

KEMA TYPE TEST CERTIFICATE OF COMPLETE TYPE TESTS

Object	Protection Relay	1651-22
Type	SIL-C: Feeder and generator protection SIR-C: Feeder protection and Recloser control SIU-C: Voltage and Frequency protection relay	Serial No. See chapter 2.2

Operating range	-40- +70 °C	EMC emission class	A
Mechanical class	1	EMC immunity zone	A

Client Fanox Electronic, S.L.,
Parque tecnológico de Bizkaia, Edificio 604, 48160 Derio, Spain

Manufacturer Fanox Electronic, S.L.,
Parque tecnológico de Bizkaia, Edificio 604, 48160 Derio, Spain

Tested by KEMA B.V.,
Klingelbeekseweg 195, Arnhem, The Netherlands

Date of tests May 17 to October 24, 2022

The object, constructed in accordance with the description, drawings and photographs incorporated in this Certificate, has been subjected to the series of proving tests in accordance with the complete type test requirements of

IEC 60255-1:2009

The results are shown in the record of proving tests and the oscillograms attached hereto. The values obtained and the general performance are considered to comply with the above standard(s) and to justify the ratings assigned by the manufacturer as listed on page 9.

This Certificate 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 Certificate consists of 173 pages in total.

Issued by KEMA B.V.



Alessandro Bertani
Director,
Services & Smart Technologies

Arnhem, October 28, 2022

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 behavior 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	October 28, 2022	First issue

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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
Dimension of structure and visual inspection	Passed
Product safety	Passed
Electromagnetic compatibility (EMC)	Passed
Burden	Passed
Climatic environmental conditions	Passed
Mechanical environmental conditions	Passed
Enclosure protection	Passed
Additional Electromagnetic compatibility (EMC)	Passed
Contact performance tests	Passed

Additional tests have been performed on the test object:

- Slow damped oscillatory wave 100 kHz according to customer's instruction, refer to IEC 61000-4-18
- Pulse magnetic field according to customer's instruction, refer to IEC 61000-4-9
- Damped oscillatory magnetic field (100kHz and 1MHz) according to customer's instruction, refer to IEC 61000-4-10
- High leakage current according to customer's instruction, refer to IEC 60255-27
- Reversal of DC power supply according to customer's instruction, refer to IEC 60255-27
- Main frequency voltage according to customer's instruction, refer to IEC 61000-4-16

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

- change 1: Improved EMC/surge test via IRIG-B port.
- change 2: RS-485 cable shield wire connection in user manual documentation SIU-C rev1.06, SIR-C rev.1.0, SIL-C rev.1.03
- change 3: AC Power supply rating changed to 100 - 230Vac ($\pm 15\%$)
- change 4: Burden limits updated in user manual documentation SIU-C rev1.06, SIR-C rev.1.0, and SIL-C rev.1.03
- change 5: Updated the label with warning symbol 14.

2 IDENTIFICATION OF THE OBJECT TESTED

2.1 Ratings/characteristics of the object tested

Rated voltage, U_R (SIL-C, SIU-C)	100-130 Vac (with VTs) 200-480 Vac (Direct connection)
Rated voltage, U_R (SIR-C, LEA)	8 Vrms (maximum)
Rated current I_R	1/5 A
Rated frequency	50 Hz
Rated auxiliary voltage	24-220 Vdc
	100-230 Vac
Binary input voltage (SIL-C, SIU-C))	24-220 Vdc
	100-230 Vac
Output contacts continuous current	8 A
Maximum operating temperature	+70 °C
Minimum operating temperature	-40 °C
Maximum storage temperature	80 °C
Minimum storage temperature	-40 °C

Classification

IP-class	Front side; IP54 Top-, Bottom-, Left-, Right, Back- side; IP40 Rear terminals; IP20
Mechanical class	1
EMC emission class	A
EMC immunity zone	A
Overvoltage category	III
Pollution degree	2
Insulation type	Basic/Functional

2.2 Description of the object tested

Manufacturer	Fanox Electronic, S.L., Parque tecnológico de Bizkaia, Edificio 604, 48160 Derio, Spain
Type	SIL-C: Feeder and generator Protection relay SIR-C: Feeder protection and Recloser control SIU-C: Voltage and frequency protection relay
Object	Protection Relay
Settings	Unless otherwise specified, the default settings of the manufacturer were used.

Overview of test objects

Model	Serial No.	Software	Remark
SIRC001C2B1DAB	22600009	01.10-01.05-01.04	Isolation sample
SIRC001C2B1DAB	22600001	01.10-01.05-01.04	
SIRC001C2B1DAB	22600002	01.10-01.05-01.04	
SIRC001C2B1DAB	22600003	01.10-01.05-01.04	
SILC000C1B1CAB	22600004	01.10-01.05-01.04	
SILC000C1B1CAB	22600005	01.10-01.05-01.04	
SILC000C1B1CAB	22600006	01.10-01.05-01.04	Isolation sample
SIUC000C1A1CAB	22600010	01.10-01.00	Isolation sample
SIUC000C1A1CXB	22600007	01.10-01.00	
SIUC000C1A1CAB	22607532	01.10-01.00	

PCBs in each test object (SIL-C)

PCB(s)	Version
CPU and HMI board	1.02
Current transformer / CTs board	1.09
Binary input, Binary output and RS-485 board	1.01
Communication board: Ethernet and IRIG-B	1.03
Power supply (PSU) and VT board	1.09

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.

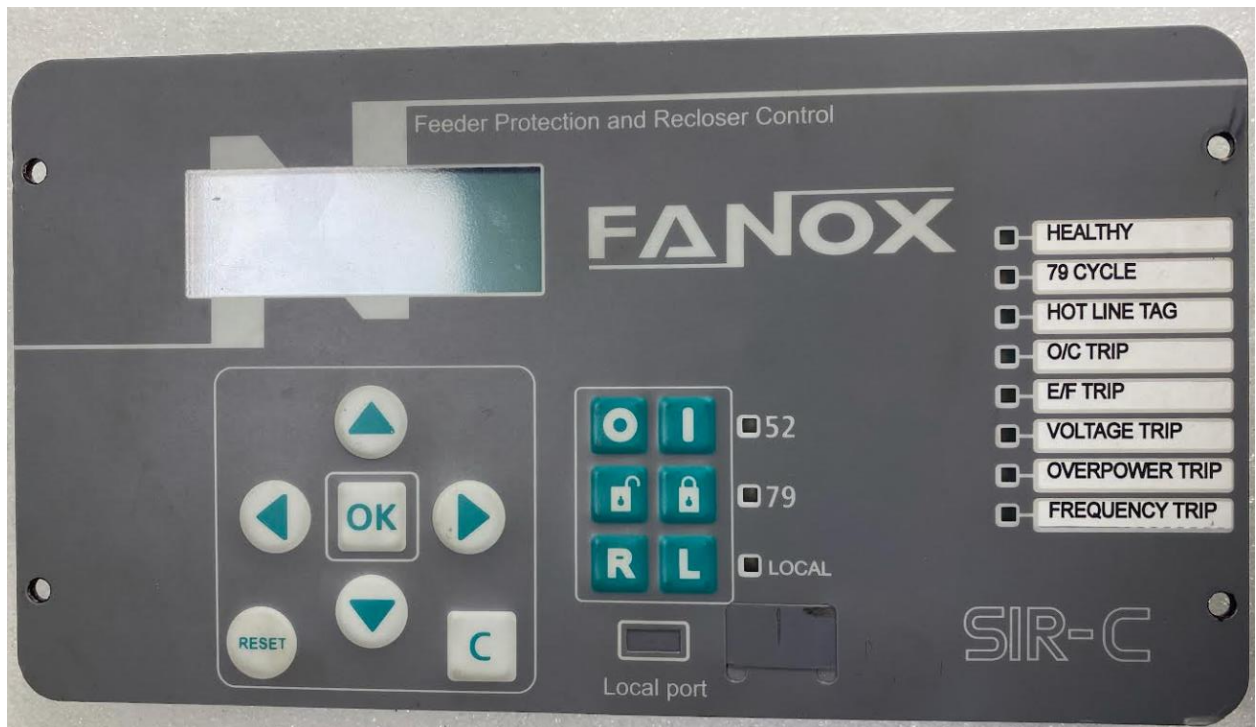
Schematic circuit no./document no.	Revision
FANOX – SILB / Alimentacion	1.01
FANOX – SILB-B/ Medida-I	1.06
FANOX – SILB-B/ Autoalimentación	1.04
FANOX – SILB / In11-Out5- Com	1.01
FANOX – SILB / Ethernet	1.02
FANOX – SILB-B / Fuente	1.04

Drawing no./document no.	Revision
Dimensiones SIR-C vertical	N/A
Dimensiones SIR-C horizontal	N/A
Dimensiones SILC vertical	N/A
Dimensiones SIL-C horizontal	N/A
Dimensiones SIU-C vertical	N/A
Dimensiones SIU-C horizontal	N/A

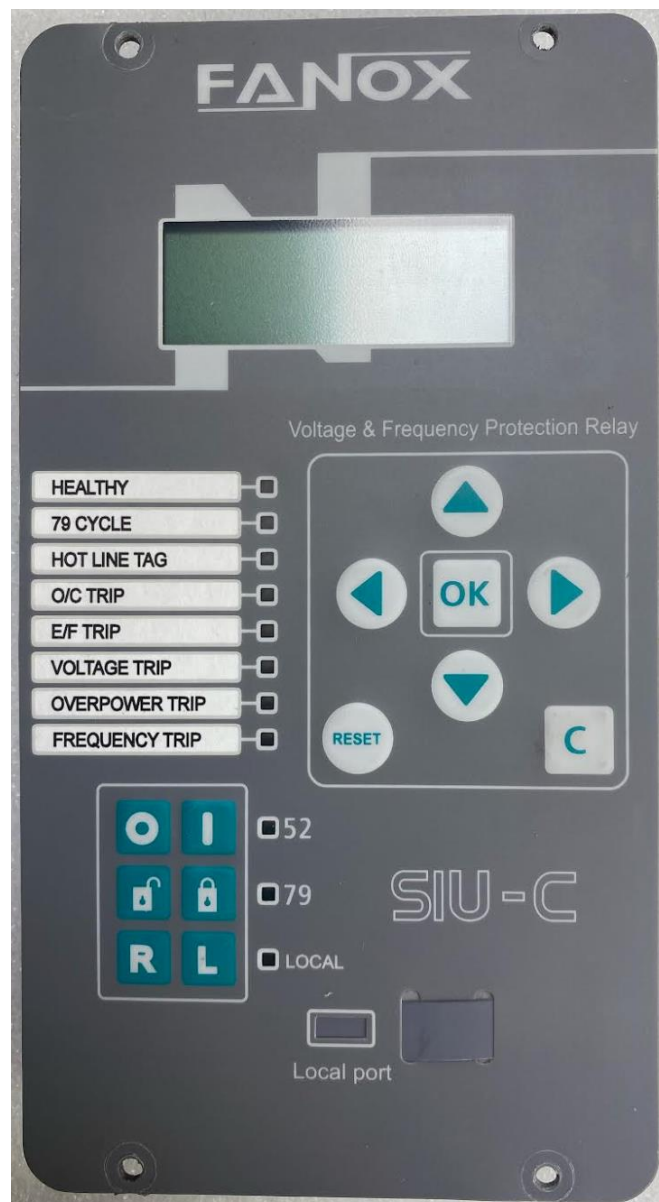
2.4 Photograph of test object



Test object of SIL-C



Test object of SIR-C



Test object of SIU-C

3 GENERAL INFORMATION

3.1 The tests were witnessed by

Name

Jira Chareonpak
Gert Van Wee
Mihai Bivolaru

Company

KEMA.B.,
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 DEKRA Certification B.V., Arnhem, the Netherlands:

- contact performance in accordance with IEC 61810-1.

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 certificate. Unless otherwise stated, the measurement uncertainties of the results presented in this certificate are as indicated in that table.

3.6 Instruments used

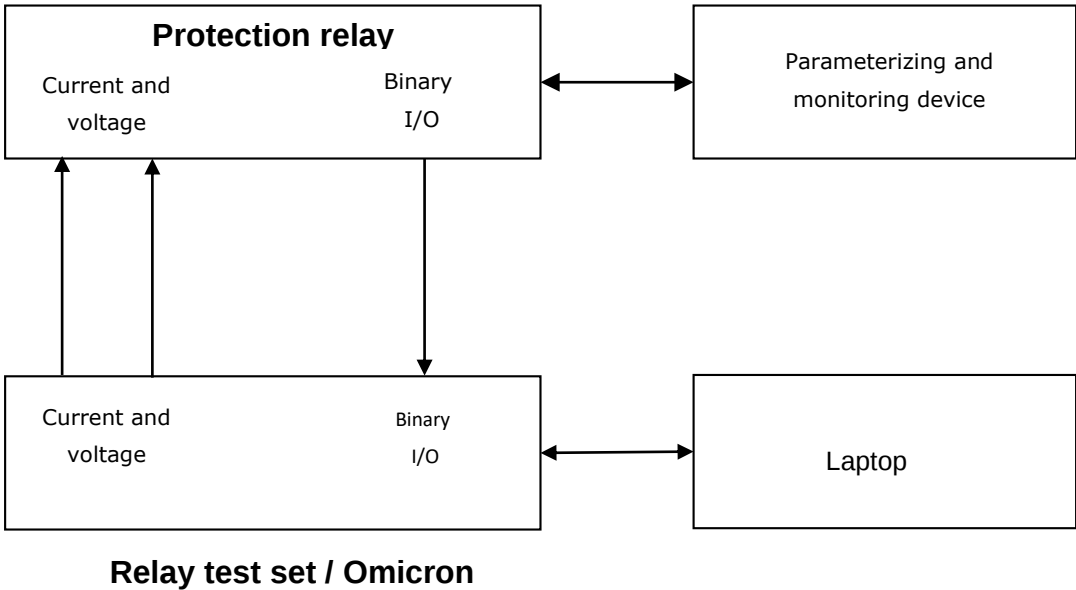
A detailed list with instruments used is enclosed in this Certificate

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 protection relay is parameterized and monitored by means of the human machine interface and interface on the display and LED's.



5 DIMENSIONS OF STRUCTURE

Standard and date

Standard IEC 60255-1, subclause 6.2

Basic standard IEC 60297-3-101

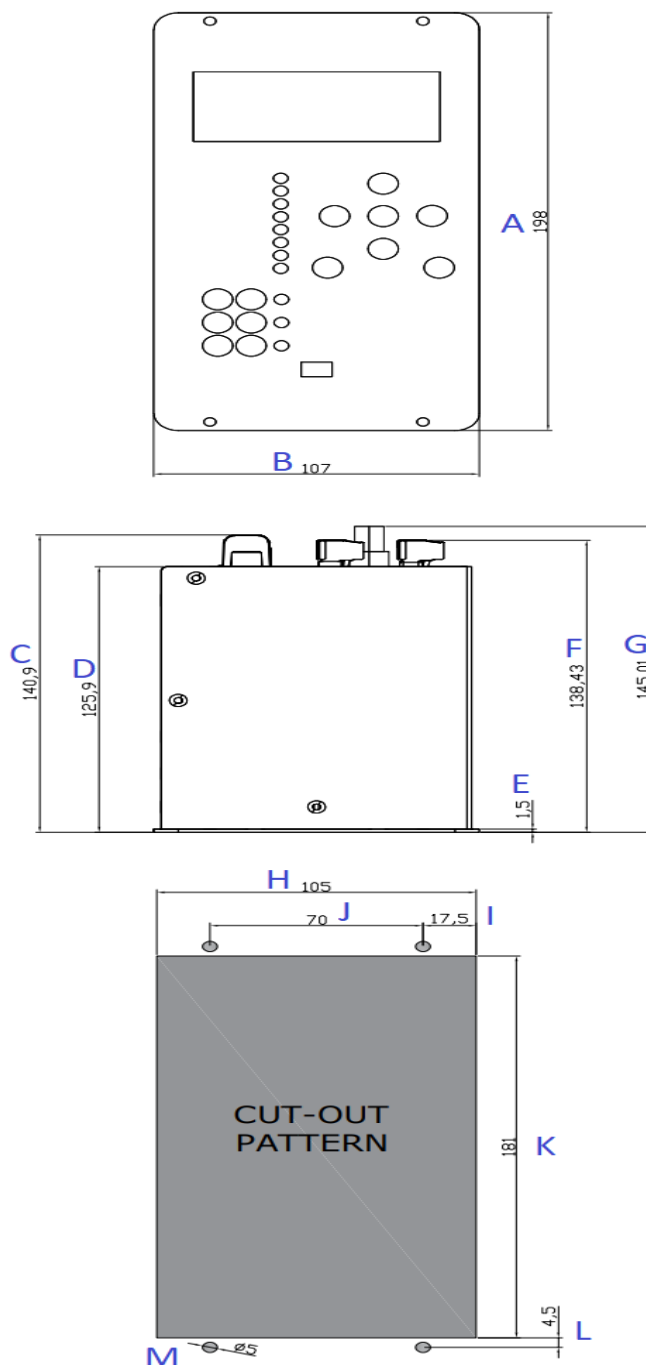
Test date August 2, 2022

5.1 Characteristic test data

Test object: SIL-C

Serial number: 22600006

Dimension and cutout pattern



Item	Unit	Measured	Specified by the client
Side A	mm	198,4	198
Side B	mm	107,3	107
Side C	mm	140,7	140.9
Side D	mm	128,1	125.9
Side E	mm	1,9	1.5
Side F	mm	139	138.43
Side G	mm	146,5	145.01
Side H	mm	105,5	105
Side I	mm	17,7	17.5
Side K	mm	70,3	70
Side L	mm	4,05	4.5
Side M	mm	3,76	4.5

Observations

The measured dimensions were within the specified dimensions.

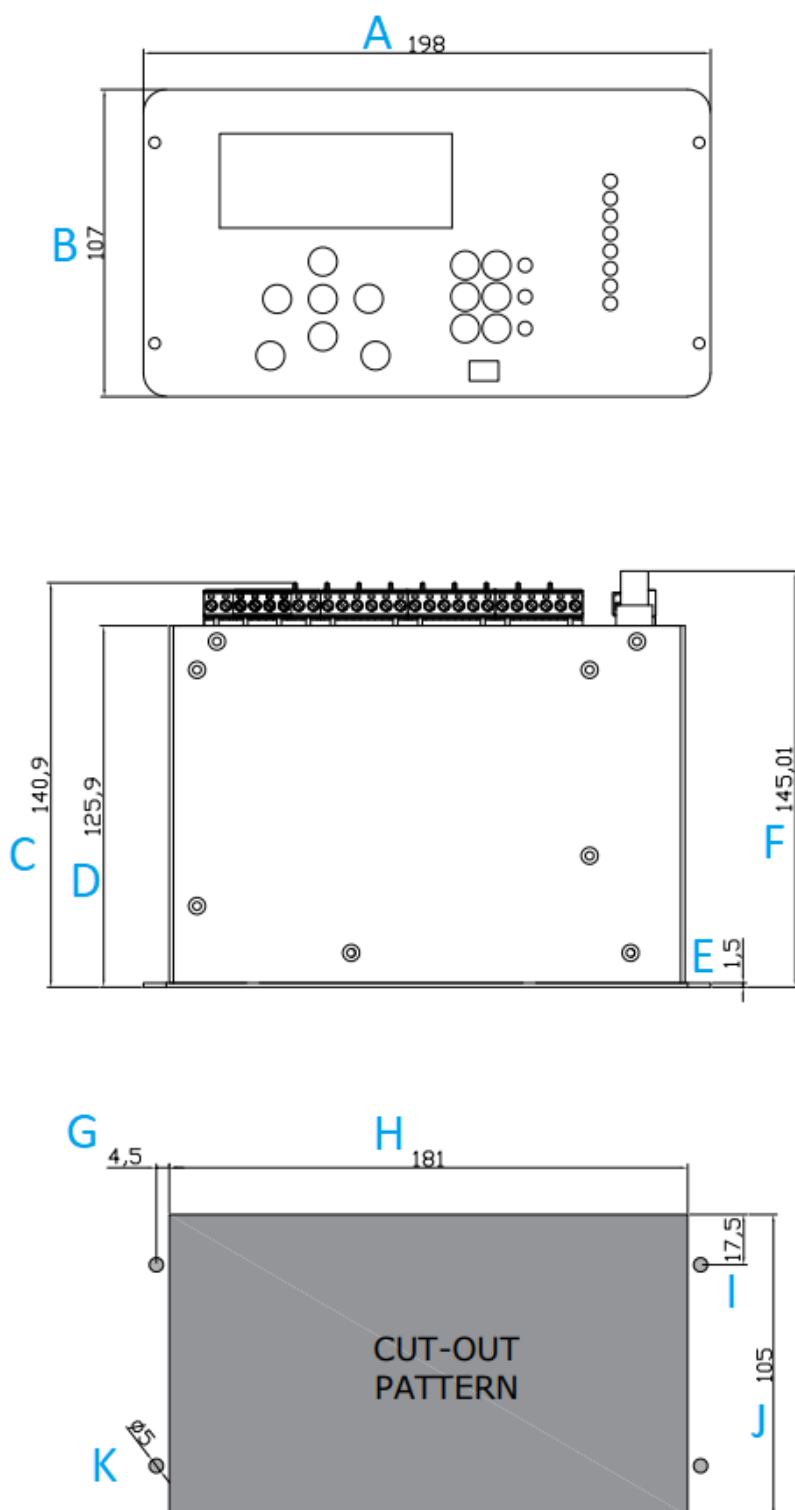
Result

Passed

Test object: SIR-C

Serial number: 22600001

Dimension and cutout pattern



Item	Unit	Measured	Specified by the client
Side A	mm	198,5	198
Side B	mm	107,2	107
Side C	mm	140,2	140.9
Side D	mm	127,8	125.9
Side E	mm	2,2	1.5
Side F	mm	146,4	145.01
Side G	mm	4,9	4.5
Side H	mm	180,1	181
Side I	mm	17,8	17.5
Side J	mm	107,3	105
Side K	mm	3,6	4.5

Observations

The measured dimensions were within the specified dimensions.

Result

Passed

6 ENCLOSURE PROTECTION

Standard and date

Standard	IEC 60255-1, subclause 6.3
Basic standard	IEC 60255-27, subclause 10.6.2.6.
Test date	September 14 and 15, 2022

Characteristic test data

Serial number (SIR-C)	22600001
Serial number (SIL-C)	22600004

Terminal side	Degree of protection	
	Specification by the manufacturer	Observation
Front	IP 54	IP 54
Top	IP 40	IP 40
Bottom	IP 40	IP 40
Back	IP 40	IP 40
Left	IP 40	IP 40
Right	IP 40	IP 40
Rear terminals	IP 20	IP 20

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:

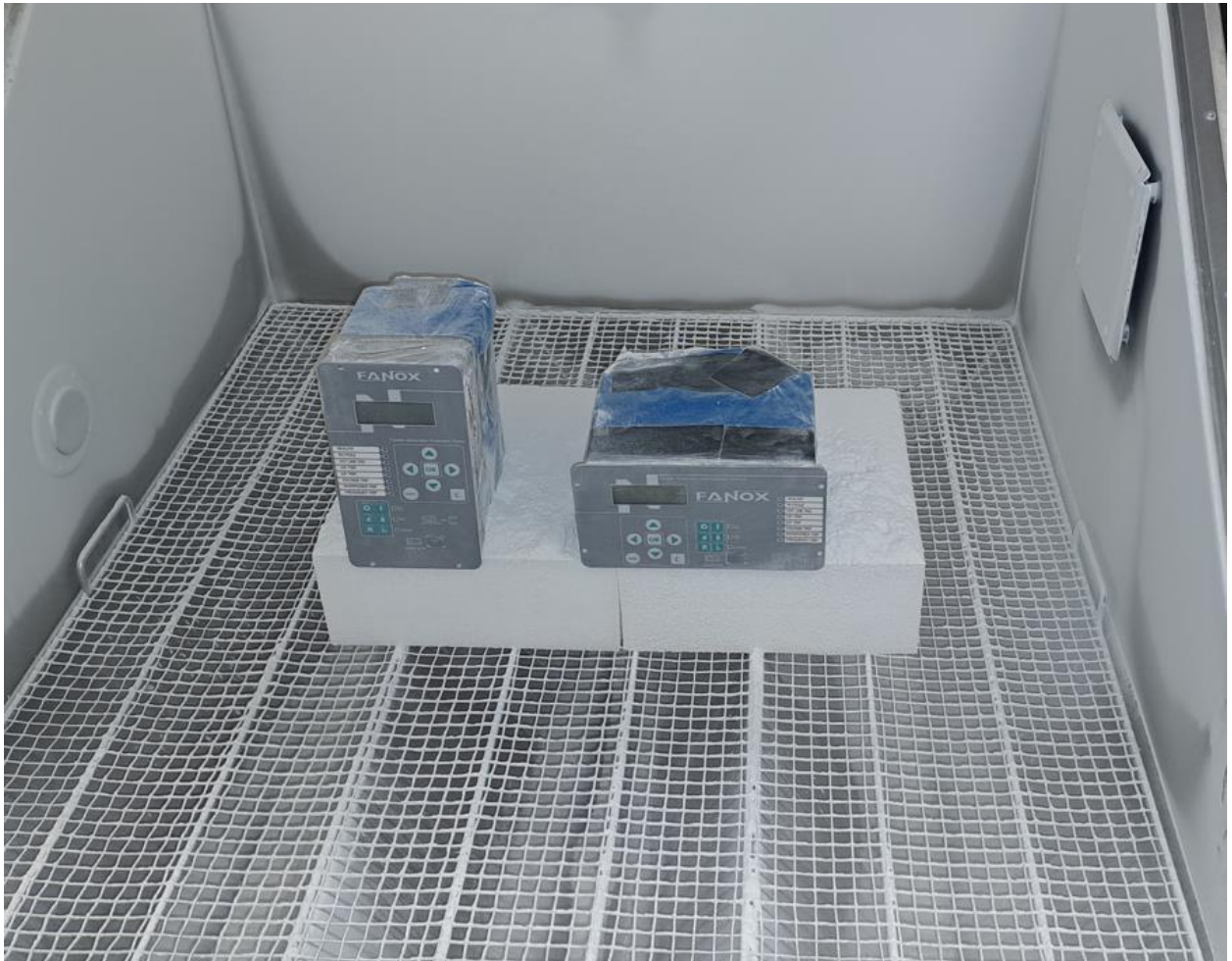
- The front side shall comply with IP54.

Result

The object(s) passed the test.

Photograph of test arrangement IPx4



Photograph of test arrangement IP5x

7 PACKAGING

Standard and date

Standard	IEC 60255-1, subclause 8
Basic standard	IEC 60255-27, subclause 9.3
Test date	September 9, 2022

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





8 PRODUCT SAFETY

8.1 Inspection

8.1.1 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.

8.1.2 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.

8.2 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	August 24 and 26, 2022

Environmental conditions

Ambient temperature	20.9 °C
Relative humidity	61.9 %

Characteristic test data

Serial number (SIL-C)	22600006
Serial number (SIR-C)	22600001
Serial number (SIU-C)	22600010
Time to rise-value	1,2 µs (± 30%)
Time to half-value	50 µs (± 20%)
Source impedance	500 Ω (± 10%)
Output energy	0,5 J (± 10%)
Pulse interval	≥ 1 s

Test result

Voltage applied to Circuit/terminals	Terminal	Voltage applied (kV)	No. of impulses	Polarity	Observations
SIL-C					
Power supply: AC/DC	B1, B2	5,0	5	Positive	1
			5	Negative	
CT input: IN	A7 to A8	5,0	5	Positive	2
			5	Negative	
CT input: IA-IB-IC	A1 to A8	5,0	5	Positive	2
			5	Negative	
VT input: VC	B7, B8	5,0	5	Positive	2
			5	Negative	
VT input: VA, VB, VC, VR ₉₋₁₀ , VB ₁₁₋₁₂	B3 - B12	5,0	5	Positive	2
			5	Negative	
Binary input: IN1 to IN11	C1 - C13	5,0	5	Positive	2
			5	Negative	
Binary input: IN1-6 against IN7-11	C1 - C7 to C8 - C13	5,0	5	Positive	1
			5	Negative	
Binary output: Output 4, Output 5	C21-C22 to C23-C24	5,0	5	Positive	2
			5	Negative	
Binary output: Output 3, Output 4, Output 5	C19 to C24	5,0	5	Positive	2
			5	Negative	
Binary output: Output 1,2 against Output 3, 4, 5	C14 - C18 to C19 - C24	5,0	5	Positive	2
			5	Negative	
Ethernet / RJ45	Ethernet	1,0	5	Positive	2

Voltage applied to Circuit/terminals SIL-C	Terminal	Voltage applied (kV)	No. of impulses	Polarity	Observations
			5	Negative	
RS485	C25, C26	1,0	5	Positive	2
			5	Negative	
IRIG-B	IRIG-B	1,0	5	Positive	2
			5	Negative	

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.

Observations

1. Breakdown observed. Waveshape has been attenuated down to 600 V. The test object passes this test with the intended overvoltage protection in place. (varistors)
2. No breakdown or flashover observed.

Voltage applied to Circuit/terminals SIR-C	Terminal	Voltage applied (kV)	No. of impulses	Polarity	Observations
Power supply: AC/DC	B1, B2	5,0	5	Positive	1
			5	Negative	
CT input: IN	A7, A8	5,0	5	Positive	2
			5	Negative	
CT input: IA-IB-IC	A1 – A6	5,0	5	Positive	2
			5	Negative	
VT input: LINE LEAs, BUS LEAs	B3 - B8, B9 - B14	1,0	5	Positive	2
			5	Negative	
VT input: LINE LEA	B3 - B8	1,0	5	Positive	2
			5	Negative	
VT input: BUS LEA	B9 - B14	1,0	5	Positive	2
			5	Negative	
Binary input: IN1 to IN11	C1 - C13	5,0	5	Positive	2
			5	Negative	
Binary output: Output 1 to Output 5	C14 - C24	5,0	5	Positive	2
			5	Negative	
Ethernet / RJ45	Ethernet	1,0	5	Positive	2
			5	Negative	
RS485	C25, C26	1,0	5	Positive	2
			5	Negative	
IRIG-B	IRIG-B	1,0	5	Positive	2

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

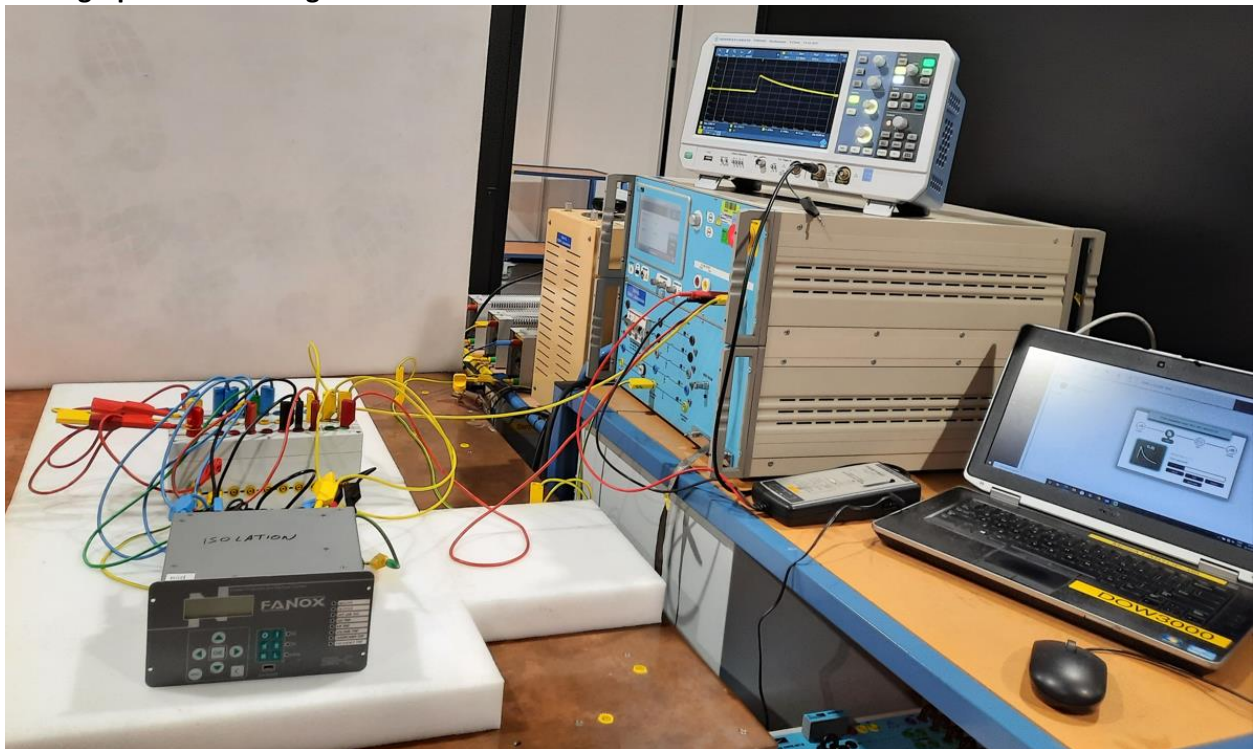
- No disruptive discharge (spark-over, flashover or puncture) shall occur.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Observations

3. Breakdown observed. Waveshape has been attenuated down to 600 V. The test object passes this test with the intended overvoltage protection in place. (varistors)
4. No breakdown or flashover observed.

Result

The object passed the test

Photograph of test arrangement

8.3 Dielectric voltage test

Standard and date

Standard IEC 60255-1, subclause 6.4
 Basic standard IEC 60255-27, subclause 10.6.4.3, subclause 10.6.4.4
 Test date July 14, 2022

Environmental conditions

Ambient temperature 21 °C
 Relative humidity 56 %

Characteristic test data

Serial number (SIR-C) 22600003
 Serial number (SIL-C) 22600006
 Serial number (SIU-C) 22607532
 Frequency 50 Hz
 Rated insulation voltage 300 V
 Test duration 1 min

Test results

Voltage applied to Circuit/terminals	Terminal	Voltage applied	Observations
SIR-C		kVac	
Power supply input	B1, B2	2	-
CT A	A1, A2	2	-
CT B	A3, A4	2	-
CT C	A5, A6	2	-
CT N	A7, A8	2	-
V-Sensors	B3 – B14	2	-
BI	C1-C7	2	-
BI	C8-C13	2	-
BO	C14-C20	2	-
BO	C21-C24	2	-
IRIG-B	-	0,5	-
RS 485	-	0,5	-
LAN RJ45	-	0,5	-

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.

Voltage applied to Circuit/terminals	Terminal	Voltage applied kVac	Observations
SIL-C			
Power supply input	B1, B2	2	-
CT A	A1, A2	2	-
CT B	A3, A4	2	-
CT C	A5, A6	2	-
CT N	A7, A8	2	-
VT	B3 – B9	2	-
BI	C1-C7	2	-
BI	C8-C13	2	-
BO	C14-C20	2	-
BO	C21-C24	2	-
IRIG-B	-	0,5	-
RS 485	-	0,5	-
LAN RJ45	-	0,5	-

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.

Voltage applied to Circuit/terminals	Terminal	Voltage applied kVac	Observations
SIU-C			
Power supply input	B1, B2	2	-
CT A	A1, A2	2	-
CT B	A3, A4	2	-
CT C	A5, A6	2	-
CT N	A7, A8	2	-
BI	C1-C7	2	-
BI	C8-C13	2	-
BO	C14-C20	2	-
BO	C21-C24	2	-
RS 485	-	0,5	-

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.

Additional test performed 23 August 2022; a retest of dielectric strength on the auxiliary power supply input of sample "isolation" This is the prepared sample without varistors and capacitors (CG000, C515, C516, V501 and V502 removed). Insulation resistance > 550 Mohm. The result is pass.

Observations

No breakdown or flashover has been observed during the test.

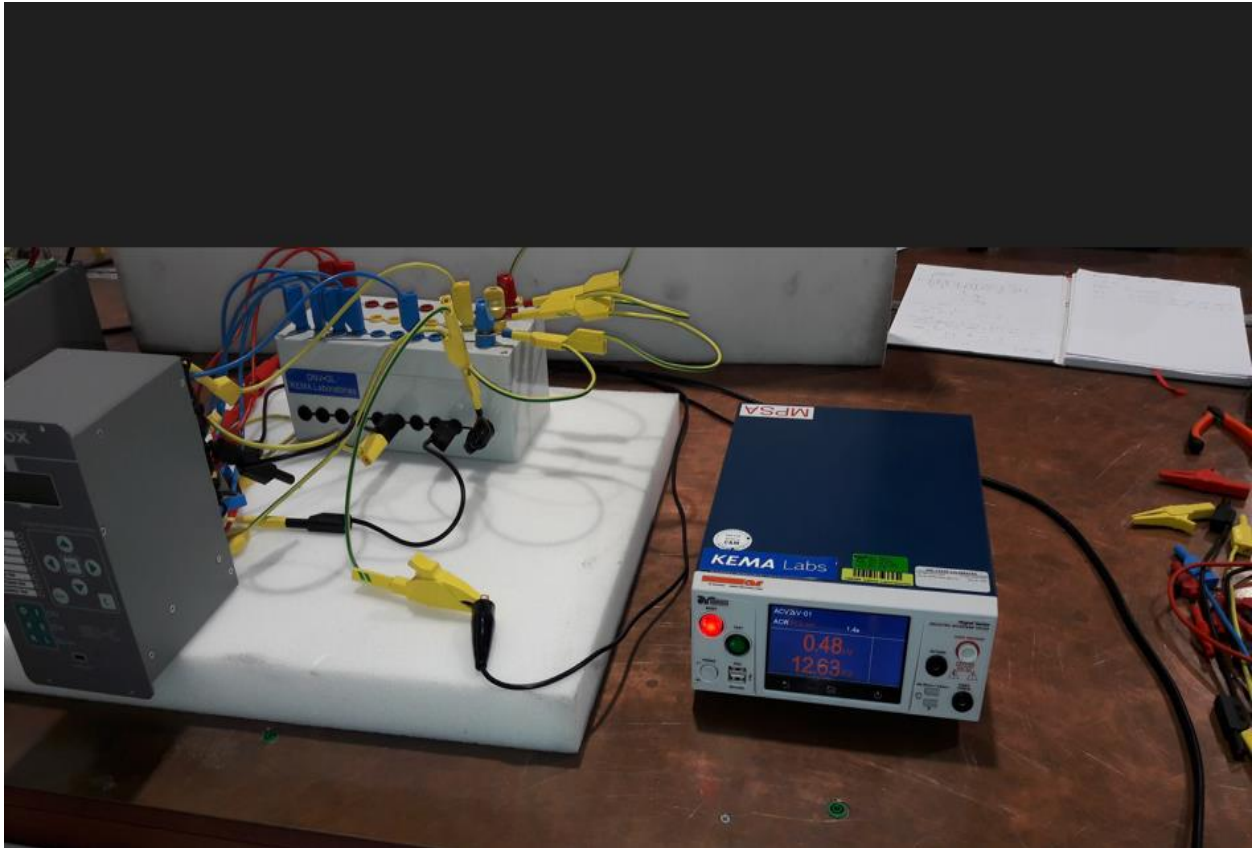
Requirement

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

Result

The object(s) passed the test.

Photograph of test arrangement



Test setup for SIU-C

8.4 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	August 24, 2022

Characteristic test data

Serial number (SIR-C)	22600008
Serial number (SIL-C)	22600004
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 : SIR-C

Position	Measurement between	PCB-ID : SIR-C	Rated insulation voltage or working voltage V	Clearance Required mm	Measured mm
1	VTs and Logic	Fuente/ Power supply board	300	3.00	≥ 3.20
2	Binary input and logic	In11-Out5- Com/ Interface board	300	3.00	≥ 3.24
3	RS485 and logic	In11-Out5- Com/ Interface board	300	3.00	≥ 3.33
4	Binary output and logic	In11-Out5- Com/ Interface board	300	3.00	≥ 5.15

Requirement

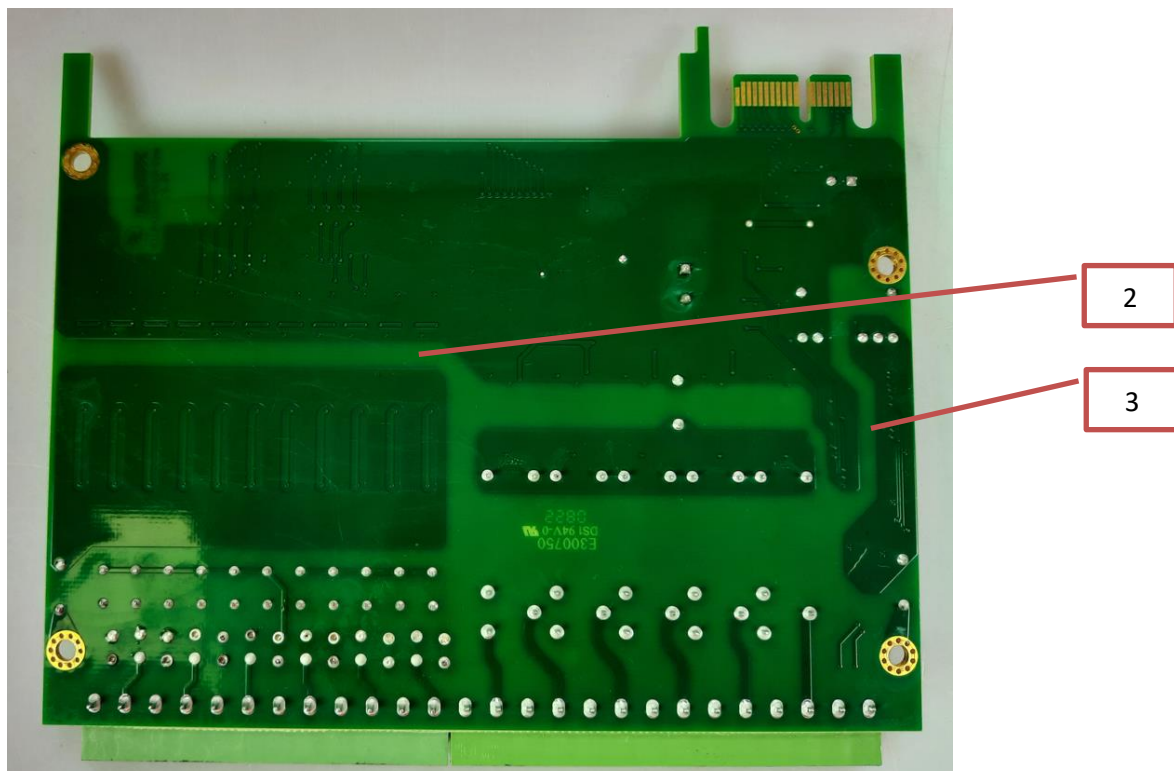
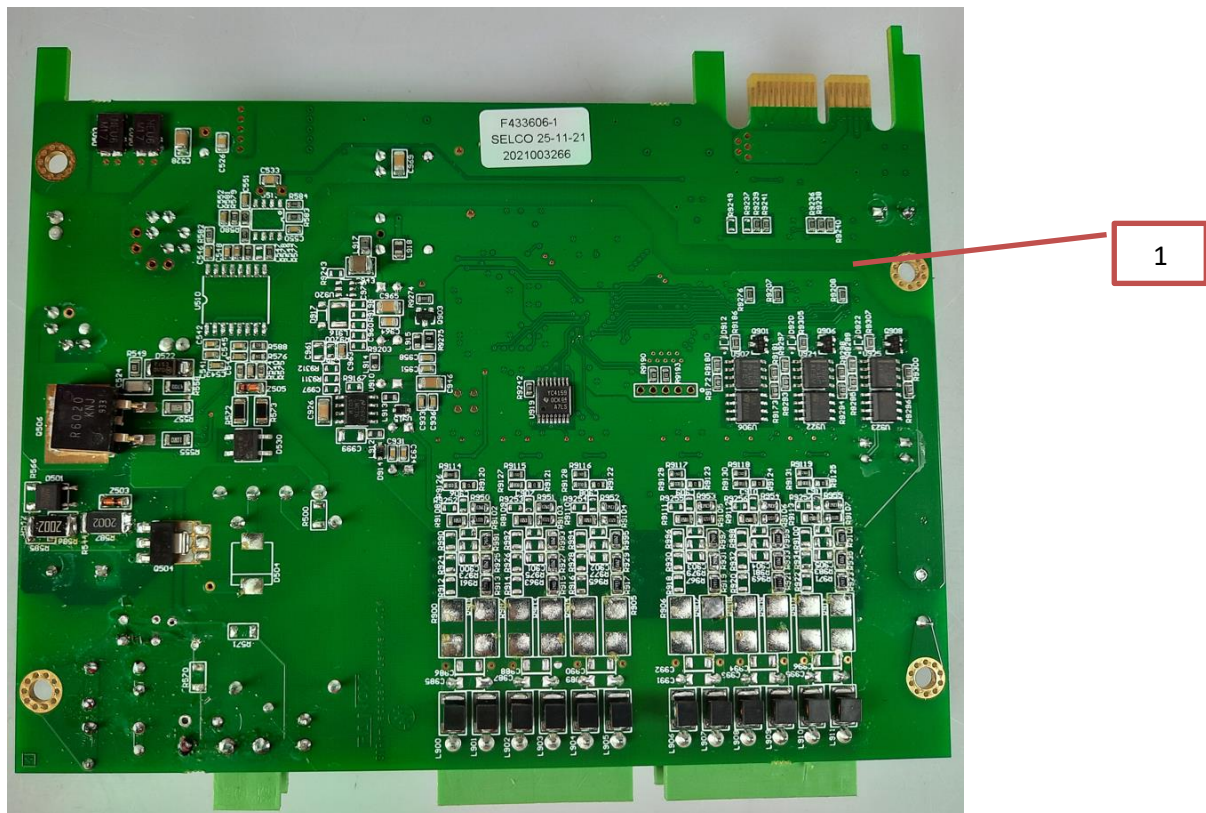
The test object shall meet the requirements for the applicable clearance and creepage distances according Annex C Table C.6.

Result

The object passed the test.

Photograph of creepage measurements

SIR - C



Creepage | SIL-C

Position	Measurement between	PCB-ID : SIL-C	Rated insulation voltage or working voltage V	Clearance Required mm	Measured mm
1	Power supply and VT circuit	In11-Out5- Com/ Interface board	300	3.06	≥ 5.15

Requirement

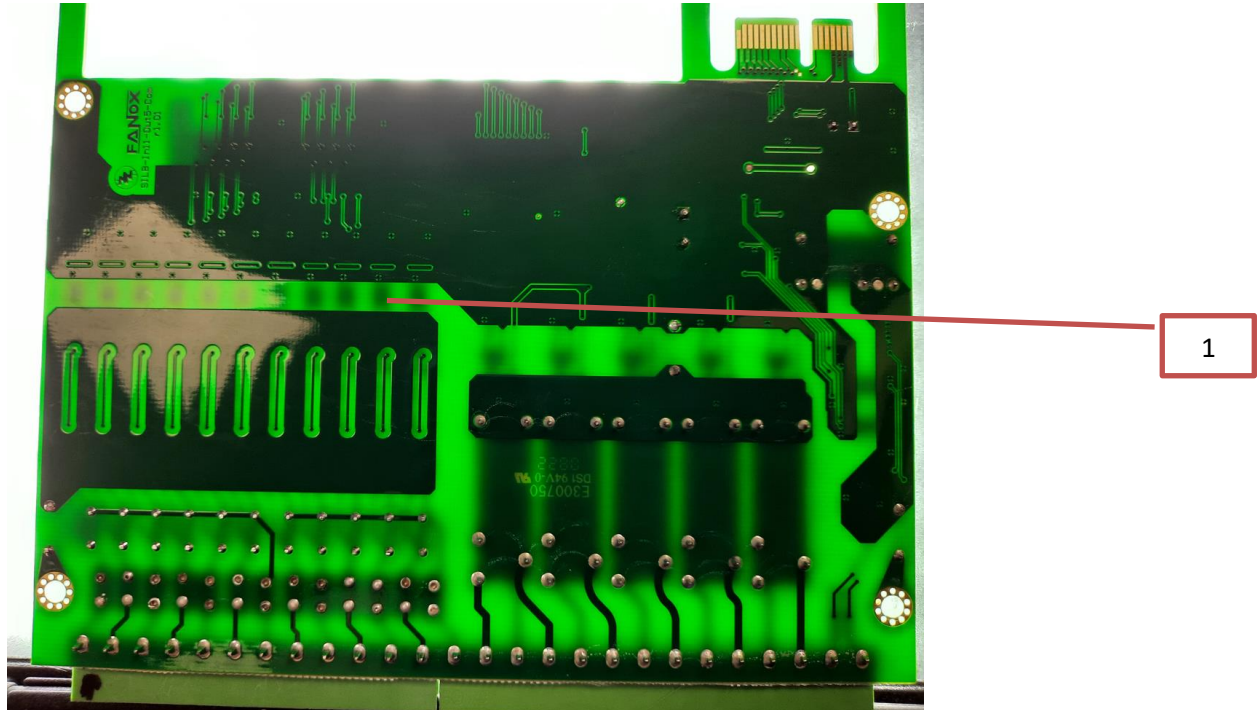
The test object shall meet the requirements for the applicable clearance and creepage distances according Annex C Table C.6.

Result

The object passed the test.

Photograph of creepage measurements

SIL - C



8.5 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 August 24, 2022

Characteristic test data

Serial number (SIL-C) 22600006
 Test voltage < 12 Vdc
 Test current 20 A
 Test duration 60 s

Test results of SIL-C

Test point ¹⁾	Measured against	Resistance m Ω
Test point 1	Protective Earth connection	9
Test point 2	Protective Earth connection	9

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



8.6 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	September 14, 2022

Characteristic test data

Serial number (SIL-C)	22600004
-----------------------	----------

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;

Module	Component	Make / Material	Article no. / Drawing / Document	Specified flammability	Required flammability
HMI	Front film	PET-based film	-	VTM-2	-
IO	Connector	Phoenix contact	1757077	V0	V-1
IO	Connector	Phoenix contact	1759130	V0	V-1
IO	Connector	Phoenix contact	1766149	V0	V-1
IO	Connector	Phoenix contact	1767041	V0	V-1
IO	Connector	Molex	74 Series	V0	V-1
IO	Connector	TE	1-1337543-0	-	V-1
Fire enclosure	Housing	Metal	-	-	V-1

Materials inside a fire enclosure;

Module	Component	Make / Material	Article no. / Drawing / Document	Specified flammability	Required flammability
Fire enclosure	Electronic components	Optocouplers	-	-	V-1
Fire enclosure	Electronic components	Varistor EPCOS	-	V0	V-1
Fire enclosure	Electronic components	Schaffner Choke	RN - series	V0	V-1
Fire enclosure	Electronic components	Safe PCB	-	V0	V-1
Fire enclosure	Electronic components	TE Relay PCB	RY-series	V0	V-1
Fire enclosure	Electronic components	Transformers PRAX	EDE / EDA	V0	V-1

Requirement

- 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.

8.7 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 September 22, 2022

Environmental conditions

Ambient temperature 19 °C

Characteristic test data

Serial number (SIL-C) 22600004

Circuit	Test	Observations
Power supply	Overload on TP500/ 501 (+5 VDC) circuit for 2 hours	1
	Short circuit on TP500/ 501 (+5 VDC) circuit	2
	Short circuit on secondary side	3

Observations

- 1 Normal functioning: temperature on T501 goes up to 120°C
- 2 Switched off directly
- 3 Goes defective: Q506 burns but non spread of fire; no risk of electrical shock

Requirement

- 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.

8.8 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	September 15, 2022

Characteristic test data

Serial number (SIL-C)	22600004
-----------------------	----------

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, rear, 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, rear, 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, rear, top, bottom, left side, right side	N/A no preset controls present on the test object	-
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	Symbol 14 present	It concerns the cover on the CT-terminal
Subclause 5.1.5.2.6 Wiring terminals which are normally not accessible shall be IP1X	Rear side	Wiring terminals comply with IP2x	A cover has been provided on the CT terminals

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.

8.9 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	September 19 and 20, 2022

Environmental conditions

Ambient temperature	20 °C
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Characteristic test data

Serial number (SIL-C)	22600004
Rated current	1 and 5 A
Frequency	50 Hz

Result of short time over-current

Terminal/pins	Applied current A	Test duration s	Observations
A1, A2	150	20	1,2
A5, A6	150	20	1,2
A7, A8	150	20	1,2
A1, A2	500	1	1,2
A5, A6	500	1	1,2
A7, A8	500	1	1,2

Observations

- 1 No fire hazard or electric shock risk occurred. Correct operation of the test object during and after the test.
- 2 No fire hazard or electric shock risk occurred. Correct operation of the test object after the test.

Measurement thermal with stand

Terminal/pins	Applied current A	Test duration hrs	Observations
A1, A2	20	4	1,2
A5, A6	20	4	1,2
A7, A8	20	4	1,2

Observations

- 1 No fire hazard or electric shock risk occurred. Correct operation of the test object during and after the test.
- 2 No fire hazard or electric shock risk occurred. Correct operation of the test object after the test.

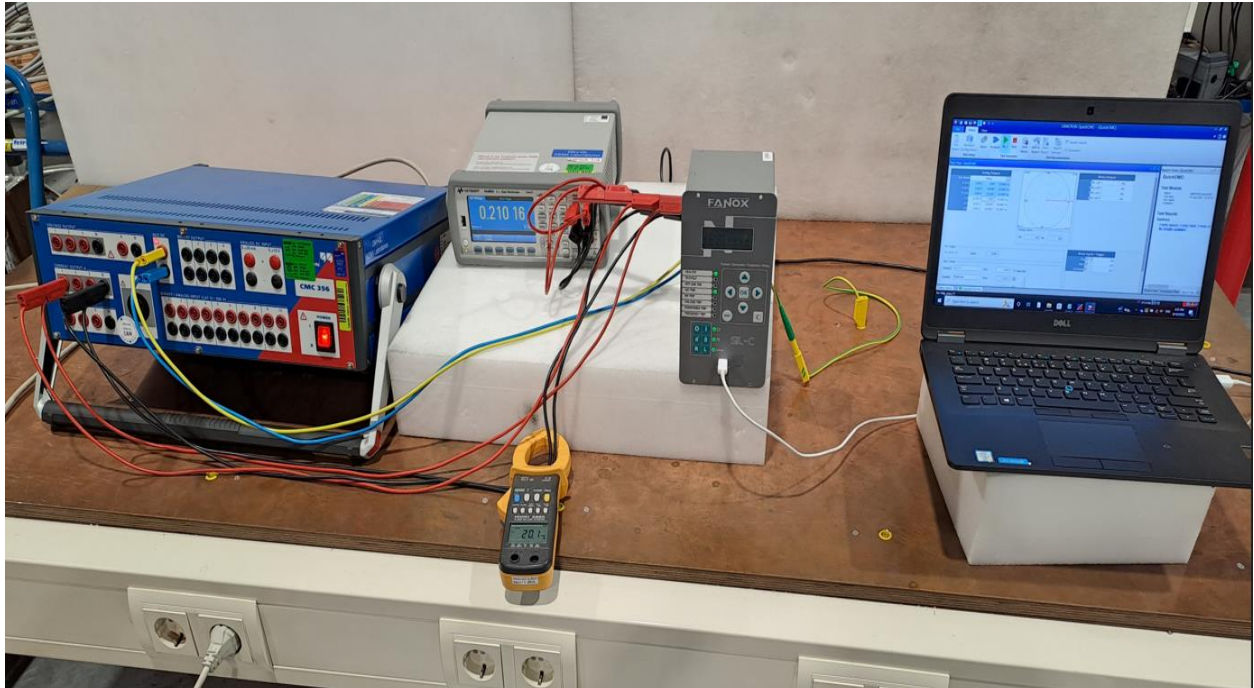
Requirement

- The equipment CT input circuits shall withstand overcurrent 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.

Photograph of test arrangement



Test setup for SIL-C

8.10 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	September 19 and 20, 2022

Environmental conditions

Ambient temperature	20 °C
---------------------	-------

Characteristic test data

Serial number (SIL-C)	22600006
Frequency	50 Hz
U _R (phase – phase, direct connection)	200-480 V
Thermal with stand specification	Continuously; 2 xU _R
Thermal with stand specification	10s; 2,4 x U _R

Result of continuous over-voltage

Terminal/pins	Applied voltage V	Test duration hrs	Observations
B3, B4	960	4	1,2
B7, B8	960	4	1,2
B9, B10	960	4	1,2

Observations

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

Result of short time over-voltage

Terminal/pins	Applied voltage V	Test duration s	Observations
B3, B4	1152	10	1,2
B7, B8	1152	10	1,2
B9, B10	1152	10	1,2

Observations

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

Measurement thermal with stand

Requirement

- The equipment VT input circuits shall withstand overvoltage 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.

Photograph of test arrangement



Test setup for SIL-C

8.11 Marking and documentation

Standard and date

Standard	IEC 60255-1, subclause 6.4
Basic standard	IEC 60255-27, subclause 9
Test date	August 17 and 18 and October 3 to 6, 2022

Test object serial number (SIL-C)

22600006

Documentation (SIL-C)

Version 1.03

Requirement

- The markings on the test object shall comply with the requirements of IEC 60255-27, subclause 9.1.
- The documentation of the test object shall comply with the requirements of IEC 60255-27, subclause 9.2.

Result

The object passed the test.

9 ENERGIZING QUANTITIES

9.1 Burden for current measuring input

Standard and date

Standard IEC 60255-1, subclause 6.10.2

Test date July 4, 2022

Characteristic test data

Serial number (SIL-C) 22600006

Rated input energizing current 1 A

Number of measurements 5 (issue maximum value)

Current transformers			Burden		Remarks
Circuit	Applied Input current Iac	Measured Input voltage mV	Calculated mVA	Specified mVA	
IA	1	7,016	0,007	0,015	
IB	1	6,670	0,007	0,015	
IC	1	7,051	0,007	0,015	
IN	1	7,887	0,008	0,015	
IA	5	35,775	0,179	0,375	
IB	5	32,790	0,164	0,375	
IC	5	31,072	0,155	0,375	
IN	5	38,475	0,192	0,375	

Result

The object passed the test.

9.2 Burden for voltage measuring input

Standard and date

Standard IEC 60255-1, subclause 6.10.1

Test date July 1, September 8 and 9, and October 24, 2022

Characteristic test data

Serial number (SIR-C) 22600009
 Serial number (SIL-C) 22600004
 Rated input energizing voltage (SIR-C) 8 V (LEA)
 Rated input energizing voltage (SIL-C) 100 –130 V (Phase-Phase)
 Number of measurements 5 (issue maximum value)

Voltage transformers			Burden		Remarks
Circuit	Applied Input voltage Vac	Measured Input current mA	Calculated mVA	Specified mVA	
SIL-C					
VA_BUS	130	0,11	14,30	70	
VB_BUS	130	0,11	14,30	70	
VC_BUS	130	0,11	14,30	70	
VR_BUS	130	0,11	14,30	70	
VB_LINE	130	0,11	14,30	70	

Voltage transformers			Burden		Remarks
Circuit	Applied Input voltage Vac	Measured Input current uA	Calculated mVA	Specified mVA	
SIR-C					
VA_BUS	8	7,83	0,063	0.064	
VB_BUS	8	7,84	0,063	0.064	
VC_BUS	8	7,88	0,063	0.064	
VA_LINE	8	7,83	0,063	0.064	
VB_LINE	8	7,67	0,061	0.064	
VC_LINE	8	7,69	0,062	0.064	

Result

The object passed the test.

9.3 Burden for power supply unit

Standard and date

Standard IEC 60255-1, subclause 6.10.4

Test date July 11, 2022

Characteristic test data

Serial number (SIL-C) 22600006
 Power input supply See table
 Load See table
 Number of measurements 5 (issue maximum value)
 Number of energized BI 3
 Number of energized BO 3

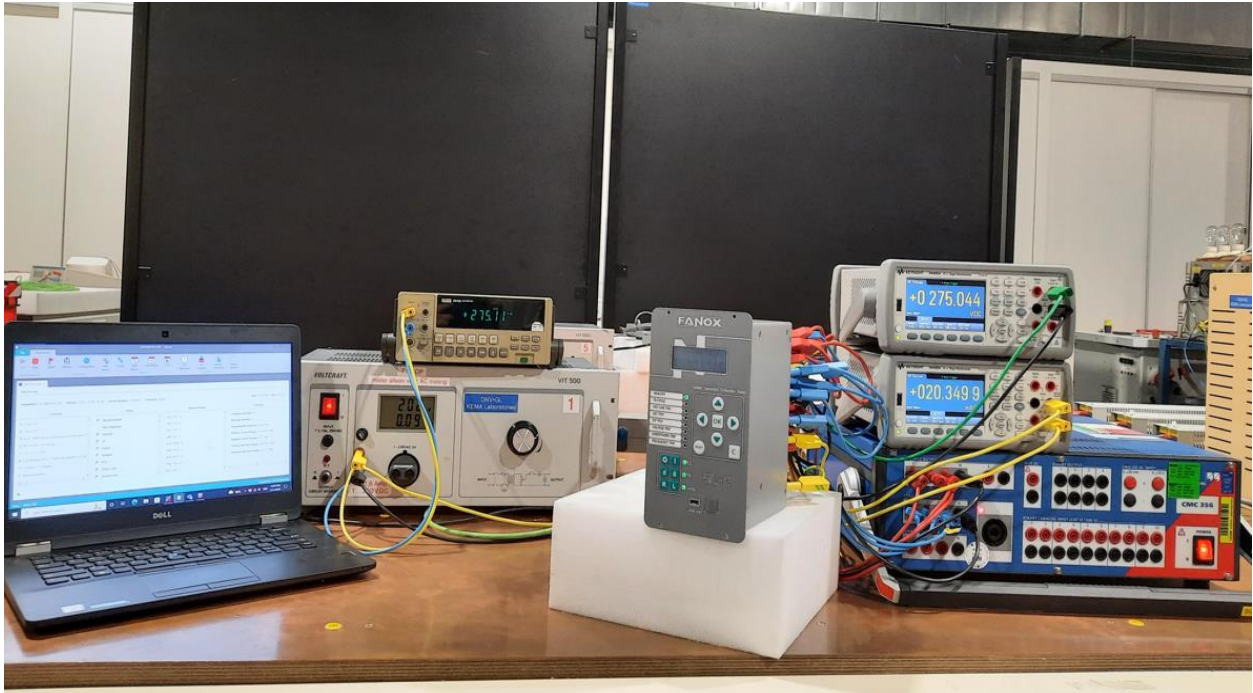
Power input voltage Vdc / load	Burden specified Maximum VA	Burden measured Maximum VA	Remarks
19.2 / quiescent	5,38	20	
19.2 / 50% loaded	6,34	20	
24 / quiescent	5,28	20	
24 / 50% loaded	6	20	
230 / quiescent	4,6	20	
230 / 50% loaded	4,6	20	
276 / quiescent	5,52	20	
276 / 50% loaded	5,52	20	

Power input voltage Vac / load	Burden specified Maximum VA	Burden measured Maximum VA	Remarks
85 / quiescent	10,20	20	
85 / 50% loaded	10,20	20	
100 / quiescent	11,00	20	
100 / 50% loaded	11,00	20	
230 / quiescent	11,50	20	
230 / 50% loaded	11,50	20	
264.5 / quiescent	10,58	20	
264.5 / 50% loaded	10,58	20	

Result

The object passed the test.

Photograph of test arrangement



Test setup for SIL-C

9.4 Burden for binary input

Standard and date

Standard IEC 60255-1, subclause 6.10.5

Test date July 20, 2022

Characteristic test data

Serial number (SIL-C)

22600006

Binary input supply

See table Vdc

Number of measurements

5 (issue maximum value)

Binary inputs		Burden		Remarks
Circuit	Input voltage Vac	Specified mVA	Measured mVA	
Binary input 1	24	< 50	11,76	
Binary input 1	230	< 500	223,1	
Binary input 7	24	< 50	10,08	
Binary input 7	230	< 500	174,8	

Binary inputs		Burden		Remarks
Circuit	Input voltage Vdc	Specified mVA	Measured mVA	
Binary input 1	24	< 20	10,08	
Binary input 1	230	< 200	174,8	
Binary input 7	24	< 20	10,08	
Binary input 7	230	< 200	174,8	

Result

The object passed the test

9.5 Inrush current power supply unit

Standard and date

Standard IEC 60255-1, subclause 6.10.3 AC power supply/6.10.4 DC power supply

Test date July 1 and 19, 2022

Characteristic test data

Serial number (SIL-C) 22600006

Number of measurements 5 (issue maximum value)

Power input voltage	Measured		Observations
	Peak current A	Time to 10% of quiescent current mS	
24Vdc	2,7	1,5	
230Vdc	36	1,4	
100Vac	7,42	1,08	
230Vac	5,2	6,2	

Requirement

According subclause 6.10.3/6.10.4 the peak value of the inrush current and the duration from switching instant to the instant that the current gets within 10% of the quiescent current shall be recorded.

Result

The object passed the test.

Photograph of test arrangement



Inrush current at 230 Vac



Inrush current at 24 Vdc

Photograph of test arrangement



Test setup for SIL-C

10 CONTACT PERFORMANCE

10.1 Inspection

10.1.1 Pre-inspection

The contact output(s) which will be subjected to the contact performance test has(have) been configured and checked for correct operation prior to the test.

10.1.2 Final inspection

After the contact performance tests a functional inspection is carried out. The tested relay contact(s) shall be functional.

10.2 Relay contact specification

The manufacturer shall state the following contact specifications for a non-tripping relay contact;

Parameter	Specified value
Contact voltage	250Vdc
Limited making capacity	250Vdc, 10A
Contact current continuous	5A
Contact current short duration	30A
Limited breaking capacity	250Vdc, 0.15A
Mechanical endurance unloaded	10,000
Mechanical endurance loaded	1,000

A relay tripping contact for controlling switchgear and control gear shall meet the specifications listed below;

Parameter	Required value
Contact voltage	250
Limited making capacity	≥ 1000 W at L/R = 40 ms
Contact current continuous	5 A
Contact current short duration	30 A, 200 ms on, 15 s off
Limited breaking capacity	≥ 30 W at L/R = 40 ms
Mechanical endurance unloaded	10000
Mechanical endurance loaded (making/breaking)	1000

Result

The object passed the test.

10.3 Mechanical endurance

Standard and date

Standard IEC 60255-1, subclause 6.11

Test date August 24, 2022

Characteristic test data

Serial number (SIL-C) 22600005

Contact tested BO4

Contact load no-load

Time between cycles s	Mechanical endurance		Observations
	Required	Tested	
1	10000 cycles	10000 cycles	-

Requirement

The tested relay contact(s) shall be functional after the test.

Result

The object passed the test.

10.4 Continuous contact current

Standard and date

Standard IEC 60255-1, subclause 6.11

Test date August 30, 2022

Characteristic test data

Serial number (SIL-C) 22600005

Contact	Duration h	Continuous contact current		Observations
		Required value A	Test value A	
BO4	2	≥ 5	5	-

Requirement

The tested relay contact(s) shall be functional after the test.

Result

The object passed the test.

10.5 Short duration contact current

Standard and date

Standard IEC 60255-1, subclause 6.11

Test date August 30, 2022

Characteristic test data

Serial number (SIL-C) 22600005

Contacts tested BO4

Contact voltage	Duration (on/off) s	Short duration contact current		Observations
		Required value	Test value	
Vdc		A	A	
250	0,2/15	≥ 30	30	-

Requirement

The tested relay contact(s) shall be functional after the test.

Result

The object passed the test.

10.6 Limiting making capacity

Standard and date

Standard IEC 60255-1, subclause 6.11

Test date September 1, 2022

Environmental conditions

Ambient temperature 21 °C

Characteristic test data

Serial number (SIL-C) 22600005

Contacts tested BO3

Contact voltage Vdc	Number of cycles	Limiting making capacity (at L/R = 40 ms)		Observations
		Required value W	Test value W	
250	1000	≥ 1000	1000	-

Requirement

The tested relay contact(s) shall be functional after the test.

Result

The object passed the test.

10.7 Limiting breaking capacity

Standard and date

Standard IEC 60255-1, subclause 6.11

Test date September 5, 2022

Characteristic test data

Serial number (SIL-C) 22600005

Contact voltage Vdc	Number of cycles	Limiting braking capacity (at L/R = 40 ms)		Observations
		Required value W	Test value W	
250	1000	≥ 37,5	37,5	-

Requirement

The tested relay contact(s) shall be functional after the test.

Result

The object passed the test.

11 ELECTROMAGNETIC COMPATIBILITY

11.1 Inspection

11.1.1 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.

11.1.2 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.

11.2 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	September 26, 2022

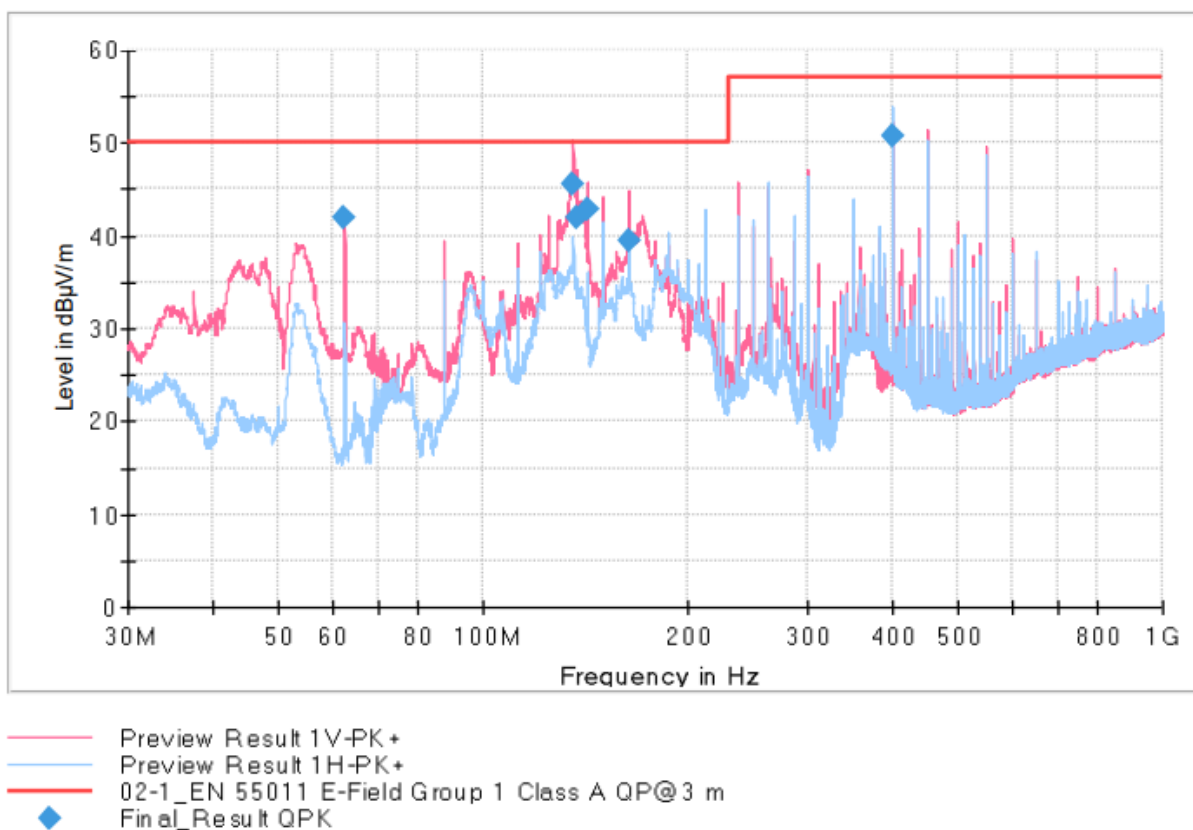
Characteristic test data

Serial number (SIL-C)	22600006
Serial number (SIR-C)	22600001
Power supply	24 – 230 Vdc 100 - 230 Vac

Pre-scans were done at other power supply voltage, and that 230 Vac is the worst-case.

SIL-C

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

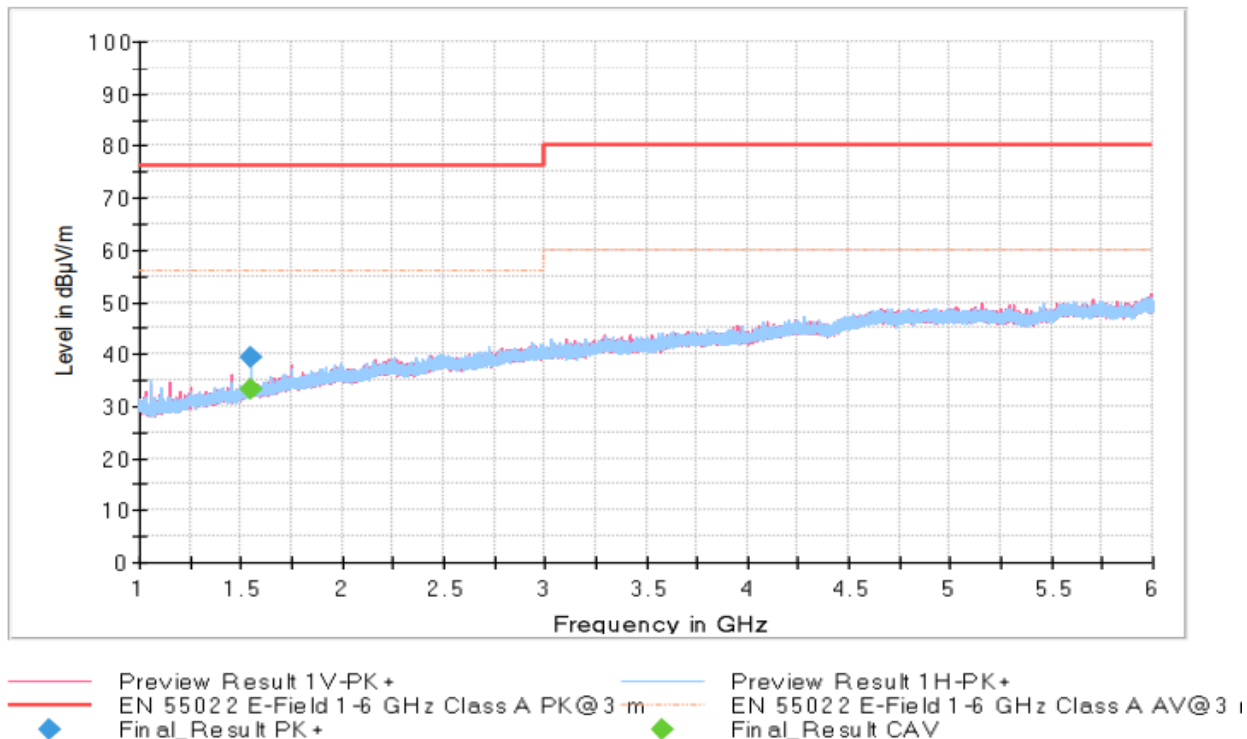


Final_Result (30 - 1000 MHz)

Frequency MHz	Level QP dBμV/m	Limit dBμV/m @ 3 m	Margin dB	Meas, Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg
62,490	42,00	50,00	8,00	3000	120	176,0	V	7,6
135,720	45,65	50,00	4,35	3000	120	100,0	V	10,8
137,490	42,04	50,00	7,96	3000	120	108,0	V	10,3
142,860	42,83	50,00	7,17	3000	120	104,0	V	9,7
164,280	39,37	50,00	10,63	3000	120	104,0	V	10,5
399,990	50,85	57,00	6,15	3000	120	100,0	H	16,4

SIL-C

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



Final_Result (1000 - 6000 MHz)

Frequency MHz	MaxPeak dBμV/m @ 3m	AV dBμV/m @ 3 m	Limit dBμV/m @ 3 m PK	Margin dB	Meas, Time ms	Bandwidth h kHz	Height cm	Pol	Azimuth deg
1550,00	-	33,16	-	-	2000	1000	195,0	H	133,0
1550,00	39,41	-	76,00	36,59	2000	1000	195,0	H	133,0

Requirement

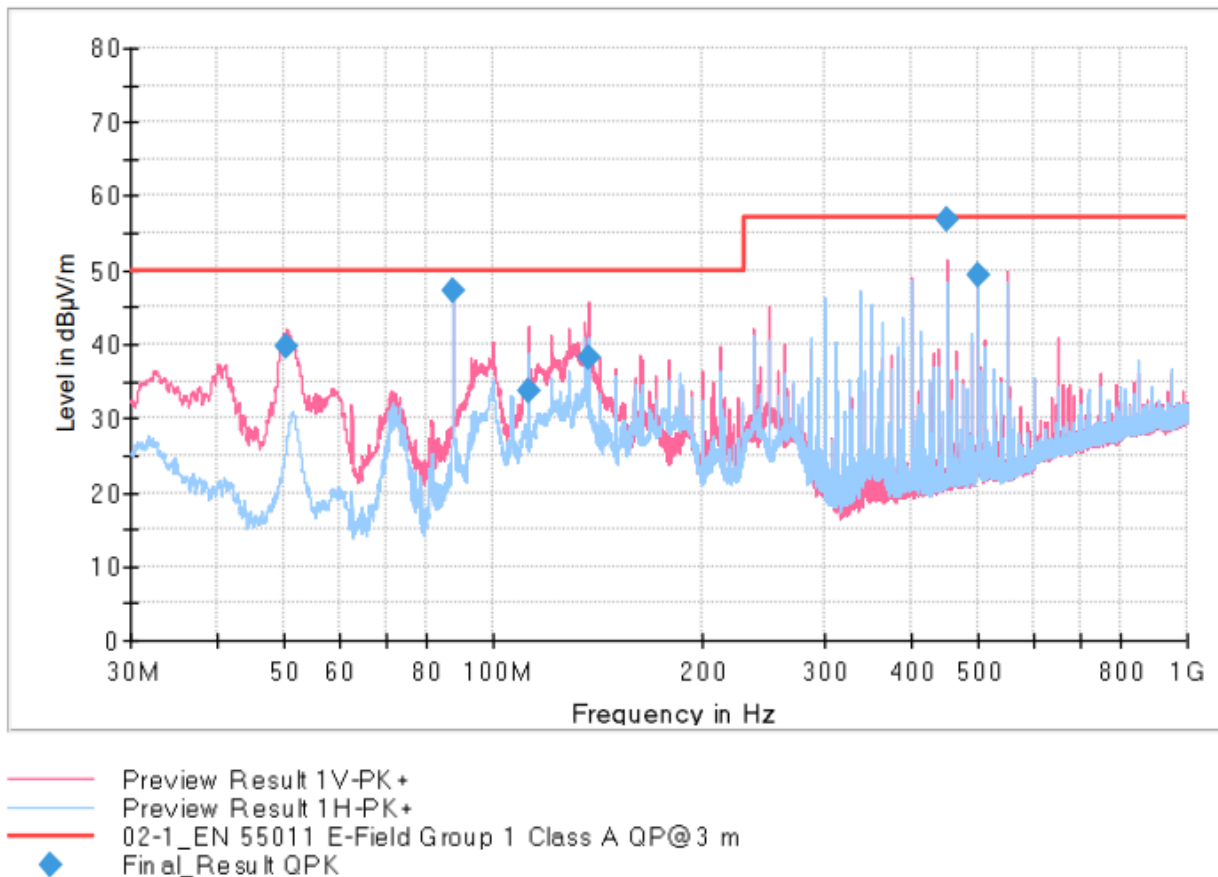
The radiated emission shall not exceed the limits specified in the standard CISPR 22 for class A equipment.

Result

The object passed the test.

SIR-C

Power supply voltage of @ 220Vdc with horizontal and vertical antenna polarization, in the frequency range 30 MHz – 1 GHz (red = vertical, blue = horizontal)

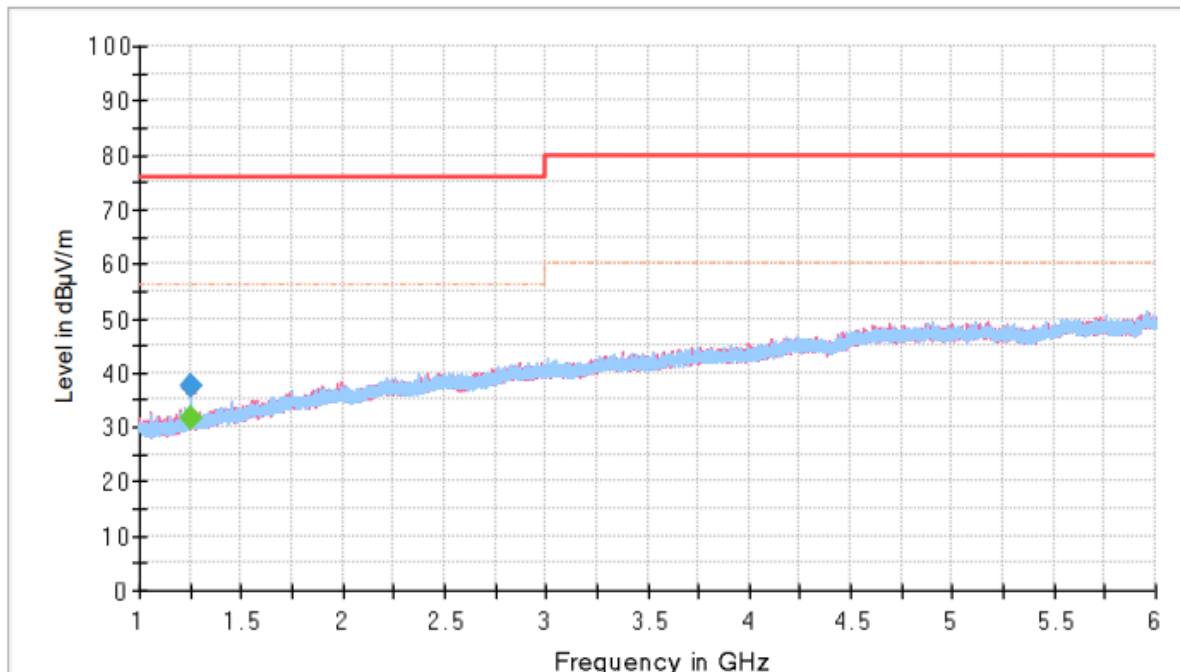


Final_Result (30 - 1000 MHz)

Frequency MHz	Level QP dBµV/m	Limit dBµV/m @ 3 m	Margin dB	Meas, Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg
50,460	39,79	50,00	10,21	3000	120	100	V	7,0
87,510	47,07	50,00	2,93	3000	120	396	H	10,1
112,500	33,70	50,00	16,30	3000	120	105	V	11,2
137,490	38,17	50,00	11,83	3000	120	104	V	10,3
450,00	56,88	50,00	0,12	3000	120	109	V	17,5
500,010	49,22	57,00	7,78	3000	120	223	V	18,9

SIR-C

Power supply voltage of @ 220Vdc with horizontal and vertical antenna polarization, in the frequency range 1 GHz – 6 GHz (red = vertical, blue = horizontal)



Preview Result 1V-PK+
 Critical_Freqs PK+
 EN 55022 E-Field 1-6 GHz Class A AV@3 m
 Final_Result CAV
 CAverage-CAV (Single)
 Preview Result 1H-PK+
 EN 55022 E-Field 1-6 GHz Class A PK@3 m
 Final_Result PK+
 MaxPeak-PK+ (Single)

Final_Result (1000 - 6000 MHz)

Frequency MHz	MaxPeak dBμV/m @ 3m	AV dBμV/m @ 3 m	Limit dBμV/m @ 3 m	Margin dB	Meas, Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg
1250,001	37,62	-	76,00	38,38	2000	1000	100	H	20
1250,001	-	31,48	-	-	2000	1000	100	H	20

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



Test setup radiated emission

11.3 Conducted emission

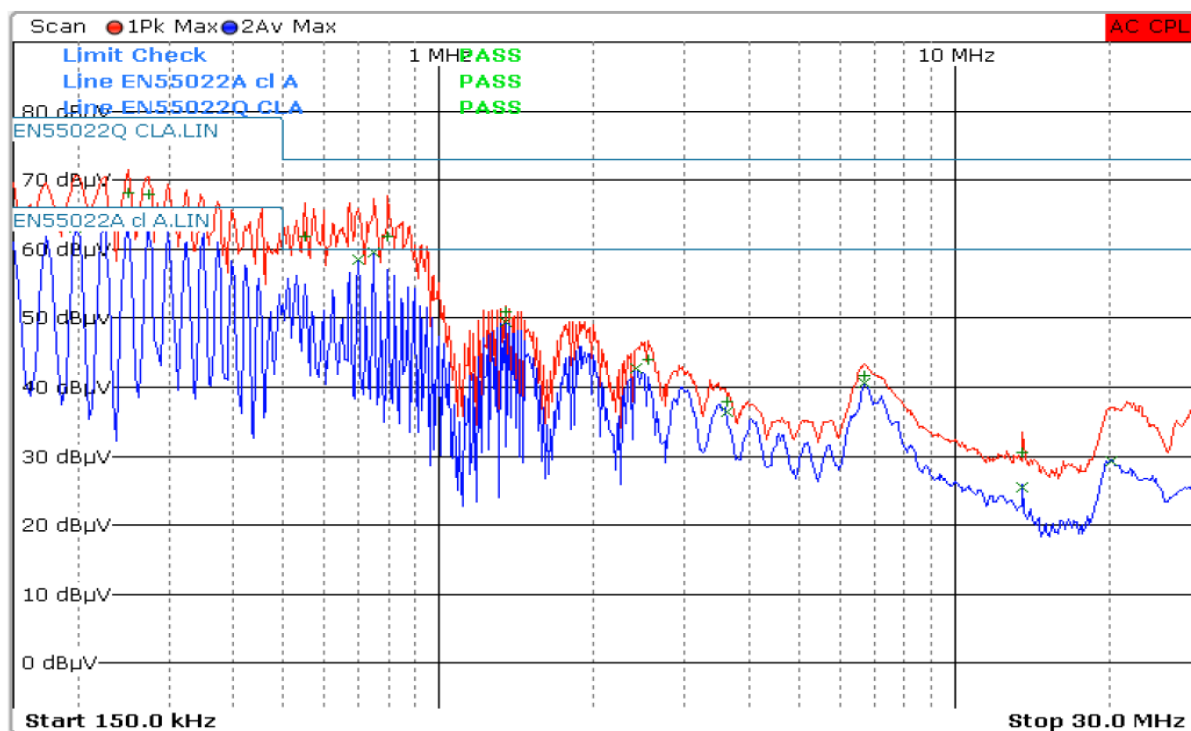
Standard and date

Standard	IEC 60255-1, subclause 6.15 / IEC 60255-26 subclause 5.2
Basic standard	CISPR 11, CISPR 22
Test date	May 26, 2022

Characteristic test data

Serial number	22600001
Power supply	24 – 230 Vdc
	100 – 230 Vac

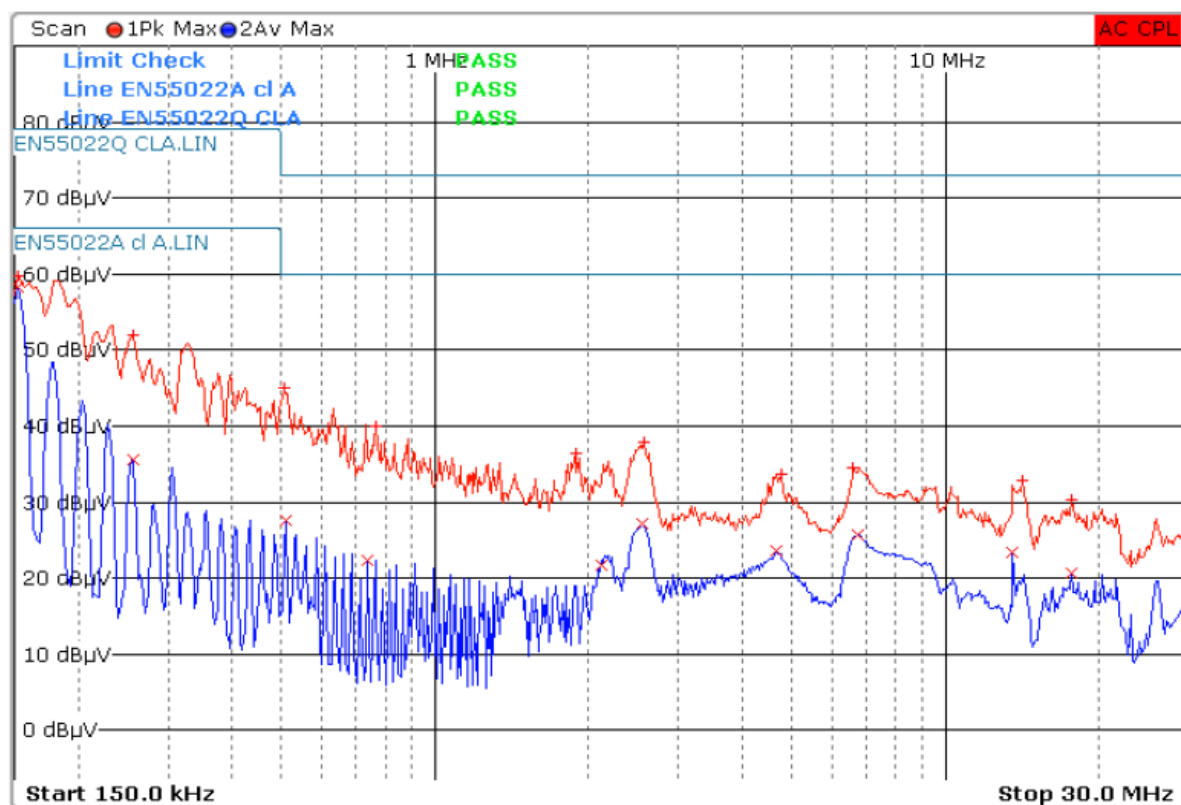
Power supply port with a power supply voltage of 100Vac



Final Result

Frequency MHz	Level dBμV	Phase	Detector	Delta limit dB
0,198	63,19	L1	Average	-2,81
0,250	68,10	L1	Quasi Peak	-10,90
0,274	68,00	L1	Quasi Peak	-11,00
0,274	64,02	L1	Average	-1,98
0,550	61,91	L1	Quasi Peak	-11,09
0,698	58,45	L1	Average	-1,55
0,746	59,44	L1	Average	-0,56
0,798	61,78	L1	Quasi Peak	-11,22
1,346	51,01	L1	Quasi Peak	-21,99
1,346	49,37	L1	Average	-10,63
2,418	42,80	L1	Average	-17,20
2,542	44,00	L1	Quasi Peak	-29,00
3,614	37,97	L1	Quasi Peak	-35,03
3,614	36,42	L1	Average	-23,58
6,682	41,73	N	Quasi Peak	-31,27
6,706	40,67	N	Average	-19,33
13,562	30,57	N	Quasi Peak	-42,43
13,562	25,52	N	Average	-34,48
20,142	29,32	L1	Average	-30,68
29,982	34,72	N	Quasi Peak	-38,28

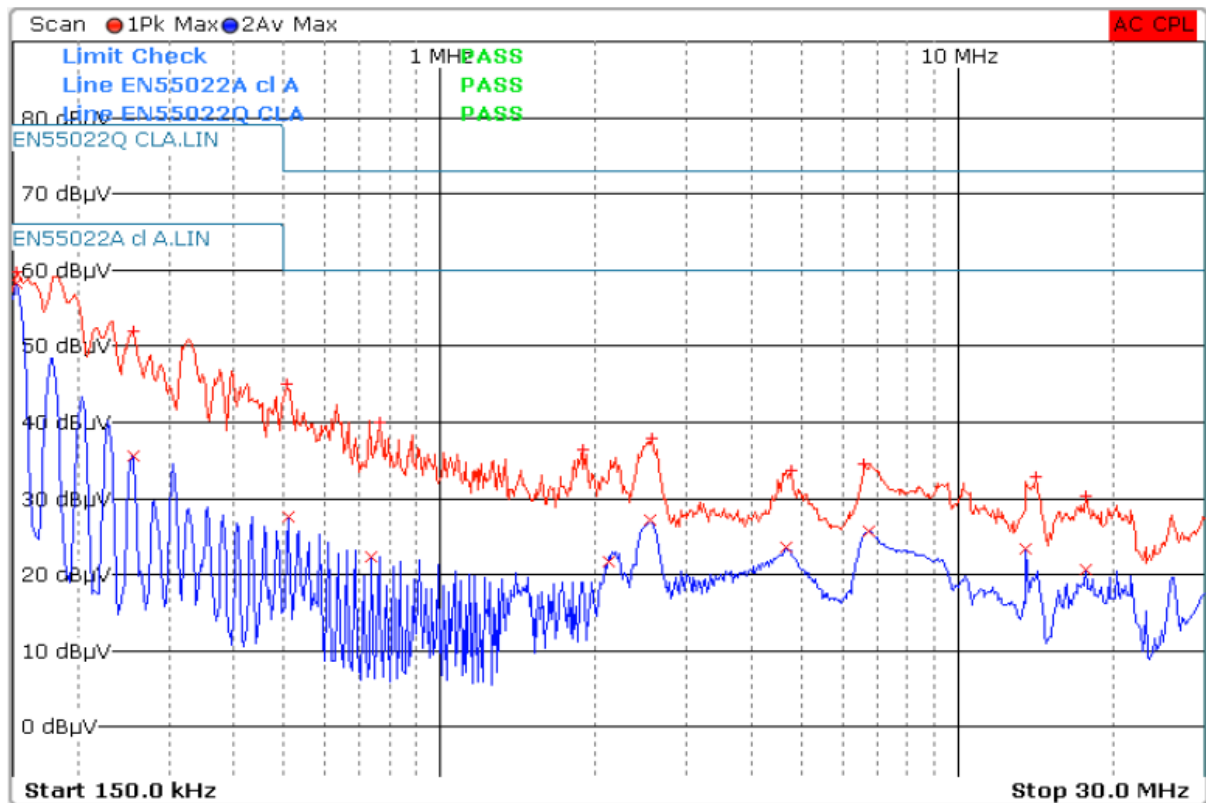
Power supply port with a power supply voltage of 230Vac



Final_Result

Frequency MHz	Level dBμV	Phase	Detector	Delta limit dB
0,155	39,07	N	Average	-26,93
0,158	55,11	N	Quasi Peak	-35,32
0,258	43,68	N	Quasi Peak	-35,32
0,406	31,83	L1	Average	-34,17
0,678	41,31	L1	Quasi Peak	-31,69
0,714	37,09	L1	Average	-22,91
0,762	37,02	L1	Average	-22,68
0,902	41,02	L1	Quasi Peak	-31,98
1,782	39,48	L1	Quasi Peak	-33,52
1,782	38,95	L1	Average	-21,05
2,902	39,26	L1	Quasi Peak	-33,74
2,902	38,76	L1	Average	-21,24
4,098	38,24	L1	Average	-21,76
5,218	38,93	L1	Quasi Peak	-34,07
6,466	44,45	L1	Quasi Peak	-28,55
6,466	43,92	L1	Quasi Peak	-16,08
10,946	32,38	L1	Average	-27,62
17,134	31,89	N	Quasi Peak	-41,11
21,130	44,14	N	Quasi Peak	-28,86
21,990	34,25	N	Average	-25,75

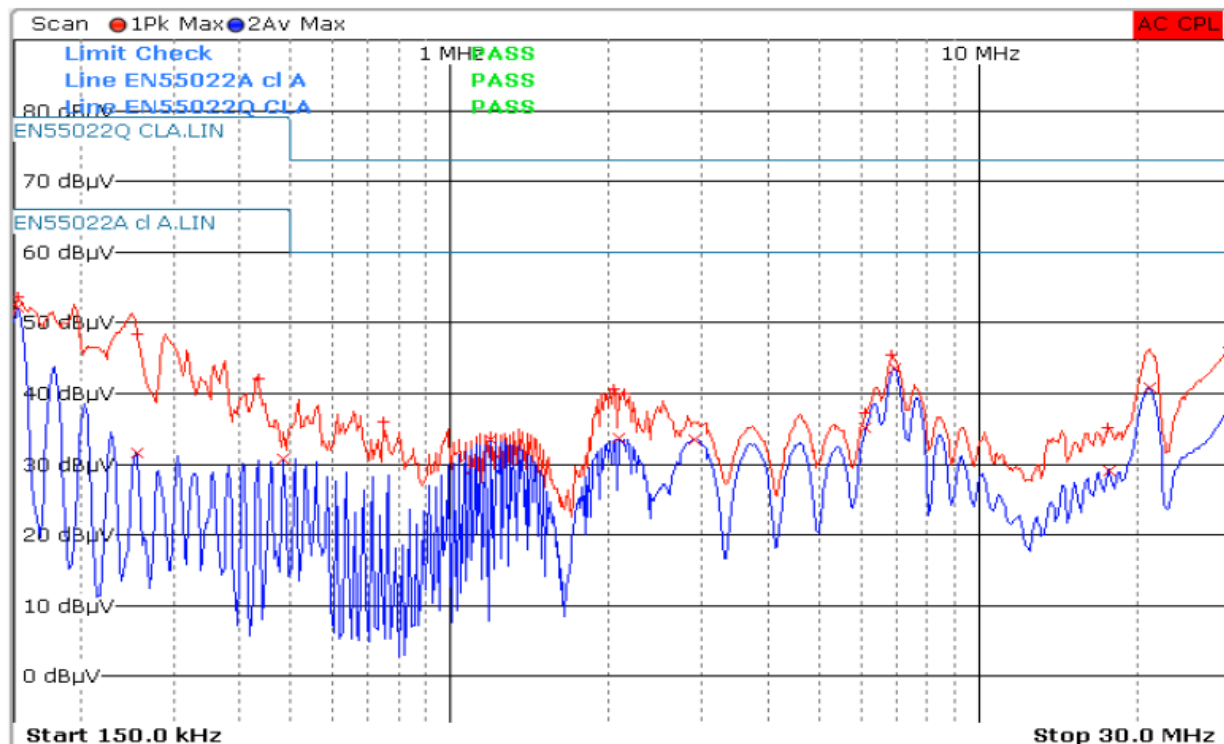
Power supply port with a power supply voltage of 24Vdc



Final_Result

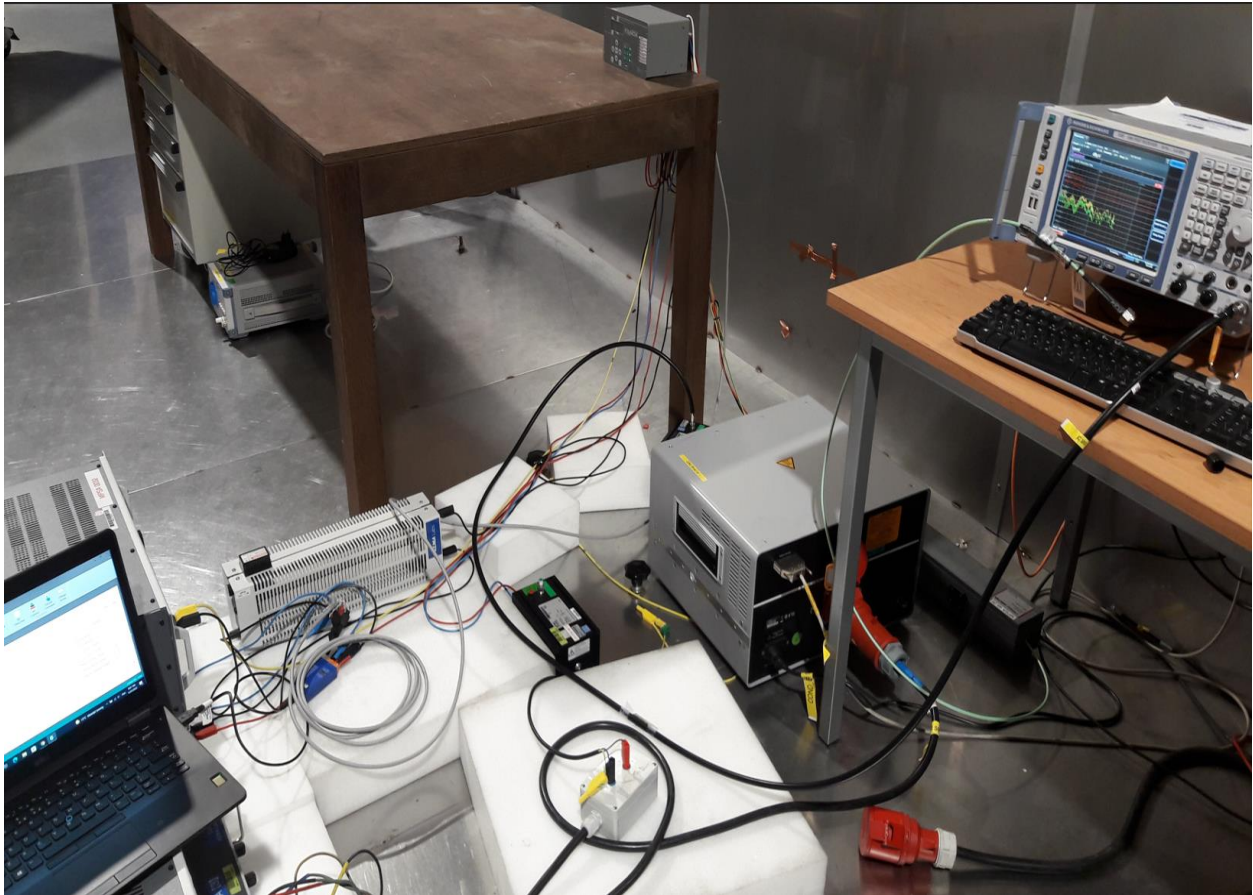
Frequency MHz	Level dBμV	Phase	Detector	Delta limit dB
0,152	59,72	L1	Positive Peak	-19,28
0,152	58,25	N	Average	-7,75
0,255	52,00	L1	Positive Peak	-27,00
0,255	52,00	N	Average	-30,00
0,507	35,00	L1	Positive Peak	-27,99
0,510	45,01	L1	Average	-32,65
0,737	27,65	L1	Average	-32,35
0,766	22,35	L1	Positive Peak	-36,63
1,887	40,09	L1	Positive Peak	-38,87
2,116	36,37	N	Average	-32,76
2,541	21,63	N	Average	-35,06
2,562	27,24	N	Positive Peak	-36,33
4,659	37,94	N	Average	-39,21
4,782	27,24	N	Positive Peak	-23,58
6,591	34,64	L1	Positive Peak	-36,33
6,744	25,62	L1	Average	-34,38
13,560	23,34	N	Average	-36,66
14,151	32,85	L1	Postive Peak	-40,15
17,693	30,29	N	Postive Peak	-42,71
17,693	20,73	N	Average	-39,27

Power supply port with a power supply voltage of 230Vdc



Final_Result

Frequency MHz	Level dBμV	Phase	Detector	Delta limit dB
0,152	53,58	N	Positive Peak	-25,42
0,152	58,24	N	Average	-13,76
0,255	48,33	N	Positive Peak	-30,67
0,255	31,59	N	Average	-34,41
0,433	42,19	N	Positive Peak	-36,81
0,433	30,83	L1	Average	-35,17
0,750	33,45	L1	Positive Peak	-37,03
1,196	40,71	N	Average	-26,55
2,035	33,68	L1	Positive Peak	-32,29
2,087	40,07	N	Average	-26,32
2,139	33,56	L1	Positive Peak	-32,93
2,901	37,23	N	Average	-26,44
6,110	35,12	N	Positive Peak	-35,77
6,110	45,12	L1	Average	-24,88
6,848	45,50	L1	Positive Peak	-27,50
6,949	43,61	N	Average	-16,39
17,569	35,11	N	Positive Peak	-37,89
17,641	29,07	N	Average	-30,93
21,052	40,84	N	Average	-19,16
29,782	46,50	N	Positive Peak	-26,50

Photograph of test arrangement

Test setup for SIR-C

11.4 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 June 17 and August 11, 2022

Environmental conditions

Ambient temperature 19,7 °C
 Relative humidity 62,8 %
 Air pressure 19,7 hPa

Characteristic test data

Serial number 22600006
 Power supply 24 - 230 Vdc

Discharge type	Test level	Test points	Polarity	Observations
SIL-C	kV			
Air	2, 4, 8, 15	Display and bottoms	+ and -	2
Contact	2, 4, 6, 8	Screws	+ and -	1
Indirect contact	2, 4, 6, 8	VCP right of object	+ and -	1
		HCP under object	+ and -	1

Characteristic test data

Serial number 22600002
 Power supply 24 - 230 Vdc

Discharge type	Test level	Test points	Polarity	Observations
SIR-C	kV			
Air	2, 4, 8, 15	Display and bottoms	+ and -	2
Contact	2, 4, 6, 8	Screws	+ and -	1
Indirect contact	2, 4, 6, 8	VCP right of object	+ and -	1
		HCP under object	+ and -	1

Note

Additional tests, not required by the standard; level 8kV (contact) and 15kV (Air).

Observations

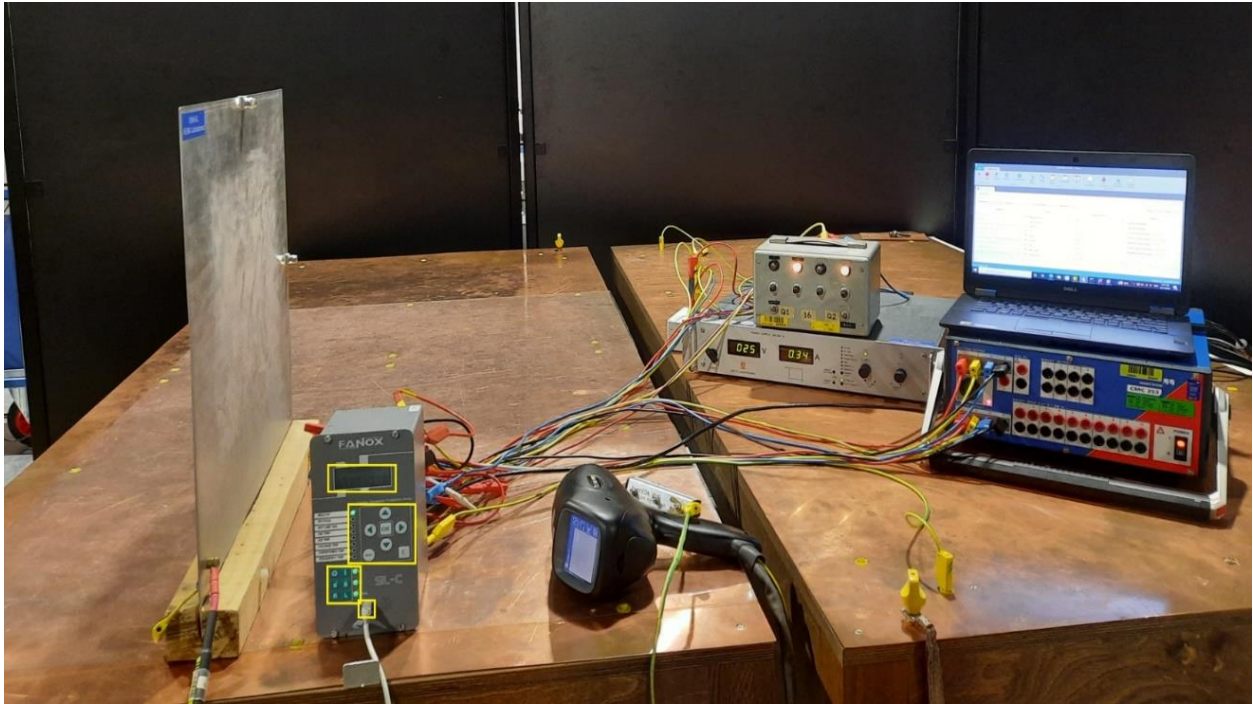
1. No degradation of performance observed during and after the test.
2. Degradation of performance observed during the test 8kV (AD) and 15kV (AD); LCD getting the dark monitor and then the equipment was recovered to normal operation.

Requirement

- 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

Test setup for SIL-C

11.5 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	September 29, 2022

Characteristic test data

Serial number(SIR-C)	22600001
Serial number (SIU-C)	22600008
Amplitude modulated	80 % AM (1 kHz)
Dwell time frequency sweep	1.0 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	≤ 1%	80 – 1000	-
			1400 – 2700	-
y side of EUT (horizontal & vertical polarization)	10	≤ 1%	80 – 1000	-
			1400 – 2700	-
z side of EUT (horizontal & vertical polarization)	10	≤ 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	-

Requirement

- 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



11.6 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	May 25 and 27 and October 10, 2022

Characteristic test data

Serial number(SIR-C)	22600001
Serial number (SIU-C)	22600008
Polarity	Positive/negative
Test duration	1 minute
Burst duration	15 ms
Burst period	300 ms
Rise time	5 ns
Pulse width	50 ns

Zone A

Circuit/Port SIR-C	Terminals	Coupling	Test voltage kV	Repetition Frequency kHz	Observations
Power supply port	B1,B2	CM (CDN)	4	5	-
Voltage input port: (BUS) VA, VB, VC	B9 - B14	CM (CDN)	4	5	-
Voltage input port: (LEAR) VA, VB, VC	B3 - B8	CM (CDN)	4	5	-
Current input port: IA, IB, IC, IN	A1 – A8	CM (CDN)	4	5	-
Ethernet port	G4	CM (CCC)	2	5	-
RS485	C25,C26	CM (CCC)	2	5	-
Irig-B	G8	CM (CCC)	2	5	-
Binary input : In1 ON	C1, C7	CM (CCC)	4	5	-
Binary input : In2 OFF	C2, C7	CM (CCC)	4	5	-
Binary input : In6 OFF	C6, C7	CM (CCC)	4	5	-
Binary input : In7 ON	C8, C13	CM (CCC)	4	5	-
Binary input: In8 OFF	C9, C13	CM (CCC)	4	5	-
Binary input : In9 OFF	C10, C13	CM (CCC)	4	5	-
Binary output 1	C15, C16	CM (CCC)	4	5	-
Binary output 2	C17,C18	CM (CCC)	4	5	-
Binary output 5	C23,C24	CM (CCC)	4	5	-

Note

CM = Common Mode

CDN = Coupling-Decoupling Network

CCC = Capacitive Coupling Clamp

Circuit/Port	Terminals	Coupling	Test voltage kV	Repetition Frequency kHz	Observations
SIR-U					
Power supply port	B1,B2	CM (CDN)	4	5	-
Voltage input port: VA, VB, VC	B9 - B14	CM (CDN)	4	5	-
Voltage input port: VB	B9 – B10	CM (CDN)	4	5	-
Voltage input port: VR	B11 – B12	CM (CDN)	4	5	-
RS485	C25,C26	CM (CCC)	2	5	-
Binary input : In1 ON	C1, C7	CM (CCC)	4	5	-
Binary input : In4 OFF	C4, C7	CM (CCC)	4	5	-
Binary input : In7 ON	C8, C13	CM (CCC)	4	5	-
Binary output 1	C15, C16	CM (CCC)	4	5	-
Binary output 2	C17,C18	CM (CCC)	4	5	-
Binary output 5	C23,C24	CM (CCC)	4	5	-

Note

CM = Common Mode

CDN = Coupling-Decoupling Network

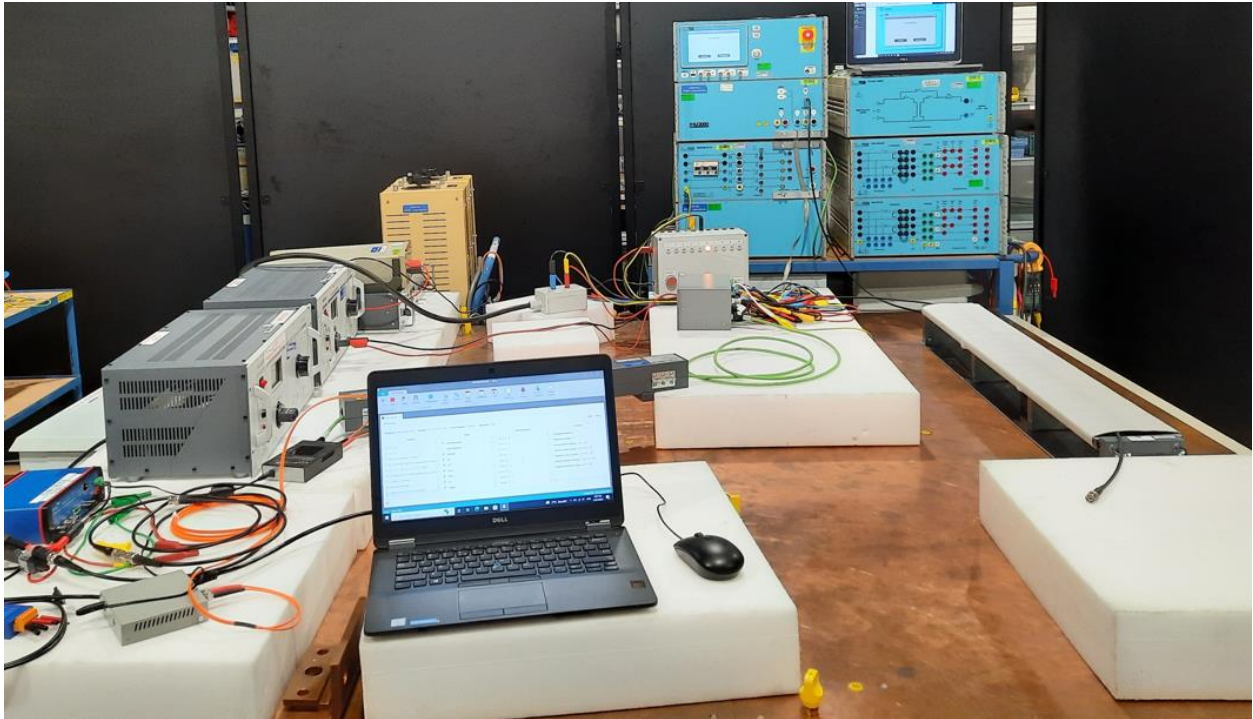
CCC = Capacitive Coupling Clamp

Requirement

- 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

Test setup for SIR-C

11.7 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	May 17 to 23, 2022

Characteristic test data

Serial number (SIR-C)	22600008
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
Burst duration	>2 S

Circuit SIR-C	Terminals	Coupling	Test voltage KV	Observation
Power supply port (24VDC)	B1, B2	CM	2,5	1
		DM	1,0	1
Voltage input port: (VT Bus) VA, VB, VC	B9 - B14	CM	2,5	1
		DM	1,0	1
Voltage input port: (VT Line) VA, VB, VC	B3 - B8	CM	2,5	1
		DM	1,0	1
Current input port: (CT) IA, IB, IC	A1 - A6	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In1	C1, C7	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In2	C2, C7	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In5	C5, C7	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In7	C8, C14	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In9	C10, C14	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In11	C112 C13	CM	2,5	1
		DM	1,0	1
Binary output port: Output1	C15, C16	CM	2,5	1
		DM	1,0	1
Binary output port: Output2	C17, C18	CM	2,5	1
		DM	1,0	1
Binary output port: Output4	C21, C22	CM	2,5	1
		DM	1,0	1
Binary output port: Output5	C23, C24	CM	2,5	1
		DM	1,0	1
Ethernet port	G4	CM ¹	1,0	1
		CM ¹	2,5	1
RS485	C25, C26	CM ¹	1,0	1
		CM ¹	2,5	1
IRIG-B	G8	CM ¹	1,0	1
		CM ¹	2,5	1

Note

CM = Common Mode

DM = Differential mode

¹⁾ Injected on the shield

Circuit SIU-C	Terminals	Coupling	Test voltage KV	Observations
Power supply port (24VDC)	B1, B2	CM	2,5	1
		DM	1,0	1
VT BUSBAR: VA, VB, VC	B3 – B8	CM	2,5	1
		DM	1,0	1
VT LINE: VA	B11, B12	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In1	C1, C7	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In5	C5, C7	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In7	C8, C14	CM	2,5	1
		DM	1,0	1
Binary output port: Output1 (Digital)	C15, C16	CM	2,5	1
		DM	1,0	1
Binary output port: Output2 (In1,2,3 ON)	C17, C18	CM	2,5	1
		DM	1,0	1
Binary output port: Output4	C21, C22	CM	2,5	1
		DM	1,0	1
Ethernet port	G4	CM ¹	1,0	1
		CM ¹	2,5	1
RS485	C25, C26	CM ¹	1,0	1
		CM ¹	2,5	1
IRIG-B	G8	CM ¹	1,0	1
		CM ¹	2,5	1

Note

CM = Common Mode

DM = Differential mode

¹⁾ Injected on the shield.

Observations

1. No degradation of performance observed during and after the test.

Requirement

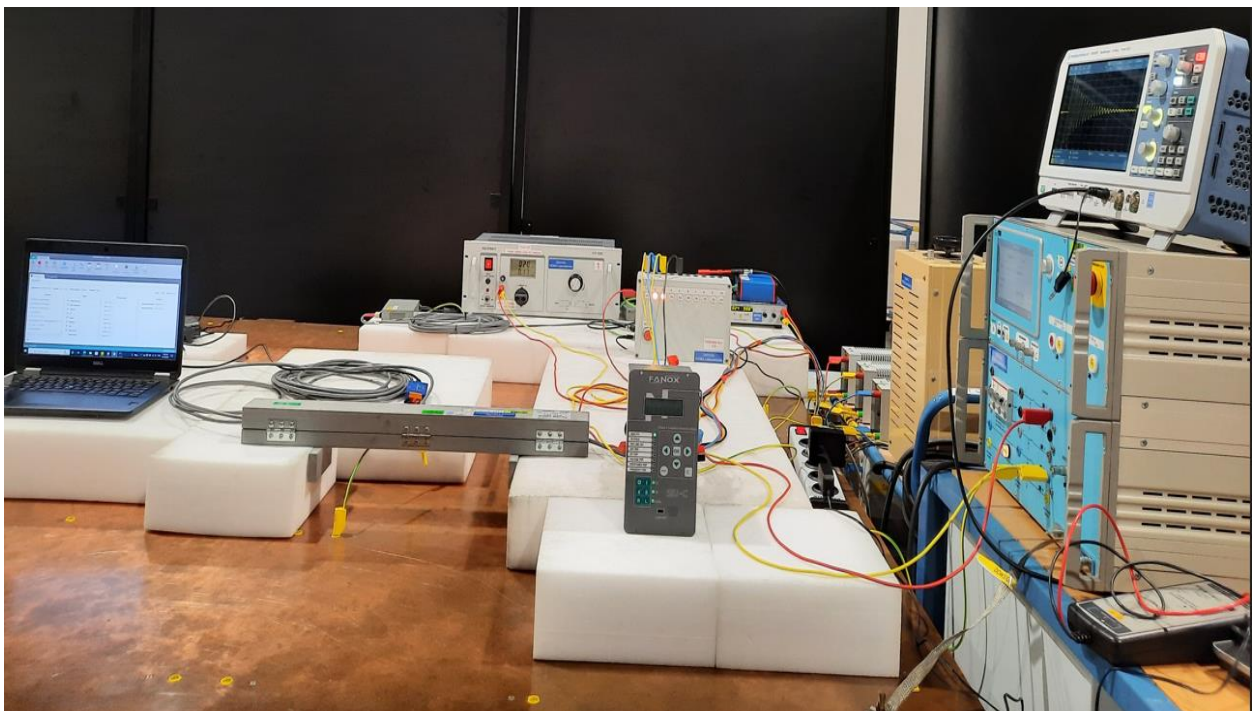
- The object shall comply with acceptance criteria B of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test

Photograph of test arrangement

Test setup for SIR-C



Test setup for SIL-C

11.8 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	May 30 and 31 and August 2, 2022

Characteristic test data

Serial number (SIR-C)	22600001
Serial number (SIU-C)	22600007
Source impedance	2 Ω
Front time (voltage)	1,2 μs
Time to half value (voltage)	50 μs
Front time (current)	8 μs
Time to half value (current)	20 μs
Auxiliary power supply port	
Coupling capacitor	9 / 18 μF
Coupling resistor	0 / 10 Ω
Input and output ports	
Coupling resistor	40 Ω
Coupling capacitor	0,5 μF

Circuit SIR-C	Terminals	Coupling	Test voltage kV	Observations
Power port: (220Vac)	B1, B2	LL	0,5/1/2	-
		LE	1/2/4	-
Power port: (24Vdc)	B1, B2	LL	0,5/1/2	-
		LE	1/2/4	-
Voltage input: BUS: C	B9 - B14	LL	0,5/1/2	-
		LE	1/2/4	-
Voltage input: LEAR: B	B5, B6	LL	0,5/1/2	-
		LE	1/2/4	-
Current input: Phase: A	A1, A2	LL	0,5/1/2	-
		LE	1/2/4	-
Current input: Phase: N	A7, A8	LL	0,5/1/2	-
		LE	1/2/4	-
Ethernet port	G4	LL	-	N/A
		LE	1/2/4 ¹⁾	-
RS485	C25, C26	LL	-	N/A
		LE	1/2/4 ¹⁾	-
Irig-B	G8	LL	0,5/1/2	-
		LE	1/2/4	-
Binary input : In2	C2, C7	LL	0,5/1/2	-
		LE	1/2/4	-
Binary input : In7	C8, C13	LL	0,5/1/2	-
		LE	1/2/4	-
Binary output 2	C17, C18	LL	0,5/1/2	-
		LE	1/2/4	-
Binary output 5	C23, C24	LL	0,5/1/2	-
		LE	1/2/4	-

Note
¹⁾ Direct injection on the shield.

Circuit SIU-C	Terminals	Coupling	Test voltage (kV)	Observations
Power port: (220Vac)	B1 ,B2	LL	0,5/1/2	-
		LE	1/2/4	-
Power port: (24Vdc)	B1, B2	LL	0,5/1/2	
		LE	1/2/4	
Voltage input: BUS	B3, B4	LL	0,5/1/2	-
		LE	1/2/4	-
RS485	C25, C26	LL	-	N/A
		LE	1/2/4 ¹⁾	
Binary input : In1	C1, C7	LL	0,5/1/2	-
		LE	1/2/4	-
Binary input : In7	C8, C13	LL	0,5/1/2	-
		LE	1/2/4	-
Binary output 2	C17, C18	LL	0,5/1/2	-
		LE	1/2/4	-
Binary output 4	C21, C22	LL	0,5/1/2	-
		LE	1/2/4	-

Note

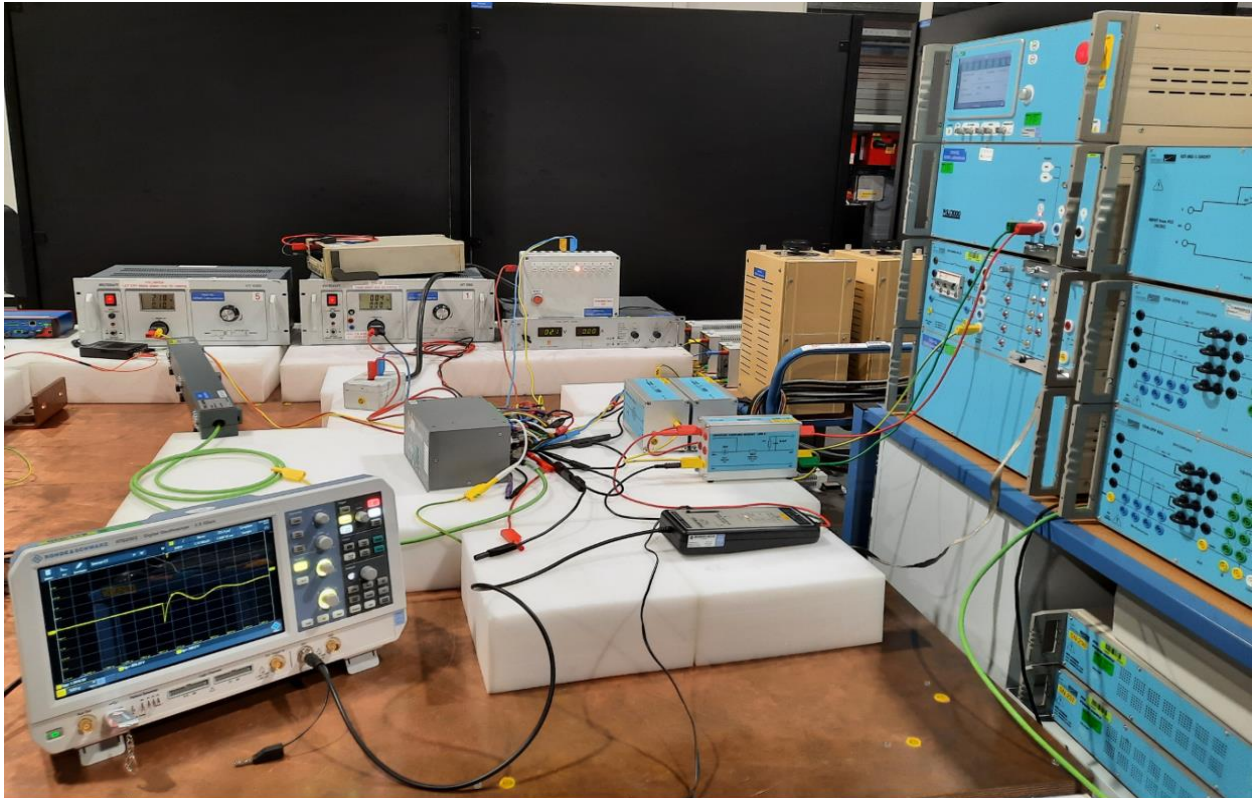
¹⁾ Direct injection on the shield

Requirement

- 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**Test setup for SIR-C**

11.9 Conducted disturbance induced by radio-frequency fields

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 61000-4-6
Test date	May 10 to 16, 2022

Characteristic test data

Serial number (SIR-C)	22600008
Serial number (SIU-C)	22600007
Source impedance	150 Ω
Amplitude modulated	80 % AM (1 kHz)
Sweep rate	1 %
	$1,5 \times 10^{-3}$ decade/s
Dwell time frequency sweep	1 s
Test duration spot frequencies	10 s

Frequency sweep

Circuit	Terminals	Test level	CDN	Sweep rate	Frequency sweep MHz	Observations
SIR-C		V				
Power supply port	B1, B2	10	M2	≤ 1 %	0,15 - 80	-
Voltage input port: (Line) VA, VB, VC	B9 - B14	10	M4	≤ 1 %	0,15 - 80	-
Voltage input port: (busbar) VA, VB, VC	B3 - B8	10	M4	≤ 1 %	0,15 - 80	-
Current input port: IA, IB, IC	A1 - A6	10	M4	≤ 1 %	0,15 - 80	-
Ethernet port	G4	10	S8	≤ 1 %	0,15 - 80	-
IRIG-B	G8	10	S1	≤ 1 %	0,15 - 80	-
RS485	C25, C6	10	EM Clamp	≤ 1 %	0,15 - 80	1
Earth port	PE	10	M1	≤ 1 %	0,15 - 80	-
Binary input port: Relay In1 (turn-on)	C1, C7	10	AFx	≤ 1 %	0,15 - 80	-
Binary input port: Relay In3 (turn-off)	C3, C7	10	AFx	≤ 1 %	0,15 - 80	-
Binary input port: Relay In5 (turn-off)	C5, C7	10	AFx	≤ 1 %	0,15 - 80	-
Binary input port: Relay In7 (turn-on)	C8, C14	10	AFx	≤ 1 %	0,15 - 80	-
Binary input port: Relay In9 (turn-off)	C10, C14	10	AFx	≤ 1 %	0,15 - 80	-
Binary input port: Relay In10 (turn-off)	C11, C14	10	AFx	≤ 1 %	0,15 - 80	-
Binary output port: Output1 (In2, In8 turn-on)	C15, C16	10	AF2	≤ 1 %	0,15 - 80	-
Binary output port: Output4 (In1 turn-on)	C21, C22	10	AF2	≤ 1 %	0,15 - 80	-
Binary output port: Output5 (In1 turn-on)	C23, C24	10	AF2	≤ 1 %	0,15 - 80	-

Observations

1. RS485 test performed with 3 wires: positive, negative, and shielding connection between equipment and earth; The object passed test.

Circuit	Terminals	Test level	CDN	Sweep rate	Frequency sweep MHz	Observations
SIU-C		V				
Power supply port	B1, B2	10	M2	$\leq 1 \%$	0,15 - 80	-
Voltage input port: VA, VB, VC	B9 - B14	10	M4	$\leq 1 \%$	0,15 - 80	-
Voltage input port: VB, VR	B9 - B12	10	M4	$\leq 1 \%$	0,15 - 80	-
IRIG-B	G8	10	S1	$\leq 1 \%$	0,15 - 80	-
RS485 ¹⁾	C25, C6	10	EM Clamp	$\leq 1 \%$	0,15 - 80	-
Earth port	PE	10	M1	$\leq 1 \%$	0,15 - 80	-
Binary input port: Relay In1 (turn-on)	C1, C7	10	AFx	$\leq 1 \%$	0,15 - 80	-
Binary input port: Relay In3 (turn-off)	C3, C7	10	AFx	$\leq 1 \%$	0,15 - 80	-
Binary input port: Relay In5 (turn-off)	C5, C7	10	AFx	$\leq 1 \%$	0,15 - 80	-
Binary input port: Relay In7 (turn-on)	C8, C14	10	AFx	$\leq 1 \%$	0,15 - 80	-
Binary input port: Relay In9 (turn-off)	C10, C14	10	AFx	$\leq 1 \%$	0,15 - 80	-
Binary input port: Relay In10 (turn-off)	C11, C14	10	AFx	$\leq 1 \%$	0,15 - 80	-
Binary output port: Output1 (In2, In8 turn-on)	C15, C16	10	AF2	$\leq 1 \%$	0,15 - 80	-
Binary output port: Output4 (In1 turn-on)	C21, C22	10	AF2	$\leq 1 \%$	0,15 - 80	-
Binary output port: Output5 (In1 turn-on)	C23, C24	10	AF2	$\leq 1 \%$	0,15 - 80	-

Note
¹⁾ RS485 test performed with shielding connected to the PE-terminal.

Spot frequencies

Circuit SIR-R	Terminals	Test level V	CDN	Duty cycle %	Spot frequencies MHz	Observations
Power supply port	B1,B2	10	M2	100	27, 68	-
Voltage input port (line) VA, VB, VC	B9 - B14	10	M4	100	27, 68	-
Voltage input port (busbar) VA, VB, VC	B3 - B8	10	M4	100	27, 68	-
Current input port IA, IB, IC	A1 - A6	10	M4	100	27, 68	-
Ethernet port	G4	10	S8	100	27, 68	-
IRIG-B	G8	10	S1	100	27, 68	-
RS-485	C25, C6	10	EM clamp	100	27, 68	-
Earth port	PE	10	M1	100	27, 68	-
Binary input port: Relay In1 (turn-on)	C1, C7	10	AF2	100	27, 68	-
Binary input port: Relay In3 (turn-off)	C3, C7	10	AF2	100	27, 68	-
Binary input port: Relay In5 (turn-off)	C5, C7	10	AF2	100	27, 68	-
Binary input port: Relay In7 (turn-on)	C8, C14	10	AF2	100	27, 68	-
Binary input port: Relay In9 (turn-off)	C10, C14	10	AF2	100	27, 68	-
Binary input port: Relay In10 (turn-off)	C11, C14	10	AF2	100	27, 68	-
Binary output port: Output1 (In2,In8 turn-on)	C15, C16	10	AF2	100	27, 68	-
Binary output port: Output4 (In1 turn-on)	C21, C22	10	AF2	100	27, 68	-
Binary output port: Output5 (In1 turn-on)	C23, C24	10	AF2	100	27, 68	-

Circuit	Terminals	Test level V	CDN	Duty cycle %	Spot frequencies MHz	Observation
SIR-U						
Power supply port	B1, B2	10	M2	100	27, 68	-
Voltage input port: VA, VB, VC	B9 - B14	10	M4	100	27, 68	-
Voltage input port: VB, VR	B3 - B8	10	M4	100	27, 68	-
IRIG-B	G8	10	S1	100	27, 68	-
RS-485 ¹⁾	C25, C6	10	EM clamp	100	27, 68	-
Earth port	PE	10	M1	100	27, 68	-
Binary input port: Relay In1 (turn-on)	C1, C7	10	AF2	100	27, 68	-
Binary input port: Relay In3 (turn-off)	C3, C7	10	AF2	100	27, 68	-
Binary input port: Relay In5 (turn-off)	C5, C7	10	AF2	100	27, 68	-
Binary input port: Relay In7 (turn-on)	C8, C14	10	AF2	100	27, 68	-
Binary input port: Relay In9 (turn-off)	C10, C14	10	AF2	100	27, 68	-
Binary input port: Relay In10 (turn-off)	C11, C14	10	AF2	100	27, 68	-
Binary output port: Output1 (In2, In8 turn-on)	C15, C16	10	AF2	100	27, 68	-
Binary output port: Output4 (In1 turn-on)	C21, C22	10	AF2	100	27, 68	-
Binary output port: Output5 (In1 turn-on)	C23, C24	10	AF2	100	27, 68	-

Note

¹⁾ RS485 test performed with shielding connected to the PE-terminal.

Requirement

- 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



Test setup for SIR-C

11.10 Power frequency immunity

Standard and date

Standard	IEC 60255-1, subclause 6.15, IEC 60255-26, subclause 6.4
Basic standard	IEC 61000-4-16
Test date	N/A

Characteristic test data

Serial number	N/A
Frequency	50 / 60 Hz

The test object has been provided with AC binary inputs and AC/DC power supply input. Therefore, the power frequency immunity test is not applicable.

Observations

N/A

Requirement

- 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

N/A

11.11 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 May 6 and July 25, 2022

Characteristic test data

Serial number (SIL-C) 22600006

Power supply 45 Vdc
 Frequency 50 / 60 Hz

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

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

Observations

1. No degradation of performance observed during and after the test.

Requirement

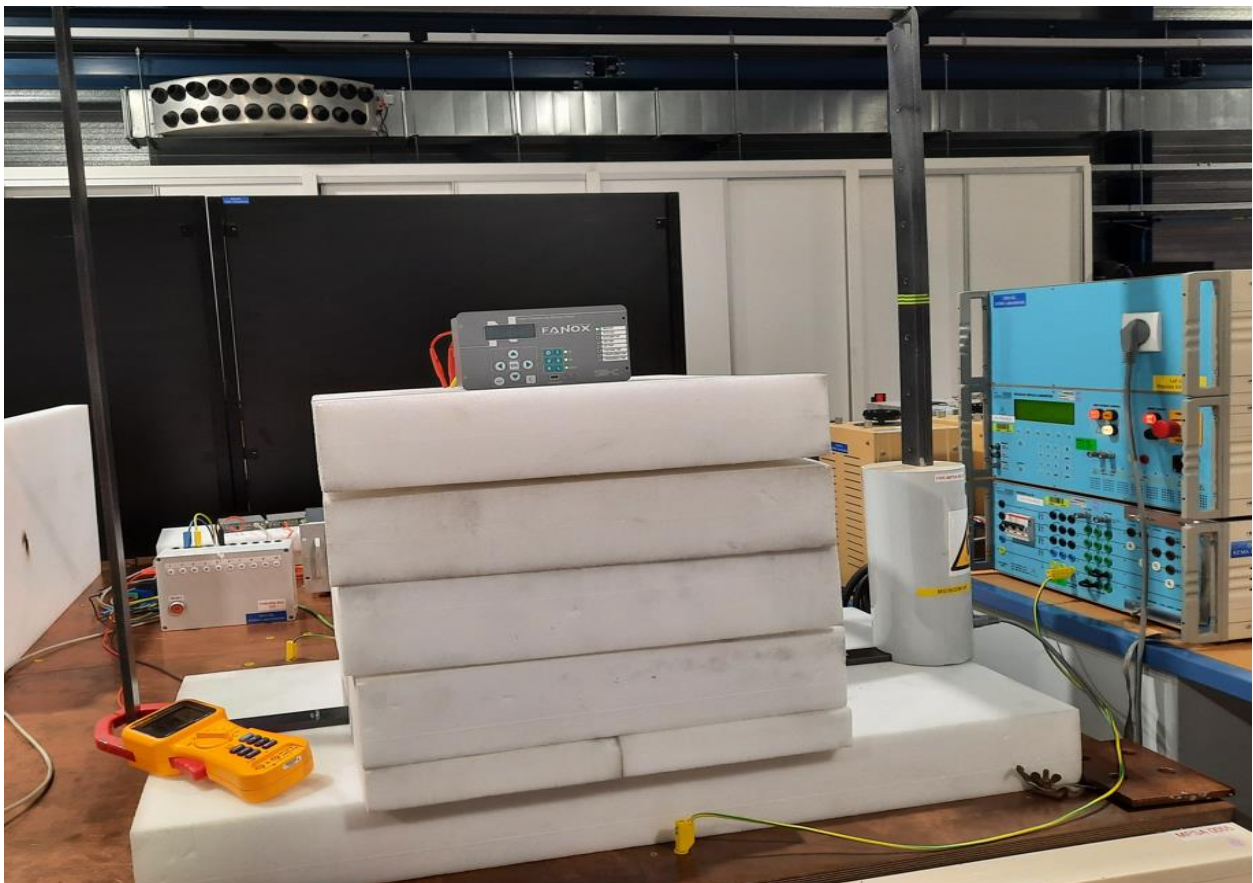
- The object shall comply with the required acceptance criteria of IEC 60255-26, Table 23.
- The visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement

Test setup for SIL-C



Test setup for SIR-C

11.12 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 June 9 to 13, 2022

Characteristic test data

Serial number (SIR-C) 22600008
 High impedance $\geq 100 \text{ k}\Omega$
 Number of voltage dips 3
 Interruption between dips $\geq 10 \text{ s}$
 Specified input voltage range 24 - 230 Vdc (-20% / +10%)

Voltage dips

Power supply voltage Vdc	Dip duration ms	Residual voltage		Acceptance criteria	Observations
		%	Vdc		
19.2	10	0	0	A	1
19.2	200	40	9.6Vdc	C	1
19.2	500	70	16.8Vdc	C	1

Umin = lowest rated voltage minus the specified tolerance

Observations

1. Normal operation

Voltage interruptions

Power supply voltage Vdc	Duration s	Residual voltage %	Acceptance criteria	Observations
19.2 (low impedance)	5	0	C	1
19.2 (high impedance)	5	0	C	1

Observations

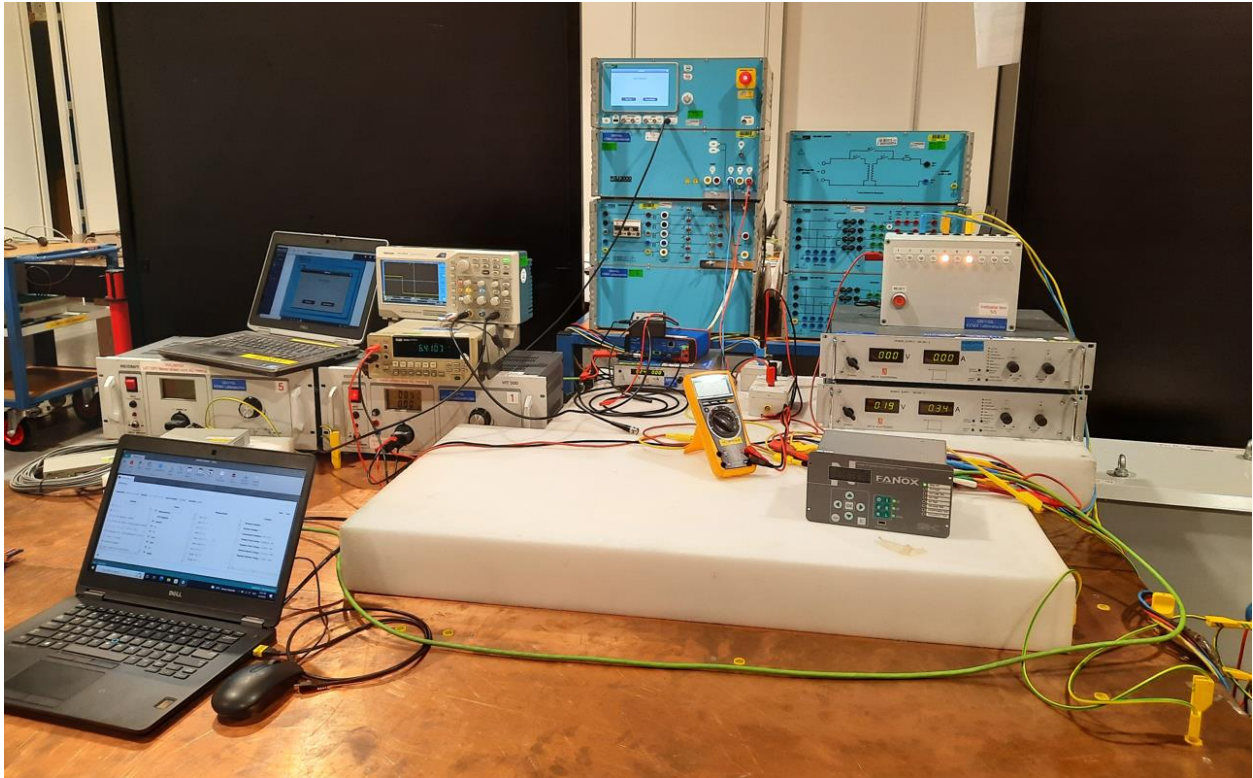
1. Device is restarting due to the voltage interruption. No unwanted change of output state.
Correct operation after the restart.

Requirement

- 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

Test setup for SIR-C

11.13 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 June 14 and 15, 2022

Characteristic test data

Serial number (SIR-C) 22600008
 Auxiliary power supply input voltage 24-230 Vdc (tolerance +/-20%)
 Rated power frequency 50/60 Hz

Power supply voltage	Test frequency	Ripple	See oscillogram on next pages	Observations
Vdc	50 Hz	V / %		
19,2	100	3.6 / 15	1	1
264	100	34.5 / 15	3	1

Power supply voltage	Test frequency	Ripple	See oscillogram on next pages	Observations
Vdc	60 Hz	V / %		
19,2	120	3.6 / 15	2	1
264	120	34.5 / 15	4	1

Observations

1. No degradation of performance observed during and after the test.

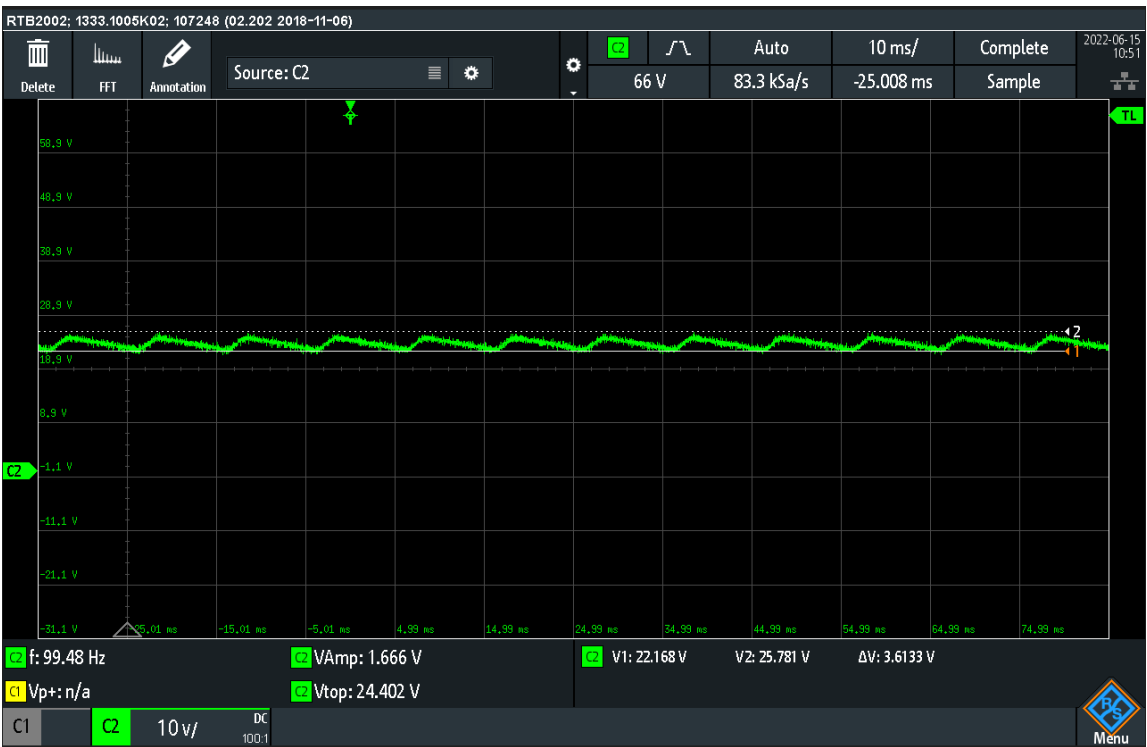
Requirement

- 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.

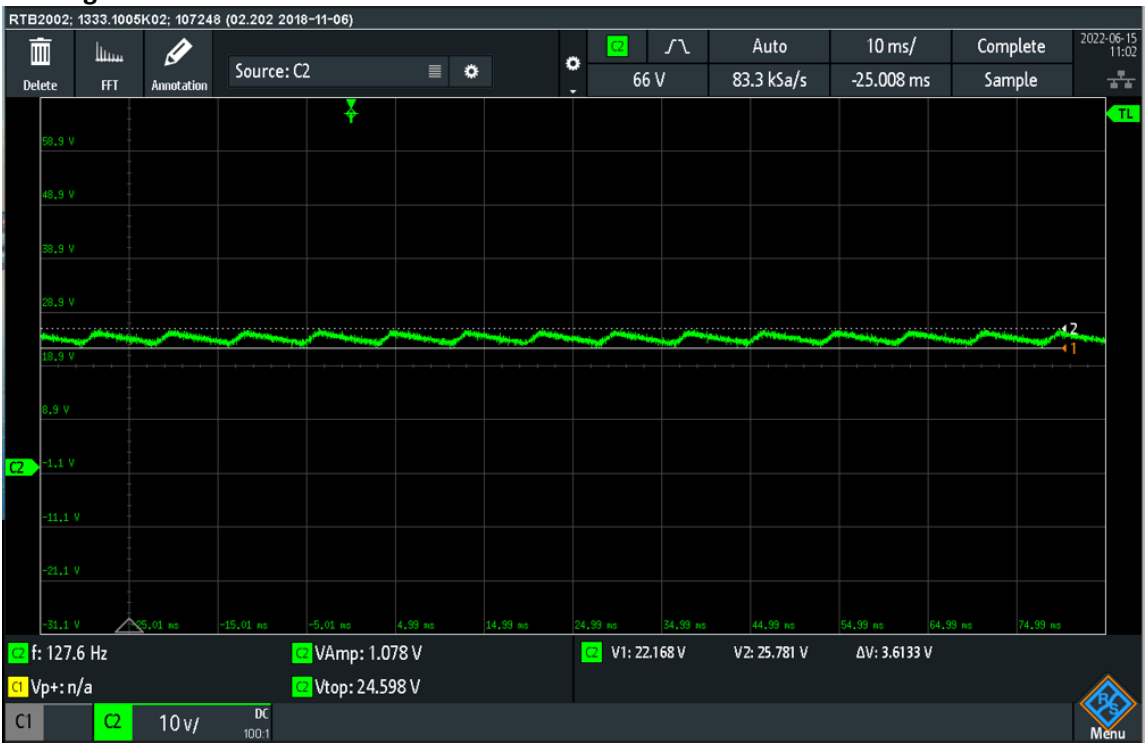
Result

The object passed the test.

Oscillogram 1: 19.2 Vdc at 100 Hz



Oscillogram 2: 19.2 Vdc at 120 Hz



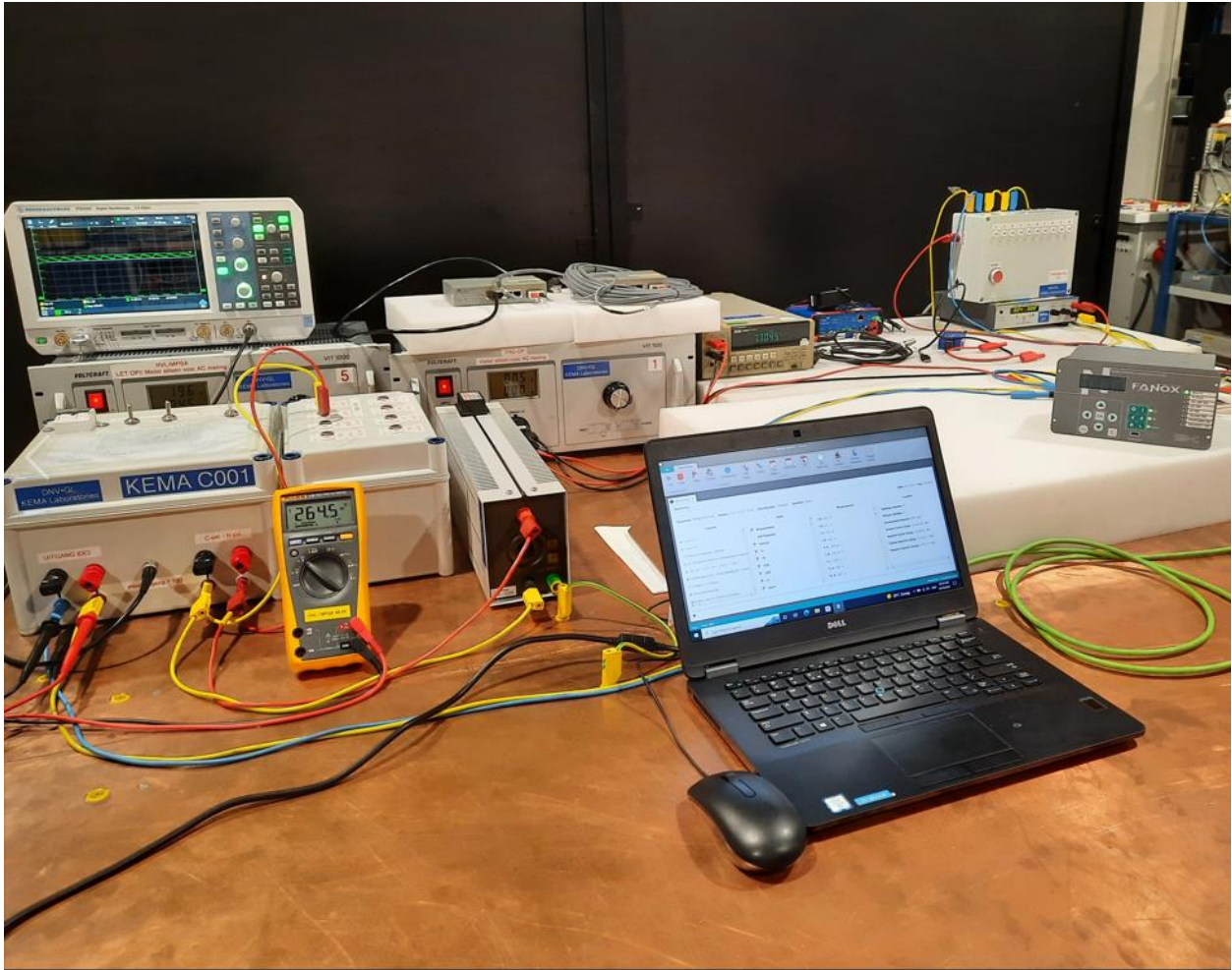
Oscillogram 3: 264 Vdc at 100 Hz



Oscillogram 4: 264 Vdc at 120 Hz



Photograph of test arrangement



Test setup for SIR-C

11.14 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 June 13 and 14, 2022

Characteristic test data

Serial number (SIR-C) 22600008
 Power supply 100 - 230 Vac ($\pm 15\%$)
 Power frequency 50 /60 Hz

PSU voltage range	Minimum Vac	Maximum Vac
AC	85	264,5

Test voltage = 100V (Umin - 15%)

Voltage dips 50Hz

Power supply voltage Vac	Residual voltage %	Duration Cycles	Acceptance criteria	Observations
85	0	0.5	A	2
85	40	10/12	C	2
85	70	25/30	C	2

Voltage interrupts 50Hz

Power supply voltage Vac	Residual voltage %	Duration Cycles	Acceptance criteria	Observations
85	0	250/300	C	1

Observations

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

Requirement

- 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.

Voltage dips 60Hz

Power supply voltage Vac	Residual voltage %	Duration Cycles	Acceptance criteria	Observations
85	0	0.5	A	2
85	40	10/12	C	2
85	70	25/30	C	2

Voltage interrupts 60Hz

Power supply voltage Vac	Residual voltage %	Duration Cycles	Acceptance criteria	Observations
85	0	250/300	C	1

Observations

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

Requirement

- 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



Test setup for SIR-C

11.15 Gradual shut-down/start-up

Standard and date

Standard	IEC 60255-1, subclause 6.15, IEC 60255-26, subclause 6.2
Basic standard	-
Test date	June 7, 2022

Characteristic test data

Serial number (SIR-C)	22600001
Shut-down ramp	60 s
Power off	5 min
Start-up ramp	60 s

PSU voltage range	Minimal input voltage	Maximal input voltage
AC	100 Vac - 15 %	230 Vac + 15 %
PSU voltage range	Minimal input voltage	Maximal input voltage
DC	24 Vdc - 20 %	230 Vdc + 20 %

Test results

Power supply voltage	Vac	Observations
Shut-down limit (SDL)	11.89	1
Start-up limit (SUL)	18.53	2

Observations

1. Tests performed until the test object went off.
2. The test object starts and resumes normal operation.

Test results

Power supply voltage	Vdc	Observations
Shut-down limit (SDL)	11.79	1
Start-up limit (SUL)	13.05	1

Observations

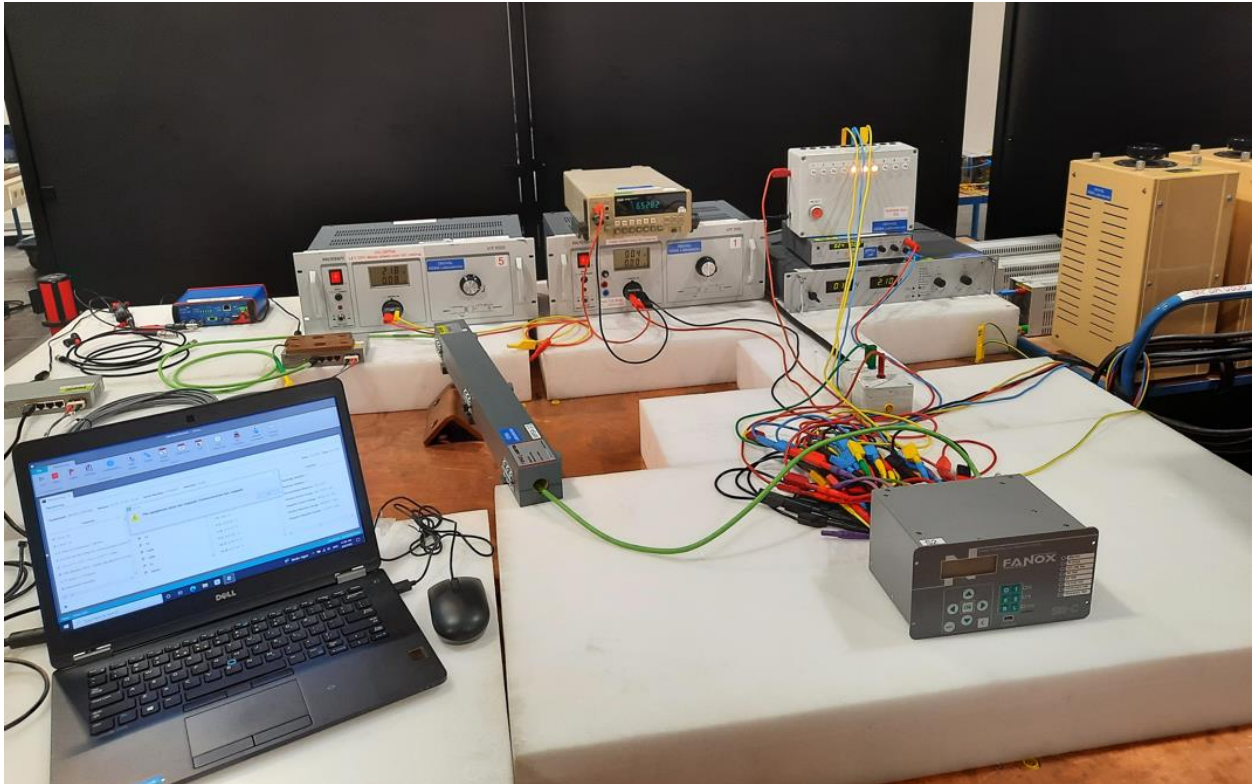
1. Tests performed until the test object went off.
2. The test object starts and resumes normal operation.

Requirement

- 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.

Photograph of test arrangement**Test setup for SIR-C**

12 CLIMATIC ENVIRONMENT

12.1 Inspection

12.1.1 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

12.1.2 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.

12.1.3 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;

1. Insulation test
2. Dielectrical strength test
3. Insulation test
4. Protective bonding test.

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

12.2 Photograph of test arrangement



12.3 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 July 14 and August 23 and 24, 2022

Characteristic test data

Serial number (SIR-C) 22600003
Serial number (SIL-C) 22600006
Serial number (SIU-C) 22607532
Test voltage 500 Vdc

Before climatic tests:

Test arrangement (SIR-C)		Insulation resistance at 500 Vdc (MΩ)	Observations
Voltage applied to	Tested between		
Power supply	Earth and all others	≥550	1
CT A : A1, A2	Earth and all others	≥550	-
CT B : A3, A4	Earth and all others	≥550	-
CT C : A5, A6	Earth and all others	≥550	-
CT N : A7, A8	Earth and all others	≥550	-
VT : B3 – B9	Earth and all others	≥550	-
BI : C1 - C7	Earth and all others	≥550	-
BI: C8 - C13	Earth and all others	≥550	-
BO: C14 - C20	Earth and all others	≥550	-
BO: C21-C24	Earth and all others	≥550	-
IRIG-B	Earth and all others	≥550	-
RS 485	Earth and all others	≥550	-
Ethernet RJ45	Earth and all others	≥550	-

After climatic tests:

Test arrangement (SIR-C)		Insulation resistance at 500 Vdc (MΩ)	Observations
Voltage applied to	Tested between		
Power supply	Earth and all others	≥550	1
CT A : A1, A2	Earth and all others	≥550	-
CT B : A3, A4	Earth and all others	≥550	-
CT C : A5, A6	Earth and all others	≥550	-
CT N : A7, A8	Earth and all others	≥550	-
VT : B3 – B9	Earth and all others	≥550	-
BI : C1 - C7	Earth and all others	≥550	-
BI: C8 - C13	Earth and all others	≥550	-
BO: C14 - C20	Earth and all others	≥550	-
BO: C21-C24	Earth and all others	≥550	-
IRIG-B	Earth and all others	≥550	-
RS 485	Earth and all others	≥550	-

Test arrangement (SIR-C)		Insulation resistance at 500 Vdc (MΩ)	Observations
Voltage applied to	Tested between		
Ethernet RJ45	Earth and all others	≥550	-

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.

Before climatic tests:

Test arrangement (SIL-C)		Insulation resistance at 500 Vdc (MΩ)	Observations
Voltage applied to	Tested between		
Power supply	Earth and all others	≥550	1
CT A : A1, A2	Earth and all others	≥550	-
CT B : A3, A4	Earth and all others	≥550	-
CT C : A5, A6	Earth and all others	≥550	-
CT N : A7, A8	Earth and all others	≥550	-
VT : B3 – B9	Earth and all others	≥550	-
BI : C1 - C7	Earth and all others	≥550	-
BI: C8 - C13	Earth and all others	≥550	-
BO: C14 - C20	Earth and all others	≥550	-
BO: C21-C24	Earth and all others	≥550	-
IRIG-B	Earth and all others	≥550	-
RS 485	Earth and all others	≥550	-
Ethernet RJ45	Earth and all others	≥550	-

After climatic tests:

Test arrangement (SIL-C)		Insulation resistance at 500 Vdc (MΩ)	Observations
Voltage applied to	Tested between		
Power supply	Earth and all others	≥550	1
CT A : A1, A2	Earth and all others	≥550	-
CT B : A3, A4	Earth and all others	≥550	-
CT C : A5, A6	Earth and all others	≥550	-
CT N : A7, A8	Earth and all others	≥550	-
VT : B3 – B9	Earth and all others	≥550	-
BI : C1 - C7	Earth and all others	≥550	-
BI: C8 - C13	Earth and all others	≥550	-
BO: C14 - C20	Earth and all others	≥550	-
BO: C21-C24	Earth and all others	≥550	-
IRIG-B	Earth and all others	≥550	-
RS 485	Earth and all others	≥550	-
Ethernet RJ45	Earth and all others	≥550	-

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.

Before climatic tests:

Test arrangement (SIU-C)		Insulation resistance at 500 Vdc MΩ	Observations
Voltage applied to	Tested between		
Power supply:	Earth and all others	≥550	1
CT A : A1, A2	Earth and all others	≥550	-
CT B : A3, A4	Earth and all others	≥550	-
CT C : A5, A6	Earth and all others	≥550	-
VT : B3 - B14	Earth and all others	≥550	-
BI : C1 - C7	Earth and all others	≥550	-
BI: C8 - C13	Earth and all others	≥550	-
BO: C14 - C20	Earth and all others	≥550	-
BO: C21-C24	Earth and all others	≥550	-
RS 485	Earth and all others	≥550	-

After climatic tests:

Test arrangement (SIL-C)		Insulation resistance at 500 Vdc MΩ	Observations
Voltage applied to	Tested between		
Power supply:	Earth and all others	≥550	1
CT A : A1, A2	Earth and all others	≥550	-
CT B : A3, A4	Earth and all others	≥550	-
CT C : A5, A6	Earth and all others	≥550	-
VT : B3 - B14	Earth and all others	≥550	-
BI : C1 - C7	Earth and all others	≥550	-
BI: C8 - C13	Earth and all others	≥550	-
BO: C14 - C20	Earth and all others	≥550	-
BO: C21-C24	Earth and all others	≥550	-
RS 485	Earth and all others	≥550	-

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.

Observations

1. The minimum resistance shall be > 100 Mohm for new equipment and not be less than 10 Mohm after the test;

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

12.4 Climatic environmental tests

12.4.1 Dry-heat test - operational

Standard and date

Standard	IEC 60255-1, subclause 6.12.3.1
Basic standard	IEC 60068-2-2
Test date	May 16 to 20, 2022

Characteristic test data

Serial number (SIR-C)	22600003
Serial number (SIL-C)	22600006
Serial number (SIU-C)	22607532
Type of test	Bd
Operating conditions	energized
Power supply	220 V
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	-
Correct function at rated load/current	96		-

Observations

No degradation of performance observed during and after the test.

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.

12.4.2 Cold test - operational

Standard and date

Standard IEC 60255-1, subclause 6.12.3.2
 Basic standard IEC 60068-2-1
 Test date June 27 to July 1, 2022

Characteristic test data

Serial number (SIR-C) 22600003
 Serial number (SIL-C) 22600006
 Serial number (SIU-C) 22607532
 Type of test Ad
 Operating conditions energized
 Power supply 220 V
 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	-
Correct function at rated load/current	96		1

Observations

- During test the equipment LCD went dark. After the test, the display was visible again.

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.

12.4.3 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 May 5 to 9, 2022

Characteristic test data

Serial number (SIR-C) 22600003
 Serial number (SIL-C) 22600006
 Serial number (SIU-C) 22607532
 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	96	+80	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.

12.4.4 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 May 9 to 13, 2022

Characteristic test data

Serial number (SIR-C) 22600003
Serial number (SIL-C) 22600006
Serial number (SIU-C) 22607532
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	96	-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.

12.4.5 Change of temperature test

Standard and date

Standard IEC 60255-1, subclause 6.12.3.5
 Basic standard IEC 60068-2-14
 Test date July 4 to 7, 2022

Characteristic test data

Serial number (SIR-C) 22600003
 Serial number (SIL-C) 22600006
 Serial number (SIU-C) 22607532
 Type of test Nb
 Operating conditions energized
 Power supply 220 V
 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	5	-40	2
			+70	2

Observations

1. Correct start up, normal operation.
2. No degradation of performance observed during and after the test.

Requireent

- 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.

12.4.6 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 June 13 to 23, 2022

Characteristic test data

Serial number (SIR-C) 22600003
 Serial number (SIL-C) 22600006
 Serial number (SIU-C) 22607532
 Type of test Cab
 Operating conditions energized
 Power supply 220 V
 Relative humidity 93 %

Test procedure	Duration of exposure	Operating Temperature °C	Observations
Powering up after	1 h	+40	-
Correct function	10 days		-

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.

12.4.7 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	June 13 and 23, 2022

Characteristic test data

Serial number (SIR-C)	22600003
Serial number (SIL-C)	22600006
Serial number (SIU-C)	22607532
Type of test	Db
Operating conditions	energized
Power supply	220 V
Cycles	6

Test procedure	Duration of exposure h	Duration of exposure cycles	Operating temperature °C	Humidity %	Observations
Pre-conditioning	1	-	+25	60	-
Correct function	12	6	+25	97	-
	12	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.

13 MECHANICAL ENVIRONMENTAL CONDITION TESTS

13.1 Inspection

13.1.1 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

13.1.2 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.

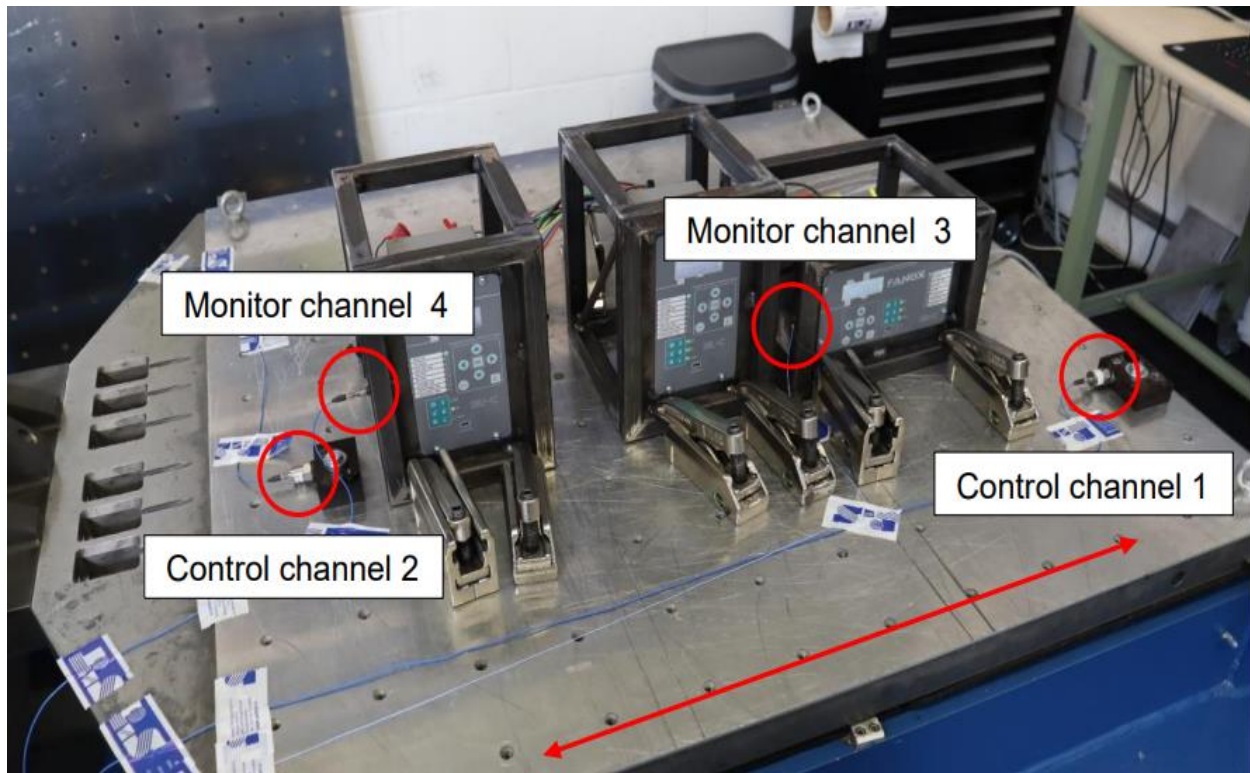
The measurements of analogue input data shall not exceed twice the class index for the measurement.

There shall be no:

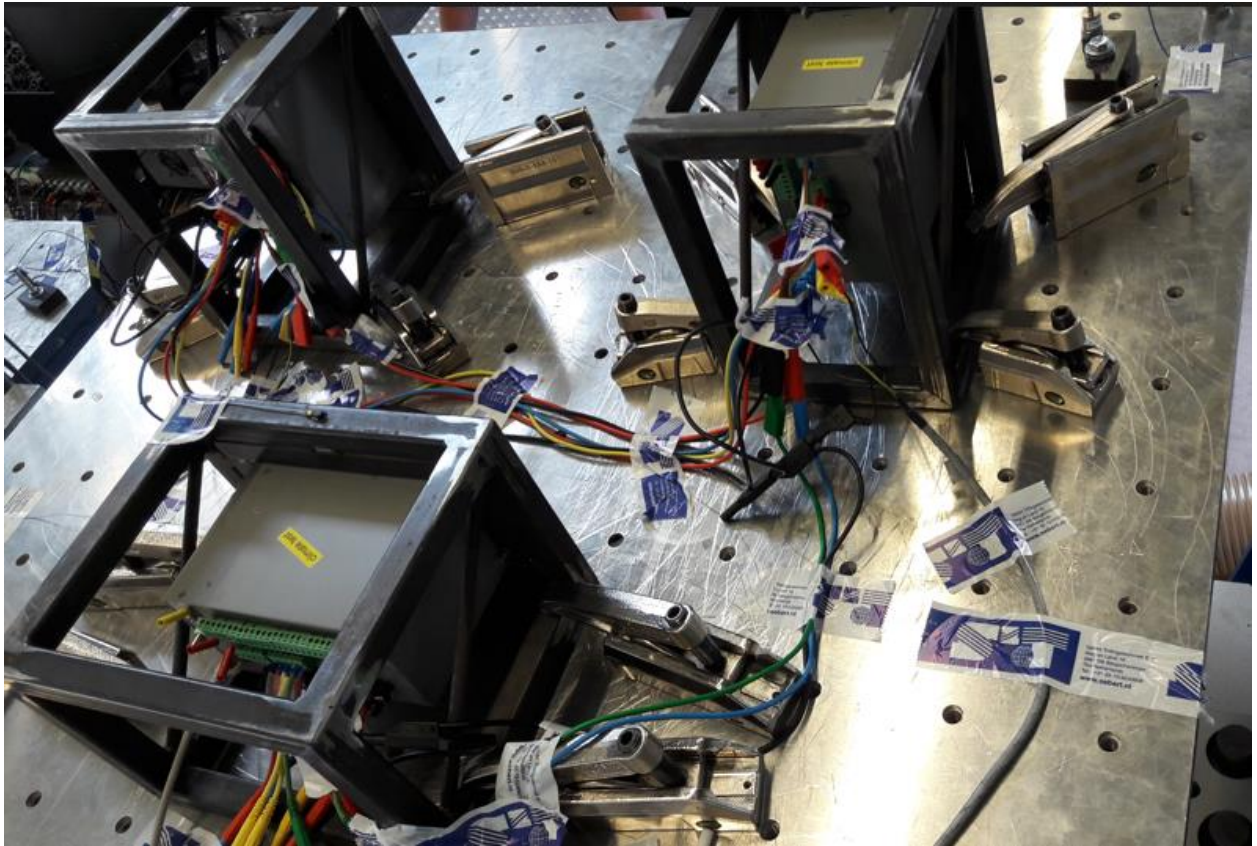
- alarm indications on display and LED's.
- error messages reported in the maintenance computer.
- unintentional change of contact outputs.
- unintentional change of digital input status.

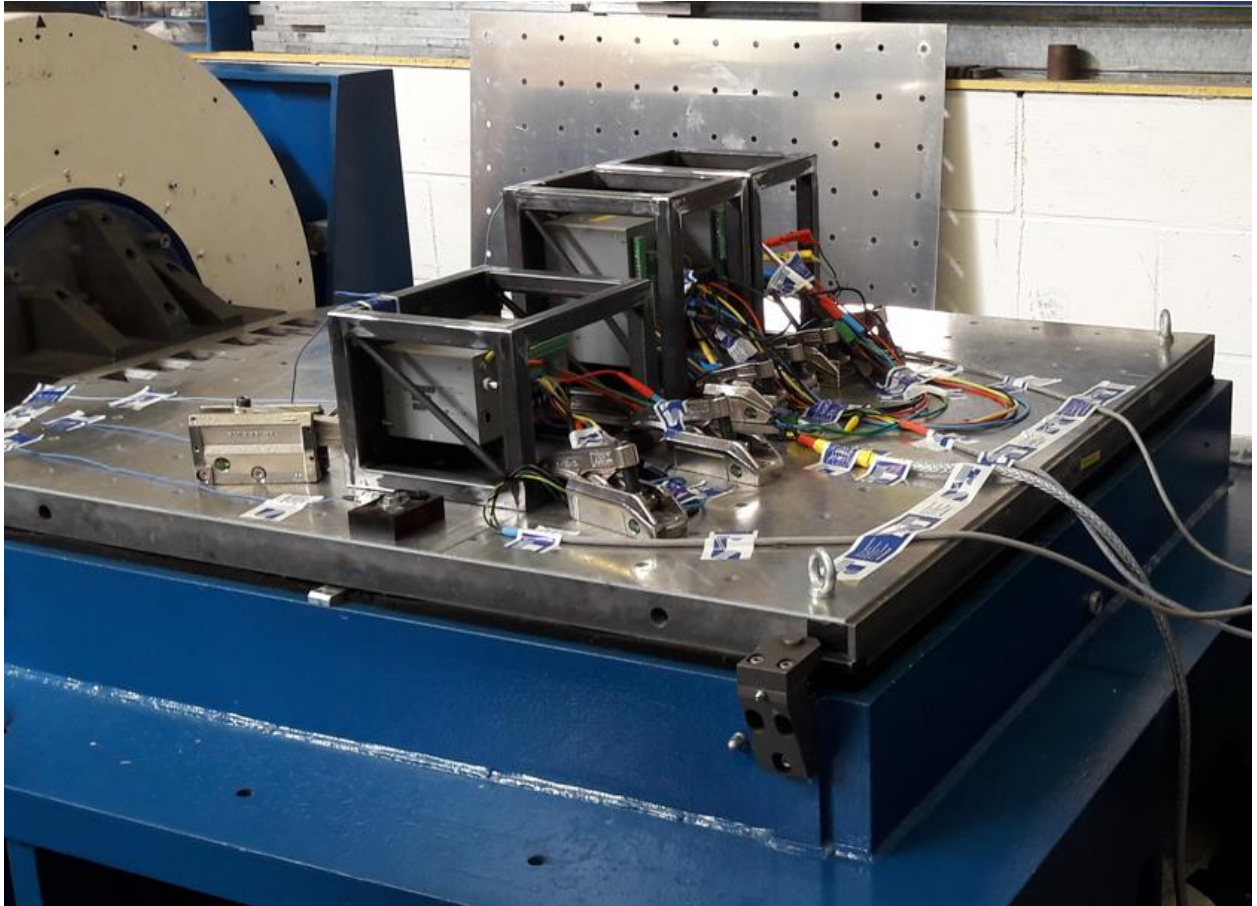
Unless otherwise stated the visual and functional inspection was carried out successfully after each test.

13.2 Photographs of test arrangement



Test arrangement horizontal longitudinal direction



Test arrangement horizontal transversal direction

Test arrangement vertical direction

13.3 Vibration response test

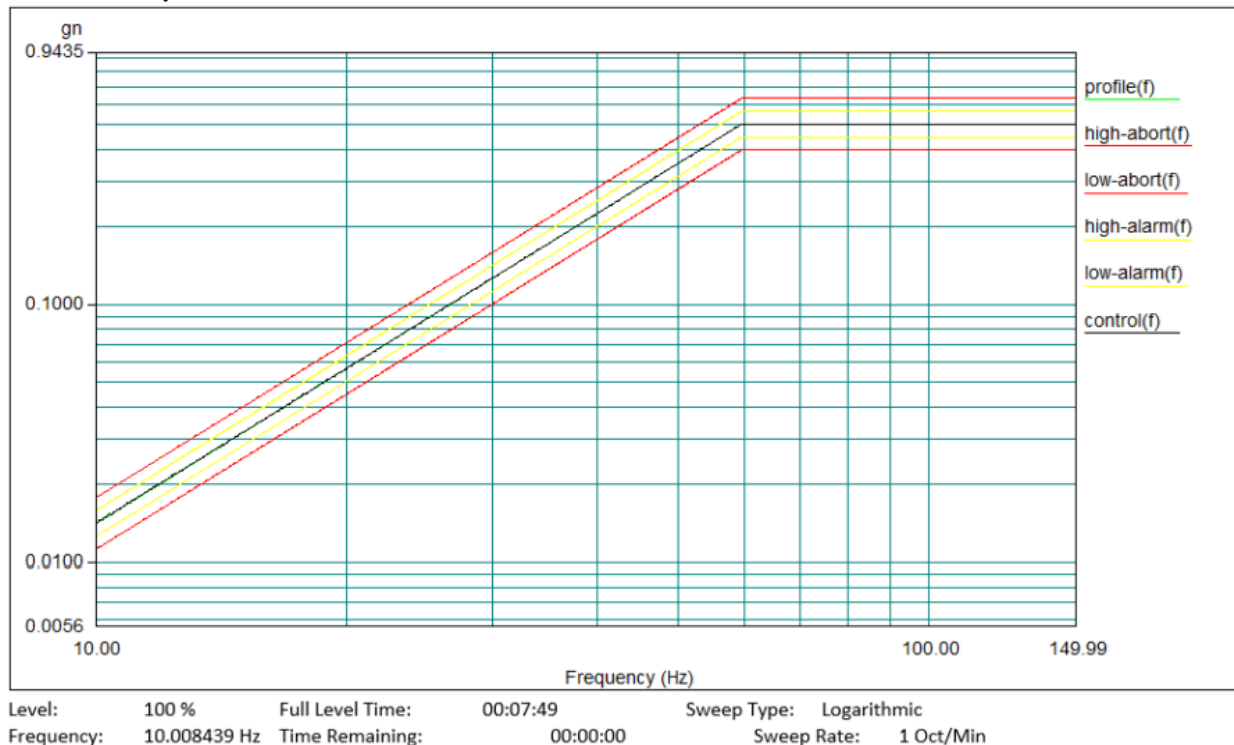
Standard and date

Standard IEC 60255-1, subclause 6.13
 Basic standard IEC 60255-21-1
 Test date August 24 to September 2, 2022

Characteristic test data

Serial number (SIL-C) 20600003
 Serial number (SIU-C) 22600007
 Serial number (SIR-C) 20600001
 Test object energized
 Power supply 100 Vdc
 VT input 57.73 Vac
 VT input (SIR-C) 3 Vac
 CT input 0.9 A
 Frequency range 10 to 150 Hz
 Displacement 0,035 mm
 Acceleration 0,5 g
 Number of sweep cycles in each axis 1
 Number of axis 3

Vibration response test class 1



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.

13.4 Vibration endurance test

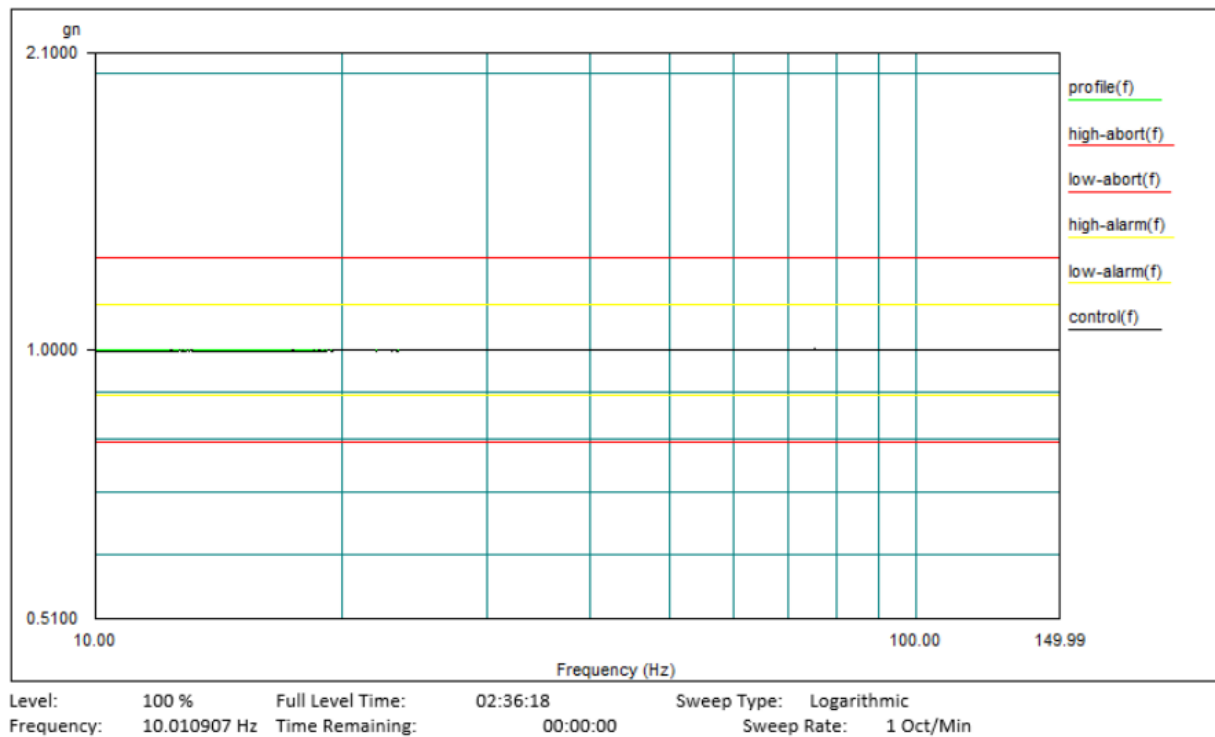
Standard and date

Standard IEC 60255-1, subclause 6.13
 Basic standard IEC 60255-21-1
 Test date August 25 to 31, 2022

Characteristic test data

Serial number (SIL-C) 20600003
 Serial number (SIU-C) 20600007
 Serial number (SIR-C) 20600001
 Test object non-energized
 Power supply 0 Vdc
 Frequency range 10 to 150 Hz
 Acceleration 1 g
 Number of sweep cycles in each axis 20
 Number of axis 3

Vibration endurance test class 1



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.

13.5 Shock response test

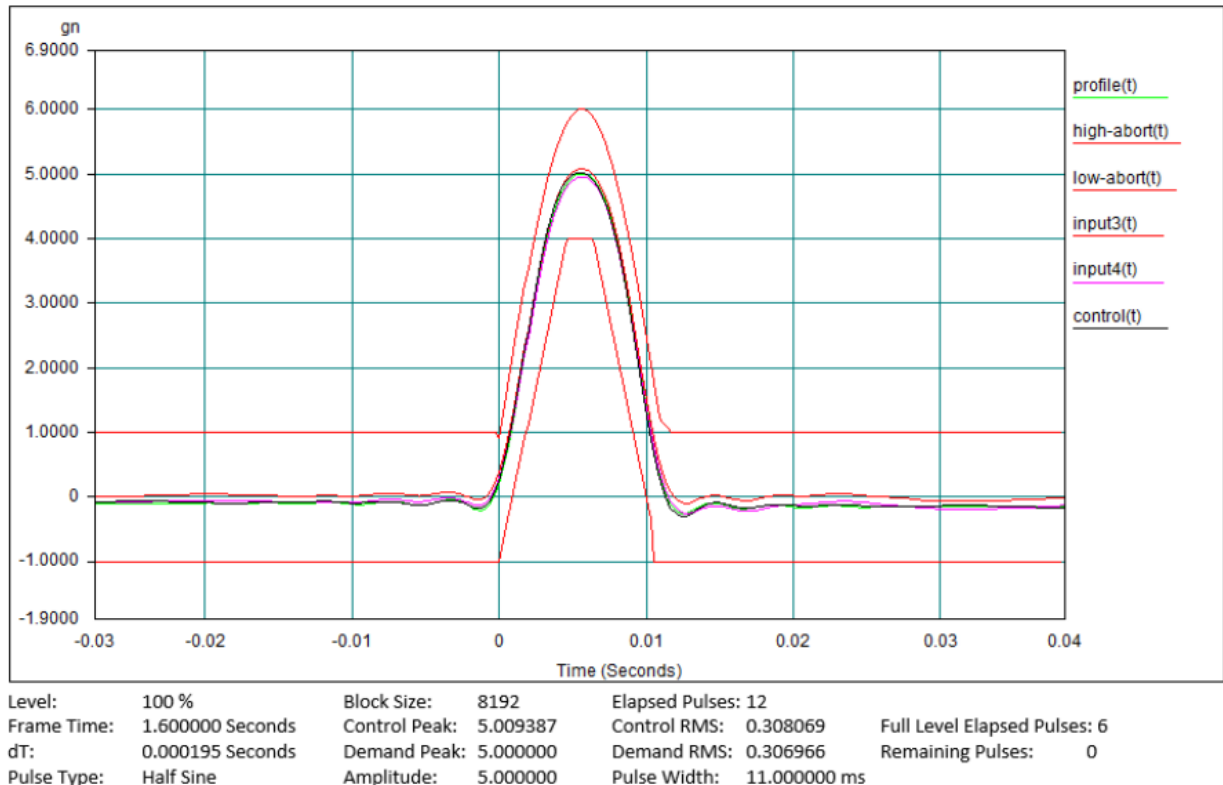
Standard and date

Standard	IEC 60255-1, subclause 6.13
Basic standard	IEC 60255-21-2
Test date	August 25 to 31, 2022

Characteristic test data

Serial number (SIL-C)	20600003
Serial number (SIU-C)	22600007
Serial number (SIR-C)	20600001
Test object	energized
Power supply	100 Vdc
VT input	57.73 Vac
VT input (SIR-C)	3 Vac
CT input	0.9 A
Acceleration	5 g
Duration of pulses	11 ms
Number of pulses in each axis	6
Number of axis	3

Shock response test class 1



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) does 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.

13.6 Shock withstand test

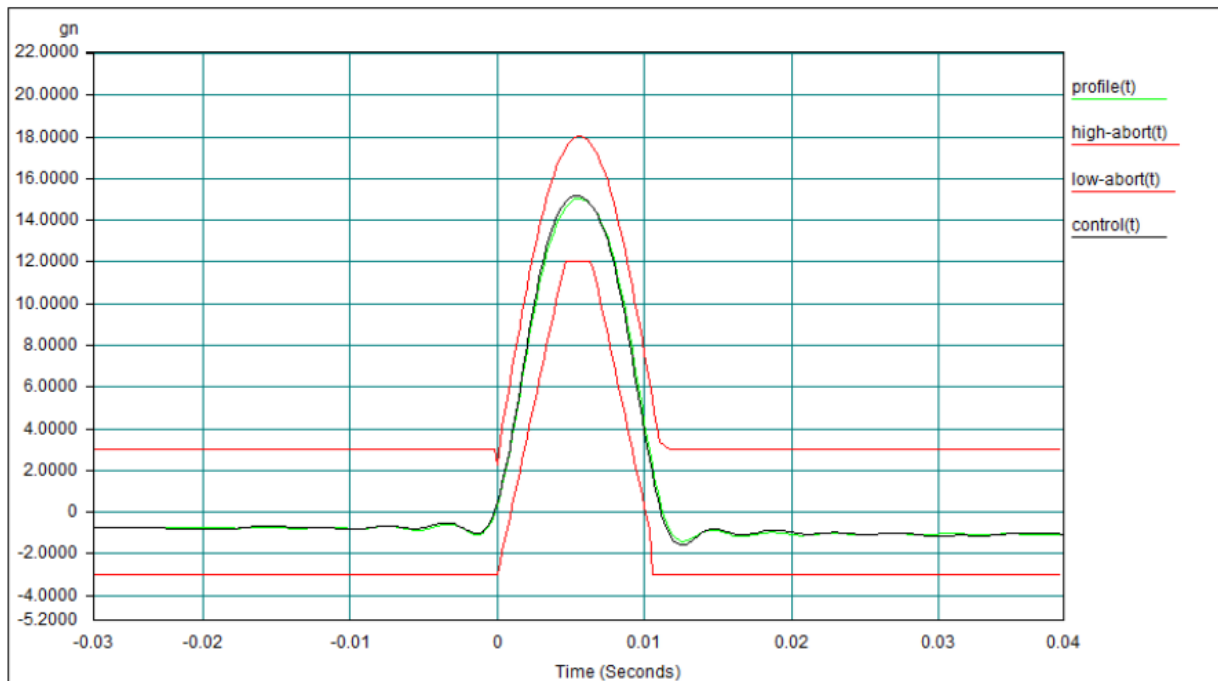
Standard and date

Standard	IEC 60255-1, subclause 6.13
Basic standard	IEC 60255-21-2
Test date	August 25 to 31, 2022

Characteristic test data

Serial number (SIL-C)	20600003
Serial number (SIU-C)	22600007
Serial number (SIR-C)	20600001
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 class 1



Level:	100 %	Block Size:	4096	Elapsed Pulses:	13	
Frame Time:	0.682667 Seconds	Control Peak:	15.145083	Control RMS:	1.478720	Full Level Elapsed Pulses:
dT:	0.000167 Seconds	Demand Peak:	14.999999	Demand RMS:	1.468817	Remaining Pulses:
Pulse Type:	Half Sine	Amplitude:	14.999999	Pulse Width:	11.000000 ms	0

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.

13.7 Bump test

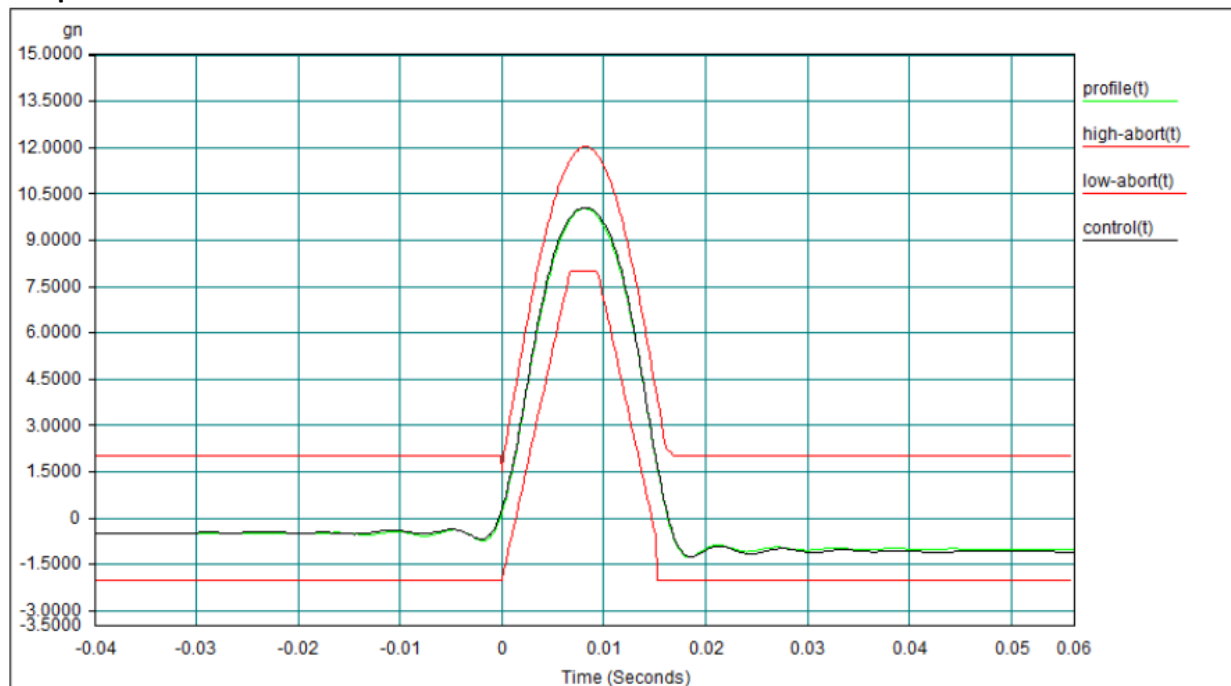
Standard and date

Standard IEC 60255-1, subclause 6.13
 Basic standard IEC 60255-21-2
 Test date August 25 to 31, 2022

Characteristic test data

Serial number (SIL-C) 20600003
 Serial number (SIU-C) 22600007
 Serial number (SIR-C) 20600001
 Acceleration 10 g
 Duration of pulses 16 ms
 Number of pulses in each axis 2000
 Number of axis 3

Bump test class 1



Level: 100 %	Block Size: 4096	Elapsed Pulses: 2007	
Frame Time: 0.800000 Seconds	Control Peak: 10.032967	Control RMS: 1.127282	Full Level Elapsed Pulses: 2000
dT: 0.000195 Seconds	Demand Peak: 9.999999	Demand RMS: 1.110142	Remaining Pulses: 0
Pulse Type: Half Sine	Amplitude: 10.000000	Pulse Width: 16.000000 ms	

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.

13.8 Single axis sine sweep seismic test

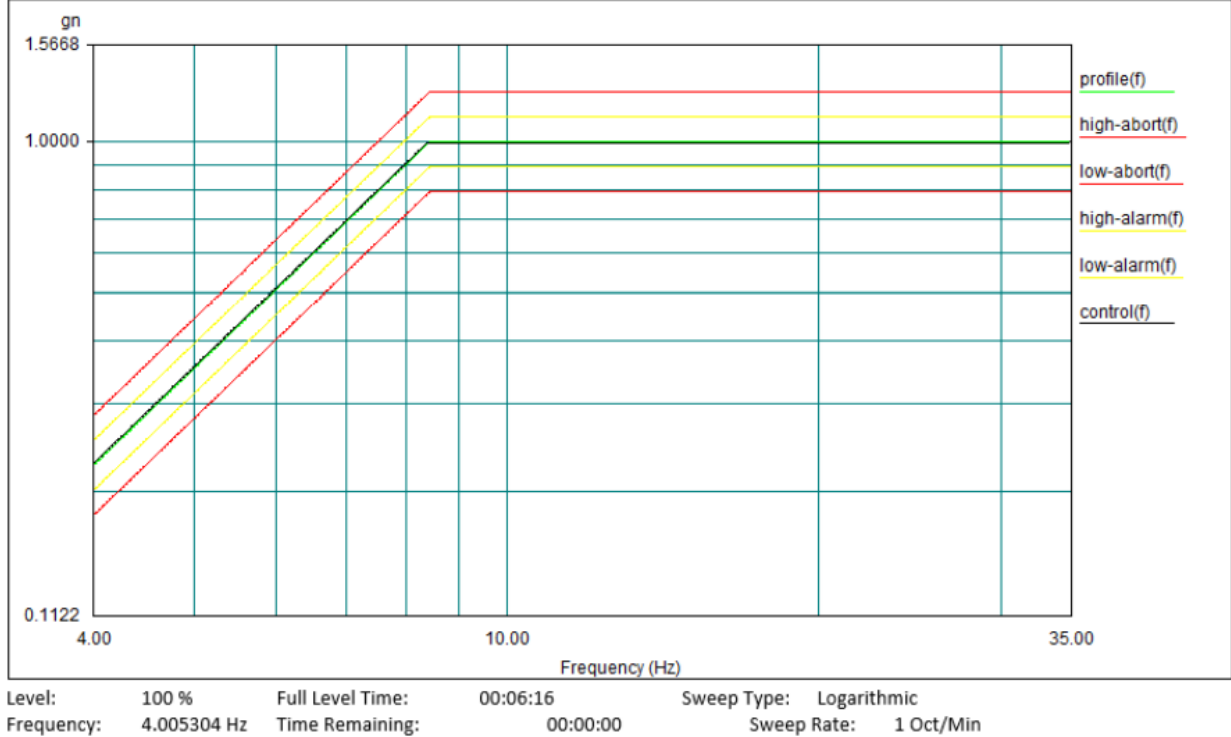
Standard and date

Standard	IEC 60255-1, subclause 6.13
Basic standard	IEC 60255-21-3
Test date	August 25 to 31, 2022

Characteristic test data

Serial number (SIL-C)	20600003
Serial number (SIU-C)	22600007
Serial number (SIR-C)	20600001
Test object	energized
Power supply	100 Vdc
VT input	57.73 Vac
VT input (SIR-C)	3 Vac
CT input	0.9 A
Frequency range	1 to 35 Hz
Cross-over frequency	8 to 9 Hz
Displacement horizontal axis (x)	3,5 mm
Displacement vertical axis (y)	1,5 mm
Acceleration horizontal axis (x)	1,0 g
Acceleration vertical axis (y)	0,5 g
Number of sweep cycles in each axis	1
Number of axis	3

Single axis sine sweeps seismic test in horizontal transversal (y) direction class 1



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.

14 ADDITIONAL TESTS (NOT REQUIRED BY THE STANDARD)

14.1 Slow damped oscillatory wave, 100 kHz

Standard and date

Standard -
Basic standard IEC 61000-4-18
Test date May 9 to 12, 2022

Characteristic test data

Serial number (SIR-C) 22680008
Voltage oscillation frequency 100 kHz
Voltage rise time 75 ns
Repetition frequency 40 Hz
Polarity of first half period Positive and negative

Circuit	Terminals	Coupling	Test voltage	Observation
<u>SIR-C</u>			KV	
Power supply port (24VDC)	B1, B2	CM	2,5	1
		DM	1,0	1
Voltage input port: (VT Bus) VA, VB, VC	B9 - B14	CM	2,5	1
		DM	1,0	1
Voltage input port: (VT Line) VA, VB, VC	B3 - B8	CM	2,5	1
		DM	1,0	1
Current input port: (CT) IA, IB, IC	A1 - A6	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In1	C1, C7	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In2	C2, C7	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In5	C5, C7	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In7	C8, C14	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In9	C10, C14	CM	2,5	1
		DM	1,0	1
Binary input port: Relay In11	C112 C13	CM	2,5	1
		DM	1,0	1
Binary output port: Output1	C15, C16	CM	2,5	1
		DM	1,0	1
Binary output port: Output2	C17, C18	CM	2,5	1
		DM	1,0	1
Binary output port: Output4	C21, C22	CM	2,5	1
		DM	1,0	1

Circuit	Terminals	Coupling	Test voltage KV	Observation
<u>SIR-C</u>				
Binary output port: Output5	C23, C24	CM	2,5	1
		DM	1,0	1
Ethernet port	G4	CM ¹	1,0	1
		CM ¹	2.5	1
RS485	C25, C26	CM ¹	1,0	1
		CM ¹	2,5	1
IRIG-B	G8	CM ¹	1,0	1
		CM ¹	2,5	1

Note

CM = Common Mode

DM = Differential mode

¹⁾ Injected on the shield

Observations

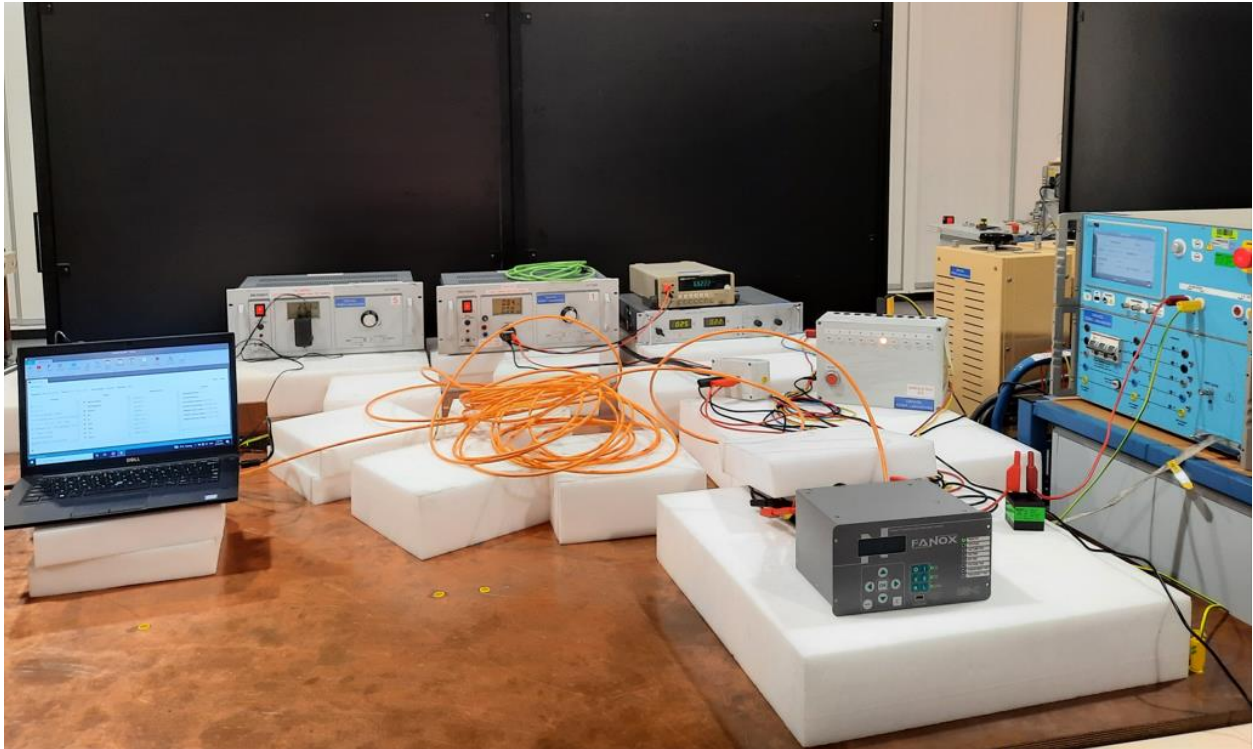
1. No degradation of performance observed during and after the test.

Requirement

- 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

Test setup for SIR-C

14.2 Pulse magnetic field

Standard and date

Standard IEC61000-4-10

Test date May 9, 2022

Characteristic test data

Serial number 2260008

Waveform 8/20 us

Polarity Positive and negative

Number of impulses 5

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

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

Test setup for SIR-C

14.3 Damped oscillatory magnetic field (100 kHz and 1 MHz)

Standard and date

Standard IEC61000-4-10

Test date April 28, 2020

Characteristic test data

Serial number (SIR-C) 22600008

Frequency 1 MHz ($\pm 10\%$)

Oscillation period 1 μ s

Repetition time of the pulses 2,50 ms

Direction	Test level	Polarity	Duration	Acceptance criteria	Observations
	A/m		s		
Horizontal longitudinal (x)	100	Positive	60	A	-
	100	Negative	60	A	-
Horizontal transversal (y)	100	Positive	60	A	-
	100	Negative	60	A	-
Vertical (z)	100	Positive	60	A	-
	100	Negative	60	A	-

Characteristic test data

Serial number 22600008

Frequency 100 kHz ($\pm 10\%$)

Oscillation period 10 μ s

Repetition time of the pulses 25 ms

Direction	Test level	Polarity	Duration	Acceptance criteria	Observations
	A/m		s		
Horizontal longitudinal (x)	100	Positive	60	A	-
	100	Negative	60	A	-
Horizontal transversal (y)	100	Positive	60	A	-
	100	Negative	60	A	-
Vertical (z)	100	Positive	60	A	-
	100	Negative	60	A	-

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

Test setup for SIR-C

14.4 High leakage current

Standard and date

Standard IEC 60990
Test date August 31, 2022

Characteristic test data

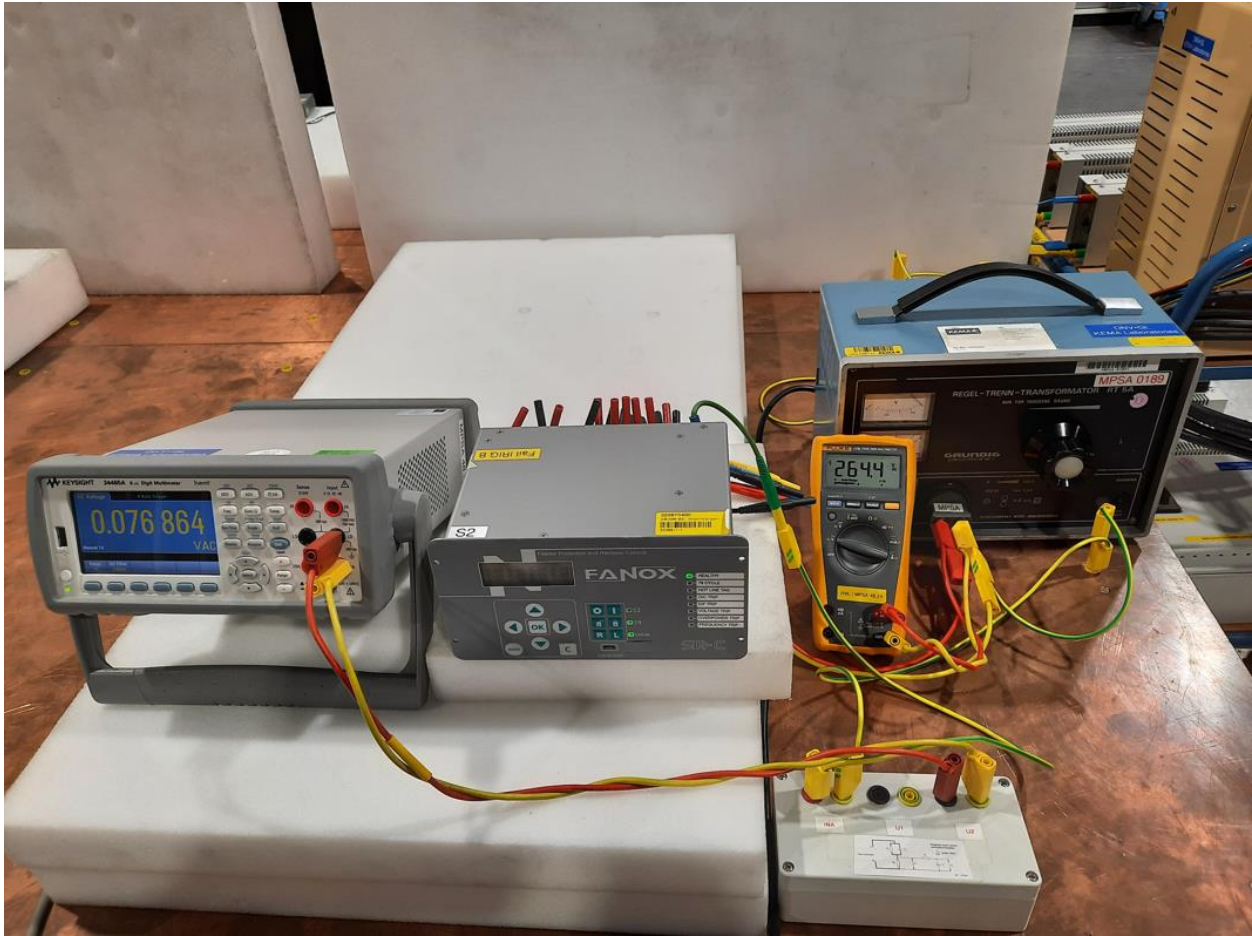
Serial number (SIR-C) 22600009
Rs 1500 Ω
Rb 500 Ω
Cs 0,22 μ F
R1 10 k Ω
C1 0,022 μ F

Power supply	85Vac	100Vac	230Vac	264,5Vac	Limit
<u>Test condition</u>	mA	mA	mA	mA	mA
Normal operation of equipment normal	0,32	0,38	0,88	1,00	3,50
Normal operation of equipment reverse polarity	0,32	0,38	0,92	1,04	3,50
General no connection to earth	0,16	0,16	0,18	1,80	3,50
Fault condition No,1 loss of protective earth	0,06	0,06	0,04	0,04	3,50
Fault condition No,1 neutral open	0,60	0,72	0,80	1,92	3,50
Fault condition No,1 neutral open, reverse polarity	0,60	0,72	1,70	1,92	3,50

Result

The object passed the test.

Photograph of test arrangement



Test setup for SIR-C

14.5 Reversal of DC power supply

Standard and date

Standard IEC 60255-1, subclause 6.15, IEC 60255-27, subclause 10.6.6

Test date August 29, 2022

Characteristic test data

Serial number (SIR-C) 22600009

Test voltage Vdc	Duration s	Observations
-24	60	1
-230	60	1

Observations

1. Normal startup and operating during the test.

Requirements

- The reversal application of the supply voltage shall not cause excessive internal temperatures, spread of fire or risk of electrical shock.

Result

The object passed the test.

Photograph of test arrangement



Test setup for SIR-C

14.6 Mains frequency voltage immunity

Standard and date

Standard IEC 6100-4-16
Test date August 29, 2022

Characteristic test data

Serial number (SIR-C) 22600009

Binary input 1 V_{ac}	Duration S	Observation
30	Continue	-
300	1	-

Observations

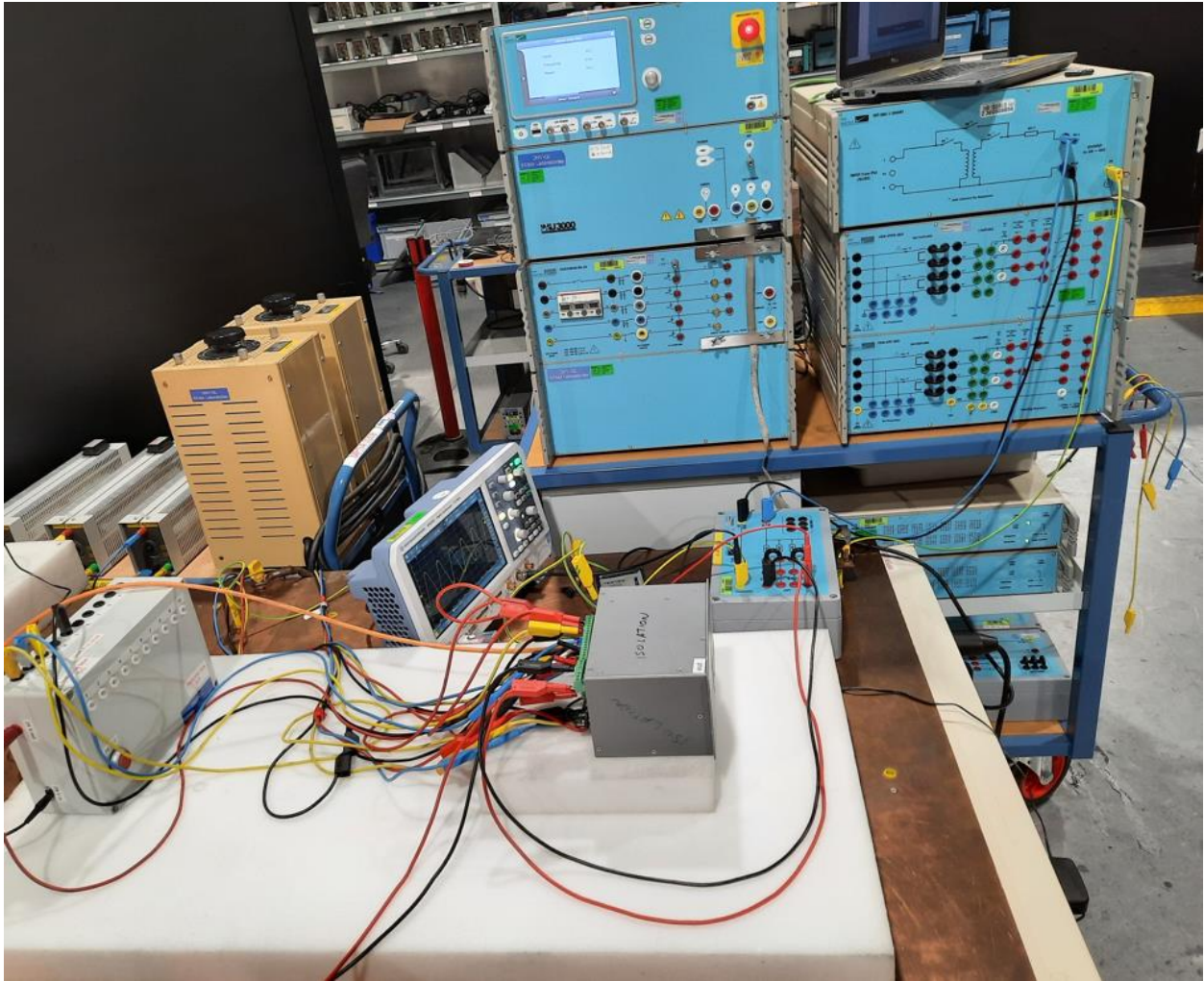
No degradation of performance observed.

Requirements

The input shall not be activated due the mains frequency voltage disturbance.

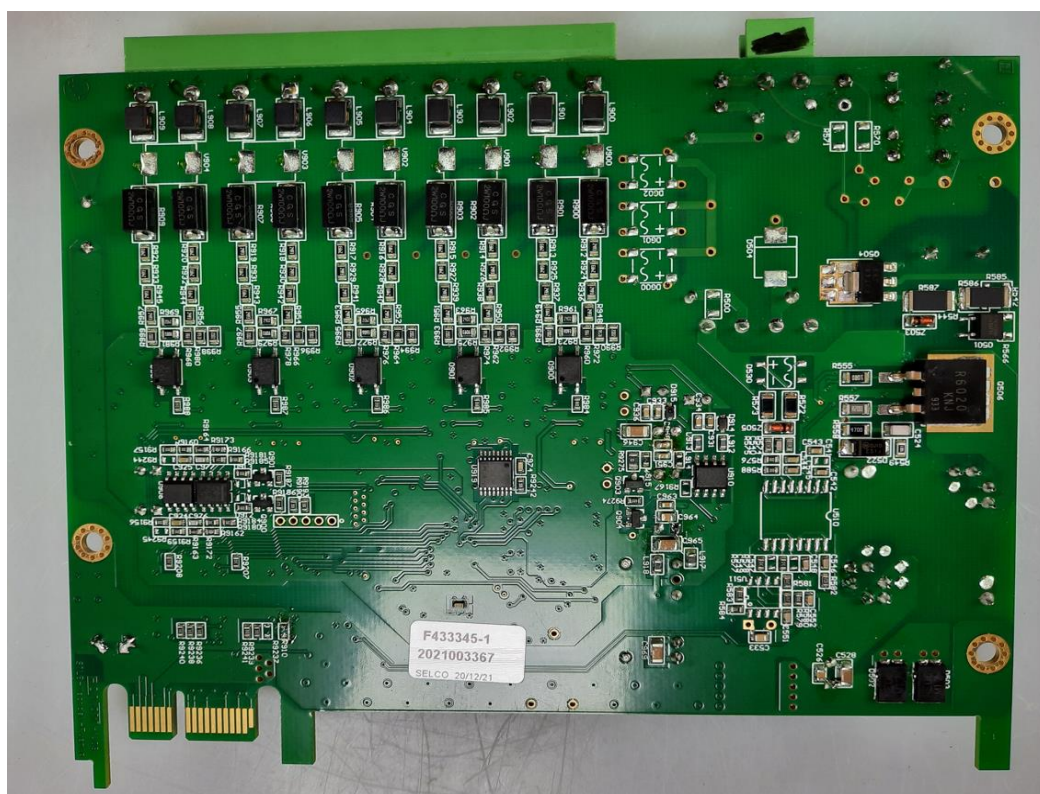
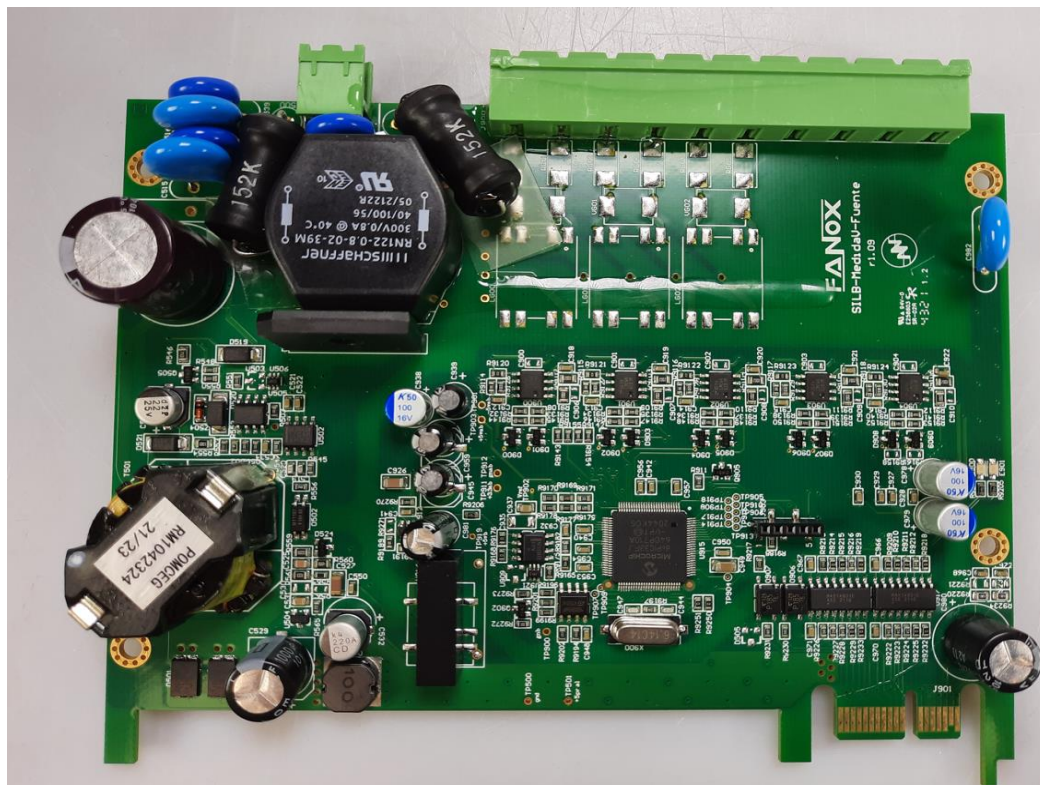
Result

The object passed the test.

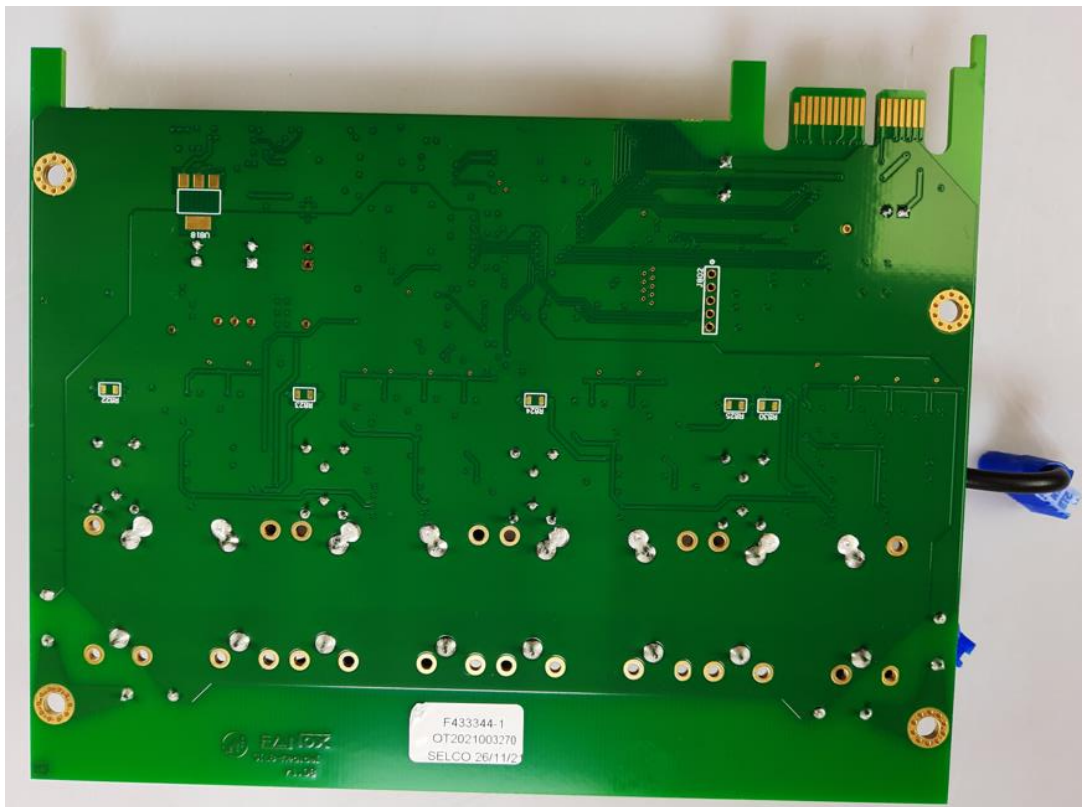
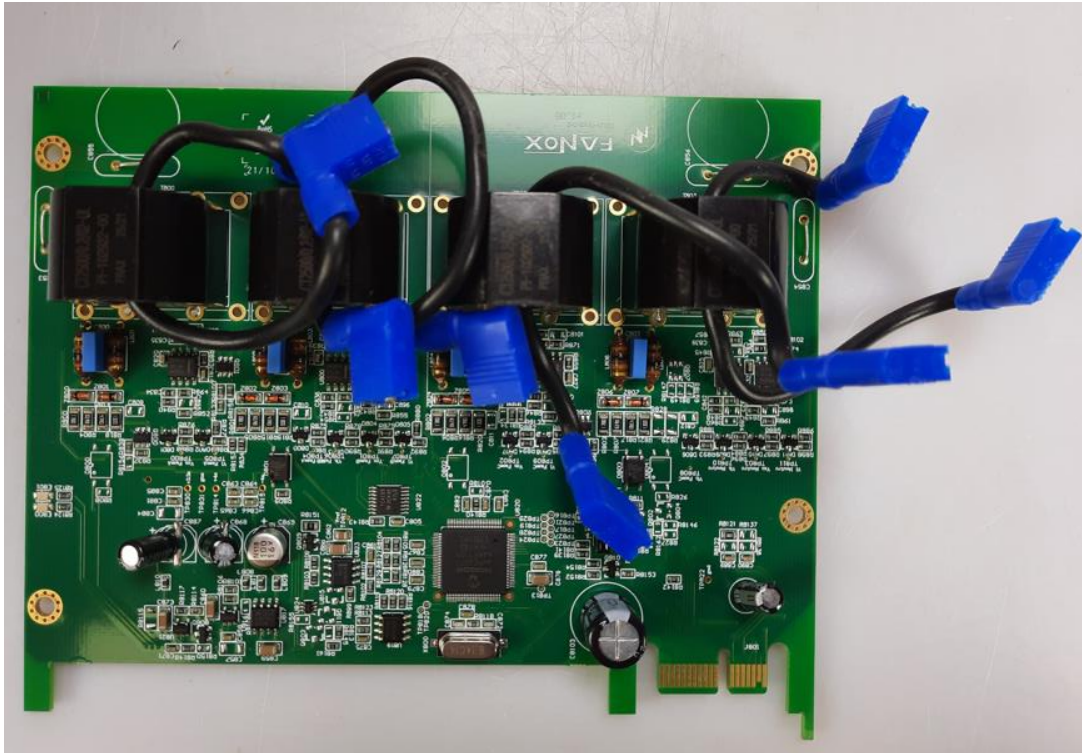
Photograph of test arrangement**Test setup for SIR-C**

15 PHOTOGRAPHS OF PRINTED CIRCUIT BOARDS

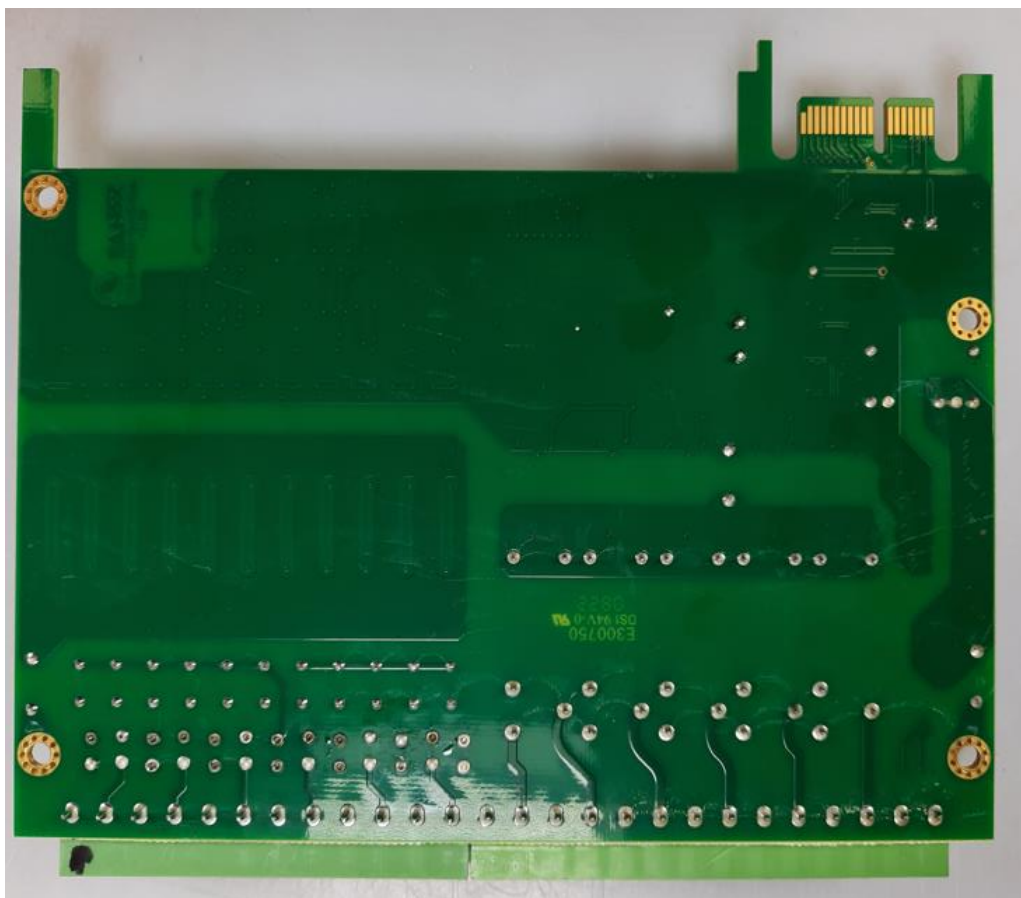
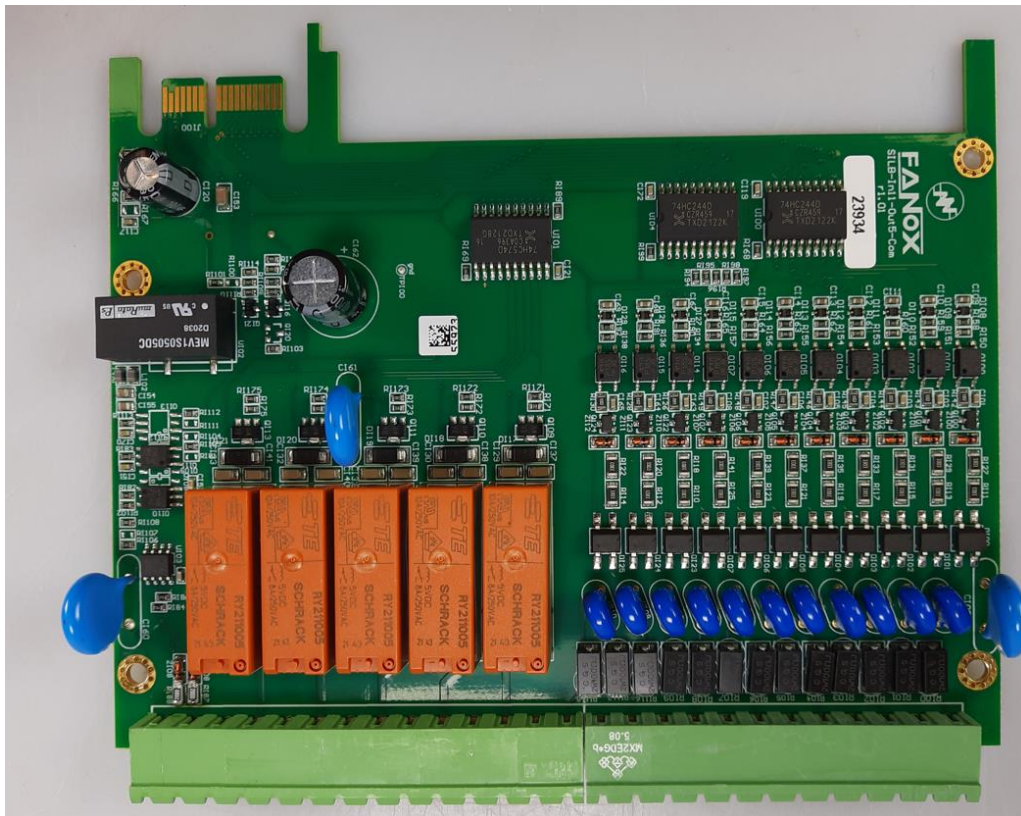
15.1 SIL-C



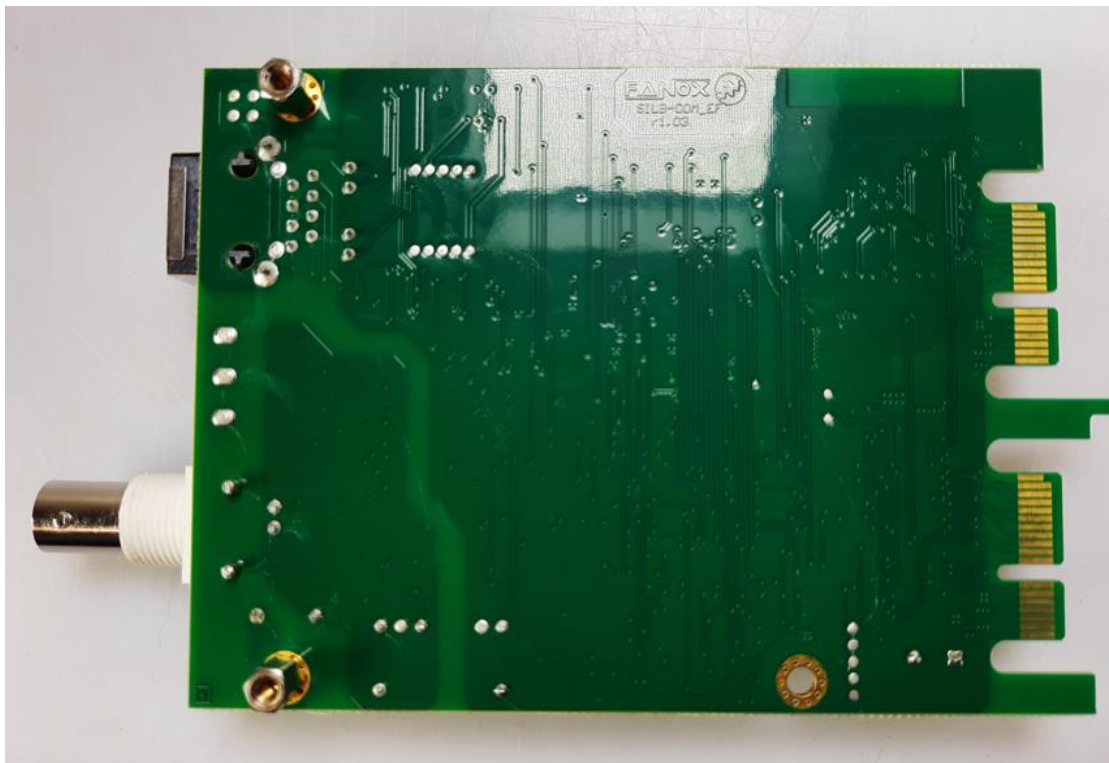
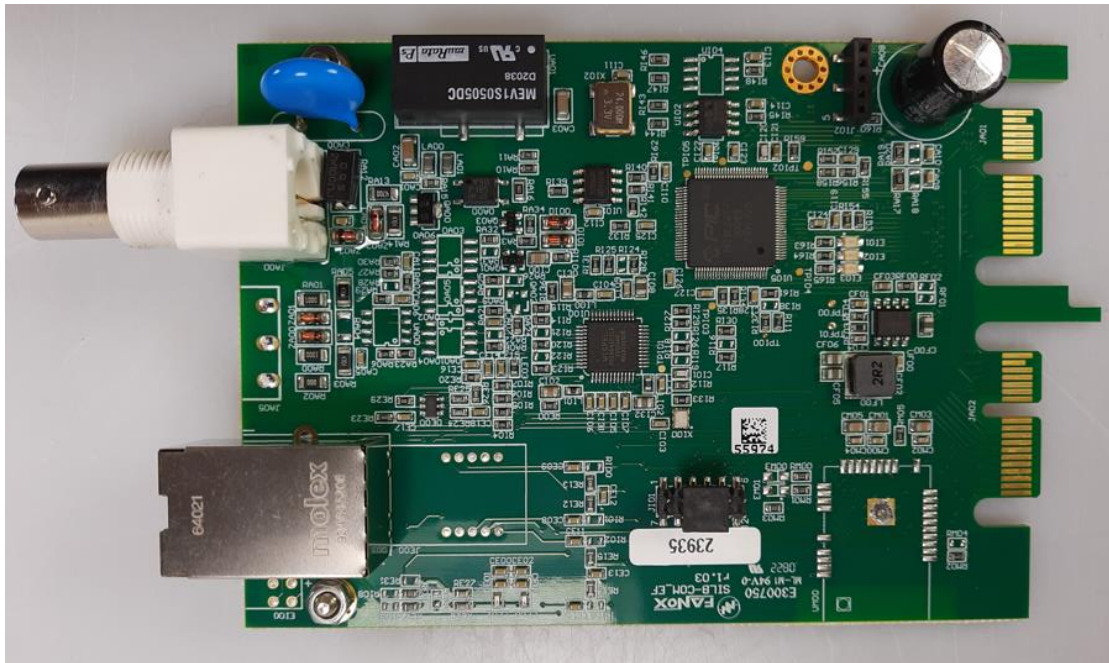
Power supply (PSU) and VT board v.109



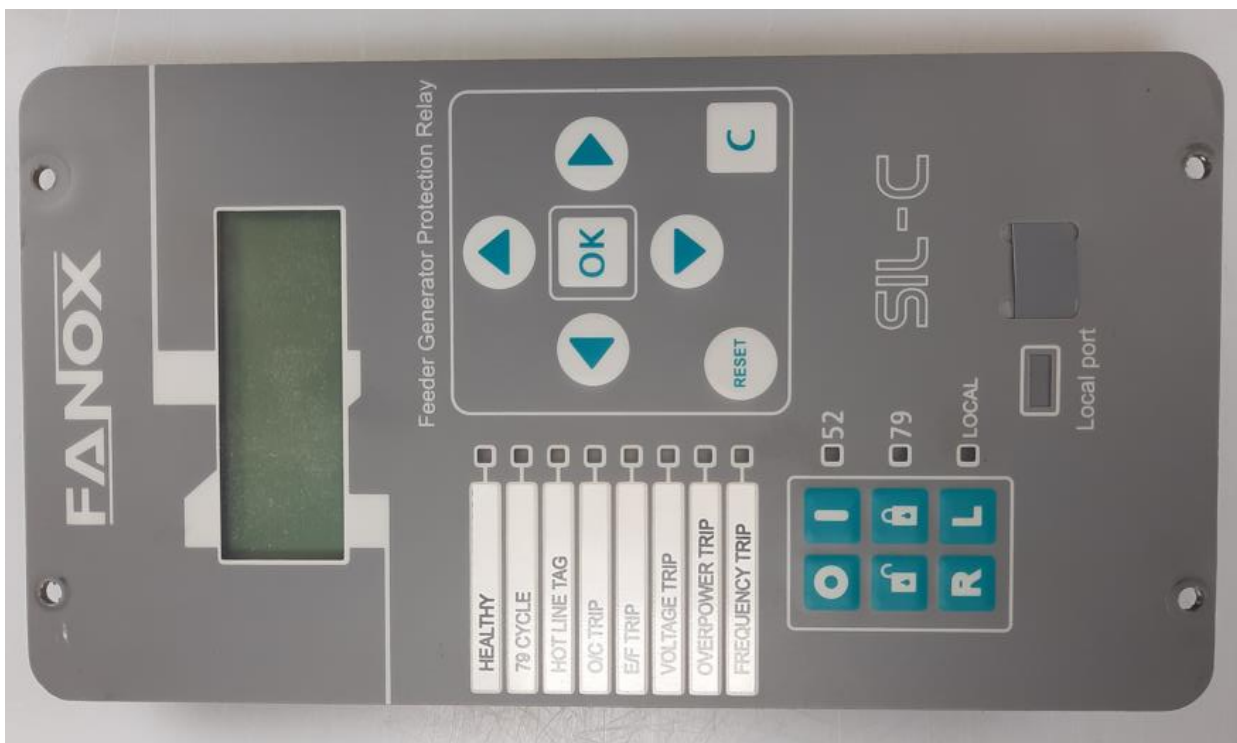
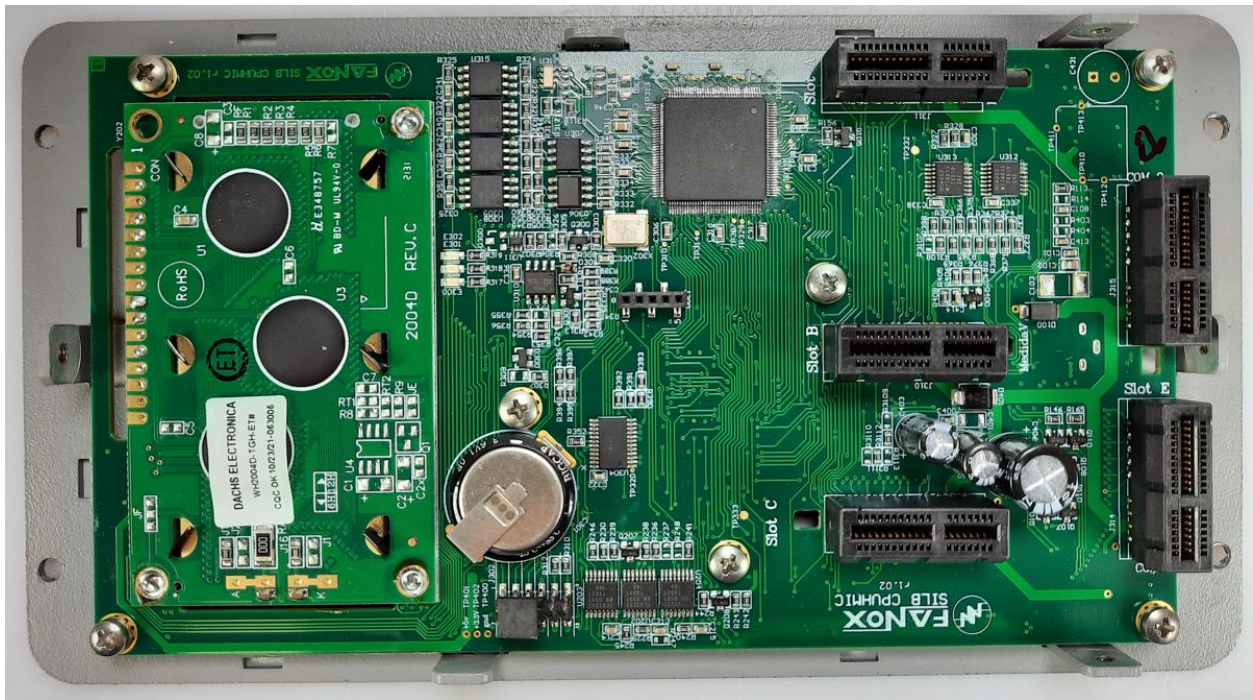
CT board V1.09



Binary input, Binary output and RS-485 board V1.01

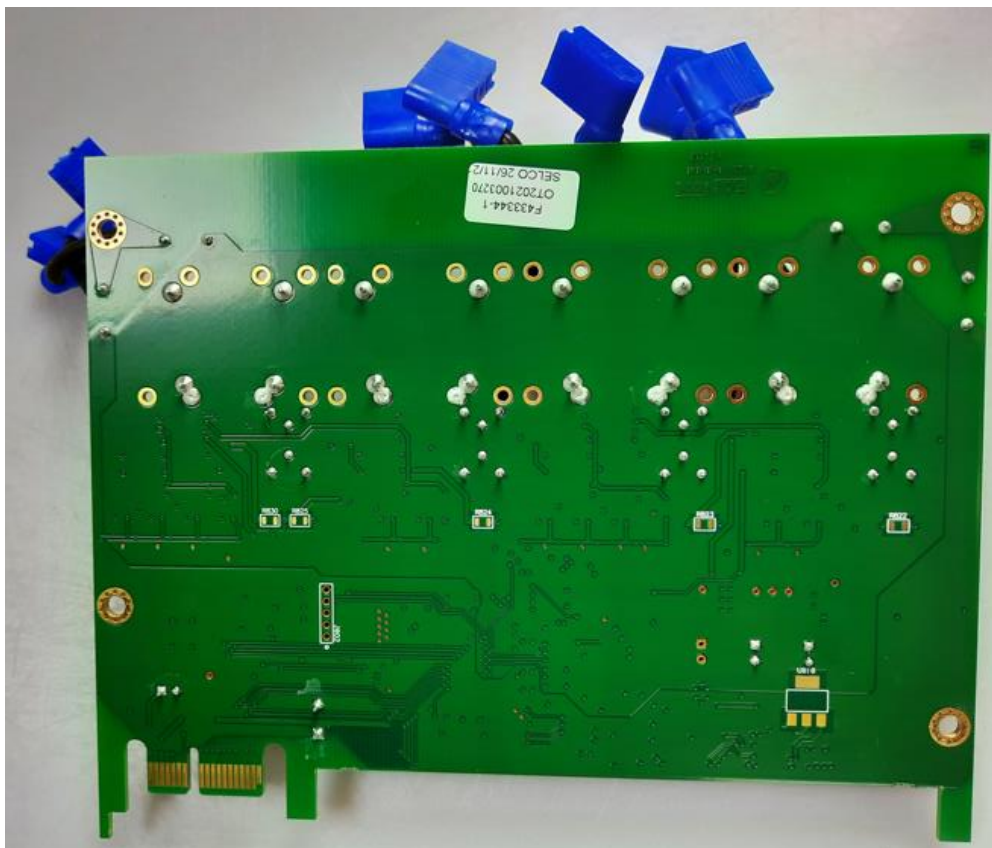
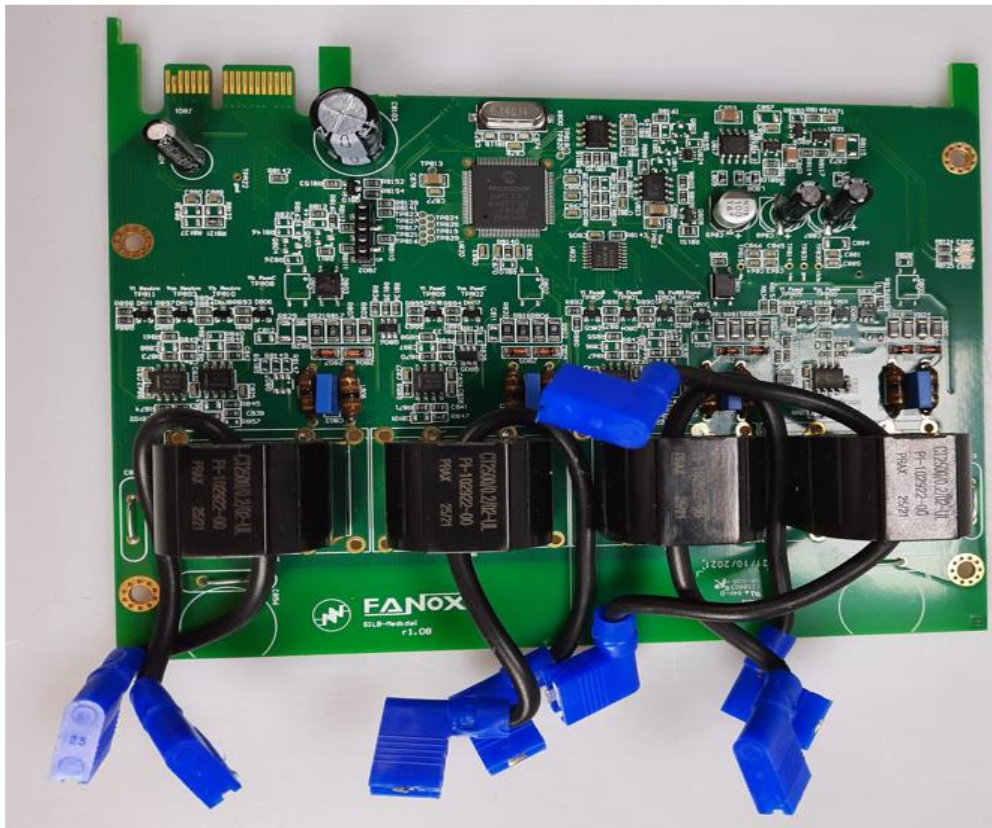


Communication board: Ethernet and IRIG-B V1.03



CPU and HMI board v.1.02

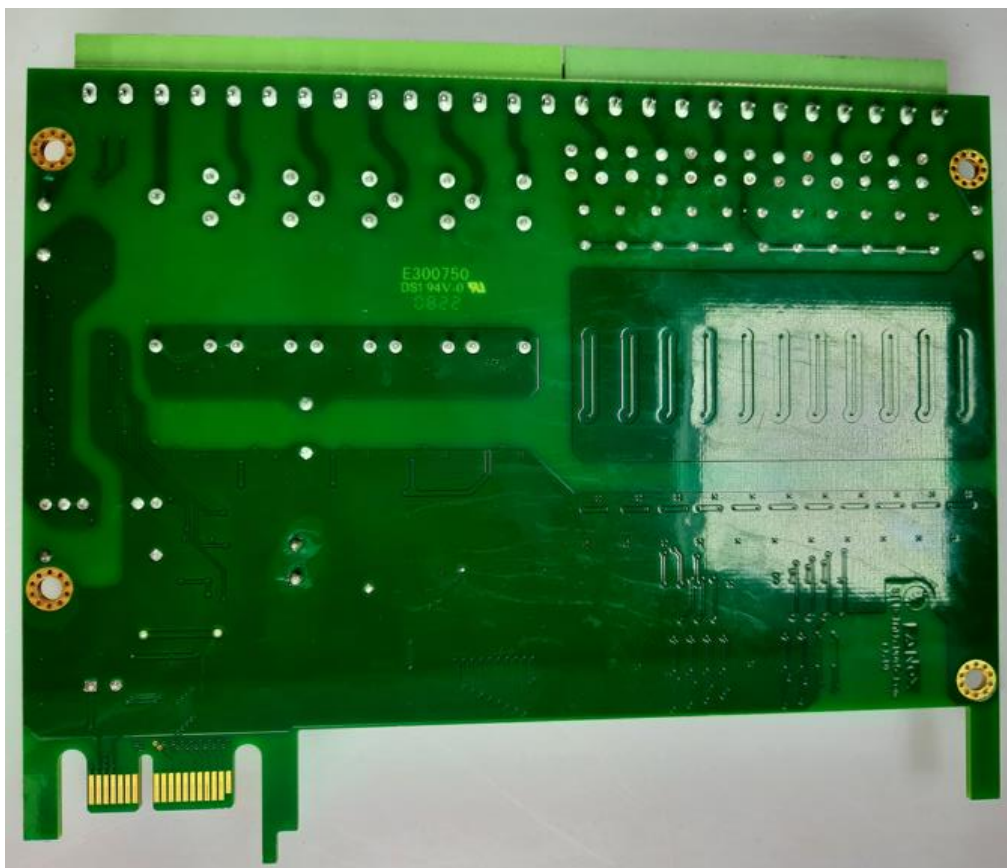
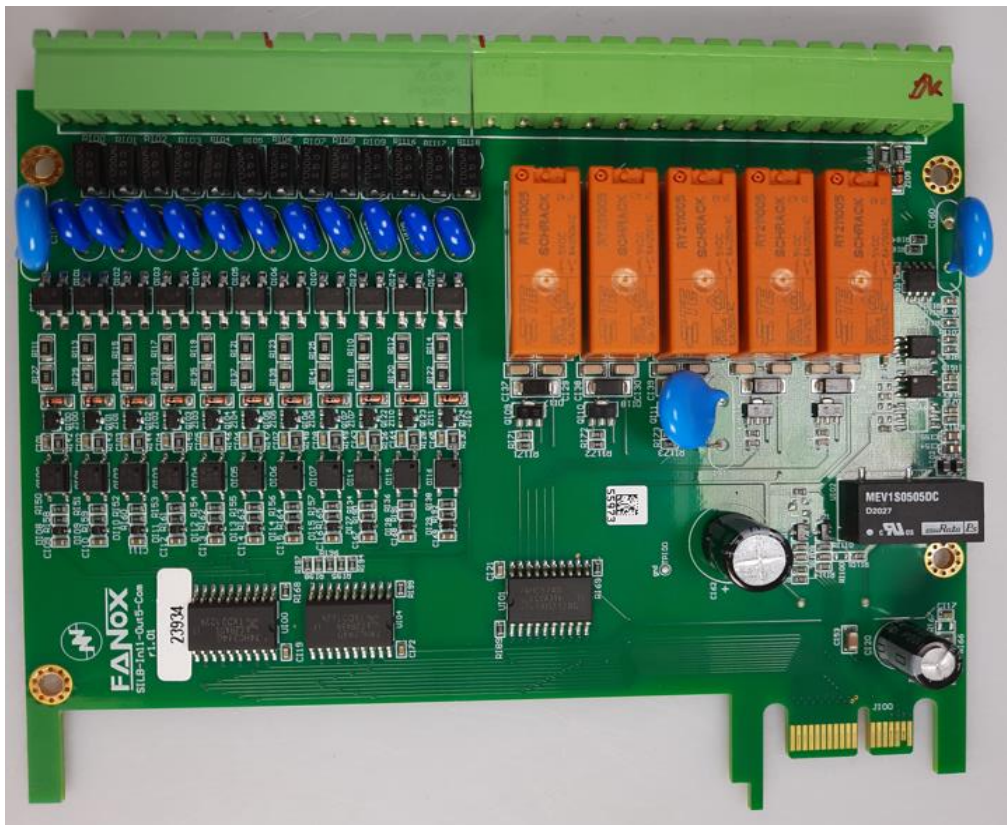
15.2 SIR-C



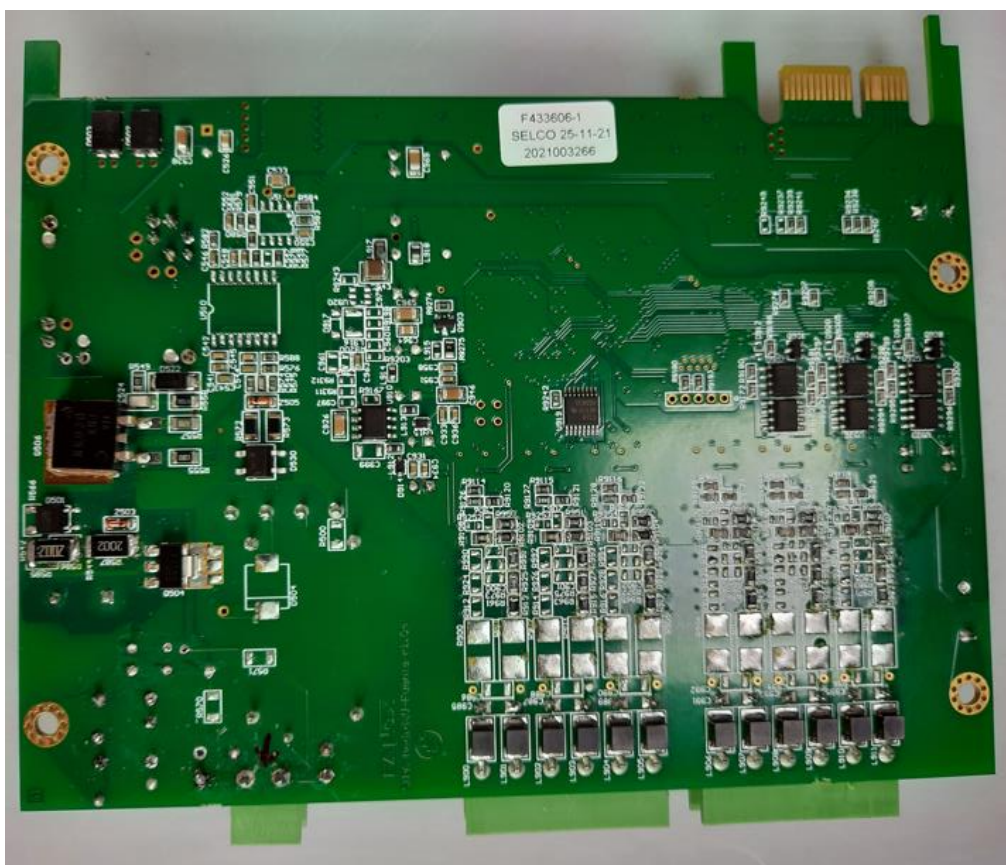
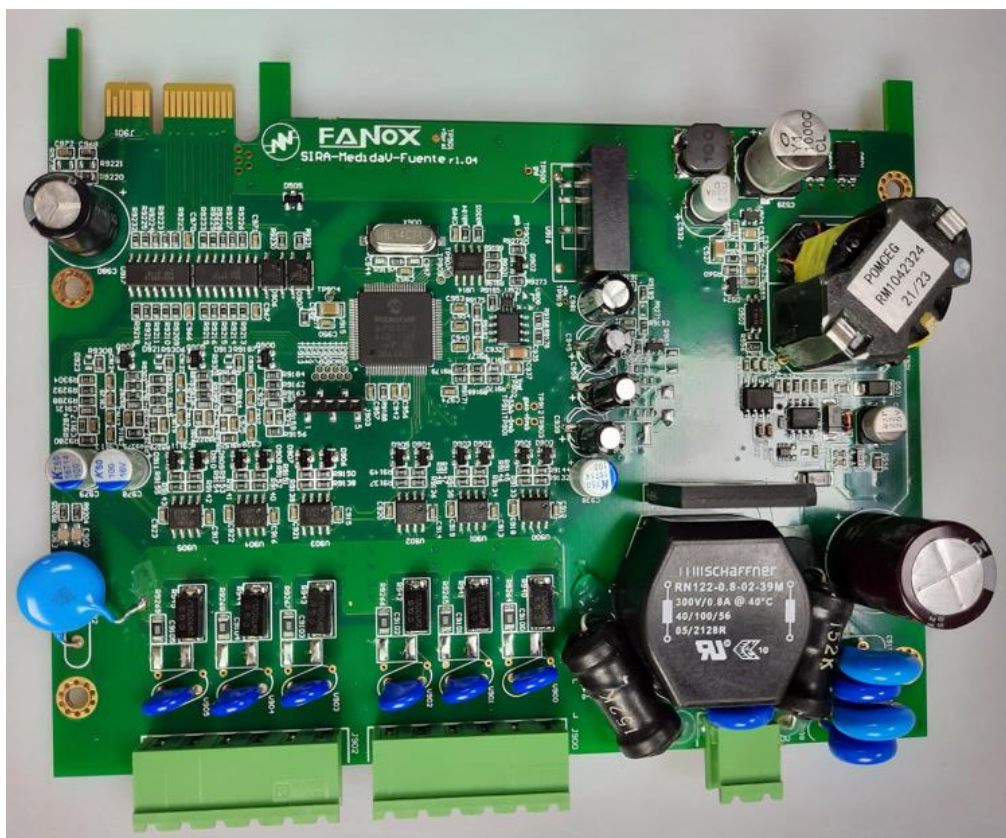
CT board



CPU and HMI board v.1.03



Binary input, Binary output and RS-485 board V1.01

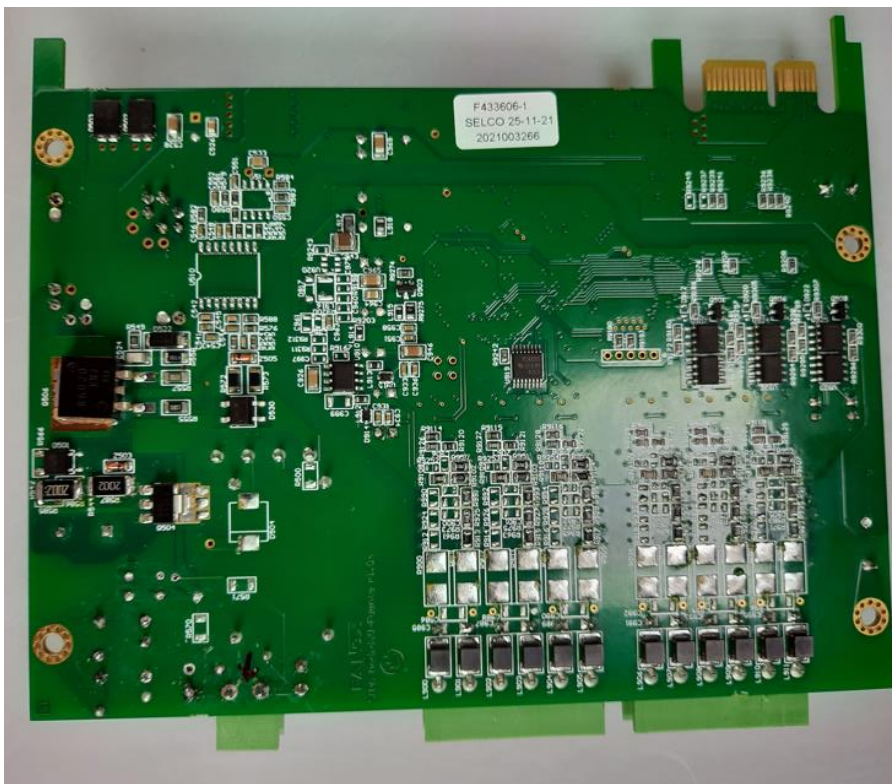
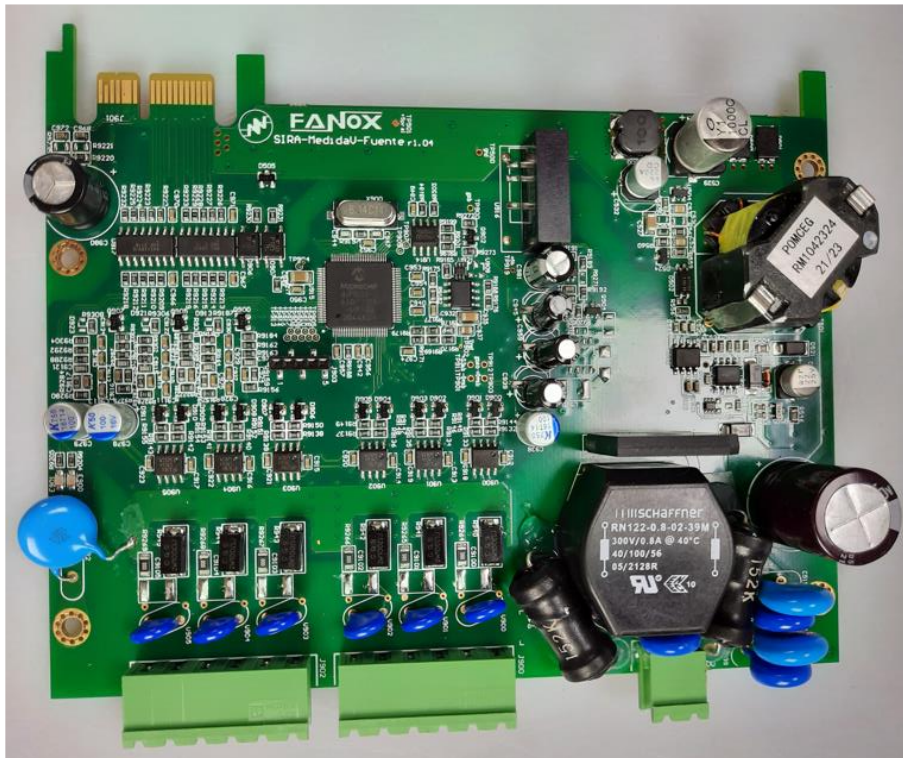


Power supply (PSU) and LEAR - VT board V1.04

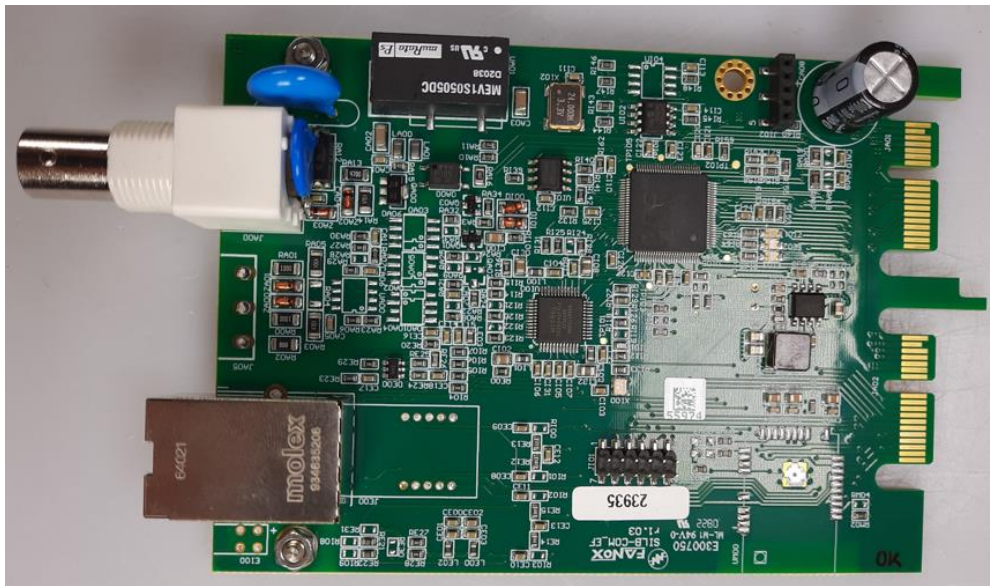


Communication board: Ethernet and IRIG-B V1.03

15.3 SIU-C



Power supply (PSU) and VT board V1.04



Communication board: Ethernet and IRIG-B V1.03



CPU and HMI board

16 MEASUREMENT UNCERTAINTY

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

16.1 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

16.2 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 is 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%.

17 LIST OF INSTRUMENTS USED

17.1 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
Dielectric 50Hz AC Voltage test	SQS Electronic	HA3300D	105156
Dielectric 50Hz AC Voltage test	SQS Electronic	HA4000D	125345

EMC test equipment			
Description	Manufacturer	Type	ORS number
Multi EMC generator	EMC-Partner	IMU3000 F6SRTDVC	152084
CDN	EMC-Partner	CDN3000A-08-32 690V	152089
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

Radiated EM-equipment DEKRA			
Description	Manufacturer	Type	Number
Measurement receiver	Rohde & Schwarz	ESU26	126351
Antenna	ARA	Horn DRG 118/a	118369
Anechoic chamber	COMTEST	1712-000	129683
Pre Amplifier	Kuhne	BB-0180-C-N	128919
Coax cable	Suhner	RG214	129994
Pulse Limiter	Rohde&Schwarz	ESH3-Z2	116979
Bilog Antenna	Schwarzbeck	Vulbane-9161-4010	116983
Controller	Maturo	NCD/194/17340915	-
Turntable	Maturo	TT 2.5-2t	-
Antenna mast	Maturo	BAM 4.0-P	-
Test software	Rohde&Schwarz	EMC32 V10.20.01	-
Conducted RF-equipment DEKRA			
EMI Test Receiver	Rohde&Schwarz	ESR 7	132186
Artificial Mains Network	Rohde&Schwarz	ESH2-Z5	128201
ISN / CDN/RJ45	Teseq	ST08	127031
Test Software	Rohde & Schwarz	EMC32 V.10.20.01	-
Immunity test equipment DEKRA			
Radiated Immunity test rack	Dekra Certification	TS 080	127190
BiconiLog Antenna	Teseq	CBL 6144	129745
Horn Antenna	ARA	DRG 118/a	116667
Anechoic Chamber	Siemens – Matsushita	EAC 52772	118125
Test Software	Rohde & Schwarz	EMC32 V.10.20.01	-

17.2 Environmental Measurement equipment

Environmental instrumentation S2T			
Description	Manufacturer	Type	Serial number
ICP Accelerometer (reference point)	PCB Piezotronics	353B34	203417
Shaker control system	Dactron	Laser	4816833
ICP Accelerometer (reference point)	PCB Piezotronics	353B18	175664
ICP Accelerometer (check point)	PCB Piezotronics	353B18	6419
Monitoring of the environmental conditions	Novasina	ClimaLog 30	1206059
Signal Conditioner	PCB Piezotronics	482C16	440
Position Drop Table	Lansmont Corporation	PDT-56 ^E	PT-56E-0216
Electric-dynamic shaker	Tira	TV59355/AIT-440 TGT Model 48XXL	036/07

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	PL Contactvingers	Test vinger 12,5mm	150691
Test finger 2.5mm	PL Contactvingers	Test vinger 2,5mm	150692
Test finger 1mm	PL Contactvingers	Test vinger 1mm	150693

17.3 Measurement equipment

Measurement equipment			
Description	Manufacturer	Type	ORS number
Oscilloscope	Rohde & Schwarz	RTB2002	152140
Oscilloscope	Rohde & Schwarz	RTB2002	152287
Oscilloscope	Rohde & Schwarz	RTB2004	152142
Oscilloscope	Rohde & Schwarz	RTM3002	152229
Current probe	Tektronix	TCP A300&303	151982 151983
Current probe	Tektronix	TCP A300&303	151942 151937
Oscilloscope	Tektronix	TBS 1052B	151943
Oscilloscope	Tektronix	TBS 1052B	151500
Oscilloscope	Tektronix	TBS 1052B	151519
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	152266
Multimeter	Fluke	8846A	152265
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	365	152025
Clamp meter			77395
Multimeter clamp meter	Fluke	337	104632
Multimeter 179	Fluke	179	152027
Multimeter 179	Fluke	179	152028

17.4 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