EMI – TEST REPORT

- FCC Part 15B -

Type / Model Name : RRU 1400

Product Description : RFID UHF Reader 902-928 MHz

Applicant : Kathrein Sachsen GmbH

Address : Lindenstrasse 3

09241 Mühlau, Germany

Manufacturer : Kathrein Sachsen GmbH

Address : Lindenstrasse 3

09241 Mühlau, Germany

Test Result according to the standards listed in clause 1 test standards:	**POSITIVE**

Test Report No. : 80086331-04 Rev_1	18. October 2021 Date of issue

Deutsche Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart A - General (August, 2021)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15 Subpart B - Unintentional Radiators (August, 2021)

Part 15, Subpart B, Section 15.107	AC Line conducted emissions
Part 15, Subpart B, Section 15.109	Radiated emissions, general requirements
ANSI C63.4: 2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C95.1:1992	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
CISPR 16-4-2: 2003	Uncertainty in EMC measurement
CISPR 22: 2005 EN 55022: 2006	Information technology equipment

2 SUMMARY

GENERAL REMARKS:

The EuT is capable to exchange data with a PC via RJ45 Ethernet cable.
This test report describes the radiated and conducted disturbance produced by the data transfer via Data cable and the power supply (ancillary equipment).

The measurement has been performed in standby mode.

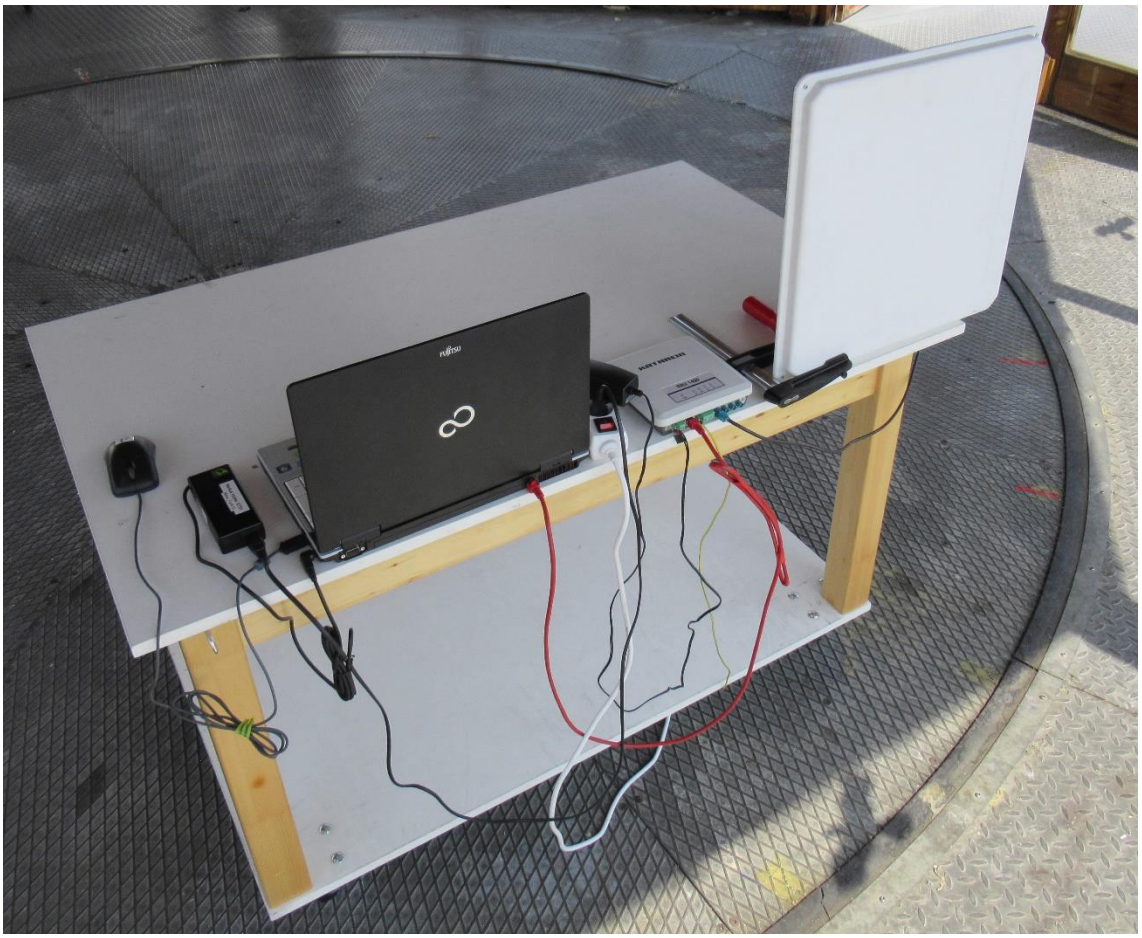
The Reader was tested as a system with RFID Antenna WIRA-40-linear-FCC and with original antenna cable which was supplied by manufacturer.

For detailed information about the model and the antenna please refer to the user manual or technical documentation from the manufacturer.

The EuT is declared as Class B digital device.

It is not possible to set the EuT only in receiving mode.

Test Setup:



FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 12. July 2021

Testing concluded on : 26. August 2021

Checked by:

Klaus Gegenfurtner
2021.10.18
15:28:25 +02'00'

Gegenfurtner Klaus
Teamleader Radio

Tested by:

Markus Huber
2021.10.18
10:06:50 +02'00'

Huber Markus

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Detailed photos see Attachment A

3.2 Power supply system utilised

Power supply voltage : Primary: 115 V / 60 Hz / 1ϕ
Secondary: 24.0 V / DC

3.3 Short description of the equipment under test (EUT)

The device is a UHF RFID reader. The UHF RFID Reader can read active and passive Tags in the frequency range from 902 to 928 MHz.

Number of tested samples: 1
Serial number: G0O3026983

The equipment under test was operated during the measurement under the following conditions:

- Data download via Data Cable RJ45

-

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EUT configuration:

The following peripheral devices and interface cables were connected during the measurements:

- Test software Model: Supplied by manufacturer
- Lap Top Model: Supplied by CSA Group Bayern GmbH
- Antenna Model: RFID Antenna WIRA-40-linear-FCC, 52010252
- Power supply Model : GE18I24, S/N OFB9452668
- Model :
- Model :
- Model :
- Model :

- customer specific cables

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY

4.2 Statement regarding the usage of logos in test reports

The accreditation and notification body logos displayed in this test report are only valid for standards listed in the accreditation or notification scope of CSA Group Bayern GmbH.

4.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	86-106 kPa

4.4 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor k = 2. The true value is located in the corresponding interval with a probability of 95 % The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.5 Measurement Protocol for FCC, VCCI and AUSTEL

4.5.1 GENERAL INFORMATION

4.5.1.1 Test Methodology

The test methods used comply with ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

4.5.1.2 Justification

The Equipment under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each in order to obtain maximum disturbances from the unit.

4.6 Determination of worst case measurement conditions

All radiated tests were performed with following antenna type and power supply:

- Antenna: RFID Antenna WIRA-40-linear-FCC, 52010252
- Power Setting: Standby
- Power supply: Mean Well GE18I24
    - S/N: OFB9452668

4.6.1 DETAILS OF TEST PROCEDURES

4.6.1.1 General Standard Information

The test methods used comply with CISPR Publication 22, EN 55022 - " Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

5 TEST CONDITIONS AND RESULTS

5.1 Conducted emissions

For test instruments and accessories used see section 6 Part **A 4**.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up – see Attachment C

5.1.3 Applicable standard

According to FCC Part 15B, Section 15.107(a):
Except as shown in paragraphs (b) and (c) of this Section, for an unintentional radiator that is designed to be connected to the public utility AC power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

5.1.4 Description of Measurement

The correction factors for cable loss and antenna gain are stored in the memory of the EMI receiver therefore the final level (dBµV) appears directly in the reading of the EMI receiver. This level is compared to the FCC limit.
To convert between dBµV and µV, the following conversions apply:

dBµV = 20(log µV)

µV = 10^(dBµV/20)

The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a line impedance stabilization network (LISN) with 50Ω/50 µH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.5 Test result

Frequency range:	0.15 MHz - 30 MHz
Min. limit margin	10.89 dB at 0.5295 MHz

The requirements are **FULFILLED.**

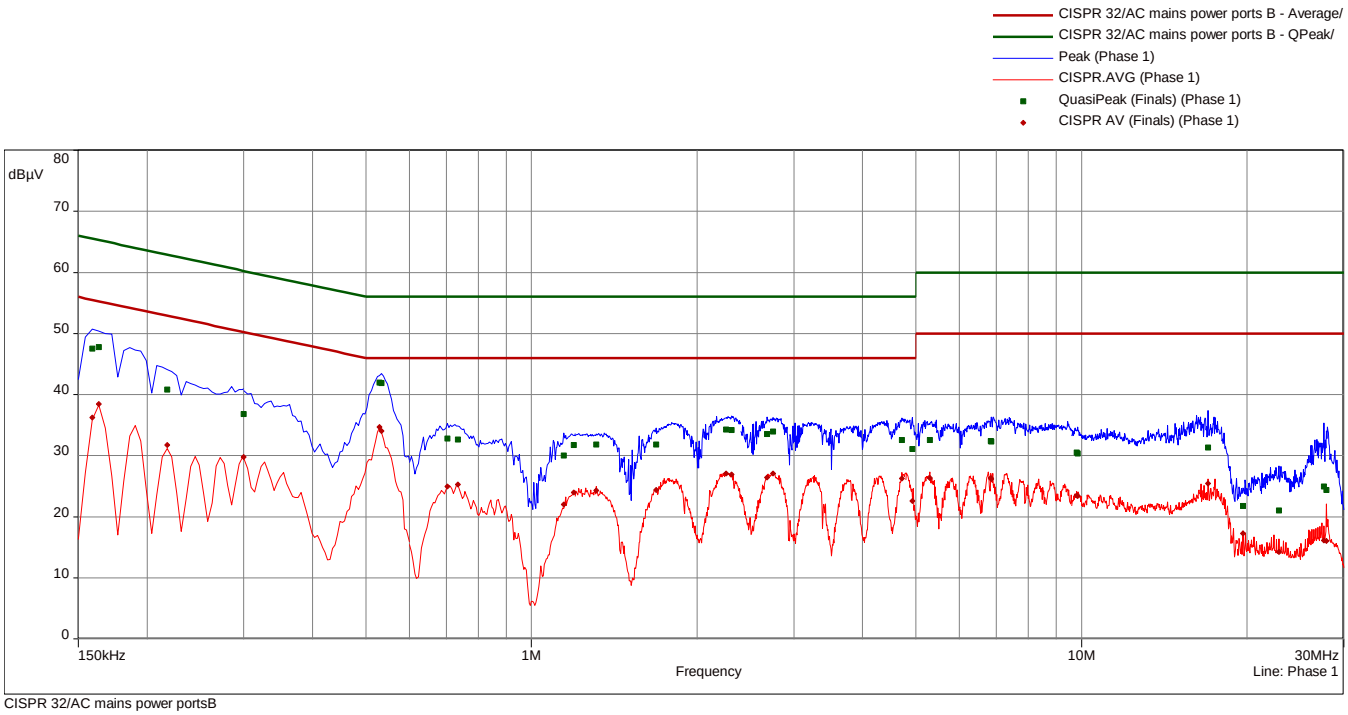
Remarks: _____

_____

_____

5.1.6 Test protocol

Test point L1 Result: Passed
Operation mode: Standby mode
Remarks: Wide Range Antenna 52010252
Voltage: 115 V / 60 Hz / 1ϕ



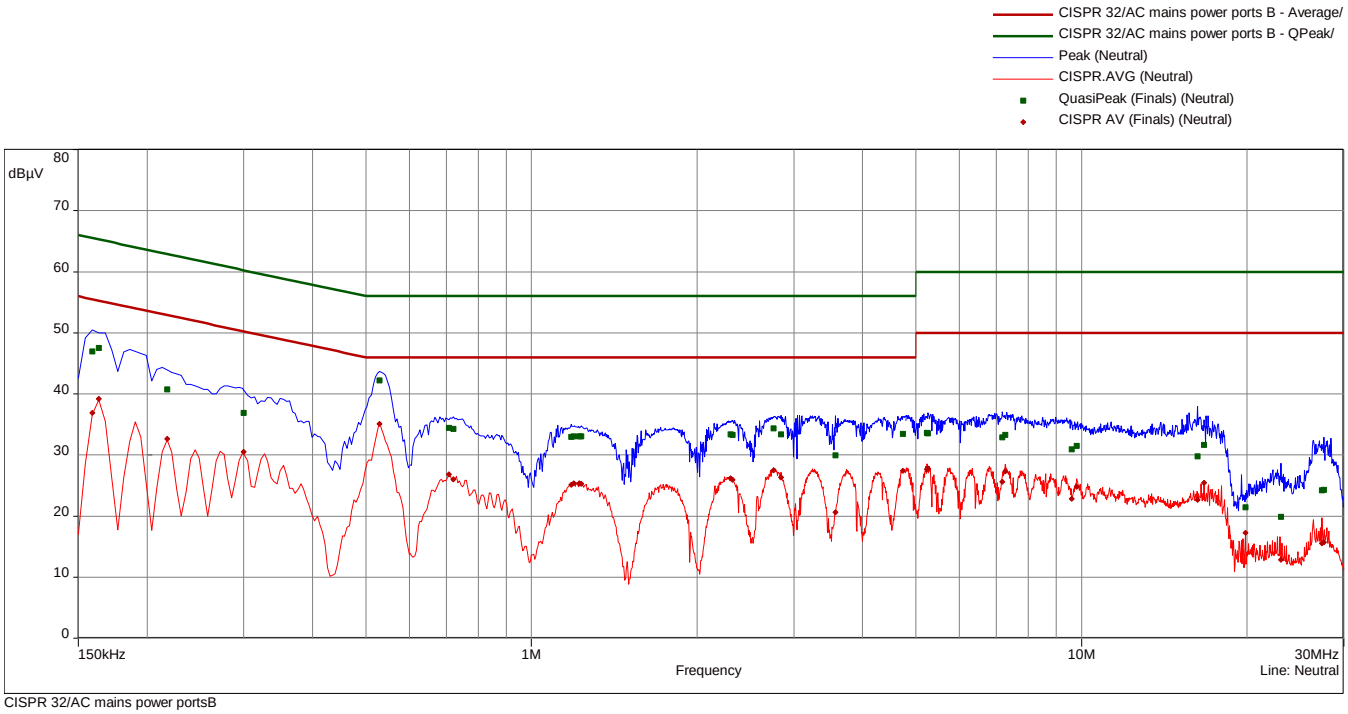
CISPR 32/AC mains power portsB

freq	SR	QP	margin	limit	AV	margin	limit	line	RBW	Measure time	corr
MHz		dBµV	dB	dBµV	dBµV	dB	dBµV		Hz	sec	dB
0.159	1	47.51	-18.01	65.52	36.24	-19.28	55.52	Phase 1	9k	1.00	10.10
0.1635	1	47.80	-17.49	65.28	38.48	-16.80	55.28	Phase 1	9k	1.00	10.10
0.2175	1	40.82	-22.09	62.91	31.76	-21.15	52.91	Phase 1	9k	1.00	10.11
0.3	2	36.78	-23.47	60.24	29.79	-20.46	50.24	Phase 1	9k	1.00	10.14
0.5295	2	41.95	-14.05	56.00	34.71	-11.29	46.00	Phase 1	9k	1.00	10.16
0.534	2	41.87	-14.13	56.00	34.00	-12.00	46.00	Phase 1	9k	1.00	10.16
0.7035	3	32.78	-23.22	56.00	24.92	-21.08	46.00	Phase 1	9k	1.00	10.19
0.735	3	32.66	-23.34	56.00	25.26	-20.74	46.00	Phase 1	9k	1.00	10.19
1.1445	3	30.04	-25.96	56.00	22.02	-23.98	46.00	Phase 1	9k	1.00	10.22
1.194	3	31.77	-24.23	56.00	23.98	-22.02	46.00	Phase 1	9k	1.00	10.23
1.3125	4	31.80	-24.20	56.00	24.28	-21.72	46.00	Phase 1	9k	1.00	10.25
1.686	4	31.84	-24.16	56.00	24.40	-21.60	46.00	Phase 1	9k	1.00	10.27
2.2575	4	34.30	-21.70	56.00	27.11	-18.89	46.00	Phase 1	9k	1.00	10.30
2.3115	4	34.22	-21.78	56.00	26.89	-19.11	46.00	Phase 1	9k	1.00	10.30
2.679	5	33.53	-22.47	56.00	26.45	-19.55	46.00	Phase 1	9k	1.00	10.33
2.751	5	33.99	-22.01	56.00	27.05	-18.95	46.00	Phase 1	9k	1.00	10.34

freq	SR	QP	margin	limit	AV	margin	limit	line	RBW	Measure time	corr
MHz		dBµV	dB	dBµV	dBµV	dB	dBµV		Hz	sec	dB
4.713	5	32.58	-23.42	56.00	26.28	-19.72	46.00	Phase 1	9k	1.00	10.43
4.9305	6	31.12	-24.88	56.00	22.54	-23.46	46.00	Phase 1	9k	1.00	10.44
5.304	6	32.56	-27.44	60.00	26.38	-23.62	50.00	Phase 1	9k	1.00	10.47
6.843	6	32.43	-27.57	60.00	26.36	-23.64	50.00	Phase 1	9k	1.00	10.59
6.861	6	32.28	-27.72	60.00	26.14	-23.86	50.00	Phase 1	9k	1.00	10.59
9.8115	7	30.50	-29.50	60.00	23.50	-26.50	50.00	Phase 1	9k	1.00	10.73
9.852	7	30.33	-29.67	60.00	23.44	-26.56	50.00	Phase 1	9k	1.00	10.73
16.98	7	31.33	-28.67	60.00	25.43	-24.57	50.00	Phase 1	9k	1.00	11.31
19.668	8	21.79	-38.21	60.00	17.24	-32.76	50.00	Phase 1	9k	1.00	11.44
22.8585	8	21.01	-38.99	60.00	14.25	-35.75	50.00	Phase 1	9k	1.00	11.60
27.588	8	24.98	-35.02	60.00	16.14	-33.86	50.00	Phase 1	9k	1.00	11.70
27.876	8	24.39	-35.61	60.00	16.00	-34.00	50.00	Phase 1	9k	1.00	11.70

Test point N
Operation mode: Standby mode
Remarks: Wide Range Antenna 52010252
Voltage: 115 V / 60 Hz / 1ϕ

Result: Passed



CISPR 32/AC mains power portsB

freq	SR	QP	margin	limit	AV	margin	limit	line	RBW	Measure time	corr
MHz		dBµV	dB	dBµV	dBµV	dB	dBµV		Hz	sec	dB
0.159	9	46.93	-18.59	65.52	36.88	-18.64	55.52	Neutral	9k	1.00	10.10
0.1635	9	47.49	-17.79	65.28	39.20	-16.08	55.28	Neutral	9k	1.00	10.10
0.2175	9	40.76	-22.16	62.91	32.61	-20.30	52.91	Neutral	9k	1.00	10.13
0.3	10	36.87	-23.37	60.24	30.56	-19.69	50.24	Neutral	9k	1.00	10.14
0.5295	10	42.23	-13.77	56.00	35.11	-10.89	46.00	Neutral	9k	1.00	10.16
0.708	11	34.45	-21.55	56.00	26.81	-19.19	46.00	Neutral	9k	1.00	10.19
0.7215	11	34.26	-21.74	56.00	25.98	-20.02	46.00	Neutral	9k	1.00	10.19
1.1805	11	32.98	-23.02	56.00	25.15	-20.85	46.00	Neutral	9k	1.00	10.23
1.194	11	33.09	-22.91	56.00	25.36	-20.64	46.00	Neutral	9k	1.00	10.23
1.2225	12	33.07	-22.93	56.00	25.37	-20.63	46.00	Neutral	9k	1.00	10.23
1.2315	12	33.07	-22.93	56.00	25.26	-20.74	46.00	Neutral	9k	1.00	10.23
2.3025	12	33.38	-22.62	56.00	26.22	-19.78	46.00	Neutral	9k	1.00	10.30
2.3205	12	33.31	-22.69	56.00	25.90	-20.10	46.00	Neutral	9k	1.00	10.30
2.7555	13	34.34	-21.66	56.00	27.51	-18.49	46.00	Neutral	9k	1.00	10.34
2.841	13	33.40	-22.60	56.00	26.35	-19.65	46.00	Neutral	9k	1.00	10.34
3.57	13	29.93	-26.07	56.00	20.63	-25.37	46.00	Neutral	9k	1.00	10.35
4.74	13	33.44	-22.56	56.00	27.40	-18.60	46.00	Neutral	9k	1.00	10.42
5.2365	14	33.59	-26.41	60.00	27.66	-22.34	50.00	Neutral	9k	1.00	10.45
5.259	14	33.56	-26.44	60.00	27.85	-22.15	50.00	Neutral	9k	1.00	10.45

freq	SR	QP	margin	limit	AV	margin	limit	line	RBW	Measure time	corr
MHz		dBµV	dB	dBµV	dBµV	dB	dBµV		Hz	sec	dB
7.185	14	32.86	-27.14	60.00	25.58	-24.42	50.00	Neutral	9k	1.00	10.58
7.275	14	33.33	-26.67	60.00	27.34	-22.66	50.00	Neutral	9k	1.00	10.58
9.6045	15	30.94	-29.06	60.00	22.81	-27.19	50.00	Neutral	9k	1.00	10.66
9.8025	15	31.53	-28.47	60.00	24.80	-25.20	50.00	Neutral	9k	1.00	10.66
16.26	15	29.82	-30.18	60.00	22.63	-27.37	50.00	Neutral	9k	1.00	11.07
16.6965	15	31.70	-28.30	60.00	25.47	-24.53	50.00	Neutral	9k	1.00	11.10
19.857	16	21.45	-38.55	60.00	17.24	-32.76	50.00	Neutral	9k	1.00	11.24
23.034	16	19.85	-40.15	60.00	12.87	-37.13	50.00	Neutral	9k	1.00	11.27
27.3495	16	24.19	-35.81	60.00	15.54	-34.46	50.00	Neutral	9k	1.00	11.18
27.5745	16	24.32	-35.68	60.00	15.70	-34.30	50.00	Neutral	9k	1.00	11.17

5.2 Radiated emissions

For test instruments and accessories used see section 6 Part **SER 1, SER 2, SER 3**.

5.2.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.2.2 Photo documentation of the test set-up – see Attachment C

5.2.3 Applicable standard

According to FCC Part 15B, Section 15.109 (a):
Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 m shall not exceed the given limit.

According to FCC Part 15C, Section 15.209:
The emissions from intentional radiators shall not exceed the effective field strength limits.

5.2.4 Description of Measurement

The spurious emissions from the EUT will be measured on an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The antenna was positioned 3, 10 or 30 m horizontally from the EUT. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions. In the case where larger measuring distances are required the results will extrapolated based on the values measured on the closer distances according to Section 15.31(f)(2). The final measurement will be performed with an EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used according to Section 15.209(d)(2).

Radiated emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 dB(µV/m) non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The set up of the equipment under test will be in accordance to ANSI C63.4. The interface cables that are closer than 40 cm to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 cm from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna was positioned 3 m horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres, measurement scans are made with horizontal and vertical antenna polarization and the EUT is rotated 360 degrees.

The resolution bandwidth during the measurement is as following:
9 kHz – 150 kHz: RBW: 200 Hz
150 kHz – 30 MHz: RBW: 9 kHz

30 MHz – 1000 MHz: RBW: 120 kHz

5.2.5 Test result

Frequency [kHz]	L: QP [dBµV]	L: AV [dBµV]	Bandwidth [kHz]	Correct [dB]	L: QP [dBµV/m]	L: AV [dBµV/m]	Limit [dBµV/m]	Delta [dB]
536.8	24.1	19.7	9.0	20	44.1	39.7	73.0	-33.3
1073.6	23.4	18.0	9.0	20	43.4	38.0	67.0	-29.0
1342.0	21.6	15.9	9.0	20	41.6	35.9	65.0	-29.1

Note: No unwanted emissions from the EuT could be measured in the relevant frequency ranges. Only ambient noises could be detected!

Frequency [MHz]	L: QP [dBµV]	Correct [dB]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
33.78	3.7	13.4	17.1	40.0	-22.9
118.54	9.3	12.9	22.2	43.5	-21.3
517.43	4.8	21.9	26.7	46.0	-19.3

Note: No unwanted emissions from the EuT could be measured in the relevant frequency ranges. Only ambient noises could be detected!

Frequency [GHz]	L: PK [dBµV]	L: AV [dBµV]	Bandwidth (kHz)	Correct [dB]	L: PK dB[µV/m]	L: AV dB[µV/m]	Limit AV dB[µV/m]	Delta [dB]
1375.0	28.1	20.5	1000	-18.7	9.4	1.8	54.0	-52.2
2640.0	30.7	21.9	1000	-12.8	17.9	9.1	54.0	-44.9
3696.0	32.3	27.4	1000	-12.2	20.1	15.2	54.0	-38.8

*) Average values were measured with spectrum analyzer by the following settings
RBW: 1 MHz
VBW: 10 Hz
Sweep: Auto

Note: No unwanted emissions from the EuT could be measured in the relevant frequency ranges. Only ambient noises could be detected!

Limit according to FCC Part 15 Subpart 15.209(a):

Frequency	Field strength of spurious emissions		Measurement distance
(MHz)	(µV/m)	dB(µV/m)	(metres)
0.009-0.490	**2400/F(kHz)**	**--**	**300**
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

Limit according to FCC part 15B, Section 15.109(a):

Frequency (MHz)	Limit (µV/m)	Limit dB(µV/m)
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

The requirements are **FULFILLED.**

Remarks: The measurement was performed according to FCC Part 15A, Section 15.33(b), up to 5 GHz.

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	BAT-EMC 3.18.0.26	01-02/68-13-001				
	ESCI	02-02/03-15-001	11/06/2022	11/06/2021		
	ESH 2 - Z 5	02-02/20-05-004	25/10/2021	25/10/2020		
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155	18/11/2021	18/11/2020		
	SP 103 /3.5-60	02-02/50-05-182				
SER 1	ESCI	02-02/03-05-005	11/12/2021	11/12/2020		
	HFH 2 - Z 2	02-02/24-15-001	22/03/2022	22/03/2021		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 2	ESVS 30	02-02/03-05-006	06/06/2022	06/06/2021		
	VULB 9168	02-02/24-05-005	18/04/2022	18/04/2021		
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSP 30	02-02/11-05-001	09/10/2021	09/10/2020		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	08/05/2022	08/05/2021		
	18N-20	02-02/50-17-003				
	NMS111-GL200SC01-NMS11	02-02/50-17-012				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				