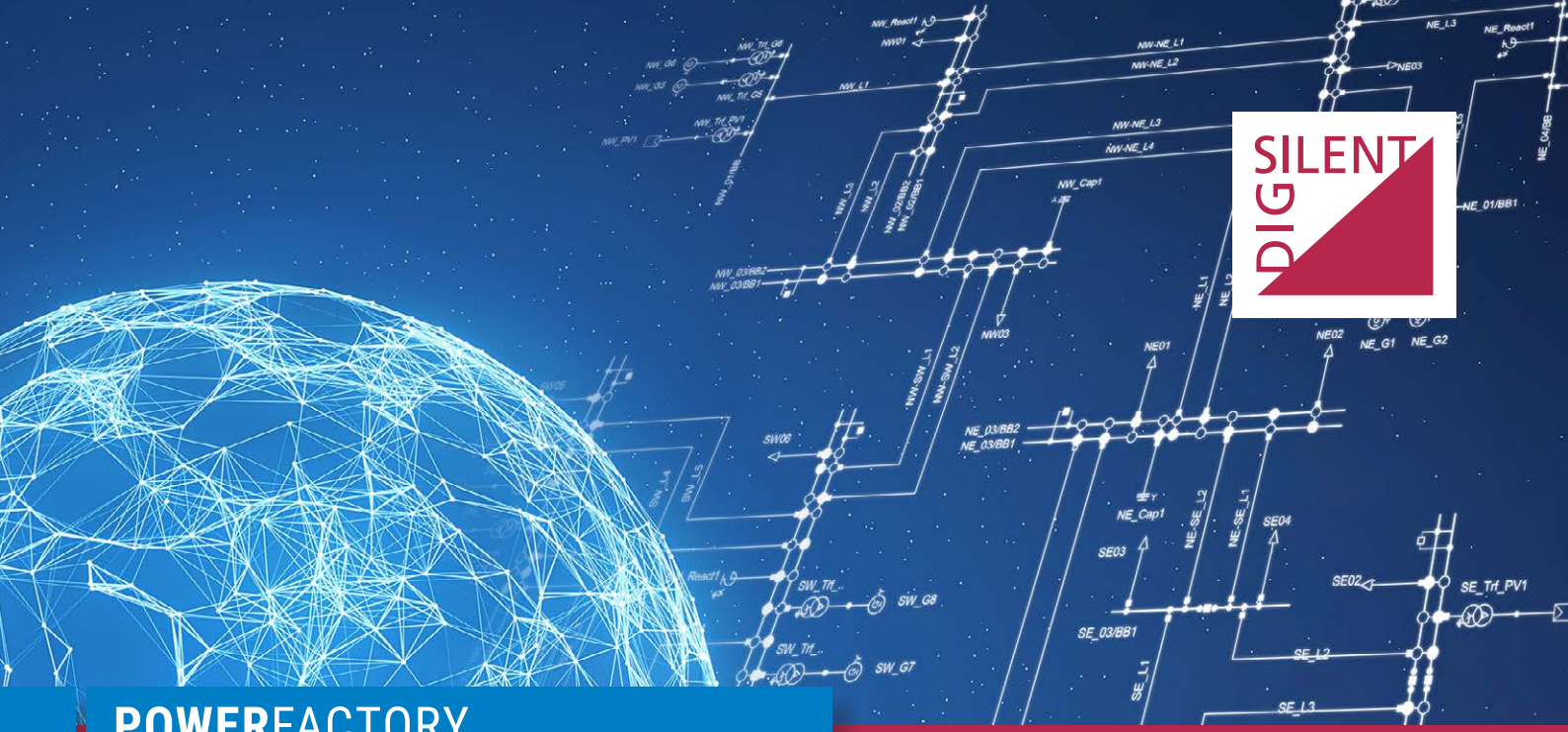

POWERFACTORY

PowerFactory 2021

Technical Reference

Instantaneous Overcurrent

Relloc, Typloc

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Contents

1 General Description

The *Instantaneous Overcurrent* “Relloc” block implements a directional or non directional overcurrent or undercurrent current definite time element. The block defines a current trip threshold and a time delay ; it creates in the time-current diagram the trip characteristic with the shape represented here below in Figure 1.1:

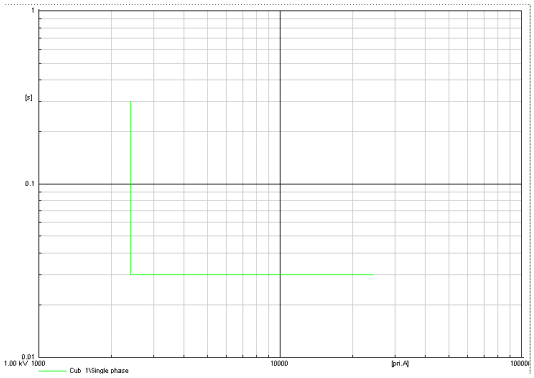


Figure 1.1: *DIgSILENT* The *Instantaneous Overcurrent* “Relloc” Time-Current diagram.

Moreover the user can define a “Total Clear Curve” characteristic to represent the overall time spent to remove the fault or the maximum time spent by the device to detect the fault. The Ioc characteristic when the “Total Clear Curve”is defined is represented in Figure 1.2.

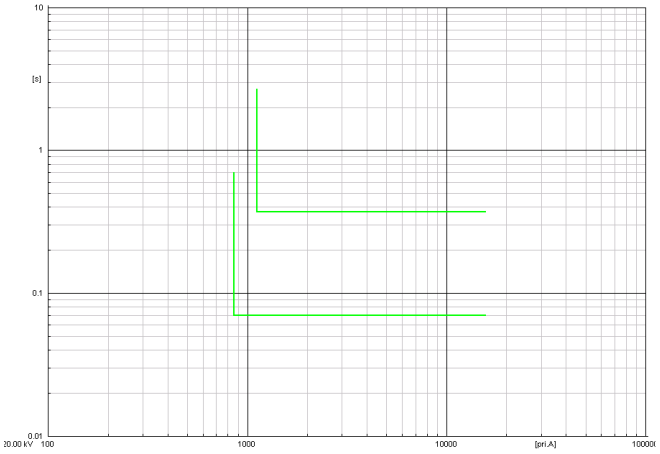


Figure 1.2: *DIgSILENT* The *Instantaneous Overcurrent* “Relloc” Time-Current diagram with the “Total Time Curve” enabled.

The block can be set to calculate the trip time using the “Minimum Trip Curve” or the “Total Clear Curve” characteristic. The *Instantaneous Overcurrent* “Relloc” block is operational during short circuit, load flow and RMS/EMT simulations.

2 Features & User interface

2.1 Time-Overcurrent (Relloc)

The user can change the block settings using the “Instantaneous overcurrent” dialogue (“Relloc ” class). The dialogue consists of 4 tab pages: *Basic data*, *Tripping times*, *Blocking*, and *Description*. The main settings are located in the *Basic data* tab page.

2.1.1 Basic data

The “Instantaneous overcurrent” dialogue provides a *presentation* area where the red text shows some info regarding:

- The international symbols used to represent the block protective function.
- Which currents are measured by the block.

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 (’Directional Overcurrent “RelDir” class). The current threshold and the time delay can be set using the “Pickup Current”, and the “Time Setting” control. The controls are combo boxes for ranges of discrete values or otherwise edit boxes. The blue text provides additional info regarding the current threshold in terms of primary current.

2.1.2 Tripping times

The *Tripping times* tab page allows the user to select whether the *Minimum Trip Curve* or the *Total Clear Curve* is used to calculate the element tripping time. The radio buttons are only displayed if the *Total Clear Curve* has been defined.

2.1.3 Blocking

This tab page defines the blocking input signals configuration.
If the “Consider Blocking” setting is set to *User configurable* in the relevant *Blocking* tab page of the *Instantaneous Overcurrent Type(Typloc)* dialogue (see 2.2.3), the “Consider Blocking” check box is displayed. If the check box is *not* set, the input blocking signals are not considered and the *Instantaneous Overcurrent*(“Relloc ”) block is allowed to trip. If the check box *is* set the block doesn’t trip if the blocking input signals are *on* and before the “Release Blocking Time” time has expired.

In the “Release Blocking Time”the user can insert the expiration time for the blocking input signals. When a block trip is triggered , if the blocking input signals are active, a timer is activated. When the timer has counted a time equal to the expiration time, the blocking input signals are ignored and the block is allowed to trip.

The relevant *Blocking* tab page of the *Instantaneous Overcurrent Type(Typloc)* dialogue (see 2.2.3) must be used to define which features are available.

2.1.4 Description

The *Description* tab page can be used to insert some information to identify the Ioc 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 Instantaneous Overcurrent Type(Typloc)

The *Instantaneous Overcurrent* block main characteristics must be configured in the "Instantaneous Overcurrent Type" dialogue (*TypIoc* class). The dialogue contains three tab pages: *Basic data*, *Total clear curve*, and *Blocking*.

2.2.1 Basic data

The *Basic data* tab page contains most of the controls used to configure the *Instantaneous Overcurrent* block.

The block can be configured using the "Type" combo box variable as:

- 3 phase element ("Phase Current (3ph)")
- single phase element ("Phase Current (1ph)")
- earth fault element ("Earth Current (3*I0)")
- sensitive earth fault element ("Sensitive Earth Current (3*I0)")
- zero sequence element ("Zero Sequence Current (I0)")
- negative sequence element ("Negative Sequence Current (I2)")
- unbalance current element ("3*Negative Sequence Current (3*I2)"
- Phase A element ("Phase A Current")
- Phase B element ("Phase B Current")
- Phase C element ("Phase C Current")
- Thermal image (3ph)
- Thermal image (1ph)
- 3 phase element for special purposes ("3ph (other)")
- single phase element for special purposes ("1ph (other)")

Furthermore if the "External Starting" check box is set, the block starts only when the "wstart_A", "wstart_B", and "wstart_C" input signals are active.

Many of the types detailed above are provided for "documentation only" purpose. The underlying types are:

- a 3 phase block (3 phase element and 3 phase element for special purposes)

- a single phase block (single phase element, earth fault element, sensitive earth fault element, zero sequence element, negative sequence element, unbalance current element, Phase A element, Phase B element, Phase C element and single phase element for special purposes)
- a 3 phase block with external starting ("External Starting" check box set, 3 phase element and 3 phase element for special purposes)
- a single phase block with external starting ("External Starting" check box set, single phase element, earth fault element, sensitive earth fault element, zero sequence element, negative sequence element, unbalance current element, Phase A element, Phase B element, Phase C element and single phase element for special purposes)

The *Instantaneous Overcurrent* ("Relloc ")element has been conceived to work together with the other relay elements: some settings can be set to depend upon the settings of other overcurrent blocks:

- The element can be set to get a threshold value reference from another block: the "Pickup current" value becomes a multiplier of the current threshold set in the other block.
- The directional characteristic can be set using the *Instantaneous Overcurrent*"Relloc " block dialogue or can be set depending on the setting of an external "Directional" block.

2.2.2 Total Clear Curve

The "Total clear curve" tab page contains settings which allow definition of the curve representing the overall time spent clearing the fault or the maximum time spent by the device in order to detect the fault.

The following features are available:

- Ability to automatically add the *Breaker Opening Time* to the *Total Clear Curve* trip characteristic.
- Definition of the current and time multipliers and shift factors applied to the *Minimum Trip Curve* in order to generate the *Total Clear Curve* trip characteristic.

Breaker operating time The "Total Clear Curve" can include the "Breaker operating time" if required.
The user can configure the behaviour by adapting the "Include Breaker Operating Time" check box. When the "Include Breaker Operating Time" check box is not checked and the "Consider Breaker Operating time" check box in the "Overcurrent Plot Settings" dialogue(Seloc plot class) is checked, the "Total Clear" curve time values used to draw the curve are increased by the operating time of the breaker associated with the relay.
The *Breaker operating time* value can be inserted inside the "Breaker time" control located in the *Basic Data* tab page ("t_open" variable)inside the "Switch Type" dialogue of the switchgear associated with the relay.

If in the Ioc element dialogue (Relloc class) the "Compute Time Using" is set to "Total Clear Curve" and in the *Instantaneous Overcurrent Type*("Typloc ") dialogue the "Include Breaker Operating Time" check box is not checked, the tripping time is equal to the breaker operating time plus the tripping time calculated using the "Total Clear" trip characteristic.
No value is added in the graphical representation or to the tripping time calculation if no switch type is available or if the "Breaker time" is zero.

"Total Clear Curve" definition The "Enable" check box can be used to enable or disable the "Total Clear" definition and the relevant controls in the dialogue.
Please note that the "Total clear" curve is always defined and drawn inside the overcurrent plot windows even when the "Enable" check box is not checked, the "Include Breaker Operating Time" check box is not checked and the "Consider Breaker Operating time" check box in the "Overcurrent Plot Settings" dialogue("Seloc plot" class) is checked.
The "Total Clear" curve can be defined with the application of a "shifter" and "multiplier" both to the current values and to the time values which define the "Min trip" curve. The "shifter" is simply an additive factor, the "multiplier" is a multiplicative factor.

The "Total Clear" curve current values are calculated using the following formula:

$$I_{TotalClear} = (I_{MinTrip} * \text{“}CurrentMultiplier'') + \text{“}CurrentShifter'' \quad (1)$$

The "Total Clear" curve time values are calculated using the following formula:

$$t_{TotalClear} = (t_{MinTrip} * \text{“}TimeMultiplier'') + \text{“}TimeShifter'' \quad (2)$$

2.2.3 Blocking

The *Blocking* tab page allows definition of the effect of the blocking input signals: the block can be

- Always enabled
- Always disabled
- User configurable

Moreover it is possible to define the range of the expiration time for the blocking input signals. When a block trip is triggered , if the blocking input signals are active, a timer is activated. When the timer has counted a time equal to the expiration time the blocking input signals are ignored and the block is allowed to trip.

3 Integration in the relay scheme

The *Instantaneous Overcurrent*“Relloc ” type class name is *Typloc* . The *Instantaneous Overcurrent* dialogue class name is *Relloc* . 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. Please note that inside the “Typloc ” dialogue if the “Type” is set as “3ph (other)” (or “1ph (other)”) a normal 3 phase loc element (or a single phase “Relloc ”) is still used. The only difference is that the Time Current characteristic is not displayed in the “Time-Overcurrent plot”. It can be useful if the *Instantaneous Overcurrent*“Relloc ” element is for instance used for control purposes and is not directly settable by the user. The typical connection of a single phase *Instantaneous Overcurrent*“Relloc ” block is showed in Figure 3.1.

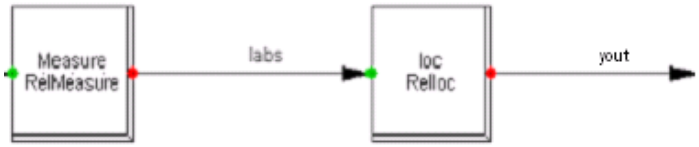


Figure 3.1: *DIgSILENT* The typical connection scheme of a single phase *Instantaneous Overcurrent*“Relloc ” block.

If the *Instantaneous Overcurrent*“Relloc ” block is directional the “wfwd” and the “wrev” signals must be connected to a directional block (see 3.2).

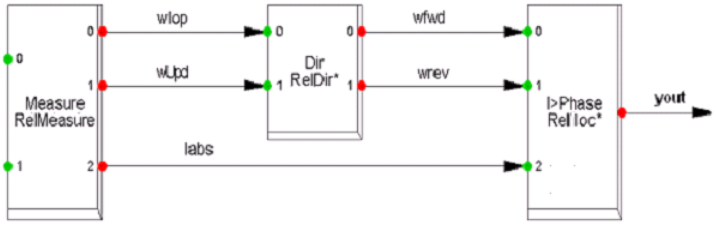


Figure 3.2: *DIgSILENT* Typical connection scheme of a single phase directional *Instantaneous Overcurrent*“Relloc ” block.

The connections associated with a three phase *Instantaneous Overcurrent*“Relloc ” block are quite similar. The main difference is that a current signal and a forward/reverse directional signal for each phase is included. The *Instantaneous Overcurrent*“Relloc ” block can be made sensitive to the current flow direction by using the “Tripping direction” combobox in the “Relloc ” dialogue.

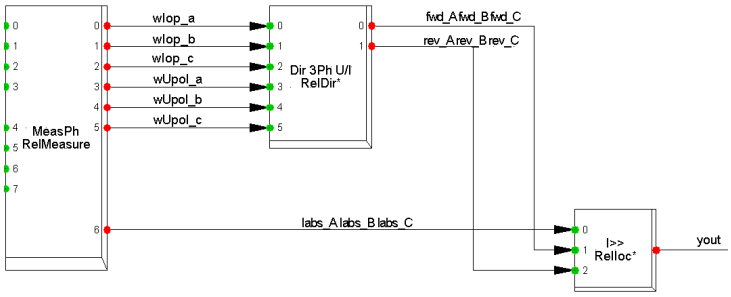


Figure 3.3: *DIgSILENT* Typical connection scheme of a three phase directional *Instantaneous Overcurrent*“Relloc ” block.

The available options present in the combobox must be set using the “Directional” combobox in the “Typloc ” dialogue. Please keep in mind the follow rules:

- If the “Forward” direction is set the “fwd” signal (“fwd_A” or “fwd_B” or “fwd_C” for the 3phase version)must be activated to allow starting of the element.
- If the “Reverse” direction is set the “rev” signal (“rev_A” or “rev_B” or “rev_C” for the 3phase version)must be activated to allow starting of the element.
- If the “External” direction is set the “fwd” signal (“fwd_A” or “fwd_B” or “fwd_C” for the 3phase version)must be activated to allow starting of the element. The “rev” signal status is ignored (it can be disconnected). “External” makes the block direction dependant on an external “directional” block setting.

If the “External Starting” check box is set the block starting depends upon the status of the wstart input signal: in the 3 phase version each phase works independently so the starting depends upon the status of the wstart_A, wstart_B, wstart_C input signals.

To control a *Instantaneous Overcurrent*“Relloc ” block with a reclosing element (“RelRecl” object) the following configuration must be used:

- the “iblock” input signal must be connected with the output signal of the reclosing element, where the reclosing element has been programmed to block (yblock_loc x with $1 <= x <= 5$ or yblock_Logick with $1 <= k <= 16$) . Please read the“RelRecl” documentation for more details about the way to program a reclosing sequence.
- in the “Typeloc ” dialogue the “Recl. Feature” combobox must be selected to “Normal” or “Lockout”. If “Normal” is selected a standard reclosing sequence is triggered, if “Lockout” is selected a trip of the *Instantaneous Overcurrent*“Relloc ” element puts the reclosing element in lockout status and no other reclosing is attempted. Please note that if “None” is the selected option in the “Recl. Feature” combobox no reclosing operation is attempted. This is also true if the *Instantaneous Overcurrent*“Relloc ” element “iblock” input is connected to a reclosing element. 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 *Instantaneous Overcurrent*“Relloc ” element.

To get a current threshold value reference from another block the following operation must be performed :

- Inside the “Typloc ” dialogue set the “Ref. Current from” item with the link to the element from which the *Instantaneous Overcurrent*“Relloc ” element gets the reference value.

- Inside the “Typloc ” dialogue set the “Current Range” unit equal to “p.u.”. Please note that if “Sec.A” is selected as the unit then the whole feature doesn’t work and the *Instantaneous Overcurrent*“Relloc ” secondary amps threshold is used.

4 Logic

4.1 Single phase

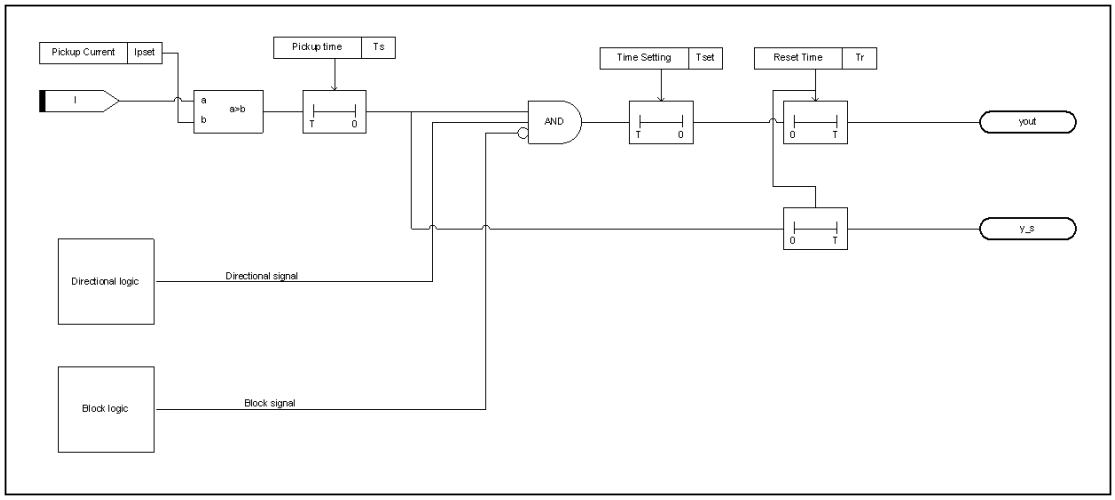


Figure 4.1: The *Instantaneous Overcurrent (Relloc)logic*

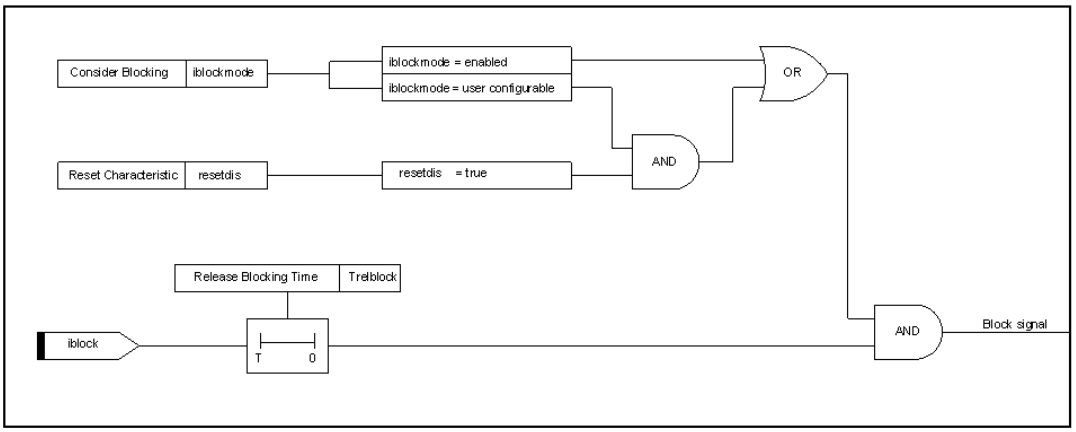
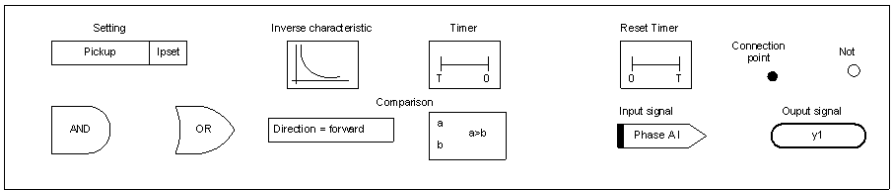


Figure 4.2: The *Instantaneous Overcurrent (Relloc) Block logic*



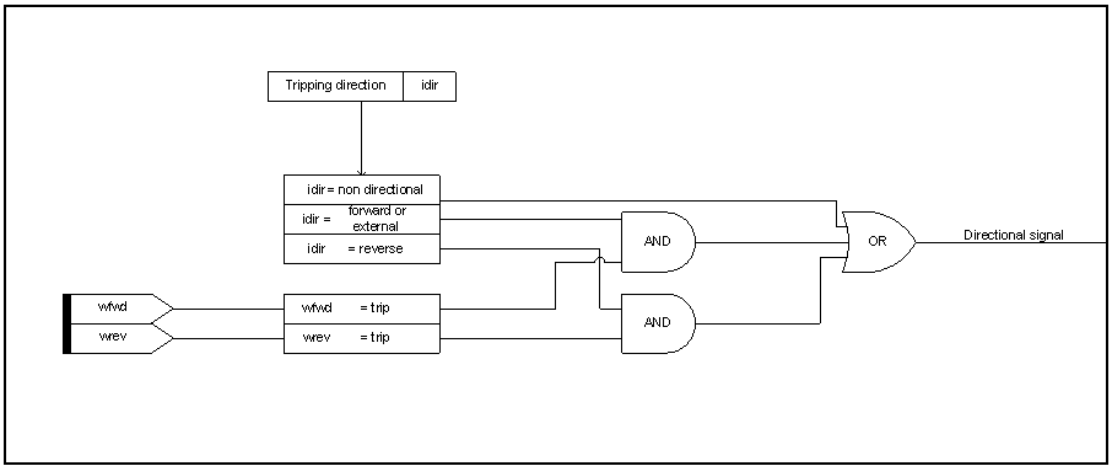
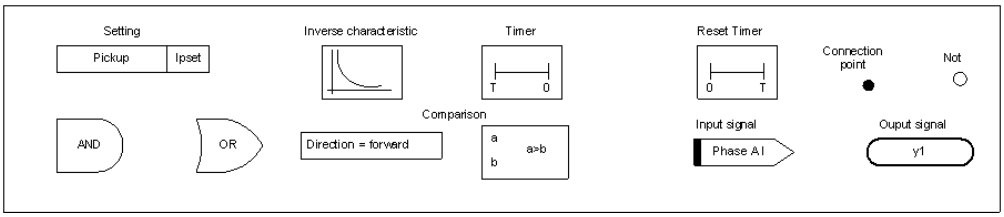


Figure 4.3: The *Instantaneous Overcurrent (Relloc) Directional logic*



4.2 3 phase

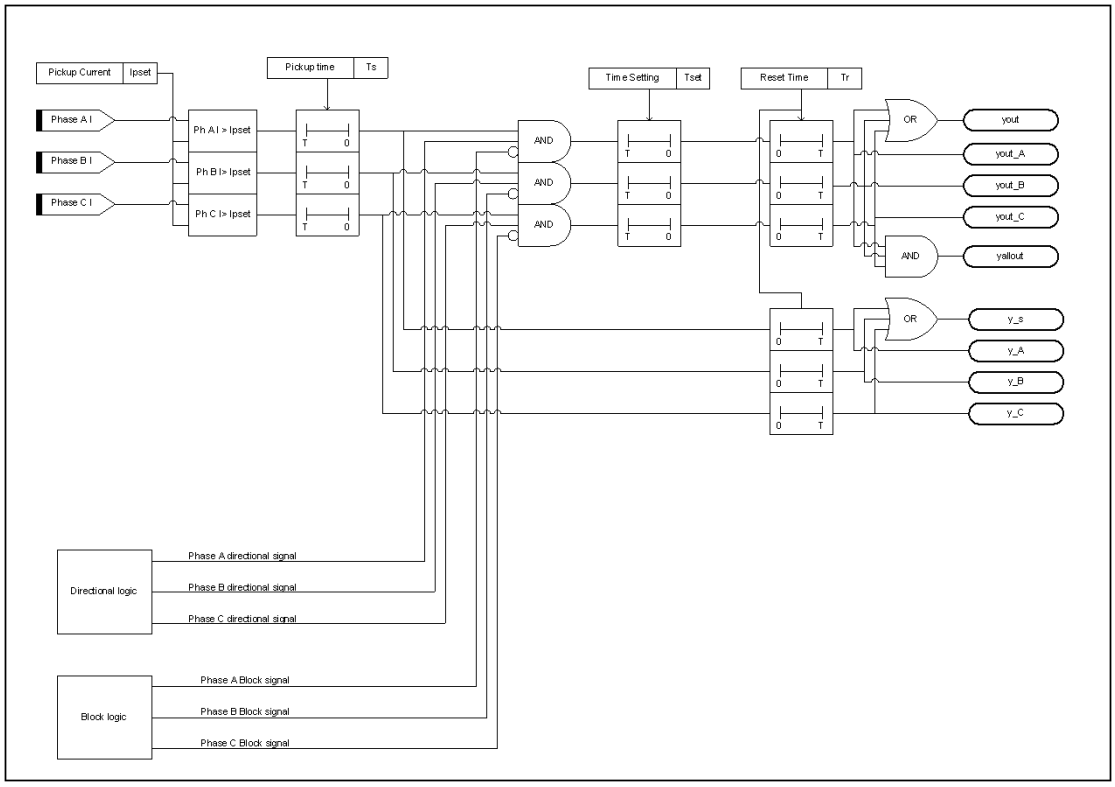
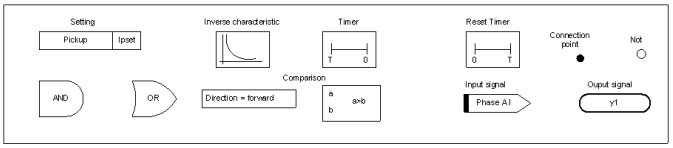


Figure 4.4: The *Instantaneous Overcurrent (Relloc) logic*



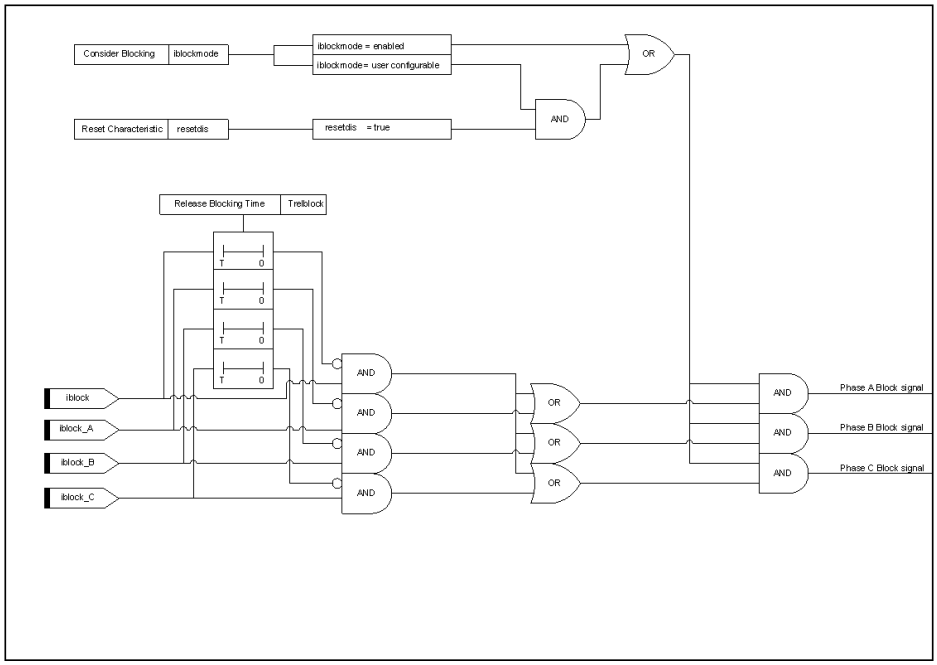


Figure 4.5: The *Instantaneous Overcurrent (Relloc) Block logic*

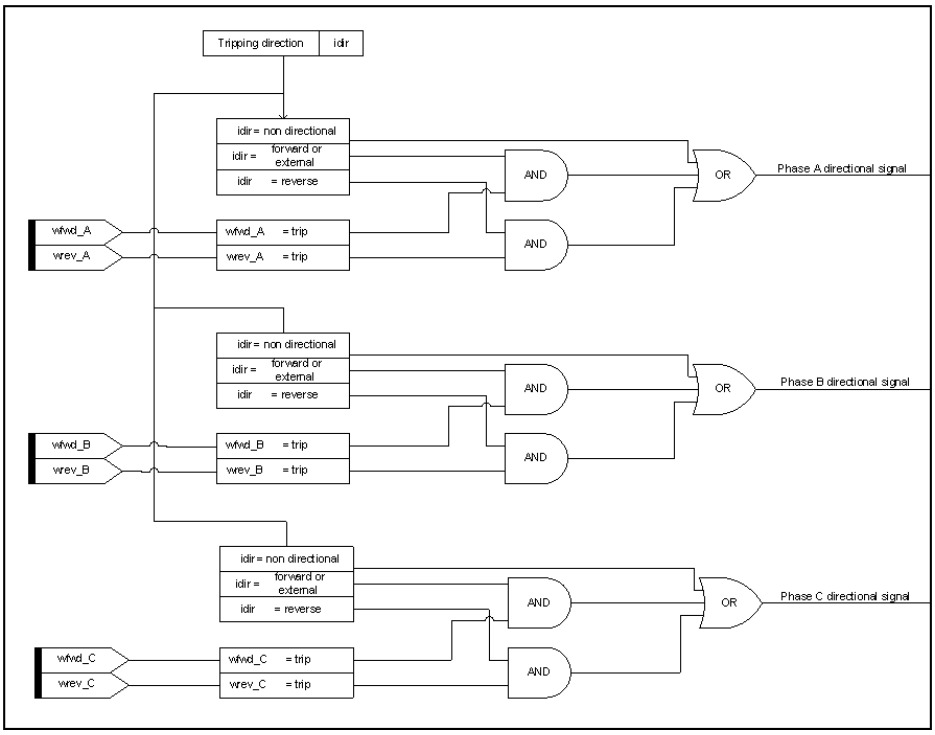
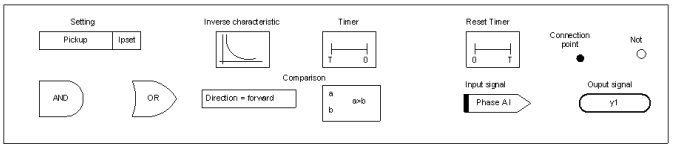


Figure 4.6: The *Instantaneous Overcurrent (Relloc) Directional logic*



A Parameter Definitions

A.1 Ioc Type (Typloc)

Table A.1: Input parameters of Ioc type (*Typloc*)

Parameter	Description	Unit
loc_name	Name assigned by the user to the block type	Text
sfiec	IEC symbol (I>>,IE>>,I2>>)	Text
sfansi	ANSI symbol (50,50N,46)	Text
itype	Block Type (“Phase Current (3ph)”, “Phase Current (1ph)”, “Earth Current (3*I0)”, “Sensitive Earth Current (3*I0)”, “Zero Sequence Current (I0)”, “Negative Sequence Current (I2)”, “3*Negative Sequence Current (3*I2)”, “Phase A Current”, “Phase B Current”, “Phase C Current”, “3ph (other)”, “1ph (other)”)	Integer
irecltarget	Reclosing feature (None, Normal, Lockout)	Integer
inegout	Flag to set the element to act as an undercurrent element	Integer
idirpos	Directional available options (None, None/Forward, None/Forward/Reverse, Forward/Reverse, None/External, External)	Integer
iincTs	Are the timers including the pick up time?	Y/N
iextstart	Is the block starting depending upon an external signal?	Y/N
pIref	Pointer to the block providing the current reference(optional)	Pointer
pTref	Pointer to the block providing the time reference(optional)	Pointer
rIpset	Range of the Current threshold	Text
iunit	Current theshold unit (Sec. Amps, pu)	Integer
rTset	Range of the trip time delay	Text
itunit	Trip time delay unit (Sec, cycles)	Integer
Ts	Pick up time, it’s the time spent measuring the currents in the load flow and short circuit calculation and in the RMS simulation	Seconds
Tr	Reset time, it’s the delay with which the block reset the trip outputs after that the current went below the trip threshold * Kr	Seconds
Kr	Reset ratio	Real
iinckbreakt	Flag: if it’s “true” the clear curve definition already includes the breaker time operating time, so the breaker operating time is added to the curve itself.	Y/N
ienable	Flag to enable/disable the curve definition	Y/N
ishifter	Additive factor added to each current value of the points belonging to the “Min trip” curve to generate the “Total clear” curve	pu or Sec.Amps
imultiplier	Multiplicative factor applied to each current value of the points belonging to the “Min trip” curve to generate the “Total clear” curve	Real
imcunit	ishifter unit (pu or Sec.Amps)	Integer
tshifter	Additive factor added to each time value of the points belonging to the “Min trip” curve to generate the “Total clear” curve	Seconds or cycles
tmultiplier	Multiplicative factor applied to each time value of the points belonging to the “Min trip” curve to generate the “Total clear” curve	Real
tmcunit	tshifter unit (seconds or cycles)	Integer
iblockmode	How the input block signals is considered (*Ignored*, *Always considered*, *User configurable*)	Integer
rTrelblock	Range of the *Release Blocking Time* variable	Text

A.2 Ioc Element (Relloc)

Table A.2: Input parameters of Ioc element (*Relloc*))

Parameter	Description	Unit
loc_name	Name assigned to the user to the block element	Text
Typ_id	Pointer to the relevant TyIoc object	Pointer
Outserv	Flag to put out of service the block	Y/N
idir	Tripping direction (None, external, forward, reverse the available options depend upon the idirpos value in the relevant Typloc object)	Integer
Ipset	Current threshold in Amps	Sec Amps
Ipsetr	Current threshold in pu	pu
Tset	Trip time delay in seconds	Seconds
cTset	Trip time delay in cycles	Cycles
calcuse	Flag to select which curve should be used to calculate the element tripping time. 0 = “Minimum trip curve”, 1= “Total time curve”	Integer
iacceptblock	Flag to enable/disable the ability to consider input block signal (available only if “Consider blocking”(“iblockmode” variable in the Typloc class) is “User configurable”)	Integer
Trelblock	Maximum time that the input block signals are considered	Seconds

B Signal Definitions

B.1 Single phase

Table B.1: Input/output signals of the single phase Ioc element (*Calloc1p*)

Name	Description	Unit	Type	Model
Iabs	Input current	Sec Amps	IN	Any
iblock	Blocking signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wfwd	Forward current signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wrev	Reverse current signal	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wstart	External starting signal (available only if iextstart = 1 in Typloc)	Seconds (or 1/0 RMS/EMT simulation)	IN	Any
yout	Trip signal	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any
y_s	Start signal	Seconds(or 1/0 RMS/EMT simulation)	OUT	Any

B.2 3 phase

Table B.2: Input/output signals of 3 phase Ioc element (*Calloc*)

Name	Description	Unit	Type	Model
Iabs_A	Phase A input current	Sec Amps	IN	Any
Iabs_B	Phase B input current	Sec Amps	IN	Any
Iabs_C	Phase C input current	Sec Amps	IN	Any
iblock	Blocking signal	Seconds (or 1/0 RMS/EMT simulation)	IN	Any
iblock_A	Phase A Blocking signal	Seconds (or 1/0 RMS/EMT simulation)	IN	Any
iblock_B	Phase B Blocking signal	Seconds (or 1/0 RMS/EMT simulation)	IN	Any
iblock_C	Phase C Blocking 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
wstart_A	Phase A external starting signal (available only if iextstart = 1 in Typloc)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wstart_B	Phase B external starting signal (available only if iextstart = 1 in Typloc)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
wstart_C	Phase C external starting signal (available only if iextstart = 1 in Typloc)	Seconds(or 1/0 RMS/EMT simulation)	IN	Any
yout	Trip signal (any phase)	Seconds (or 1/0 RMS/EMT simulation)	OUT	Any
yout_A	Phase A trip signal	Seconds (or 1/0 RMS/EMT simulation)	OUT	Any
yout_B	Phase B trip signal	Seconds (or 1/0 RMS/EMT simulation)	OUT	Any
yout_C	Phase C trip signal	Seconds (or 1/0 RMS/EMT simulation)	OUT	Any
yallout	All phases trip signal	Seconds (or 1/0 RMS/EMT simulation)	OUT	Any
y_s	Start signal (any phase)	Seconds (or 1/0 RMS/EMT simulation)	OUT	Any
y_A	Phase A start signal	Seconds (or 1/0 RMS/EMT simulation)	OUT	Any
y_B	Phase B start signal	Seconds (or 1/0 RMS/EMT simulation)	OUT	Any
y_C	Phase C start signal	Seconds (or 1/0 RMS/EMT simulation)	OUT	Any

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