Measuring Point I-3ph

Addr.	Parameter	C	Setting Options	Default Setting
General				
_:8881:115	CT 3-phase:CT connection		• not assigned • 3-phase + IN • 3-phase • 3-phase + IN-separate • 3-phase, 2 primary CT • 3ph,2prim.CT + IN-sep • 2ph, 2p. CT + IN-sep	3-phase + IN
_:8881:127	CT 3-phase:Tracking		• inactive • active	active
_:8881:130	CT 3-phase:Measuring-point ID		0 to 100	0
CT phases				
_:8881:101	CT 3-phase:Rated primary current		1.0 A to 100000.0 A	1000.0 A
_:8881:102	CT 3-phase:Rated secondary current		• 1 A • 5 A	1 A
_:8881:117	CT 3-phase:Current range		• 1.6 x IR • 100 x IR • 50 x IR	100 x IR
_:8881:118	CT 3-phase:Internal CT type		• CT protection • CT measurement • CT Process bus	CT protection
_:8881:116	CT 3-phase:Neutr.point in dir.of ref.obj		• no • yes	yes
_:8881:114	CT 3-phase:Inverted phases		• none • AC • BC • AB	none
_:8881:107	CT 3-phase:CT error changeover		1.00 to 10.00	1.00
_:8881:108	CT 3-phase:CT error A		0.5 % to 50.0 %	5.0 %
_:8881:109	CT 3-phase:CT error B		0.5 % to 50.0 %	15.0 %
CT IN				
_:8881:104	CT 3-phase:Rated primary current		1.0 A to 100000.0 A	1000.0 A
_:8881:105	CT 3-phase:Rated secondary current		• 1 A • 5 A	1 A
_:8881:119	CT 3-phase:Current range		• 1.6 x IR • 100 x IR • 50 x IR	100 x IR
_:8881:120	CT 3-phase:Internal CT type		• CT protection • CT measurement • CT Process bus	CT protection
CT IN2				
_:8881:106	CT 3-phase:Rated primary current		1.0 A to 100000.0 A	1000.0 A
_:8881:113	CT 3-phase:Rated secondary current		1 A to 5 A	1 A

Addr.	Parameter	C	Setting Options	Default Setting
_:8881:121	CT 3-phase:Current range		• 1.6 x IR • 100 x IR • 50 x IR	1.6 x IR
_:8881:122	CT 3-phase:Internal CT type		• CT protection • CT measurement • CT Process bus	CT protection
CT 1				
_:3841:103	CT 1:Magnitude correction		0.010 to 10.000	1.000
_:3841:117	CT 1:Phase		• I A • I B • I C • IN • INsens • Ix	
CT 2				
_:3842:103	CT 2:Magnitude correction		0.010 to 10.000	1.000
_:3842:117	CT 2:Phase		• I A • I B • I C • IN • INsens • Ix	
CT 3				
_:3843:103	CT 3:Magnitude correction		0.010 to 10.000	1.000
_:3843:117	CT 3:Phase		• I A • I B • I C • IN • INsens • Ix	
CT 4				
_:3844:103	CT 4:Magnitude correction		0.010 to 10.000	1.000
_:3844:117	CT 4:Phase		• I A • I B • I C • IN • INsens • Ix	
Brk.wire det.				
_:5581:1	Brk.wire det.:Mode		• off • on • test	off
Supv. balan. I				
_:2491:1	Supv. balan. I:Mode		• off • on • test	off

Addr.	Parameter	C	Setting Options	Default Setting
_:2491:101	Supv. balan. I:Release threshold	1 A @ 100 Irated	0.030 A to 35.000 A	0.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	2.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	0.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	2.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	0.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	2.500 A
_:2491:102	Supv. balan. I:Threshold min/max		0.10 to 0.95	0.50
_:2491:6	Supv. balan. I:Delay supervision alarm		0.00 s to 100.00 s	5.00 s
Supv. ph.seq. I				
_:2551:1	Supv. ph.seq.I:Mode		• off • on • test	off
_:2551:6	Supv. ph.seq.I:Delay supervision alarm		0.00 s to 100.00 s	5.00 s
Supv. sum I				
_:2431:1	Supv. sum I:Mode		• off • on • test	off
_:2431:102	Supv. sum I:Threshold	1 A @ 100 Irated	0.030 A to 10.000 A	0.100 A
		5 A @ 100 Irated	0.15 A to 50.00 A	0.50 A
		1 A @ 50 Irated	0.030 A to 10.000 A	0.100 A
		5 A @ 50 Irated	0.15 A to 50.00 A	0.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	0.100 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	0.500 A
_:2431:101	Supv. sum I:Slope factor		0.00 to 0.95	0.10
_:2431:6	Supv. sum I:Delay supervision alarm		0.00 s to 100.00 s	5.00 s
Supv.ADC sum I				
_:2401:1	Supv.ADC sum I:Mode		• off • on • test	off

Measuring Point V-1ph

Addr.	Parameter	C	Setting Options	Default Setting
General				
_:2311:101	General:Rated primary voltage		0.200 kV to 1200.000 kV	400.000 kV
_:2311:102	General:Rated secondary voltage		80 V to 340 V	100 V
_:2311:103	General:Tracking		• inactive • active	inactive
_:2311:130	General:Measuring-point ID		0 to 100	0
VT 1				
_:3811:103	VT 1:Magnitude correction		0.010 to 10.000	1.000

Addr.	Parameter	C	Setting Options	Default Setting
_:3811:108	VT 1:Phase		• V A • V B • V C • V AB • V BC • V CA • VN • Vx • VCB •	
_:3811:107	VT 1:Sequence number device		1 to 2147483647	2147483647
VT miniatureCB				
_:2641:101	VT miniatureCB:Response time		0.00 s to 0.03 s	0.00 s

Measuring Point V-3ph

Addr.	Parameter	C	Setting Options	Default Setting
General				
_:8911:101	VT 3-phase:Rated primary voltage		0.200 kV to 1200.000 kV	400.000 kV
_:8911:102	VT 3-phase:Rated secondary voltage		80 V to 230 V	100 V
_:8911:103	VT 3-phase:Matching ratio Vph / VN		0.10 to 9.99	1.73
_:8911:104	VT 3-phase:VT connection		• not assigned • 3 ph-to-gnd volt. + VN • 3 ph-to-gnd voltages • 3 ph-to-ph volt. + VN • 3 ph-to-ph voltages • 2 ph-to-ph volt. + VN • 2 ph-to-ph voltages	3 ph-to-gnd volt. + VN
_:8911:106	VT 3-phase:Inverted phases		• none • AC • BC • AB	none
_:8911:111	VT 3-phase:Tracking		• inactive • active	active
_:8911:130	VT 3-phase:Measuring-point ID		0 to 100	0
VT 1				
_:3811:103	VT 1:Magnitude correction		0.010 to 10.000	1.000
_:3811:108	VT 1:Phase		• V A • V B • V C • V AB • V BC • V CA • VN • Vx • VCB	

Addr.	Parameter	C	Setting Options	Default Setting
_:3811:107	VT 1:Sequence number device		1 to 2147483647	2147483647
VT 2				
_:3812:103	VT 2:Magnitude correction		0.010 to 10.000	1.000
_:3812:108	VT 2:Phase		• V A • V B • V C • V AB • V BC • V CA • VN • Vx • VCB	
_:3812:107	VT 2:Sequence number device		1 to 2147483647	2147483647
VT 3				
_:3813:103	VT 3:Magnitude correction		0.010 to 10.000	1.000
_:3813:108	VT 3:Phase		• V A • V B • V C • V AB • V BC • V CA • VN • Vx • VCB •	
_:3813:107	VT 3:Sequence number device		1 to 2147483647	2147483647
VT 4				
_:3814:103	VT 4:Magnitude correction		0.010 to 10.000	1.000
_:3814:108	VT 4:Phase		• V A • V B • V C • V AB • V BC • V CA • VN • Vx • VCB •	
_:3814:107	VT 4:Sequence number device		1 to 2147483647	2147483647
Supv. balan. V				
_:2521:1	Supv. balan. V:Mode		• off • on • test	off
_:2521:101	Supv. balan. V:Release threshold		0.300 V to 170.000 V	50.000 V
_:2521:102	Supv. balan. V:Threshold min/max		0.58 to 0.95	0.75

Addr.	Parameter	C	Setting Options	Default Setting
_:2521:6	Supv. balan. V:Delay supervision alarm		0.00 s to 100.00 s	5.00 s
Supv. ph.seq.V				
_:2581:1	Supv. ph.seq.V:Mode		• off • on • test	off
_:2581:6	Supv. ph.seq.V:Delay supervision alarm		0.00 s to 100.00 s	5.00 s
Supv. sum V				
_:2461:1	Supv. sum V:Mode		• off • on • test	off
_:2461:3	Supv. sum V:Threshold		0.300 V to 170.000 V	25.000 V
_:2461:6	Supv. sum V:Delay supervision alarm		0.00 s to 100.00 s	5.00 s
VT miniatureCB				
_:2641:101	VT minia-tureCB:Response time		0.00 s to 0.03 s	0.00 s

6.1.7 Information List

General

No.	Information	Data Class (Type)	Type
General			
_:2311:500	General:>Phs-rotation reversal	SPS	I
_:2311:501	General:>Invert Phases	SPS	I
General			
_:2311:319	General:Phase sequence ABC	SPS	O
_:2311:320	General:Phase sequence ACB	SPS	O
_:2311:321	General:Freq.out of oper.range	SPS	O
_:2311:322	General:f sys	MV	O
_:2311:323	General:f track	MV	O

Measuring Point I-1ph

No.	Information	Data Class (Type)	Type
CT 1			
_:3841:300	CT 1:Sampled val. current	SAV	O

Measuring Point I-3ph

No.	Information	Data Class (Type)	Type
General			
_:8881:319	CT 3-phase:Phases AB inverted	SPS	O
_:8881:320	CT 3-phase:Phases BC inverted	SPS	O
_:8881:321	CT 3-phase:Phases AC inverted	SPS	O

No.	Information	Data Class (Type)	Type
CT 1			
_:3841:300	CT 1:Sampled val. current	SAV	O
CT 2			
_:3842:300	CT 2:Sampled val. current	SAV	O
CT 3			
_:3843:300	CT 3:Sampled val. current	SAV	O
CT 4			
_:3844:300	CT 4:Sampled val. current	SAV	O
Brk.wire det.			
_:5581:82	Brk.wire det.:>Block function	SPS	I
_:5581:54	Brk.wire det.:Inactive	SPS	O
_:5581:52	Brk.wire det.:Behavior	ENS	O
_:5581:53	Brk.wire det.:Health	ENS	O
_:5581:301	Brk.wire det.:Phs A BW suspected	SPS	O
_:5581:302	Brk.wire det.:Phs B BW suspected	SPS	O
_:5581:303	Brk.wire det.:Phs C BW suspected	SPS	O
_:5581:304	Brk.wire det.:Phase A broken wire	SPS	O
_:5581:305	Brk.wire det.:Phase B broken wire	SPS	O
_:5581:306	Brk.wire det.:Phase C broken wire	SPS	O
_:5581:307	Brk.wire det.:Broken wire suspected	SPS	O
_:5581:308	Brk.wire det.:Broken wire confirmed	SPS	O
Supv. balan. I			
_:2491:82	Supv. balan. I:>Block function	SPS	I
_:2491:54	Supv. balan. I:Inactive	SPS	O
_:2491:52	Supv. balan. I:Behavior	ENS	O
_:2491:53	Supv. balan. I:Health	ENS	O
_:2491:71	Supv. balan. I:Failure	SPS	O
Supv. ph.seq.I			
_:2551:82	Supv. ph.seq.I:>Block function	SPS	I
_:2551:54	Supv. ph.seq.I:Inactive	SPS	O
_:2551:52	Supv. ph.seq.I:Behavior	ENS	O
_:2551:53	Supv. ph.seq.I:Health	ENS	O
_:2551:71	Supv. ph.seq.I:Failure	SPS	O
Supv. sum I			
_:2431:82	Supv. sum I:>Block function	SPS	I
_:2431:54	Supv. sum I:Inactive	SPS	O
_:2431:52	Supv. sum I:Behavior	ENS	O
_:2431:53	Supv. sum I:Health	ENS	O
_:2431:71	Supv. sum I:Failure	SPS	O
Supv.ADC sum I			
_:2401:82	Supv.ADC sum I:>Block function	SPS	I
_:2401:54	Supv.ADC sum I:Inactive	SPS	O
_:2401:52	Supv.ADC sum I:Behavior	ENS	O
_:2401:53	Supv.ADC sum I:Health	ENS	O
_:2401:71	Supv.ADC sum I:Failure	SPS	O

Measuring Point V-1ph

No.	Information	Data Class (Type)	Type
VT 1			
_:3811:300	VT 1:Sampled val. voltage	SAV	O
Definite-T 1			
_:2641:500	VT miniatureCB:>Open	SPS	I

Measuring Point V-3ph

No.	Information	Data Class (Type)	Type
General			
_:8911:315	VT 3-phase:Phases AB inverted	SPS	O
_:8911:316	VT 3-phase:Phases BC inverted	SPS	O
_:8911:317	VT 3-phase:Phases AC inverted	SPS	O
VT 1			
_:3811:300	VT 1:Sampled val. voltage	SAV	O
VT 2			
_:3812:300	VT 2:Sampled val. voltage	SAV	O
VT 3			
_:3813:300	VT 3:Sampled val. voltage	SAV	O
VT 4			
_:3814:300	VT 4:Sampled val. voltage	SAV	O
Supv. balan. V			
_:2521:82	Supv. balan. V:>Block function	SPS	I
_:2521:54	Supv. balan. V:Inactive	SPS	O
_:2521:52	Supv. balan. V:Behavior	ENS	O
_:2521:53	Supv. balan. V:Health	ENS	O
_:2521:71	Supv. balan. V:Failure	SPS	O
Supv. ph.seq.V			
_:2581:82	Supv. ph.seq.V:>Block function	SPS	I
_:2581:54	Supv. ph.seq.V:Inactive	SPS	O
_:2581:52	Supv. ph.seq.V:Behavior	ENS	O
_:2581:53	Supv. ph.seq.V:Health	ENS	O
_:2581:71	Supv. ph.seq.V:Failure	SPS	O
Supv. sum V			
_:2461:82	Supv. sum V:>Block function	SPS	I
_:2461:54	Supv. sum V:Inactive	SPS	O
_:2461:52	Supv. sum V:Behavior	ENS	O
_:2461:53	Supv. sum V:Health	ENS	O
_:2461:71	Supv. sum V:Failure	SPS	O
Definite-T 1			
_:2641:500	VT miniatureCB:>Open	SPS	I

6.2 Group Indications of Overcurrent Protection Functions

6.2.1 Description

The function block **Group indications of the overcurrent protection functions** uses the pickup and operate indications of the following functions:

- Overcurrent Protection, Phases
- Overcurrent Protection, Ground
- Directional time-overcurrent protection, phases
- Directional Overcurrent Protection, Ground
- Instantaneous High-Current Tripping

The group indications of the overcurrent protection are generated by a logical OR of the stage-selective pickup and operate indications of the functions listed above (see also *Figure 6-4*):

- `Pickup`
- `Operate`

The pickup and operate indications are output, where present, with direction information.

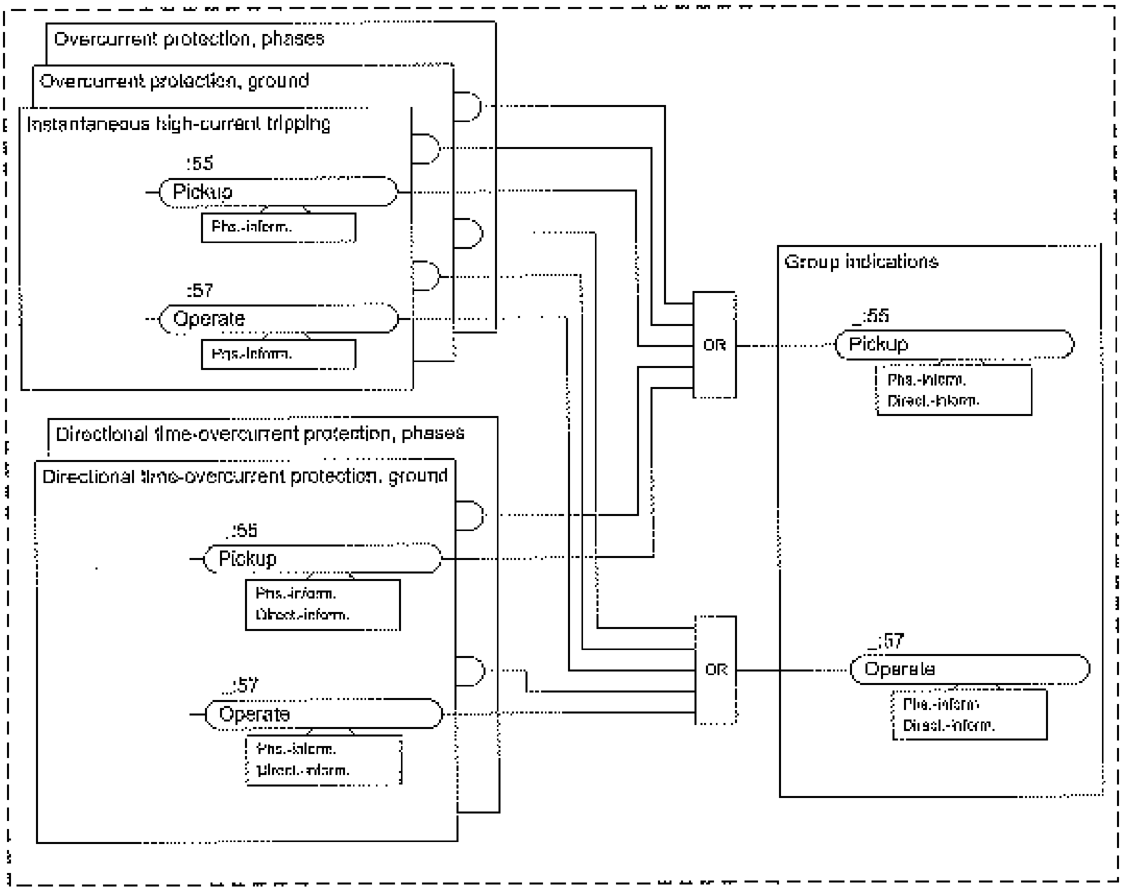

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Figure 6-4 Logic Diagram of the Overcurrent Protection Group Indications

6.3 Overcurrent Protection, Phases

6.3.1 Overview of Functions

The **Overcurrent protection, phases** function (ANSI 50/51):

- Detects short circuits in electrical equipment
- Can be used as backup overcurrent protection in addition to the main protection

6.3.2 Structure of the Function

The **Overcurrent protection, phases** function is used in protection function groups. 2 kinds of functions are available for the 3-phase overcurrent protection:

- **Overcurrent protection, phases – advanced** (50/51 OC-3ph-A)
- **Overcurrent protection, phases – basic** (50/51 OC-3ph-B)

The Basic function type is provided for standard applications. The Advanced function type offers more functionality and is provided for more complex applications.

Both function types are preconfigured by the manufacturer with 2 **Definite time-overcurrent protection** stages and with 1 **Inverse time-overcurrent protection** stage.

In the **Overcurrent protection, phase– advanced** function type, the following stages can be operated simultaneously:

- Maximum of 4 stages **Definite time-overcurrent protection – advanced**
- 2 stages **Inverse time-overcurrent protection – advanced**
- 2 stages **User-defined overcurrent protection characteristic curve**

In the **Overcurrent protection, phases – basic** function type, the following stages can be operated simultaneously:

- Maximum of 4 stages **Definite time-overcurrent protection – basic**
- 1 stage **Inverse time-overcurrent protection – basic**

Stages that are not preconfigured are shown in gray in the following figures. Apart from the tripping delay characteristic, the stages are identical in structure.

The optional function block **Filter** offered in the advanced function allows to gain harmonics or to compensate the amplitude attenuation for the RMS value.

The group-indication output logic generates the following group indications of the protection function by the logical OR of the stage-selective indications:

- `Pickup`
- `Operate`

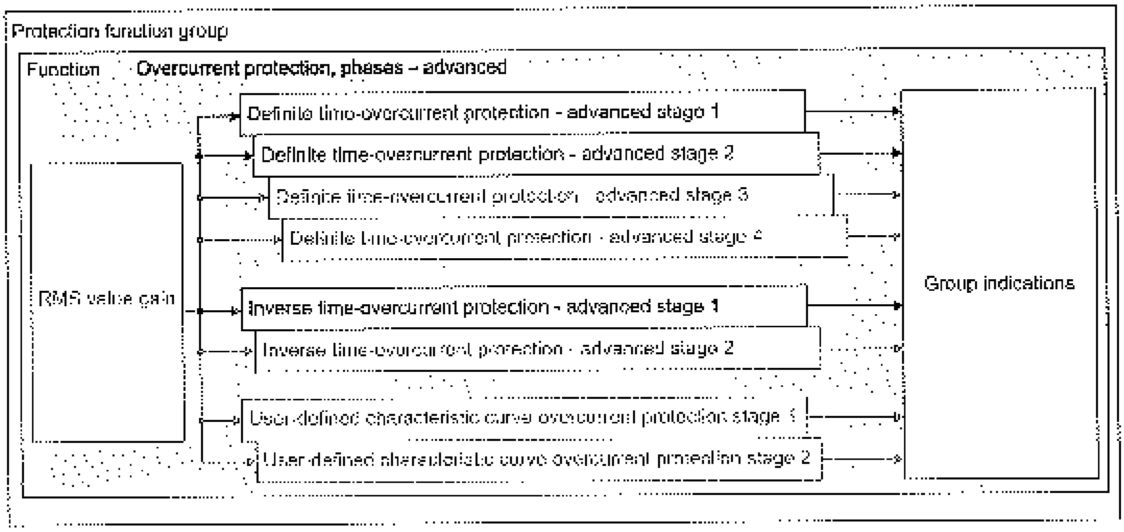


Figure 6-5 Structure/Embedding of the Function Overcurrent Protection, Phases – Advanced

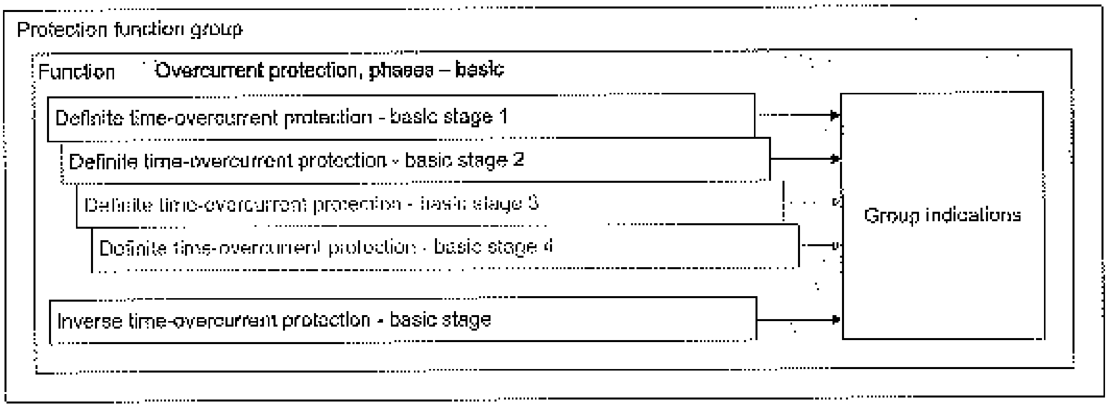


Figure 6-6 Structure/Embedding the Function Overcurrent Protection, Phases – Basic

If the device-internal functions listed in the following are present in the device, these functions can influence the pickup values and tripping delays of the stages or block the stages. The stage can also be affected by an external source via a binary input signal.

- Automatic reclosing (AREC)
- Cold-load pickup detection
- Binary input signal

If the device is equipped with an **Inrush-current detection** function, the stages can be stabilized against tripping due to transformer-inrush currents (available in both function types).

6.3.3 Filter for RMS Value Gain

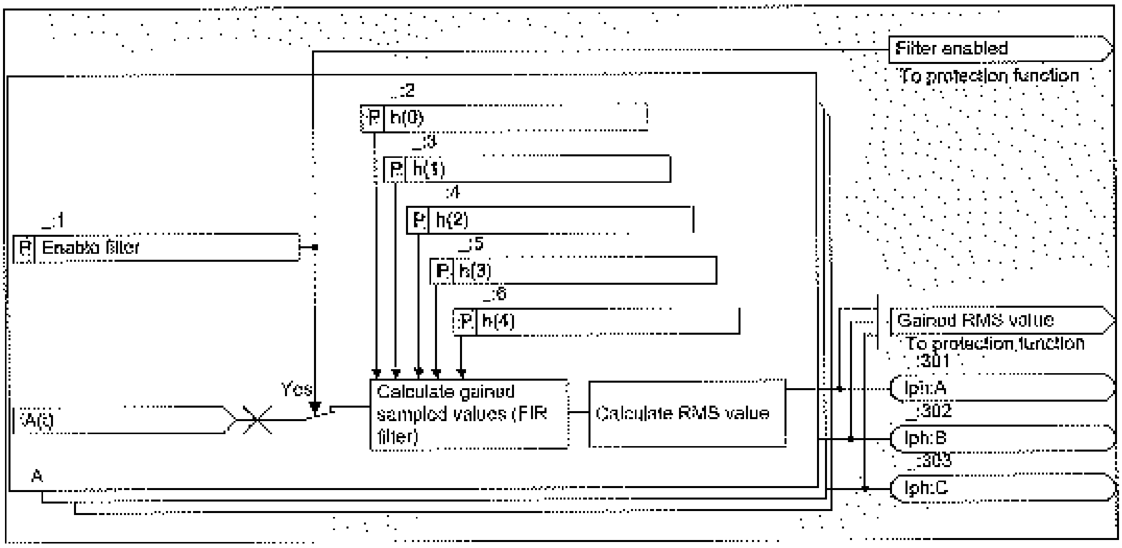
6.3.3.1 Description

The function block **Filter** can be used to adapt the RMS value for 2 means:

- To gain harmonics in a defined way. Higher harmonics can stress the protected object thermally more than lower harmonics. This is the case for reactors applied in AC filters. In addition, the amplitude attenuation of higher frequencies due to the anti-aliasing filter of the device is automatically compensated by the filter
- To only compensate the amplitude attenuation of higher frequencies due to the anti-aliasing filter

The filter gain (amplitude response) is realized by a 9-order FIR filter.

Logic



[lo_TOLP_filterStage_1_en_US]

Figure 6-7 Logic Diagram of the Function Block Filter

The FIR filter gains the 8-kHz sampled values according to the set filter coefficients. Afterwards, the RMS value is calculated. The symmetrical 9-order filter coefficients are set via the values of the respective parameters `h(0)`, `h(1)`, `h(2)`, `h(3)`, and `h(4)`.

NOTE

A FIR-filter configuration tool is provided as an auxiliary PC tool. With this PC tool, the coefficients h(0), h(1), h(2), h(3), h(4) of the FIR filter are generated according to the required gain factors (amplitude response). The tool can be obtained from the SIPROTEC download area. For more information about the tool, refer to the tool help function.

The gained RMS value is delivered to the protection stages only when the function block **Filter** is instantiated and the parameter `Enable filter` is set as *yes*. Otherwise, the normal RMS value is used.

Functional Measured Values

Values	Description	Primary	Secondary	% Referenced to
Iph:A	Gained RMS measured value of current A	kA	A	Parameter `Rated current`
Iph:B	Gained RMS measured value of current B	kA	A	Parameter `Rated current`

Values	Description	Primary	Secondary	% Referenced to
Iph:C	Gained RMS measured value of current C	kA	A	Parameter **Rated current**

You can find the parameter **Rated current** in the FB **General** of function groups where the **Overcurrent protection, phases – advanced** function is used.

If the parameter **Enable filter** is set to *no*, the functional measured values are shown as ---.

6.3.3.2 Application and Setting Notes

Parameter: Enable filter

- Default setting (_:1) **Enable filter** = *no*.

With the parameter **Enable filter**, you set whether the **Filter** is enabled.

Parameter Value	Description
yes	If gained RMS values should be used in one of the protection stages, set parameter **Enable filter** = *yes*.
no	If no gained RMS values are needed, set the parameter **Enable filter** = *no*.

Parameter: h(0), h(1), h(2), h(3), h(4)

- Default setting (_:2) **h(0)** = *0.000*
- Default setting (_:3) **h(1)** = *0.000*
- Default setting (_:4) **h(2)** = *0.000*
- Default setting (_:5) **h(3)** = *0.000*
- Default setting (_:6) **h(4)** = *1.000*

With the default value of the coefficients, the filter has no effect and no gain is applied.

If the filter shall be applied to adapt the RMS value calculation to a specific protection object such as a reactor, the reactor manufacturer has to provide the required amplitude response (gain factors) for the reactor. To determine the coefficients h(0) to h(4) for the FIR filter, you must enter the gain factors into the auxiliary PC tool which is available in the SIPROTEC download area. The 5 required coefficients are generated by the tool. They have to be entered manually as settings to configure the filter. The amplitude attenuation of higher frequencies due to the anti aliasing filter of the device is automatically taken into account and compensated by the filter.

To only compensate the attenuation of higher frequencies by the device, set the following coefficients in the filter.

Rated Frequency	Filter Coefficients for Only Compensating the Device Amplitude Attenuation
50 Hz	h(0) = -0.002 h(1) = -0.012 h(2) = 0.045 h(3) = -0.110 h(4) = 1.151
60 Hz	h(0) = -0.005 h(1) = -0.020 h(2) = 0.058 h(3) = -0.128 h(4) = 1.170

6.3.3.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
Filter				
_:1	Filter:Enable filter		• no • yes	no
_:2	Filter:h(0)		-100.000 to 100.000	0.000
_:3	Filter:h(1)		-100.000 to 100.000	0.000
_:4	Filter:h(2)		-100.000 to 100.000	0.000
_:5	Filter:h(3)		-100.000 to 100.000	0.000
_:6	Filter:h(4)		-100.000 to 100.000	1.000

6.3.3.4 Information List

No.	Information	Data Class (Type)	Type
Filter			
_:301	Filter:Iph:A	MV	O
_:302	Filter:Iph:B	MV	O
_:303	Filter:Iph:C	MV	O

6.3.4 Stage with Definite-Time Characteristic Curve

6.3.4.1 Description

Logic of the Basic Stage

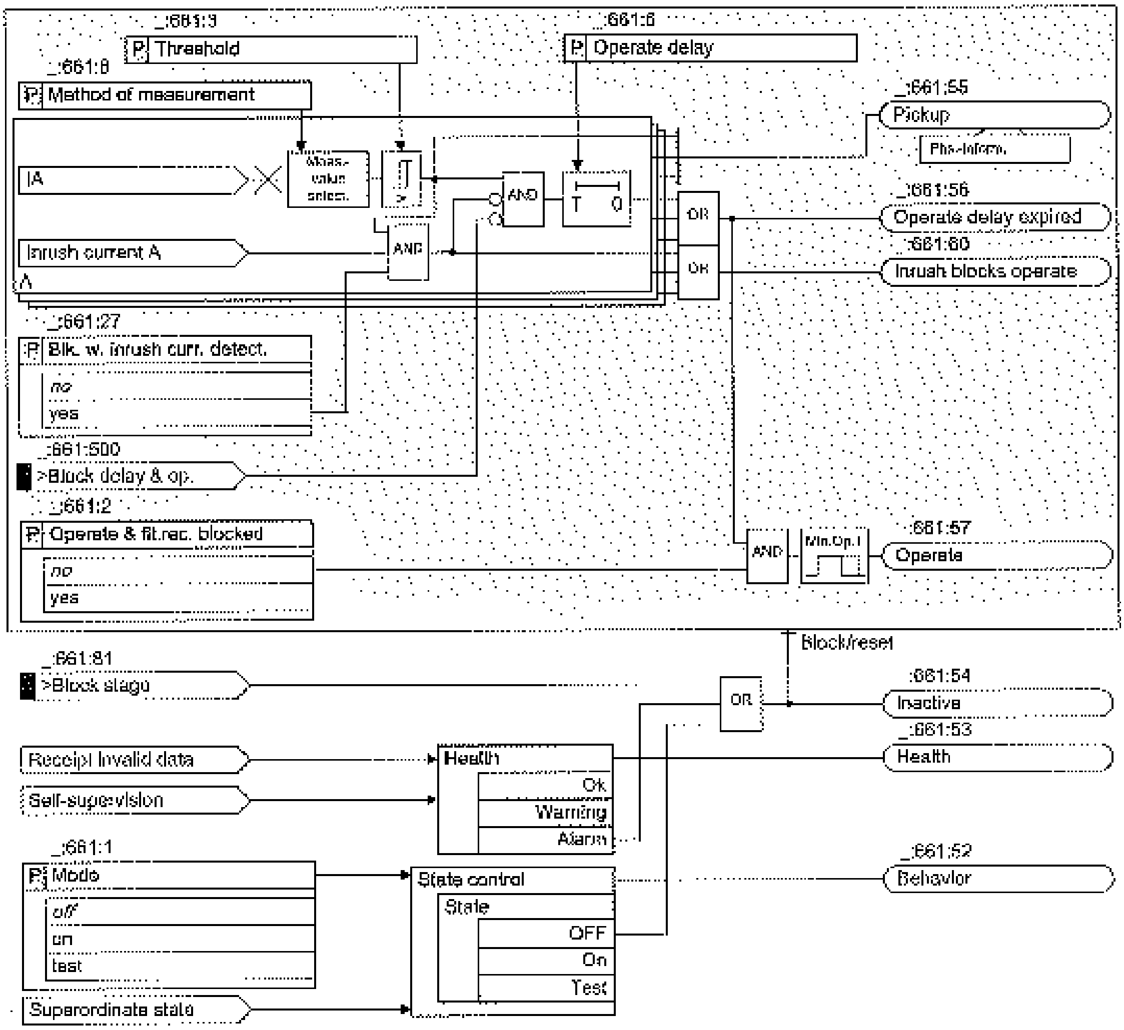


Figure 6-8 Logic Diagram of the Definite Time-Overcurrent Protection (Phases) – Basic

Logic of the Advanced Stage

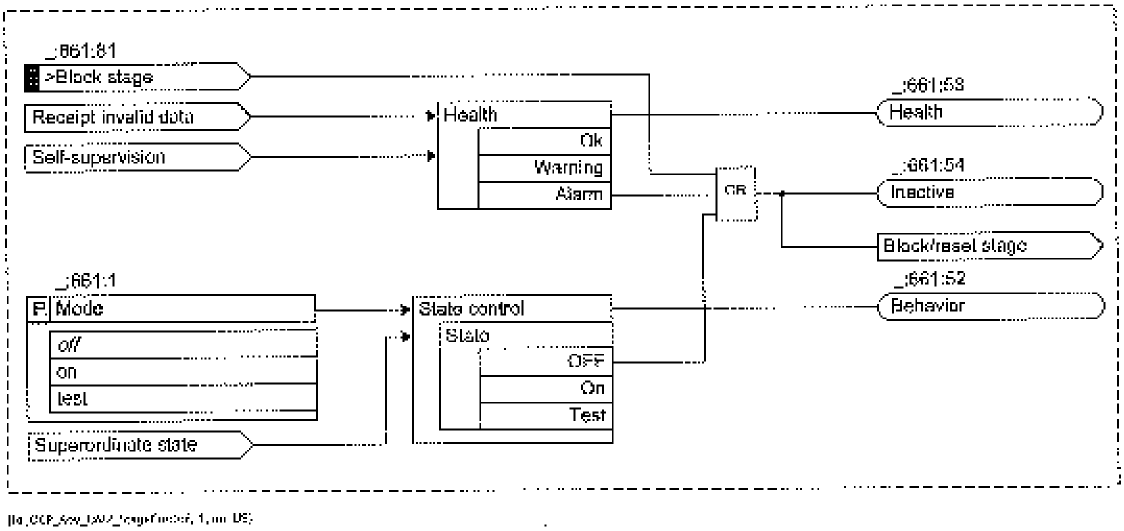


Figure 6-9 Logic Diagram of the Stage Control

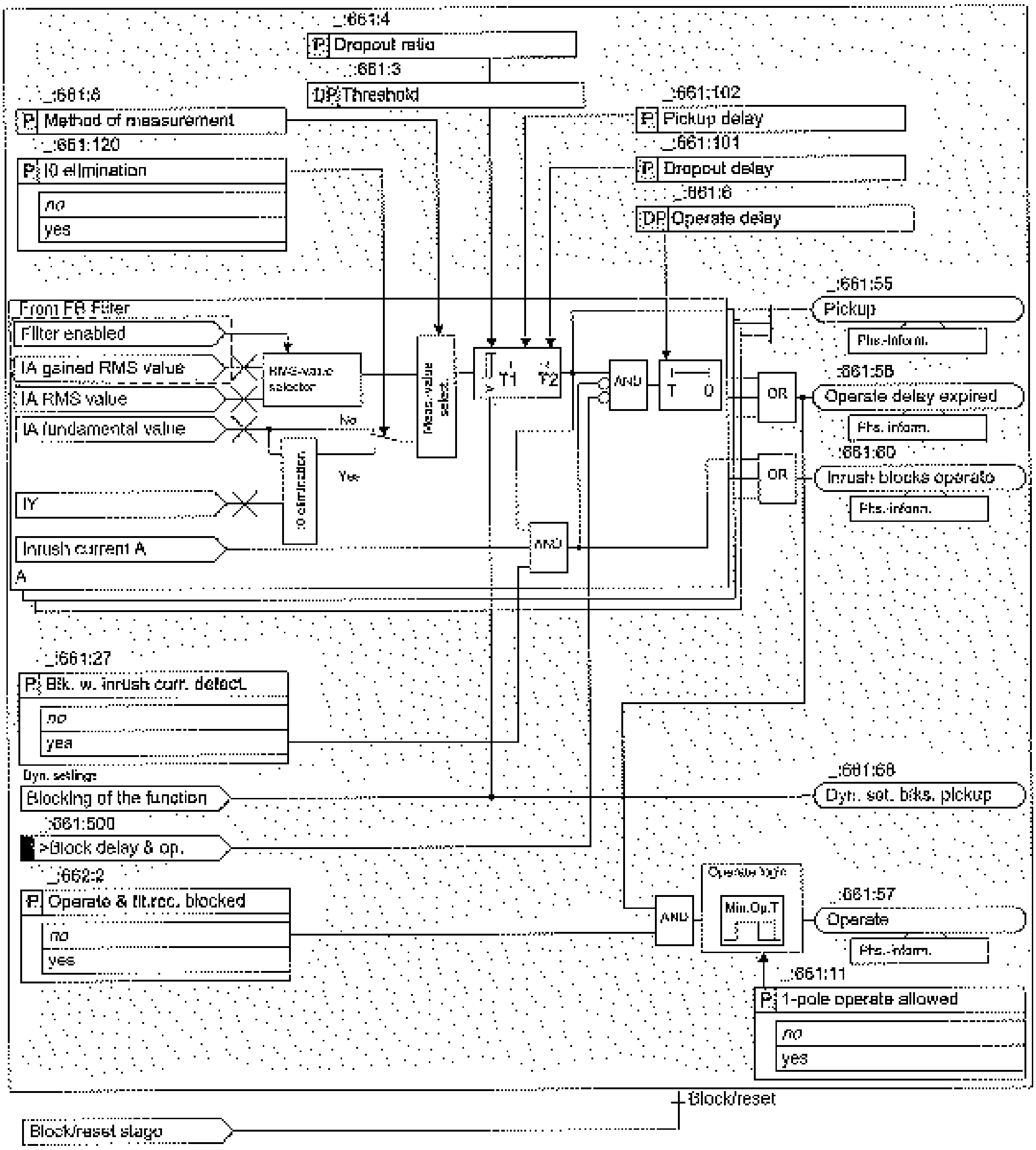


Figure 6-10 Logic Diagram of the Definite Time-Overcurrent Protection (Phases) – Advanced

Method of measurement (Basic and Advanced Stage)

You use the `Method of measurement` parameter to define whether the stage uses the ***fundamental comp.*** or the calculated ***RMS value***.

- Measurement of the fundamental component:

  This method of measurement processes the sampled current values and filters out the fundamental component numerically.

- Measurement of the RMS value:

  This method of measurement determines the current amplitude from the sampled values according to the defining equation of the RMS value. Harmonics are included in the analysis.

RMS-Value Selection (Advanced Stage)

If `RMS value` is selected as the method of measurement, the protection function supports 2 kinds of RMS measurement.

- Normal RMS value
- Gained RMS value from the function block **Filter**

If the function block **Filter** is configured and if you have enabled the filter, the gained RMS value is automatically used.

NOTE

When the function block **Filter** is applied, only one 3-phase current measuring point is allowed to be connected to the 3-phase current interface of the function group.

I0 Elimination (Advanced Stage)

In order to increase the sensitivity for the phase-to-phase faults on the transformer low-voltage side, use the I0 elimination of the phase currents for the overcurrent-protection application on one transformer.
In order to determine the I0 elimination of the phase currents, the transformer neutral point current I_Y must be measured.

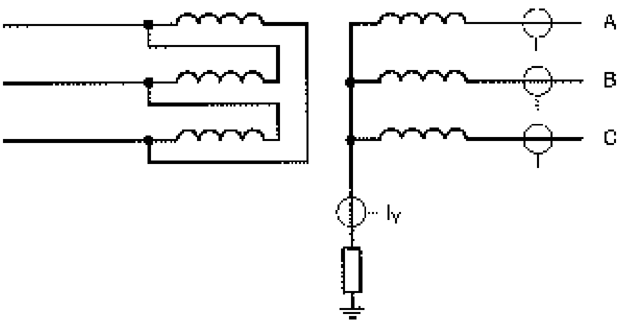


Figure 6-11 I0 Elimination Principle

The transformer neutral point current I_Y is measured via a 1-phase current measuring point that is connected to the **Voltage/current 1-phase**. The function group **Voltage/current 1-phase** must be connected to the function group **Voltage/current 3-phase** in which the function **Overcurrent protection, phases** is being used.

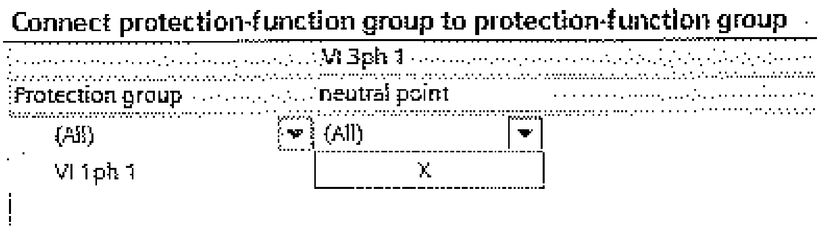


Figure 6-12 Connection of the Voltage/Current 1-Phase Function Group with the Neutral Point Input of the Voltage/Current 3-Phase Function Group

In case of an I0 elimination, the following calculations result:

$I_{A\text{-elim.}} = I_A - 1/3\ I_Y$

$I_{B\text{-elim.}} = I_B - 1/3\ I_Y$

$I_{C\text{-elim.}} = I_C - 1/3\ I_Y$

The phase current $I_{phx\text{-elim.}}$ is necessary for the following protection process.

If the **Method of measurement** parameter is set to ***fundamental comp.***, the I0 elimination is applied. The currents $I_{ph-elim.}$ are available as functional values.

Pickup delay (Advanced Stage)

If the current exceeds the threshold value, the pickup delay is generated. If the threshold remains exceeded during the pickup delay time, the pickup signal is generated.

Dropout Delay (Advanced Stage)

If the value falls below the dropout threshold, the pickup dropout can be delayed. The pickup is maintained for the specified time. The tripping delay continues to run. If the time delay expires while the pickup is still maintained, the stage operates.

Blocking of the Stage (Basic and Advanced Stage)

The following blockings reset the picked up stage completely:

- Via the binary input signal **>Block stage** from an external or internal source
- Via the functionality of the **dynamic settings** (only available in the Advanced function type, see subtitle **Influence of other functions via dynamic settings** and chapter *6.3.8.1 Description*).

Blocking of the Time Delay (Basic and Advanced Stage)

You can use the binary input signal **>Block delay & op.** to prevent the start of the time delay and thus also the operate signal. A running time delay is reset. The pickup is indicated and the fault logging and recording takes place.

Blocking of the Operate Delay and the Operate Signal via the Device-Internal Inrush-Current Detection Function (Basic and Advanced Stage)

Blocking of the operate delay and the operate signal via the device-internal **Inrush-current detection** function is described in chapter *6.3.7.1 Description* .

Influence of Other Functions via Dynamic Settings (Advanced Stage)

If available in the device, the following functions can influence the overcurrent-protection stages:

- Automatic Reclosing
- Cold-load pickup detection
- Binary input signal

The influence of these functions via dynamic settings is described in chapter *6.3.8.1 Description* .

6.3.4.2 Application and Setting Notes

Parameter: Method of measurement

- Recommended setting value **(_:661:8) Method of measurement** = ***fundamental comp.***

You use the **Method of measurement** parameter to define whether the stage uses the ***fundamental comp.*** (standard method) or the calculated ***RMS value*** parameter Value

Parameter Value	Description
fundamental comp.	Select this method of measurement if harmonics or transient current peaks are to be suppressed. Siemens recommends using this method as the standard method.
RMS value	Select this method of measurement if you want the stage to take harmonics into account (for example, at capacitor banks). For this method of measurement, do not set the **threshold value** of the stage to less than $0.1\ I_{rated,sec}$.

Parameter: **Threshold** , **Operate delay**

- Default setting (_:661:3) **Threshold** = *1.500 A* (for the 1st stage)
- Default setting (_:661:6) **Operate delay** = *0.30 s* (for the 1st stage)

Set the **Threshold** and **Operate delay** parameters for the specific application.

The following details apply to a 2-stage characteristic curve (1st stage = definite time-overcurrent protection stage and 2nd stage = high-current stage).

1st stage (overcurrent stage):

The setting depends on the maximum occurring operating current. Pickup by overload must be excluded since overcurrent protection operates with short tripping times as short-circuit protection and not as overload protection. Therefore, set the **Threshold** parameter for lines to approx. 10 %, for transformers and motors to approx. 20% above the maximum load that is expected.

EXAMPLE

Overcurrent-protection stage: 110-kV overhead line, 150 mm² cross-section

Maximum transmittable power

P_{max}	= 120 MVA
Correspondingly	
I_{max}	= 630 A
Current transformer	= 600 A/5 A
Safety factor	= 1.1

Settings in primary and secondary values result in the setting values:

$$\text{Threshold value } 1^{st} \text{ stage (primary)} = 1.1 \cdot 630\ A = 693\ A$$

$$\text{Threshold value } 1^{st} \text{ stage (secondary)} = 1.1 \cdot \frac{630\ A}{600\ A} \cdot 5\ A = 5.8\ A$$

[Dwgraph1-00311-01.06.2, en_US]

The **Operate delay** to be set is derived from the time-grading schedule that has been prepared for the system.

2nd stage (high-current stage):

This tripping stage can also be used for current grading. This applies in the case of very long lines with low source impedance or ahead of high reactances (for example, transformers, shunt reactors). Set the **Threshold** parameter to ensure that the stage does not pick up in case of a short circuit at the end of the line.

Set the **Operate delay** parameter to *0* or to a low value.

Siemens recommends that the threshold values be determined with a system analysis. The following example illustrates the principle of grading with a current threshold on a long line.

EXAMPLE

High-current stage: 110-kV overhead line, 150 mm² cross-section

s (length)	= 60 km
Z_1/s	= 0.46 Ω/km

Ratio of zero-sequence impedance and positive-sequence impedance of the line: $Z_{0}/Z_{1} = 4$

Short-circuit power at the beginning of the line:

S_{sc}'	= 2.5 GVA

Ratio of zero-sequence impedance and positive-sequence impedance of the source impedance at the beginning of the line: $Z_{P0}/Z_{P1} = 2$

Current transformer = 600 A/5 A

Resulting in the following values for the line impedance Z_L and the source impedance Z_P:

$$Z_L = 0.46\ \Omega/\text{km} \cdot 60\text{km} = 27.6\ \Omega$$

[fo_OCP002_030311_1_en_US]

$$Z_P = \frac{110\ \text{kV}^2}{2500\ \text{MVA}} = 4.84\ \Omega$$

[fo_OCP003_030311_1_en_US]

The 3-phase short-circuit current at the end of the line is $I_{sc\ end}$:

$$I_{sc\ end} = \frac{1.1 \cdot V_{rated}}{\sqrt{3} \cdot (Z_P + Z_L)} = \frac{1.1 \cdot 110\ kV}{\sqrt{3} \cdot (4.84\ \Omega + 27.6\ \Omega)} = 2150\ A$$

[fo_ocp004_030311_1_en_US]

The settings in primary and secondary values result in the following setting values which include a safety margin of 10 %:

Threshold value 2nd stage (primary) $= 1.1 \cdot 2150\ A = 2365\ A$

Threshold value 2nd stage (secondary) $= 1.1 \cdot \frac{2150\ A}{600\ A} \cdot 5\ A = 19.7\ A$

[foocp004-030311-01.tif_2_en_US]

If short-circuit currents exceed 2365 A (primary) or 19.7 A (secondary), there is a short circuit on the line to be protected. The overcurrent protection can cut off this short circuit immediately.

Note: The amounts in the calculation example are accurate enough for overhead lines. If the source impedance and line impedance have different angles, you have to use complex numbers to calculate the **Threshold**.

Parameter: I0 elimination

- Default setting (_:661:120) I0 elimination = *no*

This parameter is not visible in the basic stage.

The I0 elimination in phase currents for overcurrent-protection applications can be used in a transformer. This increases the sensitivity for the phase-to-phase fault on the transformer low-voltage side. The following conditions must be fulfilled:

- The transformer neutral point current I_Y is measured and is available for the protection function group.
- The parameter Method of measurement is set to *fundamental comp.* .

With the I0 elimination parameter, you can switch the I0 elimination function on or off.

Parameter: Pickup delay

- Default setting (_:661:102) Pickup delay = *0.00 s*

This parameter is not visible in the basic stage.

For special applications, it is desirable that a short exceeding of the current threshold does not lead to the pickup of the stage and start fault logging and recording. If this stage is used as a thermal overload function, that is considered a special application.

When using the Pickup delay parameter, a time interval is defined during which a pickup is not triggered if the current threshold is exceeded.

For all short-circuit protection applications, this value is 0.00 s as a default.

Parameter: `Dropout delay`

- Recommended setting value (_:661:101) `Dropout delay` = *0.00 s*

This parameter is not visible in the basic stage.

Siemens recommends to use the default setting *0* since the dropout of a protection stage must be done as fast as possible.

You can use the `Dropout delay` parameter ≠ *0* to obtain a uniform dropout behavior if you use it together with an electromechanical relay. This is required for time grading. The dropout time of the electromechanical relay must be known for this purpose. Subtract the dropout time of your own device (see Technical Data) and set the result.

Parameter: `Dropout ratio`

- Recommended setting value (_:661:4) `Dropout ratio` = *0.95*

This parameter is not visible in the basic stage.

The recommended set value of *0.95* is appropriate for most applications.

To achieve high-precision measurements, the setting value of the parameter `Dropout ratio` can be reduced, for example, to *0.98*. If you expect highly fluctuating measurands at the response threshold, you can increase the setting value of the parameter `Dropout ratio`. This avoids chattering of the tripping stage.

Parameter: `1-pole operate allowed`

- Default setting (_:661:11) `1-pole operate allowed` = *no*

The parameter must be set for the specific application.

Parameter Value	Description
no	The stage always operates 3-pole.
yes	The stage operates phase-selectively. However, tripping by the device (generated in the tripping logic of the function group **Circuit-breaker**) is always 3-pole because the device does not support phase-selective tripping.

6.3.4.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
General				
_:661:1	Definite-T 1:Mode		• off • on • test	off
_:661:2	Definite-T 1:Operate & flt.rec. blocked		• no • yes	no
_:661:11	Definite-T 1:1-pole operate allowed		• no • yes	no
_:661:26	Definite-T 1:Dynamic settings		• no • yes	no
_:661:27	Definite-T 1:Blk. w. inrush curr. detect.		• no • yes	no
_:661:8	Definite-T 1:Method of measurement		• fundamental comp. • RMS value	fundamental comp.
_:661:120	Definite-T 1:I0 elimination		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
_:661:3	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:661:4	Definite-T 1:Dropout ratio		0.90 to 0.99	0.95
_:661:102	Definite-T 1:Pickup delay		0.00 s to 60.00 s	0.00 s
_:661:101	Definite-T 1:Dropout delay		0.00 s to 60.00 s	0.00 s
_:661:6	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
Dyn.s: AR off/n.rdy				
_:661:28	Definite-T 1:Effect. by AR off/n.ready		• no • yes	no
_:661:35	Definite-T 1:Stage blocked		• no • yes	no
Dyn.set: AR cycle 1				
_:661:29	Definite-T 1:Effected by AR cycle 1		• no • yes	no
_:661:36	Definite-T 1:Stage blocked		• no • yes	no
_:661:14	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:661:20	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
Dyn.set: AR cycle 2				
_:661:30	Definite-T 1:Effected by AR cycle 2		• no • yes	no
_:661:37	Definite-T 1:Stage blocked		• no • yes	no
_:661:15	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:661:21	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
Dyn.set: AR cycle 3				
_:661:31	Definite-T 1:Effected by AR cycle 3		• no • yes	no
_:661:38	Definite-T 1:Stage blocked		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
_:661:16	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:661:22	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
Dyn.s: AR cycle>3				
_:661:32	Definite-T 1:Effected by AR cycle gr. 3		• no • yes	no
_:661:39	Definite-T 1:Stage blocked		• no • yes	no
_:661:17	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:661:23	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
Dyn.s: Cold load PU				
_:661:33	Definite-T 1:Effect. b. cold-load pickup		• no • yes	no
_:661:40	Definite-T 1:Stage blocked		• no • yes	no
_:661:18	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:661:24	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
Dyn.set: bin.input				
_:661:34	Definite-T 1:Effected by binary input		• no • yes	no
_:661:41	Definite-T 1:Stage blocked		• no • yes	no
_:661:19	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:661:25	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s

6.3.4.4 Information List

No.	Information	Data Class (Type)	Type
Group indicat.			
_:4501:55	Group indicat.:Pickup	ACD	O
_:4501:57	Group indicat.:Operate	ACT	O
Definite-T 1			
_:661:81	Definite-T 1:>Block stage	SPS	I
_:661:84	Definite-T 1:>Activ. dyn. settings	SPS	I
_:661:500	Definite-T 1:>Block delay & op.	SPS	I
_:661:54	Definite-T 1:Inactive	SPS	O
_:661:52	Definite-T 1:Behavior	ENS	O
_:661:53	Definite-T 1:Health	ENS	O
_:661:60	Definite-T 1:Inrush blocks operate	ACT	O
_:661:62	Definite-T 1:Dyn.set. AR cycle1act.	SPS	O
_:661:63	Definite-T 1:Dyn.set. AR cycle2act.	SPS	O
_:661:64	Definite-T 1:Dyn.set. AR cycle3act.	SPS	O
_:661:65	Definite-T 1:Dyn.set. ARcycl.>3act	SPS	O
_:661:66	Definite-T 1:Dyn.set. CLP active	SPS	O
_:661:67	Definite-T 1:Dyn.set. BI active	SPS	O
_:661:68	Definite-T 1:Dyn. set. blks. pickup	SPS	O
_:661:55	Definite-T 1:Pickup	ACD	O
_:661:56	Definite-T 1:Operate delay expired	ACT	O
_:661:57	Definite-T 1:Operate	ACT	O
_:661:302	Definite-T 1:I0el.Iph	WYE	O

6.3.5 Stage with Inverse-Time Characteristic Curve

6.3.5.1 Description

Logic of the Basic Stage

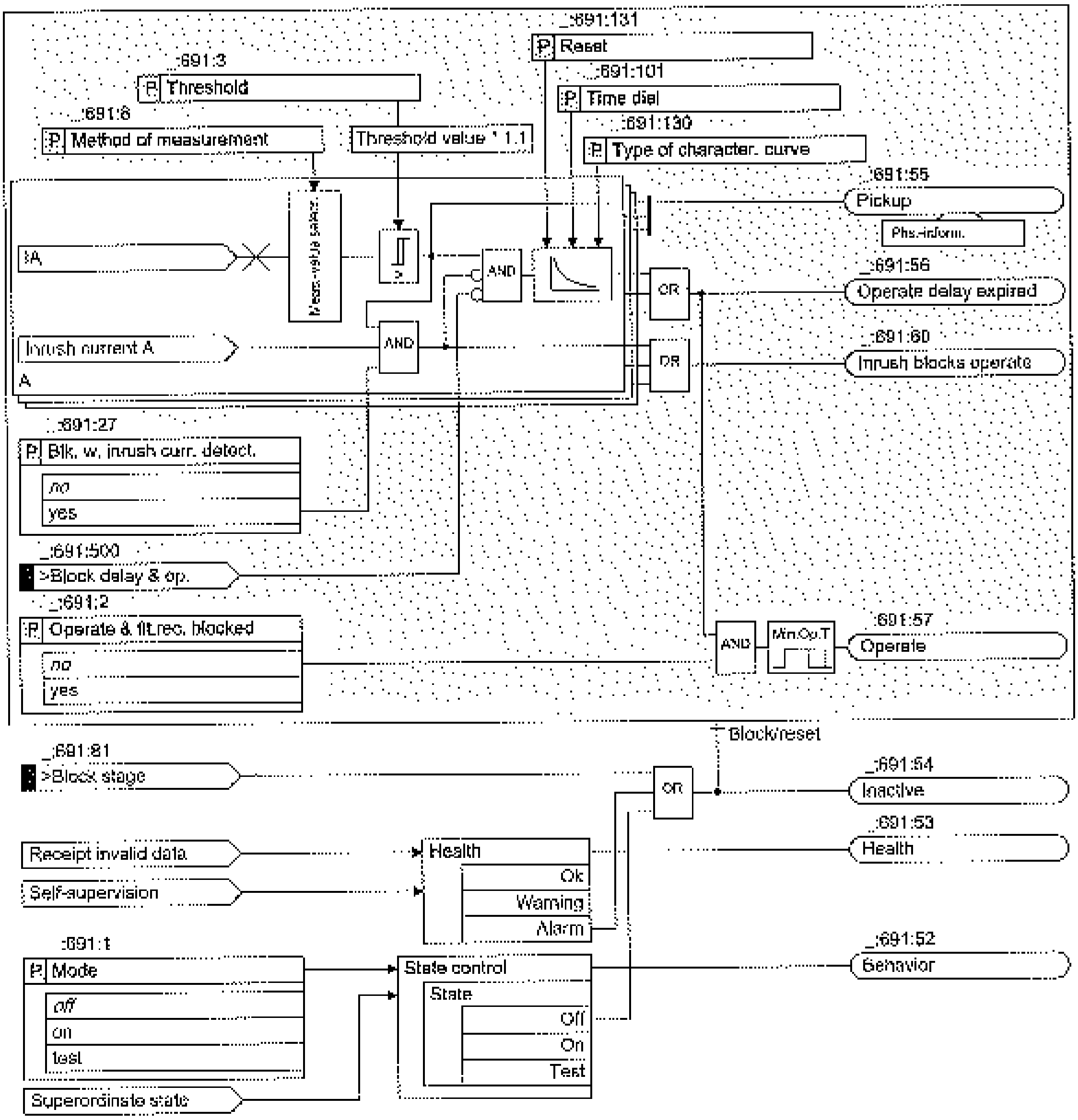


Figure 6-13 Logic Diagram of the Inverse Time-Overcurrent Protection (Phases) – Basic

Logic of the Advanced Stage

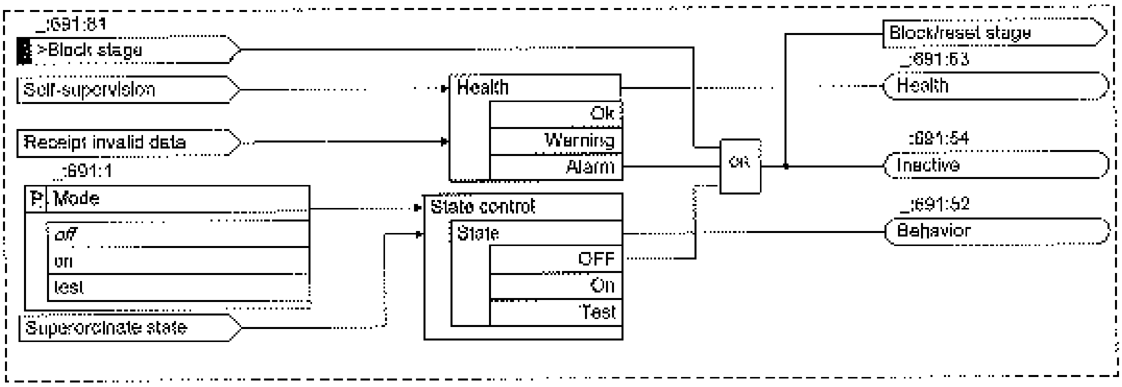


Figure 6-14 Logic Diagram of the Stage Control

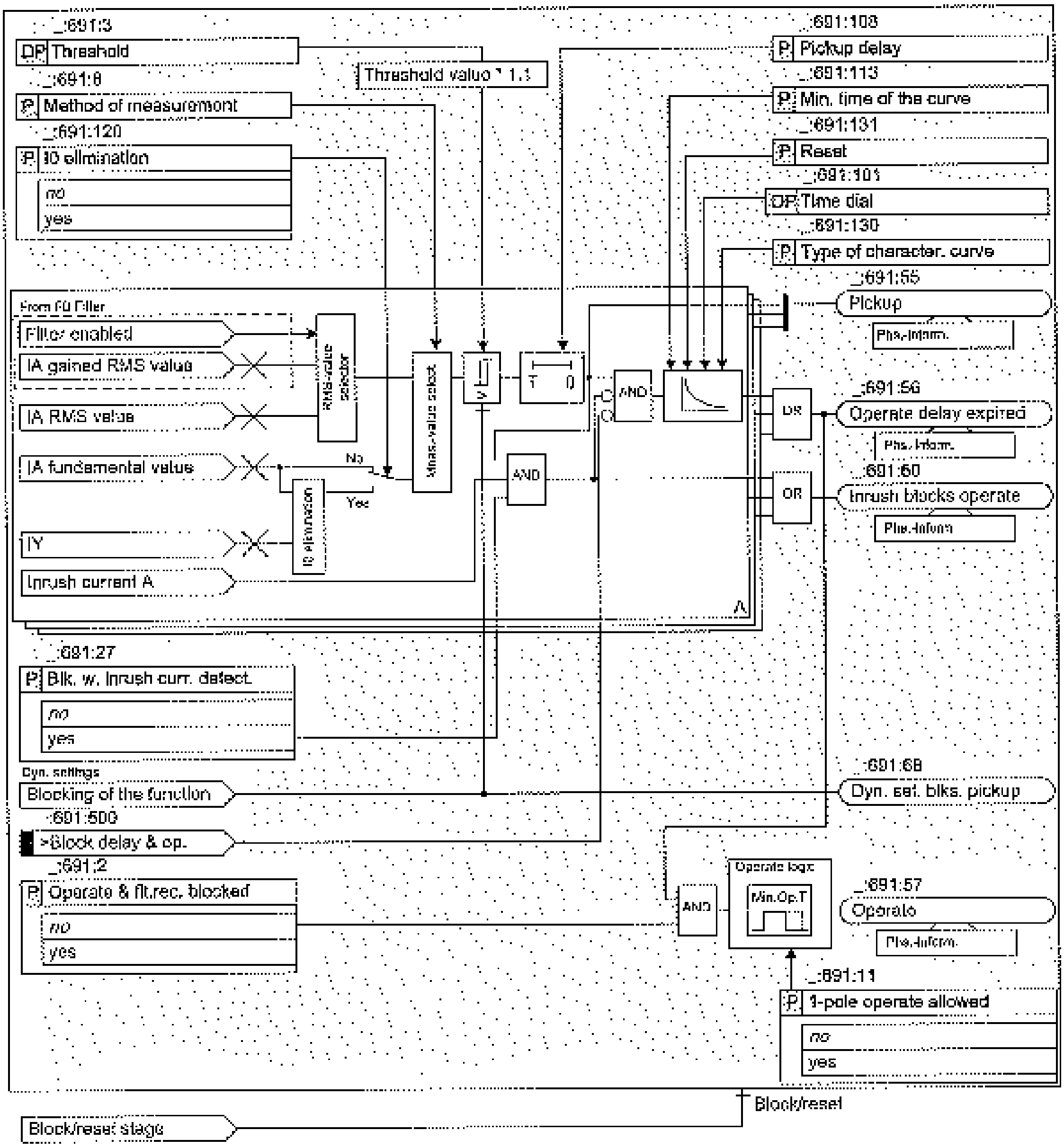


Figure 6-15 Logic Diagram of the Inverse Time-Overcurrent Protection (Phases) – Advanced

RMS-Value Selection (Advanced Stage)

If *RMS value* is selected as the method of measurement, the protection function supports 2 kinds of RMS measurement.

- Normal RMS value
- Gained RMS value from the function block **Filter**

If the function block **Filter** is configured and if youSelf practise_LG_OCP_Inverse time_Advanced, 1, en_US have enabled the filter, the gained RMS value is automatically used.

NOTE

When the function block **Filter** is applied, only one 3-phase current measuring point is allowed to be connected to the 3-phase current interface of the function group.

Pickup and Dropout Behavior of the Inverse-Time Characteristic Curve according to IEC and ANSI (Basic and Advanced Stage)

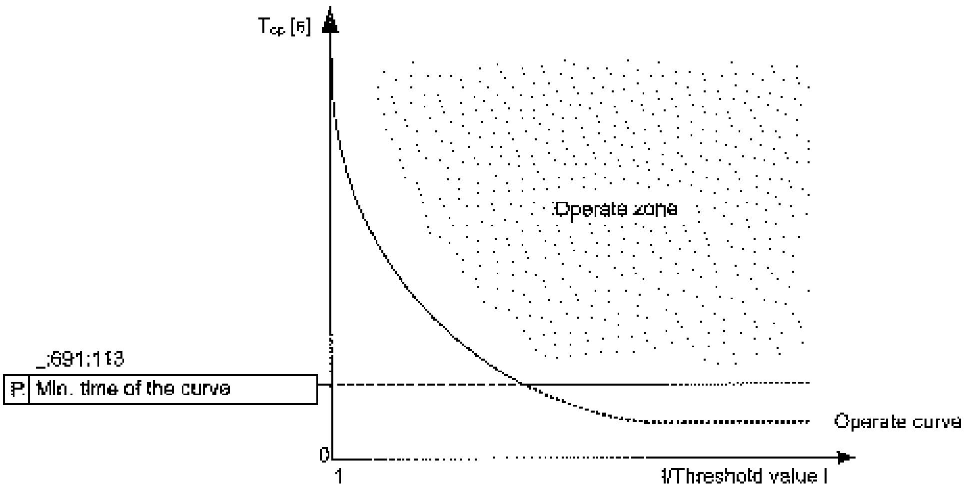
When the input variable exceeds the threshold value by a factor of 1.1, the inverse-time characteristic curve is processed. An integrating method of measurement summarizes the weighted time. The weighted time results from the characteristic curve. For this, the time that is associated with the present current value is determined from the characteristic curve. Once the weighted time exceeds the value 1, the stage operates.

When the measured value falls below the pickup value by a factor of 1.045 (0.95 x 1.1 x threshold value), the dropout is started. The pickup will be indicated as clearing. You can influence the dropout behavior via setting parameters. You can select between instantaneous dropout (totalized time is deleted) or dropout according to the characteristic curve (reduction of totalized time depending on the characteristic curve). The dropout according to characteristic curve (disk emulation) is the same as turning back a rotor disk. The weighted reduction of the time is initiated from 0.9 of the set threshold value.

The characteristic curve and associated formulas are shown in the Technical Data.

Minimum Time of the Curve (Advanced Stage)

With the parameter `Min. time of the curve`, you define a minimum operate delay time. The operate delay time of inverse-time characteristic curve never falls below the minimum operate delay time.



[DwDcsMin_20140715-01, 1, en_US]

Figure 6-16 Minimum Operating Time of the Curve

Additional Time Delay (Advanced Stage)

With the parameter `Additional time delay`, you define a definite-time delay in addition to the inverse-time delay. With this setting, the whole curve is shifted on the time axis by this additional definite time.

Method of Measurement (Basic and Advanced Stage)

You use the `Method of measurement` parameter to define whether the stage uses the *`fundamental comp.`* or the calculated *`RMS value`*.

- Measurement of the fundamental component:

  This method of measurement processes the sampled current values and filters out the fundamental component numerically.

- Measurement of the RMS value:

  This method of measurement determines the current amplitude from the sampled values according to the defining equation of the RMS value. Harmonics are included in the analysis.

I0 Elimination (Advanced Stage)

In order to increase the sensitivity for the phase-to-phase fault on the transformer low-voltage side, use the I0 elimination of the phase currents for the overcurrent-protection applications on one transformer.

In order to determine the I0 elimination of the phase currents, the transformer neutral point current I_Y must be measured.

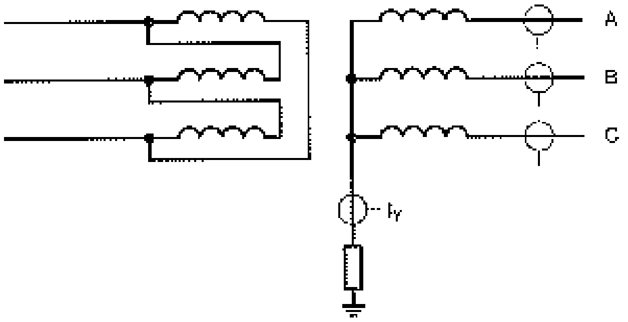


Figure 6-17 I0 Elimination Principle

The transformer neutral point current I_Y is measured via a 1-phase current measuring point that is connected to the **Voltage/current 1-phase**. The function group **Voltage/current 1-phase** must be connected to the function group **Voltage/current 3-phase** in which the function **Overcurrent protection, phases** is used.

Connect protection-function group to protection-function group

	VI 3ph 1
Protection group	neutral point
(All)	(All)
VI 1ph 1	X

Figure 6-18 Connection of the Function Group Voltage/Current 1-Phase with the Neutral Point Input of the Voltage/Current 3-Phase Function Group

In case of an I0 elimination, the following calculations must be considered:

$\underline{I}_{A\text{-elim.}} = \underline{I}_A - 1/3\ \underline{I}_Y$

$\underline{I}_{B\text{-elim.}} = \underline{I}_B - 1/3\ \underline{I}_Y$

$\underline{I}_{C\text{-elim.}} = \underline{I}_C - 1/3\ \underline{I}_Y$

The phase current $\underline{I}_{phx\ elim.}$ is necessary for the following protection process.

If the **Method of measurement** parameter is set to ***fundamental comp.***, the I0 elimination is operating.

The currents $\underline{I}_{phx\text{-}elim.}$ are available as functional values.

Pickup Delay (Advanced Stage)

If the current exceeds the threshold value, the pickup delay starts. If the threshold is exceeded during the pickup delay time, the pickup signal is generated.

Blocking of the Stage (Basic and Advanced Stage)

The following blockings reset the picked up stage completely:

- Via the binary input signal **>Block stage** from an external or internal source
- Via the functionality of the **dynamic settings** (only available in the Advanced function type, see subtitle **Influence of other functions via dynamic settings** and chapter 6.3.8.1 *Description*).

Blocking of the Time Delay (Basic and Advanced Stage)

You can use the binary input signal **>Block delay & op.** to prevent the start of the time delay and thus also the operate signal. A running time delay is reset. The pickup is indicated and the fault logging and recording takes place.

Blocking of the Operate Delay and the Operate Signal via the Device-Internal Inrush-Current Detection Function (Basic and Advanced Stage)

Blocking of the operate delay and the operate signal via the device-internal **Inrush-current detection** function is described in chapter *6.3.7.1 Description* .

Influence of Other Functions via Dynamic Settings (Advanced Stage)

If available in the device, the following functions can influence the overcurrent-protection stages:

- Automatic Reclosing
- Cold-load pickup detection
- Binary input signal

The influence of these functions via dynamic settings is described in chapter *6.3.8.1 Description* .

6.3.5.2 Application and Setting Notes

Parameter: **Method of measurement**

- Recommended setting value (_:691:8) **Method of measurement** = ***fundamental comp.***

You use the **Method of measurement** parameter to define whether the stage uses the ***fundamental comp.*** (standard method) or the calculated ***RMS value*** Parameter Value

Parameter Value	Description
fundamental comp.	Select this method of measurement if harmonics or transient current peaks are to be suppressed. Siemens recommends using this method as the standard method.
RMS value	Select this method of measurement if you want the stage to take harmonics into account (for example, at capacitor banks). For this method of measurement, do not set the **threshold value** of the stage to less than 0.1 $I_{rated,sec}$.

Parameter: **Type of character. curve**

- Default setting (_:691:130) **Type of character. curve** = ***IEC normal inverse***

The device offers all the usual inverse-time characteristic curves according to IEC and ANSI. Select the **Type of character. curve** required for your specific application. For more information about the parameter **Type of character. curve**, refer to chapter *12.5.2 Stage with Inverse-Time Characteristic Curve*.

Parameter: **Min. time of the curve**

- Default setting (_:691:113) **Min. time of the curve** = ***0.00 s***

This parameter is only available in the advanced stage.

With the parameter **Min. time of the curve**, you define a minimum operate delay time. The operate delay time of inverse-time characteristic curve never falls below the minimum operate delay time. If the setting is left on its default value of 0 s, this parameter has no effect on the inverse-time characteristic curve.

This parameter is only required for time coordination in recloser schemes. For all other applications, Siemens recommends keeping the default setting of 0 s.

NOTE

If the set value is smaller than the smallest possible time delay of the inverse-time characteristic curve, the parameter has no influence on the delay time.

Parameter: `Additional time delay`

- Default setting (_:691:115) `Additional time delay` = *0.00 s*

With the parameter `Additional time delay`, you define a definite-time delay in addition to the inverse-time delay.

If the setting is left on its default value of 0 s, this parameter has no effect on the inverse-time characteristic time.

This parameter is only required for time coordination in recloser schemes. For all other applications, Siemens recommends keeping the default setting of 0 s.

Parameter: `Threshold`

- Default setting (_:691:3) `Threshold` = *1.500 A*

Set the `Threshold` and `Type of character. curve` parameters for the specific application.

The setting depends on the maximum occurring operating current. Pickup by overload must be excluded since overcurrent protection operates with short tripping times as short-circuit protection and not as overload protection. Set the `Threshold` parameter for lines to approx. 10 %, for transformers and motors to approx. 20 % above the maximum expected load.

Note that a safety margin is set between pickup value and threshold value. The stage only picks up at approx. 10 % above the `Threshold`.

EXAMPLE

Overcurrent-protection stage: 110-kV overhead line, 150 mm² cross-section

Maximum transmittable power

P_{max} = 120 MVA

Correspondingly

I_{max} = 630 A

Current transformer = 600 A/5 A

Settings in primary and secondary values result in the setting values:

Threshold value I> (primary) = 630 A

$$\text{Threshold value I> (secondary)} = \frac{630\ \text{A}}{600\ \text{A}} \cdot 5\ \text{A} = 5.25\ \text{A}$$

[eq_dw_030311_01.dt, 2, en_US]

Parameter: `I0 elimination`

- Default setting (_:661:120) `I0 elimination` = *no*

This parameter is not visible in the basic stage.

The I0 elimination in phase currents for overcurrent-protection applications can be used in a transformer. This increases the sensitivity for the phase-to-phase faults on the low-voltage side of the transformer. The following conditions must be fulfilled:

- The transformer neutral point current I_Y is measured and is available for the protection function group.
- The parameter `Method of measurement` is set to *fundamental comp.*.

With the `I0 elimination` setting, you can switch the I0 elimination function on or off.

Parameter: **Pickup delay**

- Default setting (_:661:102) **Pickup delay** = *0.00 s*

This parameter is not visible in the basic stage.

For special applications it is desirable if the current threshold is briefly exceeded, that this will not lead to the pickup of the stage and starts fault logging or recording. If this stage is used as a thermal overload function, that is considered a special application.

When using the **Pickup delay** parameter, a time interval is defined during which a pickup is not trigger if the current threshold is exceeded.

For all short-circuit protection applications, this value is 0.00 s and is considered as a default.

Parameter: **Time dial**

- Default setting (_:691:101) **Time dial** = *1.00*

Use the **Time dial** parameter to displace the characteristic curve in the time direction.

The set value for the **Time dial** parameter is derived from the time-grading chart that has been prepared for the electrical power system.

Where no time grading and therefore no displacement of the characteristic curve is required, leave the parameter **Time dial** at *1* (default setting).

Parameter: **Reset**

- Default setting (_:691:131) **Reset** = *disk emulation*

You use the **Reset** parameter to define whether the stage drops out according to the dropout characteristic curve (in accordance with the behavior of a disk emulation = rotor disk) or instantaneously.

Parameter Value	Description
disk emulation	Select this setting if the device is coordinated with electromechanical devices or other devices which perform a dropout after a disk emulation.
instantaneous	Use this setting if the dropout is not to be performed after disk emulation and an instantaneous dropout is desired instead.

Parameter: **1-pole operate allowed**

- Default setting (_:691:11) **1-pole operate allowed** = *no*

The parameter must be set for the specific application.

Parameter Value	Description
no	The stage always operates 3-pole.
yes	The stage operates phase-selectively. However, tripping by the device (generated in the tripping logic of the function group **Circuit-breaker**) is always 3-pole because the device does not support phase-selective tripping.

6.3.5.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
General				
_:691:1	Inverse-T 1:Mode		• off • on • test	off
_:691:2	Inverse-T 1:Operate & flt.rec. blocked		• no • yes	no
_:691:11	Inverse-T 1:1-pole operate allowed		• no • yes	no
_:691:26	Inverse-T 1:Dynamic settings		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
_:691:27	Inverse-T 1:Blk. w. inrush curr. detect.		• no • yes	no
_:691:8	Inverse-T 1:Method of measurement		• fundamental comp. • RMS value	fundamental comp.
_:691:120	Inverse-T 1:3I0 elimination		• no • yes	no
_:691:3	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:691:108	Inverse-T 1:Pickup delay		0.00 s to 60.00 s	0.00 s
_:691:130	Inverse-T 1:Type of character. curve			
_:691:113	Inverse-T 1:Min. time of the curve		0.00 s to 1.00 s	0.00 s
_:691:131	Inverse-T 1:Reset		• instantaneous • disk emulation	disk emulation
_:691:101	Inverse-T 1:Time dial		0.00 to 15.00	1.00
_:691:115	Inverse-T 1:Additional time delay		0.00 s to 60.00 s	0.00 s
`Dyn.s: AR off/n.rdy`				
_:691:28	Inverse-T 1:Effect. by AR off/n.ready		• no • yes	no
_:691:35	Inverse-T 1:Stage blocked		• no • yes	no
`Dyn.set: AR cycle 1`				
_:691:29	Inverse-T 1:Effected by AR cycle 1		• no • yes	no
_:691:36	Inverse-T 1:Stage blocked		• no • yes	no
_:691:14	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:691:102	Inverse-T 1:Time dial		0.00 to 15.00	1.00
`Dyn.set: AR cycle 2`				
_:691:30	Inverse-T 1:Effected by AR cycle 2		• no • yes	no
_:691:37	Inverse-T 1:Stage blocked		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
_:691:15	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:691:103	Inverse-T 1:Time dial		0.00 to 15.00	1.00
Dyn.set: AR cycle 3				
_:691:31	Inverse-T 1:Effected by AR cycle 3		• no • yes	no
_:691:38	Inverse-T 1:Stage blocked		• no • yes	no
_:691:16	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:691:104	Inverse-T 1:Time dial		0.00 to 15.00	1.00
Dyn.s: AR cycle>3				
_:691:32	Inverse-T 1:Effected by AR cycle gr. 3		• no • yes	no
_:691:39	Inverse-T 1:Stage blocked		• no • yes	no
_:691:17	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:691:105	Inverse-T 1:Time dial		0.00 to 15.00	1.00
Dyn.s: Cold load PU				
_:691:33	Inverse-T 1:Effect. b. cold-load pickup		• no • yes	no
_:691:40	Inverse-T 1:Stage blocked		• no • yes	no
_:691:18	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:691:106	Inverse-T 1:Time dial		0.00 to 15.00	1.00
Dyn.set: bin.input				
_:691:34	Inverse-T 1:Effected by binary input		• no • yes	no
_:691:41	Inverse-T 1:Stage blocked		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
_:691:19	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:691:107	Inverse-T 1:Time dial		0.00 to 15.00	1.00

6.3.5.4 Information List

No.	Information	Data Class (Type)	Type
Group indicat.			
_:4501:55	Group indicat.:Pickup	ACD	O
_:4501:57	Group indicat.:Operate	ACT	O
Inverse-T 1			
_:691:81	Inverse-T 1:>Block stage	SPS	I
_:691:500	Inverse-T 1:>Block delay & op.	SPS	I
_:691:54	Inverse-T 1:Inactive	SPS	O
_:691:52	Inverse-T 1:Behavior	ENS	O
_:691:53	Inverse-T 1:Health	ENS	O
_:691:60	Inverse-T 1:Inrush blocks operate	ACT	O
_:691:59	Inverse-T 1:Disk emulation running	SPS	O
_:691:55	Inverse-T 1:Pickup	ACD	O
_:691:56	Inverse-T 1:Operate delay expired	ACT	O
_:691:57	Inverse-T 1:Operate	ACT	O

6.3.6 Stage with User-Defined Characteristic Curve

6.3.6.1 Description

This stage is only available in the advanced function type.

This stage is structured the same way as the **Inverse time-overcurrent protection – advanced** stage (see chapter 6.3.5.1 *Description*). The only difference is that you can define the characteristic curve as desired.

User-Defined Characteristic Curve

With the user-defined characteristic curve, you can define the operate curve point by point using up to 30 value pairs of current and time. The device uses linear interpolation to calculate the characteristic curve from these values. You can also define a dropout characteristic curve if you wish.

Pickup and Dropout Behavior with the User-Defined Characteristic Curve

When the input variable exceeds the threshold value by 1.1 times, the characteristic curve is processed.

An integrating method of measurement totalizes the weighted time. The weighted time results from the characteristic curve. For this, the time that is associated with the present current value is determined from the characteristic curve. Once the weighted time exceeds the value 1, the stage operates.

When the measured value falls short of the pickup value by a factor of 1.045 (0.95 x 1.1 x threshold value), the dropout is started. The pickup will be indicated as clearing. You can influence the dropout behavior via setting parameters. You can select between instantaneous dropout (totalized time is deleted) or dropout according to the characteristic curve (reduction of totalized time depending on the characteristic curve). The dropout according to characteristic curve (disk emulation) is the same as turning back a rotor disk. The weighted reduction of the time is initiated from 0.9 of the set threshold value.

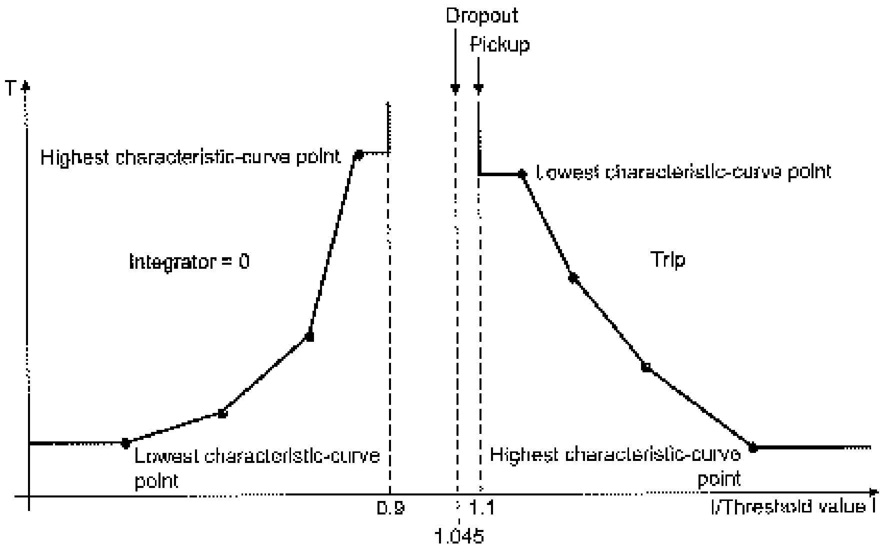


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Figure 6-19 Pickup Behavior and Dropout Behavior When Using a User-Defined Characteristic Curve

NOTE

The currents that are lower than the current value of the smallest characteristic-curve point do not extend the operate time. The pickup characteristic runs in parallel to the current axis up to the smallest characteristic-curve point. Currents that are larger than the current value of the largest characteristic-curve point do not reduce the operate time. The pickup characteristic runs in parallel to the current axis from the largest characteristic-curve point.

6.3.6.2 Application and Setting Notes

This stage is structured the same way as the **Inverse time-overcurrent protection – advanced** stage. The only difference is that you can define the characteristic curve as desired. This chapter provides only application and setting notes for setting characteristic curves.

Parameter: `Current/time value pairs` (from the operate curve)

Use these settings to define the characteristic curve. Set a current/time value pair for each characteristic curve point. The setting depends on the characteristic curve you want to realize.

Set the current value as a multiple of the threshold value. Siemens recommends that you set the `Threshold` parameter to `1.00` in order to obtain a simple relation. You can change the threshold value setting afterwards if you want to shift the characteristic curve.

Set the time value in seconds. The characteristic curve is shifted via the `Time dial` parameter.

NOTE

The value pairs must be entered in continuous order.

Parameter: `Time dial`

- Default setting `(_:101) Time dial = 1`

Use the `Time dial` parameter to displace the characteristic curve in the time direction.

The set value for the **Time dial** parameter is derived from the time-grading chart that has been prepared for the electrical power system. Where no time grading and therefore no displacement of the characteristic curve is required, leave the **Time dial** parameter at *1*.

Parameter: Reset

- Default setting (_:110) **Reset** = ***disk emulation***

You use the **Reset** parameter to define whether the stage drops out according to the dropout characteristic curve (in accordance with the behavior of a disk emulation = rotor disk) or instantaneously.

Parameter Value	Description
disk emulation	In the case of this setting, a dropout characteristic curve has to be set in addition to the operate curve. Select this setting if the device is coordinated with electromechanical devices or other devices which perform a dropout after a disk emulation.
instantaneous	Use this setting if the dropout is not to be performed after disk emulation but an instantaneous dropout is desired.

Parameter: Current/time value pairs (of the dropout characteristic curve)

Use these settings to define the characteristic curve. Set a current/time value pair for each characteristic-curve point. The setting depends on the characteristic curve you want to realize.

Set the current value as a multiple of the threshold value. Siemens recommends that you set the **Threshold** parameter to *1.00* in order to obtain a simple relation. You can change the threshold value setting afterwards if you want to shift the characteristic curve.

Set the time value in seconds. The characteristic curve is shifted via the **Time dial** parameter.

NOTE

The value pairs must be entered in continuous order.

Parameter: 1-pole operate allowed

- Default setting (_:11) **1-pole operate allowed** = ***no***

The parameter must be set for the specific application.

Parameter Value	Description
no	The stage always operates 3-pole.
yes	The stage operates phase-selectively. However, tripping by the device (generated in the tripping logic of the function group **Circuit breaker**) is always 3-pole because the device does not support phase-selective tripping.

6.3.6.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
General				
_:1	User curve #:Mode		• off • on • test	off
_:2	User curve #:Operate & flt.rec. blocked		• no • yes	no
_:11	User curve #:1-pole operate allowed		• no • yes	no
_:26	User curve #:Dynamic settings		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
_:27	User curve #:Blk. w. inrush curr. detect.		• no • yes	no
_:8	User curve #:Method of measurement		• fundamental comp. • RMS value	fundamental comp.
_:120	User curve #:I0 elimination		• no • yes	no
_:3	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:111	User curve #:Pickup delay		0.00 s to 60.00 s	0.00 s
_:110	User curve #:Reset		• instantaneous • disk emulation	disk emulation
_:101	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.s: AR off/n.rdy				
_:28	User curve #:Effect. by AR off/n.ready		• no • yes	no
_:35	User curve #:Stage blocked		• no • yes	no
Dyn.set: AR cycle 1				
_:29	User curve #:Effected by AR cycle 1		• no • yes	no
_:36	User curve #:Stage blocked		• no • yes	no
_:14	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:102	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.set: AR cycle 2				
_:30	User curve #:Effected by AR cycle 2		• no • yes	no
_:37	User curve #:Stage blocked		• no • yes	no
_:15	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:103	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.set: AR cycle 3				
_:31	User curve #:Effected by AR cycle 3		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
_:38	User curve #:Stage blocked		• no • yes	no
_:16	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:104	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.s: AR cycle>3				
_:32	User curve #:Effected by AR cycle gr. 3		• no • yes	no
_:39	User curve #:Stage blocked		• no • yes	no
_:17	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:105	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.s: Cold load PU				
_:33	User curve #:Effect. b. cold-load pickup		• no • yes	no
_:40	User curve #:Stage blocked		• no • yes	no
_:18	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:106	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.set: bin.input				
_:34	User curve #:Effected by binary input		• no • yes	no
_:41	User curve #:Stage blocked		• no • yes	no
_:19	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:107	User curve #:Time dial		0.05 to 15.00	1.00

6.3.6.4 Information List

No.	Information	Data Class (Type)	Type
User curve #			
_:81	User curve #:>Block stage	SPS	I
_:84	User curve #:>Activ. dyn. settings	SPS	I
_:500	User curve #:>Block delay & op.	SPS	I
_:54	User curve #:Inactive	SPS	O
_:52	User curve #:Behavior	ENS	O
_:53	User curve #:Health	ENS	O
_:60	User curve #:Inrush blocks operate	ACT	O
_:62	User curve #:Dyn.set. AR cycle1act.	SPS	O
_:63	User curve #:Dyn.set. AR cycle2act.	SPS	O
_:64	User curve #:Dyn.set. AR cycle3act.	SPS	O
_:65	User curve #:Dyn.set. ARcycl.>3act	SPS	O
_:66	User curve #:Dyn.set. CLP active	SPS	O
_:67	User curve #:Dyn.set. BI active	SPS	O
_:68	User curve #:Dyn. set. blks. pickup	SPS	O
_:59	User curve #:Disk emulation running	SPS	O
_:55	User curve #:Pickup	ACD	O
_:56	User curve #:Operate delay expired	ACT	O
_:57	User curve #:Operate	ACT	O

6.3.7 Blocking of the Tripping by Device-Internal Inrush-Current Detection

6.3.7.1 Description

With the `Blk. w. inrush curr. detect.` parameter, you can define whether tripping of the stage should be blocked when a threshold value is exceeded due to an inrush current. In case of a blocking, the stage picks up. The start of the tripping delay and the trip signal are blocked. The function signals this through a corresponding indication. If the blocking drops out and the threshold value of the stage is still exceeded, the time delay is started. After that time, the stage operates. The following figure only shows the part of the stage (exemplified by definite time-overcurrent protection stage 1) that illustrates the influence of the blocking. Only if the central function **Inrush-current detection** (see chapter *12.10 Inrush-Current Detection*) is in effect can the blocking be set.

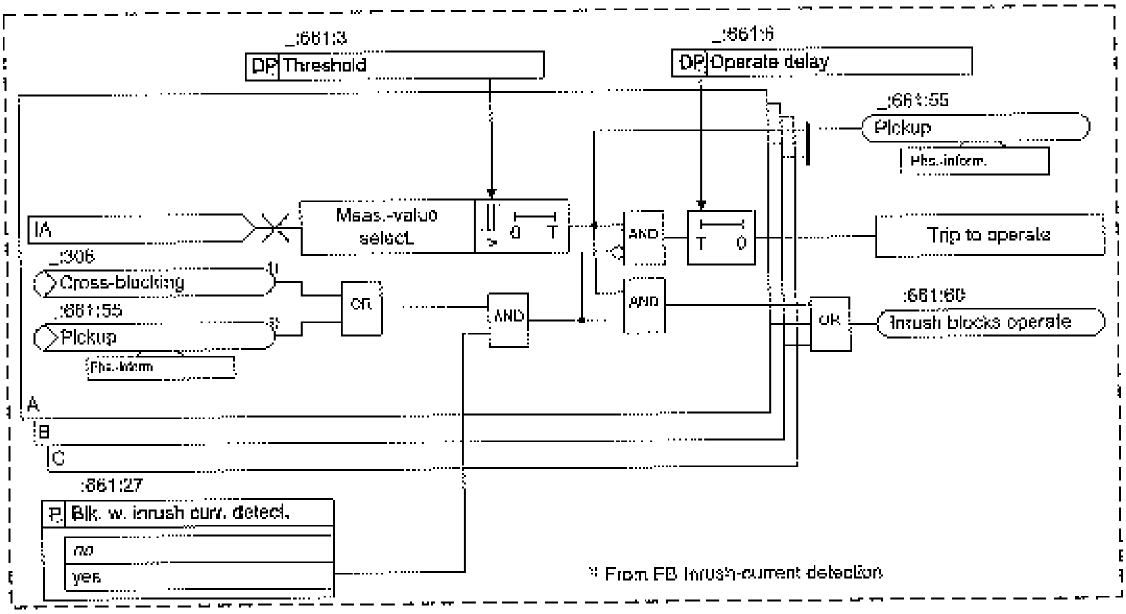


Figure 6-20 Part Logic Diagram on the Influence of Inrush Current Detection Exemplified by the 1st Definite Time-Overcurrent Protection Stage

6.3.7.2 Application and Setting Notes

Parameter: **Blk. w. inrush curr. detect.**

- Default setting (_:661:27) **Blk. w. inrush curr. detect.** = *no*

Parameter Value	Description
no	The transformer inrush current detection does not affect the stage. Select this setting in the following cases: • In cases where the device is not used on transformers. • In cases where the device is used on transformers and the threshold value of the stage is set above the maximum inrush current of the transformer. This, for example, applies to the high-current stage that is set such according to the short-circuit voltage V_{sc} of the transformer that it only picks up on faults from the high-voltage side. The transformer-inrush current cannot become larger than the maximum transmittable short-circuit current.
yes	When the transformer inrush current detection detects an inrush current that would lead to a tripping of the stage, the start of the time delay and tripping of the stage are blocked. Select this setting if the device is used on transformers and the threshold value of the stage is set below the maximum inrush current of the transformer. This applies to the overcurrent-protection stage, which is used as a backup stage with grading time for faults on the undervoltage side of the transformer.

6.3.8 Influence of Other Functions via Dynamic Settings

6.3.8.1 Description

The parameters **Threshold** and **Operate delay** used for tripping are so-called **dynamic settings**. Depending on other functions, the settings of these parameters can be changed dynamically (see

Figure 6-21). Depending on other functions, the stage can also be blocked dynamically. This functionality is only available in function type Advanced.

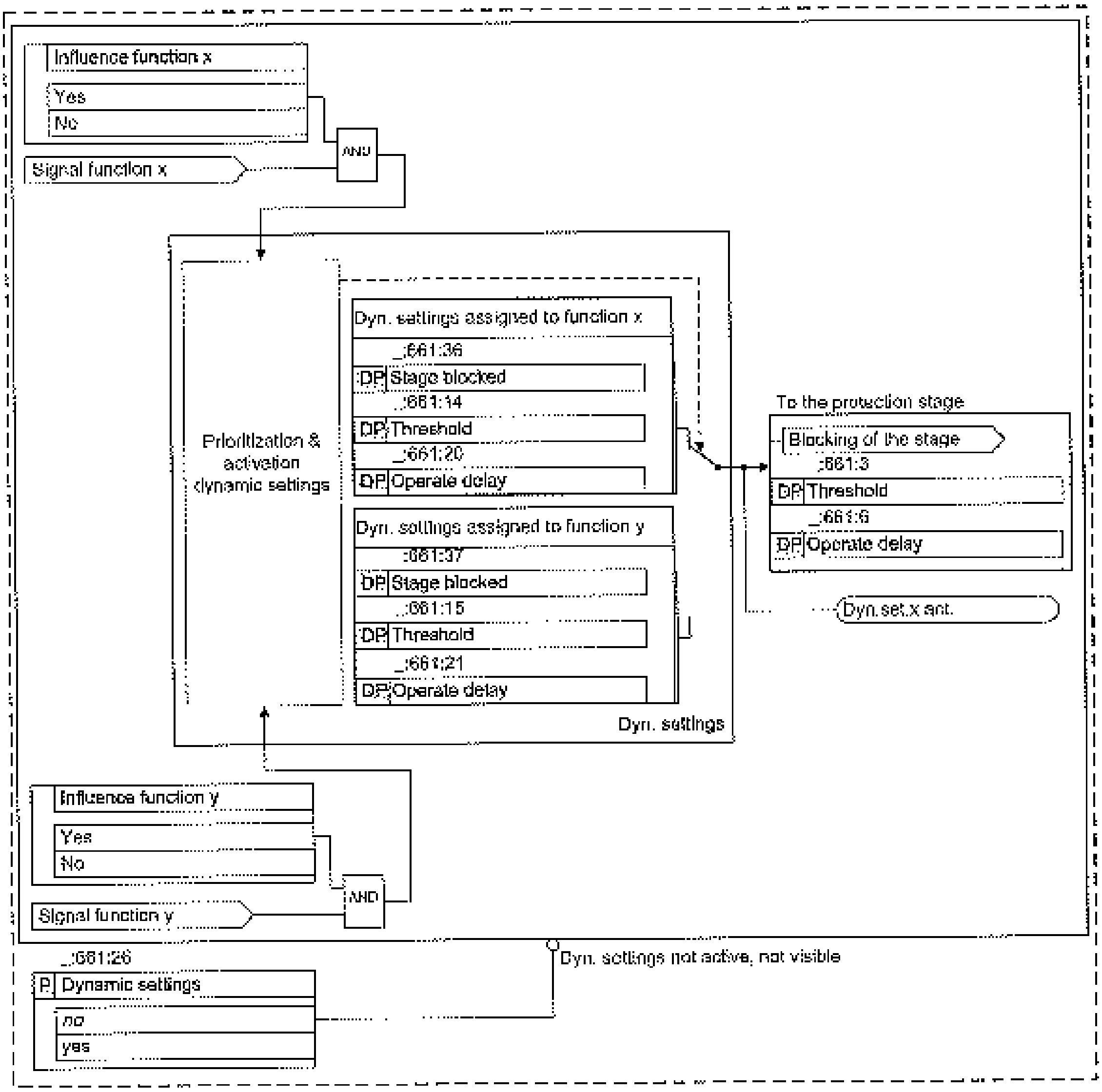


Figure 6-21 Principle of the Dynamic Settings Exemplified by 1st Definite Time-Overcurrent Protection Stage

If available in the device, the following functionalities can affect the overcurrent-protection stages:

Functionalities	Priority
Automatic reclosing (AREC)	Priority 1
Cold-load pickup detection	Priority 2
Binary input signal	Priority 3

These functionalities generate signals that change the settings of the dynamic settings of the overcurrent-protection stage or block it, if required. In the latter case, the settings of the **Threshold** and **Operate delay** parameters are of no relevance. Within the overcurrent protection stage, each of these signals is provided with a configuration parameter **Influence of function ...** and its own dynamic settings (**Operate delay** and **Threshold**). The configuration settings are used to set whether the signal shall be active or not, this means whether the dynamic settings shall be activated or not. If one of these signals (for example, signal function x) becomes active and is to take effect, these settings become dynamic, that is, instantly active. This means that the setting assigned to the signal replaces the standard setting. If the signal becomes inactive, the standard settings apply again. The activation of the dynamic settings is reported.

Where several signals are active in parallel, the priority specified above shall apply. This means that a signal with priority 2 precedes that of priority 3. The settings assigned to signal 2 become active.

The functionality of the dynamic settings can be disabled. In this case, the settings assigned to the signals are not visible and are without effect.

Link to the Device-Internal Function *Automatic Reclosing (Advanced Stage)*

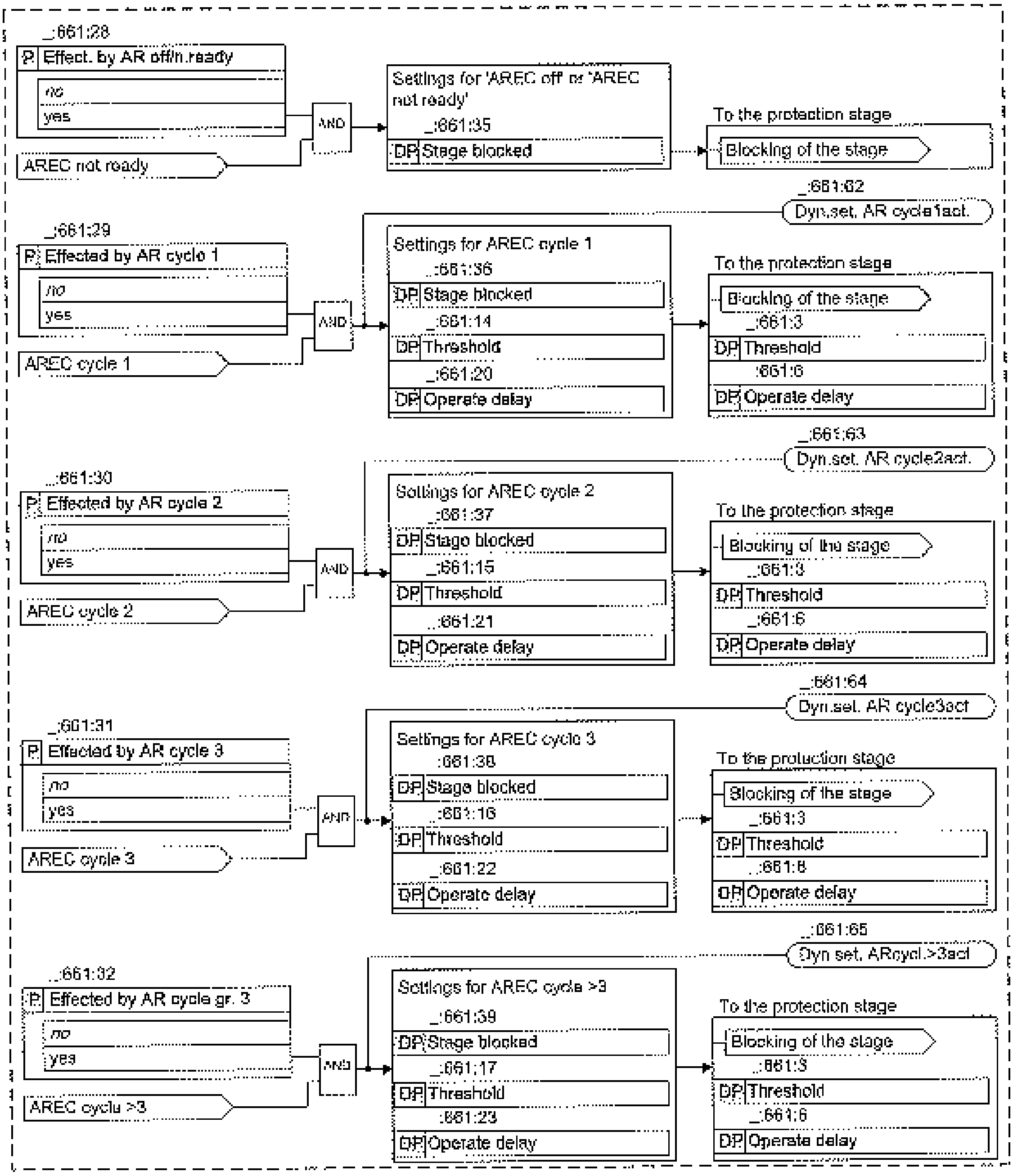


Figure 6-22 Influence of the AREC Signals on the Overcurrent-Protection Stage

Several AREC signals can affect the setting for the **Threshold** and **Operate delay** parameters of the protection stage and its blocking.

- AREC is ready for reclosing 1 (= Automatic reclosing cycle 1)
- AREC is ready for reclosing 2 (= Automatic reclosing cycle 2)
- AREC is ready for reclosing 3 (= Automatic reclosing cycle 3)
- AREC is ready for reclosing 4 (= Automatic reclosing cycle >3)

The following signal can only block the protection stage:

- AREC is not ready or switched off (= Automatic reclosing off / not ready)

This means that if the AREC is ready and the protection stage is in the idle state, the settings for **AREC cycle 1** are active and not the standard settings. The standard settings are active in the case of **AREC off/not ready**.

The influence can be activated for each signal individually. You also have to set the **Threshold** and **Operate delay** or **Stage blocked** parameters, which take effect when the signal is active.

The way AREC signals are generated is described in chapter *6.45.1 Overview of Functions*.

Link to the Device-Internal Function *Cold-Load Pickup Detection (Advanced Stage)*

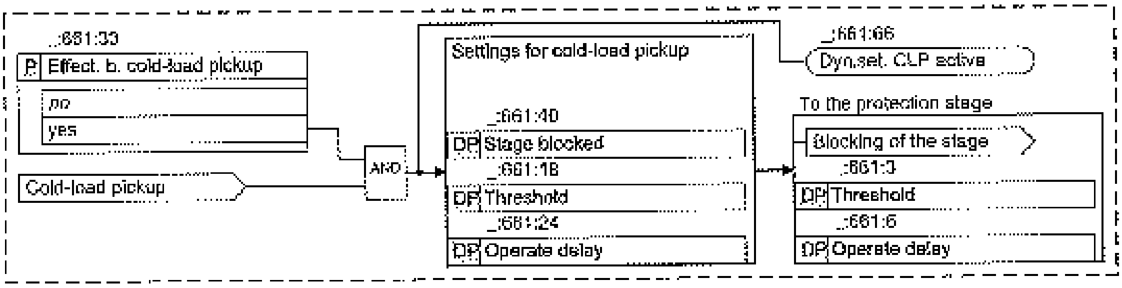


Figure 6-23 Influence of the Cold-Load Pickup Detection on the Overcurrent-Protection Stage

In the case of cold-load pickup, you have the option to change the settings for the **Threshold** and **Operate delay** parameters of the protection level. You can also block the level. To do so, you must activate the influence of the cold-load pickup. You also have to set the **Threshold** and **Operate delay** or assign settings to **Stage blocked**, which take effect when the signal is active.

The way signals are generated **Cold-load pickup** is described in chapter *5.8.1 Overview of Functions*.

Link to an External *Function via a Binary Input Signal (Advanced Stage)*

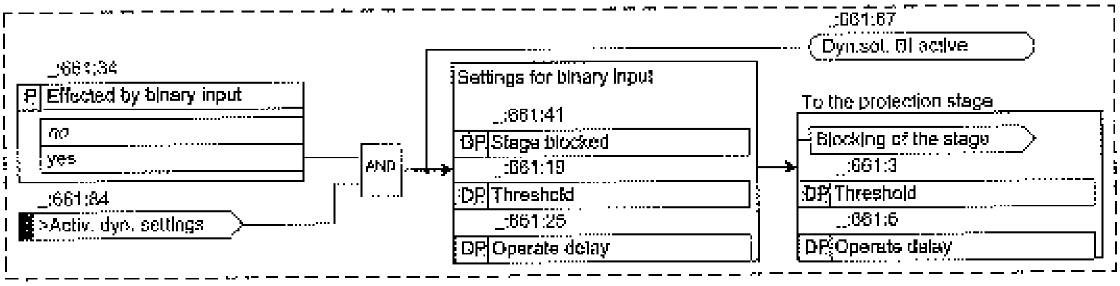


Figure 6-24 Influence of the Binary Input on the Overcurrent-Protection Stage

You can use the binary input signal **>Activ. dyn. settings** to change the settings for the **Threshold** and the **Operate delay** parameters of the protection stage. You can also block the level. To do so, you must activate the influence of the binary input. You also have to set the **Threshold** and **Operate delay** or assign settings to **Stage blocked**, which take effect when the signal is active.

6.3.8.2 Application and Setting Notes (Advanced Stage)

Parameter: Dynamic settings

- Default setting (_:661:26) **Dynamic settings** = *no*

Parameter Value	Description
no	The influence on the overcurrent-protection stage by device-internal or external functions is not necessary.
yes	If a device-internal function (automatic reclosing function or cold-load pickup detection) or an external function should affect the overcurrent-protection stage (such as change the setting of the threshold value or time delay, blocking of the stage), the setting must be changed to **yes**. This makes the configuration parameters **Influence of function...** as well as the dynamic settings **Threshold**, **Operate delay** and **Stage blocked** of the stage visible and enables the settings to be set for the specific influence.

Influence of AREC

The example of how the overcurrent stage (1st stage) can be used as a fast stage before automatic reclosing describes the influence exerted by AREC.

The setting of the overcurrent stage (1st stage) results from the time-grading schedule. Additionally, it is to be used as fast stage before an automatic reclosing. Because a fast disconnection of the short circuit current takes priority over the selectivity prior to reclosing, the tripping delay can be set to *0* or a very small value. To achieve the selectivity, the final disconnection must be done with the grading time.

AREC is set to 2 reclosings. A secondary **Threshold** of *1.5 A* and a **Operate delay** of *600 ms* are assumed (according to the time-grading schedule) for the overcurrent-protection stage. The standard settings of the stage are set to these values.

To realize the application, the configuration settings **Effected by AR cycle 1** and **Effected by AR cycle 2** are changed in the example to **yes** (= influenced). This activates the **AR cycle 1** and **AR cycle 2** input signals within the stage. When they become active, they switch to the assigned dynamic settings.

The two dynamic settings **Operate delay** assigned to these input signals (sources of influence) are set to the time delay *0* (instantaneous tripping). The two dynamic settings **Threshold** assigned to these input signals are set to the normal threshold value of *1.5 A*.

If the threshold value (*1.5 A*) is exceeded before AREC 1 and AREC 2, the overcurrent-protection stage trips instantaneously. If the fault still exists after AREC 2 (unsuccessful AREC), the stage trips with the time delay of *600 ms* according to the time-grading schedule.

Influence of External Devices

The influence of an external device can also be configured. The above is an example of how the overcurrent-protection stage (1st stage) can be used as a fast stage before automatic reclosing, in which case the AREC function is performed by an external device.

To realize the application, the configuration setting **Effected by binary input** must be changed to **yes** (= influenced). This activates the **>Activ. dyn. settings** input signal within the stage. When the input signal becomes active, it switches to the assigned dynamic settings. The external device must provide the **Cycle 1** and **Cycle 2** signals or, alternatively, the **AR ready** signal. The signals must be connected with the binary input signal **>Activ. dyn. settings**.

The dynamic setting **Operate delay**, which is assigned to the input signal (source of influence) **>Activ. dyn. settings**, is set to the time delay *0* (instantaneous tripping). The dynamic setting **Threshold** assigned to this input signal is set to the normal threshold value of *1.5 A*.

If the threshold value (*1.5 A*) is exceeded before AREC 1 and AREC 2, the overcurrent-protection stage trips instantaneously. If the fault still exists after AREC 2 (unsuccessful AREC), the stage trips with the time delay of *600 ms* according to the time-grading schedule.

6.4 Voltage-Dependent Overcurrent Protection, Phases

6.4.1 Overview of Functions

The **Voltage-dependent overcurrent protection** (ANSI 51V) function:

- Detects short circuits affecting electric equipment
- Can be used for special network conditions where the overcurrent pickup level should be decreased depending on the fault voltage
- Can be used for generators where the excitation voltage is derived from the machine terminals and the overcurrent pickup should be kept depending on the fault voltages

6.4.2 Structure of the Function

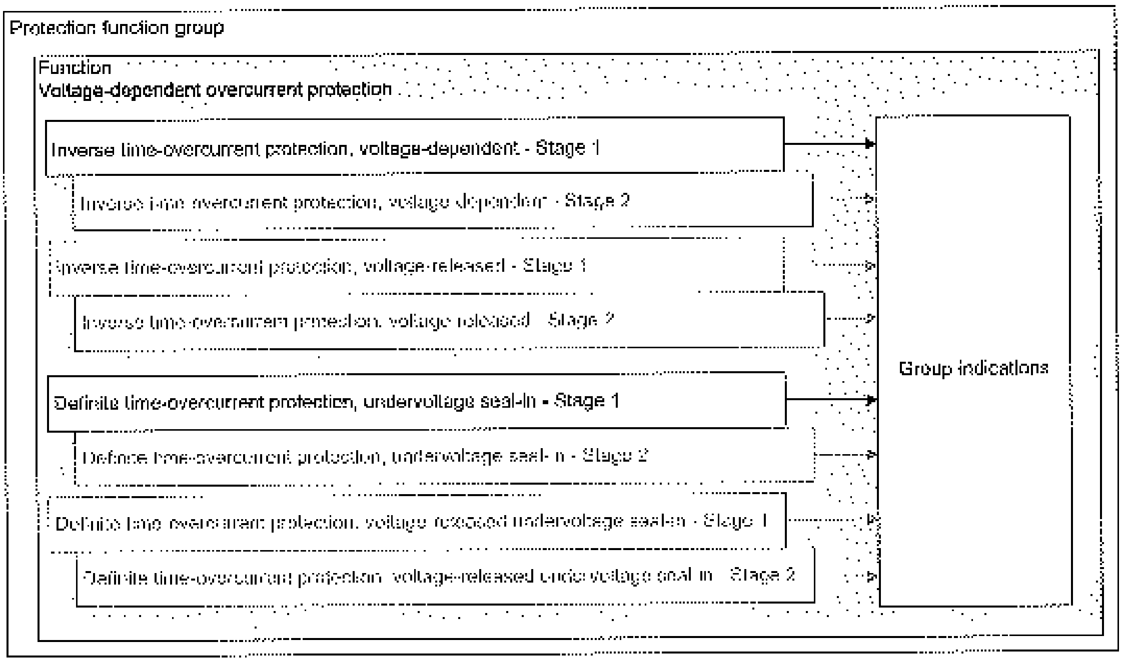
The **Voltage-dependent overcurrent protection** function is used in protection function groups with 3-phase current and voltage measurement.

The function **Voltage-dependent overcurrent protection** comes with the following factory-set stages:

- Inverse time-overcurrent protection, voltage-dependent stage
- Definite time-overcurrent protection, undervoltage seal-in stage

In this function, the following stages can operate simultaneously:

- A maximum of 2 inverse time-overcurrent protection, voltage-dependent stages
- A maximum of 2 inverse time-overcurrent protection, voltage-released stages
- A maximum of 2 definite time-overcurrent protection, undervoltage seal-in stages
- A maximum of 2 definite time-overcurrent protection, voltage-released undervoltage seal-in stages



[dwstrvol-210713-01_Release-ver_2_en_25]

Figure 6-25 Structure/Embedding of the Function

6.4.3 Stage with Inverse Time-Overcurrent Protection, Voltage-Dependent

6.4.3.1 Description

Logic of the Stage

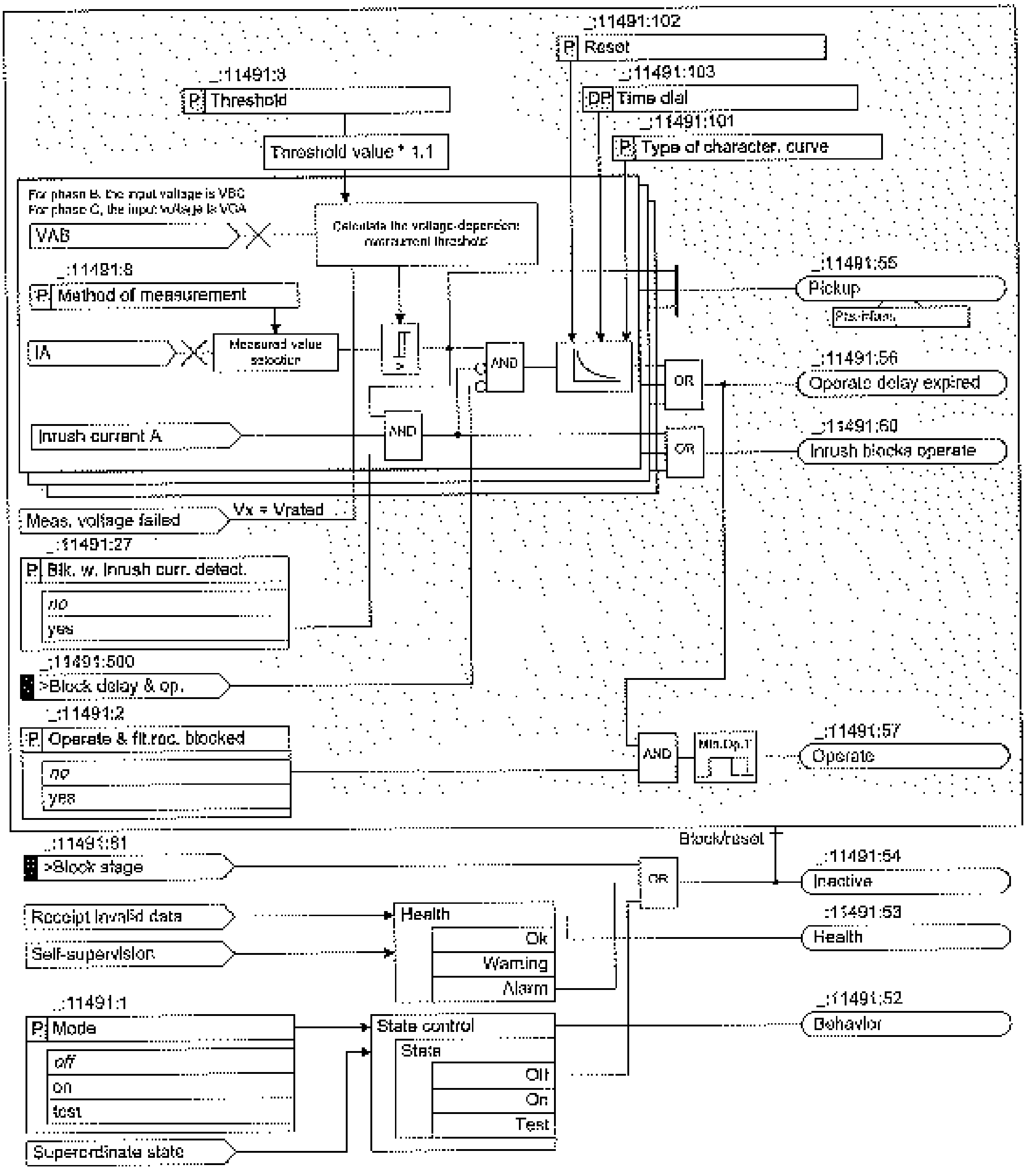


Figure 6-26 Logic Diagram of the Inverse Time-Overcurrent Protection, Voltage-Dependent

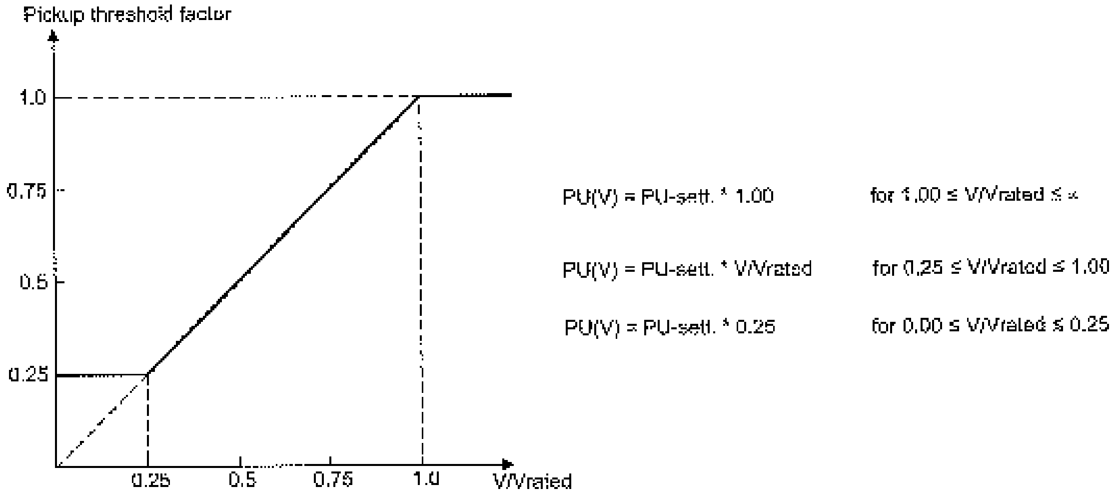
Method of Measurement

You use the `Method of measurement` parameter to define whether the stage uses the *Fundamental comp.* (standard method) or the calculated *RMS value*.

- Measurement of the fundamental comp.:
  This method of measurement processes the sampled current values and filters out the fundamental component numerically.
- Measurement of the RMS value:
  This method of measurement determines the current amplitude from the sampled values according to the defining equation of the RMS value. Harmonics are included in the analysis.

Voltage-Dependent Pickup Threshold

The pickup threshold of the overcurrent stage depends on the voltage magnitude. A lower voltage decreases the current pickup value (see *Figure 6-27*). In the range between V/V_{rated} = 1.00 to 0.75 a linear, directly proportional dependence is realized.



[dwvudpc-220713-01.tif, 1, en_US]

Figure 6-27 Voltage Influence of the Pickup Threshold

With:

V	=	Measured phase-to-phase voltage
V_{rated}	=	Rated voltage (parameter Rated voltage in the function block General of the protection function group)
PU sett.	=	Pickup threshold setting (parameter address: _11491:3)
PU(V)	=	Applied pickup threshold according to the voltage influence

The minimum current pickup threshold value is 0.03 * Irated. This value cannot be decreased any further even not by voltage-dependent pickup threshold factor.

Decreasing the pickup threshold is carried out phase-selectively. The assignment of voltages to current-carrying phases is shown in *Table 6-1*.

Table 6-1 Controlling Voltages in Relation to the Fault Current

Current	Controlling Voltage
I_A	V_{AB}
I_B	V_{BC}
I_C	V_{CA}

Pickup and Dropout Behavior of the Inverse-Time Characteristic Curve According to IEC and ANSI

When the input variable exceeds the threshold value by a factor of 1.1, the inverse-time characteristic curve is processed.

An integrating method of measurement totalizes the weighted time. The weighted time results from the characteristic curve. For this, the time that is associated with the present current value is determined from the characteristic curve. Once the weighted time exceeds the value 1, the stage operates.

When the measured value falls below the pickup value by 1.045 times (0.95 x 1.1 x threshold value), the dropout is started. The pickup will be indicated as clearing. You can influence the dropout behavior via setting parameters. You can select between instantaneous dropout (totalized time is deleted) or dropout according to the characteristic curve (reduction of totalized time depending on the characteristic curve). The dropout according to the characteristic curve (disk emulation) is the same as turning back a rotor disk. The weighted reduction of the time is started from 0.9 of the set threshold value.

The characteristic curve and associated formulas are shown in the Technical data.

Influence On the Operate Curve

The current pickup threshold is decreased proportional to the voltage decrease. Consequently, for a constant current I the I/Threshold-value ratio is increased and the operate time is reduced. Compared with the standard curves represented in the **Technical Data**, the operate curve shifts to the left side as the voltage decreases.

Measuring-Voltage Failure Detection

In case of a measuring-voltage failure detection the input voltage value is automatically set to V_{rated}, so that the pickup threshold factor will be 1.

Blocking of the Time Delay

You can use the binary input signal *>Block delay & op.* to prevent the start of the time delay and thus also the operate signal. A running time delay is reset. The pickup is indicated and the fault logging and recording takes place.

Blocking of the Operate Delay and the Operate Signal via the Device-Internal Inrush-Current Detection Function

Blocking of the operate delay and the operate signal via the device internal **Inrush-current detection** function is described in chapter *6.3.7.1 Description*.

6.4.3.2 Application and Setting Notes

Parameter: Blk. w. inrush curr. detect.

- Default setting (_:11491:27) Blk. w. inrush curr. detect. = no

Parameter Value	Description
no	The transformer inrush-current detection does not affect the stage. Select this setting in the following cases: • In cases where the device is not used on transformers. • In cases where the device is used on transformers and the threshold value of the stage is set above the maximum inrush current of the transformer. This applies, for example, to the high-current stage that is set according to the short-circuit voltage Vsc of the transformer in such a way that the stage only picks up on faults from the high-voltage side. The transformer inrush current cannot become larger than the maximum transmittable short-circuit current.
yes	When the transformer inrush-current detection detects an inrush current that would lead to a tripping of the stage, the start of the time delay and tripping of the stage are blocked. Select this setting if the device is used on transformers and the threshold value of the stage is set below the maximum inrush current of the transformer. This applies to the overcurrent-protection stage, which is used as a backup stage with grading time for faults on the undervoltage side of the transformer.

Parameter: `Method of measurement`

- Recommended setting value (_:11491:8) `Method of measurement` = *fundamental comp.*

You use the `Method of measurement` parameter to define whether the stage uses the *fundamental comp.* (standard method) or the calculated *RMS value*.

Parameter Value	Description
fundamental comp.	Select this method of measurement if harmonics or transient current peaks are to be suppressed. Siemens recommends using this method as the standard process.
RMS value	Select this method of measurement if you want the stage to take harmonics into account (for example at capacitor banks).

Parameter: `Threshold`

- Default setting (_:11491:3) `Threshold` = *1.500 A*

The recommended setting value of 1.500 A is suitable for most applications.

Set the `Threshold` and `Type of character. curve` parameters for the specific application.

The setting depends on the maximum occurring operating current. Pickup by overload must be excluded since overcurrent protection operates with short tripping times as short-circuit protection and not as overload protection.

Set the `Threshold` parameter for lines to approx. 10 %, for transformers and motors to approx. 20 % above the maximum expected load.

Note that a safety margin is set between pickup value and threshold value. The stage only picks up at approx. 10 % above the `Threshold`.

Parameter `Type of character. curve`

- Default setting (_:11491:101) `Type of character. curve` = *IEC normal inverse*

The device offers all the usual inverse-time characteristic curves according to IEC and ANSI. Select the `Type of character. curve` required for your specific application.

Parameter: `Reset`

- Default setting (_:11491:102) `Reset` = *disk emulation*

The `Reset` parameter allows you to define whether the stage decreases according to the dropout characteristic curve (behavior of a disk emulation – rotor disc) or instantaneously.

Parameter Value	Description
disk emulation	Select this setting if the device is coordinated with electromechanical devices or other devices which perform a dropout after a disk emulation.
instantaneous	Select this setting if the dropout does not have to be performed after a disk emulation and an instantaneous dropout is desired instead.

Parameter: `Time dial`

- Default setting (_:11491:103) `Time dial` = 1

You can use the `Time dial` parameter to displace the characteristic curve in the time direction.

The setting value for the `Time dial` parameter is derived from the time-grading chart that has been prepared for the electrical power system.

Where no time grading and therefore no displacement of the characteristic curve is required, leave the parameter `Time dial` at 1 (default setting).

6.4.3.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
V-dependent 1				
_:11491:1	V-dependent 1:Mode		• off • on • test	off
_:11491:2	V-dependent 1:Operate & flt.rec. blocked		• no • yes	no
_:11491:27	V-dependent 1:Blk. w. inrush curr. detect.		• no • yes	no
_:11491:8	V-dependent 1:Method of measurement		• fundamental comp. • RMS value	fundamental comp.
_:11491:3	V-dependent 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:11491:101	V-dependent 1:Type of character. curve			
_:11491:102	V-dependent 1:Reset		• instantaneous • disk emulation	disk emulation
_:11491:103	V-dependent 1:Time dial		0.05 to 15.00	1.00

6.4.3.4 Information List

No.	Information	Data Class (Type)	Type
Group indicat.			
_:4501:55	Group indicat.:Pickup	ACD	O
_:4501:57	Group indicat.:Operate	ACT	O
V-dependent 1			
_:11491:81	V-dependent 1:>Block stage	SPS	I
_:11491:500	V-dependent 1:>Block delay & op.	SPS	I
_:11491:54	V-dependent 1:Inactive	SPS	O
_:11491:52	V-dependent 1:Behavior	ENS	O
_:11491:53	V-dependent 1:Health	ENS	O
_:11491:60	V-dependent 1:Inrush blocks operate	ACT	O
_:11491:59	V-dependent 1:Disk emulation running	SPS	O
_:11491:55	V-dependent 1:Pickup	ACD	O
_:11491:56	V-dependent 1:Operate delay expired	ACT	O
_:11491:57	V-dependent 1:Operate	ACT	O

6.4.4 Stage with Inverse Time-Overcurrent Protection, Voltage-Released

6.4.4.1 Description

Logic of the Stage

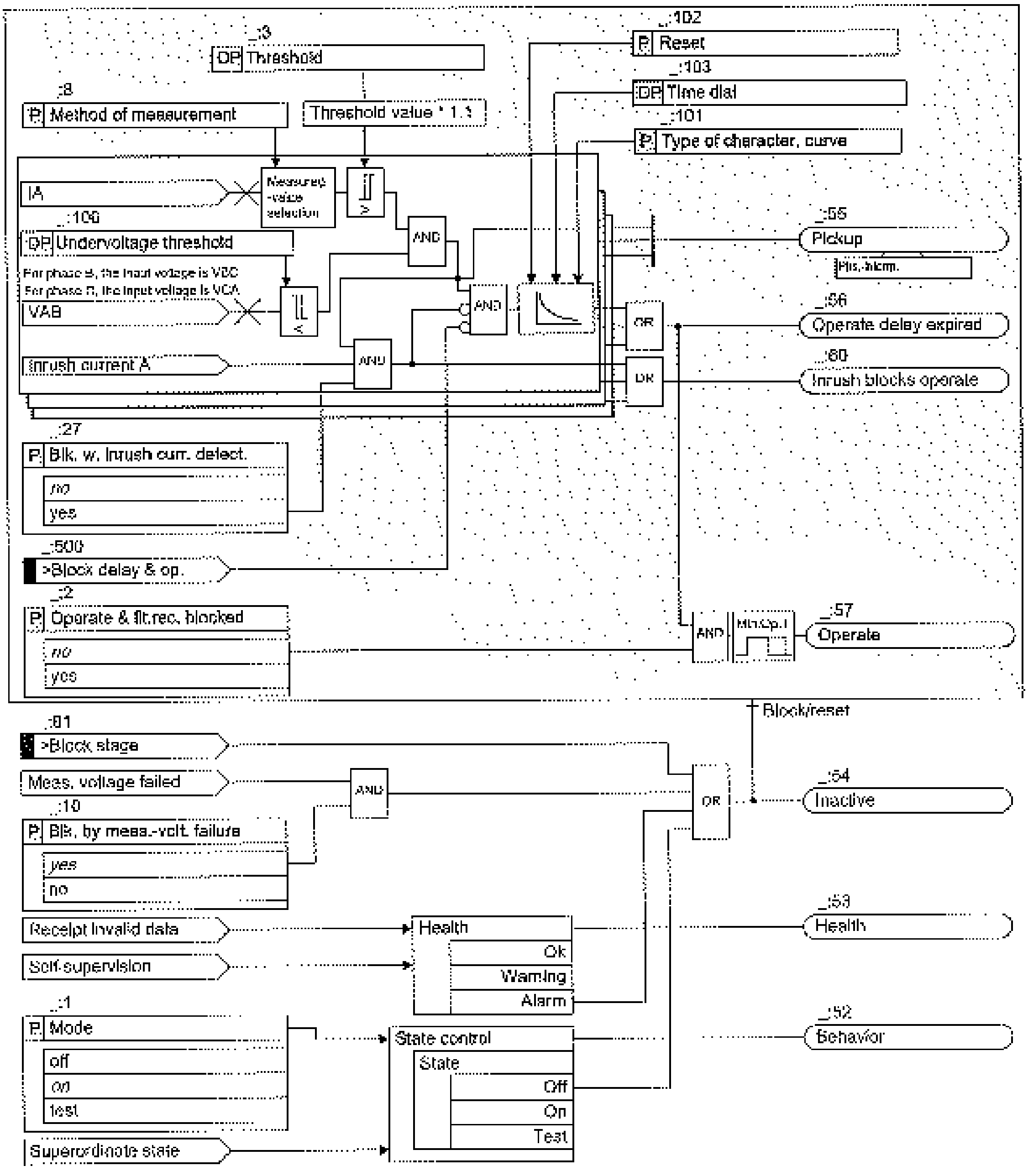


Figure 6-28 Logic Diagram of the Inverse Time-Overcurrent Protection, Voltage-Released

This stage is structured in the same way as the inverse time-overcurrent, voltage-dependent stage (see chapter 6.4.3.1 *Description*). The only differences are the conditions for the pickup and the influence on the operate curve.

Measuring-Element Release

When the controlling voltage drops below the setting **Undervoltage threshold**, the respective measuring element is released.

The release of the measuring elements is carried out phase-selectively. The assignment of voltages to current-carrying phases is shown in *Figure 6-27*.

Blocking of the Stage with Measuring-Voltage Failure

The stage can be blocked if a measuring-voltage failure occurs. In case of a blocking, the picked up stage is reset. The following blocking options are available for the stage:

- From an internal source upon pickup of the **Measuring-voltage failure detection** function
- From an external source via the binary input signal *>Open* of the function block **Volt.-transf. c. b.**, which links in the tripping of the voltage-transformer circuit breaker

The **Blk. by meas.-volt. failure** parameter can be set so that measuring-voltage failure detection blocks the stage or does not block it.

6.4.4.2 Application and Setting Notes

This stage is structured in the same way as the **Inverse time-overcurrent, voltage-dependent** stage. The only differences are the conditions for the pickup and the influence on the operate curve. This chapter only provides the application and setting notes for the setting **Blk. by meas.-volt. failure** and **Undervoltage threshold**. For guidance on the other parameters of this stage, refer to chapter *6.4.3.2 Application and Setting Notes*.

Parameter: Blk. by meas.-volt. failure

- Recommended setting value (_:10) **Blk. by meas.-volt. failure** = *yes*

You can use the **Blk. by meas.-volt. failure** parameter to control the response of the stage when a measuring-voltage failure is detected.

A measuring-voltage failure can only be detected if one of the following 2 conditions is met:

- The device-internal **Measuring-voltage failure detection** function is configured and switched on.
- The binary input signal *>Open* of the function block **Voltage-transformer circuit breaker** is connected to the voltage-transformer circuit breaker.

Parameter Value	Description
no	The overcurrent-protection stage is not blocked when a measuring-voltage failure is detected.
yes	The overcurrent-protection stage is blocked when a measuring voltage failure is detected. Siemens recommends using the default setting, as correct operation of the stage cannot be guaranteed if a measuring-voltage failure occurs.

Parameter: Undervoltage threshold

- Default setting (_:104) **Undervoltage threshold** = *75.0 V*

When the controlling voltage is below the set value, the inverse time-overcurrent stage is released.

The parameter is set to a value just below the lowest phase-to-phase voltage admissible during operation, for example, from 75 % to 80 % of V_{rated}.

6.4.4.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
V-release #				
_:1	V-release #:Mode		• off • on • test	off
_:2	V-release #:Operate & flt.rec. blocked		• no • yes	no
_:10	V-release #:Blk. by meas.-volt. failure		• no • yes	yes
_:27	V-release #:Blk. w. inrush curr. detect.		• no • yes	no
_:8	V-release #:Method of measurement		• fundamental comp. • RMS value	fundamental comp.
_:3	V-release #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 100 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.500 A
		5 A @ 50 Irated	0.15 A to 175.00 A	7.50 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.500 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	7.500 A
_:101	V-release #:Type of character. curve		• ANSI long-time inv. • ANSI short time inv. • ANSI extremely inv. • ANSI very inverse • ANSI normal inverse • ANSI moderately inv. • ANSI definite inverse • IEC normal inverse • IEC very inverse • IEC extremely inv. • IEC long-time inverse	IEC normal inverse
_:102	V-release #:Reset		• instantaneous • disk emulation	disk emulation
_:103	V-release #:Time dial		0.05 to 15.00	1.00
_:104	V-release #:Undervoltage threshold		0.300 V to 175.000 V	75.000 V

6.4.4.4 Information List

No.	Information	Data Class (Type)	Type
V-release #			
_:81	V-release #:>Block stage	SPS	I
_:500	V-release #:>Block delay & op.	SPS	I
_:54	V-release #:Inactive	SPS	O
_:52	V-release #:Behavior	ENS	O
_:53	V-release #:Health	ENS	O
_:60	V-release #:Inrush blocks operate	ACT	O
_:59	V-release #:Disk emulation running	SPS	O
_:55	V-release #:Pickup	ACD	O
_:56	V-release #:Operate delay expired	ACT	O
_:57	V-release #:Operate	ACT	O

6.4.5 Stage with Definite Time-Overcurrent Protection, Undervoltage Seal-In

6.4.5.1 Description

Logic of the Stage

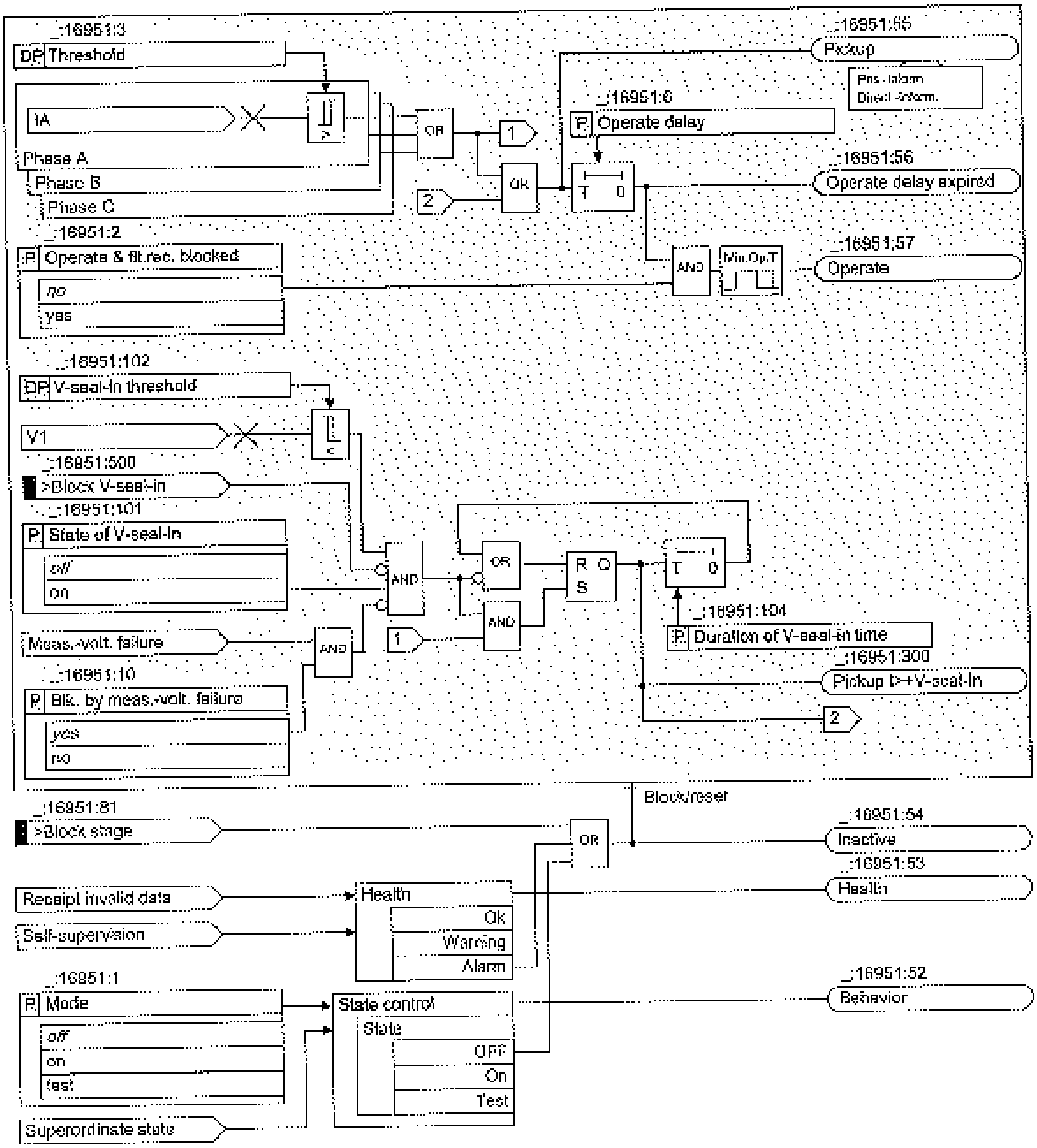


Figure 6-29 Logic Diagram of the Definite Time-Overcurrent Protection, Undervoltage Seal-In

Undervoltage Seal-In

In generators where the excitation voltage is derived from the machine terminals, the short-circuit current decreases quickly in the event of close-in faults (for example, in a generator or a generator-transformer range). The current decreases to a value below the current threshold within a few seconds because of the absence of the excitation voltage. To avoid a dropout of the relay, the positive-sequence voltages are used as an additional criterion for detecting a short-circuit fault.

The pickup signal is maintained for a settable seal-in time `Duration of V-seal-in time`, if the positive-sequence voltage falls below a settable threshold `V-seal-in threshold` after an overcurrent pickup, even if the current falls below the threshold again. If the voltage recovers before the seal-in time has elapsed, or if the undervoltage seal-in is blocked via a binary input *>Block V-seal-in*, the signal *Pickup I>+V-seal-in* drops out immediately.

You can switch off the undervoltage seal-in via the parameter `State of V-seal-in`.

Blocking of the Undervoltage Seal-In with Measuring-Voltage Failure

The **Undervoltage seal-in** can be blocked if a measuring-voltage failure occurs. In case of a blocking, the pickup signal *Pickup I>+V-seal-in* drops out immediately. The following blocking options are available for the **Undervoltage seal-in**:

- From an internal source upon pickup of the **Measuring-voltage failure detection** function.
- From an external source via the binary input signal *>Open* of the function block **VT miniature CB**, which links in the tripping of the voltage-transformer circuit breaker.

The parameter `Blk. by meas.-volt. failure` can be used to control the measuring-voltage failure detection. The **Undervoltage seal-in** remains unaffected if the parameter `Blk. by meas.-volt. failure` is switched off.

6.4.5.2 Application and Setting Notes

Parameter: `Operate & flt.rec. blocked`

- Default setting (_:16951:2) `Operate & flt.rec. blocked` = `no`

With the parameter `Operate & flt.rec. blocked`, you can block the operate indication, the fault recording, and the fault log.

Parameter: `Threshold`

- Default setting (_:16951:3) `Threshold` = *1.350 A*

The setting is mainly determined by the maximum operating current.

Pickup by overload must be excluded since the protection may trip if a short operate delay time is set. Set the `Threshold` parameter for generators to a value between 20 % and 30 %, for transformers and motors approx. 40 % above the expected peak load.

Parameter: `Operate delay`

- Default setting (_:16951:6) `Operate delay` = *3.00 s*

The parameter `Operate delay` must be coordinated with the time grading of the network protection to guarantee the selectivity. Practical time delays are between 1 s to 2 s.

Parameter: `Blk. by meas.-volt. failure`

- Default setting (_:16951:10) `Blk. by meas.-volt. failure` = *yes*

With the parameter `Blk. by meas.-volt. failure`, you can activate (*yes*) or deactivate (*no*) the blocking by the **Measuring voltage failure detection** function. The recommended setting is the default setting.

Parameter: `State of V-seal-in`

- Default setting (_:16951:101) `State of V-seal-in` = *off*

With the parameter `State of V-seal-in`, the seal-in functionality can be activated (switched *on*). Siemens recommends this setting if the excitation transformer is connected to the main lead of the generator.

Parameter: `V-seal-in threshold`

- Default setting (_:16951:102) `V-seal-in threshold` = *46.2 V*

The `V-seal-in threshold` (positive-sequence voltage) is set to a value below the lowest phase-to-phase voltage admissible during an operation, for example 80 % of the rated voltage of a generator. The positive-sequence voltage is evaluated. The practicable value for a voltage transformer with a rated secondary voltage of 100 V is 46.2 V.

The following table shows an example of a specification:

Threshold	$1.4 * I_{rated, Gen}$		
Operate delay	3.00 s		
Undervoltage seal-in	$0.8 * V_{rated, Gen}$		
Duration of V-seal-in time	4.00 s		
Dropout ratio	0.95		
Rated current $I_{rated, Gen}$	483 A	Rated voltage $V_{rated, Gen}$	6.3 kV
Rated current $I_{rated, VT, prim}$	500 A	Rated voltage $V_{rated, VT, prim}$	6.3 kV
Rated current $I_{rated, VT, sec}$	1 A	Rated voltage $V_{rated, VT, sec}$	100 V

The following secondary setting values result from this specification:

$$\text{Threshold} = \frac{1.4 \times I_{rated\ ,Gen}}{I_{rated\ ,CT\ ,prim}} \times I_{rated\ ,VT,sec} = \frac{1.4 \times 483\ A}{500\ A} \times 1\ A = 1.35\ A$$

[fo_OCP_UVd_Threshold, 1, en_US]

$$\text{Undervoltage seal-in} = \frac{0.8 \times V_{rated\ ,Gen}}{V_{rated\ ,VT\ ,prim}} \times \frac{V_{rated\ ,VT,sec}}{\sqrt{3}} = \frac{0.8 \times 6.3\ kV}{6.3\ kV} \times \frac{100\ V}{\sqrt{3}} = 46.200\ V$$

[fo_OCP_UVd_SealIn, 1, en_US]

Parameter: `Duration of V-seal-in time`

- Default setting (_:16951:104) `Duration of V-seal-in time` = *4.00 s*

The parameter `Duration of V-seal-in time` limits the pickup seal-in induced by an overcurrent or undervoltage. The value must be set higher than the value of the parameter `Operate delay`. The difference shall be greater than 0.5 s. In the default setting, a difference of 1 s is used.

6.4.5.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
V-seal-in 1				
_:16951:1	V-seal-in 1:Mode		• off • on • test	off
_:16951:2	V-seal-in 1:Operate & flt.rec. blocked		• no • yes	no
_:16951:3	V-seal-in 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.350 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.75 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.350 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.75 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.350 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.750 A
_:16951:6	V-seal-in 1:Operate delay		0.00 s to 60.00 s	3.00 s
_:16951:10	V-seal-in 1:Blk. by meas.-volt. failure		• no • yes	yes

Addr.	Parameter	C	Setting Options	Default Setting
_:16951:101	V-seal-in 1:State of V-seal-in		• off • on	off
_:16951:102	V-seal-in 1:V-seal-in threshold		0.300 V to 175.000 V	80.019 V
_:16951:104	V-seal-in 1:Duration of V-seal-in time		0.10 s to 60.00 s	4.00 s

6.4.5.4 Information List

No.	Information	Data Class (Type)	Type
V-seal-in 1			
_:16951:81	V-seal-in 1:>Block stage	SPS	I
_:16951:500	V-seal-in 1:>Block V seal-in	SPS	I
_:16951:52	V-seal-in 1:Behavior	ENS	O
_:16951:53	V-seal-in 1:Health	ENS	O
_:16951:54	V-seal-in 1:Inactive	SPS	O
_:16951:55	V-seal-in 1:Pickup	ACD	O
_:16951:300	V-seal-in 1:Pickup I>+V-seal-in	SPS	O
_:16951:56	V-seal-in 1:Operate delay expired	ACT	O
_:16951:57	V-seal-in 1:Operate	ACT	O

6.4.6 Stage with Definite Time-Overcurrent Protection, Voltage-Released Undervoltage Seal-In

6.4.6.1 Description

Logic of the Stage

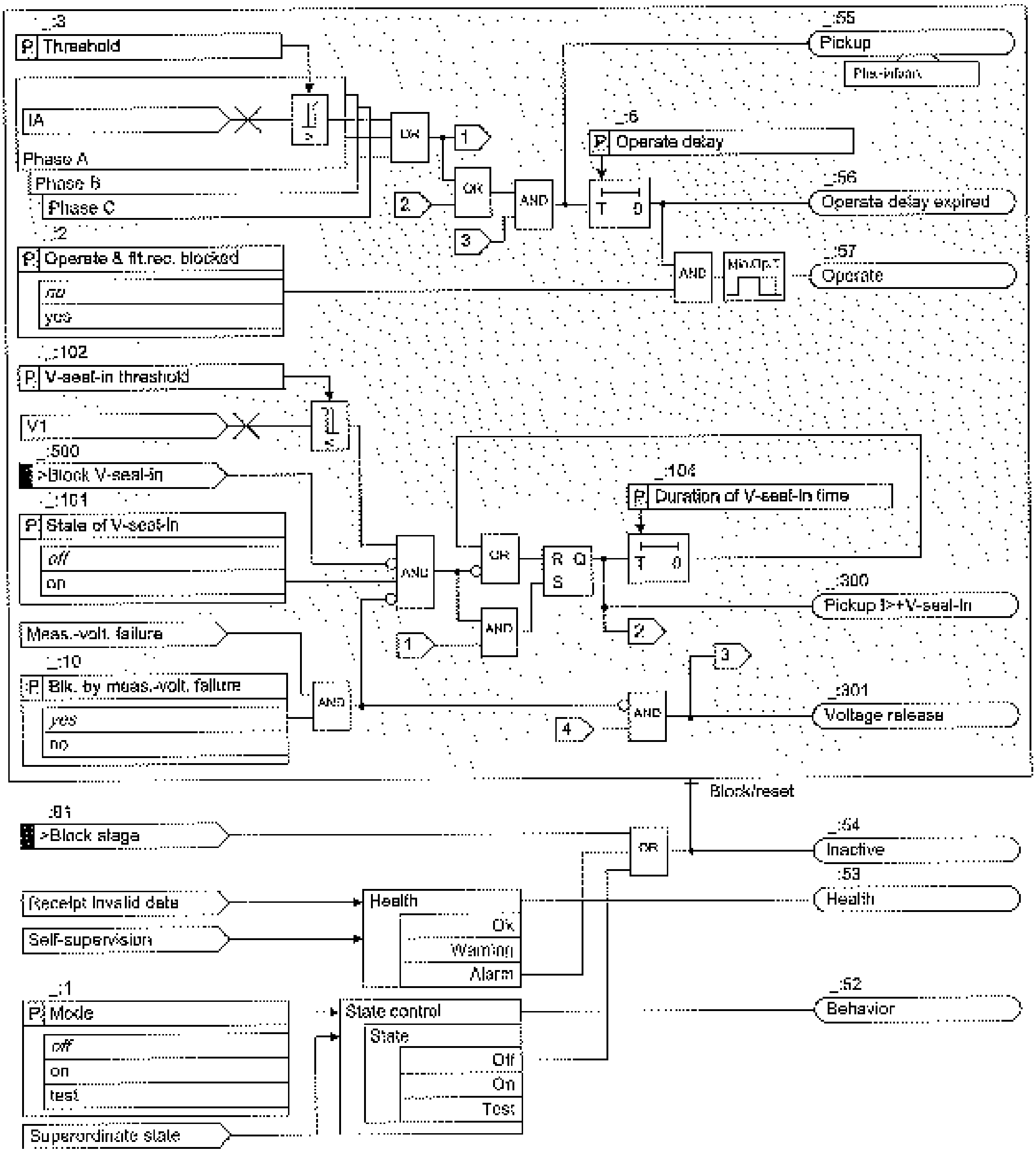
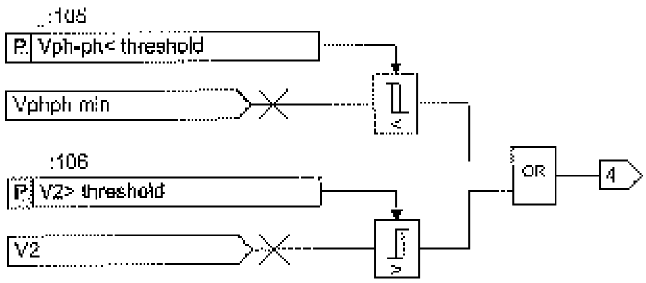


Figure 6-30 Logic Diagram of the Definite Time-Overcurrent Protection, Voltage-Released Undervoltage Seal-in, Part 1

Signal 4 in the following figure refers to *Figure 6-30*.



[lo_seal in_fig2, 1, en_US]

Figure 6-31 Logic Diagram of the Definite Time-Overcurrent Protection, Voltage-Released Undervoltage Seal-in, Part 2

Voltage Release

In addition to the current criterion with undervoltage seal-in, a voltage-released logic must be present to issue the indication *Pickup*. The voltage-released logic monitors the negative-sequence voltage and phase-to-phase voltages respectively for detecting unsymmetrical faults and symmetrical faults. With the voltage-released logic, the setting value of the parameter **Threshold** can be reduced in a certain range and the reliability and sensibility of this function can be improved correspondingly.

Undervoltage Seal-In

In generators where the excitation voltage is derived from the machine terminals, the short-circuit current decreases quickly in the event of close-in faults (for example, in a generator or a generator-transformer range). The current decreases to a value below the current threshold within a few seconds because of the absence of the excitation voltage. To avoid a dropout of the relay, the positive-sequence voltages are used as an additional criterion for detecting a short-circuit fault.

The pickup signal is maintained for a settable seal-in time **Duration of V-seal-in time**, if the positive-sequence voltage falls below a settable threshold **V-seal-in threshold** after an overcurrent pickup, even if the current falls below the threshold again. If the voltage recovers before the seal-in time has elapsed, or if the undervoltage seal-in is blocked via a binary input *>Block V-seal-in*, the signal *Pickup I>+V-seal-in* drops out immediately.

You can switch off the undervoltage seal-in via the parameter **State of V-seal-in**.

Blocking of the Undervoltage Seal-in with Measuring-Voltage Failure

The **Undervoltage seal-in** can be blocked if a measuring-voltage failure occurs. In case of a blocking, the pickup signal *Pickup I>+V-seal-in* drops out immediately. The following blocking options are available for the **Undervoltage seal-in**:

- From an internal source upon pickup of the **Measuring-voltage failure detection** function.
- From an external source via the binary input signal *>Open* of the function block **VT miniature CB**, which links in the tripping of the voltage-transformer circuit breaker.

The parameter **Blk. by meas.-volt. failure** can be used to control the measuring-voltage failure detection. The **Undervoltage seal-in** remains unaffected if the parameter **Blk. by meas.-volt. failure** is switched off.

6.4.6.2 Application and Setting Notes

Parameter: Operate & flt.rec. blocked

- Default setting (_:2) **Operate & flt.rec. blocked** = *no*

With the parameter **Operate & flt.rec. blocked**, you can block the operate indication, the fault recording, and the fault log.

Parameter: `Threshold`

- Default setting (_:3) `Threshold` = *1.350 A*

The setting is mainly determined by the maximum operating current.

Pickup by overload must be excluded since the protection may trip if a short operate delay time is set. Set the `Threshold` parameter for generators to a value between 20 % and 30 %, for transformers and motors approx. 40 % above the expected peak load.

Parameter: `Operate delay`

- Default setting (_:6) `Operate delay` = *3.00 s*

The parameter `Operate delay` must be coordinated with the time grading of the network protection to guarantee the selectivity. Practical time delays are between 1 s to 2 s.

Parameter: `Blk. by meas.-volt. failure`

- Default setting (_:10) `Blk. by meas.-volt. failure` = *yes*

With the parameter `Blk. by meas.-volt. failure`, you can activate (*yes*) or deactivate (*no*) the blocking by the **Measuring voltage failure detection** function. The recommended setting is the default setting.

Parameter: `State of V-seal-in`

- Default setting (_:101) `State of V-seal-in` = *off*

With the parameter `State of V-seal-in`, the seal-in functionality can be activated (switched *on*). Siemens recommends this setting if the excitation transformer is connected to the main lead of the generator.

Parameter: `V-seal-in threshold`

- Default setting (_:102) `V-seal-in threshold` = *46.2 V*

The `V-seal-in threshold` (positive-sequence voltage) is set to a value below the lowest phase-to-phase voltage admissible during an operation, for example 80 % of the rated voltage of a generator. The positive-sequence voltage is evaluated. The practicable value for a voltage transformer with a rated secondary voltage of 100 V is 46.2 V.

The following table shows an example of a specification:

Threshold	1.4 * $I_{rated, Gen}$		
Operate delay	3.00 s		
Undervoltage seal-in	0.8 * $V_{rated, Gen}$		
Duration of V-seal-in time	4.00 s		
Dropout ratio	0.95		
Rated current $I_{rated, Gen}$	483 A	Rated voltage $V_{rated, Gen}$	6.3 kV
Rated current $I_{rated, VT, prim}$	500 A	Rated voltage $V_{rated, VT, prim}$	6.3 kV
Rated current $I_{rated, VT, sec}$	1 A	Rated voltage $V_{rated, VT, sec}$	100 V

The following secondary setting values result from this specification:

$$\text{Threshold} = \frac{1.4 \times I_{rated,Gen}}{I_{rated,CT,prim}} \times I_{rated,VT,sec} = \frac{1.4 \times 483\ A}{500\ A} \times 1\ A = 1.35\ A$$

[fo_OCP_dVV_threshold, 1, en_US]

$$\text{Undervoltage seal-in} = \frac{0.8 \times V_{rated,Gen}}{V_{rated,VT,prim}} \times \frac{V_{rated,VT,sec}}{\sqrt{3}} = \frac{0.8 \times 6.3\ kV}{6.3\ kV} \times \frac{100\ V}{\sqrt{3}} = 46.200\ V$$

[fo_OCP_UVSI_Seal in, 1, en US]

Parameter: `Duration of V-seal-in time`

- Default setting `(_:104) Duration of V-seal-in time` = *4.00 s*

The parameter `Duration of V-seal-in time` limits the pickup seal-in induced by an overcurrent or undervoltage. The value must be set higher than the value of the parameter `Operate delay`. The difference shall be greater than 0.5 s. In the default setting, a difference of 1 s is used.

Parameter: `Vph-ph< threshold`

- Default setting `(_:105) Vph-ph< threshold` = *60.000 V*

With the parameter `Vph-ph< threshold`, you can set the threshold at which the output signal *Voltage release* is activated when the minimum phase-to-phase voltage falls below this threshold.

Parameter: `V2> threshold`

- Default setting `(_:106) V2> threshold` = *4.600 V*

With the parameter `V2> threshold`, you can set the threshold at which the output signal *Voltage release* is issued when V2 exceeds the threshold.

6.4.6.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
Vseal-in+Vrel#				
_:1	Vseal-in+Vrel#:Mode		• off • on • test	off
_:2	Vseal-in+Vrel#:Operate & flt.rec. blocked		• no • yes	no
_:3	Vseal-in+Vrel#:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.350 A
		5 A @ 100 Irated	0.150 A to 175.000 A	6.750 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.350 A
		5 A @ 50 Irated	0.150 A to 175.000 A	6.750 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.350 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.750 A
_:6	Vseal-in+Vrel#:Operate delay		0.00 s to 60.00 s	3.00 s
_:10	Vseal-in+Vrel#:Blk. by meas.-volt. failure		• no • yes	yes
_:101	Vseal-in+Vrel#:State of V-seal-in		• off • on	off
_:102	Vseal-in+Vrel#:V-seal-in threshold		0.300 V to 175.000 V	46.200 V
_:104	Vseal-in+Vrel#:Duration of V-seal-in time		0.10 s to 60.00 s	4.00 s
_:105	Vseal-in+Vrel#:Vph-ph< threshold		0.300 V to 175.000 V	60.000 V
_:106	Vseal-in+Vrel#:V2> threshold		0.300 V to 200.000 V	4.600 V

6.4.6.4 Information List

No.	Information	Data Class (Type)	Type
Vseal-in+Vrel#			
_:81	Vseal-in+Vrel#:>Block stage	SPS	I
_:500	Vseal-in+Vrel#:>Block V-seal-in	SPS	I
_:52	Vseal-in+Vrel#:Behavior	ENS	O
_:53	Vseal-in+Vrel#:Health	ENS	O
_:54	Vseal-in+Vrel#:Inactive	SPS	O
_:55	Vseal-in+Vrel#:Pickup	ACD	O
_:300	Vseal-in+Vrel#:Pickup I>+V-seal-in	SPS	O
_:301	Vseal-in+Vrel#:Voltage release	SPS	O
_:56	Vseal-in+Vrel#:Operate delay expired	ACT	O
_:57	Vseal-in+Vrel#:Operate	ACT	O

6.5 Overcurrent Protection, Ground

6.5.1 Overview of Functions

The **Overcurrent protection, ground** function (ANSI 50N/51N):

- Detects short circuits in electrical equipment
- Can be used as backup overcurrent protection in addition to the main protection

6.5.2 Structure of the Function

The **Overcurrent protection, ground** function is used in protection function groups. 2 kinds of functions are available for the 3-phase overcurrent protection:

- **Overcurrent protection, ground – advanced** (50N/51N OC-gnd-A)
- **Overcurrent protection, ground – basic** (50N/51N OC-gnd-B)

The function type Basic is provided for standard applications. The function type Advanced offers more functionality and is provided for more complex applications.

Both function types are pre-configured by the manufacturer with 2 **Definite time-overcurrent protection** stages and with 1 **Inverse time-overcurrent protection** stage.

In the function type **Overcurrent protection, ground – advanced** the following stages can be operated simultaneously:

- Maximum of 3 stages **Definite time-overcurrent protection – advanced**
- 1 stage **Inverse time-overcurrent protection – advanced**
- 1 stage **User-defined characteristic curve overcurrent protection**

In the function type **Overcurrent protection, ground – basic** the following stages can be operated simultaneously:

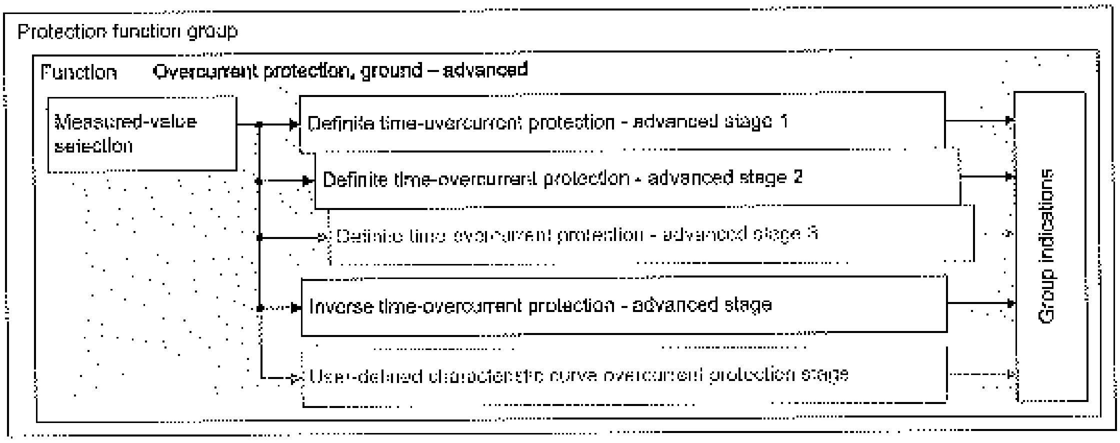
- Maximum of 3 stages **Definite time-overcurrent protection – basic**
- 1 stage **Inverse time-overcurrent protection – basic**

The non-preconfigured stages are shown in gray in the following figures. Apart from the tripping delay characteristic, the stages are identical in structure.

The measured-value selection (only advanced stage) is general functionality and has a uniform effect on the stages (see *Figure 6-32* and chapter *6.5.3.1 Description*). This ensures that all stages of the function receive the same measured current value.

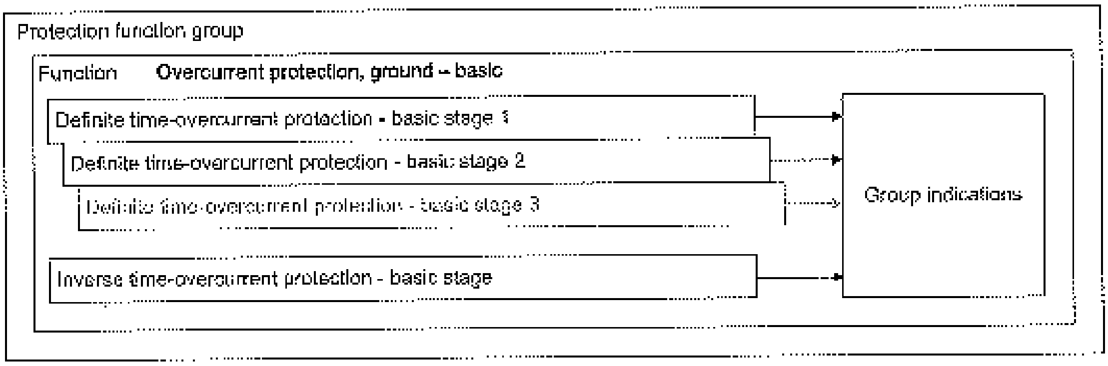
The group-indication output logic generates the following group indications of the protection function by the logical OR of the stage-selective indications:

- `Pickup`
- `Operate`



[dwocpg2-060213-01.tif, 1, en_US]

Figure 6-32 Structure/Embedding the Function Overcurrent Protection, Ground – Advanced



[illegible]

Figure 6-33 Structure/Embedding the Function Overcurrent Protection, Ground – Basic

If the following listed, device-internal functions are present in the device, these functions can influence the pickup values and tripping delays of the stages or block the stages. The stage can also be affected by an external source via a binary input signal.

- Automatic reclosing (AREC)
- Cold-load pickup detection
- Binary input signal

If the device is equipped with an **Inrush-current detection** function, the stages can be stabilized against tripping due to transformer-inrush currents (available in both function types).

6.5.3 General Functionality

6.5.3.1 Description

Measured-Value Selection

The function provides the option to select between the values *IN measured* or *3I0 calculated*.

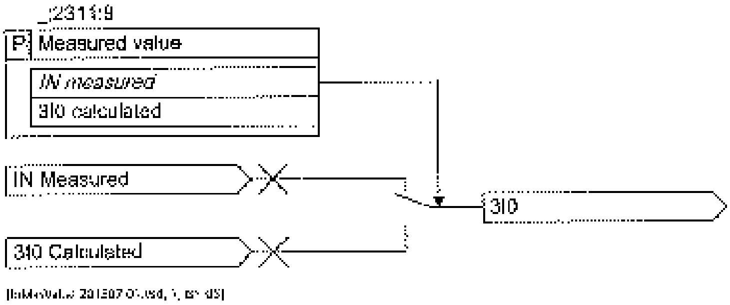


Figure 6-34 Logic Diagram of Measured-Value Selection

Both options are only available for the current-transformer connection types `3-phase + IN` and `3-phase + IN-separate`. For other connection types respectively, only one option is possible. If you select an option that is not allowed, an inconsistency message is given.

Depending on the CT secondary rated current, the CT connection type, and the selected setting, the secondary threshold setting range varies according to the following table.

Table 6-2 Threshold Setting Range

Connection Type	Measured Value	CT Terminal Type	Threshold Setting Range (rated I-sec.: ph = 1 A, IN = 1 A)	Threshold Setting Range (rated I-sec.: ph = 1 A, IN = 5 A)	Threshold Setting Range (rated I-sec.: ph = 5 A, IN = 1 A)	Threshold Setting Range (rated I-sec.: ph = 5 A, IN = 5 A)
3ph + IN	3I0 calculated	4 * Protection	0.030 A to 35.000 A	N/A	N/A	0.15 A to 175.00 A
		4 * Measurement	0.001 A to 1.600 A	N/A	N/A	0.005 A to 8.000 A
	IN measured	4 * Protection	0.030 A to 35.000 A	N/A	N/A	0.15 A to 175.00 A
		4 * Measurement	0.001 A to 1.600 A	N/A	N/A	0.005 A to 8.000 A
3ph + IN-seperate	3I0 calculated	4 * Protection	0.030 A to 35.000 A	0.030 A to 35.000 A	0.15 A to 175.00 A	0.15 A to 175.00 A
		3 * Protection, 1 * sen.	0.030 A to 35.000 A	0.030 A to 35.000 A	0.15 A to 175.00 A	0.15 A to 175.00 A
		4 * Measurement	0.001 A to 1.600 A	0.001 A to 1.600 A	0.005 A to 8.000 A	0.005 A to 8.000 A
	IN measured	4 * Protection	0.030 A to 35.000 A	0.15 A to 175.00 A	0.030 A to 35.000 A	0.15 A to 175.00 A
		3 * Protection, 1 * sen.	0.001 A to 1.600 A	0.005 A to 8.000 A	0.001 A to 1.600 A	0.005 A to 8.000 A
		4 * Measurement	0.001 A to 1.600 A	0.005 A to 8.000 A	0.001 A to 1.600 A	0.005 A to 8.000 A

6.5.3.2 Application and Setting Notes

Parameter: `Measured value`

- Recommended setting value `Measured value` = *IN Measured*

This parameter is not available in the basic function.

Parameter Value	Description

IN Measured	The function operates with the measured ground current IN. This is the recommended setting unless there is a specific reason to use the calculated zero-sequence current 3I0.
3I0 Calculated	The function operates with the calculated zero sequence current 3I0. This setting option can be used when applying a redundant 50N/51N function for safety reasons.

6.5.3.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
General				
_:2311:9	General:Measured value		• 3I0 calculated • IN measured	IN measured

6.5.4 Stage with Definite-Time Characteristic Curve

6.5.4.1 Description

Logic of the Basic Stage

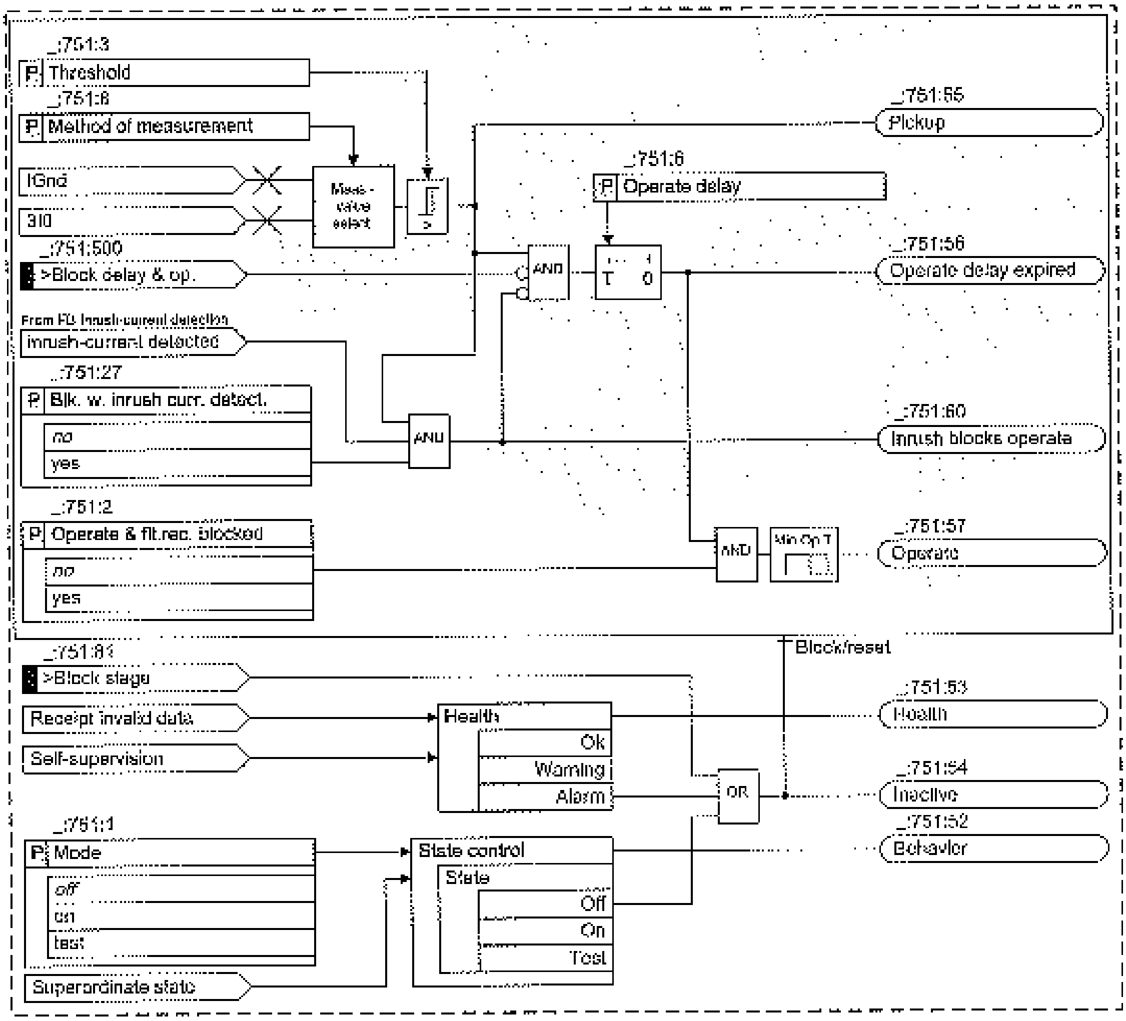


Figure 6-35 Logic Diagram of the Definite Time-Overcurrent Protection (Ground) – Basic

Logic of the Advanced Stage

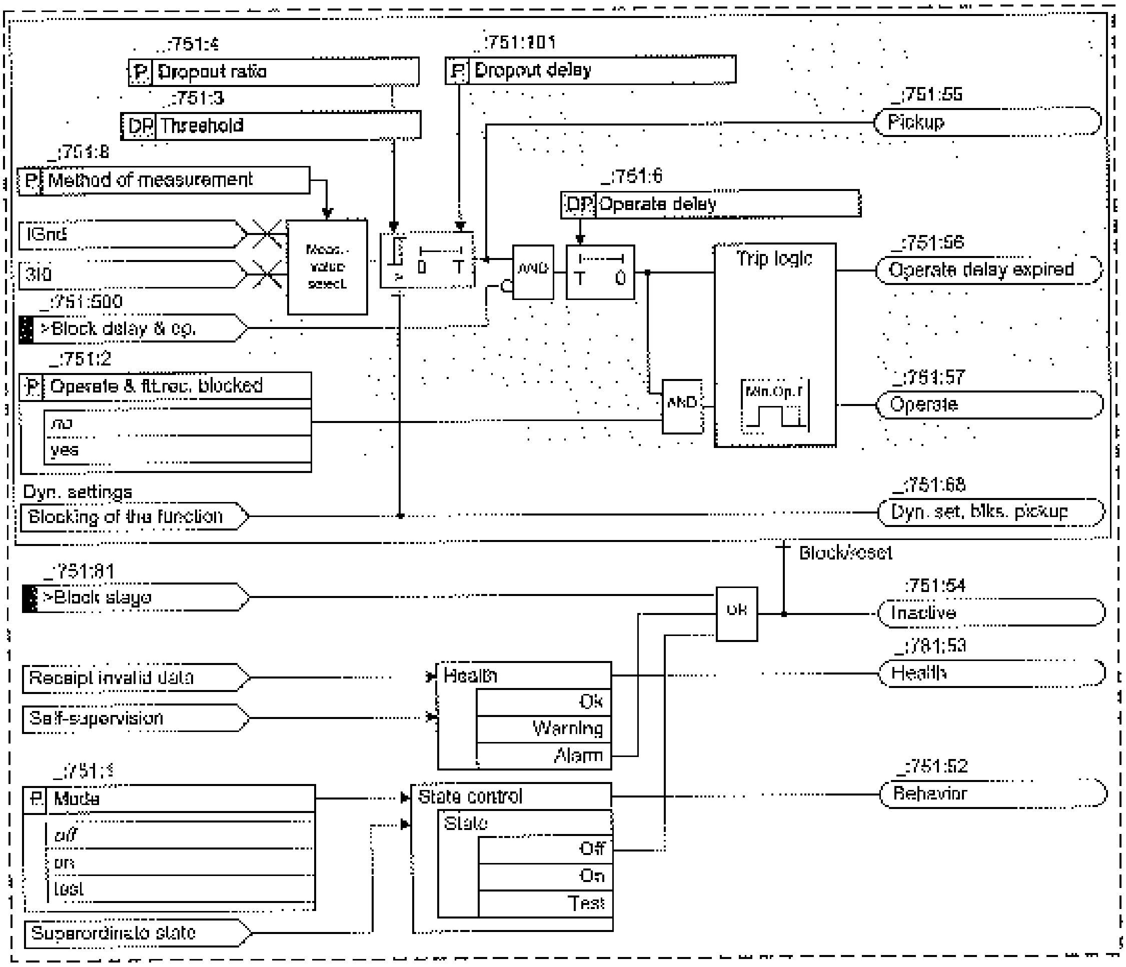


Figure 6-36 Logic Diagram of the Definite Time-Overcurrent Protection (Ground) – Advanced

Method of Measurement (Basic and Advanced Stage)

You use the **Method of measurement** parameter to define whether the stage uses the ***fundamental comp.*** or the calculated ***RMS value***.

- Measurement of the fundamental component:

  This method of measurement processes the sampled current values and filters out the fundamental component numerically.

- Measurement of the RMS value:

  This method of measurement determines the current amplitude from the sampled values according to the defining equation of the RMS value. Harmonics are included in the analysis.

Dropout Delay (Advanced Stage)

If the value falls below the dropout threshold, the pickup dropout can be delayed. The pickup is maintained for the specified time. The tripping delay continues to run. If the time delay expires while the pickup is still maintained, the stage operates.

Blocking of the Stage (Basic and Advanced Stage)

The following blockings reset the picked up stage completely:

- Via the binary input signal `>Block stage` from an external or internal source
- Via the functionality of the `dynamic settings` (see chapter **Influence of other functions via dynamic settings** and section *6.5.8.1 Description*).

Blocking of the Time Delay (Basic and Advanced Stage)

You can use the binary input signal `>Block delay & op.` to prevent the start of the time delay and thus also the operate signal. A running time delay is reset. The pickup is indicated and the fault logging and recording takes place.

Blocking of the Operate Delay and the Operate Signal via the Device-Internal Inrush-Current Detection Function (Basic and Advanced Stage)

Blocking of the operate delay and the operate signal via the device-internal **Inrush-current detection** function is described in chapter *6.5.7.1 Description*.

Influence of Other Functions via Dynamic Settings (Advanced Stage)

If available in the device, the following functions can influence the overcurrent-protection stages:

- Automatic reclosing
- Cold-load pickup detection
- Binary input signal

The influence of these functions via dynamic settings is described in chapter *6.5.8.1 Description* .

6.5.4.2 Application and Setting Notes

Parameter: `Method of measurement`

- Recommended setting value `(_:751:8) Method of measurement` = *`fundamental comp.`*

The `Method of measurement` parameter allows you to define whether the stage uses the *`fundamental comp.`* (standard method) or the calculated *`RMS value`*.

Parameter Value	Description
`fundamental comp.`	Select this method of measurement if harmonics or transient current peaks are to be suppressed. Siemens recommends using this method as the standard method.
`RMS value`	Select this method of measurement if you want the stage to take harmonics into account (for example, at capacitor banks). For this method of measurement, do not set the `threshold value` of the stage to less than 0.1 $I_{rated,sec}$.

Parameter: `Threshold`, `Operate delay`

- Default setting `(_:751:3) Threshold` = *1.20 A* (for the first stage)
- Default setting `(_:751:6) Operate delay` = *0.300 s* (for the first stage)

Set the `Threshold` and `Operate delay` parameters for the specific application.

The following details apply to a 2-stage characteristic curve (1st stage = definite time-overcurrent protection stage and 2nd stage = high-current stage).

1st stage (overcurrent stage):

The setting depends on the minimal occurring ground-fault current. This must be determined.

The `Operate delay` to be set is derived from the time-grading schedule that has been prepared for the system.

2nd stage (high-current stage):

This tripping stage can also be used for current grading. This applies in the case of very long lines with low source impedance or ahead of high reactances (for example, transformers, shunt reactors). Set the **Threshold** parameter to ensure that the stage does not pick up in case of a short-circuit at the end of the line.

Set the **Operate delay** parameter to *0* or to a low value.

Siemens recommends that the threshold values be determined with a system analysis. The following example illustrates the principle of grading with a current threshold on a long line.

EXAMPLE

High-current stage: 110-kV overhead line, 150 mm² cross-section

s (length) = 60 km

Z_L/s = 0.46 Ω/km

Ratio of zero-sequence impedance and positive-sequence impedance of the line: Z_{L0}/Z_{L1} = 4

Short-circuit power at the beginning of the line:

S_{sc}'' = 2.5 GVA

Ratio of zero-sequence impedance and positive-sequence impedance of the source impedance at the beginning of the line: Z_{P0}/Z_{P1} = 2

Current transformer = 600 A/5 A

Resulting in the following values for the line impedance Z_L and the source impedance Z_P:

$$Z_L = 0.46\ \Omega/\text{km} \cdot 60\text{km} = 27.6\ \Omega$$

[fo_OCP002_030311_1_en_US]

$$Z_P = \frac{110\ \text{kV}^2}{2500\ \text{MVA}} = 4.84\ \Omega$$

[fo_OCP001_030311_1_en_US]

The 1-pole short-circuit current at the end of the line is $I_{scG\ end}$:

$$I_{sc\ gnd\ end} = \frac{1.1 \cdot V_N \cdot 3}{\sqrt{3} \cdot \left[Z_P \cdot \left(2 + \frac{Z_{P0}}{Z_{P1}}\right) + Z_1 \cdot \left(2 + \frac{Z_{L0}}{Z_{L1}}\right)\right]} = \frac{1.1 \cdot 110\text{kV} \cdot 3}{\sqrt{3} \cdot [4.84\ \Omega \cdot (2 + 2) + 27.6\ \Omega \cdot (2 + 4)]} = 1133\ \text{A}$$

[fo_ocp005_030311_1_en_US]

The settings in primary and secondary values result in the following setting values which include a safety margin of 10 %:

Threshold value 2nd stage (primary) = 1.1 · 1133 A = 1246.3 A

Threshold value 2nd stage (secondary) $= 1.1 \cdot \frac{1133\ \text{A}}{600\ \text{A}} \cdot 5\ \text{A} = 10.39\ \text{A}$

[fo_ocp004_030311_01.tif_3_en_US]

In case of short-circuit currents exceeding 1246 A (primary) or 10.39 A (secondary) there is a short-circuit on the line to be protected. The overcurrent protection can cut off this short circuit immediately.

Note: The amounts in the calculation example are accurate enough for overhead lines. If the source impedance, line impedance and zero-sequence impedance have very different angles, you have use complex numbers to calculate the **Threshold**.

Parameter: `Dropout delay`

- Recommended setting value (_:751:101) `Dropout delay` = *0*

This parameter is not visible in the basic stage.

Siemens recommends to use the default setting *0* since the dropout of a protection stage must be done as fast as possible.

You can use the `Dropout delay` parameter ≠ *0* to obtain a uniform dropout behavior if you use it together with an electromechanical relay. This is required for time grading. The dropout time of the electromechanical relay must be known for this purpose. Subtract the dropout time of your own device (see Technical Data) and set the result.

Parameter: `Dropout ratio`

- Recommended setting value (_:751:4) `Dropout ratio` = *0.95*

This parameter is not visible in the basic stage.

The recommended set value of *0.95* is appropriate for most applications.

To achieve high-precision measurements, the setting value of the parameter `Dropout ratio` can be reduced, for example, to *0.98*. If you expect highly fluctuating measurands at the response threshold, you can increase the setting value of the parameter `Dropout ratio`. This avoids chattering of the tripping stage.

6.5.4.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
General				
_:751:1	Definite-T 1:Mode		• off • on • test	off
_:751:2	Definite-T 1:Operate & flt.rec. blocked		• no • yes	no
_:751:26	Definite-T 1:Dynamic settings		• no • yes	no
_:751:27	Definite-T 1:Blk. w. inrush curr. detect.		• no • yes	no
_:751:8	Definite-T 1:Method of measurement		• fundamental comp. • RMS value	fundamental comp.
_:751:3	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:751:4	Definite-T 1:Dropout ratio		0.90 to 0.99	0.95
_:751:101	Definite-T 1:Dropout delay		0.00 s to 60.00 s	0.00 s
_:751:6	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
Dyn.s: AR off/n.rdy				
_:751:28	Definite-T 1:Effect. by AR off/n.ready		• no • yes	no
_:751:35	Definite-T 1:Stage blocked		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
`Dyn.set: AR cycle 1`				
_:751:29	Definite-T 1:Effected by AR cycle 1		• no • yes	no
_:751:36	Definite-T 1:Stage blocked		• no • yes	no
_:751:14	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:751:20	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
`Dyn.set: AR cycle 2`				
_:751:30	Definite-T 1:Effected by AR cycle 2		• no • yes	no
_:751:37	Definite-T 1:Stage blocked		• no • yes	no
_:751:15	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:751:21	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
`Dyn.set: AR cycle 3`				
_:751:31	Definite-T 1:Effected by AR cycle 3		• no • yes	no
_:751:38	Definite-T 1:Stage blocked		• no • yes	no
_:751:16	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:751:22	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
`Dyn.s: AR cycle>3`				
_:751:32	Definite-T 1:Effected by AR cycle gr. 3		• no • yes	no
_:751:39	Definite-T 1:Stage blocked		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
_:751:17	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:751:23	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
Dyn.s: Cold load PU				
_:751:33	Definite-T 1:Effect. b. cold-load pickup		• no • yes	no
_:751:40	Definite-T 1:Stage blocked		• no • yes	no
_:751:18	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:751:24	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s
Dyn.set: bin.input				
_:751:34	Definite-T 1:Effected by binary input		• no • yes	no
_:751:41	Definite-T 1:Stage blocked		• no • yes	no
_:751:19	Definite-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:751:25	Definite-T 1:Operate delay		0.00 s to 60.00 s	0.30 s

6.5.4.4 Information List

No.	Information	Data Class (Type)	Type
Group indicat.			
_:4501:55	Group indicat.:Pickup	ACD	O
_:4501:57	Group indicat.:Operate	ACT	O
Definite-T 1			
_:751:81	Definite-T 1:>Block stage	SPS	I
_:751:84	Definite-T 1:>Activ. dyn. settings	SPS	I
_:751:500	Definite-T 1:>Block delay & op.	SPS	I
_:751:54	Definite-T 1:Inactive	SPS	O
_:751:52	Definite-T 1:Behavior	ENS	O
_:751:53	Definite-T 1:Health	ENS	O

No.	Information	Data Class (Type)	Type
_:751:60	Definite-T 1:Inrush blocks operate	ACT	O
_:751:55	Definite-T 1:Pickup	ACD	O
_:751:56	Definite-T 1:Operate delay expired	ACT	O
_:751:57	Definite-T 1:Operate	ACT	O

6.5.5 Stage with Inverse-Time Characteristic Curve

6.5.5.1 Description

Logic of the Basic Stage

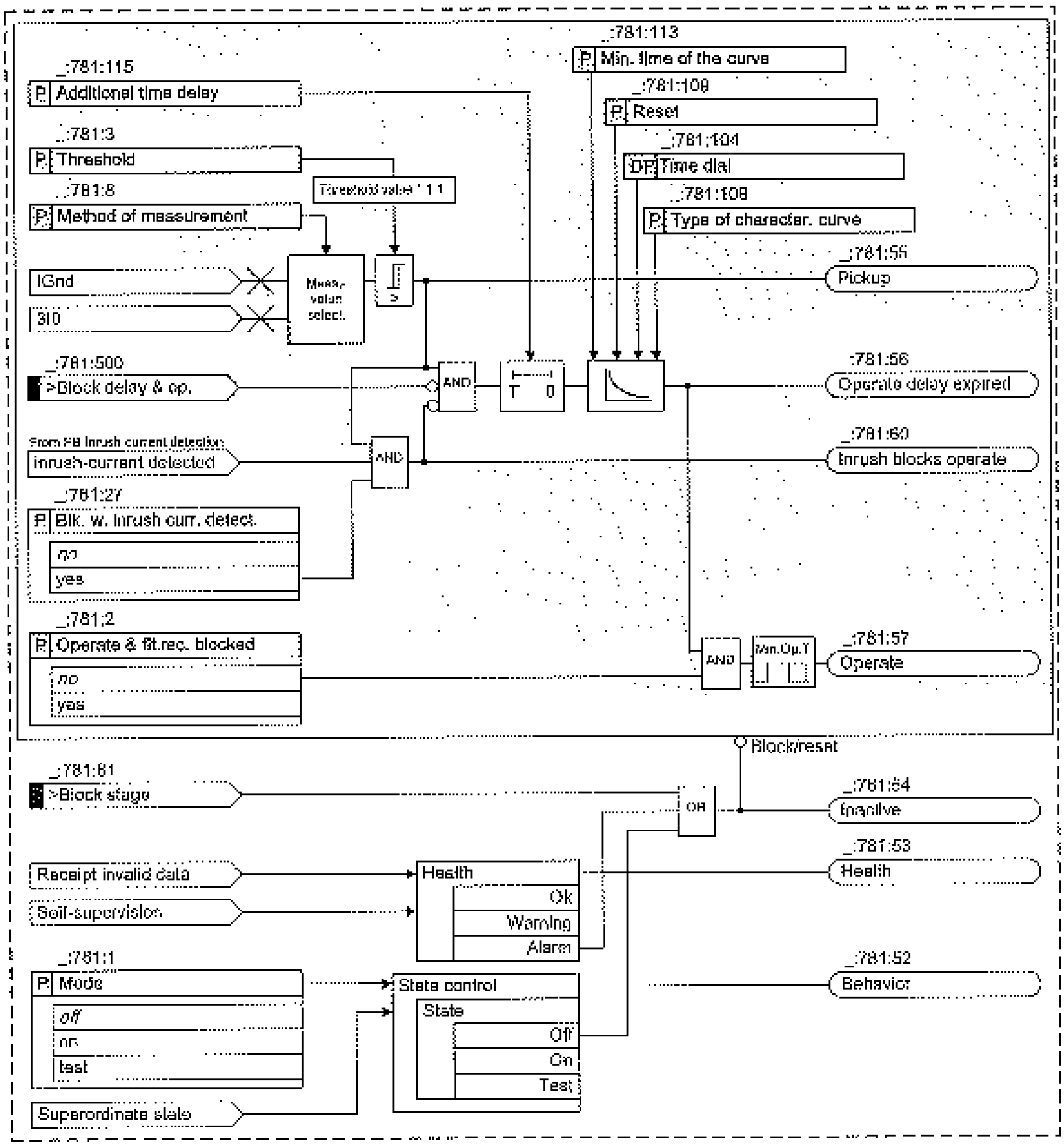


Figure 6-37 Logic Diagram of the Inverse Time-Overcurrent Protection (Ground) – Basic

Logic of the Advanced Stage

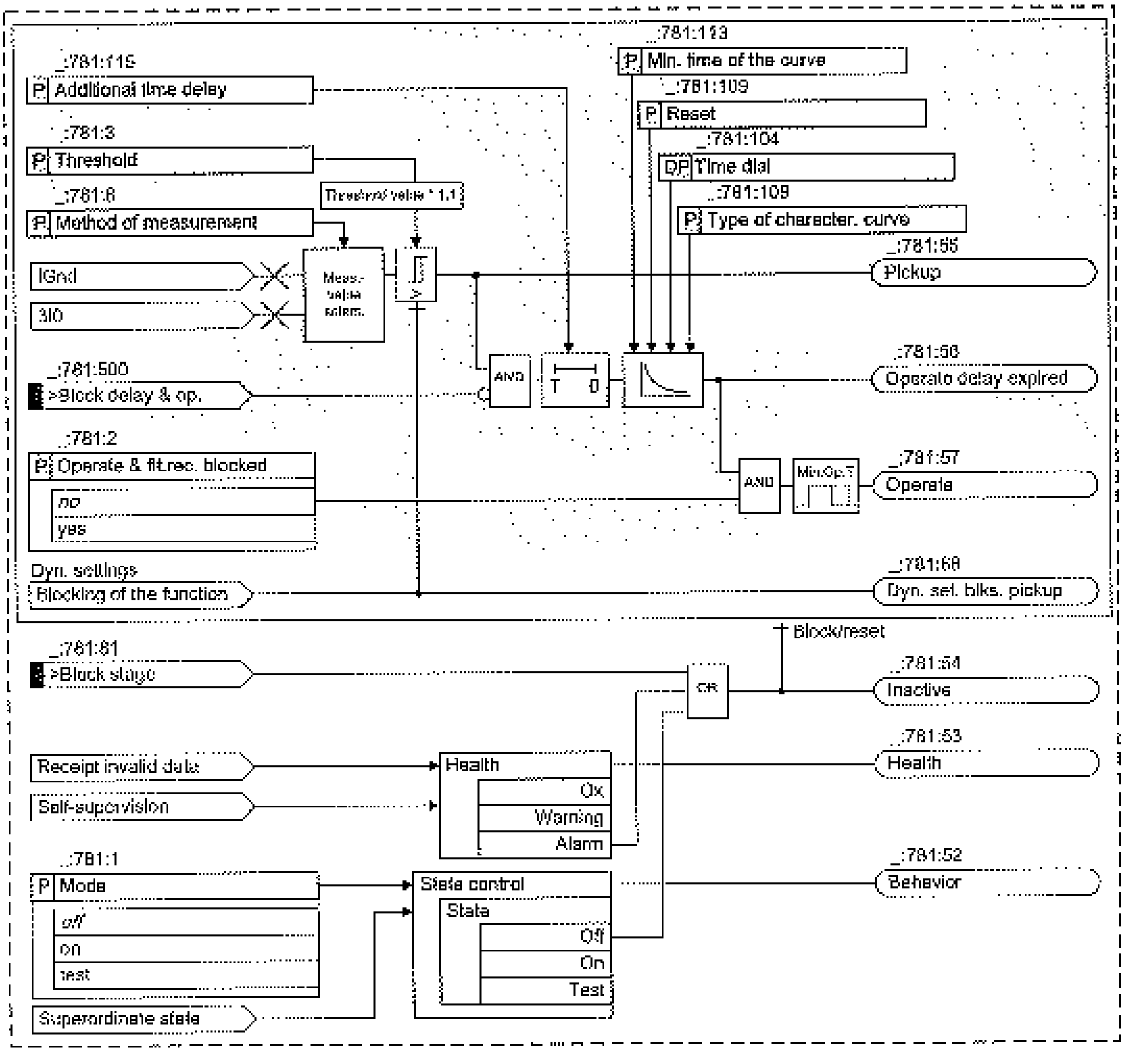


Figure 6-38 Logic Diagram of the Inverse Time-Overcurrent Protection (Ground) – Advanced

Pickup and Dropout Behavior of the Inverse-Time Characteristic Curve according to IEC and ANSI (Basic and Advanced Stage)

When the input variable exceeds the threshold value by a factor of 1.1, the inverse-time characteristic curve is processed. An integrating method of measurement totalizes the weighted time. The weighted time results from the characteristic curve. For this, the time that is associated with the present current value is determined from the characteristic curve. Once the weighted time exceeds the value 1, the stage operates.

When the measured value falls short of the pickup value by a factor of 1.045 (0.95 x 1.1 x threshold value), the dropout is started. The pickup will be indicated as clearing. You can influence the dropout behavior via setting parameters. You can select between instantaneous dropout (totalized time is deleted) or dropout according to the characteristic curve (reduction of totalized time depending on the characteristic curve). The dropout according to characteristic curve (disk emulation) is the same as turning back a rotor disk. The weighted reduction of the time is initiated from 0.9 of the set threshold value.

The characteristic curve and associated formulas are shown in the Technical Data.

Minimum Time of the Curve (Advanced Stage)

With the parameter `Min. time of the curve`, you define the minimum operate delay time. The operate delay time of inverse-time characteristic curve never falls below the minimum operate delay time.

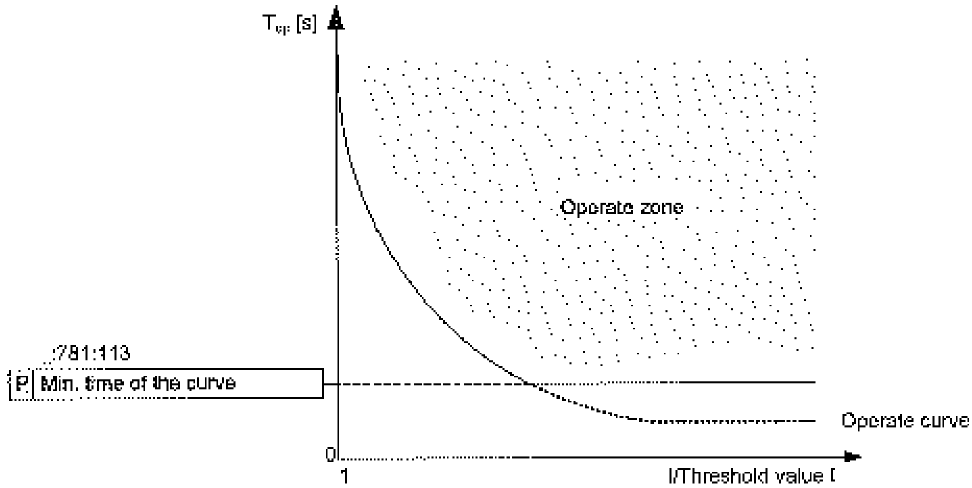


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Figure 6-39 Minimum Operating Time of the Curve

Additional Time Delay (Advanced Stage)

With the parameter `Additional time delay`, you define a definite-time delay in addition to the inverse-time delay. With this setting, the whole curve is shifted on the time axis by this additional definite time.

Method of Measurement (Basic and Advanced Stage)

You use the `Method of measurement` parameter to define whether the stage uses the `fundamental comp.` or the calculated `RMS value`.

- Measurement of the fundamental component:
  This method of measurement processes the sampled current values and filters out the fundamental component numerically.
- Measurement of the RMS value:
  This method of measurement determines the current amplitude from the sampled values according to the defining equation of the RMS value. Harmonics are included in the analysis.

Blocking of the Stage (Basic and Advanced Stage)

The following blockings reset the picked up stage completely:

- Via the binary input signal `>Block stage` from an external or internal source
- Via the functionality of the `dynamic settings` (see subtitle **Influence of other functions via dynamic settings** and chapter *6.5.8.1 Description*).

Blocking of the Time Delay (Basic and Advanced Stage)

You can use the binary input signal `>Block delay & op.` to prevent the start of the time delay and thus also the operate signal. A running time delay is reset. The pickup is indicated and the fault logging and recording takes place.

Blocking of the Operate Delay and the Operate Signal via the Device-Internal Inrush-Current Detection Function (Basic and Advanced Stage)

Blocking of the operate delay and the operate signal via the device-internal **Inrush-current detection** function is described in chapter *6.5.7.1 Description*.

Influence of Other Functions via Dynamic Settings (Advanced Stage)

If available in the device, the following functions can influence the overcurrent-protection stages:

- Automatic reclosing
- Cold-load pickup detection
- Binary input signal

The influence of these functions via dynamic settings is described in chapter *6.5.8.1 Description* .

Influence of Other Functions via Dynamic Settings (Advanced Stage)

If available in the device, the following functions can influence the overcurrent-protection stages:

- Automatic reclosing
- Binary input signal

The influence of these functions via dynamic settings is described in chapter *6.5.8.1 Description* .

6.5.5.2 Application and Setting Notes

Parameter: `Method of measurement`

- Recommended setting value (_:781:8) `Method of measurement` = ***fundamental comp.***

You use the `Method of measurement` parameter to define whether the stage uses the ***fundamental comp.*** (standard method) or the calculated ***RMS value***.

Parameter Value	Description
fundamental comp.	Select this method of measurement if harmonics or transient current peaks are to be suppressed. Siemens recommends using this method as the standard method.
RMS value	Select this method of measurement if you want the stage to take harmonics into account (for example, at capacitor banks). For this method of measurement, do not set the `threshold value` of the stage to less than 0.1 $I_{rated,sec}$

Parameter: Type of character. curve

- Default setting (_:781:108) `Type of character. curve` = ***IEC normal inverse***

The device offers all the usual inverse-time characteristic curves according to IEC and ANSI. Select the `Type of character. curve` required for your specific application. For more information about the parameter `Type of character. curve`, refer to chapter *12.7.2 Stage with Inverse-Time Characteristic Curve*.

Parameter: `Min. time of the curve`

- Default setting (_:781:113) `Min. time of the curve` = ***0.00 s***

This parameter is only available in the advanced stage.

With the parameter `Min. time of the curve`, you define a minimum operate delay time. The operate delay time of inverse-time characteristic curve never falls below the minimum operate delay time. If the setting is left on its default value of 0 s, this parameter has no effect on the inverse-time characteristic curve.

This parameter is only required for time coordination in recloser schemes. For all other applications, Siemens recommends keeping the default setting of 0 s.

NOTE

If the set value is smaller than the smallest possible time delay of the inverse-time characteristic curve, the parameter has no influence on the delay time.

Parameter: `Additional time delay`

- Recommended setting value (_:781:115) `Additional time delay` = *0.00 s*

With the parameter `Additional time delay`, you define a definite-time delay in addition to the inverse-time delay.
If the setting is left on its default value of 0 s, this parameter has no effect on the inverse-time characteristic curve.
This parameter is only required for time coordination in recloser schemes. For all other applications, Siemens recommend keeping the default setting of 0 s.

Parameter: `Threshold`

- Default setting (_:781:3) `Threshold` = *1.20 A*

The setting depends on the minimal occurring ground-fault current. This must be determined.

Parameter: `Time dial`

- Default setting (_:781:101) `Time dial` = *1*

Use the `Time dial` parameter to displace the characteristic curve in the time direction.
The set value for the `Time dial` parameter is derived from the time-grading chart that has been prepared for the electrical power system.
Where no time grading and therefore no displacement of the characteristic curve is required, leave the `Time dial` parameter at *1*.

Parameter: `Reset`

- Default setting (_:781:109) `Reset` = *disk emulation*

You use the `Reset` parameter to define whether the stage drops out according to the dropout characteristic curve (in accordance with the behavior of a disk emulation – rotor disk) or instantaneously.

Parameter Value	Description
disk emulation	Select this setting if the device is coordinated with electromechanical devices or other devices which perform a dropout after a disk emulation.
instantaneous	Use this setting if the dropout is not to be performed after disk emulation and an instantaneous dropout is desired instead.

6.5.5.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
General				
_:781:1	Inverse-T 1:Mode		• off • on • test	off
_:781:2	Inverse-T 1:Operate & flt.rec. blocked		• no • yes	no
_:781:26	Inverse-T 1:Dynamic settings		• no • yes	no
_:781:27	Inverse-T 1:Blk. w. inrush curr. detect.		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
_:781:8	Inverse-T 1:Method of measurement		• fundamental comp. • RMS value	fundamental comp.
_:781:3	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:781:108	Inverse-T 1:Type of charact. curve			
_:781:113	Inverse-T 1:Min. time of the curve		0.00 s to 1.00 s	0.00 s
_:781:109	Inverse-T 1:Reset		• instantaneous • disk emulation	disk emulation
_:781:101	Inverse-T 1:Time dial		0.00 to 15.00	1.00
_:781:115	Inverse-T 1:Additional time delay		0.00 s to 60.00 s	0.00 s
Dyn.s: AR off/n.rdy				
_:781:28	Inverse-T 1:Effect. by AR off/n.ready		• no • yes	no
_:781:35	Inverse-T 1:Stage blocked		• no • yes	no
Dyn.set: AR cycle 1				
_:781:29	Inverse-T 1:Effected by AR cycle 1		• no • yes	no
_:781:36	Inverse-T 1:Stage blocked		• no • yes	no
_:781:14	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:781:102	Inverse-T 1:Time dial		0.00 to 15.00	1.00
Dyn.set: AR cycle 2				
_:781:30	Inverse-T 1:Effected by AR cycle 2		• no • yes	no
_:781:37	Inverse-T 1:Stage blocked		• no • yes	no
_:781:15	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:781:103	Inverse-T 1:Time dial		0.00 to 15.00	1.00
Dyn.set: AR cycle 3				
_:781:31	Inverse-T 1:Effected by AR cycle 3		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
_:781:38	Inverse-T 1:Stage blocked		• no • yes	no
_:781:16	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:781:104	Inverse-T 1:Time dial		0.00 to 15.00	1.00
Dyn.s: AR cycle>3				
_:781:32	Inverse-T 1:Effected by AR cycle gr. 3		• no • yes	no
_:781:39	Inverse-T 1:Stage blocked		• no • yes	no
_:781:17	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:781:105	Inverse-T 1:Time dial		0.00 to 15.00	1.00
Dyn.s: Cold load PU				
_:781:33	Inverse-T 1:Effect. b. cold-load pickup		• no • yes	no
_:781:40	Inverse-T 1:Stage blocked		• no • yes	no
_:781:18	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:781:106	Inverse-T 1:Time dial		0.00 to 15.00	1.00
Dyn.set: bin.input				
_:781:34	Inverse-T 1:Effected by binary input		• no • yes	no
_:781:41	Inverse-T 1:Stage blocked		• no • yes	no
_:781:19	Inverse-T 1:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:781:107	Inverse-T 1:Time dial		0.00 to 15.00	1.00

6.5.5.4 Information List

No.	Information	Data Class (Type)	Type
Group indicat.			
_:4501:55	Group indicat.:Pickup	ACD	O
_:4501:57	Group indicat.:Operate	ACT	O
Inverse-T 1			
_:781:81	Inverse-T 1:>Block stage	SPS	I
_:781:500	Inverse-T 1:>Block delay & op.	SPS	I
_:781:54	Inverse-T 1:Inactive	SPS	O
_:781:52	Inverse-T 1:Behavior	ENS	O
_:781:53	Inverse-T 1:Health	ENS	O
_:781:60	Inverse-T 1:Inrush blocks operate	ACT	O
_:781:59	Inverse-T 1:Disk emulation running	SPS	O
_:781:55	Inverse-T 1:Pickup	ACD	O
_:781:56	Inverse-T 1:Operate delay expired	ACT	O
_:781:57	Inverse-T 1:Operate	ACT	O

6.5.6 Stage with User-Defined Characteristic Curve

6.5.6.1 Description

This stage is only available in the advanced function type.

This stage is structured the same way as the **Inverse time-overcurrent protection – advanced** stage (see chapter 6.5.5.1 Description). The only difference is that you can define the characteristic curve as desired.

User-Defined Characteristic Curve

With the user-defined characteristic curve, you can define the operate curve point by point using up to 30 value pairs of current and time. The device uses linear interpolation to calculate the characteristic curve from these values. You can also define a dropout characteristic curve if you wish.

Pickup and Dropout Behavior with the User-Defined Characteristic Curve

When the input variable exceeds the threshold value by 1.1 times, the characteristic curve is processed.

An integrating method of measurement totalizes the weighted time. The weighted time results from the characteristic curve. For this, the time that is associated with the present current value is determined from the characteristic curve. Once the weighted time exceeds the value 1, the stage operates.

When the measured value falls short of the pickup value by a factor of 1.045 (0.95 x 1.1 x threshold value), the dropout is started. You can influence the dropout behavior via setting parameters. You can select between instantaneous dropout (totalized time is deleted) or dropout according to the characteristic curve (reduction of totalized time depending on the characteristic curve). The dropout according to characteristic curve (disk emulation) is the same as turning back a rotor disk. The weighted reduction of the time is initiated from 0.9 of the set threshold value.

The following figure shows the pickup and dropout behavior when a user-defined characteristic curve is used.

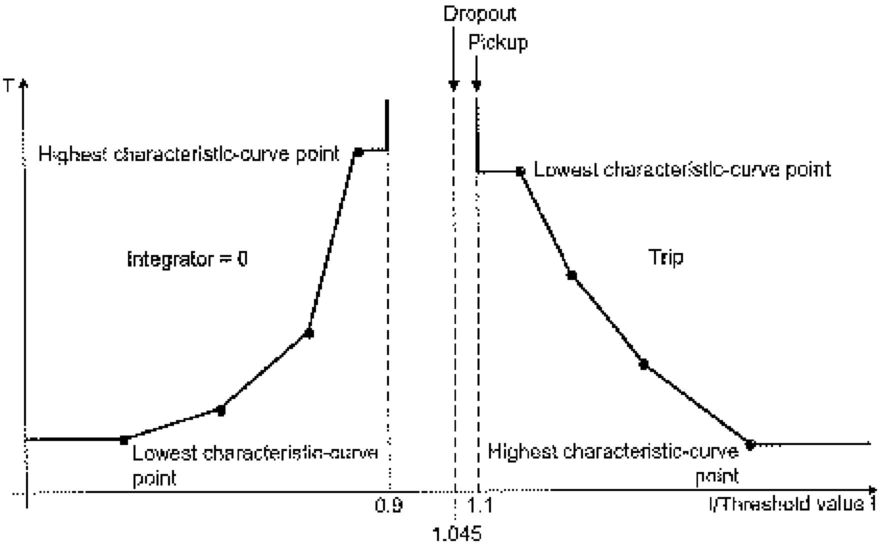

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Figure 6-40 Pickup Behavior and Dropout Behavior when Using a User-Defined Characteristic Curve

> **NOTE**
>
> Note that the currents that are lower than the current value of the smallest characteristic-curve point do not extend the operate time. The pickup characteristic runs in parallel to the current axis up to the smallest characteristic-curve point. Currents that are larger than the current value of the largest characteristic-curve point do not reduce the operate time. The pickup characteristic runs in parallel to the current axis from the largest characteristic-curve point.

6.5.6.2 Application and Setting Notes

This stage is structured the same way as the **Inverse time-overcurrent protection – advanced** stage. The only difference is that the user can define the characteristic curve as desired. This chapter only provides application and setting notes for setting characteristic curves. For guidance on the other parameters of the stage, see chapter *6.5.5.7 Application and Setting Notes* .

Parameter: `Current/time value pairs` (from the operate curve)

Use these settings to define the characteristic curve. Set a current/time value pair for each characteristic-curve point. The setting depends on the characteristic curve you want to realize.

Set the current value as a multiple of the threshold value. Siemens recommends that you set the **`Threshold`** parameter to *1.00* in order to obtain a simple relation. You can change the threshold value setting afterwards if you want to displace the characteristic curve.

Set the time value in seconds. The characteristic curve is displaced using the **`Time dial`** parameter.

> **NOTE**
>
> The value pairs must be entered in continuous order.

Parameter: `Time dial`

- Default setting (_:101) **`Time dial`** = 1

Use the **`Time dial`** parameter to displace the characteristic curve in the time direction.

The set value for the **Time dial** parameter is derived from the time-grading chart that has been prepared for the electrical power system. Where no time grading and therefore no displacement of the characteristic curve is required, leave the parameter **Time dial** at *1* (default setting).

Parameter: **Reset**

- Default setting (_:110) **Reset** = ***disk emulation***

You use the **Reset** parameter to define whether the stage drops out according to the dropout characteristic curve (in accordance with the behavior of a disk emulation = rotor disk) or instantaneously.

Parameter Value	Description
disk emulation	In the case of this setting, a dropout characteristic curve has to be set in addition to the operate curve. Select this setting if the device is coordinated with electromechanical devices or other devices which perform a dropout after a disk emulation.
instantaneous	Use this setting if the dropout is not to be performed after disk emulation and an instantaneous dropout is desired instead.

Parameter: **Current/time value pairs** (of the dropout characteristic curve)

Use these settings to define the characteristic curve. Set a current/time value pair for each characteristic-curve point. The setting depends on the characteristic curve you want to realize.

Set the current value as a multiple of the threshold value. Siemens recommends that you set the **Threshold** parameter to *1.00* in order to obtain a simple relation. You can change the threshold value setting afterwards if you want to displace the characteristic curve.

Set the time value in seconds. The characteristic curve is displaced using the **Time dial** parameter.

NOTE

The value pairs must be entered in continuous order.

6.5.6.3 Settings

Addr.	Parameter	C	Setting Options	Default Setting
General				
_:1	User curve #:Mode		• off • on • test	off
_:2	User curve #:Operate & flt.rec. blocked		• no • yes	no
_:26	User curve #:Dynamic settings		• no • yes	no
_:27	User curve #:Blk. w. inrush curr. detect.		• no • yes	no
_:8	User curve #:Method of measurement		• fundamental comp. • RMS value	fundamental comp.
_:3	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:110	User curve #:Reset		• instantaneous • disk emulation	disk emulation

Addr.	Parameter	C	Setting Options	Default Setting
_:101	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.s: AR off/n.rdy				
_:28	User curve #:Effect. by AR off/n.ready		• no • yes	no
_:35	User curve #:Stage blocked		• no • yes	no
Dyn.set: AR cycle 1				
_:29	User curve #:Effected by AR cycle 1		• no • yes	no
_:36	User curve #:Stage blocked		• no • yes	no
_:14	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:102	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.set: AR cycle 2				
_:30	User curve #:Effected by AR cycle 2		• no • yes	no
_:37	User curve #:Stage blocked		• no • yes	no
_:15	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:103	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.set: AR cycle 3				
_:31	User curve #:Effected by AR cycle 3		• no • yes	no
_:38	User curve #:Stage blocked		• no • yes	no
_:16	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:104	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.s: AR cycle>3				
_:32	User curve #:Effected by AR cycle gr. 3		• no • yes	no
_:39	User curve #:Stage blocked		• no • yes	no

Addr.	Parameter	C	Setting Options	Default Setting
_:17	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:105	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.s: Cold load PU				
_:33	User curve #:Effect. b. cold-load pickup		• no • yes	no
_:40	User curve #:Stage blocked		• no • yes	no
_:18	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:106	User curve #:Time dial		0.05 to 15.00	1.00
Dyn.set: bin.input				
_:34	User curve #:Effected by binary input		• no • yes	no
_:41	User curve #:Stage blocked		• no • yes	no
_:19	User curve #:Threshold	1 A @ 100 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 100 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 50 Irated	0.030 A to 35.000 A	1.200 A
		5 A @ 50 Irated	0.15 A to 175.00 A	6.00 A
		1 A @ 1.6 Irated	0.001 A to 1.600 A	1.200 A
		5 A @ 1.6 Irated	0.005 A to 8.000 A	6.000 A
_:107	User curve #:Time dial		0.05 to 15.00	1.00

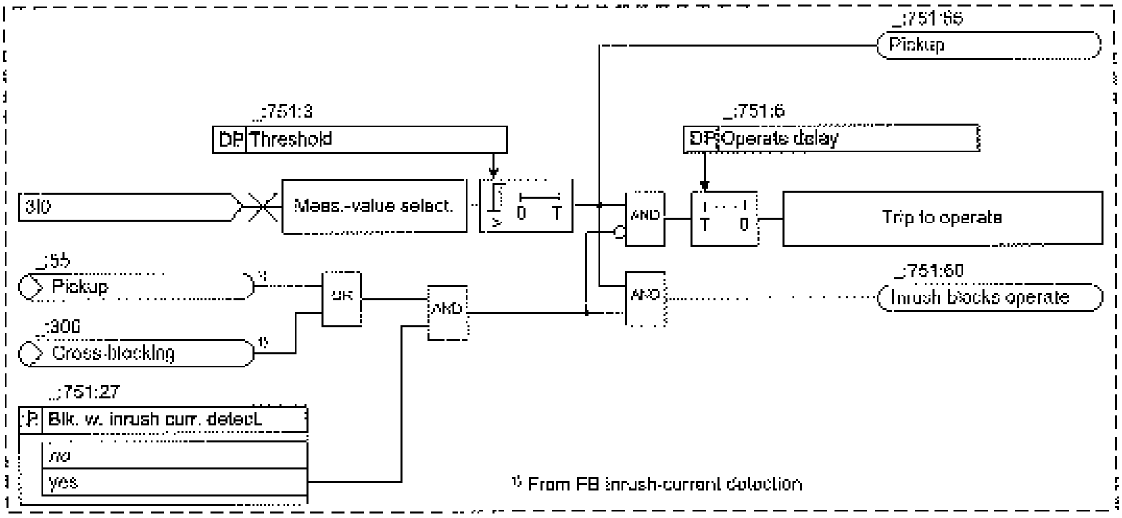
6.5.6.4 Information List

No.	Information	Data Class (Type)	Type
User curve #			
_:81	User curve #:>Block stage	SPS	I
_:500	User curve #:>Block delay & op.	SPS	I
_:54	User curve #:Inactive	SPS	O
_:52	User curve #:Behavior	ENS	O
_:53	User curve #:Health	ENS	O
_:60	User curve #:Inrush blocks operate	ACT	O
_:59	User curve #:Disk emulation running	SPS	O
_:55	User curve #:Pickup	ACD	O
_:56	User curve #:Operate delay expired	ACT	O
_:57	User curve #:Operate	ACT	O

6.5.7 Blocking of the Tripping by Device-Internal Inrush-Current Detection

6.5.7.1 Description

With the `Blk. w. inrush curr. detect.` parameter, you can define whether tripping of the stage should be blocked when a threshold value is exceeded due to an inrush current. In case of a blocking, the stage picks up. The start of the tripping delay and the trip signal are blocked. The function signals this through a corresponding indication. If the blocking drops out and the threshold value of the stage is still exceeded, the time delay is started. After that time, the stage operates. The following figure only shows the part of the stage (exemplified by definite time-overcurrent protection stage 1) that illustrates the influence of the inrush-current detection. Only if the central function **Inrush-current detection** (see section *12.10 Inrush-Current Detection*) is in effect can the blocking be set.



[loscdgre-210812-01.tif, 1, en_US]

Figure 6-41 Part-Logic Diagram on the Influence of Inrush-Current Detection Exemplified by the 1st Definite Time-Overcurrent Protection Stage

6.5.7.2 Application and Setting Notes

Parameter: `Blk. w. inrush curr. detect.`

- Default setting (`_:751:27`) `Blk. w. inrush curr. detect.` = *no*

Parameter Value	Description
no	The transformer inrush current detection does not affect the stage. Select this setting in the following cases: • In cases where the device is not used on transformers. • In cases where the device is used on transformers and the threshold value of the stage is set above the maximum inrush current of the transformer. This, for example, applies to the high-current stage that is set such according to the short-circuit voltage V_{sc} of the transformer that it only picks up on faults from the high-voltage side. The transformer-inrush current cannot become larger than the maximum transmittable short-circuit current.

Parameter Value	Description
yes	When the transformer inrush current detection detects an inrush current that would lead to a tripping of the stage, the start of the time delay and tripping of the stage are blocked. Select this setting if the device is used on transformers and the threshold value of the stage is set below the maximum inrush current of the transformer. This applies to the overcurrent-protection stage, which is used as a backup stage with grading time for faults on the undervoltage side of the transformer.

6.5.8 Influence of Other Functions via Dynamic Settings

6.5.8.1 Description

The **Threshold** and **Operate delay** settings used for tripping are so called **dynamic settings**. Depending on other functions, the settings of these parameters can be changed dynamically. Depending on other functions, the stage can also be blocked dynamically. This functionality is only available in function type Advanced.

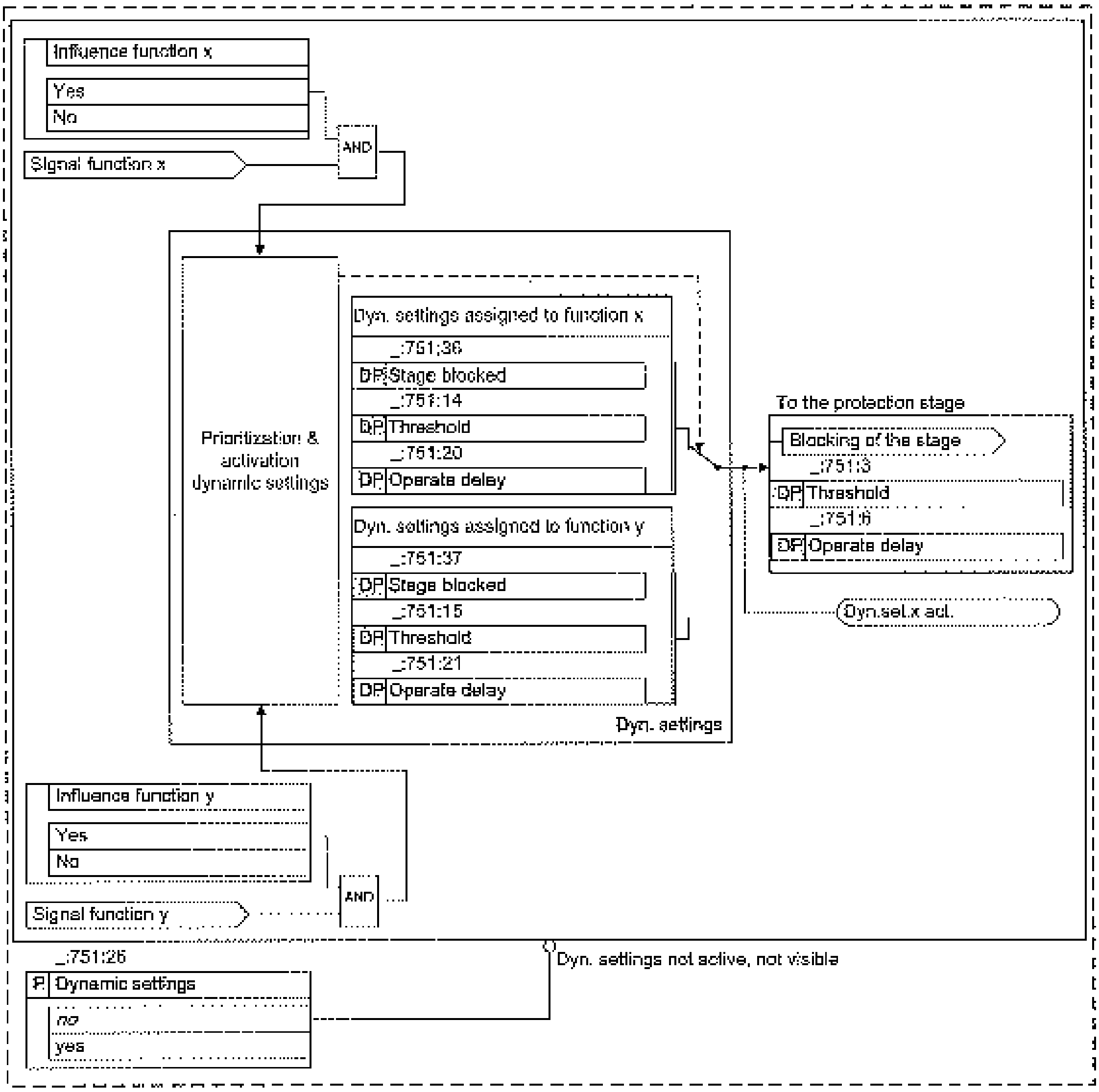


Figure 6-42 Principle of the Dynamic Settings in the Example of 1st Definite Time-Overcurrent Protection Stage

If available in the device, the following functionalities can affect the overcurrent-protection stages:

Functionalities	Priority
Automatic reclosing (AREC)	Priority 1
Cold-load pickup detection	Priority 2
Binary input signal	Priority 3

These functionalities generate signals that change the settings of the dynamic settings of the overcurrent-protection stage or block it, if required. In the latter case, the settings for the `Threshold` and the `Operate delay` are of no relevance. Within the overcurrent-protection stage, each of these signals is provided with a configuration parameter `Influence of function ...` and its own dynamic settings (`Operate delay` and `Threshold`). The configuration settings are used to set whether the signal shall be active or not, this means whether the dynamic settings shall be activated or not. If one of these signals (for example, signal function x) becomes active and is to take effect, these parameter settings become dynamic, that is, instantly active. This means that the setting assigned to the signal replaces the standard setting. If the signal becomes inactive, the standard settings apply again. The activation of the dynamic settings is reported.

Where several signals are active in parallel, the priority specified above shall apply. This means that a signal with priority 2 precedes that of priority 3. The settings assigned to signal 2 become active.

The functionality of the dynamic settings can be disabled. In this case, the settings assigned to the signals are not visible and are without effect.

Link to the Device-Internal Function *Automatic Reclosing (Advanced Stage)*

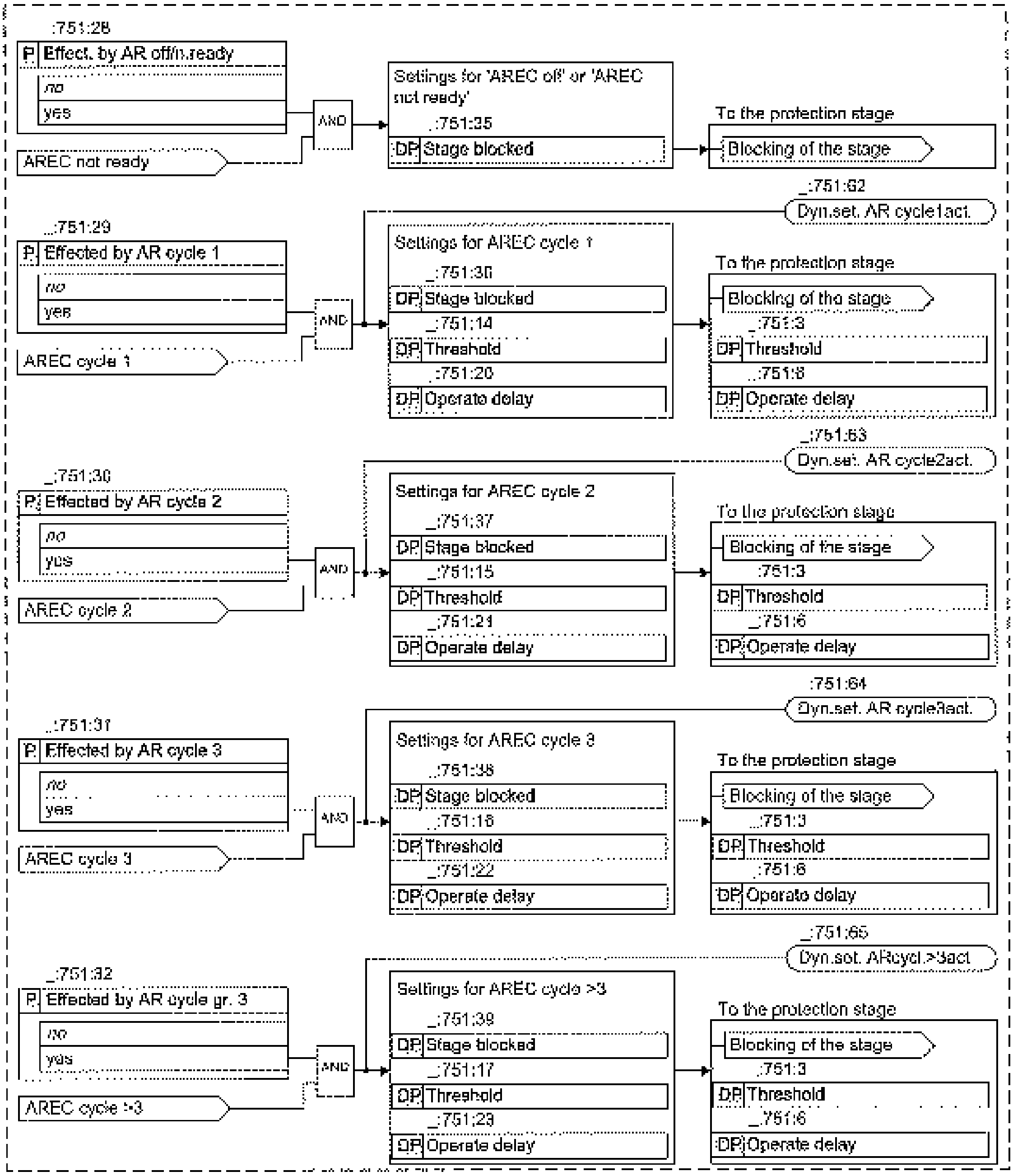


Figure 6-43 Influence of the AREC Signals on the Overcurrent-Protection Stage

Several AREC signals can affect the setting for the **Threshold** and the **Operate delay** of the protection stage and its blocking.

- AREC is ready for reclosing 1 (= Automatic reclosing cycle 1)
- AREC is ready for reclosing 2 (= Automatic reclosing cycle 2)
- AREC is ready for reclosing 3 (= Automatic reclosing cycle 3)
- AREC is ready for reclosing 4 (= Automatic reclosing cycle >3)

The following signal can only block the protection stage:

- AREC is not ready or switched off (= Automatic reclosing off / not ready)

This means that if the AREC is ready and the protection stage is in the idle state, the settings for **AREC cycle 1** are active and not the standard settings. The standard settings are active in the case of **AREC off/not ready**.

The influence can be activated for each signal individually. You also have to set the **Threshold** and **Operate delay** or **Stage blocked** parameters, which take effect when the signal is active.

The way AREC signals are generated is described in chapter 6.43.1 *Overview of Functions*.

Link to the Device-Internal Function *Cold-Load Pickup Detection (Advanced Stage)*

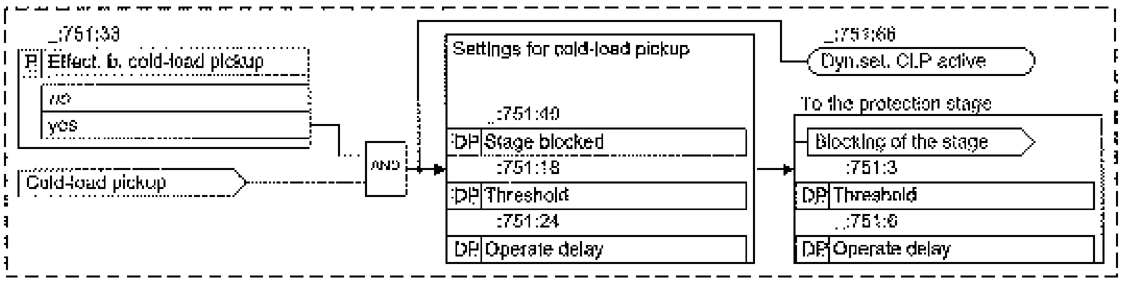


Figure 6-44 Influence of the Cold-Load Pickup Detection on the Overcurrent-Protection Stage

You have the option of changing the settings for the **Threshold** and the **Operate delay** of the protection stage for a cold-load pick-up. You can also block the stage. To do so, you must activate the influence of the cold-load pickup. You also have to set the **Threshold** and **Operate delay** or assign settings to **Stage blocked**, which take effect when the signal is active.

The way signals are generated **Cold-load pickup** is described in chapter 5.8.8 *Cold-Load Pickup Detection (Optional)* .

Link to an External *Function via a Binary Input Signal (Advanced Stage)*

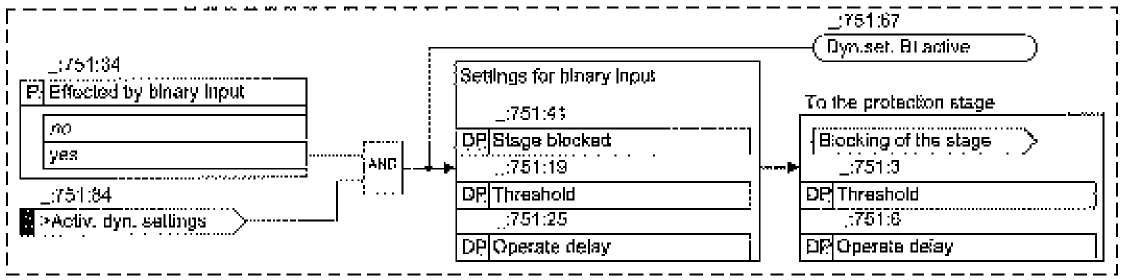


Figure 6-45 Influence of the Binary Input on the Overcurrent-Protection Stage

You can use the binary input signal **>Activ. dyn. settings** to change the settings for the **Threshold** and the **Operate delay** of the protection stage. You can also block the stage. To do so, you must activate the influence of the binary input. You also have to set the **Threshold** and **Operate delay** or assign settings to **Stage blocked**, which take effect when the signal is active.

6.5.8.2 Application and Setting Notes (Advanced Stage)

Binary Input Signal: `Dynamic settings`

- Default setting (_:751:26) `Dynamic settings` = `no`

Parameter Value	Description
no	The influence on the overcurrent-protection stage by device-internal or external functions is not necessary.
yes	If a device-internal function (automatic reclosing function or cold-load pickup detection) or an external function should affect the overcurrent-protection stage (such as change the setting of the threshold value or time delay, blocking of the stage), the setting must be changed to **yes**. This makes the configuration parameters **Influence of function...** as well as the dynamic settings **Threshold**, **Operate delay** and **Stage blocked** of the stage visible and enables the settings to be set for the specific influence.

Influence of AREC

The example of how the overcurrent-protection stage (1st stage) can be used as a fast stage before automatic reclosing describes the influence exerted by AREC.

The setting of the overcurrent level (1st level) results from the time-grading schedule. It is to be used as fast stage before an automatic reclosing. Because fast disconnection of the short circuit current takes priority over the selectivity prior to reclosing, the **Operate delay** parameter can be set to *0* or to a very low value. To achieve the selectivity, the final disconnection must be done with the grading time.

AREC is set to 2 reclosings. A secondary **Threshold** of *1.5 A* and a **Operate delay** of *600 ms* are assumed (according to the time-grading schedule) for the overcurrent-protection stage. The standard settings of the stage are set to these values.

To realize the application, the configuration settings **Effected by AR cycle 1** and **Effected by AR cycle 2** are changed in the example to **yes** (= influenced). This activates the **AR cycle 1** and **AR cycle 2** input signals within the stage. When they become active, they switch to the assigned dynamic settings.

The two dynamic settings **Operate delay** assigned to these input signals (sources of influence) are set to the time delay *0* (instantaneous tripping). The two dynamic settings **Threshold** assigned to these input signals are set to the normal threshold value of *1.5 A*.

If the threshold value (*1.5 A*) is exceeded before AREC 1 and AREC 2, the overcurrent-protection stage trips instantaneously. If the fault still exists after AREC 2 (unsuccessful AREC), the stage trips with the time delay of *600 ms* according to the time-grading schedule.

Influence of External Devices

The influence of an external device can also be configured. The above is an example of how the overcurrent-protection stage (1st stage) can be used as a fast stage before automatic reclosing, in which case the AREC function is performed by an external device.

To realize the application, the configuration setting **Effected by binary input** must be changed to **yes** (= influenced). This activates the **>Activ. dyn. settings** input signal within the stage. When the input signal becomes active, it switches to the assigned dynamic settings. The external device must provide the **Cycle 1** and **Cycle 2** signals or, alternatively, an AREC ready signal. The signals must be connected with the binary input signal **>Activ. dyn. settings**.

The dynamic setting **Operate delay**, which is assigned to the input signal (source of influence) **>Activ. dyn. settings**, is set to the time delay *0* (instantaneous tripping). The dynamic setting **Threshold** assigned to this input signal is set to the normal threshold value of *1.5 A*.

If the threshold value (*1.5 A*) is exceeded before AREC 1 and AREC 2, the overcurrent-protection stage trips instantaneously. If the fault still exists after AREC 2 (unsuccessful AREC), the stage trips with the time delay of *600 ms* according to the time-grading schedule.

6.6 Directional Overcurrent Protection, Phases

6.6.1 Overview of Functions

The **Directional time-overcurrent protection, phases** (ANSI 67):

- Detects short circuits at electrical equipment
- Can be used as backup overcurrent protection in addition to the main protection
- Ensures selective fault detection for parallel lines or transformers with infeed at one end
- Ensures selective fault detection in cable runs with infeed at both ends or in lines connected to form ring topologies

6.6.2 Structure of the Function

The **Directional time-overcurrent protection, phases** function is used in protection function groups. 2 function types are offered:

- **Directional time-overcurrent protection, phases - advanced** (67 Dir.OC-3ph-A)
- **Directional time-overcurrent protection, phases - basic** (67 Dir.OC-3ph-B)

The Basic function type is provided for standard applications. The Advanced function type offers more functionality and is provided for more complex applications.

Both function types are preconfigured by the manufacturer with 2 **directional, definite time-overcurrent protection** stages and with 1 **directional inverse time-overcurrent protection** stage.

In the advanced function type **Directional time-overcurrent protection, phases – advanced** the following stages can be operated simultaneously:

- Maximum of 4 stages **Definite time-overcurrent protection – advanced**
- 1 stage **Inverse time-overcurrent protection – advanced**
- 1 stage **User-defined overcurrent protection characteristic curve**

In the Basic function type **Directional time-overcurrent protection, phases – basic** the following stages can be operated simultaneously:

- Maximum of 4 stages **Definite time-overcurrent protection – basic**
- 1 stage **Inverse time-overcurrent protection – basic**

Stages that are not preconfigured are shown in gray in the following figures. Apart from the tripping delay characteristic, the stages are identical in structure.

The direction determination occurs on function level and has the same effects in all stages (see following figure and chapter 6.6.7.1 *Description*). In this way, it is ensured that all stages of a function receive the same direction result. Every stage can be set to the forward or reverse direction.

The group-indication output logic generates the following group indications of the protection function by the logical OR of the stage-selective indications:

- `Pickup`
- `Operate`