

TEST REPORT

Test Report No.: 1-1397/20-01-06_B

ENetZ/CAB-02/21-102

Testing Laboratory

CTC advanced GmbH

Untertürkheimer Straße 6 – 10
66117 Saarbrücken/GERMANY
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: <https://ctcadvanced.com/>
e-mail: mail@ctcadvanced.com

Accredited Testing Laboratory:

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS). The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Applicant

X2E GmbH

Große Ahlmühle 19
76865 Rohrbach/GERMANY
Contact: Gerhard Spengler
e-mail: gerhard.spengler@x2e.de

Manufacturer

X2E GmbH

Große Ahlmühle 19
76865 Rohrbach/GERMANY
Contact: Gerhard Spengler

Test Standard/s

FCC - Title 47 CFR Part 15: 2021-09

FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

ANSI C63.4: 2014-06

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

Test Item

Kind of test item: Data Logger
Model name: N4000+
detailed information see chapter 6.1 and 6.2 of this test report



This test report is electronically signed and valid without handwritten signature. The public keys can be requested at the test laboratory to verify the electronic signatures.

Test report authorised:

Jens Hennemann
Lab Manager
Electromagnetic Compatibility & Acoustics

Test performed:

Uli Kraus
Head of Department
Electromagnetic Compatibility & Acoustics

1 Table of contents

1	Table of contents	2
2	General information	3
2.1	Notes and disclaimer.....	3
2.2	Application details.....	4
3	Test standard/s:	4
4	Test Environment	4
5	Test Laboratories sub-contracted	4
6	Information about Test Conditions	5
6.1	Test Item	5
6.2	EUT: Type, S/N etc. and Short Descriptions Used in this Test Report	5
6.3	Auxiliary Equipment (AE): Type, S/N etc. and Short Descriptions.....	6
6.4	EUT Operating Modes	11
7	Summary of Test Results	13
7.1	Emission	13
7.2	Measurement and Test Set-up	14
7.3	Measurement uncertainty	14
7.4	Reporting statements of conformity – decision rule	14
8	Detailed test results - Emission	15
8.1	Conducted Emission	15
8.2	Electromagnetic Radiated Emissions (Distance 10 m).....	20
8.3	Electromagnetic Radiated Emissions (Distance 5 m).....	27
9	Test equipment and ancillaries used for tests	34
10	Observations	36
Annex A	Photographs of the test set-up	37
Annex B	Photographs of the EUT	40
Annex C	Document history	46
Annex D	Further information	46

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CTC advanced GmbH.

The testing service provided by CTC advanced GmbH has been rendered under the current "General Terms and Conditions for CTC advanced GmbH".

CTC advanced GmbH will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.

Under no circumstances does the CTC advanced GmbH test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.

Under no circumstances does the CTC advanced GmbH test report include or imply any product or service warranties from CTC advanced GmbH, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CTC advanced GmbH.

All rights and remedies regarding vendor's products and services for which CTC advanced GmbH has prepared this test report shall be provided by the party offering such products or services and not by CTC advanced GmbH. In no case this test report can be considered as a Letter of Approval.

The present test report can only be used for the sDOC procedure in the USA if the „Responsible Party“ (located in USA) or an official of the responsible party confirms the report in writing, as designated in FCC§2.938.

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

This test report is a new release and replaces all former versions of this report. Please refer to Annex C “Document history” for further information.

2.2 Application details

Date of receipt of order: 2021-09-10
Date of receipt of test item: 2021-09-14
Start of test¹⁾: 2021-09-14
End of test¹⁾: 2021-09-15
Person(s) present during the test: Mr. Spengler
Mr. Glöckler

¹⁾ Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

3 Test standard/s:

Test Standard	Test Standard Description
FCC - Title 47 CFR Part 15: 2021-09	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
ANSI C63.4: 2014-06	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
ICES-003, Issue 7: 2020-10	ICES-003 — Information Technology Equipment (including Digital Apparatus)

4 Test Environment

Temperature: 15°C – 35°C
Relative humidity content: 30 % - 60 %
Air pressure: 860 – 1060 hPa
Power supply of measurement equipment: 230 V / 50 Hz

5 Test Laboratories sub-contracted

6 Information about Test Conditions

6.1 Test Item

Kind of test item :	Data Logger		
Type identification :	N4000+		
Equipment classification:	Equipment for fixed use		
Environment classification:	Industrial environment		
Supply voltage :	AC 115 V/ 60 Hz		
Ports : (maximum cable lengths declared by manufacturer)	Description	Direction	Length
	DC power port	Input	> 3m
Is mounting position / usual operating position defined?			Table Top
Additional information:			
<p>the full information about shielding and port connections for this test is documented in: Testplan Xoroya N4000+; Xoroya N4000+ V1.4.pdf</p> <p>the test was performed for 2 Versions of this product. V1 was full tested and V2 was only tested radiated.</p> <p>- this is a class A digital device:</p> <p>the instructions furnished the user shall include a statement according to §15.105 of the used FCC rules</p> <p>- FCC ID: 2AU4HN4000P</p> <p>- Equipment Class: JAD</p>			

6.2 EUT: Type, S/N etc. and Short Descriptions Used in this Test Report

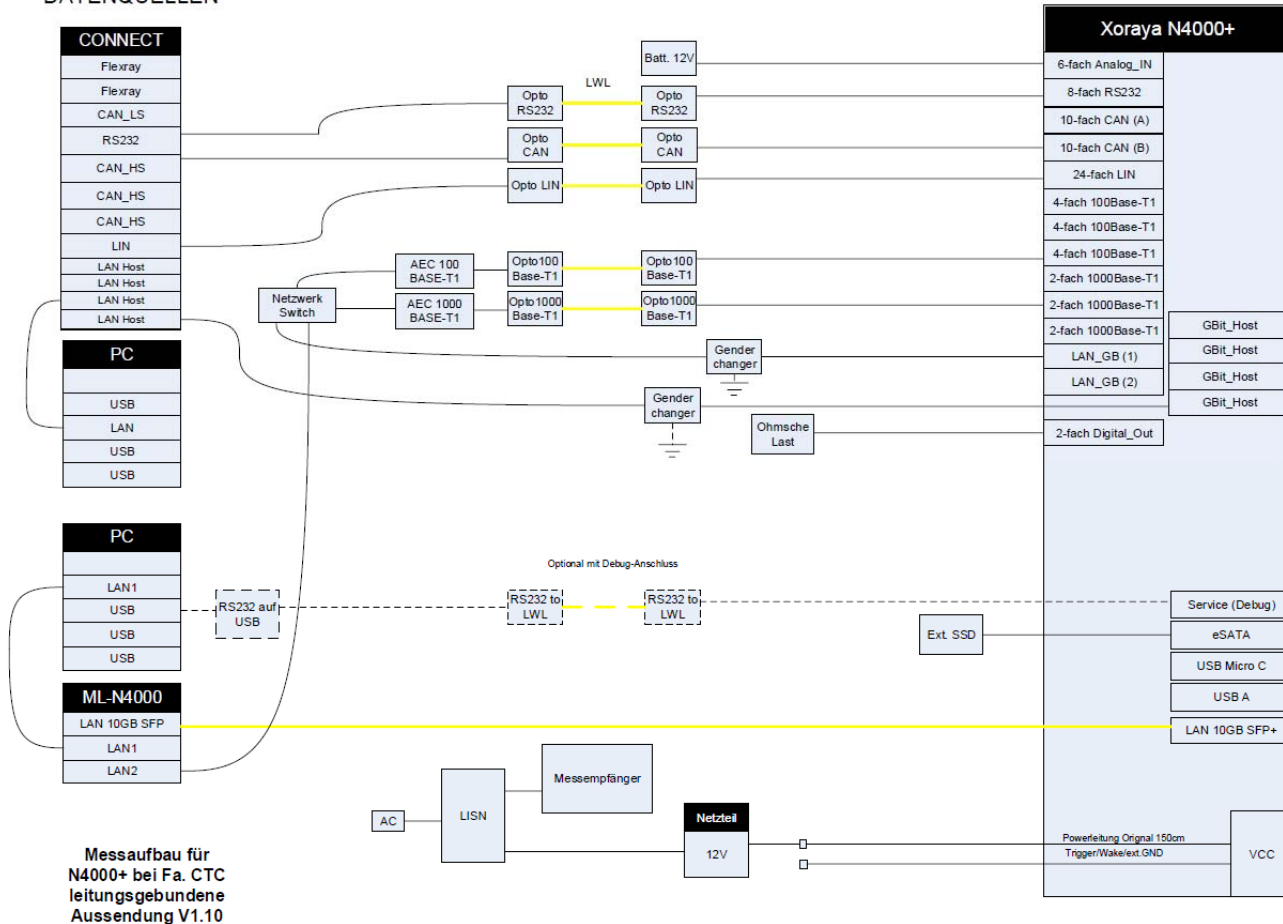
short description*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	Data Logger Model 1	N4000+ (V1)	000008	09/2021	4.0a.812d; FPGA: 9002.0b03; Power: 2.04.2200
EUT B	Data Logger Model 2	N4000+ (V2)	000001	09/2021	4.0a.812d; FPGA: 9002.0b03; Power: 2.04.2200

*) EUT short description is used to simplify the identification of the EUT in this test report.

6.3 Auxiliary Equipment (AE): Type, S/N etc. and Short Descriptions

Set 1

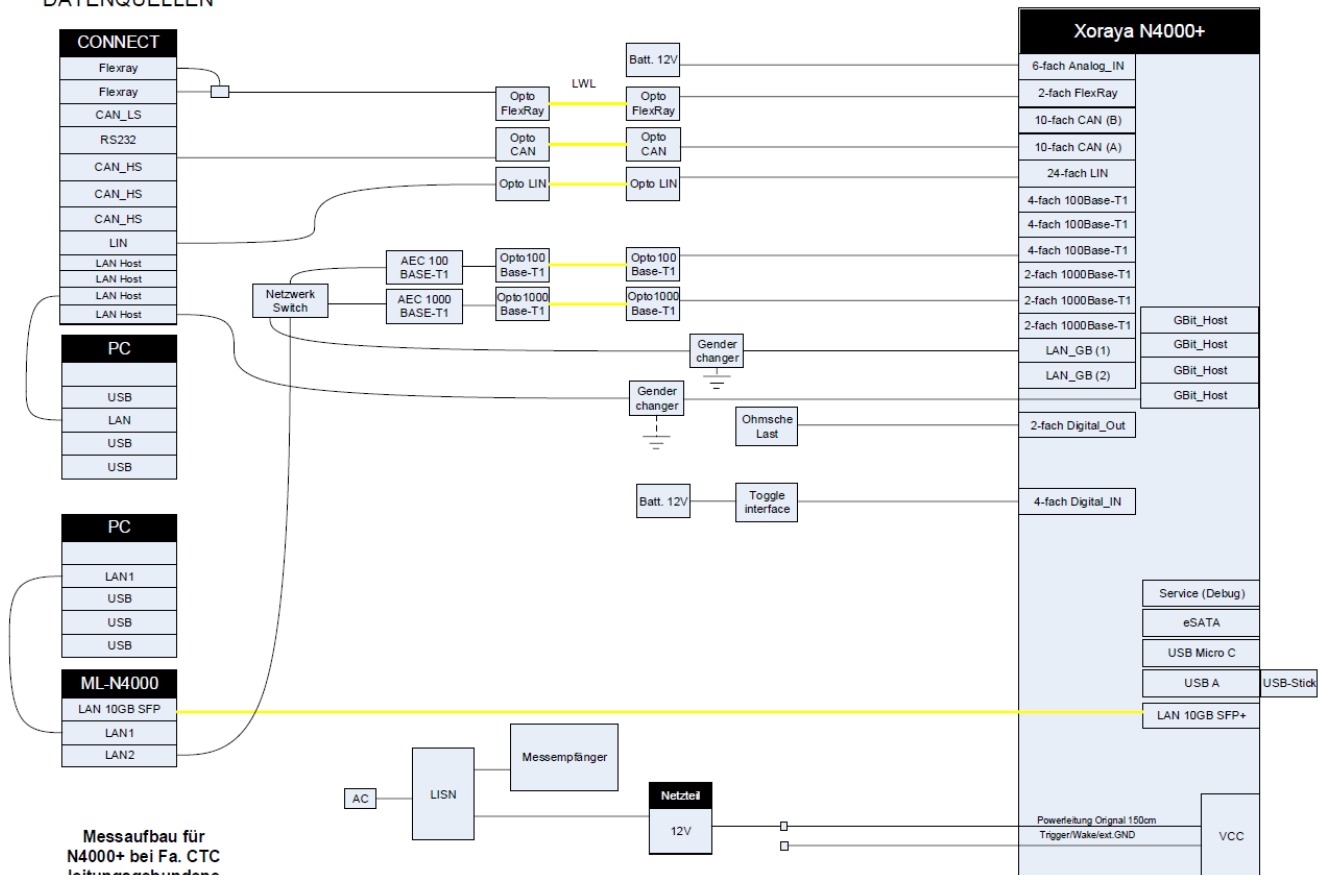
DATENQUELLEN



03.09.2021 G.Sp.

Set 2

DATENQUELLEN

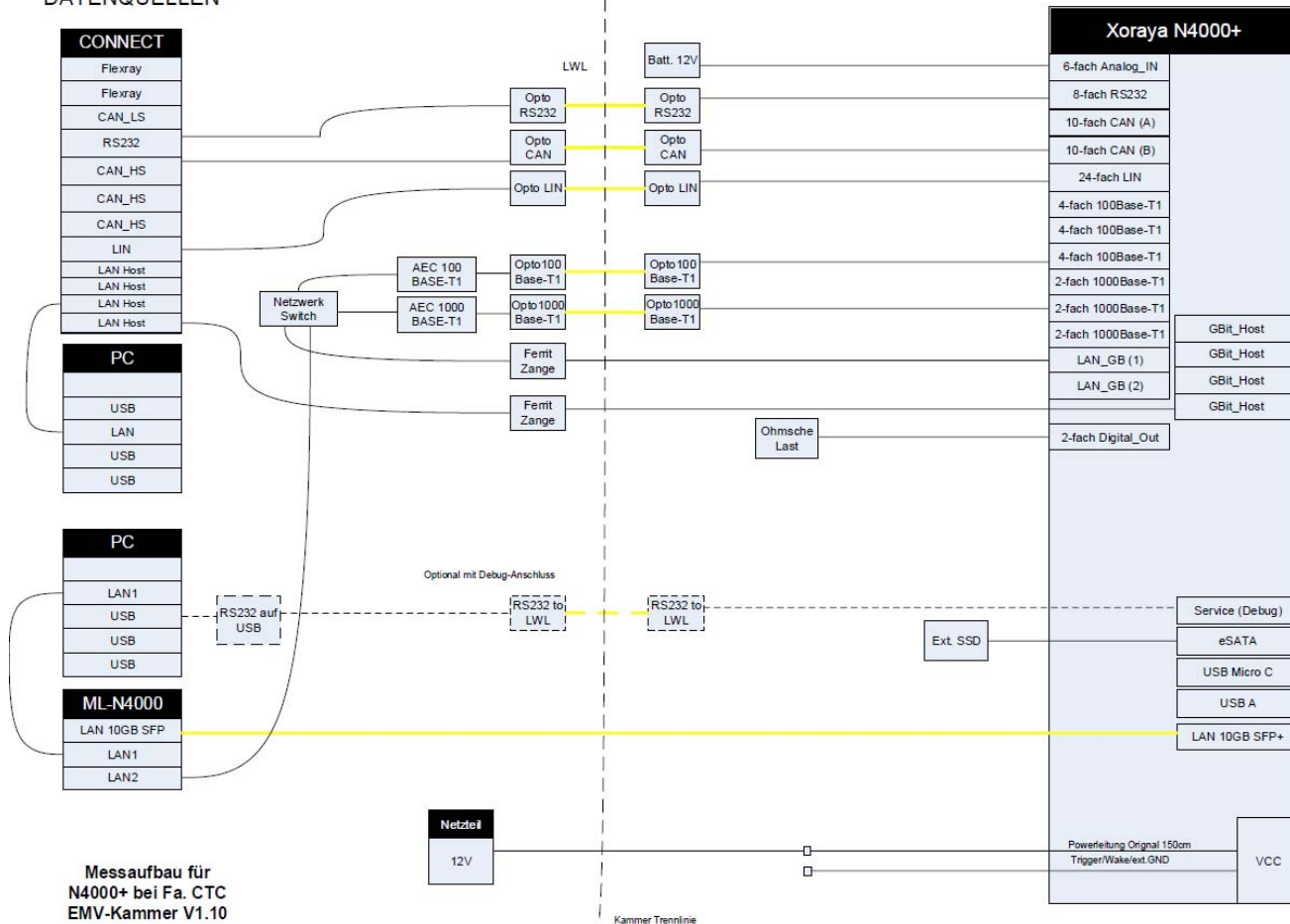


Messaufbau für N4000+ bei Fa. CTC leitungsgebundene Aussendung V1.20

03.09.2021 G.Sp.

Set 3

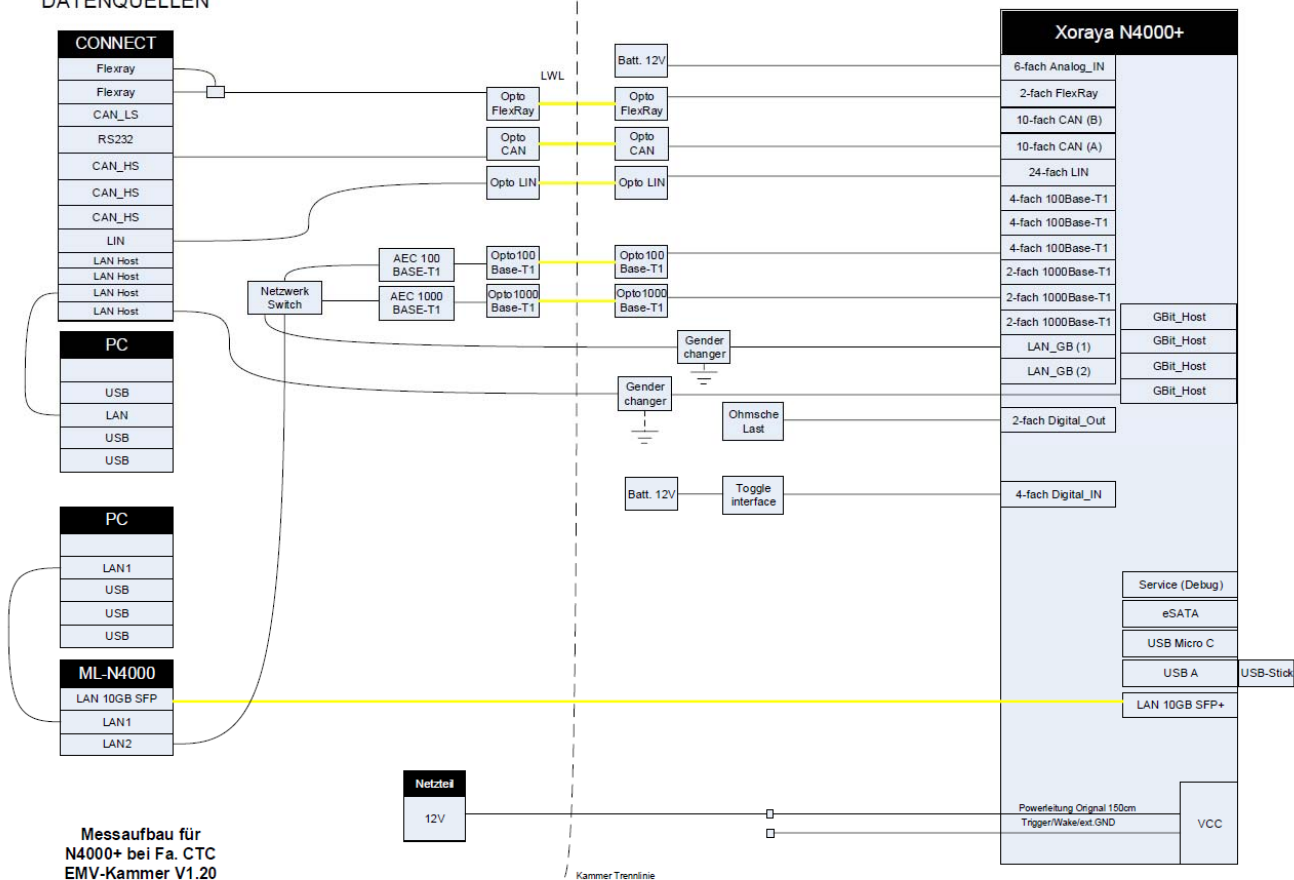
DATENQUELLEN



Messaufbau für N4000+ bei Fa. CTC EMV-Kammer V1.10

Set 4

DATENQUELLEN



03.09.2021 G.Sp.

Menge:	Bezeichnung:	Hersteller:	Funktion:	Ser.Nr.:	Zusatzinfo:
2	RS-232 Fiber Modem	Criterion	Konverter von Draht-RS232 auf LWL u. zurück	----	Modifiziert im Alu-EMV-Gehäuse
1	PCAN-LWL	Peak Systems	Konverter von Draht-CAN auf LWL u. zurück	00499#1	
1	PCAN-LWL	Peak Systems	Konverter von Draht-CAN auf LWL u. zurück	00597#2	
1	DTSE9 G2 USB 3.0 16GB	Kingston	USB-Stick	ohne	Direkt am DUT eingesteckt
1	Xoraya ESU-M.2	X2E GmbH	Optionale externe Festplatte 1TB	000360 Rev.:0200	
1	ETC70H-12	Deutronic	12V/5,5A Netzteil zur Prüflingsversorgung	Date Code:1701	
2	LipoStar Turbo 11,1V/1300mAh	Jamara	Lipo Akku zur Versorgung von Analog_IN und Toggle-Generator für Digital_IN	ohne	Modifiziert im Alu-EMV-Gehäuse
1	Bleiakku 12V/22AH	SIGA	Akku zur PCAN-LWL Versorgung	ohne	
1	ThinkPad T540p	Lenovo	Prüflingüberwachung mittels GUI	R9-OHPD51 15/10	
1	ThinkPad T510	Lenovo	Aktivierung und Überwachung der Datenquellen	R9-BGEHR 11/02	
1	Toggle-Generator	X2E GmbH	Zyklisches Umschalten der Digital_IN-Karte	Ohne	Eigenbau für diesen Test
2	optoFlex	mkMesstechnik	Konverter von Draht-FlexRay auf LWL u. zurück	17-009353 17-009354	
2	optoLIN	mkMesstechnik	Konverter von Draht-LIN auf LWL u. zurück	17-008795 170089796	
2	optoLAN-BC89810	mkMesstechnik	Konverter von Draht-100Base-T1 auf LWL u. zurück	15-006304 15-00635	
2	optoLAN-GB-88Q2112	mkMesstechnik	Konverter von Draht-1000Base-T1 auf LWL u. zurück	21-023074 21-023075	
1	AkkuPack	mkMesstechnik	Zur Versorgung opto's	18-014031	
1	AEC (Automotive ETH-Converter)	X2E GmbH	Zur Wandelung 100Base-T auf 100Base-T1	000089 Rev. 103	
1	AEC (Automotive ETH-Converter)	X2E GmbH	Zur Wandelung 1000Base-T auf 1000Base-T1	00008A Rev. 103	
1	5-Port LAN Switch TL-SG105	TP-Link	Verteilung der Ethernet-Quellen	217A162007399	
1	Connect	X2E GmbH	Datenquelle für LIN/FlexRay/RS232/CAN	000052	
1	ResistorDummy 2x12 Ohm	X2E GmbH	Last für Digitale Out Kanäle	ohne	
1	Xoraya ML-N4000 0200_0600_0101	X2E GmbH	Datenquelle für Ethernet (100/1000Base-T)	000119	
1	Xoraya ML-N4000 0200_0600_0102	X2E GmbH	Datenquelle für Ethernet (10GB SFP+)	000297	

6.4 EUT Operating Modes

EUT operating mode no. *)	Description of operating modes	Additional information
op. 1	Data loggin	- / -

*) EUT operating mode no. is used to simplify the test report.

additional information (declaration of customer):

DUT S/N: 000008		
Schnittstelle:	Nachrichten/s:	kBit/s:
ETH1 (1000Base-T)	11450	91966
ETH3 (1000Base-T1)	11450	91966
ETH17 (100Base-T1)	11450	91966
Analog_1		0,17
Analog_2		0,17
Analog_3		0,17
Analog_4		0,17
Analog_5		0,17
Analog_6		0,17
RS232_1	444	42,66
RS232_2	444	42,66
RS232_3	444	42,66
RS232_4	444	42,66
RS232_5	444	42,66
RS232_6	444	42,66
LIN_1	142	18,18
LIN_2	142	18,18
LIN_3	142	18,18
LIN_4	142	18,18
LIN_5	142	18,18
LIN_6	142	18,18
CAN_1	4175	533,97
CAN_2	4175	533,97
CAN_3	4175	533,97
CAN_4	4175	533,97
CAN_5	4175	533,97
CAN_6	4175	533,97
ETH SFP+		1000000
ETH → GUI		Nicht spezifiziert, da keine Logging-Schnittstelle
eSATA		Alle Loggingschnittstellen, max. 6Gbit/s

DUT S/N: 000001		
Schnittstelle:	Nachrichten/s:	kBit/s:
ETH1 (1000Base-T)	11450	91966
ETH3 (1000Base-T1)	11450	91966
ETH17 (100Base-T1)	11450	91966
Analog_1		0,17
Analog_2		0,17
Analog_3		0,17
Analog_4		0,17
Analog_5		0,17
Analog_6		0,17
Digital_IN_1	9	0,62
Digital_IN_2	9	0,62
Digital_IN_3	9	0,62
Digital_IN_4	9	0,62
FlexRay_1	7339	1409
FlexRay_2	7339	1409
LIN_1	142	18,18
LIN_2	142	18,18
LIN_3	142	18,18
LIN_4	142	18,18
LIN_5	142	18,18
LIN_6	142	18,18
CAN_1	4175	533,97
CAN_2	4175	533,97
CAN_3	4175	533,97
CAN_4	4175	533,97
CAN_5	4175	533,97
CAN_6	4175	533,97
ETH SFP+		1000000
ETH → GUI		Nicht spezifiziert, da keine Logging-Schnittstelle
eSATA		Alle Loggingschnittstellen, max. 6Gbit/s

7 Summary of Test Results

- No deviations from the technical specifications were ascertained
 There were deviations from the technical specifications ascertained

7.1 Emission

7.1.1 Enclosure

EMI Phenomenon	Frequency range	Basic standard	Result
Radiated Interference Field Strength	30 - 1000 MHz	FCC Part 15 Class B	passed
Radiated Interference Field Strength	> 1 GHz	FCC Part 15 Class B	passed

7.1.2 AC Mains Power Input/Output Ports

EMI Phenomenon	Frequency range	Basic standard	Result
Conducted interference voltage	0,15– 30 MHz	FCC Part 15 Class B	passed

Remarks:

NA1	Not tested because not required by used standard
NA2	Test not applicable because port does not exists
NA3	Test not applicable because port only for services
NA4	Test not applicable because port lengths not longer than 3m
NA5	Not tested because not required by customer
NA6	Not tested because used frequency < 108 MHz
NA7	Not tested because the device is for vehicular use

7.2 Measurement and Test Set-up

Note: The test configuration is in accordance with the requirements given in the standards in point 3

7.3 Measurement uncertainty

The uncertainty of the measurement equipment fulfils CISPR 16 and the related European and national standards.

The semi anechoic chamber fulfils the requirements of CISPR 16-1 (ANSI C63.4) for a test volume of 4m Ø.

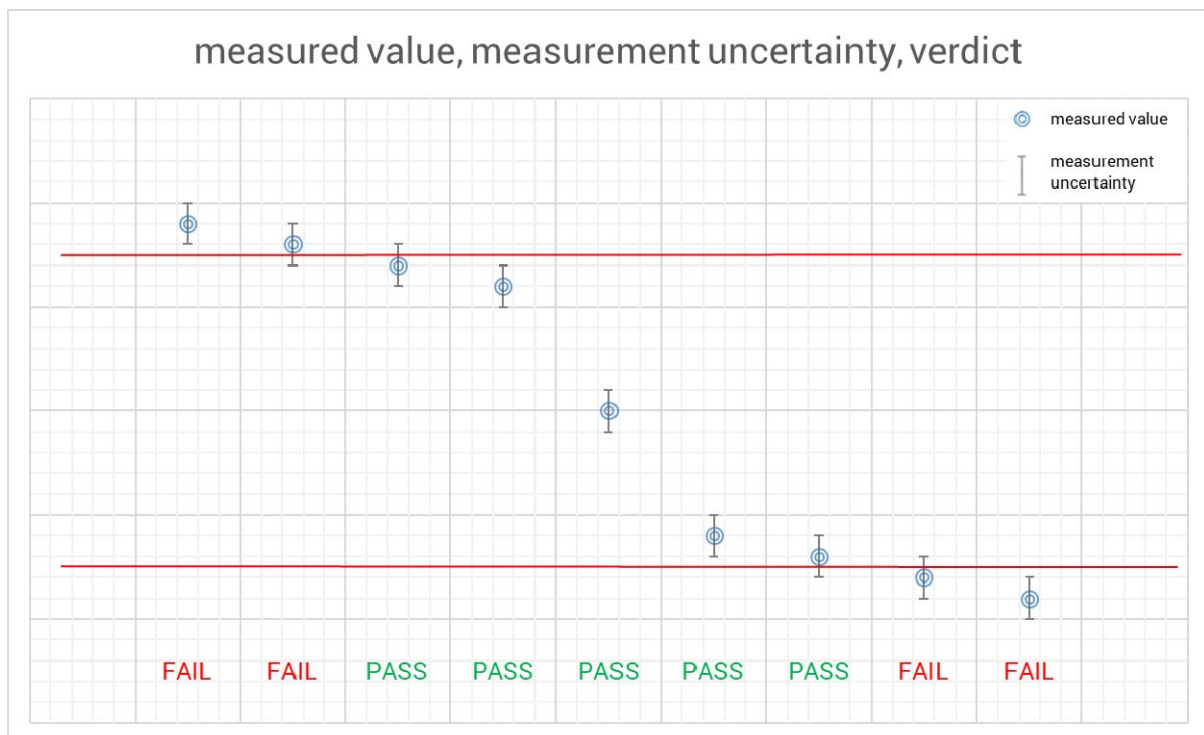
The table below shows the measurement uncertainties for each measurement method. The expended uncertainty (k=2 or 95%) was calculated with worst case values.

Measurement Method	Frequency area Impulse duration time	Description	Expanded uncertainty (k=2 or 95%)
Radiated Emission FCC part 15 B, ANSI C63.4	30 MHz – 18 GHz	- / -	± 4.28 dB
Conducted Emission FCC part 15 B, ANSI C63.4	9 kHz – 30 MHz	- / -	± 3.49 dB

7.4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.

The measurement uncertainty is mentioned in this test report, see chapter above, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



8 Detailed test results - Emission

8.1 Conducted Emission

8.1.1 Instrumentation for Test (see equipment list)

G 1	G 2	F 21								
-----	-----	------	--	--	--	--	--	--	--	--

8.1.2 Test Plan

EUT set-up	Set 1		
Operating mode	Port / Line	Limit	Result
op 1	AC power line	FCC part 15 B Class A	passed

Remark :	Powered by external power supply (Deutronic ETHC70H-12) input 115V / 60Hz, output 12V 5,5A DC) only EUT 1 was measured.
-----------------	---

8.1.3 Conducted Limits (Power-Line)

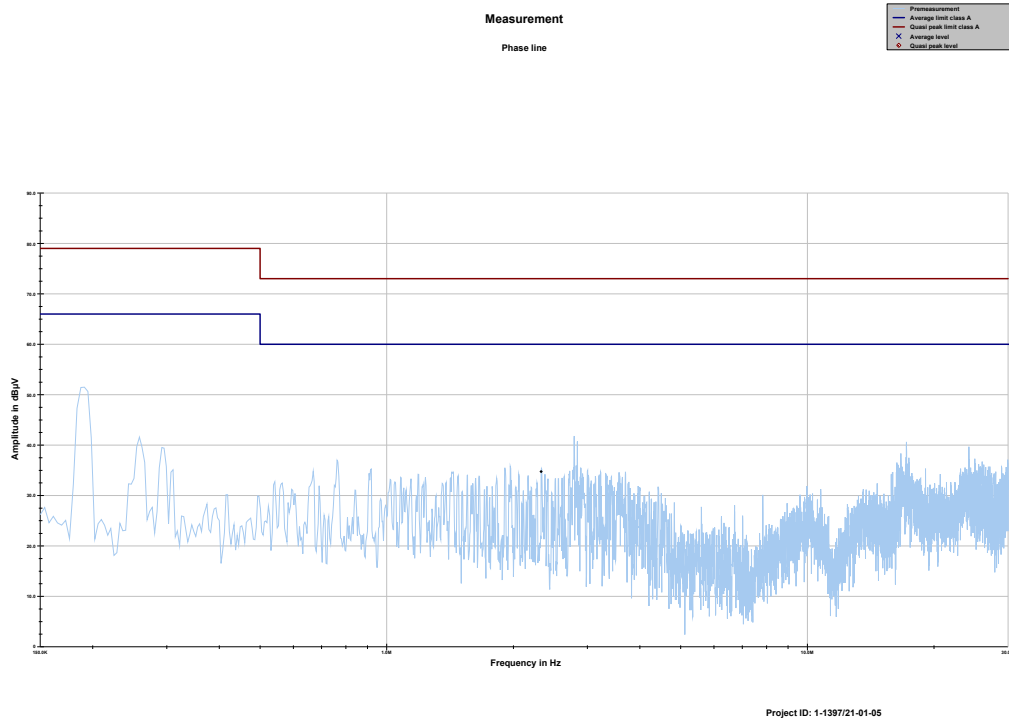
Frequency- range	FCC part 15 B Class B		FCC part 15 B Class A	
	Quasi-Peak (dB μ V)	Average (dB μ V)	Quasi-Peak (dB μ V)	Average (dB μ V)
0,15 MHz – 0,5 MHz	66-56	56-46	79	66
0,5 MHz -5 MHz	56	46	73	60
5 MHz -30 MHz	60	50	73	60

8.1.4 Calibration Information

Device	Serial number	Internal Number	Calibration valid until	Calibration interval
ESCI	100083	3000003312	12 / 2021	12 month
VISN ESH 3-Z5	893045/004	300000584	12 / 2022	24 month

Remarks: All emission components and the shielded room were checked weekly
 Cable loss: 0.6 to 2.4 dB (150kHz to 30 MHz)

8.1.5 Test Results of Main

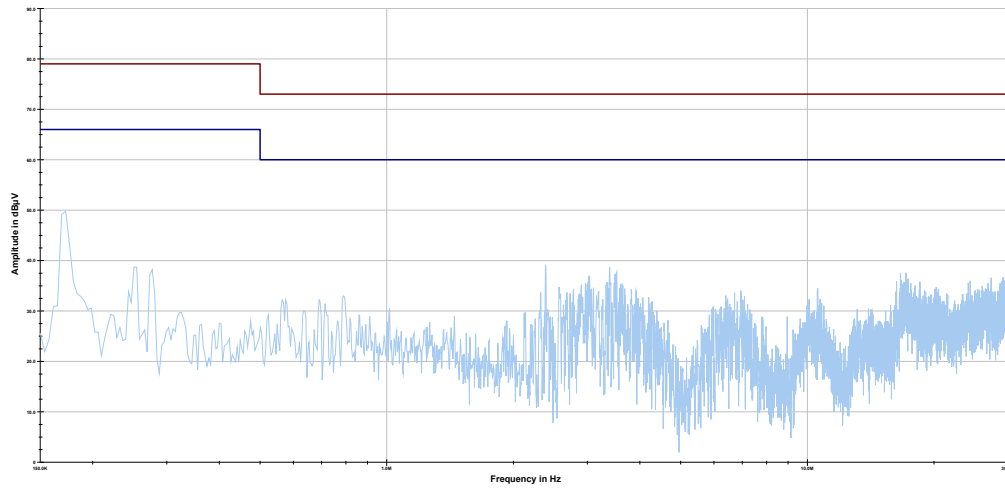
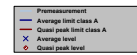


Phase line tbl

Project ID: 1-1397/21-01-05

Project ID - 1-1397/21-01-05
EUT - Xoraya N4000+
Serial Number - 000008
Operating mode - Data login

Measurement
Neutral line



Project ID: 1-1397/21-01-05

Neutral line tbl

Project ID: 1-1397/21-01-05

Project ID - 1-1397/21-01-05
EUT - Xoraya N4000+
Serial Number - 000008
Operating mode - Data login

8.1.6 Signal strength calculation

Calculation formula:

$$SS = UR + CF + VC$$

List of abbreviations:

SS	▶	signal strength
UR	▶	voltage at the receiver
CF	▶	loss of the cable and filter (passband filter 130 kHz – 30 MHz)
VC	▶	correction factor of the ISN (ESH3-Z5)

List with correction factors:

Frequency [MHz]	CF [dB]	VC [dB]
0,150	9,80	1,42
1,000	9,80	0,41
5,000	9,90	0,32
10,000	9,90	0,23
15,000	10,00	0,39
20,000	10,00	1,19
25,000	10,20	1,55
30,000	10,30	1,31

Example calculation:

For example at 10,000 000 MHz the measured Voltage (UR) is 37,62 dB μ V, the loss of the cable and filter (CF) is 9,90 dB and the correction factor of the ISN (VC) is 0,23 dB the final result will be calculated:

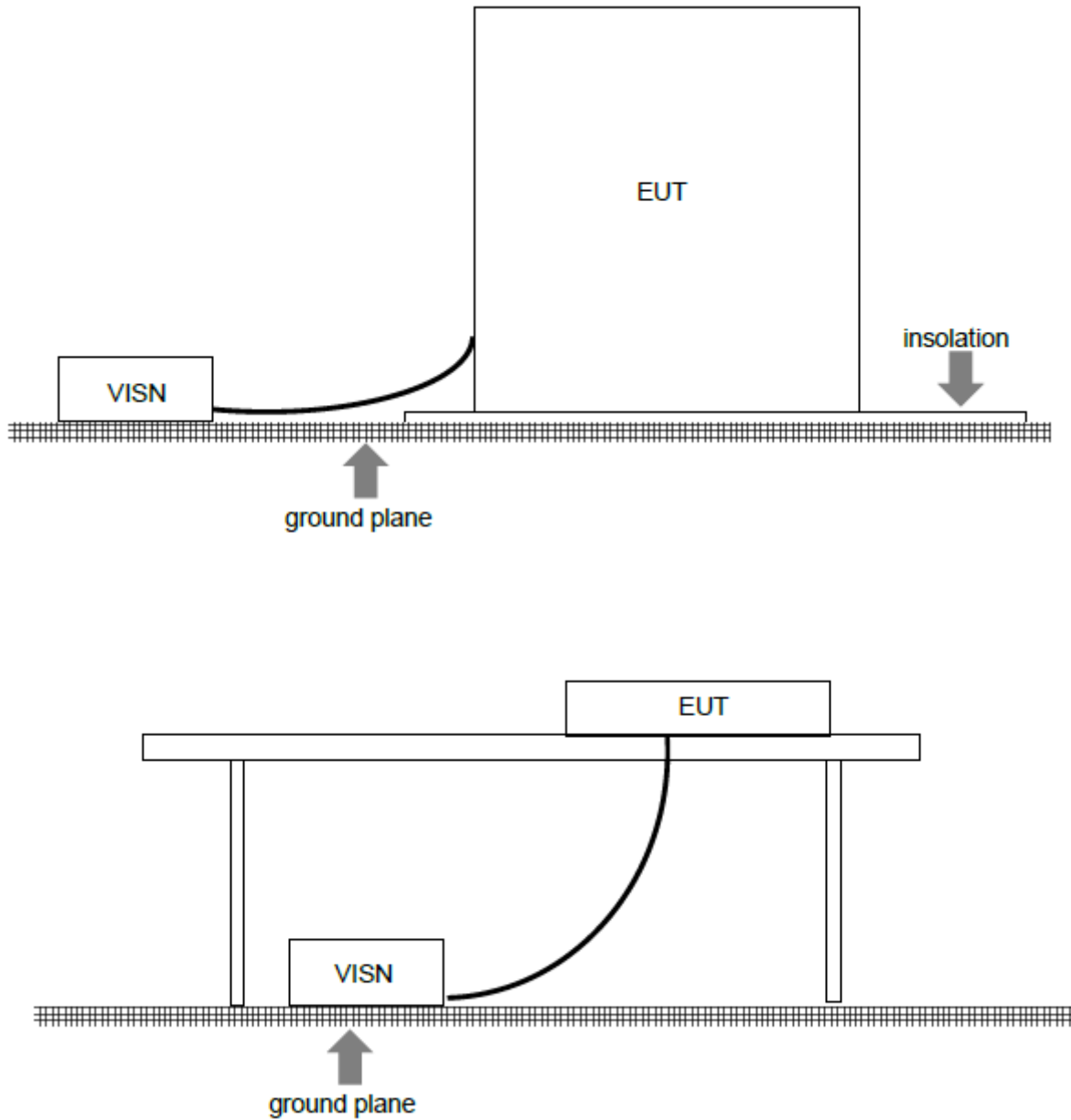
$$SS \text{ [dB}\mu\text{V]} = 37,62 \text{ [dB}\mu\text{V]} + 9,90 \text{ [dB]} + 0,23 \text{ [dB]} = \underline{47,75 \text{ [dB}\mu\text{V]}} \text{ (244,06 } \mu\text{V)}$$

8.1.7 Version of test software

Software Version: TILE 7.3.0.15

8.1.8 Test Set-up

According to EMC basic standard **ANSI C 63.4**



8.2 Electromagnetic Radiated Emissions (Distance 10 m)

8.2.1 Instrumentation for Test (see equipment list)

F 1	F 2	F 4b	F 5	F 6	F 7	F 8	F 21				
-----	-----	------	-----	-----	-----	-----	------	--	--	--	--

8.2.2 Test Plan

EUT set-up	set 3 (Model 1) / set 4 (Model 4)		
Operating mode	Application	Limit	Result
op 1	Enclosure	FCC part 15 B Class A	passed

Remarks:	Powered 12V
-----------------	-------------

8.2.3 Radiated Limits

Frequency- range	FCC part 15 B Class B	FCC part 15 B Class A
30 MHz – 88 MHz	30 dB μ V/m	39,1 dB μ V/m
88 MHz – 216 MHz	33,5 dB μ V/m	43,5 dB μ V/m
216 MHz – 960 MHz	36 dB μ V/m	46,4 dB μ V/m
above 960 MHz	44 dB μ V/m	49,5 dB μ V/m
	* This values are recalculated from the class B limits at 3 m antenna distance in §15.109 (g 2) of the FCC rules	

8.2.4 Calibration Information

Device	Serial number	Internal Number	Calibration valid until	Calibration interval
ESR 3	1316.3003K03-102587-ct	300005771	12 / 2021	12 month
Trilog Antenna	9163-1029	300005379	08 / 2023	24 month

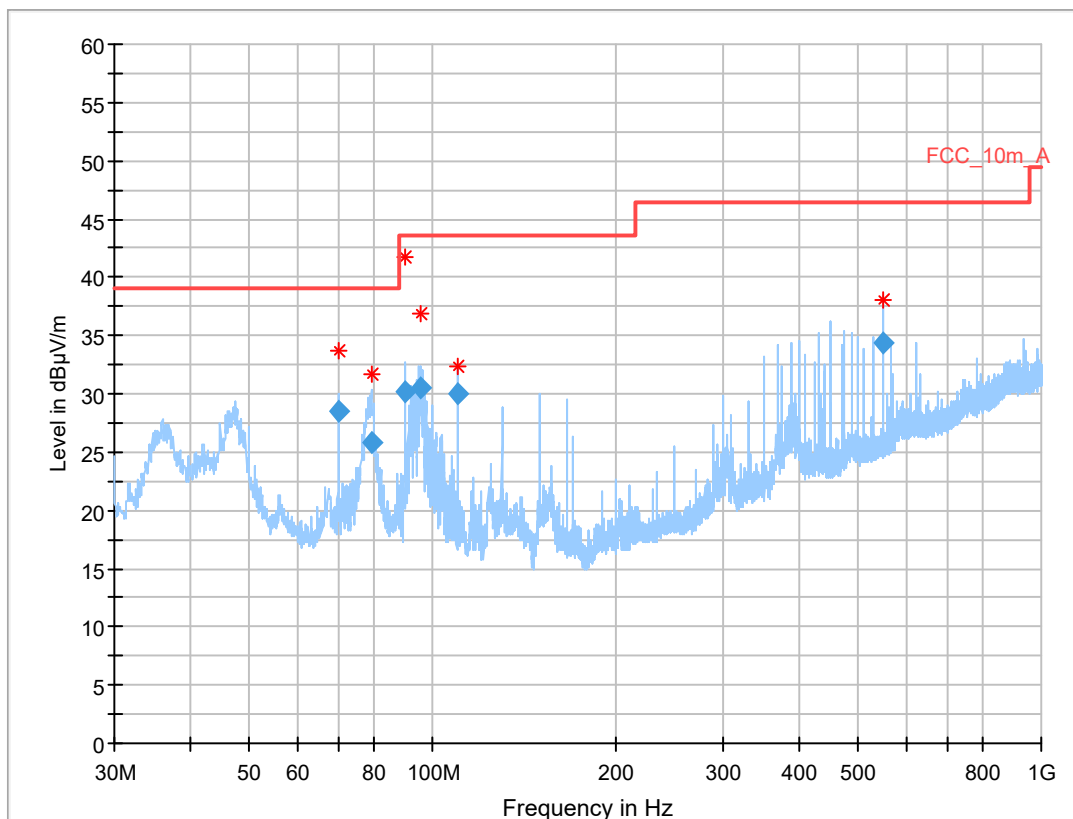
Remarks:
System check of all relevant devices and the chamber (weekly)

8.2.5 Test Results

Set 3 (EUT A)

Common Information

EUT: Xoraya N4000 + Model 1
 Serial number:
 Test description: FCC part 15 B class A
 Operating condition: test mode
 Operator name: Kraus
 Comment: DC 12 V



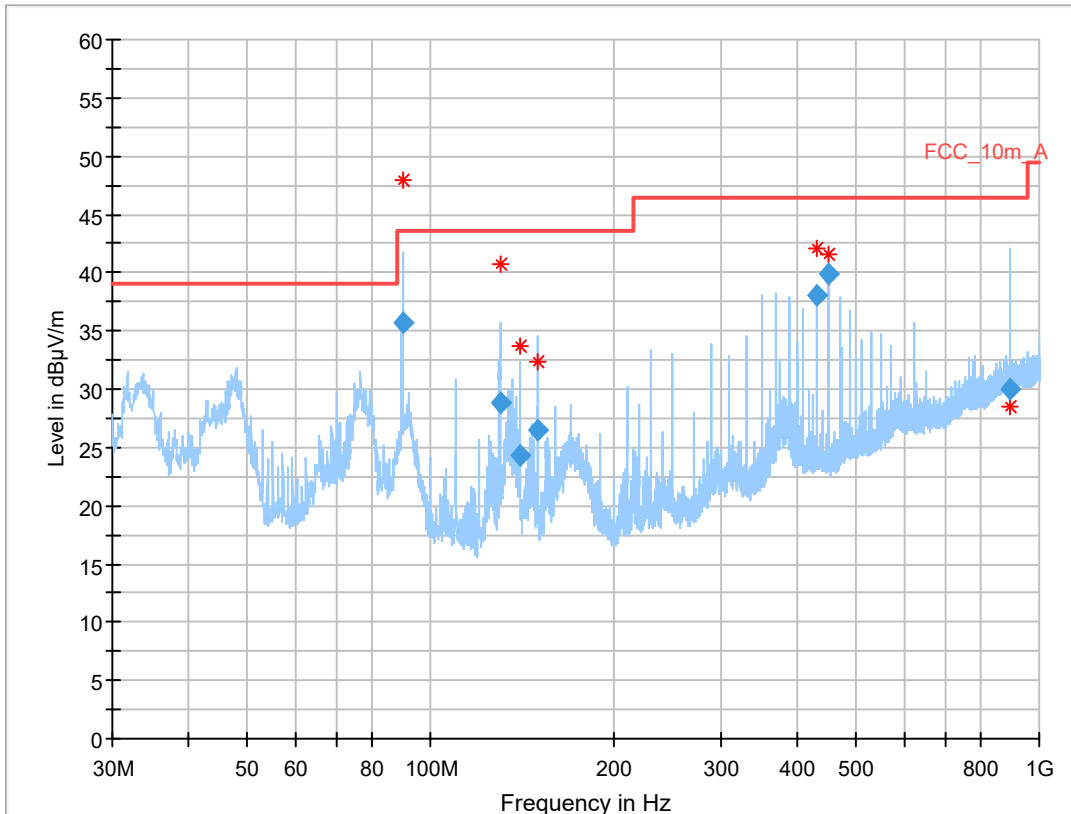
Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
69.987	28.41	39,1	10,7	1000	120.0	388.0	V	210	11
79.223	25.89	39,1	13,2	1000	120.0	104.0	V	63	8
89.992	30.23	43,5	13,3	1000	120.0	372.0	V	221	11
95.594	30.53	43,5	13,0	1000	120.0	107.0	V	308	13
109.855	30.00	43,5	13,5	1000	120.0	176.0	V	248	13
550.025	34.44	46,4	12,0	1000	120.0	100.0	V	255	20

Set 4 (EUT B)

Common Information

EUT: Xoraya N4000 + Model 2
 Serial number:
 Test description: FCC part 15 B class A
 Operating condition: test mode
 Operator name: Kraus
 Comment: DC 12 V



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
90.016	35.68	43,5	7,8	1000	120.0	129.0	V	332	11
130.033	28.78	43,5	14,7	1000	120.0	203.0	V	106	10
139.999	24.38	43,5	19,1	1000	120.0	400.0	V	65	10
149.969	26.52	43,5	17,0	1000	120.0	212.0	V	333	10
430.004	37.98	46,4	8,4	1000	120.0	343.0	H	158	19
449.997	39.86	46,4	6,5	1000	120.0	303.0	V	275	18
898.015	30.05	46,4	16,4	1000	120.0	368.0	V	150	25

8.2.6 Hardware Set-up

Subrange 1

Frequency Range:	30 MHz - 2 GHz
Receiver:	ESR 3 [ESR 3] @ GPIB0 (ADR 20), SN 1316.3003K03/102587, FW 3.46 SP1
Signal Path:	without Notch FW 1.0
Antenna:	VULB 9163
Antenna Tower:	Tower [EMCO 2090 Antenna Tower] @ GPIB0 (ADR 8), FW REV 3.12
Turntable:	Turntable [EMCO Turntable] @ GPIB0 (ADR 9), FW REV 3.12
Software version:	EMC32 V10.59.0

8.2.7 Sequence of testing

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a nonconducting table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position $\pm 45^\circ$ and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.2.8 Signal strength calculation

Calculation formula:

$$SS = U_R + CL + AF$$

List of abbreviations:

SS	▶	signal strength
U_R	▶	voltage at the receiver
CL	▶	loss of the cable
AF	▶	antenna factor

List with correction factors:

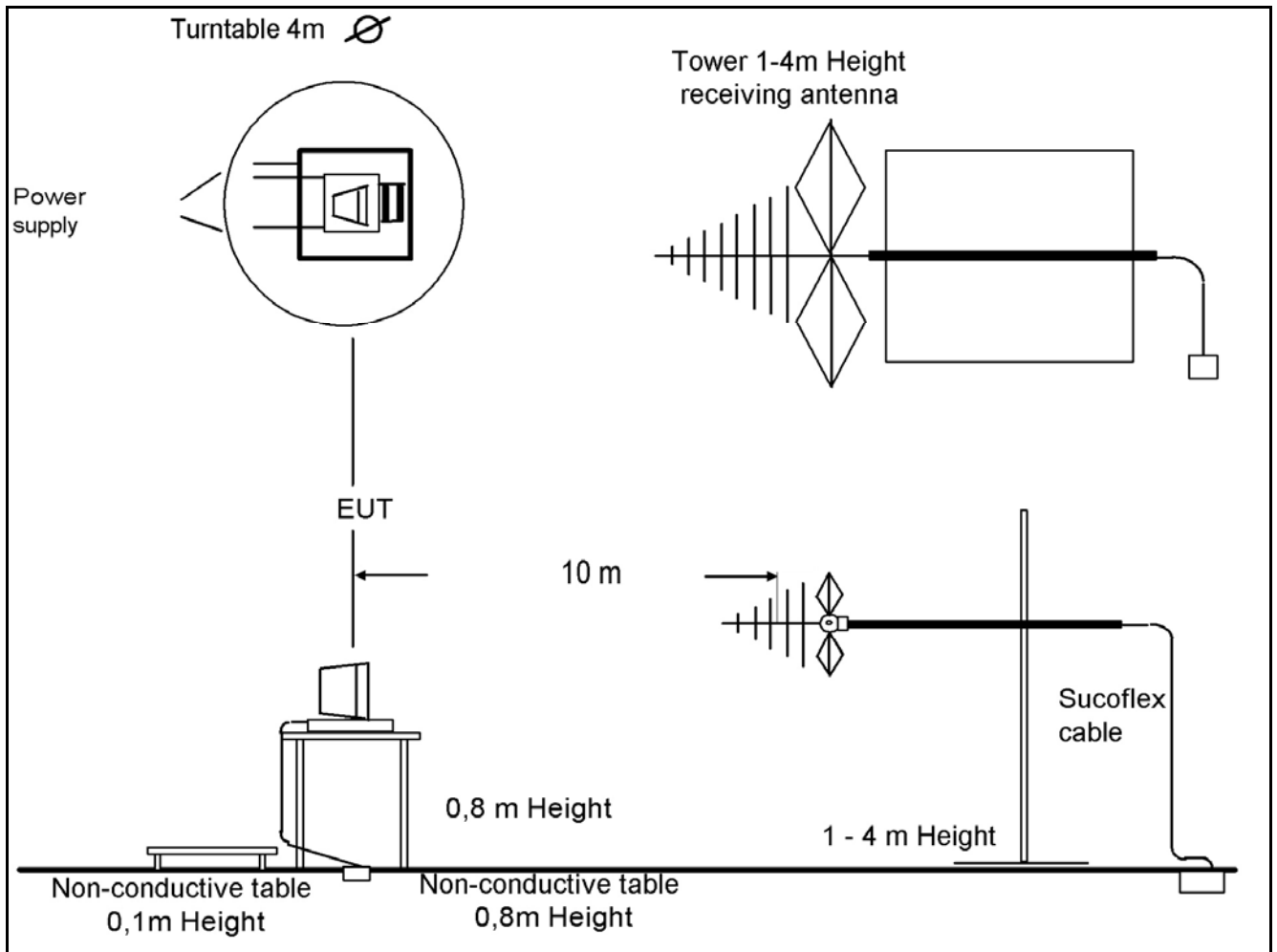
Frequency [MHz]	CL [dB]	AF [1/m]
30,000	0,20	12,30
100,000	0,60	11,30
200,000	1,10	10,60
300,000	1,30	13,20
400,000	1,60	15,30
500,000	1,90	16,80
600,000	2,00	18,80
700,000	2,20	20,30
800,000	2,30	21,50
900,000	2,40	22,80
1000,000	2,50	23,30

Example calculation:

For example at 500,000 000 MHz the measured Voltage (U_R) is 12,35 dB μ V, the loss of the cable (CL) is 1,90 dB and the antenna factor (AF) is 16,80 dB (m^{-1}) the final result will be calculated:

$$SS \text{ [dB}\mu\text{V/m]} = 12,35 \text{ [dB}\mu\text{V]} + 1,90 \text{ [dB]} + 16,80 \text{ [dB (m}^{-1}\text{)]} = \underline{31,05 \text{ [dB}\mu\text{V/m]}} \text{ (35,69 } \mu\text{V/m)}$$

8.2.9 Test Set-up



8.3 Electromagnetic Radiated Emissions (Distance 5 m)

8.3.1 Instrumentation for Test (see equipment list)

F 1	F 6	F 21	F 30	F 32	F 33						
-----	-----	------	------	------	------	--	--	--	--	--	--

8.3.2 Test Plan

EUT set-up	set 3 (Model 1) / set 4 (Model 2)		
Operating mode	Application	Limit	Result
op 1	Enclosure	FCC part 15 B Class A	passed

Remarks:	The measured values are recalculated from 5m to 3m distance Powered 12V
-----------------	--

8.3.3 Radiated Limits

Frequency- range	47CFR15: (FCC part 15 B) Class B	47CFR15: (FCC part 15 B) Class A *
above 1GHz	54 dB μ V/m	59,5 dB μ V/m
		* This values are recalculated from the class A limits at 10 m antenna distance in §15.109 (g 2) of the FCC rules.

8.3.4 Calibration Information

Device	Serial number	Internal Number	Calibration valid until	Calibration interval
FSU 26	200809	300003874	12/2021	12 month
Horn Antenna	9107-3697	300001605	03/2023	24 month

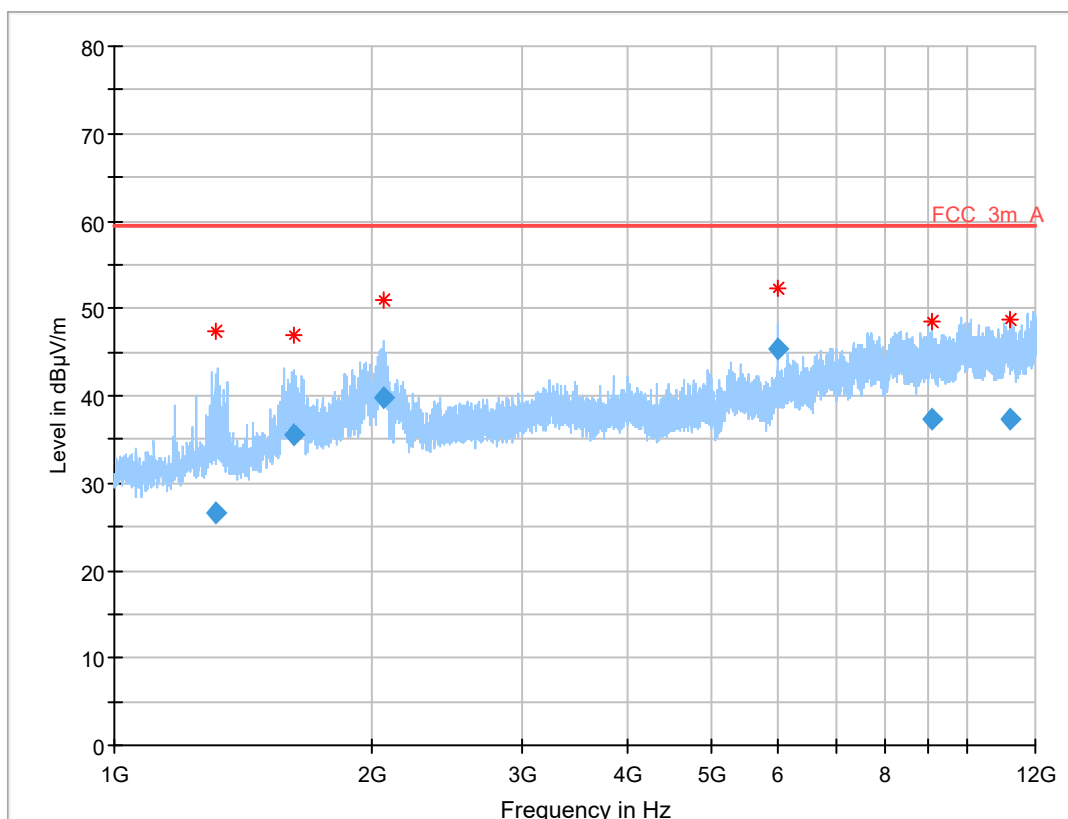
Remarks:
System check of all relevant devices and the chamber (weekly)

8.3.5 Test Results

Set 3 (Model 1)

Common Information

EUT: Xoraya N4000 +
 Serial number:
 Test description: FCC part 15 B class A
 Operating condition: test mode
 Operator name: Kraus
 Comment: DC 12 V



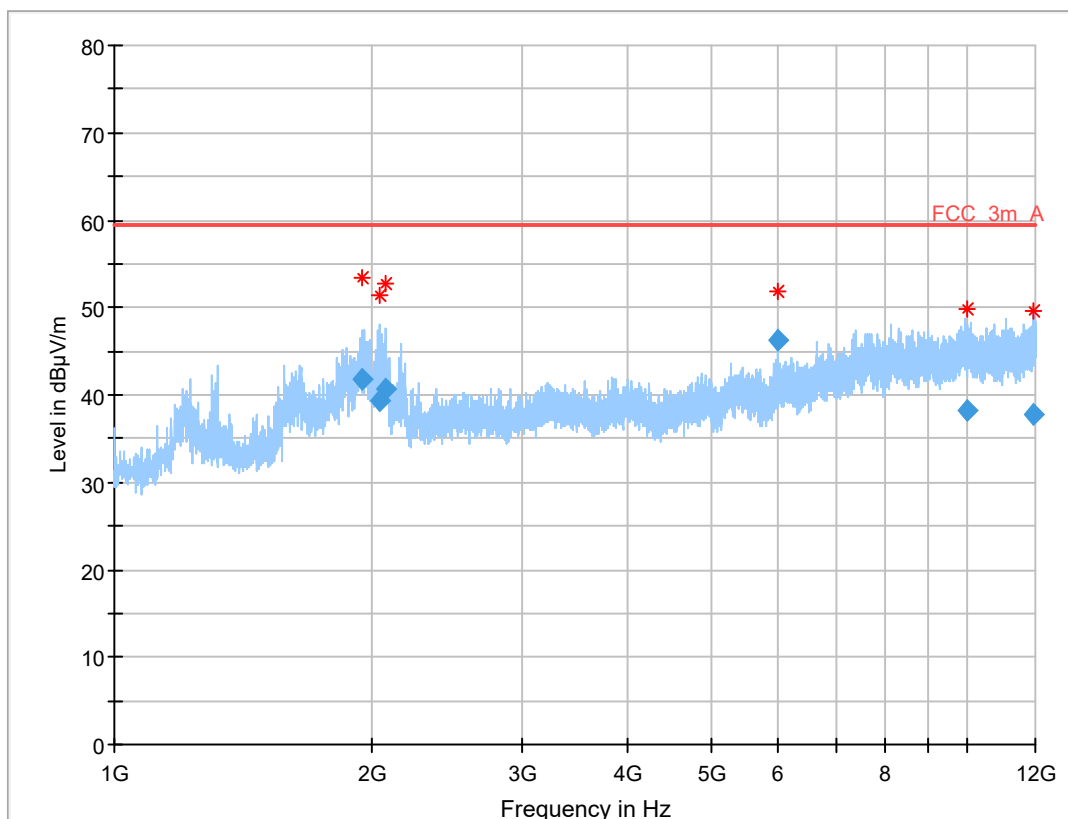
Final Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azim uth (deg)	Corr. (dB/m)	Comm ent
1317.417	26.49	59.5	33.0	1000	1000.0	H	-1	-8	
1625.524	35.42	59.5	24.1	1000	1000.0	H	155	-7	
2067.794	39.87	59.5	19.6	1000	1000.0	H	131	-5	
5999.731	45.27	59.5	14.2	1000	1000.0	V	243	1	
9094.382	37.42	59.5	22.1	1000	1000.0	H	157	6	
11215.747	37.39	59.5	22.1	1000	1000.0	H	271	9	

Set 4 (Model 2)

Common Information

EUT: Xoraya N4000 + Model 2
 Serial number:
 Test description: FCC part 15 B class A
 Operating condition: test mode
 Operator name: Kraus
 Comment: DC 12 V



Final Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
1948.485	41.82	59.5	17.7	1000	1000.0	H	13	-5	
2050.637	39.43	59.5	20.1	1000	1000.0	H	115	-5	
2077.778	40.70	59.5	18.8	1000	1000.0	H	128	-5	
5999.940	46.15	59.5	13.4	1000	1000.0	V	290	1	
9993.461	38.13	59.5	21.4	1000	1000.0	H	22	9	
11964.923	37.73	59.5	21.8	1000	1000.0	H	264	10	

8.3.6 Hardware Set-up

Subrange 1

Frequency Range:	1 GHz - 18 GHz
Receiver:	FSU 26 [FSU 26] @ GPIB0 (ADR 17), SN 200809/026, FW 4.71
Signal Path:	1_18_EN FW 1.0
Antenna:	Horn Antenna EMCO 3115
Turntable:	Turntable [EMCO Turntable] @ GPIB0 (ADR 9), FW REV 3.12
Software version:	EMC32 V10.59.0

1

8.3.7 Sequence of testing

Setup

- The Equipment was setup to simulate a typical usage like described in the user manual / or described by manufacturer.
- If the EUT is a tabletop system, a nonconducting table with 0,8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is: (see ANSI C 63.4)
< 18 GHz = 5 m
The EUT was set into operation.

Premeasurement

- The turntable rotates continuous from 0° to 360°
- The antenna is polarized vertical and horizontal.
- In accordance to the antenna beam and the size of the EUT the antenna height changes in 30 cm steps, start at 1 meter. If it is not possible to tilt the emissions will be checked with a manually tilted antenna from top side.
- The analyzer scans quickly to find the maximum emissions of the EUT

Final measurement

- The final measurement will be performed with minimum the six highest peaks (depends on emissions and number of measured points below 1 GHz)
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$).
- The final measurement will be done with AV (Average / see ANSI C 63.4) detector
- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit, and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

8.3.8 Signal strength calculation

Calculation formula:

$$SS = U_R + CL + AF + PA + DC$$

List of abbreviations:

- SS ▶ signal strength
- U_R ▶ voltage at the receiver
- CL ▶ loss of the cable and gain of the preamp
- AF ▶ antenna factor
- DC ▶ distance correction (results measured on 5 m calculated to 3 m)

List with correction factors: column CL in table contains cable factor and preamplifier correction

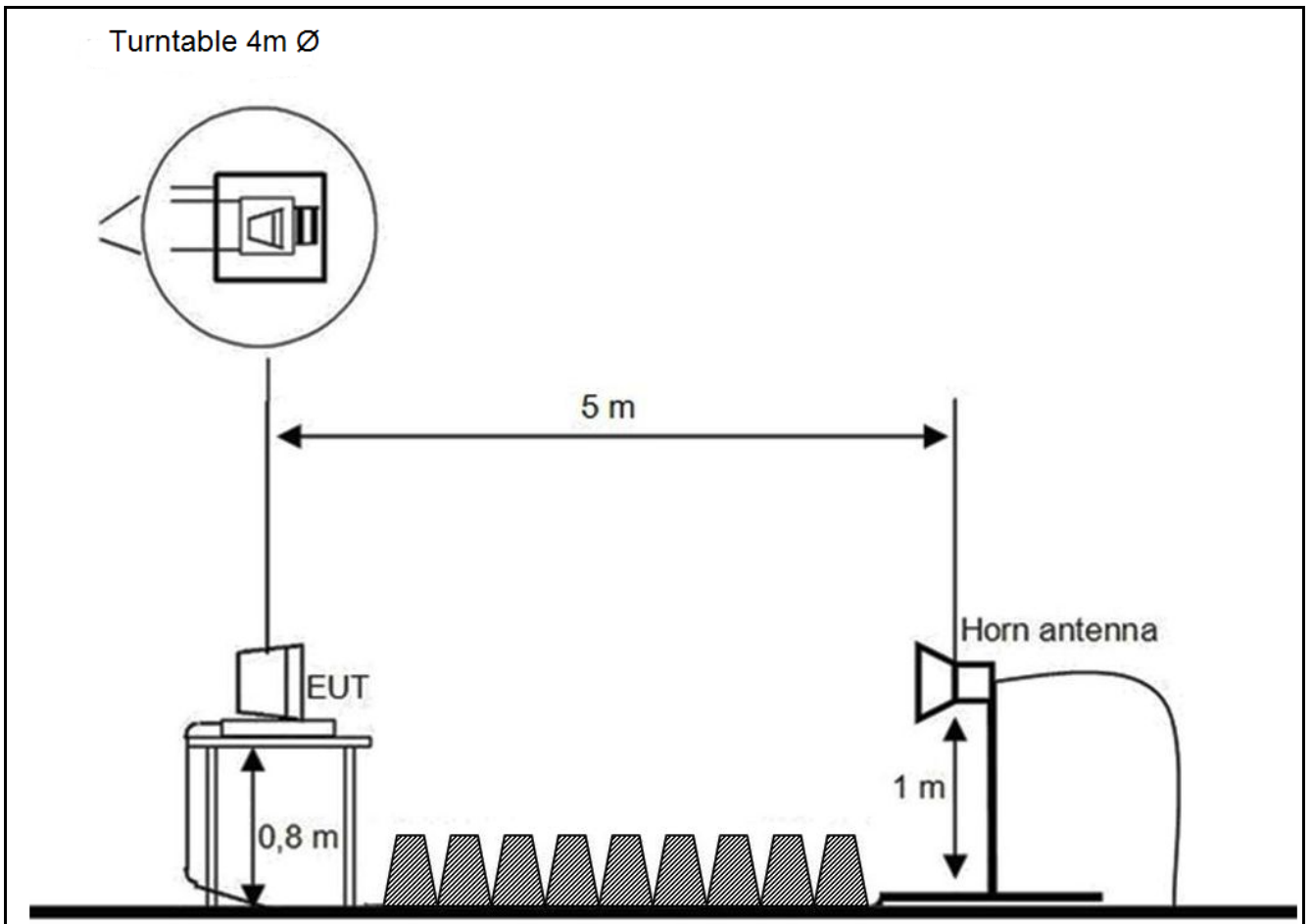
Frequency [GHz]	CL [dB]	AF [dB1/m]	DC [dB]
1,000	-35,50	24,40	4,40
1,500	-35,20	25,10	4,40
2,000	-35,10	27,40	4,40
2,500	-35,00	28,50	4,40
3,000	-34,70	30,20	4,40
3,500	-34,80	31,20	4,40
4,000	-35,00	32,60	4,40
4,500	-34,90	32,50	4,40
5,000	-34,80	33,40	4,40
5,500	-34,35	34,10	4,40
6,000	-34,00	34,40	4,40
6,500	-33,50	34,50	4,40
7,000	-33,10	35,50	4,40
7,500	-33,40	36,50	4,40
8,000	-33,80	36,90	4,40
8,500	-33,75	37,20	4,40
9,000	-33,70	37,40	4,40
9,500	-33,50	37,50	4,40
10,000	-33,40	37,90	4,40
11,000	-35,90	38,30	4,40
12,000	-34,40	39,10	4,40
13,000	-37,30	39,30	4,40
14,000	-36,20	41,30	4,40
15,000	-36,90	40,10	4,40
16,000	-34,90	37,60	4,40
17,000	-35,60	40,80	4,40
18,000	-35,70	45,70	4,40

Example calculation:

For example at 4,000 000 000 GHz the measured Voltage (U_R) is 46,13 dBμV, the loss of the cable (CL) is -35,00 dB, the antenna factor (AF) is 32,60 dB(m-1) and the distance correction (DC) is 4,40 dB the final result will be calculated:

$$SS \text{ [dB}\mu\text{V/m]} = 46,13 \text{ [dB}\mu\text{V]} + (-35,00) \text{ [dB]} + 32,60 \text{ [dB(m-1)]} + 4,4 \text{ [dB]} = 48,13 \text{ [dB}\mu\text{V/m]} \text{ (202,53 } \mu\text{V/m)}$$

8.3.9 Test Set-up



9 Test equipment and ancillaries used for tests

To simplify the identification of the test equipment and/or ancillaries which were used, the reporting of the relevant test cases only refer to the test item number as specified in the table below.

No.	Instrument/Ancillary	Manufacturer	Type	Serial-No.	Internal identification
Radiated emission in chamber F					
F-1	Control Computer	F+W		2934939v001	300005258
F-2	Trilog-Antenna	Schwarzbeck	VULB 9163	9163-1029	300005379
F-3a	Amplifier	Veritech Microwave Inc.	0518C-138	- / -	- / -
F-4b	Switch	Netgear	GS108P	26V12A3H50336	300000368
F-5	EMI Test receiver	R&S	ESR	1316.3003K03-102587-ct	300005771
F-6	Turntable Interface-Box	EMCO / ETS-LINDGREN	Model 105637	44583	300003747
F-7	Tower/Turntable Controller	EMCO / ETS-LINDGREN	Model 2090	64672	300003746
F-8	Tower	EMCO / ETS-LINDGREN	Model 2175	64762	300003745
F-9	Ultra Notch-Filter Rejected band Ch. 62	WRCD		9	
Radiated immunity in chamber F					
F-10	Control Computer	F+W		2934939v001	300005258
F-11	Signal Generator	R&S	SMB 100A	1406.6000k02-113856	300005266
F-13	RF-Amplifier	Bonn	BLWA 0860-250/100D	035491	300003210
F-14	Stacked Logper Antenna	Schwarzbeck	STLP9128 E	9128 E 013	300003408
F-14a	Bicon-Antenna	EMCO	3109	8906-2309	300000575
F-14b	Bicon-Antenna	Schwarzbeck	Balun VHBD 9134 elements BBFA 9146	3011 0057	300005385
F-15	RF-Amplifier	ar	1000LM20	20562	-/-
F-16	Directional Coupler	ar	DC7144A	312786	300003411
F-16a	Directional coupler	emv	DC 2000	9401-1677	300000592
F-18	Power Meter	R&S	NRP2	104973	300005114
F-19	Power sensor	R&S	NRP-Z91	103332	300005114-1
F-20	Power sensor	R&S	NRP-Z91	103333	300005114-2
F-35	RF- Amplifier	Bonn	BLMA 2060-5	097392A	300003908
F-36	Stacked Microwave Log.-Per. Antenna	Schwarzbeck	STLP9149	9149-044	300003919
Harmonics and flicker in front of chamber F					
F-21	Flicker and Harmonics Test System	Spitzenberger & Spies	PHE4500/B I PHE4500/B II	B5983 B5984	300003314
F-21a	Power Supply	HBS Electronic	ACS-1600-PS	2002-001247-0	300006074
F-28	Power Supply	Hewlett Packard	6032 A	2920 A 04466	300000580
Radiated emission in chamber F > 1GHz					
F-29	Horn antenna	Schwarzbeck	BBHA 9120 B	188	300003896
F-30	Amplifier	ProNova	0518C-138	005	F 024
F-31	Amplifier	Miteq	42-00502650-28-5A	1103782	300003379
F-32	Horn antenna	EMCO	3115	9107-3697	300001605
F-33	Spectrum Analyzer	R&S	FSU26	200809	300003874
F-34	Loop antenna	EMCO	6502	8905-2342	300000256

No.	Instrument/Ancillary	Manufacturer	Type	Serial-No.	Internal identification
Conducted emission in chamber G					
G-1	EMI Receiver	R&S	ESCI	100083	300003312
G-2	V-ISN	Rohde & Schwarz	ESH 3-Z5	892475/017	300002209
G-2a	V-ISN	Rohde & Schwarz	ESH 2-Z5	892602/024	300000587
G-3	2-Wire ISN	Schaffner	ISN T200	19075	300003422
G-4	4-Wire ISN	Schaffner	ISN T400	22325	300003423
G-5	Shielded wire ISN	Schaffner	ISN ST08	22583	300003433
G-6	Unshielded 8 wire ISN	Teseq	ISN T800	26113	300003833
G-7	Unshielded 8 wire ISN	Teseq	ISN T8-Cat. 6	26374	300003851
G-8	RF Current probe	Solar	9134-1	100254	300004163
G-9	V-ISN	Schaffner	ISN PLC-150	21579	300003318
G-10	V-ISN	Schaffner	ISN PLC-25-30	21584	300003319
G 10a	PLC Filter	TESEQ	Filter PLC	23436	300003598
G 10b	Coupling unit 75 Ohm	Fiedler	AC	----	300003272.04
Conducted immunity in chamber G					
G-11	Signal generator	R&S	SMG	8610647025	300000204.01
G-12	RF-Amplifier	BONN	BSA 0125-75	066502-01	300003545
G-13	Power Meter	R&S	URV 5	837723/025	300002844.01
G-14	Power Sensor	R&S	URV 5-Z2	832874/021	300002239
G-15	Directional coupler	emv	DC 2000	9401-1677	300000592
G-16	Attenuator 6dB	Alan	50HP6-100 N	121048 0348	300003148
G-17	EM-Injection Clamp	FCC	203i	232	300000626
G-18	CDN	FCC	FCC-801-M3-16	237	300000627
G-19	CDN	FCC	FCC-801-T2	78	300000629
G-20	CDN	FCC	FCC-801-AF 2	62	300000630
G-21	CDN	FCC	FCC-801-AF 4	61	300000631
G-22	CDN	FCC	FCC-801-M1	2027	300002761
G-23	CDN	TESEQ	CDN M016S	38741	300004847
G-23a	CDN	TESEQ	CDN M516A	35049	300004848
G-24	transformer for 50Hz Loop Antenna	EM-Test	MC2630	0200-10	300002659.01
G-25	50Hz Loop Antenna	EM-Test	MS 100	none	300002659
Surge, Burst, Dips and Interruptions in chamber G					
G-26	Hybrid-Generator	EM-Test	UCS 500N7	P1506148835	300005070
G-27	Motor Variac	EM-Test	MV 2616	0600-01	300002658
G-28	Capacitive Coupling Clamp	MWB	KKS 100	---	300000589
G-29a	Coupling Decoupling Network	EMC-Partner	CDN-2000-06-32	158	300004108
G-29	Coupling Decoupling Network	EMC-Partner	CDN-UTP8 ED3	1503	300004752
ESD in chamber G					
G-30	ESD generator	Schlöder	SESD 30000	511333	300005097
Emission on bench in chamber G					
G-31	Absorbing Clamp	R&S	MDS-21	832 231/006	300000527
generic in chamber G					
G-32	power supply	Hewlett Packard	6038A	2848A06673	300001512
Conducted interference in chamber G					
G 33	Arbitrary Function Generator	33521B	Keysight	MY52702534	300005023
G 34	Audio amplifier	Crown 5002VZ	MACRO-TECH 5002VZ	8001641218	300004094
G 35	Shunt	Schwarzbeck	Shunt 9570	9570118	300004107

10 Observations

No observations, exceeding those reported with the single test cases, have been made.

Annex A Photographs of the test set-up

Photo 1: testsetup conductet emission

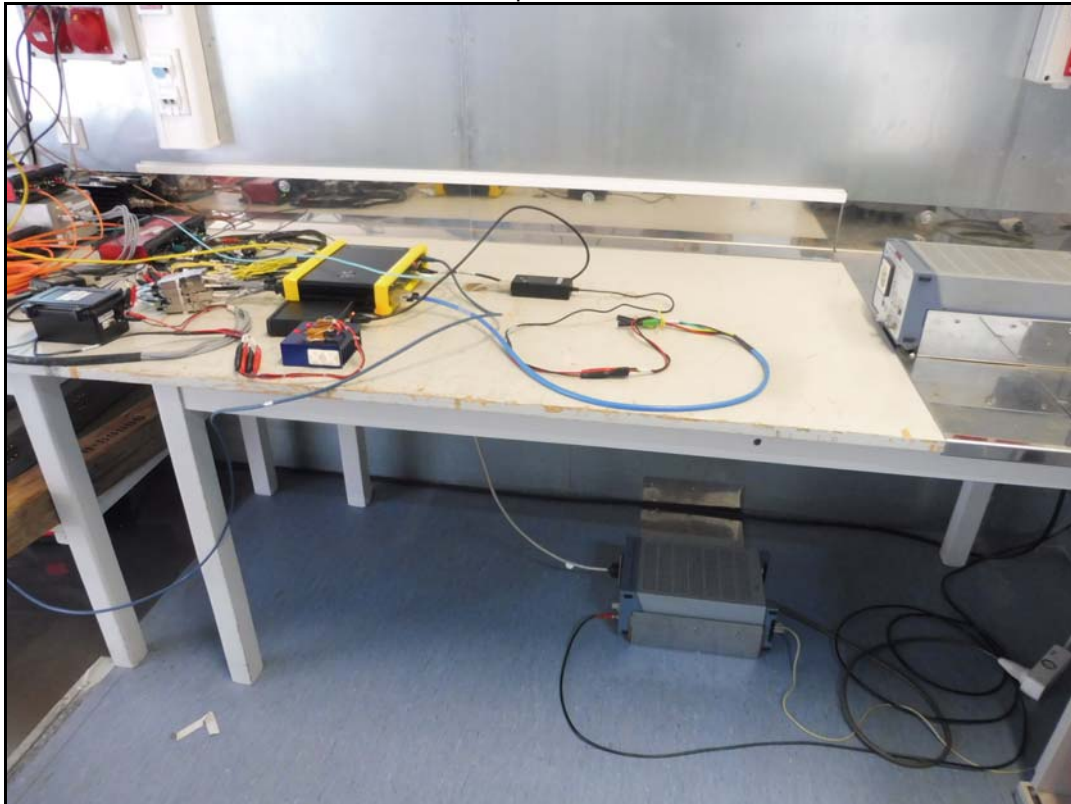


Photo 2: testsetup radiated emission Set 3

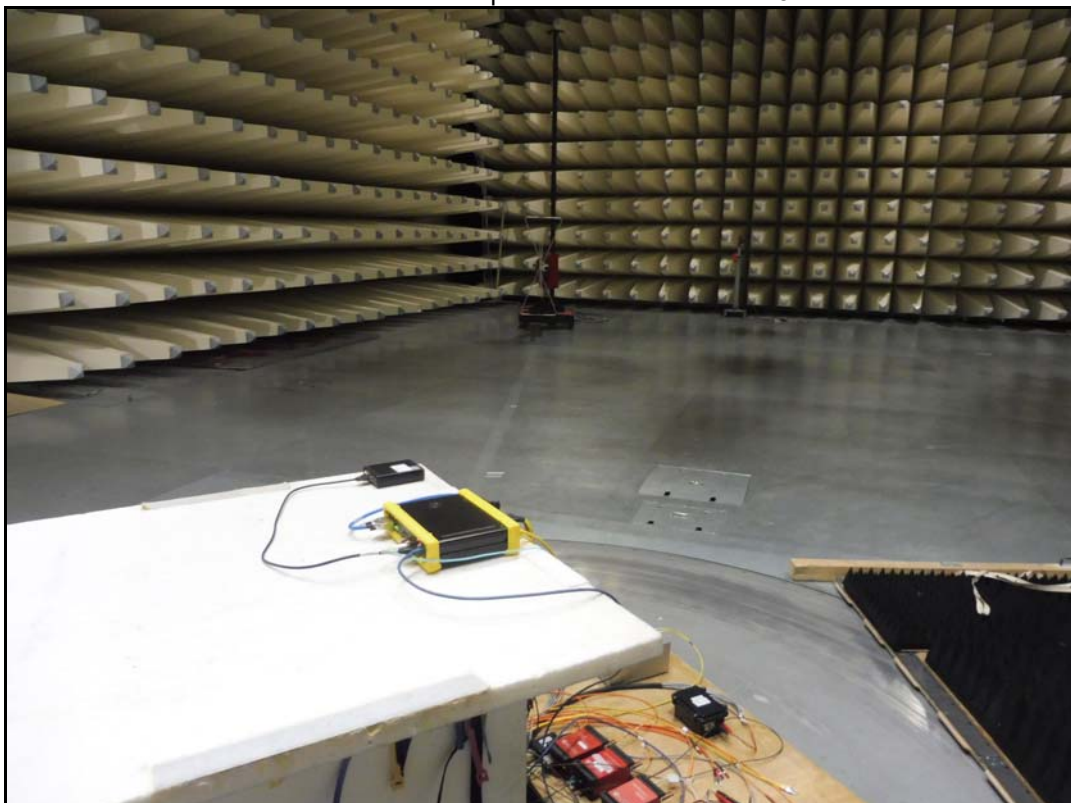


Photo 3: testsetup radiated emission Set 3

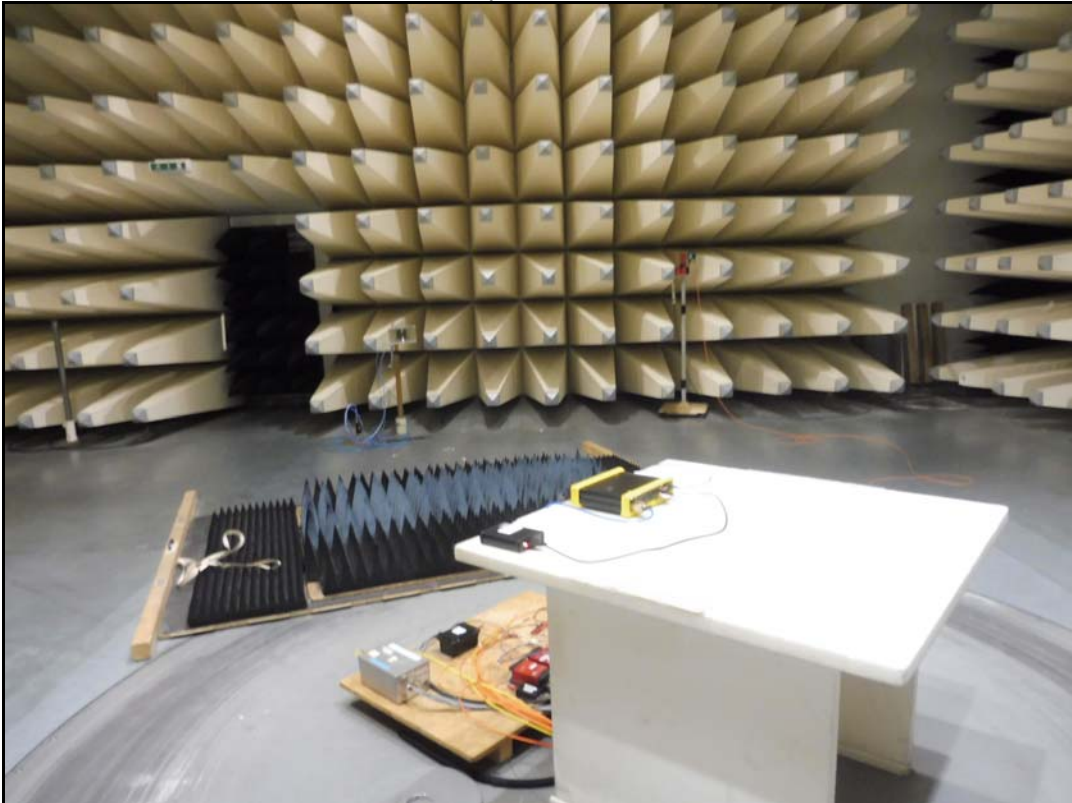


Photo 4: testsetup radiated emission Set 4

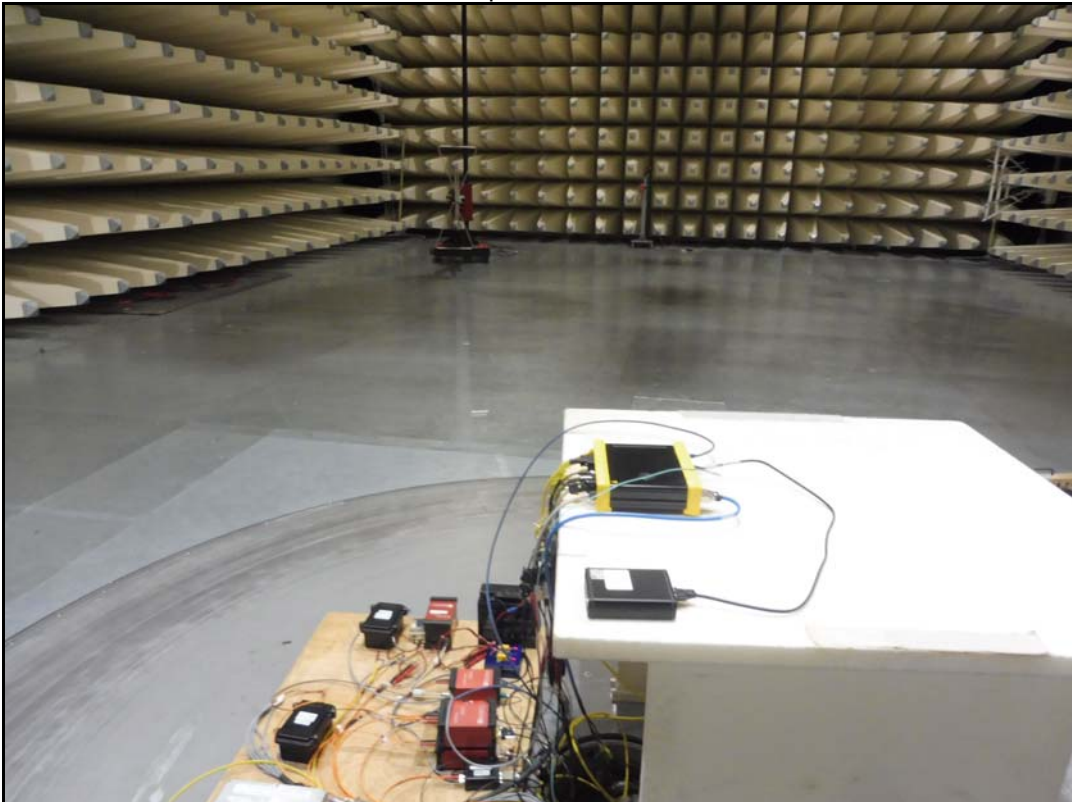


Photo 5: testsetup radiated emission Set 4

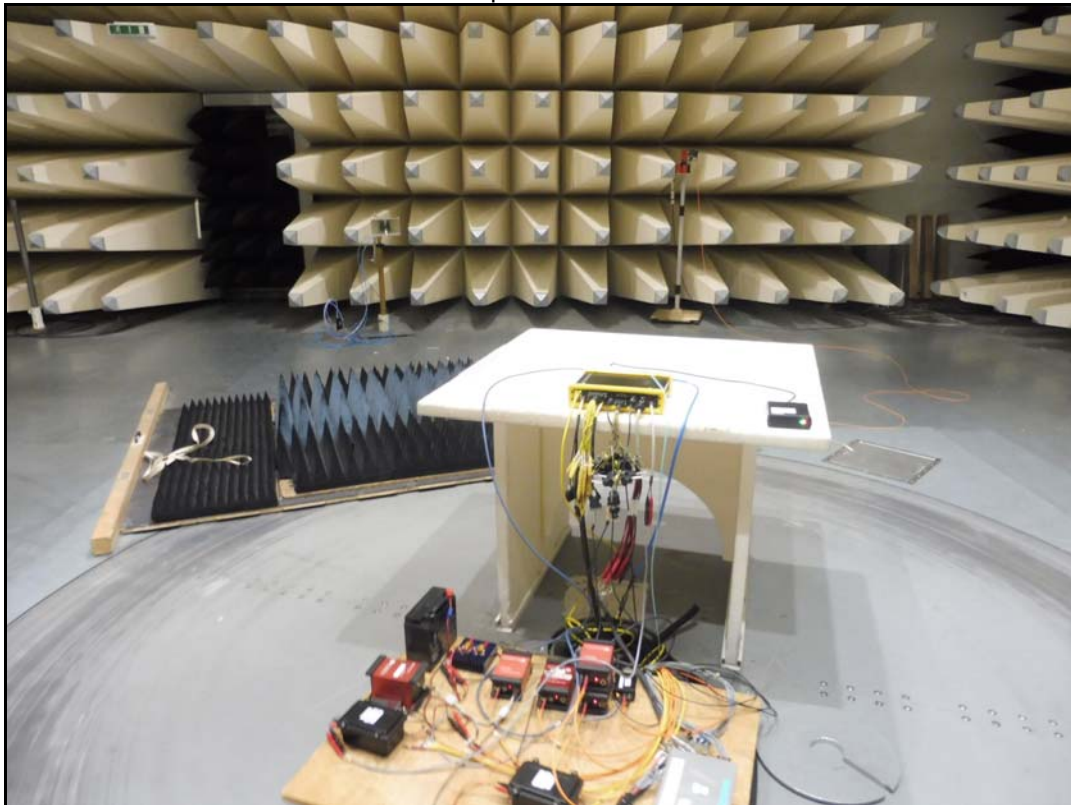


Photo 8: bottom view EUT A



Photo 9: rear view EUT A

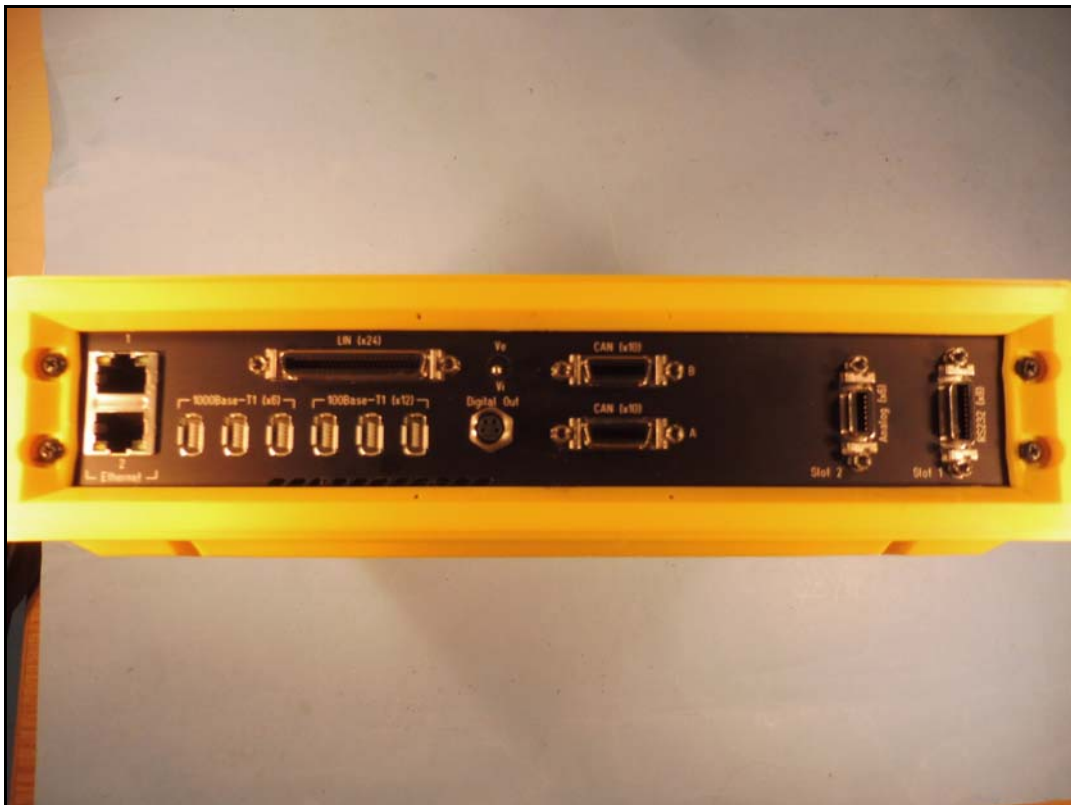


Photo 10: label of EUT A



Photo 11: front view of EUT B



Photo 12: top view of EUT B

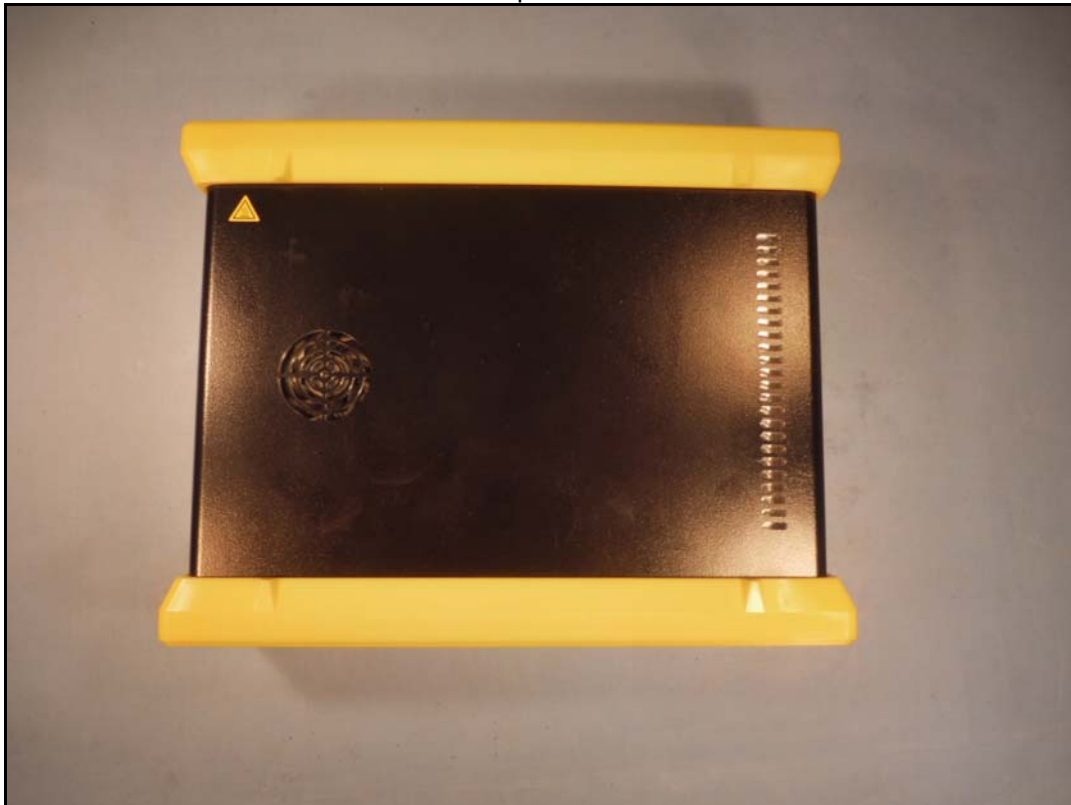


Photo 13: bottom view of EUT B



Photo 14: rear view of EUT B



Photo 15: label of EUT B



Photo 16: power supply of EUT



Annex C Document history

Version	Applied changes	Date of release
_B	FCC ID and Equipment Class have been added	2022-01-24
_A	chapter 6.4 “???” replaced with “- / -“	2021-11-02
- / -	Initial release	2021-10-26

This test report replaces the test report 1-1397/20-01-06_A and dated 2021-11-02

Annex D Further information**Glossary**

DUT	-	Device under Test
EMC	-	Electromagnetic Compatibility
EUT	-	Equipment under Test
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
IC	-	Industry Canada
Inv. No.	-	Inventory number
N/A	-	not applicable
S/N	-	Serial Number
SW	-	Software