

REPORT OF PERFORMANCE

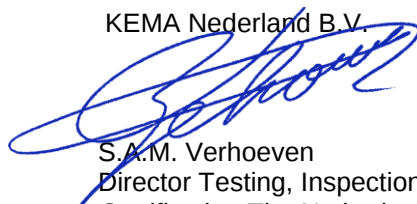
OBJECT	SIA-C Overcurrent & Earth Fault Protection Relay		
TYPE	SIAC11500032AFA	SERIAL No.	13470165, 13470167
Rated voltage CT	Self powered	0.2xIn (1 phase) or 0.1xIn (3 phase)	
	1 A	50 Hz	
MANUFACTURER	FANOX Electronic, S.L., Derio, Spain		
CLIENT	FANOX Electronic, S.L., Derio, Spain		
TESTED BY	KEMA HIGH-VOLTAGE LABORATORY, Arnhem, the Netherlands		
DATE OF TESTS	3 to 23 December 2013		
INSPECTION PROGRAMME	Selected tests in accordance with IEC 60255-1 and IEC 60068-series (see page paragraph 3.1).		
SUMMARY AND CONCLUSION	The object passed the tests. See page 4 for a detailed summary of the test results.		

This Report of Performance applies only to the object tested. The responsibility for conformity of any object having the same designations with that tested rests with the Manufacturer

This Report of Performance consists of 72 pages in total.

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KEMA Nederland B.V.



S.A.M. Verhoeven
Director Testing, Inspections &
Certification The Netherlands

Arnhem, 18 February 2014

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SUMMARY

By the order of FANOX Electronic, S.L., located in Derio, Spain, EMC, climatic tests and mechanical tests were performed on the SIA-C Overcurrent & Earth Fault Protection Relay, for use in substation and industrial environments.

Manufacturer	Fanox
Object	SIA-C Overcurrent & Earth Fault Protection Relay
Type	SIAC11500032AFA
Software Com	2.14
Software DSP	1.72
Software PIC	1.03
Hardware release number	R1.19

The SIA-C Overcurrent & Earth Fault Protection Relay is tested for use in HV substations and connections to HV equipment according to EMC tests IEC 60255-26, 61000-4 series, insulation tests IEC 60255-27, IEC 60255-5, mechanical tests IEC 60255-21 series and climatic tests IEC 60068-2 series.

SIA-C Overcurrent & Earth Fault Protection Relay is a “self-powered” relay, the energy for functioning is extracted from the CT coils.

The following tests are performed with positive test results on the SIA-C Overcurrent & Earth Fault Protection Relay.

Test programme for climate tests according to IEC 60068-2

Climatic environmental conditions			
test description	requirement	test standard	ports
low air temperature for use	-25 °C, 72 h	IEC 60068-2-1	D
low air temperature for storage	-40 °C, 72 h	IEC 60068-2-1	D
high air temperature for use	+70 °C, 72 h	IEC 60068-2-2	D
high air temperature for storage	+85 °C, 72 h	IEC 60068-2-2	D
damp heat cyclic	97%, 93 % +35 °C, +40 °C 2 cycles 12h+12h	IEC 60068-2-30	D
damp heat steady state	93 %, +40 °C 2 days	IEC 60068-2-78	D
change of temperature	-25 °C; 70 °C 5 cycles 3 h	IEC 60068-2-14	D

Test programme for EMC tests according to IEC 60255-26 and IEC 61000-4 series

Electromagnetic compatibility (EMC)					
test description	IEC 60255-26 reference / Zone specification	requirement	test standard	acceptance criteria (see 3.4.4)	ports
induced disturbances by RF-fields	6	0,15 – 80 MHz AM 80% 1 kHz 10 V (un-modulated)	IEC 60255-26 IEC 61000-4-6	A	A, B, C
surges	6 / Zone A	4 kV CM 2 kV DM	IEC 60255-26 IEC 61000-4-5	B	A, B, C
1 MHz oscillatory waves	6	2,5 kV CM 1,0 kV DM	IEC 60255-26 IEC 61000-4-18	B	A, B, C
fast transient	6 / Zone A	4 kV CM	IEC 60255-26 IEC 61000-4-4	B	A, B, C
EM-fields	5	0,08 – 1 GHz 1,4 – 2,7 GHz AM 80% 1 kHz 10 V/m (un- modulated)	IEC 60255-26 IEC 61000-4-3	A	D

test description	IEC 60255-26 reference / Zone specification	requirement	test standard	acceptance criteria (see 3.4.4)	ports
radiated emission	5	30 MHz to 6 GHz	IEC 60255-26 CISPR 11 cl. B CISPR 22 cl. B		D
induced CM voltages	6 / Zone B	30 V cont., 300 V 1 s	IEC 60255-26 IEC 61000-4-16	A	A, B, C
electrostatic discharge immunity	6	6 kV contact 8 kV air	IEC 60255-26 IEC 61000-4-2	B	D
PF magnetic field	6	30 A/m continuous 300 A/m 1 s to 3 s	IEC 60255-26 IEC 61000-4-8	A B	D
1 MHz damped oscillatory magnetic field		100 A/m	IEC 61000-4-10	B	D
100 kHz damped oscillatory magnetic field		100 A/m	IEC 61000-4-10	B	D
pulsed H-field		1000 A/m	IEC 61000-4-9	B	D

Test programme for insulation tests according to IEC 60255-27 and IEC 60255-5

Insulation				
test description	requirement	test standard	ports	
dielectric power frequency test	2,0 kVrms 50 Hz 1 min	IEC 60255-27, clause 10.6.4.3	A, B, C	
Insulation resistance	500 V DC	IEC 60255-27, clause 10.6.4.4	A, B, C	
impulse voltage test	5,0 kV	IEC 60255-27, clause 10.6.4.2	A, B, C	

Test programme for mechanical tests according to IEC 60255-21

mechanical environmental conditions				
test description	IEC 60255-1 reference	requirement	test reference	ports
vibration response	6.13.1	class 1	IEC 60255-21-1	D
vibration endurance	6.13.1	class 1	IEC 60255-21-1	D
shock response	6.13.2		IEC 60255-21-2	D
shock withstand	6.13.2	class 1	IEC 60255-21-2	D
bump	6.13.2	class 1	IEC 60255-21-2	D
seismic	6.13.3	class 1	IEC 60255-21-3	D

Ports

- A CT ports
- B Output ports
- C Functional earth port
- D Housing

1 IDENTIFICATION OF THE TEST OBJECT

1.1 Description of the test object

Manufacturer	FANOX
Object	SIA-C Overcurrent & Earth Fault Protection Relay
Type	SIAC11500032AFA
Power supply	Self-powered
Software Com	2.14
Software DSP	1.72
Software PIC	1.03
Hardware release	R1.19



Front side EUT



Rear side EUT

1.2 List of electronic diagrams, PCB lay-outs, component lists

The manufacturer has guaranteed that the object submitted for tests has been manufactured in accordance with the following electronic diagrams, PCB layouts and BOM's. KEMA has not verified that these electronic diagrams, PCB layouts and BOM's adequately represents the object tested.

The following electronic diagrams, PCB layouts and BOM's are included in this Report of Performance.

drawing no./document no.	revision	date	title
SIAC_EPCB__SIAC-cpu_fast.PCBDOC	R0.04	4/10/2013	SIAC-cpu-fast
SIAC_EPCB__SIAC-Ferrantis.PCBDOC	R0.03	4/10/2013	SIAC-Ferrantis
SIAC_EPCB_SIACxxxxxxxxFx_SIAC-HMI-F.PCBDOC	R0.01	4/10/2013	SIAC-HMI-F
SIAC_EPCB_SIACxxxxxxxxFx_SIAC-IOs-F.PCBDOC	R0.01	4/10/2013	SIAC-IOs-F
SIAC_EPCB__SIAC-Extension-WD.PCBDOC	R0.02	4/10/2013	SIAC-Extension-WD

Document description	Included the GERBER files for all PCB's
SIAC_GPCB__SIAC-Extension-WD R002_R002	SIAC_PPCB__SIAC-Extension-WD R002_R002.APT
	SIAC_PPCB__SIAC-Extension-WD R002_R002.FRE
	SIAC_PPCB__SIAC-Extension-WD R002_R002.GBL
	SIAC_PPCB__SIAC-Extension-WD R002_R002.GBS
	SIAC_PPCB__SIAC-Extension-WD R002_R002.GSC
	SIAC_PPCB__SIAC-Extension-WD R002_R002.GTL
	SIAC_PPCB__SIAC-Extension-WD R002_R002.GTO
	SIAC_PPCB__SIAC-Extension-WD R002_R002.GTP
	SIAC_PPCB__SIAC-Extension-WD R002_R002.GTS
	SIAC_PPCB__SIAC-Extension-WD R002_R002.TAL
	SIAC_PPCB__SIAC-Extension-WD R002_R002.TXT
SIAC_GPCB_SIAC-cpu_fast R004_R004	SIAC_PPCB_SIAC-cpu_fast R004_R004.APT
	SIAC_PPCB_SIAC-cpu_fast R004_R004.G1
	SIAC_PPCB_SIAC-cpu_fast R004_R004.G2
	SIAC_PPCB_SIAC-cpu_fast R004_R004.GBL
	SIAC_PPCB_SIAC-cpu_fast R004_R004.GBS
	SIAC_PPCB_SIAC-cpu_fast R004_R004.GSC
	SIAC_PPCB_SIAC-cpu_fast R004_R004.GTL
	SIAC_PPCB_SIAC-cpu_fast R004_R004.GTO
	SIAC_PPCB_SIAC-cpu_fast R004_R004.GTP
	SIAC_PPCB_SIAC-cpu_fast R004_R004.GTS
	SIAC_PPCB_SIAC-cpu_fast R004_R004.TAL
	SIAC_PPCB_SIAC-cpu_fast R004_R004.TXT
SIAC_GPCB_SIAC-FerrantisR003_R001	SIAC_GPCB_SIAC-FerrantisR003_R001.APT
	SIAC_GPCB_SIAC-FerrantisR003_R001.GBL
	SIAC_GPCB_SIAC-FerrantisR003_R001.GBS
	SIAC_GPCB_SIAC-FerrantisR003_R001.GKO
	SIAC_GPCB_SIAC-FerrantisR003_R001.GTL
	SIAC_GPCB_SIAC-FerrantisR003_R001.GTO
	SIAC_GPCB_SIAC-FerrantisR003_R001.GTS
	SIAC_GPCB_SIAC-FerrantisR003_R001.TXT
SIAC_GPCB_SIACxxxxxxxxFx_SIAC-HMI-F R001_R001	lee.me
	SIAC_PPCB_SIACxxxxxxxxFx_SIAC-HMI-F R001_R001.APT
	SIAC_PPCB_SIACxxxxxxxxFx_SIAC-HMI-F

	R001_R001.FRE
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-HMI-F R001_R001.GBL
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-HMI-F R001_R001.GBS
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-HMI-F R001_R001.GSC
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-HMI-F R001_R001.GTL
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-HMI-F R001_R001.GTO
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-HMI-F R001_R001.GTP
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-HMI-F R001_R001.GTS
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-HMI-F R001_R001.TAL
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-HMI-F R001_R001.TXT
SIAC_GPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001	lee.me
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001.APT
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001.FRE
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001.GBL
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001.GBS
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001.GSC
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001.GTL
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001.GTO
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001.GTP
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001.GTS
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001.TAL
	SIAC_PPCB_SIAxxxxxxxxFx_SIAC-IOs-F R001_R001.TXT

2 GENERAL INFORMATION

2.1 The tests were witnessed by

The tests were not witnessed.

2.2 The tests were carried out by

Name	Company
Mr D.M. van Aartrijk	KEMA Nederland B.V., Arnhem, the Netherlands
Mr A. Steenbakker	DEKRA Certification B.V., Arnhem, the Netherlands

2.3 Subcontracting

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

Test	Standard
Radiated emission	EN 55022, CISPR11 Class B
Radiated, radio-frequency, electromagnetic field immunity test	IEC 60255-26, IEC 61000-4-3

The following tests were subcontracted to Sebert Trillingstechniek b.v., Bergschenhoek, the Netherlands:

Test	Standard
Vibration response and endurance	IEC 60255-21-1
Shock response and withstand	IEC 60255-21-2
Bump	IEC 60255-21-2
Seismic	IEC 60255-21-3

2.4 Purpose of the test

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

2.5 Measurement uncertainty

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

2.6 Applicable standards

When reference is made to a standard and the date of issue is not stated, this applies to the latest issue, including amendments, which have been officially published prior to the date of the tests.

3 TEST PROCEDURE

3.1 Environmental test conditions

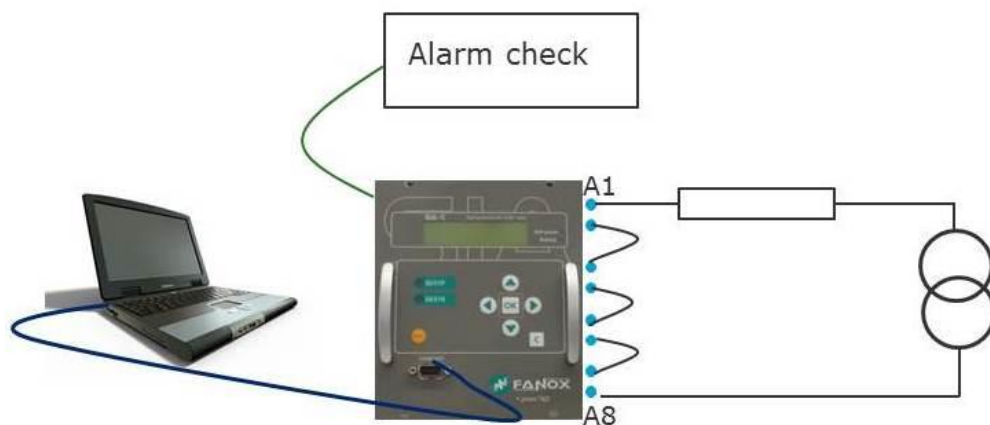
Unless otherwise specified, all tests are carried out under the conditions stated in the table below.

Influence quantity	Reference parameter
Operating temperature	20 °C ± 5 °C
Relative humidity	45 % to 75 % RH
Atmospheric pressure	86 kPa to 106 kPa

3.2 Test set-up

A general test set up is made by connecting the CT connection to a current source. The CT's are connected in series. The status of the alarm contacts is monitored. The protective relay is parameterized and monitored by means of the human machine interface and interface on the display and LED's.

50N1 alarm was set at 0.96 and 50P1 was set at 1.04 In. In was adjusted to 1 Amp or 0.92 Amp depending of the kind of test. During long periods of tests In was adjusted to 0,92 Amp. Both output contacts of the 50N1 and 50P1 function are monitored during the tests.



3.3 Test samples

<u>Sample</u>	<u>Serial number</u>
EUT1	13470165
EUT2	13470167

Test sample 13470165 was used for:

- climatic environmental testing
- impulse voltage test
- dielectric test
- insulation resistance test

Test sample 13470167 was used for all other remaining tests.

3.4 Performance criteria

3.4.1 Pre-inspection

The pre-inspection is performed to verify that the protection relay is in the normal operating state. 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:

- 1 Analogue inputs
- 2 Contact outputs

3.4.2 Visual inspection

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

EMC tests

- 1 No burn of any components.
- 2 No paint blisters on any components.
- 3 No discoloration on components.
- 4 No deformation of modules or components.
- 5 No interruptions or damage on interconnecting cables, wires and connectors.

Mechanical and climatic tests

- 1 No visual defects of the EUT enclosure.
- 2 No bending or deformation of modules, PCB's, PCB supports, connectors and connector pins.
- 3 No interruptions or damage on interconnecting cables, wires and connectors.

3.4.3 Functional inspection

- 1 A functional inspection is performed to verify the correct operation.
- 2 No alarm indications on display and LED's.
- 3 No error messages reported in the maintenance computer.
- 4 No unintentional change of contact outputs.

3.4.4 Acceptance criteria

The following acceptance criteria are based on 60255-26 chapter 8.2; immunity tests. These criteria are also used for all other tests if not directly related to IEC 60255-26

Criteria	Function	Conditions for acceptance
A	Protection	Normal performance within the specification limits, during and after the test.
	Command and control	Normal performance within the specification limits, during and after the test.
	Measurement	No degradation during test.
	Integral human-machine interface and visual alarms	No degradation or no loss of function during test. No loss of stored data.
	Data communication ^b	Possible bit error rate increase but no loss of transmitted data.
	Binary input, binary output and output contacts	No unwanted change of status is allowed during the test ^a .
B	Protection	Normal performance within the specification limits, during and after the test.
	Command and control	Normal performance within the specification limits, during and after the test.
	Measurement	Temporary degradation during test, with self-recovery at the end of the test. No loss of stored data.
	Integral human-machine interface and visual alarms	Temporary degradation or loss of function during test, with self-recovery at the end of the test. No loss of stored data.
	Data communication ^b	Possible bit error rate increase but no loss of transmitted data.
	Binary input, binary output and output contacts	No unwanted change of status is allowed during the test ^a .
C	Protection	Temporary loss of function provided the function is self-recoverable. No unwanted operation shall be observed.
	Command and control	Temporary loss of function provided the function is self-recoverable. No unwanted operation shall be observed.
	Measurement	Temporary loss of function provided the function is self-recoverable.
	Integral human-machine interface and visual alarms	Temporary loss of function provided the function is self-recoverable.
	Data communication ^b	Temporary loss of function, provided the function is self-recoverable Possible loss of transmitted data.
	Binary input, binary output and output contacts	No unwanted change of status is allowed during the test ^a .
If the manufacturer is using a specification for degradation during or after the testing required by this standard, the specification shall be provided in the product documentation available to the user.		
^a For binary inputs the manufacturer shall state the minimum filtering value for which the test was successful.		
^b Excluding communication ports for protection or control functionality. For those acceptance criteria see protection or command and control.		

4 PRODUCT SAFETY

4.1 Impulse voltage

Standard and date

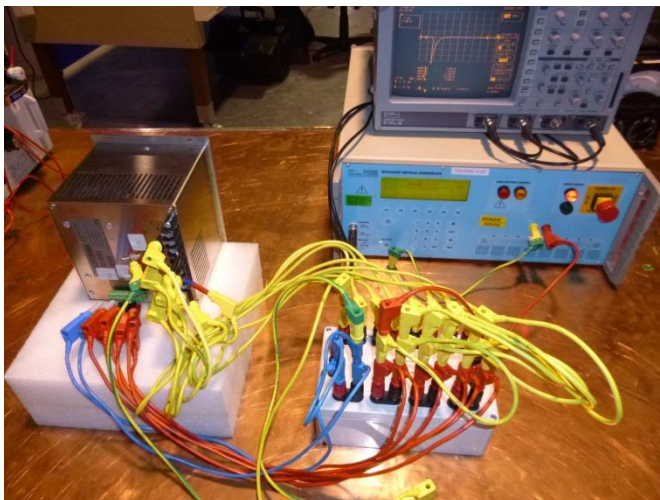
Generic standard	IEC 60255-1
Standard	IEC 60255-27, clause 10.6.4.2
Test date	23 December 2013

Characteristic test data

Sample	13470165
T_{rise}	$1,2 \mu s \pm 30\%$
T_{half}	$50 \mu s \pm 30\%$
Output impedance	500Ω
Output energy	$0,5 J \pm 10\%$
Number of pulses	3 positive and 3 negative
Pulse interval	$\geq 1 s$
Test leads	$\leq 2 m$
Method	Between each circuit (or each group of circuits specified at the impulse voltage specified for this circuit (or this group of circuits); between the terminals of a circuit
Group G1	CT input terminals
Group G2	Trip output terminals
Ground	Chassis

The test was performed after the climate tests (Chapter 6)

Test set-up



Results

circuit	against	test voltage (kV)	number of repetitions	polarity	observation
group G1	ground	5	3	+	passed
		5	3	-	passed
group G1	group G2	5	3	+	passed
		5	3	-	passed
group G2	ground				1)

1) Trip output (D16 –D17) is part of Group G2, and is connected to ground in case output is not activated.

Results

The object passed the test.

4.2 AC or DC dielectric voltage

Standard and date

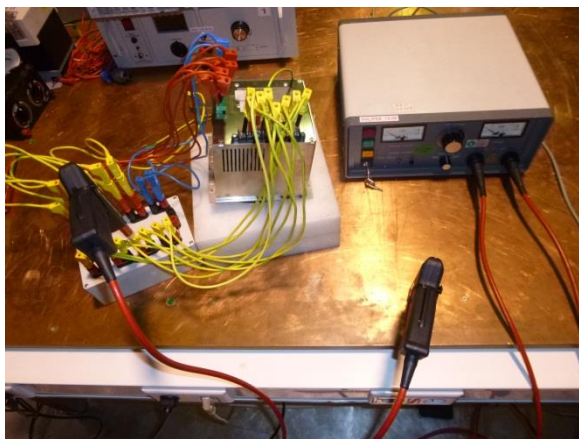
Generic standard	IEC 60255-1
Standard	IEC 60255-27, clause 10.6.4.3
Test date	23 December 2013

Characteristic test data

Sample	13470165
AC or DC	AC
Duration	1 minute
Method	Between each circuit (or each group of circuits specified at the impulse voltage specified for this circuit or this group of circuits); between the terminals of a circuit
Group G1	CT input terminals
Group G2	Trip output terminals
Ground	Chassis

The test was performed after the climate tests (Chapter 6)

Test set-up



Results

circuit	against	rated insulation voltage (V)	test voltage (kV)	duration (min)	observation
group G1	ground	500	2	1	passed
group G2	group G1	500	2	1	passed
group G2	ground	-	-	-	1)

1) Trip output (D16 –D17) is part of Group G2, and is connected to ground in case output is not activated.

Results

The object passed the test.

4.3 Insulation resistance

Standard and date

Standard IEC 60255-27, clause 10.6.4.4, IEC 60255-5
 Test date 23 December 2013

Characteristic test data

Sample 13470165
 Test voltage 500 VDC
 Test method Between each circuit (or each group of circuits specified at the impulse voltage specified for this circuit (or this group of circuits); between the terminals of a circuit
 Group G1 CT input terminals
 Group G2 Trip output terminals
 Ground Chassis

The test was performed after the climate tests (Chapter 6).

Results

circuit	against	before dielectric voltage test (MΩ)	after dielectric voltage test (MΩ)	before impulse voltage test (MΩ)	after impulse voltage test (MΩ)	observation
group G1	ground	> 500	> 500	> 500	> 500	passed
group G2	ground	0	0	0	0	1)
group G1	group G2	> 500	> 500	> 500	> 500	passed

- 1) Trip output (D16 –D17) is part of Group G2, and is connected to ground in case output is not activated.

Results

The object passed the test.

5 ELECTROMAGNETIC COMPATIBILITY

5.1 Oscillatory wave immunity test 1MHz

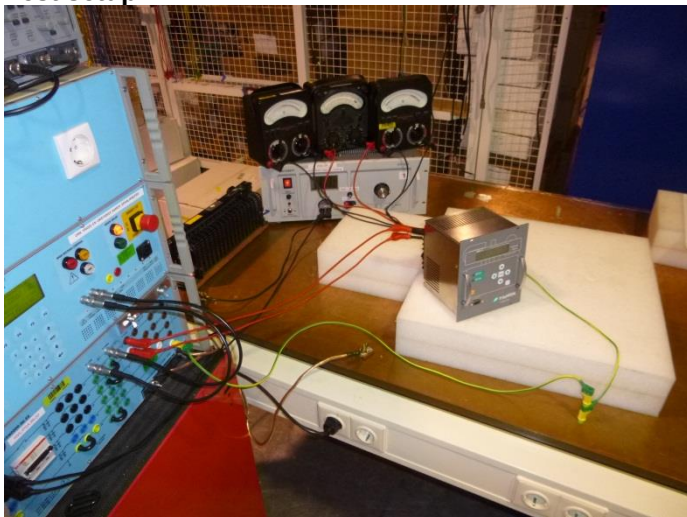
Standard and date

Generic Standard	IEC 60255-1, IEC 60255-26
Standard	IEC 61000-4-18
Test date	6 December 2013

Characteristic test data

Sample	13470167
Current applied to CT	0,96 A
Test voltages	CM 2,5 kV; DM 1,0 kV
T_{rise}	75 ns +/- 20%
Oscillation freq.	1 MHz +/- 10 %
Repetition rate	400/s for 1 MHz +/- 10%
Burst duration	Not less than 2 sec.
Output impedance	200 Ω
Open circuit voltage	250 V to 2,5 kV +/- 10%
Short circuit current	1,25 A to 12,5 A +/- 20 %
Polarity of the first half-period	Positive and negative
Acceptance criteria	B

Test setup



Results

circuit	terminals	coupling	test voltage (kV)	polarity	observation
CT inputs	A1 – A2	CM1	2,5	+/-	passed
	A1 – A2	DM	1,0	+/-	passed
	A3 – A4	CM1	2,5	+/-	passed
	A3 – A4	DM	1,0	+/-	passed
	A5 – A6	CM1	2,5	+/-	passed
	A5 – A6	DM	1,0	+/-	passed
	A7 – A8	CM1	2,5	+/-	passed
	A7 – A8	DM	1,0	+/-	passed
phase trip output	D10 - D11	CM1	2,5	+/-	passed
	D10 - D11	DM	1,0	+/-	passed
neutral trip output	D12 - D13	CM1	2,5	+/-	passed
	D12 - D13	DM	1,0	+/-	passed
watchdog output	D14 - D15	CM1	2,5	+/-	passed
	D14 - D15	DM	1,0	+/-	passed
trip output	D16 - D17	CM1	2,5	+/-	passed
	D16 - D17	DM	1,0	+/-	passed

Requirements

Performance criteria B (see clause 3.4.4. "Acceptance criteria").

Result

The object passed the test with performance criteria A and B.

5.2 Electrostatic discharge immunity test

Standard and date

Generic standards IEC 60255-1, IEC 60255-26
 Test standards IEC 61000-4-2
 Test date 3 December 2013

Characteristic test data

Sample 13470167
 Current applied to CT 0,96 A
 Class 2 6 kV contact; 8 kV air
 T_{rise} 0,7 – 1,05 ns
 T_{half} 60 ns
 Number of discharges 10 positive and 10 negative
 Repetition rate At least 1 sec. between the discharges
 Acceptance criteria B

Test setup



Overview of test points

- Contact 6 kV
- Air 8 kV



Results

discharge type	test level (kV)	test points	polarity	observation
air	8	display	+ / -	passed
air	8	self-powered Led	+ / -	passed
air	8	button 'up'	+ / -	passed
air	8	button 'down / right'	+ / -	passed
air	8	button 'left / ok'	+ / -	passed
air	8	indicator 50/51P 50/51N	+ / -	passed
air	8	button 'C'	+ / -	passed
contact	6	handle	+ / -	passed
contact	6	handle	+ / -	passed
contact	6	DB9 screw	+ / -	passed
contact	6	DB9 screw	+ / -	passed

Requirements

Performance criteria B (see clause 3.4.4. "Acceptance criteria").

Results

The object passed the test with performance criteria A and B.

5.3 Radiated, radio-frequency, electromagnetic field immunity test

Standard and date

Generic standards	IEC 60255-1, IEC 60255-26
Test standard	IEC 61000-4-3
Test date	9 December 2013

Characteristic test data

Sample	13470167
Mains power supply	Self-powered
Current applied to CT	0,96 A
Sweep test	
-frequency range	80 MHz – 2,7 GHz
-modulation	AM, 1 kHz (sine wave) 80%
-sweep time	$1,5 \cdot 10^{-3}$ decade/s
-test points	200 per octave (logarithmic distribution)
Dwell time frequency sweep	1,0 s
Spot frequencies	
-frequencies	80 MHz; 160 MHz; 380 MHz; 450 MHz; 900 MHz ; 1,85 GHz ; 2,7 GHz
-modulation	AM, 1 kHz (sine wave) 80%
-dwell time	1 s
Acceptance criteria	A

Test set-up



Results

direction	frequency (MHz)	test level (V/m)	result
x both sides of EUT (horizontal & vertical polarization)	80 – 1000	10	passed
	1000 - 2700	10	passed
	80; 160; 380; 450; 900 1850; 2150 20, 100 (AM)	10	passed
y both sides of EUT (horizontal & vertical polarization)	80 – 1000	10	passed
	1000 - 2700	10	passed
	80; 160; 380; 450; 900 1850; 2150 20, 100 (AM)	10	passed
z both sides of EUT (horizontal & vertical polarization)	80 – 1000	10	passed
	1000 - 2700	10	passed
	80; 160; 380; 450; 900 1850; 2150 20, 100 (AM)	10	passed

Requirements

Performance criteria A (see clause 3.4.4. “Acceptance criteria”).

Results

The object passed the test with performance criteria A.

5.4 Fast transient immunity test

Standard and date

Generic standard	IEC 60255-1, IEC 60255-26
Test standard	IEC 61000-4-4
Test date	13 December 2013

Characteristic test data

Test sample	13470167
Mains power supply	Self-powered
Current applied to CT	0,96 A
Level 3	4,0 kV CM PSU; 1,0 kV CM other ports
T_{rise}	5 ns $\pm$ 30 %
T_{half}	50 ns $\pm$ 30 %
Burst duration	15 ms $\pm$ 20 % and 0,75 $\pm$ 15 %
Period time	300 ms $\pm$ 20 %
Repetition rate	5,0 kHz and 100 kHz $\pm$ 20 % (0,5 kV; 1,0 kV; 2,0 kV; 4,0 kV)
Polarity	positive and negative
Test duration	1 minute
Maximum energy	4 mJ / pulse at 2 kV into 50 Ω
Coupling	Direct coupling (CM1) Capacitive coupling with a clamp (CM2)
Zone specification	A
Acceptance criteria	B

Test set-up



Results

circuit	terminals	test voltage (kV)	coupling	polarity	Observation 5kHz 15ms	100kHz 0,75 ms
CT inputs	A1 - A2	4	CM	+	passed	passed
	A1 - A2	4	CM	-	passed	passed
	A3 - A4	4	CM	+	passed	passed
	A3 - A4	4	CM	-	passed	passed
	A5 - A6	4	CM	+	passed	passed
	A5 - A6	4	CM	-	passed	passed
	A7 - A8	4	CM	+	passed	passed
	A7 - A8	4	CM	-	passed	passed
phase trip output	D10 - D11	4	CM2	+	passed	passed
	D10 - D11	4	CM2	-	passed	passed
neutral trip output	D12 - D13	4	CM2	+	passed	passed
	D12 - D13	4	CM2	-	passed	passed
watchdog output	D14 - D15	4	CM2	+	passed	passed
	D14 - D15	4	CM2	-	passed	passed
trip output	D16 - D17	4	CM2	+	passed	passed
	D16 - D17	4	CM2	-	passed	passed

Requirements

Performance criteria B (see clause 3.4.4. "Acceptance criteria").

Results

The object passed the test with performance criteria B.

5.5 Surge immunity test

Standard and date

Generic standard	IEC 60255-1, IEC 60255-26
Test standard	IEC 61000-4-5
Test date	6 December 2013

Characteristic test data

Sample	13470167
Mains power supply	Self-powered
Current applied to CT	0,92 A
$T_{rise_voltage}$	1,2 μs for PSU and alarm port
$T_{half_voltage}$	50 μs for PSU and alarm port
$T_{rise_current}$	8 μs
$T_{half_current}$	20 μs
Source impedance	2 Ω for PSU and alarm port / 25 Ω for telecom lines
Number of pulses	5 positive and 5 negative
Delay time between pulses	40 seconds delay between the impulses
Coupling	I/O terminals and CT terminals From the terminals of a circuit to earth (L-E.2 via 40 Ω in series with 0,5 μF). Between the terminals of a circuit (L-L.2 via 40 Ω in series with 0,5 μF).
Zone specification	A
Acceptance criteria	B

Test set-up



Results

circuit	terminals	test voltage (kV)	coupling	polarity	observation
CT inputs L1, L2, L3, E	A1 - A8	2	L-E 40 Ω / 0,5 μ F	+	passed
		2	L-E 40 Ω / 0,5 μ F	-	passed
		1	L-L 40 Ω / 0,5 μ F	+	passed
		1	L-L 40 Ω / 0,5 μ F	-	passed
phase trip output	D10 - D11	2	L-E 40 Ω / 0,5 μ F	+	passed
		2	L-E 40 Ω / 0,5 μ F	-	passed
		1	L-L 40 Ω / 0,5 μ F	+	passed
		1	L-L 40 Ω / 0,5 μ F	-	passed
neutral trip output	D12 - D13	2	L-E 40 Ω / 0,5 μ F	+	passed
		2	L-E 40 Ω / 0,5 μ F	-	passed
		1	L-L 40 Ω / 0,5 μ F	+	passed
		1	L-L 40 Ω / 0,5 μ F	-	passed
watchdog output	D14 - D15	2	L-E 40 Ω / 0,5 μ F	+	passed
		2	L-E 40 Ω / 0,5 μ F	-	passed
		1	L-L 40 Ω / 0,5 μ F	+	passed
		1	L-L 40 Ω / 0,5 μ F	-	passed
trip output	D16 - D17	2	L-E 40 Ω / 0,5 μ F	+	passed
		2	L-E 40 Ω / 0,5 μ F	-	passed
		1	L-L 40 Ω / 0,5 μ F	+	passed
		1	L-L 40 Ω / 0,5 μ F	-	passed

Requirements

Performance criteria B (see clause 3.4.4. "Acceptance criteria").

Results

The object passed the test with performance criteria B.

5.6 Conducted disturbance induced by radio frequency field

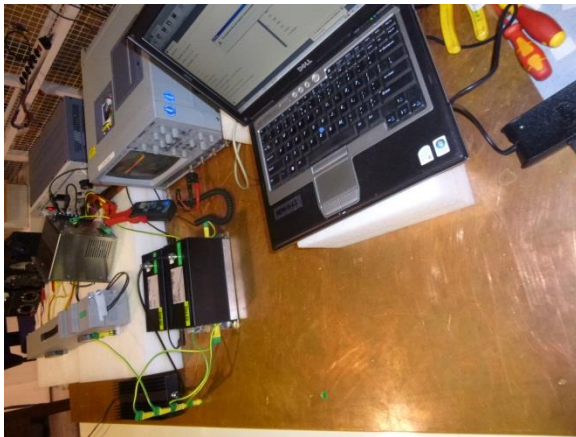
Standard and date

Generic standard	IEC60255-1, IEC 60255-26
Test standard	IEC 61000-4-6
Test date	5 December 2013

Characteristic test data

Sample	13470167
Mains power supply	Self-powered
Current applied to CT	0,92 A
Frequency range	150 kHz – 80 MHz
Modulation	AM, 1 kHz (sine wave) 80%
Step size	1%
Dwell time	1 s
Spot frequencies	Clock frequencies 27 MHz, 68 MHz
Testing time spot frequencies	10 s
Output impedance	50 Ω
Output class flatness	± 1 dB (un-)controlled
Harmonic and distortion	≤ -20 dB below carrier class
Acceptance criteria	B

Test setup



Results

circuit	terminals	CDN	frequency (MHz)	test voltage (V)
CT input	A1 – A2	CDN-M4	0,15 – 80 27, 68	10
CT input	A7 – A8	CDN-M4	0,15 – 80 27, 68	10
neutral trip output	D12 –D13	clamp EM101	0,15 – 80 27, 68	10
watchdog output	D14 –D15	clamp EM101	0,15 – 80 27, 68	10
phase trip output	D10 –D11	clamp EM101	0,15 – 80 27, 68	10
trip output	D16 –D17	clamp EM101	0,15 – 80 27, 68	10
earth	earth	AF2	0,15 – 80 27, 68	10

Requirements

Performance criteria B (see clause 3.4.4. “Acceptance criteria”).

Result

The object passed the test with performance criteria A and B.

5.7 Power frequency CM voltage immunity tests

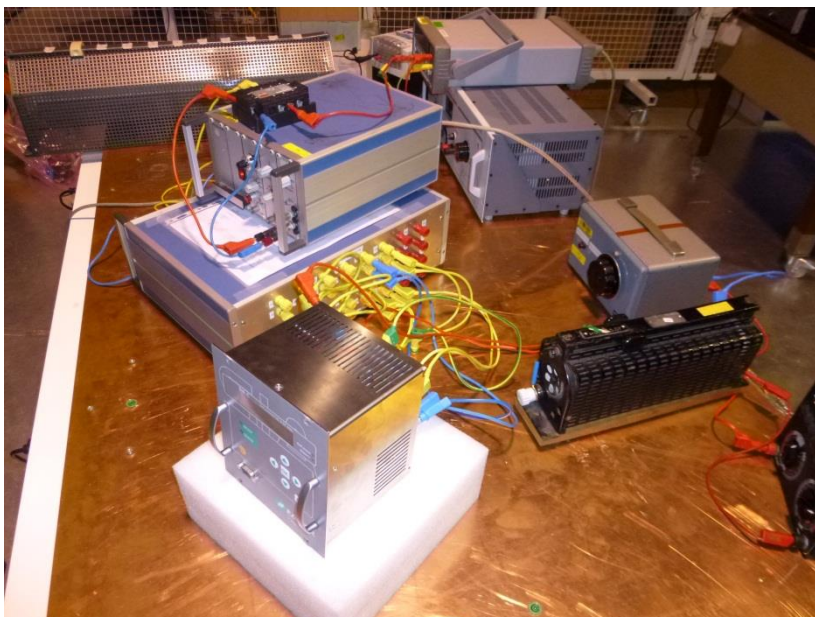
Standard and date

Generic standard	IEC 60255-1, IEC 60255-26
Test standard	IEC 61000-4-16
Test date	16 December 2013

Characteristic test data

Test sample	13470167
Mains power supply	Self-powered
Current applied to CT	0,96 A
Mode	Continuous
Duration	1 - 60 s
Frequency	50 Hz
Output impedance generator	< 150 Ω
On/off mode	Slowly increase and decrease
Coupling	R = 100 Ω , C = 0,1 μ F (DM) R = 220 Ω , C = 0,47 μ F (CM)
Group G1	CT input terminals (A1 –A8)
Group G2	Trip output terminals (D16 – D17)
Group G3	Phase, Neutral, Watchdog output terminals (D10 – D15)
Ground	Chassis
Zone specification	B
Acceptance criteria	A

Test setup



Results

Group	terminals	test voltage VAC	Time (s)	observation
G2 to Ground	D16 – D17 chassis	30	60	passed
		300	1	passed
G3 to Ground	D10 – D15 chassis	30	60	passed
		300	1	passed

Requirements

Performance criteria A (see clause 3.4.4. "Acceptance criteria").

Results

The object passed the test with performance criteria A.

5.8 Power frequency magnetic field immunity tests

Standard and date

Generic standard IEC 60255-1, IEC 60255-26
 Test standard IEC 61000-4-8
 Test date 6 December 2013

Characteristic test data

Test sample 13470167
 Mains power supply Self-powered
 Current applied to CT 0,96 A
 Frequency 50 Hz
 Coil factor 100
 Maximum distortion 8%
 Acceptance criteria A during 30 A/m continuous
 Acceptance criteria B during 300 A/m during 2 sec

Test setup



Results

direction	test level (A/m)	duration	observation
transversal (x)	30	continuous	passed
	300	2 sec	passed
longitudinal (y)	30	continuous	passed
	300	2 sec	passed
vertical (z)	30	continuous	passed
	300	2 sec	passed

Requirements

Performance criteria A for test level 30 A/m and B for test level 300 A/m (see clause 3.4.4. "Acceptance criteria").

Results

The object passed the test for both test levels with performance criteria A and B.

5.9 Damped oscillatory magnetic field 100 kHz

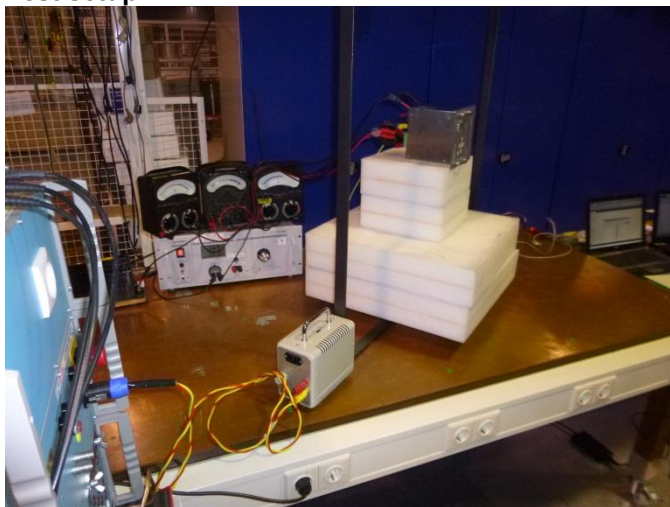
Standard and date

Generic standard -
 Test standard IEC 61000-4-10
 Test date 6 December 2013

Characteristic test data

Sample 13470167
 Mains power supply Self-powered
 Frequency 100 kHz
 Decay rate 50% of the peak value after 3 to 6 cycles
 Repetition rate 40 transients per second
 Test time 3 s
 Level 5

Test setup



Results

direction	test level (A/m)	duration (s)	result
transversal (x)	100	3	passed
longitudinal (y)	100	3	passed
vertical (z)	100	3	passed

Requirements

Performance criteria B (see clause 3.4.4. "Acceptance criteria").

Results

The object passed the test with performance criteria A and B.

5.10 Damped oscillatory magnetic field 1 MHz

Standard and date

Generic standard -
 Test standard IEC 61000-4-10
 Test date 6 December 2013

Characteristic test data

Sample 13470167
 Mains power supply Self-powered
 Frequency 1 MHz
 Decay rate 50% of the peak value after 3 to 6 cycles
 Repetition rate 400 transients per second
 Test time 3 s

Test setup



Results

direction	test level (A/m)	duration (s)	result
transversal (x)	100	3	passed
longitudinal (y)	100	3	passed
vertical (z)	100	3	passed

Requirements

Performance criteria B (see clause 3.4.4. "Acceptance criteria").

Results

The object passed the test with performance criteria A and B.

5.11 Pulsed magnetic field

Standard and date

Generic Standard -
Standard IEC 61000-4-9
Test date 6 December 2013

Characteristic test data

Sample 13470167
Current applied to CT 0,96 A
 $T_{\text{rise_current}}$ 6,4 μs
 $T_{\text{half_current}}$ 16 μs
Applied max.current 1000 A/m
Number of pulses 5 positive, 5 negative

Test setup



Results

direction	test level (A/m)	number of repetitions	polarity	observation
transversal (x)	1000	5	+	passed
	1000	5	-	passed
longitudinal (y)	1000	5	+	passed
	1000	5	-	passed
vertical (z)	1000	5	+	passed
	1000	5	-	passed

Requirements

Performance criteria B (see clause 3.4.4. "Acceptance criteria").

Results

The object passed the test with performance criteria A and B.

5.12 Radiated emission

Standard and date

Generic standard	IEC 60255-1, IEC 60255-26
Test standard	CISPR 11, CISPR 22
Test date	10 December 2013

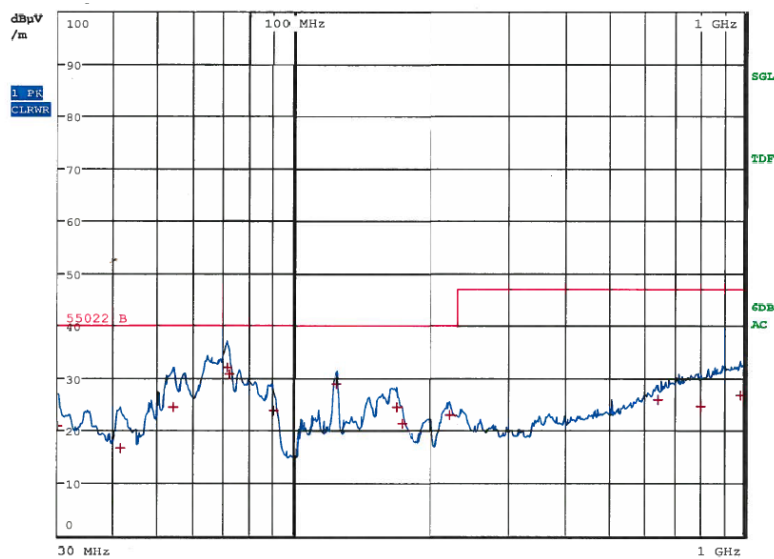
Characteristic test data

Sample	13470167
Mains power supply	Self-powered
Current applied to CT	0,92 A
Class	A
Test frequency band	30 MHz to 6 GHz

Test setup

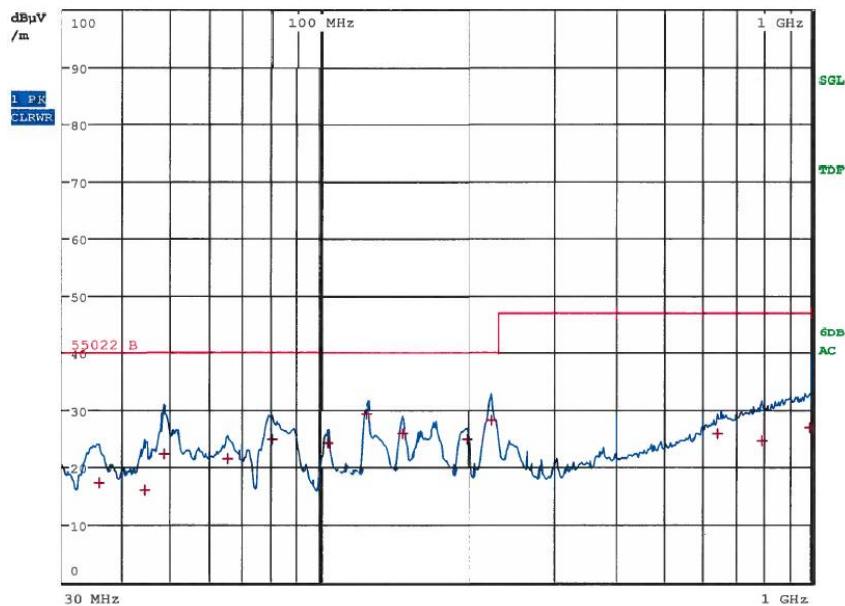


Results



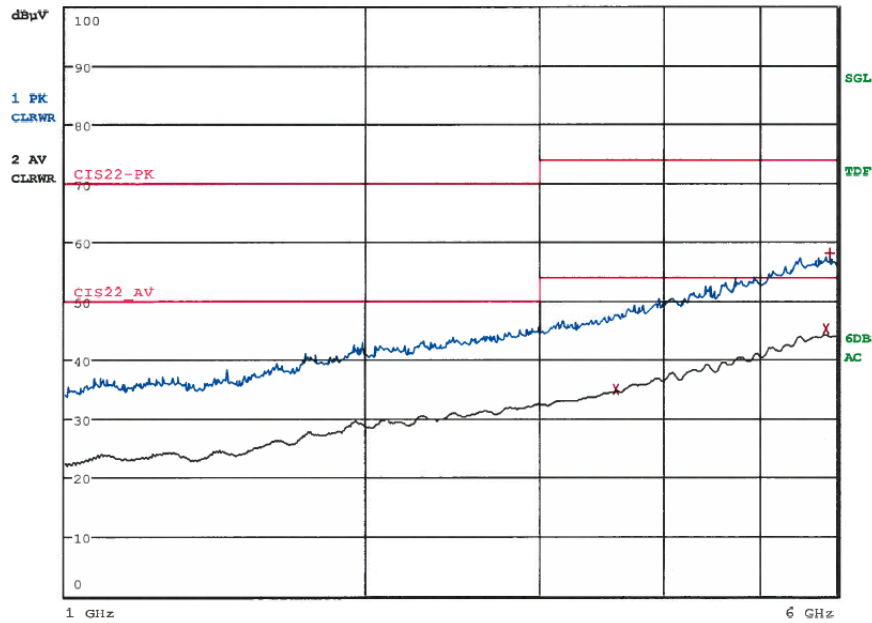
Antenna in vertical position

Frequency (MHz)	Level (dB μ V/m)	Detector
71,31	32,05	Quasi peak
72,12	30,69	Quasi peak
123,96	28,99	Quasi peak
169,62	24,54	Quasi peak
54,12	24,48	Quasi peak
89,94	23,76	Quasi peak
221,22	22,96	Quasi peak
173,85	21,26	Quasi peak
30,00	20,99	Quasi peak



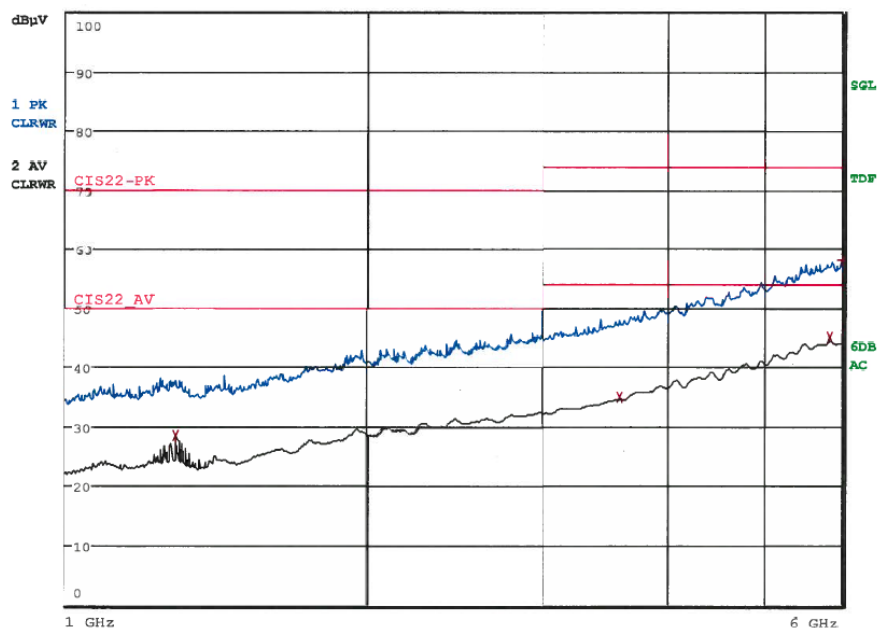
Antenna in horizontal position

Frequency (MHz)	Level (dB μ V/m)	Detector
124,41	29,37	Quasi peak
222,54	28,20	Quasi peak
147,45	25,85	Quasi peak
080,07	24,91	Quasi peak
198,96	24,89	Quasi peak
104,10	24,20	Quasi peak
048,39	22,28	Quasi peak
064,98	21,53	Quasi peak
996,12	27,06	Quasi peak



Antenna in horizontal position

Frequency (GHz)	Level (dBμV/m)	Detector
3,58750	34,92	Average
5,85175	45,19	Average
5,90025	58,01	Max Peak



Antenna in vertical position

Frequency (GHz)	Level (dB μ V/m)	Detector
1,29025	28,53	Average
3,58725	34,88	Average
5,82275	45,14	Average
5,99125	58,01	Max Peak

Results

The scan measurements were performed in an anechoic chamber. Distance between EUT and antenna is 3 m.

Requirements

Test standard	Class
CISPR 11	A
CISPR 22	A
Frequency (MHz)	Limit of radiated emission at 3 m quasi peak dB
30 – 230	40
230 – 1000	47
1000 – 3000	70
3000 – 6000	74

Result

The object passed the test for Class A and B.

6 CLIMATIC ENVIRONMENT

6.1 Dry heat operation test

Standard and date

Generic standard IEC 60255, clause 6.12.3.1

Test standard IEC 60068, IEC 60068-2-2

Test dates 10 to 14 December 2013

Characteristic test data

Sample 13470165

Mains Self-powered

Current applied to CT 0,92 A

Test object 1 hour non-energized followed by 71 hours energized

Test Bd

Temperature 70 °C

Test time 72 hours

Max. rate of change 1 °C/min over a 5 min period

Test setup



Results

test	observation	result
dry heat operation test	the first attempt for powering up after 1 hour at 70 °C	passed
	high voltage withstand test at ambient temperature after climate test	passed
	insulation resistance after climate tests > 100 MΩ	passed

Requirements

Performance criteria A (see clause 3.4.4. "Acceptance criteria").

Result

The object passed the test with performance criteria A.

6.2 Cold operation test

Standard and date

Generic standard	IEC 60255-1, clause 6.12.3.2
Test standard	IEC 60068, IEC 60068-2-1
Test dates	4 to 7 December 2013

Characteristic test data

Sample	13470165
Mains	Self-powered
Current applied to CT	0,92 A
Test object	1 hour non-energized followed by 71 hours energized
Test	Ad
Temperature	-25 °C
Test time	72 hours
Max. rate of change	1 °C/min over a 5 min period

Test setup



Results

test	observation	result
cold operation test	the first attempt for powering up after 1 hour at -25 °C	passed
	high voltage withstand test at ambient temperature after climate test	passed
	insulation resistance after climate tests > 100 MΩ	passed

Requirements

Performance criteria A (see clause 3.4.4. "Acceptance criteria").

Result

The object passed the test with performance criteria A.

6.3 Dry heat transport and storage test

Standard and date

Generic standard	IEC 60255-1, clause 6.12.3.3
Test standard	IEC 60068, IEC 60068-2-2
Test dates	13 to 15 December 2013

Characteristic test data

Sample	13470165
Mains	Self-powered
Test object	not energized
Test	Bb
Temperature	85 °C
Test time	72 hours
Max. rate of change	1 °C/min over a 5 min period
CT input	Non-energized

Test setup



Results

test	observation	result
dry heat storage test	correct operation at ambient temperature after 72 hours at 85 °C	passed
	high voltage withstand test at ambient temperature after climate test	passed
	insulation resistance after climate tests > 100 MΩ	passed

Requirements

Correct operation before and after the test with Performance criteria A (see clause 3.4.4. "Acceptance criteria").

Result

The object passed the test.

6.4 Cold transport and storage test

Standard and date

Generic standard	IEC 60255-1, clause 6.12.3.4
Test standard	IEC 60068, IEC 60068-2-1
Test dates	7 to 10 December 2013

Characteristic test data

Sample	13470165
Mains	Self-powered
Test object	Non-energized
Test	Ab
Temperature	-40 °C
Test time	72 hours
Max. rate of change	1 °C/min over a 5 min period
CT input	Non-energized

Test setup



Results

test	observation	result
cold transport and storage test	correct operation at ambient temperature after 72 hours at -40 °C	passed
	high voltage withstand test at ambient temperature after climate test	passed
	insulation resistance after climate tests > 100 MΩ	passed

Requirements

Correct operation before and after the test with Performance criteria A (see clause 3.4.4. "Acceptance criteria").

Result

The object passed the test.

6.5 Change of temperature

Standard and date

Generic standard	IEC 60255, clause 6.12.3.5
Test standard	IEC 60068, IEC 60068-2-14
Test dates	16 to 18 December 2013

Characteristic test data

Sample	13470165
Mains	Self-powered
Current applied to CT	0,92 A
Test	Nb
Temperature	70 °C upper temperature, -25 °C lower temperature
Test time	5 cycles, (cycle 3h+3h)
Max. rate of change	1 °C/min over a 5 min period

Test set-up



Results

test	observation	result
change of temperature test	correct operation during and after the test, energized at +70 °C, -25 °C	passed
	high voltage withstand test at ambient temperature after climate test	passed
	insulation resistance after climate tests > 100 MΩ	passed

Requirements

Performance criteria A (see clause 3.4.4. "Acceptance criteria").

Result

The object passed the test with performance criteria A.

6.6 Damp heat steady state

Standard and date

Generic standard	IEC 60255, clause 6.12.3.6
Test standard	IEC 60068, IEC 60068-2-78
Test dates	18 to 20 December 2013

Characteristic test data

Sample	13470165
Mains	Self-powered
Current applied to CT	0,92 A
Test object	energized
Test	Cab
Temperature	40 °C upper temperature
Humidity	85%
Test time	2 days
Max. rate of change	1 °C/min over a 5 min period

Test set-up



Results

test	observation	result
damp heat steady state test	correct operation during and after the test, energized at +40 °C	passed
	high voltage withstand test at ambient temperature after climate test	passed
	insulation resistance after climate tests > 100 MΩ	passed

Requirements

Performance criteria A (see clause 3.4.4. "Acceptance criteria").

Result

The object passed the test with performance criteria A.

6.7 Damp heat cyclic test

Standard and date

Generic standard	IEC 60255, clause 6.12.3.7
Test standard	IEC 60068, IEC 60068-2-30
Test dates	20 to 23 December 2013

Characteristic test data

Sample	13470165
Mains	Self-powered
Current applied to CT	0,92 A
Test object	1 hour non-energized followed by 16 hours energized
Test	-
Temperature	40 °C upper temperature, 25 °C lower temperature
Test time	2 cycles (cycle 12h+12h)
Humidity	97% at lower temperature, 93% at upper temperature
Max. rate of change	1 °C/min over a 5 min period

Test set-up



Results

test	observation	result
damp heat cyclic test	correct operation during and after the test at 40 °C upper temperature, 25 °C lower temperature	passed
	high voltage withstand test at ambient temperature after climate test	passed
	insulation resistance after climate tests > 100 MΩ	passed

Requirements

Performance criteria A (see clause 3.4.4. "Acceptance criteria").

Result

The object passed the test with performance criteria A.

7 MECHANICAL ENVIRONMENT

7.1 Mechanical environment

7.2 Vibration response test

Standard and date

Standard	IEC 60255-1 subclause 6.13.1
Test standard	IEC 60255-21-1
Test dates	30 and 31 October 2013

Characteristic test data

Sample	13470167
Mains power supply	Self-powered
Current applied to CT	0,92 A
Class	1
Test object	Energized
Frequency range / displacement / acceleration	10 – 60 Hz 0,035 mm/ 60 – 150 Hz 0,5g
Number of sweeps per axis	2 sweep cycles

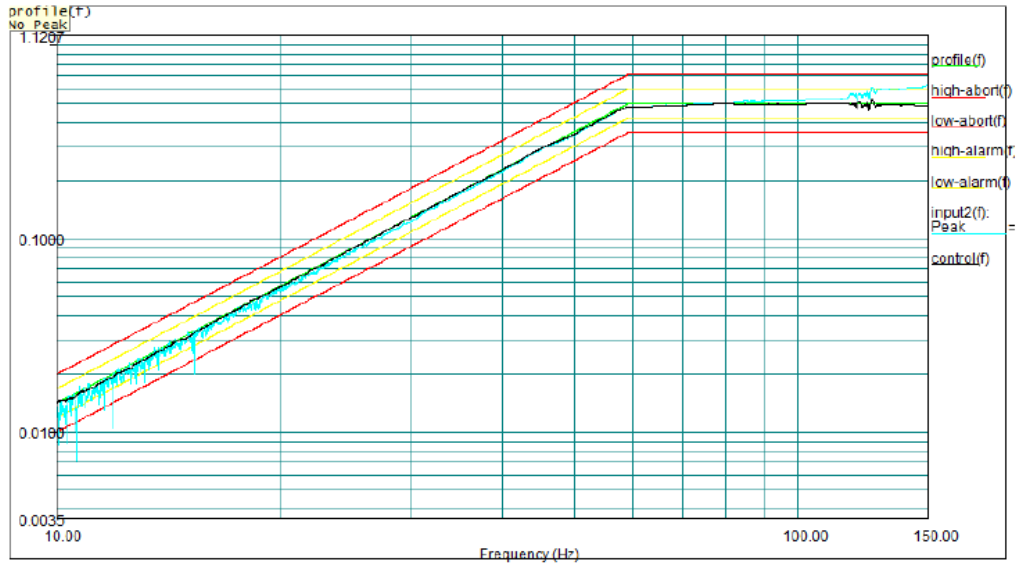
Test set-up



Requirements

Normal performance within the specification limits (see clause 4.5.3. “performance criteria”).

Results



Result

The object passed the test.

7.3 Vibration endurance test

Standard and date

Standard	IEC 60255-1 subclause 6.13.1
Test standard	IEC 60255-21-1
Test dates	30 and 31 October 2013

Characteristic test data

Sample	13470167
Mains power supply	Self-powered
Class	1
Test object	Non-energized
Frequency range / acceleration	10 – 150 Hz / 1g
Number of sweeps per axis	20 sweep cycles

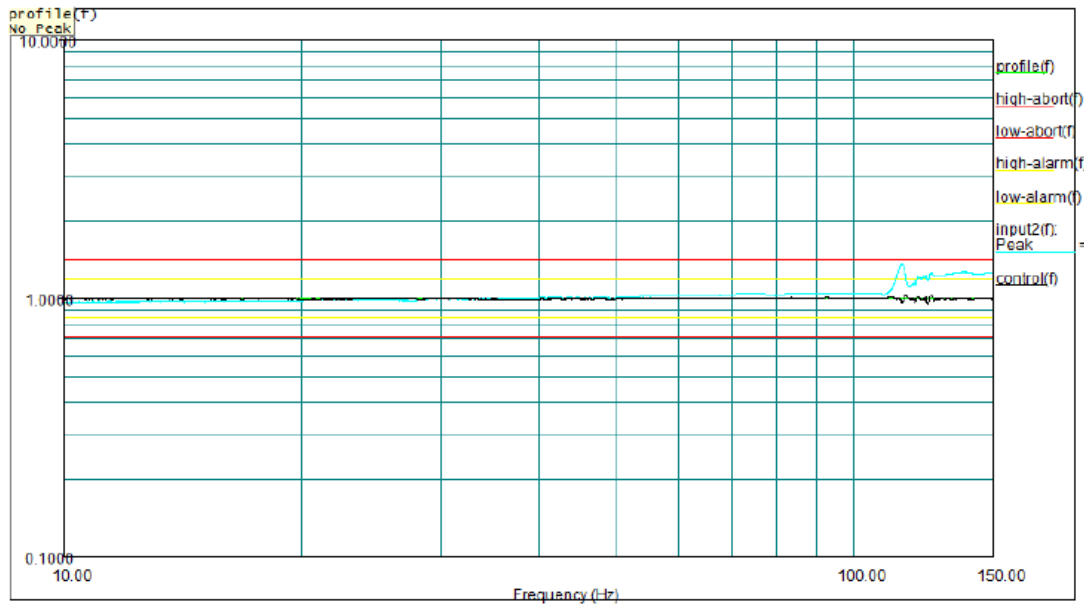
Test set-up



Requirements

Normal performance within the specification limits (see clause 4.5.3. “performance criteria”).

Results



Result

The object passed the test.

7.4 Shock response test

Standard and date

Standard	IEC 60255-1 subclause 6.13.2
Test standard	IEC 60255-21-2
Test dates	30 and 31 October 2013

Characteristic test data

Sample	13470167
Mains power supply	Self-powered
Current applied to CT	0,92 A
Class	1
Test object	Energized
Peak acceleration	5 g
Pulse duration	11 ms
Directions	Positive and negative
Number of pulses per direction	3

Test set-up

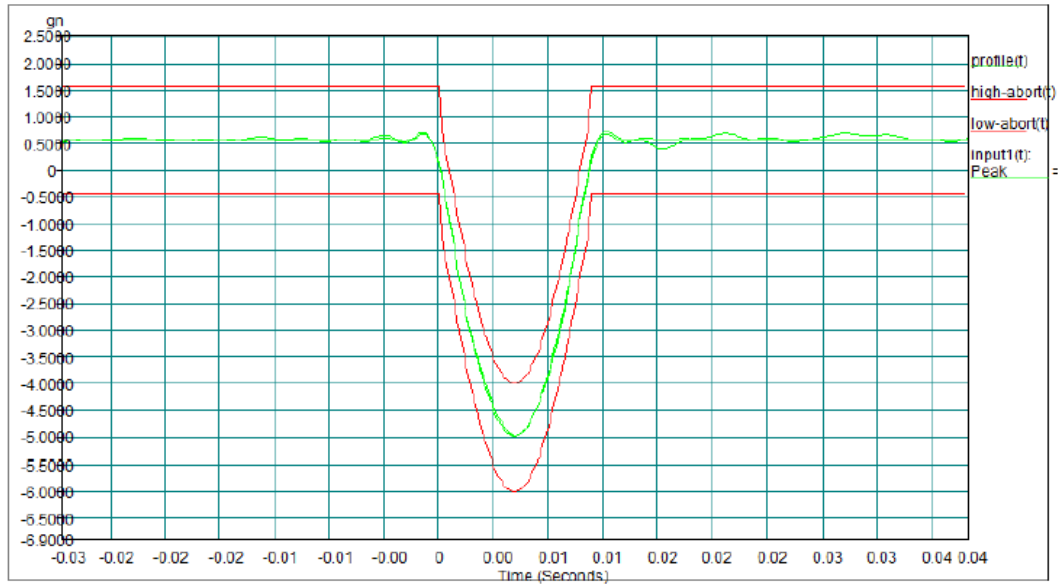


In order to check the performance the serial interface was connected after the test

Requirements

Normal performance within the specification limits (see clause 4.5.3. "performance criteria").

Results



Result

The object passed the test.

7.5 Shock withstand test

Standard and date

Standard	IEC 60255-1 subclause 6.13.2
Test standard	IEC 60255-21-2
Test dates	30 and 31 October 2013

Characteristic test data

Sample	13470167
Mains power supply	Self-powered
Current applied to CT	0,92 A
Class	1
Test object	Off
Peak acceleration	15 g
Pulse duration	11 ms
Directions	Positive and negative
Number of pulses per direction	3

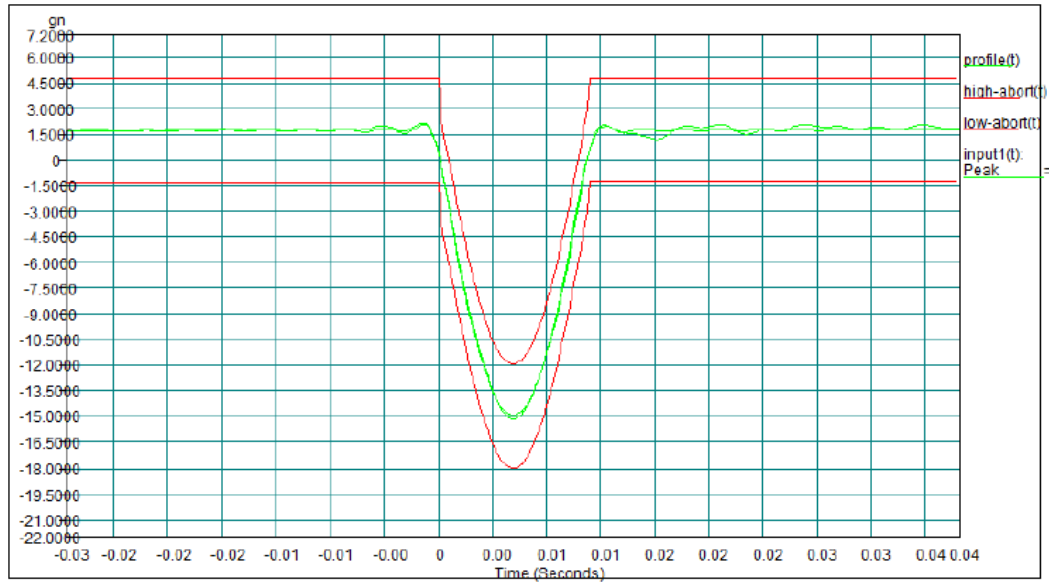
Test set-up



Requirements

Normal performance within the specification limits (see clause 4.5.3. "performance criteria").

Results



Result

The object passed the test.

7.6 Bump test

Standard and date

Standard	IEC 60255-1 subclause 6.13.1
Test standard	IEC 60255-21-2
Test dates	30 and 31 October 2013

Characteristic test data

Sample	13470167
Mains power supply	Self-powered
Current applied to CT	0,92 A
Class	1
Test object	Off
Peak acceleration	10 g
Pulse duration	16 ms
Directions	Positive and negative
Number of pulses per direction	1000

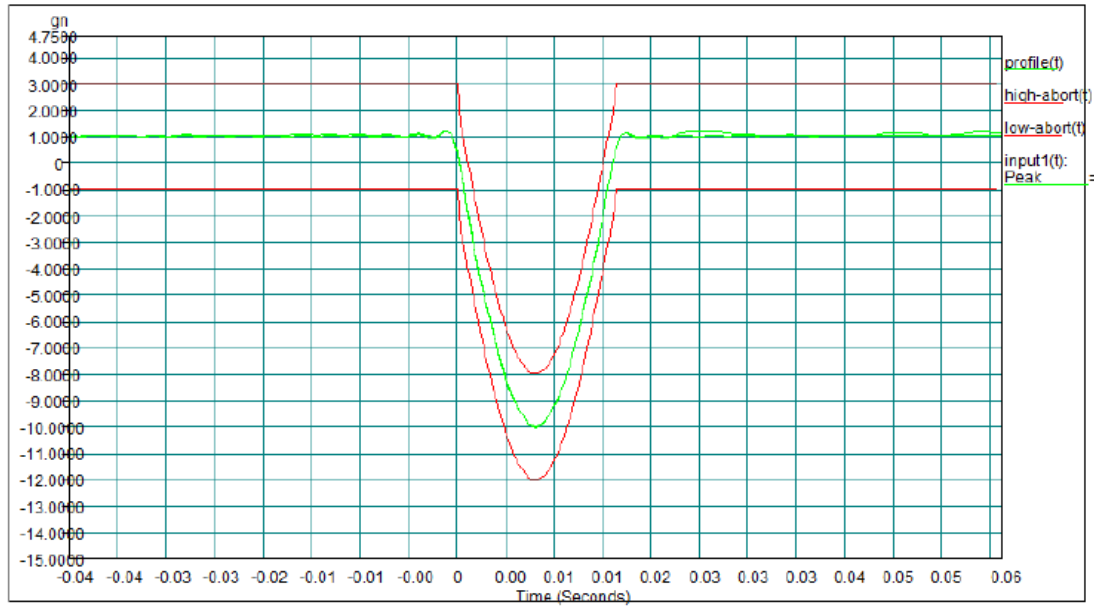
Test set-up



Requirements

Normal performance within the specification limits (see clause 4.5.3. "performance criteria").

Results



Result

The object passed the test.

7.7 Seismic test

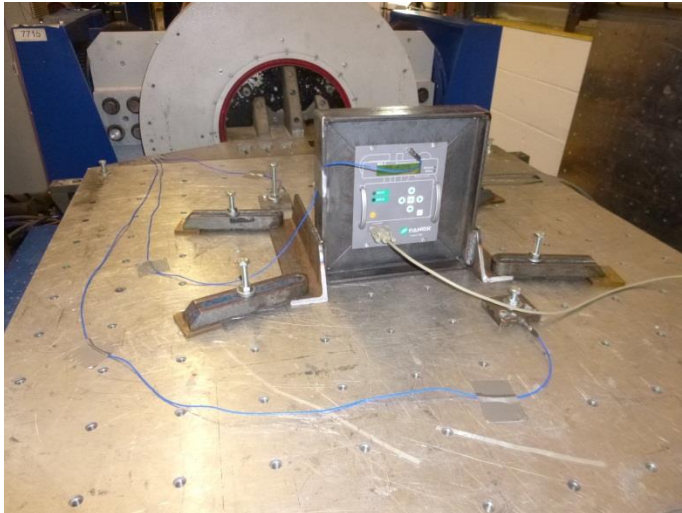
Standard and date

Standard	IEC 60255-1 subclause 6.13.3
Test standard	IEC 60255-21-3
Test dates	30 and 31 October 2013

Characteristic test data

Sample	13470167
Mains power supply	Self-powered
Current applied to CT	0,92 A
Class	1
Test object	energized
X-axis, frequency range / displacement	1 – 9 Hz / 3,5 mm
X-axis, frequency range / acceleration	9 – 35 Hz / 1 g
Y-axis, frequency range / displacement	1 – 9 Hz / 3,5 mm
Y-axis, frequency range / acceleration	9 – 35 Hz / 1 g
Z-axis, frequency range / displacement	1 – 9 Hz / 1,5 mm
Z-axis, frequency range / acceleration	9 – 35 Hz / 0,5 g
Number of sweeps per axis	2 sweep cycle

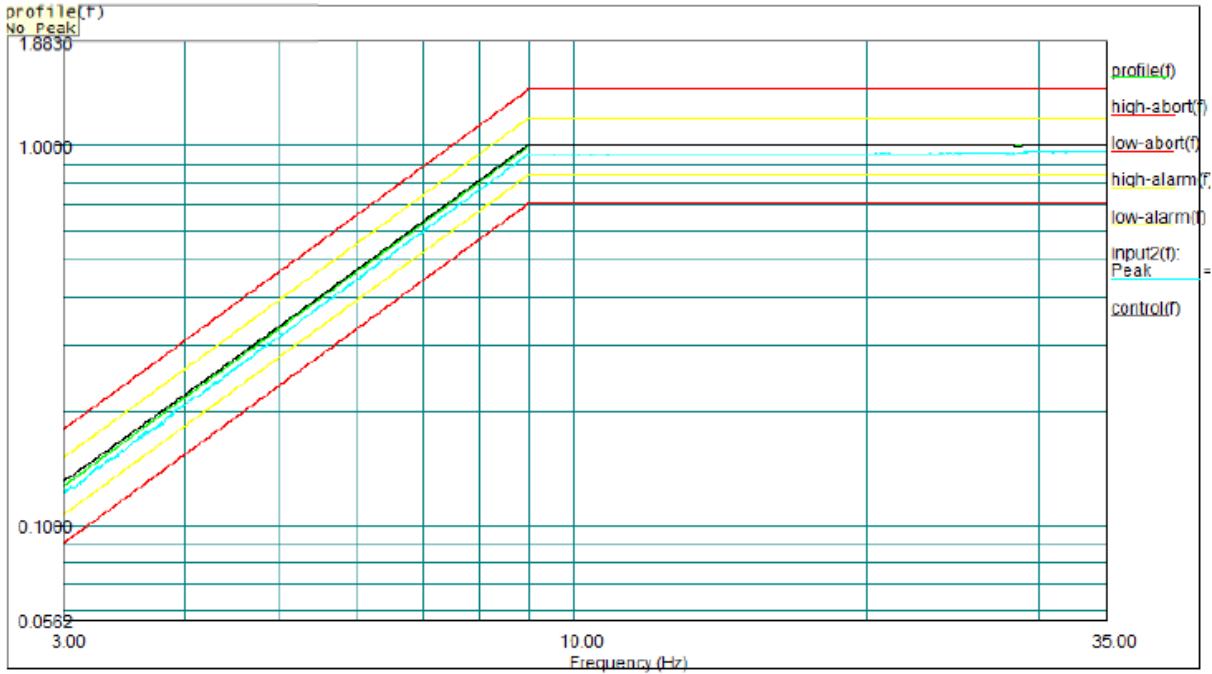
Test set-up



Requirements

Normal performance within the specification limits (see clause 4.5.3. “performance criteria”).

Results



Result

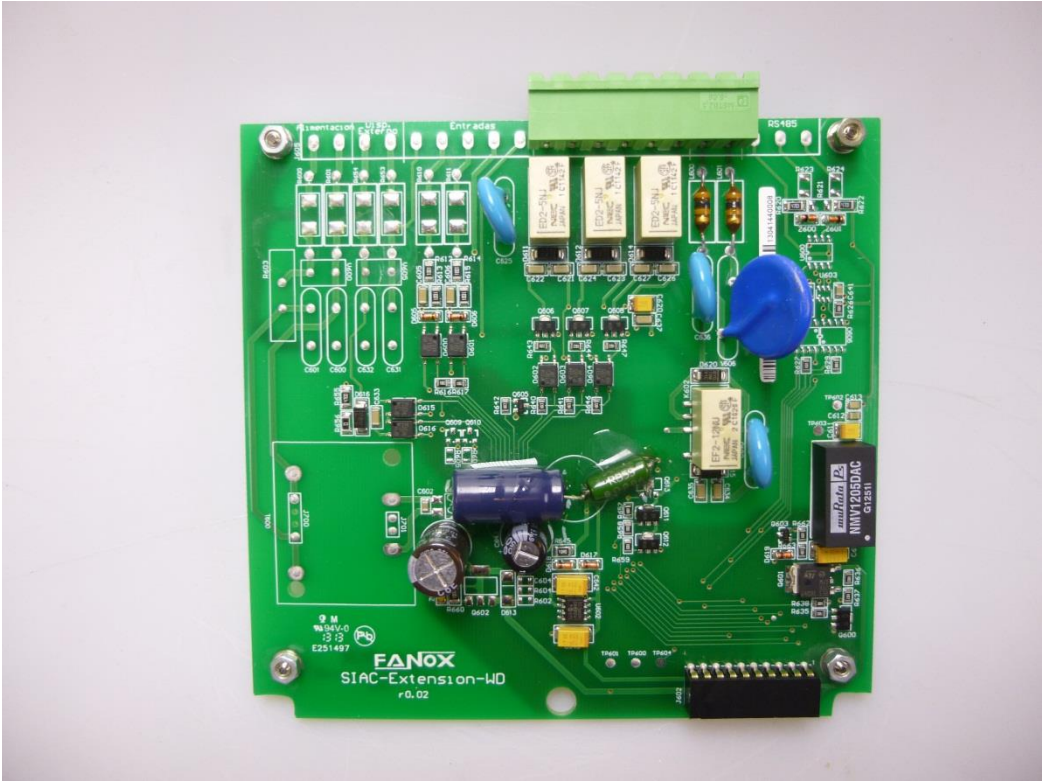
The object passed the test.

APPENDIX A MEASUREMENT UNCERTAINTIES

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%
time	0,5 ms

APPENDIX B ELECTRONIC BOARDS



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