



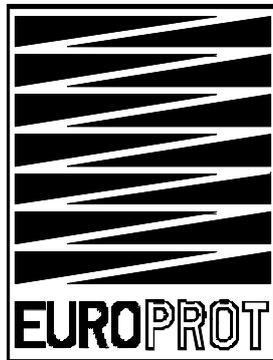
EuroProt

complex protection

software library
and
application guide
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00	10.10.2005	First issue	Petri
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Make_Io

Task of the function

Task of the function is to convert the sampled three phase current values to the momentary values of the $3I_o$ zero sequence current. The applied formula is:

$$3I_o = I_a + I_b + I_c$$

Inputs

The inputs of the function are the three phase currents.

Parameters

This function does not need any parameters.

Outputs

The function does not provide any outputs, which could be useful for the configuring engineer. The calculated I_o values are stored in the memory as calculated analogue channel values ($3I_{oo}$), and they can serve as input values e.g. for the Fourier analysis.

Application guide

When configuring the protection with this software function,

- the appropriate analogue channels must be assigned to the symbolical I_a , I_b , I_c variables. The analogue channels must be defined previously during hardware configuration.
- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the constant AR_F3_TO_0 must be defined. (The value is pre-defined by Protecta).

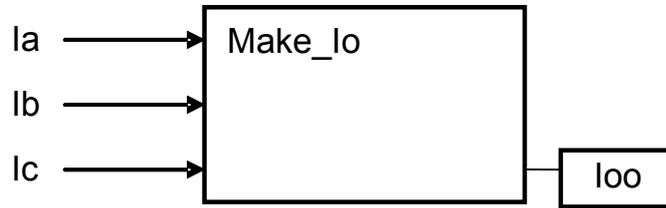
Internal parameters of the function

	AR_F3_TO_0, I_{oo} , I_a , I_b , I_c
AR_F3_TO_0	relay constant;
I_{oo}	identifier of the calculated analogue channel;
I_a , I_b , I_c	identifiers of the three analogue input channels (the three phase current inputs).

Remark: In case of higher accuracy requirements (e.g. in directional zero sequence overcurrent protection function) it is advised to use the dedicated zero sequence current input instead of calculating zero sequence current from sampled phase currents. This input can receive the zero sequence current from a toroidal current transformer, the turn's ratio of which can be different from that of the phase current transformers.

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Make_lo



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Make_Uo

Task of the function

Task of the function is to convert the sampled three phase voltage values to the momentary values of the $3U_0$ zero sequence voltage. The applied formula is:

$$3U_0 = U_a + U_b + U_c$$

Inputs

The inputs of the function are the three phase currents.

Parameters

This function does not need any parameters.

Outputs

The function does not provide any outputs, which could be useful for the configuring engineer. The calculated $3U_0$ values are stored in the memory as calculated analogue channel values ($3U_{0o}$), and they can serve as input values e.g. for the Fourier analysis.

Application guide

When configuring the protection with this software function,

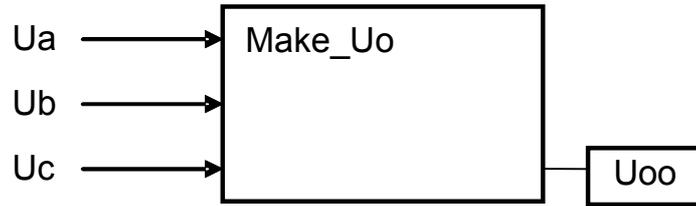
- the appropriate analogue channels must be assigned to the symbolical U_a , U_b , U_c variables. The analogue channels must be defined previously during hardware configuration.
- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the constant $AR_F3_TO_0$ must be defined. (The value is pre-defined by Protecta).

Internal parameters of the function

$AR_F3_TO_0$	$AR_F3_TO_0, U_{0o}, U_a, U_b, U_c$
U_{0o}	relay constant;
U_a, U_b, U_c	identifier of the calculated analogue channel;
	identifiers of the three analogue input channels (the three phase voltage inputs).

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Make_Uo



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Make_3Ph_line_I

Task of the function

Task of the function is to convert the sampled phase current values to current differences. The calculation is based on the following formulas:

$$I_{ab} = I_a - I_b$$

$$I_{bc} = I_b - I_c$$

$$I_{ca} = I_c - I_a$$

Inputs

The inputs of the function are the three phase currents.

Parameters

The function does not need any parameter values.

Outputs

The function does not provide any outputs, which could be useful for the configuring engineer. The calculated I_{ab} , I_{bc} , I_{ca} values are stored in the memory as calculated analogue channel values, and they can serve as input values e.g. for the Fourier analysis. They are needed in distance protection calculations.

Application guide

When configuring the protection with this software function,

- the appropriate analogue channels must be assigned to the symbolical I_a , I_b , I_c variables. The analogue channels must be defined previously during hardware configuration.
- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the constant `AR_ANJEL KEPZES` must be defined. (The value is pre-defined by Protecta).

Internal parameters of the function

`AR_ANJEL KEPZES,Iab,Ia,Ib,''`

`AR_ANJEL KEPZES,Ibc,Ib,Ic,''`

`AR_ANJEL KEPZES,Ica,Ic,Ia,''`

`AR_ANJEL KEPZES`

relay constant;

`Iab, Ibc, Ica`

identifiers of the three calculated analogue channels;

`Ia,Ib, Ic`

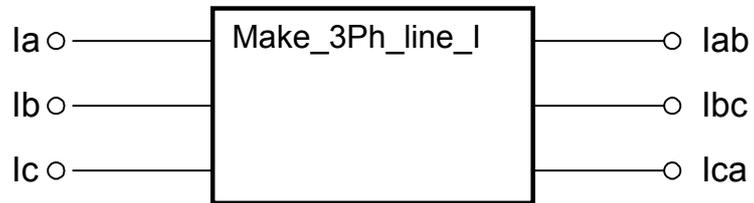
identifiers of the three analogue inputs, they are the three phase currents;

`''`

defining the difference calculation.

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Make_3Ph_line_I



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Dr. Kornél Petri	László Eperjesi	22.11.2005.	10/113

Make_3Ph_line_U

Task of the function

Task of the function is to convert the sampled phase voltage values to line voltages. The calculation is based on the following formulas:

$$U_{ab} = U_a - U_b$$

$$U_{bc} = U_b - U_c$$

$$U_{ca} = U_c - U_a$$

Inputs

The inputs of the function are the three phase voltages.

Parameters

The function does not need any parameter values.

Outputs

The function does not provide any outputs, which could be useful for the configuring engineer. The calculated U_{ab} , U_{bc} , U_{ca} values are stored in the memory as calculated analogue channel values, and they can serve as input values e.g. for the Fourier analysis. They are needed in distance protection calculations.

Application guide

When configuring the protection with this software function,

- the appropriate analogue channels must be assigned to the symbolical U_a , U_b , U_c variables. The analogue channels must be defined previously during hardware configuration.
- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the constant `AR_ANJEL KEPZES` must be defined. (The value is pre-defined by Protecta).

Internal parameters of the function

`AR_ANJEL KEPZES,Uab,Ua,Ub,''`

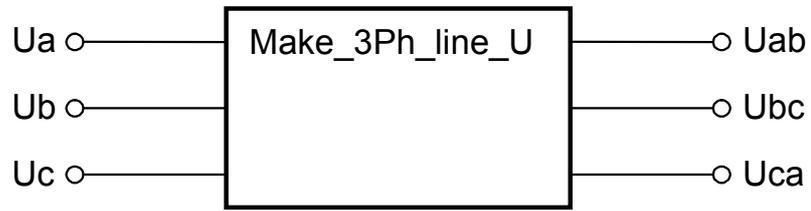
`AR_ANJEL KEPZES,Ubc,Ub,Uc,''`

`AR_ANJEL KEPZES,Uca,Uc,Ua,''`

`AR_ANJEL KEPZES` relay constant;
`Uab, Ubc, Uca` identifiers of the three calculated analogue channels;
`Ua,Ub, Uc` identifiers of the three analogue inputs, they are the three phase voltages;
`''` defining the difference calculation.

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Make_3Ph_line_U



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FFT_CT_1Ph

Task of the function

Task of the function is to calculate the basic Fourier harmonic component (RMS value and vector co-ordinates) of a single phase sampled analogue current input signal or that of a calculated analogue input (e.g. 3Io) processed by **Make_lo** function.

The method of the calculation is the numerical realisation of the Fourier analysis.

Inputs

The input of the function can be an analogue input current channel or a calculated analogue current channel.

Parameters

This function does not need any parameters.

The function applies the **Inp** pre-defined constant value, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.

Outputs

The output of the function is the **AdiMeas_I** measured value, which is the RMS value of the basic Fourier component, defined in pro-mill of the rated input of the current transformer.

The function stores the calculated vector components of the basic harmonic value and the calculated RMS value in the memory, which can be the basis of the decision by an other protection function, or the values can be processed for example for phase angle calculation.

Application guide

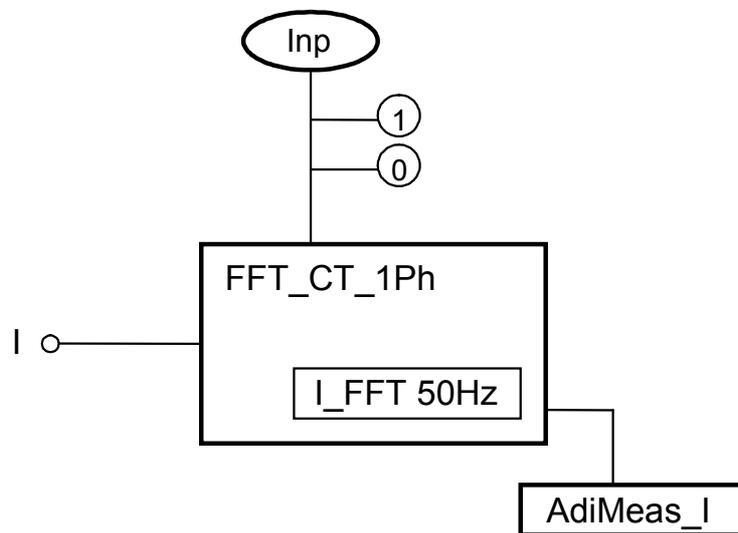
When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the **AR_FOURIER** pre-defined constant must be available.
- Among the constants the **Inp** value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- A current input channel or a calculated current analogue current channel must be assigned to the „I” symbolic input (this must be defined in the hardware configuration process, or it must be calculated e.g. by the **Make_lo** function).

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Internal parameters of the function

	AR_FOURIER,1,AdiMeas_I,I,Inp,0
AR_FOURIER	relay constant;
1	this value is always 1, referring to the basic harmonic value;
AdiMeas_I	the identifier of the measured value, which is the RMS value, expressed as pro-mill of the of the rated current input;
I	the identifier of the assigned analogue input;
Inp	pre-defined constant, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer;
0	the 0 value means that no further digital filtering is applied.



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FFT_VT_1Ph

Task of the function

Task of the function is to calculate the basic Fourier harmonic component (RMS value and vector co-ordinates) of a single phase sampled analogue input voltage signal or that of a calculated analogue input (e.g. $3U_0$) processed by **Make_Uo** function.

The method of the calculation is the numerical realisation of the Fourier analysis.

Inputs

The input of the function can be an analogue input voltage channel or a calculated analogue voltage channel.

Parameters

This function does not need any parameters.

The function applies the **Unp** pre-defined constant value, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.

Outputs

The output of the function is the **AdiMeas_U** measured value, which is the RMS value of the basic Fourier component, defined in pro-mill of the rated input of the voltage transformer.

The function stores the calculated vector components of the basic harmonic value and the calculated RMS value in the memory, which can be the basis of the decision by an other protection function, or the values can be processed for example for phase angle calculation.

Application guide

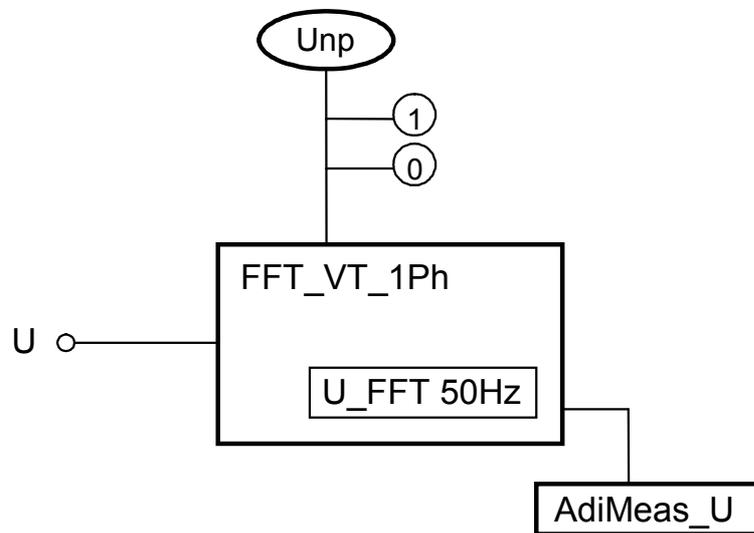
When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the **AR_FOURIER** pre-defined constant must be available.
- Among the constants the **Unp** value must be available, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.
- A voltage input channel or a calculated current analogue voltage channel must be assigned to the „U” symbolic input (this must be defined in the hardware configuration process, or it must be calculated e.g. by the **Make_Uo** function).

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Internal parameters of the function

	AR_FOURIER,1,AdiMeas_U,U,Unp,0
AR_FOURIER	relay constant;
1	this value is always 1, referring to the basic harmonic value;
AdiMeas_U	the identifier of the measured value, which is the RMS value, expressed as pro-mill of the of the rated voltage input;
U	the identifier of the assigned analogue input;
Unp	pre-defined constant, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer;
0	the 0 value means that no further digital filtering is applied.



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FFT_CT_3PH

Task of the function

Task of the function is to calculate the basic Fourier harmonic component (RMS value and vector co-ordinates) of three-phase sampled analogue current input signals or those of calculated analogue channels (e.g. Iab, Ibc, Ica) processed by `Make_3Ph_line_I` function. (The function involves three single-phase software modules. The aim is to simplify the work of the configuring engineer.

The method of the calculation is the numerical realisation of the Fourier analysis.

Inputs

The input of the function can be three analogue input current channels or three calculated analogue current channels.

Parameters

This function does not need any parameters.

The function applies the `Inp` pre-defined constant value, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware, it is defined by the producer.

Outputs

The outputs of the function are `AdiMeas_Ia`, `AdiMeas_Ib`, `AdiMeas_Ic` measured values, which are the RMS value of the basic Fourier components, defined in pro-mill of the rated input of the current transformer.

The function stores the calculated vector components of the basic harmonic value and the calculated RMS value in the memory, which can be the basis of the decision by an other protection function, or the values can be processed for example for phase angle calculation.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the `AR_FOURIER` pre-defined constant must be available.
- Among the constants the `Inp` value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Three current input channels or a calculated current analogue current channels must be assigned to the „Ia, Ib, Ic” symbolic inputs (they must be defined in the hardware configuration process, or they must be calculated e.g. by the `Make_3Ph_line_I` function).

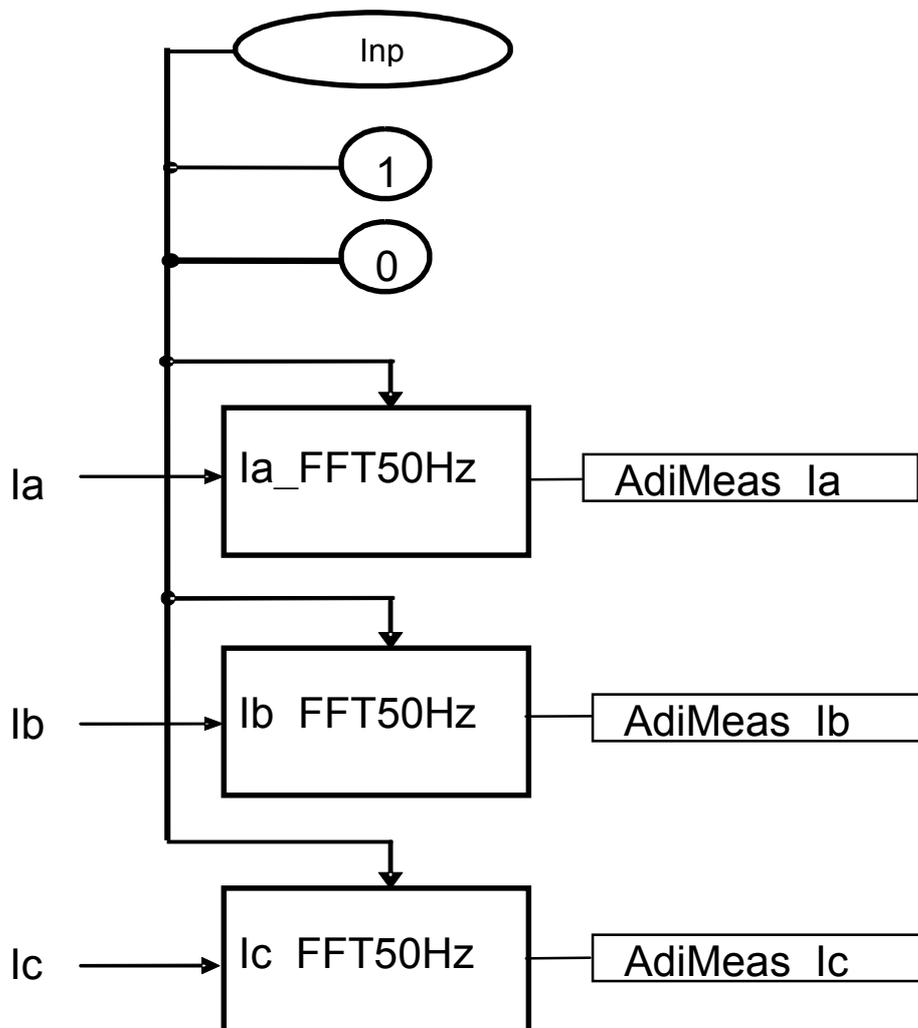
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Internal parameters of the function

This function invokes three independent Fourier software modules for the three currents, each of them needs the following parameters:

	AR_FOURIER,1,AdiMeas_Ii,Ii,Inp,0
AR_FOURIER	relay constant;
1	this value is always 1, referring to the basic harmonic value;
AdiMeas_Ii	(i=a,b,c) the identifier of the measured values, which are the RMS values, expressed as pro-mill of the of the rated current input;
Ii	(i=a,b,c) the identifiers of the assigned analogue inputs;
Inp	pre-defined constant, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer;
0	the 0 value means that no further digital filtering is applied.

FFT_CT_3Ph



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FFT_VT_3PH

Task of the function

Task of the function is to calculate the basic Fourier harmonic component (RMS value and vector co-ordinates) of three-phase sampled analogue voltage input signals or those of calculated analogue input (e.g. I_{ab} , I_{bc} , I_{ca}) processed by `Make_3Ph_line_I` function. (The function involves three single-phase software modules. The aim is to simplify the work of the configuring engineer.

The method of the calculation is the numerical realisation of the Fourier analysis.

Inputs

The input of the function can be three analogue input voltage channels or three calculated analogue voltage channels.

Parameters

This function does not need any parameters.

The function applies the `Unp` pre-defined constant value, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.

Outputs

The outputs of the function are `AdiMeas_U1`, `AdiMeas_U2`, `AdiMeas_U3` measured values, which are the RMS value of the basic Fourier components, defined in pro-cent of the rated input of the voltage transformer.

The function stores the calculated vector components of the basic harmonic value and the calculated RMS value in the memory, which can be the basis of the decision by an other protection function, or the values can be processed for example for phase angle calculation.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the `AR_FOURIER` pre-defined constant must be available.
- Among the constants the `Unp` value must be available, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.
- Three voltage input channels or a calculated voltage analogue current channels must be assigned to the „ U_a , U_b , U_c ” symbolic inputs (they must be defined in the hardware configuration process, or they must be calculated e.g. by the `Make_3Ph_line_U` function).

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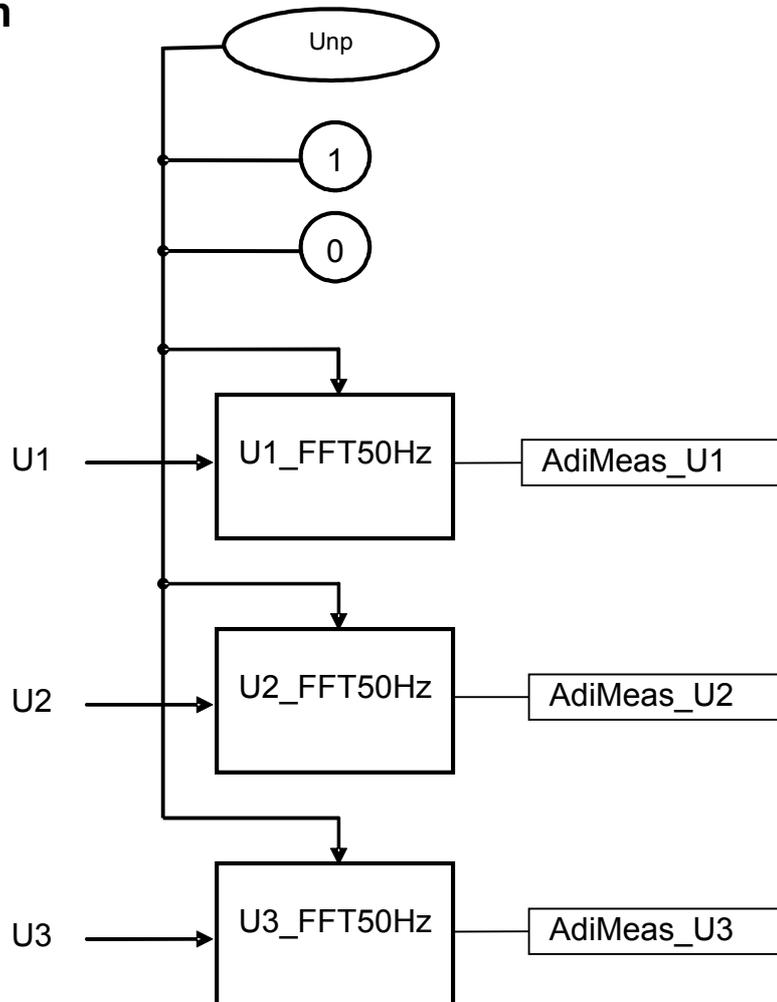
Internal parameters of the function

This function invokes three independent Fourier software modules for the three voltages; each of them needs the following parameters:

AR_FOURIER,1,AdiMeas_Ux,Ux,Unp,0

AR_FOURIER relay constant;
1 this value is always 1, referring to the basic harmonic value;
AdiMeas_Ux (x=1,2,3) the identifier of the measured values, which are the RMS values, expressed as pro-mill of the of the rated voltage input;
Ux (x=1,2,3) the identifiers of the assigned analogue inputs;
Unp pre-defined constant, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer;
0 the 0 value means that no further digital filtering is applied.

FFT_VT_3Ph



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INegSeqFilter3Ph

Task of the function

Task of the function is to calculate the 3I2 negative sequence current component of the three phase currents. The calculation is based on the following formula:

$$3I_2 = I_a + a \cdot I_b + a^2 \cdot I_c$$

Inputs

The inputs of the function are the Fourier basic harmonic components, calculated based on the three phase currents.

Parameters

There is only one constant, needed to calculate negative sequence component: the Inp pre-defined constant, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is used e.g. by the FFT_CT_3PH software function as well.

Outputs

The output of the function is AdiMeas_Ineg measured value, which is the RMS value of the negative sequent current component, related to the rated current of the current transformer of the device, expressed in pro-mill.

The function stores the calculated vector components and the RMS value in the internal data structure. These values can be applied e.g. by a function prepared for decision, or they can serve as inputs for further data processing to calculate angle values.

Application guide

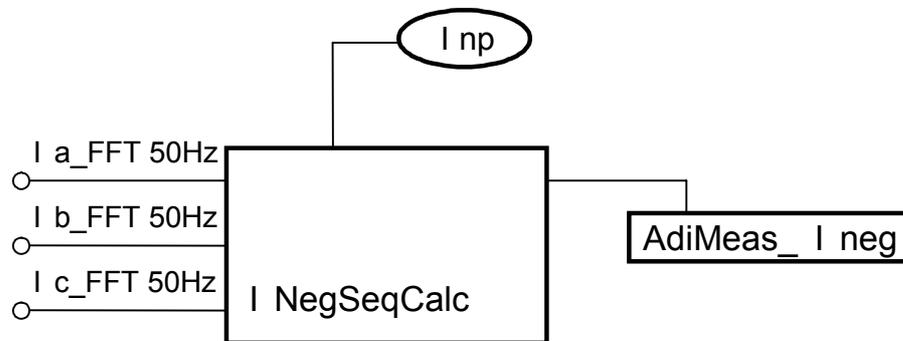
When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_NEG3 pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- It is to be checked if the result of the three-phase Fourier calculation is available (e.g. Ix_FFT50Hz, x=a, b, c), these must be assigned to the Ix_FFT50Hz inputs,

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Internal parameters of the function

	AR_NEG3, Ia_FFT50Hz, Ib_FFT50Hz, Ic_FFT50Hz, Inp, AdiMeas_Ineg
AR_NEG3	relay constant,
Ia_FFT50Hz	the Fourier function for phase „a”,
Ib_FFT50Hz	the Fourier function for phase „b”,
Ic_FFT50Hz	the Fourier function for phase „c”,
Inp	it is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer,
AdiMeas_Ineg	the identifier of the ADI measuring channel, measured value, which is the RMS value of the negative sequent current component, related to the rated current of the current transformer of the device, expressed in pro-mill.



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UNegSeqFilter3Ph

Task of the function

Task of the function is to calculate the 3U₂ negative sequence voltage component of the three phase voltages. The calculation is based on the following formula:

$$3U_{I2} = U_a + a \cdot U_b + a^2 \cdot U_c$$

Inputs

The inputs of the function are the Fourier basic harmonic components, calculated based on the three phase voltages.

Parameters

There is only one constant, needed to calculate negative sequence component: the Unp pre-defined constant, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer. The same constant is used e.g. by the FFT_VT_3PH software function as well.

Outputs

The output of the function is AdiMeas_Uneg measured value, which is the RMS value of the negative sequent voltage component, related to the rated voltage of the voltage transformer of the device, expressed in pro-cent.

The function stores the calculated vector components and the RMS value in the internal data structure. These values can be applied e.g. by a function prepared for decision, or they can serve as inputs for further data processing to calculate angle values.

Application guide

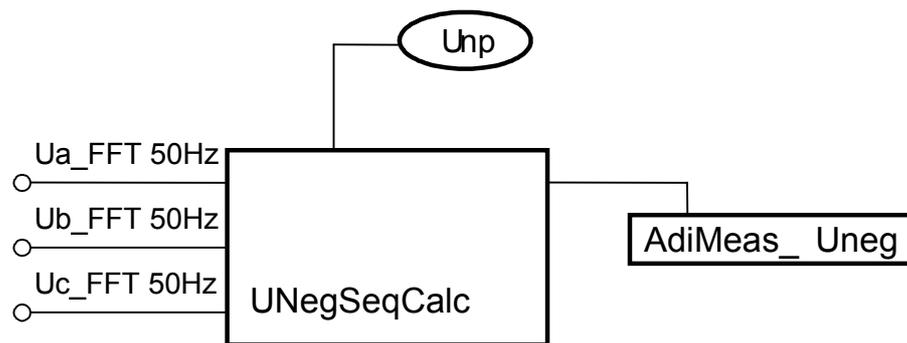
When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_NEG3 pre-defined constant must be available.
- Among the constants the Unp value must be available, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.
- It is to be checked if the result of the three-phase Fourier calculation is available (e.g. U_x_FFT50Hz, x=a, b, c), these must be assigned to the U_x_FFT50Hz inputs,

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Internal parameters of the function

	AR_NEG3,Ua_FFT50Hz,Ub_FFT50Hz,Uc_FFT50Hz,Unp,AdiMeas_Uneg
AR_NEG3	relay constant,
Ua_FFT50Hz	the Fourier function for phase „a”,
Ub_FFT50Hz	the Fourier function for phase „b”,
Uc_FFT50Hz	the Fourier function for phase „c”,
Unp	it is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer,
AdiMeas_Uneg	the identifier of the ADI measuring channel, measured value, which is the RMS value of the negative sequent voltage component, related to the rated voltage of the voltage transformer of the device, expressed in pro-cent.



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ANSI 50_50N

Task of the function

This function is the realisation of a definite time overcurrent function with a single current, which can be a phase current, but the usual application is the zero sequence overcurrent protection. The threshold value is a parameter. The function generates a start signal without time delay, this signal can not be delayed. The trip time delay is defined by a parameter as well. (This function differs from the ANSI50N_Sens sensitive earth-fault protection function by the threshold setting limit values and the steps).

This function performs the decisions and the measurement of the time delay only, for the operation it needs for example a Fourier algorithm too. It processes the values stored in the data structure of the Fourier routine.

Inputs

This function processes the calculated results of a Fourier routine, performs comparison and decision. (See e.g. FFT_CT_1PH.)

Parameters

The function needs two parameter values:

- POC_1Ph: the threshold value of the overcurrent function (30...2500, step 5) % related to the rated current of the input current transformer,
- P_TOC_1Ph: time delay of the overcurrent function (0...60000,10) ms.

LCD text*	Min **	Max **	Step **	Remark
I>/In [CT] %	30	2500	5	Current setting value, related to the rated current of the CT input, expressed in %
t [I>] = ms	0	60000	10	Time delay in ms

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

For the operation two constants are needed as well:

- Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_1PH.
- POVER defined constant parameter, which selects „over-„ function.

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Outputs

The function generates two status signals:

- The start status signal,
- The timeout state of the assigned timer.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_FOUR_DONT pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constant parameters the POVER constant parameter must be available, which selects the “over-“ function.
- It is to be checked if the result of the single phase Fourier calculation is available (e.g. I_FFT50Hz), this must be assigned to the I_FFT50Hz input.
- It is useful to define two internal status variables, which are to be assigned to the OC1PhStart and OC1PhTrip status signals. (Remark: instead of internal status signals relay outputs or LED-s can be assigned as well.)

The function automatically defines the following objects:

- ANSI50_N this is the function itself,
- AP_POC_1Ph ADI parameter, which is the transfer variable of the threshold parameter,
- POC_1Ph the threshold parameter with pre-defined limits and step value,
- P_TOC_1Ph the parameter of the time delay with pre-defined limits and step value,
- TimOC_1PhDly the timer,
- AdiStOCStart ADI status variable for the start state,
- Internal logic equations:
 - the AdiStOCStart ADI status is transferred to the selected internal variable,
 - starting the timer (pull-on time delay) with the internal variable signalling the start state,
 - transferring the time-out state of the timer to the other internal variable.

Internal parameters of the function

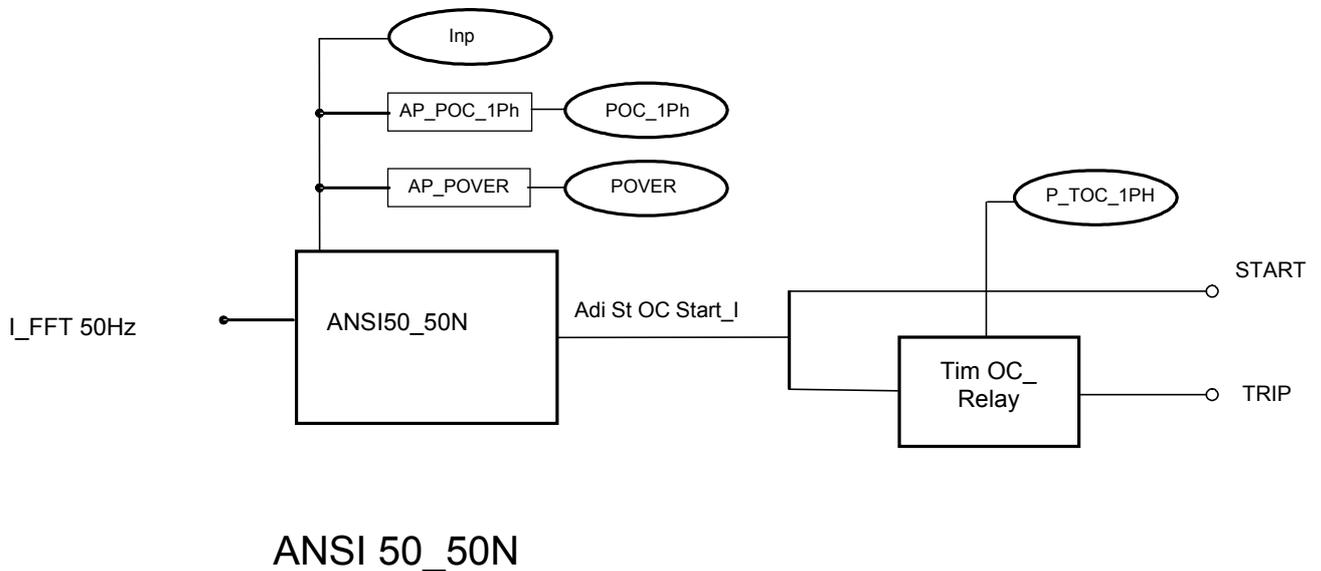
The comparing function is invoked with the following parameters:

AR_FOUR_DONT, AdiStOCStart_I, I_FFT50Hz, AP_POC, Inp, AP_POVER
 AR_FOUR_DONT relay constant,
 AdiStOCStart_I ADI status which signals the start state of the function,
 I_FFT50Hz the Fourier calculation function,
 AP_POC ADI parameter, which is the transfer variable of the threshold parameter

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Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_1PH.

AP_POVER ADI parameter, which is the transfer variable for the POVER constant parameter. This selects the “over-“ function.



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ANSI50N_Sens

Task of the function

This function is the realisation of a sensitive definite time overcurrent function with a single current, which can be a phase current, but the usual application is the zero sequence overcurrent protection. The threshold value is a parameter. The function generates a start signal without time delay, this signal can not be delayed. The trip time delay is defined by a parameter as well. (This function differs from the ANSI50_N earth-fault protection function by the threshold setting limit values and the steps).

This function performs the decisions and the measurement of the time delay only, for the operation it needs for example a Fourier algorithm too. It processes the values stored in the data structure of the Fourier routine.

Inputs

This function processes the calculated results of a Fourier routine, performs comparison and decision. (See e.g. FFT_CT_1PH.)

Parameters

The function needs two parameter values:

- POC_1Ph: the threshold value of the overcurrent function (10...140, step 1) % related to the rated current of the input current transformer,
- P_TOC_1Ph: time delay of the overcurrent function (0...60000, step 10) ms.

LCD text*	Min **	Max **	Step **	Remark
Io>/Ion [CToProt] %	10	140	1	Current setting value, related to the rated current of the CT input, expressed in %
t [I>] = ms	0	60000	10	Time delay in ms

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

For the operation two constants are needed as well:

- Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_1PH.
- POVER defined constant parameter, which selects „over-„ function.

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Outputs

The function generates two status signals:

- The start status signal,
- The timeout state of the assigned timer.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_FOUR_DONT pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constant parameters the POVER constant parameter must be available, which selects the “over-“ function.
- It is to be checked if the result of the single phase Fourier calculation is available (e.g. I_FFT50Hz), this must be assigned to the I_FFT50Hz input.
- It is useful to define two internal status variables, which are to be assigned to the OC1PhStart and OC1PhTrip status signals. (Remark: instead of internal status signals relay outputs or LED-s can be assigned as well.)

The function automatically defines the following objects:

- ANSI50_N this is the function itself,
- AP_POC_1Ph ADI parameter, which is the transfer variable of the threshold parameter,
- POC_1Ph the threshold parameter with pre-defined limits and step value,
- P_TOC_1Ph the parameter of the time delay with pre-defined limits and step value,
- TimOC_1PhDly the timer,
- AdiStOCStart ADI status variable for the start state,
- Internal logic equations:
 - the AdiStOCStart ADI status is transferred to the selected internal variable,
 - starting the timer (pull-on time delay) with the internal variable signalling the start state,
 - transferring the time-out state of the timer to the other internal variable.

Internal parameters of the function

The comparing function is invoked with the following parameters:

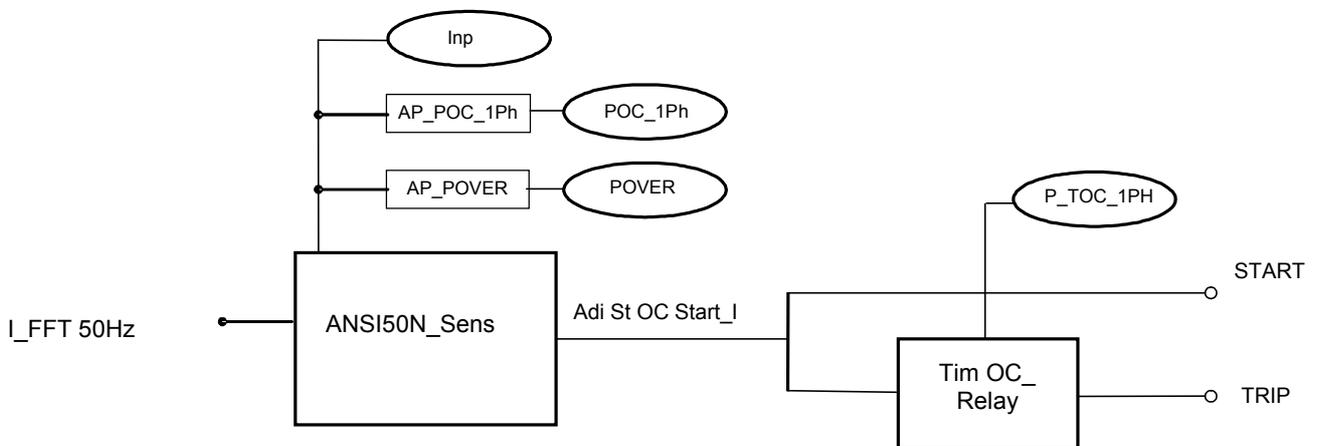
AR_FOUR_DONT, AdiStOCStart_I, I_FFT50Hz, AP_POC, Inp, AP_POVER
 AR_FOUR_DONT relay constant,
 AdiStOCStart_I ADI status which signals the start state of the function,
 I_FFT50Hz the Fourier calculation function,
 AP_POC ADI parameter, which is the transfer variable of the threshold parameter

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Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_1PH.

AP_POVER ADI parameter, which is the transfer variable for the POVER constant parameter. This selects the “over-“ function.

ANSI 50N_Sens



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ANSI 50_3Ph

Task of the function

This function is the realisation of a definite time overcurrent function with a three currents. The threshold value is a parameter. The function generates a start signal without time delay; this signal cannot be delayed. The trip time delay is defined by a parameter as well. The function evaluates the started states of the three phase current comparisons in „OR” relation, and the time delay is common for the three phases

This function performs the decisions and the measurement of the time delay only, for the operation it needs for example three Fourier algorithms too. It processes the values stored in the data structure of the Fourier routines.

Inputs

This function processes the calculated results of three Fourier routines, performs comparison and decision. (See e.g. FFT_CT_3PH.)

Parameters

The function needs two parameter values:

- POC: the threshold value of the overcurrent function (30...2500, step 5) % related to the rated current of the input current transformer,
- P_TOC: time delay of the overcurrent function (0...60000, step 10) ms.

LCD text*	Min **	Max **	Step **	Remark
I>/In [CT] %	30	2500	5	Current setting value, related to the rated current of the CT input, expressed in %
t [I>] = ms	0	60000	10	Time delay in ms

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

For the operation two constants are needed as well:

- Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_3PH.
- POVER defined constant parameter, which selects „over-” function.

Outputs

The function generates two status signals:

- The start status signal, which is the „OR” relation of the three phase start values,
- The timeout state of the assigned timer.

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Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_FOUR_DONT pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constant parameters the POVER constant parameter must be available, which selects the “over-“ function.
- It is to be checked if the result of the three-phase Fourier calculation is available (e.g. Ia_FFT50Hz, Ib_FFT50Hz, Ic_FFT50Hz), this must be assigned to the Ix_FFT50Hz inputs.
- It is useful to define two internal status variables, which are to be assigned to the OC3PhStart and OC3PhTrip status signals. (Remark: instead of internal status signals relay outputs or LED-s can be assigned as well.)

The function automatically defines the following objects:

- ANSI50Start_Ix these are the comparison functions for the phases individually (x=a, b, c),
- AP_POC ADI parameter, which is the transfer variable of the threshold parameter,
- POC the threshold parameter with pre-defined limits and step value,
- P_TOC the parameter of the time delay with pre-defined limits and step value,
- TimOCDly the timer,
- AdiStOCStart_Ix ADI status variables for the start state (x=a, b, c),
- Internal logic equations:
 - The „OR” relation of the AdiStOCStart_Ix ADI status values is transferred to the selected internal variable,
 - starting the timer (pull-on time delay) with the internal variable signalling the start state,
 - transferring the time-out state of the timer to the other internal variable.

Internal parameters of the function

The comparing function is invoked with the following parameters:

AR_FOUR_DONT,AdiStOCStart_Ix,Ix_FFT50Hz,AP_POC,Inp,AP_POVER

AR_FOUR_DONT relay constant,

AdiStOCStart_Ix ADI status variables which signal the start state of the function (x=a, b, c),

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IX_FFT50HZ

AP_POC

Inp

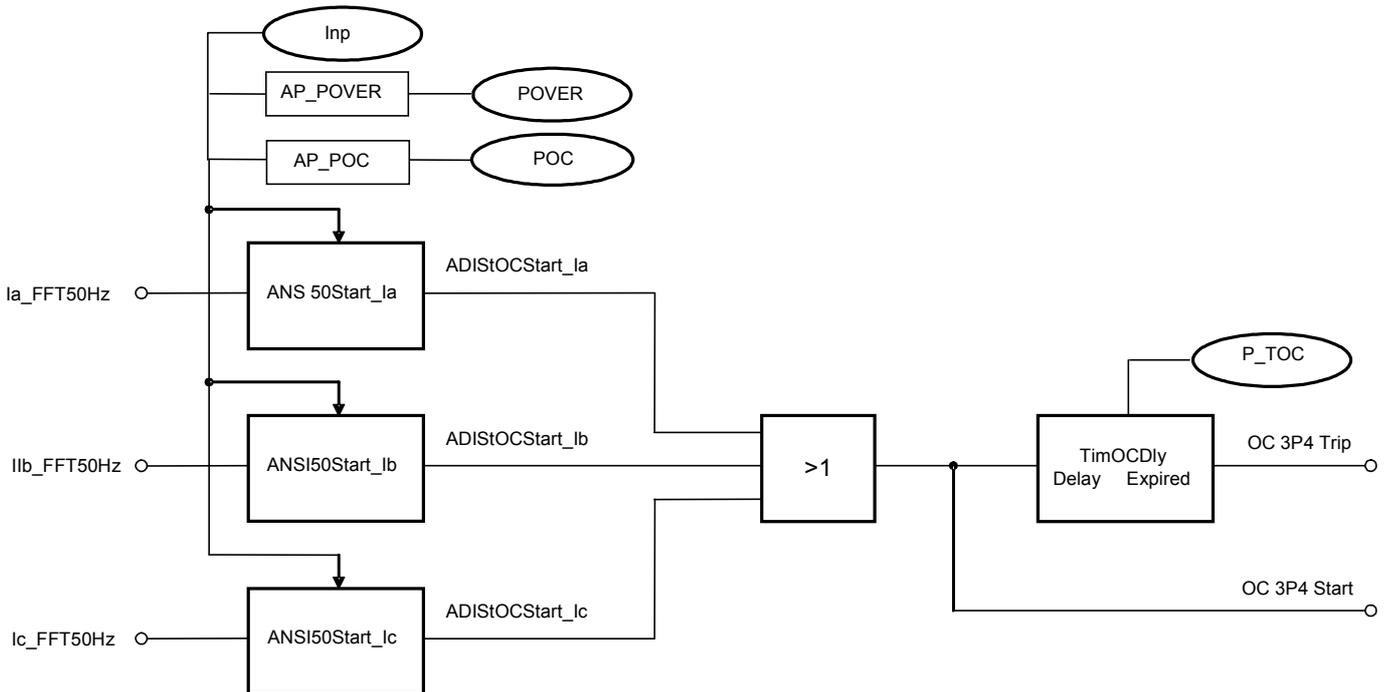
AP_POVER

THE FOURIER CALCULATION FUNCTIONS (X=A, B, C),

ADI parameter, which is the transfer variable of the threshold parameter is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_3PH.

ADI parameter, which is the transfer variable for the POVER constant parameter. This selects the “over-“ function.

ANSI50_3Ph



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ANSI 50_3x1Ph

Task of the function

This function is the realisation of a definite time overcurrent function with a three currents. The threshold value is a parameter. The function generates a start signal without time delay; this signal can not be delayed. The trip time delay is defined by a parameter as well. The function evaluates the started states of the three phase current comparisons individually, and the time delay is measured for the three phases individually too.

This function performs the decisions and the measurement of the time delays only, for the operation it needs for example three Fourier algorithms too. It processes the values stored in the data structure of the Fourier routines.

Inputs

This function processes the calculated results of three Fourier routines, performs comparison and decision. (See e.g. FFT_CT_3PH.)

Parameters

The function needs two parameter values:

- POC: the threshold value of the overcurrent function (30...2500, step 5) % related to the rated current of the input current transformer,
- P_TOC: time delay of the overcurrent function (0...60000, step 10) ms.

LCD text*	Min **	Max **	Step **	Remark
I>/In [CT] %	30	2500	5	Current setting value, related to the rated current of the CT input, expressed in %
t [I>] = ms	0	60000	10	Time delay in ms

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

For the operation two constants are needed as well:

- Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_3PH.
- POVER defined constant parameter, which selects „over-„ function.

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Outputs

The function generates the following status signals:

- The start status signals of the three phase starting individually,
- The timeout states of the assigned timers.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_FOUR_DONT pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constant parameters the POVER constant parameter must be available, which selects the “over-“ function.
- It is to be checked if the result of the three-phase Fourier calculation is available (e.g. Ia_FFT50Hz, Ib_FFT50Hz, Ic_FFT50Hz), this must be assigned to the Ix_FFT50Hz inputs.
- It is useful to define internal status variables, which are to be assigned to the OC1PhStart_Ia, OC1PhStart_Ib, OC1PhStart_Ic and to the individual trip (timer time-out) status signals. (Remark: instead of internal status signals relay outputs or LED-s can be assigned as well.)

The function automatically defines the following objects:

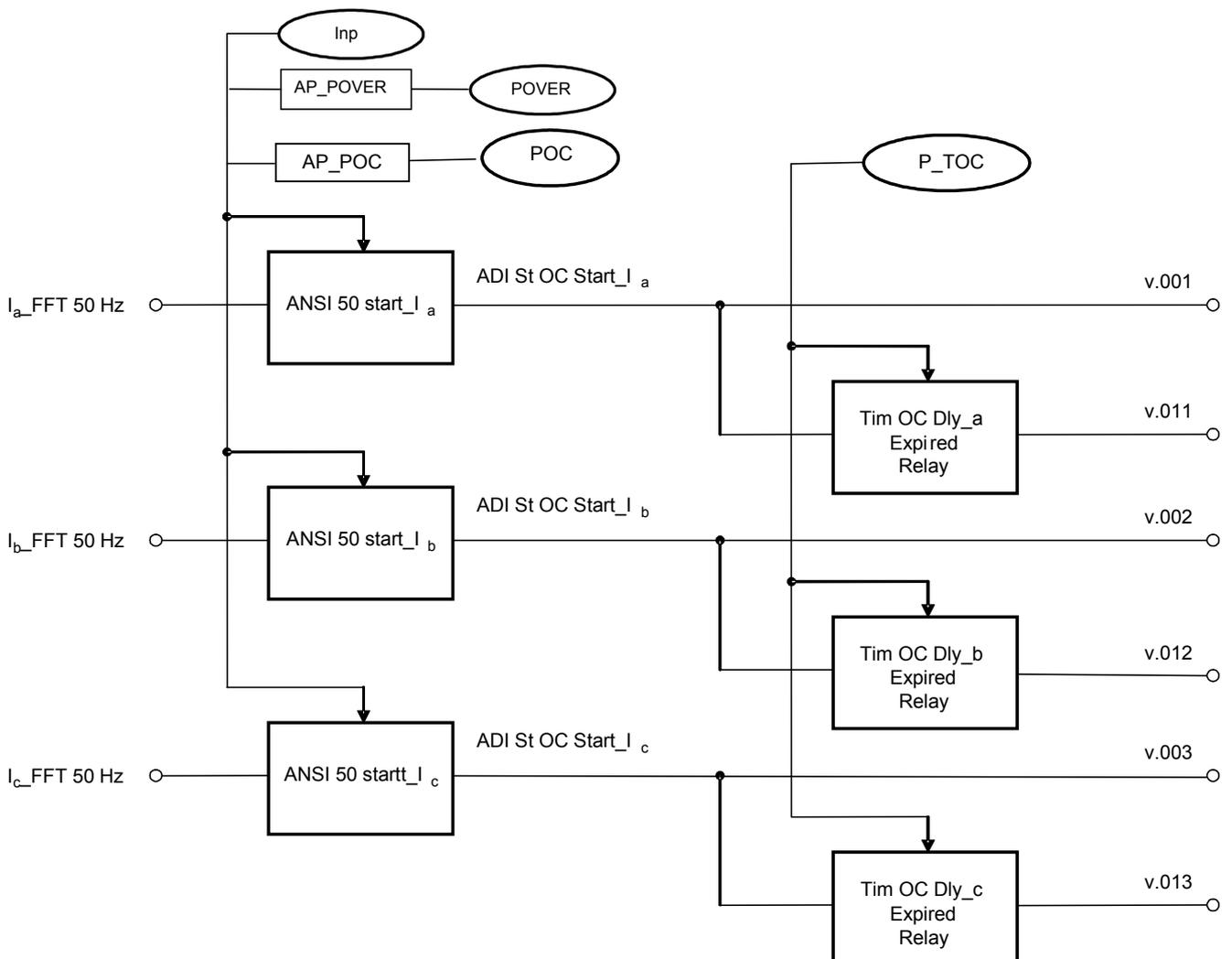
- ANSI50Start_Ix these are the comparison functions for the phases individually (x=a, b, c),
- AP_POC ADI parameter, which is the transfer variable of the threshold parameter,
- POC the threshold parameter with pre-defined limits and step value,
- P_TOC the parameter of the time delay with pre-defined limits and step value,
- TimOCDly_x the timers (x=a, b, c),
- AdiStOCStart_Ix ADI status variables for the start state (x=a, b, c),
- Internal logic equations:
 - The AdiStOCStart_Ix ADI status values are transferred to the selected internal variables (x=a, b, c),
 - starting the timers (pull-on time delay) with the internal variables signalling the started state,
 - transferring the time-out states of the timers to the other internal variables.

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Internal parameters of the function

The comparing functions for the three phases are invoked with the following parameters:
AR_FOUR_DONT, AdiStOCStart_Ix, Ix_FFT50Hz, AP_POC, Inp, AP_POVER

- AR_FOUR_DONT relay constant (x=a, b, c),
 AdiStOCStart_Ix ADI status variables which signal the start state of the function (x=a, b, c),
 Ix_FFT50Hz the Fourier calculation functions (x=a, b, c),
 AP_POC ADI parameter, which is the transfer variable of the threshold parameter is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_3PH.
 Inp
 AP_POVER ADI parameter, which is the transfer variable for the POVER constant parameter. This selects the “over-“ function.



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ANSI 51

Task of the function

This function realises inverse definite minimum time overcurrent protection tasks with a single current. Principally this current can be a phase current, but the usual application is the negative or zero sequence overcurrent protection. The status signal of the starting is generated without additional time delay. The time delay of the trip command is generated according to standard current dependent characteristics. The type of the inverse characteristics can be selected by a parameter:

$$\text{Normal inverse (Type =0)} \quad T = T_N \frac{0.14}{\left(\frac{I}{I_N}\right)^{0.02} - 1}$$

$$\text{Very inverse (Type =1)} \quad T = T_N \frac{13.5}{\left(\frac{I}{I_N}\right)^1 - 1}$$

$$\text{Extremely inverse (Type =2)} \quad T = T_N \frac{80}{\left(\frac{I}{I_N}\right)^2 - 1}$$

In all three cases the rated starting current (I_N) and the time multiplier (T_N) is to be set by parameters.

The relation of the time multiplier and the assigned parameter is explained by the following formula:

$$T = T_N \frac{c1}{\left(\frac{I_2}{I_N}\right)^{c2} - 1} = \frac{P_IDMT}{20} \frac{c1}{\left(\frac{I_2}{I_N}\right)^{c2} - 1}$$

Which means that the parameter is 20 times the usual time multiplier. If for example the parameter setting is $P_TIDMT=1$, then it corresponds to the time multiplier $T_N = 0.05$ s. The parameter is expressed in [s].

The function is extended with a minimum time delay as well (IDMT). This time delay can be set by a dedicated parameter. The function generates a trip command if both the delay of the inverse characteristics AND this minimal time delay is over.

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This function performs the decision and the time delay only. For the operation it needs for example a Fourier algorithm, the data stored in the data structure of this algorithm are processed.

Inputs

This function processes the calculated results of three Fourier routines, performs comparison and decision. (See e.g. FFT_CT_1PH.)

Parameters

The function applies the following parameters:

- PIn: threshold value of the function (10...104, step 1) % related to the rated current of the current transformer input,
- P_TIDMT: 20-times value of the time multiplier (1...256, step 1) [*20 ms].
- PType: parameter for selection among the types of the inverse characteristic (0, 1, 2)
- P_TDMT: the minimal delay time (50 ... 500, 1) ms.

LCD text*	Min **	Max **	Step **	Remark
IDMT Type (0,1,2)	0	2	1	Type selection for the characteristics, see equations above
Ipick/In %	10	104	1	Pick-up value of the function, related to the rated current of the CT, expressed in %
IDMT time multip /20 s	0	256	1	20*(time multiplier), expressed in s
Min.time delay ms	50	500	1	Minimal time delay, expressed in ms

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

The function needs the following constants:

- Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_1PH

The function needs the following constant parameters (both have factory settings):

- Pconst100 its value is 100% (in a motor protection for example it is a variable parameter)
- PconstInegrDown This parameter defines the rate of the drop-off.

Outputs

The function generates two status signals:

- Started state,
- Time-out of the function based on the selected current-dependent characteristics.

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Additionally there is a value available which is proportional to the time remaining to the trip command. This value decreases starting from 1000, at the generation of the trip command its value is 0.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_N_FUGGO pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constant parameters the POVER constant parameter must be available, which selects the “over-“ function.
- It is to be checked if the result of the Fourier calculation is available (e.g. I_FFT50Hz), this must be assigned to the I_FFT50Hz input.
- It is useful to define internal status variables, which are to be assigned to the IDMTStart and to the IDMTTrip status signals. (Remark: instead of internal status signals relay outputs or LED-s can be assigned as well.)

The function automatically defines the following objects:

- IDMTOC_ANSI51 this is the function itself,
- AP_PIn ADI parameter which transfers the threshold value to the function,
- Pin The threshold parameter with the defined limits and step value,
- AP_PT_IDMT ADI parameter, to transfer the 20 times value of the time multiplier to the function,
- PT_IDMT the 20 times value of the time multiplier with the defined limits and step value,
- AP_PType ADI parameter, to transfer the type of the characteristics to the function,
- PType the type of the characteristics (0, 1, 2),
- AP_PConst100 ADI parameter to transfer the constant parameter to the function,
- PConst100 constant parameter the value of which is 100,
- AP_PConstIntegrDown ADI parameter to transfer the constant parameter to the function,
- PConstIntegrDown constant parameter the value of which is defined by the factory,
- PTDMT the minimal delay time with the pre-defined limits and step value,
- TimDMT timer to measure the minimum delay time,
- AdiIDMTStart ADI status which signals the started state,
- AdiIDMTTrip ADI status which signals the time-out state according to the inverse characteristics,
- AdiMeas_RemTime the countdown.

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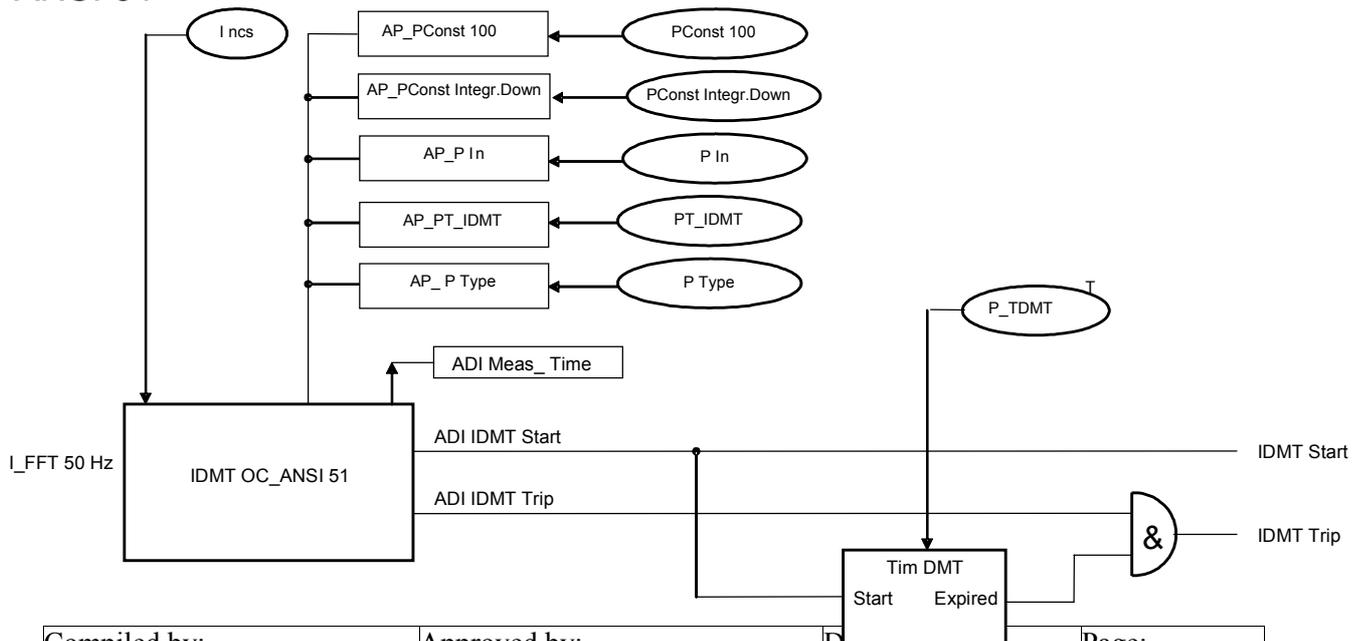
- Internal logic equations to:
 - Transfer the AdiIDMTStart ADI status to the assigned internal variable,
 - Start the timer (start time delay) with the starting internal variable,
 - Transfer the time-out of the characteristics AND the time-out of the minimum delay time to the other internal variable.

Internal parameters of the function

The IDMT function is invoked with the following parameters:

AR_N_FUGGO,	AP_PType,I_FFT50Hz,AdiIDMTStart,AdiMeas_RemTime,
AP_In,AP_PConst100,AP_PT_IDMT,AP_PConstIntegrDown,Inp	
AR_N_FUGGO	relay constant,
AP_PType	ADI parameter, to transfer the selected type of characteristics to the function,
I_FFT50Hz	the Fourier function the calculated value of which serves as input for the function,
AdiIDMTStart	ADI status to signal the started state,
AdiIDMTTrip	ADI status to signal the time-out state of the inverse characteristics,
AdiMeas_RemTime	the countdown value,
AP_In	ADI parameter, to transfer the threshold value to the function,
AP_PConst100	ADI parameter to transfer the constant parameter to the function,
AP_PT_IDMT	ADI parameter, to transfer the 20 times of the time multiplier to the function,
AP_PConstIntegrDown	ADI parameter to transfer the constant parameter to the function,
Inp	is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.

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ANSI 51_3Ph

Task of the function

This function realises inverse definite minimum time overcurrent protection tasks with three currents. The status signals of the individual starting are generated without additional time delay. The time delay of the trip command is generated according to standard current dependent characteristics. The type of the inverse characteristic can be selected by a parameter:

$$\text{Normal inverse (Type =0)} \quad T = T_N \frac{0.14}{\left(\frac{I}{I_N}\right)^{0.02} - 1}$$

$$\text{Very inverse (Type =1)} \quad T = T_N \frac{13.5}{\left(\frac{I}{I_N}\right)^1 - 1}$$

$$\text{Extremely inverse (Type =2)} \quad T = T_N \frac{80}{\left(\frac{I}{I_N}\right)^2 - 1}$$

In all three cases the rated starting current (I_N) and the time multiplier (T_N) is to be set by parameters.

The relation of the time multiplier and the assigned parameter is explained by the following formula:

$$T = T_N \frac{c1}{\left(\frac{I_2}{I_N}\right)^{c2} - 1} = \frac{P_IDMT}{20} \frac{c1}{\left(\frac{I_2}{I_N}\right)^{c2} - 1}$$

Which means that the parameter is 20 times the usual time multiplier. If for example the parameter setting is $P_TIDMT=1$, then it corresponds to the time multiplier $T_N = 0.05$ s. The parameter is expressed in [s].

The function is extended with a minimum time delay as well (IDMT). This time delay can be set by a dedicated parameter. The function generates a trip command if both the delay of the inverse characteristics AND this minimal time delay is over.

This function performs the decision and the time delay only. For the operation it needs for example a Fourier algorithm, the data stored in the data structure of this algorithm are processed.

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Inputs

The function processes the calculated results of three Fourier current routines, and generates trip command. (See for example FFT_CT_3PH.)

Parameters

The function applies the following parameters:

- PIn: threshold value of the function (10...104, step 1) % related to the rated current of the current transformer input,
- P_TIDMT: 20-times value of the time multiplier (1...256, step 1) [*20 ms].
- PType: parameter for selection among the types of the inverse characteristic (0, 1, 2)
- P_TDMT: the minimal delay time (50 ... 500, step 1) ms.

LCD text*	Min **	Max **	Step **	Remark
IDMT Type (0,1,2)	0	2	1	Type selection for the characteristics, see equations above
Ipick/In %	10	104	1	Pick-up value of the function, related to the rated current of the CT, expressed in %
IDMT time multip /20 s	0	256	1	20*(time multiplier), expressed in s
Min.time delay ms	50	500	1	Minimal time delay, expressed in ms

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

The function needs the following constants:

- Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_3PH

The function needs the following constant parameters (both have factory settings):

- Pconst100 its value is 100% (in a motor protection for example it is a variable parameter)
- PconstInegrDown This parameter defines the rate of the drop-off.

Outputs

The function generates two status signals:

- Started state, which gets logic 1 if any of the phase currents is above the threshold value (OR relation of the three phases),

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- Time-out of the function based on the selected current-dependent characteristics. This status gets logic 1 if there is time-out in any phases AND in the same phase the minimum time delay is over as well.

Additionally for each phases there is a value available which is proportional to the time remaining to the trip command. This values decrease starting from 1000, at the generation of the trip command its value is 0.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_N_FUGGO pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constant parameters the POVER constant parameter must be available, which selects the “over-“ function.
- It is to be checked if the result of the three-phase Fourier calculation is available (e.g. Ix_FFT50Hz, x=a, b, c), these must be assigned to the Ix_FFT50Hz inputs.
- It is useful to define internal status variables, which are to be assigned to the IDMTStart and to the IDMTTrip status signals. (Remark: instead of internal status signals relay outputs or LED-s can be assigned as well.)

The function automatically defines the following objects:

- IDMTOC_ANSI51_x these are the functions assigned to the three phases (x=1,2,3),
- AP_PIn ADI parameter which transfers the threshold value to the function,
- Pin The threshold parameter with the defined limits and step value,
- AP_PT_IDMT ADI parameter, to transfer the 20 times value of the time multiplier to the function,
- PT_IDMT the 20 times value of the time multiplier with the defined limits and step value,
- AP_PType ADI parameter, to transfer the type of the characteristics to the function,
- PType the type of the characteristics (0, 1, 2),
- AP_PConst100 ADI parameter to transfer the constant parameter to the function,
- PConst100 constant parameter the value of which is 100,
- AP_PConstIntegrDown ADI parameter to transfer the constant parameter to the function,
- PConstIntegrDown constant parameter the value of which is defined by the factory,
- PTDMT the minimal delay time with the pre-defined limits and step value,
- TimDMT timer to measure the minimum delay time,

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- `AdiIDMTStart_x` ADI status which signals the started state (x=a, b, c),
- `AdiIDMTTrip_x` ADI status which signals the time-out state according to the inverse characteristics (x=a, b, c),
- `AdiMeas_RemTime_x` the countdown in the individual phases (x=a, b, c).
- Internal logic equations to:
 - Transfer the logic OR connection of the `AdiIDMTStart_x` (x=a, b, c) ADI status values to the assigned internal variable,
 - Start the timers (start time delay) with the starting internal variable,
 - Transfer the time-out of the characteristics AND the time-out of the minimum delay time in the individual phases in logic OR relation to the other internal variable.

Internal parameters of the function

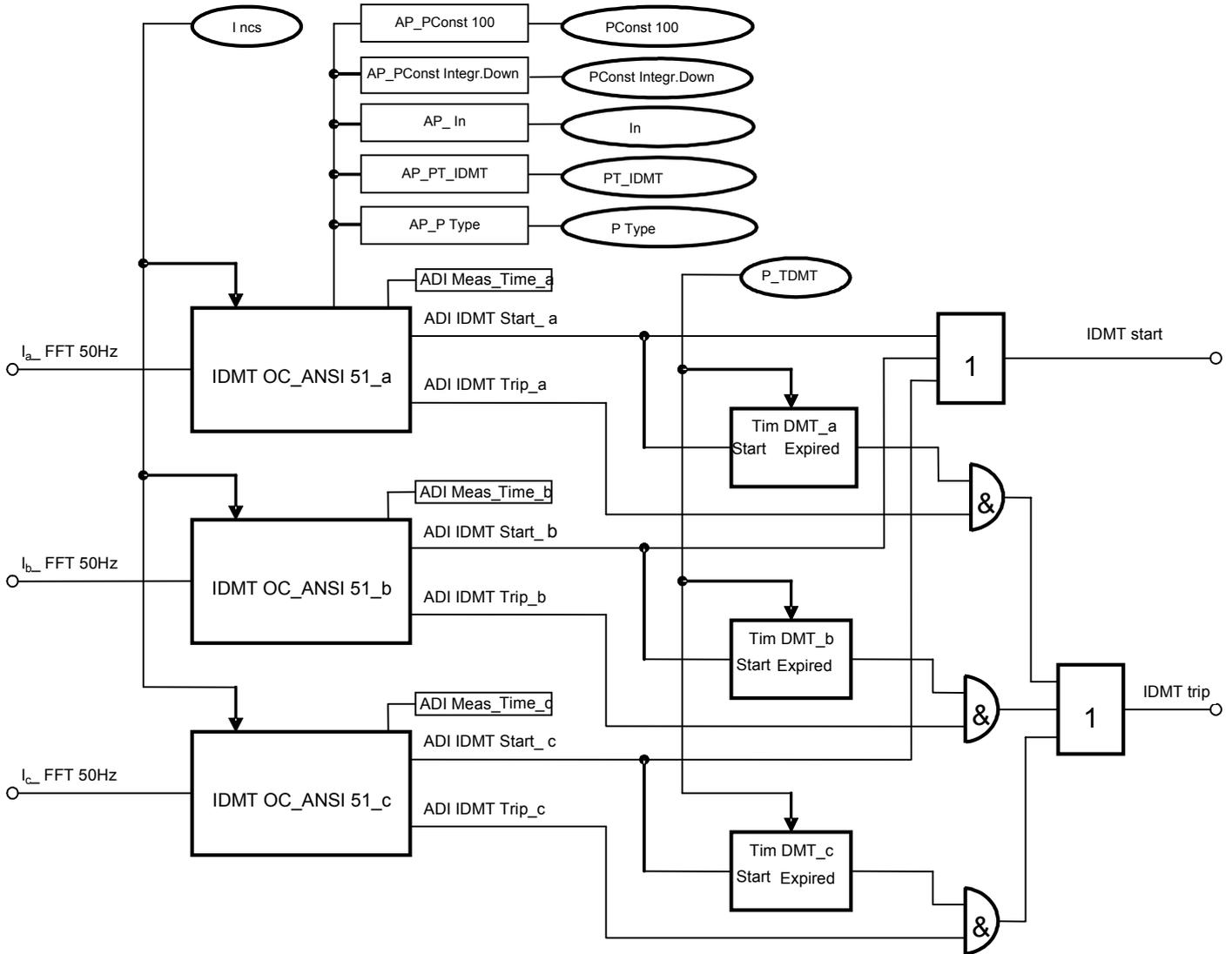
The IDMT function is invoked with the following parameters:

`AR_N_FUGGO, AP_PType, Ix_FFT50Hz, AdiIDMTStart_x, AdiMeas_RemTime_x, AP_In, AP_PConst100, AP_PT_IDMT, AP_PConstIntegrDown, Inp`

<code>AR_N_FUGGO</code>	relay constant,
<code>AP_PType</code>	ADI parameter, to transfer the selected type of characteristics to the function,
<code>Ix_FFT50Hz</code>	the Fourier functions the calculated values of which serve as input for the function,
<code>AdiIDMTStart_x</code>	ADI status to signal the started state in each phase,
<code>AdiIDMTTrip</code>	ADI status to signal the time-out state of the inverse characteristics in each phases,
<code>AdiMeas_RemTime_x</code>	the countdown values in each phases,
<code>AP_In</code>	ADI parameter, to transfer the threshold value to the function,
<code>AP_PConst100</code>	ADI parameter to transfer the constant parameter to the function,
<code>AP_PT_IDMT</code>	ADI parameter, to transfer the 20 times of the time multiplier to the function,
<code>AP_PConstIntegrDown</code>	ADI parameter to transfer the constant parameter to the function,
<code>Inp</code>	is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.

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ANSI 51_3Ph



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ANSI67N

Task of the function

Aim of the function is the realisation of the directional earth-fault protection.

Inputs

The inputs of the function are the Fourier basic harmonic components of the zero sequence current and those of the zero sequence voltage.

Parameters

For the operation of the function the following constants are needed:

- Unp is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_VT_1PH
- Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_1PH
- POVER pre-defined constant, which selects the “over-“ function.

The parameters of the function are:

- $PuoR$ the threshold value for the $3U_0$ zero sequence voltage, below which no directionality is possible. (10 ... 110, step 1) % related to the rated voltage of the voltage transformer input.
- $POC_3IoSens$ the threshold value for the $3I_0$ zero sequence current, below which no operation is possible. (10 ... 140, step 1) % related to the rated current of the current transformer input.
- $PioUoFiMin$ lower limit of the operating angle range, (0 ... 359, step 1 degrees)
- $PioUoFiMax$ upper limit of the operating angle range, (0 ... 359, step 1 degrees)
- $PioUoFiHist$ hysteresis of the operating angle range, (0 ... 359, step 1 degrees)
- $PioUoFiComp$ compensating angle to correct the angle error differences of the current transformer and the voltage transformer, (0 ... 3599, step 1/10 degrees)
- $PTOCIoFiDly$ time delay of the function,

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LCD text*	Min **	Max **	Step **	Remark
Io>/Ion [CToProt] %	10	140	1	Threshold value of the overcurrent function
Uo>/Un [VT] %	10	110	1	Threshold value of the overvoltage function
Fi (IoUo) min deg	0	359	1	Angle characteristics lower limit in degrees
Fi (IoUo) max deg	0	359	1	Angle characteristics upper limit in degrees
Fi (IoUo) hist deg	0	359	1	Hysteresis of the characteristics
Fi (IoUo) comp /10 deg	0	3500	1	Angle error compensation in deg/10
t [IoFi>] ms	0	60000	1	Time delay in ms

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

Outputs

The output of the function is the `AdiMeas_Fi` measured angle value between the voltage and the current.

Status outputs:

- Started state, which gets logic 1 if the current is above the threshold value, and in the moment of starting the voltage is above the threshold value and the angle between the voltage and the current is within the defined angle range.
- Time-out state of the dedicated timer.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the `AR_FOUR_DONT`, `AR_FOURIER_SZOGSZAM` and `AR_FOURIER_SZOGRELE` pre-defined constant must be available.
- Among the constants the `Inp` value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constants the `Unp` value must be available, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constant parameters the `POVER` constant parameter must be available, which selects the “over-“ function.
- It is to be checked if the result of the Fourier calculations are available (e.g. `U_FFT50Hz` and `I_FFT50Hz`), this must be assigned to the `U_FFT50Hz` and `I_FFT50Hz` inputs.

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- It is useful to define two internal status variables, which are to be assigned to the OC3PhStart and OC3PhTrip status signals. (Remark: instead of internal status signals relay outputs or LED-s can be assigned as well.)

The function automatically defines the following objects:

- CalcAngleIo angle calculation function, which determines the angle value and store it in the Fourier data structure. The result is available only for further data processing.
- CalcAngleUo angle calculation function, which determines the angle value and store it in the Fourier data structure. The result is available only for further data processing.
- ANSI50N overcurrent function, the operating status signal of which is available only for further data processing.
- AdiStOCStart operating status signal of the overcurrent function.
- AP_POC_3IoSens ADI parameter, which transfers the parameter setting to the overcurrent function ,
- POC_3IoSens threshold parameter of the overcurrent function with the defined limits and step value,
- ANSI59N overvoltage function, the operating status signal of which is available only for further data processing.
- AdiStVoltRelStart operating status signal of the overvoltage function.
- AP_PUoR ADI parameter, which transfers the parameter setting to the overvoltage function
- PUoR threshold parameter of the overvoltage function with the defined limits and step value,
- DirectionIoUo directional decision function, the operating status signal of which is available only for further data processing
- AdiIoUoFiStart operating status signal of the directional decision function.
- AP_PIoUoFiMin ADI parameter, which transmits the lower angle limit parameter to the directional decision function,
- PIoUoFiMin the lower angle limit parameter to the directional decision function with the defined limits and step value,
- AP_PIoUoFiMax ADI parameter, which transmits the upper angle limit parameter to the directional decision function,
- PIoUoFiMax the upper angle limit parameter to the directional decision function with the defined limits and step value,
- AP_PIoUoFiHist ADI parameter, which transmits the angle hysteresis parameter to the directional decision function,
- PIoUoFiHist the angle hysteresis parameter to the directional decision function with the defined limits and step value,
- AP_PIoUoFiComp ADI parameter, which transmits the angle error compensation parameter to the directional decision function,
- PIoUoFiComp the angle error compensation parameter to the directional decision function with the defined limits and step value,
- TimOC_IoFiDly the dedicated timer,
- P_TOCIoFi the time delay parameter with the defined limits and step value,

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- Internal logic equations:
 - Transfer the started ADI status value to the assigned internal variable. The started state gets logic 1 if the current is above the threshold value, and in the moment of starting the voltage is above the threshold value and the angle between the voltage and the current is within the defined angle range. After starting the current itself keeps the state.
 - Start the timers (start time delay) with the starting internal variable,
 - Transfer the time-out of the timer to the other internal variable.

Internal parameters of the function

The overcurrent part of the function is invoked by the following parameters:

AR_FOUR_DONT	relay constant,
AdiStOCStart_Io	status signal for overcurrent starting,
I_FFT50Hz	The reference to the Fourier function,
AP_POC_3IoSens	ADI parameter, which transfers the parameter setting to the overcurrent function,
Inp	the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer,
AP_POVER	transferred constant parameter, which selects the “over-“ function.

The overvoltage part of the function is invoked by the following parameters:

AR_FOUR_DONT	relay constant,
AdiStVoltRelStart	status signal for overvoltage starting,
U_FFT50Hz	The reference to the Fourier function
AP_PUoR	ADI parameter, which transfers the parameter setting to the overcurrent function
Unp	the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer,
AP_POVER	transferred constant parameter, which selects the “over-“ function.

Current angle calculation:

AR_FOURIER_SZOGSZAM	relay constant,
I_FFT50Hz	the reference to the Fourier function.

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Voltage angle calculation:

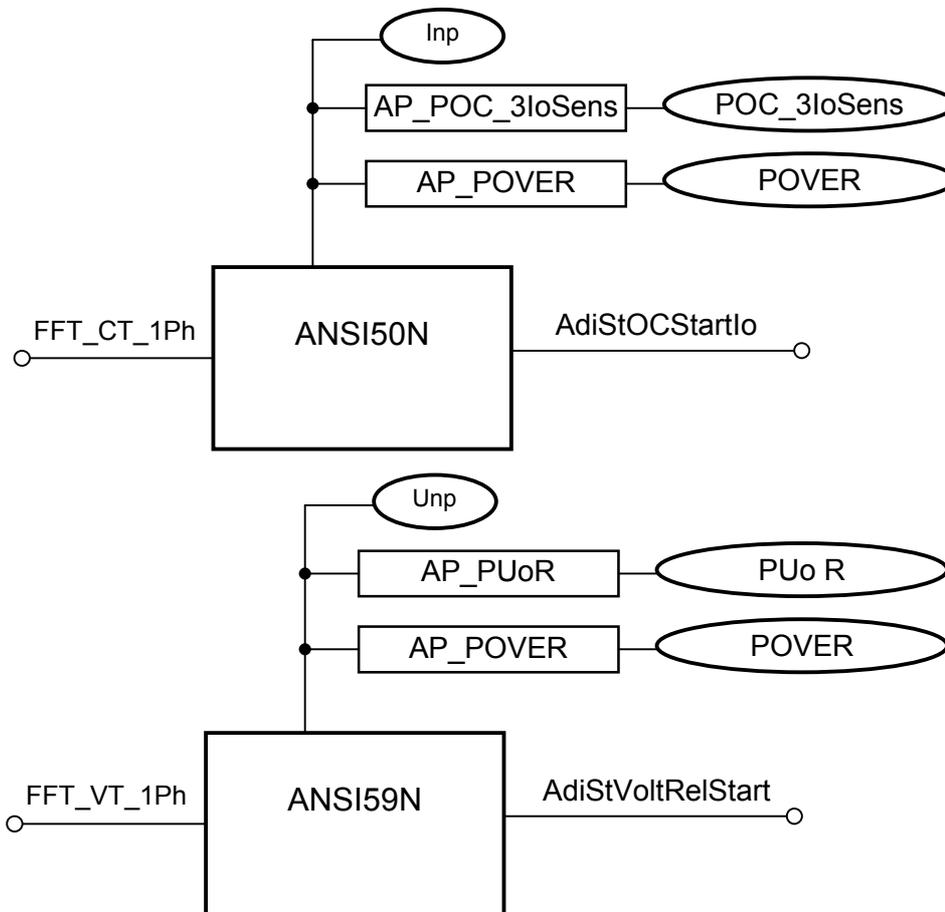
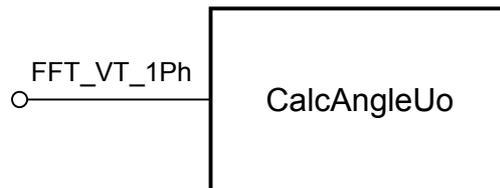
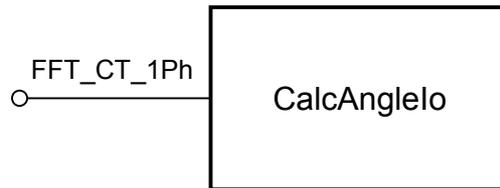
AR_FOURIER_SZOGSZAM, U_FFT50Hz
 AR_FOURIER_SZOGSZAM relay constant,
 U_FFT50Hz the reference to the Fourier function.

The directional decision function:

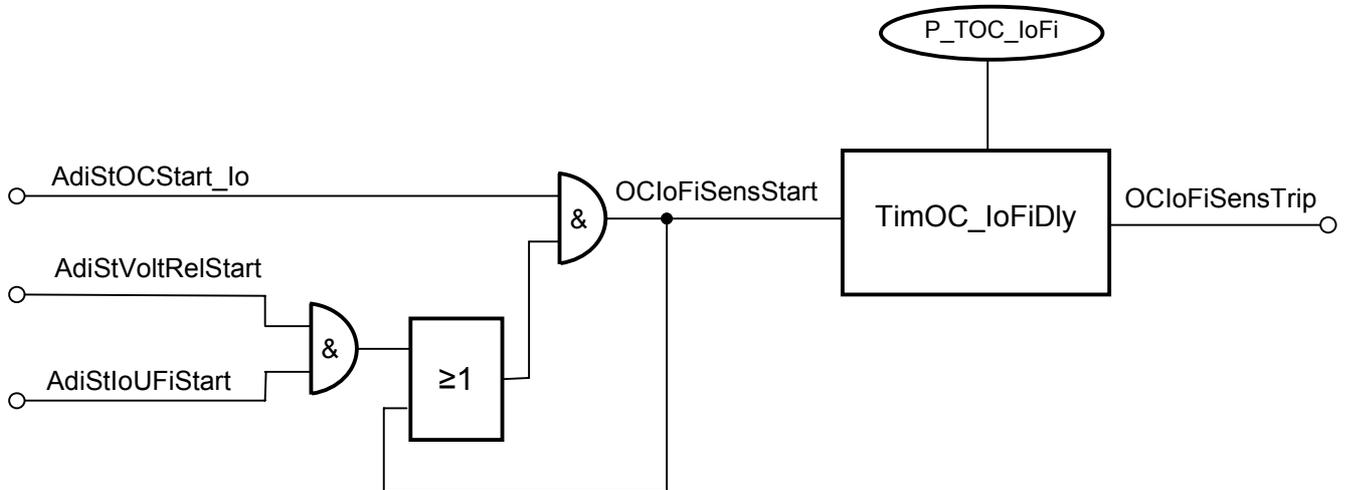
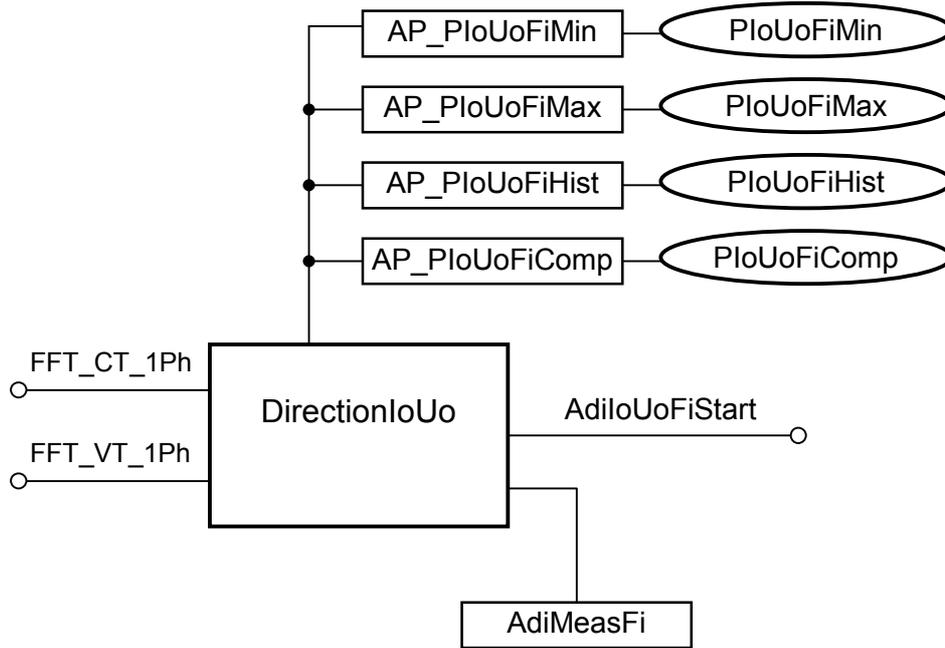
AR_FOURIER_SZOGRELE, AdiMeas_Fi, AdiIoUFiStart, U_FFT50Hz, I_FFT50Hz,
 AP_PioUoFiMin, AP_PioUoFiMax, AP_PioUoFiHist, AP_PioUoFiComp
 AR_FOURIER_SZOGRELE relay constant,
 AdiMeas_Fi the measured angle difference between the voltage and the
 current,
 AdiIoUFiStart status signal, which gets logic 1 if the angle is within the defined
 range,
 U_FFT50Hz The reference to the Fourier function,
 I_FFT50Hz The reference to the Fourier function,
 AP_PioUoFiMin ADI parameter, which transmits the lower angle limit parameter
 to the directional decision function,
 AP_PioUoFiMax ADI parameter, which transmits the upper angle limit parameter
 to the directional decision function,
 AP_PioUoFiHist the angle hysteresis parameter to the directional decision
 function with the defined limits and step value,
 AP_PioUoFiComp ADI parameter, which transmits the angle error compensation
 parameter to the directional decision function.

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ANSI59_27_1Ph

Task of the function

This is the realisation of the over-/undervoltage function with a single voltage, which can be a phase voltage, a calculated line-to-line voltage, but the usual application processes the zero sequence voltage. The threshold value is a parameter. The function starts with no additional time delay. The trip command can be delayed with parameter setting.

This function performs the decision and the timing only, it needs for the operation the results of a Fourier function as an example; it processes the data stored in the data structure of the Fourier function.

Inputs

This function performs data processing on the stored results of a Fourier function (see for example FFT_VT_1PH.)

Parameters

This function needs three parameter values:

- PUR: this is the threshold value of the over-/undervoltage function (10...110, step 1) % expressed related to the rated voltage transformer input voltage,
- PUType: this parameter defines if overvoltage (0) or undervoltage (1) function is applied,
- P_TUR: this is the time delay of the function (0...60000, step 10) ms.

LCD text	Min	Max	Step	Remark
U<>/Un [VT] %	10	110	1	Voltage relay start level, related tom the rated voltage of the VT, expressed in %
U<>type= [0=U>]	0	1	1	Selection parameter for over/undervoltage function
t [U<>] = ms	0	60000	10	Voltage relay time delay in ms

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

The function applies the following constant:

- Unp the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer, (see e.g. FFT_VT_1PH)

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Outputs

The function generates two status values:

- Starting state,
- Time-out state.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_FOUR_DONT pre-defined constant must be available.
- Among the constants the Unp value must be available, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.
- It is to be checked if the result of the single phase Fourier calculation is available (e.g. U_FFT50Hz), this must be assigned to the U_FFT50Hz input.
- It is useful to define two internal status variables, which are to be assigned to the Start and Trip status signals. (Remark: instead of internal status signals relay outputs or LED-s can be assigned as well.)

The function automatically defines the following objects:

- ANSI59_27_1Ph this is the function itself,
- AP_PUR ADI parameter, which is the transfer variable of the threshold parameter,
- PUR the threshold parameter with pre-defined limits and step value,
- P_TUR the parameter of the time delay with pre-defined limits and step value,
- TimUR_1PhDly the timer,
- diStVoltRelStart ADI status variable for the start state,
- Internal logic equations:
 - the AdiStVoltRelStart ADI status is transferred to the selected internal variable,
 - starting the timer (pull-on time delay) with the internal variable signalling the start state,
 - transferring the time-out state of the timer to the other internal variable.

Internal parameters of the function

The function is invoked with the following parameters:

AR_FOUR_DONT,AdiStVoltRelStart,U_FFT50Hz,AP_PUR,Unp,AP_PUType

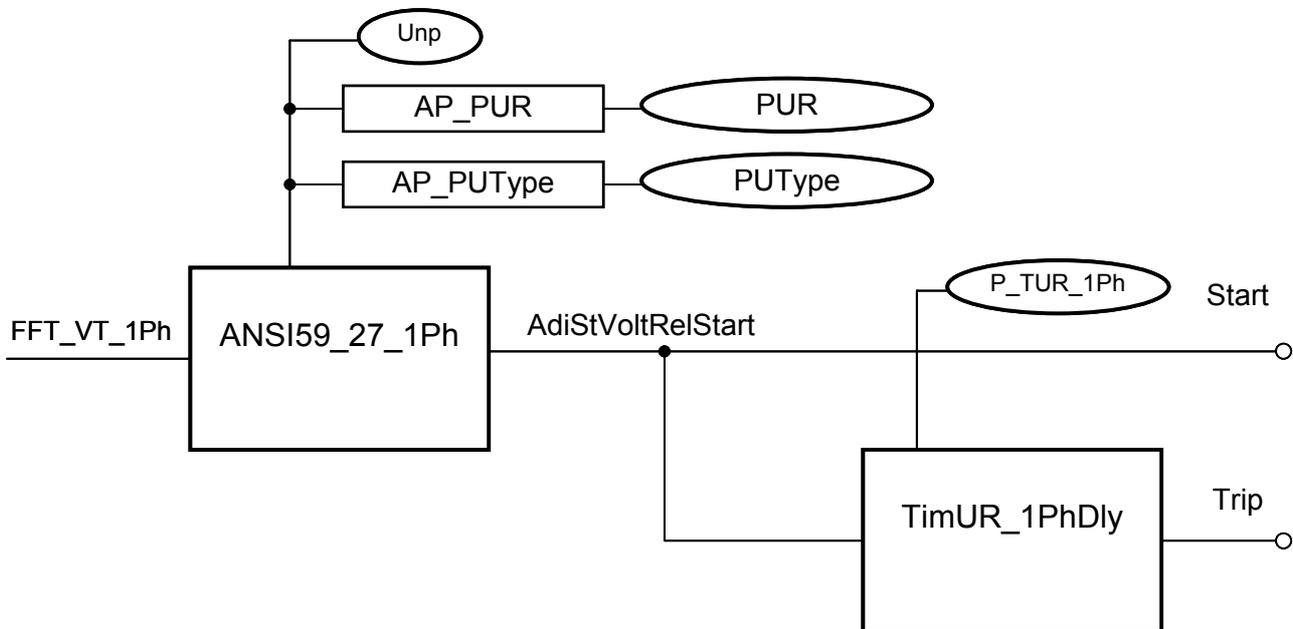
AR_FOUR_DONT relay constant,
 AdiStVoltRelStart ADI status to signal the started state,
 U_FFT50Hz The reference to the Fourier function,
 AP_PUR ADI parameter, which transfers the threshold value to the function,

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Unp the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer, (see e.g. FFT_VT_1PH)

AP_PUType ADI parameter, which transfers to the function the selection between over-/undervoltage operation.

ANSI59_27_1Ph



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ANSI59_27_3Ph

Task of the function

This is the realisation of the over-/undervoltage function with three voltages, which can be a phase voltages, or calculated line-to-line voltages. The threshold value is a parameter. The function starts with no additional time delay. The trip command can be delayed with parameter setting. The function evaluates the result of three measurement, and a parameter decides if one or at least two out of three limit violations are needed for the function to start the operation. The time delay is performed with a common timer.

This function performs the decision and the timing only, it needs for the operation the results of three Fourier functions; it processes the data stored in the data structures of the Fourier functions.

Inputs

This function performs data processing on the stored results of three Fourier functions (see for example FFT_VT_3PH.)

Parameters

The function needs the following parameters:

- PUR3Ph: threshold value of the function (10...110, step 1) % related to the rated voltage of the voltage transformer input,
- PUType3Ph: this parameter defines if overvoltage (0) or undervoltage (1) function is applied,
- PU3_2: this parameter defines if one or at least two out of three limit violations are needed for the function to start the operation,
- P_TUR_3Ph: time delay of the function (0...60000, step 10) ms.

LCD text*	Min **	Max **	Step **	Remark
U<>/Un [VT] %	10	110	1	Voltage relay start level, related to the rated voltage of the VT, expressed in %
U<>type= [0=U>]	0	1	1	Selection parameter for over/undervoltage function
t [U<>] = ms	0	60000	10	Voltage relay time delay in ms
2 out of 3 log: (1=ena)	0	1	1	Enabling parameter for the 2 out of 3 logic

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

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The function needs the following constants:

- Unp the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer, (see e.g. FFT_VT_3PH)

Outputs

The status variables assigned to the function are:

- Started state (in „OR” relationship of the phases),
- Time-out state.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_FOUR_DONT pre-defined constant must be available.
- Among the constants the Unp value must be available, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.
- It is to be checked if the result of the three-phase Fourier calculation is available (e.g. U1_FFT50Hz, U2_FFT50Hz, U3_FFT50Hz), this must be assigned to the Ux_FFT50Hz inputs.
- It is useful to define two internal status variables, which are to be assigned to the Start and Trip status signals. (Remark: instead of internal status signals relay outputs or LED-s can be assigned as well.)

The function automatically defines the following objects:

- ANSI59_27_3Ph this is the function itself,
- AP_PUR3Ph ADI parameter, which is the transfer variable of the threshold parameter,
- PUR3Ph the threshold parameter with pre-defined limits and step value,
- P_TUR_3Ph the parameter of the time delay with pre-defined limits and step value,
- TimUR3PhDly the timer,
- AdiStUxStart ADI status variables for the start states (x=1,2,3),
- Internal logic equations:
 - the AdiStUxStart ADI status is transferred to the selected internal variable,
 - starting the timer (pull-on time delay) with the internal variable signalling the start state,
 - transferring the time-out state of the timer to the other internal variable.

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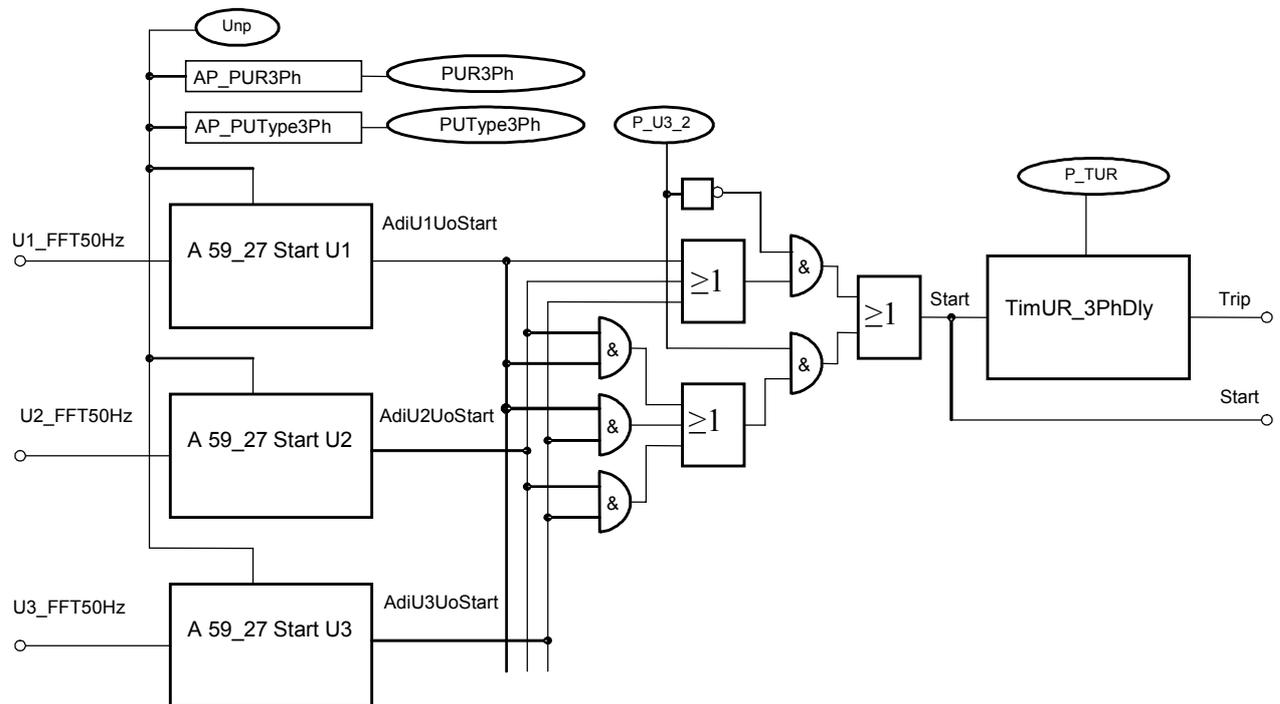
Internal parameters of the function

The functions are invoked with the following parameters:

AR_FOUR_DONT, AdiU1ouStart, U1_FFT50Hz, AP_PUR3Ph, Unp, AP_PUType3Ph

- AR_FOUR_DONT relay constant,
 AdiU1ouStart ADI status to signal the started state,
 U_x_FFT50Hz The reference to the Fourier functions (x=1,2,3),
 AP_PUR3Ph ADI parameter, which transfers the threshold value to the function,
 Unp the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer, (see e.g. FFT_VT_1PH)
 AP_PUType3Ph ADI parameter, which transfers to the function the selection between over-/undervoltage operation.

ANSI59 27 3Ph



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ANSI67_Four_3Ph-MV

Task of the function

This function realises directional phase-fault overcurrent protection.

Inputs

This function processes data which are pre-calculated based on sampled phase currents and phase voltages. These data are:

- the Fourier basic harmonic components calculated from phase currents, processed by the FFT_CT_3Ph software module.
- the Fourier basic harmonic components calculated from line-to line voltages. Here the line-to line voltages are calculated by the Make_3Ph_line_U module based on the sampled phase voltages. The Fourier analysis is performed by the FFT_CT_3Ph software module.
- the Fourier basic harmonic components calculated from phase current differences. Here the current differences are calculated by the Make_3Ph_line_I module based on the sampled phase currents. The Fourier analysis is performed by the FFT_VT_3Ph software module.

Parameters

For the operation of the function the following constants are needed:

- Unp is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_VT_3PH module.
- Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_3PH module.
- POVER pre-defined constant, which selects the “over-“ function.

The parameters of the function are:

- PUR is the threshold value for the voltage, below which no directionality is possible. (3 ... 15, step 1) % related to the rated voltage of the voltage transformer input.
- POC_Ansi67 is the threshold value for the current, below which no operation is possible. (3 ... 2500, step 5) % related to the rated current of the current transformer input.
- PioUoFiMin lower limit of the operating angle range, (0 ... 359, step 1 degrees),
- PioUoFiMax upper limit of the operating angle range, (0 ... 359, step 1 degrees),
- PioUoFiHist hysteresis of the operating angle range, (0 ... 359, step 1 degrees),
- PioUoFiComp compensating angle to correct the angle error differences of the current transformer and the voltage transformer, (0 ... 3599, step 1/10 degrees),
- PTOCIOFiDly is the time delay of the function, (0 ... 6000, step 10) ms.

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LCD text*	Min **	Max **	Step **	Remark
I>/In [CT] %	30	2500	5	Threshold value of the overcurrent function
U>dir/Un [VT] = %	3	15	1	Threshold value of the overvoltage function
Fi (IU) min deg	0	359	1	Angle characteristics lower limit in degrees
Fi (IU) max deg	0	359	1	Angle characteristics upper limit in degrees
Fi (IU) hist deg	0	359	1	Hysteresis of the characteristics
Fi (IU) comp/10 deg	0	3500	1	Angle error compensation in deg/10
t [IFi>] ms	0	60000	1	Time delay in ms

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

Outputs

The outputs of the function are the `AdiMeas_Fi_ab`, `AdiMeas_Fi_bc` `AdiMeas_Fi_ca` measured angle values between the voltages and the currents.

Status outputs:

- Started state, which gets logic 1 if there is a line-to line voltage and current pair, where the voltage is above the threshold value, the angle between them is within the defined angle range, and the current of the pair involves the phase current first in the phase sequence, which is above the threshold value. The parameter setting defines if the starting state is generated only by the current, without the voltage and directionality constraints. There is additionally a PROTLOG logic equation output, the influence of which is that the function starts with current level violation only.
- Time-out state of the dedicated timer.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the `AR_FOUR_DONT`, `AR_FOURIER_SZOGSZAM` `AR_FOURIER_SZOGRELE` pre-defined constant must be available.
- Among the constants the `Inp` value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constants the `Unp` value must be available, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constant parameters the `POVER` constant parameter must be available, which selects the “over-“ function.
- It is to be checked if the result of the Fourier calculations are available (e.g. `FFT_VT_3Ph` and `FFT_CT_3Ph`), this must be assigned to the inputs.

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- It is useful to define two internal status variables, which are to be assigned to the OC3PhStart and OC3PhTrip status signals. (Remark: instead of internal status signals relay outputs or LED-s can be assigned as well.)

The function automatically defines the following objects:

- CalcAngleIxy angle calculation functions, which determine the angle values and store them in the Fourier data structures. The results are available only for further data processing. (xy = ab, bc, ca)
- CalcAngleUxy angle calculation functions, which determine the angle value and store them in the Fourier data structures. The results are available only for further data processing. (xy = ab, bc, ca)
- ANSI50Ix overcurrent functions, the operating status signals of which are available only for further data processing. (x=a,b,c)
- AdiStOCStart_Ix operating status signals of the overcurrent functions. (x=a,b,c)
- AP_POC_Ansi67 ADI parameter, which transfers the parameter setting to the overcurrent function ,
- POC_Ansi67 threshold parameter of the overcurrent function with the defined limits and step value,
- ANSI59_Uxy overvoltage functions, the operating status signal of which are available only for further data processing. (xy = ab, bc, ca)
- AdiStVoltRelStart_Uxy operating status signals of the overvoltage functions. (xy = ab, bc, ca)
- AP_PUR ADI parameter, which transfers the parameter setting to the overvoltage functions,
- PUR threshold parameter of the overvoltage functions with the defined limits and step value,
- DirectionIU_xy directional decision functions, the operating status signal of which are available only for further data processing. (xy = ab, bc, ca)
- AdiIoUFiStart_xy operating status signals of the directional decision functions. (xy = ab, bc, ca)
- AP_PIoUoFiMin ADI parameter, which transmits the lower angle limit parameter to the directional decision function,
- PIoUoFiMin the lower angle limit parameter to the directional decision function with the defined limits and step value,
- AP_PIoUoFiMax ADI parameter, which transmits the upper angle limit parameter to the directional decision function,
- PIoUoFiMax the upper angle limit parameter to the directional decision function with the defined limits and step value,
- AP_PIoUoFiHist ADI parameter, which transmits the angle hysteresis parameter to the directional decision function,
- PIoUoFiHist the angle hysteresis parameter to the directional decision function with the defined limits and step value,
- AP_PIoUoFiComp ADI parameter, which transmits the angle error compensation parameter to the directional decision function,

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- PloUoFiComp the angle error compensation parameter to the directional decision function with the defined limits and step value,
- TimOC_IFiDly the dedicated timer,
- P_TOCIFI the time delay parameter with the defined limits and step value,
- St_EnOCDir output variable of the PROTLOG equations, which enables directionality.
- ParOCTipNoUeng logic parameter, which enables directionality.
- Internal logic equations:
 - Transfer the started ADI status value to the assigned internal variable. The started state gets logic 1 if there is a line-to line voltage and current pair, where the voltage is above the threshold value, the angle between them is within the defined angle range, and the current of the pair involves the phase current first in the phase sequence, which is above the threshold value. The parameter setting defines if the starting state is generated only by the current, without the voltage and directionality constraints. There is additionally a PROTLOG logic equation output, the influence of which is that the function starts with current level violation only.
 - Start the timers (start time delay) with the starting internal variable,
 - Transfer the time-out of the timer to the internal variable.

Internal parameters of the function

The overcurrent part of the function is invoked by the following parameters:

AR_FOUR_DONT	relay constant,
AdiStOCStart_Ix	status signals for overcurrent starting, (x=a,b,c)
Ix_FFT50Hz	The references to the Fourier functions, (x=a,b,c)
AP_POC_Anisi67	ADI parameter, which transfers the parameter setting to the overcurrent function,
Inp	the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer,
AP_POVER	transferred constant parameter, which selects the “over-“ function.

The overvoltage part of the function is invoked by the following parameters:

AR_FOUR_DONT	relay constant,
AdiStVoltRelStart_Uxy	status signals for overvoltage starting, (xy=ab, bc, ca)
Ux_FFT50Hz	The references to the Fourier functions (x=1,2,3)
AP_PUR	ADI parameter, which transfers the parameter setting to the overcurrent function
Unp	the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer,
AP_POVER	transferred constant parameter, which selects the “over-“ function.

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Current angle calculation:

AR_FOURIER_SZOGSZAM, Ix_FFT50Hz
 AR_FOURIER_SZOGSZAM relay constant,
 Ix_FFT50Hz The references to the Fourier functions. (x=a,b,c)

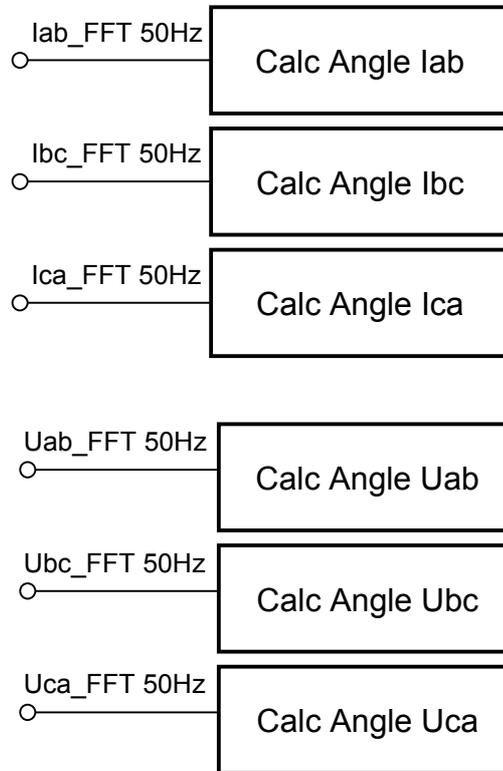
Voltage angle calculation:

AR_FOURIER_SZOGSZAM, Ux_FFT50Hz
 AR_FOURIER_SZOGSZAM relay constant,
 Ux_FFT50Hz The references to the Fourier functions. (x=1,2,3)

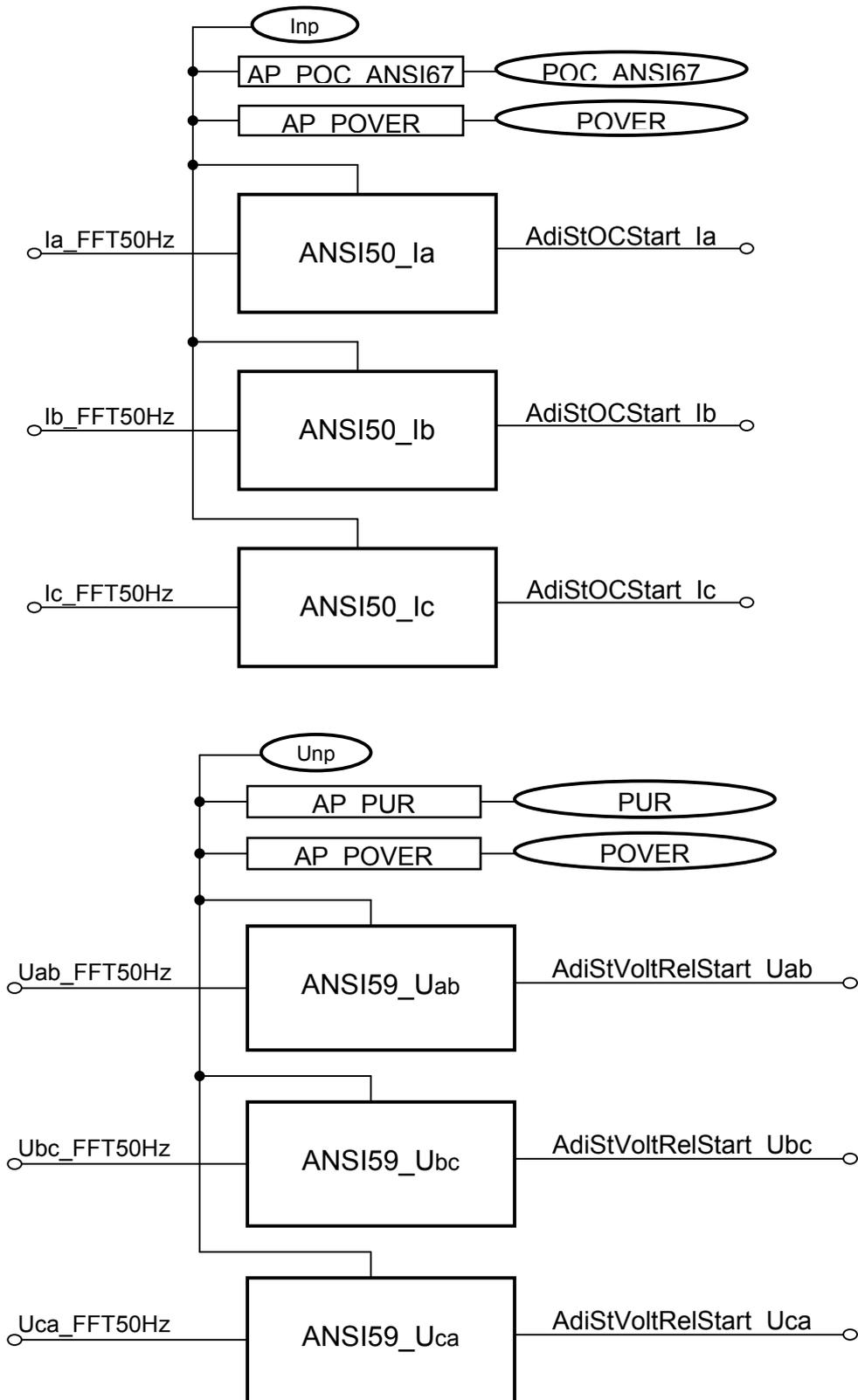
The directional decision function:

AR_FOURIER_SZOGRELE, AdiMeas_Fi_xy, AdiIoUFiStart_xy, Ux_FFT50Hz, Ix_FFT50Hz,
 AP_PiUFiMin, AP_PiUFiMax, AP_PiUFiHist, AP_PiUFiComp
 AR_FOURIER_SZOGRELE relay constant,
 AdiMeas_Fi_xy the measured angle differences between the voltages and the
 currents, (xy=ab, bc, ca)
 AdiIoUFiStart_xy status signals which gets logic 1 if the angle is within the
 defined range, (xy=ab, bc, ca)
 Ux_FFT50Hz The references to the Fourier functions, (x=1,2,3)
 Ix_FFT50Hz The references to the Fourier functions, (x=a,b,c)
 AP_PioUoFiMin ADI parameter, which transmits the lower angle limit parameter
 to the directional decision function,
 AP_PioUoFiMax ADI parameter, which transmits the upper angle limit parameter
 to the directional decision function,
 AP_PioUoFiHist the angle hysteresis parameter to the directional decision
 function with the defined limits and step value,
 AP_PioUoFiComp ADI parameter, which transmits the angle error compensation
 parameter to the directional decision function.

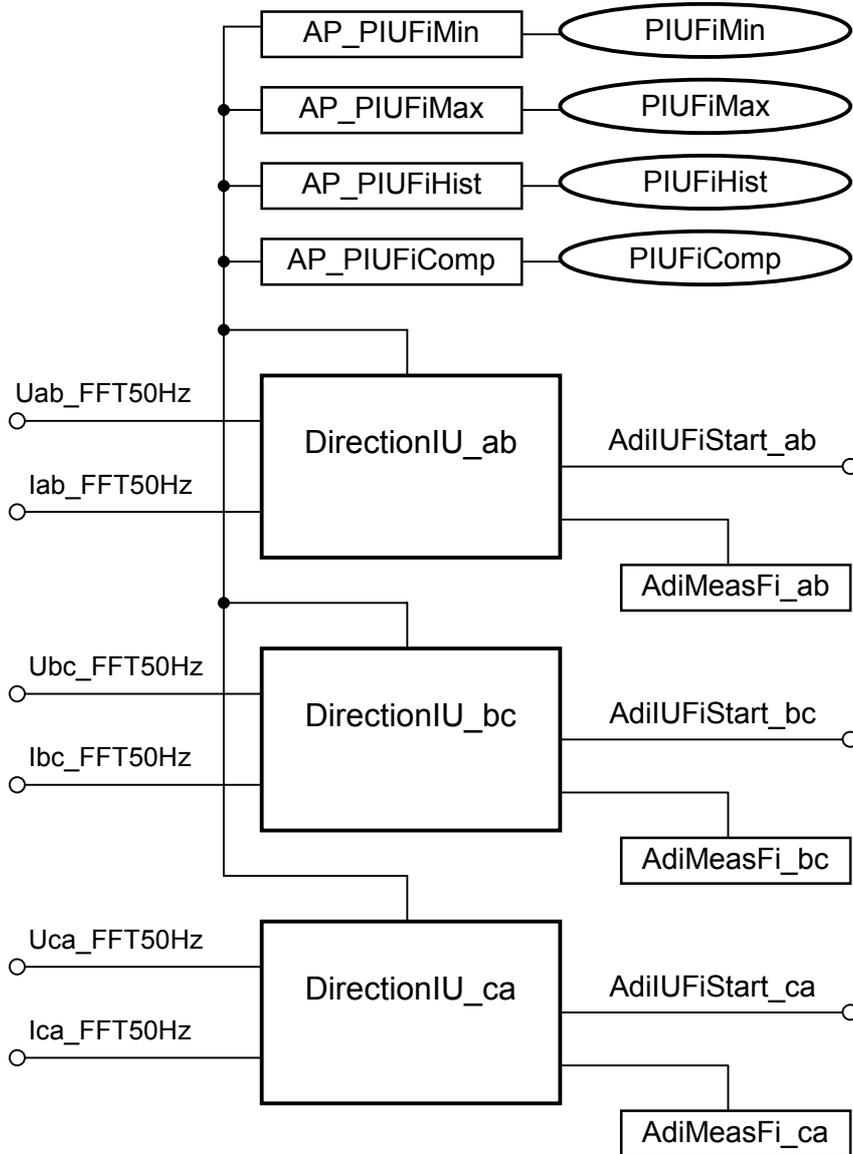
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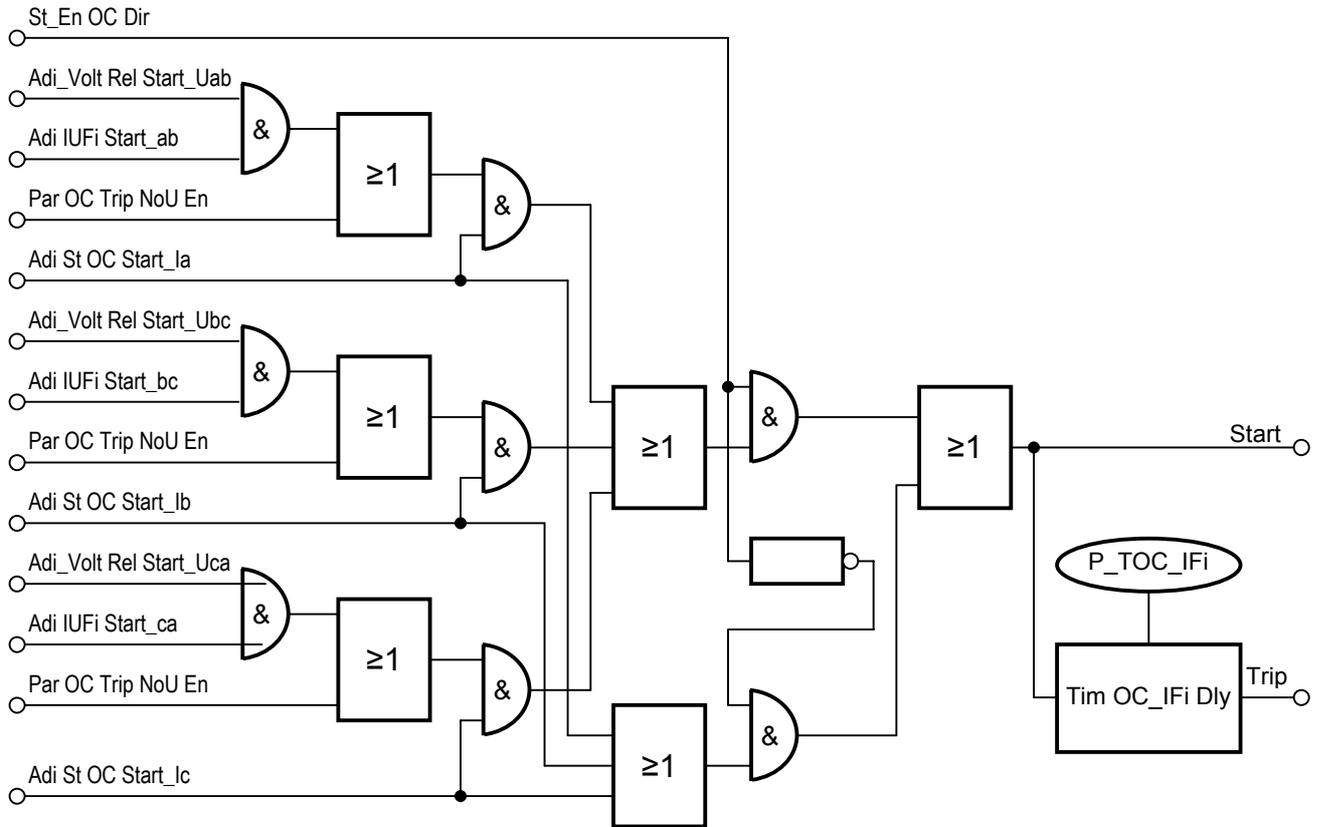
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CB failure

Task of the function

This function realises circuit breaker failure protection function.

Inputs

The function processes the results of three Fourier current software modules from the decision. (See e.g. CT_3PH.)

The binary inputs of the function:

- CB_Failure_start This is the starting status signal for the function, this must be defined in the configuration process.
- CB_Open This is the status signal, indicating the open state of the circuit breaker. This must be defined in the configuration process.

Parameters

The circuit breaker failure function involves three overcurrent functions, the parameter of which is the threshold value.

- POC_: threshold value of the overcurrent function (10...2500,5) % related to the rated current of the current transformer,
- P_TCB_Fail: this is the time delay parameter of the circuit breaker failure function (0...60000,10) ms.

LCD text*	Min **	Max **	Step **	Remark
I [CBFail]/In [CT]	10	2500	5	Threshold value of the overcurrent function related to the rated current of the CT
t [CB Fail] ms	0	64000	10	Time delay in ms

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

The constants needed for the operation of the function are:

- Inp the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer, (the same constant is applied e.g. by FFT_CT_3PH)
- AP_POVER transferred constant parameter, which selects the “over-“ function.

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Outputs

The function has only one digital output:

- CBFailTrip which indicates the time-out state of the dedicated timer.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_FOUR_DONT pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constant parameters the POVER constant parameter must be available, which selects the “over-“ function.
- It is to be checked if the result of the Fourier calculations are available (e.g. Ia_FFT50Hz, Ib_FFT50Hz, Ic_FFT50Hz), this must be assigned to the inputs.
- It is useful to define an internal status variable, which is to be assigned to the CBFailTrip status signal. (Remark: instead of internal status signal relay output or LED can be assigned as well.)

The function automatically defines the following objects:

- ANSI50StartIx Overcurrent functions, (x=a,b,c),
- AP_POC ADI parameter, which transfers the parameter setting to the overcurrent function,
- POC The threshold value with the defined limits and step value,
- P_TCB_Fail The time delay parameter with the defined limits and step value,
- TimCBFailDly the dedicated timer,
- AdiStCBStartIx ADI status values to indicate the started states of the internal functions, (x=a,b,c),
- Internal logic equations:
 - Starting the timer with the combination of the logic status signals. The timer starts, if the „CB_Failure_start” logic signal is active, and at the same time there is overcurrent stating in any of the phases, or the circuit breaker is closed (NOT(CB Open)),
 - The time-out state of the timer is transmitted to the dedicated internal variable.

Internal parameters of the function

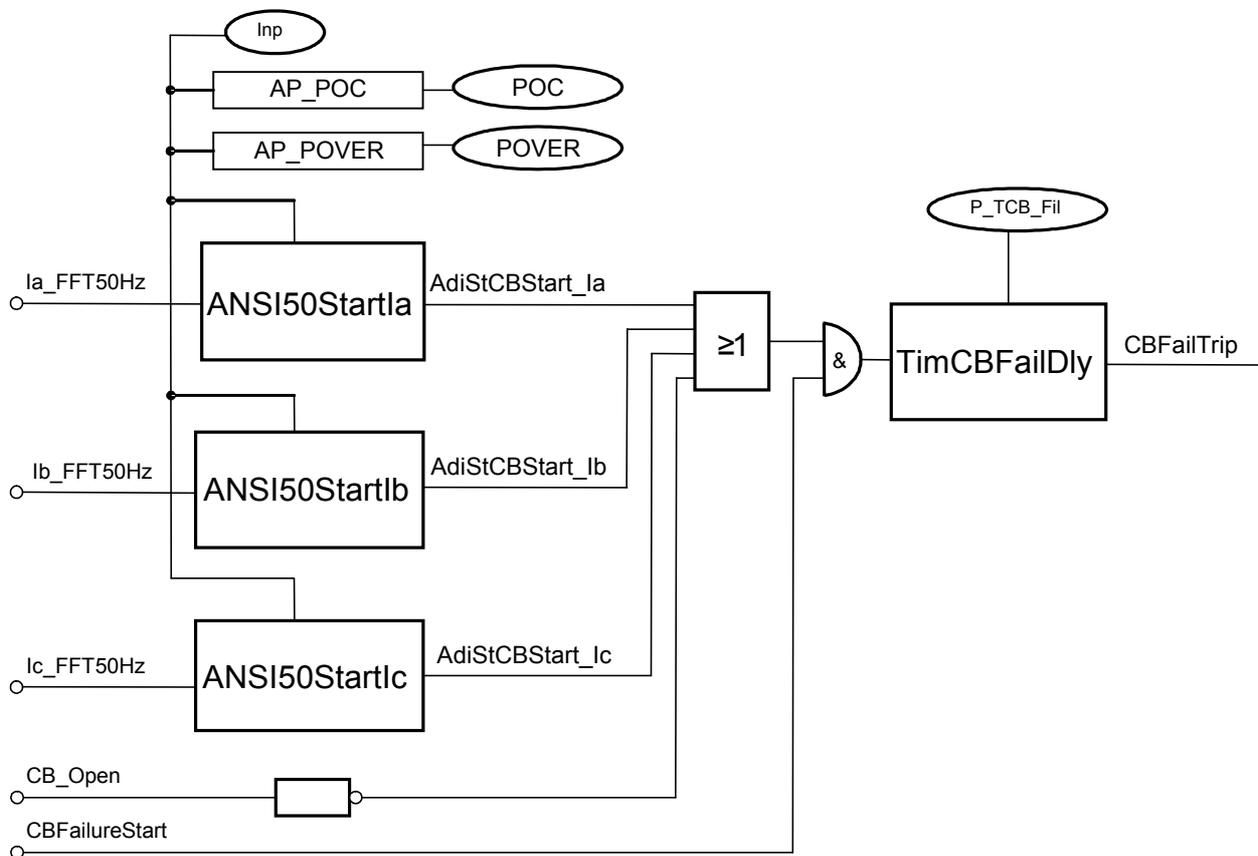
The overcurrent functions are invoked with the following parameters:

AR_FOUR_DONT	relay constant,
AdiStCBStart_Ix	overcurrent starting status values, (x=a,b,c)
Ix_FFT50Hz	references to the Fourier routines, (x=a,b,c)
AP_POC	ADI parameter, which transfers the parameter setting to the overcurrent function,

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Inp the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer,
 AP_POVER transferred constant parameter, which selects the “over-“ function.

CB_Failure



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ANSI 50_3x1Ph_Start

Task of the function

This function is the realisation of a definite time overcurrent starting function with a three currents. The threshold value is a parameter. The function generates a start signal without time delay; this signal cannot be delayed. The function evaluates the started states of the three phase current comparisons individually.

This function performs the decisions only, for the operation it needs for example three Fourier algorithms too. It processes the values stored in the data structure of the Fourier routines.

Inputs

This function processes the calculated results of three Fourier routines, performs comparison and decision. (See e.g. FFT_CT_3PH.)

Parameters

The function needs one parameter value:

- POC: the threshold value of the overcurrent function (30...2500, step 5) % related to the rated current of the input current transformer,

LCD text*	Min **	Max **	Step **	Remark
I>/In [CT] %	10	2500	5	Current setting value, related to the rated current of the CT input, expressed in %

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

For the operation two constants are needed as well:

- Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_3PH.
- POVER defined constant parameter, which selects „over-„ function.

Outputs

The function generates the following status signals:

- The start status signals of the three-phase starting individually.

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Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_FOUR_DONT pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constant parameters the POVER constant parameter must be available, which selects the “over-“ function.
- It is to be checked if the result of the three-phase Fourier calculation is available (e.g. Ia_FFT50Hz, Ib_FFT50Hz, Ic_FFT50Hz), this must be assigned to the Ix_FFT50Hz inputs.
- It is useful to define internal status variables, which are to be assigned to the OC1PhStart_Ia, OC1PhStart_Ib, OC1PhStart_Ic and to the individual trip (timer time-out) status signals. (Remark: instead of internal status signals relay outputs or LED-s can be assigned as well.)

The function automatically defines the following objects:

- ANSI50Start_Ix these are the comparison functions for the phases individually (x=a, b, c),
- AP_POC ADI parameter, which is the transfer variable of the threshold parameter,
- POC the threshold parameter with pre-defined limits and step value,
- AdiStOCStart_Ix ADI status variables for the start state (x=a, b, c),
- Internal logic equations:
 - The AdiStOCStart_Ix ADI status values are transferred to the selected internal variables (x=a, b, c).

Internal parameters of the function

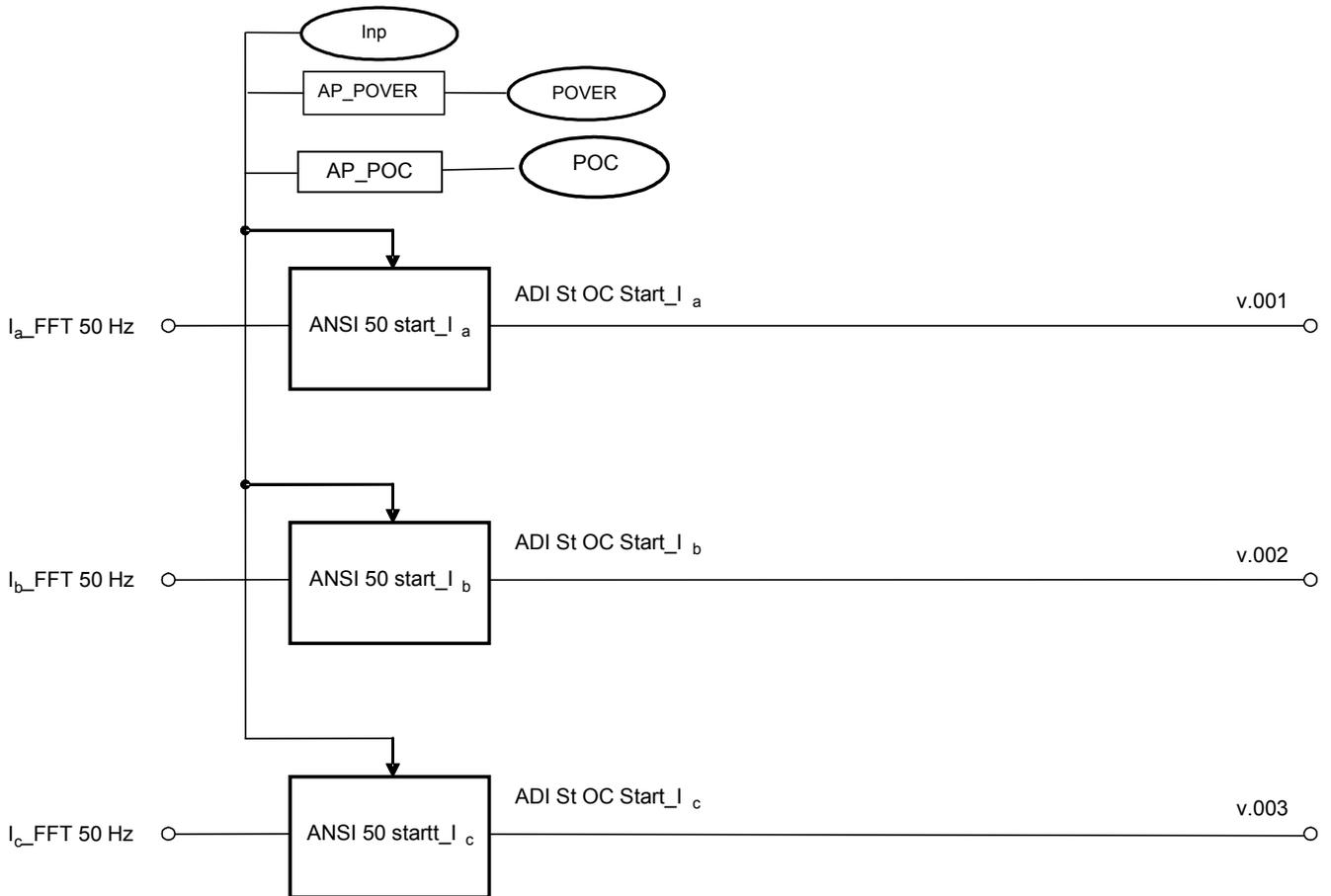
The comparing functions for the three phases are invoked with the following parameters:

AR_FOUR_DONT, AdiStOCStart_Ix, Ix_FFT50Hz, AP_POC, Inp, AP_POVER

AR_FOUR_DONT	relay constant (x=a, b, c),
AdiStOCStart_Ix	ADI status variables which signal the start state of the function (x=a, b, c),
Ix_FFT50Hz	the Fourier calculation functions (x=a, b, c),
AP_POC	ADI parameter, which is the transfer variable of the threshold parameter
Inp	is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer. The same constant is applied e.g. by FFT_CT_3PH.
AP_POVER	ADI parameter, which is the transfer variable for the POVER constant parameter. This selects the “over-“ function.

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ANSI 50_3x1PhStart



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ZphE_Calc_3point_3Ph

Task of the function

This function calculates the impedances of the three phase-earth loops. For this calculation the zero sequence current is needed too, which is usually calculated from the three measured phase currents. In applications with parallel lines the zero sequence current of the parallel line influences the measured impedance too. In this case a dedicated analogue input receives this current.

The theoretical formula to calculate the complex impedance is:

$$Z_{Ph_E} = \frac{U_{Ph}}{I_{Ph} + \alpha 3I_o + \beta 3I_{oP}}$$

where

- U_{Ph} the phase voltage vector,
- I_{Ph} the phase current vector,
- $3I_o$ the zero sequence current component,
- α the complex mixing factor for the zero sequence current (dependent on the positive and zero sequence impedance of the protected line),
- $3I_{oP}$ the zero sequence current component of the parallel line,
- β the complex mixing factor for the zero sequence current of the parallel line (dependent on the mutual and positive sequence impedance of the protected line).

The method of calculation is solving the differential equation of the faulty loop. In this method the complex mixing factors are resolved by two real factors individually:

$$\alpha_R = \frac{R_0 - R_1}{3R_1}, \alpha_L = \frac{L_0 - L_1}{3L_1}, \beta_R = \frac{R_m}{3R_1}, \beta_L = \frac{L_m}{3L_1}$$

where

- R_0 the zero sequence resistance of the protected line (for 1 km length),
- R_1 the positive sequence resistance of the protected line (for 1 km length),
- L_0 the zero sequence inductance of the protected line (for 1 km length),
- L_1 the positive sequence inductance of the protected line (for 1 km length),
- R_m the mutual resistance of the protected line and of the parallel line (for 1 km length),
- L_m the zero sequence inductance of the protected line and of the parallel line (for 1 km length),

The impedances are calculated with three sampled current and voltage values just after the zero crossing of the current. This method ensures correct calculated values even with serious current transformer saturation.

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The calculation is enabled, if the current value is above the pre-determined current limit. This avoids division by zero, and avoids errors caused by division with small and noisy sampled current values.

If the voltage is small because of close-in faults, the direction of the fault is decided based on pre-fault voltage samples, stored in the memory. The application of stored voltages is enabled if the voltage is below the pre-determined voltage limit.

In case of switch-onto-fault (SOTF) no voltages are stored in the memory. In this case – after a manual close command to the circuit breaker – the switch-onto-fault logic is enabled for a time span, determined by a parameter value.

The following Figure shows the internal logic of the impedance calculation. The decision needs three internal logic signals, (CURRENT_OK, VOLT_OK and MEM_AVAIL) and additionally a logic parameter setting SOTF_ENA. The explanation of these signals is as follows:

Status signal	Explanation
CURRENT_OK	The current is suitable for impedance calculation in the processed loop, if after a zero crossing there are three sampled values above a defined limit (constant parameter)
VOLT_OK	The voltage is suitable for the calculation, if among the last sampled three values there is a sample above the defined limit (constant parameter)
MEM_AVAIL	This status signal is true, if the voltage memory is filled up with available samples above the defined limit for 80 ms.
SOTF_ENA	This logic parameter is true, if the “switch-onto-fault” logic is enabled.

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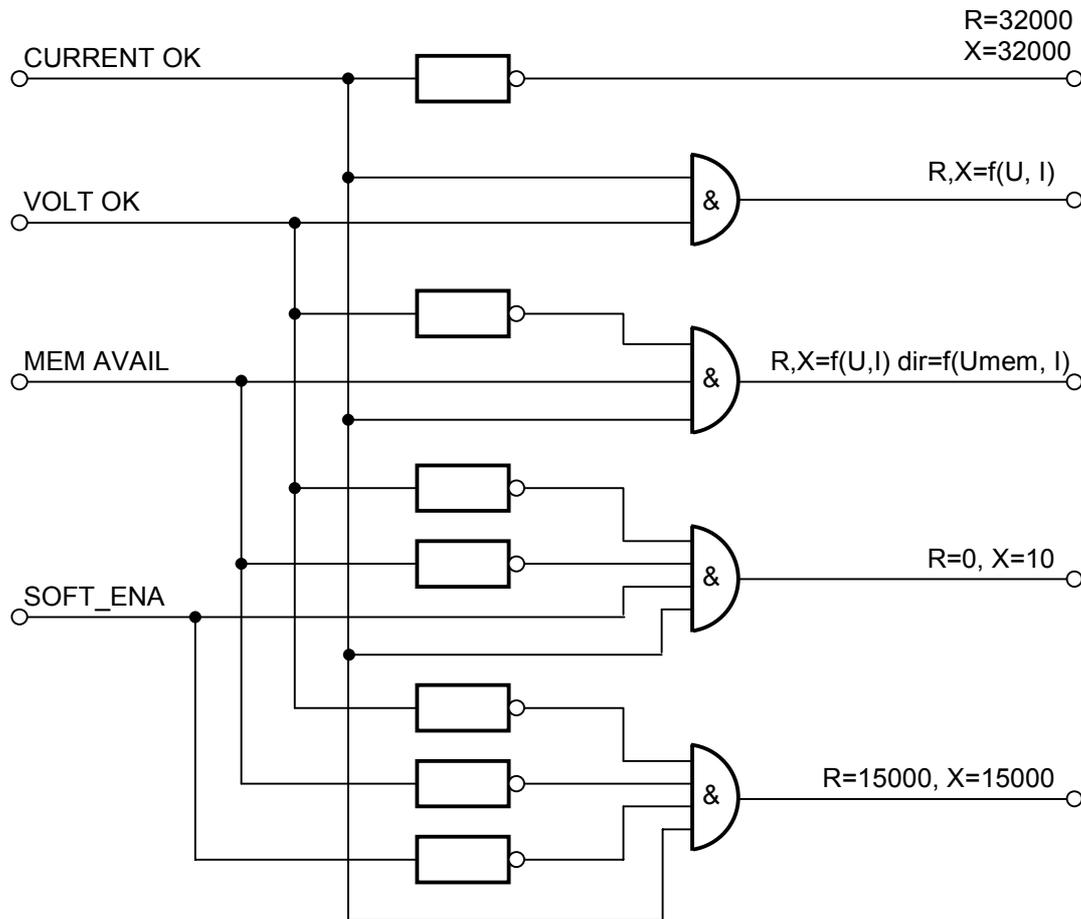


Fig Z_CALC internal logic

The short explanation of the internal logic for the impedance calculation is as follows:

If the CURRENT_OK status signal is false, the current is very small and so no fault is possible. In this case the impedance is set to extreme high values, and no further calculation is performed:

$$R=32000, X=32000 (*10 \text{ m}\Omega).$$

The subsequent decisions are performed, if the current is sufficient for the calculation.

If the CURRENT_OK status signal is true, and the VOLT_OK status signal is true as well, then the current is suitable for calculation, and the voltage is sufficient for the directionality decision. In this case normal impedance calculation is performed based on the sampled currents and voltages. (The calculation method is explained later.)

$$R, X=f(u, i)$$

If the CURRENT_OK status signal is true, but the VOLT_OK status signal is false, it means that the directionality decision cannot be performed based on the available voltage signals. In

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this case the magnitude of R and X is calculated based on the sampled currents and voltages, but the direction of the fault (the +/- sign of R and X) must be decided based on voltage value stored in the memory 80 ms earlier. This decision is possible only, if there are stored values in the memory for 80 ms, and these values were sampled during a healthy period.

$$R, X=f(u, i) \quad \text{direction} = f(u_{\text{mem}}, i)$$

If the voltage is not sufficient for directional decision, and no stored voltage samples are available, then the SOTF_ENA parameter is needed for the process: If the “switch-onto-fault” logic is enabled, then the fault is supposed to be just in front of the bus-bar in forward direction:

$$R=0, \quad X=10 (*10 \text{ m}\Omega).$$

If the voltage is not sufficient for directional decision, and no stored voltage samples are available, and “switch-onto-fault” logic is not enabled, then the impedance is set to a high value:

$$R=15000, \quad X=15000 (*10 \text{ m}\Omega).$$

The applied numerical method is solving the differential equation of the faulty loop, based on three consecutive samples.

Inputs

The inputs of the function are

- the three phase currents,
- the three phase voltages,
- the zero sequence current ($3I_0$, calculated with the three phase currents, see e.g. *MakeI0*),
- the zero sequence current of the parallel line ($3I_{0p}$, measured on dedicated analogue input).

Parameters

The function needs the following parameters:

- PTSOTF delay time of the switch-onto-fault (SOTF) logic, expressed in ms,
- PAlfaL the mixing factor for the zero sequence current calculated with the inductances (reactances), expressed in %. WARNING: If this parameter is set to 0, then the zero sequence current of the line and the zero sequence current of the parallel line is not taken into consideration!
- PAlfaR the mixing factor for the zero sequence current calculated with the resistances, expressed in %,
- PBetaL the mixing factor for the zero sequence current of the parallel line calculated with the inductances (reactances), expressed in %,
- PbetaR the mixing factor for the zero sequence current of the parallel line calculated with the resistances, expressed in %,

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LCD text*	Min **	Max **	Step **	Remark
SOTF delay= ms	0	60000	100	delay time of the switch-onto-fault (SOTF) logic
AlphaX(IoXcomp.) %	0	500 ***	2	the mixing factor for the zero sequence current calculated with the inductances (reactances)
AlphaR(IoRcomp.) %	0	500 ***	2	the mixing factor for the zero sequence current calculated with the resistances
BetaX(IopXcomp.) %	0	100	2	the mixing factor for the zero sequence current of the parallel line calculated with the inductances (reactances)
BetaR(IopRcomp.) %	0	100	2	the mixing factor for the zero sequence current of the parallel line calculated with the resistances

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

*** Warning: High setting values amplify the error differences of the current transformers!

The constants needed for the operation of the function are:

Inp	the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer,
Unp	the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer,
Izp	minimal current value, which is needed for impedance calculation; it is defined by the producer,
UdirLim	minimal voltage value under which the sampled voltage values stored in the memory are applied for directional decision. If the CB gets manual close command, and the voltage is below this level, then the SOTF logic gets active; it is defined by the producer.

Outputs

Based on the measured voltages and currents the function calculates the components of the impedances:

- AdiMeasRy (y=a,b,c) resistance component of the indicated phase “a”-earth loop expressed in secondary ohm value and multiplied with the “Cu, Ci” factors,
- AdiMeasXy (y=a,b,c) resistance component of the indicated phase “a”-earth loop expressed in secondary ohm value and multiplied with the “Cu, Ci” factors.

(The “Cu, Ci” factors depend on the input VT and CT measuring transformers.)

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Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_IMPEDI_SZAM pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constants the Unp value must be available, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constants the Izp value must be available, which is the minimal current value, which is needed for impedance calculation. This value depends on the hardware; it is defined by the producer.
- Among the constants the UdirLim value must be available, which is the minimal voltage value under which the sampled voltage values stored in the memory are applied for directional decision. This value depends on the hardware; it is defined by the producer.
- It is useful to define an internal status variable, which is to be assigned to the running state of the timer of the SOTF logic.

The function automatically defines the following objects:

- APhImpCalc, BPhImpCalc, CphImpCalc three impedance calculation functions,
- AdiMeasRy (y=a,b,c) Measured resistance value of the phase “a” – earth loop.
- AdiMeasXy (y=a,b,c) Measured reactance value of the phase “a” – earth loop.
- PAlfaR PAlfaR parameter setting,
- PAlfaL PAlfaL parameter setting,
- PBetaR PBetaR parameter setting,
- PBetaL PBetaL parameter setting,
- AP_PAlfaR ADI parameter, which transfers the PAlfaR parameter setting to the impedance calculation function,
- AP_PAlfaL ADI parameter, which transfers the PAlfaL parameter setting to the impedance calculation function,
- AP_PBetaR ADI parameter, which transfers the PBetaR parameter setting to the impedance calculation function,
- AP_PBetaL ADI parameter, which transfers the PBetaL parameter setting to the impedance calculation function,
- Tim_SOTF timer of the switch-onto-fault logic,
- PTSOTF timer parameter,
- SOTF_ENA internal variable for the SOTF logic,
- Internal logic equations:

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- Starting the Tim_SOTF timer with the dedicated digital input signal (In_ManualClose),
- The running state of the timer is transmitted to the dedicated internal variable (SOTF_En)

Internal parameters of the function

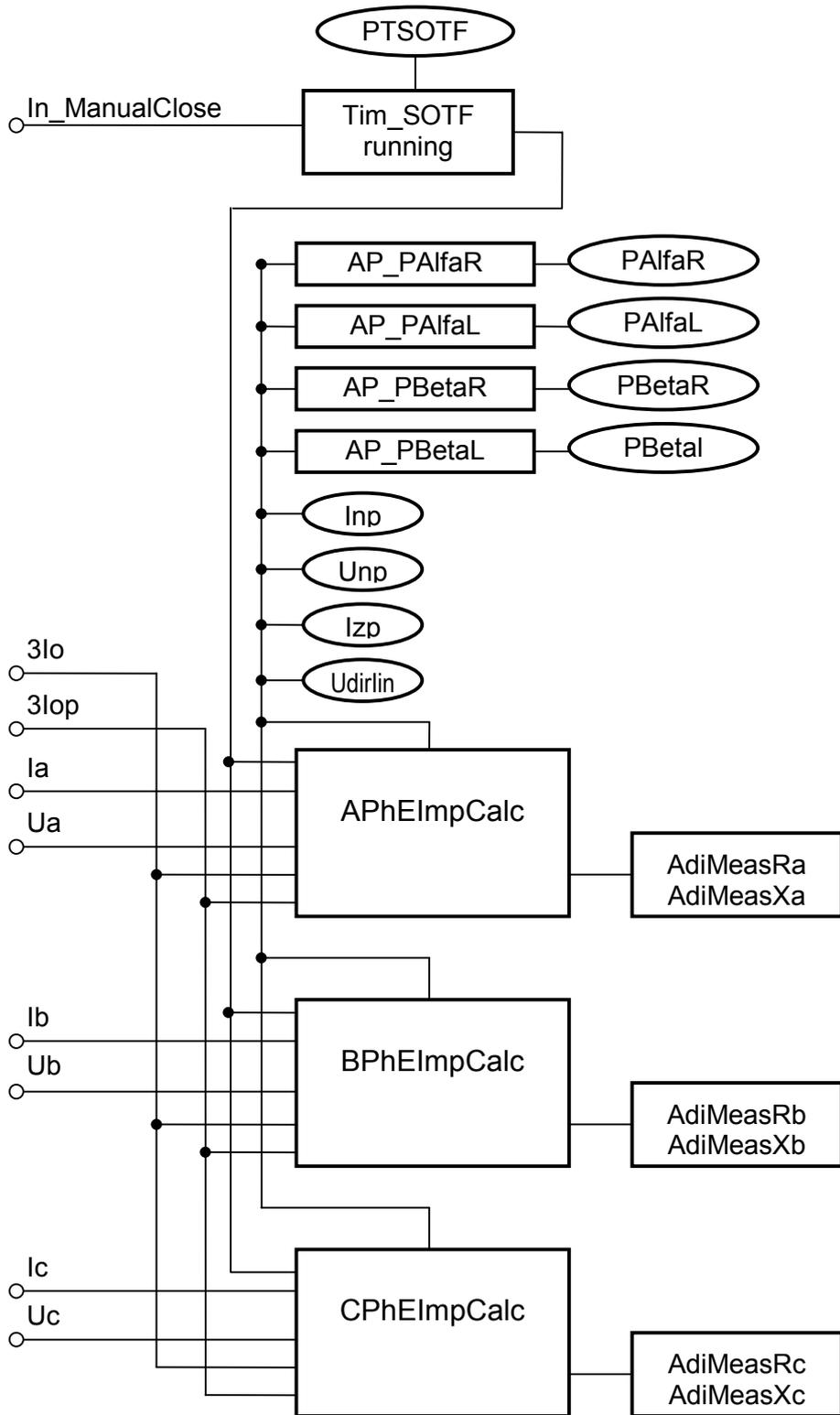
The functions are invoked with the following parameters (in this example for phase “a”-earth loop):

AR_IMPEDI_SZAM, AdiMeasRa, Ia, Ua, Ioo, AP_PAlfaL, Inp, Unp, Udirlim, Izp, SOTF_En, AP_PAlfaR, Io2, AP_PBetaL, AP_PbetaR

AR_IMPEDI_SZAM relay constant,

AdiMeasRa	measured resistance,
Ia	phase current input,
Ua	phase voltage input,
Ioo	calculated zero sequence current, normally the calculated analogue channel,
AP_PAlfaL	ADI parameter, which transfers the PAlfaX parameter setting to the impedance calculation function,
Inp	the A/D sampled numerical value in case of the rated current peak sample,
Unp	the A/D sampled numerical value in case of the rated voltage peak sample,
Udirlim	minimal voltage value under which the sampled voltage values stored in the memory are applied for directional decision
Izp	minimal current value, which is needed for impedance calculation,
SOTF_En	internal variable of the SOTF logic,
AP_PAlfaR	ADI parameter, which transfers the PAlfaR parameter setting to the impedance calculation function,
Io2	zero sequence current of the parallel line,
AP_PBetaL	ADI parameter, which transfers the PAlfaR parameter setting to the impedance calculation function,
AP_PbetaR	ADI parameter, which transfers the PAlfaR parameter setting to the impedance calculation function.

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Zline_Calc_3point_3Ph

Task of the function

This function calculates the impedances of the three phase-phase loops.

The theoretical formula to calculate the complex impedance is:

$$Z_{Ph_Ph} = \frac{U_{line}}{I_{line}}$$

where

U_{line} the line voltage vectors (U_a-U_b , U_b-U_c , U_c-U_a) (See Make_3Ph_line_U function)

I_{line} the line difference vectors (I_a-I_b , I_b-I_c , I_c-I_a) (See Make_3Ph_line_I function)

The method of calculation is solving the differential equation of the faulty loop.

The impedances are calculated with three sampled current and voltage values just after the zero crossing of the current difference. This method ensures correct calculated values even with serious current transformer saturation.

The calculation is enabled, if the current value is above the pre-determined current limit. This avoids division by zero, and avoids errors caused by division with small and noisy sampled current values.

If the voltage is small because of close-in faults, the direction of the fault is decided based on pre-fault voltage samples, stored in the memory. The application of stored voltages is enabled if the voltage is below the pre-determined voltage limit.

In case of switch-onto-fault (SOTF) no voltages are stored in the memory. In this case – after a manual close command to the circuit breaker – the switch-onto-fault logic is enabled for a time span, determined by a parameter value.

The following Figure shows the principal scheme of the internal logic for the impedance calculation. The decision needs three internal logic signals, (CURRENT_OK, VOLT_OK and MEM_AVAIL) and additionally a logic parameter setting SOTF_ENA. The explanation of these signals is as follows:

Status signal	Explanation
CURRENT_OK	The current is suitable for impedance calculation in the processed loop, if after a zero crossing there are three sampled values above a defined limit
VOLT_OK	The voltage is suitable for the calculation, if among the last sampled three values there is a sample above the defined limit
MEM_AVAIL	This status signal is true, if the voltage memory is filled up with available samples above the defined limit for 80 ms.
SOTF_ENA	This logic parameter is true, if the “switch-onto-fault” logic is enabled.

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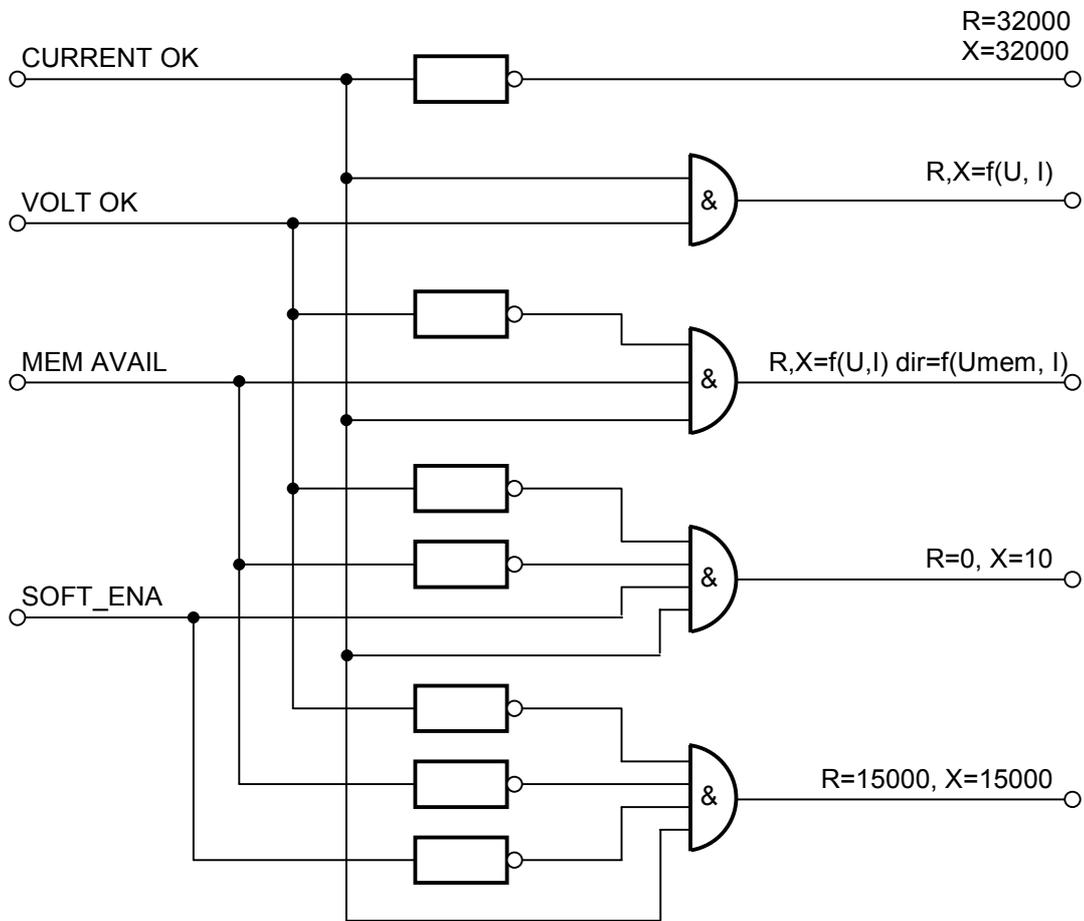


Fig Z_CALC internal logic

The short explanation of the internal logic for the impedance calculation is as follows:

If the CURRENT_OK status signal is false, the current is very small and so no fault is possible. In this case the impedance is set to extreme high values, and no further calculation is performed:

$$R=32000, X=32000 (*10 \text{ m}\Omega).$$

The subsequent decisions are performed, if the current is sufficient for the calculation.

If the CURRENT_OK status signal is true, and the VOLT_OK status signal is true as well, then the current is suitable for calculation, and the voltage is sufficient for the directionality decision. In this case normal impedance calculation is performed based on the sampled currents and voltages. (The calculation method is explained later.)

$$R, X=f(u, i)$$

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If the CURRENT_OK status signal is true, but the VOLT_OK status signal is false, it means that the directionality decision cannot be performed based on the available voltage signals. In this case the magnitude of R and X is calculated based on the sampled currents and voltages, but the direction of the fault (the +/- sign of R and X) must be decided based on voltage value stored in the memory 80 ms earlier. This decision is possible only, if there are stored values in the memory for 80 ms, and these values were sampled during a healthy period.

$$R, X=f(u, i) \quad \text{direction} = f(u_{\text{mem}}, i)$$

If the voltage is not sufficient for directional decision, and no stored voltage samples are available, then the SOTF_ENA parameter is needed for the process: If the “switch-onto-fault” logic is enabled, then the fault is supposed to be just in front of the bus-bar in forward direction:

$$R=0, \quad X=10 \text{ (*10 m}\Omega\text{)}.$$

If the voltage is not sufficient for directional decision, and no stored voltage samples are available, and “switch-onto-fault” logic is not enabled, then the impedance is set to a high value:

$$R=15000, \quad X=15000 \text{ (*10 m}\Omega\text{)}.$$

The applied numerical method is solving the differential equation of the faulty loop, based on three consecutive samples.

Inputs

The inputs of the function are

- the three line currents (phase current differences, produced by the *Make_3Ph_line_I* function),
- the three line voltages (phase voltage differences, produced by the *Make_3Ph_line_U* function).

Parameters

The function needs the following parameters:

- PTSOTF delay time of the switch-onto-fault (SOTF) logic, expressed in ms,
- PNoAlfa constant parameter, because no mixing factor for the zero sequence current is needed.

LCD text*	Min **	Max **	Step **	Remark
SOTF delay= ms	0	60000	100	delay time of the switch-onto-fault (SOTF) logic

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

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The constants needed for the operation of the function are:

Inp	the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer,
Unp	the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer,
Izp	minimal current value, which is needed for impedance calculation,
UdirLim	minimal voltage value under which the sampled voltage values stored in the memory are applied for directional decision. If the CB gets manual close command, and the voltage is below this level, then the SOTF logic gets active.

The constant parameter needed for the operation of the function is:

Outputs

Based on the measured voltages and currents the function calculates the components of the impedances:

- $AdiMeasR_{yz}$ ($yz=ab, bc, ca$) resistance component of the indicated phase -phase loop expressed in secondary ohm value and multiplied with the “Cu, Ci” factors,
- $AdiMeasX_{yz}$ ($yz=ab, bc, ca$) resistance component of the indicated phase -phase loop expressed in secondary ohm value and multiplied with the “Cu, Ci” factors.

(The “Cu, Ci” factors depend on the input VT and CT measuring transformers.)

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_IMPED_SZAM_2 pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constants the Unp value must be available, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constants the Izp value must be available, which is the minimal current value, which is needed for impedance calculation. This value depends on the hardware; it is defined by the producer.
- Among the constants the UdirLim value must be available, which is the minimal voltage value under which the sampled voltage values stored in the memory are

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applied for directional decision. This value depends on the hardware; it is defined by the producer.

- Among the constant parameters the PNoAlfa value must be available, which excludes the zero sequence currents from the impedance calculations,
- It is useful to define an internal status variable, which is to be assigned to the running state of the timer of the SOTF logic.

The function automatically defines the following objects:

- yzImpCalc (yz=AB,BC,CA) three impedance calculation functions,
- AdiMeasRyz (yz=ab,bc,ca) Measured resistance value of the phase -phase loop.
- AdiMeasXyz (yz=ab,bc,ca) Measured reactance value of the phase -phase loop.
- PNoAlfa constant parameter, indicating that no zero sequence current compensation is needed,
- AP_PNoAlfa ADI parameter, which transfers the PNoAlfa parameter to the impedance calculation function,
- Tim_SOTF timer of the switch-onto-fault logic,
- PTSOTF timer parameter,
- SOTF_En internal variable for the SOTF logic,
- Internal logic equations:
 - Starting the Tim_SOTF timer with the dedicated digital input signal (In_ManualClose),
 - The running state of the timer is transmitted to the dedicated internal variable (SOTF_En)

Internal parameters of the function

The functions are invoked with the following parameters (in this example for phase “ab” loop):

AR_IMPEDI_SZAM_2,AdiMeasRab,Iab,Uab,Iab,AP_PNoAlfa,Inp,Unp,Udirlim,Izp,SOTF_En,AP_PNoAlfa,Iab,AP_PNoAlfa,AP_PNoAlfa

AR_IMPEDI_SZAM relay constant,

AdiMeasRab measured resistance,

Iab line current input,

Uab line voltage input,

AP_PNoAlfa ADI parameter, which transfers the PNoAlfa constant parameter to the impedance calculation function,

Inp the A/D sampled numerical value in case of the rated current peak sample,

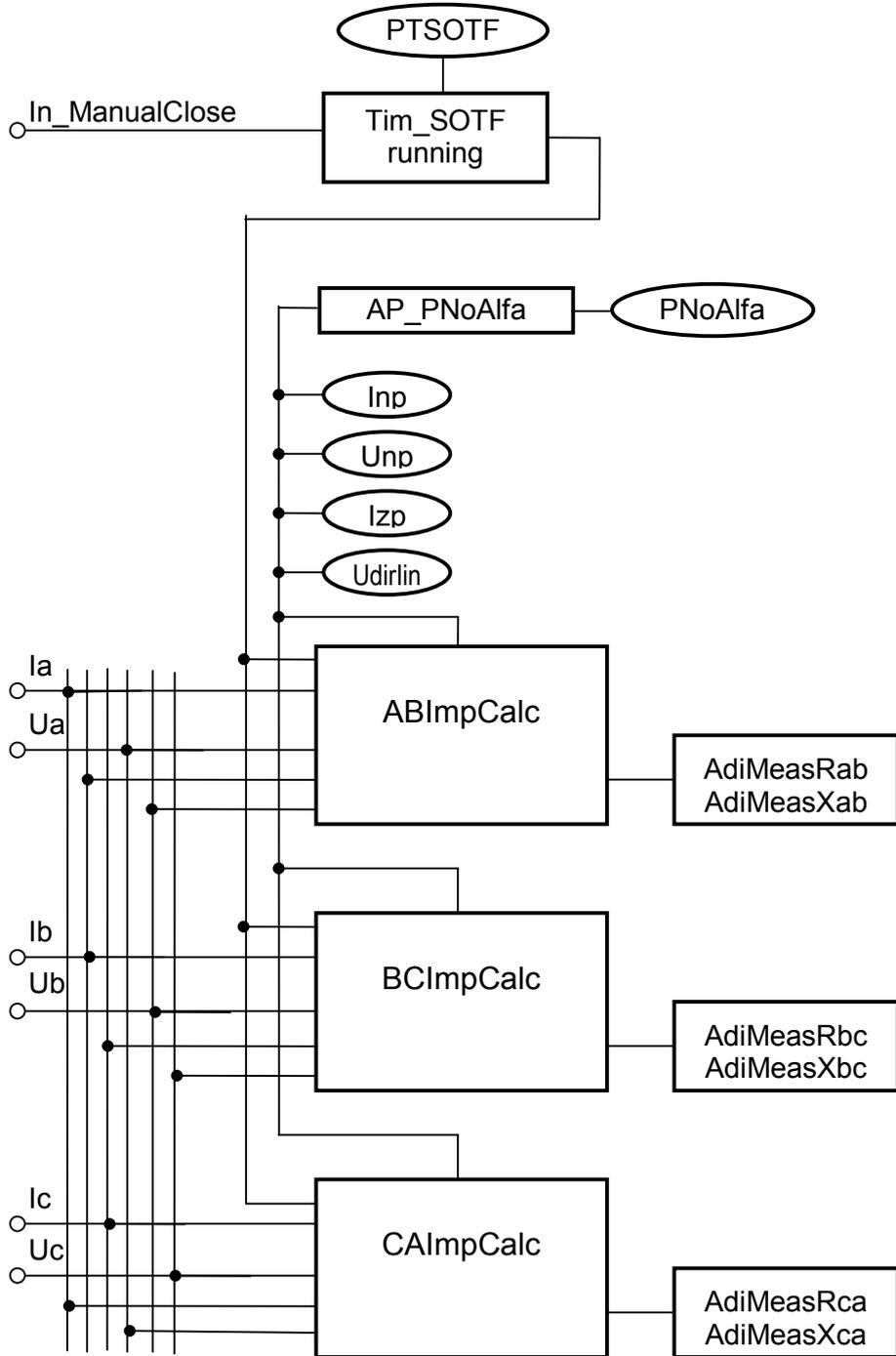
Unp the A/D sampled numerical value in case of the rated voltage peak sample,

Udirlim minimal voltage value under which the sampled voltage values stored in the memory are applied for directional decision

Izp minimal current value, which is needed for impedance calculation,

SOTF_En internal variable of the SOTF logic.

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Bias_ANSI50N

Task of the function

This function is usually needed by the measuring loop selection of the distance protection functions. If considerable zero sequence current is present, then one of the phase-earth loops is faulty. In absence of zero sequence current the distance decision is based on measurement of phase-phase loops. This function supports this selection.

In the decision the basic harmonic Fourier component of the zero sequence current (calculated as the sum of the three phase currents) is compared to the biasing current. The zero sequence current must be above the base sensitivity, defined by the parameter (P_{Io}) and above the line defined by the slope parameter (P_{fIo}) and the biasing current. The biasing current is the maximum of the basic harmonic Fourier components of the phase currents.

Inputs

The function uses the calculated basic harmonic components of the three phase currents, and the calculated basic harmonic components of the zero sequence current (3I_o), which is calculated by the MakeIo function.

- I_x_FFT50Hz (x=a,b,c) the basic harmonic Fourier components of the three phase currents,
- I_o_FFT50Hz the basic harmonic Fourier components of the 3I_o zero sequence current, calculated by the *MakeIo* function.

Parameters

The function

- P_{Io} the base sensitivity of the function, given is % of the CT rated input,
- P_{fIo} the slope of the characteristics expressed in %.

LCD text*	Min **	Max **	Step **	Remark
3I _o >/In = %	10	50	2	the base sensitivity of the function, given is % of the CT rated input
I _o biasing = %	5	30	2	the slope of the characteristics expressed in %

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

The constant needed for the operation of the function is:

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Inp the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer, (the same constant is applied e.g. by FFT_CT_3PH)

Outputs

The function has a single output:

- StartBiasIo which is an internal variable stating that the zero sequence current is above the defined characteristics.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_DTVIO pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- It is useful to define an internal status variable, which is to be assigned to the StartBiasIo output of the function.

The function automatically defines the following objects:

- Bias_An50N the relay function,
- PIon parameter which defines the base sensitivity of the function,
- PFIon parameter which defines the slope of the characteristics,
- AP_PIon ADI parameter, which transfers the PIon parameter to the function,
- AP_PFIon ADI parameter, which transfers the PFIon parameter to the function,
- Internal logic equation:
 - The decision of the function is transmitted to the internal status variable (StartBiasIo)

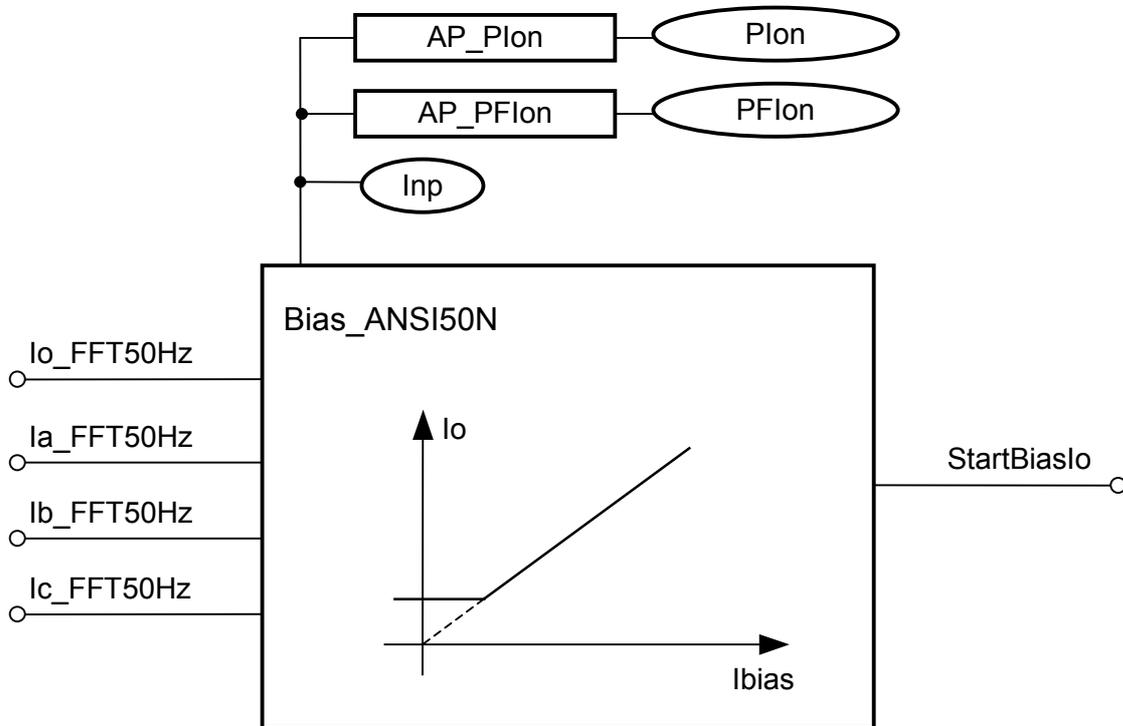
Internal parameters of the function

The functions are invoked with the following parameters:

AR_DTVIO,AdiBiasIon,AP_PIon,I_FFT50Hz,Ia_FFT50Hz,Ib_FFT50Hz,Ic_FFT50Hz,AP_PFIo,Inp

AR_DTVIO	relay constant,
AdiBiasIon	started state of the function,
AP_PIon	ADI parameter, which transfers the PIon parameter to the function
I_FFT50Hz	basic harmonic Fourier component of the zero sequence current,
I _x _FFT50Hz	(x=a,b,c) basic harmonic Fourier component of the phase current,
AP_PFIo	ADI parameter, which transfers the PFIon parameter to the function,
Inp	the A/D sampled numerical value in case of the rated current peak sample.

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HvDist1Zone

Task of the function

This function decides if the calculated complex impedances of all fault loops are inside the polygon characteristics of the first impedance zone, and performs phase selection as well. This stage performs all decisions after each impedance calculations (within 1 ms).

Inputs

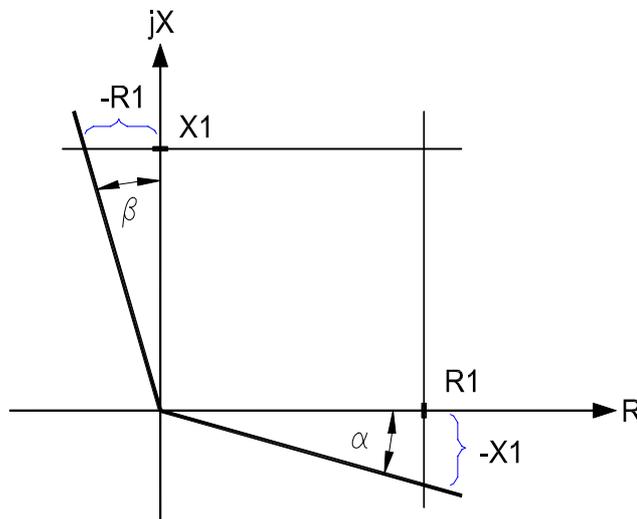
The function gets the complex impedance calculated by *Zline_Calc_3point_3Ph* and *ZPhE_Calc_3point_3Ph* library functions for all six fault-loops.

The function needs the results of the *Bias_ANSI50N* function, which processes the zero sequence current to help phase selection: If considerable zero sequence current is present, then one of the phase-earth loops is faulty. In absence of zero sequence current the distance decision is based on measurement of phase-phase loops.

The function additionally needs the results of the three-phase overcurrent function *ANSI50_3Ph* to avoid errors in decision if no voltage and no current is present.

Parameters

The function needs the parameters of the polygon characteristics:



- PZR setting value of the first zone polygon in R direction,
- PZX setting value of the first zone polygon in X direction,
- PZXperR slope of the polygon line for negative reactances (α),
- PZRperX slope of the polygon line for negative resistances (β),
- PZDir parameter for selection of forward or reverse direction.

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LCD text*	Min **	Max **	Step **	Remark
R [mOhm] = [*10*Cu*Ci]	10	10000	10	setting value of the first zone polygon in R direction ***
X [mOhm] = [*10*Cu*Ci]	10	10000	10	setting value of the first zone polygon in X direction ***
-X/R = %	0	50	1	slope of the polygon line for negative reactances
-R/X = %	0	50	1	slope of the polygon line for negative resistances
Zdir(0=forward)=	0	1	1	parameter for selection of forward or reverse direction

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

*** The value can be calculated in secondary ohms by multiplying with 10 and with the C_u and C_i factors, which depend on the rated secondary values of the voltage transformer and that of the current transformer.

Outputs

The function has seven internal status variables, out of which only one can be active:

- AdiStZ13Ph indicating three-phase fault,
- AdiStZ1ab indicating AB fault,
- AdiStZ1bc indicating BC fault,
- AdiStZ1ca indicating CA fault,
- AdiStZ1a indicating A phase fault,
- AdiStZ1b indicating B phase fault,
- AdiStZ1c indicating C phase fault.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_POLIGON1 and AR_FKIV_HTX pre-defined constant must be available.
- The *Zline_Calc_3point_3Ph*, *ZPhE_Calc_3point_3Ph*, *Bias_ANSI50N* and *ANSI50_3Ph* functions must be declared.

The function automatically defines the following objects:

- Z1HvZone it is the function itself,
- ZxPolygon (x=a,b,c) the polygon comparison functions for the phase-earth loop measurements,
- ZxyPolygon (xy=ab,bc,ca) the polygon comparison functions for the phase-phase loop measurements,
- parameters (see above),
- ADI parameters, which transfer the parameters to the function,

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Internal parameters of the function

The internal functions are invoked with the following parameters:

For the polygon comparisons:

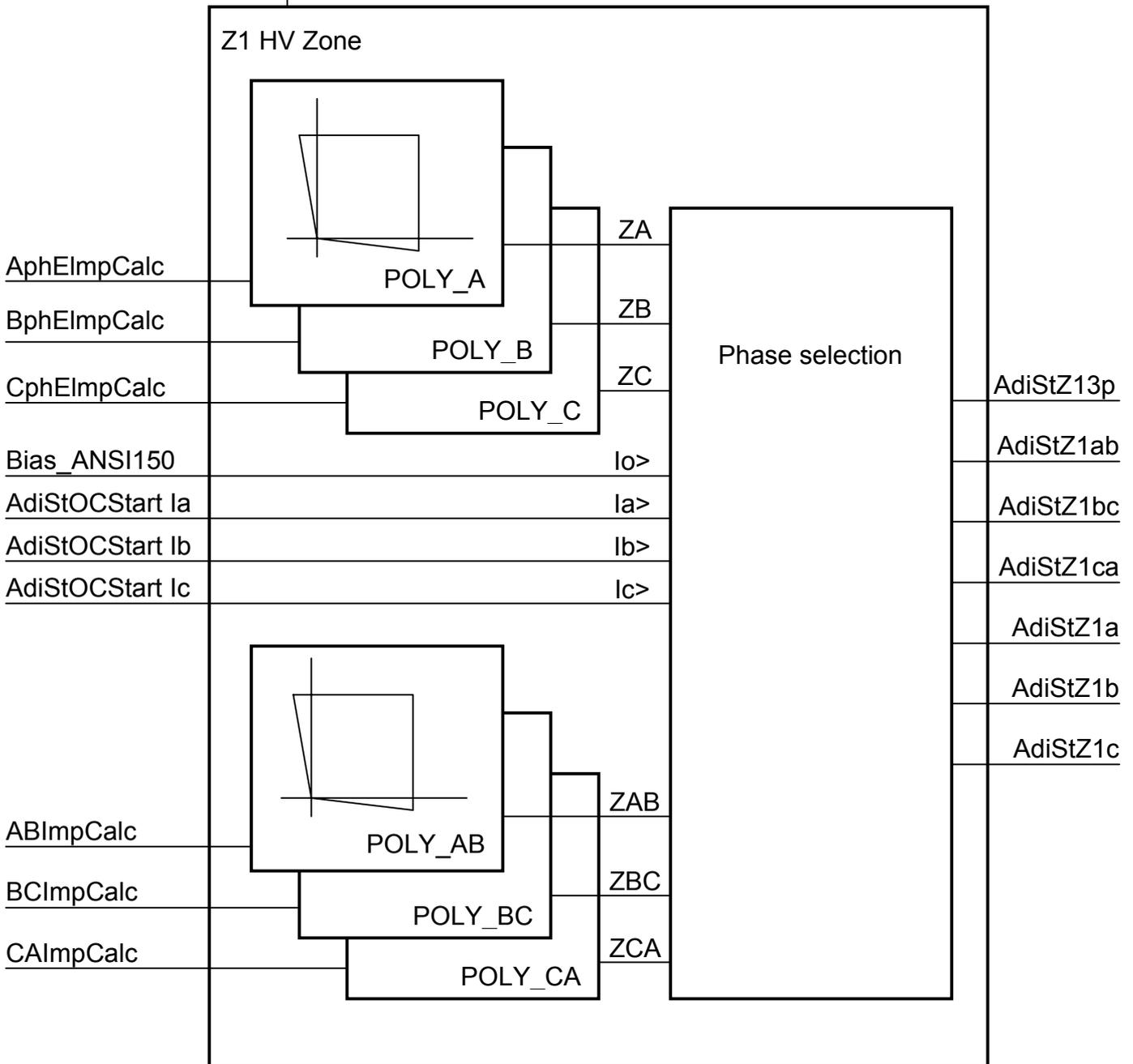
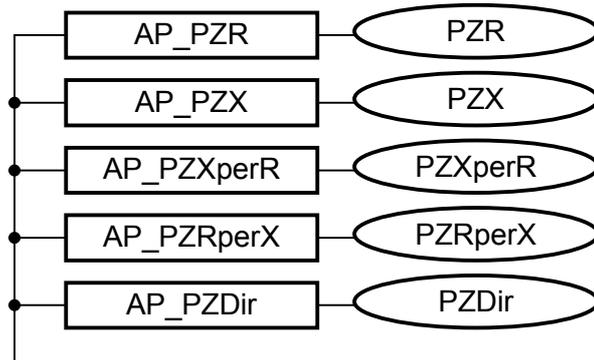
AR_POLIGON1,xxxImpCalc,AP_PZR,AP_PZX,AP_PZRperX,AP_PZXperR,AP_PZDir,-1
 AR_POLIGON1 relay constant,
 xxxImpCalc (xxx can be: APhE, BPhE, CPhE, AB, BC, CA) identifier of the impedance calculation functions
 AP_PZR ADI parameter which transfers the PZR parameter to the function,
 AP_PZX ADI parameter which transfers the PZX parameter to the function,
 AP_PZRperX ADI parameter which transfers the PZRperX parameter to the function,
 AP_PZXperR ADI parameter which transfers the PZXperR parameter to the function,
 AP_PZDir ADI parameter which transfers the PZDir parameter to the function,
 -1 this constant defines that the function does not deliver own status variables.

For the phase selection logic:

AR_FKIV_HTX,-1,AdiStZ13ph,Bias_ANSI50N,ZaPoligon,ZbPoligon,ZcPoligon,
 ZabPoligon,ZbcPoligon,ZcaPoligon,
 APhEImpCalc,BPhEImpCalc,CPhEImpCalc,
 ABImpCalc,BCImpCalc,CAImpCalc,
 AdiStOCStart_Ia

AR_FKIV_HTX relay constant,
 -1 this constant defines that the function does not deliver calculated distance value,
 AdiStZ13ph the function supposes that the status variables are declared in the sequence as described in the "Outputs" section,
 Bias_ANSI50N identifier of the biased zero sequence overcurrent function, which decides if zero sequence current is present or not,
 ZxPoligon (x=a,b,c) identifiers of the polygon comparison functions,
 ZxyPoligon (xy=ab,bc,ca) identifiers of the polygon comparison functions,
 xPhEImpCalc (x=a,b,c) identifiers of the impedance calculation functions (reserved for further use only),
 xyImpCalc (xy=ab,bc,ca) identifiers of the impedance calculation functions (reserved for further use only)
 AdiStOCStart_Ia the function supposes that the ADI status variables, which deliver information about the measured phase currents are declared in the sequence a,b,c.

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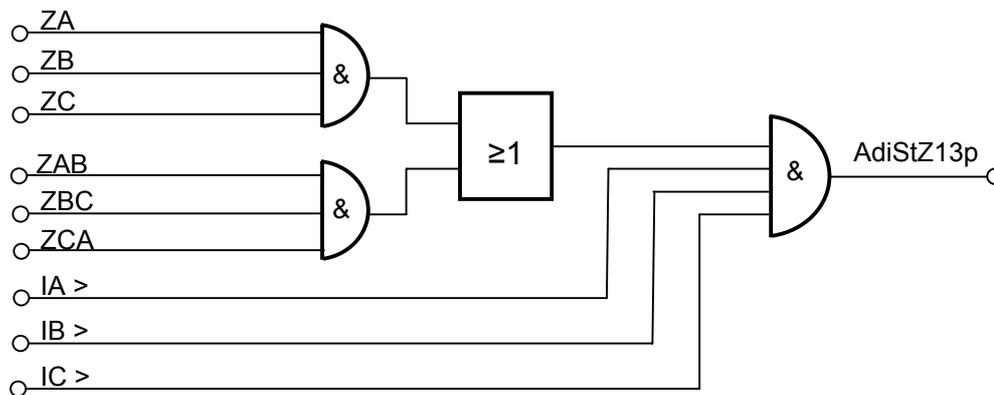
The phase selection logic can be explained with the following figures:

Detection three phase fault

The processing of logic diagrams in the following Figures is sequential. If the result of one of them gets true, no further processing is performed.

The following Figure shows that if

- all three phase-earth loops caused start of the polygon impedance logic,
 - or all three phase-phase loops caused start of the polygon impedance logic,
 - and the currents in all three phases are above the setting limit,
- then three phase fault is detected, and no further check is performed.



FigThree phase fault detection

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Detection “AB”, “BC”, “CA” faults

The following Figure explains detection of phase-to-phase fault between phases “A” and “B”:

- no three phase fault is detected,
- start of the polygon impedance logic in the loop “AB”,
- “OR” relation of the following logic states:
 - no zero sequence current above the limit, and no start of the polygon logic in an other phase-to-phase loop or the loop “AB” detects the lowest reactance, or
 - start of the polygon impedance logic in the loops “A” and ”B” individually as well,
- the currents in the involved phases are above the setting limit.

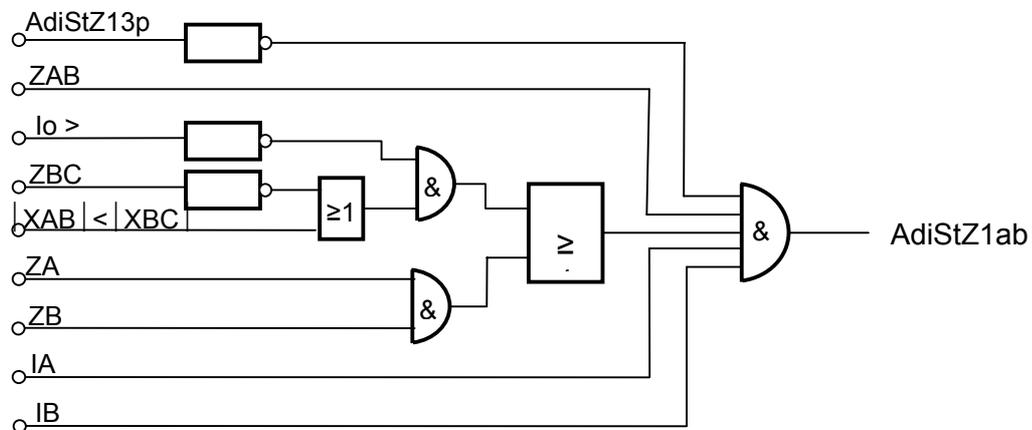


Fig AB fault detection

Fig. 5.c and Fig. 5d show similar logic for the loops “BC” and “CA” respectively.

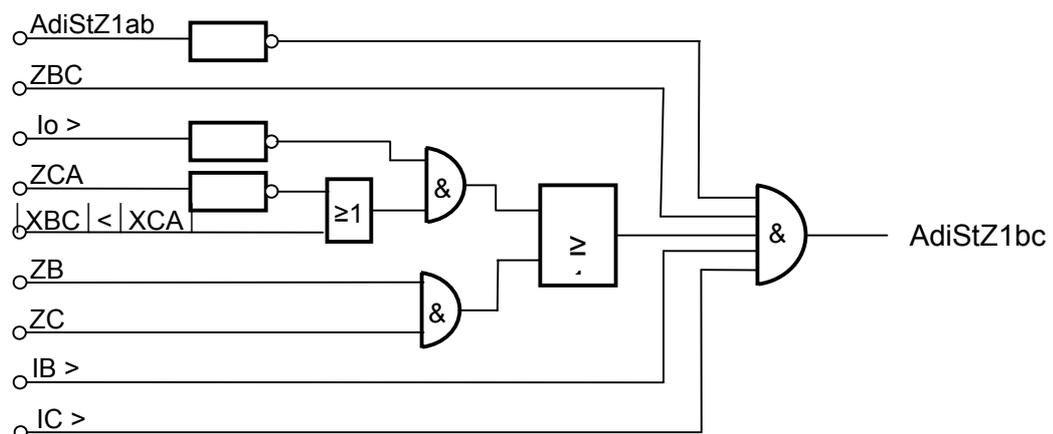


Fig. BC fault detection

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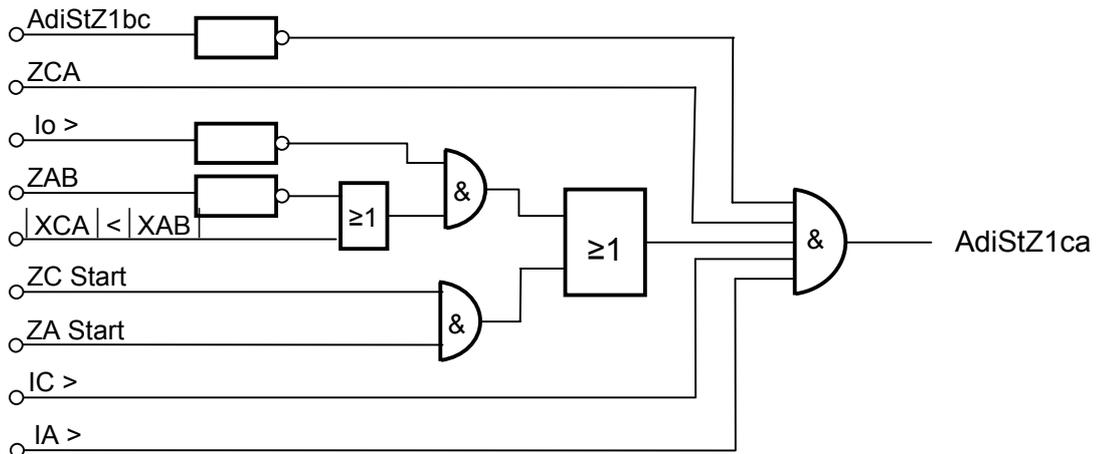


Fig. CA fault detection

Detection “A”, “B”, “C” faults

The following Figure explains detection of phase-to-ground fault in phase “A”:

- no fault between phases “C” and “A” is detected,
- the zero sequence current above the limit,
- start of the polygon impedance logic in the loop “A”,
- no start of the polygon logic in an other phase-to-ground loop,
- the current in the involved phase is above the setting limit.

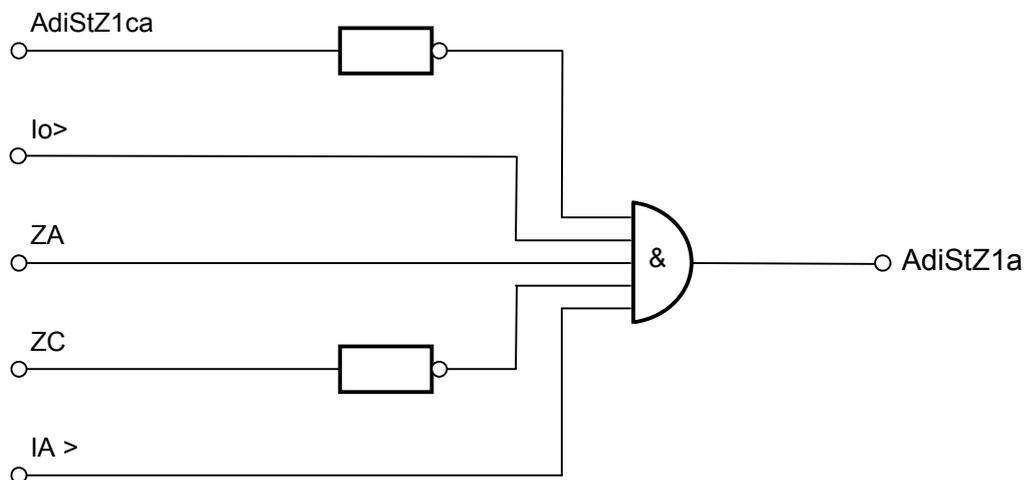


Fig. A-N fault detection

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The following figures show similar logic for the loops “B” and “C” respectively.

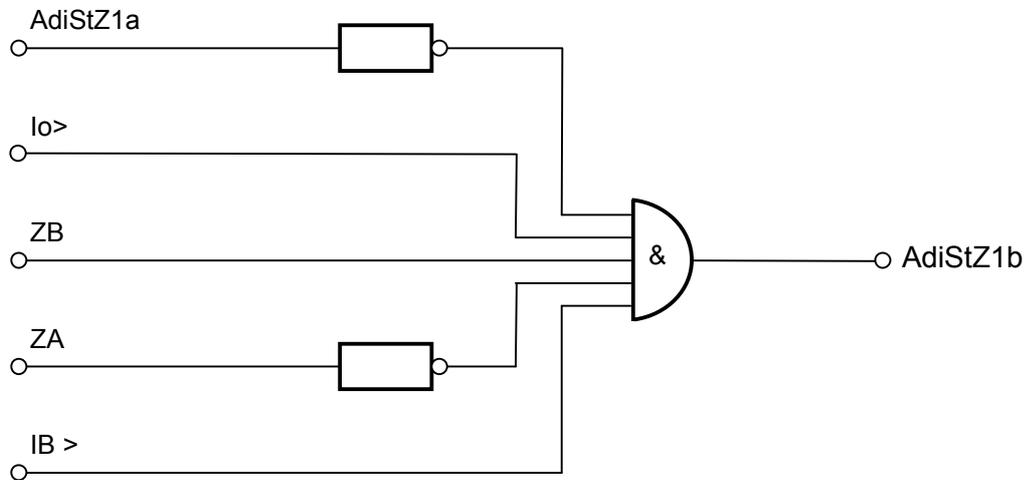


Fig. B-N fault detection

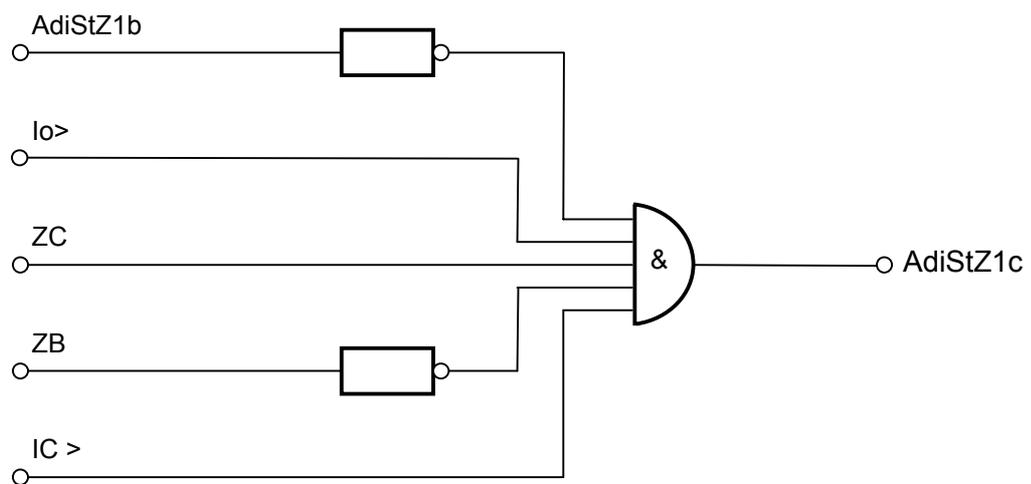


Fig. C-N fault detection

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HvDist25Zone

Task of the function

This function decides if the calculated complex impedance of a fault loop is inside the polygon characteristics of the second (or higher) impedance zone, and performs phase selection as well. This function is basically the same as function *HvDist1Zone* with the exception that this function calculates impedance after each zero crossing (in each 10 ms).

Internal parameters of the function

The technical difference between *HvDist1Zone* and this function is that the relay constant for the polygon comparison here is:

AR_POLIGON25 relay constant.

HvDist25ZoneHTX

Task of the function

This function decides if the calculated complex impedance of a fault loop is inside the polygon characteristics of the second (or higher) impedance zone, and performs phase selection as well. This function is basically the same as function *HvDist25Zone* with the exception that this function calculates distance relative to the line length.

Internal parameters of the function

The technical difference between *HvDist25Zone* and this function is that the function parameter after the relay constant for the phase selection logic is not "-1", but it is "AdiMeasHtx", which is the measuring channel for the distance to fault.

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PowSwingBlock

Task of the function

This function can block operation of the distance zones during power swings.

Power swings are relatively slow phenomena. One period of the swing is in the “s” (second) range. During this time the symmetrical current increases and the symmetrical voltage decreases, which results that the calculated fault impedance slowly moves into the operating zones of the distance protection. A fault however is a sudden change in the network state, the calculated impedance “jumps” into the operating zones of the distance protection.

If during power swings the blocking of the distance protection for three-phase symmetrical faults is needed, this function can be applied. For asymmetrical faults this function allows operation of the distance protection function.

The realisation is as follows: there are two concentric circles on the impedance plane with the centre of the origin. The radius of both circles is defined by parameter setting. If the impedance calculated with the phase “A” voltage and current (symmetrical state is supposed) is between these two circles for at least the time period determined by parameter setting, then the power swing blocking gets active until time-out, according to parameter setting.

Inputs

The function measures the phase “A” voltage, as calculated e.g. by the $Ua_FFT50Hz$ function and the phase “A” current as calculated e.g. by the $Ia_FFT50Hz$ function, and calculates the absolute value of the impedance.

Parameters

The function needs the following parameters:

- PPsBIZ1 radius of the outer circle on the impedance plane,
- PPsBIZ2 radius of the inner circle on the impedance plane,
- PPsBIT1 time during which the calculated impedance should be between the circles to activate power swing blocking,
- PpsBITimOut maximum duration of the blocking.

LCD text*	Min **	Max **	Step **	Remark
Z1 (PSwBl) = [*10mOhm*Cu*Ci]	1000	10000	10	Radius of the outer circle
Z2 (PSwBl) = [*10mOhm*Cu*Ci]	1000	10000	10	Radius of the inner circle
t [PSwBl.Sart] = ms	100	32000	10	time during which the calculated impedance should be between the circles to activate power swing blocking
t [timeout PSwBl] = ms	100	32000	10	maximum duration of the blocking

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- * The LCD text can be changed during configuration
- ** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

The constants needed for the operation of the function are:

Inp the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer, (the same constant is applied e.g. by FFT_CT_3PH)

Unp the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer, (the same constant is applied e.g. by FFT_VT_3PH)

Outputs

The function has one output only:

- **AdiPsBl** which is the status variable for power swing blocking.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_LENDESZAR pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constants the Unp value must be available, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.

The function automatically defines the following objects:

- **PowSwingBlock** this is the function,
- parameters (see above),
- ADI parameters, which transfer the parameters to the function,
- **AdiStPowSwingBl** which is the status variable for power swing blocking.

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Internal parameters of the function

The functions are invoked with the following parameters:

AR_LENDESZAR,U1_FFT50Hz,Ia_FFT50Hz,AdiStPsBl,AP_PPsbIZ1,AP_PPsbIZ2,AP_PPsbIT1,AP_PPsbITimOut,Unp,Inp

AR_LENDESZAR relay constant,

U1_FFT50Hz Reference to the function for calculation of the basic Fourier component of the voltage,

Ia_FFT50Hz Reference to the function for calculation of the basic Fourier component of the current,

AdiStPsBl the status variable for power swing blocking

AP_PPsbIZ1 ADI parameter which transfers the PPsBIZ1 parameter value to the function,

AP_PPsbIZ2 ADI parameter which transfers the PPsBIZ2 parameter value to the function,

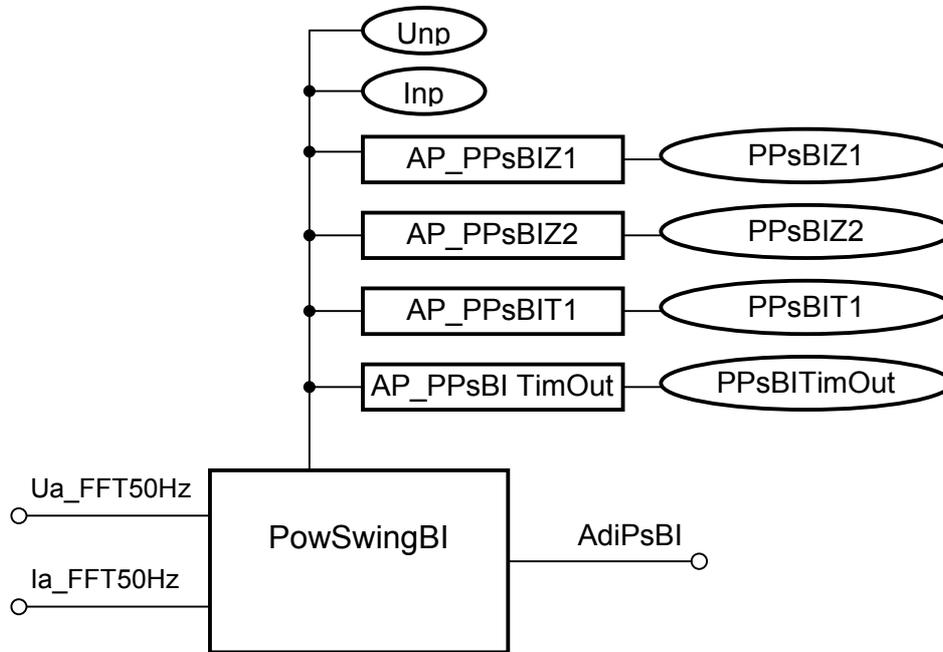
AP_PPsbIT1 ADI parameter which transfers the PPsBIT1 parameter value to the function,

AP_PpsBITimOut ADI parameter which transfers the PPsBITimOut parameter value to the function,

Unp the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer

Inp the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.

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VTS

Task of the function

This function realises voltage transformer supervision. If the fuse in one of the voltage transformer secondary circuits blows out, then zero sequence voltage is detected. If at the same time no zero sequence current component or negative sequent current component is measured, then the false zero sequence voltage component is caused by not asymmetrical faults, but by error in the VT secondary circuit.

Inputs

The function processes the result of

- the basic harmonic Fourier component of the zero sequence current (See FFT_CT_1Ph),
- the basic harmonic Fourier component of the zero sequence voltage (See FFT_VT_1Ph),
- the basic harmonic Fourier component of the zero sequence current (See InegSequFilter3Ph).

Setting the following logic variable with Protlog equation can disable the VTS function:

- VTSDisable.

Parameters

The function needst the following parameters:

- PIo_VTS zero sequence current limit for VTS function,
- PI2_VTS negative sequence current limit for VTS function,
- PUo zero sequence voltage limit for VTS function

LCD text*	Min **	Max **	Step **	Remark
I ₀ >VTS/In [CT] = %	100	500	2	zero sequence current limit
U ₀ >VTS/Un [VT] = %	10	100	1	zero sequence voltage limit
I ₂ >VTS/In [CT] = %	10	100	2	negative sequence current limit

* The LCD text can be changed during configuration

** In order to keep the required accuracy and avoid problems caused by numerical overflow the Min, Max and Step values can be changed during configuration with the appropriate authority level only

The constants needed for the operation of the function are:

PUType_VTS constant parameter for selection overvoltage function,
 POVER constant parameter for selection overcurrent function,
 Inp the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer, (the same constant is applied e.g. by FFT_CT_3PH)

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Uonp the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer,

Outputs

The function has a single digital output, which is active if the VTS function is not disabled, there is zero sequence voltage over the limit, and there is no zero or negative sequence current above the limit:

- VTSFault status variable announcing detected VTS fault.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_ FOUR_DONT pre-defined constant must be available.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- Among the constants the Uonp value must be available, which is the A/D sampled numerical value in case of the rated voltage peak sample. This value depends on the hardware; it is defined by the producer.
- The POVER constant parameter must be declared,
- The PUType_VTS constant parameter must be declared,
- It is useful to define an internal status variable, which is to be assigned to the VTSFault logic variable.

The function automatically defines the following objects:

- ANSI50_VTS zero sequence overcurrent function with the parameters and output variable:
 - PIo_VTS overcurrent parameter setting,
 - AP_PIo_VTS ADI parameter which transfers the PIo_VTS parameter to the function,
 - AdiStStart_VTSIo output status variable.
- ANSI50Neg_VTS negative sequence overcurrent function with the parameters and output variable:
 - PI2_VTS overcurrent parameter setting,
 - AP_PI2_VTS ADI parameter which transfers the PI2_VTS parameter to the function,
 - AdiStStart_VTSINeg output status variable.
- ANSI59_VTS zero sequence overvoltage function with the parameters and output variable:
 - PUo overcurrent parameter setting,
 - AP_PUo ADI parameter which transfers the PUo parameter to the function,
 - PUType_VTS overvoltage function selection constant parameter,

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- AP_PUType_VTS ADI parameter which transfers the PUType_VTS parameter to the function,
- AdiStStart_VTSIo output status variable.

- Internal logic equation:
 - The voltage transformer supervision function delivers active output, if the function is enabled, zero sequence voltage is detected, and at the same time no zero sequence current component or negative sequent current component is measured.

Internal parameters of the function

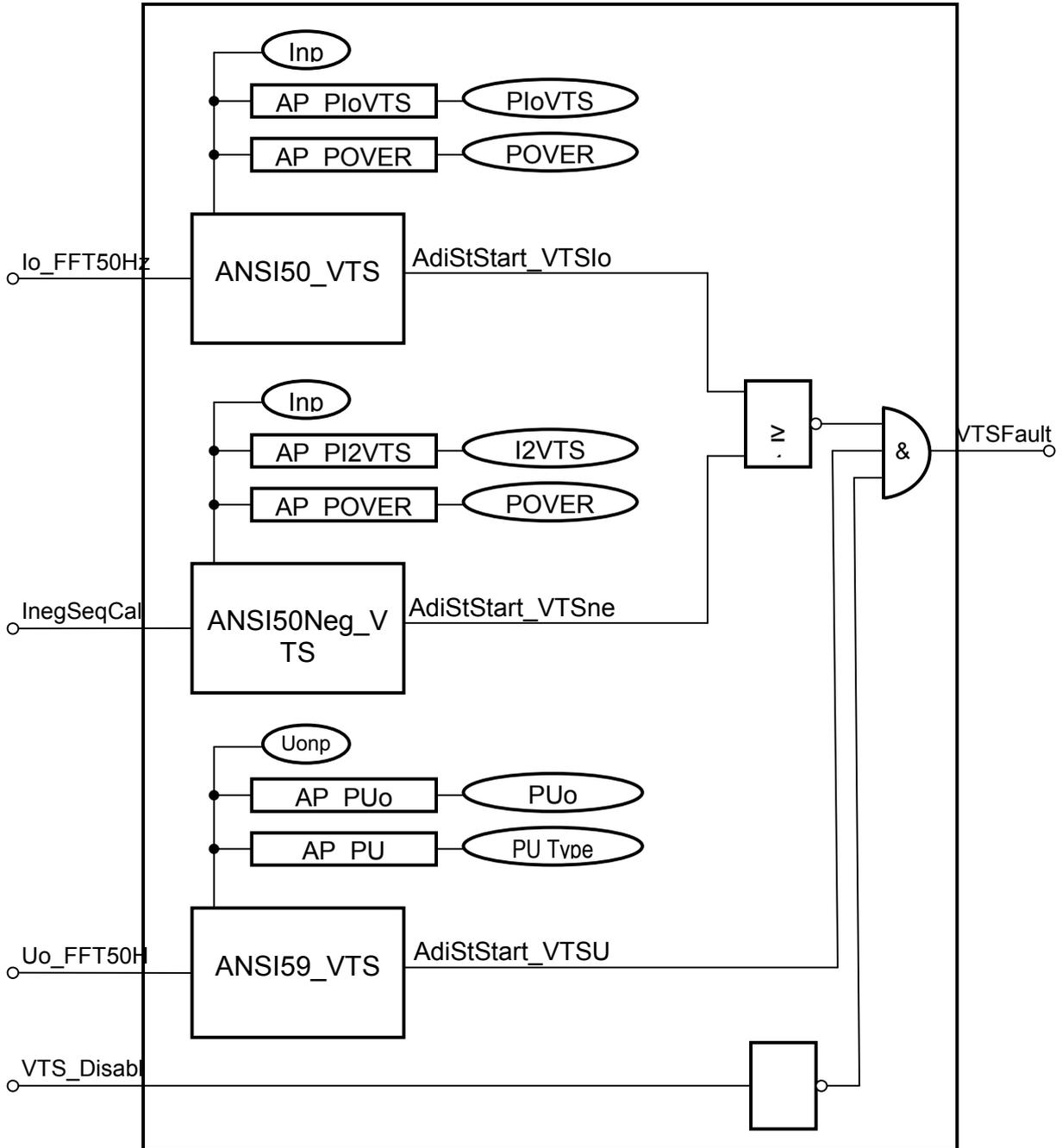
The three internal functions are invoked with the following parameters:

AR_FOUR_DONT,AdiStStart_VTSIo,I_FFT50Hz,AP_PIo_VTS,Inp,AP_POVER
 AR_FOUR_DONT,AdiStStart_VTSUo,U_FFT50Hz,AP_PUo,Uonp,AP_PUType_VTS
 AR_FOUR_DONT,AdiStStart_VTSINeg,INegSeqCalc,AP_PI2_VTS,Inp,AP_POVER

AR_FOUR_DONT	relay constant,
AdiStStart_VTSIo	status variable, which is active if the zero sequence current is above the parameter value,
AdiStStart_VTSUo	status variable, which is active if the zero sequence voltage is above the parameter value,
AdiStStart_VTSINeg	status variable, which is active if the negative sequence current is above the parameter value,
I_FFT50Hz	reference to the basic Fourier harmonic calculation function for the zero sequence current,
U_FFT50Hz	reference to the basic Fourier harmonic calculation function for the zero sequence voltage,
INegSeqCalc	reference to the basic Fourier harmonic calculation function for the negative sequence current,
AP_PIo_VTS	ADI parameter which transfers the PIo_VTS parameter to the function,
AP_PUo	ADI parameter which transfers the PUo parameter to the function,
AP_PI2_VTS	ADI parameter which transfers the PI2_VTS parameter to the function,
Inp	the A/D sampled numerical value in case of the rated current peak sample,
Uonp	the A/D sampled numerical value in case of the rated voltage peak sample,
AP_POVER	ADI parameter which transfers the POVER parameter to the function,
AP_PUType_VTS	ADI parameter which transfers the PUType_VTS parameter to the function.

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VTS



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PQCalc3Ph

Task of the function

This function calculates active and reactive power individually for the three phases.

Inputs

The function processes the basic harmonic components of the phase voltages and phase currents (See e.g. FFT_VT_3Ph, FFT_CT_3Ph)

Parameters

The function calculates the power values related to the CT and VT rated values. It needs the following constant parameters to scale the calculated power values:

PVTCT the multiplier factor for the calculated power values,
PPQDivider the divider factor for the calculated power values.

If the multiplier factor is 1000 and the divider factor is 1, then the power values are displayed in pro-mill, related to the rated VT and CT values.

Outputs

- The function calculates active and reactive power for the three phases.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_FOURIER_PQ pre-defined constant must be available.
- Among the constants the PVTCT value must be available, which is the multiplier factor for the calculated power values,
- Among the constants the PPQDivider value must be available, which is the divider factor for the calculated power values

The function automatically defines the following objects:

CalcPQx (x=a,b,c) the power calculation function for the three phases individually,
PVTCT the multiplier factor for the calculated power values,
PPQDivider the divider factor for the calculated power values.
AP_PVTCT ADI parameter which transfers the PVTCT parameter to the function,
AP_PPQDivider ADI parameter which transfers the PPQDivider parameter to the function.

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Internal parameters of the function

The function is invoked with the following parameters:

AR_FOURIER_PQ,AdiMeasPx,Ux_FFT50Hz,Ix_FFT50Hz,AP_PVTCT,AP_PVTCT,AP_PPQDivider

AR_FOURIER_PQ relay constant,

AdiMeasPx (x=a,b,c) the measured active (and subsequently reactive) power for the indicated phase,

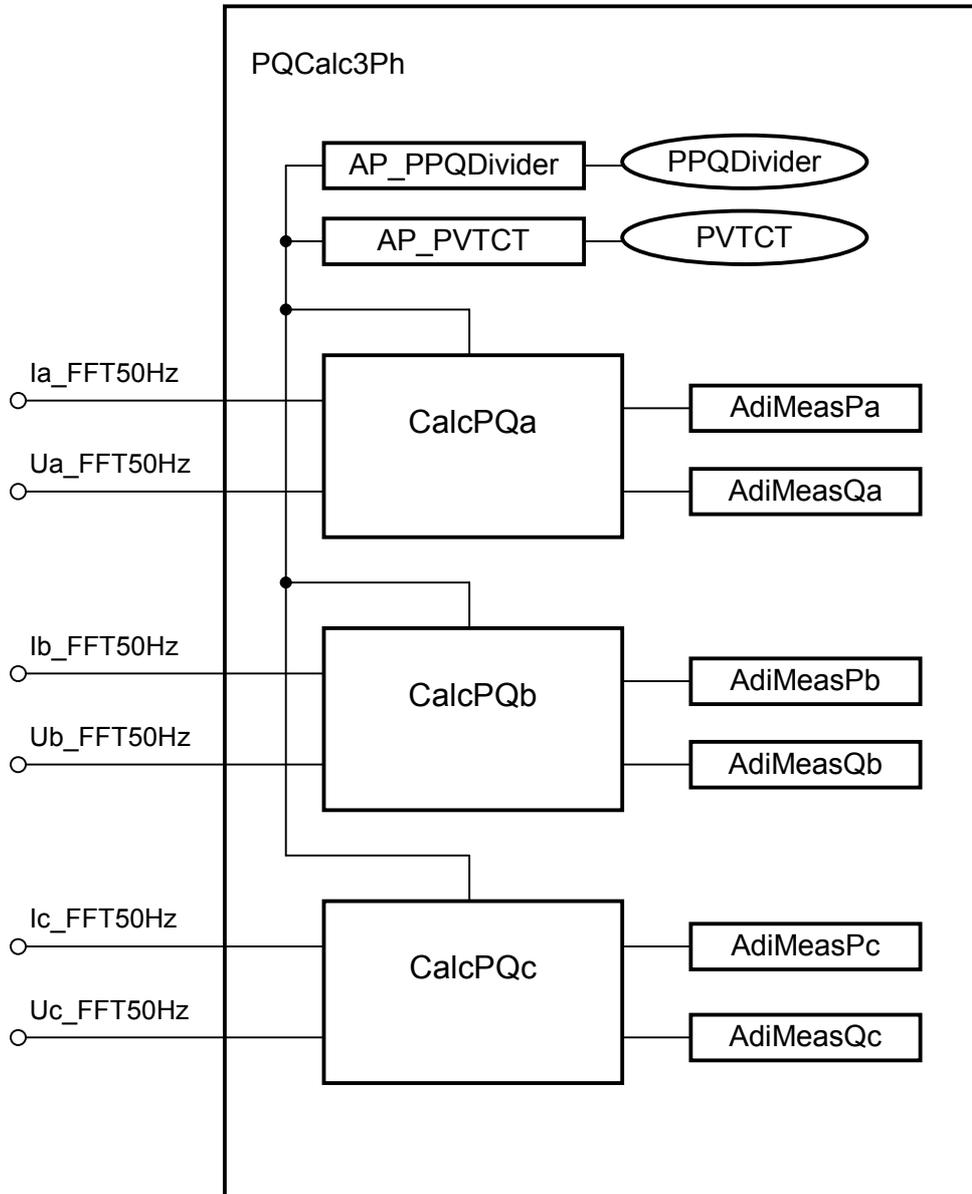
Ux_FFT50Hz (x=a,b,c) the Fourier function for the voltage of the indicated phase,

Ix_FFT50Hz (x=a,b,c) the Fourier function for the current of the indicated phase,

AP_PVTCT ADI parameter which transfers the PVTCT parameter to the function,

AP_PPQDivider ADI parameter which transfers the PPQDivider parameter to the function.

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ANSI50_3PH_HighSpeed

Task of the function

This overcurrent function ensures high speed reaction in case of extreme overcurrents.

Inputs

The function processes the three phase currents. If the pre-defined number of sampled currents are above the pre-defined limit in any of the three phases, the function generates start command for a given time.

Parameters

The function applies a constant parameter:

PHsOc this is the setting value of the function (factory setting is 3500).

For the operation the following constants are needed as well:

- Inp is the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.
- NoOfTrip defined constant, which defines the number of consecutive samples, the value of which must be above the setting value to start the function.
- 25 constant value which defines the drop-off time of the function (ms).

Outputs

The function generates a status signal:

- HsOc_Start started state of the function,
- HsOc_Start_x (x=a,b,c) started state in the individual phases.

Application guide

When the function is applied:

- Among the „Relay constants” (Relay Configuration / Internal Objects / Others / ADI relay constant) the AR_HSOC pre-defined constant must be available.
- Among the constants the NoOfTrip value must be available, which defines the number of consecutive samples, the value of which must be above the setting value to start the function.
- Among the constants the Inp value must be available, which is the A/D sampled numerical value in case of the rated current peak sample.

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Internal parameters of the function

The function is invoked with the following parameters:

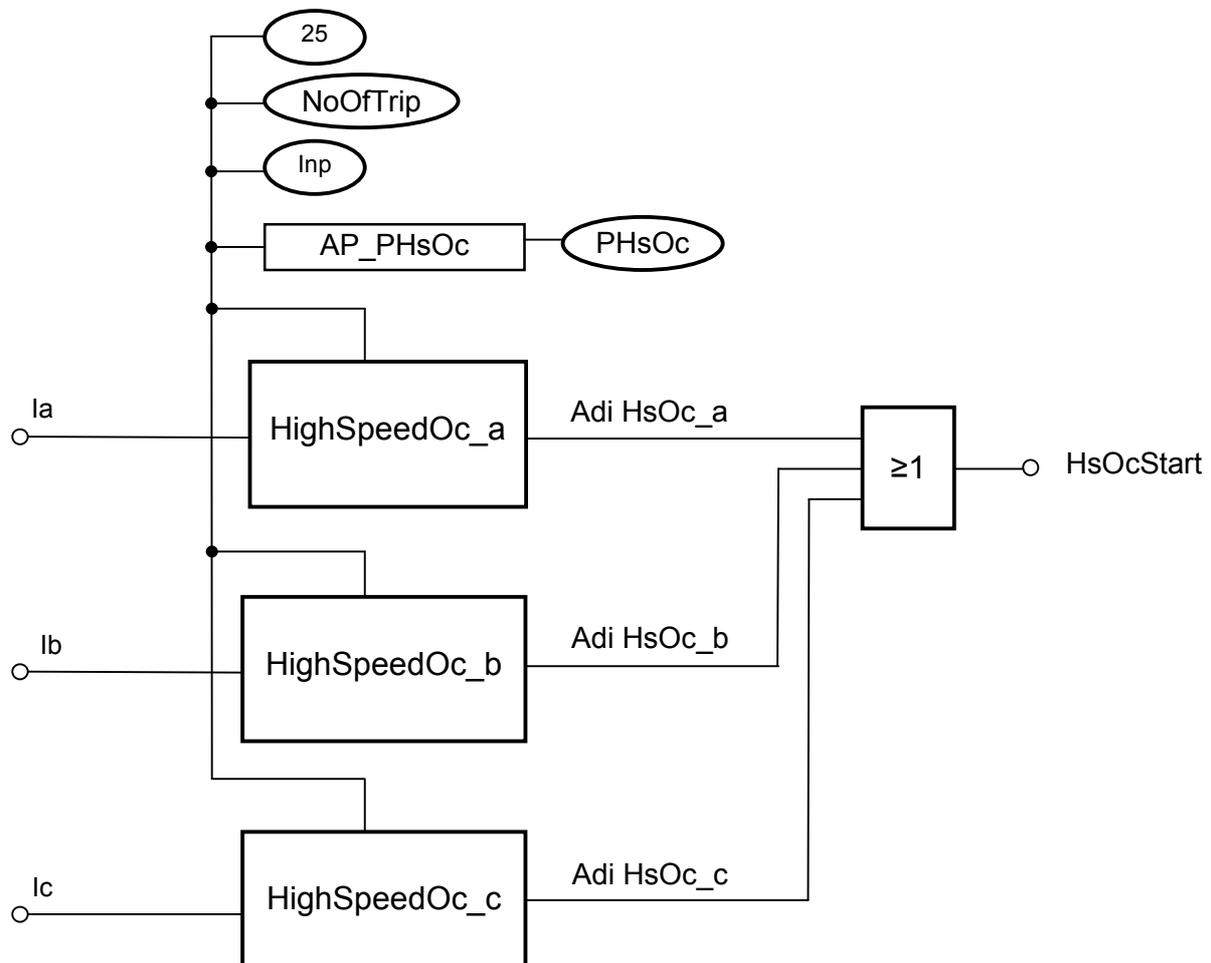
AR_HSOC,Ix,AdiHsOc_x,AP_PHSOc,Inp,NoOfTrip,25

AR_HSOC relay constant
Ix Current input (x=a,b,c)
AdiHsOc_x Status output (x=a,b,c),
AP_PHSOc ADI parameter which transfers the PHSOc constant parameter to the function.

Inp the A/D sampled numerical value in case of the rated current peak sample. This value depends on the hardware; it is defined by the producer.

NoOfTrip Constant value, which defines the number of consecutive samples, the value of which must be above the setting value to start the function

25 constant value which defines the drop-off time of the function (ms)



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