

Test Report

Report Number:

F230973E1

Equipment under Test (EUT):

**Level probing radar
FMR43**

Applicant:

Endress+Hauser SE+Co. KG

Manufacturer:

Endress+Hauser SE+Co. KG



Deutsche
Akkreditierungsstelle
D-PL-17186-01-00

References

- [1] **ANSI C63.10-2020**, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- [2] **FCC CFR 47 Part 15**, Radio Frequency Devices
- [3] **KDB publication 890966 D01 v01r01**, Measurement procedure for Level Probing Radars v01 (September 2014)

Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.
“Passed” indicates that the equipment under test conforms with the relevant limits of the testing standard without taking any measurement uncertainty into account as stated in clause 1.4 of ANSI C63.10 (2020). However, the measurement uncertainty is calculated and shown in this test report.

Tested and
written by:

Signature

Reviewed and
approved by:

Signature

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The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

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1 Identification

1.1 Applicant

Name:	Endress+Hauser SE+Co. KG
Address:	Hauptstr. 1 79689 Maulburg
Country:	Germany
Name for contact purposes:	Mr. Ralf REIMELT
Phone:	+49 76 22 28 – 18 90
Fax:	ralf.reimelt@endress.com
eMail Address:	+49 76 22 28 – 15 890
Applicant represented during the test by the following person:	Mr. Ralf REIMELT (partly)

1.2 Manufacturer

Name:	Endress+Hauser SE+Co. KG
Address:	Hauptstr. 1 79689 Maulburg
Country:	Germany
Name for contact purposes:	Mr. Ralf REIMELT
Phone:	+49 76 22 28 – 18 90
Fax:	ralf.reimelt@endress.com
eMail Address:	+49 76 22 28 – 15 890
Manufacturer represented during the test by the following person:	Mr. Ralf REIMELT (partly)

1.3 Test Laboratory

The tests were carried out by: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkKS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-00, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment under Test)

EUT number	Model name	Serial number	Sensor board	Display board	Mainboard	Power board	Terminal board	Hardware version	Software version
5b	FMR43	FMR43_IOL-_035	71607254	71599584	71439136	71502179	71508546	01.00.00	01.00.00
6b		FMR43_IOL_019							

EUT number	Display type	Housing material	Antenna	Antenna gain
5b	Front Foil display	Stainless steel	PTFE M24	29.17 dBi
6b			PTFE ½"	26.93 dBi

*: Declared by the applicant.

Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical Data of Equipment

Rated rf-output power: *	20 dBm/MHz		
Antenna type: *	Refer table above		
Operating frequency band: *	174,800 MHz to 182,000 MHz		
Nominal channel bandwidth(s): *	7,200 MHz		
Type of modulation: *	FMCW		
Antenna connector: *	None		
FCC ID:	LCGFMR43L		
Temperature range: *	-50 °C to +80 °C		
Supply voltage range: *	$U_{nom} = 24.0 \text{ V}_{DC}$	$U_{min} = 12.0 \text{ V}_{DC}$	$U_{max} = 30.0 \text{ V}_{DC}$
Lowest internal frequency: *	32 MHz		

*: Declared by the applicant.

Ports/Connectors

Identification	Connector		Length
	EUT	Ancillary	
DC and data	Fixed	-	2.0 m
-	-	-	-
-	-	-	-

*: Length during the test

1.6 Dates

Date of receipt of test sample:	15.02.2022
Start of test:	16.11.2023
End of test:	10.04.2024

2 Operational States

The EUTs are level probing radars.

All measurements were carried out with an unmodified single sensor, supplied with 24 V_{DC}, operating in normal operation mode after powered up.

3 Additional Information

The antenna requirements were not tested. The required antenna data were provided by the applicant. Refer also the document FMR43L_Antenna_pattern.pdf.

As declared by the applicant, all EUTs are equipped with the same RF-frontend and mainboard (refer also to the table in clause 1.4 of this test report). The tests, documented in this test report were carried out according to the applicants test plan, which selected the combination of different housings and displays.

The transmitter unwanted emission measurement between 1 GHz and 40 GHz were carried out with the EUTs mounted on a positioner device inside the fully anechoic chamber. The vertical axis was rotated in 30 ° steps. The measurement plots in this frequency range are showing the maximum value from all positions. In all other frequency ranges the EUTs were positioned on a non-conducting support in two orthogonal directions (position 1: the antenna of the EUT shows to the measuring antenna; position 2: the antenna of the EUT shows downwards).

To determine the necessary measurement times for transmitter measurements the transmitter timing of the EUT was measured. This timing was used as base for the sweep time calculation when using a spectrum analyser with RMS detection.

As declared by the applicant the EUT powers up at 174.8 GHz and then starts a up chirp to 181.8 GHz.

The tested samples were not labelled as requested be FCC / ISED.

It was requested by the applicant to test the frequency stability within the normative temperature range of -20 °C to 50 °C only. Because both EUTs have the same front but different antennas, the frequency stability test was carried out with EUT 5b only.

The EUT contains also an BLE transceiver, which was operational during all measurements documented in this test report. Object of this test report is the radar part of the EUT only. The results of the BLE transceiver are documented under PHOENIX TESTLAB GmbH test report reference F230973E4 and F230973E6.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	Status
Fundamental emission bandwidth	174800 – 182000	15.258 (b)	Passed
Fundamental emission	174800 – 182000	15.258 (b)	Passed
Frequency stability	174800 – 182000	15.258 (d)	Passed
Radiated emissions	0.009 – 550000	15.258 (c), 15.209	Passed
Conducted emissions on supply line	0.15 – 30	15.207	Passed
Antenna requirement	174800 – 182000	15.258 (b)(2)	Passed *

*: Integrated antenna only, Antenna data sheet is provided by the applicant, requirement fulfilled.

5 Results

5.1 Test setups

5.1.1 Radiated: 9 kHz to 30 MHz

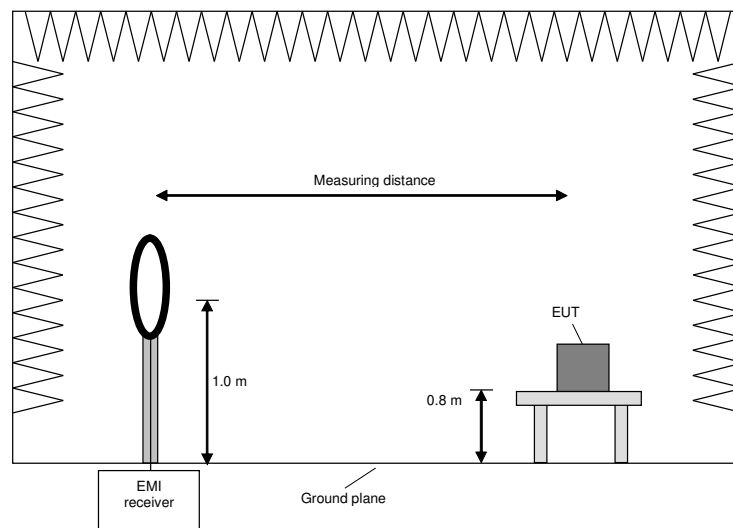
5.1.1.1 Preliminary measurement 9 kHz to 30 MHz

In the first stage a preliminary measurement is performed in a semi-anechoic chamber at a measuring distance of 3 meters. Table-top devices are set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices are placed directly on the turntable / ground plane. The setup of the equipment under test is in accordance with [1].

The frequency range 9 kHz to 30 MHz is monitored with an EMI receiver while the system and its cables are manipulated to find out the configuration with the maximum emission levels if applicable. The EMI receiver is set to MAX hold mode. The EUT and the measuring antenna are rotated around their vertical axis to find the maximum emission levels.

The resolution bandwidth of the EMI receiver is set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	10 kHz



Procedure preliminary measurement:

Pre-scans are performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

The following procedure is used:

- 1) Monitor the frequency range with the measuring antenna facing the EUT and an EUT / turntable azimuth of 0°.
- 2) Manipulate the system cables to produce the maximum levels of emissions.
- 3) Rotate the EUT by 360° to maximize the detected signals.
- 4) Measure the frequencies of the highest detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency values.
- 5) If the EUT is portable or ceiling mounted, repeat steps 1 to 4 with other orientations (x,y,z) of the EUT.
- 6) Rotate the measuring antenna and repeat steps 1 to 5.

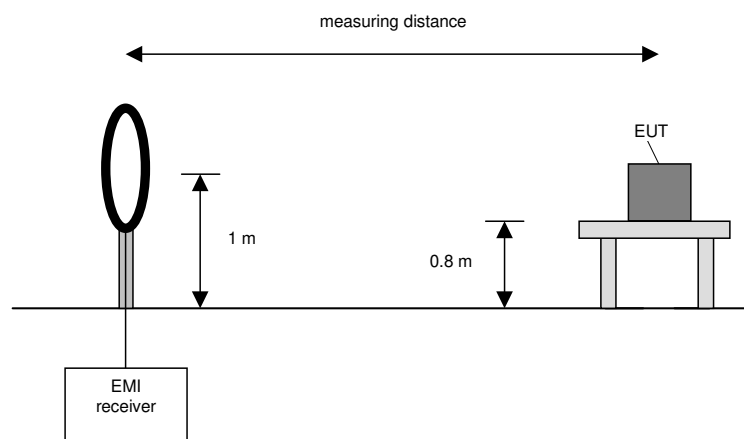
5.1.1.2 Final measurement 9 kHz to 30 MHz

In the second stage a final measurement is performed on an open area test site with no conducting ground plane at a measuring distance of 3 m, 10 m, or 30 m. If the standard requires larger measuring distances for a given frequency, the results are extrapolated according to section 15.31 (f) (2) [2]. The final measurement is performed with an EMI receiver set to Quasi-Peak detector, except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an Average detector is used according to section 15.209 (d) [2].

At the frequencies, which were detected during the preliminary measurements, the final measurement is performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum level value is found.

The resolution bandwidth of the EMI receiver is set to the following values:

Frequency range	Resolution bandwidth	Measuring time
9 kHz to 150 kHz	200 Hz	1 s
150 kHz to 30 MHz	9 kHz	1 s



Procedure final measurement:

The following procedure is used:

- 1) Monitor the selected frequencies from the preliminary measurement with the measuring antenna facing the EUT and an EUT azimuth of 0 °.
- 2) Rotate the EUT by 360 ° to maximize the detected signals.
- 3) Rotate the measuring antenna and repeat steps 1 to 2 until the maximum value is found and note it.
- 4) If the EUT is portable or ceiling mounted, repeat steps 1 to 3 with other orientations (x,y,z) of the EUT.

5.1.2 Radiated: 30 MHz to 1 GHz

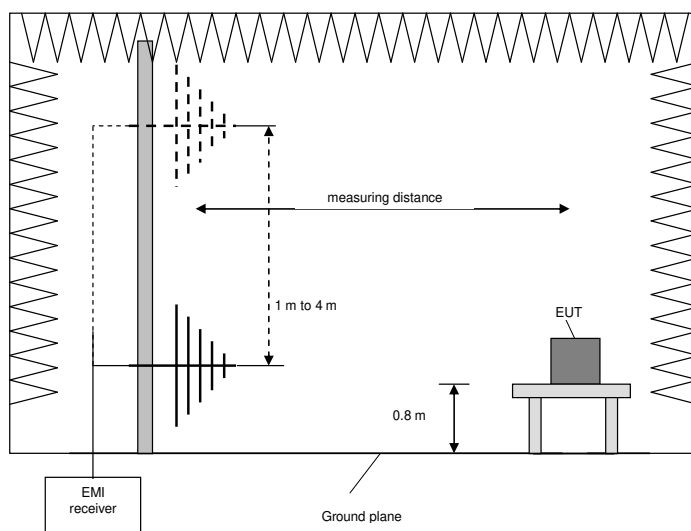
5.1.2.1 Preliminary and final measurement 30 MHz to 1 GHz

The preliminary and final measurements are performed in a semi-anechoic chamber with a metal ground plane at a measuring distance of 3 meters. Table-top devices are set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices are placed directly on the turntable / ground plane. The setup of the equipment under test is in accordance with [1].

During the tests the EUT is rotated in the range of 0 ° to 360 °, the measuring antenna is set to horizontal and vertical polarization and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI receiver is set to the following values:

Test	Frequency range	Step-size	Resolution bandwidth	Measuring time	Detector
Preliminary measurement	30 MHz to 1 GHz	30 kHz	120 kHz	-	Peak Average
Frequency peak search	± 120 kHz	10 kHz	120 kHz	1 s	Peak
Final measurement	30 MHz to 960 MHz	-	120 kHz	1 s	QuasiPeak
Final measurement	960 MHz to 1 GHz	-	120 kHz	1 s	RMS average



Procedure preliminary measurement:

The following procedure is used:

- 1) Set the measuring antenna to 1 m height.
- 2) Monitor the frequency range at horizontal polarization of the measuring antenna and an EUT / turntable azimuth of 0 °.
- 3) Rotate the EUT by 360° to maximize the detected signals.
- 4) Repeat steps 2 to 3 with the vertical polarization of the measuring antenna.
- 5) Increase the height of the measuring antenna for 0.5 m and repeat steps 2 to 4 until the final height of 4 m is reached.
- 6) The highest values for each frequency are saved by the software, including the measuring antenna height and polarization and the turntable azimuth for that value.

Procedure final measurement:

The following procedure is used:

- 1) Select the highest frequency peaks (lowest margin to the limit) for the final measurement.
- 2) The software determines the exact peak frequencies by doing a partial scan with reduced step size of the pre-scan of the selected peaks.
- 3) If the EUT is portable or ceiling mounted, find the worst-case EUT orientation (x,y,z) for the final test.
- 4) The worst-case measuring antenna height is found via varying the height by +/- 0.5 m from the value obtained in the preliminary measurement while monitoring the emission level.
- 5) The worst-case turntable position is found via varying the turntable azimuth by +/- 30° from the value obtained in the preliminary measurement while monitoring the emission level.
- 6) The final measurement is performed at the worst-case measuring antenna height and the worst-case turntable azimuth.
- 7) Steps 2 to 6 are repeated for each frequency peak selected in step 1.

5.1.3 Radiated: 1 GHz to 40 GHz

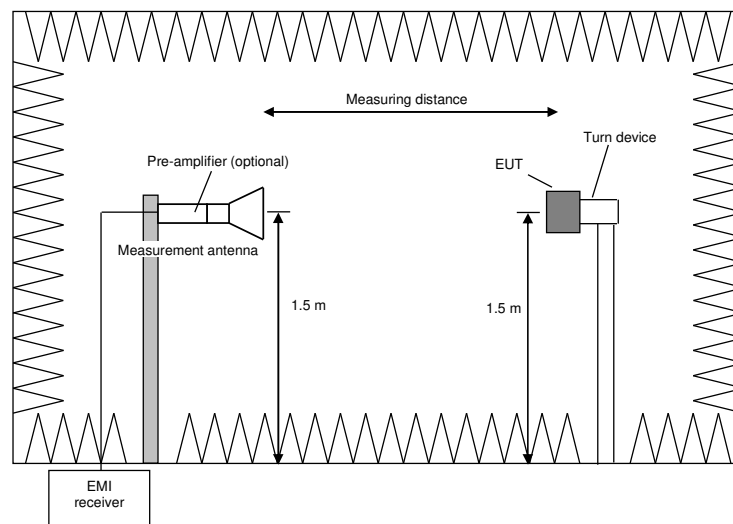
5.1.3.1 Preliminary and final measurement 1 GHz to 40 GHz

The preliminary and final measurements are performed in a fully anechoic chamber at a measuring distance of 1 or 3 meters (depending on the frequency range). Table-top devices are set up on a non-conducting turn device at the height of 1.5 m. The setup of the equipment under test is in accordance with [1].

During the tests the EUT is rotated in the range of 0 ° to 360 ° and the measuring antenna is set to horizontal and vertical polarization to find the maximum level of emissions. After these steps, the measurement is repeated after reorientating the EUT in 30 ° steps.

The resolution bandwidth of the EMI receiver is set to the following values:

Test	Frequency range	Step-size	Resolution bandwidth	Measuring time	Detector
Preliminary measurement	1 GHz - 40 GHz	-	1 MHz	-	Peak
Final measurement	1 GHz - 40 GHz	-	1 MHz	1 ms per sweep point	Peak and average



Procedure preliminary measurement:

The following procedure is used:

- 1) Monitor the frequency range at horizontal polarisation of the measuring antenna and an EUT / turntable azimuth of 0 °.
- 2) Rotate the EUT by 360° to maximize the detected signals.
- 3) Repeat steps 1 to 2 with the vertical polarisation of the measuring antenna.
- 4) Repeat steps 1 to 3 with the EUT reorientated by an angle of 30° (60°, 90°, 120° and 150°), according to 6.6.5.4 in [1].
- 5) The highest values for each frequency are saved by the software, including the measuring antenna polarization, the turntable azimuth and the turn device elevation for that value.

Procedure final measurement:

The following procedure is used:

- 1) Set the turntable and the turn device to the position which leads to the highest emission for the first frequency identified in the preliminary measurements.
- 2) Set the measurement antenna to the polarisation which leads to the highest emission for the first frequency identified in the preliminary measurements.
- 3) Set the spectrum analyser to EMI mode with Peak and Average detector activated.
- 4) The worst-case turntable position is found via varying the turntable azimuth by +/- 30° from the value obtained in the preliminary measurement while monitoring the emission level.
- 5) The final measurement is performed at the worst-case turntable azimuth.
- 6) Repeat steps 1 to 5 for each frequency detected during the preliminary measurements.

5.1.4 Radiated: 40 GHz to 550 GHz

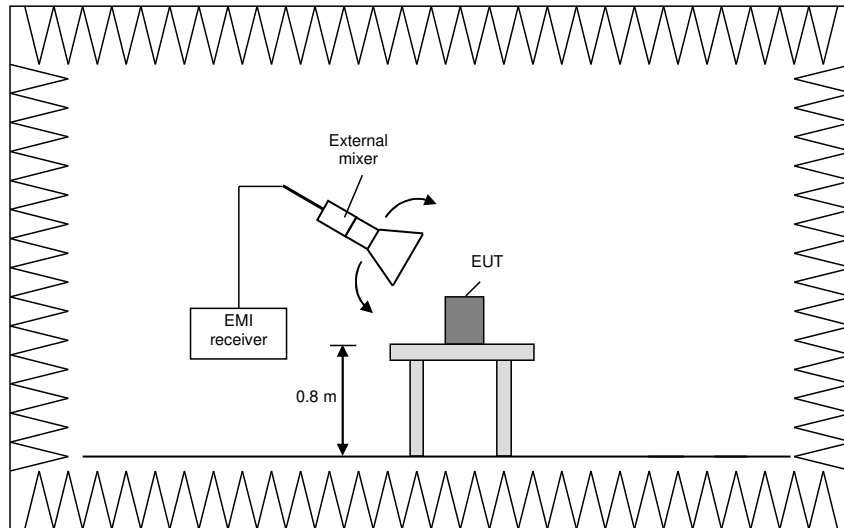
5.1.4.1 Preliminary and final measurement 40 GHz to 550 GHz

The frequency range will be divided into different sub ranges depending on the frequency range of the used horn antennas and frequency mixers. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 1 MHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna, the antenna close to the EUT and while moving the antenna over all sides of the EUT. With the spectrum analyser in CLEAR / WRITE mode the cone of the emission should be found. After that the measuring distance will be set to the final measurement distance with the receiving antenna moving in this cone of emission. At this position the final measurement will be carried out using the Auto ID functionality of the analyser. The used measuring distance for the used antenna has to be above the minimum measuring distance calculated for accreditation.

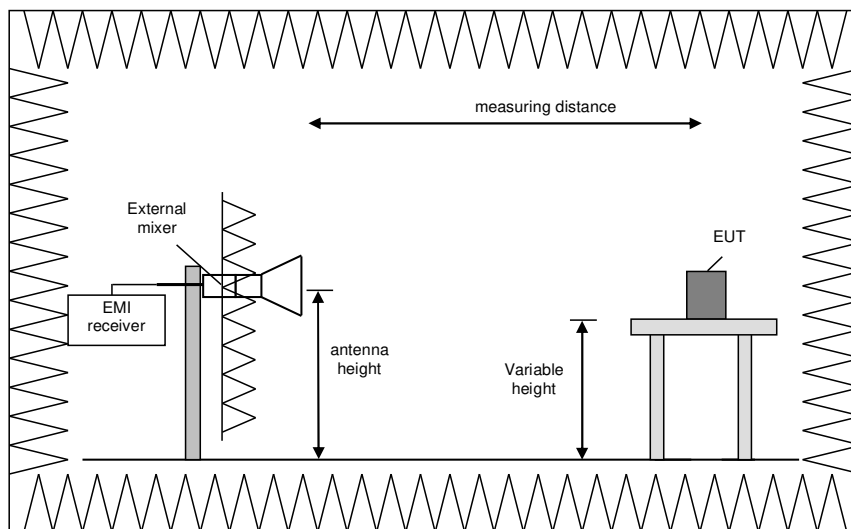
The resolution bandwidth of the EMI Receiver will be set to the following values:

Test	Frequency range	Resolution bandwidth	Measuring time	Detector
Preliminary measurement	40 GHz - 550 GHz	1 MHz	-	Peak
Final measurement	40 GHz - 550 GHz	1 MHz	1 ms per sweep point	Peak and average

Set up preliminary measurement:



Set up final measurement:



Procedure of measurement:

The measurements were performed in the frequency range 40 GHz to 55 GHz, 55 GHz to 75 GHz, 75 GHz to 90 GHz, 90 GHz to 110 GHz, 110 GHz to 130 GHz, 130 GHz to 150 GHz, 150 GHz to 174.8 GHz, 174.8 GHz to 182 GHz, 182 GHz to 200 GHz, 200 GHz to 220 GHz, 220 GHz to 260 GHz, 260 GHz to 300 GHz, 300 GHz to 330 GHz, 330 GHz to 364 GHz, 364 GHz to 398 GHz, 398 GHz to 432 GHz, 432 GHz to 466 GHz, 466 GHz to 500 GHz and 500 GHz to 550 GHz.

The following procedure will be used:

- 1) Monitor the frequency range at horizontal polarisation and move the antenna over all sides of the EUT (if necessary, move the EUT to another orthogonal axis).
- 2) Change the antenna polarisation and repeat 1) with vertical polarisation.
- 3) Make a hardcopy of the spectrum.
- 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
- 5) Change the analyser mode to Clear / Write and find the cone of emission.
- 6) Rotate and move the EUT, so that the measuring distance can be enlarged to the final measurement distance and the antenna will be still inside the cone of emission.
- 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarisation and azimuth and the peak and average detector, which causes the maximum emission.
- 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.

Step 1) to 6) are defined as preliminary measurement.

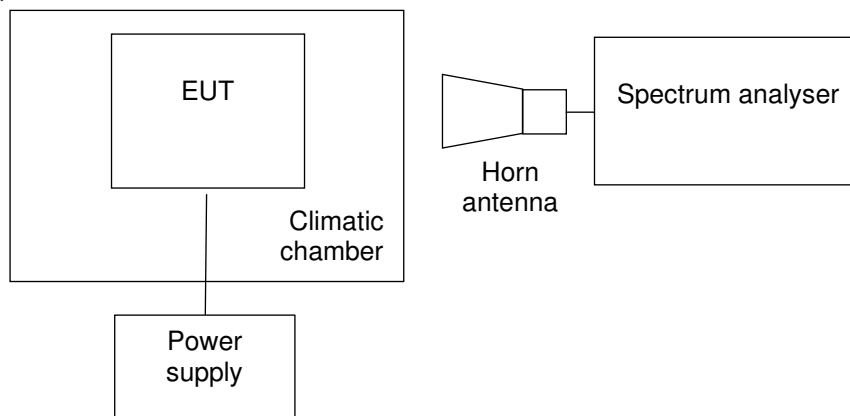
5.1.5 Frequency stability

5.1.5.1 Method of measurement (frequency stability)

The following procedure will be used:

- 1) Place the EUT in the climatic chamber.
- 2) Switch on the EUT and check the correct function and the settings of the spectrum analyser.
- 3) Switch off the EUT and tune the climatic chamber to a temperature of 50 °C (or the highest temperature specified for the EUT). Wait until the thermal balance is obtained.
- 4) Switch the EUT on with nominal supply voltage and record the frequencies according to the measurement procedure described below at start up, 2 min, 5 min and 10 min after EUT is energized and document the measured frequencies.
- 5) Only at 20 ° C: Switch the EUT on with minimum supply voltage (85 %) and record the frequencies according to the measurement procedure described below at start up, 2 min, 5 min and 10 min after EUT is energized and document measured frequencies. Switch the EUT off and wait for ten minutes before the next step.
- 6) Only at 20 ° C: Switch the EUT on with maximum supply voltage (115 %) and record the frequencies according to the measurement procedure described below at start up, 2 min, 5 min and 10 min after EUT is energized and document measured frequencies.
- 7) Switch off the EUT and tune the climatic chamber to a temperature range of 50 °C (or the highest temperature specified for the EUT) to –20 °C (or the lowest temperature specified for the EUT) in ten-degree steps. Wait until the thermal balance is obtained for every step and repeat step 4) to 7) with the next temperature step until –20 °C (or the lowest temperature specified for the EUT) is reached.

Test set-up:



Measurement procedure:

Adjust the following spectrum analyser settings:

RBW: 1 MHz.

VBW: Three times the RBW.

Detector: Peak.

Span: Equal to the desired operating frequency band.

Number of sweep points: Span / RBW.

Sweep time: Number of sweep points multiplied by the transmitter duty cycle time.

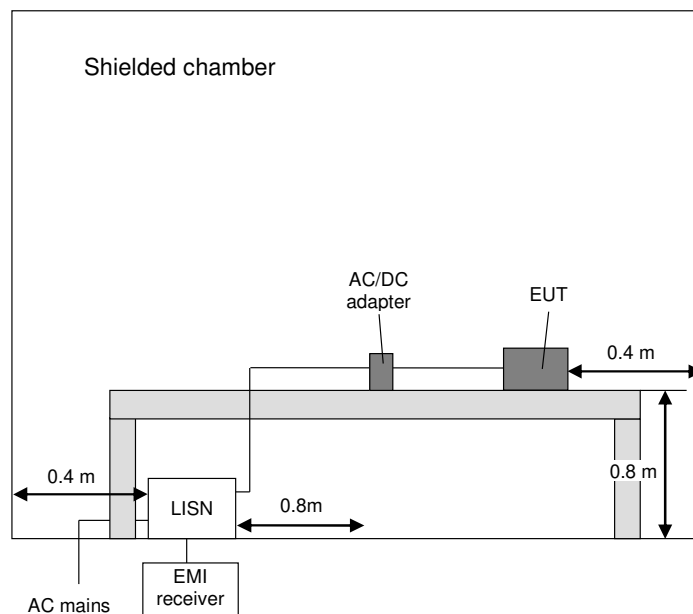
Find the signal peak and use the marker functionality of the spectrum analyser to find the frequency points, where the signal is 20 dB below this peak value and document the frequencies. Calculate and document the 20 dB bandwidth and the highest peak frequency.

5.1.6 Conducted: AC power line

The test is carried out in a shielded chamber. Table-top devices are set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm above the ground plane. Floor-standing devices are placed directly on the ground plane. In case of DC powered equipment, which is not exclusively powered by a battery, it is connected to the LISN via a suitable AC/DC adaptor. The setup of the equipment under test is in accordance with [1].

The frequency range 150 kHz to 30 MHz is measured with an EMI receiver set to MAX hold mode with Peak and Average detectors and a resolution bandwidth of 9 kHz. A scan is carried out on the phase and neutral line of the AC mains network. If emissions less than 10 dB below the appropriate limit are detected, these emissions are measured with an Average and Quasi-Peak detector on all lines.

Frequency range	Resolution bandwidth	Measuring time
150 kHz to 30 MHz	9 kHz	5 s



5.2 Fundamental emissions bandwidth

5.2.1 Test setup (Fundamental emission bandwidth)

Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Radiated: 40 GHz to 550 GHz	5.1.4	Measured at boresight
<input type="checkbox"/>	Conducted: Antenna port		EUT has no antenna connector

5.2.2 Test method (99 % bandwidth)

Used	Sub-Clause	Name of method	Applicability	Comment
<input checked="" type="checkbox"/>	9.4 [1]	99 % emission bandwidth	No limitations	-

Due to the large OBW of the EUT, the following adjustments of the spectrum analyser were used for this measurement:

Span: [1] requires a span of app. 1.5 times of the OBW. Because the bandwidth of the EUT is in the same order of magnitude as the IF of the external mixers, undesirable mixing products can be displayed if the span is too large, which falsify the measurement result. For this reason, the span was reduced to app. 1.2 times the OBW, in deviation from [1].

RBW: According to 9.4 a) 2) [1] a RBW of 10 MHz was used instead of 1 % to 5 % of the OBW.

5.2.3 Test results (fundamental emission bandwidth)

Ambient temperature:	21 °C
Relative humidity:	33 %

Date:	10.04.2024
Tested by:	Thomas KÜHN

The plots of this measurement are shown in A.1.1 and A.2.1 of annex A of this test report.

99 % bandwidth						
EUT number	Lower frequency [GHz]		Upper frequency [GHz]		99 % bandwidth [GHz]	
	Measured value	Limit	Measured value	Limit	Measured value	Limit
5b	174.91458	174.800	181.76749	182.000	6.853	7.2
6b	174.92122	174.800	181.75588	182.000	6.835	7.2

Test result: Passed

Test equipment (please refer to chapter 6 for details)
7, 28, 29, 37, 43, 44

5.3 Fundamental emission

5.3.1 Test setup (Fundamental emission)

Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Radiated: 40 GHz to 550 GHz	5.1.3	Measured at boresight
<input type="checkbox"/>	Conducted: Antenna port	-	EUT has no antenna connector

5.3.2 Test method (peak emission)

Used	Sub-Clause	Name of method	Applicability	Comment
<input checked="" type="checkbox"/>	9.6 to 9.8 + annex C [1], F [3]	Fundamental emission for FMCW transmitters	No limitations	-

5.3.3 Test results (fundamental emission)

Ambient temperature:	21 °C
Relative humidity:	33 %

Date:	10.04.2024
Tested by:	Thomas KÜHN

The plots of this measurement are shown in A.1.2 and A. 2.2 of annex A of this test report.

Fundamental emission (peak)					
EUT number	Frequency [MHz]	Measuring distance [m]	Level fundamental (EIRP) [dBm]	Limit [dBm]	Margin [dB]
5b	179.226	0.3	24.8	43.0	18.2
6b	175.000	0.3	23.6	43.0	17.5

The peak value is measured with a RBW of 50 MHz, the measurement with a higher bandwidth did not result in a higher peak value. The difference between this direct measurement and the determination of the peak value using the pulse desensitization factor according to Annex C [1] is therefore negligible. As documented in A.1.3 and A.2.3 of annex A of this test report, the EUTs are using FMCW modulation with a sweep of 1.08 ms up chirp. According to [1] + [3] the average fundamental emission level will be calculated with the measured peak emission level and a calculated averaging factor. The following formulas were used:

$$\text{Dwell time } (T_D) = T_S / \Delta f$$

$$\text{Averaging factor } (AF) = 10 \times \log (T_D / \text{cycle time})$$

The fundamental emission level (average) then is calculated with the fundamental emission level (peak, measured with 1 MHz RBW) + averaging factor

Averaging factor calculation									
EUT number	Bandwidth (Δf) [MHz]	Sweep time (T_S) [ms]	Dwell time (T_D) [$\mu\text{s}/\text{MHz}$]	Cycle time [ms]	Averaging factor [dB]	Level fundamental (EIRP, peak) [dBm/MHz]	Calculated fundamental average level (EIRP) [dBm/MHz]	Limit [dBm/MHz]	Margin [dB]
5b	6853	1.08	0.158	179.5	-60.6	24.8	-35.8	40.0	75.8
				50.2	-55.0		-30.2		70.2
6b	6835	1.08	0.158	171.1	-60.3	23.6	-36.5		76.5
				50.5	-55.0		-31.2		71.2

Test result: Passed

Test equipment (please refer to chapter 6 for details)
7, 28, 29, 37, 38 – 40, 43, 44

5.4 Unwanted emissions (radiated)

5.4.1 Test setup (Maximum unwanted emissions)

Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Test setup (radiated)	5.1.1 to 5.1.4	-

5.4.2 Test method (Maximum unwanted emissions)

Used	Sub-Clause	Name of method	Applicability	Comment
<input checked="" type="checkbox"/>	6.6 [1], 9.10 [1], G [3],	Unwanted radiated emissions	No limitations	-

5.4.3 Test results (Maximum unwanted emissions)

5.4.3.1 Test results preliminary measurement 9 kHz to 30 MHz

Ambient temperature:	22 °C
Relative humidity:	34 %

Date:	16.11.2023
Tested by:	Thomas KÜHN

Position of EUT: For tests for between 9 kHz to 30 MHz, the EUT was set-up on a table with a height of 80 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex B in the test report.

Remark: Two positions were tested separately for both EUTs, the plots below are showing the maximum values of all measurements. The plots of this measurement are shown in annex A.1.4 and A.2.4 of this test report.

EUT number 5b	
Frequency range	Frequencies for final measurement
9 kHz to 150 kHz	No significant frequencies above the noise floor of the system (-28.9 dB μ V/m (peak) in 300 m distance, measured at 3 m and converted with 40 dB / decade correction factor) were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.
150 kHz to 30 MHz	No significant frequencies above the noise floor of the system (-33.0 dB μ V/m (peak) in 30 m distance, measured at 3 m and converted with 40 dB / decade correction factor) were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.
EUT number 6b	
Frequency range	Frequencies for final measurement
9 kHz to 150 kHz	No significant frequencies above the noise floor of the system (-30.0 dB μ V/m (peak) in 300 m distance, measured at 3 m and converted with 40 dB / decade correction factor) were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.
150 kHz to 30 MHz	No significant frequencies above the noise floor of the system (-35.9 dB μ V/m (peak) in 30 m distance, measured at 3 m and converted with 40 dB / decade correction factor) were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.

Test result: Passed

Test equipment (please refer to chapter 6 for details)
42 – 44, 47, 48, 50 – 53

5.4.3.2 Test results preliminary measurement 30 MHz – 1 GHz

Ambient temperature:	23 °C
Relative humidity:	39 %

Date:	05.04.2024
Tested by:	Thomas KÜHN

Position of EUT: For tests for f between 30 MHz to 1 GHz, the EUT was set-up on a table with a height of 80 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex B in the test report.

Remark: Two positions were tested separately for both EUTs, the plots below are showing the maximum values of all measurements. The plots of this measurement are shown in annex A.1.4 and A.2.4 of this test report.

EUT 5b									
Frequency [MHz]	Result (QP) [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Reading [dBμV]	Correction [dB/m]	Height [cm]	Azimuth [deg]	Pol.	Position
39.310	16.4	40.0	23.6	-4.0	20.4	100	319	Vert.	2
49.150	8.1	40.0	31.9	-6.1	14.2	100	65	Vert.	1
52.420	16.0	40.0	24.0	3.3	12.6	100	332	Vert.	2
55.690	7.4	40.0	32.6	-4.5	11.9	230	155	Vert.	1
60.170	6.1	40.0	34.0	-6.2	12.3	100	159	Vert.	2
65.530	9.9	40.0	30.1	-3.6	13.5	156	201	Vert.	2
371.260	19.4	46.0	26.6	-1.5	20.9	217	243	Vert.	2
EUT 6b									
Frequency [MHz]	Result (QP) [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Reading [dBμV]	Correction [dB/m]	Height [cm]	Azimuth [deg]	Pol.	Position
39.310	16.3	40.0	23.7	-4.1	20.4	1.00	14	V	2
49.150	9.0	40.0	31.0	-5.2	14.2	1.00	79	V	2
52.420	15.7	40.0	24.3	3.1	12.6	3.48	332	V	2
55.690	7.2	40.0	32.8	-4.7	11.9	2.34	33	V	1
60.400	8.3	40.0	31.8	-4.0	12.3	1.00	172	V	2
65.530	8.9	40.0	31.1	-4.6	13.5	1.25	255	V	1
349.990	21.9	46.0	24.1	1.6	20.4	1.00	122	H	2
371.260	19.4	46.0	26.6	-1.5	20.9	2.25	2	V	1

Test result: Passed

Test equipment (please refer to chapter 6 for details)
43 – 53

5.4.3.3 Test results measurement 1 GHz to 40 GHz)

Ambient temperature:	22 °C
Relative humidity:	36 %

Date:	21. + 22.02.2024
Tested by:	Thomas KÜHN

Position of EUT: In the frequency range 1 GHz to 40 GHz, the EUTs were set-up on a positioner device with a height of 150 cm. For all other frequency ranges both EUTs were positioned on a non-conducting support with a variable height

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex B in the test report.

Remark: The plots of this measurement are shown in annex A.1.4 and A.2.4 of this test report.

Calculation:

Result @ 3 m = Max. [dBμV] - distance correction [dB]

Distance correction [dB] = 20 log (normative distance [m] / used distance [m]), according to [1]

Margin [dB] = Limit [dBμV/m] – Result @ 3 m [dBμV/m]

Results of EUT 5b measured with peak detector											
Frequency [MHz]	Result (PK) [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Reading [dBμV]	Correction [dB/m]	Dist. [m]	Dist. Corr. [dB]	Height [cm]	Azimuth [deg]	Elevation [deg]	Pol.
5047.500	49.5	74.0	24.5	51.5	-1.6	3.0	0.0	150	213	90	Hor.
5646.500	49.8	74.0	24.2	49.6	0.2	3.0	0.0	150	48	60	Hor.
15141.960	46.4	74.0	27.6	36.4	10.0	3.0	0.0	150	152	120	Hor.
Results of EUT 6b measured with peak detector											
Frequency [MHz]	Result (PK) [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Reading [dBμV]	Correction [dB/m]	Dist. [m]	Dist. Corr. [dB]	Height [cm]	Azimuth [deg]	Elevation [deg]	Pol.
5054.750	50.0	74.0	24.0	51.6	-1.6	3.0	0.0	150	152	150	Vert.
5667.750	48.5	74.0	25.5	48.5	0.0	3.0	0.0	150	264	0	Vert.
15164.750	46.1	74.0	27.9	36.1	10.0	3.0	0.0	150	158	120	Vert.
16406.000	48.2	74.0	25.8	38.7	9.5	3.0	0.0	150	190	120	Vert.
16590.750	49.0	74.0	25.0	39.6	9.4	3.0	0.0	150	212	120	Vert.

Continued next page

Results of EUT 5b measured with average detector												
Frequency [MHz]	Result (AV) [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Reading [dB μ V]	Correction [dB/m]	Dist. [m]	Dist. Corr. [dB]	Height [cm]	Azimuth [deg]	Elevation [deg]	Pol.	
5047.500	33.7	54.0	20.3	35.3	-1.6	3.0	0.0	150	213	90	Hor.	
5646.500	29.8	54.0	24.2	29.6	0.2	3.0	0.0	150	48	60	Hor.	
15141.960	28.9	54.0	25.1	18.9	10.0	3.0	0.0	150	152	120	Hor.	
Results of EUT 6b measured with average detector												
Frequency [MHz]	Result (AV) [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Reading [dB μ V]	Correction [dB/m]	Dist. [m]	Dist. Corr. [dB]	Height [cm]	Azimuth [deg]	Elevation [deg]	Pol.	
5054.750	34.2	54.0	19.8	35.8	-1.6	3.0	0.0	150	152	150	Vert.	
5667.750	29.4	54.0	24.6	29.4	0.0	3.0	0.0	150	264	0	Vert.	
15164.750	31.6	54.0	22.4	21.6	10.0	3.0	0.0	150	158	120	Vert.	
16406.000	31.8	54.0	22.2	22.2	9.5	3.0	0.0	150	190	120	Vert.	
16590.750	30.7	54.0	23.3	33.3	9.4	3.0	0.0	150	212	120	Vert.	

Test result: Passed

Test equipment (please refer to chapter 6 for details)
6, 9 – 19, 43, 44

5.4.3.4 Test results measurement 40 GHz to 550 GHz

Ambient temperature:	20 ° C to 22 °C
Relative humidity:	33 % to 35 %

Date:	29.02. till 10.04.2024
Tested by:	Thomas KÜHN

- Position of EUT:** In this frequency range the EUT was positioned on a non-conducting support with a variable height and was tested in two orthogonal directions.
- Cable guide:** For detail information of test set-up and the cable guide refer to the pictures in the annex B in the test report.
- Test record:** The plots submitted annex A.1.4 and A.2.4 of this test report showing the maximum emissions level position.
- Calculation:** The limit of 90 pW/cm² is converted to an effective isotropic radiated power (EIRP) of -10 dBm with the following formular:
- $$\text{EIRP [dBm]} = P_D \times 4 \times \pi \times d^2$$
- Where: P_D = power density limit in W/m²
 d = distance, where the limit has to be reached (3 m)
- Test result:** No emissions were found in this frequency range. Therefore, the maximum noise level in each frequency range was reported in the table below.

Unwanted emissions level of EUT 5b				
Frequency range	Mean emission level [dBm]	Used measurement distance [cm]	Limit [dBm]	Margin [dB]
40 GHz to 55 GHz	-53.4	30	-10.0	43.4
55 GHz to 75 GHz	-40.2	30	-10.0	30.2
75 GHz to 90 GHz	-39.8	30	-10.0	29.8
90 GHz to 110 GHz	-34.7	30	-10.0	24.7
110 GHz to 130 GHz	-38.9	30	-10.0	28.9
130 GHz to 150 GHz	-34.2	30	-10.0	24.2
150 GHz to 174.8 GHz	-27.4	30	-10.0	17.4
182 GHz to 200 GHz	-29.8	30	-10.0	19.8
200 GHz to 220 GHz	-43.7	30	-10.0	33.7
220 GHz to 260 GHz	-34.8	30	-10.0	24.8
260 GHz to 300 GHz	-39.6	30	-10.0	29.6
300 GHz to 330 GHz	-37.4	30	-10.0	27.4
330 GHz to 364 GHz	-38.8	30	-10.0	28.8
364 GHz to 398 GHz	-35.5	30	-10.0	25.5
398 GHz to 432 GHz	-38.3	30	-10.0	28.3
432 GHz to 466 GHz	-37.7	30	-10.0	27.7
466 GHz to 500 GHz	-34.0	30	-10.0	24.0
500 GHz to 550 GHz	-33.6	30	-10.0	23.6

Continued next page

Unwanted emissions level of EUT 6b				
Frequency range	Mean emission level [dBm]	Used measurement distance [cm]	Limit [dBm]	Margin [dB]
40 GHz to 55 GHz	-53.3	30	-10.0	43.3
55 GHz to 75 GHz	-40.2	30	-10.0	30.2
75 GHz to 90 GHz	-39.8	30	-10.0	29.8
90 GHz to 110 GHz	-34.7	30	-10.0	24.7
110 GHz to 130 GHz	-38.9	30	-10.0	28.9
130 GHz to 150 GHz	-34.2	30	-10.0	24.2
150 GHz to 174.8 GHz	-35.0	30	-10.0	25.0
182 GHz to 200 GHz	-34.1	30	-10.0	24.1
200 GHz to 220 GHz	-44.5	30	-10.0	34.5
220 GHz to 260 GHz	-34.6	30	-10.0	24.6
260 GHz to 300 GHz	-39.6	30	-10.0	29.6
300 GHz to 330 GHz	-37.7	30	-10.0	27.7
330 GHz to 364 GHz	-39.6	30	-10.0	29.6
364 GHz to 398 GHz	-39.3	30	-10.0	29.3
398 GHz to 432 GHz	-39.3	30	-10.0	29.3
432 GHz to 466 GHz	-38.8	30	-10.0	28.8
466 GHz to 500 GHz	-33.8	30	-10.0	23.8
500 GHz to 550 GHz	-31.1	30	-10.0	21.1

Test result: Passed

Test equipment (please refer to chapter 6 for details)
8, 21 –26, 29 – 37, 43, 44

5.5 Frequency stability

5.5.1 Test setup (frequency stability)

Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Frequency stability	5.1.5	-

5.5.2 Test method (frequency stability)

Used	Clause	Name of method	Sub-clause	Comment
<input checked="" type="checkbox"/>	9.5 [1], H [3]	Frequency stability for mm-wave devices	5.1.5	-

5.5.3 Test result (frequency stability)

Ambient temperature:	22 %
Relative humidity:	43 % + 39 %

Date:	18. + 19.03.2024
Tested by:	Thomas KÜHN

Test set-up: For this test the EUT was fixed on a wooden table inside the climatic chamber. The measurement distance was adjusted to 1 m. For further information of the setup refer to the pictures in annex B of this test report.

Remark: Because of the large OBW and the low duty cycle of the EUT the necessary measurement time exceeds 10 minutes. Therefore, no measurements could be carried out directly at start up, 2 min, 5 min, and 10 min after powering up the EUT, so, one measurement was carried out with a sweep time of 1370 s. As ordered by the applicant the measurement was carried out in the temperature range 50 °C to -20 °C.

Temperature	Supply voltage	Lower frequency [GHz]	Upper frequency [GHz]	-20 dB bandwidth [GHz]	Peak frequency [GHz]	Result
50 °C	24 V _{DC} (U _{nom})	174.8975	181.8035	6.906	181.2956	Passed
40 °C	24 V _{DC} (U _{nom})	174.8975	181.8035	6.906	179.0799	Passed
30 °C	24 V _{DC} (U _{nom})	174.8955	181.8185	6.923	181.5856	Passed
20 °C	12 V _{DC} (U _{min})	174.8955	181.8475	6.952	181.5516	Passed
	24 V _{DC} (U _{nom})	174.8955	181.8445	6.949	179.1959	Passed
	30 V _{DC} (U _{max})	174.8395	181.8445	6.951	179.2309	Passed
10 °C	24 V _{DC} (U _{nom})	174.8975	181.9335	7.036	181.1846	Passed
0 °C	24 V _{DC} (U _{nom})	174.9004	181.9564	7.056	181.3116	Passed
		174.9015	181.8075	6.906	181.3586	Passed
-10 °C	24 V _{DC} (U _{nom})	174.9085	181.8075	6.899	181.5316	Passed
-20 °C	24 V _{DC} (U _{nom})	174.9179	181.8085	6.891	181.4716	Passed

Test result: Passed

Test equipment (please refer to chapter 6 for details)
8, 27, 28, 36, 37, 41, 43, 44

5.6 AC power-line conducted emissions

5.6.1 Test setup (AC power-line conducted emissions)

Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Conducted: AC power line	5.1.6	-
<input type="checkbox"/>	Not applicable, because ...	-	-

5.6.2 Test method (AC power-line conducted emissions)

Used	Clause	Name of method	Sub-clause	Comment
<input checked="" type="checkbox"/>	6.2 [1]	Tabletop equipment testing	5.1.6	The EUT is DC supplied, therefore, an AC / DC adaptor has to be used.
<input type="checkbox"/>	6.2 [1]	Floor-standing equipment testing	-	-

During the measurement the EUT was supplied with 24.0 V_{DC} by an AC / DC adaptor MINI-PS-100-240AC/24DC/1.3. The adaptor itself was supplied by an AC mains network with 120 V_{AC} 60 Hz.

5.6.3 Test results (Conducted emissions on power supply lines)

Ambient temperature:	22 °C
Relative humidity:	38 % + 29 %

Date:	04. + 07.03.2024
Tested by:	Thomas KÜHN

The curves in the diagrams in A.1.5 and A.2.5 of annex A of this test report only represent for each frequency point the maximum measured value of all preliminary measurements which were made for each power supply line. The top measured curve represents the peak measurement and the bottom measured curve the average measurement. The quasi-peak measured points are marked by ◆ and the average measured points by ◆.

Results of EUT 5b							
Frequency [MHz]	QuasiPeak [dB(μV)]	Average [dB(μV)]	Limit [dB(μV)]	Margin [dB]	Line	PE	Corr. [dB]
0.164400	---	39.13	55.24	16.10	L1	GND	9.8
0.165300	48.57	---	65.19	16.62	L1	GND	9.8
0.205800	---	38.94	53.37	14.43	L1	GND	9.8
0.205800	43.21	---	63.37	20.16	L1	GND	9.8
18.295800	46.12	---	60.00	13.88	L1	FLO	10.9
18.336300	---	42.86	50.00	7.14	L1	FLO	10.9
Results of EUT 6b							
Frequency [MHz]	QuasiPeak [dB(μV)]	Average [dB(μV)]	Limit [dB(μV)]	Margin [dB]	Line	PE	Corr. [dB]
0.164400	---	38.40	55.24	16.84	L1	GND	9.8
0.165300	47.94	---	65.19	17.25	L1	GND	9.8
0.205800	42.85	---	63.37	20.52	L1	FLO	9.8
0.205800	---	38.31	53.37	15.06	L1	GND	9.8
17.844900	47.45	---	60.00	12.55	L1	GND	10.9
17.883600	---	44.26	50.00	5.74	L1	GND	10.9
17.884500	46.94	---	60.00	13.06	N	GND	10.9
17.925000	---	43.83	50.00	6.17	N	GND	10.9

Test result: Passed

Test equipment (please refer to chapter 6 for details)
1 – 5, 43, 44

6 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Transient filter limiter	CFL 9206A	Teseq	38268	481982	28.03.2024	03.2026
2	LISN	NSLK8128	Schwarzbeck	8128161	480138	28.02.2024	02.2026
3	Software	EMC32 V10.60.20	Rohde & Schwarz	100061	481022	Calibration not necessary	
4	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
5	EMI receiver / spectrum analyser	ESIB 26	Rohde & Schwarz	100292	481182	22.02.2024	02.2026
6	Fully anechoic chamber M20	B83117-E2439- T232	Albatross Projects	103	480303	Calibration not necessary	
7	EMI receiver / spectrum analyser	ESW44	Rohde & Schwarz	101635	482467	27.02.2024	02.2026
8	Spectrum analyser	FSW43	Rohde & Schwarz	100586 & 100926	481720	17.03.2023	03.2025
9	Log.-Per. antenna	HL050	Rohde & Schwarz	100908	482977	22.09.2022	09.2025
10	Preamplifier 100 MHz - 16 GHz	AFS6-00101600- 23-10P-6-R	MITEQ	2011215	482333	20.02.2024	02.2026
11	RF-cable No. 36	Sucoflex 106B	Suhner	500219/6B	482416	Calibration not necessary	
12	RF-cable No. 38	Sucoflex 106B	Suhner	500218/6B	482415	Calibration not necessary	
13	Standard gain horn 12 GHz - 18 GHz	18240-20	Flann	483	480294	Calibration not necessary	
14	Preamplifier 12 GHz - 18 GHz	JS3-12001800- 16-5A	MITEQ	571667	480343	19.02.2024	02.2026
15	Standard gain horn 18 GHz - 26.5 GHz	20240-20	Flann	411	480297	Calibration not necessary	
16	Preamplifier 18 GHz - 26 GHz	JS4-18002600- 20-5A	MITEQ	658697	480342	19.02.2024	02.2026
17	Standard gain horn 26.5 GHz - 40 GHz	22240-20	Flann	468	480298	Calibration not necessary	
18	Preamplifier 26 GHz - 40 GHz	JDM2-26004000- 25-10P	MITEQ	128746	482806	19.02.2024	02.2026
19	RF-cable 2 m	KPS-1533-800- KPS	Insulated Wire	-	480302	Calibration not necessary	
20	Standard gain horn 40 GHz - 60 GHz	24240-20	Flann	263442	482858	Calibration not necessary	
21	Harmonic mixer 40 GHz - 60 GHz	FS-Z60	Radiometer Physics	100980	482708	22.03.2023	03.2025
22	Standard gain horn 50 GHz - 75 GHz	25240-20	Flann		483369	Calibration not necessary	
23	Spektrum analyzer extension module 50 GHz - 75 GHz	WR15SAX-M6- UP	Virginia Diode	SAX 683	483364	22.03.2023	03.2025
24	Standard gain horn 75 GHz - 110 GHz	27240-20	Flann	263447	482861	Calibration not necessary	
25	Harmonic mixer 75 GHz - 110 GHz	FS-Z110	Radiometer Physics	101528	482707	22.03.2023	03.2025

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
26	Standard gain horn 110 GHz - 175 GHz	29240-20	Flann	263464	482863	Calibration not necessary	
27	Harmonic mixer 140 GHz - 170 GHz	FS-Z170	Rohde & Schwarz	100978	482838	29.03.2023	03.2025
28	Standard gain horn 140 GHz - 220 GHz	30240-20	Flann	274470	483371	Calibration not necessary	
29	Spektrum analyzer extension module 140 GHz - 220 GHz	WR5.1SAX-M18- UP	Virginia Diode	SAX 685	483366	28.03.2023	03.2025
30	Standard gain horn 220 GHz - 330 GHz	32240-20	Flann	274468	483372	Calibration not necessary	
31	Spektrum analyzer extension module 220 GHz - 330 GHz	WR3.4SAX-M24- UP	Virginia Diode	SAX 686	483367	29.03.2023	03.2025
32	Standard gain horn 330 GHz - 500 GHz	SGH-26-WR2.2	Anteral	4368	483888	Calibration not necessary	
33	Spektrum analyzer extension module 330 GHz - 500 GHz	WR2.2SAX-F	Virginia Diodes	SAX 1104	483857	Calibration not necessary	
34	Standard gain horn 500 GHz - 750 GHz	SGH-26-WR1.5	Anteral	4362	483882	Calibration not necessary	
35	Spektrum analyzer extension module 500 GHz - 750 GHz	WR1.5SAX-F	Virginia Diodes	SAX 1105	483858	Calibration not necessary	
36	RF-cable 0.5 m	Sucoflex 102	Huber+Suhner	510210/2	483030	Calibration not necessary	
37	RF-cable 0.5 m	Sucoflex 102	Huber+Suhner	510213/2	483031	Calibration not necessary	
38	Standard gain horn 140 GHz - 220 GHz	30240-20	Flann	274470	483371	Calibration not necessary	
39	Waveguide detector 140 GHz - 220 GHz	SFD-144224- 05SF-P1-M	Eravant	28909-01	483885	Calibration not necessary	
40	Digital oszilloscop	WR66Zi	Teledyne	LCRY3106N589 34	482018	06.02.2024	02.2026
41	Dynamic temperature chamber	MK 240	Binder	05-79022	480462	21.11.2023	11.2024
42	Loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	21.02.2024	02.2026
43	Power supply	TOE8752-32 (DC)	Toellner	31566	480010	Calibration not necessary	
44	Multimeter	971A	Hewlett Packard	JP39009358	480721	07.09.2023	09.2024
45	Attenuator 6 dB	WA2-6	Weinschel	-	482793	Calibration not necessary	
46	Ultralog antenna	HL562E	Rohde & Schwarz	101061	483152	18.05.2021	05.2024
47	RF switch matrix	OSP220	Rohde & Schwarz	-	482976	Calibration not necessary	
48	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
49	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
50	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
51	Semi anechoic chamber M276	SAC5-2	Albatross Projects	C62128-A540- A138-10-0006	483227	Calibration not necessary	
52	EMI Testreceiver	ESW43	Rohde & Schwarz	101828	482979	08.12.21 + 21.02.24	02.24 + 02.26

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
53	EMC test software	Elektra V5.02.1	Rohde & Schwarz	100970	483755	Calibration not necessary	

7 Measurement Uncertainties

Measurement method	Standard used for calculating measurement uncertainty	Expanded measurement uncertainty (95 %) U_{lab}
Conducted measurements		
Conducted emissions from 150 kHz to 30 MHz with LISN	CISPR 16-4-2	2.8 dB
Radiated measurements		
Frequency error		
(Semi-) Anechoic chamber	ETSI TR 100 028	4.5×10^{-8}
OATS	ETSI TR 100 028	4.5×10^{-8}
Test fixture	ETSI TR 100 028	4.5×10^{-8}
Bandwidth measurements		
(Semi-) Anechoic chamber	-	9.0×10^{-8}
OATS	-	9.0×10^{-8}
Test fixture	-	9.1×10^{-8}
Radiated field strength M20		
CBL6112B @ 3 m 30 MHz – 1 GHz	CISPR 16-4-2	5.3 dB
R&S HL050 @ 3 m		
1 GHz – 6 GHz	CISPR 16-4-2	5.1 dB
6 GHz – 18 GHz	CISPR 16-4-2	5.4 dB
Flann Standard Gain Horns 18 GHz – 40 GHz	-	5.9 dB
Radiated field strength M276		
R&S HL562E @ 3 m 30 MHz – 1 GHz	CISPR 16-4-2	4.8 dB
Radiated emissions above 40 GHz		
40 GHz – 60 GHz	-	7.0 dB
50 GHz – 75 GHz	-	7.0 dB
60 GHz – 90 GHz	-	7.0 dB
75 GHz – 110 GHz	-	7.0 dB
90 GHz – 140 GHz	-	7.6 dB
110 GHz – 170 GHz	-	6.9 dB
140 GHz – 220 GHz	-	7.8 dB
220 GHz – 330 GHz	-	8.1 dB
330 GHz – 500 GHz	-	Under calculation
500 GHz – 750 GHz	-	Under calculation

8 Test site Verification

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Shielded chamber M4	480088	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	08.11.2022	11.2024
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA/RSM	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	01.03.2023	03.2025
Semi anechoic chamber M276	483227	1 -18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	28.02.2023	02.2025
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 Amd. 1	17.08.2022	08.2024

9 Report History

Report Number	Date	Comment
F230973E1	31.07.2024	Initial Test Report
-	-	-
-	-	-

10 List of Annexes

Annex A	Measurement plots	26 pages
Annex B	Test setup photos	20 pages