SIEMENS

Division Energy Management
Digital Grid

Test Report

Test Report No. : **TS0617-003**

Date of issue : **2017-07-27**

Subject:

Type test Generator Protection SIPROTEC 5 - V07.5x / Edition 03

The tests were performed by:

SIEMENS AG
Development
EM DG PRO D
Wernerwerkdamm 5
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The tests were performed for:

SIEMENS AG
Products
EM DG PRO LM
Humboldtstr. 59
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This test report consists of 210 pages.

Tested equipment	**Multifunction Protection Relays SIPROTEC 5** **Product group: Generator Protection** 7UM85 **Firmware V07.5x**
Tests are according to:	**IEC/EN 60255, VDE 0435**
Performed tests:	**Properties at reference conditions**
Test results:	**The equipment has successfully passed the type test. The equipment did not show any changes and was fully in order subsequent to these tests.**

SIEMENS AG - EM DG PRO
Division Energy Management
Digital Grid

Place: **EM DG PRO D**
13629 Berlin (Siemensstadt)

Date: **2017-07-27**

Tested by: Wang Ya Li

Wang Ya Li
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Reviewed by: Rochow

Signature

Scope of protocol

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Range of validity

SIPROTEC 5 Platform and Hardware Characteristics

The SIPROTEC 5 series includes both modular and non-modular devices.

Modular devices consist of a base module (1/3 of 19 inches) and can be expanded with expansion modules (1/6 of 19 inches). The device type identifier for modular devices is XXX85, XXX86 or XXX87, for example, 7SA86 Type XXX84 devices have the same hardware properties as the modular devices, but they cannot be expanded with expansion modules.

All non-modular devices consist of just a base module (1/3 of 19 inches) and cannot be expanded with expansion modules (1/6 of 19 inches). The device type identifier for non-modular devices is 7XX82, e.g., 7SJ82.

Hardware Characteristics of Modular Devices

A modular device always consists of a base module and optionally of expansion modules. The modules can be chosen according to hardware characteristics. These characteristics are:

- Module size
- Type of construction
- Mounting of the on-site operation panel
- Layout (or design) of the on-site operation panel
- Input and output module
- Plug-in modules

The modules are available in 2 sizes:

- Base module (1/3 of 19 in)
- Extension module (1/6 of 19 in)

The devices are available in 3 designs:

- Flush-mounting devices with on-site operation panel fitted directly on the device
- Surface-mounting devices with integrated on-site operation panel
- Surface-mounting devices with detached on-site operation panel

The on-site operation panels of the base modules can be selected from 3 variants:

- With a large display, keypad, and 16 2-colored LEDs
- With a small display, keypad, and 16 2-colored LEDs
- Without a display, without a keypad, but with 16 2-colored LEDs

The on-site operation panels of the extension modules can be selected from 4 variants:

- With 16 1-colored LEDs and 2 key switches
- With 16 1-colored LEDs
- With 8 push-buttons and 8 1-colored LEDs
- Without display elements

The base module always contains the power-supply module PS201 and an input and output module IO2XX.

The extension module contains an input and output module IO2XX or a plug-in module assembly with integrated power supply CB202.

The 1st extension module in the 2nd device row always contains power supply module PS203.

The plug-in modules are available for various applications. The following plug-in modules can be installed in the base module or in an extension module with plug-in module assembly with integrated power supply CB202:

- Communication module
- Measuring-transducer module

Range of validity

Hardware Characteristics of Non-Modular Devices

A non-modular device always consists of just one module (1/3 of 19 inches) and cannot be expanded with expansion modules (1/6 of 19 inches). These hardware characteristics are:

- Module size: 1/3 of 19 in.
- Type of construction: Flush-mounting devices with on-site operation panel fitted directly on the device

The on-site operation panels can be chosen from 2 variants:

- With a large display, keypad, and 16 2-colored LEDs
- With a small display, keypad, and 16 2-colored LEDs

The module always contains the power supply module PS101 and an input and output module IO10X. The input and output module IO10X includes the terminals for current and voltage transformers. Optionally, the module can be equipped an additional input and output module IO110 for extra binary inputs and outputs.The plug-in modules are available for various applications. The following plug-in modules can be installed in the module:

- Communication modules
- Measuring-transducer modules

Range of validity

SIPROTEC 5 devices

All type tests were performed at various combinations of all modules of the SIPROTEC 5 platform. As a result the following devices were covered:

Model of Protective Relay		Trip Detection	Quantity structure
7UM85	Generator Protection	3-pole trip	I/Os fully modular

Range of validity

SIPROTEC 5, functional description of power supply, CPU, IO boards and plug-in modules
All hardware type tests were performed at various combinations with all modules of the SIPROTEC 5 platform. As a result all realized devices were covered:

SIPROTEC 5

Functional description of boards for modular devices

Board name	Functional description
PS201	Power Supply Board (DC: 24 V/48 V or 60 V to 250 V and AC: 100 V to 230 V), mounted in 1/3 19-inch size housing, including 3 binary inputs, 2 binary outputs and one status life contact
PS203	Power Supply Board for the 2nd row of devices, (DC: 24 V/48 V or 60 V to 250 V and AC: 100 V to 230 V), mounted in 1/6 19-inch size housing
CB202	Plug-in module assembly, including an additional power supply, (DC: 24 V/48 V or 60 V to 250 V and AC: 100 V to 230 V), mounted in 1/6 19-inch size housing
CP200/CP300	Processor (CPU) Board, mounted into the front cover of the 1/3 19-inch size housing, different variants for the aviable device designs
IO201	Input Output Board, 4 current inputs, 8 binary inputs, 6 binary outputs, reduced assembled variant of IO202
IO202	Input Output Board, 4 current measuring inputs, 4 voltage measuring inputs, 8 binary inputs, 6 binary outputs, mounted in 1/6 or 1/3 19-inch size housing
IO203	Input Output Board, 8 current measuring inputs, 4 binary inputs, 4 binary outputs, mounted in 1/6 19-inch size housing
IO204	Input Output Board, 10 binary inputs, 4 binary outputs, 4 power relays for controlling 2 motors, mounted in 1/6 19-inch size housing
IO205	Input Output Board, 12 binary inputs, 16 binary outputs, mounted in 1/6 19-inch size housing
IO206	Input Output Board, 6 binary inputs, 7 binary outputs, mounted in 1/6 19-inch size housing, reduced assembled variant of IO205
IO207	Input Output Board, 16 binary inputs, 8 binary outputs, mounted in 1/6 19-inch size housing
IO208	Input Output Board, 4 current measuring inputs, 4 voltage measuring inputs, 4 binary inputs, 11 binary outputs, mounted in 1/3 or 1/6 19-inch size housing
IO209	Input Output Board, 8 binary inputs, 4 High Speed Outputs, mounted in 1/6 19-inch size housing
IO210	Input Output Board, 4 current measuring inputs, 3 voltage measuring inputs, 7 binary outputs, 4 high-speed measuring-transducer inputs for current or voltage, mounted in 1/6 19-inch size housing
IO211	Input Output Board, 8 voltage measuring inputs, 8 binary inputs, mounted in 1/6 or 1/3 19-inch size housing
IO212	Input Output Board, 8 high-speed measuring-transducer inputs for current or voltage, 8 binary inputs, mounted in 1/6 19-inch size housing
IO214	Input Output Board, 4 current measuring inputs, 4 voltage measuring inputs, 2 binary in-puts, 5 binary outputs, mounted in 1/6 or 1/3 19-inch size housing, reduced assembled variant of IO202
IO215	Input Output Board, 4 current measuring inputs, 4 voltage measuring inputs (designed for a measuring range up to 7.07 V) 8 binary inputs, 6 binary outputs, mounted in 1/6 or 1/3 19-inch size housing
IO230	Input Board, 48 binary inputs, mounted in 1/6 19-inch size housing
IO231	Input Output Board, 24 binary inputs, 24 binary outputs, mounted in 1/6 19-inch size housing
IO233	Input Board, 48 binary inputs (a fixed pickup threshold value of DC 105 V

Range of validity

	applies), mounted in 1/6 19-inch size housing
PB201	Process-Bus Module, 7 LC Duplex interfaces of which one is a service port, mounted in 1/6 19-inch size housing

Functional description of boards for non-modular devices

Board name	Functional description
PS101	Power Supply Board (DC: 24 V/48 V or DC: 60 V to 125 V or DC: 110 V to 250 V and AC: 100 V to 230 V), including 3 binary inputs, 2 binary outputs and one status life contact
IO101	Input Output Board, 4 current inputs, 8 binary inputs, 6 binary outputs, reduced assembled variant of IO102
IO102	Input Output Board, 4 current inputs, 4 voltage inputs, 8 binary inputs, 6 binary outputs
IO103	Input Output Board, 8 current inputs, 4 binary inputs, 4 binary outputs
IO110	Input Output Board, 12 binary inputs, 7 binary outputs
IO111	Temperature module, 12 resistance temperature detectors
CP100	Processor (CPU) Board, mounted into the front cover of the device

Functional description of plug-in modules for modular devices and for non-modular devices

USART-xx[1]-y[2]EL	Serial communication module, electrical connection
USART-xx[1]-y[2]FO	Serial communication module, optical connection
USART-xx[1]-y[2]LDFO	Serial communication module for long distances, optical connection
ETH-xx[1]-2EL	Ethernet module, electrical connection
ETH-xx[1]-2FO	Ethernet module, optical connection
ANAI-CA-4EL	Measuring-transducer module
ARC-CD-3FO[3]	Arc Protection module

Valid for all firmware and DIGSI versions.

[1] xx: two letters, unique code for the module in the product code of the device
[2] y: 1 = 1 channel;
2 = 2 channels
[3] Not available for Busbar Protection and Fault Recorder

Scope of editions

Edition	Date	Modifications or supplements compared to the former edition
01	2016-02-05	First edition, Software V07.0x
02	2016-07-22	Revision and extended at Software V07.3x
03	2017-07-27	Revision and extended at Software V07.5x

Subcontracting

Testing laboratory	Marking

Technical information; Technical Data

Technical Information; Description:

	Manual		Edition
1.	SIPROTEC 5		
	Protection Devices		
	Product Information	Part No. C53000-B5000-C001-C	German
		C53000-B5040-C001-C	English
2.	SIPROTEC 5		
	Hardware		
	Manual	Part No. C53000-G5000-C002-C	German
		C53000-G5040-C002-C	English
3.	SIPROTEC 5		
	Operating		
	Manual	Part No. C53000-G5000-C003-8	German
		C53000-G5040-C003-8	English
4.	SIPROTEC 5		
	Generator Protection 7UM85		
	Manual	Part No. C53000-G5000-C027-3	German
		C53000-G5040-C027-3	English

For the Technical Data see the description (Technical Information).

Summary

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Summary

1 Properties at reference conditions

1.1 General

1.1.1 Standards

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

1.1.2 Time specifications and measurings

If not otherwise declared, all specifications/results of pickup/tripping/reset times refer to the output of signals via fast output relays (Type F).

BO = Binary output

Binary outputs:
Number and data acc. to the order variant, see also general diagrams of devices

1.1.3 Relay operating times

Switching time (OOT)	OOT (Output Operating Time): additional delay of the output medium used				
Type S = standard relay	OOT:				
	Closing time:	typical:	8 ms;	maximum:	10 ms;
	Opening time:	typical:	2 ms;	maximum:	5 ms;
Type F = fast relay	OOT:				
	Closing time:	typical:	4 ms;	maximum:	5 ms;
	Opening time:	typical:	2 ms;	maximum:	5 ms;
Type HS = High-Speed Relay	OOT:				
	Closing time:	typical:	0,2 ms;	maximum:	0,2 ms;
	Opening time:	typical:	9 ms;	maximum:	9 ms;

Summary

1.2 87G Generator Differential Protection

1.2.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.2.2 General test conditions

frated: 50 Hz, 60 Hz

Irated: 1 A, 5 A

1.2.3 I-DIFF

1.2.3.1 Operate Curve

1.2.3.1.1 I-DIFF Threshold

Test condition: 0.05 ≤ I/IratedObj ≤ 2.00

Permissive tolerance/Limiting values: |δ| ≤ 2 % of setting value

Test results/Remarks: |δ| < 2 %

1.2.3.1.2 I-DIFF Slope 1

Test condition: 0.00 to 0.80

Test results/Remarks: confirmed

1.2.3.1.3 I-DIFF Intersection 1 Irest

Test condition: 0.00 ≤ I/IratedObj ≤ 5.00

Test results/Remarks: confirmed

1.2.3.1.4 I-DIFF Slope 2

Test condition: 0.25 to 0.95

Test results/Remarks: confirmed

1.2.3.1.5 I-DIFF Intersection 2 Irest

Test condition: 1.00 ≤ I/IratedObj ≤ 20.00

Test results/Remarks: confirmed

1.2.3.2 Starting Detection

1.2.3.2.1 Threshold Startup Detection

Test condition: 0.1 ≤ I/IratedObj ≤ 2.0

Permissive tolerance/Limiting values: |δ| ≤ 2 % of setting value

Test results/Remarks: |δ| < 2 %

1.2.3.2.2 Factor Increasing Char.

Test condition: 1.0 to 5.0

Test results/Remarks: confirmed

1.2.3.2.3 Max. perm. Start Time

Test condition: 0.1 s ≤ T ≤ 180.0 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| < 1 % of setting value or 10 ms

1.2.3.3 DC offset Detection

1.2.3.3.1 Factor Increasing Char. DC

Test condition: 1.0 to 5.0

Test results/Remarks: confirmed

Summary

1.2.3.4 Ext. Fault Detection

1.2.3.4.1 Threshold of add-on stabiliz.

Test condition: 1.00 ≤ I/IratedObj ≤ 20.00

Permissive tolerance/Limiting values: |δ| ≤ 2 % of setting value

1.2.3.4.2 Test results/Remarks: |δ| < 2 %

Time of add-on stabiliz.

Test condition: 0.00 s ≤ T ≤ 5.00 s, ∞

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| < 1 % of setting value or 10 ms

1.2.3.5 Cross-blk time of add-on stabiliz.

1.2.3.5.1 Test condition: 0.00 s ≤ T ≤ 2.00 s, ∞

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| < 1 % of setting value or 10 ms

1.2.3.5.2 Dropout Ratio

1.2.3.5.3 Test condition: see item 1.2.3.1.1

Permissive tolerance/Limiting values: r approx. 0.70

Test results/Remarks: 0.68 ≤ r ≤ 0.72

Operating Times

Test condition: see item 1.2.3.1.1

Test values: I/Irated = 1, I/Irated = 2

Permissive tolerance/Limiting values: t approx.
23 ms + OOT at 50 Hz
20 ms + OOT at 60 Hz

1.2.3.5.4 Test results/Remarks: t approx.
< 23 ms + OOT at 50 Hz
< 20 ms + OOT at 60 Hz

Dropout Times

Test condition: see item 1.2.3.1.1

Test values: see item 0

1.2.3.5.5 Permissive tolerance/Limiting values: t approx.
29 ms + OOT at 50 Hz
26 ms + OOT at 60 Hz

Test results/Remarks: t approx.
< 29 ms + OOT at 50 Hz
< 26 ms + OOT at 60 Hz

I-DIFF Fast

Threshold

Test condition: 0.5 ≤ I/IratedObj ≤ 35.0

Permissive tolerance/Limiting values: |δ| ≤ 2 % of setting value

Test results/Remarks: |δ| < 2 %

Dropout Ratio

Test condition: see item 0

1.2.3.6 Permissive tolerance/Limiting values: r approx. 0.70

1.2.3.6.1 Test results/Remarks: 0.68 ≤ r ≤ 0.72

Operating Times

Test condition: see item 0

Test values: I/Irated = 1, I/Irated = 2

Permissive tolerance/Limiting values: t approx.
8 ms + OOT at 50 Hz
8 ms + OOT at 60 Hz

Summary

Test results/Remarks: t approx.
< 8 ms + OOT at 50 Hz
< 8 ms + OOT at 60 Hz

1.2.3.6.2 Dropout Times

1.2.3.6.3 Test condition: see item 0

Test values: see item 0

Permissive tolerance/Limiting values: t approx.
29 ms + OOT at 50 Hz
26 ms + OOT at 60 Hz

Test results/Remarks: t approx.
< 29 ms + OOT at 50 Hz
< 26 ms + OOT at 60 Hz

1.2.3.6.4 Time Delays

1.2.3.6.5 Test condition: added to the inherent operating times

Test values: 0.00 s ≤ TD ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| □1 % of setting value or 10 ms

I-DIFF Unrestraint

Threshold

Test condition: 0.5 ≤ I/IρατεδΟβφ ≤ 35.0

Permissive tolerance/Limiting values: |δ| ≤ 2 % of setting value

Test results/Remarks: |δ| < 2 %

1.2.3.1 Dropout Ratio

Test condition: see item 0

Permissive tolerance/Limiting values: r approx. 0.70

Test results/Remarks: 0.68 ≤ r ≤ 0.72

1.2.3.2 Operating Times

Test condition: see item 0

Test values: I/Irated = 1, I/Irated = 2

Permissive tolerance/Limiting values: t approx.
8 ms + OOT at 50 Hz
8 ms + OOT at 60 Hz

Test results/Remarks: t approx.
< 8 ms + OOT at 50 Hz
< 8 ms + OOT at 60 Hz

1.2.3.3 Dropout Times

Test condition: see item 0

Test values: see item 1.2.3.2

Permissive tolerance/Limiting values: t approx.
29 ms + OOT at 50 Hz
26 ms + OOT at 60 Hz

Test results/Remarks: t approx.
< 29 ms + OOT at 50 Hz
< 26 ms + OOT at 60 Hz

1.2.3.4 Time Delays

Test condition: added to the inherent operating times

Test values: 0.00 s ≤ TD ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| < 1 % of setting value or 10 ms

Summary

1.2.4 Frequency Operating Range

Frequency manual update:	10 Hz to 80 Hz
Test results/Remarks:	confirmed

Summary

1.3 87T Transformer Differential Protection

1.3.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.3.2 General Test conditions

frated: 50 Hz, 60 Hz

Irated: 1 A, 5 A

1.3.3 I-DIFF

1.3.3.1 Operate Curve

1.3.3.1.1 I-DIFF Threshold

Test condition: 0.05 ≤ I/IratedObj ≤ 2.00

Permissive tolerance/Limiting values: |δ| ≤ 2 % of setting value

Test results/Remarks: |δ| < 2 %

1.3.3.1.2 I-DIFF Slope 1

Test condition: 0.00 to 0.80

Test results/Remarks: confirmed

1.3.3.1.3 I-DIFF Intersection 1 Irest

Test condition: 0.00 ≤ I/IratedObj ≤ 5.00

Test results/Remarks: confirmed

1.3.3.1.4 I-DIFF Slope 2

Test condition: 0.25 to 0.95

Test results/Remarks: confirmed

1.3.3.1.5 I-DIFF Intersection 2 Irest

Test condition: 1.00 ≤ I/IratedObj ≤ 20.00

Test results/Remarks: confirmed

1.3.3.2 Starting Detection

1.3.3.2.1 Threshold Startup Detection

Test condition: 0.1 ≤ I/IratedObj ≤ 2.0

Permissive tolerance/Limiting values: |δ| ≤ 2 % of setting value

Test results/Remarks: |δ| < 2 %

1.3.3.2.2 Factor Increasing Char.

Test condition: 1.0 to 5.0

Test results/Remarks: confirmed

1.3.3.2.3 Max. perm. Start Time

Test condition: 0.1 s ≤ T ≤ 180.0 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| < 1 % of setting value or 10 ms

1.3.3.3 DC offset Detection

1.3.3.3.1 Factor Increasing Char. DC

Test condition: 1.0 to 5.0

Test results/Remarks: confirmed

Summary

1.3.3.4 Inrush Blocking

1.3.3.4.1 2nd harmonic content

Test condition:	10 % to 45 %
Test results/Remarks:	confirmed

1.3.3.4.2 Crossblock Time 2nd har.

Test condition:	0.00 s ≤ T ≤ 200.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.3.3.5 Overexcit. Blocking

1.3.3.5.1 3rd harmonic content

Test condition:	10 % to 80 %
Test results/Remarks:	confirmed

1.3.3.5.2 Crossblock Time 3rd har.

Test condition:	0.00 s ≤ T ≤ 200.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.3.3.5.3 5th harmonic content

Test condition:	10 % to 80 %
Test results/Remarks:	confirmed

1.3.3.5.4 Crossblock Time 5th har.

Test condition:	0.00 s ≤ T ≤ 200.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.3.3.6 Ext. Fault Detection

1.3.3.6.1 Threshold of add-on stabiliz.

Test condition:	1.00 ≤ I/IratedObj ≤ 20.00
Permissive tolerance/Limiting values:	|δ| ≤ 2 % of setting value
Test results/Remarks:	|δ| < 2 %

1.3.3.6.2 Time of add-on stabiliz.

Test condition:	0.00 s ≤ T ≤ 5.00 s, ∞
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.3.3.6.3 Cross-blk Time of add-on stabiliz.

Test condition:	0.00 s ≤ T ≤ 2.00 s, ∞
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.3.3.7 Dropout Ratio

Test condition:	see item 1.3.3.1.1
Permissive tolerance/Limiting values:	r approx. 0.70
Test results/Remarks:	0.68 ≤ r ≤ 0.72

Summary

1.3.3.8 Operating Times

Test condition:	see item 1.3.3.1.1
Test values:	I/Irated = 1, I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 23 ms + OOT at 50 Hz 20 ms + OOT at 60 Hz
Test results/Remarks:	t approx. <23 ms + OOT at 50 Hz <20 ms + OOT at 60 Hz

1.3.3.9 Dropout Times

Test condition:	see item 1.3.3.1.1
Test values:	see item 1.3.3.8
Permissive tolerance/Limiting values:	t approx. 29 ms + OOT at 50 Hz 26 ms + OOT at 60 Hz
Test results/Remarks:	t approx. <29 ms + OOT at 50 Hz <26 ms + OOT at 60 Hz

1.3.4 I-DIFF Fast

1.3.4.1 Threshold

Test condition:	$0.5 \leq$ I/IratedObj ≤ 35.0
Permissive tolerance/Limiting values:	$\lvert\delta\rvert \leq 2$ % of setting value
Test results/Remarks:	$\lvert\delta\rvert < 2$ %

1.3.4.2 Dropout Ratio

Test condition:	see item 1.3.4.1
Permissive tolerance/Limiting values:	r approx. 0.70
Test results/Remarks:	$0.68 \leq r \leq 0.72$

1.3.4.3 Operating Times

Test condition:	see item 1.3.4.1
Test values:	I/Irated = 1, I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 8 ms + OOT at 50 Hz 8 ms + OOT at 60 Hz
Test results/Remarks:	t approx. <8 ms + OOT at 50 Hz <8 ms + OOT at 60 Hz

1.3.4.4 Dropout Times

Test condition:	see item 1.3.4.1
Test values:	see item 1.3.4.3
Permissive tolerance/Limiting values:	t approx. 29 ms + OOT at 50 Hz 26 ms + OOT at 60 Hz
Test results/Remarks:	t approx. <29 ms + OOT at 50 Hz <26 ms + OOT at 60 Hz

1.3.4.5 Time Delays

Test condition:	added to the inherent operating times
Test values:	$0.00\ s \leq TD \leq 60.00\ s$
Permissive tolerance/Limiting values:	$\lvert\delta\rvert \leq 1$ % of setting value or 10 ms
Test results/Remarks:	$\lvert\delta\rvert < 1$ % of setting value or 10 ms

Summary

1.3.5 I-DIFF Unrestraint

1.3.5.1 Threshold

Test condition:	0.5 ≤ I/IratedObj ≤ 35.0
Permissive tolerance/Limiting values:	|δ| ≤ 2 % of setting value
Test results/Remarks:	|δ| < 2 %

1.3.5.2 Dropout Ratio

Test condition:	see item 1.3.7
Permissive tolerance/Limiting values:	r approx. 0.70
Test results/Remarks:	0.68 ≤ r ≤ 0.72

1.3.5.3 Operating Times

Test condition:	see item 1.3.7
Test values:	I/Irated = 1, I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 8 ms + OOT at 50 Hz 8 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 8 ms + OOT at 50 Hz < 8 ms + OOT at 60 Hz

1.3.5.4 Dropout Times

Test condition:	see item 1.3.7
Test values:	see item 1.3.7.2
Permissive tolerance/Limiting values:	t approx. 29 ms + OOT at 50 Hz 26 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 29 ms + OOT at 50 Hz < 26 ms + OOT at 60 Hz

1.3.5.5 Time Delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ TD ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.3.6 Frequency Operating Range

Frequency manual update:	10 Hz to 80 Hz
Test results/Remarks:	confirmed

Summary

1.4 87N Restricted Earth Fault Protection (IREF$_>$)

1.4.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.4.2 Pickup value (IREF$_>$)

Test condition:	0.05 ≤ IREF$_>$/Irated$_{r\ Obj}$ ≤ 2.00
Test values:	0.05 ≤ IREF$_>$/Irated$_{r\ Obj}$ ≤ 2.00 frated = 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	|δ| ≤ 2 % of setting value at I < 5 Irated
Test results/Remarks:	|δ| < 2 % of setting value at I < 5 Irated

1.4.3 Pickup times (IREF$_>$)

1.4.3.1 1.5 x setting value (IREF$_>$)

Test condition:	IEC/EN 60255-1
Test values:	1.5 x setting value IREF$_>$ frated = 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	t approx. 33 ms + OOT at frated = 50 Hz 32 ms + OOT at frated = 60 Hz
Test results/Remarks:	t < 33 ms + OOT at frated = 50 Hz < 32 ms + OOT at frated = 60 Hz

1.4.3.2 2.5 x setting value (IREF$_>$)

Test condition:	see item 1.4.3.1
Test values:	2.5 x setting value IREF$_>$ frated = 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	t approx. 27 ms + OOT at frated = 50 Hz 26 ms + OOT at frated = 60 Hz
Test results/Remarks:	t < 27 ms + OOT at frated = 50 Hz < 26 ms + OOT at frated = 60 Hz

1.4.3.3 Dropout times

Test condition:	see item 1.4.3.1
Test values:	see item 1.4.3.1
Permissive tolerance/Limiting values:	t approx. 80 ms at frated = 50 Hz 67 ms at frated = 60 Hz
Test results/Remarks:	t < 80 ms at frated = 50 Hz < 67 ms at frated = 60 Hz

1.4.3.4 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ TD ≤ 60.00 s, ∞
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.4.3.5 Dropout ratio (IREF$_>$)

Test condition:	see item 1.4.3.1
Test values:	see item 1.4.3.1
Permissive tolerance/Limiting values:	r approx. 0.70
Test results/Remarks:	0.68 ≤ r ≤ 0.72

Summary

1.5 87M Motor Differential Protection

1.5.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.5.2 General test conditions

frated: 50 Hz, 60 Hz

Irated: 1 A, 5 A

1.5.3 I-DIFF

1.5.3.1 Operate Curve

1.5.3.1.1 I-DIFF Threshold

Test condition: 0.05 ≤ I/IratedObj ≤ 2.00

Permissive tolerance/Limiting values: |δ| ≤ 2 % of setting value

Test results/Remarks: |δ| < 2 %

1.5.3.1.2 I-DIFF Slope 1

Test condition: 0.00 to 0.80

Test results/Remarks: confirmed

1.5.3.1.3 I-DIFF Intersection 1 Irest

Test condition: 0.00 ≤ I/IratedObj ≤ 5.00

Test results/Remarks: confirmed

1.5.3.1.4 I-DIFF Slope 2

Test condition: 0.25 to 0.95

Test results/Remarks: confirmed

1.5.3.1.5 I-DIFF Intersection 2 Irest

Test condition: 1.00 ≤ I/IratedObj ≤ 20.00

Test results/Remarks: confirmed

1.5.3.2 Starting Detection

1.5.3.2.1 Threshold Startup Detection

Test condition: 0.1 ≤ I/IratedObj ≤ 2.0

Permissive tolerance/Limiting values: |δ| ≤ 2 % of setting value

Test results/Remarks: |δ| < 2 %

1.5.3.2.2 Factor Increasing Char.

Test condition: 1.0 to 5.0

Test results/Remarks: confirmed

1.5.3.2.3 Max. perm. Start Time

Test condition: 0.1 s ≤ T ≤ 180.0 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| < 1 % of setting value or 10 ms

1.5.3.3 DC offset Detection

1.5.3.3.1 Factor Increasing Char. DC

Test condition: 1.0 to 5.0

Test results/Remarks: confirmed

Summary

1.5.3.4 Ext. Fault Detection

1.5.3.4.1 Threshold of add-on stabiliz.

Test condition:	1.00 ≤ I/IratedObj ≤ 20.00
Permissive tolerance/Limiting values:	|δ| ≤ 2 % of setting value
Test results/Remarks:	|δ| < 2 %

1.5.3.4.2 Time of add-on stabiliz.

Test condition:	0.00 s ≤ T ≤ 5.00 s, ∞
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.5.3.4.3 Cross-blk time of add-on stabiliz.

Test condition:	0.00 s ≤ T ≤ 2.00 s, ∞
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.5.3.5 Dropout Ratio

Test condition:	see item 1.5.3.1.1
Permissive tolerance/Limiting values:	r approx. 0.70
Test results/Remarks:	0.68 ≤ r ≤ 0.72

1.5.3.6 Operating Times

Test condition:	see item 1.5.3.1.1
Test values:	I/Irated = 1, I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 23 ms + OOT at 50 Hz 20 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 23 ms + OOT at 50 Hz < 20 ms + OOT at 60 Hz

1.5.3.7 Dropout Times

Test condition:	see item 1.5.3.1.1
Test values:	see item 1.5.3.6
Permissive tolerance/Limiting values:	t approx. 29 ms + OOT at 50 Hz 26 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 29 ms + OOT at 50 Hz < 26 ms + OOT at 60 Hz

1.5.4 I-DIFF Fast

1.5.4.1 Threshold

Test condition:	0.5 ≤ I/IratedObj ≤ 35.0
Permissive tolerance/Limiting values:	|δ| ≤ 2 % of setting value
Test results/Remarks:	|δ| < 2 %

1.5.4.2 Dropout Ratio

Test condition:	see item 1.5.4.1
Permissive tolerance/Limiting values:	r approx. 0.70
Test results/Remarks:	0.68 ≤ r ≤ 0.72

Summary

1.5.4.3 Operating Times

Test condition:	see item 1.5.4.1
Test values:	I/Irated = 1, I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 8 ms + OOT at 50 Hz 8 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 8 ms + OOT at 50 Hz < 8 ms + OOT at 60 Hz

1.5.4.4 Dropout Times

Test condition:	see item 1.5.4.1
Test values:	see item 1.5.4.3
Permissive tolerance/Limiting values:	t approx. 29 ms + OOT at 50 Hz 26 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 29 ms + OOT at 50 Hz < 26 ms + OOT at 60 Hz

1.5.4.5 Time Delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ TD ≤ 60.00 s
Permissive tolerance/Limiting values:	$\|\delta\| \leq 1$ % of setting value or 10 ms
Test results/Remarks:	$\|\delta\| < 1$ % of setting value or 10 ms

1.5.5 I-DIFF Unrestraint

1.5.5.1 Threshold

Test condition:	0.5 ≤ I/IratedObj ≤ 35.0
Permissive tolerance/Limiting values:	$\|\delta\| \leq 2$ % of setting value
Test results/Remarks:	$\|\delta\| < 2$ %

1.5.5.2 Dropout Ratio

Test condition:	see item 1.5.6
Permissive tolerance/Limiting values:	r approx. 0.70
Test results/Remarks:	0.68 ≤ r ≤ 0.72

1.5.5.3 Operating Times

Test condition:	see item 1.5.6
Test values:	I/Irated = 1, I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 8 ms + OOT at 50 Hz 8 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 8 ms + OOT at 50 Hz < 8 ms + OOT at 60 Hz

1.5.5.4 Dropout Times

Test condition:	see item 1.5.6
Test values:	see item 1.5.6.2
Permissive tolerance/Limiting values:	t approx. 29 ms + OOT at 50 Hz 26 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 29 ms + OOT at 50 Hz < 26 ms + OOT at 60 Hz

Summary

1.5.5.5 Time Delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ TD ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.5.6 Frequency Operating Range

Frequency manual update:	10 Hz to 80 Hz
Test results/Remarks:	confirmed

Summary

1.6 Impedance Protection

1.6.1 Pickup values

1.6.1.1 Current

Test condition:	0.030 Irated ≤ Iph ≤ 35.000 Irated
Test values:	0.05 Irated ≤ Iph ≤ 10.00 Irated
Permissive tolerance/Limiting values:	|δ| ≤ 5 % of setting value
Test results/Remarks:	|δ| ≤ 1.0 % or 1 % Irated

1.6.1.2 Voltage

Test condition:	0.500 V ≤ Vph-gnd ≤ 70.00 V 1.000 V ≤ Vph-ph ≤ 130.0 V
Test values:	5.00 V ≤ Vph-gnd ≤ 50.00 V 8.00 V ≤ Vph-ph ≤ 80.0 V
Permissive tolerance/Limiting values:	|δ| ≤ 5 % of setting value
Test results/Remarks:	|δ| < 5 % or 0.5 V

1.6.2 Dropout ratio

Test condition:	0.030 Irated ≤ Iph ≤ 35.000 Irated
Test values:	0.05 Irated ≤ Iph ≤ 10.00 Irated
Permissive tolerance/Limiting values:	r approx. 0.95
Test results/Remarks:	r approx. 0.95

1.6.3 Distance measurement

1.6.3.1 Polygonal characteristic

Test condition:

parameters:

- Zone Z1: X1	=	2.5 Ω
- Zone Z2: X2	=	5.0 Ω
- Zone Z3: X3	=	10.0 Ω
- Zone Z4: X4	=	12.0 Ω

Test values: I = 1.5 Irated; Fault L-N,L-L,L-L-L ; Angle φ(V,I) in range 0...360° with steps of 5°

Permissive tolerance/Limiting values:
X: |δ| ≤ 5 % of setting value for 30° ≤ PHI(V,I) ≤ 90°
R: |δ| ≤ 5 % of setting value for 0° ≤ PHI(V,I) ≤ 60°

Test results/Remarks:
X, R:
- Zone Z1: |δ| ≤ 3 %
- Zone Z2: |δ| ≤ 3 %
- Zone Z3: |δ| ≤ 3 %
- Zone Z4: |δ| ≤ 3 %

1.6.4 Directional measurement

Test condition:	fault L-N,L-L,L-L-L,
Permissive tolerance/Limiting values:	function according to manual
Test results/Remarks:	function correct

1.6.5 Time stages of distance zones

1.6.5.1 Pickup times

Test condition:
fault L-N,L-L,L-L-L
fault angle 90°
SIR 1
measured with fast relay

Permissive tolerance/Limiting values: $t_{,min}$ approx. 40/35 ms (fast relay/high speed relay)

Test results/Remarks:

	50 Hz	60 Hz	
tmin =	25.9 ms	21.8 ms	
taverage =		32.3 ms	27.4 ms
tmax =	37.4 ms	30.5 ms	

Summary

1.6.5.2 Dropout times

Test condition:	fault L-N,L-L,L-L-L
Permissive tolerance/Limiting values:	t approx. 20 ms
Test results/Remarks:	tmin = 13.6 ms taverage = 18.2 ms tmax = 23.4 ms

1.6.5.3 Tolerances of time stages

Test condition:	time stages: T11pol; T21pol; T31pol; T41pol $T1_{>1pol}$; $T2_{>1pol}$; $T3_{>1pol}$; $T4_{>1pol}$
Test values:	$0.00\ s \leq T \leq 60.00\ s; \infty$
Permissive tolerance/Limiting values:	$\lvert\delta\rvert \leq 1\ \%$ of setting value or 10 ms
Test results/Remarks:	$\lvert\delta\rvert \leq 1\ \%$ or 10 ms

1.6.5.4 Zone directions

Permissive tolerance/Limiting values:	function according to manual
Test results/Remarks:	function correct

Summary

1.7 Stator Ground Fault Protection 90%

1.7.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.7.2 3I0 stage

1.7.2.1 Pickup values

Test condition:	Fundamental components, RMS values frated = 50 Hz, 60 Hz 0.001 Irated ≤ 3I0> ≤ 1.600 Irated for CT sensitive 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Test values:	Fundamental components, RMS values frated = 50 Hz, 60 Hz 0.001 Irated ≤ 3I0> ≤ 1.600 Irated for CT sensitive 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Permissive tolerance/Limiting values:	For CT sensitive: $\|\delta\|$ ≤ 1 % from setting value or 0.1% of Irated For CT protection: $\|\delta\|$ ≤ 1 % from setting value or 1.0% of Irated
Test results/Remarks:	For CT sensitive: $\|\delta\|$ < 1 % from setting value or 0.1% of Irated For CT protection: $\|\delta\|$ < 1 % from setting value or 1.0% of Irated

1.7.2.2 Dropout ratio

Test condition:	see item 1.7.2.1
Test values:	r = 0.95
Permissive tolerance/Limiting values:	For CT sensitive: 0.93 ≤ r ≤ 0.97 of threshold value or 0.1% of Irated For CT protection: 0.93 ≤ r ≤ 0.97 of threshold value or 1.5% of Irated
Test results/Remarks:	For CT sensitive: 0.93 ≤ r ≤ 0.97 of threshold value or 0.1% of Irated For CT protection: 0.93 ≤ r ≤ 0.97 of threshold value or 1.5% of Irated

1.7.2.3 Pickup times

Test condition:	see item 1.7.2.1
Test values:	3I0 = 0.050 A at Ifault = 1.000 A
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 23 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 23 ms + OOT at frated = 60 Hz

1.7.2.4 Dropout times

Test condition:	see item 1.7.2.1
Test values:	see item 1.7.2.3
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz

1.7.2.5 Time delays

Test condition:	see item 1.7.2.1
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	$\|\delta\|$ ≤ 1 % of setting value or 10 ms

Summary

Test results/Remarks: |δ| < 1 % or 10 ms

1.7.3 3I0 with φ (V,I)-measurement stage

1.7.3.1 Pickup values 3I0

Test condition: frated = 50 Hz, 60 Hz
0.001 Irated ≤ 3I0> ≤ 1.600 Irated for CT sensitive
0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection

Test values: frated = 50 Hz, 60 Hz
0.001 Irated ≤ 3I0> ≤ 1.600 Irated for CT sensitive
0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection

Permissive tolerance/Limiting values: For CT sensitive:
|δ| ≤ 1 % from setting value or 0.1% of Irated
For CT protection:
|δ| ≤ 1 % from setting value or 1.0% of Irated

Test results/Remarks: For CT sensitive:
|δ| < 1 % from setting value or 0.1% of Irated
For CT protection:
|δ| < 1 % from setting value or 1.0% of Irated

1.7.3.2 Pickup values V0

Test condition: frated = 50 Hz, 60 Hz
0.300 V ≤ V0> ≤ 200.000 V

Test values: frated = 50 Hz, 60 Hz
0.300 V ≤ V0> ≤ 200.000 V

Permissive tolerance/Limiting values: |δ| ≤ 1 % from setting value or 0.05 V

Test results/Remarks: |δ| < 1 % or 0.05 V

1.7.3.3 Rotation angle of the reference voltage

Test condition: -180° ≤ φ ≤ 180°

Test values: -180° ≤ φ ≤ 180°

Permissive tolerance/Limiting values: |δ| ≤ 1° at 3I0 > 5 mA, V0> = 0.6 V

Test results/Remarks: |δ| < 1° at 3I0 > 5 mA, V0> = 0.6 V

1.7.3.4 Dropout ratio

Test condition: see item 1.7.3.1 and 1.7.3.2

Test values: r = 0.95

Permissive tolerance/Limiting values: For CT sensitive:
0.93 ≤ r ≤ 0.97 of threshold value or 0.1% of Irated
For CT protection:
0.93 ≤ r ≤ 0.97 of threshold value or 1.5% of Irated

Test results/Remarks: For CT sensitive:
0.93 ≤ r ≤ 0.97 of threshold value or 0.1% of Irated
For CT protection:
0.93 ≤ r ≤ 0.97 of threshold value or 1.5% of Irated

1.7.3.5 Pickup times

Test condition: see item 1.7.3.1 and 1.7.3.2

Test values: 3I0 = 0.050 A at Ifault = 0.100 A

Permissive tolerance/Limiting values: t approx.
23 ms + OOT at frated = 50 Hz
21 ms + OOT at frated = 60 Hz

Test results/Remarks: t approx.
23 ms + OOT at frated = 50 Hz
21 ms + OOT at frated = 60 Hz

1.7.3.6 Dropout times

Test condition: see item 1.7.3.1 and 1.7.3.2

Test values: see item 1.7.3.5

Summary

Permissive tolerance/Limiting values: t approx.
21 ms + OOT at frated = 50 Hz
20 ms + OOT at frated = 60 Hz

Test results/Remarks: t approx.
21 ms + OOT at frated = 50 Hz
20 ms + OOT at frated = 60 Hz

1.7.3.7 Time delays

Test condition: see item 1.7.3.1 and 1.7.3.2

Test values: 0.00 s ≤ T> ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| < 1 % or 10 ms

1.7.4 Overvoltage protection stage V0>

1.7.4.1 Pickup values

Test condition: Fundamental components, RMS values
frated = 50 Hz, 60 Hz
0.300 V ≤ V0> ≤ 200.000 V

Test values: Fundamental components, RMS values
frated = 50 Hz, 60 Hz
0.300 V ≤ V0> ≤ 200.000 V

Permissive tolerance/Limiting values: |δ| ≤ 1.0 % from setting value or 0.05 V

Test results/Remarks: |δ| < 1.0 % or 0.05 V

1.7.4.2 Dropout ratio

Test condition: r = setable dropout ratio
0.90 ≤ r ≤ 0.99

Test values: 0.90 ≤ r ≤ 0.99

Test results/Remarks: 0.90 ≤ r ≤ 0.99

1.7.4.3 Pickup times

Test condition: see item 1.7.4.1

Test values: V0 = 10 V at Vfault = 20 V

Permissive tolerance/Limiting values: t approx.
RMS values, standard filter:
25 ms + OOT at frated = 50 Hz
22 ms + OOT at frated = 60 Hz
Fundamental components, filter over 2 cycles:
34 ms + OOT at frated = 50 Hz
28 ms + OOT at frated = 60 Hz

Test results/Remarks: t approx.
RMS values, standard filter:
25 ms + OOT at frated = 50 Hz
22 ms + OOT at frated = 60 Hz
Fundamental components, filter over 2 cycles:
34 ms + OOT at frated = 50 Hz
28 ms + OOT at frated = 60 Hz

1.7.4.4 Dropout times

Test condition: see item 1.7.4.1

Test values: see item 1.7.4.3

Permissive tolerance/Limiting values: t approx.
RMS values, standard filter:
21 ms + OOT
Fundamental components, filter over 2 cycles:
21 ms + OOT

Test results/Remarks: t approx.
RMS values, standard filter:
21 ms + OOT
Fundamental components, filter over 2 cycles:
21 ms + OOT

Summary

1.7.4.5 Time delays

Test condition:	see item 1.7.4.1
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % or 10 ms

Summary

1.8 64G Stator Ground Fault Protection 100% 20Hz

1.8.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.8.2 I(RMS)> stage

1.8.2.1 Pickup values

Test condition:	RMS values 0.020 Irated ≤ I(RMS)> ≤ 1.500 Irated for CT sensitive
Test values:	frated = 50 Hz, 60 Hz 0.020 Irated ≤ I(RMS)> ≤ 1.500 Irated for CT sensitive
Permissive tolerance/Limiting values:	For CT sensitive: |δ| ≤ 3 % of setting value or 3 mA
Test results/Remarks:	|δ| < 3 % of setting value or 3 mA

1.8.2.2 Dropout ratio

Test condition:	see item 1.8.2.1
Test values:	see item 1.8.2.1
Permissive tolerance/Limiting values:	r = 0.80
Test results/Remarks:	0.77 ≤ r ≤ 0.83 of threshold value

1.8.2.3 Pickup times

Test condition:	see item 1.8.2.1
Test values:	I(RMS) = 0.400 A at Ifault = 0.600 A
Permissive tolerance/Limiting values:	t approx. < 110 ms + OOT
Test results/Remarks:	t approx. < 110 ms + OOT

1.8.2.4 Dropout times

Test condition:	see item 1.8.2.1
Test values:	see item 1.8.2.3
Permissive tolerance/Limiting values:	t approx. < 120 ms + OOT
Test results/Remarks:	t approx. < 120 ms + OOT

1.8.2.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % from setting value or 10 ms
Test results/Remarks:	|δ| < 1 % from setting value or 10 ms

1.8.3 R20< stage

1.8.3.1 Pickup values

Test condition:	20 Ohm ≤ R20> ≤ 700 Ohm
Test values:	frated = 50 Hz, 60 Hz 20 Ohm ≤ R20> ≤ 700 Ohm
Permissive tolerance/Limiting values:	|δ| ≤ 5 % from setting value or 2 Ohm
Test results/Remarks:	|δ| ≤ 5 % from setting value or 2 Ohm

1.8.3.2 Dropout ratio

Test condition:	see item 1.8.3.1
Test values:	see item 1.8.3.1
Permissive tolerance/Limiting values:	approx. 1.20

Summary

Test results/Remarks: ~1.20

1.8.3.3 Pickup times

Test condition: see item 1.8.3.1

Test values: I/Irated = 1.4

Permissive tolerance/Limiting values: t approx.
≤ 300 ms + OOT

Test results/Remarks: t approx.
< 300 ms + OOT

1.8.3.4 Dropout times

Test condition: see item 1.8.3.1

Test values: see item 1.8.3.1

Permissive tolerance/Limiting values: t approx.
≤ 130 ms + OOT

Test results/Remarks: t approx.
< 130 ms + OOT

1.8.3.5 Time delays

Test condition: added to the inherent operating times

Test values: 0.00 s ≤ T> ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % from setting value or 10 ms

Test results/Remarks: |δ| < 1 % from setting value or 10 ms

Summary

1.9 27/59TN Stator Ground Fault Protection 3rd Harm.

1.9.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-127

1.9.2 General

1.9.2.1 P min

1.9.2.1.1 Pickup values

Test condition:	0.0 % ≤ threshold value ≤ 100.0 %
Test values:	0.0 % ≤ threshold value ≤ 100.0 %
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 3 % of setting value
Test results/Remarks:	in the range frated ±10 % |δ| < 3 % of setting value

1.9.2.1.2 Dropout ratio

Test condition:	see item 1.9.2.1.1
Test values:	r = 0.90
Permissive tolerance/Limiting values:	0.88 ≤ r ≤ 0.92 of threshold value or ≤ 0.5 % Srated
Test results/Remarks:	0.88 ≤ r ≤ 0.92 of threshold value or < 0.5 % Srated

1.9.2.2 V1 min

1.9.2.2.1 Pickup values

Test condition:	0.300 V ≤ threshold value ≤ 200.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 1.0 % of setting value or 0.05 V
Test results/Remarks:	in the range frated ±10 % |δ| < 1.0 % of setting value or 0.05 V

1.9.2.2.2 Dropout ratio

Test condition:	see item 1.9.2.2.1
Test values:	r = 0.90
Permissive tolerance/Limiting values:	0.88 ≤ r ≤ 0.92 of threshold value or ≤ 0.2 V
Test results/Remarks:	0.88 ≤ r ≤ 0.92 of threshold value or < 0.2 V

1.9.3 V0 3. Harm. <

1.9.3.1 Pickup values

Test condition:	0.300 V ≤ threshold value ≤ 100.000 V
Test values:	0.300 V ≤ threshold value ≤ 100.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 1.0 % of setting value or 0.10 V
Test results/Remarks:	in the range frated ±10 % |δ| < 1.0 % of setting value or 0.10 V

1.9.3.2 Dropout ratio

Test condition:	see item 1.9.3.1
Test values:	r = 1.10
Permissive tolerance/Limiting values:	1.08 ≤ r ≤ 1.12 of threshold value or ≤ 0.2 V
Test results/Remarks:	1.08 ≤ r ≤ 1.12 of threshold value or < 0.2 V

1.9.3.3 Pickup times

Test condition:	see item 1.9.3.1

Summary

Test values: 0.8* threshold value

Permissive tolerance/Limiting values: t approx.
61 ms + OOT at frated = 50 Hz
52 ms + OOT at frated = 60 Hz

Test results/Remarks: t approx.
61 ms + OOT at frated = 50 Hz
52 ms + OOT at frated = 60 Hz

1.9.3.4 Dropout times

Test condition: see item 1.9.3.1

Permissive tolerance/Limiting values: t approx.
19 ms + OOT at frated = 50 Hz
16 ms + OOT at frated = 60 Hz

Test results/Remarks: t approx.
19 ms + OOT at frated = 50 Hz
16 ms + OOT at frated = 60 Hz

1.9.3.5 Time delays

Test condition: see item 1.9.3.1

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| < 1 % of setting value or 10 ms

1.9.4 V0 3. Harm. >

1.9.4.1 Pickup values

Test condition: 0.300 V ≤ threshold value ≤ 100.000 V

Test values: 0.300 V ≤ threshold value ≤ 100.000 V

Permissive tolerance/Limiting values: in the range frated ±10 %
|δ| ≤ 1.0 % of setting value or 0.10 V

Test results/Remarks: in the range frated ±10 %
|δ| < 1.0 % of setting value or 0.10 V

1.9.4.2 Dropout ratio

Test condition: see item 1.9.4.1

Test values: r = 0.90

Permissive tolerance/Limiting values: 0.88 ≤ r ≤ 0.92 of threshold value or ≤ 0.2 V

Test results/Remarks: 0.88 ≤ r ≤ 0.92 of threshold value or < 0.2 V

1.9.4.3 Pickup times

Test condition: see item 1.9.4.1

Test values: 1.2* threshold value

Permissive tolerance/Limiting values: t approx.
53 ms + OOT at frated = 50 Hz
47 ms + OOT at frated = 60 Hz

Test results/Remarks: t approx.
53 ms + OOT at frated = 50 Hz
47 ms + OOT at frated = 60 Hz

1.9.4.4 Dropout times

Test condition: see item 1.9.4.1

Permissive tolerance/Limiting values: t approx.
27 ms + OOT at frated = 50 Hz
22 ms + OOT at frated = 60 Hz

Test results/Remarks: t approx.
27 ms + OOT at frated = 50 Hz
22 ms + OOT at frated = 60 Hz

1.9.4.5 Time delays

Test condition: see item 1.9.4.1

Summary

Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.9.5 Delta V0 3. Harm. >

1.9.5.1 Pickup values

Test condition:	0.300 V ≤ threshold value ≤ 100.000 V
Test values:	0.300 V ≤ threshold value ≤ 100.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 2.0 % of setting value or 0.10 V
Test results/Remarks:	in the range frated ±10 % |δ| < 2.0 % of setting value or 0.10 V

1.9.5.2 Dropout ratio

Test condition:	see item 1.9.5.1
Test values:	r = 0.90
Permissive tolerance/Limiting values:	0.88 ≤ r ≤ 0.92 of threshold value or ≤ 0.2 V
Test results/Remarks:	0.88 ≤ r ≤ 0.92 of threshold value or < 0.2 V

1.9.5.3 Pickup times

Test condition:	see item 1.9.5.1
Test values:	1.2* threshold value
Permissive tolerance/Limiting values:	t approx. 51 ms + OOT at frated = 50 Hz 42 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 51 ms + OOT at frated = 50 Hz 42 ms + OOT at frated = 60 Hz

1.9.5.4 Dropout times

Test condition:	see item 1.9.5.1
Permissive tolerance/Limiting values:	t approx. 33 ms + OOT at frated = 50 Hz 29 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 33 ms + OOT at frated = 50 Hz 29 ms + OOT at frated = 60 Hz

1.9.5.5 Time delays

Test condition:	see item 1.9.5.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

Summary

1.10 50/51 Overcurrent Protection, Phases

1.10.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.10.2 Overcurrent Protection, phases with definite time overcurrent stages (definite time)

1.10.2.1 Pickup values

Test condition:	0.030 Irated ≤ threshold value ≤ 35.000 Irated frated = 50 Hz, 60 Hz
Method of measurement = fundamental components of phases:	
Permissive tolerance/Limiting values:	1 % of setting value or 0.005 Irated
Test results/Remarks:	1 % of setting value or 0.005 Irated
Method of measurement = RMS value of phases, no filter applied:	
Permissive tolerance/Limiting values:	up to 30th harmonic: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th harmonic: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
Method of measurement = RMS value of phases, with filter for the compensation of the amplitude attenuation due to the anti-aliasing:	
Permissive tolerance/Limiting values:	up to 30th harmonic: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 2 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 3 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th harmonic: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 2 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 3 % of setting value or 0.02 Irated
Method of measurement = RMS value of phases, with filter for the gain of harmonics (including compensation of the amplitude attenuation[1]	
Permissive tolerance/Limiting values:	up to 30th harmonic: 1.5 % of setting value or 0.01 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th harmonic: 1.5 % of setting value or 0.01 Irated[2] up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated[3] up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated[3]

1.10.2.2 Dropout ratio

Test condition:	see item 1.10.2.1
Test values:	0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	1 % of dropout value
Test results/Remarks:	1 % of dropout value

1.10.2.3 Pickup times

Test condition:	see item 1.10.2.1
Test values:	1.2*threshold
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz

[1] In case that the filter response exactly matches the user defined gain factor
[2] In case that the user-defined gain factor is set below 3. The tolerance is amplified if the gain factor is larger
[3] In case that the user-defined gain factor is set below 7. The tolerance is amplified if the gain factor is larger

Summary

1.10.2.4 Dropout times

Test condition:	see item 1.10.2.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.10.2.5 Time delay

Test condition:	see item 1.10.2.1 1.2*threshold
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 30 ms
Test results/Remarks:	1 % of setting value or 30 ms

1.10.3 Overcurrent Protection, phases with inverse time overcurrent stage (inverse time)

1.10.3.1 Pickup values

Test condition:	0.030 Irated ≤ threshold value ≤ 35.000 Irated frated = 50 Hz, 60 Hz

Method of measurement = fundamental components of phases:

Permissive tolerance/Limiting values:	1 % of setting value or 0.005 Irated
Test results/Remarks:	1 % of setting value or 0.005 Irated

Method of measurement = RMS value of phases, no filter applied:

Permissive tolerance/Limiting values:	up to 30th harmonic: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th harmonic: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

Method of measurement = RMS value of phases,

with filter for the compensation of the amplitude attenuation due to the anti-aliasing:

Permissive tolerance/Limiting values:	up to 30th harmonic: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 2 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 3 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th harmonic: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 2 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 3 % of setting value or 0.02 Irated

Method of measurement = RMS value of phases,

with filter for the gain of harmonics (including compensation of the amplitude attenuation[1]

Permissive tolerance/Limiting values:	up to 30th harmonic: 1.5 % of setting value or 0.01 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th harmonic: 1.5 % of setting value or 0.01 Irated[2] up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated[3] up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated[3]

1.10.3.2 Dropout ratio

Test condition:	see item 1.10.3.1
Instantaneous:	
Test values:	1.05 * threshold value 0.95 * pickup value
Disk emulation	
Test values:	0.90 * threshold value
Permissive tolerance/Limiting values:	1 % of dropout value

[1] In case that the filter response exactly matches the user defined gain factor
[2] In case that the user-defined gain factor is set below 3. The tolerance is amplified if the gain factor is larger
[3] In case that the user-defined gain factor is set below 7. The tolerance is amplified if the gain factor is larger

Summary

Test results/Remarks: 1% of dropout value

1.10.3.3 Pickup times

Test condition: see item 1.10.3.1
1.2*threshold

Permissive tolerance/Limiting values: t approx.
25 ms + OOT at 50 Hz
22 ms + OOT at 60 Hz

Test results/Remarks: t approx.
25 ms + OOT at 50 Hz
22 ms + OOT at 60 Hz

1.10.3.4 Dropout times

Test condition: see item 1.10.3.1

Permissive tolerance/Limiting values: t approx.
20 ms + OOT

Test results/Remarks: t approx.
20 ms + OOT

1.10.3.5 Tripping time characteristics

Test condition: see item 1.10.3.1
1.2*threshold

Test values: Time dial: $0.05 \leq T \leq 15.00$

Permissive tolerance/Limiting values: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.5.1 IEC normal inverse (type A)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.5.2 IEC very inverse (type B)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.5.3 IEC extremely inverse (type C)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.5.4 IEC long-time inverse (type B)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.5.5 ANSI long-time inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.5.6 ANSI short-time inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.5.7 ANSI extremely inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.5.8 ANSI very inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.5.9 ANSI normal inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.5.10 ANSI moderately inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.5.11 ANSI definite inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.6 Dropout characteristics

Test condition: see item 1.10.3.1
Disk emulation: 0.8*threshold

Test values: Time dial: $0.05 \leq T \leq 15.00$

Permissive tolerance/Limiting values: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.6.1 IEC normal inverse (type A)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.6.2 IEC very inverse (type B)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

Summary

1.10.3.6.3 IEC extremely inverse (type C)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.6.4 IEC long-time inverse (type B)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.6.5 ANSI long-time inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.6.6 ANSI short-time inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.6.7 ANSI extremely inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.6.8 ANSI very inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.6.9 ANSI normal inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.6.10 ANSI moderately inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.3.6.11 ANSI definite inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.4 Overcurrent Protection, phases with user-defined characteristic[1]

1.10.4.1 Pickup

Test condition: 0.030 Irated ≤ threshold value ≤ 35.000 Irated
frated = 50 Hz, 60 Hz

Method of measurement = fundamental components of phases:

Permissive tolerance/Limiting values: 1 % of setting value or 0.005 Irated

Test results/Remarks: 1 % of setting value or 0.005 Irated

Method of measurement = RMS value of phases, no filter applied :

Permissive tolerance/Limiting values:
up to 30th harmonic: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

Test results/Remarks:
up to 30th harmonic: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

Method of measurement = RMS value of phases,

with filter for the compensation of the amplitude attenuation due to the anti-aliasing:

Permissive tolerance/Limiting values:
up to 30th harmonic: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 2 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 3 % of setting value or 0.02 Irated

Test results/Remarks:
up to 30th harmonic: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 2 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 3 % of setting value or 0.02 Irated

Method of measurement = RMS value of phases,

with filter for the gain of harmonics (including compensation of the amplitude attenuation[2]

Permissive tolerance/Limiting values:
up to 30th harmonic: 1.5 % of setting value or 0.01 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

Test results/Remarks:
up to 30th harmonic: 1.5 % of setting value or 0.01 Irated[3]
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated[1]
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated[1]

1.10.4.2 Dropout ratio

Test condition: see item 1.10.4.1

[1] Not available for Busbar Protection
[2] In case that the filter response exactly matches the user defined gain factor
[3] In case that the user-defined gain factor is set below 3. The tolerance is amplified if the gain factor is larger

Summary

Instantaneous:

Test values: 1.05 * threshold value
0.95 * pickup value

Disk emulation

Test values: 0.90 * threshold value

Permissive tolerance/Limiting values: 1 % of dropout value

Test results/Remarks: 1% of dropout value

1.10.4.3 Pickup times

Test condition: see item 1.10.4.1
1.2*threshold

Permissive tolerance/Limiting values: t approx.
25 ms + OOT at 50 Hz
22 ms + OOT at 60 Hz

Test results/Remarks: t approx.
25 ms + OOT at 50 Hz
25 ms + OOT at 60 Hz

1.10.4.4 Dropout times

Test condition: see item 1.10.4.1

Permissive tolerance/Limiting values: t approx.
25 ms + OOT

Test results/Remarks: t approx.
25 ms + OOT

1.10.4.5 Tripping time characteristics

Test condition: see item 1.10.4.1
1.2*threshold

Test values: Time dial: $0.05 \leq T \leq 15.00$

Permissive tolerance/Limiting values: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.10.4.6 Dropout characteristics

Test condition: see item 1.10.4.1
Disk emulation: 0.8*threshold

Test values: Time dial: $0.05 \leq T \leq 15.00$

Permissive tolerance/Limiting values: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

[1] In case that the user-defined gain factor is set below 7. The tolerance is amplified if the gain factor is larger

Summary

1.11 67 Directional Overcurrent Protection, Phases

1.11.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.11.2 Directional overcurrent protection, phases with definite time overcurrent stages (definite time)

1.11.2.1 Pickup values

Test condition:	0.030 Irated ≤ threshold value ≤ 35.000 Irated frated = 50 Hz, 60 Hz
Method of measurement = fundamental components:	
Permissive tolerance/Limiting values:	1 % of setting value or 0.005 Irated
Test results/Remarks:	1 % of setting value or 0.005 Irated
Method of measurement = RMS value:	
Permissive tolerance/Limiting values:	up to 30th hamonics: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th hamonics: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

1.11.2.2 Dropout ratio

Test condition:	see item 1.11.2.1
Test values:	0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	1 % of dropout value
Test results/Remarks:	1 % of dropout value

1.11.2.3 Pickup times

Test condition:	see item 1.11.2.1 1.2*threshold
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz

1.11.2.4 Dropout times

Test condition:	see item 1.11.2.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.11.2.5 Time delay

Test condition:	see item 1.11.2.1 1.2*threshold
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

Summary

1.11.3 Directional overcurrent protection, phases with inverse time overcurrent stage (inverse time)

1.11.3.1 Pickup values

Test condition:	0.030 Irated ≤ threshold value ≤ 35.000 Irated frated = 50 Hz, 60 Hz
Method of measurement = fundamental components:	
Permissive tolerance/Limiting values:	1 % of setting value or 0.005 Irated
Test results/Remarks:	1 % of setting value or 0.005 Irated
Method of measurement = RMS value:	
Permissive tolerance/Limiting values:	up to 30th hamonics: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th hamonics: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

1.11.3.2 Dropout ratio

Test condition:	see item 1.11.3.1
Instantaneous:	
Test values:	1.05 * threshold value 0.95 * pickup value
Disk emulation	
Test values:	0.90 * threshold value
Permissive tolerance/Limiting values:	1 % of dropout value
Test results/Remarks:	1% of dropout value

1.11.3.3 Pickup times

Test condition:	see item 1.11.3.1 1.2*threshold
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 25 ms + OOT at 60 Hz

1.11.3.4 Dropout times

Test condition:	see item 1.11.3.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.11.3.5 Tripping time characteristics

Test condition:	see item 1.11.3.1 1.2*threshold
Test values:	Time dial: 0.05 ≤ T ≤ 15.00
Permissive tolerance/Limiting values:	5 % of setting value or + 2 % of current tolerance or 10 ms

1.11.3.5.1 IEC normal inverse (type A)

Test results/Remarks:	5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.5.2 IEC very inverse (type B)

Test results/Remarks:	5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.5.3 IEC extremely inverse (type C)

Test results/Remarks:	5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.5.4 IEC long-time inverse (type B)

Test results/Remarks:	5 % of setting value or ± 2 % of current tolerance or 30 ms

Summary

1.11.3.5.5 ANSI long-time inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.5.6 ANSI short-time inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.5.7 ANSI extremely inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.5.8 ANSI very inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.5.9 ANSI normal inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.5.10 ANSI moderately inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.5.11 ANSI definite inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.6 Dropout characteristics

Test condition: see item 1.11.3.1

Disk emulation: 0.8*threshold

Test values: Time dial: $0.05 \leq T \leq 15.00$

Permissive tolerance/Limiting values: 5 % of setting value or + 2 % of current tolerance or 10 ms

1.11.3.6.1 IEC normal inverse (type A)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.6.2 IEC very inverse (type B)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.6.3 IEC extremely inverse (type C)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.6.4 IEC long-time inverse (type B)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.6.5 ANSI long-time inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.6.6 ANSI short-time inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.6.7 ANSI extremely inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.6.8 ANSI very inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.6.9 ANSI normal inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.6.10 ANSI moderately inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.11.3.6.11 ANSI definite inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

Summary

1.11.4 Overcurrent protection, phases with user-defined characteristic

1.11.4.1 Pickup

Test condition:	0.030 Irated ≤ threshold value ≤ 35.000 Irated frated = 50 Hz, 60 Hz
Method of measurement = fundamental components:	
Permissive tolerance/Limiting values:	1 % of setting value or 0.005 Irated
Test results/Remarks:	1 % of setting value or 0.005 Irated
Method of measurement = RMS value:	
Permissive tolerance/Limiting values:	up to 30th hamonics: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th hamonics: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

1.11.4.2 Dropout ratio

Test condition:	see item 1.11.4.1
Instantaneous:	
Test values:	1.05 * threshold value 0.95 * pickup value
Disk emulation	
Test values:	0.90 * threshold value
Permissive tolerance/Limiting values:	1 % of dropout value
Test results/Remarks:	1% of dropout value

1.11.4.3 Pickup times

Test condition:	see item 1.11.4.1 1.2*threshold
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 25 ms + OOT at 60 Hz

1.11.4.4 Dropout times

Test condition:	see item 1.11.4.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 25 ms + OOT

1.11.4.5 Tripping time characteristics

Test condition:	see item 1.11.4.1 1.2*threshold
Test values:	Time dial: 0.05 ≤ T ≤ 15.00
Permissive tolerance/Limiting values:	5 % of setting value or + 2 % of current tolerance or 10 ms
Test results/Remarks:	5 % of setting value or ± 2 % of current tolerance or 10 ms

1.11.4.6 Dropout characteristics

Test condition:	see item 1.11.4.1
Disk emulation:	0.8*threshold
Test values:	Time dial: 0.05 ≤ T ≤ 15.00
Permissive tolerance/Limiting values:	5 % of setting value or + 2 % of current tolerance or 10 ms
Test results/Remarks:	5 % of setting value or ± 2 % of current tolerance or 10 ms

Summary

1.11.5 Directional determination

Test condition:	0.030 Irated ≤ threshold value ≤ 35.000 Irated frated = 50 Hz, 60 Hz
Test values:	-180°≤ φ ≤ 180°
Permissive tolerance/Limiting values:	1°
Test results/Remarks:	4°

Summary

1.12 50N/51N Overcurrent Protection, Ground

1.12.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.12.2 Overcurrent Protection, ground with definite time overcurrent stages (definite time)

1.12.2.1 Pickup values

Test condition:
0.010 Irated ≤ threshold value ≤ 35.000 Irated for protection CT
0.001 A ≤ threshold value ≤ 1.600 A for instrument CT (Current range: 1.6A)
0.002 A ≤ threshold value ≤ 8.000 A for instrument CT (Current range: 8A)
frated = 50 Hz, 60 Hz

Method of measurement = fundamental components of phases and 3I0:

Permissive tolerance/Limiting values:
For protection CT:
1 % of setting value or 0.005 Irated
For instrument CT:
1 % of setting value or 0.0005 Irated

Test results/Remarks:
For protection CT:
1 % of setting value or 0.005 Irated
For instrument CT:
1 % of setting value or 0.0005 Irated

Method of measurement = RMS value of phases and 3I0:

Permissive tolerance/Limiting values:
For protection CT:
up to 30th harmonics: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
For instrument CT:
up to 30th harmonics: 1 % of setting value or 0.0005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.001 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.001 Irated

Test results/Remarks:
For protection CT:
up to 30th harmonics: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
For instrument CT:
up to 30th harmonics: 1 % of setting value or 0.0005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.001 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.001 Irated

1.12.2.2 Dropout ratio

Test condition:
see item 1.12.2.1

Test values:
For protection CT:
95 % of Threshold value or 0.015 Irated or 50% of threshold value (for secondary current threshold ≤ 0.030 Irated)
For instrument CT:
95 % of Threshold value or 0.0005 Irated or 50% of threshold value (for secondary current threshold ≤ 0.001 Irated)

Permissive tolerance/Limiting values:
For protection CT:
1 % of setting value or 0.005 Irated
For instrument CT:
1 % of setting value or 0.0005 Irated

Summary

Test results/Remarks: For protection CT:
1 % of setting value or 0.005 Irated
For instrument CT:
1 % of setting value or 0.0005 Irated

1.12.2.3 Pickup times

Test condition: see item 1.12.2.1

Test values: 1.2*threshold

Permissive tolerance/Limiting values: t approx.
25 ms + OOT at 50 Hz
22 ms + OOT at 60 Hz

Test results/Remarks: t approx.
25 ms + OOT at 50 Hz
22 ms + OOT at 60 Hz

1.12.2.4 Dropout times

Test condition: see item 1.12.2.1

Permissive tolerance/Limiting values: t approx.
20 ms + OOT

Test results/Remarks: t approx.
20 ms + OOT

1.12.2.5 Time delay

Test condition: see item 1.12.2.1
1.2*threshold

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: 1 % of setting value or 30 ms

Test results/Remarks: 1 % of setting value or 30 ms

1.12.3 Overcurrent Protection, ground with inverse time overcurrent stage (inverse time)

1.12.3.1 Pickup values

Test condition: 0.010 Irated ≤ threshold value ≤ 35.000 Irated for protection CT
0.001 A ≤ threshold value ≤ 1.600 A for instrument CT (Current range: 1.6A)
0.002 A ≤ threshold value ≤ 8.000 A for instrument CT (Current range: 8A)
frated = 50 Hz, 60 Hz

Method of measurement = fundamental components of phases and 3I0:

Permissive tolerance/Limiting values: For protection CT:
1 % of setting value or 0.005 Irated
For instrument CT:
1 % of setting value or 0.0005 Irated

Test results/Remarks: For protection CT:
1 % of setting value or 0.005 Irated
For instrument CT:
1 % of setting value or 0.0005 Irated

Method of measurement = RMS value of phases and 3I0:

Permissive tolerance/Limiting values: For protection CT:
up to 30th harmonics: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
For instrument CT:

Summary

up to 30th harmonics: 1 % of setting value or 0.0005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.001 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.001 Irated

Test results/Remarks:

For protection CT:
up to 30th harmonics: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
For instrument CT:
up to 30th harmonics: 1 % of setting value or 0.0005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.001 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.001 Irated

1.12.3.2 Dropout ratio

Test condition:

see item 1.12.3.1

Instantaneous:
Test values:

For protection CT:
95 % of pickup value or 0.015 Irated or 50% of pickup value (for secondary current threshold ≤ 0.030 Irated)
For instrument CT:
95 % of pickup value or 0.0005 Irated or 50% of pickup value (for secondary current threshold ≤ 0.001 Irated)

Disk emulation
Test values:

90% of pickup value

Permissive tolerance/Limiting values:

For protection CT:
1 % of setting value or 0.005 Irated
For instrument CT:
1 % of setting value or 0.0005 Irated

Test results/Remarks:

For protection CT:
1 % of setting value or 0.005 Irated
For instrument CT:
1 % of setting value or 0.0005 Irated

1.12.3.3 Pickup times

Test condition:

see item 1.12.3.1
1.2*threshold

Permissive tolerance/Limiting values:

t approx.
25 ms + OOT at 50 Hz
22 ms + OOT at 60 Hz

Test results/Remarks:

t approx.
25 ms + OOT at 50 Hz
22 ms + OOT at 60 Hz

1.12.3.4 Dropout times

Test condition:

see item 1.12.3.1

Permissive tolerance/Limiting values:

t approx.
20 ms + OOT

Test results/Remarks:

t approx.
20 ms + OOT

1.12.3.5 Tripping time characteristics

Test condition:

see item 1.12.3.1
1.2*threshold

Summary

Test values: Time dial: 0.05 ≤ T ≤ 15.00

Permissive tolerance/Limiting values: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.5.1 IEC normal inverse (type A)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.5.2 IEC very inverse (type B)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.5.3 IEC extremely inverse (type C)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.5.4 IEC long-time inverse (type B)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.5.5 ANSI long-time inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.5.6 ANSI short-time inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.5.7 ANSI extremely inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.5.8 ANSI very inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.5.9 ANSI normal inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.5.10 ANSI moderately inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.5.11 ANSI definite inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.6 Dropout characteristics

Test condition: see item 1.12.3.1
Disk emulation: 0.8*threshold

Test values: Time dial: 0.05 ≤ T ≤ 15.00

Permissive tolerance/Limiting values: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.6.1 IEC normal inverse (type A)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.6.2 IEC very inverse (type B)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.6.3 IEC extremely inverse (type C)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.6.4 IEC long-time inverse (type B)
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.6.5 ANSI long-time inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.6.6 ANSI short-time inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.6.7 ANSI extremely inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.6.8 ANSI very inverse
Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

Summary

1.12.3.6.9 ANSI normal inverse

Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.6.10 ANSI moderately inverse

Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.3.6.11 ANSI definite inverse

Test results/Remarks: 5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.4 Overcurrent Protection, ground with user-defined characteristic[1]

1.12.4.1 Pickup

Test condition: 0.010 Irated ≤ threshold value ≤ 35.000 Irated for protection CT
0.001 A ≤ threshold value ≤ 1.600 A for instrument CT (Current range: 1.6A)
0.002 A ≤ threshold value ≤ 8.000 A for instrument CT (Current range: 8A)
frated = 50 Hz, 60 Hz

Method of measurement = fundamental components of phases and 3I0:

Permissive tolerance/Limiting values: For protection CT:
1 % of setting value or 0.005 Irated
For instrument CT:
1 % of setting value or 0.0005 Irated

Test results/Remarks: For protection CT:
1 % of setting value or 0.005 Irated
For instrument CT:
1 % of setting value or 0.0005 Irated

Method of measurement = RMS value of phases and 3I0:

Permissive tolerance/Limiting values: For protection CT:
up to 30th hamonics: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
For instrument CT:
up to 30th hamonics: 1 % of setting value or 0.0005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.001 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.001 Irated

Test results/Remarks: For protection CT:
up to 30th hamonics: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
For instrument CT:
up to 30th hamonics: 1 % of setting value or 0.0005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.001 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.001 Irated

1.12.4.2 Dropout ratio

Test condition: see item 1.12.4.1

Instantaneous:
Test values: For protection CT:
95 % of pickup value or 0.015 Irated or 50% of pickup value (for secondary current threshold ≤ 0.030 Irated)
For instrument CT:
95 % of pickup value or 0.0005 Irated or 50% of pickup value (for secondary current threshold ≤ 0.001 Irated)

[1] Not available for Busbar Protection

Summary

Disk emulation

Test values:	90% of pickup value
Permissive tolerance/Limiting values:	For protection CT: 1 % of setting value or 0.005 Irated For instrument CT: 1 % of setting value or 0.0005 Irated
Test results/Remarks:	For protection CT: 1 % of setting value or 0.005 Irated For instrument CT: 1 % of setting value or 0.0005 Irated

1.12.4.3 Pickup times

Test condition:	see item 1.12.4.1 1.2*threshold
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 25 ms + OOT at 60 Hz

1.12.4.4 Dropout times

Test condition:	see item 1.12.4.1
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT
Test results/Remarks:	t approx. 25 ms + OOT

1.12.4.5 Tripping time characteristics

Test condition:	see item 1.12.4.1 1.2*threshold
Test values:	Time dial: $0.05 \leq T \leq 15.00$
Permissive tolerance/Limiting values:	5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms
Test results/Remarks:	5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

1.12.4.6 Dropout characteristics

Test condition:	see item 1.12.4.1 Disk emulation: 0.8*threshold
Test values:	Time dial: $0.05 \leq T \leq 15.00$
Permissive tolerance/Limiting values:	5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms
Test results/Remarks:	5 % of the reference (calculated) value + 2 % of current tolerance or 30 ms

Summary

1.13 67 Directional Overcurrent Protection, Ground

1.13.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.13.2 Overcurrent Protection, 3I0 with definite time overcurrent stages (definite time)

1.13.2.1 Pickup values

Test condition:	0.030 Irated ≤ 3I0> ≤ 35.000 Irated
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 20.000 Irated
Method of measurement = fundamental components:	
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.005 Irated
Test results/Remarks:	|δ| ≤ 1 % of setting value or 0.005 Irated
Method of measurement = RMS value:	
Permissive tolerance/Limiting values:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated

1.13.2.2 Dropout ratio

Test condition:	see item 1.13.2.1
Test values:	r = settable dropout ratio
Permissive tolerance/Limiting values:	0.90 ≤ r ≤ 0.99 for I ≥ 0.5 Irated
Test results/Remarks:	0.90 ≤ r ≤ 0.99 for I ≥ 0.5 Irated

1.13.2.3 Pickup times

Test condition:	see item 1.13.2.1
Test values:	3I0/Irated = 2
Permissive tolerance/Limiting values:	t approx. 30 ms + OOT at 50 Hz 25 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 30 ms + OOT at 50 Hz 25 ms + OOT at 60 Hz

1.13.2.4 Dropout times

Test condition:	see item 1.13.2.1
Test values:	see item 1.13.2.3
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.13.2.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

Summary

1.13.3 Overcurrent Protection, 3I0 with inverse time overcurrent stage (inverse time)

1.13.3.1 Pickup values

Test condition:	0.030 Irated ≤ 3I0> ≤ 35.000 Irated Time dial: 0.05 ≤ T ≤ 15.00
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 20.000 Irated
Method of measurement = fundamental components:	
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.005 Irated
Test results/Remarks:	|δ| ≤ 1 % of setting value or 0.005 Irated
Method of measurement = RMS value:	
Permissive tolerance/Limiting values:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated

1.13.3.2 Dropout ratio

Test condition:	see item 1.13.3.1
Instantaneous:	
Test values:	see item 1.13.3.1
Permissive tolerance/Limiting values:	approx. 1.05 * threshold value approx. 0.95 * pickup value
Test results/Remarks:	approx. 1.05 * threshold value approx. 0.95 * pickup value
Disk emulation	
Test values:	dropout time for 3I0/I-threshold value ≤ 0.90
Permissive tolerance/Limiting values:	approx. 0.90 * threshold value
Test results/Remarks:	approx. 0.90 * threshold value

1.13.3.3 Pickup times

Test condition:	see item 1.13.3.1
Test values:	pickup time for 2 ≤ 3I0/I-threshold value ≤ 20
Permissive tolerance/Limiting values:	5 % of set point value or +2 % current tolerance or 30 ms
Test results/Remarks:	5 % of set point value or +2 % current tolerance or 30 ms

1.13.3.4 Dropout times

Test condition:	see item 1.13.3.1
Instantaneous:	
Test values:	see item 1.13.3.3
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT
Disk emulation	
Test values:	dropout time for 3I0/I-threshold value ≤ 0.90
Permissive tolerance/Limiting values:	5 % of set point value or +2 % current tolerance or 30 ms

Summary

Test results/Remarks: 5 % of set point value or
+2 % current tolerance or
30 ms

1.13.3.5 Tripping time characteristics

Test condition: see item 1.13.3.1

Test values: tripping times tk

Permissive tolerance/Limiting values: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.5.1 IEC normal inverse (type A)
Test results/Remarks: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.5.2 IEC very inverse (type B)
Test results/Remarks: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.5.3 IEC extremely inverse (type C)
Test results/Remarks: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.5.4 IEC long-time inverse (type B)
Test results/Remarks: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.5.5 ANSI long-time inverse
Test results/Remarks: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.5.6 ANSI short-time inverse
Test results/Remarks: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.5.7 ANSI extremely inverse
Test results/Remarks: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.5.8 ANSI very inverse
Test results/Remarks: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.5.9 ANSI normal inverse
Test results/Remarks: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.5.10 ANSI moderately inverse
Test results/Remarks: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.5.11 ANSI definite inverse
Test results/Remarks: $|\delta| \leq 5\ \% \pm 15$ ms for $2 \leq 3I0/IP \leq 20$

1.13.3.6 Dropout characteristics

Test condition: see item 1.13.3.1

Test values: dropout times

Permissive tolerance/Limiting values: $|\delta| \leq 5\ \% \pm 30$ ms for $0.05 \leq 3I0/IP \leq 0.90$

1.13.3.6.1 IEC normal inverse (type A)
Test results/Remarks: $|\delta| \leq 5\ \% \pm 30$ ms for $0.05 \leq 3I0/IP \leq 0.90$

1.13.3.6.2 IEC very inverse (type B)
Test results/Remarks: $|\delta| \leq 5\ \% \pm 30$ ms for $0.05 \leq 3I0/IP \leq 0.90$

1.13.3.6.3 IEC extremely inverse (type C)
Test results/Remarks: $|\delta| \leq 5\ \% \pm 30$ ms for $0.05 \leq 3I0/IP \leq 0.90$

1.13.3.6.4 IEC long-time inverse (type B)
Test results/Remarks: $|\delta| \leq 5\ \% \pm 30$ ms for $0.05 \leq 3I0/IP \leq 0.90$

1.13.3.6.5 ANSI long-time inverse
Test results/Remarks: $|\delta| \leq 5\ \% \pm 30$ ms for $0.05 \leq 3I0/IP \leq 0.90$

1.13.3.6.6 ANSI short-time inverse
Test results/Remarks: $|\delta| \leq 5\ \% \pm 30$ ms for $0.05 \leq 3I0/IP \leq 0.90$

1.13.3.6.7 ANSI extremely inverse
Test results/Remarks: $|\delta| \leq 5\ \% \pm 30$ ms for $0.05 \leq 3I0/IP \leq 0.90$

1.13.3.6.8 ANSI very inverse
Test results/Remarks: $|\delta| \leq 5\ \% \pm 30$ ms for $0.05 \leq 3I0/IP \leq 0.90$

Summary

1.13.3.6.9 ANSI normal inverse

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.13.3.6.10 ANSI moderately inverse

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.13.3.6.11 ANSI definite inverse

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.13.4 Overcurrent Protection, 3I0 with user-defined characteristic

1.13.4.1 Pickup

Test condition: 0.030 Irated ≤ 3I0> ≤ 35.000 Irated
Time dial:
0.05 ≤ T ≤ 15.00

Test values: frated = 50 Hz, 60 Hz
0.030 Irated ≤ 3I0> ≤ 18.000 Irated

Method of measurement = fundamental components:

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 0.005 Irated

Test results/Remarks: |δ| ≤ 1 % of setting value or 0.005 Irated

Method of measurement = RMS value:

Permissive tolerance/Limiting values: up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated

Test results/Remarks: up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated

1.13.4.2 Dropout ratio

Test condition: see item 1.13.4.1

Instantaneous:

Test values: see item 1.13.4.1

Permissive tolerance/Limiting values: approx. 1.05 * threshold value
approx. 0.95 * pickup value

Test results/Remarks: approx. 1.05 * threshold value
approx. 0.95 * pickup value

Disk emulation

Test values: dropout time for 3I0/I-threshold value ≤ 0.90

Permissive tolerance/Limiting values: approx. 0.90 * threshold value

Test results/Remarks: approx. 0.90 * threshold value

1.13.4.3 Pickup times

Test condition: see item 1.13.4.1

Test values: pickup time for 2 ≤ Ip/I-threshold value ≤ 20

Permissive tolerance/Limiting values: 5 % of set point value or
+2 % current tolerance or
30 ms

Test results/Remarks: 5 % of set point value or
+2 % current tolerance or
30 ms

1.13.4.4 Dropout times

Test condition: see item 1.13.4.1

Instantaneous:

Test values: see item 1.13.4.3

Permissive tolerance/Limiting values: t approx. 20 ms + OOT

Test results/Remarks: t approx. 20 ms + OOT

Summary

Disk emulation

Test values:	dropout time for I/I-threshold value ≤ 0.90
Permissive tolerance/Limiting values:	5 % of set point value or +2 % current tolerance or 30 ms
Test results/Remarks:	5 % of set point value or +2 % current tolerance or 30 ms

1.13.5 Overcurrent Protection, Logarithmic inverse curve stage (inverse time)

1.13.5.1 Pickup values

Test condition:	0.030 Irated ≤ 3I0> ≤ 35.000 Irated
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 20.000 Irated

Method of measurement = fundamental components:

Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.005 Irated
Test results/Remarks:	|δ| ≤ 1 % of setting value or 0.005 Irated

Method of measurement = RMS value:

Permissive tolerance/Limiting values:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated
	up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated
	up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated
	up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated
	up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated

1.13.5.2 Dropout ratio

Test condition:	see item 1.13.5.1
Test values:	see item 1.13.5.1
Permissive tolerance/Limiting values:	approx. 1.05 * threshold value approx. 0.95 * pickup value
Test results/Remarks:	approx. 1.05 * threshold value approx. 0.95 * pickup value

1.13.5.3 Pickup times

Test condition:	see item 1.13.5.1
Test values:	3I0/Irated = 2
Permissive tolerance/Limiting values:	t approx. 35 ms + OOT at 50 Hz 32 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 30 ms + OOT at 50 Hz 25 ms + OOT at 60 Hz

1.13.5.4 Dropout times

Test condition:	see item 1.13.5.1
Test values:	see item 1.13.5.3
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.13.5.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 5 % of setting value ± 15 ms
Test results/Remarks:	|δ| ≤ 5 % of setting value or 15 ms

Summary

1.13.6 Overcurrent Protection, The logarithmic inverse time characteristic with knee point

1.13.6.1 Pickup values

Test condition:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 35.000 Irated
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 20.000 Irated
Method of measurement = fundamental components:	
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.005 Irated
Test results/Remarks:	|δ| ≤ 1 % of setting value or 0.005 Irated
Method of measurement = RMS value:	
Permissive tolerance/Limiting values:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated

1.13.6.2 Dropout ratio

Test condition:	see item 1.13.6.1
Test values:	see item 1.13.6.1
Permissive tolerance/Limiting values:	approx. 0.95 * threshold value
Test results/Remarks:	approx. 0.95 * threshold value

1.13.6.3 Pickup times

Test condition:	see item 1.13.6.1
Test values:	3I0/Irated = 2
Permissive tolerance/Limiting values:	t approx. 35 ms + OOT at 50 Hz 32 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 30 ms + OOT at 50 Hz 25 ms + OOT at 60 Hz

1.13.6.4 Dropout times

Test condition:	see item 1.13.6.1
Test values:	see item 1.13.6.3
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.13.6.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 100.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 5 % of setting value ± 15 ms
Test results/Remarks:	|δ| ≤ 5 % of setting value or 15 ms

1.13.7 Directional determination

1.13.7.1 Rotation angle of reference voltage

Test condition:	-180° ≤ Phi ≤ 180°
Test values:	various settings
Permissive tolerance/Limiting values:	|δ| ≤ 1°
Test results/Remarks:	|δ| < 1°

Summary

1.13.7.2 Min. voltage V0 or V2

Test condition:	0.15 V ≤ V0/V2 ≤ 20.00 V
Test values:	various settings
Permissive tolerance/Limiting values:	$\|\delta\| \leq 1$ %
Test results/Remarks:	$\|\delta\| < 1$ %

1.13.7.3 Forward section +/-

Test condition:	0° ≤ Phi ≤ 90°
Test values:	various settings
Permissive tolerance/Limiting values:	$\|\delta\| \leq 1°$
Test results/Remarks:	$\|\delta\| < 1°$

1.13.7.4 Polarization with

Test condition:	- zero sequence - negative sequence
Test values:	various settings
Permissive tolerance/Limiting values:	function according to manual
Test results/Remarks:	function correct

Summary

1.14 50/51 Overcurrent Protection 1-phase

1.14.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.14.2 Overcurrent protection, 1-phase with definite time-overcurrent stage

1.14.2.1 Pickup values

Test condition:	0.030 Irated ≤ I> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ I> ≤ 1.600 Irated for CT sensitive
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ I> ≤ 35.000 Irated for CT protection
Method of measurement = fundamental components:	
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.005 Irated
Test results/Remarks:	|δ| < 1 % of setting value or 0.005 Irated
Method of measurement = RMS value:	
Permissive tolerance/Limiting values:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated

1.14.2.2 Dropout ratios

Test condition:	see item 1.14.2.1
Test values:	see item 1.14.2.1
Permissive tolerance/Limiting values:	0.95 (fixed)
Test results/Remarks:	0.95 (fixed)

1.14.2.3 Pickup times

Test condition:	see item 1.14.2.1
Test values:	$I/Irated_{fr}$ = 2 frated = 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	t approx. 15 ms + OOT at 50 Hz 14 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 15 ms + OOT at 50 Hz 14 ms + OOT at 60 Hz

1.14.2.4 Dropout times

Test condition:	see item 1.14.2.1
Test values:	see item 1.14.2.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.14.2.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.000 s ≤ T ≤ 60.000 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

Summary

1.14.3 Overcurrent Protection,1-ph with inverse-time overcurrent stage

1.14.3.1 Pickup values

Test condition:	0.030 Irated ≤ I> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ I> ≤ 1.600 Irated for CT sensitive Time dial: 0.05 ≤ T ≤ 15.00
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ I> ≤ 35.000 Irated for CT protection
Method of measurement = fundamental components:	
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.005 Irated
Test results/Remarks:	|δ| < 1 % of setting value or 0.005 Irated
Method of measurement = RMS value:	
Permissive tolerance/Limiting values:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated

1.14.3.2 Dropout ratios

Test condition:	see item 1.14.3.1
Test values:	see item 1.14.3.1
Instantaneous:	
Permissive tolerance/Limiting values:	approx. 1.05 * threshold value approx. 0.95 * pickup value
Test results/Remarks:	approx. 1.05 * threshold value approx. 0.95 * pickup value
Disk emulation	
Permissive tolerance/Limiting values:	approx. 0.90 * threshold value
Test results/Remarks:	approx. 0.90 * threshold value

1.14.3.3 Pickup times

Test values:	pickup time for 2 ≤ I/I-threshold value ≤ 20
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz

1.14.3.4 Dropout times

Instantaneous:	
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT
Disk emulation	
Test values:	dropout time for I/I-threshold value ≤ 0.90
Permissive tolerance/Limiting values:	5 % of set point value or +2 % current tolerance or 30 ms
Test results/Remarks:	5 % of set point value or +2 % current tolerance or 30 ms

Summary

1.14.3.5 Tripping time characteristics

Test values: tripping times t

Permissive tolerance/Limiting values: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.5.1 IEC normal inverse (type A)

Test results/Remarks: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.5.2 IEC very inverse (type B)

Test results/Remarks: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.5.3 IEC extremely inverse (type C)

Test results/Remarks: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.5.4 IEC long-time inverse (type B)

Test results/Remarks: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.5.5 ANSI long-time inverse

Test results/Remarks: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.5.6 ANSI short-time inverse

Test results/Remarks: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.5.7 ANSI extremely inverse

Test results/Remarks: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.5.8 ANSI very inverse

Test results/Remarks: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.5.9 ANSI normal inverse

Test results/Remarks: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.5.10 ANSI moderately inverse

Test results/Remarks: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.5.11 ANSI definite inverse

Test results/Remarks: |δ| ≤ 5 % ± 15 ms for 2 ≤ I/IP ≤ 20
|δ| ≤ 5 % ± 15 ms for 2 ≤ 3I0/IP ≤ 20

1.14.3.6 Dropout characteristics

Test values: dropout times

Permissive tolerance/Limiting values: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.14.3.6.1 IEC normal inverse (type A)

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.14.3.6.2 IEC very inverse (type B)

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.14.3.6.3 IEC extremely inverse (type C)

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.14.3.6.4 IEC long-time inverse (type B)

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

Summary

1.14.3.6.5 ANSI long-time inverse

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.14.3.6.6 ANSI short-time inverse

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.14.3.6.7 ANSI extremely inverse

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.14.3.6.8 ANSI very inverse

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.14.3.6.9 ANSI normal inverse

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.14.3.6.10 ANSI moderately inverse

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.14.3.6.11 ANSI definite inverse

Test results/Remarks: |δ| ≤ 5 % ± 30 ms for 0.05 ≤ I/IP ≤ 0.90
|δ| ≤ 5 % ± 30 ms for 0.05 ≤ 3I0/IP ≤ 0.90

1.14.4 Overcurrent Protection, 1-ph with user-defined characteristic curve stage

1.14.4.1 Pickup

Test condition: 0.030 Irated ≤ I> ≤ 35.000 Irated for CT protection
0.001 Irated ≤ I> ≤ 1.600 Irated for CT sensitive
Time dial:
0.05 ≤ T ≤ 15.00

Test values: frated = 50 Hz, 60 Hz
0.030 Irated ≤ I> ≤ 35.000 Irated for CT protection

Method of measurement = fundamental components:

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 0.005 Irated

Test results/Remarks: |δ| < 1 % or 0.5 % Irated

Method of measurement = RMS value:

Permissive tolerance/Limiting values: up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated

Test results/Remarks: up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: |δ| ≤ 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: |δ| ≤ 4 % of setting value or 0.02 Irated

1.14.4.2 Dropout ratios

Test condition: see item 1.14.4.1

Test values: see item 1.14.4.1

Instantaneous:

Permissive tolerance/Limiting values: approx. 1.05 * threshold value
approx. 0.95 * pickup value

Test results/Remarks: approx. 1.05 * threshold value
approx. 0.95 * pickup value

Disk emulation

Permissive tolerance/Limiting values: approx. 0.90 * threshold value

Test results/Remarks: approx. 0.90 * threshold value

Summary

1.14.4.3 Pickup times

Test values:	pickup time for 2 ≤ I/I-threshold value ≤ 20
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz

1.14.4.4 Dropout times

Instantaneous:

Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

Disk emulation

Test values:	dropout time for I/I-threshold value ≤ 0.90
Permissive tolerance/Limiting values:	5 % of set point value or +2 % current tolerance or 30 ms
Test results/Remarks:	5 % of set point value or +2 % current tolerance or 30 ms

1.14.5 Overcurrent Protection, 1-phase with fast stage

1.14.5.1 Pickup

Test condition:	0.030 Irated ≤ I> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ I> ≤ 1.600 Irated for CT sensitive
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ I> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ I> ≤ 1.600 Irated for CT sensitive
Permissive tolerance/Limiting values:	$\|\delta\| \leq 5$ % of setting value or 0.01 Irated
Test results/Remarks:	$\|\delta\| \leq 5$ % or 0.01 Irated

1.14.5.2 Dropout ratio

Test values:	r = settable dropout ratio
Permissive tolerance/Limiting values:	$0.90 \leq r \leq 0.99$
Test results/Remarks:	confirmed

1.14.5.3 Pickup times

Test values:	$I/Irated_{fr} = 2$ frated = 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	t approx. 8 ms + OOT at 50 Hz / 60 Hz
Test results/Remarks:	t approx. 8 ms + OOT at 50 Hz / 60 Hz

1.14.5.4 Dropout times

Test condition:	see item 1.14.5.1
Test values:	see item 1.14.5.1
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT
Test results/Remarks:	t approx. 25 ms + OOT

Summary

1.14.5.5 Time delays

Test condition:	added to inherent operating times
Test values:	0.00 s ≤ TD> ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

Summary

1.15 51V Voltage-dependent Overcurrent-Protection

1.15.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-127

1.15.2 Voltage-released stage

1.15.2.1 Pickup values I>

Test condition:	0.030 Irated ≤ threshold value ≤ 35.000 Irated
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ threshold value ≤ 18.000 Irated
Method of measurement = fundamental components of phases	
Permissive tolerance/Limiting values:	1 % of setting value or 0.005 Irated
Test results/Remarks:	1 % of setting value or 0.005 Irated
Method of measurement = RMS value of phases	
Permissive tolerance/Limiting values:	up to 30th hamonics: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th hamonics: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

1.15.2.2 Dropout ratio

Test condition:	see item 1.15.2.1
Instantaneous:	
Test values:	1.05 * threshold value 0.95 * pickup value
Disk emulation	
Test values:	0.90 * threshold value
Permissive tolerance/Limiting values:	1 % of dropout value
Test results/Remarks:	1% of dropout value

1.15.2.3 Pickup values Vph-ph<

Test condition:	0.300 V ≤ threshold value ≤ 175.000V
Test values:	0.300 V ≤ threshold value ≤ 175.000V
Permissive tolerance/Limiting values:	in the range frated ±10 % 0.5 % of setting value or 0.05 V
Test results/remarks:	in the range frated ±10 % 0.5 % of setting value or 0.05 V

1.15.2.4 Pickup time

Test condition:	see item 1.15.2.1
Test values:	1.2*threshold
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz

1.15.2.5 Dropout times

Test condition:	see item 1.15.2.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

Summary

1.15.2.6 Tripping time characteristics

Test condition: see item 1.15.2.1

1.2*threshold

Test values: Time dial: 0.05 ≤ T ≤ 15.00

Permissive tolerance/Limiting values: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.6.1 IEC normal inverse (type A)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.6.2 IEC very inverse (type B)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.6.3 IEC extremely inverse (type C)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.6.4 IEC long-time inverse (type B)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.6.5 ANSI long-time inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.6.6 ANSI short-time inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.6.7 ANSI extremely inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.6.8 ANSI very inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.6.9 ANSI normal inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.6.10 ANSI moderately inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.6.11 ANSI definite inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.7 Dropout characteristics

Test condition: see item 1.15.2.1

Disk emulation: 0.8*threshold

Test values: Time dial: 0.05 ≤ T ≤ 15.00

Permissive tolerance/Limiting values: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.7.1 IEC normal inverse (type A)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.7.2 IEC very inverse (type B)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.7.3 IEC extremely inverse (type C)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.7.4 IEC long-time inverse (type B)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.7.5 ANSI long-time inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.7.6 ANSI short-time inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.7.7 ANSI extremely inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.7.8 ANSI very inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.7.9 ANSI normal inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

Summary

1.15.2.7.10 ANSI moderately inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.2.7.11 ANSI definite inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3 Voltage-dependent.Stage

1.15.3.1 Pickup values I>

Test condition: 0.030 Irated ≤ threshold value ≤ 35.000 Irated

Test values: frated = 50 Hz, 60 Hz
0.030 Irated ≤ threshold value ≤ 18.000 Irated

Method of measurement = fundamental components of phases

Permissive tolerance/Limiting values: 1 % of setting value or 0.005 Irated

Test results/Remarks: 1 % of setting value or 0.005 Irated

Method of measurement = RMS value of phases

Permissive tolerance/Limiting values: up to 30th hamonics: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

Test results/Remarks: up to 30th hamonics: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

1.15.3.2 Dropout ratio

Test condition: see item 1.15.3.1

Instantaneous:

Test values: 1.05 * threshold value
0.95 * pickup value

Disk emulation

Test values: 0.90 * threshold value

Permissive tolerance/Limiting values: 1 % of dropout value

Test results/Remarks: 1% of dropout value

1.15.3.3 Pickup time

Test condition: see item 1.15.3.1

Test values: 1.2*threshold

Permissive tolerance/Limiting values: t approx.
25 ms + OOT at 50 Hz
22 ms + OOT at 60 Hz

Test results/Remarks: t approx.
25 ms + OOT at 50 Hz
22 ms + OOT at 60 Hz

1.15.3.4 Dropout times

Test condition: see item 1.15.3.1

Permissive tolerance/Limiting values: t approx.
20 ms + OOT

Test results/Remarks: t approx.
20 ms + OOT

1.15.3.5 Tripping time characteristics

Test condition: see item 1.15.3.1
1.2*threshold

Test values: Time dial: 0.05 ≤ T ≤ 15.00

Permissive tolerance/Limiting values: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.5.1 IEC normal inverse (type A)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

Summary

1.15.3.5.2 IEC very inverse (type B)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.5.3 IEC extremely inverse (type C)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.5.4 IEC long-time inverse (type B)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.5.5 ANSI long-time inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.5.6 ANSI short-time inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.5.7 ANSI extremely inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.5.8 ANSI very inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.5.9 ANSI normal inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.5.10 ANSI moderately inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.5.11 ANSI definite inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6 Dropout characteristics

Test condition: see item 1.15.3.1

Disk emulation: 0.8*threshold

Test values: Time dial: 0.05 ≤ T ≤ 15.00

Permissive tolerance/Limiting values: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6.1 IEC normal inverse (type A)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6.2 IEC very inverse (type B)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6.3 IEC extremely inverse (type C)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6.4 IEC long-time inverse (type B)
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6.5 ANSI long-time inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6.6 ANSI short-time inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6.7 ANSI extremely inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6.8 ANSI very inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6.9 ANSI normal inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6.10 ANSI moderately inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.3.6.11 ANSI definite inverse
Test results/Remarks: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.15.4 Undervoltage seal-in stage

1.15.4.1 Pickup values I>

Test condition: 0.030 Irated ≤ threshold value ≤ 35.000 Irated

Summary

Test values: frated = 50 Hz, 60 Hz
0.030 Irated ≤ threshold value ≤ 35.000 Irated

Method of measurement = fundamental components of phases

Permissive tolerance/Limiting values: 1 % of setting value or 0.005 Irated

Test results/Remarks: 1 % of setting value or 0.005 Irated

Method of measurement = RMS value of phases

Permissive tolerance/Limiting values: up to 30th hamonics: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

Test results/Remarks: up to 30th hamonics: 1 % of setting value or 0.005 Irated
up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated
up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

1.15.4.2 Dropout ratio

Test condition: see item 1.15.4.1

Test values: 0.90 ≤ r ≤ 0.99

Permissive tolerance/Limiting values: 1 % of dropout value

Test results/Remarks: 1 % of dropout value

1.15.4.3 Pickup values V-seal-in

Test condition: 0.300 V ≤ threshold value ≤ 175.000V

Test values: 0.300 V ≤ threshold value ≤ 175.000V

Permissive tolerance/Limiting values: in the range frated ±10 %
0.5 % of setting value or 0.05 V

Test results/remarks: in the range frated ±10 %
0.5 % of setting value or 0.05 V

1.15.4.4 Dropout ratio of V-seal-in

Test condition: 0.300 V ≤ threshold value ≤ 175.000V

Test values: 1.01 ≤ r ≤ 1.20

Permissive tolerance/Limiting values: 1 % of dropout value

Test results/Remarks: 1 % of dropout value

1.15.4.5 Pickup times

Test condition: see item 1.15.4.1

Test values: 1.2*threshold

Permissive tolerance/Limiting values: t approx.
30 ms + OOT at 50 Hz
25 ms + OOT at 60 Hz

Test results/Remarks: t approx.
30 ms + OOT at 50 Hz
25 ms + OOT at 60 Hz

1.15.4.6 Dropout times

Test condition: see item 1.15.4.1

Permissive tolerance/Limiting values: t approx.
20 ms + OOT

Test results/Remarks: t approx.
20 ms + OOT

1.15.4.7 Operate delays

Test condition: Irated value

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: 1 % of setting value or 10 ms

Test results/Remarks: 1 % of setting value or 10 ms

Summary

1.15.4.8 Duration of V-seal-in time

Test condition:	Irated value
Test values:	0.10 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

1.15.5 Undervoltage Seal-in and voltage released stage

1.15.5.1 Pickup values I>

Test condition:	0.030 Irated ≤ threshold value ≤ 35.000 Irated
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ threshold value ≤ 35.000 Irated

Method of measurement = fundamental components of phases

Permissive tolerance/Limiting values:	1 % of setting value or 0.005 Irated
Test results/Remarks:	1 % of setting value or 0.005 Irated

Method of measurement = RMS value of phases

Permissive tolerance/Limiting values:	up to 30th hamonics: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated
Test results/Remarks:	up to 30th hamonics: 1 % of setting value or 0.005 Irated up to 50th harmonic, frated = 50 Hz: 3 % of setting value or 0.02 Irated up to 50th harmonic, frated = 60 Hz: 4 % of setting value or 0.02 Irated

1.15.5.2 Pickup values V2

Test condition:	0.300 V ≤ threshold value ≤ 200.000V
Test values:	0.300 V ≤ threshold value ≤ 200.000V
Permissive tolerance/Limiting values:	in the range frated ±10 % 0.5 % of setting value or 0.05 V
Test results/remarks:	in the range frated ±10 % 0.5 % of setting value or 0.05 V

1.15.5.3 Dropout ratio

Test condition:	0.030 Irated ≤ threshold value ≤ 35.000 Irated 0.300 V ≤ threshold value ≤ 200.000V
Test values:	0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	1 % of dropout value
Test results/Remarks:	1 % of dropout value

1.15.5.4 Pickup values Vph-ph<, V-seal-in

Test condition:	0.300 V ≤ threshold value ≤ 175.000V
Test values:	0.300 V ≤ threshold value ≤ 175.000V
Permissive tolerance/Limiting values:	in the range frated ±10 % 0.5 % of setting value or 0.05 V
Test results/remarks:	in the range frated ±10 % 0.5 % of setting value or 0.05 V

1.15.5.5 Dropout ratio of V-seal-in

Test condition:	0.300 V ≤ threshold value ≤ 175.000V
Test values:	1.01 ≤ r ≤ 1.20
Permissive tolerance/Limiting values:	1 % of dropout value
Test results/Remarks:	1 % of dropout value

1.15.5.6 Pickup time

Test condition:	see item 1.15.5.1
Test values:	1.2*threshold

Summary

Permissive tolerance/Limiting values:	t approx. 30 ms + OOT at 50 Hz 25 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 30 ms + OOT at 50 Hz 25 ms + OOT at 60 Hz

1.15.5.7 Dropout times

Test condition:	see item 1.15.5.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.15.5.8 Operate delays

Test condition:	Irated value
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

1.15.5.9 Duration of V-seal-in time

Test condition:	Irated value
Test values:	0.10 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

Summary

1.16 Startup Overcurrent

1.16.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.16.2 Pickup values

Test condition:	0.100 Irated ≤ threshold value ≤ 35.000 Irated
Test values:	frequency operating range is from 2 Hz to 15 Hz 0.100 Irated ≤ threshold value ≤ 35.000 Irated
Permissive tolerance/Limiting values:	8 % of setting value
Test results/Remarks:	8 % of setting value

Permissive tolerance/Limiting values of harmonics influence:

10 % of 2nd, 3rd , 5th, 30th, 35th,and 50th harmonics : 9 % of setting value

Test results/Remarks:

10 % of 2nd, 3rd , 5th, 30th, 35th,and 50th harmonics : 9 % of setting value

1.16.3 Dropout ratio

Test condition:	see item 1.16.2
Test values:	r = 0.80
Permissive tolerance/Limiting values:	f from 10 Hz to 15Hz 0.78 ≤ r ≤ 0.82 of threshold value f from 2 Hz to 10 Hz 0.74 ≤ r ≤ 0.78 of threshold value
Test results/Remarks:	f from 10 Hz to 15 Hz 0.78 ≤ r ≤ 0.82 of threshold value f from 2 Hz to 10 Hz 0.74 ≤ r ≤ 0.78 of threshold value

1.16.4 Pickup times

Test condition:	0 -> 1.2* Threshold(Threshold = Irated)
Permissive tolerance/Limiting values:	t approx. 120 ms or higher + OOT(depends on signal frequency)
Test results/Remarks:	t approx. 120 ms or higher + OOT(depends on signal frequency)

1.16.5 Dropout times

Test condition:	1.2* Threshold(Threshold = Irated) -> 0
Permissive tolerance/Limiting values:	t approx. 550 ms + OOT
Test results/Remarks:	t approx. 550 ms + OOT
Test condition:	1.2* Threshold(Threshold = Irated) -> 0.2 Irated
Permissive tolerance/Limiting values:	t approx. 60 ms or higher + OOT(depends on signal frequency)
Test results/Remarks:	t approx. 60 ms or higher + OOT(depends on signal frequency)

1.16.6 Operate delays

Test condition:	Threshold = default value
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms

Summary

Test results/Remarks:	1 % of setting value or 10 ms

1.16.7 Dropout delay

Test condition:	Threshold = default value
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

Summary

1.17 Non-Directional Intermittent-Ground-Fault-Protection

1.17.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC60255-151

1.17.2 Intermittent ground fault protection stage

1.17.2.1 Pickup values 3I0>

Test condition:	Fundamental components, RMS values 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ 3I0> ≤ 1.600 Irated for CT sensitive
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ 3I0> ≤ 1.600 Irated for CT sensitive
Permissive tolerance/Limiting values:	For CT protection: |δ| ≤ 1 % of setting value or 0.005 Irated For CT sensitive: |δ| ≤ 1 % of setting value or 0.0001 Irated
Test results/Remarks:	For CT protection: |δ| ≤ 1 % of setting value or 0.005 Irated For CT sensitive: |δ| ≤ 1 % of setting value or 0.0001 Irated

1.17.2.2 Dropout ratio

Test condition:	see item 1.17.2.1
Test values:	see item 1.17.2.1
Permissive tolerance/Limiting values:	approx. 0.95
Test results/Remarks:	approx. 0.95

1.17.2.3 Pickup time

Test condition:	see item 1.17.2.1
Test values:	I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 23 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 23 ms + OOT at 60 Hz

1.17.2.4 Dropout times

Test condition:	see item 1.17.2.1
Test values:	see item 1.17.2.1
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz

1.17.2.5 Pickup extension time

Test condition:	0.00 s ≤ T ≤ 10.00 s
Test values:	0.00 s ≤ T ≤ 10.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

Summary

1.17.2.6 Sum of extended pickup times

Test condition:	0.00 s ≤ T ≤ 100.00 s
Test values:	0.00 s ≤ T ≤ 100.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.17.2.7 Reset time

Test condition:	0.00 s ≤ T ≤ 600.00 s
Test values:	0.00 s ≤ T ≤ 600.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

Summary

1.18 51Ns Sensitive Ground Fault Protection

1.18.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.18.2 3I0

1.18.2.1 Pickup values

Test condition:	0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ 3I0> ≤ 35.000 Irated for CT sensitive
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ 3I0> ≤ 35.000 Irated for CT sensitive
Permissive tolerance/Limiting values:	For CT protection: $\|\delta\| \leq 1$ % of setting value or 0.5% of Irated For CT sensitive: $\|\delta\| \leq 1$ % of setting value or 0.01% of Irated
Test results/Remarks:	For CT protection: $\|\delta\| \leq 1$ % of setting value or 0.5% of Irated For CT sensitive: $\|\delta\| \leq 1$ % of setting value or 0.01% of Irated

1.18.2.2 Dropout ratio

Test condition:	see item 1.18.2.1
Test values:	see item 1.18.2.1
Permissive tolerance/Limiting values:	0.95 (fixed)
Test results/Remarks:	0.95 (fixed)

1.18.2.3 Pickup times

Test condition:	see item 1.18.2.1
Test values:	I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 23 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 23 ms + OOT at frated = 60 Hz

1.18.2.4 Dropout times

Test condition:	see item 1.18.2.1
Test values:	see item 1.18.2.1
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz

1.18.2.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	$\|\delta\| \leq 1$ % of setting value or 10 ms
Test results/Remarks:	$\|\delta\| \leq 1$ % of setting value or 10 ms

Summary

1.18.3 Admittance protection stage Y0>

1.18.3.1 Pickup values Y0>

Test condition:	Fundamental components, RMS values 0.10 mS ≤ Y0> ≤ 100.00 mS
Test values:	frated = 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	For CT protection: |δ| ≤ 1 % of setting value or 1% of Irated For CT measurement: |δ| ≤ 1 % of setting value or 0.1% of Irated
Test results/Remarks:	For CT protection: |δ| ≤ 1 % of setting value or 1% of Irated For CT measurement: |δ| ≤ 1 % of setting value or 0.1% of Irated

1.18.3.2 Threshold values V0>

Test condition:	0.300 V ≤V0> ≤ 200.000V
Test values:	0.300 V ≤V0> ≤ 200.000V
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.5 V
Test results/remarks:	|δ| ≤ 1 % of setting value or 0.5 V

1.18.3.3 Pickup time

Test condition:	see item 1.18.3.1
Test values:	I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 32 ms + OOT at 50 Hz 29 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 32 ms + OOT at 50 Hz 29 ms + OOT at 60 Hz

1.18.3.4 Dropout times

Test condition:	see item 1.18.3.1
Test values:	see item 1.18.3.1
Permissive tolerance/Limiting values:	t approx. 32 ms + OOT
Test results/Remarks:	t approx. 32 ms + OOT

1.18.3.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % from setting value or 10 ms
Test results/Remarks:	|δ| < 1 % or 10 ms

Summary

1.19 67Ns Directional Sensitive Ground Fault Protection

1.19.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.19.2 3I0 stage

1.19.2.1 Pickup values

Test condition:	Fundamental components, RMS values 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ 3I0> ≤ 35.000 Irated for CT sensitive
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Permissive tolerance/Limiting values:	For CT protection: |δ| ≤ 1 % from setting value or 1% of Irated For CT measurement: |δ| ≤ 1 % from setting value or 0.1% of Irated
Test results/Remarks:	|δ| < 1 %

1.19.2.2 Dropout ratio

Test condition:	see item 1.19.2.1
Test values:	see item 1.19.2.1
Permissive tolerance/Limiting values:	approx. 0.95
Test results/Remarks:	0.93…0.97

1.19.2.3 Pickup times

Test condition:	see item 1.19.2.1
Test values:	I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 23 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 23 ms + OOT at frated = 60 Hz

1.19.2.4 Dropout times

Test condition:	see item 1.19.2.1
Test values:	see item 1.19.2.1
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT
Test results/Remarks:	t approx. 25 ms + OOT

1.19.2.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % from setting value or 10 ms
Test results/Remarks:	|δ| < 1 % or 10 ms

Summary

1.19.3 3I0 with cos φ- or sin φ-measurement stage

1.19.3.1 Pickup values 3I0

Test condition:	Fundamental components, RMS values 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ 3I0> ≤ 35.000 Irated for CT sensitive
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection1
Permissive tolerance/Limiting values:	For CT protection: |δ| ≤ 1 % from setting value or 1% of Irated For CT measurement: |δ| ≤ 1 % from setting value or 0.1% of Irated
Test results/Remarks:	|δ| < 1 %

1.19.3.2 Pickup values V0

Test condition:	frated = 50 Hz, 60 Hz 0.300 V ≤ V0> ≤ 200.000 V
Test values:	0.300 V ≤ V0> ≤ 200.000 V
Permissive tolerance/Limiting values:	|δ| ≤ 1 % from setting value or 0.05 V
Test results/Remarks:	|δ| < 1 % or 0.05 V

1.19.3.3 Angle correction φ

Test condition:	-45° ≤ φ ≤ 45°
Test values:	-45° ≤ φ ≤ 45°
Permissive tolerance/Limiting values:	|δ| ≤ 1° at 3I0 > 5 mA, V0> = 0.6 V
Test results/Remarks:	|δ| < 1° at 3I0 > 5 mA, V0> = 0.6 V

1.19.3.4 Dropout ratio

Test condition:	see item 1.19.3.1 and 1.19.3.2
Test values:	see item 1.19.3.1 and 1.19.3.2
Permissive tolerance/Limiting values:	approx. 0.95
Test results/Remarks:	0.93…0.97

1.19.3.5 Pickup times

Test condition:	see item 1.19.3.1 and 1.19.3.2
Test values:	I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 32 ms + OOT at frated = 50 Hz 29 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 32 ms + OOT at frated = 50 Hz 29 ms + OOT at frated = 60 Hz

1.19.3.6 Dropout times

Test condition:	see item 1.19.3.1 and 1.19.3.2
Test values:	see item 1.19.3.1 and 1.19.3.2
Permissive tolerance/Limiting values:	t approx. 32 ms + OOT
Test results/Remarks:	t approx. 32 ms + OOT

1.19.3.7 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % from setting value or 10 ms
Test results/Remarks:	|δ| < 1 % or 10 ms

Summary

1.19.4 3I0 with φ (V,I)-measurement stage

1.19.4.1 Pickup values 3I0

Test condition:	frated = 50 Hz, 60 Hz Fundamental components, RMS values 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ 3I0> ≤ 35.000 Irated for CT sensitive
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Permissive tolerance/Limiting values:	For CT protection: |δ| ≤ 1 % from setting value or 1% of Irated For CT measurement: |δ| ≤ 1 % from setting value or 0.1% of Irated
Test results/Remarks:	|δ| < 1 %

1.19.4.2 Pickup values V0

Test condition:	frated = 50 Hz, 60 Hz 0.300 V ≤ V0> ≤ 200.000 V
Test values:	0.300 V ≤ V0> ≤ 200.000 V
Permissive tolerance/Limiting values:	|δ| ≤ 1 % from setting value or 0.05 V
Test results/Remarks:	|δ| < 1 % or 0.05 V

1.19.4.3 Rotation angle of the reference voltage

Test condition:	-180° ≤ φ ≤ 180°
Test values:	-180° ≤ φ ≤ 180°
Permissive tolerance/Limiting values:	|δ| ≤ 1° at 3I0 > 5 mA, V0 ≥ 0.6 V
Test results/Remarks:	|δ| ≤ 3° at 3I0 ≤ 2 mA, V0 ≥ 0.6 V |δ| ≤ 2° at 2 mA < 3I0 < 10 mA, V0 ≥ 0.6 V |δ| ≤ 1° at 3I0 ≥ 10 mA, V0 ≥ 0.6 V

1.19.4.4 Dropout ratio

Test condition:	see item 1.19.4.1 and 1.19.4.2
Test values:	see item 1.19.4.1 and 1.19.4.2
Permissive tolerance/Limiting values:	0.5% of dropout value or 15mA
Test results/Remarks:	0.5% of dropout value or 15mA

1.19.4.5 Pickup times

Test condition:	see item 1.19.4.1 and 1.19.4.2
Test values:	1.2*threshold
Permissive tolerance/Limiting values:	t approx. 23 ms + OOT at frated = 50 Hz 21 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 23 ms + OOT at frated = 50 Hz 21 ms + OOT at frated = 60 Hz

1.19.4.6 Dropout times

Test condition:	see item 1.19.4.1 and 1.19.4.2
Permissive tolerance/Limiting values:	t approx. 21 ms + OOT at frated = 50 Hz 20 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 21 ms + OOT at frated = 50 Hz 20 ms + OOT at frated = 60 Hz

Summary

1.19.4.7 Time delays

Test condition:	see item 1.19.4.1 and 1.19.4.2
	1.2*threshold
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	≤ 1 % of setting value or 10 ms

1.19.5 Overvoltage protection stage V0>

1.19.5.1 Pickup values

Test condition:	frated = 50 Hz, 60 Hz Fundamental components, RMS values 0.300 V ≤ V0> ≤ 200.000 V
Test values:	0.300 V ≤ V0> ≤ 200.000 V
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % from setting value or 0.05 V
Test results/Remarks:	|δ| < 0.5 % or 0.05 V

1.19.5.2 Dropout ratio

Test condition:	r = setable dropout ratio 0.90 ≤ r ≤ 0.99
Test values:	0.90 ≤ r ≤ 0.99
Test results/Remarks:	0.90 ≤ r ≤ 0.99

1.19.5.3 Pickup times

Test condition:	see item 1.19.5.1
Test values:	see item 1.19.5.1
Permissive tolerance/Limiting values:	t approx. RMS values, standard filter: 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz Fundamental components, filter over 2 cycles: 45 ms + OOT at frated = 50 Hz 39 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. RMS values, standard filter: 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz Fundamental components, filter over 2 cycles: 45 ms + OOT at frated = 50 Hz 39 ms + OOT at frated = 60 Hz

1.19.5.4 Dropout times

Test condition:	see item 1.19.5.1
Test values:	see item 1.19.5.1
Permissive tolerance/Limiting values:	t approx. RMS values, standard filter: 21 ms + OOT Fundamental components, filter over 2 cycles: 30 ms + OOT
Test results/Remarks:	t approx. RMS values, standard filter: 21 ms + OOT Fundamental components, filter over 2 cycles: 30 ms + OOT

1.19.5.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % from setting value or 10 ms
Test results/Remarks:	|δ| < 1 % or 10 ms

Summary

1.19.6 Transient ground fault protection stage

1.19.6.1 Pickup values 3I0

Test condition:	frated = 50 Hz, 60 Hz Fundamental components, RMS values 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ 3I0> ≤ 35.000 Irated for CT sensitive
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Permissive tolerance/Limiting values:	For CT protection: |δ| ≤ 1 % from setting value or 1% of Irated For CT measurement: |δ| ≤ 1 % from setting value or 0.1% of Irated
Test results/Remarks:	For CT protection: |δ| ≤ 1 % from setting value or 1% of Irated For CT measurement: |δ| ≤ 1 % from setting value or 0.1% of Irated

1.19.6.2 Pickup values V0

Test condition:	frated = 50 Hz, 60 Hz 0.300 V ≤ V0> ≤ 200.000 V
Test values:	0.300 V ≤ V0> ≤ 200.000 V
Permissive tolerance/Limiting values:	|δ| ≤ 1 % from setting value or 0.05 V
Test results/Remarks:	|δ| ≤ 1 % from setting value or 0.05 V

1.19.6.3 Pickup times

Test condition:	see item 1.19.6.1 and 1.19.6.2
Test values:	I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 60 ms + OOT at frated = 50 Hz 55 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 60 ms + OOT at frated = 50 Hz 55 ms + OOT at frated = 60 Hz

1.19.6.4 Dropout times

Test condition:	see item 1.19.6.1 and 1.19.6.2
Test values:	see item 1.19.6.1 and 1.19.6.2
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT at frated = 50 Hz 15 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 20 ms + OOT at frated = 50 Hz 15 ms + OOT at frated = 60 Hz

1.19.6.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % from setting value or 10 ms
Test results/Remarks:	|δ| < 1 % or 10 ms

Summary

1.19.7 Y0-with G0 or B0-measurement stage

1.19.7.1 Pickup values 3I0>

Test condition:	Fundamental components, RMS values 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection 0.001 Irated ≤ 3I0> ≤ 35.000 Irated for CT sensitive
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Permissive tolerance/Limiting values:	For CT protection: |δ| ≤ 1 % from setting value or 1% of Irated For CT measurement: |δ| ≤ 1 % from setting value or 0.1% of Irated
Test results/Remarks:	For CT protection: |δ| ≤ 1 % from setting value or 1% of Irated For CT measurement: |δ| ≤ 1 % from setting value or 0.1% of Irated

1.19.7.2 Pickup values V0>

Test condition:	0.300 V ≤V0> ≤ 200.000V
Test values:	0.300 V ≤V0> ≤ 200.000V
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.05 V
Test results/remarks:	|δ| ≤ 1 % of setting value or 0.05 V

1.19.7.3 Angle correction φ

Test condition:	-45° ≤ φ ≤ 45°
Test values:	-45° ≤ φ ≤ 45°
Permissive tolerance/Limiting values:	|δ| ≤ 1° at 3I0 > 5 mA, V0> = 0.6 V
Test results/Remarks:	|δ| ≤ 1° at 3I0 > 5 mA, V0> = 0.6 V

1.19.7.4 Pickup time

Test condition:	see item 1.19.7.1
Test values:	I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 32 ms + OOT at 50 Hz 29 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 32 ms + OOT at 50 Hz 29 ms + OOT at 60 Hz

1.19.7.5 Dropout times

Test condition:	see item 1.19.7.1
Test values:	see item 1.19.7.1
Permissive tolerance/Limiting values:	t approx. 32 ms + OOT at 50 Hz 27 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 32 ms + OOT at 50 Hz 27 ms + OOT at 60 Hz

1.19.7.6 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % from setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % from setting value or 10 ms

Summary

1.19.7.7 Polarized G0/B0 threshold

Test condition:	0.10 mS ≤ Y0 ≤ 100.00 mS
Test values:	0.10 mS ≤ Y0 ≤ 100.00 mS
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.05 mS (Irated=1A/1.6A) or 0.25 mS (Irated=5A/8A)
Test results/Remarks:	|δ| ≤ 1 % of setting value or 0.05 mS (Irated=1A/1.6A) or 0.25 mS (Irated=5A/8A)

1.19.8 Admittance protection stage Y0>

1.19.8.1 Pickup values Y0>

Test condition:	Fundamental components, RMS values 0.10 mS ≤ Y0> ≤ 100.00 mS
Test values:	frated = 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	For CT protection: |δ| ≤ 1 % of setting value or 1% of Irated For CT measurement: |δ| ≤ 1 % of setting value or 0.1% of Irated
Test results/Remarks:	For CT protection: |δ| ≤ 1 % of setting value or 1% of Irated For CT measurement: |δ| ≤ 1 % of setting value or 0.1% of Irated

1.19.8.2 Threshold values V0>

Test condition:	0.300 V ≤V0> ≤ 200.000V
Test values:	0.300 V ≤V0> ≤ 200.000V
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.5 V
Test results/remarks:	|δ| ≤ 1 % of setting value or 0.5 V

1.19.8.3 Pickup time

Test condition:	see item 1.19.8.1
Test values:	I/Irated = 2
Permissive tolerance/Limiting values:	t approx. 32 ms + OOT at 50 Hz 29 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 32 ms + OOT at 50 Hz 29 ms + OOT at 60 Hz

1.19.8.4 Dropout times

Test condition:	see item 1.19.8.1
Test values:	see item 1.19.8.1
Permissive tolerance/Limiting values:	t approx. 32 ms + OOT
Test results/Remarks:	t approx. 32 ms + OOT

1.19.8.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % from setting value or 10 ms
Test results/Remarks:	|δ| < 1 % or 10 ms

1.19.9 pulse-pattern detection stage

1.19.9.1 Threshold values V0>

Test condition:	0.300 V ≤V0> ≤ 200.000V
Test values:	0.300 V ≤V0> ≤ 200.000V
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.05 V

Summary

Test results/remarks: |δ| ≤ 1 % of setting value or 0.05 V

1.19.9.2 Threshold values 3I0>

Test condition: 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
0.001 Irated ≤ 3I0> ≤ 35.000 Irated for CT sensitive

Test values: frated = 50 Hz, 60 Hz
0.001 Irated ≤ 3I0> ≤ 35.000 Irated for CT sensitive

Permissive tolerance/Limiting values: For CT protection:
|δ| ≤ 1 % from setting value or 0.5% of Irated
For CT measurement:
|δ| ≤ 1 % from setting value or 0.01% of Irated

Test results/Remarks: For CT protection:
|δ| ≤ 1 % from setting value or 0.5% of Irated
For CT measurement:
|δ| ≤ 1 % from setting value or 0.01% of Irated

1.19.9.3 Pickup time

Test condition: Pulse-on duration=1s, Pulse-off duratiom=1.5s, Max.tolera.pulse-on or off=0.15s[1]

Test values: see item 1.19.9.1 and 1.19.9.2

Permissive tolerance/Limiting values: t approx.
2.5s + 0.3s + OOT

Test results/Remarks: t approx.
2.5s + 0.3s + OOT

1.19.9.4 Dropout times

Test condition: see item 1.19.9.1

Test values: see item 1.19.9.1

Permissive tolerance/Limiting values: t approx.
32 ms + OOT

Test results/Remarks: t approx.
32 ms + OOT

1.19.10 Directional stage with phasor measurement of a harmonic

1.19.10.1 Threshold values V0>

Test condition: 0.300 V ≤V0> ≤ 200.000V

Test values: 0.300 V ≤V0> ≤ 200.000V

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 0.05 V

Test results/remarks: |δ| ≤ 1 % of setting value or 0.05 V

1.19.10.2 Threshold values 3I0> harmonic

Test condition: 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
0.001 Irated ≤ 3I0> ≤ 35.000 Irated for CT sensitive

Test values: frated = 50 Hz, 60 Hz
0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
0.001 Irated ≤ 3I0> ≤ 35.000 Irated for CT sensitive

Permissive tolerance/Limiting values: For CT protection:
|δ| ≤ 1 % of setting value or 0.5% of Irated
For CT measurement:
|δ| ≤ 1 % of setting value or 0.01% of Irated

Test results/Remarks: For CT protection:
|δ| ≤ 1 % of setting value or 0.5% of Irated
For CT measurement:
|δ| ≤ 1 % of setting value or 0.01% of Irated

1.19.10.3 Pickup time

Test condition: see item 1.19.10.1 and 1.19.10.2

Test values: 1.2*Threshold

[1] After the first valid pulse is detected, the function picks up. For a typical Pulse-on/off duration setting of e.g. 1.0/1.5 s, a typical Max.tolera.pulse-on or off setting of e.g. 0.15s, the inherent pickup time is approx. 1s+1.5s+2*0.15s+OOT.

Summary

Permissive tolerance/Limiting values:	t approx. 70 ms + OOT at 50 Hz 60 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 70 ms + OOT at 50 Hz 60 ms + OOT at 60 Hz

1.19.10.4 Dropout times

Test condition:	see item 1.19.10.1 and 1.19.10.2
Test values:	see item 1.19.10.1 and 1.19.10.2
Permissive tolerance/Limiting values:	t approx. 30 ms + OOT at 50 Hz 20 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 30 ms + OOT at 50 Hz 20 ms + OOT at 60 Hz

1.19.10.5 Dropout ratio 3I0 harmonic

Test condition:	see item 1.19.10.2
Test values:	see item 1.19.10.2
Permissive tolerance/Limiting values:	For CT protection: $\|\delta\| \leq 1$ % of dropout value or 1.5% of Irated For CT measurement: $\|\delta\| \leq 1$ % of dropout value or 0.05% of Irated
Test results/Remarks:	For CT protection: $\|\delta\| \leq 1$ % of dropout value or 1.5% of Irated For CT measurement: $\|\delta\| \leq 1$ % of dropout value or 0.05% of Irated

1.19.10.6 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	$\|\delta\| \leq 1$ % from setting value or 10 ms
Test results/Remarks:	$\|\delta\| \leq 1$ % from setting value or 10 ms

Summary

1.20 37 Undercurrent Protection with 3-phase

1.20.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.20.2 Pickup values

Test condition:	0.030 Irated ≤ I> ≤ 35.000 Irated
Test values:	frated = 50 Hz, 60Hz 0.030 Irated ≤ I> ≤ 20.000 Irated
Method of measurement = fundamental components:	
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.005 Irated
Test results/Remarks:	|δ| ≤ 2 % of setting value or 0.005 Irated
Method of measurement = RMS value:	
Permissive tolerance/Limiting values:	up to 30th hamonics: |δ| ≤ 1 % of setting value or 0.005 Irated
Test results/Remarks:	up to 30th hamonics: |δ| ≤ 2 % of setting value or 0.005 Irated

1.20.3 Dropout ratio

Test condition:	see item 1.20.2
Test values:	see item 1.20.2
Permissive tolerance/Limiting values:	1.05 (fixed)
Test results/Remarks:	1.05 (fixed)

1.20.4 Pickup times

Test condition:	see item 1.20.2
Test values:	I/ Irated = 1 ; I/ Irated = 2
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz

1.20.5 Dropout times

Test condition:	see item 1.20.2
Test values:	see item 1.20.2
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz

1.20.6 Time delays

Test condition:	added to the inherent operating times
Test values:	0.000 s ≤ T ≤ 60.000 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

Summary

1.21 47/59 Overvoltage Protection

1.21.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-127

1.21.2 3ph Voltage ph-to-gnd, ph-to-ph V with definite time overvoltage stage

1.21.2.1 Pickup values

Test condition:	Fundamental components, RMS values frated = 50 Hz, 60Hz 0.300 V ≤ threshold value ≤ 340.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V
Test results/Remarks:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V

1.21.2.2 Dropout ratio

Test condition:	See item 1.21.2.1
Test values:	r = setable dropout ratio 0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % of dropout value or 0.05 V
Test results/Remarks:	|δ| ≤ 0.5 % of dropout value or 0.05 V

1.21.2.3 Pickup times

Test condition	See item 1.21.2.1 1.2* threshold value
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz

1.21.2.4 Dropout times

Test condition:	See item 1.21.2.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.21.2.5 Time delays

Test condition:	See item 1.21.2.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.21.3 3ph Voltage ph-to-gnd, ph-to-ph V with inverse time overvoltage stage

1.21.3.1 Pickup values

Test condition:	Fundamental components, RMS values frated = 50 Hz, 60Hz 0.300 V ≤ pickup value ≤ 340.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V
Test results/Remarks:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V

1.21.3.2 Dropout ratio

Test condition	See item 1.21.3.1

Summary

Permissive tolerance/Limiting values: |δ| ≤ 0.5 % of setting value or 0.05 V

Test results/Remarks: |δ| ≤ 0.5 % of setting value or 0.05 V

1.21.3.3 Pickup times

Test condition: See item 1.21.3.1
1.2* pickup value

Permissive tolerance/Limiting values: Approx.
25 ms + OOT at frated = 50 Hz
22 ms + OOT at frated = 60 Hz

Test results/Remarks: Approx.
25 ms + OOT at frated = 50 Hz
22 ms + OOT at frated = 60 Hz

1.21.3.4 Dropout times

Test condition: See item 1.21.3.1
Reset time is set 0 s

Permissive tolerance/Limiting values: Approx.
20 ms + OOT

Test results/Remarks: Approx.
20 ms + OOT

1.21.3.5 Definite time delays

Test condition: See item 1.21.3.1

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| ≤ 1 % of setting value or 10 ms

1.21.3.6 Reset time

Test condition: See item 1.21.3.1

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| ≤ 1 % of setting value or 10 ms

1.21.3.7 Inverse time characteristic

Test condition: See item 1.21.3.1

Charact.constant k: 0.00 ≤ k ≤ 300.00
Charact.constant α: 0.010 ≤ α ≤ 5.000
Charact.constant c: 0.000 ≤ c ≤ 5.000
Time dial: 0.05 ≤ T ≤ 15.00

Permissive tolerance/Limiting values: |δ| ≤ 5 % of the setting value or 30 ms

Test results/Remarks: |δ| ≤ 5 % of the setting value or 30 ms

1.21.4 Positive sequence V1

1.21.4.1 Pickup values

Test condition: frated = 50 Hz, 60Hz
0.300 V ≤ threshold value ≤ 200.000 V

Permissive tolerance/Limiting values: in the range frated ±10 %
|δ| ≤ 0.5 % of setting value or 0.05 V

Test results/Remarks: in the range frated ±10 %
|δ| ≤ 0.5 % of setting value or 0.05 V

1.21.4.2 Dropout ratio

Test condition: See item 1.21.4.1

Test values: r = setable dropout ratio
0.90 ≤ r ≤ 0.99

Permissive tolerance/Limiting values: |δ| ≤ 0.5 % of dropout value or 0.05 V

Test results/Remarks: |δ| ≤ 0.5 % of dropout value or 0.05 V

Summary

1.21.4.3 Pickup times

Test condition	See item 1.21.4.1 1.2* threshold value
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz

1.21.4.4 Dropout times

Test condition	See item 1.21.4.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.21.4.5 Time delays

Test condition:	See item 1.21.4.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.21.5 Zero Sequence, Residual Voltage V0

1.21.5.1 Pickup values

Test condition:	RMS values, fundamental components, fundamental components over 2 cycles 0.300 V ≤ threshold value ≤ 340.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V
Test results/Remarks:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V

1.21.5.2 Dropout ratio

Test condition:	See item 1.21.5.1
Test values:	r = setable dropout ratio 0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % of dropout value or 0.05 V
Test results/Remarks:	|δ| ≤ 0.5 % of dropout value or 0.05 V

1.21.5.3 Pickup times (Filter = RMS value, Standard Filter)

Test condition	See item 1.21.5.1 1.2* threshold value
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz

1.21.5.4 Dropout times (Filter = RMS value, Standard Filter)

Test condition	See item 1.21.5.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT at frated = 50 Hz 16.6 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 20 ms + OOT at frated = 50 Hz 16.6 ms + OOT at frated = 60 Hz

Summary

1.21.5.5 Pickup times (Filter = over 2 cycles)

Test condition	See item 1.21.5.1 1.2* threshold value
Permissive tolerance/Limiting values:	t approx. 45 ms + OOT at frated = 50 Hz 39 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 45 ms + OOT at frated = 50 Hz 39 ms + OOT at frated = 60 Hz

1.21.5.6 Dropout times (Filter = over 2 cycles)

Test condition	See item 1.21.5.1
Permissive tolerance/Limiting values:	t approx. 31.06 ms + OOT at frated = 50 Hz 27.06 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 31.06 ms + OOT at frated = 50 Hz 27.06 ms + OOT at frated = 60 Hz

1.21.5.7 Time delays

Test condition:	See item 1.21.5.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.21.6 Any Voltage Vx

1.21.6.1 Pickup values

Test condition:	Fundamental components, RMS values frated = 50 Hz, 60Hz 0.300 V ≤ threshold value ≤ 340.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V
Test results/Remarks:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V

1.21.6.2 Dropout ratio

Test condition:	See item 1.21.6.1
Test values:	r = setable dropout ratio 0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % of setting value or 0.05 V
Test results/Remarks:	|δ| ≤ 0.5 % of setting value or 0.05 V

1.21.6.3 Pickup times

Test condition	See item 1.21.6.1 1.2* threshold value
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz

1.21.6.4 Dropout times

Test condition:	See item 1.21.6.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

Summary

1.21.6.5 Time delays

Test condition:	See item 1.21.6.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.21.7 Negative sequence V2

1.21.7.1 Pickup values

Test condition:	frated = 50 Hz, 60Hz 0.300 V ≤ threshold value ≤ 200.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V
Test results/Remarks:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V

1.21.7.2 Dropout ratio

Test condition:	See item 1.21.7.1
Test values:	r = setable dropout ratio 0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % of dropout value or 0.05 V
Test results/Remarks:	|δ| ≤ 0.5 % of dropout value or 0.05 V

1.21.7.3 Pickup times

Test condition	See item 1.21.7.1 1.2* threshold value
Permissive tolerance/Limiting values:	t approx. Measuring window length 1 cycle: 55ms + OOT Measuring window length 10 cycles: 210ms + OOT (depends on the measuring window length) at frated = 50 Hz Measuring window length 1 cycle: 48ms + OOT Measuring window length 10 cycles: 190ms + OOT (depends on the measuring window length) at frated = 60 Hz
Test results/Remarks:	t approx. Measuring window length 1 cycle: 55ms + OOT Measuring window length 10 cycles: 210ms + OOT (depends on the measuring window length) at frated = 50 Hz Measuring window length 1 cycle: 48ms + OOT Measuring window length 10 cycles: 190ms + OOT (depends on the measuring window length) at frated = 60 Hz

1.21.7.4 Dropout times

Test condition	See item 1.21.7.1
Permissive tolerance/Limiting values:	t approx. Measuring window length 1 cycle: 20ms + OOT Measuring window length 10 cycles: 70ms + OOT (depends on the measuring window length)
Test results/Remarks:	t approx. Measuring window length 1 cycle: 20ms + OOT Measuring window length 10 cycles: 70ms + OOT (depends on the measuring window length)

1.21.7.5 Time delays

Test condition:	See item 1.21.7.1

Summary

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| ≤ 1 % of setting value or 10 ms

1.21.8 Ratio of negative-sequence to positive-sequence, V2/V1

1.21.8.1 Pickup values

Test condition: frated = 50 Hz, 60Hz
0.5% ≤ threshold value ≤ 100%

Permissive tolerance/Limiting values: in the range frated ±10 %
|δ| ≤ 0.5 % of setting value or 0.05 V

Test results/Remarks: in the range frated ±10 %
|δ| ≤ 0.5 % of setting value or 0.05 V

1.21.8.2 Dropout ratio

Test condition: See item 1.21.8.1

Test values: r = setable dropout ratio
0.90 ≤ r ≤ 0.99

Permissive tolerance/Limiting values: |δ| ≤ 0.5 % of setting value or 0.05 V

Test results/Remarks: |δ| ≤ 0.5 % of setting value or 0.05 V

1.21.8.3 Pickup times

Test condition: See item 1.21.8.1
1.2* threshold value

Permissive tolerance/Limiting values: t approx.

Measuring window length 1 cycle: 55ms + OOT
Measuring window length 10 cycles: 210ms + OOT
(depends on the measuring window length) at frated = 50 Hz

Measuring window length 1 cycle: 48ms + OOT
Measuring window length 10 cycles: 190ms + OOT
(depends on the measuring window length) at frated = 60 Hz

Test results/Remarks: t approx.

Measuring window length 1 cycle: 55ms + OOT
Measuring window length 10 cycles: 210ms + OOT
(depends on the measuring window length) at frated = 50 Hz

Measuring window length 1 cycle: 48ms + OOT
Measuring window length 10 cycles: 190ms + OOT
(depends on the measuring window length) at frated = 60 Hz

1.21.8.4 Dropout times

Test condition: See item 1.21.8.1

Permissive tolerance/Limiting values: t approx.

Measuring window length 1 cycle: 22ms + OOT
Measuring window length 10 cycles: 55ms + OOT
(depends on the measuring window length) at frated = 50 Hz

Measuring window length 1 cycle: 18ms + OOT
Measuring window length 10 cycles: 45ms + OOT
(depends on the measuring window length) at frated = 60 Hz

Test results/Remarks: t approx.

Measuring window length 1 cycle: 22ms + OOT
Measuring window length 10 cycles: 55ms + OOT
(depends on the measuring window length) at frated = 50 Hz

Summary

Measuring window length 1 cycle: 18ms + OOT
Measuring window length 10 cycles: 45ms + OOT
(depends on the measuring window length) at frated = 60 Hz

1.21.8.5 Time delays

Test condition:	See item 1.21.8.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

Summary

1.22 27 Undervoltage Protection

1.22.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-127

1.22.2 3ph Voltage ph-to-gnd, ph-to-ph define time with definite time undervoltage stages

1.22.2.1 Pickup values

Test condition:	fundamental components, RMS values 0.300 V ≤ threshold value ≤ 175.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V
Test results/Remarks:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V

1.22.2.2 Dropout ratio

Test condition:	see item 1.22.2.1
Test values:	r = setable dropout ratio 1.01 ≤ r ≤ 1.20
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % of dropout value or 0.05 V
Test results/Remarks:	|δ| ≤ 0.5 % of dropout value or 0.05 V

1.22.2.3 Pickup times

Test condition	see item 1.22.2.1 0.8* threshold value no pickup delay
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz

1.22.2.4 Pickup delay

Test condition	see item 1.22.2.1 0.8* pickup value
Permissive tolerance/Limiting values:	t approx. 40 ms
Test results/Remarks:	t approx. 40 ms

1.22.2.5 Dropout times

Test condition:	see item 1.22.2.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.22.2.6 Time delays

Test condition:	see item 1.22.2.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.22.3 3ph Voltage ph-to-gnd, ph-to-ph with inverse time undervoltage stages

1.22.3.1 Pickup values

Test condition:	fundamental components, RMS values 0.300 V ≤ threshold value ≤ 175.000 V

Summary

Permissive tolerance/Limiting values: in the range frated ±10 %
|δ| ≤ 0.5 % of setting value or 0.05 V

Test results/Remarks: in the range frated ±10 %
|δ| ≤ 0.5 % of setting value or 0.05 V

1.22.3.2 Dropout ratio

Test condition: see item 1.22.3.1

Test values: 1.05

Permissive tolerance/Limiting values: |δ| ≤ 0.5 % of dropout value or 0.05 V

Test results/Remarks: |δ| ≤ 0.5 % of dropout value or 0.05 V

1.22.3.3 Pickup times

Test condition: see item 1.22.3.1
0.8* pickup value
no pickup delay

Permissive tolerance/Limiting values: t approx.
25 ms + OOT at frated = 50 Hz
22 ms + OOT at frated = 60 Hz

Test results/Remarks: t approx.
25 ms + OOT at frated = 50 Hz
22 ms + OOT at frated = 60 Hz

1.22.3.4 Pickup delay

Test condition: see item 1.22.3.1
0.8* pickup value

Permissive tolerance/Limiting values: t approx.
40 ms

Test results/Remarks: t approx.
40 ms

1.22.3.5 Dropout times

Test condition: see item 1.22.3.1
with no reset time

Permissive tolerance/Limiting values: t approx.
20 ms + OOT

Test results/Remarks: t approx.
20 ms + OOT

1.22.3.6 Inverse time characteristics

Test condition: see item 1.22.3.1
0.8*pickup value

Test values: Charact.constant k: 0.00 ≤ k ≤ 300.00
Charact.constant α: 0.010 ≤ α ≤ 5.000
Charact.constant c: 0.000 ≤ c ≤ 5.000
Time dial: 0.05 ≤ T ≤ 15.00

Permissive tolerance/Limiting values: 5 % of setting value or 30 ms

Test results/Remarks: 5 % of setting value or 30 ms

1.22.3.7 Definite Time delays

Test condition: see item 1.22.3.1

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| ≤ 1 % of setting value or 10 ms

1.22.3.8 Reset Time

Test condition: see item 1.22.3.1

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| ≤ 1 % of setting value or 10 ms

Summary

1.22.4 Positive-Sequence Voltage V1

1.22.4.1 Pickup values

Test condition:	fundamental components, RMS values 0.300 V ≤ threshold value ≤ 200.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V
Test results/Remarks:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V

1.22.4.2 Dropout ratio

Test condition:	see item 1.22.4.1
Test values:	r = setable dropout ratio 1.01 ≤ r ≤ 1.20
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % of dropout value or 0.05 V
Test results/Remarks:	|δ| ≤ 0.5 % of dropout value or 0.05 V

1.22.4.3 Pickup times

Test condition	see item 1.22.4.1 0.8* threshold value
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz

1.22.4.4 Dropout times

Test condition:	see item 1.22.4.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.22.4.5 Time delays

Test condition:	see item 1.22.4.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.22.5 Any Voltage Vx

1.22.5.1 Pickup values

Test condition:	fundamental components, RMS values 0.300 V ≤ threshold value ≤ 200.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V
Test results/Remarks:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V

1.22.5.2 Dropout ratio

Test condition:	see item 1.22.5.1
Test values:	r = setable dropout ratio 1.01 ≤ r ≤ 1.20
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % of dropout value or 0.05 V
Test results/Remarks:	|δ| ≤ 0.5 % of dropout value or 0.05 V

1.22.5.3 Pickup times

Test condition	see item 1.22.5.1 0.8* threshold value

Summary

Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz

1.22.5.4 Dropout times

Test condition:	see item 1.22.5.1
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.22.5.5 Time delays

Test condition:	see item 1.22.5.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	$\|\delta\| \leq 1$ % of setting value or 10 ms
Test results/Remarks:	$\|\delta\| \leq 1$ % of setting value or 10 ms

Summary

1.23 27 Undervoltage-controlled Reactive Power Protection

1.23.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-127

1.23.2 Protection stage

1.23.2.1 Pickup values V<

Test condition:	frated = 50 Hz, 60Hz 3.000 V ≤ V< ≤ 175.000 V
Test values:	3.000 V ≤ V< ≤ 175.000 V
Permissive tolerance/Limiting values:	< 0.5 % of set point value or 0.05 V
Test results/Remarks:	< 0.5 % of set point value or 0.05 V

1.23.2.2 V dropout ratio

Test condition:	frated = 50 Hz, 60Hz r = dropout ratio
Test values:	r = 1.05
Test results/Remarks:	1.01 ≤ r ≤ 1.20

1.23.2.3 Pickup values I1>

Test condition:	0.030 A ≤ I1> ≤ 10.000 Irated
Test values:	frated = 50 Hz, 60Hz
Permissive tolerance/Limiting values:	1 % of setting value or 0.005 Irated
Test results/remarks:	1 % of setting value or 0.005 Irated

1.23.2.4 Dropout ratio release current

Test condition:	frated = 50 Hz, 60Hz r = dropout ratio
Test values:	r = 0.95
Test results / remarks:	0.90 ≤ r ≤ 0.99

1.23.2.5 Pickup values Q<

Test condition:	frated = 50 Hz, 60Hz 1.0% ≤ Q< ≤ 200.0%
Test values:	1.0% ≤ Q< ≤ 200.0%
Permissive tolerance/Limiting values:	<0.5 % Sn/r ± 3 % of setting value
Test results / remarks:	<0.5 % Sn/r ± 3 % of setting value

1.23.2.6 Q dropout ratio

Test condition:	frated = 50 Hz, 60Hz r = dropout ratio
Test values:	r ≤ 0.95
Test results / remarks:	0.90 ≤ r ≤ 0.99

1.23.2.7 Pickup time

Test condition:	see item 1.23.2.1, 1.23.2.3, 1.23.2.5
Test values:	frated = 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	t approx. 55 ms + OOT at frated = 50 Hz 45 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 55 ms + OOT at frated = 50 Hz 45 ms + OOT at frated = 60 Hz

Summary

1.23.2.8 Dropout times

Test condition:	see item 1.23.2.1, 1.23.2.3, 1.23.2.5
Test values:	frated = 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	t approx. 55 ms + OOT at frated = 50 Hz 45 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 55 ms + OOT at frated = 50 Hz 45 ms + OOT at frated = 60 Hz

1.23.2.9 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.23.2.10 Operate delay generator CB

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.23.2.11 Operate delay grid CB

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.23.3 Recloser stage

1.23.3.1 V> reclosure threshold

Test condition:	frated = 50 Hz, 60Hz 3.000 V ≤ V> ≤ 340.000 V
Test values:	3.000 V ≤ V> ≤ 340.000 V
Permissive tolerance/Limiting values:	< 0.5 % of set point value or 0.05V
Test results/Remarks:	< 0.5 % of set point value or 0.05V

1.23.3.2 V dropout ratio

Test condition:	frated = 50 Hz, 60Hz r = dropout ratio
Test values:	r = 0.95
Test results / remarks:	0.90 ≤ r ≤ 0.99

1.23.3.3 f-difference positive

Test condition:	0.01 Hz to 5.00 Hz
Test values:	0.01 Hz to 5.00 Hz
Permissive tolerance/Limiting values:	10 mHz
Test results/Remarks:	10 mHz

1.23.3.4 f-difference negative

Test condition:	-5.00 Hz to -0.01 Hz
Test values:	-5.00 Hz to -0.01 Hz
Permissive tolerance/Limiting values:	10 mHz
Test results/Remarks:	10 mHz

Summary

1.23.3.5 I> release threshold

Test condition:	0.030 Irated ≤ I> ≤ 10.000 Irated
Test values:	frated = 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	1 % of setting value or 0.005 Irated
Test results/Remarks:	1 % of setting value or 0.005 Irated

1.23.3.6 Dropout ratio release current

Test condition:	frated = 50 Hz, 60Hz r = dropout ratio
Test values:	r = 0.95
Test results/Remarks:	0.90 ≤ r ≤ 0.99

1.23.3.7 Time delay

Test condition:	0.00 s ≤ T ≤ 3600.00 s
Test values:	0.00 s ≤ T ≤ 3600.00 s
Permissive tolerance/Limiting values:	≤1% of setting value or 10 ms
Test results/Remarks:	≤1% of setting value or 10 ms

Summary

1.24 Vector Jump Protection

1.24.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.24.2 General

1.24.2.1 Pickup values

1.24.2.1.1 Threshold V1 min

Test condition:	Positive sequence voltage, set parameter Threshold V1 max = 175.000 V
Test values:	1.000 V < threshold value ≤ 158.200 V
Permissive tolerance/Limiting values:	1 % of setting value or 0.05 V
Test results/Remarks:	1 % of setting value or 0.05 V

1.24.2.1.2 Threshold V1 max

Test condition:	Positive sequence voltage, set parameter Threshold V1 min = 0.300 V
Test values:	1.000 V < threshold value ≤ 175.000 V
Permissive tolerance/Limiting values:	1 % of setting value or 0.05 V
Test results/Remarks:	1 % of setting value or 0.05 V

1.24.2.1.3 T Block

Test condition:	Change voltage or frequency from out of range to be within working range as following: Change voltage from 0.5 Vrated to Vrated at f = frated Change voltage from 1.5 Vrated to Vrated at f = frated Change frequency from 0.5 frated to frated at V = Vrated Change frequency from 1.5 frated to frated at V = Vrated
Test values:	0.00 s ≤ T > ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

1.24.3 Stage Δφ

1.24.3.1 Pickup values

1.24.3.1.1 Threshold Δφ

Test condition:	V = Vrated
Test values:	2.0 ° < threshold value ≤ 30.0 °
Permissive tolerance/Limiting values:	± 0.5 °
Test results/Remarks:	± 0.5 °

1.24.3.2 Pickup times

Test condition:	V = Vrated Change Δφ to + 12.0 ° (leading angle) or to – 12.0 ° (lagging angle), at threshold Δφ = 10.0 °
Permissive tolerance/Limiting values:	t approx. 44 ~ 63 ms + OOT at 50 Hz 36 ~ 53 ms + OOT at 60 Hz
Test results/Remarks:	44 ~ 63 ms + OOT at 50 Hz 36 ~ 53 ms + OOT at 60 Hz

1.24.3.3 Operate delay

Test condition:	V = Vrated Change Δφ to + 15.0 ° at threshold Δφ = 10.0 °
Test values:	0.00 s ≤ T > ≤ 59.90 s (the range of operate delay: 0.00 s ≤ T > ≤ 60.00 s, but the setting must less than T-reset, so test range: 0.00 s ≤ T > ≤ 59.90 s)

Summary

Permissive tolerance/Limiting values: 1 % of setting value or 10 ms

Test results/Remarks: 1 % of setting value or 10 ms

1.24.3.4 T Reset

Test condition: V = Vrated

Change Δφ to + 15.0 ° at threshold Δφ = 10.0 °

Test values: 0.00 s ≤ T > ≤ 60.00 s

Permissive tolerance/Limiting values: 1 % of setting value or 10 ms

Test results/Remarks: 1 % of setting value or 10 ms

1.24.4 Stage I1 < Release

1.24.4.1 Pickup value

1.24.4.1.1 I<Threshold

Test condition: V = Vrated

Test values: 0.030 A < threshold value ≤ 10.000 A

(the range of I<Threshold: 0.030 A ≤ Threshold value ≤ 30.000 A)

Permissive tolerance/Limiting values: 1 % setting value or 0.010 Irated

Test results/Remarks: 1 % setting value or 0.010 Irated

Summary

1.25 DC Protection

1.25.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151
- IEC/EN 60255-127

1.25.2 Stage DC-I>

1.25.2.1 Pickup values

Test condition:	-20.00 A ≤ threshold value* ≤ 20.00 A * depends on measuring-transducer configuration Configuration in FN MT fast: Unit: A Upper limit: 20.00 mA Upper limit – Sensor: 20.00 Lower limit: -20.00 mA Lower limit – Sensor: -20.00
Test values:	-20.00 mA ≤ DC I ≤ 20.00 mA
Permissive tolerance/Limiting values:	|δ| ≤ 1.0 % of setting value or 0.10 mA
Test results/Remarks:	|δ| ≤ 1.0 % of setting value or 0.10 mA

1.25.2.2 Dropout ratio

Test condition:	see item 1.25.2.1
Test values:	r = 0.95 at Threshold > 0 r = 1.05 at Threshold < 0
Permissive tolerance/Limiting values:	0.93 ≤ r ≤ 0.97 of threshold value or ≤ 0.15 mA at Threshold > 0 1.03 ≤ r ≤ 1.07 of threshold value or ≤ 0.15 mA at Threshold < 0 0.15 mA at Threshold = 0
Test results/Remarks:	0.93 ≤ r ≤ 0.97 of threshold value or ≤ 0.15 mA at Threshold >0 1.03 ≤ r ≤ 1.07 of threshold value or ≤ 0.15 mA at Threshold < 0 0.15 mA at Threshold = 0

1.25.2.3 Pickup times

Test condition:	see item 1.25.2.1
Test values:	Threshold = 10.00 A, DC I from 0 to 1.2*Threshold.
Permissive tolerance/Limiting values:	t approx. 60 ~ 70 ms + OOT
Test results/Remarks:	t approx. 60 ~ 70 ms + OOT

1.25.2.4 Dropout times

Test condition:	see item 1.25.2.1
Test values:	Threshold = 10.00 A, DC I from 2*Threshold to 0.8*Threshold.
Permissive tolerance/Limiting values:	t approx. 60 ~ 70 ms + OOT
Test results/Remarks:	t approx. 60 ~ 70 ms + OOT

1.25.2.5 Operate delays

Test condition:	see item 1.25.2.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.25.3 Stage DC-I<

1.25.3.1 Pickup values

Test condition:	1.25.2.1

Summary

Test values: 1.25.2.1

Permissive tolerance/Limiting values: |δ| ≤ 1.0 % of setting value or 0.10 mA

Test results/Remarks: |δ| ≤ 1.0 % of setting value or 0.10 mA

1.25.3.2 Dropout ratio

Test condition: see item 1.25.2.1

Test values: r = 1.05 at Threshold > 0
r = 0.95 at Threshold < 0

Permissive tolerance/Limiting values: 1.03 ≤ r ≤ 1.07 of threshold value or ≤ 0.15 mA at Threshold > 0
0.93 ≤ r ≤ 0.97 of threshold value or ≤ 0.15 mA at Threshold < 0
0.15 mA at Threshold = 0

Test results/Remarks: 1.03 ≤ r ≤ 1.07 of threshold value or ≤ 0.15 mA at Threshold >0
0.93 ≤ r ≤ 0.97 of threshold value or ≤ 0.15 mA at Threshold < 0
0.15 mA at Threshold = 0

1.25.3.3 Pickup times

Test condition: see item 1.25.2.1

Test values: Threshold = 10.00 A, DC I from 2*Threshold to 0.8*Threshold.

Permissive tolerance/Limiting values: t approx.
60 ~ 70 ms + OOT

Test results/Remarks: t approx.
60 ~ 70 ms + OOT

1.25.3.4 Dropout times

Test condition: see item 1.25.2.1

Test values: Threshold = 10.00 A, DC I from 0 to 1.2*Threshold.

Permissive tolerance/Limiting values: t approx.
60 ~ 70 ms + OOT

Test results/Remarks: t approx.
60 ~ 70 ms + OOT

1.25.3.5 Operate delays

Test condition: see item 1.31.4.1

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| ≤ 1 % of setting value or 10 ms

1.25.4 Stage DC-V>

1.25.4.1 Pickup values

Test condition: -10.000 V ≤ threshold value* ≤ 10.000 V
* depends on measuring-transducer configuration
Configuration in FN MT fast:
Unit: V
Upper limit: 10.00 V
Upper limit – Sensor: 10.00
Lower limit: -10.00 V
Lower limit – Sensor: -10.00

Test values: -10.000 V ≤ DC V ≤ 10.000 V

Permissive tolerance/Limiting values: |δ| ≤ 1.0 % of setting value or 0.10 V

Test results/Remarks: |δ| ≤ 1.0 % of setting value or 0.10 V

1.25.4.2 Dropout ratio

Test condition: see item 1.25.4.1

Test values: r = 0.95 at Threshold > 0
r = 1.05 at Threshold < 0

Permissive tolerance/Limiting values: 0.93 ≤ r ≤ 0.97 of threshold value or ≤ 0.05 V at Threshold > 0
1.03 ≤ r ≤ 1.07 of threshold value or ≤ 0.05 V at Threshold < 0
0.05 V at Threshold = 0

Test results/Remarks: 0.93 ≤ r ≤ 0.97 of threshold value or ≤ 0.05 V at Threshold >0

Summary

1.03 ≤ r ≤ 1.07 of threshold value or ≤ 0.05 V at Threshold < 0
0.05 V at Threshold = 0

1.25.4.3 Pickup times

Test condition: see item 1.25.4.1

Test values: Threshold = 5.00 V, DC V from 0 to 1.2*Threshold.

Permissive tolerance/Limiting values: t approx.
60 ~ 70 ms + OOT

Test results/Remarks: t approx.
60 ~ 70 ms + OOT

1.25.4.4 Dropout times

Test condition: see item 1.25.4.1

Test values: Threshold = 5.00 V, DC V from 2*Threshold to 0.8*Threshold.

Permissive tolerance/Limiting values: t approx.
60 ~ 70 ms + OOT

Test results/Remarks: t approx.
60 ~ 70 ms + OOT

1.25.4.5 Operate delays

Test condition: see item 1.25.4.1

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| ≤ 1 % of setting value or 10 ms

1.25.5 Stage DC-V<

1.25.5.1 Pickup values

Test condition: see item 1.25.4.1

Test values: -10.000 V ≤ threshold value ≤ 10.000 V

Permissive tolerance/Limiting values: |δ| ≤ 1.0 % of setting value or 0.10 V

Test results/Remarks: |δ| ≤ 1.0 % of setting value or 0.10 V

1.25.5.2 Dropout ratio

Test condition: see item 1.25.4.1

Test values: r = 1.05 at Threshold > 0
r = 0.95 at Threshold < 0

Permissive tolerance/Limiting values: 1.03 ≤ r ≤ 1.07 of threshold value or ≤ 0.05 V at Threshold > 0
0.93 ≤ r ≤ 0.97 of threshold value or ≤ 0.05 V at Threshold < 0
0.05 V at Threshold = 0

Test results/Remarks: 1.03 ≤ r ≤ 1.07 of threshold value or ≤ 0.05 V at Threshold >0
0.93 ≤ r ≤ 0.97 of threshold value or ≤ 0.05 V at Threshold < 0
0.05 V at Threshold = 0

1.25.5.3 Pickup times

Test condition: see item 1.25.4.1

Test values: Threshold = 5.00 V, DC V from 2*Threshold to 0.8*Threshold.

Permissive tolerance/Limiting values: t approx.
60 ~ 70 ms + OOT

Test results/Remarks: t approx.
60 ~ 70 ms + OOT

1.25.5.4 Dropout times

Test condition: see item 1.25.4.1

Test values: Threshold = 5.00 V, DC V from 0 to 1.2*Threshold.

Permissive tolerance/Limiting values: t approx.
60 ~ 70 ms + OOT

Test results/Remarks: t approx.
60 ~ 70 ms + OOT

Summary

1.25.5.5 Operate delays

Test condition:	see item 1.25.4.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

Summary

1.26 81 Frequency Protection

1.26.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.26.2 Pickup values f<, f>

Test condition:	40.00 Hz ≤ f> ≤ 70.00 Hz Method A: Angle difference method Method B : Filtering method
Test values:	A: frated - 0.2 Hz < f < frated + 0.2 Hz B: frated - 3.0 Hz < f < frated + 3.0 Hz
Permissive tolerance/Limiting values:	A: ± 5 mHz at V = Vrated B: ± 10 mHz at V = Vrated
Test results/Remarks:	A: ± 5 mHz at V = Vrated B: ± 10 mHz at V = Vrated

1.26.3 Dropout ratio Δf

Test condition:	20 mHz to 2000 mHz
Permissive tolerance/Limiting values:	± 5 mHz at V = Vrated
Test results/Remarks:	± 5 mHz at V = Vrated

1.26.3.1 Pickup times f<, f>

Permissive tolerance/Limiting values:	Method A: t approx. 70 ms + OOT at frated = 50 Hz 60 ms + OOT at frated = 60 Hz Method B: t approx. 75 ms + OOT at frated = 50 Hz 75 ms + OOT at frated = 60 Hz
Test results/Remarks:	Method A: t < 70 ms + OOT at frated = 50 Hz < 60 ms + OOT at frated = 60 Hz Method B: t < 75 ms + OOT at frated = 50 Hz < 75 ms + OOT at frated = 60 Hz

1.26.3.2 Dropout times f<, f>

Test values:	dropout by I, V -> 0
Permissive tolerance/Limiting values:	60 ms ≤ t ≤ 80 ms
Test results/Remarks:	60 ms ≤ t ≤ 80 ms

1.26.3.3 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % or 10 ms

1.26.4 Positive- or negative sequence V1, V2

1.26.4.1 Pickup values

Test condition:	0.300 V ≤ V ≤ 200.000 V
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % of setting value or 0.5 V
Test results/Remarks:	|δ| ≤ 0.5 % of setting value or 0.5 V

Summary

1.26.4.2 Dropout ratio

Test condition:	r = setable dropout ratio 0.90 ≤ r> ≤ 0.99
Test results/Remarks:	confirmed

1.26.4.3 Pickup times

Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz
Test results/Remarks:	t < 25 ms + OOT at frated = 50 Hz < 22 ms + OOT at frated = 60 Hz

1.26.4.4 Dropout times

Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t < 20 ms + OOT

1.26.4.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	≤1% of setting value or 10ms
Test results/Remarks:	|δ| < 1 % or 10 ms

1.26.4.6 Operating ranges

Permissive tolerance/Limiting values:	Method A: 5 V ≤ Vphph ≤ 230 V 10 Hz ≤ f ≤ 80 Hz Method B: 5 V ≤ Vphph ≤ 230 V 25 Hz ≤ f ≤ 80 Hz
Test results/Remarks:	Method A: 5 V ≤ Vphph ≤ 230 V 10 Hz ≤ f ≤ 80 Hz Method B: 5 V ≤ Vphph ≤ 230 V 25 Hz ≤ f ≤ 80 Hz

Summary

1.27 81R Rate of Frequency Change

1.27.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.27.2 df/dt falling

1.27.2.1 Pickup values

Test condition:	0.9 ≤ f/frated ≤ 1.1
Test values:	0.10 Hz/s ≤ df/dt ≤ 20.00 Hz/s
Permissive tolerance/Limiting values:	< 5 % of set point value or 0.1 Hz/s
Test results/Remarks:	Measuring window ≤ 3 periods < 5 %; < 0.06 Hz/s Measuring window > 3 periods < 3 %; < 0.06 Hz/s

1.27.2.2 Dropout differential

Test condition:	0.9 ≤ f/frated ≤ 1.1
Test values:	0.02 Hz/s≤ Dropout differential ≤ 0.99 Hz/s
Permissive tolerance/Limiting values:	< 5 % of Dropout value or 0.1 Hz/s
Test results/Remarks:	Measuring window ≤ 3 periods < 5 %; < 0.06 Hz/s Measuring window > 3 periods < 3 %; < 0.06 Hz/s

1.27.2.3 Pickup times

Test condition:	0.10 Hz/s ≤ df/dt ≤ 20.00 Hz/s
Test results/Remarks:	Approx.165 ms to 225 ms (depends on measuring window length)

1.27.2.4 Dropout times

Test condition:	0.10 Hz/s ≤ df/dt ≤ 20.00 Hz/s
Test results/Remarks:	Approx.165 ms to 225 ms (depends on measuring window length)

1.27.2.5 Time delays

Test condition:	Added to the inherent operating times
Test values:	0.00 s to 60.00 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	< 1 % or 10 ms

1.27.3 df/dt rising

1.27.3.1 Pickup values

Test condition:	0.9 ≤ f/frated ≤ 1.1
Test values:	0.10 Hz/s ≤ df/dt ≤ 20.00 Hz/s
Permissive tolerance/Limiting values:	< 5 % of set point value or 0,1 Hz/s
Test results/Remarks:	Measuring window ≤ 3 periods < 5 %; < 0.06 Hz/s Measuring window > 3 periods < 3 %; < 0.06 Hz/s

1.27.3.2 Dropout differential

Test condition:	0.9 ≤ f/frated ≤ 1.1
Test values:	0.02 Hz/s≤ Dropout differential ≤ 0.99 Hz/s
Permissive tolerance/Limiting values:	< 5 % of Dropout value or 0,1 Hz/s
Test results/Remarks:	Measuring window ≤ 3 periods < 5 %; < 0.06 Hz/s Measuring window > 3 periods < 3 %; < 0.06 Hz/s

1.27.3.3 Pickup times

Test condition:	0.10 Hz/s ≤ df/dt ≤ 20.00 Hz/s
Test results/Remarks:	Approx.165 ms to 225 ms (depends on measuring window length)

Summary

1.27.3.4 Dropout times

Test condition:	0.10 Hz/s ≤ df/dt ≤ 20.00 Hz/s
Test results/Remarks:	Approx.165 ms to 225 ms (depends on measuring window length)

1.27.3.5 Time delays

Test condition:	Added to the inherent operating times
Test values:	0.00 s to 60.00 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	< 1 % or 10 ms

Summary

1.28 81AB Abnormal Frequency Protection

1.28.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.28.2 Stage Accumul.Time superv

1.28.2.1 Pickup values

1.28.2.1.1 Frequency higher limit

Test condition:	V = Vrated
Test values:	20 Hz < threshold value ≤ 80 Hz
Permissive tolerance/Limiting values:	± 10 mHz
Test results/Remarks:	± 10 mHz

1.28.2.1.2 Frequency lower limit

Test condition:	V = Vrated
Test values:	20 Hz ≤ threshold value < 80 Hz
Permissive tolerance/Limiting values:	± 10 mHz
Test results/Remarks:	± 10 mHz

1.28.2.2 Dropout differential

Test condition:	V = Vrated
Test values:	20.00 mHz ≤ dropout differential ≤ 2000.00 mHz
Permissive tolerance/Limiting values:	± 10 mHz
Test results/Remarks:	± 10 mHz

1.28.2.3 Pickup times

Test condition:	V = Vrated
	50.00 Hz -> 51.00 Hz (frequency limit range: 50.50 Hz - 51.50 Hz) at frated = 50 Hz
	60.00 Hz -> 61.20 Hz (frequency limit range: 60.80 Hz – 62.00 Hz) at frated = 60 Hz
Permissive tolerance/Limiting values:	t approx. 62 ~ 71 ms + OOT at 50 Hz
	55 ~ 64 ms + OOT at 60 Hz
Test results/Remarks:	62 ~ 71 ms + OOT at 50 Hz
	55 ~ 64 ms + OOT at 60 Hz

1.28.2.4 Dropout times

Test condition:	see item 1.28.2.3
	change f = frated after pickup
Permissive tolerance/Limiting values:	t approx. 49 ~ 58 ms + OOT at 50 Hz
	40 ~ 46 ms + OOT at 60 Hz
Test results/Remarks:	49 ~ 58 ms + OOT at 50 Hz
	40 ~ 46 ms + OOT at 60 Hz

1.28.2.5 Dead time

Test condition:	see item 1.28.2.3
Test values:	0.00 s ≤ T > ≤ 200.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

1.28.2.6 Max. Accumulative time

Test condition:	see item 1.28.2.3
Test values:	0.00 min ≤ T > ≤ 60000.00 min

Summary

Auto test: 0.00 min ≤ T > ≤ 120.00 min

Manual test: T> = 240.00 min, 320.00 min, 6000.00 min, 60000.00 min,

Set statistic Max.accumulative time value close to the setting value, check the differential time with omicron.

Permissive tolerance/Limiting values: 1 % of setting value or 10 ms

Test results/Remarks: 1 % of setting value or 10 ms

1.28.3 Stage Dur.Time superv

1.28.3.1 Pickup values

1.28.3.1.1 Frequency higher limit

Test condition: V = Vrated

Test values: 20 Hz < threshold value ≤ 80 Hz

Permissive tolerance/Limiting values: ± 10 mHz

Test results/Remarks: ± 10 mHz

1.28.3.1.2 Frequency lower limit

Test condition: V = Vrated

Test values: 20 Hz ≤ threshold value < 80 Hz

Permissive tolerance/Limiting values: ± 10 mHz

Test results/Remarks: ± 10 mHz

1.28.3.2 Dropout differential

Test condition: V = Vrated

Test values: 20.00 mHz ≤ dropout differential ≤ 2000.00 mHz

Permissive tolerance/Limiting values: ± 10 mHz

Test results/Remarks: ± 10 mHz

1.28.3.3 Pickup times

Test condition: V = Vrated

50.00 Hz -> 51.00 Hz (frequency limit range: 50.50 Hz - 51.50 Hz) at frated = 50 Hz

60.00 Hz -> 61.20 Hz (frequency limit range: 60.80 Hz – 62.00 Hz) at frated = 60 Hz

Permissive tolerance/Limiting values: t approx.
62 ~ 70 ms + OOT at 50 Hz

55 ~ 62 ms + OOT at 60 Hz

Test results/Remarks: 62 ~ 70 ms + OOT at 50 Hz

55 ~ 62 ms + OOT at 60 Hz

1.28.3.4 Dropout times

Test condition: see item 1.28.3.3

change f = frated after pickup

Permissive tolerance/Limiting values: t approx.
50 ~ 58 ms + OOT at 50 Hz

40 ~ 47 ms + OOT at 60 Hz

Test results/Remarks: 50 ~ 58 ms + OOT at 50 Hz

40 ~ 47 ms + OOT at 60 Hz

1.28.3.5 Duration time

Test condition: see item 1.28.3.3

Test values: 0.00 s ≤ T > ≤ 300.00 s

Permissive tolerance/Limiting values: 1 % of setting value or 10 ms

Test results/Remarks: 1 % of setting value or 10 ms

Summary

Summary

1.29 Underfrequency Load Shedding Protection

1.29.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.29.2 General function block

1.29.2.1 Minimum Voltage

Test condition:	frated = 50 Hz, 60 Hz.
Test values:	0.300 p.u. ≤ threshold value ≤ 0.900 p.u.
Permissive tolerance/Limiting values:	in the range frated ±10 % 0.5 % of setting value or 0.05 V
Test results/Remarks:	in the range frated ±10 % 0.5 % of setting value or 0.05 V

1.29.2.2 Phi (power criterion)

Test condition:	see item 1.29.2.1
Test values:	-30°≤ threshold value ≤ 30°
Permissive tolerance/Limiting values:	in the range frated ±10 % 1°
Test results/remarks:	in the range frated ±10 % 1°

Min.current(power crit.)

Test condition:	see item 1.29.2.1
Test values:	0.020 p.u. ≤ threshold value ≤ 0.200 p.u.
Permissive tolerance/Limiting values:	in the range frated ±10 % 1 % of setting value or 0.005 Irated
Test results/Remarks:	in the range frated ±10 % 1 % of setting value or 0.005 Irated

1.29.2.3 Df/dt-rising blk. threshold

Test condition:	0.9 ≤ f/frated ≤ 1.1
Test values:	0.10 Hz/s ≤ threshold value ≤ 20.00 Hz/s
Permissive tolerance/Limiting values:	5 % of setting value or 0.1 Hz/s
Test results/Remarks:	Measuring window ≤ 3 periods, 5 % of setting value or 0.06 Hz/s Measuring window > 3 periods, 3 % of setting value or 0.06 Hz/s

1.29.2.4 Df/dt-falling blk. threshold

Test condition:	0.9 ≤ f/frated ≤ 1.1
Test values:	0.10 Hz/s ≤ threshold value ≤ 20.00 Hz/s
Permissive tolerance/Limiting values:	5 % of setting value or 0.1 Hz/s
Test results/Remarks:	Measuring window ≤ 3 periods, 5 % of setting value or 0.06 Hz/s Measuring window > 3 periods, 3 % of setting value or 0.06 Hz/s

1.29.2.5 Df/df dropout differential

Test condition:	0.9 ≤ f/frated ≤ 1.1
Test values:	0.02 Hz/s≤ Dropout differential ≤ 0.99 Hz/s
Permissive tolerance/Limiting values:	5 % of Dropout value or 0.1 Hz/s
Test results/Remarks:	Measuring window ≤ 3 periods,5 % of setting value or 0.06 Hz/s Measuring window > 3 periods,3 % of setting value or 0.06 Hz/s

1.29.3 Underfrequency Protection stage

1.29.3.1 Pickup values

Test condition:	frated = 50 Hz, 60 Hz f< stabilization counter = 6
Test values:	frated - 10.0 Hz < f < frated + 10.0 Hz

Summary

Permissive tolerance/Limiting values:	5 mHz at V = Vrated
Test results/Remarks:	5 mHz at V = Vrated

1.29.3.2 Frequency dropout differential

Test condition:	see item 1.29.3.1
Test values:	20 mHz to 2000 mHz
Permissive tolerance/Limiting values:	5 mHz at V = Vrated (frated - 10.0 Hz < f < frated + 10.0 Hz)
Test results/Remarks:	5 mHz at V = Vrated (frated - 10.0 Hz < f < frated + 10.0 Hz)

1.29.3.3 Pickup times

Test condition:	see item 1.29.3.1
Test values:	1.2*threshold
Permissive tolerance/Limiting values	85 ms + OOT at 50 Hz 80 ms + OOT at 60 Hz
Test results/Remarks:	85 ms + OOT at 50 Hz 80 ms + OOT at 60 Hz

1.29.3.4 Dropout times

Test condition:	see item 1.29.3.1
Permissive tolerance/Limiting values:	80 ms + OOT at 50 Hz 75 ms + OOT at 60 Hz
Test results/Remarks:	80 ms + OOT at 50 Hz 75 ms + OOT at 60 Hz

1.29.3.5 Operate delay

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1% of setting value or 10ms
Test results/Remarks:	1% of setting value or 10ms

Summary

1.30 24 Overexcitation Protection

1.30.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.30.2 General Test conditions

frated:	50 Hz, 60 Hz
Vrated:	100 V

1.30.3 Definite Time

1.30.3.1 V/f Threshold

Test condition:	$1.00 \leq V/f \leq 1.40$
Permissive tolerance/Limiting values:	$\|\delta\| \leq 2$ % of setting value
Test results/Remarks:	$\|\delta\| < 2$ %

1.30.3.2 Dropout ratio

Test condition:	see item 1.30.3.1
Test values:	see item 1.30.3.1
Permissive tolerance/Limiting values:	r approx.0.98
Test results/Remarks:	$0.96 \leq r \leq 0.99$

1.30.3.3 Pickup Times

Test condition:	see item 1.30.3.1
Test values:	$1.00 \leq V/f \leq 1.40$
Permissive tolerance/Limiting values:	t approx. 33 ms + OOT at 50 Hz 30 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 33 ms + OOT at 50 Hz < 30 ms + OOT at 60 Hz

1.30.3.4 Dropout times

Test condition:	see item 1.30.3.1
Test values:	$1.00 \leq V/f \leq 1.40$
Permissive tolerance/Limiting values:	t approx. 10 ms + OOT at 50 Hz 10 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 10 ms + OOT at 50 Hz < 10 ms + OOT at 60 Hz

1.30.3.5 Time delays

Test condition:	added to the inherent operating times
Test values:	$0.00 \text{ s} \leq T \leq 60.00 \text{ s}$
Permissive tolerance/Limiting values:	$\|\delta\| \leq 1$ % of setting value or 10 ms
Test results/Remarks:	$\|\delta\| < 1$ % of setting value or 10 ms

1.30.4 Thermal Characteristic

1.30.4.1 V/f Threshold

Test condition:	$1.00 \leq V/f \leq 1.20$
Permissive tolerance/Limiting values:	$\|\delta\| \leq 2$ % of setting value
Test results/Remarks:	$\|\delta\| < 2$ %

1.30.4.2 Dropout ratio

Test condition:	see item 1.30.4.1
Test values:	see item 1.30.4.1

Summary

Permissive tolerance/Limiting values:	r approx.0.98
Test results/Remarks:	0.96 ≤ r ≤ 0.99

1.30.4.3 Pickup Times

Test condition:	see item 1.30.4.1
Test values:	1.00 ≤ V/f ≤ 1.20
Permissive tolerance/Limiting values:	t approx. 33 ms + OOT at 50 Hz 30 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 33 ms + OOT at 50 Hz < 30 ms + OOT at 60 Hz

1.30.4.4 Dropout times

Test condition:	see item 1.30.4.1
Test values:	1.00 ≤ V/f ≤ 1.20
Permissive tolerance/Limiting values:	t approx. 10 ms + OOT at 50 Hz 10 ms + OOT at 60 Hz
Test results/Remarks:	t approx. < 10 ms + OOT at 50 Hz < 10 ms + OOT at 60 Hz

1.30.4.5 Cooling time therm. replica

Test condition:	added to the inherent operating times
Test values:	0 s ≤ T ≤ 100000 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.30.4.6 Operate curve

Test condition:	1.00 p.u. ≤ V/f ≤ 10.00 p.u. 0 s ≤ t ≤ 100000 s
Test values:	1.00 p.u. ≤ V/f] ≤ 10.00 p.u. 0 s ≤ t ≤ 100000 s
Permissive tolerance/Limiting values:	|δ| ≤ 5 % in relation to V/f, ± 600ms
Test results/Remarks:	|δ| < 5 % in relation to V/f, ± 600ms

1.30.5 Frequency Operating Range

Frequency manual update:	10 Hz to 80 Hz
Test results/Remarks:	confirmed

Summary

1.31 40 Underexcitation Protection

1.31.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-127

1.31.2 General

1.31.2.1 V1 min

1.31.2.1.1 Pickup values

Test condition:	fundamental components, RMS values 0.300 V ≤ threshold value ≤ 200.000 V
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V
Test results/Remarks:	in the range frated ±10 % |δ| ≤ 0.5 % of setting value or 0.05 V

1.31.2.1.2 Dropout ratio

Test condition:	see item 1.31.2.1.1
Test values:	r = 1.10
Permissive tolerance/Limiting values:	1.08 ≤ r ≤ 1.12 of threshold value or ≤ 0.2 V
Test results/Remarks:	1.08 ≤ r ≤ 1.12 of threshold value or ≤ 0.2 V

1.31.2.1.3 Pickup times

Test condition:	see item 1.31.2.1.1
Permissive tolerance/Limiting values:	t approx. 37 ms + OOT at frated = 50 Hz 33 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 37 ms + OOT at frated = 50 Hz 33 ms + OOT at frated = 60 Hz

1.31.2.1.4 Dropout times

Test condition:	see item 1.31.2.1.1
Permissive tolerance/Limiting values:	t approx. 10 ms + OOT at frated = 50 Hz 10 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 10 ms + OOT at frated = 50 Hz 10 ms + OOT at frated = 60 Hz

1.31.3 Characteristics

1.31.3.1 1/xd characteristic

Test condition:	0.10 ≤ 1/xd ≤ 5.00
Permissive tolerance/Limiting values:	|δ| ≤ 2 % of setting value or 0.01 p.u.
Test results/Remarks:	|δ| ≤ 2 % of setting value or 0.01 p.u.

1.31.3.2 Angle characteristic

Test condition:	50° ≤ α ≤ 120°
Permissive tolerance/Limiting values:	|δ| ≤ 1° el.
Test results/Remarks:	|δ| ≤ 1° el.

1.31.3.3 Dropout ratio

Test condition:	see item 1.31.3.1 / 1.31.3.2
Test values:	r = 0.95
Permissive tolerance/Limiting values:	0.92 ≤ r ≤ 0.98
Test results/Remarks:	0.92 ≤ r ≤ 0.98

Summary

1.31.3.4 Pickup times

Test condition:	see item 1.31.3.1 / 1.31.3.2
Permissive tolerance/Limiting values:	t approx. 26 ms + OOT at frated = 50 Hz 23 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 26 ms + OOT at frated = 50 Hz 23 ms + OOT at frated = 60 Hz

1.31.3.5 Dropout times

Test condition:	see item 1.31.3.1 / 1.31.3.2
Permissive tolerance/Limiting values:	t approx. 31 ms + OOT at frated = 50 Hz 29 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 31 ms + OOT at frated = 50 Hz 29 ms + OOT at frated = 60 Hz

1.31.3.6 Time delays

Test condition:	see item 1.31.3.1 / 1.31.3.2
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.31.4 V excitation <

1.31.4.1 Pickup values

Test condition:	-1000.000 V ≤ threshold value* ≤ 1000.000 V * depends on measuring-transducer configuration
Test values:	-1000.000 V ≤ threshold value* ≤ 1000.000 V * depends on measuring-transducer configuration
Permissive tolerance/Limiting values:	|δ| ≤ 1.0 % of setting value or 0.10 V
Test results/Remarks:	|δ| ≤ 1.0 % of setting value or 0.10 V

1.31.4.2 Dropout ratio

Test condition:	see item 1.31.4.1
Test values:	r = 1.10 or 0.50 V
Permissive tolerance/Limiting values:	r = 1.10 of threshold value or ≤ 0.60 V
Test results/Remarks:	r = 1.10 of threshold value or ≤ 0.60 V

1.31.4.3 Pickup times

Test condition:	see item 1.31.4.1
Test values:	$Vexc_<$ = 2 V at Vpre-fault = 10 V and Vfault = 1 V
Permissive tolerance/Limiting values:	t approx. 42 ms + OOT at frated = 50 Hz 42 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 42 ms + OOT at frated = 50 Hz 42 ms + OOT at frated = 60 Hz

1.31.4.4 Dropout times

Test condition:	see item 1.31.4.1
Test values:	see item 1.31.4.3
Permissive tolerance/Limiting values:	t approx. 22 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 22 ms + OOT at frated = 50 Hz 22 ms + OOT at frated = 60 Hz

Summary

1.31.4.5 Time delays

Test condition:	see item 1.31.4.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

Summary

1.32 64R Rotor Ground Fault Protection

1.32.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.32.2 General

1.32.2.1 I < supervision

1.32.2.1.1 Pickup values

Test condition:	0.001 A ≤ threshold value ≤ 0.050 A (CT sensitive)
Test values:	frated = 50 Hz, 60 Hz 0.001 A ≤ threshold value ≤ 0.050 A (CT sensitive)
Permissive tolerance/Limiting values:	in the range frated ±10 % |δ| ≤ 1.0 % of setting value or 0.10 mA
Test results/Remarks:	in the range frated ±10 % |δ| < 1.0 % of setting value or 0.10 mA

1.32.2.1.2 Dropout ratio

Test condition:	see item 1.32.2.1.1
Test values:	r = 1.20
Permissive tolerance/Limiting values:	1.16 ≤ r ≤ 1.24 of threshold value or ≤ 0.6mA
Test results/Remarks:	1.16 ≤ r ≤ 1.24 of threshold value or ≤ 0.6mA

1.32.3 Ground current function I >

1.32.3.1 Pickup values

Test condition:	0.001 A ≤ threshold value ≤ 1.600 A (CT sensitive)
Test values:	frated = 50 Hz, 60 Hz 0.001 A ≤ threshold value ≤ 1.600 A (CT sensitive)
Permissive tolerance/Limiting values:	For CT sensitive: |δ| ≤ 1 % of setting value or 0.10 mA
Test results/Remarks:	For CT sensitive: |δ| ≤ 1 % of setting value or 0.10 mA

1.32.3.2 Dropout ratio

Test condition:	see item 1.32.3.1
Test values:	r = 0.95
Permissive tolerance/Limiting values:	0.93 ≤ r ≤ 0.97 of threshold value or ≤ 0.60 mA
Test results/Remarks:	0.93 ≤ r ≤ 0.97 of threshold value or ≤ 0.60 mA

1.32.3.3 Pickup times

Test condition:	see item 1.32.3.1
Test values:	1.2* threshold value
Permissive tolerance/Limiting values:	t approx. 33 ms + OOT at frated = 50 Hz 28 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 33 ms + OOT at frated = 50 Hz 28 ms + OOT at frated = 60 Hz

1.32.3.4 Dropout times

Test condition:	see item 1.32.3.1
Permissive tolerance/Limiting values:	t approx. 21 ms + OOT at frated = 50 Hz 18 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 21 ms + OOT at frated = 50 Hz 18 ms + OOT at frated = 60 Hz

Summary

1.32.3.5 Time delays

Test condition:	see item 1.32.3.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

1.32.4 Ground resistance function R <

1.32.4.1 Pickup values

Test condition:	1.0 kΩ ≤ threshold value ≤ 30.0 kΩ
Test values:	frated = 50 Hz, 60 Hz 1.0 kΩ ≤ threshold value ≤ 30.0 kΩ
Permissive tolerance/Limiting values:	5 % at 1 kΩ ≤ Rrg ≤ 30 kΩ and 0.15 µF ≤ Crg ≤ 3 µF
Test results/Remarks:	5 % at 1 kΩ ≤ Rrg ≤ 30 kΩ and 0.15 µF ≤ Crg ≤ 3 µF

1.32.4.2 Dropout ratio

Test condition:	see item 1.32.4.1
Test values:	r = 1.25
Permissive tolerance/Limiting values:	1.23 ≤ r ≤ 1.27
Test results/remarks:	1.23 ≤ r ≤ 1.27

1.32.4.3 Pickup times

Test condition:	see item 1.32.4.1
Permissive tolerance/Limiting values:	t approx. 38 ms + OOT at frated = 50 Hz 34 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 38 ms + OOT at frated = 50 Hz 34 ms + OOT at frated = 60 Hz

1.32.4.4 Dropout times

Test condition:	see item 1.32.4.1
Permissive tolerance/Limiting values:	t approx. 38 ms + OOT at frated = 50 Hz 31 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 38 ms + OOT at frated = 50 Hz 31 ms + OOT at frated = 60 Hz

1.32.4.5 Time delays

Test condition:	see item 1.32.4.1
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

Summary

1.33 Rotor Ground Fault Protection (1-3 Hz)

1.33.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-127

1.33.2 Pickup values

Test condition:	1.0 kΩ ≤ threshold value ≤ 80.0 kΩ
Test values:	1.0 kΩ ≤ threshold value ≤ 80.0 kΩ
Permissive tolerance/Limiting values:	5 % or 0.5 kΩ at 0.15 µF ≤ Cgnd ≤ 3 µF at 0.5 Hz ≤ fgen ≤ 1.5 Hz 10 % or 0.5 kΩ at 0.15 µF ≤ Cgnd ≤ 1 µF at 1.5 Hz < fgen ≤ 3.5 Hz
Test results/Remarks:	5 % or 0.5 kΩ at 0.15 µF ≤ Cgnd ≤ 3 µF at 0.5 Hz ≤ fgen ≤ 1.5 Hz 10 % or 0.5 kΩ at 0.15 µF ≤ Cgnd ≤ 1 µF at 1.5 Hz < fgen ≤ 3.5 Hz (determined with injection unit 7XT7100-0EA00/EE)

1.33.3 Dropout ratio

Test condition:	see item 1.33.2
Test values:	r = 1.25
Permissive tolerance/Limiting values:	1.21 ≤ r ≤ 1.29 or 0.5 kΩ
Test results/remarks:	1.21 ≤ r ≤ 1.29 or 0.5 kΩ

1.33.4 Pickup times

Test condition:	see item 1.33.2
Test values:	Threshold = 5.0 kΩ, Rgnd from oo to 2.5 kΩ, Cgnd = 1µF, fgen = 1.5 Hz
Permissive tolerance/Limiting values:	t approx. = 1 s (depends on settings of 7XT71)
Test results/Remarks:	t approx. = 1 s

1.33.5 Dropout times

Test condition:	see item 1.33.2
Test values:	Threshold = 5.0 kΩ, Rgnd from 2.5 kΩ to oo, Cgnd = 1µF, fgen = 1.5 Hz
Permissive tolerance/Limiting values:	t approx. = 1 s (depends on settings of 7XT71)
Test results/Remarks:	t approx. = 1 s

1.33.6 Time delays

Test condition:	see item 1.33.2
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

Summary

1.34 External Trip Initiation

1.34.1 Pickup times

Test condition:	with initiation via binary input signal
Test values:	frated=50 Hz, 60 Hz
Permissive tolerance/Limiting values:	t approx. 5 ms + OOT
Test results/Remarks:	t < 5 ms + OOT

1.34.2 Dropout times

Test condition:	with initiation via binary input signal
Test values:	frated=50 Hz, 60 Hz
Permissive tolerance/Limiting values:	t approx. 3 ms + OOT
Test results/Remarks:	t < 3 ms + OOT

1.34.3 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s to 60.00 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	< 1 % of setting value or 10 ms

Summary

1.35 78 Out-of-Step Protection

1.35.1 Specifications

- VDE 0435
- IEC/EN 60255-1, Item 7, Annex A, B

1.35.2 Power-swing frequency

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct

1.35.3 Number of acceptable swings

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct

1.35.4 Maximum negative sequence current

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct

1.35.5 Characteristic

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct

1.35.6 Times

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct

Summary

1.36 Inrush-Current Detection

1.36.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.36.2 General test conditions

frated	50 Hz, 60 Hz

1.36.3 Operating-range limit Imax

Test condition:	0.030 Irated ≤ Imax ≤ 35.000 Irated
Test values:	0.030 Irated ≤ Imax ≤ 35.000 Irated
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.005 Irated
Test results/Remarks:	|δ| ≤ 1 % of setting value or 0.005 Irated

1.36.4 Content of 2nd harmonics

Test condition:	10 % ≤ I/I2ndHarm. ≤ 45 %
Test values:	10 % ≤ I/I2ndHarm. ≤ 45 %
Permissive tolerance/Limiting values:	|δ| ≤ 1% of setting value
Test results/Remarks:	|δ| < 1% of setting value

1.36.5 Duration of the cross-blocking

Test condition:	0.03 s ≤ T ≤ 200.00 s
Test values:	0.03 s ≤ T ≤ 200.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.36.6 Pickup times

Permissive tolerance/Limiting values:	approx. 29 ms + OOT
Test results/Remarks:	approx. 29 ms + OOT

1.36.7 Dropout ratios

1.36.7.1 Current measurement Imax

Test condition:	r = 0.95 or 0.015 A at Irated = 1 A r = 0.95 or 0.075 A at Irated = 5 A
Permissive tolerance/Limiting values:	1% of the setting value or 5mA
Test results/Remarks:	1% of the setting value or 5mA

1.36.7.2 Harmonics I2.Harm/I1.Harm

Test condition:	r = 0.95
Permissive tolerance/Limiting values:	1% of the setting value for settings of I2ndHarm/I1stHarm Time delays
Test results/Remarks:	1% of the setting value for settings of I2ndHarm/I1stHarm Time delays

Summary

1.37 50 High-Speed Instantaneous Overcurrent Protection

1.37.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.37.2 General test conditions

frated	50 Hz, 60 Hz

1.37.3 Pickup values

Test condition:	0.030 Irated ≤ I> ≤ 35.000 Irated
Test values:	0.100 Irated ≤ I> ≤ 5.000 Irated
Permissive tolerance/Limiting values:	|δ| ≤ 5 % of setting value or 0.010 Irated
Test results/Remarks:	|δ| < 5 % of setting value or 0.010 Irated

1.37.4 Dropout ratio

Test condition:	see item 1.37.2
Test values:	r = settable dropout ratio 0.50 ≤ r ≤ 0.90
Permissive tolerance/Limiting values:	|δ| ≤ 5 % of setting value
Test results/Remarks:	|δ| < 5 % of setting value

1.37.5 Pickup times

Test condition:	current > 2√2 of threshold value
Test values:	t in ms
Permissive tolerance/Limiting values:	t ≤ 8 ms + OOT
Test results/Remarks:	t < 8 ms + OOT

1.37.6 Dropout times

Test condition:	current change from > 2√2 to 0 of threshold value
Test values:	t in ms
Test results/Remarks:	t approx. 30 ms + OOT

Summary

1.38 48 Starting Time Supervision for Motors

1.38.1 Specifications

- VDE 0435
- IEC/EN 60255-6

1.38.2 Start.current./mot.rated current

Test condition:	1.00 I/IrObj ≤ I ≤ 20.00 I/ $IN_{/r\ Obj}$
Test values:	1.00 I/IrObj ≤ I ≤ 20.00 I/ $IN_{/r\ Obj}$
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.005 Irated
Test results/Remarks:	|δ| ≤ 1 % of setting value or 0.005 Irated

1.38.3 Pickup times

Test condition:	See item 1.38.2
Permissive tolerance/Limiting values:	approx. 35 ms + OOT
Test results/Remarks:	approx. 35 ms + OOT

1.38.4 Dropout times

Test condition:	See item 1.38.2
Permissive tolerance/Limiting values:	approx. 35 ms + OOT
Test results/Remarks:	approx. 35 ms + OOT

1.38.5 Max.locked rotor time

Test condition:	0,5s ≤ T ≤ 180.0s
Test values:	0,5s ≤ T ≤ 180.0s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10ms

1.38.6 Max.start time, cold motor

Test condition:	1,0s ≤ T ≤ 180.0s
Test values:	1,0s ≤ T ≤ 180.0s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10ms

1.38.7 Max.start time, warm motor

Test condition:	0,5s ≤ T ≤ 180.0s
Test values:	0,5s ≤ T ≤ 180.0s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10ms

1.38.8 Tripping time characteristic (Inverse-Time Characteristic)

Test condition:	1,0s ≤ T ≤ 180.0s (Max.start.time,cold motor)
	0,5s ≤ T ≤ 180.0s (Max.start.time,warm motor)
Test values:	various settings
Permissive tolerance/Limiting values:	|δ| ≤ 5 % of setting value or 30ms
Test results/Remarks:	|δ| ≤ 5 % of setting value or 30ms

1.38.9 Tripping time characteristic (Inverse-Time Characteristic)

Test values:	various settings
Permissive tolerance/Limiting values:	|δ| ≤ 5 % of setting value or 30ms
Test results/Remarks:	|δ| ≤ 5 % of setting value or 30ms

Summary

1.39 66 Restart inhibit for motors

1.39.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.39.2 Thermal stage

1.39.2.1 Min. restart inhibit time

Test condition:	Fundamental components, RMS values 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 200 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 200 ms

1.39.3 Counter stage

1.39.3.1 Time interval (per.starts)

Test condition:	Fundamental components, RMS values 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Permissive tolerance/Limiting values:	|δ| ≤ 5 % of setting value or 2 s
Test results/Remarks:	|δ| ≤ 5 % of setting value or 2 s

1.39.4 Timer stage

1.39.4.1 Min. time between starts

Test condition:	Fundamental components, RMS values 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ 3I0> ≤ 35.000 Irated for CT protection
Permissive tolerance/Limiting values:	|δ| ≤ 5 % of setting value or 2 s
Test results/Remarks:	|δ| ≤ 5 % of setting value or 2 s

Summary

1.40 32 General Power Protection 3-phases

1.40.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.40.2 Pickup values

Test condition:	-200.0 % to +200.0 %
Test values:	-200.0 % to +200.0 %
Permissive tolerance/Limiting values:	$\|\delta\| \leq 0.5\ \%\ Sn_{/r} \pm 3\ \%$ of setting value
Test results/Remarks:	$\|\delta\| < 0.5\ \%\ Sn_{/r} \pm 3\ \%$ of setting value

1.40.3 Tilt power characteristic

Test condition:	-89.0 ° to +89.0 °
Test values:	-89.0 ° to +89.0 °
Permissive tolerance/Limiting values:	function according to manual
Test results/Remarks:	function correct

1.40.4 Dropout ratio

Test condition:	0.90 to 0.99 at >stage 1.01 to 1.10 at <stage
Test values:	0.90 to 0.99 at >stage 1.01 to 1.10 at <stage
Permissive tolerance/Limiting values:	function according to manual
Test results/Remarks:	function correct

1.40.5 Pickup times

Permissive tolerance/Limiting values:	t approx. 55 ms + OOT at frated = 50 Hz 45 ms + OOT at frated = 60 Hz
Test results/Remarks:	t < 55 ms + OOT at frated = 50 Hz < 45 ms + OOT at frated = 60 Hz

1.40.6 Dropout times

Permissive tolerance/Limiting values:	t approx. 55 ms + OOT at frated = 50 Hz 45 ms + OOT at frated = 60 Hz
Test results/Remarks:	t < 55 ms + OOT at frated = 50 Hz < 45 ms + OOT at frated = 60 Hz

1.40.7 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s to 60.00 s
Permissive tolerance/Limiting values:	$\|\delta\| \leq 1\ \%$ of setting value or 10 ms
Test results/Remarks:	$\|\delta\| < 1\ \%$ or 10 ms

Summary

1.41 Power Plant Disconnection

1.41.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.41.2 Function stage

1.41.2.1 Pickup values of I>

Test condition:	0.030 I_{rated} ≤ I> ≤ 35.000 I_{rated} f_{rated} = 50 Hz, 60 Hz
Test values:	0.030 I_{rated} ≤ I> ≤ 35.000 I_{rated}
Permissive tolerance/Limiting values:	1 % of setting value or 0.005 I_{rated}
Test results/Remarks:	1 % of setting value or 0.005 I_{rated}

1.41.2.2 Dropout ratio of I>

Test condition:	0.030 I_{rated} ≤ I> ≤ 35.000 I_{rated} f_{rated} = 50 Hz, 60 Hz
Test values:	r = 0.95
Permissive tolerance/Limiting values:	1 % of dropout value or 0.005 I_{rated}
Test results/Remarks:	1 % of dropout value or 0.005 I_{rated}

1.41.2.3 Pickup values of P1>

Test condition:	50 % ≤ P1> ≤ 100 % f_{rated} = 50 Hz, 60 Hz
Test values:	50 % ≤ P1> ≤ 100 %
Permissive tolerance/Limiting values:	0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}
Test results/Remarks:	0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}

1.41.2.4 Dropout ratio of P1>

Test condition:	50 % ≤ P1> ≤ 100 % f_{rated} = 50 Hz, 60 Hz
Test values:	r = 0.95
Permissive tolerance/Limiting values:	0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}
Test results/Remarks:	0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}

1.41.2.5 Pickup values of Vph-ph<

Test condition:	0.3 V ≤ Vph-ph< ≤ 175 V f_{rated} = 50 Hz, 60 Hz
Test values:	0.3 V ≤ threshold value ≤ 175 V
Permissive tolerance/Limiting values:	0.5 % of setting value or 0.05 V
Test results/Remarks:	0.5 % of setting value or 0.05 V

1.41.2.6 Dropout ratio of Vph-ph<

Test condition:	0.3 V ≤ Vph-ph< ≤ 175 V f_{rated} = 50 Hz, 60 Hz
Test values:	r = 1.05
Permissive tolerance/Limiting values:	0.5 % of dropout value or 0.05 V
Test results/Remarks:	0.5 % of dropout value or 0.05 V

1.41.2.7 Pickup values of dP1<

Test condition:	-100 % ≤ dP1< ≤ -30 % f_{rated} = 50 Hz, 60 Hz
Test values:	-100 % ≤ dP1< ≤ -30 %
Permissive tolerance/Limiting values:	0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}
Test results/Remarks:	0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}

Summary

1.41.2.8 Dropout ratio of dP1<

Test condition: -100 % ≤ dP1< ≤ -30 %
f_{rated} = 50 Hz, 60 Hz

Test values: r = 0.95

Permissive tolerance/Limiting values: 0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}

Test results/Remarks: 0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}

1.41.2.9 Pickup values of P1<

Test condition: 0 % ≤ P1< ≤ 60 %
f_{rated} = 50 Hz, 60 Hz

Test values: 0 % ≤ P1< ≤ 60 %

Permissive tolerance/Limiting values: 0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}

Test results/Remarks: 0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}

1.41.2.10 Dropout ratio of P1<

Test condition: 0 % ≤ P1< ≤ 60 %
f_{rated} = 50 Hz, 60 Hz

Test values: r = 1.05

Permissive tolerance/Limiting values: 0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}

Test results/Remarks: 0.5 % S_{rated} or ± 3 % of setting value when Q < 0.5 S_{rated}

1.41.2.11 Dropout delay

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: 1 % of setting value or 10 ms

Test results/Remarks: 1 % of setting value or 10 ms

1.41.2.12 Pickup times

1.41.2.12.1 Characteristic curve = no

Permissive tolerance/Limiting values: t approx.
28 ms + OOT at 50 Hz
25 ms + OOT at 60 Hz

Test results/Remarks: t approx.
28 ms + OOT at 50 Hz
25 ms + OOT at 60 Hz

1.41.2.12.2 Characteristic curve = yes

Permissive tolerance/Limiting values: t approx.
26 ms + OOT at 50 Hz
24 ms + OOT at 60 Hz

Test results/Remarks: t approx.
26 ms + OOT at 50 Hz
24 ms + OOT at 60 Hz

1.41.2.13 Dropout times

1.41.2.13.1 Characteristic curve = no

Permissive tolerance/Limiting values: t approx.
19 ms + OOT at 50 Hz
18 ms + OOT at 60 Hz

Test results/Remarks: t approx.
19 ms + OOT at 50 Hz
18 ms + OOT at 60 Hz

1.41.2.13.2 Characteristic curve = yes

Permissive tolerance/Limiting values: t approx.
22 ms + OOT at 50 Hz
20 ms + OOT at 60 Hz

Test results/Remarks: t approx.
22 ms + OOT at 50 Hz
20 ms + OOT at 60 Hz

Summary

1.41.2.14 Operate delay

1.41.2.14.1 Characteristic curve = no

Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

1.41.2.14.2 Characteristic curve = yes

Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

Summary

1.42 46 Negative-Sequence Protection

1.42.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.42.2 46 Negative-Sequence protection with definite time overcurrent stage

1.42.2.1 Pickup values

1.42.2.1.1 Reference value: rated current

Test condition:	5.0 % ≤ IZ> ≤ 999.9 %
Test values:	various settings
Permissive tolerance/Limiting values:	|δ| ≤ 2 % of setting value or 0.8 % absolute
Test results/Remarks:	|δ| < 2 % or 0.8 % absolute

1.42.2.1.2 Reference value: pos. seq. current

Test condition:	5.0 % ≤ IZ> ≤ 999.9 %
Test values:	various settings
Permissive tolerance/Limiting values:	|δ| ≤ 2 % of setting value or 4 % absolute
Test results/Remarks:	|δ| < 2 % or 4 % absolute

1.42.2.2 Dropout ratio

Test condition:	see item 1.42.2.1
Test values:	r = settable dropout ratio 0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	0.90 ≤ r ≤ 0.99
Test results/Remarks:	0.90 ≤ r ≤ 0.99

1.42.2.3 Pickup times

Test condition:	see item 1.42.2.1
Test values:	$I/Irated_{/r}$ = 1.2
Permissive tolerance/Limiting values:	t approx. 40 ms + OOT at 50Hz 35 ms + OOT at 60Hz
Test results/Remarks:	t< 40 ms + OOT at 50Hz t< 35 ms + OOT at 60Hz

1.42.2.4 Dropout times

Test condition:	see item 1.42.2.1
Test values:	see item 1.42.2.3
Permissive tolerance/Limiting values:	t approx. 35 ms + OOT
Test results/Remarks:	t< 35 ms + OOT

1.42.2.5 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T> ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % or 10 ms

Summary

1.42.3 46 Negative-Sequence protection with inverse time overcurrent stage

1.42.3.1 Pickup values

1.42.3.1.1 Reference value: rated current

Test condition:	5.0 % ≤ IZ> ≤ 999.9 %
Test values:	various settings
Permissive tolerance/Limiting values:	|δ| ≤ 2 % of setting value or 0.8 % absolute
Test results/Remarks:	|δ| < 2 % or 0.8 % absolute

1.42.3.1.2 Reference value: pos. seq. current

Test condition:	5.0 % ≤ IZ> ≤ 999.9 %
Test values:	various settings
Permissive tolerance/Limiting values:	|δ| ≤ 2 % of setting value or 4 % absolute
Test results/Remarks:	|δ| < 2 % or 4 % absolute

1.42.3.2 Pickup times

Test condition:	see item 1.42.3.1
Test values:	$I/Irated_{/r}$ = 1.2
Permissive tolerance/Limiting values:	t approx. 40 ms + OOT at 50Hz 35 ms + OOT at 60Hz
Test results/Remarks:	t< 40 ms + OOT at 50Hz t< 35 ms + OOT at 60Hz

1.42.3.3 Dropout times

Test condition:	see item 1.42.3.1
Test values:	see item 1.42.3.2
Permissive tolerance/Limiting values:	t approx. 35 ms + OOT
Test results/Remarks:	t< 35 ms + OOT

1.42.3.4 Tripping time characteristics

Test condition:	see item 1.42.3.1
Test values:	Time dial: 0.05 ≤ T ≤ 15.00
Permissive tolerance/Limiting values:	5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.4.1 IEC normal inverse (type A)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.4.2 IEC very inverse (type B)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.4.3 IEC extremely inverse (type C)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.4.4 IEC long-time inverse (type B)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.4.5 ANSI long-time inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.4.6 ANSI short-time inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.4.7 ANSI extremely inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.4.8 ANSI very inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.4.9 ANSI normal inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

Summary

1.42.3.4.10 ANSI moderately inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.4.11 ANSI definite inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.5 Dropout characteristics

Test condition: see item 1.42.3.1

Disk emulation: < 0.8*threshold

Test values: Time dial: $0.05 \leq T \leq 15.00$

Permissive tolerance/Limiting values: 5 % of setting value or + 2 % of current tolerance or 30 ms

1.42.3.5.1 IEC normal inverse (type A)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.5.2 IEC very inverse (type B)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.5.3 IEC extremely inverse (type C)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.5.4 IEC long-time inverse (type B)
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.5.5 ANSI long-time inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.5.6 ANSI short-time inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.5.7 ANSI extremely inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.5.8 ANSI very inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.5.9 ANSI normal inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.5.10 ANSI moderately inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

1.42.3.5.11 ANSI definite inverse
Test results/Remarks: 5 % of setting value or ± 2 % of current tolerance or 30 ms

Summary

1.43 46 Directional Negative-Sequence Protection with definite-time characteristic

1.43.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.43.2 Pickup values

Test condition:	0.030 Irated ≤ I> ≤ 35.00 Irated
Permissive tolerance/Limiting values:	|δ| ≤ 2 % of setting value or 10 mA
Test results/Remarks:	|δ| < 2 % or 0.8 % absolute

1.43.3 Dropout ratio

Test condition:	see item 1.43.2
Permissive tolerance/Limiting values:	r approx. 0.95
Test results/Remarks:	0.93 ≤ r ≤ 0.97

1.43.4 Pickup times

Test condition:	see item 1.43.2
Permissive tolerance/Limiting values:	t approx. 40 ms + OOT
Test results/Remarks:	t < 40 ms + OOT

1.43.5 Dropout times

Permissive tolerance/Limiting values:	t approx. 40 ms + OOT
Test results/Remarks:	t < 39 ms + OOT

1.43.6 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % or 10 ms

1.43.7 Directional determination

1.43.7.1 Angle forward α

Test condition:	0° ≤ α ≤ 360°
Test values:	various settings
Permissive tolerance/Limiting values:	|δ| ≤ 1°
Test results/Remarks:	|δ| < 1°

1.43.7.2 Angle reverse β

Test condition:	0° ≤ β ≤ 360°
Test values:	various settings
Permissive tolerance/Limiting values:	|δ| ≤ 1°
Test results/Remarks:	|δ| < 1°

1.43.7.3 Min. neg.-seq. voltage V2

Test condition:	0.15 V ≤ V2 ≤ 34.0 V
Test values:	various settings
Permissive tolerance/Limiting values:	|δ| ≤ 1 %
Test results/Remarks:	|δ| < 1 %

Summary

1.43.7.4 Minimum negative sequence current I2

Test condition:	0.030 A ≤ I2 ≤ 10.000 Irated
Test values:	various settings
Permissive tolerance/Limiting values:	$\|\delta\| \leq 1$ %
Test results/Remarks:	$\|\delta\| < 1$ %

Summary

1.44 46 Unbalanced-Load Protection

1.44.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.44.2 Thermal characteristics

1.44.3 Max. continuously perm. I2

Test condition:	3 % ≤ I2 ≤ 30 %
Test values:	3 % ≤ I2 ≤ 30 %
Permissive tolerance/Limiting values:	|δ| ≤ 3 % of setting value or 3 mA at Irated = 1 A or 15 mA at Irated = 5 A
Test results/Remarks:	|δ| ≤ 3 % of setting value or 3 mA at Irated = 1 A or 15 mA at Irated = 5 A

1.44.4 Unbalanced load factor K

Test condition:	1.0 s ≤ K ≤ 100.0 s
Test values:	various settings
Test results/Remarks:	function correct

1.44.5 Cooling time thermal replica $TCool_{down}$

Test condition:	0 s ≤ $TCool_{down}$ ≤ 50000 s
Test values:	various settings
Test results/Remarks:	function correct

1.44.6 Time delays

Test condition:	added to the inherent operating times
Test values:	0.00 s ≤ T> ≤ 60.00 s or ∞
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % or 10 ms

Summary

1.45 Load-jam Protection

1.45.1 Pickup values

1.45.1.1 Warning

Test condition:	0.030 Irated ≤ Iph> ≤ 35.000 Irated
Test values:	frated= 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	deviation δ of set point value |δ| ≤ 1 % of setting value or |δ| ≤ 0.5 % of Irated
Test results/Remarks:	|δ| < 1 %

1.45.1.2 Operate

Test condition:	frated= 50 Hz, 60 Hz 0.030 Irated ≤ Iph> ≤ 35.000 Irated
Test values:	frated= 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	deviation δ of set point value |δ| ≤ 1 % of setting value or |δ| ≤ 0.5 % of Irated
Test results/Remarks:	|δ| < 1 %

1.45.2 Pickup times

Test condition:	see item 1.45.1.2
Test values:	frated= 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	t ≤ 30 ms + OOT at frated = 50 Hz t ≤ 25 ms + OOT at frated = 60 Hz
Test results/Remarks:	t < 30 ms + OOT at frated = 50 Hz t < 25 ms + OOT at frated = 60 Hz

1.45.3 Dropout times

Test condition:	see item 1.45.1.2
Test values:	frated= 50 Hz, 60 Hz
Permissive tolerance/Limiting values:	t approx. 15 ms + OOT
Test results/Remarks:	t approx. 15 ms + OOT

1.45.4 Dropout ratio

Test condition:	see item 1.45.1.2
Test values:	see item 1.45.1.1
Permissive tolerance/Limiting values:	r ca. 0.95
Test results/Remarks:	r ca. 0.95

1.45.5 Time delays

1.45.5.1 Warning delay

Test condition:	added to the inherent operating times
Test values:	0.000 s ≤ T ≤ 600.000 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

1.45.5.2 Operate delay

Test condition:	added to the inherent operating times
Test values:	0.000 s ≤ T ≤ 600.000 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

Summary

1.45.5.3 Release delay

Test condition:	added to the inherent operating times
Test values:	0.000 s ≤ T ≤ 600.000 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

Summary

1.46 32R Reverse Power Protection

1.46.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.46.2 Angle correction

Test condition:	-10.00 ° ≤ Angle correction ≤ 10.00 °
Test values:	-10.00 ° ≤ Angle correction ≤ 10.00 °
Permissive tolerance/Limiting values:	0.15 % Sn or 5 % of Setting values when Q < 0.5Sn
Test results/Remarks:	0.15 % Sn or 5 % of Setting values when Q < 0.5Sn

1.46.3 Minimum voltage V1

Test condition:	0.300 V ≤ Minimum voltage V1 ≤ 60.000 V frated = 50 Hz, 60 Hz
Test values:	0.300 V ≤ Minimum voltage V1 ≤ 60.000 V
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % of dropout value or 0.05 V
Test results/Remarks:	|δ| ≤ 0.5 % of dropout value or 0.05 V

1.46.4 Threshold

Test condition:	-30.00 % ≤ threshold value ≤ -0.30 % frated = 50 Hz, 60 Hz
Test values:	-30.00 % ≤ threshold value ≤ -0.30 %
Permissive tolerance/Limiting values:	0.15 % Sn or 5 % of Setting values when Q < 0.5Sn
Test results/Remarks:	0.15 % Sn or 5 % of Setting values when Q < 0.5Sn

1.46.5 Dropout ratio

Test condition:	-30.00 % ≤ threshold value ≤ -0.30 %
Test values:	0.40 ≤ threshold value ≤ 0.99
Permissive tolerance/Limiting values:	0.15 % Sn or 5 % of Setting values when Q < 0.5Sn
Test results/Remarks:	0.15 % Sn or 5 % of Setting values when Q < 0.5Sn

1.46.6 Pickup time

Test condition:	Threshold = -1.00 % frated = 50 Hz, 60Hz from 0 to 1.20 * Threshold value
Permissive tolerance/Limiting values:	t approx. 360 ms + OOT at 50 Hz 300 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 347 ms + OOT at 50 Hz 290 ms + OOT at 60 Hz

1.46.7 Dropout times

Test condition:	Threshold = -1.00 % frated = 50 Hz, 60 Hz from 1.20 * Threshold value to 0.44 * dropout value
Permissive tolerance/Limiting values:	t approx. 360 ms + OOT at 50 Hz 300 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 232 ms + OOT at 50 Hz 184 ms + OOT at 60 Hz

1.46.8 Dropout delay

Test condition:	see item 1.46.7
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms

Summary

Test results/Remarks: |δ| ≤ 1 % of setting value or 10 ms

1.46.9 Operate delay

Test condition: See item 1.46.6

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| ≤ 1 % of setting value or 10 ms

1.46.10 Operate delay stop valve

Test condition: See item 1.46.6

Test values: 0.00 s ≤ T ≤ 60.00 s

Permissive tolerance/Limiting values: |δ| ≤ 1 % of setting value or 10 ms

Test results/Remarks: |δ| ≤ 1 % of setting value or 10 ms

Summary

1.47 51 Shaft Current Protection

1.47.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.47.2 Threshold

Test condition:	0.30 mA ≤ Threshold value ≤ 1600 mA, only for sensitive CT, Irated = 1 A
Test values:	frated = 50 Hz, 60 Hz
Method of measurement = fundamental comp. :	
	0.30 mA ≤ Threshold value ≤ 1600 mA, only for sensitive CT, Irated = 1 A
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.1 mA at 50 Hz |δ| ≤ 1 % of setting value or 0.1 mA at 60 Hz
Test results/Remarks:	|δ| < 1 % of setting value or 0.1 mA at 50 Hz |δ| < 1 % of setting value or 0.1 mA at 60 Hz
Test values:	frated = 50 Hz, 60 Hz
Method of measurement = 3rd Harmonic comp. :	
	0.30 mA ≤ Threshold value ≤ 1000 mA, only for sensitive CT, Irated = 1 A
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.1 mA at 50 Hz |δ| ≤ 1 % of setting value or 0.1 mA at 60 Hz
Test results/Remarks:	|δ| < 1 % of setting value or 0.1 mA at 50 Hz |δ| < 1 % of setting value or 0.1 mA at 60 Hz
Test values:	frated = 50 Hz, 60 Hz
Method of measurement = 1st and 3rd Harm.comp. :	
	0.30 mA ≤ Threshold value ≤ 1000 mA, only for sensitive CT, Irated = 1 A
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.1 mA at 50 Hz |δ| ≤ 1 % of setting value or 0.1 mA at 60 Hz
Test results/Remarks:	|δ| < 1 % of setting value or 0.1 mA at 50 Hz |δ| ≤ 1 % of setting value or 0.1 mA at 60 Hz

1.47.3 Dropout ratio

Test condition:	see item 1.47.2
Test values:	0.80 ≤ Dropout ratio ≤ 0.95
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 0.15 mA
Test results/Remarks:	|δ| ≤ 1 % of setting value or 0.15 mA

1.47.4 Pickup time

Test condition:	Threshold = 1.67 mA 50 measurements		
Test value:	frated = 50 Hz, 60 Hz		
	1.20 * Threshold		
Method of measurement = fundamental comp. :			
Permissive tolerance/Limiting values:		50 Hz	60 Hz
	tmin =	57 ms + OOT	49 ms + OOT
	tmax =	77 ms + OOT	65 ms + OOT
	taverage =		66 ms + OOT 57 ms + OOT

Summary

Test results/Remarks:

	50 Hz	60 Hz	
tmin =	57 ms + OOT	49 ms + OOT	
tmax =	77 ms + OOT	65 ms + OOT	
taverage =		66 ms + OOT	57 ms + OOT

Method of measurement = 3rd Harmonic comp. :

Permissive tolerance/Limiting values:

	50 Hz	60 Hz	
tmin =	70 ms + OOT	57 ms + OOT	
tmax =	90 ms + OOT	79 ms + OOT	
taverage =		79 ms + OOT	68 ms + OOT

Test results/Remarks:

	50 Hz	60 Hz	
tmin =	70 ms + OOT	57 ms + OOT	
tmax =	90 ms + OOT	79 ms + OOT	
taverage =		79 ms + OOT	68 ms + OOT

Method of measurement = 1st and 3rd Harm.comp. :

Permissive tolerance/Limiting values:

	50 Hz	60 Hz	
tmin =	66 ms + OOT	50 ms + OOT	
tmax =	85 ms + OOT	74 ms + OOT	
taverage =		75 ms + OOT	63 ms + OOT

Test results/Remarks:

	50 Hz	60 Hz	
tmin =	66 ms + OOT	50 ms + OOT	
tmax =	85 ms + OOT	74 ms + OOT	
taverage =		75 ms + OOT	63 ms + OOT

1.47.5 Dropout time

Test condition: Threshold = 1.67 mA
50 measurements

Test value: frated = 50 Hz, 60 Hz

1.20 * Threshold

Method of measurement = fundamental comp. :

Permissive tolerance/Limiting values:

	50 Hz	60 Hz	
tmin =	6 ms + OOT	6 ms + OOT	
tmax =	24 ms + OOT	24 ms + OOT	
taverage =		15 ms + OOT	15 ms + OOT

Test results/Remarks:

	50 Hz	60 Hz	
tmin =	6 ms + OOT	6 ms + OOT	
tmax =	24 ms + OOT	24 ms + OOT	
taverage =		15 ms + OOT	15 ms + OOT

Method of measurement = 3rd Harmonic comp. :

Permissive tolerance/Limiting values:

	50 Hz	60 Hz	
tmin =	14 ms + OOT	11 ms + OOT	
tmax =	35 ms + OOT	31 ms + OOT	
taverage =		25 ms + OOT	21 ms + OOT

Test results/Remarks:

	50 Hz	60 Hz	
tmin =	14 ms + OOT	11 ms + OOT	
tmax =	35 ms + OOT	31 ms + OOT	
taverage =		25 ms + OOT	21 ms + OOT

Method of measurement = 1st and 3rd Harm.comp. :

Summary

Permissive tolerance/Limiting values:

	50 Hz	60 Hz	
tmin =	9 ms + OOT	6 ms + OOT	
tmax =	30 ms + OOT	28 ms + OOT	
taverage =		19 ms + OOT	18 ms + OOT

Test results/Remarks:

	50 Hz	60 Hz	
tmin =	9 ms + OOT	6 ms + OOT	
tmax =	30 ms + OOT	28 ms + OOT	
taverage =		19 ms + OOT	18 ms + OOT

1.47.6 Operate delay

Test condition: see item 1.47.4

Test values: $0.00\ s \leq T \leq 60.00\ s$

Permissive tolerance/Limiting values: $|\delta| < 1\ \%$ of setting value or 10 ms

Test results/Remarks: $|\delta| < 1\ \%$ of setting value or 10 ms

1.47.7 Dropout delay

Test condition: see item 1.47.5

Test values: $0.00\ s \leq T \leq 60.00\ s$

Permissive tolerance/Limiting values: $|\delta| < 1\ \%$ of setting value or 10 ms

Test results/Remarks: $|\delta| < 1\ \%$ of setting value or 10 ms

Summary

1.48 Inadvertent Energization

1.48.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-151

1.48.2 Pickup values

Test condition: 0.030 Irated ≤ threshold value ≤ 35.000 Irated

Test values: frated = 50 Hz, 60 Hz
0.030 Irated ≤ threshold value ≤ 35.000 Irated

Permissive tolerance/Limiting values of harmonics influence:

no harmonics: ±2 % of setting value or 0.005 Irated
2nd harmonics: -10 % of setting value or 0.01 Irated
3rd hamonics: -3 % of setting value or 0.01 Irated
5th hamonics: ±2 % of setting value or 0.005 Irated
10th - 50th hamonics: ±2 % of setting value or 0.005 Irated

Test results/Remarks:

no harmonics: ±2 % of setting value or 0.005 Irated
2nd harmonics: -10 % of setting value or 0.01 Irated
3rd hamonics: -3 % of setting value or 0.01 Irated
5th hamonics: ±2 % of setting value or 0.005 Irated
10th - 50th hamonics: ±2 % of setting value or 0.005 Irated

Permissive tolerance/Limiting values of frequency influence:

1-30 Hz: -37 % of setting value
30-45 Hz: -30 % of setting value
45-55 Hz: -10 % of setting value
55-99 Hz: -12 % of setting value

Test results/Remarks:

1-30 Hz: -37 % of setting value
30-45 Hz: -30 % of setting value
45-55 Hz: -10 % of setting value
55-99 Hz: -12 % of setting value

1.48.3 Dropout ratio

Test condition: see item 1.48.2

Test values: 0.60 ≤ r ≤ 0.99

Permissive tolerance/Limiting values: 2 % of dropout value

Test results/Remarks: 2 % of dropout value

1.48.4 Voltage release

Test condition: 0.300 V ≤ threshold value ≤ 175.000V

Test values: 0.300 V ≤ threshold value ≤ 175.000V

Permissive tolerance/Limiting values:

1 % of setting value or 0.05 V

Test results/remarks:

1 % of setting value or 0.05 V

Permissive tolerance/Limiting values of frequency influence:

1 Hz: +40 % of setting value
2-15 Hz: +25 % of setting value
15-45 Hz: ±1 % of setting value
45-55 Hz: ± 0.5 % of setting value
55-65 Hz: ±1 % of setting value
65-85 Hz: +2 % of setting value
85-99 Hz: +4 % of setting value

Test results/Remarks:

1 Hz: +40 % of setting value
2-15 Hz: +25 % of setting value
15-45 Hz: ±1 % of setting value
45-55 Hz: ±0.5 % of setting value
55-65 Hz: ±1 % of setting value

Summary

65-85 Hz: +2 % of setting value
85-99 Hz: +4 % of setting value

1.48.5 Dropout ratio of Voltage

Test condition:	0.300 V ≤ threshold value ≤ 175.000V
Test values:	1.01 ≤ r ≤ 1.20
Permissive tolerance/Limiting values:	1 % of dropout value
Test results/Remarks:	1 % of dropout value

1.48.6 Pickup times

Test condition:	see item 1.48.2
Test values:	1.2*threshold
Permissive tolerance/Limiting values:	t approx. 15 ms + OOT at 50 Hz 13 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 15 ms + OOT at 50 Hz 13 ms + OOT at 60 Hz

1.48.7 Dropout times

Test condition:	see item 1.48.2
Permissive tolerance/Limiting values:	t approx. 15 ms + OOT
Test results/Remarks:	t approx. 15 ms + OOT

1.48.8 Pickup delays

Test condition:	Threshold=Irated
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

1.48.9 Dropout delay

Test condition:	Threshold=Irated
Test values:	0.10 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

Summary

1.49 59 Interturn Protection (Turn to turn fault protection)

1.49.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-127

1.49.2 Pickup values

Test condition:	0.30 V ≤ threshold value ≤ 130.00 V
Test values:	0.30 V ≤ threshold value ≤ 130.00 V
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % of setting value or 50 mV
Test results/Remarks:	|δ| ≤ 0.5 % of setting value or 50 mV
Permissive tolerance/Limiting values of harmonics influence:	
	10 % of 2nd, 3rd harmonics : |δ| ≤ 1 % of setting value or 50 mV
Test results/Remarks:	
	10 % of 2nd, 3rd harmonics : |δ| ≤ 1 % of setting value or 50 mV

1.49.3 Dropout ratio

Test condition:	see item 1.49.2
Test values:	0.50 ≤ dropout ratio ≤ 0.95
Permissive tolerance/Limiting values:	|δ| ≤ 0.5 % of dropout ratio or 50 mV
Test results/Remarks:	|δ| ≤ 0.5 % of dropout ratio or 50 mV

1.49.4 Pickup times

Test condition:	0 -> 1.2* Threshold (Threshold = 2.00 V)
Permissive tolerance/Limiting values:	t approx. 38 ms + OOT at frated = 50 Hz 33 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 38 ms + OOT at frated = 50 Hz 33 ms + OOT at frated = 60 Hz

1.49.5 Dropout times

Test condition:	2* Threshold (Threshold = 2.00 V) -> 0.8*dropout value Dropout ratio = 0.80
Permissive tolerance/Limiting values:	t approx. 38 ms + OOT at frated = 50 Hz 33 ms + OOT at frated = 60 Hz
Test results/Remarks:	t approx. 38 ms + OOT at frated = 50 Hz 33 ms + OOT at frated = 60 Hz

1.49.6 Operate delays

Test condition:	Threshold = default value
Test values:	0.00 s ≤ T ≤ 60.00 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| ≤ 1 % of setting value or 10 ms

Summary

1.50 50BF Circuit Breaker Failure Protection

1.50.1 General test conditions

frated	50 Hz, 60 Hz
I_{rated}	1 A, 5 A
$3I0_{criterion}$	Plausibility check / Direct release
$I2_{criterion}$	Plausibility check / Direct release

1.50.2 Pickup values

Test condition:	0.030 Irated ≤ I> ≤ 35.000 Irated
Permissive tolerance/Limiting values:	2 % of setting value or 1 % Irated
Test results/Remarks:	2 % of setting value or 1 % Irated

1.50.3 Dropout ratio

Test condition:	approx. 0.95
Permissive tolerance/Limiting values:	2 % of setting value or 1 % Irated
Test results/Remarks:	2 % of setting value or 1 % Irated

1.50.4 Pickup times

Test condition:	Pickup time
Permissive tolerance/Limiting values:	≤ 10 ms
Test results/Remarks:	< 10 ms

1.50.5 Dropout times

1.50.5.1 Dropout time via the current-flow criterion

Test condition:	dropout time via the current-flow criterion
Permissive tolerance/Limiting values:	≤ 15 ms typical
Test results/Remarks:	≤ 15 ms [1]

1.50.5.2 Dropout time, via circuit-breaker auxiliary contact criterion

Test condition:	dropout time, via circuit-breaker auxiliary contact criterion
Permissive tolerance/Limiting values:	≤ 5 ms
Test results/Remarks:	≤ 5 ms [1]

1.50.6 Time delays

Test condition:	added to the inherent operating times
Test values:	0.000 s to 60.000 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	≤ 1 % of setting value or 10 ms

1.50.7 Operation with CB auxiliary contact

Permissive tolerance/Limiting values:	funct. acc. to manual
Test results/Remarks:	function correct

[1] The dropout time is the time required by the CBFP function to detect that the CB is open. The time for switching a contact is not included

Summary

1.51 Circuit Breaker Restrike Protection

1.51.1 Pickup values

Test condition:	0.030 Irated ≤ I> ≤ 35.000 Irated
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ I> ≤ 35.000 Irated
Permissive tolerance/Limiting values:	≤1 % of setting value or 0.5 % Irated
Test results/Remarks:	≤1 % of setting value or 0.5 % Irated

1.51.2 Dropout ratio

Test condition:	see item 1.51.1
Test value:	95% of threshold value
Permissive tolerance/Limiting values:	≤1 % of setting value or 0.5 % Irated
Test results/Remarks:	≤1 % of setting value or 0.5 % Irated

1.51.3 Pickup times

Test condition:	see item 1.51.1 1.2*threshold
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 25 ms + OOT at 50 Hz 22 ms + OOT at 60 Hz

1.51.4 Dropout times

Test condition:	see item 1.51.1 1.2*threshold
Permissive tolerance/Limiting values:	20 ms + OOT
Test results/Remarks:	20 ms + OOT

1.51.5 Time delay T1 for 3-pole retrip

Test condition:	see item 1.51.1 1.2*threshold
Test values:	0.00 s to 60.00 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	≤ 1 % of setting value or 10 ms

1.51.6 Time delay T2 for 3-pole trip

Test condition:	see item 1.51.1 1.2*threshold
Test values:	0.05 s to 60.00 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	≤ 1 % of setting value or 10 ms

1.51.7 Time delay for minimum operate

Test condition:	see item 1.51.1 1.2*threshold
Test values:	0.00 s to 60.00 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	≤ 1 % of setting value or 10 ms

Summary

1.51.8 Time delay for dropout

Test condition:	see item 1.51.1 1.2*threshold
Test values:	0.00 s to 60.00 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 35 ms
Test results/Remarks:	≤ 1 % of setting value or 35 ms

1.51.9 Position recognition delay

Test condition:	see item 1.51.1 1.2*threshold
Test values:	0.00 s to 60.00 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	≤ 1 % of setting value or 10 ms

1.51.10 Monitoring duration

Test condition:	see item 1.51.1 1.2*threshold
Test values:	1.00 s to 600.00 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	≤ 1 % of setting value or 10 ms

Summary

1.52 49 Thermal Overload Protection 3phases

1.52.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-8

Test condition/Test values: calculation method = O/L-calculation
- Modus Θ-max = Θ max
- Modus Θ-Imax = Θ of Imax

Permissive tolerance/Limiting values: k = Factor according to IEC 60255-8 or VDE 0435 T3011

1.52.2 Pickup threshold k * ·IN

Test condition: k = Imax/Irated
0.10 ≤ k ≤ 4.00

Test values: k = 0.10, 1.00, 4.00

No filter applied

Permissive tolerance/Limiting values: Up to 30th harmonic, 2% or 0.01 Irated, 2% class acc. to IEC60255-8
Up to 50th harmonic, frated = 50 Hz, 4% or 0.02 Irated, 4% class acc. to IEC60255-8
Up to 50th harmonic, frated = 60 Hz, 5% or 0.025 Irated, 5% class acc. to IEC60255-8

Test results/Remarks: Up to 30th harmonic, 2% or 0.01 Irated, 2% class acc. to IEC60255-8
Up to 50th harmonic, frated = 50 Hz, 4% or 0.02 Irated, 4% class acc. to IEC60255-8
Up to 50th harmonic, frated = 60 Hz, 5% or 0.025 Irated, 5% class acc. to IEC60255-8

With the filter for the compensation of the amplitude attenuation due to the anti-aliasing

Permissive tolerance/Limiting values: Up to 30th harmonic, 2% or 0.01 Irated, 2% class acc. to IEC60255-8
Up to 50th harmonic, frated = 50 Hz, 3% or 0.02 Irated, 4% class acc. to IEC60255-8
Up to 50th harmonic, frated = 60 Hz, 4% or 0.02 Irated, 5% class acc. to IEC60255-8

Test results/Remarks: Up to 30th harmonic, 2% or 0.01 Irated, 2% class acc. to IEC60255-8
Up to 50th harmonic, frated = 50 Hz, 3% or 0.02 Irated, 4% class acc. to IEC60255-8
Up to 50th harmonic, frated = 60 Hz, 4% or 0.02 Irated, 5% class acc. to IEC60255-8

With filter for the gain of harmonics including compensation of the amplitude attenuation[1]

Permissive tolerance/Limiting values: Up to 30th harmonic, 2% or 0.01 Irated, 2% class acc. to IEC60255-8
Up to 50th harmonic, frated = 50 Hz, 4% or 0.02 Irated, 4% class acc. to IEC60255-8
Up to 50th harmonic, frated = 60 Hz, 5% or 0.025 Irated, 5% class acc. to IEC60255-8

Test results/Remarks: Up to 30th harmonic, 2% or 0.01 Irated, 2% class acc. to IEC60255-8 [2]
Up to 50th harmonic, frated = 50 Hz, 4% or 0.02 Irated, 4% class acc. to IEC60255-8[3]
Up to 50th harmonic, frated = 60 Hz, 5% or 0.025 Irated, 5% class acc. to IEC60255-8[4]

1.52.3 Thermal warning stage

Test condition: 50 % ≤ Θ-warn ≤ 100 %

Test values: Θ-warn = 50 %, 63 %, 90 %, 100 %

Test results/Remarks: function correct

1.52.4 Current warning stage

Test condition: 0.03 Irated ≤ Iwarn ≤ 35.00 Irated

Test results/Remarks: function correct

1.52.5 Dropout ratio

Test condition: dropout threshold ratio
50 % ≤ r ≤ 99 %

Test results/Remarks: function correct

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[1] In case that the filter response exactly matches the user defined gain factor
[2] In case that the user-defined gain factor is set below 3. The tolerance is amplified if the gain factor is larger
[3] In case that the user-defined gain factor is set below 7. The tolerance is amplified if the gain factor is larger
[4] In case that the user-defined gain factor is set below 7. The tolerance is amplified if the gain factor is larger

Summary

1.52.6 Tripping time characteristics

1.52.6.1 Parameter k, τ

Test condition: k = Imax/Irated (IEC 60255-8)
τ = Time constant

Test values: tripping times t

Permissive tolerance/Limiting values: |δ| ≤ 3 % or 1 s
3 % class acc. to IEC 60255-8 for I/(k * Irated) > 1.25

1.52.6.2 Range of k, τ

Test condition: 0.10 ≤ k ≤ 4.00
30 s ≤ τ ≤ 60000 s

Test values: fault L-N, Modus Θ-max

Permissive tolerance/Limiting values: $t = \tau \ ln\{ ((I/k\ Irated)^{2} - (Ipre/k\ Irated)^{2}) / ((I/k\ Irated)^{2-1}) \}$ for I/(k* Irated) ≤ 8

1.52.6.3 With and without preload

Test condition: with and without preload

Test values:
a) k = 0.1; τ = (300, 500) min; I = 0.7 A
b) k = 1.1; τ = (20, 100) min; I = 2.5 A
c) k = 4.0; τ = (1, 5) min; I = 5.0 A
d) k = 1.0; τ = (1, 3, 10) min; I = 1.0 A

1.52.6.4 Range I/(k*Irated) ≥ 8

Test condition: range I/(k*Irated) ≥ 8

Test values: a) k = 1.0: I/(k*Irated) = 8, 10, 12
b) k = 0.1: I/(k*Irated) = 8, 10, 50

Permissive tolerance/Limiting values: t[≥ 8] = const = t[8]
t[8] = t according to formula for I/(k*Irated) = 8

Test results/Remarks: function correct

Summary

1.53 49 Thermal Overload Protection 1phase

1.53.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

Test condition/Test values: calculation method = O/L-calcul
- Modus Θ-max = Θ max
- Modus Θ-Imax = Θ of Imax

Permissive tolerance/Limiting values: k = Factor according to IEC 60255-8 or VDE 0435 T3011

1.53.2 Pickup threshold k * ·IN

Test condition: k = Imax/Irated
0.10 ≤ k ≤ 4.00

Test values: k = 0.10, 1.00, 4.00

Permissive tolerance/Limiting values: |δ| ≤ 2% or 10mA at Irated = 1A
|δ| ≤ 2% or 50mA at Irated = 5A
class 2% acc. to IEC 255-8

Test results/Remarks: |δ| < 2 %

1.53.3 Thermal time constant

Test condition: 30s ≤ τ_{th} ≤ 60000s

Test values: τ_{th} = 30s, 100s, 60000s

Test results/Remarks: function correct

1.53.4 Thermal warning stage

Test condition: Θ-warn/Θ-trip
50% ≤ Θ-warn ≤ 100%

Test values: Θ-warn = 50%, 70%, 90%, 100%

Test results/Remarks: function correct

1.53.5 Current warning stage

Test condition: 0.03 Irated ≤ Iwarn ≤ 35.00 Irated

Test values: Iwarn = 0.03A, 0.5A, 5A, 10A

Test results/Remarks: function correct

1.53.6 Maximum thermal current

Test condition: 0.03 Irated ≤ $I_{max\ thermal}$ ≤ 10.00 Irated

Test values: $I_{max\ thermal}$ = 1.1A, 2.5A, 10A

Test results/Remarks: function correct

1.53.7 Dropout ratio

Test condition: dropout threshold operate ratio
50% ≤ r ≤ 99%

Test values: r = 50%, 70%, 90%, 99%

Test results/Remarks: function correct

Summary

1.53.8 Tripping time characteristics

Test condition:	k = Imax/Irated (IRC 255-8) $0.10 \leq k \leq 4.00$ τ = Time constant $30\ s \leq \tau \leq 60000\ s$ with and without preload
Test values:	tripping times t Fault L-N, Modus Θ-max k = 0.1, 1, 4; τ = 100s k = 1; τ = 30s, 100s, 60000s
Permissive tolerance/Limiting values:	$\lvert\delta\rvert \leq 3$ % or 1s class 3 % acc. to IEC 255-8 for I/(k * Irated) > 1.25 $t = \tau\ ln\{ ((I/k\ Irated)^{2} \cdot (Ipre/k\ Irated)^{2})) / ((I/k\ Irated)^{2-1})) \}$ for $I/(k^{*}\ Irated) \leq 8$
Test results/Remarks:	function correct $\lvert\delta\rvert < 2\%$ or 0.2s

Summary

1.54 Thermal Overload Protection Rotor

Please refer to **66 Restart inhibit for motors**

Summary

1.55 49 Thermal Overload Protection, User-Defined Characteristic Curve

1.55.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-8

1.55.2 Pickup threshold k * IN

Test condition:	k = Imax/Irated (Imax = $IkL_{,1}$ - 0.01, $IkL_{,1}$ is the first point in user-defined curve)
Test values:	k = 0.71, 2
Permissive tolerance/Limiting values:	|δ| ≤ 2 % or 10 mA at Irated = 1 A |δ| ≤ 2 % or 50 mA at Irated = 5 A class 2 % acc. to IEC 60255-8
Test results/Remarks:	|δ| ≤ 2 % or 10 mA at Irated = 1 A |δ| ≤ 2 % or 50 mA at Irated = 5 A class 2 % acc. to IEC 60255-8

1.55.3 Thermal warning

Test condition:	50 % ≤ Θ-warn ≤ 100 %
Test values:	Θ-warn = 50 %, 70 %, 90 %,
Test results/Remarks:	function correct

1.55.4 Dropout threshold operate

Test condition:	50 % ≤ Θ-dropout op. ≤ 99 %
Test values:	Θ-dropout op.= 90 %, 99 %,
Test results/Remarks:	function correct

1.55.5 Current warning

Test condition:	0.030 Irated ≤ Iwarn ≤ 35.000 Irated
Test values:	frated = 50 Hz, 60 Hz 0.030 Irated ≤ threshold value ≤ 35.000 Irated
Permissive tolerance/Limiting values:	1 % of setting value or 0.005 Irated
Test results/Remarks:	1 % of setting value or 0.005 Irated

1.55.6 Dropout ratio I-warning

Test condition:	see item 1.55.5
Test values:	r = 0.95
Permissive tolerance/Limiting values:	0.94 ≤ r ≤ 0.96 of threshold value or ≤ 0.020 A
Test results/Remarks:	0.94 ≤ r ≤ 0.96 of threshold value or ≤ 0.020 A

1.55.7 Emerg.start T overtravel

Test condition:	Operate char. curve
Test values:	0.00 s ≤ T ≤ 15000 s
Permissive tolerance/Limiting values:	1 % of setting value or 20 ms
Test results/Remarks:	1 % of setting value or 20 ms

1.55.8 Preload

Test condition:	0 % ≤ Preload ≤ 100 %
Test values:	Preload = 0 %, 80 %, 100 %,
Permissive tolerance/Limiting values:	|δ| ≤ 3 % or 1 s class 3 % acc. to IEC 60255-8 for I/(k * Irated) > 1.25
Test results/Remarks:	|δ| ≤ 3 % or 1 s class 3 % acc. to IEC 60255-8 for I/(k * Irated) > 1.25

1.55.9 Tripping time characteristics

Test condition:	Operate char. curve

Summary

Test values:	Tripping times t
Permissive tolerance/Limiting values:	$\|\delta\| \leq 3$ % or 1 s class 3 % acc. to IEC 60255-8 for I/(k * Irated) > 1.25
Test results/Remarks:	$\|\delta\| \leq 3$ % or 1 s class 3 % acc. to IEC 60255-8 for I/(k * Irated) > 1.25

Summary

1.56 Field Winding Overload protection

1.56.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255- 149

1.56.2 Sensor : MT fast

1.56.2.1 Pickup values

Test condition:	0 A ≤ Field current I-base ≤ 5000 A With the configuration of MT fast measuring transducer as following: Unit: A Upper limit: 20.00 mA Upper limit – Sensor: 5000.00 Lower limit: 4.00 mA Lower limit – Sensor: 0.00
Test values:	4.00 mA ≤ Field current I-base ≤ 20.00 mA
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.56.2.2 Dropout ratio

Test condition:	see item 0.1.2.1
Test values:	0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.56.2.3 No load field current

Test condition:	see item 0.1.2.1
Test values:	4.00 mA ≤ No load field current ≤ 20.00 mA
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.56.2.4 Dropout ratio no load current

Test condition:	see item 0.1.2.1
Test values:	r = 1.05
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.56.2.5 Pickup times

Test condition:	set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms If = 0→1.2*threshold
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT @ measuring window = 10 ms 50 ms + OOT @ measuring window = 40 ms 100 ms + OOT @ measuring window = 100 ms
Test results/Remarks:	t approx. 20 ms + OOT @ measuring window = 10 ms 50 ms + OOT @ measuring window = 40 ms 100 ms + OOT @ measuring window = 100 ms

1.56.2.6 Dropout times

Test condition:	set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms

Summary

If = 1.2*threshold → 0

Permissive tolerance/Limiting values: t approx.
20 ms + OOT @ measuring window = 10 ms
50 ms + OOT @ measuring window = 40 ms
100 ms + OOT @ measuring window = 100 ms

Test results/Remarks: t approx.
20 ms + OOT @ measuring window = 10 ms
50 ms + OOT @ measuring window = 40 ms
100 ms + OOT @ measuring window = 100 ms

1.56.2.7 Warning delay

Test condition: set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms
If = 1.2* threshold

Test values: 0.00 s ≤ Warning delay ≤ 60.00 s

Permissive tolerance/Limiting values: 1 % of setting value or 10 ms @ measuring window = 10 ms
1 % of setting value or 20 ms @ measuring window = 40 ms
1 % of setting value or 100 ms @ measuring window = 100 ms

Test results/Remarks: 1 % of setting value or 10 ms @ measuring window = 10 ms
1 % of setting value or 20 ms @ measuring window = 40 ms
1 % of setting value or 100 ms @ measuring window = 100 ms

1.56.2.8 Operate time characteristic

Test condition: set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms
If/Ib = 1.05, 1.10, 1.20, 2.00, 4.00, 8.00 (Ib = Field current I-base)

Permissive tolerance/Limiting values: 1 % of calculated value or 10 ms @ measuring window = 10 ms
1 % of calculated value or 40 ms @ measuring window = 40 ms
1 % of calculated value or 100 ms @ measuring window = 100 ms

Test results/Remarks: 1 % of calculated value or 10 ms @ measuring window = 10 ms
1 % of calculated value or 40 ms @ measuring window = 40 ms
1 % of calculated value or 100 ms @ measuring window = 100 ms

1.56.2.9 Cooling time thermal replica

Test condition: set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms

Test values: 0 s ≤ Cooling time thermal replica ≤ 7200 s

Permissive tolerance/Limiting values: 2 % of setting value or 20 ms @ measuring window = 10 ms
2 % of setting value or 40 ms @ measuring window = 40 ms
2 % of setting value or 100 ms @ measuring window = 100 ms

Test results/Remarks: 2 % of setting value or 20 ms @ measuring window = 10 ms
2 % of setting value or 40 ms @ measuring window = 40 ms
2 % of setting value or 100 ms @ measuring window = 100 ms

1.56.2.10 Cooling time at no load

Test condition: set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms

Test values: 0 s ≤ Cooling time at no load ≤ 7200 s

Permissive tolerance/Limiting values: 2 % of setting value or 20 ms @ measuring window = 10 ms
2 % of setting value or 40 ms @ measuring window = 40 ms
2 % of setting value or 100 ms @ measuring window = 100 ms

Test results/Remarks: 2 % of setting value or 20 ms @ measuring window = 10 ms

Summary

2 % of setting value or 40 ms @ measuring window = 40 ms

2 % of setting value or 100 ms @ measuring window = 100 ms

1.56.3 Sensor : MT module

1.56.3.1 Pickup values

Test condition:	0 A ≤ Field current I-base ≤ 5000 A With the configuration of MT module measuring transducer as following: Unit: A Upper limit: 20.000 mA Upper limit – Sensor: 5000 Lower limit: 4.000 mA Lower limit – Sensor: 0
Test values:	4.00 mA ≤ Field current I-base ≤ 20.00 mA
Permissive tolerance/Limiting values:	0.015 mA
Test results/Remarks:	0.015 mA

1.56.3.2 Dropout ratio

Test condition:	see item 0.1.3.1
Test values:	0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	0.015 mA
Test results/Remarks:	0.015 mA

1.56.3.3 No load field current

Test condition:	see item 0.1.3.1
Test values:	4.00 mA ≤ No load field current ≤ 20.00 mA
Permissive tolerance/Limiting values:	0.015 mA
Test results/Remarks:	0.015 mA

1.56.3.4 Dropout ratio of no load field current

Test condition:	see item 0.1.3.1
Test values:	r = 1.05
Permissive tolerance/Limiting values:	0.015 mA
Test results/Remarks:	0.015 mA

1.56.3.5 Pickup times

Test condition:	If = 0 → 1.2*threshold
Permissive tolerance/Limiting values:	t approx. 200 ms + OOT
Test results/Remarks:	t approx. 200 ms + OOT

1.56.3.6 Dropout times

Test condition:	If = 1.2*threshold → 0
Permissive tolerance/Limiting values:	t approx. 200 ms + OOT
Test results/Remarks:	t approx. 200 ms + OOT

Summary

1.56.3.7 Warning delay

Test condition:	If = 1.2* threshold
Test values:	0.00 s ≤ Warning delay ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 200 ms
Test results/Remarks:	1 % of setting value or 200 ms

1.56.3.8 Operate time characteristic

Test condition:	If/Ib = 1.05, 1.10, 1.20, 2.00, 4.00, 8.00 (Ib = Field current I-base)
Permissive tolerance/Limiting values:	2 % of calculated value or 200 ms
Test results/Remarks:	2 % of calculated value or 200 ms

1.56.3.9 Cooling time thermal replica

Test values:	0 s ≤ Cooling time thermal replica ≤ 7200 s
Permissive tolerance/Limiting values:	2 % of setting value or 200 ms
Test results/Remarks:	2 % of setting value or 200 ms

1.56.3.10 Cooling time at no load

Test values:	0 s ≤ Cooling time at no load ≤ 7200 s
Permissive tolerance/Limiting values:	2 % of setting value or 200 ms
Test results/Remarks:	2 % of setting value or 200 ms

Summary

1.57 Rotor Overload Protection with Cold-Gas Temperature

1.57.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255- 149

Sensor : MT fast

1.57.2 Thermal stage

1.57.2.1 Pickup values

Test condition:	10 A ≤ Field current I-base ≤ 10000 A With the configuration of MT fast measuring transducer as following: Unit: A Upper limit: 20.00 mA Upper limit – Sensor: 10000.00 Lower limit: 4.00 mA Lower limit – Sensor: 10.00
Test values:	4.00 mA ≤ Field current I-base ≤ 20.00 mA
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.57.2.2 Dropout ratio

Test condition:	see item 0.1.2.1
Test values:	0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.57.2.3 No load field current

Test condition:	see item 0.1.2.1
Test values:	4.00 mA ≤ No load field current ≤ 20.00 mA
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.57.2.4 Dropout ratio no load current

Test condition:	see item 0.1.2.1
Test values:	r = 1.05
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.57.2.5 Pickup times

Test condition:	set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms If = 0→1.2*threshold
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT @ measuring window = 10 ms 77 ms + OOT @ measuring window = 40 ms 180 ms + OOT @ measuring window = 100 ms
Test results/Remarks:	t approx. 20 ms + OOT @ measuring window = 10 ms 77 ms + OOT @ measuring window = 40 ms 180 ms + OOT @ measuring window = 100 ms

1.57.2.6 Dropout times

Test condition:	set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms If = 1.2*threshold → 0

Summary

Permissive tolerance/Limiting values: t approx.
10 ms + OOT @ measuring window = 10 ms
36 ms + OOT @ measuring window = 40 ms
100 ms + OOT @ measuring window = 100 ms

Test results/Remarks: t approx.
24 ms + OOT @ measuring window = 10 ms
36 ms + OOT @ measuring window = 40 ms
100 ms + OOT @ measuring window = 100 ms

1.57.2.7 Warning delay

Test condition: set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms
If = 1.2* threshold

Test values: 0.00 s ≤ Warning delay ≤ 60.00 s

Permissive tolerance/Limiting values: 1 % of setting value or 10 ms @ measuring window = 10 ms
1 % of setting value or 20 ms @ measuring window = 40 ms
1 % of setting value or 100 ms @ measuring window = 100 ms

Test results/Remarks: 1 % of setting value or 10 ms @ measuring window = 10 ms
1 % of setting value or 20 ms @ measuring window = 40 ms
1 % of setting value or 100 ms @ measuring window = 100 ms

1.57.2.8 Operate time characteristic

Test condition: set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms
If = 1.05*Ib, 1.20*Ib, 2.00*Ib, 3.00*Ib, 4.00*Ib, 8000, 9000, 10000 (Ib = Field current I-base)

Permissive tolerance/Limiting values: 1 % of calculated value or 10 ms @ measuring window = 10 ms
1 % of calculated value or 40 ms @ measuring window = 40 ms
1 % of calculated value or 100 ms @ measuring window = 100 ms

Test results/Remarks: 1 % of calculated value or 10 ms @ measuring window = 10 ms
1 % of calculated value or 40 ms @ measuring window = 40 ms
1 % of calculated value or 100 ms @ measuring window = 100 ms

1.57.2.9 Cooling time thermal replica

Test condition: set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms

Test values: 0 s ≤ Cooling time thermal replica ≤ 7200 s

Permissive tolerance/Limiting values: 1 % of setting value or 50 ms @ measuring window = 10 ms
1 % of setting value or 200 ms @ measuring window = 40 ms
1 % of setting value or 100 ms @ measuring window = 100 ms

Test results/Remarks: 1 % of setting value or 50 ms @ measuring window = 10 ms
1 % of setting value or 200 ms @ measuring window = 40 ms
1 % of setting value or 100 ms @ measuring window = 100 ms

1.57.2.10 Cooling time at no load

Test condition: set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms

Test values: 0 s ≤ Cooling time at no load ≤ 7200 s

Permissive tolerance/Limiting values: 1 % of setting value or 100 ms @ measuring window = 10 ms
1 % of setting value or 180 ms @ measuring window = 40 ms
1 % of setting value or 200 ms @ measuring window = 100 ms

Test results/Remarks: 1 % of setting value or 100 ms @ measuring window = 10 ms
1 % of setting value or 180 ms @ measuring window = 40 ms
1 % of setting value or 200 ms @ measuring window = 100 ms

Summary

1.57.3 Over Temperature stage

1.57.3.1 Pickup values of Threshold

Test condition:	0 °C ≤ Threshold ≤ 150 °C With the configuration of MT fast measuring transducer as following: Unit: °C Upper limit: 20.000 mA Upper limit – Sensor: 200 Lower limit: 4.000 mA Lower limit – Sensor: 0
Test values:	0 °C ≤ Threshold ≤ 150 °C
Permissive tolerance/Limiting values:	0.2 °C
Test results/Remarks:	0.2 °C

1.57.3.2 Dropout ratio

Test condition:	see item 0.1.3.1
Test values:	0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	0.2 °C
Test results/Remarks:	0.2 °C

1.57.3.3 Pickup times

Test condition:	set the par. Measuring window of MT fast as 10 ms, 40 ms, 100 ms Temp. = 0 → 1.2*threshold
Permissive tolerance/Limiting values:	t approx. 25 ms + OOT @ measuring window = 10 ms 93 ms + OOT @ measuring window = 40 ms 220 ms + OOT @ measuring window = 100 ms
Test results/Remarks:	t approx. 25 ms + OOT @ measuring window = 10 ms 93 ms + OOT @ measuring window = 40 ms 220 ms + OOT @ measuring window = 100 ms

1.57.3.4 Dropout times

Test condition:	set the par. Measuring window of MT fast as 10 ms, 40 ms, 100 ms Temp. = 1.2*threshold → 0
Permissive tolerance/Limiting values:	t approx. 10 ms + OOT @ measuring window = 10 ms 39 ms + OOT @ measuring window = 40 ms 109 ms + OOT @ measuring window = 100 ms
Test results/Remarks:	t approx. 25 ms + OOT @ measuring window = 10 ms 39 ms + OOT @ measuring window = 40 ms 109 ms + OOT @ measuring window = 100 ms

1.57.3.5 Operate time

Test condition:	set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms 0.00 s ≤ Operate delay ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms @ measuring window = 10 ms 1 % of setting value or 40 ms @ measuring window = 40 ms 1 % of setting value or 100 ms @ measuring window = 100 ms
Test results/Remarks:	1 % of setting value or 10 ms @ measuring window = 10 ms 1 % of setting value or 40 ms @ measuring window = 40 ms 1 % of setting value or 100 ms @ measuring window = 100 ms

Sensor : MT module

Summary

1.57.4 Thermal stage

1.57.4.1 Pickup values

Test condition:	10 A ≤ Field current I-base ≤ 10000 A With the configuration of MT module measuring transducer as following: Unit: A Upper limit: 20.00 mA Upper limit – Sensor: 10000.00 Lower limit: 4.00 mA Lower limit – Sensor: 10.00
Test values:	4.00 mA ≤ Field current I-base ≤ 20.00 mA
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.57.4.2 Dropout ratio

Test condition:	see item 0.1.4.1
Test values:	0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.57.4.3 No load field current

Test condition:	see item 0.1.4.1
Test values:	4.00 mA ≤ No load field current ≤ 20.00 mA
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.57.4.4 Dropout ratio no load current

Test condition:	see item 0.1.4.1
Test values:	r = 1.05
Permissive tolerance/Limiting values:	0.010 mA
Test results/Remarks:	0.010 mA

1.57.4.5 Pickup times

Test condition:	If = 0→1.2*threshold
Permissive tolerance/Limiting values:	t approx. 349 ms + OOT
Test results/Remarks:	t approx. 349 ms + OOT

1.57.4.6 Dropout times

Test condition:	If = 1.2*threshold → 0
Permissive tolerance/Limiting values:	t approx. 316 ms + OOT
Test results/Remarks:	t approx. 316 ms + OOT

1.57.4.7 Warning delay

Test condition:	If = 1.2* threshold
Test values:	0.00 s ≤ Warning delay ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 200 ms
Test results/Remarks:	1 % of setting value or 200 ms

1.57.4.8 Operate time characteristic

Test condition:	If = 1.05*Ib, 1.20*Ib, 2.00*Ib, 3.00*Ib, 4.00*Ib, 8000, 9000, 10000 (Ib = Field current I-base)

Summary

Permissive tolerance/Limiting values: 1 % of calculated value or 200 ms

Test results/Remarks: 1 % of calculated value or 200 ms

1.57.4.9 Cooling time thermal replica

Test values: 0 s ≤ Cooling time thermal replica ≤ 7200 s

Permissive tolerance/Limiting values: 1 % of setting value or 50 ms

Test results/Remarks: 1 % of setting value or 50 ms

1.57.4.10 Cooling time at no load

Test values: 0 s ≤ Cooling time at no load ≤ 7200 s

Permissive tolerance/Limiting values: 1 % of setting value or 150 ms

Test results/Remarks: 1 % of setting value or 150 ms

1.57.5 Over Temperature stage

1.57.5.1 Pickup values of Threshold

Test condition: 0 °C ≤ Threshold ≤ 150 °C

With the configuration of MT module measuring transducer as following:
Unit: °C
Upper limit: 20.000 mA
Upper limit – Sensor: 200
Lower limit: 4.000 mA
Lower limit – Sensor: 0

Test values: 0 °C ≤ Threshold ≤ 150 °C

Permissive tolerance/Limiting values: 0.2 °C

Test results/Remarks: 0.2 °C

1.57.5.2 Dropout ratio

Test condition: see item 0.1.5.1

Test values: 0.90 ≤ r ≤ 0.99

Permissive tolerance/Limiting values: 0.2 °C

Test results/Remarks: 0.2 °C

1.57.5.3 Pickup times

Test condition: Temp. = 0 → 1.2*threshold

Permissive tolerance/Limiting values: t approx.
419 ms + OOT

Test results/Remarks: t approx.
419 ms + OOT

1.57.5.4 Dropout times

Test condition: Temp. = 1.2*threshold → 0

Permissive tolerance/Limiting values: t approx.
340 ms + OOT

Test results/Remarks: t approx.
340 ms + OOT

1.57.5.5 Operate time

Test condition: 0.00 s ≤ Operate delay ≤ 60.00 s

Permissive tolerance/Limiting values: 1 % of setting value or 200 ms

Test results/Remarks: 1 % of setting value or 200 ms

Summary

1.58 Stator Overload Protection with Cold-Gas Temperature

1.58.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255- 149

1.58.2 Thermal stage

1.58.2.1 Pickup values

Test condition:	refer to user defined curve
Test values:	frated = 50 Hz, 60 Hz refer to user defined curve
Permissive tolerance/Limiting values:	1 % of dropout value or 0.005 Irated
Test results/Remarks:	1 % of dropout value or 0.005 Irated

1.58.2.2 Dropout ratio

Test condition:	see item 0.1.2.1
Test values:	0.90 ≤ r ≤ 0.99
Permissive tolerance/Limiting values:	1 % of dropout value or 0.005 Irated
Test results/Remarks:	1 % of dropout value or 0.005 Irated

1.58.2.3 Pickup times

Test condition:	I = 0→1.2*threshold
Permissive tolerance/Limiting values:	t approx. 20 ms + OOT
Test results/Remarks:	t approx. 20 ms + OOT

1.58.2.4 Dropout times

Test condition:	I = 1.2*threshold → 0
Permissive tolerance/Limiting values:	t approx. 22 ms + OOT
Test results/Remarks:	t approx. 22 ms + OOT

1.58.2.5 Warning delay

Test condition:	I = 1.2* threshold
Test values:	0.00 s ≤ Warning delay ≤ 60.00 s
Permissive tolerance/Limiting values:	1 % of setting value or 10 ms
Test results/Remarks:	1 % of setting value or 10 ms

1.58.2.6 Operate time characteristic

Test condition:	I/Ib = 1.05, 1.10, 1.20, 1.50, 2.00, 4.00, 5.00 (Ib = Stator current I-base)
Permissive tolerance/Limiting values:	1 % of calculated value or 30 ms
Test results/Remarks:	1 % of calculated value or 30 ms

1.58.2.7 Cooling time thermal replica

Test values:	0 s ≤ Cooling time thermal replica ≤ 7200 s
Permissive tolerance/Limiting values:	1 % of setting value or 30 ms
Test results/Remarks:	1 % of setting value or 30 ms

1.58.2.8 Cooling time at no load

Test values:	0 s ≤ Cooling time at no load ≤ 7200 s
Permissive tolerance/Limiting values:	1 % of setting value or 30 ms

Summary

Test results/Remarks: 1 % of setting value or 30 ms

1.58.3 Over temperature stage

1.58.3.1 Pickup values of Threshold

1.58.3.1.1 Sensor : MT fast

Test condition: 0 °C ≤ Threshold ≤ 150 °C

With the configuration of MT fast (module) measuring transducer as following:
Unit: °C
Upper limit: 20.000 mA
Upper limit – Sensor: 200
Lower limit: 4.000 mA
Lower limit – Sensor: -50

Test values: 4.00 mA ≤ Threshold ≤ 20.00 mA

Permissive tolerance/Limiting values: 0.010 mA

Test results/Remarks: 0.010 mA

1.58.3.1.2 Sensor : MT module

Test condition: see item 0.1.3.1.1

Test values: 4.00 mA ≤ Threshold ≤ 20.00 mA

Permissive tolerance/Limiting values: 0.010 mA

Test results/Remarks: 0.010 mA

1.58.3.2 Dropout ratio

1.58.3.2.1 Sensor : MT fast

Test condition: see item 0.1.3.1.1

Test values: 0.90 ≤ r ≤ 0.99

Permissive tolerance/Limiting values: 0.010 mA

Test results/Remarks: 0.010 mA

1.58.3.2.2 Sensor : MT module

Test condition: see item 0.1.3.1.1

Test values: 0.90 ≤ r ≤ 0.99

Permissive tolerance/Limiting values: 0.010 mA

Test results/Remarks: 0.010 mA

1.58.3.3 Pickup times

1.58.3.3.1 Sensor : MT fast

Test condition: set the par. Measuring window of MT fast as 10 ms, 40 ms, 100 ms
Temp. = 0 → 1.2*threshold

Permissive tolerance/Limiting values: t approx.
13 ms + OOT @ measuring window = 10 ms
70 ms + OOT @ measuring window = 40 ms
98 ms + OOT @ measuring window = 100 ms

Test results/Remarks: t approx.
13 ms + OOT @ measuring window = 10 ms
70 ms + OOT @ measuring window = 40 ms
98 ms + OOT @ measuring window = 100 ms

1.58.3.3.2 Sensor : MT module

Test condition: Temp. = 0 → 1.2*threshold

Permissive tolerance/Limiting values: t approx.
177 ms + OOT

Test results/Remarks: t approx.
177 ms + OOT

Summary

1.58.3.4 Dropout times

1.58.3.4.1 Sensor : MT fast

Test condition: set the par. Measuring window of MT fast as 10 ms, 40 ms, 100 ms
Temp. = 1.2*threshold → 0

Permissive tolerance/Limiting values: t approx.
12 ms + OOT @ measuring window = 10 ms
29 ms + OOT @ measuring window = 40 ms
97 ms + OOT @ measuring window = 100 ms

Test results/Remarks: t approx.
12 ms + OOT @ measuring window = 10 ms
29 ms + OOT @ measuring window = 40 ms
97 ms + OOT @ measuring window = 100 ms

1.58.3.4.2 Sensor : MT module

Test condition: Temp. = 1.2*threshold → 0

Permissive tolerance/Limiting values: t approx.
376 ms + OOT

Test results/Remarks: t approx.
376 ms + OOT

1.58.3.5 Operate time

1.58.3.5.1 Sensor : MT fast

Test condition: set the par. Measuring window of MT fast as 10 ms, 40 ms,100 ms
0.00 s ≤ Operate delay ≤ 60.00 s

Permissive tolerance/Limiting values: 1 % of setting value or 10 ms @ measuring window = 10 ms
1 % of setting value or 40 ms @ measuring window = 40 ms
1 % of setting value or 100 ms @ measuring window = 100 ms

Test results/Remarks: 1 % of setting value or 10 ms @ measuring window = 10 ms
1 % of setting value or 40 ms @ measuring window = 40 ms
1 % of setting value or 100 ms @ measuring window = 100 ms

1.58.3.5.2 Sensor : MT module

Test condition: 0.00 s ≤ Operate delay ≤ 60.00 s

Permissive tolerance/Limiting values: 1 % of setting value or 200 ms

Test results/Remarks: 1 % of setting value or 200 ms

Summary

1.59 Temperature Supervision

1.59.1 Pickup values

Test condition:	-50 °C to 250 °C -58 °F to 482 °F
Permissive tolerance/Limiting values:	±0.5 % of the setting value or ±1 °C or ±2 °F
Test results/Remarks:	±0.5 % of the setting value or ±1 °C or ±2 °F

1.59.2 Dropout ratio

Test condition:	-50 °C to 250 °C -58 °F to 482 °F
Permissive tolerance/Limiting values:	3 °C or 6 °F
Test results/Remarks:	3 °C or 6 °F

1.59.3 Time delays

Permissive tolerance/Limiting values:	0.00 s to 60.00 s
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	< 1 % or 10 ms

Summary

1.60 49H HotSpot Calculation

1.60.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC 60076-7
- IEEE C57.91:2011

1.60.2 General Test Conditions

frated:	50 Hz, 60 Hz
Irated:	1 A, 5 A

1.60.3 General

1.60.3.1 HST Warning Threshold

Test condition:	80 °C to 140 °C
	176 °F to 284 °F
Permissive tolerance/Limiting values:	|δ| ± 0.5 % of measured value or ± 1 K
Test results/Remarks:	|δ| < 0.5 %

1.60.3.2 HST Alarm Threshold

Test condition:	80 °C to 140 °C
	176 °F to 284 °F
Permissive tolerance/Limiting values:	|δ| ± 0.5 % of measured value or ± 1 K
Test results/Remarks:	|δ| < 0.5 %

1.60.3.3 Operating Times

Test condition:	see item 1.60.3.1 and 1.60.3.2
Test results/Remarks:	Due to long process of HotSpot calculation the operating time is depend on oil-temperature and load increasing

1.60.3.4 Emergency Start Time Delay

Test condition:	added to the inherent operating times
Test values:	0 s ≤ T ≤ 15000 s
Permissive tolerance/Limiting values:	|δ| ≤ 1 % of setting value or 10 ms
Test results/Remarks:	|δ| < 1 % of setting value or 10 ms

Summary

1.61 Arc Protection

1.61.1 General test conditions

frated	50 Hz, 60 Hz
Irated	1 A

1.61.2 Light only

1.61.2.1 Pickup time

Test condition:	100 measurements Pickup of stage measured with high-speed-relais
Test results/Remarks:	tmax = 3.6 ms tmin = 2.6 ms taverage = 3.0 ms

1.61.2.2 Dropout time

Test condition:	100 measurements Pickup of stage measured with high-speed-relais
Test results/Remarks:	tmax = 27.3 ms tmin = 26.7 ms taverage = 27.3 ms

1.61.3 Light and current

1.61.3.1 Threshold I>

Test condition:	1pol-fault, 3pol-fault 0.03 ≤ I/IratedObj ≤ 10.00
Permissive tolerance/Limiting values:	no operate below threshold, measurement accuracy not considered
Test results/Remarks:	confirmed

1.61.3.2 Threshold 3I0>

Test condition:	1pol-fault, IN calculated, IN measured 0.03 ≤ I/IratedObj ≤ 10.00
Permissive tolerance/Limiting values:	no operate below threshold, measurement accuracy not considered
Test results/Remarks:	confirmed

1.61.3.3 Dropout ratio I>

Test condition:	1pol-fault, 3pol-fault 0.03 ≤ I/IratedObj ≤ 10.00
Permissive tolerance/Limiting values:	approx. 0.90
Test results/Remarks:	0.80 – 0.95

1.61.3.4 Dropout ratio 3I0>

Test condition:	1pol-fault 0.03 ≤ I/IratedObj ≤ 10.00
Permissive tolerance/Limiting values:	approx. 0.90
Test results/Remarks:	0.80 – 0.95

1.61.3.5 Pickup time

Test condition:

100 measurements per fault type and frequency
fault inception angle 10x(0°, 18°, 36°…162°)
Current jump from 1A to 10A at default threshold
Pickup of stage measured with high-speed-relais

Test results/Remarks:

	1pol, 50 Hz	1pol, 60 Hz	3pol, 50 Hz	3pol, 60 Hz
tmax =	9.2 ms	9.0 ms	6.9 ms	6.9 ms
tmin =	4.4 ms	3.8 ms	4.0 ms	3.8 ms
taverage =		5.5 ms	5.8 ms	5.3 ms 5.3 ms

Summary

1.61.3.6 Dropout time

Test condition:

100 measurements
Current jump to 0 A
Pickup of stage measured with high-speed-relais

Test results/Remarks:

	1pol, 50 Hz	1pol, 60 Hz	3pol, 50 Hz	3pol, 60 Hz	
tmax =	27.3 ms	27.8 ms	27.3 ms	27.8 ms	
tmin =	26.7 ms	26.3 ms	26.2 ms	26.2 ms	
taverage =		27.2 ms	27.3 ms	27.2 ms	27.3 ms

1.61.4 Frequency operating range

Test condition:

Itest = 5 Irated at default threshold, f = 5 Hz - 100 Hz

Permissive tolerance/Limiting values:

10 Hz – 80 Hz

Test results/Remarks:

confirmed

Summary

1.62 25 Synchronization Function

1.62.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B

1.62.2 Tolerances

1.62.2.1 Tolerances of the voltage settings

Permissive tolerance/Limiting values: 2 % of setting value or 1 V

Test results/Remarks: ≤ 2 % or ≤ 1 V

1.62.2.2 Voltage difference V2>V1; V2<V1

Permissive tolerance/Limiting values: 1 V

Test results/Remarks: ≤ 0,15 V

1.62.2.3 Frequency difference f2>f1; f2<f1

Permissive tolerance/Limiting values: 1 mHz

Test results/Remarks: ≤ 1mHz

1.62.2.4 Angular difference α2>α1; α2<α1

Permissive tolerance/Limiting values: 1 °

Test results/Remarks: ≤ 0,2 °

1.62.2.5 Tolerance of all time settings

Permissive tolerance/Limiting values: 10 ms

Test results/Remarks: ≤ 10 ms

1.62.2.6 Max. phase displacement angle

Permissive tolerance/Limiting values: 5 ° for Δf ≤ 1 Hz
10 ° for Δf > 1 Hz

Test results/Remarks: ≤ 5 ° for Δf ≤ 1 Hz
≤ 10 ° for Δf > 1 Hz

1.62.3 Tested functionality

Test values:

Synchronous operation mode
Asynchronous operation mode
De-energized switching
- Dead line
- Dead bus

Df/dt limitation
Low frequent oscillations
Direct closing
Function values
Error reactions
Threshold values for
- Voltages and voltage difference
- Frequency and frequency difference
- Angle difference
- Rate of frequency change
- Delay time

Binary inputs
- Start and stop
- Selection
- Blocking
- De-energized switching

Start synchronization by
- Control function
- Auto recloser
- Binary input

Conditions
- Connection types Ph-Ph and Ph-Gnd
- 3ph and 1ph measuring points
- V sync. Selection by measuring point ID

Test results/Remarks: Functionality according to manual confirmed

Summary

Summary

1.63 Balancing Command for Synchronization Function

1.63.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255- 8

1.63.2 Balancing Voltage v2

1.63.2.1 TV pulse min

Test values:	0.01 s ≤ TV pulse min ≤ 1.00 s
Permissive tolerance/Limiting values:	10 ms
Test results/Remarks:	10 ms

1.63.2.2 TV pulse max

Test values:	0.01 s ≤ TV pulse max ≤ 60.00 s
Permissive tolerance/Limiting values:	10 ms
Test results/Remarks:	10 ms

1.63.2.3 T position impulse (Calculated impulse length for voltage control)

Test values:	0.100 V ≤ dV per second ≤ 50.000 V
	-5.000 V ≤ dV ≤ 5.000 V
Permissive tolerance/Limiting values:	1 % of calculated impulse or 10 ms
Test results/Remarks:	1 % of calculated impulse or 10 ms

1.63.2.4 T pause V

Test values:	0.10 s ≤ Tpause V ≤ 60.00 s
Permissive tolerance/Limiting values:	10 ms
Test results/Remarks:	10 ms

1.63.3 Balancing Frequency f2

1.63.3.1 T f pulse min

Test values:	0.01 s ≤ Tf pulse min ≤ 1.00 s
Permissive tolerance/Limiting values:	10 ms
Test results/Remarks:	10 ms

1.63.3.2 T f pulse max

Test values:	0.01 s ≤ Tf pulse max ≤ 60.00 s
Permissive tolerance/Limiting values:	10 ms
Test results/Remarks:	10 ms

1.63.3.3 T position impulse (Calculated impulse length for frequency control)

Test values:	0.05 Hz/s ≤ df/dt of the controller ≤ 5.00 Hz/s
	-1.00 Hz ≤ df ≤ 1.00 Hz
Permissive tolerance/Limiting values:	1 % of calculated impulse or 10 ms
Test results/Remarks:	1 % of calculated impulse or 10 ms

1.63.3.4 T pause f

Test values:	0.10 s ≤ T pause f ≤ 60.00 s
Permissive tolerance/Limiting values:	10 ms
Test results/Remarks:	10 ms

Summary

1.64 CB wear monitoring

1.64.1 ∑Ix-method

No accuracies defined, because this method is a monitoring function, which contains no protection-specific task and the principles are based upon empiric determined data.

1.64.2 2P-method

No accuracies defined, because this method is a monitoring function, which contains no protection-specific task and the principles are based upon empiric determined data.

1.64.3 I2t-method

No accuracies defined, because this method is a monitoring function, which contains no protection-specific task and the principles are based upon empiric determined data.

1.64.4 Supv.CB make time

1.64.4.1 Circuit breaker closing time

Test condition/Operative range:	frated = 50 Hz, 60Hz 0.001 s ≤ tCBcltm ≤ 0.600 s
Test values:	0.03 A ≤ I ≤ 5 A
Permissive tolerance/Limiting values:	tCBcltm ≤ 2 ms
Test results/Remarks:	tCBcltm < 2 ms

Summary

1.65 Thermoboxes for Temperature Detection

1.65.1 Specifications

- IEC/EN 60255-1

1.65.2 Connection

- Ethernet: TR1200 IP
- RS 485: TR1200

1.65.3 Temperature detectors

Test condition:	Connectable Thermoboxes 4
Test values:	Number of Thermoboxes per type 4
Test results/Remarks:	numbers correct

1.65.4 Number of temperature sensors per thermobox

Test condition:	Max. 12
Test values:	Max. 12
Test results/Remarks:	numbers correct

1.65.5 Thresholds for Indication stage 1

Test condition:	-50 °C to 250 °C -58 °F to 482 °F
Test values:	-50 °C to 250 °C -58 °F to 482 °F
Permissive tolerance/Limiting values:	≤ 1% of setting value or ± 1 °C or ±2 °F
Test results/Remarks:	< 1% of setting value or ± 1 °C or ±2 °F

1.65.6 Thresholds for Indication stage 2

Test condition:	-50 °C to 250 °C -58 °F to 482 °F
Test values:	-50 °C to 250 °C -58 °F to 482 °F
Permissive tolerance/Limiting values:	≤ 1% of setting value or ± 1 °C or ±2 °F
Test results/Remarks:	< 1% of setting value or ± 1 °C or ±2 °F

1.65.7 Dropout ratio

Test condition:	3 °C or 6 °F
Test values:	3 °C or 6 °F
Test results/Remarks:	Function correct

1.65.8 Time delays

Test condition:	Added to the Inherent Operating Times
Test values:	0.00 s to 60.00 s or ∞
Permissive tolerance/Limiting values:	≤ 1 % of setting value or 10 ms
Test results/Remarks:	< 1 % of setting value or 10 ms

Summary

1.66 Supervision Functions

1.66.1 Voltage-transformer circuit breaker

Permissive tolerance/Limiting values:	funct. acc. to manual
Test results/Remarks:	Function correct

1.66.2 Current-balance supervision

Permissive tolerance/Limiting values:	funct. acc. to manual
Test results/Remarks:	Function correct

1.66.3 Voltage-balance supervision

Permissive tolerance/Limiting values:	funct. acc. to manual
Test results/Remarks:	Function correct

1.66.4 Current-sum supervision

Permissive tolerance/Limiting values:	funct. acc. to manual
Test results/Remarks:	Function correct

1.66.5 Voltage-sum supervision

Permissive tolerance/Limiting values:	funct. acc. to manual
Test results/Remarks:	Function correct

1.66.6 Measuring-voltage failure (Fuse failure monitor)

Permissive tolerance/Limiting values:	funct. acc. to manual
Test results/Remarks:	Function correct

1.66.7 Current phase rotation supervision

Permissive tolerance/Limiting values:	funct. acc. to manual
Test results/Remarks:	Function correct

1.66.8 Voltage phase rotation supervision

Permissive tolerance/Limiting values:	funct. acc. to manual
Test results/Remarks:	Function correct

1.66.9 74TC Trip circuit supervision

Test condition:	Number trip circuit: 1 to 3 Operation mode: with 1 or 2 BI
Permissive tolerance/Limiting values:	funct. acc. to manual
Test results/Remarks:	Function correct

Summary

1.67 Voltage-Comparison Supervision

1.67.1 Specifications

- VDE 0435
- IEC/EN 60255-1, item 7, Annex A, B
- IEC/EN 60255-127

1.67.2 Function stage

1.67.2.1 Pickup times

Permissive tolerance/Limiting values:	t approx. 5 ms + OOT at 50 Hz 5 ms + OOT at 60 Hz
Test results/Remarks:	t approx. 5 ms + OOT at 50 Hz 5 ms + OOT at 60 Hz

Summary

1.68 Ancillary Functions

1.68.1 Log buffers

1.68.1.1 Operational log

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct

1.68.1.2 Fault log

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct. Not applicable for Fault Recorder 7KE85.

1.68.1.3 Ground fault log

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct. Not applicable for Fault Recorder 7KE85.

1.68.2 Fault recording

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct

1.68.3 Date and time

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct

1.68.4 Setting group switching

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct Not applicable for Fault Recorder 7KE85.

1.68.5 Test functions

1.68.5.1 CB tripping test

Test condition: Live tripping of CB

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct Not applicable for Fault Recorder 7KE85.

1.68.5.2 Test record

Permissive tolerance/Limiting values: Funct. acc. to manual

Test results/Remarks: Function correct

Summary

1.69 Operational Measured Values

1.69.1 Specifications

- IEC/EN 60255-1, Annex A, B

1.69.2 Currents, instrument transformers

Test condition:	Current range	< 1.6 Irated
	Nominal range	1 A, 5 A
	Measuring ranges	(0.1 to 1.6) Irated
	Frequency range: frated = 50 Hz: 49 Hz to 51 Hz frated = 60 Hz: 59 Hz to 61 Hz	
Test values:	IA, IB, IC, 3I0 in A (prim), A (sec), % (of Irated)	
Permissive tolerance/Limiting values:	≤ 0.15 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 0.15 %	
Test condition:	Frequency range: frated = 50 Hz: 40 Hz to 60 Hz frated = 60 Hz: 50 Hz to 70 Hz	
Test values:	IA, IB, IC, 3I0 in A (prim), A (sec), % (of Irated)	
Permissive tolerance/Limiting values:	≤ 0.3 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 0.3 %	

1.69.3 Currents, protection-class transformers

Test condition:	Current range	<100 Irated[1] , <50 Irated[2]
	Nominal range	1 A, 5 A
	Measuring ranges	0.1 to 25 A
	Frequency range: frated = 50 Hz: 49 Hz to 51 Hz frated = 60 Hz: 59 Hz to 61 Hz	
Test values:	IA, IB, IC, 3I0 in A (prim), A (sec), % (of Irated)	
Permissive tolerance/Limiting values:	≤ 0.2 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 0.2 % of the measured value	
Test condition:	Frequency range: frated = 50 Hz: 40 Hz to 60 Hz frated = 60 Hz: 50 Hz to 70 Hz	
Test values:	IA, IB, IC, 3I0 in A (prim), A (sec), % (of Irated)	
Permissive tolerance/Limiting values:	≤ 0.3 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 0.3 %	

[1] for modular device only
[2] for non-modular device only

Summary

1.69.4 Voltages

Test condition:	Voltage Range	< 200 V (sec.)
	Secondary rated voltage	100 V to 125 V
	Measuring Range	(1.1 to 2) Vrated
	Frequency range: frated = 50 Hz: 49 Hz to 51 Hz frated = 60 Hz: 59 Hz to 61 Hz	
Test values:	VA, VB, VC, VAB, VBC, VCA in kV (prim), in V (sec), % of Vrated	
Permissive tolerance/Limiting values:	0.2 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 0.2 %	
Test condition:	Frequency range: frated = 50 Hz: 40 Hz to 60 Hz frated = 60 Hz: 50 Hz to 70 Hz	
Test values:	VA, VB, VC, VAB, VBC, VCA in kV (prim), in V (sec), % of Vrated	
Permissive tolerance/Limiting values:	0.3 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 0.3 %	

1.69.5 Phase angle, current and voltage

Test condition:	Irated, Vrated	
	Frequency range: frated = 50 Hz: 47.5 Hz to 52.5 Hz frated = 60 Hz: 57.5 Hz to 62.5 Hz	
	(operative range 10 Hz to 80 Hz with higher tolerances)	
Test values:	φ (IA-IB), φ (IB-IC), φ (IC-IA) in ° φ (VA-VB), φ (VB-VC), φ (VC-VA) in °	
Permissive tolerance/Limiting values:	Current Voltage	≤ 0.2 ° at Irated ≤ 0.2 ° at Vrated
Test results/Remarks:	Current Voltage	< 0.2 ° at Irated < 0.2 ° at Vrated

1.69.6 Power, ratings

1.69.6.1 Active Power P

Test condition:	W secondary	
	Measuring Range:	$\lvert\cos\phi\rvert \geqslant 0.01$
	Voltage Range:	(0.8 to 1.2) Vrated
	Current range:	(0.1 to 2) Irated
	Frequency range: frated = 50 Hz: frated = 60 Hz:	 49 Hz to 51 Hz 59 Hz to 61 Hz
Test values:	P, PA, PB, PC in W (secondary)	
Permissive tolerance/Limiting values:	≤ 0.3 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 0.3 %	
Test condition:	Frequency range: frated = 50 Hz: 40 Hz to 60 Hz frated = 60 Hz: 50 Hz to 70 Hz	
Test values:	P, PA, PB, PC in W (secondary)	
Permissive tolerance/Limiting values:	≤ 0.5 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 0.5 %	

Summary

1.69.6.2 Reactive Power Q

Test condition:	VAr secondary	
	Measuring Range:	$\|\cos\phi\| \geq 0.984$
	Voltage Range:	(0.8 to 1.2) Vrated
	Current range:	(0.1 to 2) Irated
	Frequency range: frated = 50 Hz: frated = 60 Hz:	 49 Hz to 51 Hz 59 Hz to 61 Hz
Test values:	Q, QA, QB, QC in VAr (secondary)	
Permissive tolerance/Limiting values:	≤ 1 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 1 %	
	Frequency range: frated = 50 Hz: 40 Hz to 60 Hz frated = 60 Hz: 50 Hz to 70 Hz	
Test values:	Q, QA, QB, QC in VAr (secondary)	
Permissive tolerance/Limiting values:	≤ 1.5 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 1.5 %	

1.69.6.3 Apparent Power S

Test condition:	VA secondary	
	Measuring Range:	(0.01 to 2) Srated
	Voltage Range:	(0.8 to 1.2) Vrated
	Current range:	(0.1 to 2) Irated
	Frequency range: frated = 50 Hz: frated = 60 Hz:	 49 Hz to 51 Hz 59 Hz to 61 Hz
Test values:	S, SA, SB, SC in VA (secondary)	
Permissive tolerance/Limiting values:	≤ 0.3 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 0.3 %	
Test condition:	Frequency range: frated = 50 Hz: 40 Hz to 60 Hz frated = 60 Hz: 50 Hz to 70 Hz	
Test values:	S, SA, SB, SC in VA (secondary)	
Permissive tolerance/Limiting values:	≤ 0.5 % of the measured value in the above mentioned ranges	
Test results/Remarks:	≤ 0.5 %	

1.69.7 Frequency

Test condition:	Frequency range	10 Hz to 80 Hz
Test values:	f in Hz and frated	
Permissive tolerance/Limiting values:	≤ 20 mHz in the range frated ±10 % at Vrated, Irated	
Test results/Remarks:	≤ 10 mHz in the range frated ±10 % at Vrated, Irated (operative range > frated ±10 % with higher tolerances)	

Summary

1.70 Interfaces

1.70.1 USB interface (front panel)

Permissive tolerance/Limiting values:	Funct. acc. to manual
Test results/Remarks:	Function correct

1.70.2 Integrated ethernet interface (rear)

Permissive tolerance/Limiting values:	Funct. acc. to manual
Test results/Remarks:	Function correct

1.70.3 System interfaces

1.70.3.1 IEC 60870-5-103

Test values:	RS232, RS485, LWL
Permissive tolerance/Limiting values:	Funct. acc. to manual
Test results/Remarks:	Function correct

1.70.3.2 IEC 60870-5-104

Test values:	LWL
Permissive tolerance/Limiting values:	Funct. acc. to manual
Test results/Remarks:	Function correct

1.70.3.3 DNP3.0

Test values:	RS485, LWL
Permissive tolerance/Limiting values:	Funct. acc. to manual
Test results/Remarks:	Function correct

1.70.3.4 IEC 61850 (Edition 1 and 2)

Permissive tolerance/Limiting values:	Funct. acc. to manual
Test results/Remarks:	Function correct

1.70.4 Time synchronization

Test condition:	IRIG-B, DCF77, SNTP
Permissive tolerance/Limiting values:	Funct. acc. to manual
Test results/Remarks:	Function correct

1.70.5 Protection interfaces

Test values:	Transmission of status information
Permissive tolerance/Limiting values:	Funct. acc. to manual
Test results/Remarks:	Function correct

1.70.6 Phasor measurement unit (PMU)

Permissive tolerance/Limiting values:	Accuracy according to IEEE C37.118.1 (class P) Accuracy according to IEEE C37.118.1 (class M)
Test results/Remarks:	Requirements for class P and M in accordance to IEEE C37.118.1 passed