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Test report No:6209666.51v1.1

## TEST REPORT

### Electromagnetic Compatibility (EMC)

Identification of item tested	PV Microinverter
Trademark	
Model and /or type reference	SG1600; SG2000
Ratings	<p>Operating temperature range: - 40 °C to + 65 °C</p> <p>Protective class: I</p> <p>Ingress protection rating: IP67</p> <p>Power factor range (adjustable): &gt;0,99 (0,8 leading...0,8 lagging)</p> <p>Overvoltage category: III(Mains), II(PV)</p> <p>SG1600:</p> <p>Max input voltage: 65 V, MPPT voltage range: 25-55 V, Max input current: 14*4 A, PV Isc: 25*4 A.</p> <p>Rated grid frequency: 50 Hz, Rated output power: 1600 W, Rated grid voltage: L/N/PE, 230 V, Max output current: 6,96 A.</p> <p>SG2000:</p> <p>Max input voltage: 65 V, MPPT voltage range: 25-55 V, Max input current: 16*4 A, PV Isc: 25*4 A.</p> <p>Rated grid frequency: 50 Hz, Rated output power: 2000 W, Rated grid voltage: L/N/PE, 230 V, Max output current: 8,7 A.</p>
Test Laboratory / address	DEKRA Testing and Certification (Shanghai) Ltd. No.250, Jiangchangsang Road, Jing'an District, Shanghai, China
Applicant's name / address	Solenso electronic materials Co., LTD. 4F., No. 56, Zili 5th St., Zhongli Dist., Taoyuan City 320, Taiwan, China
Test method requested, standard	ETSI EN 301 489-3 V2.3.2 (2023-01) ETSI EN 301 489-1 V2.2.3 (2019-11)
Verdict Summary	IN COMPLIANCE

Tested by (name / position & signature)	Kaiyuan Dai Project Manager	
Approved by (name / position & signature)	Wency Yang Technical Manager	
Date of issue	2025-01-09	
Report template No	TRF_ETSI EN 301489-1_ETSI EN 301489-3_EMV V1.0	

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## COMPETENCES AND GUARANTEES

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DEKRA is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated in the report and it is based on the knowledge and technical facilities available at DEKRA at the time of performance of the test.

DEKRA is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

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## GENERAL CONDITIONS

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1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or Competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA.
5. This report will not be used for social proof function in China market.
6. The test results presented in this report relate only to the object tested.

## UNCERTAINTY

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For all measurements where guidance for the calculation of the instrumentation uncertainty of a measurement is specified in EN 55016-4-2 (CISPR 16-4-2), EN/IEC 61000-4 series or a product standard, the measurement instrumentation uncertainty has been calculated and applied in accordance with these standards.

Uncertainties have been calculated according to the DEKRA internal document. The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95%. Refer to the Annex 1 for further information.

## ENVIRONMENTAL CONDITIONS

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The climatic conditions during the tests are within the limits specified by the manufacturer for the operation of the EUT and the test equipment. The climatic conditions during the tests were within the following limits:

Ambient temperature	15 °C – 35 °C
Relative Humidity air	30% - 60%
Atmospheric pressure	86 kPa – 106 kPa

If explicitly required in the basic standard or applied product / product family standard the climatic values are recorded and documented separately in this test report.

## POSSIBLE TEST CASE VERDICTS

Test case does not apply to test object	N/A
Test object does meet requirement	P (Pass) / PASS
Test object does not meet requirement	F (Fail) / FAIL
Not measured	N/M

## DEFINITION OF SYMBOLS USED IN THIS TEST REPORT

<input checked="" type="checkbox"/> Indicates that the listed condition, standard or equipment is applicable for this report/test/EUT.			
<input type="checkbox"/> Indicates that the listed condition, standard or equipment is not applicable for this report/test/EUT.			
Decimal separator used in this report	<input checked="" type="checkbox"/>	Comma (,)	<input type="checkbox"/> Point (.)

## ABBREVIATIONS

For the purposes of the present document, the following abbreviations apply:

EUT	:	Equipment Under Test
QP	:	Quasi-Peak
CAV	:	CISPR Average
AV	:	Average
CDN	:	Coupling Decoupling Network
SAC	:	Semi-Anechoic Chamber
OATS	:	Open Area Test Site
BW	:	Bandwidth
AM	:	Amplitude Modulation
PM	:	Pulse Modulation
HCP	:	Horizontal Coupling Plane
VCP	:	Vertical Coupling Plane
$U_N$	:	Nominal voltage
Tx	:	Transmitter
Rx	:	Receiver
N/A	:	Not Applicable
N/M	:	Not Measured

## DOCUMENT HISTORY

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Report nr.	Date	Description
6209666.51	2024-12-02	First release.
6209666.51v1.1	2025-01-09	Correction.

## CONCLUSION,REMARKS AND COMMENTS

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The equipment under test (EUT) does meet the essential requirements of the stated standard(s)/test(s).

The test results relate only to the samples tested.

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The tests described in this report do not result in the right to use any approval mark as conferred by DEKRA. As far as the tests were based on certain specifications, these are mentioned in the report.

The ETSI EN 301 489-3 standard have been used in conjunction with ETSI EN 301 489-1 standard.

According to the declaration from manufacturer, the two models have the same material and structure except for the different rated powers.

After review, all test were carried out on the model SG2000. The test results stated in this report are also representative for all models.

# 1 GENERAL INFORMATION

## 1.1 General Description of the Item(s)

Description of the item .....	PV Microinverter
Test Model / Type number.....	SG2000
Serial number .....	N/A
Trademark.....	
Manufacturer.....	Solenso electronic materials Co., LTD. 4F., No. 56, Zili 5th St., Zhongli Dist., Taoyuan City 320, Taiwan, China

Mode of Operation .....	SRD
Operating frequency range(s).....	433.050 ~ 434.790 MHz (Band H)
Type of Modulation .....	FSK
Antenna Type .....	External antenna
Antenna Gain .....	1 dBi
Receiver Category: .....	2

Rated power supply .....	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	<input type="checkbox"/>	AC: 220 – 240 V, 50/60 Hz	<input type="checkbox"/>				
	<input type="checkbox"/>	AC: 100 – 240 V, 50/60 Hz	<input type="checkbox"/>				
	<input checked="" type="checkbox"/>	DC: 25-55 Vdc					
	<input type="checkbox"/>	Battery:					
Rated Power .....	2000 W						
Clock frequencies .....	433.050 ~ 434.790 MHz (Band H)						
Other parameters.....	Not provided						
Software version .....	Not provided						
Hardware version.....	Not provided						
Dimensions in cm (W x H x D)....	Not provided						
Mounting position.....	<input checked="" type="checkbox"/>	Table top equipment					
	<input checked="" type="checkbox"/>	Wall/Ceiling mounted equipment					
	<input type="checkbox"/>	Floor standing equipment					
	<input type="checkbox"/>	Hand-held equipment					
	<input type="checkbox"/>	Other:					

Intended use of the Equipment Under Test (EUT)
The product is micro inverter which supports Sub-1 GHz function. The Inverter combines the functions of photovoltaic inverter which converts direct current (DC) electricity from solar panels into alternating current (AC)

electricity for use in the home or business environment.

Copy of marking plate:  
 Not provided

**1.2 Test date**

Test Location	DEKRA Testing and Certification (Shanghai) Ltd. No. 250, Jiangchangsan Road,Jing'an District, Shanghai, China
Date (receive sample)	2024-08-09
Date (start test)	2024-08-19
Date (finish test)	2024-08-20

**1.3 The environment(s) in which the EUT is intended to be used**

The equipment under test (EUT) is intended to be used in the following environment(s):

<input checked="" type="checkbox"/>	Residential (domestic) environment.
<input checked="" type="checkbox"/>	Commercial and light-industrial environment.
<input type="checkbox"/>	Industrial environment.
<input type="checkbox"/>	Vehicular environment
<input type="checkbox"/>	Telecommunication centre environment

**1.4 Classification according to EN 55032**

The radio equipment and/or associated ancillary equipment under test is classified as:

<input checked="" type="checkbox"/>	Class B	An ancillary equipment intended to be used exclusively in an residential (domestic) or commercial and light-industrial environment.
<input type="checkbox"/>	Class A	An ancillary equipment intended to be used exclusively in an industrial environment or telecommunication centres.

## 2 DESCRIPTION OF TEST SETUP

### 2.1 Operating mode(s) used for tests

During the tests the following operating mode(s) has(have) been used.

Operating mode	Operating mode description	Used for testing	
		Emission	Immunity
1	Transmit Data (SUB-1 GHz)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	Standby	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3		<input type="checkbox"/>	<input type="checkbox"/>
4		<input type="checkbox"/>	<input type="checkbox"/>
<u>Supplemental information:</u>			

### 2.2 Port(s) of the EUT

Port name and description	Connected to / Termination	Cable		
		Length used during test [m]	Attached during test	Shielded
DC input port	DC Source	1,5 m	<input checked="" type="checkbox"/>	<input type="checkbox"/>
AC grid port	LV power grid	1,5 m	<input checked="" type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>
<u>Supplemental information:</u>				

### 2.3 Support / Auxiliary equipment / unit / software for the EUT

The EUT has been tested with the following auxiliary equipment / unit / software:

Auxiliary equipment / unit / software	Type / Version	Manufacturer	Supplied by
Notebook PC	SHA-NL0026-21T100	DELL	Test Lab
DC Source	IT6018C-1500-40	ITECH	Test Lab
<u>Supplemental information:</u>			

### 2.4 Test Configuration / Block diagram used for tests

Refer to Annex 3.

### 3 VERDICT SUMMARY SECTION

This chapter presents an overview of standards and results. Refer to the next chapters for details of measured test results and applied test levels.

#### 3.1 Standards

Standard	Year	Description
ETSI EN 301 489-3 V2.3.2	2023	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz; Harmonised Standard for ElectroMagnetic Compatibility
ETSI EN 301 489-1 V2.2.3	2019	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements.
EN 55032 +A1 +A1	2015 2020 2020	Electromagnetic compatibility of multimedia equipment – Emission requirements.
EN 55016-2-1 +A1	2014 2017	Methods of measurement of disturbances and immunity - Conducted disturbance measurements.
EN 55016-2-3 +A1	2017 2019	Methods of measurement of disturbances and immunity - Radiated disturbance measurements.
CISPR 25	2021	Radio disturbance characteristics for the protection of receivers used on board vehicles, boats, and on devices - Limits and methods of measurement.
EN 61000-4-2	2009	Electrostatic discharge immunity test.
EN 61000-4-3 +A1 +A2	2006 2008 2010	Radiated, radio-frequency, electromagnetic field immunity test.
EN 61000-4-4	2012	Electrical fast transient/burst immunity test.
EN 61000-4-5 +A1	2014 2018	Surge immunity test.
EN 61000-4-6	2014	Immunity to conducted disturbances, induced by radio-frequency fields.
EN IEC 61000-4-11	2020	Voltage dips, short interruptions and voltage variations immunity tests.
EN IEC 61000-3-2 +A1	2019 2021	Limits for harmonic current emissions (equipment input current $\leq 16$ A per phase).
EN 61000-3-12	2011	Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current $>16$ A and $\leq 75$ A per phase
EN IEC 61000-3-3 +A1 +A2	2013 2018 2021	Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current $\leq 16$ A per phase and not subject to conditional connection.
EN IEC 61000-3-11	2019	Electromagnetic compatibility (EMC) - Part 3-11: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current = 75 A and subject to conditional connection

### 3.2 Deviation(s) from the Standard(s) / Test Specification(s)

The following deviation(s) was / were made from the published requirements of the listed standards: N/A.

### 3.3 Overview of results

EMISSION TESTS – ETSI EN 301 489-3, ETSI EN 301 489-1			
Requirement – Test case	Basic standard(s)	Verdict	Remark
Conducted disturbance voltage at AC mains power input / output port(s)	EN 55032, EN 55016-2-1	PASS	---
Conducted disturbance voltage at DC power input / output port(s)	EN 55032 and/or CISPR 25 (equipment for vehicular use)	PASS	---
Conducted disturbance voltage at wired network port(s)	EN 55032, EN 55016-2-1	N/A	See 1)
Radiated electromagnetic disturbances (30 MHz to 1000 MHz)	EN 55032, EN 55016-2-3	PASS	---
Radiated electromagnetic disturbances (above 1 GHz)	EN 55032, EN 55016-2-1	PASS	---
Harmonic current emissions	EN 61000-3-2/EN 61000-3-12	N/A	See 3)
Voltage changes, voltage fluctuations and flicker	EN 61000-3-3/EN 61000-3-11	N/A	See 3)
<u>Supplementary information:</u>			
1) The EUT does not have a DC mains power input / output port. 2) The test is not applicable to DC power input / output ports connected to cable(s) ≤ 3 m. 3) The EUT does not have an AC mains power input port. 4) The EUT does not have a wired network port. 5) Since the rated power of the EUT is less then 75 Watts harmonics test is not applicable. 6) The EUT is regarded as a professional equipment with a total rated power greater than 1 KW. The test is not applicable. 7) The highest internal frequency of the EUT is less than 108 MHz. 8) The EUT is not ancillary equipment, so it needs not to perform this test item. 9) The EUT does not produce significant voltage fluctuations of flicker.			

IMMUNITY TESTS – ETSI EN 301 489-3, ETSI EN 301 489-1			
Requirement – Test case	Basic standard(s)	Verdict	Remark
Electrostatic discharge	EN 61000-4-2	PASS	---
Radio-frequency electromagnetic fields	EN 61000-4-3	PASS	---
Fast transients	EN 61000-4-4	PASS	---
Surge transient	EN 61000-4-5	PASS	---
Injected currents (radio-frequency common mode)	EN 61000-4-6	PASS	---
Voltage dips and short interruptions	EN 61000-4-11	N/A	See 2)
Transients and surges in the vehicular environment	ISO 7637-2	N/A	See 3)
<u>Supplementary information:</u>			
1) Not applicable because no test requirements have been specified for DC/battery powered apparatus. 2) These tests are applicable to radio and ancillary equipment intended for vehicular use. 3) The EUT does not have an AC mains power input port.			

### 3.4 Exclusion bands for ETSI EN 301489-3

The emission measurement and immunity test exclusions are referred to as "exclusion bands". The frequencies on which Short Range Devices (SRD) are intended to operate, are excluded from the conducted and radiated RF immunity tests.

The frequencies on which the SRD transmitters are intended to operate are excluded from conducted and radiated emission measurements when performed in transmit mode of operation.

#### 3.4.1 Exclusion bands for receivers - Emission testing

There is no frequency exclusion band applied to emission measurements of SRD receivers, and/or associated ancillary equipment.

#### 3.4.2 Exclusion bands for receivers - Immunity testing

The exclusion band for receivers (including receivers part of transceivers) intended to be used in a channelized frequency band, is determined as follows:

ETSI EN 301 489-3 V2.3.2	
Receiver Operating Frequency $f_o$	Extension value
< 300 KHz	$f_o \pm 300$ KHz (see note 1)
300 KHz to < 30 MHz	$f_o \pm 3$ MHz (see note 1)
30 MHz to < 1 GHz	$f_o \pm 15$ MHz, $\pm 5\% \times f_o$ , whichever is greater
1 GHz to < 6 GHz	$f_o \pm 100$ MHz (see note 2)
$\geq 6$ GHz	$5\% \times f_o$

Supplementary information:  
 The exclusion band is based on an extension value. The lower limit of the exclusion band is the lower edge of the Operating Channel (OC) minus the extension value, or zero, whichever is the greater. The upper limit is the upper edge of the OC plus the extension value.

#### 3.4.3 Exclusion band for transmitters – Emission & Immunity testing

The exclusion band shall be those frequencies specified in the relevant radio standard as the operating frequency band and the Out of Band domain.

Where this is not so specified the exclusions bands shall be as below:

- For transmitters operating, or intended to operate, in a channelized frequency band, the exclusion band is five times (i.e.  $\pm 250$  %) the maximum operating channel width (OCW) allowed for that service, centred around the operating frequency.
- For wide band transmitters, i.e. transmitters in a non-channelized frequency band, the exclusion band is twice the intended operating frequency band centred around the centre frequency of the intended operating frequency band.
- The exclusion band shall only apply when the EUT is in transmit mode of operation.

**NOTE:** Refer to the ETSI EN 301 489-3 and ETSI EN 301 489-1 standards for further and more detailed information about exclusion bands.

## 4 EMISSION TEST RESULTS

<b>Conducted disturbance voltage – AC power port(s)</b>	<b>VERDICT: PASS</b>
---	----------------------

Standard	ETSI EN 301 489-3,ETSI EN 301 489-1
Basic standard(s)	EN 55032, EN 55016-2-1

### Limits – Class B

Frequency range [MHz]	Limit: QP [dB(μV) <sup>1)</sup>	Limit: AV [dB(μV) <sup>1)</sup>	IF BW	Detector(s)
0,15 - 0,50	66 – 56 <sup>2)</sup>	56 - 46 <sup>2)</sup>	9 KHz	QP, CAV
0,50 - 5,0	56	46	9 KHz	QP, CAV
5,0 - 30	60	50	9 KHz	QP, CAV

<sup>1)</sup> At the transition frequency, the lower limit applies.

<sup>2)</sup> The limit decreases linearly with the logarithm of the frequency.

**NOTE 1:** The exclusion band for transmitters shall be considered for transmitters operating at frequencies below 30 MHz.

**NOTE 2:** Where the AC output port is directly connected (or via a circuit breaker) to the AC power input port of the EUT the AC power output port need not to be tested.

### Performed measurements

Port under test		Terminal							
<input type="checkbox"/>	AC mains input power	<input checked="" type="checkbox"/>	N	<input checked="" type="checkbox"/>	L1	<input type="checkbox"/>	L2	<input type="checkbox"/>	L3
<input type="checkbox"/>	AC output power	<input type="checkbox"/>	N	<input type="checkbox"/>	L1	<input type="checkbox"/>	L2	<input type="checkbox"/>	L3
Voltage – Mains [V]	230								
Frequency – Mains [Hz]	50								
Test method applied	<input checked="" type="checkbox"/>	Artificial mains network							
	<input type="checkbox"/>	Voltage probe							
Test setup	<input checked="" type="checkbox"/>	Table top	<input type="checkbox"/>	Artificial hand applied					
	<input type="checkbox"/>	Floor standing	<input type="checkbox"/>	Other:					
Refer to the Annex 3 for test setup photo(s).									
Operating mode(s) used	1,2								
Remark	The disturbance level was investigated at all operating modes listed at chapter 2.1 respectively. The worst case results were reported.								

See next page.

<b>Measurement data</b>	Port under test	AC mains output power
Operating mode / voltage / frequency used during the test		Mode 1 / 230 Vac / 50 Hz

Line



Rg	Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	CAV Level [dBµV]	CAV: AVG Limit [dBµV]	CAV Margin [dB]	Correction [dB]	Line
1	0.188	30.48	64.11	33.63	30.47	54.11	23.64	9.56	L1
1	0.240	15.34	62.10	46.76	14.65	52.10	37.45	9.58	L1
1	0.380	8.51	58.29	49.78	7.54	48.29	40.75	9.60	L1
1	1.896	7.64	56.00	48.36	6.21	46.00	39.79	9.67	L1
1	14.579	25.60	60.00	34.40	19.21	50.00	30.79	9.91	L1
1	21.667	15.20	60.00	44.80	13.51	50.00	36.49	9.88	L1

Remark

1. QPK Level [dBµV]=Reading QPK Level [dBµV] + Correction [dB]
2. CAV Level [dBµV]=Reading CAV Level [dBµV] + Correction [dB]
3. Correction [dB]= AMN VDF [dB] + Cable Loss [dB]

<b>Measurement data</b>	Port under test	AC mains output power
-------------------------	-----------------	-----------------------

Operating mode / voltage / frequency used during the test	Mode 1 / 230 Vac / 50 Hz
---	--------------------------

Neture



Rg	Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	CAV Level [dBµV]	CAV: AVG Limit [dBµV]	CAV Margin [dB]	Correction [dB]	Line
1	0.188	31.35	64.11	32.77	31.36	54.11	22.76	9.55	N
1	0.240	15.46	62.10	46.64	14.80	52.10	37.29	9.55	N
1	0.377	9.59	58.34	48.75	8.88	48.34	39.46	9.57	N
1	1.892	7.66	56.00	48.34	6.22	46.00	39.78	9.64	N
1	14.579	24.75	60.00	35.25	18.81	50.00	31.19	9.89	N
1	21.667	14.65	60.00	45.35	12.91	50.00	37.09	9.92	N

Remark	1. QPK Level [dBµV]=Reading QPK Level [dBµV] + Correction [dB] 2. CAV Level [dBµV]=Reading CAV Level [dBµV] + Correction [dB] 3. Correction [dB]= AMN VDF [dB] + Cable Loss [dB]
--------	--

<b>4.2 Conducted disturbance voltage – DC power port(s)</b>	<b>VERDICT: PASS</b>
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Standard	ETSI EN 301 489-3,ETSI EN 301 489-1
Basic standard(s)	EN 55016-2-1

**Limits**

Frequency range [MHz]	Limit: QP [dB(μV) <sup>1)</sup>	Limit: AV [dB(μV) <sup>1)</sup>	IF BW	Detector(s)
0,15 - 0,50	79	66	9 KHz	QP, CAV
0,50 - 30	73	60	9 KHz	QP, CAV

<sup>1)</sup> At the transition frequency, the lower limit applies.

<sup>2)</sup> Applicable only to ports intended for connection to a local DC power network, or a local battery by a connecting cable exceeding a length of 30 m.

**Performed measurements**

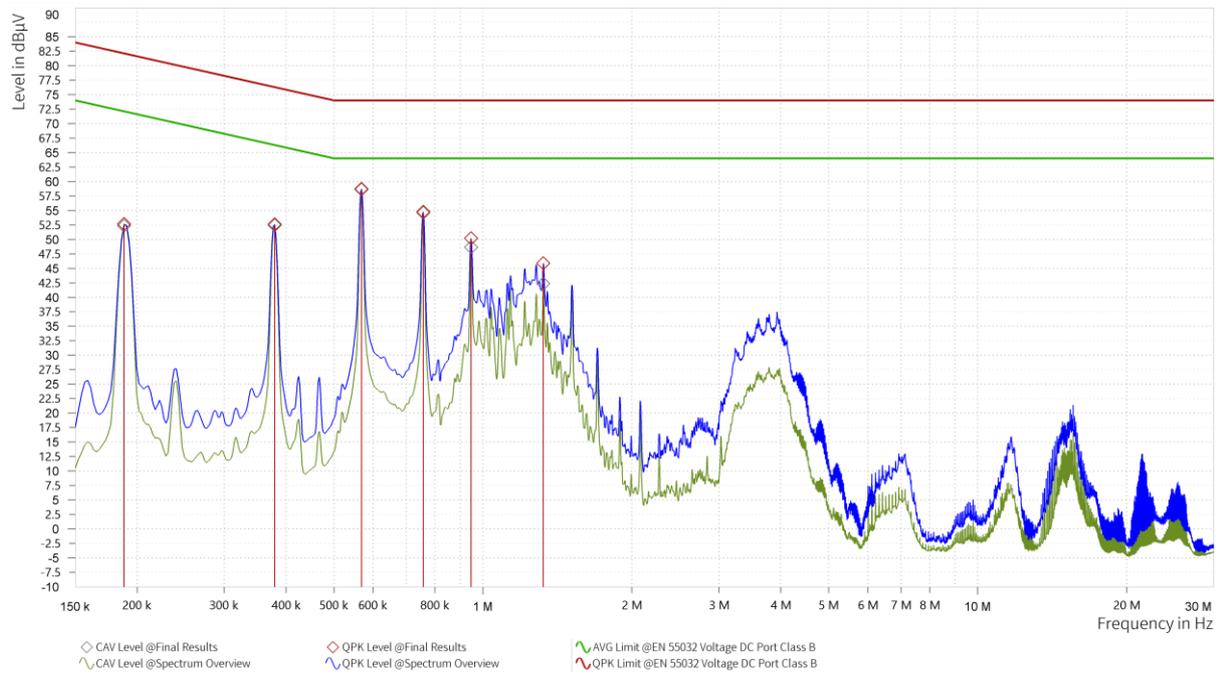
Port under test	Terminal			
<input checked="" type="checkbox"/> DC input power	<input checked="" type="checkbox"/> Positive (+)	<input checked="" type="checkbox"/> Negative (-)		
<input type="checkbox"/> Other:	<input type="checkbox"/> Positive (+)	<input type="checkbox"/> Negative (-)		
Voltage – Mains [V]	48 Vdc			
Frequency – Mains [Hz]	N/A			
Test method applied	<input checked="" type="checkbox"/>	Artificial mains network as specified EN 55016-1-2		
	<input type="checkbox"/>	Artificial Network (AN) as specified in CISPR 25 Annex D		
Test setup	<input checked="" type="checkbox"/>	Table top	<input type="checkbox"/>	Artificial hand applied
	<input type="checkbox"/>	Floor standing	<input type="checkbox"/>	Other:
	Refer to the Annex 3 for test setup photo(s).			
Operating mode(s) used	Mode 1			
Remark	---			

See next page.

<b>Measurement data</b>	Port under test	DC input power
-------------------------	-----------------	----------------

Operating mode / voltage	Mode 1 / 48 Vdc
--------------------------	-----------------

PV 1- Positive (+)



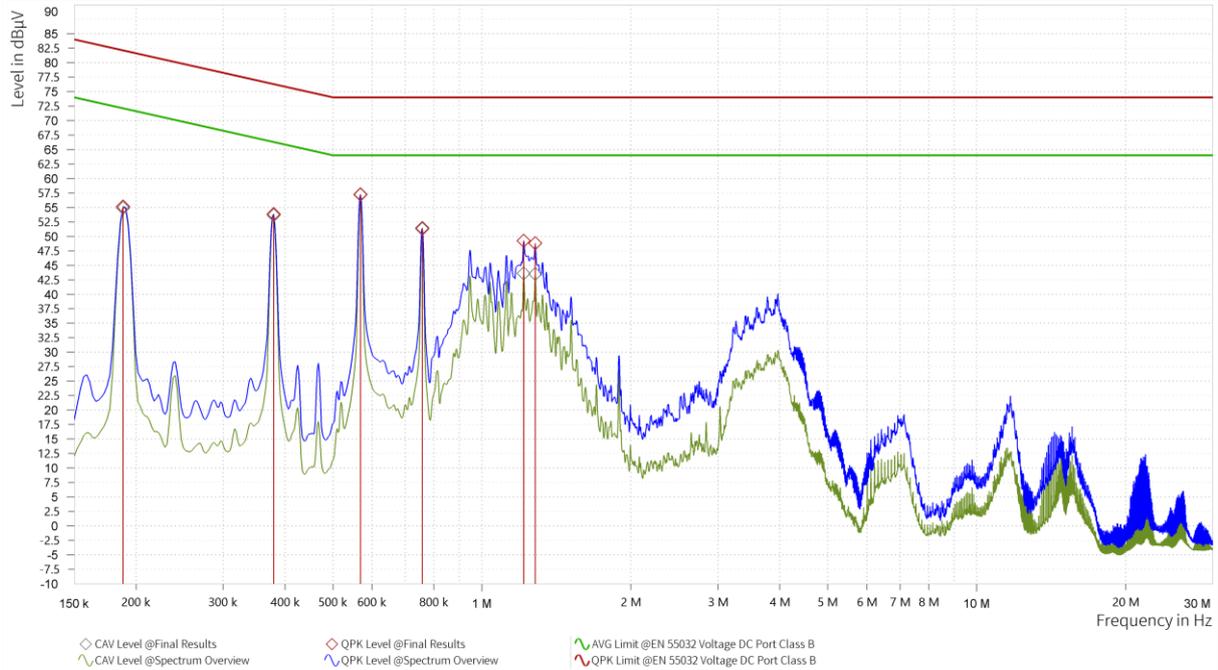
Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	CAV Level [dBµV]	CAV: AVG Limit [dBµV]	CAV Margin [dB]	Correction [dB]	Line
0.188	52.65	82.11	29.46	52.37	72.11	19.74	9.78	Positive
0.380	52.63	76.29	23.66	52.45	66.29	13.84	9.75	Positive
0.569	58.72	74.00	15.28	58.62	64.00	5.38	9.74	Positive
0.758	54.76	74.00	19.24	54.60	64.00	9.40	9.81	Positive
0.947	50.19	74.00	23.81	48.64	64.00	15.36	9.87	Positive
1.325	45.88	74.00	28.12	42.34	64.00	21.66	9.87	Positive

Remark	1. QPK Level [dBµV]=Reading QPK Level [dBµV] + Correction [dB] 2. CAV Level [dBµV]=Reading CAV Level [dBµV] + Correction [dB] 3. Correction [dB]= AMN VDF [dB] + Cable Loss [dB]
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<b>Measurement data</b>	Port under test	DC input power
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Operating mode / voltage	Mode 1 / 48 Vdc
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PV 1- Negative (-)



Frequency [MHz]	QPK Level [dBµV]	QPK Limit [dBµV]	QPK Margin [dB]	CAV Level [dBµV]	CAV: AVG Limit [dBµV]	CAV Margin [dB]	Correction [dB]	Line
0.188	55.14	82.11	26.97	54.91	72.11	17.20	9.83	Negative
0.380	53.86	76.29	22.43	53.67	66.29	12.62	9.78	Negative
0.569	57.27	74.00	16.73	57.17	64.00	6.83	9.74	Negative
0.758	51.44	74.00	22.56	51.27	64.00	12.73	9.82	Negative
1.214	49.25	74.00	24.75	43.62	64.00	20.38	9.90	Negative
1.282	48.84	74.00	25.16	43.53	64.00	20.47	9.90	Negative

Remark	1. QPK Level [dBµV]=Reading QPK Level [dBµV] + Correction [dB] 2. CAV Level [dBµV]=Reading CAV Level [dBµV] + Correction [dB] 3. Correction [dB]= AMN VDF [dB] + Cable Loss [dB]
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<b>4.3 Radiated electromagnetic disturbances (30 – 1000 MHz)</b>	<b>VERDICT: PASS</b>
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Standard	ETSI EN 301 489-3, ETSI EN 301 489-1
Basic standard(s)	EN 55032, EN 55016-2-3
Test method	Antenna method according to EN 55032 standard.
<b>NOTE:</b> This test is only applicable to ancillary equipment not incorporated in the radio equipment and intended to be measured on a stand-alone basis, as declared by the manufacturer.	

**Limits – Class B**

Frequency [MHz]	Limit: QP [dB(μV/m) <sup>1)</sup>			IF BW	Detector
	@3 m.	@5 m.	@10 m.		
30 - 230	40	36	30	120 KHz	QP
230 - 1000	47	43	37	120 KHz	QP

<sup>1)</sup> At the transition frequency, the lower limit applies.

**Limits – Class A**

Frequency [MHz]	Limit: QP [dB(μV/m) <sup>1)</sup>			IF BW	Detector
	@3 m.	@5 m.	@10 m.		
30 - 230	50	46	40	120 KHz	QP
230 - 1000	57	53	47	120 KHz	QP

<sup>1)</sup> At the transition frequency, the lower limit applies.

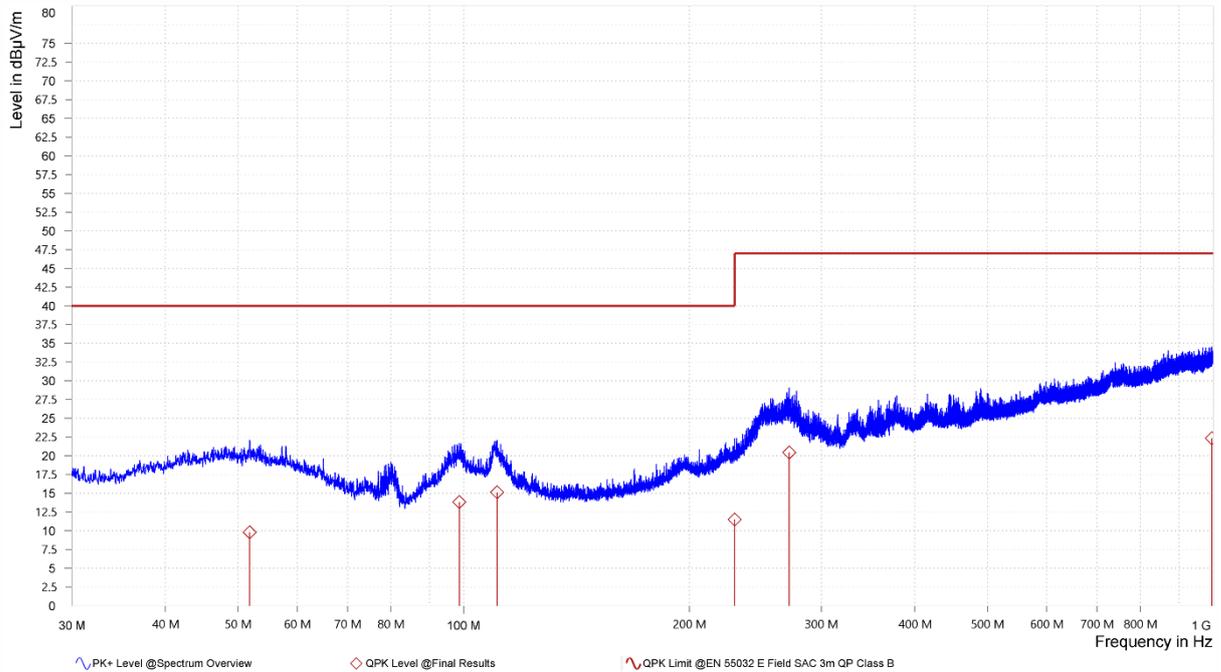
**Performed measurements**

Port under test	Enclosure				
Voltage – Mains [V]	230				
Frequency – Mains [Hz]	50				
Test method applied	<input checked="" type="checkbox"/>	OATS or SAC with measurement distance [m]: 3 m.			
	<input type="checkbox"/>	OATS or SAC with measurement distance [m]: 5 m.			
	<input type="checkbox"/>	OATS or SAC with measurement distance [m]: 10 m.			
Test setup	<input checked="" type="checkbox"/>	Equipment on a table of 80 cm height			
	<input type="checkbox"/>	Equipment on the floor (insulated from ground plane)			
	<input type="checkbox"/>	Other:			
Refer to the Annex 3 for test setup photo(s).					
Operating mode(s) used	1,2				
Remark	The disturbance level was investigated at all operating modes listed at chapter 2.1 respectively. The worst case results were reported.				

See next page.

Measurement data	<input checked="" type="checkbox"/> Horizontal	<input type="checkbox"/> Vertical
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Operating mode / voltage / frequency used during the test    Mode 1 / 230 Vac / 50 Hz and DC 48 V

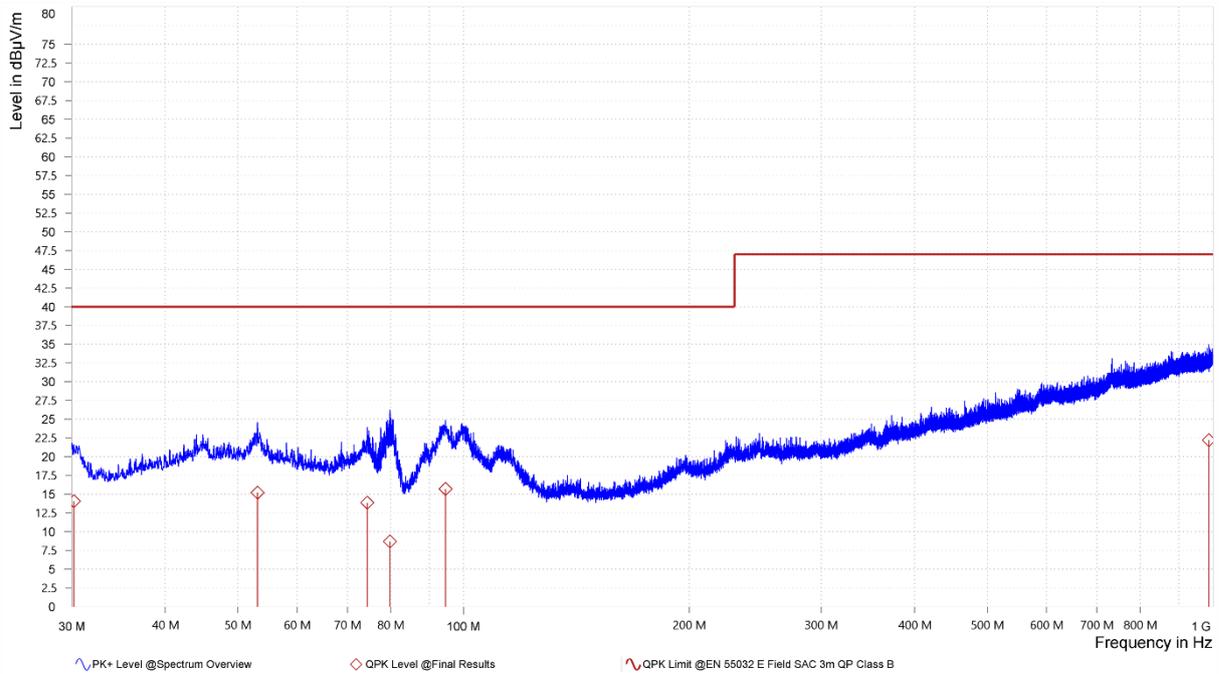


Frequency [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	Correction [dB]	Polarization
51.840	9.82	40.00	30.18	21.06	H
98.700	13.85	40.00	26.15	18.93	H
110.820	15.13	40.00	24.87	18.49	H
229.920	11.49	40.00	28.51	19.88	H
271.920	20.46	47.00	26.54	20.61	H
996.330	22.34	47.00	24.66	32.24	H

Remark	1. QPK Level [dBµV/m]=Reading QPK Level [dBµV/m] + Correction [dB/m] 2. Correction [dB/m]=Antenna Factor [dB/m] + Cable Loss [dB]
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Measurement data	<input type="checkbox"/>	Horizontal	<input checked="" type="checkbox"/>	Vertical
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Operating mode / voltage / frequency used during the test    Mode 1 / 230 Vac / 50 Hz and DC 48 V



Frequency [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	Correction [dB]	Polarization
30.210	14.09	40.00	25.91	17.37	V
53.130	15.22	40.00	24.78	21.04	V
74.400	13.87	40.00	26.13	15.37	V
79.800	8.69	40.00	31.31	14.26	V
94.650	15.70	40.00	24.30	18.34	V
987.840	22.20	47.00	24.80	32.09	V

**Remark**

1. QPK Level [dBµV/m]=Reading QPK Level [dBµV/m] + Correction [dB/m]
2. Correction [dB/m]=Antenna Factor [dB/m] + Cable Loss [dB]

<b>4.4 Radiated electromagnetic disturbances (above 1 GHz)</b>	<b>VERDICT: PASS</b>
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Standard	ETSI EN 301 489-3, ETSI EN 301 489-1	
Basic standard(s)	EN 55032, EN 55016-2-3	
Test method	Antenna method according to EN 55032 standard.	
Required highest frequency for radiated measurement		
	Highest internal frequency [ $f_x$ ]	Highest measured frequency
<input type="checkbox"/>	$f_x \leq 108$ MHz	1 GHz
<input type="checkbox"/>	$108$ MHz < $f_x \leq 500$ MHz	2 GHz
<input type="checkbox"/>	$500$ MHz < $f_x \leq 1$ GHz	5 GHz
<input checked="" type="checkbox"/>	$f_x \geq 1$ GHz	$5x f_x$ or up to 6 GHz

**Limits – Class B**

Frequency [GHz]	Limit: PK@3m.[dB( $\mu$ V/m) <sup>1)</sup> ]	Limit: AV@3m.[dB( $\mu$ V/m) <sup>1)</sup> ]	IF BW	Detector
1 - 3	70	50	1 MHz	PK, CAV
3 - 6	74	54	1 MHz	PK, CAV

<sup>1)</sup> At the transition frequency, the lower limit applies.

**Limits – Class A**

Frequency [GHz]	Limit: PK@3m.[dB( $\mu$ V/m) <sup>1)</sup> ]	Limit: AV@3m.[dB( $\mu$ V/m) <sup>1)</sup> ]	IF BW	Detector
1 - 3	76	56	1 MHz	PK, CAV
3 - 6	80	60	1 MHz	PK, CAV

<sup>1)</sup> At the transition frequency, the lower limit applies.

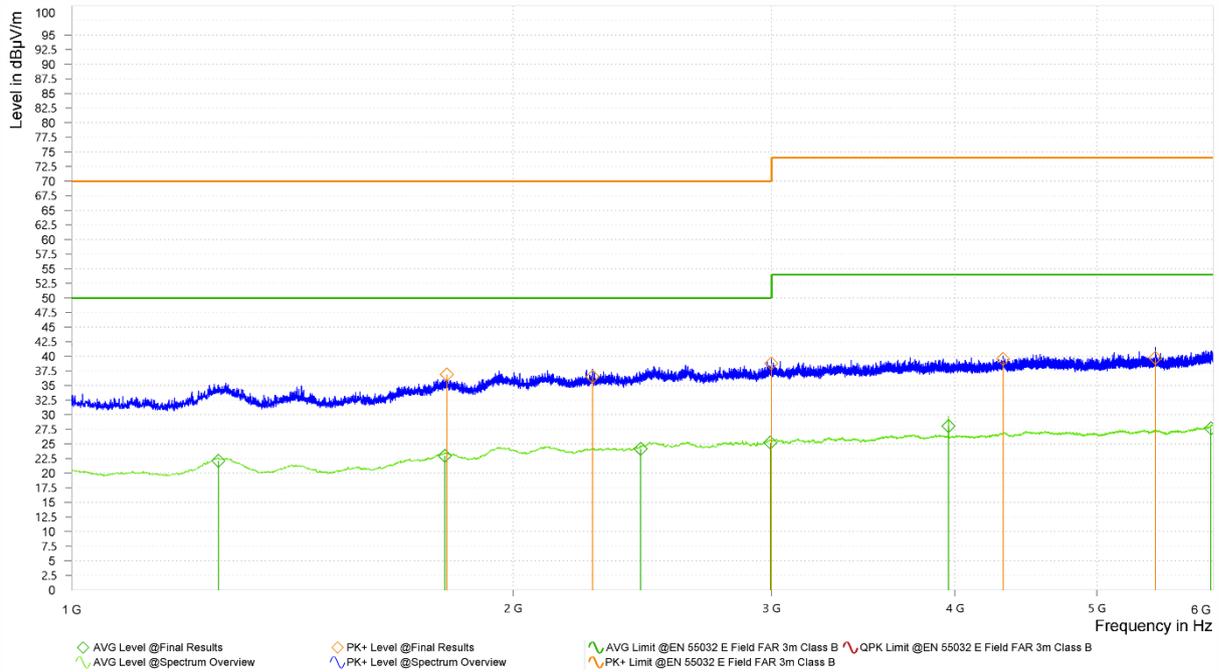
**Performed measurements**

Port under test	Enclosure	
Voltage – Mains [V]	230	
Frequency – Mains [Hz]	50	
Test method applied	<input checked="" type="checkbox"/>	Absorber-lined OATS or SAC with measurement distance [m]: 3 m.
	<input type="checkbox"/>	Absorber-lined OATS or SAC with measurement distance [m]: 1 m.
Test setup	<input checked="" type="checkbox"/>	Equipment on a table of 80 cm height
	<input type="checkbox"/>	Equipment on the floor (insulated from ground plane)
	<input type="checkbox"/>	Other:
Refer to the Annex 3 for test setup photo(s).		
Operating mode(s) used	1,2	
Remark	The disturbance level was investigated at all operating modes listed at chapter 2.1 respectively. The worst case results were reported.	

See next page.

Measurement data	<input checked="" type="checkbox"/> Horizontal	<input type="checkbox"/> Vertical
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Operating mode / voltage / frequency used during the test    Mode 1 / 230 Vac / 50 Hz



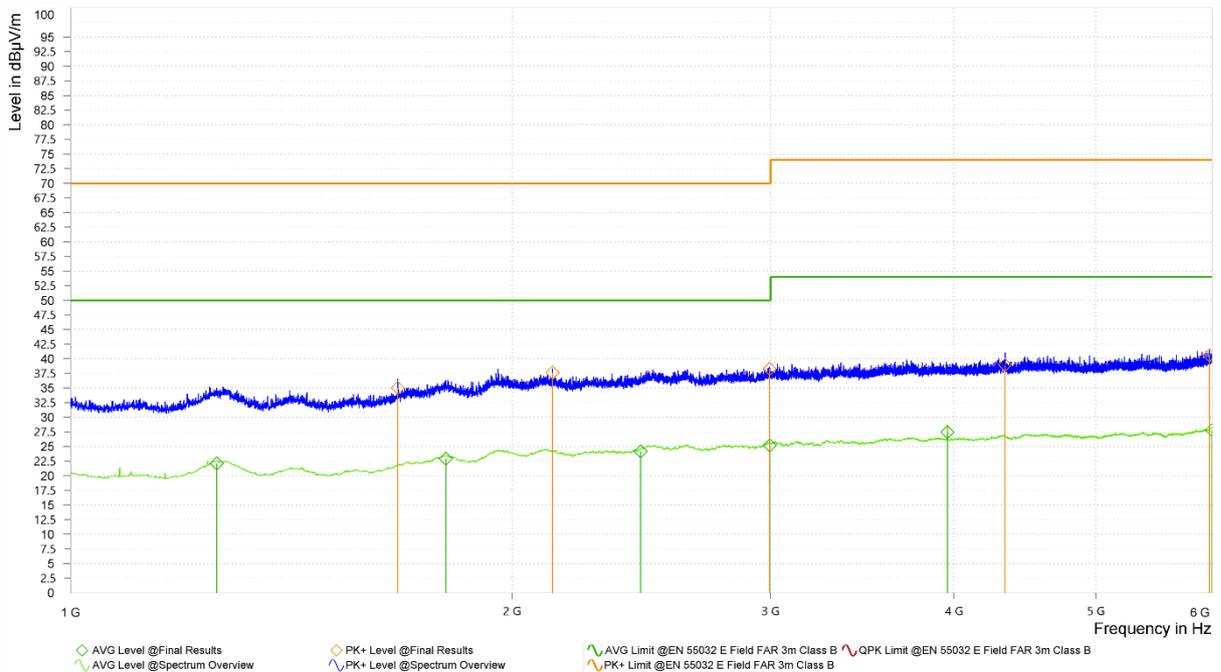
Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Polarization
1,259.000				22.09	50.00	27.91	-9.70	H
1,796.750				22.94	50.00	27.06	-7.79	H
1,802.500	36.90	70.00	33.10				-7.76	H
2,265.750	36.51	70.00	33.49				-6.15	H
2,443.250				24.15	50.00	25.85	-5.30	H
2,994.000				25.22	50.00	24.78	-3.95	H
2,999.500	38.76	70.00	31.24				-3.91	H
3,961.500				28.05	54.00	25.95	-2.08	H
4,316.250	39.56	74.00	34.44				-1.33	H
5,481.000	39.72	74.00	34.28				0.92	H
5,981.500				27.67	54.00	26.33	2.34	H

- PK Level [dBµV/m]=Reading PK Level [dBµV/m] + Correction [dB/m]
- AVG Level [dBµV/m]=Reading AVG Level [dBµV/m] + Correction [dB/m]
- Correction [dB/m]=Antenna Factor [dB/m] + Cable Loss [dB]

Remark

Measurement data	<input type="checkbox"/>	Horizontal	<input type="checkbox"/>	Vertical
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Operating mode / voltage / frequency used during the test    Mode 1 / 230 Vac / 50 Hz



Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AVG Level [dBµV/m]	AVG Limit [dBµV/m]	AVG Margin [dB]	Correction [dB]	Polarization
1,258.000				22.08	50.00	27.92	-9.69	V
1,671.500	35.00	70.00	35.00				-9.38	V
1,802.500				22.94	50.00	27.06	-7.76	V
2,131.000	37.63	70.00	32.37				-6.30	V
2,447.000				24.16	50.00	25.84	-5.28	V
2,996.000	38.27	70.00	31.73				-3.94	V
2,997.250				25.19	50.00	24.81	-3.93	V
3,961.750				27.44	54.00	26.56	-2.08	V
4,337.000	38.96	74.00	35.04				-1.35	V
5,976.750	40.59	74.00	33.41				2.32	V
6,000.000				27.79	54.00	26.21	2.44	V

- PK Level [dBµV/m]=Reading PK Level [dBµV/m] + Correction [dB/m]
- AVG Level [dBµV/m]=Reading AVG Level [dBµV/m] + Correction [dB/m]
- Correction [dB/m]=Antenna Factor [dB/m] + Cable Loss [dB]

Remark

## 5 IMMUNITY TEST RESULTS

### 5.1 Performance (Compliance) criteria

The performance criteria are:

- Performance criteria A for immunity tests with phenomena of a continuous nature;
- Performance criteria B for immunity tests with phenomena of a transient nature;
- Performance criteria C for immunity tests with power interruptions exceeding a certain time.

The equipment shall meet the minimum performance criteria as specified for each test.

Criteria	During test	After test
<b>A</b>	Shall operate as intended. (see note 1). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance (see note 3). Shall be no loss of function. Shall be no loss of stored data or user programmable functions.
<b>B</b>	May show loss of function (one or more). May show degradation of performance (see note 2). Shall be no unintentional transmissions.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no degradation of performance (see note 3). Shall be no loss of stored data or user programmable functions.
<b>C</b>	May be loss of function (one or more).	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no degradation of performance (see note 3)

**NOTE 1:** Operate as intended during the test allows a level of degradation not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

**NOTE 2:** Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

**NOTE 3:** No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

#### 5.1.1 Performance criteria for Continuous phenomena applied to Transmitters (CT)

The performance criteria A shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACKnowledgement (ACK) or Not ACKnowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

#### 5.1.2 Performance criteria for Transient phenomena applied to Transmitters (TT)

The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration, for which performance criteria C shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an acknowledgement (ACK) or not-acknowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

#### 5.1.3 Performance criteria for Continuous phenomena applied to Receivers (CR)

The performance criteria A shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

#### 5.1.4 Performance criteria for Transient phenomena applied to Receivers (TR)

The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration for which performance criteria C shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

#### 5.1.5 Performance criteria related to immunity tests

Immunity test	Performance criteria
Electrostatic discharge	B
Radio-frequency electromagnetic fields	A
Fast transients	B
Surge transient	B
Injected currents (radio-frequency common mode)	A
Voltage dips and short interruptions	B, C

#### 5.1.6 Manufacturer defined performance criteria

Not provided.

**5.2 Monitored – Checked Functions / Parameters**

During the immunity tests the following functions of the EUT has/have been monitored/checked.

<input type="checkbox"/>	Motor speed	<input checked="" type="checkbox"/>	Display data
<input type="checkbox"/>	Switching	<input type="checkbox"/>	Data storage
<input type="checkbox"/>	Standby mode	<input type="checkbox"/>	Sensor functions
<input type="checkbox"/>	Temperature	<input type="checkbox"/>	Audible signals
<input type="checkbox"/>	Power consumption	<input type="checkbox"/>	Others : PER
<input type="checkbox"/>	AC mains input current	<input type="checkbox"/>	Others :
<input type="checkbox"/>	Timing	<input type="checkbox"/>	Others :
<input type="checkbox"/>	Illumination	<input type="checkbox"/>	Others :
<u>Supplementary information :</u>			

Immunity test	Monitored - Checked function(s)/parameter(s) during / after the test	Method
Electrostatic discharge	PASS	Visual
Radio-frequency electromagnetic fields	PASS	Visual / Camera
Fast transients	PASS	Visual
Surge transient	PASS	Visual
Injected currents (radio-frequency common mode)	PASS	Visual
Voltage dips and short interruptions	PASS	Visual
<u>Supplementary information :</u>		

<b>5.3 Electrostatic discharge immunity</b>	<b>VERDICT: PASS</b>
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Electrostatic discharges (ESD) are the result of persons or objects that accumulate static electricity due to for instance walking on synthetic carpets. The ESD can influence the operation of equipment or damage its electronics, either by a direct discharge or indirectly by coupling or radiation. Both effects are simulated during the tests.

**Requirements**

Standard	ETSI EN 301 489-3, ETSI EN 301 489-1							
Basic standard	EN 61000-4-2							
Port under test	Enclosure							
Air discharges	<input checked="" type="checkbox"/>	±2 kV	<input checked="" type="checkbox"/>	±4 kV	<input checked="" type="checkbox"/>	±8 kV	<input type="checkbox"/>	kV
Contact discharges	<input checked="" type="checkbox"/>	±2 kV	<input checked="" type="checkbox"/>	±4 kV	<input type="checkbox"/>	±8 kV	<input type="checkbox"/>	kV
Number of discharges	≥ 10 per polarity with ≥ 1 sec interval.							

**Performed tests**

Set-up	<input checked="" type="checkbox"/>	Table-top	<input type="checkbox"/>	Floor standing
Ambient temperature [°C]	27		Relative Humidity air [%]	52
Voltage – Mains [V]	230			
Frequency – Mains [Hz]	50			
Operating mode(s) used	1,2			

	Test Point (Location of discharge, see also photo)	Test Voltage [kV] & Polarity	Coupling type	# of applied discharges / polarity	Discharge interval [s]
<input checked="" type="checkbox"/>	Points on conductive surface.	±2 / ±4	Contact	10	1
<input checked="" type="checkbox"/>	Points on non-conductive surface.	±2 / ±4 / ±8	Air	10	1
<input checked="" type="checkbox"/>	HCP top side.	±4	Contact	10	1
<input checked="" type="checkbox"/>	HCP bottom side.	±4	Contact	10	1
<input checked="" type="checkbox"/>	VCP right side.	±4	Contact	10	1
<input checked="" type="checkbox"/>	VCP left side.	±4	Contact	10	1
<input checked="" type="checkbox"/>	VCP front side.	±4	Contact	10	1
<input checked="" type="checkbox"/>	VCP rear side.	±4	Contact	10	1

Observation(s)	During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance or data was observed.
<u>Supplementary information:</u>	

<b>5.4</b>	<b>Radio-frequency electromagnetic fields immunity</b>	<b>VERDICT: PASS</b>
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During the test it is verified if the equipment under test (EUT) has sufficient immunity against radiated electromagnetic fields. Industrial electromagnetic sources, walkie-talkies, radio transmitters, television transmitters and telecommunication equipment including cellular telephones and other emitting devices can generate these fields.

**Requirements**

Standard	ETSI EN 301 489-3,ETSI EN 301 489-1			
Basic standard	EN 61000-4-3			
Port under test	Enclosure			
Frequency range	Test level	Modulation <sup>1)</sup>	Dwell time	Step size
80 - 1000 MHz	3 V/m	80% AM (1kHz)	≥ 0,5 s	≤ 1%
1000 - 6000 MHz	3 V/m	80% AM (1kHz)	≥ 0,5 s	≤ 1%
<u>Supplementary information:</u>				
<sup>1)</sup> The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1000 Hz. If the wanted signal is modulated at 1000 Hz, then an audio signal of 400 Hz shall be used.				

**Performed tests**

Test method	<input checked="" type="checkbox"/>	EN 61000-4-3	<input type="checkbox"/>	EN 61000-4-20		
Test set-up	<input checked="" type="checkbox"/>	Equipment on the table (0,8 m height)				
(see annex 3 for photo)	<input type="checkbox"/>	Equipment standing on floor (0,05 – 0,15 m height)				
Voltage – Mains [V]	230		Frequency – Mains [Hz]	50		
Operating mode(s) used	1,2					
Frequency range (applied)	Antenna Polarization	Test level (applied)	Modulation (applied)	Dwell time (applied)	Remark	
80 – 1000 MHz (step size 1%)	H	3 V/m	80% AM (1kHz)	2 s	---	
	V	3 V/m	80% AM (1kHz)	2 s	---	
1000 – 6000 MHz (step size 1%)	H	3 V/m	80% AM (1kHz)	2 s	---	
	V	3 V/m	80% AM (1kHz)	2 s	---	
Exposed side of the EUT	<input checked="" type="checkbox"/>	Front (0°)	<input checked="" type="checkbox"/>	Right (90°)	<input type="checkbox"/>	Top
	<input checked="" type="checkbox"/>	Rear (180°)	<input checked="" type="checkbox"/>	Left (270°)	<input type="checkbox"/>	Bottom
Observation(s)	During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance or data was observed.					
<u>Supplementary information:</u>						

<b>Electrical Fast Transients immunity</b>	<b>VERDICT: PASS</b>
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The EFT immunity test simulates disturbances by bursts of very short transients caused for example by switching off loads such as an AC motor or bouncing relay contacts. The transients are likely to disturb electronics but less likely to cause damage.

### Requirements

Standard	ETSI EN 301 489-3, ETSI EN 301 489-1			
Basic standard	EN 61000-4-4			
Pulse characteristics	5/50 ns			
Port under test	Test level	Repetition frequency	Duration	
<input checked="" type="checkbox"/> AC input-output power	± 1000 V	5 KHz	2 min. / polarity	
<input checked="" type="checkbox"/> DC input-output power <sup>1) 2)</sup>	± 500 V	5 KHz	2 min. / polarity	
<input type="checkbox"/> Signal/Control/Wired network <sup>1)</sup>	± 500 V	5 KHz	2 min. / polarity	
<input type="checkbox"/> xDSL network	± 500 V	100 KHz	2 min. / polarity	
<sup>1)</sup> Only applicable to ports interfacing with cables whose total length may exceed 3 m. <sup>2)</sup> Only applicable to equipment that is connected to the mains while in use.				

### Performed tests

Voltage – Mains [V]	230		
Frequency – Mains [Hz]	50		
Operating mode(s) used	1,2		
Test Set-up (see annex 3 for photo)	<input checked="" type="checkbox"/>	Equipment standing on floor at (0,1 ± 0,01) m above ground plane	
	<input type="checkbox"/>	Equipment on the table (0,1 ± 0,01) m above ground plane	
	<input type="checkbox"/>	Artificial hand applied. Location refer to chapter 9.	
Coupling	<input checked="" type="checkbox"/>	Common mode	<input type="checkbox"/> Other:

Port under test	Test Voltage & Polarity	Repetition Frequency	Test duration / polarity	Injection method		
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
AC / DC mains power input	±1 kV	5 KHz	2 min	<input checked="" type="checkbox"/>	CDN	<input type="checkbox"/> Clamp
AC / DC power output		5 KHz		<input type="checkbox"/>	CDN	<input type="checkbox"/> Clamp
Ethernet / LAN	±0.5 kV	5 KHz	2 min	<input type="checkbox"/>	CDN	<input checked="" type="checkbox"/> Clamp
I / O signal		5 KHz		<input type="checkbox"/>	CDN	<input type="checkbox"/> Clamp
xDSL network		100 KHz		<input type="checkbox"/>	CDN	<input type="checkbox"/> Clamp
Observation(s)	During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance or data was observed.					
Supplementary information:						

<b>5.6</b>	<b>Surge transient immunity</b>	<b>VERDICT: PASS</b>
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The surge transient immunity test simulates the surges that are caused by over-voltages due to indirect (induced) lightning transients. The pulse is a slow transient with high-energy contents and due to its long duration may cause damage to an unprotected EUT.

**Requirements**

Standard		ETSI EN 301 489-3, ETSI EN 301 489-1		
Basic standard		EN 61000-4-5		
Pulse characteristics		1,2/50µs Voltage; 8/20µs Current		
Repetition rate		≤ 60 secs. (for each test level and phase angle)		
Number of pulses		5 pulses (at each polarity and phase angle)		
Port		Test level & Polarity & Coupling		Phase angle [°]
		Line to Line	Line to Earth	
<input checked="" type="checkbox"/>	AC mains power input	±1 kV	±2 kV	0, 90, 180, 270
<input type="checkbox"/>	Wired network, indoor cables >30m. <sup>3)</sup>	N/A	±0,5 kV	---
<input checked="" type="checkbox"/>	Symmetrically operated wired network, outdoor cables <sup>2) 3)</sup>	N/A	±1 kV	---
<input type="checkbox"/>	Non-symmetrically operated wired network, outdoor cables <sup>1) 3)</sup>	± 0,5 kV	±1 kV	---
<sup>1)</sup> In addition to the specified test level, all lower test levels as detailed in EN 61000-4-5 should also be satisfied. <sup>2)</sup> The test generator shall provide the 10/700 µs pulse as defined in EN 61000-4-5, clause 6.2. <sup>3)</sup> No test shall be required where normal functioning cannot be achieved, because of the impact of the CDN on the EUT.				

**Performed tests**

Voltage – Mains [V]	230
Frequency – Mains [Hz]	50
Operating mode(s) used	1,2,3,4
Repetition rate	60 secs. (for each test level and phase angle)
Number of pulses	5 pulses (at each polarity and phase angle)

Port under test	Coupling	Test level & Polarity	Phase angle [°]	Remark
<input checked="" type="checkbox"/> AC mains input power	Line to Neutral	±0,5 / ±1 kV	0, 90, 180, 270	---
<input type="checkbox"/> AC mains input power	Line to Earth	±0,5 / ±1 / ±2 kV	0, 90, 180, 270	---
<input type="checkbox"/> AC mains input power	Neutral to Earth	±0,5 / ±1 / ±2 kV	0, 90, 180, 270	---
<input checked="" type="checkbox"/> Wired network port	Line to Earth	±0,5 / ±1 kV	-	---

Observation(s) During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance or data was observed.

Supplementary information:  
 1. The EUT does not include an earth port.

<b>5.7</b>	<b>Injected currents (RF common mode) immunity</b>	<b>VERDICT: PASS</b>
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During this test the immunity of the equipment for induced or conducted electromagnetic fields is checked. Fields generated by radio and other transmitters cause RF voltages in long cables like the mains network. This test reproduces these induced disturbing voltages by injecting them to the EUT via the cabling.

#### Requirements

Standard	ETSI EN 301 489-3, ETSI EN 301 489-1				
Basic standard	EN 61000-4-6				
Frequency range	0,15 – 80 MHz				
Port under test	Test level, $U_0$	Modulation <sup>3)</sup>	Step size	Dwell time	
<input checked="" type="checkbox"/> AC input-output power	3 V	80% AM (1kHz)	1%	≥ 0,5 s	
<input type="checkbox"/> DC input-output power <sup>1)</sup>	3 V	80% AM (1kHz)	1%	≥ 0,5 s	
<input checked="" type="checkbox"/> Signal/Control/Wired network <sup>1) 2)</sup>	3 V	80% AM (1kHz)	1%	≥ 0,5 s	
<sup>1)</sup> Only applicable to ports interfacing with cables whose total length may exceed 3 m. <sup>2)</sup> Change of state commands are not applied during the test. <sup>3)</sup> The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1000 Hz. If the wanted signal is modulated at 1000 Hz, then an audio signal of 400 Hz shall be used.					

#### Performed tests

Test method (applied)	Frequency range (applied)	Modulation (applied)	Step size (applied)		
EN 61000-4-6	0,15 – 80 MHz	80% AM (1kHz)	1%		
Voltage – Mains [V]	230	Frequency – Mains [Hz]	50		
Operating mode(s) used	1,2				
Test set-up (see annex 3 for photo)	<input type="checkbox"/>	Equipment standing on floor at (0,1 ± 0,01) m above ground plane.			
	<input checked="" type="checkbox"/>	Equipment on the table (0,1 ± 0,01) m above ground plane.			
	<input type="checkbox"/>	Artificial hand applied. Location refer to Annex 3.			
Port under test	Test Level (applied)	Injection method	Dwell time (applied)	Remark	
AC mains power input	3 V	CDN-M3	3s	---	
Wired network Port	3 V	RF-Injection Clamp	3s	---	
Observation(s)	During the test no loss of performance was observed. After the test the EUT functioned as intended. No unacceptable loss of performance or data was observed.				
<u>Supplementary information:</u>					
1. During the test the metal enclosure of the EUT was connected to the reference ground plane through CDN-M1, the RF port was terminated with 50 Ohm.					

## 6 IDENTIFICATION OF THE EQUIPMENT UNDER TEST

### EUT PHOTO



## 7 ANNEX 1 - MEASUREMENT UNCERTAINTIES

The table(s) below show(s) measurement uncertainties of the EMC test set-ups. The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Emission tests		$U_{LAB}$	$U_{CISPR}$
Conducted disturbance using AMN 9 kHz – 150 kHz	Shielded Room No.2 AMN: R&S ENV216	3.0 dB	3.8 dB
Conducted disturbance using AMN 150 kHz – 30 MHz		2.5 dB	3.4 dB
Conducted disturbance using AMN 9 kHz – 150 kHz	Shielded Room No.2 AMN: R&S ENV432	3.2 dB	3.8 dB
Conducted disturbance using AMN 150 kHz – 30 MHz		2.7 dB	3.4 dB
Radiated disturbance in a SAC 30 MHz – 1000 MHz	Horizontal polarization	4.8 dB	6.3 dB
	Vertical polarization	5.4 dB	

Immunity tests		$U_{LAB}$	$U_{IEC}$ (Recommendation)
Electrostatic discharge	Rise time ( $t_r$ )	12.4 %	≤ 15 %
	Peak current ( $I_p$ )	6.4 %	≤ 7 %
	Current at 30 ns ( $I_{30}$ )	6.4 %	≤ 7 %
	Current at 60 ns ( $I_{60}$ )	6.4 %	≤ 7 %
Electrical fast transients/burst	Rise time ( $t_r$ )	7.2 %	N/A
	Peak voltage ( $V_p$ )	6.8 %	
	Pulse width ( $t_w$ )	5.4 %	
Surge	Front time ( $t_f$ )	4.3 %	N/A
	Peak voltage ( $V_p$ )	6.7 %	
	Voltage duration ( $T_d$ )	1.3 %	
Conducted disturbances, induced by radio-frequency fields	CDN ( $v$ )	1.6 dB	N/A
	EM clamp ( $v$ )	3.6 dB	
Power frequency magnetic field	Test level: 1 A/m ( $I_1$ )	0.1 A/m	N/A
	Test level: 3 A/m ( $I_3$ )	0.3 A/m	
	Test level: 10 A/m ( $I_{10}$ )	0.8 A/m	
	Test level: 30 A/m ( $I_{30}$ )	2.1 A/m	
Voltage dips, short interruptions and voltage variations	Time at reduced voltage ( $t_s$ )	3.0 %	N/A
	Voltage rising time ( $t_r$ )	3.0 %	
	Voltage fall time ( $t_f$ )	3.0 %	
	Voltage dips ( $v$ )	0.4 %	
Radiated radio-frequency electromagnetic field 80 MHz – 1000 MHz		1.9 dB	N/A
Radiated radio -frequency electromagnetic field 1000 MHz – 6000 MHz		2.0 dB	N/A

## 8 ANNEX 2 – USED EQUIPMENT

### Conducted disturbance -Shielded Room No.2

Equipment	Manufacturer	Model No.	Serial No.	Cal. due date
EMI test receiver	R&S	ESR3	102305	2025/06/13
Four-line V-network	R&S	ENV432	101634	2024/11/28
Artificial Mains Network	R&S	ENV216	102747	2024/11/28
Software	R&S	ELEKTRA	4.32.0	N/A

### Radiated disturbance (30 MHz to 1000 MHz) -Anechoic Chamber No.1

Equipment	Manufacturer	Model No.	Serial No.	Cal. due date
EMI test receiver	R&S	ESR7	102433	2024/11/28
Trilog broadband antenna+Attenuator	SCHWARZBECK	VULB9163/ 6dB	01514	2025/03/12
Open Switch and control unit	R&S	OSP220	102232	N/A
Software	R&S	ELEKTRA	4.20.2	N/A

### Electrostatic discharge immunity

Equipment	Manufacturer	Model No.	Serial No.	Cal. due date
ESD generator	TESEQ	NSG 438	1870	2024/11/23

### Radio-frequency electromagnetic fields immunity (80 MHz~1000 MHz) -Anechoic Chamber No.2

Equipment	Manufacturer	Model No.	Serial No.	Cal. due date
Signal generator	R&S	SMB100B	103114	2024/11/28
Broadband Amplifier	R&S	BBA150 BC250	104841	2024/11/28
High Gain Log-periodic antenna	R&S	HL046E	100355	N/A
Open Switch and control unit	R&S	OSP220	102233	N/A
NRP6AN average power sensor	R&S	NRP6AN	101697	2024/11/28
NRP6AN average power sensor	R&S	NRP6AN	101698	2024/11/28
Field probe	LUMILOOP	LSProbe 1.2	531	2025/10/10
Software	R&S	ELEKTRA	4.20.2	N/A

Fast transient immunity

Equipment	Manufacturer	Model No.	Serial No.	Cal. due date
Compact immunity test system	TESEQ	NSG-3040-MF	2006/EFT:0535	2025/06/13
EFT/Burst capacitive coupling clamp	TESEQ	CDN 3425	1786	N/A

Surge immunity

Equipment	Manufacturer	Model No.	Serial No.	Cal. due date
Compact immunity test system	TESEQ	NSG-3040-MF	2006 /SURGE:1234	2025/06/13
Coupling/Decoupling Network (CDN)	TESEQ	CDN 117-M	35452	N/A

Injected currents immunity

Equipment	Manufacturer	Model No.	Serial No.	Cal. due date
Compact immunity test system	TESEQ	NSG 4070-30	35895	2025/06/13
Coupling/Decoupling Network (CDN)	TESEQ	CDN M016S	34640	2025/06/13
Attenuator	TESEQ	ANT 6050	34847	2025/06/13
EM clamp	TESEQ	KEMZ 801A	35475	2025/06/13

Power frequency magnetic field immunity

Equipment	Manufacturer	Model No.	Serial No.	Cal. due date
AC power source	EMTEST	Netwave7-400	P2136256253	2025/01/21
Magnetic Field Immunity Loop	FCC	F-1000-4-8/9/10-L-1M	05016	2025/01/14

## 9 ANNEX 3 - TEST PHOTOS

### Conducted disturbance voltage at mains output terminals



### Conducted disturbance voltage at DC input terminals



**Radiated electromagnetic disturbances (30 MHz to 1000 MHz)**



**Radiated electromagnetic disturbances (1000 MHz to 6000 MHz)**



### Electrostatic discharge immunity



### Radiated EM Field Immunity



### Radiated EM Field Immunity



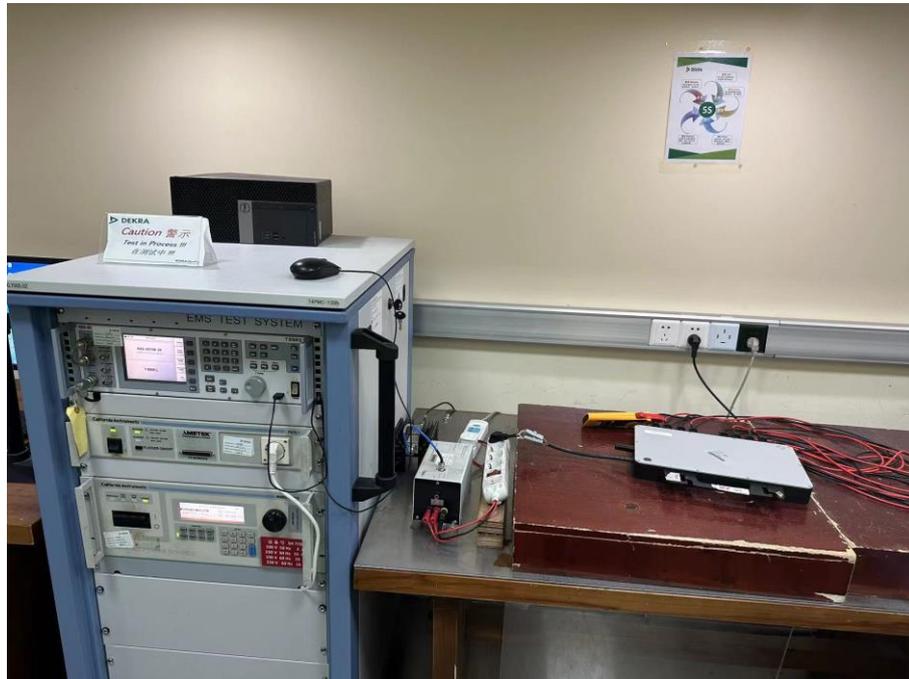
**Electrical fast transient (EFT) / Burst transients immunity**



**Surge transients immunity**



### Conducted RF disturbances immunity



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