

## KEMA REPORT OF PERFORMANCE

1196-18

|                               |                                                                                                                                                                             |                   |                 |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------|
| <b>Object</b>                 | Self and dual powered relay with input energizing quantities for current protection                                                                                         |                   |                 |
| <b>Type</b>                   | SIAC11531132AG<br>SIAC11543032AE<br>SIAC11553032AE<br>SIAC116B1011AB<br>SIAC11542032AE<br>SIAC11552032AE<br>SIAC11551032AE<br>SIAC11551032AJ                                | <b>Serial No.</b> | see chapter 2.2 |
| <b>Client</b>                 | Fanox Electronic, S.L.,<br>Parque Tecnológico de Bizkaia, Edificio 604, Derio, Spain                                                                                        |                   |                 |
| <b>Manufacturer</b>           | Fanox Electronic, S.L.,<br>Parque Tecnológico de Bizkaia, Edificio 604, Derio, Spain *)                                                                                     |                   |                 |
| <b>Tested by</b>              | DNV GL Netherlands B.V.,<br>Arnhem, the Netherlands                                                                                                                         |                   |                 |
| <b>Date of tests</b>          | 30 April to 7 May 2018                                                                                                                                                      |                   |                 |
| <b>Test specification</b>     | The tests have been carried out in accordance with IEC 60255-26:2013, subclause 6.2, test items 4.5, 4.6, 4.7 and 4.8, IEC 61000-3-2:2018 and IEC 61000-3-3:2013, +A1:2017. |                   |                 |
| <b>Summary and conclusion</b> | The object has complied with the relevant requirements of the standards.                                                                                                    |                   |                 |

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

\*) as declared by the manufacturer

This report consists of 43 pages in total.

DNV GL Netherlands B.V.



J.P. Fonteijne  
Executive Vice President  
KEMA Laboratories



Laboratories

Arnhem, 12 June 2018

## 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 DNV GL. 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. DNV GL 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 DNV GL's Certification procedure applicable to KEMA Laboratories.

### 2 KEMA Report of Performance

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

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

### 3 KEMA Test Report

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

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

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

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

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

### 4 Official and uncontrolled test documents

The official test documents of DNV GL 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.

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## 1 SUMMARY

By order of the client type tests according to IEC 60255-26, subclause 6.2 (test items 4.5, 4.6, 4.7 and 4.8), IEC 61000-3-2 and IEC 61000-3-3 have been performed on the test object.

| Test / Measurement                                              | Test result |
|-----------------------------------------------------------------|-------------|
| Limits for harmonic current emissions                           | Passed      |
| Limitation of voltage changes, voltage fluctuations and flicker | Passed      |
| AC voltage dips and interruptions                               | Passed      |
| DC voltage dips and interruptions                               | Passed      |
| DC ripple                                                       | Passed      |
| DC gradual shutdown/start-up                                    | Passed      |

## 2 IDENTIFICATION OF THE OBJECT TESTED

### 2.1 Ratings/characteristics of the object tested

|                         |                    |
|-------------------------|--------------------|
| Rated voltage, $U_R$    | Not applicable Vac |
| Rated current $I_R$     | 1 A                |
| Rated frequency         | 50 and 60 Hz       |
| Rated auxiliary voltage | 85 – 265 Vac       |
|                         | 230 Vac            |
| Rated auxiliary voltage | 85 – 265 Vdc       |
|                         | 48 Vdc             |
|                         | 24 Vdc             |

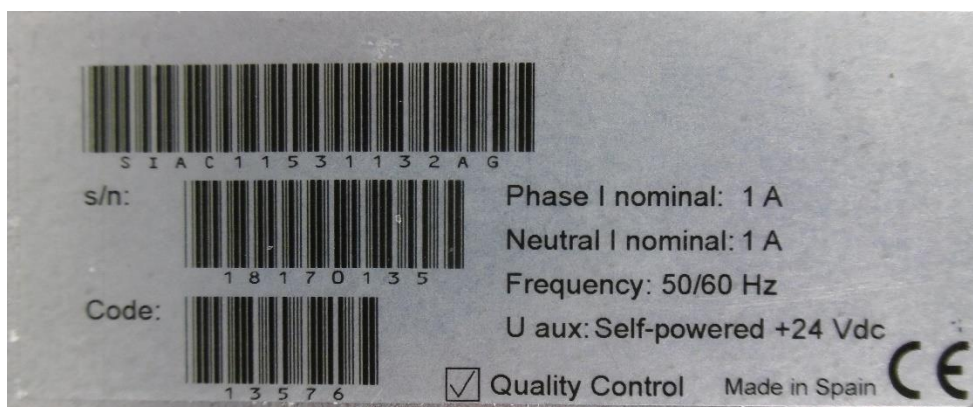
## 2.2 Description of the object tested

|              |                                                                                                                                  |
|--------------|----------------------------------------------------------------------------------------------------------------------------------|
| Manufacturer | Fanox Electronic, S.L.,<br>Derio, Spain                                                                                          |
| Type         | SIA-C                                                                                                                            |
| Object       | Self and Dual powered overcurrent and earth fault<br>protection relay with input energizing quantities for<br>current protection |
| Settings     | Unless otherwise specified, the default settings of the<br>manufacturer were used.                                               |

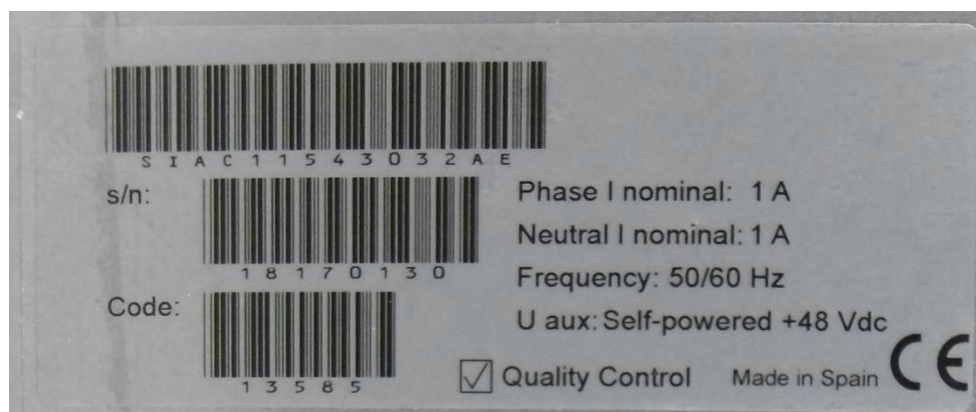
| Type                                                                               | Serial No. | Hardware               | Software / firmware |
|------------------------------------------------------------------------------------|------------|------------------------|---------------------|
| SIAC11531132AG<br>(self-powered and 24 Vdc,<br>striker and external trip)          | 18170135   | CPU: 1.06<br>IOS: 1.03 | 3.18/1.05           |
| SIAC11543032AE<br>(self-powered and 48 Vdc,<br>coil and external trip)             | 18170130   | CPU: 1.06<br>IOS: 1.03 | 3.18/1.05           |
| SIAC11553032AE<br>(self-powered and 85 –<br>265 Vac/dc, coil and<br>external trip) | 18170134   | CPU: 1.06<br>IOS: 1.03 | 3.18/1.05           |
| SIAC116B1011AB<br>(self-powered and 230 Vac,<br>striker and external trip)         | 18170099   | CPU: 1.06<br>IOS: 1.03 | 3.18/1.05           |

## 2.3 Photograph of test object

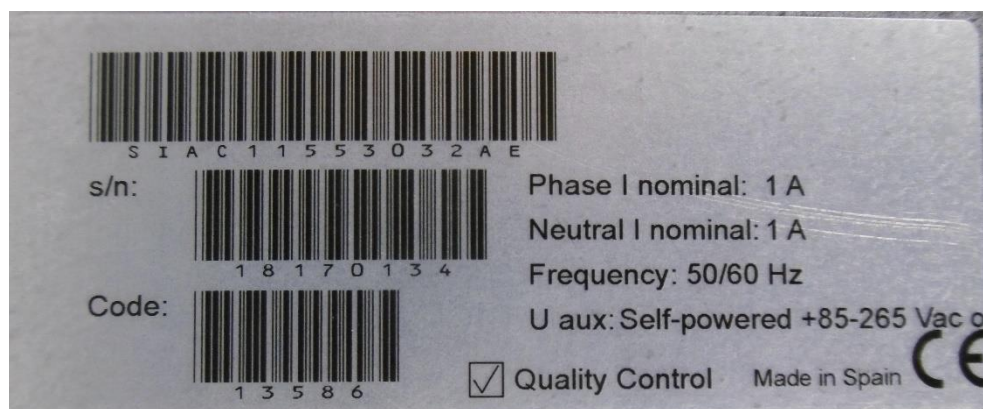
SIAC11531132AG



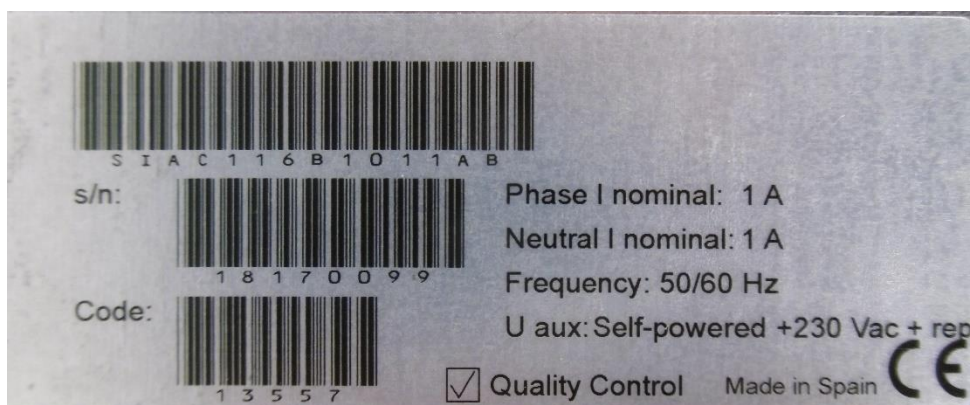
SIAC11543032AE



SIAC11553032AE



SIAC116B1011AB



### 3 GENERAL INFORMATION

#### 3.1 The tests were witnessed by

The tests were carried out without a representative of the client present.

#### 3.2 The tests were carried out by

| Name         | Company                                             |
|--------------|-----------------------------------------------------|
| Gert van Wee | DNV GL Netherlands B.V.,<br>Arnhem, the Netherlands |

#### 3.3 Subcontracting

The following tests were subcontracted to DEKRA, Arnhem, the Netherlands:

- measurement of harmonic current emission according IEC 61000-3-2
- measurement of inrush and flicker according IEC 61000-3-3.

#### 3.4 Purpose of the tests

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

#### 3.5 Instruments used

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

## 4 TEST ARRANGEMENT

A general test set-up is made by connecting the protective relay to an ac-current source. The protective relay is powered with rated auxiliary voltage. Currents are applied to the current input of the test object. The operation and resetting is monitored while powered by auxiliary power and/or by powering via the CT's (self-power mode). The protective relay is parameterized and monitored by means of the FANOX service tool SCom and the display and LED's on the test object.

## 5 RISK ASSESSMENT

Clause 7.3 in IEC 60255-1 describes that testing a product which is part of a product family shall be considered sufficient to cover the entire product family provided a documented risk assessment is carried out to determine which type tests are valid and which tests need to be repeated on the rest of the product family.

A risk assessment is performed for the following line protection IED's and modules:

| Tests performed according to                                  | Model SIAC115311 32AG | Model SIAC115430 32AE | Model SIAC115530 32AE | Model SIAC116B10 11AB | Model SIAC115420 32AE | Model SIAC115520 32AE |
|---------------------------------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| IEC 61000-3-2<br>IEC 61000-3-3<br>IEC 60255-26, subclause 6.2 | X                     | X                     | X                     | X                     | -                     | -                     |

### Legend

X = Test performed.

- = No test performed, see note.

### Note

No test has been performed because these models are electrically similar compared to the tested models. The only difference is these models are provided with the coil only option (no external trip). Therefore these models are deemed to comply with the test requirements without being tested.

## 6 ELECTROMAGNETIC COMPATIBILITY

### 6.1 Inspection

#### 6.1.1 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 (current)
- contact outputs
- data communication port

#### 6.1.2 Visual and functional inspection

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

The test object is dual powered. When a Minimum current is injected into the CT input the self-powered function takes over the powering. It is therefore not possible to conduct power supply port related tests when current is injected. Therefore, the tests have been applied on the auxiliary power supply input with no current injected. During the test some current has been injected momentarily to check if the current measuring function was still operational and to check if the self-powering function was still operational. In this particular case it is therefore not required to perform accuracy measurements.

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

There shall be no:

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

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

## 6.2 Harmonic current emissions

### Standard and date

Standard IEC 61000-3-2  
Basic standard -  
Test date 30 April 2018

### Environmental conditions

Ambient temperature 22 °C

### Characteristic test data

Type SIAC116B1011AB  
Serial number 18170099  
Test supply voltage 230 Vac  
Frequency 60 Hz  
Equipment class A

| Harmonic | Measured<br>A | Limit<br>A                                                                                                                    |
|----------|---------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1        | 0,0101        | -                                                                                                                             |
| 2        | <0,001        | 1,080                                                                                                                         |
| 3        | 0,0035        | 2,300                                                                                                                         |
| 4 - 40   | <0,001        | See IEC 61000-3-2<br>$8 \leq h \leq 40; 0,23 * \frac{8}{h}$<br>for odd harmonics:<br>$15 \leq h \leq 39; 0,15 * \frac{15}{h}$ |

**Characteristic test data**

Type SIAC11553032AE  
 Serial number 18170134  
 Test supply voltage 230 Vac  
 Frequency 50 Hz  
 Equipment class A

| Harmonic | Measured<br>A | Limit<br>A                                                                                                                                        |
|----------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | 0,0034        | -                                                                                                                                                 |
| 2        | <0,001        | 1,080                                                                                                                                             |
| 3        | 0,0032        | 2,300                                                                                                                                             |
| 4        | <0,001        | 0,430                                                                                                                                             |
| 5        | 0,0030        | 1,140                                                                                                                                             |
| 6        | <0,001        | 0,300                                                                                                                                             |
| 7        | 0,0027        | 0,770                                                                                                                                             |
| 8        | <0,001        | 0,230                                                                                                                                             |
| 9        | 0,0024        | 0,400                                                                                                                                             |
| 10       | <0,001        | 0,184                                                                                                                                             |
| 11       | 0,0019        | 0,330                                                                                                                                             |
| 12       | <0,001        | 0,153                                                                                                                                             |
| 13       | 0,0015        | 0,210                                                                                                                                             |
| 14       | <0,001        | 0,131                                                                                                                                             |
| 15       | 0,0011        | 0,150                                                                                                                                             |
| 16 - 40  | <0,001        | See IEC 61000-3-2 for even harmonics:<br>$8 \leq h \leq 40; 0,23 * \frac{8}{h}$<br>for odd harmonics:<br>$15 \leq h \leq 39; 0,15 * \frac{15}{h}$ |

**Note**

The test shall be conducted at 230 Vac only. For input voltages below 220 Vac no limits have been considered.

**Requirements**

The object shall comply with the equipment class A harmonic current emission limits of IEC 61000-3-2.

**Result**

The object passed the test.

**Photograph of test arrangement**



## 6.3 Inrush current

### Standard and date

Standard IEC 61000-3-3

Test date 30 April 2018

### Environmental conditions

Ambient temperature 22 °C

### Characteristic test data

Type SIAC116B1011AB  
 Serial number 18170099  
 Test supply voltage 230 Vac  
 Frequency 60 Hz

|              | P <sub>max</sub> | P <sub>st</sub> | P <sub>lt</sub> | t <sub>max</sub><br>s | D <sub>max</sub><br>% | D <sub>c</sub><br>% |
|--------------|------------------|-----------------|-----------------|-----------------------|-----------------------|---------------------|
| Measurements | 0,000            | 0,001           | 0,0031          | 0,000                 | 0,000                 | -                   |
| Limits       |                  | 1,00            | 0,65            | 0,50                  | 4,0                   | 3,3                 |

### Note

The P<sub>lt</sub> has been calculated over 12 periods.

### Observations

No significant inrush and flicker has been measured.

### Characteristic test data

Type SIAC11553032AE  
 Serial number 18170134  
 Test supply voltage 230 Vac  
 Frequency 50 Hz

|              | P <sub>max</sub> | P <sub>st</sub> | P <sub>lt</sub> | t <sub>max</sub><br>s | D <sub>max</sub><br>% | D <sub>c</sub><br>% |
|--------------|------------------|-----------------|-----------------|-----------------------|-----------------------|---------------------|
| Measurements | 0,000            | 0,001           | 0,0031          | 0,000                 | 0,000                 | -                   |
| Limits       |                  | 1,00            | 0,65            | 0,50                  | 4,0                   | 3,3                 |

### Note

The P<sub>lt</sub> has been calculated over 12 periods.

The requirements are applicable for equipment to be connected to a power distribution system with a line to neutral voltage of 220 – 250 Vac at 50 Hz. Therefore, the test has been performed with 230 Vac 50 Hz power supply voltage.

### Observations

No significant inrush and flicker has been measured.

**Requirements**

The object shall comply with the inrush and flicker requirements of IEC 61000-3-3.

**Result**

The object passed the test.

**Photograph of test arrangement**

## 6.4 Voltage dips and voltage interruptions on AC power supply voltage

### Standard and date

|                |                                                    |
|----------------|----------------------------------------------------|
| Standard       | IEC 60255-26, subclause 6.2, test item 4.5 and 4.6 |
| Basic standard | IEC 61000-4-11                                     |
| Test date      | 1 May 2018                                         |

### Environmental conditions

|                     |         |
|---------------------|---------|
| Ambient temperature | 21,6 °C |
|---------------------|---------|

### Characteristic test data

|                                                  |                |
|--------------------------------------------------|----------------|
| Type                                             | SIAC116B1011AB |
| Serial number                                    | 18170099       |
| Voltage dips                                     | 30, 60 %       |
| Voltage dip duration (no. cycles)                | 25, 10         |
| Voltage interruptions                            | 100 %          |
| Voltage dips duration <sup>a)</sup> (no. cycles) | .... Cycles    |
| Voltage interruptions (no. cycles)               | 250            |
| High impedance                                   | ≥100 kΩ        |
| Number of voltage dips                           | 3              |
| Interruption between dips                        | ≥10            |

<sup>a)</sup> Manufacturer shall declare the duration among the following values: 0,5 cycle, 1 cycle, 2,5 cycles, 5 cycles, 10 cycles or 25 cycles. The manufacturer did not specify the characteristic value.

| PSU voltage range | Minimum       | Maximum |     |
|-------------------|---------------|---------|-----|
| AC                | -             | -       | Vac |
| AC                | 230 V +/- 20% |         | Vac |

Test voltage: 230 – 20% = 184 V.

Setting; In = 0,080 A, in quiescent mode (no pickup)

Setting In = 0A

### Test result AC voltage dips

| PSU | Dips duration (no. cycles) | Dips | Performance criteria | Residual voltage | Observations |
|-----|----------------------------|------|----------------------|------------------|--------------|
| Vac |                            | %    |                      | Vac              |              |
| 184 | 25                         | 30   | C                    | 128              | 1            |
| 184 | 30                         | 30   | C                    | 128              | 1            |
| 184 | 10                         | 60   | C                    | 73               | 2            |
| 184 | 12                         | 60   | C                    | 73               | 2            |
| 184 | ≤ 5 at 50 Hz               | 0    | A                    | 0                | 3            |
| 184 | ≤ 2,5 at 60 Hz             | 0    | A                    | 0                | 4            |

All phase angles according IEC 61000-4-11 have been tested (0, 45, 90, 135, 180, 225, 270, 315)

There are two states in powering;

1. Runs in self-powered mode ( $I_{Ct} \geq 0,08 \text{ A}$ ), @ 0,15A full self-powering (LED self-power blinks)
2. Runs in auxiliary powered mode ( $I_{Ct} = 0 \text{ A}$ )

With  $I_n = 0,08 \text{ A}$  and also auxiliary powered no change of state for all tests (DUT takes power from the  $C_t$ 's during the interruptions).

### Observations

With  $I_n = 0 \text{ A}$ , the DUT runs on auxiliary power only, see observations in the table and in detail below;

1. Short interruption of reading and indication of power LED Vaux, no change of state of control/protection
2. Short interruption of reading and indication of power LED Vaux, Short interruption of reading and indication of power LED Vaux, no change of state of control/protection
3. 0,5/1/2,5/5 cycles interruption does not result in a change of state. Power interruptions >5 cycles; the DUT operation is interrupted. Control/protection; no change of state.
4. 0,5/1/2,5 cycles interruption does not result in a change of state. Power interruptions >2,5 cycles; the DUT operation is interrupted. Control/protection; no change of state.

### Test result AC voltage interruptions

| PSU<br>Vac | Interruption duration<br>(no. cycles) | Performance<br>criteria | Observations |
|------------|---------------------------------------|-------------------------|--------------|
| 0          | 250/300                               | C                       | 1            |

### Observations

1. DUT switches off when there is insufficient current to activate the self-powering function. After the test the DUT restarts without user intervention. No change of state of the control/protection.

### Requirements

- the object shall comply with acceptance criteria C in clause 8.2 of IEC 60255-26 for 30% and 60% dips
- the object shall comply with acceptance criteria A in clause 8.2 of IEC 60255-26 for 100% dips
- the object shall comply with acceptance criteria C in clause 8.2 of IEC 60255-26 for interruptions
- the visual and functional inspection shall not reveal any defects or malfunctions.

### Result

The object passed the test. It passed the test for interruptions  $\leq 2,5$  cycles.

|                                                  |                |
|--------------------------------------------------|----------------|
| Type                                             | SIAC11553032AE |
| Serial number                                    | 18170134       |
| Voltage dips                                     | 30, 60 %       |
| Voltage dip duration (no. cycles)                | 25, 10         |
| Voltage interruptions                            | 100 %          |
| Voltage dips duration <sup>a)</sup> (no. cycles) | .... Cycles    |
| Voltage interruptions (no. cycles)               | 250            |
| High impedance                                   | ≥100 kΩ        |
| Number of voltage dips                           | 3              |
| Interruption between dips                        | ≥10            |

<sup>a)</sup> Manufacturer shall declare the duration among the following values: 0,5 cycle, 1 cycle, 2,5 cycles, 5 cycles, 10 cycles or 25 cycles. The manufacturer did not specify the characteristic value.

| PSU voltage range | Minimum   | Maximum   |     |
|-------------------|-----------|-----------|-----|
| AC                | 85 – 20 % | 265 + 20% | Vac |
| AC                | -         |           | Vac |

Test voltage; 85 – 20% = 68 V.

### Test result AC voltage dips

85 - 265 Vac model

| PSU | Dips duration (no. cycles) | Dips | Performance criteria | Residual voltage | Observations |
|-----|----------------------------|------|----------------------|------------------|--------------|
| Vac |                            | %    |                      | Vac              |              |
| 68  | 25                         | 30   | C                    | 47,6             | -            |
| 68  | 30                         | 30   | C                    | 47,6             | -            |
| 68  | 10                         | 60   | C                    | 27,2             | 1            |
| 68  | 12                         | 60   | C                    | 27,2             | 1            |
| 68  | ≤ 5 at 50 Hz               | 0    | A                    | 0                | 2            |
| 68  | ≤ 5 at 60 Hz               | 0    | A                    | 0                | 2            |

### Test result AC voltage interruptions

| PSU | Interruption duration (no. cycles) | Performance criteria | Observations |
|-----|------------------------------------|----------------------|--------------|
| Vac |                                    |                      |              |
| 0   | 250/300                            | C                    | 3            |

### Observations

With no current in the Ct's, operating solely on the auxiliary power supply;

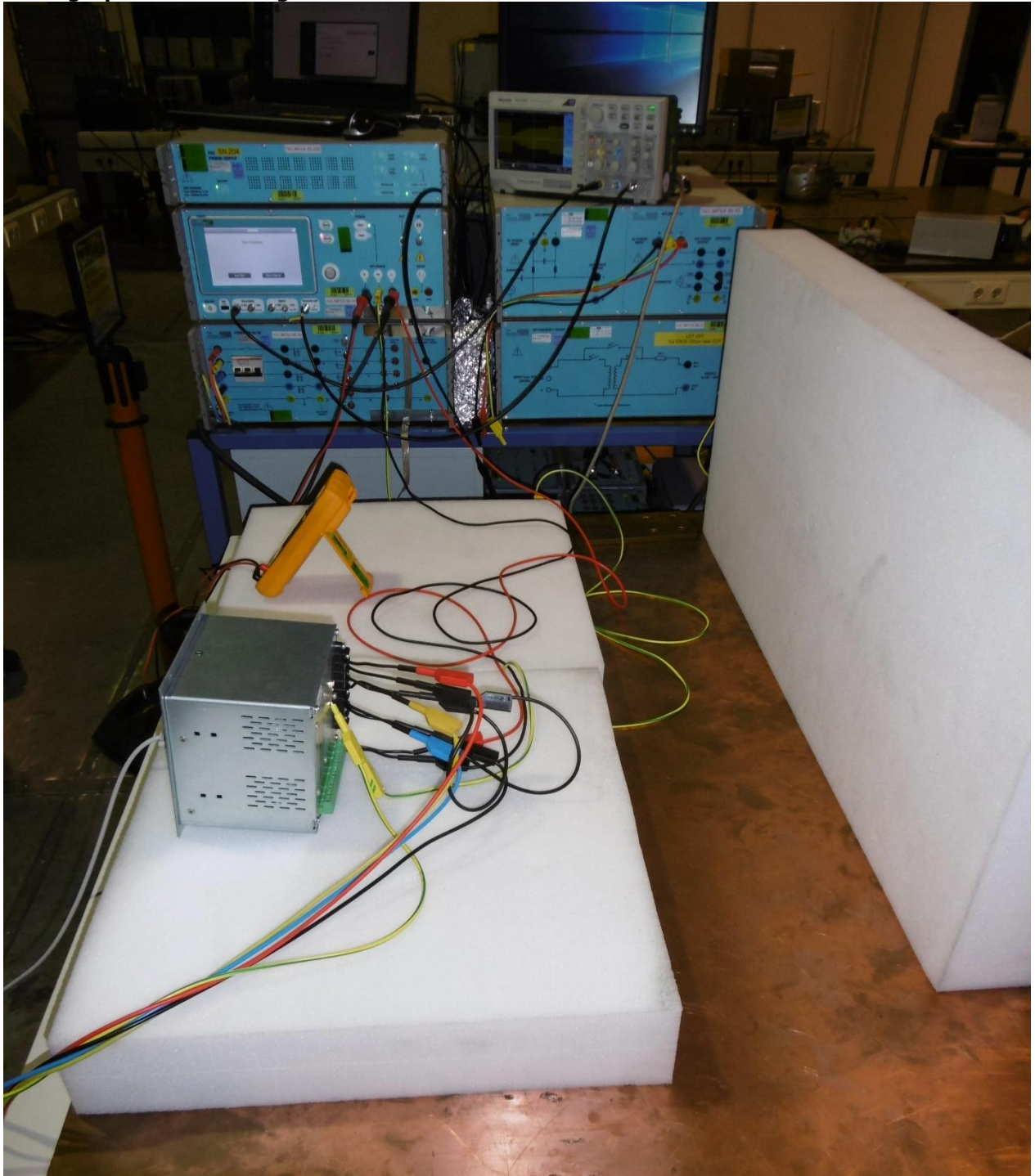
1. Short interruption of reading and indication of power LED Vaux, no change of state of control/protection
2. 0,5/1/2,5/5 cycles interruption does not result in a change of state. Power interruptions > 5 cycles; the DUT operation is interrupted. Control/protection; no change of state. DUT switches off when there is insufficient current to activate the self-powering function.
3. DUT switches off when there is insufficient current to activate the self-powering function. After the test the DUT restarts without user intervention. No change of state of the control/protection.

**Requirements**

- the object shall comply with acceptance criteria C in clause 8.2 of IEC 60255-26 for 30% and 60% dips
- the object shall comply with acceptance criteria A in clause 8.2 of IEC 60255-26 for 100% dips
- the object shall comply with acceptance criteria C in clause 8.2 of IEC 60255-26 for interruptions
- the visual and functional inspection shall not reveal any defects or malfunctions.

**Result**

The object passed the test. It passed the test for interruptions  $\leq 5$  cycles.

**Photograph of test arrangement**

## 6.5 Voltage dips and voltage interruptions on DC power supply voltage

### Standard and date

|                |                                                    |
|----------------|----------------------------------------------------|
| Standard       | IEC 60255-26, subclause 6.2, test item 4.5 and 4.6 |
| Basic standard | IEC 61000-4-29                                     |
| Test date      | 3 May 2018                                         |

### Environmental conditions

|                     |       |
|---------------------|-------|
| Ambient temperature | 22 °C |
|---------------------|-------|

### Characteristic test data

|                                                 |                |
|-------------------------------------------------|----------------|
| Type                                            | SIAC11531132AG |
| Serial number                                   | 18170135       |
| Voltage dips                                    | 30, 60 %       |
| Voltage dip duration                            | 500, 200 ms    |
| Voltage interruptions                           | 100 %          |
| Voltage dips duration <sup>a)</sup> (100% dips) | .... ms        |
| Voltage interruptions                           | 5 s            |
| High impedance                                  | ≥100 kΩ        |
| Number of voltage dips                          | 3              |
| Interruption between dips                       | ≥10 s          |

<sup>a)</sup> Manufacturer shall declare the duration among the following values: 10 ms, 20 ms, 30 ms, 50 ms, 100 ms, 200 ms, 300 ms, 500 ms or 1000 ms

| PSU voltage range | Minumum    | Maximum |     |
|-------------------|------------|---------|-----|
| DC                | -          | -       | Vdc |
| DC                | 24 +/- 10% |         | Vdc |

The test voltage is  $24 - 10\% = 21,6 \text{ V}$

### Voltage dips

| PSU<br>Vdc / impedance | Dips duration<br>ms | Dips<br>% | Residual voltage<br>Vdc | Observations |
|------------------------|---------------------|-----------|-------------------------|--------------|
| 21,6                   | 500                 | 30        | 15,12                   | 1            |
| 21,6                   | 200                 | 60        | 8,64                    | 1            |
| 21,6 / low             | 10 - 1000           | 0         | 0                       | 2            |
| 21,6 / high            | 10 - 1000           | 0         | 0                       | 3            |

### Voltage interruptions

| PSU<br>Vdc/ load impedance | Interruption duration<br>ms | Observations |
|----------------------------|-----------------------------|--------------|
| 21,6 / low                 | 5000                        | 4            |
| 21,6 / high                | 5000                        | 4            |

### Observations

1. DUT switches off but resumes normal operation after the test. No change of state of the protection/control observed (no change of trip contact). Output contacts state changes and returns to the initial, energized state.
2. The DUT remains operational at interruptions 10 – 50 ms. At  $\geq 100$  ms the device shuts down and restarts without user intervention. Output contacts state changes and return after the test to the initial, energized state. No change of state of the protection/control function observed.
3. The DUT remains operational at interruptions 10 – 50 ms. At  $\geq 100$  ms, the device shuts down and restarts without user intervention. Output contacts state changes and return after the test to the initial, energized state. No change of state of the protection/control function observed.
4. DUT switches off but resumes normal operation after the test. No change of state of the protection/control observed (no change of trip contact). Output contacts state changes and return after the test to the initial, energized state.

### Requirements

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

### Result

The object passed the test. It passed the test for interruptions  $\leq 50$  ms.

### Characteristic test data

|                                                 |                       |
|-------------------------------------------------|-----------------------|
| Type                                            | SIAC11543032AE        |
| Serial number                                   | 18170130              |
| Voltage dips                                    | 30, 60 %              |
| Voltage dip duration                            | 500, 200 ms           |
| Voltage interruptions                           | 100 %                 |
| Voltage dips duration <sup>a)</sup> (100% dips) | .... ms               |
| Voltage interruptions                           | 5 s                   |
| High impedance                                  | $\geq 100$ k $\Omega$ |
| Number of voltage dips                          | 3                     |
| Interruption between dips                       | $\geq 10$ s           |

<sup>a)</sup> Manufacturer shall declare the duration among the following values: 10 ms, 20 ms, 30 ms, 50 ms, 100 ms, 200 ms, 300 ms, 500 ms or 1000 ms. The manufacturer did not specify the characteristic value.

| PSU voltage range | Minumum    | Maximum |     |
|-------------------|------------|---------|-----|
| DC                | -          | -       | Vdc |
| DC                | 48 +/- 10% |         | Vdc |

The test voltage is  $48 - 10\% = 43,2$  V

### Voltage dips

| PSU<br>Vdc / load impedance | Dips duration<br>ms | Dips<br>% | Residual voltage<br>Vdc | Observations |
|-----------------------------|---------------------|-----------|-------------------------|--------------|
| 43                          | 500                 | 30        | 30,20                   | -            |
| 43                          | 200                 | 60        | 17,28                   | -            |
| 43 / low                    | 10 - 1000           | 0         | 0                       | 1            |
| 43 / high                   | 10 - 1000           | 0         | 0                       | 2            |

**Voltage interruptions**

| PSU<br>Vdc / load impedance | Interruption duration<br>ms | Observations |
|-----------------------------|-----------------------------|--------------|
| 43 / low                    | 5000                        | 3            |
| 43 / high                   | 5000                        | 3            |

Outputs 2 and 3 were active.

**Observations**

1. The DUT remains operational at interruptions 10 – 200ms. At  $\geq 300$  ms the device shuts down and restarts without user intervention. No change of state of the protection/control function observed.
2. The DUT remains operational at interruptions 10 – 200 ms. At 300 ms the display disappears shortly. At  $\geq 500$  ms the device shuts down and restarts without user intervention. No change of state of the protection/control function observed.
3. DUT switches off but resumes normal operation after the test. No change of state of the protection/control observed.

**Requirements**

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

**Result**

The object passed the test. It passed the test for interruptions  $\leq 200$  ms.

**Characteristic test data**

|                                                 |                       |
|-------------------------------------------------|-----------------------|
| Type                                            | SIAC11553032AE        |
| Serial number                                   | 18170134              |
| Voltage dips                                    | 30, 60 %              |
| Voltage dip duration                            | 500, 200 ms           |
| Voltage interruptions                           | 100 %                 |
| Voltage dips duration <sup>a)</sup> (100% dips) | .... ms               |
| Voltage interruptions                           | 5 s                   |
| High impedance                                  | $\geq 100$ k $\Omega$ |
| Number of voltage dips                          | 3                     |
| Interruption between dips                       | $\geq 10$ s           |

<sup>a)</sup> Manufacturer shall declare the duration among the following values: 10 ms, 20 ms, 30 ms, 50 ms, 100 ms, 200 ms, 300 ms, 500 ms or 1000 ms. The manufacturer did not specify the characteristic value.

| PSU voltage range | Minumum     | Maximum   |     |
|-------------------|-------------|-----------|-----|
| DC                | 85 V – 20 % | 265 + 20% | Vdc |
| DC                | -           |           | Vdc |

The test voltage is  $85 \text{ V} - 20\% = 68 \text{ V}$ .

**Voltage dips**

| PSU<br>Vdc / load impedance | Dips duration<br>ms | Dips<br>% | Residual voltage<br>Vdc | Observations |
|-----------------------------|---------------------|-----------|-------------------------|--------------|
| 68                          | 500                 | 30        | 47,6                    | -            |
| 68                          | 200                 | 60        | 27,2                    | 1            |
| 68 / high                   | 10 - 1000           | 0         | 0                       | 3            |
| 68 / low                    | 10 - 1000           | 0         | 0                       | 2            |

**Voltage interruptions**

| PSU<br>Vdc / load impedance | Interruption duration<br>ms | Observations |
|-----------------------------|-----------------------------|--------------|
| 68 / high                   | 5000                        | 1            |
| 68 / low                    | 5000                        | 1            |

Outputs 2 and 3 were active.

**Observations**

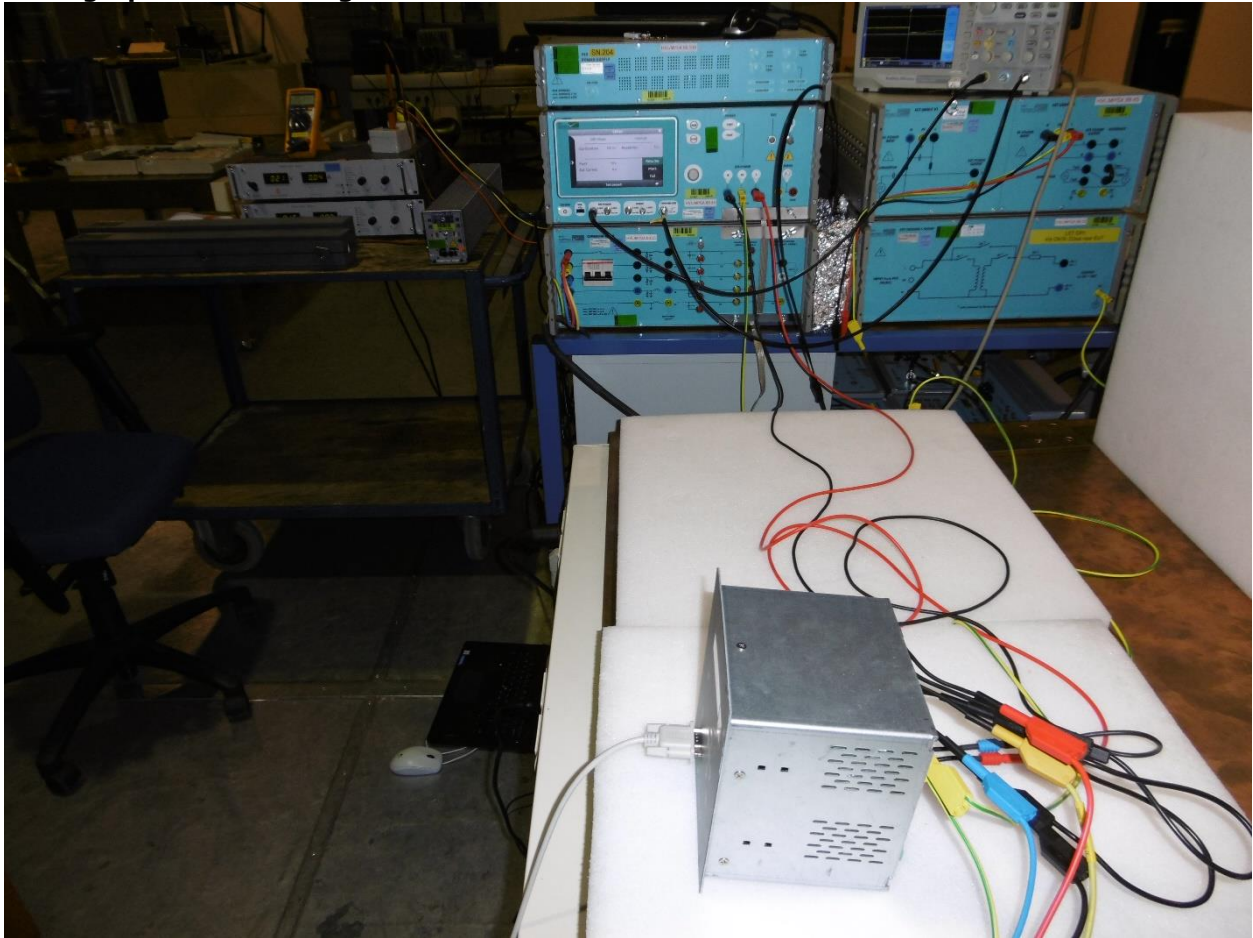
1. DUT switches off but resumes normal operation after the test. No change of state of the protection/control observed.
2. The DUT remains operational at interruptions 10 – 100ms. At  $\geq 200$  ms the device shuts down and restarts without user intervention. No change of state of the protection/control function observed.
3. The DUT remains operational at interruptions 10 – 30ms. At  $\geq 30$  ms the device shuts down and restarts without user intervention. No change of state of the protection/control function observed.

**Requirements**

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

**Result**

The object passed the test. It passed the test for interruptions  $\leq 30$  ms.

**Photograph of test arrangement**

## 6.6 Voltage ripple on DC power supply voltage

### Standard and date

|                |                                            |
|----------------|--------------------------------------------|
| Standard       | IEC 60255-26, subclause 6.2, test item 4.7 |
| Basic standard | IEC 61000-4-17                             |
| Test date      | 1 May 2018                                 |

### Environmental conditions

|                     |       |
|---------------------|-------|
| Ambient temperature | 22 °C |
|---------------------|-------|

| Characteristic test data |                |         |     |
|--------------------------|----------------|---------|-----|
| Type                     | SIAC11531132AG |         |     |
| Serial number            | 18170135       |         |     |
| PSU voltage range        | Minimum        | Maximum |     |
| DC                       | 24             | -       | Vdc |

### Ripple test

| Power supply voltage | Test frequency | Ripple | See oscillogram on next pages | Observations |
|----------------------|----------------|--------|-------------------------------|--------------|
| Vdc                  | Hz             | V/%    |                               |              |
| 21,6                 | 100            | 3,6/15 | 1                             | 1            |

| Characteristic test data |                |         |     |
|--------------------------|----------------|---------|-----|
| Type                     | SIAC11543032AE |         |     |
| Serial number            | 18170130       |         |     |
| PSU voltage range        | Minimum        | Maximum |     |
| DC                       | 48             | -       | Vdc |

### Ripple test

| Power supply voltage | Test frequency | Ripple | See oscillogram on next pages | Observations |
|----------------------|----------------|--------|-------------------------------|--------------|
| Vdc                  | Hz             | V/%    |                               |              |
| 43,2                 | 100            | 7,2/15 | 2                             | 1            |

| Characteristic test data |                |           |     |
|--------------------------|----------------|-----------|-----|
| Type                     | SIAC11553032AE |           |     |
| Serial number            | 18170134       |           |     |
| PSU voltage range        | Minimum        | Maximum   |     |
| DC                       | 85 – 20%       | 265 + 20% | Vdc |

### Ripple test

| Power supply voltage | Test frequency | Ripple  | See oscillogram on next pages | Observations |
|----------------------|----------------|---------|-------------------------------|--------------|
| Vdc                  | Hz             | V/%     |                               |              |
| 68                   | 100            | 12,8/15 | 3                             | 1            |
| 318                  | 100            | 39,8/15 | 4                             | 1            |

### Observations

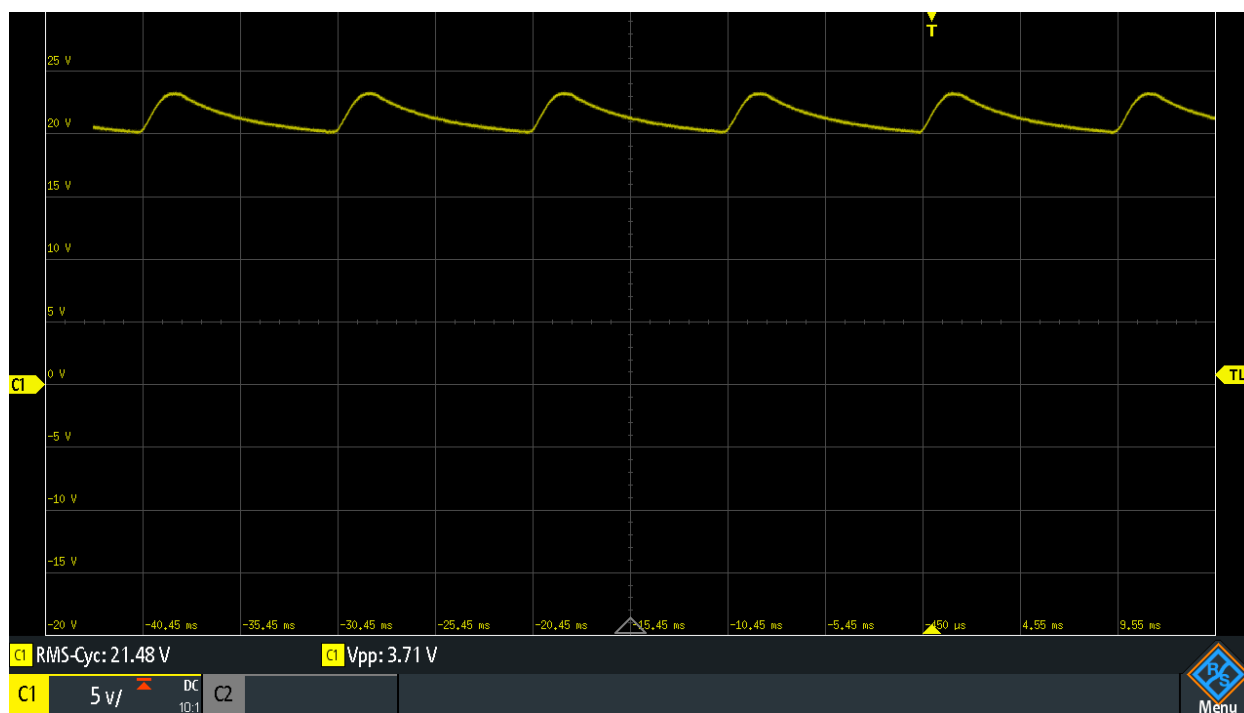
1. No change of state or loss of performance has been observed during and after the test.

**Requirements**

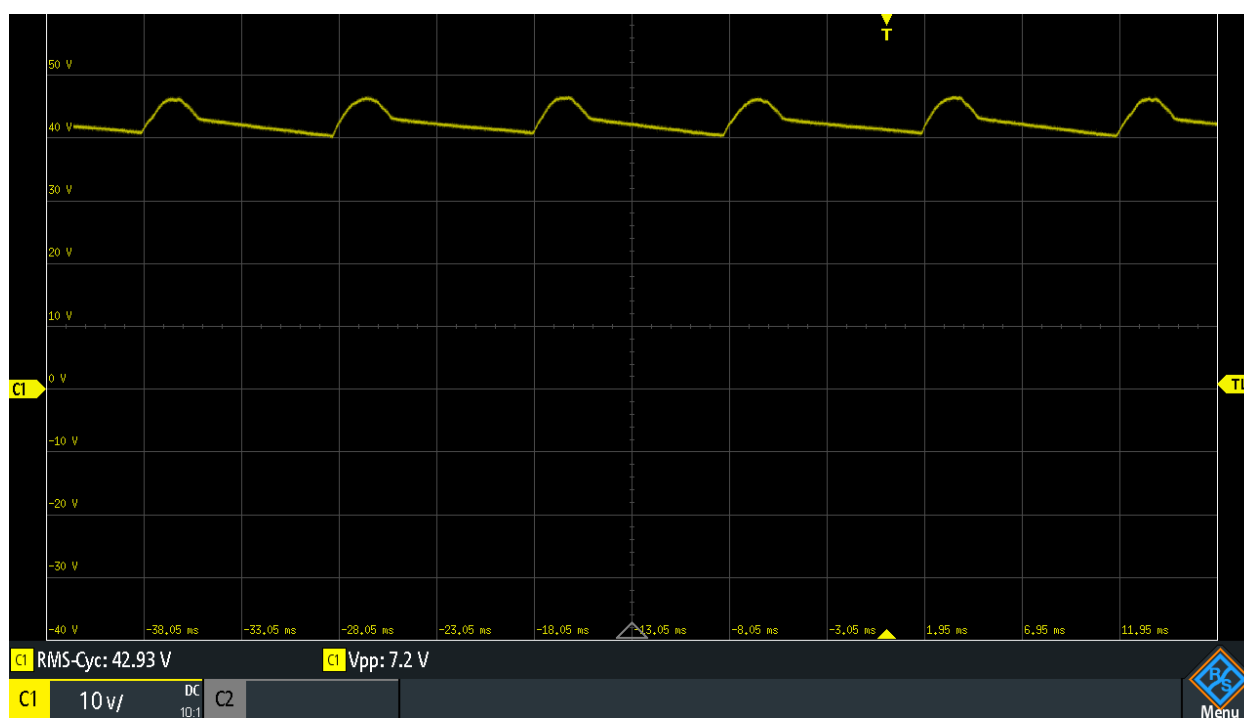
- the object shall comply with the required acceptance criteria A of IEC 60255-26, Table 23.
- the visual and functional inspection shall not reveal any defects or malfunctions.

**Result**

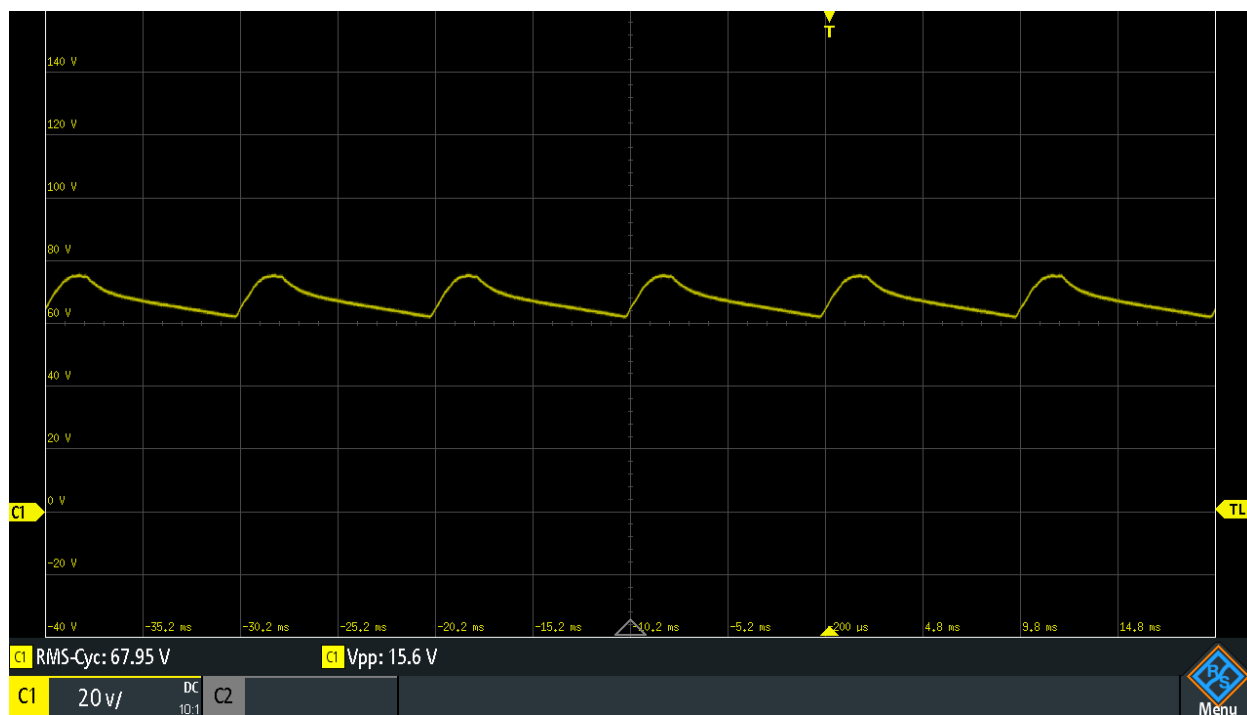
The object passed the test.

**Oscillogram**

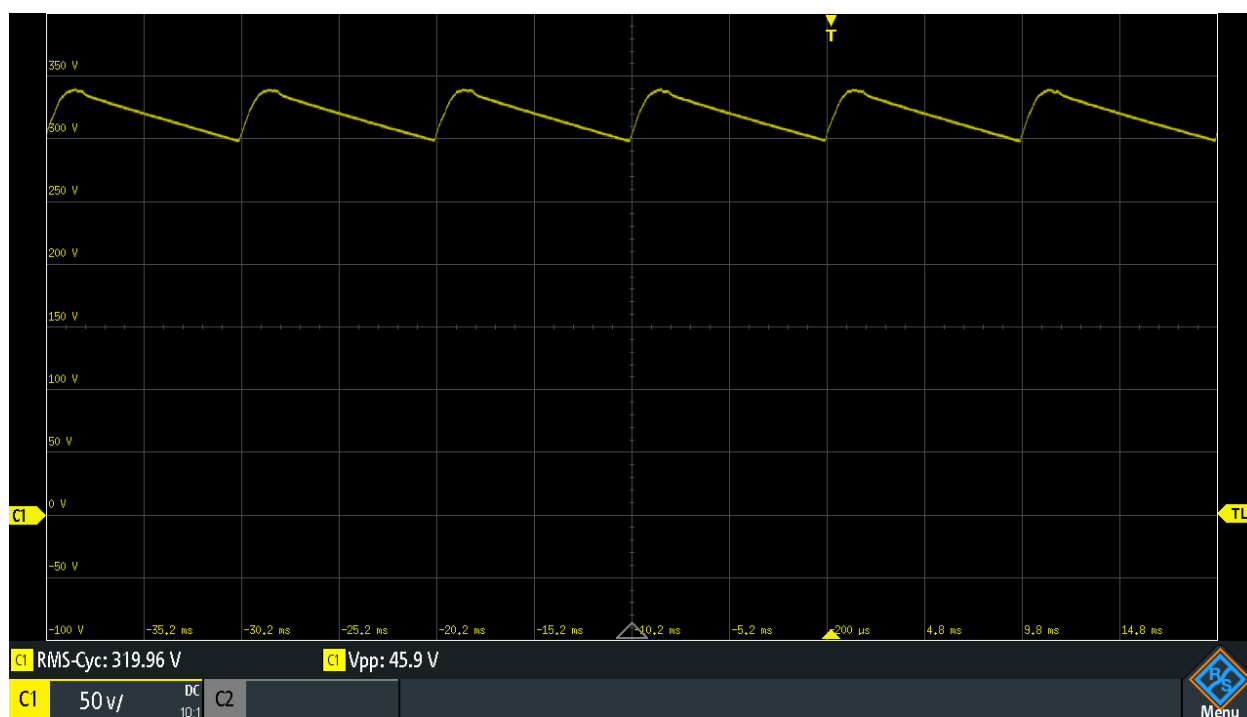
Oscillogram 1



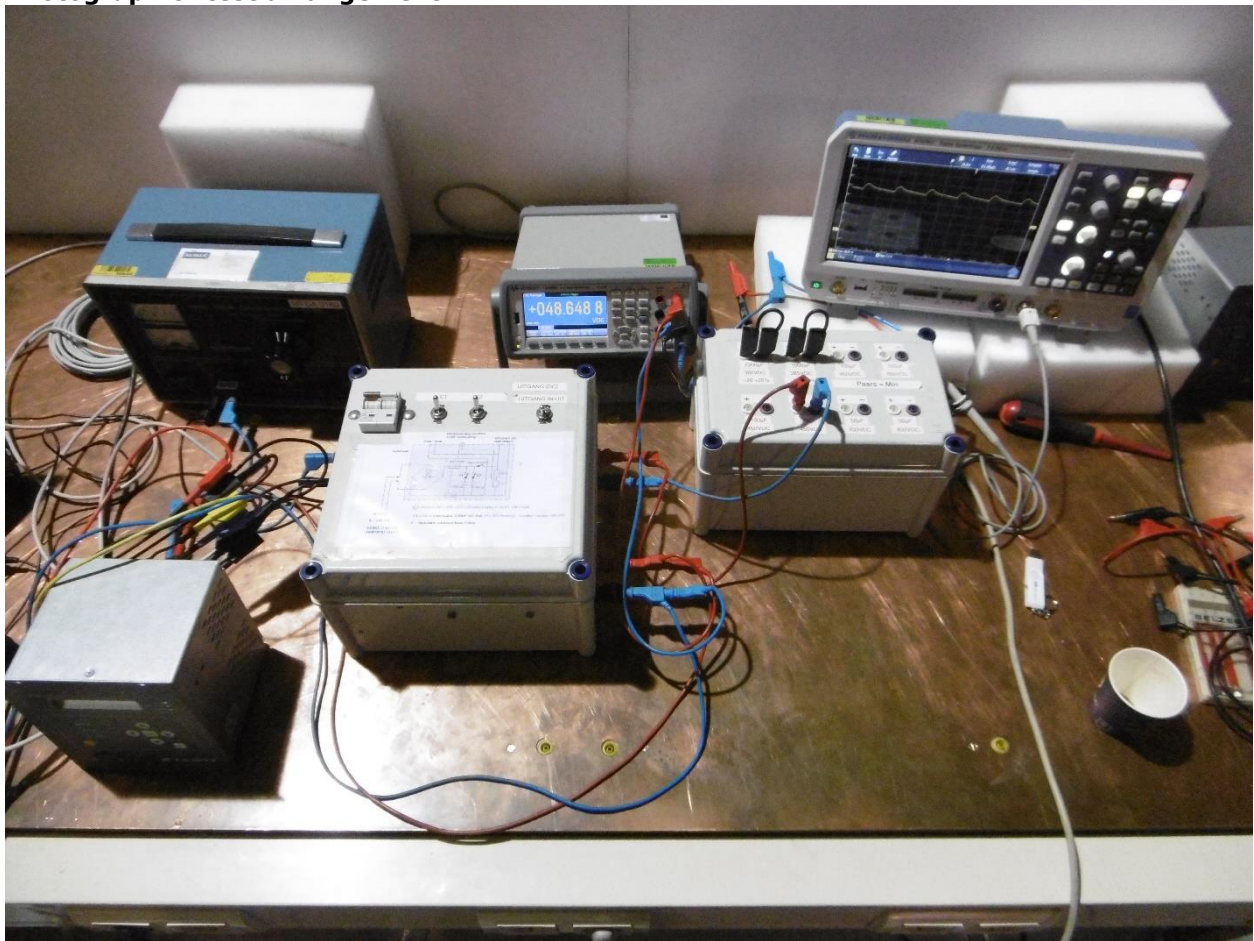
Oscillogram 2



Oscillogram 3



Oscillogram 4

**Photograph of test arrangement**

## 6.7 DC Gradual shut-down/start-up

### Standard and date

Standard IEC 60255-26, subclause 6.2, test item 4.8

Test date 1 May 2018

### Environmental conditions

Ambient temperature 21 °C

### Test requirements

Shut-down ramp 60 s

Power off 5 min

Start-up ramp 60 s

| Characteristic test data |                |           |     |
|--------------------------|----------------|-----------|-----|
| Type                     | SIAC11531132AG |           |     |
| Serial number            | 18170135       |           |     |
| PSU voltage range        | Minimum        | Maximum   |     |
| DC                       | 24 V -10%      | 24 V +10% | Vdc |

### Test

| Ramp voltage<br>Vdc | Measured voltage<br>Vdc | Test condition        | Duration<br>s | Observations |
|---------------------|-------------------------|-----------------------|---------------|--------------|
| 24 to 0             | 17,64                   | Shut-down limit (SDL) | 60            | 1            |
| 0                   | 0                       | Power off             | 300           | -            |
| 0 to 24             | 17,68                   | Start-up limit (SUL)  | 60            | 2            |

### Observations

- LED stops blinking, output relays stop switching, display works. After lowering power supply voltage to 15,8 V the display reading faints. At 15,00 V the display went off. Programmed LED is still on. At approx. 14,2 V The DUT switches off.
- Below 14,5 V LEDs self-power and battery LED's light up. At 14,5 V the EUT switches off the LED's. At approx. 15,0 V the displays become readable. At 17,5 V the watchdog Led lights. At 17,68 V normal operation resumed.

During ramp down and ramp up, not change of trip contact state.

When tripped, the DUT runs on the self-power input (via CT). The state of the auxiliary power supply is then of no influence.

### Requirements

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

### Result

The object passed the test.

| Characteristic test data |                |               |     |
|--------------------------|----------------|---------------|-----|
| Type                     | SIAC11543032AE |               |     |
| Serial number            | 18170130       |               |     |
| PSU voltage range        | Minumum        | Maximum       |     |
| DC                       | 48 Vdc – 10 %  | 48 Vdc + 10 % | Vdc |

**Test**

| Ramp voltage<br>Vdc | Measured voltage<br>Vdc | Test condition        | Duration<br>s | Observations |
|---------------------|-------------------------|-----------------------|---------------|--------------|
| 48 to 0             | 33,48                   | Shut-down limit (SDL) | 60            | 1            |
| 0                   | 0                       | Power off             | 300           | -            |
| 0 to 48             | 33,54                   | Start-up limit (SUL)  | 60            | 2            |

**Observations**

- LED stops blinking, output relays stop switching, display works. After lowering power supply voltage to 28,5 V the display reading faints. At 27,0 V the display turned off. Programmed LED is still on. At 26,9 V a relay starts switching very fast. At approx. 26,45 V The DUT switches off. LED VAUX remains on (turned off at approx. 18,7 V).
- At 20 V the three LEDS light up. At 28,5 V the EUT switches off the LED's. Display turned on. At 33,54 V normal operation resumed.

During ramp down and ramp up, not change of trip contact state.

When tripped, the DUT runs on the self-power input (via CT). The state of the auxiliary power supply is then of no influence.

**Requirements**

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

**Result**

The object passed the test.

**Characteristic test data**

|                   |                |              |     |
|-------------------|----------------|--------------|-----|
| Type              | SIAC11553032AE |              |     |
| Serial number     | 18170130       |              |     |
| PSU voltage range | Minumum        | Maximum      |     |
| AC                | 85 V – 20 %    | 265 V + 20 % | Vac |
| DC                | 85 V – 20 %    | 265 V + 20 % | Vdc |

**Test**

| Ramp voltage<br>Vdc | Measured voltage<br>Vdc | Test condition        | Duration<br>s | Observations |
|---------------------|-------------------------|-----------------------|---------------|--------------|
| 85 to 0             | 40,80                   | Shut-down limit (SDL) | 60            | 1            |
| 0                   | 0                       | Power off             | 300           | -            |
| 0 to 85             | 64,78                   | Start-up limit (SUL)  | 60            | 2            |

**Observations**

1. The DUT switches off.
2. At approx. 30 V the three LEDS start to flash. At approx. 47 V, the flashing stops. DUT tries to start op at 59 V. At 64,78 V the DUT operates normal.

During ramp down and ramp up, no change of trip contact state.

When tripped, the DUT runs on the self-power input (via CT). The state of the auxiliary power supply is then of no influence.

**Requirements**

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

**Result**

The object passed the test.

| Characteristic test data |                |              |     |
|--------------------------|----------------|--------------|-----|
| Type                     | SIAC116B1011AB |              |     |
| Serial number            | 18170099       |              |     |
| PSU voltage range        | Minumum        | Maximum      |     |
| AC                       | 230 V – 20 %   | 230 V + 20 % | Vac |

**Test**

| Ramp voltage<br>Vac | Measured voltage<br>Vac | Test condition        | Duration<br>s | Observations |
|---------------------|-------------------------|-----------------------|---------------|--------------|
| 230 to 0            | 130,0                   | Shut-down limit (SDL) | 60            | 1            |
| 0                   | 0                       | Power off             | 300           | -            |
| 0 to 230            | 158,4                   | Start-up limit (SUL)  | 60            | 2            |

**Observations**

- At 135 V the display faints. At 133 V DUT went off
- At 139,8 V the DUT display turns on. Display warning; no trip power. At 150,7 V, this message disappears. At 158,4 V the LED VAUX lights, DUT fully operational.

During ramp down and ramp up, no change of trip contact state.

**Requirements**

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

**Result**

The object passed the test. (for information only, this test is not applicable for devices provided with an AC power supply port).

**Photograph of test arrangement**

## 7 MEASUREMENT UNCERTAINTY

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%<br>Range 0,050 – 20 A: 0,5% |
| Voltage                                 | Range 0,1 V – 0,5 V: 1%<br>Range 0,5 V – 150 V: 0,5%  |
| Phase angle between current and voltage | 0,1 deg                                               |
| Time                                    | 0,5 ms                                                |

The used EMC test generators are calibrated on an annual base and comply with the tolerances mentioned in the applicable test standard.

## 8 LIST OF INSTRUMENTS USED

### 8.1 EMC equipment

| Description                                                           | Manufacturer                        | Type                   | ORS number |
|-----------------------------------------------------------------------|-------------------------------------|------------------------|------------|
| Immunity tester, including                                            | EMC partner                         | IMU4000 F-S-D-V-C-1500 | 151487     |
| Power supply                                                          | EMC partner                         | PS3-0204               | 151522     |
| Multifunction measurement unit and mains impedance simulating network | Spitzenberger & Spies <sup>1)</sup> | ARS                    | 129813     |
| 4-quadrant amplifier                                                  | Spitzenberger & Spies <sup>1)</sup> | PAS 10000              | 129811     |

<sup>1)</sup>This equipment has been used by DEKRA.

### 8.2 Measurement equipment

| Description  | Manufacturer | Type       | ORS number |
|--------------|--------------|------------|------------|
| Oscilloscope | R&S          | RTB2002    | 152141     |
| Oscilloscope | Tektronix    | TBS 1052B  | 161519     |
| Multimeter   | Keysight     | 34465A     | 152267     |
| Multimeter   | Fluke        | 179        | 151520     |
| Power supply | Delta        | SM 300 - 5 | 3009231    |
| Power supply | Delta        | SM 300 - 5 | 150741     |
| Transformer  | Grundig      | RT 5A      | 069124     |