PHOENIX TESTLAB

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Test Report

Report Number:

F191188E1

Equipment under Test (EUT):

TDC-E210AC

Applicant:

SICK AG

Manufacturer:

Mobilisis d.o.o.

ilac-MRA

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

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:		Ruben BRAUN 18.03.2022
	Signature	
Reviewed and approved by:		Bernd STEINER 18.03.2022
	Signature	

This test report is only valid in its original form.

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1 Identification

1.1 Applicant

Name:	SICK AG
Address:	Erwin-Sick-Str.1 DE-79183 Waldkirch
Country:	Germany
Name for contact purposes:	Mr. Patrick FLAIG
Phone:	+49 7681 202-6776
eMail address:	patrick.flaig@sick.de
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	Mobilisis d.o.o.
Address:	Varaždinska ulica - Odvojak II 7 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:	-

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: *	Telematic data collector
Model name: *	TDC-E210AC
Model number: *	6079357
Order number: *	6079357
FCC ID: *	2AHDRTDCE210
Contains FCC ID: *	XMR201903EG25G 2AHDRM1
Contains IC ID: *	10224A-201903EG25G 21147-M1

	EUT number		
	1	2	3
Serial number: *	1943 0003	2020 0001	2020 0002
PCB identifier: *	1.3	1.3	1.3
Hardware version: *	1.3 r3	1.3 r3	1.3 r3
Software version: *	TDC-E OS System Version 1.0.7	TDC-E OS System Version 1.0.7	TDC-E OS System Version 1.0.7

* Declared by the applicant

3 different EUTs were used for the tests. EUT 1 was used for the radiated emissions test in the frequency range 30 MHz – 12 GHz. EUT 2 was used for the radiated emissions test in the frequency range 12 – 14 GHz. EUT 3 was used for the conducted emissions on power supply lines test.

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		

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: *	MPA19DP3E001427 (EUT 1), MPA19IA0E001459 (EUT 2), MPA19IA0E000069 (EUT 3)					
IMEI: *	867698040131024 (EUT 1), 867698040563861 (EUT 2), 867698040549969 (EUT 3)					
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					

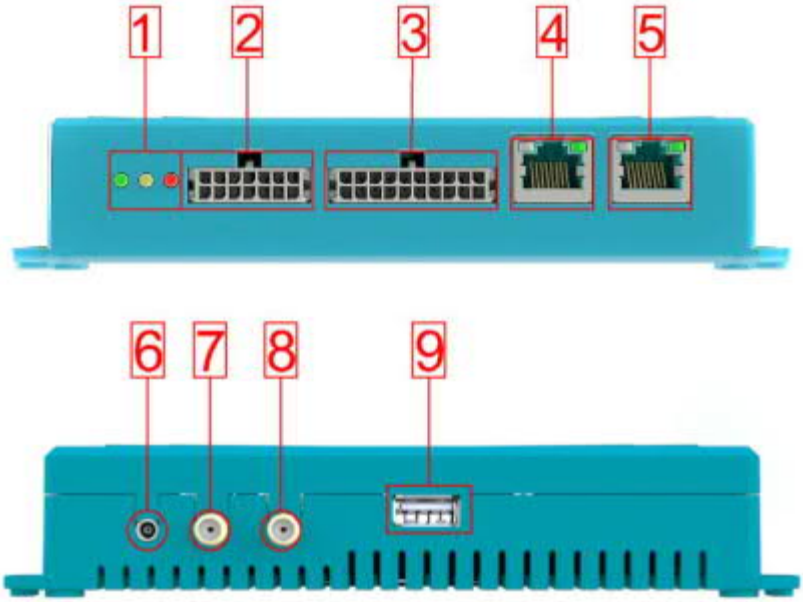
* Declared by the applicant

GNSS module:

<table>
<tr><td>Manufacturer: *</td><td colspan="6">u-blox</td></tr>
<tr><td>Model name: *</td><td colspan="6">CAM-M8Q</td></tr>
<tr><td>Power supply GNSS module: *</td><td colspan="6">DC</td></tr>
<tr><td>Supply voltage GNSS module: *</td><td>U_{nom} =</td><td>3.0V DC</td><td>U_{min} =</td><td>2.7 V DC</td><td>U_{max} =</td><td>3.6 V DC</td></tr>
<tr><td>Supported GNSS: *</td><td colspan="6">
<table>
<tr><th>GNSS</th><th colspan="4">GNSS Signals</th></tr>
<tr><td>BDS</td><td>☒ B1I</td><td></td><td></td><td></td></tr>
<tr><td>Galileo</td><td>☒ E1</td><td>☐ E5a</td><td>☐ E5b</td><td>☐ E6</td></tr>
<tr><td>GLONASS</td><td>☒ G1</td><td>☐ G2</td><td></td><td></td></tr>
<tr><td>GPS</td><td>☒ L1</td><td>☐ L2</td><td>☐ L5</td><td></td></tr>
<tr><td>SBAS</td><td>☒ L1</td><td></td><td>☐ L5</td><td></td></tr>
</table>
</td></tr>
<tr><td>Antenna type: *</td><td colspan="6">External active antenna</td></tr>
<tr><td>Antenna name: *</td><td colspan="6">Navisys, GA0040</td></tr>
<tr><td>Antenna gain: *</td><td colspan="6">4.5 dBic typical, 28 dB gain of amplifier</td></tr>
<tr><td>Antenna connector: *</td><td colspan="6">MCX</td></tr>
</table>

* 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	-	-



Equipment used for testing	
Simulation box *1	Box that simulates traffic on CAN, RS-232 and RS-485
Laptop *1	Lenovo ideapad 100-15IBY
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:	28.10.2019
Start of test:	07.04.2020
End of test:	18.08.2021

2 Operational States

Description of function of the EUT:
TDC-E is industrial sensor gateway that is built on embedded system with Docker platform.

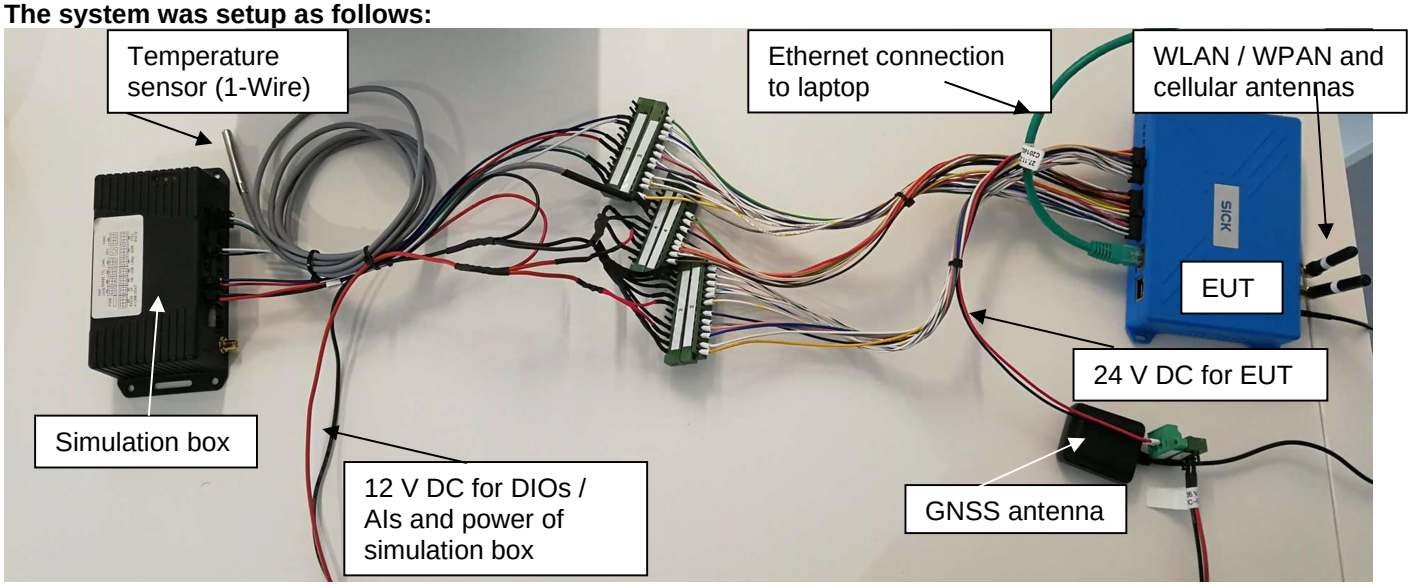
The TDC-E gateway system is a system that receives and processes sensor data, and then forwards these data to a higher-level infrastructure (cloud server or local server). The system functions can be extended via the integrated applications or by adding user-defined applications.

For the tests, the EUT was running in normal operation mode, except for the WLAN, WPAN and cellular part of the EUT, which were not activated.

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 or a 12 V DC battery.
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.
Additionally, the GNSS function of the EUT was receiving continuously.

The system was setup as follows:

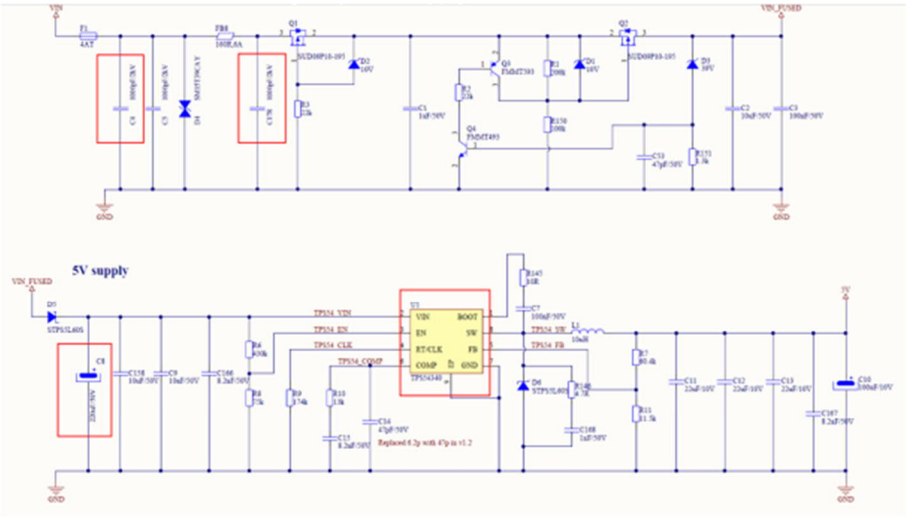


3 Additional Information

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

3 different EUTs were used for the tests.
EUT 1 was used for the radiated emissions test in the frequency range 30 MHz – 12 GHz.
EUT 2 was used for the radiated emissions test in the frequency range 12 – 14 GHz.
EUT 3 was used for the conducted emissions on power supply lines test.

According to the applicant the following changes were done for EUT 2 and 3 compared to EUT 1:



C4 and C178 (1000pF/2kV) replaced with 10uF/50V capacitor.
C8 (200uF/50V) is replaced with 330uF/50V from same series of capacitor.
U1 (TPS54340) is replaced with TPS54340B, direct replacement this DC switcher.

The reason for the changes were issues with compliance testing for European standards.

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	3	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, 2	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, 2	Passed

Remark: As declared by the applicant the highest internal clock frequency is 2690 MHz.
Therefore, the radiated emission measurement must be carried out up to 5th of the highest internal clock frequency in this case 14 GHz.
The EUT was classified by the applicant as CLASS B equipment.

5 Results

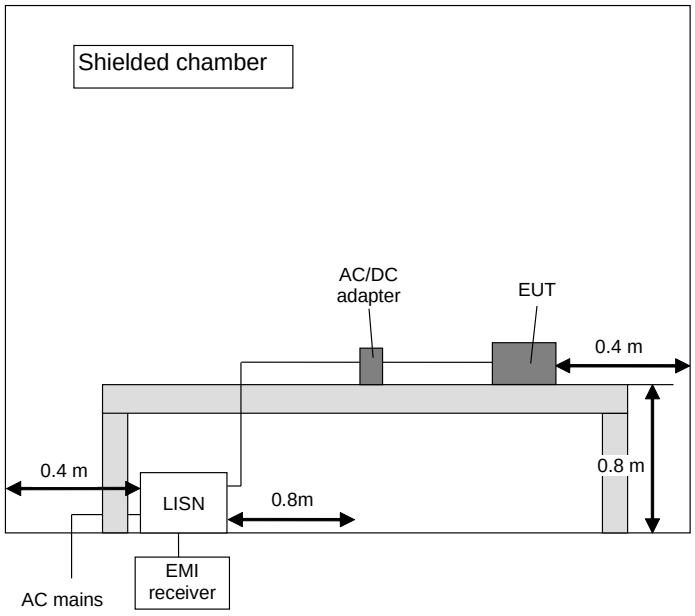
5.1 Conducted emissions on power supply lines

5.1.1 Test method

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
150 kHz to 30 MHz	9 kHz

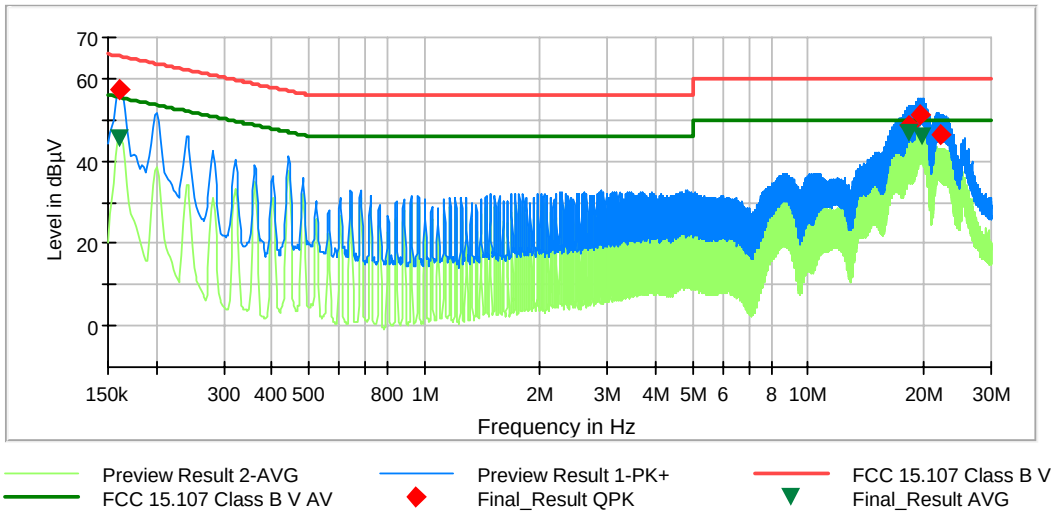


5.1.2 Test results

Ambient temperature:	22 °C
Relative humidity:	45 %

Date:	06.10.2020
Tested by:	R. BRAUN

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 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
0.159900	---	45.37	55.47	10.10	5000.0	9.000	L1	GND	9.8
0.160800	57.29	---	65.42	8.14	5000.0	9.000	N	FLO	9.8
18.282750	---	46.81	50.00	3.19	5000.0	9.000	L1	GND	10.7
18.291750	48.66	---	60.00	11.34	5000.0	9.000	L1	GND	10.7
19.655250	51.27	---	60.00	8.73	5000.0	9.000	L1	FLO	10.8
19.686750	---	46.06	50.00	3.94	5000.0	9.000	L1	GND	10.8
22.261650	46.51	---	60.00	13.49	5000.0	9.000	N	GND	10.7

Measurement uncertainty ±2.8 dB

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1 - 4

5.2 Radiated emissions

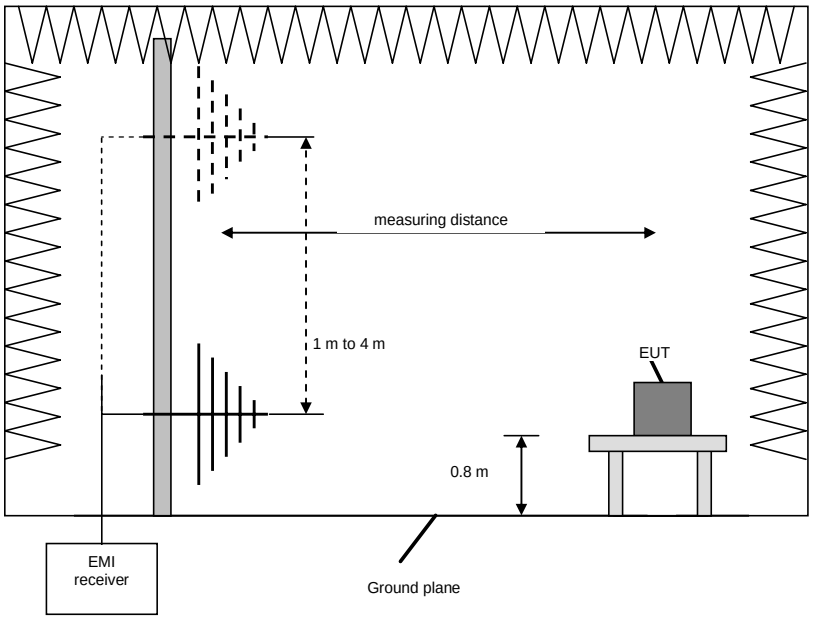
5.2.1 Test method

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 in a 3 m distance.
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	Resolution bandwidth
Preliminary measurement	30 MHz to 1 GHz	100 kHz
Frequency peak search	+ / - 1 MHz	10 kHz
Final measurement	30 MHz to 1 GHz	120 kHz



Procedure preliminary measurement:

The following procedure is used:

1) Set the measuring antenna to 1 m height.
2) Monitor the frequency range at horizontal polarisation 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 polarisation 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:

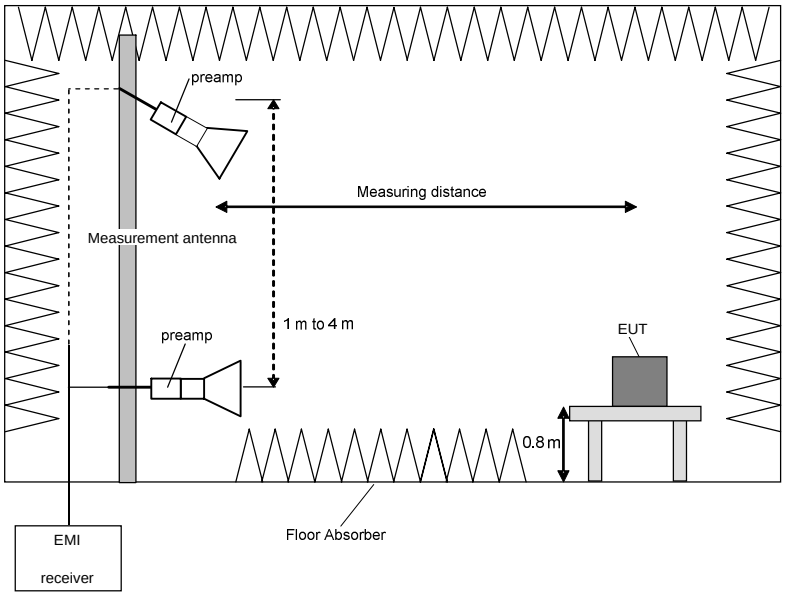
1) Select the highest frequency peaks (lowest margin to the limit) for the final measurement.
2) The software determines the exact peak frequencies by doing a partial scan with reduced RBW with +/- 10 times the RBW of the pre-scan of the selected peaks.
3) If the EUT is portable or ceiling mounted, find 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.

Preliminary and final measurement > 1 GHz

The preliminary and final measurements are performed in a semi-anechoic chamber with floor absorbers between EUT and measuring antenna. The measuring distance is 3 m.
During the tests the EUT is rotated in the range of 0 ° to 360 °, the measuring antenna is set to horizontal and vertical polarisation 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	Resolution bandwidth
Preliminary measurement	1 - 40 GHz	1 MHz
Frequency peak search	+ / - 10 MHz	100 kHz
Final measurement	1 - 40 GHz	1 MHz



Procedure preliminary measurement:

The following procedure is used:

1) Set the measuring antenna to 1 m height.
2) Monitor the frequency range at horizontal polarisation 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 polarisation 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:

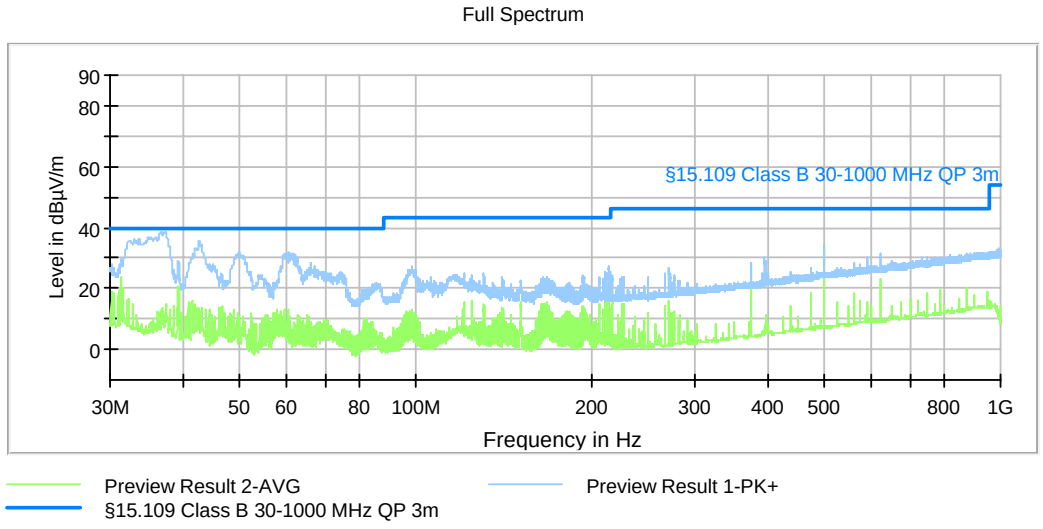
1) Select the highest frequency peaks (lowest margin to the limit) for the final measurement.
2) The software determines the exact peak frequencies by doing a partial scan with reduced RBW with +/- 10 times the RBW of the pre-scan of the selected peaks.
3) If the EUT is portable or ceiling mounted, find 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.

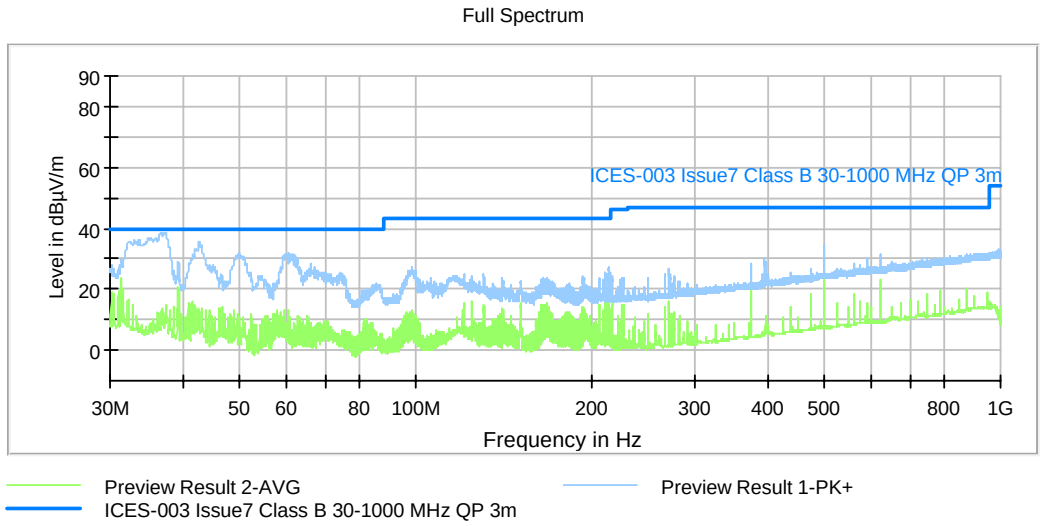
5.2.2 Test results final measurement 30 MHz to 1 GHz

Ambient temperature:	23 °C
Relative humidity:	32 %

Date:	07.04.2020
Tested by:	R. BRAUN

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 standards.





The results of the standard subsequent measurement in a semi-anechoic chamber 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 3 m measuring distance.

Frequency in MHz	QuasiPeak in dB(µV/m)	Limit in dB(µV/m)	Margin in dB	Meas. Time in ms	Bandwidth in kHz	Height in cm	Pol	Azimuth in deg	Corr. in dB
32.980	15.1	40.0	24.9	1000.0	120.0	110.0	V	236.0	23.8
36.810	18.6	40.0	21.4	1000.0	120.0	100.0	V	203.0	21.7
37.350	19.8	40.0	20.2	1000.0	120.0	100.0	V	203.0	21.4
42.540	19.9	40.0	20.1	1000.0	120.0	102.0	V	297.0	18.2
49.980	13.7	40.0	26.3	1000.0	120.0	102.0	V	23.0	13.7
500.010	28.3	46.0	17.7	1000.0	120.0	150.0	H	252.0	24.6

Test result: Passed

The correction factor was calculated as follows:
Corr. (dB) = cable attenuation (dB) + 6 dB attenuator (dB) + antenna factor (dB)

Therefore, the reading can be calculated as follows:
Reading (dBµV/m) = result QuasiPeak (dBµV/m) - Corr. (dB)

Test equipment (please refer to chapter 7 for details)
5 - 13

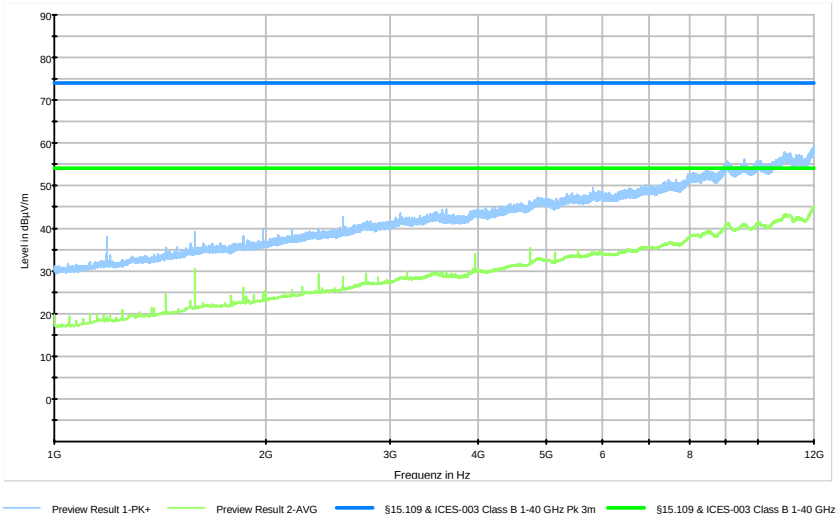
5.2.3 Test results final measurement above 1 GHz

5.2.3.1 1 – 12 GHz

Ambient temperature:	23 °C
Relative humidity:	32 %

Date:	07.04.2021
Tested by:	R. BRAUN

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 bottom measured curve represents the average measurement.



The results of the standard subsequent measurement above 1 GHz in a semi-anechoic chamber 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 3 m measuring distance.

Frequency in MHz	MaxPeak in dB(µV/m)	Average in dB(µV/m)	Limit in dB(µV/m)	Margin in dB	Meas. Time in ms	Bandwidth in MHz	Height in cm	Pol	Azimuth in deg	Corr. in dB
1187.700	36.1	---	74.0	37.9	100.0	1000.0	123.0	V	-5.0	-9.4
1187.700	---	18.6	54.0	35.4	100.0	1000.0	123.0	V	-5.0	-9.4
1584.100	40.5	---	74.0	33.5	100.0	1000.0	104.0	V	46.0	-6.0
1584.100	---	29.9	54.0	24.1	100.0	1000.0	104.0	V	46.0	-6.0
2574.100	---	26.3	54.0	27.7	100.0	1000.0	246.0	H	321.0	-0.3
2574.100	41.7	---	74.0	32.3	100.0	1000.0	246.0	H	321.0	-0.3
11988.250	---	43.0	54.0	11.0	100.0	1000.0	300.0	V	170.0	22.4
11988.250	55.4	---	74.0	18.6	100.0	1000.0	300.0	V	170.0	22.4

Test result: Passed

The correction factor was calculated as follows:
Corr. (dB) = cable attenuation (dB) + preamplifier (dB) + antenna factor (dB)

Therefore, the reading can be calculated as follows:
Reading (dBµV/m) = result Peak or Average (dBµV/m) - Corr. (dB)

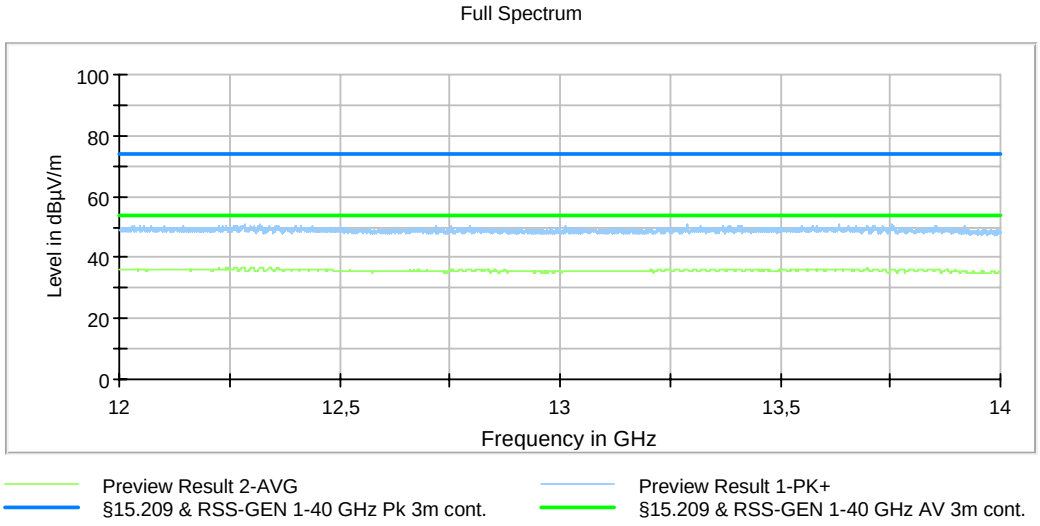
Test equipment (please refer to chapter 7 for details)
7 - 13, 15, 17

5.2.3.2 12 – 14 GHz

Ambient temperature:	22 °C
Relative humidity:	49 %

Date:	18.08.2021
Tested by:	R. BRAUN

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 bottom measured curve represents the average measurement.



The results of the standard subsequent measurement above 1 GHz in a semi-anechoic chamber 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 3 m measuring distance.

Frequency in MHz	MaxPeak in dB(µV/m)	Average in dB(µV/m)	Limit in dB(µV/m)	Margin in dB	Meas. Time in ms	Bandwidth in MHz	Height in cm	Pol	Azimuth in deg	Corr. in dB
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Test result: Passed

The correction factor was calculated as follows:
Corr. (dB) = cable attenuation (dB) + preamplifier (dB) + antenna factor (dB)

Therefore, the reading can be calculated as follows:
Reading (dBµV/m) = result Peak or Average (dBµV/m) - Corr. (dB)

Test equipment (please refer to chapter 7 for details)
7 – 14, 16

6 Measurement Uncertainties

Measurement method	Standard used for calculating measurement uncertainty	Expanded measurement uncertainty (95 %) Ulab	Umax, acc. to standards
Conducted emissions from 150 kHz to 30 MHz with LISN	DIN EN 55016-4-2	2.8 dB	-
Radiated field strength M276 (FCC)			
R&S HL562E @ 3 m 30 MHz – 1 GHz	DIN EN 55016-4-2	4.8 dB	-
R&S HL050 @ 3 m	-	-	-
1 – 6 GHz	DIN EN 55016-4-2	5.1 dB	-
6 – 12 GHz	DIN EN 55016-4-2	5.4 dB	-
Flann Standard Gain Horns 12 – 40 GHz	DIN EN 55016-4-2	5.9 dB	-

7 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	LISN	NSLK8128RC	Rohde & Schwarz	0412	483186	Calibration not necessary	
2	Shielded chamber M155	SK3	Albatross Projects		482786	Calibration not necessary	
3	Software	EMC32	Rohde & Schwarz	100619	483182	Calibration not necessary	
4	EMI receiver / spectrum analyzer	ESR7	Rohde & Schwarz	101939	482558	18.02.2020	02.2022
5	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
6	Ultralog antenna	HL562E	Rohde & Schwarz	101079	482978	07.08.2019 18.03.2021	08.2022 03.2024
7	Software	EMC32	Rohde & Schwarz	100970	482972	Calibration not necessary	
8	RF switch matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
9	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
10	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
11	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
12	Semi-anechoic chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
13	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	14.11.2019	11.2021
14	Low noise amplifier	LNA-30-12001800-13-10P	Narda-Miteq	2089798	482968	Calibration not necessary	
15	Log.-per. antenna	HL050	Rohde & Schwarz	100908	482977	13.08.2019	08.2022
16	Standard gain horn	18240-20	Pro Nova	269813	483215	Calibration not necessary	
17	Low noise amplifier	LNA-30-00101800-25-10P	Narda-Miteq	2110917	482967	18.02.2020	02.2022

8 Test site Validation

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Shielded chamber M155	482784	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	25.09.2020	24.09.2022
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA/RSM	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	28.10.2019	27.10.2021
Semi anechoic chamber M276	483227	1 -18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	28.10.2019 19.02.2021	27.10.2021 18.02.2023

9 Report History

Report Number	Date	Comment
F191188E1	18.03.2022	Initial Test Report
-	-	-
-	-	-

10 List of Annexes

Annex A	Test Setup Photos	6 pages