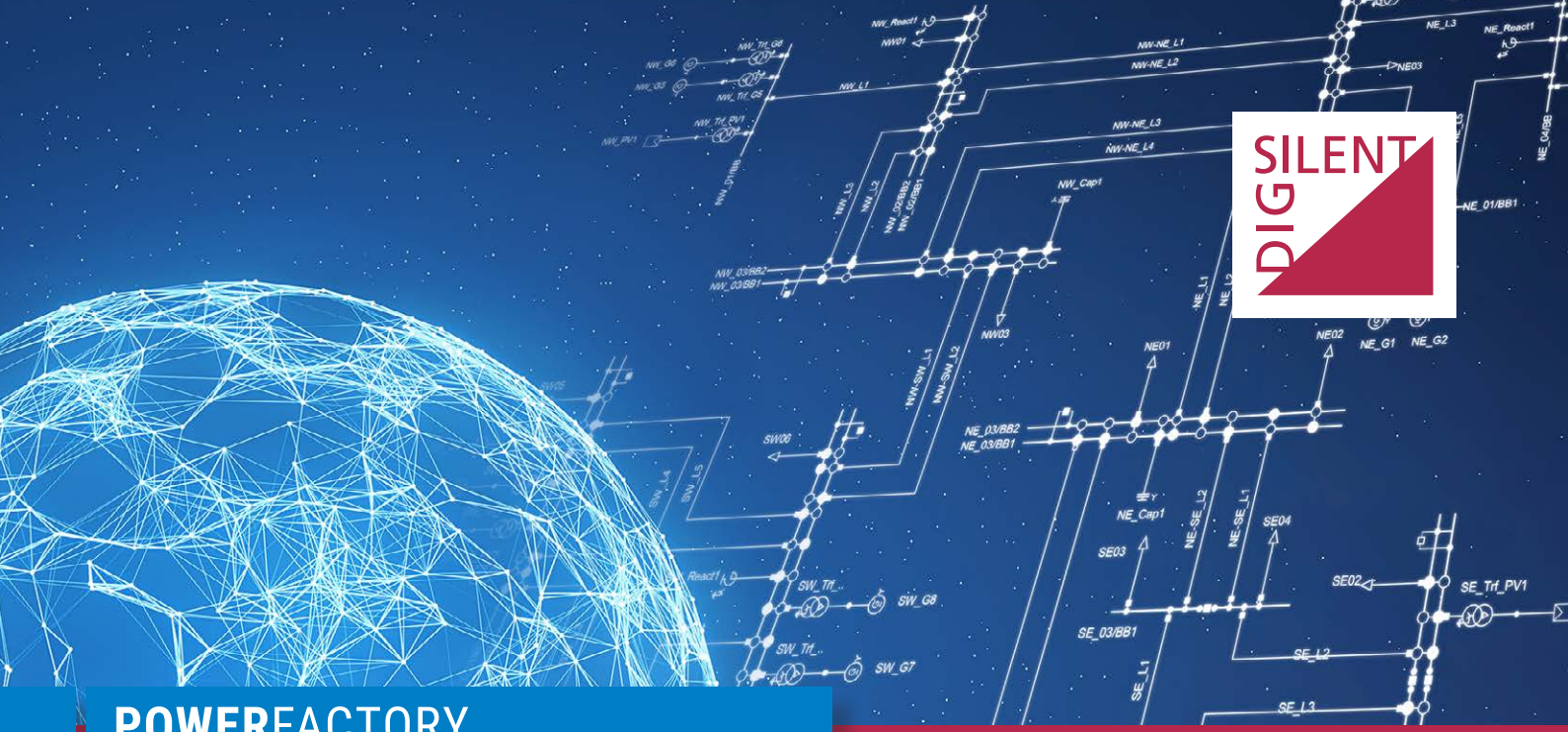

POWERFACTORY

PowerFactory 2021

Technical Reference

AEG/Alstom starting unit

RelFdetaegalst, TypFdetaegalst

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

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Revision 1

Contents

1 General Description

The AEG/Alstom starting block implements the fault detection logic available in the following relay models

- AEG PD 521
- AEG PD 531
- AEG PD 532
- AEG PD 551
- AEG PD 552
- AEG PD 932
- Alstom/Areva P437

The following logic of fault detection are available:

- *Overcurrent*
- *Undervoltage*
- *Underimpedance*
- *Earth*

Accordingly with the relay manuals the following detection logic are active:

- AEG PD 521, AEG PD 531, AEG PD 551
  1. “OvercurrentI”.
  2. “Undervoltage”.
  3. *Earth*
- AEG PD 532, AEG PD 552, AEG PD 932, Alstom/Areva P437
  1. “OvercurrentI”.
  2. “Undervoltage”.
  3. *Underimpedance*
  4. *Earth*

1.1 Available settings

521 / **531** :

The *521* and the *531* starting block define:

- An overcurrent starting with double current threshold.
- An undervoltage starting logic with single current release threshold.
- An earth detection logic with single neutral current threshold and stabilization slope.
- Loop preferences for single phase fault, 2 phase fault and 3 phase fault.

The underimpedance element must be manually set as *Disabled* in the AEG/Alstom type dialogue (“iimped” parameter).

551 / **552** :

The *521* and the *531* starting block define:

- An overcurrent starting with double current threshold.
- An undervoltage starting logic with single current release threshold.
- An underimpedance starting logic with single current release threshold.
- An earth detection logic with single neutral current threshold and stabilization slope.
- Loop preferences for single phase fault, 2 phase fault and 3 phase fault.

532 / **932** :

The *532* and the *932* starting block define:

- An overcurrent starting with double current threshold.
- An undervoltage starting logic with single current release threshold.
- An underimpedance starting logic with single current release threshold.
- An earth detection logic with single neutral current threshold and stabilization slope.
- Phase priority logic.

437 : The *521* and the *531* starting block define:

- An overcurrent starting with double current threshold.
- An undervoltage starting logic with double current release threshold.
- An underimpedance starting logic with double current release threshold.
- An earth detection logic with single neutral current threshold and stabilization slope.
- Loop preferences for single phase fault, 2 phase fault and 3 phase fault.

2 Features & User interface

2.1 AEG/Alstom Starting Logic (RelFdetaegalst)

The user can change the block settings using the “AEG/Alstom Starting” dialogue (“RelFdetaegalst” class). The dialogue consists of seven tab pages: *Basic Data*, *Overcurrent*, *Undervoltage*, *Underimpedance*, *Earth*, *Fault Loop Settings*, and *Description*.

2.1.1 Basic data

The “Basic Data” tab page contains the block name, a link to the relevant starting type object, up to four check buttons which allow to select the active starting logic between the logic available for the given model and three combo box which allow to define the power system grounding (*Solidly earthed*, *Compensated* or *Isolated*) and, only for the *437* type, which phase and ground current threshold value must be used (*High Values* or *Sensitive*). Multiple starting logic can be active at the same time. In Figure 2.1 the whole starting logic is showed. The *High range* and *Sense range* threshold logic is displayed in Figure 2.2

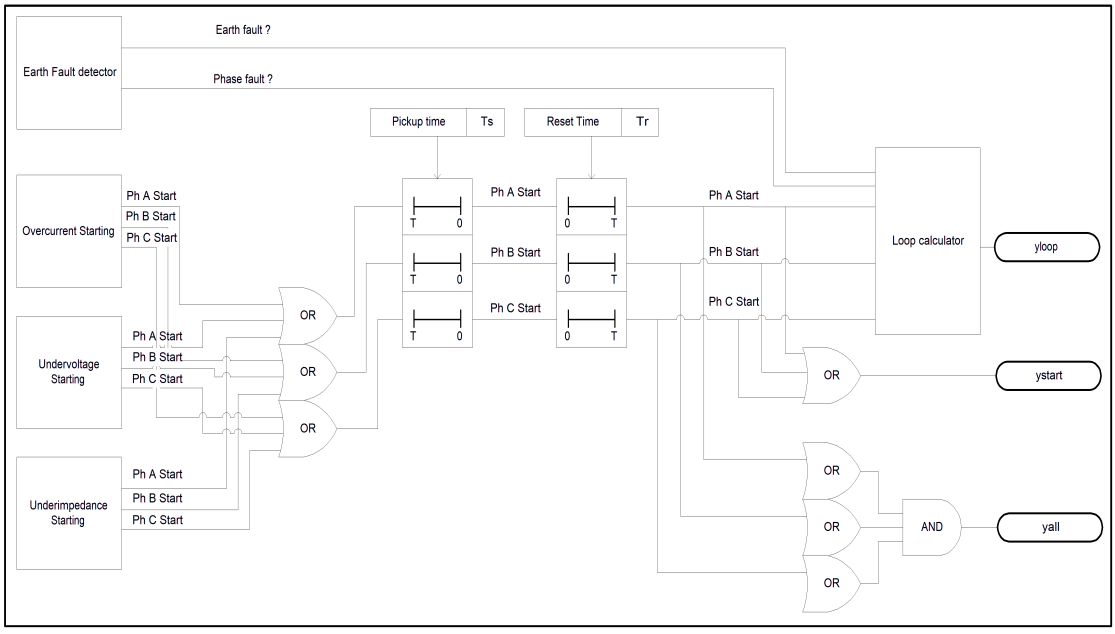
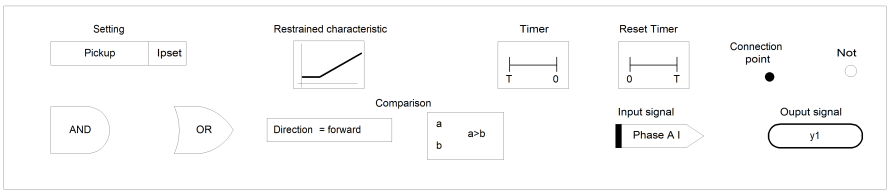


Figure 2.1: *DIgSILENT* AEG/Alstom *starting logic*



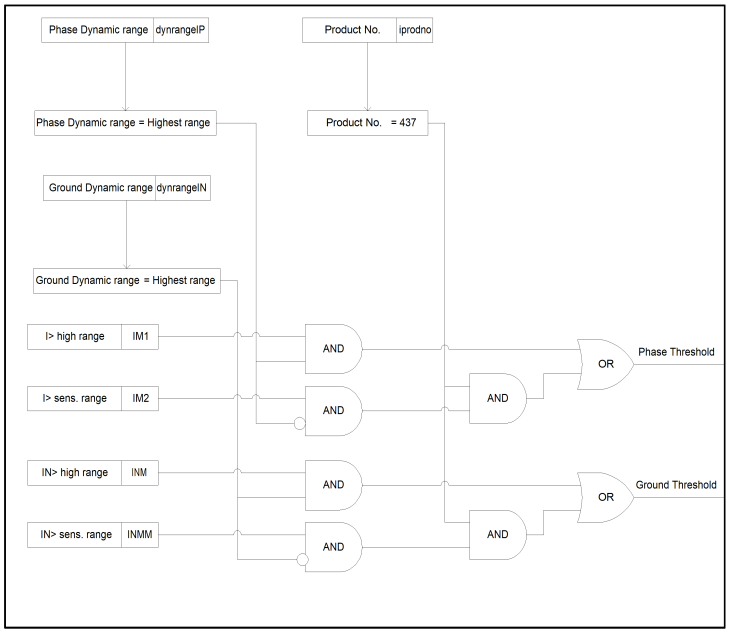


Figure 2.2: *DIgSILENT* AEG/Alstom *437 phase and ground threshold selection logic*

2.1.2 Overcurrent

When the overcurrent starting is available and the *Overcurrent* checkbox is set, the phase currents are compared with the $I>>$ ("IMM" parameter) and the $I>>>$("IMMM" parameter) phase current threshold. If the system grounding is *Solidly earthed* a phase is declared to be in starting condition only if the relevant current is greater than 2/3 the greater phase current.
Running a short circuit or a load flow the starting time is considered to be an half cycle if the current is greater than $I>>>$("IMMM" parameter) or a cycle if the current is greater than $I>>$("IMM" parameter).

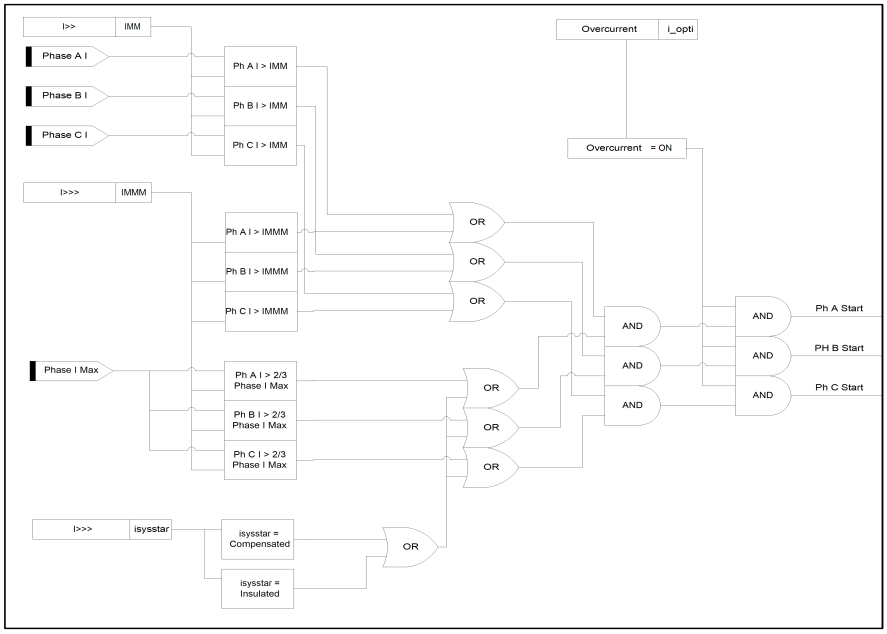


Figure 2.3: *DIgSILENT* AEG/Alstom *Overcurrent starting logic*

2.1.3 Undervoltage

When the undervoltage starting is available and the *Undervoltage* checkbox is set, the phase voltages are compared with the U_j (“Um” parameter)

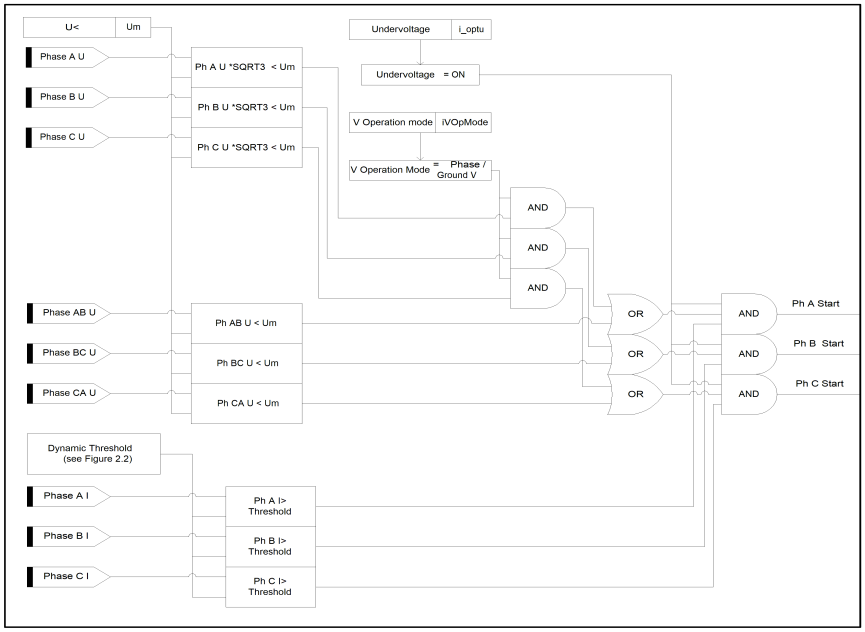
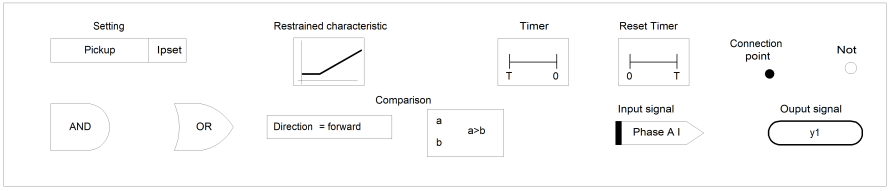


Figure 2.4: *DIgSILENT* AEG/Alstom *Undervoltage starting logic*



2.1.4 Underimpedance

When the underimpedance starting is available and the *Underimpedance* checkbox is set the phase currents must exceed a threshold value. Only for the *437* type, the user can select in the *Basic data* tab page if the *High Values* or the *Sensitive* phase current threshold must be used as enabling threshold.
The distance starting zone shape is shown in Figure 2.7.

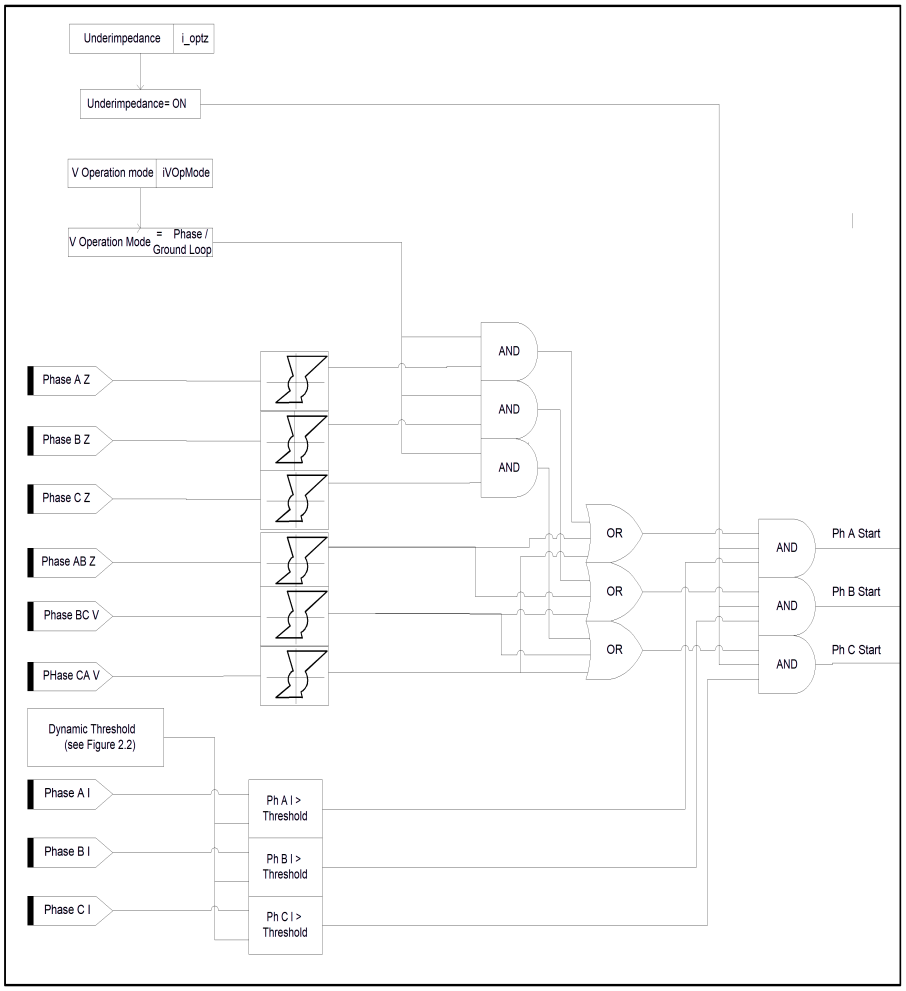
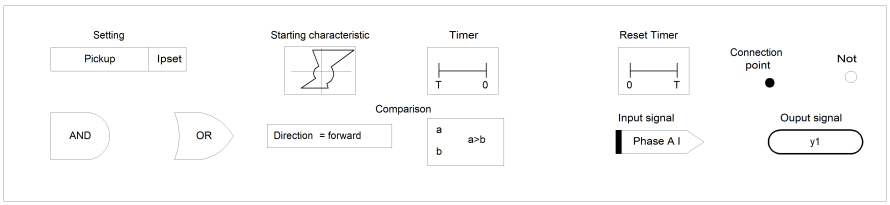


Figure 2.5: *DIgSILENT* AEG/Alstom *Underimpedance starting logic*



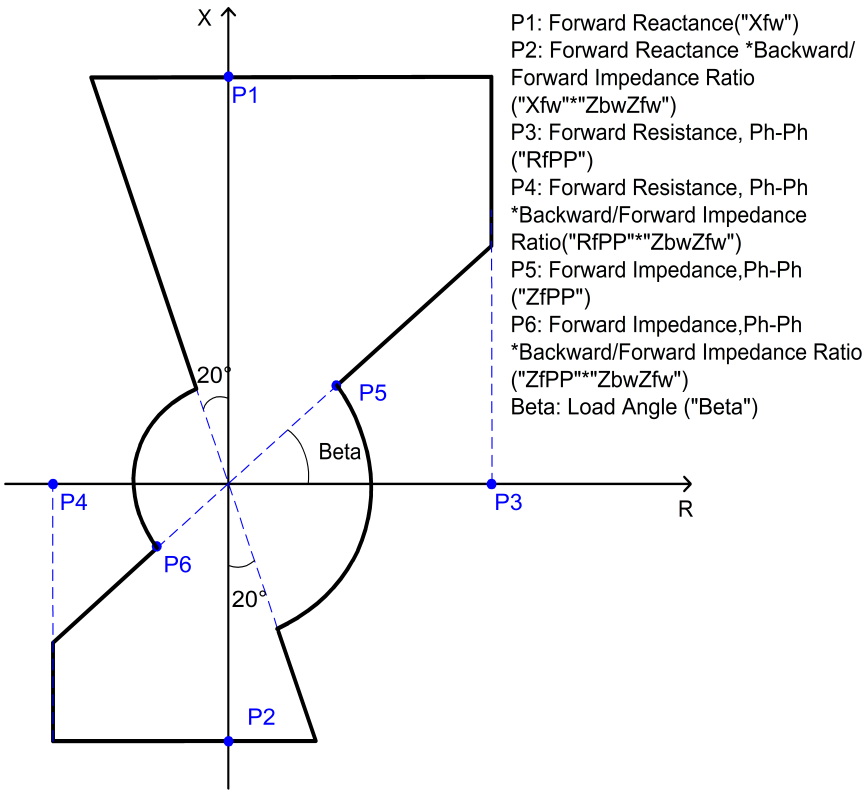


Figure 2.6: *DIgSILENT* The *Underimpedance phase starting detection zone*

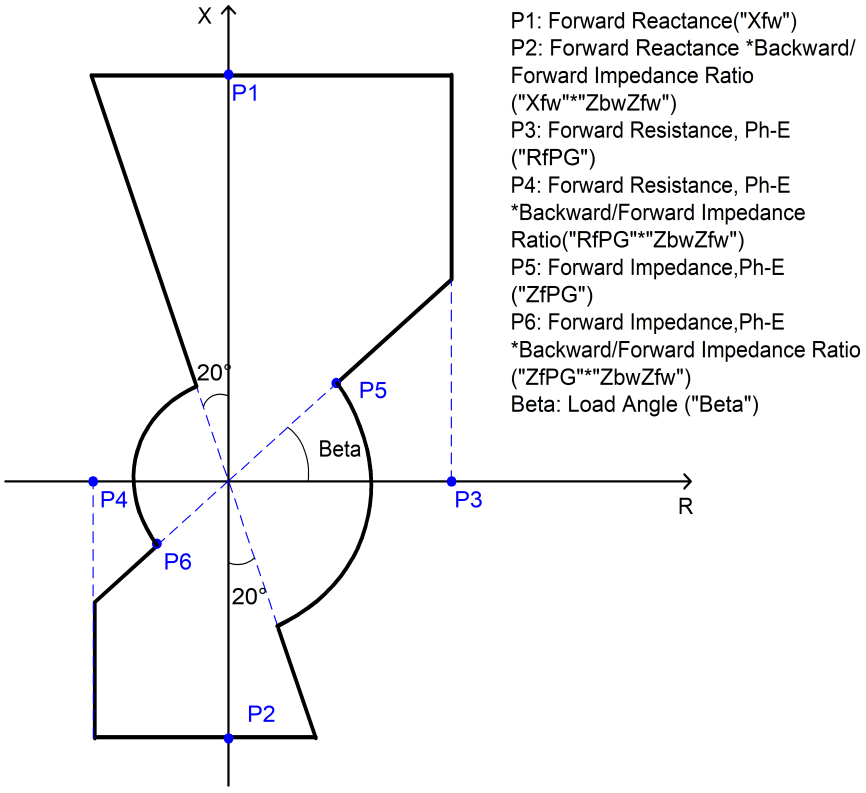


Figure 2.7: *DIgSILENT* The *Underimpedance ground starting detection zone*

2.1.5 Earth Fault Detection

The ground detection logic use one zero sequence current threshold with restrain characteristic and time delay and one zero sequence voltage threshold to detect the ground fault condition. Different logic are applied for a solidly earthed network and for a not earthed or a compensated network. When *Solidly Earthed* has been set in the “System Grounding” (“isysstar”parameter)an earth fault is detected if one of the following conditions is verified:

- the earth current is greater than than the earth threshold (which can be “IN>sens.range” or “IN>high range” depending up on the “Ground Dynamic range” (“dynrangeIN” parameter)).
- the zero sequence voltage is greater than “VNG>”

When *Compensated* or *Isolated* has been set an earth fault is detected if following conditions are verified at the same time:

- the earth current is greater than than the earth threshold (which can be “IN>sens.range” or “IN>high range” depending up on the “Ground Dynamic range” (“dynrangeIN” parameter)).
- the zero sequence voltage is greater than “VNG>”.
- At least 2 phase currents are greater than the phase starting current or an *Underimpedance* starting has been declared or a *Undervoltage* starting has been declared or the “tIN>” time expired.

The lower zero sequence current threshold can be set to use a stabilization slope to avoid spurious trips. The earth detection logic is showed in the Figure 2.8

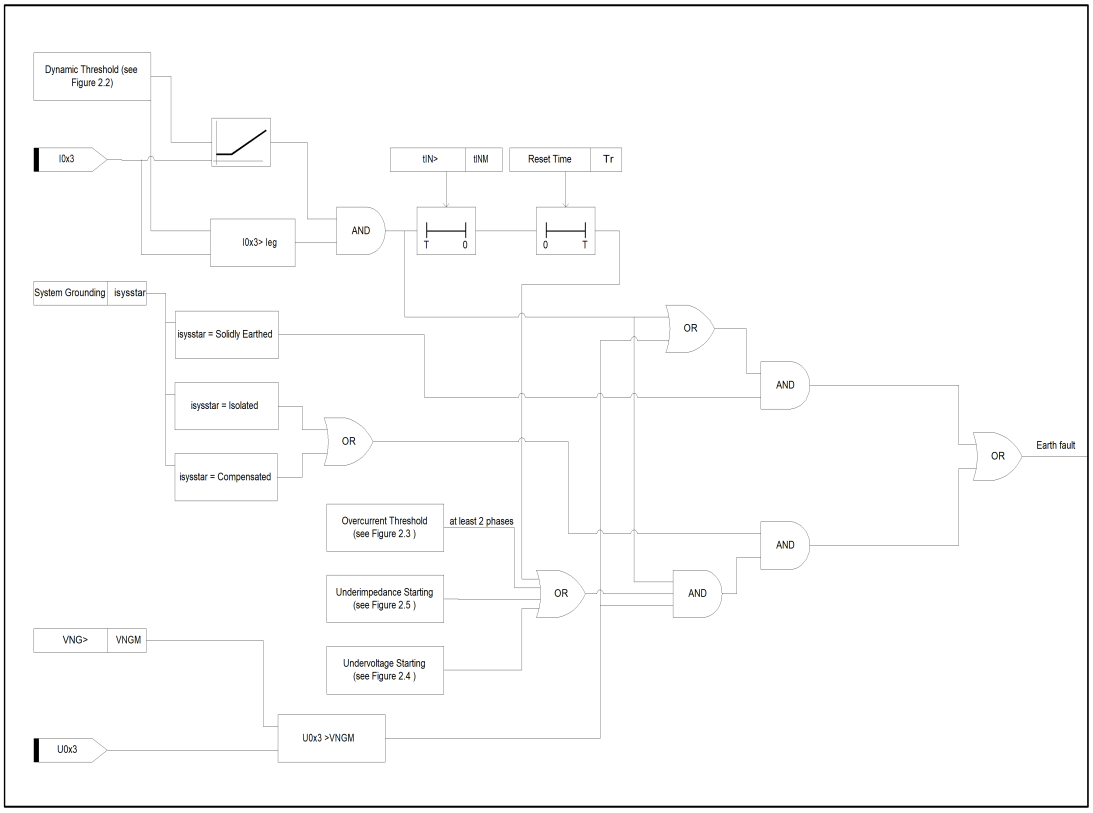


Figure 2.8: *DIgSILENT* AEG/Alstom *Earth detection starting logic*

2.1.6 Fault Loop Settings

The *Fault Loop* logic defines additional loop selection preferences in case of single Phase-Ground, Phase-Phase-Ground or three Phases-Ground faults. Function of the type id, two different groups of settings are active:

The ”532” and the ”932” type ids activate the following settings:

- *Transfer for 1p* (“itransf1p” parameter)
- *Phase Priority 2pG* (“iphpriority” parameter)

All other type ids activate the following settings:

- *Meas. start. 1pG* (“iStart1pG” parameter)
- *Meas. start. 2pG* (“iStart2pG” parameter)
- *Meas. start. 3pG* (“iStart3pG” parameter)
- *Transfer for 1p* (“itransf1p” parameter)

Meas. start. 1pG It’s the logic applied when a Phase-Ground fault has been detected. One between the following options can be selected:

- *None*
- *Ground Loops*

When the *None* option is set the element doesn’t start for single Phase-Ground fault and the protection doesn’t operate. The *Ground Loops* option allows the starting logic to detect has expected a single Phase-Ground fault.

Meas. start. 2pG It’s the logic applied when a Phase-Phase-Ground fault has been detected. One between the following options can be selected:

- *Phase Loops*
- *Ground Loops*

When the *Phase Loops* option is set and a Phase-Phase-Ground fault has been detected the relevant phase loop is declared as started. Example: if a B-C-Ground fault is applied and *Phase Loops* option is set, the “yloop” is set equal to 5, if the *Ground Loops* option is set, the “yloop” is set equal to 2.

Meas. start. 3pG It’s the logic applied when a 3Phase-Ground fault has been detected. One between the following options can be selected:

- *Phase Loops*
- *Ground Loops*

Example: if a A-B-C-Ground fault is applied and *Phase Loops* option is set, the “yloop” is set equal to 23, if the *Ground Loops* option is set, the “yloop” is set equal to 22.

Transfer for 1p It's the starting logic used when only a phase has been detected as started and no ground fault has been detected. One between the following options can be selected:

- *Ground*
- *P or G =f(Imed,Imax)*

When the *Ground* option is set a phase-ground fault is declared if the zero sequence current has been greater than the "INM" setting for a time greater than the "tINM" setting.
When the *P or G =f(Imed,Imax)* option is set a phase-ground fault is declared if the average phase current is greater than $2/3maxI_{phase}$; if it's smaller a phase-ground fault is declared if the zero sequence current has been greater than the "INM" setting for a time greater than the "tINM" setting.

Phase Priority 2pG It's the logic applied when a Phase-Phase-Ground fault has been detected and the type is *532* or *932*. One between the following options can be selected:

- *C before A acyclic*
- *A before B before C cyclic*
- *A before C acyclic*
- *C before B before A cyclic*
- *B before A acyclic*
- *A before B acyclic*
- *C before B acyclic*
- *B before C acyclic*

Table 2.1: Started loop applying the Phase Priority logic to a Ph-Ph-Grnd fault

FaultType	**C before A acyclic**	**A before B before C cyclic**	**A before C acyclic**	**C before B before A acyclic**	**B before A acyclic**	**A before B acyclic**	**C before B acyclic**	**B before C acyclic**
A-B-Grnd	A	A	A	B	B	A	B	B
A-C-Grnd	C	C	A	A	A	A	C	C
B-C-Grnd	C	B	C	C	B	B	C	B

2.1.7 Description

The *Description* tab page can be used to insert some information to identify the Aeg/Alstom Starting 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 AEG/Alstom Starting Type(TypFdetaegalst)

The *AEG/Alstom Starting* block main characteristics must be configured in the “AEG/Alstom Starting Type” dialogue (*TypFdetaegalst* class). The dialogue contains six tab pages: *Basic Data*,*Overcurrent*, *Undervoltage Ground Fault Detection*, *Impedance*, and *Common*.

2.2.1 Basic Data

The *Basic data* tab page contains the combox which allow to select the active Aeg/Alstom starting type. The following types are available:

- 437
- 521
- 531
- 532
- 551
- 552
- 932

Four combo boxes (*Overcurrent* , *Undervoltage*, *Underimpedance*, and *Earth Fault*) allow to define which starting types are shown in the “AEG/Alstom Starting” dialogue (“RelFdetaegalst” class). Each combobox contains the following options

- *Disabled*
- *Enabled*
- *User Configurable*

When the *Disabled* option is selected the relevant check box is hidden in the “Basic Data” tab page of the “AEG/Alstom Starting” dialogue. When the *Enabled* option is selected the relevant check box is showed checked and cannot be modified. When the *User Configurable* option is selected the relevant check box is showed and can be checked or unchecked.

2.2.2 Overcurrent

The *Overcurrent* tab page contains the range definition for the element parameters available in the “Overcurrent” tab page of the “AEG/Alstom Starting” dialogue.

2.2.3 Underimpedance

The *Underimpedance* tab page contains the range definition for the element parameters available in the “Underimpedance” tab page of the “AEG/Alstom Starting” dialogue.

2.2.4 Ground Fault Detection

The *Ground Fault Detection* tab page contains the range definition for the element parameters available in the “Earth Fault Detection” tab page of the “AEG/Alstom Starting” dialogue.

2.2.5 Undervoltage

The *Undervoltage* tab page contains the range definition for the element parameters available in the “Undervoltage” tab page of the “AEG/Alstom Starting” dialogue.

2.2.6 Common

The *Common* tab page defines the pickup delay (*Pickup Time*“Ts” parameter), the *Reset Time* (“Tr” parameter) and four separated *Reset Ratios* for the *Overcurrent* (“Krl” parameter), the *Impedance* (“KrRX” parameter), the *Voltage* (“KrU” parameter) and the *Earth detection* (“Kre” parameter) starting logic of the Aeg/Alstom starting element. Please notice that the *Overcurrent* “Krl” parameter and the *Earth detection* “Kre” parameter must be smaller than 1 and the *Impedance Z* “KrRX” parameter and the *Voltage* “KrU” parameter must be greater than 1.

3 Integration in the relay scheme

The *AEG/Alstom starting* type class name is *TypFdetaegalst*. The *AEG/Alstom starting* dialogue class name is *RelFdetaegalst*. In the relay scheme the AEG/Alstom starting element gets the voltage and the current signals from the measurement element. The signal with the ID(s) of the started loop(s) is used by the polygonal or the mho trip zones.

A complete connection scheme is showed here below.

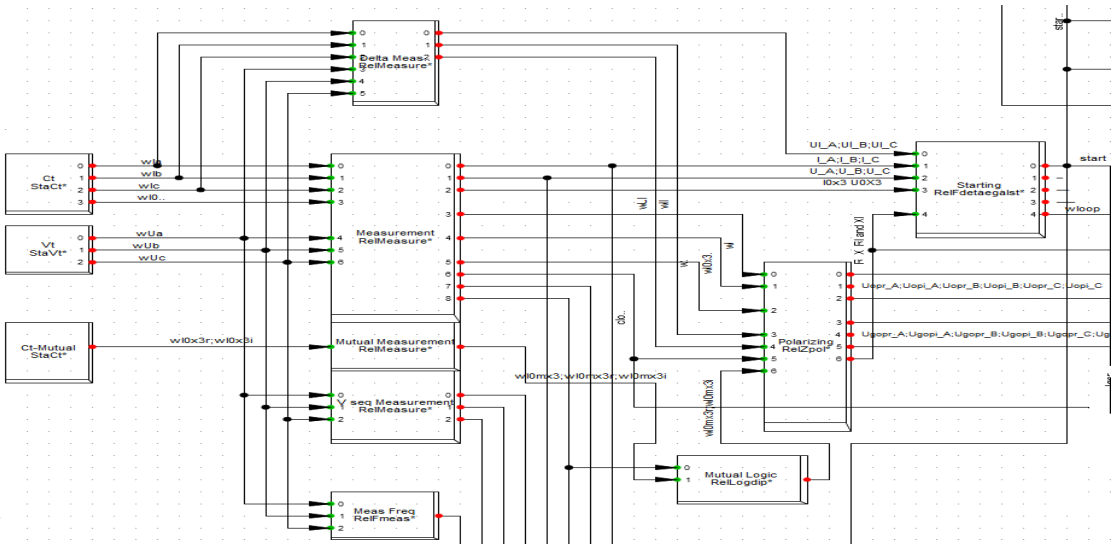


Figure 3.1: *DIgSILENT* Connection scheme of a *AEG/Alstom starting* “RelFdetaegalst” block.

A Parameter Definitions

A.1 AEG/Alstom starting block Type (TypFdetaegalst)

Table A.1: Input parameters of AEG/Alstom starting type (*TypFdetaegalst*)

Parameter	Description	Unit
loc_name	Name assigned by the user to the block type	Text
iprodno	The AEG starting block type (supported number: 521, 531, 532, 551, 552, 932)	Integer
ioverc	Flag defining if the overcurrent starting is always *Enabled*, *Disabled* or is *User Configurable*	Integer
iimped	Flag defining how the impedance starting is always *Enabled*, *Disabled* or is *User Configurable*	Integer
iundu	Flag defining how the undervoltage starting is always *Enabled*, *Disabled* or is *User Configurable*	Integer
igrnd	Flag defining how the earth detection is always *Enabled*, *Disabled* or is *User Configurable*	Integer
rIMM	Range of the first phase overcurrent starting threshold	Text
rIMMM	Range of the second phase overcurrent starting threshold	Text
rIM1	Range of the first ("I > high") phase overcurrent underimpedance starting threshold	Text
rIM2	Range of the second ("I > sens.") phase overcurrent underimpedance starting threshold	Text
rXfw	Range of the Forward Reactance	Text
rZbwZfw	Range of the Backward/Foward Impedance Ratio	
rRfPP	Range of the Resistance Forward, Ph-Ph	Text
rRfPG	Range of the Resistance Forward, Ph-E	Text
rZfPP	Range of the Load Impedance Forward, Ph-Ph	Text
rZfPG	Range of the Load Impedance Forward, Ph-E	Text
rBeta	Range of the Load Impedance angle limit (I & III quadrant)	Text
rINMM	Range of the ("IN > high") neutral overcurrent starting threshold	Text
rINM	Range of the ("I > sens.") neutral overcurrent starting threshold	Text
rtINM	Range of the time delay applied to the ("IN > high") neutral overcurrent starting threshold	Text
rVNGMM	Range of the second neutral overvoltage threshold VNG > >	Text
rtVNGMM	Range of the delay of the second neutral overvoltage threshold VNG > >	Text
rVNGM	Range of the first neutral overvoltage threshold VNG >	Text
rEstabfac	Range of the stabilization factor applied to the earth threshold calculation	Text
rUm	Range of the phase undervoltage threshold $U_{\text{¡}}$ used by the undervoltage starting logic	Text
Ts	Pick up time, its the time spent measuring the currents in the load flow and short circuit calculation and in the RMS simulation	Seconds
Tr	Reset time, its the delay with which the block reset the trip outputs after that the start	Seconds
KrZ	Underimpedance reset ratio	Real number
KrI	Current reset ratio	Real number
KrU	Voltage reset ratio	Real number
kre	Earth current reset ratio	Real number

A.2 AEG/Alstom starting Element (RelFdetaegalst)

Table A.2: Input parameters of AEG/Alstom starting element (*RelFdetaegalst*))

Parameter	Description	Unit
loc_name	Name assigned by the user to the block	Text
iopt_i	Flag to enable the current starting logic	Integer
iopt_u	Flag to enable the undervoltage starting logic	Integer
iopt_z	Flag to enable the underimpedance starting logic	Integer
iopt_ie	Flag to enable the earth fault detection starting logic	Integer
isysstar	Earthing system (*Solidly Earthed*, *Compensated*, *Insulated*)	Integer
dynrangeIP	Flag activating the phase high or sensitive current threshold (*Highest Range*, *Sensitive*)	Integer
dynrangeIN	Flag activating the ground high or sensitive current threshold (*Highest Range*, *Sensitive*)	Integer
IMM	First phase overcurrent starting threshold	pu
IMMM	Second phase overcurrent starting threshold	Multiple of IMM
iVOpMode	Operation mode of the undervoltage starting logic, it defines which loops are evaluated by the logic (*Phase Voltage*,*Phase/Ground Voltage*)	Integer
iZOpMode	Operation mode of the underimpedance starting logic, it defines which loops are evaluated by the logic (*Phase Loops*,*Phase/Ground Loops*)	Integer
IM1	("I > high") phase overcurrent underimpedance starting threshold	pu
IM2	("I > sens.") phase overcurrent underimpedance starting threshold	pu
Xfw	Forward Reactance	Sec Ohm
ZbwZfw	Backward/Foward Impedance Ratio	
RfPP	Resistance Forward, Ph-Ph	Sec Ohm
RfPG	Resistance Forward, Ph-E	Sec Ohm
ZfPP	Load Impedance Forward, Ph-Ph	Sec Ohm
ZfPG	Load Impedance Forward, Ph-E	Sec Ohm
Beta	Load Impedance angle limit (I & III quadrant)	Degrees
INMM	("IN > high") neutral overcurrent starting threshold	pu
INM	("I > sens.") neutral overcurrent starting threshold	pu
tINM	Time delay applied to the ("IN > high") neutral overcurrent starting threshold	s
VNGMM	Second neutral overvoltage threshold VNG > >	pu
tVNGMM	Delay of the second neutral overvoltage threshold VNG > >	s
VNGM	First neutral overvoltage threshold VNG >	pu
Estabfac	Stabilization factor applied to the earth threshold calculation	%
rUm	Phase undervoltage threshold $U_{\text{¡}}$ used by the undervoltage starting logic	pu
iStart1pG	Loops used to detect a single phase fault (*None*, *Ground Loops*)	Integer
iStart2pG	Loops used to detect a double phase fault (*Phase Loops*, *Ground Loops*)	Integer
iStart3pG	Loops used to detect a three phase fault (*Phase Loops*, *Ground Loops*)	Integer
itransf1p	Special logic for single phase starting detection without earth fault detection	Integer
iphpriority	Phase priority in case of a Ph-Ph-Ground fault	Integer

B Signal Definitions

Table B.1: Input/output signals of the AEG/Alstom starting element (*CalFdetaegalst*)

Name	Description	Unit	Type	Model
I_A	Phase A current	Secondary Amperes	IN	Any
I_B	Phase B current	Secondary Amperes	IN	Any
I_C	Phase C current	Secondary Amperes	IN	Any
I0x3	Zero sequence current	Secondary Amperes	IN	Any
I2x3	Negative sequence current	Secondary Amperes	IN	Any
U0x3	Zero sequence voltage	Secondary Volts	IN	Any
R_A	Phase A loop resistance	Secondary Ohms	IN	Any
X_A	Phase A loop inductance	Secondary Ohms	IN	Any
R_B	Phase B loop resistance	Secondary Ohms	IN	Any
X_B	Phase B loop inductance	Secondary Ohms	IN	Any
R_C	Phase C loop resistance	Secondary Ohms	IN	Any
X_C	Phase C loop inductance	Secondary Ohms	IN	Any
RI_A	Phase A - Phase B loop resistance	Secondary Ohms	IN	Any
XI_A	Phase A Phase B loop inductance	Secondary Ohms	IN	Any
RI_B	Phase B - Phase C loop resistance	Secondary Ohms	IN	Any
XI_B	Phase B Phase C loop inductance	Secondary Ohms	IN	Any
RI_C	Phase C - Phase A loop resistance	Secondary Ohms	IN	Any
XI_C	Phase C Phase A loop inductance	Secondary Ohms	IN	Any
U_A	Phase A voltage	Secondary Volts	IN	Any
U_B	Phase B voltage	Secondary Volts	IN	Any
U_C	Phase C voltage	Secondary Volts	IN	Any
UI_A	Phase A Phase B voltage	Secondary Volts	IN	Any
UI_B	Phase B Phase C voltage	Secondary Volts	IN	Any
UI_C	Phase C Phase A voltage	Secondary Volts	IN	Any
yloop	ID of the loop from which the fault must be removed		OUT	Any
ystart	Starting signal/ starting time	Seconds (or 1/0 RMS/EMT simulation)	OUT	Any
ysall	Starting signal/ starting time for all loops (3ph fault)	Seconds (or 1/0 RMS/EMT simulation)	OUT	Any
yfaulttype	Fault type ID		OUT	Any

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