POWERFACTORY

PowerFactory 2021

Technical Reference

Distance Polygon

RelDispoly, TypDispoly

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

Publisher:
DIgSILENT GmbH
Heinrich-Hertz-Straße 9
72810 Gomaringen / Germany
Tel.: +49 (0) 7072-9168-0
Fax: +49 (0) 7072-9168-88
info@digsilent.de

Please visit our homepage at:
https://www.digsilent.de

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Contents

1 General Description

The *Distance Polygonal* “RelDispoly” block implements the typical polygonal and quadrilateral impedance distance protection . The type of the distance shape can be one of the following:

- Generic quadrilateral.
- Generic polygonal.
- ABB polygonal.
- Siemens polygonal.
- GE polygonal.
- EPAC quadrilateral.
- Asea RAZFE.

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

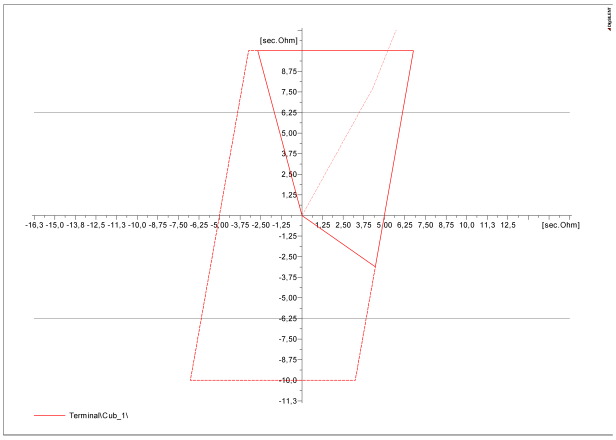


Figure 1.1: The *DIgSILENT Quadrilateral* distance shape.

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

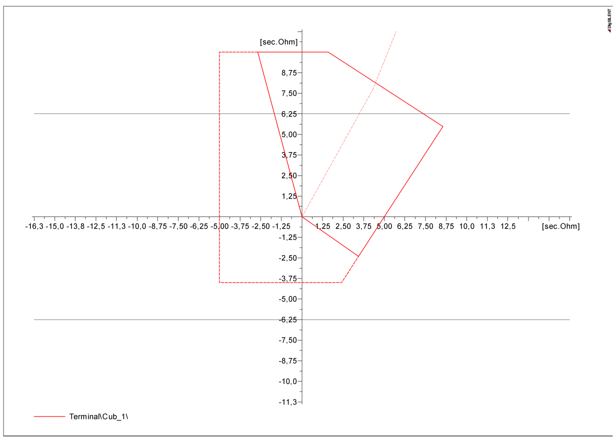


Figure 1.2: The *DIgSILENT Polygon* distance shape.

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

2 Features & User interface

2.1 Distance Polygon (RelDispoly)

The user can change the block settings using the “Distance polygon” dialogue (“RelDispoly ” class). The dialogue consists of 2 tab pages: *Basic Data*, and *Description*. The main settings are located in the *Basic Data* tab page.

2.1.1 Basic data

The “Distance polygon” *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 polygonal/quadrilateral characteristic (i.e. “Polygonal (90)”)

The block can be disabled using the “Out of service” check box. A directional feature can be set using the “Tripping direction” combo box. Please notice that the directional logic relies on a separate block (’Distance Directional “DisDir” 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 polygonal characteristic (see 2.2.1) defines which settings are available.

2.1.2 Description

The *Description* tab page can be used to insert some information to identify the *Distance Polygonal* 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 Polygonal Type(TypDispoly)

The *Distance Polygon* block main characteristics must be configured in the “Distance Polygon Type” dialogue (*TypDispoly* class). The dialogue contains two tab pages: *Polygon Settings*, and *Advanced settings*.

2.2.1 Polygon Settings

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

- The block IEC and ANSI symbol (the entered text is displayed in the Distance Polygon (RelDispoly) dialogue).

- The number of phases (“iphases” setting).
- The unit type (*Phase-Phase*, *Earth*, *3-Phase*, *Multifunctional*. “aunit” setting).
- The number of the protective zone modeled by the Polygonal/Quadrilateral characteristic (“izone” setting).
- The purpose for which the zone is used (*Zone*, *Starting*,*Overreach zone*, *Power Swing*, “iusage” setting).
- A reference block (optional).
- The Polygon type (“ichatp” setting).
- Which directional features can be set (*Forward*, *Reverse*, *None*, “idirpos”setting).
- The range and the step of the settings used to represent the quadrilateral/polygonal (see A.1)).

Please note that the *shape* (“isiemrx”) setting has been added to support *manufacturer* specific shapes and is displayed only for some *Types*; when the *Siemens (R,X)* type is set the following *Shapes* are available

- R,X
- R,X Z-red
- R,X, rev. X

when the *Quadrilateral (Z)* type is set the following *Shapes* are available

- Standard
- REL 512

when the *ABB (R,X)* type is set the following *Shapes* are available

- 5xx
- 316
- 6xx
- 6xx series comp line

when the *Quad (Beta)* type is set the following *Shapes* are available

- Standard
- AEG/Alstom

Reference block :

The *Distance Polygon* (“RelDispoly ”)element has been conceived to work together with other relay distance elements like other *Distance Polygon* (“RelDispoly ”)elements and the *Distance Mho* (“RelDismho”) 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 following setttings are displayed:

- *dR* (“dR” setting)
- *dX* (“dX” setting)
- *kR* (“kR” setting)
- *kX* (“kX” setting)
- *dZ* (“dZ” setting)

and all other setting are hidden.

Polygon types :

The shape generated by the block can be configured using one of the following *Types*:

- Quadrilateral
- Quadrilateral Offset
- Polygonal (+R, +X)
- Polygonal (90)
- Polygonal (Beta)
- Siemens (R,X)
- Quadrilateral Z
- ABB(R,X)
- ASEA RAZFE
- Quad (Beta)
- Quad Offset (Siemens 7SL32)
- EPAC Quadrilateral
- Quadrilateral Z (2)

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.

Quadrilateral

It represents a generic quadrilateral shape. The directional block settings are directly applied to the trip zone shape , the *R Resistance* (“Rmin”) variable creates a cut area on the left part of the diagram. The block must be always directional controlled (forward or reverse).

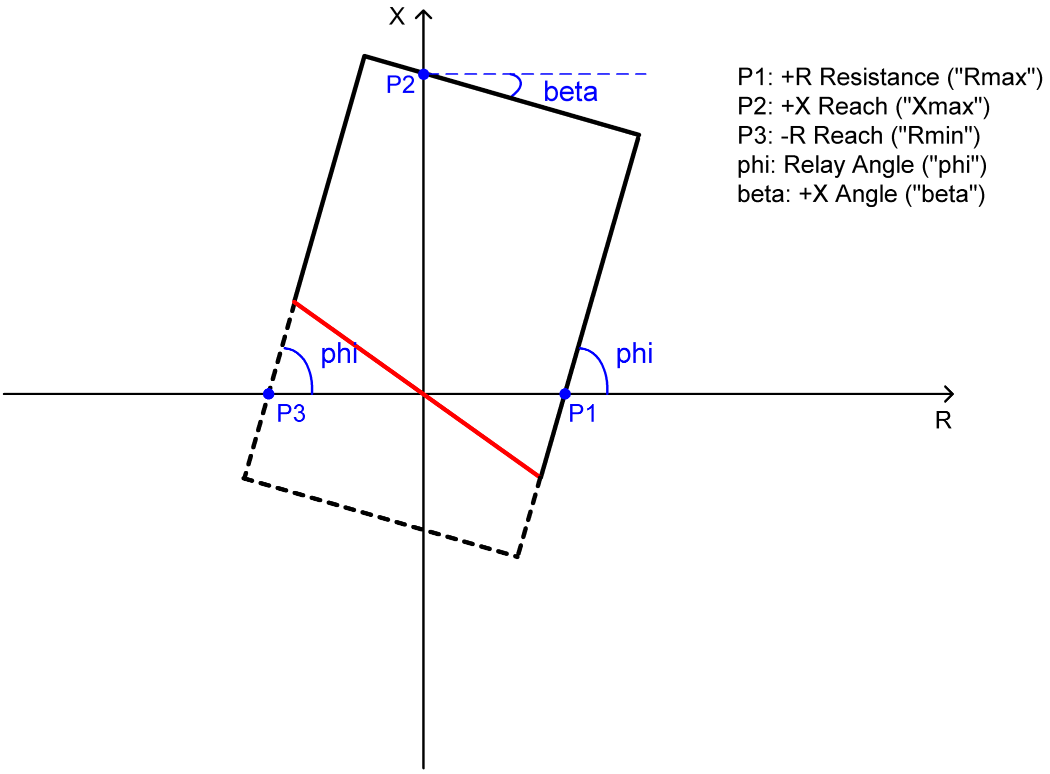


Figure 2.1: The *DIgSILENT* “Quadrilateral” type characteristic

+R Resistance (“Rmax”), can be defined in:

- sec. Ohm (secondary Ohm)
- +R/X Ratio:+R Resistance = R/X Ratio*(+X Reach)

-R Reach (“Rmin”), can be defined in:

- sec. Ohm (secondary Ohm) as positive value
- R Ratio (-R/X): -R Reach = -R Ratio * (+X Reach)
- R Ratio (-R/R): -R Reach = -R Ratio * (+R Resistance)
- R Ratio (-R/-X): -R Reach = -R Ratio * (-X Reach)

Relay Angle (“phi”) and *+X Angle* (“beta”) are in degrees.

Quadrilateral Offset

The “Quadrilateral Offset” type represents a generic quadrilateral shape. The block is non-directional.

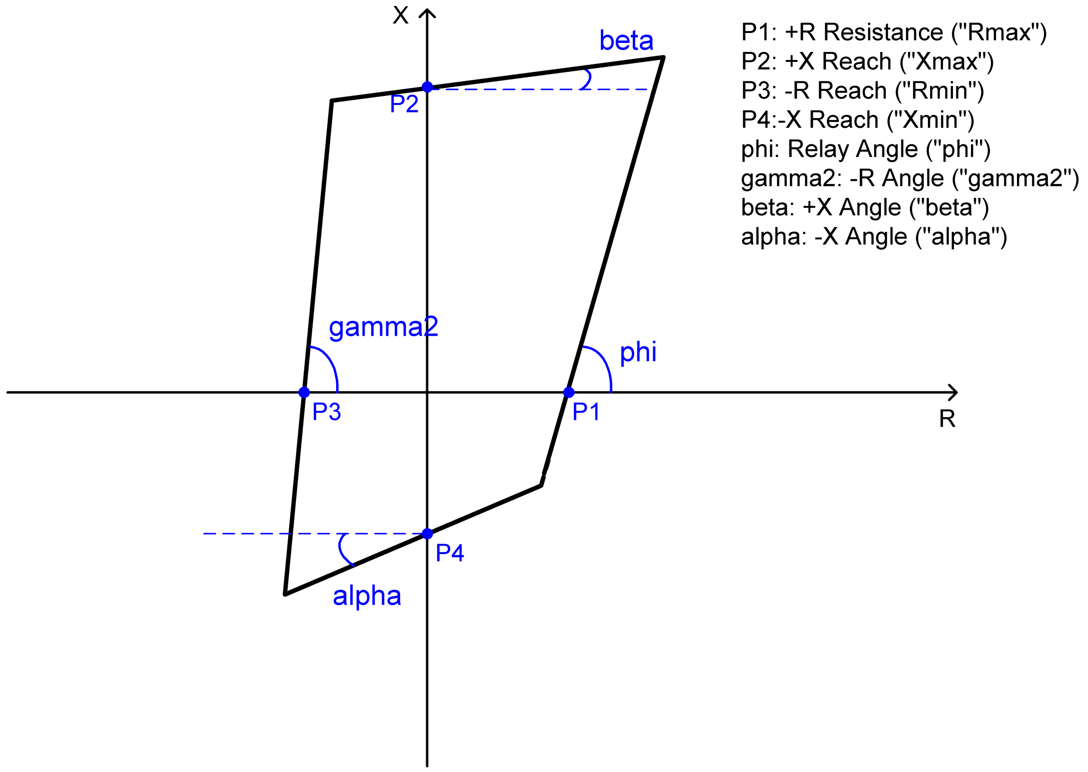


Figure 2.2: The *DIgSILENT* “Quadrilateral offset” type characteristic

+R Reach (“Rmax”), can be defined in:

- sec. Ohm (secondary Ohm)
- R/X Ratio:+R Resistance = R/X Ratio*(+X Reach)

-R Reach (“Rmin”), can be defined in:

- sec. Ohm (secondary Ohm) as positive value
- R Ratio (-R/X): -R Reach = -R Ratio * (+X Reach)
- R Ratio (-R/R): -R Reach = -R Ratio * (+R Resistance)
- R Ratio (-R/-X): -R Reach = -R Ratio * (-X Reach)

-X Reach (“Xmin”), can be defined in:

- sec. Ohm (secondary Ohm) as positive value
- R Ratio (-R/X): -R Resistance = -R Ratio * (+X Reach)
- R Ratio (-R/R): -R Resistance = -R Ratio * (+R Resistance)
- R Ratio (-R/-X): -R Reach = -R Ratio * (-X Reach)

Relay Angle, *+X Angle* and *X Angle* are in degrees

Polygonal (+R, +X)

It is a simplified version of the Quadrilateral type: the main difference is that the *-R resistance* (smarksRmin) variable is missing. The directional block settings are applied to the trip zone shape. The block must be directional controlled (forward or reverse).

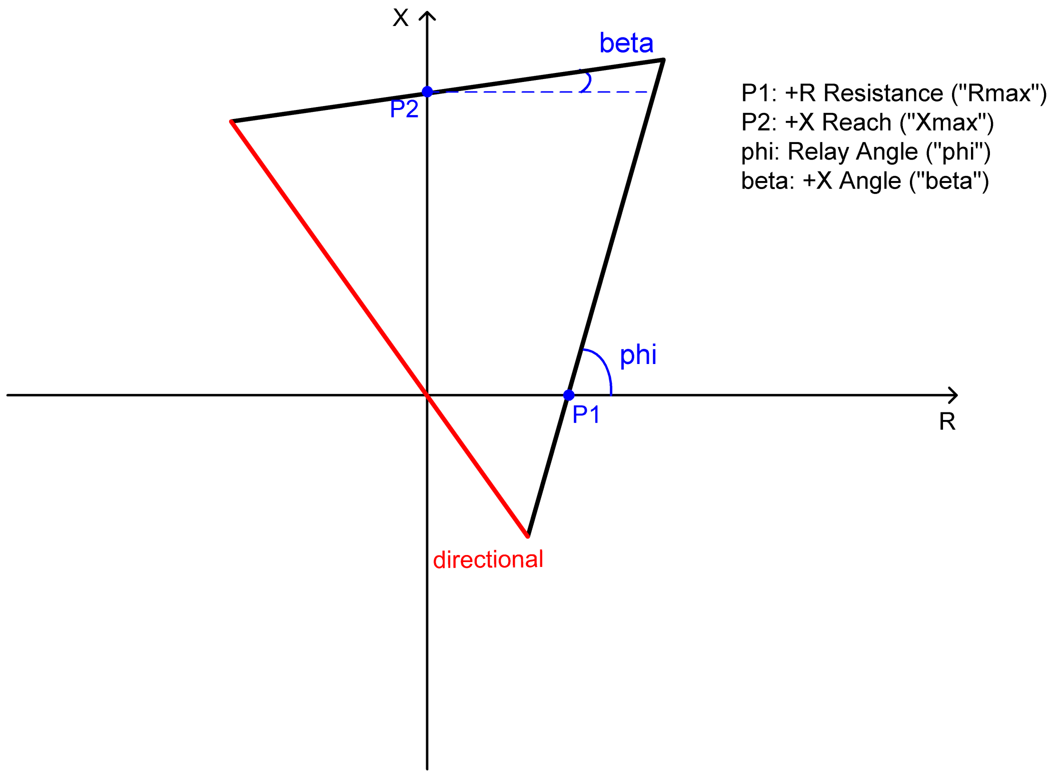


Figure 2.3: The *DIgSILENT* "Polygonal (+R, +X)" type characteristic

+R Resistance ("Rmax"), can be defined in:

- sec. Ohm (secondary Ohm)
- +R/X Ratio:+R Resistance = R/X Ratio*(+X Reach)

Relay Angle (
smarksphi) and *+X Angle* ("beta") are in degrees.

Polygonal (90)

It is a polygonal distance trip zone: an additional side is defined by the *Tilt Resistance* parameter. The directional block settings are applied to the trip zone shape. The *-X Reach* parameter is used if the characteristic is non-directional controlled.

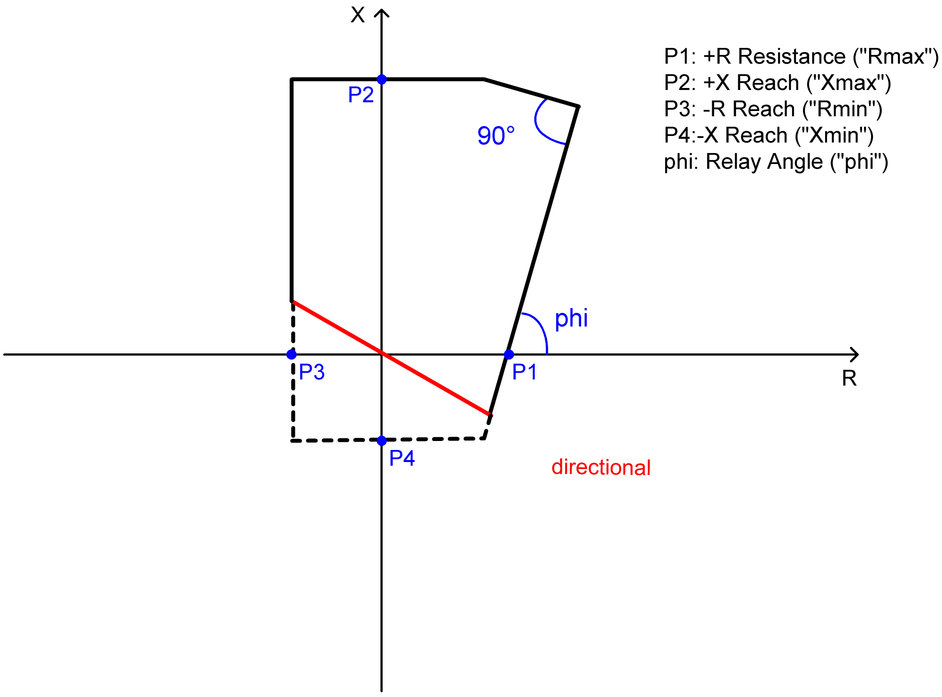


Figure 2.4: The *DIgSILENT* "Polygonal (90)" type characteristic

+R Resistance ("Rmax"), can be defined in:

- sec. Ohm (secondary Ohm)
- +R/X Ratio:+R Resistance = R/X Ratio*(+X Reach)

Tilt Resistance ("Rtilt"), can be defined in:

- sec. Ohm (secondary Ohm)
- Rt Ratio (R/X): Tilt Resistance = Rt Ratio * (+X Reach)
- Rt Ratio (R/+R): Tilt Resistance = Rt Ratio*(+R Resistance)
- "Relay Angle": Tilt Resistance = +X Reach / tan(α)

-R Resistance ("Rmin"), can be defined in:

- sec. Ohm (secondary Ohm) as positive value
- R Ratio (-R/X): -R Resistance = -R Ratio * (+X Reach)
- R Ratio (-R/R): -R Resistance = -R Ratio * (+R Resistance)
- R Ratio (-R/-X): -R Reach = -R Ratio * (-X Reach)

-X Reach ("Xmin") is only valid if the "External Directional" parameter is disabled and can be defined in:

- sec. Ohm (secondary Ohm) as positive value
- X/X Ratio: -X Reach = "-X/X Ratio" * (+X Resistance)

Relay Angle ("phi") is in degree

Polygonal (Beta)

It is a custom polygonal distance trip zone, similar to the “Polygonal (90)” type: also in this case the *Tilt Resistance* (“Rtilt”)parameter is present but the *+X angle* (“beta”) parameter allows to define the angle of the upper right part of the zone. The directional block settings are applied to the trip zone shape. The *-X Reach* (“Xmin”) parameter is used if the characteristic is non-directional controlled.

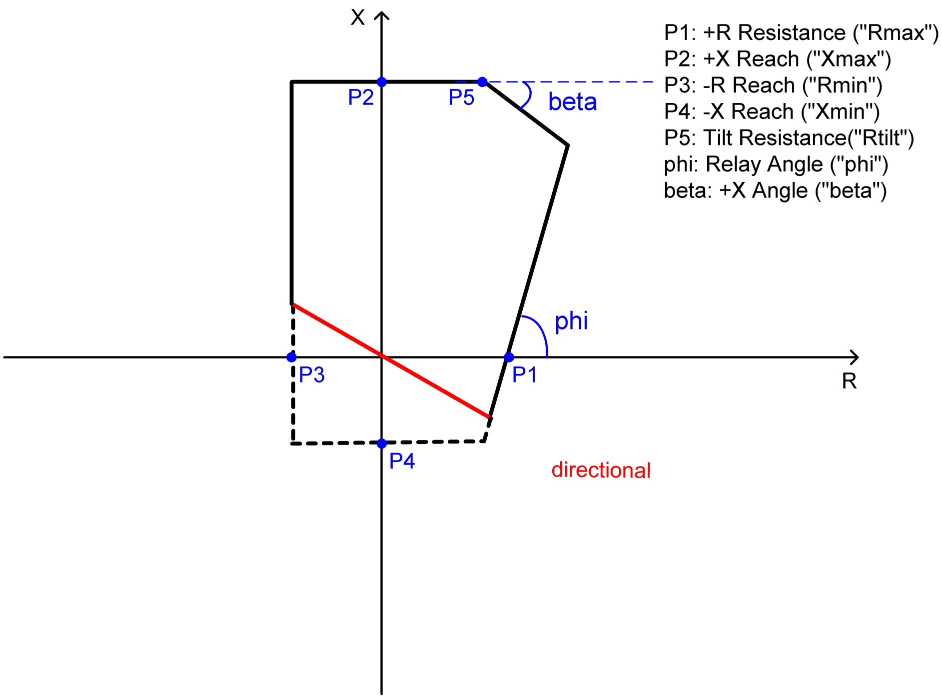


Figure 2.5: The *DIgSILENT* “Polygonal (Beta)” type characteristic

Relay Angle (“phi”) and *+X Angle* (“beta”) are in degrees.
+R Resistance (“Rmax”), can be defined in:

- sec. Ohm (secondary Ohm)
- +R/X Ratio:+R Resistance = R/X Ratio*(+X Reach)

Tilt Resistance (“Rtilt”), can be defined in:

- sec. Ohm (secondary Ohm)
- Rt Ratio (R/X): Tilt Resistance = Rt Ratio * (+X Reach)
- Rt Ratio (R/+R): Tilt Resistance = Rt Ratio*(+R Resistance)
- “Relay Angle”: Tilt Resitance = +X Reach / tan(α)

-R Reach (“Rmin”), can be defined in:

- sec. Ohm (secondary Ohm) as positive value
- R Ratio (-R/X): -R Reach = -R Ratio * (+X Reach)
- R Ratio (-R/R): -R Reach = -R Ratio * (+R Resistance)
- R Ratio (-R/-X): -R Reach = -R Ratio * (-X Reach)

-X Reach (“Xmin”), only valid if the External Directional parameter is disabled, can be defined in:

- sec. Ohm (secondary Ohm) as positive value
- X/X Ratio: -X Reach = -X/X Ratio * (+X Reach)

Siemens (R,X)

It implements the distance trip zone present in the Siemens relays (i.e. 7SAxxx family): it is basically a “Polygonal (+R, +X)” zone but the same parameters, when the “+R resistance” parameter is replaced by the “+R resistance (PH-E)” parameter, define also the ground trip zone. When the
smarksSiemens (R, X) type is selected the *Unit* variable is set automatically equal to *Multifunctional*; to guarantee a correct behaviour of the block this selection must be left as it is. To handle the first zone (load reduction) or the fifth zone (reverse reactance) of the 7SA522 the following *Shape* (“isiemrx”) are available:

- *R,X*
- *R,X Z-red* (first zone, additional parameter to define the X angle)
- *R,X rev.X* (fifth zone, additional parameter to define the reverse reach)

Relay Angle and *+X Angle* are in degrees. Tilt Resistance (available only if shape type = “R,X, Z-red.”)is equal to (+X Reach) / tan(α)

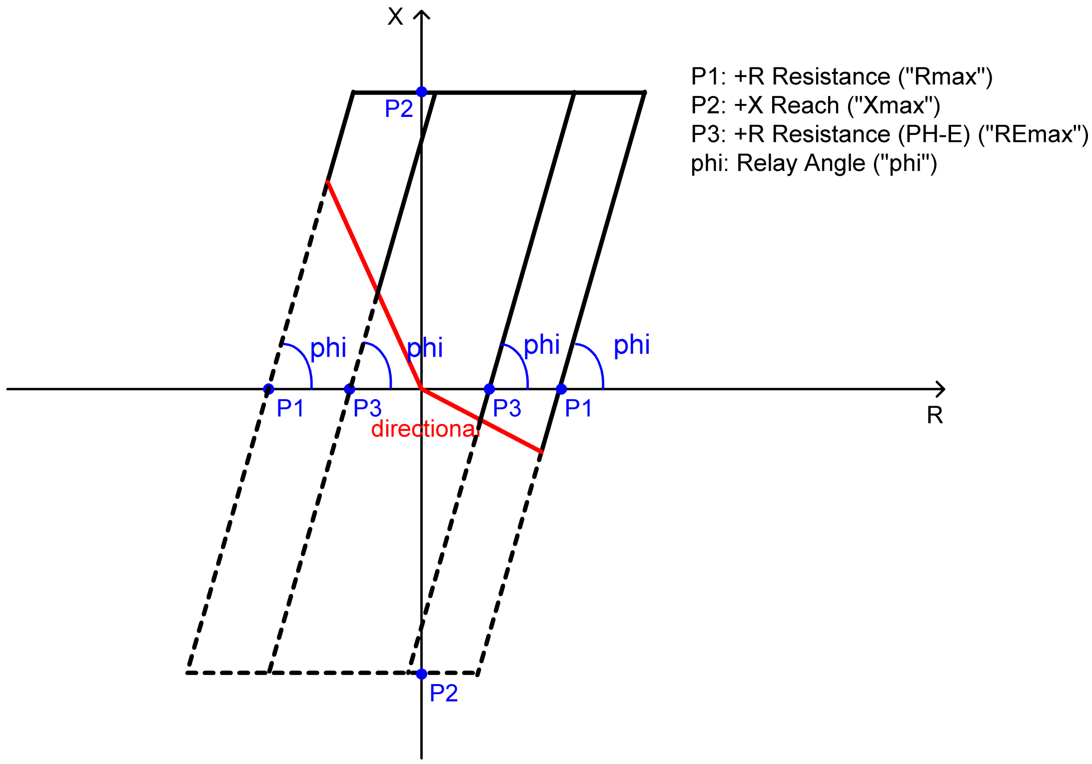


Figure 2.6: The *DIgSILENT*
smarksSiemens (R,X) R,X phase and ground type characteristic

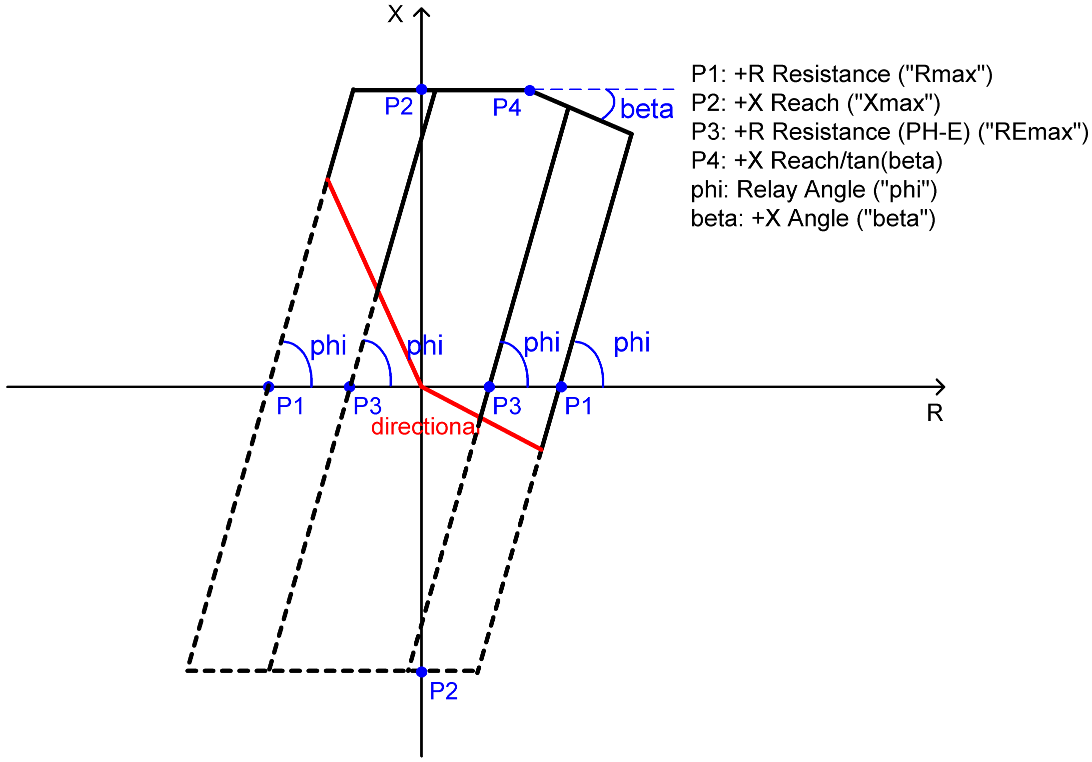


Figure 2.7: The *DIgSILENT*
smarksSiemens (R,X) R,X Z-red phase and ground type characteristic

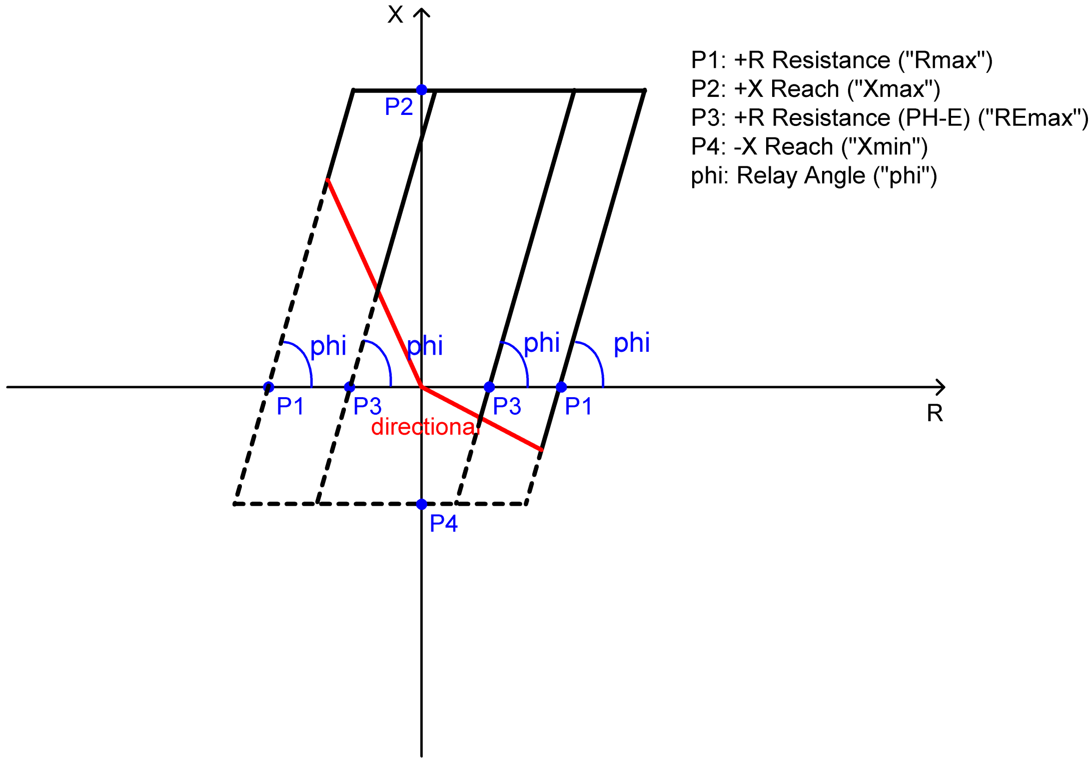


Figure 2.8: The *DIgSILENT*
smarksSiemens (R,X) R,X rev.X phase and ground type characteristic

Quadrilateral Z

The “Quadrilateral Z” type is similar to the “Quadrilateral” type but the “X Reach” parameter is replaced by the “Z Reach” (
smarksZmax) parameter. The characteristic can be directional controlled (forward or reverse). To handle the ABB REL 512 shape the following *Shape* (“isiemrx”) are available:

- Standard
- REL 512

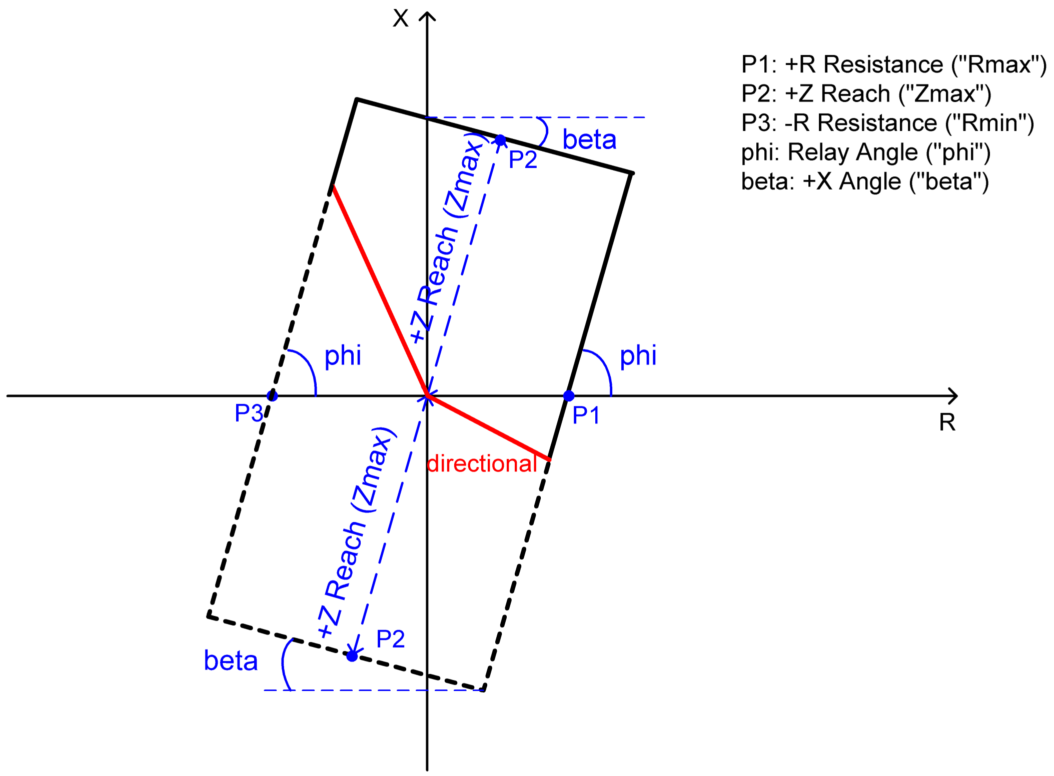


Figure 2.9: The *DIgSILENT* “Quadrilateral Z Standard” type characteristic

+R Resistance (“Rmax”) can be defined in:

- sec. Ohm (secondary Ohm)
- +R/X Ratio:+R Resistance = R/X Ratio*(+X Reach)

Please notice that (+X Reach)= *Z Reach* * sin(α) *-R Reach* (“Rmin”) can be defined in:

- sec. Ohm (secondary Ohm) as positive value
- R Ratio (-R/X): -R Reach = -R Ratio * (+X Reach)
- R Ratio (-R/R): -R Reach = -R Ratio * (+R Resistance)
- R Ratio (-R/-X): -R Reach = -R Ratio * (-X Reach)

Relay Angle and *+X Angle* are in degrees.

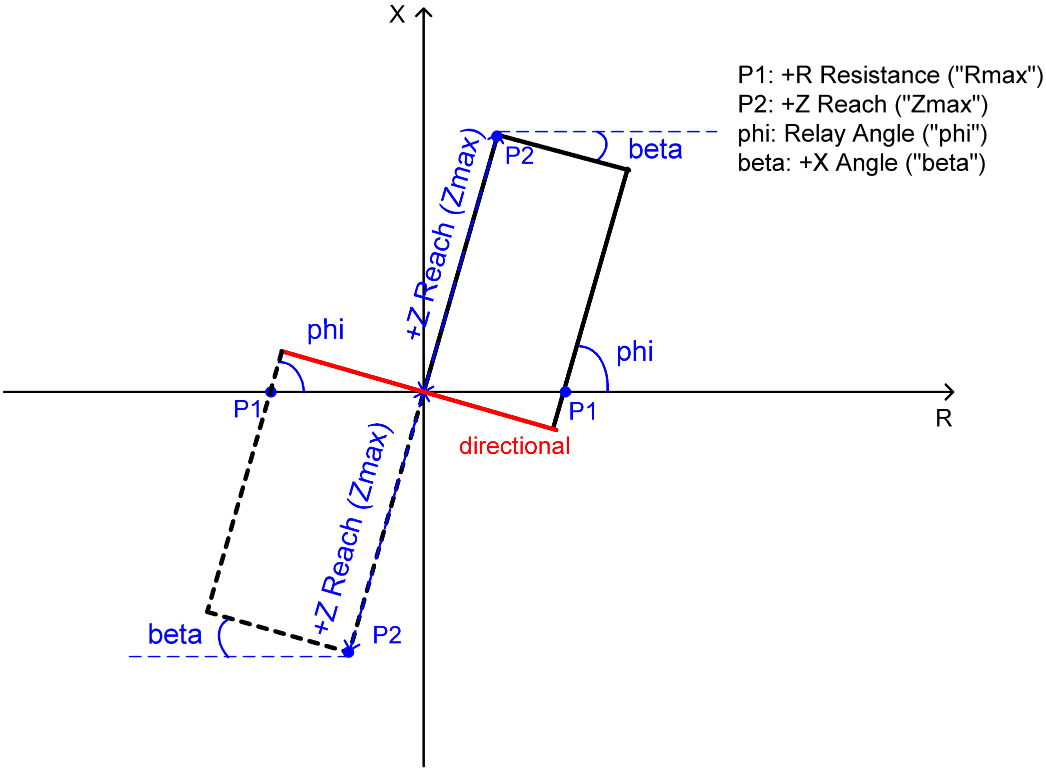


Figure 2.10: The *DIgSILENT* “Quadrilateral Z REL 512” type characteristic

ABB(R,X)

It implements the distance trip zone present in the ABB relays (i.e. REL5xx family): the name of the parameters is exactly the same present in the ABB relay manuals. When the “ABB (R, X)” type is selected the “Unit” variable is set automatically equal to “Phase-Phase”; please note that different parameters are available when the “Earth” unit variable is set. To handle the different ABB relay models the following *Shape* (“isiemrx” parameter) items are available:

- 5xx
- 316
- 6xx
- 6xx series comp line

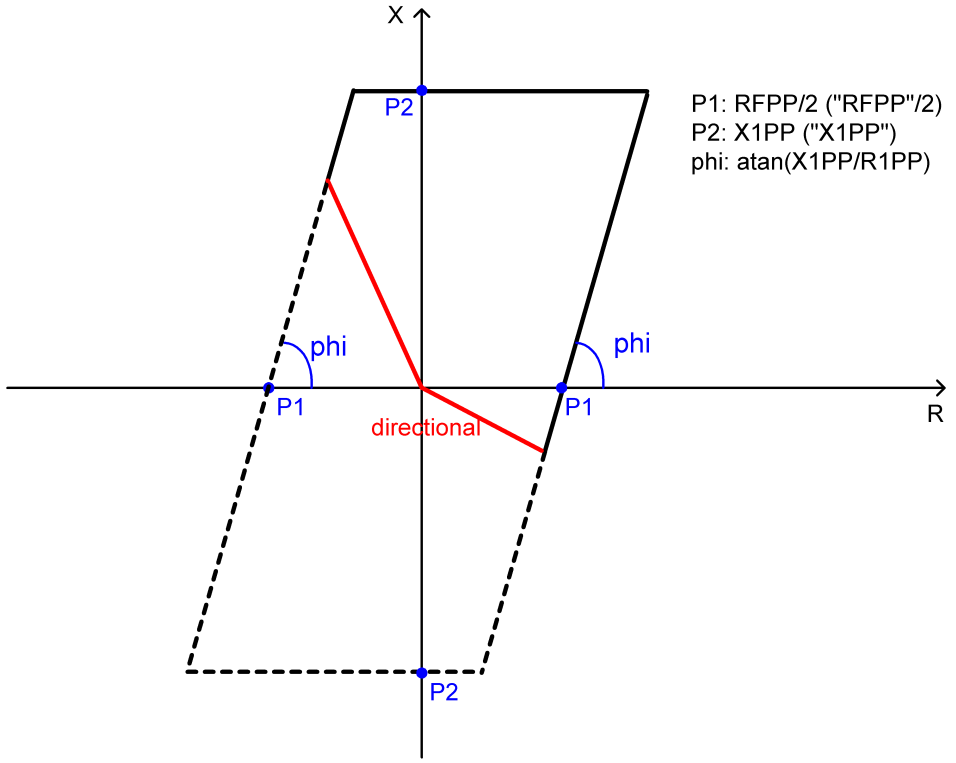


Figure 2.11: The *DIgSILENT* “ABB (R,X) “5xx” shape”phase-phase type characteristic

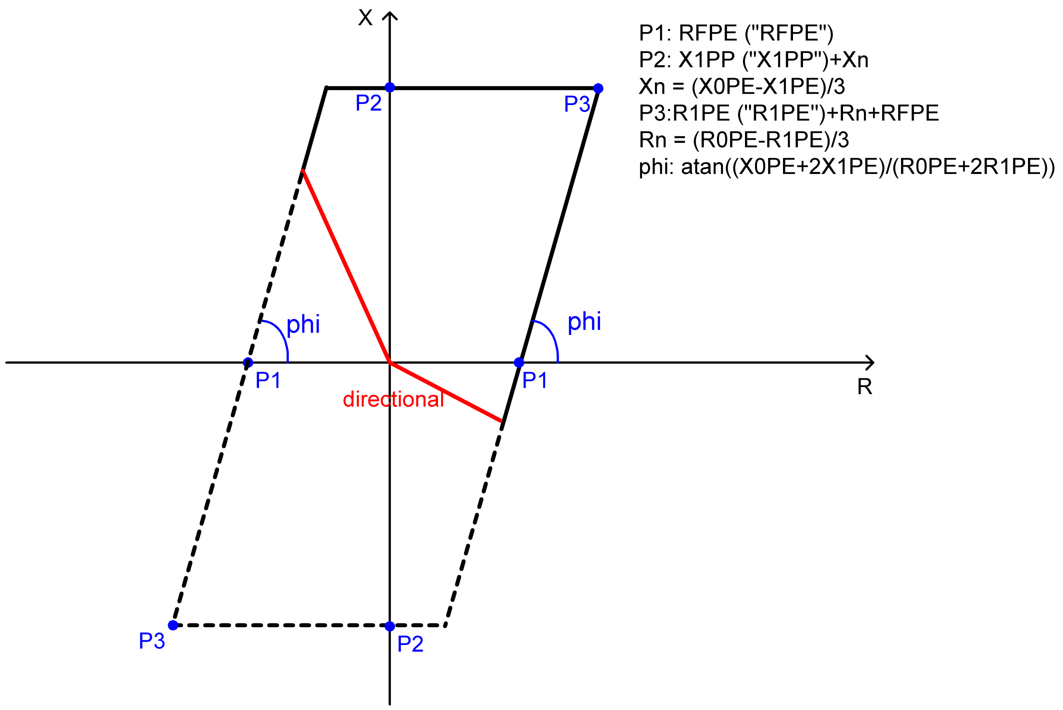


Figure 2.12: The *DIgSILENT* “ABB (R,X) “5xx” shape”phase-ground type characteristic

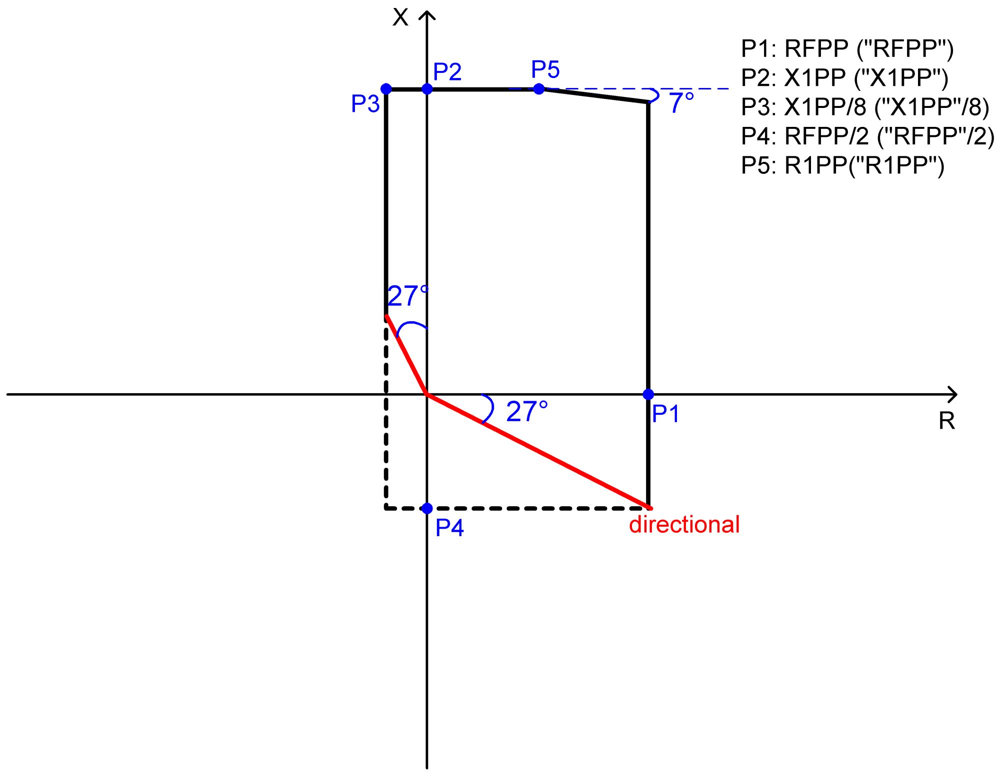


Figure 2.13: The *DIgSILENT* “ABB (R,X) “316” phase-phase shape” type characteristic

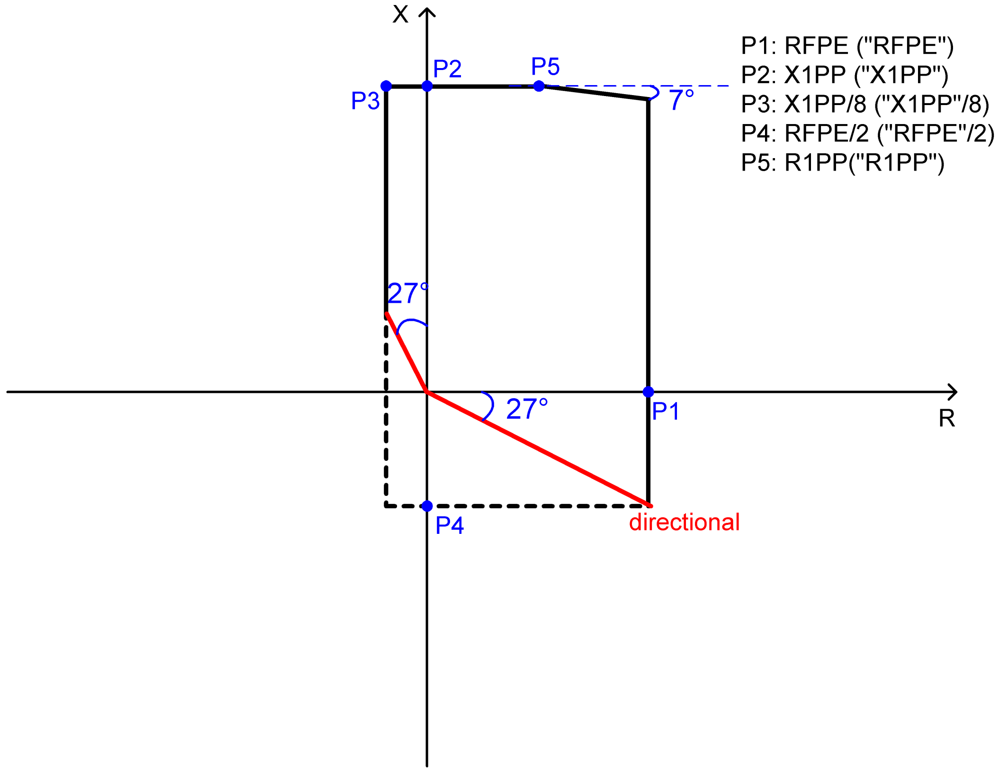


Figure 2.14: The *DIgSILENT* “ABB (R,X) “316” phase-ground shape” type characteristic

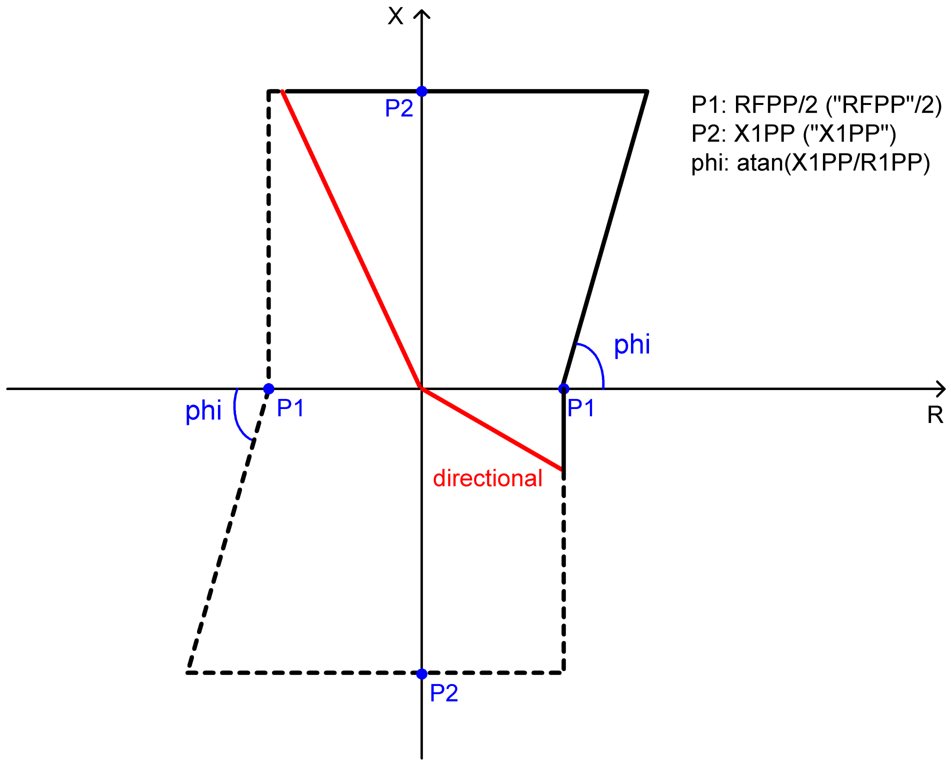


Figure 2.15: The *DIgSILENT* “ABB (R,X) “6xx” phase-phase shape ” type characteristic

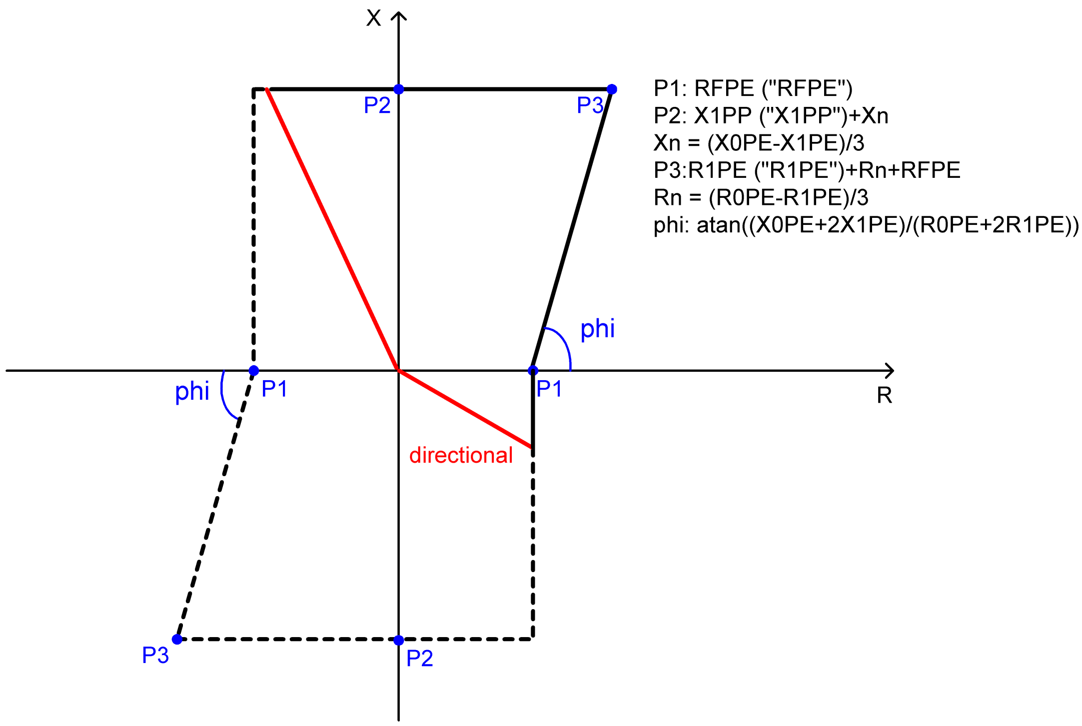


Figure 2.16: The *DIgSILENT* “ABB (R,X) “6xx” phase-ground shape” type characteristic

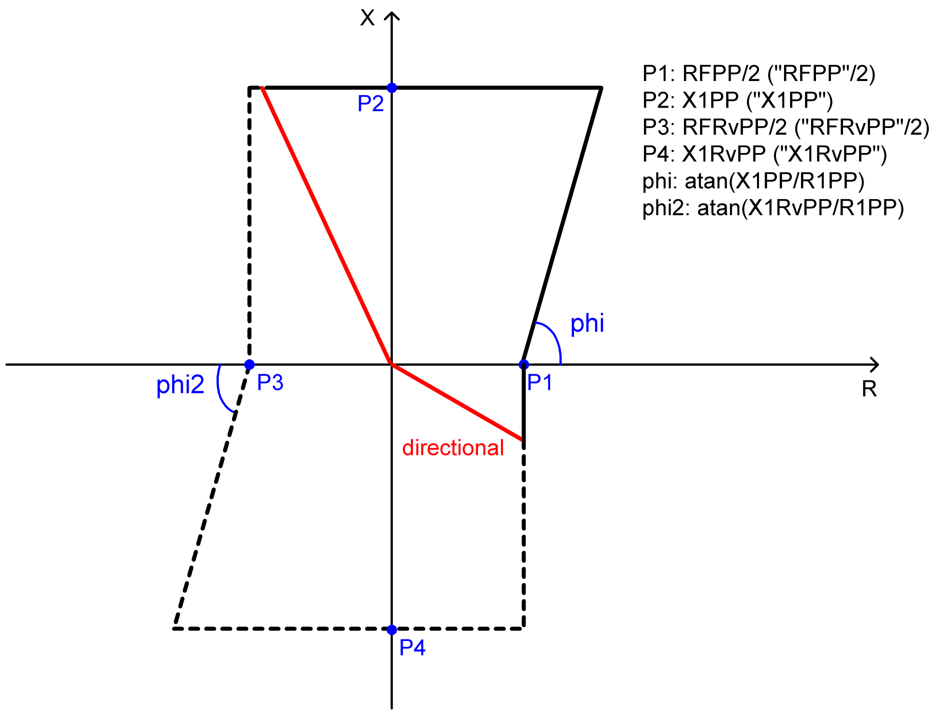


Figure 2.17: The *DIgSILENT* “ABB (R,X)
smarks6xx series comp line phase-phase shape ” type characteristic

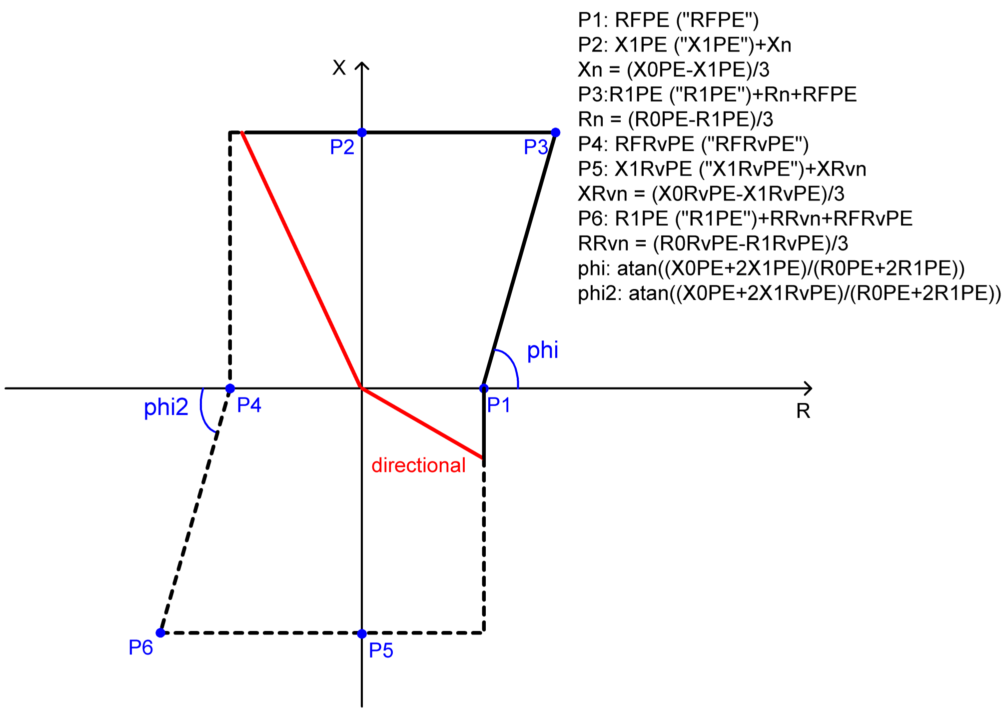


Figure 2.18: The *DIgSILENT* “ABB (R,X)
smarks6xx series comp line phase-ground shape” type characteristic

ASEA RAZFE

It implements the distance trip zone present in the Asea RAZFE relay. The internal logic to detect the position of the power system working point models exactly the logic used by the ASEA RAZFE relay.

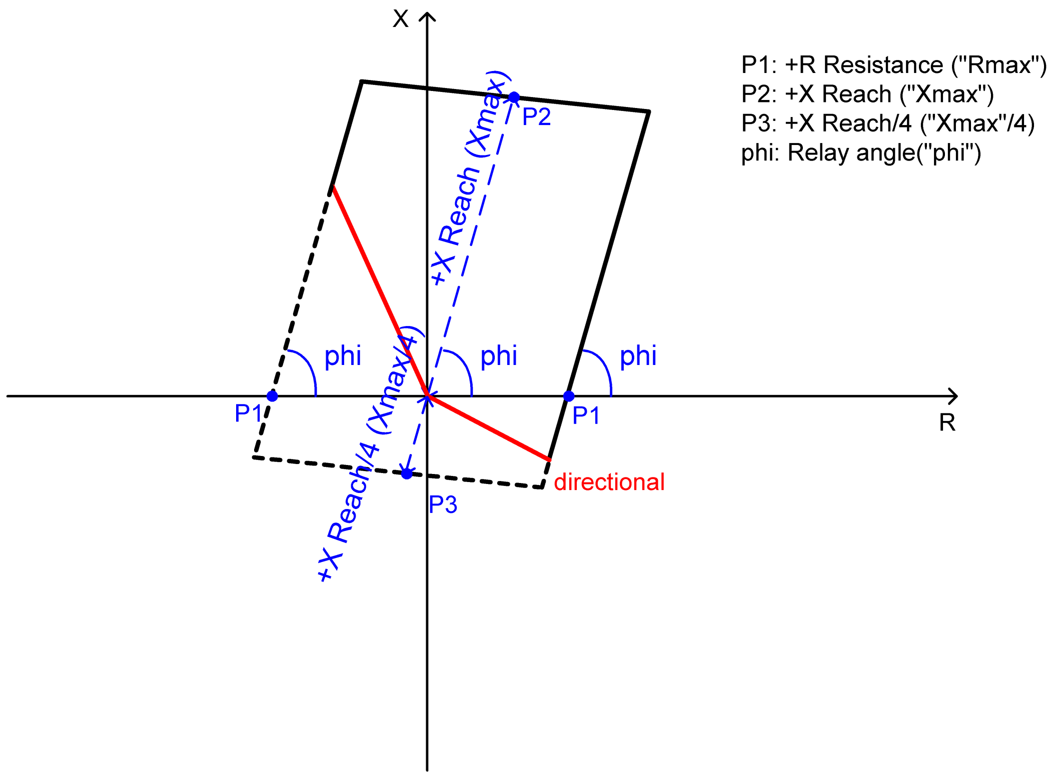


Figure 2.19: The *DIgSILENT* "ASEA RAZFE " type characteristic

+R Resistance can be defined in:

- sec. Ohm (secondary Ohm)
- Ratio (+R/+X):+R Resistance = Ratio (+R/+X)*(+X Reach)

Quad (Beta)

It represents a quadrilateral shape with a tilt resistance. The directional block settings are directly applied to the trip zone shape, the “R Resistance” variable creates a cut area on the left part of the diagram and the “-X Reactance” a cut on the bottom part of the diagram.

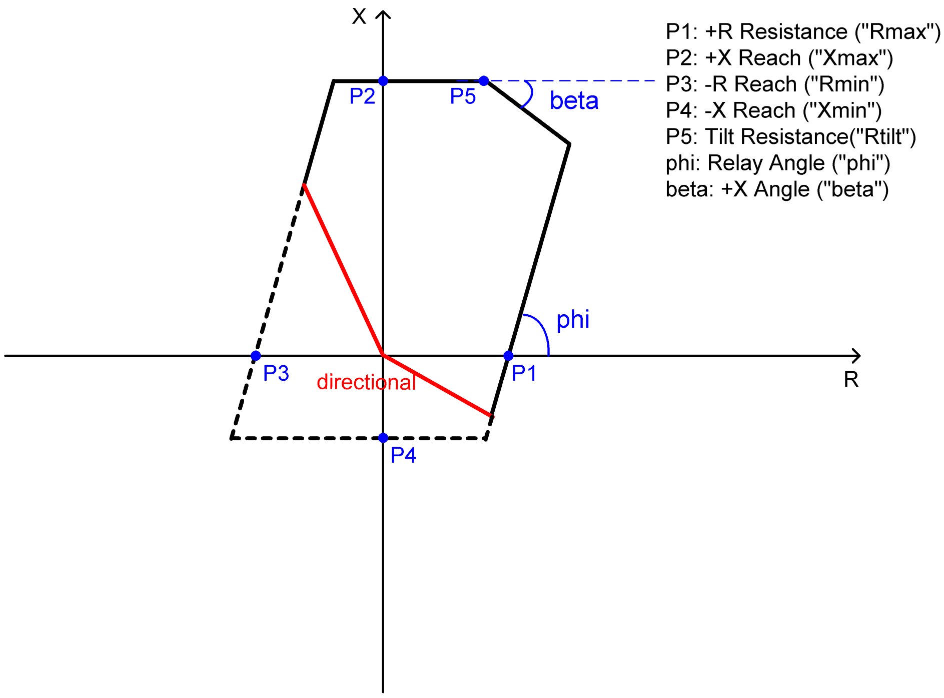


Figure 2.20: The *DIgSILENT* “Quad (Beta)” type characteristic

+R Resistance can be defined in:

- sec. Ohm (secondary Ohm)
- +R/X Ratio:+R Resistance = R/X Ratio*(+X Reach)

Tilt Resistance can be defined in:

- a) sec. Ohm (secondary Ohm)
- Rt Ratio (R/X): Tilt Resistance = Rt Ratio * (+X Reach)
- Rt Ratio (R/+R): Tilt Resistance = Rt Ratio*(+R Resistance)
- “Relay Angle”: Tilt Resistance = +X Reach / tan(α)

-R Reach can be defined in:

- sec. Ohm (secondary Ohm) as positive value
- R Ratio (-R/X): -R Reach = -R Ratio * (+X Reach)
- R Ratio (-R/R): -R Reach = -R Ratio * (+R Resistance)
- R Ratio (-R/-X): -R Reach = -R Ratio * (-X Reach)

-X Reach is valid only if parameter: “External Directional” is disabled and can be defined in:

- sec. Ohm (secondary Ohm) as positive value
- X/X Ratio: -X Reach = “-X/X Ratio” * (+X Reach)

Quad Offset (Siemens 7SL32)

It models the quadrilateral starting distance zone available in the Siemens 7SL32 distance relays.

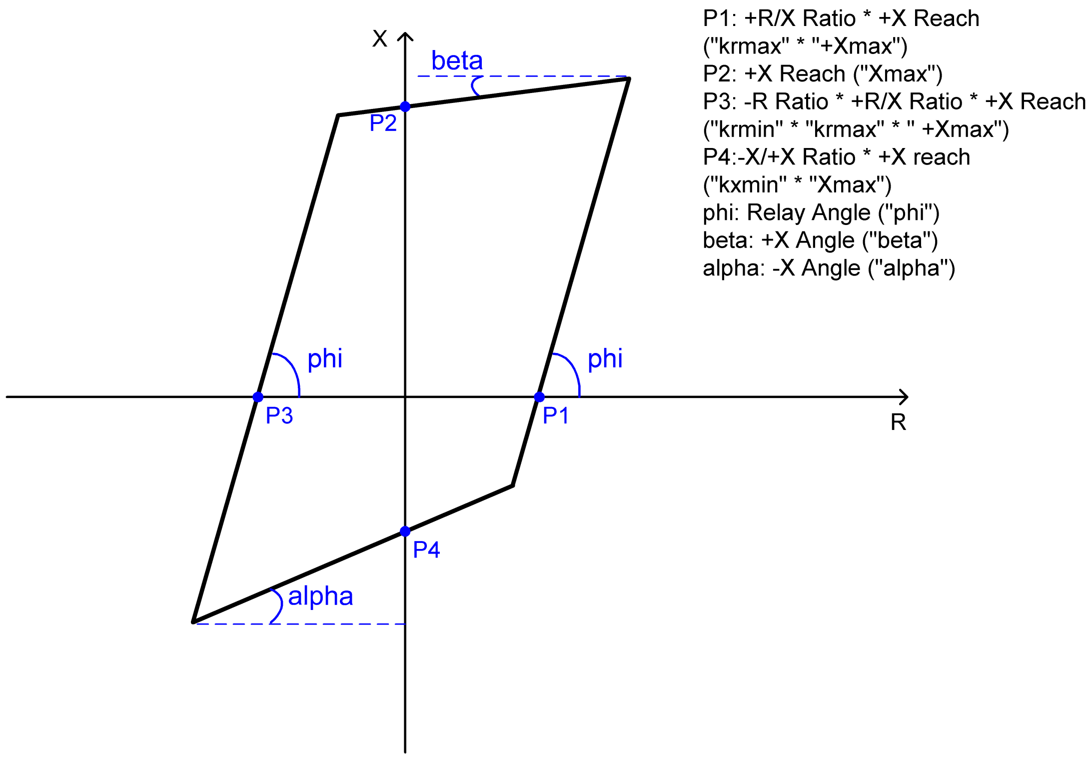


Figure 2.21: The *DIgSILENT* "Quad Offset (Siemens 7SL32)" type characteristic

EPAC Quadrilateral)

It models the quadrilateral distance zone available in the Alstom EPAC distance relays. The shape angle is calculated using the “R1”, “X1”, “R01”, and “X01” parameter which are part of the *Starting* element of the Alstom EPAC relay models. The *Starting* element is an instance of the“RelFdetalst” class; “R1”, and “X1” are part of the *Basic Data* tab page, “R01”, and “X01” are part of the *Underimpedance* tab page .

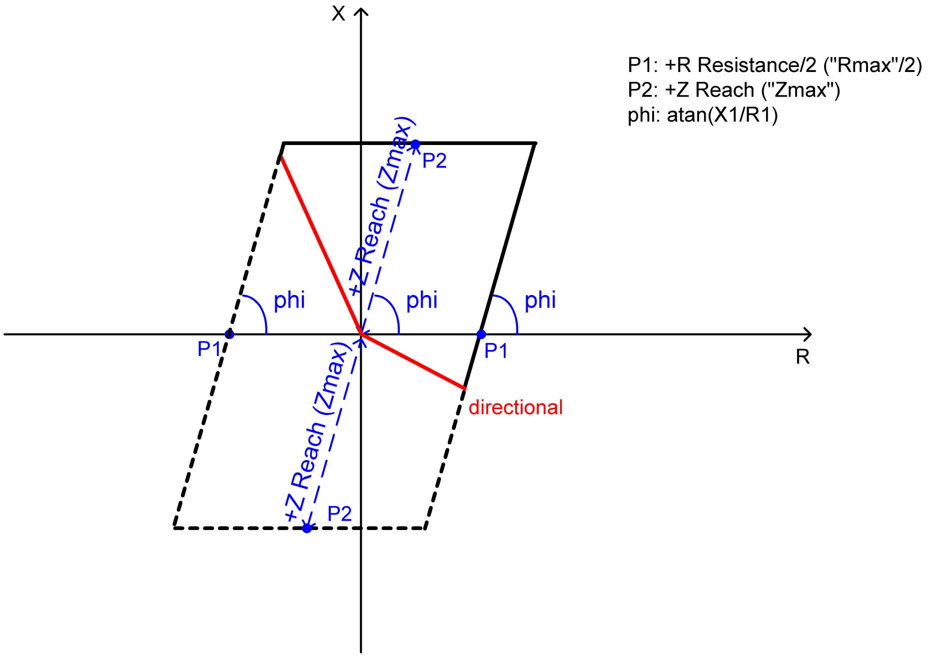


Figure 2.22: The *DIgSILENT* “EPAC Quadrilateral phase” type characteristic

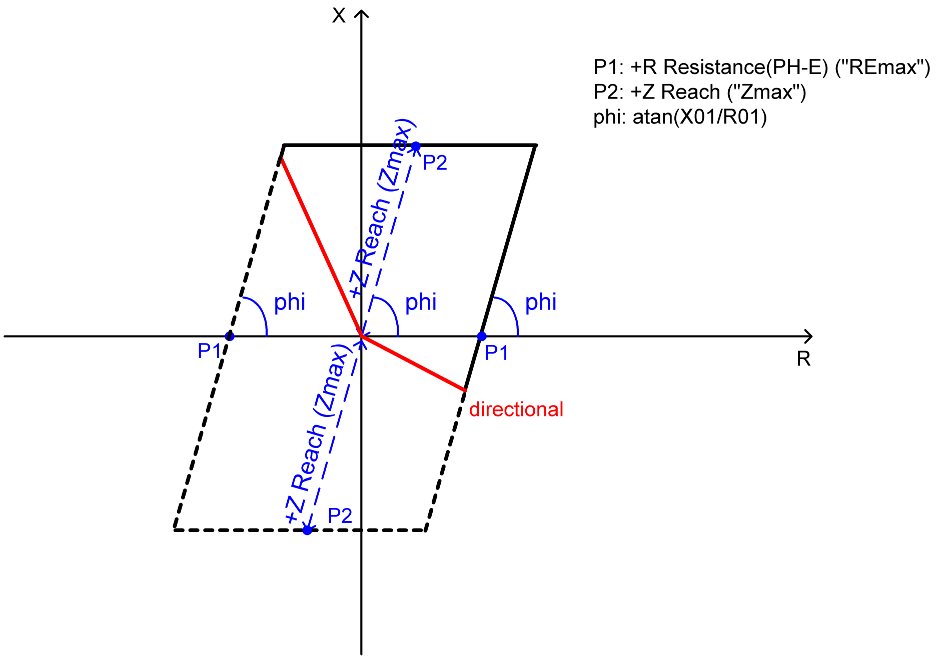


Figure 2.23: The *DIgSILENT* “EPAC Quadrilateral ground” type characteristic

GE Quadrilateral (Z))

Its a variant of the *Quadrilateral Z* type with some additional parameters. It has been added to support the GE UR relay family. The additional parameters allow setting independently the right and left side angle and position and the reverse impedance reach; both the Z reach and the relay angle in the reverse direction can set with independent variables.The characteristic can be directional controlled (forward or reverse).

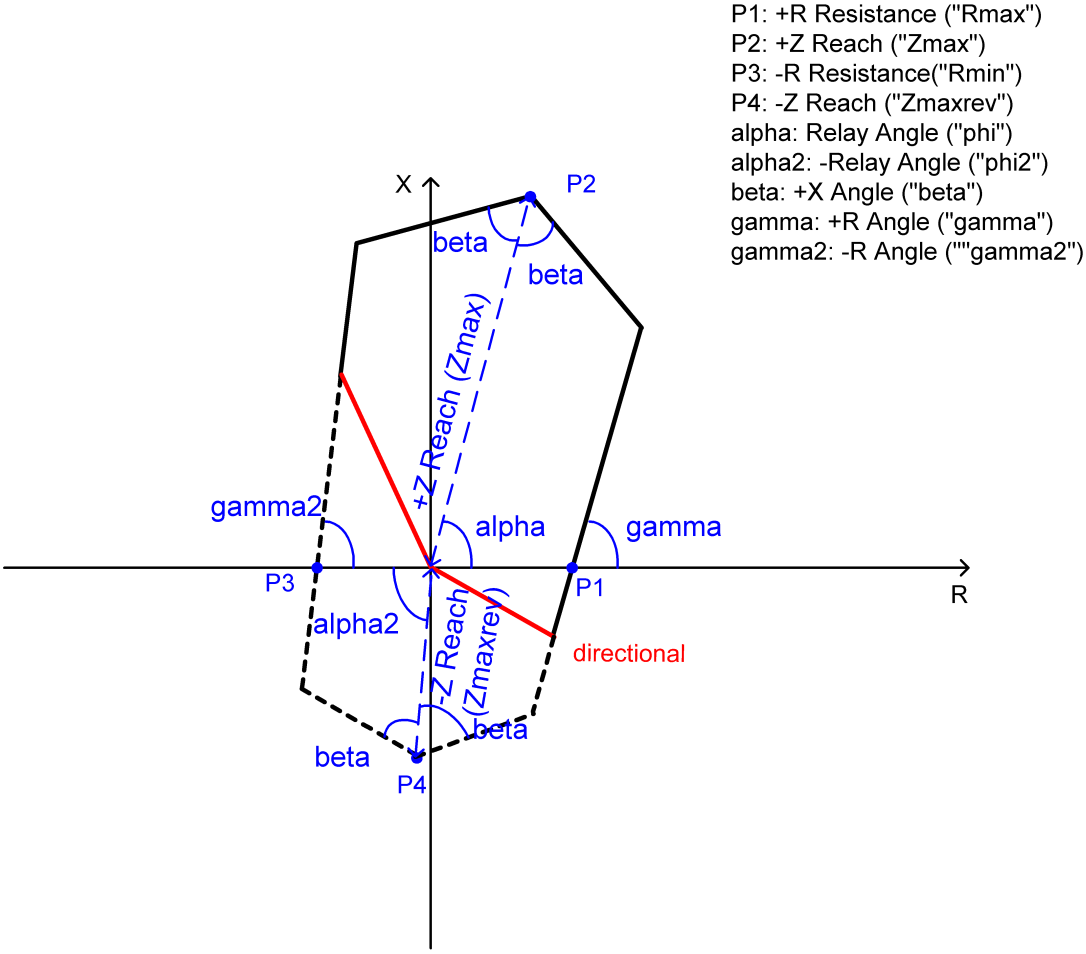


Figure 2.24: The *DIgSILENT* “GE Quadrilateral (Z) phase” type characteristic

+R Resistance can be defined in:

- sec. Ohm (secondary Ohm)
- R/X Ratio:+R Resistance = R/X Ratio*(+X Reach)

The *Z Reach* is equal to $ZReach * sin(\alpha)$ *-R Reach* can be defined in:

- sec. Ohm (secondary Ohm) as positive value
- R Ratio (-R/X): -R Reach = -R Ratio * (+X Reach)
- R Ratio (-R/R): -R Reach = -R Ratio * (+R Resistance)
- R Ratio (-R/-X): -R Reach = -R Ratio * (-X Reach)

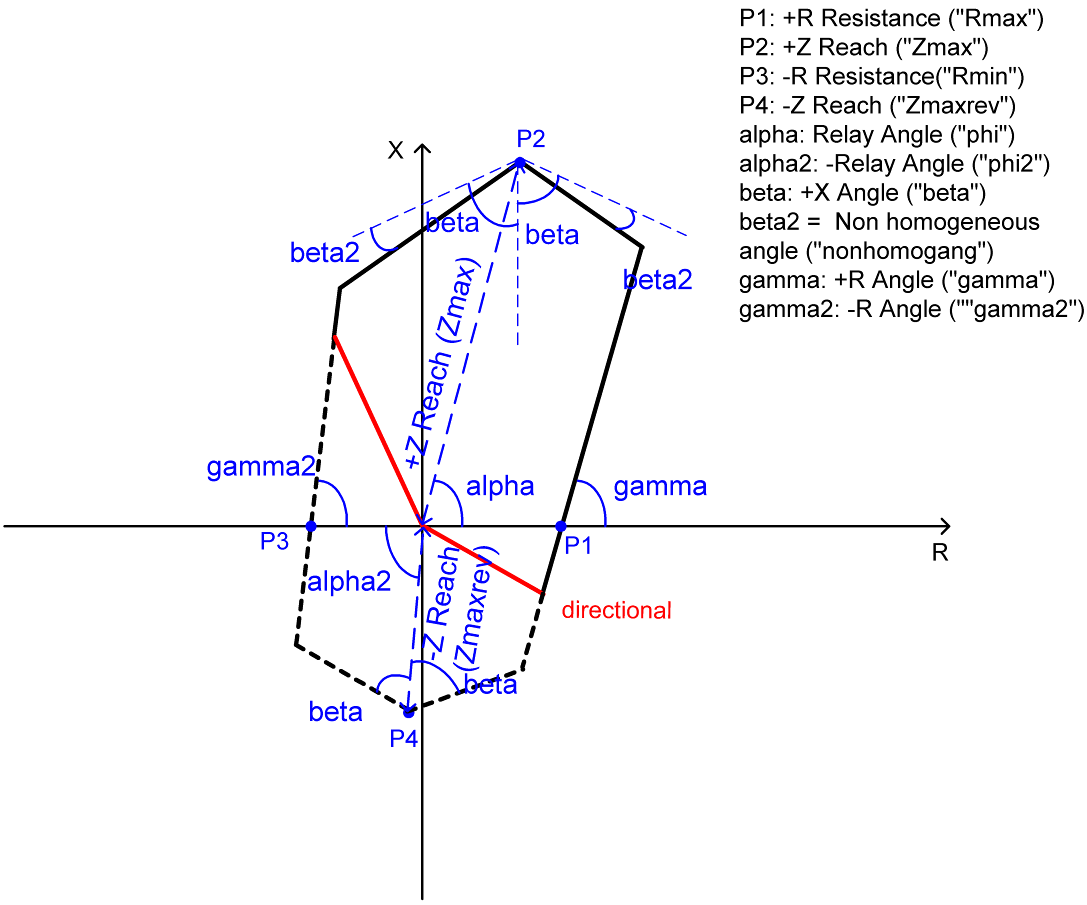


Figure 2.25: The *DIgSILENT* "GE Quadrilateral (Z) ground" type characteristic

2.2.2 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 Polygon*"RelDispoly" type class name is *TypDispoly* . The *Distance Polygon* dialogue class name is *RelDispoly*. 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 upon which of these versions is used and up on the selected *Type* ("ichatp" variable). The typical connection of a 3 phase *Distance Polygon* ("RelDispoly"class) block is showed in Figure 3.1.

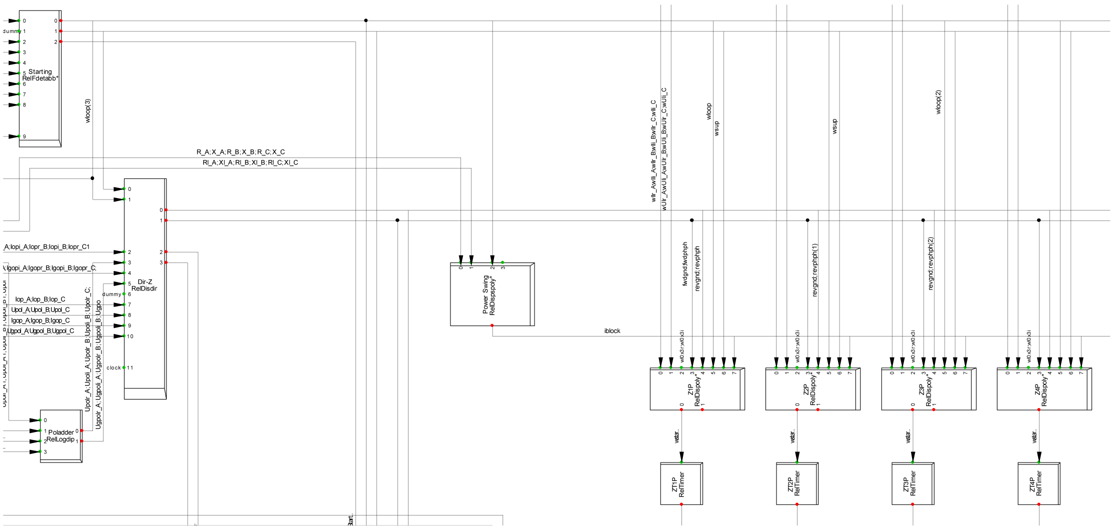


Figure 3.1: The *DIgSILENT PowerFactory* typical connection scheme of a 3 phase *Distance Polygon*"RelDispoly" block.

The "Z1P" block models the first trip zone so usually no delay is present but, in this relay model, a delay can be set for the first zone; for this reason the model includes the "Z1PD" block which simulates the timer associated to the first zone. The "ZP2" block models the 2nd zone and the delay is implemented by the "Z2PD" timer block. Identical scheme is used for the 3^{rd} and the 4^{th} zone blocks.
In an alternative configuration the trip of the polygonal block can be delayed connecting the "wtimer" input of the polygonal block to the output of a timer block.

The *Polygon*"RelDispoly" element has been conceived to work together with the following elements:

- Starting element ("RelFdetect" or "RelFdetsie", or "RelFdetabb", or "'RelFdetaegalst", or "'RelFdetalst" class).
- Polarizing element ("RelZpol" class).
- Directional element ("RelDisdir" class).
- Load encroachment element("RelDisloadenc" class).
- Power swing detection element ("RelDispspoly" class).
- Reclosing element ("RelRecl" class).

The polygon blocks represented in Figure 3.1 are getting the input signals from the Polarizing block (not shown in the picture), from the fault detector block ("Starting" block), from the directional block ("Dir-Z") and the power swing detection block ("Power Swing") : the Operating

Currents(*Iopr* and *Iopi*) and Voltages(*Uopr* and *Uopi*) are coming from the Polarizing block. The supervising signals (*wsup* and *wloop*) which enable the block to trip are provided by the fault detector block. The directional signals (“fwdphph”,
smarksrevphph,
smarksfwdgnd, and
smarksrevgnd) are provided by the directional block. The power swing block block inhibits the polygon block trip if a power swing condition has been detected setting the “iblock” input signal of the polygon block.

To control a *Polygon*“RelDispoly” 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 polygon*(“RelDispoly” class) element.

3.1 Calculation method

From a calculation point of view two families of polygonal/quadrilateral elements can be characterized:

- The Siemens (R,X) type
- Any other type

When the *Siemens (R,X)* type is set (“ichatp” setting) the block gets directly in the input signals the impedance values (see B.3.2). When any other type is set the block gets the operating current and the operating voltage value vectors.
For this reason the calculations performed by these two families of polygonal/quadrilateral elements to check if the power system working point is inside or is outside of the shape are made using different principles:

- the *Siemens (R,X)* type block checks merely in a graphic way (even-odd algorithm) that the impedance point is inside the polygon.

- Any other type block uses a vectorial approach: for each polygon (or quadrilateral) vertex a vector is generated; the angle between such vector multiplied by the operating current vector and the operating voltage vector must be smaller than 90 to declare the working point as internal to the shape.

4 Logic

4.1 Single phase

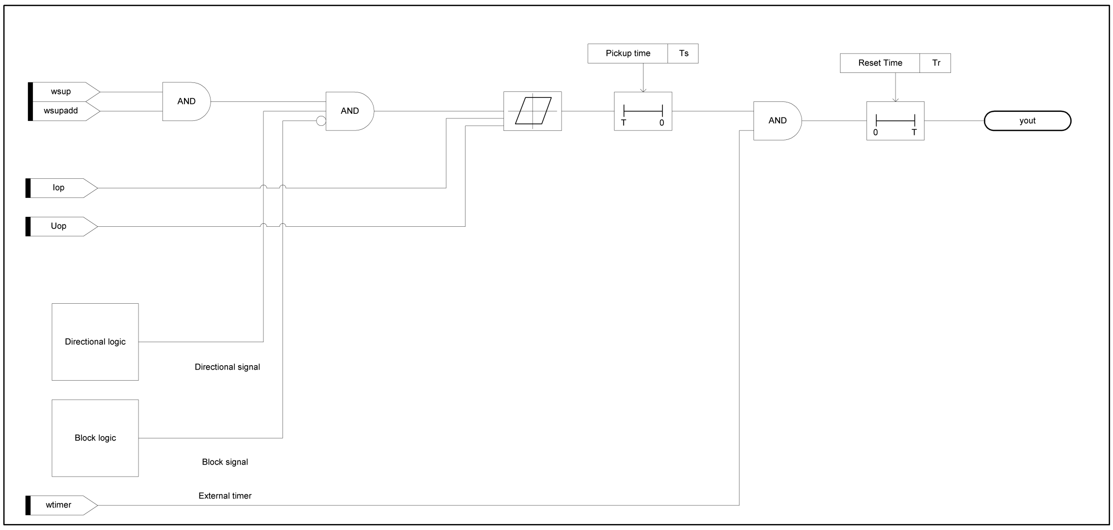


Figure 4.1: The *DIgSILENT Single phase Polygonal* logic

4.1.1 Asea RAZFE

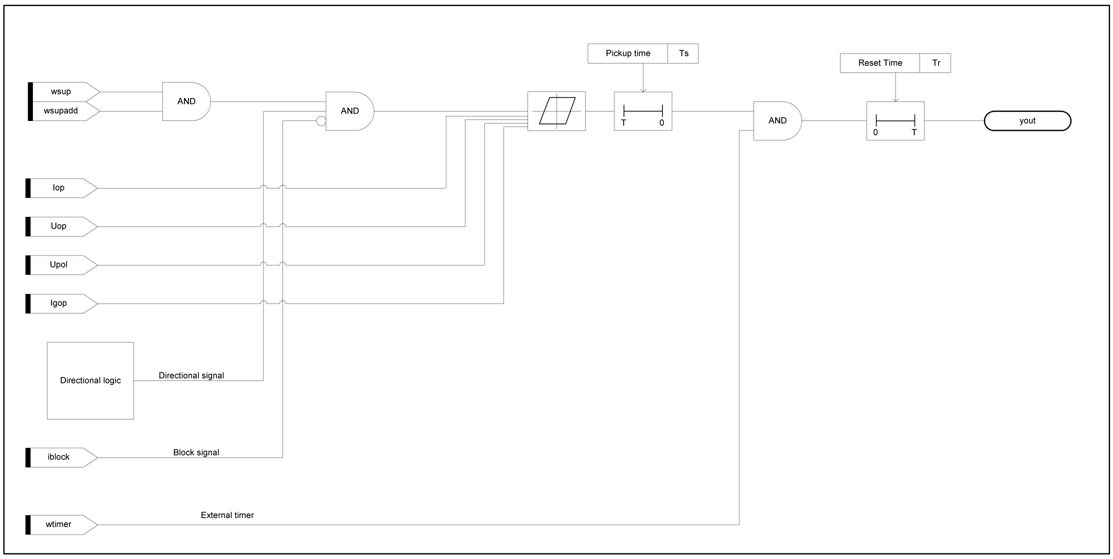
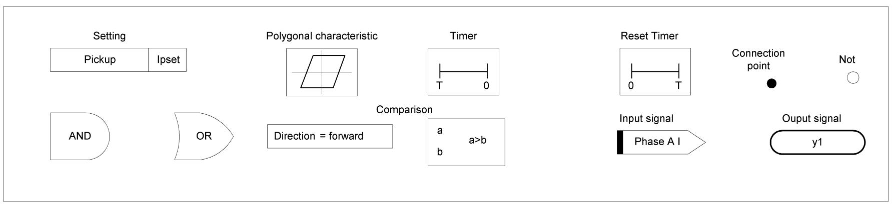


Figure 4.2: The *DIgSILENT Single phase Asea RAZFE Polygonal* logic



4.1.2 Block logic

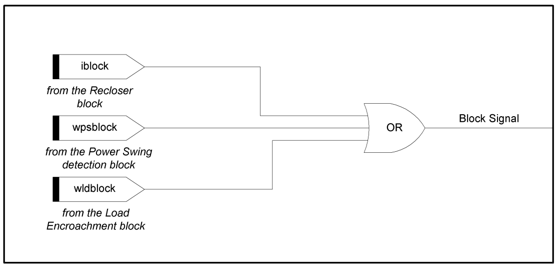


Figure 4.3: The *DIgSILENT Polygonal* Block logic

4.1.3 Directional logic

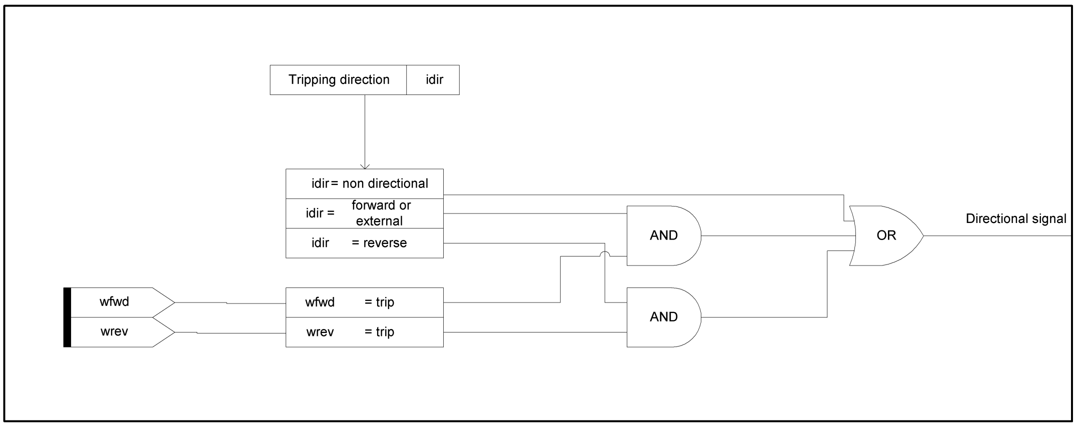
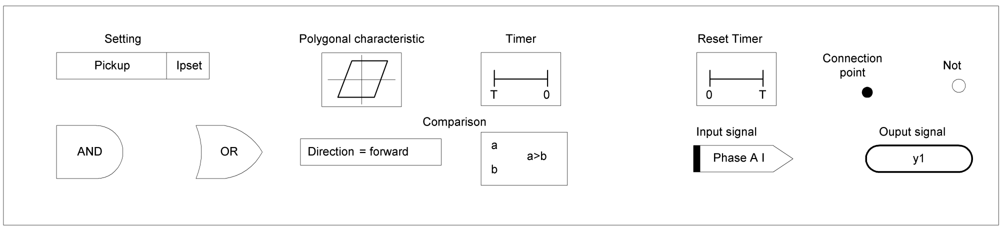


Figure 4.4: The *DIgSILENT Single phase Polygonal* Directional logic



4.2 3 phase

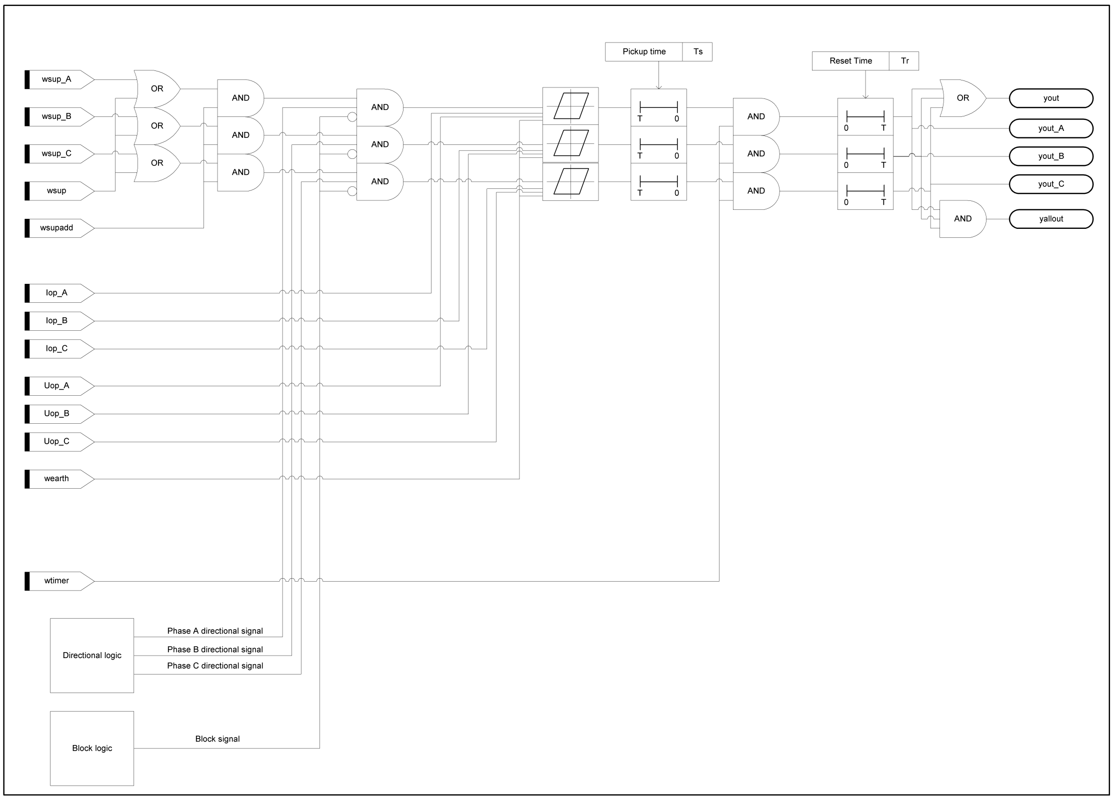
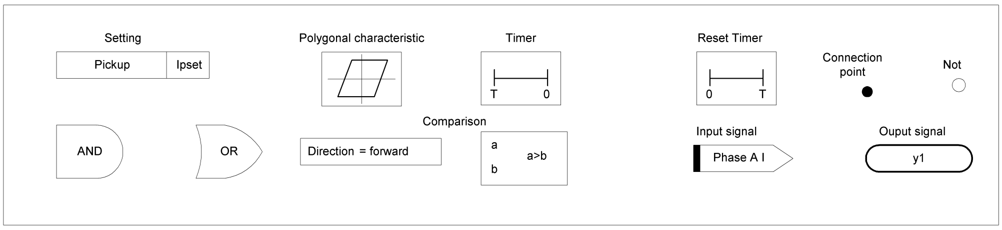


Figure 4.5: The *DIgSILENT 3 phase Polygonal* logic



4.2.1 ABB (R,X)

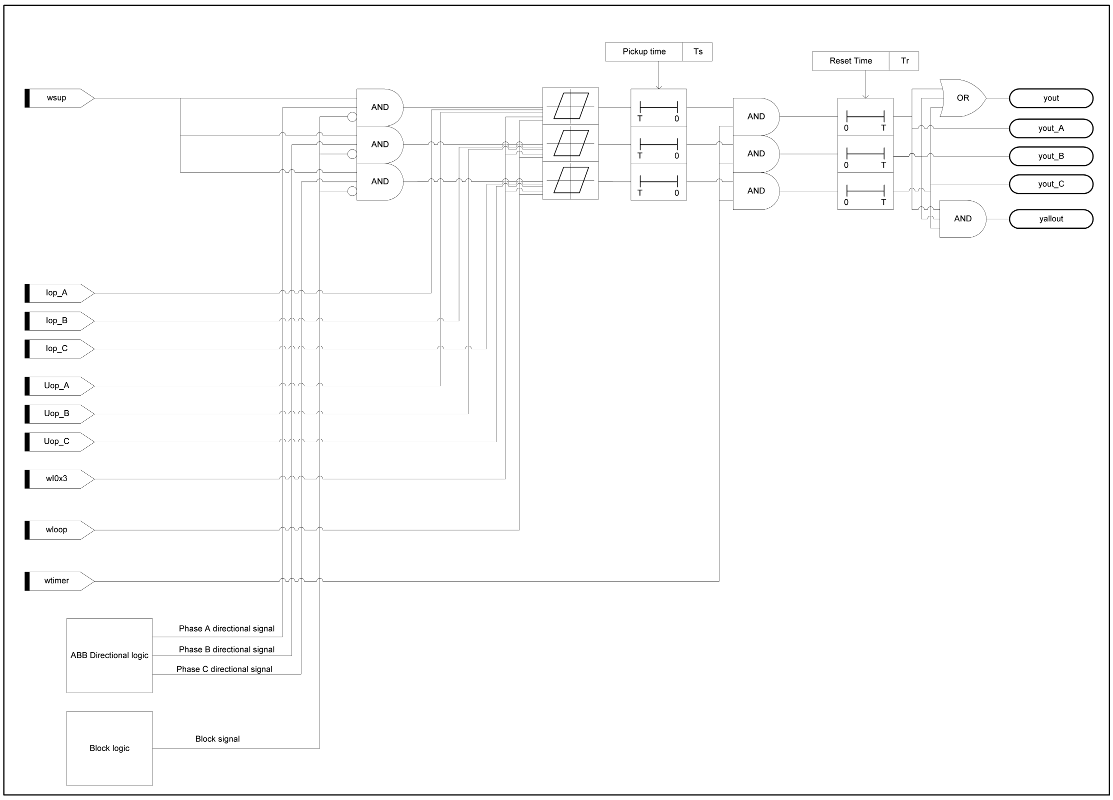
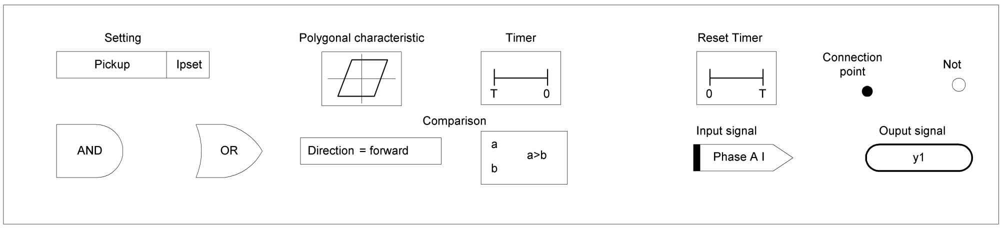


Figure 4.6: The *DIgSILENT 3 phase ABB(R,X)* logic



4.3 6 phase

4.3.1 ABB (R,X)

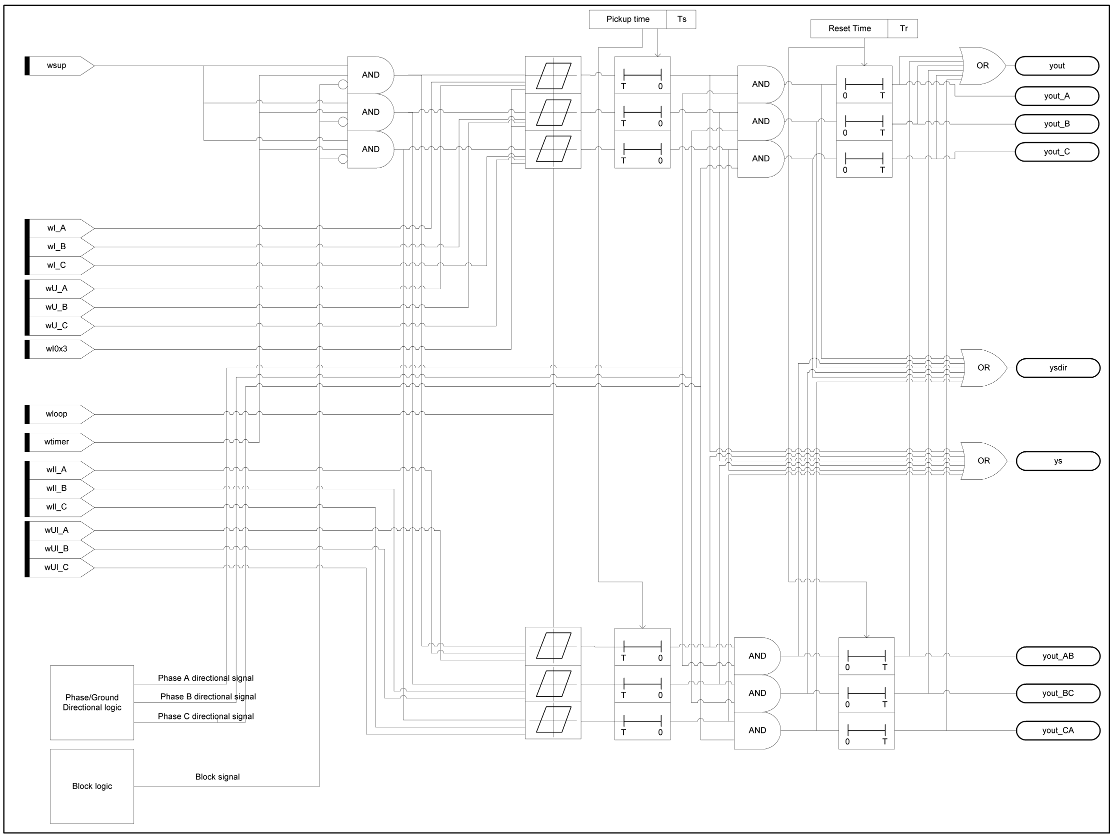
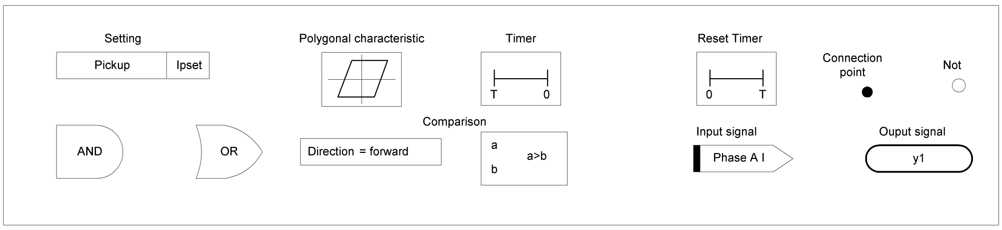


Figure 4.7: The *DIgSILENT 6 phase ABB (R,X)* logic



4.3.2 Siemens (R,X)

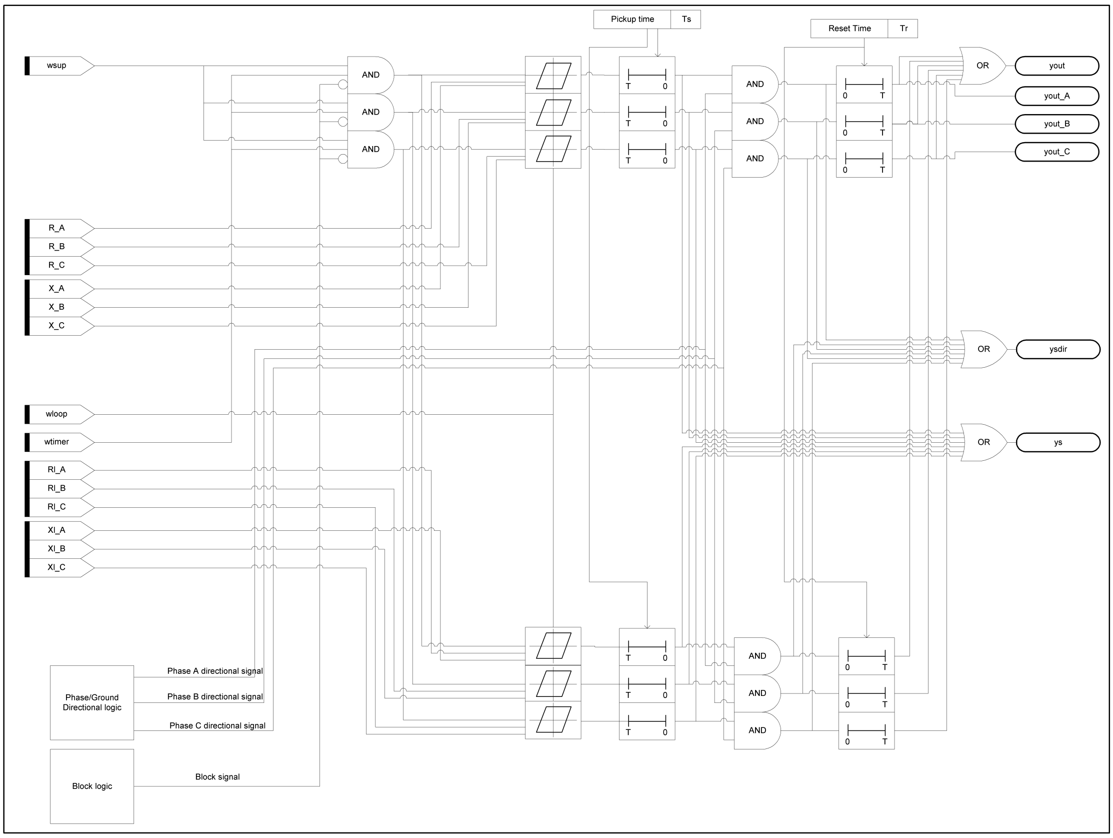
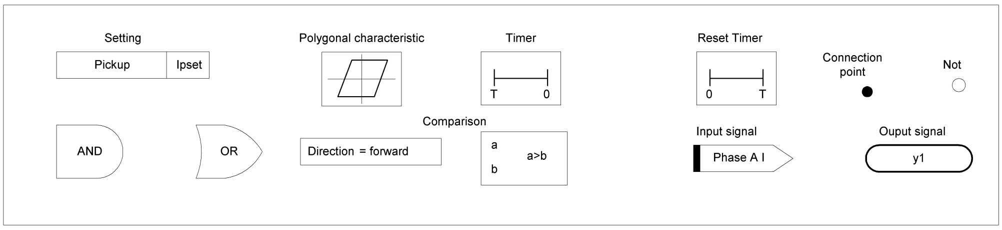


Figure 4.8: The *DIgSILENT 6 phase Siemens (R,X)* logic



4.3.3 Block logic

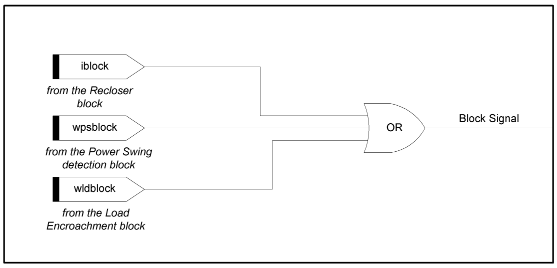


Figure 4.9: The *DIgSILENT 3/6 phase Polygonal* Block logic

4.3.4 Directional logic

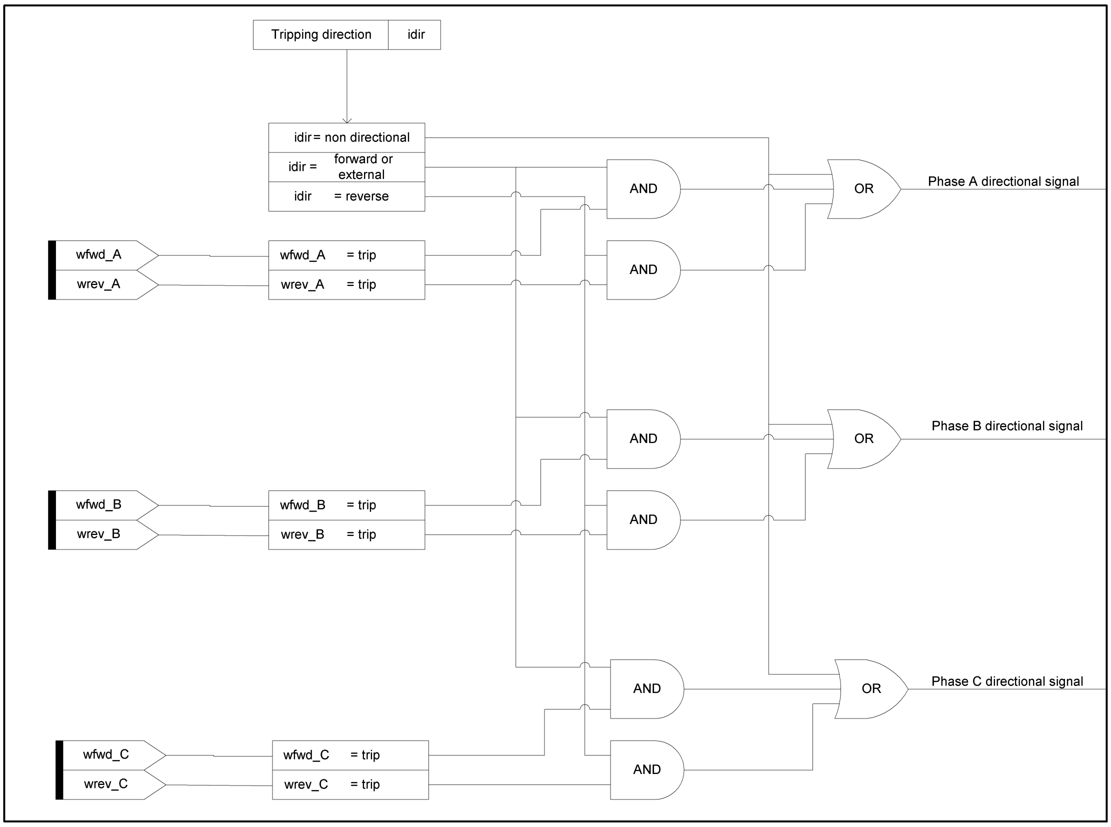
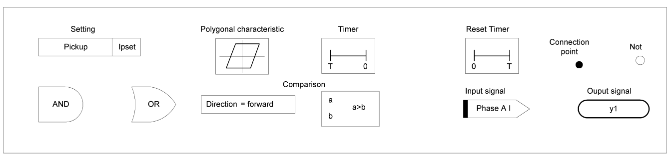


Figure 4.10: The *DIgSILENT 3/6 phase Polygonal Directional logic*



4.3.5 Phase/Ground Directional logic

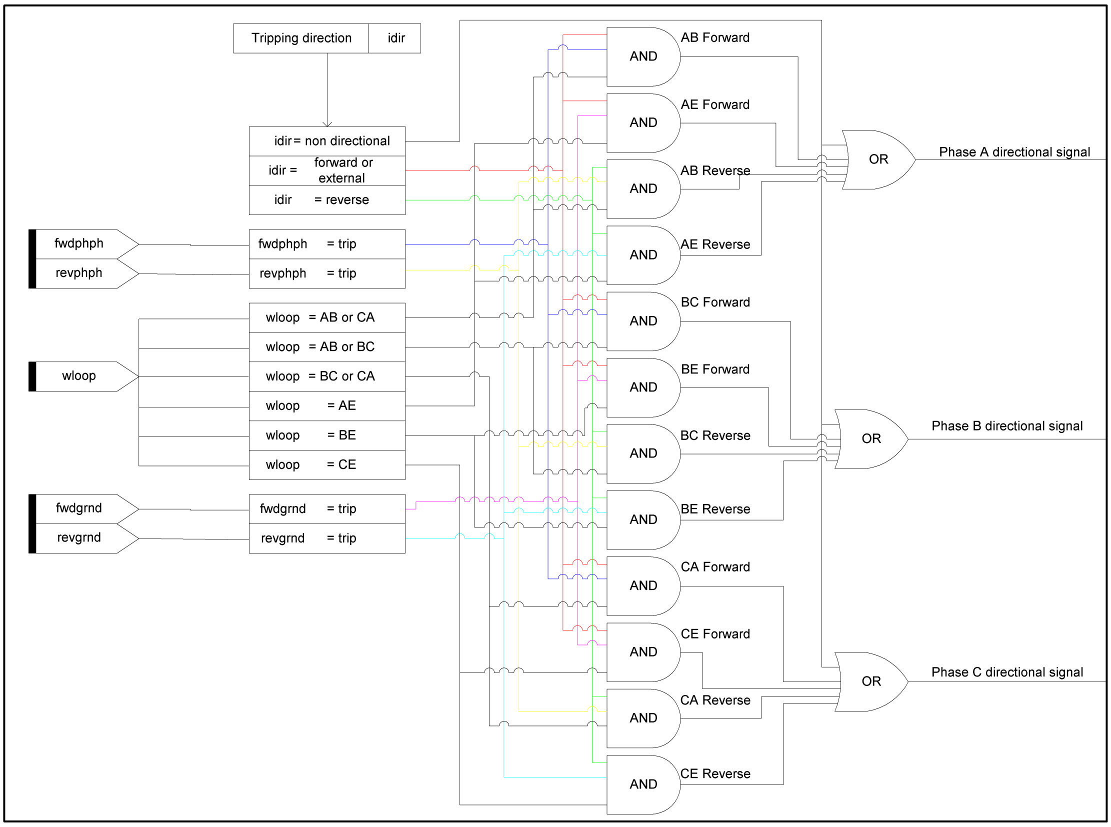


Figure 4.11: The *DIgSILENT 3/6 phase Phase/Ground Polygonal Directional logic*

4.4 Polygonal side calculation logic

When the impedance values are not provided but the operating current and the operating voltage values are available instead the calculation logic is based on a vectorial approach which is different if the block is directional or not.

4.4.1 Non directional

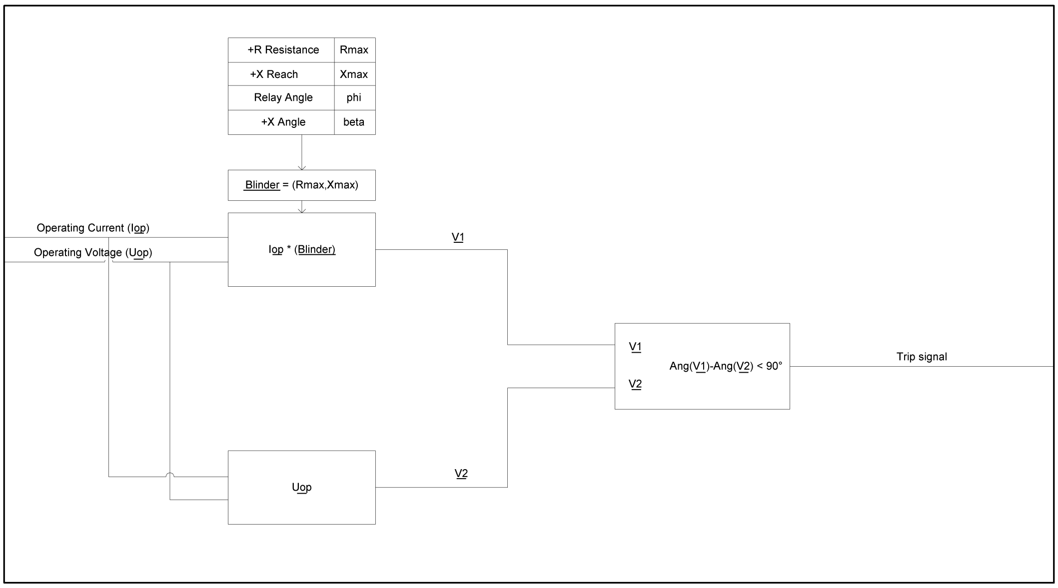


Figure 4.12: The *DIgSILENT Non directional polygon side calculation logic (i.e. Quadrilateral offset type)*

4.4.2 Directional)

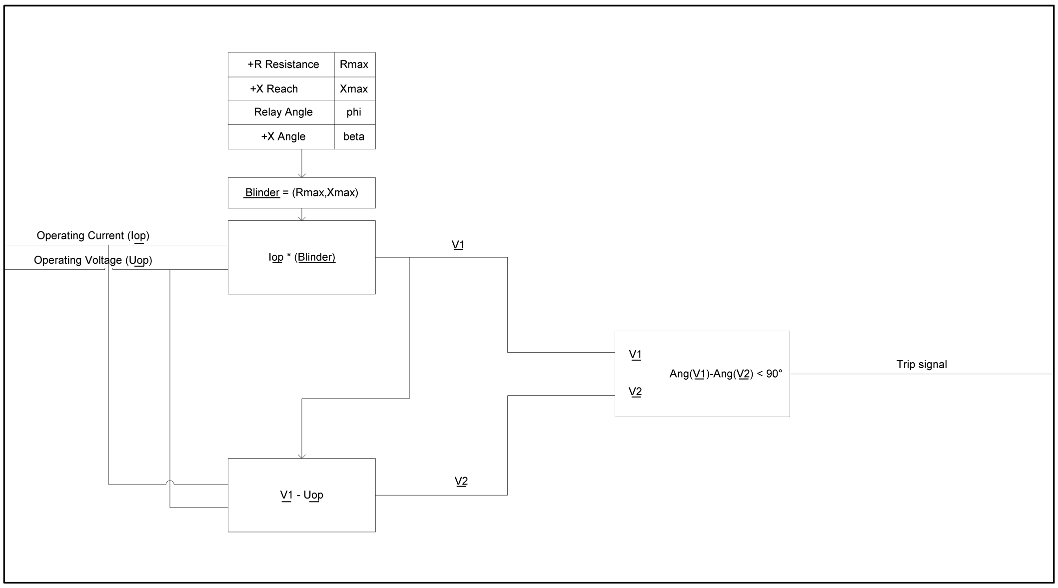


Figure 4.13: The *DIgSILENT Directional polygon side calculation logic (i.e. Quadrilateral type)*

4.5 Polygonal Siemens(R,X) calculation logic

When this polygonal type is selected the block get directly as input signal the impedance values of the power system working point. To detect if the point is inside or outside the shape the generic “even-odd” algorithm is used.
A general enunciation of the algorithm can be ”the rule determines the insideness of a point on the canvas by drawing a ray from that point to infinity in any direction and counting the number of path segments from the given shape that the ray crosses. If this number is odd, the point is inside; if even, the point is outside”. Considering that our polygon is a simple polygon, the *DIgSILENT PowerFactory* implementation of the ray casting algorithm consecutively checks intersections of a ray with all sides of the polygon in turn.
More info about such algorithm can be found on Internet
(i.e. http://en.wikipedia.org/wiki/Point_in_polygon).

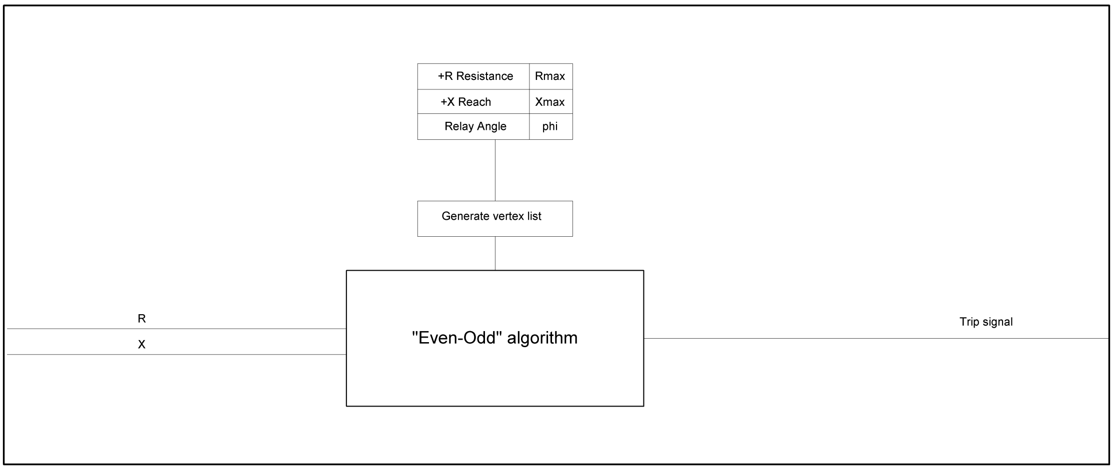


Figure 4.14: The *DIgSILENT Polygonal Siemens(R,X) calculation logic*

A Parameter Definitions

A.1 Distance Polygonal Type (TypDispoly)

Table A.1: Input parameters of Distance Polygonal type (*TypDispoly*)

Parameter	Description	Unit
loc_name	The name assigned by the user to the Polygonal type object	Text
sfiec	IEC symbol label displayed as info in the *RelDispoly* dialogue	Text
sfansi	ANSI symbol label displayed as info in the *RelDispoly* 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 polygonal characteristic	Integer
iusage	The usage of the polygonal characteristic (it can be 0 = “Starting zone” or 1 = “Zone”)	Integer
prefblock	Reference block pointer	Pointer
ichatp	The type of polygonal block(“Quadilateral”,“Quadrilateral ofset”,“Polygonal (+R,+X)” etc)	Integer
iextdir	External Directional flag	Y/N
isiemrx	Shape selector (available only when *ichatp* is “Siemens (R,X)”, “Quadrilateral Z”, and “ABB (R,X)”	Integer
idirpos	Available direction options (“None”, “None”, “Forward”, “None”, “Forward”, “Reverse” etc)	Integer
hsalgconf	High speed algorithm (available only when *ichatp* is “ABB (R,X)”)	Integer
rXmax	Range of “+X Reach”	Text
rX1PP	Range of “X1PP”	Text
rX1RvPP	Range of “X1RvPP”	Text
rX1PE	Range of “ X1PE”	Text
rX1RvPE	Range of “ X1RvPE”	Text
rZmax	Range of “ Z reach”	Text
rZmaxrev	Range of “-Z reach” (available only when *ichatp* is “GE Quadrilateral”	Text
rRmax	Range of “ +R Reach”	Text
iRmax	Unit used by Rmax (sec.Ohm, Ratio (+R/+X))	Integer
rREmax	Range of “ +R (PH-E) Reach”	Text
rkrmax	Range of “R/X Ratio”	Text
rXmin	Range of “ -X Reach”	Text
iXmin	Unit used by Xmin (sec. Ohm, Ratio X/X)	Integer
rkxmin	Range of “ -X/X Ratio”	Text
rRFPP	Range of “ RFPP”	Text
rRFRvPP	Range of “ RFRvPP”	Text
rRFPE	Range of “ RFPE ”	Text
rRFRvPE	Range of “ RFRvPE ”	Text
rR1PP	Range of “ R1PP”	Text
rR1PE	Range of “ R1PE”	Text
rRmin	Range of “ -R Reach ”	Text
iRmin	Unit used by Rmin (sec.Ohm, Ratio (-R/X), Ratio (-R/R), Ratio (-R/-X))	Integer
rkrmin	Range of “ -R Ratio ”	Text
rX0PE	Range of “X0PE”	Text
rX0RvPE	Range of “X0RvPE”	Text
rR0PE	Range of “ R0PE ”	Text
rk0	Range of “k0”	Text
rphik0	Range of “phik0”	Text
rtilt	Range of “Tilt Resistance”	Text
iRtilt	Unit used by Rtilt (sec.Ohm, Ratio (R/X), Ratio (R/+R))	Integer
rkrtilt	Range of “Rtilt Ratio”	Text
rphi	Range of “ Relay Angle”	Text
rphi2	Range of “-Relay Angle” (available only when *ichatp* is“GE Quadrilateral (Z)”	Text
ralpha	Range of “ -X Angle”	Text
rbeta	Range of “ +X Angle”	Text
rgamma	Range of “+R Angle” (available only when *ichatp* is“GE Quadrilateral (Z)”	Text
rgamma2	Range of “-R Angle” (available only when *ichatp* is“GE Quadrilateral (Z)”	Text
rdR	Range of “dR”	Text
rdX	Range of “dX”	Text
rkR	Range of “kR”	Text
rkX	Range of “kX”	Text
rdZ	Range of “dZ”	Text
iz1loadcomp	Flag to enable the load compensation (ABB (R,X) type, 5xx shape only)	Integer

Table A.1: Input parameters of Distance Polygonal type (*TypDispoly*)

Parameter	Description	Unit
rnonhomogang	Range of the non homogeneous angle (available only when *ichatp* is“GE Quadrilateral (Z)”)	Text
Ts	Pickup Time	Seconds
Tr	Reset Time	Seconds
Kr	Reset Ratio	Real

A.2 Distance Polygonal Element (RelDispoly)

Table A.2: Input parameters of Distance Polygonal element (*RelDispoly*))

Parameter	Description	Unit
loc_name	The name assigned by the user to the polygonal object	Text
typ_id	Pointer to the relevant TypDispoly object	Pointer
idir	Tripping Direction(it can be “Forward” = 0 or “Reverse” = 1 or “None” = 2)	Integer
outserv	Flag to put Out of service the element	Integer
Xmax	+X Reach	Sec. Ohm
cpXmax	+X Reach	Primary Ohm
Zmax	Z reach	Sec. Ohm
cpZmax	Z reach	Primary Ohm
Zmaxrev	Z reach (reverse direction)	Sec. Ohm
cpZmaxrev	Z reach (reverse direction)	Primary Ohm
X1PP	X1PP	Sec. Ohm
cpX1PP	X1PP	Primary Ohm
X1RvPP	X1RvPP (reverse direction)	Sec. Ohm
cpX1RvPP	X1RvPP (reverse direction)	Primary Ohm
X1PE	X1PE	Sec. Ohm
cpX1PE	X1PE	Primary Ohm
X1RvPE	X1RvPE (reverse direction)	Sec. Ohm
cpX1RvPE	X1RvPE (reverse direction)	Primary Ohm
Rmax	+R Reach	Sec. Ohm / Real number
cpRmax	+R Reach	Primary Ohm / Real number
Krmax	R/X Ratio	Real number
Xmin	-X Reach	Sec. Ohm / Real number
cpXmin	-X Reach	Primary Ohm / Real number
Kxmin	-X/X Ratio	Real number
RFPP	RFPP	Sec. Ohm
cpRFPP	RFPP	Primary Ohm
RFRvPP	RFRvPP (reverse direction)	Sec. Ohm
cpRFRvPP	RFRvPP (reverse direction)	Primary Ohm
RFPE	RFPE	Sec. Ohm
cpRFPE	RFPE	Primary Ohm
RFRvPE	RFRvPE (reverse direction)	Sec. Ohm
cpRFRvPE	RFRvPE (reverse direction)	Primary Ohm
R1PP	R1PP	Sec. Ohm
cpR1PP	R1PP	Primary Ohm
R1PE	R1PE	Sec. Ohm
cpR1PE	R1PE	Primary Ohm
Rmin	-R Reach	Sec. Ohm / Real number
cpRmin	-R Reach	Primary Ohm / Real number
Krmin	R Ratio	Real number
X0PE	X0PE	Sec. Ohm
cpX0PE	X0PE	Primary Ohm
X0RvPE	X0RvPE (reverse direction)	Sec. Ohm
cpX0RvPE	X0RvPE (reverse direction)	Primary Ohm
R0PE	R0PE	Sec. Ohm
cpR0PE	R0PE	Primary Ohm
Rtilt	Tilt Resistance	Sec. Ohm / Real number
cpRtilt	Tilt Resistance	Primary Ohm / Real number
Krtilt	Rtilt Ratio	Real number
Phi	Relay Angle	Real number

Table A.2: Input parameters of Distance Polygonal element (*RelDispoly*))

Parameter	Description	Unit
Phi2	Relay Angle in the reverse direction	Real number
Alpha	-X Angle	Real number
Beta	+X Angle	Real number
gamma	+R Angle (available only when *ichatp* is“GE Quadrilateral (Z)”	Real number
gamma2	-R Angle (available only when *ichatp* is“GE Quadrilateral (Z)”	Real number
nonhomogang	Non homogeneous angle (ABB (R,X) ”6xx series comp lines” shape, ph-ground)	Real number
dR	dR (resistance addictive factor)	Sec. Ohm
cpdR	dR (resistance addictive factor)	Primary Ohm
dX	dX (reactance addictive factor)	Sec. Ohm
cpdX	dX (reactance addictive factor)	Primary Ohm
kR	kR (resistance multiplicative factor)	Real number
kX	kX (reactance multiplicative factor)	Real number
dZ	dZ (impedance addictive factor)	Sec. Ohm
cpdZ	dZ (impedance addictive factor)	Primary Ohm

B Signal Definitions

B.1 Single phase

Table B.1: Input/output signals of the single phase Distance Impedance element (*CalDispoly1p*)

Name	Description	Unit	Type	Model
Iopr	Phase operating current real part	Sec Amps	IN	Any
Iopi	Phase operating current imaginary part	Sec Amps	IN	Any
Uopr	Operating voltage real part	Sec V	IN	Any
Uopi	Operating voltage imaginary part	Sec V	IN	Any
fwd	Directional forward signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
rev	Directional reverse signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsup	Supervising Signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsupadd	Supervising additional signal (free signal)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wtimer	Timer Signal(used to add an additional delay to the trip time)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wldblock	Block signal coming from the *Load encroachment* element	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wpsblock	Block signal coming from the *Power Swing* element	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
yout	Tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any

B.1.1 RAZFE

Table B.2: Input/output signals of the single phase RAZFE Distance Impedance element (*CalDispoly1p*)

Name	Description	Unit	Type	Model
Iopr	Phase operating current real part	Sec Amps	IN	Any
Iopi	Phase operating current imaginary part	Sec Amps	IN	Any
Igopr	Ground operating current real part	Sec Amps	IN	Any
Igopi	Ground operating current imaginary part	Sec Amps	IN	Any
Uopr	Operating voltage real part	Sec V	IN	Any
Uopi	Operating voltage imaginary part	Sec V	IN	Any
Upolr	Polarizing voltage real part	Sec V	IN	Any
Upoli	Polarizing voltage imaginary part	Sec V	IN	Any
fwd	Directional forward signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
rev	Directional reverse signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsup	Supervising Signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsupadd	Supervising additional signal (free signal)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wearthfault	Ground fault flag input signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any

Table B.2: Input/output signals of the single phase RAZFE Distance Impedance element (*CalDispoly1p*)

Name	Description	Unit	Type	Model
wtimer	Timer Signal(used to add an additional delay to the trip time)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
yout	Tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any

B.2 3 phase

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

Name	Description	Unit	Type	Model
Iopr_A	Operating current phase A real part	Sec Amps	IN	Any
Iopi_A	Operating current phase A imaginary part	Sec Amps	IN	Any
Iopr_B	Operating current phase B real part	Sec Amps	IN	Any
Iopi_B	Operating current phase B imaginary part	Sec Amps	IN	Any
Iopr_C	Operating current phase C real part	Sec Amps	IN	Any
Iopi_C	Operating current phase C imaginary part	Sec Amps	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
wsup_A	Phase A supervising Signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsup_B	Phase B supervising Signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsup_C	Phase C supervising Signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsupadd	Supervising additional signal (free signal)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wtimer	External timer input signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wearth	Ground fault flag input signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wfwd_A	Phase A forward current signal	Seconds (or 1/0 RMS/EMT simulation)	IN	Any
wfwd_B	Phase B forward current signal	Seconds (or 1/0 RMS/EMT simulation)	IN	Any
wfwd_C	Phase C forward current signal	Seconds (or 1/0 RMS/EMT simulation)	IN	Any
wrev_A	Phase A reverse current signal	Seconds (or 1/0 RMS/EMT simulation)	IN	Any
wrev_B	Phase B reverse current signal	Seconds (or 1/0 RMS/EMT simulation)	IN	Any
wrev_C	Phase C reverse current signal	Seconds (or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wldblock	Block signal coming from the *Load encroachment* element	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wpsblock	Block signal coming from the *Power Swing* element	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
yallout	3 ph tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
yout	Tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_A	Phase A tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_B	Phase B tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_C	Phase C tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any

B.2.1 ABB (R,X)

Table B.4: Input/output signals of the 3 phase ABB Distance Polygonal element (*CalDisabbrx*)

Name	Description	Unit	Type	Model
wIr_A	Operating current phase A real part	Sec Amps	IN	Any
wIi_A	Operating current phase A imaginary part	Sec Amps	IN	Any
wIr_B	Operating current phase B real part	Sec Amps	IN	Any
wIi_B	Operating current phase B imaginary part	Sec Amps	IN	Any
wIr_C	Operating current phase C real part	Sec Amps	IN	Any
wIi_C	Operating current phase C imaginary part	Sec Amps	IN	Any
wI0x3r	Operating ground current real part	Sec Amps	IN	Any
wI0x3i	Operating ground current imaginary part	Sec Amps	IN	Any
wUr_A	Operating voltage phase A real part	Sec V	IN	Any
wUi_A	Operating voltage phase A imaginary part	Sec V	IN	Any

Table B.4: Input/output signals of the 3 phase ABB Distance Polygonal element (*CalDisabbrx*)

Name	Description	Unit	Type	Model
wUr_B	Operating voltage phase B real part	Sec V	IN	Any
wUi_B	Operating voltage phase B imaginary part	Sec V	IN	Any
wUr_C	Operating voltage phase C real part	Sec V	IN	Any
wUi_C	Operating voltage phase C imaginary part	Sec V	IN	Any
wloop	Id containing the code of the faulted loop	Integer	IN	Any
wsup	Supervising signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wtimer	External timer input signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
fwdgnd	Directional ground forward signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
revgnd	Directional ground reverse signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
fwdphph	Directional phase forward signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
revphph	Directional phase reverse signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wldblock	Block signal coming from the *Load encroachment* element	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wpsblock	Block signal coming from the *Power Swing* element	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
yallout	3 ph tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
yout	Tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_A	Phase A tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_B	Phase B tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_C	Phase C tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
hs_out	High speed tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any

B.3 6 phase

B.3.1 ABB (R,X)

Table B.5: Input/output signals of the 6 phase ABB Distance Polygonal element (*CalDisabbrx6p*)

Name	Description	Unit	Type	Model
wIlr_A	Ph-ph operating current phase A real part	Sec Amps	IN	Any
wIli_A	Ph-ph operating current phase A imaginary part	Sec Amps	IN	Any
wIlr_B	Ph-ph operating current phase B real part	Sec Amps	IN	Any
wIli_B	Ph-ph operating current phase B imaginary part	Sec Amps	IN	Any
wIlr_C	Ph-ph operating current phase C real part	Sec Amps	IN	Any
wIli_C	Ph-ph operating current phase C imaginary part	Sec Amps	IN	Any
wIr_A	Phase-grnd operating current phase A real part	Sec Amps	IN	Any
wIi_A	Phase-grnd operating current phase A imaginary part	Sec Amps	IN	Any
wIr_B	Phase-grnd operating current phase B real part	Sec Amps	IN	Any
wIi_B	Phase-grnd operating current phase B imaginary part	Sec Amps	IN	Any
wIr_C	Phase-grnd operating current phase C real part	Sec Amps	IN	Any
wIi_C	Phase-grnd operating current phase C imaginary part	Sec Amps	IN	Any
wI0x3r	Operating ground current real part	Sec Amps	IN	Any
wI0x3i	Operating ground current imaginary part	Sec Amps	IN	Any
wUlr_A	Ph-ph operating voltage phase A real part	Sec V	IN	Any
wUli_A	Ph-ph operating voltage phase A imaginary part	Sec V	IN	Any
wUlr_B	Ph-ph operating voltage phase B real part	Sec V	IN	Any
wUli_B	Ph-ph operating voltage phase B imaginary part	Sec V	IN	Any
wUlr_C	Ph-ph operating voltage phase C real part	Sec V	IN	Any
wUli_C	Ph-ph operating voltage phase C imaginary part	Sec V	IN	Any
wUr_A	Phase-grnd operating voltage phase A real part	Sec V	IN	Any

Table B.5: Input/output signals of the 6 phase ABB Distance Polygonal element (*CalDisabbrx6p*)

Name	Description	Unit	Type	Model
wUi_A	Phase-grnd operating voltage phase A imaginary part	Sec V	IN	Any
wUr_B	Phase-grnd operating voltage phase B real part	Sec V	IN	Any
wUi_B	Phase-grnd operating voltage phase B imaginary part	Sec V	IN	Any
wUr_C	Phase-grnd operating voltage phase C real part	Sec V	IN	Any
wUi_C	Phase-grnd operating voltage phase C imaginary part	Sec V	IN	Any
wloop	Id containing the code of the faulted loop	Integer	IN	Any
wsup	Supervising signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
fwdgnd	Directional ground forward signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
revgnd	Directional ground reverse signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
fwdphph	Directional phase forward signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
revphph	Directional phase reverse signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wtimer	Timer Signal (used to add an additional delay to the trip time)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wldblock	Block signal coming from the *Load encroachment* element	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wpsblock	Block signal coming from the *Power Swing* element	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
yout	Tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_A	Phase A tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_B	Phase B tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_C	Phase C tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_AB	Loop AB tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_BC	Loop BC tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_CA	Loop CA tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
hs_out	High speed tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
yloop	Faulted loop ID	Integer	OUT	Any

B.3.2 Siemens (R,X)

Table B.6: Input/output signals of 6 phase Siemens Distance Polygonal element (*CalDissierx*)

Name	Description	Unit	Type	Model
R_A	Resistance loop AE	Sec Ohms	IN	Any
R_B	Resistance loop BE	Sec Ohms	IN	Any
R_C	Resistance loop CE	Sec Ohms	IN	Any
X_A	Reactance loop AE	Sec Ohms	IN	Any
X_B	Reactance loop BE	Sec Ohms	IN	Any
X_C	Reactance loop CE	Sec Ohms	IN	Any
Rl_A	Resistance loop AB	Sec Ohms	IN	Any
Rl_B	Resistance loop BC	Sec Ohms	IN	Any
Rl_C	Resistance loop CA	Sec Ohms	IN	Any
Xl_A	Reactance loop AB	Sec Ohms	IN	Any
Xl_B	Reactance loop BC	Sec Ohms	IN	Any
Xl_C	Reactance loop CA	Sec Ohms	IN	Any

Table B.6: Input/output signals of 6 phase Siemens Distance Polygonal element (*CalDissierx*)

Name	Description	Unit	Type	Model
fwdgnd	Directional ground forward signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
revgnd	Directional ground reverse signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
fwdphph	Directional phase forward signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
revphph	Directional phase reverse signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsup	Supervising signal	Seconds(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)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
Tdelay	Time delay (used to get the external timer time delay)	Seconds	IN	Any
wldblock	Block signal coming from the *Load encroachment* element	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wpsblock	Block signal coming from the *Power Swing* element	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
iblock	Blocking signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
yout	Tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_A	Phase A tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_B	Phase B tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_C	Phase C tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
ys	Start signal (without directional check)	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
ysdir	Start signal (with directional check)	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any

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