

KEMA REPORT OF PERFORMANCE

1539-20

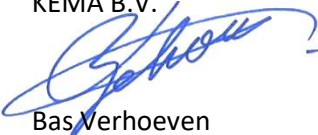
Object	Feeder & Generator Protection Relay		
Type	SIL-G	Serial No.	See chapter 2.2
Operating range	-40 - +70 °C	EMC emission class	A
Mechanical class	1	EMC immunity zone	A
Auxiliary power supply	24-220 Vdc / 48-230 Vac		
Client	Fanox Electronic, S.L., 48160 Derio, Bizkaia, Spain		
Manufacturer	Fanox Electronic, S.L., 48160 Derio, Bizkaia, Spain *)		
Tested by	KEMA B.V., Klingelbeekseweg 195, Arnhem, The Netherlands		
Date of tests	7 November 2019 to 2 December 2020		
Test specification	The tests have been carried out in accordance with IEC 60255-1:2009, subclause 6.12, 6.13, 6.15.		
Summary and conclusion	The object has complied with the relevant requirements of the standard.		

This report applies only to the object tested. The responsibility for conformity of any object having the same type references as that tested rests with the Manufacturer.

*) as declared by the manufacturer

This report consists of 141 pages in total.

KEMA B.V.


Bas Verhoeven
Director, High-Voltage
Laboratory

Arnhem, 26 January 2021

INFORMATION SHEET

1 KEMA Type Test Certificate

A KEMA Type Test Certificate contains a record of a series of (type) tests carried out in accordance with a recognized standard. The object tested has fulfilled the requirements of this standard and the relevant ratings assigned by the manufacturer are endorsed by KEMA Labs. In addition, the object's technical drawings have been verified and the condition of the object after the tests is assessed and recorded. The Certificate contains the essential drawings and a description of the object tested. A KEMA Type Test Certificate signifies that the object meets all the requirements of the named subclauses of the standard. It can be identified by gold-embossed lettering on the cover and a gold seal on its front sheet.

The Certificate is applicable to the object tested only. KEMA Labs is responsible for the validity and the contents of the Certificate. The responsibility for conformity of any object having the same type references as the one tested rests with the manufacturer.

Detailed rules on types of certification are given in KEMA LABS's Certification procedure applicable to KEMA Labs.

2 KEMA Report of Performance

A KEMA Report of Performance is issued when an object has successfully completed and passed a subset (but not all) of test programmes in accordance with a recognized standard. In addition, the object's technical drawings have been verified and the condition of the object after the tests is assessed and recorded. The report is applicable to the object tested only. A KEMA Report of Performance signifies that the object meets the requirements of the named subclauses of the standard. It can be identified by silver-embossed lettering on the cover and a silver seal on its front sheet.

The sentence on the front sheet of a KEMA Report of Performance will state that the tests have been carried out in accordance with The object has complied with the relevant requirements.

3 KEMA Test Report

A KEMA Test Report is issued in all other cases. Reasons for issuing a KEMA Test Report could be:

- Tests were performed according to the client's instructions.
- Tests were performed only partially according to the standard.
- No technical drawings were submitted for verification and/or no assessment of the condition of the object after the tests was performed.
- The object failed one or more of the performed tests.

The KEMA Test Report can be identified by the grey-embossed lettering on the cover and grey seal on its front sheet.

In case the number of tests, the test procedure and the test parameters are based on a recognized standard and related to the ratings assigned by the manufacturer, the following sentence will appear on the front sheet. The tests have been carried out in accordance with the client's instructions. Test procedure and test parameters were based on If the object does not pass the tests such behaviour will be mentioned on the front sheet. Verification of the drawings (if submitted) and assessment of the condition after the tests is only done on client's request.

When the tests, test procedure and/or test parameters are not in accordance with a recognized standard, the front sheet will state the tests have been carried out in accordance with client's instructions.

4 Official and uncontrolled test documents

The official test documents of KEMA Labs are issued in bound form. Uncontrolled copies may be provided as a digital file for convenience of reproduction by the client. The copyright has to be respected at all times.

REVISION OVERVIEW

Rev. No	Date of issue	Reason for issue
0	21 December 2020	First issue
1	26 January 2021	Update object description front page

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1 SUMMARY

By order of the client type tests according to IEC 60255-1 have been performed on the test object.

Test / Measurement	Test result
Dimensions of structure and visual inspection	Passed
Functional requirements	Passed
Product safety ¹⁾	Passed
Electromagnetic compatibility (EMC)	Passed
Burden	Passed
Climatic environmental conditions	Passed
Mechanical environmental conditions	Passed
Enclosure protection	Passed

Note

¹⁾The short-time overcurrent specified for the 5 A CT inputs is 500 A, for 1 second.

During the testing period the following changes were made to the test object:

- Change 1: Software update to 19 October 2020
During the Fast-transient burst test (EFT), the pickup tripped a relay, after the software update this behavior was not been seen.
- After the first mechanical test several changes has been made for EMC and mechanical structure of the printed circuit boards.

2 IDENTIFICATION OF THE OBJECT TESTED

2.1 Ratings/characteristics of the object tested

Rated voltage, U_R	110-250 Vac
Rated current I_R	1/5 A
Rated frequency	50/60 Hz
Rated auxiliary voltage	24-220 Vdc
	48-230 Vac
Binary input voltage	24-220 Vdc
	48-230 Vac
Output contact continuous current	5 A
Maximum operating temperature	+70 °C
Minimum operating temperature	-40 °C
Maximum storage temperature	+80 °C
Minimum storage temperature	-40 °C

Classification

IP-class	IP54 (front)
Mechanical class	1
EMC emission class	A
EMC immunity zone	A
Overvoltage category	III
Pollution degree	2
Insulation type	Functional

2.2 Description of the object tested

Manufacturer	Fanox Electronic, S.L., 48160 Derio, Bizkaia, Spain
Type	SIL-G
Object	Generator protection relay
Settings	Unless otherwise specified, the default settings of the manufacturer were used.

IED SILG000C1AA4AB, 2029103 Sample Mechanical / EMC

Slot	Module	Serial No.	Hardware	Software
Main	SILB-CPUHMI (mainboard)	23351/47736	CPUHMI r1.06	01.00-01.02-01.02
Main	SILB-HMI	23352/47737	HMI r1.07	-
1	SILB-Medial	23354/47738	Medial r1.05	-
2	SILB-MedidaV-Fuente	23355/47739	MedidaV-Fuente r1.06	-
3	SILB-In-Out-Com	23350/48209	In-Out-Com r1.03	-
4	SILB-ArcFlash	23353/48212	ArcFlash r1.04	-

IED SILG000C0FA4AB, 19600001 Sample EMC / IP / Code 15897

Slot	Module	Serial No.	Hardware	Software
Main	SILB-CPUHMI (mainboard)	23351/47736	CPUHMI r1.06	01.00-01.02-01.02
Main	SILB-HMI	23352/47737	HMI r1.07	-
1	SILB-Medial	23354/47738	Medial r1.05	-
2	SILB-MedidaV-Fuente	23355/47739	MedidaV-Fuente r1.06	-
3	SILB-In-Out-Com	23350/48209	In-Out-Com r1.03	-
4	SILB-ArcFlash	23353/48212	ArcFlash r1.04	-

IED SILG000C0FA4AB, 19600004 Sample EMC / Thermal withstand / Mechanical / Code 15897

Slot	Module	Serial No.	Hardware	Software
Main	SILB-CPUHMI (mainboard)	23351/47736	CPUHMI r1.06	01.00-01.02-01.02
Main	SILB-HMI	23352/47737	HMI r1.07	-
1	SILB-Medial	23354/47738	Medial r1.05	-
2	SILB-MedidaV-Fuente	23355/47739	MedidaV-Fuente r1.06	-
3	SILB-In-Out-Com	23350/48209	In-Out-Com r1.03	-
4	SILB-ArcFlash	23353/48212	ArcFlash r1.04	-

IED SILG000C0FA4AB, 19600006 Sample EMC / climate test / Code 15897

Slot	Module	Serial No.	Hardware	Software
Main	SILB-CPUHMI (mainboard)	23351/47736	CPUHMI r1.06	01.00-01.02-01.02
Main	SILB-HMI	23352/47737	HMI r1.07	-
1	SILB-Medial	23354/47738	Medial r1.05	-
2	SILB-MedidaV-Fuente	23355/47739	MedidaV-Fuente r1.06	-
3	SILB-In-Out-Com	23350/48209	In-Out-Com r1.03	-
4	SILB-ArcFlash	23353/48212	ArcFlash r1.04	-

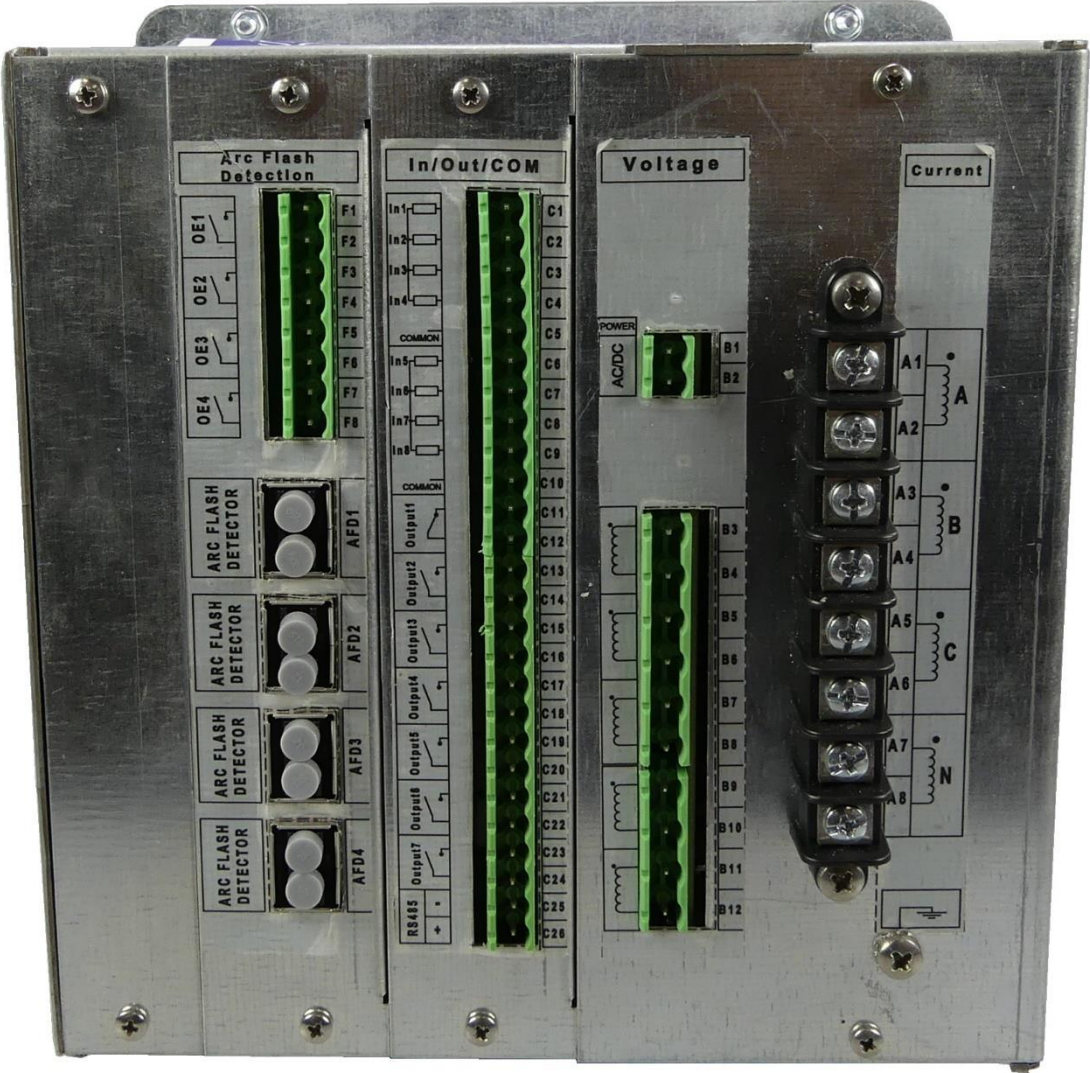
2.3 List of drawings

According to the client the following drawings and/or documents number(s) refer(s).
KEMA Labs has not verified these drawings and/or documents.

Drawing no./document no.	Revision
EN_FANOXTD_DATA_SIL_Feeder-Generator_SILG-new	R06
EN_FANOXTD_MANU_SIL_Generator_SILG	R023

2.4 Photograph of test object





3 GENERAL INFORMATION

3.1 The tests were carried out under responsibility of

Name

Peter Hildering
Marcel van Anholt

Company

KEMA B.V.,
Arnhem, The Netherlands

3.2 Subcontracting

The following tests were subcontracted to DEKRA Certification B.V., Arnhem, the Netherlands:

- Measurement of radiated emission in accordance with IEC 60255-26, CISPR11 and CISPR22;
- Measurement of conducted emission in accordance with IEC 60255-26 and CISPR22;
- Radiated, radio-frequency and electromagnetic field immunity test in accordance with IEC 60255-26 and IEC 61000-4-3.

The following tests were subcontracted to Sebert Trillingstechniek B.V., Bergschenhoek, the Netherlands:

- Measurement of vibration response and endurance in accordance with IEC 60255-21-1;
- Measurement of shock response and withstand in accordance with IEC 60255-21-2;
- Bump measurement in accordance with IEC 60255-21-2;
- Seismic measurement in accordance with IEC 60255-21-3.

3.3 Purpose of the tests

Purpose of the tests was to verify whether the material complies with the specified requirements.

3.4 Environmental conditions

Tests have been performed in a controlled laboratory environment, where the environmental conditions are maintained within the applicable ranges.

Ambient temperature	15 °C – 35 °C
Relative Humidity	30% - 60%
Atmospheric pressure	86 kPa (860 mbar) to 106 kPa (1060 mbar)

When a condition has direct influence on a test, the value of the condition will be presented explicitly.

3.5 Measurement uncertainty

A table with measurement uncertainties is enclosed in this report. Unless otherwise stated, the measurement uncertainties of the results presented in this report are as indicated in that table.

3.6 Instruments used

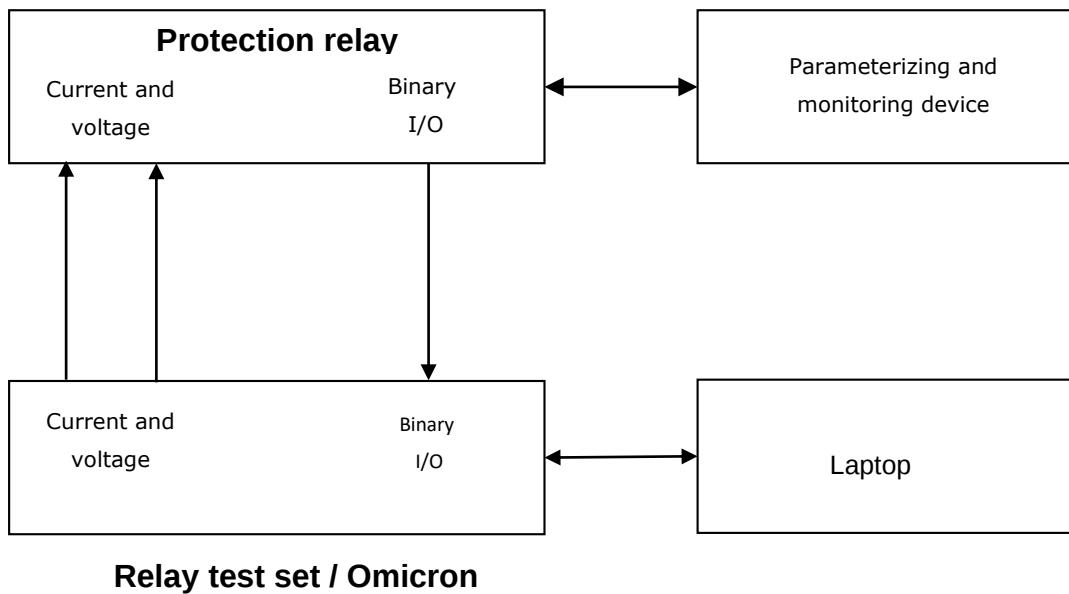
A detailed list with instruments used is enclosed in this report.

3.7 Standards

The product standard IEC 60255-1 (2009) refers to documents, in whole or in part, these documents are normatively referenced to in this product standard and these documents are indispensable for its application. For dated references, only the edition cited applies. For undated references the latest edition of the referenced document (including any amendments) applies. KEMA Labs will use the latest edition of the referenced documents (including any amendments) in all cases, also in the cases reference is made to dated editions.

4 TEST ARRANGEMENT

A general test set-up is made by connecting the protection relay to a relay test set. The protection relay is powered with rated auxiliary voltage. Currents and/or voltages are applied to the analogue input module(s). If required status signals are applied to the binary input module(s). The operation and resetting is monitored with the binary output modules operated with 24 VDC. The protection relay is parameterized and monitored by means of the human machine interface and interface on the display and LED's.



5 ENCLOSURE PROTECTION

Standard and date

Standard IEC 60255-1, subclause 6.3
 Basic standard IEC 60255-27, subclause 10.6.2.6.
 Test date 26 and 27 March

Characteristic test data

Serial number 19600001

Terminal side	Degree of protection	
	Specification by the manufacturer	Observation
Front	IP 54	IP 54
Top	IP 54	IP 54
Bottom	IP 54	IP 54
Back	IP 1X	IP 1X
Left	IP 2X	IP 2X
Right	IP 2X	IP 2X

Requirement

The equipment case meets the manufacturer's claimed IP class in normal use. (see IEC 60255-27, subclause 5.1.5.2.6).

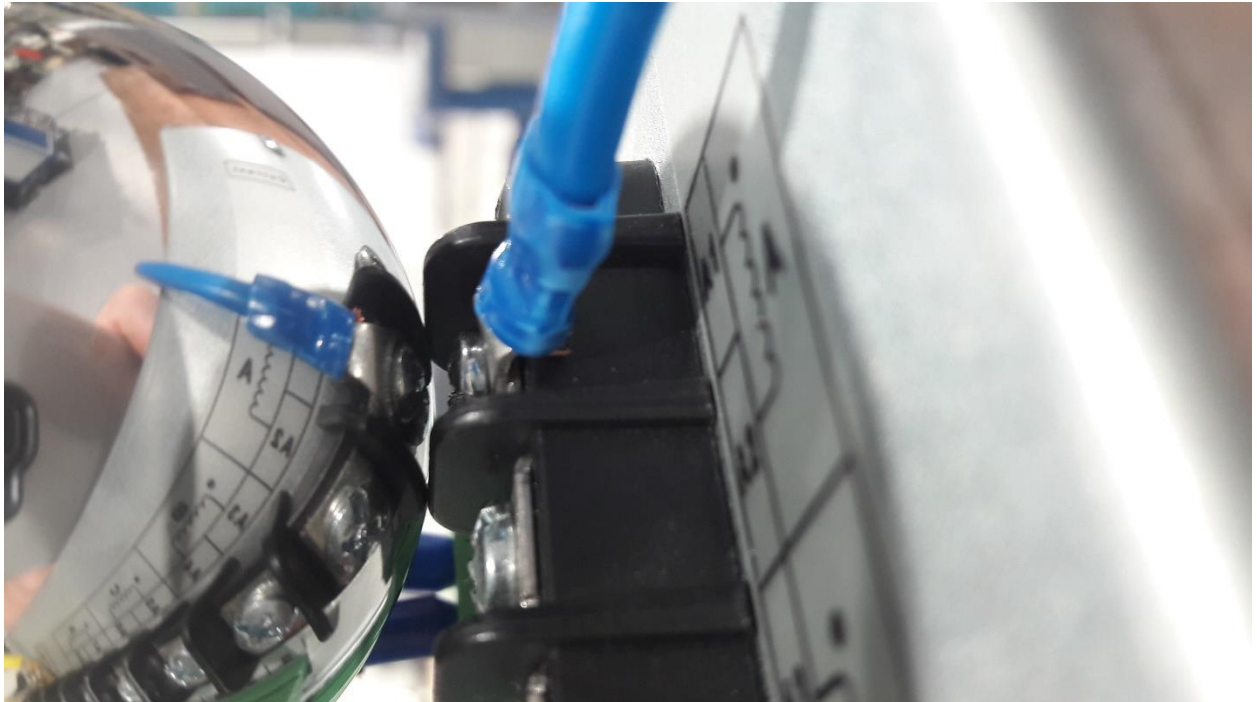
The manufacturer specifies:

- The front side shall comply with IP54.
- Top Bottom Left and Right sides shall comply with IP2X.
- The rear side shall comply with IP 1X.

Result

The object passed the test.

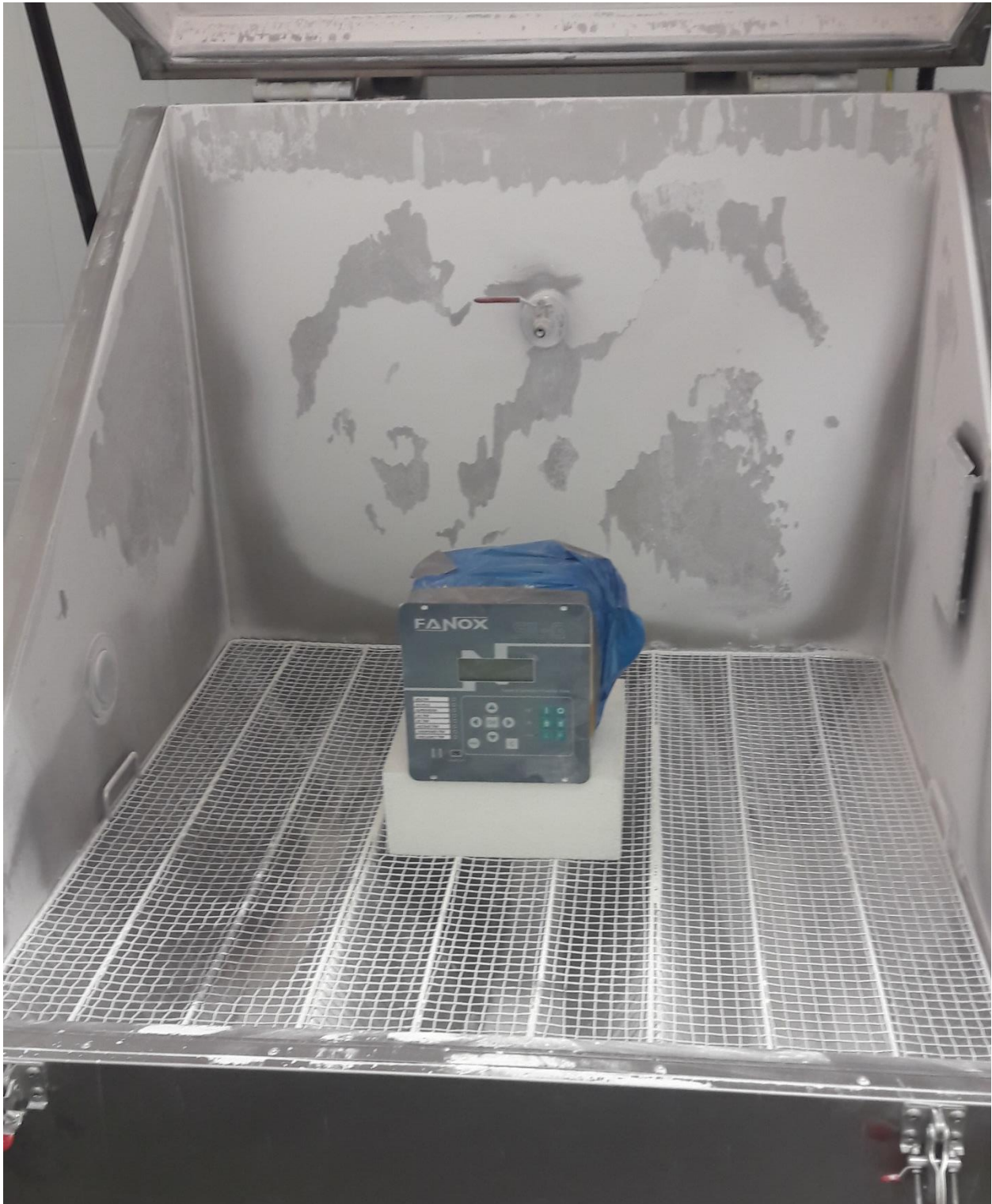
Photograph of test arrangement IP1X



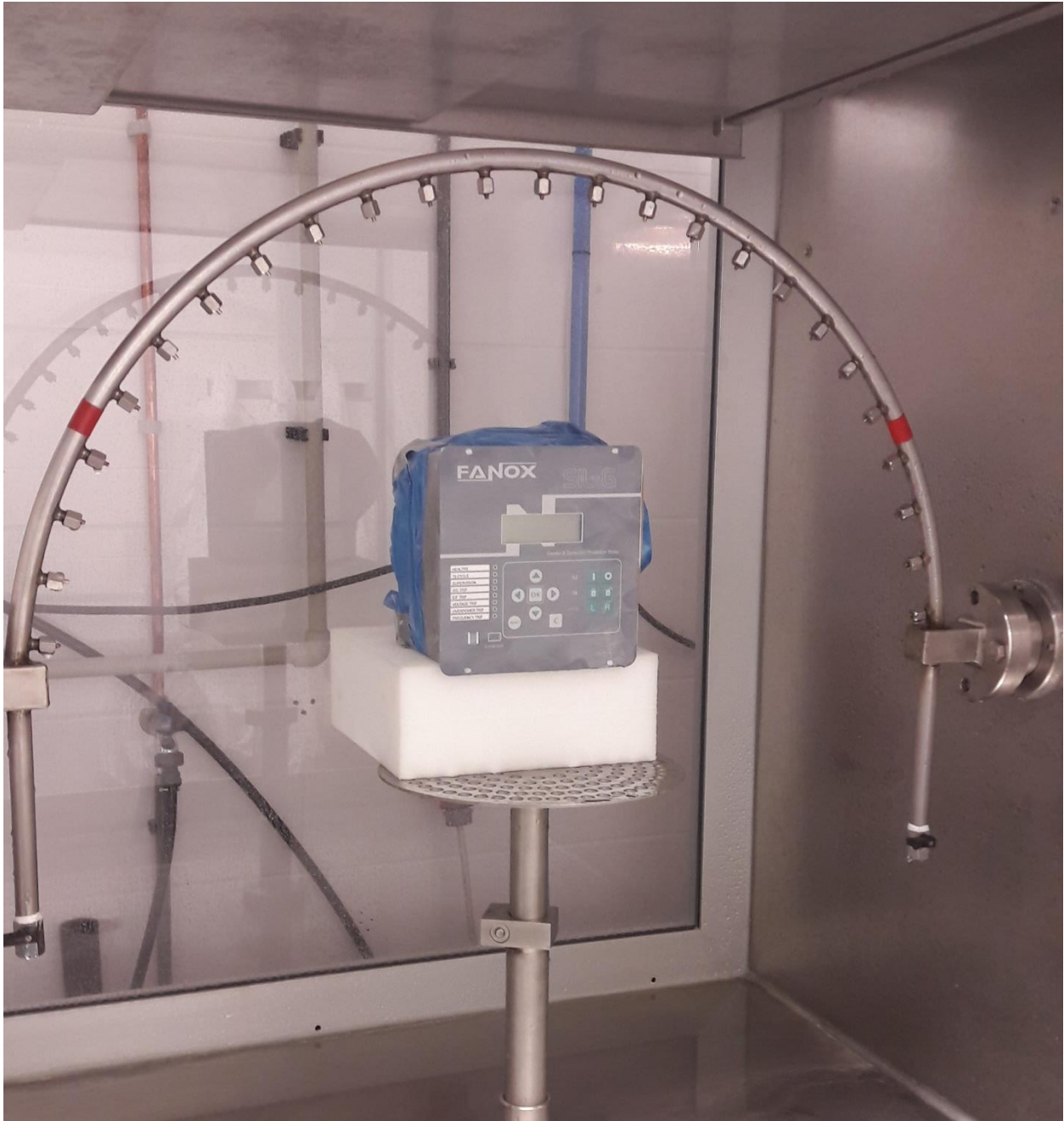
Photograph of test arrangement IP2X



Photograph of test arrangement IP54



Photograph of test arrangement IP54



6 PACKAGING

Standard and date

Standard	IEC 60255-1, subclause 8
Basic standard	IEC 60255-27, subclause 9.3
Test date	7 November 2019

Requirement

The manufacturer shall ensure that the equipment is suitably packaged to withstand, without damage, reasonable handling and environmental conditions appropriate to the method(s) of transportation to the user's delivery address.

A visual inspection should be performed by the user to check that the equipment has not been damaged during transportation.

Result

- The packaging meets the packaging requirements.
- No visual damage to the packaging and the equipment has been observed.

Photographs of the packaging







7 PRODUCT SAFETY

7.1 Inspection

7.1.1 Pre-inspection

The pre-inspection is performed to verify that the test object is in operating state as described in IEC 60255-1, Annex A 2.5. The pre-inspection is carried out prior to the test procedure.

The communication with the maintenance computer is verified. Signals are simulated to verify the functioning and operation with the specified performance specification for the following inputs and outputs:

- Analogue inputs
- Digital inputs
- Contact outputs
- Data communication ports.

7.1.2 Visual and functional inspection during and after the product safety assessment

No visual and/or functional inspection is required after the product safety tests. In general, the test object shall remain safe regarding the spread of fire or risk of having an electric shock. Specific assessment/test requirements are listed at each specific test.

7.2 Impulse voltage test

Standard and date

Standard IEC 60255-1, subclause 6.4
 Basic standard IEC 60255-27, subclause 10.6.4.2
 Test date 24 September 2020

Environmental conditions

Ambient temperature 20.4 °C
 Relative humidity 59 %

Characteristic test data

Serial number 20291033
 Time to rise-value 1,2 μ s ($\pm$ 30%)
 Time to half-value 50 μ s ($\pm$ 20%)
 Source impedance 500 Ω ($\pm$ 10%)
 Output energy 0,5 J ($\pm$ 10%)
 Pulse interval $\geq$ 1 s

Test results

Voltage applied to Circuit/terminals	Voltage applied kV	No. of impulses	Polarity	Observations
Uaux B1, B2	5	5	Positive	1
		5	Negative	1
Current (CT) A1 – A8	5	5	Positive	-
		5	Negative	-
Voltage (VT) B3 – B12	5	5	Positive	-
		5	Negative	-
Inputs C1 – C10	5	5	Positive	-
		5	Negative	-
Outputs C11 - C24	5	5	Positive	-
		5	Negative	-
RS485 C25, C26	1	5	Positive	-
		5	Negative	-
Arc Flash Detector F1 – F8	5	5	Positive	-
		5	Negative	-
RS485 C25, C26	1	5	Positive	-
		5	Negative	-

Observations

1. Varistor in power supply (See detail in scope picture).

Note

Each circuit has been tested against all other circuits and earth connected together.
 The test has been performed after completion of the climatic tests.

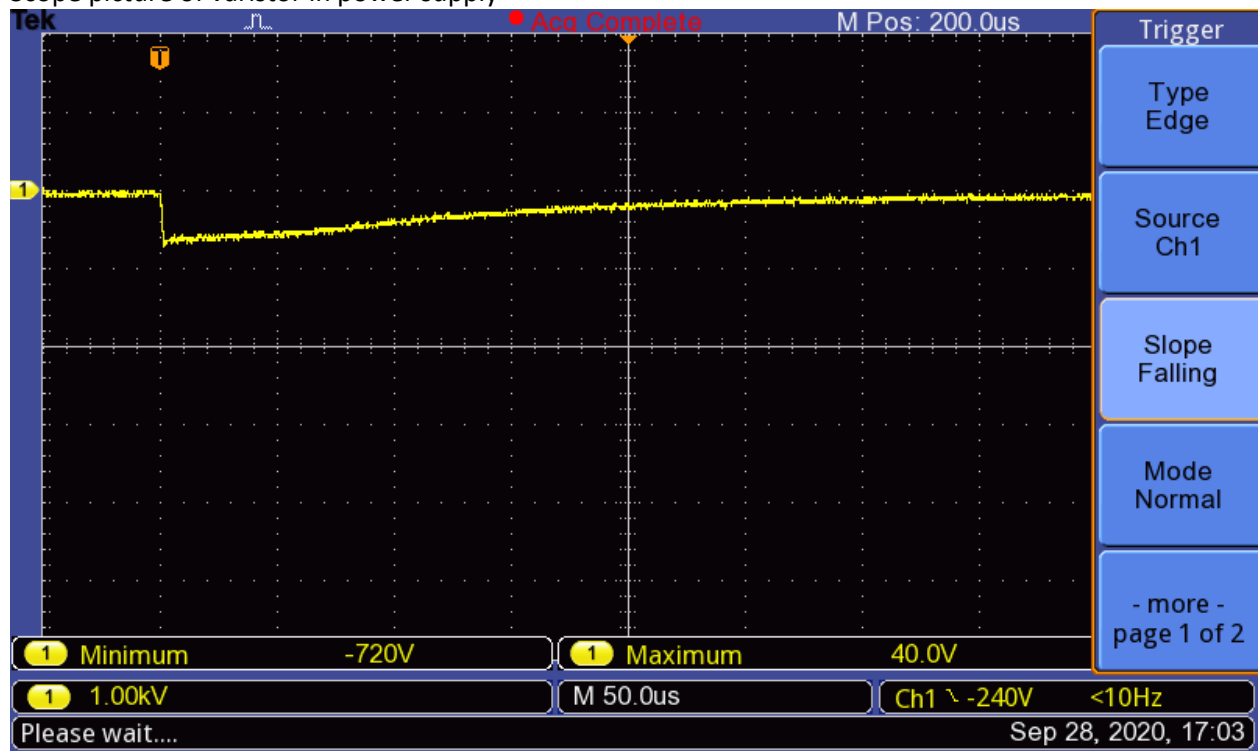
Requirement

- No disruptive discharge (spark-over, flashover or puncture) shall occur.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

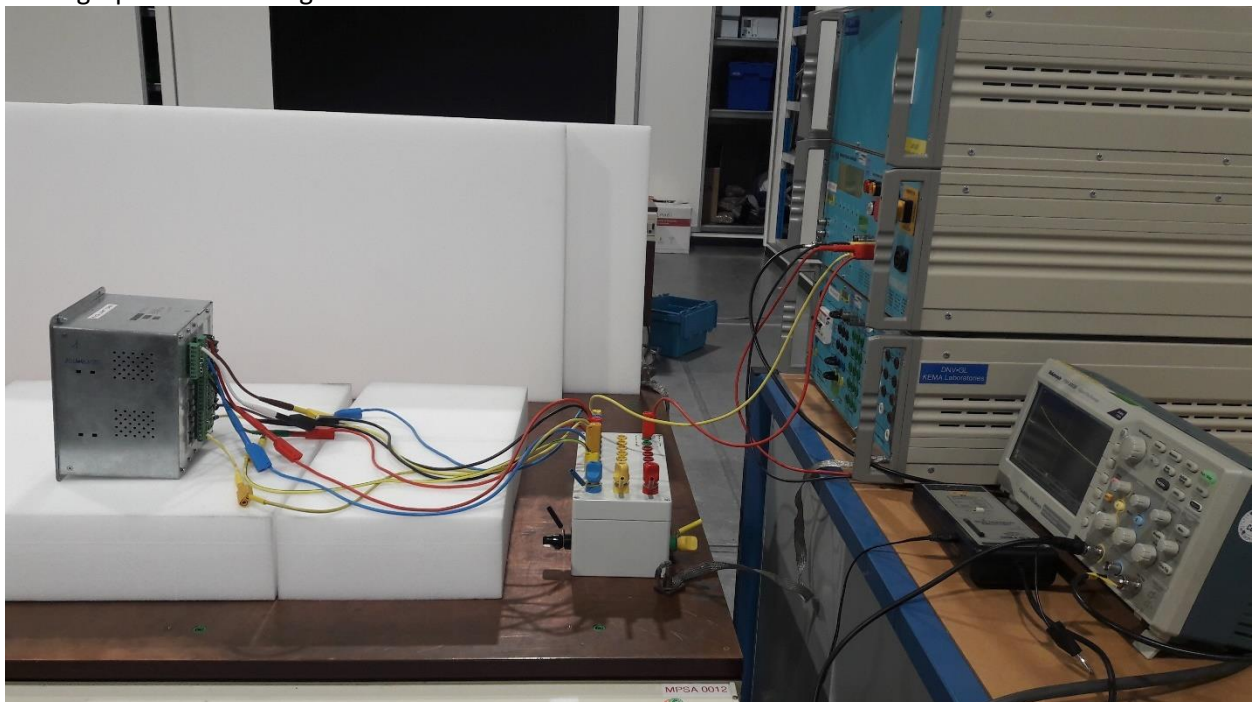
The object passed the test.

Scope picture of varistor in power supply



At 720V the varistor steps in.

Photograph of test arrangement



7.3 Dielectric voltage test

Standard and date

Standard IEC 60255-1, subclause 6.4
 Basic standard IEC 60255-27, subclause 10.6.4.3.
 Test date 23 March 2020

Environmental conditions

Ambient temperature 21.1 °C
 Relative humidity 34 %

Characteristic test data

Serial number 19600001
 Frequency 50 Hz
 Test duration 1 min

Test results

Voltage applied to Circuit/terminals	Voltage applied kVac	Observations
Uaux B1, B2	2,0	-
Current (CT) A1 – A8	2,0	-
Voltage (VT) B3 – B12	2,0	-
Inputs C1 – C10	2,0	-
Outputs C11 – C24	2,0	-
RS485 C25, C26	0,5	-
Arc Flash Detector F1 – F8	2,0	-

Note

Each circuit has been tested against all other circuits and earth connected together
 The test has been performed after completion of the climatic tests.

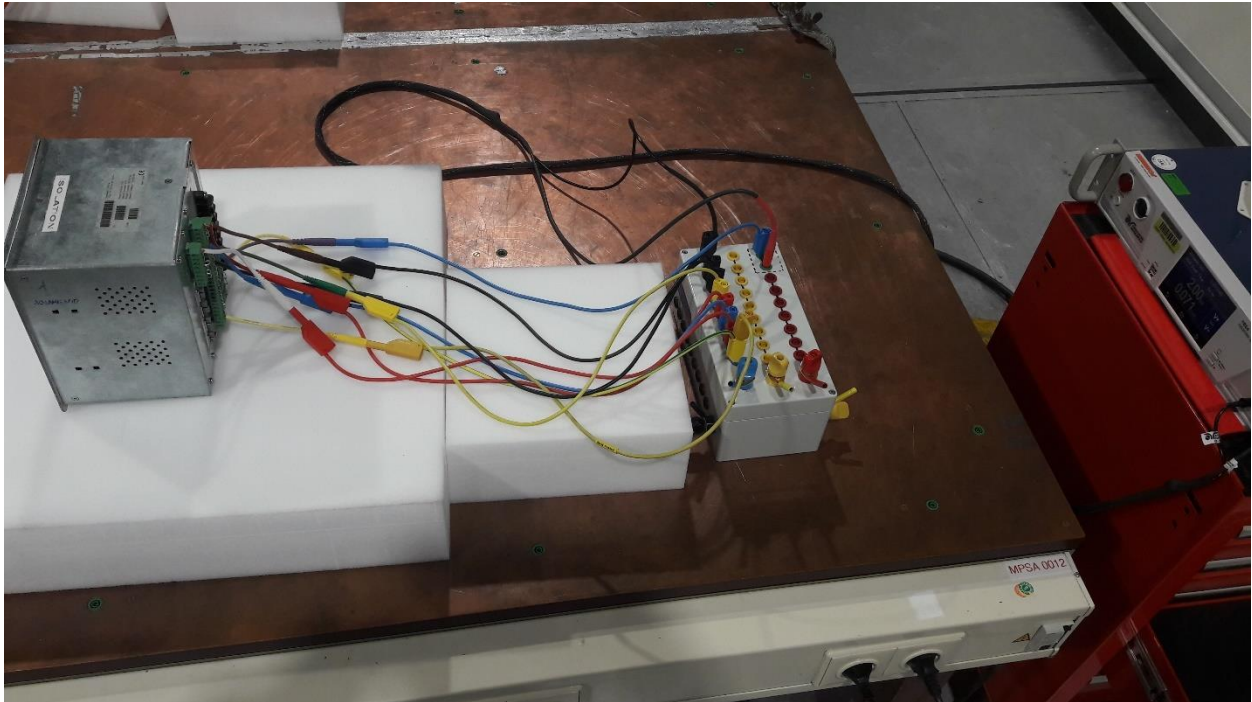
Requirement

- No breakdown or flashover shall occur.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement



7.4 Clearance and creepage distances

Standard and date

Standard	IEC 60255-1, subclause 6.4
Basic standard	IEC 60255-27, subclause 10.6.3
Test date	29 October 2020

Characteristic test data

Serial number	19600001
Overvoltage category	III
Pollution degree	2

Measurement results

Table C.6 functional, basic or supplementary insulation, pollution degree 2, overvoltage category III has been applied as a requirement for the clearance and creepage measurement.

Creepage

Position	Measurement between	PCB-ID	Rated insulation voltage or working voltage [V]	Clearance Required [mm]	Measured [mm]
1	Power	23355/47739	300	≥3	3.85
2	VT	23355/47739	300	≥3	3.98
3	VT	23355/47739	300	≥3	3.32
4	VT	23355/47739	300	≥3	3.15
6	Bout	23350/48209	300	≥3	3.03
7	Bout	23350/48209	300	≥3	3.05
8	Bin	23350/48209	300	≥3	3.35
9	Arc flash	23353/48212	300	≥3	3.50
10	Arc Flash	23353/48212	300	≥3	3.36

Clearance

Position	Measurement between	PCB-ID	Rated insulation voltage or working voltage V	Creepage Required mm	Measured mm
5	CT	23354/47738	300	≥3	6.46

The observed clearance is well above the required clearance distance. No measurements required.

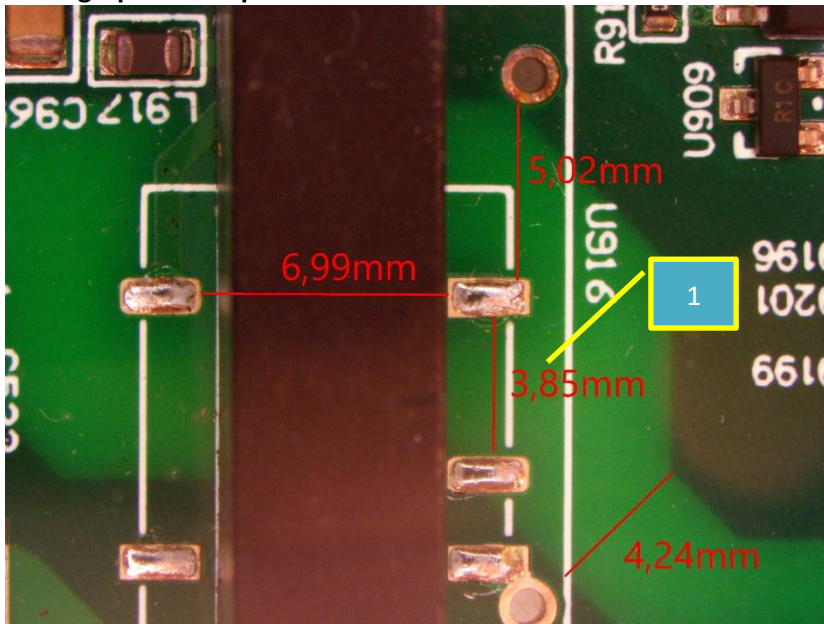
Requirement

The test object shall meet the requirements for the applicable clearance and creepage distances according Annex C Table C.6.

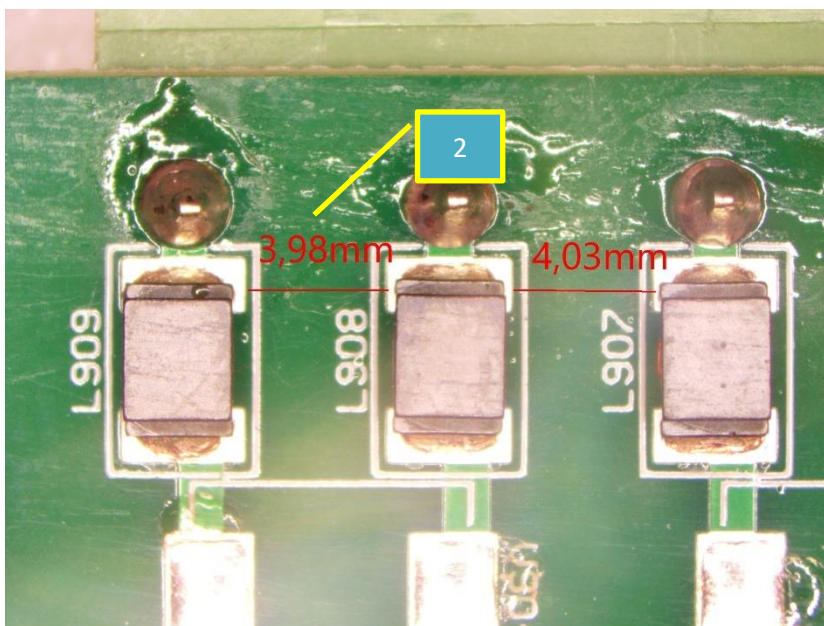
Result

The object passed the test.

Photograph of test points

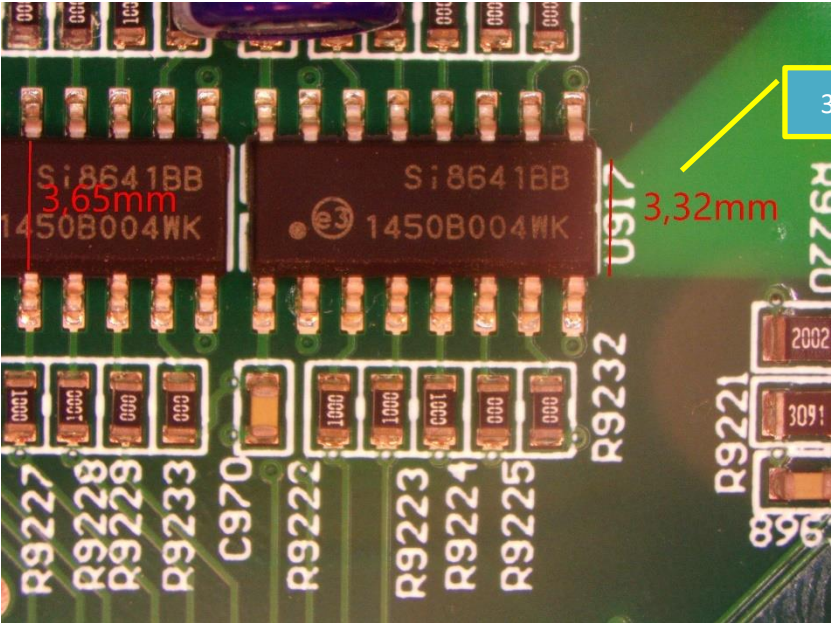


Power supply

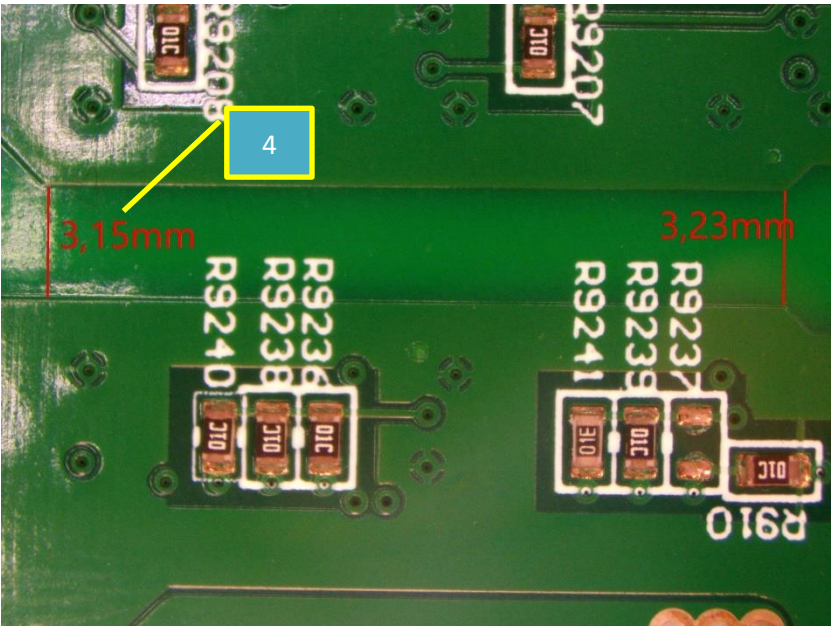


VT

Photograph of test points

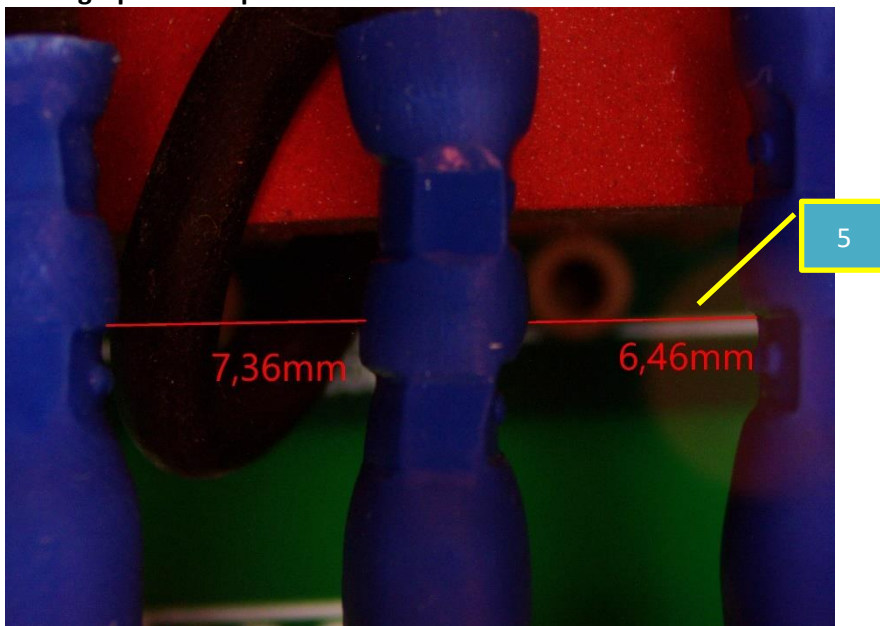


VT

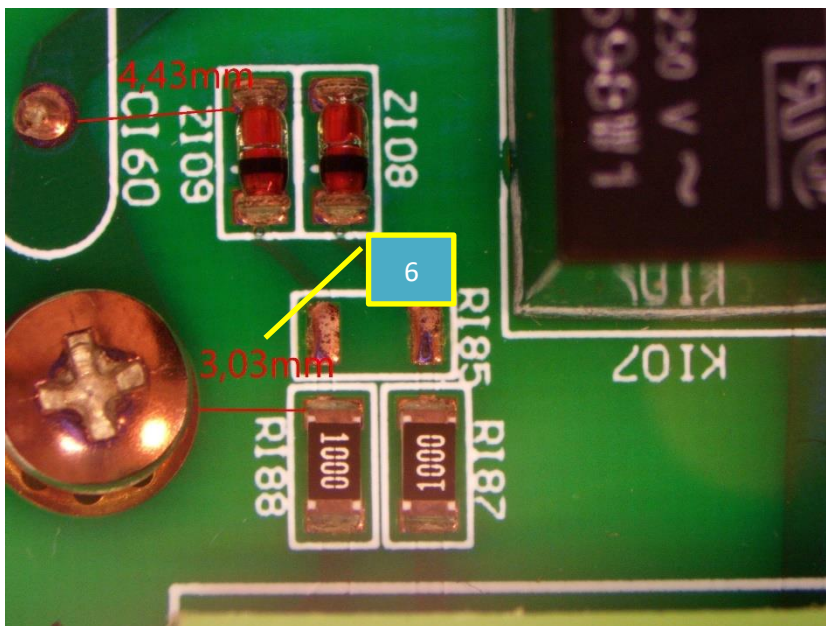


VT

Photograph of test points

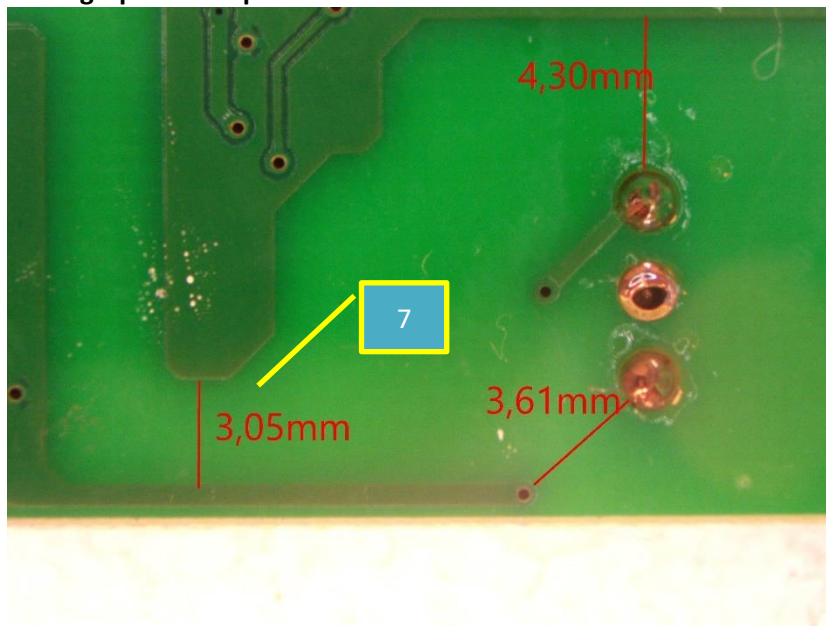


CT (Clearance)

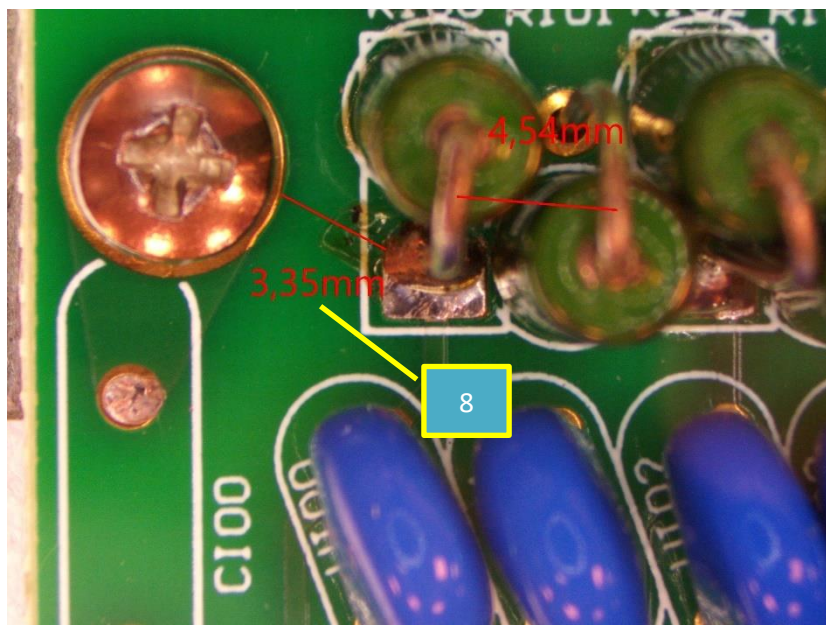


Bout

Photograph of test points

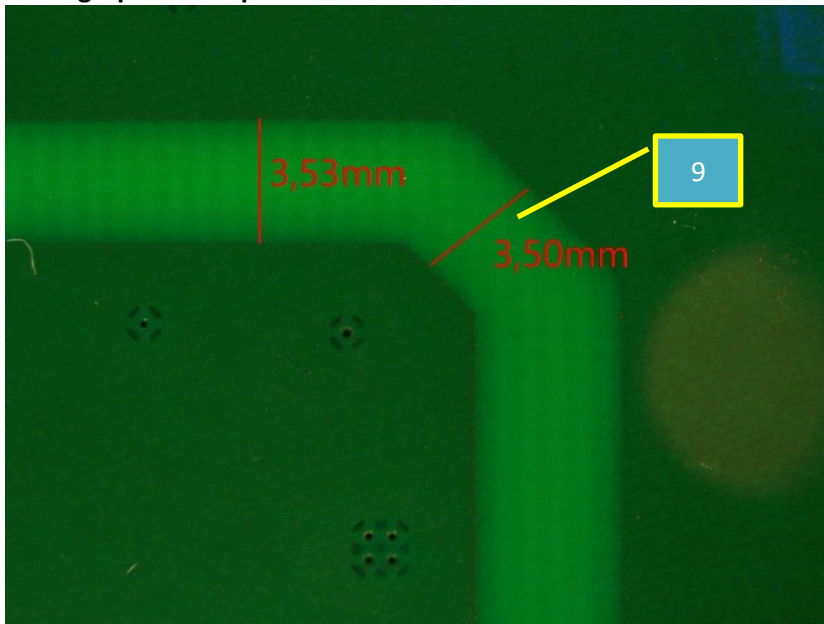


Bout

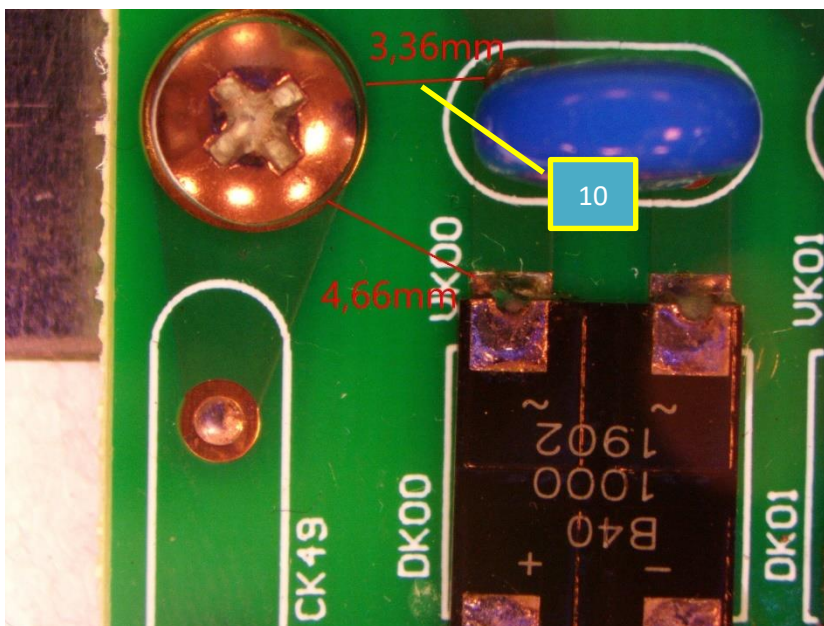


Bin

Photograph of test points



Arc



Arc

7.5 Protective bonding resistance

Standard and date

Standard IEC 60255-1, subclause 6.4
 Basic standard IEC 60255-27, subclause 10.6.4.5
 Test date 23 March 2020

Characteristic test data

Serial number 19600001
 Test voltage < 12 Vdc
 Test current 20 A
 Test duration 60 s

Test results

Test point	Measured against	Resistance mΩ
Test point 1	Protective Earth connection	9
Test point 2	Protective Earth connection	6
Test point 3	Protective Earth connection	5
Test point 4	Protective Earth connection	7

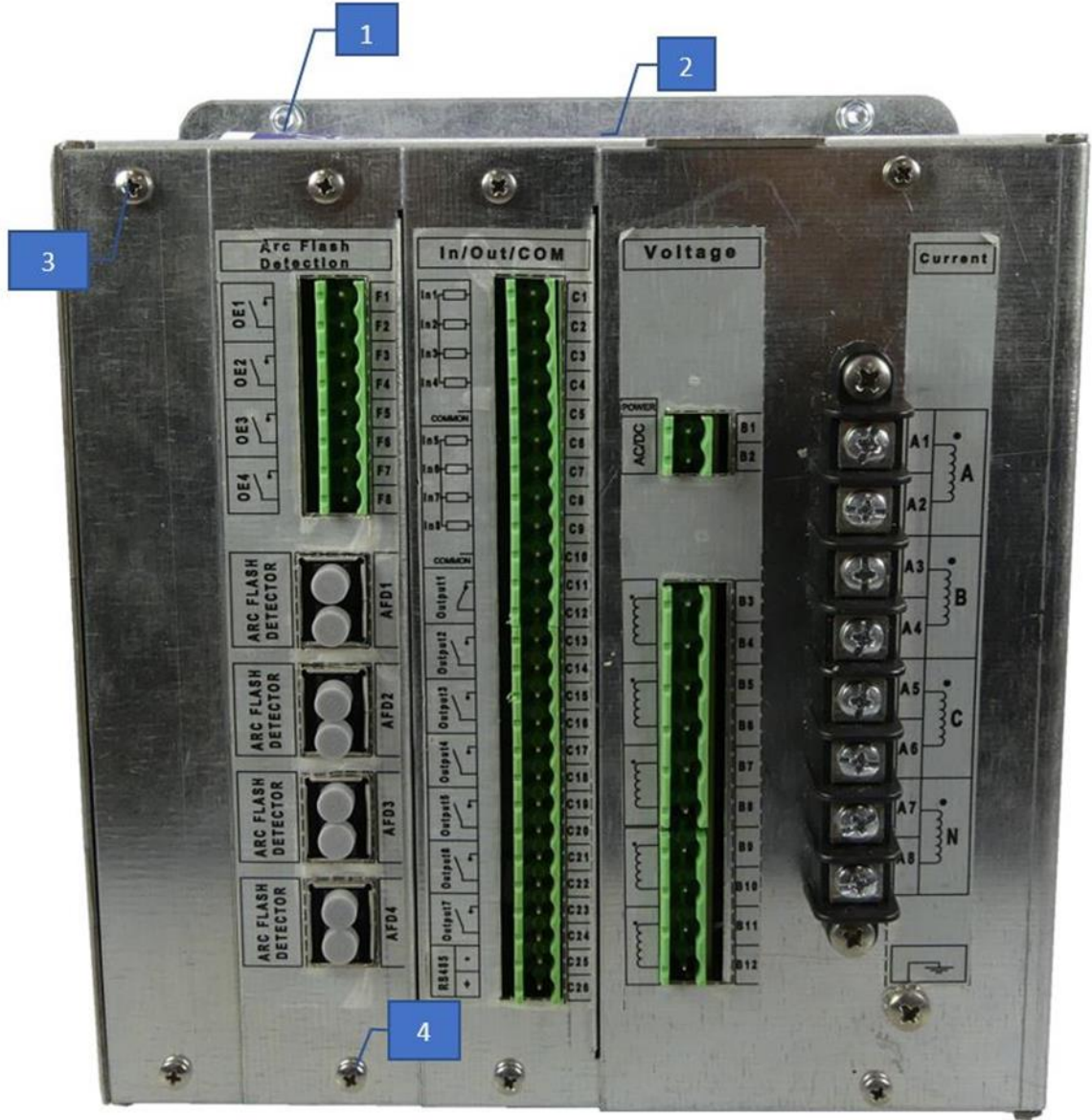
Requirement

- The resistance between the test point and the protective earth conductor terminal shall not exceed 0,1 Ω.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test points



7.6 Flammability of insulating materials, components and fire enclosures

Standard and date

Standard	IEC 60255-1, subclause 6.4
Basic standard	IEC 60255-27, subclause 10.6.5.2
Test date	16 April 2020

Characteristic test data

Serial number	Not applicable (only documentation)
---------------	-------------------------------------

Assessment results

- Housing/enclosure is made of metal/plastic having a flammability rating of V1 or better
- Bottom ventilation holes are covered with a metal screen providing suitable flame barrier. Mechanical properties are compliant with subclause 7.10
- The sides shall have no openings within the area that is included within the inclined line C
- Materials for components which fill an opening in a fire enclosure, and which are intended to be mounted in that opening shall be of flammability class V-1, or better or pass the flammability test of IEC 60695-11-10.

Materials which fill an opening in the fire enclosure, or which are outside the fire enclosure are listed in the table below;

Materials inside a fire enclosure;

Item		Manufacturer	Material	UL document	Specified flammability
PCB	PCB	Safe-PCB	PCBs FR4	ZPMV2.E357 349	UL 94V-0
Connectors	1757077	Phoenix Contact	-	E60425	UL 94V-0
	1759130	Phoenix Contact	-	E60425	UL 94V-0
	1766149	Phoenix Contact	-	E60425	UL 94V-0
	1767041	Phoenix Contact	-	E60425	UL 94V-0
	0387416608 or 7498	Molex	-	E48521	UL 94V-0
	AFBR-S10TR001Z	Broadcom	-	E173874	UL 94V-0
	10018784-10200TLF	FCI	-	E66906	UL 94V-0
	1051330001	Molex	-	DUXR2.E107 635	-
Bobbin (PSU)	RN112-1.5-02-3M3	Schaffner	-	UL 94V-0 in datasheet	-
	GBU6J	ON / Fairchild	-	E258596	-
Optocouplers	TCMT1107	Vishay	-	E76222	-
	TLP185(GB,E	Toshiba	-	E67349	-
	FODM124	ON	-	E90700	-
	SI8641BB-B-IS1	Silicon Labs	-	E257455	-

	HCPL0611-000E	Avago	-	E55361	-
	TLP152	Toshiba	-	E67349	-
Relay	HF118F/005-1ZS1	Hongfa	-	E134517	-
Varistor	B72210P2301K101	Epcos	-	E321126	-
	B72207S0301K101	Epcos	-	E321126	-
VT	-	-	-	-	-
CT	CT2500/0.2/02	Prax	-		-
X1/Y2 Capacitors	DE2F3KY103MN3AM0 2F	Murata	-	FOWX2.E379 21	-
LCD	ACM2004G-FLW-FBW- XBM	Zettler	-	-	-
Cover	SILB_CARA_SILGx_DEL ANTERA_R105	Teclaplast	Polycarbonate	-	UL 94V-2

Requirements

- The object shall comply with the flammability requirements of IEC 60255-27, subclause 7.1. to 7.12.
- No visual or functional inspection required.

Result

The object passed the test.

7.7 Single-fault condition

Standard and date

Standard IEC 60255-1, subclause 6.4
 Basic standard IEC 60255-27, subclause 10.6.5.5, 5.2
 Test date 2 December 2020

Environmental conditions

Ambient temperature 19,8 °C

Characteristic test data

Serial number 19600001
 Circuit under test Test Observation

Circuit under test	Test	Observation
Power supply	Over-load circuit internal voltage	2
	Max. 6,34 A current on 5.2 Vdc	2
	Short circuit internal voltage 5 Vdc	1

Observations

1. Switched off directly.
2. Normal functioning.

Requirements

- The test shall not result in the spread of fire or result in an electric shock hazard.
- The test object does not have to be functional after the test.
- No visual or functional inspection required.

Result

The object passed the test.

Photograph of test arrangement



7.8 Accessible parts test

Standard and date

Standard IEC 60255-1, subclause 6.4
 Basic standard IEC 60255-27, subclause 10.6.2.5., subclause 5.1.5.2
 Test date 26 and 27 March 2020

Characteristic test data

Serial number 19600001

Test results

Test item	Position	Result	Observations/remarks
Subclause 5.1.5.2.2 The jointed test finger shall not touch any hazardous live parts	front/top/bottom/left side/right side	hazardous live parts are not touched	-
Subclause 5.1.5.2.3 The 4 mm test pin shall not touch any hazardous live parts	front/top/bottom/left side/right side	hazardous live parts are not touched	-
Subclause 5.1.5.2.4 The 3 mm test pin shall not penetrate too far at preset controls	Front/top/bottom/left side/right side	the test pin doesn't penetrate too far and did not touched live hazardous parts	-
Subclause 5.1.5.2.5 After removing of a cover without the aid of a tool, ELV or live parts become accessible, then symbol 14 and/or 12 of table 10 shall become visible	front/rear/top/bottom/left side/right side	not applicable	-
Subclause 5.1.5.2.6 Wiring terminals which are normally not accessible shall be IP1X	rear	Wiring terminals are not touched	-

Requirement

The requirements for the accessible parts test according to IEC 60255-27 are:

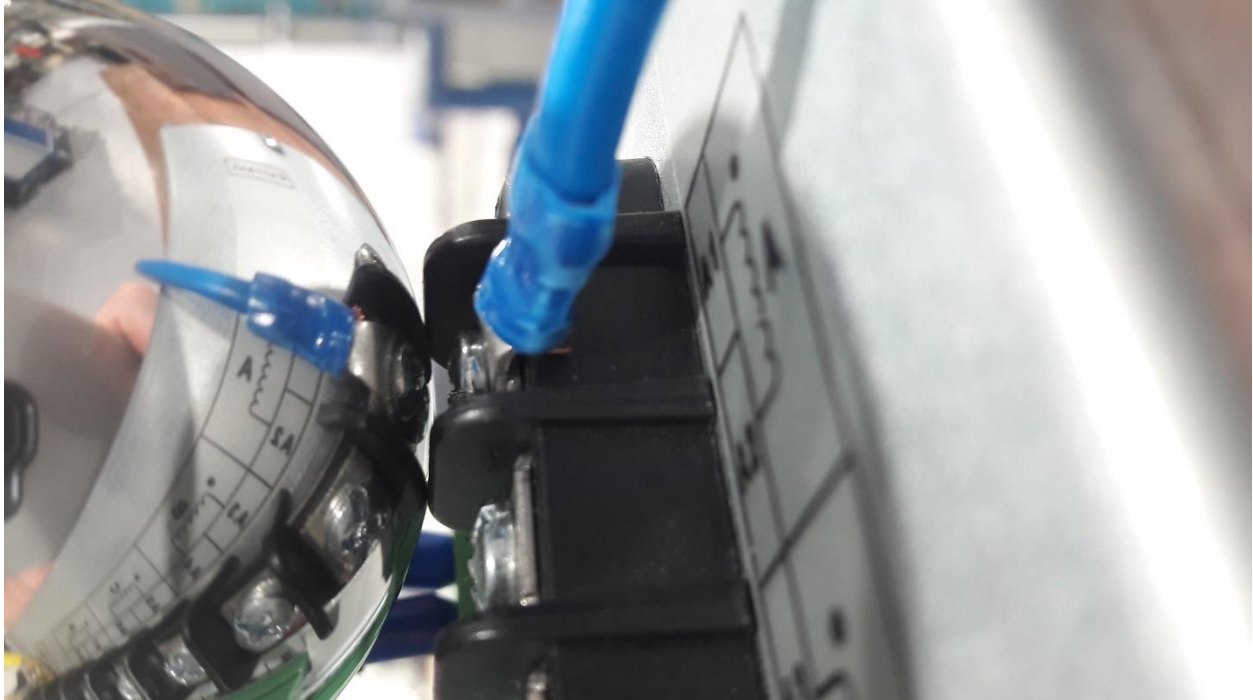
- subclause 5.1.5.2.2 general examination; test with IP 2X test finger;
- subclause 5.1.5.2.3 openings above hazardous live parts; test with 4 mm test pin;
- subclause 5.1.5.2.4 openings for pre-set controls; test with 3 mm test pin.

The requirement for connectors not accessible during normal use is IP1X. See IEC 60255-27 subclause 5.1.5.2.6.

Result

The object passed the test.

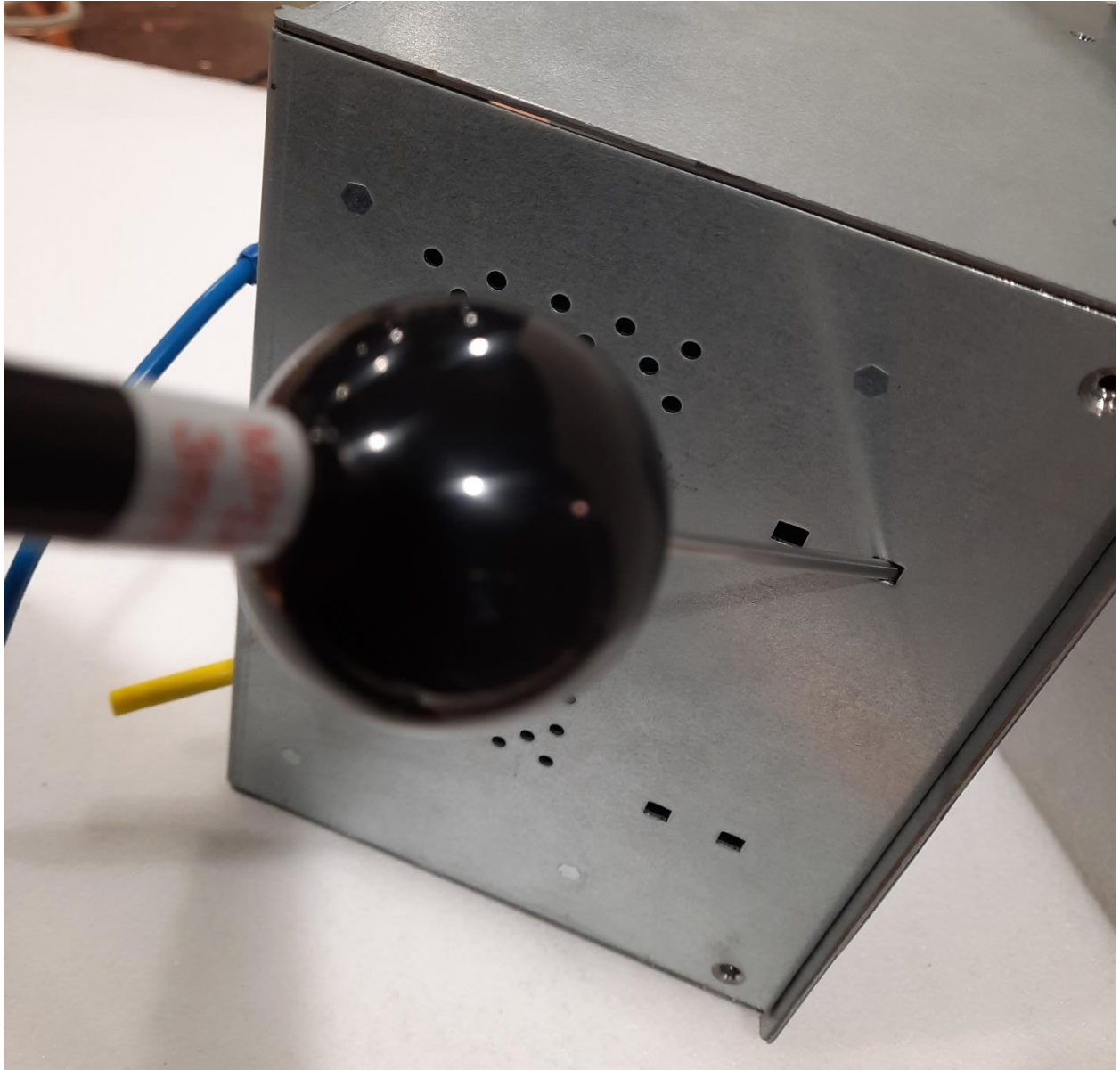
Test on rear side, IP10, A1 -A8 terminal. The test probe does not touch the metal parts of the connector.



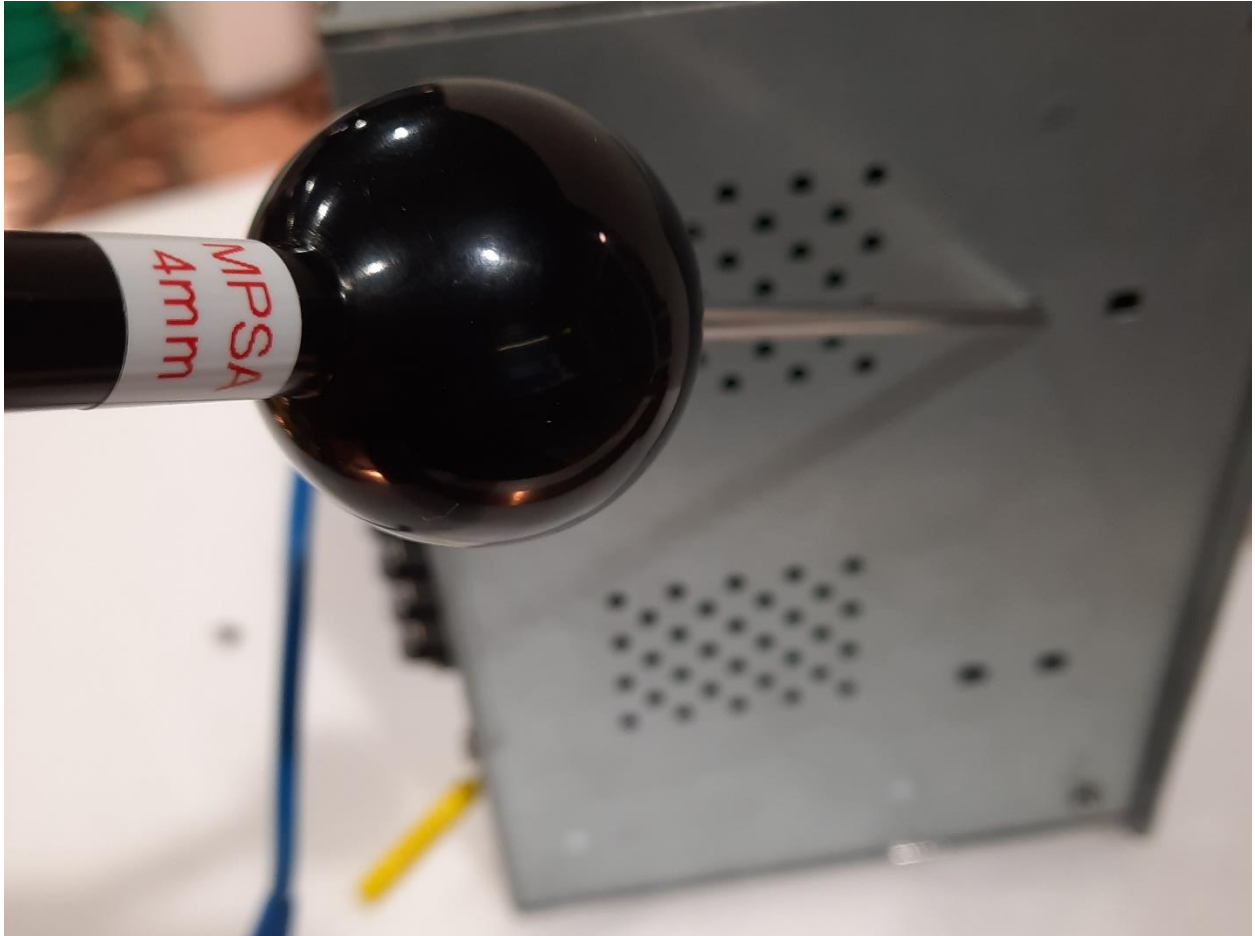
Test on left and right side, IP20. The test finger does not penetrate the housing



Test on left and right side of IED, 3 mm test probe. The test probe does penetrate the housing through the square holes.



Test on left and right side of IED, 4mm test probe. The test probe does not penetrate the housing through the square holes.



Test on left and right side of IED, 3 mm test probe. The test probe does not penetrate the housing through the holes.



7.9 Thermal withstand current transformer

Standard and date

Standard IEC 60255-1, subclause 6.4, 6.9
 Basic standard IEC 60255-27, subclause 10.6.5.3
 Test date 29 May 2020

Environmental conditions

Ambient temperature 20,2 °C

Characteristic test data

Serial number 19600004
 Rated current 5 A
 Frequency 50 Hz
 Insulation resistance 100 MΩ

Tests according to IEC 60255-27

Circuit	Terminal	Test current A	Duration s	Observation
CT (A)	A1, A2	500	1	1 and 2
CT (A)	A1, A2	100	10	1 and 2

Observations

1. No damage of the test object.
2. Correct operation of the test object after the test.

Optional functionality tests

Circuit	Terminal	Test current A	Duration (hrs)	Observation
CT (A)	B3, B4	20	4	1 and 2
CT (B)	B5, B6	20	4	1 and 2
CT (C)	B7, B8	20	4	1 and 2

Note

This time has been applied until thermal stabilisation has reached.
 The maximum measured temperature is 38 °C.

Observations

1. No damage of the test object.
2. Correct operation of the test object after the test.

Requirement

- The equipment CT input circuits shall withstand overcurrents declared by the manufacturer, both continuously and for 1 s duration, without creating a fire or electric shock risk.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

7.10 Thermal withstand voltage transformer

Standard and date

Standard IEC 60255-1, subclause 6.4
 Basic standard IEC 60255-27, subclause 10.6.5.3
 Test date 29 May 2020

Environmental conditions

Ambient temperature 20.2 °C

Characteristic test data

Serial number 19600004
 Frequency 50 Hz
 U_R 110/220 V

Terminal/pins	Test voltage V	Duration	Observations
VT (A)/B3, B4	960	4 h	1 and 2
	1152	10 s	1 and 2

Observations

1. No damage or flashover of the test object.
2. Correct operation of the test object after the test.

Requirement

- The equipment VT input circuits shall withstand overvoltage's declared by the manufacturer, without damage, both continuously and for 10 s duration.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

8 ELECTROMAGNETIC COMPATIBILITY

8.1 Inspection

8.1.1 Pre-inspection

The pre-inspection is performed to verify that the test object is in operational state as described in IEC 60255-1, Annex A 2.5. The pre-inspection is carried out prior to the test procedure.

The communication with the maintenance computer is verified. Signals are simulated to verify the functioning and operation with the specified performance specification for the following inputs and outputs:

- Analogue inputs;
- Digital inputs;
- Contact outputs;
- Data communication ports.

8.1.2 Visual and functional inspection

After each test a visual and functional inspection is carried out as described in this chapter.

The visual inspection is carried out to verify that there is no visual mechanical damage.

There shall be no:

- Burning of any components.
- Paint blisters on any components.
- Discolouration on components.
- Deformation of modules or components.
- Interruptions or damage on interconnecting cables, wires and connectors.

Functional inspection is carried out to verify the correct operation of the test object.

The measurements of analogue input data shall not exceed twice the class index for the measurement.

There shall be no:

- Alarm indications on display and LED's;
- Error messages reported in the maintenance computer;
- Unintentional change of contact outputs;
- Unintentional change of digital input status.

Unless otherwise stated the visual and functional inspection was carried out successfully after each test.

8.2 Radiated emission

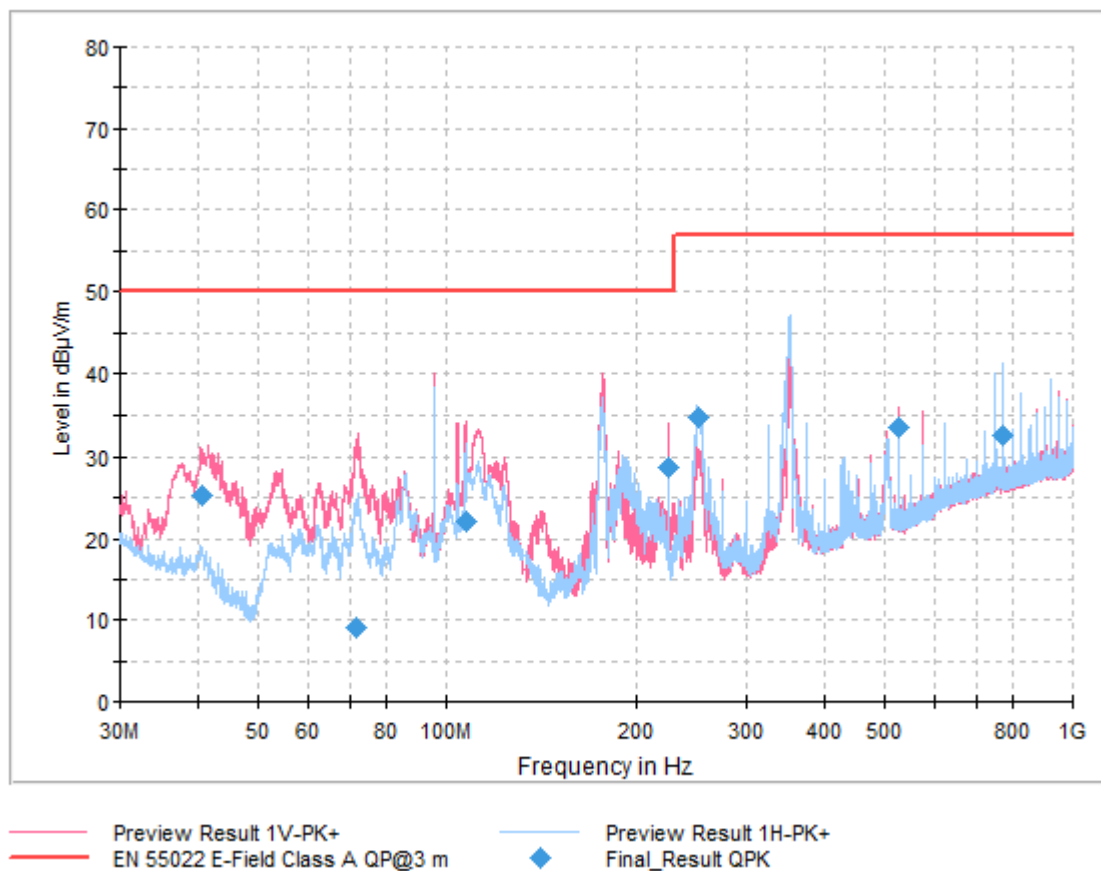
Standard and date

Standard	IEC 60255-1, subclause 6.15 / IEC 60255-26 subclause 5.1
Basic standard	CISPR 11, CISPR 22
Test date	13 January 2020

Characteristic test data

Serial number	19600004
Power supply	230 Vac

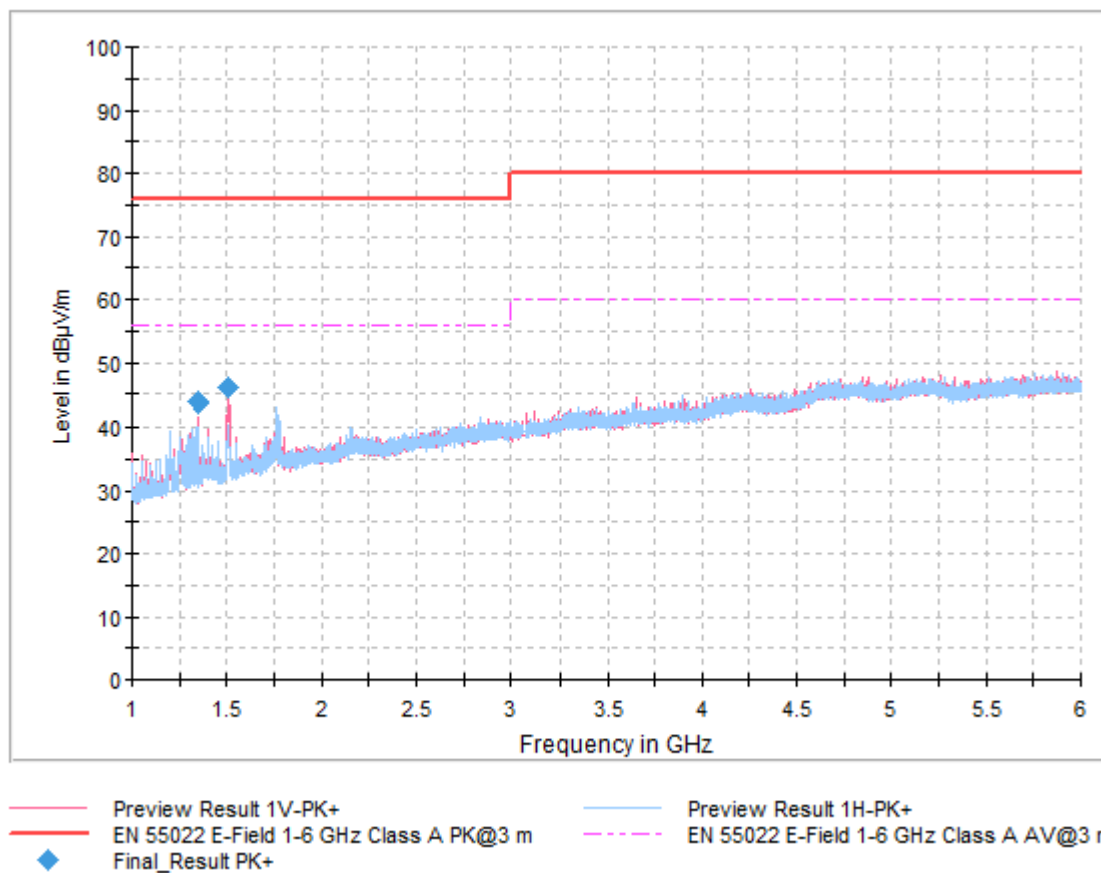
Power supply voltage of 230 Vac with horizontal and vertical antenna polarisation, in the frequency range 30 MHz – 1GHz (red = vertical, blue = horizontal)



Final_Result (30 – 1000 MHz)

Frequency MHz	QuasiPeak dBµV/m	Limit dBµV/m 3m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg
40,71	25,39	50,00	24,61	1000,0	120,00	100	V	104
71,67	9,10	50,00	40,90	1000,0	120,00	312	V	155
107,22	22,13	50,00	27,87	1000,0	120,00	108	V	98
225,00	28,70	50,00	21,30	1000,0	120,00	158	V	248
250,77	34,73	57,00	22,27	1000,0	120,00	117	H	244
525,00	33,57	57,00	23,44	1000,0	120,00	103	V	314
774,99	32,62	57,00	24,38	1000,0	120,00	100	H	55

Power supply voltage of 230 Vac with horizontal and vertical antenna polarisation, in the frequency range 1 – 6 GHz (red = vertical, blue = horizontal)



Final_Result (1000 – 6000 MHz)

Frequency MHz	QuasiPeak dBµV/m	Limit dBµV/m 3m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg
1350,00	43,96	76,00	32,04	1000,0	1000,00	107	V	173
1510,00	46,17	76,00	29,83	1000,0	1000,00	104	V	148

Requirement

The radiated emission shall not exceed the limits specified in the standard CISPR 22 for class A equipment.

Result

The object passed the test.

Photograph of test arrangement



8.3 Conducted emission

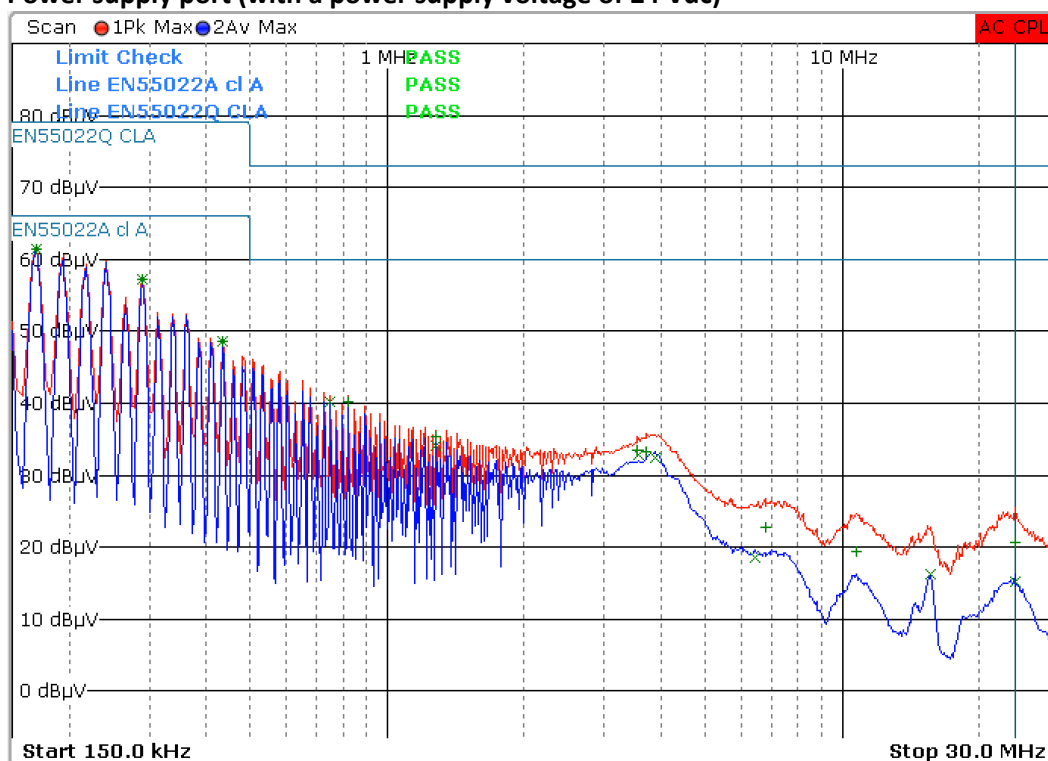
Standard and date

Standard IEC 60255-1, subclause 6.15 / IEC 60255-26 subclause 5.2
 Basic standard CISPR 11, CISPR 22
 Test date 17 September 2020

Characteristic test data

Serial number 20291033
 Power supply 24/220 Vdc
 48/230 Vac

Power supply port (with a power supply voltage of 24 Vdc)

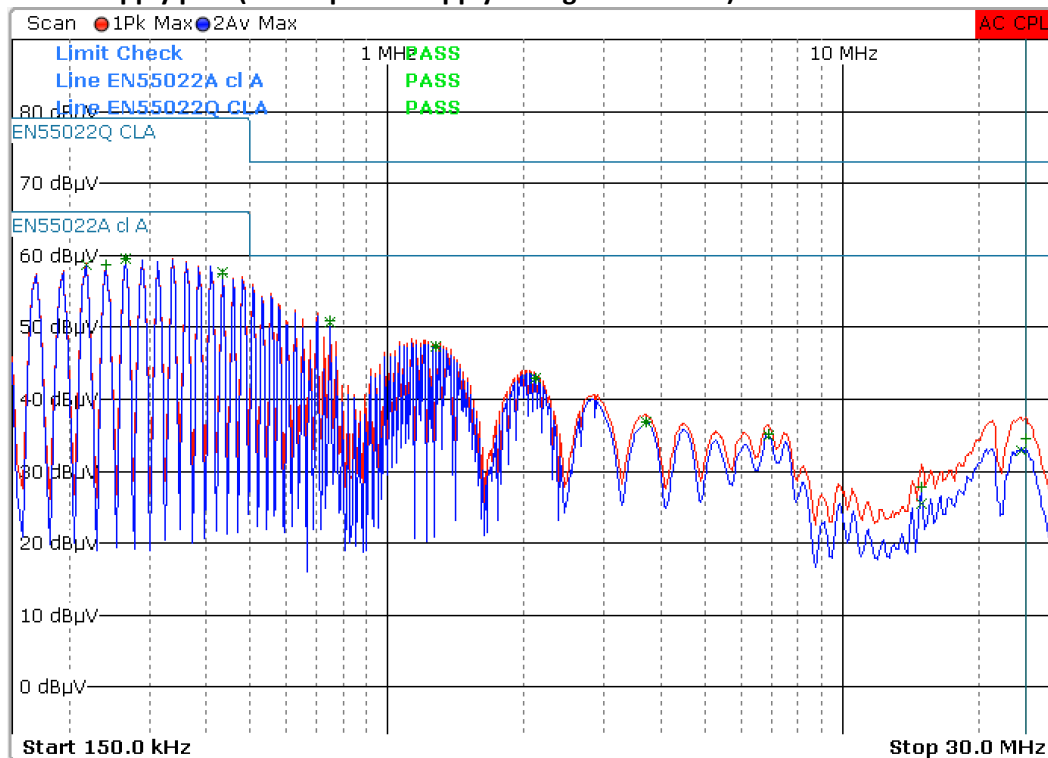


Final_Result

Meas Time 1.0 s
 Margin 50.0 dB
 Peaks 25

Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
1	170.000 kHz	61.42	N	Quasi Peak	-17.58
2	170.000 kHz	61.43	N	Average	-4.57
1	290.000 kHz	57.16	L1	Quasi Peak	-21.84
2	290.000 kHz	57.13	L1	Average	-8.87
1	434.000 kHz	48.56	L1	Quasi Peak	-30.44
2	434.000 kHz	48.56	L1	Average	-17.44
2	750.000 kHz	40.16	L1	Average	-19.84
1	822.000 kHz	40.29	L1	Quasi Peak	-32.71
1	1.282 MHz	35.28	L1	Quasi Peak	-37.72
2	1.282 MHz	34.05	L1	Average	-25.95
1	3.554 MHz	33.46	N	Quasi Peak	-39.54
2	3.578 MHz	32.81	N	Average	-27.19
1	3.702 MHz	33.21	N	Quasi Peak	-39.79
2	3.870 MHz	32.53	N	Average	-27.47
2	6.434 MHz	18.65	N	Average	-41.35
1	6.770 MHz	22.68	N	Quasi Peak	-50.32
1	10.730 MHz	19.43	N	Quasi Peak	-53.57
2	15.598 MHz	16.26	N	Average	-43.74
1	24.006 MHz	20.65	N	Quasi Peak	-52.35
2	24.006 MHz	15.18	L1	Average	-44.82

Power supply port (with a power supply voltage of 220 Vdc)

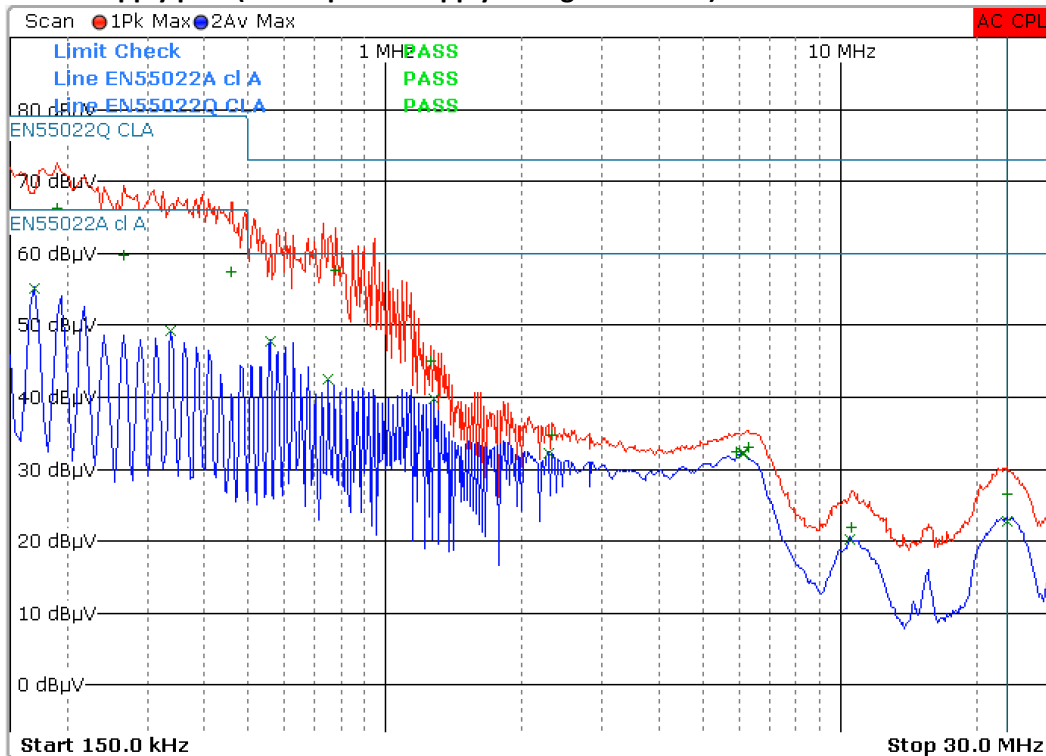


Final_Result

Meas Time 1.0 s
Margin 50.0 dB
Peaks 25

Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
2	218.000 kHz	58.77	L1	Average	-7.23
1	242.000 kHz	58.73	L1	Quasi Peak	-20.27
1	266.000 kHz	59.54	L1	Quasi Peak	-19.46
2	266.000 kHz	59.56	L1	Average	-6.44
1	434.000 kHz	57.53	L1	Quasi Peak	-21.47
2	434.000 kHz	57.55	L1	Average	-8.45
1	750.000 kHz	50.86	N	Quasi Peak	-22.14
2	750.000 kHz	50.70	N	Average	-9.30
1	1.282 MHz	47.44	N	Quasi Peak	-25.56
2	1.282 MHz	47.43	N	Average	-12.57
1	2.126 MHz	42.87	N	Quasi Peak	-30.13
2	2.126 MHz	42.89	N	Average	-17.11
1	3.698 MHz	36.94	N	Quasi Peak	-36.06
2	3.698 MHz	36.82	N	Average	-23.18
1	6.886 MHz	35.21	N	Quasi Peak	-37.79
2	6.886 MHz	35.05	N	Average	-24.95
2	14.906 MHz	25.58	N	Average	-34.42
1	14.978 MHz	27.90	N	Quasi Peak	-45.10
2	24.718 MHz	32.77	L1	Average	-27.23
1	25.366 MHz	34.62	N	Quasi Peak	-38.38

Power supply port (with a power supply voltage of 48 Vac)



Final_Result

Meas Time

1.0 s

Margin

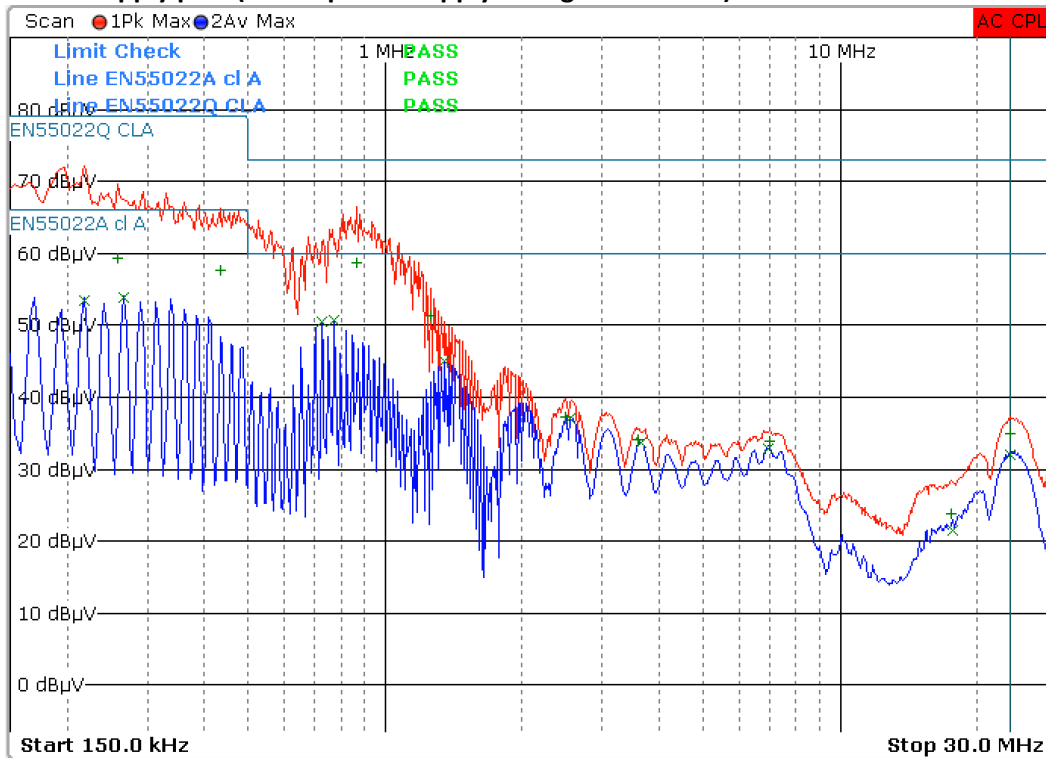
50.0 dB

Peaks

25

Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
2	170.000 kHz	55.21	L1	Average	-10.79
1	190.000 kHz	66.31	N	Quasi Peak	-12.69
1	266.000 kHz	59.76	N	Quasi Peak	-19.24
2	338.000 kHz	49.22	N	Average	-16.78
1	458.000 kHz	57.52	N	Quasi Peak	-21.48
2	558.000 kHz	47.69	N	Average	-12.31
2	750.000 kHz	42.52	N	Average	-17.48
1	778.000 kHz	57.69	N	Quasi Peak	-15.31
1	1.258 MHz	45.07	N	Quasi Peak	-27.93
2	1.282 MHz	39.79	N	Average	-20.21
2	2.298 MHz	32.26	N	Average	-27.74
1	2.322 MHz	34.75	N	Quasi Peak	-38.25
1	5.930 MHz	32.48	N	Quasi Peak	-40.52
2	6.118 MHz	32.29	N	Average	-27.71
2	6.166 MHz	32.30	N	Average	-27.70
1	6.314 MHz	33.02	N	Quasi Peak	-39.98
2	10.494 MHz	20.28	N	Average	-39.72
1	10.622 MHz	21.89	N	Quasi Peak	-51.11
2	23.238 MHz	22.87	L1	Average	-37.13
1	23.334 MHz	26.50	L1	Quasi Peak	-46.50

Power supply port (with a power supply voltage of 110 Vac)

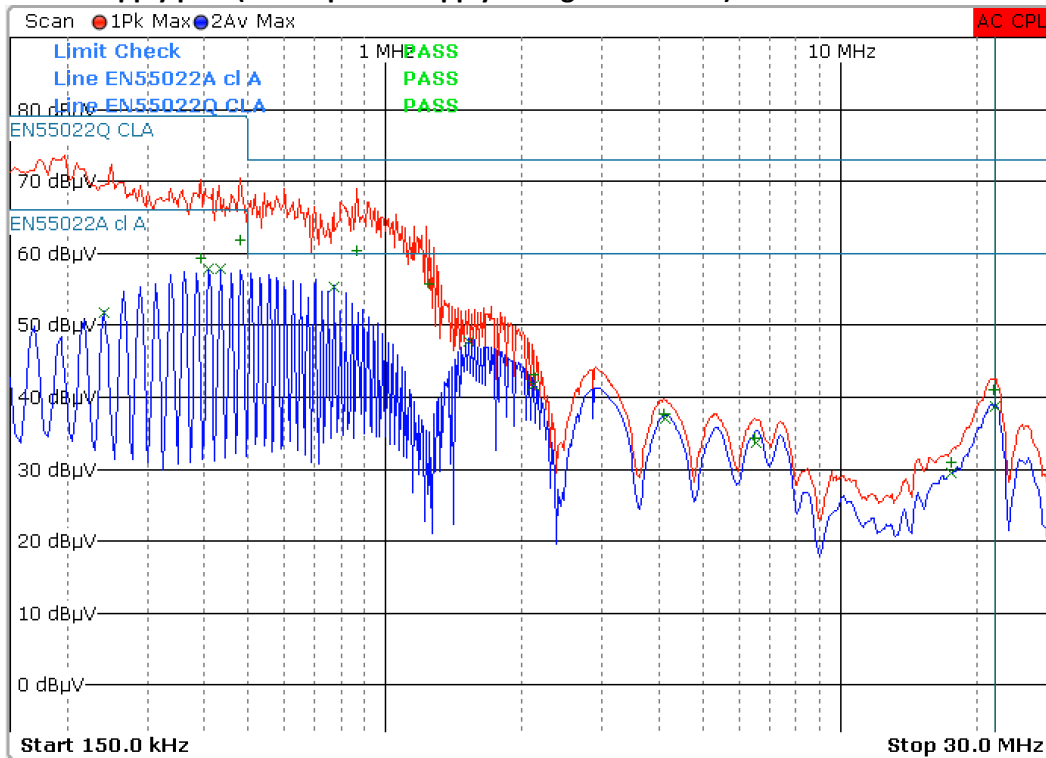


Final_Result

Meas Time 1.0 s
Margin 50.0 dB
Peaks 25

Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
1	218.000 kHz	64.14	N	Quasi Peak	-14.86
2	218.000 kHz	53.37	N	Average	-12.63
1	258.000 kHz	59.34	N	Quasi Peak	-19.66
2	266.000 kHz	53.87	N	Average	-12.13
1	434.000 kHz	57.70	N	Quasi Peak	-21.30
2	726.000 kHz	50.40	N	Average	-9.60
2	774.000 kHz	50.69	N	Average	-9.31
1	866.000 kHz	58.77	N	Quasi Peak	-14.23
1	1.258 MHz	51.41	N	Quasi Peak	-21.59
2	1.354 MHz	44.96	N	Average	-15.04
1	2.494 MHz	37.37	N	Quasi Peak	-35.63
2	2.542 MHz	36.96	N	Average	-23.04
1	3.606 MHz	34.21	N	Quasi Peak	-38.79
2	3.654 MHz	33.78	N	Average	-26.22
2	6.946 MHz	32.86	N	Average	-27.14
1	6.994 MHz	33.81	N	Quasi Peak	-39.19
1	17.498 MHz	23.81	L1	Quasi Peak	-49.19
2	17.642 MHz	21.61	L1	Average	-38.39
2	23.666 MHz	31.95	L1	Average	-28.05
1	23.714 MHz	34.90	L1	Quasi Peak	-38.10

Power supply port (with a power supply voltage of 230 Vac)



Final_Result

Meas Time

1.0 s

Margin

50.0 dB

Peaks

25

Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
1	198.000 kHz	64.89	L1	Quasi Peak	-14.11
2	242.000 kHz	51.81	N	Average	-14.19
1	394.000 kHz	59.34	N	Quasi Peak	-19.66
2	410.000 kHz	57.94	N	Average	-8.06
2	434.000 kHz	57.84	N	Average	-8.16
1	482.000 kHz	61.91	L1	Quasi Peak	-17.09
2	774.000 kHz	55.37	N	Average	-4.63
1	866.000 kHz	60.32	N	Quasi Peak	-12.68
1	1.254 MHz	55.70	N	Quasi Peak	-17.30
2	1.522 MHz	47.87	N	Average	-12.13
1	2.126 MHz	43.15	N	Quasi Peak	-29.85
2	2.126 MHz	41.70	N	Average	-18.30
1	4.106 MHz	37.71	N	Quasi Peak	-35.29
2	4.130 MHz	37.10	N	Average	-22.90
1	6.474 MHz	34.43	N	Quasi Peak	-38.57
2	6.546 MHz	33.77	N	Average	-26.23
2	17.578 MHz	29.45	L1	Average	-30.55
1	17.602 MHz	30.91	L1	Quasi Peak	-42.09
1	21.830 MHz	41.03	L1	Quasi Peak	-31.97
2	21.974 MHz	38.78	L1	Average	-21.22

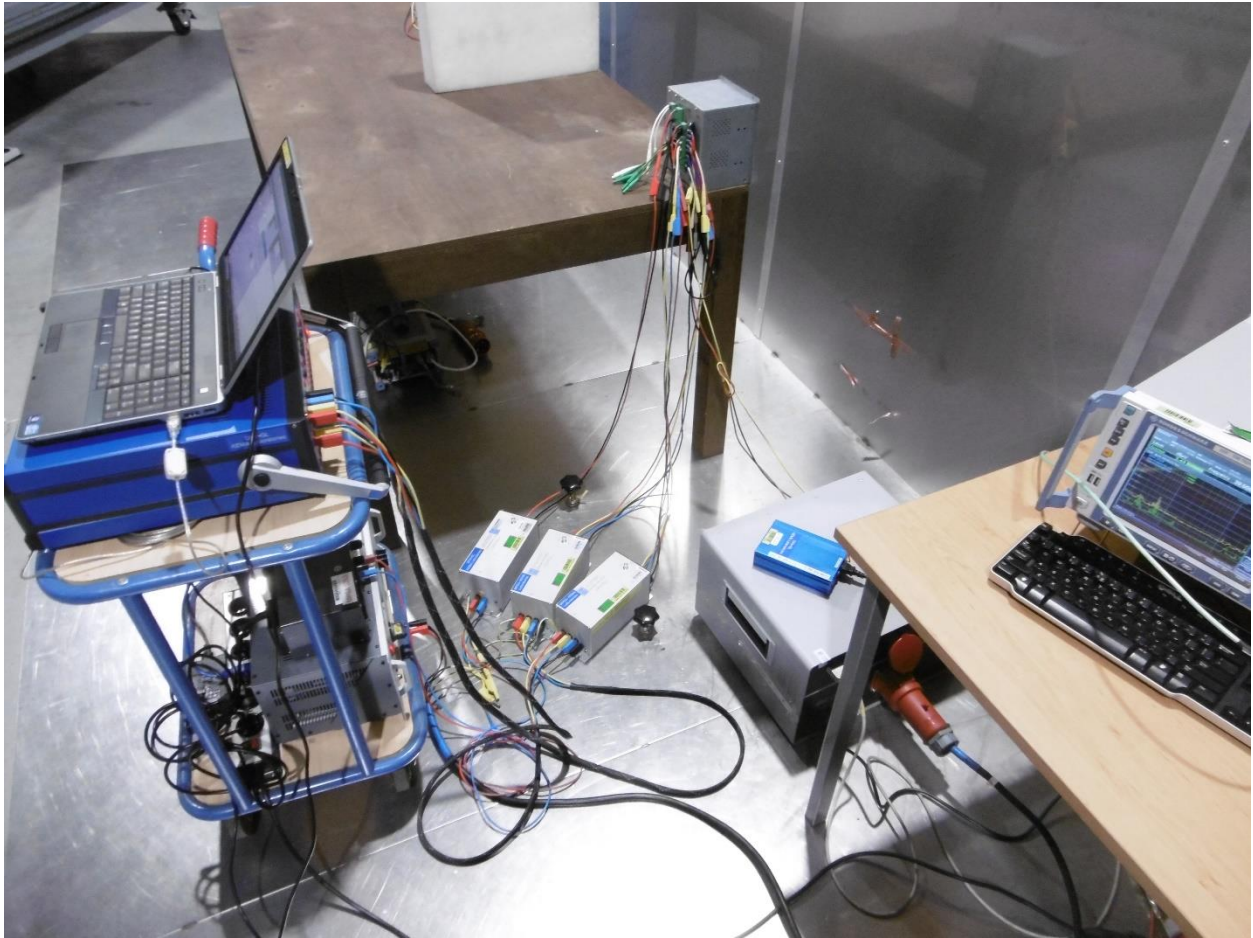
Requirement

The conducted emission shall not exceed the limits for class A equipment, specified in the standard CISPR 22.

Result

The object passed the test.

Photograph of test arrangement



8.4 Electrostatic discharge

Standard and date

Standard IEC 60255-1, subclause 6.15, IEC 60255-26, subclause 6.1
 Basic standard IEC 61000-4-2
 Test date 18 March 2020

Environmental conditions

Ambient temperature 21 °C
 Relative humidity 45 %
 Air pressure 1021 hPa

Characteristic test data

Serial number 19600004
 Power supply 48 Vdc

Discharge type	Test level kV	Test points	Polarity	Observations
Air	2, 4, 8	5 to 11	+ and -	-
Contact	2, 4, 6	1 to 4	+ and -	-
Indirect contact	2, 4, 6	VCP right of object	+ and -	-
		HCP under object	+ and -	-

Requirements

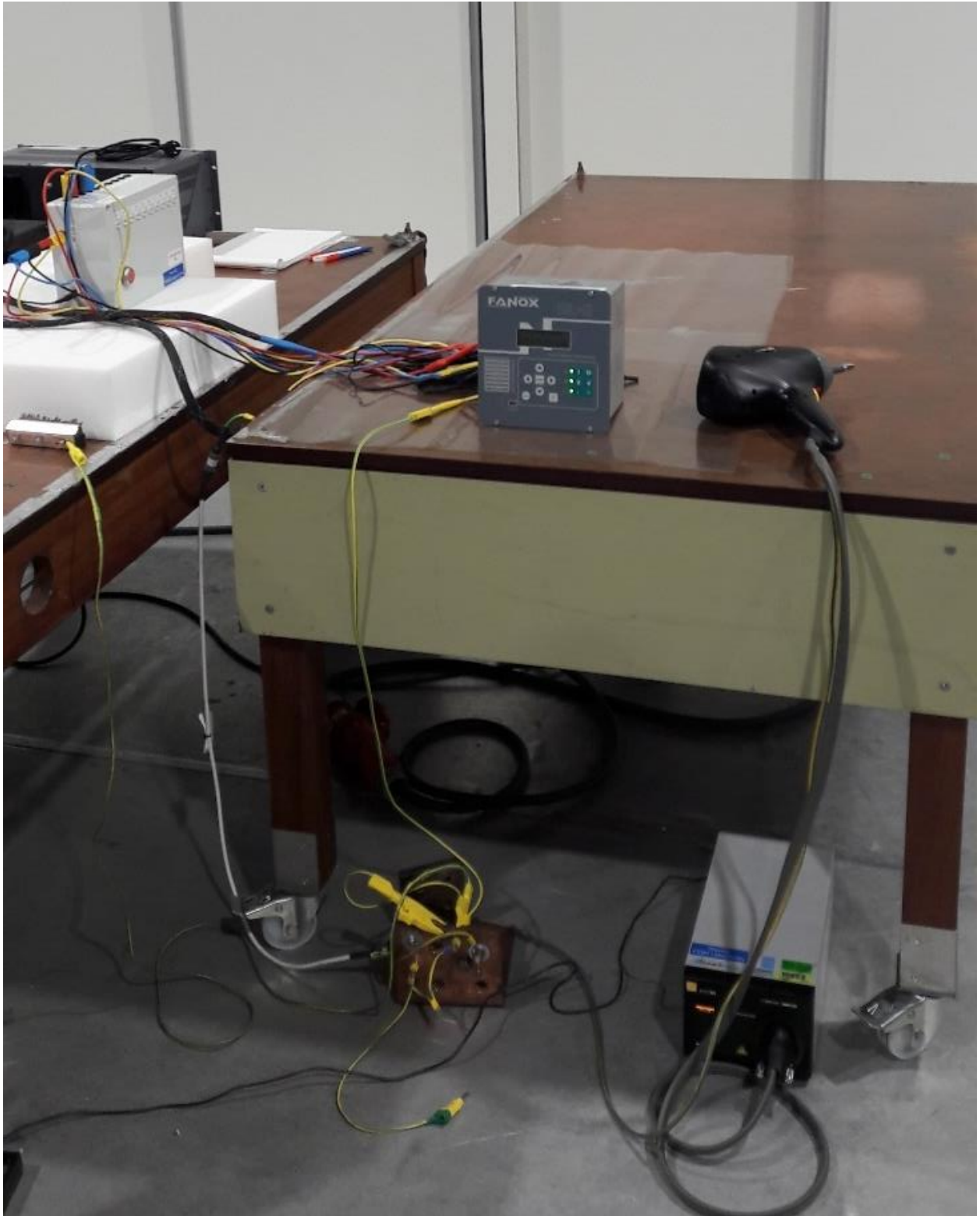
- The object shall comply with acceptance criteria B of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photographs of test points



Photographs of test arrangement

8.5 Radiated interference

Standard and date

Standard IEC 60255-1, subclause 6.15, IEC 60255-26, subclause 6.1
 Basic standard IEC 61000-4-3
 Test date 21 November 2019

Characteristic test data

Serial number 19600004
 Amplitude modulated 80 % AM (1 kHz)
 Dwell time frequency sweep 1 s
 Test duration spot frequencies 10 s

Frequency sweep

Direction	Test level V/m	Step size	Frequency sweep MHz	Observations
x side of EUT (horizontal & vertical polarization)	10	$\leq 1\%$	80 – 1000	-
			1400 – 2700	-
y side of EUT (horizontal & vertical polarization)	10	$\leq 1\%$	80 – 1000	-
			1400 – 2700	-
z side of EUT (horizontal & vertical polarization)	10	$\leq 1\%$	80 – 1000	-
			1400 – 2700	-

Spot frequencies

Direction	Test level V/m	Duty cycle	Spot frequencies MHz	Observations
x side of EUT (horizontal & vertical polarization)	10	100%	80; 160; 380; 450; 900; 1850; 2150	-
y side of EUT (horizontal & vertical polarization)	10	100%	80; 160; 380; 450; 900; 1850; 2150	-
z side of EUT (horizontal & vertical polarization)	10	100%	80; 160; 380; 450; 900; 1850; 2150	-

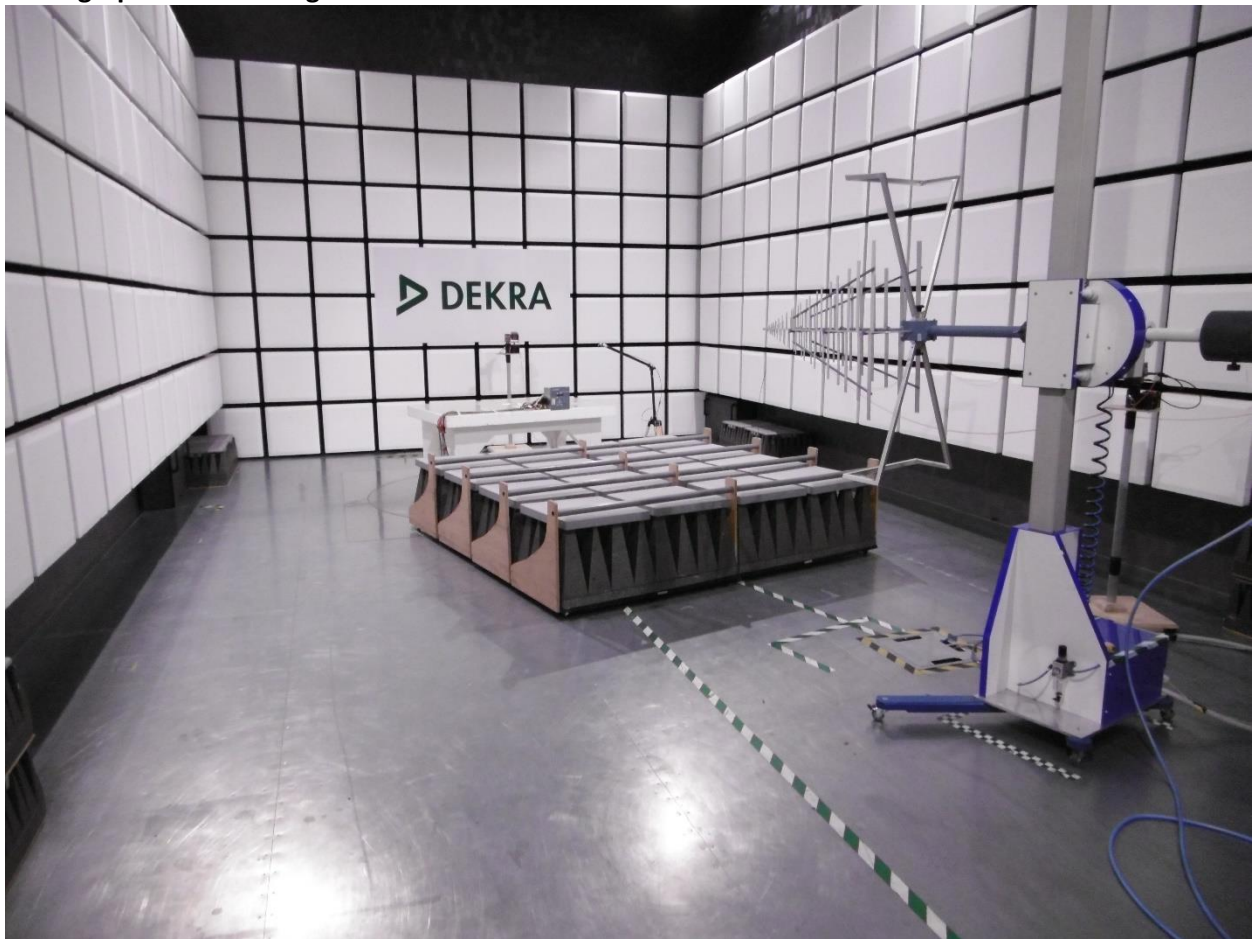
Requirements

- The object shall comply with acceptance criteria A of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement



8.6 Electrical fast transient

Standard and date

Standard IEC 60255-1, subclause 6.15, IEC 60255-26, subclause 6.2, 6.3, 6.4 and 6.5
 Basic standard IEC 61000-4-4
 Test date 26 October 2020

Characteristic test data

Serial number 20291033
 Polarity Positive/negative
 Test duration 1 minute

Zone A

Circuit	Terminals	Coupling	Test voltage kV	Repetition Frequency kHz	Observations
Power supply	B1, B2 and PE	CM (CDN)	4	5	-
RS485	C25, C26	CM (CCC)	2	5	-
Voltage transformer	B3, B4, B5, B6, B7, B8, B9, B10	CM (CDN)	4	5	-
Current transformer	A1, A2, A3, A4, A5, A6, A7, A8	CM (CDN)	4	5	-
BI	C1-C5 C6-C10	CM(CDN)	2	5	-
BO	C11, C12	CM (CDN)	4	5	-
Relais	C15, C16	CM (CDN)	4	5	-
Relais Arc	F5, F6	CM (CDN)	4	5	-
Earth port	PE	CM (CDN)	4	5	-

Note

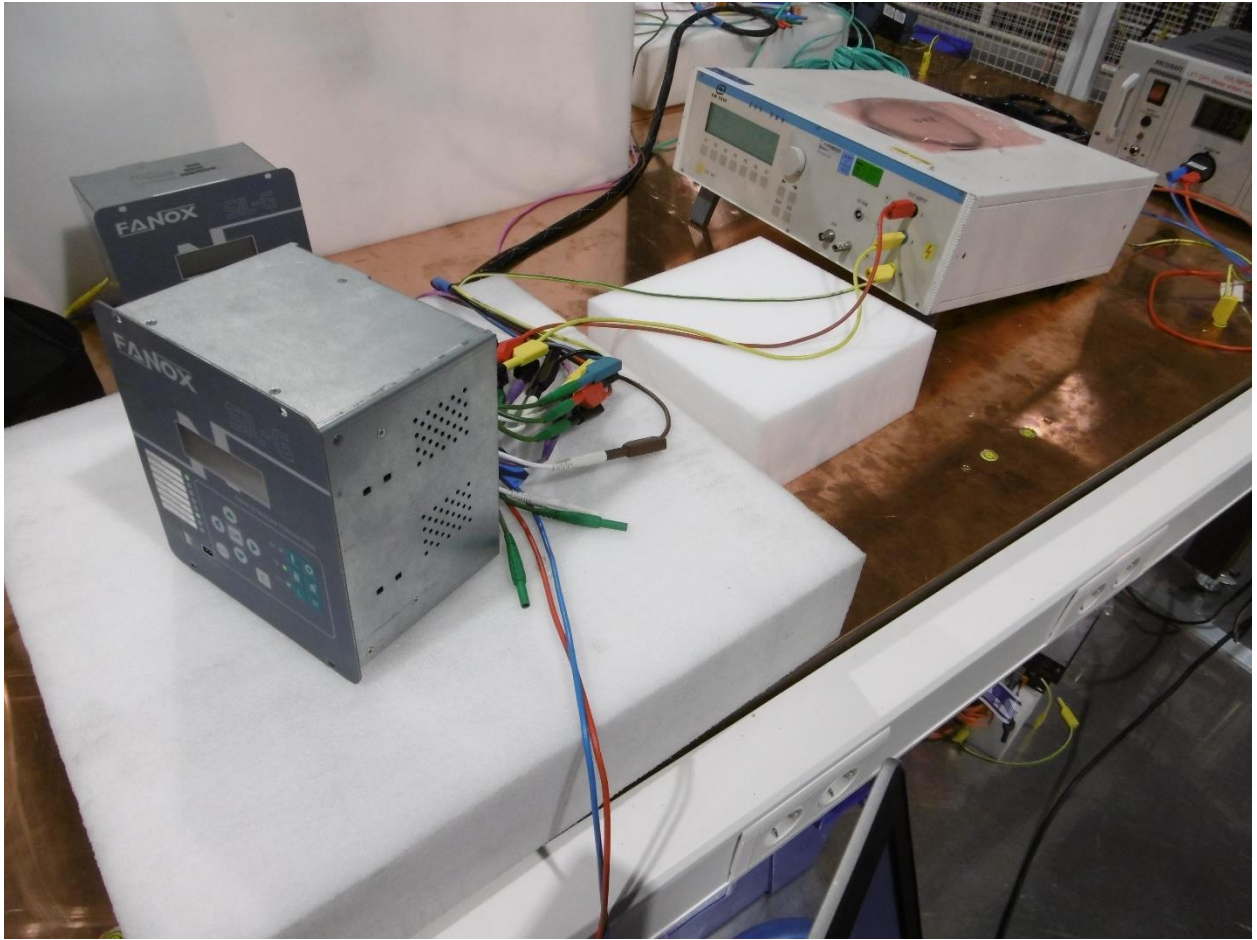
CM = Common Mode
 CDN = Coupling-Decoupling Network
 CCC = Capacitive Coupling Clamp

Requirements

- The object shall comply with acceptance criteria B of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement

8.7 Slow damped oscillatory wave

Standard and date

Standard IEC 60255-1, subclause 6.15, IEC 60255-26, subclause 6.2, 6.3 and 6.4
 Basic standard IEC 61000-4-18
 Test date 23 September 2020

Characteristic test data

Serial number 20291033
 Voltage oscillation frequency 1 MHz
 Voltage rise time 75 ns
 Repetition frequency 400 Hz
 Output impedance 200 Ohm
 Polarity of the first half-period Positive and negative

Circuit	Terminals	Coupling	Test voltage kV	Observations
Power supply	B1, B2 and PE	CM	2,5	-
		DM	1,0	-
RS485	C25, C26	CM ¹⁾	1,0	-
Voltage transformer	B3, B4, B5, B6, B7, B8, B9, B10	CM	2,5	1
		DM	1,0	-
Current transformer	A1, A2, A3, A4, A5, A6, A7, A8	CM	2,5	-
		DM	1,0	-
BI	C1-C5	CM	2,5	-
		DM	1,0	-
BO	C11, C12	CM	2,5	-
		DM	1,0	-
Relais	C15, C16	CM	2,5	-
		DM	1,0	-
Relais Arc	F5, F6	CM	2,5	-
		DM	1,0	-

Note

¹⁾ Direct injection on the shield

CM = Common Mode

DM = Differential mode

Observations

1. Display shows a ">>> pickup" No unwanted trips.

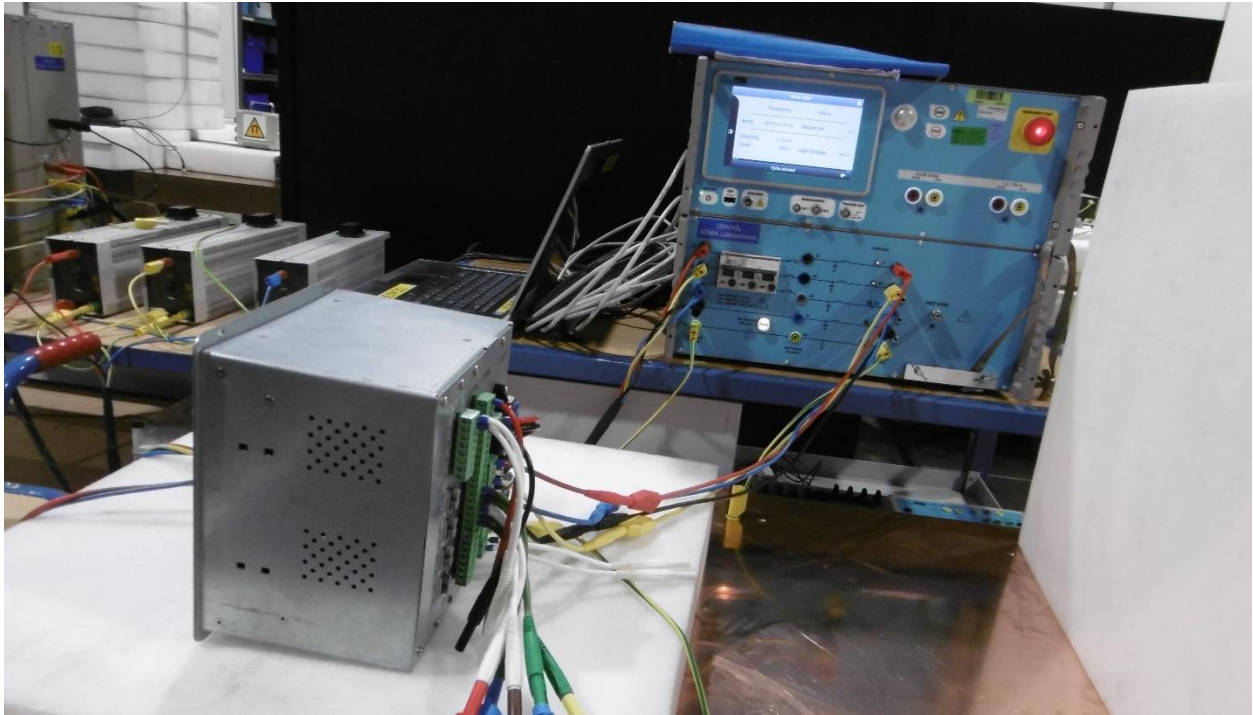
Requirements

- The object shall comply with acceptance criteria B of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement



8.8 Surge

Standard and date

Standard IEC 60255-1, subclause 6.15, IEC 60255-26 subclause 6.2, 6.3 and 6.4
 Basic standard IEC 61000-4-5
 Test date 25 September 2020

Characteristic test data

Serial number 20291033
 Source impedance 2 Ω
 Front time (voltage) 1,2 μ s
 Time to half value (voltage) 50 μ s
 Front time (current) 8 μ s
 Time to half value (current) 20 μ s

Auxiliary power supply port

Coupling capacitor 9 / 18 μ F
 Coupling resistor 0 / 10 Ω

Input and output ports

Coupling resistor 40 Ω
 Coupling capacitor 0,5 μ F

Circuit	Terminals	Coupling	Test voltage kV	Observations
Power supply	B1, B2 and PE	LL	0,5/1/2	-
		LE	1/2/4	-
RS485	C25, C26	LL	0,5/1/2	-
		LE	1/2/4	-
Voltage transformer	B3, B4 B11, B12	LL	0,5/1/2	-
		LE	1/2/4	-
Current transformer	A1, A2 A7, A8	LL	0,5/1/2	-
		LE	1/2/4	-
BI	C1, C5	LL	0,5/1/2	-
		LE	1/2/4	-
BO	C11, C12	LL	0,5/1/2	-
		LE	1/2/4	-
Relay	C21, C22	LL	0,5/1/2	-
		LE	1/2/4	-
Relay Arc	F1, F2	LL	0,5/1/2	-
		LE	1/2/4	-

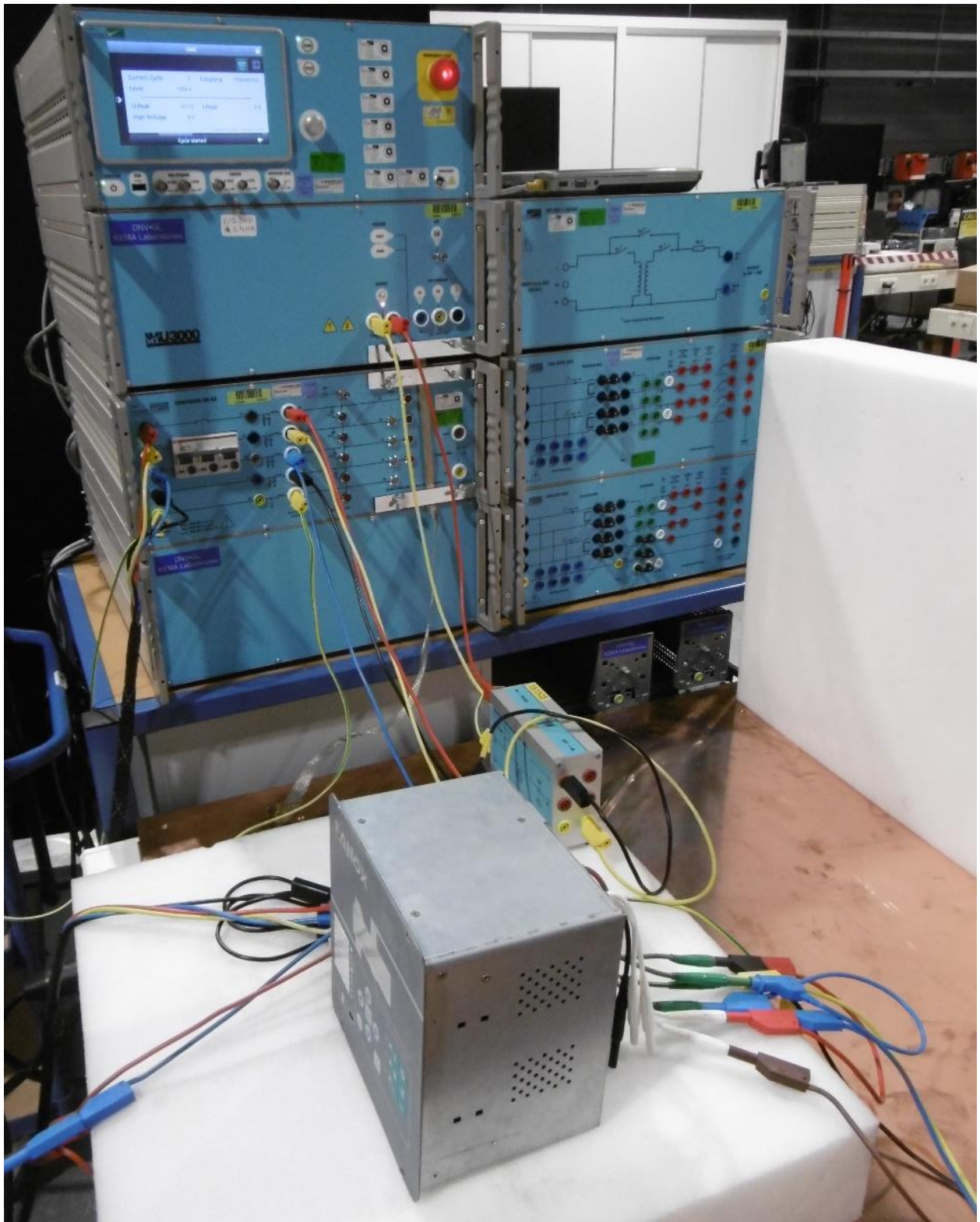
Requirements

- The object shall comply with acceptance criteria B of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement



8.9 Conducted disturbance induced by radio-frequency fields

Standard and date

Standard IEC 60255-1, subclause 6.15, IEC 60255-26, subclauses 6.2, 6.3, 6.4 and 6.5
 Basic standard IEC 61000-4-6
 Test date 13 and 14 January 2020

Characteristic test data

Serial number 19600004
 Source impedance 150 Ω
 Amplitude modulated 80 % AM (1 kHz)
 Sweep rate 1 %
 Dwell time frequency sweep 0,5 s
 Test duration spot frequencies 10 s

Frequency sweep

Circuit/ Terminals	Test level V	CDN	Sweep rate	Frequency sweep MHz	Observations
Power (B1, B2 and PE)	10	M2	$\leq 1\%$	0,15 – 80	-
VT (B3, B4, B5, B6, B7, B8, B9, B10)	10	M4	$\leq 1\%$	0,15 - 80	-
CT (A1, A2, A3, A4, A5, A6, A7, A8)	10	M4	$\leq 1\%$	0,15 - 80	-
Output (C11, C12)	10	M2	$\leq 1\%$	0,15 - 80	-
Relay (C15, C16)	10	M2	$\leq 1\%$	0,15 - 80	-
Relay (F5, F6)	10	M2	$\leq 1\%$	0,15 - 80	-
BI (C6, C7, C8, C9, C10)	10	AF3	$\leq 1\%$	0,15 - 80	-
BI (C6, C7, C8, C9, C10)	10	Clamp	$\leq 1\%$	0,15 - 80	-
RS485 (C25, C26)	10	AF2	$\leq 1\%$	0,15 – 80	-
PE	10	M1	$\leq 1\%$	0,15 – 80	-

Spot frequencies

Circuit/ Terminals	Test level V	CDN	Duty cycle %	Spot frequencies MHz	Observations
Power (B1, B2 and PE)	10	M2	100	27, 68	-
VT (B3, B4, B5, B6, B7, B8, B9, B10)	10	M4	100	27, 68	-
CT (A1, A2, A3, A4, A5, A6, A7, A8)	10	M4	100	27, 68	-
Output (C11, C12)	10	M2	100	27, 68	-
Relay (C15, C16)	10	M2	100	27, 68	-
Relay (F5, F6)	10	M2	100	27, 68	-
BI (C6, C7, C8, C9, C10)	10	AF3	100	27, 68	-
BI (C6, C7, C8, C9, C10)	10	Clamp	100	27, 68	-
RS485 (C25, C26)	10	AF2	100	27, 68	-
PE	10	M1	100	27, 68	-

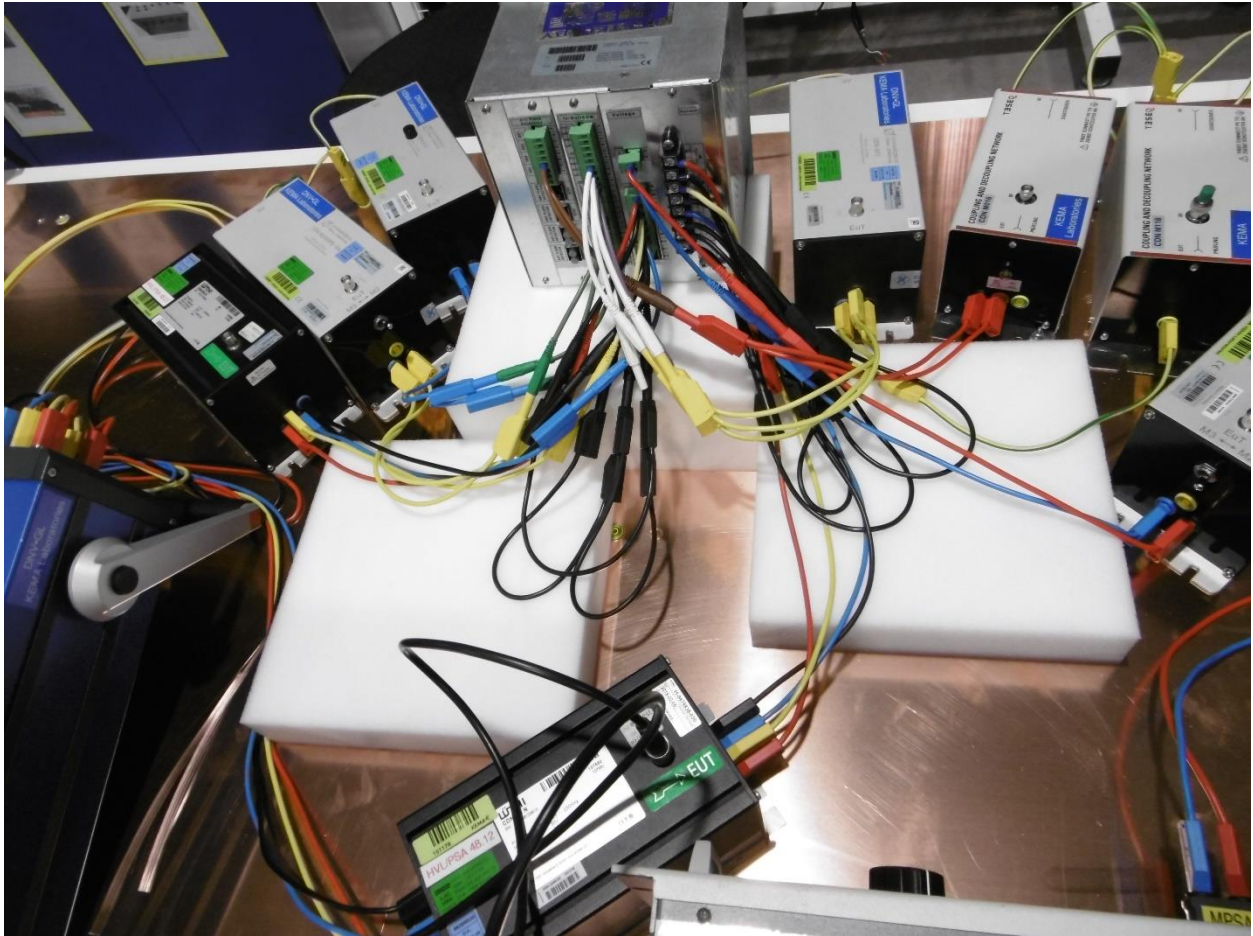
Requirements

- The object shall comply with acceptance criteria A of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement



8.10 Power frequency magnetic field

Standard and date

Standard IEC 60255-1, subclause 6.15, IEC 60255-26, subclause 6.1
 Basic standard IEC 61000-4-8
 Test date 5 March 2020

Characteristic test data

Serial number 196000004
 Power supply 100 Vdc
 Frequency 50 Hz

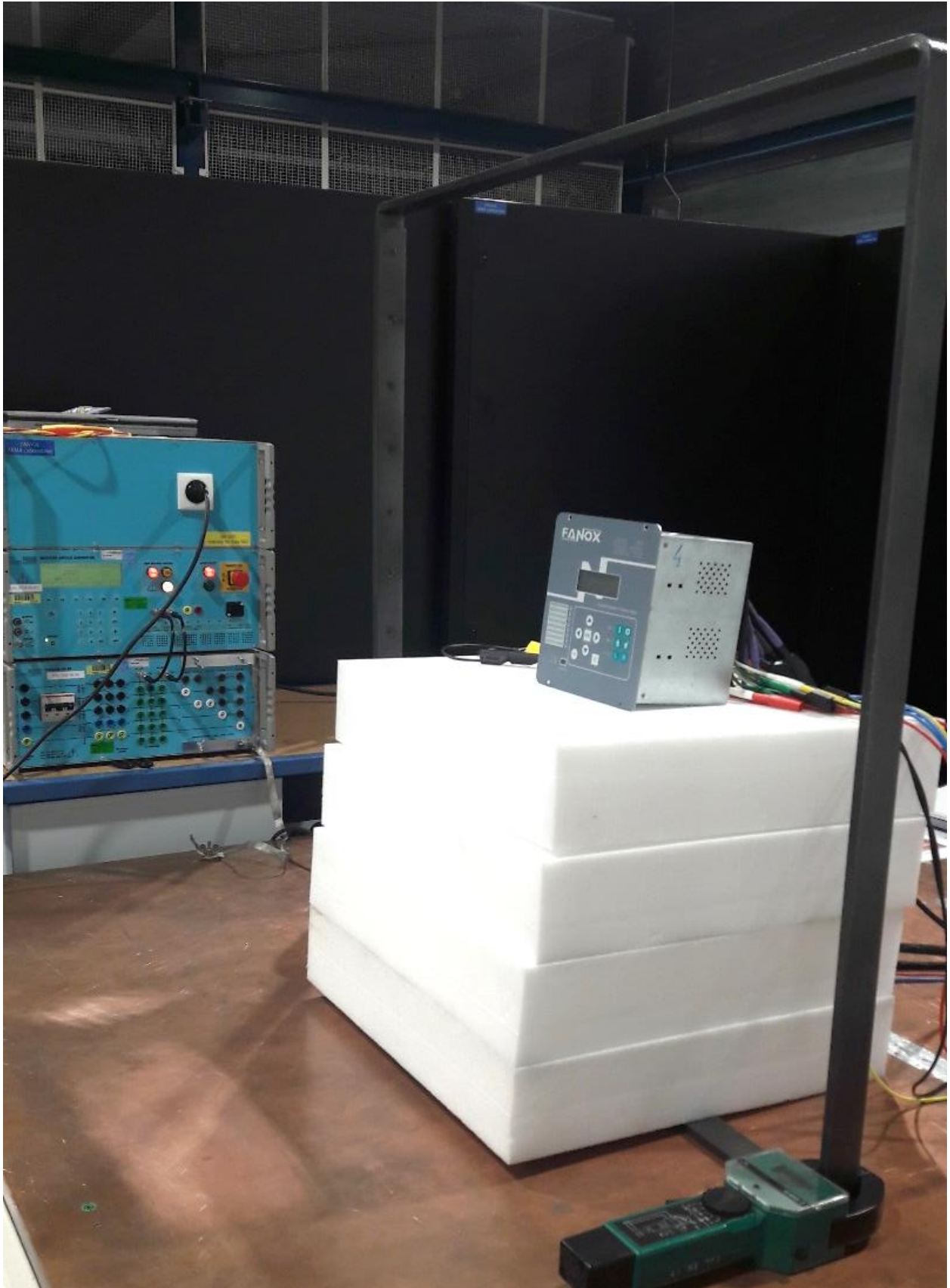
Direction	Test level A/m	Duration s	Acceptance criteria	Observations
Horizontal longitudinal (x)	30	Continuous	A	-
	300	1 to 3 s	B	-
Horizontal transversal (y)	30	Continuous	A	-
	300	1 to 3 s	B	-
Vertical (z)	30	Continuous	A	-
	300	1 to 3 s	B	-

Requirements

- The object shall comply with the required acceptance criteria of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement

8.11 Voltage dips and voltage interruptions on DC power supply voltage

Standard and date

Standard	IEC 60255-1, subclause 6.15, IEC 60255-26, subclause 6.2
Basic standard	IEC 61000-4-29
Test date	6 March 2020

Characteristic test data

Serial number	19600004
High impedance	$\geq 100 \text{ k}\Omega$
Number of voltage dips	3
Interruption between dips	$\geq 10 \text{ s}$
Specified input voltage range	24 - 220 Vdc (-20/ +10%)

Voltage dips

Power supply voltage Vdc	Dip duration ms	Residual voltage % of 24 Vdc	Acceptance criteria	Observations
19,2	10	0	A	-
19,2	200	40	C	1
19,2	500	70	C	1

(Umin = lowest rated voltage minus the specified tolerance)

Observations

1. Device is restarting due to the voltage dip. No unwanted change of signal state. Correct operation after the restart.

Voltage interruptions

Power supply voltage Vdc	Duration s	Residual voltage % of 24 Vdc	Acceptance criteria	Observations
19,20 (low impedance)	5	0	C	1
19,20 (high impedance)	5	0	C	1

Observations

1. Device is restarting due to the voltage interruption. No unwanted change of output state. Correct operation after the restart.

Requirements

- The object shall comply with the required acceptance criteria of IEC 60255-26, Table 23
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement

8.12 Voltage ripple on DC power supply voltage

Standard and date

Standard IEC 60255-1, subclause 6.15, IEC 60255-26, subclause 6.2
 Basic standard IEC 61000-4-17
 Test date 6 March 2020

Characteristic test data

Serial number 19600004
 Auxiliary power supply input voltage 24 - 220 Vdc (-20/+10 %)
 Rated power frequency 50/60 Hz

Power supply voltage Vdc	Test frequency Hz	Ripple V / %	See oscillogram on next pages	Observations
19.2	100/120	3,60 / 15	1 / 3	-
242	100/120	33,0 / 15	2 / 4	-

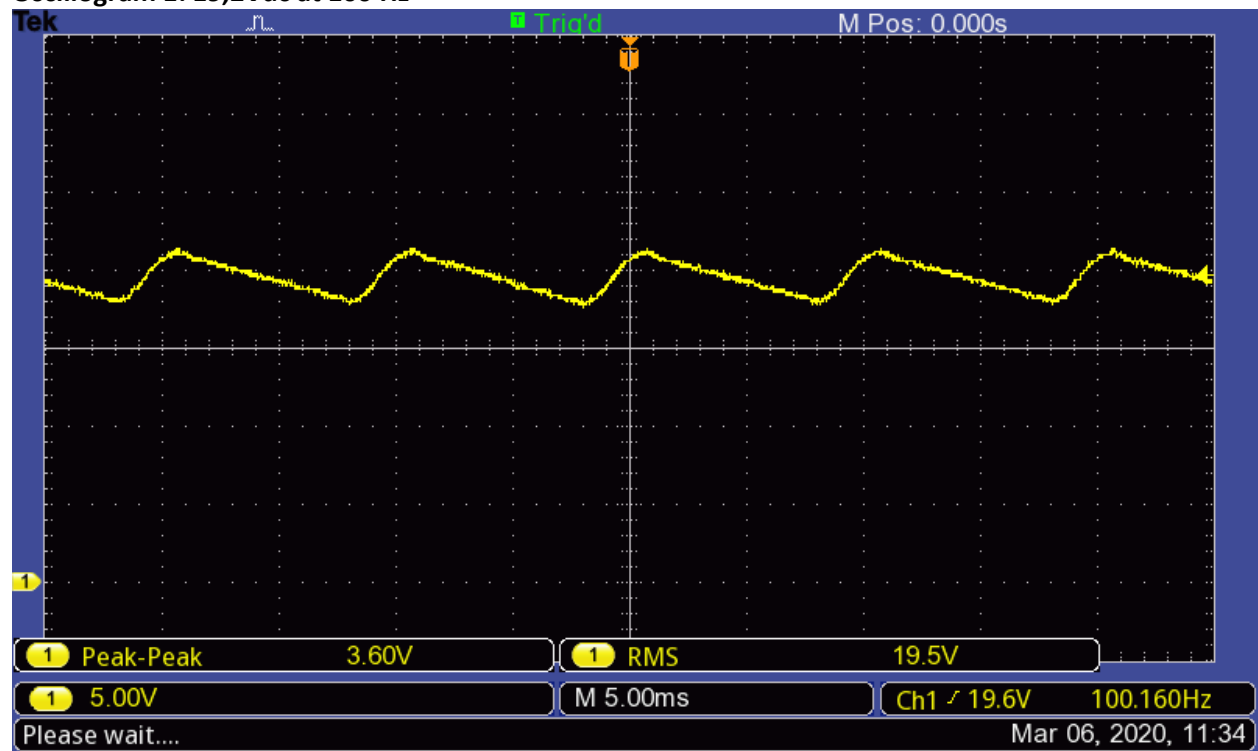
Requirements

- The object shall comply with the required acceptance criteria A of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

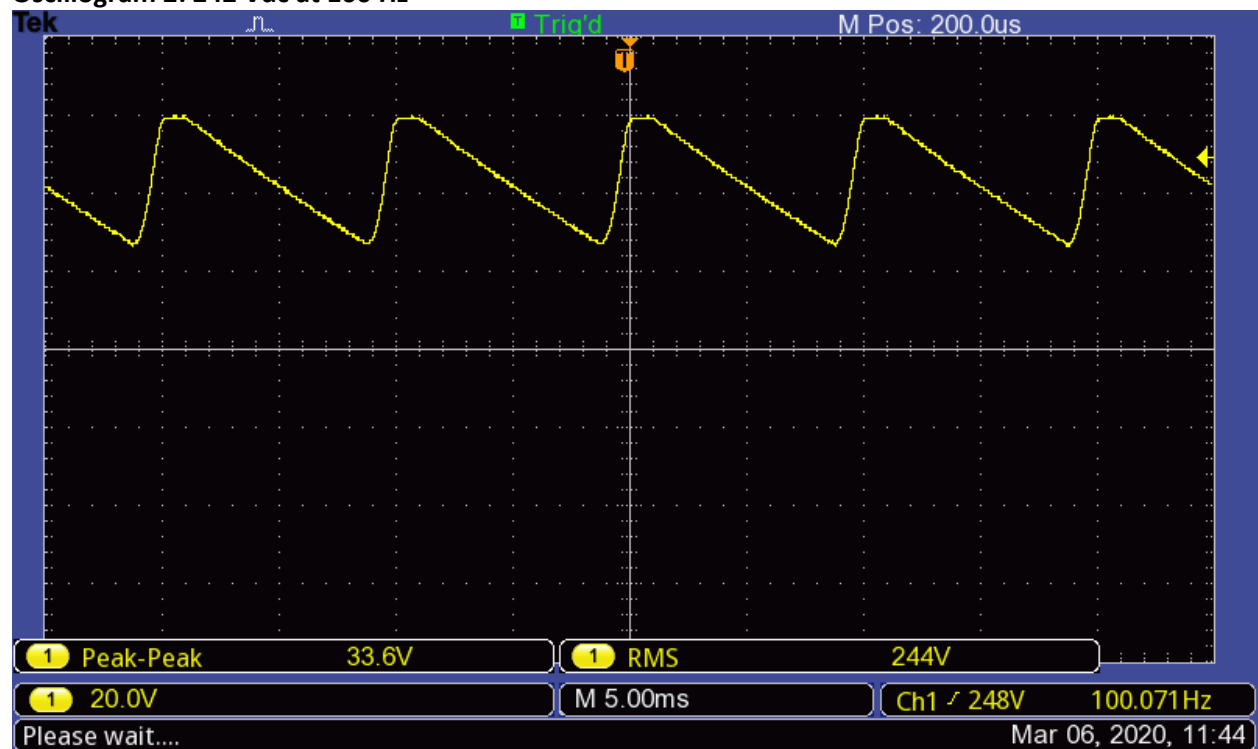
Result

The object passed the test.

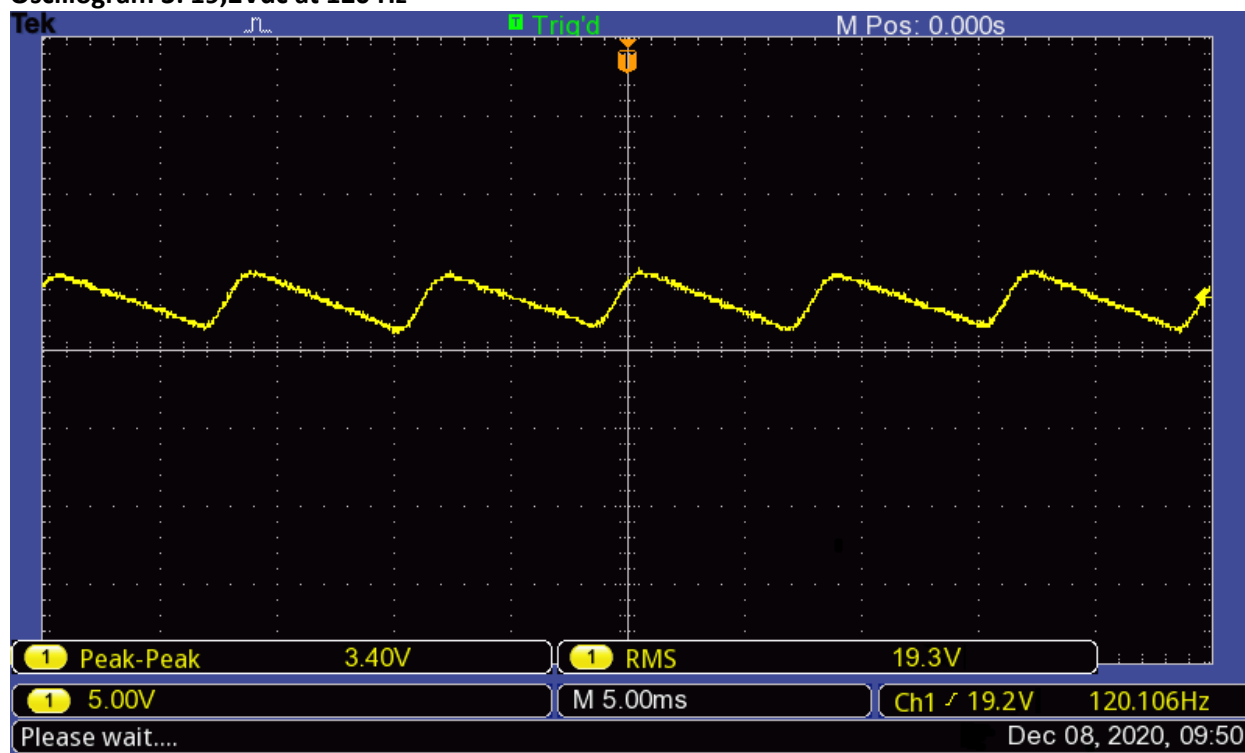
Oscillogram 1: 19,2Vdc at 100 Hz



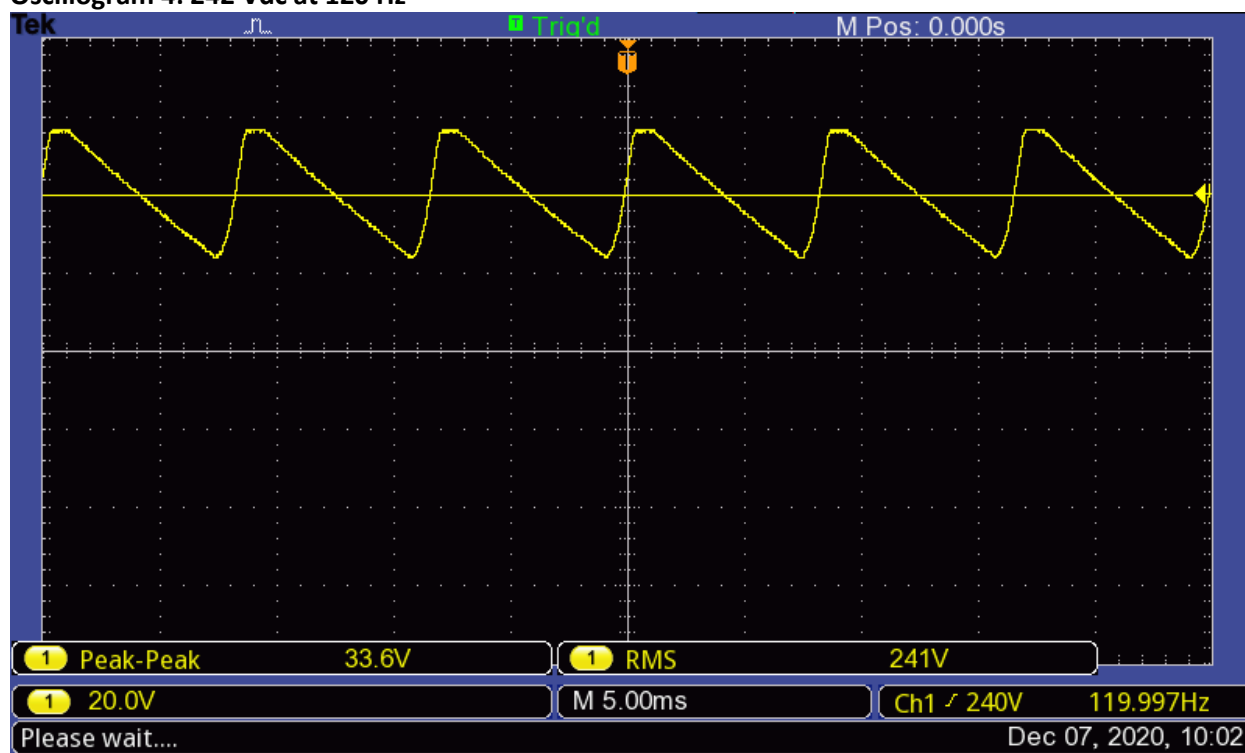
Oscillogram 2: 242 Vdc at 100 Hz



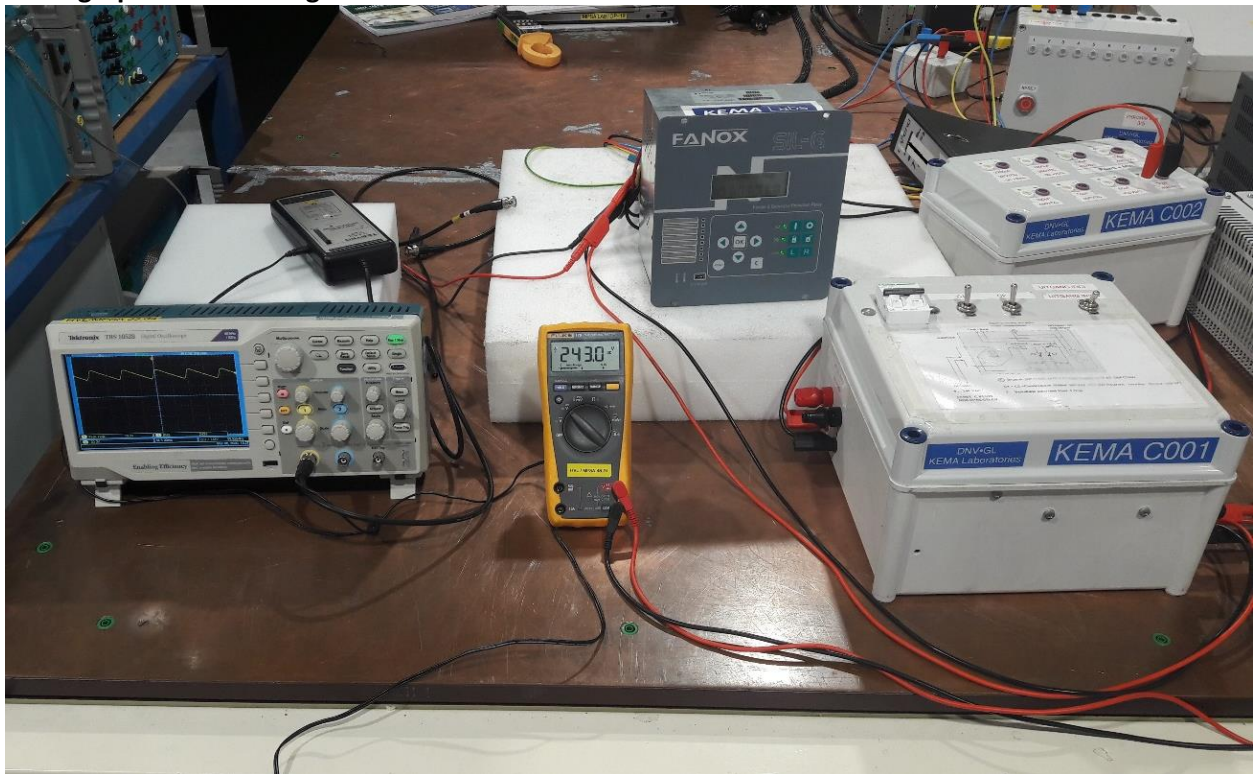
Oscillogram 3: 19,2Vdc at 120 Hz



Oscillogram 4: 242 Vdc at 120 Hz



Photograph of test arrangement



8.13 Voltage dips and voltage interruptions on AC power supply voltage

Standard and date

Standard IEC 60255-1, subclause 6.15, IEC 60255-26, subclause 6.2
 Basic standard IEC 61000-4-11
 Test date 6 March 2020

Characteristic test data

Serial number 19600004
 Power supply 48 - 230 Vac(-20/+10 %)
 Power frequency 50/60 Hz

Voltage dips 50Hz

Power supply voltage Vac	Residual voltage % of 48 Vac	Duration Cycles	Acceptance criteria	Observations
38,40	0	0,5	A	-
38,40	40	10/12	C	-
38,40	70	25/30	C	-

Voltage dips 60Hz

Power supply voltage Vac	Residual voltage % of 48Vac	Duration Cycles	Acceptance criteria	Observations
38,40	0	1,0	A	-
38,40	40	12	C	-
38,40	70	30	C	-

Voltage interrupts 50Hz

Power supply voltage Vac	Residual voltage % of 48 Vac	Duration Cycles	Acceptance criteria	Observations
38,40	0	250	C	1

Voltage interrupts 60Hz

Power supply voltage Vac	Residual voltage %	Duration Cycles	Acceptance criteria	Observations
38,40	0	300	C	1

Observations

1. Device is restarting due to the voltage interruption. No unwanted change of output state.
Correct operation after the restart.

Requirements

- The object shall comply with the required acceptance criteria of IEC 60255-26, Table 23
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

8.14 Gradual shut-down/start-up

Standard and date

Standard IEC 60255-1, subclause 6.15, IEC 60255-26, subclause 6.2
 Test date 6 March 2020

Characteristic test data

Serial number 19600004
 Shut-down ramp 60 s
 Power off 5 min
 Start-up ramp 60 S
 Auxiliary power supply input 24 - 220 Vdc (-20/+10 %)
 voltage

Test results

Power supply voltage	Vdc	Observations
Shut-down limit (SDL)	9,71	-
Start-up limit (SUL)	19,28	-

Requirements

- The object shall comply with the required acceptance criteria C of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

9 CLIMATIC ENVIRONMENT

9.1 Inspection

9.1.1 Pre-inspection

The pre-inspection is performed to verify that the test object is in operational state as described in IEC 60255-1, Annex A 2.5. The pre-inspection is carried out prior to the test procedure.

The communication with the maintenance computer is verified. Signals are simulated to verify the functioning and operation with the specified performance specification for the following inputs and outputs:

- Analogue inputs
- Digital inputs
- Contact outputs
- Data communication ports.

9.1.2 Visual and functional inspection

After each test a visual and functional inspection is carried out as described in this chapter.

The visual inspection is carried out to verify that there is no visual mechanical damage.

There shall be no:

- Burning of any components.
- Paint blisters on any components.
- Discolouration on components.
- Deformation of modules or components.
- Interruptions or damage on interconnecting cables, wires and connectors.

Functional inspection is carried out to verify the correct operation of the test object.

The measurements of analogue input data shall not exceed twice the class index for the measurement.

There shall be no:

- Alarm indications on display and LED's.
- Error messages reported in the maintenance computer.
- Unintentional change of contact outputs.
- Unintentional change of digital input status.

Unless otherwise stated the visual and functional inspection was carried out successfully after each test.

9.1.3 Safety related inspection

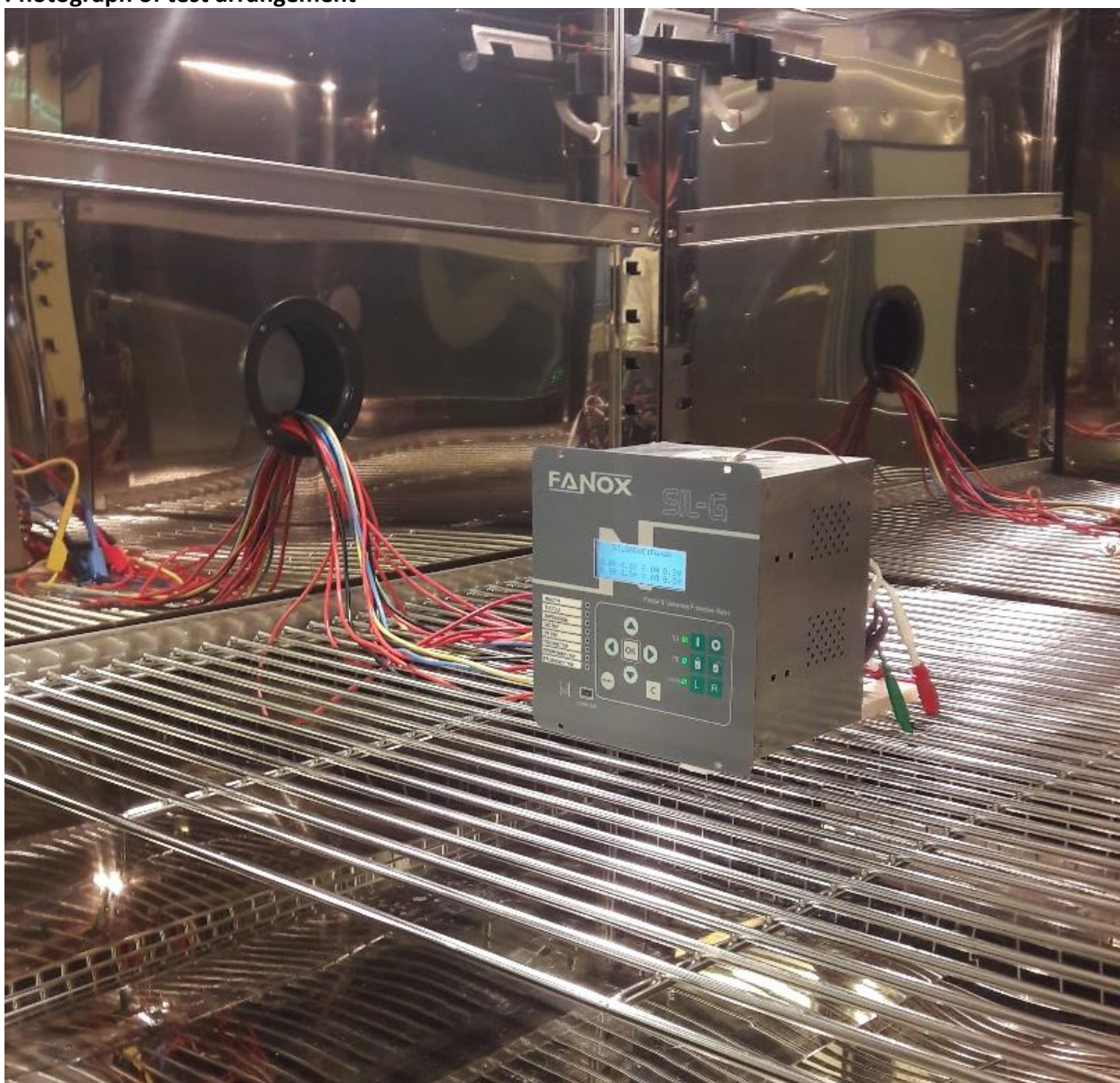
Before the climatic environmental tests an insulation test has been performed.

After the climatic environmental tests, the following safety related tests have been performed in the sequence listed;

- Insulation test
- Dielectrical strength test
- Insulation test
- Protective bonding test.

The results of these tests are presented in chapter 9, Product safety.

Photograph of test arrangement



9.2 Measurement of insulation resistance before and after the climate tests

Standard and date

Standard	IEC 60255-1, subclause 6.12.2.2
Basic standard	IEC 60255-27, subclause 10.6.4.4
Test date	20 December and 23 March 2020

Characteristic test data

Serial number	19600004
Test voltage	500 Vdc

Voltage applied to Circuit/terminals	Measurement of resistance		Observations
	MΩ Before the climate tests	MΩ After the climate tests ¹⁾	
Uaux B1, B2	≥ 550	≥ 550	-
Current (CT) A1 – AA8	≥ 550	≥ 550	-
Voltage (VT) B3 – B12	≥ 550	≥ 550	-
Inputs C1 – C10	≥ 550	≥ 550	-
Outputs C11 – C24	≥ 550	≥ 550	-
RS485 C25, C26	≥ 550	≥ 550	-
Arc Flash Detector F1 – F8	≥ 550	≥ 550	-

Note

Each circuit has been tested against all other circuits and earth connected together.
The test has been performed before and after completion of the climatic tests.

¹⁾ The dielectrical strength test has been performed after this test.

Requirement

- The insulation resistance for equipment in a new condition shall not be less 100 MΩ at 500 Vdc.
- The insulation resistance after the climate tests shall not be less than 10 MΩ.

Result

The object passed the test.

9.3 Climatic environmental tests

9.3.1 Dry-heat test - operational

Standard and date

Standard IEC 60255-1, subclause 6.12.3.1
 Basic standard IEC 60068-2-2
 Test date 8 to 11 January 2020

Characteristic test data

Serial number 19600004
 Type of test Bd
 Operating conditions energized
 Power supply 100 Vdc
 Relative humidity < 50 %
 Maximum rate of change 1 °C/min over a period of 5 min

Test procedure	Duration of exposure h	Operating temperature °C	Observations
Powering up after	1	+70	1
Correct function at rated load/current	72		2

Observations

1. Correct start up, normal operation.
2. Correct operation within the specified accuracy.

Requirement

- A dielectric voltage test shall be performed
- A measurement of insulation resistance shall be performed
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

9.3.2 Cold test - operational

Standard and date

Standard IEC 60255-1, subclause 6.12.3.2
 Basic standard IEC 60068-2-1
 Test date 13 to 16 January 2020

Characteristic test data

Serial number 19600004
 Type of test Ad
 Operating conditions energized
 Power supply 100 Vdc
 Relative humidity < 50 %
 Maximum rate of change 1 °C/min over a period of 5 min

Test procedure	Duration of exposure h	Operating temperature °C	Observations
Powering up after	1	-40	1
Correct function at rated load/current	72		2

Observations

1. Correct start up, normal operation.
2. Correct operation within the specified accuracy.

Requirement

- A dielectric voltage test shall be performed.
- A measurement of insulation resistance shall be performed.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

9.3.3 Dry-heat test at maximum storage temperature

Standard and date

Standard IEC 60255-1, subclause 6.12.3.3
 Basic standard IEC 60068-2-2
 Test date 23 to 26 December 2019

Characteristic test data

Serial number 19600004
 Type of test Bb
 Operating conditions non-energized
 Relative humidity < 50 %
 Maximum rate of change 1 °C/min over a period of 5 min

Test procedure	Duration of exposure h	Storage temperature °C	Observations
Storage	72	+85	1

Observations

1. Correct operation after the test, accuracy measurements are within the specifications.

Requirement

- A dielectric voltage test shall be performed.
- A measurement of insulation resistance shall be performed.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

9.3.4 Cold test at minimum storage temperature

Standard and date

Standard IEC 60255-1, subclause 6.12.3.4
 Basic standard IEC 60068-2-1
 Test date 20 to 23 December 2019

Characteristic test data

Serial number 19600004
 Type of test Ab
 Operating conditions non-energized
 Relative humidity < 50 %
 Maximum rate of change 1 °C/min over a period of 5 min

Test procedure	Duration of exposure h	Storage temperature °C	Observations
Storage	72	-40	1

Observations

1. Correct operation after the test, accuracy measurements are within the specifications.

Requirement

- A dielectric voltage test shall be performed.
- A measurement of insulation resistance shall be performed.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

9.3.5 Change of temperature test

Standard and date

Standard IEC 60255-1, subclause 6.12.3.5
 Basic standard IEC 60068-2-14
 Test date 25 to 28 January 2020

Characteristic test data

Serial number 19600004
 Type of test Nb
 Operating conditions energized
 Power supply 100 Vdc
 Relative humidity < 50 %
 Maximum rate of change 1 °C/min
 Exposure time t_1 3 h
 Duration of exposure 6 cycles

Test procedure	Exposure time h	Duration of exposure	Operating temperature °C	Observations
Pre-conditioning	1	-	+22	1
Correct function	3	6	Min. -40	1
			Max. +70	1

Observations

1. Correct operation within the specified accuracy.

Requirement

- A dielectric voltage test shall be performed.
- A measurement of insulation resistance shall be performed.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

9.3.6 Damp-heat steady-state test

Standard and date

Standard IEC 60255-1, subclause 6.12.3.6
Basic standard IEC 60068-2-78
Test date 3 to 13 March 2020

Characteristic test data

Serial number 19600006
Type of test Cab
Operating conditions energized
Power supply 100 Vdc
Relative humidity 93 %

Test procedure	Duration of exposure	Operating temperature °C	Observations
Correct function	10 days	+40	-

Requirement

- A dielectric voltage test shall be performed.
- A measurement of insulation resistance shall be performed.
- A protective bonding resistance test shall be performed.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

9.3.7 Cyclic temperature with humidity test

Standard and date

Standard IEC 60255-1, subclause 6.12.3.7
 Basic standard IEC 60068-2-30
 Test date 17 to 23 March 2020

Characteristic test data

Serial number 19600006
 Type of test Db
 Operating conditions energized
 Power supply 100 Vdc
 Cycles 6

Test procedure	Duration of exposure cycles	Operating temperature °C	Humidity %	Observations
Correct function	6	+25	97	-
	6	+40	93	-

Requirement

- A dielectric voltage test shall be performed.
- A measurement of insulation resistance shall be performed.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

10 MECHANICAL ENVIRONMENTAL CONDITION TESTS

10.1 Inspection

10.1.1 Pre-inspection

The pre-inspection is performed to verify that the test object is in operational state as described in IEC 60255-1, Annex A 2.5. The pre-inspection is carried out prior to the test procedure.

The communication with the maintenance computer is verified. Signals are simulated to verify the functioning and operation with the specified performance specification for the following inputs and outputs:

- Analogue inputs
- Digital inputs
- Contact outputs
- Data communication ports

10.1.2 Visual and functional inspection

After each test a visual and functional inspection is carried out as described in this chapter.

The visual inspection is carried out to verify that there is no visual mechanical damage.

There shall be no:

- Burning of any components.
- Paint blisters on any components.
- Discolouration on components.
- Deformation of modules or components.
- Interruptions or damage on interconnecting cables, wires and connectors.

Functional inspection is carried out to verify the correct operation of the test object.

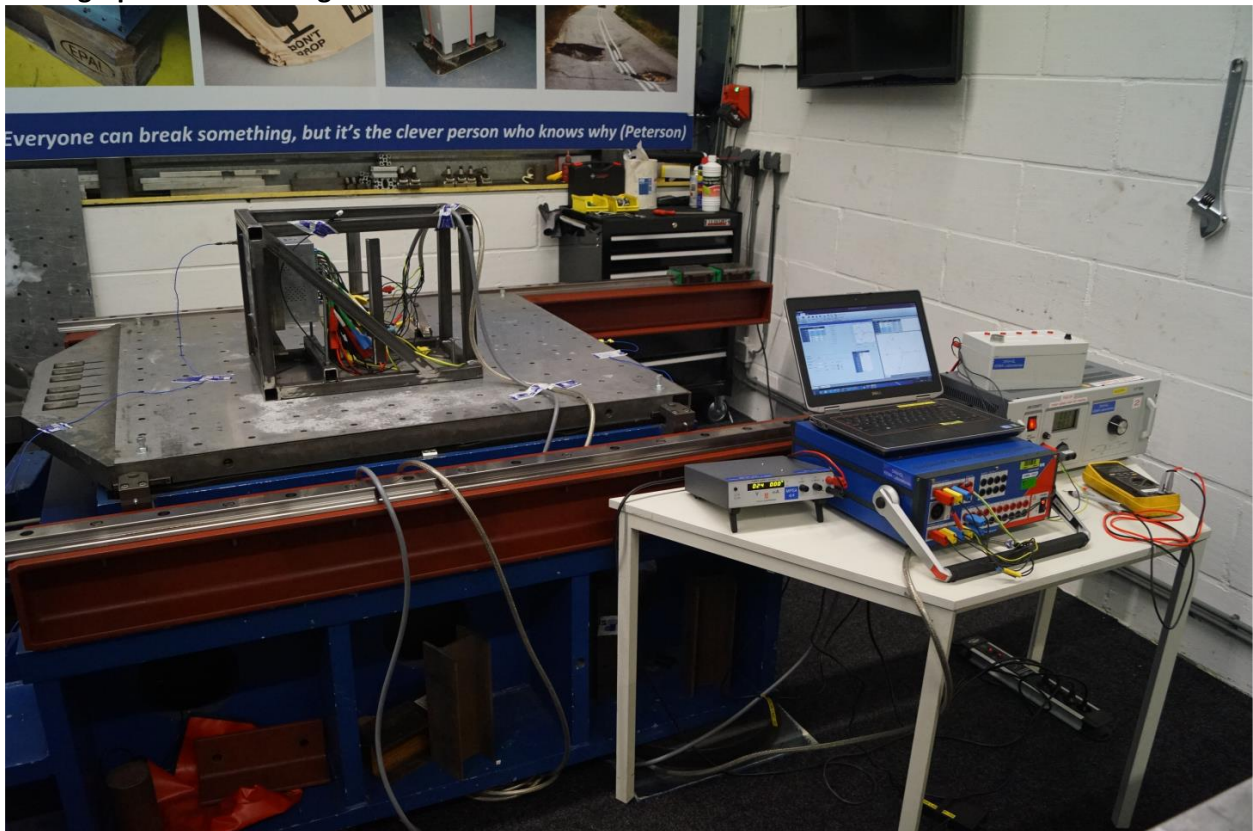
The measurements of analogue input data shall not exceed twice the class index for the measurement.

There shall be no:

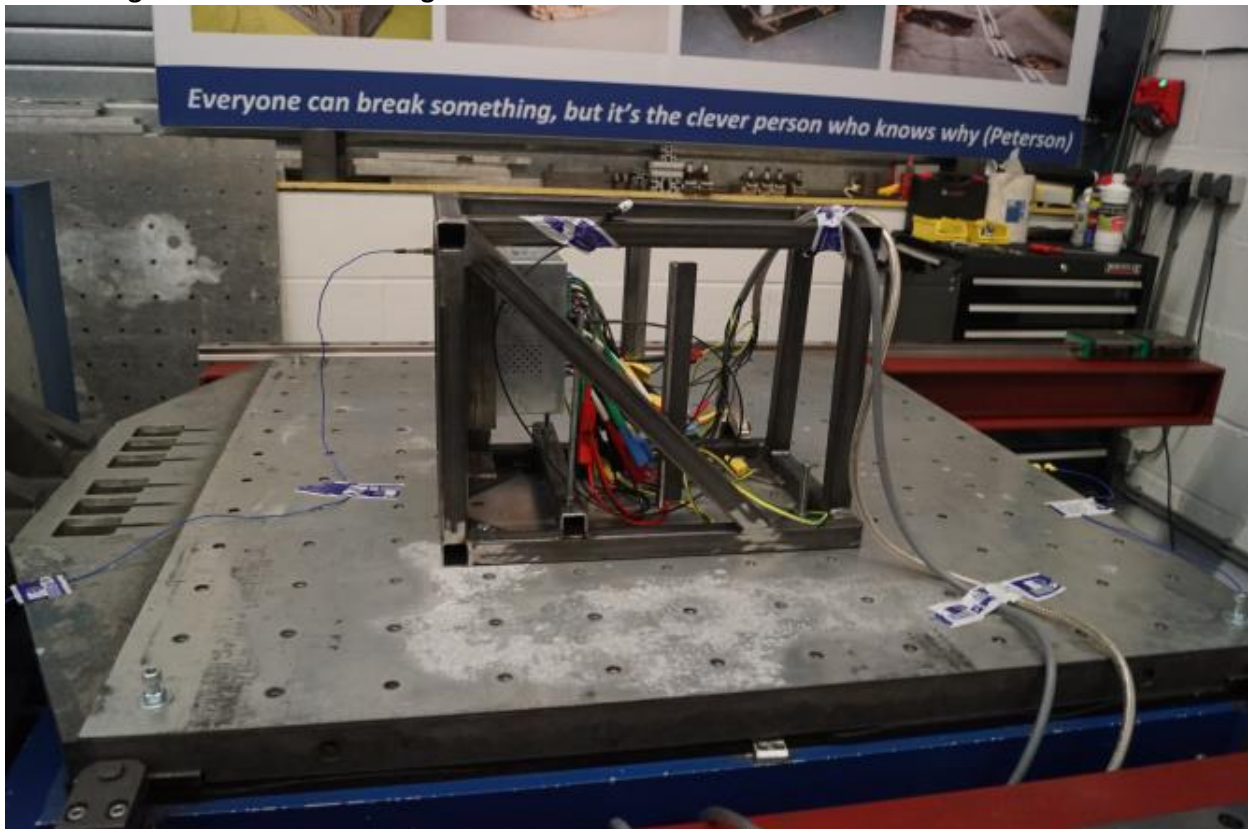
- Alarm indications on display and LED's.
- Error messages reported in the maintenance computer.
- Unintentional change of contact outputs.
- Unintentional change of digital input status.

Unless otherwise stated the visual and functional inspection was carried out successfully after each test.

Photographs of test arrangement



Test arrangement horizontal X longitudinal direction



Test arrangement horizontal Y transversal direction



Test arrangement Z vertical direction



10.2 Vibration response test

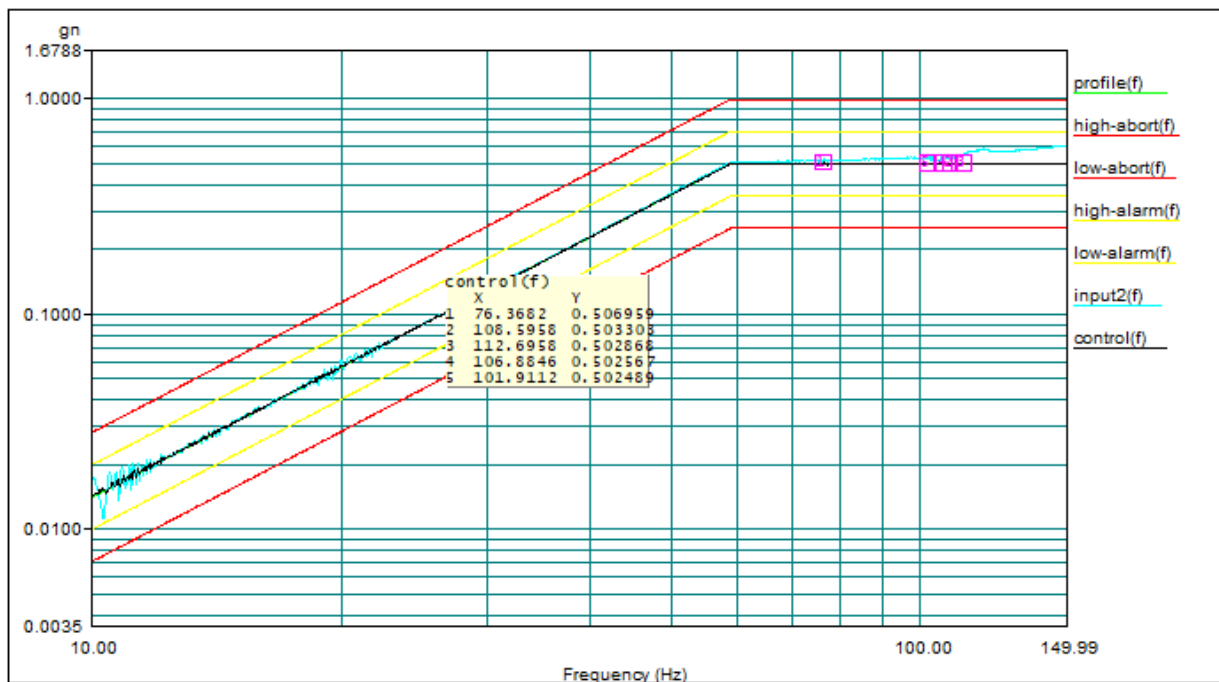
Standard and date

Standard IEC 60255-1, subclause 6.13
 Basic standard IEC 60255-21-1
 Test date 27, 28 and 29 June 2020

Characteristic test data

Serial number 20291033
 Test object energized
 Power supply 230 Vdc
 VT input 63.35 Vac
 CT input 1 A
 Frequency range 10 to 150 Hz
 Displacement 0,035 mm
 Acceleration 0,5 g
 Number of sweep cycles 1
 in each axis
 Number of axis 3

Vibration response test



Observations

- During and after the test, the test object was functional.
- No visual damage or functional errors have been found on the test object.

Requirement

- Normal state of output circuit(s) do not change for more than 2 ms.
- After the test, the test object shall not have changed its setting by more than 0,5 times the assigned error.
- Tthe visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

10.3 Vibration endurance test

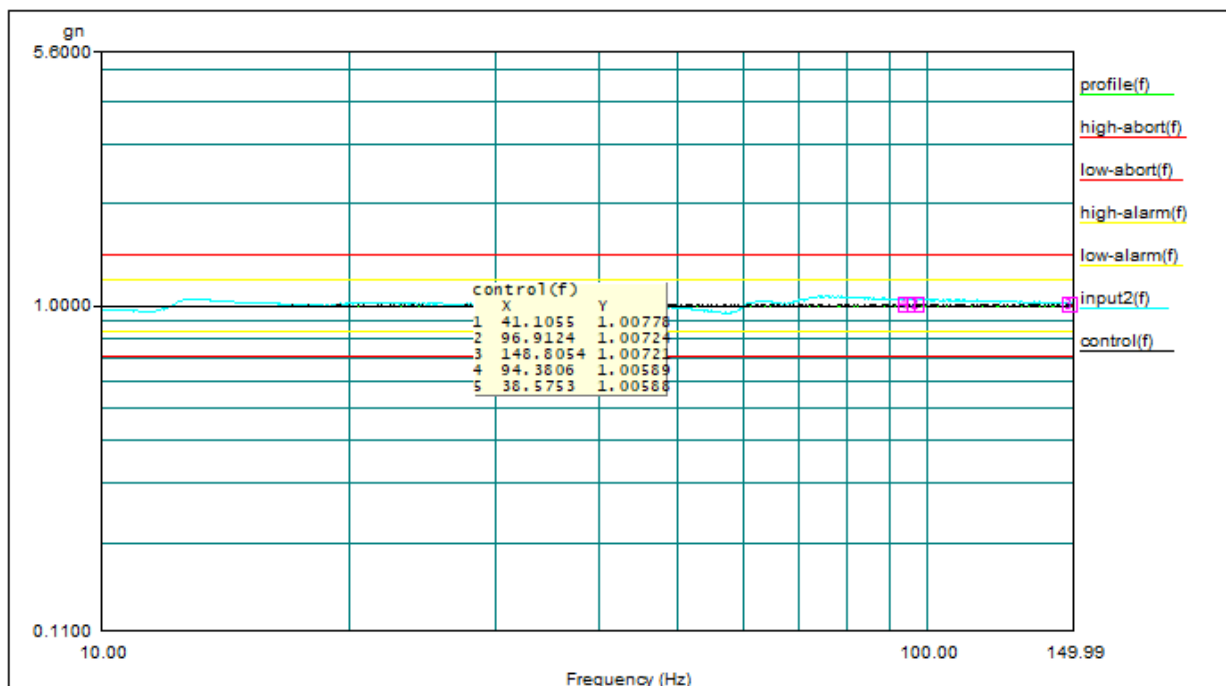
Standard and date

Standard IEC 60255-1, subclause 6.13
 Basic standard IEC 60255-21-1
 Test date 27, 28 and 29 June 2020

Characteristic test data

Serial number 20291033
 Test object non-energized
 Frequency range 10 to 150 Hz
 Acceleration 1 g
 Number of sweep cycles in each axis 20
 Number of axis 3

Vibration endurance test



Observations

No visual damage or functional errors have been found on the test object.

Requirement

The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

10.4 Shock response test

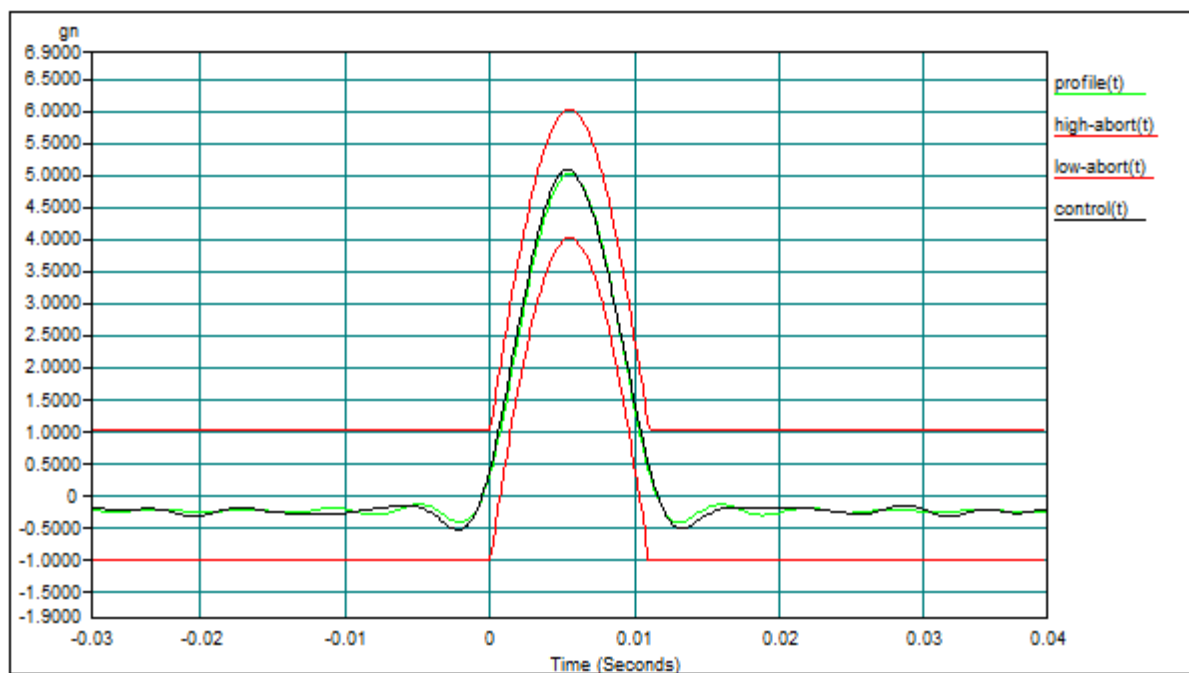
Standard and date

Standard	IEC 60255-1, subclause 6.13
Basic standard	IEC 60255-21-2
Test date	27, 28 and 29 June 2020

Characteristic test data

Serial number	20291033
Test object	energized
Power supply	230 Vdc
VT input	63.35 Vac
CT input	1 A
Acceleration	5 g
Duration of pulses	11 ms
Number of pulses in each axis	6
Number of axis	3

Shock response



Observations

- During and after the test, the test object was functional.
- No visual damage or functional errors have been found on the test object.

Requirement

- Normal state of output circuit(s) do not change for more than 2 ms.
- After the test, the test object shall not have changed its setting by more than 0,5 times the assigned error.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

10.5 Shock withstand test

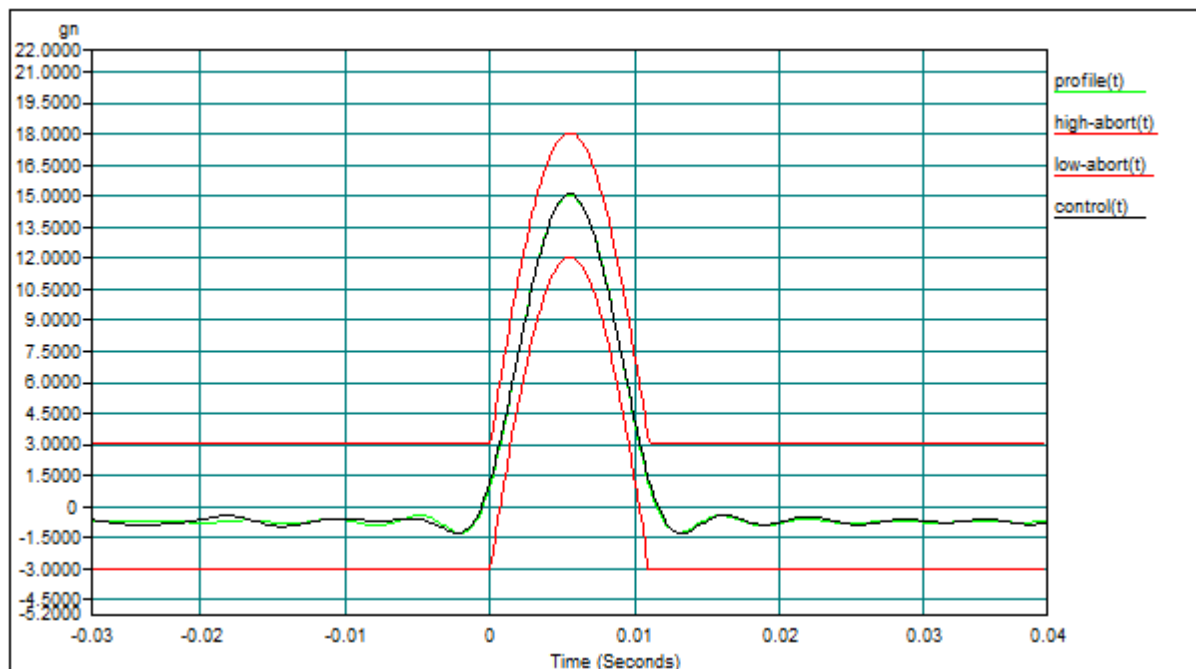
Standard and date

Standard	IEC 60255-1, subclause 6.13
Basic standard	IEC 60255-21-2
Test date	27, 28 and 29 June 2020

Characteristic test data

Serial number	20291033
Test object	non-energized
Acceleration	15 g
Duration of pulses	11 ms
Number of pulses in each axis	6
Number of axis	3

Shock withstand test



Observations

No visual damage or functional errors have been found on the test object.

Requirement

The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

10.6 Bump test

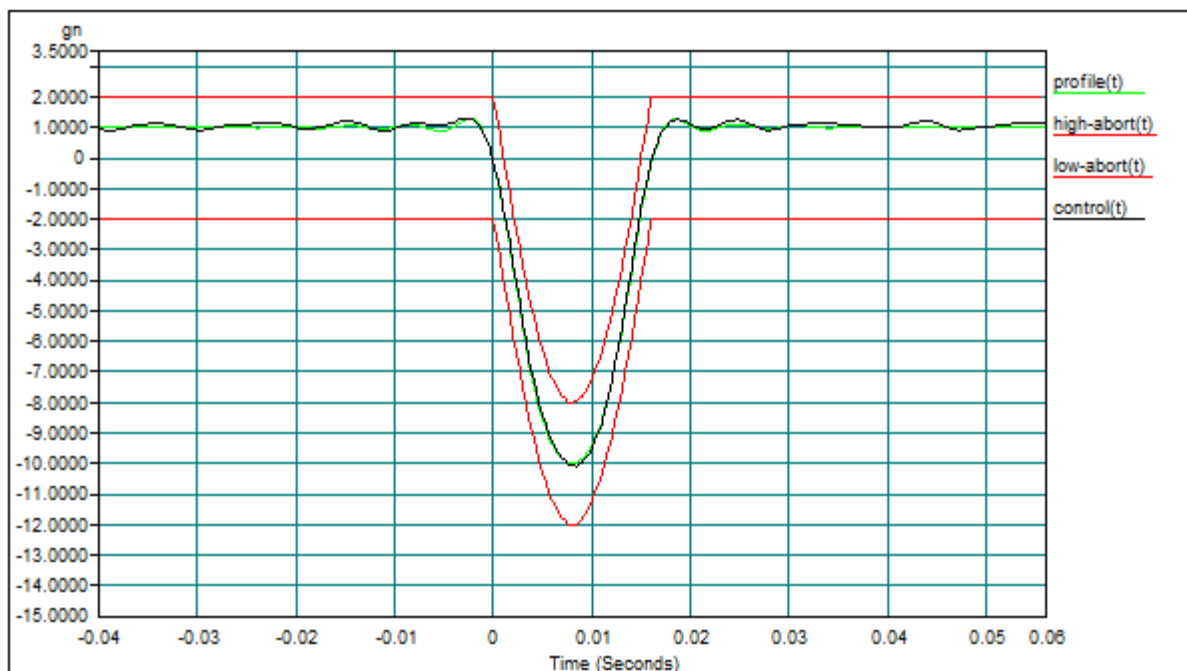
Standard and date

Standard IEC 60255-1, subclause 6.13
 Basic standard IEC 60255-21-2
 Test date 27, 28 and 29 June 2020

Characteristic test data

Serial number 20291033
 Test object non-energized
 Acceleration 10 g
 Duration of pulses 16 ms
 Number of pulses in each axis 2000
 Number of axis 3

Bump



Observations

No visual damage or functional errors have been found on the test object.

Requirement

The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

10.7 Single axis sine sweep seismic test

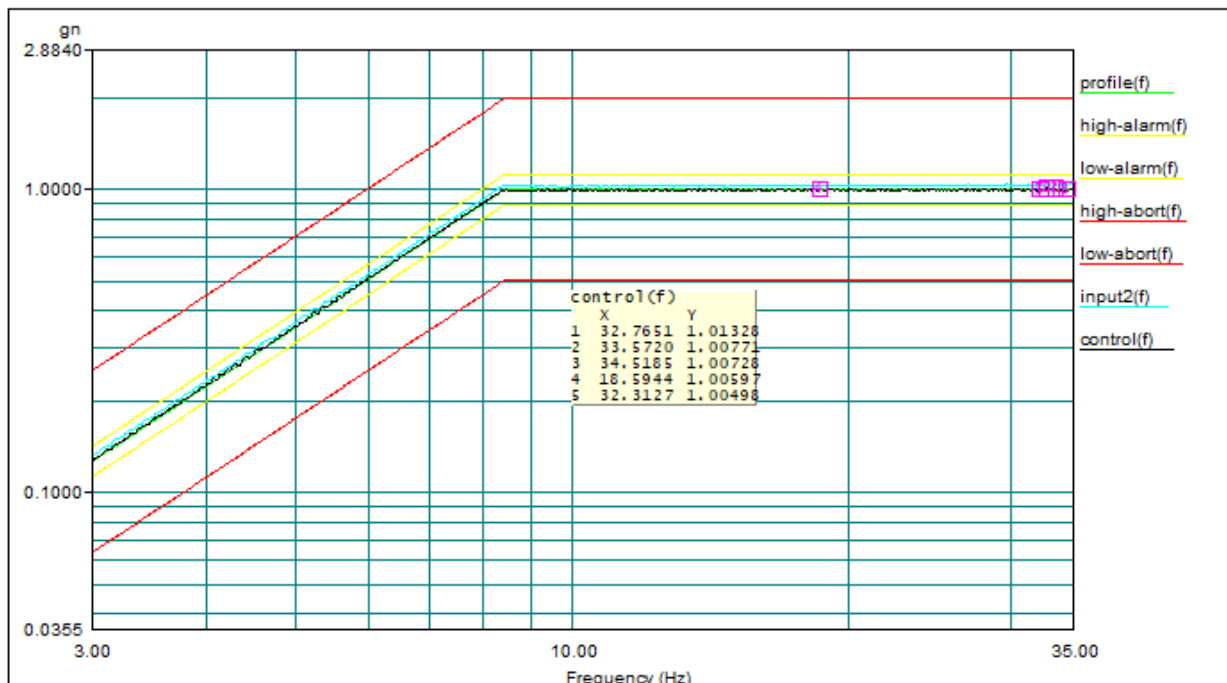
Standard and date

Standard IEC 60255-1, subclause 6.13
 Basic standard IEC 60255-21-3
 Test date 27, 28 and 29 June 2020

Characteristic test data

Serial number 20291033
 Test object energized
 Power supply 230 Vdc
 Power supply (VT input) 63.35 Vac
 Power supply (CT input) 1 A
 Frequency range 1 to 35 Hz
 Cross-over frequency 8 to 9 Hz
 Displacement horizontal axis (x) 3,5
 Displacement vertical axis (y) 1,5
 Acceleration horizontal axis (x) 1,0
 Acceleration vertical axis (y) 0,5
 Number of sweep cycles
 in each axis 1
 Number of axis 3

Single axis sine sweep seismic test



Observations

No visual damage or functional errors have been found on the test object.

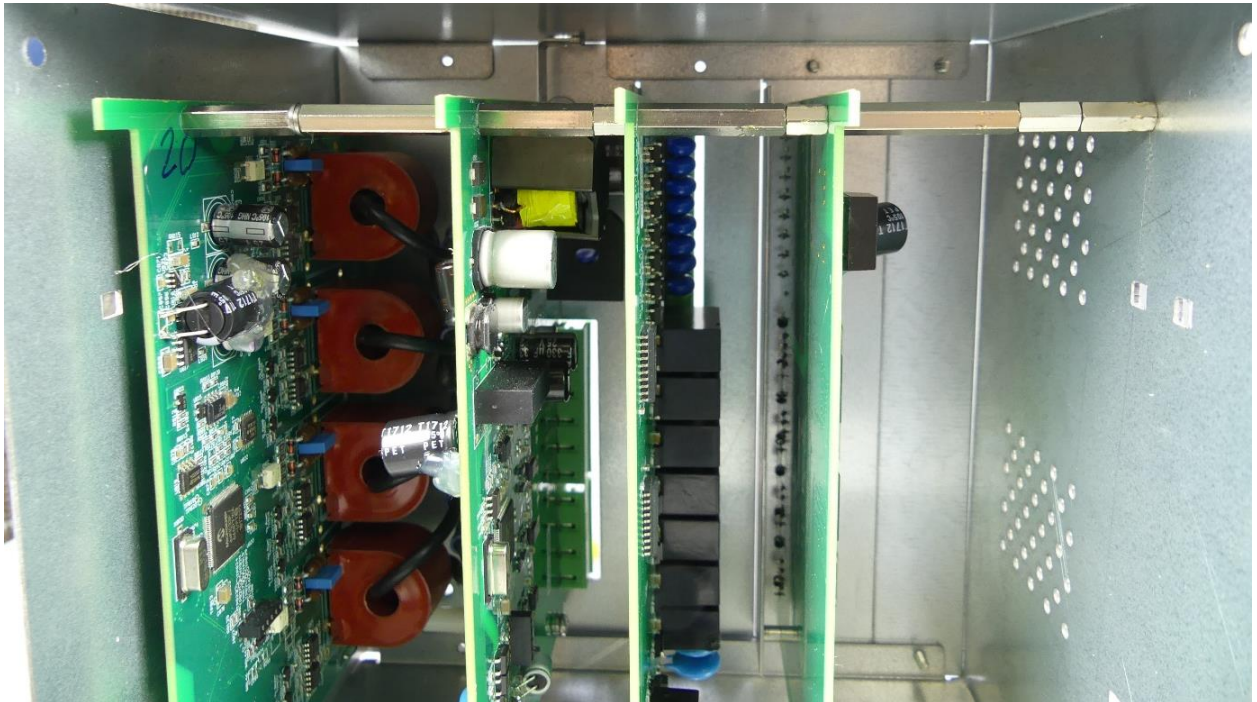
Requirement

The visual and functional inspection shall not reveal any defects or malfunctions.

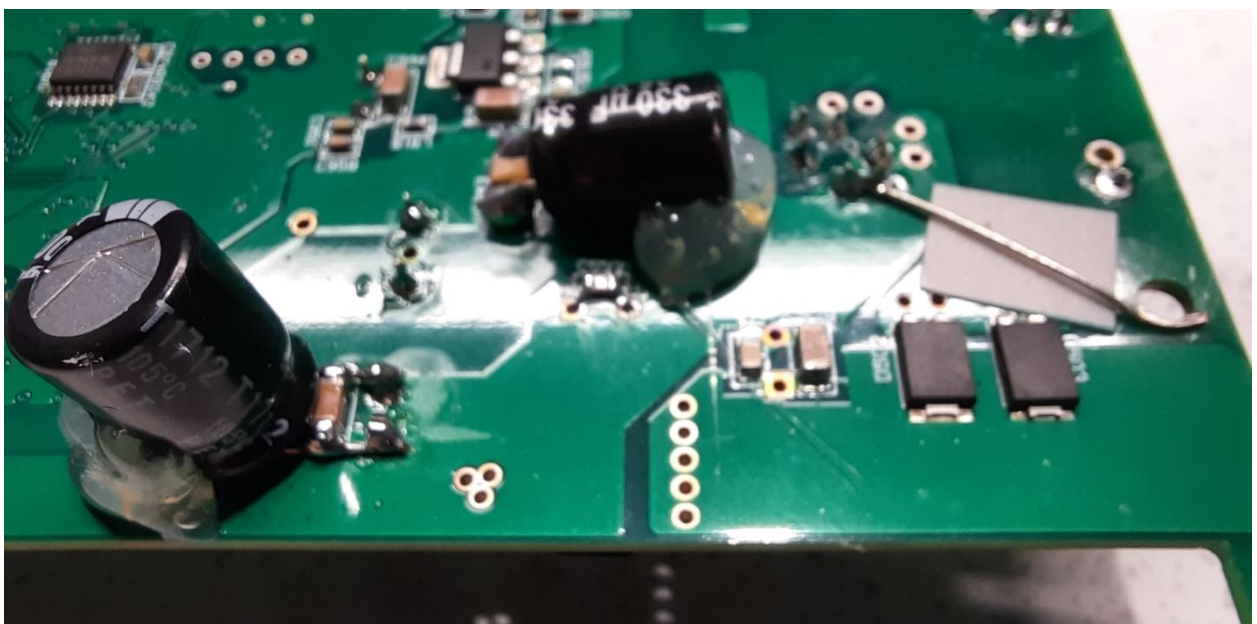
Result

The object passed the test.

10.8 Observations after the mechanical tests



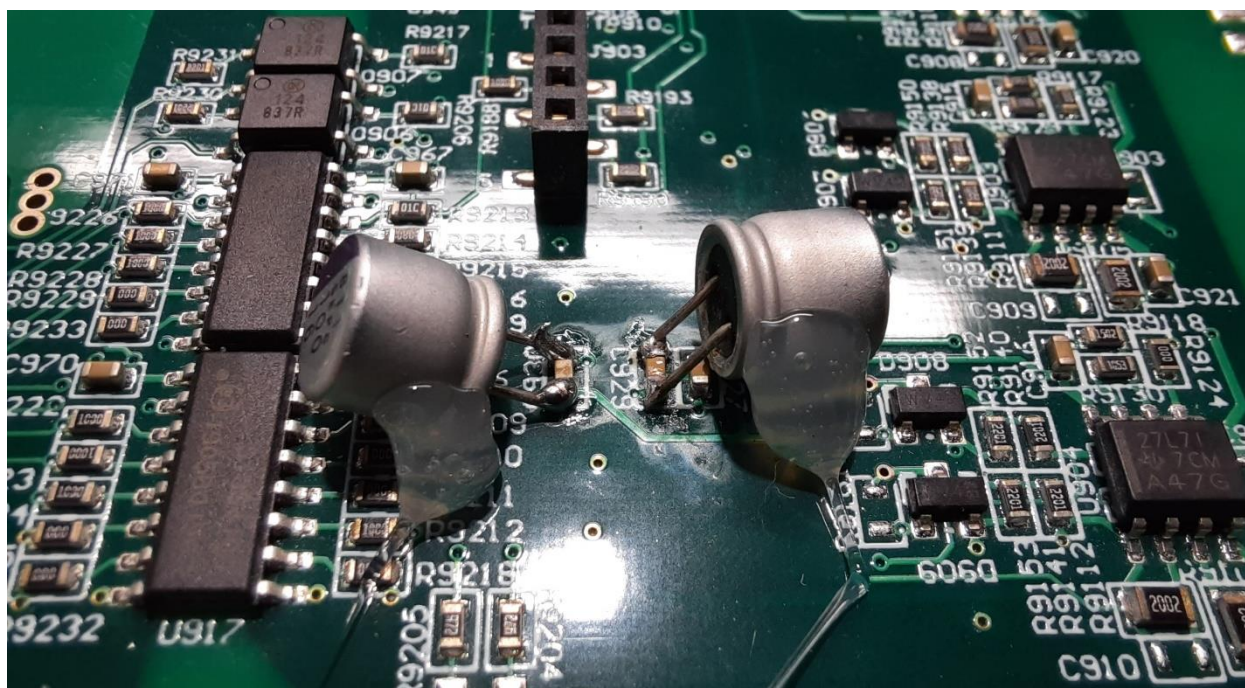
Prints are fixed together



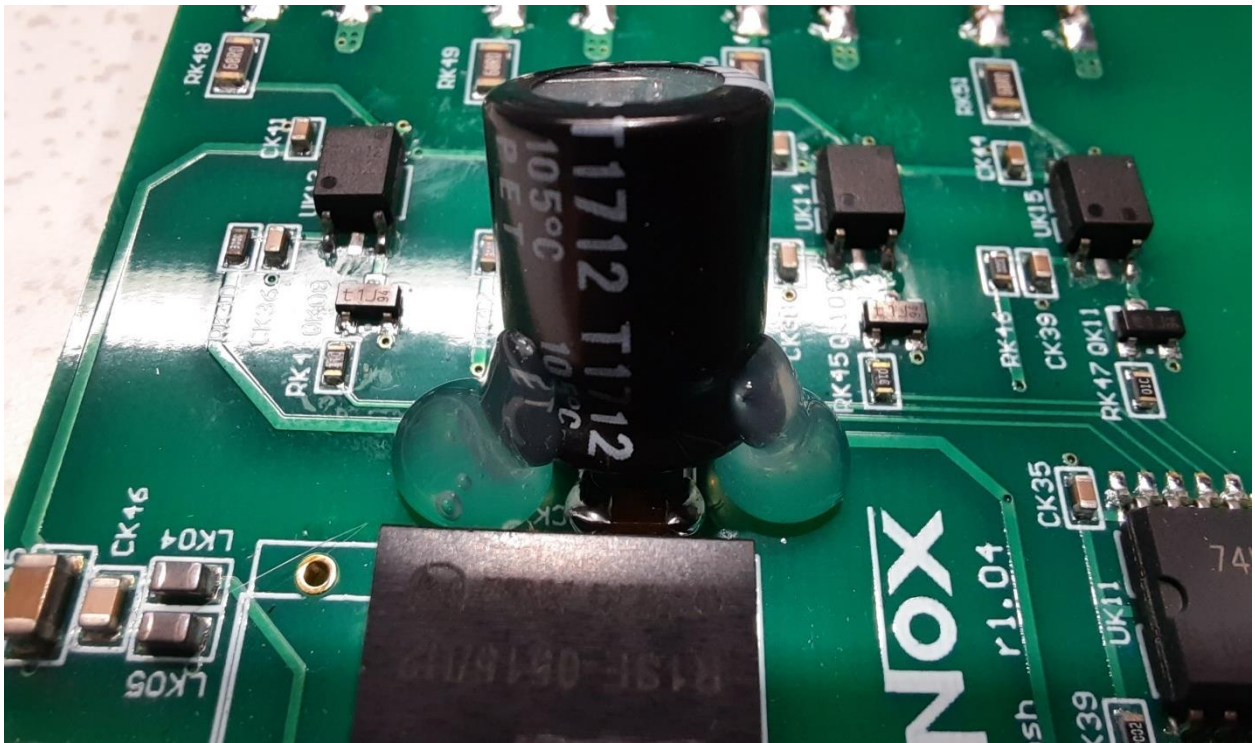
Hot glue has been applied on SILB-MedidaV-Fuente board



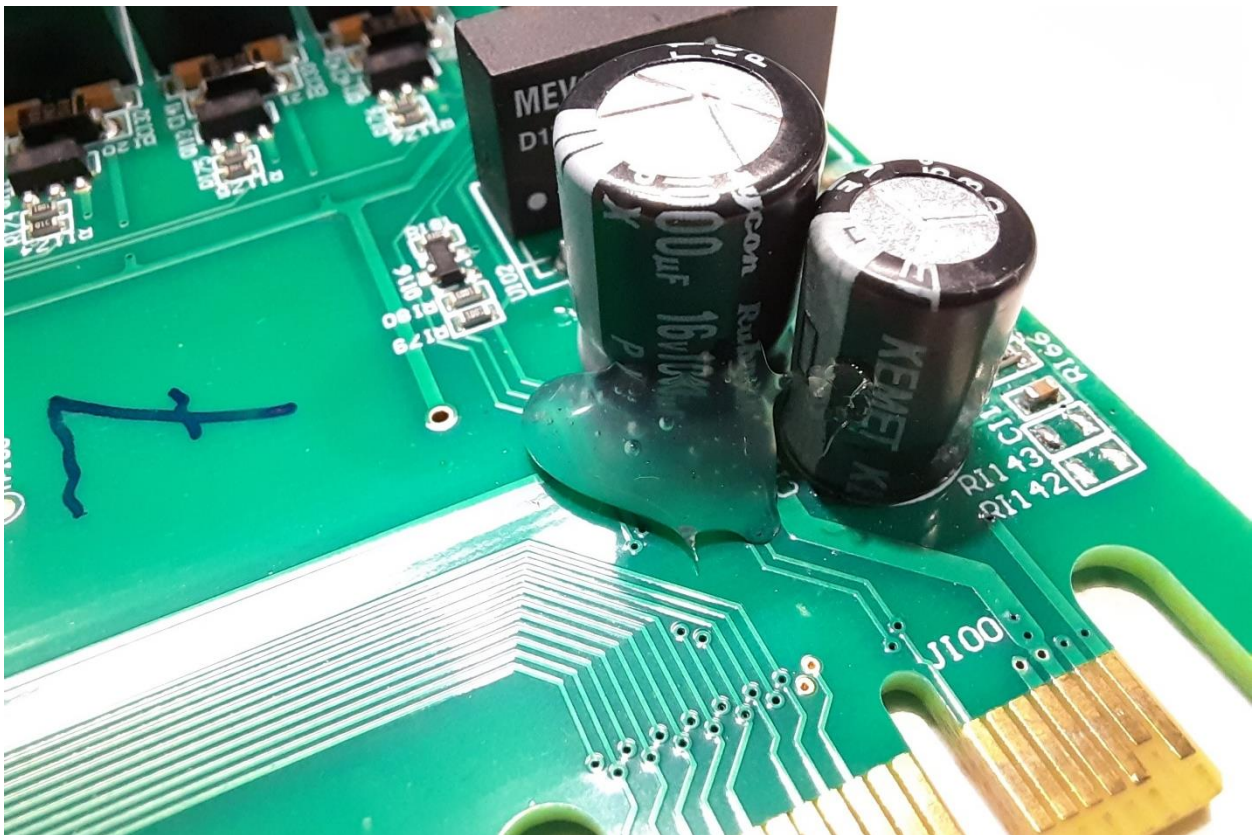
Surge arrester on SILB-MedidaV-Fuente board



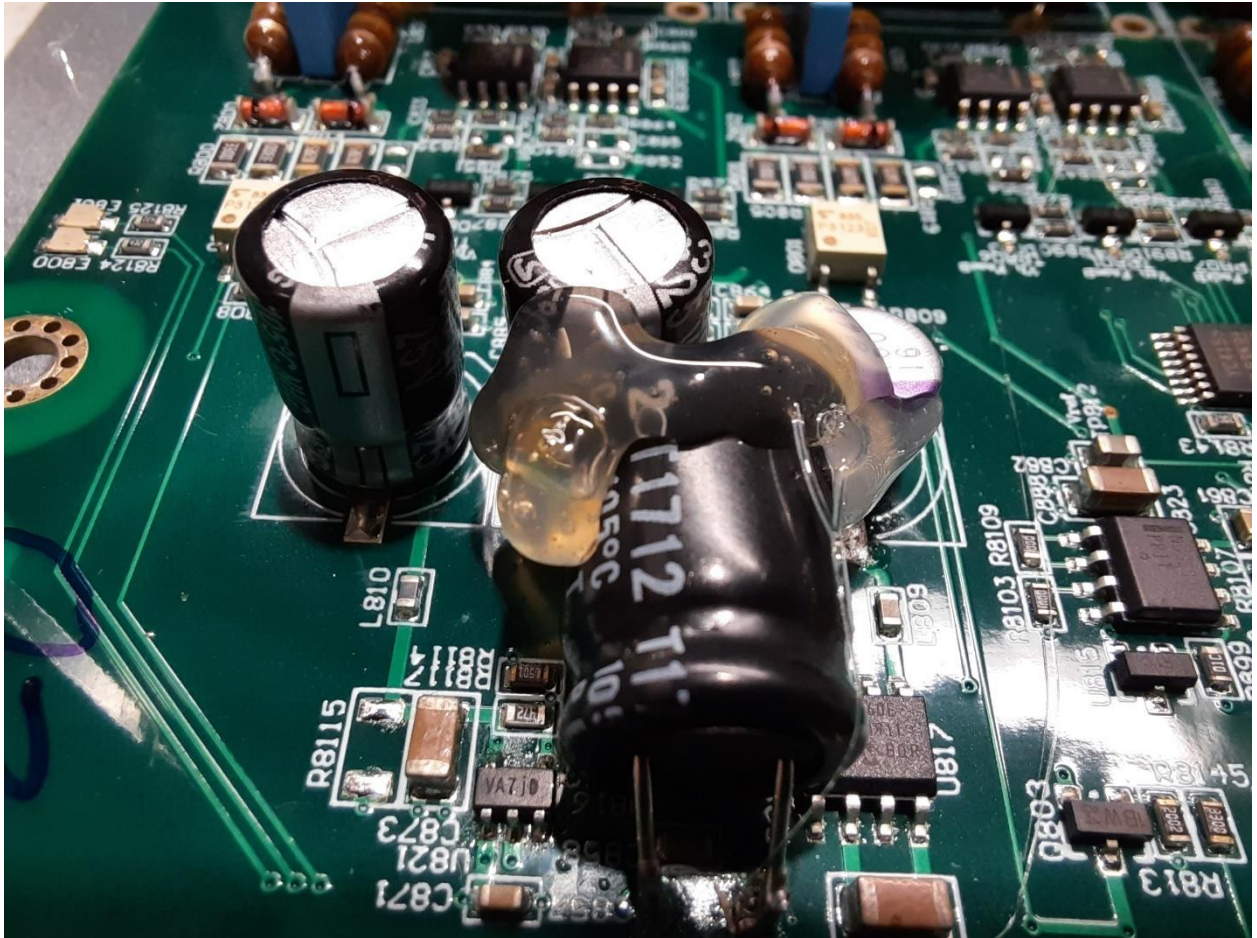
Hot glue has been applied on SILB-MedidaV-Fuente board



Hot glue has been applied on SILB-ArcFlash board



Hot glue has been applied on SILB-In-Out-Com board



Hot glue has been applied on SILB-Medical board

11 ADDITIONAL TESTS (NOT REQUIRED BY THE STANDARD)

11.1 Damped oscillatory wave magnetic field, 100 kHz and 1 MHz

Standard and date

Standard -
Basic standard IEC 61000-4-10
Test date 5 March 2020

Characteristic test data

Serial number 19600004
Current oscillation frequency 100 kHz
1 MHz
Current rise time 75 ns
Repetition frequency 40 Hz (100kHz)
400 Hz (1 MHz)
Polarity of first half period Positive and negative

Test results 100 kHz

Direction	Test level A/m	Duration s	Observations
Horizontal longitudinal (x)	100	Continuous (60)	-
	100	2 s	-
Horizontal transversal (y)	100	Continuous (60)	-
	100	2 s	-
Vertical (z)	100	Continuous (60)	-
	100	2 s	-

Test results 1 MHz

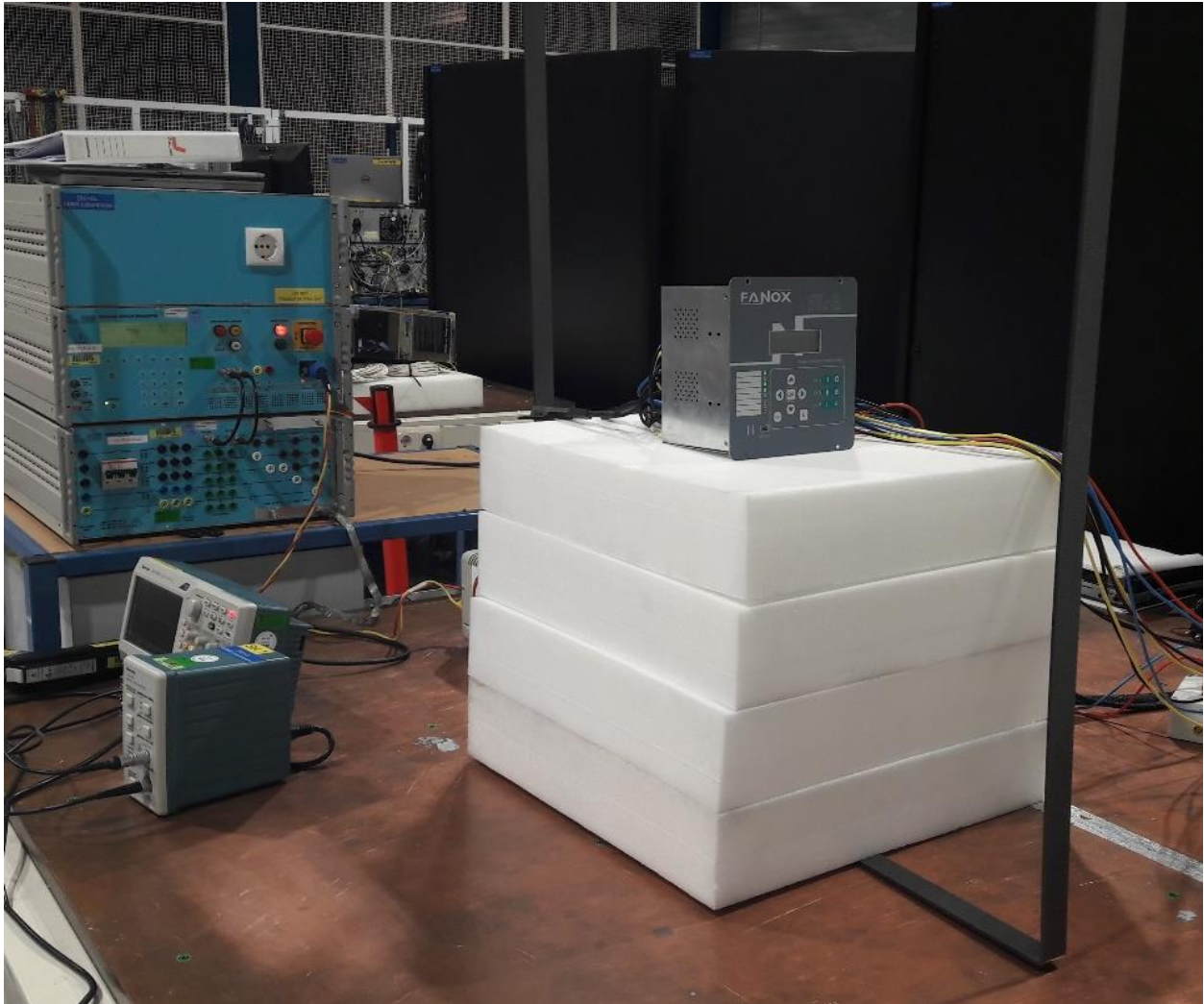
Direction	Test level A/m	Duration s	Observations
Horizontal longitudinal (x)	100	Continuous (60)	-
	100	2 s	-
Horizontal transversal (y)	100	Continuous (60)	-
	100	2 s	-
Vertical (z)	100	Continuous (60)	-
	100	2 s	-

Requirements

- Additional tests which is not required according to IEC 60255-26. However, the acceptance criteria B of IEC 60255-26, Table 23, complies with the observations.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement

11.2 Slow damped oscillatory wave 100kHz

Standard and date

Standard

Basic standard IEC 61000-4-18

Test date 23 September 2020

Characteristic test data

Serial number 20291033

Voltage oscillation frequency 100 kHz

Voltage rise time 75 ns

Repetition frequency 40 Hz

Output impedance 200 Ohm

Polarity of the first half-period Positive and negative

Circuit	Terminals	Coupling	Test voltage kV	Observations
Power supply	B1, B2 and PE	CM	2,5	-
		DM	1,0	-
RS485	C25, C26	CM ¹⁾	1,0	-
Voltage transformer	B3, B4, B5, B6, B7, B8, B9, B10	CM	2,5	1
		DM	1,0	-
Current transformer	A1, A2, A3, A4, A5, A6, A7, A8	CM	2,5	-
		DM	1,0	-
BI	C1-C5	CM	2,5	-
		DM	1,0	-
BO	C11, C12	CM	2,5	-
		DM	1,0	-
Relais	C15, C16	CM	2,5	-
		DM	1,0	-
Relais Arc	F5, F6	CM	2,5	-
		DM	1,0	-

Note

CM = Common Mode

DM = Differential mode

Observations

1. Display shows a ">>> pickup" No unwanted trips

Requirements

- The object shall comply with acceptance criteria B of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement



11.3 Pulse magnetic field

Standard and date

Standard -
Basic standard IEC 61000-4-9
Test date 5 March 2020

Characteristic test data

Serial number 19600004
Power supply 100 Vdc
Source impedance 2 Ω
Coupling capacitor 18 μ F
Front time (current) 8 μ s
Duration time (current) 20 μ s
Number of pulses 5 positive and 5 negative
Repetition rate 1 surge/min

Test results

Direction	Test level A/m	Polarity s	Observations
Horizontal longitudinal (x)	1000	Positive	-
	1000	Negative	-
Horizontal transversal (y)	1000	Positive	-
	1000	Negative	-
Vertical (z)	1000	Positive	-
	1000	Negative	-

Requirements

- Additional tests which is not required according to IEC 60255-26. However, the acceptance criteria B of IEC 60255-26, Table 23, complies with the observations.
- The visual and functional inspection shall not reveal any defects or malfunctions.

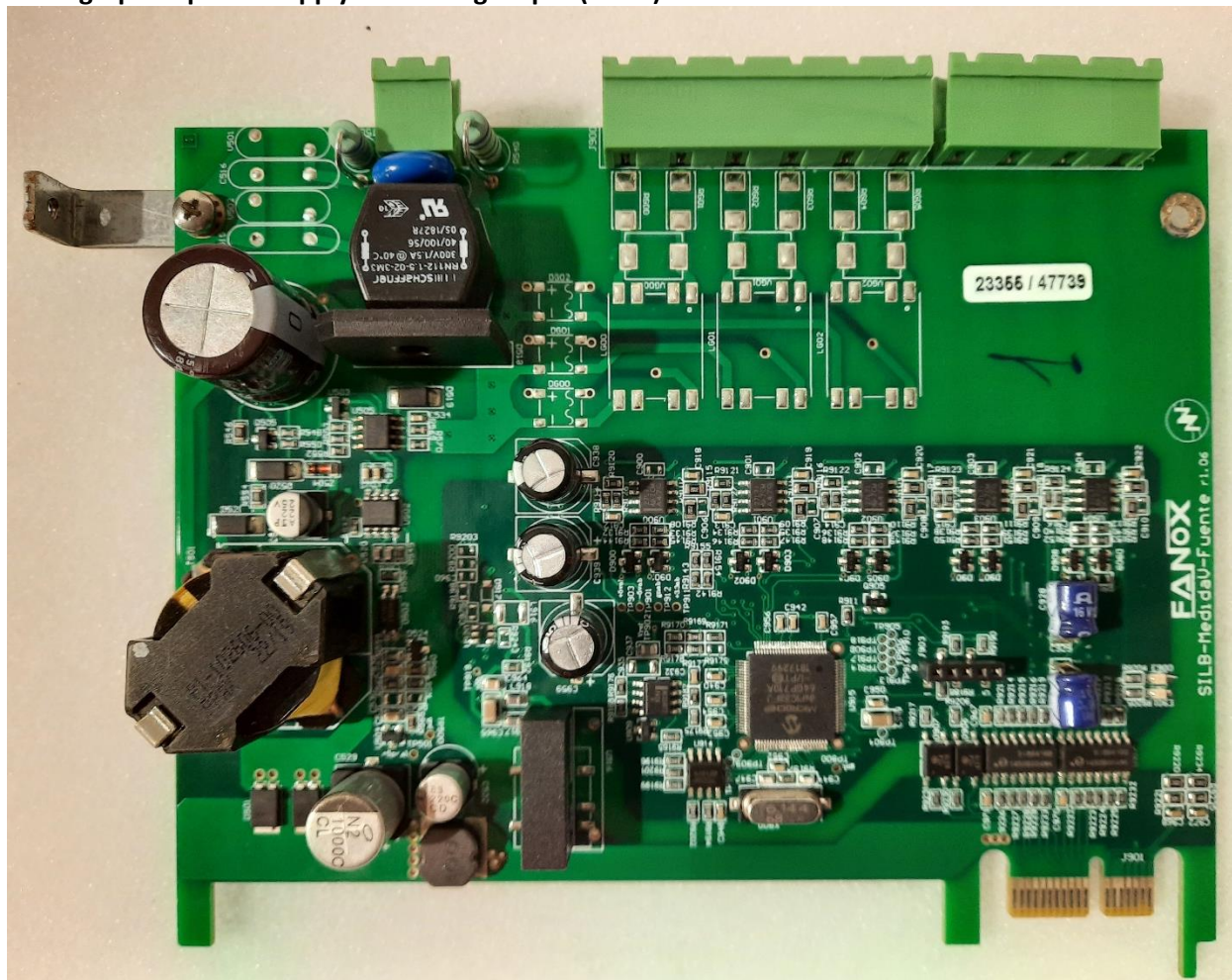
Result

The object passed the test.

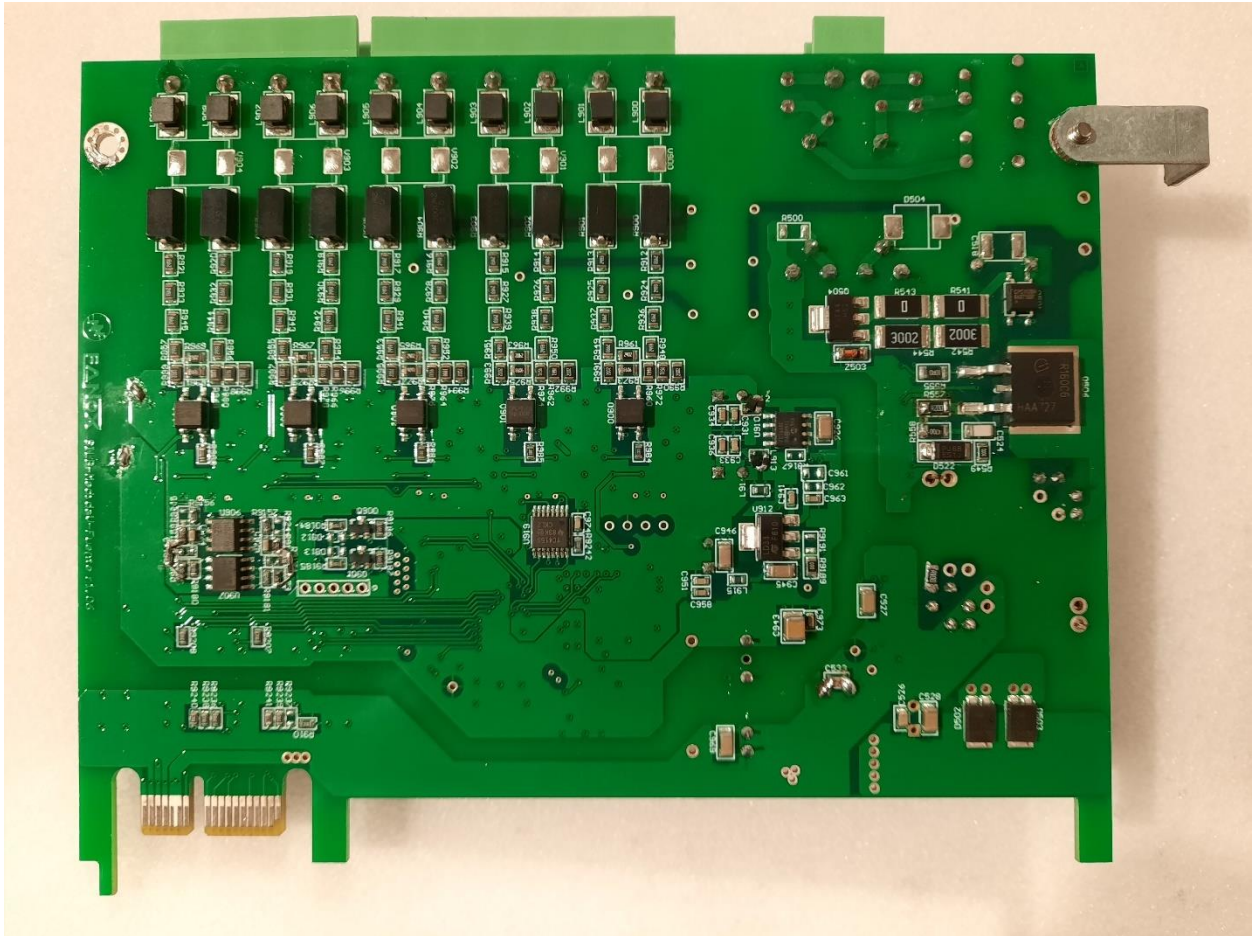
Photograph of test arrangement

12 PHOTOGRAPHS OF PRINTED CIRCUIT BOARDS

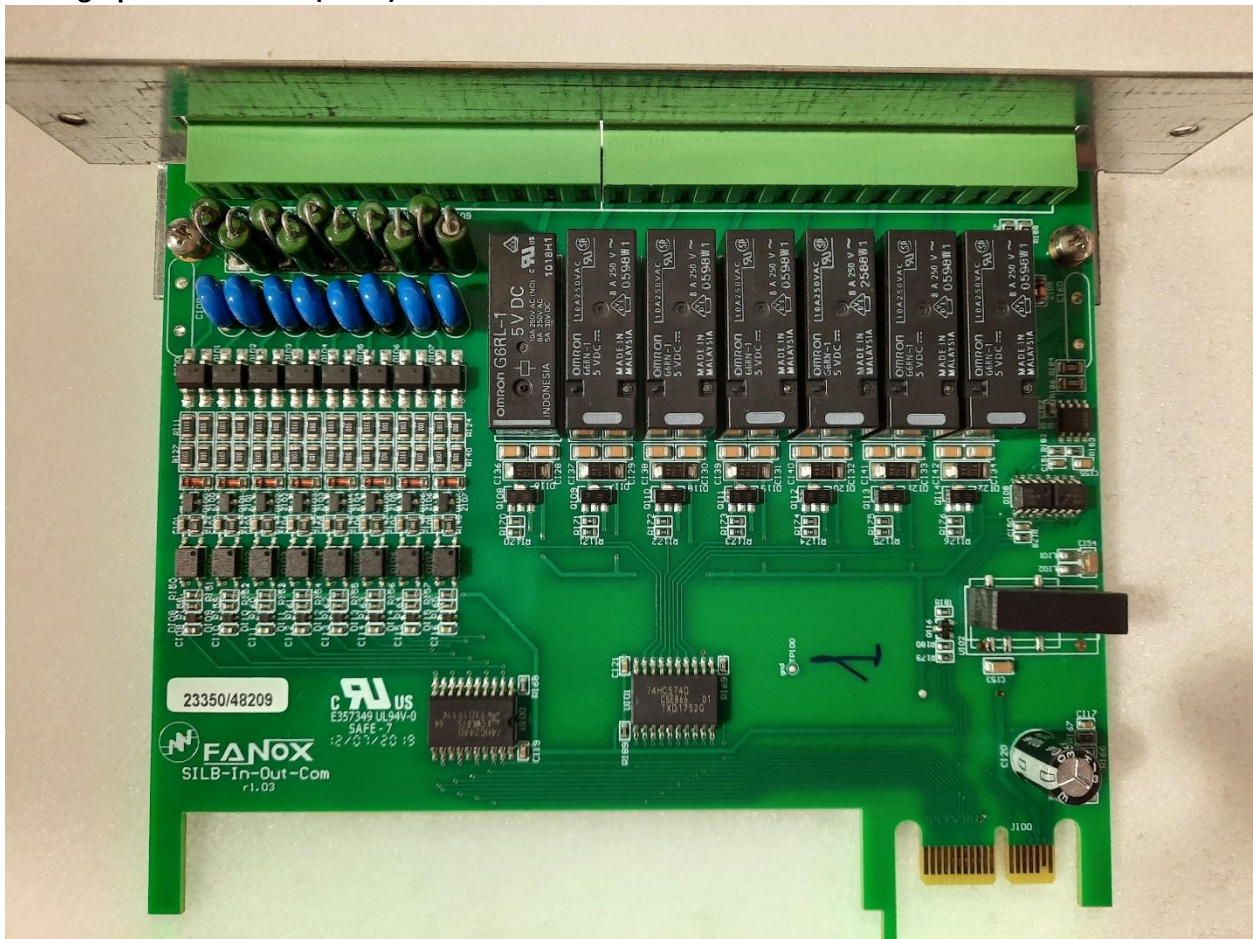
Photograph of power supply and Voltage input (Front)



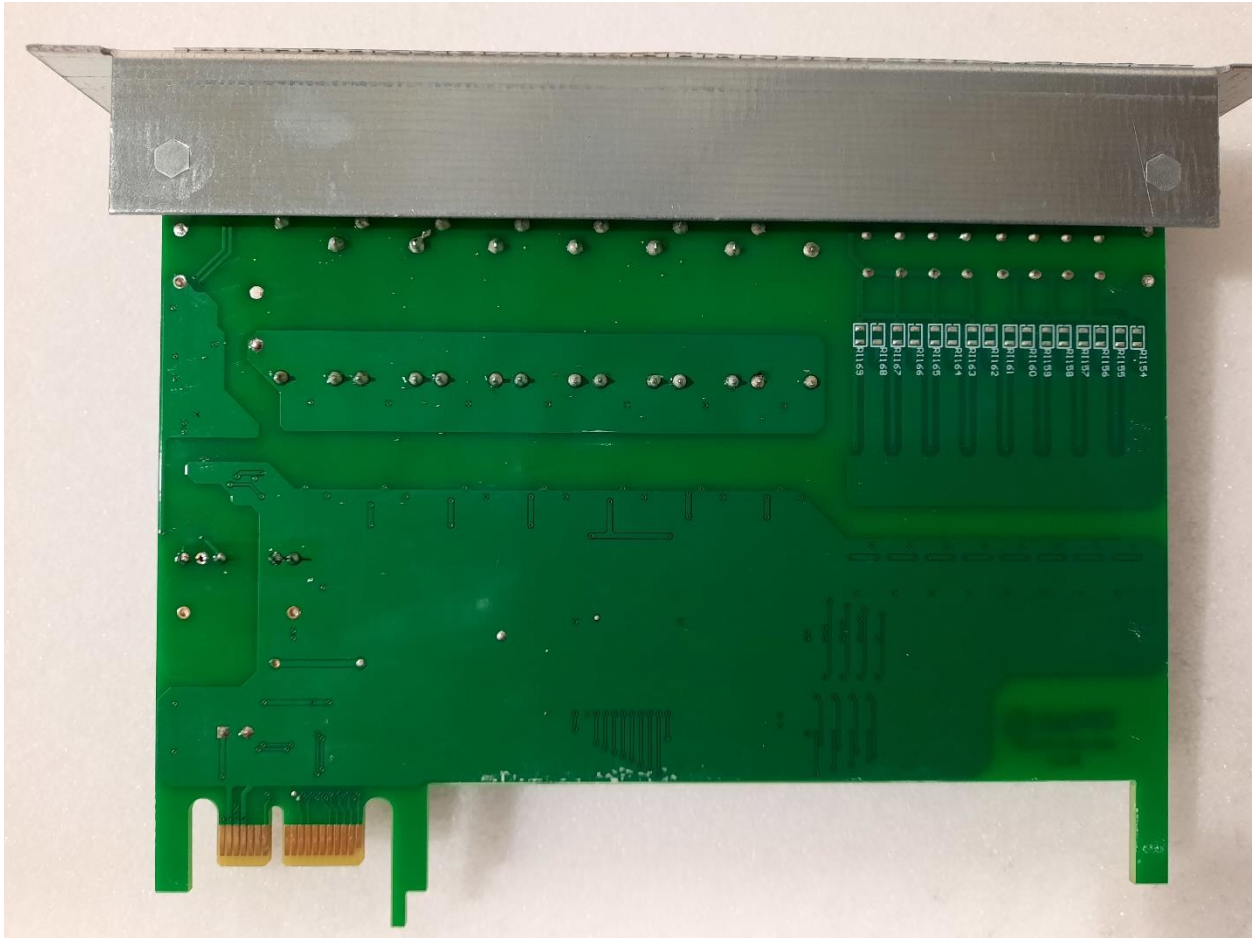
Photograph of power supply and Voltage input (Back)



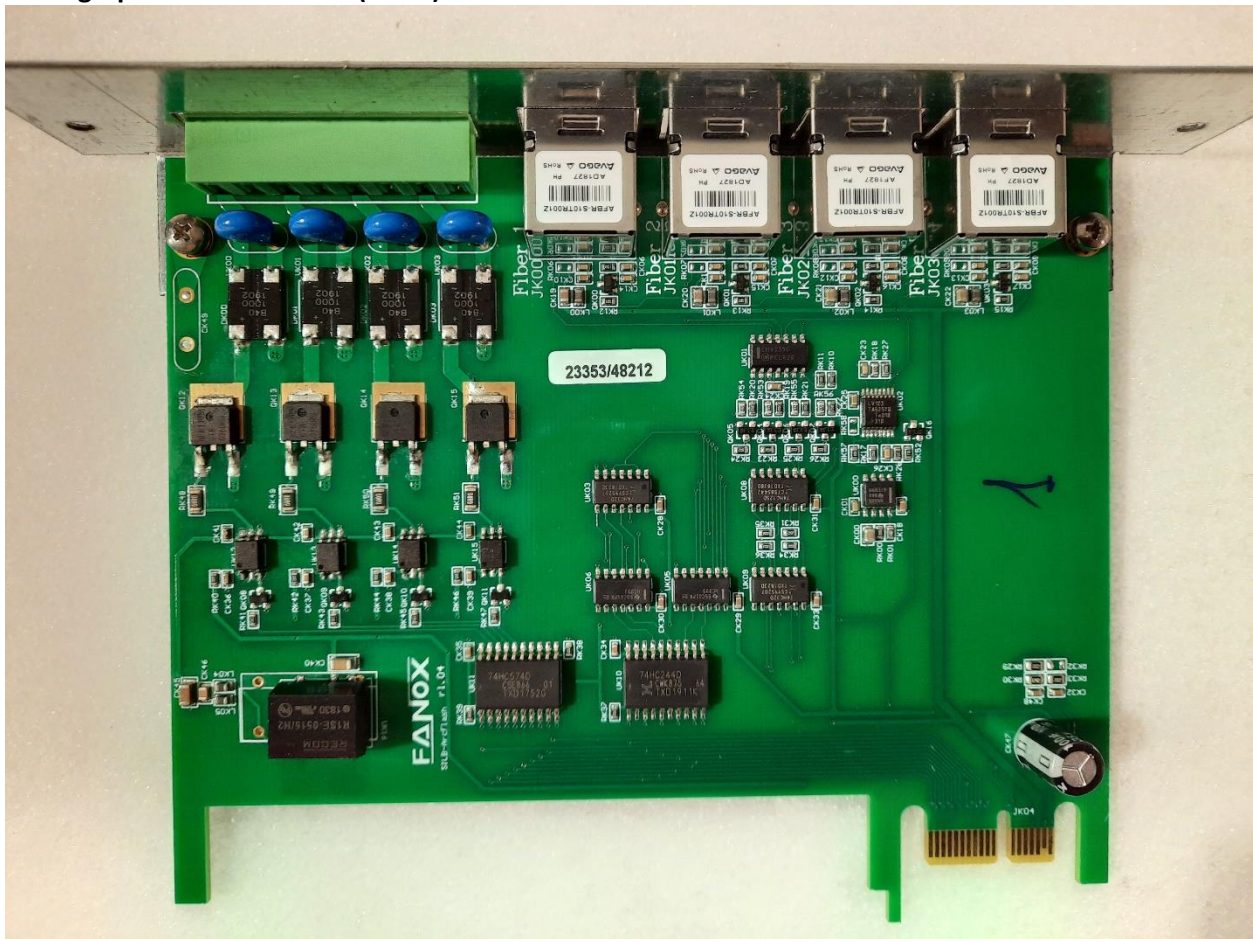
Photograph of BI and BO (Front)

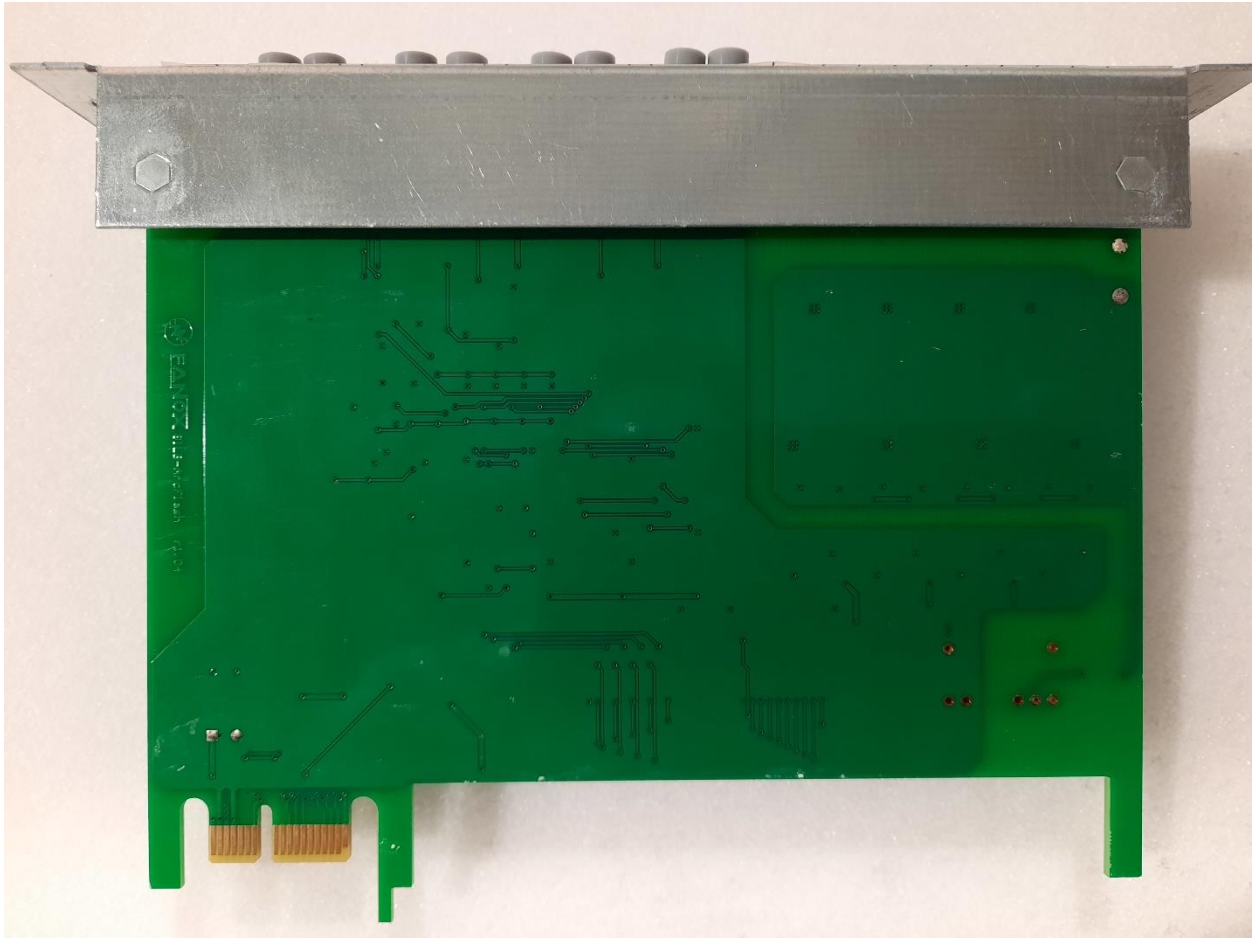


Photograph of BI and BO (Back)

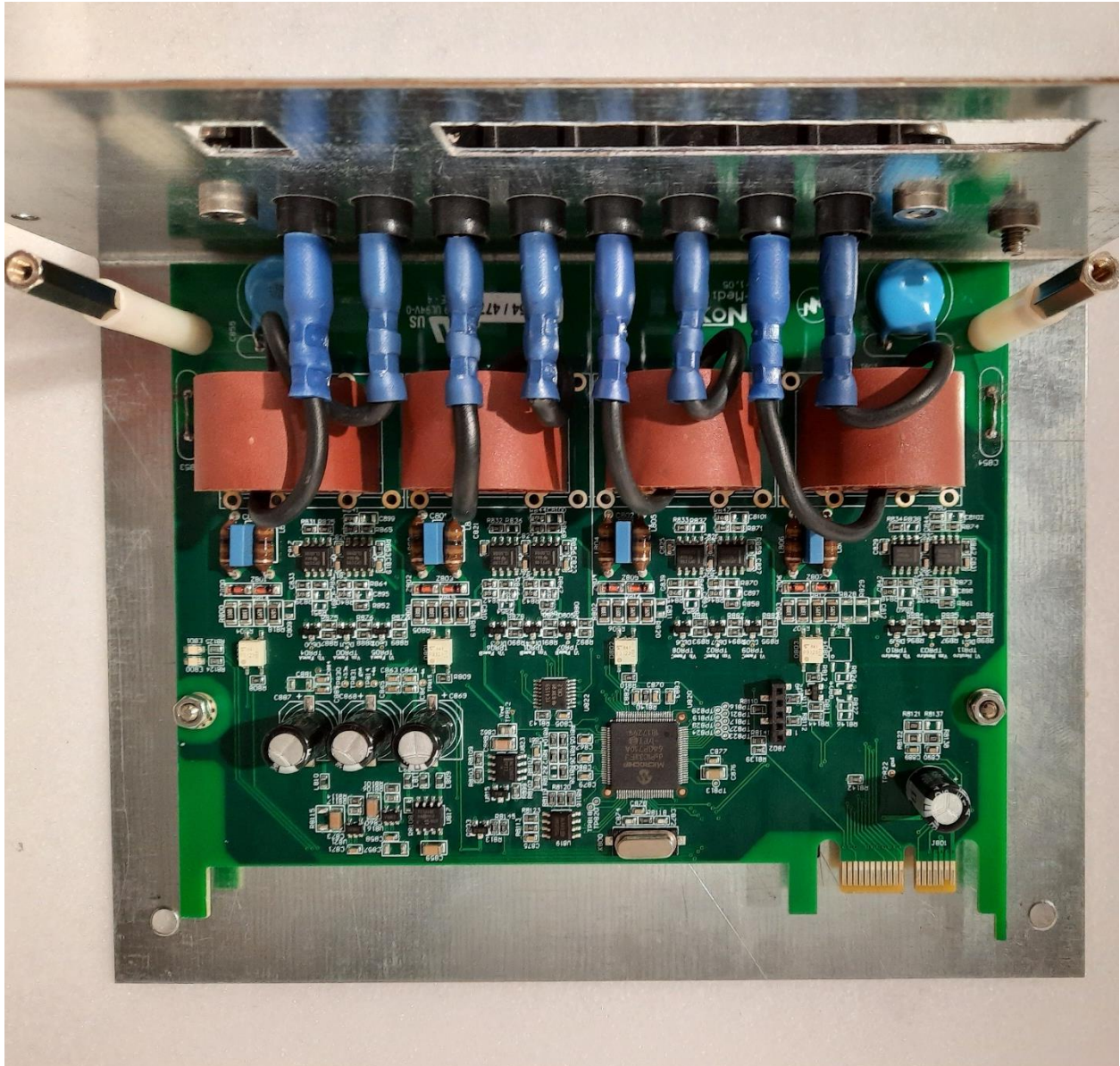


Photograph of Arc detection (Front)

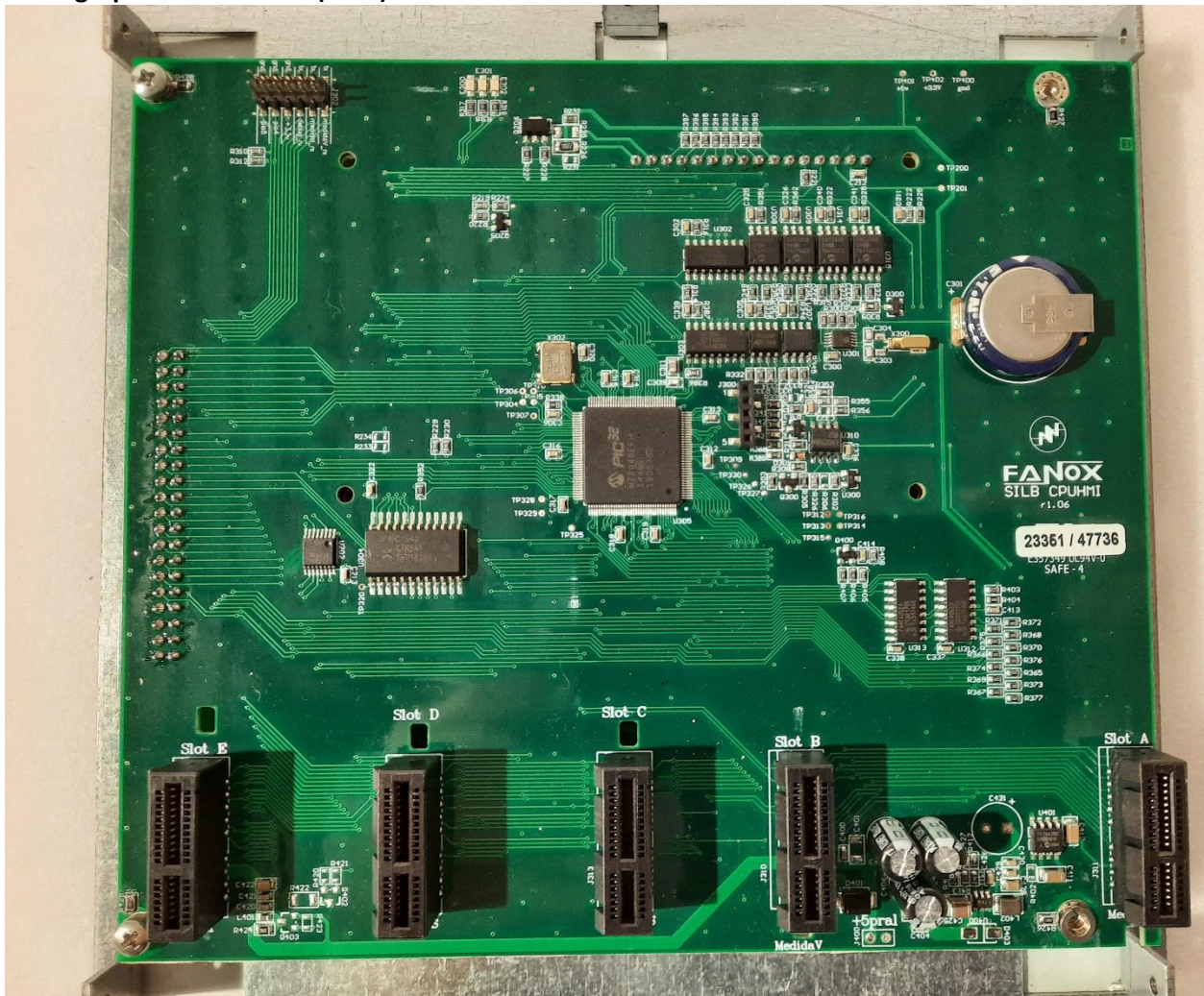


Photograph of Arc detection (Back)

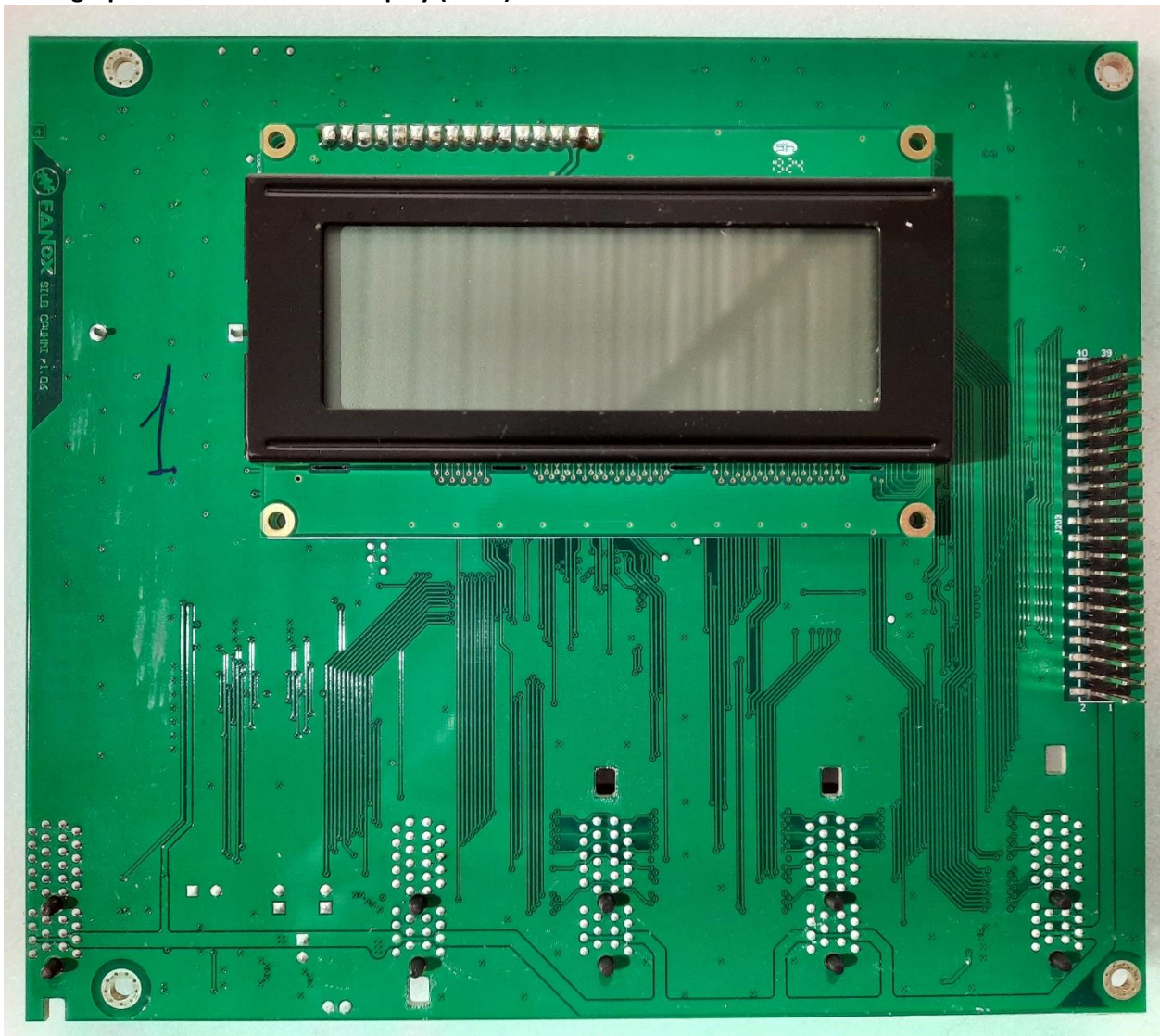
Photograph of Current transformers (Front)

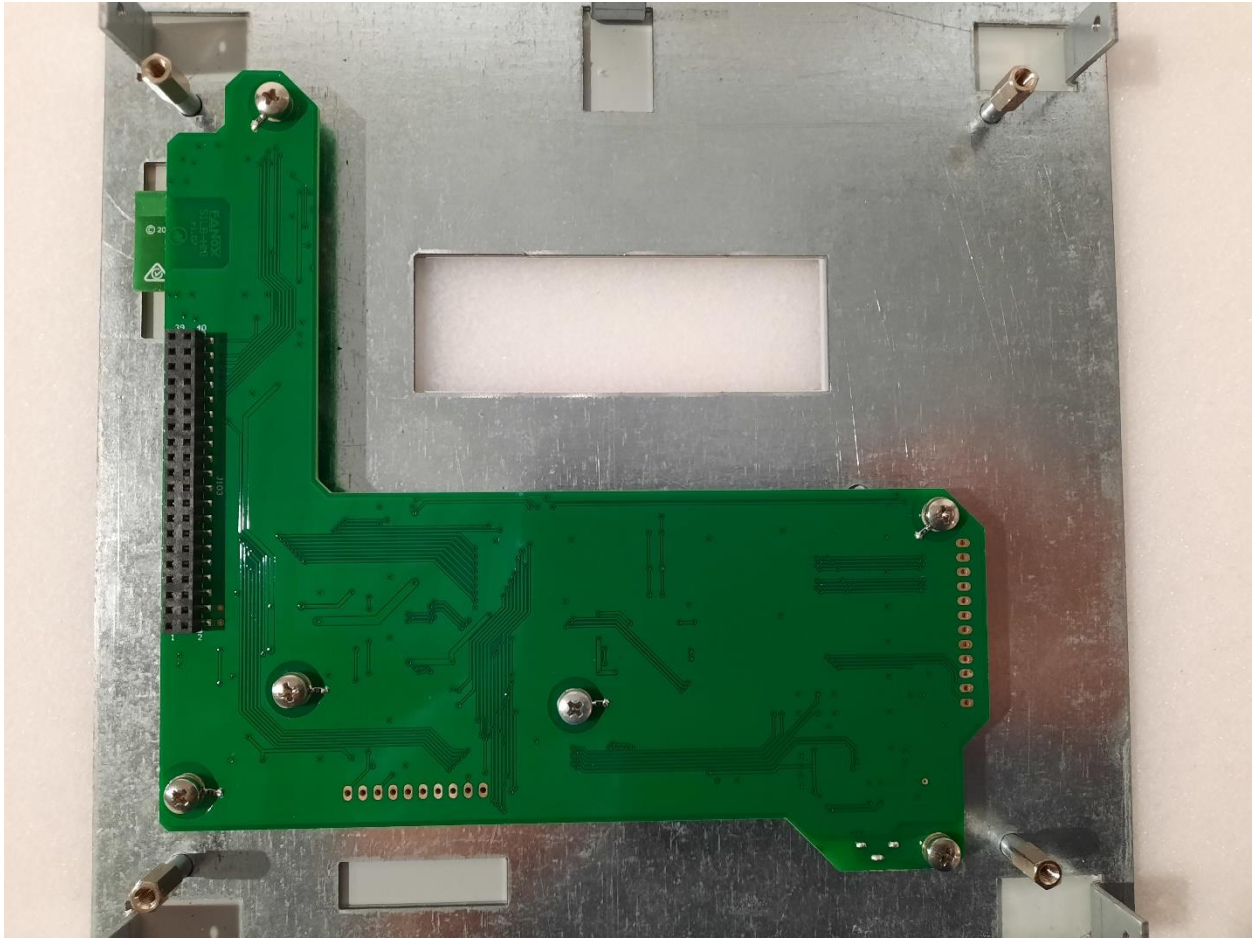


Photograph of Mainboard (Back)

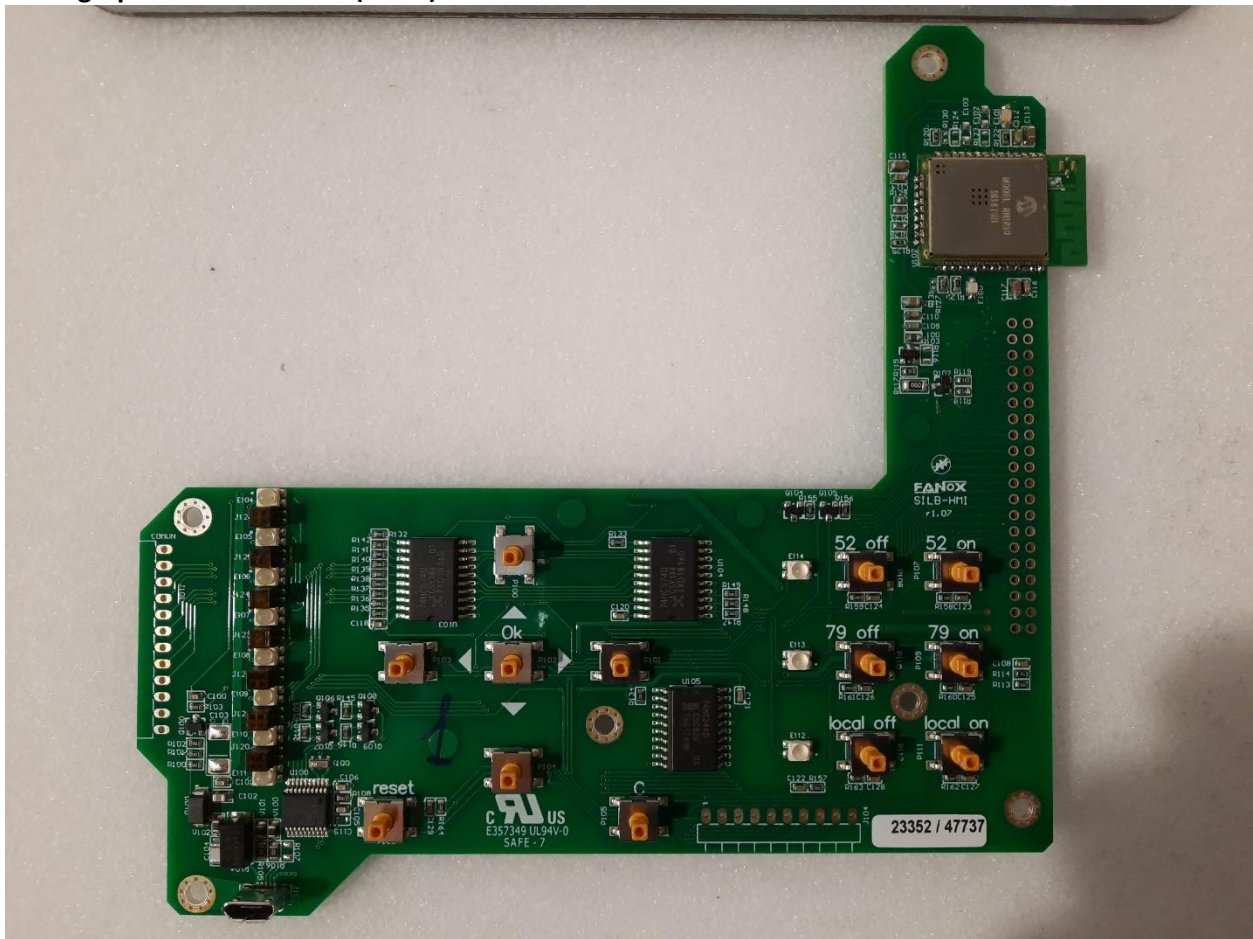


Photograph of Mainboard and display (front)



Photograph of Push buttons (Back)

Photograph of Push buttons (Front)

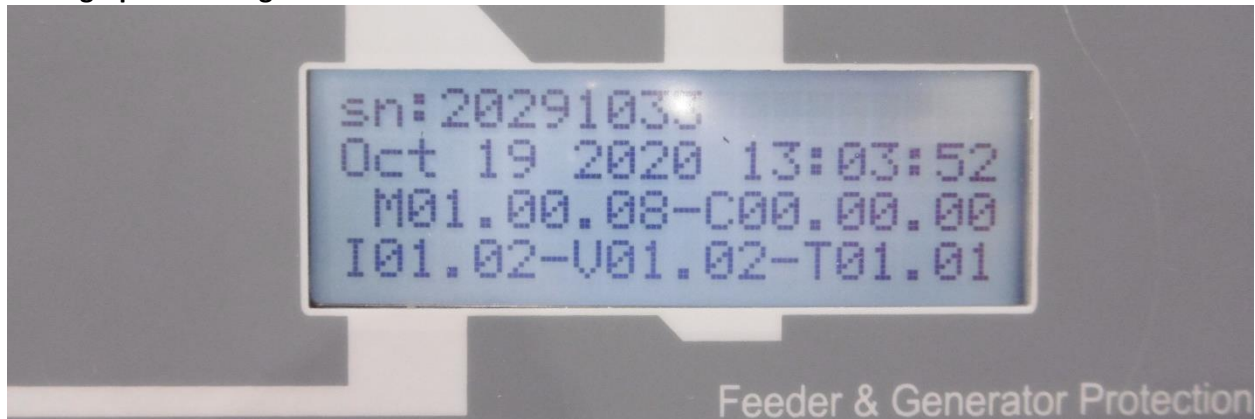


13 PHOTOGRAPHS OF CHANGES TO THE TEST OBJECT

New software: M01.00.08-C00.00.00 I01.02-V01.02-T01.01

Glu and fix the slots to one solid fixture for mechanical test

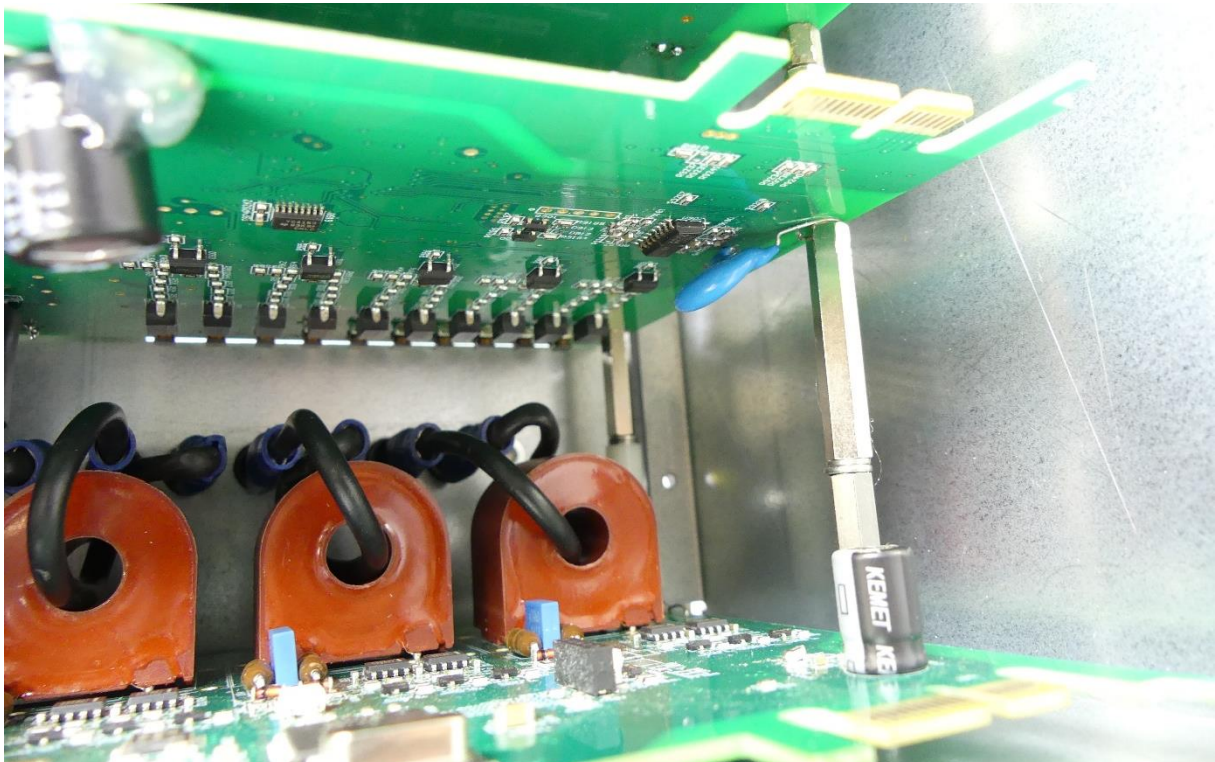
Photographs of change new software 19 Okt 2020



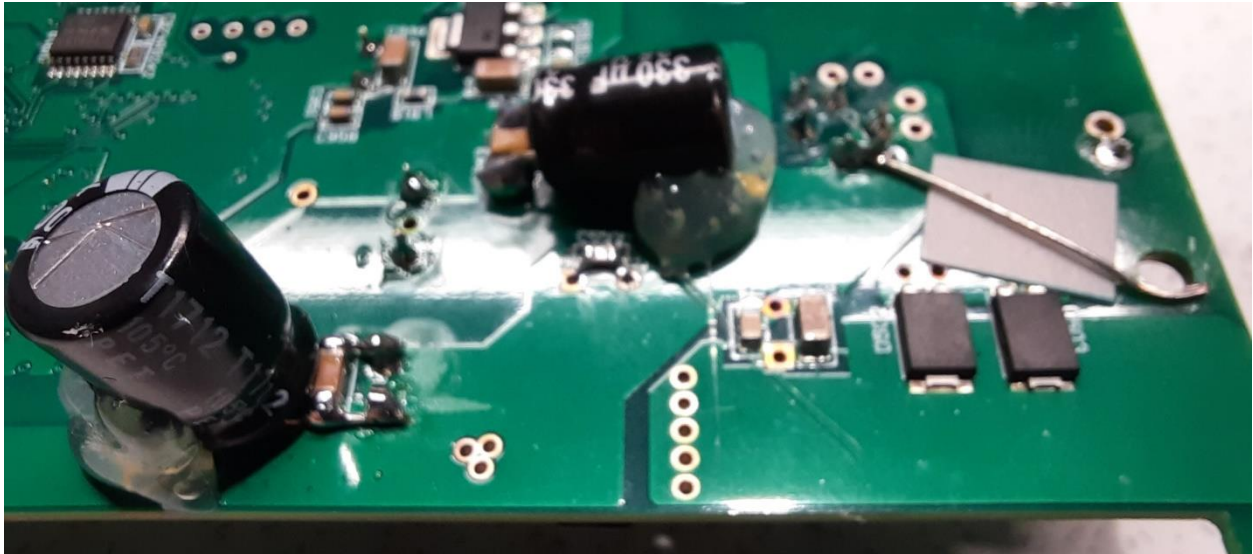
Photographs of change, Glu and fix the slots to one solid fixture



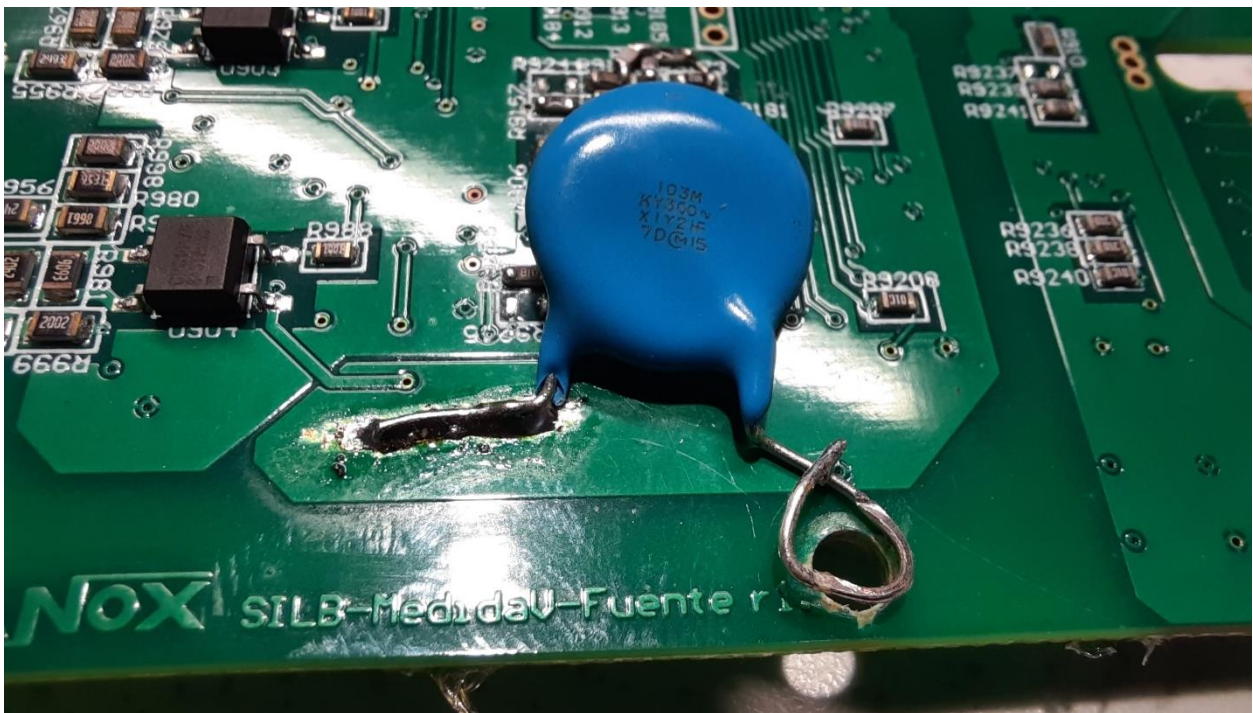
Photographs of change, Glu and fix the slots to one solid fixture



Photographs of change, EMC



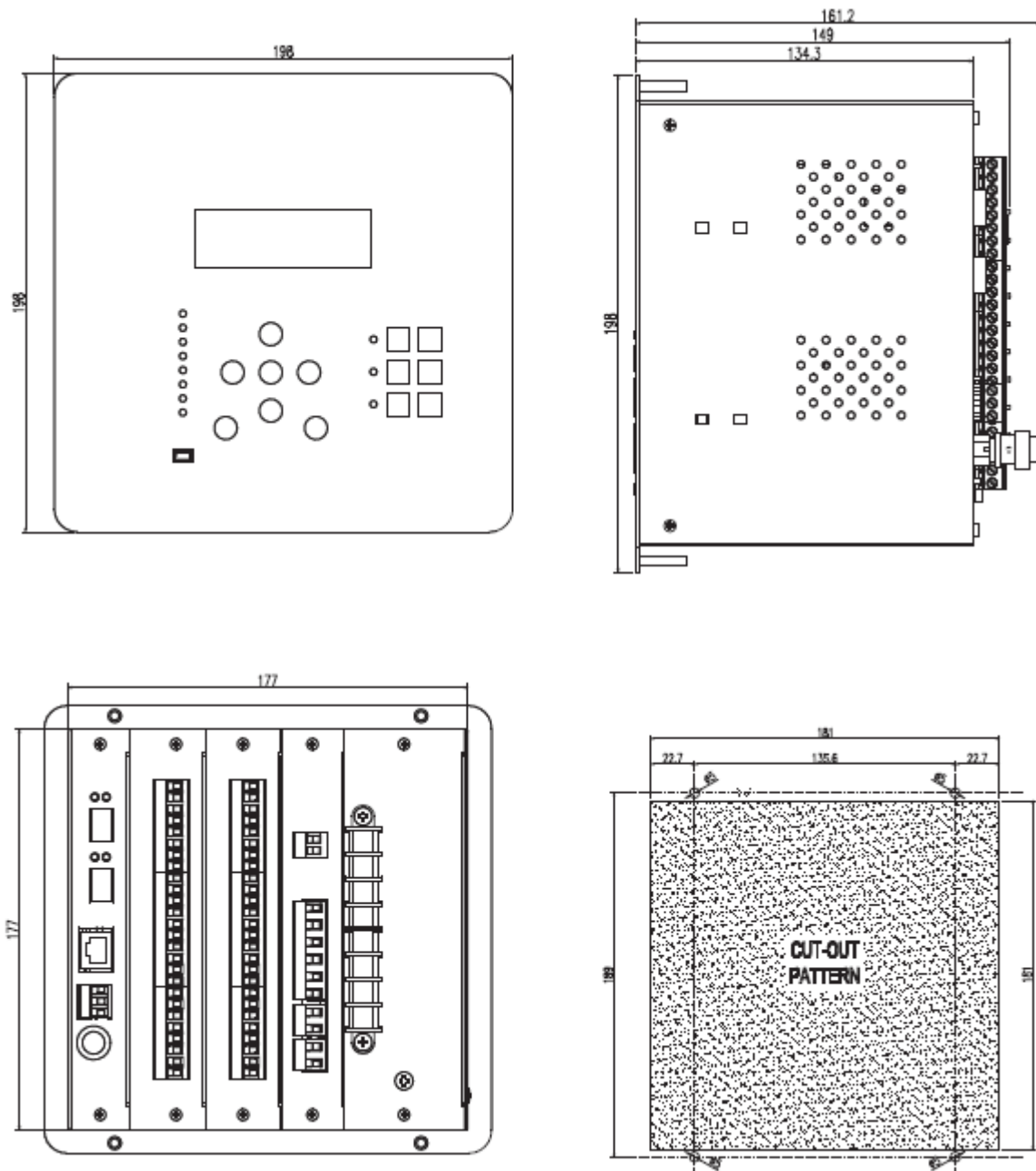
Earth connection has been made



New Surge arrester

14 DRAWINGS

Dimensions and cutout pattern.



15 MEASUREMENT UNCERTAINTY

The used test and measurement equipment are calibrated on an annual base.

15.1 Functional performance testing

The measurement uncertainties in the results presented are as specified below unless otherwise indicated.

Measurement	Measurement uncertainty
Current	Range 0,010 – 0,050 A: 5% Range 0,050 – 20 A: 0,5%
Voltage	Range 0,1 V – 0,5 V: 1% Range 0,5 V – 150 V: 0,5%
Phase angle between current and voltage	0,1 deg
Time	0,5 ms

15.2 Environmental testing

The used climate rooms and EMC test and measurement equipment are calibrated on an annual base. All the parameters are within the tolerances required by the basic (test/measurement) standards, taking into account the measurement uncertainty reported in the calibration certificates.

The test report shall present the measurement uncertainty for the measurements according CISPR 22;

Measurement	UCISPR	ULAB
Conducted emissions mains port; 150 kHz – 30 MHz	3,4 dB	2,8 dB
Conducted emission shielded TP RJ45 ports; 150 kHz – 30 MHz	5,0 dB	4,0 dB
Conducted emission 4-wire unshielded TP ports; 150 kHz – 30 MHz	5,0 dB	4,6 dB

The measurement uncertainty of the radiated emission measurement are not listed in this report because the measurements are subcontracted to an accredited test laboratory.

The calculated expanded uncertainty is 2,8 dB the mains port, 4,0 dB for shielded TP RJ45 ports and 4,6 dB for 4-wire unshielded TP ports and for the frequency range from 0,15 MHz to 30 MHz with a coverage factor of $k = 2$, which provides a coverage probability of approximately 95%.

16 LIST OF INSTRUMENTS USED

16.1 EMC equipment

EMC test equipment			
Description	Manufacturer	Type	ORS number
Fast transient burst tester	EM Test	EFT500	105169
Capacitive coupling clamp			106168
Electrostatic discharge tester	EM Test	NX30	152004
Air discharge	EM Test	Air	152012
Contact discharge	EM Test	Contact	152011
Bleeding resistors ESD	EM Test	Weerstandskabel ESD	152013
Bleeding resistors ESD	EM Test	Weerstandskabel ESD	122014
Insulation tester	EMC partner	MIG0603OS2	105333
Oscillatory wave test system including	EMC partner	MIG0603OMI	150022
CDN	EMC partner	CDN2000-06-25	150023
CDN-KIT1000	EMC partner	CN-U / DN-HF DN-LF1 / DN-LF2	89.02
H-field antenna	EMC partner	MF1000-1	151494
H-field antenna	EMC partner	MF1000-3	151495
Continuous wave simulator including	EM Test	CWS500N1.1	151165
50 ohm attenuator	EM Test	ATT 6/75	151158
CDN M1	EM Test	CDN M1	151180
CDN M2/M3	EM Test	CDN M2/M3	151164
CDN M2/M3	EM Test	CDN M2/M3	151179
CDN M4 N	EM Test	CDN M4 N	151160
CDN M4 N	EM Test	CDN M4 N	151178
CDN S8 RJ45	EM Test	CDN S8 RJ45	151181
CDN AF2	EM Test	CDN AF2	151162
Injection clamp	EM Test	EM101	151159
HF absorbing clamp	EM Test	FTC101	151168
HF absorbing clamp	EM Test	FTC101	151156
HF absorbing clamp	EM Test	FTC101	151157
Immunity tester, including	EMC partner	IMU4000 F-S-D-V-C-1500	151487
HF absorbing clamp	EM Test	FTC101	151168
HF ATTENUATION CLAMP	TESEQ	KEMA 801A	152042
HF ATTENUATION CLAMP	AMETEK CTS	KEMA 801A	152275
HF ATTENUATION CLAMP	AMETEK CTS	KEMA 801A	152276
CDN	EMC-Partner	EXT-TRA3000 C-SHORT-1506	151486
CDN	EMC-Partner	PS3-0204	
CDN	EMC-Partner	CN16-1514	151489
CDN	EMC-Partner	CN16T-1507	151491
CDN	EMC-Partner	CN16-22-7C-1503	151490
CDN	EMC-Partner	CN16-22-7D-1503	151492
Capacitive coupling clamp	EMC-Partner	CN-EFT1000-1568	151497
CDN	EMC-Partner	CN-BALUN-1505	151493
Insulation tester	FLUKE	1503	150150
Insulation Combitester	FLUKE	1653B	150738
Multi EMC generator	EMC-Partner	IMU3000 F6SRTDVC	152084
CDN	EMC-Partner	CDN3000A-08-32 690V	152089

EMC test equipment			
Description	Manufacturer	Type	ORS number
Power supply	EMC-Partner	PS3 Pwr1	152087
Power supply	EMC-Partner	PS3 Pwr2	152088
IEC 61000-4-16 extension	EMC-Partner	EXT-TRA3000 C-SHORT	152086
IEC 61000-4-29 extension	EMC-Partner	EXT-TRA3000 D-29D	152084
IEC 61000-4-2 extension	EMC-Partner	EXT-TRA3000 E (ESD)	152085
IEC 61000-4-5 CDN	EMC-Partner	CDN-UTP8 ED3	152077
IEC 61000-4-5 CDN	EMC-Partner	ADAPTER BOX RJ45	152079
ADAPTER BOX	EMC-Partner	ADAPTER BOX 90VG 1 to 16	152078
IEC 61000-4-16 CDN	EMC-Partner	CN16	152208
DOW generator	EMC-Partner	DOW3000 S-F-I	152090
Generator	EMC-Partner	MIG1803	152367
CDN	EMC-Partner	NW-IEC61036C218-1502	152368
CDN	EMC-Partner	NW-NMI-M6C3C4-1502	152369
test pistols	EMC-Partner	CN-MIG18 AMP	152094
EUT safety connection box	EMC-Partner	CN-MIG24	152095
IEC 61000-4-5 CDN kit	EMC-Partner	1000ED3	152146
Amplifier 80-1000 MHz	ETS Lindgren	8000-034RF	151972
Amplifier 1000-6000 MHz	ETS Lindgren	8100-045RF	151971
XYZ field probe	DARE!	Radisense 6 + interface	151973
Power meter	DARE!	RPR2006C	151969
Power meter	DARE!	RPR2006C	151970
HYPOTULTRA	AR	7854	152281

Conducted RF-emission test equipment			
Description	Manufacturer	Type	ORS number
Measurement receiver	Rohde & Schwarz	ESR	151944
LISN (AMN)	Rohde & Schwarz	ENV432	151954
LISN (AAN) S8 RJ45	Lüthi	S8 RJ45	151181
LISN (AAN) T8	Rohde & Schwarz	ENY41	151948
Connection cable	-	LMR240	152211

16.2 Environmental Measurement equipment

Environmental instrumentation			
Description	Manufacturer	Type	ORS number
IP Water chamber	Attrezzature tecniche speciali	353B34	151968
Flowmeter	Officine orobiche	0.4-3.5L/min	152365
Flowmeter	Officine orobiche	1.5-14L/min	152366
IP Dustchamber	ESPEC	EDC-27	MPSA 0243
Climate chamber	ESPEC	ARS-1100	151962
Test finger	Stahl	Test vinger 50mm	152410
Test finger	Stahl	Test vinger 12,5mm	152412
Test finger 3mm	Stahl	Test vinger 3mm	152405
Test finger 4mm	Stahl	Test vinger 4mm	152406

16.3 Measurement equipment

Measurement equipment			
Description	Manufacturer	Type	ORS number
Oscilloscope	Rohde & Schwarz	RTB2004	152142
Oscilloscope	Rohde & Schwarz	RTM3002	152229
Oscilloscope	Tektronix	TBS 1064	152001
Differentiaal probe	Testec	TT-SI 9010A	151822
Differentiaal probe	Testec	TT-SI 9010	152277
EFT Veri1K	EMC Partner	Veri1K EFT	152157
EFT Veri50	EMC Partner	Veri50 EFT	152158
Multimeter	Fluke	8840A	069145
Analogue multimeter	avometer	MK.6	067424
Multimeter	Fluke	8846A	152264
Multimeter	Keysight	34465A	152269
Multimeter	Keysight	34465A	152268
Multimeter	Keysight	34465A	152267
Multimeter clamp meter	Fluke	365	152024
Multimeter clamp meter	Fluke	337	104632
Multimeter 179	Fluke	179	152028

16.4 Test set

Test set			
Description	Manufacturer	Type	ORS number
Relay test set	KEMA		150026
Relay test set	KEMA		151759
Relay test set	Omicron	CMC353	152044
Relay test set	Omicron	CMC356	152036