REPORT
issued by a Technical Service and an Accredited Testing Laboratory

Contact person RISE	Date	Reference	Page
Esa Liimatainen	2023-09-24	P119189rev1	1 (27)
Safety and Transport			
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Resolve-EV AB
Isak Söderlund
Hildedalsgatan 200
417 05 Göteborg, Sweden

EMC tests of Resolve EV Controller
Rev1: 3 fiducials are added to the PCB and the PCB revision is updated to rev3

Test object

Product name:	Resolve VCU Leaf
Product No:	12P5X0001
Serial No:	Prototype
PCB:	P112P5Xrev3*
Rated Voltage:	12V

*3 Fiducials are added to the PCB and the PCB revision is updated to rev3.
Tested PCB revision was rev2.

Conclusion

It is the judgement of RISE as a technical service, that the above stated product, with the differences described in the documentation is fully compliant with the immunity and emission parts of "UN ECE Regulation No. 10 rev 06:2019, 06 series of amendments – Date of entry into force: 15 October 2019" since the tested variant was compliant.

Equipment not included in the tests, or additional new systems/ECU:s are not covered in this statement.

Layouts, component lists and detailed photos of the products are stored at RISE.

RISE Research Institutes of Sweden AB
Vehicles and Automation – EMC Vehicles

Performed by

Esa Liimatainen

Examined by

Krister Kilbrandt

Accred. No. 1002
Testing
ISO/IEC 17025

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Table of Content

Summary

Type approval test according to UN ECE Regulation No. 10 Revision 6:2019, 06 series of amendments – Date of entry into force: 15 October 2019.

The functional tests were performed by RISE Engineers. The functional criteria can be found on page 5.

Result

Standard	Compliant
UN ECE Regulation No. 10. Revision 6:2019, 06 series of amendments – Date of entry into force: 15 October 2019	**Yes**
Emission:	
Annex 7 (CISPR 25) Radiated broadband emission 30-1000 MHz	Yes
Annex 8 (CISPR 25) Radiated narrowband emission 30-1000 MHz	Yes
Annex 10 (ISO 7637-2) Transient emission	Yes
Immunity:	
Annex 9 (ISO 11452-4 (BCI) and ISO 11452-2 (ALSE)) RF immunity 20 – 2000 MHz	Yes
Annex 10 (ISO 7637-2) Transient immunity	Yes

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Commission

Type approval test according to UN ECE Regulation No. 10 Revision 6:2019, 06 series of amendments – Date of entry into force: 15 October 2019.

Client

Resolve-EV AB, Isak Söderlund, Hildedalsgatan 200, 417 05 Göteborg, Sweden.

Test object

The Resolve controller, the DUT, makes it possible for electric conversion of vehicles. All major powertrain components has to be of Nissan Leaf fabricate.

A client PC with installed CAN-SW monitored the DUT performance during tests. The CAN traffic between DUT and client PC was established with CAN/Opto-converters.

A throttle pedal was connected to the DUT during tests and monitored by the client PC.

The client delivered the test object.

Reservation

The test results in this report apply only to the particular DUT as it is declared in the report.

Performance and result

Functional tests before, during and after the immunity tests were performed in order to verify compliance with the performance criteria in the used standards as specified by the client.

Immunity tests

Operating mode during immunity measurements:

Annex 9:	The DUT was supplied by a 12V automotive battery and thru LISN's. The throttle pedal position and other parameters were monitored via CAN-SW installed on client PC.
Performance criteria:	No influence on the system was accepted. FSC A.
Annex 10:	During the transient immunity tests the DUT was supplied from the test system. The throttle pedal position and other parameters were monitored via CAN-SW installed on client PC.
Performance criteria:	Pulse 3a and 3b: FSC A. Pulse 2a: FSC B. Pulse 1, 2b and 4: FSC C.
Explanation of performance criteria:	**Functional Status Classification A (FSC A)**: All functions of a device/system perform as designed during and after exposure to interference.
	Functional Status Classification B (FSC 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 **FSC A**.
	Functional Status Classification C (FSC C): A function of a device/system is not performed as designed during exposure but returns automatically to normal operation after exposure is removed.

Emission measurement

Operating mode during emission measurements:

Annex 7 and 8:	Same setup as in Annex 9.
Annex 10:	During the transient emission tests the DUT was supplied by a 12V automotive battery and through transient emission test system.

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Test participants

Isak Söderlund, Resolve-EV AB
Esa Liimatainen and Markus Hasselgren, RISE

Uncertainties

Measurement and test instrument uncertainties are described in the quality assurance documentation " RISE-3936". The uncertainties are calculated with a coverage factor k=2 (95% level of confidence). Compliancy evaluation is based on a shared risk principle with respect to the measurement uncertainty. The measurement uncertainties can be found in the table below:

Standard	Method	Uncertainty
CISPR 25	Emission, Annex 7 and 8	4.4 dB
ISO 11452-2	Immunity, ALSE, Annex 9	1.5 dB
ISO 11452-4	Immunity, BCI, Annex 9	2.1 dB

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Test results

Radiated broadband and narrowband emission measurements according to Annex 7/8, UN ECE Regulation No. 10 Rev 6:2019

| Date	Temperature	Humidity
2023-06-16	24 °C ± 3 °C	38 % ± 5 %

Test set-up and procedure

The test of radiated emission was performed in RISE:s semi anechoic chamber "Gauss". The set-up was according to CISPR 25. The DUT and the associated cables were isolated from the ground plane with a 50 mm thick insulator. The ground plane was connected to the chamber ground with several wide ground straps. The measurements were performed with both horizontal and vertical polarization of the antenna. The antenna distance and height was 1.0 m. The battery supply voltage was checked during the test and was never below 12 VDC. Functional state according to page 5.

Test setup: Radiated Emission, 30-200 MHz

Test setup: Radiated Emission, 200-1000 MHz
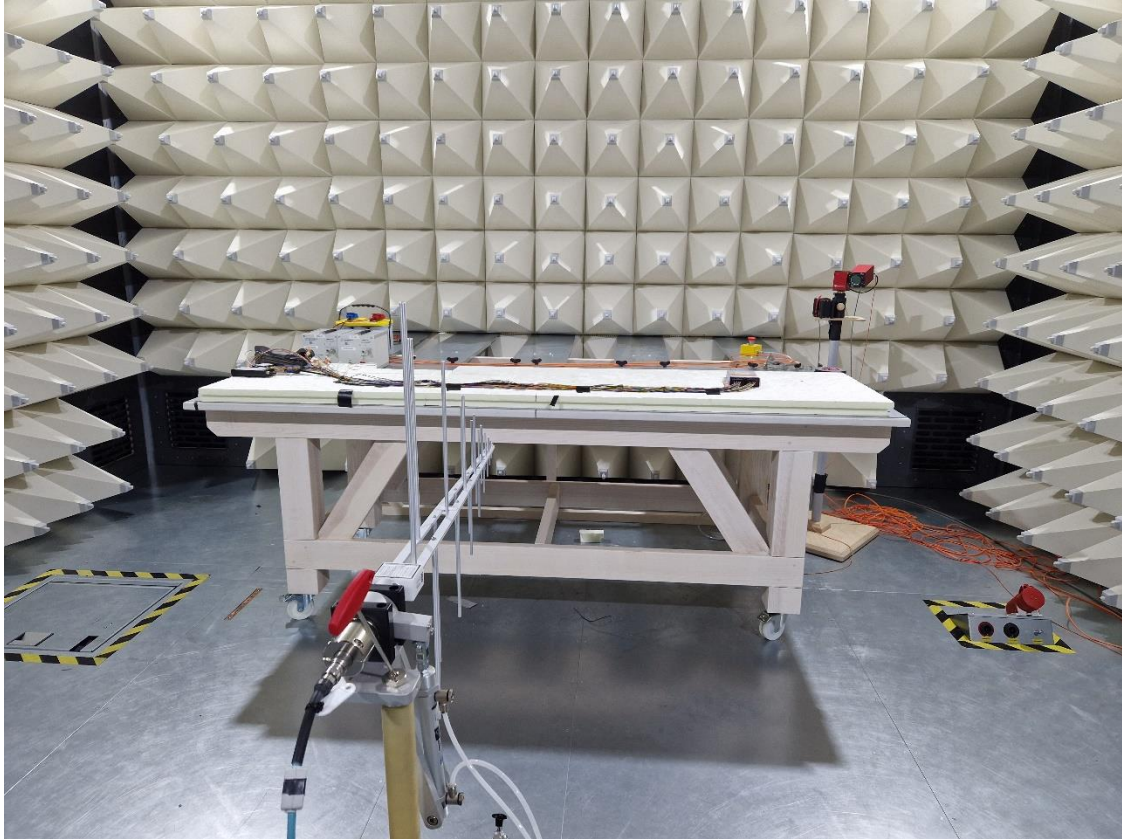
| Measurement equipment	RISE number
GI TDEMI Ultra 18 Measurement HW	KWP09918
GI EMI64k Version 6.30 Measurement SW	KWP10367
Biconical Antenna Schwarzbeck VHBB 9124	KWP09546
Log-periodic Antenna Schwarzbeck USLP 9143B	KWP09642
RF Cable Rosenberger	KWP09777
RF Cable Rosenberger	KWP09915
RF Cable Rosenberger	KWP09778
Comb Generator Schwarzbeck SG9303	KWP11933
Cojot Antenna WB30512H1 (30M-512M)	KWP11208
Cojot Antenna WD460Q (420M-6G)	KWP11209
Attenuator 10 dB	KWP09923
LISN Schwarzbeck NNBM8124 5μH 50 Ω	KWP09547
LISN Schwarzbeck NNBM8124 5μH 50 Ω	KWP09657
Testo 625, Temperature and humidity meter	KWP09976

Result

Emission below limit?	Yes

The radiated emission spectra can be found on the following pages.

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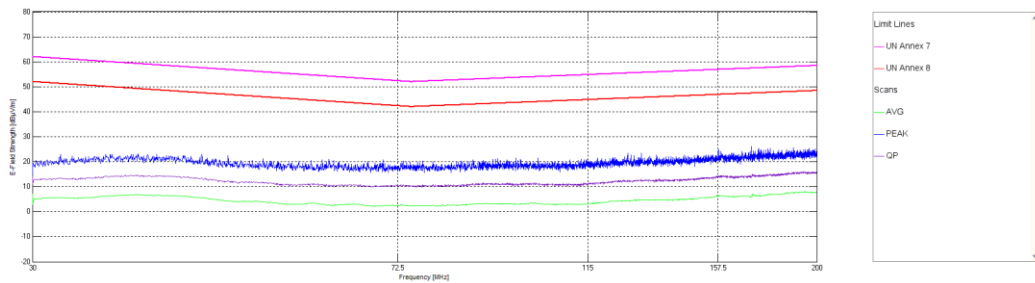P119189rev1

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30 – 200 MHz, Vertical Polarization, Comb generator
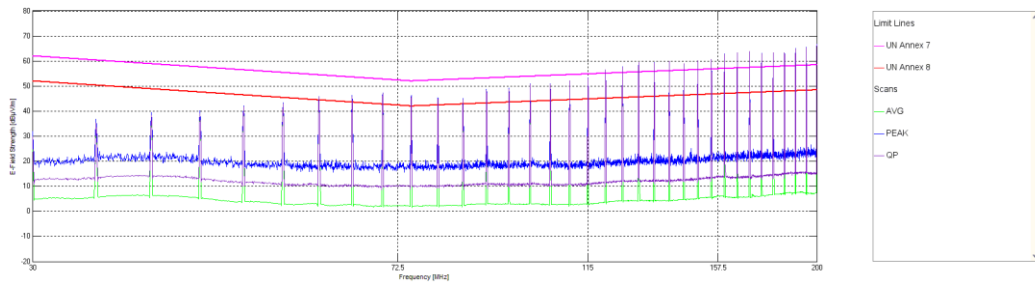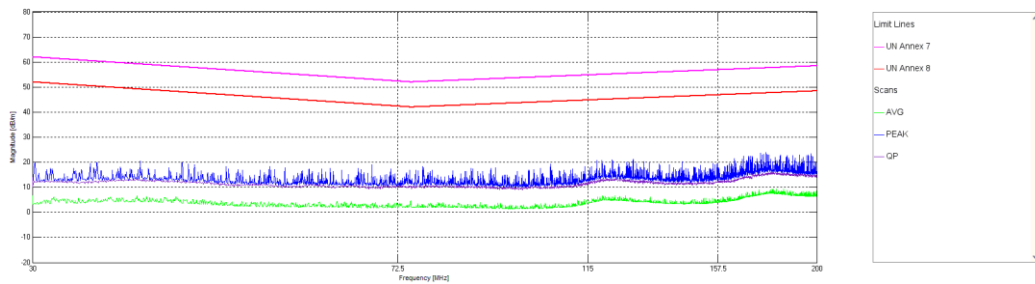

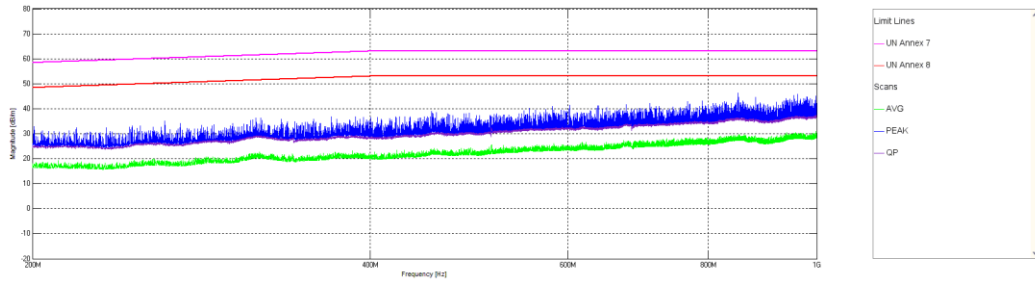## 200 – 1000 MHz, Vertical Polarization, Comb generator
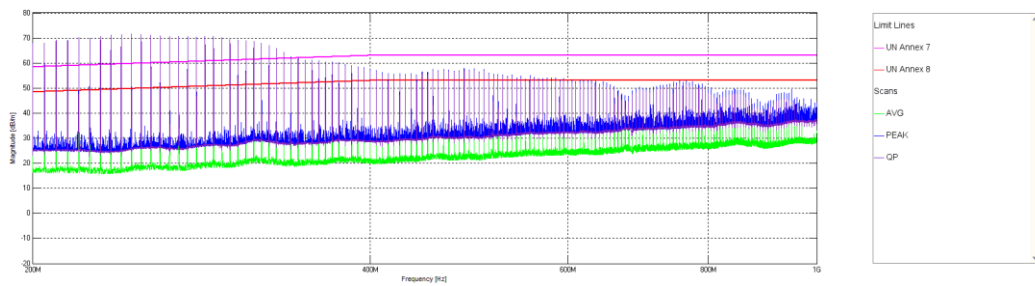
30 – 200 MHz, Vertical Polarization, Ambient

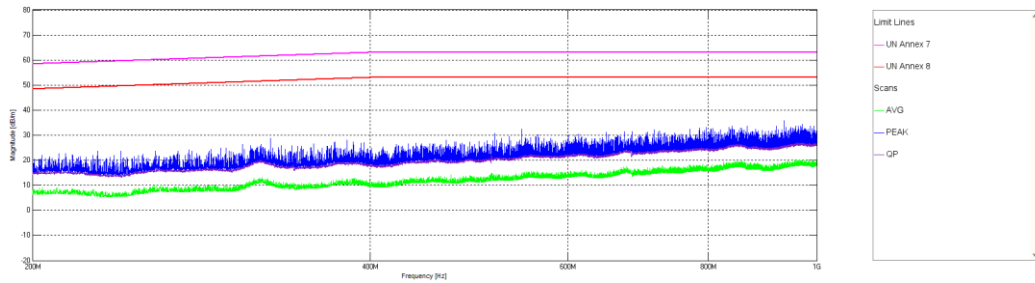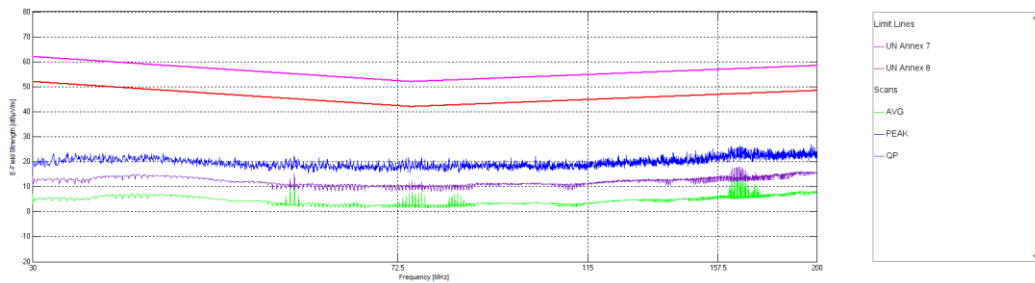## 30 – 200 MHz, Horizontal Polarization, Ambient
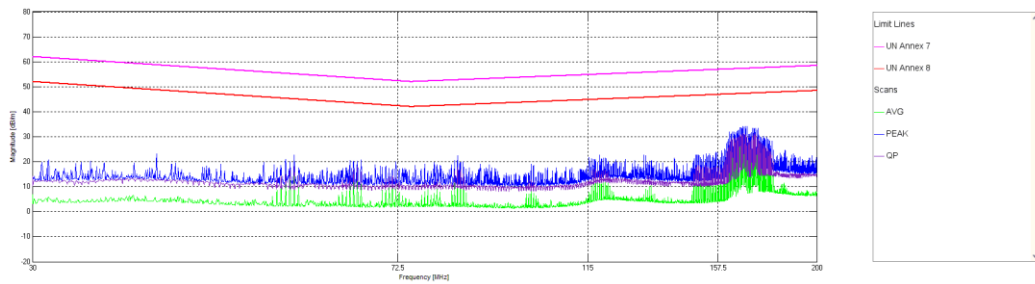
200 – 1000 MHz, Vertical Polarization, Ambient

200 – 1000 MHz, Horizontal Polarization, Ambient

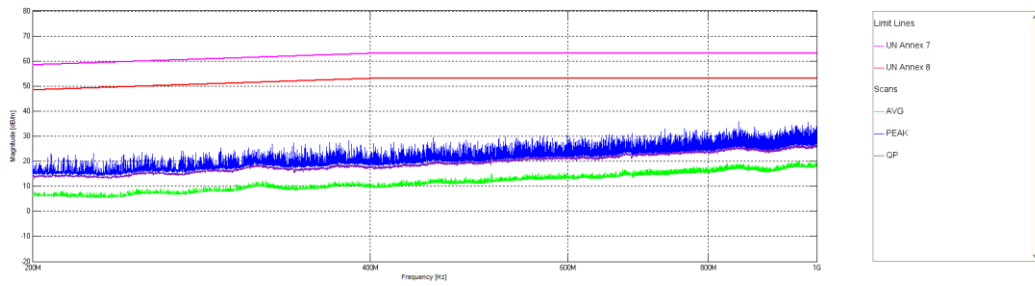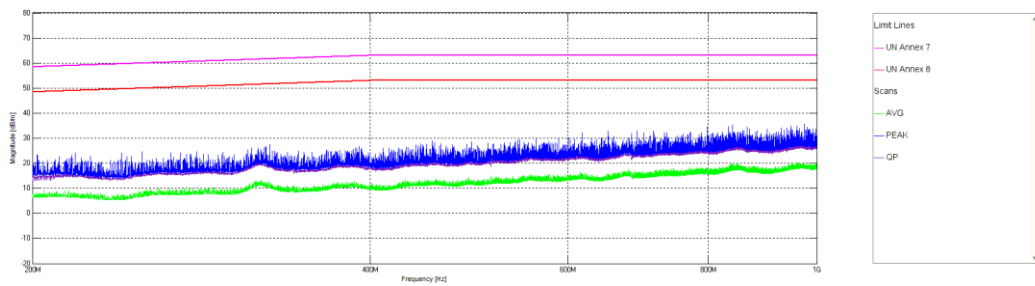## 30 – 200 MHz, Vertical Polarization DUT

30 – 200 MHz, Horizontal Polarization DUT

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200 – 1000 MHz, Vertical Polarization DUT

200 – 1000 MHz, Horizontal Polarization DUT

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Immunity to Radiated electromagnetic field according to Annex 9, UN ECE Regulation No. 10 Rev 6:2019

Date	Temperature	Humidity
2023-06-16	24 °C ± 3 °C	38 % ± 5 %

Test set-up and procedure

Test method	Frequency	Modulation	Severity level
ISO 11452-4	20 – 200 MHz	AM, 1 kHz, 80 %	60 mA
ISO 11452-2	200 – 800 MHz	AM, 1 kHz, 80 %	30 V/m
ISO 11452-2	800 – 2000 MHz	PM, t_{on}=577μs, t_{period}=4600 μs.	30 V/m

Functional state and functional status classification according to page 4-5.

Performance criterion: FSC A

Radiated susceptibility test according to ISO 11452-4 BCI

The test was performed in the semi anechoic chamber "Gauss" at RISE. A BCI-probe was used in the frequency range 20-200 MHz. The DUT was placed on an insulating board 50 mm above the ground plane. Cables under test were placed 50 mm above the ground plane in a BCI-fixture. The BCI-probe was applied 150, 450 and 750 mm from DUT. The set-up was according to standard. The DUT was monitored with optical fibre linked video cameras and an optical fibre linked microphone. Functional state, operating mode and performance criterion according to page 5.

Test setup, BCI-probe at 150mm from DUT

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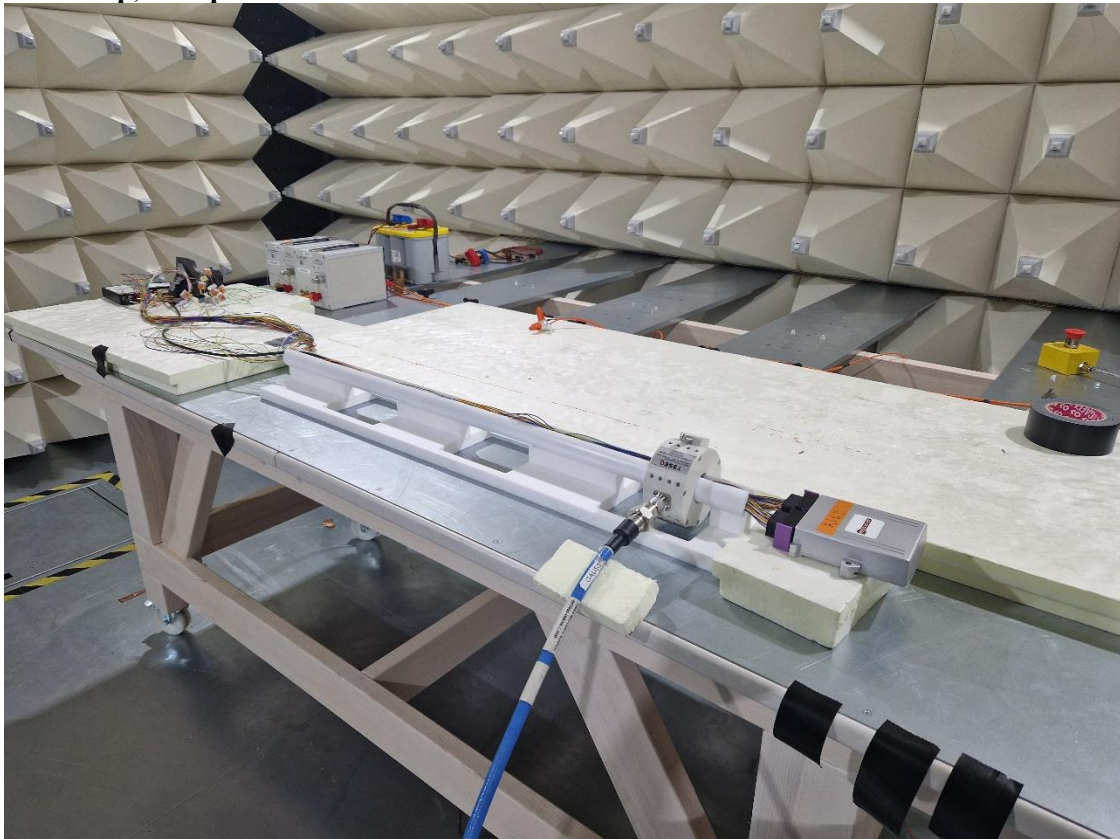
Radiated susceptibility test according to ISO 11452-2, Absorber Lined Shielded Enclosure (ALSE)

The tests were performed in a semi anechoic chamber, "Gauss", at RISE. The DUT and the associated cables were placed on an insulating board 50 mm above the ground. The exposed cables were placed 100 mm from the edge of the ground plane and the exposed cable length was 1.5 m. The antenna distance and height during the test was 1.0 m. During the tests above 1 GHz the antenna was placed in front of the DUT enclosure. During the tests below 1 GHz the antenna was placed in centre of the exposed cables from the DUT. The DUT was monitored with optical fibre linked video cameras and an optical fibre linked microphone. Functional state, operating mode and performance criterion according to page 5.
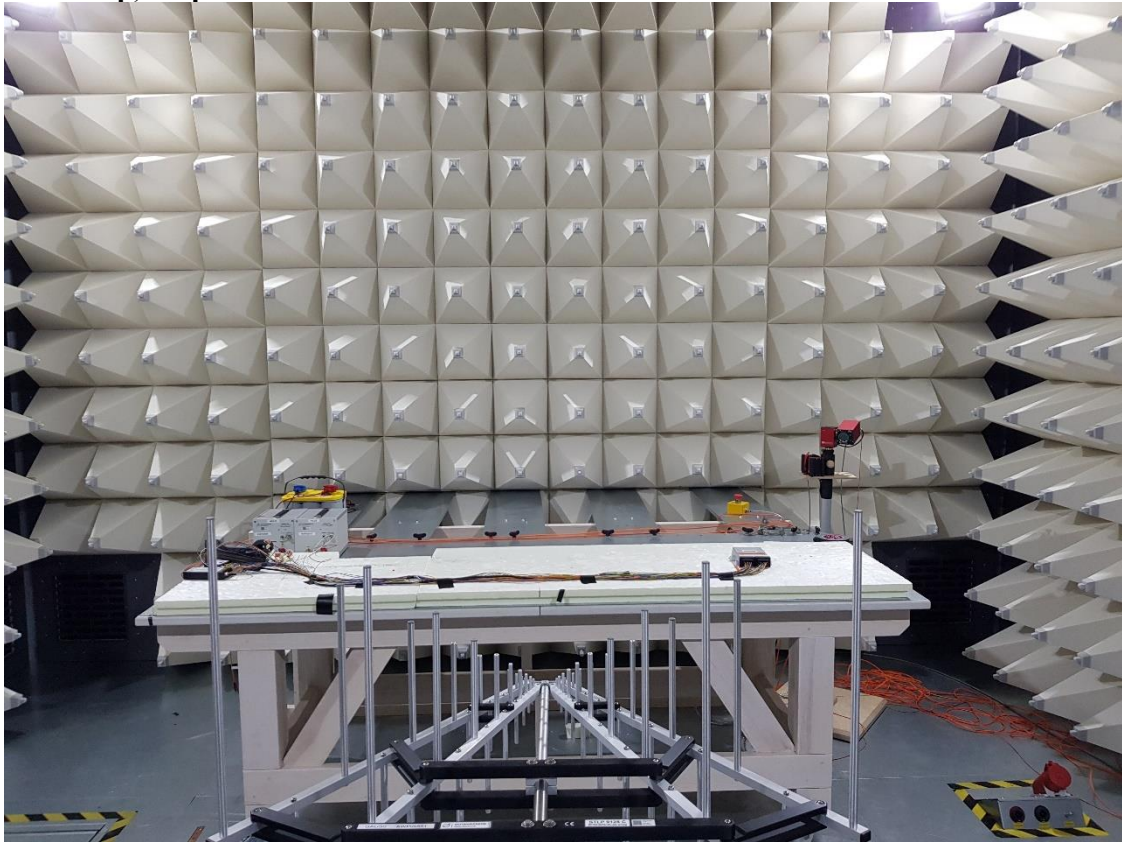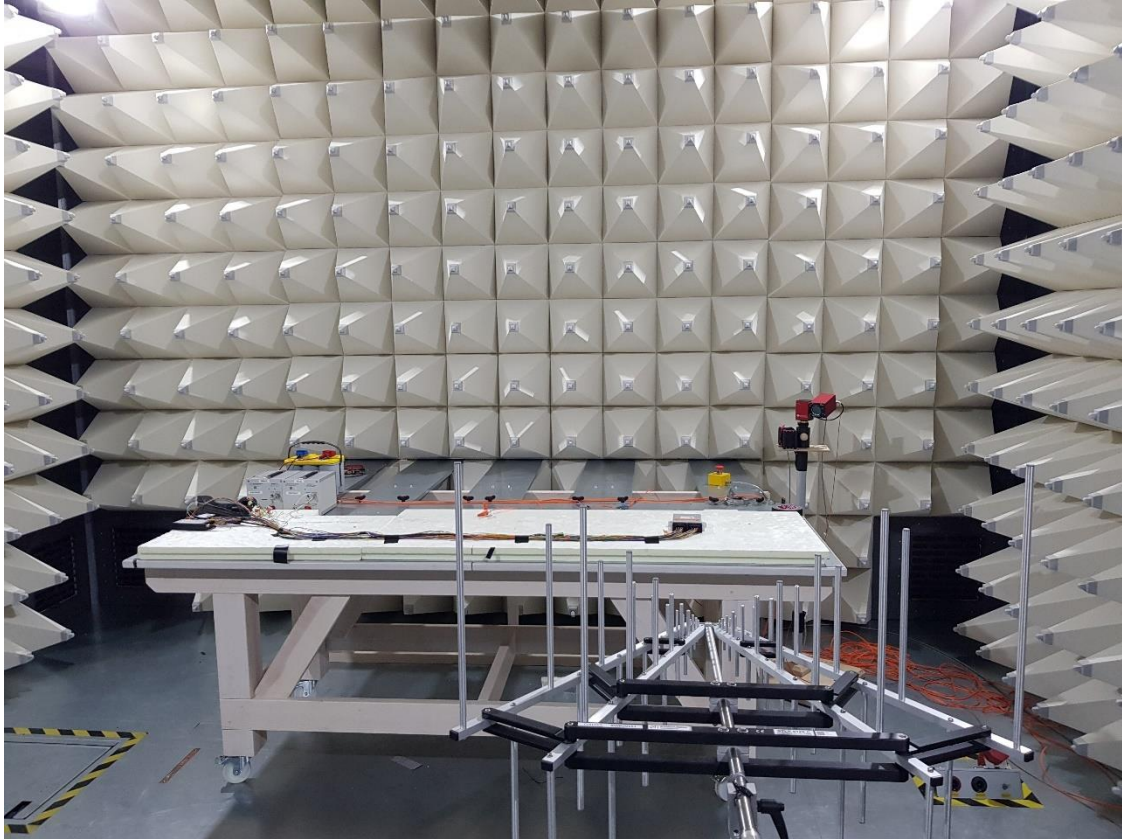
Test setup, frequencies < 1GHz

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Test setup, frequencies 1 - 2 GHz

Test equipment	RISE number
Software SPIMM 7	KWP10533
Signal generator R&S SMCV 100B	KWP08308
Peak Power meter Boonton PMX40	KWP08312
Peak Power sensor Boonton FWD	KWP10528
Peak Power sensor Boonton REV	KWP08434
Switchbox CYTEC	KWP08334
Cables incl. switches	KWP10093
AR1000W1000G	KWP03324
AR350S1G4M1	KWP08311
Werlatone Dual Directional Couplier AR1000	KWP10532
AR Directional Coupler AR350	KWP11198
Logperiodic antenna Schwarzbeck STLP 9128 C	KWP09551
BCI clamp Teseq CIP 9136A	KWP09552
LISN Schwarzbeck NNBM8124 5µH 50 Ω	KWP09547
LISN Schwarzbeck NNBM8124 5µH 50 Ω	KWP09657
AR Field analyzer FA7006	KWP08331
E-field probe AR FL-7006	KWP09920
Testo 625, Temperature and humidity meter	KWP09976

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Result

ALSE, 12V

ISO 11452-2, Modulation: AM ISO 80% 1 kHz, PM t_{on}=577µs, t_{period}=4600 µs					
Frequency MHz, Step, Modulation	DUT side Antenna facing	Horizontal		Vertical	
		V/m	Result	V/m	Result
2000-1000, 20, PM	DUT	-	-	30	Pass
1000-800, 10, PM	Mid harness	-	-	30	Pass
800-400, 10, AM ISO	Mid harness	-	-	30	Pass
400-200, 5, AM ISO	Mid harness	-	-	30	Pass

BCI, 12V

ISO 11452-4, AM ISO 80 %, 1 kHz			
Frequency MHz, Step	Cable	Injected current	
		mA	Result
20 – 200, 2	LVDC cable harness at 150, 450 and 750 mm from DUT.	60	Pass

No interference was noted during the test.

Performance requirements fulfilled?	Yes

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Immunity and emission of transients according to Annex 10, UN ECE Regulation No. 10 Rev 6:2019

Date	Temperature	Humidity
2023-06-15	25°C ± 3 °C	35 % ± 5 %

Applicable test standards

ISO 7637-2:2004

Severity

Transient immunity pulses no: 1, 2a, 2b, 3a, 3b and 4 were tested for 12V.
Parameters according to table 1 in this chapter

Transient emission limits, Power supply 12V (Rs = 40 Ω)

Polarity of pulse amplitude	Maximum allowed pulse amplitude
Positive 12V	+ 75 V
Negative 12V	- 100 V

Test set-up and procedure

The test was carried out in RISE's "ISO rack area". The DUT and the associated cables were placed on a 50 mm thick insulator .Functional state, operating mode and performance criterion according to page 5.

Test setup, Transient Immunity

Test setup, Transient Emission
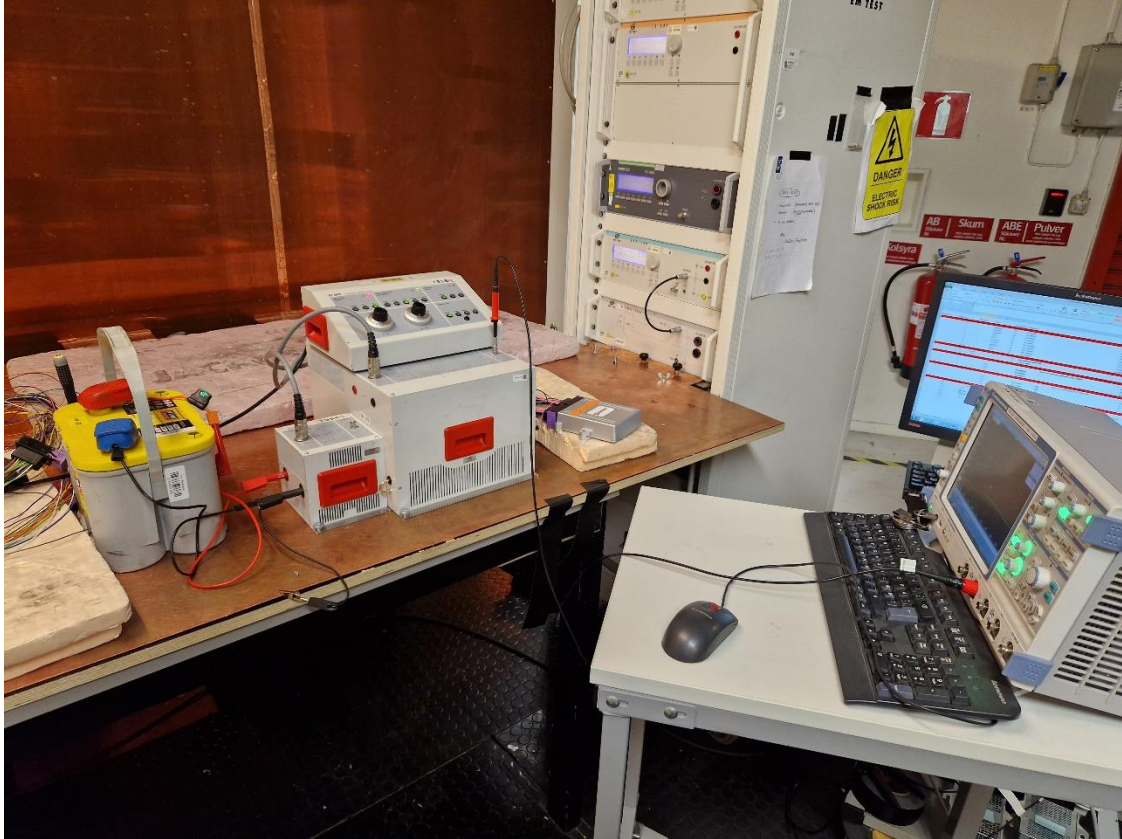
Test equipment	RISE number
Complete EMTEST ISO7637 rack	-
SW version: EMTEST ISO Control	5.2.3
SW version: EMTEST Autowave	5.8.8.0
EMTEST LD 200	503 626
EMTEST MPG 200	503 627
EMTEST EFT 200	503 628
EMTEST CNA 200	BX80987
EMTEST PFS 200N	BX80986
EMTEST Autowave	BX70690
Oscilloscope R&S RTE 1104	BX70087
Testo 625, Temperature and humidity meter	504 195
Teseq SC5501, ES5501, AN5501, MS5501	901 288

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Results

Transient immunity results

PULSE	1	2a	2b	3a	3b	4
12V	-75V	+37V	+10V	-112V	+75V	-6V
Test time, number of pulses	5000 pulses	5000 pulses	10 pulses	60 min	60 min	1 pulse
Performance criteria, FSC	C	B	C	A	A	C
Test result, FSC	C	A	C	A	A	A
Result of test	PASS	PASS	PASS	PASS	PASS	PASS

Transient emission results

12V (Rs = 40 Ω)	Fast pulses		Slow pulses	
	Off	On	Off	On
Maximum allowed pulse amplitude	-100V	+75V	-100V	+75V
Test result, 12V	-1.0V	+19.1V	-0.9V	+18.6V
Result of test	PASS	PASS	PASS	PASS

Performance and Emission requirements fulfilled?	Yes

The emission spectra can be found on the following page.

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Table 1, Transient immunity pulses

Pulse	Picture	Parameters		
1		**Parameters**	**12 V system**	**24 V system**
		Vs:	-75 V	-450 V
		t1:	1.0 s	1.0 s
		t2:	200 ms	200 ms
		tr:	1 µs	3 µs
		td:	2000 µs	1000 µs
		Ri:	10 Ω	50 Ω
		Coupling:	Battery	Battery
		Events:	5000	5000
		Duration:	01:23:20 h	01:23:20 h
2a		**Parameters**	**12 V system**	**24 V system**
		Vs:	+37 V	+37 V
		t1:	0.2 s	0.2 s
		tr:	1 µs	1 µs
		td:	50 µs	50 µs
		Ri:	2 Ω	2 Ω
		Coupling:	Battery	Battery
		Events:	5000	5000
		Duration:	00:33:00 h	00:33:00 h
2b		**Parameters**	**12 V system**	**24 V system**
		Vs:	10.0 V	20.0 V
		t1:	1.0 s	1.0 s
		t6:	1 ms	1 ms
		td:	200 ms	200 ms
		Int:	1 s	1 s
		Ri:	0.05 Ω	0.05 Ω
		t12:	1 ms	1 ms
		tr:	1 ms	1 ms
		Events:	10	10
		Duration:	00:00:28 h	00:00:28 h
3a		**Parameters**	**12 V system**	**24 V system**
		Vs:	-112 V	-150 V
		f1:	10 kHz	10 kHz
		t4:	10 ms	10 ms
		t5:	90 ms	90 ms
		tr:	5 ns	5 ns
		td:	150 ns	150 ns
		Ri:	50 Ω	50 Ω
		Coupling:	Battery	Battery
		Duration:	1 h	1 h
3b		**Parameters**	**12 V system**	**24 V system**
		Vs:	+75 V	+150 V
		f1:	10 kHz	10 kHz
		t4:	10 ms	10 ms
		t5:	90 ms	90 ms
		tr:	5 ns	5 ns
		td:	150 ns	150 ns
		Ri:	50 Ω	50 Ω
		Coupling:	Battery	Battery
		Duration:	1 h	1 h
4		**Parameters**	**12 V system**	**24 V system**
		Va1:	-6 V	-12 V
		Va2:	-2.5 V	-5 V
		t1:	1.0 s	1.0 s
		t6:	5 ms	10 ms
		t7:	15 ms	50 ms
		t8:	50 ms	50 ms
		t9:	2,5 s	3.0 s
		t11:	5 ms	10 ms
		Events:	1	1
		Duration:	00:00:02	00:00:02

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Emission spectra

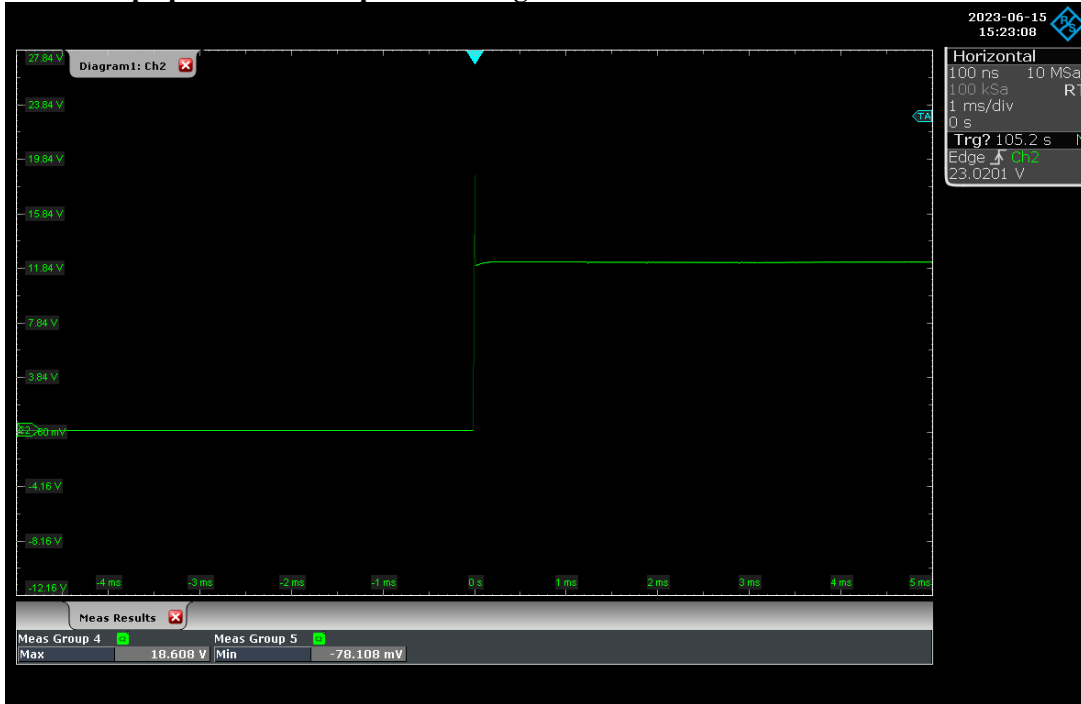**Oscilloscope picture of fast pulses during switch on 12 VDC:**

Oscilloscope picture of fast pulses during switch off 12 VDC:

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Oscilloscope picture of slow pulses during switch on 12 VDC:

Oscilloscope picture of slow pulses during switch off 12 VDC:

Verifikat

Transaktion 09222115557501316485

Dokument

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Huvuddokument
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