Test Report

ElectroMagnetic Compatibility

Document No.	073969.558.23 V1.0
EUT	Motorrad - Steuerbox
EUT P/N	D-Box
EUT S/N	29739
Test Date	23.11.2023 – 24.11.2023

Purchaser/ Manufacturer	Joost Elektronik Selsinger Straße 28 27404 Rhade Germany
Test Location	MeßTechnikNord GmbH, EMC-Centre Industriestrasse 29 22880 Wedel, Germany
Standards	UN ECE R10 Rev.6, 11.2019
Test Result (ref. to page 7)	Test Requirements are fulfilled ☒
	Test Requirements are partially fulfilled ☐
	Test Requirements are not fulfilled ☐

Prepared (person responsible)	, 04.12.2023 (Stefan Schwenn, Date)
Approved (vice head of laboratory)	Tim Stammwitz Bestätigung mit dig. Unterschrift 04.12.2023 17:42:24 (Tim Stammwitz, B.Eng., Date)

Meß**T**echnik**N**ord GmbH
Akkreditierte Labore für Kalibrierung und EMV

Industriestraße 29
D-22880 Wedel
Germany
Phone: +49 4103 18886 - 44
Fax: +49 4103 18886 - 29
EMail: info@messtechniknord.de
Internet: www.messtechniknord.de

ilac-MRA
DAkkS Deutsche Akkreditierungsstelle
D-PL-15086-01-01

Revision History

Issue	Date	Chapter	Description
1.0	04.12.2023	all	first release of this document

List of Participants

Name	Company
Andrej Klan	MeßTechnikNord GmbH
Axel Joost	Joost Elektronik

Distribution List

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1 Test Result Summary

The tests were performed according to the standard UNECE R10 Rev.6 (emission and susceptibility). This standard includes the necessary test levels and limits and refer to the listed standards in the following table in respect to the test methods.

Chapter	Reference	Description	Result
5.1	DIN EN 55025	Radiated Emission Broadband	PASSED
5.2	DIN EN 55025	Radiated Emission Narrowband	PASSED
5.3	ISO 7637-2	Emission Of Transient Conducted Disturbances On 12/24 V Supply Lines	PASSED
5.4	ISO 11452-2	Immunity To Electromagnetic Radiation – Absorber Chamber Test	PASSED
5.5	ISO 7637-2	Immunity To Transient Disturbances Conducted Along 12/24 V Supply Lines	PASSED

Tab. 1-1: Test result summary

2 General

2.1 Purpose

This document contains all required information about the electromagnetic compatibility tests of the EUT:

Motorrad - Steuerbox, P/N D-Box

All relevant data for the traceability of the tests will be documented. All measurement results of emission and susceptibility will be estimated and checked against the required limits.

2.2 Applicable Documents

Reference	Document Title	Version
UN ECE R 10 Rev 6	E/ECE/324/Add.9/Rev.6−E/ECE/TRANS/505/Add.9/Rev.6 Concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations	11.2019
DIN EN 55025	Vehicles, boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers	05.2002
ISO 7637-1	Road vehicles — Electrical disturbances from conduction and coupling — Part 1: Definitions and general considerations	03.2002
ISO 7637-2	Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only	06.2004
ISO 11452-1	Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 1: General principles and terminology	02.2005
ISO 11452-2	Road vehicles - Component test methods for electrical disturbances from narrowband radiated electromagnetic energy Part 2: Absorber-lined shielded enclosure	11.2004
ISO 11452-4	Road vehicles - Component test methods for electrical disturbances from narrowband radiated electromagnetic energy Part 4: Harness excitation methods	04.2005
EA-4/02 M: 2013	Evaluation of the Uncertainty of Measurement in Calibration	09.2013
ISO/IEC Guide 98-3	Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)	09.2008
IEC/TR 61000-1-6	Electromagnetic compatibility (EMC) - Part 1-6: General - Guide to the assessment of measurement uncertainty	07.2012
DIN EN 55016-4-2	Specification for radio disturbance and immunity measuring apparatus and methods - Part 4-2: Uncertainties, statistics and limit modelling - Measurement instrumentation uncertainty	11.2014

Tab. 2-1: Applicable documents

3 Measurement Uncertainty and Evaluation of Conformity

3.1 Measurement Uncertainty

The measurement uncertainty of each measurement in this report had been calculated. The results of these calculations are stored within the quality assurance documents of MeßTechnikNord GmbH and can be shown on request. The calculation is based on following applicable standards and publications:

- EA-4/02 M: 2013,
- ISO/IEC Guide 98-3,
- IEC/TR 61000-1-6,
- DIN EN 55016-4-2

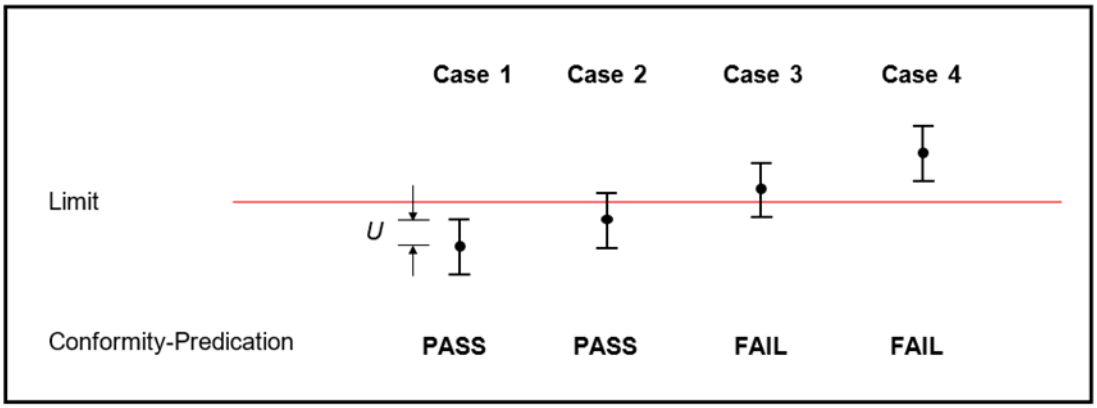
If no further note is added to the tests within this report the measurement uncertainty fulfils the minimum requirements of the applied standards.
The correlation between the calculation of the measurement uncertainty and the measurement methods used is given by associated, unique MTN-IDs and referenced in each chapter of the test results.

3.2 Conformity

According to the requirements of DIN EN ISO / IEC 17025, an evaluation of conformity is required. Unless otherwise defined in the underlying standard or specification, the determinations in the following chapters apply to emission and susceptibility.

3.2.1 Evaluation of Conformity for Emission

The four basic cases according to “ILAC-G8:09/2019 Guideline on the Decision Rules and Statements of Conformity“ - Fig. 3 shall apply:
The cases 1 and 2 will be stated as conform, cases 3 and 4 as none conform.

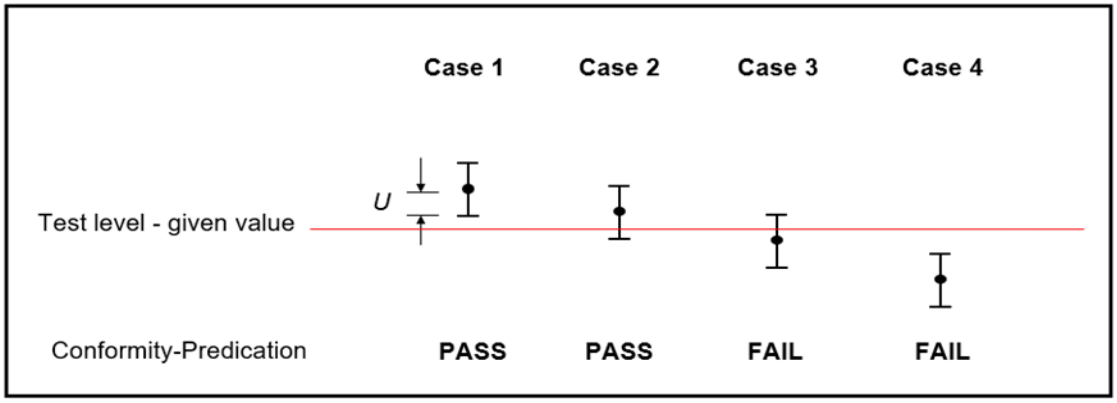


U = 95% extended measurement uncertainty

Fig. 3-1: Decision cases - emission

3.2.2 Evaluation of Conformity for Susceptibility

At susceptibility testing the 4 basic cases apply for the test level setting as follows:



U = 95% extended measurement uncertainty

Fig. 3-2: Decision cases – susceptibility

The test criteria for EUT operating mode will be agreed amicably with customer before testing.

4 Equipment Under Test (EUT)

4.1 State of construction

The following table documents the state of construction of the EUT and the peripheral equipment inclusive the possible necessary modifications developed during the tests.

Name	P/N	S/N	Modifications for Tests
Motorrad - Steuerbox	D-Box	29739	-

Tab. 4-1: EUT

Name	P/N	S/N	Modifications for Tests
Tets adapter	-	-	-

Tab. 4-2: Peripheral equipment

Fig. 4-1: Type label, Motorrad - Steuerbox

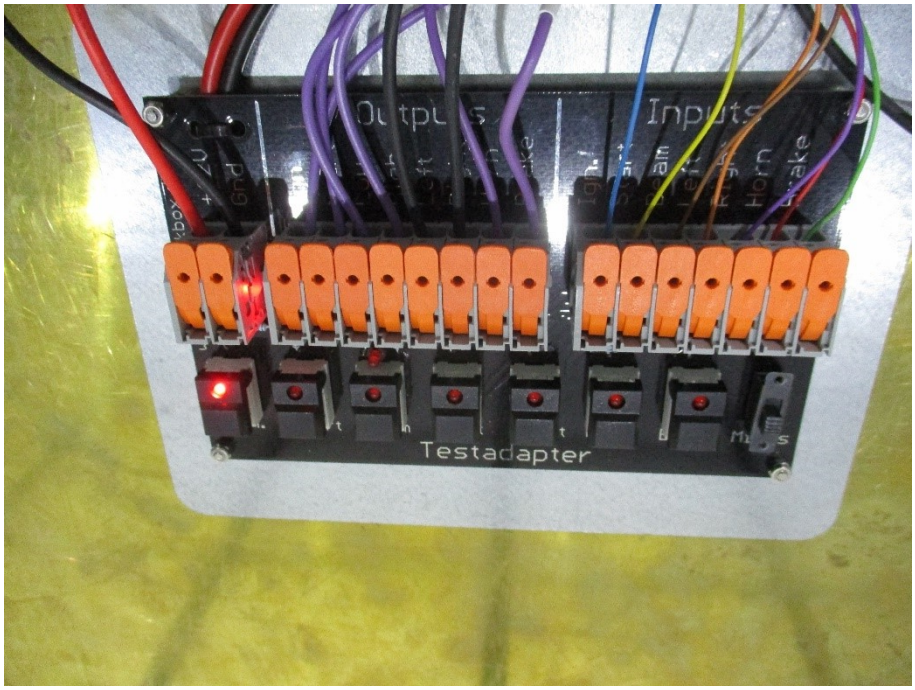


Fig. 4-2: Peripheral equipment, test adapter

4.2 Detailed EUT and Setup Description

The EUT is a control box for motorcycles. It has following features:

- Integrated flasher relay, can be controlled via push-button or with switches
- Output for indicator control available
- 2 inputs for side stand and neutral switch are implemented
- Adjustable blinker reset and blinker position light function (position light)
- An output for the indicator control LED in the speedometer is integrated
- Control of high and low beam via push-button or switch
- Horn control via push-button
- Brake light control
- Control LEDs at the outputs for easier monitoring of the functions

The following table shows the cable configuration used during all tests.

Signal Name	Signal Type	Shielded/ unshielded	Cable length
Power input bundle	12 Vdc	unshielded	1.5 m

Tab. 4-3: Cable configuration

4.3 Operating states

If not otherwise defined the following operating states will be used during tests.

4.3.1 Operating State 1

- EUT is powered by 13.5 Vdc
- Hazard lights on (1 Hz per second) and loaded with a pull-down load of 60 Ω parallel with 33 µF each side

4.4 Test Criteria Operating Behaviour

The operating behaviour of the EUT is observed during and after the test by measuring the output voltage Uout with a multimeter.

The following table shows the allocation of the test criteria or functional status for the standard ISO 11452-1 and ISO 7637-2 to the corresponding operating state of the EUT.

ISO 11452-1 Criteria	ISO 7637-2 Status	Description Operating or Error State
A	-	All functions of a device or system perform as designed during and after exposure to a disturbance. The EUT output voltage must be in the tolerance of ± 12 mV.
B	-	All functions of a device or system perform as designed during exposure; however, one or more of them may go beyond the specified tolerance. All functions return automatically to within normal limits after exposure is removed. Memory functions shall remain class A.
C	-	One or more functions of a device or system do not perform as designed during exposure but return automatically to normal operation after exposure is removed.
-	A	All functions of a device/system perform as designed during and after exposure to disturbance.
-	B	All functions of a device/system perform as designed during exposure. However, one or more of them can go beyond specified tolerance. All functions return automatically to within normal limits after exposure is removed. Memory functions shall remain class A.
-	C	One or more functions of a device/system do not perform as designed during exposure but return automatically to normal operation after exposure is removed.
-	D	One or more functions of a device/system do not perform as designed during exposure and do not return to normal operation until exposure is removed and the device/system is reset by simple “operator/use” action.
-	E	One or more functions of a device/system do not perform as designed during and after exposure and cannot be returned to proper operation without repairing or replacing the device/system.

Tab. 4-4: Test criteria, operating behaviour

5 Test Results

5.1 Radiated Emission Broadband

EUT:	Motorrad - Steuerbox
EUT P/N:	D-Box
EUT S/N:	29739
Operating State:	Operating State 1
Test Engineer:	MeßTechnikNord GmbH, Andrej Klan
Participants:	Joost Elektronik, Axel Joost
Date:	23.11.2023
Test Location:	semi anechoic shielded chamber no. 4
Requirements:	UNECE R10 Rev.6 section 6.5 and attachment 7, 30 MHz – 1 GHz DIN EN 55025
Limit:	UNECE R10 Rev.6 section 6.5.2. ESA broadband type-approval limits
Test Criteria:	Meet required emission level.
Test Results: (refer to Tab. 5-4)	PASSED

5.1.1 Test Equipment

Inventory No.	Test Equipment	Manufacturer	S/N	Next Calibration
30001-00054	EMI Software EMC32	Rohde&Schwarz	V10.60.20	-
20001-06245	EMI Test Receiver 10 Hz - 7 GHz ESR7	Rohde&Schwarz	101176	27.02.2024
20001-09855	LISN 1x 150 A / 5 µH HV-AN 150	TESEQ GmbH	54002	01.07.2025
20001-09770	LISN 1x 150 A / 5 µH HV-AN 150	TESEQ GmbH	49548	15.03.2024
20001-06174	DC Power Supply +-60V / 10 A PA5740/230	TESEQ GmbH	571-0011	---[1])
20001-06257	Biconical Antenna 25 MHz - 300 MHz VHBB9124 + BBA9106	Schwarzbeck	697	29.12.2025
20001-04220	LogPer Antenna 200 MHz - 1 GHz 96005	Eaton Electric GmbH	2312	29.12.2025
20001-09917	13.5x6.5x6.4 m Semi-Anechoic Chamber 4	Comtest	n/a	---[1])
20001-09920	Conductive brass table H=0.8m, B=1.0m, L=3.0m Conductive table	Comtest	n/a	---[1])
[1]): Equipment checked; output data measured/verified with calibrated equipment.				

Tab. 5-1: Test equipment, radiated emission brodband

5.1.2 Measurement Uncertainty

MTN-ID	Description	Expanded Measurement Uncertainty	Standard	Next Review
RE-005 / MU-002	25 MHz - 220 MHz Maximum electric field strength, measured in a semi anechoic shielded chamber with a biconical antenna in vertical and horizontal polarization with 1 m distance from the EUT at the applicable antenna height above a reflecting ground plane	±4.9 dB	DIN EN 55016-4-2	22.08.2024
RE-005 / MU-003	200 MHz - 1 GHz Maximum electric field strength, measured in a semi anechoic shielded chamber with a log.-per. antenna in vertical and horizontal polarization with 1 m distance from the EUT at the applicable antenna height above a reflecting ground plane	±4.7 dB	DIN EN 55016-4-2	15.08.2024

Tab. 5-2: Measurement uncertainty, radiated emission brodband

5.1.3 Test Setup

Fig. 5-1: Radiated emission broadband, biconical antenna, 30 MHz – 200 MHz, horizontal

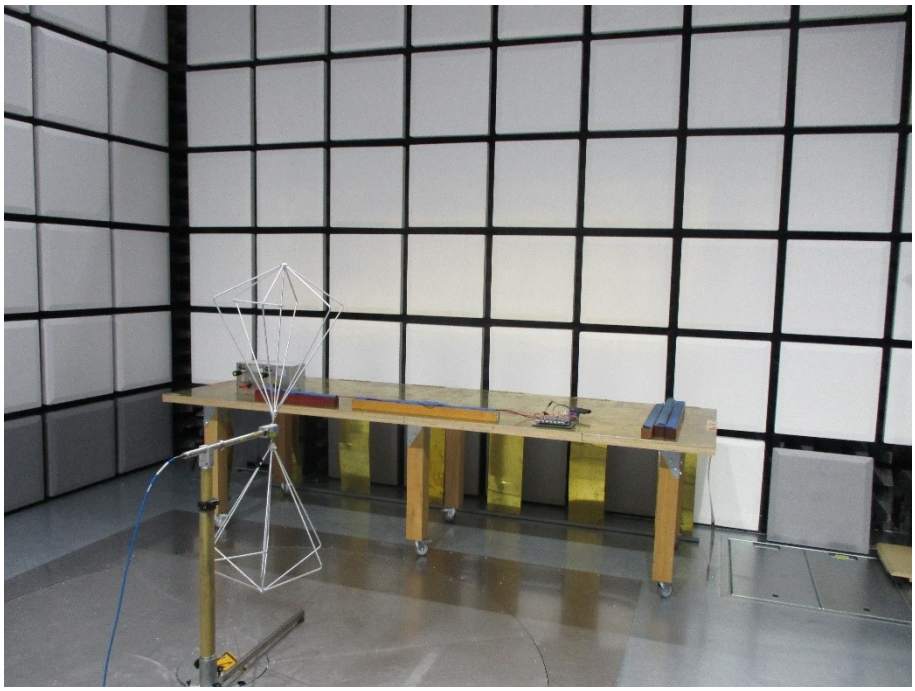


Fig. 5-2: Radiated emission broadband, biconical antenna, 30 MHz – 200 MHz, vertical

Fig. 5-3: Radiated emission broadband, log. -per. antenna, 200 MHz – 1 GHz horizontal

Fig. 5-4: Radiated emission broadband, log. -per antenna, 200 MHz – 1 GHz vertical

5.1.4 Test Parameter

The critical values (minimum 6 dB below applicable limit) are marked in each diagram for each detector and each band.

5.1.5 Scan Table Receiver Settings

Scan Setup: R10_EUB_BB_QP_1m_ESR7 [EMI radiated]

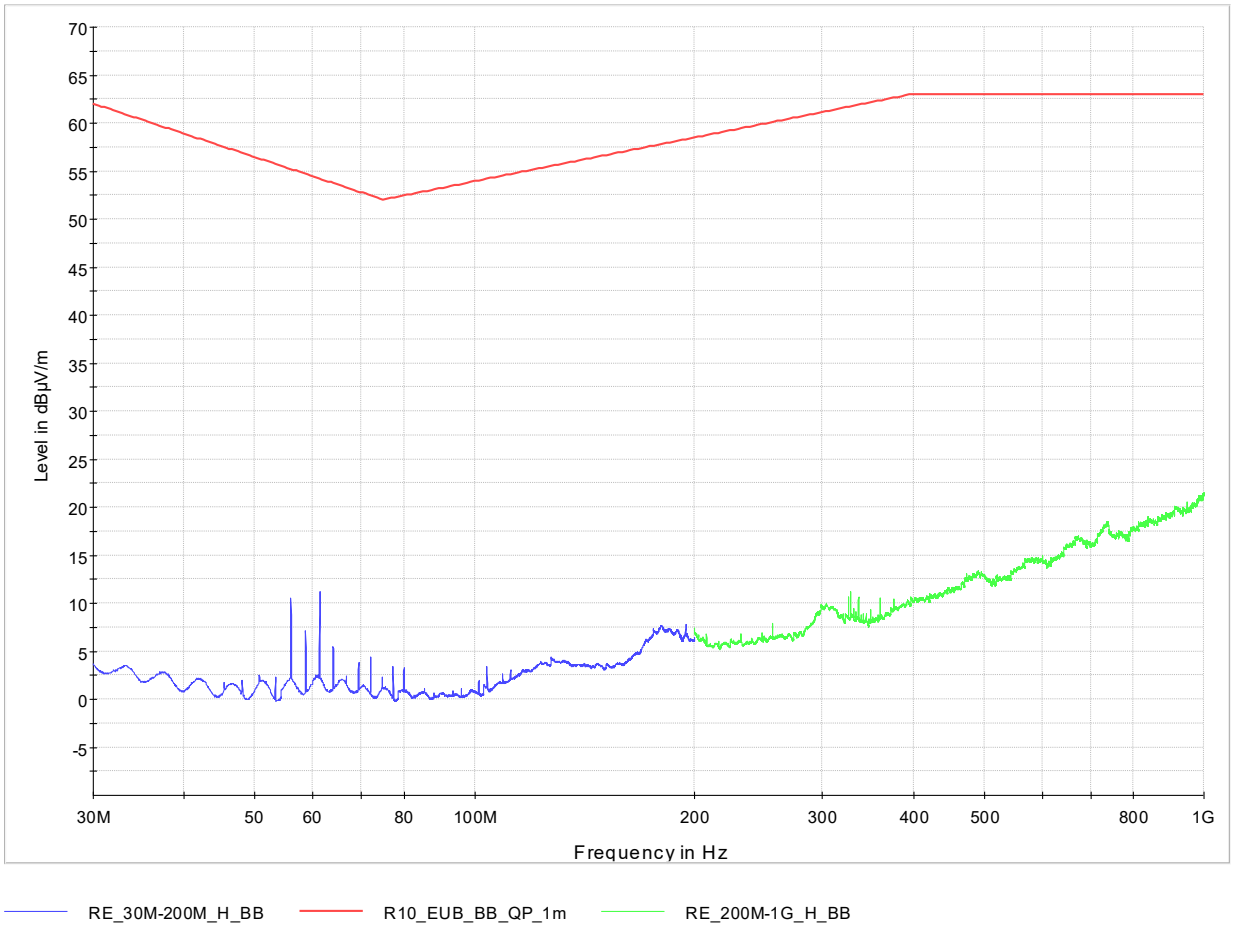
Hardware Setup:	Halle_04_E-Field_ESR7
Receiver:	[ESR 7]
Level Unit:	dBµV/m

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
30 MHz - 200 MHz	30 kHz	QPK	120 kHz	2 s	20 dB
200 MHz - 960 MHz	30 kHz	QPK	120 kHz	2 s	20 dB
960 MHz - 1 GHz	30 kHz	QPK	120 kHz	2 s	20 dB

Tab. 5-3: Receiver settings for final measurement with the QuasiPeak detector, broadband

5.1.6 Results Horizontal Broadband 30 MHz – 1 GHz

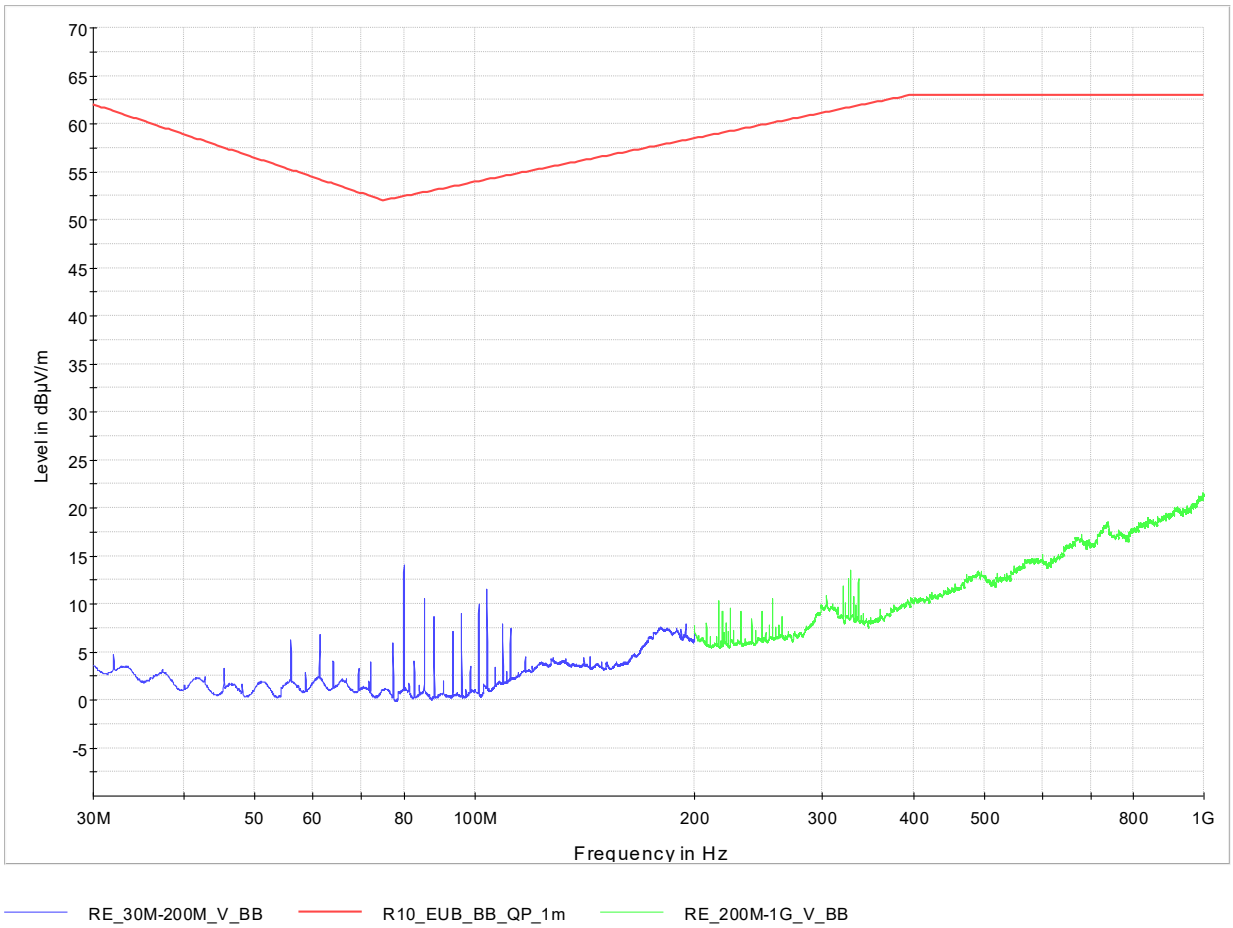
Operating state:	Operating State 1
Measurement point:	antenna position 1 m in front of the EUT, broadband measurements horizontal
Antenna height:	0.9 m
EUT Position:	front of EUT
Remarks:	-



Diag. 5-1: Radiated emission broadband, horizontal

5.1.7 Results Vertical Broadband 30 MHz – 1 GHz

Operating state:	Operating State 1
Measurement point:	antenna position 1 m in front of the EUT, broadband measurements vertical
Antenna height:	0.9 m
EUT Position:	front of EUT
Remarks:	-



Diag. 5-2: Radiated emission broadband, vertical

5.1.8 Result Summary

Operating State	Diagram	Frequency Range	Bandwidth	Polarisation	Remark	Result
Operating State 1	Diag. 5-1	30 MHz – 1 GHz	broadband	horizontal	within ESA broadband type-approval limits	PASSED
	Diag. 5-2	30 MHz – 1 GHz	broadband	vertical	within ESA broadband type-approval limits	PASSED

Tab. 5-4: Result summary, radiated emission broadband

5.2 Radiated Emission Narrowband

EUT:	Motorrad - Steuerbox
EUT P/N:	D-Box
EUT S/N:	29739
Operating State:	Operating State 1
Test Engineer:	MeßTechnikNord GmbH, Andrej Klan
Participants:	Joost Elektronik, Axel Joost
Date:	23.11.2023
Test Location:	semi anechoic shielded chamber no. 4
Requirements:	UNECE R10 Rev.6 section 6.6 and attachment 8, 30 MHz – 1 GHz DIN EN 55025
Limit:	UNECE R10 Rev.6 section 6.6.2. ESA narrowband type-approval limits
Test Criteria:	Meet required emission level.
Test Results: (refer to Tab. 5-4)	PASSED

5.2.1 Test Equipment

Inventory No.	Test Equipment	Manufacturer	S/N	Next Calibration
30001-00054	EMI Software EMC32	Rohde&Schwarz	V10.60.20	-
20001-06245	EMI Test Receiver 10 Hz - 7 GHz ESR7	Rohde&Schwarz	101176	27.02.2024
20001-09855	LISN 1x 150 A / 5 µH HV-AN 150	TESEQ GmbH	54002	01.07.2025
20001-09770	LISN 1x 150 A / 5 µH HV-AN 150	TESEQ GmbH	49548	15.03.2024
20001-06174	DC Power Supply +-60V / 10 A PA5740/230	TESEQ GmbH	571-0011	---[1])
20001-06257	Biconical Antenna 25 MHz - 300 MHz VHBB9124 + BBA9106	Schwarzbeck	697	29.12.2025
20001-04220	LogPer Antenna 200 MHz - 1 GHz 96005	Eaton Electric GmbH	2312	29.12.2025
20001-09917	13.5x6.5x6.4 m Semi-Anechoic Chamber 4	Comtest	n/a	---[1])
20001-09920	Conductive brass table H=0.8m, B=1.0m, L=3.0m Conductive table	Comtest	n/a	---[1])
[1]): Equipment checked; output data measured/verified with calibrated equipment.				

Tab. 5-5: Test equipment, radiated emission narrowband

5.2.2 Measurement Uncertainty

MTN-ID	Description	Expanded Measurement Uncertainty	Standard	Next Review
RE-005 / MU-002	25 MHz - 220 MHz Maximum electric field strength, measured in a semi anechoic shielded chamber with a biconical antenna in vertical and horizontal polarization with 1 m distance from the EUT at the applicable antenna height above a reflecting ground plane	±4.9 dB	DIN EN 55016-4-2	22.08.2024
RE-005 / MU-003	200 MHz - 1 GHz Maximum electric field strength, measured in a semi anechoic shielded chamber with a log.-per. antenna in vertical and horizontal polarization with 1 m distance from the EUT at the applicable antenna height above a reflecting ground plane	±4.7 dB	DIN EN 55016-4-2	15.08.2024

Tab. 5-6: Measurement uncertainty, radiated emission narrowband

5.2.3 Test Setup

For the test setup please refer to 5.1.3

5.2.4 Test Parameter

The critical values (minimum 6 dB below applicable limit) are marked in each diagram for each detector and each band.

5.2.5 Scan Table Receiver Settings

Scan Setup: R10_EUB_NB_AV_1m_ESR7 [EMI radiated]

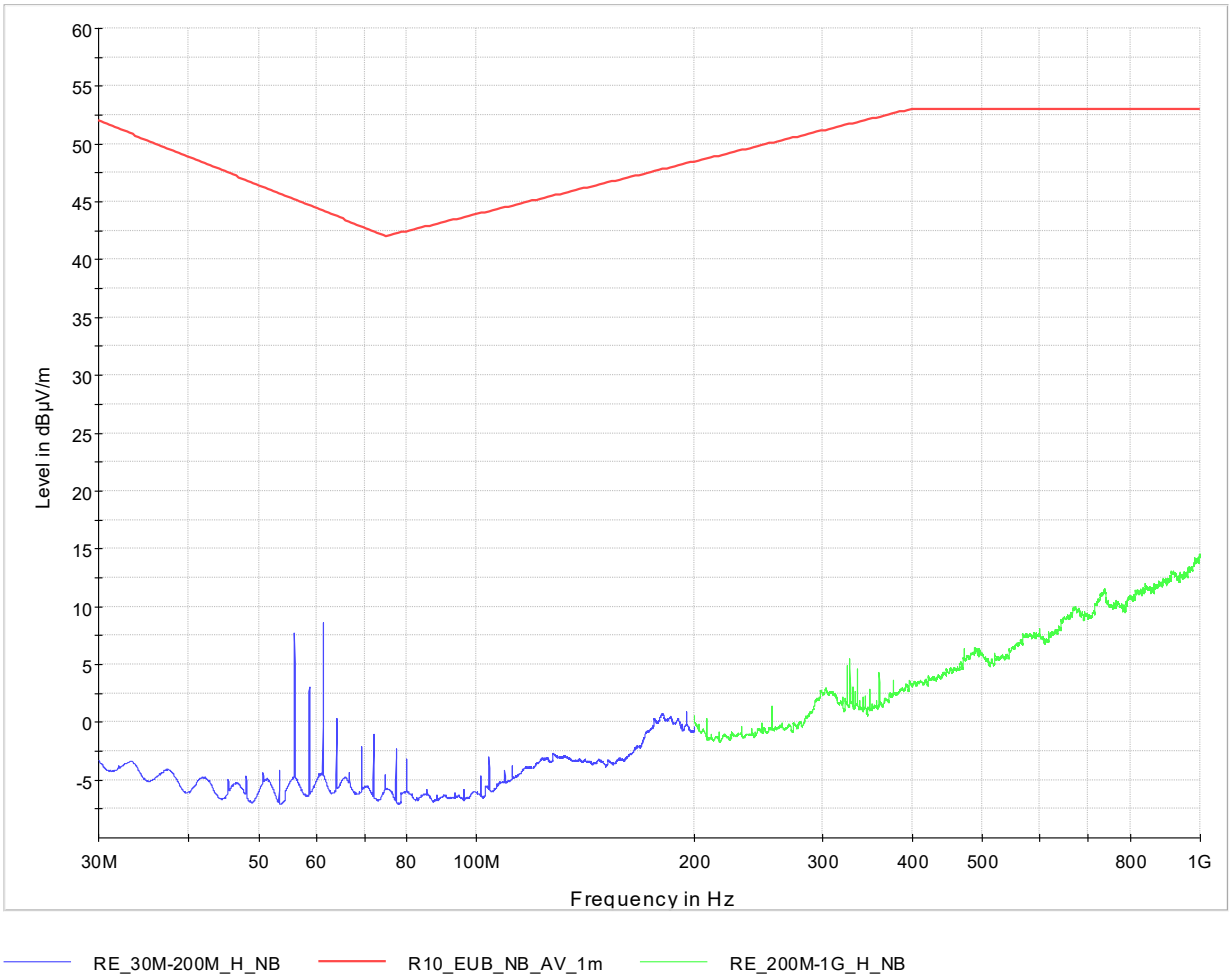
Hardware Setup:	Halle_04_E-Field_ESR7
Receiver:	[ESR 7]
Level Unit:	dBµV/m

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
30 MHz - 200 MHz	30 kHz	CAV	120 kHz	1 s	20 dB
200 MHz - 960 MHz	30 kHz	CAV	120 kHz	1 s	20 dB
960 MHz - 1 GHz	30 kHz	CAV	120 kHz	1 s	20 dB

Tab. 5-7: Receiver settings for final measurement with the Average detector, narrowband

5.2.6 Results Horizontal Narrowband 30 MHz – 1 GHz

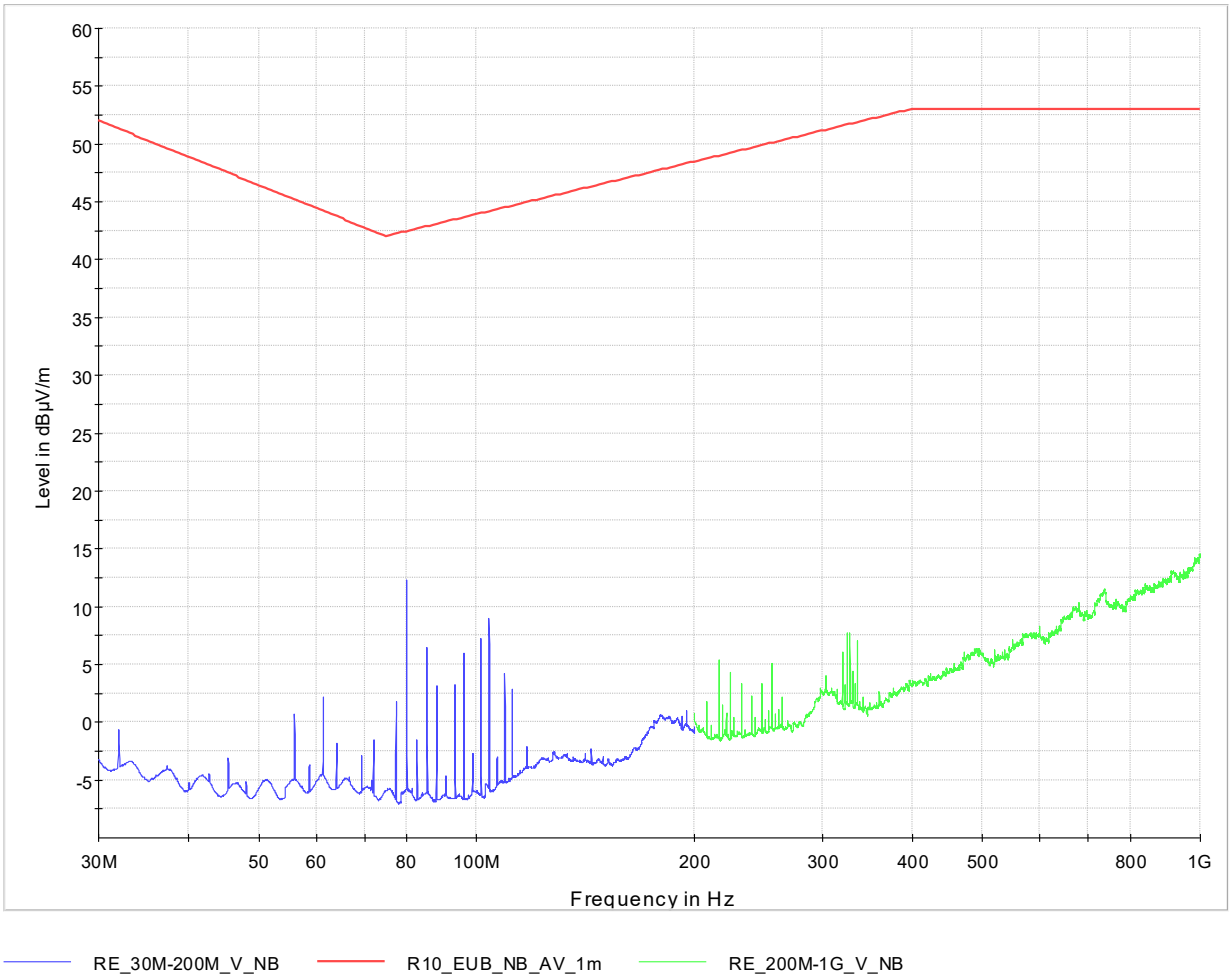
Operating state:	Operating State 1
Measurement point:	antenna position 1 m in front of the EUT, narrowband measurements horizontal
Antenna height:	0.9 m
EUT Position:	front of EUT
Remarks:	-



Diag. 5-3: Radiated emission narrowband, horizontal

5.2.7 Results Vertical Narrowband 30 MHz – 1 GHz

Operating state:	Operating State 1
Measurement point:	antenna position 1 m in front of the EUT, narrowband measurements vertical
Antenna height:	0.9 m
EUT Position:	front of EUT
Remarks:	-



Diag. 5-4: Radiated emission narrowband, vertical

5.2.8 Result Summary

Operating State	Diagram	Frequency Range	Bandwidth	Polarisation	Remark	Result
Operating State 1	Diag. 5-3	30 MHz – 1 GHz	narrowband	horizontal	within ESA narrowband type-approval limits	PASSED
	Diag. 5-4	30 MHz – 1 GHz	narrowband	vertical	within ESA narrowband type-approval limits	PASSED

Tab. 5-8: Result summary, radiated emission narrowband

5.3 Emission Of Transient Conducted Disturbances On 12/24 V Supply Lines

EUT:	Motorrad - Steuerbox			
EUT P/N:	D-Box			
EUT S/N:	29739			
Operating State:	Operating State 1			
Test Engineer:	MeßTechnikNord GmbH, Andrej Klan			
Participants:	Joost Elektronik, Axel Joost			
Date:	23.11.2023			
Test Location:	semi anechoic shielded chamber no. 4			
Requirements:	UNECE R10 Rev.6 section 6.7, table 1 and attachment 10 ISO 7637-2 chapter 4.3			
Measuring Point:	Pulses	Limit in V	Test setup as	Measurement point
	slow (ms)	+75 / -100 (12 V system)	ISO 7637-2, Fig. 1a	System power supply
	fast (ns/µs)	+75 / -100 (12 V system)	ISO 7637-2, Fig. 1b	System power supply
Test Result: ref to Tab. 5-10 and Tab. 5-11	PASSED			

5.3.1 Test Equipment

Inventory No.	Test Equipment	Manufacturer	S/N	Next Calibration
20001-09747	Dual-Output Power Supply TOE 8852-32	TOELLNER	55674	---[1])
20001-10563	True RMS OLED Multimeter U1253B	Keysight Technologies	MY55490001	06.03.2024
20001-09769	LISN 1x 150 A / 5 µH HV-AN 150	TESEQ GmbH	49196	15.03.2024
20001-09770	LISN 1x 150 A / 5 µH HV-AN 150	TESEQ GmbH	49548	15.03.2024
20001-09837	Electronic Switch ES35/300V3S	SBF electronic	2019ES01V03S	---[1])
20001-09757	4 ch Oscilloscope 1 GHz, 2.5 GS/s HDO 6104	LeCroy	LCRY3561N18170	02.02.2024
20001-06216	Voltage Probe 10x PPO11	LeCroy	001	03.05.2024
[1]): Equipment checked; output data measured/verified with calibrated equipment.				

Tab. 5-9: Test equipment, emission of transient conducted disturbances

5.3.2 Test Setup

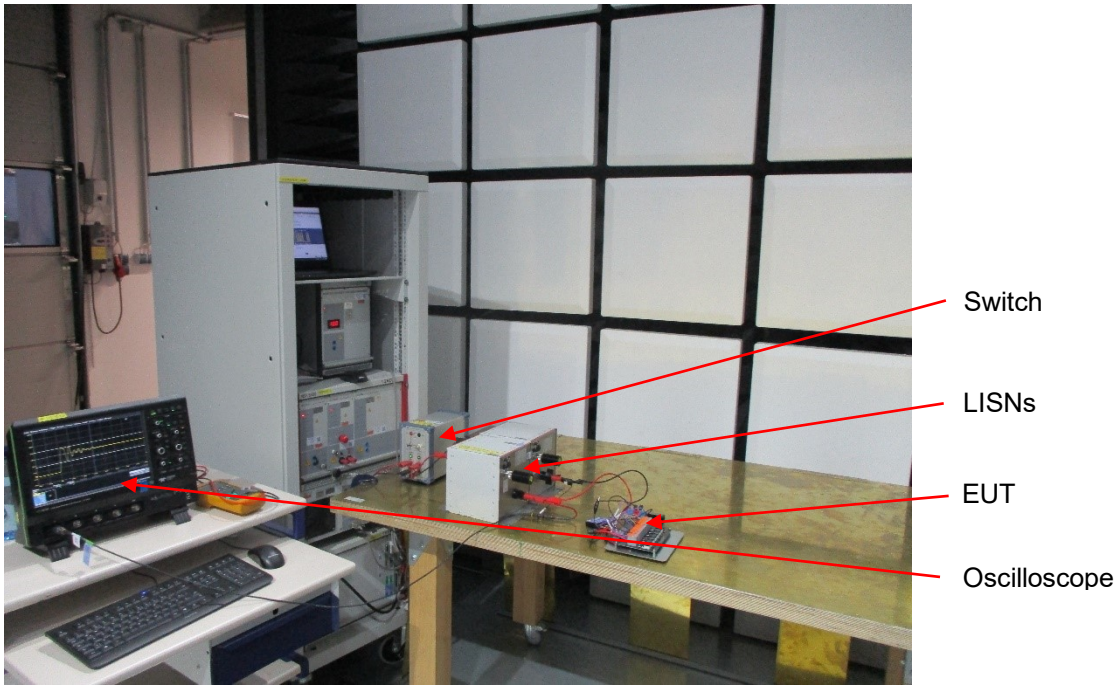


Fig. 5-5: Emission of transient conducted disturbances, slow pulses, test setup overview

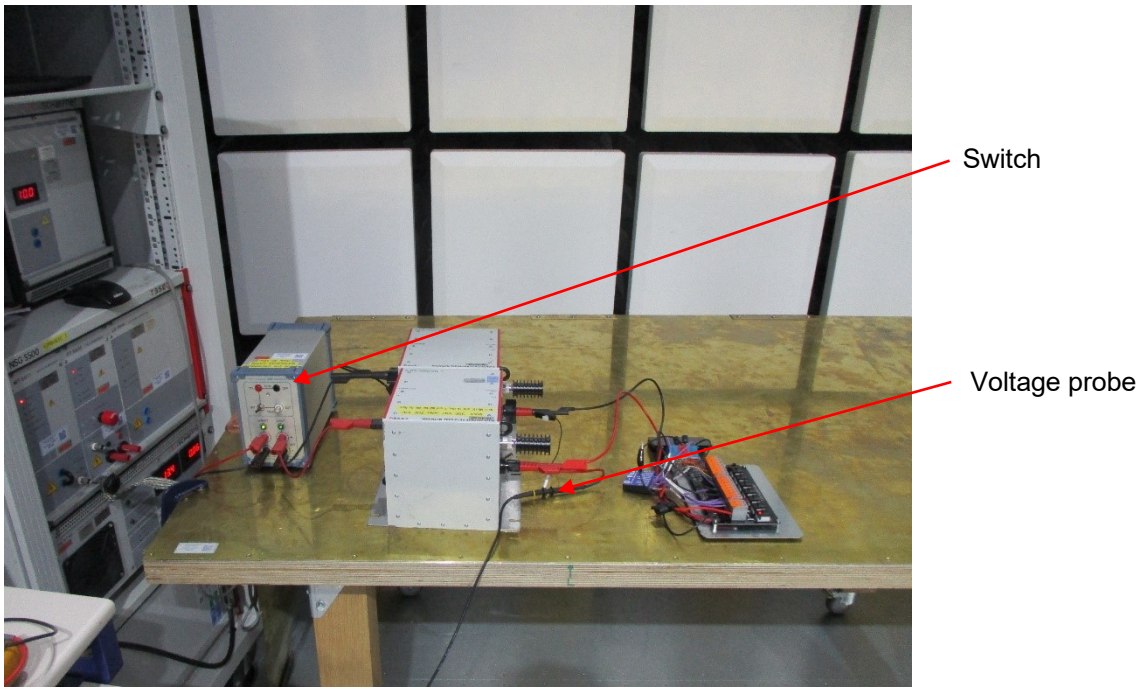


Fig. 5-6: Emission of transient conducted disturbances, slow pulses, detailed view

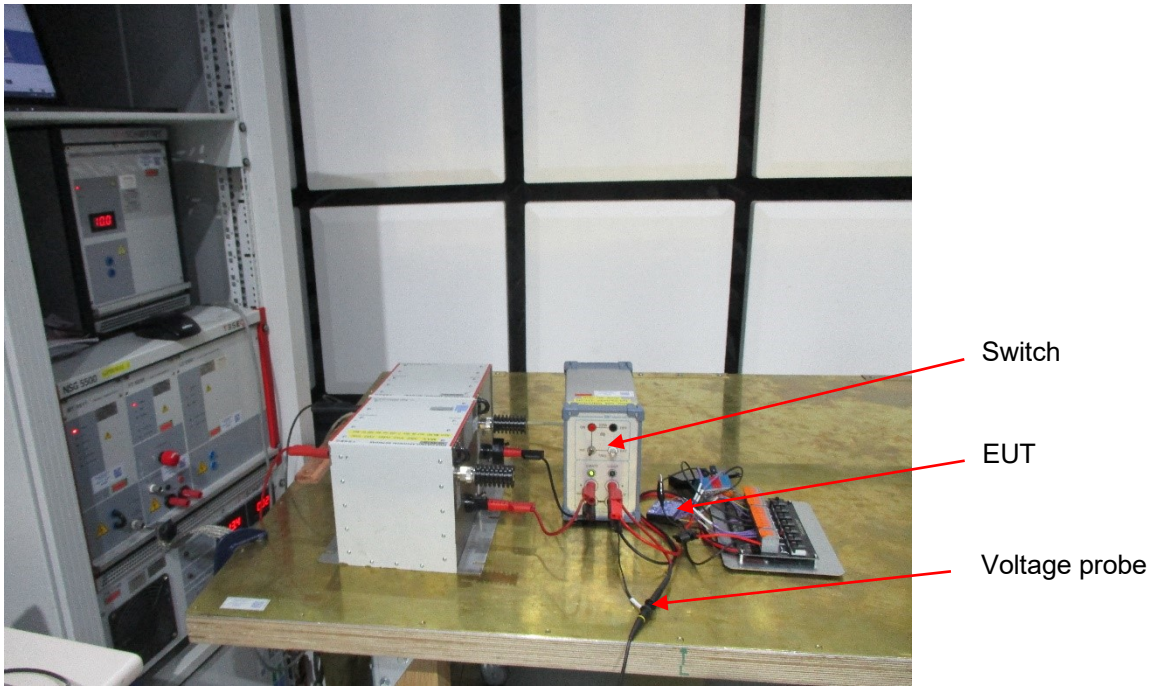
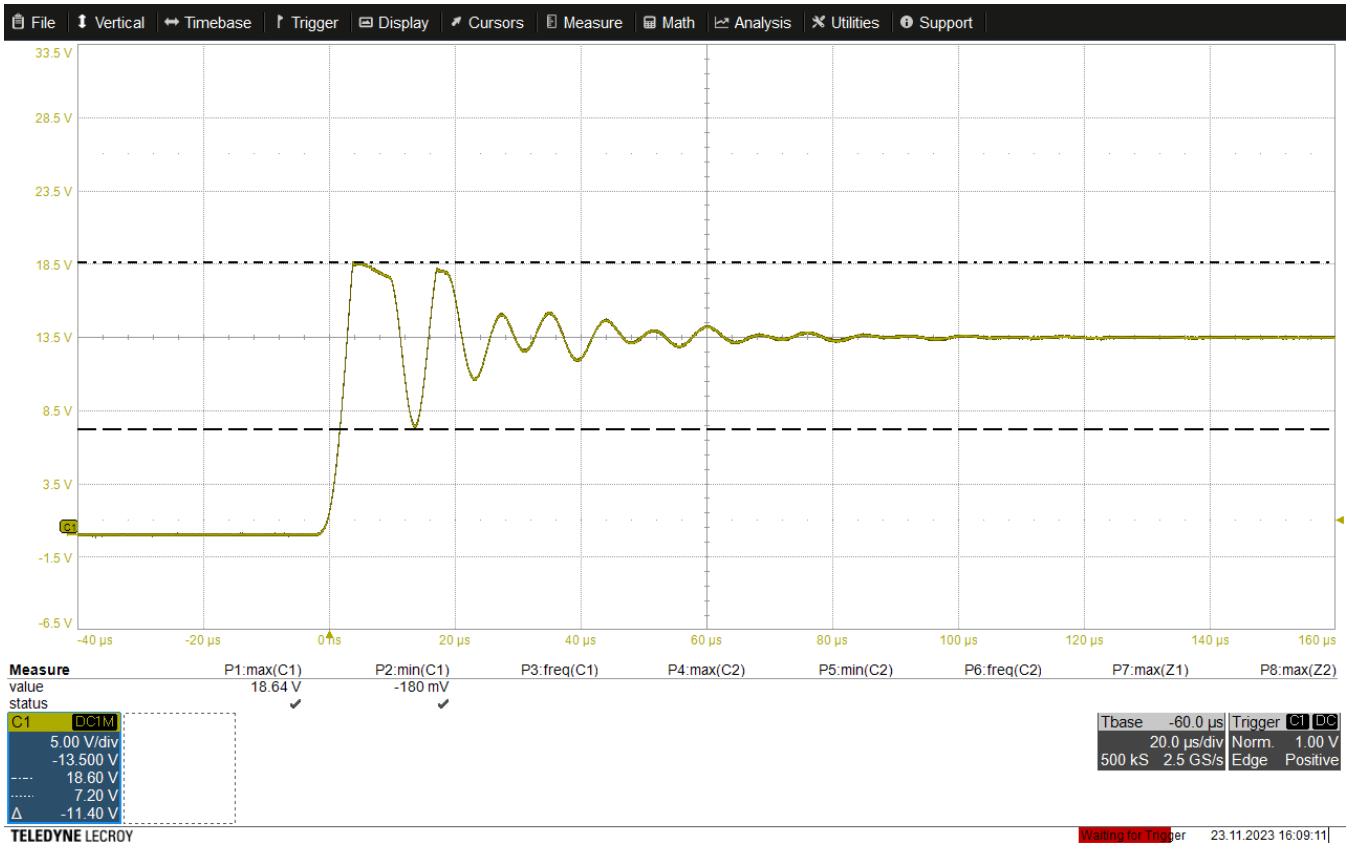
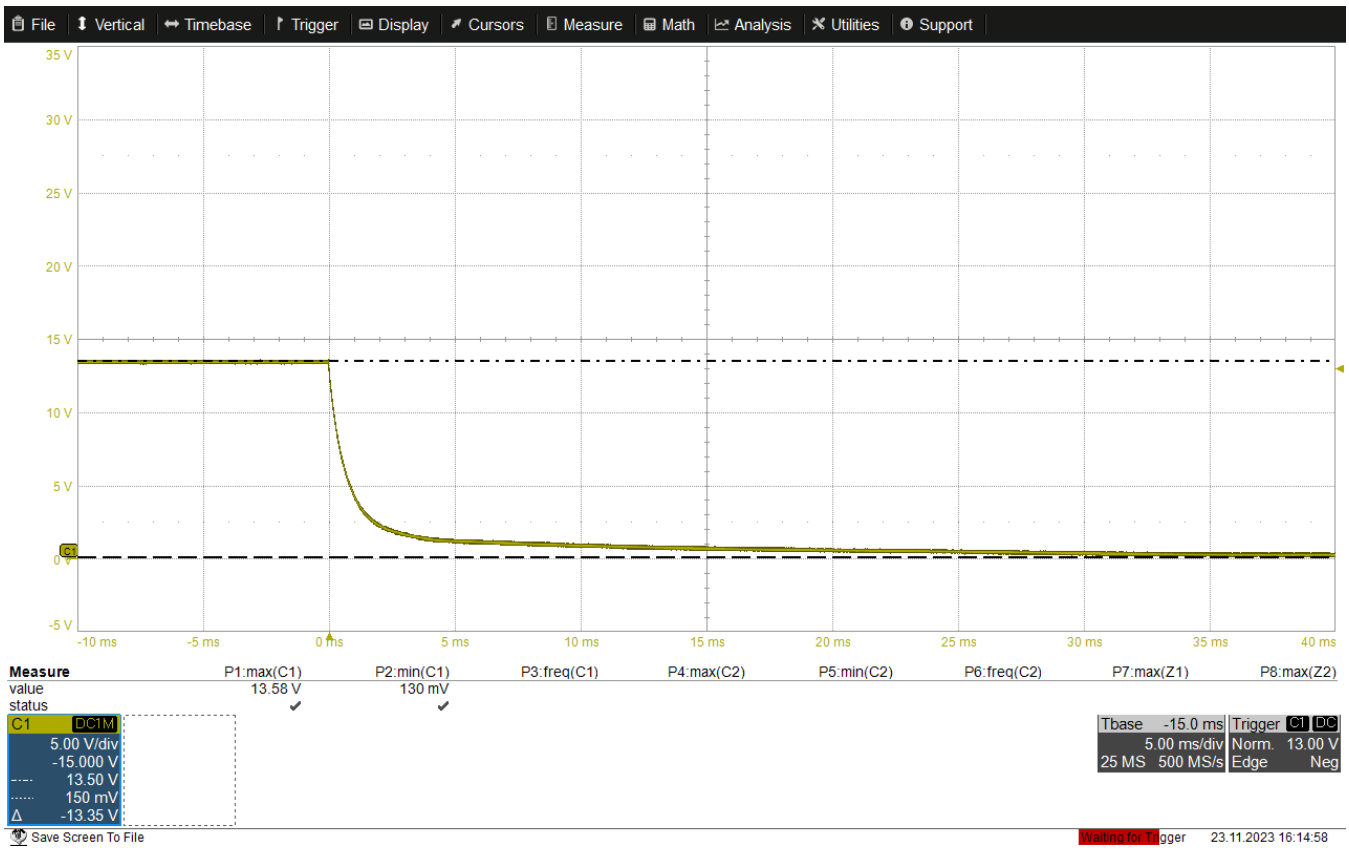


Fig. 5-7: Emission of transient conducted disturbances, fast pulses, detailed view

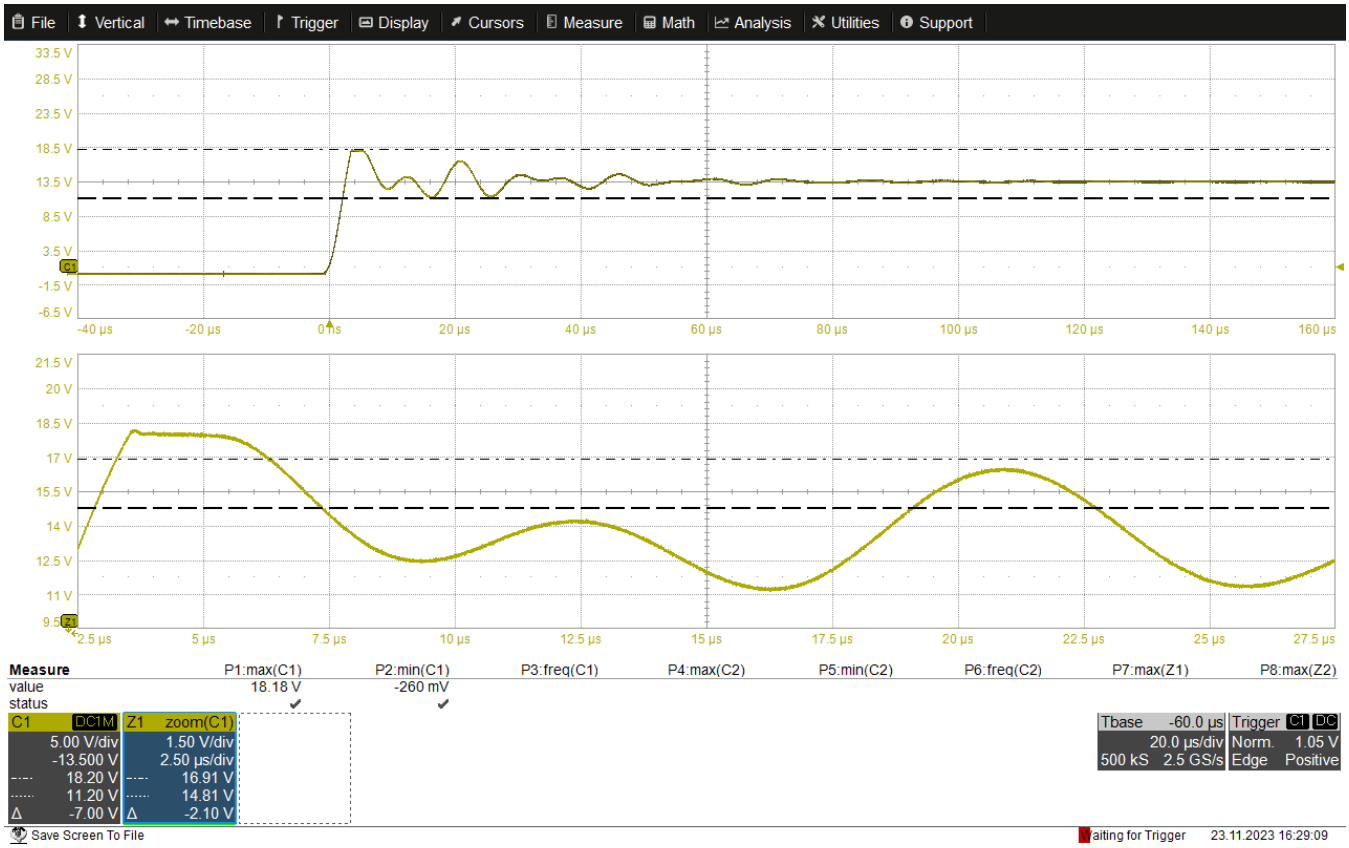
5.3.3 Results



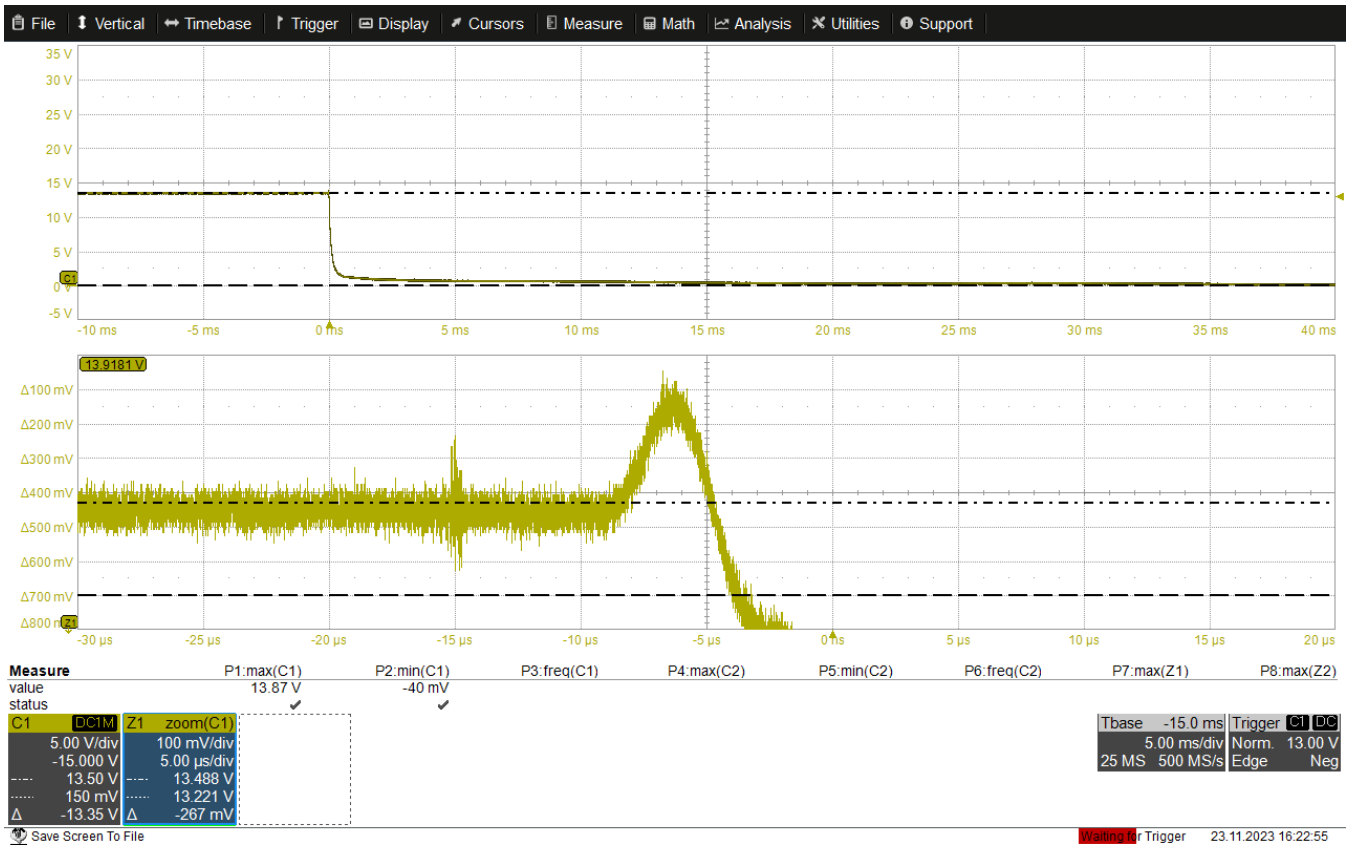
Diag. 5-5: Emission of transient conducted disturbances, slow switch on



Diag. 5-6: Emission of transient conducted disturbances, slow switch off



Diag. 5-7: Emission of transient conducted disturbances, fast switch on



Diag. 5-8: Emission of transient conducted disturbances, fast switch off

5.3.4 Result Summary

Limit value	Measured value			
	Slow switch on	Slow switch off	Fast switch on	Fast switch off
+75 V	5.14 V	-	4.66 V	-
-100 V	-	-	-	-

Tab. 5-10: Measurement results, emission of transient conducted disturbances

Operating state	Pulse	Limit value	Diagram	Remarks	Result
1	slow switch on	+75 V / -100 V	Diag. 5-5	within limit	PASSED
					PASSED
	slow switch off	+75 V / -100 V	Diag. 5-6	within limit	PASSED
					PASSED
	fast switch on	+75 V / -100 V	Diag. 5-7	within limit	PASSED
					PASSED
	fast switch off	+75 V / -100 V	Diag. 5-8	within limit	PASSED
					PASSED

Tab. 5-11: Result summary, emission of transient conducted disturbances

5.4 Immunity To Electromagnetic Radiation – Absorber Chamber Test

EUT:	Motorrad - Steuerbox				
EUT P/N:	D-Box				
EUT S/N:	29739				
Operating State:	Operating State 1				
Test Engineer:	MeßTechnikNord GmbH, Andrej Klan				
Participants:	Joost Elektronik, Axel Joost				
Date:	23.11.2023				
Test Location:	semi anechoic shielded chamber no. 4				
Requirements:	UNECE R10 Rev.6 section 6.8 and attachment 9 ISO 11452-2 chapter 4 to 8 Antenna polarization only vertical				
Limit:	Frequency Range	Modulation	Test Level	Frequency Step	Time Step
	20 MHz – 400 MHz	AM (1 kHz, 80%)	30 V/m	5 %	1.00 s
	400 MHz – 800 MHz	AM (1 kHz, 80%)	30 V/m	2 %	1.00 s
	800 MHz – 2 GHz	PM (217 Hz, 577 µs)	30 V/m	2 %	1.00 s
Test Criteria:	refer to chapter 4.4 and the allocation for the standard ISO 11452-1				
Test Results: (refer to Tab. 5-14)	PASSED				

5.4.1 Test Equipment

Inventory No.	Test Equipment	Manufacturer	S/N	Next Calibration
30001-00054	EMI Software EMC32	Rohde&Schwarz	V10.60.20	-
20001-09747	Dual-Output Power Supply TOE 8852-32	TOELLNER	55674	---[1])
20001-09769	LISN 1x 150 A / 5 µH HV-AN 150	TESEQ GmbH	49196	15.03.2024
20001-09770	LISN 1x 150 A / 5 µH HV-AN 150	TESEQ GmbH	49548	15.03.2024
20001-01565	Biconical Antenna 20 MHz - 200 MHz VHBD9134	Schwarzbeck	9134-022	---[1])
20001-04221	Bilog Antenna 80 MHz - 1 GHz 96005 mod.	Eaton Electric GmbH	2311	---[1])
20001-06212	Horn Antenna 400 MHz - 8 GHz BBHA 9120E	Schwarzbeck	9120E503	06.05.2024
20001-06089	Amplifier 800 MHz - 4.5 GHz / 60 W 50S1G4A 50W	Amplifier Research	308050	---[1])
20001-00676	Directional Coupler 800 MHz - 4.2 GHz DC7144M1	Amplifier Research	308037	18.08.2026
20001-06182	Power Sensor 50 MHz - 18 GHz NRP-Z81	Rohde&Schwarz	100117	27.02.2024
20001-06275	Amplifier 80 MHz - 1 GHz / 1000 W 1000W1000E (with int. DC)	Amplifier Research	0579971	---[1])
20001-06231	Directional Coupler 80 MHz - 1 GHz BDC 0810-50/1500	BONN Elektronik GmbH	129105	04.04.2025
20001-09886	Power Amplifier 9 kHz - 220 MHz / 3 kW BSA 0122-3000	BONN Elektronik GmbH	2027414	---[1])
20001-06232	Directional Coupler 9 kHz - 250 MHz BDC 0125-50/2000	BONN Elektronik GmbH	129105	23.12.2024
20001-04211	Power Sensor 9 kHz - 3.3 GHz URV5-Z2	Rohde&Schwarz	833196/002	17.01.2024
20001-04212	Power Sensor 9 kHz - 3.3 GHz URV5-Z2	Rohde&Schwarz	893432/0048	24.01.2024
20001-09765	Signal Generator 100 kHz - 12.75 GHz SMB100A03	Rohde&Schwarz	177570	24.03.2026
20001-04717	Dual Power Meter DC - 40 GHz NRVD	Rohde&Schwarz	100237	14.06.2024
20001-09917	13.5x6.5x6.4 m Semi-Anechoic Chamber 4	Comtest	n/a	---[1])
20001-09920	Conductive brass table H=0.8m, B=1.0m, L=3.0m Conductive table	Comtest	n/a	---[1])
[1]): Equipment checked; output data measured/verified with calibrated equipment.				

Tab. 5-12: Test equipment, immunity absorber chamber test

5.4.2 Measurement Uncertainty

MTN-ID	Description	Expanded Measurement Uncertainty	Standard	Next Review
RS-006 / MU-002	10 MHz - 9.25 GHz Radiated susceptibility to electromagnetic field Test level adjustment for substitution method	±2.8 dB	DIN EN 61000-1-6 DIN EN 61000-4-3	22.08.2024
RS-006 / MU-005	10 MHz - 9.25 GHz Radiated susceptibility to electromagnetic field Testing by substitution method	±3.2 dB	DIN EN 61000-1-6 DIN EN 61000-4-3	22.08.2024

Tab. 5-13: Measurement uncertainty, immunity absorber chamber test

5.4.3 Test Setup

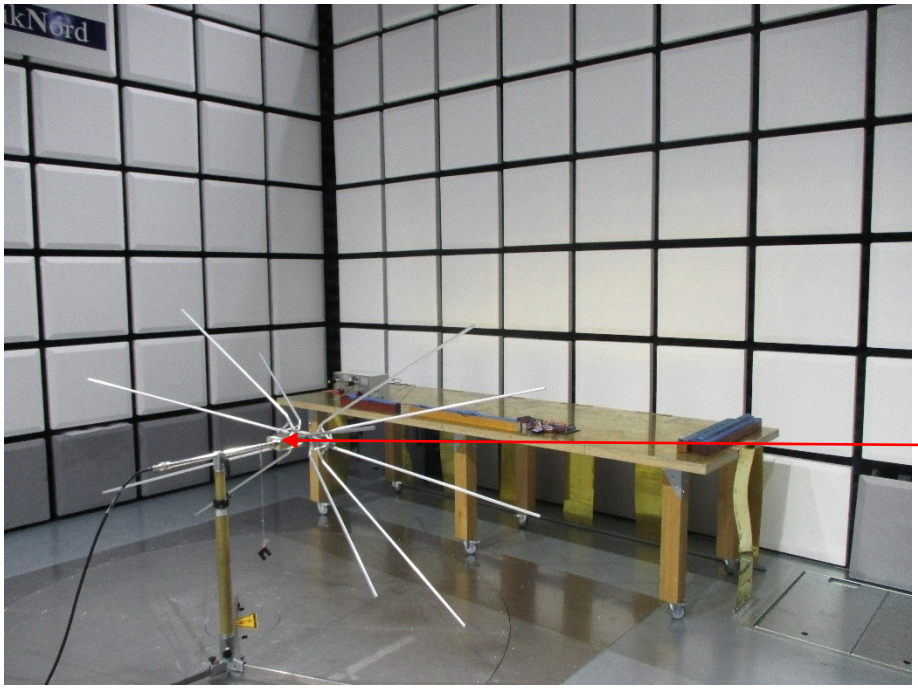


Fig. 5-8: Immunity absorber chamber test, 20 MHz – 200 MHz, horizontal

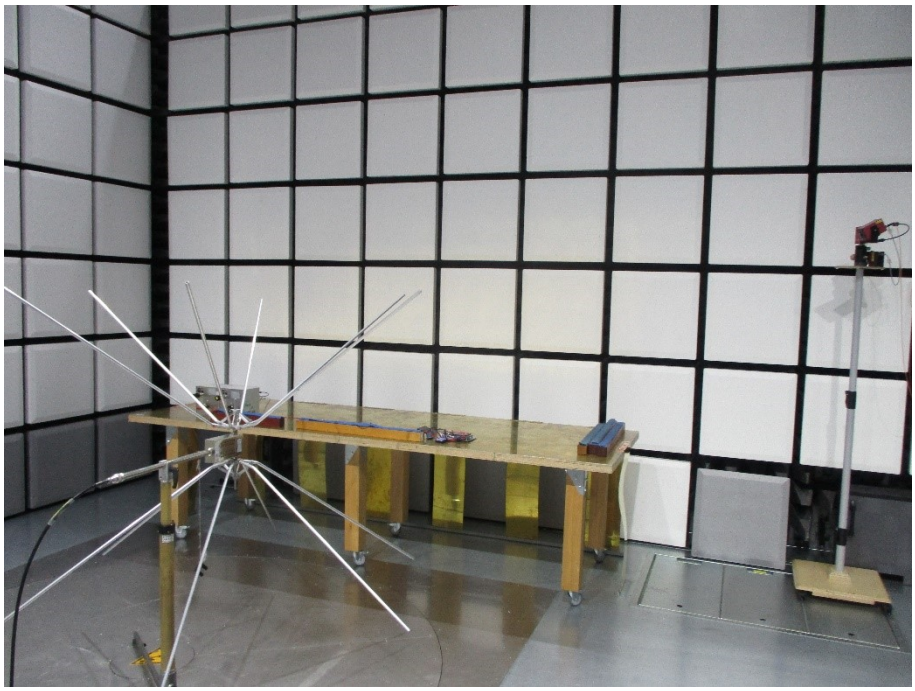


Fig. 5-9: Immunity absorber chamber test, 20 MHz – 200 MHz, vertical

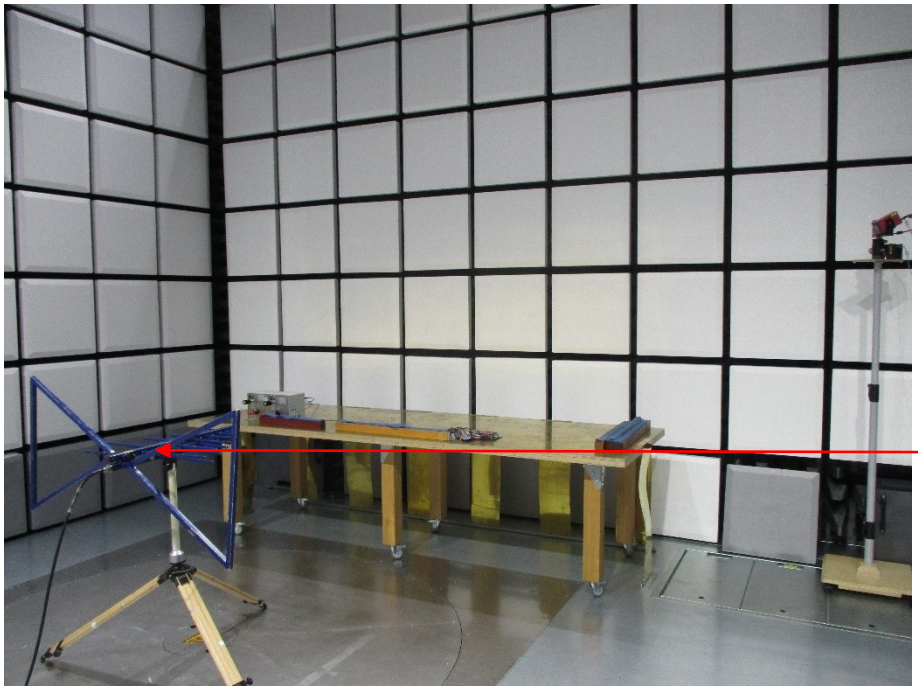


Fig. 5-10: Immunity absorber chamber test, 200 MHz – 1 GHz, horizontal

Fig. 5-11: Immunity absorber chamber test, 200 MHz – 1 GHz, vertical

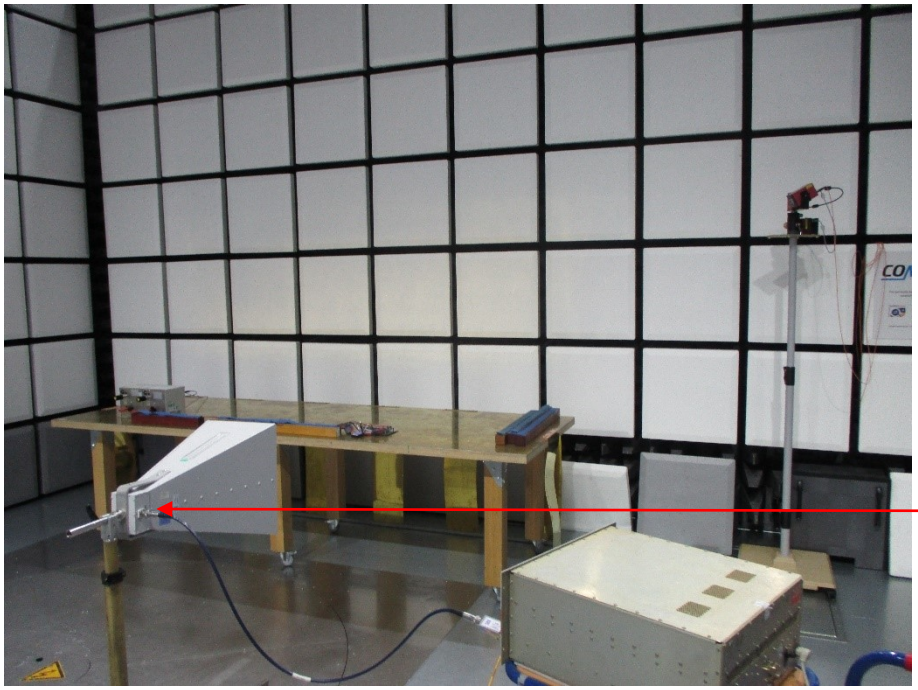


Fig. 5-12: Immunity absorber chamber test, 1 GHz – 2 GHz, horizontal

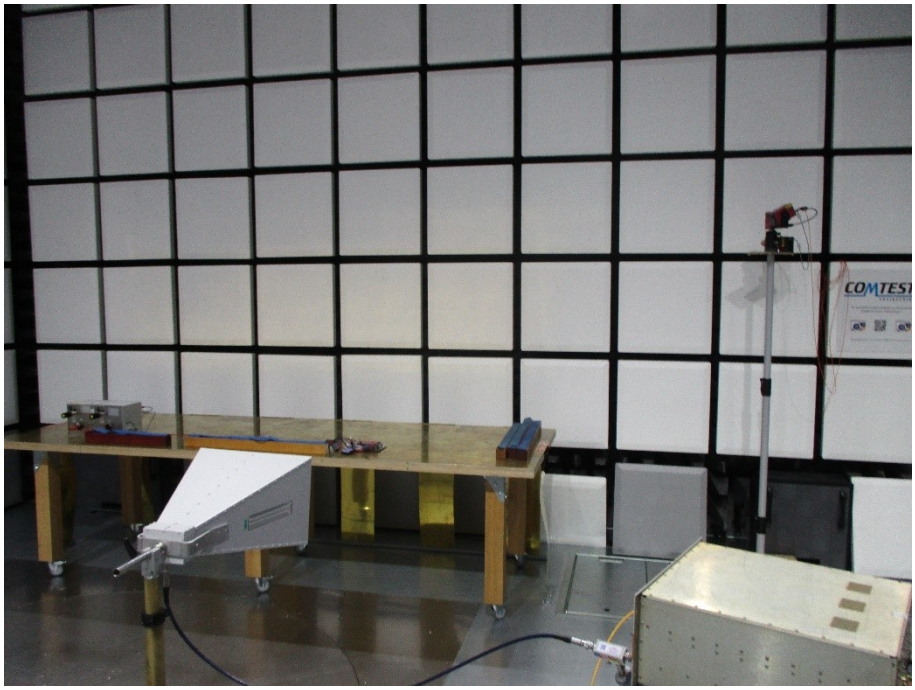
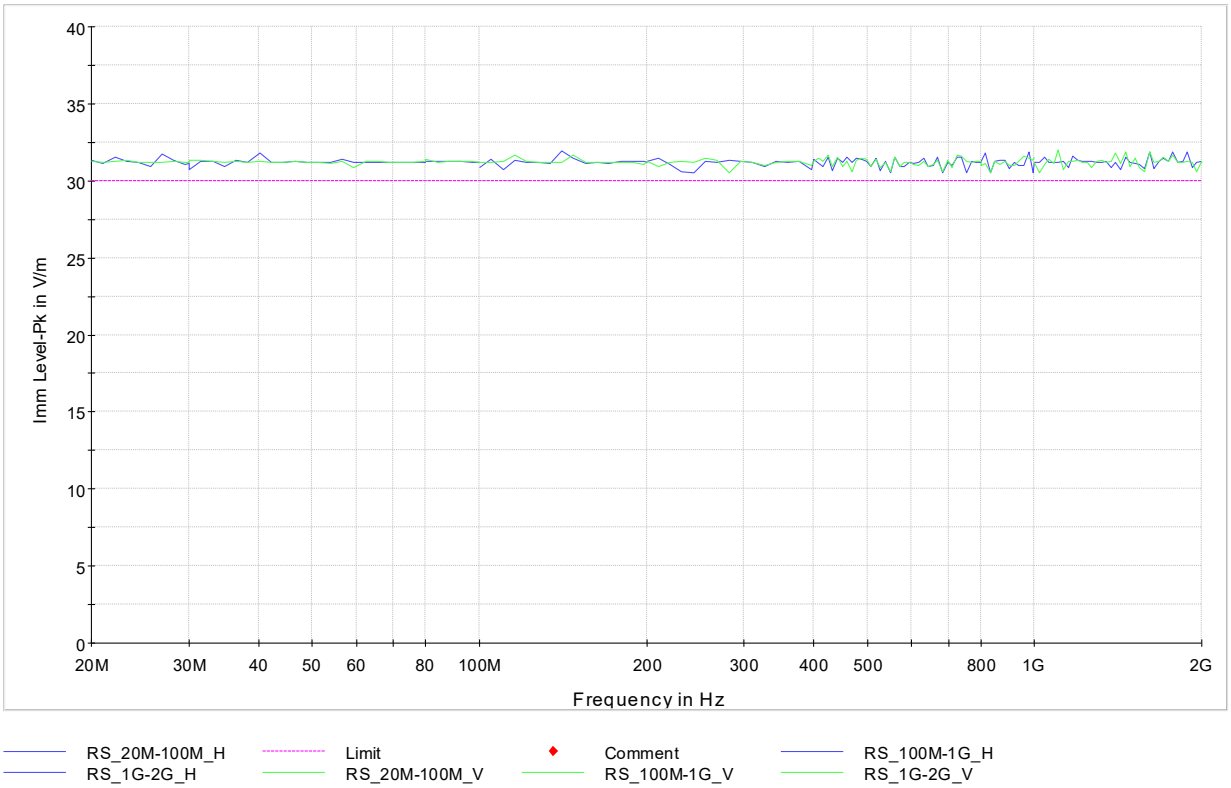
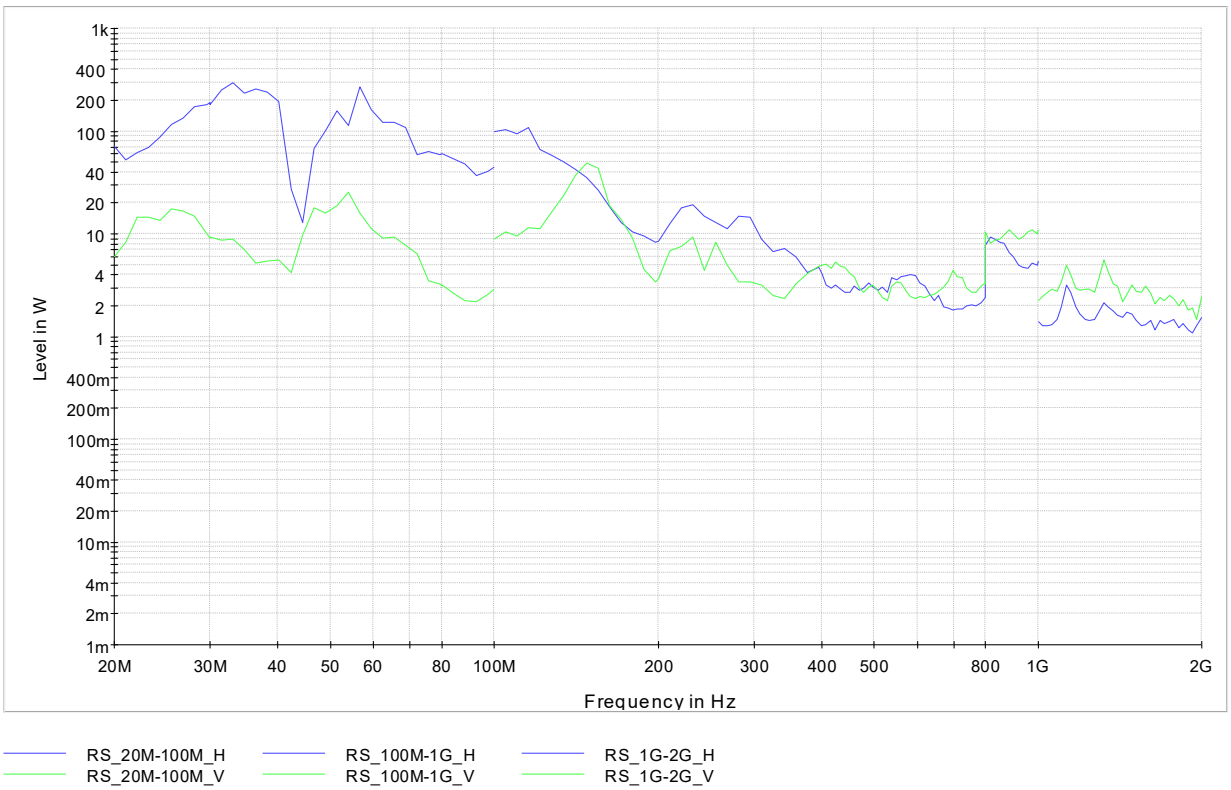


Fig. 5-13: Immunity absorber chamber test, 1 GHz – 2 GHz, vertical

5.4.4 Results



Diag. 5-9: RS field strength, vertical, AM 20 MHz – 800 MHz, PM 800 MHz – 2 GHz



Diag. 5-10: RS forward power, vertical, AM 20 MHz – 800 MHz, PM 800 MHz – 2 GHz

5.4.5 Result Summary

Operating State	Diagram	Frequency	Modulation	Polarization	Remark	Result
Operating State 1	Diag. 5-9 Diag. 5-10	20 MHz – 800 MHz	AM	horizontal	no recognizable effect	PASSED
	Diag. 5-9 Diag. 5-10	20 MHz – 800 MHz	AM	vertical	no recognizable effect	PASSED
	Diag. 5-9 Diag. 5-10	800 MHz – 2 GHz	PM	horizontal	no recognizable effect	PASSED
	Diag. 5-9 Diag. 5-10	800 MHz – 2 GHz	PM	vertical	no recognizable effect	PASSED

Tab. 5-14: Result summary, immunity absorber chamber test

5.5 Immunity To Transient Disturbances Conducted Along 12/24 V Supply Lines

EUT:	Motorrad - Steuerbox					
EUT P/N:	D-Box					
EUT S/N:	29739					
Operating State:	Operating State 1					
Test Engineer:	MeßTechnikNord GmbH, Andrej Klan					
Participants:	Joost Elektronik, Axel Joost					
Date:	24.11.2023					
Test Location:	semi anechoic shielded chamber no. 4					
Requirements:	UNECE R10 Rev.6 section 6.9 and attachment 10 ISO 7637-2, Test Level III					
Test Level:	Pulse	Immunity Test Level	Functional Status	Voltage Level	Duration	Repetition Rate
	1	III	C	-75 V	5000 pulses	0.5 s
	2a	III	B	+37 V	5000 pulses	0.2 s
	2b	III	C	+10 V	10 pulses	2 s (with td = 0.2 s)
	3a	III	A	-112 V	60 min	90 ms
	3b	III	A	+75 V	60 min	90 ms
	4	III	C	+6 V / +9.5 V	1 pulse	-
Test Criteria:	refer to chapter 4.4 and the allocation for the standard ISO 7637-2					
Test Result: ref to Tab. 5-16	PASSED					

5.5.1 Test Equipment

Inventory No.	Test Equipment	Manufacturer	S/N	Next Calibration
30001-00051	Autostar	TESEQ	V 6.2.2	-
20001-06173	Puls Generator / ISO Output Resistance Unit INA5025	TESEQ GmbH	1120	---[1])
20001-06174	DC Power Supply +-60V / 10 A PA5740/230	TESEQ GmbH	571-0011	---[1])
20001-06164	Puls Generator / ISO Fast Transients, Coupling NW FT5530 & CDN 5500	TESEQ GmbH	1204/1202	---[1])
20001-06165	Puls Generator / ISO Micro Transients MT5511	TESEQ GmbH	1204/1202	---[1])
20001-06167	Signal Generator DC - 320 kHz FG5620	TESEQ GmbH	1202/1212	08.03.2024
20001-09757	4 ch Oscilloscope 1 GHz, 2.5 GS/s HDO 6104	LeCroy	LCRY3561N18170	02.02.2024
20001-06216	Voltage Probe 10x PPO11	LeCroy	001	03.05.2024
[1]): Equipment checked; output data measured/verified with calibrated equipment.				

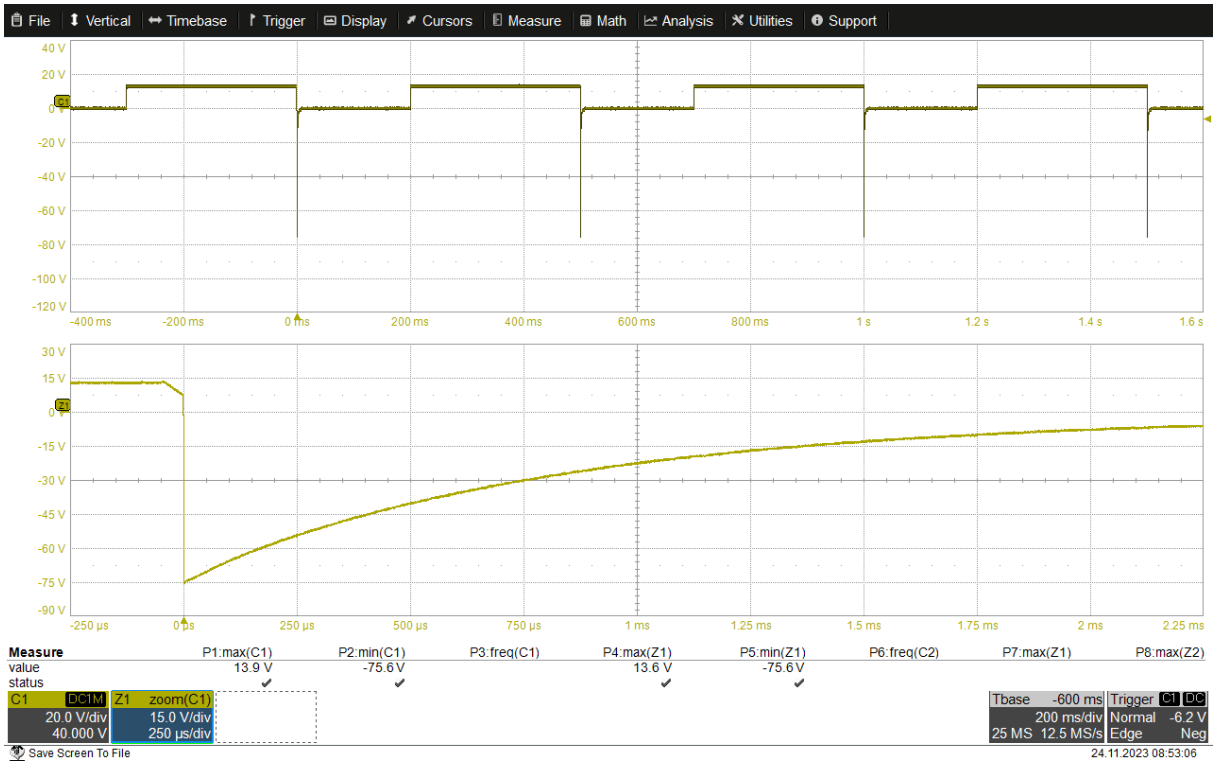
Tab. 5-15: Test equipment, immunity to transient disturbances

5.5.2 Test Setup

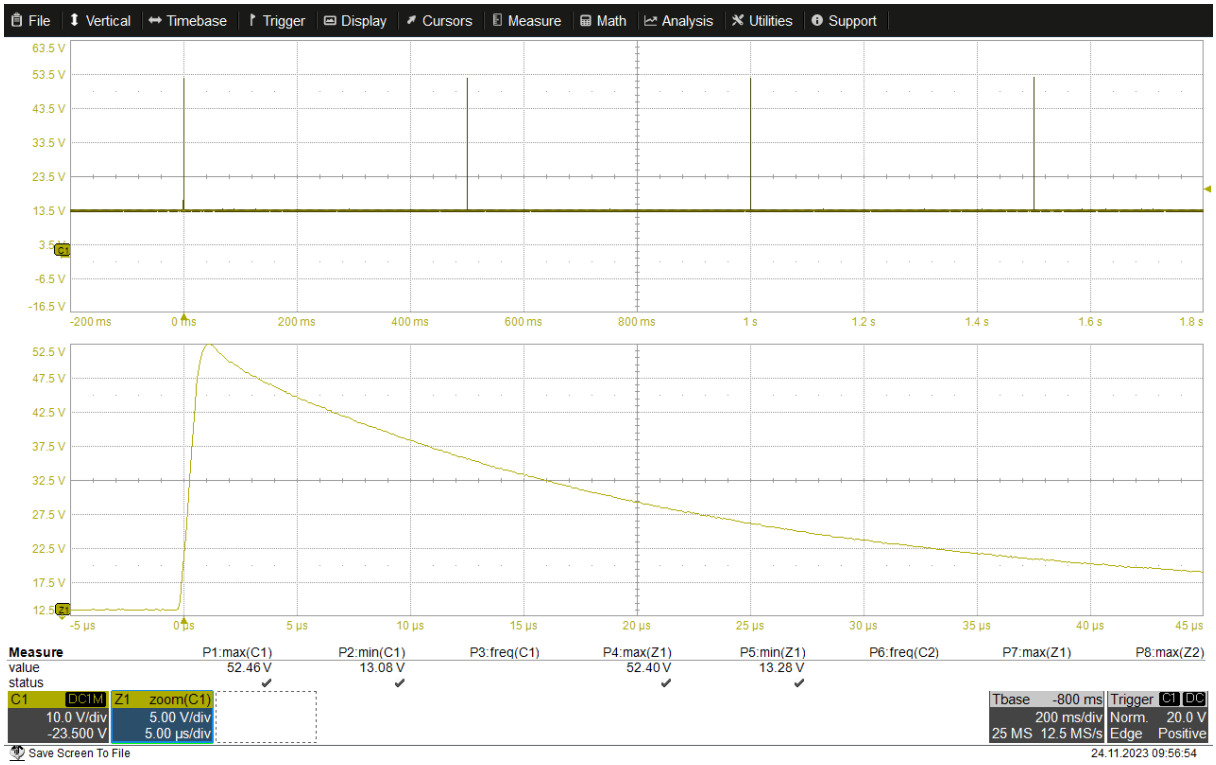
Fig. 5-14: Immunity to transient disturbances test setup

5.5.3 Results

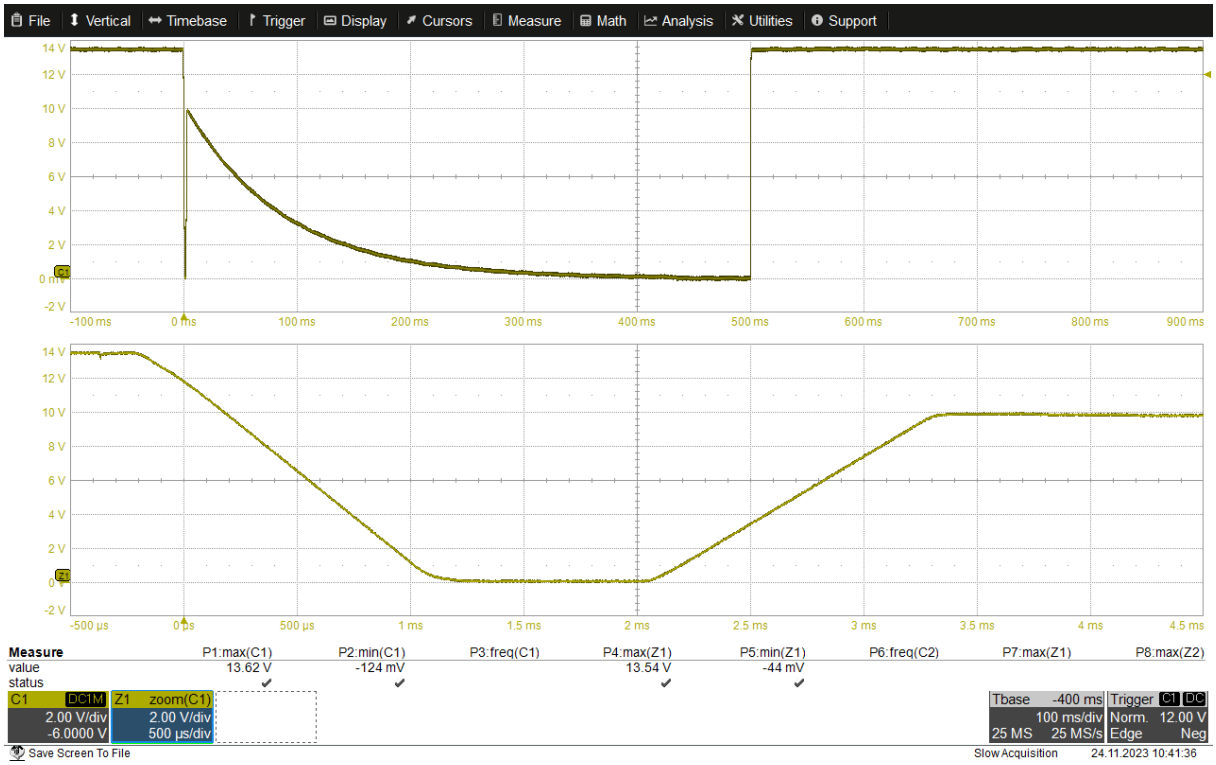
The following figures shows the open circuit test pulses.



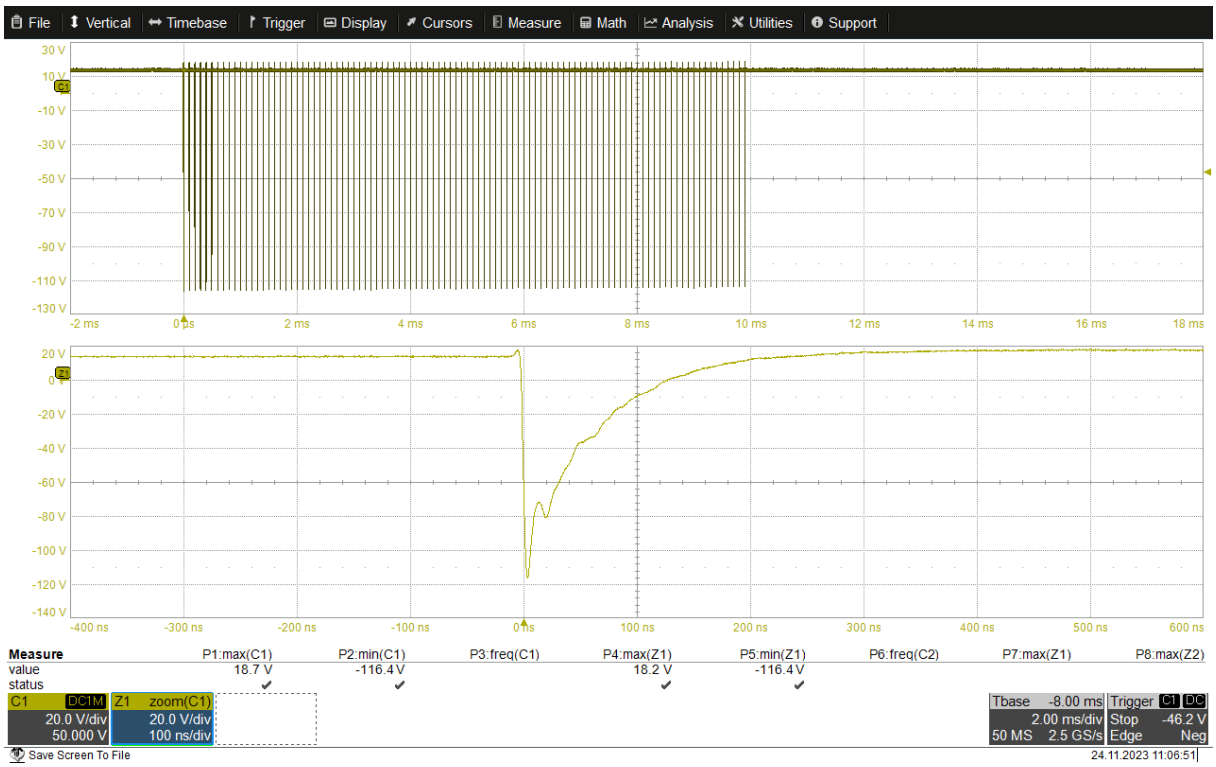
Diag. 5-11: Transient immunity test, test pulse 1, t = 200 ms/div



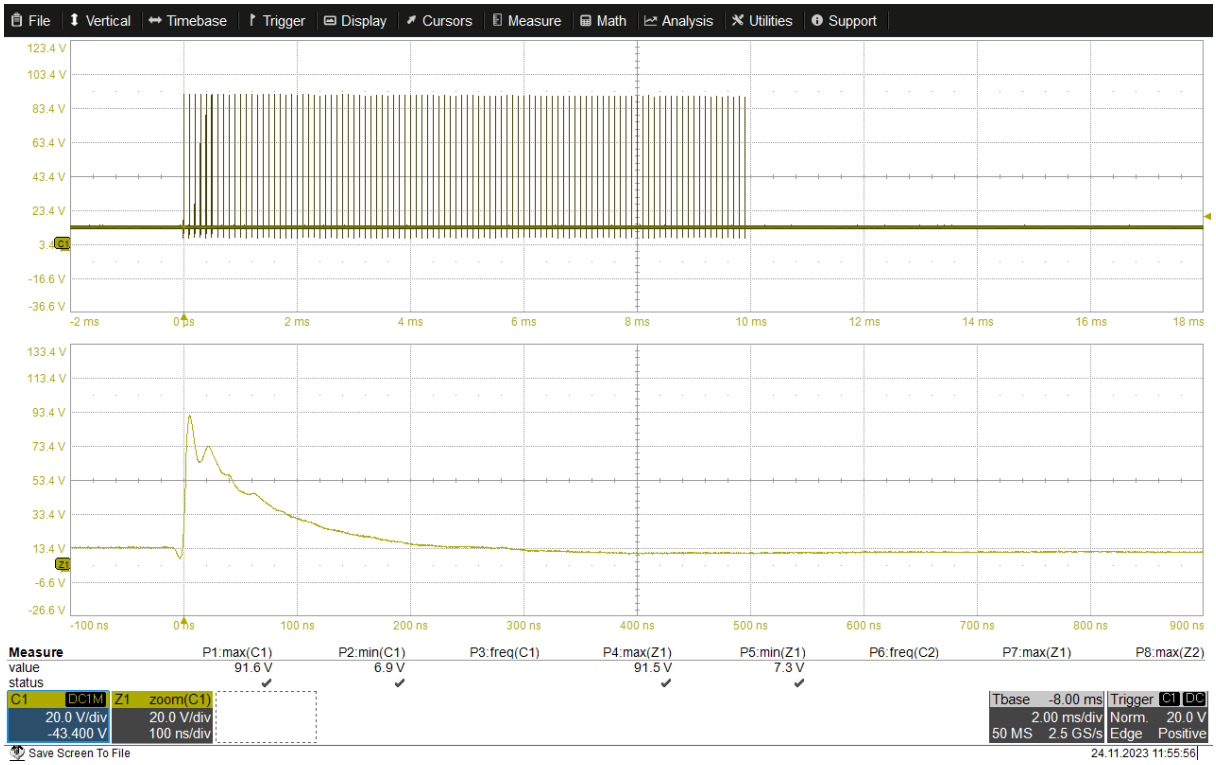
Diag. 5-12: Transient immunity test, test pulse 2a, t = 200 ms/div



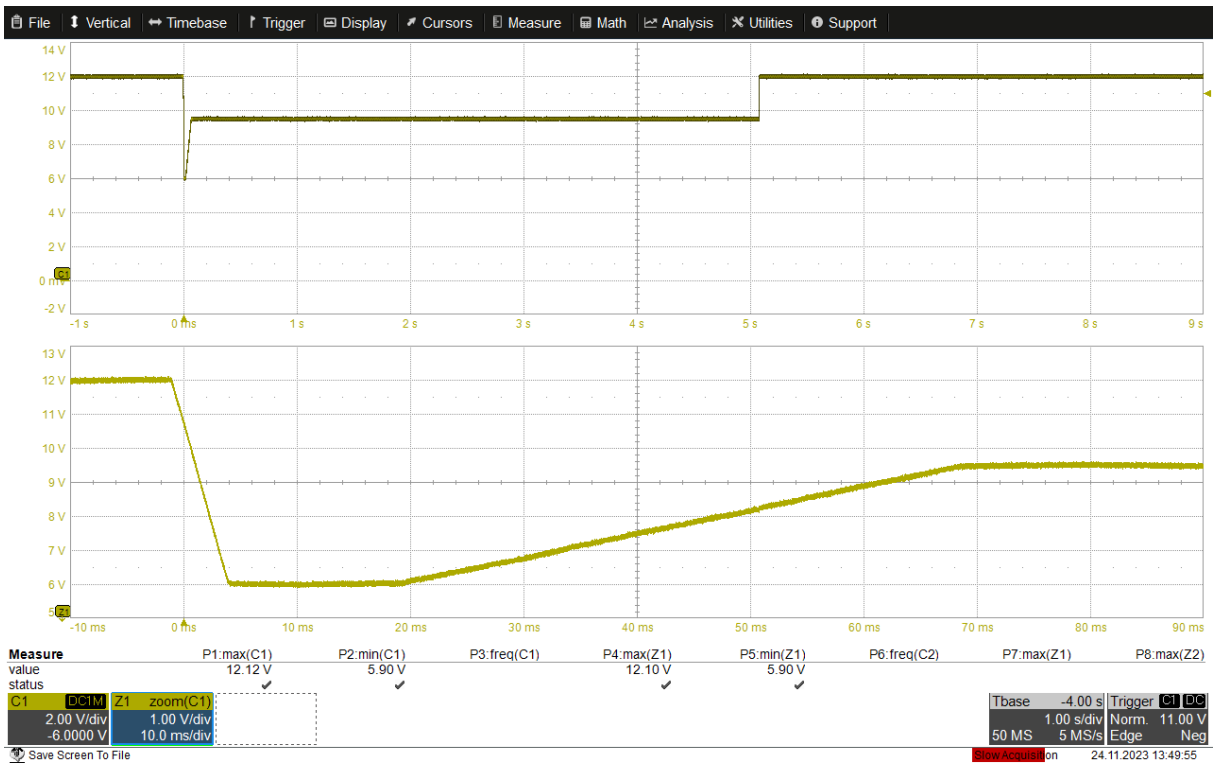
Diag. 5-13: Transient immunity test, test pulse 2b, t = 100 ms/div



Diag. 5-14: Transient immunity test, test pulse 3a, t = 2 ms/div



Diag. 5-15: Transient immunity test, test pulse 3b, t = 2 ms/div



Diag. 5-16: Transient immunity test, test pulse 4, t = 1 s/div

5.5.4 Result Summary

Test pulse	Test level	Number of pulses or test time	Diagram	Functional status required	Functional status passed	Comment	Result
1	-75 V	5000 pulses	Diag. 5-11	C	A	no recognizable effect	PASSED
2a	+37 V	5000 pulses	Diag. 5-12	B	A	no recognizable effect	PASSED
2b	+10 V	10 pulses	Diag. 5-13	C	A	no recognizable effect	PASSED
3a	-112 V	60 min	Diag. 5-14	A	A	no recognizable effect	PASSED
3b	+75 V	60 min	Diag. 5-15	A	A	no recognizable effect	PASSED
4	+6 V / +9,5 V	1 pulse	Diag. 5-16	C	A	no recognizable effect	PASSED

Tab. 5-16: Result summary, immunity to transient disturbances