Bundesnetzagentur
BNetzA-CAB-14/21-09

DAkkS Deutsche Akkreditierungsstelle D-PL-11020-03-04

SGS Germany GmbH

Test Report No.: U12K0003

FCC ID: 2AVB6-PA10012519

Order No.: U12K **Pages:** 29

Client:	Christ Electronic Systems GmbH Regulatory Affairs
Equipment Under Test:	Touch Industrial PC VESA 12.1 OEM
Manufacturer / Importer:	Christ Electronic Systems GmbH Regulatory Affairs
Task:	Compliance with the requirements mentioned below:
Test Specification(s): [covered by accreditation]	• FCC 47 CFR Part 15 §15.107 §15.109
Result:	The EUT complies with the requirements of the test specifications.

The results relate only to the items tested as described in this test report.

approved by:	**Date**	**Signature**
Wössner Group Leader	Oct 12, 2023	

This document was signed electronically.

CONTENTS

1 Result Summary

This report presents the test procedures used and the results obtained during the performance of an FCC 47 CFR Part 15 test program. The test program was conducted to assess the ability of the tested sample to successfully satisfy the requirements specified in the references listed in Section 2 of this report.

Tables of Results:

Phenomena	Reference	Frequency range	Criteria	Verdict [1]
Conducted Emission AC power port [2]	FCC 47 CFR Part 15 §15.107	150 kHz – 30 MHz	Class A	P Note: Class B passed also
Radiated Emission Electric Field	FCC 47 CFR Part 15 §15.109	30 MHz - 1 GHz	Class A	P Note: Class B passed also
Radiated Emission Electric Field	FCC 47 CFR Part 15 §15.109	1 GHz - 18 GHz [3]	Class A	P Note: Class B passed also

[1] **P** (Pass): test object meets the requirement; **F** (Fail): test object does not meet the requirement; **NA**:test case does not apply to the test object; **NR**: test case is not requested by the client; **NP**: test case was not performed

[2] According ANSI C.63.4 chapter 7.1: If the EUT normally receives power from another device that in turn connects to the public-utility ac power lines, measurements shall be made on that device with the EUT in operation to ensure that the device continues to comply with the appropriate limits while providing the EUT with power. If the EUT is operated only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines (600 VAC or less) to operate the EUT (such as an adapter), then ac power-line conducted measurements are not required.

[3] See chapt. 4.2.4; Clock frequencies of the EUT resulting in determination of frequency range

2 References

2.1 Specification(s)

[1] FCC 47 CFR Part 15:
Code of Federal Regulations. Title 47: Telecommunication Part 15: Radio Frequency Devices

[2] 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

[3] FCC Public Notice DA 09-2478; Nov 25, 2009; Office of Engineering and Technology Clarifies Use of Recently Published ASC C63®

[4] Measurement Standards for Compliance Testing of Intentional and Unintentional Radiators under Part 15

2.2 Glossary

AC	Alternating Current
AMN	Artificial Mains Network
AV	Average Detector
DC	Direct Current
EMC	Electromagnetic Compatibility
EUT	Equipment Under Test
HW	Hardware
LISN	Line Impedance Stabilization Network
QP	Quasi Peak Detector

2.3 Information concerning FCC Equipment Authorization and Labelling

CERTIFICATION (47 CFR Section 2.907)
Certification is the most rigorous approval process for RF Devices with the greatest potential to cause harmful interference to radio services. It is an equipment authorization issued by an FCC-recognized Telecommunication Certification Body (TCB) based on an evaluation of the supporting documentation and test data submitted by the responsible party (e.g., the manufacturer or importer) to the TCB. Testing is performed by an FCC-recognized accredited testing laboratory. Information including the technical parameters and descriptive information for all certified equipment is posted on a Commission-maintained public database. In addition, equipment subject to approval using the Supplier's Declaration of Conformity (SDoC) procedure can optionally use the Certification procedure.

SUPPLIER'S DECLARATION OF CONFORMITY (47 CFR Section 2.906) → SDoC
Supplier's Declaration of Conformity (SDoC) is a procedure that requires the party responsible for compliance ensure that the equipment complies with the appropriate technical standards. The responsible party, who must be located in the United States, is not required to file an equipment authorization application with the Commission or a TCB. Equipment authorized under the SDoC procedure is not listed in a Commission database. However, the responsible party or any other party marketing the equipment must provide a test report and other information demonstrating compliance with the rules upon request by the Commission. The responsible party has the option to use the certification procedure in place of the SDoC procedure.

The key FCC rule sections for SDoC are:
- Section 2.906 Supplier's Declaration of Conformity
- Section 2.909 Responsible party
- Section 2.931 Responsibilities
- Section 2.938 Retention of records
- Section 2.1072 Limitations on Supplier's Declaration of Conformity
- Section 2.1074 Identification
- Section 2.1077 Compliance Information

See Guidance on the use of SDoC in 896810 D01 SDoC v02 and 896810 D02 SDoC FAQ v01r02 .

As the EMC-Lab of SGS Germany GmbH is an FCC-recognized accredited testing laboratory, this test report can be used as basis for both procedures.

Based on **§15.3** the following description for locations and its emission classes is defined:

(h) **Class A digital device**. A digital device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

(i) **Class B digital device**. A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public.

Based on **§15.105** the relevant **information to the limit class** has to be included in the manual.

Guidelines for **labeling and user information for RF** devices are contained in the following documents:
- 784748 D01 General labeling and Notification v09r01 provides general guidance for Part 15 and Part 18 labeling and user information.
- 784748 D02 e labeling v02 provides guidelines for displaying label information electronically (e-label).

See also important summarized information in FCC public notice DA 19-91, February 15, 2019.

For guidance concerning **integration of aleady FCC-certified wireless transmitter modules in host systems** see 996369 D04 Module Integration Guide v01 Modular Transmitter Integration Guide – Guidence for Host Product Manufacturers.

3 General Information

3.1 Identification of Client

Christ Electronic Systems GmbH
Regulatory Affairs
Alpenstraße 34
87700 Memmingen
Ingo Röhr

3.2 Test Laboratory

SGS Germany GmbH
Hofmannstraße 50
81379 München

3.3 Time Schedule

Delivery of EUT:	31.08.2023
Start of test:	31.08.2023
End of test:	31.08.2023

3.4 Participants

Name	**Function**
Sven Suurmaa	Accredited testing, Editor

3.5 Environmental conditions

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

Temperature:	20 - 26 °C
Humidity:	30 - 60 %

4 Equipment Under Test

All information regarding the EUT(s) was provided by the customer and has been approved by customer during report-review-process.

Test item description .....:	Touch Industrial PC
Trade Mark ....:	---
Manufacturer / Importer .. ..:	Christ Electronic Systems GmbH Regulatory Affairs
Model/Type ....:	VESA 12.1 OEM
Number of tested samples....:	1
Serial Number(s) ....:	---
Ratings ....:	100 - 240 V AC 47-63 Hz/ 24 V DC

- *The EUT is a touch industrial PC.*

Figure 4-1: Touch Industrial PC

Figure 4-2: Touch Industrial PC

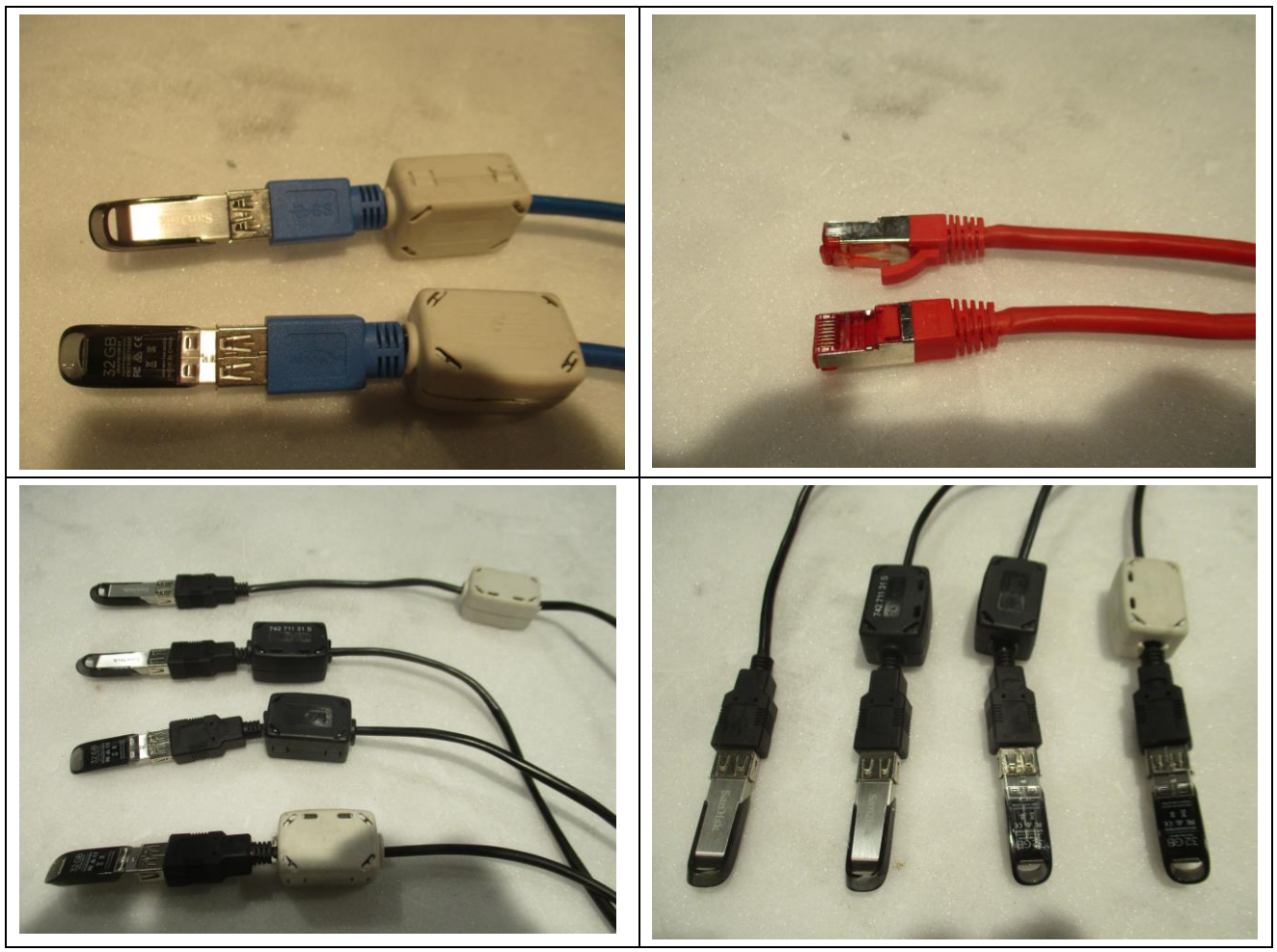


Figure 4-3: Cables connected to EUT

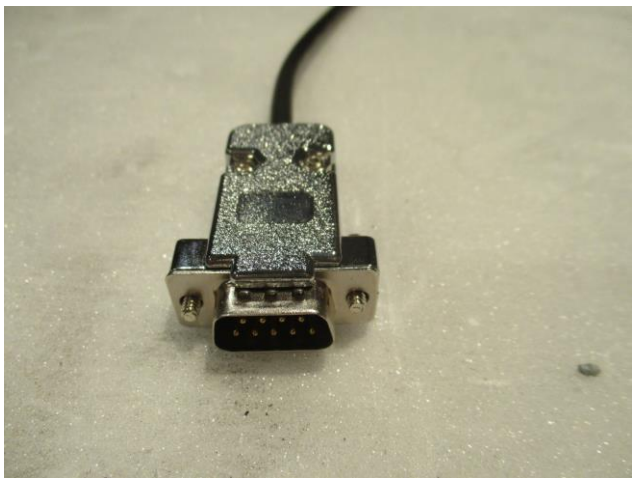
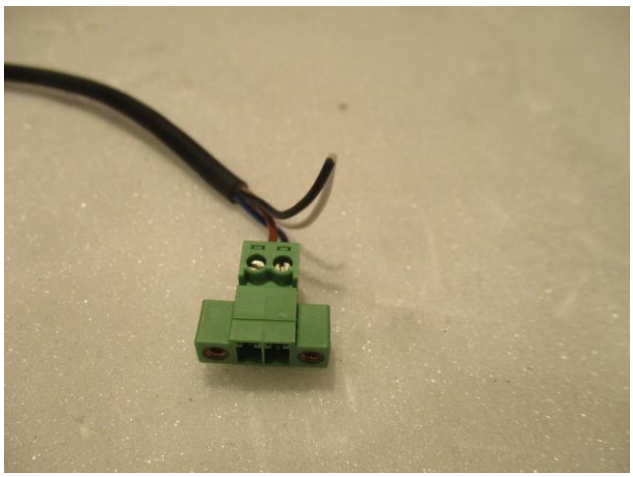



Figure 4-4: Cables connected to EUT

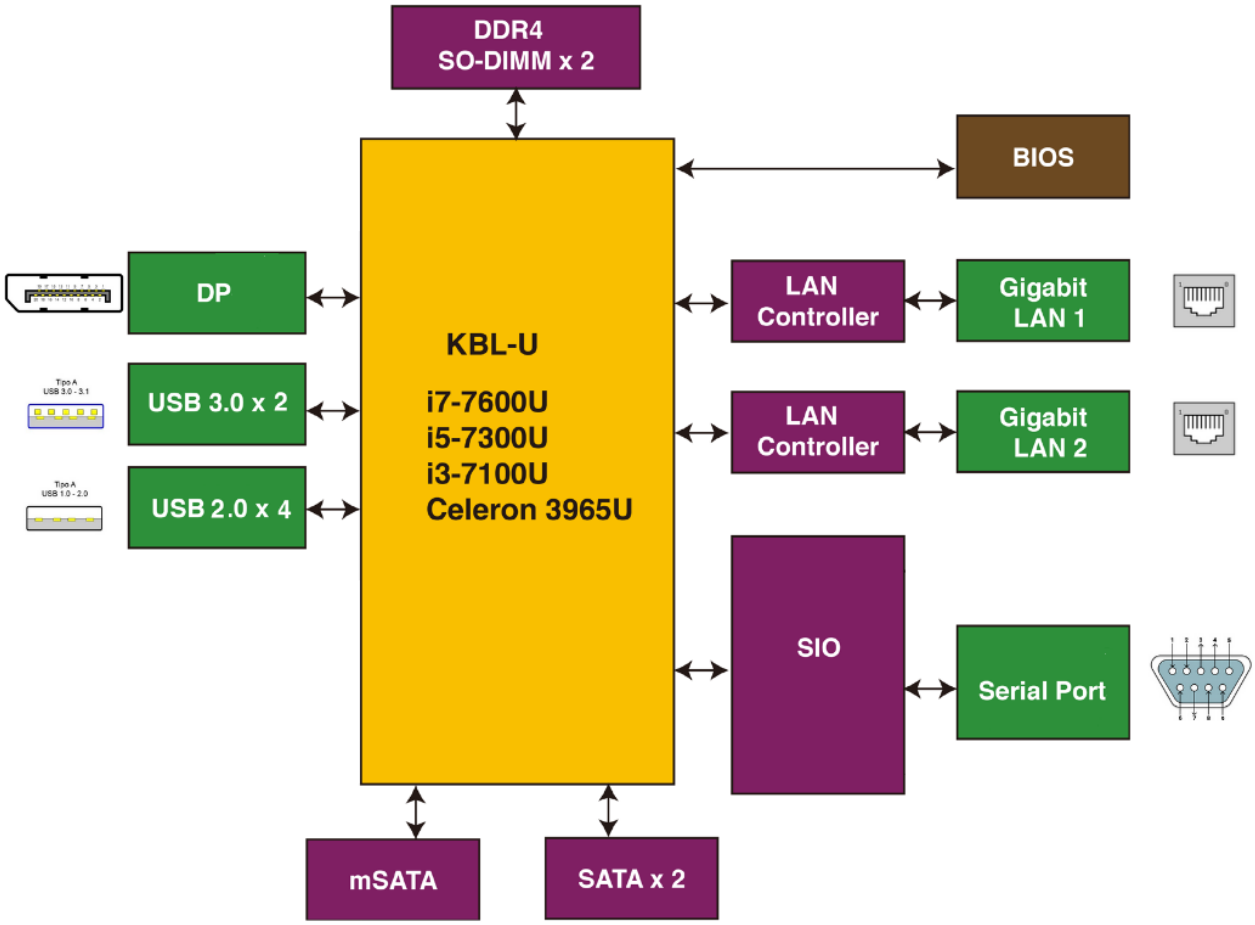


Figure 4-5: Block diagram

4.1 Operational conditions

4.1.1 Software

Software necessary for operating, controlling and monitoring the EUT:

Name	Identification Code/Issue	Task

4.1.2 Operation modes

☒ Normal operation: EUT powered und switched on.

☐ Other operation:

Operation mode 1 ..... :

Operation mode 2 ..... :

4.2 Hardware Configuration

4.2.1 Components of the EUT

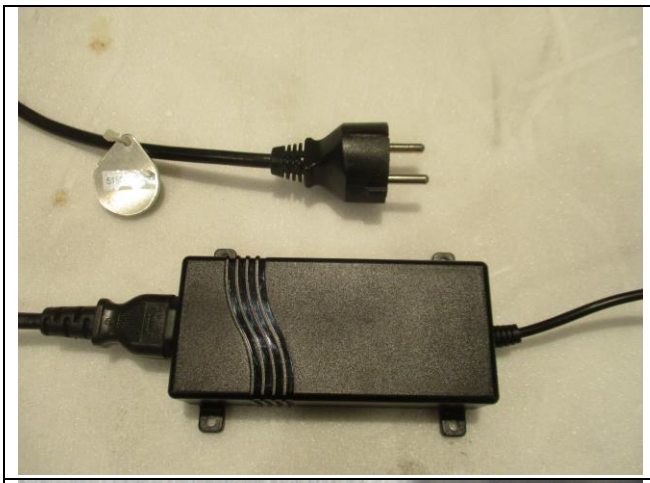
Name	Identification Code/Issue/Serial Number	Interface type	Quantity
Touch Industrial PC VESA 12.1 OEM	---	---	1

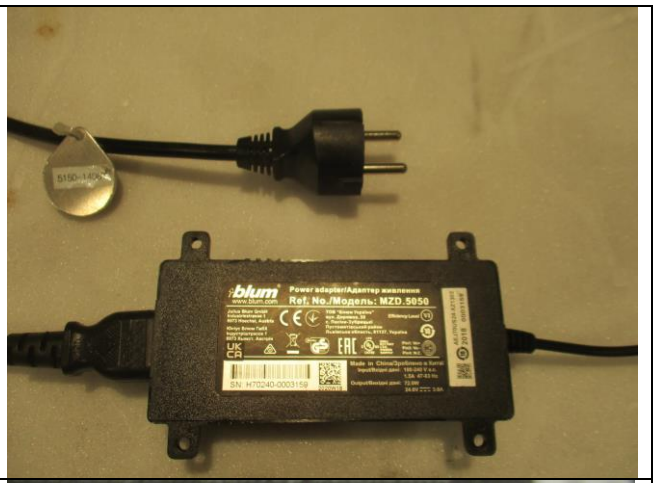
4.2.2 Interface description

All interfaces are identified independent whether they are tested or not.

4.2.2.1 Power supply port

Power Supply	Type (AC/DC)	Voltage	Frequency	Current	Power
Rated voltage range	AC	100 - 240 V	50 / 60 Hz	---	---
Tested voltage	AC	120 V	60 Hz	---	---





4.2.2.2 Earthing and Grounding connections [4]

Type	Task	Connected to	Test E/I/NA
The grounding is via the Schuko connection.			NA

[4] Safety ground, functional earth, specific ground connections

4.2.2.3 Communication [5] and signal [6] ports

Type	Bit rate/frequency/ Signal	Task	Connected to
Ethernet	1 Gbits	Communication	Cable open
Ethernet	1 Gbits	Communication	Cable open
RS232	115.2 kbaud	Communication	Cable open
USB 2.0	480 Mbits	Signal	USB Device
USB 3.2 1x1	5 Gbits	Signal	USB Device
Display	5.4 Gbits	Signal	Cable open

4.2.3 Cabling

Name	Identification Code/Issue/ Serial Number	shield	Description of Connection / plug type	length	Quantity
Ethernet	--	yes	Ethernet connector	100 m	2
RS232	--	yes	RS232 connector	2 m	1
USB 2.0	--	yes	USB connector	5 m	4
USB 3.2 1x1	--	yes	USB connector	5 m	2
DisplayPort cable	--	yes	DisplayPort connector	15 m	1

4.2.4 Clock frequencies of the EUT resulting in determination of frequency range

System / Sub-system	Highest clock frequency
CPU	2.2 GHz

The result of the table above with the highest frequency of internal source is basis of the determination of the necessity of measurement above 1 GHz. The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes.
See **FCC §15.33 a)** for relevant frequency range of **intentional radiators**.
See **FCC §15.33 b)** for relevant frequency range of **unintentional radiators**.

See e.g. the following table taken from FCC §15.33 b) 1)

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	**Upper frequency of measurement range (MHz)**

5 connections to communication networks, analog, Ethernet, antenna, wireless, GPS,

6 Signaling, monitoring and control ports

Below 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

4.2.5 External protection devices or measures

EMC relevant external protection devices or measures specified in the user's manual (e.g. overvoltage, shielding, bonding and grounding).

None

4.2.6 Modifications during the test

None

4.3 Deviations from Standard

None

5 Test Equipment

5.1 Test Facility

The EMC-tests are carried out in the EMC-laboratory of SGS Germany, Consumer and Retail, Hofmannstraße 50, 81379 München, Germany.

Chamber	1	2	3	4 / 5	6	7
Dimensions (net)	17.7 * 10.8 * 6.8 m	9.6 * 8.5 * 5.3 m	7.4 * 6.6 * 5.2 m	4.1 * 3.5 * 3.5m	6.4 * 4.3 * 4.3m	4.58 * 4.28 * 3.01m
Max. Door Exit (w x h)	2.9 * 3.86 m	3.9 * 4.0 m	2.0 * 2.7 m	0.9 * 2.25 m	1.8 * 3.0 m	1.2 * 2.050 m
Shielding material	Sheet steel (Thick-ness:1.5mm on floor, 1.0 mm on walls and ceiling)	Sheet steel	Sheet steel	Sheet steel	Sheet steel	Sheet steel
Absorbers	Hybrid absorbers on walls and ceiling (TDK), length 1 m	Hybrid absorbers on walls and ceiling (E+C), length 0.5 m	Hybrid absorbers on walls and ceiling (E+C), length 0.3 m	Without absorbers	Without absorbers	Hybrid absorbers on walls and ceiling
Floor	Metallic ground plane floor load: 12 t/m²	Metallic ground plane floor load: 1.5 t/m²	Metallic ground plane floor load: 1 t/m²	Metallic ground plane	Metallic ground plane	Metallic ground plane
Turntable	∅ 4 m / 7 t	∅ 3.2 m / 1.5 t	∅ 2.0 m / 1 t			
Listings		VCCI-listed Reg. No. R-12623, G-10266			VCCI-listed Reg. No. C-12866 T-11942	
Specials	***Emission*:** ***30 – 1000 MHz (d = 10 m)*** - NSA acc. to: ・ CISPR 16-1-4 ・ ANSI C63.4 ***1 – 18 GHz (d = 3 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4	***Emission*:** ***30 – 1000 MHz (d = 3 m)*** - NSA acc. to: ・ CISPR 16-1-4 ・ ANSI C63.4 ***1 – 18 GHz (d = 3 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4	***Emission*:** ***30 – 1000 MHz (d = 3 m)*** - NSA acc. to: ・ CISPR 16-1-4 ・ ANSI C63.4 ***1 – 18 GHz (d = 3 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4			For automotive components only
	Immunity: Field uniformity 27 – 6000 MHz acc. IEC/EN 61000-4-3	***Immunity:*** Field uniformity 80 – 6000 MHz acc. IEC/EN 61000-4-3	***Immunity:*** Field uniformity 80 – 6000 MHz acc. IEC/EN 61000-4-3			

FCC (Federal Communication Commission): Recognition by Bundesnetzagentur (BNetzA-CAB-14/21-09) and Designation as **CAB (Conformity Assessment Body):** Designation Number DE0013; Test firm Registration #: 366296
Designation **KBA** (**Kraftfahrt-Bundesamt**) as Technical Service category A and D. Registration Number: KBA-P 00083-97
CB Testing Laboratory under the responsibility of SGS CEBEC as National Certification Body and to carry out testing within the **IECEE CB Scheme.**
Designation No. for **RRA** (Radio Research Agency) in **Korea; EU0145**
VCCI Member No. 2793

5.2 Measurement Uncertainty

As far as the underlying standards include requirements concerning the uncertainty of measuring instruments or measuring methods, they are met.

The expanded measurement uncertainty of the measuring chain was calculated for all relevant tests according to the “ISO Guide to the expression of uncertainty in measurement (GUM)”. The tables below shows the relevant uncertainties.

Emission

Test	U_{LAB}	Test	U_{LAB}
Conducted emission 9 kHz – 150 kHz CISPR 32 / CISPR 25	+2.2 dB / -2.5 dB	Conducted emission 150 kHz – 30 MHz CISPR 32 / CISPR 25 / FCC	+2.2 dB / -2.5 dB
Radiated emission H-Field 9 kHz – 30 MHz CISPR 11/36	+2.9 dB / -4.0 dB	Disturbance power 30 – 300 MHz CISPR 14-1	+3.1 dB / -3.8 dB
Radiated Emission 30 – 1000 MHz CISPR 32 / FCC	+3.1 dB / -3.9 dB	Radiated Emission 1 – 6 GHz CISPR 32 / FCC	+3.9 dB / -5.2 dB
Radiated Emission, ESA 30 – 1000 MHz CISPR 25 / ECE R10	+3.6 dB / -4.8 dB	Radiated Emission, Vehicle 30 – 1000 MHz CISPR 12 / ECE R10	+3.1 dB / -4.0 dB
Radiated Emission 6 – 18 GHz FCC	+4.2 dB / -5.7 dB	Radiated Emission 18 – 40 GHz FCC	+5.1 dB / -7.5 dB
Harmonics IEC 61000-3-2 IEC 61000-3-12	+ 0.6 dB / -0.6 dB	Flicker IEC 61000-3-3 IEC 61000-3-11	+ 0.6 dB / -0.6 dB
DC voltages with multimeter	+0,05% / -0,05%	DC currents with multimeter	+0,68% / -0,68%
Voltages with Oscilloscope	+3.33% / -3.25%		

Note: CISPR 32 includes also CISPR 11, CISPR 14-1, CISPR 15, IEC 61000-6-3, IEC 61000-6-4 if single tests are applicable in those standards.

Immunity

Test	U_{LAB}	Test	U_{LAB}
ESD IEC 6100-4-2 / ISO 10605	+1.0 dB / -1.1 dB	Radiated Immunity 20 – 1000 MHz IEC 61000-4-3	+3.7 / -4.4.dB
Radiated Immunity 1 – 18 GHz IEC 61000-4-3	+2.7 / -3.4.dB	Burst/EFT IEC 61000-4-4	+2.3 dB / -3.1 dB
Surge IEC 61000-4-5	+0.8 dB / -0.9 dB	Conducted immunity HF with CDN IEC 61000-4-6	+2.7 / -3.6 dB
Conducted immunity HF with clamp IEC 61000-4-6	+2.9 / -3.9 dB	Conducted immunity HF with current clamp IEC 61000-4-6	+2.7 / -3.6 dB
Radiated Immunity magnetic field 50 Hz, IEC 61000-4-8	+1.9 / -2.3 dB	Voltage Dips/Interruptions, IEC 61000-4-11 IEC 61000-4-34	+0.8 / -1.2 dB
Radiated immunity ALSE ISO 11452-2	+1.9 dB / -2.1 dB	BCI ISO 11452-4	+2.7 dB / -3.6 dB
Stripline / TEM ISO 11452-5/3,	+1.6 dB / -1.8 dB		

Expanded uncertainty:

Conducted emission	0.15 – 30 MHz	+ 2.2 dB / -2.5 dB
Radiated emission	30 – 1000 MHz	+3.1 dB / -3.9 dB
Radiated emission	1 – 6 GHz	+3.9 dB / -5.2 dB
Radiated emission	6 – 18 GHz	+4.2 dB / -5.7 dB
Radiated emission	18 – 40 GHz	+5.1 dB / -7.5 dB

5.3 Statement of Conformity & Decision Rule

If not otherwise stated, the Decision Rule is considered in different ways.

Emission based on CISPR 11, CISPR 14-1, CISPR 15, CISPR 32, CISPR 36, IEC 61000-6-3, IEC 61000-6-4:
The decision rule for statement of conformity is based on U_{CISPR} given in CISPR 16-4-2. The relevant MIU (Measurement Instrumentation Uncertainty) calculations U_{LAB} of the EMC-lab for the single emission tests is below U_{CISPR}. Therefore, it can be considered that the measurement result is valid without any need of adaption and e.g., a result of 0 dB to the limit can be stated as pass.

All other emission tests:
For all other emission tests, the relevant MIU have been calculated by the EMC-lab and U_{LAB} keep typical levels. In this case, the “Binary Statement for Simple Acceptance Rule” acc. 4.2.1 of ILAC G8:2019 is applied. The result can be considered to be passed if the measurement value is at least equal to the limit. Probability is only 50% in this case. If the measured value is below the limit by the amount of the measurement uncertainty, the risk of an incorrect assumption is already reduced to 2.5%.

Immunity
The calculated MIU U_{LAB} of the test levels are according to the requirements of the corresponding test standards. As the influence of the characteristics of the test disturbance is not known and the DUT shows non-linear system behaviour in most cases, no decision rule can be stated for immunity tests.

6 Test Conditions and Results

The test results in the report refer exclusively to the test object described in section 4 and the test period in section 3.3. The results apply to the sample(s) as received.

6.1 Conducted disturbance (150 kHz to 30 MHz)

Phenomena	Reference	Frequency Range	Criteria	Verdict [1]
Conducted Emission AC Power Ports	FCC 47 CFR Part 15 §15.107	150 kHz – 30 MHz	Class A	P Note: Class B passed also

Tested by : Suurmaa

Test date : 2023-08-31 Test location : EMC chamber No. 02

Test procedure

Measured levels of powerline conducted emission are the radio-noise voltage levels across the 50 Ω LISN port (to which the EUT is connected) terminated into a 50 Ω EMI receiver. All radio-noise voltage measurements are made on each current carrying conductor at the plug end of the EUT power cord. The measurement is performed using a receiver with peak and average detector.
Only if the measured peak value is near or above the quasi-peak limit the detector function is changed to quasi-peak for final measurement of the highest voltage levels.

Exploratory emission measurements are to be performed considering operation states and cable arrangement to evaluate configuration with highest emission levels (C63.4-2014, Clause 7.3.3 and 7.3.4).
Table-top equipment is arranged 80 cm above ground plane.

Acc. ANSI C63.4 chapter 10.2.8.3: AC power-line conducted emissions measurements are to be separately carried out only on each of the phase ("hot") line(s) and (if used) on the neutral line(s), but not on the ground [protective earth) line(s).

EMC-Test-SW: EMC32 version 10.60.10 (R&S)

Sample Calculation with all conversion and correction factors used:
$\sum CF = CF_{Cables} + CF_{LISN}$

Instruments and accessories

ID	Description	Manufacturer	Model	Serial No.	Status	Cal. date	Due date
P0337	EMC chamber 2	Siemens			chk		
P1327	EMI receiver	R&S	ESU40	100048	cal	Apr 21, 2023	Apr 30, 2024
P0441	LISN MZ3 (integrated pulse limiter P0488)	R&S	ESH3-Z5	894498/004	cal	Mar 21, 2023	Mar 31, 2025
P2622	Power Supply	dataTec	Chroma 61605, AC-/DC Source	6160500029 41	ind		

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, service = Wartung (Service), man = Maintenance, calservice = Calibration & Service, chkservice = Check & Service, calchkservice = Calibration & Check & Service

Photo documentation of the test set-up:

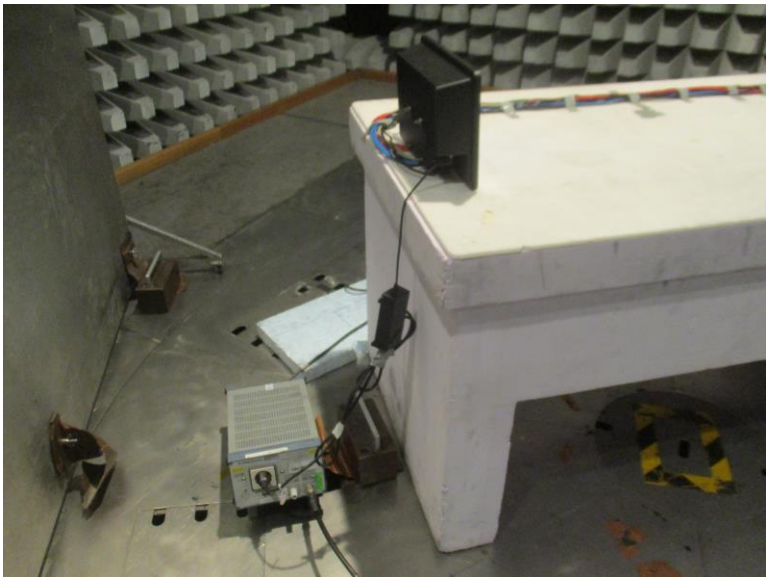


Figure 6-1: test setup Low voltage AC mains continuous disturbance

Result:

verdict:	**pass**

For detailed results, please see below.

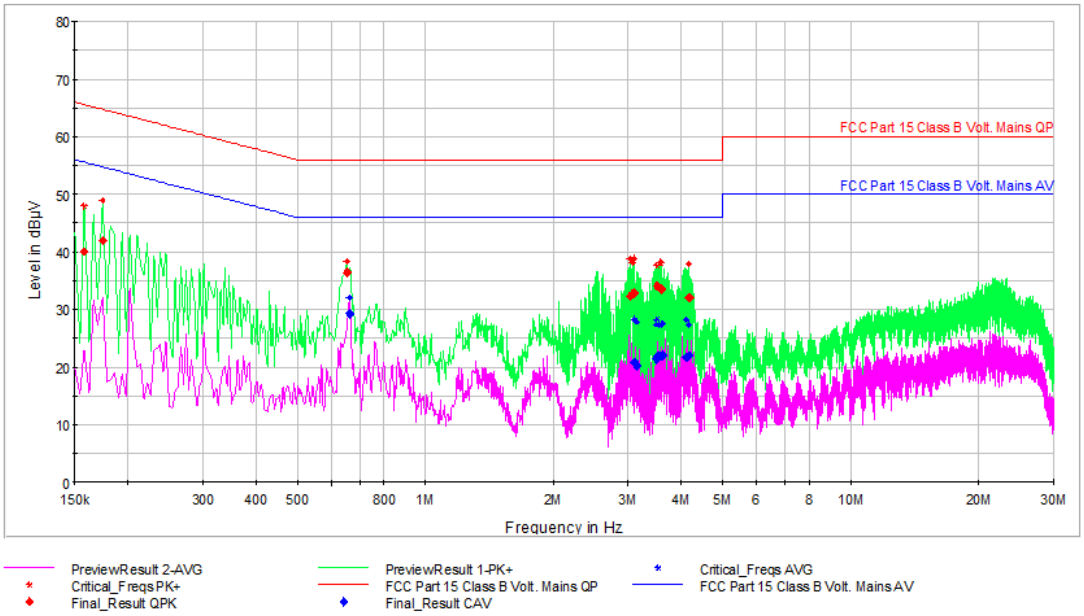


Figure 6-2: Graphical presentation Low voltage AC mains continuous disturbance, Neutral line

Result table: (Class B)

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.158000	40.10	---	65.57	25.47	1000.0	9.000	N	GND	10
0.174000	42.03	---	64.77	22.74	1000.0	9.000	N	GND	10
0.654000	36.42	---	56.00	19.58	1000.0	9.000	N	GND	10
0.662000	---	29.29	46.00	16.71	1000.0	9.000	N	GND	10
3.022000	32.32	---	56.00	23.68	1000.0	9.000	N	GND	10
3.074000	32.74	---	56.00	23.26	1000.0	9.000	N	GND	10
3.102000	---	20.77	46.00	25.23	1000.0	9.000	N	GND	10
3.102000	32.87	---	56.00	23.13	1000.0	9.000	N	GND	10
3.142000	---	20.24	46.00	25.76	1000.0	9.000	N	GND	10
3.482000	---	21.39	46.00	24.61	1000.0	9.000	N	GND	10
3.510000	34.05	---	56.00	21.95	1000.0	9.000	N	GND	10
3.510000	---	21.87	46.00	24.13	1000.0	9.000	N	GND	10
3.550000	---	21.96	46.00	24.04	1000.0	9.000	N	GND	10
3.562000	33.66	---	56.00	22.34	1000.0	9.000	N	GND	10
3.578000	---	21.99	46.00	24.01	1000.0	9.000	N	GND	10
3.578000	33.46	---	56.00	22.54	1000.0	9.000	N	GND	10
3.618000	---	22.01	46.00	23.99	1000.0	9.000	N	GND	10
4.106000	---	21.73	46.00	24.27	1000.0	9.000	N	GND	10
4.174000	---	21.93	46.00	24.07	1000.0	9.000	N	GND	10
4.174000	31.99	---	56.00	24.01	1000.0	9.000	N	GND	10

Note: As Class B is met Class A is passed also.

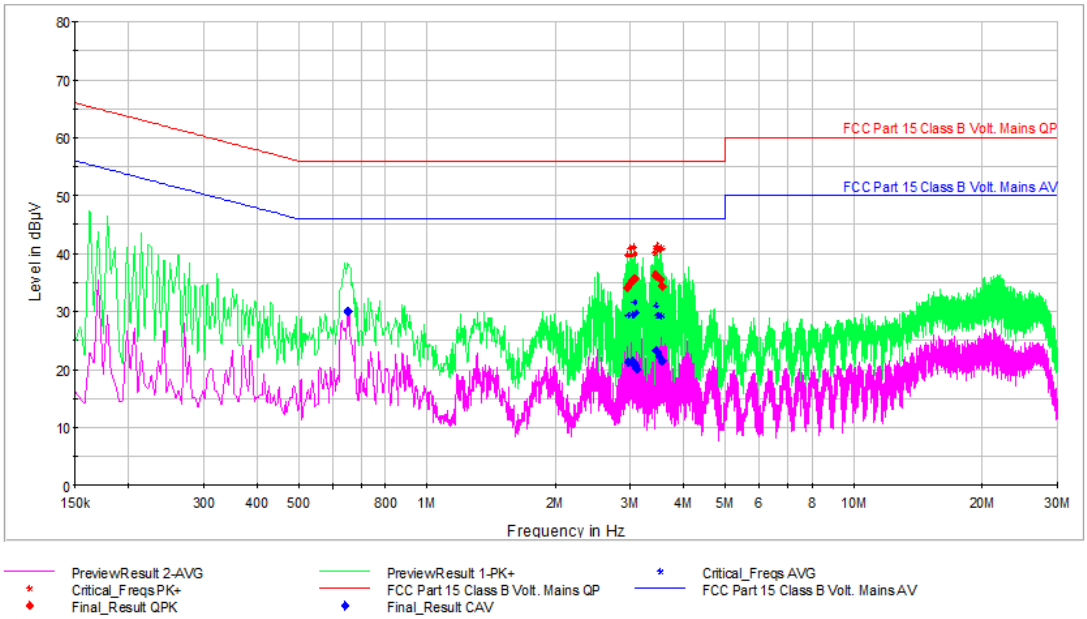


Figure 6-3: Graphical presentation Low voltage AC mains continuous disturbance, Phase

Result table: (Class B)

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.650000	---	30.07	46.00	15.93	1000.0	9.000	L1	GND	10
2.950000	34.10	---	56.00	21.90	1000.0	9.000	L1	GND	10
2.962000	---	21.24	46.00	24.76	1000.0	9.000	L1	GND	10
2.990000	34.90	---	56.00	21.10	1000.0	9.000	L1	GND	10
3.018000	35.32	---	56.00	20.68	1000.0	9.000	L1	GND	10
3.030000	---	21.44	46.00	24.56	1000.0	9.000	L1	GND	10
3.058000	---	21.13	46.00	24.87	1000.0	9.000	L1	GND	10
3.058000	35.52	---	56.00	20.48	1000.0	9.000	L1	GND	10
3.070000	35.64	---	56.00	20.36	1000.0	9.000	L1	GND	10
3.070000	---	20.75	46.00	25.25	1000.0	9.000	L1	GND	10
3.098000	---	20.08	46.00	25.92	1000.0	9.000	L1	GND	10
3.422000	36.25	---	56.00	19.75	1000.0	9.000	L1	GND	10
3.438000	36.25	---	56.00	19.75	1000.0	9.000	L1	GND	10
3.438000	---	23.24	46.00	22.76	1000.0	9.000	L1	GND	10
3.450000	36.09	---	56.00	19.91	1000.0	9.000	L1	GND	10
3.478000	---	22.98	46.00	23.02	1000.0	9.000	L1	GND	10
3.506000	---	22.34	46.00	23.66	1000.0	9.000	L1	GND	10
3.518000	35.55	---	56.00	20.45	1000.0	9.000	L1	GND	10
3.546000	---	21.42	46.00	24.58	1000.0	9.000	L1	GND	10
3.546000	34.42	---	56.00	21.58	1000.0	9.000	L1	GND	10

Note: As Class B is met Class A is passed also.

6.2 Radiated disturbances (30 MHz to 1000 MHz)

Phenomena	Reference	Frequency Range	Criteria	Verdict [1]
Radio Disturbance Electric Field	FCC 47 CFR Part 15 §15.109	30 MHz - 1 GHz distance 3	Class A	P Note: Class B passed also

Tested by : Suurmaa

Test date : 2023-08-31 Test location : EMC chamber No. 02

Test procedure:

Radiated measurements are performed in a semi-anechoic chamber meeting the normalized site attenuation of ANSI C63.4 and listed with the FCC. The applicable frequency spectrum is scanned with a calibrated RF measuring system using an appropriate broadband antenna and an EMI-receiver/spectrum analyzer and compared to the required limits. The measuring instrument performs the field strength calculations automatically. The measuring software provides resident AF and CF figures for individual antennas and cables. The receiver/analyzer is set to "peak" mode from 30 MHz to 1 GHz. On any emission of concern, the receiver is set to quasi-peak mode.

“Maximization” of each suspect frequency is accomplished by a combination of a 360° azimuth search using a turntable and varying the antenna to ground plane height from 1 m to 4 m. Also, both the vertical and horizontal polarization is scanned in the required frequency range per ANSI C63.4.
Maximization of emission results starts at 0° of the turn table with antenna in horizontal polarization is set to 1 m. While the turntable slowly moves to 360°, the spectrum analyzer is sweeping from 30 to 1000 MHz and maximum data is recorded. Antenna is set to 2 m and turntable slowly moves back to 0° while the spectrum analyzer is sweeping again. This is repeated until the antenna height of 4 m is reached.
The antenna polarization is set to vertical and the procedure described above is repeated.
For each frequency the measuring software stores the maximum level as well as the corresponding settings of turntable and antenna. An azimuth resolution of about 3° is realized using this method.
At least the six highest frequencies are selected automatically by the software for performing the final measurements.
At each of these frequencies the turntable as well as the antenna is set to the corresponding settings. Then the antenna is slowly moved 50 cm down/up related to initial position while the receiver is measuring at this frequency. The highest emission level and the corresponding height are recorded. At this final position, the measurement is performed with quasi-peak detector.
Exploratory emission measurements are to be performed considering operation states and cable arrangement to evaluate configuration with highest emission levels (C63.4, Clause 8.3.1 and 8.3.2).
Table-top equipment is arranged 80 cm above ground plane.

EMC-Test-SW: EMC32 version 10.60.10 (R&S)

Sample Calculation with all conversion and correction factors used:
$\sum CF = CF_{Cables} + CF_{Antenna}$

Instruments and accessories

ID	Description	Manufacturer	Model	Serial No.	Status	Cal. date	Due date
P0337	EMC chamber 2	Siemens			chk		
P1284	Controller	innco GmbH	CO 3000	CO3000/914/37830316/L	cnn		
P1327	EMI receiver	R&S	ESU40	100048	cal	Apr 21, 2023	Apr 30, 2024
P1283	Mast (MZ2)	innco GmbH	MA 4740-XPET	MA4000/170/13470706/L	cnn		
P0018	antenna + 4 dB Attenuator (MZ 2)	Chase	CBL6111A + 4dB	1566 + CM7710	cal	Jun 02, 2023	Jun 30, 2025
P2622	Power Supply	dataTec	Chroma 61605, AC-/DC Source	616050002941	ind		

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, service = Wartung (Service), man = Maintenance, calservice = Calibration & Service, chkservice = Check & Service, calchkservice = Calibration & Check & Service

Photo documentation of the test set-up:

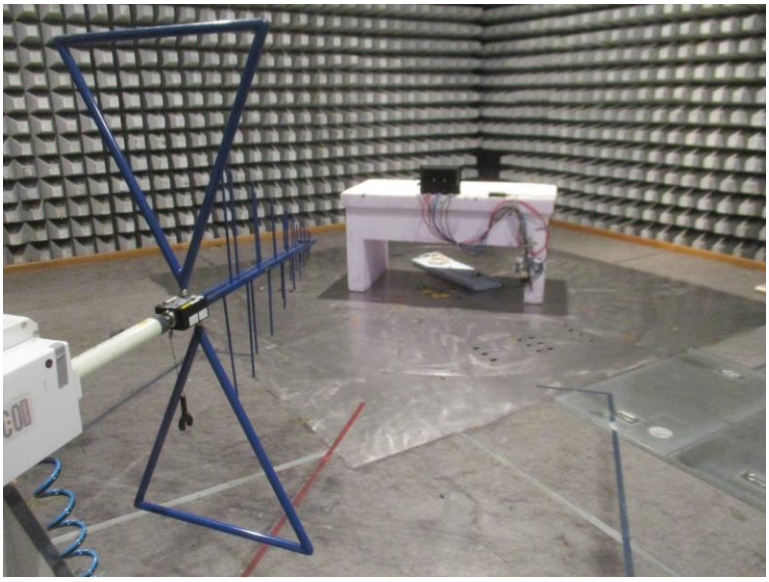


Figure 6-4: test setup for Radiated disturbances 30 MHz to 1000 MHz

Result:

verdict:	**pass**

For detailed results, please see below.

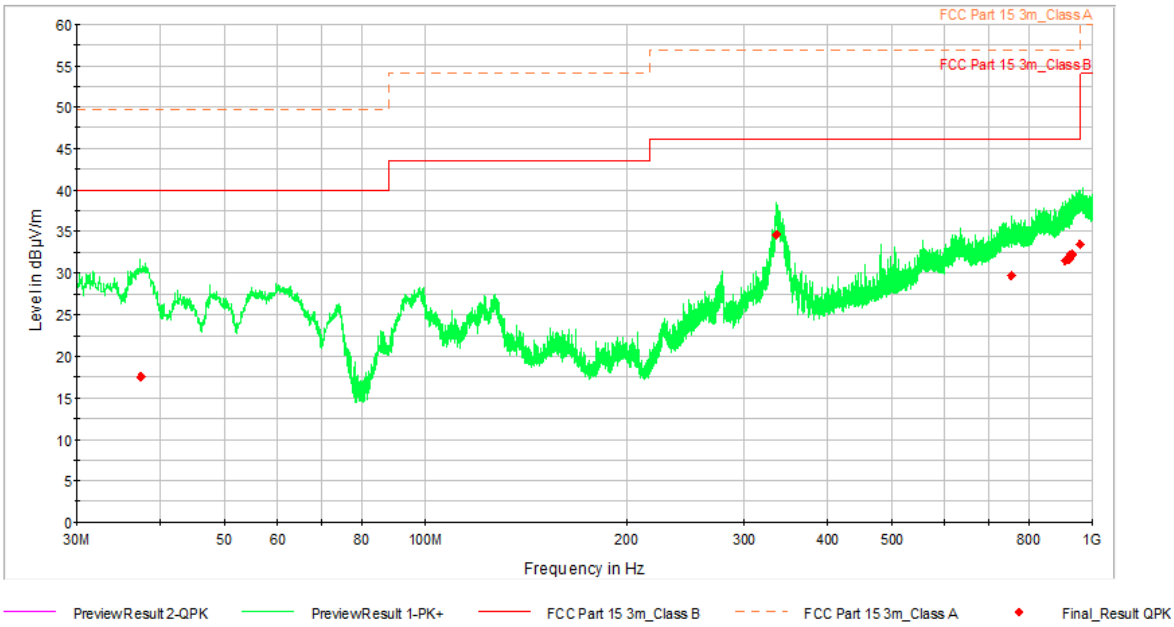


Figure 6-5: Graphical presentation Radiated disturbances 30 MHz to 1000 MHz

Result table:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Sig Path (dB)
37.323500	17.56	40.00	22.44	1000.0	120.000	138.0	H	264.0	20	0
335.210500	34.66	46.00	11.34	1000.0	120.000	158.0	H	1.0	20	2
754.735500	29.70	46.00	16.30	1000.0	120.000	119.0	V	159.0	29	3
908.044000	31.45	46.00	14.55	1000.0	120.000	120.0	V	1.0	31	3
918.471500	31.70	46.00	14.30	1000.0	120.000	269.0	H	236.0	31	3
922.060500	31.99	46.00	14.01	1000.0	120.000	344.0	H	42.0	31	3
925.649500	32.23	46.00	13.77	1000.0	120.000	303.0	H	264.0	32	3
929.772000	32.25	46.00	13.75	1000.0	120.000	120.0	V	293.0	32	3
954.701000	33.41	46.00	12.59	1000.0	120.000	182.0	H	318.0	33	3

6.3 Radiated disturbances (1 GHz to 18 GHz)

Phenomena	Reference	Frequency Range	Criteria	Verdict [1]
Radio Disturbance Electric Field	FCC 47 CFR Part 15 §15.109	1 GHz - 18 GHz Distance 3 m	Class A	P Note: Class B passed also

Tested by : Suurmaa

Test date : 2023-08-31 Test location : EMC chamber No. 02

Test Execution

Radiated measurements are performed in a semi-anechoic chamber meeting the normalized site attenuation of ANSI C63.4 as well as the Site VSWR requirements of CISPR16 and listed with the FCC. The applicable frequency spectrum is scanned with a calibrated RF measuring system using an appropriate broadband antenna and an EMI-receiver/spectrum analyzer and compared to the required limits. The measuring instrument performs the field strength calculations automatically. The measuring software provides resident AF and CF figures for individual antennas and cables. The receiver/analyzer is set to "peak" mode in the relevant frequency range. On any emission of concern, the receiver is set to average mode.

For EUTs having a size larger than the beamwidth of the antenna, appropriate countermeasures shall be taken, e.g. increasing the measuring distance or different antenna positions (lateral) to scan the complete surface of EUT.
"Maximization" of each suspect frequency is accomplished by a combination of a 360° azimuth search using a turntable and varying the antenna to ground plane height from 1 m to 4 m. Both, the vertical and horizontal polarization is scanned in the required frequency range per ANSI C63.4.
Maximization of emission results starts at 0° of the turn table with antenna in horizontal polarization is set to 1 m. While the turntable slowly moves to 360°, the spectrum analyzer is sweeping from 1 to 18 GHz and maximum data is recorded. Antenna is set to 1.5 m and turntable slowly moves back to 0° while the spectrum analyzer is sweeping again. This is repeated until the antenna height of 4 m is reached (step: 0.5m).
The antenna polarization is set to vertical and the procedure described above is repeated.
For each frequency the measuring software stores the maximum level as well as the corresponding settings of turntable and antenna. An azimuth resolution of about 3° is realized using this method.
At least the six highest frequencies are selected automatically by the software for performing the final measurements. At each of these frequencies the turntable as well as the antenna is set to the corresponding settings. Then the antenna is slowly moved 25 cm down/up related to initial position while the receiver is measuring at this frequency. The highest emission level and the corresponding height are recorded. At this final position, the measurement is performed with average detector.
Exploratory emission measurements are to be performed considering operation states and cable arrangement to evaluate configuration with highest emission levels (C63.4, Clause 8.3.1 and 8.3.2).
Final measurements were performed acc C63.4, clause 8.3.2.2 aimed at the emission source for receiving the maximum signal.
Table-top equipment is arranged 80 cm above ground plane.

EMC-Test-SW: EMC32 version 10.60.10 (R&S)

Sample Calculation with all conversion and correction factors used:

$\sum CF = CF_{Cables} + CF_{Antenna} + CF_{Preamplifier}$

Instruments and accessories

ID	Description	Manufacturer	Model	Serial No.	Status	Cal. date	Due date
P0337	EMC chamber 2	Siemens			chk		
P1284	Controller	innco GmbH	CO 3000	CO3000/914/ 37830316/L	cnn		
P1327	EMI receiver	R&S	ESU40	100048	cal	Apr 21, 2023	Apr 30, 2024
P1283	Mast (MZ2)	innco GmbH	MA 4740-XPET	MA4000/170/ 13470706/L	cnn		
P1575	antenna (MZ2)	R&S	HL050	100097	cal	Jul 06, 2022	Jul 31, 2024
P1589	preamplifier (MZ1)	Kuhne electronic	KU LNA BB 202 A	505201	cal	Mar 31, 2022	Mar 31, 2024
P2622	Power Supply	dataTec	Chroma 61605, AC-/DC Source	6160500029 41	ind		

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, service = Wartung (Service), man = Maintenance, calservice = Calibration & Service, chkservice = Check & Service, calchkservice = Calibration & Check & Service

Photo documentation of the test set-up:

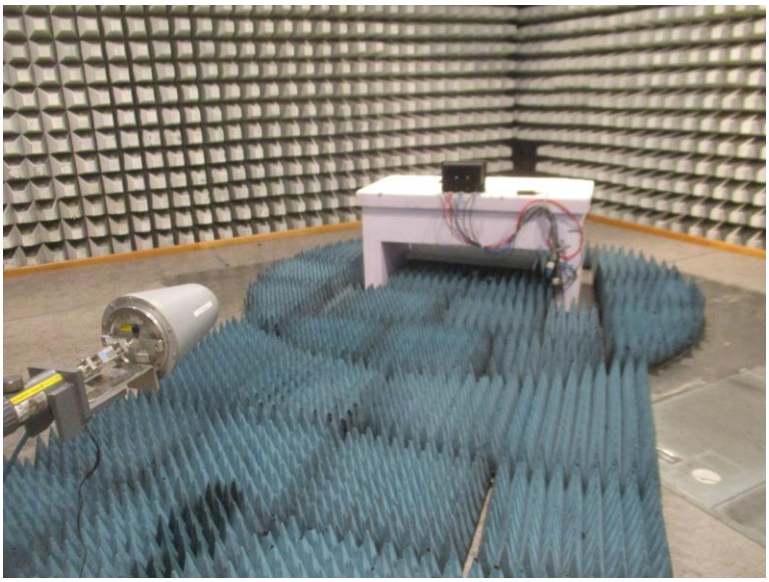


Figure 6-6: test setup for radiated disturbances 1 GHz to 18 GHz

Result:

verdict:	**pass**

For detailed results, please see below.

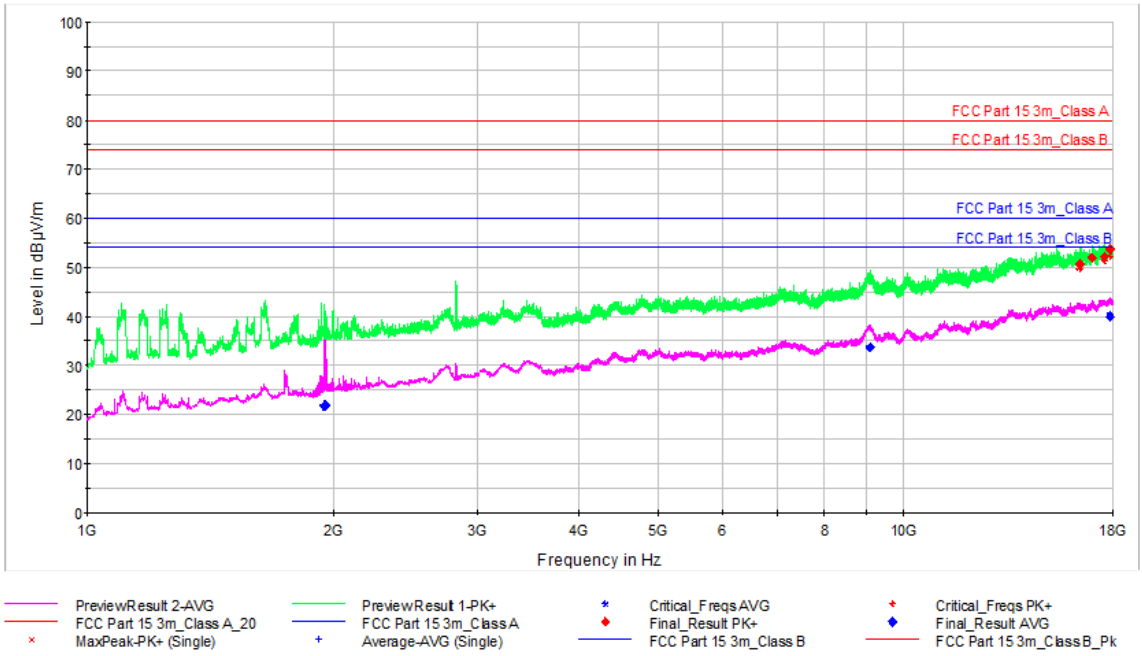


Figure 6-7: Graphical presentation Radiated disturbances 1 GHz to 18 GHz

Result table:

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1949.166667	---	21.75	60.00	38.25	1000.0	1000.000	116.0	H	304.0
1952.000000	---	21.80	60.00	38.20	1000.0	1000.000	123.0	H	183.0
1958.800000	---	21.97	60.00	38.03	1000.0	1000.000	125.0	H	304.0
9084.633333	---	33.67	60.00	26.33	1000.0	1000.000	259.0	H	315.0
16422.400000	50.65	---	80.00	29.35	1000.0	1000.000	225.0	H	161.0
17007.200000	51.82	---	80.00	28.18	1000.0	1000.000	174.0	V	97.0
17614.100000	52.04	---	80.00	27.96	1000.0	1000.000	229.0	V	113.0
17860.600000	---	39.99	60.00	20.01	1000.0	1000.000	175.0	H	344.0
17881.566667	53.64	---	80.00	26.36	1000.0	1000.000	275.0	V	244.0

End of Test Report

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