POWERFACTORY

PowerFactory 2021

Technical Reference

Distance Mho

RelDismho, TypDismho

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

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Contents

1 General Description

The *Distance Mho* “RelDismho”block implements the typical distance protection circular impedance and Mho characteristic. The type of the distance characteristic can be one of the following:

- Circular Impedance (centered in the axis origin).
- Digital circular Impedance (centered in the axis origin and using the impedance values).
- Circular Impedance with an offset.
- Mho.
- Mho with an offset.
- Asea RAKZB Mho (custom type for the Asea RAKZB relay).

The *Impedance* types create in the R-X diagram a distance zone with a shape similar to the shape represented here below in Figure 1.1:

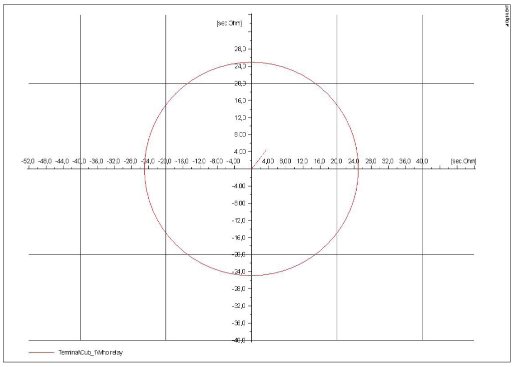


Figure 1.1: The *DIgSILENT Impedance* distance shape.

The *Mho* types create in the R-X diagram a distance zone with a shape similar to the shape represented here below in Figure 1.2:

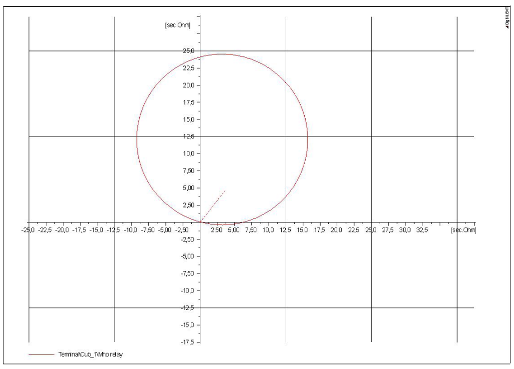


Figure 1.2: The *DIgSILENT Mho* distance shape.

The *Distance Mho* “RelDisMho”block is operational during short circuit, load flow and RMS/EMT simulations.

2 Features & User interface

2.1 Distance Mho (RelDismho)

The user can change the block settings using the "Distance mho"dialogue ("RelDismho "class). The dialogue consists of 3 tab pages: *Basic Data*, *Arc compensation*, and *Description*. The main settings are located in the *Basic Data* tab page.

2.1.1 Basic data

The "Distance mho"*Basic data* tab page provides a *presentation* area where the red text shows some info regarding:

- The international symbols used to represent the block protective function.
- The protection zone number implemented by the block.
- Which currents are measured by the block.
- The type of mho characteristic (i.e. "Impedance Offset")

The block can be disabled using the "Out of service" check box. A directional feature can be set using the "Tripping direction" combo box. The following settings are available:

- Forwared, Reverse
- Forwared
- Reverse
- Reverse,External
- None
- None,Forward
- None,Forward,Reverse

Note: Direction settings that include 'None' are only supported for impedance type models without Arc compensation.

The directional logic relies on a separate block (Distance Directional "RelDisdir" class). The controls are combo boxes for ranges of discrete values or otherwise edit boxes. The settings representing impedances can be entered in terms of primary impedance or in terms of secondary impedance. The selected type of mho characteristic (see 2.2.1) defines which settings are available.

When available, the "Character Angle" control ("alpha" variable) defines the shape of the Mho characteristic: values greater than 90 creates a "lens" shape, values smaller than 90 draw a "tomato".

The radius of the impedance or of the mho circle is

$radius = Zm * Zres/100$

Where *Zm* is the "Replica impedance" setting and *ZRes* is the "Reach Multiplier" or the "Restraint" setting in the user interface.

The replica impedance can be alternatively entered as resistance, reactance values and can be configured with the "Impedance Input" parameter.

Note: Not supported for type "Mho Offset 2X".

2.1.2 Arc compensation

The *Arc compensation* page simulates in detail the relevant feature of the AEG, Alstom and Areva distance relays ("PD5xx" and "Micom" relays).
The *Arc compensation* settings are visible only when an *Impedance* type (*Impedance*, *Impedance (Digital)*, *Impedance Offset*) has been selected and the feature has been activated in the *Arc compensation* tab page of the *Distance mho Type("TypDismho" class)* dialogue (see 2.2.2).
If the *Configuration* ("iarcconf" setting) in the *Distance mho Type("TypDismho" class)* dialogue is *User configurable*, the *Enable* ("arcen" setting) checkbox must be set to enable the *Arc compensation*.
Depending up on the ranges and the steps defined in the *Distance mho Type("TypDismho" class)* dialogue, the *Alpha* ("'arcalpha" setting, arc compensation limit angle) and the *k* ("arck" setting, arc stretching factor) can be visible and user configurable.

2.1.3 Description

The *Description* tab page can be used to insert some information to identify the *Distance Mho* protective element (both with a generic string and with an unique textual string similar to the *Foreign Key* approach used in the relational databases) and to identify the source of the data used to create it.

2.2 Distance Mho Type (TypDismho)

The *Distance mho* block main characteristics must be configured in the "Distance Mho Type"dialogue (*TypDismho* class). The dialogue contains three tab pages: *Mho Settings*, *Arc Compensation*, and *Advanced settings*.

2.2.1 Mho Settings

The *Mho Settings* tab page contains most of the controls used to configure the *Distance Mho* block. The followings settings can be set:

- The Mho type ("achatp"setting).
- The unit type (*Phase-Phase*, *Earth*, *3-Phase*, *Multifunctional*. "aunit"setting)
- The calculation method type ("imethod"setting).
- The number of phases ("iphases"setting).
- The number of the protective zone protected by the Mho characteristic ("izone"setting).
- Which directional features can be set (*Forward*, *Reverse*, *None*, "idirpos" setting).

- The range and the step of the variables used to represent the characteristic (*Replica Impedance* “rZm”, *Reach multiplier/Restraint factor* “rZres”, *Relay Angle* “rphi”, *Character. Angle* “ralpha”, *Offset Impedance* “rZoff”, *Offset Angle* “roffang”).

Please note that the “Calculation method” setting has been added to support the special phase comparison algorithm used by some Asea Razfe and the Enertec devices. “Calculation method = Standard” guarantees that the normal phase comparison (angle difference between the operation current and the polarizing voltage greater than *Character. Angle* “alpha” to be inside the Mho) is applied.

The “Sq wave threshold”setting is available only for the *Mho* types. It represents the voltage threshold used to generate from the polarizing and operating signal the square waves used in the static protective devices to figure out the time difference (and so the angular difference) between the polarizing and the operating signal. Please note that if the DFT calculation has been enabled in the relay measurement block the “Sq wave threshold”won’t be used and the angular difference will be simply calculated using the polarizing and the operating vector.

Reference block :

The *Distance mho* (“RelDismho ”)element has been conceived to work together with other relay distance elements: the distance settings can be set to depend upon the settings of a master distance block specified in the *Reference block* (“prefblock” setting) control. When the master distance block has been set, the *kZ*(“kZ”setting) and the *dZ* (“dZ” setting) are displayed instead of *Replica Impedance* “rZm”, *Reach multiplier/Restraint factor* “rZres”, *Relay Angle* “rphi”, *Character. Angle* “ralpha”, *Offset Impedance* “rZoff”, and *Offset Angle* “roffang”.
The block uses the master block *Relay Angle* “rphi”, *Character. Angle* “ralpha”, and *Offset Angle* “roffang” setting values. The impedance reach (equal to “Zm” · “Zres”) is equal to

$$Zm \cdot Zres = Zm_{master} \cdot Zres_{master} \cdot \; kZ + dZ$$

Mho types :

The block can be configured using the “Type”setting as:

- Impedance
- Impedance (digital)
- Impedance Offset
- Mho
- Mho Offset MTA
- Mho Offset X
- Mho Offset Generic
- Mho Offset 2X
- Asea RAKZB Mho Offset

The following paragraphs shows the shape associated to each *Type*. The relationships between the block settings and the graphical representation of the shape are displayed in the pictures.

Impedance & Impedance (Digital) :

It represents an impedance circle with the centre in the axis origin.

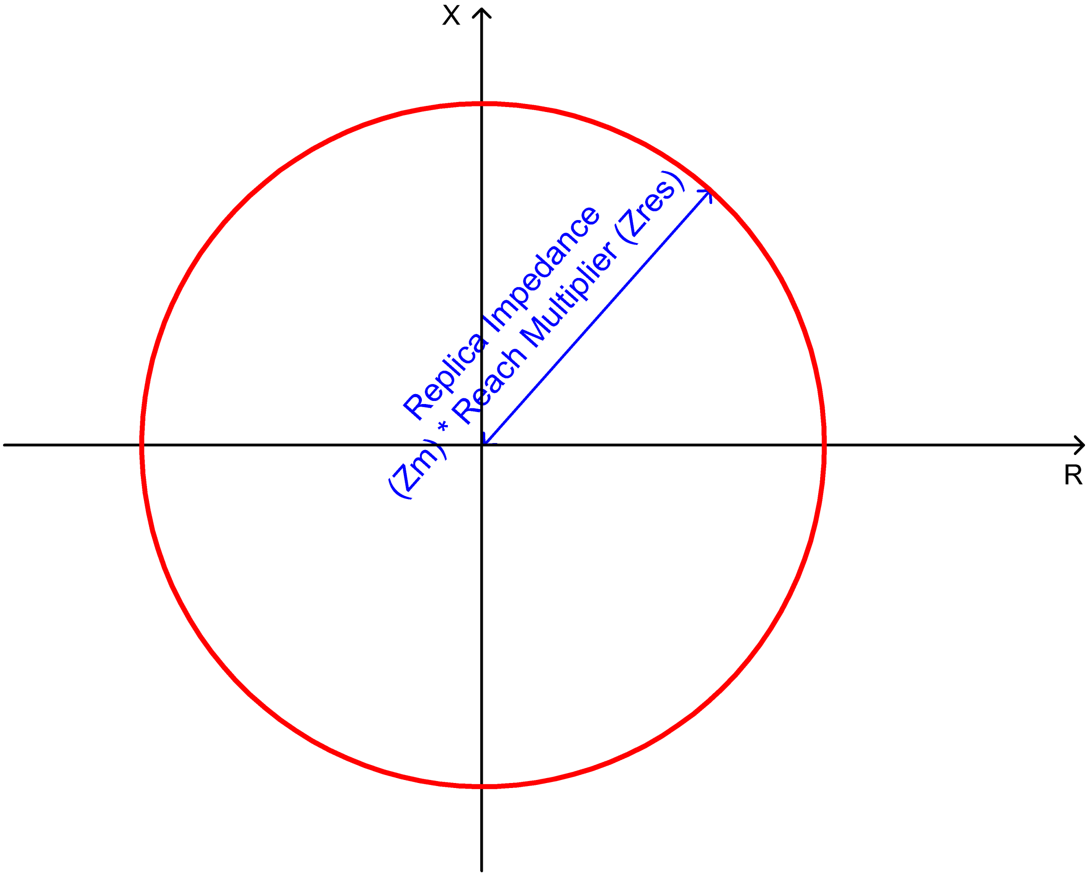


Figure 2.1: The *DIgSILENT* "Impedance" and the "Impedance (Digital)" type characteristic

The difference between the "Impedance" and the "Impedance (Digital)" type is in the way the impedance is calculated: the "Impedance" type is comparing the module of the polarizing and of the operating vector (to detect a trip the operating voltage must be smaller than the "Replica impedance" · the operating current); the "Impedance (Digital)" type is getting directly the fault reactance and the resistance values and the module of such impedance vector must be smaller than the "Replica Impedance" value.

With the "Impedance Input" parameter the replica impedance can be alternatively entered as reactance, resistance value.

Impedance Offset :

It represents an impedance circle with the centre shifted from the axis origin by the offset quantity defined by the “Impedance” distance (“Zoff” variable) and the “Angle”(“offang” variable).

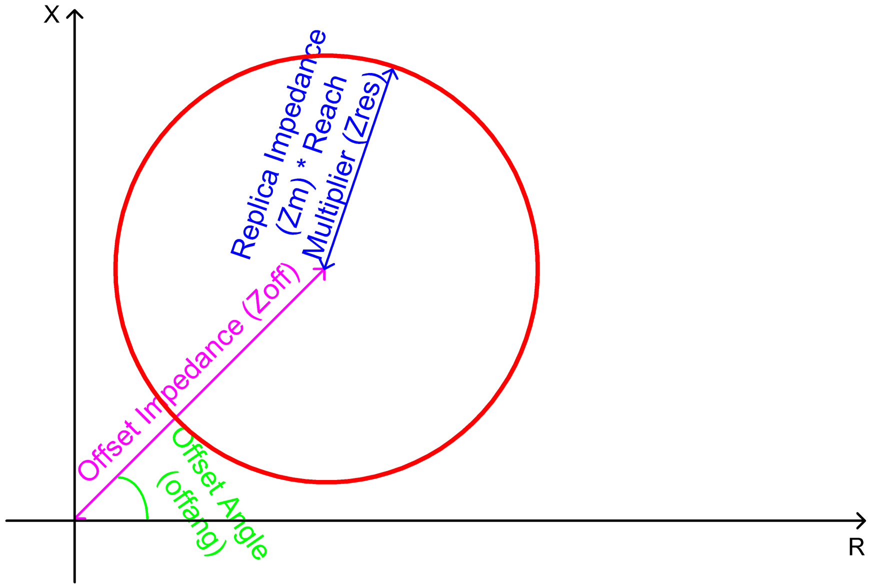


Figure 2.2: The *DIgSILENT* “Impedance offset” type characteristic

Mho :

It represents an impedance circle passing through the axis origin. This is the typical Mho characteristic.

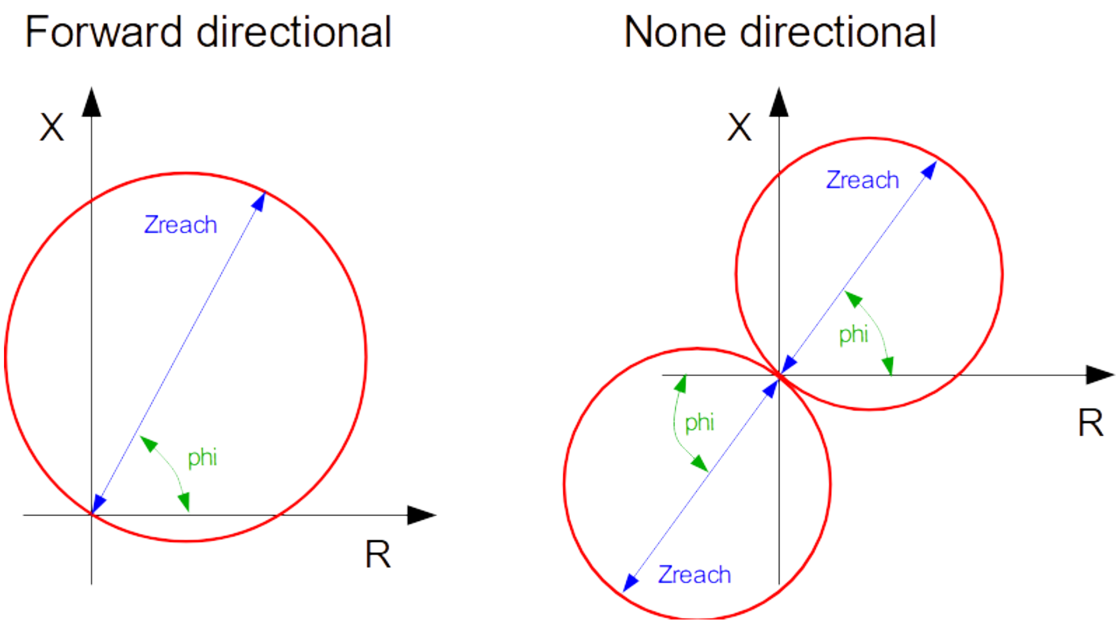


Figure 2.3: The *DIgSILENT* “Mho” type characteristic

where:

- $Zreach = Zm \cdot Zres$
- Zm is the replica impedance
- $Zres$ is the reach multiplier
- phi is the relay angle

Mho Offset MTA :

It represents an impedance circle passing at the distance from the axis origin defined by the "Impedance" distance ("Zoff" variable).

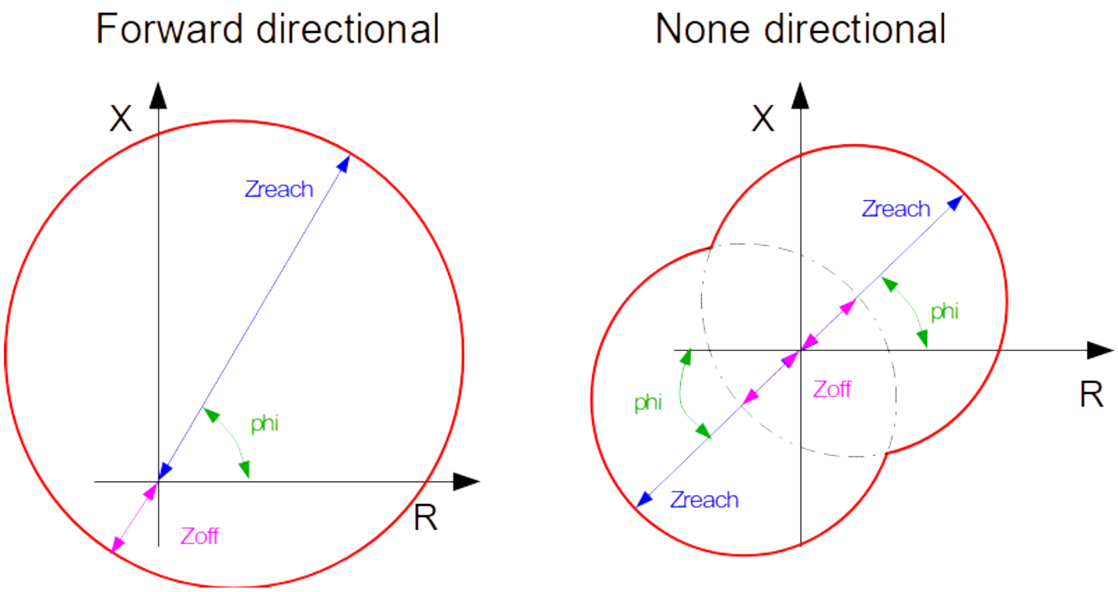


Figure 2.4: The *DIgSILENT* "Mho Offset MTA" type characteristic

where:

- $Zreach = Zm \cdot Zres$
- Zm is the replica impedance
- $Zres$ is the reach multiplier
- phi is the relay angle
- $Zoff$ is the offset impedance, in line with $Zreach$

Mho Offset X :

It represents an impedance circle defined in the way that the diameter passing through the line max reach point Zreach is intersecting the reactance axis at the point defined by the “Impedance”distance (“Zoff” variable).

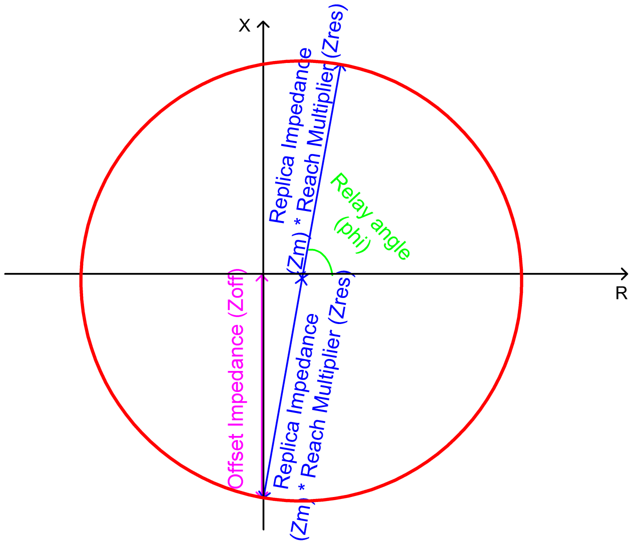


Figure 2.5: The *DIgSILENT* “Mho Offset X” type characteristic

Mho Offset Generic :

It represents an impedance circle defined in the way that the 2nd point of the diameter passing through the line max reach point Zreach is shifted from the axis origin by the offset quantity defined by the “Impedance” distance (“Zoff” variable) and the “Angle” (“offang” variable).

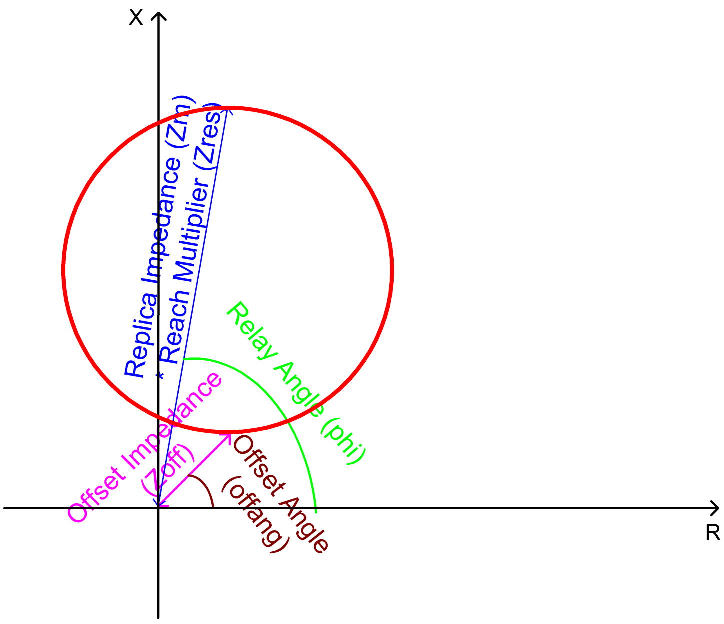


Figure 2.6: The *DIgSILENT* “Mho Offset Generic” type characteristic

Mho Offset 2X :

It represents an impedance circle defined in the way that the diameter passing through the axis origin and the line defined by the “Relay Angle” (“phi” variable) is intersecting the impedance circle itself at the points having reactance defined by the “+Reactance” distance (“xpos” variable) and by the “-Reactance” distance (“xneg” variable)

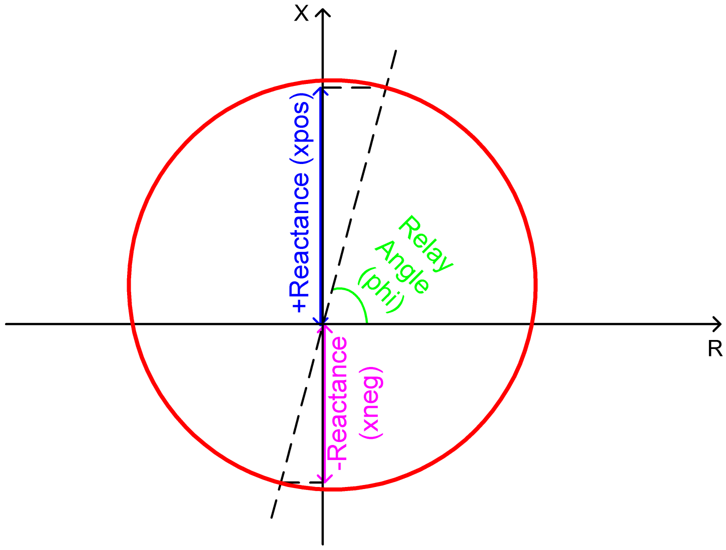


Figure 2.7: The *DIgSILENT* “Mho Offset 2X” type characteristic

Asea RAKZB Mho Offset :

It represents an impedance circle defined in the way that the 2nd point of the diameter passing through the line max reach point Zreach is shifted from the axis origin by the offset quantity defined by the “Impedance” distance (“Zoff” variable). The formula to calculate the offset is :

$offset = (Zm - Zoff)/2$.

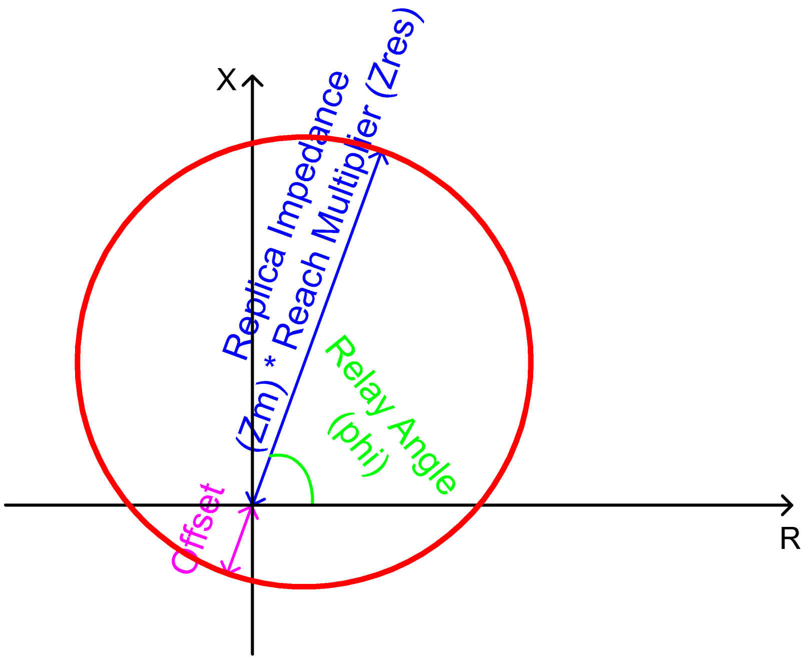


Figure 2.8: The *DIgSILENT* “Asea RAKZB Mho Offset” type characteristic

2.2.2 Arc Compensation

The “Arc Compensation” tab page has been introduced to support the special features present in some AEG, Alstom and Areva distance relays (“PD5xx” and “Micom” relays). The relevant settings are visible only when a *Impedance* type has been selected. The *Arc Compensation* can be

- Always enabled
- Always disabled
- User configurable

The settings define step and ranges of the limit angle (“rarcalpha” setting) of the arc compensation characteristic and of the stretch factor applied to the arc compensation characteristic(“rarck” setting).

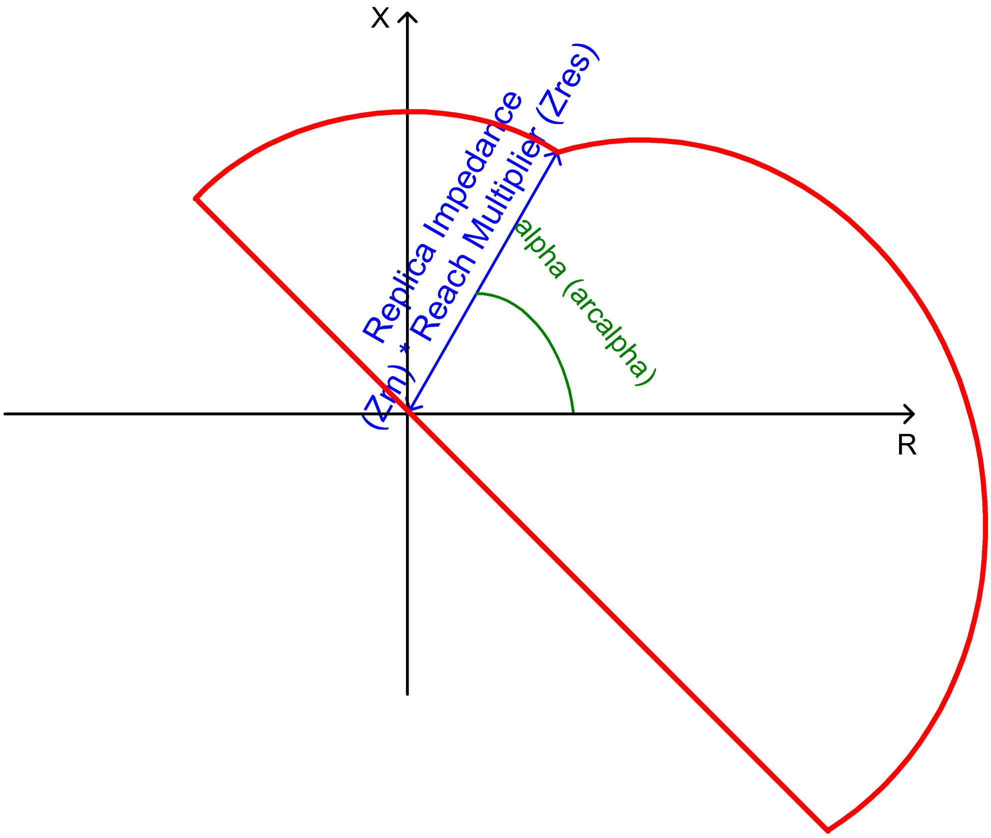


Figure 2.9: The *DIgSILENT* “Impedance” type characteristic with the *Arc compensation enabled*

2.2.3 Advanced Settings

The *Advanced Settings* tab page contains the settings which define the trip *Pickup Time*, the trip *Reset Time* and the *Reset Ratio*. The *Reset Ratio* setting (“kr”variable) is a multiplier which is used to define an impedance reset zone larger than the impedance trip zone. It is defined to avoid any toggle effect for impedance values close to the trip zone boundary.

3 Integration in the relay scheme

The *Distance Mho*“RelDismho” type class name is *TypDismho* . The *Distance Mho* dialogue class name is *RelDismho*. As already shown, there are two main versions of the block: a single phase and a three phase version. The number and the name of the input signals depends only upon which of these versions is used. The typical connection of a 3 phase *Distance Mho* (“RelDismho” class) block is showed in Figure 3.1.

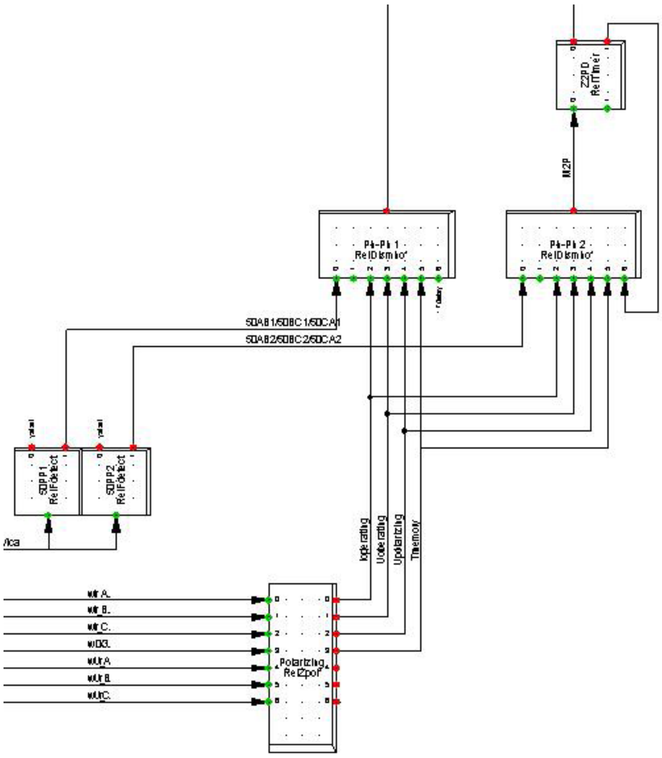


Figure 3.1: The *DIgSILENT PowerFactory* typical connection scheme of a 3 phase *Distance mho* “RelDismho” block.

In the picture above the typical connection scheme of two 3phase Mho blocks is showed. “Ph-Ph 1” represents the first trip zone so no delay is present, Ph-Ph 2 is the 2nd zone and the delay is implemented using the “Z2PD” timer which is creating a loop with the Mho block :the *yout* output of the Mho block is connected with the *wstart* input of the timer and the timer *Tdelay* output is connected to the *tdelay* input of the Mho block; in this way the Mho block is aware of the delay introduced by the timer and during the short circuit calculation the block is able to decide if to use or not the polarising voltage pre-fault value.

Both the mho blocks represented in Figure 3.1 are getting the input signals from the Polarizing block and from the fault detector blocks (“50PP1” and “50PP2”) : The Operating Currents (*Iopr* and *Iopi*) and Voltages (*Uopr* and *Uopi*) and the Polarizing voltage (*Upolr* and *Upoli*) are coming from the Polarizing block. The supervising signals (*wsup*) are provided by the fault detector (“Starting” block) Usually, as displayed in Figure 3.1, the trip zone delay is implemented connecting an additional timer to the *yout* output of the Mho block; as option the trip of the Mho block can be further delayed connecting the *wtimer* input of the Mho block to the output of a timer block.

To control a *Distance mho* “RelDismho” block with a reclosing element (“RelRecl” object) the “iblock” input signal must be connected with an output signal of the reclosing element (*yblock_Toc**x*** with $1 <= x <= 5$ or *yblock_Logic**k*** with $1 <= k <= 16$) . Please read the “RelRecl” documentation for more details about the way to program a reclosing sequence.

If a reclosing element is not present the *iblock* signal (in the 3 phase version also *iblock_A*, *iblock_B* and *iblock_C* to act on each phase) can be used by any other element to block the starting of the *Distance mho* (“RelDismho” class) element.

4 Logic

4.1 Single phase

4.1.1 Impedance

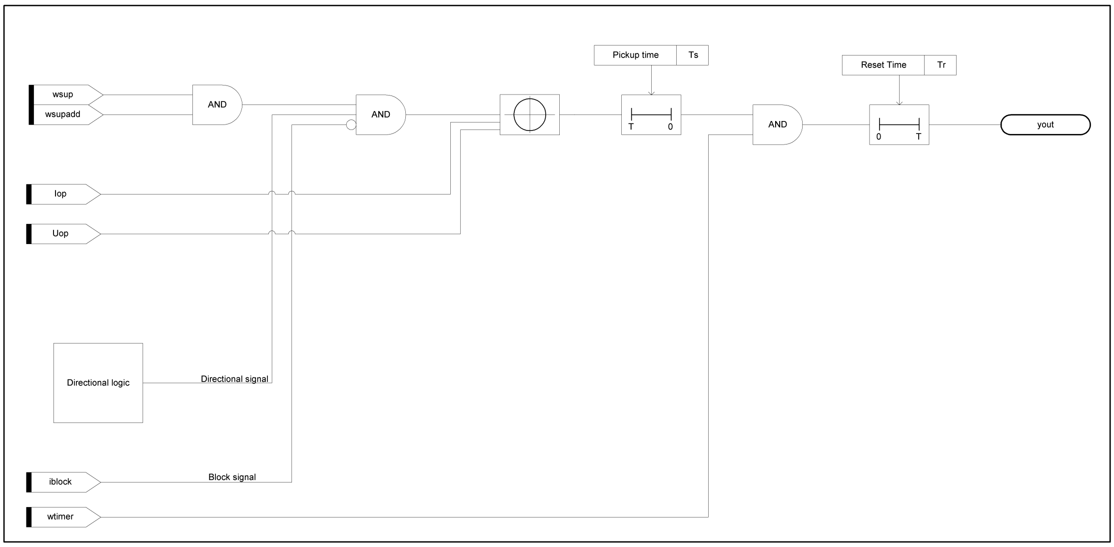
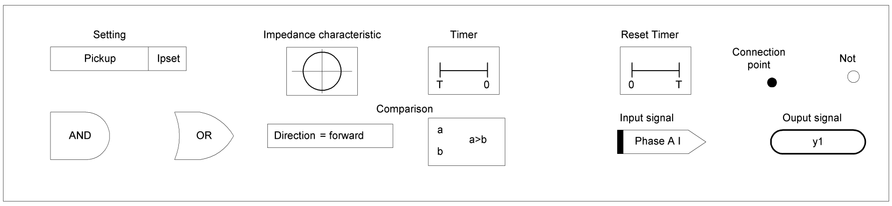


Figure 4.1: The *DIgSILENT Single phase Mho* logic



4.1.2 Mho

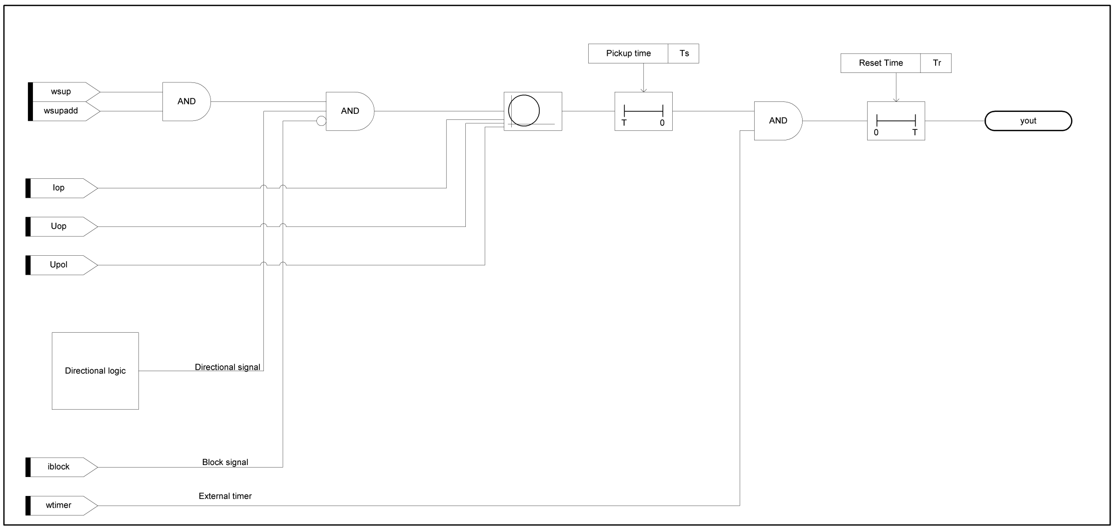


Figure 4.2: The *DIgSILENT Single phase Mho* logic

4.1.3 Directional logic

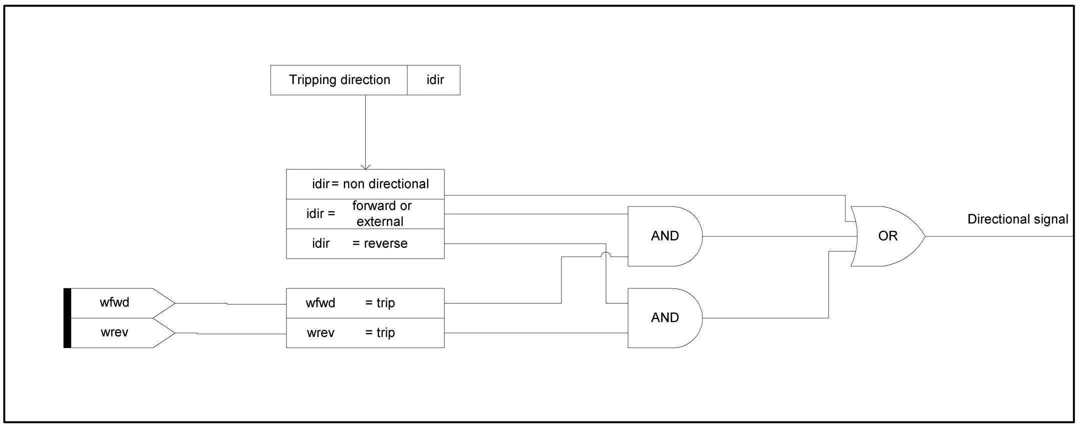
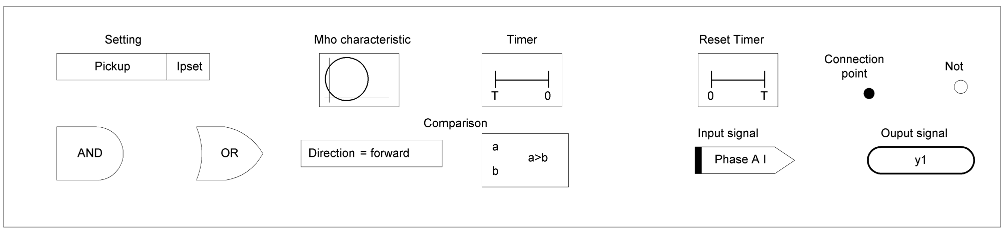


Figure 4.3: The *DIgSILENT Single phase Mho* directional logic



4.2 3 phase

4.2.1 Impedance

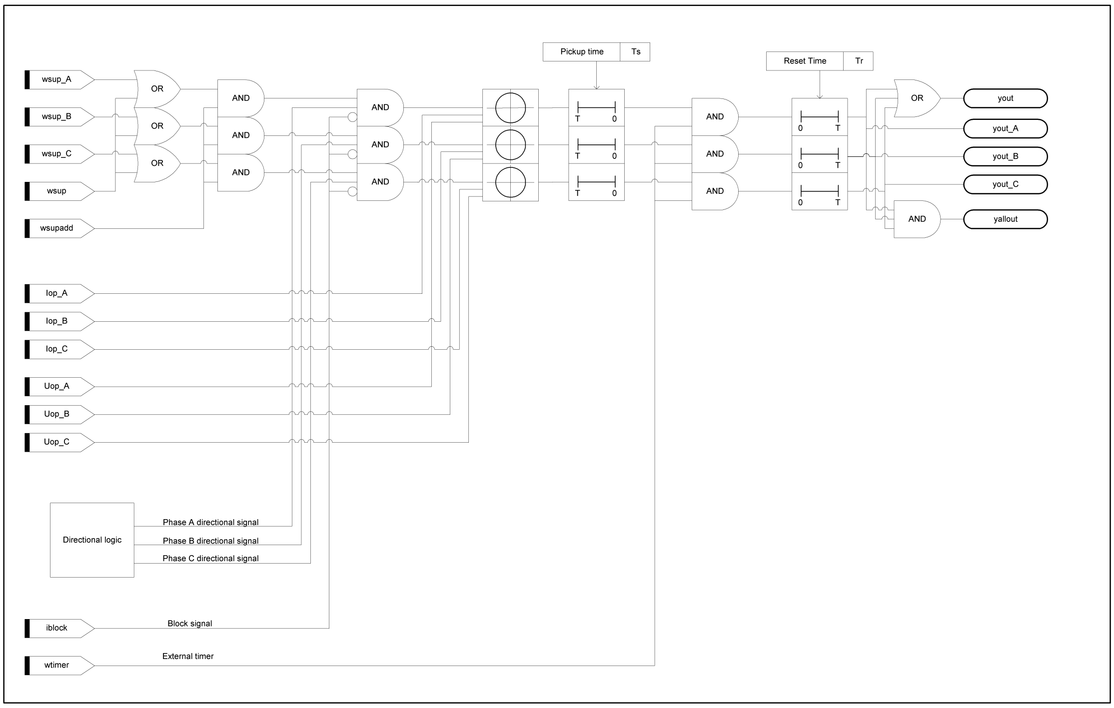
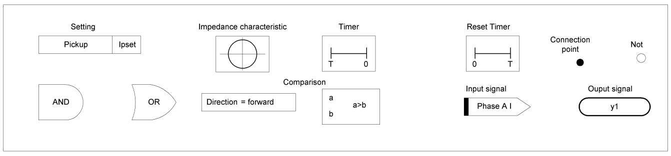


Figure 4.4: The *DIgSILENT 3 phase Mho* logic



4.2.2 Impedance (digital)

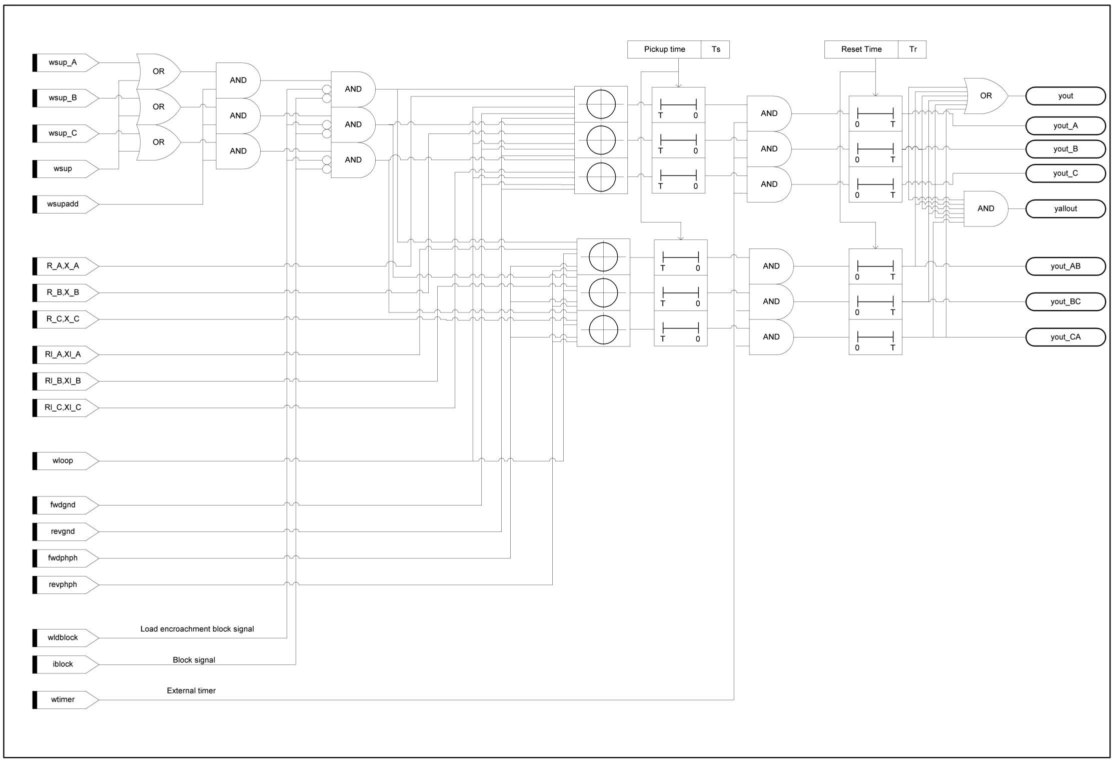
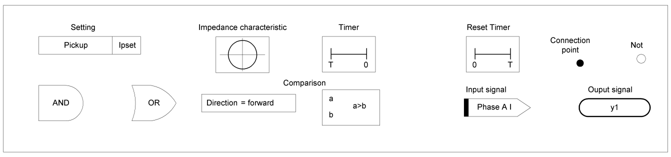


Figure 4.5: The *DIgSILENT 3 phase Mho* logic



4.2.3 3 phase Mho

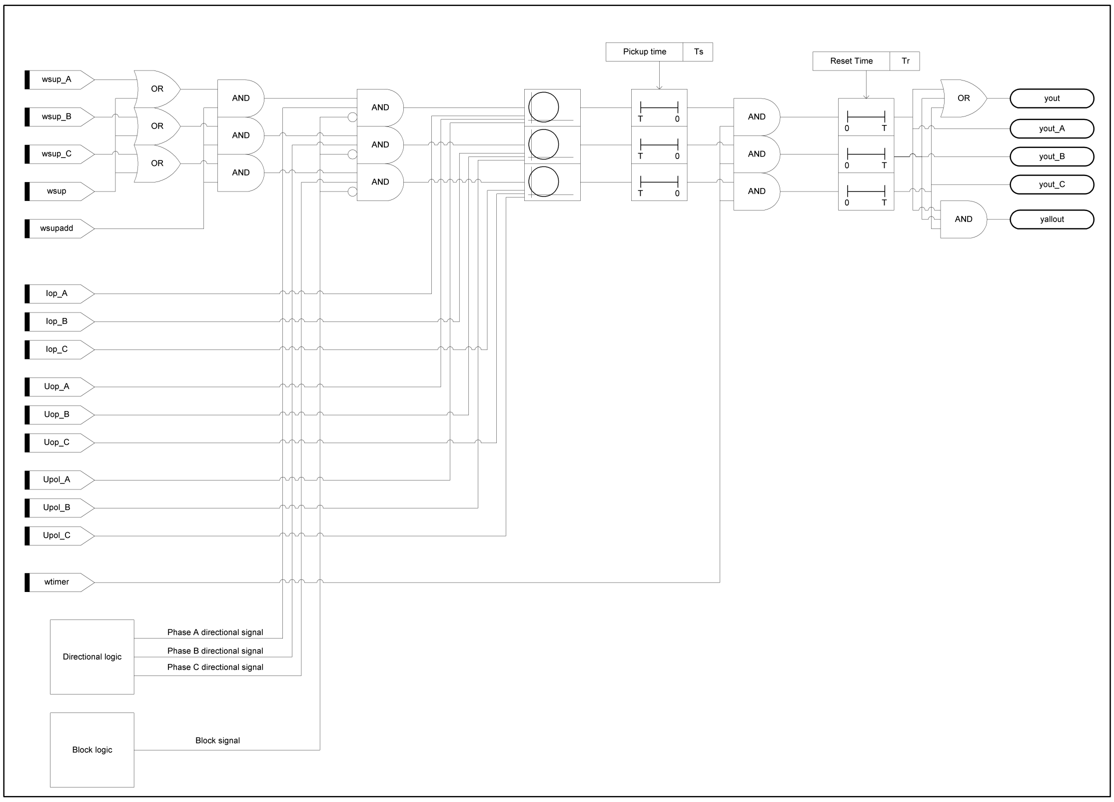
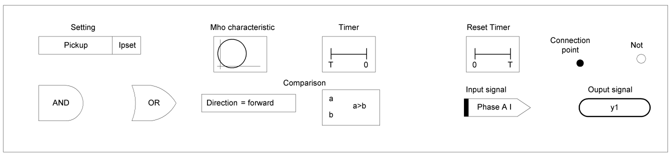


Figure 4.6: The *DIgSILENT 3 phase Mho* logic



4.2.4 6 phase Mho

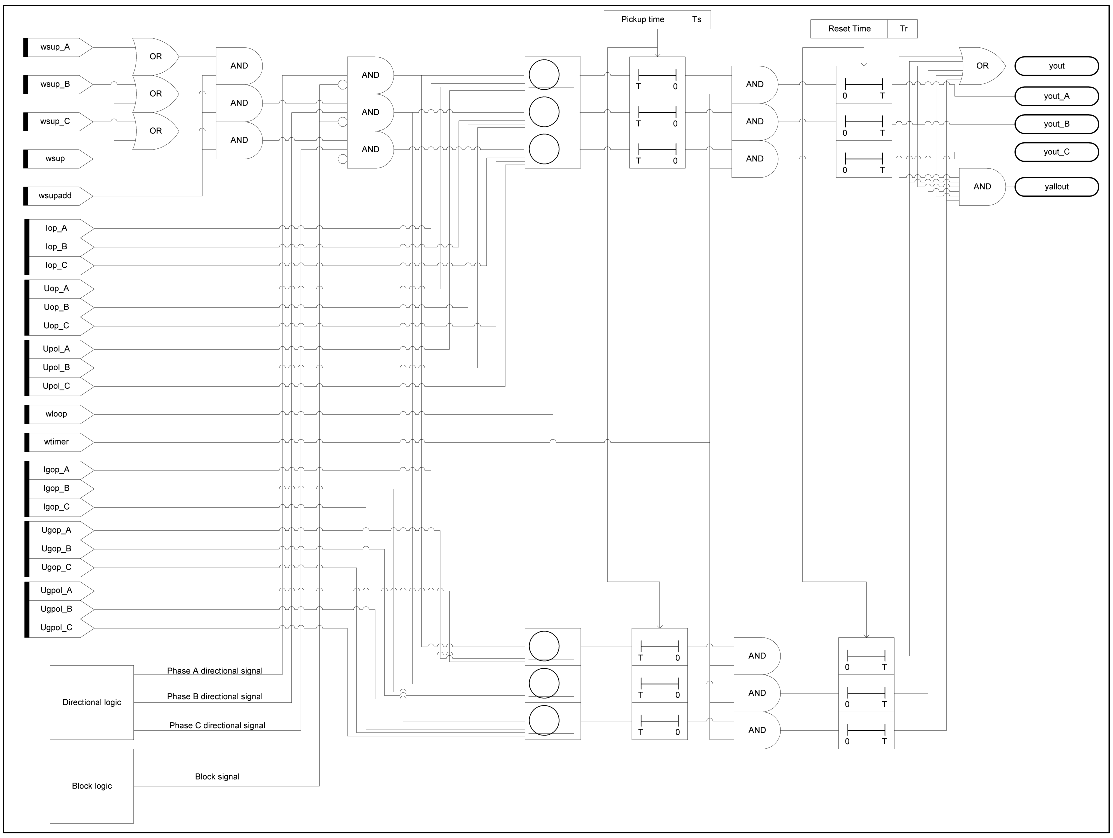
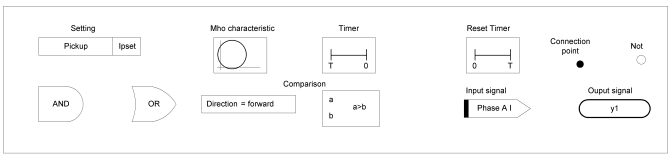


Figure 4.7: The *DIgSILENT 6 phase Mho* logic



4.2.5 Blocking logic

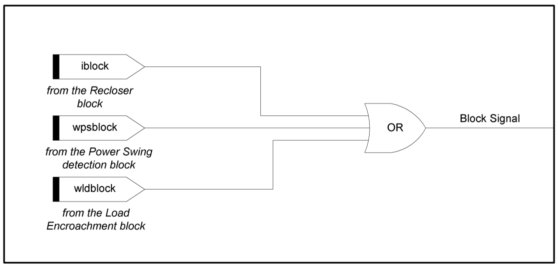


Figure 4.8: The *DIgSILENT 3 phase Mho* blocking logic

4.2.6 Directional logic

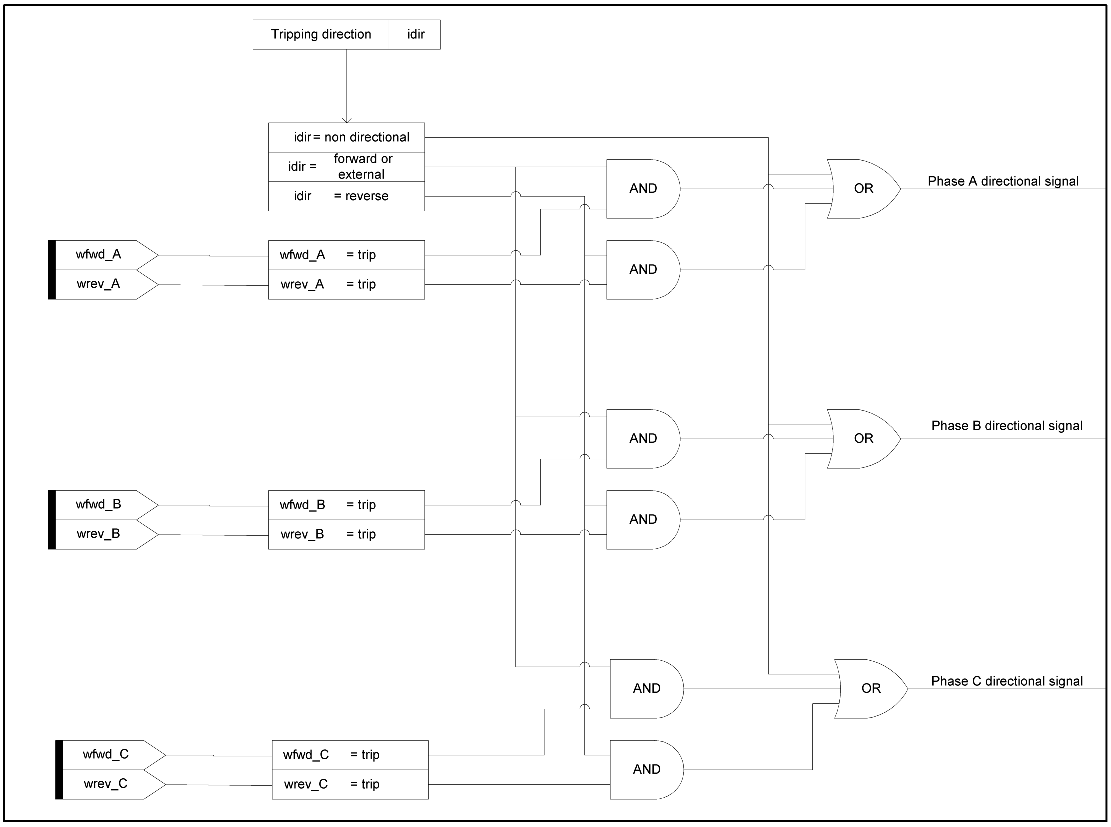
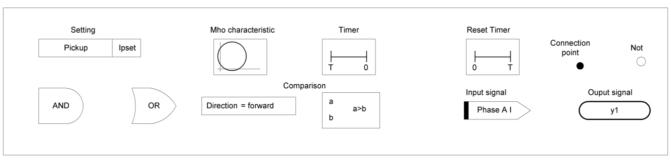


Figure 4.9: The *DIgSILENT Distance Mho (RelDismho) directional logic*



4.3 Impedance (digital) calculation logic

4.3.1 Impedance

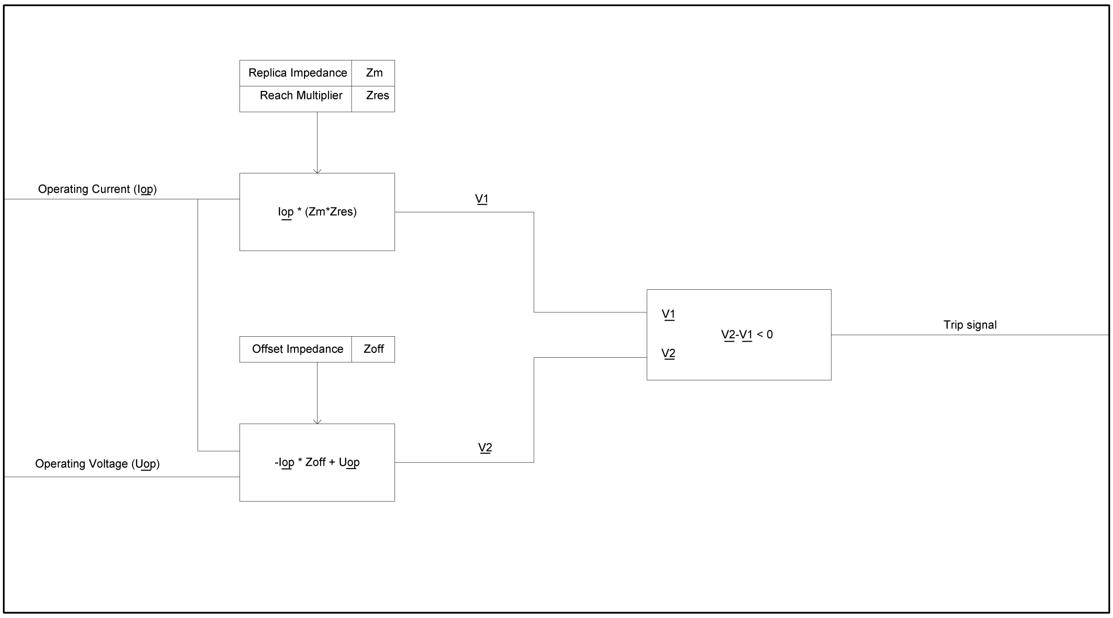


Figure 4.10: The *DIgSILENT Impedance calculation logic*

4.3.2 Impedance (digital)

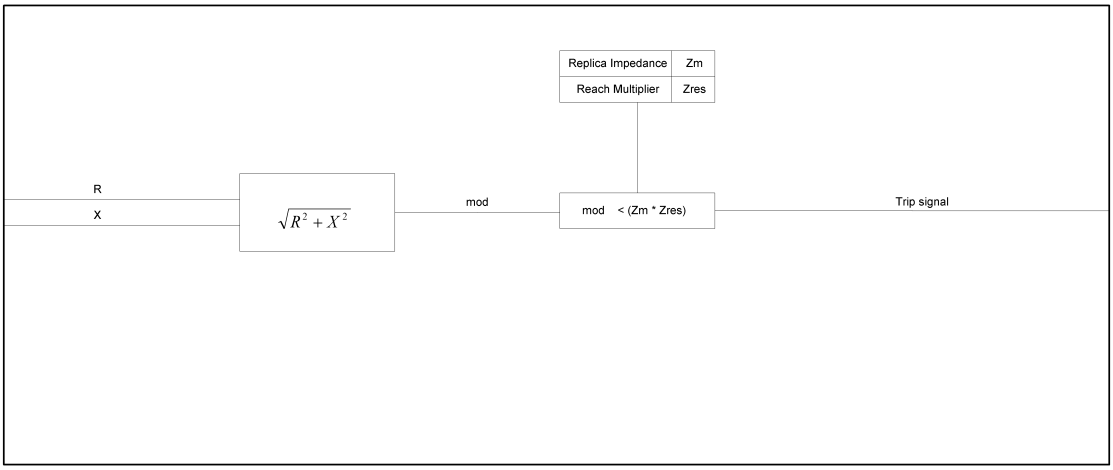


Figure 4.11: The *DIgSILENT Impedance (digital) calculation logic*

4.4 Mho calculation logic

4.4.1 With polarization

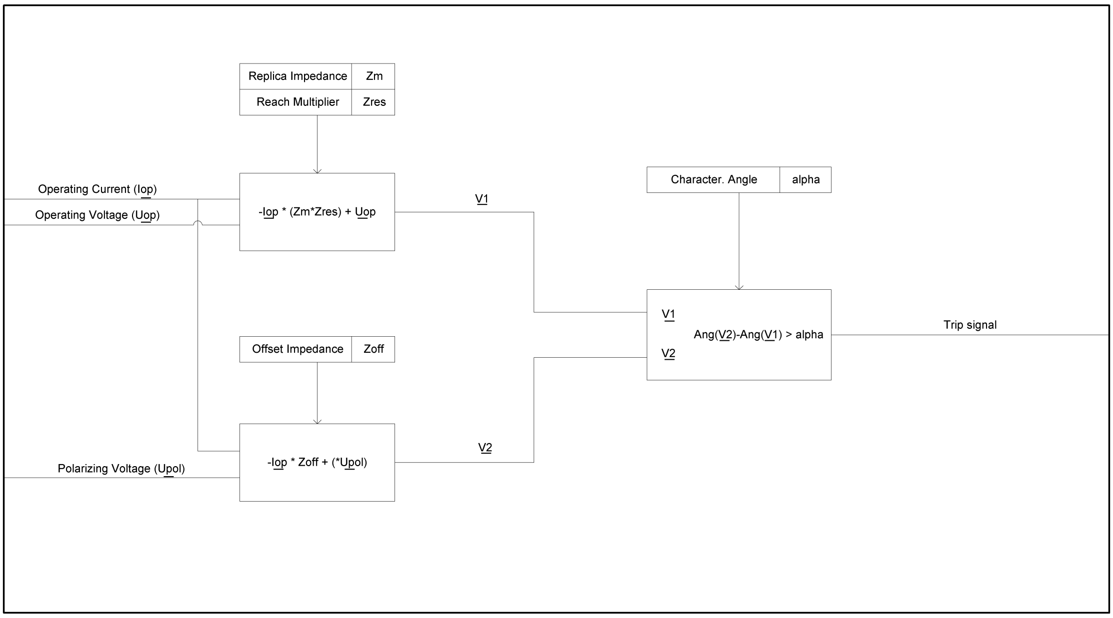


Figure 4.12: The *DIgSILENT Mho calculation logic with polarization*

4.4.2 Without polarization

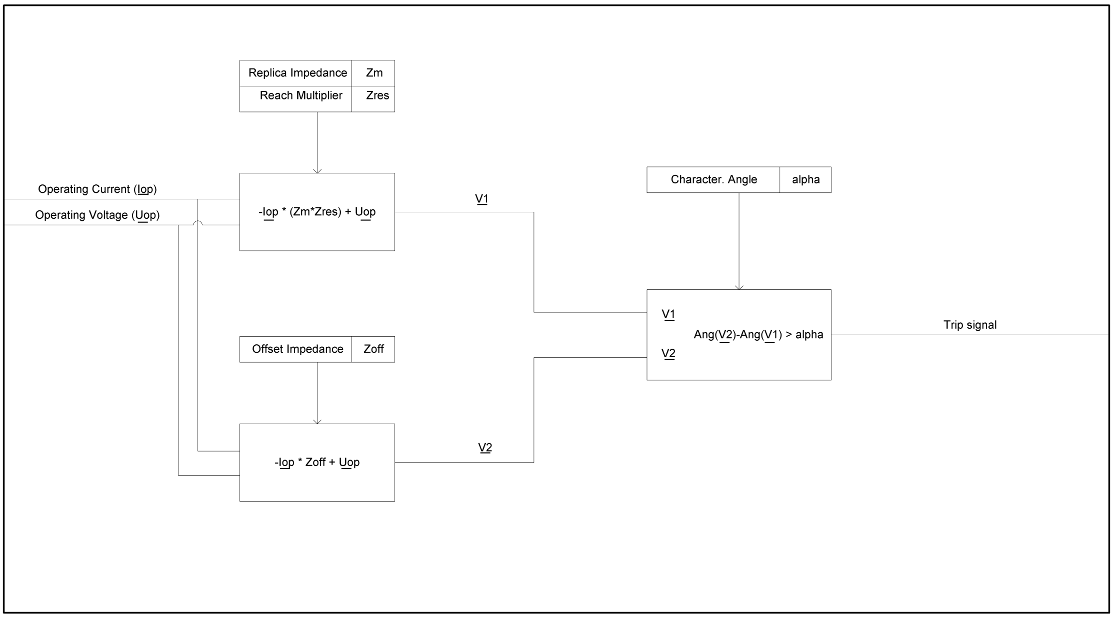


Figure 4.13: The *DIgSILENT Mho calculation logic without polarization*

A Parameter Definitions

A.1 Distance Mho Type (TypDismho)

Table A.1: Input parameters of Distance Mho type (*TypDismho*)

Parameter	Description	Unit
loc_name	The name assigned by the user to the Mho type object	Text
sfiec	The IEC Symbol associated to the element (documentation purpose only, it is displayed in the RelDismho dialogue)	Text
sfansi	The ANSI Symbol associated to the element (documentation purpose only, it is displayed in the RelDismho dialogue)	Text
iphases	The number of phases	Integer
aunit	The type of trip block(it can be “Earth”, “Phase-Phase”, “3-Phase”, “Multi-functional”)	Text
izone	The number of the zone associated to the Mho characteristic	Integer
iusage	The usage of the Mho characteristic (it can be 0 = “Starting zone” or 1 = “Zone”)	Integer
achatp	The type of Mho block (“Impedance”, “Impedance (digital)”, “Impedance Offset”, “Mho”, “Mho Offset Mta”, “Mho Offset X”, “Mho Offset Generic”), “Mho Offset 2 X”, “Asea RAKZB Mho Offset”	Text
imethod	Calculation method (standard, ASEA, Enertec)	Integer
rZm	Replica Impedance range	Text
rZres	Restraint range	Text
rphi	Relay angle range	Text
rphi	Relay angle range	Text
impInput	Impedance Input (0 = Impedance,Angle and 1 = Reactance,Resistance)	Integer
rXm	Replica Reactance range	Text
rRm	Replica Resistance range	Text
ralpha	Range of the characteristic angle (its used to create a circle or a lens or a tomato)	Text
rZoff	Offset Impedance range	Text
iZoff	Offset Impedance unit (sec.Ohm or Zoff/Zmax)	Integer
rkoff	Range of Zoff/Zmax	Text
roffang	Offset Angle range	Text
rxpos	Range of *+ Reactance*	Text
rxneg	Range of *- Reactance*	Text
rsqwvthresh	Square wave threshold range	Text
sqwvthreshun	Square wave threshold (p.u. or sec.V)	Integer
iarcconf	Flag to enable always,disable always or make user configurable the *Arc Configuration* feature (available options “Enabled”, “Disabled”, “User configurable”)	Integer
iarctyp	Type of *Arc Compensation* feature	Text
rarcalpha	Range of the arc limit angle	Text
rarck	Range of the arc stretch factor	Text
Ts	Pickup Time	s
Tr	Reset Time	s
Kr	Reset Ratio	Real number

A.2 Distance Mho Element (RelDismho)

Table A.2: Input parameters of Distance Mho element (*RelDismho*))

Parameter	Description	Unit
loc_name	The name assigned by the user to the Mho object	Text
typ_id	Pointer to the relevant TypDismho object	Pointer
idir	Tripping Direction(it can be “Forward”= 0 or “Reverse”= 1)	Integer
Zm	Replica Impedance	sec.Ohm
cpZm	Replica Impedance	pri.Ohm
Xm	Replica Reactance	sec.Ohm
cpXm	Replica Reactance	pri.Ohm
Rm	Replica Resistance	sec.Ohm
cpRm	Replica Resistance	pri.Ohm
Zres	Restraint	%
phi	Relay angle	deg
alpha	Characteristic angle (its used to create a circle or a lens or a tomato)	deg
Zoff	Impedance (Offset Impedance)	sec.Ohm or Zoff/Zmax
cpZoff	Impedance (Offset Impedance)	pri.Ohm
koff	Zoff/Zmax ratio	Real number
offang	Angle (Offset Angle)	deg
xpos	+ Reactance	sec.Ohm
xpos	+ Reactance	pri.Ohm
xneg	- Reactance	sec.Ohm
xneg	- Reactance	pri.Ohm
sqwvthresh	Square wave threshold	sec.V
arcen	Flag to enable the *Arc compensation* feature	Integer
arcalpha	Arc limit angle	deg
arck	Arc stretch factor	Text

B Signal Definitions

B.1 Single phase

B.1.1 Impedance

Table B.1: Input/output signals of the single phase Distance Impedance element (*CalDiszimp1p*)

Name	Description	Unit	Type	Model
Iopr	Operating current real part	sec.A	IN	Any
Iopi	Operating current imaginary part	sec.A	IN	Any
Uopr	Operating voltage real part	sec.V	IN	Any
Uopi	Operating voltage imaginary part	sec.V	IN	Any
wfwd	Directional forward signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wrev	Directional reverse signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsup	Supervising Signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsupadd	Supervising additional signal (free signal)	s (or 1/0 RMS/EMT simulation)	IN	Any
wtimer	Timer Signal(used to add an additional delay to the trip time)	s (or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	s (or 1/0 RMS/EMT simulation)	IN	Any
yout	Tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any

B.1.2 Mho

Table B.2: Input/output signals of the single phase Distance Mho element (*CalDismho1p*)

Name	Description	Unit	Type	Model
Iopr	Operating current real part	sec.A	IN	Any
Iopi	Operating current imaginary part	sec.A	IN	Any
Uopr	Operating voltage real part	sec.V	IN	Any
Uopi	Operating voltage imaginary part	sec.V	IN	Any
Upolr	Polarising voltage real part	sec.V	IN	Any
Upoli	Polarising voltage imaginary part	sec.V	IN	Any
wfwd	Directional forward signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wrev	Directional reverse signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsup	Supervising Signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsupadd	Supervising additional signal (free signal)	s (or 1/0 RMS/EMT simulation)	IN	Any
wtimer	Timer Signal(used to add an additional delay to the trip time)	s (or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	s (or 1/0 RMS/EMT simulation)	IN	Any
yout	Tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any

B.2 3 phase

B.2.1 Impedance

Table B.3: Input/output signals of 3 phase Distance Impedance element (*CalDiszimp*)

Name	Description	Unit	Type	Model
Iopr_A	Operating current phase A real part	sec.A	IN	Any
Iopi_A	Operating current phase A imaginary part	sec.A	IN	Any
Iopr_B	Operating current phase B real part	sec.A	IN	Any
Iopi_B	Operating current phase B imaginary part	sec.A	IN	Any
Iopr_C	Operating current phase C real part	sec.A	IN	Any
Iopi_C	Operating current phase C imaginary part	sec.A	IN	Any
Uopr_A	Operating voltage phase A real part	sec.V	IN	Any
Uopi_A	Operating voltage phase A imaginary part	sec.V	IN	Any
Uopr_B	Operating voltage phase B real part	sec.V	IN	Any

Table B.3: Input/output signals of 3 phase Distance Impedance element (*CalDiszimp*)

Name	Description	Unit	Type	Model
Uopi_B	Operating voltage phase B imaginary part	sec.V	IN	Any
Uopr_C	Operating voltage phase C real part	sec.V	IN	Any
Uopi_C	Operating voltage phase C imaginary part	sec.V	IN	Any
wsup_A	Phase A supervising Signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsup_B	Phase B supervising Signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsup_C	Phase C supervising Signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsupadd	Supervising additional signal (free signal)	s(or 1/0 RMS/EMT simulation)	IN	Any
wfwd_A	Phase A forward current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wfwd_B	Phase B forward current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wfwd_C	Phase C forward current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wrev_A	Phase A reverse current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wrev_B	Phase B reverse current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wrev_C	Phase C reverse current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	s (or 1/0 RMS/EMT simulation)	IN	Any
yallout	3 ph tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
yout	Tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_A	Phase A tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_B	Phase B tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_C	Phase C tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any

B.2.2 Impedance (digital)

Table B.4: Input/output signals of 3 phase Distance Impedance Digital element (*CalDiszimpdig*)

Name	Description	Unit	Type	Model
R_A	Resistance loop AE	sec.Ohm	IN	Any
R_B	Resistance loop BE	sec.Ohm	IN	Any
R_C	Resistance loop CE	sec.Ohm	IN	Any
X_A	Reactance loop AE	sec.Ohm	IN	Any
X_B	Reactance loop BE	sec.Ohm	IN	Any
X_C	Reactance loop CE	sec.Ohm	IN	Any
Rl_A	Resistance loop AB	sec.Ohm	IN	Any
Rl_B	Resistance loop BC	sec.Ohm	IN	Any
Rl_C	Resistance loop CA	sec.Ohm	IN	Any
Xl_A	Reactance loop AB	sec.Ohm	IN	Any
Xl_B	Reactance loop BC	sec.Ohm	IN	Any
Xl_C	Reactance loop CA	sec.Ohm	IN	Any
fwdgnd	Directional ground forward signal	s (or 1/0 RMS/EMT simulation)	IN	Any
revgnd	Directional ground reverse signal	s (or 1/0 RMS/EMT simulation)	IN	Any
fwdphph	Directional phase forward signal	s (or 1/0 RMS/EMT simulation)	IN	Any
revphph	Directional phase reverse signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsup_A	Phase A super visioning signal (must be on to allow the trip)	s (or 1/0 RMS/EMT simulation)	IN	Any
wsup_B	Phase B super visioning signal (must be on to allow the trip)	s (or 1/0 RMS/EMT simulation)	IN	Any
wsup_C	Phase C super visioning signal (must be on to allow the trip)	s (or 1/0 RMS/EMT simulation)	IN	Any
wsupadd	Supervising additional signal (free signal)	s (or 1/0 RMS/EMT simulation)	IN	Any
wloop	Id containing the code of the faulted loop	Integer	IN	Any
wtimer	Timer Signal (used to add an additional delay to the trip time)	s (or 1/0 RMS/EMT simulation)	IN	Any
wldblock	Block signal coming from the *Load encroachment* element	s (or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	s (or 1/0 RMS/EMT simulation)	IN	Any
yallout	3 ph tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
yout	Tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_A	Phase A tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_B	Phase B tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_C	Phase C tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_AB	Loop AB tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_BC	Loop BC tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_CA	Loop CA tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any

B.2.3 Mho

Table B.5: Input/output signals of 3 phase Distance Mho element (*CalDismho*)

Name	Description	Unit	Type	Model
Iopr_A	Operating current phase A real part	sec.A	IN	Any
Iopi_A	Operating current phase A imaginary part	sec.A	IN	Any
Iopr_B	Operating current phase B real part	sec.A	IN	Any
Iopi_B	Operating current phase B imaginary part	sec.A	IN	Any
Iopr_C	Operating current phase C real part	sec.A	IN	Any
Iopi_C	Operating current phase C imaginary part	sec.A	IN	Any
Uopr_A	Operating voltage phase A real part	sec.V	IN	Any
Uopi_A	Operating voltage phase A imaginary part	sec.V	IN	Any
Uopr_B	Operating voltage phase B real part	sec.V	IN	Any
Uopi_B	Operating voltage phase B imaginary part	sec.V	IN	Any
Uopr_C	Operating voltage phase C real part	sec.V	IN	Any
Uopi_C	Operating voltage phase C imaginary part	sec.V	IN	Any
Upolr_A	Polarising voltage phase A real part	sec.V	IN	Any
Upoli_A	Polarising voltage phase A imaginary part	sec.V	IN	Any
Upolr_B	Polarising voltage phase B real part	sec.V	IN	Any
Upoli_B	Polarising voltage phase B imaginary part	sec.V	IN	Any
Upolr_C	Polarising voltage phase C real part	sec.V	IN	Any
Upoli_C	Polarising voltage phase C imaginary part	sec.V	IN	Any
Umpolr_A	Mutual polarising voltage phase A real part	sec.V	IN	Any
Umpoli_A	Mutual polarising voltage phase A imaginary part	sec.V	IN	Any
Umpolr_B	Mutual polarising voltage phase B real part	sec.V	IN	Any
Umpoli_B	Mutual polarising voltage phase B imaginary part	sec.V	IN	Any
Umpolr_C	Mutual polarising voltage phase C real part	sec.V	IN	Any
Umpoli_C	Mutual polarising voltage phase C imaginary part	sec.V	IN	Any
wsup_A	Phase A supervising Signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsup_B	Phase B supervising Signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsup_C	Phase C supervising Signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsupadd	Supervising additional signal (free signal)	s (or 1/0 RMS/EMT simulation)	IN	Any
wfwd_A	Phase A forward current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wfwd_B	Phase B forward current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wfwd_C	Phase C forward current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wrev_A	Phase A reverse current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wrev_B	Phase B reverse current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wrev_C	Phase C reverse current signal	s (or 1/0 RMS/EMT simulation)	IN	Any
Tmemory	Memory time (signal coming from the polarising block and providing the length of the buffer for polarising voltage values)	s	IN	Any
wtimer	Timer Signal (used to add an additional delay to the trip time)	s (or 1/0 RMS/EMT simulation)	IN	Any
wldblock	Block signal coming from the *Load encroachment* element	s (or 1/0 RMS/EMT simulation)	IN	Any
wpsblock	Block signal coming from the *Power Swing* element	s (or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	s (or 1/0 RMS/EMT simulation)	IN	Any
yallout	3 ph tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
yout	Tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_A	Phase A tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_B	Phase B tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_C	Phase C tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any

B.3 6 phase

B.3.1 Mho

Table B.6: Input/output signals of 6 phase Distance Mho element (*CalDismho6p*)

Name	Description	Unit	Type	Model
Iopr_A	Ph-ph operating current phase A real part	sec.A	IN	Any
Iopi_A	Ph-ph operating current phase A imaginary part	sec.A	IN	Any
Iopr_B	Ph-ph operating current phase B real part	sec.A	IN	Any
Iopi_B	Ph-ph operating current phase B imaginary part	sec.A	IN	Any
Iopr_C	Ph-ph operating current phase C real part	sec.A	IN	Any
Iopi_C	Ph-ph operating current phase C imaginary part	sec.A	IN	Any
Igopr_A	Phase-grnd operating current phase A real part	sec.A	IN	Any
Igopi_A	Phase-grnd operating current phase A imaginary part	sec.A	IN	Any
Igopr_B	Phase-grnd operating current phase B real part	sec.A	IN	Any
Igopi_B	Phase-grnd operating current phase B imaginary part	sec.A	IN	Any
Igopr_C	Phase-grnd operating current phase C real part	sec.A	IN	Any
Igopi_C	Phase-grnd operating current phase C imaginary part	sec.A	IN	Any
Upolr_A	Ph-ph polarising voltage phase A real part	sec.V	IN	Any
Upoli_A	Ph-ph polarising voltage phase A imaginary part	sec.V	IN	Any
Upolr_B	Ph-ph polarising voltage phase B real part	sec.V	IN	Any
Upoli_B	Ph-ph polarising voltage phase B imaginary part	sec.V	IN	Any
Upolr_C	Ph-ph polarising voltage phase C real part	sec.V	IN	Any
Upoli_C	Ph-ph polarising voltage phase C imaginary part	sec.V	IN	Any
Ugpolr_A	Phase-grnd polarising voltage phase A real part	sec.V	IN	Any
Ugpoli_A	Phase-grnd polarising voltage phase A imaginary part	sec.V	IN	Any
Ugpolr_B	Phase-grnd polarising voltage phase B real part	sec.V	IN	Any
Ugpoli_B	Phase-grnd polarising voltage phase B imaginary part	sec.V	IN	Any
Ugpolr_C	Phase-grnd polarising voltage phase C real part	sec.V	IN	Any
Ugpoli_C	Phase-grnd polarising voltage phase C imaginary part	sec.V	IN	Any
wsup_A	Phase A supervising Signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsup_B	Phase B supervising Signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsup_C	Phase C supervising Signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wsupadd	Supervising additional signal (free signal)	s (or 1/0 RMS/EMT simulation)	IN	Any
fwdphph	Phase phase loop forward directional signal	s (or 1/0 RMS/EMT simulation)	IN	Any
revphph	Phase phase loop reverse directional signal	s (or 1/0 RMS/EMT simulation)	IN	Any
fwdgrnd	Ground phase loop forward directional signal	s (or 1/0 RMS/EMT simulation)	IN	Any
fwdrev	Ground phase loop reverse directional signal	s (or 1/0 RMS/EMT simulation)	IN	Any
wloop	Faulted loop id	Integer	IN	Any
wtimer	Timer Signal (used to add an additional delay to the trip time)	s (or 1/0 RMS/EMT simulation)	IN	Any
wldblock	Block signal coming from the *Load encroachment* element	s (or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	s (or 1/0 RMS/EMT simulation)	IN	Any
yallout	3 ph tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
yout	Tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_A	Phase A tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_B	Phase B tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any
y_C	Phase C tripping signal/time	s (or 1/0 RMS/EMT simulation)	OUT	Any

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