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

LENHARDT WORLDWIDE | TESTING | CERTIFICATION

Bundesnetzagentur BNetzA-CAB-21/21-21

Test Report

Test report no.: 24090527-42644-0
Date of issue: 2025-03-06

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

Applicant
Swiss Birdradar Solution AG

Manufacturer
Swiss Birdradar Solution AG

Test Item
FaunaScan MR2

RF-Spectrum Testing according to:

FCC 47 CFR Part 90
Private Land Mobile Radio Services

Tested by (name, function, signature)	*Karsten Geraldy* *Lab Manager RF*	signature
Approved by (name, function, signature)	*Sebastian Janoschka* *Head of Laboratory RF*	signature

Applicant and Test item details	
Applicant	Swiss Birdradar Solution AG Technoparkstr. 2 8406, Winterthur, Switzerland
Manufacturer	Swiss Birdradar Solution AG Technoparkstr. 2 8406, Winterthur, Switzerland
Test item description	The FaunaScan MR2 is a radar system designed for observing aerial biomass like birds, bats and insects. The radar detects, analyses and stores data locally on the system and, if configured, in the Swiss Birdradar cloud-based web interface.
Model/Type reference	FaunaScan MR2
Standard specific information	
FCC ID	2BNNW-MR2V
Technology	X-Band FMCW Radar System
Frequency	8.5 GHz to 9.5 GHz bands
Antenna	integrated patch antenna
Power supply	110 V AC
Temperature range	-20 °C to +50 °C

Disclaimer and Notes

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

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

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2 GENERAL INFORMATION

2.1 Administrative details

Testing laboratory	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: https://ib-lenhardt.com/ E-Mail: info@ib-lenhardt.com
Accreditation / Designation	The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025:2018. Scope of testing and registration number: • Attachment to the accreditation certificate D-PL-21375-01-00 ○ Electronics ○ Electromagnetic Compatibility ○ Radio ○ Electromagnetic Compatibility and Telecommunication (FCC requirements) ○ Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards ○ Automotive EMC Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the ILAC Mutual Recognition Arrangement. • Designations ○ FCC Testing Laboratory Designation Number DE0024 ○ ISED ISED Company Number 27156 Testing Laboratory CAB Identifier DE0020 ○ Kraftfahrt-Bundesamt KBA-P 00120-23
Testing location	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	2024-12-06
Start – End of tests	2024-12-09 – 2025-02-21

2.2 Possible test case verdicts

Test sample meets the requirements	P (PASS) – the measured value is below the acceptance limit, AL = TL
Test sample does not meet the requirements	F (FAIL) – the measured value is above the acceptance limit, AL = TL
Test case does not apply to the test sample	N/A (Not applicable)
Test case not performed	N/P (Not performed)

2.3 Observations

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

2.4 Opinions and interpretations

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

2.5 Revision history

-0 Initial Version

2.6 Further documents

List of further applicable documents belonging to the present test report:
– no additional documents –

3 ENVIRONMENTAL & TEST CONDITIONS

3.1 Environmental conditions of test laboratory

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

3.2 Normal and extreme test conditions

	minimum	normal	maximum
Temperature	-30 °C	20 °C	+50 °C
Relative humidity	-/-	45 % r.h.	-/-
Power supply	93 V AC	110 V AC	127 V AC

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	**Description**
FCC 47 CFR Part 90	Private Land Mobile Radio Services

Reference	**Description**
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product description

The FaunaScan MR2 is a radar system designed for observing aerial biomass like birds, bats and insects. The radar detects, analyses and stores data locally on the system and, if configured, in the Swiss Birdradar cloud-based web interface.

5.2 Description of test item

Model name*	FaunaScan MR2
Serial number*	MR2_2001
Hardware status*	V1.0
Software status*	0.2.3/V24

*: as declared by applicant

5.3 Technical data of test item

Technology*	X-Band FMCW Radar System
Operational frequency band*	8.5 GHz to 9.5 GHz bands
Operational frequencies*	CH1: 8.8000 GHz CH2: 8.9065 GHz CH3: 9.2500 GHz CH4: 9.4000 GHz
Type of radio transmission*	modulated carrier
Modulation type*	FMCW
Number of channels*	4
Channel bandwidth*	CH1: 85 MHz CH2: 73 MHz CH3: 85 MHz CH4: 85 MHz or 50 MHz
Duty cycle*	~42% for each polarisation
Antenna*	integrated patch antenna
Antenna gain(simulated)*	CH1: 18.2 dBi CH2: 18.3 dBi CH3: 18.4 dBi CH4: 18.5 dBi
Power supply*	110 V AC
Temperature range*	-20 °C to +50 °C

*: as declared by applicant

5.4 Additional information

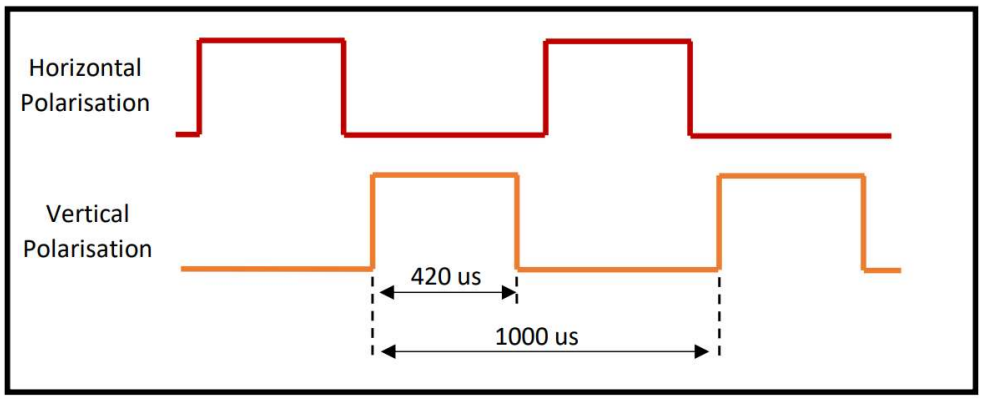
Model differences	– none –
Ancillaries tested with	AC/AC converter/transformer 115 / 230 V AC as EUT runs on 230 V AC
Additional equipment used for testing	Notebook used to setup test modes, i.e. Tx channel and Tx bandwidth

5.5 Additional information provided by the manufacturer

Following information is derived from documentation of the manufacturer.

Radar specifications:
The radar is transmitting FMCW up-chirps with a duration of 420 µs per polarisation. Cycle time is 1000 µs.

The FaunaScan MR2 utilizes two polarisations, which are transmitted alternately, as illustrated in the figure below:



The radar continuously transmits with a pulse width of 420 us and a repetition rate of 1 kHz for each polarisation. This results in a duty cycle of 42% per polarisation, leading to a total duty cycle of 84%.

Frequency configuration:

Band	Bandwidth 1	Bandwidth 2
8.8 GHz	85 MHz @ 8.8 GHz	
8.906 GHz	73 MHz @ 8.9065 GHz	
9.25 GHz	85 MHz @ 9.25 GHz	
9.4 GHz	85 MHz @ 9.4 GHz	50 MHz @ 9.4 GHz

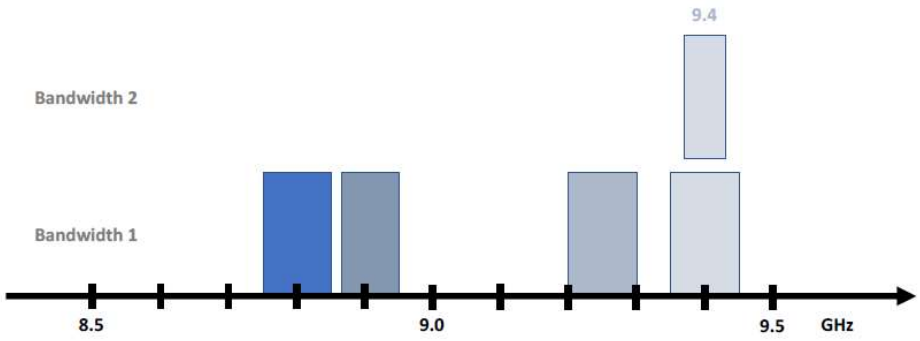


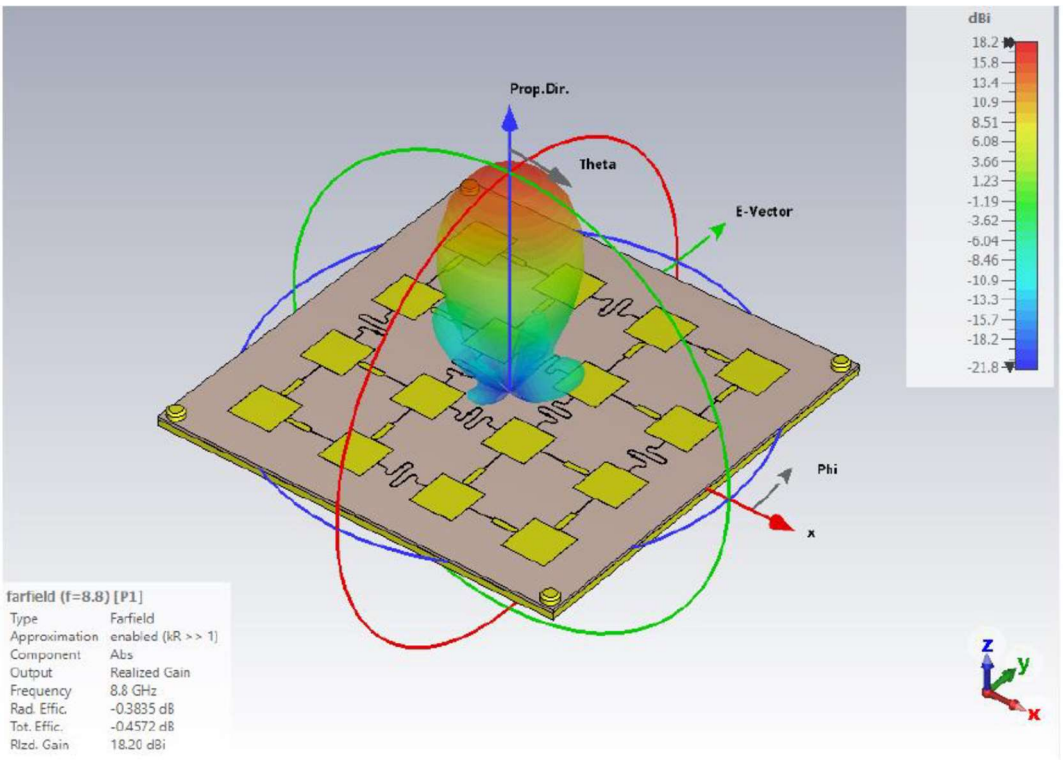
Figure 3: Frequency Bands

5.6 Antenna characteristics

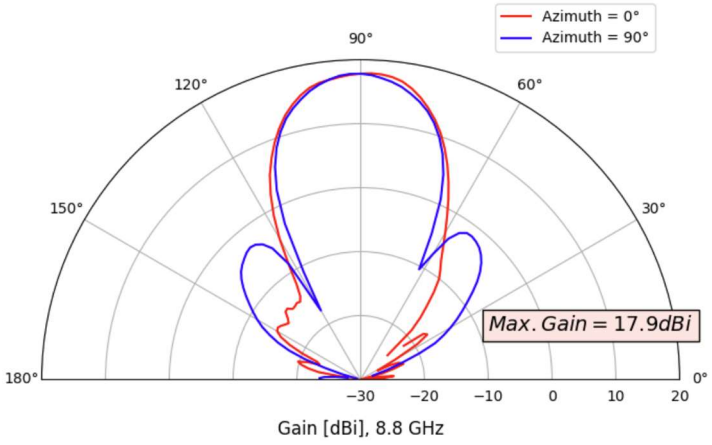
Following information is derived from documentation of the manufacturer.

The patch antennas are made for a specific frequency band, i.e. 8.8 GHz, 8.906 GHz, 9.25 GHz and 9.4 GHz.
For each antenna there exists a simulation as shown below in 1st figure.
At 8.8 GHz and 9.4 GHz there also exist measurements which include radome and absorber collar matching the final implementation in the radar housing as shown in 2nd figure.

Simulated radiation pattern of the antenna:



Antenna measurements with radome and absorber collar:



Note:
As simulated antenna gains as listed under 5.3 are slightly higher than measured antenna gains, simulated gains are used for testing as worst case.

Figure 6 shows the patch antenna and the 8 feeding points of the antenna. Depending on the desired polarisation CHA or CHB is used. Both channels are driven by a dedicated power amplifier. The 4 ports per polarisation are fed synchronous with no phase shift, but with an amplitude tapering. The outer 2 ports are fed with a quarter of the power compared to the 2 inner ones.

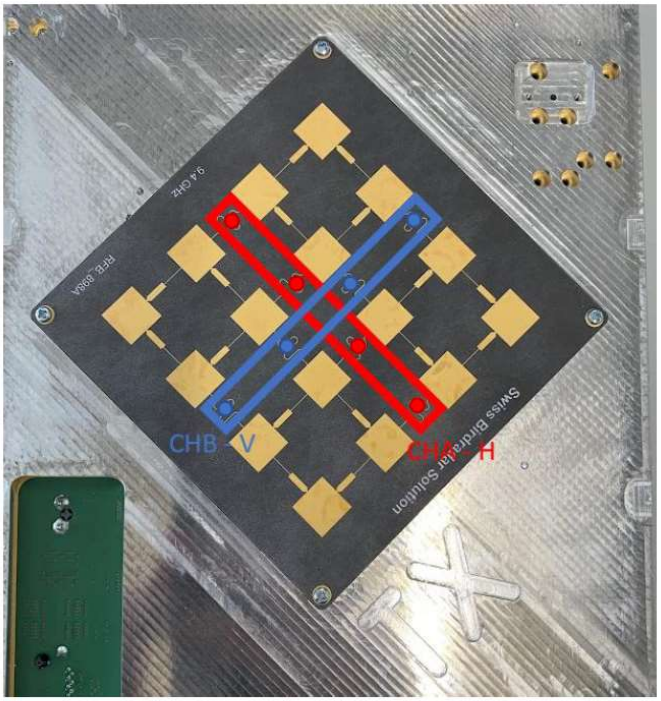


Figure 6: Patch antenna and feeding

For conducted measurements the transmitter is equipped with SMA connectors at the 8 feeding points as show in Figure 7.

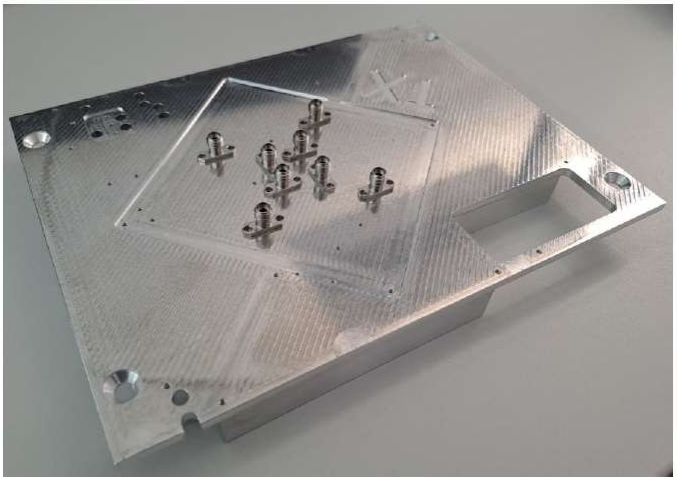


Figure 7: Transmitter with SMA connectors

6 SUMMARY OF TEST RESULTS

Test specification
FCC 47 CFR Part 90

Clause	Requirement / Test case	Test Conditions	Result / Remark	Verdict
§2.1046 §90.205 (r)	RF power output	Nominal	58.6 dBm EIRP 730 W EIRP	**- PASS -**
§2.1047 §90.207 (n)	Modulation characteristics	Nominal	FMCW	**- PASS -**
§2.1049 §90.209 (b)	Occupied bandwidth	Nominal	86.3 MHz	**- PASS -**
§2.1051 §90.210 (n)	Spurious emissions at antenna terminals	Nominal	< limit	**- PASS -**
§2.1053 §90.210 (n)	Field strength of spurious radiation	Nominal	< limit	**- PASS -**
§2.1055 §90.213 (a)	Frequency stability	Nominal Extreme	17 ppm	**- PASS -**
§15.207	AC conducted emissions	Nominal	< limit	**- PASS -**

Notes
The radar is equipped with two identical transmitters / transmit chains feeding two orthogonally arranged antennas. Both transmitters operate alternately as shown in chapter 5.5. Each antenna has four antenna ports. These four ports per polarisation are fed synchronously with no phase shift, but with an amplitude tapering. The outer two ports are fed with a quarter of the power compared to the two inner ones. Current test report includes testing Tx power for each Tx channel frequency and each single antenna port. In a next step the total power (sum of four ports for each polarisation, i.e. ports 1-2-5-6 and ports 3-4-7-8) is calculated. Furthermore, the difference between total power per polarisation and the power of the inner ports (1-2 and 3-4) is calculated. The resulting value is used as correction factor when performing further testing (e.g. Tx spurious emissions, …) as a single port measurement on port #2 and port #4 for both polarisations.

Comments and observations
– none –

7 TEST RESULTS

7.1 RF power output (§2.1046 & §90.205)

Description / Limits

§2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

§90.205 (r)

All other frequency bands. Requested transmitter power will be considered and authorized on a case-by-case basis.

Test procedure

Mean Power

Method with power meter

The power meter shall be connected to the measurement antenna. The frequency correction factor shall be taken into account. The power meter shall be a true RMS power meter. The measurement time shall be equal or longer than the EUT cycle time.

Mean Power:

ANSI C63.26, 5.2.4.1 c), 5.2.4.2 b)

A conventional average power meter with no signal gating capability can also be used if the measured burst duty cycle is constant (i.e., duty cycle variations are less than or equal to ±2%) by performing the measurement over the on/off burst cycles and then correcting (increasing) the measured level by a factor equal to [10 log (1/duty cycle)]. See 5.2.4.3.4 for guidance with respect to measuring the transmitter duty cycle.

Test procedure used: Method with Power Meter

Test setup: 8.4

Measurement plots: see Annex 1, Measurement Results, Part 1, Plots 1 – 40 (general function tests within the Tx bands, for information only); measured RF power values are documented in text box with each plot

Test results Mean Power:

	Conducted mean power [dBm]					Conducted mean power [W]				
	85/73 MHz FMCW				50 MHz	85/73 MHz FMCW				50 MHz
Tx-Port	CH1	CH2	CH3	CH4	CH4	CH1	CH2	CH3	CH4	CH4
1	32.7	32.8	31.9	31.4	31.4	1.86	1.91	1.55	1.38	1.38
2	32.7	32.8	32.0	31.6	31.5	1.86	1.91	1.58	1.45	1.41
3	33.0	32.8	32.3	32.4	32.4	2.00	1.91	1.70	1.74	1.74
4	33.1	32.8	32.4	32.3	32.3	2.04	1.91	1.74	1.70	1.70
5	26.2	26.5	24.7	24.3	24.1	0.42	0.45	0.30	0.27	0.26
6	25.8	26.1	24.3	24.0	23.8	0.38	0.41	0.27	0.25	0.24
7	26.9	26.9	25.4	25.4	25.3	0.49	0.49	0.35	0.35	0.34
8	26.1	26.1	25.0	25.4	25.3	0.41	0.41	0.32	0.35	0.34

	Total mean power Tx port 1-2-5-6 [dBm]					Total mean power Tx port 1-2-5-6 [Watt]				
Pol1	36.6	36.7	35.7	35.2	35.2	4.52	4.66	3.70	3.35	3.29

	Total mean power Tx port 3-4-7-8 [dBm]					Total mean power Tx port 3-4-7-8 [Watt]				
Pol2	36.9	36.7	36.1	36.2	36.1	4.93	4.71	4.10	4.13	4.11

Differences of total power compared to reference Tx ports 1/2 resp. 3/4 [dB]

	85/73 MHz FMCW					50 MHz
	CH1	CH2	CH3	CH4		CH4
Pol1 // Port 1/2	3.9 dB	3.9 dB	3.7 dB	3.6 dB		3.7 dB
Pol2 // Port 3/4	3.8 dB	3.9 dB	3.7 dB	3.8 dB		3.7 dB

Note:
Tx output power is measured as conducted mean power with an AVG power sensor on all Tx ports for all Tx channels. Above calculated max. correction factor of +3.9 dB is used to continue all other RF tests as single port measurements on Tx port #2 for polarisation #1 and Tx port #4 for polarisation #2 for all Tx channels and FMCW bandwidths as specified by the manufacturer.

Duty cycle as specified by manufacturer: 42%. Duty cycle correction factor (DCCF): 3.8 dB
Below listed EIRP values are corrected by DCCF.

	Mean EIRP Tx port 1-2-5-6 [dBm]					Mean EIRP Tx port 1-2-5-6 [Watt]				
Pol1	58.6	58.8	57.9	57.5	57.5	716.6	756.6	613.7	568.3	558.7

	Mean EIRP Tx port 3-4-7-8 [dBm]					Mean EIRP Tx port 3-4-7-8 [Watt]				
Pol2	58.9	58.8	58.3	58.5	58.4	782.0	763.6	680.3	701.3	698.6

7.2 Modulation characteristics (§2.1047 & §90.207)

Description

§2.1047 Modulation characteristics

(d) Other types of equipment. A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

§90.207 (n)

Other emissions. Requests for emissions other than those listed in paragraphs (c) through (e) of this section will be considered on a case-by-case basis to ensure that the requested emission will not cause more interference than other currently permitted emissions.

Statement of applicant / manufacturer concerning modulation characteristics of EUT	
Modulation type	FMCW, sawtooth with up-chirp
Duty cycle (all-over)	42%
Timing (T_{on}, T_{off})	T_{on}: 420µs, T_{off}: 580µs, T_{cycle}: 1ms
Sweep bandwidth	85 MHz (CH1, CH3, CH4), 73 MHz (CH2), 50 MHz (CH4)

Test setup: 8.4

Measurement plots: see Annex 1, Measurement Results, Part 1, Plots 111 – 130

7.3 Occupied bandwidth / authorized bandwidth (§2.1049 & § 90.209)

Description / Limits

§2.1049 Measurements required: Occupied bandwidth.

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

§90.209 (b) footnote 2:
Bandwidths for radiolocation stations in the 420-450 MHz band and for stations operating in bands subject to this footnote will be reviewed and authorized on a case-by-case basis.

Test procedure

ANSI C63.26, 5.4.4

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

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

a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

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

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
Note: Step a) through step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.

e) If the instrument does not have a 99% OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.

f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s)

The OBW measurement of an FMCW radar shall be performed with the transmitter operating in normal mode (i.e., with frequency sweep or step active).

Note

Measurements with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results (see ANSI C63.26, chapter D2: general considerations).

Occupied bandwidth tests are performed as single port measurement on Tx port #2 for polarisation #1 and Tx port #4 for polarisation #2 for all Tx channels and FMCW bandwidths as specified by the manufacturer.

Test setup: 8.4

Measurement plots: see Annex 1, Measurement Results, Part 1, Plots 41 – 50

Test results				
EUT mode	**Test conditions**	**f_L [GHz]**	**f_H [GHz]**	**99% OBW [MHz]**
CH1 / Pol1	22 °C	8.7570	8.8430	86.02
CH1 / Pol2	22 °C	8.7568	8.8431	86.31
CH2 / Pol1	22 °C	8.8692	8.9439	74.73
CH2 / Pol2	22 °C	8.8691	8.9440	74.94
CH3 / Pol1	22 °C	9.2073	9.2928	85.55
CH3 / Pol2	22 °C	9.2073	9.2916	84.32
CH4 / Pol1	22 °C	9.3573	9.4429	85.61
CH4 / Pol2	22 °C	9.3566	9.4427	86.10
CH4 / Pol1	22 °C	9.3750	9.4248	49.77
CH4 / Pol2	22 °C	9.3748	9.4249	50.08

7.4 Spurious emissions at antenna terminals (§2.1051 & §90.210)

Description / Limits

§ 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§90.210 (b)

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

§90.210 (n)

Other frequency bands. Transmitters designed for operation under this part on frequencies other than listed in this section must meet the emission mask requirements of Emission Mask B. Equipment operating under this part on frequencies allocated to but shared with the Federal Government, must meet the applicable Federal Government technical standards.

Note

Measurements with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results (see ANSI C63.26, chapter D2: general considerations).

Test setup: 8.4

Measurement plots: see Annex 1, Measurement Results, Part 1, Plots 51 – 110

Test results

Channel / Mode	Frequency [GHz]	Detector	Level [dBm]	Limit [dBm]	Margin [dB]
No critical peaks found. Please refer to plots.					

7.5 Field strength of spurious radiation (§2.1053 & §90.210)

Description

§2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

§90.210 (b)

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

§90.210 (n)

Other frequency bands. Transmitters designed for operation under this part on frequencies other than listed in this section must meet the emission mask requirements of Emission Mask B. Equipment operating under this part on frequencies allocated to but shared with the Federal Government, must meet the applicable Federal Government technical standards.

Calculation of the far field distance (Rayleigh distance):

The aperture dimensions of these horn antennas shall be small enough so that the measurement distance in meters is equal to or greater than the Rayleigh distance (i.e. $R_m = 2D^2 / \lambda$), where D is the largest linear dimension (i.e. width or height) of the antenna aperture in m and λ is the free-space wavelength in meters at the frequency of measurement.

Antenna type	Frequency range [GHz]	D [m]	Highest frequency in use [GHz]	Far field distance R_m [m]
20240-20	18.0 – 26.5	0.0520	26.5	0.478
22240-20	26.5 – 40.0	0.0342	40	0.312

Used test distances

Up to 18 GHz: 3.00 m
18 – 40 GHz: 0.50 m

Note

Measurements with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results (see ANSI C63.26, chapter D2: general considerations).

Test setup: 8.1 – 8.3 (in case of field strength measurements below 1 GHz: test distance correction factor of 20dB/decade is already considered in the plots / test result table)
Measurement plots: see Annex 2, Measurement Results, Part 2
Test results

Channel / Mode	Frequency [GHz]	Detector	Test distance [m]	Level [dBm @LD]	Limit [dBm @LD]	Margin [dB]
No critical peaks found. Please refer to plots.						

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

7.6 Frequency stability (§2.1055 & §90.213)

Description / Limit

§2.1055 Measurements required: Frequency stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30°C to + 50°C for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

§90.213 (a) Footnote 10

For all other equipment, frequency stability is to be specified in the station authorization.

Test procedure

ANSI C63.26, 5.4.4

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

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

a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

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

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
Note: Step a) through step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.

e) If the instrument does not have a 99% OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.

f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s)

Note

Measurement of peak occupied bandwidth is used to determine Tx center frequency and frequency stability.

Test setup: 8.5

Measurement plots: see Annex 1, Measurement Results, Part 1, Plots 131 – 166

Test results for f_C = 8.800 GHz					
EUT mode	**Test conditions**	**f_L [GHz]**	**f_H [GHz]**	**f_C [MHz]**	**Deviation [ppm]**
CH1 / Pol1	-30 °C	8.757143	8.843007	8.800075	8.5
CH1 / Pol1	-20 °C	8.757143	8.843007	8.800075	8.5
CH1 / Pol1	-10 °C	8.757143	8.843157	8.800150	17.0
CH1 / Pol1	00 °C	8.757143	8.843007	8.800075	8.5
CH1 / Pol1	10 °C	8.757143	8.843007	8.800075	8.5
CH1 / Pol1	20 °C	8.757143	8.843007	8.800075	8.5
CH1 / Pol1	30 °C	8.757143	8.843007	8.800075	8.5
CH1 / Pol1	40 °C	8.757143	8.843007	8.800075	8.5
CH1 / Pol1	50 °C	8.757143	8.843007	8.800075	8.5
With voltage variation					
Input voltage variation does not affect the transmitted signal (see plots for ambient/normal temperature).					

Test results for f_C = 8.9065 GHz					
EUT mode	**Test conditions**	**f_L [GHz]**	**f_H [GHz]**	**f_C [MHz]**	**Deviation [ppm]**
CH2 / Pol1	-30 °C	8.869281	8.943906	8.906594	10.5
CH2 / Pol1	-20 °C	8.869281	8.943906	8.906594	10.5
CH2 / Pol1	-10 °C	8.869281	8.943906	8.906594	10.5
CH2 / Pol1	00 °C	8.869281	8.943906	8.906594	10.5
CH2 / Pol1	10 °C	8.869281	8.943906	8.906594	10.5
CH2 / Pol1	20 °C	8.869131	8.943906	8.906519	2.1
CH2 / Pol1	30 °C	8.869131	8.943906	8.906519	2.1
CH2 / Pol1	40 °C	8.869131	8.943906	8.906519	2.1
CH2 / Pol1	50 °C	8.869131	8.943906	8.906519	2.1
With voltage variation					
Input voltage variation does not affect the transmitted signal (see plots for ambient/normal temperature).					

Test results for f_C = 9.250 GHz					
EUT mode	**Test conditions**	**f_L [GHz]**	**f_H [GHz]**	**f_C [MHz]**	**Deviation [ppm]**
CH3 / Pol1	-30 °C	9.207293	9.292857	9.250075	8.1
CH3 / Pol1	-20 °C	9.207293	9.292857	9.250075	8.1
CH3 / Pol1	-10 °C	9.207293	9.292857	9.250075	8.1
CH3 / Pol1	00 °C	9.207293	9.292857	9.250075	8.1
CH3 / Pol1	10 °C	9.207293	9.292707	9.250000	0.0
CH3 / Pol1	20 °C	9.207293	9.292707	9.250000	0.0
CH3 / Pol1	30 °C	9.207293	9.292707	9.250000	0.0
CH3 / Pol1	40 °C	9.207293	9.292707	9.250000	0.0
CH3 / Pol1	50 °C	9.207143	9.292707	9.249925	-8.1
With voltage variation					
Input voltage variation does not affect the transmitted signal (see plots for ambient/normal temperature).					

Test results for f_C = 9.400 GHz					
EUT mode	**Test conditions**	**f_L [GHz]**	**f_H [GHz]**	**f_C [MHz]**	**Deviation [ppm]**
CH4 / Pol1	-30 °C	9.357143	9.442857	9.400000	0.0
CH4 / Pol1	-20 °C	9.357293	9.442857	9.400075	8.0
CH4 / Pol1	-10 °C	9.357293	9.442857	9.400075	8.0
CH4 / Pol1	00 °C	9.357293	9.442857	9.400075	8.0
CH4 / Pol1	10 °C	9.357293	9.442857	9.400075	8.0
CH4 / Pol1	20 °C	9.357293	9.442857	9.400075	8.0
CH4 / Pol1	30 °C	9.357293	9.442857	9.400075	8.0
CH4 / Pol1	40 °C	9.357293	9.442857	9.400075	8.0
CH4 / Pol1	50 °C	9.357293	9.442857	9.400075	8.0
With voltage variation					
Input voltage variation does not affect the transmitted signal (see plots for ambient/normal temperature).					

7.7 AC Conducted Emissions (§15.207)

Description / Limits

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

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

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

Note: Testing was performed for all 4 Tx channels.

Test setup: see 8.6

Measurement plots: see Annex 2, Measurement Results, Part 2

8 Test Setup Description

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

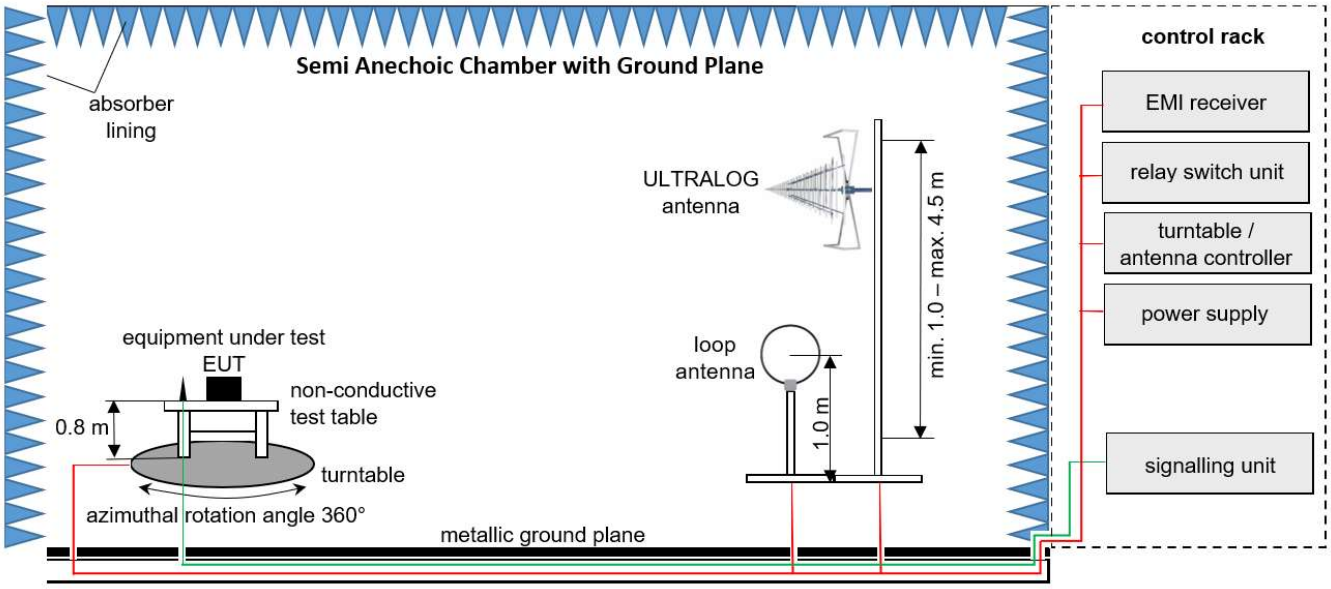
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Kind of calibration (abbreviations):

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

8.1 Semi Anechoic Chamber with Ground Plane

Radiated measurements are performed in vertical and horizontal plane in the frequency range 30 MHz to 1 GHz in a Semi Anechoic Chamber with a metallic ground plane. The EUT is positioned on a non-conductive test table with a height of 0.80 m above the metallic ground plane that covers the whole chamber. The receiving antennas conform to specification ANSI C63.26-2015, American National Standard for Testing Unlicensed Wireless Devices. These antennas can be moved over the height range between 1.0 m and 4.5 m in order to search for maximum field strength emitted from the EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by a spectrum analyzer where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



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

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)

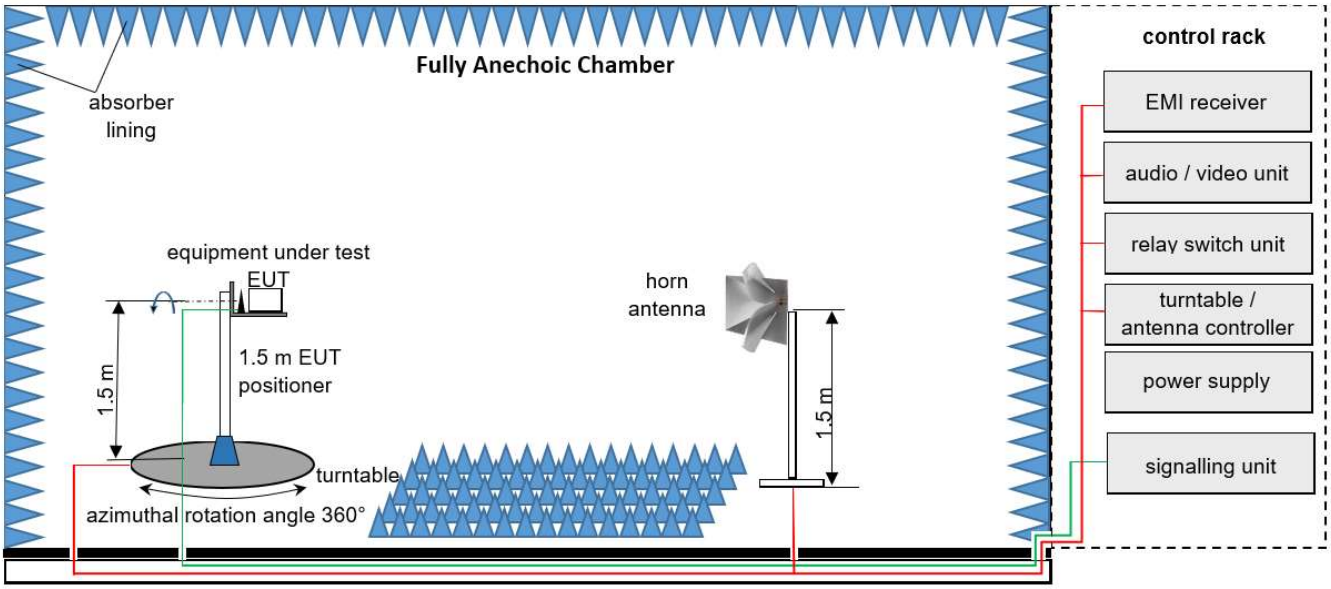
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 µW)

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Power Supply	Rohde & Schwarz	IN 600	101554	LAB000824	NR	–
2	Antenna	Rohde & Schwarz	HL562E	102173	LAB000673	C	2022-10-17 → 36M → 2025-10-17
3	Power Supply	Chroma	61602		LAB000507	NR	–
4	EMI Test Receiver	Rohde & Schwarz	ESW26	101517	LAB000363	C	2025-01-10 → 12M → 2026-01-10
5	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NR	–
6	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NR	–
7	Antenna Mast	Berlebach	Tripod HFH2-Z8 & -Z9	101762	LAB000292	NR	–
8	Positioner	maturo GmbH	TD 1.5-10KG		LAB000258	NR	–
9	Compressed Air	Implotex	1-850-30	-	LAB000256	NR	–
10	Semi/Fully Anechoic Chamber	Albatross Projects GmbH	Babylon 5 (SAC 5)	20168.PRB	LAB000235	CM	2024-02-28 → 24M → 2026-02-28
11	Measurement Software	Rohde & Schwarz	EMC32 V11.20		LAB000226	NR	–
12	Turntable	maturo GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NR	–
13	Antenna Mast	maturo GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NR	–
14	Antenna Mast	maturo GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NR	–
15	Controller	maturo GmbH	FCU 3.0	10082	LAB000222	NR	–
16	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350292	LAB000191	NR	–
17	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	CM	2022-05-31 → 36M → 2025-05-31
18	Antenna	Rohde & Schwarz	HF907	102899	LAB000151	C	2023-05-15 → 36M → 2026-05-15
19	Antenna	Rohde & Schwarz	HL562E	102005	LAB000150	C	2022-12-22 → 36M → 2025-12-22
20	Open Switch and Control Platform	Rohde & Schwarz	OSP220 Base Unit 2HU	101748	LAB000149	NR	–
21	Antenna	Rohde & Schwarz	HFH2-Z2E	100954	LAB000108	C	2023-05-05 → 36M → 2026-05-05

8.2 Fully Anechoic Chamber



Measurement distance: horn antenna at 3 m
EMC32 software version: 11.20.00

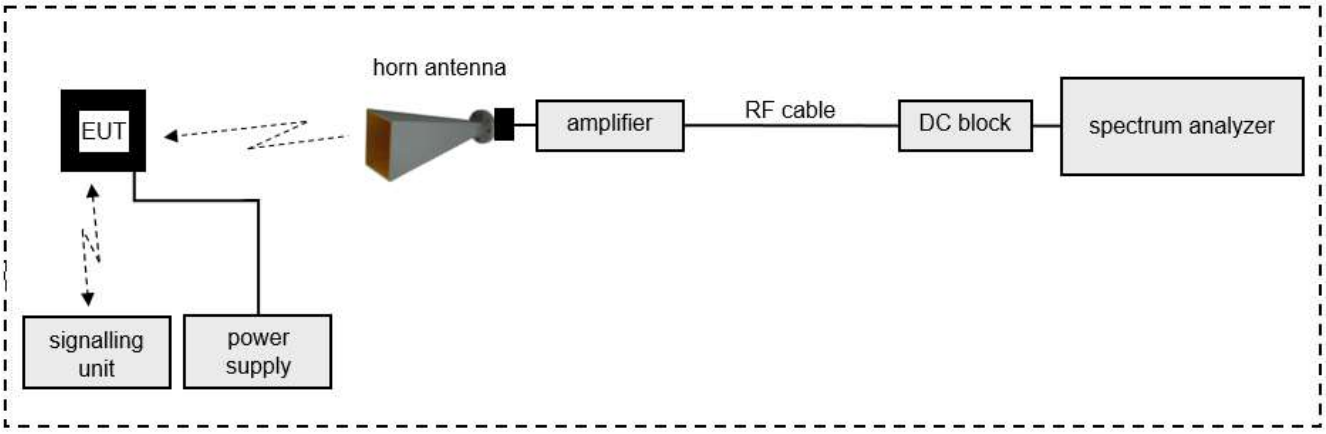
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 µW)

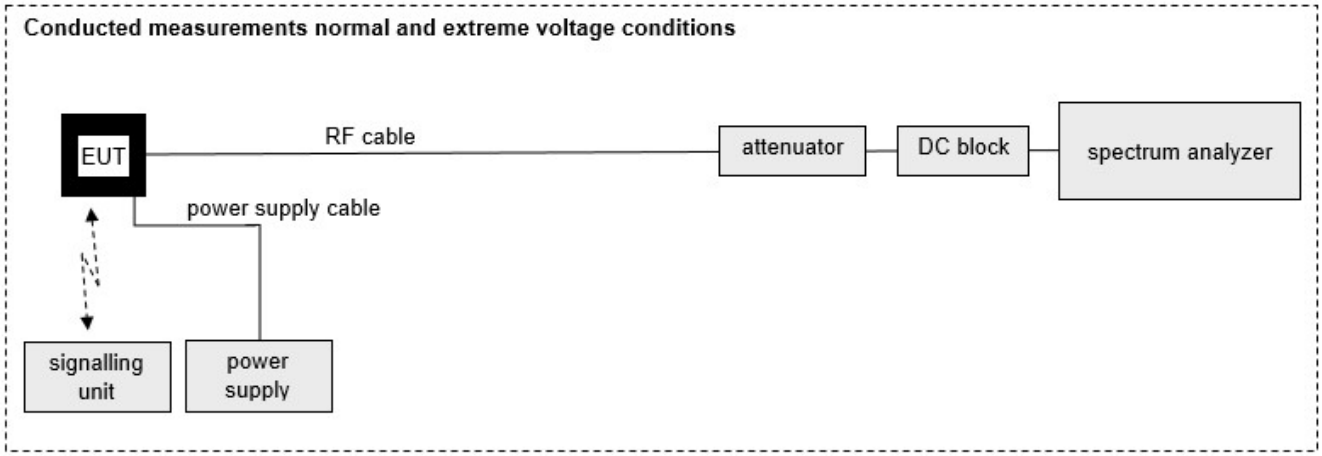
List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Power Supply	Rohde & Schwarz	IN 600	101554	LAB000824	NR	–
2	Antenna	Rohde & Schwarz	HL562E	102173	LAB000673	C	2022-10-17 → 36M → 2025-10-17
3	Power Supply	Chroma	61602		LAB000507	NR	–
4	EMI Test Receiver	Rohde & Schwarz	ESW26	101517	LAB000363	C	2025-01-10 → 12M → 2026-01-10
5	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NR	–
6	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NR	–
7	Antenna Mast	Berlebach	Tripod HFH2-Z8 & -Z9	101762	LAB000292	NR	–
8	Positioner	maturo GmbH	TD 1.5-10KG		LAB000258	NR	–
9	Compressed Air	Implotex	1-850-30	-	LAB000256	NR	–
10	Semi/Fully Anechoic Chamber	Albatross Projects GmbH	Babylon 5 (SAC 5)	20168.PRB	LAB000235	CM	2024-02-28 → 24M → 2026-02-28
11	Measurement Software	Rohde & Schwarz	EMC32 V11.20		LAB000226	NR	–
12	Turntable	maturo GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NR	–
13	Antenna Mast	maturo GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NR	–
14	Antenna Mast	maturo GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NR	–
15	Controller	maturo GmbH	FCU 3.0	10082	LAB000222	NR	–
16	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350292	LAB000191	NR	–
17	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	CM	2022-05-31 → 36M → 2025-05-31
18	Antenna	Rohde & Schwarz	HF907	102899	LAB000151	C	2023-05-15 → 36M → 2026-05-15
19	Antenna	Rohde & Schwarz	HL562E	102005	LAB000150	C	2022-12-22 → 36M → 2025-12-22
20	Open Switch and Control Platform	Rohde & Schwarz	OSP220 Base Unit 2HU	101748	LAB000149	NR	–

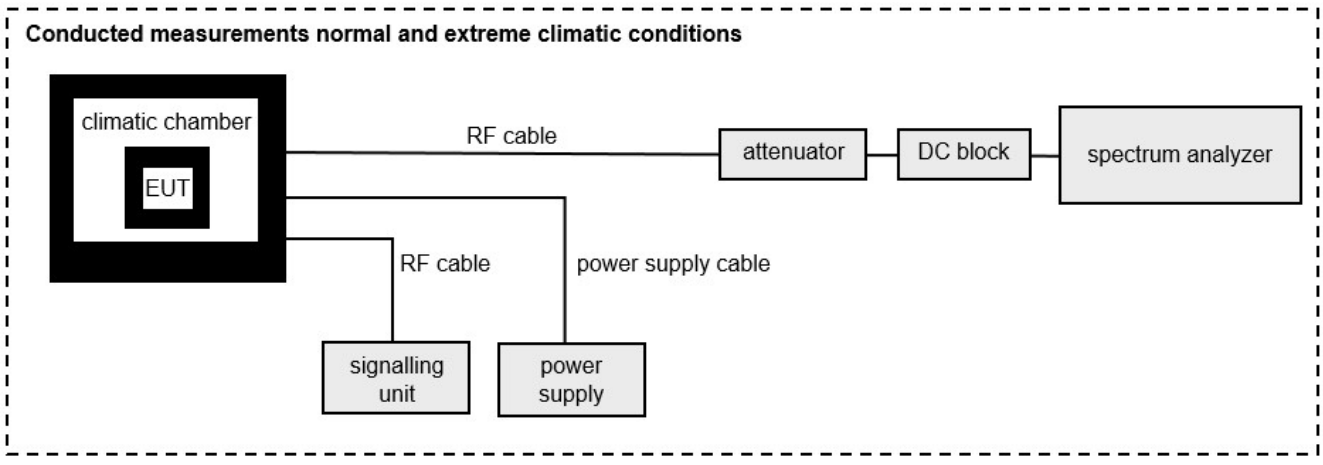
8.3 Radiated measurements > 18 GHz



8.4 Conducted measurements



8.5 Measurements under extreme conditions



ROP = AV + D - G
(ROP-rad. output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain)

Example calculation:
ROP [dBm] = -54.0 [dBm] + 64.0 [dB] - 20.0 [dBi] = -10 [dBm] (100 µW)

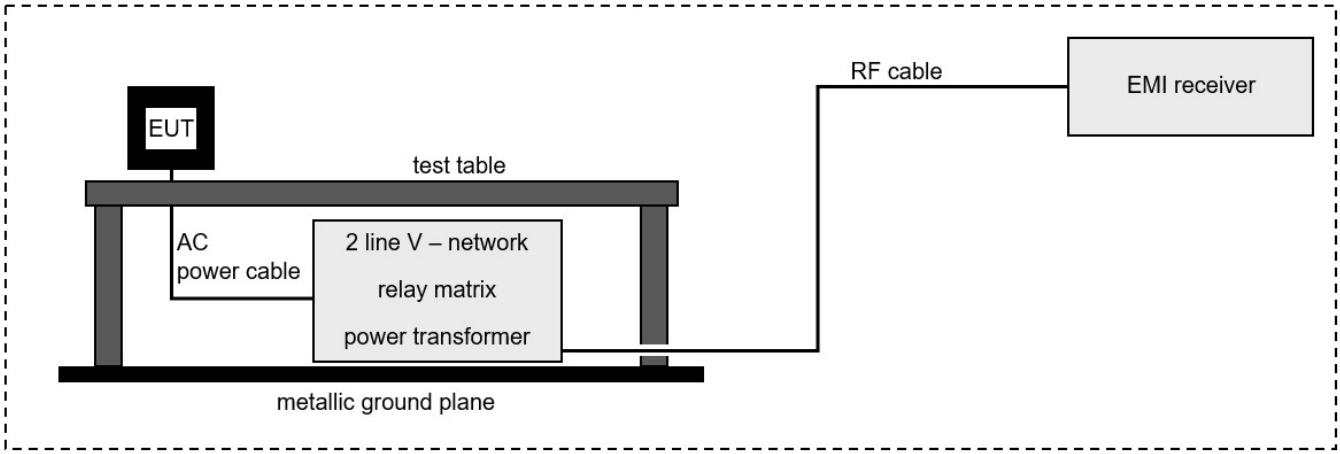
List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Filter (Coax/WG, LPF, HPF, Band)	Flann Microwave Ltd	18094-SF40, Coax-WG-Coax HPF, R140/WR62	164988 & 174583	LAB000988	CM	2024-12-11 → 12M → 2025-12-11
2	Attenuator	RF TeleWorld	TWA2.92X-20-40-30	-	LAB000979	CM	—
3	Attenuator	RF TeleWorld	TWA2.92X-20-40-20	-	LAB000978	CM	—
4	Attenuator	RF TeleWorld	TWA2.92X-20-40-10	-	LAB000977	CM	—
5	Water Chiller	HAFNER-MUSCHLER	HMKT-A 50 P5	213297-2200249559	LAB000448	NR	–
6	Climatic Chamber	Heraeus Vötsch	VTS 7060-5	58566055460040	LAB000447	NR	–
7	Spectrum Analyser	Rohde & Schwarz	FSW43	101391	LAB000289	C	2024-06-04 → 12M → 2025-06-04
8	Spectrum Analyser	Rohde & Schwarz	FSV40	101403	LAB000278	C	2024-04-10 → 12M → 2025-04-10
9	WG-Coax-Adapter	Flann Microwave Ltd	22093-TF30 UG599/U	273263	LAB000183	CM	2024-07-16 → 12M → 2025-07-16
10	WG-Coax-Adapter	Flann Microwave Ltd	20093-TF30 UBR220	273374	LAB000181	CM	2024-07-16 → 12M → 2025-07-16
11	Coaxial Cable	Huber & Suhner	SF101/1.5m	503987/1	LAB000165	CM	2024-07-17 → 12M → 2025-07-17
12	Coaxial Cable	Huber & Suhner	SF101/0.5m	504117/1	LAB000161	CM	2024-07-17 → 12M → 2025-07-17
13	Coaxial Cable	Huber & Suhner	ST18/72"	2278434	LAB000160	CM	2024-07-17 → 12M → 2025-07-17
14	Antenna	Flann Microwave Ltd	22240-20 (26.5-40.0 GHz)	270448	LAB000130	CM	2024-07-16 → 12M → 2025-07-16
15	Antenna	Flann Microwave Ltd	20240-20 (18.0-26.5 GHz)	266403	LAB000128	CM	2024-07-16 → 12M → 2025-07-16
16	Power Meter	Rohde & Schwarz	NRP-Z81	106194	LAB000120	C	2024-05-22 → 12M → 2025-05-22
17	Multimeter	Keysight	U1242B	MY59110034	LAB000009	C	2024-08-06 → 12M → 2025-08-06

List of externally provided test equipment:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	LPF	MCL	ZLFW-K6500+	1321422	-	CM	2024-12-09 (prior testing)
2	HPF	MCL	ZHSS-K15G+	1323042	-	CM	2024-12-09 (prior testing)
3	Stubtuner	Narda	904N	78	-	CM	2024-12-09 (prior testing)

8.6 AC conducted emissions



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)

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	EMI Test Receiver	Rohde & Schwarz	EPL1000	100921	LAB000873	C	2024-12-19 → 12M → 2025-12-19
2	Power Supply	Chroma	61704		LAB000540	NR	–
3	Shielded room	Albatross Projects GmbH	Sputnik 1 (Schirmkabine)		LAB000257	NR	–
4	Open Switch and Control Platform	Rohde & Schwarz	OSP-B200S2	101443	LAB000239	NR	–
5	Two-Line V-Network	Rohde & Schwarz	ENV216	102597	LAB000220	C	2024-10-28 → 12M → 2025-10-28

9 MEASUREMENT PROCEDURES

9.1 Radiated spurious emissions from 9 kHz to 30 MHz

Test setup

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

Pre-scan

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

Final measurement

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

Distance correction (extrapolation)

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

Detailed requirements can be found in e.g. ANSI C63.4 / C63.26

9.2 Radiated spurious emissions from 30 MHz to 1 GHz

Test setup

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

Pre-scan

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

Final measurement

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

Distance correction (extrapolation)

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

Detailed requirements can be found in e.g. ANSI C63.4 / C63.26

9.3 Radiated spurious emissions from 1 GHz to 18 GHz

Test setup

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

Pre-scan

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

Final measurement

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

Distance correction (extrapolation)

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

Detailed requirements can be found in e.g. ANSI C63.4 / C63.26

9.4 Radiated spurious emissions above 18 GHz

Test setup

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

Pre-scan

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

Final measurement

- Significant emissions found during the pre-scan will be maximized, i.e. position and antenna orientation causing the highest emissions with Peak and RMS detector
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4 / C63.26).
- Final plot showing measurement data, levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit is recorded.

Note

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

Distance correction (extrapolation)

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

Detailed requirements can be found in e.g. ANSI C63.4 / C63.26

10 MEASUREMENT UNCERTAINTIES

Radio frequency	≤ ± 10 ppm
Radiated emission	≤ ± 6 dB
Temperature	≤ ± 1 °C
Humidity	≤ ± 5 %
DC and low frequency voltages	≤ ± 3 %

The indicated expanded measurement uncertainty corresponds to the standard measurement uncertainty for the measurement results multiplied by the coverage factor k = 2. It was determined in accordance with EA-4/01 m:2013. The true value is located in the corresponding interval with a probability of 95 %.