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Test Report

Report Number:

F201362E1

Equipment under Test (EUT):

TNSLR-Q130-EN

Applicant:

Werner Turck GmbH & Co. KG

Manufacturer:

Werner Turck GmbH & Co. KG

ilac-MRA
DAkkS Deutsche Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

References

[1] **ANSI C63.10: 2013** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

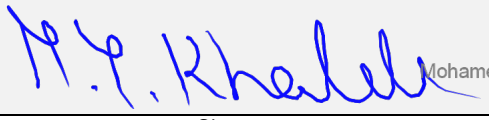
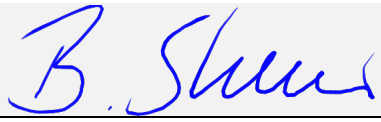
[2] **FCC CFR 47 Part 15** Radio Frequency Devices

[3] **RSS-210 Issue 10 (December 2019)**
License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

[4] **RSS-Gen Issue 5 (March 2019) Amendment 1**
General Requirements for Compliance of Radio Apparatus

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 1.3 of ANSI C63.10 (2013). However, the measurement uncertainty is calculated and shown in this test report.

Tested and written by:		Mohamed Yassine Khalek 13.06.2022
	Signature	
Reviewed and approved by:		Bernd STEINER 13.06.2022
	Signature	

This test report is only valid in its original form.

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:	Hans Turck GmbH & Co. KG
Address:	Witzlebenstraße 7 45472 Mülheim an der Ruhr
Country:	Germany
Name for contact purposes:	Mr. Markus TEUBNER
Phone:	+49 23 53 709 – 61 24
eMail address:	markus.teubner@turck.com
Applicant represented during the test by the following person:	None

1.2 Manufacturer

Name:	Werner Turck GmbH & Co. KG
Address:	Goethestr. 7, 58553 Halver
Country:	Germany
Name for contact purposes:	Mr. Markus TEUBNER
Phone:	+49 23 53 709 – 61 24
eMail address:	markus.teubner@turck.com
Manufacturer represented during the test by the following person:	None

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-17186-01-06 and D-PL-17186-01-05, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment under Test)

Test object: *	RFID read/write device
Model name: *	TNSLR-Q130-EN
Model number: *	Not available
Order number: *	100004502
FCC ID: *	YQ7-TNSLRQ130
IC certification number: *	8821A-TNSLRQ130
PMN: *	TNSLR-Q130-EN Series
HVIN: *	7202/3
FVIN: *	V1.0.0.0

*: Declared by the applicant

	EUT number		
	1	2	3
Serial number: *	Engineering sample		---
PCB identifier: *	7202/3		---
Hardware version: *	V3.0		---
Software version: *	V1.0.0.0		---

*: Declared by the applicant

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

1.5 Technical Data of Equipment

Equipment category: *	Equipment with integral antenna		
Operating frequency *	13.56 MHz		
Channel spacing: *	Not applicable (one channel operation)		
Antenna characteristics: *	Average loop area: 122 x 32 mm		
Antenna gain: *	-30 dB		
ITU classification: *	424KK1D		
Alignment range: *	Not applicable (one channel operation)		
Switching range: *	Not applicable (one channel operation)		
Modulation: *	ASK		
Bit rate of transmitter: *	26.48 kbaud		
Supply voltage: *	U_{nom}= 24.0 V_{DC}	U_{min}= 18 V_{DC}	U_{max}= 30 V_{DC}
Type of power supply: *	External DC		
Temperature range: *	-25 °C to +70 °C		

*: Declared by the applicant

Ports / Connectors			
Identification	Connector		Length during test
	EUT	Ancillary	
System line	Five-pole connector	-	2 m
2 Ethernet ports	Four-pole connector	RJ45	-
-	-	-	-

Equipment used for testing	
TAG *1	10mm Tag Infineon
Gateway *1	TBEN-L5-PLC-10
Power adapter *2	MINI-PS-100-240AC/24DC/1.3

*1 Provided by the applicant
*2 Provided by the test laboratory

1.6 Dates

Date of receipt of test sample:	01.02.2022
Start of test:	01.02.2022
End of test:	22.03.2022

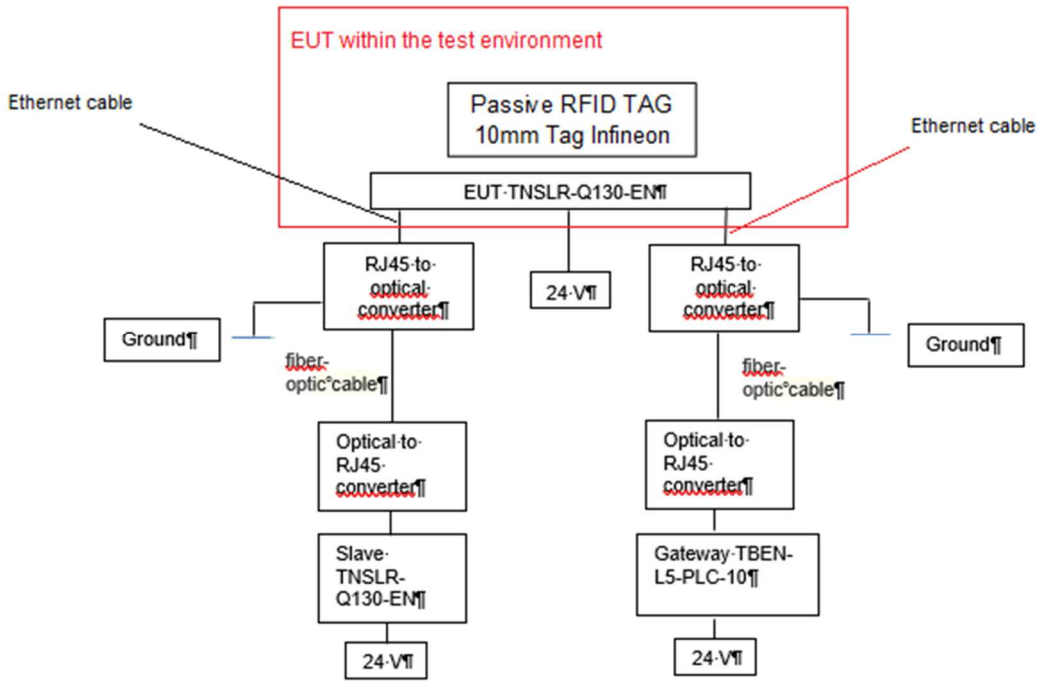
2 Operational States

Description of function of the EUT:

The EUT is a RFID Reader/Writer. All tests were carried out with an unmodified test sample, which operates in normal operation mode. If stated a TAG Type “10mm Tag Infineon” was positioned in the front of the EUT.

The following states were defined as the operating conditions:

The EUT TNSLR-Q130-EN is connected to a PLC with one of its Ethernet ports. This continuously polls the tag present bit of the TNSLR-Q130-EN and displays an LED on the PLC when a tag is within range.
A second TNSLR-Q130-EN is connected as a slave device to the second Ethernet connection of the TNSLR-Q130-EN. The PLC also queries the tag present bit from this and uses another LED to indicate to the PLC when a tag is within range.
This type of connection corresponds to the type of connection for later use.
The conversion into optical signals of the Ethernet interfaces is due to the decoupling of the test object from the outside world with regard to interference from the environment of the anechoic chamber.
The slave TNSLR-Q130-EN is not placed in the anechoic chamber.
The power supply of the RFID read/write heads is ensured with a 24V power supply unit.
One power pack is outside and one power pack is inside the anechoic chamber.
The picture below shows a rough sketch of the test setup for the measurement of this report.



The spurious radiation measurement of the receiver was not carried out, because the co-located transmitter transmits continuously.
Because no dedicated position of operating is defined by the applicant, all radiated measurements were carried out with the EUT in three orthogonal positions and only worst case has been presented in this test report.

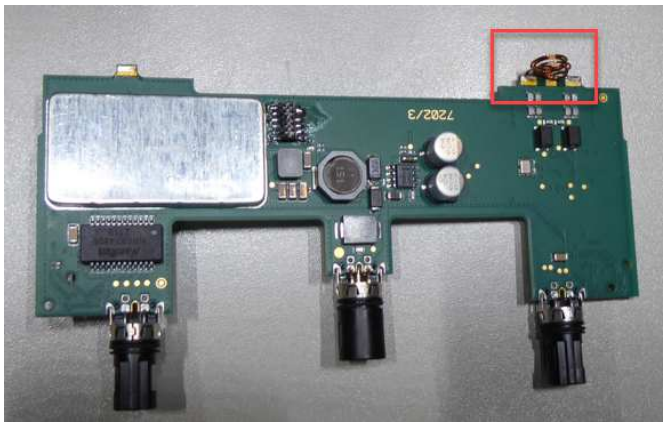
The radiated emission measurement is divided into three stages:
1. A preliminary measurement inside a semi anechoic chamber with 3 m distance;
2. A final measurement inside a semi anechoic chamber with 3 m distance for frequencies above 30 MHz;
3. A final measurement on an outdoor test site without reflecting groundplane and 3 m / 10 m distance for frequencies below 30 MHz.

3 Additional Information

The EUT was not labeled as required by FCC / IC.

To fulfil the conducted emission test, a dummy load as described below was used, according to KDB 174176 (06/2015):

The following components were used / changed by the applicant to create suitable dummy load in lieu of the antenna:



4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-Gen, Issue 5 [4] and RSS-210, Issue 10 [3]	Tested EUT	Status
Spectrum mask	13.110 to 14.110	15.225 (a) – (d)	B.6 [3]	-	Passed
20 dB bandwidth	13.56	15.215 (c)	-	-	Passed
99 % bandwidth	13.56	-	6.7 [4]	-	Passed
Frequency tolerance	13.560	15.225 (e)	B.6 [3] 6.11 [4]	-	Passed
Conducted emissions on supply line	0.15 – 30	15.207 (a)	8.8 [4]	-	Passed
Radiated emissions	0.009 – 1000***	15.205 (a) 15.209 (a)	8.9 and 8.10 [4] 7.1 and 7.3 [3]	-	Passed
Radiated emissions (receiver)	30 – 5.000	15.109 (a)	6.1 [4]	-	N/A **
Antenna requirement	-	15.203 [2]	6.8 [4]	-	Passed *

*: Integrated antenna only, requirement fulfilled.

**: No measurement of the receiver spurious emissions was performed, because of a continuously operating co-located transmitter.

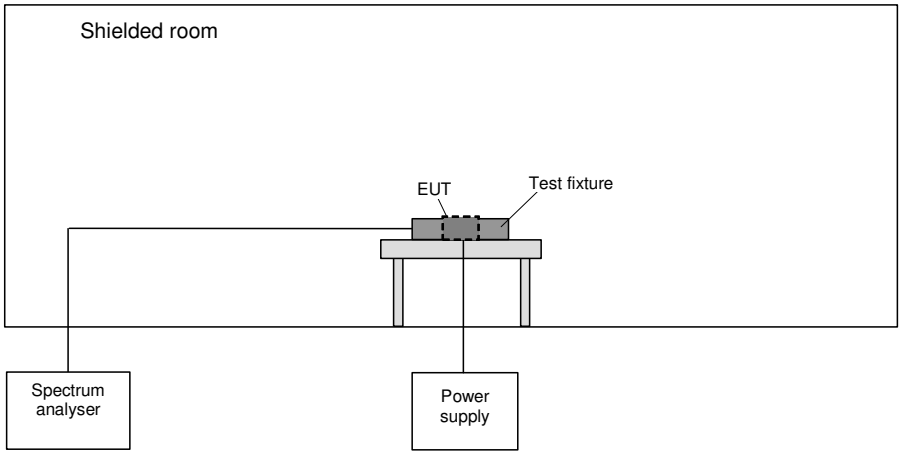
***: As declared by the applicant the highest fundamental frequency is 13.56 MHz.
Therefore the radiated emission measurement must be carried out up to 10th of the highest radio clock frequency in this case 1 GHz.

5 Results

5.1 Test setups

5.1.1 Radiated: Test fixture

The test is carried out in a shielded chamber. Table-top devices are set up on a table and the spectrum analyser is connected to a test fixture / loop antenna, which is placed around / on top of the EUT.



Alternatively, the EUT and test fixture are placed on a non-conductive table inside a temperature chamber if measurements at extreme temperatures are performed.

5.1.2 Radiated: 9 kHz to 30 MHz

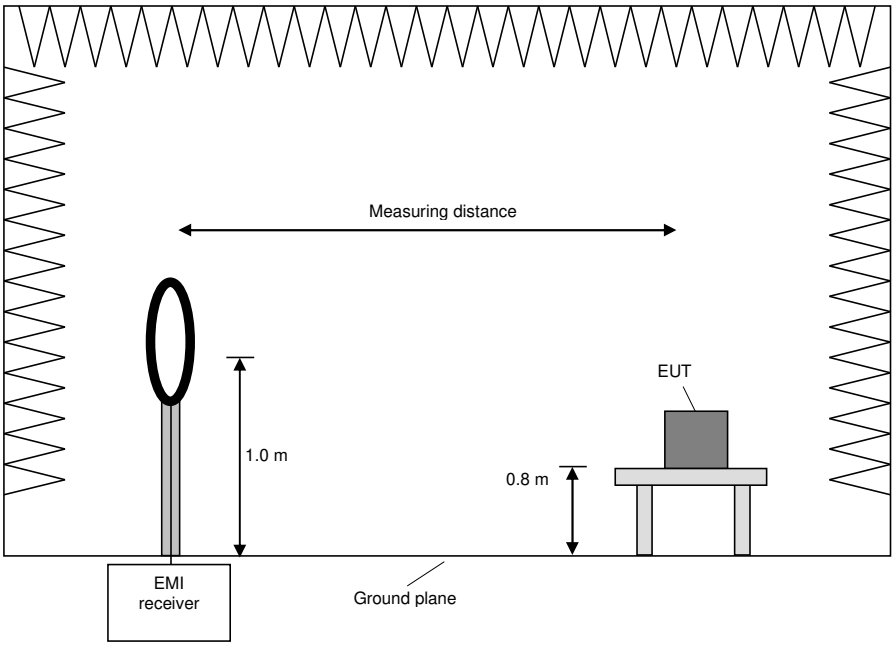
5.1.2.1 Preliminary measurement 9 kHz to 30 MHz

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	9 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.

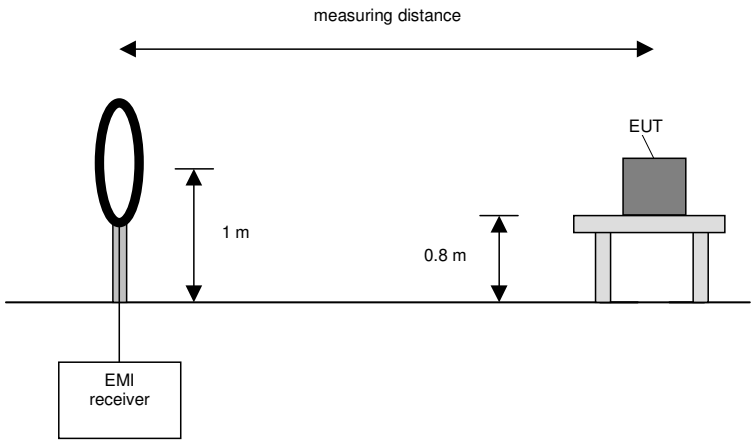
5.1.2.2 Final measurement 9 kHz to 30 MHz

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 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.

5.1.3 Radiated: 30 MHz to 1 GHz

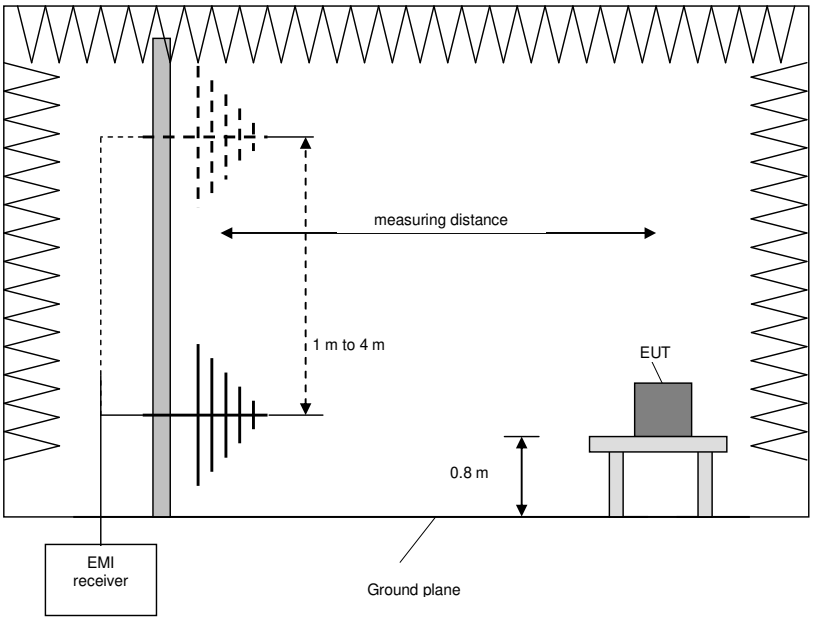
5.1.3.1 Preliminary and final measurement 30 MHz to 1 GHz

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 1 GHz	-	120 kHz	1 s	QuasiPeak



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:

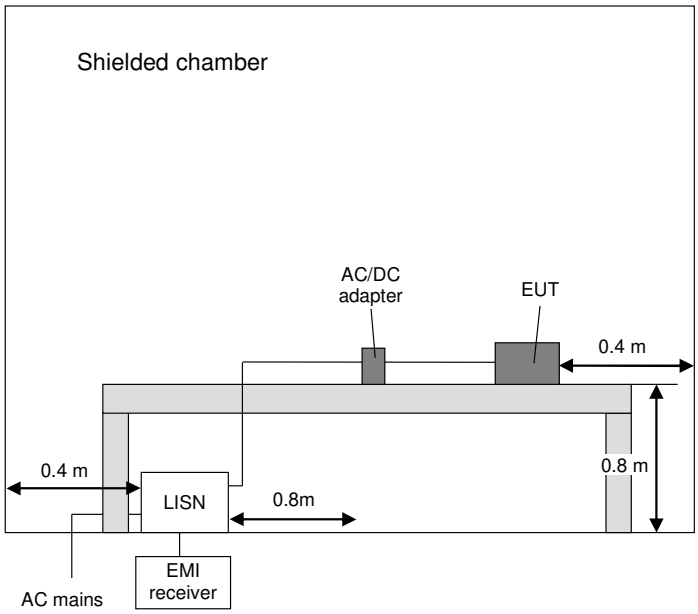
1) Select the highest frequency peaks (lowest margin to the limit) for the final measurement.
2) The software determines the exact peak frequencies by doing a partial scan with reduced step size of the pre-scan of the selected peaks.
3) If the EUT is portable or ceiling mounted, find the worst-case EUT 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.

5.1.4 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 appropriable 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 Spectrum mask

5.2.1 Test setup (Spectrum mask)

Test setup (Spectrum mask)			
Used	Setup	See sub-clause	Comment
☒	Radiated: Test fixture	5.1.1	-

5.2.2 Test method (Spectrum mask)

The following procedure is used for the spectrum mask measurement:

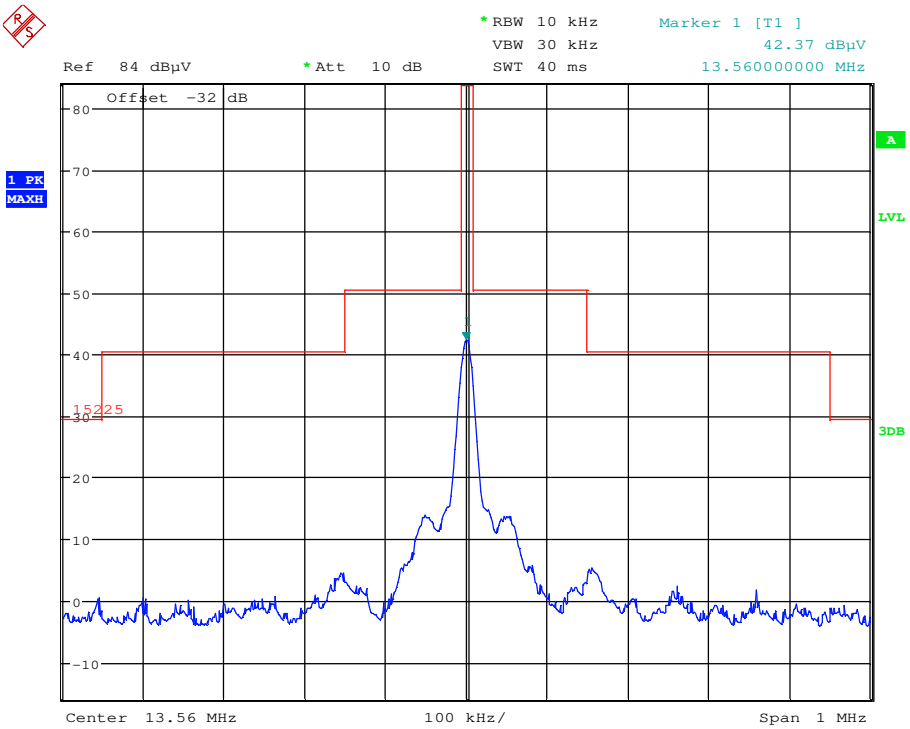
1) Place the EUT in the test fixture and switch it on.
2) Use the following spectrum analyzer settings:
    a. RWB = 10 kHz
    b. VBW = 30 kHz
    c. Span = wide enough to capture the whole 13 MHz band including the frequency ranges where the limit [2; 3] applies
    d. Trace mode = Max hold
    e. Select the limit line.
3) After trace stabilization, set the marker to the signal peak.
4) The reference level will be calculated by the margin of the wanted signal to its 30 m emission limit plus the marker value.
5) The whole signal trace has to be below the limit line.

5.2.3 Test results (spectrum mask)

Ambient temperature:	22 °C
Relative humidity:	35 %

Date:	27.04.2022
Tested by:	Y. KHALEK

Operation mode of transmitter: Continuously reading a TAG.



Test result: Passed

Test equipment (please refer to chapter 7 for details)
11 – 12, 15

5.3 20 dB bandwidth

5.3.1 Test setup (20 dB bandwidth)

Test setup (20 dB bandwidth)			
Used	Setup	See sub-clause	Comment
☒	Radiated: Test fixture	5.1.1	-

5.3.2 Test method (20 dB bandwidth)

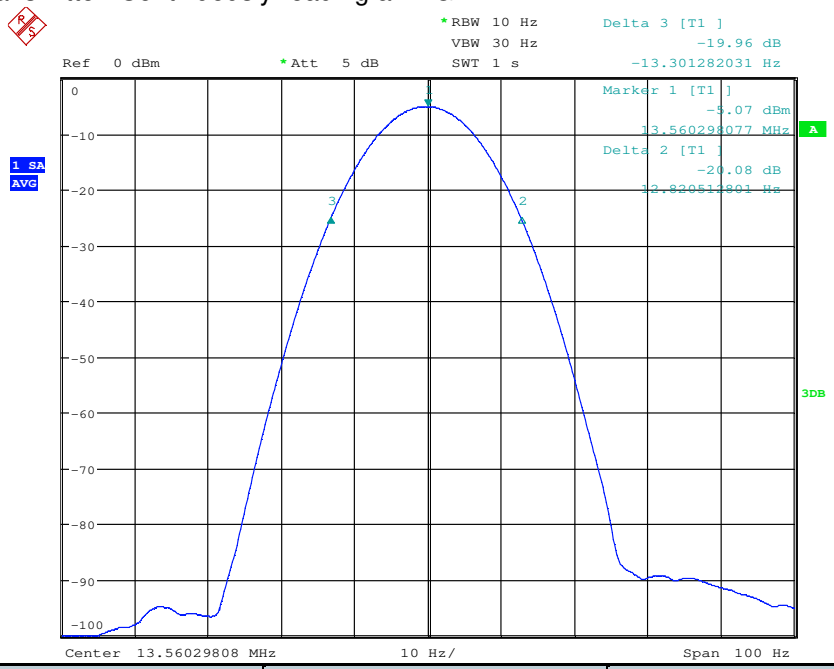
Test method (20 dB bandwidth)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☒	6.9.2	Occupied bandwidth – relative measurement procedure	-	-

5.3.3 Test results (20 dB bandwidth)

Ambient temperature:	22 °C
Relative humidity:	39 %

Date:	21.03.2022
Tested by:	Y. KHALEK

Operation mode of transmitter: Continuously reading a TAG.



F_L	F_U	BW (F_U - F_L)
13.5602847 MHz	13.5603111 MHz	26.4 Hz

Test result: Passed

Test equipment (please refer to chapter 7 for details)
11 – 12, 15

5.4 99 % bandwidth

5.4.1 Test setup (99 % bandwidth)

Test setup (99 % bandwidth)			
Used	Setup	See sub-clause	Comment
☒	Radiated: Test fixture	5.1.1	-

5.4.2 Test method (99 % bandwidth)

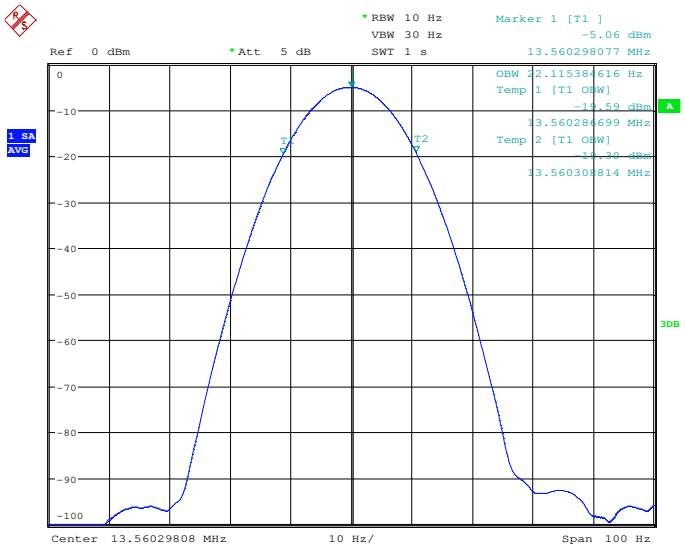
Test method (99 % bandwidth)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☒	6.9.3	Occupied bandwidth – power bandwidth (99%) measurement procedure	-	-

5.4.3 Test results (99 % bandwidth)

Ambient temperature:	22 °C
Relative humidity:	39 %

Date:	21.03.2022
Tested by:	Y. KHALEK

Operation mode of transmitter: Continuously reading a TAG.



F_L	F_U	BW (F_U - F_L)
13.560286699 MHz	13.560308814 MHz	22.11 Hz

Test result: Passed

Test equipment (please refer to chapter 7 for details)
11 – 12, 15

5.5 Frequency tolerance

5.5.1 Test setup (frequency tolerance)

Test setup (frequency tolerance)			
Used	Setup	See sub-clause	Comment
☒	Radiated: Test fixture	5.1.1	-

5.5.2 Test method (frequency tolerance)

The following procedure is used for the spectrum mask measurement:

6) Place the EUT in the test fixture and switch it on.
7) Use the following spectrum analyzer settings:
   a. RWB = VBW = 1 kHz
   b. Span = wide enough to capture the whole 13 MHz band including the frequency ranges where the limit [2; 3] applies
   c. Trace mode = Max hold
   d. Select the limit line.
   e. The bandwidth usually has to be 10 kHz for the measurement [1]. Because a measurement with this bandwidth results into an envelope, which is too wide for the 14 kHz spectrum mask, the bandwidth was reduced. The amplitude was determined using the 10 kHz bandwidth.
8) After trace stabilization, set the marker to the signal peak.
9) The reference level will be calculated by the margin of the wanted signal to its 30 m emission limit plus the marker value.
10) The whole signal trace has to be below the limit line.
11) The frequency tolerance is determined using the procedure described in §8.6 [1].

5.5.3 Test results

Ambient temperature:	22 °C
Relative humidity:	52 %

Date:	08.03.2022
Tested by:	Y. KHALEK

Operation mode of transmitter: Continuously reading a TAG.

Temperature	Voltage	Minutes after switch-on	Frequency	Allowed tolerance	Measured tolerance	Result
+70 °C	24 V DC	0	13.5603330	±1.356kHz	33 Hz	Passed
		2	13.5604170	±1.356kHz	117 Hz	Passed
		5	13.5604330	±1.356kHz	133 Hz	Passed
		10	13.5604500	±1.356kHz	150 Hz	Passed
+60 °C	24 V DC	0	13.5603000	±1.356kHz	0 Hz	Passed
		2	13.5603330	±1.356kHz	33 Hz	Passed
		5	13.5603500	±1.356kHz	50 Hz	Passed
		10	13.5603670	±1.356kHz	67 Hz	Passed
+50 °C	24 V DC	0	13.5603000	±1.356kHz	0 Hz	Passed
		2	13.5603000	±1.356kHz	0 Hz	Passed
		5	13.5603170	±1.356kHz	17 Hz	Passed
		10	13.5603170	±1.356kHz	17 Hz	Passed
+40 °C	24 V DC	0	13.5603170	±1.356kHz	17 Hz	Passed
		2	13.5603000	±1.356kHz	0 Hz	Passed
		5	13.5603000	±1.356kHz	0 Hz	Passed
		10	13.5603000	±1.356kHz	0 Hz	Passed
+30 °C	24 V DC	0	13.5603330	±1.356kHz	33 Hz	Passed
		2	13.5603170	±1.356kHz	17 Hz	Passed

		5	13.5603000	±1.356kHz	0 Hz	Passed
		10	13.5603000	±1.356kHz	0 Hz	Passed
+20 °C	18 V DC	0	13.5603000	±1.356kHz	0 Hz	Passed
	24 V DC		13.5603000	-	-	Passed
	30 V DC		13.5603000	±1.356kHz	0 Hz	Passed
+10 °C	24 V DC	0	13.5603670	±1.356kHz	67 Hz	Passed
		2	13.5603330	±1.356kHz	33 Hz	Passed
		5	13.5603330	±1.356kHz	33 Hz	Passed
		10	13.5603330	±1.356kHz	33 Hz	Passed
0 °C	24 V DC	0	13.5603670	±1.356kHz	67 Hz	Passed
		2	13.5603670	±1.356kHz	67 Hz	Passed
		5	13.5603500	±1.356kHz	50 Hz	Passed
		10	13.5603500	±1.356kHz	50 Hz	Passed
-10 °C	24 V DC	0	13.5603500	±1.356kHz	50 Hz	Passed
		2	13.5603670	±1.356kHz	67 Hz	Passed
		5	13.5603670	±1.356kHz	67 Hz	Passed
		10	13.5603670	±1.356kHz	67 Hz	Passed
-20 °C	24 V DC	0	13.5603000	±1.356kHz	0 Hz	Passed
		2	13.5603500	±1.356kHz	50 Hz	Passed
		5	13.5603670	±1.356kHz	67 Hz	Passed
		10	13.5603670	±1.356kHz	67 Hz	Passed
-25 °C	24 V DC	0	13.5602500	±1.356kHz	-50 Hz	Passed
		2	13.5603330	±1.356kHz	33 Hz	Passed
		5	13.5603500	±1.356kHz	50 Hz	Passed
		10	13.5603500	±1.356kHz	50 Hz	Passed

Test result: Passed

Test equipment (please refer to chapter 7 for details)
11 - 12, 14, 15, 17

5.6 Radiated emissions

5.6.1 Test setup (Maximum unwanted emissions)

Test setup (Maximum unwanted emissions)			
Used	Setup	See sub-clause	Comment
☒	Radiated: 9 kHz to 30 MHz / 30 MHz to 1 GHz	5.1.2 / 5.1.3	-

5.6.2 Test method (Maximum unwanted emissions)

☒ Test method (radiated) see sub-clause 5.1.2 / 5.1.3 as described herein

5.6.3 Test results (Maximum unwanted emissions)

5.6.3.1 Test results preliminary measurement 9 kHz to 30 MHz

Ambient temperature:	22 °C
Relative humidity:	51 %

Date:	18.02.2022
Tested by:	Y. KHALEK

Position of EUT: For tests of frequencies 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 A in the test report.

Test record: The measurement value is corrected as described in 47 CFR 15.31(f)(2) according to the measurement distance as requested in 47 CFR 15.209(a)

Remark: All 3 orthogonal planes were tested separately

Calculations:

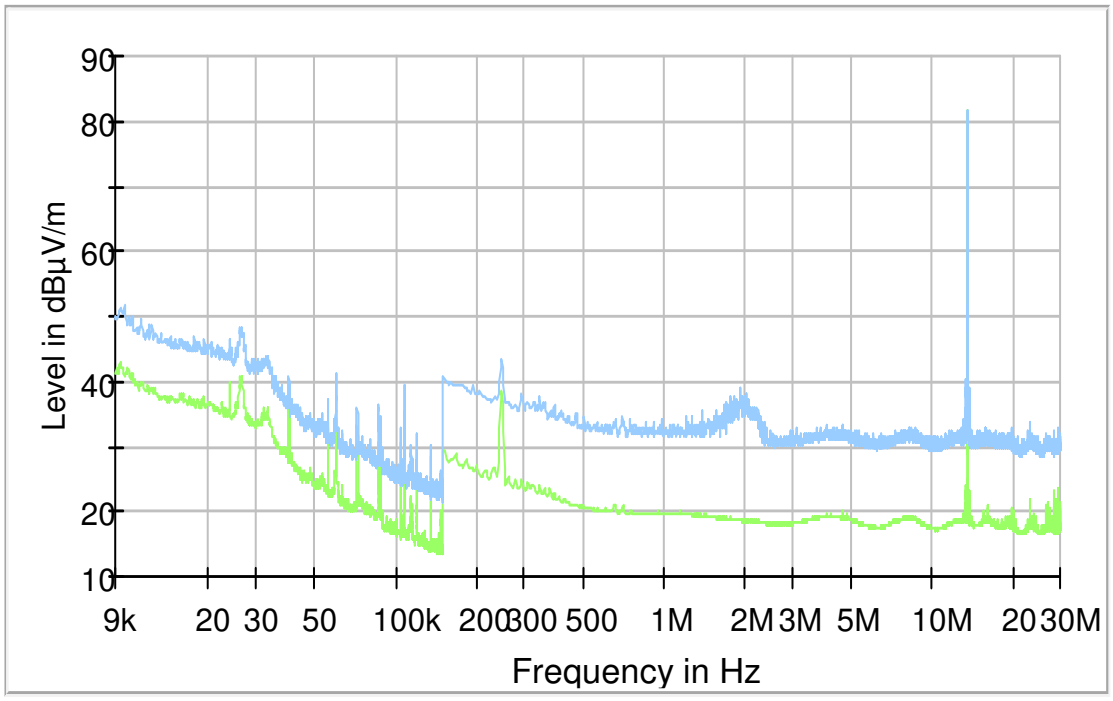
Result @ norm. dist. [dBµV/m] = Reading [dBµV] + AF [dB/m] + Distance corr. fact. [dBµV/m]

Result @ norm. dist. [dBµA/m] = Result @ norm. dist. [dBµV/m] – 20 x $\log_{10}$ (377 Ω)

Margin [dB] = Limit [dB(µV|µA)/m] - Result [dB(µV|µA)/m]

Worst case plot:

Spurious emissions from 9 kHz to 30 MHz (operation mode: lying):



Remark: No emissions close than 20 dB to the limit, so no final measurement will be carried out.

5.6.3.2 Test results final measurement 9 kHz to 30 MHz

Ambient temperature:	9 °C
Relative humidity:	70 %

Date:	24.02.2022
Tested by:	Y. KHALEK

The results of the standard subsequent measurement on the outdoor test site are indicated in the table below. The limits as well as the measured results (levels) refer to the above-mentioned standard while taking account of the specified requirements for a 30 | 300 m measuring distance.

Results 9kHz - 30 MHz										
Frequency [MHz]	Reading @ meas. distance [dB(µV)]	Result* @ norm. distance [dB(µV/m)]	Limit acc. To FCC 15.225 .and RSS-210 [dB(µV/m)]	Margin** [dB]	Detector	Antenna factor [dB/m]	Measuring distance [m]	Normative distance [m]	Distance correction factor*** [dB]	Position
13.560 (F)	43.1	43.0	84.0	24.5	QP	19.9	10	30	20	H

* Result @ norm dist. = Reading + Antenna factor - Distance correction factor;
Result [dBµA/m] = Result [dBµV/m] - 20*log(377 Ω)
** Margin = Limit [dBµ{V|A}/m] - Result @ norm dist.
*** 40dB/decade according Part §15.31 (f) (2)

F: Fundamental frequency.

No final measurement done; no emission closer than 20 dB to the limit.

Test result: Passed

Test equipment (please refer to chapter 7 for details)
3 - 10, 12-13, 18

5.6.3.3 Test results (30 MHz – 1 GHz)

Ambient temperature:	22 °C
Relative humidity:	51 %

Date:	01.02.2022
Tested by:	Y. KHALEK

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 A in the test report.

Test record: Plots for each frequency range are submitted below.

Remark: All 3 orthogonal planes were tested separately
Operation mode of transmitter: Continuously reading a TAG.

Calculations:

Result [dBµV/m] = Reading [dBµV] + Correction [dBµV/m]

Correction [dBµV/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]

Margin [dB] = Limit [dBµV/m] - Result [dBµV/m]

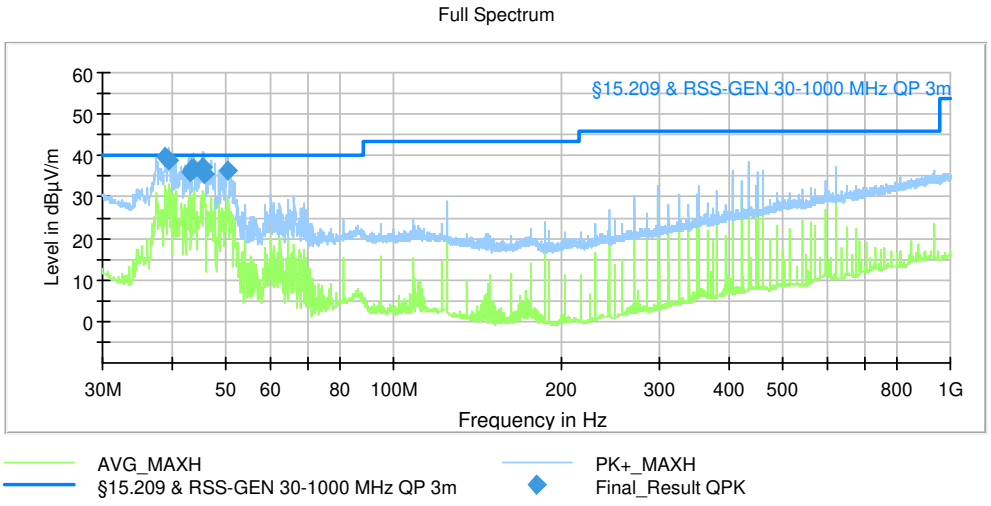
The following frequencies were found in the frequency range 30 MHz to 1 GHz:
38.950MHz, 39.470 MHz, 42.940 MHz, 43.510 MHz, 43.790 MHz, 45.260 MHz, 45.750 MHz, 50.450 MHz

These frequencies have to be measured within a final measurement.

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with "◆" are the measured results of the standard subsequent measurement in a semi-anechoic chamber.

Worst case plot:

Spurious emissions from 30 MHz to 1 GHz (operation mode 1 - lying):



Result tables:

(Operation mode 1 - Lying):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Readings [dBµV]	Correction [dB/m]	Height [cm]	Azimuth [deg]	Pol. (H/V)	Position #
38.950	39.6	40.0	0.4	18.9	19.9	100.0	22	V	Lying
39.470	38.9	40.0	1.2	18.5	19.6	101.0	23	V	Lying
42.940	36.1	40.0	4.0	17.8	17.4	132.0	56	V	Lying
43.510	36.7	40.0	3.3	18.8	17.1	100.0	-2	V	Lying
43.790	36.9	40.0	3.1	19.3	16.9	100.0	9	V	Lying
45.260	37.2	40.0	2.8	20.5	15.9	102.0	-12	V	Lying
45.750	35.7	40.0	4.3	19.3	15.6	104.0	-6	V	Lying
50.450	36.3	40.0	3.7	22.7	12.8	112.0	-1	V	Lying

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1 – 2, 4 -10, 12, 25

5.7 AC power-line conducted emissions

5.7.1 Test setup (Conducted emissions on power supply lines)

Test setup (Conducted emissions on power supply lines)			
Used	Setup	See sub-clause	Comment
☒	Conducted: AC power line	5.1.4	-
☐	Not applicable, because …	-	-

5.7.2 Test method (Conducted emissions on power supply lines)

Test setup (Conducted emissions on power supply lines)				
Used	Clause [1]	Name of method	Sub-clause	Comment
☒	6.2	Tabletop equipment testing	5.1.4	AC switching power adaptor “MINI-PS-100-240AC/24DC/1.3” provided by test laboratory
☐	6.2	Floor-standing equipment testing	-	-

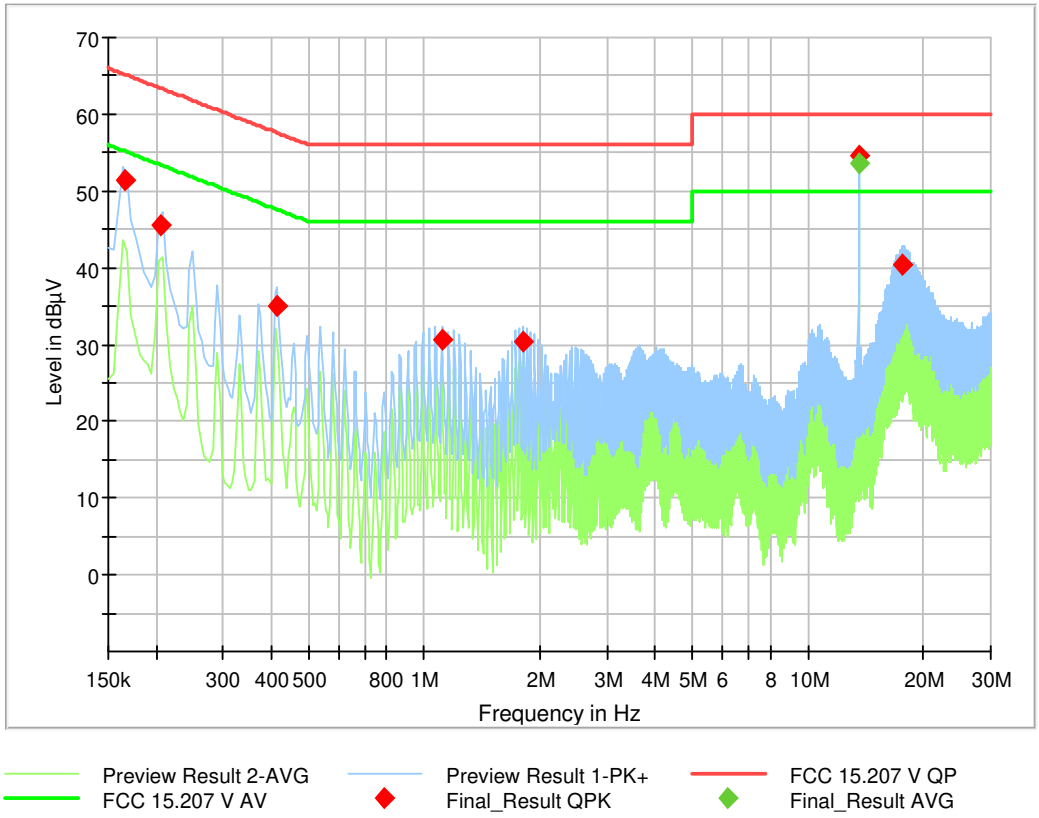
The power adaptor itself was supplied by $120V_{AC}$ 60Hz.

5.7.3 Test results (Conducted emissions on power supply lines)

Ambient temperature:	22 °C
Relative humidity:	22 %

Date:	09.03.2022
Tested by:	Y. KHALEK

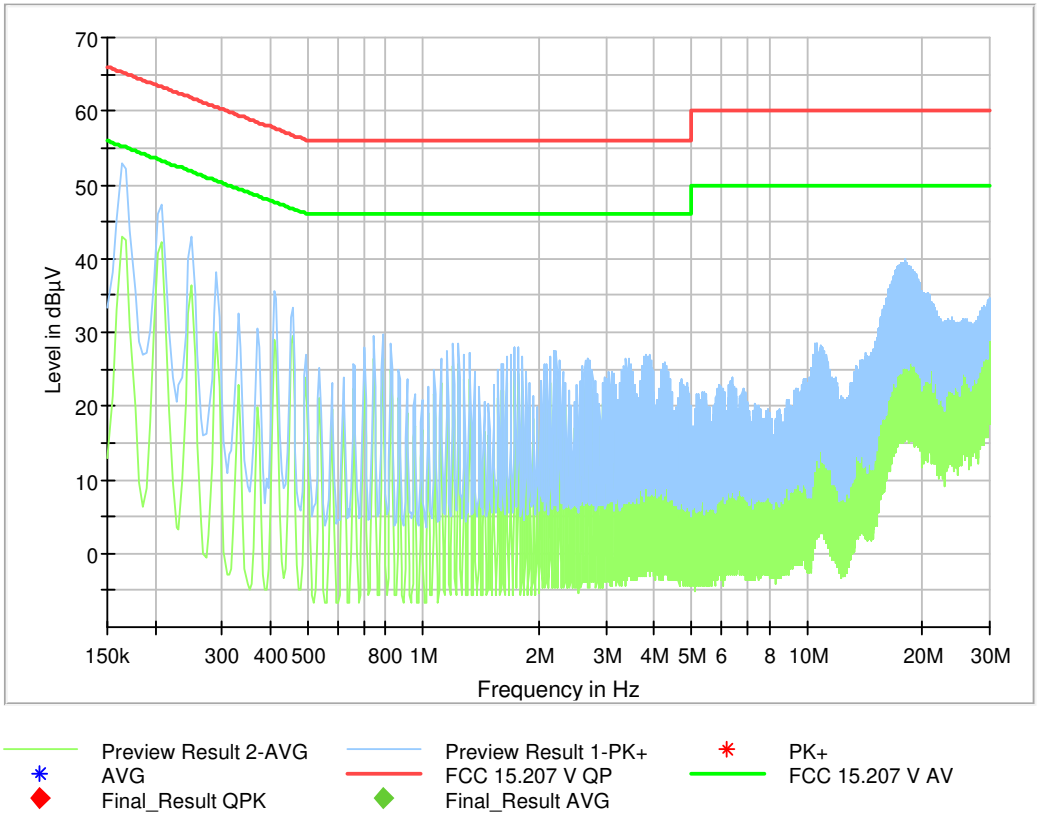
The curves in the diagrams below only represent for each frequency point the maximum measured value of all preliminary measurements which were made for each power supply line. The top measured curve represents the peak measurement and the bottom measured curve the average measurement. The quasi-peak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



Test plot for AC mains conducted emissions with antenna

Frequency in MHz	QuasiPeak in dB(µV)	Average in dB(µV)	Limit in dB(µV)	Margin in dB	Meas. Time in ms	Bandwidth in kHz	Line	PE	Corr. in dB
0.165300	51.39	---	65.19	13.81	5000.0	9.000	N	GND	9.8
0.205800	45.64	---	63.37	17.74	5000.0	9.000	N	GND	9.8
0.412800	34.99	---	57.59	22.60	5000.0	9.000	N	FLO	9.9
1.113900	30.67	---	56.00	25.33	5000.0	9.000	N	FLO	9.9
1.814100	30.42	---	56.00	25.58	5000.0	9.000	N	GND	10.0
13.560000 (F)	54.54	---	60.00	5.46	5000.0	9.000	N	FLO	10.8
13.560000 (F)	---	53.66	50.00	-3.66	5000.0	9.000	N	GND	10.8
17.636100	40.37	---	60.00	19.63	5000.0	9.000	N	GND	10.9

F: Fundamental frequency.



Test plot for AC mains conducted emissions with dummy load

Test result: Passed

Test equipment (please refer to chapter 7 for details)
19 - 24

6 Measurement Uncertainties

Conducted measurements		
Measurement method	Standard used for calculating measurement uncertainty	Expanded measurement uncertainty (95 %) U_{lab}
Frequency error	ETSI TR 100 028	4.5×10^{-8}
Bandwidth measurements	-	9.0×10^{-8}
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 – 6 GHz	CISPR 16-4-2	5.1 dB
6 – 18 GHz	CISPR 16-4-2	5.4 dB
Flann Standard Gain Horns 18 – 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
R&S HL050 @ 3 m	-	
1 – 6 GHz	CISPR 16-4-2	5.1 dB
6 – 18 GHz	CISPR 16-4-2	5.4 dB
Flann Standard Gain Horns 18 – 40 GHz	-	5.9 dB
OATS		
Field strength measurements below 30 MHz on OATS without ground plane	-	4.4 dB

7 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Attenuator 6 dB	WA2-6	Weinschel		482793	Calibration not necessary	
2	Ultralog Antenna	HL562E	Rohde & Schwarz	101079	482978	18.03.2021	03.2024
3	loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	22.02.2022	02.2024
4	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
5	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
6	Antennasupport	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
7	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
8	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
9	Software	EMC32	Rohde & Schwarz	100970	482972	Calibration not necessary	
10	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	08.12.2021	12.2023
11	Loop antenna	22.5 cm	PHOENIX TESTLAB GmbH	-	410085	Calibration not necessary	
12	Power Supply	TOE8852 (DC)	Toellner Electronic Inst.	51712	480233	Calibration not necessary	
13	EMI Receiver / Spectrum Analyser	ESI 40	Rohde & Schwarz	100064/040	480355	18.02.2022	02.2023
14	Multimeter	971A	Hewlett Packard	JP40010640	480724	11.02.2022	02.2024
15	Spectrum Analyser	FSU46	Rohde & Schwarz	200125	480956	21.02.2022	02.2023
16	Signal & Spectrum Analyzer	FSW43	Rohde & Schwarz	100586 & 100926	481720	19.11.2021	11.2022
17	Dynamic temperature chamber	MK 240	WTB Binder Labortechnik GmbH	05-79022	480462	07.12.2021	12.2022
18	Outdoor test site	-	PHOENIX TESTLAB GmbH	-	480293	Calibration not necessary	
19	LISN	NSLK8128	Schwarzbeck	8128161	480138	15.02.2022	02.2024
20	AC Source	AC6803A AC Quelle 2000VA	Keysight	JPVJ002509	482350	Calibration not necessary	
21	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
22	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
23	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	16.02.2022	02.2024
24	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	15.02.2022	02.2024
25	Cable 416	Sucoflex 116	Huber & Suhner	500651/119	-	Calibration not necessary	

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	12.05.2020	11.05.2022
OATS Outdoor	480293	9 kHz – 30 MHz	-	ANSI C63.4-2014	-	-
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA/RSM	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	03.03.2021	02.03.2023

9 Report History

Report Number	Date	Comment
F201362E1	25.05.2022	Initial Test Report
-	-	-
-	-	-

10 List of Annexes

Annex A	Test Setup Photos	7 pages
Annex B	EUT External Photos	3 pages
Annex C	EUT Internal Photos	5 pages