



RF - TEST REPORT

- FCC Part 15.255 -

Type / Model Name : KY-LOC 1D.02.03

Product Description : Radar sensor

Applicant : Kymati GmbH

Address : Am Hochacker 5

85630 GRASBRUNN, GERMANY

Manufacturer : Kymati GmbH

Address : Am Hochacker 5

85630 GRASBRUNN, GERMANY

Test Result according to the standards listed in clause 1 test standards:	POSITIVE
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Test Report No. : 80172510-01 Rev_0	02. July 2024 Date of issue
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Deutsche
Akkreditierungsstelle
D-PL-12030-01-03
D-PL-12030-01-04

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ATTACHMENTs A, B as separate supplements

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations (June 2024)

Part 15, Subpart A	General
Part 15, Subpart C, Section 15.255	Operation within the band 57-71 GHz.
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices

2 EQUIPMENT UNDER TEST

2.1 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

2.2 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according to his/her instructions.

2.3 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

2.4 Equipment type

The EUT qualifies under FCC §15.255(c)(2)(v) / §15.255(c)(2)(iii)(B)(1) as a field disturbance sensor

2.5 Short description of the equipment under test (EUT)

The EUT is a radar sensor in the operating band 61.0 GHz to 61.5 GHz and 60 GHz to 64 GHz. It determines the distance in primary or secondary radar mode.

Number of tested samples: 1
Serial number: 000004
Firmware ID: 4D.01
FCC ID: 2AXR5-1D-02-03

2.6 Variants of the EUT

There are no variants.

2.7 Operation frequency and channel plan

Operating frequency range 1: 61.0 GHz to 61.5 GHz
Operating frequency range 2: 60.0 GHz to 64.0 GHz.

2.8 Transmit operating modes

Two operation modes with two operating frequency ranges are available:

Primary radar mode	0.5 GHz OBW for operating frequency range 1 or 4 GHz OBW for operating frequency range 2, FMCW, passive reflection
Secondary radar mode	0.5 GHz OBW for operating frequency range 1 or 4 GHz OBW for operating frequency range 2, FMCW and FSK (The communication link between device 1 and device 2 uses the FSK), two way ranging, active reflection

2.9 Antenna

The following antennas shall be used with the EUT:

- Antenna 0 Integrated patch antenna, 7 dBi.
- Antenna 1 Integrated patch antenna, 7 dBi.
- Antenna 2 Integrated patch antenna, 7 dBi.

2.10 Power supply system utilised

Power supply voltage : 9 – 36 V/DC
Alternative power supply PoE : 53.5 V/DC

2.11 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- Notebook	Model : ThinkPad
- AC adaptor notebook	Model : Lenovo ADLX65YLC3A
- Switch with PoE+	Model : tp-link TL-SG1005P
- AC adaptor PoE switch	Model : Tp-link T535131-2-DT
- LAN cable	Model : CAT6 M12-RJ45

2.12 Determination of worst-case conditions for final measurement

Exploratory measurements have been made in all three orthogonal axes and the settings of the EUT are changed to locate at which position and at what setting the EUT produces the maximum of the emissions. For the further measurement, the EUT is set in X position while the receiving antenna is in vertical polarisation (in co-polarisation with EUT antennas).

As worst case, the following channels and test modes are selected for the final test:

Operating frequency range 1:

Frequency range (GHz)	Power setting	Used antenna	Modulation
61.0 - 61.5	P0	0	FMCW and FSK
61.0 - 61.5	P0	1	FMCW and FSK
61.0 - 61.5	P0	2	FMCW and FSK
61.0 - 61.5	P0	0+2	FMCW and FSK

Operating frequency range 2:

Frequency range (GHz)	Power setting	Used antenna	Modulation
60.0 – 64.0	P0	0	FMCW and FSK
60.0 – 64.0	P0	1	FMCW and FSK
60.0 – 64.0	P0	2	FMCW and FSK
60.0 – 64.0	P5	0+2	FMCW and FSK

Note: Only secondary mode was tested, as this mode is considered as worst case.

2.12.1 Test jig

No test jig is used.

2.12.2 Test software

For testing the Kymati Commander Software V3.0.71 provided by the customer is used.

3 TEST RESULT SUMMARY

Operating in the 61.0 - 61.5 GHz band and in the 57 - 71 GHz band:

FCC Rule Part	Description	Result
15.207(a)	AC power line conducted emissions	passed
15.255(c)(2)(v)* 15.255(c)(2)(iii)(B)(1)**	EIRP	passed
15.255(d) 15.209(a)	Spurious emissions	passed
15.255(e)	Peak conducted output power	passed
15.255(c)(2)(v)* 15.255(e)(1)	Emission bandwidth, 99% bandwidth	passed
15.255(f)	Frequency stability	passed
15.203	Antenna requirement	passed

Note* Applicable only for mode 1: Operating frequency range 61.0 – 61.5 GHz

Note** Applicable only for mode 2: Operating frequency range 60.0 – 64.0 GHz

3.1 Revision history of test report

Test report No	Rev.	Issue Date	Changes
80172510-01	0	02 July 2024	Initial test report

The test report with the highest revision number replaces the previous test reports.

3.2 Final assessment

The equipment under test fulfils the requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 03 August 2023

Testing concluded on : 11 June 2024

Checked by:

Tested by:

Thomas Weise
Laboratory Manager

Sabine Kugler
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15 - 35 °C

Humidity: 30 - 60 %

Atmospheric pressure: 86 - 106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report on basis of the ETSI Technical Report TR 100 028 Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1 and Part 2. The results are documented in the quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
Output power ERP, radiated	40000 MHz to 110000 MHz	95%	± 5.41 dB
Field strength of the fundamental	1000 MHz to 40000 MHz	95%	± 2.34 dB
Field strength of the fundamental	40000 MHz to 110000 MHz	95%	± 5.41 dB
Power spectral density	40000 MHz to 110000 MHz	95%	± 5.41 dB
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	± 2.15 dB
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	± 3.47 dB
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	± 3.53 dB
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	± 4.44 dB
Spurious Emissions, radiated	1000 MHz to 40000 MHz	95%	± 2.89 dB
Spurious Emissions, radiated	40000 MHz to 60000 MHz	95%	± 5.04 dB
Spurious Emissions, radiated	60000 MHz to 90000 MHz	95%	± 5.04 dB
Spurious Emissions, radiated	75000 MHz to 110000 MHz	95%	± 5.04 dB
Spurious Emissions, radiated	110000 MHz to 170000 MHz	95%	± 5.04 dB
Spurious Emissions, radiated	140000 MHz to 220000 MHz	95%	± 5.04 dB

4.4 Conformity Decision Rule

The applied conformity decision rule is based on ILAC G8:09/2019 clause 4.2.1 Binary Statement for Simple Acceptance Rule ($w = 0$).

Details can be found in the procedure CSA_B_V50_29.

4.5 Measurement protocol for FCC and ISED

4.5.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011
ISED: DE0009

4.5.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

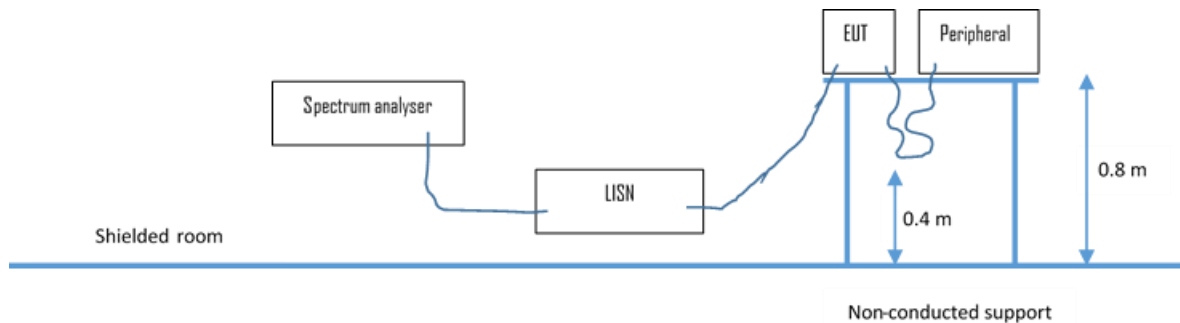
4.5.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions.

4.5.3 Details of test procedures

4.5.3.1 Conducted emission

Test setup according ANSI C63.10



The final level, expressed in dB μ V, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

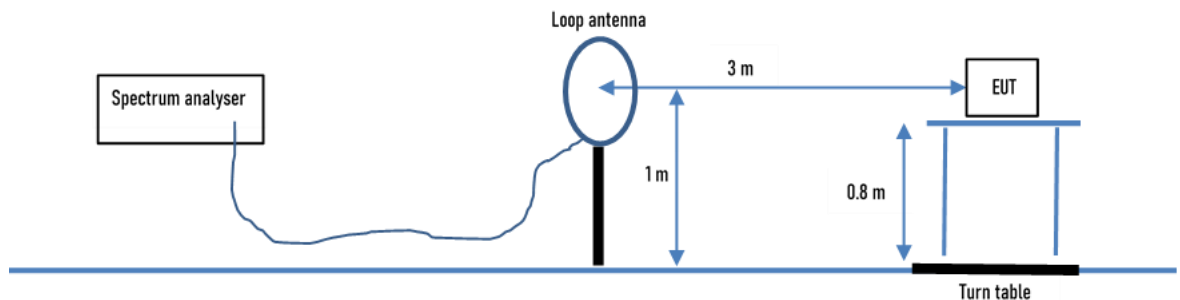
$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50 Ω / 50 μ H (CISPR 16) characteristics. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

4.5.3.2 Radiated emission

4.5.3.2.1 OATS1 test site (9 kHz - 30 MHz):

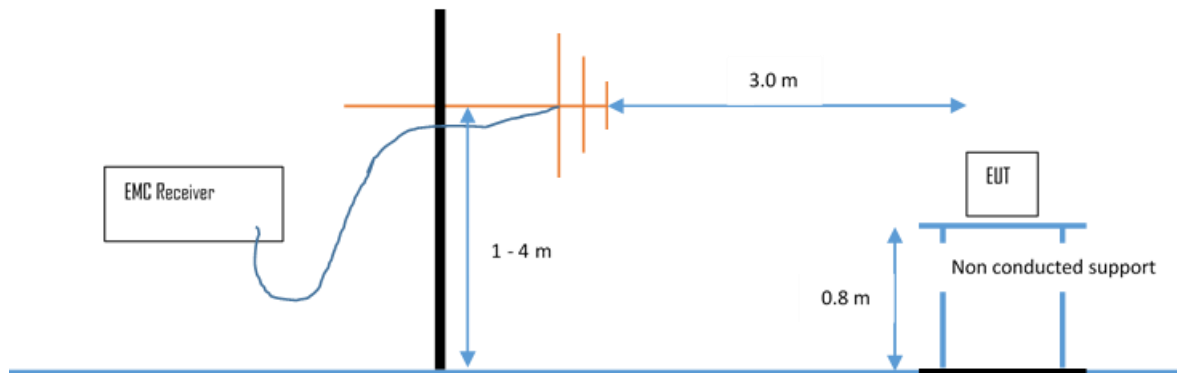
Test setup according ANSI C63.10



Emissions from the EUT are measured in the frequency range of 9 MHz to 30 MHz using a tuned receiver and a calibrated loop antenna. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied along the site axis and the EUT is rotated 360 degrees.

4.5.3.2.2 OATS1 test site (30 MHz - 1 GHz):

Test setup according ANSI C63.10.



Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees. The final level in dB μ V/m is calculated by taking the reading from the EMI receiver (Level dB μ V) and adding the correction factors and cable loss factor (dB). The FCC limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:

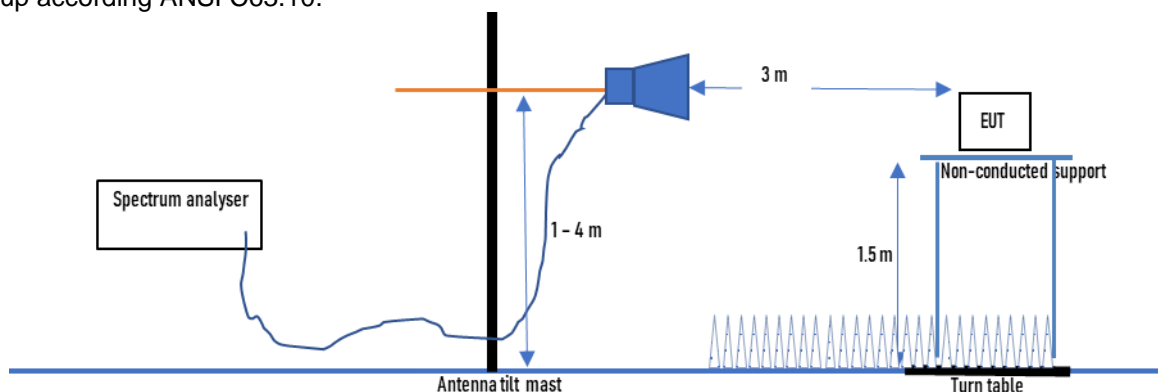
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency (MHz)	Level (dB μ V)	+	Factor (dB)	=	Level (dB μ V/m)	-	Limit (dB μ V/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

4.5.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

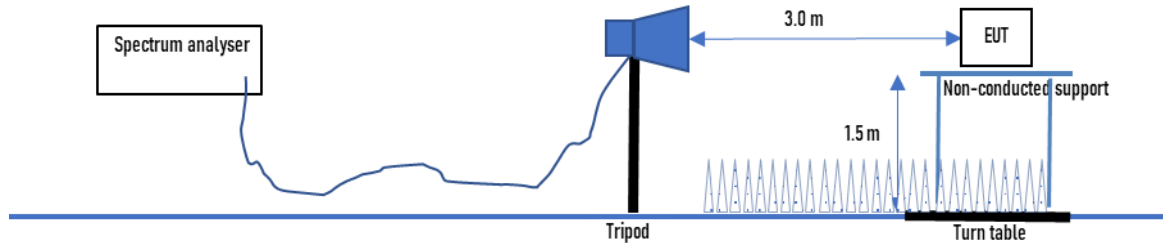
Test setup according ANSI C63.10.



Radiated emissions from the EUT are measured in the frequency range 1 GHz up to 18 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully

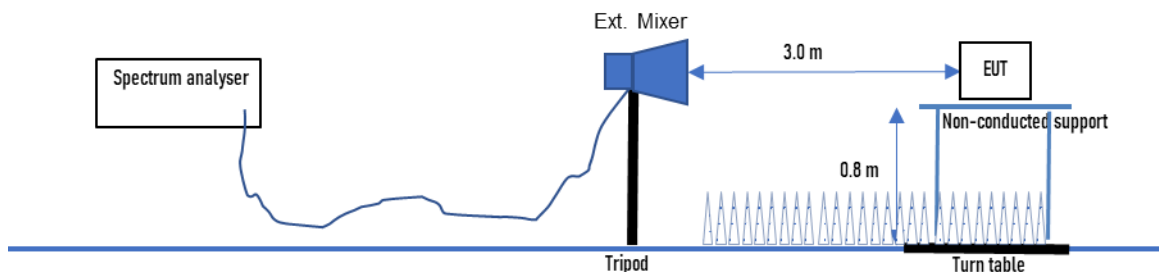
anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements.

4.5.3.2.4 Anechoic chamber 1 (18 GHz – 40 GHz)



Emissions from the EUT are measured in the frequency range 18 GHz up to 40 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limit are adopted.

4.5.3.2.1 Anechoic chamber 1 (40 GHz – 200 GHz)



Emissions from the EUT are measured in the frequency range 40 GHz up to 200 GHz as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and external mixer with standard gain horn. Table top equipment is placed on a non-conducting table, 0.8 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limit are adopted.

5 TEST CONDITIONS AND RESULTS

5.1 AC power line conducted emissions

For test instruments and accessories used see section 6 Part A 4.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.1.3 Applicable standard

According to FCC Part 15, Section 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 given limits.

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10 described under item 4.4.3. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin -7.2 dB at 0.498 MHz

Limit according to FCC Part 15, Section 15.207(a):

Frequency of Emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

The requirements are **FULFILLED**.

Remarks: For detailed test result please refer to following test protocols.

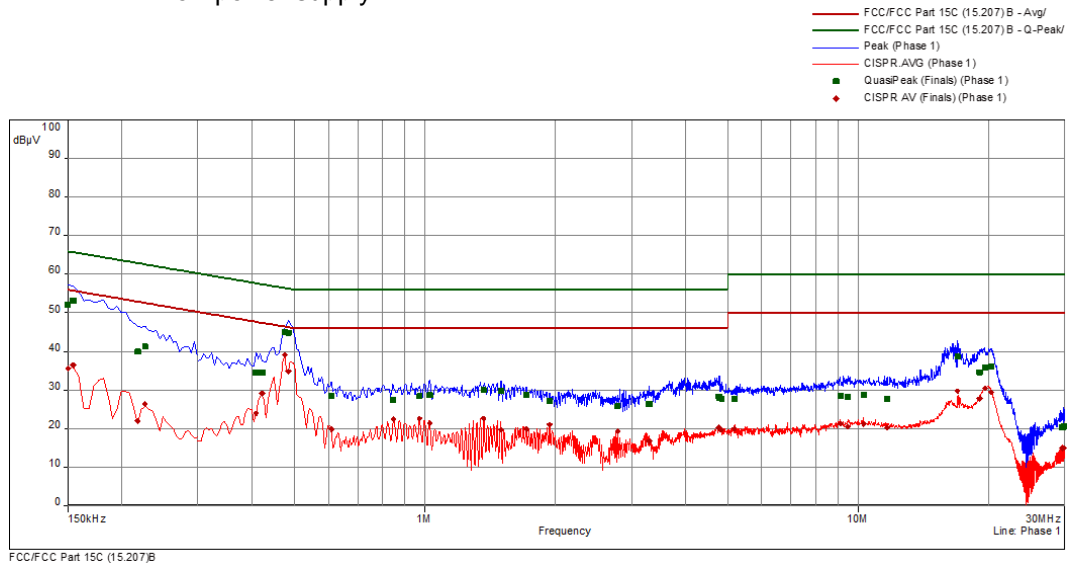
PoE power supply: AC adapter TP-Link, model T535131-2-DT

DC powered mode performed with commercially available laboratory DC power supply HM8143.

5.1.6 Test protocol

Test point: L1
Operation mode: TX
Remarks: PoE power supply

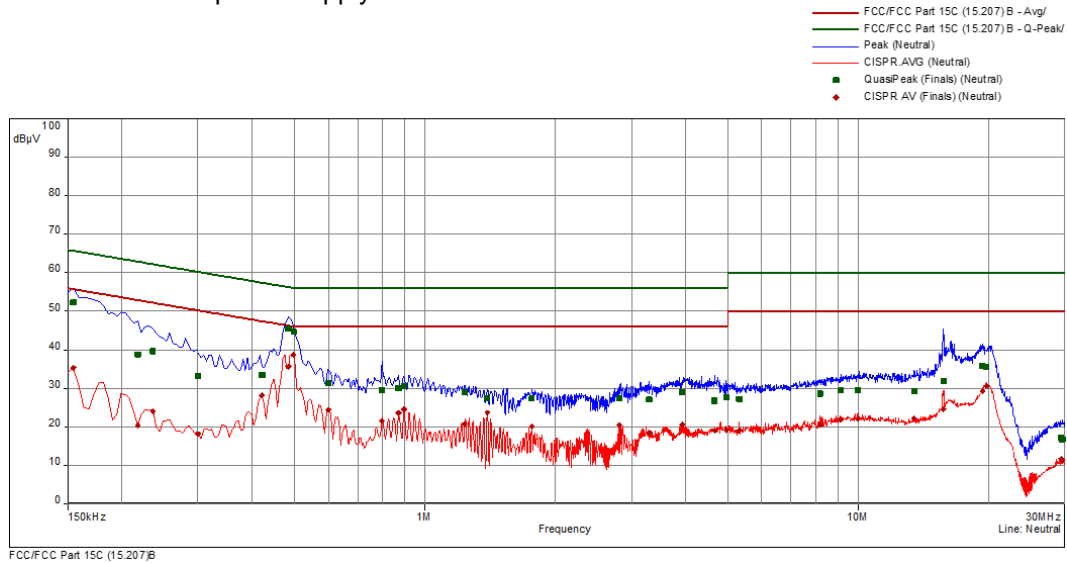
Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.150	1	52.2	-13.8	66.0	35.6	-20.4	56.0	Phase 1	10.1
0.155	1	53.3	-12.5	65.8	36.5	-19.3	55.8	Phase 1	10.1
0.218	1	40.0	-22.9	62.9	22.0	-30.9	52.9	Phase 1	10.1
0.227	1	41.3	-21.2	62.6	26.4	-26.2	52.6	Phase 1	10.1
0.408	2	34.6	-23.1	57.7	23.9	-23.8	47.7	Phase 1	10.1
0.422	2	34.5	-22.9	57.4	29.2	-18.2	47.4	Phase 1	10.1
0.476	2	45.1	-11.3	56.4	39.1	-7.3	46.4	Phase 1	10.2
0.485	2	44.9	-11.3	56.3	34.9	-11.3	46.3	Phase 1	10.2
0.609	3	28.5	-27.5	56.0	19.8	-26.2	46.0	Phase 1	10.2
0.848	3	27.5	-28.5	56.0	22.4	-23.6	46.0	Phase 1	10.2
0.974	3	28.4	-27.6	56.0	22.6	-23.5	46.0	Phase 1	10.2
1.028	3	28.8	-27.2	56.0	21.5	-24.5	46.0	Phase 1	10.2
1.371	4	30.0	-26.0	56.0	22.7	-23.3	46.0	Phase 1	10.3
1.502	4	29.8	-26.2	56.0	19.6	-26.4	46.0	Phase 1	10.3
1.718	4	28.7	-27.3	56.0	19.8	-26.2	46.0	Phase 1	10.3
1.943	4	27.1	-28.9	56.0	21.1	-24.9	46.0	Phase 1	10.3
2.792	5	25.7	-30.3	56.0	19.3	-26.8	46.0	Phase 1	10.3
3.300	5	26.4	-29.6	56.0	16.8	-29.2	46.0	Phase 1	10.3
4.772	5	28.4	-27.6	56.0	20.2	-25.8	46.0	Phase 1	10.4
4.799	5	28.0	-28.0	56.0	19.9	-26.1	46.0	Phase 1	10.4
4.841	6	27.8	-28.2	56.0	19.6	-26.4	46.0	Phase 1	10.4
5.192	6	27.8	-32.2	60.0	20.0	-30.0	50.0	Phase 1	10.5
9.111	6	28.6	-31.4	60.0	21.3	-28.7	50.0	Phase 1	10.7
9.476	6	28.1	-31.9	60.0	20.6	-29.4	50.0	Phase 1	10.7
10.298	7	28.9	-31.1	60.0	21.2	-28.8	50.0	Phase 1	10.7
11.675	7	27.7	-32.3	60.0	20.2	-29.8	50.0	Phase 1	10.8
16.994	7	38.6	-21.4	60.0	29.8	-20.3	50.0	Phase 1	11.1
19.109	7	34.7	-25.4	60.0	27.8	-22.2	50.0	Phase 1	11.2
19.673	8	35.8	-24.2	60.0	30.4	-19.6	50.0	Phase 1	11.2
20.280	8	36.2	-23.8	60.0	29.5	-20.5	50.0	Phase 1	11.3
29.636	8	20.4	-39.6	60.0	15.0	-35.0	50.0	Phase 1	11.5
29.861	8	20.7	-39.3	60.0	15.0	-35.0	50.0	Phase 1	11.5

Test point: N
Operation mode: TX
Remarks: PoE power supply

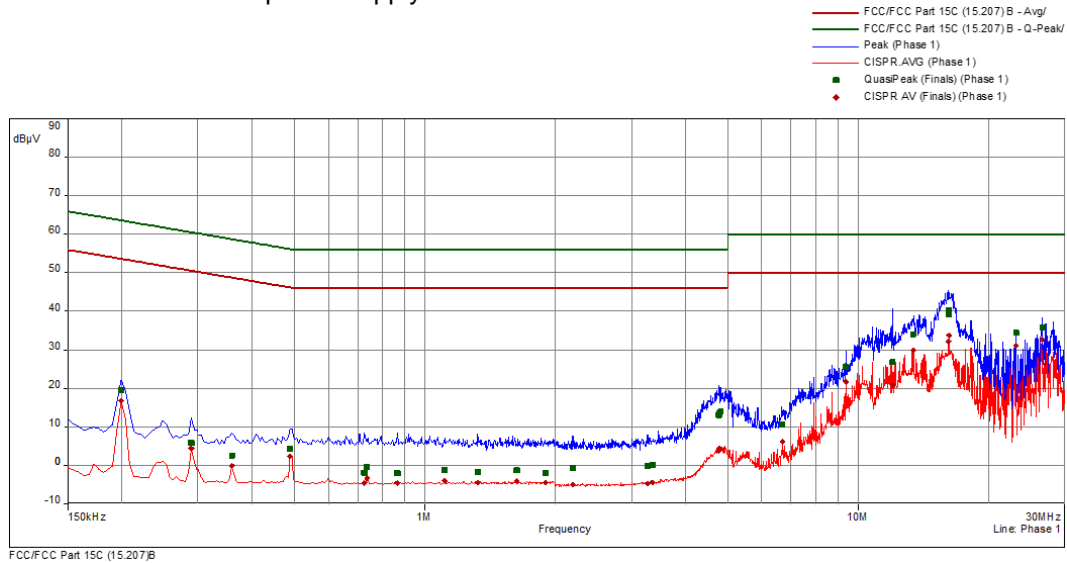
Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.155	9	52.4	-13.4	65.8	35.3	-20.4	55.8	Neutral	10.1
0.218	9	38.9	-24.0	62.9	20.4	-32.5	52.9	Neutral	10.1
0.236	9	39.7	-22.5	62.3	24.1	-28.2	52.3	Neutral	10.1
0.300	10	33.1	-27.1	60.2	18.2	-32.1	50.2	Neutral	10.2
0.422	10	33.5	-23.9	57.4	28.2	-19.3	47.4	Neutral	10.2
0.485	10	45.6	-10.7	56.3	35.7	-10.6	46.3	Neutral	10.2
0.498	10	44.7	-11.4	56.0	38.8	-7.2	46.0	Neutral	10.2
0.600	11	31.5	-24.5	56.0	24.4	-21.6	46.0	Neutral	10.2
0.798	11	29.7	-26.3	56.0	21.6	-24.5	46.0	Neutral	10.2
0.870	11	30.0	-26.0	56.0	23.6	-22.4	46.0	Neutral	10.2
0.897	11	30.7	-25.3	56.0	24.5	-21.5	46.0	Neutral	10.2
1.236	12	29.2	-26.8	56.0	20.8	-25.2	46.0	Neutral	10.3
1.394	12	27.6	-28.4	56.0	23.8	-22.2	46.0	Neutral	10.3
1.767	12	27.4	-28.6	56.0	20.0	-26.0	46.0	Neutral	10.3
2.814	13	27.5	-28.5	56.0	20.5	-25.5	46.0	Neutral	10.4
3.300	13	27.1	-28.9	56.0	18.4	-27.6	46.0	Neutral	10.4
3.935	13	29.1	-27.0	56.0	20.6	-25.4	46.0	Neutral	10.4
4.668	13	26.8	-29.2	56.0	19.0	-27.0	46.0	Neutral	10.4
4.971	14	27.6	-28.4	56.0	19.3	-26.8	46.0	Neutral	10.5
5.327	14	27.3	-32.7	60.0	19.1	-30.9	50.0	Neutral	10.5
8.198	14	28.7	-31.4	60.0	20.4	-29.6	50.0	Neutral	10.6
9.129	14	29.4	-30.6	60.0	21.8	-28.2	50.0	Neutral	10.6
10.019	15	29.6	-30.4	60.0	22.1	-27.9	50.0	Neutral	10.7
13.488	15	29.3	-30.7	60.0	22.2	-27.8	50.0	Neutral	10.9
15.756	15	31.8	-28.2	60.0	24.6	-25.4	50.0	Neutral	10.9
19.376	16	35.8	-24.2	60.0	29.3	-20.7	50.0	Neutral	11.1
19.785	16	35.7	-24.3	60.0	30.6	-19.4	50.0	Neutral	11.1
29.429	16	17.1	-42.9	60.0	11.7	-38.3	50.0	Neutral	11.0
29.654	16	16.8	-43.2	60.0	11.4	-38.6	50.0	Neutral	11.0

Test point L1
Operation mode: TX
Remarks: 24 V/DC power supply

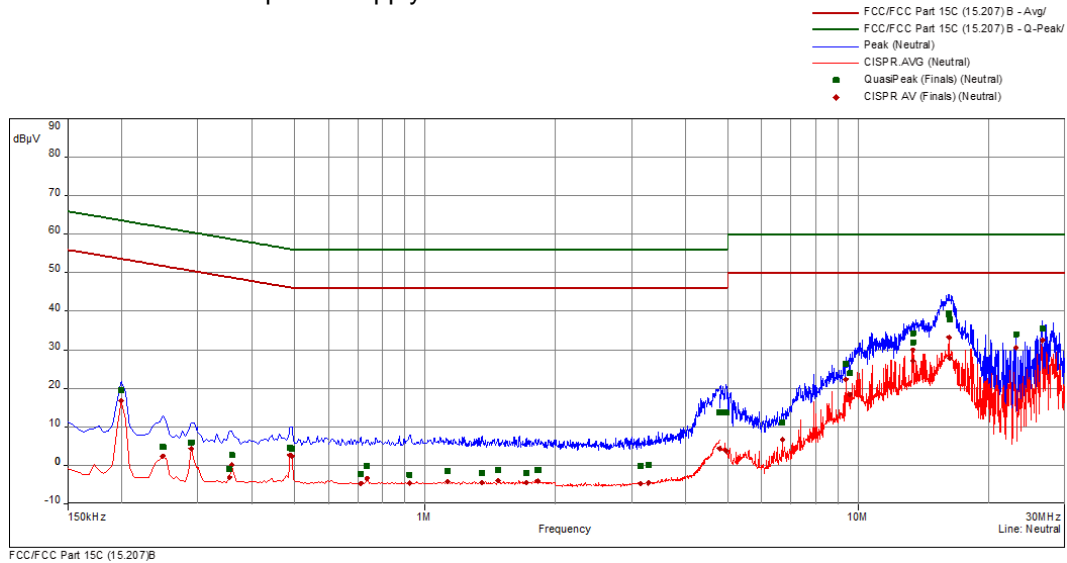
Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.200	1	19.6	-44.1	63.6	16.7	-37.0	53.6	Phase 1	10.1
0.290	1	5.9	-54.7	60.5	4.4	-46.2	50.5	Phase 1	10.1
0.359	2	2.6	-56.2	58.8	-0.1	-48.8	48.8	Phase 1	10.1
0.489	2	4.3	-51.9	56.2	2.3	-43.9	46.2	Phase 1	10.2
0.726	3	-1.9	-57.9	56.0	-4.5	-50.5	46.0	Phase 1	10.2
0.735	3	-0.3	-56.3	56.0	-3.3	-49.3	46.0	Phase 1	10.2
0.866	3	-2.0	-58.0	56.0	-4.6	-50.6	46.0	Phase 1	10.2
1.113	3	-1.2	-57.2	56.0	-4.1	-50.1	46.0	Phase 1	10.2
1.326	4	-1.8	-57.8	56.0	-4.5	-50.5	46.0	Phase 1	10.3
1.632	4	-1.3	-57.3	56.0	-4.1	-50.1	46.0	Phase 1	10.3
1.898	4	-2.0	-58.0	56.0	-4.5	-50.5	46.0	Phase 1	10.3
2.199	4	-0.6	-56.6	56.0	-5.1	-51.1	46.0	Phase 1	10.3
3.269	5	-0.1	-56.1	56.0	-4.7	-50.7	46.0	Phase 1	10.3
3.354	5	0.0	-56.0	56.0	-4.5	-50.5	46.0	Phase 1	10.3
4.776	5	13.1	-42.9	56.0	3.8	-42.2	46.0	Phase 1	10.4
4.781	5	13.6	-42.4	56.0	4.4	-41.6	46.0	Phase 1	10.4
4.814	6	13.9	-42.1	56.0	4.1	-41.9	46.0	Phase 1	10.4
6.704	6	10.7	-49.3	60.0	6.1	-43.9	50.0	Phase 1	10.6
9.390	6	25.6	-34.5	60.0	21.7	-28.3	50.0	Phase 1	10.7
12.012	7	26.9	-33.1	60.0	20.8	-29.2	50.0	Phase 1	10.9
13.421	7	34.1	-25.9	60.0	29.9	-20.1	50.0	Phase 1	11.0
16.166	7	39.2	-20.8	60.0	32.3	-17.7	50.0	Phase 1	11.1
16.229	7	40.4	-19.6	60.0	33.8	-16.2	50.0	Phase 1	11.1
23.129	8	34.4	-25.6	60.0	31.0	-19.0	50.0	Phase 1	11.4
26.612	8	35.9	-24.1	60.0	32.7	-17.3	50.0	Phase 1	11.5

Test point: N
Operation mode: TX
Remarks: 24 V/DC power supply

Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.200	9	19.6	-44.1	63.6	16.7	-36.9	53.6	Neutral	10.1
0.249	9	4.9	-56.9	61.8	2.4	-49.4	51.8	Neutral	10.1
0.290	9	6.0	-54.6	60.5	4.4	-46.2	50.5	Neutral	10.2
0.354	10	-0.9	-59.8	58.9	-3.2	-52.0	48.9	Neutral	10.2
0.359	10	2.7	-56.1	58.8	0.0	-48.8	48.8	Neutral	10.2
0.489	10	4.6	-51.6	56.2	2.6	-43.6	46.2	Neutral	10.2
0.494	10	4.4	-51.7	56.1	2.4	-43.7	46.1	Neutral	10.2
0.713	11	-2.2	-58.2	56.0	-4.6	-50.6	46.0	Neutral	10.2
0.735	11	-0.2	-56.2	56.0	-3.3	-49.3	46.0	Neutral	10.2
0.924	11	-2.4	-58.4	56.0	-4.7	-50.7	46.0	Neutral	10.2
1.131	11	-1.4	-57.4	56.0	-4.2	-50.2	46.0	Neutral	10.2
1.358	12	-2.0	-58.0	56.0	-4.5	-50.5	46.0	Neutral	10.3
1.479	12	-1.2	-57.2	56.0	-4.0	-50.0	46.0	Neutral	10.3
1.718	12	-2.0	-58.0	56.0	-4.5	-50.5	46.0	Neutral	10.3
1.826	12	-1.2	-57.2	56.0	-4.1	-50.1	46.0	Neutral	10.3
3.152	13	-0.1	-56.1	56.0	-4.8	-50.8	46.0	Neutral	10.4
3.287	13	0.1	-56.0	56.0	-4.6	-50.6	46.0	Neutral	10.4
4.799	13	13.7	-42.3	56.0	4.4	-41.6	46.0	Neutral	10.4
4.958	14	13.8	-42.2	56.0	3.7	-42.3	46.0	Neutral	10.5
6.704	14	11.1	-48.9	60.0	6.6	-43.4	50.0	Neutral	10.6
9.390	14	26.5	-33.5	60.0	22.3	-27.7	50.0	Neutral	10.6
9.575	14	24.0	-36.0	60.0	18.4	-31.6	50.0	Neutral	10.6
13.416	15	32.1	-27.9	60.0	27.2	-22.8	50.0	Neutral	10.9
13.421	15	34.4	-25.6	60.0	30.0	-20.0	50.0	Neutral	10.9
16.229	15	39.4	-20.6	60.0	33.2	-16.8	50.0	Neutral	10.9
16.247	15	38.0	-22.0	60.0	27.9	-22.1	50.0	Neutral	10.9
23.129	16	34.1	-25.9	60.0	30.6	-19.4	50.0	Neutral	11.1
26.612	16	35.5	-24.5	60.0	32.5	-17.5	50.0	Neutral	11.1

5.2 EBW and OBW

For test instruments and accessories used see section 6 Part **CPR3, MB**.

5.2.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 1 m

5.2.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.2.3 Applicable standard

According to FCC Part 15, Section 15.255(c)(2)(v):

For field disturbance sensors that occupy 500 MHz or less of bandwidth and that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm.

According to FCC Part 15, Section 15.255(e)(1):

Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz.

5.2.4 Description of Measurement

According to FCC Part 15, Section 15.255(e)(1):

For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -6 dB. The reference level is the level of the highest signal amplitude observed at the transmitter at either the fundamental frequency or the first order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

Spectrum analyser settings for EBW:

RBW: 100 kHz, VBW: 3 x RBW, Detector: Max peak, Sweep time: auto, Span: > 2 EBW;

Spectrum analyser settings for OBW:

RBW: 5 MHz, VBW: 3 x RBW, Detector: Max peak, Sweep time: auto, Span: > 2 OBW;

5.2.5 Test result

6dB bandwidth			
operating range	f_{low}	f_{high}	EBW 6dB
	(GHz)	(GHz)	(GHz)
1	61.010	61.464	0.454
2	60.002	63.986	3.984

The requirements are **FULFILLED**.

Remarks: For detailed test results please refer to following test protocols.

No limit defined for the occupied bandwidth!

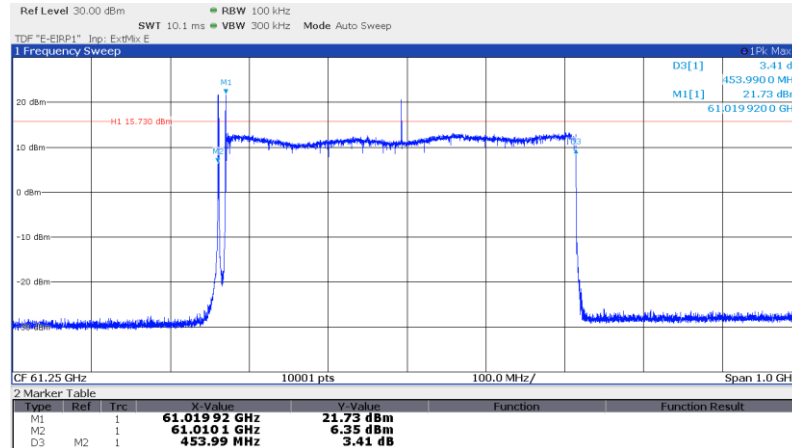
Measurement procedure for operation range 2: To avoid overlap of wanted signal with unwanted signal (image), LO of external mixer is tuned to appropriate frequency to obtain higher ZF. VBW reduced due to high dynamic for higher ZF. For test instruments see section 6, part MB.

Measurements performed with Ant 0+2 configuration.

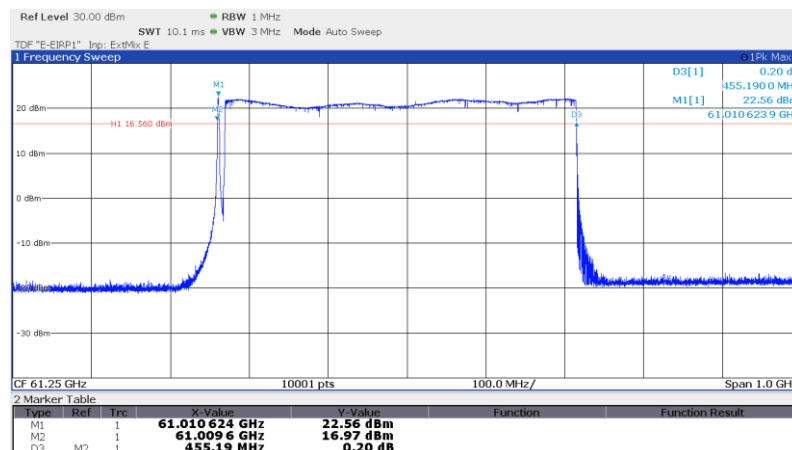
5.2.6 Test protocols

Operating frequency range 1:

6dB EBW

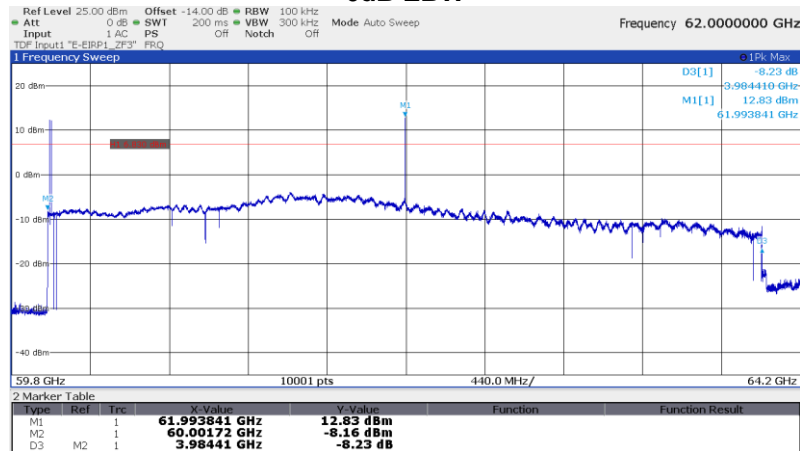


Note: f_{high} below 6dB reduction due to desensitisation of FMCW part for RBW = 100kHz, see below for f_{high} with RBW = 1 MHz, where no desensitization occurs.

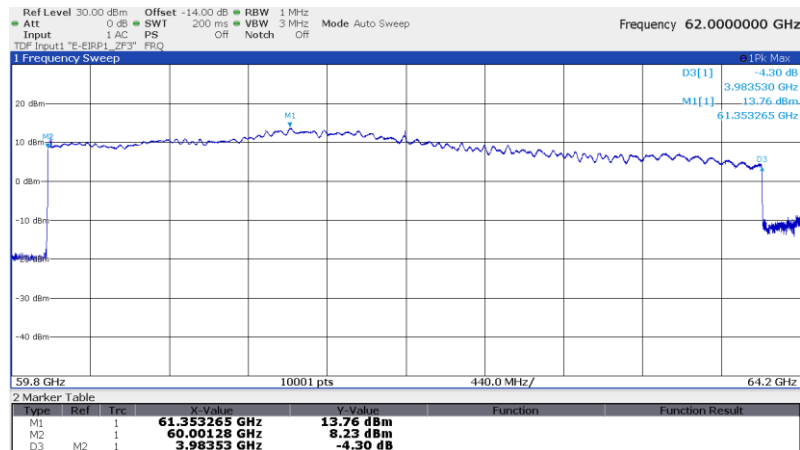


Operating frequency range 2:

6dB EBW



Note: f_{high} below 6dB reduction of FMCW part due to desensitisation for RBW = 100kHz, see below for f_{high} with RBW = 1 MHz, where no desensitization occurs.



5.3 EIRP and transmitter off-times

For test instruments and accessories used see section 6 Part **CPR 3, MB**.

5.3.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 1 m

5.3.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.3.3 Applicable standard

According to FCC Part 15C, Section 15.255(c)(2)(iii)(B)(1):

57.0-64.0 GHz: The peak EIRP shall not exceed 20 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds when operated outdoors: As part of a temporary or permanently fixed application.

According to FCC Part 15C, Section 15.255(c)(2)(v):

For field disturbance sensors/radars that occupy 500 MHz bandwidth or less that are contained wholly within the frequency band 61.0–61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0–61.5 GHz band, measured during the transmit interval, but still within the 57–71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

5.3.4 Description of Measurement

The radiated emission of the fundamental wave from the EUT is measured using a spectrum analyser and appropriate linear polarized antennas. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 9.8. The EUT is measured in TX continuous unmodulated under normal conditions.

Analyser settings:

PK measurement:	RBW: 1 MHz	VBW: 10 MHz	Detector: PK	Trace. Max hold
AV measurement:	RBW: 1 MHz	VBW: 10 MHz	Detector: RMS	Trace. Max hold

5.3.5 Test result

EIRP:

Operation range	Operating frequency range (GHz)	Antenna	Power setting	Level PK (dBm)	Limit PK (dBm)	Margin PK (dB)	Level AV (dBm)	Limit AV (dBm)	Margin AV (dB)
1	61-61.5	0	P0	17.4	43.0	-25.6	16.3	40.0	-23.7
		1	P0	16.6	43.0	-26.4	15.6	40.0	-24.4
		2	P0	16.0	43.0	-27.0	15.0	40.0	-25.0
		0+2	P0	22.4	43.0	-20.6	21.4	40.0	-18.6
2	60-64	0	P0	18.7	20.0	-1.3	-	N/A	-
		1	P0	18.4	20.0	-1.6	-	N/A	-
		2	P0	18.3	20.0	-1.7	-	N/A	-
		0+2	P5	18.8	20.0	-1.2	-	N/A	-

Transmitter off-times:

Observation interval (ms)	Sum of transmitter on-times (ms)	Sum of transmitter off-times (ms)	Limit transmitter off-times (ms)
33	7.4	25.6	≥16.5

EIRP limit according to FCC Part 15C, Section 15.255(c)(2)(iii)(B):

The peak EIRP shall not exceed 20 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds when operated outdoors.

EIRP limit according to FCC Part 15C, Section 15.255(c)(2)(v):

For field disturbance sensors/radars that occupy 500 MHz bandwidth or less that are contained wholly within the frequency band 61.0–61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0–61.5 GHz band, measured during the transmit interval, but still within the 57–71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

The requirements are **FULFILLED**.

Remarks: For detailed test results please refer to following test protocols.

Only worst case plots are listed (Ant 0+2).

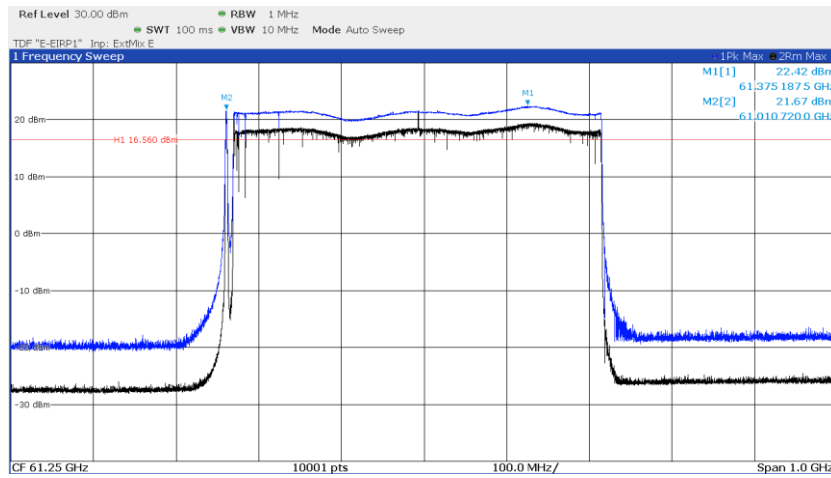
Measurement procedure for operation range 2: To avoid overlap of wanted signal with unwanted signal (image), LO of external mixer is tuned to appropriate frequency to obtain higher ZF. VBW

reduced due to high dynamic for higher ZF. For test instruments see section 6, part MB.

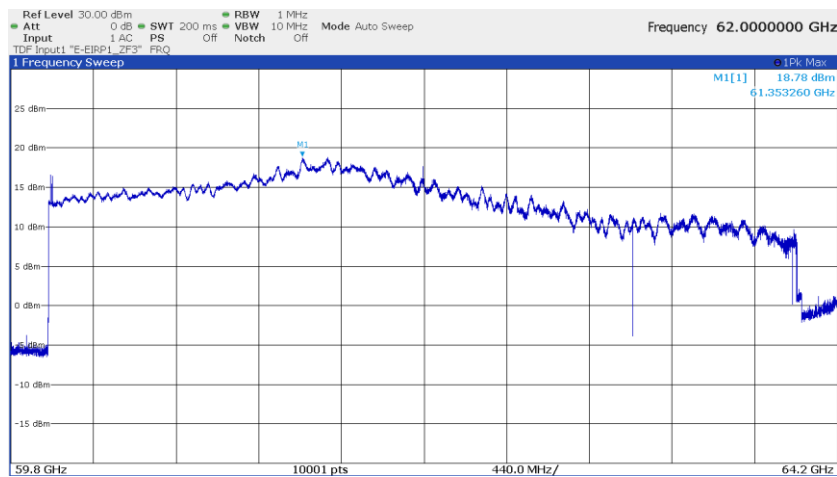
Transmitter off-times: Chirp bandwidth set to 0 by test software to determine on-off-times.

5.3.6 Test protocols

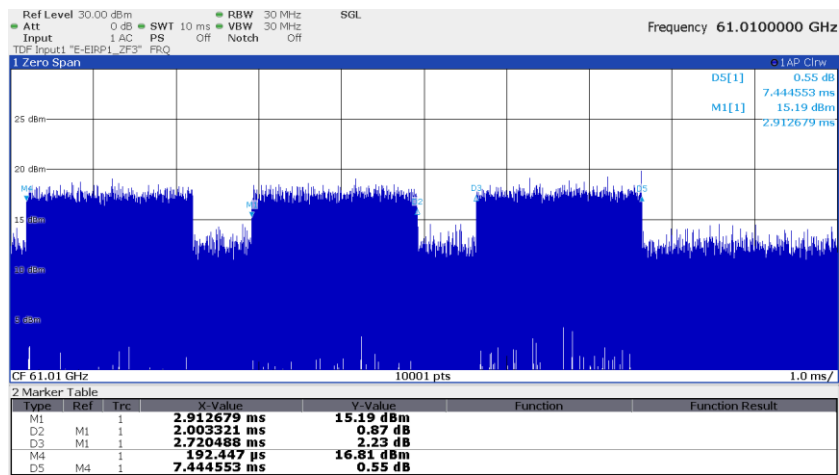
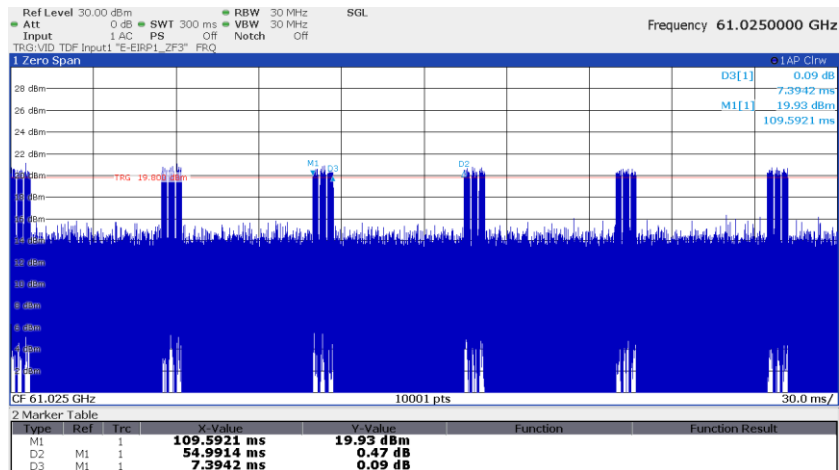
Operating frequency range 1:



Operating frequency range 2:



Transmitter off-times:



5.4 Peak conducted output power

For test instruments and accessories used see section 6 Part **CPR 3, MB**.

5.4.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 1 m

5.4.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.4.3 Applicable standard

According to FCC Part 15C, Section 15.255(e):

Except as specified paragraph (e)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (c) of this section. (2): Peak transmitter conducted output power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57–71 GHz band and that has a video bandwidth of at least 10 MHz.

5.4.4 Description of Measurement

The radiated emission of the fundamental wave from the EUT is measured using a spectrum analyser and appropriate linear polarized antennas. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 9.8 and 9.11. The EUT is measured in TX continuous, FMCW stopped, under normal conditions.

Analyser settings:

PK measurement: RBW: 1 MHz VBW: 10 MHz Detector: Peak Trace. Max hold

5.4.5 Test result

Calculation of the peak transmitter output power:

Operation range	Operating frequency range (GHz)	Antenna	Power setting	EIRP level PK (dBm)	Antenna gain (dBi)	Conducted level PK (dBm)	Conducted level PK (mW)	Limit (mW)	Margin (mW)
1	61-61.5	0	P0	17.4	7.0	10.4	10.965	500	-489.0
		1	P0	16.6	7.0	9.6	9.162	500	-490.8
		2	P0	16.0	7.0	9.0	7.925	500	-492.1
		0+2	P0	22.4	7.0	15.4	34.514	500	-465.5
2	60-64	0	P0	18.7	7.0	11.7	14.723	500	-485.3
		1	P0	18.4	7.0	11.4	13.740	500	-486.3
		2	P0	18.3	7.0	11.3	13.583	500	-486.4
		0+2	P5	18.8	7.0	11.8	15.066	500	-484.9

Limit according to FCC Part 15C, Section 15.255(e):

Except as specified paragraph (e)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (c) of this section. (1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

Determination of the limit:

The limit is given as 500 mW (EBW 6 dB > 100 MHz)

The requirements are **FULFILLED**.

Remarks: For determination of emission bandwidth please refer to section 5.2.

5.5 Spurious emissions

For test instruments and accessories used see section 6 Part **SER1, SER 2, SER 3.**

5.5.1 Description of the test location

Test location:	OATS 1
Test distance:	3 m
Test location:	Anechoic chamber 1
Test distance:	3 m (1 GHz – 40 GHz)
Test distance:	1 m (40 GHz – 200 GHz)

5.5.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.5.3 Applicable standard

According to FCC Part 15C, Section 15.255 (d):

- (1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.
- (2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.
- (3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm² at a distance of 3 meters.
- (4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

5.5.4 Description of Measurement

The radiated emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 9. In the frequency range above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. If the emission level in peak mode complies with the average limit testing is stopped and peak values will be reported, otherwise, the emission is measured in average mode again and reported. The EUT is measured in TX continuous mode under normal conditions.

Instrument settings:

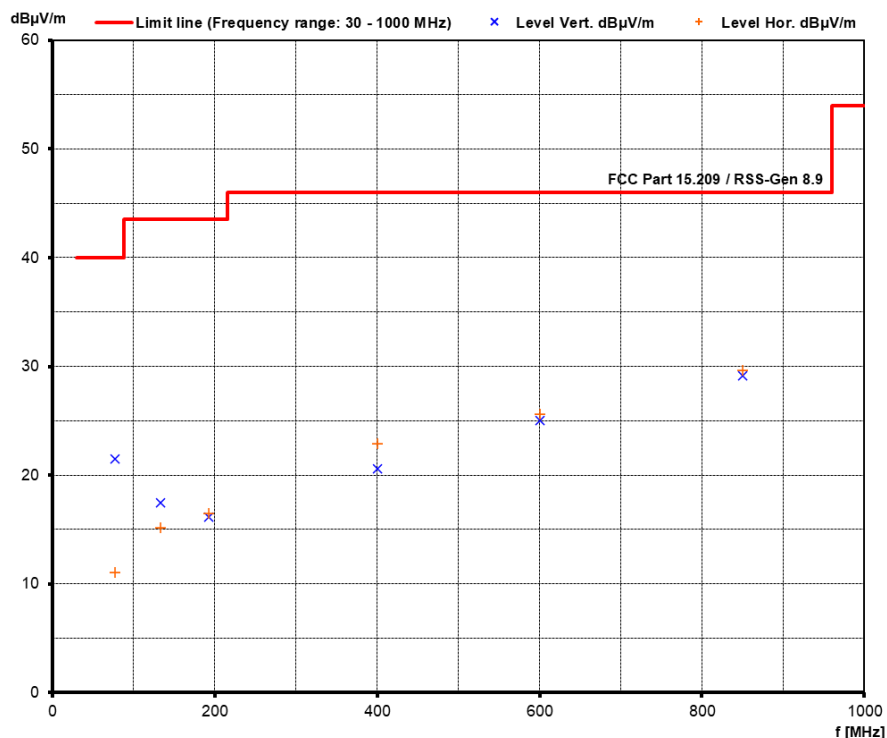
9 kHz – 150 kHz:	RBW: 200 Hz,	Detector: Quasi peak, Mes. Time: 1 s,
150 kHz – 30 MHz:	RBW: 9 kHz,	Detector: Quasi peak, Mes. Time: 1 s,
30 MHz – 1 GHz:	RBW: 120 MHz,	Detector: Quasi peak, Mes. Time: 1 s,
1 GHz – 200 GHz:	RBW: 1 MHz,VBW: 3 MHz,	Detector: Max. peak, Trace: Max. hold, Sweep: Auto

5.5.5 Test result $f < 1$ GHz

According to FCC 15.209					
Frequency (MHz)	Reading (dB μ V)	Correction (dB)	Field strength (dB μ V/m)	Limit (dB μ V/m)	Dlimit (dB)
0.022	43.2	18.9	-17.9	40.9	-58.8
0.052	26.9	18.9	-34.2	33.4	-67.6
0.077	33.4	18.6	-28.0	29.9	-57.9
0.400	16.8	17.1	-46.1	15.6	-61.7
4.077	6.1	17.9	-16.0	30.0	-46.0
11.513	4.9	17.0	-18.1	30.0	-48.1
27.4	3.4	17.7	-18.9	30.0	-48.9

* Correction = Antenna factor + Δ alternative test site + distance extrapolation factor

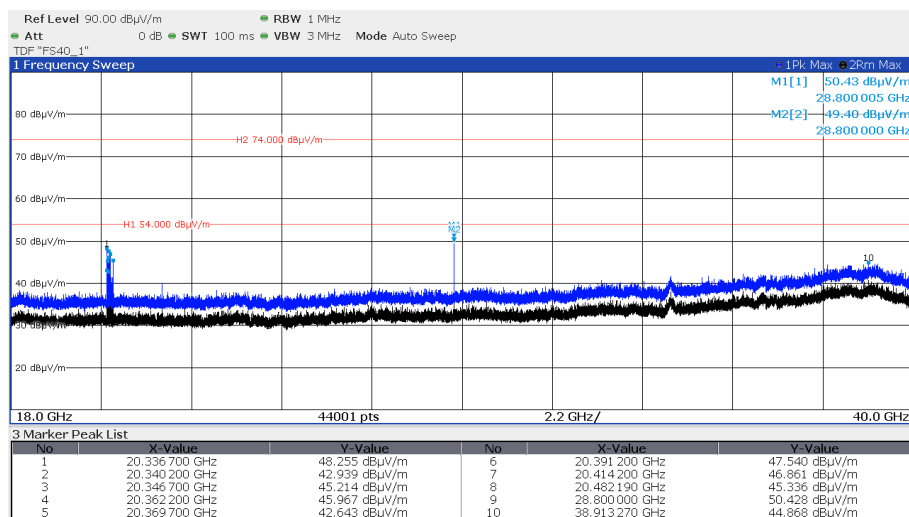
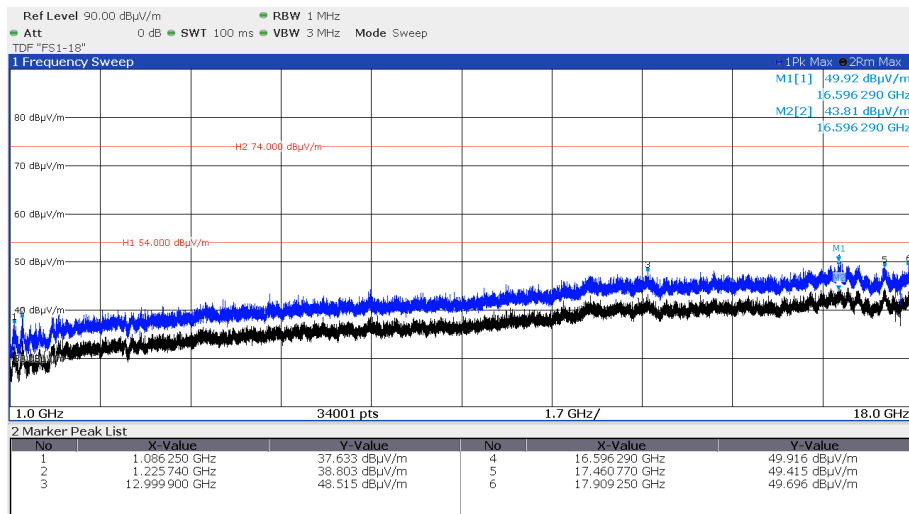
Frequency (MHz)	Reading Vert. (dB μ V)	Reading Hor. (dB μ V)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dB μ V/m)	Level Hor. (dB μ V/m)	Limit (dB μ V/m)	Dlimit (dB)
76.70	6.8	-4.0	14.7	15.1	21.5	11.1	40.0	-18.5
132.94	-1.1	-2.7	18.6	17.8	17.5	15.1	43.5	-26.0
192.36	-1.4	-0.5	17.5	17.0	16.1	16.5	43.5	-27.0
400.00	-2.7	-0.7	23.3	23.6	20.6	22.9	46.0	-23.1
600.00	-3.3	-3.0	28.3	28.6	25.0	25.6	46.0	-20.4
850.00	-3.1	-3.0	32.3	32.7	29.2	29.7	46.0	-16.3



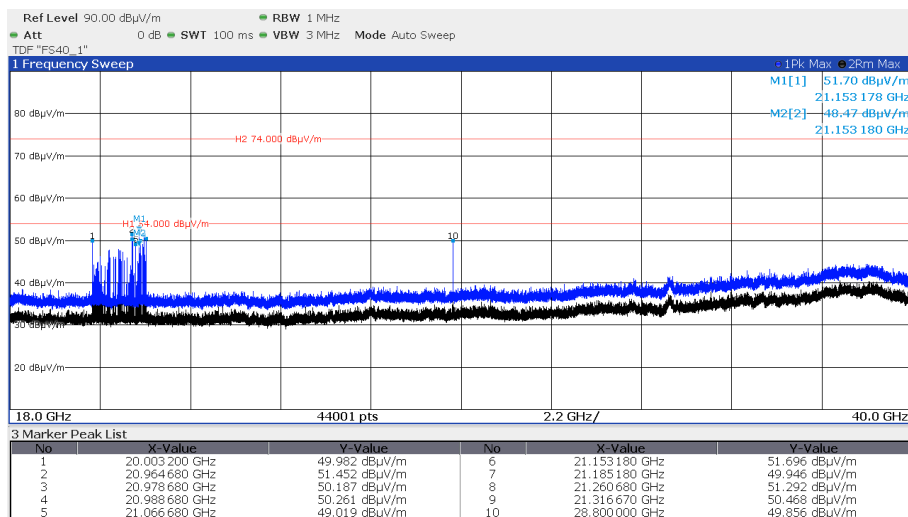
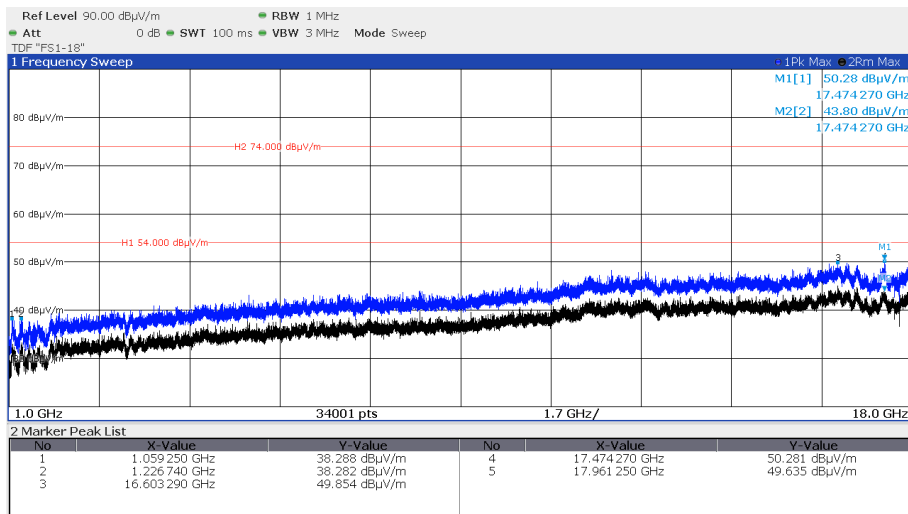
Note: For frequencies < 1 GHz the general radiated limit has been applied.

5.5.6 Test result 1 GHz < f < 40 GHz

Operating frequency range 1:



Operating frequency range 2:



5.5.7 Test result f > 40 GHz

Determination of the EIRP emission limit for f > 40 GHz:

For calculation of the limit the Friis formula is used.

$$P_d = \frac{P_{out} * G}{4 * \pi * r^2}$$

$P_{out} * G = \text{EIRP}$;
Therefore

$$\text{EIRP} = P_d * 4 * \pi * r^2$$

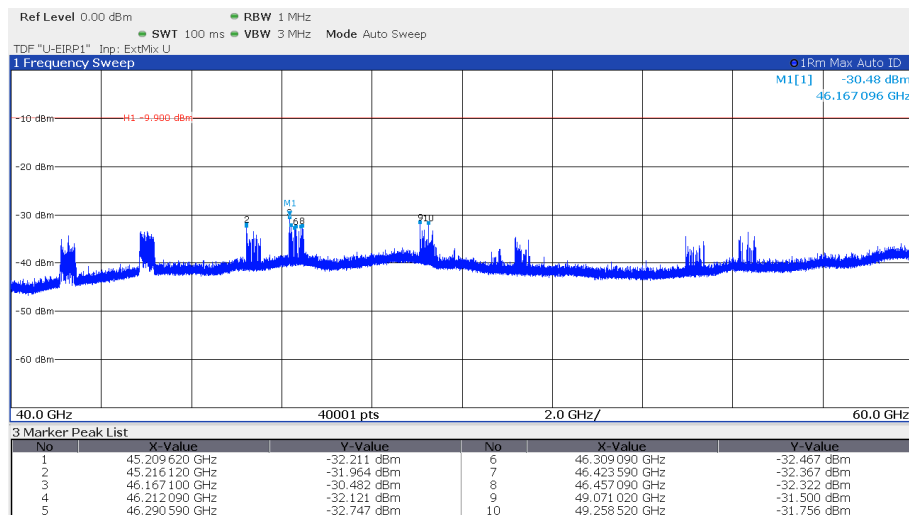
$$\text{EIRP} = -9.9 \text{ dBm}$$

where

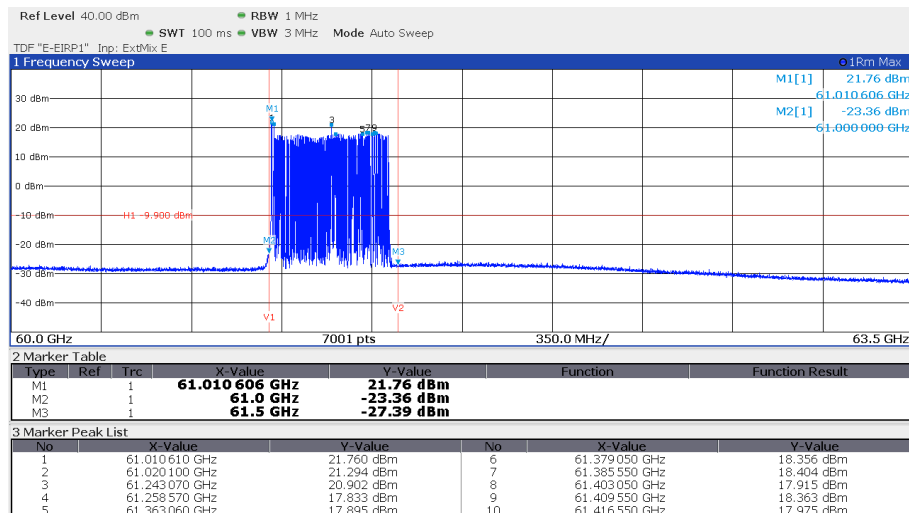
r is the measurement distance (3 m)

P_d is the emission density (90 pW/cm²)

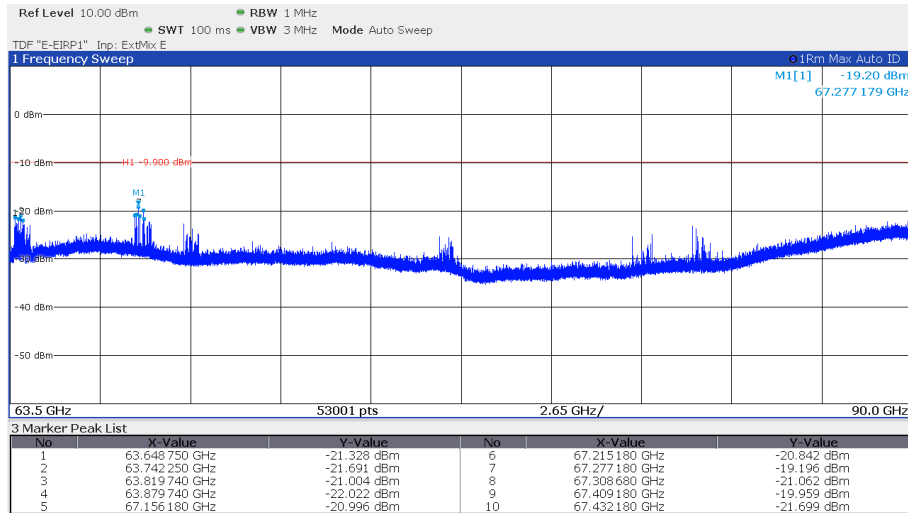
Operating frequency range 1:



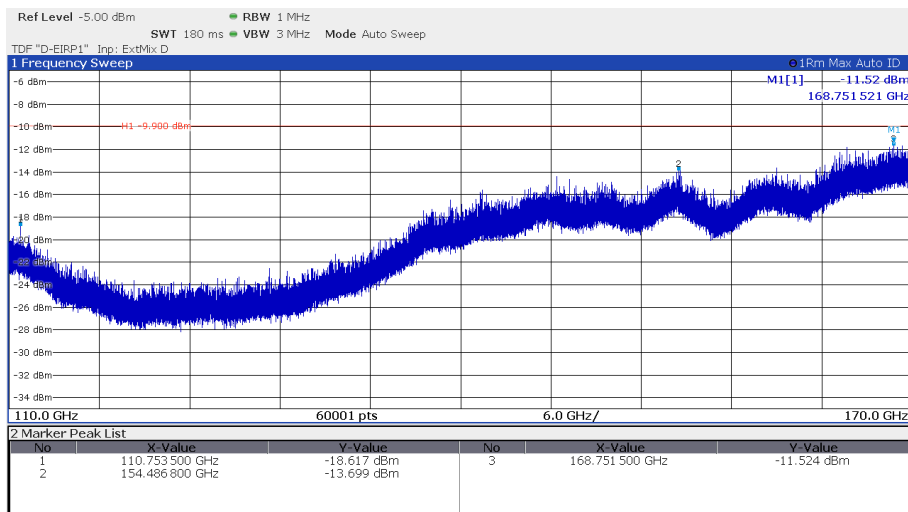
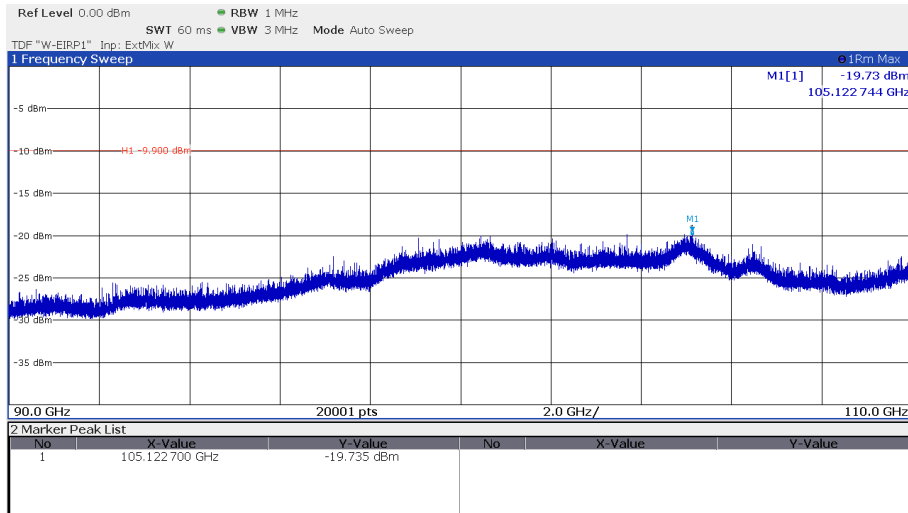
Note: To minimize unintended mixing products generated by the external mixer the AutotID function was used.

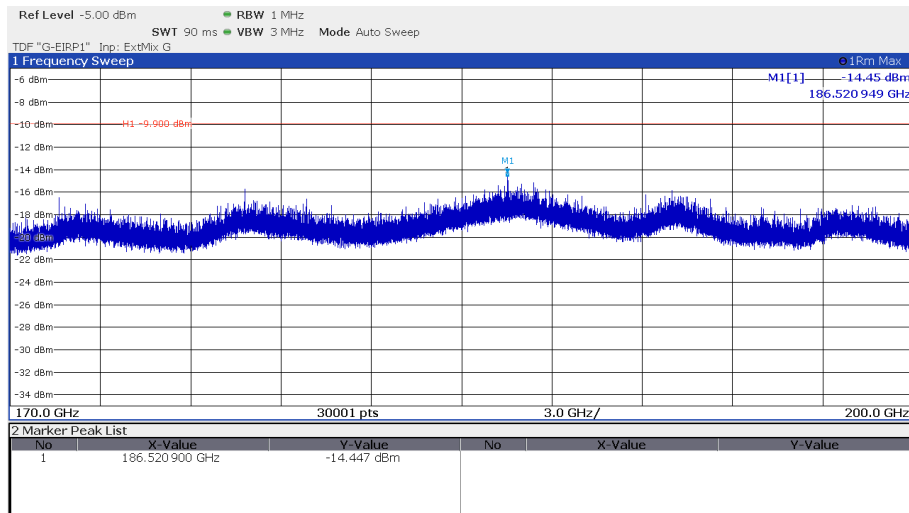


Note: V1 to V2 shows operating frequency range 1.

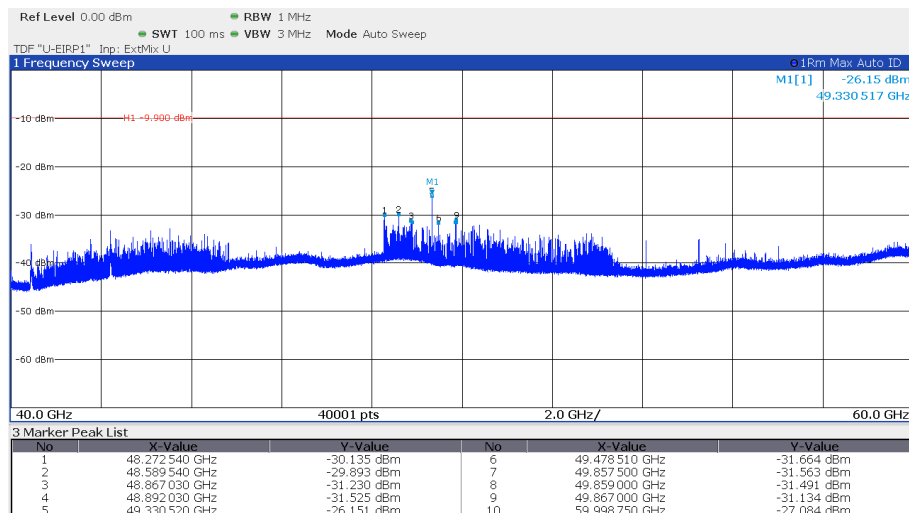


Note: To minimize unintended mixing products generated by the external mixer the AutoID function was used.

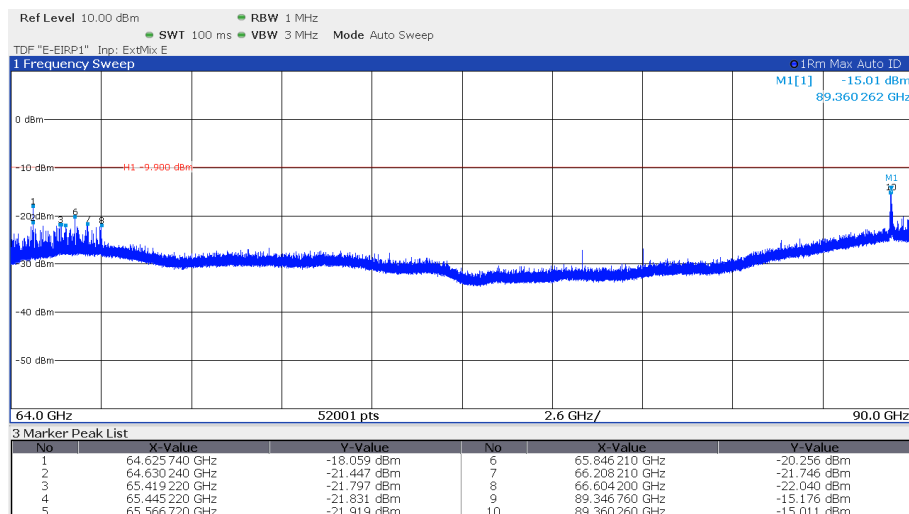




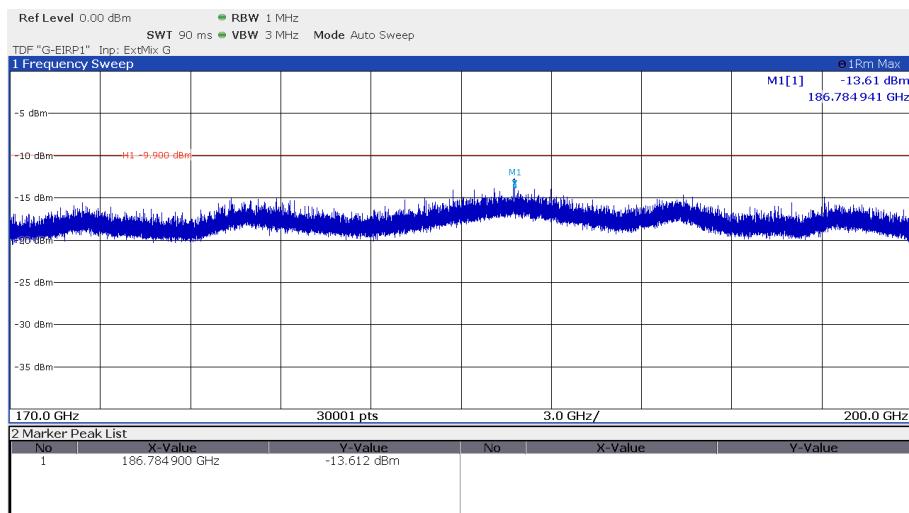
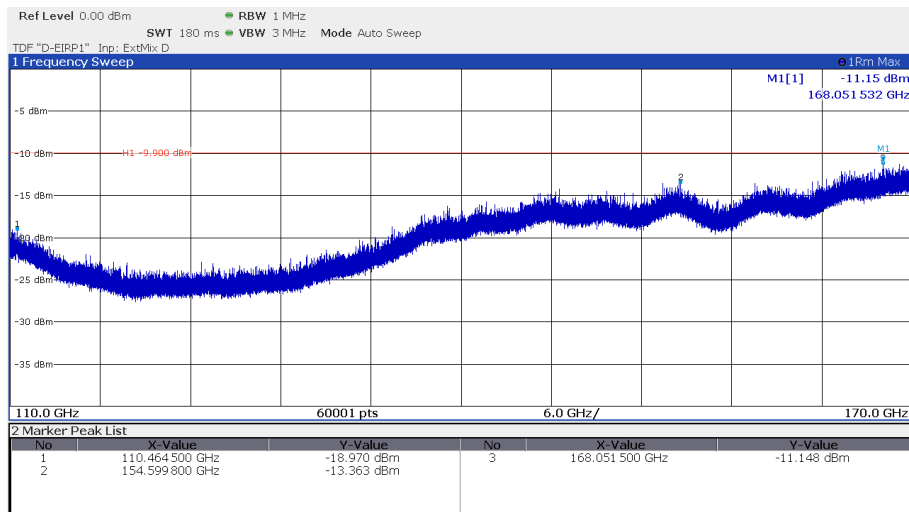
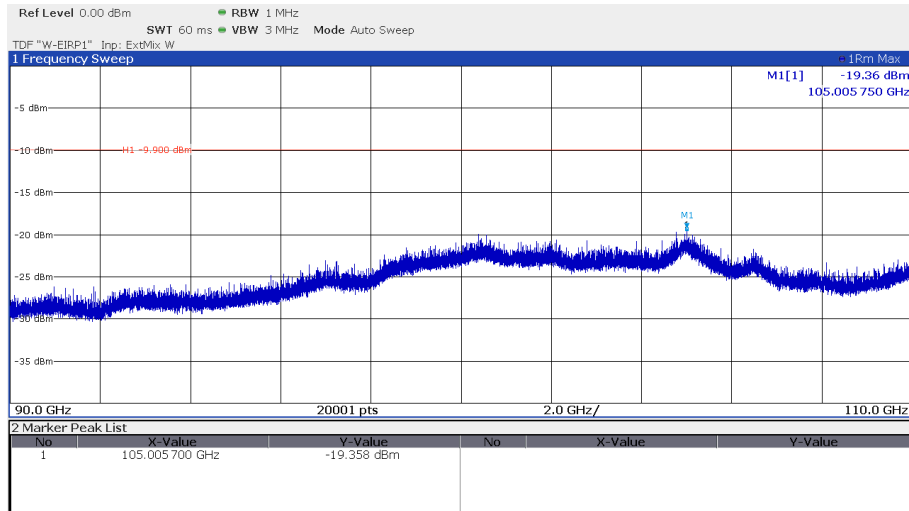
Operating frequency range 2:



Note: To minimize unintended mixing products generated by the external mixer the AutoID function was used.



Note: To minimize unintended mixing products generated by the external mixer the AutoID function was used.



Average limit according to FCC Part 15C, Section 15.255(d):

- (1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.
- (2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.
- (3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm² at a distance of 3 meters.
- (4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

General radiated limit according to FCC Part 15C, Section 15.209:

Frequency (MHz)	15.209 Limits (μV/m)	Measurement distance (m)
0.009 - -0.49	2400/f(kHz)	300
0.49 – 1.705	24000/f(kHz)	30
1.705 – 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

The requirements are **FULFILLED**.

Remarks: The measurement was performed up to 200 GHz.

For frequencies < 40 GHz the general radiated limit has been applied.

Only worst-case plots are listed: Ant 0+2

5.6 Frequency stability

For test instruments and accessories used see section 6 Part **FE1, FE2**.

5.6.1 Description of the test location

Test location: AREA4

5.6.2 Photo documentation of the test set-up

See Attachment B for detailed photo documentation of the test set-up.

5.6.3 Applicable standard

According to FCC Part 15C, Section 15.255(f):

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

5.6.4 Description of Measurement

The frequency stability is measured with the spectrum analyser. The sweep points are set to maximum for higher the frequency resolution or the function "frequency counter" is used. The signal is unmodulated; the marker of the analyser is set to maximum amplitude at normal temperature, the frequency is recorded. Then the maximum supply voltage is set and the marker of the analyser is set to maximum amplitude. This procedure is done again for the minimum supply voltage. The EUT is now driven at normal supply voltage but in the climatic chamber to range the temperature from -20 °C to +50 °C in steps of 10 degrees. The drifting carrier is measured by setting the marker at the analyser.

5.6.5 Result

DC power supply:

61.0 - 61.5 GHz frequency band:

Highest frequency f_h	61.4643485 GHz
Lowest frequency f_l	61.0099883 GHz

Test conditions		Test result	
		Frequency (GHz)	
		Low	High
$T_{min} (-30)^\circ\text{C}$	V_{nom}	61.00998826	61.46434155
$T (-20)^\circ\text{C}$	V_{nom}	61.00998841	61.46434150
$T (-10)^\circ\text{C}$	V_{nom}	61.00999405	61.46434745
$T (0)^\circ\text{C}$	V_{nom}	61.00999440	61.46434780
$T (10)^\circ\text{C}$	V_{nom}	61.00999190	61.46434515
$T_{nom} (20)^\circ\text{C}$	$V_{min} (7.65 \text{ V})$	61.00999115	61.46434445
$T_{nom} (20)^\circ\text{C}$	$V_{nom} (24.0 \text{ V})$	61.00999130	61.46434465
$T_{nom} (20)^\circ\text{C}$	$V_{max} (41.4 \text{ V})$	61.00999140	61.46434480
$T (30)^\circ\text{C}$	V_{nom}	61.00998866	61.46434190
$T (40)^\circ\text{C}$	V_{nom}	61.00999505	61.46434845
$T (50)^\circ\text{C}$	V_{nom}	61.00999505	61.46434845
$T (60)^\circ\text{C}$	V_{nom}	61.00998866	61.46434205
$T (70)^\circ\text{C}$	V_{nom}	61.00998841	61.46434165
$T_{max} (75)^\circ\text{C}$	V_{nom}	61.00999165	61.46434495

57 - 71 GHz frequency band:

Highest frequency f_h	63.9751058 GHz
Lowest frequency f_l	60.0099883 GHz

Test conditions		Test result	
		Frequency (GHz)	
		Low	High
$T_{min} (-30)^\circ\text{C}$	V_{nom}	60.00998876	63.97509851
$T (-20)^\circ\text{C}$	V_{nom}	60.00998826	63.97509851
$T (-10)^\circ\text{C}$	V_{nom}	60.00999415	63.97510480
$T (0)^\circ\text{C}$	V_{nom}	60.00999445	63.97510520
$T (10)^\circ\text{C}$	V_{nom}	60.00999190	63.97510230
$T_{nom} (20)^\circ\text{C}$	$V_{min} (7.65 \text{ V})$	60.00999130	63.97510165
$T_{nom} (20)^\circ\text{C}$	$V_{nom} (24.0 \text{ V})$	60.00999140	63.97510180
$T_{nom} (20)^\circ\text{C}$	$V_{max} (41.4 \text{ V})$	60.00999165	63.97510205
$T (30)^\circ\text{C}$	V_{nom}	60.00998891	63.97509901
$T (40)^\circ\text{C}$	V_{nom}	60.00999505	63.97510580
$T (50)^\circ\text{C}$	V_{nom}	60.00999530	63.97510580
$T (60)^\circ\text{C}$	V_{nom}	60.00998891	63.97509916
$T (70)^\circ\text{C}$	V_{nom}	60.00998841	63.97509891
$T_{max} (75)^\circ\text{C}$	V_{nom}	60.00999155	63.97510240

PoE power supply:

61.0 - 61.5 GHz frequency band:

Highest frequency f_h	61.4643710 GHz
Lowest frequency f_l	61.0099899 GHz

Test conditions		Test result	
		Frequency (GHz)	
		Low	High
$T_{min} (-30)^{\circ}\text{C}$	V_{nom}	61.00999260	61.46434633
$T (-20)^{\circ}\text{C}$	V_{nom}	61.01000106	61.46435430
$T (-10)^{\circ}\text{C}$	V_{nom}	61.01000854	61.46436203
$T (0)^{\circ}\text{C}$	V_{nom}	61.01001439	61.46436775
$T (10)^{\circ}\text{C}$	V_{nom}	61.01001763	61.46437099
$T_{nom} (20)^{\circ}\text{C}$	$V_{min} (36 \text{ V})$	61.01000804	61.46436152
$T_{nom} (20)^{\circ}\text{C}$	$V_{nom} (48 \text{ V})$	61.01000829	61.46436153
$T_{nom} (20)^{\circ}\text{C}$	$V_{max} (57 \text{ V})$	61.01000841	61.46436190
$T (30)^{\circ}\text{C}$	V_{nom}	61.01001551	61.46436900
$T (40)^{\circ}\text{C}$	V_{nom}	61.01001638	61.46436987
$T (50)^{\circ}\text{C}$	V_{nom}	61.01001700	61.46437037
$T (60)^{\circ}\text{C}$	V_{nom}	61.01000293	61.46435655
$T (70)^{\circ}\text{C}$	V_{nom}	61.00998986	61.46434309
$T_{max} (75)^{\circ}\text{C}$	V_{nom}	61.00999210	61.46434533

57 - 71 GHz frequency band:

Highest frequency f_h	63.9751294 GHz
Lowest frequency f_l	60.0099903 GHz

Test conditions		Test result	
		Frequency (GHz)	
		Low	High
$T_{min} (-30)^{\circ}\text{C}$	V_{nom}	60.00999247	63.97510247
$T (-20)^{\circ}\text{C}$	V_{nom}	60.01000107	63.97511219
$T (-10)^{\circ}\text{C}$	V_{nom}	60.01000829	63.97511966
$T (0)^{\circ}\text{C}$	V_{nom}	60.01001426	63.97512614
$T (10)^{\circ}\text{C}$	V_{nom}	60.01001738	63.97512937
$T_{nom} (20)^{\circ}\text{C}$	$V_{min} (36 \text{ V})$	60.01000791	63.97511928
$T_{nom} (20)^{\circ}\text{C}$	$V_{nom} (48 \text{ V})$	60.01000804	63.97511941
$T_{nom} (20)^{\circ}\text{C}$	$V_{max} (57 \text{ V})$	60.01000829	63.97511978
$T (30)^{\circ}\text{C}$	V_{nom}	60.01001514	63.97512713
$T (40)^{\circ}\text{C}$	V_{nom}	60.01001613	63.97512800
$T (50)^{\circ}\text{C}$	V_{nom}	60.01001663	63.97512862
$T (60)^{\circ}\text{C}$	V_{nom}	60.01000281	63.97511393
$T (70)^{\circ}\text{C}$	V_{nom}	60.00999032	63.97510060
$T_{max} (75)^{\circ}\text{C}$	V_{nom}	60.00999235	63.97510284

Limit according to FCC Part 15C, Section 15.255(f):

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

The requirements are **FULFILLED**.

Remarks: The carrier is always inside of the operating frequency band.

EUT is considered operating over a temperature range of -30°C to +75°C.

For power supply via PoE: voltages according to IEEE 802.3af applied.

Test instruments DC: refer to FE1, test instruments PoE: refer to FE2 of section 6.

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

5.7 Antenna requirement

According to FCC Part 15C, Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

The EUT has integrated antennas. No other antenna can be used with the device.

The supplied antenna meets the requirements of part 15.203.

Remarks: None.

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	BAT-EMC 2022.0.23.0	01-02/68-13-001				
	ESCI	02-02/03-05-005	30/01/2024	30/01/2023		
	ESH 2 - Z 5	02-02/20-05-004	13/10/2025	13/10/2022	17/10/2023	17/04/2023
	NSLK 8127	02-02/20-05-005	08/09/2023	08/03/2023		
	EMV D 30000/PAS	02-02/30-05-006	14/12/2025	14/12/2022	14/12/2023	14/12/2022
	N-4000-BNC	02-02/50-05-138				
	ESH 3 - Z 2	02-02/50-05-185	27/10/2025	27/10/2022	18/10/2023	18/04/2023
	HM 8143	02-02/50-10-016				
	6430	02-02/50-13-014				
Note: A4 performed on 03/08/2023						
CPR 3	FS-Z90	02-02/11-14-003	10/05/2025	10/05/2024	10/05/2025	10/05/2024
	FSW43	02-02/11-15-001	13/05/2025	13/05/2024		
	QWH-EPRR00/WR-12/60-90	02-02/24-14-004				
	UFA210A (LU7-022-1000)	02-02/50-17-030				
	UFA210A (LU7-022-1000)	02-02/50-17-031				
Note: CPR3 performed on 06/06/2024 and 07/06/2024.						
FE1	FS-Z90	02-02/11-14-003	08/05/2024	08/05/2023	08/05/2024	08/05/2023
	FSW43	02-02/11-15-001	04/05/2024	04/05/2023		
	QWH-EPRR00/WR-12/60-90	02-02/24-14-004				
	METRAHIT WORLD	02-02/32-15-001	11/11/2023	11/11/2022		
	WK-340/40	02-02/45-05-001	27/07/2024	27/07/2023	27/01/2024	27/07/2023
	VLP-1602 PRO	02-02/50-10-015				
	UFA210A (LU7-022-1000)	02-02/50-17-030				
	UFA210A (LU7-022-1000)	02-02/50-17-031				
Note: FE1 performed on 22/08/2023.						
FE2	FS-Z90	02-02/11-14-003	08/05/2024	08/05/2023	08/05/2024	08/05/2023
	FSW43	02-02/11-15-001	04/05/2024	04/05/2023		
	QWH-EPRR00/WR-12/60-90	02-02/24-14-004				
	METRAHIT WORLD	02-02/32-15-001	22/11/2024	22/11/2023		
	WK-340/40	02-02/45-05-001	27/07/2024	27/07/2023	27/01/2024	27/07/2023
	VLP-1602 PRO	02-02/50-10-015				
	UFA210A (LU7-022-1000)	02-02/50-17-030				
	UFA210A (LU7-022-1000)	02-02/50-17-031				
	EX-60310	09-16/50-23-005				
	E-6100-PoE	09-16/50-23-006				
Note: FE2 performed on 12/12/2023						
MB	FS-Z90	02-02/11-14-003	10/05/2025	10/05/2024	10/05/2025	10/05/2024
	FSW43	02-02/11-15-001	13/05/2025	13/05/2024		
	QWH-EPRR00/WR-12/60-90	02-02/24-14-004				
	UFA210A (LU7-022-1000)	02-02/50-17-030				
	UFA210A (LU7-022-1000)	02-02/50-17-031				
	ESW44	09-16/03-24-001	21/11/2024	21/11/2023		
Note: MB performed on 06/06/2024 and 07/06/2024.						

SER 1	ESW26	02-02/03-17-002	08/03/2024	08/03/2023		
	HFH 2 - Z 2	02-02/24-05-020	01/06/2025	01/06/2022	01/06/2024	01/06/2023
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
	ANT1010A	02-02/50-16-034				
Note: SER1 performed on 23/08/2023						
SER 2	ESW26	02-02/03-17-002	08/03/2024	08/03/2023		
	VULB 9168	02-02/24-05-005	20/04/2024	20/04/2023	03/05/2024	03/05/2023
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
	50F-003 N 3 dB	02-02/50-21-010				
Note: SER2 performed on 03/08/2023						
SER 3	FS-Z110	02-02/11-14-002	10/05/2025	10/05/2024	10/11/2024	10/05/2024
	FS-Z90	02-02/11-14-003	10/05/2025	10/05/2024	10/05/2025	10/05/2024
	FSW43	02-02/11-15-001	13/05/2025	13/05/2024		
	RPG FS-Z170	02-02/11-17-001	07/05/2025	07/05/2024		
	RPG FS-Z220	02-02/11-17-002	06/06/2025	06/06/2024		
	FS-Z60	02-02/11-18-001	10/05/2025	10/05/2024	10/05/2025	10/05/2024
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	LNA-40-18004000-33-5P	02-02/17-20-002				
	BBHA 9170	02-02/24-05-013	21/03/2026	21/03/2023	22/01/2025	22/01/2024
	QWH-UPRR00/WR-19/40-60	02-02/24-14-001				
	QWH-EPRR00/WR-12/60-90	02-02/24-14-004				
	QWH-WPRR00/WR-10/75-11	02-02/24-14-006				
	FH-SG-170/WR6/110-170	02-02/24-17-002				
	05-HA25/WR5/140-220	02-02/24-17-004				
	3117	02-02/24-20-007	15/11/2024	15/11/2023		
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	UFA210A (LU7-022-1000)	02-02/50-17-030				
	UFA210A (LU7-022-1000)	02-02/50-17-031				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
	KMS116-GL140SE-KMS116-	02-02/50-20-026				
Note: SER3 performed on 10/06/2024 and 11/06/2024.						

- End of test report -