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Test Report

Report Number:

F231651E1 3rd version

Equipment under Test (EUT):

TDC-E220AC

Applicant:

SICK AG

Manufacturer:

Sick Mobilisis d.o.o.

ilac-MRA

DAkkS
Deutsche
Akkreditierungsstelle
D-PL-17186-01-00

References

[1] ANSI C63.4:2014 American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

[2] FCC 47 CFR Part 2: General Rules and Regulations

[3] FCC 47 CFR Part 15: Radio Frequency Devices (Subpart B)

[4] ICES-003 Issue 7: (October 2020) Spectrum Management and Telecommunications. Interference-Causing Equipment Standard. Information Technology Equipment (Including Digital Apparatus) —Limits and Methods of Measurement

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 10.2.8.2 of ANSI C63.4 (2014). However, the measurement uncertainty is calculated and shown in this test report.

Tested and written by:	Mohamed Yassine Khalek 15.03.2024 Signature
Reviewed and approved by:	Bernd STEINER 15.03.2024 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:	SICK AG
Address:	Erwin-Sick-Str.1 79183 Waldkirch
Country:	Germany
Name for contact purposes:	Mr. Kristijan KANIŽAJ
Phone:	+385 99 311 54 40
eMail address:	kristijan.kanizaj@sick.com
Applicant represented during the test by the following person:	None

1.2 Manufacturer

Name:	Sick Mobilisis d.o.o.
Address:	Varaždinska ulica 7, Odvojak II 42000 Varaždin - Jalkovec
Country:	Croatia
Name for contact purposes:	Mr. Goran KANIŽAJ
Phone:	+385 42 311 777
eMail address:	info@mobilisis.hr
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-17186-01-05 and D-PL-17186-01-06, 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: *	Telematic data collector
Model name: *	TDC-E220AC
Model number: *	6085793
Order number: *	6085793
FCC ID: *	2AHDRTDCE210
Contains FCC ID: *	XMR201903EG25G 2AHDRM1
Contains IC ID: *	10224A-201903EG25G 21147-M1

	EUT number		
	1	2	3
Serial number: *	2340 0001	-	-
PCB identifier: *	1.3	-	-
Hardware version: *	1.3 r3	-	-
Software version: *	1.0.7	-	-

* Declared by the applicant

One EUT was used for all tests.

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

General			
Power supply EUT: *	DC		
Supply voltage EUT: *	U_{nom} = 24 V DC	U_{min} = 9 V DC	U_{max} = 36 V DC
Temperature range: *	-20 °C to +70 °C		
Lowest / highest internal frequency: *	560 kHz / 2690 MHz		

* Declared by the applicant

Cellular module:

Manufacturer: *	Quectel Wireless Solutions Co.		
Model name: *	EG25-G MINIPCIE		
Power supply module: *	DC		
Supply voltage module: *	U_{nom} = 3.8 V DC	U_{min} = 3.3 V DC	U_{max} = 4.3 V DC
Serial Number: *	MPQ22I26B000796		
IMEI: *	865326065345244		
Hardware version: *	v 1.1		
Firmware version: *	EG25GGBR07A07M2G		
Supported bands: *	GSM/GPRS/EDGE: 850/900/1800/1900 MHz ** WCDMA/HSPA+: Band I, II, IV, V, VI, VIII, XVIIII ** LTE FDD: Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 18, 19, 20, 25, 26, 28 ** LTE TDD: Band 38, 39, 40, 41 **		
Max. output power: *	GSM/GPRS/EDGE: Class 4 (33 dBm) @ 850 / 900 MHz Class 1 (30 dBm) @ 1800 / 1900 MHz WCDMA/HSPA+: Class 3 (24 dBm) LTE FDD / TDD: Class 3 (23 dBm)		
Antenna name: *	Embedded antenna design ltd, LTE-Stubby Antenna		
Antenna type: *	External antenna		
Max. antenna gain: *	2.2 dBi		
Antenna connector: *	SMA		

* Declared by the applicant
** Not all bands are used in the end application.

WLAN / WPAN module:

Manufacturer: *	Laird		
Model name: *	Sterling-LWB		
Power supply module: *	DC		
Supply voltage module: *	U_{nom} = 3.3 V DC	U_{min} = 3.0 V DC	U_{max} = 3.6 V DC
Fulfils specification: *	WLAN, IEEE 802.11 b/g/n20		
Type of modulation: *	IEEE 802.11 b: DSSS (1Mbps DBPSK, 2Mbps DQPSK, 5.5/11Mbps CCK) IEEE 802.11 g: OFDM (6/9Mbps BPSK, 12/18Mbps QPSK, 24/36Mbps 16-QAM, 48/54Mbps 64-QAM) IEEE 802.11n (HT20): OFDM (BPSK, QPSK, 16-QAM, 64-QAM)		
Number of channels: *	11		
Fulfils specification: *	WPAN, IEEE 802.15.1 WPAN, IEEE 802.15.4		
Type of modulation: *	IEEE 802.15.1: 1 Mbps: GFSK 2 Mbps: π/4-DQPSK 3 Mbps: 8DPSK IEEE 802.15.4: GFSK (1 Mbit/s; 500 kbit/s; 125 kbit/s)		
Number of channels: *	79 (IEEE 802.15.1), 40 (IEEE 802.15.4)		
Antenna type: *	External antenna		
Antenna name: *	Pulse Electronics, Wireless External Antenna for 2.4 GHz Application		
Antenna gain: *	2.0		
Antenna connector: *	SMA		

* Declared by the applicant

GNSS module:

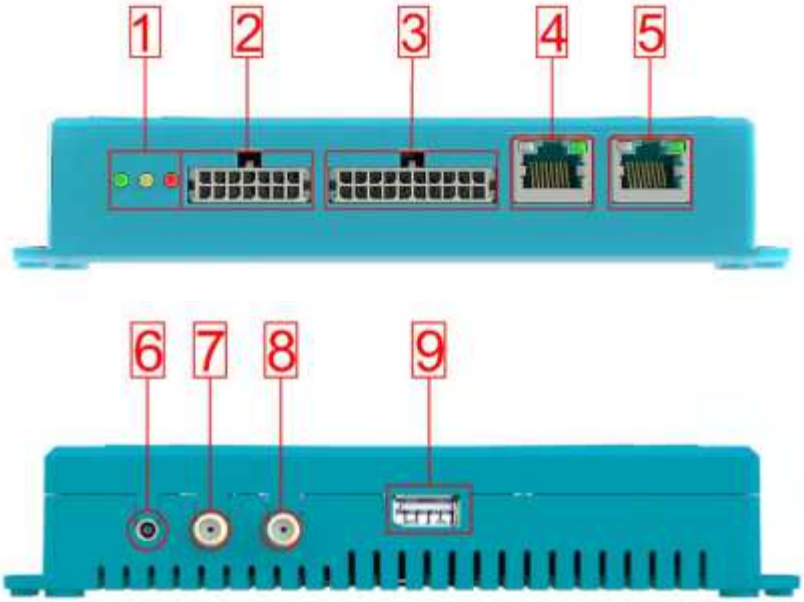
Manufacturer: *	u-blox		
Model name: *	CAM-M8Q		
Power supply GNSS module: *	DC		
Supply voltage GNSS module: *	U_{nom} = 3.0V DC	U_{min} = 2.7 V DC	U_{max} = 3.6 V DC
Supported GNSS: *			

GNSS	GNSS Signals			
BDS	☒ B1I			
Galileo	☒ E1	☐ E5a	☐ E5b	☐ E6
GLONASS	☒ G1	☐ G2		
GPS	☒ L1	☐ L2	☐ L5	
SBAS	☒ L1		☐ L5	

Antenna type: *	External active antenna
Antenna name: *	Navisys, GA0040
Antenna gain: *	4.5 dBic typical, 28 dB gain of amplifier
Antenna connector: *	MCX

* Declared by the applicant

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
DC, DIO, AI (2)	14-pin connector	Laboratory plug	Various	No
RS-232, RS-485/RS-422/SSI CAN, 1-Wire, DIO (3)	20-pin connector	Laboratory plug (DIOs), sim. box (refer ancillary equ.), temperature sensor	Various	No
Ethernet 2x (4, 5)	RJ45	RJ45	Various	No
GNSS antenna (6)	MCX connector	GNSS antenna	< 3 m	Yes
Cellular antenna (7)	SMA connector	Cellular antenna	-	-
WLAN / WPAN antenna (8)	SMA connector	WLAN / WPAN antenna	-	-
USB (9)	USB port	USB stick	-	-



Provided by the applicant

Equipment used for testing	
Simulation box *1	Box that simulates traffic on CAN, RS-232 and RS-485
Laptop *1	Lenovo ideapad 100-15IBY, Model Name: 80MJ
USB stick *2	Kingston DataTraveler 32 GB
AC adapter *2	PHOENIX CONTACT MINI-PS.100-240AC/24DC/1.3

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

1.6 Dates

Date of receipt of test sample:	20.10.2023
Start of test:	24.10.2023
End of test:	27.10.2023

2 Operational States

Description of function of the EUT:

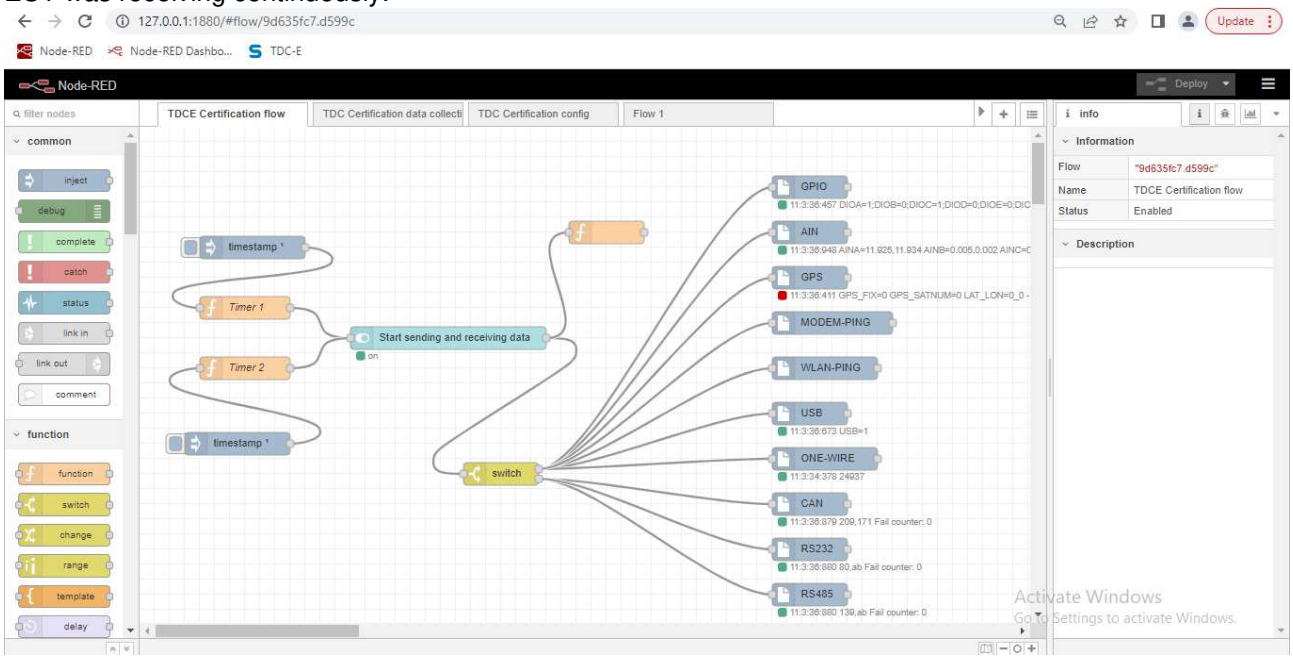
TDC-E220AC is industrial sensor gateway that is built on embedded system with Docker platform.

The TDC-E220AC gateway system is a system that receives and processes sensor data, and then forwards these data to a higher-level infrastructure (cloud server or local server). The system functions can be extended via the integrated applications or by adding user-defined applications.

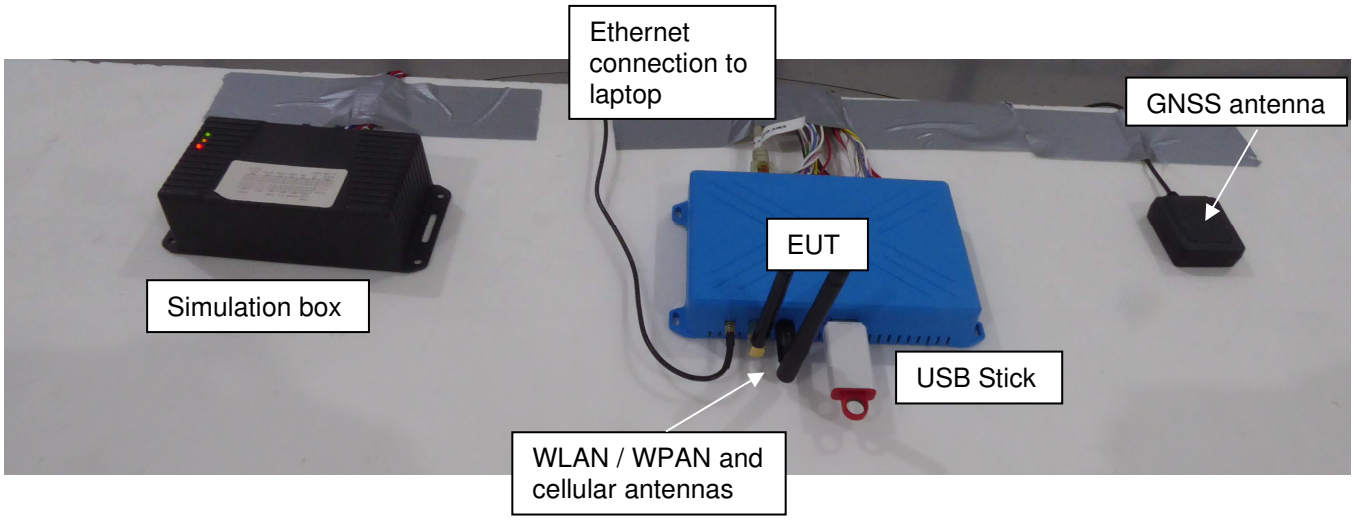
The following states were defined as the operating conditions:
The EUT was supplied by 24 V DC during all tests.

The EUT was connected to an ancillary laptop via Ethernet. A Node-RED dashboard was running on the laptop which showed if the digital functions of the EUT were running / active. The dashboard and thus the needed programming, etc. was created by the applicant. A simulation box was connected to the EUT which simulates traffic for CAN, RS-232 and RS-485. All digital / analogue IOs were powered with 12 V DC via a laboratory power supply. All non-radio functions (DIOs, AIs, CAN, RS-232, RS-485, 1-Wire) were active during the measurements and monitored via the Node-RED dashboard. A USB Stick has been connected to the USB port.

Additionally, WLAN, WPAN and cellular part of the EUT, were not in transmit mode. and the GNSS function of the EUT was receiving continuously.

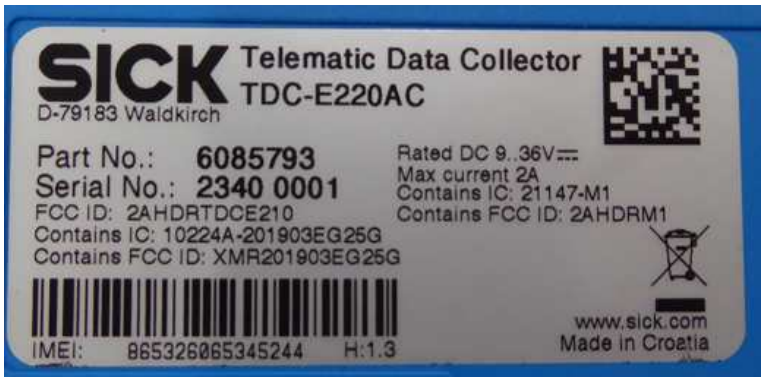


The system was setup as follows:



3 Additional Information

The applicant has done some changes to the digital part. Therefore, spurious emissions measurements have been conducted to apply for a class 2 permissive change. For more information, please refer to the C2PC letter provided by the applicant.
The EUT was labeled as required by FCC / IC.



4 Overview

Conducted emissions FCC 47 CFR Part 15 section 15.107 (a), (b) [3] ICES-003 Issue 7 section 3.2.1[4]					
Application	Frequency range	Limits	Reference standard	Tested EUT	Status
AC supply line Class B	0.15 to 0.5 MHz 0.5 to 5 MHz 5 to 30 MHz	66 to 56 dB(µV) QP* 56 to 46 dB(µV) AV* 56 dB(µV) QP 46 dB(µV) AV 60 dB(µV) QP 50 dB(µV) AV	ANSI C63.4	1	Passed
*: Decreases with the logarithm of the frequency					

Radiated emissions FCC 47 CFR Part 15 section 15.109 (a), (b) [3]					
Application	Frequency range	Limits	Reference standard	Tested EUT	Status
Radiated Emission Class B	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz above 1000 MHz	40.0 dB(µV/m) QP at 3 m 43.5 dB(µV/m) QP at 3 m 46.0 dB(µV/m) QP at 3 m 54.0 dB(µV/m) QP at 3 m 54.0 dB(µV/m) AV at 3 m and 74.0 dB(µV/m) PK at 3 m	ANSI C63.4	1	Passed

Radiated emissions ICES-003 Issue 7 section 3.2.2 [4]					
Application	Frequency range	Limits	Reference standard	Tested EUT	Status
Radiated Emission Class B	30 to 88 MHz 88 to 216 MHz 216 to 230 MHz 230 to 960 MHz 960 to 1000 MHz above 1000 MHz	40.0 dB(µV/m) QP at 3 m 43.5 dB(µV/m) QP at 3 m 46.0 dB(µV/m) QP at 3 m 47.0 dB(µV/m) QP at 3 m 54.0 dB(µV/m) QP at 3 m 54 dB(µV/m) AV at 3 m and 74 dB(µV/m) PK at 3 m	ANSI C63.4	1	Passed

Remark: As declared by the applicant the highest frequency is 2690 MHz.
Therefore the radiated emission measurement must be carried out up to the 5th harmonic of 2690 MHz, in this case the measurement was carried out up to 14 GHz.

The EUT was classified by the applicant as CLASS B equipment.

5 Results

5.1 Test setups

5.1.1 Radiated: 30 MHz to 1 GHz

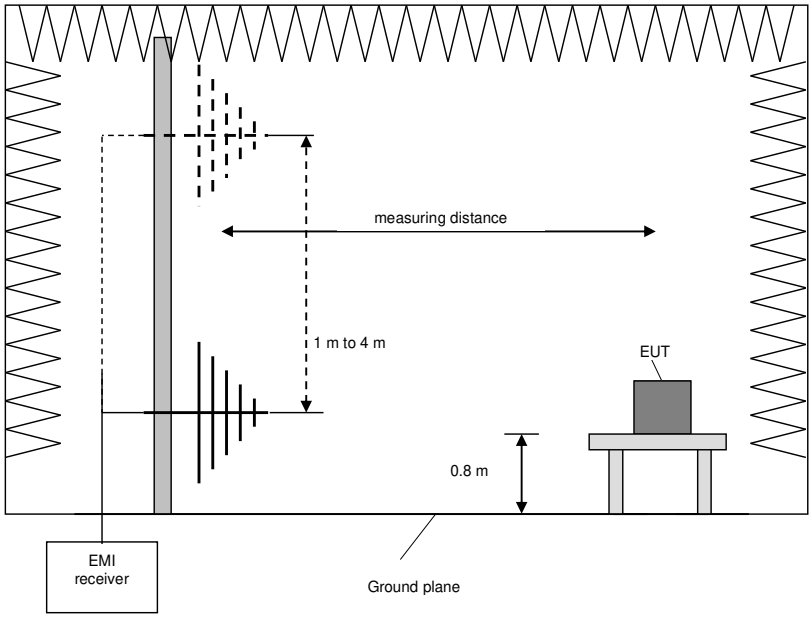
5.1.1.1 Preliminary and final measurement 30 MHz to 1 GHz

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.

5.1.2 Radiated: 1 GHz to 40 GHz

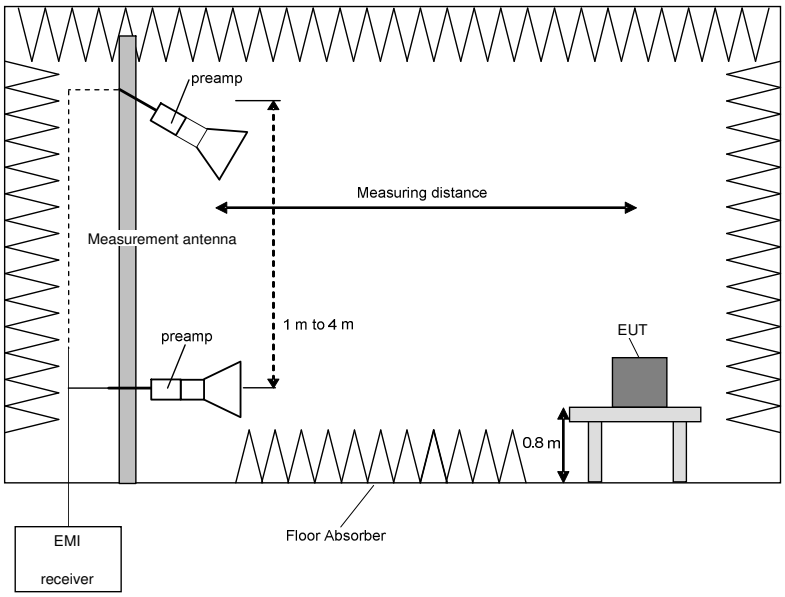
5.1.2.1 Preliminary and final measurement 1 GHz to 40 GHz

The preliminary and final measurements are performed in a semi-anechoic chamber at a measuring distance of 3 meters, with floor absorbers between EUT and measuring antenna. 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. While changing the height, the measuring antenna gets tilted so that it is always aiming at the EUT.

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	250 kHz	1 MHz	-	Peak Average
Frequency peak search	+ / - 1 MHz	50 kHz	1 MHz	100 ms	Peak
Final measurement	1 - 40 GHz	-	1 MHz	100 ms	Peak 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:

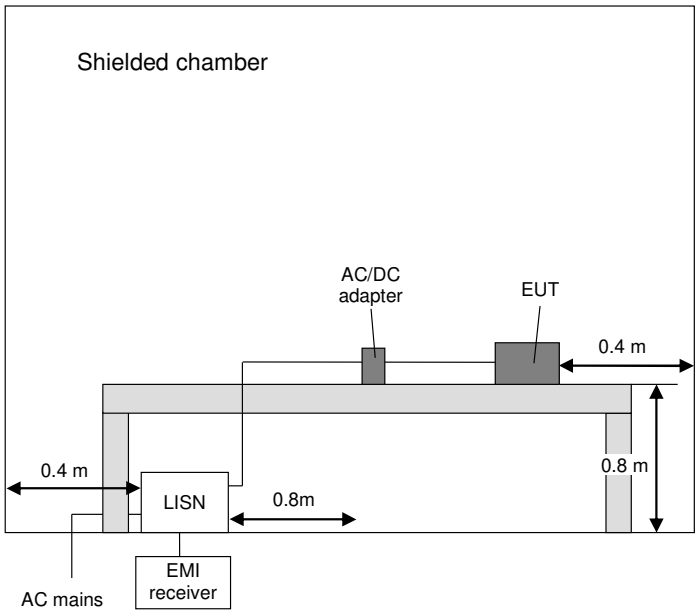
1) Select the highest frequency peaks (lowest margin to the limit) for the final measurement.
2) The software determines the exact peak frequencies by doing a partial scan with reduced step size of the pre-scan of the selected peaks.
3) If the EUT is portable or ceiling mounted, find the worst-case EUT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

5.2.1 Test setup (Maximum unwanted emissions)

Test setup (Maximum unwanted emissions)			
Used	Setup	See sub-clause	Comment
☒	Radiated: 30 MHz to 1 GHz / 1 GHz to 40 GHz	5.1.1 / 5.1.2	-

5.2.2 Test method (Maximum unwanted emissions)

☒ Test method (radiated) see sub-clause 5.1.1 / 5.1.2 as described herein

5.2.3 Test results (Maximum unwanted emissions)

5.2.3.1 Test results (30 MHz – 1 GHz)

Ambient temperature:	22 °C
Relative humidity:	41 %

Date:	27.10.2023
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: None

Calculations:

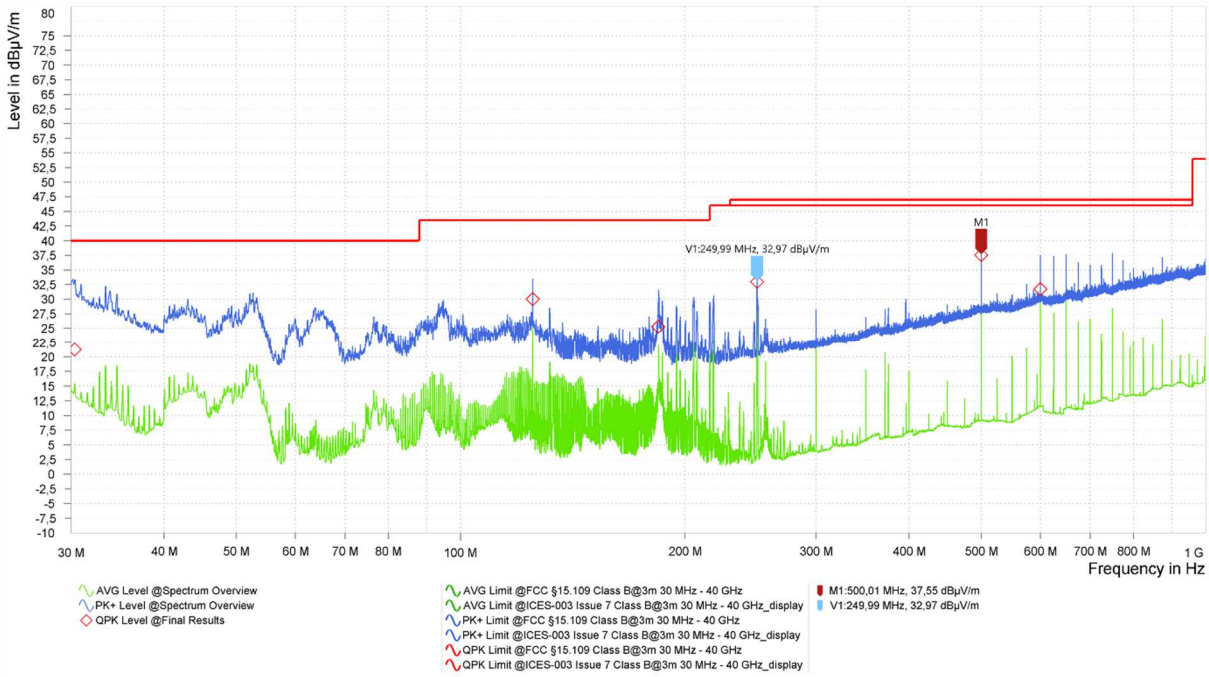
Result [dBµV/m] = Reading [dBµV] + Correction [dB/m]

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

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

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.

Spurious emissions from 30 MHz to 1 GHz :



Result tables:

Results according to FCC 47 CFR Part 15 section 15.109 (a), (b) [3]

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Height [cm]	Azimuth [deg]	Pol. (H/V)	Position #
30.360	21.22	40.00	18.78	25.76	150	356	V	lying
125.010	30.01	43.50	13.49	17.24	101	70	V	lying
184.230	25.30	43.50	18.20	15.36	103	327	V	lying
249.990	32.97	46.00	13.03	17.32	106	175	V	lying
500.010	37.55	46.00	8.45	24.54	144	208	H	lying
600.000	31.72	46.00	14.28	26.06	138	188	H	lying

Results according to ICES-003 Issue 7 section 3.2.2 [4]

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Height [cm]	Azimuth [deg]	Pol. (H/V)	Position #
30.360	21.22	40.00	18.78	25.76	150	356	V	lying
125.010	30.01	43.50	13.49	17.24	101	70	V	lying
184.230	25.30	43.50	18.20	15.36	103	327	V	lying
249.990	32.97	46.00	13.03	17.32	106	175	V	lying
500.010	37.55	46.00	8.45	24.54	144	208	H	lying
600.000	31.72	46.00	14.28	26.06	138	188	H	lying

Test result: Passed

Test equipment (please refer to chapter 7 for details)
3 - 11

5.2.3.2 Test results (radiated 1 GHz to 14 GHz)

Ambient temperature:	22 °C
Relative humidity:	47 %

Date:	24.10.2023
Tested by:	Y. KHALEK

Position of EUT: For tests for f between 1 GHz and the 5th harmonic, 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: The EUT has been tested in lying position. For more information, refer to test setup photos

Calculation:

Max Peak [dBµV/m] = Reading [dBµV] + Correction [dB/m]

Average [dBµV/m] = Reading [dBµV] + Correction [dB/m]

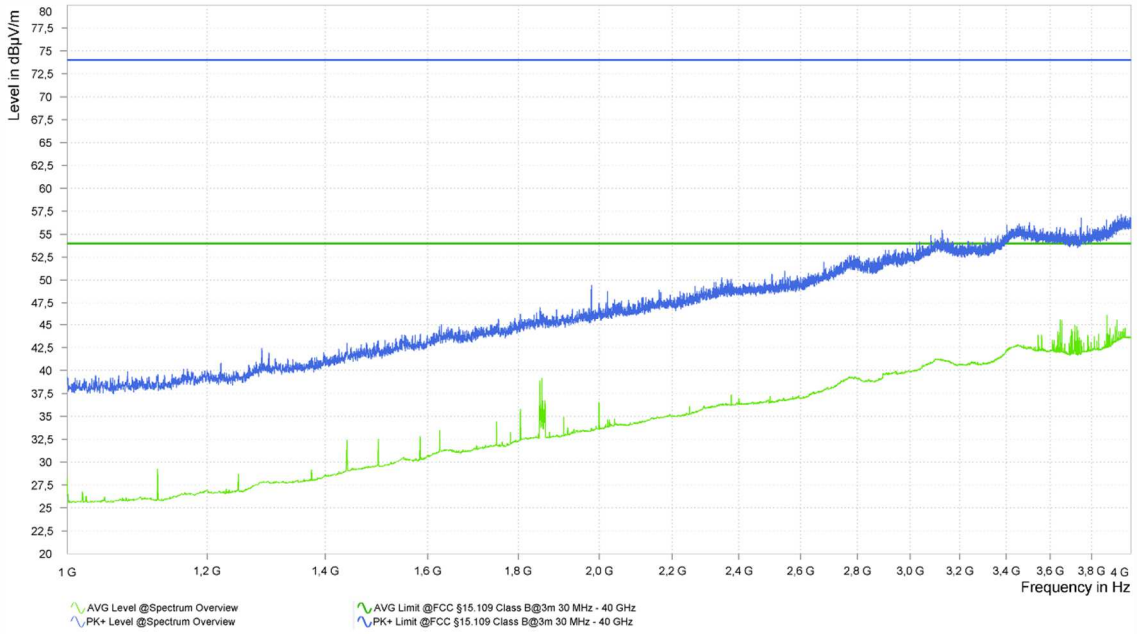
Correction [dB/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]+DCCF* [dB]
* (if applicable – only for Average values, that are fundamental related)

Margin [dB] = Limit [dBµV/m] – Max Peak | Average [dBµV/m]

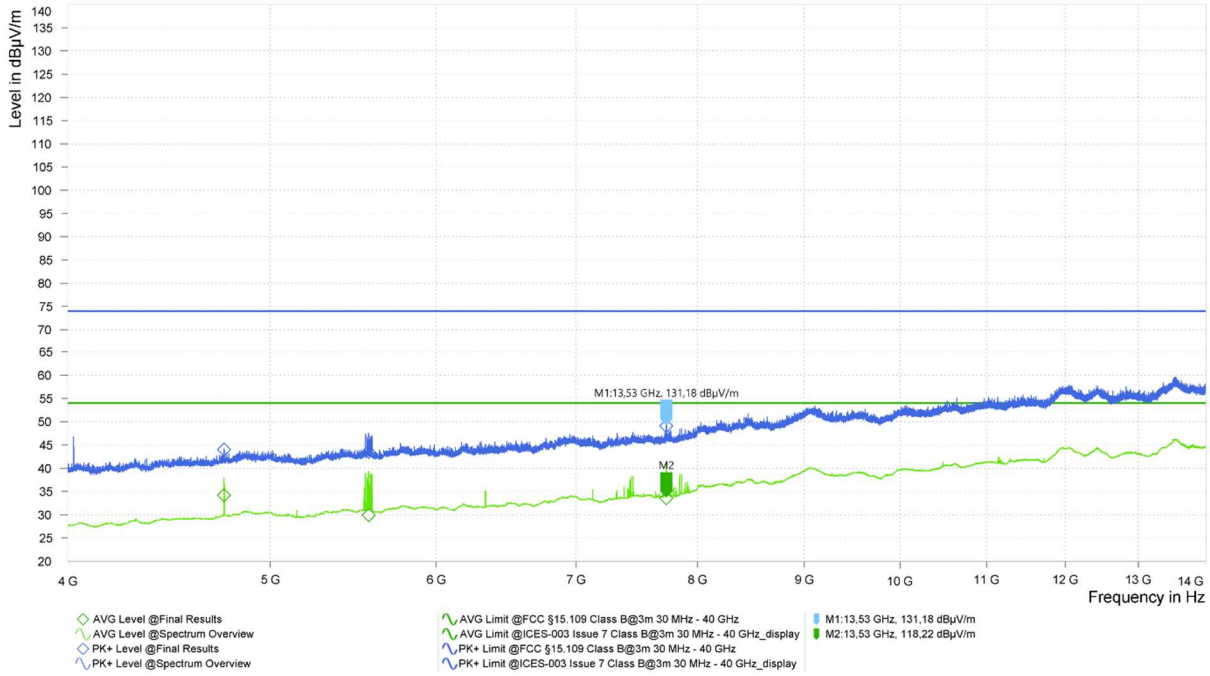
The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with various EUT and antenna positions.
The top measured curve represents the peak measurement. The measured points marked with "◇" are frequency points for the final peak detector measurement. These values are indicated in the following table. The bottom measured curve represents the average measurement. The measured points marked with "◇" are frequency points for the final average detector measurement.

Plots:

Spurious emissions from 1 GHz to 4 GHz:



Spurious emissions from 4 GHz to 14 GHz:



Result tables:

Frequency [MHz]	PK level [dB(µV/m)]	PK Limit [dB(µV/m)]	PK Margin [dB(µV/m)]	Average [dB(µV/m)]	AVG Limit [dB(µV/m)]	AVG Margin [dB(µV/m)]	Height [m]	Pol [H/V]	Azimuth [deg]	Corr. [dB]
4752.000	44.04	74.00	29.96	34.20	54.00	19.80	2.25	V	64	9.01
5571.250	43.56	74.00	30.44	29.95	54.00	24.05	2.87	V	20	11.22
7732.000	49.09	74.00	24.91	33.55	54.00	20.45	2.43	H	340	14.59

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1-2, 5-11, 18

5.3 AC power-line conducted emissions

5.3.1 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	5.1.3	passed
☐	Not applicable, because …	-	-

5.3.2 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
☒	7.3; 11.5; 11.8	Tabletop equipment testing	5.1.3	AC switching power adaptor provided by test lab
☐	7.3; 11.6; 11.8	Floor-standing equipment testing	-	-

An of the shelf AC power adaptor was used by the test laboratory because the applicant has not provided one: PHOENIX CONTACT MINI-PS.100-240AC/24DC/1.3

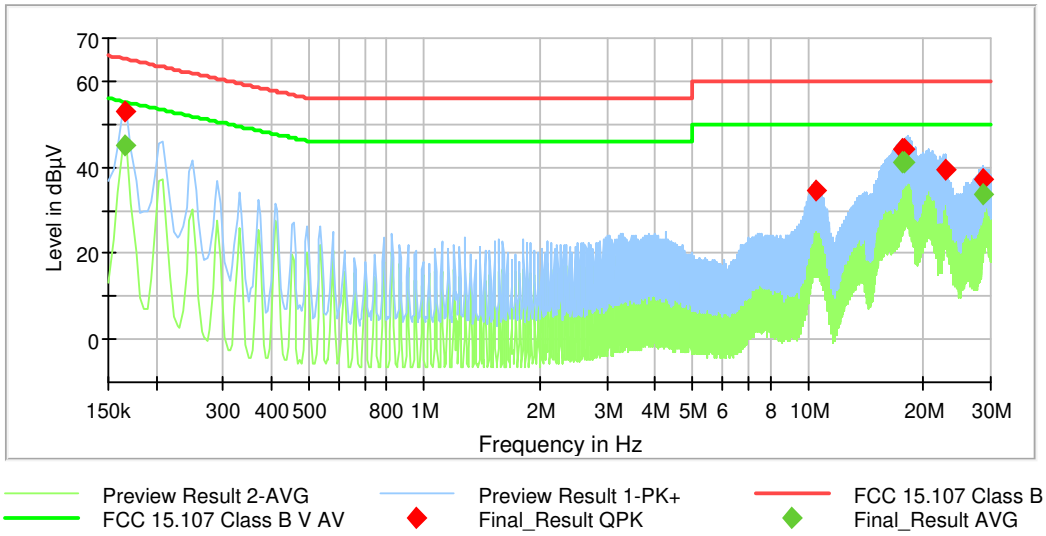
The power adaptor itself was supplied by 120V_{AC} 60Hz.

5.3.3 Test results (Conducted emissions on power supply lines)

Ambient temperature:	26°C
Relative humidity:	46 %

Date:	12.05.2023
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 ▼.



Frequency [MHz]	QuasiPeak [dB(µV)]	Average [dB(µV)]	Limit [dB(µV)]	Margin [dB]	Line	PE	Corr. [dB]
0.165300	52.77	---	65.19	12.42	L1	FLO	9.8
0.165300	---	45.25	55.19	9.94	L1	FLO	9.8
10.516200	34.75	---	60.00	25.25	N	FLO	10.6
17.566800	44.02	---	60.00	15.98	L1	GND	10.9
17.568600	---	41.22	50.00	8.78	L1	FLO	10.9
17.898900	44.42	---	60.00	15.58	L1	FLO	10.9
17.898900	---	41.16	50.00	8.84	L1	GND	10.9
22.891200	39.35	---	60.00	20.65	L1	FLO	10.9
28.742100	37.32	---	60.00	22.68	L1	GND	11.2
28.744800	---	33.74	50.00	16.26	L1	GND	11.2

Test result: Passed

Test equipment (please refer to chapter 7 for details)
12-17

6 Measurement Uncertainties

Conducted measurements		
Measurement method	Standard used for calculating measurement uncertainty	Expanded measurement uncertainty (95 %) U_{lab}
Conducted emissions from 150 kHz to 30 MHz with LISN	CISPR 16-4-2	2.8 dB

Radiated measurements		
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

7 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Low Noise Amplifier 100 MHz - 18 GHz	LNA-30-00101800-25-10P	Narda-Miteq	2110917	482967	18.02.2022	02.2024
2	Log.-Per. antenna	HL050	Rohde & Schwarz	100908	482977	22.09.2022	09.2025
3	Attenuator 6 dB	WA2-6	Weinschel		482793	Calibration not necessary	
4	Ultralog Antenna	HL562E	Rohde & Schwarz	101079	482978	18.03.2021	03.2024
5	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
6	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
7	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
8	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
9	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
10	Testsoftware M276	Elektra version 5.00	Rohde&Schwarz	101381	483755	Calibration not necessary	
11	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	08.12.2021	12.2023
12	LISN	NSLK8128	Schwarzbeck	8128155	480058	14.02.2022	02.2024
13	AC Source	AC6803A AC Source 2000VA	Keysight	JPVJ002509	482350	Calibration not necessary	
14	Software	EMC32 version V10.60.20	Rohde & Schwarz	100061	481022	Calibration not necessary	
15	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
16	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	16.02.2022	02.2024
17	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	15.02.2022	02.2024
18	Highpass Filter	WHKX4.0/18G-8SS	Wainwright Instruments GmbH	1	480587	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	08.11.2022	07.11.2024
Semi anechoic chamber M276	483227	30 MHz– 1000 MHz	NSA/RSM	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	01.03.2023	28.02.2025
Semi anechoic chamber M276	483227	1 GHz - 18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	28.02.2023	27.02.2025

9 Report History

Report Number	Date	Comment
F231651E1	05.12.2023	Initial Test Report
F231651E1 2nd version	23.02.2024	Added additional information for C2PC in page 11
F231651E1 3rd version	15.03.2024	- Added additional EUT information - Added pictures in the internal photos annex. - Editorial changes

10 List of Annexes

Annex A	Test Setup Photos	4 pages
Annex B	EUT External Photos	2 pages
Annex C	EUT Internal Photos	5 pages