DIgSILENT

POWERFACTORY

PowerFactory 2021

Technical Reference

Distance Blinder

RelDisbl, TypDisbl

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

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Contents

1 General Description

The *Distance Blinder* (“RelDisbl” class) block implements a distance zone delimited by a straight line in the RX(resistance-reactance) or in the GB(conductance-susceptance) diagram. The distance characteristic type can be one of the following:

- Reactive Blinder
- Resistive Blinder
- Negative Reactive Blinder
- Negative Resistive Blinder
- Admittive Blinder
- Conductive Blinder
- Negative Admittive Blinder
- Negative Conductive Blinder

The *Distance Blinder* “RelDisbl” block is operational during short circuit, load flow and RMS/EMT simulations. There is no available graphical representation in *DIgSILENT PowerFactory* of the GB(conductance-susceptance) diagram.

2 Features & User interface

2.1 Distance Blinder (RelDisbl)

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

2.1.1 Basic data

The “Distance blinder” *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 blinder characteristic (i.e. *Resistive Blinder)*

The block can be disabled using the “Out of service” check box (“outserv” parameter).

The other graphical controls are combo boxes for ranges of discrete values otherwise edit boxes.

The “Relay Angle” setting (“phi” parameter) is always available and is user configurable if a range definition has been inserted in the Distance Blinder Type dialogue(“TypDisbl”class).

The selected type of *Blinder* characteristic (see 2.2.2) defines which setting is available between the following:

- Resistance (“R” parameter)
- Reactance (“X” parameter)
- Conductance (“G” parameter)
- Susceptance (“B” parameter)

2.1.2 Description

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

The *Distance blinder* block main characteristics must be configured in the “Distance Blinder Type” dialogue (*TypDisbl* class). The dialogue doesn’t contain any tab page, all parameters are showed in the dialogue unique page.

The followings values should be set:

- The “IEC Symbol” (“sfiec” parameter), only for documentation purpose.
- The “ANSI Symbol” (“sfansi” parameter), only for documentation purpose.
- The number of phases (“iphases” parameter).
- The unit type (*Phase-Phase*, *Earth*, *3-Phase*, *Multifunctional*) (“aunit” parameter)
- The number of the protective zone at which the Blinder characteristic belongs (“izone” parameter).
- The *Digital* (“idigital” parameter) flag to activate the digital trip logic.
- The Blinder type (“ichatp” parameter).
- The calculation method (“imethod” parameter).
- The range and the step of the variables used to represent the characteristic (*Resistance* “rR”, *Reactance* “rX”, *Conduttance*“rG”, *Susceptance*“rB” , *Relay Angle* “rphi”).

The number of phases (“iphases” parameter), the *Digital* (“idigital” parameter) flag and the calculation method (“imethod” parameter) affects the block inputs/outputs configuration.
The unit type (“aunit” parameter) is used by the RX diagram logic to decide, depending up on its “Relay Unit” setting (“ishow” parameter) value (“R-X Plot Setting” dialogue, “SetDisplt” class), if the blinder must be displayed.

2.2.1 Method

The “Method” (“imethod” parameter) setting has been added to support the special phase comparison algorithm used by some Enertec devices.
When the *Standard* “Method” has been selected and the *Digital* (“idigital” parameter) flag is not set the following equation is used:

$$\varphi = \angle(\bar{S_1}) - \angle(\bar{S_2})$$

$$Where\ \ \bar{S_1} = \bar{I} * \bar{Z}$$

$$\bar{S_2} = \bar{I} * \bar{Z} - \bar{U}$$

$$\bar{Z}\ is\ a\ phasor\ perpedicular\ to\ the\ blinder$$

A trip is declared when

$$\varphi < 90°$$

When the *Enertec* “Method” has been selected and the *Digital* (“idigital” parameter) flag is not set the following equations are used:

Phase fault:

$$\varphi = \angle(\bar{S_1}) - \angle(\bar{S_2}) + 90°$$

$$Where\ \ \bar{S_1} = \bar{U}_{op} - \bar{I}_{op} * \bar{Z}$$

$$\bar{S_2} = \bar{I}_{op}$$

$$\bar{Z}\ is\ a\ phasor\ perpedicular\ to\ the\ blinder$$

Ground fault ($I_{0x3} > 0$):

$$\varphi = \angle(\bar{S_1}) - \angle(\bar{S_2}) + 90°$$

$$Where\ \ \bar{S_1} = \bar{U}_{gop} - \bar{I}_{gop} * \bar{Z}$$

$\bar{S_2} = \bar{I}_{0x3}$ only for “izone” = 1

$\bar{S_2} = \bar{I}$ for “izone” ¿ 1

$$\bar{Z}\ is\ a\ phasor\ perpedicular\ to\ the\ blinder$$

A trip is declared when

$$\varphi < 90°$$

Please notice that, when the *Digital* (“idigital” parameter) flag is set, the element receive as input signal the impedance values, and a trip is declared only using geometrical considerations in the RX diagram.

2.2.2 Type

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

- Reactive Blinder
- Resistive Blinder
- Neg. Reactive Blinder
- Neg. Resistive Blinder
- Susceptive Blinder
- Conductive Blinder
- Neg. Susceptive Blinder
- Neg. Conductive Blinder

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.

Reactive Blinder :

It represents in the *R,X* diagram a line which is horizontal if the “Relay Angle” (“phi” parameter) is zero. The reactance value (“X” parameter) is the line intersection point with the X axis. The operating zone is for any reactance value smaller than reactance values which define the line.

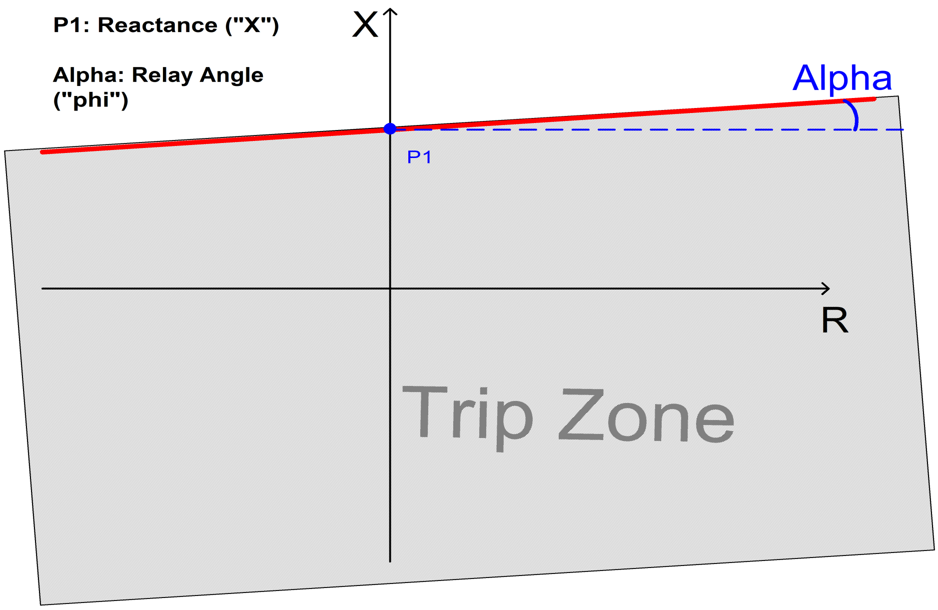


Figure 2.1: The *DIgSILENT* “Reactive Blinder” type characteristic

Resistive Blinder :

It’s in the *R,X* diagram a line which is vertical if the “Relay Angle” (“phi” parameter) is 90. The resistive value (“R” parameter) is the line intersection point with the positive part of the R axis. The operating zone is for any resistive value smaller than resistive values which define the line.

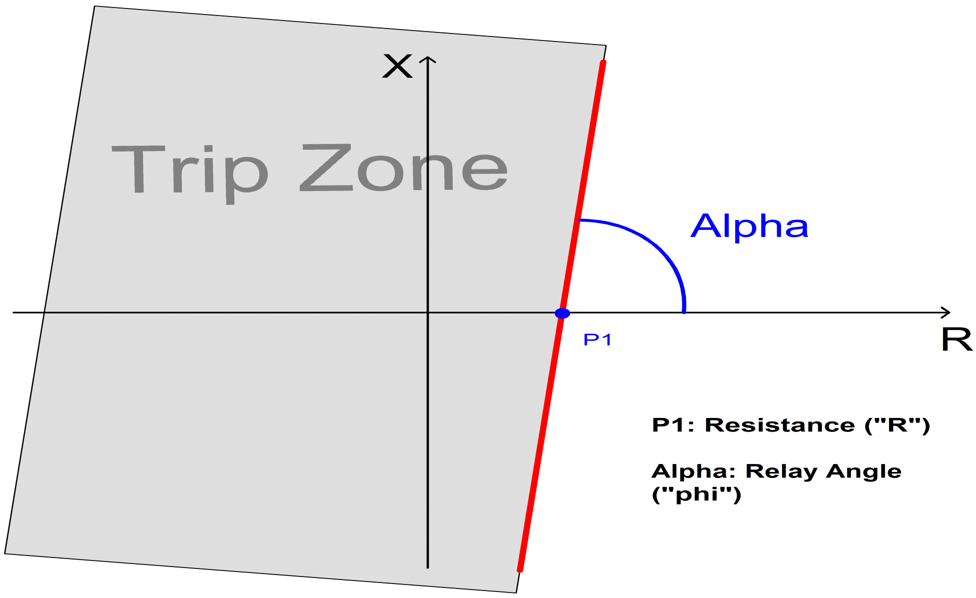


Figure 2.2: The *DIgSILENT* "Resitive Blinder" type characteristic

Neg. Reactive Blinder :

It's in the *R,X* diagram a line which is horizontal if the "Relay Angle" ("phi" parameter) is zero. The reactance value ("X" parameter) is the line intersection with the negative part of the X axis. The operating zone is for any reactance value greater than reactance values which define the line.

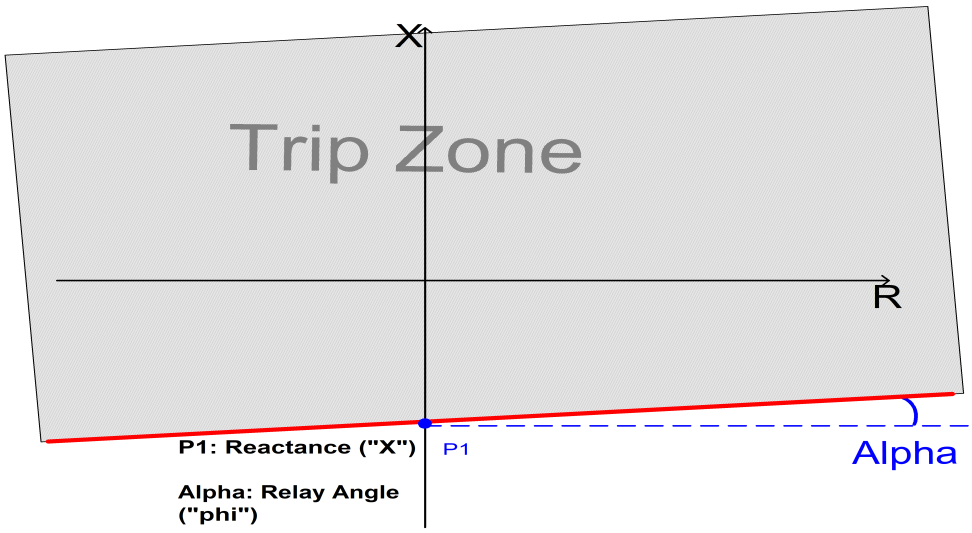


Figure 2.3: The *DIgSILENT* "Neg. Reactive Blinder" type characteristic

Neg. Resistive Blinder :

It's in the *R,X* diagram a line which is vertical if the "Relay Angle" ("phi" parameter) is 90. The resistive value ("R" parameter) is the line intersection point with the negative part of the R axis.

The operating zone is for any resistive value greater than resistive values which define the line.

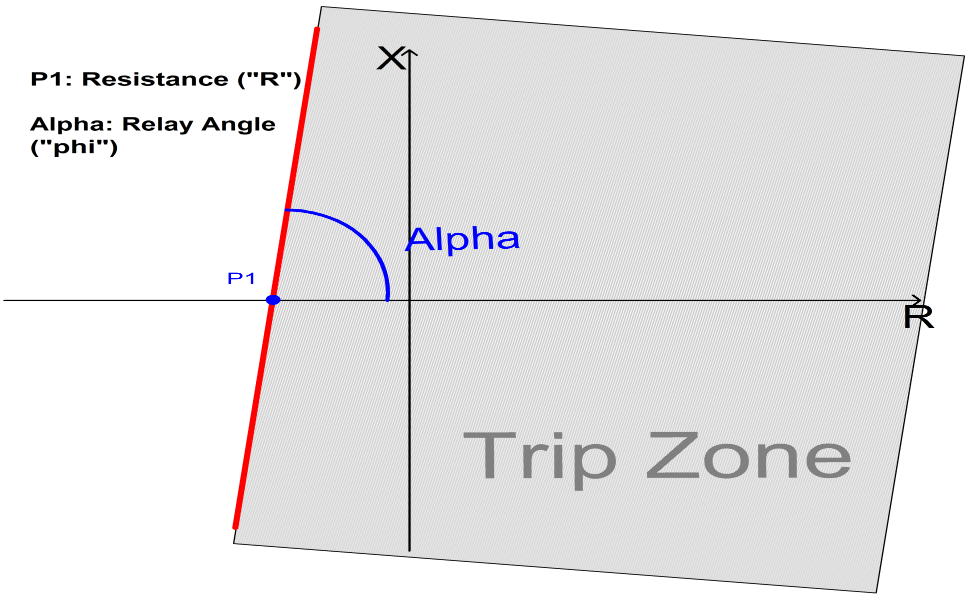


Figure 2.4: The *DIgSILENT* "Neg. Resistive Blinder" type characteristic

Susceptive Blinder :

It's in the *G,B* diagram a line (constant susceptance value) which is horizontal if the "Relay Angle" ("phi" parameter) is zero. The susceptance value ("B" parameter) is the line intersection with the positive part of the B axis.The operating zone is for any susceptance value smaller than susceptance value which defines the line.

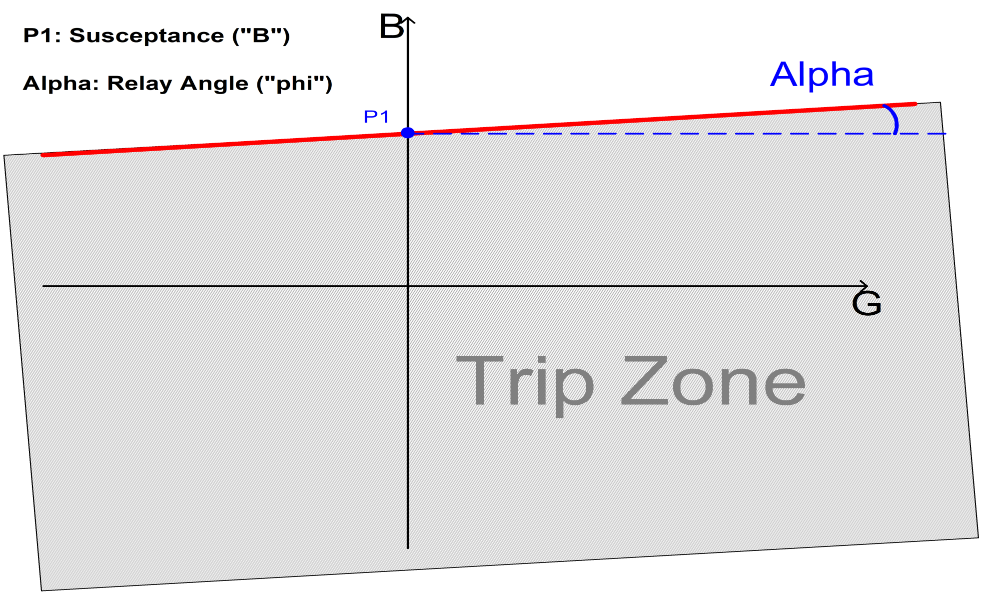


Figure 2.5: The *DIgSILENT* "Susceptive Blinder" type characteristic

Conductive Blinder :

It's in the *G,B* diagram a line which is vertical if the "Relay Angle" ("phi" parameter) is 90. The conductive value ("G" parameter) is the line intersection with the positive part of the G axis. The operating zone is for any conductive value smaller than conductive value which defines the line.

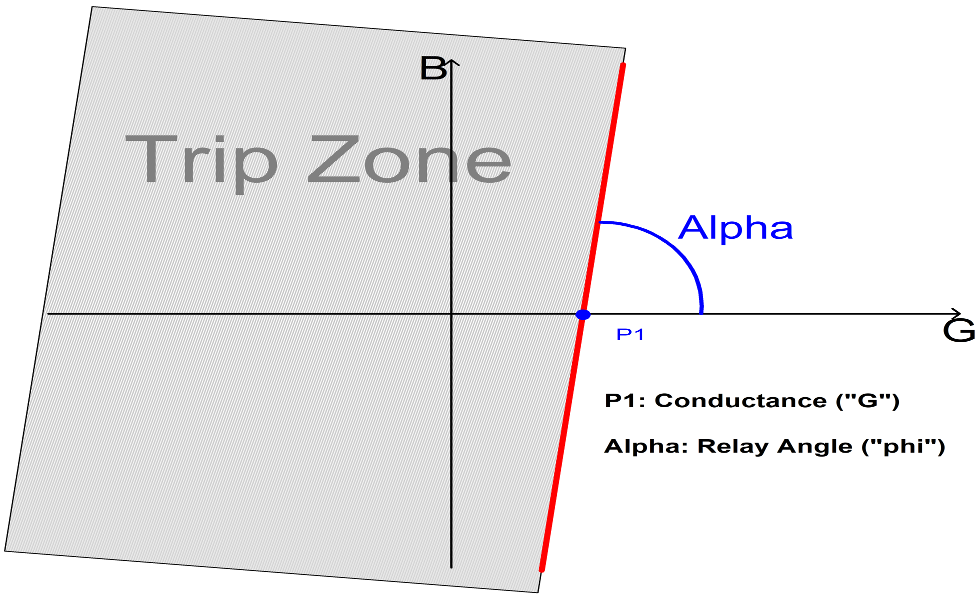


Figure 2.6: The *DIgSILENT* "Conductive Blinder" type characteristic

Neg. Susceptive Blinder :

It's in the *G,B* diagram a line which is horizontal if the "Relay Angle" ("phi" parameter) is zero. The susceptance value ("B" parameter) is the line intersection with the negative part of the B axis. The operating zone is for any susceptance value greater than susceptance value which defines the line.

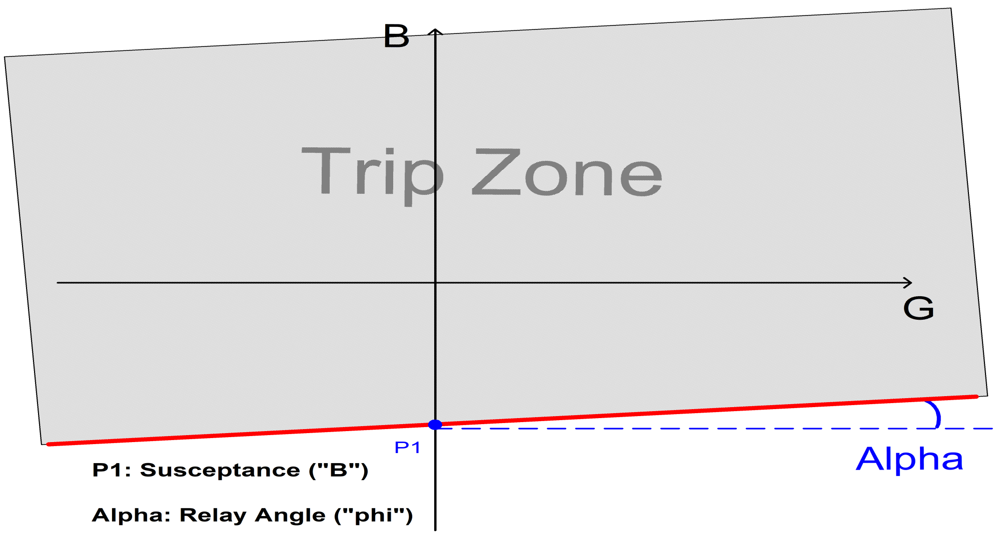


Figure 2.7: The *DIgSILENT* "Neg. Susceptive Blinder" type characteristic

Neg. Conductive Blinder :

It's in the *G,B* diagram a line which is vertical if the "Relay Angle" ("phi" parameter) is 90. The conductive value ("G" parameter) is the line intersection with the negative part of the G axis. The operating zone is for any conductive value greater than conductive value which defines the line.

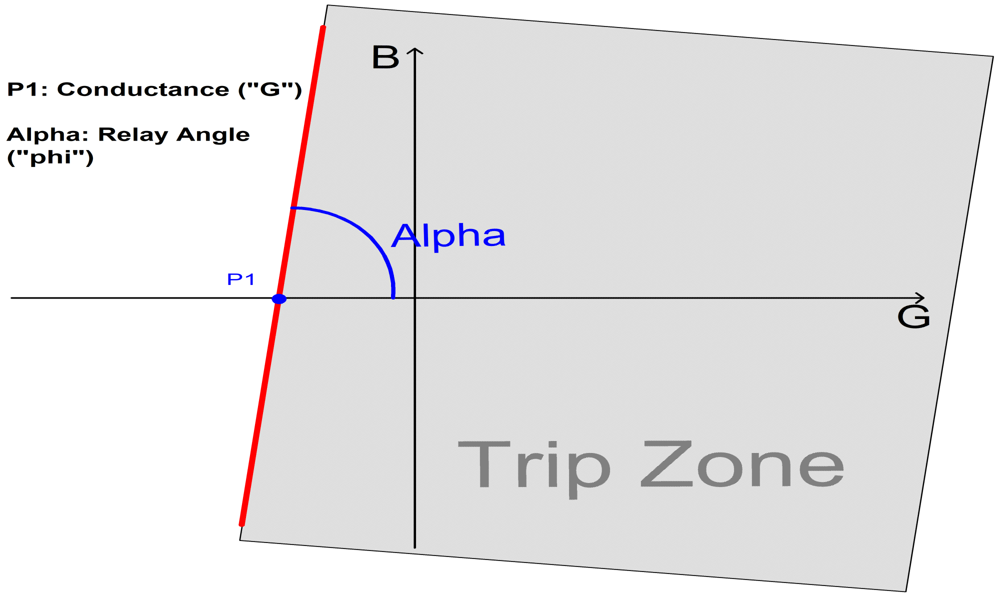


Figure 2.8: The *DIgSILENT* "Negative Conductive Blinder" type characteristic

2.2.3 Pickup and reset parameters

The settings which define the trip *Pickup Time*, the trip *Reset Time* and the *Reset Ratio* are showed at the bottom of the dialogue. They define the delays at the element pickup and reset; the *Reset Ratio* setting ("Kr"variable) is a multiplier which is used to define an impedance reset zone larger than the blinder line 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 Blinder*"RelDisbl" type class name is "TypDisbl ". The *Distance Blinder* dialogue class name is *RelDisbl*. There are five main versions of the block: a single phase, a three phase version both of which can be analog or digital and a 3 phase analog version using the *Enertec* trip logic (see 2.2.1). The number and the name of the input signals depends only on which of these versions is used. The typical connection of a 3 phase *Distance Blinder* ("RelDisbl"class) block is showed in Figure 3.1.

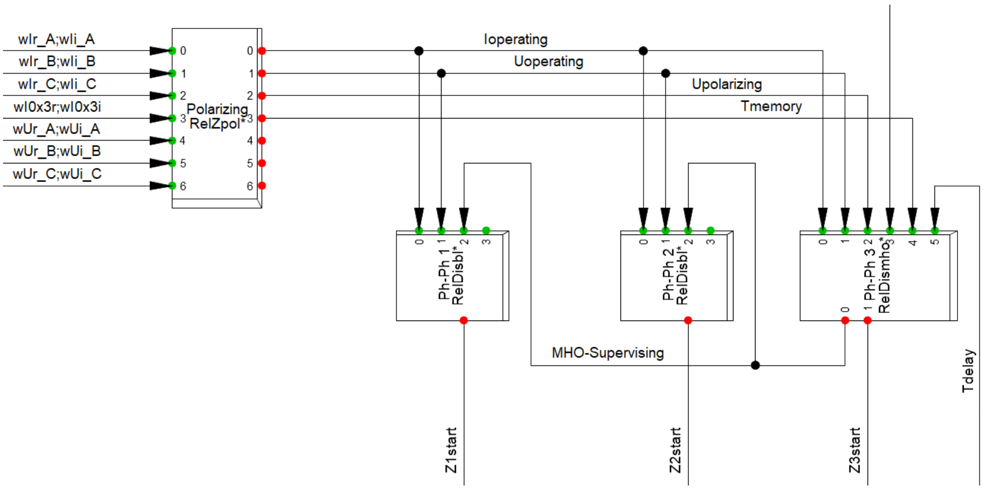


Figure 3.1: The *DIgSILENT PowerFactory* typical connection scheme of a 3 phase *Distance blinder*"RelDisbl "block.

"Ph-Ph 1" and "Ph-Ph 1" are two 3 phase *Distance Blinders* which works together with the "Ph-Ph 3" distance mho to define a trip zone in the RX diagram. The "y_A", "y_B" and "y_C" phase starting outputs of the mho element are connected by the "MHO-Supervising" signal to the Distance Blinder phase supervisioning input signals "wsup_A", "wsup_B" and "wsup_C".
In that way the blinders can recognize the fault only after that it has been detected by the mho element.

Both the blinders blocks and the mho block get the input signals from the Polarizing block: the phase Operating Currents(*Iopr_A*,*Iopi_A*,*Iopr_B*,*Iopi_B*,*Iopr_C*,*Iopi_C*) and Voltages(*Uopr_A*,*Uopi_A*, *Uopr_B*,*Uopi_B*, *Uopr_C*,*Uopi_C*) provides to the blinders all info they need for their trip logic. The starting signals provided by the fault detector (not represented in the figure) is received only by the mho element.

4 Logic

4.1 Single phase

4.1.1 Analog

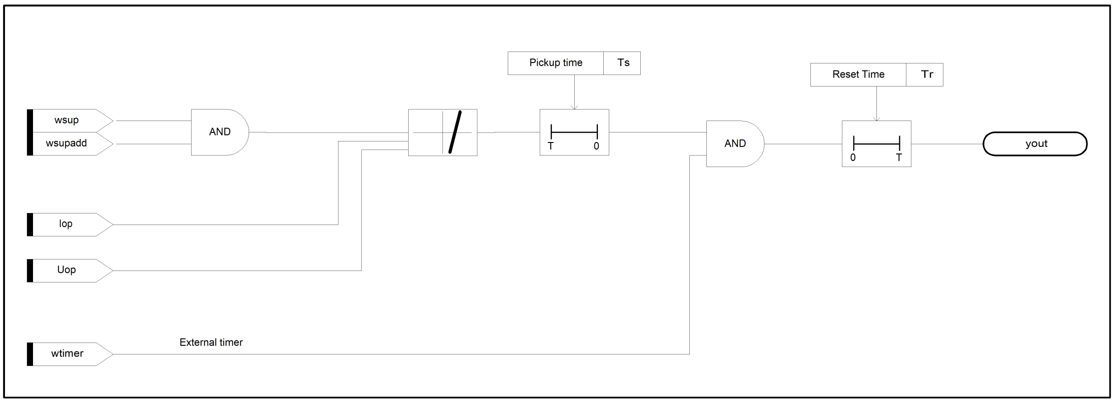


Figure 4.1: The *DIgSILENT Single phase Distance Analog Blinder* logic

4.1.2 Digital

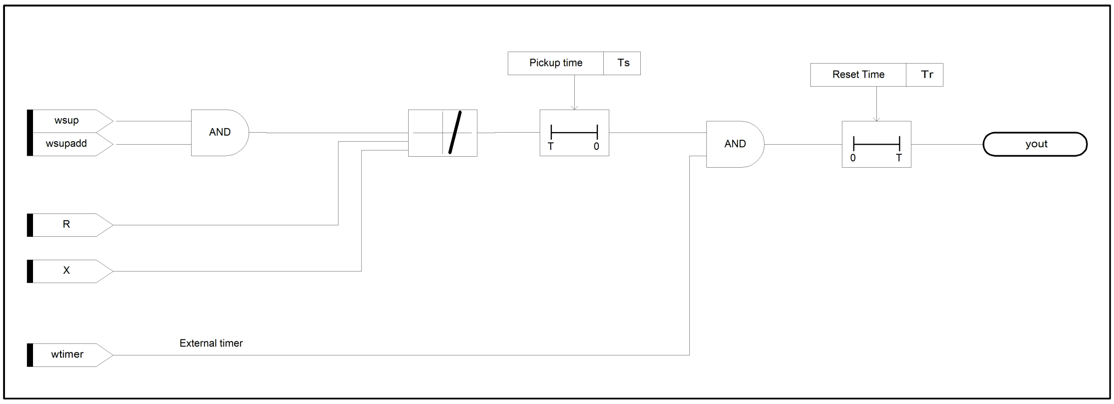
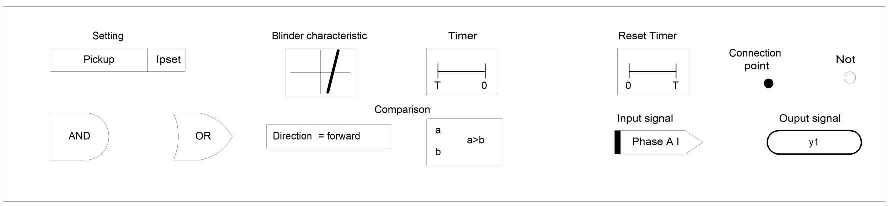


Figure 4.2: The *DIgSILENT Single phase Distance Digital Blinder* logic



4.2 3 phase

4.2.1 Analog

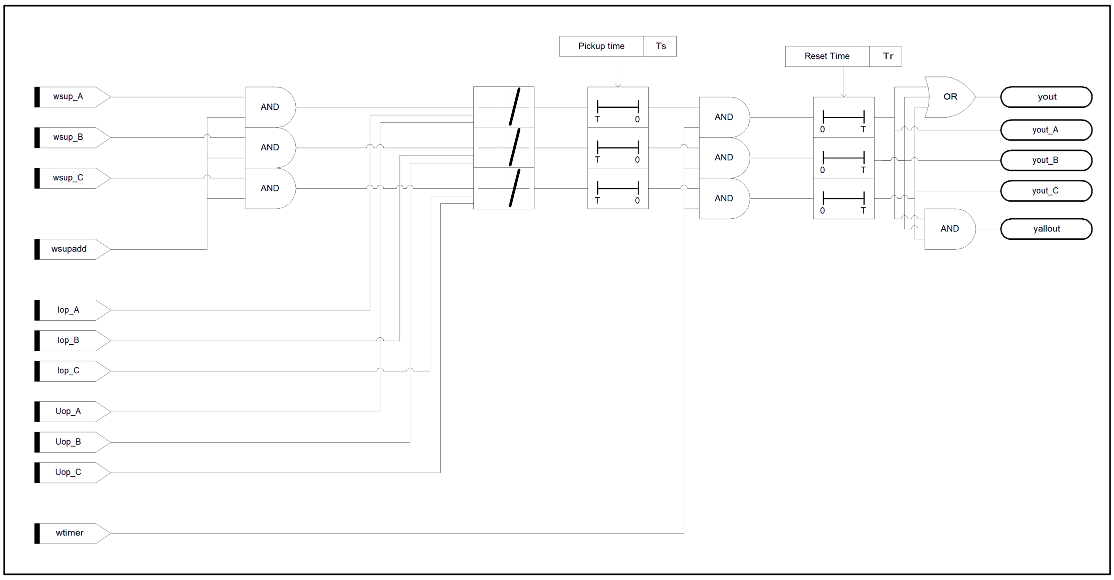


Figure 4.3: The *DIgSILENT 3 phase Distance Blinder* logic

4.2.2 Digital

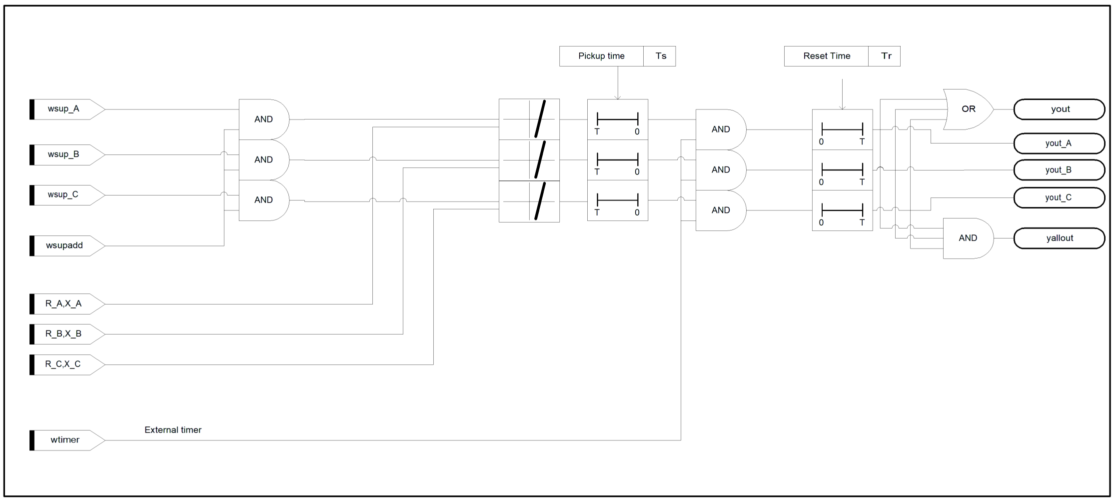
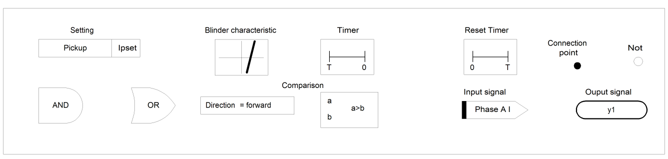


Figure 4.4: The *DIgSILENT 3 phase Distance Digital Blinder* logic



4.2.3 Analog Enerted Method

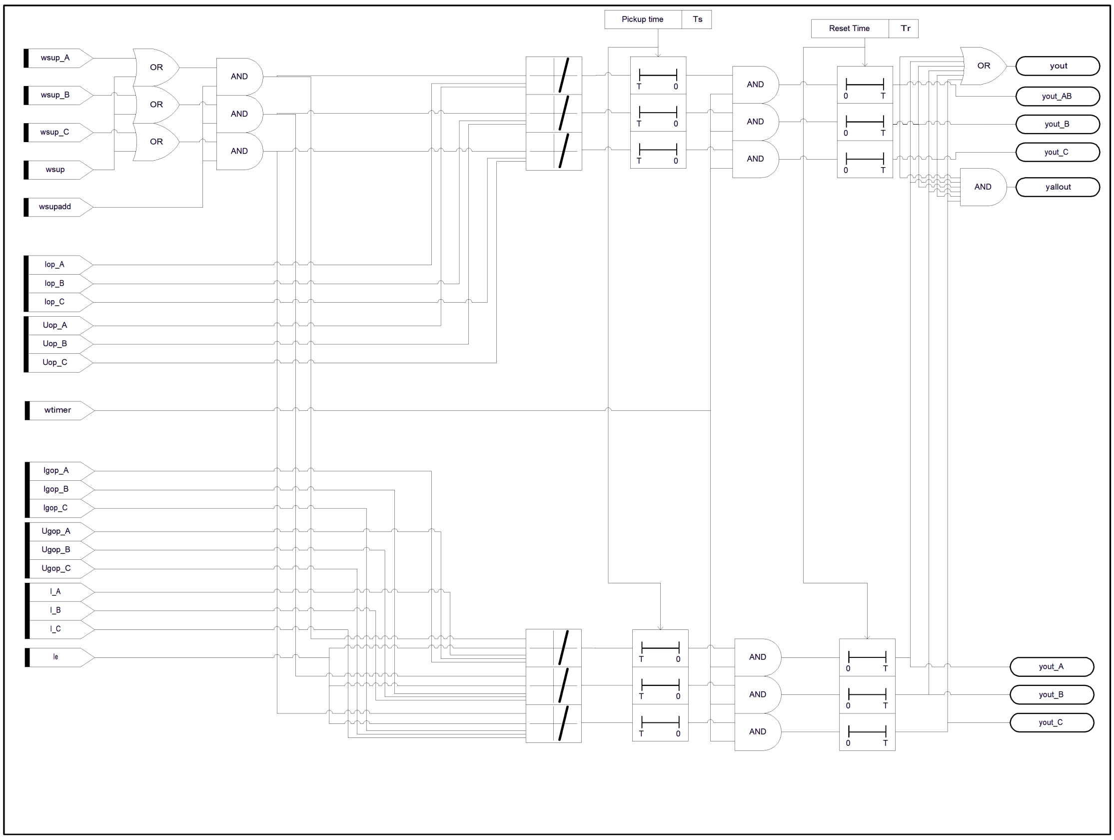


Figure 4.5: The *DIgSILENT 3 phase Distance Enertec Method Blinder* logic

A Parameter Definitions

A.1 Distance Blinder Type (TypDisbl)

Table A.1: Input parameters of Distance Blinder type (*TypDisbl*)

Parameter	Description	Unit
loc_name	The name assigned by the user to the Blinder type object	Text
sfiec	The IEC Symbol associated to the element (documentation purpose only, it is displayed in the RelDisbl dialogue)	Text
sfansi	The ANSI Symbol associated to the element (documentation purpose only, it is displayed in the RelDisbl 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 Blinder characteristic	Integer
idigital	Flag to enable the digital trip logic	Integer
ichatp	The type of Blinder block (“Reactive Blinder”, “Resistive Blinder”, “Neg. Reactive Blinder”, “Neg. Resistive Blinder”, “Susceptive Blinder”, “Conductive Blinder”, “Neg. Susceptive Blinder”, “Neg. Conductive Blinder”)	Integer
imethod	Calculation method (standard, Enertec)	Integer
rX	Reactance range	Text
rR	Resistance range	Text
rB	Susceptance range	Text
rG	Conductance range	Text
rphi	Line Angle range	Text
iphip90	Flag to add 90 deg to the “Line Angle”	Integer
Ts	Pickup Time	Seconds
Tr	Reset Time	Seconds
Kr	Reset Ratio	Real number

A.2 Distance Blinder Element (RelDisbl)

Table A.2: Input parameters of Distance Blinder element (*RelDisbl*))

Parameter	Description	Unit
loc_name	The name assigned by the user to the Blinder object	Text
typ_id	Pointer to the relevant TypDisbl object	Pointer
X	Reactance	Sec Ohm
R	Resistance	Sec Ohm
B	Susceptance	Sec Siemens
G	Conductance	Sec Siemens
phi	Line Angle	Deg

B Signal Definitions

B.1 Single phase

B.1.1 Analog

Table B.1: Input/output signals of the single phase Distance Analog Blinder element (*CalDisbl1p*)

Name	Description	Unit	Type	Model
Iopr	Operating current real part	Sec Amps	IN	Any
Iopi	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
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
yout	Tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any

B.1.2 Digital

Table B.2: Input/output signals of the single phase Distance Blinder Digital element (*CalDisbl1pdig*)

Name	Description	Unit	Type	Model
R	Resistance	Sec Ohm	IN	Any
X	Reactance	Sec Ohm	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
yout	Tripping signal/time	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any

B.2 3 phase

B.2.1 Analog

Table B.3: Input/output signals of 3 phase Distance Analog Blinder element (*CalDisbl*)

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	Timer Signal(used to add an additional delay to the trip time)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any

Table B.3: Input/output signals of 3 phase Distance Analog Blinder element (*CalDisbl*)

Name	Description	Unit	Type	Model
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.2.2 Analog Enertec Method

Table B.4: Input/output signals of 3 phase Distance Analog Enertec Method Blinder element (*CalDisblpxlp*)

Name	Description	Unit	Type	Model
Iopr_A	Operating current loop AB real part	Sec Amps	IN	Any
Iopi_A	Operating current loop AB imaginary part	Sec Amps	IN	Any
Iopr_B	Operating current loop BC real part	Sec Amps	IN	Any
Iopi_B	Operating current loop BC imaginary part	Sec Amps	IN	Any
Iopr_C	Operating current loop CA real part	Sec Amps	IN	Any
Iopi_C	Operating current loop CA imaginary part	Sec Amps	IN	Any
Igopr_A	Operating current phase A real part	Sec Amps	IN	Any
Igopi_A	Operating current phase A imaginary part	Sec Amps	IN	Any
Igopr_B	Operating current phase B real part	Sec Amps	IN	Any
Igopi_B	Operating current phase B imaginary part	Sec Amps	IN	Any
Igopr_C	Operating current phase C real part	Sec Amps	IN	Any
Igopi_C	Operating current phase C imaginary part	Sec Amps	IN	Any
Ir_A	Current phase A real part	Sec Amps	IN	Any
Ii_A	Current phase A imaginary part	Sec Amps	IN	Any
Ir_B	Current phase B real part	Sec Amps	IN	Any
Ii_B	Current phase B imaginary part	Sec Amps	IN	Any
Ir_C	Current phase C real part	Sec Amps	IN	Any
Ii_C	Current phase C imaginary part	Sec Amps	IN	Any
Ieopr_A	Earth Current real part	Sec Amps	IN	Any
Ieopi_A	Earth Current imaginary part	Sec Amps	IN	Any
Uopr_A	Operating voltage loop AB real part	Sec V	IN	Any
Uopi_A	Operating voltage loop AB imaginary part	Sec V	IN	Any
Uopr_B	Operating voltage loop BC real part	Sec V	IN	Any
Uopi_B	Operating voltage loop BC imaginary part	Sec V	IN	Any
Uopr_C	Operating voltage loop CA real part	Sec V	IN	Any
Uopi_C	Operating voltage loop CA imaginary part	Sec V	IN	Any
Ugopr_A	Operating voltage phase A real part	Sec V	IN	Any
Ugopi_A	Operating voltage phase A imaginary part	Sec V	IN	Any
Ugopr_B	Operating voltage phase B real part	Sec V	IN	Any
Ugopi_B	Operating voltage phase B imaginary part	Sec V	IN	Any
Ugopr_C	Operating voltage phase C real part	Sec V	IN	Any
Ugopi_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
wsup_AB	Loop AB supervising Signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsup_BC	Loop BC supervising Signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsup_CA	Loop CA 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
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
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

B.2.3 Digital

Table B.5: Input/output signals of 3 phase Distance Blinder Digital element (*CalDisbldig*)

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
wsup_A	Phase A super visioning signal (must be on to allow the trip)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsup_B	Phase B super visioning signal (must be on to allow the trip)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wsup_C	Phase C super visioning signal (must be on to allow the trip)	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
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

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