

KEMA TEST REPORT

1313-16

Object Self and dual powered relay with input energizing quantities for current protection

Type SIAB000B0010AA with CT016-10 **Serial No.** see chapter 2.2
 Temperature range : -25 to 70 °C
 Rated input current: 16-56 A

Client Fanox,
Derio, Spain

Manufacturer Fanox,
Derio, Spain

Tested by KEMA Nederland B.V.,
Arnhem, The Netherlands

Date of tests 8 April to 24 June 2016

Test specification The tests have been carried out in accordance with IEC 60255-1 (2009).

Summary and conclusion The SIA-B relay passed the tests listed in the summary.

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 142 pages in total.

KEMA Nederland B.V.



J.P. Fonteijne
Executive Vice President
KEMA Laboratories



Laboratories

Arnhem, 1 July 2016

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 60255-1 have been performed on the test object.

No.	Test / measurement	Test status	Pass/Fail
1 Electromagnetic compatibility (EMC) tests			
1.1	Emission		
1.1.1	Radiated emission	Test performed	passed
1.1.2	Conducted emission	Test performed	passed
1.2	Immunity		
1.2.1	1 MHz damped oscillatory wave	Test performed	passed
1.2.2	Electrostatic discharges	Test performed	passed
1.2.3	Fast transient/burst	Test performed	passed
1.2.4	Surge	Test performed	passed
1.2.5	Conducted disturbance induced by RF fields	Test performed	passed
1.2.6	Power frequency H-field (50 Hz)	Test performed	passed
1.2.7	Damped oscillatory magnetic field (100 kHz and 1 MHz)	Test performed	passed
1.2.8	Pulse magnetic field	Test performed	passed
1.2.9	A.C. voltage dips	Test performed	passed
1.2.10	A.C. voltage interruptions	Test performed	passed
2 Dielectric tests			
2.1	Impulse voltage	Test scheduled	passed
2.2	Dielectric voltage	Test scheduled	passed
2.3	Insulation resistance	Test scheduled	passed
3 Mechanical tests			
3.1	Vibration response	Test performed	passed
3.2	Vibration endurance	Test performed	passed
3.3	Shock response	Test performed	passed
3.4	Shock withstand	Test performed	passed
3.5	Bump	Test performed	passed
3.6	Seismic (single axis sweep)	Test performed	passed
4 Climate tests			
4.1	Dry heat operational	Test performed	passed
4.2	Cold operational	Test performed	passed
4.3	Dry heat storage	Test performed	passed
4.4	Cold storage	Test performed	passed
4.5	Change of temperature	Test performed	passed
4.6	Damp heat steady state	Test performed	Passed
4.7	Damp heat cyclic	Test performed	passed
5 Functional tests			
5.1	60255-151 Overcurrent	Test performed	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 CT016-10	16-56 A
Rated frequency	50 and 60 Hz
Rated auxillary voltage	230 Vac
Binary input voltage	17 Vdc
Maximum operating temperature	70 °C
Minimum operating temperature	-25 °C
Maximum storage temperature	85 °C
Minimum storage temperature	-40 °C

Classification

IP-class	IP 54
Mechanical class	1
EMC emission class	A
EMC immunity zone	A

ANSI code of protection function

Instantaneous phase over current protection	50
Time delayed phase overcurrent protection	51
Instantaneous earth fault protection	50N
Time delayed earth fault protection	51N

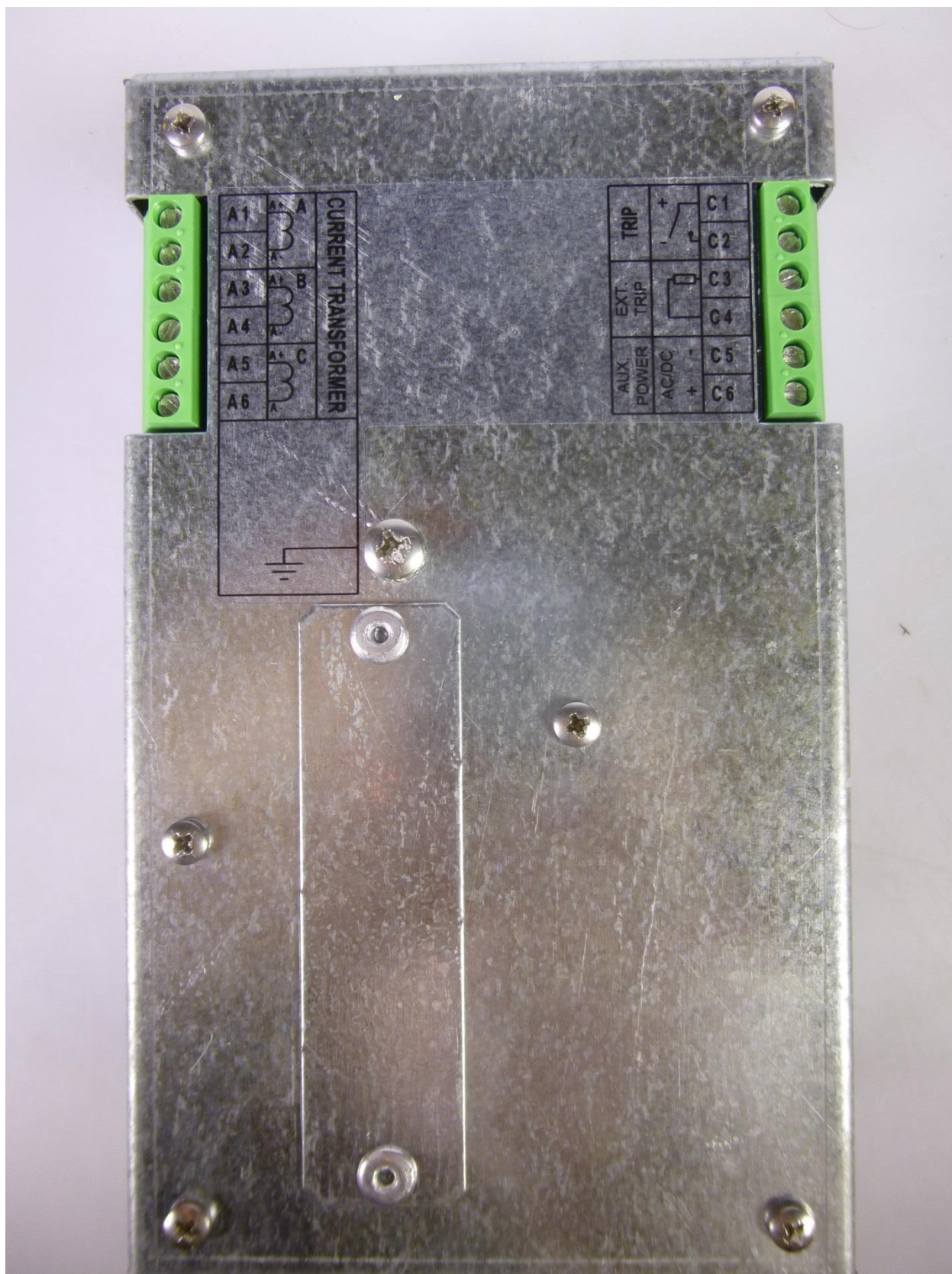
2.2 Description of the object tested

Manufacturer	Fanox, Derio, Spain
Type	SIA-B
Object	Self and Dual powered overcurrent & earth fault protection relay with input energizing quantities for current protection
Settings	Unless otherwise specified, the default settings of the manufacturer were used.

Type	Serial No.	Hardware	Software
IED SIA-B	16150320	CPU: R.10 I/O: R.09	1.30 - 1.06
IED SIA-B	16110472	CPU: R.10 I/O: R.09	1.30 - 1.06
IED SIA-B	16110463	CPU: R.10 I/O: R.09	1.30 - 1.06
CT16-10	14753602	-	-
CT16-10	14753604	-	-
CT16-10	14753603	-	-
CT16-10	14753611	-	-
CT16-10	14753608	-	-
CT16-10	14753610	-	-
CT16-10	14753613	-	-
CT16-10	14753609	-	-
CT16-10	14753612	-	-

2.3 Photograph of test object









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
Peter Hilderling	KEMA Nederland B.V.,
Martijn Dallinga	Arnhem, The Netherlands

3.3 Subcontracting

The following tests were subcontracted to DARE!! Measurement:

- Measurement of radiated emission in accordance with IEC 60255-26 and CISPR22.
- Measurement of conducted emission in accordance with IEC 60255-26 and CISPR22.

The following tests were subcontracted to Sebert Trillingstechniek B.V.:

- Vibration response and endurance in accordance with IEC 60255-21-1.
- Shock response and withstand in accordance with IEC 60255-21-2.
- Bump test in accordance with IEC 60255-21-2.
- Seismic test accordance with IEC 60255-21-3.

3.4 Purpose of the tests

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

Accuracy tests and operating time tests are performed for the phase overcurrent 50/51 and neutral overcurrent 50N/51N protection functions on the Self and Dual powered Overcurrent & Earth Fault Protection Relay, type SIA-B manufactured by Fanox. The tests are performed in combination with current transformer type CT016-10 10P80 for the phase currents. The neutral current is calculated from the phase currents.

The accuracy and operating time tests are performed based on standard IEC 60255-151 at 50 Hz and 60 Hz.

3.5 Measurement uncertainty

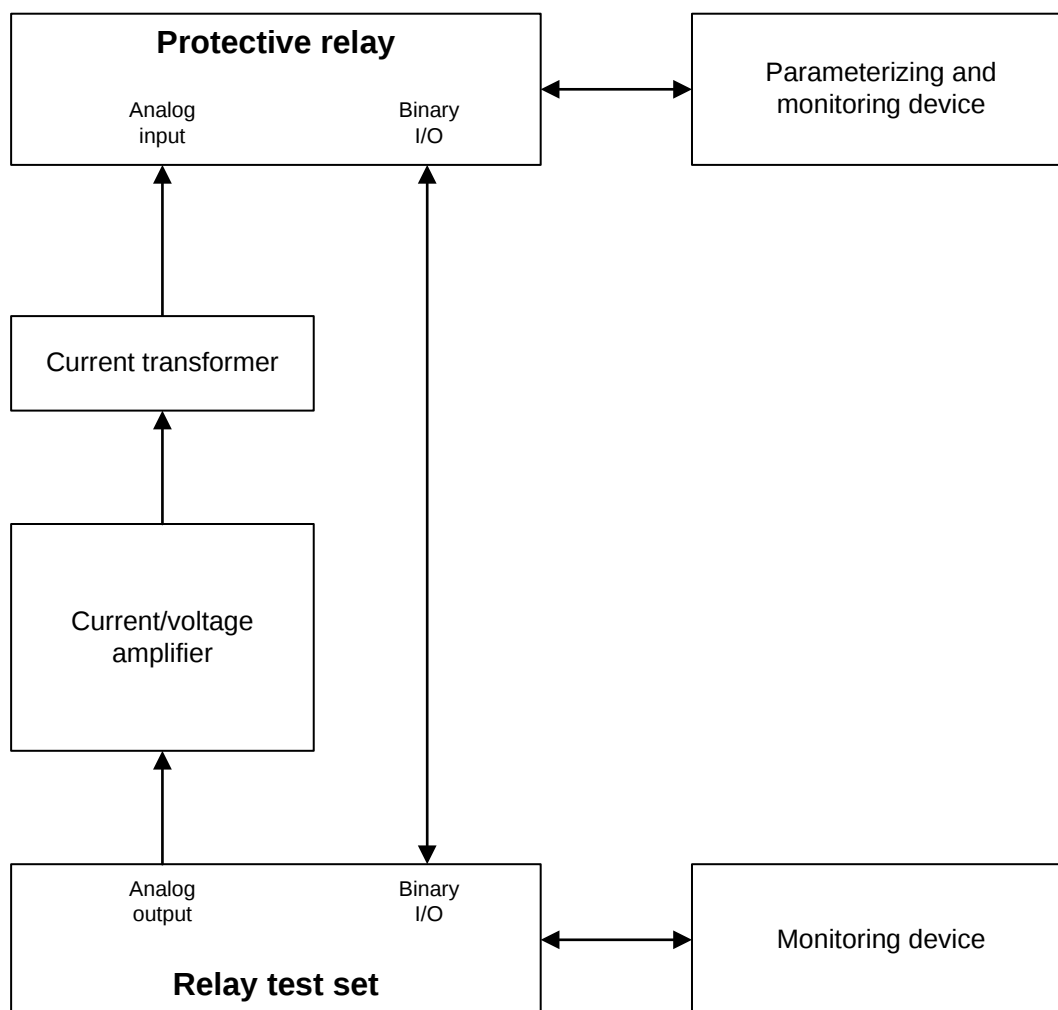
A table with measurement uncertainties is enclosed in this report. Unless otherwise stated, the measurement uncertainties of the results presented in this report are as indicated in that table.

3.6 Instruments used

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

4 TEST ARRANGEMENT

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



5 PRODUCT SAFETY

5.1 Inspection

5.1.1 Pre-inspection

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

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

- analogue inputs
- digital input
- contact output.

5.1.2 Visual and functional inspection

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

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

There shall be no:

- burning of any components.
- paint blisters on any components.
- discolouration on components.
- deformation of modules or components.
- interruptions or damage on interconnecting cables, wires and connectors.

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

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

There shall be no:

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

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

5.2 Impulse voltage test

Standard and date

Standard IEC 60255-1, Subclause 6.4

Test date 19 May 2016

Environmental conditions

Ambient temperature 22 °C

Humidity 1005 g/m³

Characteristic test data

Serial number 16110463

Time to rise-value 1,2 µs (± 30%)

Time to half-value 50 µs (± 20%)

Source impedance 500 Ω (± 10%)

Output energy 0,5 J (± 10%)

Pulse interval ≥ 1 s

Test arrangement		Voltage applied	No. of impulses	Polarity	Observations
Voltage applied to	Tested against	(kV)			
AUX Power	Earth and all other circuits	5	5	Positive	-
		5	5	Negative	-
Trip contact	Earth and all other circuits	not applicable	not applicable	Positive	-
		not applicable	not applicable	Negative	-
Ext Trip	Earth and all other circuits	5	5	Positive	-
		5	5	Negative	-
Current transformer	Earth and all other circuits	5	5	Positive	-
		5	5	Negative	-

Remarks

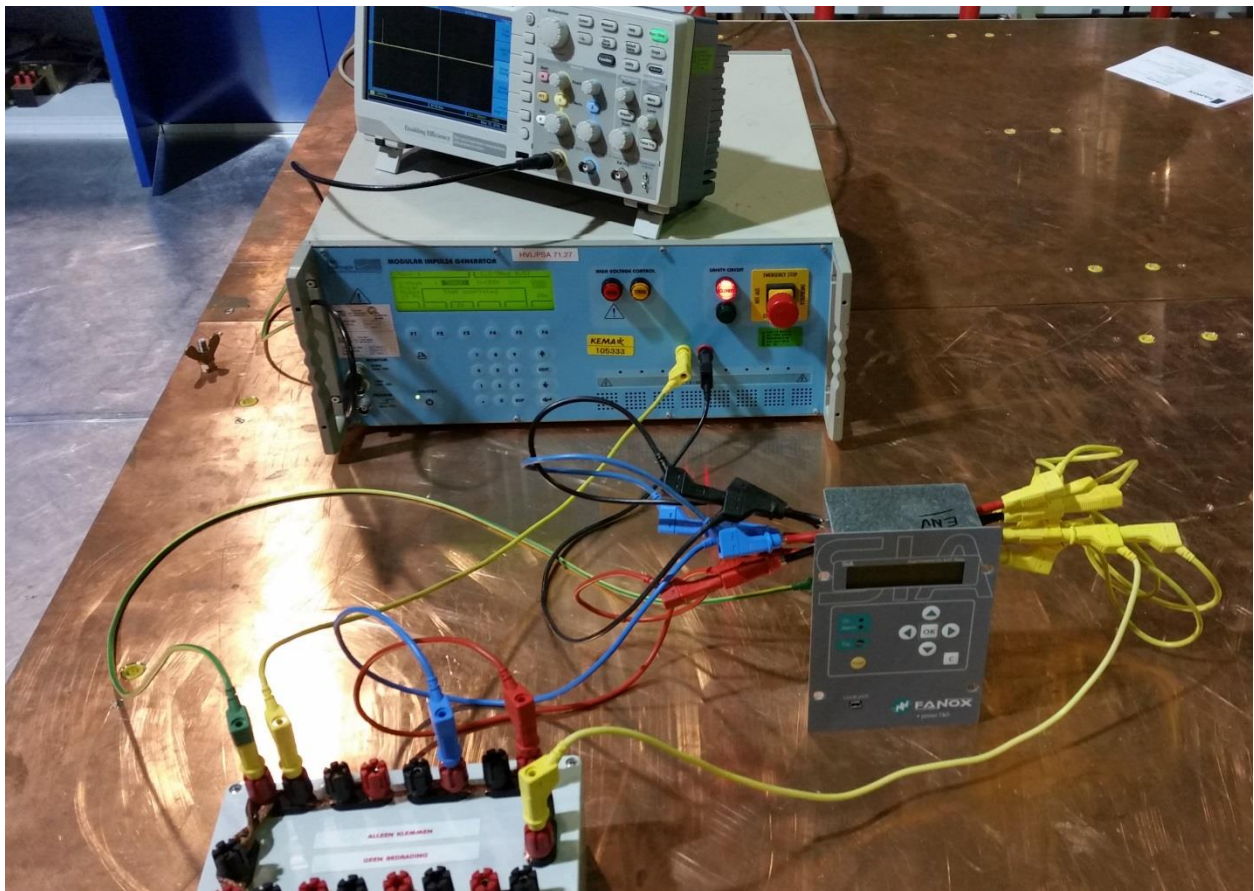
- trip contact output is connected to ground in case the output is not activated.
- the impulse voltage test has been performed after completion of the climatic tests.

Requirement

- no disruptive discharges or flashovers shall occur.
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement

5.3 Dielectric voltage test

Standard and date

Standard IEC 60255-1, Subclause 6.4

Test date 19 May 2016

Environmental conditions

Ambient temperature 23 °C

Characteristic test data

Serial number 16110463

Frequency 0 Hz

Test duration 1 min

Test arrangement		Insulation resistance at 500 Vdc (before the test)	Voltage applied	Insulation resistance at 500 Vdc (after the test)	Observations
Voltage applied to	Tested against	(MΩ)	(kVdc)	(MΩ)	
Current transformer	Earth and all other circuits	550	2,8	550	-
Trip contact	Earth and all other circuits	not applicable	not applicable	-	-
Ext Trip	Earth and all other circuits	550	2,8	550	-
Aux Power	Earth and all other circuits	550	2,8	550	-

Remark

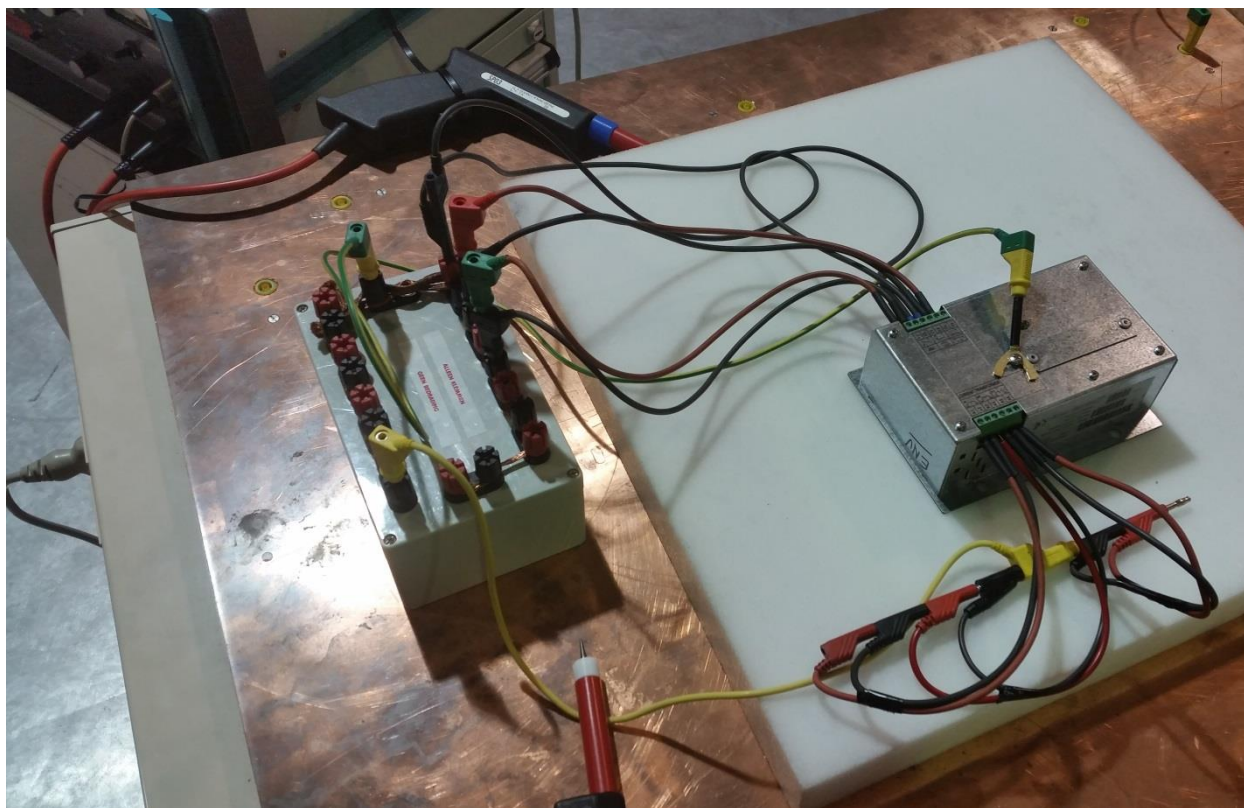
- trip contact output is connected to ground in case the output is not activated
- the dielectric voltage test has been performed after completion of the climatic tests.

Requirement

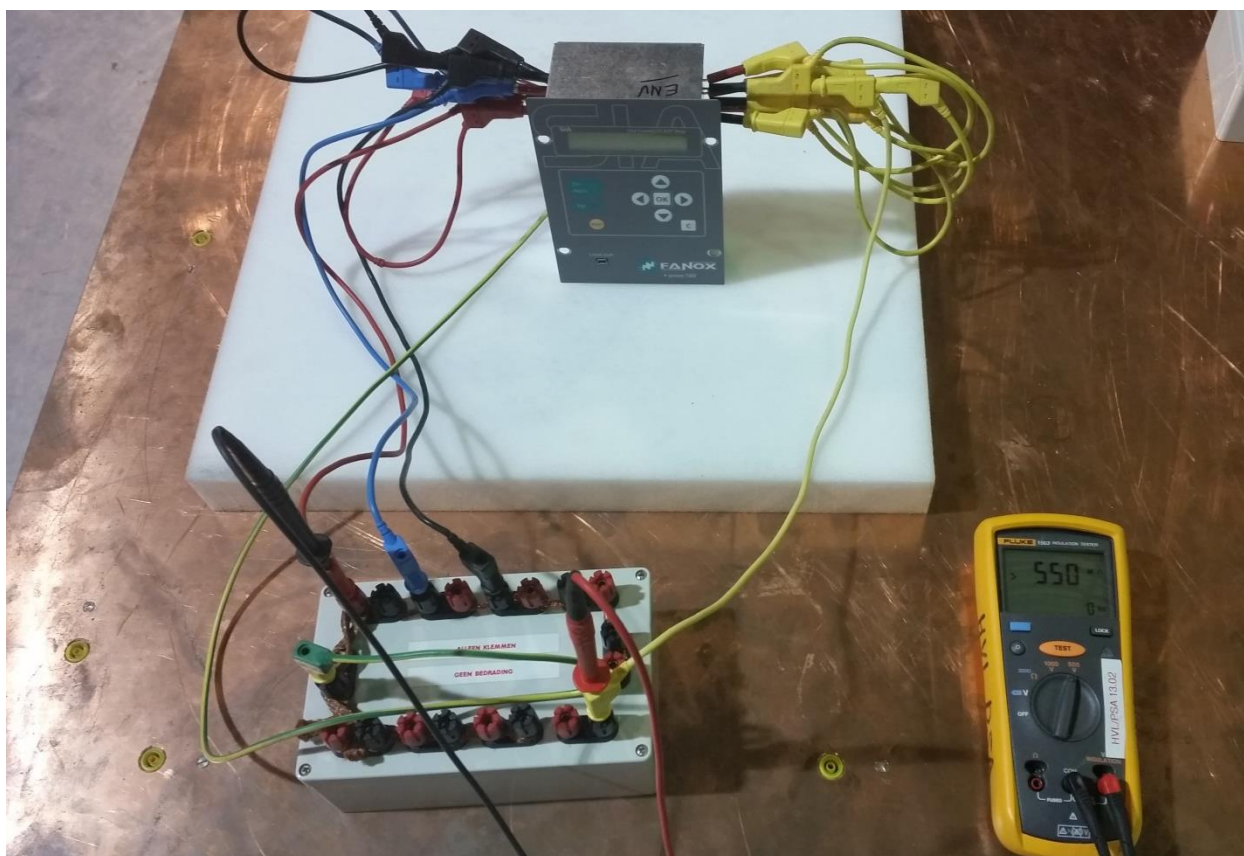
- no disruptive discharges or flashovers shall occur.
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement

Dielectric test



Insulation resistance test.

6 CURRENT PROTECTION

6.1 Instantaneous phase overcurrent protection (ANSI 50) – 50 Hz

Standard and date

Standard	IEC 60255-1, Subclause 6.5
Reference	IEC 60255-151
Test date	20 to 24 June 2016

Environmental conditions

Ambient temperature	21 °C
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Requirements

The tests shall be performed within the specification limits of the manufacturer given below.

	Tolerance
Measurement accuracy	10% for CT type CT xxx-10
Time delay	40 ms or 0,5%
Current range	16-56 A
Resetting ratio	0
T-reset	0
Accuracy	10% due to the used CT.

Note

The maximum specified operate time is depending on the used current transformer.

Maximum specified tolerance on tripping time is specified by the manufacturer as the time tolerance caused by the current measurement accuracy of the current transformer ($\pm 10\%$) added with (± 40 ms or 0,5%).

Result

The object passed the test.

6.1.1 Intrinsic accuracy

Characteristic test data

Serial number	16190250
Rated current	16-56 A
Initial start value	$\leq 2 \times$ of specified accuracy
Ramping step	0,1 x of specified accuracy
Step time	2 to 5 x t_{start}
Repetitions	5
Test frequency	50 Hz

Intrinsic accuracy (Input IL1)

Set values		Measured values				Reset			
		Operate							
% of set range	(A)	Min. (A)	Avg. (A)	Max. (A)	Deviation (%)	Min. (A)	Avg. (A)	Max. (A)	Reset ratio
0,0	16,00	16,135	16,170	16,215	1,06	16,130	16,163	16,205	99,96
0,5	16,20	16,120	16,135	16,150	-0,40	16,110	16,122	16,135	99,92
1,0	16,40	16,095	16,141	16,185	-1,58	16,090	16,132	16,170	99,94
2,0	16,80	16,115	16,139	16,170	-3,93	16,105	16,129	16,160	99,94
3,0	17,20	16,935	17,029	17,080	-0,99	16,930	17,021	17,070	99,95
5,0	18,00	17,895	17,913	17,930	-0,48	17,885	17,904	17,925	99,95
10,0	20,00	19,685	19,739	19,770	-1,30	19,675	19,729	19,760	99,95
20,0	24,00	23,425	23,461	23,515	-2,25	23,410	23,450	23,505	99,95
30,0	28,00	27,595	27,629	27,660	-1,33	27,585	27,618	27,650	99,96
60,0	40,00	39,220	39,306	39,360	-1,74	39,210	39,288	39,350	99,95
100,0	56,00	55,510	55,562	55,640	-0,78	55,490	55,542	55,630	99,96

Intrinsic accuracy (Input IL2)

Set values		Measured values				Reset			
		Operate							
% of set range	(A)	Min. (A)	Avg. (A)	Max. (A)	Deviation (%)	Min. (A)	Avg. (A)	Max. (A)	Reset ratio
0,0	16,00	16,140	16,196	16,235	1,23	16,135	16,188	16,225	99,95
0,5	16,20	15,395	15,991	16,225	-1,29	15,390	15,981	16,215	99,94
1,0	16,40	15,590	15,920	16,160	-2,93	15,575	15,909	16,145	99,93
2,0	16,80	15,970	16,156	16,230	-3,83	15,955	16,144	16,215	99,93
3,0	17,20	16,350	16,957	17,170	-1,41	16,345	16,948	17,155	99,95
5,0	18,00	17,945	18,027	18,115	0,15	17,930	18,016	18,105	99,94
10,0	20,00	19,815	19,861	19,895	-0,69	19,805	19,851	19,885	99,95
20,0	24,00	22,810	23,421	23,615	-2,41	22,800	23,411	23,605	99,96
30,0	28,00	27,485	27,588	27,650	-1,47	27,480	27,579	27,635	99,97
60,0	40,00	39,210	39,252	39,290	-1,87	39,190	39,230	39,270	99,94
100,0	56,00	55,280	55,490	55,630	-0,91	55,250	55,468	55,620	99,96

Intrinsic accuracy (Input IL3)

Set values		Measured values				Reset			
		Operate							
% of set range	(A)	Min. (A)	Avg. (A)	Max. (A)	Deviation (%)	Min. (A)	Avg. (A)	Max. (A)	Reset ratio
0,0	16,00	16,115	16,162	16,220	1,01	16,105	16,152	16,205	99,94
0,5	16,20	16,055	16,136	16,175	-0,40	16,040	16,124	16,160	99,93
1,0	16,40	16,095	16,122	16,150	-1,70	16,085	16,113	16,140	99,94
2,0	16,80	16,080	16,138	16,170	-3,94	16,070	16,130	16,165	99,95
3,0	17,20	16,975	17,013	17,080	-1,09	16,960	17,003	17,075	99,94
5,0	18,00	17,825	17,906	17,960	-0,52	17,815	17,897	17,950	99,95
10,0	20,00	19,725	19,744	19,780	-1,28	19,715	19,734	19,770	99,95
20,0	24,00	23,440	23,484	23,530	-2,15	23,430	23,473	23,515	99,95
30,0	28,00	27,510	27,612	27,660	-1,39	27,495	27,603	27,650	99,97
60,0	40,00	39,080	39,170	39,250	-2,08	39,050	39,150	39,230	99,95
100,0	56,00	55,270	55,360	55,440	-1,14	55,240	55,342	55,430	99,97

6.2 Instantaneous phase overcurrent protection (ANSI 50) – 60 Hz

Standard and date

Standard	IEC 60255-1, Subclause 6.5
Reference	IEC 60255-151
Test date	20 to 24 June 2016

Environmental conditions

Ambient temperature	21 °C
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Requirements

The tests shall be performed within the specification limits of the manufacturer given below.

	Tolerance
Measurement accuracy	10% for CT type CT xxx-10
Time delay	40 ms or 0,5%
Current range	16-56 A
Resetting ratio	0
T-reset	0

Note

The maximum specified operate time is depending on the used current transformer.

Maximum specified tolerance on tripping time is specified by the manufacturer as the time tolerance caused by the current measurement accuracy of the current transformer ($\pm 10\%$) added with ($\pm 30\text{ms}$ or $0,5\%$).

Result

The object passed the test.

6.2.1 Intrinsic accuracy

Characteristic test data

Serial number	16190250
Rated current	16-56 A
Initial start value	$\leq 2 \times$ of specified accuracy
Ramping step	0,1 x of specified accuracy
Step time	2 to 5 x t_{start}
Repetitions	5
Test frequency	60 Hz

Intrinsic accuracy (Input IL1)

Set values		Measured values				Reset			
		Operate							
% of set range	(A)	Min. (A)	Avg. (A)	Max. (A)	Deviation (%)	Min. (A)	Avg. (A)	Max. (A)	Reset ratio
0,0	16,00	16,195	16,231	16,25	1,44	16,19	16,221	16,24	99,94
0,5	16,20	16,155	16,244	16,320	0,27	16,145	16,232	16,305	99,93
1,0	16,40	16,245	16,255	16,270	-0,88	16,230	16,245	16,260	99,94
2,0	16,80	16,115	16,217	16,270	-3,47	16,110	16,207	16,255	99,94
3,0	17,20	17,095	17,191	17,245	-0,05	17,085	17,182	17,235	99,95
5,0	18,00	18,005	18,049	18,140	0,27	17,995	18,039	18,130	99,94
10,0	20,00	19,960	20,024	20,080	0,12	19,920	19,988	20,060	99,82
20,0	24,00	23,660	23,740	23,780	-1,08	23,620	23,704	23,740	99,85
30,0	28,00	28,020	28,108	28,160	0,39	27,980	28,076	28,120	99,89
60,0	40,00	39,300	39,548	39,740	-1,13	39,260	39,504	39,700	99,89
100,0	56,00	55,780	56,036	56,140	0,06	55,760	56,008	56,120	99,95

Intrinsic accuracy (Input IL2)

Set values		Measured values				Reset			
		Operate							
% of set range	(A)	Min. (A)	Avg. (A)	Max. (A)	Deviation (%)	Min. (A)	Avg. (A)	Max. (A)	Reset ratio
0,0	16,00	16,305	16,362	16,455	2,26	16,290	16,352	16,445	99,94
0,5	16,20	16,265	16,361	16,435	0,99	16,260	16,352	16,430	99,94
1,0	16,40	16,280	16,364	16,445	-0,22	16,270	16,353	16,435	99,93
2,0	16,80	16,305	16,390	16,465	-2,44	16,290	16,379	16,455	99,93
3,0	17,20	17,230	17,273	17,310	0,42	17,215	17,260	17,300	99,92
5,0	18,00	18,080	18,163	18,215	0,91	18,065	18,153	18,205	99,94
10,0	20,00	19,915	20,005	20,090	0,03	19,905	19,995	20,085	99,95
20,0	24,00	23,740	23,834	23,880	-0,69	23,735	23,824	23,870	99,96
30,0	28,00	27,790	27,896	27,995	-0,37	27,775	27,883	27,985	99,95
60,0	40,00	39,440	39,628	39,740	-0,93	39,420	39,604	39,710	99,94
100,0	56,00	55,650	55,952	56,240	-0,09	55,640	55,934	56,220	99,97

Intrinsic accuracy (Input IL3)

Set values		Measured values				Reset			
		Operate							
% of set range	(A)	Min. (A)	Avg. (A)	Max. (A)	Deviation (%)	Min. (A)	Avg. (A)	Max. (A)	Reset ratio
0,0	16,00	16,145	16,266	16,340	1,66	16,135	16,255	16,335	99,93
0,5	16,20	16,185	16,294	16,340	0,58	16,170	16,280	16,330	99,91
1,0	16,40	16,150	16,272	16,320	-0,78	16,140	16,262	16,310	99,94
2,0	16,80	16,240	16,270	16,325	-3,15	16,230	16,259	16,315	99,93
3,0	17,20	17,080	17,147	17,200	-0,31	17,075	17,140	17,190	99,96
5,0	18,00	17,890	18,022	18,105	0,12	17,885	18,014	18,095	99,96
10,0	20,00	19,845	19,907	19,970	-0,47	19,840	19,898	19,960	99,95
20,0	24,00	23,550	23,596	23,650	-1,68	23,540	23,586	23,635	99,96
30,0	28,00	27,800	27,908	28,035	-0,33	27,795	27,900	28,025	99,97
60,0	40,00	39,320	39,424	39,540	-1,44	39,290	39,404	39,530	99,95
100,0	56,00	55,370	55,820	56,030	-0,32	55,350	55,798	56,010	99,96

6.3 Time delayed phase overcurrent protection (ANSI 50 & 51) – 50 Hz

Standard and date

Standard IEC 60255-1, Subclause 6.5

Reference IEC 60255-151

Test date 2 to 18 May 2016

Environmental conditions

Ambient temperature 23 °C

Requirements

The tests shall be performed within the specification limits of the manufacturer given below.

	Tolerance
Measurement accuracy	10% for CT type CT xxx-10
Time delay	40 ms or 5%
Current range	16-56 A
Resetting ratio	0
T-reset	0

Note

The maximum specified operate time is depending on the used current transformer.

Maximum specified tolerance on tripping time is specified by the manufacturer as the time tolerance caused by the current measurement accuracy of the current transformer ($\pm 10\%$) added with (± 40 ms or 5%).

Result

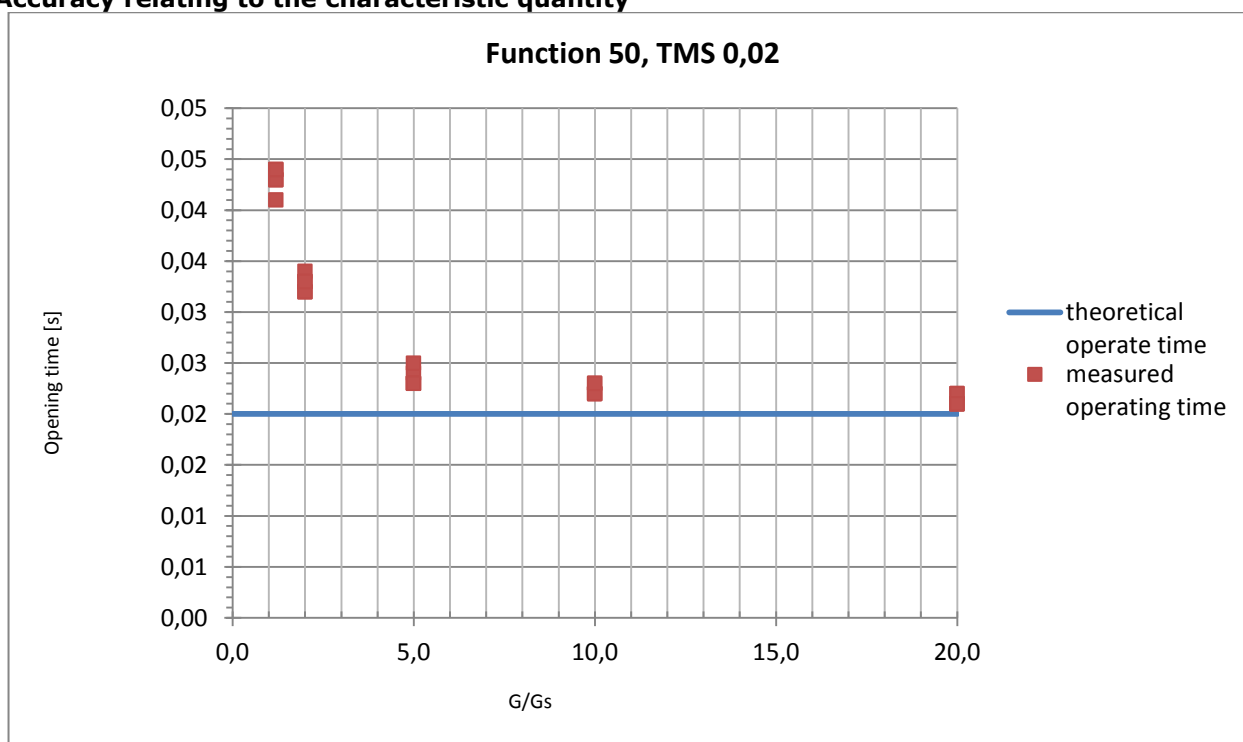
The object passed the test.

6.3.1 Definite time

Characteristic test data

Serial number	SIAB000B0010AA
Rated current (I_{rated})	16 A
Test frequency	50 Hz
Initial test current value	0 A
Curve family	DT
Range (G_s)	$1.2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	0,02

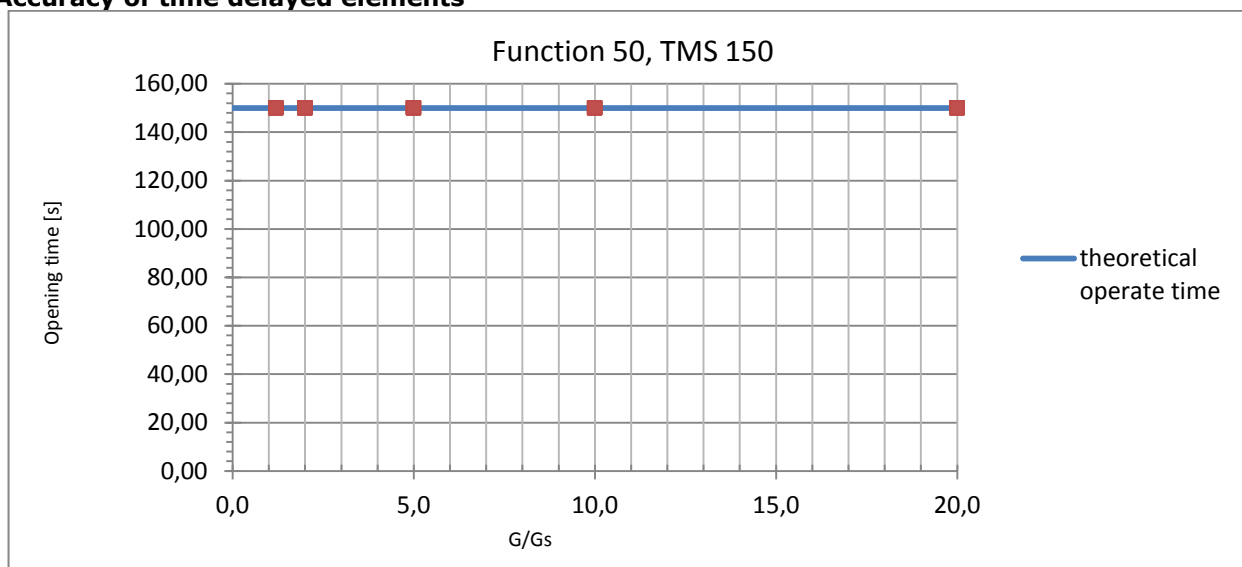
Accuracy relating to the characteristic quantity



Set values		Measured values					
G/G _s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	0,02	0,041	0,043	0,044	-	-	-
2	0,02	0,032	0,033	0,034	-	-	-
5	0,02	0,023	0,024	0,025	-	-	-
10	0,02	0,022	0,022	0,023	-	-	-
20	0,02	0,021	0,021	0,022	-	-	-

Characteristic test data

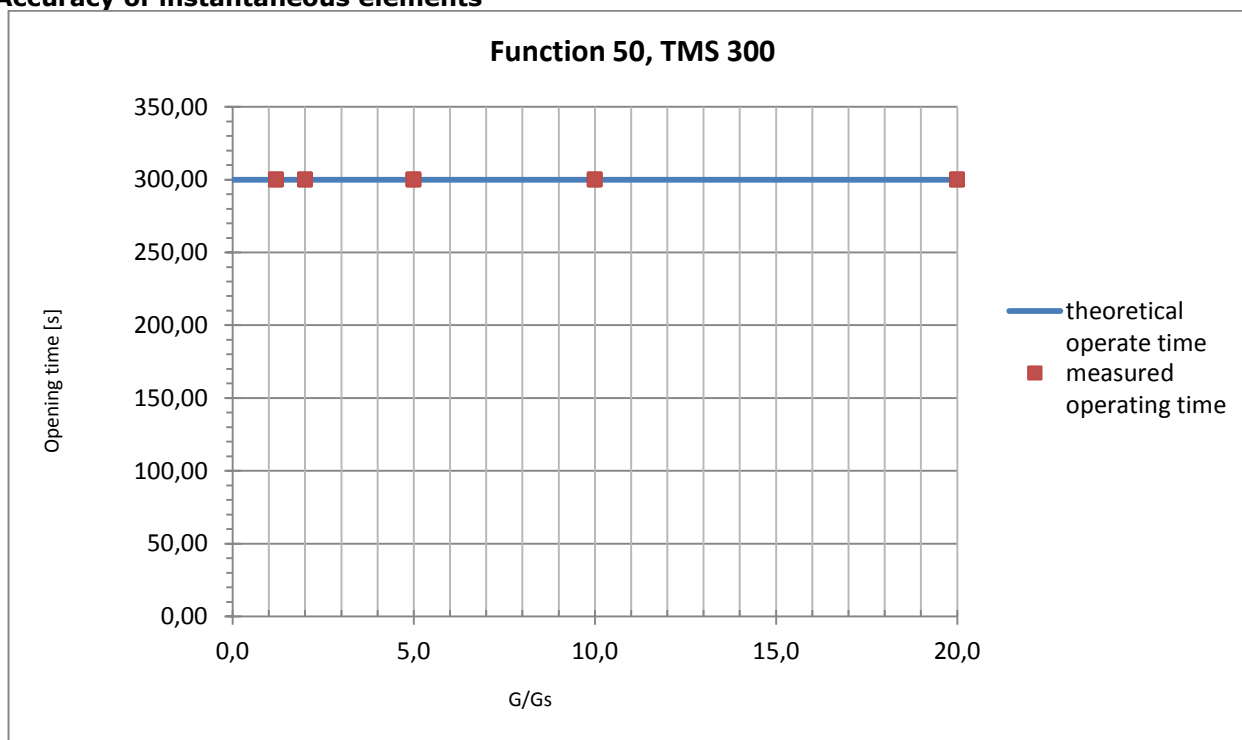
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 16 A
 Test frequency 50 Hz
 Initial test current value 0 A
 Curve family DT
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 150

Accuracy of time delayed elements

Set values		Measured values					
G/G _s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	150	150,052	150,053	150,054	-	-	-
2	150	150,044	150,045	150,045	-	-	-
5	150	150,033	150,034	150,035	-	-	-
10	150	150,000	150,026	150,036	-	-	-
20	150	150,026	150,030	150,034	-	-	-

Characteristic test data

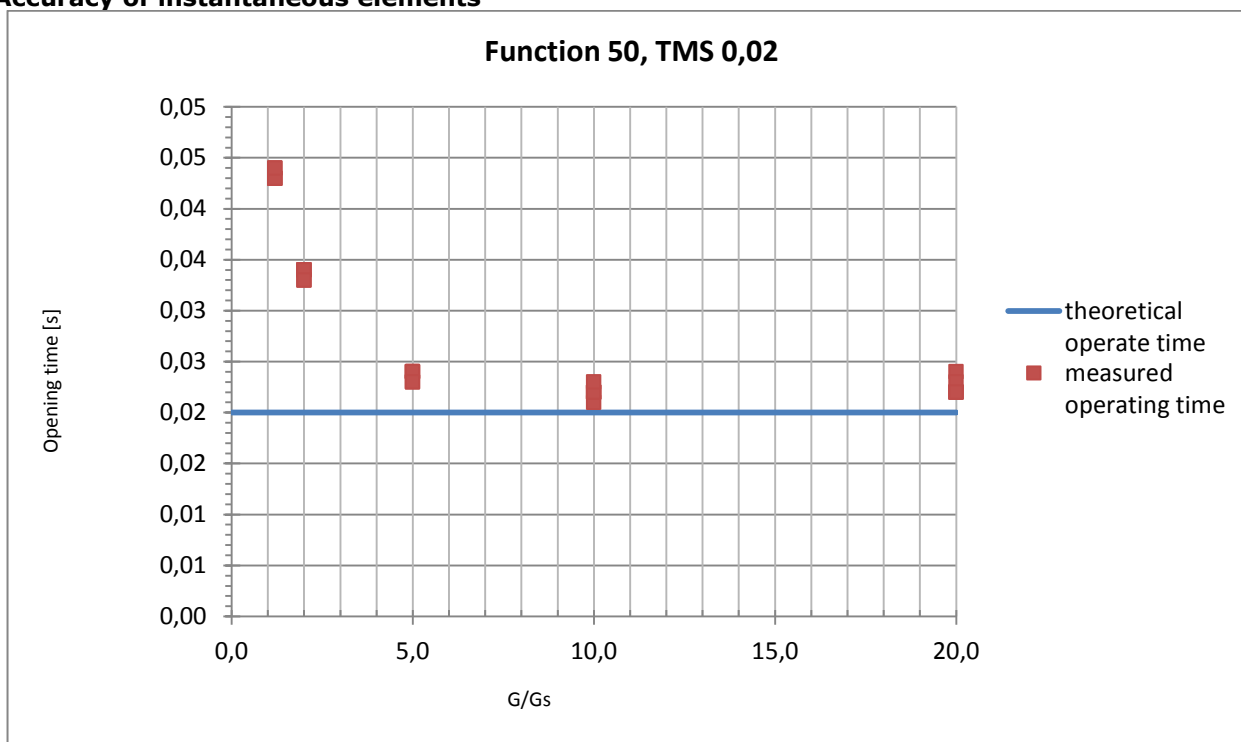
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 16 A
 Test frequency 50 Hz
 Initial test current value 0 A
 Curve family DT
 Range (G_s) $1.2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 300

Accuracy of instantaneous elements

Set values		Measured values					
G/G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	300	300,082	300,084	300,085	-	-	-
2	300	300,075	300,075	300,075	-	-	-
5	300	300,066	300,075	300,100	-	-	-
10	300	300,050	300,057	300,064	-	-	-
20	300	300,058	300,066	300,074	-	-	-

Characteristic test data

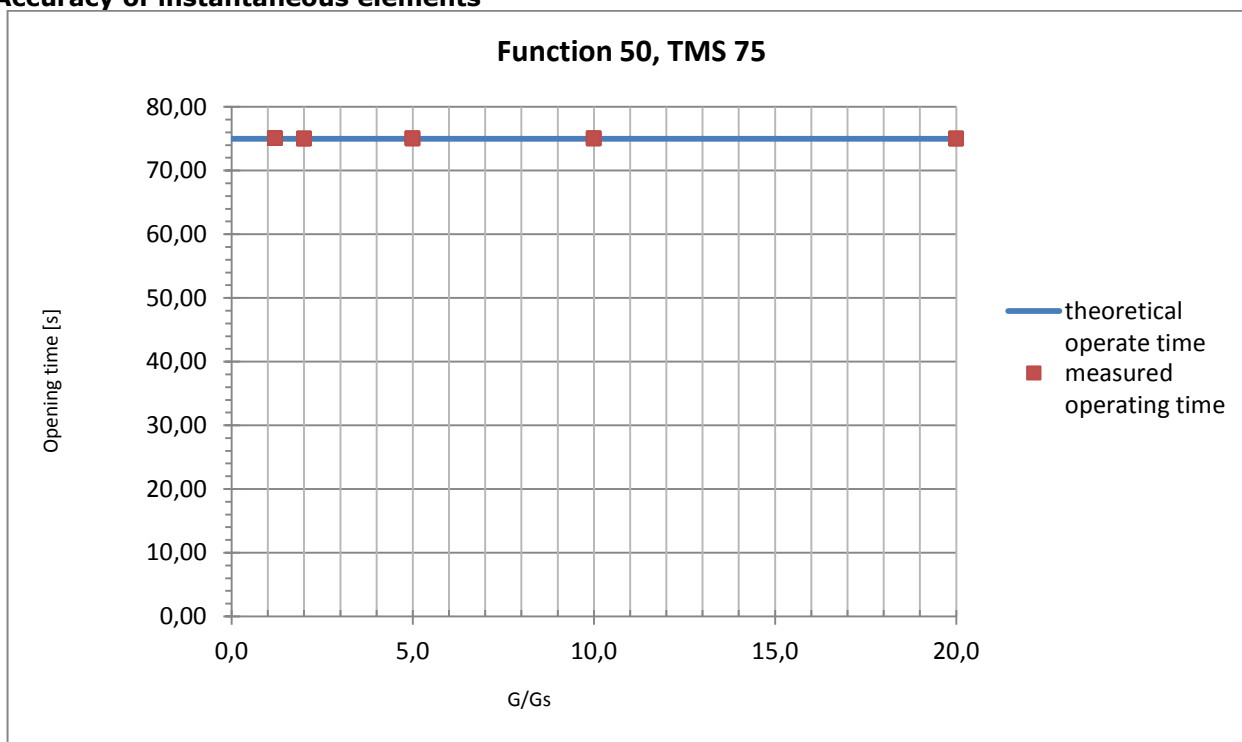
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 36 A
 Test frequency 50 Hz
 Initial test current value 0 A
 Curve family DT
 Range (G_s) $1.2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 0,02

Accuracy of instantaneous elements

Set values		Measured values					
G/G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	0,02	0,043	0,043	0,044	-	-	-
2	0,02	0,033	0,034	0,034	-	-	-
5	0,02	0,023	0,024	0,024	-	-	-
10	0,02	0,021	0,022	0,023	-	-	-
20	0,02	0,022	0,023	0,024	-	-	-

Characteristic test data

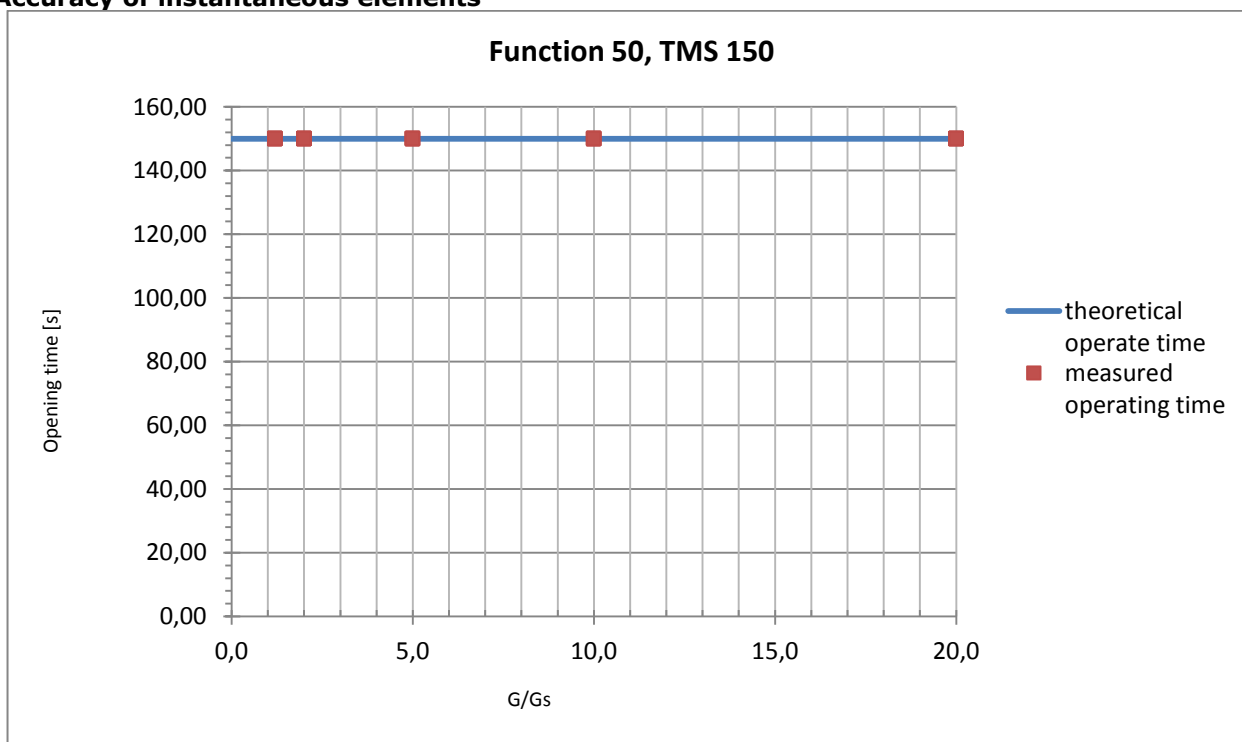
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 36 A
 Test frequency 50 Hz
 Initial test current value 0 A
 Curve family DT
 Range (G_s) $1.2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 75

Accuracy of instantaneous elements

Set values		Measured values					
G/G _s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	75	75,037	75,038	75,039	-	-	-
2	75	75,024	75,026	75,030	-	-	-
5	75	75,010	75,032	75,060	-	-	-
10	75	75,010	75,030	75,060	-	-	-
20	75	75,010	75,010	75,010	-	-	-

Characteristic test data

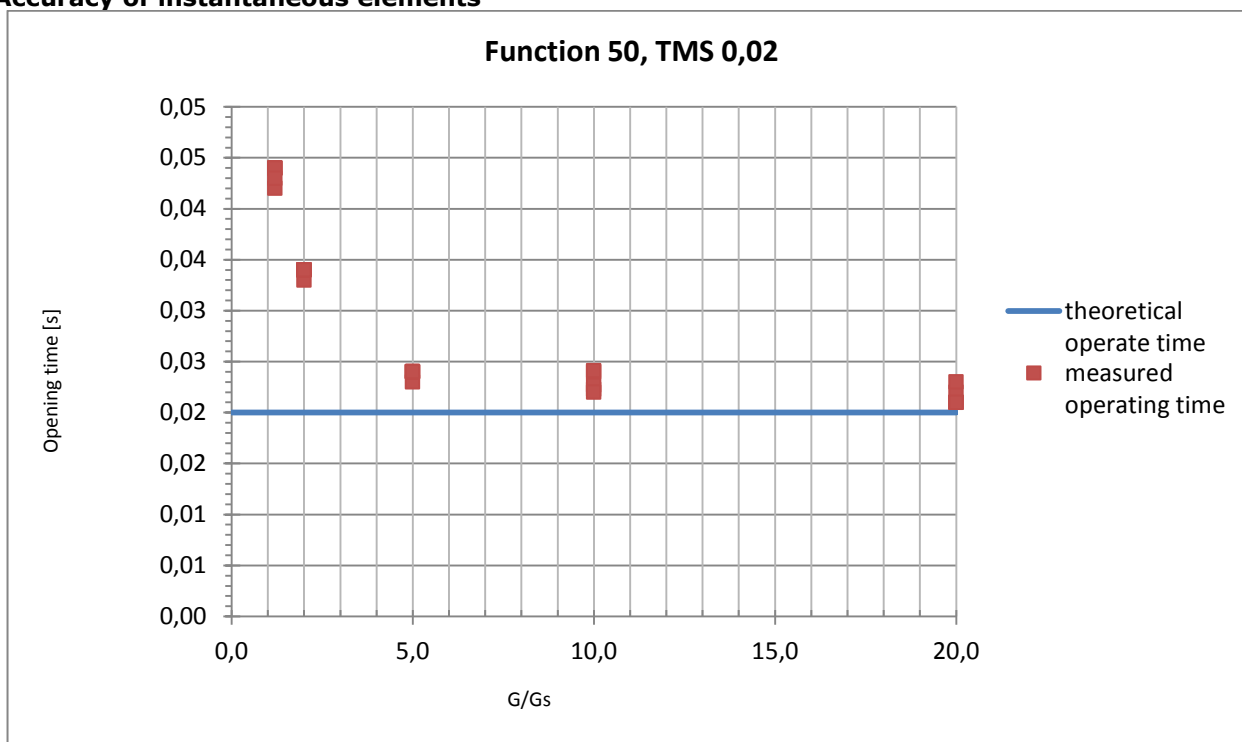
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 36 A
 Test frequency 50 Hz
 Initial test current value 0 A
 Curve family DT
 Range (G_s) $1.2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 150

Accuracy of instantaneous elements

Set values		Measured values					
G/G _s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	150	150,054	150,054	150,055	-	-	-
2	150	150,044	150,044	150,045	-	-	-
5	150	150,024	150,026	150,030	-	-	-
10	150	150,024	150,025	150,026	-	-	-
20	150	150,024	150,024	150,026	-	-	-

Characteristic test data

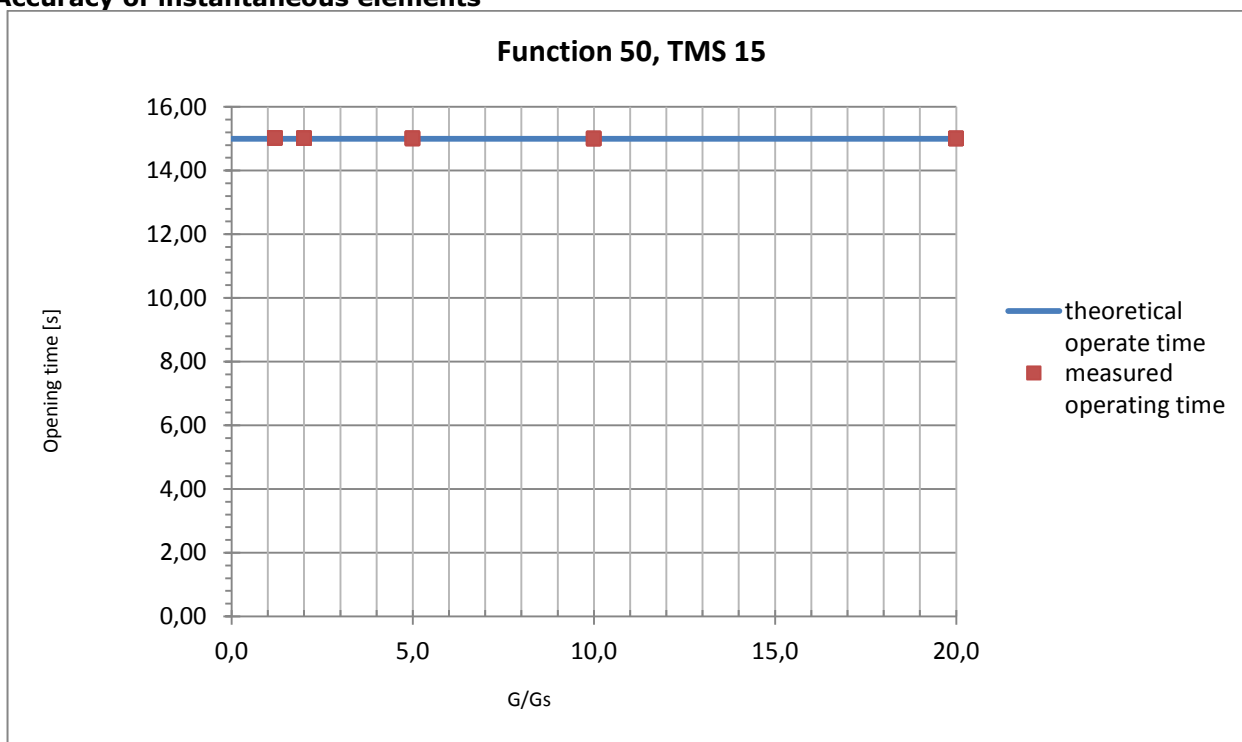
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 56 A
 Test frequency 50 Hz
 Initial test current value 0 A
 Curve family DT
 Range (G_s) $1.2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 0,02

Accuracy of instantaneous elements

Set values		Measured values					
G/G _s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	0,02	0,042	0,043	0,044	-	-	-
2	0,02	0,033	0,034	0,034	-	-	-
5	0,02	0,023	0,024	0,024	-	-	-
10	0,02	0,022	0,023	0,024	-	-	-
20	0,02	0,021	0,022	0,023	-	-	-

Characteristic test data

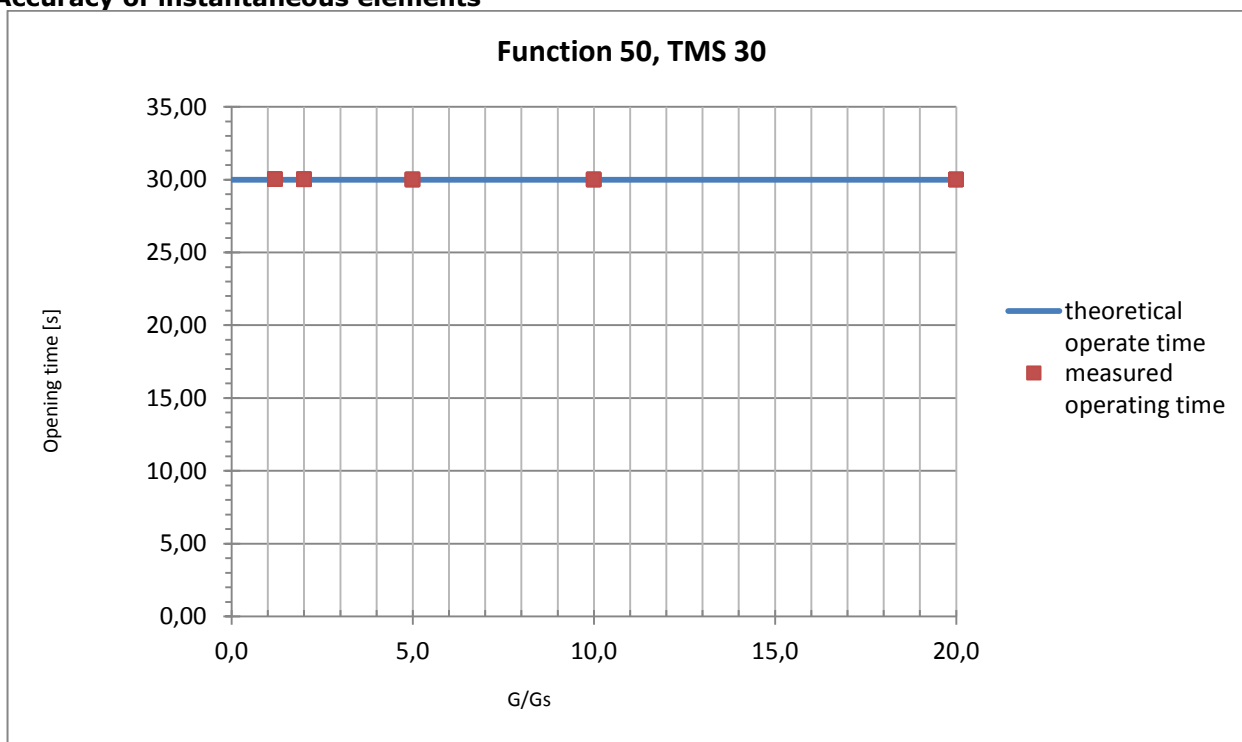
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 56 A
 Test frequency 50 Hz
 Initial test current value 0 A
 Curve family DT
 Range (G_s) $1.2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 15

Accuracy of instantaneous elements

Set values		Measured values					
$x G_s$	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	15	15,025	15,026	15,027	-	-	-
2	15	15,007	15,015	15,017	-	-	-
5	15	15,007	15,007	15,008	-	-	-
10	15	15,004	15,006	15,006	-	-	-
20	15	15,004	15,005	15,007	-	-	-

Characteristic test data

Serial number SIAB000B0010AA
 Rated current (I_{rated}) 56 A
 Test frequency 50 Hz
 Initial test current value 0 A
 Curve family DT
 Range (G_s) $1.2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 30

Accuracy of instantaneous elements

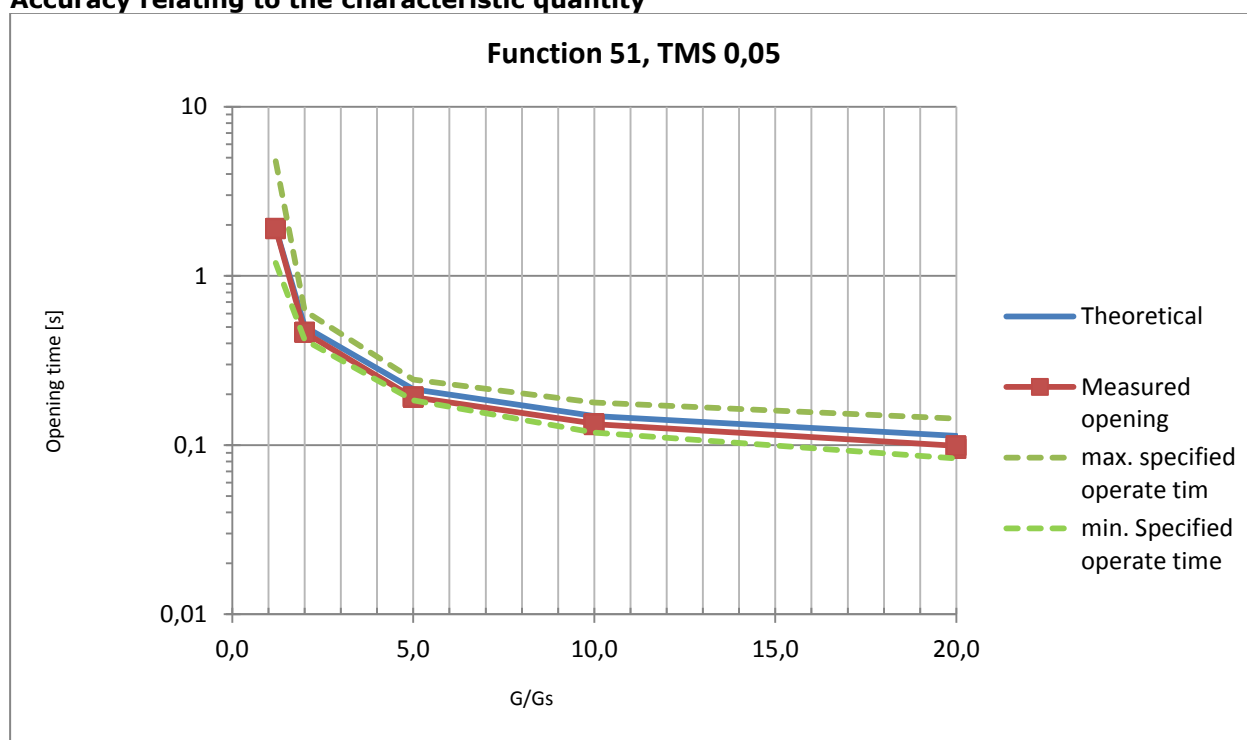
Set values		Measured values					
$x G_s$	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	30	30,028	30,029	30,030	-	-	-
2	30	30,010	30,017	30,021	-	-	-
5	30	30,008	30,010	30,011	-	-	-
10	30	30,007	30,007	30,007	-	-	-
20	30	30,006	30,006	30,006	-	-	-

6.3.2 Normal inverse time

Characteristic test data

Serial number	SIAB000B0010AA
Rated current (I_{rated})	16 A
Rated frequency	50 Hz
Curve family	INV
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	0,05

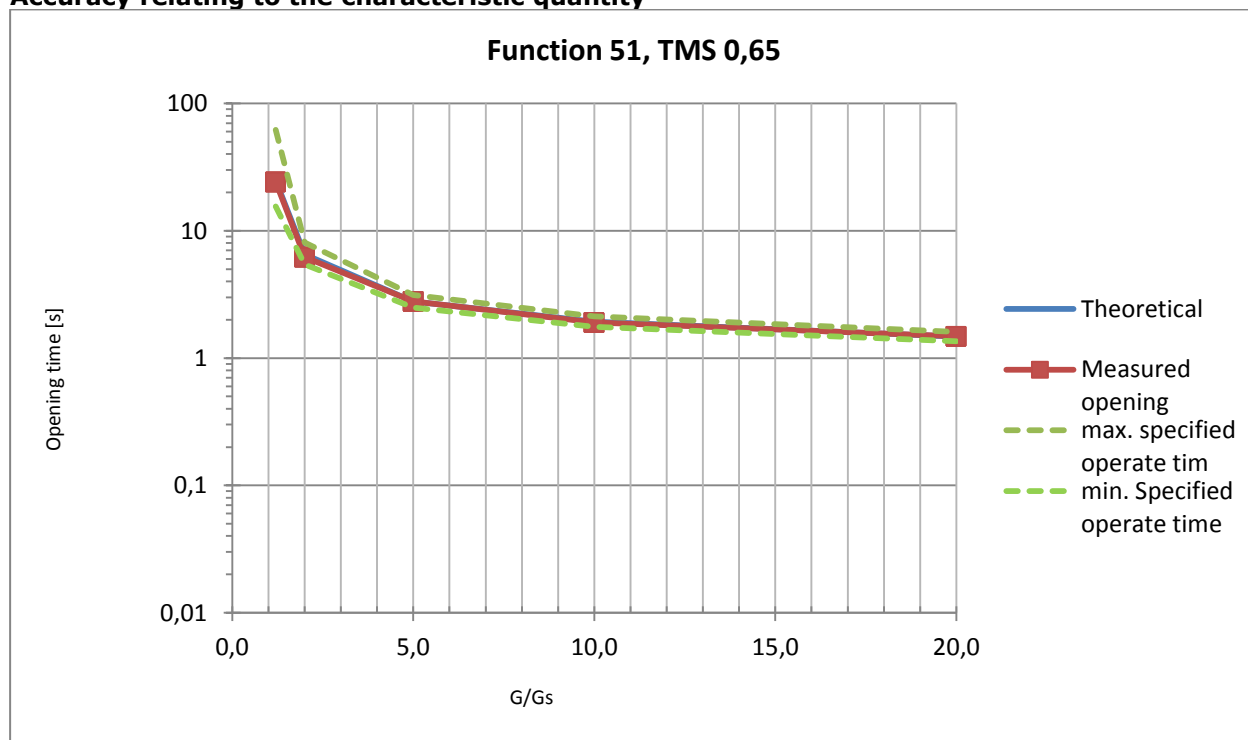
Accuracy relating to the characteristic quantity



Set values		Measured values					
G/G _s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	1,916	1,893	1,905	1,913	-	-	-
2	0,501	0,463	0,464	0,465	-	-	-
5	0,214	0,191	0,192	0,193	-	-	-
10	0,149	0,131	0,133	0,134	-	-	-
20	0,113	0,095	0,097	0,099	-	-	-

Characteristic test data

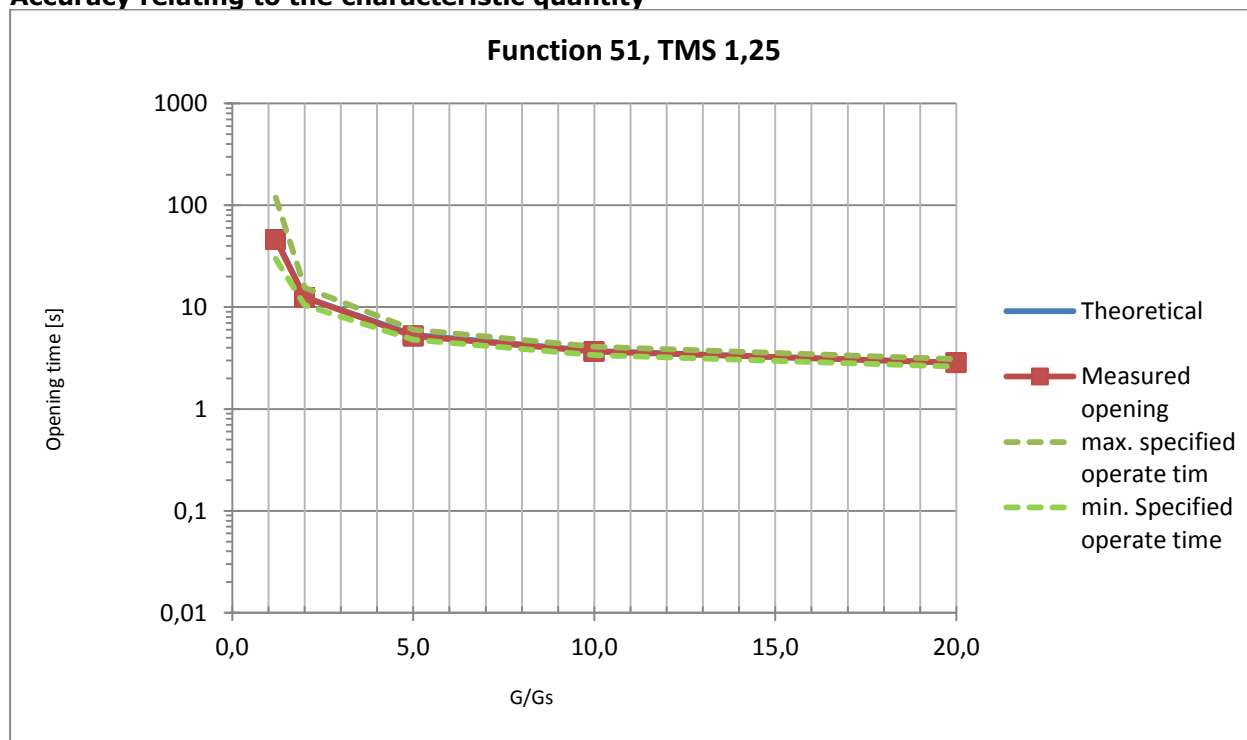
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 16 A
 Rated frequency 50 Hz
 Curve family INV
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 0,65

Accuracy relating to the characteristic quantity

Set values		Measured values					
G/G _s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	24,910	24,147	24,186	24,227	-	-	-
2	6,519	6,205	6,213	6,221	-	-	-
5	2,782	2,786	2,787	2,788	-	-	-
10	1,931	1,904	1,905	1,905	-	-	-
20	1,474	1,483	1,484	1,485	-	-	-

Characteristic test data

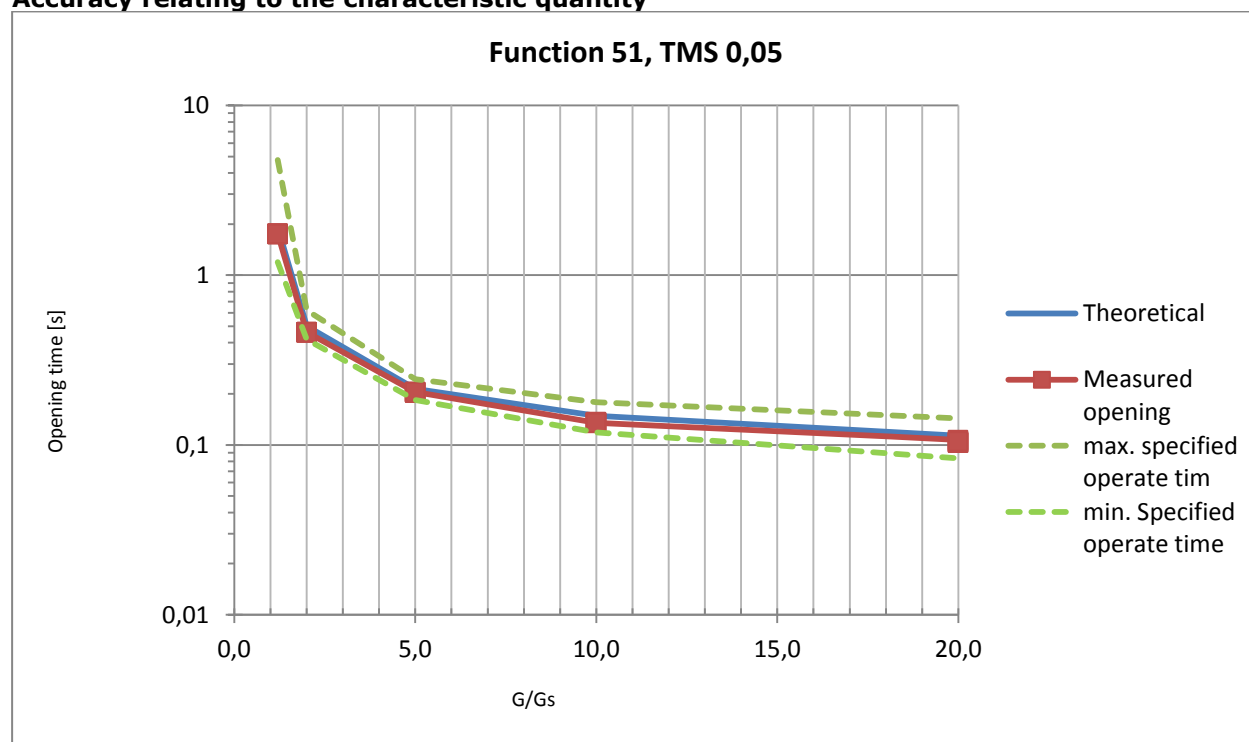
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 16 A
 Rated frequency 50 Hz
 Curve family INV
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 1,25

Accuracy relating to the characteristic quantity

Set values		Measured values					
G/ G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	45,933	45,900	45,961	45,996	-	-	-
2	12,441	12,430	12,434	12,441	-	-	-
5	5,199	5,199	5,200	5,201	-	-	-
10	3,662	3,660	3,662	3,662	-	-	-
20	2,852	2,848	2,850	2,853	-	-	-

Characteristic test data

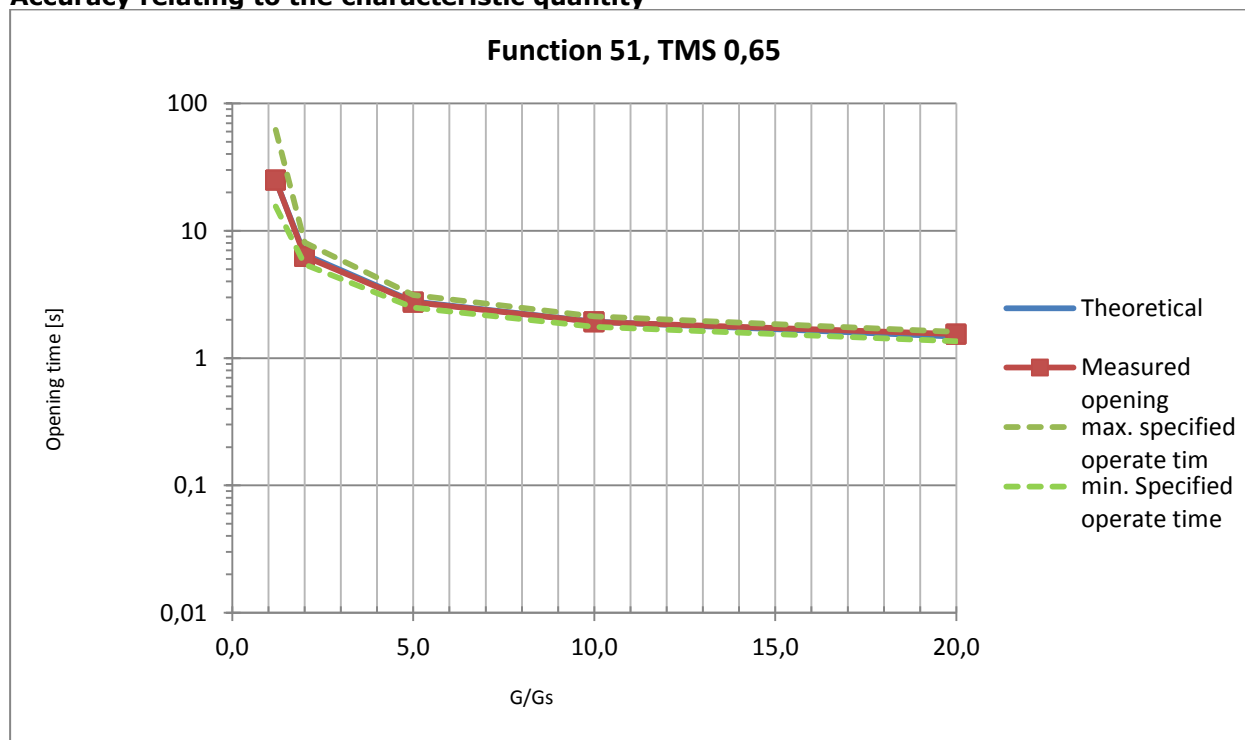
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 36 A
 Rated frequency 50 Hz
 Curve family INV
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 0,05

Accuracy relating to the characteristic quantity

Set values		Measured values					
G/G _s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	1,757	1,751	1,753	1,757	-	-	-
2	0,461	0,461	0,462	0,462	-	-	-
5	0,205	0,203	0,204	0,205	-	-	-
10	0,135	0,135	0,135	0,136	-	-	-
20	0,107	0,103	0,104	0,107	-	-	-

Characteristic test data

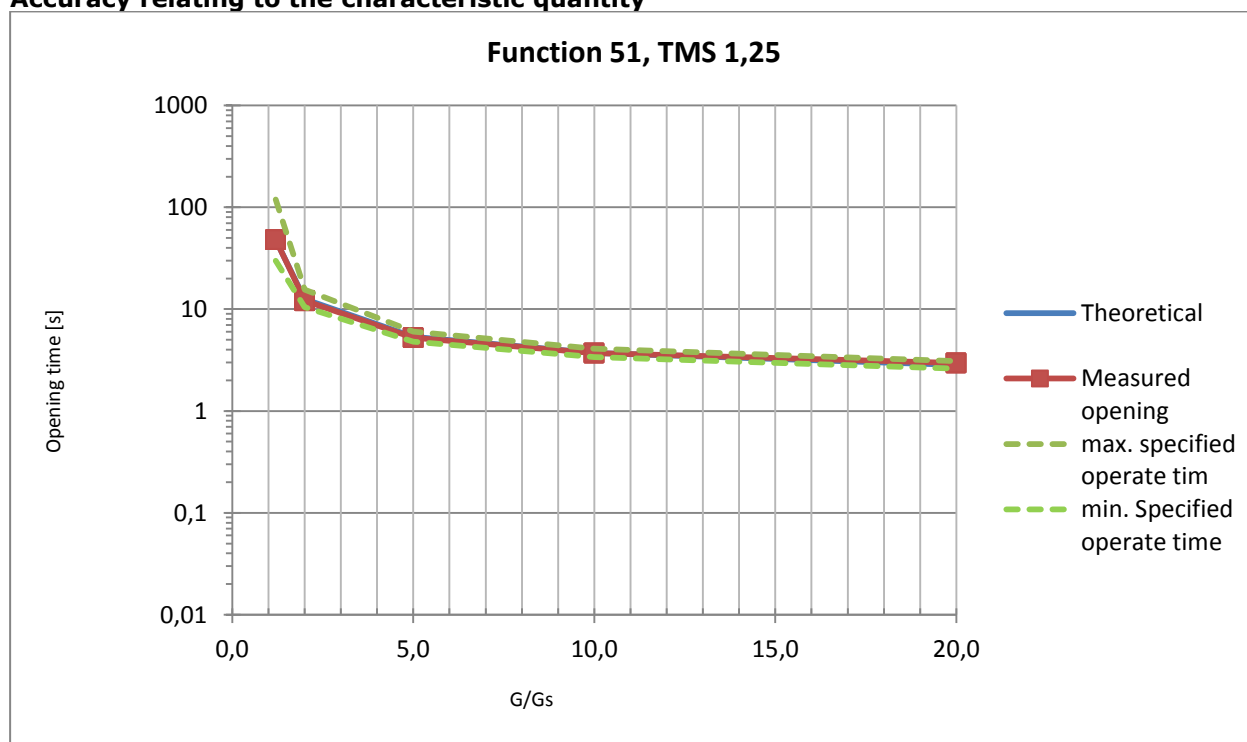
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 36 A
 Rated frequency 50 Hz
 Curve family INV
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 0,65

Accuracy relating to the characteristic quantity

Set values		Measured values					
G/G _s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	25,021	25,005	25,018	25,024	-	-	-
2	6,316	6,288	6,306	6,320	-	-	-
5	2,750	2,747	2,748	2,750	-	-	-
10	1,923	1,920	1,922	1,923	-	-	-
20	1,543	1,539	1,541	1,543	-	-	-

Characteristic test data

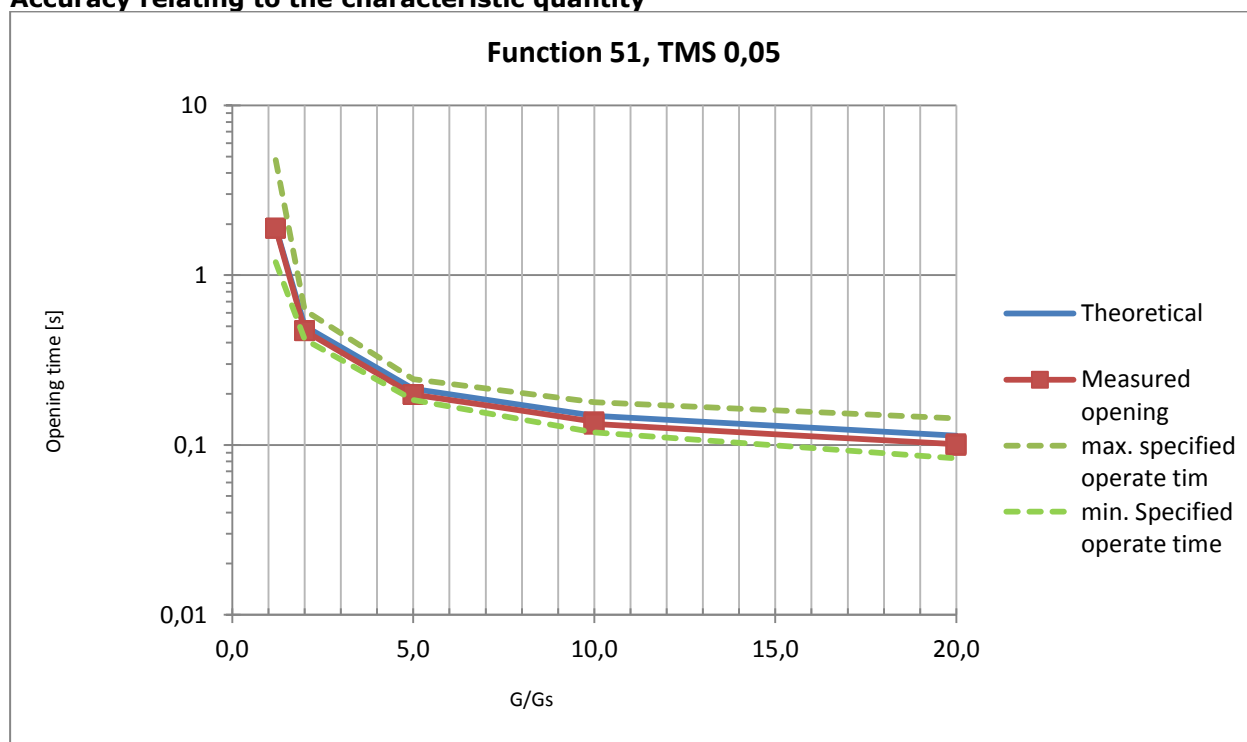
Serial number	SIAB000B0010AA
Rated current (I_{rated})	36 A
Rated frequency	50 Hz
Curve family	INV
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	1,25

Accuracy relating to the characteristic quantity

Set values		Measured values			Reset time		
	Time delay theoretical (s)	Operate time					
G/G _s		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	47,905	48,012	48,034	48,064	-	-	-
2	12,536	12,070	12,119	12,220	-	-	-
5	5,350	5,239	5,243	5,247	-	-	-
10	3,713	3,703	3,705	3,706	-	-	-
20	2,834	2,957	2,961	2,965	-	-	-

Characteristic test data

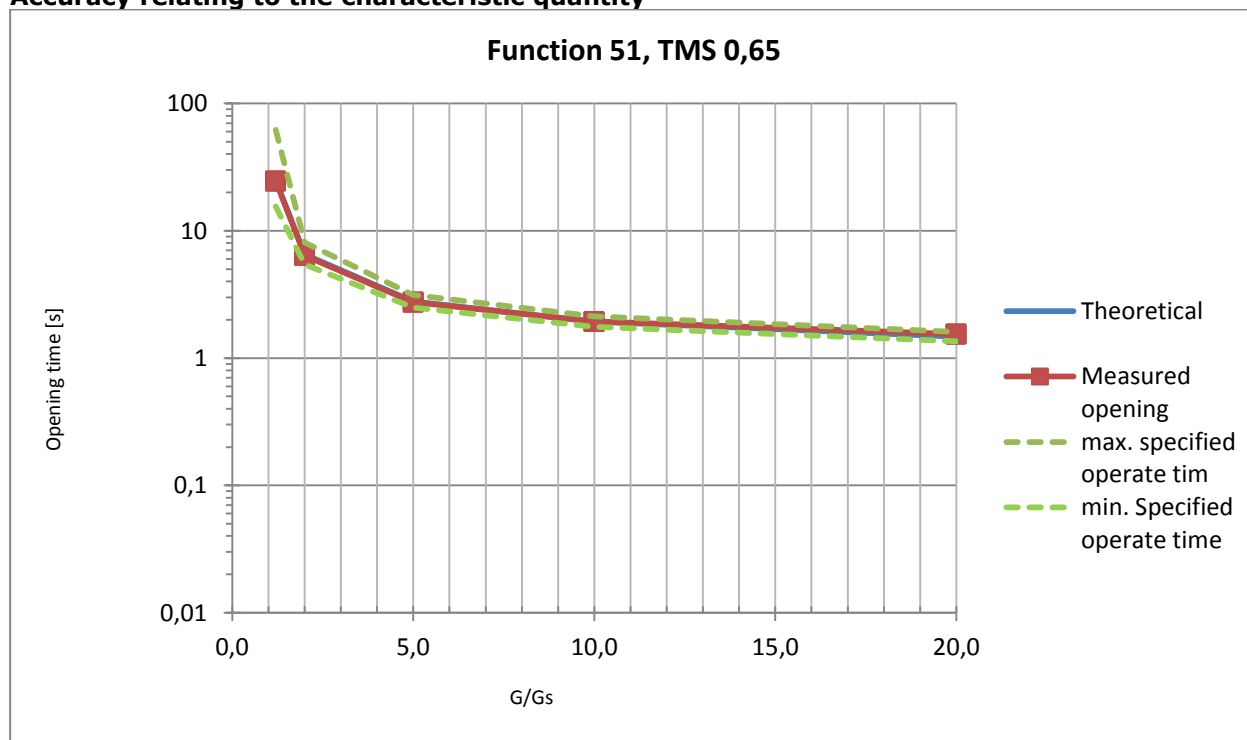
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 56 A
 Rated frequency 50 Hz
 Curve family INV
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 0,05

Accuracy relating to the characteristic quantity

Set values		Measured values			Reset time		
	Time delay theoretical (s)	Operate time					
G/G_s		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	1,916	1,890	1,892	1,896	-	-	-
2	0,501	0,470	0,471	0,472	-	-	-
5	0,214	0,198	0,198	0,198	-	-	-
10	0,149	0,132	0,134	0,137	-	-	-
20	0,113	0,099	0,100	0,102	-	-	-

Characteristic test data

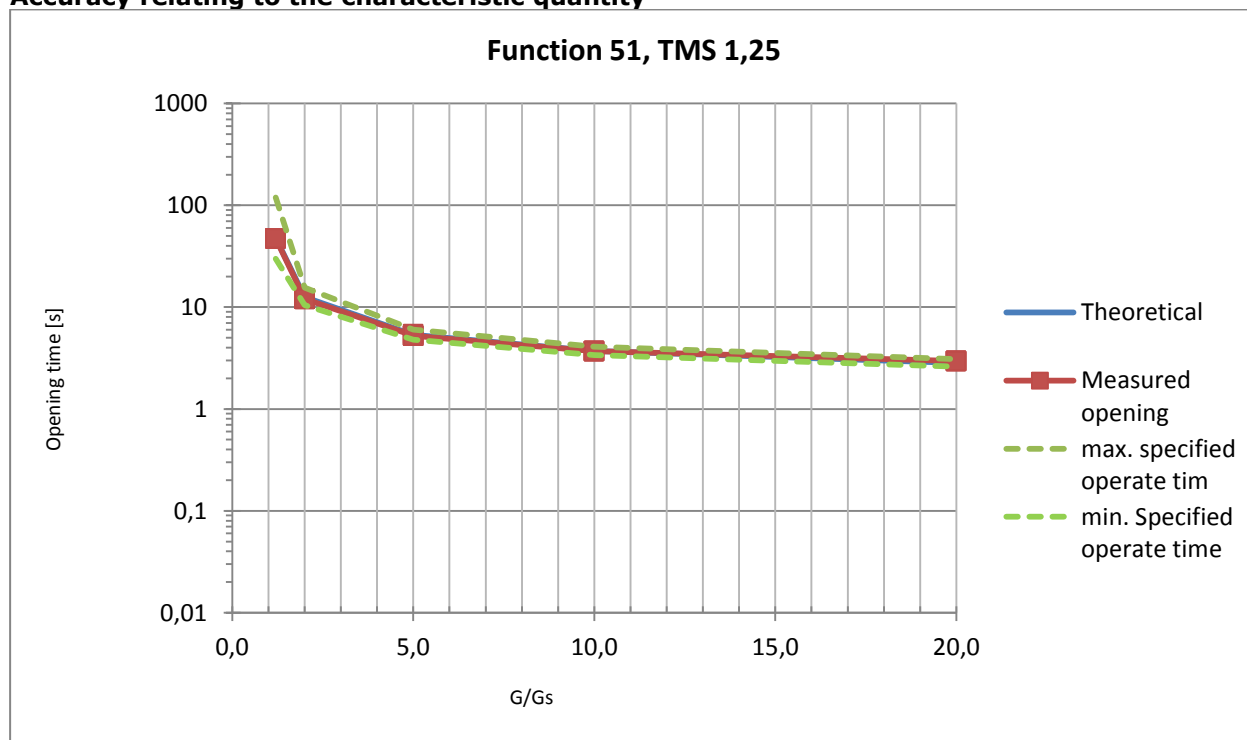
Serial number SIAB000B0010AA
 Rated current (I_{rated}) 56 A
 Rated frequency 50 Hz
 Curve family INV
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 0,65

Accuracy relating to the characteristic quantity

Set values		Measured values					
G/ G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	24,910	24,572	24,585	24,595	-	-	-
2	6,519	6,380	6,417	6,435	-	-	-
5	2,782	2,744	2,751	2,758	-	-	-
10	1,931	1,933	1,936	1,940	-	-	-
20	1,474	1,543	1,545	1,547	-	-	-

Characteristic test data

Serial number SIAB000B0010AA
 Rated current (I_{rated}) 56 A
 Rated frequency 50 Hz
 Curve family INV
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 1,25

Accuracy relating to the characteristic quantity

Set values		Measured values					
G/ G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	47,905	47,216	47,240	47,250	-	-	-
2	12,536	12,027	12,068	12,101	-	-	-
5	5,350	5,238	5,285	5,436	-	-	-
10	3,713	3,699	3,701	3,704	-	-	-
20	2,834	2,960	2,968	2,973	-	-	-

6.4 Time delayed phase overcurrent protection (ANSI 50 & 51) – 60 Hz

Standard and date

Standard	IEC 60255-1, Subclause 6.5
Reference	IEC 60255-151
Test date	20 to 24 June 2016

Environmental conditions

Ambient temperature	21 °C
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Requirements

The tests shall be performed within the specification limits of the manufacturer given below.

	Tolerance
Measurement accuracy	10% for CT type CT xxx-10
Time delay	40 ms or 5%
Current range	16-56 A
Resetting ratio	0
T-reset	0

Note

The maximum specified operate time is depending on the used current transformer.

Maximum specified tolerance on tripping time is specified by the manufacturer as the time tolerance caused by the current measurement accuracy of the current transformer ($\pm 10\%$) added with (± 40 ms or 5%).

Result

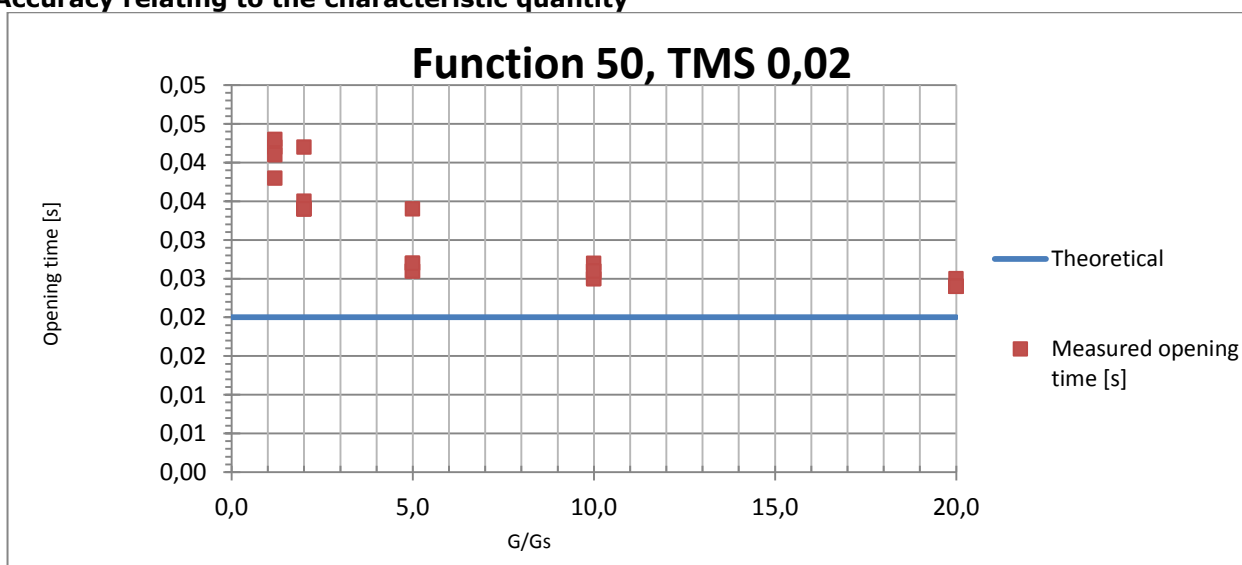
The object passed the test.

6.4.1 Definite time

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Test frequency	60 Hz
Initial test current value	0 A
Curve family	DT
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	0,02

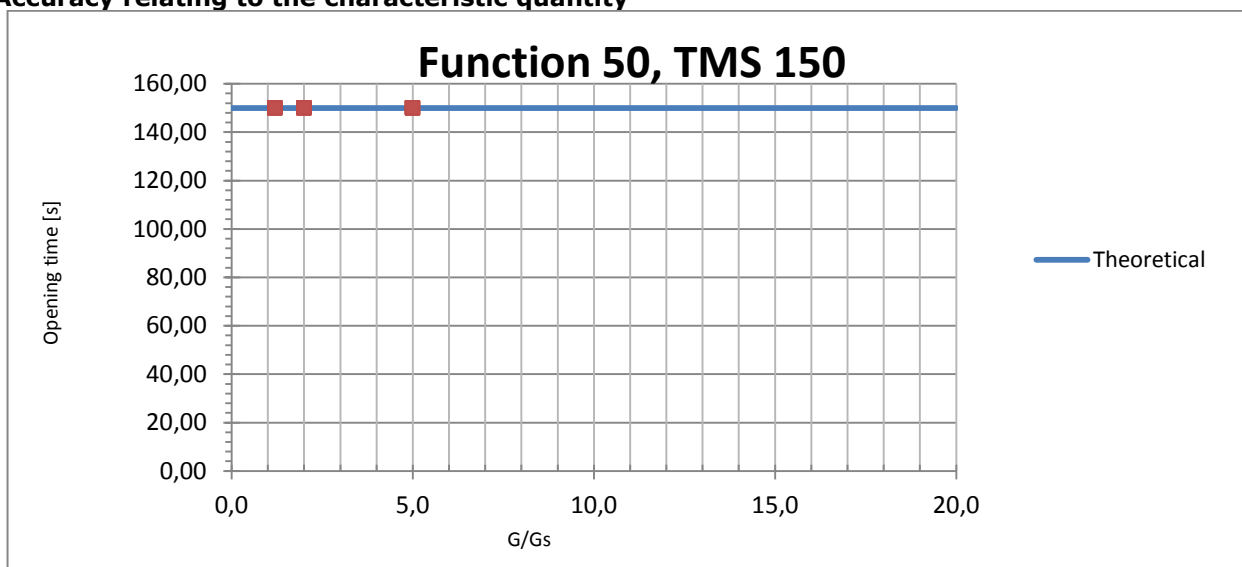
Accuracy relating to the characteristic quantity



Set values		Measured values					
$x G_s$	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	0,02	0,038	0,041	0,043	-	-	-
2	0,02	0,034	0,034	0,035	-	-	-
5	0,02	0,026	0,027	0,027	-	-	-
10	0,02	0,025	0,025	0,026	-	-	-
20	0,02	0,024	0,024	0,024	-	-	-

Characteristic test data

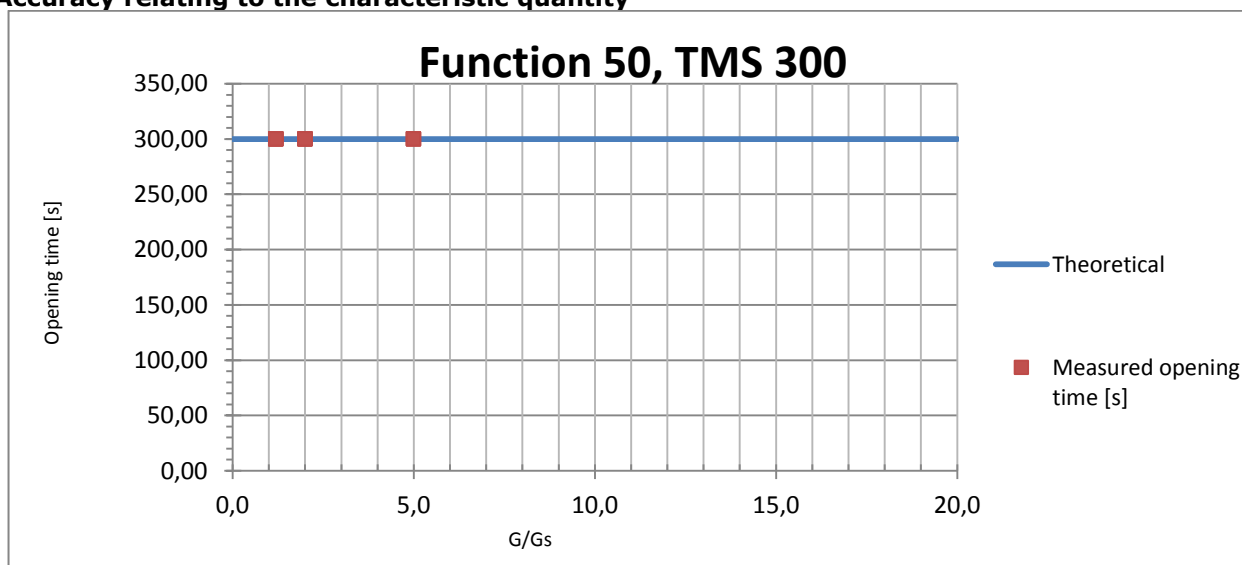
Serial number 16190250
 Rated current (I_{rated}) 16 A
 Test frequency 60 Hz
 Initial test current value 0 A
 Curve family DT
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 150

Accuracy relating to the characteristic quantity

Set values		Measured values					
$x G_s$	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	150	150,058	150,059	150,060	-	-	-
2	150	150,052	150,052	150,052	-	-	-
5	150	150,043	150,044	150,045	-	-	-

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Test frequency	60 Hz
Initial test current value	0 A
Curve family	DT
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	300

Accuracy relating to the characteristic quantity

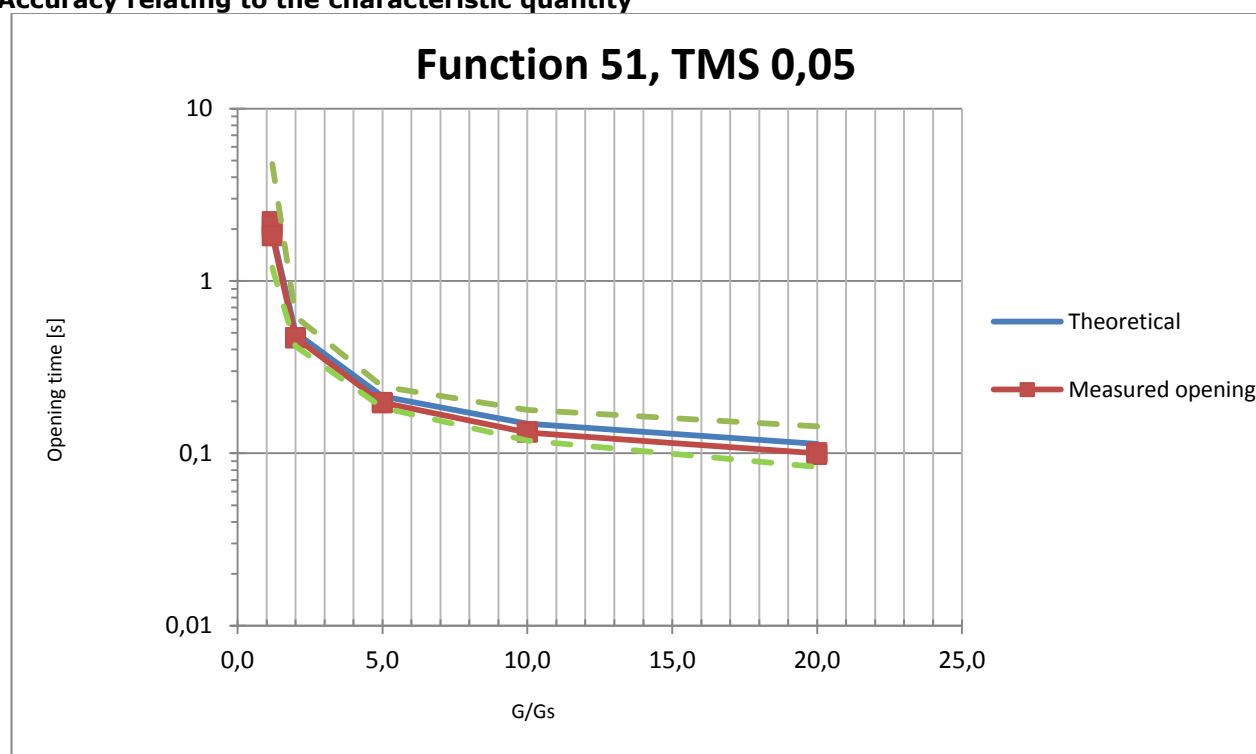
Set values		Measured values					
$x \ G_s$	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	300	300,097	300,098	300,099	-	-	-
2	300	300,090	300,091	300,092	-	-	-
5	300	300,082	300,082	300,082	-	-	-

6.4.2 Normal inverse time

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Rated frequency	60 Hz
Curve family	INV
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	0,05

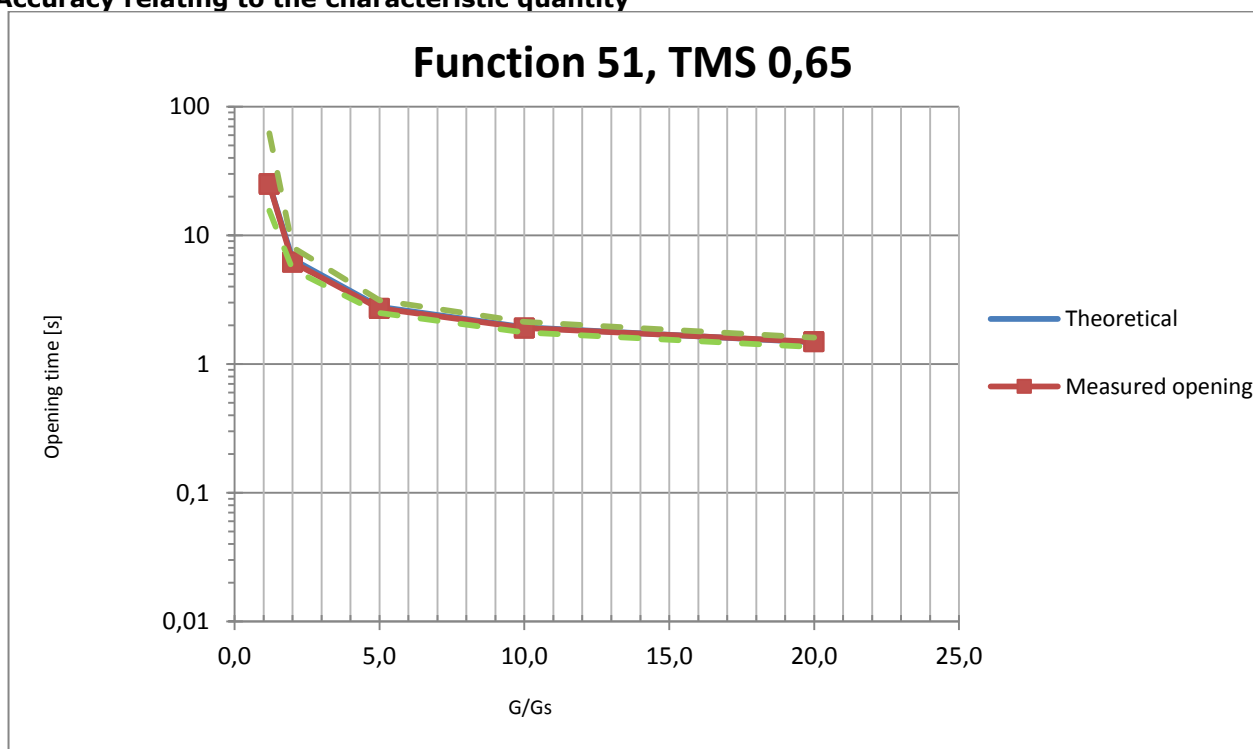
Accuracy relating to the characteristic quantity



Set values		Measured values					
x G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	1,916	1,818	2,004	2,211	-	-	-
2	0,501	0,465	0,467	0,469	-	-	-
5	0,214	0,196	0,196	0,197	-	-	-
10	0,149	0,132	0,133	0,133	-	-	-
20	0,113	0,098	0,100	0,101	-	-	-

Characteristic test data

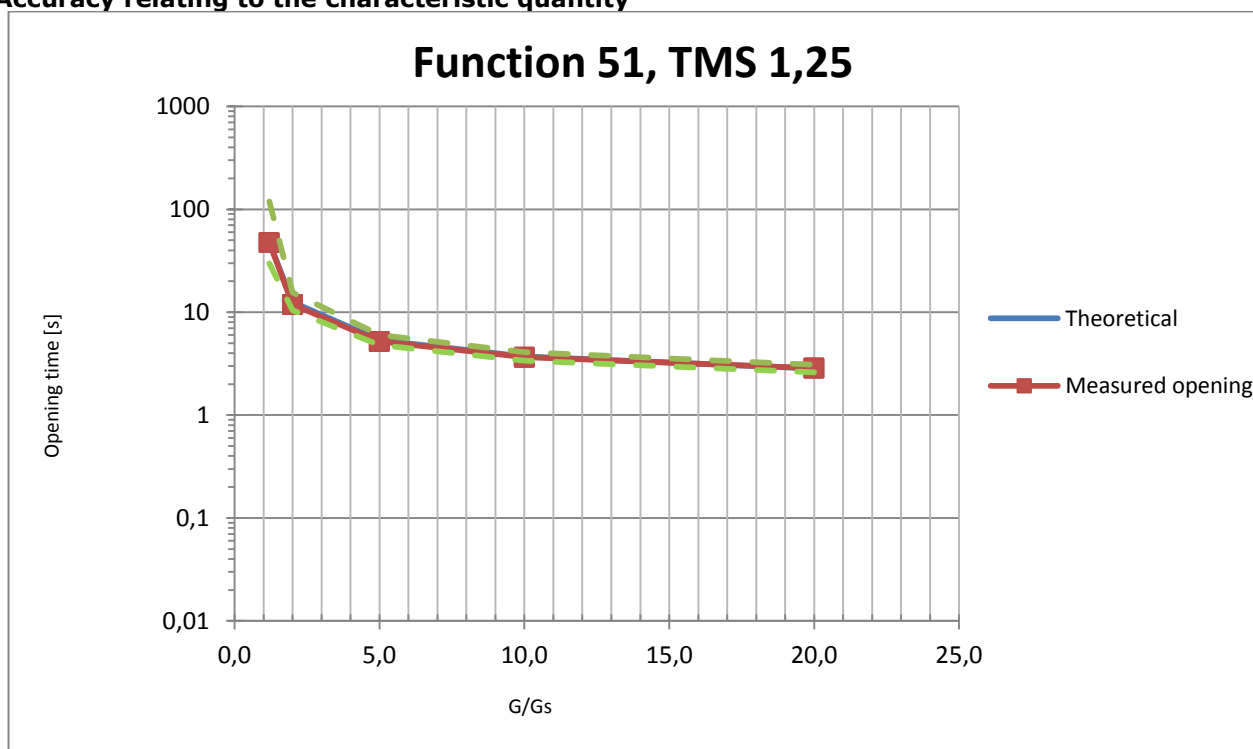
Serial number 16190250
 Rated current (I_{rated}) 16 A
 Rated frequency 60 Hz
 Curve family INV
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 0,65

Accuracy relating to the characteristic quantity

Set values		Measured values					
x G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	25,258	24,817	24,968	25,258	-	-	-
2	6,188	6,181	6,184	6,188	-	-	-
5	2,701	2,701	2,705	2,709	-	-	-
10	1,908	1,904	1,906	1,908	-	-	-
20	1,485	1,485	1,486	1,488	-	-	-

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Rated frequency	60 Hz
Curve family	INV
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	1,25

Accuracy relating to the characteristic quantity

Set values		Measured values					
x G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	47,905	47,451	47,565	47,638	-	-	-
2	12,536	11,881	11,888	11,897	-	-	-
5	5,350	5,198	5,201	5,206	-	-	-
10	3,713	3,660	3,664	3,666	-	-	-
20	2,834	2,856	2,857	2,859	-	-	-

6.5 Instantaneous neutral phase overcurrent protection (ANSI 50N) – 60 Hz

Standard and date

Standard	IEC 60255-1, Subclause 6.5
Reference	IEC 60255-151
Test date	20 to 24 June 2016

Environmental conditions

Ambient temperature	21 °C
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Requirements

The tests shall be performed within the specification limits of the manufacturer given below.

	Tolerance
Measurement accuracy	10% for CT type CT xxx-10
Time delay	40 ms or 0,5%
Current range	0,20 to 7x Is
Resetting ratio	100%
T-reset	0

Note

The maximum specified operate time is depending on the used current transformer.

Maximum specified tolerance on tripping time is specified by the manufacturer as the time tolerance caused by the current measurement accuracy of the current transformer ($\pm 10\%$) added with (± 40 ms or 0,5%).

Result

The object passed the test.

6.5.1 Intrinsic accuracy

Characteristic test data

Serial number	16190250
Rated current	16-56 A
Initial start value	$\leq 2 \times$ of specified accuracy
Ramping step	0,1 x of specified accuracy
Step time	2 to 5 x t_{start}
Repetitions	5
Test frequency	60 Hz

Intrinsic accuracy (Input IL1)

Set values		Measured values				Reset			
		Operate							
% of set range	(A)	Min. (A)	Avg. (A)	Max. (A)	Deviation (%)	Min. (A)	Avg. (A)	Max. (A)	Reset ratio
0,0	16,00	15,93	15,998	16,075	-0,01	15,925	15,993	16,07	99,97
0,5	16,20	15,875	15,9492	16,02	-1,55	15,87	15,946	16,015	99,98
1,0	16,40	15,935	15,959	15,995	-2,69	15,93	15,952	15,99	99,96
2,0	16,80	15,83	15,964	16,055	-4,98	15,825	15,959	16,05	99,97
3,0	17,20	16,705	16,861	17,06	-1,97	16,7	16,856	17,055	99,97
5,0	18,00	17,66	17,743	17,94	-1,43	16,655	17,538	17,935	98,84
10,0	20,00	19,565	19,618	19,695	-1,91	19,56	19,614	19,69	99,98
20,0	24,00	23,435	23,481	23,54	-2,16	23,43	23,476	23,535	99,98
30,0	28,00	27,425	27,524	27,695	-1,70	27,42	27,519	27,69	99,98
60,0	40,00	39,08	39,244	39,38	-1,89	39,07	39,234	39,37	99,97
100,0	56,00	55,37	55,466	55,53	-0,95	55,36	55,456	55,52	99,98

Intrinsic accuracy (Input IL2)

Set values		Measured values				Reset			
		Operate							
% of set range	(A)	Min. (A)	Avg. (A)	Max. (A)	Deviation (%)	Min. (A)	Avg. (A)	Max. (A)	Reset ratio
0,0	16,00	15,92	16,001	16,075	0,01	15,915	15,996	16,07	99,97
0,5	16,20	16,04	16,074	16,12	-0,78	16,025	16,065	16,115	99,94
1,0	16,40	15,91	16,022	16,135	-2,30	15,905	16,015	16,13	99,96
2,0	16,80	15,9	16,052	16,145	-4,45	15,895	16,047	16,14	99,97
3,0	17,20	16,85	16,885	16,9	-1,83	16,845	16,88	16,895	99,97
5,0	18,00	17,73	17,783	17,83	-1,21	17,725	17,778	17,825	99,97
10,0	20,00	19,65	19,681	19,715	-1,60	19,635	19,674	19,71	99,96
20,0	24,00	23,33	23,454	23,505	-2,27	23,325	23,449	23,5	99,98
30,0	28,00	27,345	27,434	27,5	-2,02	27,34	27,429	27,495	99,98
60,0	40,00	34,82	38,124	39,13	-4,69	34,81	38,116	39,13	99,98
100,0	56,00	54,89	55,012	55,12	-1,76	54,88	55,002	55,11	99,98

Intrinsic accuracy (Input IL3)

Set values		Measured values				Reset			
		Operate							
% of set range	(A)	Min. (A)	Avg. (A)	Max. (A)	Deviation (%)	Min. (A)	Avg. (A)	Max. (A)	Reset ratio
0,0	16,00	15,900	16,132	16,820	0,83	15,895	16,125	16,805	99,96
0,5	16,20	15,785	15,879	15,965	-1,98	15,78	15,874	15,96	99,97
1,0	16,40	15,735	15,835	15,935	-3,45	15,73	15,828	15,93	99,96
2,0	16,80	15,820	15,899	15,975	-5,36	15,815	15,894	15,97	99,97
3,0	17,20	16,725	16,787	16,850	-2,40	16,72	16,782	16,845	99,97
5,0	18,00	17,700	17,767	17,865	-1,29	17,695	17,762	17,86	99,97
10,0	20,00	19,560	19,600	19,700	-2,00	19,555	19,595	19,695	99,97
20,0	24,00	23,345	23,432	23,495	-2,37	23,34	23,427	23,49	99,98
30,0	28,00	27,350	27,483	27,590	-1,85	27,345	27,478	27,585	99,98
60,0	40,00	38,780	39,012	39,090	-2,47	38,77	38,998	39,08	99,96
100,0	56,00	55,030	55,228	55,350	-1,38	55,02	55,218	55,34	99,98

6.6 Time delayed neutral phase overcurrent protection (ANSI 50N & 51N) – 50 Hz

Standard and date

Standard	IEC 60255-1, Subclause 6.5
Reference	IEC 60255-151
Test date	20 to 24 June 2016

Environmental conditions

Ambient temperature	21 °C
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Requirements

The tests shall be performed within the specification limits of the manufacturer given below.

	Tolerance
Measurement accuracy	10% for CT type CT xxx-10
Time delay	40 ms or 5%
Current range	0,20 to 7x Is
Resetting ratio	100%
T-reset	0

Note

The maximum specified operate time is depending on the used current transformer.

Maximum specified tolerance on tripping time is specified by the manufacturer as the time tolerance caused by the current measurement accuracy of the current transformer ($\pm 10\%$) added with (± 40 ms or 5%).

Result

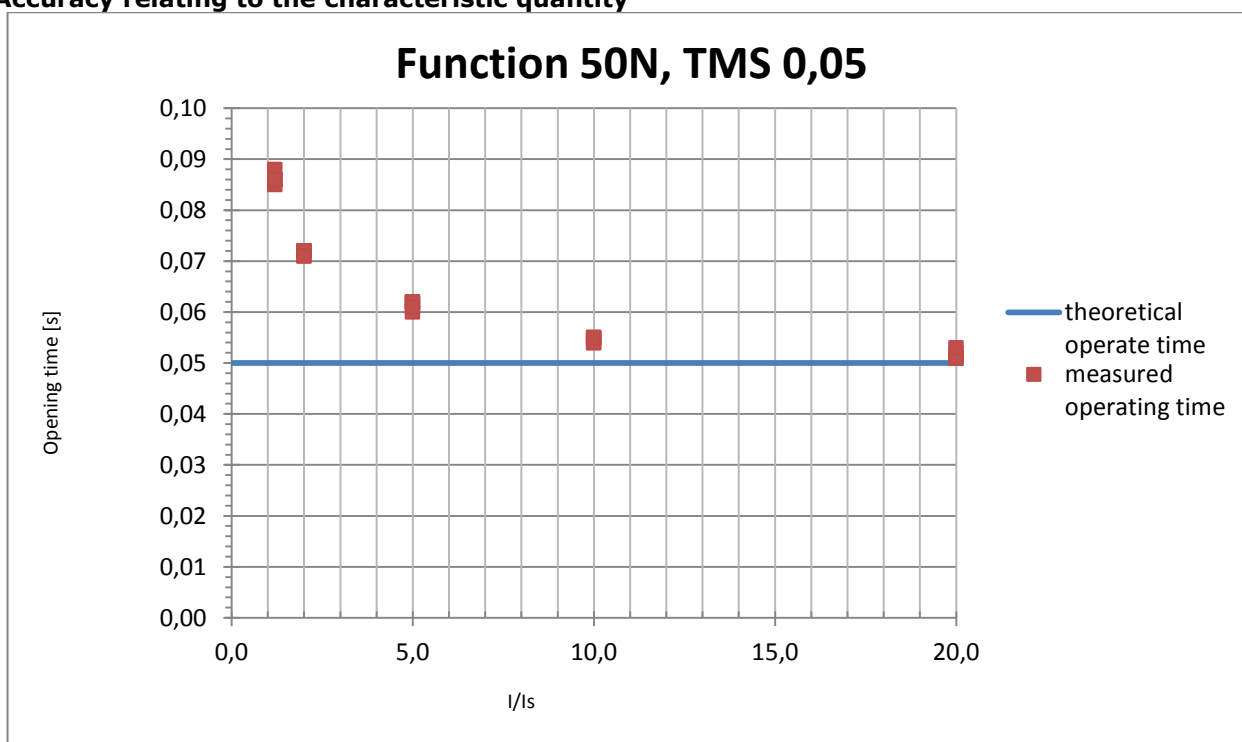
The object passed the test.

6.6.1 Definite time

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Rated frequency	50 Hz
Initial test current value	0 A
Curve family	DT
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	0,05

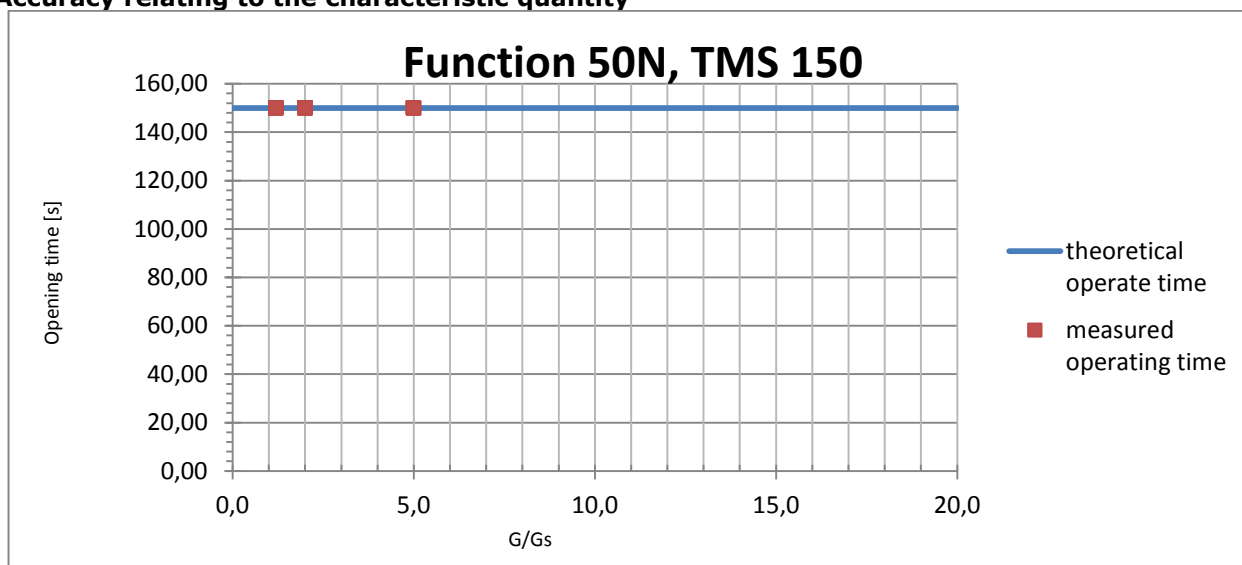
Accuracy relating to the characteristic quantity



Set values		Measured values					
$x G_s$	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	0,050	0,085	0,086	0,088	-	-	-
2	0,050	0,071	0,072	0,072	-	-	-
5	0,050	0,060	0,061	0,062	-	-	-
10	0,050	0,054	0,055	0,055	-	-	-
20	0,050	0,051	0,052	0,053	-	-	-

Characteristic test data

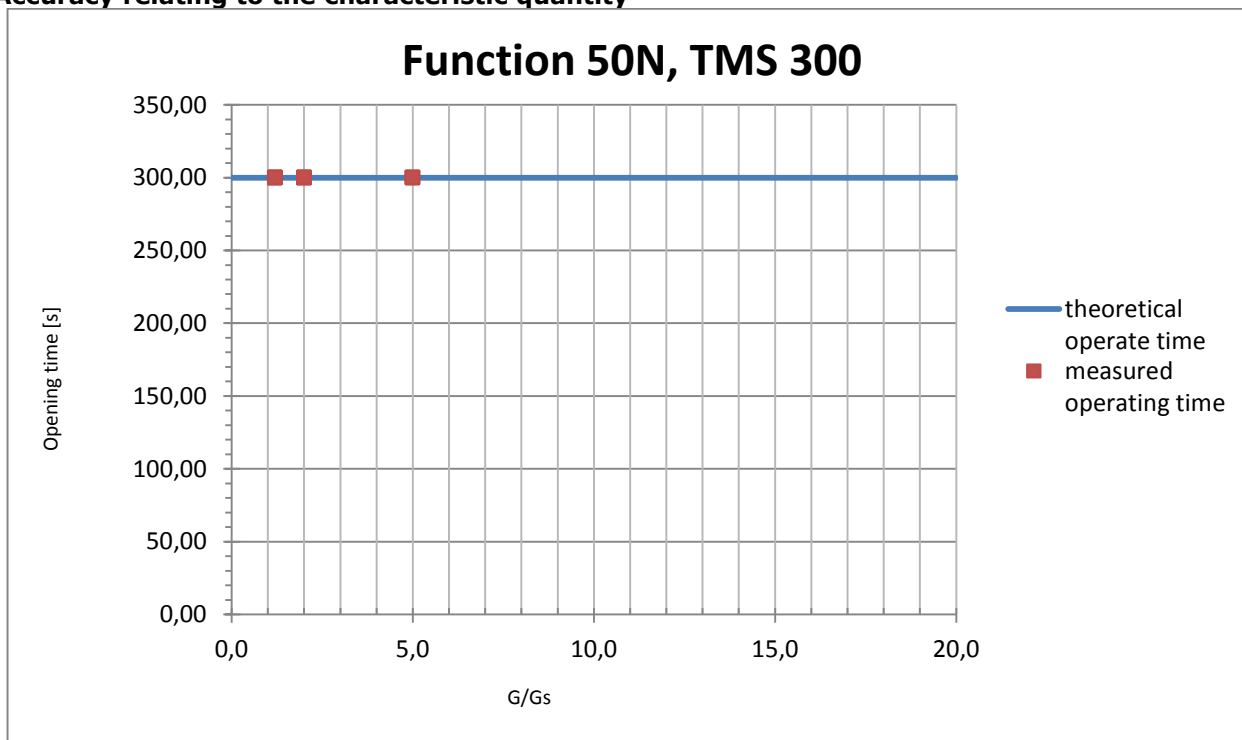
Serial number	16190250
Rated current (I_{rated})	16 A
Rated frequency	50 Hz
Initial test current value	0 A
Curve family	DT
Range (G_s)	$1,2 \times I_{rated}$ to $5 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	150

Accuracy relating to the characteristic quantity

Set values		Measured values					
$x G_s$	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	150	150,067	150,068	150,069	-	-	-
2	150	150,052	150,052	150,053	-	-	-
5	150	150,041	150,042	150,043	-	-	-

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Rated frequency	50 Hz
Initial test current value	0 A
Curve family	DT
Range (G_s)	$1,2 \times I_{rated}$ to $5 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	300

Accuracy relating to the characteristic quantity

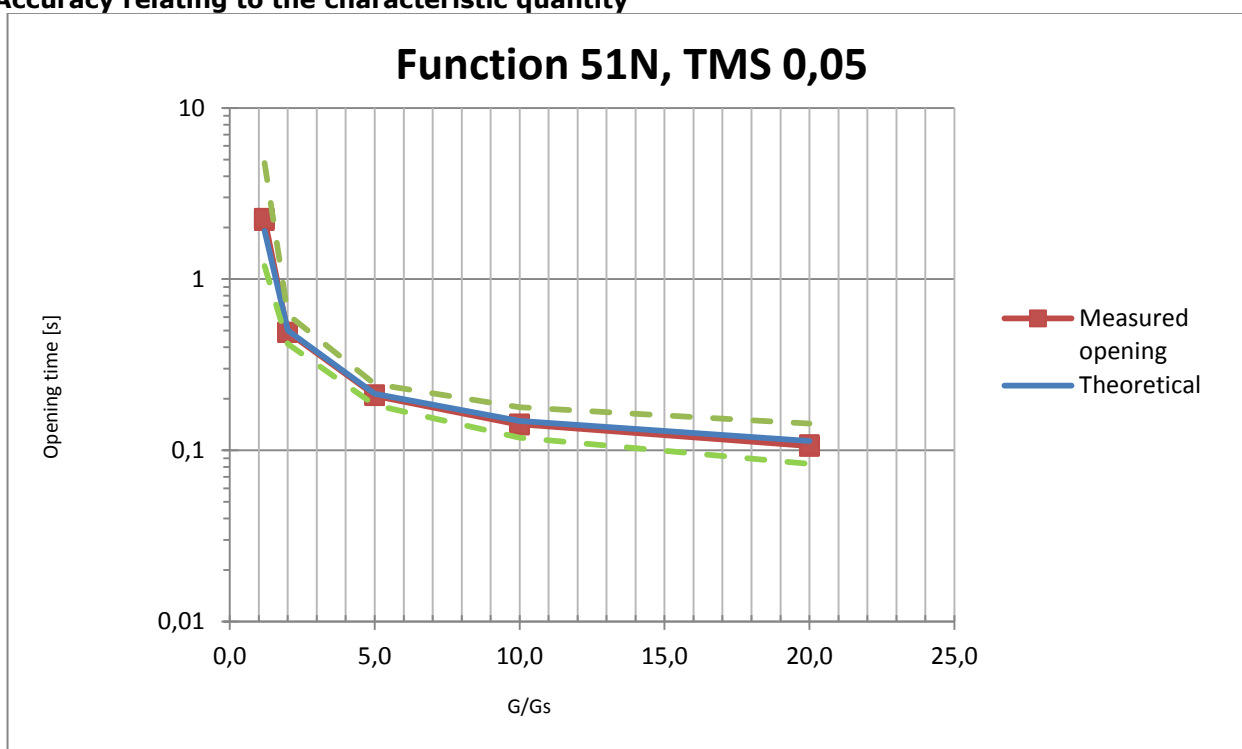
Set values		Measured values					
$x G_s$	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	300	300,068	300,071	300,074	-	-	-
2	300	300,082	300,085	300,095	-	-	-
5	300	300,071	300,072	300,073	-	-	-

6.6.2 Normal inverse time

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Rated frequency	50 Hz
Curve family	INV
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	0,05

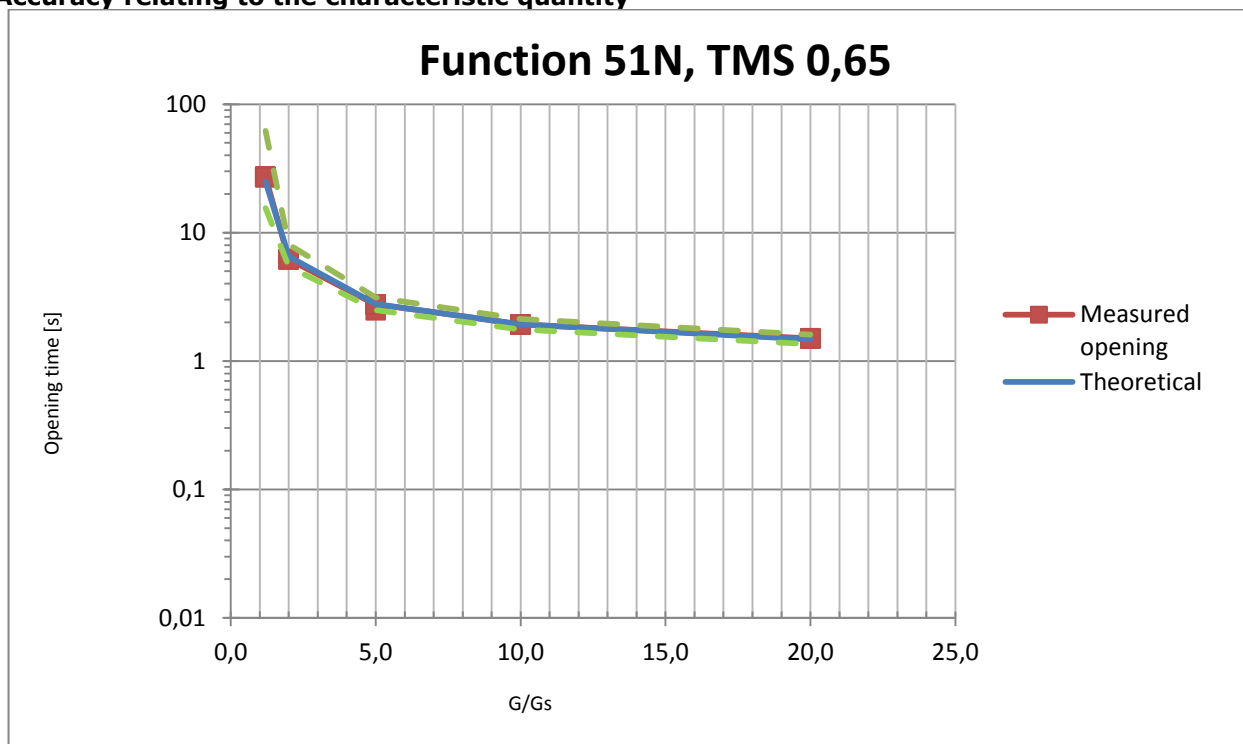
Accuracy relating to the characteristic quantity



Set values		Measured values					
x G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	1,916	2,190	2,230	2,262	-	-	-
2	0,501	0,487	0,488	0,490	-	-	-
5	0,214	0,208	0,209	0,210	-	-	-
10	0,149	0,140	0,141	0,142	-	-	-
20	0,113	0,105	0,106	0,108	-	-	-

Characteristic test data

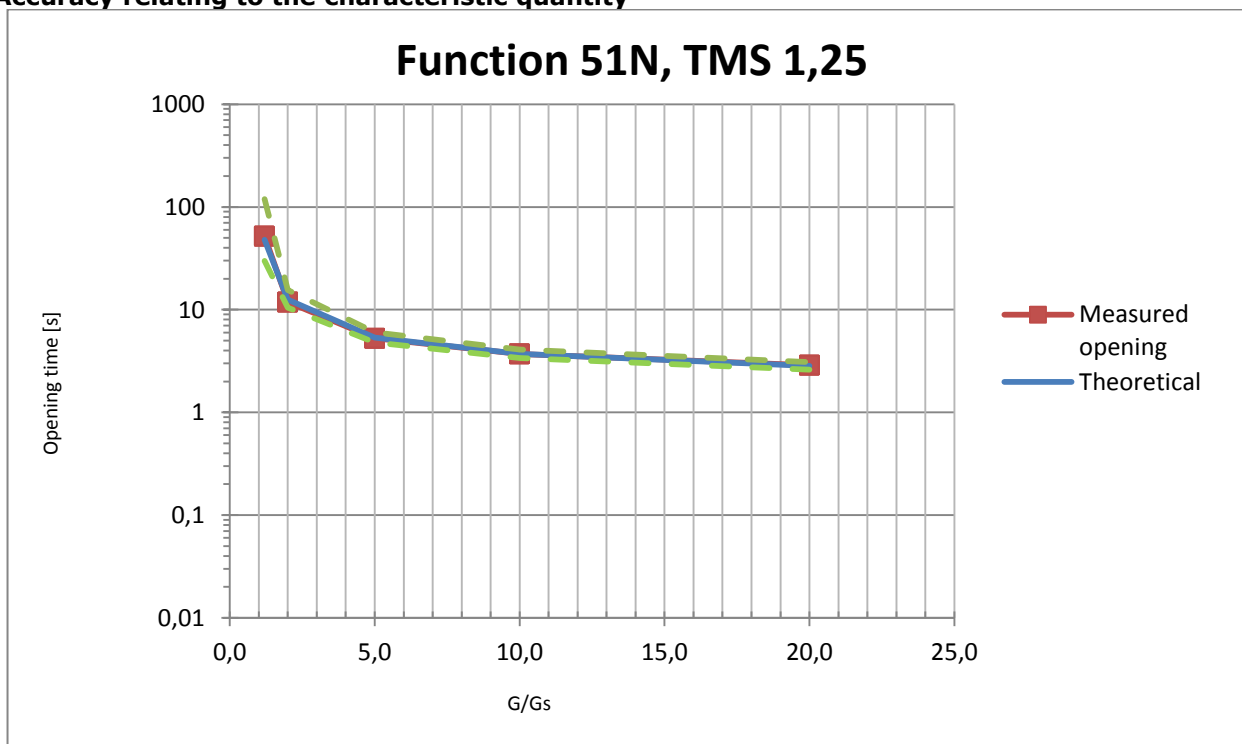
Serial number 16190250
 Rated current (I_{rated}) 16 A
 Rated frequency 50 Hz
 Curve family INV
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 0,65

Accuracy relating to the characteristic quantity

Set values		Measured values					
x G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	24,910	27,085	27,199	27,309	-	-	-
2	6,519	6,199	6,202	6,206	-	-	-
5	2,782	2,478	2,693	2,748	-	-	-
10	1,931	1,928	1,929	1,930	-	-	-
20	1,474	1,501	1,501	1,502	-	-	-

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Rated frequency	50 Hz
Curve family	INV
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	1,25

Accuracy relating to the characteristic quantity

Set values		Measured values					
x G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	47,905	51,988	52,070	52,162	-	-	-
2	12,536	11,880	11,887	11,893	-	-	-
5	5,350	5,265	5,267	5,269	-	-	-
10	3,713	3,699	3,701	3,707	-	-	-
20	2,834	2,877	2,878	2,879	-	-	-

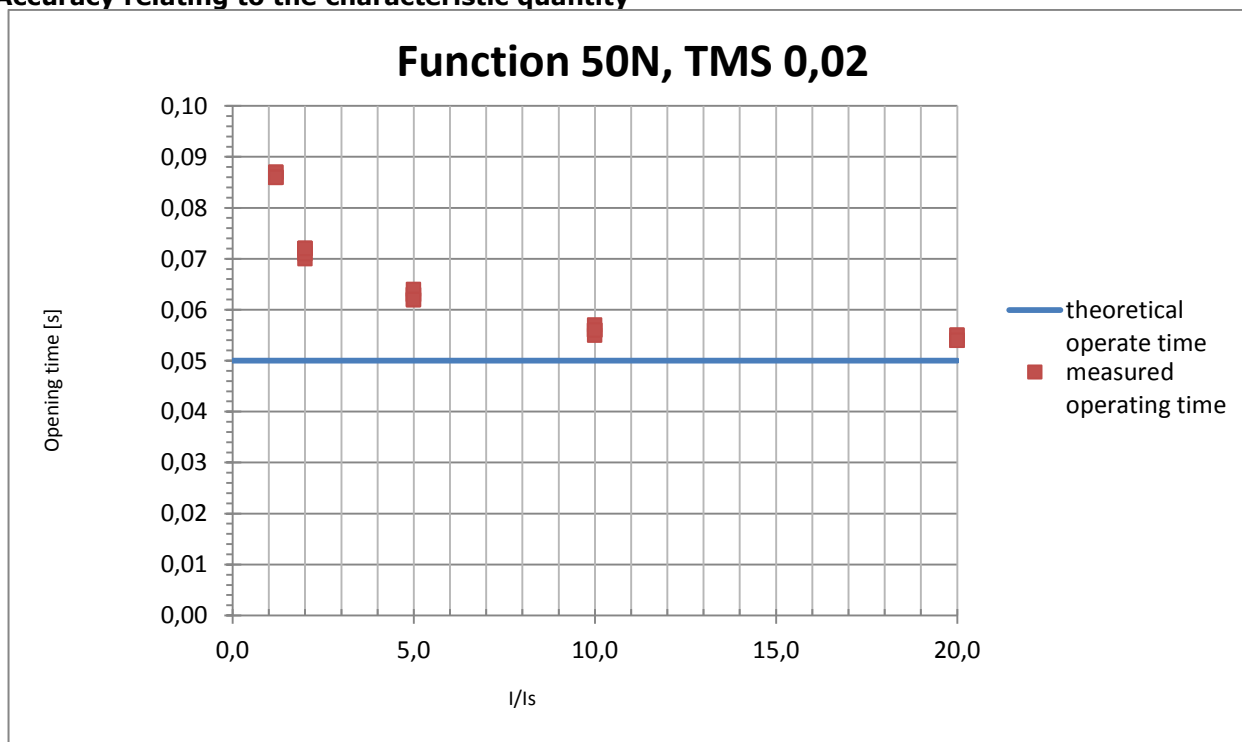
6.7 Time delayed neutral phase overcurrent protection (ANSI 50N & 51N) – 60 Hz

6.7.1 Definite time

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Rated frequency	60 Hz
Initial test current value	0 A
Curve family	DT
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	0,02

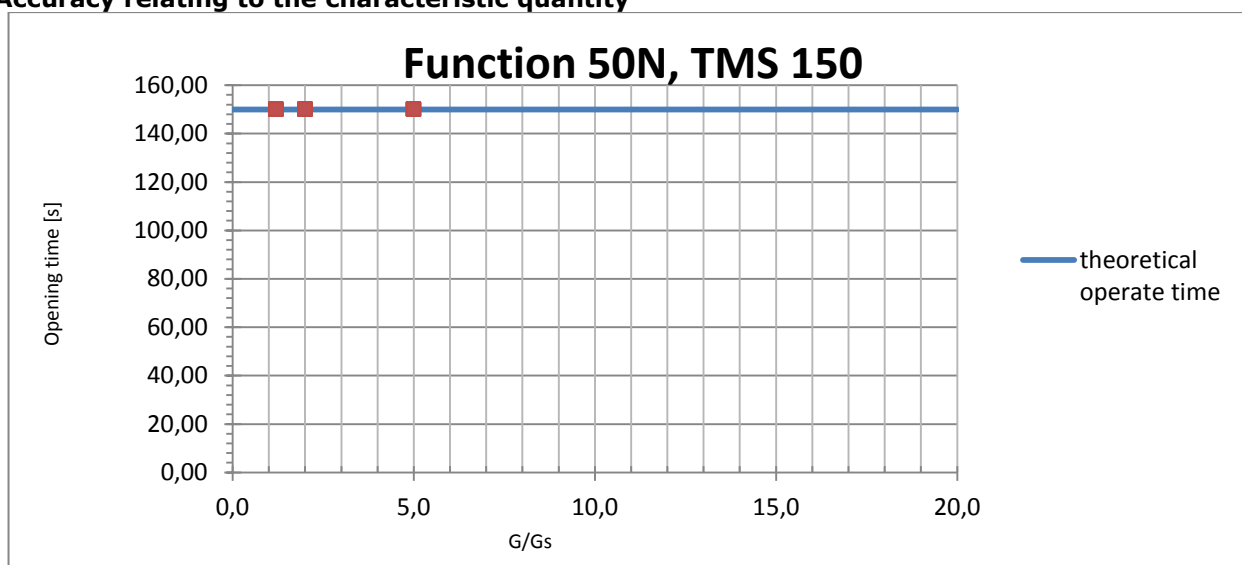
Accuracy relating to the characteristic quantity



Set values		Measured values					
$\times G_s$	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	0,050	0,086	0,086	0,087	-	-	-
2	0,050	0,070	0,071	0,072	-	-	-
5	0,050	0,062	0,063	0,064	-	-	-
10	0,050	0,055	0,056	0,057	-	-	-
20	0,050	0,054	0,054	0,055	-	-	-

Characteristic test data

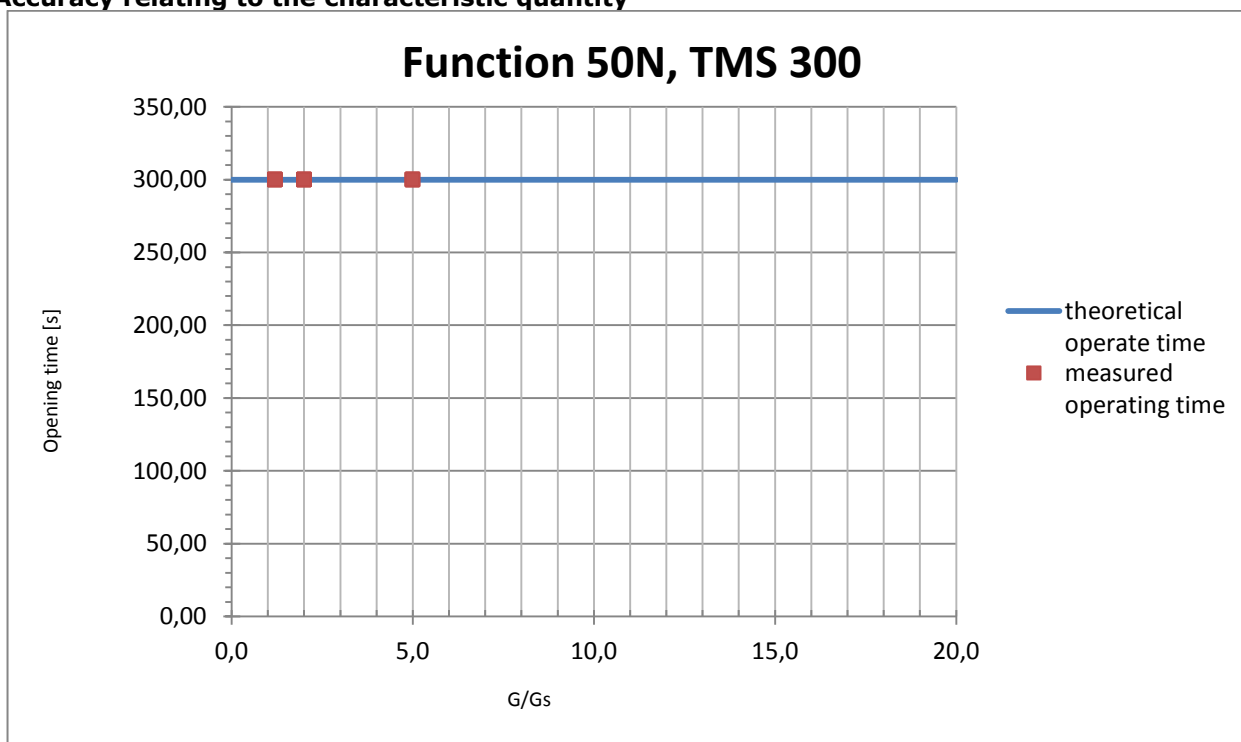
Serial number 16190250
 Rated current (I_{rated}) 16 A
 Rated frequency 60 Hz
 Initial test current value 0 A
 Curve family DT
 Range (G_s) $1,2 \times I_{rated}$ to $5 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 150

Accuracy relating to the characteristic quantity

Set values		Measured values					
x G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	150	150,071	150,072	150,073	-	-	-
2	150	150,059	150,059	150,060	-	-	-
5	150	150,050	150,051	150,052	-	-	-

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Rated frequency	60 Hz
Initial test current value	0 A
Curve family	DT
Range (G_s)	$1,2 \times I_{rated}$ to $5 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	300

Accuracy relating to the characteristic quantity

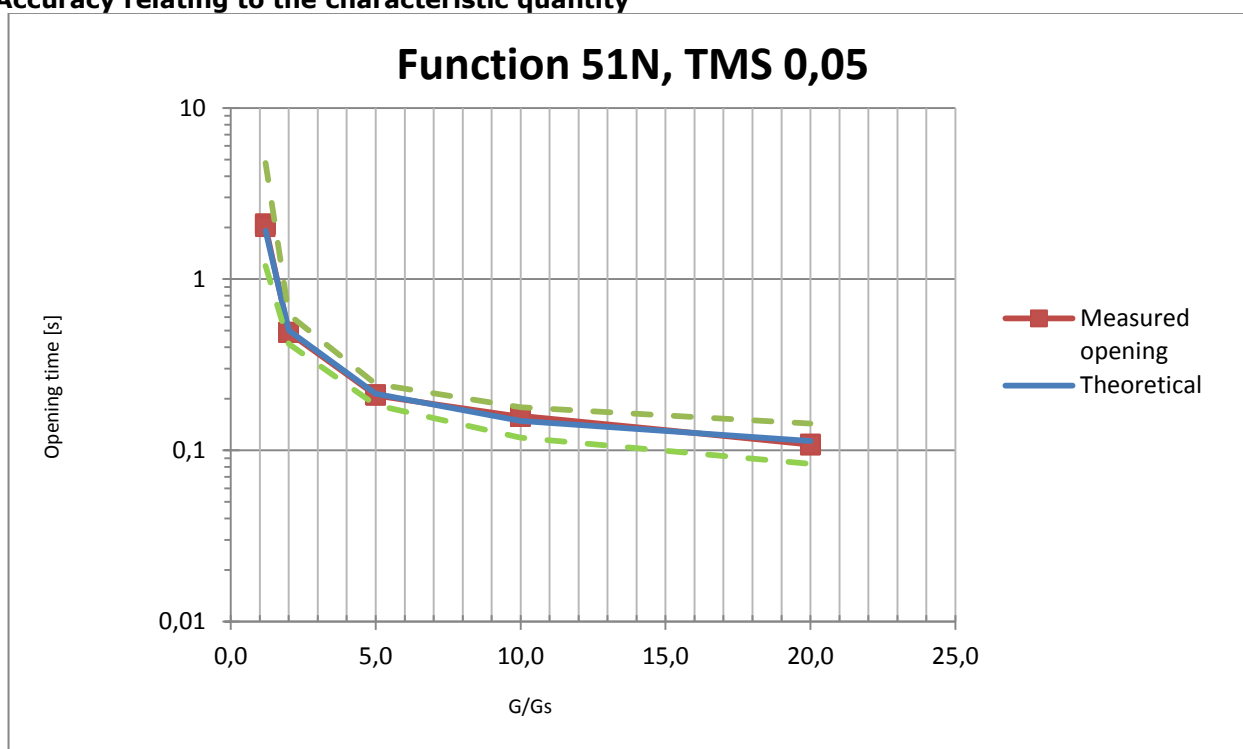
Set values		Measured values					
$x G_s$	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	300	300,109	300,111	300,114	-	-	-
2	300	300,097	300,098	300,099	-	-	-
5	300	300,090	300,090	300,091	-	-	-

6.7.2 Normal inverse time

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Rated frequency	60 Hz
Curve family	INV
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	0,05

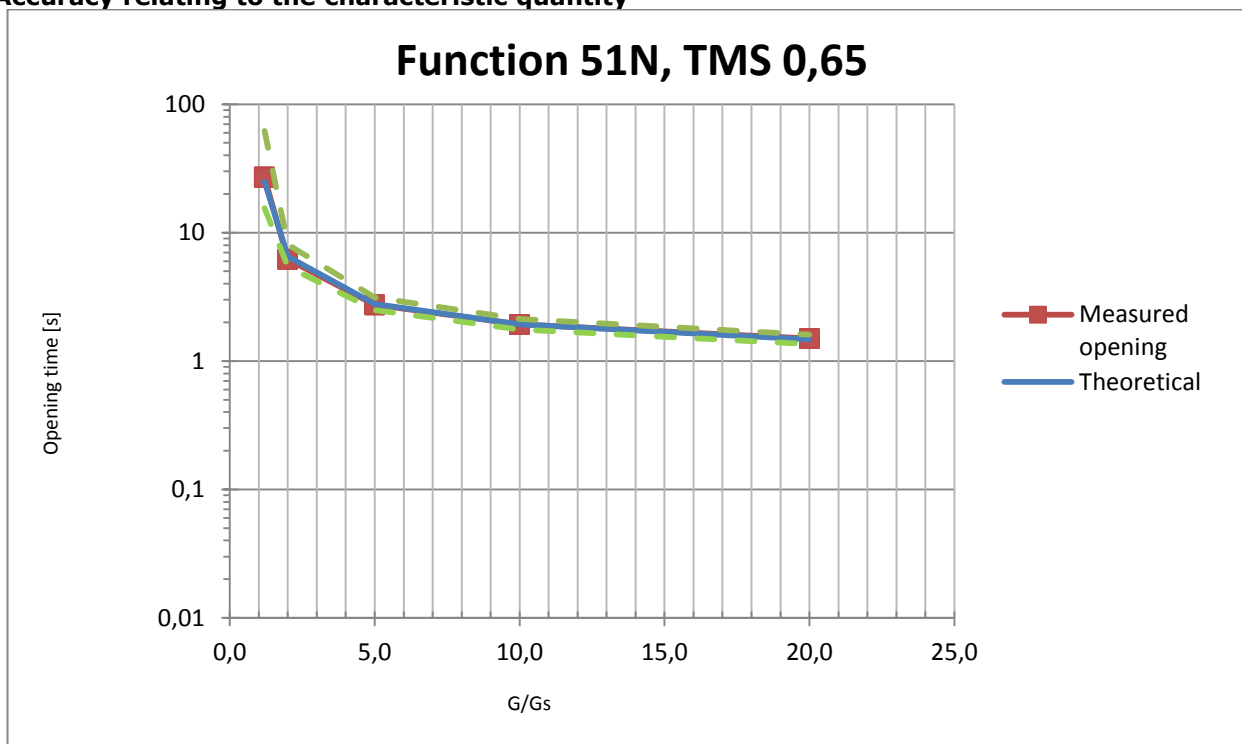
Accuracy relating to the characteristic quantity



Set values		Measured values					
x G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	1,916	2,016	2,073	2,103	-	-	-
2	0,501	0,484	0,487	0,490	-	-	-
5	0,214	0,209	0,210	0,211	-	-	-
10	0,149	0,157	0,157	0,159	-	-	-
20	0,113	0,107	0,108	0,109	-	-	-

Characteristic test data

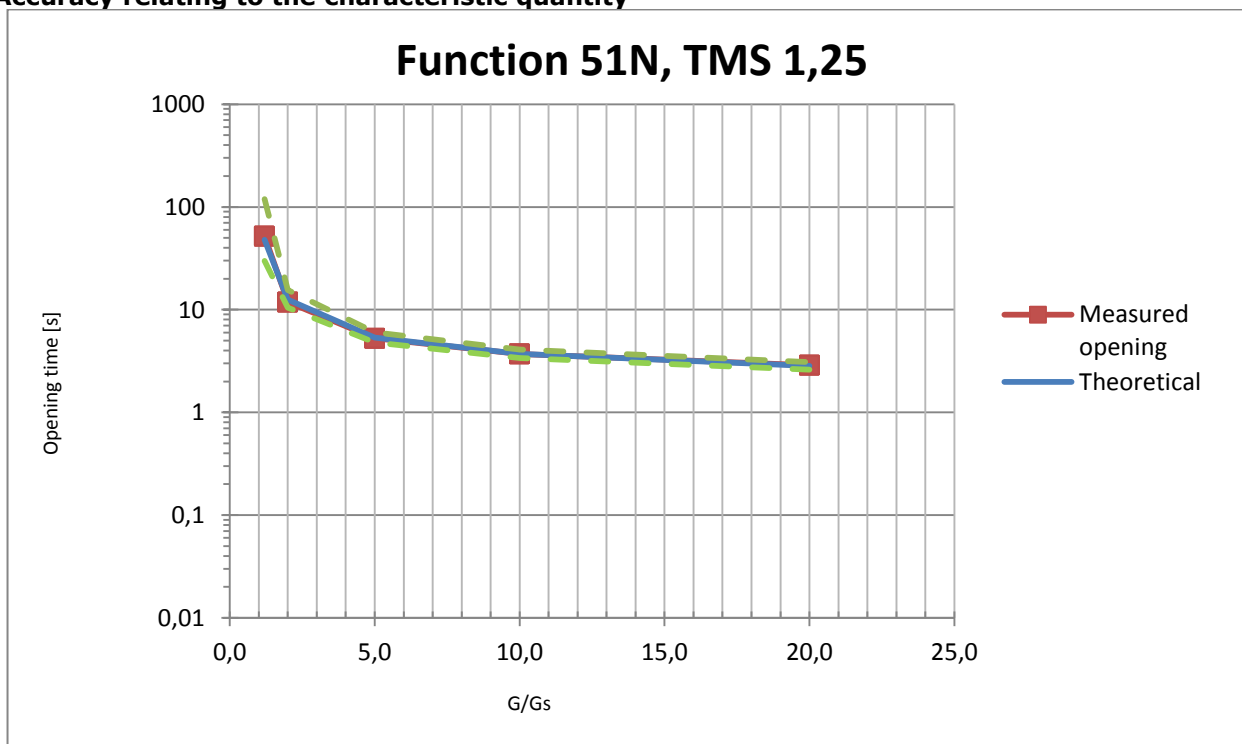
Serial number 16190250
 Rated current (I_{rated}) 16 A
 Rated frequency 60 Hz
 Curve family INV
 Range (G_s) $1,2 \times I_{rated}$ to $20 \times I_{rated}$
 G_s $1 \times I_{rated}$
 TMS 0,65

Accuracy relating to the characteristic quantity

Set values		Measured values					
x G_s	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	24,910	26,877	27,049	27,187	-	-	-
2	6,519	6,192	6,200	6,205	-	-	-
5	2,782	2,737	2,741	2,747	-	-	-
10	1,931	1,925	1,927	1,930	-	-	-
20	1,474	1,499	1,499	1,499	-	-	-

Characteristic test data

Serial number	16190250
Rated current (I_{rated})	16 A
Rated frequency	60 Hz
Curve family	INV
Range (G_s)	$1,2 \times I_{rated}$ to $20 \times I_{rated}$
G_s	$1 \times I_{rated}$
TMS	1,25

Accuracy relating to the characteristic quantity

Set values		Measured values					
$x G_s$	Time delay theoretical (s)	Operate time			Reset time		
		Min. (s)	Avg. (s)	Max. (s)	Min. (s)	Avg. (s)	Max. (s)
1,2	47,905	51,988	52,070	52,162	-	-	-
2	12,536	11,880	11,887	11,893	-	-	-
5	5,350	5,265	5,267	5,269	-	-	-
10	3,713	3,699	3,701	3,707	-	-	-
20	2,834	2,877	2,878	2,879	-	-	-

6.8 Curve types

IEC 60255-151

Curve type	Operating time $t(G) = TMS \left(\frac{k}{\left(\frac{G}{G_s}\right)^\alpha - 1} + c \right)$			Reset time $t_r(G) = TMS \left(\frac{t_r}{1 - \left(\frac{G}{G_s}\right)^\alpha} \right)$		Commonly used name
	k (s)	c (s)	a	t _r (s)	a	
A	0,14	0	0,02	¹⁾	¹⁾	Inverse
¹⁾ For curves A, B and C, the manufacturer shall declare if dependent time reset characteristic is implemented and provide the appropriate information.						

7 CLIMATIC ENVIRONMENT

7.1 Inspection

7.1.1 Pre-inspection

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

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

- analogue inputs
- digital input
- contact output.

7.1.2 Visual and functional inspection

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

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

There shall be no:

- burning of any components.
- paint blisters on any components.
- discolouration on components.
- deformation of modules or components.
- interruptions or damage on interconnecting cables, wires and connectors.

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

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

There shall be no:

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

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

7.2 Photograph of test arrangement



7.3 Climatic environmental tests

7.3.1 Dry-heat test - operational

Standard and date

Standard IEC 60255-1, Subclause 6.12.3.1

Test date 11 May 2016

Characteristic test data

Serial number 16110463

Type of test Bd

Operating conditions energized

Power supply 230 V

Relative humidity < 50 %

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

Test procedure	Duration of exposure (h)	Operating Temperature (°C)	Observations
Powering up after	1	70	-
Correct operation at rated load/current	72		-

Requirement

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

Result

The object passed the test.

7.3.2 Cold test - operational

Standard and date

Standard IEC 60255-1, Subclause 6.12.3.2

Test date 15 April 2016

Characteristic test data

Serial number 16110463

Type of test Ad

Operating conditions energized

Power supply 230 V

Relative humidity < 50 %

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

Test procedure	Duration of exposure (h)	Operating Temperature (°C)	Observations
Powering up after	1	-25	-
Correct operation at rated load/current	72		-

Requirement

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

Result

The object passed the test.

7.3.3 Dry-heat test at maximum storage temperature

Standard and date

Standard IEC 60255-1, Subclause 6.12.3.3

Test date 12 April 2016

Characteristic test data

Serial number 16110463

Type of test Bb

Operating conditions non-energized

Relative humidity < 50 %

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

Test procedure	Duration of exposure (h)	Operating Temperature (°C)	Observations
Powering up after	-	85	-
Storage	72		-

Requirement

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

Result

The object passed the test.

7.3.4 Cold test at minimum storage temperature

Standard and date

Standard IEC 60255-1, Subclause 6.12.3.4

Test date 8 April 2016

Characteristic test data

Serial number 16110463

Type of test Ab

Operating conditions non-energized

Relative humidity < 50 %

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

Test procedure	Duration of exposure (h)	Operating Temperature (°C)	Observations
Powering up after	-	-40	-
Storage	72		-

Requirement

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

Result

The object passed the test.

7.3.5 Change of temperature test

Standard and date

Standard IEC 60255-1, Subclause 6.12.3.5

Test date 17 May 2016

Characteristic test data

Serial number 16110463
Type of test Nb
Operating conditions energized
Power supply 230 V
Relative humidity < 50 %
Maximum rate of change 1 °C/min
Exposure time t_1 3 h
Duration of exposure 5 cycles

Test procedure	Exposure time (h)	Duration of exposure (cycles)	Operating Temperature (°C)	Observations
Pre-conditioning	1	-	+22	-
Correct operation	3	5	Min. -25 Max. 70	1 -

Observations

Display freezes. Normal operation during -25.

Requirement

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

Result

The object passed the test.

7.3.6 Damp-heat steady-state test

Standard and date

Standard IEC 60255-1, Subclause 6.12.3.6

Test date 19 April 2016

Characteristic test data

Serial number 16110463
Type of test Cab
Operating conditions energized
Power supply 230 V
Relative humidity 93 %

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

Requirement

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

Result

The object passed the test.

7.3.7 Cyclic temperature with humidity test

Standard and date

Standard IEC 60255-1, Subclause 6.12.3.7

Test date 29 April 2016

Characteristic test data

Serial number 16110463
Type of test Db
Operating conditions energized
Power supply 230 V

Test procedure	Duration of exposure (h)	Operating Temperature (°C)	Humidity %	Observations
Correct operation	96	40	93	-
		25	97	-

Requirement

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

Result

The object passed the test.

7.4 Measurement of insulation resistance after dielectric voltage test (before and after the climate test)

Standard and date

Standard IEC 60255-1, Subclause 6.12.2.2

Test date 23 May 2016

Characteristic test data

Serial number 16110463

Test voltage 500 Vdc

Test arrangement		Measurement of resistance	Observations
Voltage applied to	Measurement between	(MΩ)	
Aux. power	All other ports and earth	550	-
Ext. trip	All other ports and earth	550	-
Trip output	All other ports and earth	Not applicable	-
Current transformer	All other ports and earth	550	-

Remarks

Trip output is connected to ground in case output is not activated

Requirement

- the insulation resistance shall not be less than 10 MΩ.
- no visual or functional inspection required.

Result

The object passed the test.

7.5 Dielectric voltage test after climate tests

Standard and date

Standard IEC 60255-1, Subclause 6.12.2.3

Test date 23 May 2016

Characteristic test data

Serial number 16110463

Duration of test 1 min

Test arrangement		Rated insulation voltage (kVdc)	Voltage applied (kVdc)	Observations
Voltage applied to	Measurement between			
Aux. power	All other ports and earth	2,8	2,8	-
Ext. trip	All other ports and earth	2,8	2,8	-
Trip output	All other ports and earth	not applicable	not applicable	-
Current transformer	All other ports and earth	2,8	2,8	-

Remarks

- trip output is connected to ground in case output is not activated.
- it was not possible to perform the AC test because of the capacitors.

Requirement

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

Result

The object passed the test.

8 MECHANICAL ENVIRONMENTAL CONDITION TESTS

8.1 Inspection

8.1.1 Pre-inspection

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

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

- analogue inputs
- digital input
- contact output.

8.1.2 Visual and functional inspection

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

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

There shall be no:

- deformation of modules or components.
- interruptions or damage on interconnecting cables, wires and connectors.

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

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

There shall be no:

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

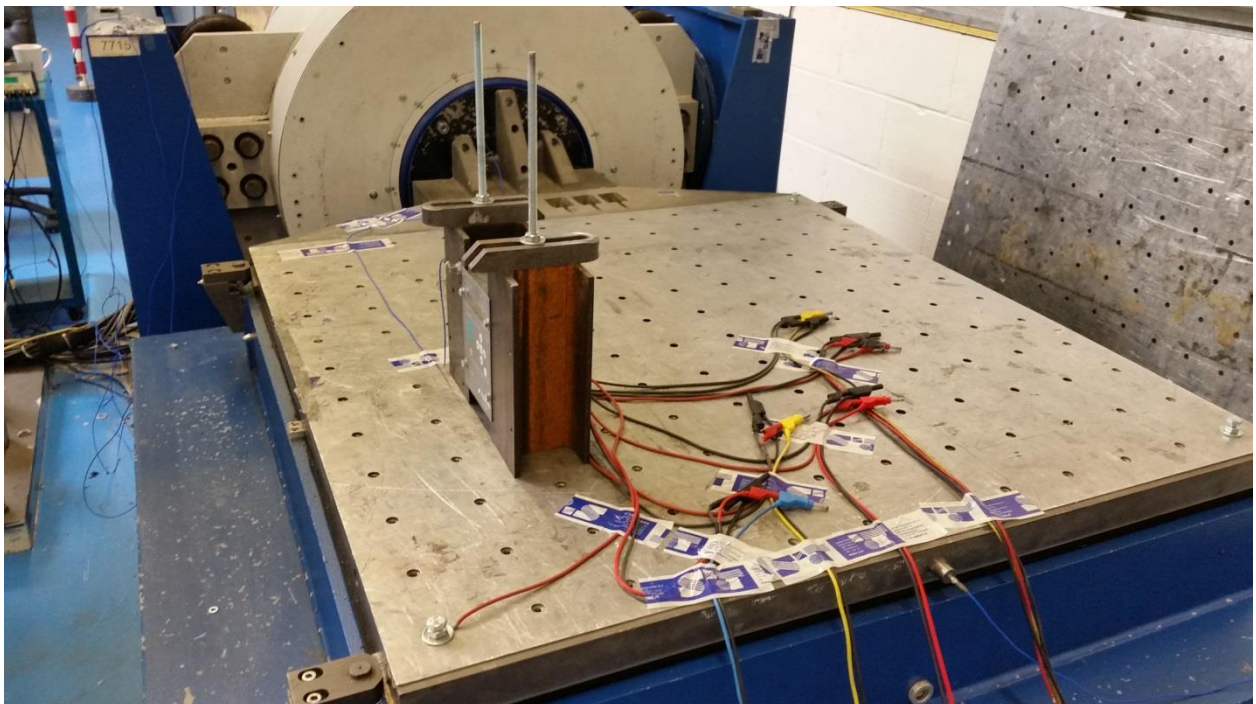
Unless otherwise stated the visual and functional inspection was carried out successfully after each test.

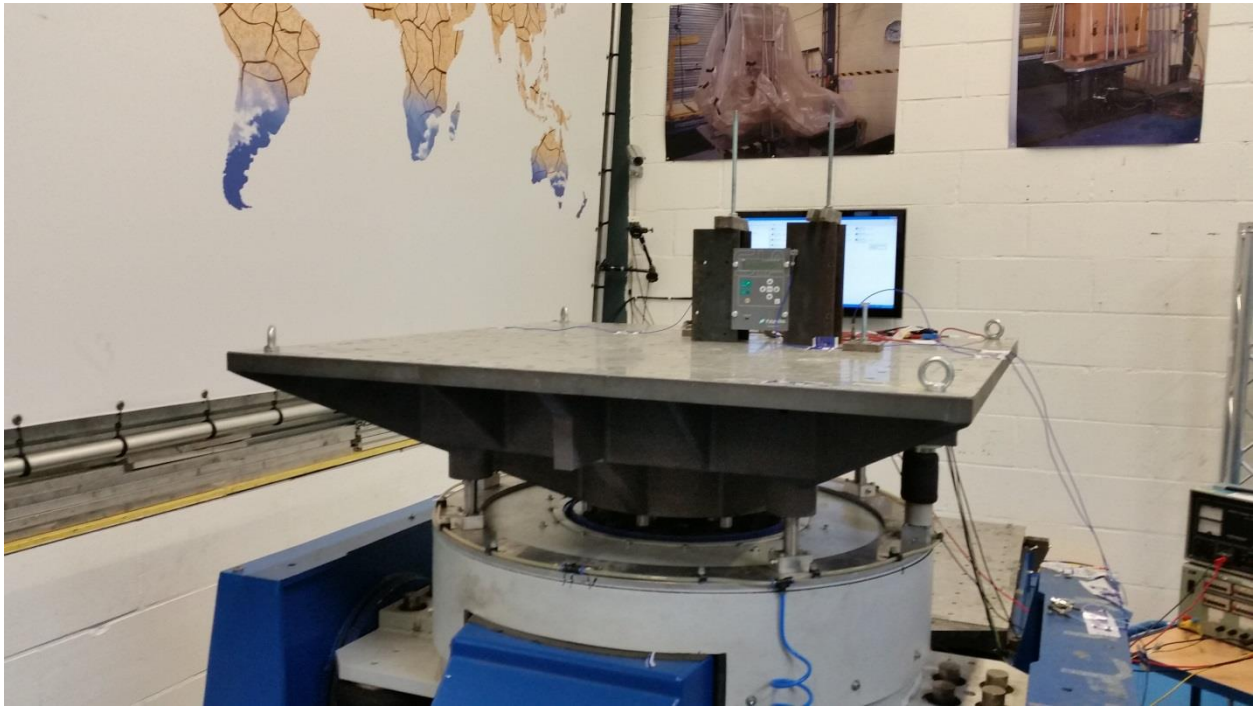
8.2 Photographs of test arrangement

Test arrangement horizontal longitudinal direction



Test arrangement horizontal transversal direction



Test arrangement vertical direction

8.3 Vibration response test

Standard and date

Standard IEC 60255-1, Subclause 6.13

Test date 18 to 20 April 2016

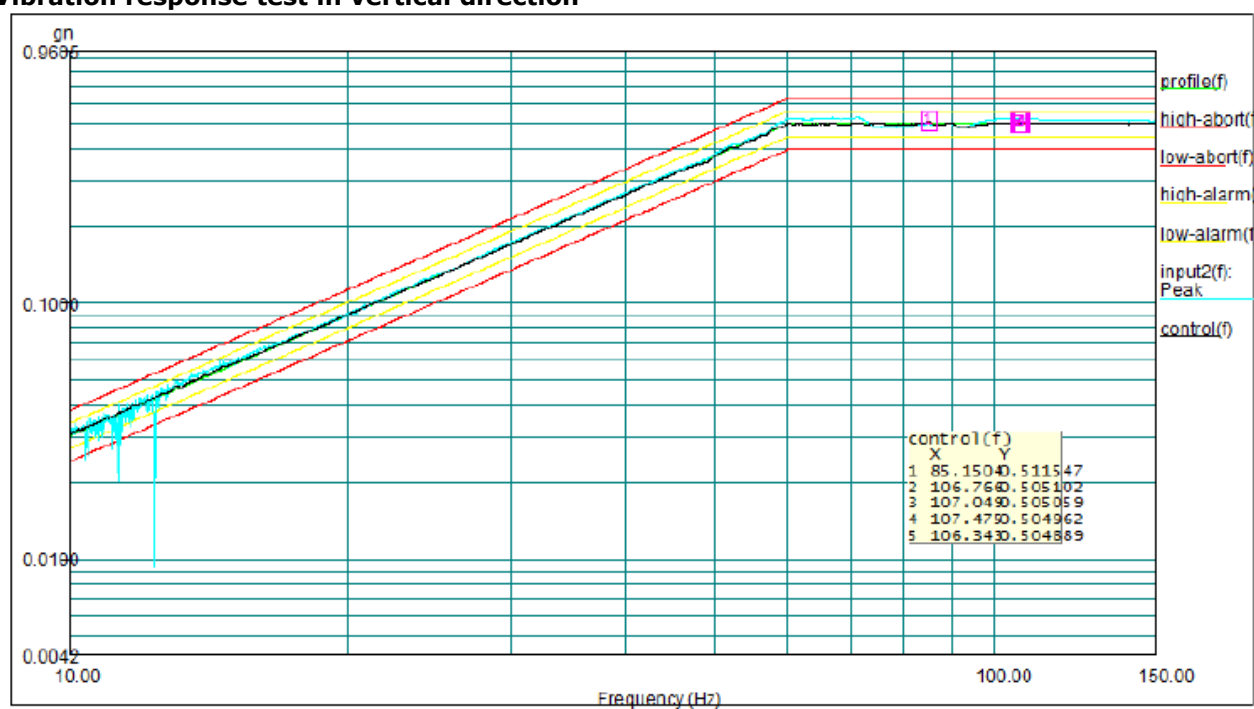
Environmental conditions

Ambient temperature 24,8 °C

Characteristic test data

Serial Number 16110472
Test object energized
Power supply 230 Vac
CT input 40 A
Frequency range 10 to 150 Hz
Displacement 0,035 mm
Acceleration 0,5 g
Number of sweep cycles 1
in each axis
Number of axis 3

Vibration response test in vertical direction



Observations

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

Requirement

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

Result

The object passed the test.

8.4 Vibration endurance test

Standard and date

Standard IEC 60255-1, Subclause 6.13

Test date 18 to 20 April 2016

Environmental conditions

Ambient temperature 24,8 °C

Characteristic test data

Serial Number 16110472

Test object non-energized

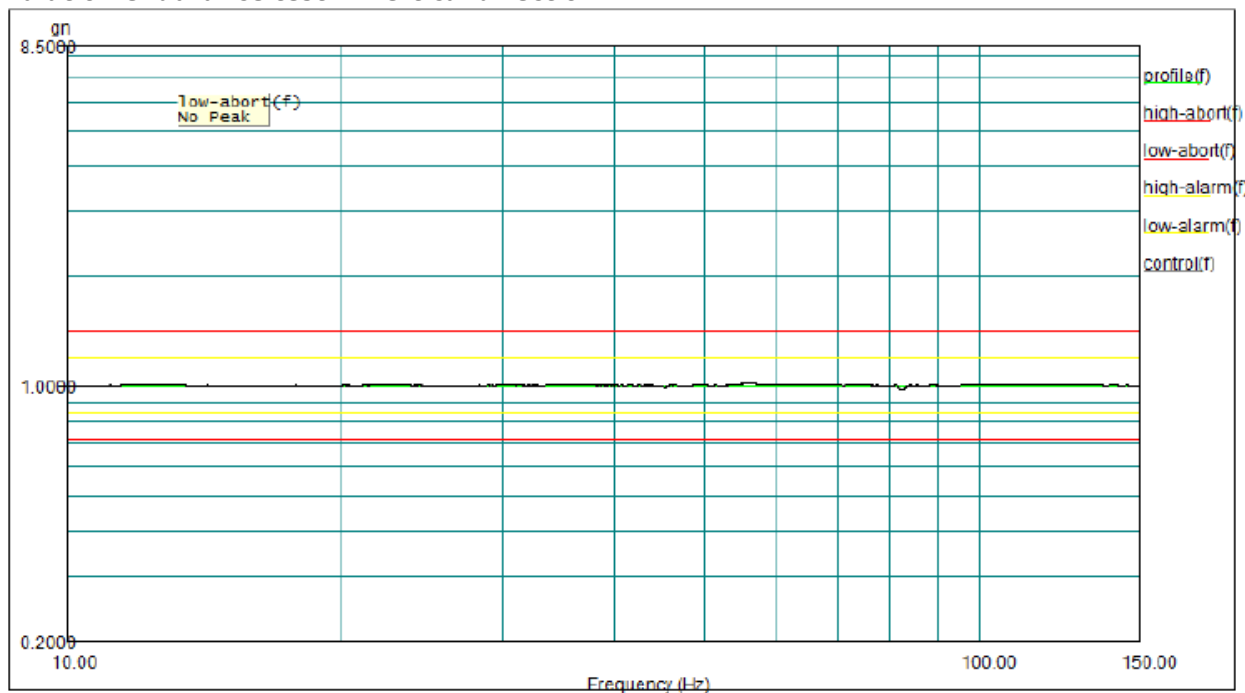
Frequency range 10 to 150 Hz

Acceleration 1 g

Number of sweep cycles 20
in each axis

Number of axis 3

Vibration endurance test in vertical direction



Observations

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

Requirement

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

Result

The object passed the test.

8.5 Shock response test

Standard and date

Standard IEC 60255-1, Subclause 6.13

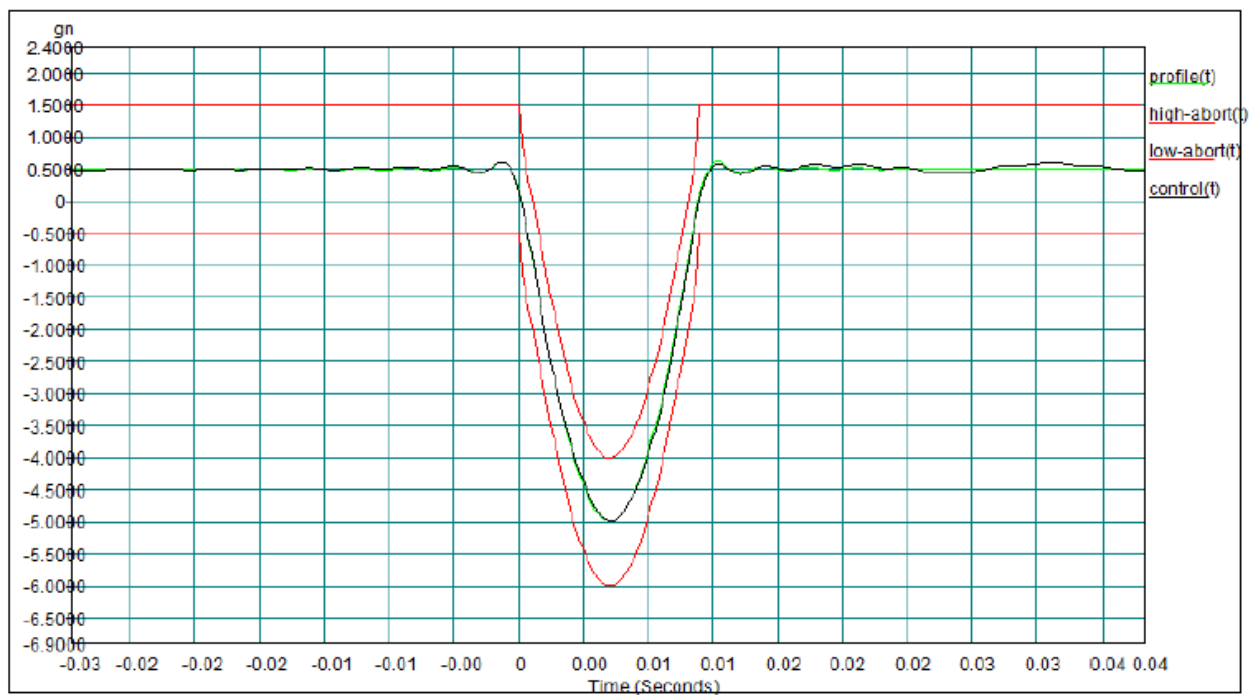
Test date 18 to 20 April 2016

Environmental conditions

Ambient temperature 24,8 °C

Characteristic test data

Serial Number	16110472
Test object	energized
Power supply	230 Vac
CT input	40 A
Acceleration	5 g
Duration of pulses	11 ms
Number of pulses in each axis	6
Number of axis	3



Observations

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

Requirement

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

Result

The object passed the test.

8.6 Shock withstand test

Standard and date

Standard IEC 60255-1, Subclause 6.13

Test date 18 to 20 April 2016

Environmental conditions

Ambient temperature 24,8 °C

Characteristic test data

Serial Number 16110472

Test object non-energized

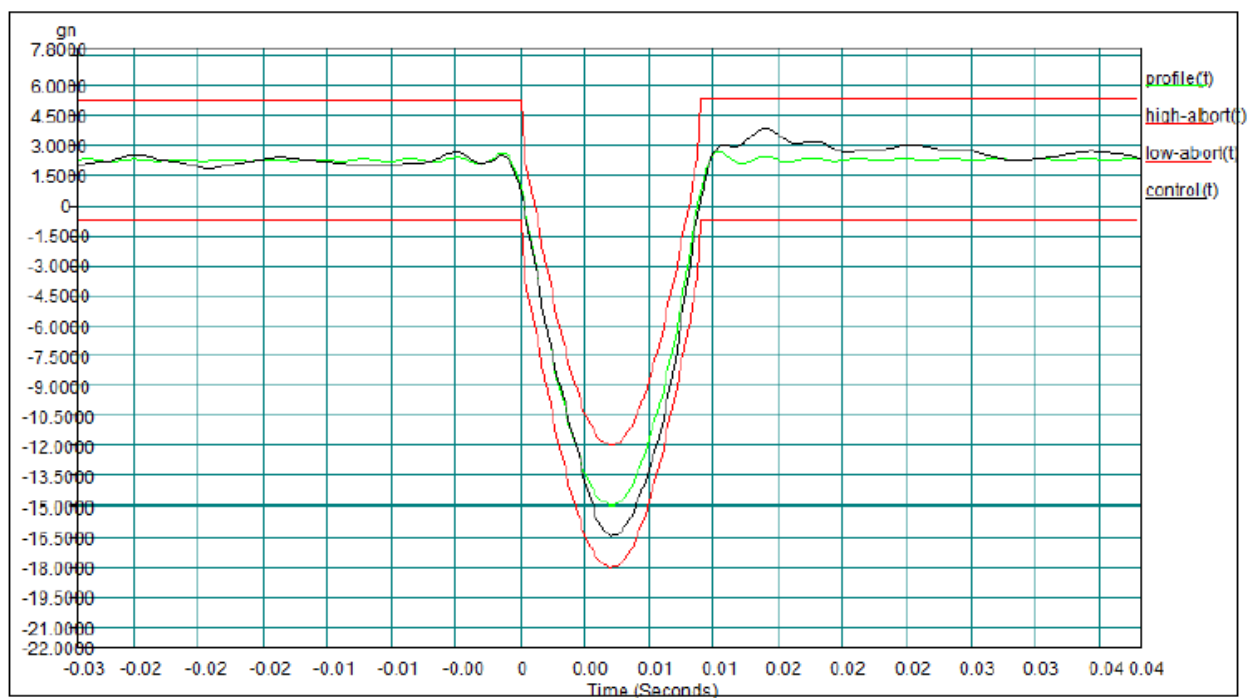
Acceleration 15 g

Duration of pulses 11 ms

Number of pulses in each 6

axis

Number of axis 3



Observations

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

Requirement

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

Result

The object passed the test.

8.7 Bump test

Standard and date

Standard IEC 60255-1, Subclause 6.13

Test date 18 to 20 April 2016

Environmental conditions

Ambient temperature 24,8 °C

Characteristic test data

Serial Number 16110472

Test object non-energized

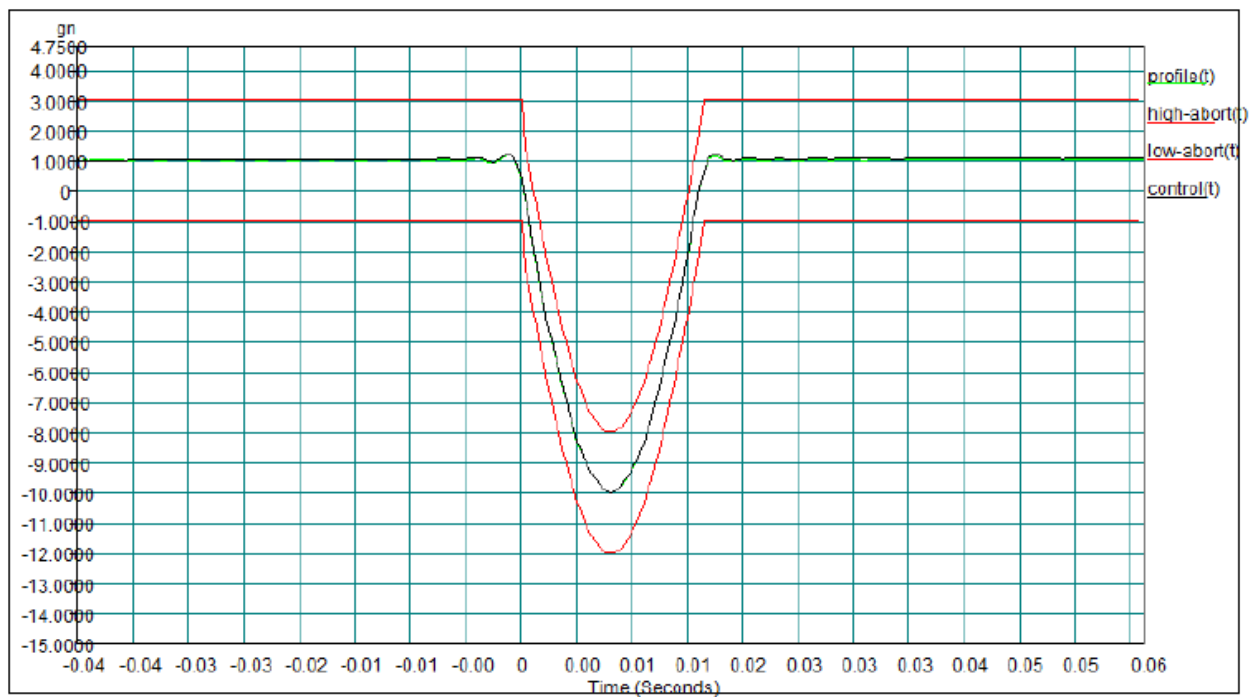
Power supply 230 Vac

Acceleration 10 g

Duration of pulses 16 ms

Number of pulses in each axis 2000

Number of axis 3



Observations

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

Requirement

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

Result

The object passed the test.

8.8 Single axis sine sweep seismic test

Standard and date

Standard IEC 60255-1, Subclause 6.13

Test date 18 to 20 April 2016

Environmental conditions

Ambient temperature 24,8 °C

Characteristic test data

Serial Number 16110472

Test object Energized

Power supply 230 Vac

CT input 40 A

Frequency range 1 to 35 Hz (the start frequency tolerance is 1 Hz +3 Hz)

Cross-over frequency 8 to 9 Hz

Displacement horizontal axis (x) 3,5 mm

Displacement vertical axis (y) 1,5 mm

Acceleration horizontal axis (x) 1,0 g

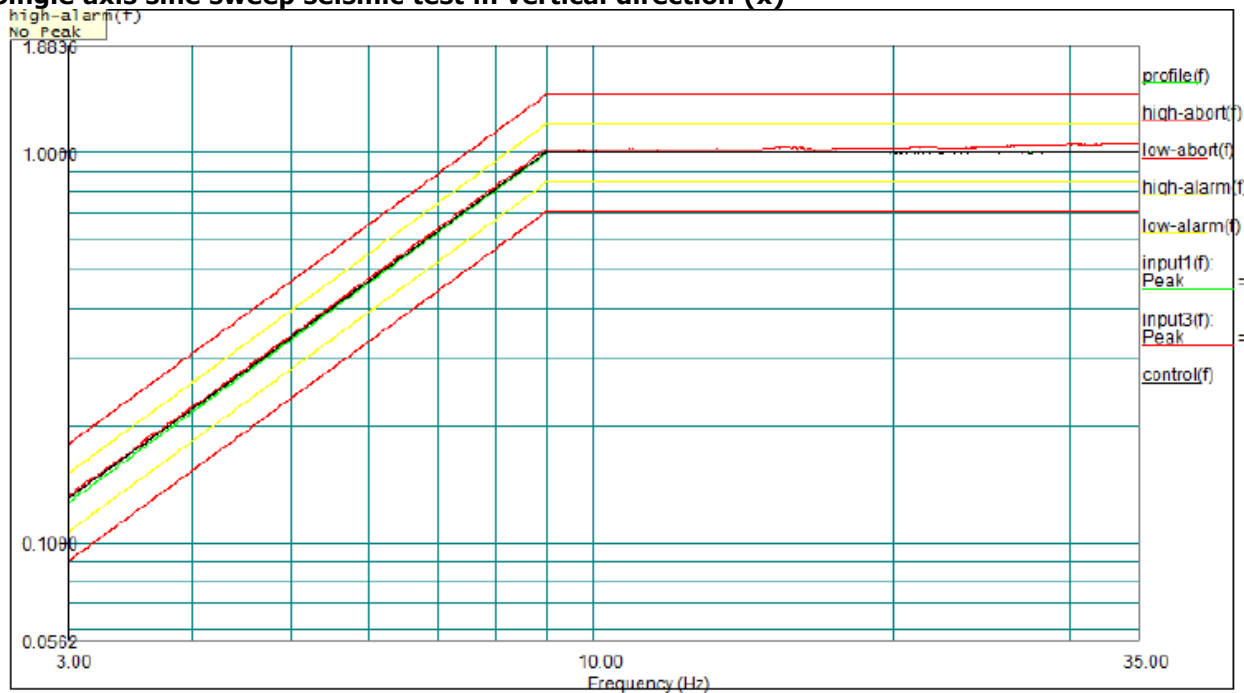
Acceleration vertical axis (y) 0,5 g

Number of sweep cycles 1

in each axis

Number of axis 3

Single axis sine sweep seismic test in vertical direction (x)



Observations

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

Requirement

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

Result

The object passed the test.

9 ELECTROMAGNETIC COMPATIBILITY

9.1 Inspection

9.1.1 Pre-inspection

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

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

- analogue inputs
- digital input
- contact output.

9.1.2 Visual and functional inspection

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

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

There shall be no:

- burning of any components.
- interruptions or damage on interconnecting cables, wires and connectors.

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

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

There shall be no:

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

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

9.2 Radiated emission

Standard and date

Standard IEC 60255-1, Subclause 6.15

Test date 19 April 2016

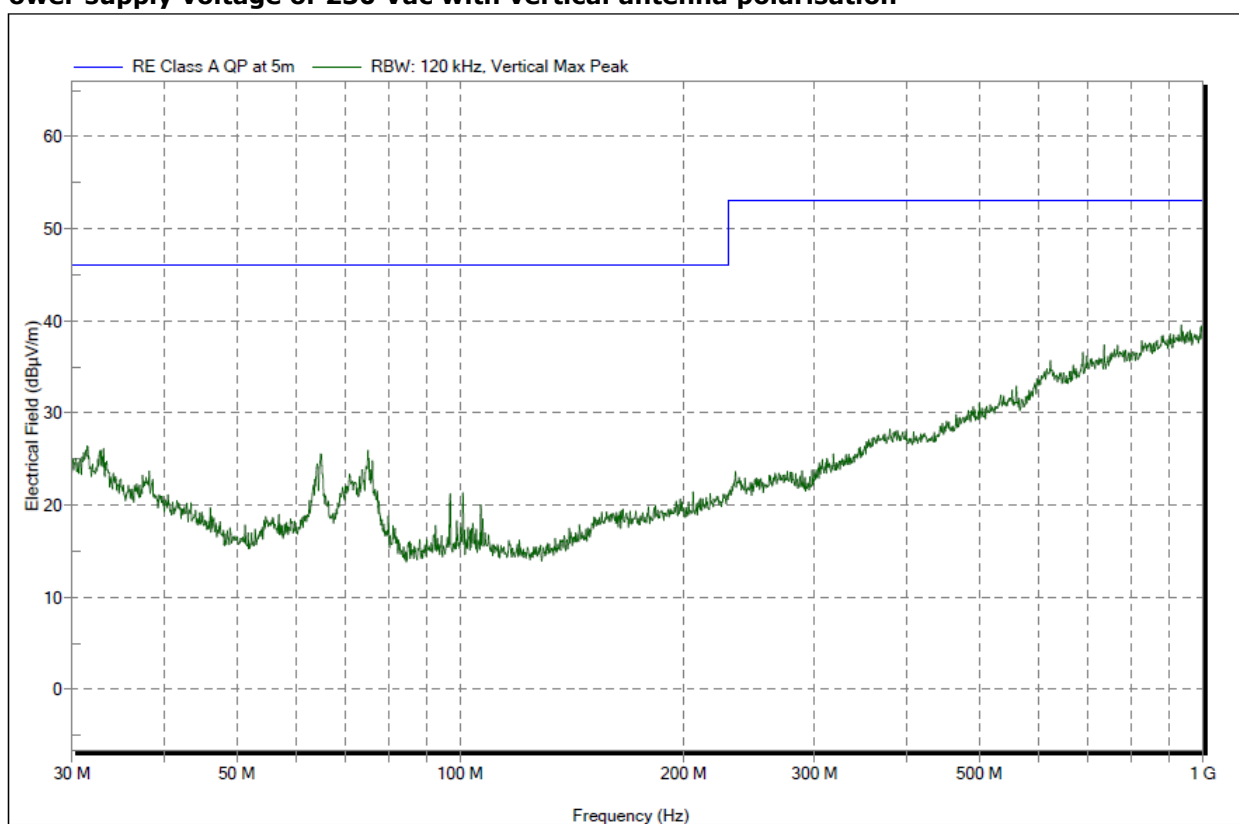
Environmental conditions

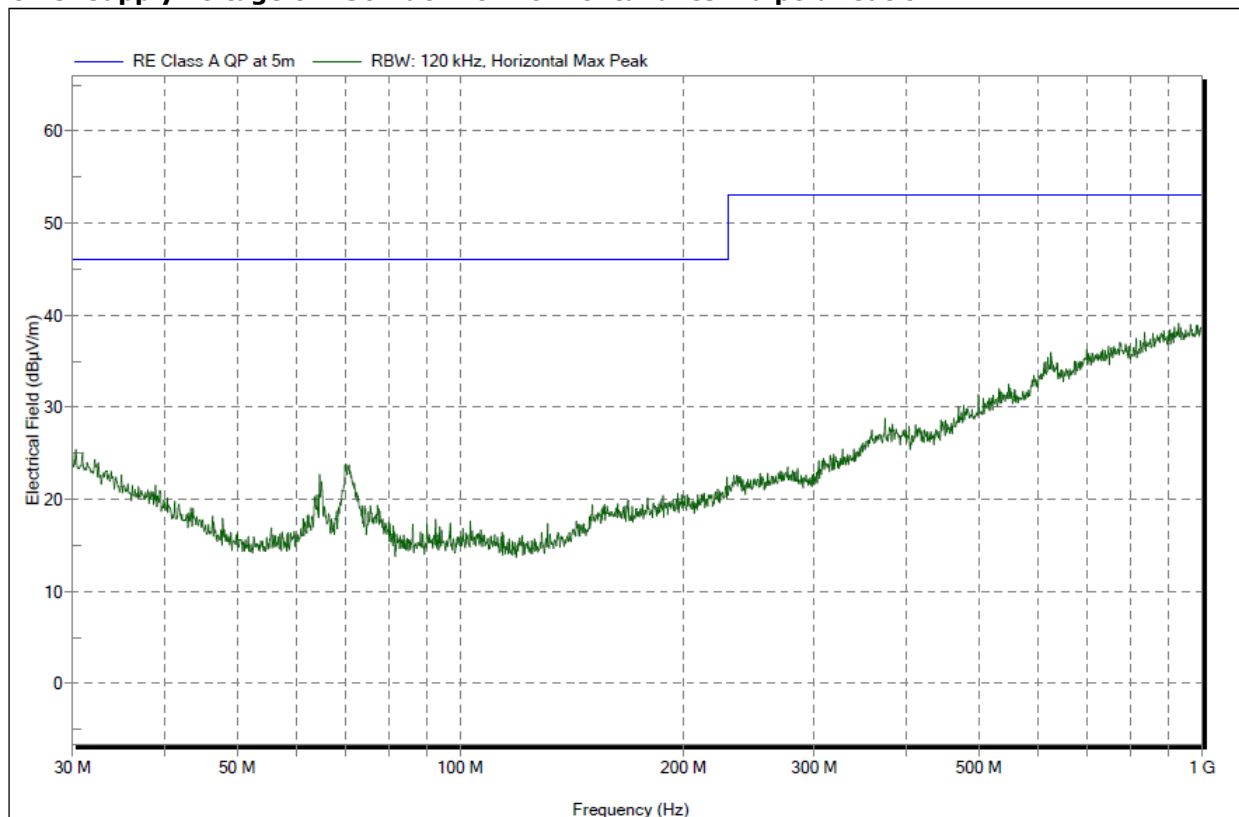
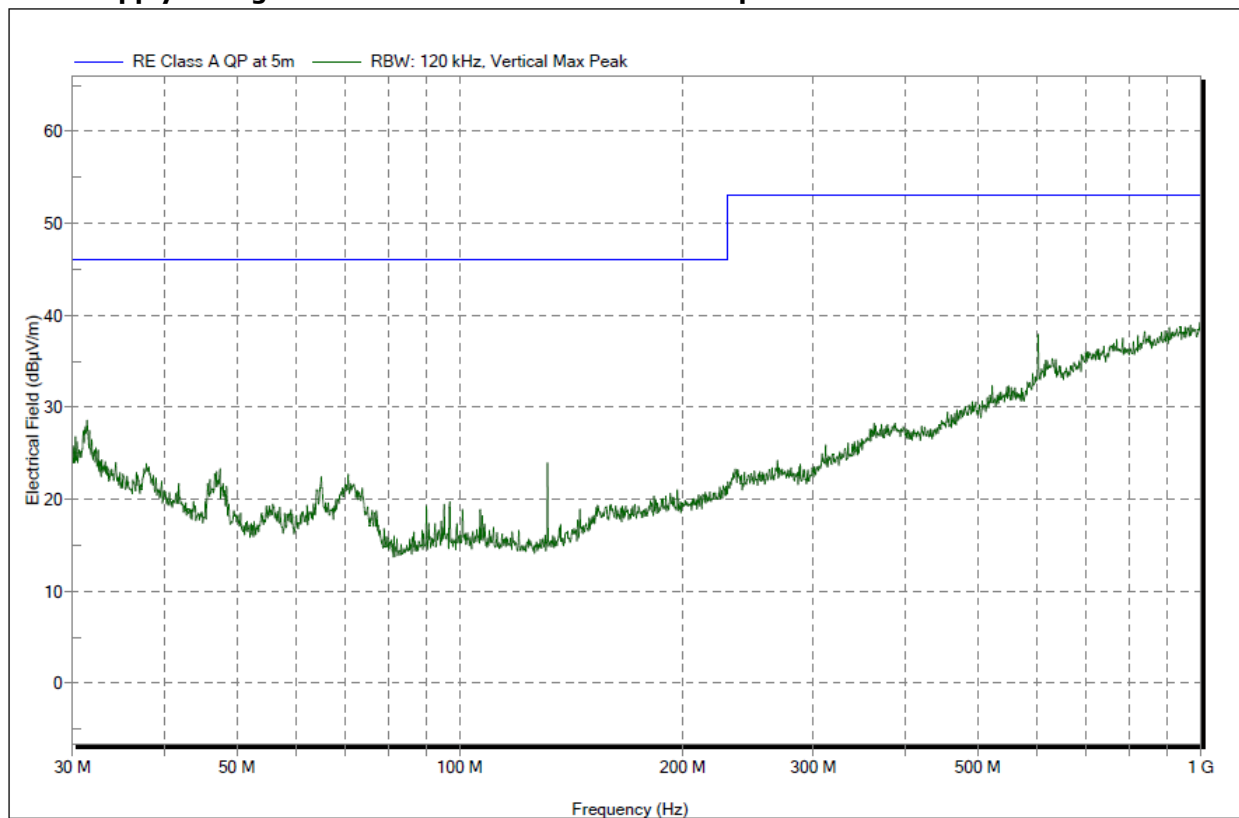
Ambient temperature 22 °C

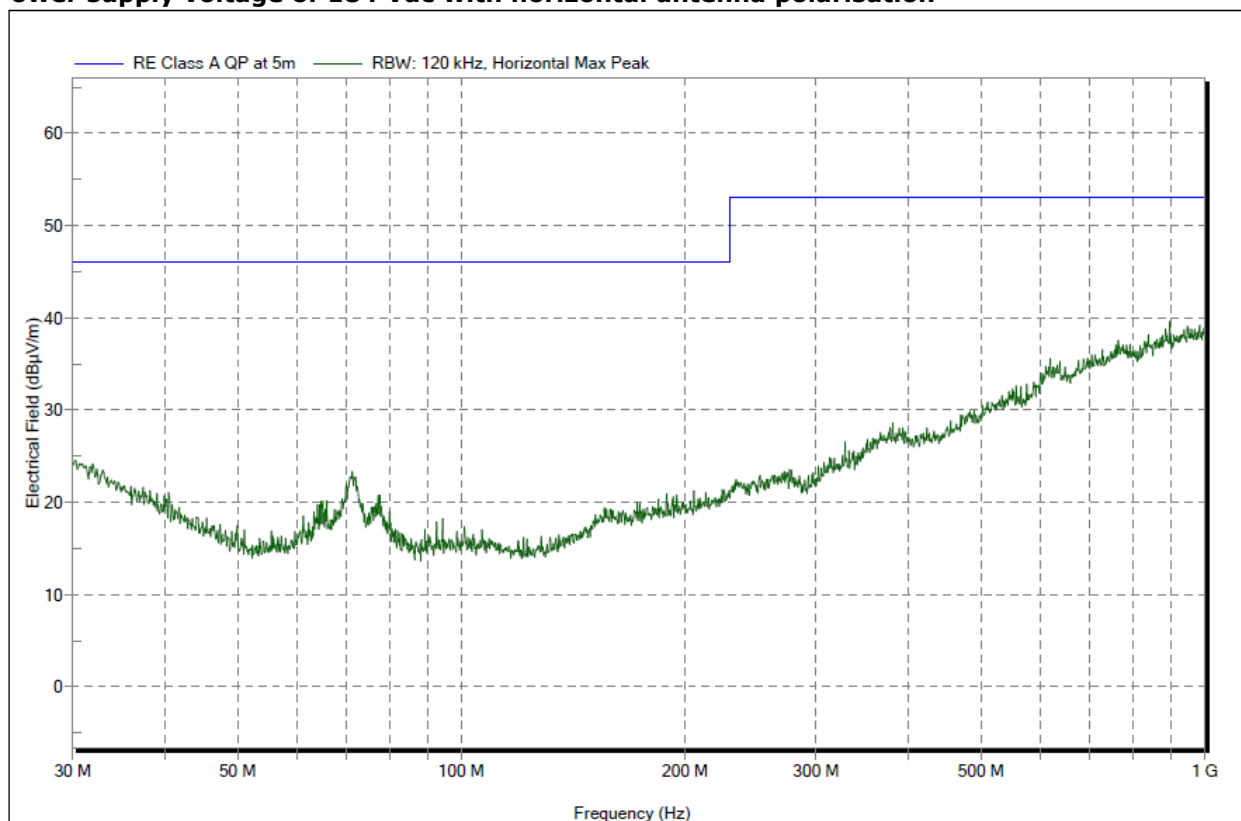
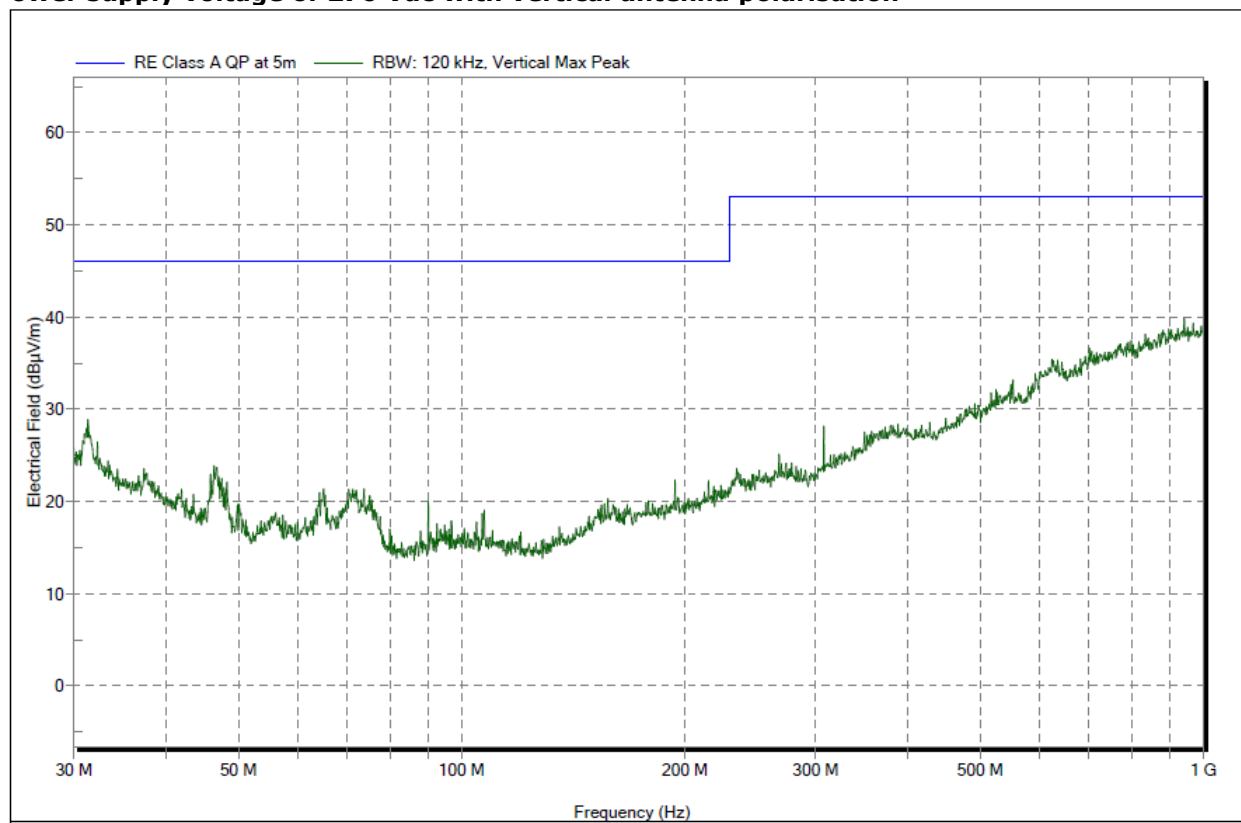
Characteristic test data

Serial number 16110472

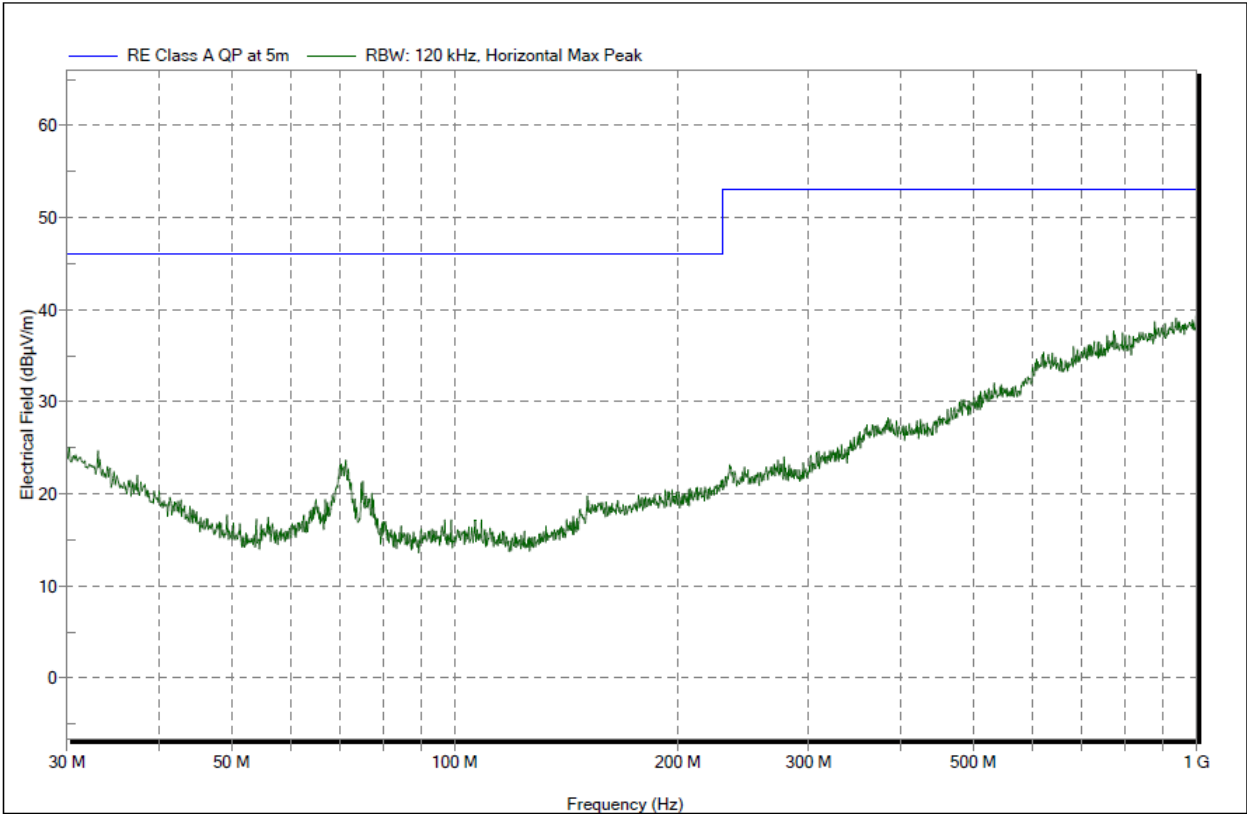
Power supply voltage of 230 Vac with vertical antenna polarisation



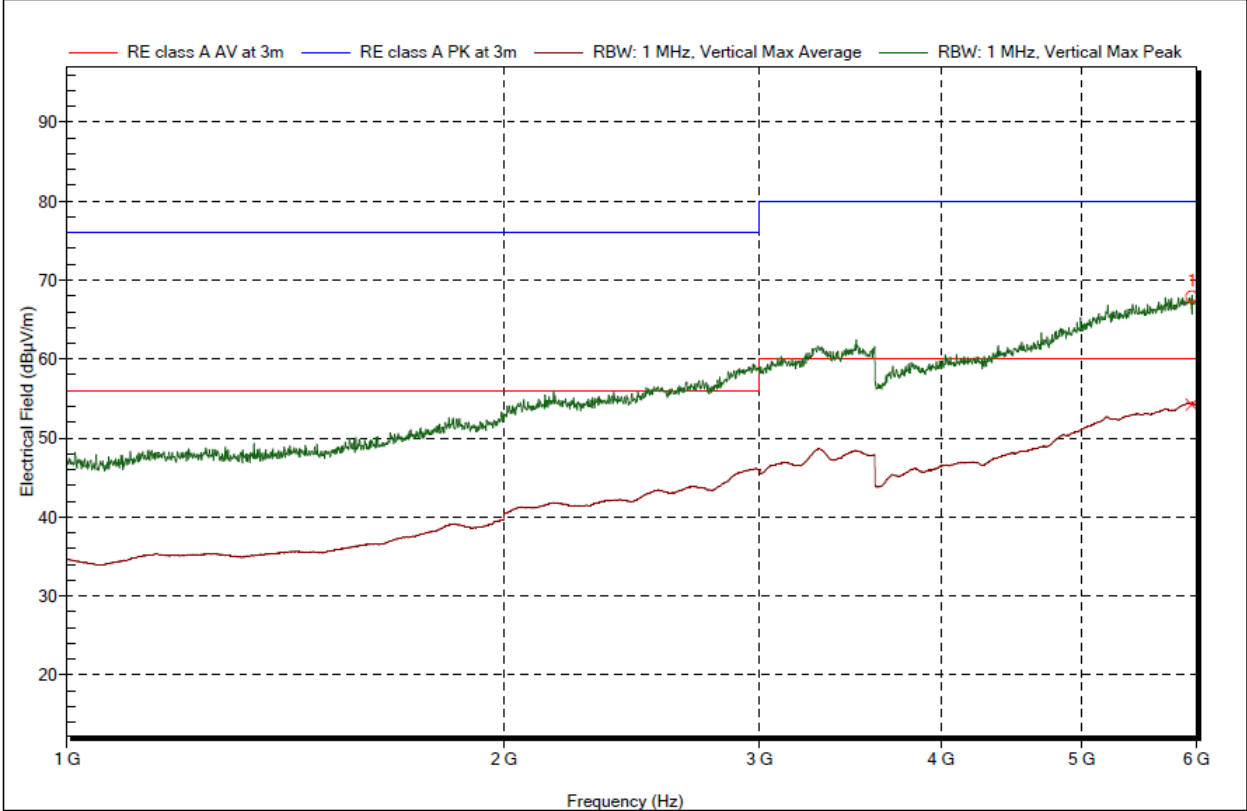
Power supply voltage of 230 Vac with horizontal antenna polarisation**Power supply voltage of 184 Vac with vertical antenna polarisation**

Power supply voltage of 184 Vac with horizontal antenna polarisation**Power supply voltage of 276 Vac with vertical antenna polarisation**

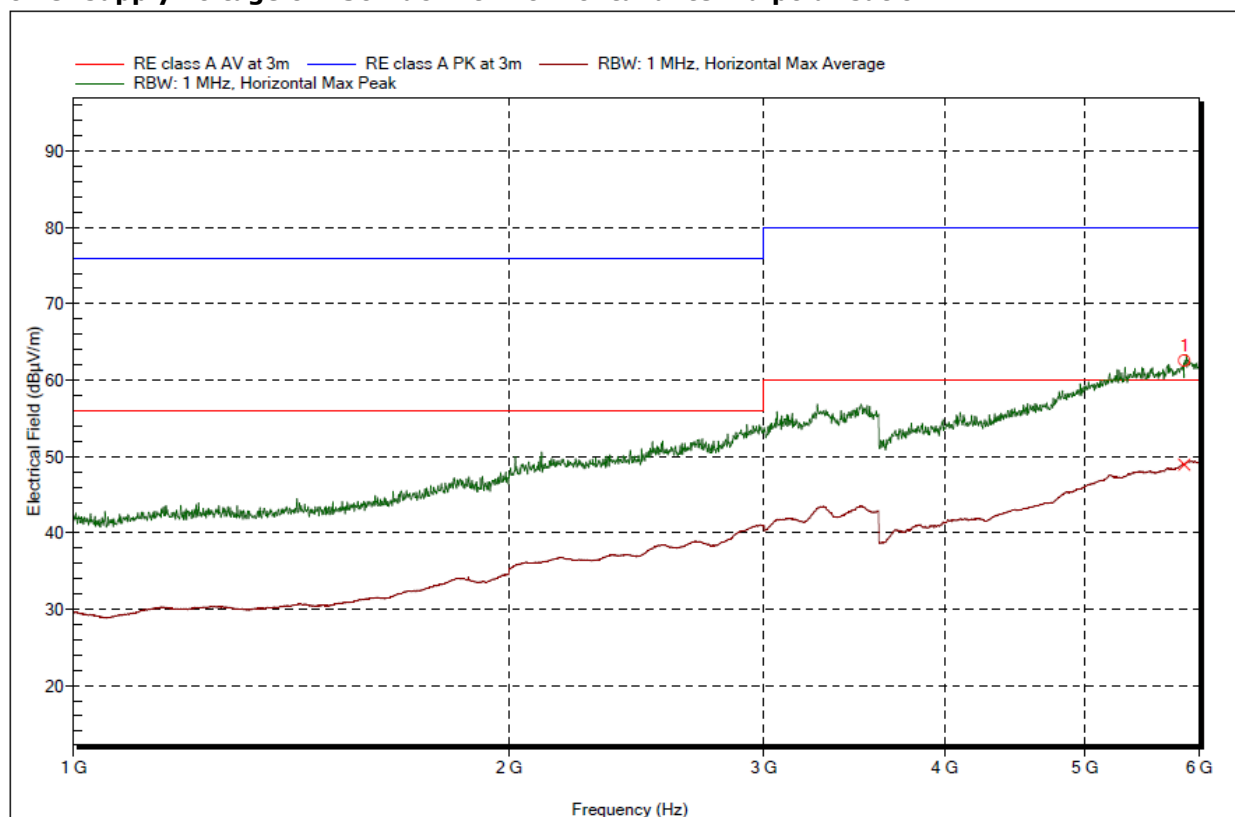
Power supply voltage of 276 Vac with horizontal antenna polarisation



Power supply voltage of 230 Vac with Vertical antenna polarisation



Power supply voltage of 230 Vac with horizontal antenna polarisation



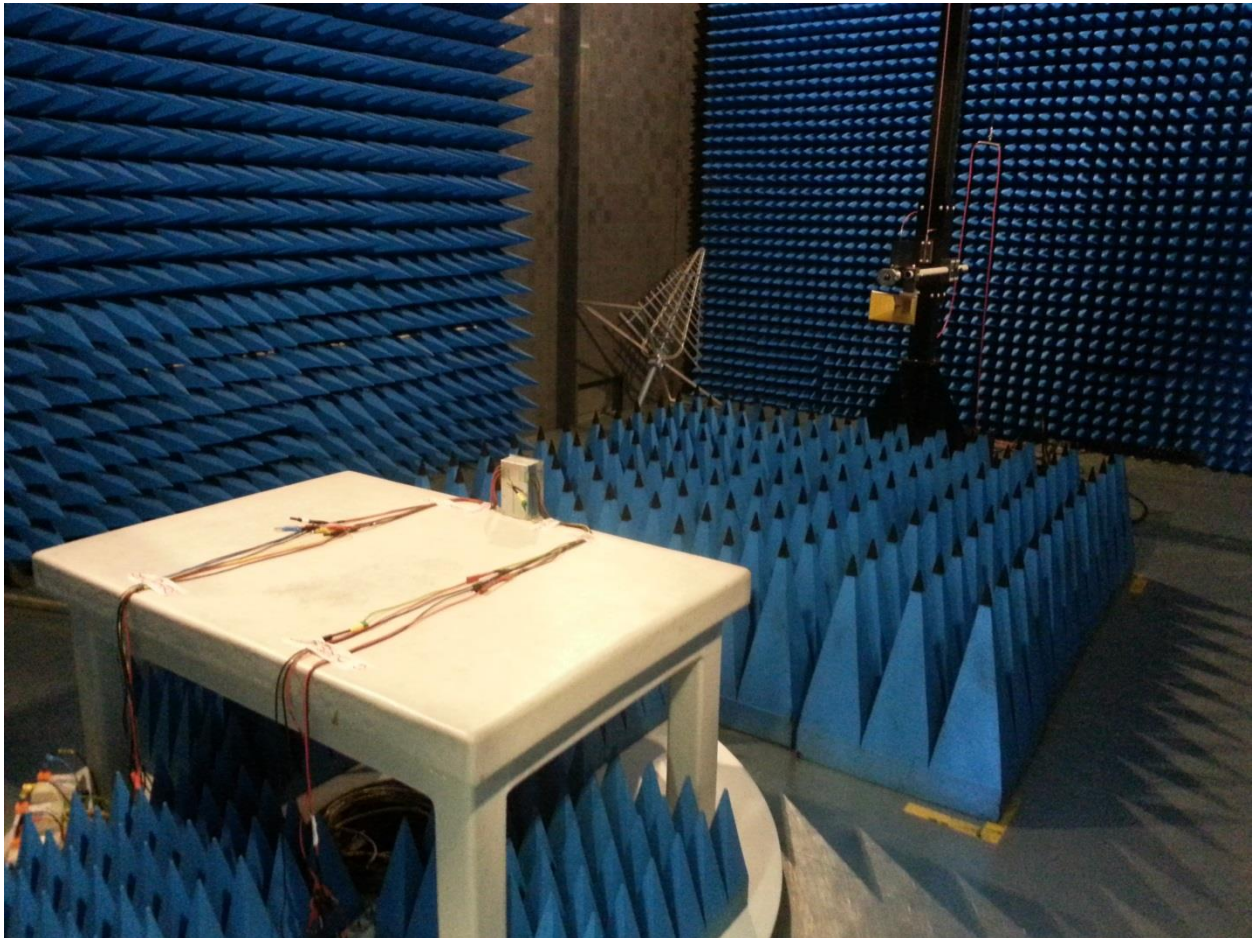
Requirement

30 MHz to 230 MHz	40 dB(μ V/m) quasi peak at 10 m 50 dB(μ V/m) quasi peak at 3 m
230 MHz to 1000 MHz	47 dB(μ V/m) quasi peak at 10 m 57 dB(μ V/m) quasi peak at 3 m
1 GHz to 3 GHz	56 dB(μ V/m) average 76 dB(μ V/m) peak at 3 m
3 GHz to 6 GHz	60 dB(μ V/m) average 80 dB(μ V/m) peak at 3 m

Result

The object passed the test.

Photograph of test arrangement (1 – 6 GHz)



9.3 Conducted emission

Standard and date

Standard IEC 60255-1, Subclause 6.15

Test date 20 April 2016

Environmental conditions

Ambient temperature 22 °C

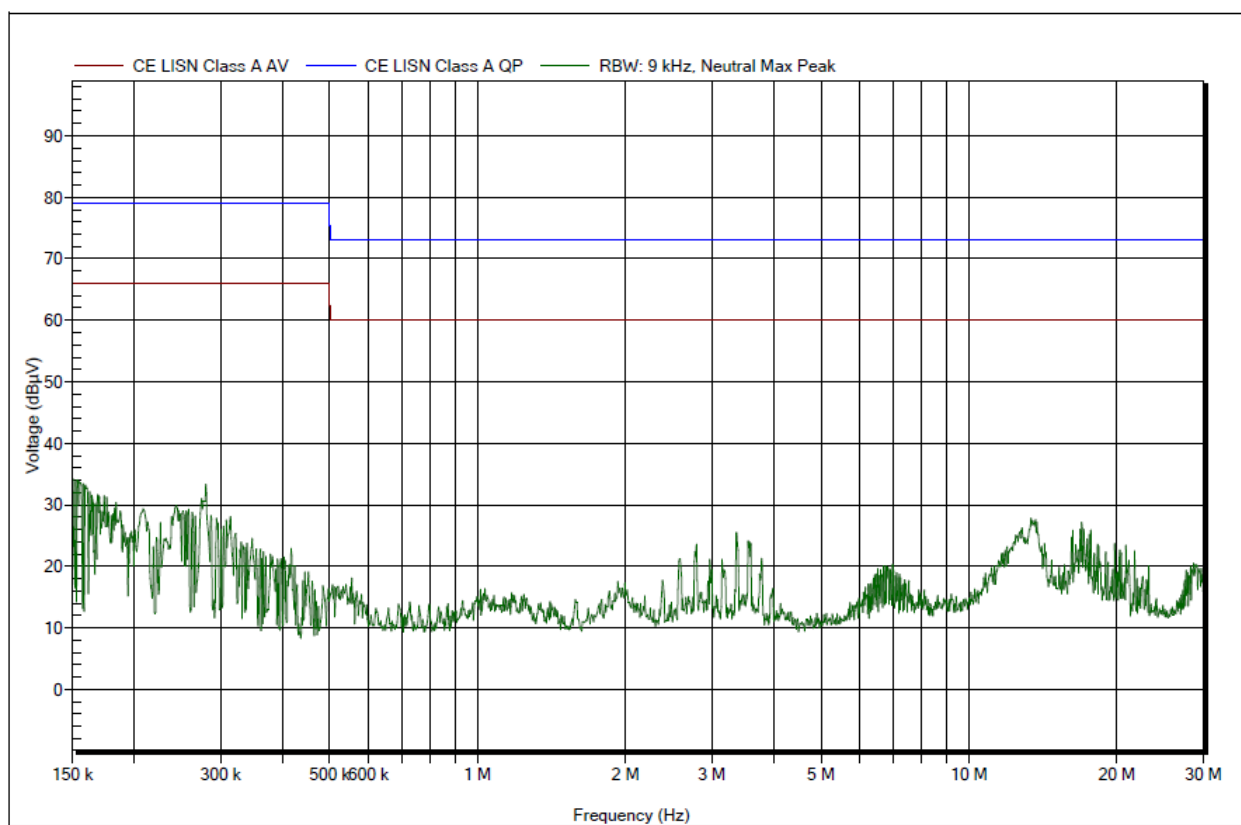
Characteristic test data

Serial number 16110472

Power supply 230 Vac

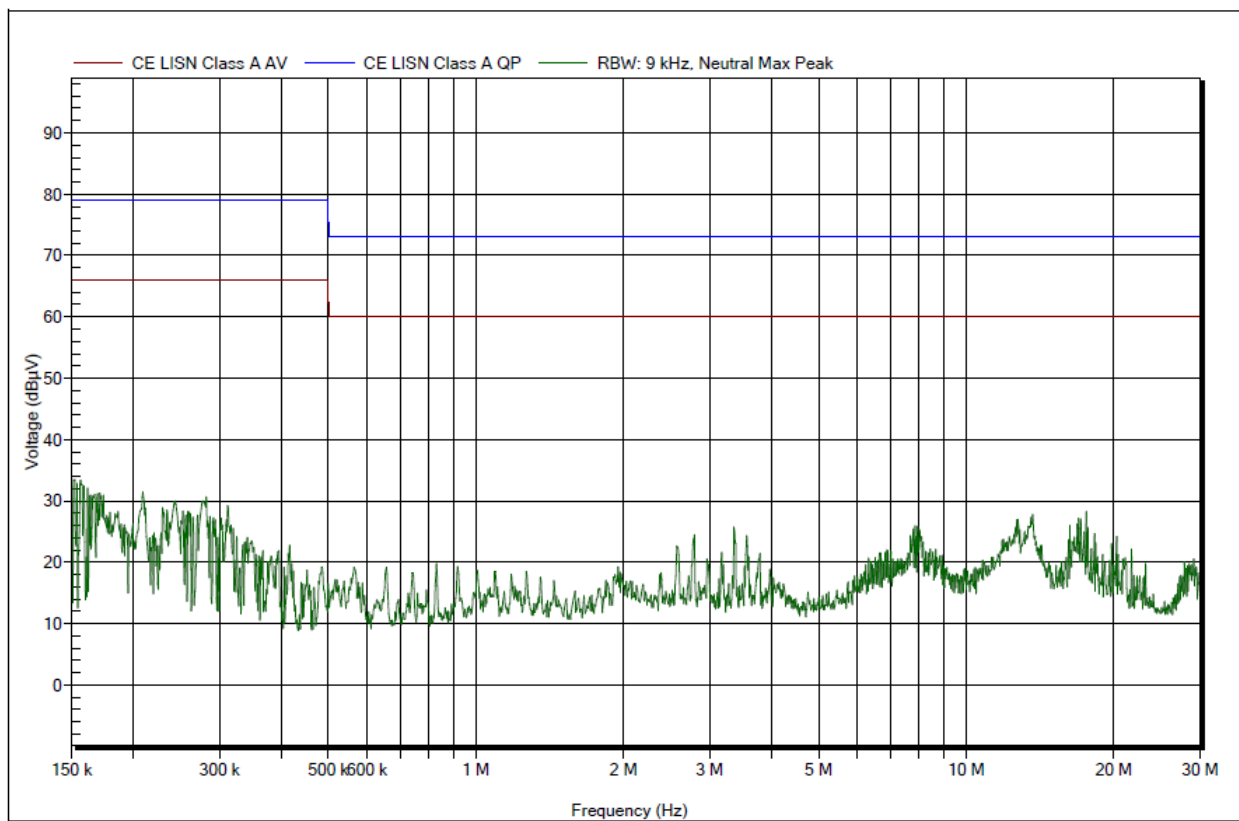
Line Neutral

Current transformers off



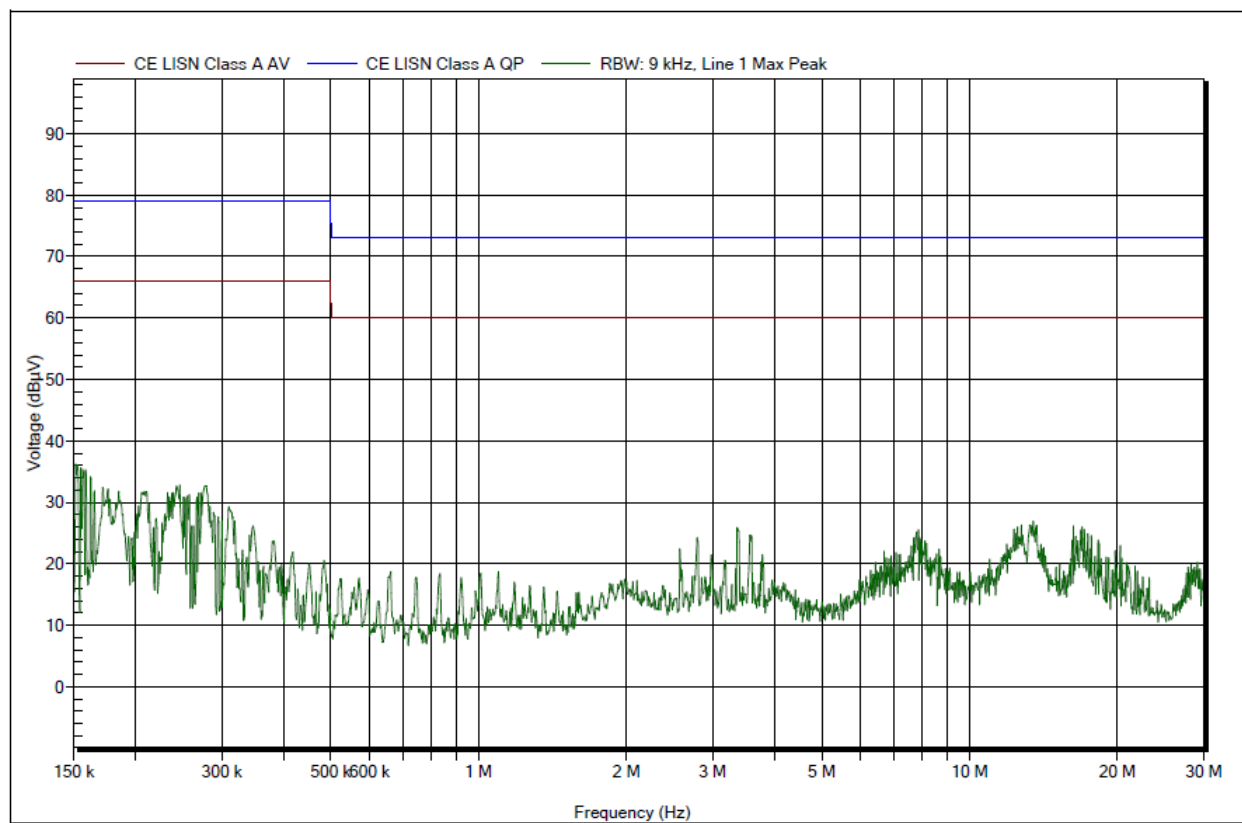
Characteristic test data

Serial number 16110472
Power supply 230 Vac
Line Neutral
Current transformers powered



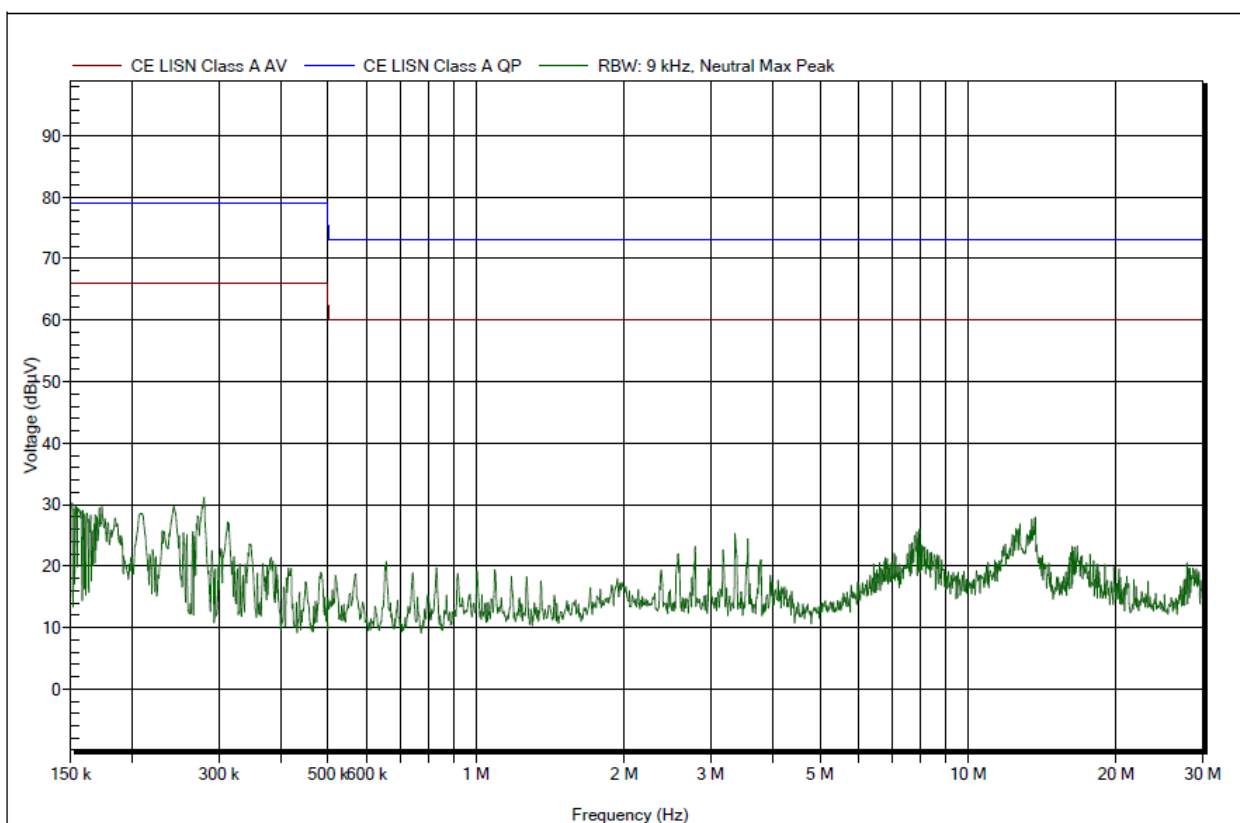
Characteristic test data

Serial number 16110472
Power supply 230 Vac
Line Neutral
Current transformers powered



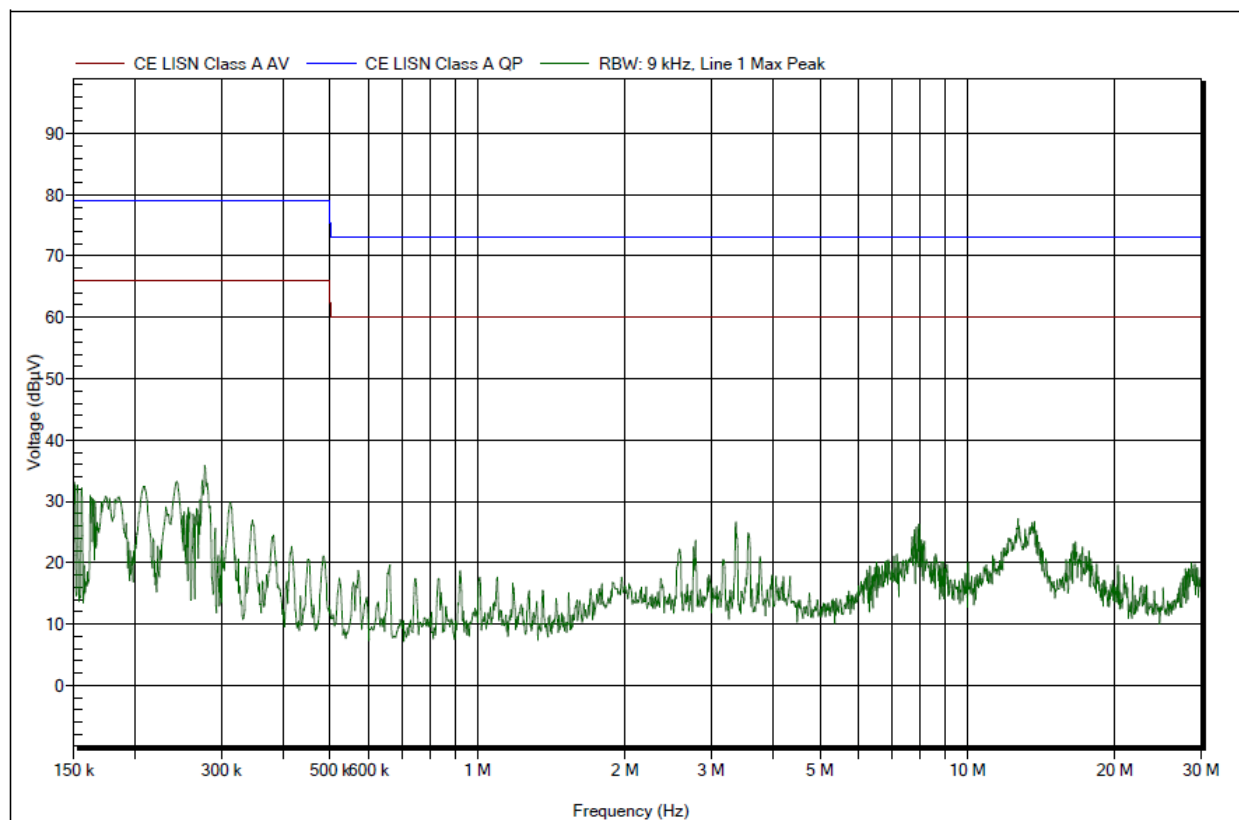
Characteristic test data

Serial number 16110472
Power supply 184 Vac
Line Neutral
Current transformers powered



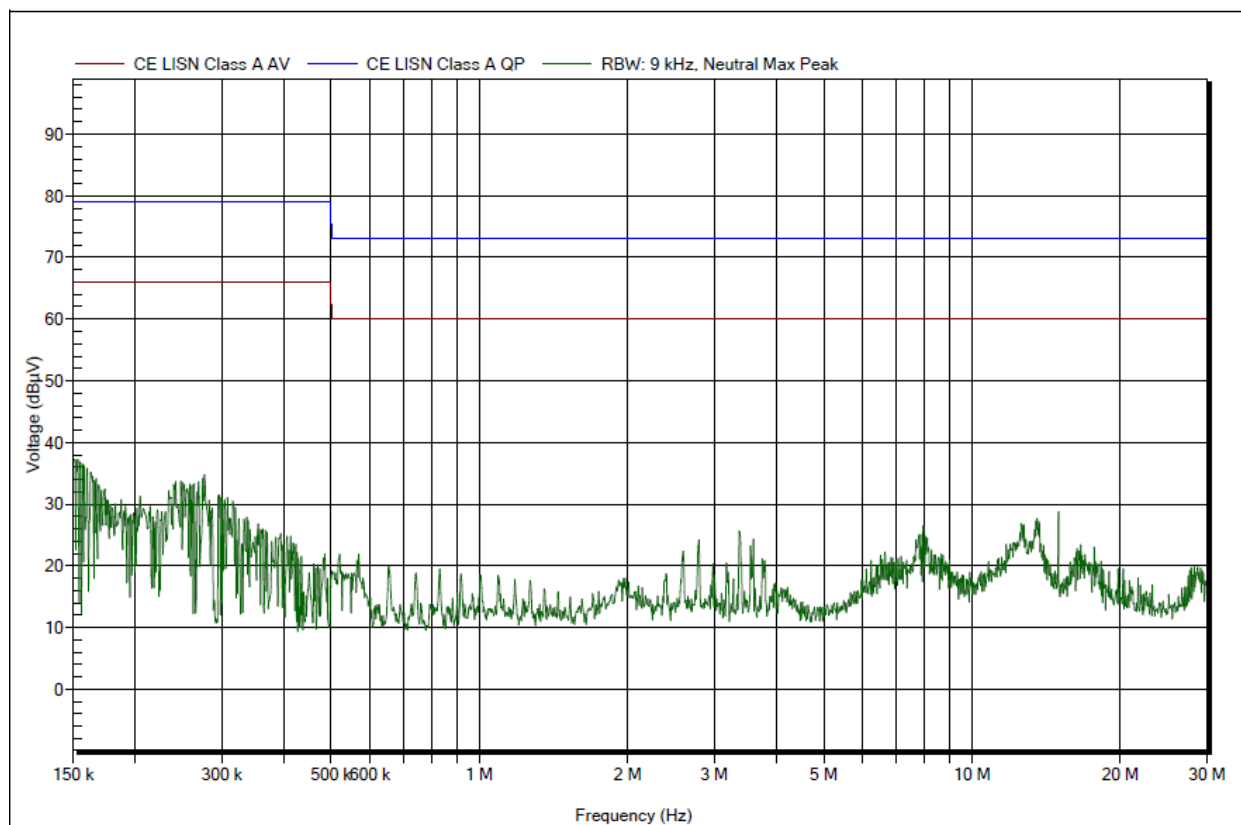
Characteristic test data

Serial number 16110472
Power supply 184 Vac
Line Line 1
Current transformers powered



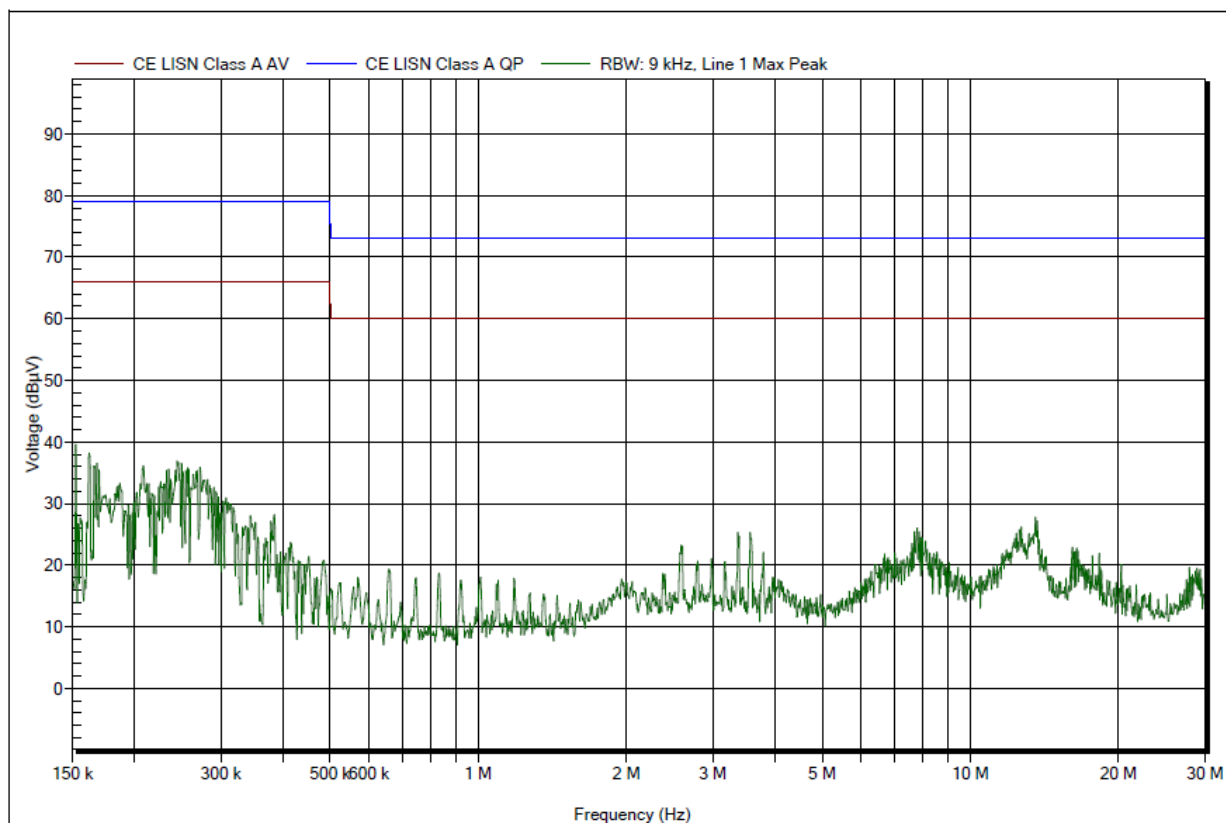
Characteristic test data

Serial number	16110472
Power supply	276 Vac
Line	Neutral
Current transformers	powered



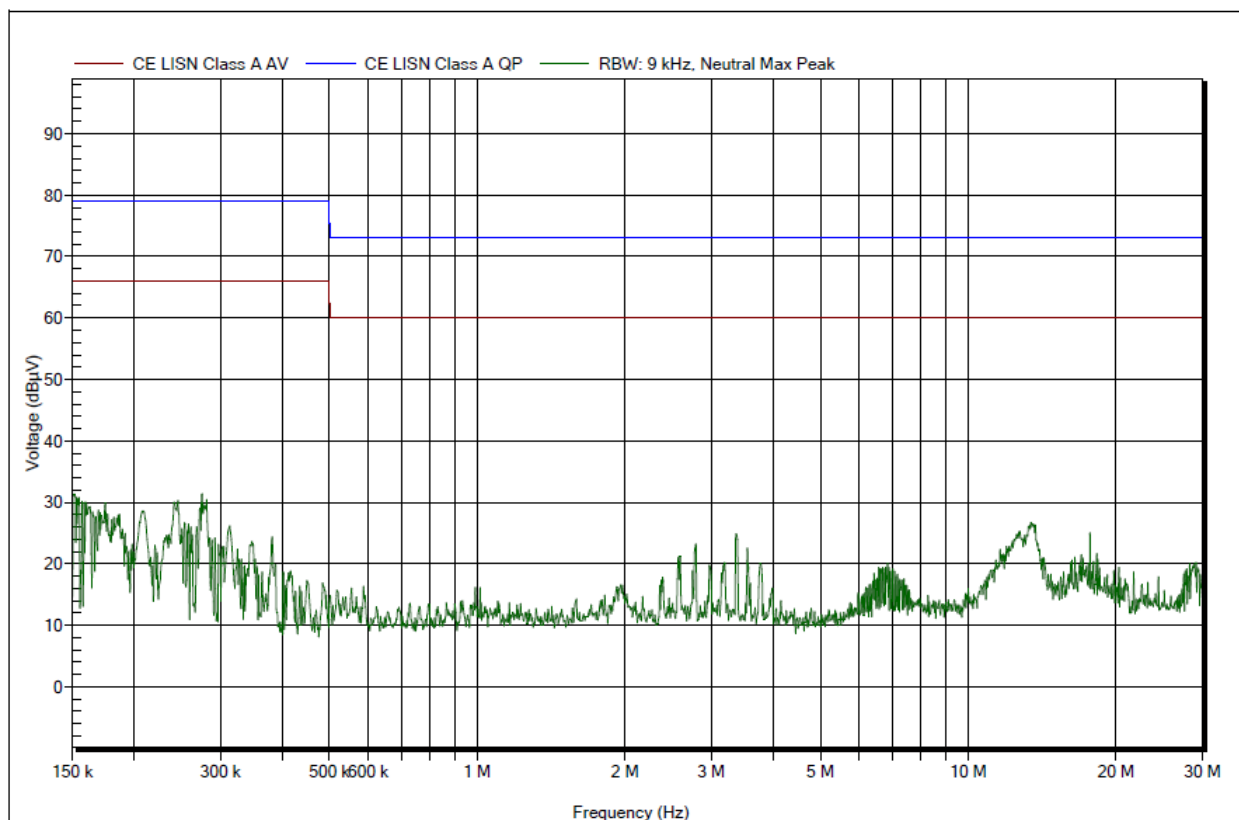
Characteristic test data

Serial number 16110472
Power supply 276 Vac
Line Line 1
Current transformers powered



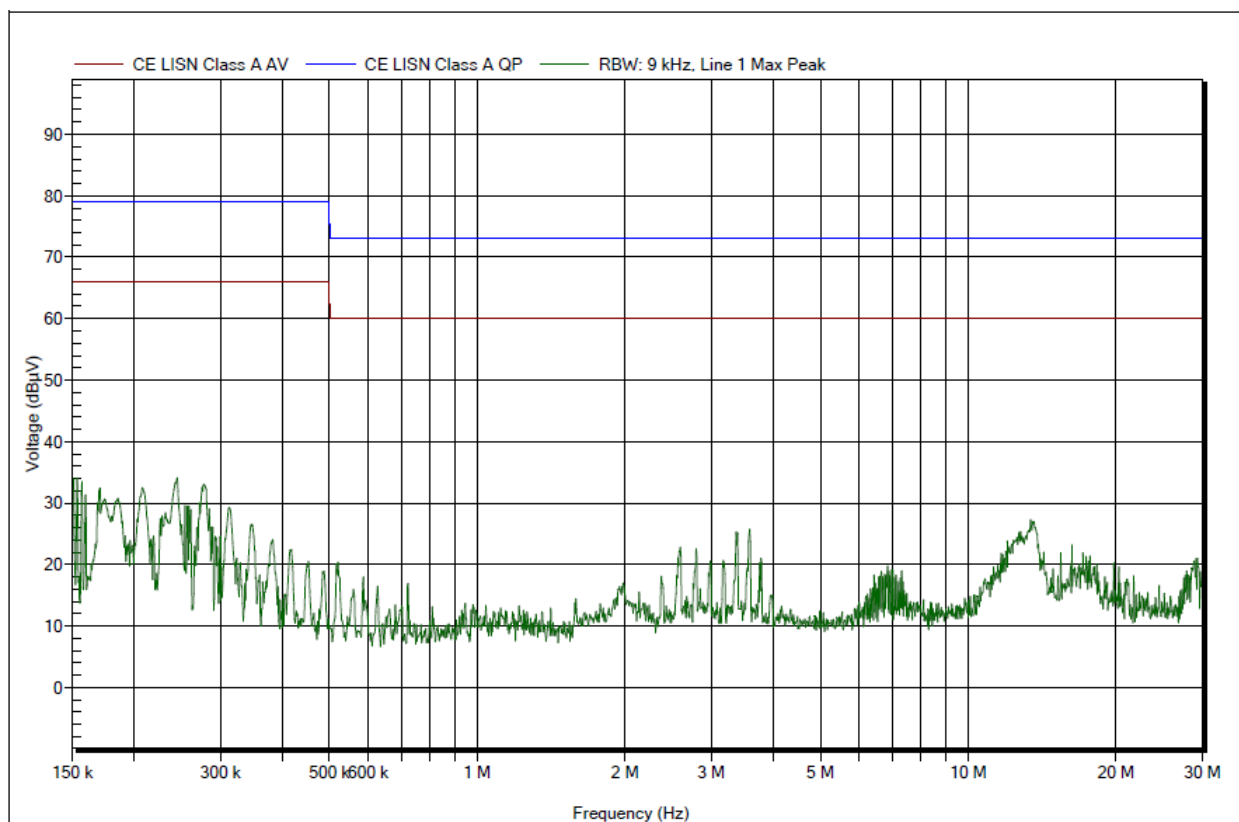
Characteristic test data

Serial number 16110472
Power supply 184 Vac
Line Neutral
Current transformers powered



Characteristic test data

Serial number 16110472
Power supply 184 Vac
Line Neutral
Current transformers Off



Characteristic test data

Serial number

16110472

Power supply

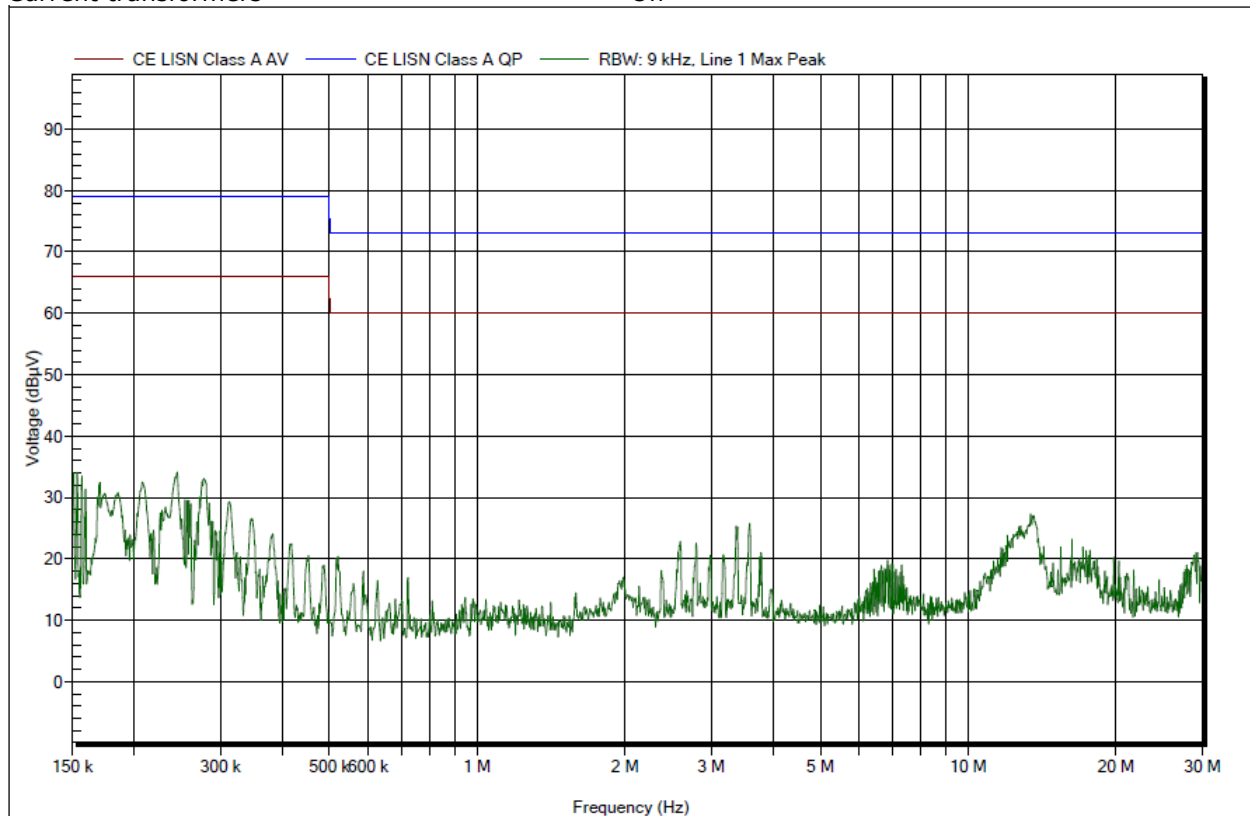
184 Vac

Line

Neutral

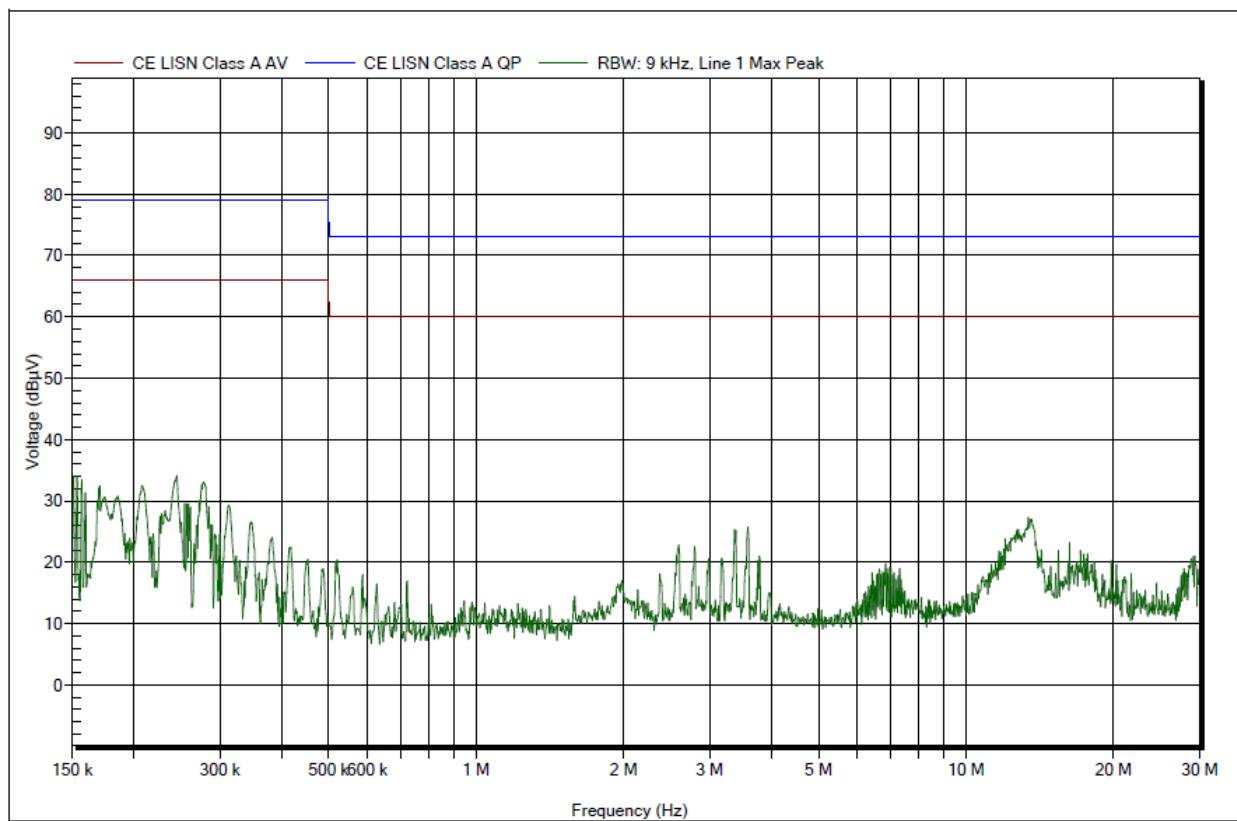
Current transformers

Off



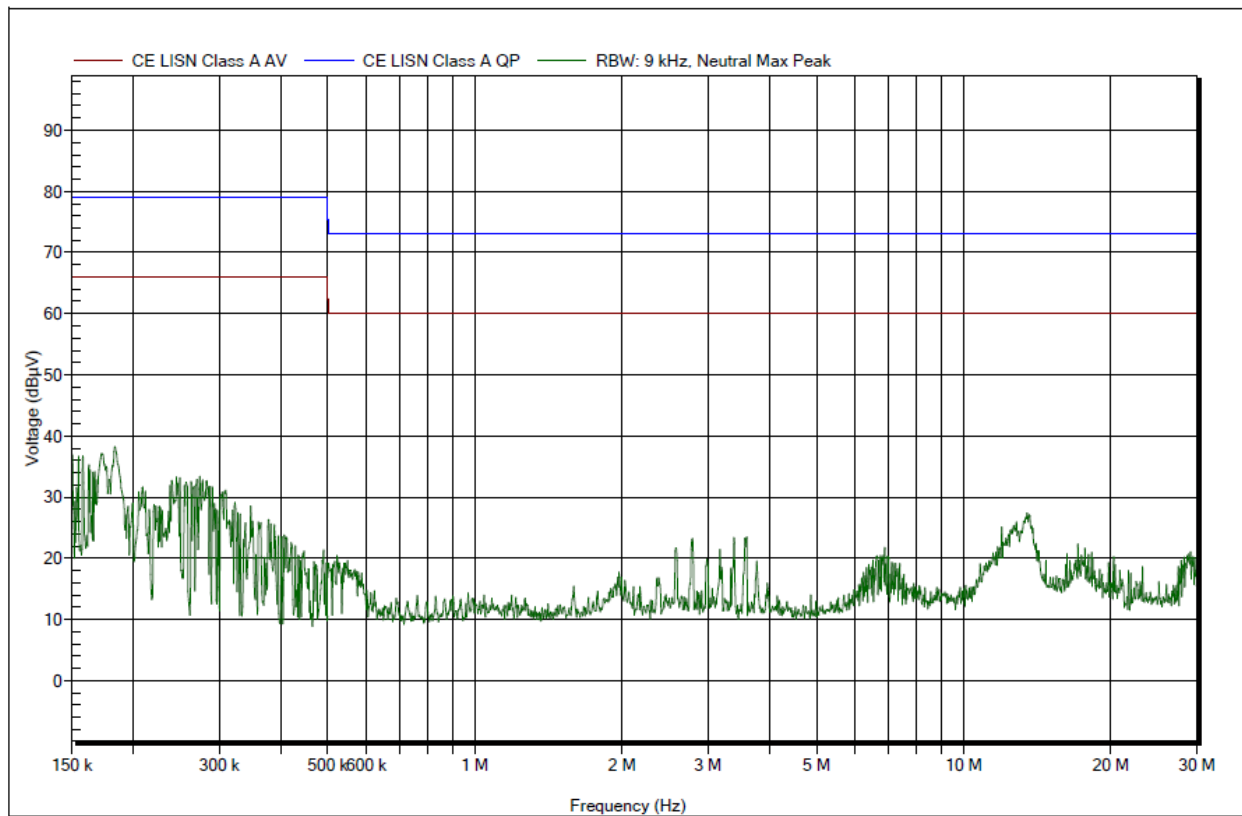
Characteristic test data

Serial number 16110472
Power supply 184 Vac
Line Line 1
Current transformers Off



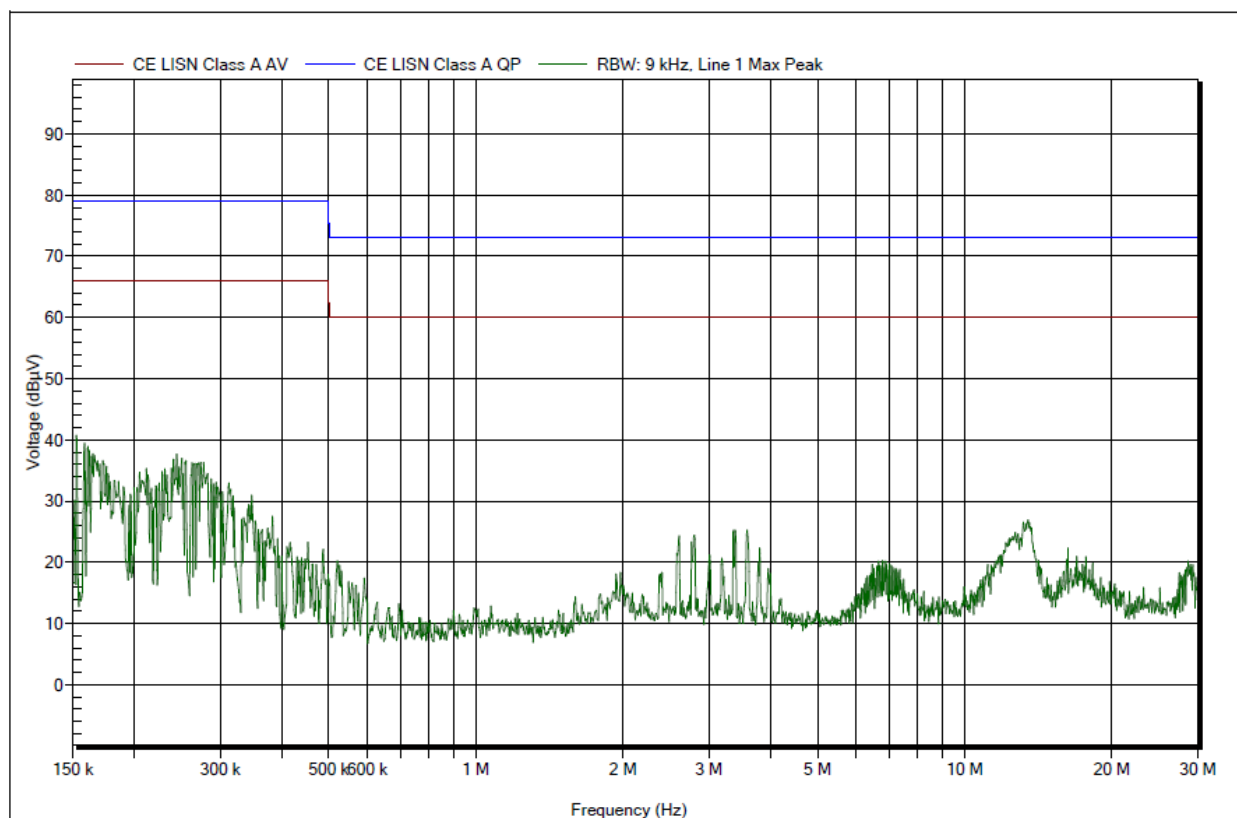
Characteristic test data

Serial number	16110472
Power supply	276 Vac
Line	Neutral
Current transformers	Off



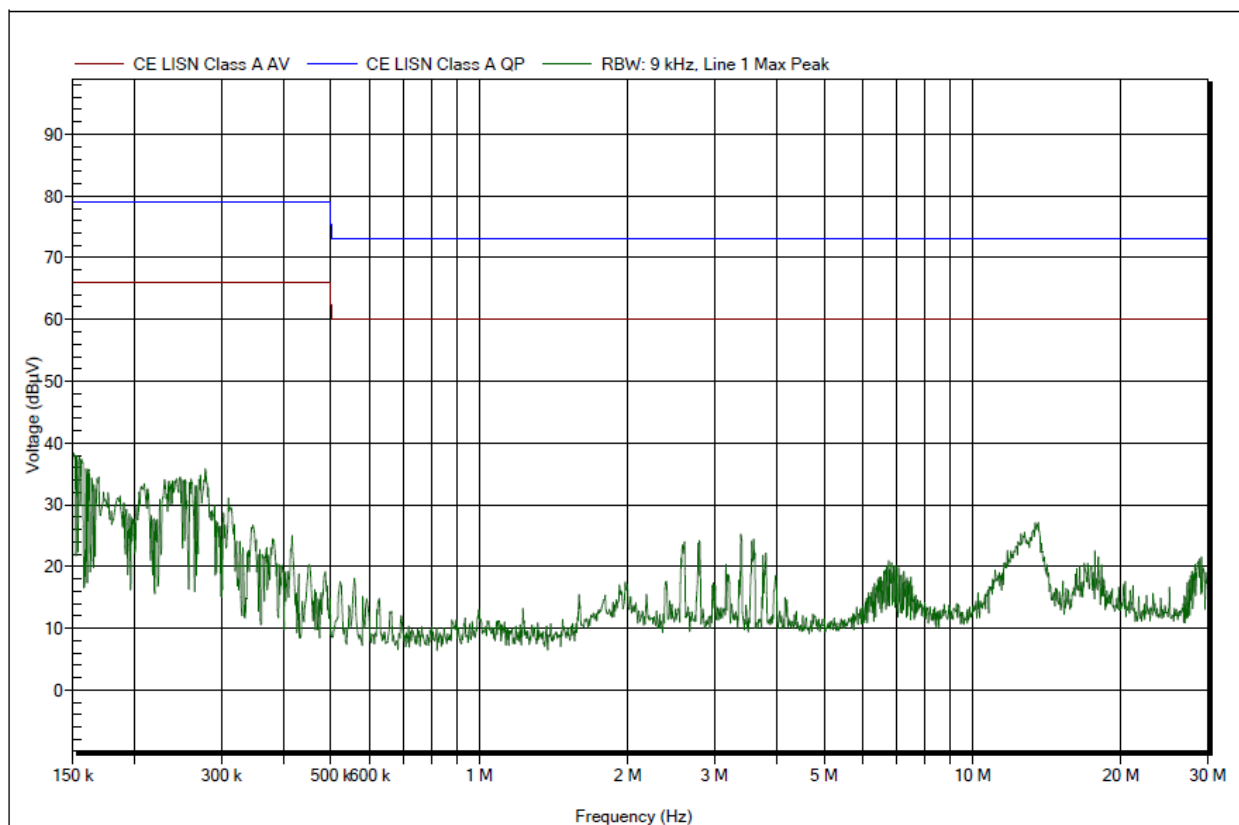
Characteristic test data

Serial number 16110472
Power supply 276 Vac
Line Line 1
Current transformers Off



Characteristic test data

Serial number	16110472
Power supply	276 Vac
Line	Line 1
Current transformers	Off

**Requirement**

The conducted emissions shall be below the limits as specified in table 2 of IEC 60255-26.

Result

The object passed the test.

Photograph of test arrangement



9.4 Electrostatic discharge

Standard and date

Standard IEC 60255-1, Subclause 6.15

Test date 14 April 2016

Environmental conditions

Ambient temperature 22 °C

Humidity 48 %

Characteristic test data

Serial number 16110472

Power supply 230 Vac

Method	Test voltage (kV)	See photographs on next pages	Observations
HCP	2, 4 and 6	-	-
VCP	2, 4 and 6	-	-
Air discharges	2, 4 and 6	1	-
Contact discharges	2, 4 and 8	2	-

Requirements

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

Result

The object passed the test.

Photographs of test points contact discharge

Photographs of test points air discharge

9.5 Electrical fast transient

Standard and date

Standard IEC 60255-1, Subclause 6.15

Test date 29 April 2016

Environmental conditions

Ambient temperature 22 °C

Characteristic test data

Serial number 16110472

Power supply 230 Vac

Rise time (t_r) 5 ns

Duration time (t_d) 50 ns

Zone A

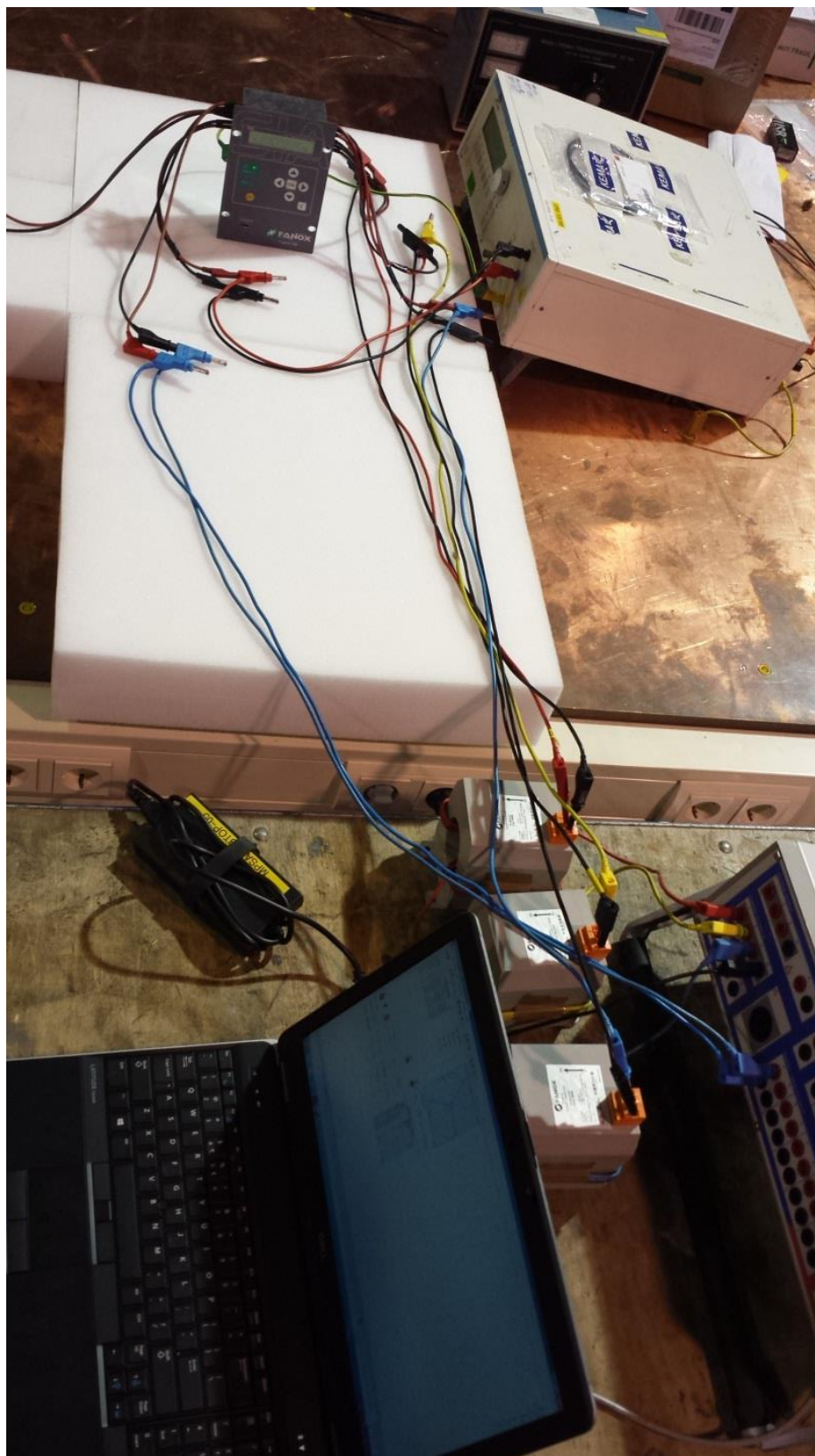
Circuit	Terminals	Coupling	Test voltage (kV)	Repetition frequency (kHz)	Observations
Aux. power	C5, C6	CDN	4	5	-
					-
Ext. Trip	C3, C4	Clamp	4	5	-
					-
Trip	C1, C2	Clamp	4	5	-
					-
Current transformer	A1, A2	CDN	4	5	-
					-
Functional earth port	Earth port	Clamp	4	5	-
					-

Requirements

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

Result

The object passed the test.

Photograph of test arrangement

9.6 Slow damped oscillatory wave

Standard and date

Standard IEC 60255-1, Subclause 6.15

Test date 23 May 2016

Environmental conditions

Ambient temperature 23 °C

Characteristic test data

Serial number 16110472

Voltage oscillation frequency 1 MHz

Voltage rise time 75 ns

Repetition frequency 400 Hz

Output impedance 200 Ω

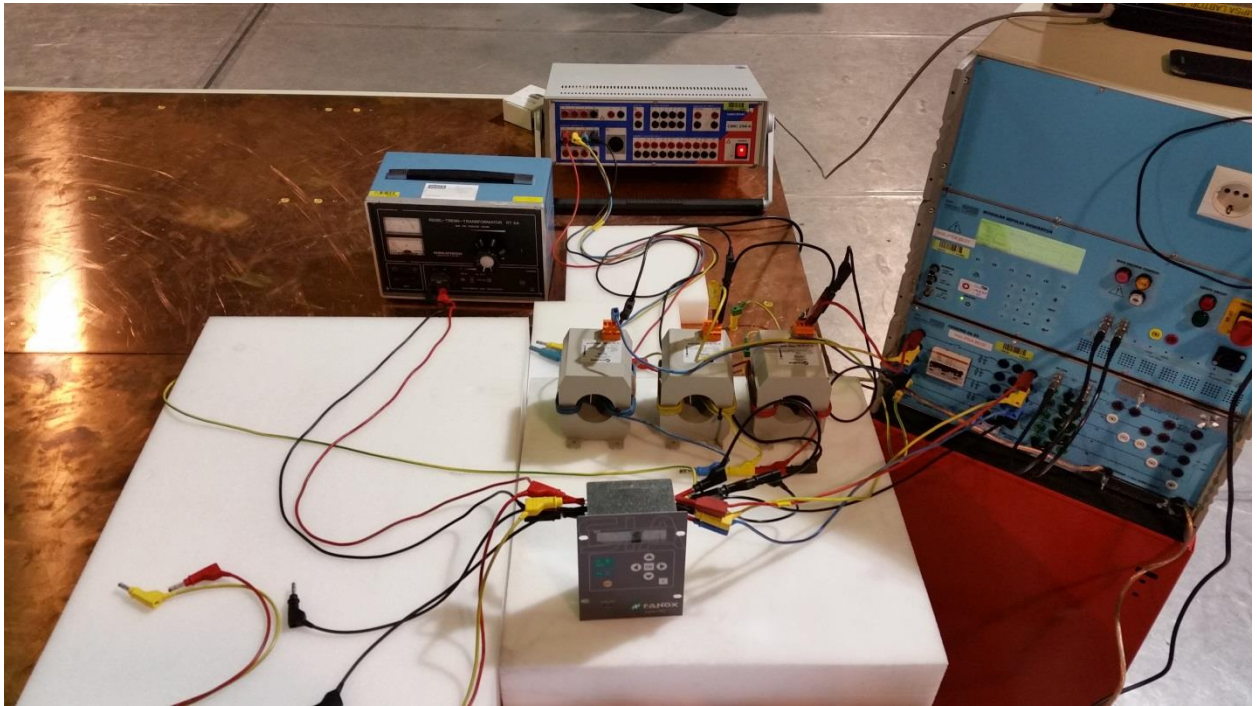
Circuit	Terminals	Coupling	Test voltage (kV)	Observations
Aux. power	C5, C6	CDN DM	1	-
		CDN CM	2,5	-
Ext. Trip	C3, C4	CDN DM	1	-
		CDN CM	2,5	-
Trip	C1, C2	CDN DM	1	-
		CDN CM	2,5	-
Current transformer	A1, A2	CDN DM	1	-
		CDN CM	2,5	-

Requirements

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

Result

The object passed the test.

Photograph of test arrangement

9.7 Surge

Standard and date

Standard IEC 60255-1, Subclause 6.15

Test date 2 May 2016

Environmental conditions

Ambient temperature 23 °C

Characteristic test data

Serial number 16110472

Source impedance 2 Ω

Front time (voltage) 1,2 μ s

Time to half value (voltage) 50 μ s

Front time (current) 8 μ s

Time to half value (current) 20 μ s

Auxiliary power supply port

Coupling capacitor 18 μ F

Coupling resistor 10 Ω

Coupling capacitor 9 μ F

Input and output ports

Coupling resistor 40 Ω

Coupling capacitor 0,5 μ F

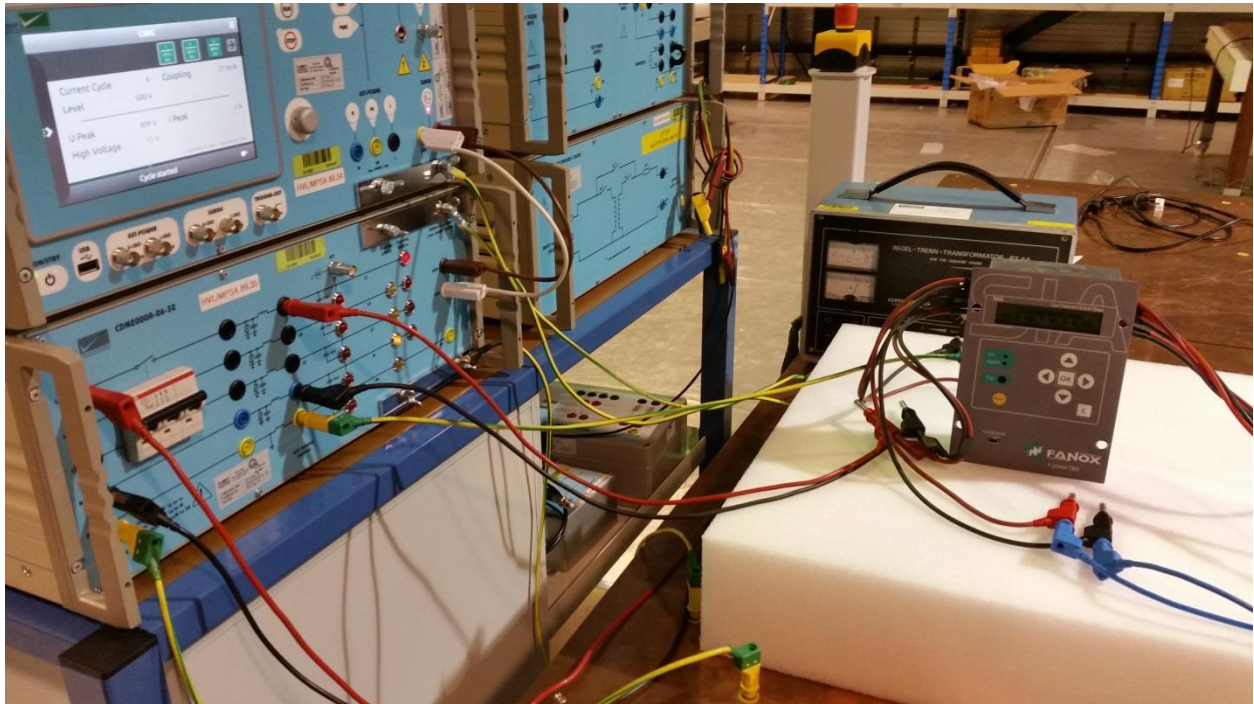
Circuit	Terminals	Coupling	Test voltage (kV)	Observations
Aux. power	C5, C6	LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Ext. Trip	C3, C4	LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Trip	C1, C2	LL	0,5/1/2	-
		LE	0,5/1/2/4	-
Current transformer	A1, A2	LL	0,5/1/2	-
		LE	0,5/1/2/4	-

Requirements

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

Result

The object passed the test.

Photograph of test arrangement

9.9 Conducted disturbance induced by radio-frequency fields

Standard and date

Standard IEC 60255-1, Subclause 6.15

Test date 22 April 2016

Environmental conditions

Ambient temperature 22 °C

Characteristic test data

Serial number 16110472

Source impedance 150 Ω

Amplitude modulated 80 % AM (1 kHz)

Dwell time 0,5 s

Test duration 10 s

Frequency sweep

Circuit	Test level (V)	Sweep rate	Frequency sweep (MHz)	Observations
Aux. Power	10	$\leq 1\%$	0,15 - 80	-
Ext. Trip	10	$\leq 1\%$	0,15 - 80	-
Trip	10	$\leq 1\%$	0,15 - 80	-
Current transformer	10	$\leq 1\%$	0,15 - 80	-
Earth port	10	$\leq 1\%$	0,15 - 80	-

Spot frequencies

Circuit	Test level (V)	Duty cycle	Spot frequencies (MHz)	Observations
Aux. Power	10	100%	27, 68	-
Ext. Trip	10	100%	27, 68	-
Trip	10	100%	27, 68	-
Current transformer	10	100%	27, 68	-
Earth port	10	100%	27, 68	-

Requirements

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

Result

The object passed the test.

Photograph of test arrangement

9.10 Power frequency magnetic field

Standard and date

Standard IEC 60255-1, Subclause 6.15

Test date 6 May 2016

Environmental conditions

Ambient temperature 22 °C

Characteristic test data

Serial number 16110472

Power supply 230 Vac

Frequency 50 Hz

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

Requirements

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

Result

The object passed the test.

Photograph of test arrangement

9.11 Pulse magnetic field

Standard and date

Standard IEC 60255-1, Subclause 6.15

Test date 6 May 2016

Environmental conditions

Ambient temperature 22 °C

Characteristic test data

Serial number 1611047

2

Power supply 230 Vac

Rise time 6,4 μ s $\pm$ 30%

Duration 16 μ s $\pm$ 30%

Polarity Positive,
negative

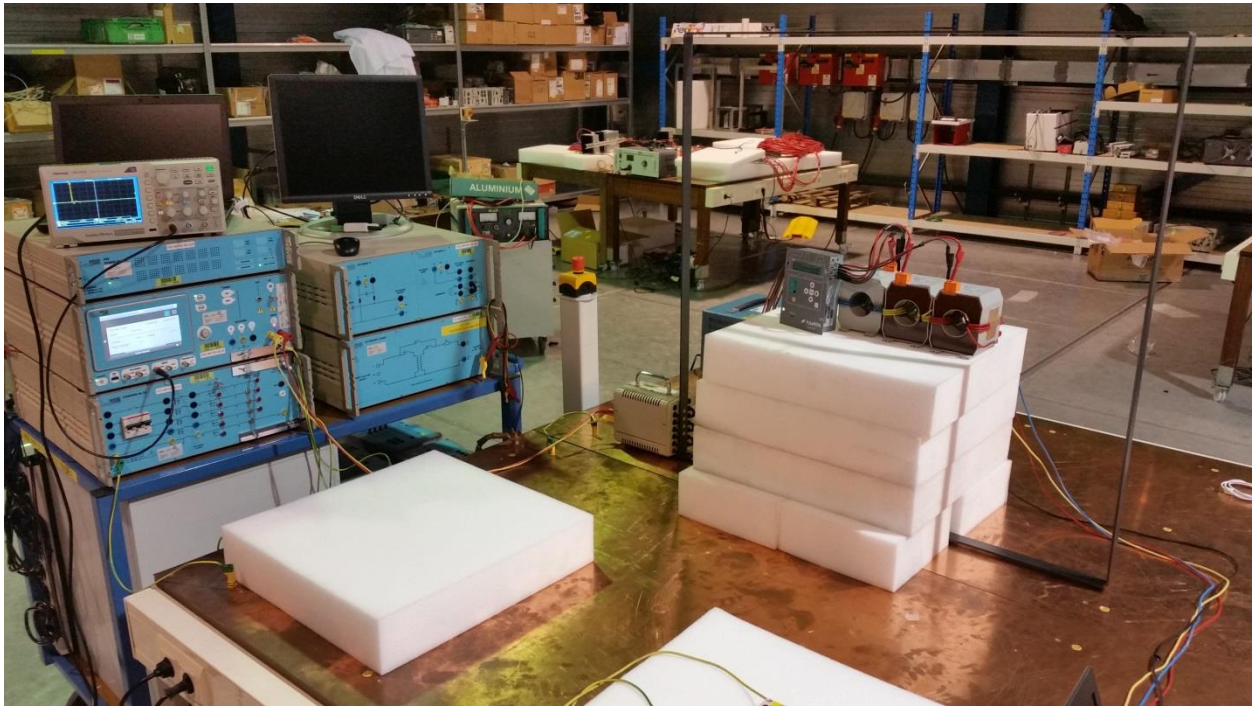
Direction	Test level (A/m)	Acceptance criteria	Observations
Horizontal longitudinal (x)	100	A	-
Horizontal transversal (y)	100	A	-
Vertical (z)	100	A	-

Requirements

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

Result

The object passed the test.

Photograph of test arrangement

9.12 Voltage dips and voltage interruptions on power supply voltage

Standard and date

Standard IEC 60255-1, Subclause 6.15

Test date 18 April 2016

Environmental conditions

Ambient temperature 22 °C

Characteristic test data

Serial number 16110472

Voltage dips

Test voltage (V)	Residual voltage (%)	Duration (cycles)	Criterion for acceptance	Observation
184	0 (0V)	5 at 50Hz	A	1
276	0 (0V)	5 at 50Hz	A	1
184	40 (73.6 V)	10 at 50 Hz	C	2
276	40 (110,4V)	10 at 50 Hz	C	2
184	70 (128.8 V)	25 at 50 Hz	C	-
276	70 (193.2 V)	25 at 50 Hz	C	-

Voltage interruptions

Power supply voltage (Vac)	Interruption (%)	Cycles	Acceptance criteria	Observations
184	0	250	C	-
276	0	250	C	-

Observations

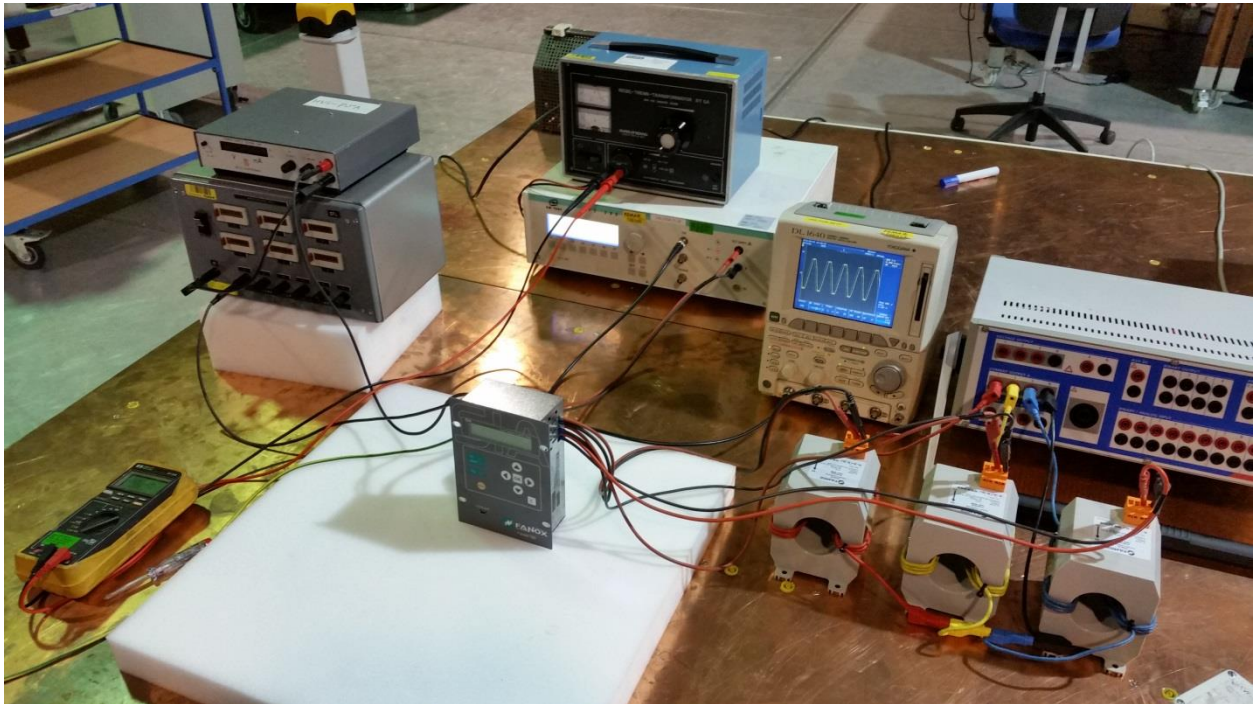
- display intensity dipped
- at 10cycles interruption (200ms) the display went off for a second.

Requirements

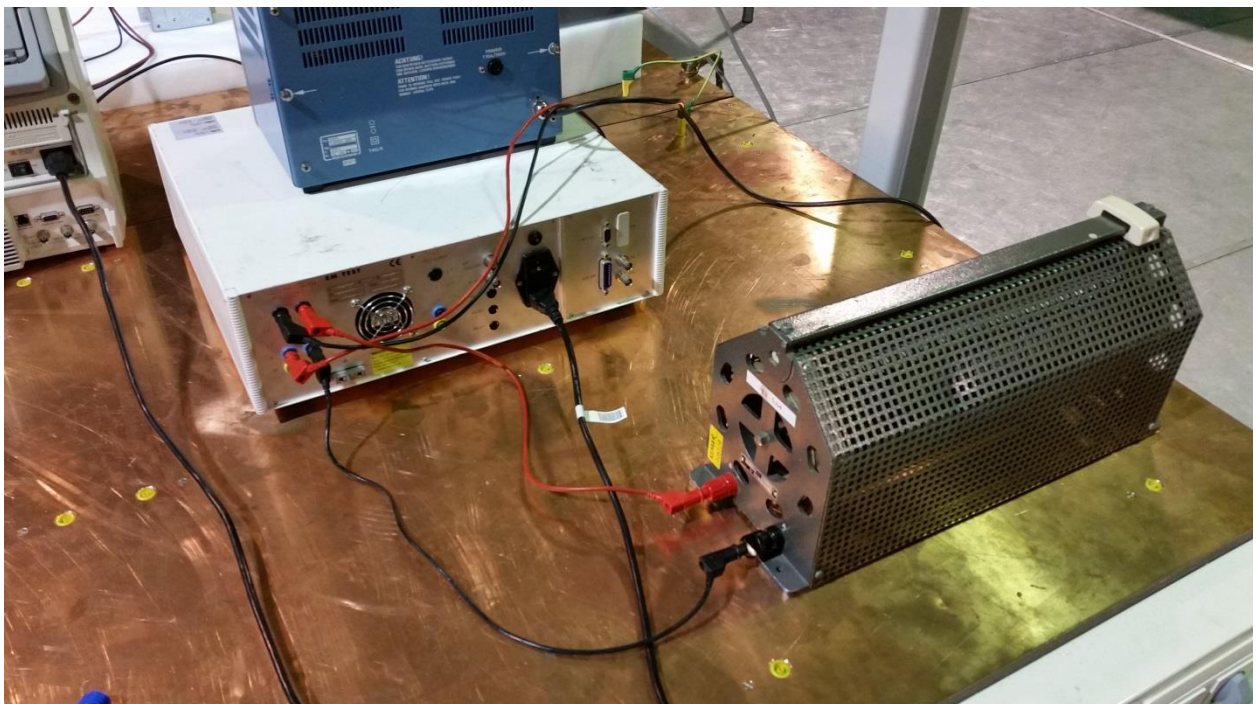
- the object shall comply with the required acceptance criteria of IEC 60255-26, Table 23.
- the visual and functional inspection shall not reveal any defects or malfunctions.

Result

The object passed the test.

Photograph of test arrangement

Interruption with high impedance



Interruption with low impedance

9.13 Damped oscillatory magnetic field tests

Standard and date

Standard IEC 61000-4-10

Test date 23 May 2016

Environmental conditions

Ambient temperature 23 °C

Characteristic test data

Serial number 16110472

Power supply

230 Vac

Frequency 50 Hz

Polarity positive/negative

Test frequency 100kHz and 1 MHz

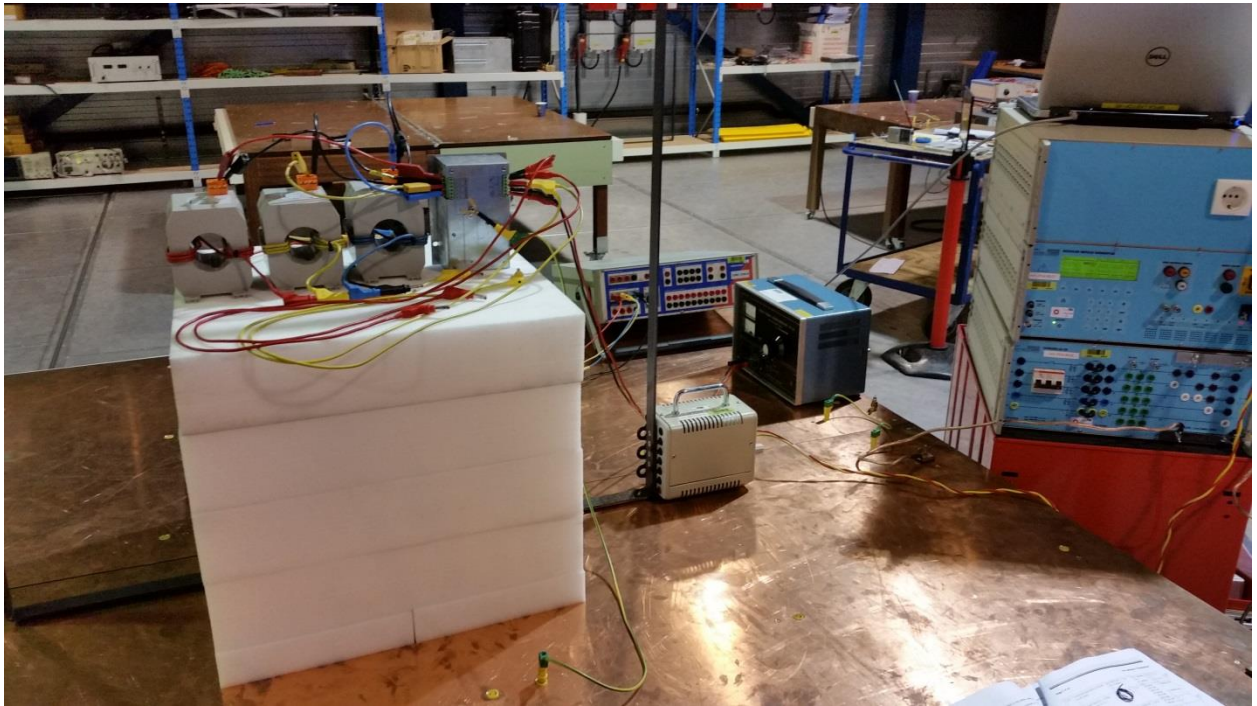
Direction	Test level A/m	Duration s	Observation
Horizontal longitudinal (x)	100	60	-
Horizontal transversal (y)	100	60	-
Vertical (z)	100	60	-

Requirements

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

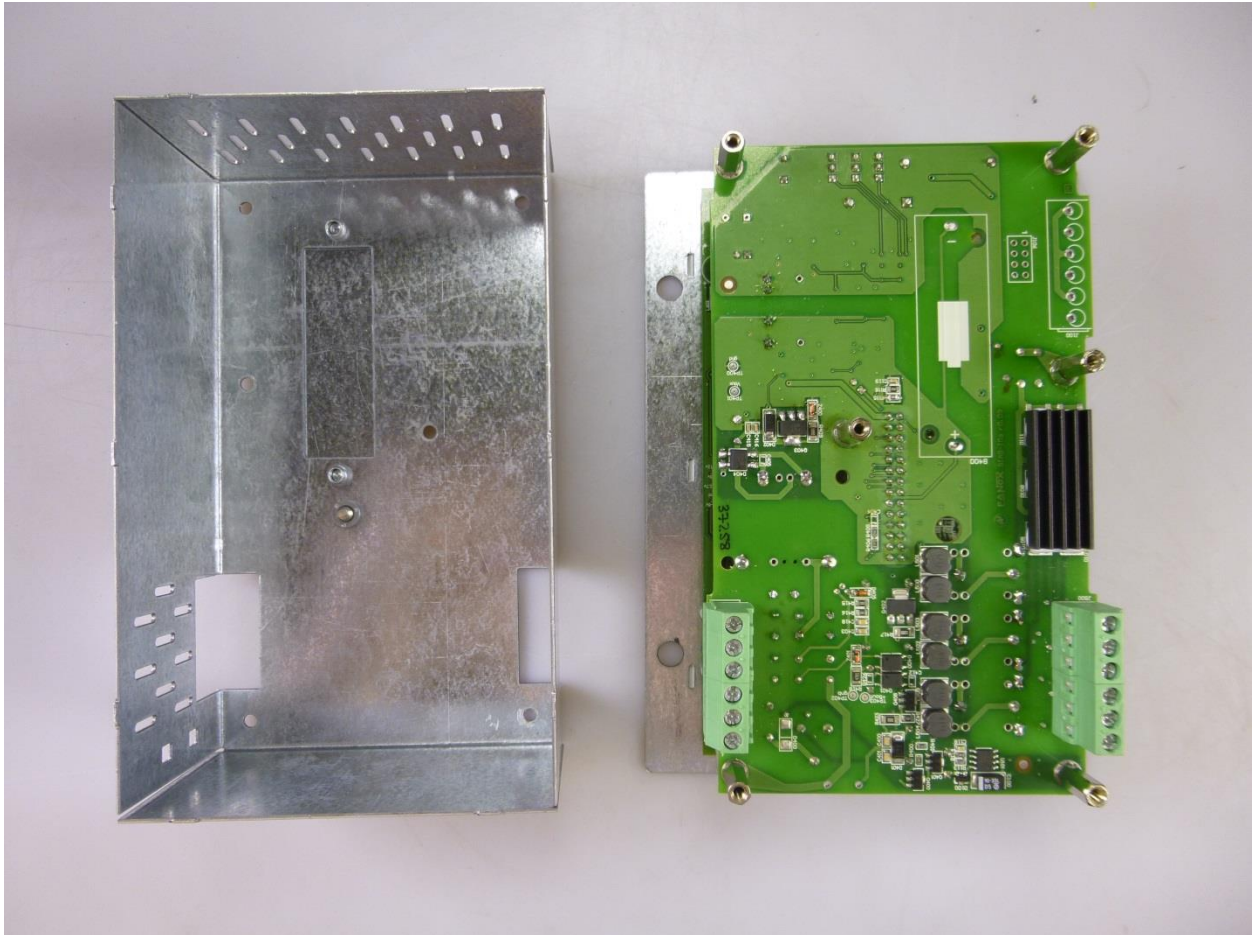
Result

The object passed the test.

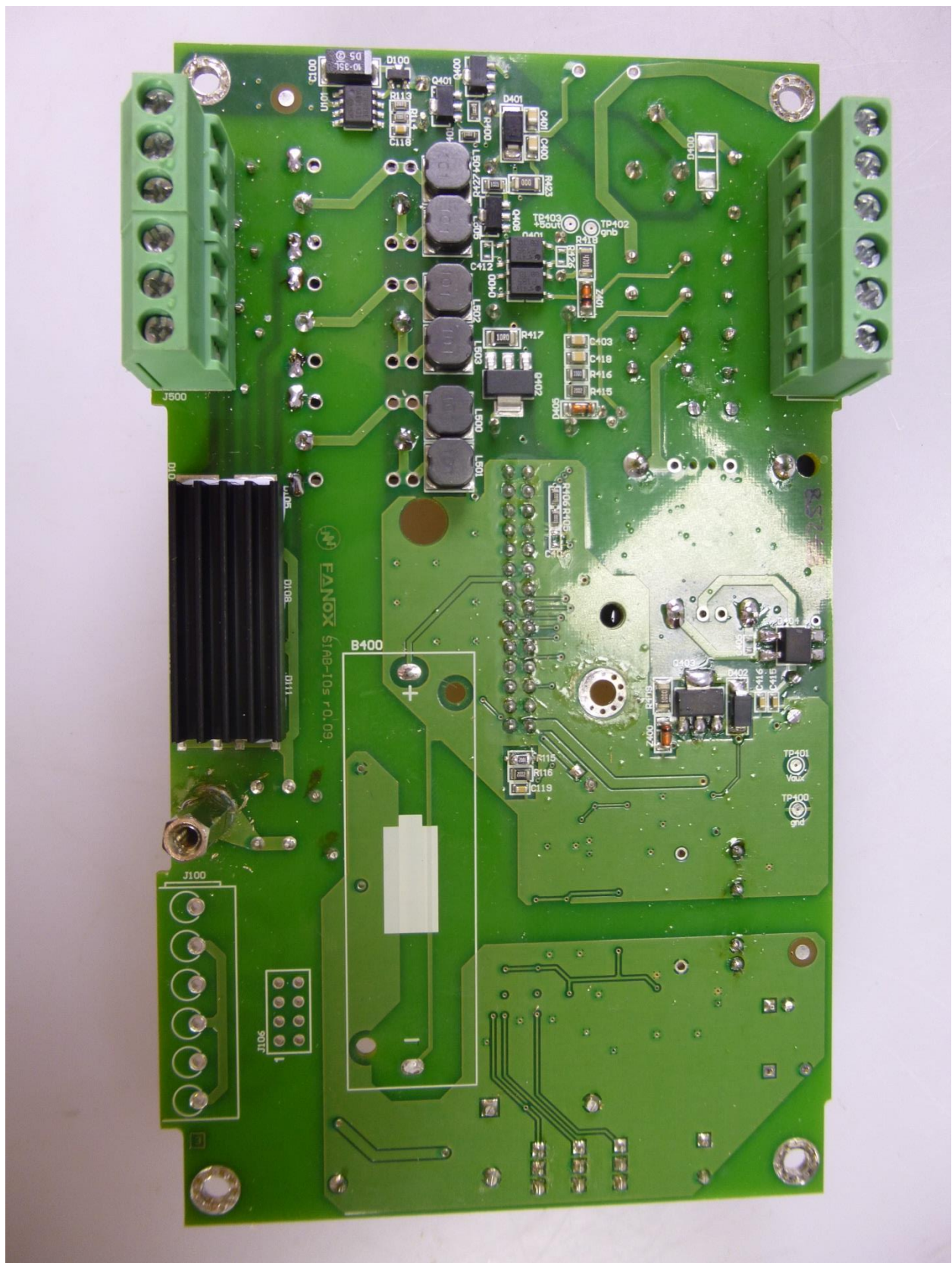
Photograph of test arrangement

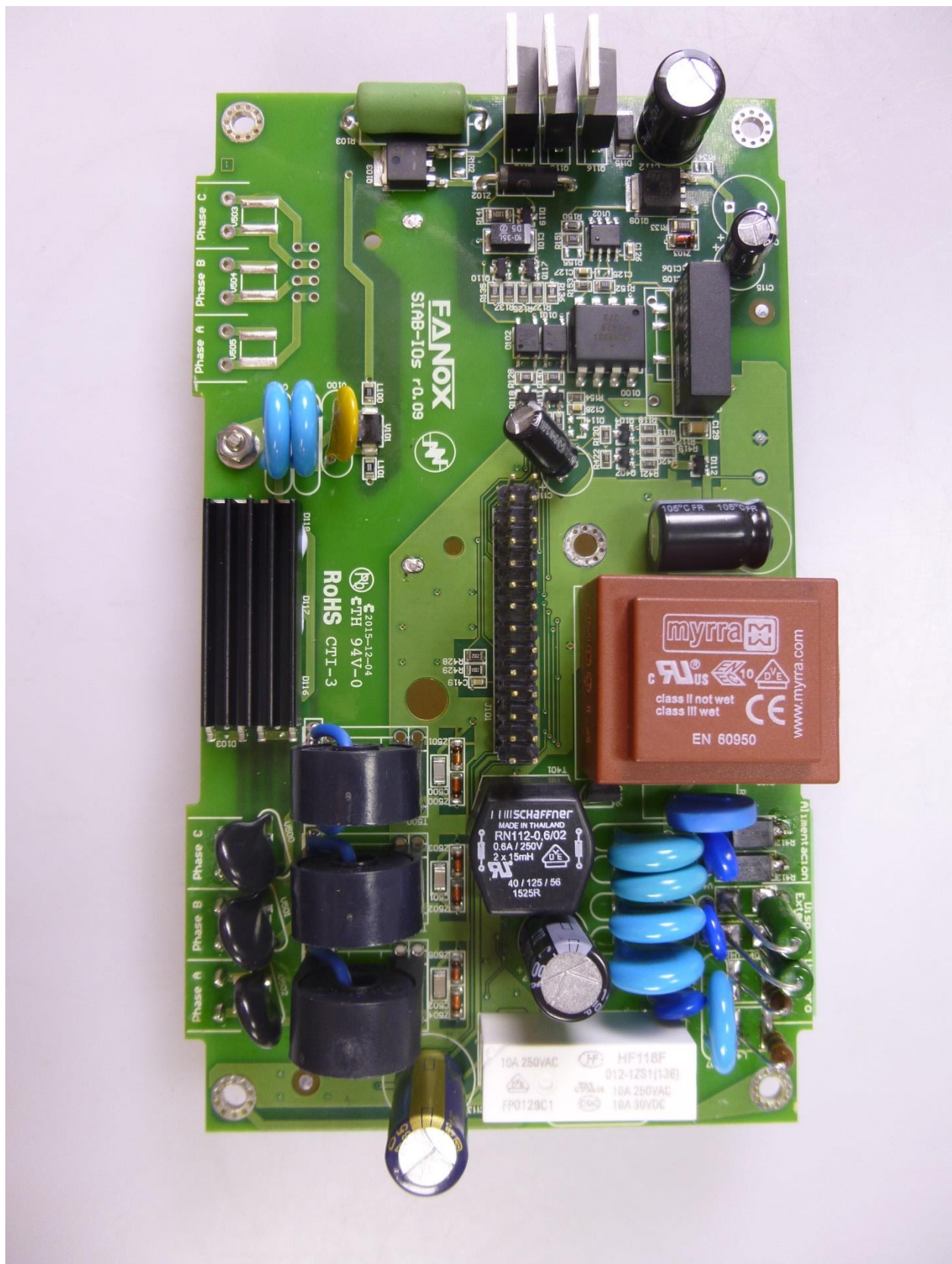
10 PHOTOGRAPHS OF PRINTBOARDS

Photograph of input board



Photograph of Input board



Photograph of Input board

Photograph of CPU board

Photograph of CPU board

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

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

12 LIST OF INSTRUMENTS USED

12.1 EMC equipment

Description	Manufacturer	Type	ORS number
PFS	EM test	PFS500	105166
Fast transient burst tester	EM Test	EFT500	105169
Capacitive coupling clamp			106168
Electrostatic discharge tester	EM Test	P18/ESD30	105167
Insulation tester	EMC partner	MIG0603OS2	105333
Oscillatory wave test system including	EMC partner	MIG0603OMI	150022
CDN		CDN2000-06-25	150023
CDN-KIT1000		CN-U / DN-HF DN-LF1 / DN-LF2	89.02
H-field antenna		MF1000-1	151494
H-field antenna		MF1000-3	151495
Continues wave simulator including	EM Test	CWS500N1.1	151165
50 ohm attenuator		ATT 6/75	151158
CDN M1		CDN M1	151180
CDN M2/M3		CDN M2/M3	151164
CDN M2/M3		CDN M2/M3	151179
CDN M4 N		CDN M4 N	151178
Immunity tester, including	EMC partner	IMU4000 F-S-D-V-C-1500	151487
CDN		EXT-TRA3000 C-SHORT-1506	151486
CDN		PS3-0204	
CDN		CN16-1514	151489
CDN		CN16T-1507	151491
CDN		CN16-22-7C-1503	151490
CDN		CN16-22-7D-1503	151492
Insulation tester	FLUKE	1503	150150
Dielectric 50Hz AC Voltage test	SQS Electronic	HA3300D	105156

12.2 Mechanical tests

Description	Manufacturer	Type	ORS number
ICP Accelerometer	PCB Piezotronics	353B18	6419
Electric-dynamic shaker	Tira	TV59355/AIT-440 TGT model48XXL	036/07
ICP Accelerometer	PCB Piezotronics	353B34	106995
ICP Accelerometer	PCB Piezotronics	353B18	149686
Shaker control system	Dactron	Laser	4637789
Signal conditioner	PCB Piezotronics	482C16	428
ICP Accelerometer	PCB Piezotronics	353B18	149911
Monitoring of the environmental conditions	Novasina	ClimaLog 40	1206059

12.3 Climate tests

Description	Manufacturer	Type	ORS number
Climate room	Espec	ARS-1100	151485

12.4 Measurement equipment

Description	Manufacturer	Type	ORS number
Scopecorder	Yokogawa	DL850	8464-14
Oscilloscope	Yokogawa	DL1640	105217
Analog multimeter	avometer	MK.6	I069115
Digital multimeter	Hewlett Packard	972A	105257
Oscilloscope	LeCroy	9310CM	105479
Multimeter	Fluke	8840A	069128
Multimeter	Fluke	8840A	069145
Analog multimeter	avometer	MK.6	I067424

12.5 Test set

Description	Manufacturer	Type	ORS number
Test set	ADwin-Pro	ADwin-Pro	150026
Current amplifier	KEMA	-	77405
Voltage amplifier	KEMA	-	108474
Test set	Adinwin-P	Adwin-Pro II	-
Current amplifier	KEMA	-	77409
Current amplifier	KEMA	-	110582
Voltage amplifier	KEMA	-	77410
omicron	omicron	CMC256-6	151169