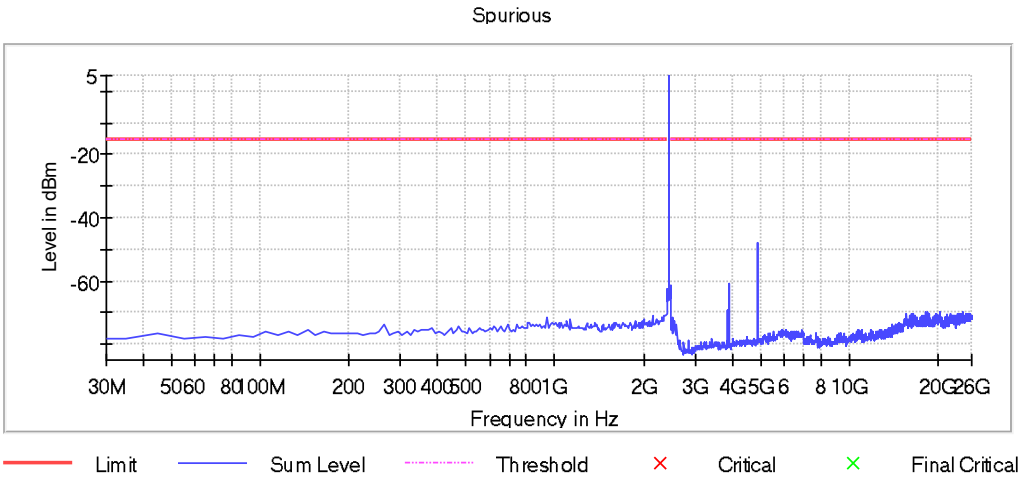
Plot 51: CSE, OP 2, high channel



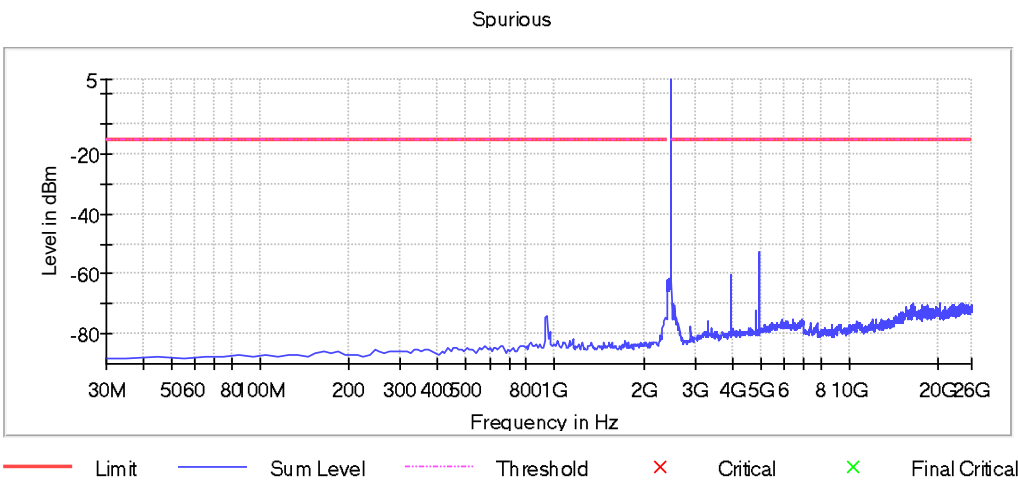
Plot 52: CSE, OP 3, low channel



Plot 53: CSE, OP 3, mid channel



Plot 54: CSE, OP 3, high channel



7.11 Radiated Spurious Emissions (RSE)

Applicability
This requirement applies to all types of DTS and FHS 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
§15.247, §15.209
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)).

RSS-247, 6.6, RSS-Gen, 8.9
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum device, digitally modulated device, or hybrid system 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 the desired power – based on either an RF conducted or a 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 under section 6.3.2, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Frequency [MHz]	Field Strength [µV/m] / [dBµV/m]	Measurement distance [m]
0.009 – 0.490	2400/F[kHz]	300
0.490 – 1.705	24000/F[kHz]	30
1.705 – 30.0	30.0 / 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 (as worst case). In case of spurious other modulations are spot-checked.

Test setup: 8.1, 8.2, 8.3 with radiated sample in test mode (see 5.2)
Test distance correction factor of 20dB/decade is already considered in the plots / result table.

Test results					
EUT Mode / Channel	**Frequency [MHz]**	**Detector**	**Level [dBµV/m @LD]**	**Limit [dBµV/m @LD]**	**Verdict**
OP 1 / low channel	(see plots)	QP / AVG	(see plots)	(see plots)	- passed -
OP 1 / mid channel	(see plots)	QP / AVG	(see plots)	(see plots)	- passed -
OP 1 / high channel	(see plots)	QP / AVG	(see plots)	(see plots)	- passed -

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

Note:
LD = Limit Distance of 300m / 30m / 3m depending on frequency range, see limit table

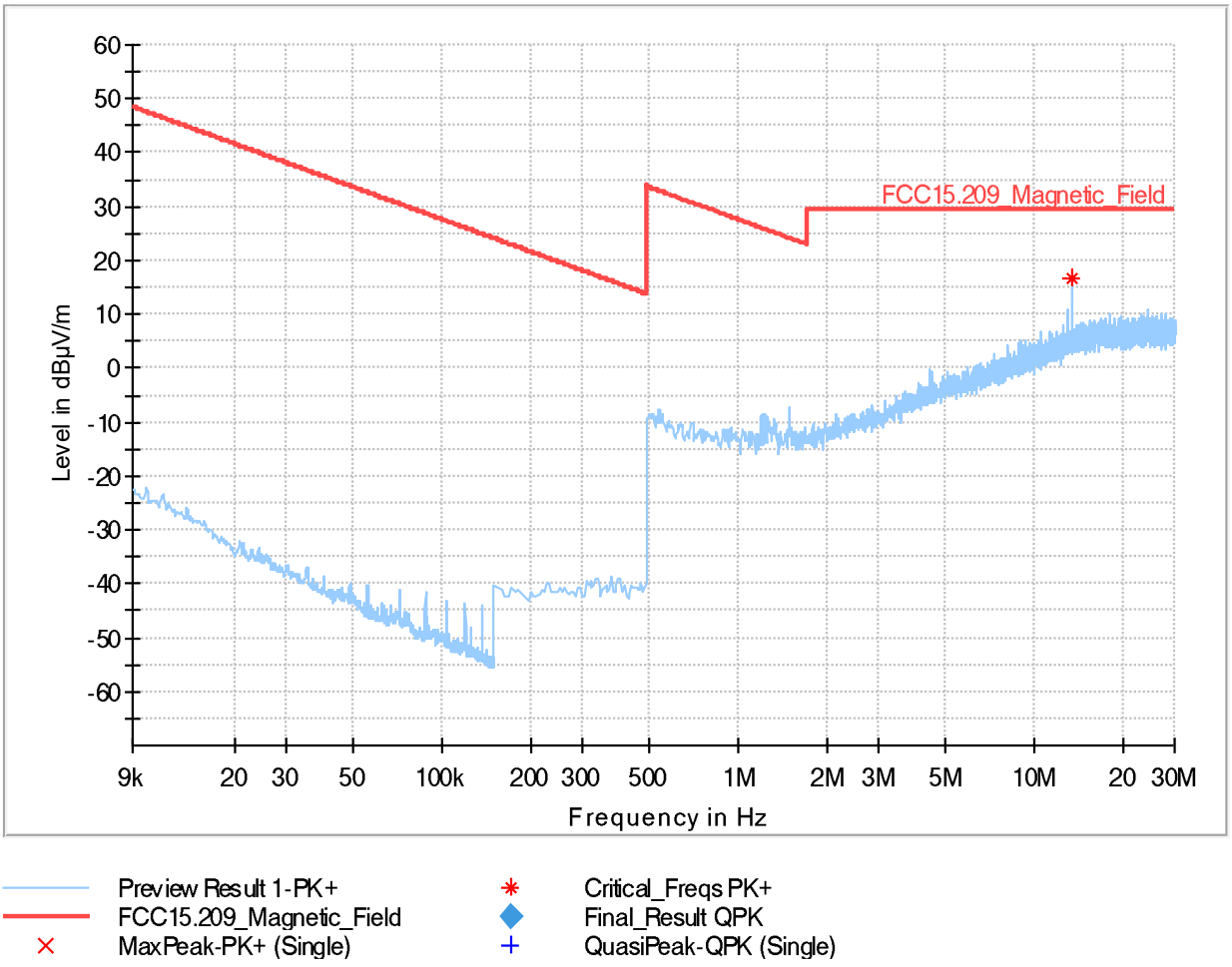
Comment:	---

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

** description of line and marker for all radiated spurious emission (RSE) measurements:

positive Peak (Max Hold) trace during pre-scan
Max Peak value
final Quasi Peak / AVG value

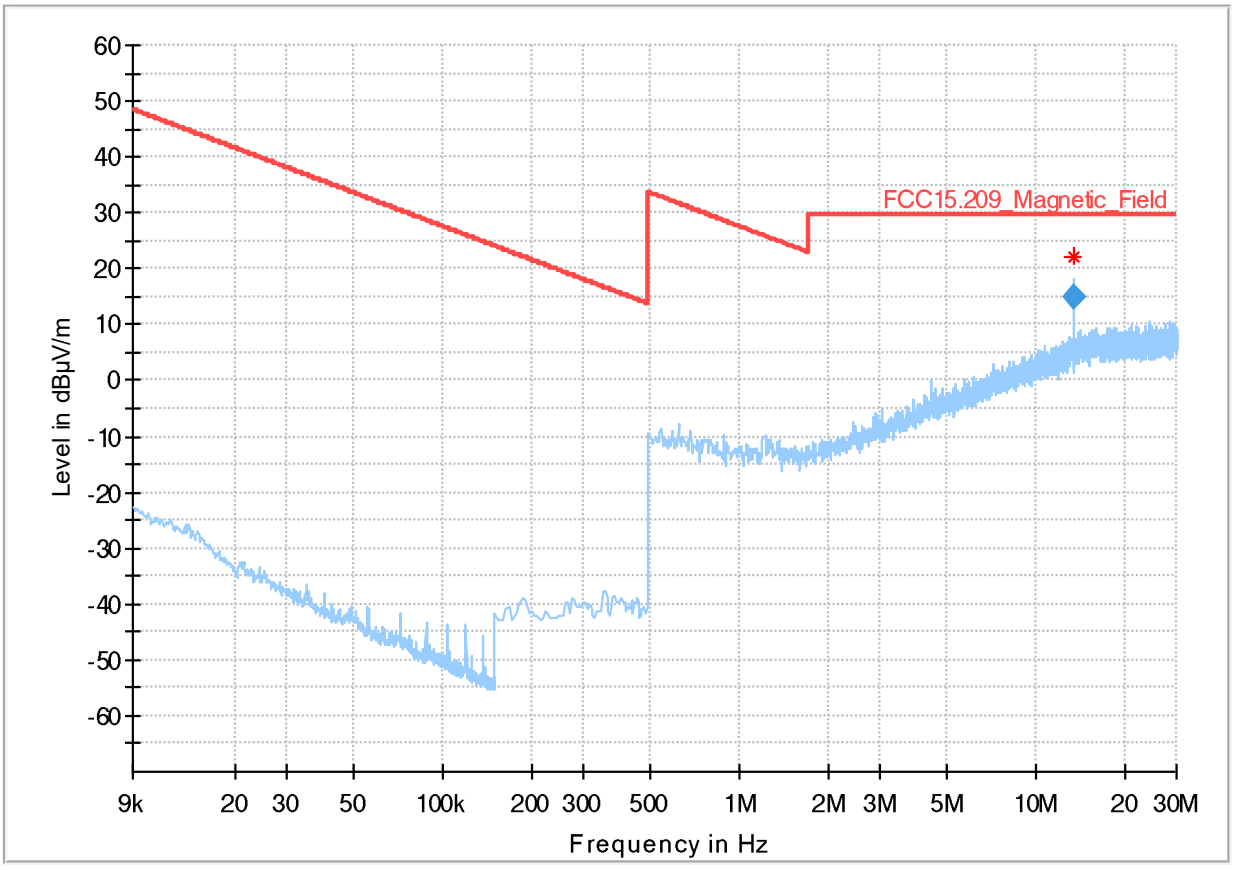
Plot 55: RSE 9 kHz – 30 MHz, OP 1, low channel, loop antenna



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.559886	16.48	29.54	13.06	---	---	V	274.0	-0.9

Note:
The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X kHz resulted in a level of Y dBµV/m, which is equivalent to Y - 51.5 = Z dBµA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.
(Certification & Engineering Bureau, Q&A on Certification Procedures and Requirements, TCB Workshop April 2020, Nicolas DesMarais, 2020-04-09 - ISED Q&A - DesMarais.pdf)

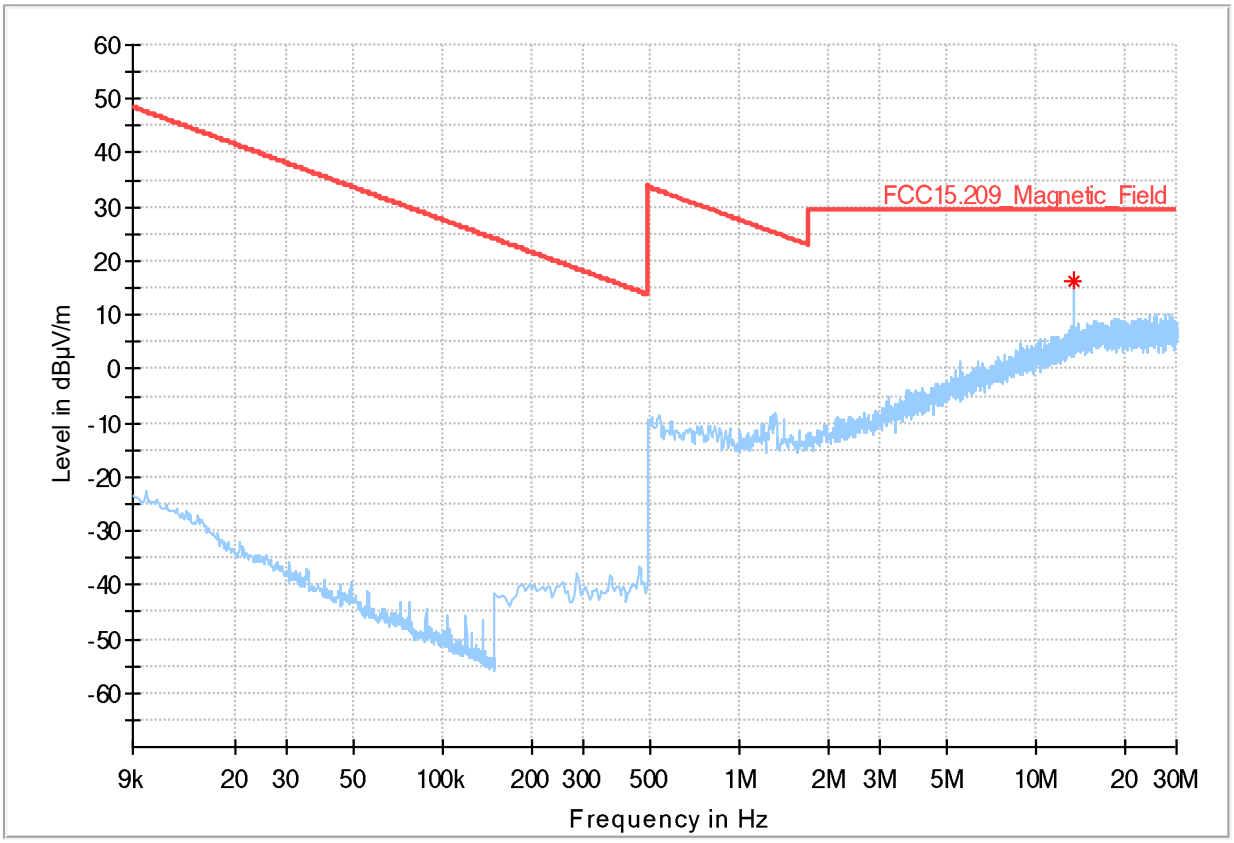
Plot 56: RSE 9 kHz – 30 MHz, OP 1, mid channel, loop antenna



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.559886	22.14	29.54	7.40	---	---	V	-10.0	-0.9

Note:
The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X kHz resulted in a level of Y dBµV/m, which is equivalent to Y - 51.5 = Z dBµA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.
(Certification & Engineering Bureau, Q&A on Certification Procedures and Requirements, TCB Workshop April 2020, Nicolas DesMarais, 2020-04-09 - ISED Q&A - DesMarais.pdf)

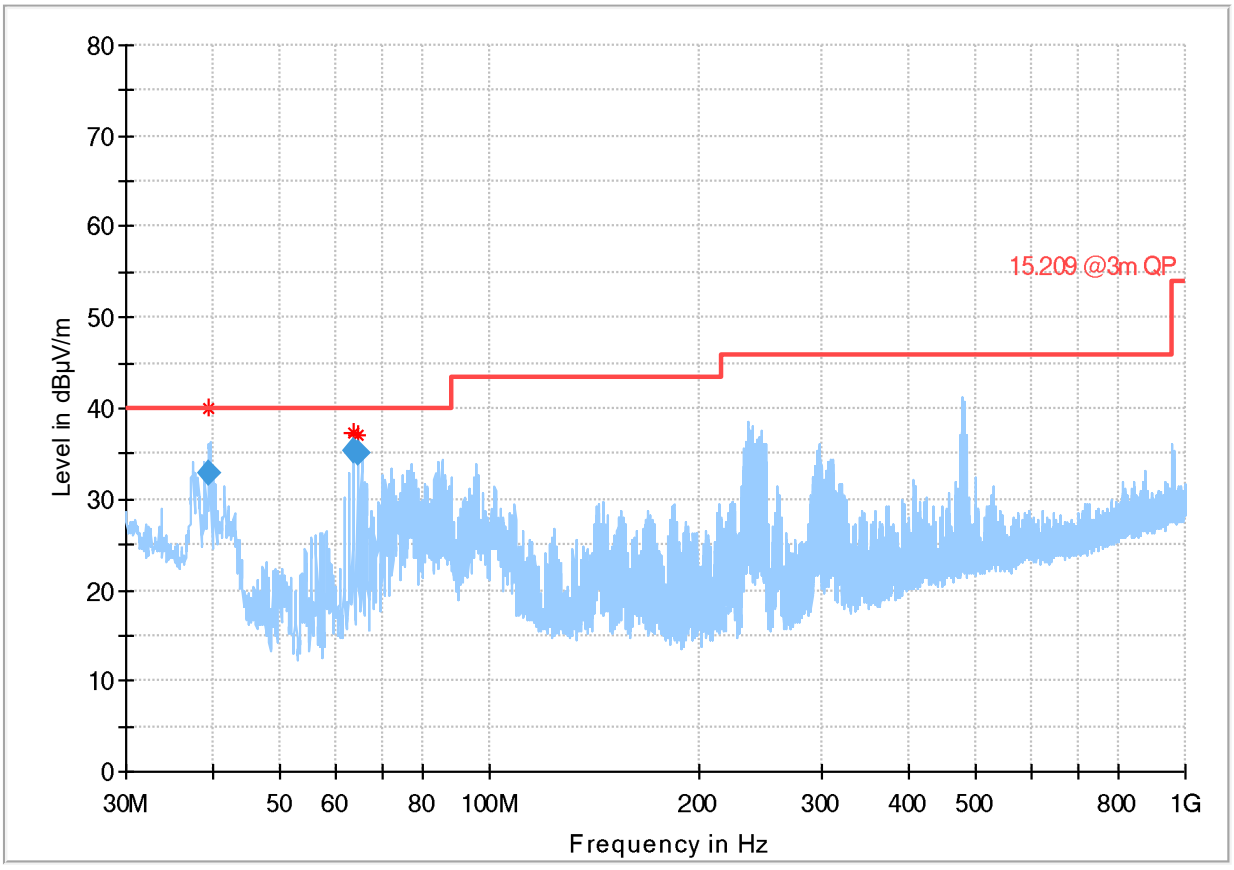
Plot 57: RSE 9 kHz – 30 MHz, OP 1, high channel, loop antenna



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.559886	16.22	29.54	13.32	---	---	V	308.0	-0.9

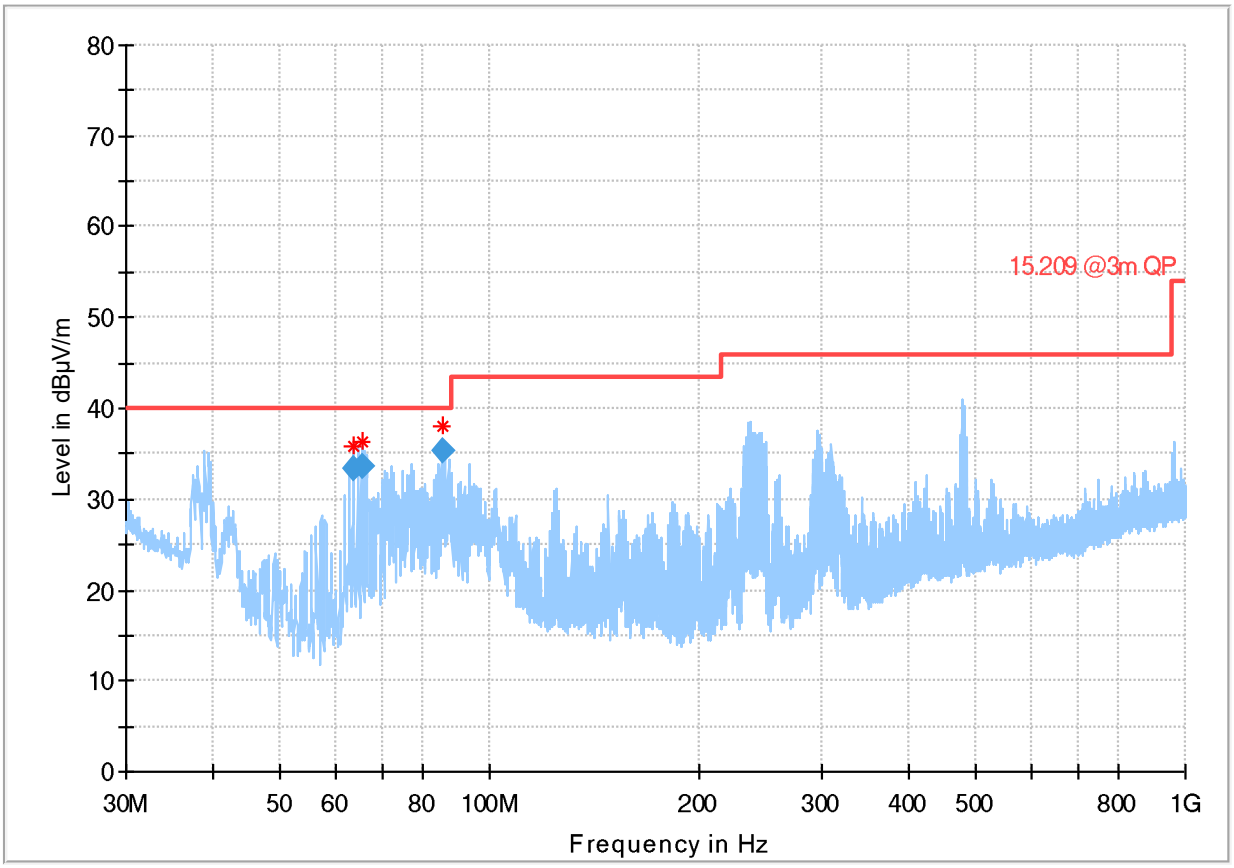
Note:
The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X kHz resulted in a level of Y dBµV/m, which is equivalent to Y - 51.5 = Z dBµA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.
(Certification & Engineering Bureau, Q&A on Certification Procedures and Requirements, TCB Workshop April 2020, Nicolas DesMarais, 2020-04-09 - ISED Q&A - DesMarais.pdf)

Plot 58: RSE 30 MHz – 1 GHz, OP 1, low channel, horizontal / vertical polarisation



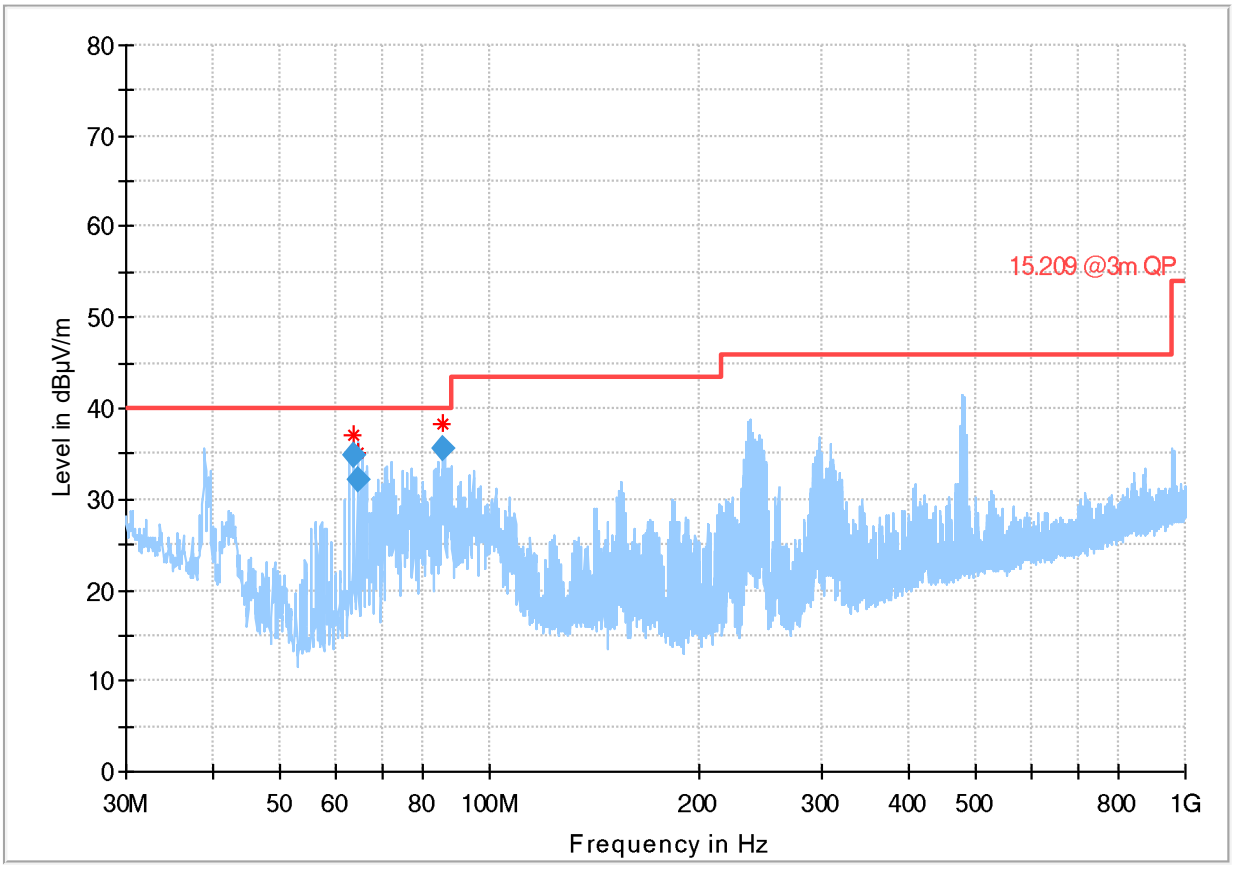
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
39.513000	32.90	40.00	7.10	100.0	120.000	100.0	V	3.0
63.737500	35.30	40.00	4.70	100.0	120.000	162.0	V	273.0
64.682000	35.06	40.00	4.94	100.0	120.000	144.0	V	272.0

Plot 59: RSE 30 MHz – 1 GHz, OP 1, mid channel, horizontal / vertical polarisation



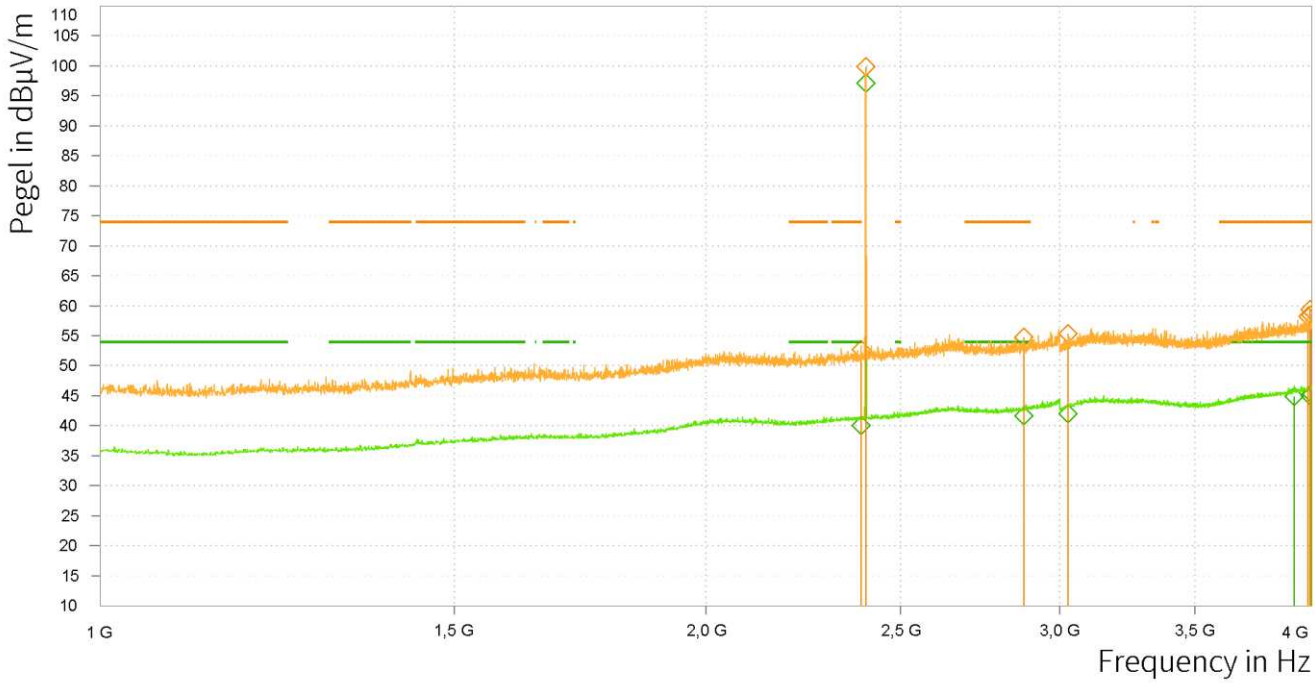
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
63.696000	33.43	40.00	6.57	100.0	120.000	165.0	V	-7.0
65.527500	33.74	40.00	6.26	100.0	120.000	135.0	V	325.0
85.465500	35.23	40.00	4.77	100.0	120.000	116.0	V	49.0

Plot 60: RSE 30 MHz – 1 GHz, OP 1, high channel, horizontal / vertical polarisation



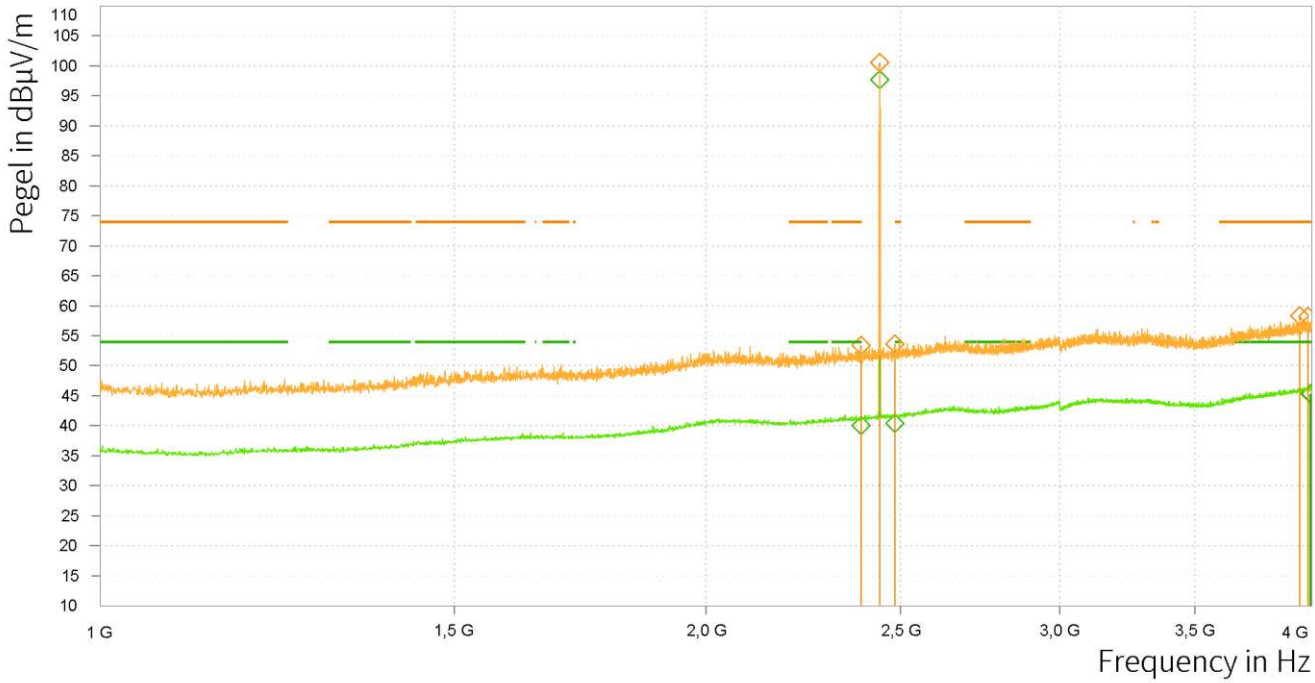
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
63.767500	34.73	40.00	5.27	100.0	120.000	141.0	V	253.0
64.677500	32.25	40.00	7.75	100.0	120.000	121.0	V	1.0
85.465500	35.61	40.00	4.39	100.0	120.000	103.0	V	66.0

Plot 61: RSE 1 GHz – 4 GHz, OP 1, low channel, horizontal / vertical polarisation



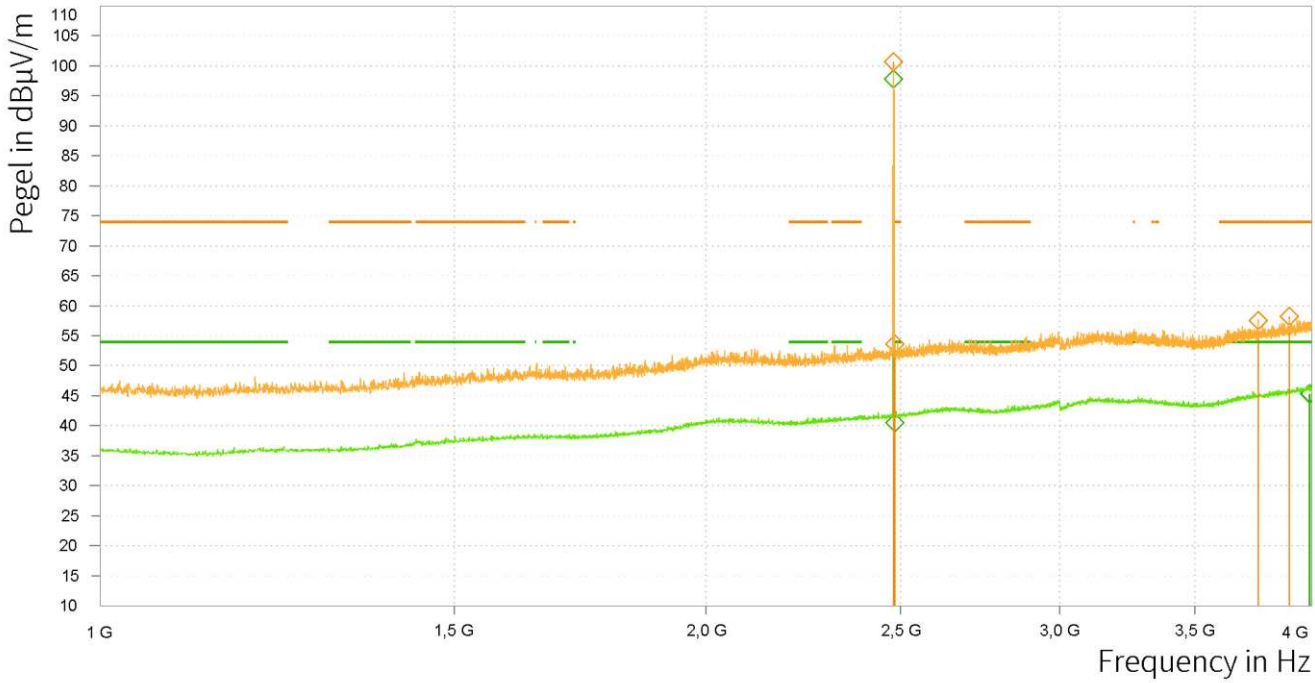
Rg	Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Polarization	Elevation [deg]	Azimuth [deg]	Meas. BW [kHz]
1	2.390,000	52,75	74,00	21,25	40,04	54,00	13,96	28,92	H	104,9	129	1.000,000
1	2.402,000	99,87			97,07			28,96	H	8,8	159,6	1.000,000
1	2.878,000	54,79	74,00	19,21	41,60	54,00	12,40	29,96	V	6,8	369,3	1.000,000
1	3.027,000	55,29			42,04			31,16	H	104,9	4,4	1.000,000
1	3.920,500				44,85	54,00	9,15	33,24	H	75	362,1	1.000,000
1	3.985,500	58,22	74,00	15,78				33,23	H	75	248,8	1.000,000
1	3.994,500	59,41	74,00	14,59	44,97	54,00	9,03	33,22	V	75	357,9	1.000,000
1	3.998,000	58,46	74,00	15,54				33,22	V	-15	18,9	1.000,000
1	3.998,500				45,31	54,00	8,69	33,22	V	81,4	3	1.000,000

Plot 62: RSE 1 GHz – 4 GHz, OP 1, mid channel, horizontal / vertical polarisation



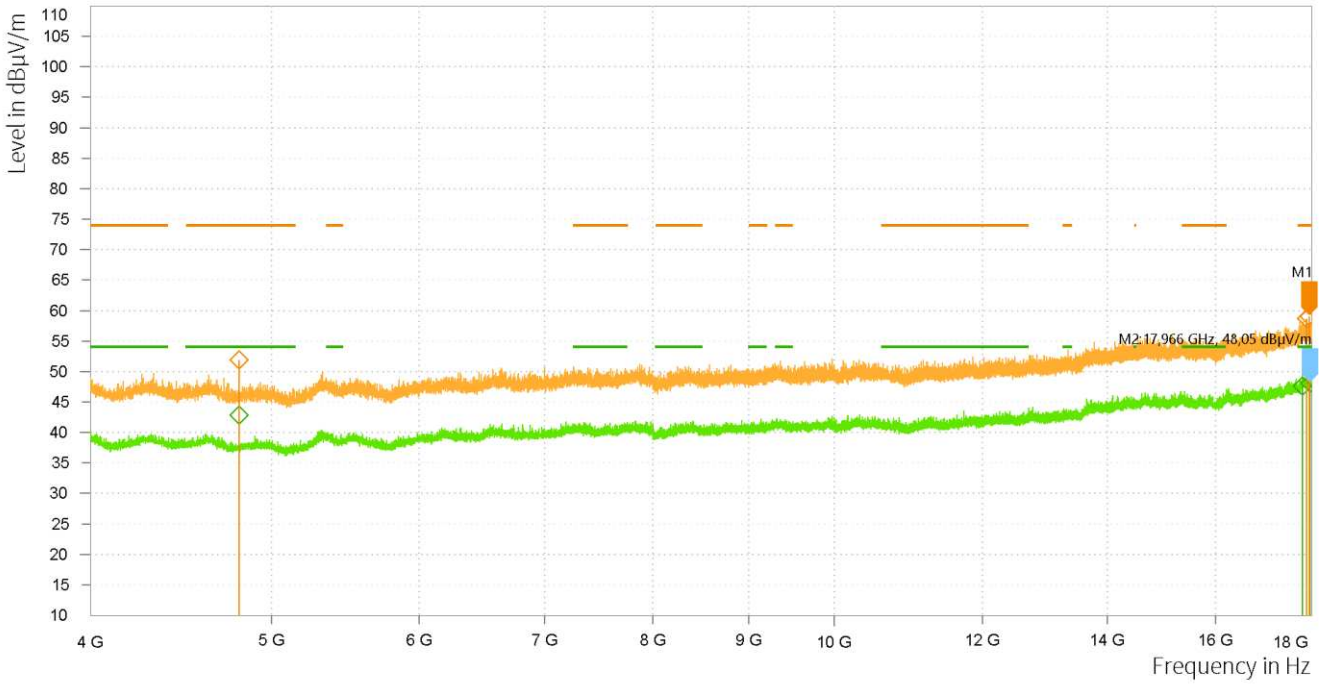
Rg	Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Polarization	Elevation [deg]	Azimuth [deg]	Meas. BW [kHz]
1	2.390,000	53,42	74,00	20,58	40,02	54,00	13,98	28,92	V	7,5	35,1	1.000,000
1	2.441,000	100,54			97,68			29,13	H	-15	271,4	1.000,000
1	2.483,500	53,58	74,00	20,42	40,41	54,00	13,59	29,36	V	75	4,5	1.000,000
1	3.946,500	58,33	74,00	15,67				33,26	V	105	151	1.000,000
1	3.985,500	58,22	74,00	15,78				33,23	V	81	11,7	1.000,000
1	3.993,500				45,30	54,00	8,70	33,23	V	14,9	56,8	1.000,000
1	3.996,500				45,31	54,00	8,69	33,22	H	81,2	5,3	1.000,000

Plot 63: RSE 1 GHz – 4 GHz, OP 1, high channel, horizontal / vertical polarisation



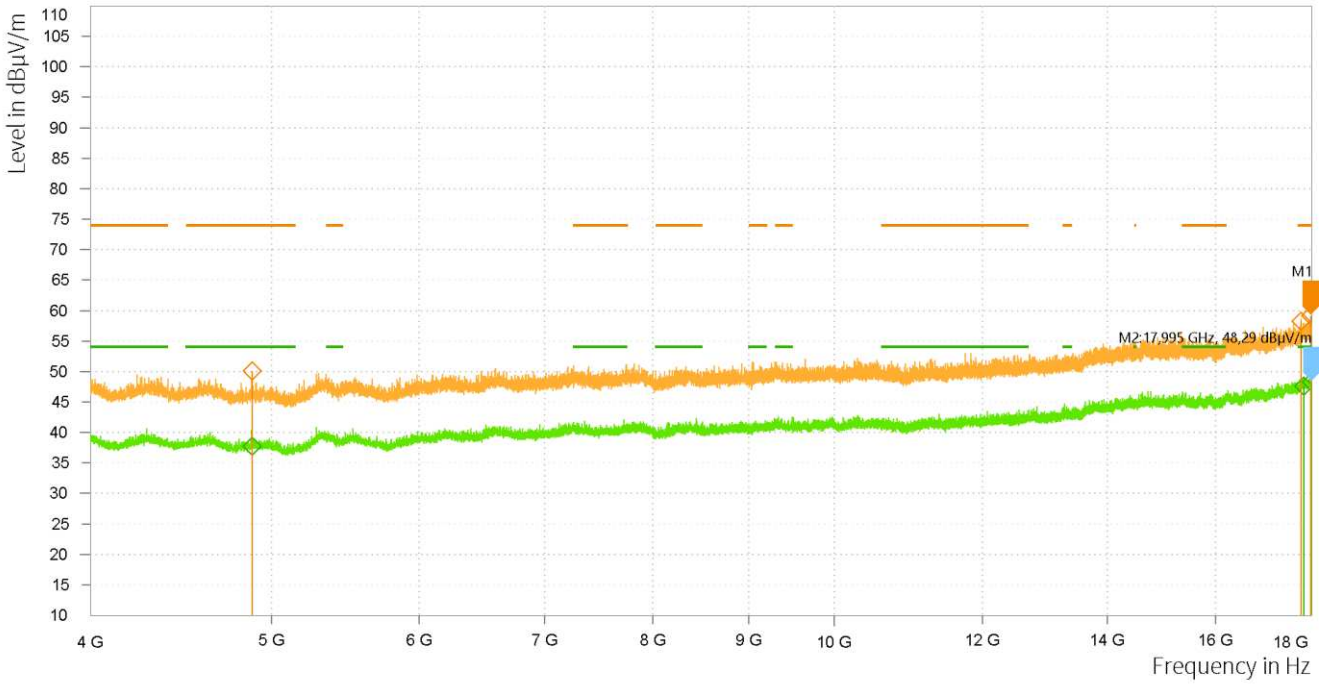
Rg	Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Polarization	Elevation [deg]	Azimuth [deg]	Meas. BW [kHz]
1	2.480,000	100,68			97,84			29,34	H	-15	281	1.000,000
1	2.483,500	53,65	74,00	20,35	40,51	54,00	13,49	29,36	V	98,7	98,1	1.000,000
1	3.764,500	57,58	74,00	16,42				33,00	V	75	112,7	1.000,000
1	3.900,500	58,25	74,00	15,75				33,22	V	104,9	302,1	1.000,000
1	3.989,500				45,28	54,00	8,72	33,23	V	105	339,9	1.000,000
1	3.993,500				45,30	54,00	8,70	33,23	V	82,4	373,9	1.000,000

Plot 64: RSE 4 GHz – 18 GHz, OP 1, low channel, horizontal / vertical polarisation



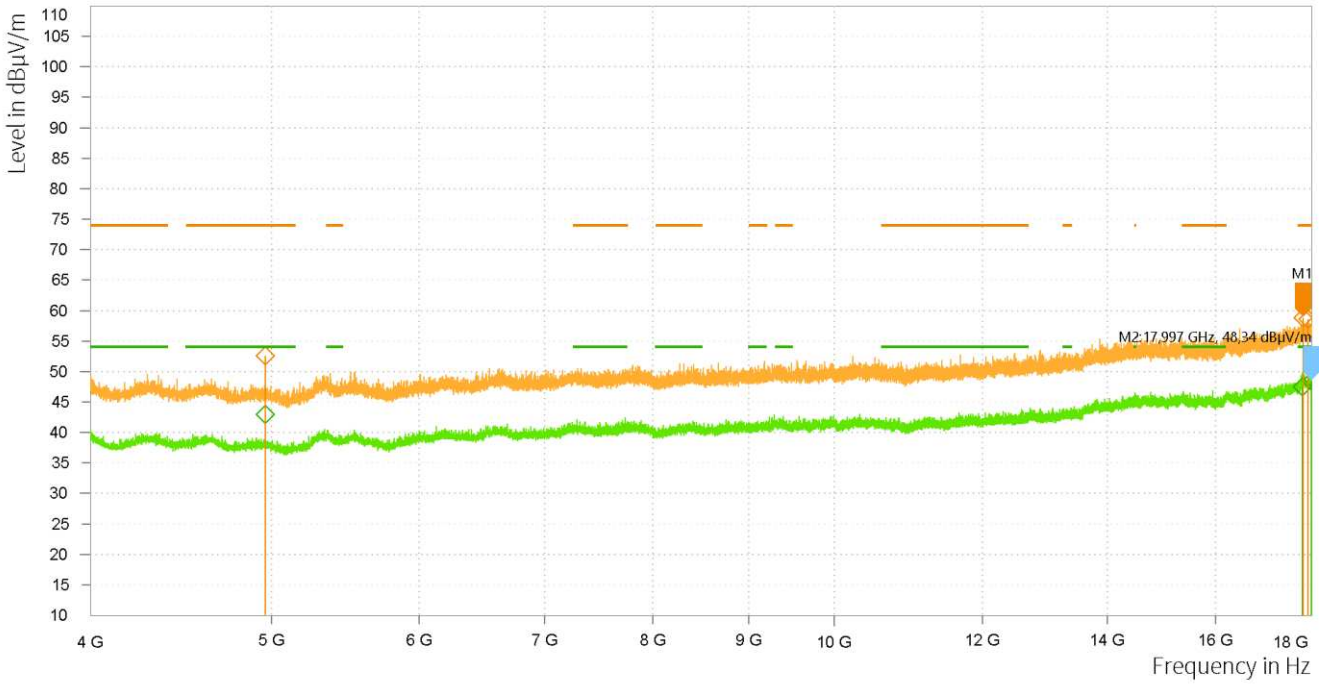
Rg	Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Elevation [deg]	Azimuth [deg]	Antenna Height [m]	Time of Meas.
2	4.806,000	51,86	74,00	22,14	42,80	54,00	11,20	34,41	15	132,6	1,50	12:00:33
2	17.807,500				47,65	54,00	6,35	43,99	94,6	391,5	1,50	11:55:37
2	17.898,500	58,75	74,00	15,25				44,20	75	234,1	1,50	11:56:51
2	17.948,500	59,08	74,00	14,92				44,35	14	207,4	1,50	11:53:43
2	17.965,500				48,05	54,00	5,95	44,40	75	304,6	1,50	11:54:41

Plot 65: RSE 4 GHz – 18 GHz, OP 1, mid channel, horizontal / vertical polarisation



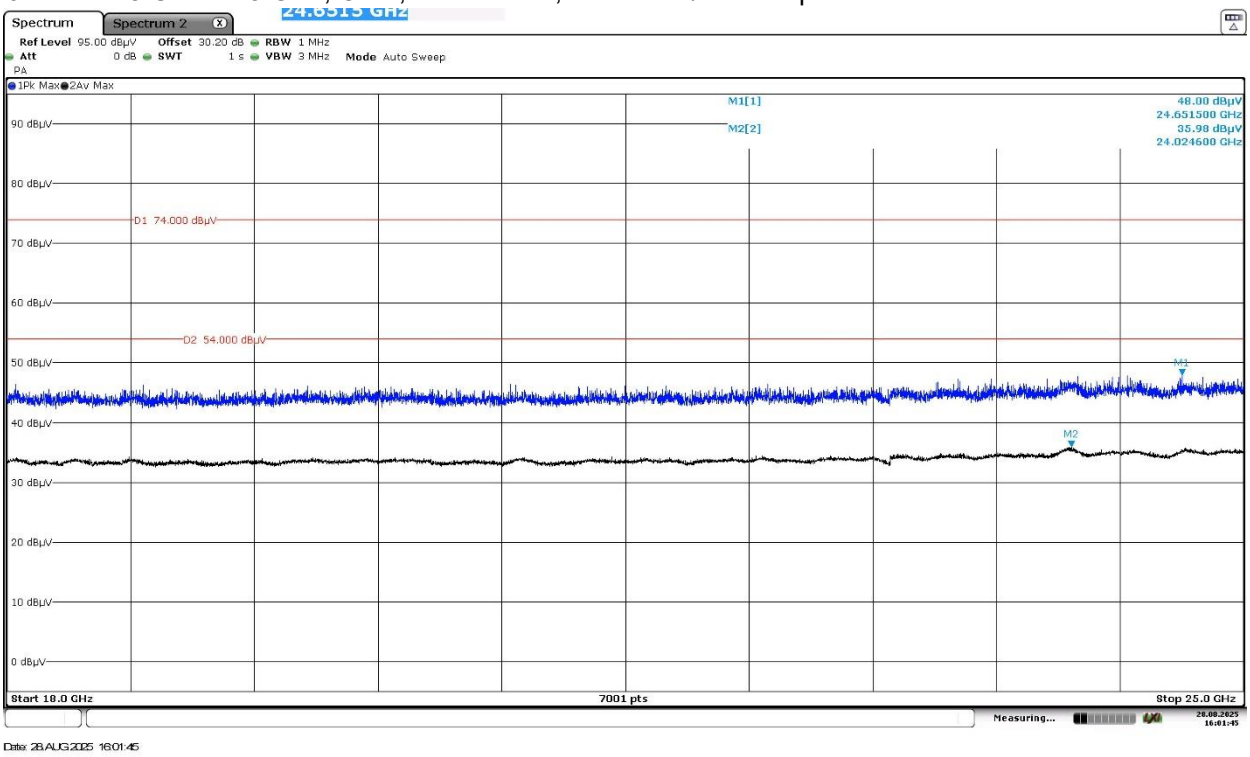
Rg	Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Elevation [deg]	Azimuth [deg]	Antenna Height [m]	Time of Meas.
2	4.882,000	50,11	74,00	23,89	37,71	54,00	16,29	34,66	75	356,3	1,50	12:41:56
2	17.777,500	58,25	74,00	15,75				43,93	4,5	381,9	1,50	12:12:12
2	17.839,500				47,65	54,00	6,35	44,05	-15	121,3	1,50	12:10:54
2	17.991,500	59,16	74,00	14,84				44,48	75	125,6	1,50	12:14:19
2	17.994,500				48,29	54,00	5,71	44,49	4,4	382,2	1,50	12:13:02

Plot 66: RSE 4 GHz – 18 GHz, OP 1, high channel, horizontal / vertical polarisation

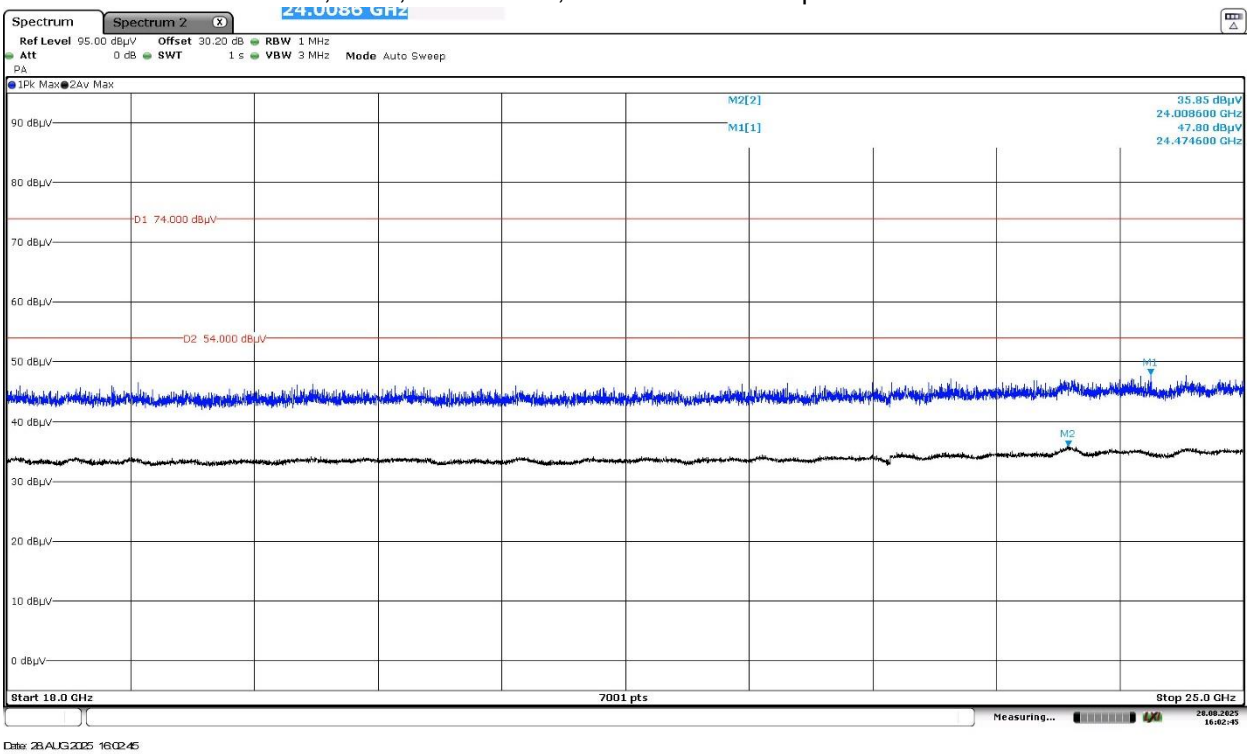


Rg	Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Elevation [deg]	Azimuth [deg]	Antenna Height [m]	Time of Meas.
2	4.962,000	52,58	74,00	21,42	42,97	54,00	11,03	34,70	85,6	120,3	1,50	13:00:27
2	17.801,000				47,45	54,00	6,55	43,97	105,1	194,7	1,50	12:50:27
2	17.815,500	58,83	74,00	15,17				44,00	105	369,4	1,50	12:51:25
2	17.931,000	58,63	74,00	15,37				44,29	104,3	71,1	1,50	12:49:26
2	17.996,500				48,34	54,00	5,66	44,50	15	364	1,50	12:48:17

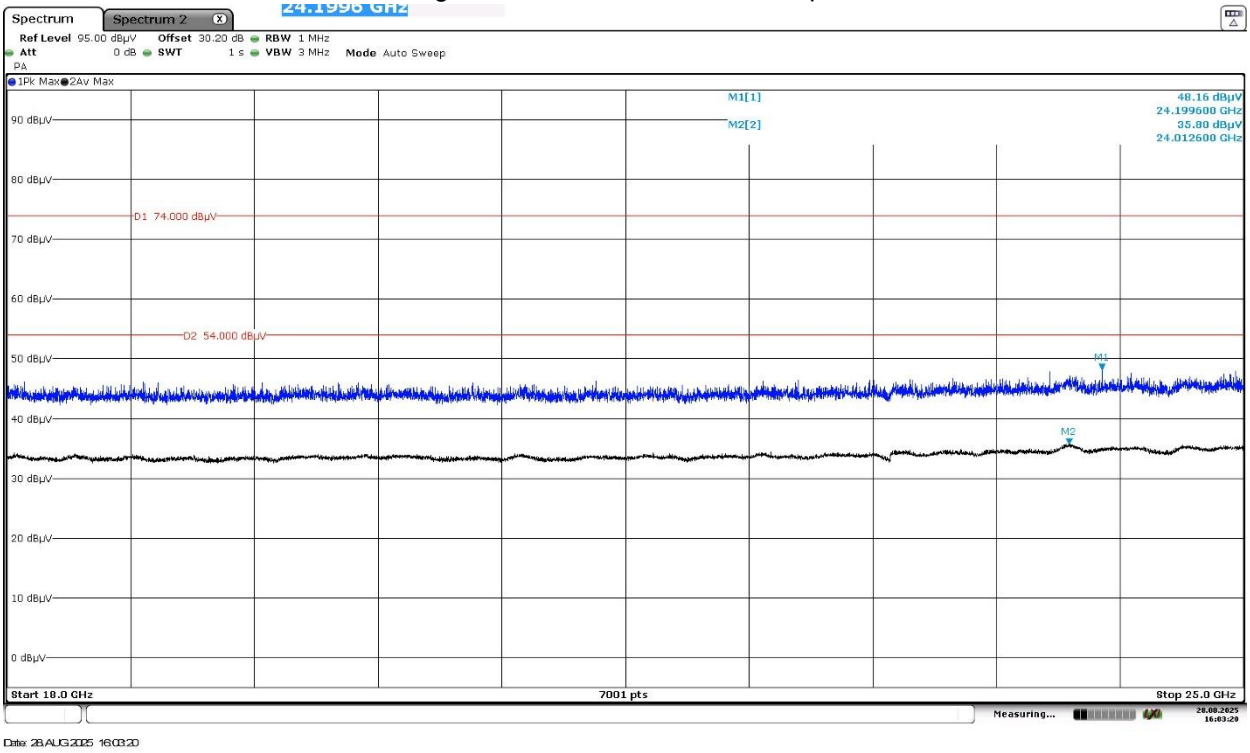
Plot 67: RSE 18 GHz – 25 GHz, OP 1, low channel, horizontal / vertical polarisation



Plot 68: RSE 18 GHz – 25 GHz, OP 1, mid channel, horizontal / vertical polarisation



Plot 69: RSE 18 GHz – 25 GHz, OP 1, high channel, horizontal / vertical polarisation



7.12 AC Conducted Emissions

Description / Limits

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission [MHz]	Conducted limit [dBµV]	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5.0	56	46
5.0 – 30	60	50
*Decreases with the logarithm of the frequency.		

§15.207 (c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtainig their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

See also RSS-Gen, 8.8 AC power-line conducted emissions limits.

Test procedure

ANSI C63.10, 5.6.4 AC power-line conducted emissions

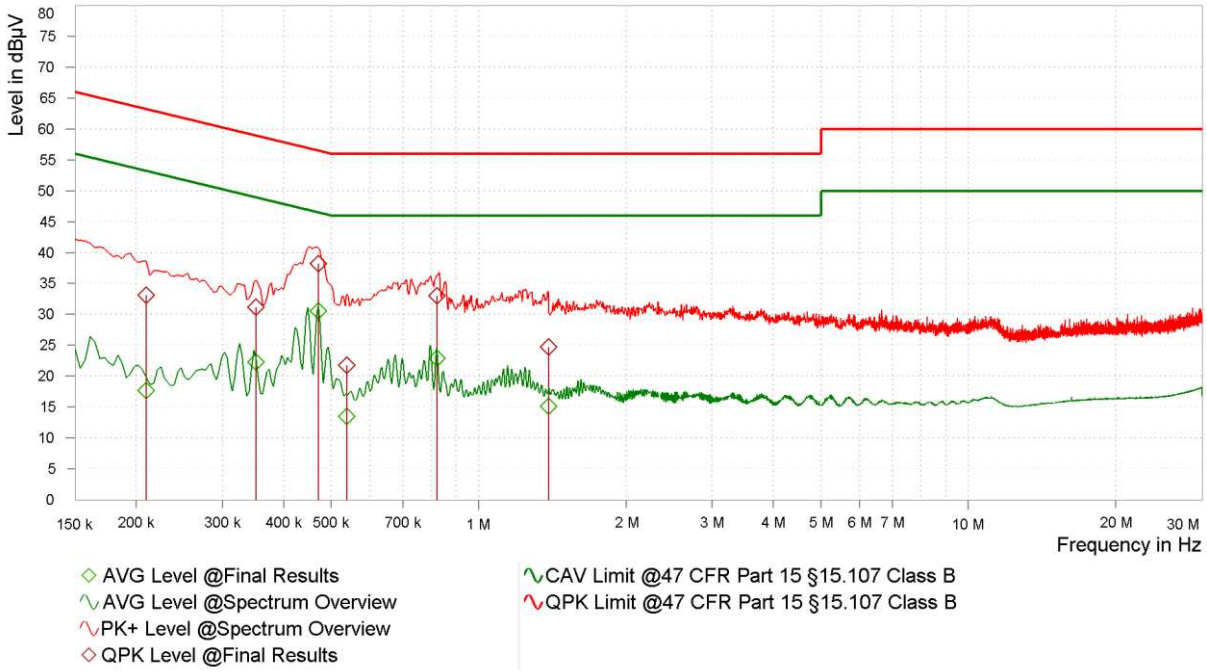
AC power-line conducted emissions do not require measurements on the minimum number of channels outlined in 5.6.1. Measurements shall only be performed on the channel and mode with the highest output power.

Test setup: 8.5 with radiated test sample in test mode (see section 5.2)

Test results

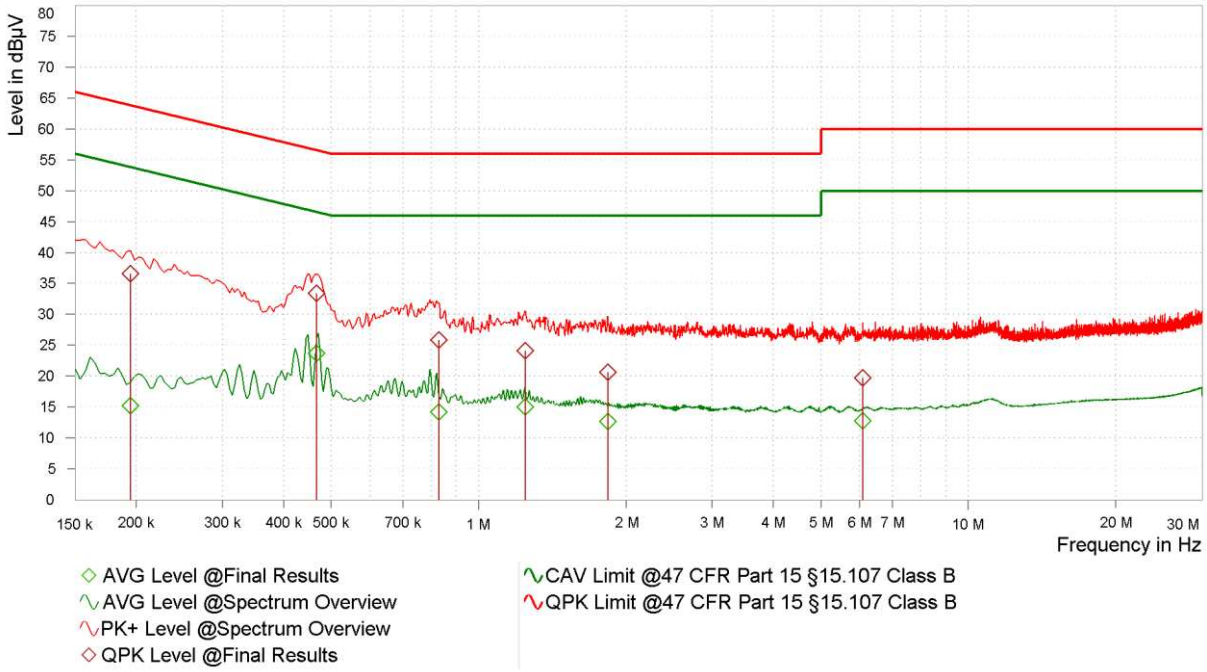
See next pages!

Plot no. 70: conducted emissions, line L1



Rg	Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	AVG Level [dBµV]	AVG: CAV Limit [dBµV]	AVG Margin [dB]	Correction [dB]	Line	Meas. BW [kHz]	Meas. Time [s]
1	0,210	33,14	63,22	30,07	17,67	53,22	35,55	9,85	L1	9,000	15,000
1	0,351	31,11	58,93	27,81	22,24	48,93	26,68	9,99	L1	9,000	15,000
1	0,471	38,16	56,50	18,34	30,59	46,50	15,91	10,16	L1	9,000	15,000
1	0,538	21,77	56,00	34,23	13,51	46,00	32,49	10,17	L1	9,000	15,000
1	0,822	33,01	56,00	22,99	22,92	46,00	23,08	10,05	L1	9,000	15,000
1	1,389	24,76	56,00	31,24	15,09	46,00	30,91	9,97	L1	9,000	15,000

Plot no. 71: conducted emissions, neutral N



Rg	Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	AVG Level [dBµV]	AVG: CAV Limit [dBµV]	AVG Margin [dB]	Correction [dB]	Line	Meas. BW [kHz]	Meas. Time [s]
1	0,195	36,63	63,83	27,21	15,23	53,83	38,60	9,84	N	9,000	15,000
1	0,467	33,44	56,56	23,12	23,74	46,56	22,82	10,15	N	9,000	15,000
1	0,829	25,87	56,00	30,13	14,17	46,00	31,83	10,04	N	9,000	15,000
1	1,247	24,07	56,00	31,93	15,00	46,00	31,00	9,97	N	9,000	15,000
1	1,837	20,66	56,00	35,34	12,62	46,00	33,38	9,96	N	9,000	15,000
1	6,086	19,69	60,00	40,31	12,73	50,00	37,27	10,11	N	9,000	15,000

8 TEST SETUP DESCRIPTION

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Cyclic chamber inspections and range calibrations are performed. Where possible, RF generating and signalling equipment as well as measuring receivers and analysers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

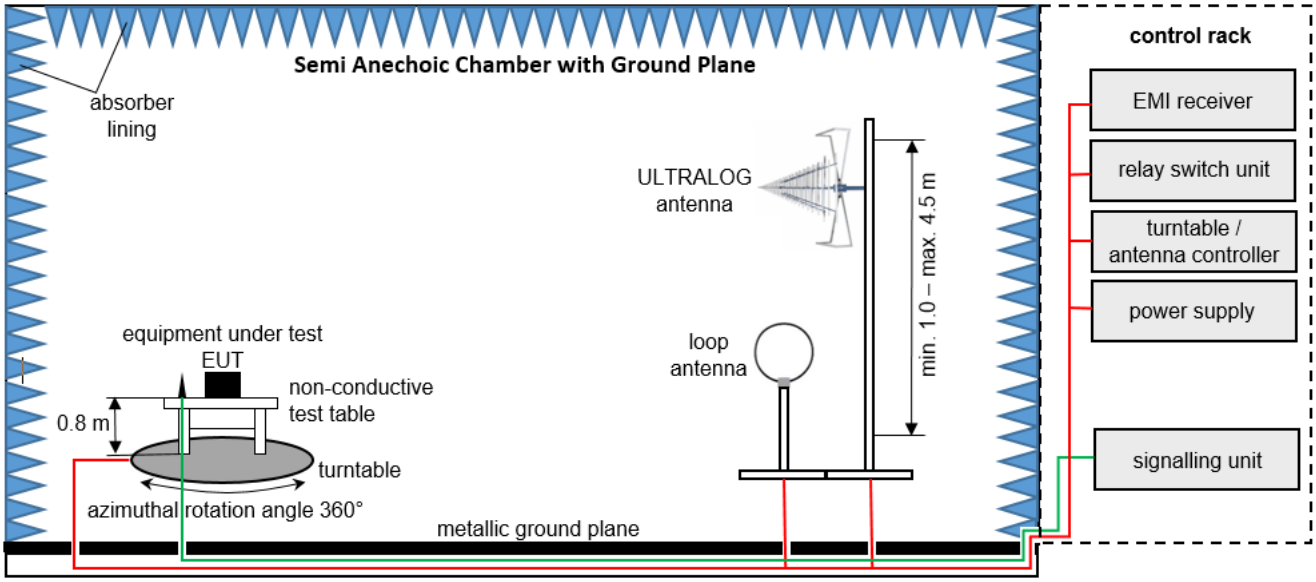
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Kind of calibration (abbreviations):

C = calibrated
CM = cyclic maintenance
NR = not required
L = locked

8.1 Semi Anechoic Chamber with Ground Plane

Radiated measurements are performed in vertical and horizontal plane in the frequency range 30 MHz to 1 GHz in a Semi Anechoic Chamber with a metallic ground plane. The EUT is positioned on a non-conductive test table with a height of 0.80 m above the metallic ground plane that covers the whole chamber. The receiving antennas conform to specification ANSI C63.10, American National Standard for Testing Unlicensed Wireless Devices. These antennas can be moved over the height range between 1.0 m and 4.5 m in order to search for maximum field strength emitted from the EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by a spectrum analyzer where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: loop antenna 3 m, ULTRALOG antenna 3 m
EMC32 software version: 11.20.00

Description:

$$E = U_{Rx} + \alpha_{cable\ loss} + A$$

$$P = 10^{\frac{EIRP|_{dBm}}{10}}$$

- radiated output power → $E|_{\frac{dB\mu V}{m}}$
- voltage at the receiver → $U|_{\frac{dB\mu V}{m}}$
- antenna factor → $A|_{\frac{dB}{m}}$
- cable loss → $\alpha_{cable\ loss}|_{dB}$

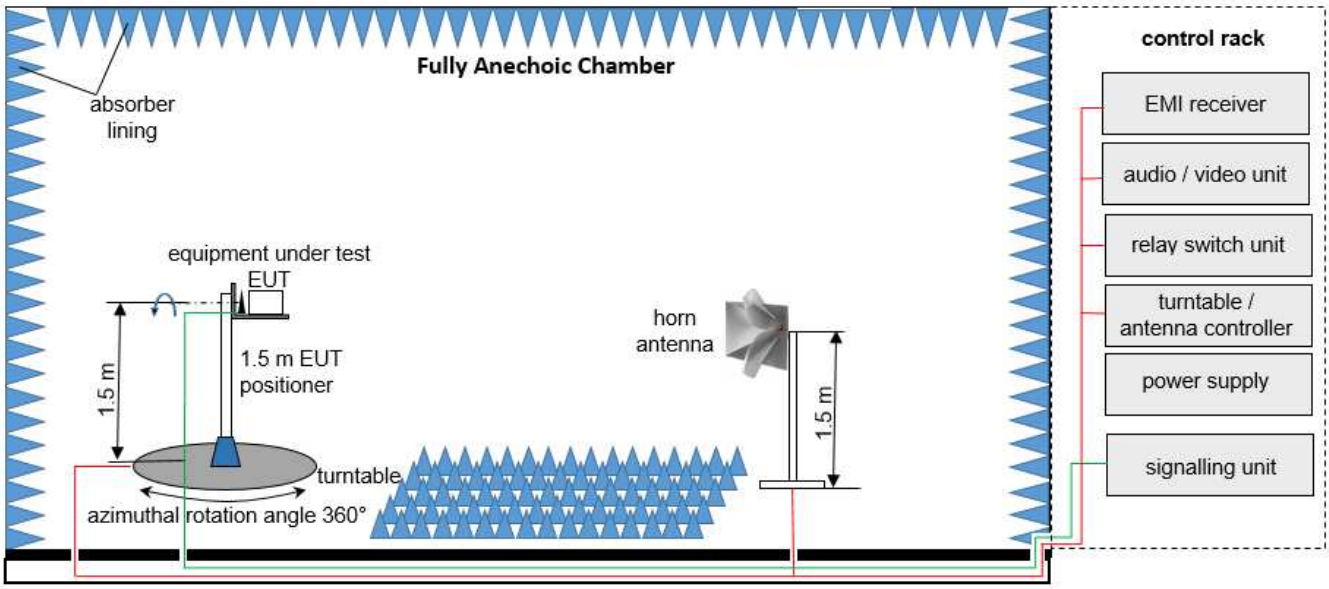
Example:

$$E = 12.35\ \frac{dB\mu V}{m} + 1.90\ dB + 16.80\ \frac{dB}{m} = 31.05\ \frac{dB\mu V}{m}$$

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Power Supply	Rohde & Schwarz	IN 600	101554	LAB000824	NR	–
2	Antenna	Rohde & Schwarz	HL562E	102173	LAB000673	C	2022-10-17 → 36M → 2025-10-17
3	Power Supply	Chroma	61602		LAB000507	NR	–
4	EMI Test Receiver	Rohde & Schwarz	ESW26	101517	LAB000363	C	2025-01-10 → 12M → 2026-01-10
5	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NR	–
6	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NR	–
7	Antenna Mast	Berlebach	Tripod HFH2-Z8 & -Z9	101762	LAB000292	NR	–
8	Positioner	maturo GmbH	TD 1.5-10KG		LAB000258	NR	–
9	Compressed Air	Implotex	1-850-30	-	LAB000256	NR	–
10	Semi/Fully Anechoic Chamber	Albatross Projects GmbH	Babylon 5 (SAC 5)	20168.PRB	LAB000235	CM	2025-03-18 → 36M → 2028-03-18
11	Measurement Software	Rohde & Schwarz	EMC32 V11.20		LAB000226	NR	–
12	Turntable	maturo GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NR	–
13	Antenna Mast	maturo GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NR	–
14	Antenna Mast	maturo GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NR	–
15	Controller	maturo GmbH	FCU 3.0	10082	LAB000222	NR	–
16	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350292	LAB000191	NR	–
17	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	CM	0000-00-00 → 12M →
18	Antenna	Rohde & Schwarz	HF907	102899	LAB000151	C	2023-05-15 → 36M → 2026-05-15
19	Antenna	Rohde & Schwarz	HL562E	102005	LAB000150	C	2022-12-22 → 36M → 2025-12-22
20	Open Switch and Control Platform	Rohde & Schwarz	OSP220 Base Unit 2HU	101748	LAB000149	NR	–
21	Antenna	Rohde & Schwarz	HFH2-Z2E	100954	LAB000108	C	2025-06-24 → 24M → 2027-06-24

8.2 Fully Anechoic Chamber



Measurement distance: horn antenna 3 meter
EMC32 software version: 11.20.00

Description:

$$E = U_{Rx} + \alpha_{cable\ loss} + A$$

$$P = 10^{\frac{EIRP|_{dBm}}{10}}$$

- radiated output power → $E|_{\frac{dB\mu V}{m}}$
- voltage at the receiver → $U_{Rx}|_{\frac{dB\mu V}{m}}$
- antenna factor → $A|_{\frac{dB}{m}}$
- cable loss → $\alpha_{cable\ loss}|_{dB}$

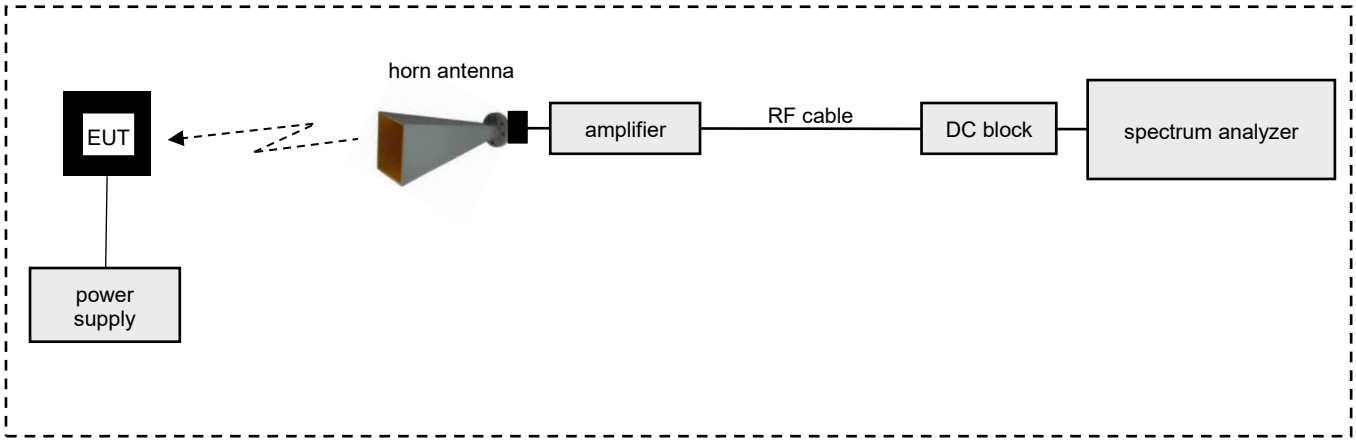
Example:

$$E = 12.35\ \frac{dB\mu V}{m} + 1.90\ dB + 16.80\ \frac{dB}{m} = 31.05\ \frac{dB\mu V}{m}$$

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Antenna	TTE Europe	HA-18G-40G-20-2.4mm-F	2110081000210	LAB000865	C	—
2	Antenna Mast	innco systems GmbH	MA3000-PP-NS	xxxxx	LAB000864	NR	–
3	Antenna Mast	innco systems GmbH	AS2500-PP-HK	xxxxx	LAB000863	NR	–
4	Positioner	innco systems GmbH	DE3750-RH	xxxxx	LAB000862	NR	–
5	Turntable	innco systems GmbH	Turntable	xxxxxxx	LAB000861	NR	–
6	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 9080-20 T	2500230006	LAB000696	NR	–
7	Fully Anechoic Chamber (FAC)	Albatross Projects GmbH	SkyLab 3 (FAC 3)	P31018	LAB000686	CM	2025-03-18 → 36M → 2028-03-18
8	Power Supply	Rohde & Schwarz	IN 600	101126	LAB000684	NR	–
9	Spectrum Analyser	Rohde & Schwarz	FSW43	101391	LAB000289	C	2025-06-12 → 12M → 2026-06-12
10	Antenna	Rohde & Schwarz	HF907	102898	LAB000124	C	2023-06-13 → 36M → 2026-06-13
11	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	C	2023-04-05 → 36M → 2026-04-05

8.3 Radiated measurements > 18 GHz

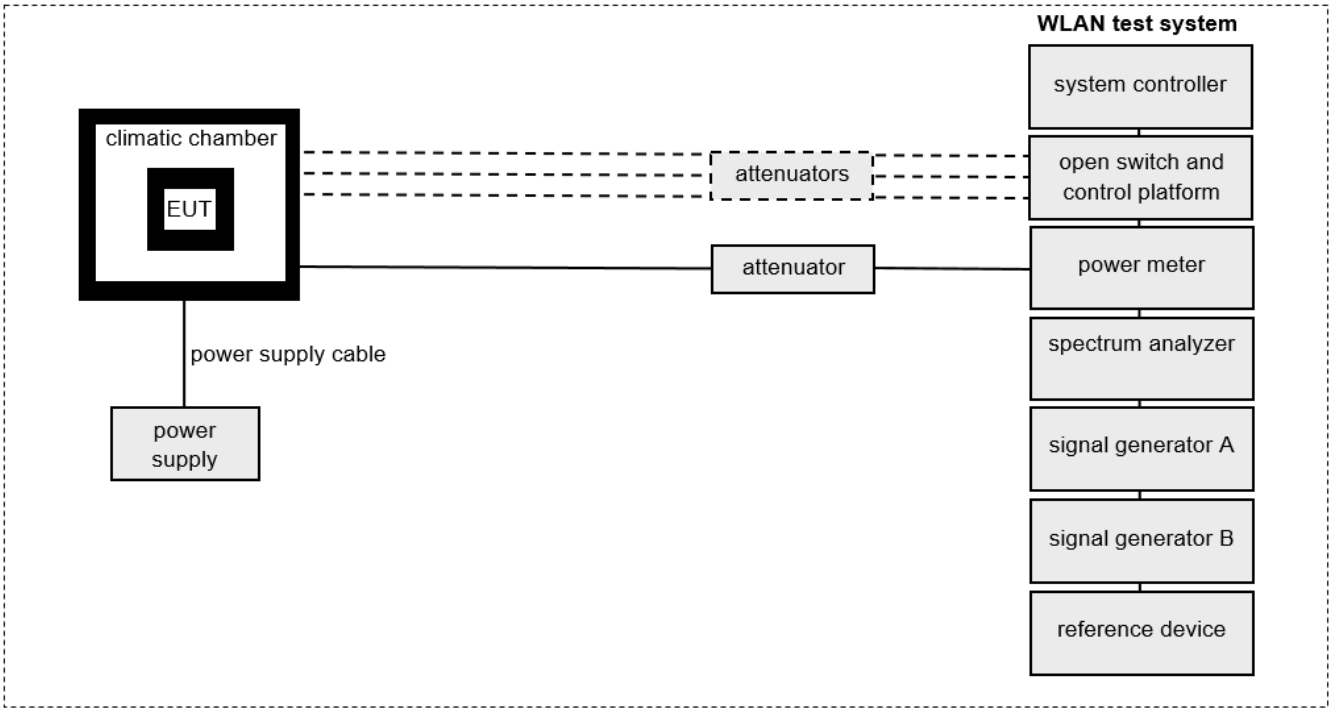


List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Absorber	Telemeter Electronic	EPP 12	-	LAB000327	NR	–
2	Test table	innco systems GmbH	PT0707-RH light	-	LAB000303	NR	–
3	Spectrum Analyser	Rohde & Schwarz	FSW43	101391	LAB000289	C	2025-06-12 → 12M → 2026-06-12
4	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350263	LAB000190	NR	–
5	WG-Coax-Adapter	Flann Microwave Ltd	20093-TF30 UBR220	273374	LAB000181	CM	2025-06-24 → 12M → 2026-06-24
6	Coaxial Cable	Huber & Suhner	SF101/1.5m	503987/1	LAB000165	CM	2025-04-25 → 12M → 2026-04-25
7	Antenna	Flann Microwave Ltd	20240-20 (18.0-26.5 GHz)	266403	LAB000128	CM	2025-05-21 → 12M → 2026-05-21
8	Antenna Mast	Schwarzbeck Mess-Elektronik OHG	AM 9104	99	LAB000109	NR	–
9	Multimeter	Keysight	U1242B	MY59110034	LAB000009	C	2025-09-05 → 12M → 2026-09-05

8.4 Conducted measurements WLAN test system R&S TS 8997

The EUT's RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The losses for all signal paths are first checked within a calibration. The measurement readings on the signalling unit/spectrum analyzer are corrected by the specific test set-up loss. The attenuator, power divider, signalling unit and the spectrum analyzer are impedance matched on 50 Ohm.

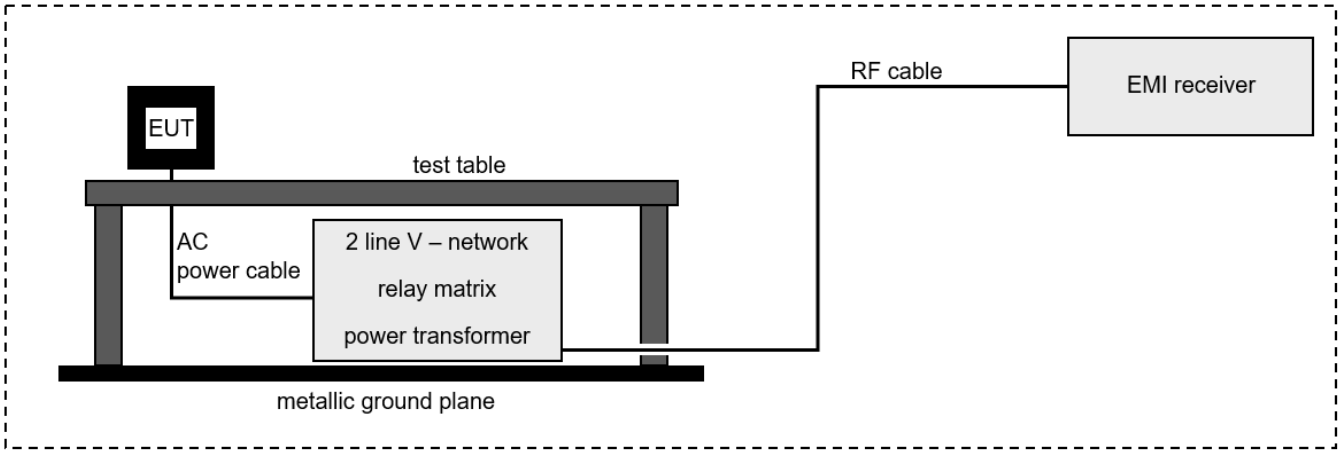


EMC32/WMS32 software version: 12.20.00

List of test equipment used:

No.	Equipment	Manufacturer	Type	S/N	IBL No.	Kind of calibration	Last / Next calibration
1	Open Switch and Control Platform	Rohde & Schwarz	OSP-B157W8Plus	100830	LAB000358	C	2025-06-17 → 12M → 2026-06-17
2	TS8997	Rohde & Schwarz	TS8997-Rack	100829	LAB000322	NR	–
3	Open Switch and Control Platform	Rohde & Schwarz	OSP-B157WX	101247	LAB000280	NR	–
4	Spectrum Analyser	Rohde & Schwarz	FSV40	101403	LAB000278	C	2025-06-13 → 12M → 2026-06-13
5	Vector Signal Generator	Rohde & Schwarz	SMBV100A-06	258240	LAB000277	C	2024-12-10 → 36M → 2027-12-10
6	Signal Generator	Rohde & Schwarz	SMB100A-20	178175	LAB000276	C	2024-04-03 → 36M → 2027-04-03
7	Radio Communication Tester	Rohde & Schwarz	CMW270	101479	LAB000275	NR	–
8	Controller	Hewlett Packard	ATS-Z230	101379	LAB000274	NR	–
9	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350263	LAB000190	NR	–

8.1 AC conducted emissions



Description:

$$E = U_{Rx} + \alpha_{cable\ loss} + VC$$

$$P = 10^{\frac{EIRP|_{dBm}}{10}}$$

- radiated output power → $E|_{\frac{dB\mu V}{m}}$
- voltage at the receiver → $U_{Rx}|_{\frac{dB\mu V}{m}}$
- correction factor of the ISN → $VC|_{\frac{dB}{m}}$
- loss of the cable and filter → $\alpha_{cable\ loss}|_{dB}$

Example:

$$E = 37.62\ \frac{dB\mu V}{m} + 9.90\ dB + 0.23\ \frac{dB}{m} = 47.75\ \frac{dB\mu V}{m}$$

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	EMI Test Receiver	Rohde & Schwarz	EPL1000	100921	LAB000873	C	2024-12-19 → 12M → 2025-12-19
2	Power Supply	Chroma	61704		LAB000540	NR	–
3	Shielded room	Albatross Projects GmbH	Sputnik 1 (Schirmkabine)		LAB000257	NR	–
4	Open Switch and Control Platform	Rohde & Schwarz	OSP-B200S2	101443	LAB000239	NR	–
5	Two-Line V-Network	Rohde & Schwarz	ENV216	102597	LAB000220	C	2025-06-11 → 12M → 2026-06-11

9 MEASUREMENT PROCEDURES

9.1 Radiated spurious emissions from 9 kHz to 30 MHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
  In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, … necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, … are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- Turntable performs an azimuthal rotation from 0° to 360° continuously.
- For each turntable position the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated with special 3D adapter set to find maximum level of emissions.
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 40 dB/decade of distance in the region closer than λ in m divided by 2π (i.e., λ/2π), and at 20 dB/decade of distance beyond that, using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the limit line of corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.10

9.2 Radiated spurious emissions from 30 MHz to 1 GHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
  In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, … necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, … are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- Turntable performs an azimuthal rotation from 0° to 360° continuously.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable position / antenna polarisation / antenna height the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C6.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., λ/2π), using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.10

9.3 Radiated spurious emissions from 1 GHz to 18 GHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
  In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, … necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, … are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- Turntable performs an azimuthal rotation from 0° to 360° continuously.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable position / antenna polarisation / antenna height the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C6.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., λ/2π), using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.10

9.4 Radiated spurious emissions above 18 GHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- Additional equipment, cables, … necessary for testing, are positioned like under normal operation.
- EUT is powered on and set into operation.
- Test distance depends on EUT size and test antenna size (farfield conditions shall be met).

Pre-scan

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and for different polarizations of the antenna.

Final measurement

- Significant emissions found during the pre-scan will be maximized, i.e. position and antenna orientation causing the highest emissions with Peak and RMS detector
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4 / C63.10).
- Final plot showing measurement data, levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit is recorded.

Note

- In case of measurements with external harmonic mixers (e.g. above 50 GHz) special care is taken to avoid possible overloading of the external mixer's input.
- As external harmonic mixers may generate false images, care is taken to ensure that any emission measured by the spectrum analyzer is indeed radiated from the EUT and not internally generated by the external harmonic mixer. Signal identification feature of spectrum analyzer is used to eliminate/reduce images of the external harmonic mixer.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., $\lambda/2\pi$), using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.10

10 MEASUREMENT UNCERTAINTIES

Radio frequency	≤ ± 1 x 10^{-7}
RF power, conducted	≤ ± 0.75 dB
Power spectral density	≤ ± 3 dB
Maximum frequency deviation	≤ ± 5 %
Deviation limitation Duty Cycle, Tx-sequence, Tx-gap	≤ ± 5 %
Occupied channel bandwidth	≤ ± 5 %
Conducted spurious emission of transmitter	≤ ± 4 dB
Conducted emission of receivers	≤ ± 4 dB
Radiated emission of transmitter	≤ ± 6 dB
Radiated emission of receiver	≤ ± 6 dB
Temperature	≤ ± 2.5 °C
Humidity	≤ ± 10 %

The indicated expanded measurement uncertainty corresponds to the standard measurement uncertainty for the measurement results multiplied by the coverage factor k = 2. It was determined in accordance with EA-4/02 M:2013. The true value is located in the corresponding interval with a probability of 95 %.