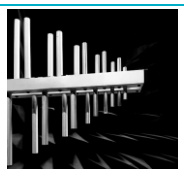
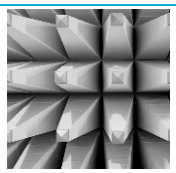




TEST REPORT

Test report no.: 1-8881-24-01-16_TR1-R02

DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-00

Testing laboratory

cetecom advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://cetecomadvanced.com
e-mail: mail@cetecomadvanced.com

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS).
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number:
D-PL-12047-01-00.
ISED Testing Laboratory Recognized Listing Number: DE0001
FCC designation number: DE0002

Applicant

endiio Engineering GmbH
Georges-Köhler-Allee 302
79110 Freiburg im Breisgau / GERMANY
Phone: +49 761 70 888 933
Contact: Omar Gorgies
e-mail: gorgies@endiio.com

Manufacturer

endiio Engineering GmbH
Georges-Köhler-Allee 302
79110 Freiburg im Breisgau / GERMANY

Test standard/s

FCC - Title 47 CFR Part 15	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 3	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 5 incl. Amendment 1 & 2	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	**RF Modul for IoT Sensor-platform**
Model name:	**endiio Gateway V2**
FCC ID:	**2BL4CEN-WM2**
ISED certification number:	**33310-ENWM2**
Frequency:	915.4 MHz – 916 MHz
Technology tested:	proprietary
Antenna:	external omni antenna
Power supply:	4.5 V to 5.5 V DC, through external AC/DC adapter
Temperature range:	-20°C to +55°C

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:

cn=Christoph Schneider, o=cetecom advanced GmbH, ou=SND-230601, email=christoph.schneider@cetecomadvanced.com, c=DE
2025.06.25 14:59:46 +02'00'

Christoph Schneider
Lab Manager
Radio Labs

Test performed:

cn=Joachim Wolsdorfer, o=cetecom advanced GmbH, ou=WLD-230605, email=joachim.wolsdorfer@cetecomadvanced.com, c=DE
2025.06.25 14:44:50 +02'00'

Hans-Joachim Wolsdorfer
Lab Manager
Radio Labs

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. cetecom advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of cetecom advanced GmbH.
The testing service provided by cetecom advanced GmbH has been rendered under the current "General Terms and Conditions for cetecom advanced GmbH".
cetecom advanced GmbH will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.
Under no circumstances does the cetecom advanced GmbH test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.
Under no circumstances does the cetecom advanced GmbH test report include or imply any product or service warranties from cetecom advanced GmbH, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by cetecom advanced GmbH.
All rights and remedies regarding vendor's products and services for which cetecom advanced GmbH has prepared this test report shall be provided by the party offering such products or services and not by cetecom advanced GmbH.
In no case this test report can be considered as a Letter of Approval.

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

This test report replaces the test report with the number 1-8881-24-01-16_TR1-R01 and dated 2025-03-27.

2.2 Application details

Date of receipt of order:	2024-11-11
Date of receipt of test item:	2025-03-13
Start of test:*	2025-03-19
End of test:*	2025-03-20
Person(s) present during the test:	-/-

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

2.3 Test laboratories sub-contracted

None

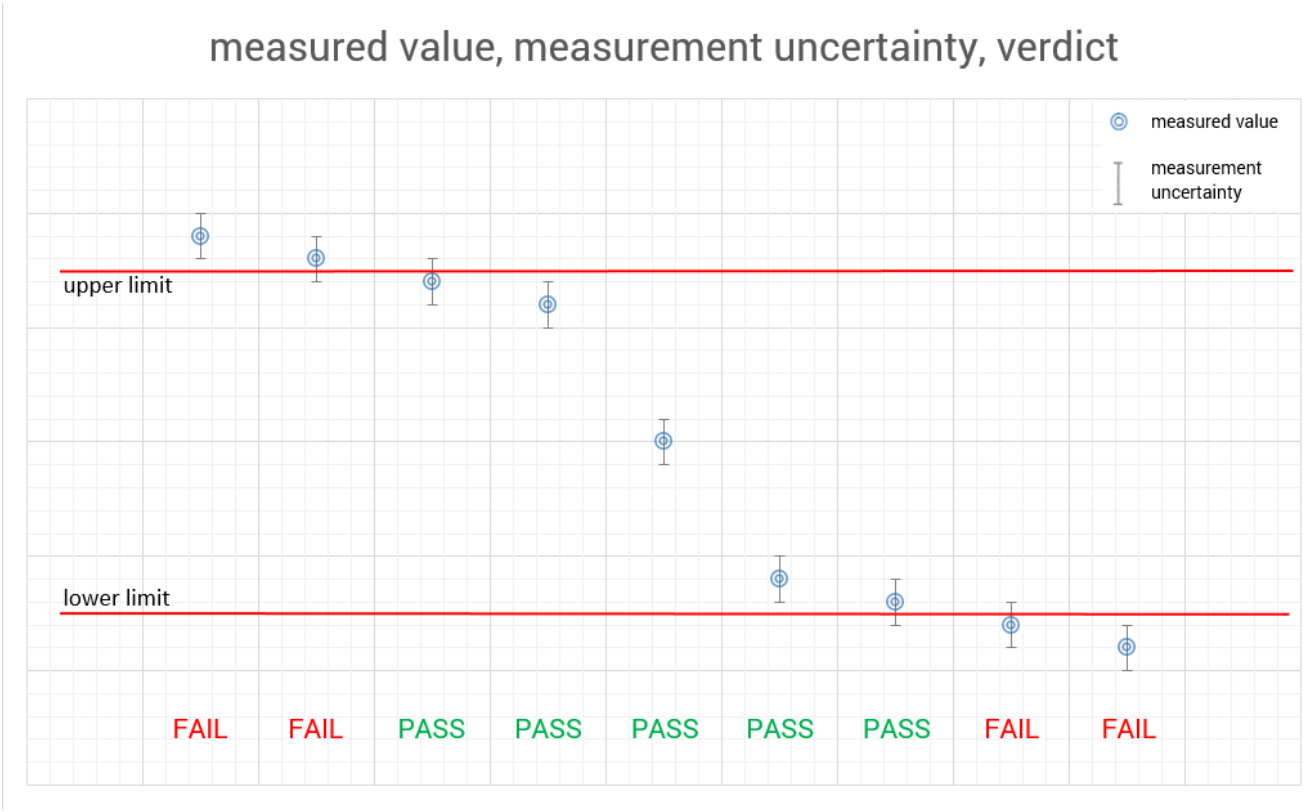
3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 15		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 3	August 2023	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 5 incl. Amendment 1 & 2	February 2021	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus

Guidance	Version	Description
KDB 558074 D01	v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
KDB 996369 D04	v02	MODULAR TRANSMITTER INTEGRATION GUIDE GUIDANCE FOR HOST PRODUCT MANUFACTURERS
ANSI C63.4a-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
ANSI C63.10-2020	-/-	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



5 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests +55 °C during high temperature tests -20 °C during low temperature tests Testing under extreme temperature conditions not required.
Relative humidity content	:		55 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom} V_{max} V_{min}	5.0 V DC, through external AC/DC adapter 5.5 V 4.5 V Testing under extreme voltage conditions not required.

6 Test item

6.1 General description

Kind of test item	:	RF Modul for IoT Sensor-platform
Model name	:	endiio Gateway V2
HMN	:	endiio Gateway V2
PMN	:	endiio WM
HVIN	:	V2.21
FVIN	:	-/-
S/N serial number	:	prototype
Hardware status	:	Up-Gateway
Software status	:	N.A.
Firmware status	:	N.A.
Frequency band	:	915.4 MHz – 916 MHz
Type of radio transmission Use of frequency spectrum	: :	modulated carrier
Type of modulation	:	FSK
Number of channels	:	4
Antenna	:	external omni antenna
Power supply	:	4.5 V to 5.5 V DC, through external AC/DC adapter
Temperature range	:	-20°C to +55°C

6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report: 1-8881-24-01-16_TR1-A101-R03
1-8881-24-01-16_TR1-A102-R01
1-8881-24-01-16_TR1-A103-R01

7 Description of the test setup

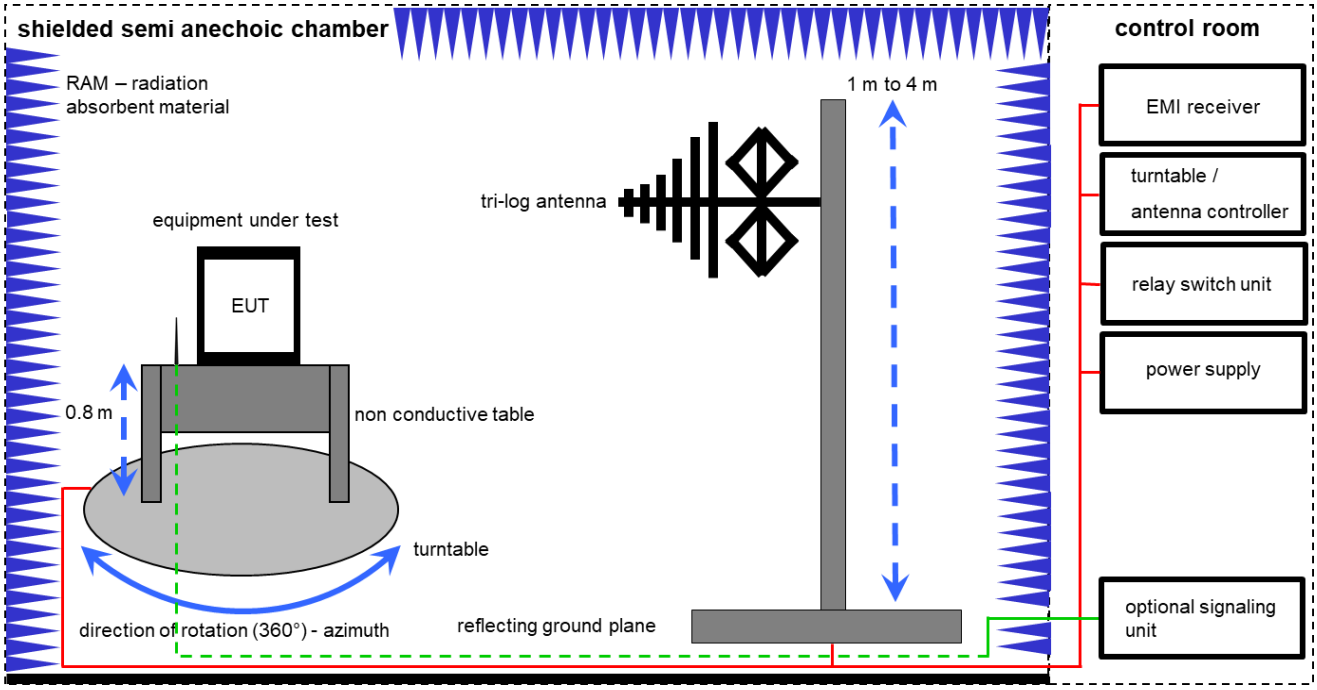
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers 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).

Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from 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 spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter
EMC32 software version: 10.59.00

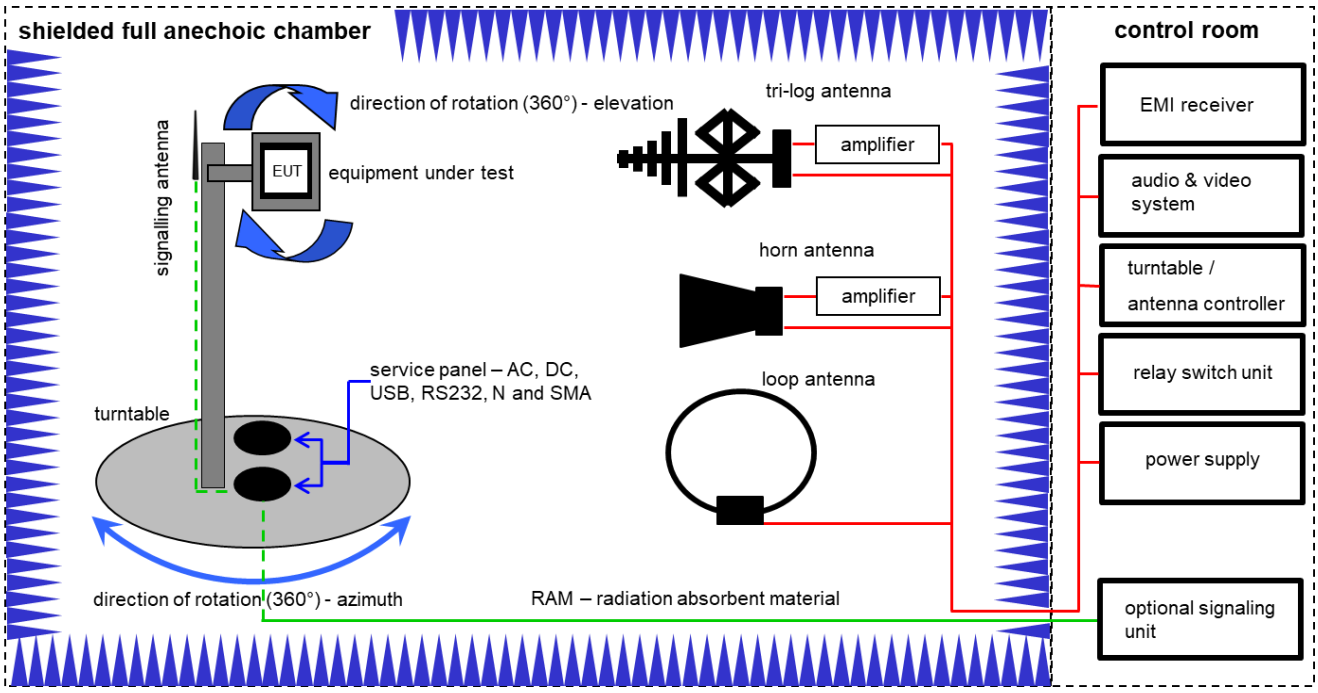
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	A	Semi anechoic chamber	3000023	MWB AG	-/-	300000551	ne	-/-	-/-
3	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
4	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
5	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
6	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	318	300003696	vlKl!	31.01.2024	30.01.2026
7	A	Turntable	2089-4.0	EMCO	-/-	300004394	ne	-/-	-/-
8	A	PC	TecLine	F+W	-/-	300004388	ne	-/-	-/-
9	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	06.12.2024	31.12.2025

7.2 Shielded fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter; loop antenna 3 meter / 1 meter

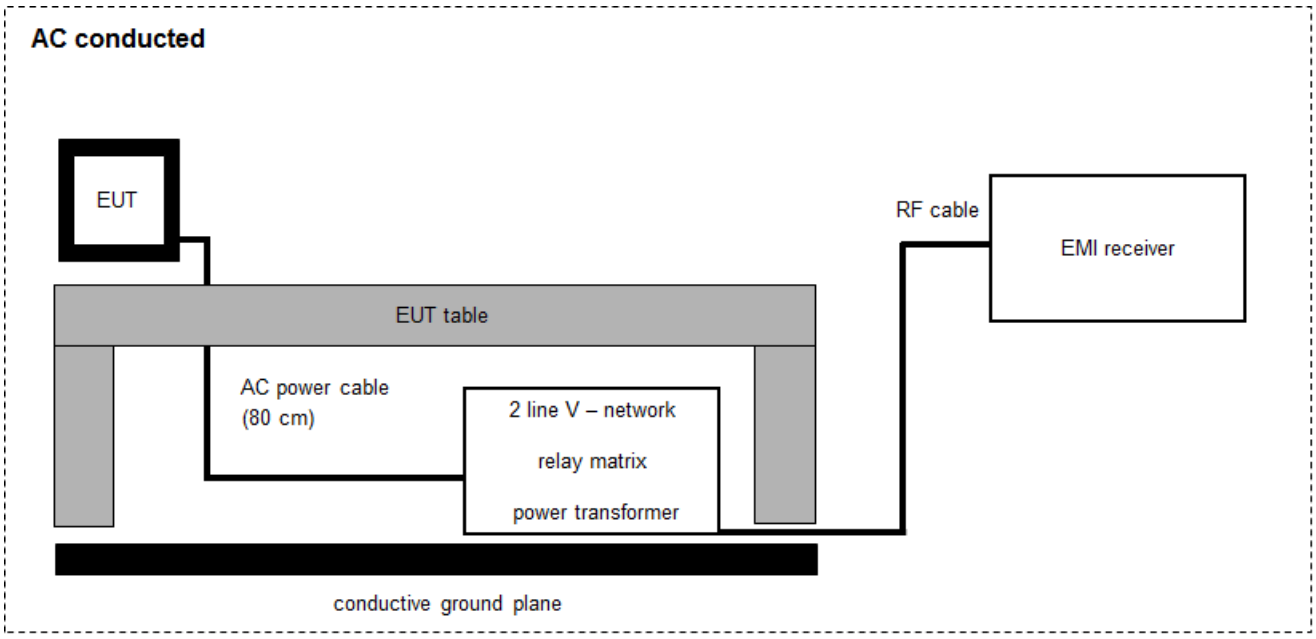
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A,B,C	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
2	A,B,C	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2024	31.12.2025
3	A,B,C	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
4	A,B,C	NEXIO EMV-Software	BAT EMC V2022.0.32.0	Nexio		300004682	ne	-/-	-/-
5	C	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vlKl!	10.10.2023	31.10.2025
6	C	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	-/-
7	C	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
8	B	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	01029	300005379	vlKl!	09.10.2023	31.10.2025
9	A	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vlKl!	02.08.2023	31.07.2025

7.3 AC conducted



FS = UR + CF + VC
(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

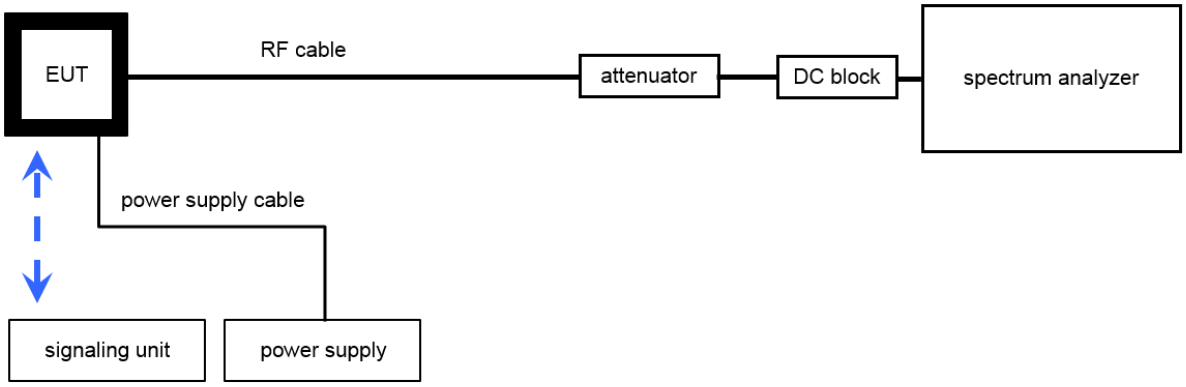
Example calculation:
FS [dBµV/m] = 37.62 [dBµV/m] + 9.90 [dB] + 0.23 [dB] = 47.75 [dBµV/m] (244.06 µV/m)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Two-line V-Network (LISN) 9 kHz to 30 MHz	ESH3-Z5	Rohde & Schwarz	892475/017	300002209	vIKI!	12.12.2023	31.12.2025
2	A	RF-Filter-section	85420E	HP	3427A00162	300002214	NK!	-/-	-/-
3	A	Hochpass 150 kHz	EZ-25	R&S	100010	300003798	ev	-/-	-/-
4	A	PC	TecLine	F+W		300003532	ne	-/-	-/-
5	A	Analyzer-Impedence-System	AIS16/1	Spitzenberger + Spies GmbH & Co. KG	UO2076 07/0 1023	400001751	k	19.10.2023	31.10.2025
6	A	EMI Test Receiver 3.6 GHz	ESR3	Rohde & Schwarz	102981	300006318	k	03.12.2024	31.12.2025

7.4 Conducted measurements

Conducted measurements normal conditions



OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Signal analyzer	FSW26	Rohde & Schwarz	101455	300004528	k	09.12.2024	31.12.2025

8 Sequence of testing

8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

*)Note: The sequence will be repeated three times with different EUT orientations.

8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

9 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Antenna gain	± 3 dB
Carrier frequency separation	± 21.5 kHz
Number of hopping channels	-/-
Spectrum bandwidth	± 21.5 kHz absolute; ± 15.0 kHz relative
Maximum output power	± 1 dB
Detailed conducted spurious emissions @ the band edge	± 1 dB
Band edge compliance radiated	± 3 dB
Spurious emissions conducted	± 3 dB
Spurious emissions radiated below 30 MHz	± 3 dB
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB

10 Summary of measurement results

☐	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☒	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

10.1 Hybrid mode (915.4 MHz - 916 MHz)

Test specification clause	Test case	Temperature conditions	Power source voltages	Mode	C	NC	NA	NP	Remark
§15.247(b)(4) RSS - 247 / 5.4 (d)	Antenna gain	Nominal	Nominal	TX single channel	☒	☐	☐	☐	-/-
§15.247(a)(1) RSS - 247 / 5.1 (b)	Carrier frequency separation	Nominal	Nominal	TX hopping	☐	☐	☐	☒	-/-
§15.247(a)(1) RSS - 247 / 5.1 (a)	Spectrum bandwidth	Nominal	Nominal	TX single channel	☐	☐	☐	☒	-/-
§15.247(f) RSS - 247 / 5.2 (b)	Power spectral density	Nominal	Nominal	TX single channel	☐	☐	☐	☒	-/-
§15.247(b)(3) RSS - 247 / 5.4 (b)	Maximum output power	Nominal	Nominal	TX single channel	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5	Detailed spurious emissions @ the band edge - conducted	Nominal	Nominal	TX hopping	☐	☐	☐	☒	-/-
§15.247(d) RSS - 247 / 5.5	Spurious emissions conducted	Nominal	Nominal	TX single channel	☐	☐	☐	☒	-/-
§15.247(f) RSS - 247 / 5.1 (d)	Time of occupancy (dwell time)	Nominal	Nominal	TX hopping	☒	☐	☐	☐	see test report 1-8881-24-01-15_TR1-R01
§15.247(d) RSS-210 / A8.5	TX spurious emissions radiated	Nominal	Nominal	TX single channel	☒	☐	☐	☐	-/-
§15.107 §15.207	Conducted emissions	Nominal	Nominal	TX single channel	☒	☐	☐	☐	-/-
§15.209(a) RSS-Gen	TX spurious emissions radiated < 30 MHz	Nominal	Nominal	TX single channel	☒	☐	☐	☐	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

11 Additional comments

Reference documents: none

Special test descriptions: all tests have been performed using the software SmartRF Studio v7 Version 2.24.0, cap array Delta setting: 00, power setting: +13dBm

Configuration descriptions: Hybrid: 915.4 MHz 915.4 MHz,
916.0 MHz 916.0 MHz;
these channels were tested in this test report.
radiated spurious emissions > 30 MHz have been tested
with 2 different cable lengths: 2 meter and 10 meter (provided by customer)

nominal operating frequencies: 915.4 MHz, 915.6 MHz, 915.8 MHz and 916.0 MHz

Test mode: ☒ Special software is used.
EUT is transmitting pseudo random data by itself

12 RF measurements

12.1 Antenna gain

Description:

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Measurement:

Measurement parameters	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Span	5 MHz
Trace mode	Max hold
Test setup	see chapter 7.2 B (radiated) see chapter 7.4 A (conducted)
Measurement uncertainty	see sub clause 9

Limits:

FCC	IC
Antenna gain	
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. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.	

Results:

	915.4 MHz	middle channel	916.0 MHz
Conducted power	7.64 dBm	-/-	7.64 dBm
Radiated power (e.i.r.p.)	7.47 dBm	-/-	7.72 dBm
Gain calculated	-0.17 dBi	-/-	0.08 dBi

12.2 Maximum Output Power

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	See plots
Resolution bandwidth:	200 kHz
Video bandwidth:	500 kHz
Span:	1 MHz
Trace-Mode:	Single sweep
Measurement method	According to ANSI C63.10-2020 11.9.1 Method peak conducted output power
Used equipment:	see chapter 7.4 A
Measurement uncertainty:	see chapter 9

Limits:

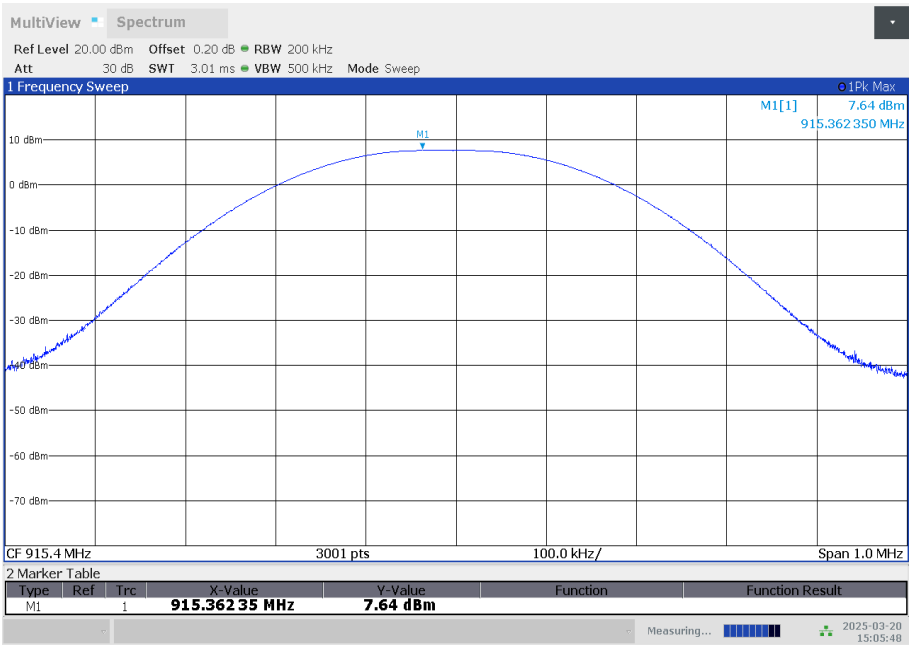
FCC	IC
Maximum Output Power Conducted	
For frequency hopping systems operating in the 902–928 MHz band: 1 watt (30 dBm) for systems employing at least 50 hopping channels; and, 0.25 watts (24 dBm) for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.	

Result:

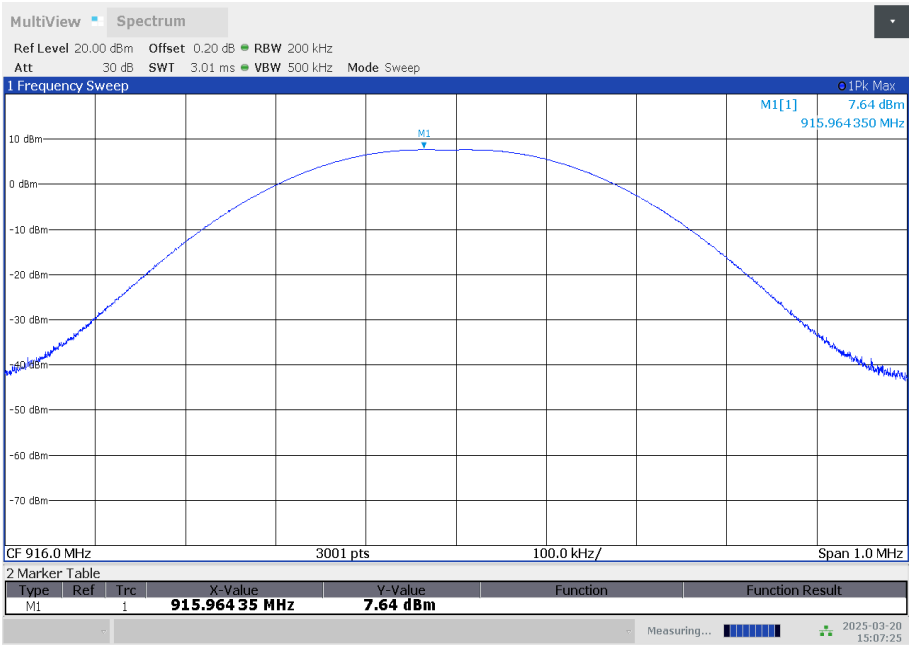
Test Conditions		Maximum Output Power Conducted	
		915.4 MHz	916.0 MHz
T_{nom}	V_{nom}	7.64 dBm	7.64 dBm

Plots:

Plot 1: 915.4 MHz



Plot 2: 916.0 MHz



12.3 Average Time of Occupancy (dwell time)

Measurement:

The measurement is performed in zero span mode to show that none of the 4 used channels is allocated more than 0.4 seconds within a 1.6 seconds interval (4 channels times 0.4s).

Limits:

FCC
Average time of occupancy
For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4

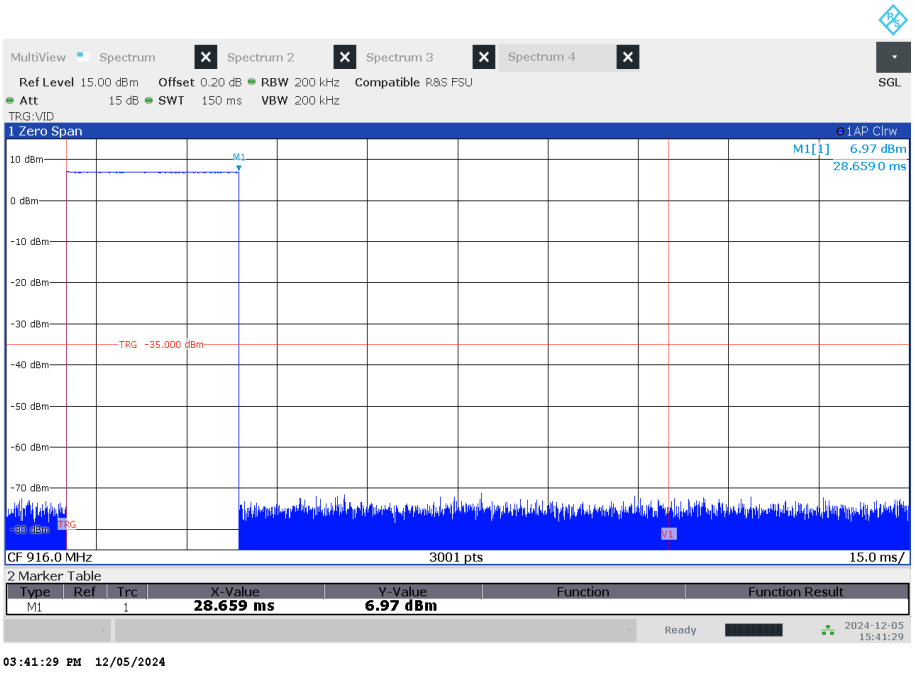
Result: The time slot length is = 28.6 ms

Within 1.6 s period, the maximum time of occupancy is 28.6 ms

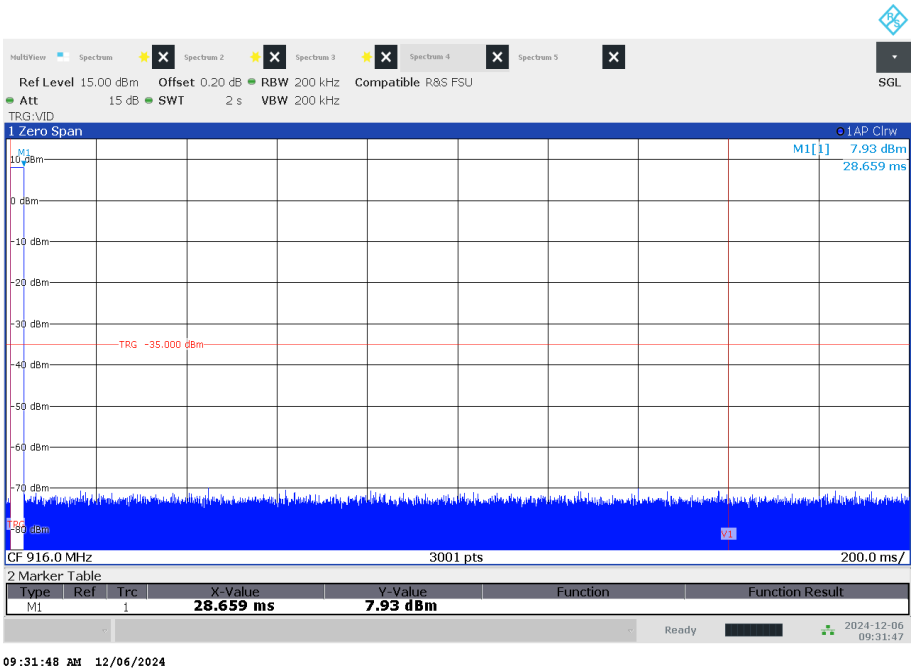
→ The max time of occupancy = 28.6 ms

Plots:

Plot 1: Time slot length = 28.65 ms



Plot 2: hops / channel @ 1.6s = 1



12.4 Spurious Emissions Radiated < 30 MHz

Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode. The measurement is performed in the mode with the highest output power. The limits are recalculated to a measurement distance of 3 m according the ANSI C63.10.

Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Resolution bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	max Hold
Used equipment:	see chapter7.2 A
Measurement uncertainty:	see chapter 9

Limits:

FCC		
Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
0.009 – 0.490	2400/(F/kHz)	300
0.490 – 1.705	24000/(F/kHz)	30
1.705 – 30	30 (29.5 dBµV/m)	30

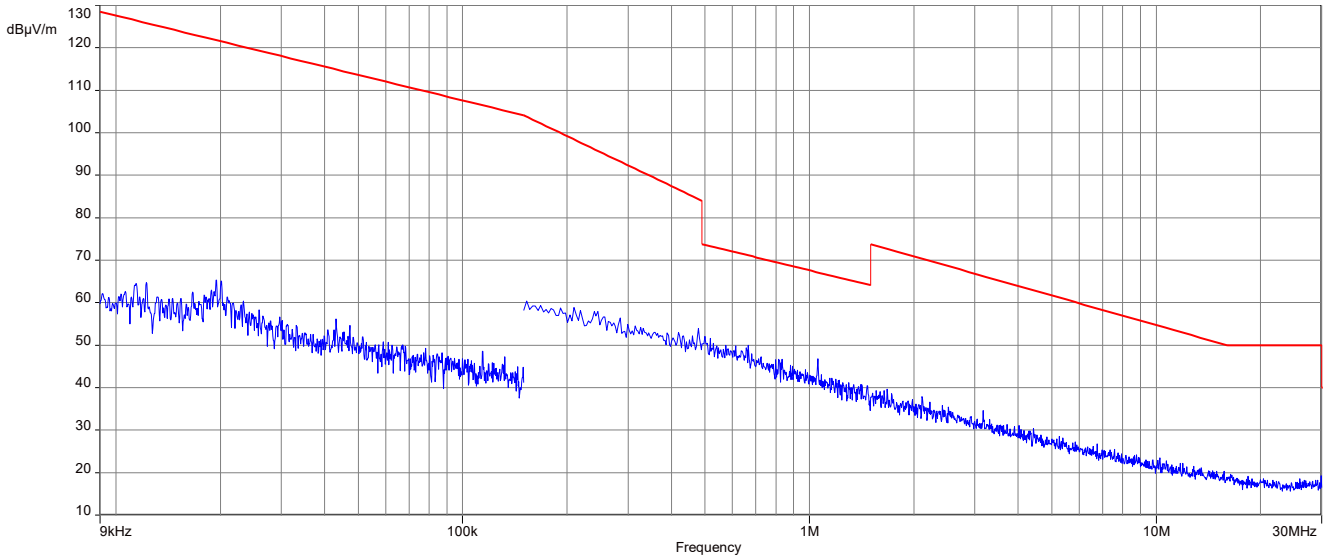
IC		
Frequency (MHz)	Field strength (µA/m)	Measurement distance (m)
0.009 – 0.490	6.37/F (F in kHz)	300
0.490 – 1.705	63.7/F (F in kHz)	30
1.705 – 30	0.08 (-22 dBµA/m)	30

Result:

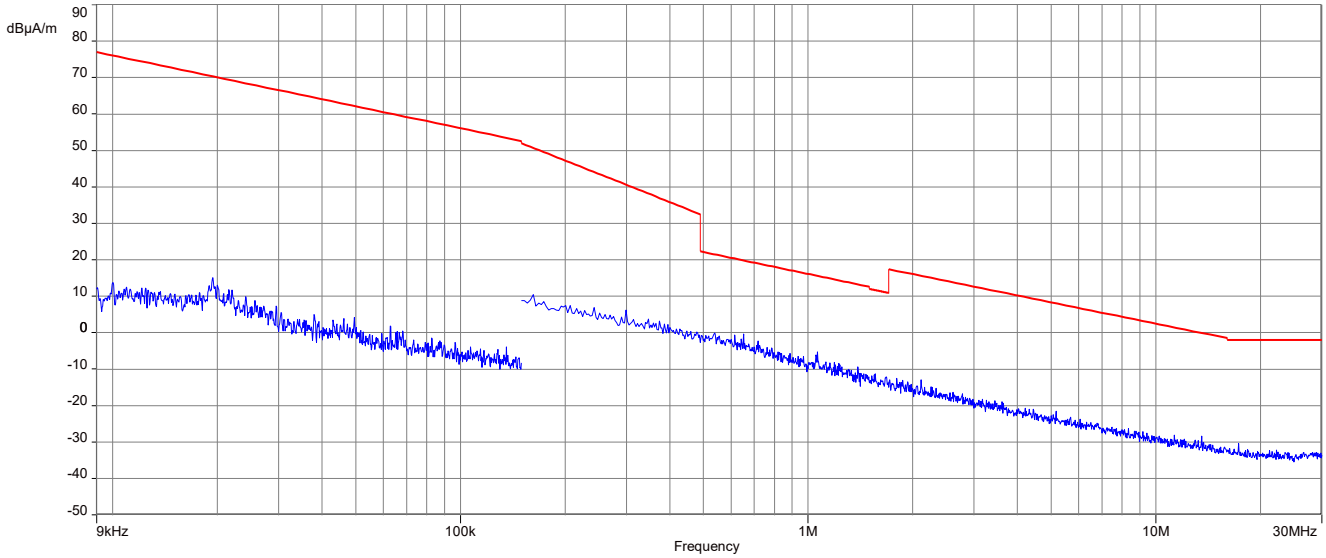
SPURIOUS EMISSIONS LEVEL								
915.4 MHz			middle channel			916.0 MHz		
Frequency / MHz	Detector	Level / (dBµV/m)	Frequency / MHz	Detector	Level / (dBµV/m)	Frequency / MHz	Detector	Level / (dBµV/m)
no peaks detected			-/-	-/-	-/-	no peaks detected		
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-

Plots:

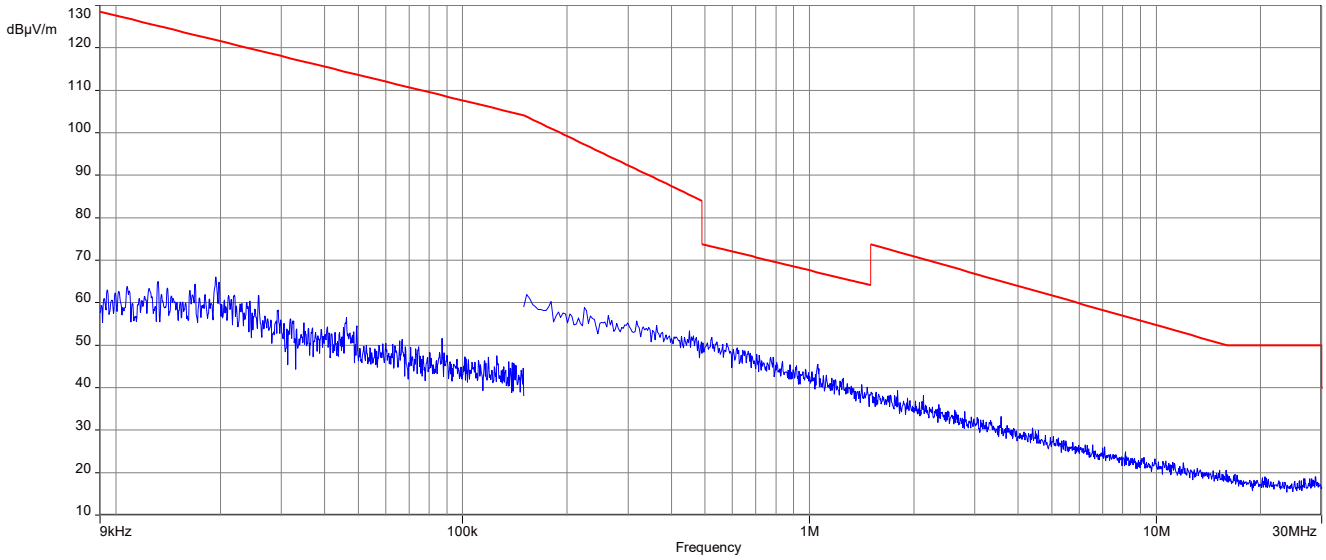
Plot 1: TX-Mode 915.4 MHz FCC



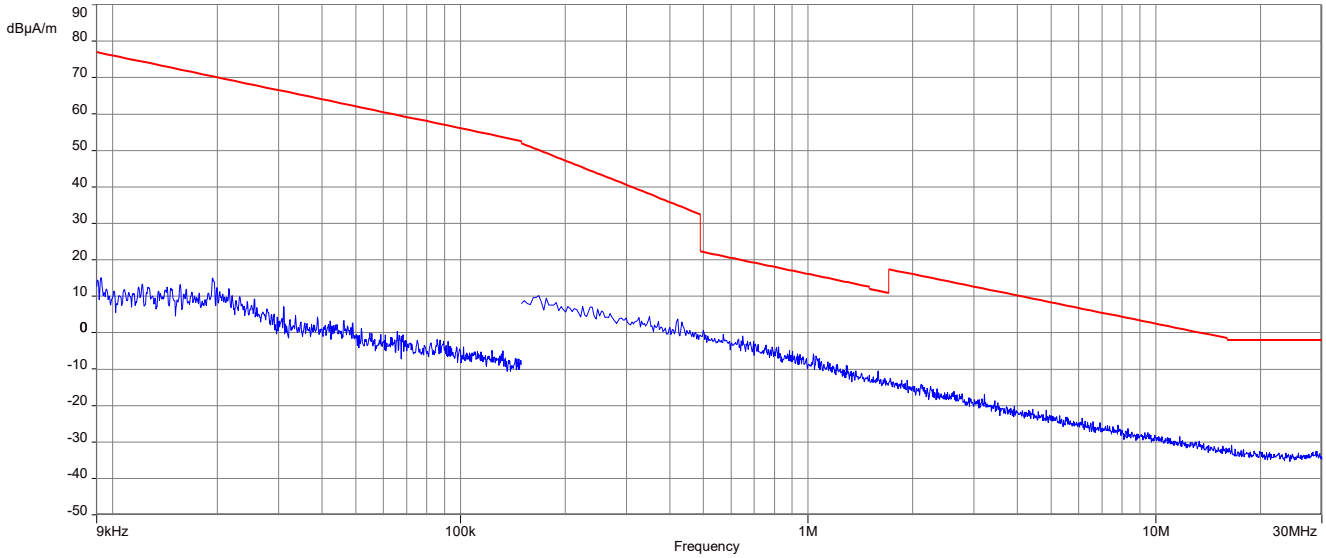
Plot 2: TX-Mode 915.4 MHz IC



Plot 3: TX-Mode 916.0 MHz FCC



Plot 4: TX-Mode 916.0 MHz IC



12.5 Spurious Emissions Radiated > 30 MHz

12.5.1 Spurious emissions radiated 30 MHz to 1 GHz

Description:

Measurement of the radiated spurious emissions in transmit mode. The measurement is performed at 915.4 MHz and 916.0 MHz.

Measurement:

Measurement parameters	
Detector	Peak / Quasi Peak
Sweep time	Auto
Resolution bandwidth	3 x VBW
Video bandwidth	120 kHz
Span	30 MHz to 1 GHz
Trace mode	max hold
Measured modulation	Hybrid
Test setup	see chapter 7.1 A
Measurement uncertainty	see chapter 9

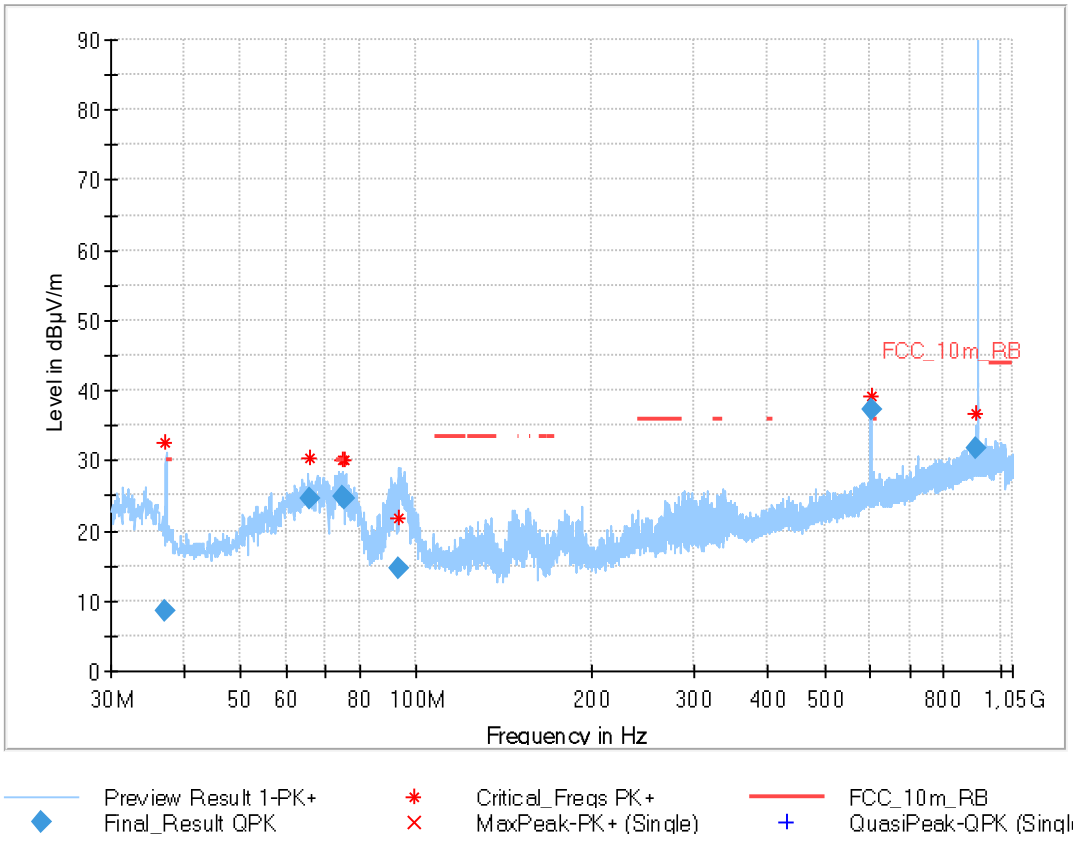
Limits:

FCC	IC	
Band-edge Compliance of conducted and radiated emissions		
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)).		
Frequency / MHz	Field Strength / (dBµV/m)	Measurement distance / m
30 - 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10
Above 960	54.0	3

Result: See result table below the plots

Plots 2m antenna cable:

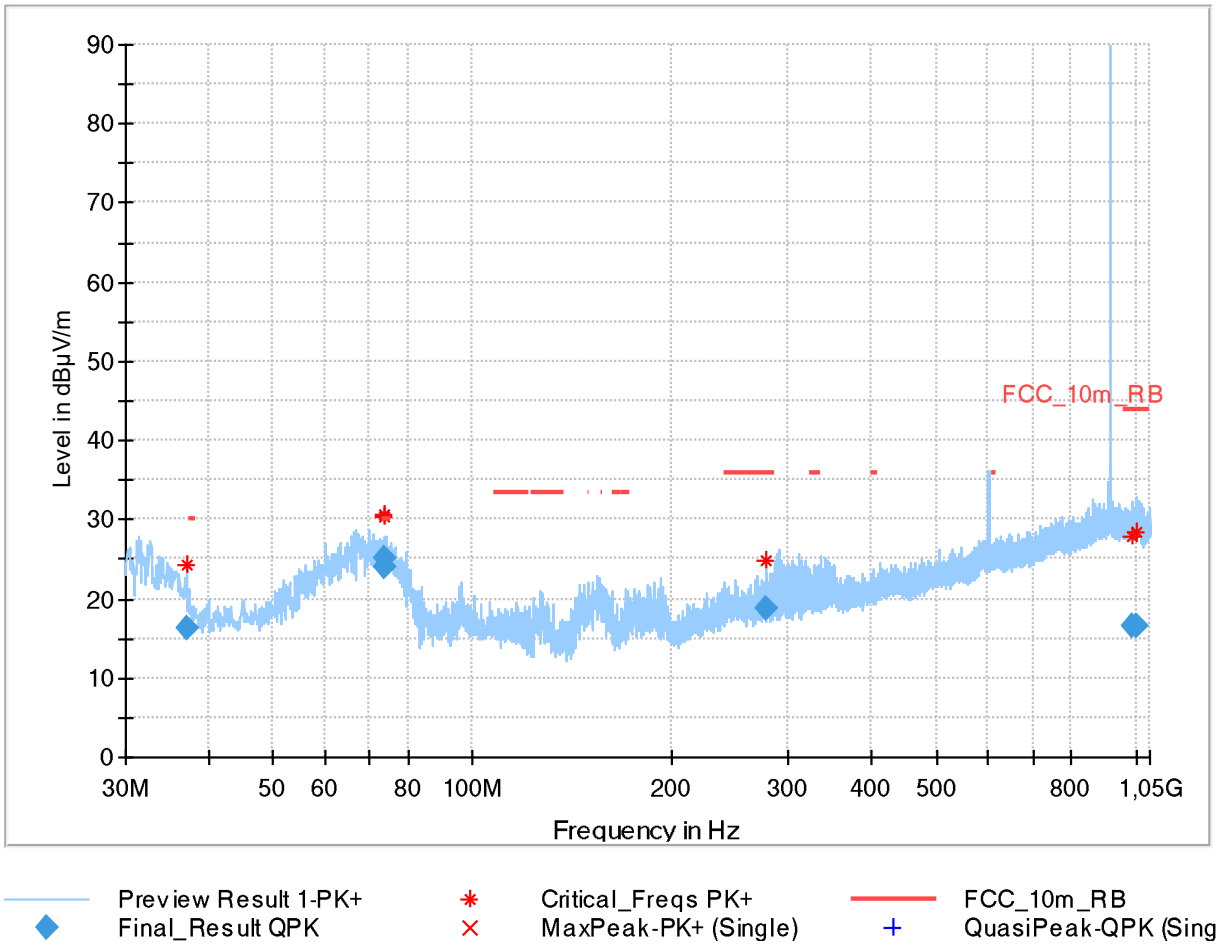
Plot 1: TX 915.4 MHz, 30 MHz – 1 GHz, horizontal & vertical polarisation



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.032	8.67	---	---	1000	120.0	400.0	H	339	14
65.745	24.48	---	---	1000	120.0	367.0	V	108	12
74.869	24.97	30.0	5.0	1000	120.0	241.0	V	201	9
75.129	24.68	30.0	5.3	1000	120.0	277.0	V	225	9
93.409	14.69	---	---	1000	120.0	194.0	V	93	12
600.035	37.27	---	---	1000	120.0	200.0	H	331	22
911.391	31.88	---	---	1000	120.0	279.0	V	41	25
915.363	95.77	---	---	1000	120.0	126.0	V	189	25
37.032	8.67	---	---	1000	120.0	400.0	H	339	14

Plot 2: TX 916.0 MHz, 30 MHz – 1 GHz, horizontal & vertical polarisation

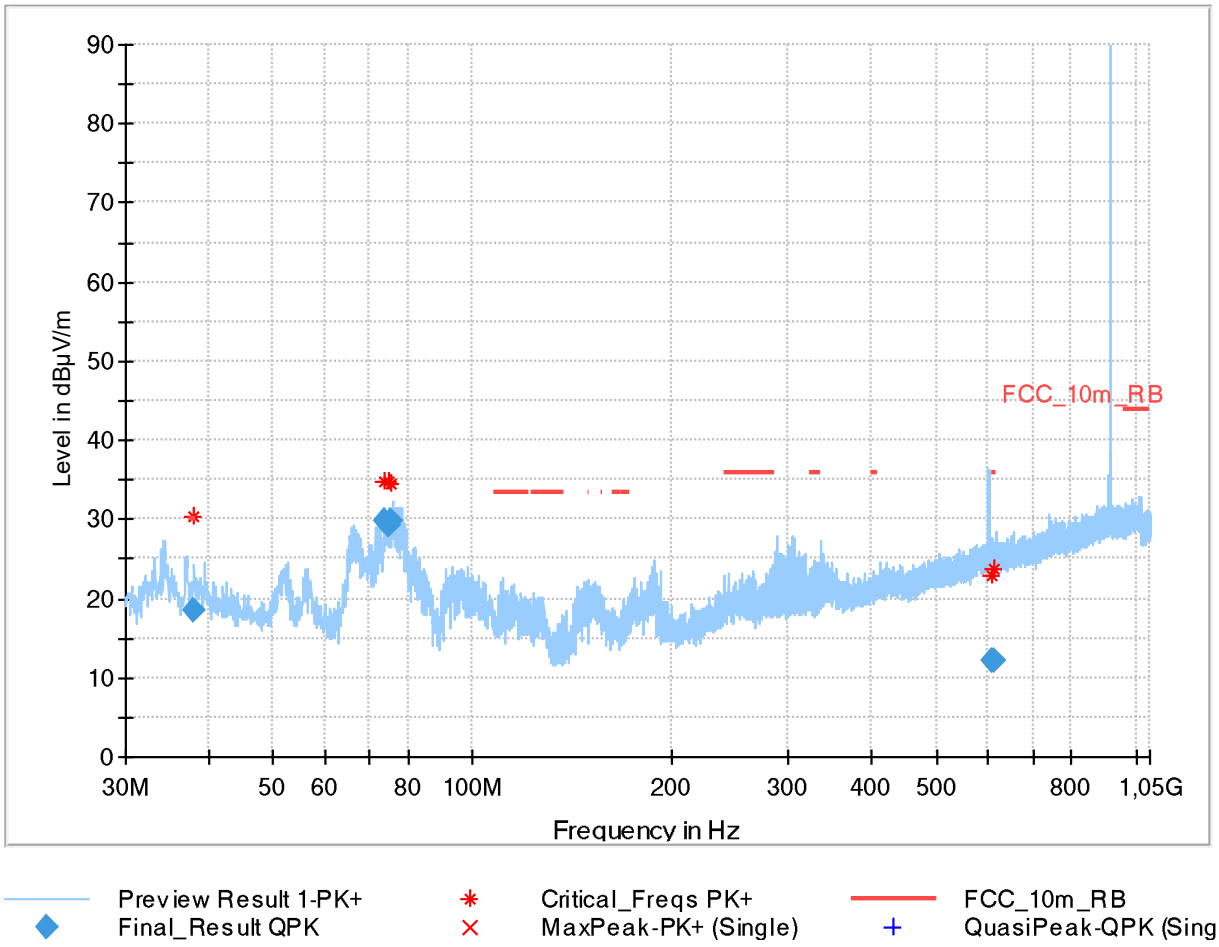


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.143	16.22	---	---	1000	120.0	130.0	V	180	14
73.596	23.96	30.0	6.0	1000	120.0	400.0	V	226	9
73.766	25.09	30.0	4.9	1000	120.0	257.0	V	90	9
277.889	18.65	36.0	17.4	1000	120.0	104.0	V	91	15
984.932	16.43	44.0	27.6	1000	120.0	200.0	V	195	26
1000.470	16.65	44.0	27.4	1000	120.0	163.0	V	315	26

Plots 10m antenna cable:

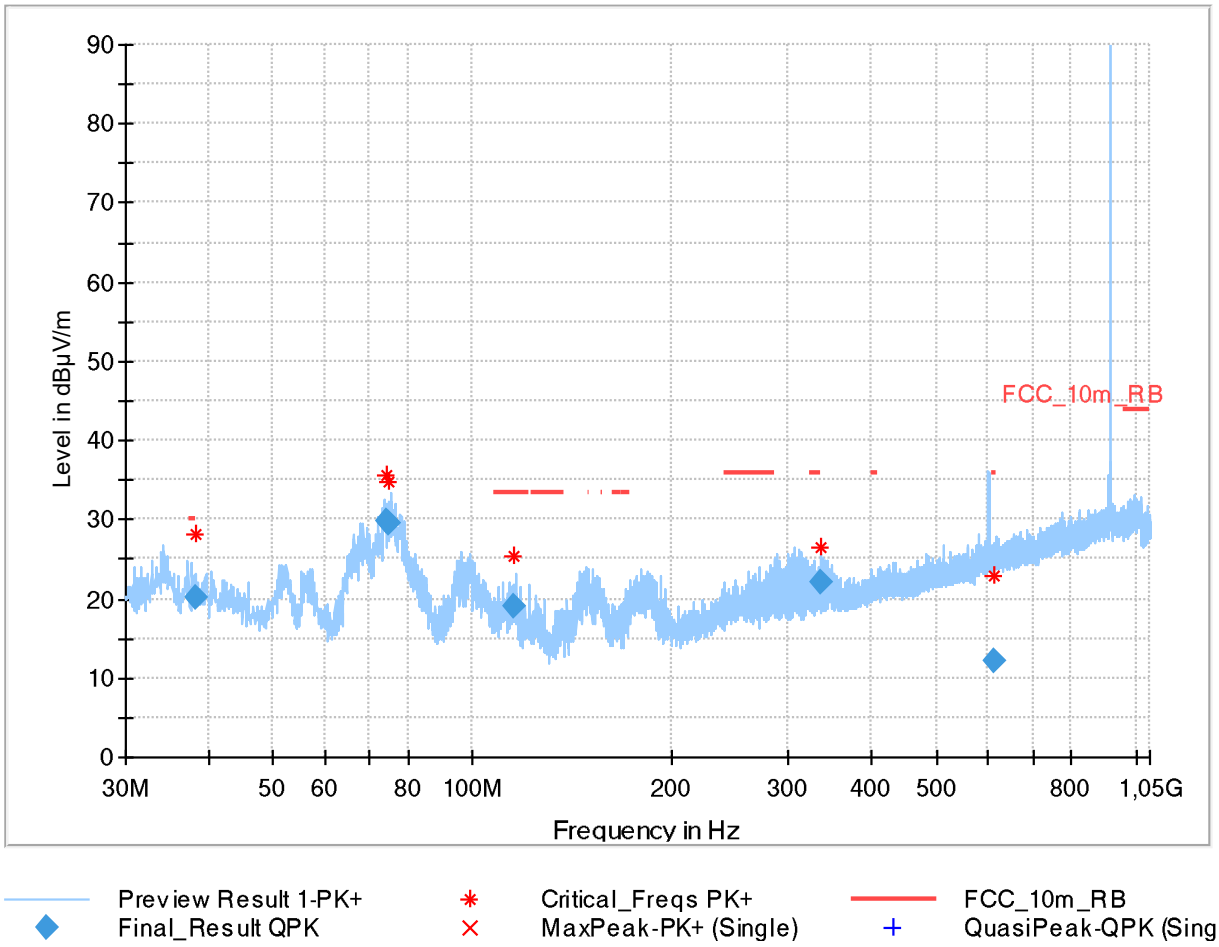
Plot 1: TX 915.4 MHz, 30 MHz – 1 GHz, horizontal & vertical polarisation



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.865	18.41	30.0	11.6	1000	120.0	182.0	V	91	14
73.765	29.83	30.0	0.2	1000	120.0	244.0	V	112	9
74.630	29.39	---	---	1000	120.0	271.0	V	122	9
75.225	29.80	---	---	1000	120.0	307.0	V	111	9
608.659	12.21	36.0	23.8	1000	120.0	295.0	V	254	22
613.553	12.11	36.0	23.9	1000	120.0	134.0	V	237	22

Plot 2: TX 916.0 MHz, 30 MHz – 1 GHz, horizontal & vertical polarisation



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38.235	20.18	30.0	9.8	1000	120.0	104.0	V	81	14
74.070	29.91	30.0	0.1	1000	120.0	324.0	V	114	9
74.785	29.51	---	---	1000	120.0	319.0	V	90	9
115.656	19.16	33.5	14.3	1000	120.0	141.0	V	84	12
334.520	22.08	36.0	13.9	1000	120.0	336.0	H	139	16
613.325	12.24	36.0	23.8	1000	120.0	340.0	H	308	22

12.5.2 Spurious emissions radiated above 1 GHz

Description:

Measurement of the radiated spurious emissions in transmit mode. The measurement is performed in the mode with the highest output power.

Measurement:

Measurement parameters	
Detector	Peak / RMS
Sweep time	Auto
Resolution bandwidth	1 MHz
Video bandwidth	3 x RBW
Span	1 GHz to 12 GHz
Trace mode	Max hold
Measured modulation	Hybrid
Test setup	see chapter 7.2 C (1 GHz – 12.75 GHz)
Measurement uncertainty	see chapter 9

The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

Limits:

FCC		IC
TX spurious emissions radiated		
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)).		
§15.209		
Frequency / MHz	Field strength / (dBµV/m)	Measurement distance / m
Above 960	54.0	3

Result:

Average emission adjusting factor according to normal mode dwell time and duty cycle:

F = 20 * log (dwell time / 100 ms)

F=20*log (28.6 ms/100 ms) = -10.87 dB

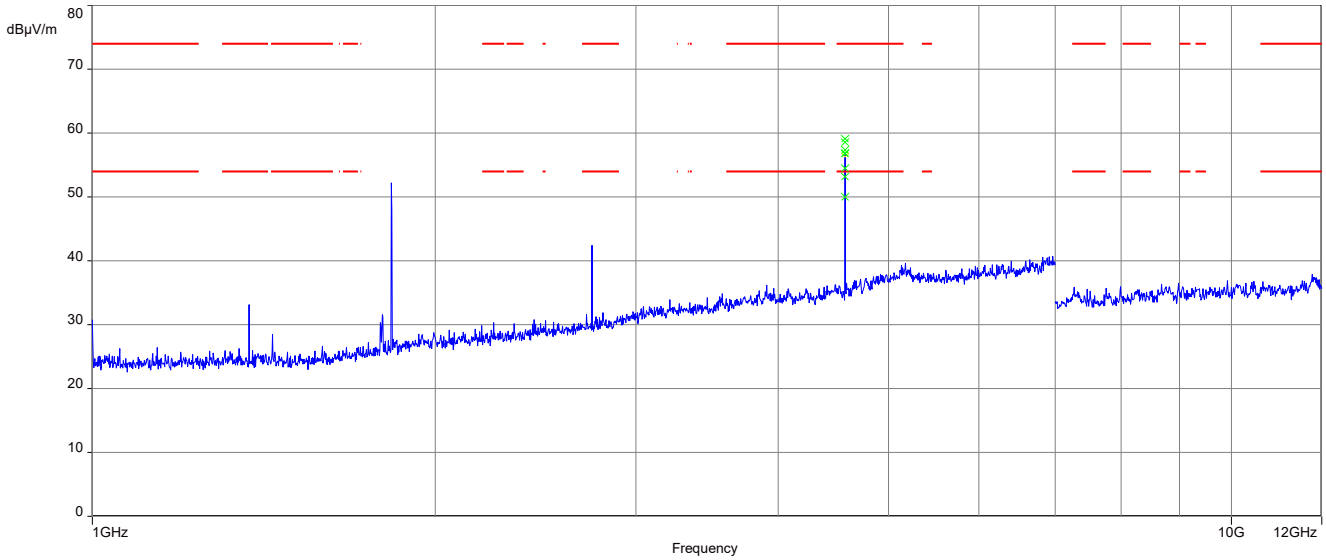
TX spurious emissions radiated 2m antenna cable								
915.4 MHz			-/-			916.0 MHz		
Frequency / MHz	Detector	Level / (dBµV/m)	Frequency / MHz	Detector	Level / (dBµV/m)	Frequency / MHz	Detector	Level / (dBµV/m)
4576.6	Peak	59.18	-/-	Peak	-/-	2747.8	Peak	51.17
	AVG*	48.31		AVG	-/-		AVG	44.92
-/-	Peak	-/-	-/-	Peak	-/-	4580.2	Peak	60.90
	AVG	-/-		AVG	-/-		AVG	50.03

* duty cycle correction factor -10.87 dB applied-see chapter 11.4

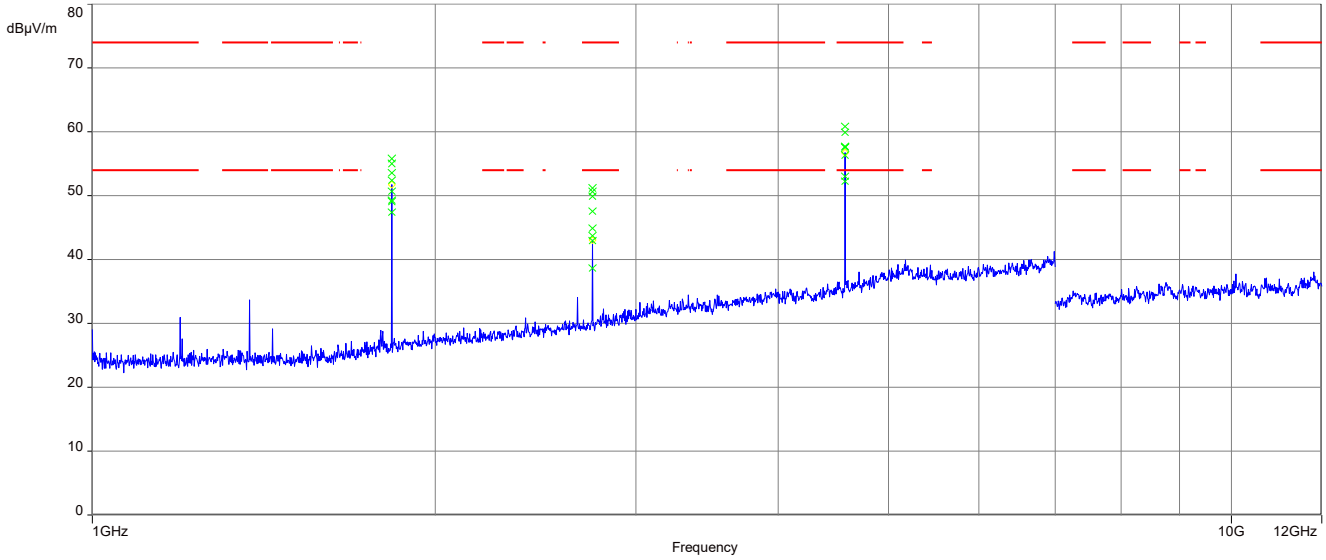
TX spurious emissions radiated 10m antenna cable								
915.4 MHz			-/-			916.0 MHz		
Frequency / MHz	Detector	Level / (dBµV/m)	Frequency / MHz	Detector	Level / (dBµV/m)	Frequency / MHz	Detector	Level / (dBµV/m)
4577.2	Peak	54.97	-/-	Peak	-/-	4580.2	Peak	55.54
	AVG	52.04		AVG	-/-		AVG	53.14
-/-	Peak	-/-	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	-/-		AVG	-/-		AVG	-/-

Plots 2m antenna cable:

Plot 1: TX 915.4 MHz, 1 GHz – 12 GHz, horizontal & vertical polarisation

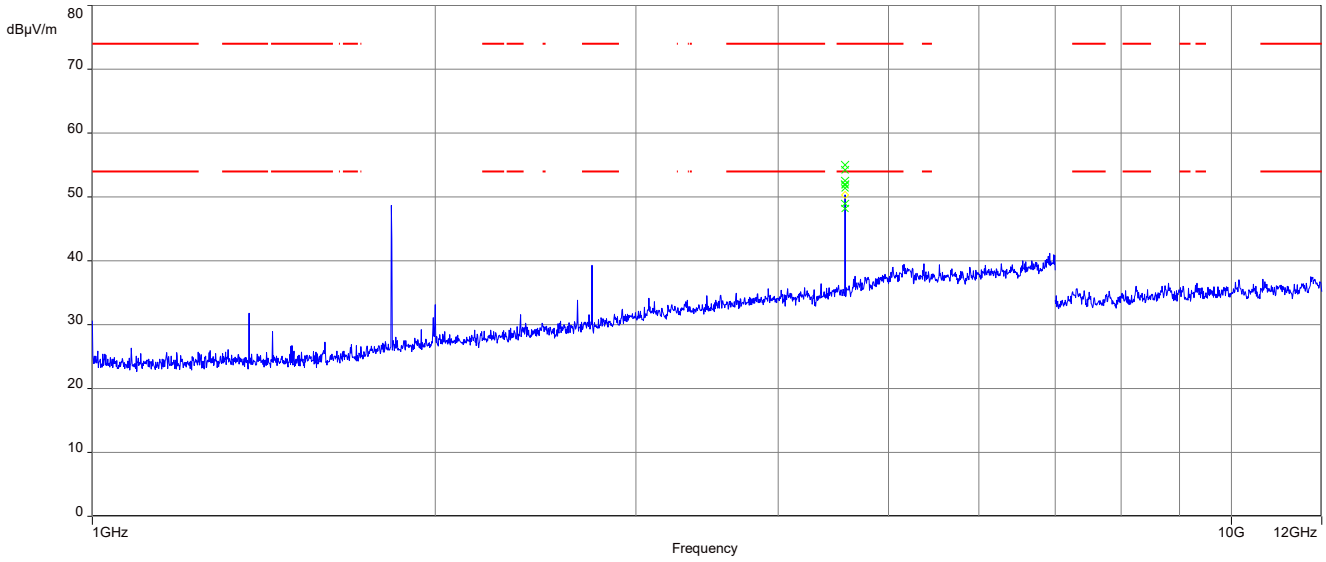


Plot 2: TX 916.0 MHz, 1 GHz – 12 GHz, horizontal & vertical polarisation

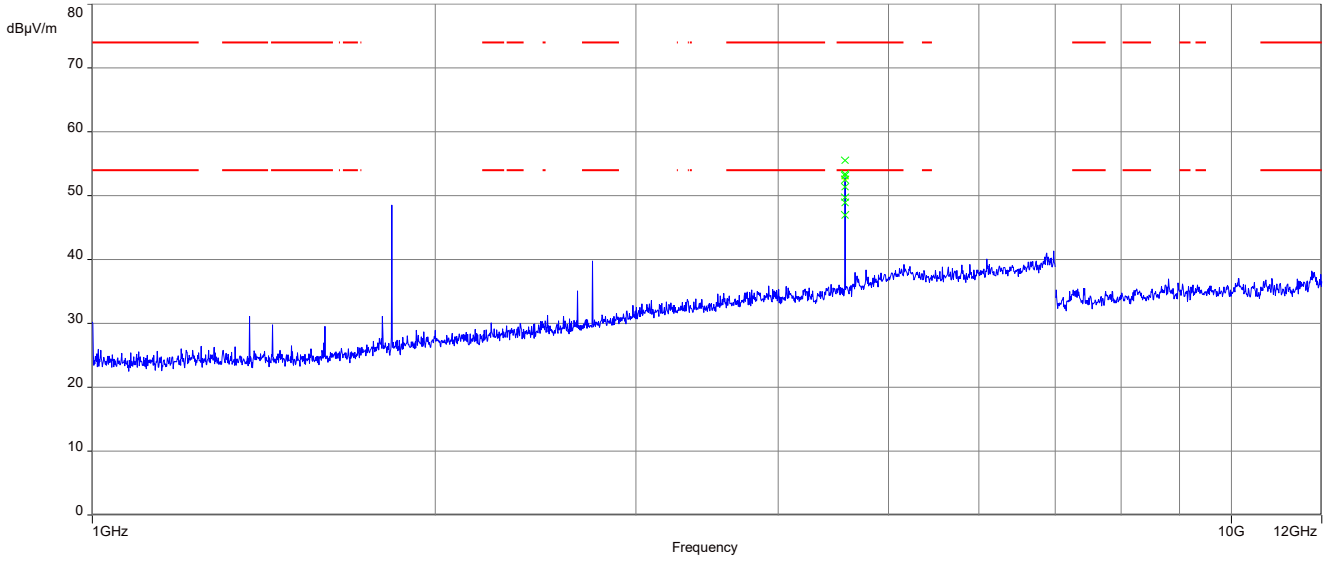


Plots 10m antenna cable:

Plot 1: TX 915.4 MHz, 1 GHz – 12 GHz, horizontal & vertical polarisation



Plot 2: TX 916.0 MHz, 1 GHz – 12 GHz, horizontal & vertical polarisation



12.6 Spurious emissions conducted below 30 MHz (AC conducted)

Description:

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. Both power lines, phase and neutral line, are measured. Found peaks are re-measured with average and quasi peak detection to show compliance to the limits.

Measurement:

Measurement parameters	
Detector	Peak - Quasi Peak / Average
Sweep time	Auto
Resolution bandwidth	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Video bandwidth	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span	9 kHz to 30 MHz
Trace mode	Max hold
Measured modulation	Hybrid
Test setup	see chapter 7.3 A
Measurement uncertainty	see chapter 9

Limits:

FCC		IC
Frequency / MHz	Quasi-Peak / (dBµV / m)	Average / (dBµV / m)
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30.0	60	50

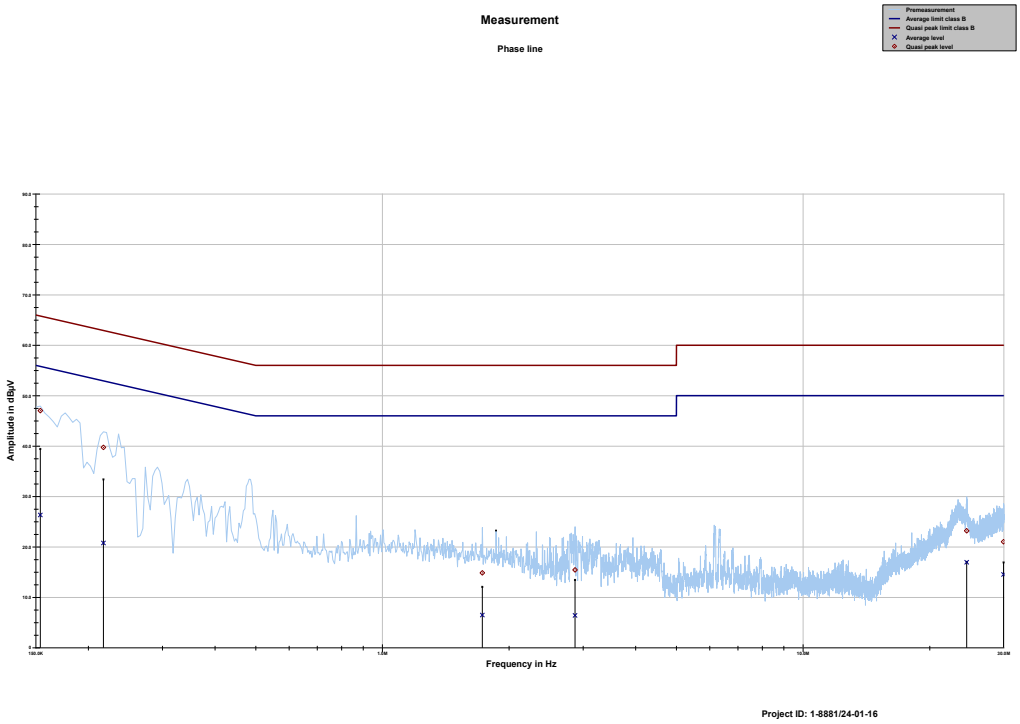
*Decreases with the logarithm of the frequency

Results:

TX spurious emissions conducted < 30 MHz / (dBµV / m) @ 3m		
f / MHz	Detector	Level / dBµV/m
See result table below the plots.		

Plots:

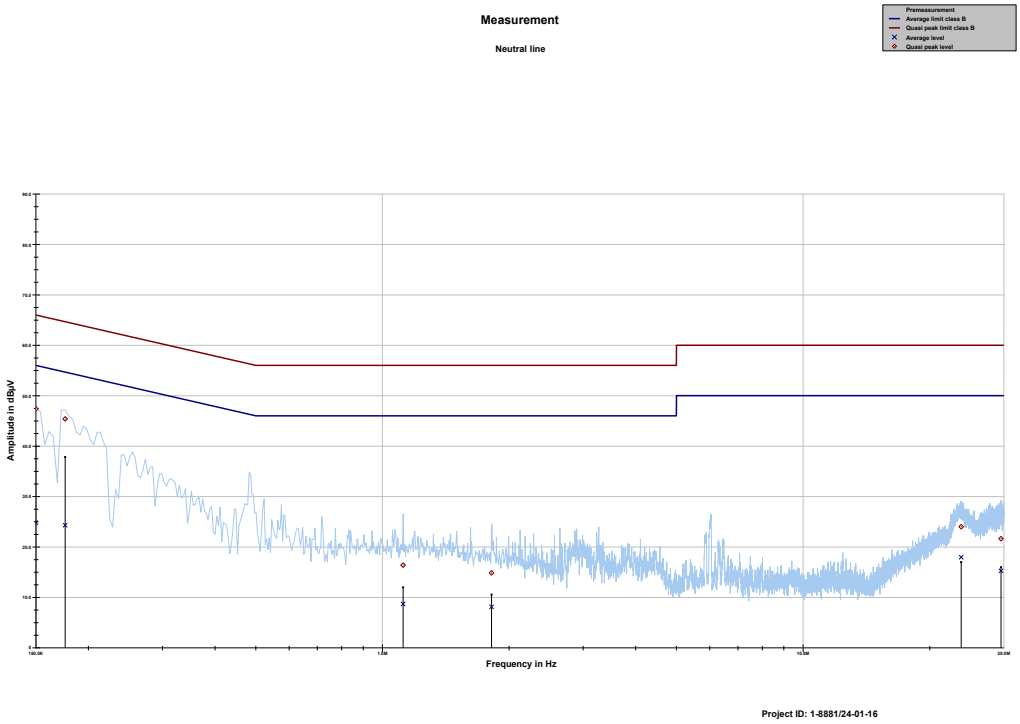
Plot 1: 150 kHz to 30 MHz, phase line



Final_Result

Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.153731	47.03	18.77	65.796	26.33	29.56	55.893
0.217163	39.74	23.19	62.927	20.77	33.31	54.081
1.728319	14.86	41.14	56.000	6.49	39.51	46.000
2.870081	15.45	40.55	56.000	6.41	39.59	46.000
24.485212	23.19	36.81	60.000	16.95	33.05	50.000
29.966419	21.02	38.98	60.000	14.54	35.46	50.000

Plot 2: 150 kHz to 30 MHz, neutral line



Final_Result

Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.150000	47.38	18.62	66.000	24.80	31.20	56.000
0.176119	45.39	19.27	64.667	24.31	30.94	55.254
1.120125	16.39	39.61	56.000	8.68	37.32	46.000
1.817869	14.85	41.15	56.000	8.12	37.88	46.000
23.757619	24.02	35.98	60.000	17.96	32.04	50.000
29.559712	21.63	38.37	60.000	15.27	34.73	50.000

13 Glossary

AVG	Average
C	Compliant
C/N_0	Carrier to noise-density ratio, expressed in dB-Hz
CAC	Channel availability check
CW	Clean wave
DC	Duty cycle
DFS	Dynamic frequency selection
DSSS	Dynamic sequence spread spectrum
DUT	Device under test
EN	European Standard
ETSI	European Telecommunications Standards Institute
EMC	Electromagnetic Compatibility
EUT	Equipment under test
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
FHSS	Frequency hopping spread spectrum
FVIN	Firmware version identification number
GNSS	Global Navigation Satellite System
GUE	GNSS User Equipment
HMN	Host marketing name
HVIN	Hardware version identification number
HW	Hardware
IC	Industry Canada
Inv. No.	Inventory number
MC	Modulated carrier
NA	Not applicable
NC	Not compliant
NOP	Non occupancy period
NP	Not performed
OBW	Occupied bandwidth
OC	Operating channel
OCW	Operating channel bandwidth
OFDM	Orthogonal frequency division multiplexing
OOB	Out of band
OP	Occupancy period
PER	Packet error rate
PMN	Product marketing name
PP	Positive peak
QP	Quasi peak
RLAN	Radio local area network
S/N or SN	Serial number
SW	Software
UUT	Unit under test
WLAN	Wireless local area network

14 Document history

Version	Applied changes	Date of release
R01	Initial release	2025-03-27
R02	update chapter 6.1	2025-06-25

################################## END OF TEST REPORT ##################################