

TEST REPORT

Test Report No.: 1-8402/19-03-06_A

6NetzA-CAB-02/21-102

Testing Laboratory

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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

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Manufacturer

X2E GmbH

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Test Standard/s

**FCC - Title 47 CFR
Part 15: 2021-08**

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: ML-N4000
FCC ID: 2AU4HML-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:

Holger Medrow
Testing Manager
Electromagnetic Compatibility & Acoustics

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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.

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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.

2.2 Application details

Date of receipt of order: 2021-08-10
Date of receipt of test item: 2021-08-10
Start of test¹⁾: 2021-08-10
End of test¹⁾: 2021-08-11
Person(s) present during the test: Gerhard Spengler

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: 2021-08	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	Interference-Causing Equipment Standard 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 :	ML-N4000		
Equipment classification:	Equipment for fixed use		
Environment classification:	Industrial environment		
Supply voltage :	DC 12V		
Ports : (maximum cable lengths declared by manufacturer)	Description	Direction	Length
	Wired network port (1x 4-way LAN 1000Base-T1)	in / output	< 30m
	Wired network port (1x 4-way LAN 100Base-T1)	in / output	< 30m
	Signal/control port (1x 4-way CAN 500 kBit/s)	in / output	< 30m
	Signal/control port (USB Typ A) * ¹	in / output	< 3m
	Signal/control port (USB Typ C)*	in / output	< 3m
	Signal/control port (eSATA)	in / output	< 1m
	Signal/control port (SFP+ 1GB/s) * ³	in / output	-----
	Wired network port (4x Front side LAN max. 1000Base-T host)	in / output	< 30m
	Signal/control port (RS232 for service)	in / output	< 30m
	Signal/control port (wake up + DC 12V) * ²	in / output	< 3m
Is mounting position / usual operating position defined?			table top
Additional information:			
<ul style="list-style-type: none"> - this is a class B digital device: - the instructions furnished the user shall include a statement according to §15.105 of the used FCC rules - the radio parts of the device are not part of this test report and already tested (contains FCC ID: 2AU4HML-N4000) - see manual site 21 [USB device interface] This port has no function for the user 			
*1 not part of the tests.			
*2 DC and signal port (wake-up) in one interface, not intended to be connected to a local DC network			
Tested according to customers test plan, see 1-8402/19-01-02-B.			
- *3 optical wire, no relevance to EMC			

6.2 Additional information

Test setup and EUT photos are included in test report:

1-8402/19-03-06_AnnexA

1-8402/19-03-06_AnnexB

6.3 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	ML-N4000	000323	3.00	4.0a.8121

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

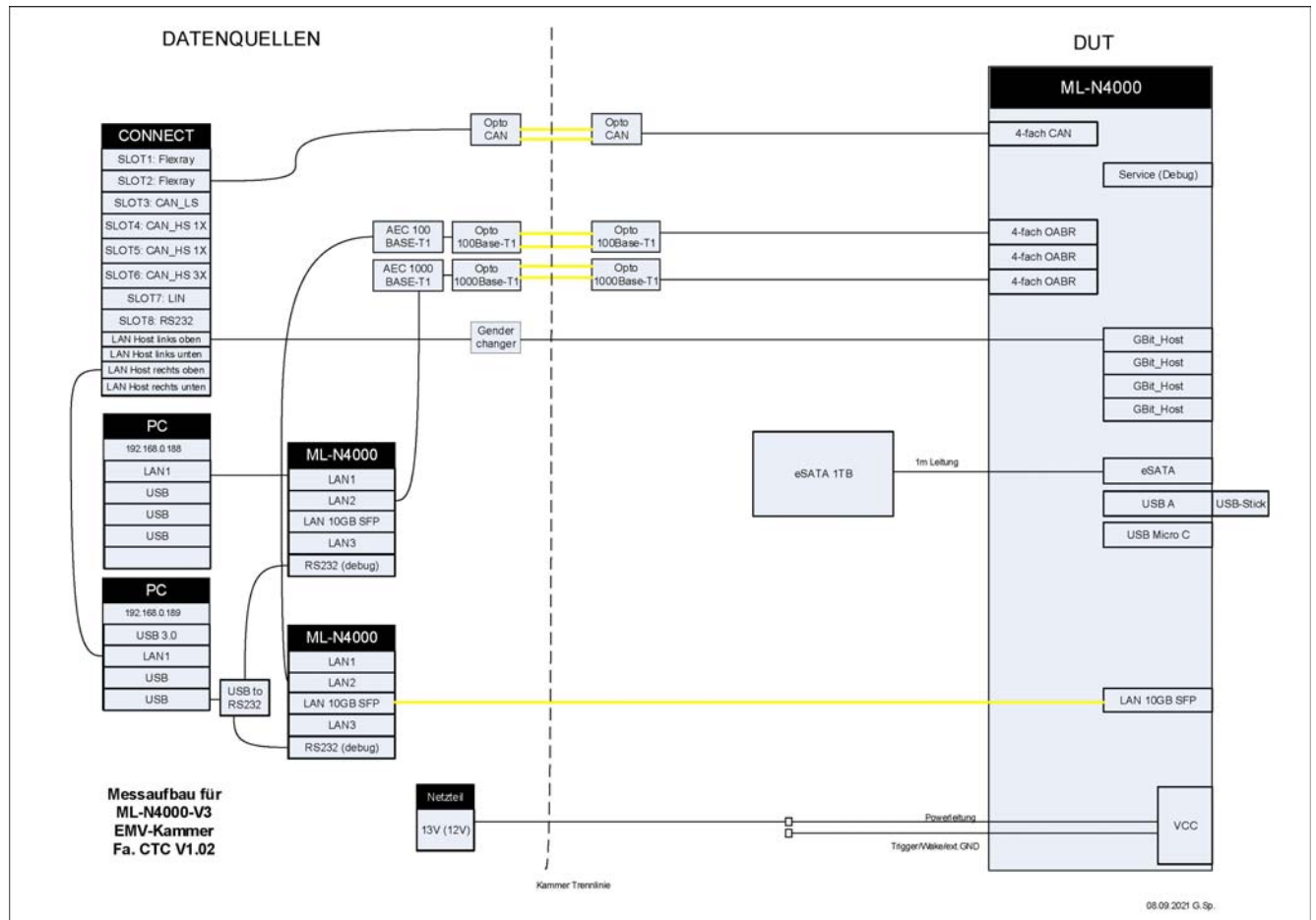
6.4 Auxiliary Equipment (AE): Type, S/N etc. and Short Descriptions

AE description*)	Auxiliary equipment	Type	S/N serial number	HW hardware status	SW software status
AE A	Data logger	Connect	--	--	--
AE B	Data logger	ML-N4000	--	--	--
AE C	PC of customer	Lenovo T510	R9-BGEHR 11/02	--	--
AE D	PC of customer	Lenovo T540p	R9-OHPD51 15/10	--	--
AE E	Data logger	ML-N4000	--	--	--
AE F	External hard disc	eSATA 1TB	--	--	--
AE G	Power supply	ETC70H-12	--	--	--

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

6.5 EUT Set-up(s)

Set 1: (Radio frequency electromagnetic field)



6.6 EUT Operating Modes

EUT operating mode no. *)	Description of operating modes	Additional information
op. 1	test mode of customer, data logging	---

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

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.

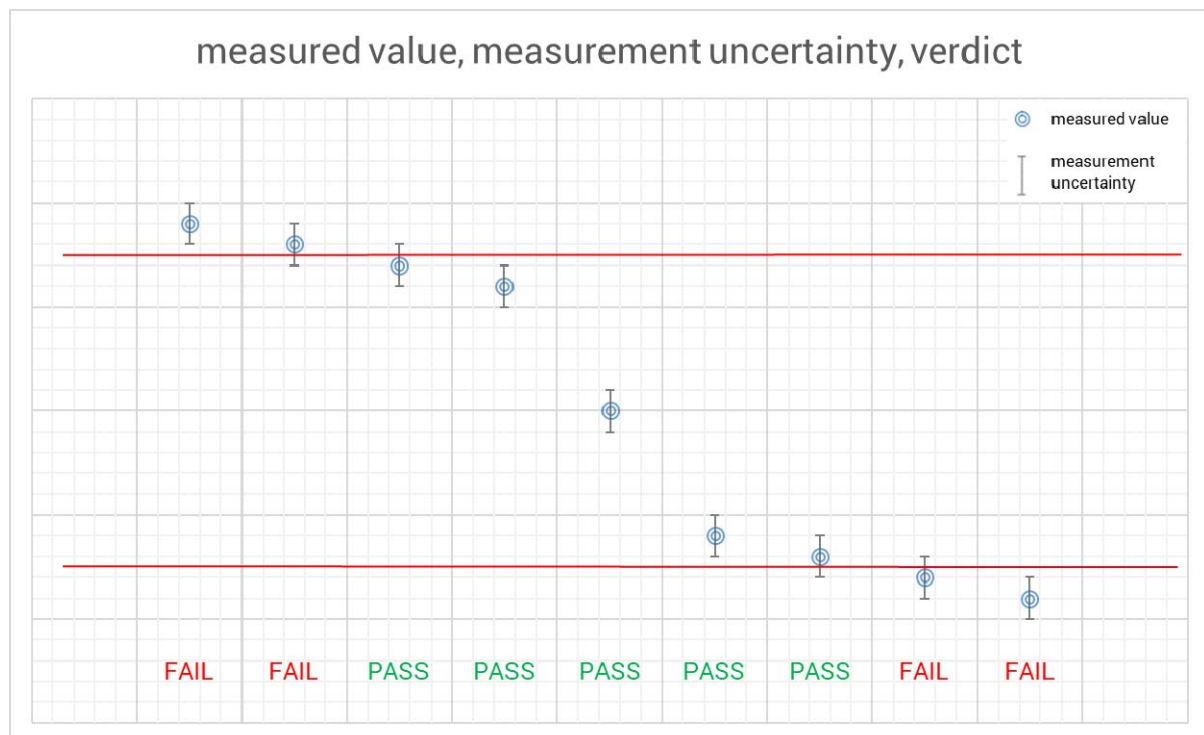
The table below shows the measurement uncertainties for each measurement method. The expended uncertainty (k=2 or 95%) was calculated with worst case values.

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)

I 25	I 28	I 29	I 30	I 31	I 34	I 39					
------	------	------	------	------	------	------	--	--	--	--	--

8.1.2 Test Plan

EUT set-up	set 2		
Operating mode	Port / Line	Limit	Result
op 1	AC power line	FCC part 15 B Class B	passed

Remark :	Powered by external power supply (115V / 60Hz)
-----------------	--

8.1.3 Conducted Limits (Power-Line)

Frequency- range	FCC part 15 B Class B		FCC part 15 B Class A	
	Quasi-Peak (dBµV)	Average (dBµV)	Quasi-Peak (dBµV)	Average (dBµV)
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

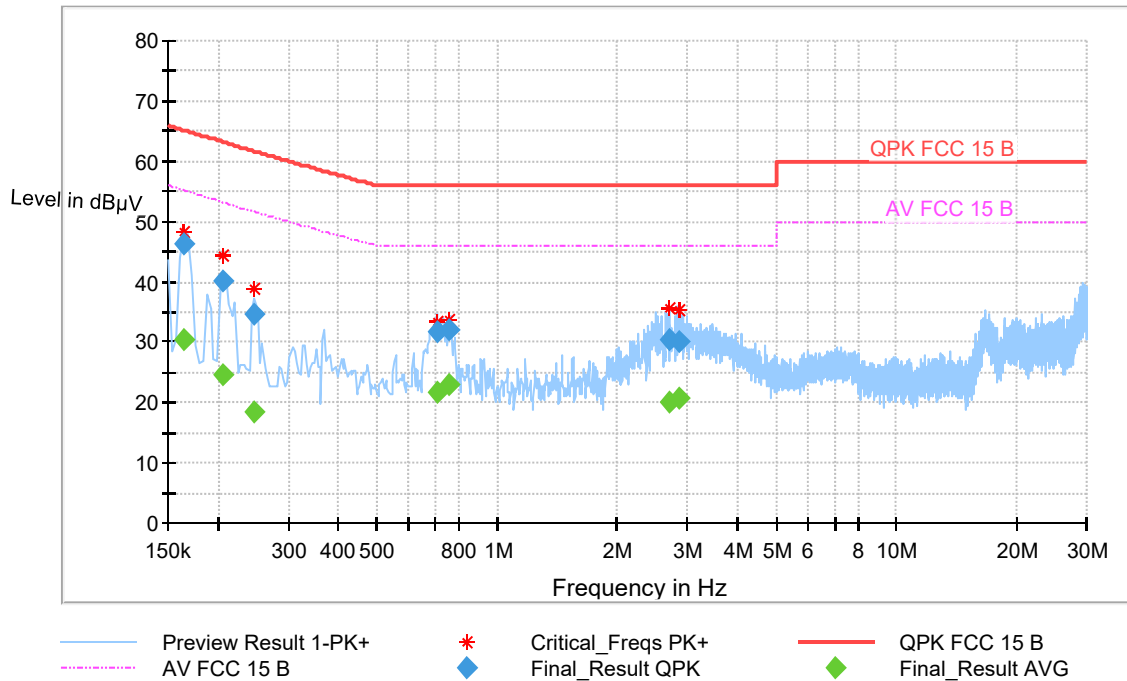
Device	Serial number	Internal Number	Calibration valid until	Calibration interval
ESCI	101240/003	3000004427	12 / 2021	12 month
VISN ESH 3-Z5	893045/004	300000584	12 / 2022	24 month

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 (L1)

EUT Information

EUT Name: Xoraya ML-N4000
 Manufacturer: X2E GmbH
 Operator: Schramm
 Operating Mode: Cont. data logging
 Comment: AC 115 V / 60 Hz



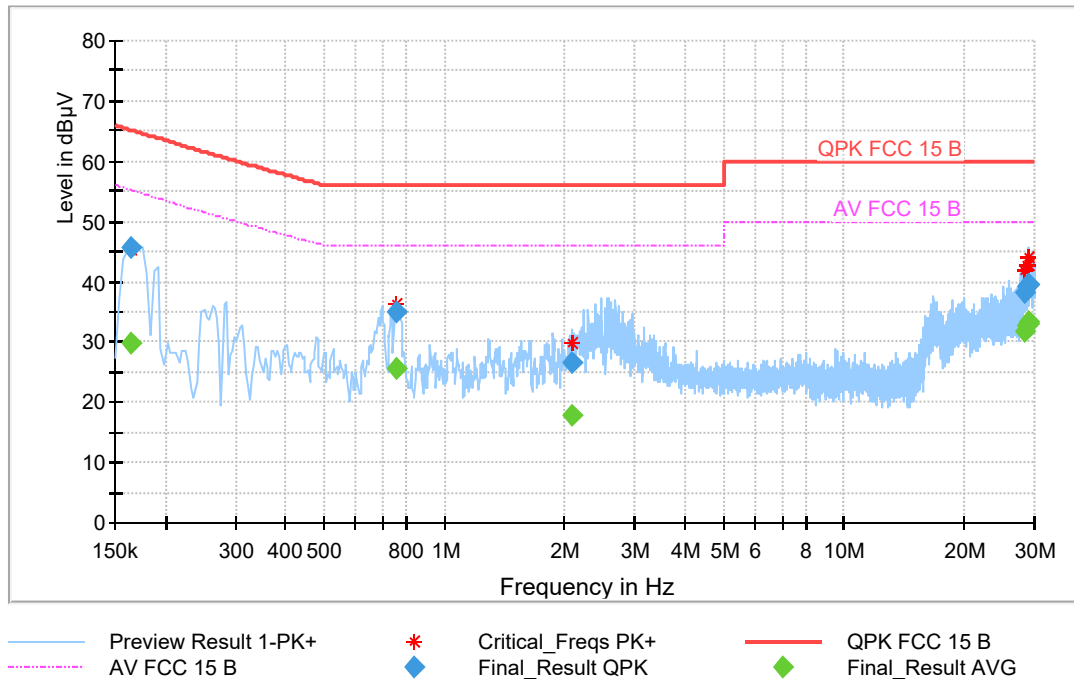
Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.164506	---	30.53	55.16	24.63	1000.0	9.000	L1	FLO	10.5
0.164506	46.19	---	65.17	18.98	1000.0	9.000	L1	FLO	10.5
0.205125	---	24.67	53.21	28.54	1000.0	9.000	L1	FLO	10.1
0.205125	40.31	---	63.24	22.93	1000.0	9.000	L1	FLO	10.1
0.246010	---	18.58	51.65	33.07	1000.0	9.000	L1	FLO	10.0
0.246010	34.70	---	61.69	26.99	1000.0	9.000	L1	FLO	10.0
0.707325	---	21.79	46.00	24.21	1000.0	9.000	L1	FLO	10.0
0.707325	31.80	---	56.00	24.20	1000.0	9.000	L1	FLO	10.0
0.761380	---	22.85	46.00	23.15	1000.0	9.000	L1	FLO	10.0
0.761380	32.08	---	56.00	23.92	1000.0	9.000	L1	FLO	10.0
2.703878	---	20.10	46.00	25.90	1000.0	9.000	L1	FLO	10.3
2.703878	30.44	---	56.00	25.56	1000.0	9.000	L1	FLO	10.3
2.855620	---	20.62	46.00	25.38	1000.0	9.000	L1	FLO	10.3
2.855620	30.07	---	56.00	25.93	1000.0	9.000	L1	FLO	10.3

8.1.6 Test Results (N)

EUT Information

EUT Name: Xoraya ML-N4000
 Manufacturer: X2E GmbH
 Operator: Schramm
 Operating Mode: Cont. data logging
 Comment: AC 115 V / 60 Hz



Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.164046	---	29.87	55.19	25.32	1000.0	9.000	N	GND	10.5
0.164046	45.59	---	65.20	19.61	1000.0	9.000	N	GND	10.5
0.756551	---	25.66	46.00	20.34	1000.0	9.000	N	GND	10.0
0.756551	34.95	---	56.00	21.05	1000.0	9.000	N	GND	10.0
2.077090	---	17.77	46.00	28.23	1000.0	9.000	N	GND	10.2
2.077090	26.57	---	56.00	29.43	1000.0	9.000	N	GND	10.2
28.439263	---	31.83	50.00	18.17	1000.0	9.000	N	GND	12.0
28.439263	38.28	---	60.00	21.72	1000.0	9.000	N	GND	12.0
28.720646	---	32.68	50.00	17.32	1000.0	9.000	N	GND	12.0
28.720646	39.10	---	60.00	20.90	1000.0	9.000	N	GND	12.0
28.864595	---	33.06	50.00	16.94	1000.0	9.000	N	GND	12.0
28.864595	39.46	---	60.00	20.54	1000.0	9.000	N	GND	12.0
28.940523	---	33.27	50.00	16.73	1000.0	9.000	N	GND	12.0
28.940523	39.66	---	60.00	20.34	1000.0	9.000	N	GND	12.0

8.1.7 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 dBμV, 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:

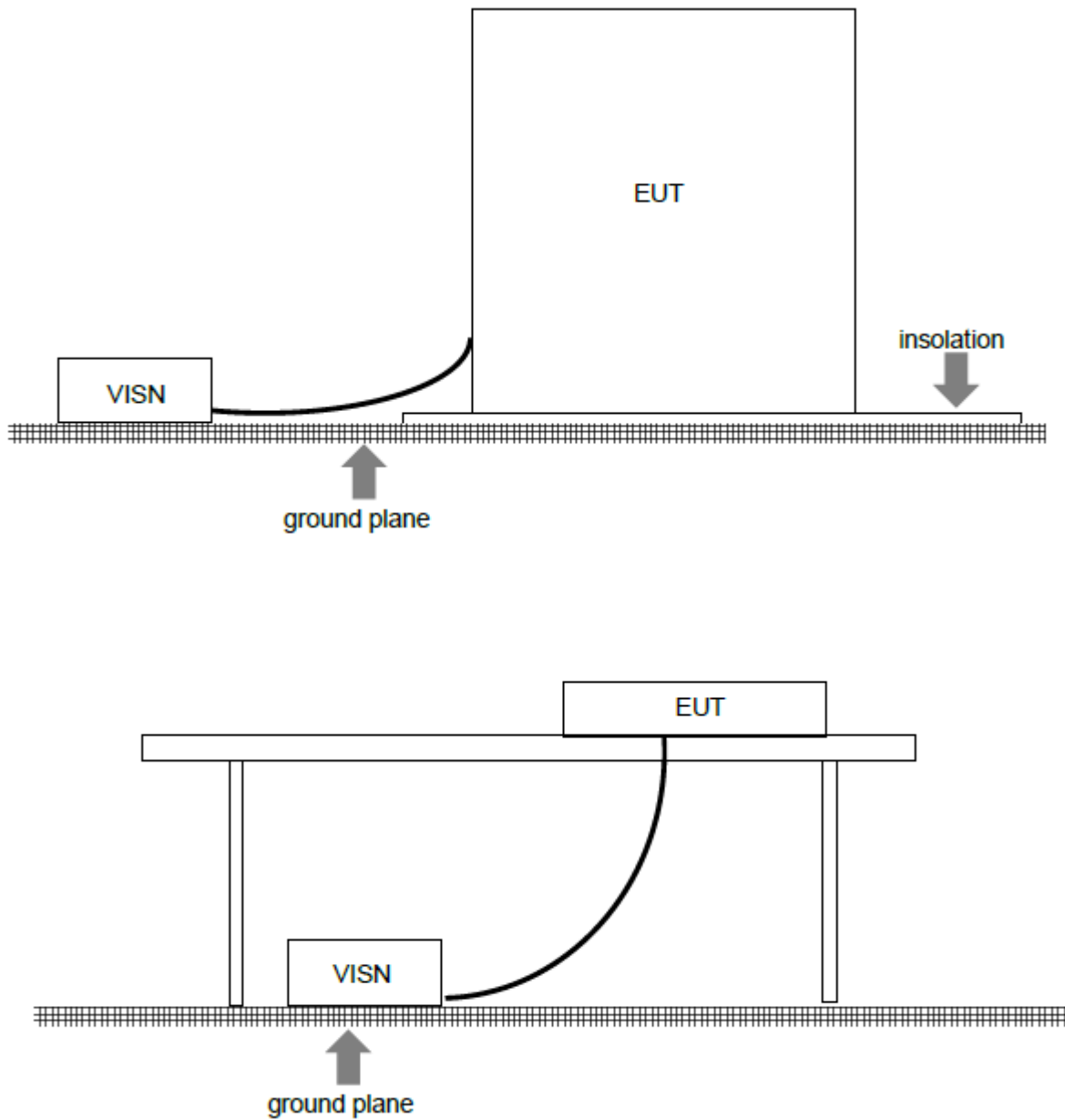
$$SS \text{ [dB}\mu\text{V]} = 37,62 \text{ [dB}\mu\text{V]} + 9,90 \text{ [dB]} + 0,23 \text{ [dB]} = \underline{47,75 \text{ [dB}\mu\text{V]}} \text{ (244, 06 } \mu\text{V)}$$

8.1.8 Version of test software

Software Version: TILE 7.3.0.15

8.1.9 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 28				
-----	-----	------	-----	-----	-----	-----	------	--	--	--	--

8.2.2 Test Plan

EUT set-up	set 1		
Operating mode	Application	Limit	Result
op 1	Enclosure	FCC part 15 B Class B	passed

Remarks: Powered by external power supply (DC 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 dBµV/m	39,1 dBµV/m
88 MHz – 216 MHz	33,5 dBµV/m	43,5 dBµV/m
216 MHz – 960 MHz	36 dBµV/m	46,4 dBµV/m
above 960 MHz	44 dBµV/m	49,5 dBµV/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

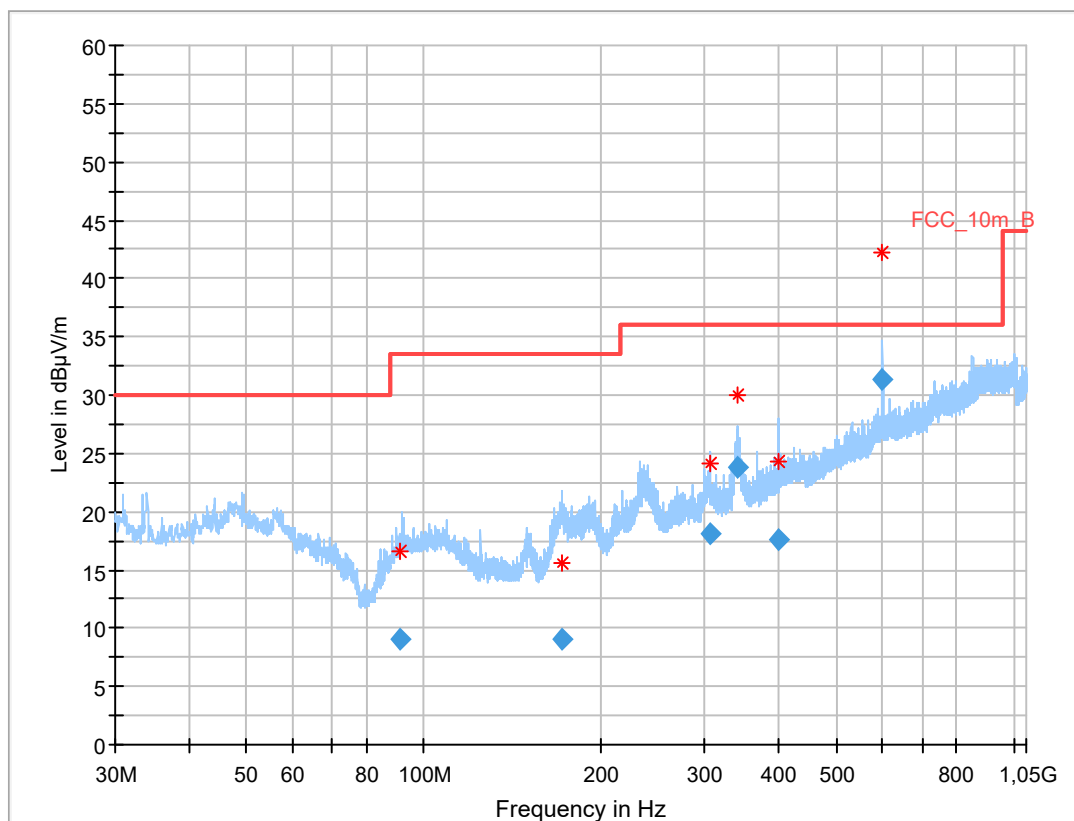
Device	Serial number	Internal Number	Calibration valid until	Calibration interval
ESR 3	1316.3003K03-102587-ct	300005771	12 / 2021	12 month
Trilog Antenna	9163-318	300003696	09 / 2021	24 month

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

8.2.5 Test Results

Common Information

EUT: ML-N4000
 Serial number: 0200_0600_0300_000323
 Test description: FCC 15B class B
 Operating condition: cont. data logging
 Operator name: MED
 Comment: DC 12V



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)
91.461	9.07	33.5	24.4	1000	120.0	150.0	V	145	12
171.796	9.06	33.5	24.4	1000	120.0	115.0	V	210	11
306.226	18.16	36.0	17.8	1000	120.0	344.0	H	159	15
340.194	23.74	36.0	12.3	1000	120.0	285.0	H	322	17
400.029	17.64	36.0	18.4	1000	120.0	119.0	V	-7	18
600.001	31.40	36.0	4.6	1000	120.0	195.0	H	338	22

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:

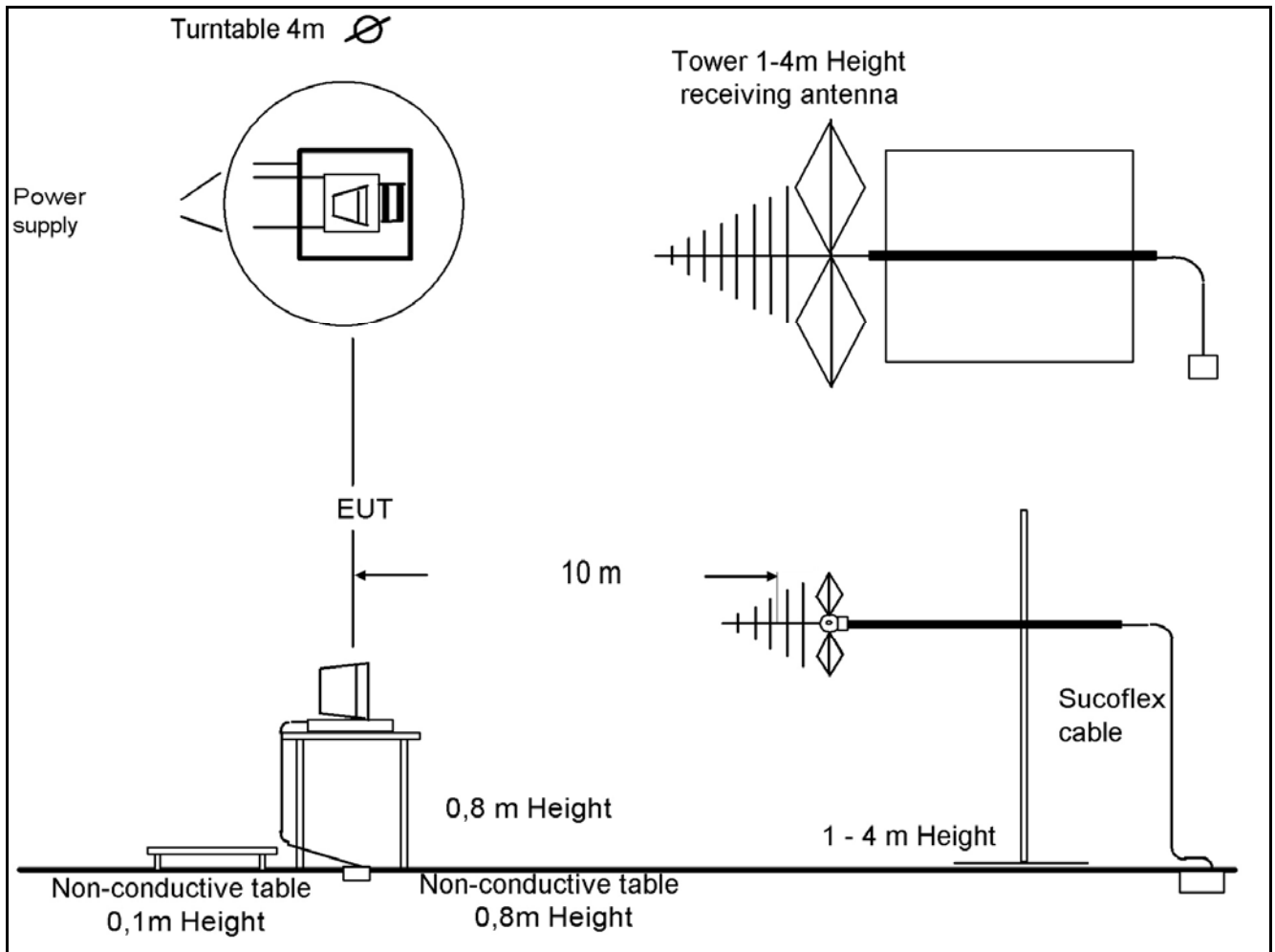
Frequency [MHz]	CL [dB]	AF [1/m]
30,000	0,20	12,30
100,000	0,60	11,30
200,000	1,10	10,60
300,000	1,30	13,20
400,000	1,60	15,30
500,000	1,90	16,80
600,000	2,00	18,80
700,000	2,20	20,30
800,000	2,30	21,50
900,000	2,40	22,80
1000,000	2,50	23,30

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:

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

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 28	F 30	F 32	F 33						
-----	-----	------	------	------	------	--	--	--	--	--	--

8.3.2 Test Plan

EUT set-up	set 1		
Operating mode	Application	Limit	Result
op 1	Enclosure	FCC part 15 B Class B	passed

Remarks:	The measured values are recalculated from 5m to 3m distance Powered by external power supply (DC 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 dBµV/m	59,5 dBµV/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

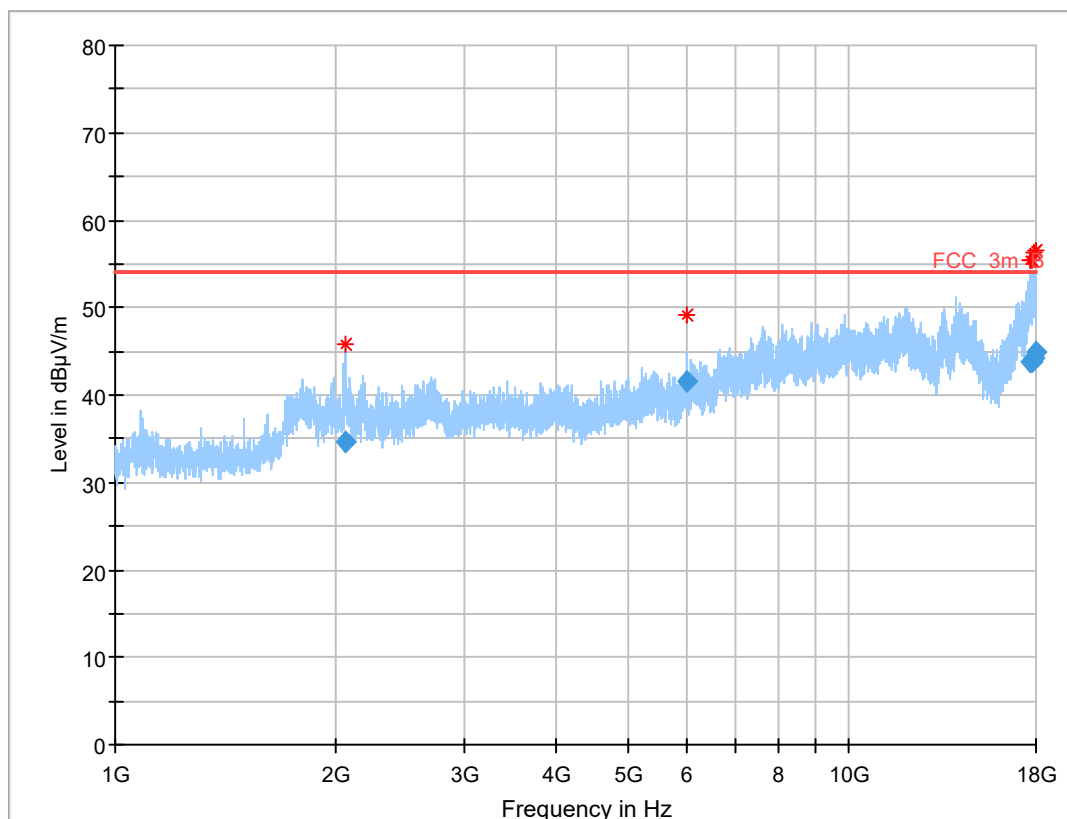
Device	Serial number	Internal Number	Calibration valid until	Calibration interval
FSU 26	200809	300003874	12/2021	12 month
Horn Antenna	9107-3697	300001605	03/2023	24 month

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

8.3.5 Test Results

Common Information

EUT: ML-N4000
 Serial number: 0200_0600_0300_000323
 Test description: FCC 15B class B
 Operating condition: cont. data logging
 Operator name: MED
 Comment: DC 12V



Final Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
2054.623	34.61	54.0	19.4	1000	1000.0	H	62	-5	
5999.913	41.52	54.0	12.5	1000	1000.0	V	257	1	
17631.597	43.82	54.0	10.2	1000	1000.0	H	323	17	
17781.536	43.76	54.0	10.2	1000	1000.0	H	136	18	
17878.145	44.24	54.0	9.8	1000	1000.0	H	109	19	
17991.844	45.00	54.0	9.0	1000	1000.0	V	164	20	

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

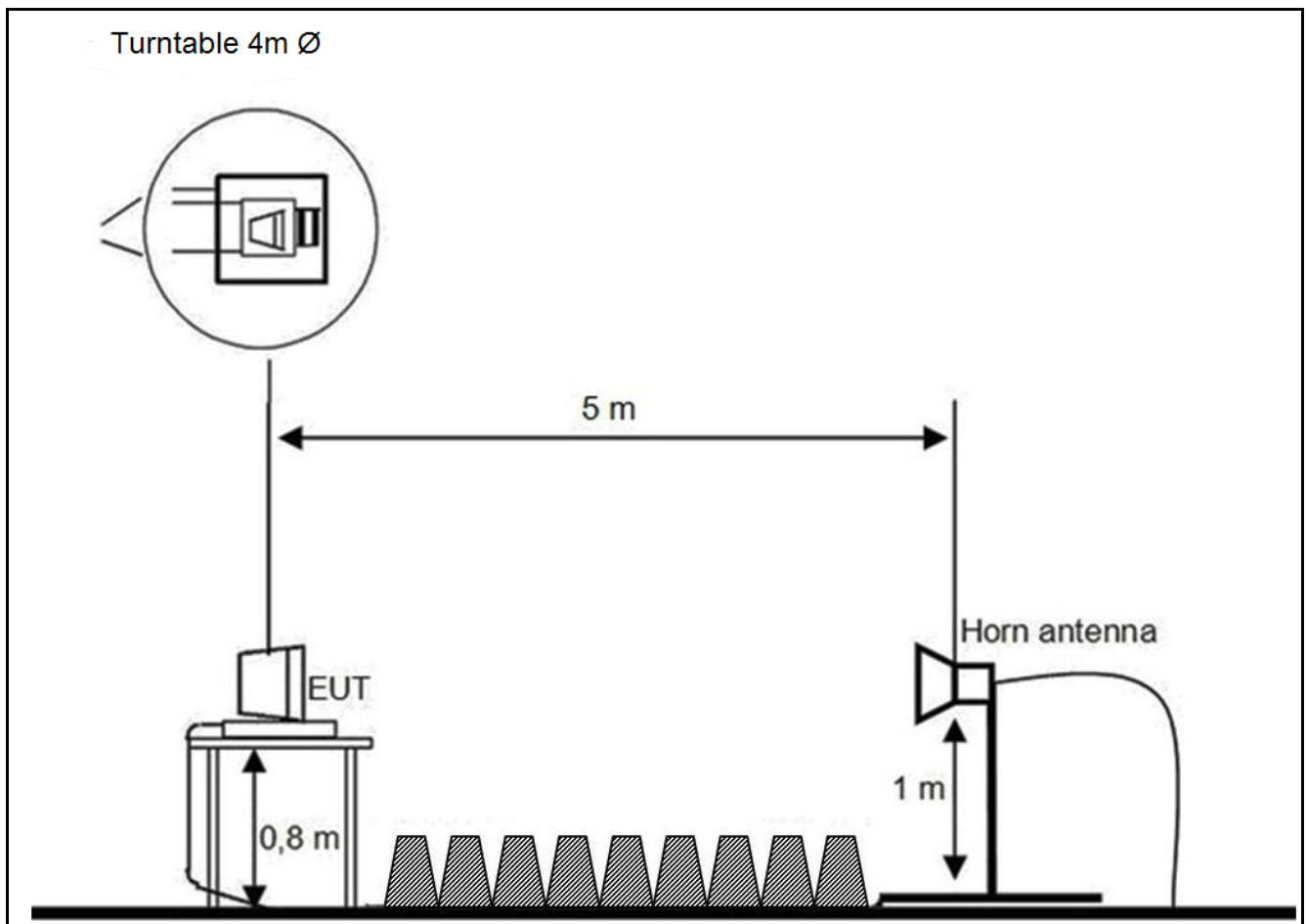
Frequency [GHz]	CL [dB]	AF [dB1/m]	DC [dB]
1,000	-35,50	24,40	4,40
1,500	-35,20	25,10	4,40
2,000	-35,10	27,40	4,40
2,500	-35,00	28,50	4,40
3,000	-34,70	30,20	4,40
3,500	-34,80	31,20	4,40
4,000	-35,00	32,60	4,40
4,500	-34,90	32,50	4,40
5,000	-34,80	33,40	4,40
5,500	-34,35	34,10	4,40
6,000	-34,00	34,40	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 dB μ V, 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-No.
<i>ESD in room 006</i>					
I-1	ESD- Generator	Schlöder	SESD 30000	402125	300003223
I-2	Pistol	Schlöder	SESD 30000	402125	300003223a
I-3	Module set	Schlöder	SESD 30000	402125	300003223b
<i>Conducted immunity (RF common mode) in room 006</i>					
I-4	Signal generator	R&S	SMB100A	115311	300005612
I-5	Measurement Software	R&S	EMC 32 V10.35.02		
I-6	Milli voltmeter	R&S	URV5	831392/004	300002038
I-7	Power Sensor	R&S	URV5-Z4	830276/006	300002645.2
	Power Sensor	R&S	URV5-Z4	840310/071	300000906
I-8	Amplifier 9 kHz – 250 MHz	BONN Elektronik	BSA 0125-75	066502-02	300003544
I-9	6 dB RF attenuator	BNOS Electronics	AT 50-6-250	521013	300000842
I-10	Electromagnetic Injection clamp	Lüthi	EM 101	35197	300001708
I-11	Filter clamp	Lüthi	FTC101	4229	300000942
I-12	Filter clamp	Lüthi	FTC101	4374	300000942
I-13	CDN	MEB	M2	11145	300000889
I-14	CDN	MEB	M3	10723	300000837
I-15	CDN	MEB	T2	11402	400000197
I-16	CDN	MEB	S25	11309	300000902
I-17	CDN	MEB	S1/50	12261	300001739
I-18	CDN	MEB	S1/50	11243	300000899
I-19	CDN	MEB	AF2	11349	300000895
I-20	CDN	MEB	AF2	11350	300000897
I-60	CDN	TESEQ	S200	26825	300003853
I-61	CDN	TESEQ	USB/p	27029	300003852
I-62	RF Current probe (BCI clamp)	FCC	F-120-4	23	300000538
G-8	RF Current probe	FCC	F-33-4	46	300003257
I-63	CDN	TESEQ	ST08	32282	300004397
G-22	CDN	FCC	FCC-801-M1	2027	300002761
<i>Conducted emission in room 006</i>					
I-25	RF receiver 9 kHz – 3 GHz	R&S	ESCI 1166.5950.03	101240/003	300004427
I-26	L.I.S.N. Artificial Mains Network	Schwarzbeck	NNBM 8125	8125401	300000567
I-27	L.I.S.N. Artificial Mains Network	Schwarzbeck	NNBM 8125	8125399	300000945
I-28	Measurement Software	R&S	EMC 32 V10.35.02		
I-29	Relay Matrix	R&S	PSU	879930/008	300001148
I-30	Relay Matrix	R&S	PSU	828628/007	300002475
I-31	Computer	F+W			300003330
I-33	DC power supply	HP	6032A	2743A-02600	300001498
I-34	Two Line V-Network	R&S	ESH3-Z5	893045/003	300000585
I-37	4-Wire T-Network	R&S	EZ-10	828757/001	300000611
I-38	Loop antenna	R&S	HFH2-Z2	881058/42	300001477
I-39	Power source	HBS Electronics	ACS Power Source	--	--
<i>Car Pulse equipment in chamber D</i>					
D-200	Ultra Compact Simulator	EM Test	UCS 200N	V0936105110	300003952
D-201	Voltage Drop Generator	EM Test	VDS 200N	V0936105111	300003953
D-202	Coupling network	EM Test	ACC	0495-01	300002281
D-203	Termination resistor for ACC	EM Test	Kw 50 Ohm	--	40000
D-204	Digital Phosphor Oscilloscope	Tektronix	DPO 7254	B022702	300003573
D-205	Current Probe	Tektronix	TCP0030	C024528	300004169
D-206	DC Power Supply	Agilent	N5767A	US26S7337F	300003839
<i>Observation equipment, audio rack 2 in Room 006</i>					
I-50	Control computer				400000209
I-51	Software	ICT			
I-52	Band pass	IMD	EWR-BF	2610100	300003507
I-53	Measurement amplifier	B&K	2636	1537486	300000190
I-54	Microphone	B&K	2669	2449486	400000207
I-55	Selective Level Meter	HP	3586A	2908A01917	300000409
I-56	Switch Control Unit	HP	3488A	none	300000135
I-57	Optical fibre microphone system	Sennheiser		keine	300003100
I-58	Artificial mouth with AF transformer	B&K	4227	1536875	300002314
I-59	sound calibrator	CR511F	CIRRUS	34688	400000206

No.	Instrument/Ancillary	Manufacturer	Type	Serial-No.	Internal-No.
<i>Radiated emission in chamber F</i>					
F-1	Control Computer	F+W		FW0502032	300003303
F-2	Trilog-Antenna	Schwarzbeck	VULB 9163	9163-1029	---
F-3a	Amplifier	Veritech Microwave Inc.	0518C-138	- / -	- / -
F-4b	Switch	HP	3488A	- / -	300000368
F-5	EMI Test receiver	R&S	ESCI	100083	300003312
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 (Ch. 62)	WRCD		9	
F-35	RF- Amplifier	Bonn	BLMA 2060-5	097392A	300003908
F-36	Stacked Microwave Log.-Per. Antenna	Schwarzbeck	STLP9149	9149-044	300003919
<i>Radiated immunity in chamber F</i>					
F-10	Control Computer	F+W		FW0502032	300003303
F-11	Signal Generator	R&S	SMB 100A	1406.6000k02-113856	300005266
F-13	RF-Amplifier	Bonn	BLMA 0825-50	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	3011	300005385
F-15	RF-Amplifier	Bonn	BLWA 0810-250	108105	300004536
F-15a	RF-Amplifier	ar	1000LM20	20562	-/-
F-16	Directional Coupler	ar	DC7144A	312786	300003411
F-17	Horn Antenna	ar	AT 4002	19739	300000633
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-16a	Directional coupler	emv	DC 2000	9401-1677	300000592
<i>Harmonics and flicker in front of chamber F</i>					
F-21	Flicker and Harmonics Test System	Spitzenberger & Spies	PHE4500/B I PHE4500/B II	B5983 B5984	300000210
F-22	Control Unit	Spitzenberger & Spies	STE	B5980	300000210
F-23	Power Amplifier	Spitzenberger & Spies	EP 4500/B	B5976	300000210
F-24	Conect Panel	Spitzenberger & Spies	Conect panel	B5982	300000210
F-25	Power Supply	Spitzenberger & Spies	NT-EP 4500	B3977	300000210
F-26	Additional transformer	Spitzenberger & Spies	UT-EP 4500	B5978	300000210
F-27	Analyzer Reference System	Spitzenberger & Spies	ARS 16/1	A3509 07/00205	300003314
F-28	Power Supply	Hewlett Packard	6032 A	2920 A 04466	300000580
<i>Radiated emission in chamber F > 1GHz</i>					
F-29	Horn antenna	Schwarzbeck	BBHA 9120B	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	9709-5289	300000213
F-33	Spectrum Analyzer	R&S	FSU26	200809	300003874
F-34	Loop antenna	EMCO	6502	8905-2342	300000256

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: Radiated emissions test setup (< 1GHz)

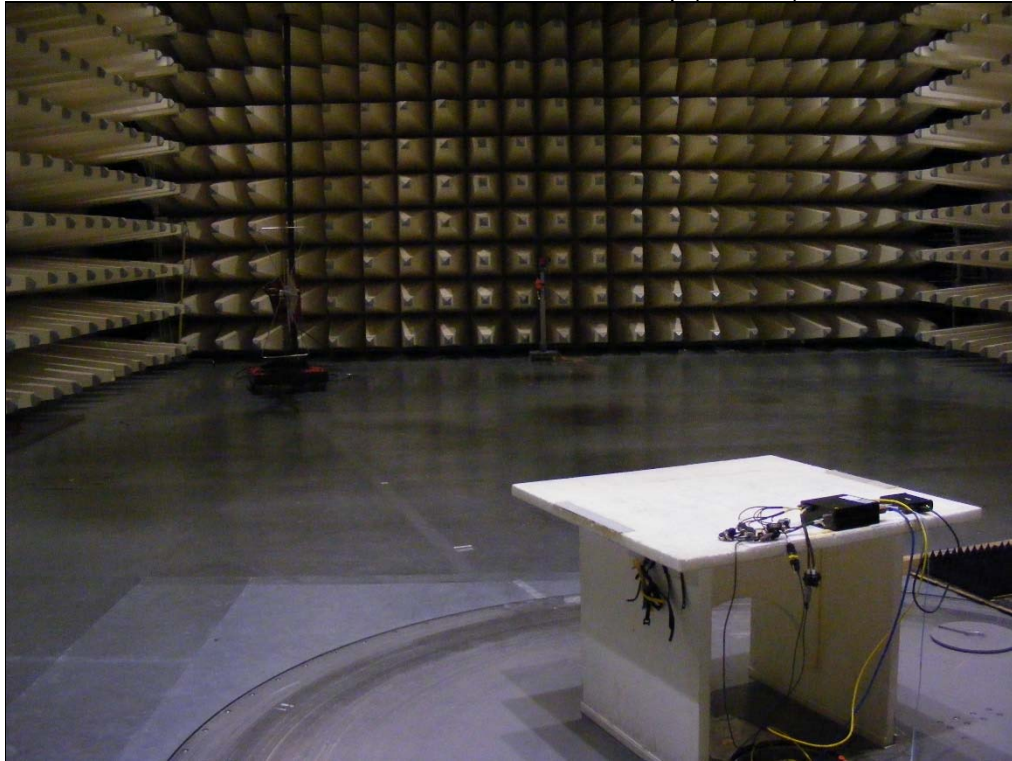
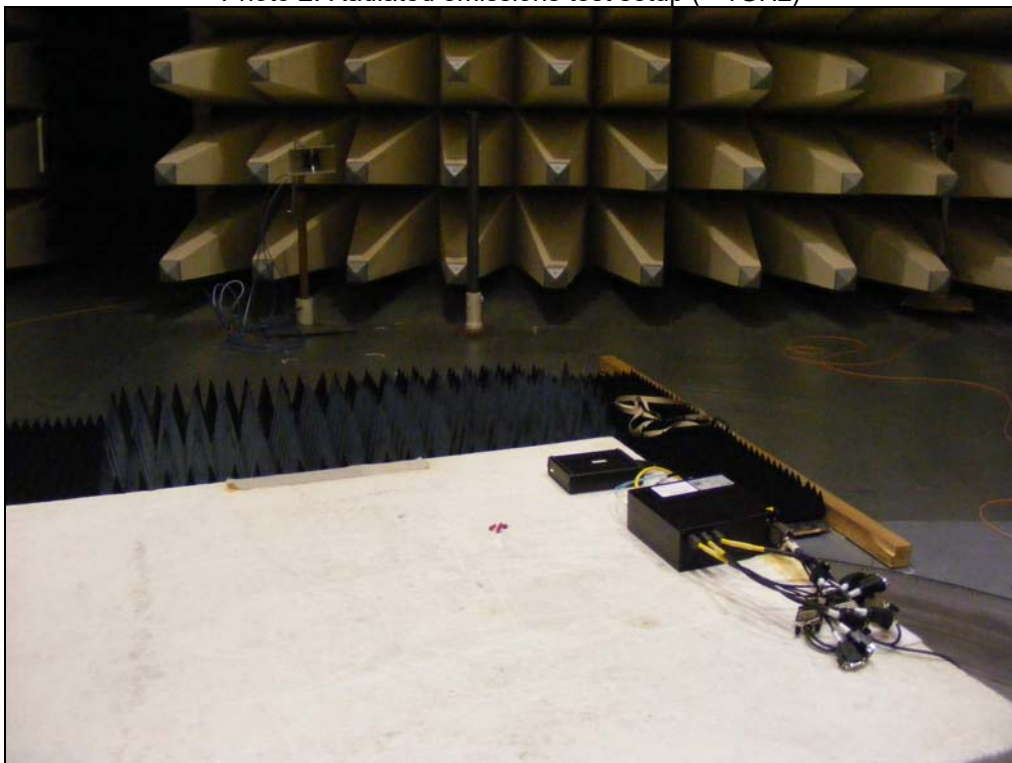


Photo 2: Radiated emissions test setup (> 1GHz)



Annex B Photographs of the EUT

Photo 3: EUT



Photo 4: EUT

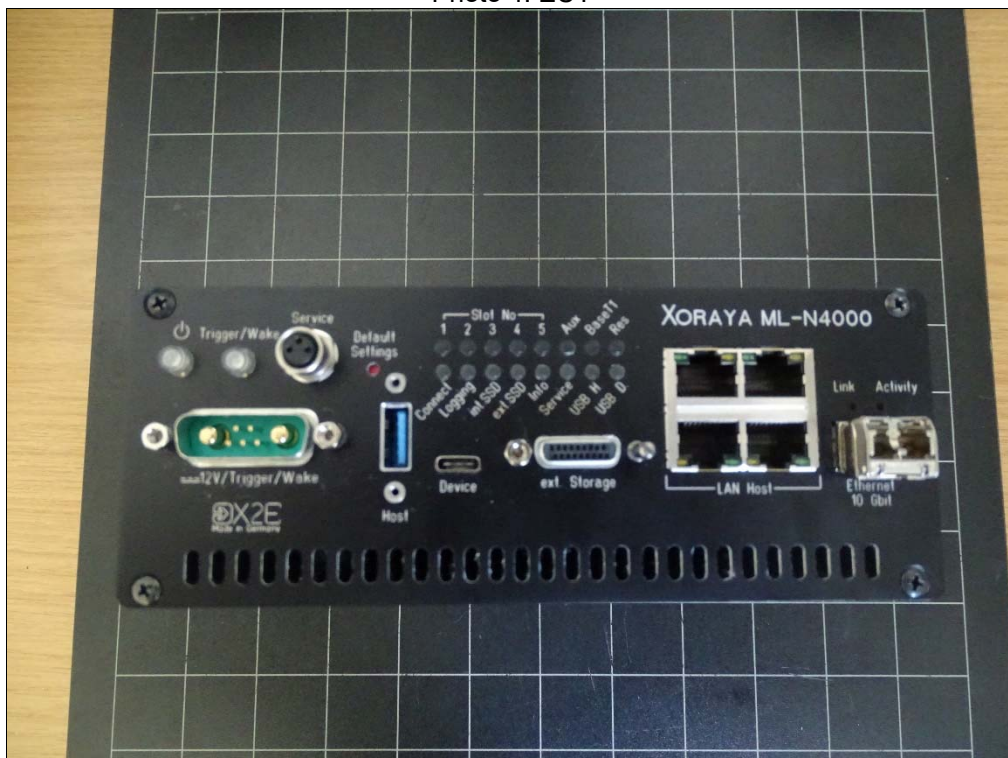


Photo 5: EUT



Photo 6: EUT

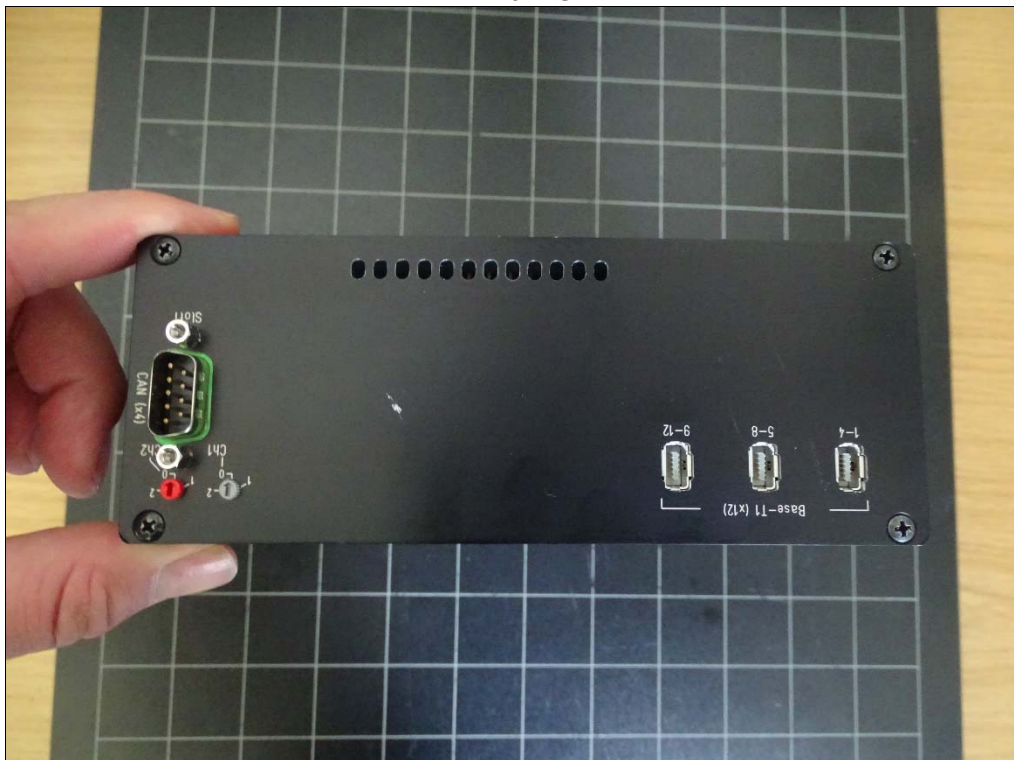


Photo 7: EUT



Photo 8: EUT

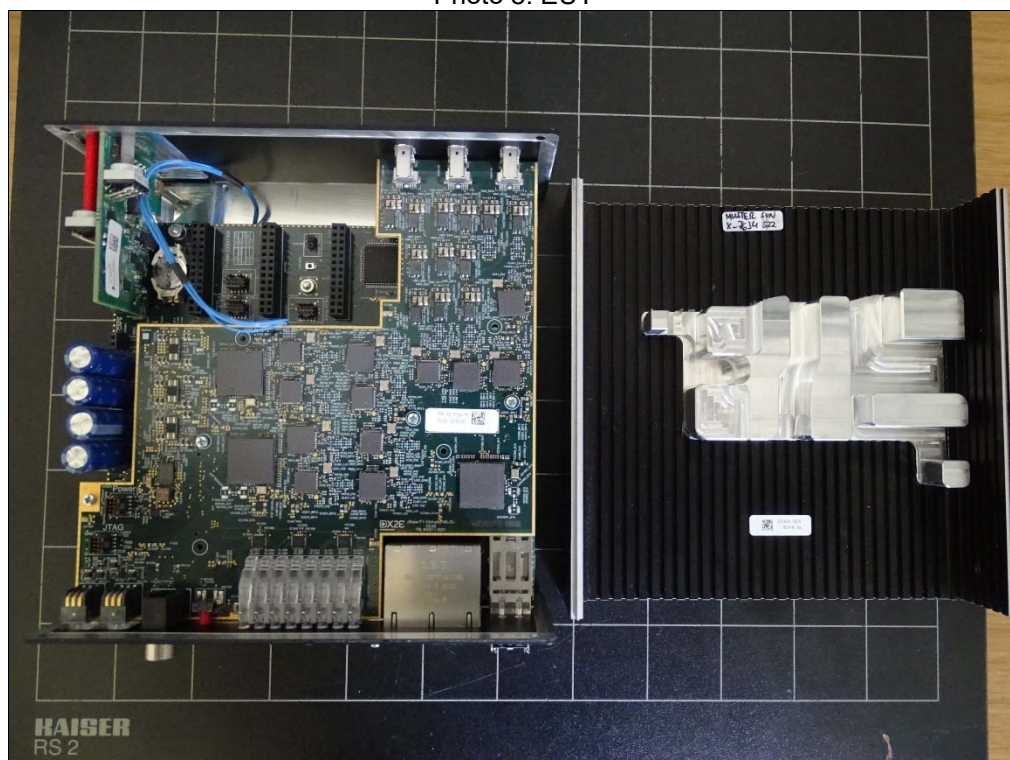


Photo 9: EUT

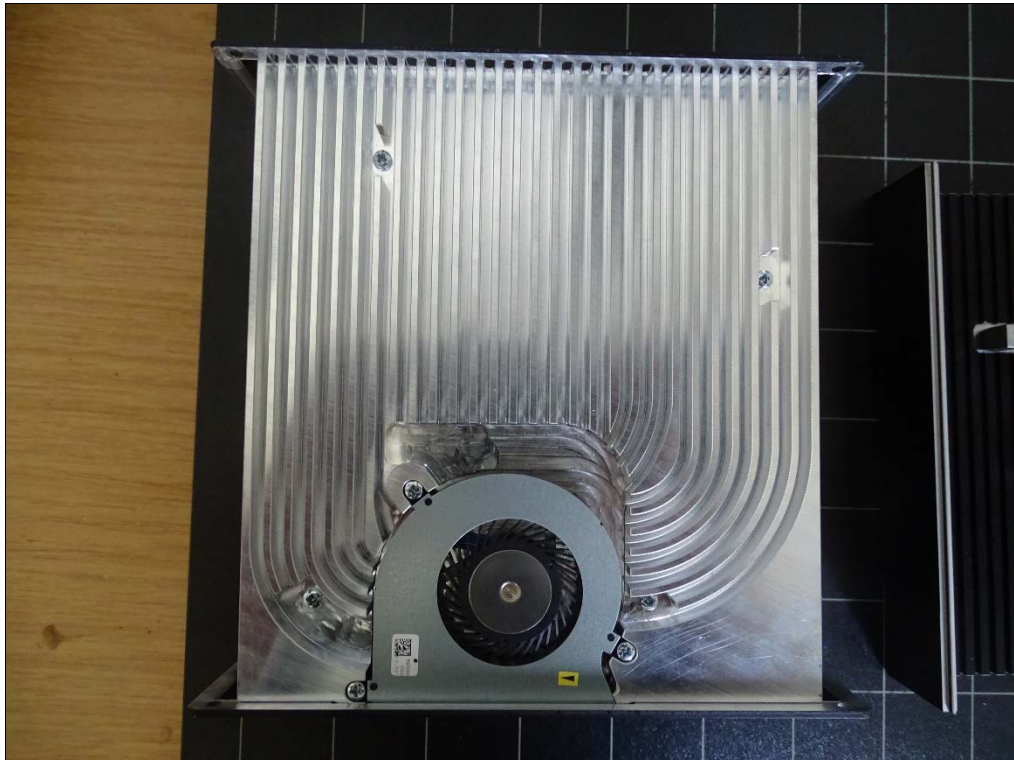


Photo 10: EUT

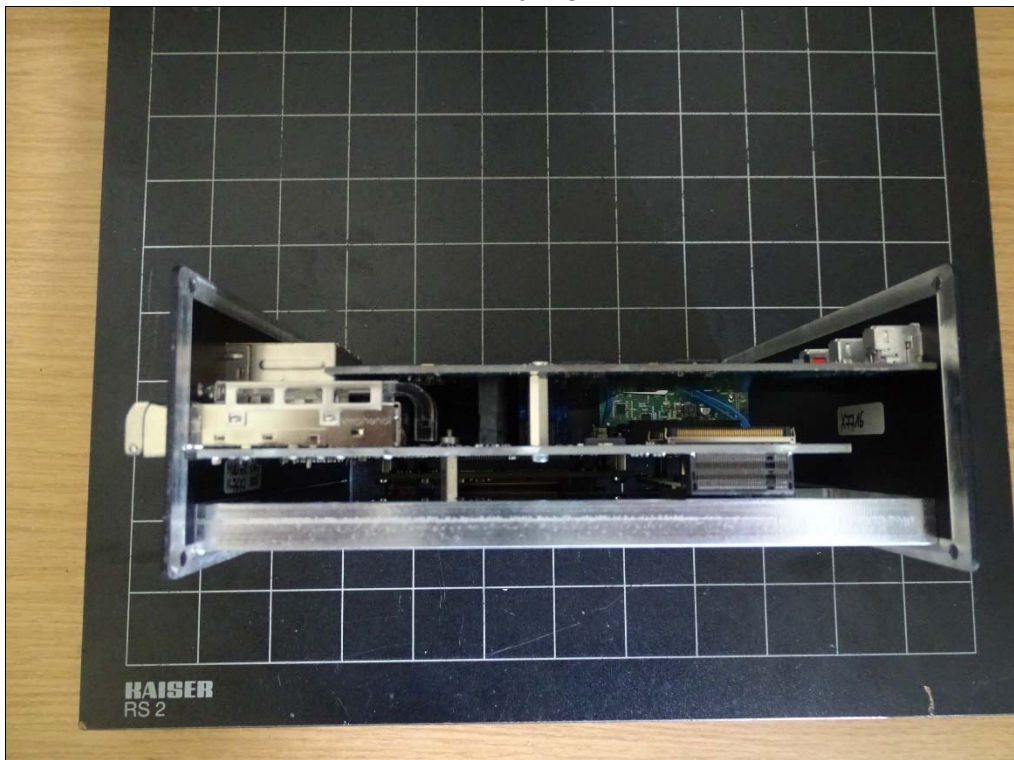
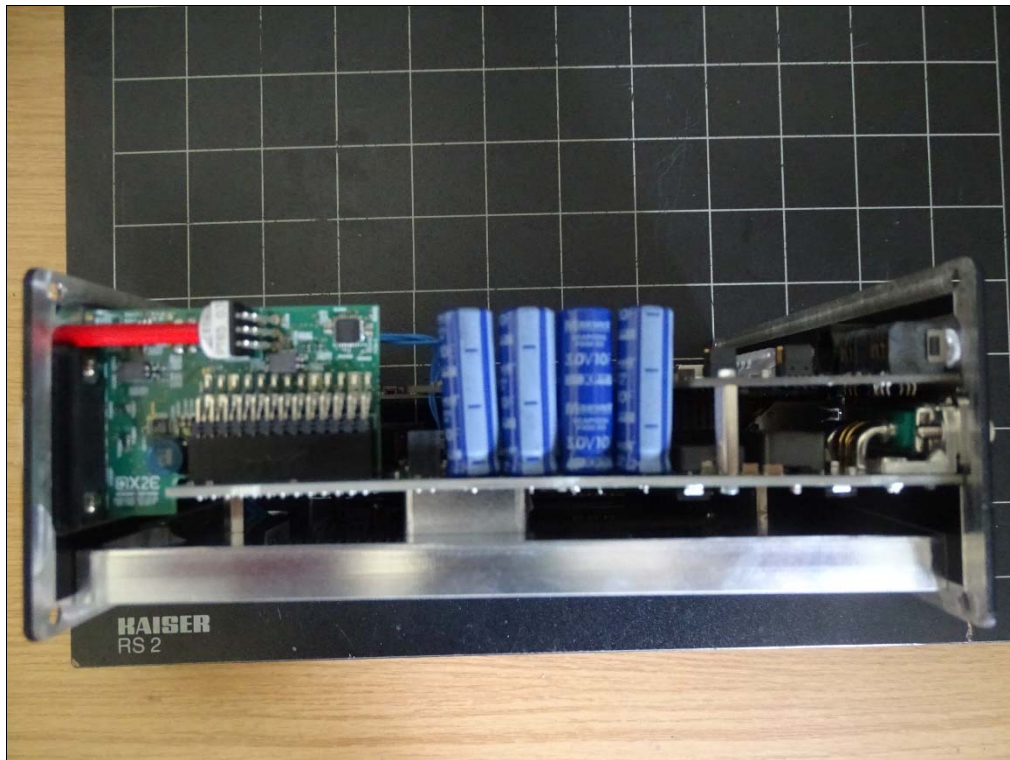


Photo 11: EUT



Annex C Document history

Version	Applied changes	Date of release
- / -	Initial release	2021-11-22
A	References to extern photo-annexes were added	2021-12-02

This test report replaces the test report 1-8402/19-03-06 and dated 2021-11-22

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