

Test Report

Report Number:

F220531E7

Equipment under Test (EUT):

**MSM-1R-CKS2-FLX-00Q0FS-J1-168595
MGB2-L1-MLI-U-Y0000-BJ-136776**

Applicant:

EUCHNER GmbH + Co. KG

Manufacturer:

EUCHNER GmbH + Co. KG



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:

Signature

Reviewed and
approved by:

Signature

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

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1 Identification

1.1 Applicant

Name:	EUCHNER GmbH + Co. KG
Address:	Kohlhammerstr. 16, 70771 Leinfelden-Echterdingen
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Name for contact purposes:	Mr. Tobias LEHMANN
Phone:	+49 (0) 711-7597-145
eMail address:	tobias.lehmann@euchner.de
Applicant represented during the test by the following person:	None

1.2 Manufacturer

Name:	EUCHNER GmbH + Co. KG
Address:	Kohlhammerstr. 16, 70771 Leinfelden-Echterdingen
Country:	Germany
Name for contact purposes:	Mr. Tobias LEHMANN
Phone:	+49 (0) 711-7597-145
eMail address:	tobias.lehmann@euchner.de
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

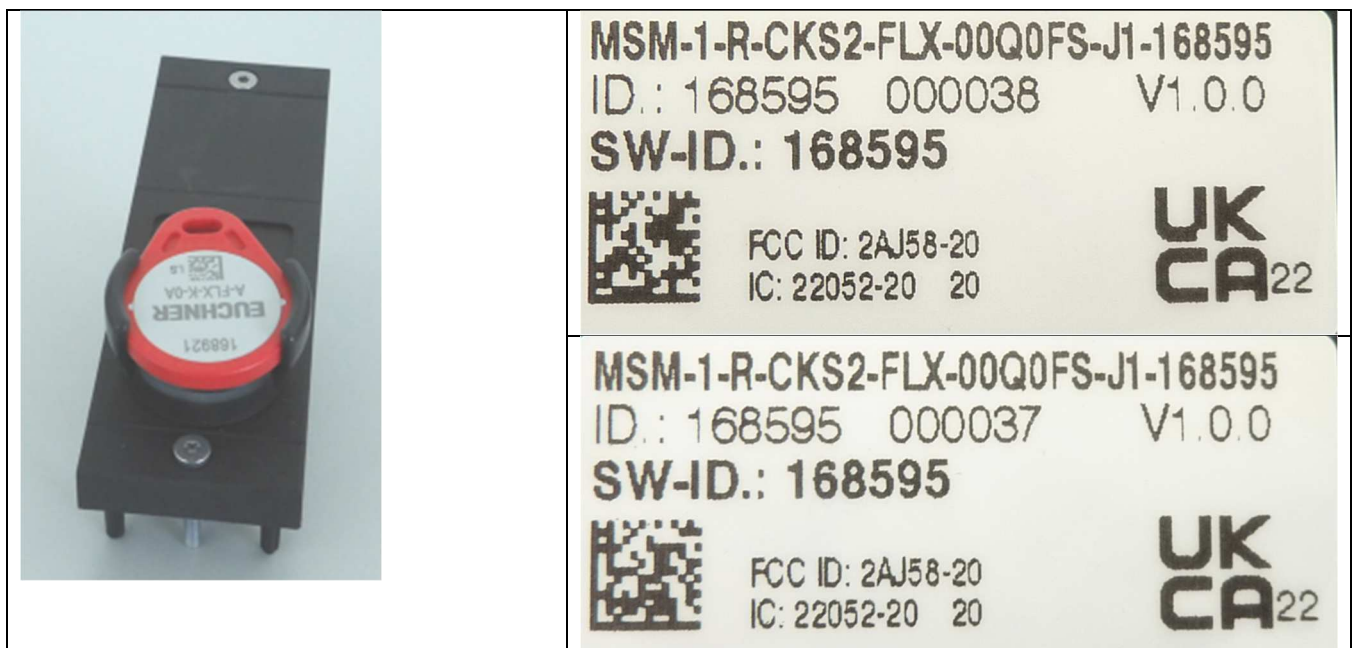
Accredited by Deutsche Akkreditierungsstelle GmbH (DAkKS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-05 and D-PL-17186-01-06, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment under Test)

Test object: *	CKS2 Submodule
Model name: *	MSM-1R-CKS2-FLX-00Q0FS-J1-168595 MGB2-L1-MLI-U-Y0000-BJ-136776
Model number: *	168595 136776
Order number: *	168595 136776
FCC ID: *	2AJ58-20 2AJ58-02
IC certification number: *	22052-20 22052-02

The following modules were tested together for simultaneous transmission test.

Submodule **MSM-1-R-CKS2-FLX-00Q0FS-J1-168595** with TAG type **A-FLX-K-0A-168921**.



Locking module **MGB2-L1.MLI.U-Y000-BJ-136776**
with TAG Handle Module type **MGB2-H-BA1A3-R-136691**.

Locking module



Handle Module type **MGB2-H-BA1A3-R-136691**



	EUT number		
	1	2	3
Serial number: *	000037	000038	001547
PCB identifier: *	169700	169700	160113
Hardware version: *	V 3.2	V 3.2	V1.4.0
Software version: *	V 1.0.0.6	V 1.0.0.6	V1.0.6.0

* Declared by the applicant

The EUT was assembled by the applicant as shown in the picture below and 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: *	24 VDC via module AC/DC adapter		
Supply voltage EUT: *	$U_{nom} = 24 \text{ V DC}$	$U_{min} = 20.4 \text{ V DC}$	$U_{max} = 27.6 \text{ V DC}$
Temperature range: *	-25 °C to +55 °C		
Lowest / highest internal frequency: *	125 kHz / 72 MHz		

* Declared by the applicant

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
DC supply + IO	M12 4 wire Plug	M12 4 wire Socket	5 m	No

Equipment used for testing	
BUS Module * ¹	MBM-PN-S3-MLI-3B-156310
Test setup with SPS and Display * ¹	Customer setup

*¹ Provided by the applicant

*² Provided by the laboratory

1.6 Dates

Date of receipt of test sample:	18.07.2022
Start of test:	12.08.2022
End of test:	02.09.2022

2 Operational States

Description of function of the EUT:

The EUT is a combination of two locking modules CKS2 and a handle module MGB2.

The following states were defined as the operating conditions:

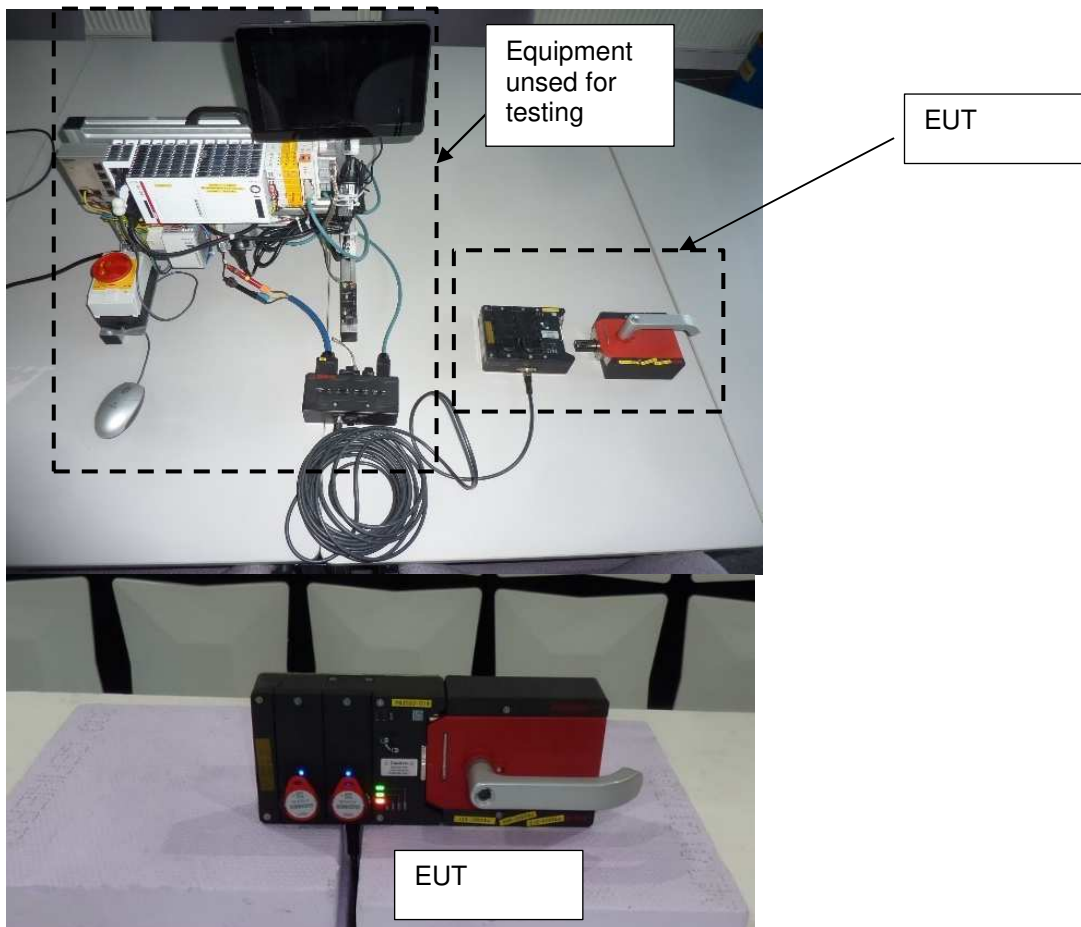
The EUT was supplied by the AC/DC power adaptor Bel HC 24-2.4-AG provided by the test laboratory. The power adaptor itself was supplied by 120V_{AC} 60Hz. The tests were carried out in the constellation below to simulate a simultaneous transmission of three 125 kHz Transmitters.

Two states have been defined for the tests:

1. Reading all TAGs.
2. Continuous search for a TAGs.

The worst-case results were measured while the EUT was reading a TAG.

The system was set up as follows:



3 Additional Information

None

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	66 to 56 dB(μ V) QP*	ANSI C63.4	1-3	Passed
	0.5 to 5 MHz	56 to 46 dB(μ V) AV*			
	5 to 30 MHz	56 dB(μ V) QP 46 dB(μ V) AV 60 dB(μ V) QP 50 dB(μ V) AV			
*: 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	40.0 dB(μ V/m) QP at 3 m	ANSI C63.4	1-3	Passed
	88 to 216 MHz	43.5 dB(μ V/m) QP at 3 m			
	216 to 960 MHz	46.0 dB(μ V/m) QP at 3 m			
	960 to 1000 MHz	54.0 dB(μ V/m) QP at 3 m			
	above 1000 MHz	54.0 dB(μ V/m) AV at 3 m and 74.0 dB(μ V/m) PK at 3 m			

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	40.0 dB(μ V/m) QP at 3 m	ANSI C63.4	1-3	Passed
	88 to 216 MHz	43.5 dB(μ V/m) QP at 3 m			
	216 to 230 MHz	46.0 dB(μ V/m) QP at 3 m			
	230 to 960 MHz	47.0 dB(μ V/m) QP at 3 m			
	960 to 1000 MHz	54.0 dB(μ V/m) QP at 3 m			
	above 1000 MHz	54 dB(μ V/m) AV at 3 m and 74 dB(μ V/m) PK at 3 m			

Remark: As declared by the applicant the highest internal clock frequency is < 108 MHz.
Therefore, the radiated emission measurement must be carried out up to 1 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

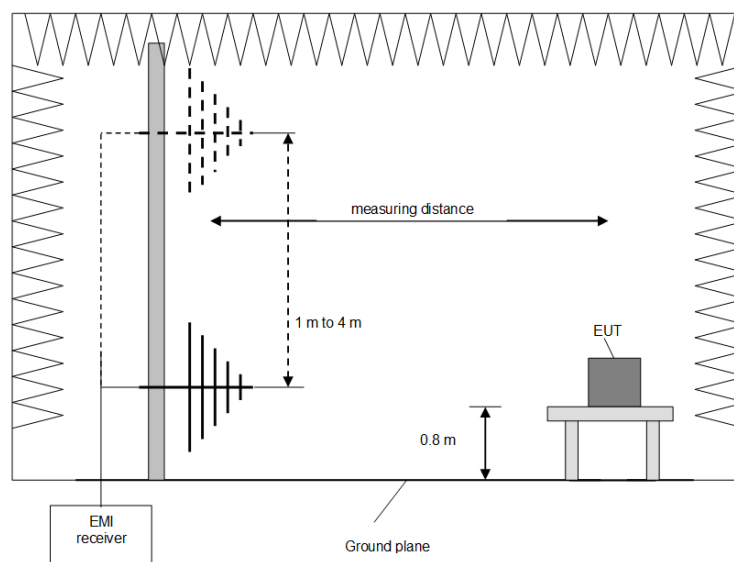
5.1.1.1 Preliminary and final measurement 30 MHz to 1 GHz

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:

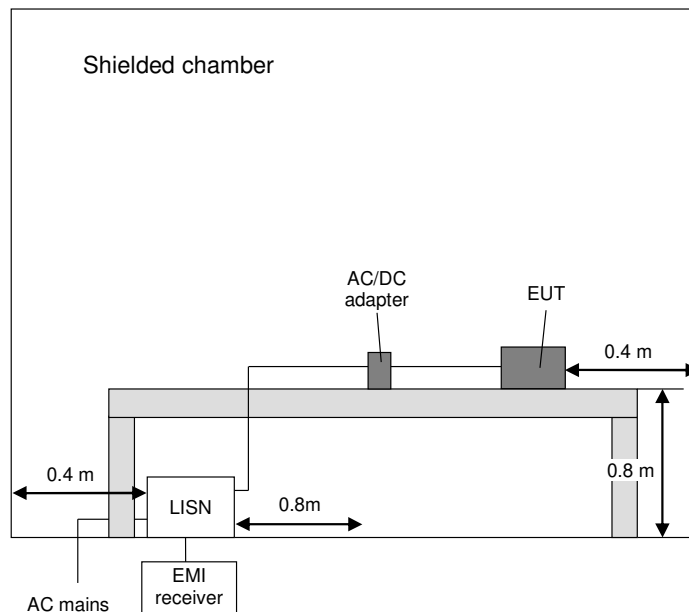
- 1) Select the highest frequency peaks (lowest margin to the limit) for the final measurement.
- 2) The software determines the exact peak frequencies by doing a partial scan with reduced step size of the pre-scan of the selected peaks.
- 3) If the EUT is portable or ceiling mounted, find the worst-case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

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

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

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



5.2 Radiated emissions

5.2.1 Test setup (Maximum unwanted emissions)

Test setup (Maximum unwanted emissions)			
Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Radiated: 30 MHz to 1 GHz / 1 GHz to 40 GHz	5.1.1	-

5.2.2 Test method (Maximum unwanted emissions)

Test method (radiated) see sub-clause 5.1.1 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:	45 %

Date:	29.08.22
Tested by:	M. DINTER

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: Only one position has been tested as described in test setup photos.

Calculations:

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

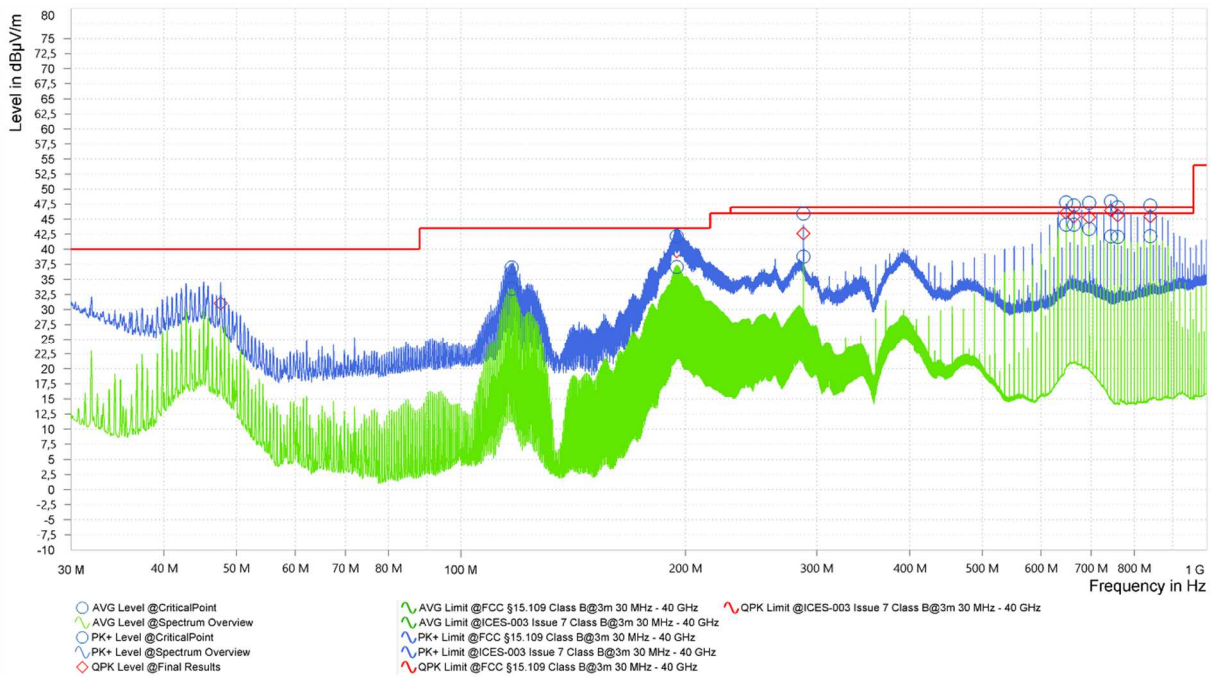
Correction [dBμV/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]

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

The 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 reading all TAGs):



Result tables:

(Operation mode 1):

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

Frequency [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Meas. Time [ms]
47.640	31.01	40.00	8.99	15.24	V	-12	1	120.000	1000
117.000	34.81	43.50	8.69	17.70	H	114	2.36	120.000	1000
194.760	39.67	43.50	3.83	15.14	V	188	1.63	120.000	1000
288.000	42.64	46.00	3.36	18.69	H	141	1.06	120.000	1000
648.000	45.40	46.00	0.60	26.88	H	42	1.08	120.000	1000
663.990	45.47	46.00	0.53	27.11	H	40	1.02	120.000	1000
696.000	45.31	46.00	0.69	27.34	H	44	1	120.000	1000
744.000	45.77	46.00	0.23	27.96	H	44	1	120.000	1000
759.990	45.62	46.00	0.38	28.19	H	34	1	120.000	1000
840.000	45.46	46.00	0.54	29.40	H	40	1.4	120.000	1000

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

Frequency [MHz]	QPK Level [dB μ V/m]	QPK Limit [dB μ V/m]	QPK Margin [dB]	Correction [dB]	Polarization	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Meas. Time [ms]
47.640	31.01	40.00	8.99	15.24	V	-12	1	120.000	1000
117.000	34.81	43.50	8.69	17.70	H	114	2.36	120.000	1000
194.760	39.67	43.50	3.83	15.14	V	188	1.63	120.000	1000
288.000	42.64	47.00	4.36	18.69	H	141	1.06	120.000	1000
648.000	45.40	47.00	1.60	26.88	H	42	1.08	120.000	1000
663.990	45.47	47.00	1.53	27.11	H	40	1.02	120.000	1000
696.000	45.31	47.00	1.69	27.34	H	44	1	120.000	1000
744.000	45.77	47.00	1.23	27.96	H	44	1	120.000	1000
759.990	45.62	47.00	1.38	28.19	H	34	1	120.000	1000
840.000	45.47	47.00	1.54	29.40	H	40	1.4	120.000	1000

Test result: Passed

Test equipment (please refer to chapter 7 for details)
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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
<input checked="" type="checkbox"/>	Conducted: AC power line	5.1.2	-
<input type="checkbox"/>	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
<input checked="" type="checkbox"/>	6.2	Tabletop equipment testing	5.1.2	Provided AC switching power adaptor
<input type="checkbox"/>	6.2	Floor-standing equipment testing	-	-

The AC power adaptor provided by the laboratory was used for the tests:

Bel HC 24-2.4-AG

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

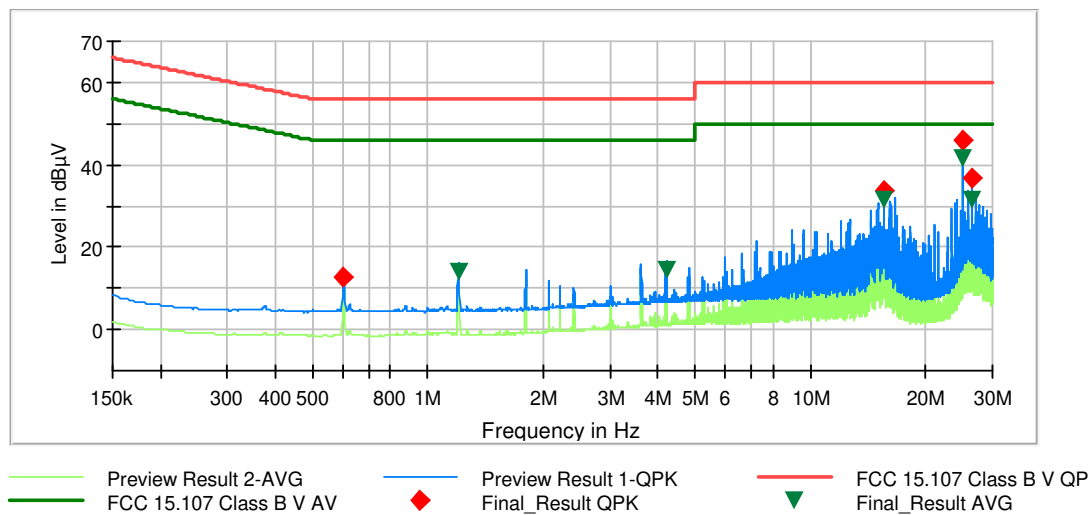
5.3.3 Test results (Conducted emissions on power supply lines)

Ambient temperature:	23 °C
Relative humidity:	39 %

Date:	02.09.2022
Tested by:	M.DINTER

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 ▼.

(Operation mode 1):



Frequency [MHz]	QuasiPeak [dB(µV)]	Average [dB(µV)]	Limit [dB(µV)]	Margin [dB]	Line	PE	Corr. [dB]
0.602250	12.82	---	56.00	43.18	L1	FLO	10.0
1.205250	---	14.00	47.00	32.00	L1	GND	10.0
4.202250	---	14.56	47.00	31.44	L1	GND	10.3
15.555750	---	31.51	50.00	18.49	N	GND	10.6
15.555750	33.73	---	60.00	26.27	N	FLO	10.6
25.001250	---	41.70	50.00	8.30	N	GND	10.8
25.001250	47.10	---	60.00	13.90	N	GND	10.8
26.538000	---	31.40	50.00	18.60	N	GND	10.9
26.547000	36.58	---	60.00	23.42	N	GND	10.9

Test result: Passed

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

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
R&S HL050 @ 3 m 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	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	ESR7	Rohde & Schwarz	101939	482558	15.02.2022	02.2024
5	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	22.02.2022	02.2024
6	Software	EMC32	Rohde & Schwarz	100970	482972	Calibration not necessary	
7	RF switch matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
8	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
9	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
10	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
11	Semi-anechoic chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
12	EMI receiver	ESW44	Rohde & Schwarz	101819	483149	18.02.2022	02.2024
13	Outdoor test site	-	PHOENIX TESTLAB	-	480293	Calibration not necessary	
14	EMI receiver	ESI 40	Rohde & Schwarz	100064/040	480355	18.02.2022	02.2023
15	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
16	Ultra-log. antenna	HL562E	Rohde & Schwarz	101079	482978	18.03.2021	03.2024

8 Test site Verification

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
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
F220531E7	20.03.2023	Initial Test Report
-	-	-
-	-	-

10 List of Annexes

Annex A	Test Setup Photos	4 pages
Annex B	EUT External Photos	10 pages
Annex C	EUT Internal Photos	7 pages