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**Measuring relays and protection equipment –
Part 121: Functional requirements for distance protection**
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**Relais de mesure et dispositifs de protection –
Partie 121: Exigences fonctionnelles pour protection de distance**

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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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Part 121: Functional requirements for distance protection**

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Partie 121: Exigences fonctionnelles pour protection de distance**

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CONTENTS

FOREWORD.....	9
1 Scope.....	11
2 Normative references	11
3 Terms and definitions	12
4 Specification of the function.....	13
4.1 General.....	13
4.2 Input energizing quantities/energizing quantities	13
4.3 Binary input signals.....	14
4.4 Functional logic.....	15
4.4.1 Faulted phase identification	15
4.4.2 Directional signals	15
4.4.3 Distance protection function characteristics	15
4.4.4 Distance protection zone timers	16
4.5 Binary output signals	16
4.5.1 General	16
4.5.2 Start (pickup) signals	16
4.5.3 Operate signals	17
4.5.4 Other binary output signals	17
4.6 Additional influencing functions/conditions	17
4.6.1 General	17
4.6.2 Inrush current	17
4.6.3 Switch onto fault/trip on reclose	17
4.6.4 Voltage transformer (VT) signal failure (loss of voltage).....	17
4.6.5 Power swings	18
4.6.6 Behavior during frequencies outside of the operating range	18
5 Performance specifications.....	18
5.1 General.....	18
5.2 Effective and operating ranges.....	18
5.3 Basic characteristic accuracy under steady state conditions	19
5.3.1 General	19
5.3.2 Determination of accuracy related to time delay setting	19
5.3.3 Disengaging time	20
5.4 Dynamic performance	20
5.4.1 General	20
5.4.2 Transient overreach (TO).....	20
5.4.3 Operate time and transient overreach (SIR diagrams).....	21
5.4.4 Operate time and transient overreach (CVT-SIR diagrams).....	21
5.4.5 Typical operate time	21
5.5 Performance with harmonics	22
5.5.1 General	22
5.5.2 Steady-state harmonics tests	23
5.5.3 Transient LC oscillation tests	23
5.6 Performance during frequency deviation	23
5.6.1 General	23
5.6.2 Steady state testing during frequency deviation	23
5.6.3 Transient testing during frequency deviation	23
5.7 Double infeed tests	24

5.7.1	General	24
5.7.2	Single line, double infeed system.....	24
5.7.3	Double line, double infeed system	24
5.8	Instrument transformer (CT, VT and CVT) requirements	25
5.8.1	General	25
5.8.2	CT requirements.....	25
6	Functional tests	29
6.1	General.....	29
6.2	Rated frequency characteristic accuracy tests	29
6.2.1	General	29
6.2.2	Basic characteristic accuracy under steady state conditions	30
6.2.3	Basic directional accuracy under steady state conditions	43
6.2.4	Determination of accuracy related to time delay setting	48
6.2.5	Determination and reporting of the disengaging time	48
6.3	Dynamic performance	50
6.3.1	General	50
6.3.2	Dynamic performance: operate time and transient overreach (SIR diagrams)	51
6.3.3	Dynamic performance: operate time and transient overreach (CVT-SIR diagrams)	61
6.3.4	Dynamic performance: transient overreach tests.....	65
6.3.5	Dynamic performance: typical operate time	69
6.4	Performance with harmonics	74
6.4.1	Steady state harmonics tests.....	74
6.4.2	Transient oscillation tests (network simulation L-C)	75
6.5	Performance during off-nominal frequency.....	82
6.5.1	Steady state frequency deviation tests.....	82
6.5.2	Transient frequency deviation tests	85
6.6	Double infeed tests	90
6.6.1	Double infeed tests for single line	90
6.6.2	Double infeed tests for parallel lines (without mutual inductance).....	96
6.6.3	Reporting of double infeed test results.....	100
7	Documentation requirements	101
7.1	Type test report	101
7.2	Documentation.....	101
Annex A (informative)	Impedance characteristics	102
A.1	Overview.....	102
A.1.1	General	102
A.1.2	Non-directional circular characteristic	102
A.1.3	MHO characteristic	102
A.1.4	Quadrilateral/polygonal.....	104
A.2	Example characteristics	106
A.2.1	General	106
A.2.2	Non-directional circular characteristic (ohm)	106
A.2.3	Reactive reach line characteristic	106
A.2.4	MHO characteristic	107
A.2.5	Resistive and reactive intersecting lines characteristic.....	107
A.2.6	Offset MHO characteristic.....	108

Annex B (informative) Informative guide for the behaviour of timers in distance protection zones for evolving faults	110
Annex C (normative) Setting example	112
Annex D (normative) Calculation of mean, median and mode.....	115
D.1 Mean	115
D.2 Median.....	115
D.3 Mode	115
D.4 Example.....	115
Annex E (informative) CT saturation and influence on the performance of distance relays	116
Annex F (informative) Informative guide for testing distance relays based on CT requirements specification	119
F.1 General.....	119
F.2 Test data	120
F.3 CT data and CT model	121
Annex G (informative) Informative guide for dimensioning of CTs for distance protection	125
G.1 General.....	125
G.2 Example 1.....	126
G.3 Example 2.....	128
Annex H (normative) Calculation of relay settings based on generic point P expressed in terms of voltage and current.....	131
H.1 Settings for quadrilateral/polygonal characteristic	131
H.2 Settings for MHO characteristic.....	133
Annex I (normative) Ramping methods for testing the basic characteristic accuracy	134
I.1 Relationship between simulated fault impedance and analog quantities	134
I.2 Pre-fault condition.....	134
I.3 Phase to earth faults	134
I.4 Phase to phase faults	136
I.5 Ramps in the impedance plane	139
I.5.1 Pseudo-continuous ramp	139
I.5.2 Ramp of shots	140
Annex J (normative) Definition of fault inception angle.....	143
Annex K (normative) Capacitive voltage instrument transformer model	145
K.1 General.....	145
K.2 Capacitor voltage transformer (CVT).....	145
Figure 1 – Simplified distance protection function block diagram.....	14
Figure 2 – Basic accuracy specification of an operating characteristic	19
Figure 3 – Basic angular accuracy specifications of directional lines	20
Figure 4 – SIR diagram – Short line average operate time	22
Figure 5 – Fault positions to be considered for specifying the CT requirements	26
Figure 6 – Test procedure for basic characteristic accuracy.....	31
Figure 7 – Calculated test points A, B and C based on the effective range of U and I	32
Figure 8 – Modified points B' and C' based on the limited setting range	32
Figure 9 – Position of test points A, B, C, D and E in the effective range of U and I	33
Figure 10 – Position of test points A, B', C', D and E in the effective range of U and I	33

Figure 11 – Quadrilateral characteristic showing ten test points	34
Figure 12 – Quadrilateral characteristic showing test ramps.....	35
Figure 13 – Quadrilateral characteristic showing accuracy limits	36
Figure 14 – Quadrilateral/polygonal characteristic showing accuracy limits	37
Figure 15 – MHO characteristic showing nine test points	37
Figure 16 – MHO characteristic showing test ramps.....	38
Figure 17 – Accuracy limits for MHO characteristic	39
Figure 18 – Basic directional element accuracy tests	44
Figure 19 – Directional element accuracy tests in the second quadrant.....	45
Figure 20 – Directional element accuracy tests in the second quadrant.....	46
Figure 21 – Directional element accuracy tests in the fourth quadrant.....	46
Figure 22 – Directional test accuracy lines in the fourth quadrant	47
Figure 23 – Position of the three-phase fault for testing the disengaging time	49
Figure 24 – Sequence of events for testing the disengaging time	50
Figure 25 – Power system network with zero load transfer.....	51
Figure 26 – Dynamic performance: operate time and dynamic overreach (SIR diagram)	55
Figure 27 – SIR diagram for short line: minimum operate time	56
Figure 28 – SIR diagram for short line: average operate time.....	57
Figure 29 – SIR diagram for short line: maximum operate time	57
Figure 30 – Dynamic performance tests (SIR diagrams).....	59
Figure 31 – SIR diagram for long line: minimum operate time	61
Figure 32 – SIR diagram for long line: average operate time.....	62
Figure 33 – SIR diagram for long line: maximum operate time	62
Figure 34 – Dynamic performance: operate time and dynamic overreach (CVT-SIR diagram)	64
Figure 35 – CVT-SIR diagram for short line: minimum operate time	66
Figure 36 – CVT-SIR diagram for short line: average operate time.....	66
Figure 37 – CVT-SIR diagram for a short line: maximum operate time	67
Figure 38 – Fault statistics for typical operate time	70
Figure 39 – Frequency distribution of operate time	73
Figure 40 – Ramping test for harmonics.....	75
Figure 41 – Steady-state harmonics test	77
Figure 42 – Simulated power system network	78
Figure 43 – Flowchart of transient oscillation tests	79
Figure 44 – Simulated voltages (U_{L1} , U_{L2} , U_{L3}) and currents (I_{L1} , I_{L2} , I_{L3})	81
Figure 45 – Transient oscillation tests – Operate time.....	82
Figure 46 – Test points for quadrilateral characteristics	83
Figure 47 – Test points for MHO characteristic	83
Figure 48 – Test ramp direction for quadrilateral characteristic	83
Figure 49 – Test ramp direction for MHO characteristic.....	84
Figure 50 – Steady-state frequency deviation tests	86
Figure 51 – Short line model for frequency deviation test.....	87
Figure 52 – Flowchart of transient frequency deviation tests	89

Figure 53 – SIR diagrams for frequency deviation tests – average operate time.....	90
Figure 54 – Network model for single line tests	91
Figure 55 – Line to earth fault	92
Figure 56 – Line to line fault	92
Figure 57 – Line to line to earth fault	92
Figure 58 – Three-phase fault.....	93
Figure 59 – Network model for parallel lines tests	98
Figure 60 – Network model for current reversal test.....	99
Figure A.1 – Non-directional circular characteristic with directional supervision	102
Figure A.2 – MHO characteristic	103
Figure A.3 – Quadrilateral/polygonal characteristics	104
Figure A.4 – Non-directional circular characteristic (ohm)	106
Figure A.5 – Reactive reach line characteristic	107
Figure A.6 – MHO characteristics	107
Figure A.7 – Resistive and reactive intersecting lines characteristics	108
Figure A.8 – Offset MHO.....	108
Figure B.1 – The same fault type evolving from time delayed zone 3 (position 1) into time delayed zone 2 (position 2) after 200 ms.....	110
Figure B.2 – Phase to earth fault in time delayed zone 3 (position 1) evolving into three-phase fault in the same zone (position 2) after 200 ms.....	111
Figure C.1 – Setting example for a radial feeder	112
Figure C.2 – Phase to earth fault (LN)	113
Figure C.3 – Phase to phase fault (LL)	114
Figure E.1 – Fault positions to be considered for specifying the CT requirements	117
Figure F.1 – Fault positions to be considered.....	119
Figure F.2 – Double source network	120
Figure F.3 – Magnetization curve for the basic CT	122
Figure F.4 – Secondary current at the limit of saturation caused by AC component with no remanent flux in the CT.....	123
Figure F.5 – Secondary current in case of maximum DC offset	123
Figure G.1 – Distance relay example 1	126
Figure G.2 – Distance relay example 2	128
Figure H.1 – Quadrilateral/polygonal characteristic showing test point P on the reactive reach line.....	131
Figure H.2 – Quadrilateral distance protection function characteristic showing test point P on the resistive reach line.	132
Figure H.3 – MHO characteristic showing test point P	133
Figure I.1 – Three-line diagram showing relay connections and L1N fault	135
Figure I.2 – Voltage and current phasors for L1N fault	135
Figure I.3 – Voltages and currents for L1N fault, constant fault current	136
Figure I.4 – Voltages and currents for L1N fault, constant fault voltage	136
Figure I.5 – Three-line diagram showing relay connections and L1L2 fault.....	137
Figure I.6 – Voltage and current phasors for L1L2 fault.....	138
Figure I.7 – Voltages and currents for L1L2 fault, constant fault current.....	138
Figure I.8 – Voltages and currents for L1L2 fault, constant fault voltage	139

Figure I.9 – Pseudo-continuous ramp distance relay characteristic on an impedance plane	140
Figure I.10 – Pseudo-continuous ramp showing impedance step change and the time step	140
Figure I.11 – Ramp of shots distance relay characteristic on an impedance plane	141
Figure I.12 – Ramp of shots showing impedance step change and the time step	142
Figure I.13 – Ramp of shots with binary search algorithm	142
Figure J.1 – Graphical definition of fault inception angle	143
Figure K.1 – CVT equivalent electrical circuit	145
Figure K.2 – Transient response of the 50 Hz version of the CVT model	147
Table 1 – Example of effective and operating ranges of distance protection	18
Table 2 – Recommended levels of remanence in the optional cases when remanence is considered	27
Table 3 – Basic characteristic accuracy for various points (quadrilateral/polygonal)	42
Table 4 – Overall basic characteristic accuracy (quadrilateral/polygonal)	42
Table 5 – Basic characteristics accuracy for various points (MHO)	42
Table 6 – Overall basic characteristic accuracy (MHO)	42
Table 7 – Basic directional accuracy for various fault types	47
Table 8 – Basic directional accuracy e_{θ}	47
Table 9 – Results of disengaging time for all the tests	50
Table 10 – Short line SIR and source impedance for selected rated current and frequency	53
Table 11 – Short line SIR and source impedances for other rated current and frequency	54
Table 12 – Long line SIR and source impedances for selected rated current and frequency	59
Table 13 – Long line SIR and source impedances for other rated current and frequency	60
Table 14 – Short line CVT-SIR source impedance	63
Table 15 – Transient overreach table for short line	68
Table 16 – Transient overreach table for long line	68
Table 17 – Transient overreach table for short line with CVTs	69
Table 18 – Typical operate time	71
Table 19 – Typical operate time	71
Table 20 – Typical operate time	72
Table 21 – Typical operate time (mode, median, mean)	73
Table 22 – Steady state harmonics test	75
Table 23 – Capacitance values	78
Table 24 – Quadrilateral/polygonal basic characteristic accuracy at f_{\min} and f_{\max}	85
Table 25 – MHO basic characteristic accuracy at f_{\min} and f_{\max}	85
Table 26 – Tests without pre-fault load	94
Table 27 – Tests with pre-fault load	95
Table 28 – Current reversal test	98
Table 29 – Evolving faults (only one line affected)	99
Table 30 – Evolving faults (both lines affected)	100
Table 31 – Double infeed test results	101

Table F.1 – Magnetization curve data	122
Table G.1 – Fault currents	127
Table G.2 – Fault currents	128
Table J.1 – Fault type and reference voltage	144
Table K.1 – Parameter values for the 50 Hz version of the CVT model	146
Table K.2 – Parameter values for the 60 Hz version of the CVT model	146

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MEASURING RELAYS AND PROTECTION EQUIPMENT –**Part 121: Functional requirements for distance protection**

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MEASURING RELAYS AND PROTECTION EQUIPMENT –

Part 121: Functional requirements for distance protection

1 Scope

This part of IEC 60255 specifies minimum requirements for functional and performance evaluation of distance protection function typically used in, but not limited to, line applications for effectively earthed, three-phase power systems. This standard also defines how to document and publish performance tests.

This standard covers distance protection function whose operating characteristic can be defined on an impedance plane and includes specification of the protection function, measurement characteristics, phase selection, directionality, starting and time delay characteristics.

The test methodologies for verifying performance characteristics and accuracy are included in this standard. The standard defines the influencing factors that affect the accuracy under steady state conditions and performance characteristics during dynamic conditions. It also includes the instrument transformer requirements for the protection function.

The distance protection functions covered by this standard are as follows:

	IEEE/ANSI C37.2 Function numbers	IEC 61850-7-4 Logical nodes
Phase distance protection	21	PDIS
Earth (ground) distance protection	21G	PDIS

This standard does not specify the functional description of additional features often associated with digital distance relays such as power swing blocking (PSB), out of step tripping (OST), voltage transformer (VT) supervision, switch onto fault (SOTF), trip on reclose (TOR), the logic for cross country faults in not effectively earthed networks, and trip conversion logic. Only their influence on the distance protection function is covered in this standard. The protection of series-compensated lines is beyond the scope of this standard.

The general requirements for measuring relays and protection equipment are defined in IEC 60255-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <<http://www.electropedia.org>>)

IEC 60255-1, *Measuring relays and protection equipment – Part 1: Common requirements*

IEC 61850 (all parts), *Communication networks and systems for power utility automation*

IEC 61869-2:2012, *Instrument transformers – Part 2: Additional requirements for current transformers*

IEC 61869-5:2011, *Instrument transformers – Part 5: Additional requirements for capacitor voltage transformers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-444, IEC 60050-447, IEC 60050-448, as well as the following apply.

3.1

distance protection

non-unit protection whose operation and selectivity depend on local measurement of electrical quantities from which the equivalent distance to the fault is evaluated by comparing with zone settings

[SOURCE: IEC 60050-448:1995, 448.14.01]

3.2

zones of non-unit protection

zones of protection (US)

reaches of the measuring elements of non-unit protection, generally distance protection, in a power system

Note 1 to entry: These non-unit protections, generally distance protection, often have two, three or even more zones available. These are usually arranged such that the shortest zone corresponds to an impedance slightly smaller than the impedance of the protected section, and is normally instantaneous in operation. Zones with longer reach settings are normally time-delayed to obtain selectivity.

[SOURCE: IEC 60050-448:1995, 448.14.02]

3.3

operating range

range for which the measuring relay under specified conditions is able to perform its intended function(s) according to the specified requirements

Note 1 to entry: When accuracy requirements have to be met, see effective range (IEC 60050-447:2010, 447.07.08).

[SOURCE: IEC 60050-447:2010, 447.03.16]

3.4

effective range

part of the operating range of an input energizing quantity or characteristic quantity within which the accuracy requirements are met

[SOURCE: IEC 60050-447:2010, 447.07.08]

3.5

characteristic quantity

electric quantity, or one of its parameters, the name of which characterizes a relay and the values of which are the subject of accuracy requirements

[SOURCE: IEC 60050-447:2010, 447.07.01]

3.6

operate time

duration of the time interval between the instant when the characteristic quantity of a measuring relay in reset condition is changed, under specified conditions, and the instant when the relay operates

[SOURCE: IEC 60050-447:2010, 447.05.05]

3.7

disengaging time

duration of the time interval between the instant a specified change is made in the value of the input energizing quantity which will cause the relay to disengage and instant it disengages

Note 1 to entry: The disengaging time is a parameter that is more commonly denoted with the word “reset time”.

[SOURCE: IEC 60050-447:2010, 447.05.10]

3.8

source impedance ratio

SIR

at a given measurement location, commonly at one end of a line, the ratio of the power system source impedance to the impedance of the protected zone

Note 1 to entry: This note applies to the French language only.

[SOURCE: IEC 60050-448:1995, 448.14.14]

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4 Specification of the function

IEC 60255-121:2014

4.1 General

<https://standards.itech.ai/catalog/standards/sist/fdb9b3b2-95ae-4fd3-958f-8ce4257f51d9/iec-60255-121-2014>

A block diagram of the distance protection function is shown in Figure 1. The main elements are:

- starting/fault detection,
- phase selection,
- directional determination,
- loop impedance calculations,
- distance protection characteristic,
- functional logic.

Distance protection function designs differ among manufacturers, and some of them may have a different architecture than the one shown in Figure 1.

4.2 Input energizing quantities/energizing quantities

The input energizing quantities are the measuring signals, which are voltages and currents in the case of distance protection. Their ratings and relevant standards are specified in IEC 60255-1. Input energizing quantities can be presented to the distance protection functional logic either hardwired from voltage and current transformers or as a data packet over a communication port using an appropriate communication protocol (such as IEC 61850-9-2).

For three-phase distance protection function, the Input energizing quantities shall be specified. As an example:

- phase-to-earth voltages: U_{L1} , U_{L2} and U_{L3}