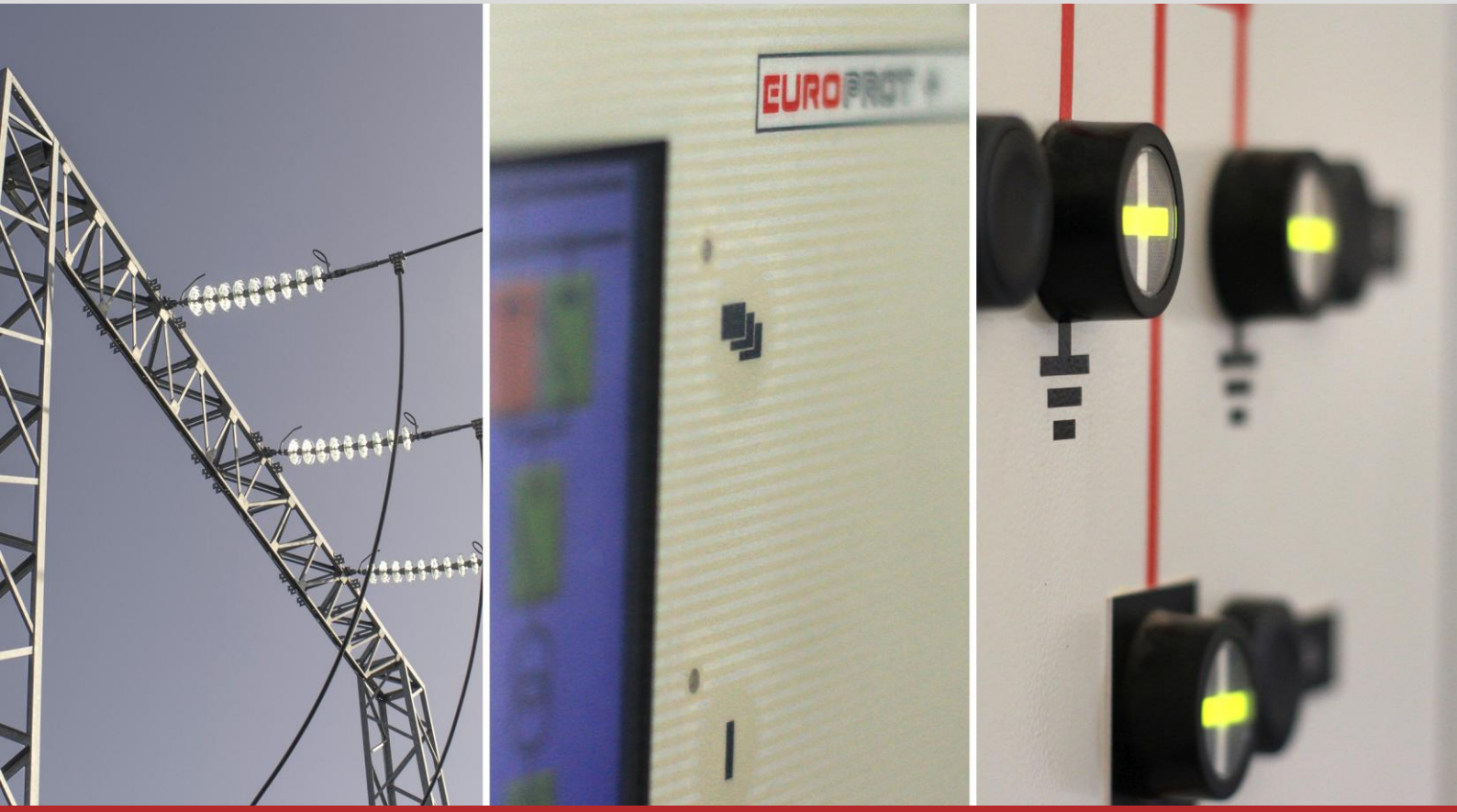

FUNCTION BLOCK DESCRIPTION

Residual Instantaneous Overcurrent Protection

ANSI 50N, IEC I_0>>>

PROTECTA HUNGARY

DOCUMENT ID: PP-13-22488
VERSION: 3.1
2025-12-09, BUDAPEST

PROTECTION, AUTOMATION AND CONTROL FOR POWER INDUSTRY

VERSION INFORMATION

VERSION	DATE	MODIFICATION	COMPILED BY
Preliminary	2009-10-30	Preliminary version, without technical information	Petri
	2010-10-05	Naming revision	Csipke
1.0	2010-11-11	First edition	Petri
1.1	2016-03-04	Modified: - The range of the setting of the *Start Current* parameter - The default value of the *Operation* parameter	Seida
2.0	2022-03-03	New design, new chapters (overview, notes for testing) added	Saina, Erdős
2.1	2022-11-28	Start Current parameter range adjusted, note added	Erdős
3.0	2025-01-17	Graphical analogue inputs added, IEC61850 info added	Ádám, Erdős
3.1	2025-12-09	Minor corrections	Erdős

CONTENTS

1 Application

The residual instantaneous overcurrent protection function operates according to_instantaneous characteristics, using the residual current (IN=3I_0). The setting value is a parameter, and it can be doubled by a binary input signal defined by the user, applying the graphic programming.

The basic calculation can be based on peak value selection or on the RMS values of the fundamental Fourier component of the residual current, according to the parameter setting. When Fourier calculation is selected then the accuracy of the operation is high, the operation time, however, is above one period of the network frequency. If the operation is based on peak values, then fast sub-cycle operation can be expected, but the transient overreach can be high.

1.1 Operating Characteristics

$$t(I) = t_{OP} \quad \text{when} \quad I > I_S$$

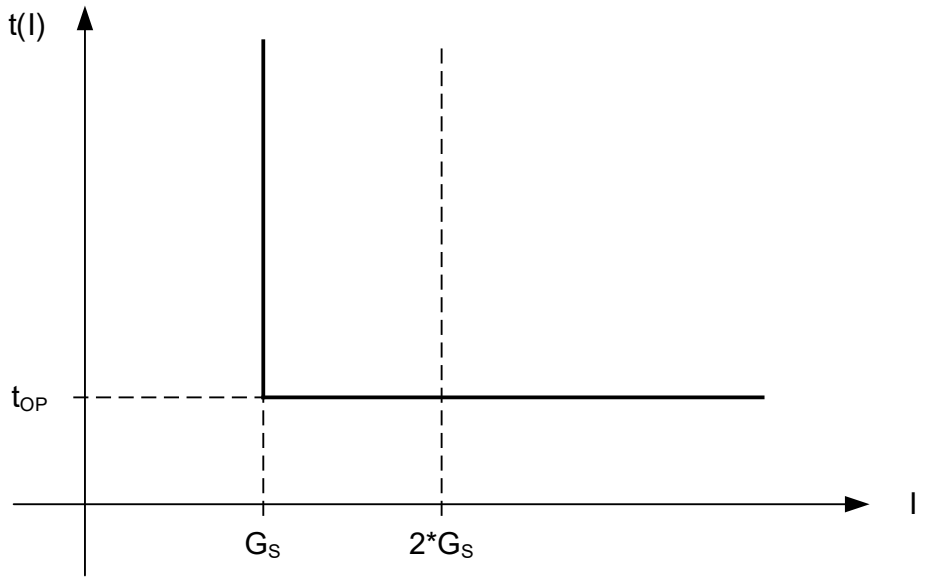

Figure 1-1 Overcurrent independent time characteristic

Where:

t_{OP} (sec.)	theoretical operating time if G> G_S (without additional time delay),
G	measured value of the characteristic quantity, peak values or Fourier base harmonic of the phase currents,
G_S	setting value of the characteristic quantity (*Start current*)

1.2 Structure of the Protection Algorithm

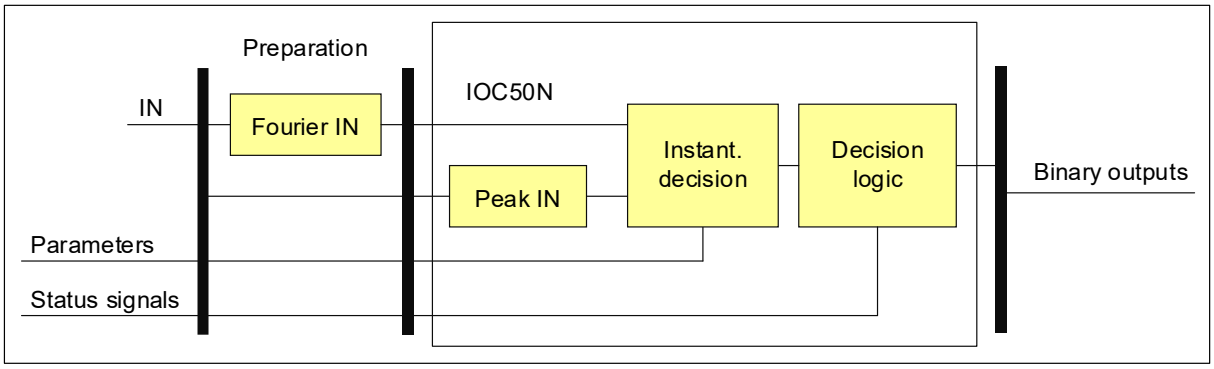

Figure 1-2 shows the structure of the residual instantaneous overcurrent protection (IOC50N) algorithm.

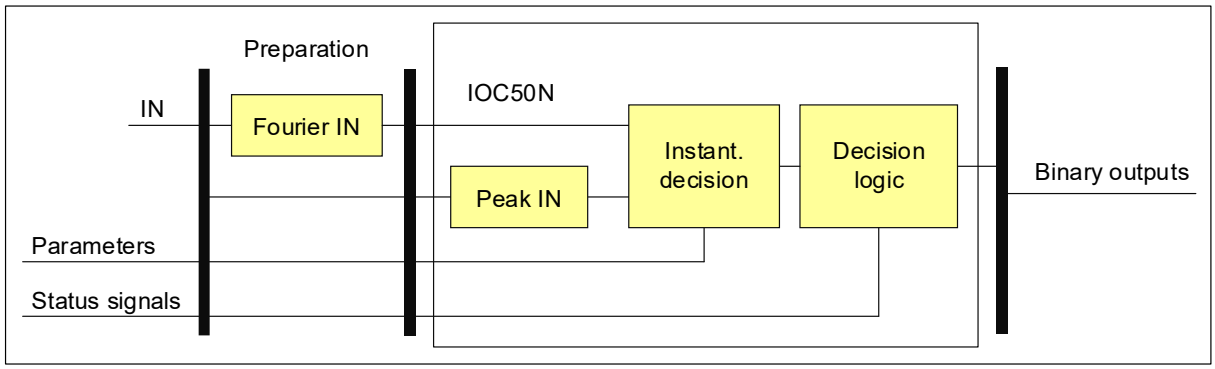

Figure 1-2 Structure of the residual instantaneous overcurrent protection algorithm

The **inputs** are

- the sampled values of the residual current,
- the RMS value of the fundamental Fourier component of the residual current,
- parameters,
- status signals.

The **outputs** are

- the binary output status signals.

The **software modules** of the differential protection function are:

Fourier calculation

This module calculates the basic Fourier current components of the residual current. It is not part of the residual instantaneous overcurrent protection function; it belongs to the preparatory phase.

Peak selection

This module selects the peak value of the residual current.

Instantaneous decision

This module compares the peak value or the Fourier basic harmonic components of the residual current with the setting value.

Decision logic

The decision logic modules generate the trip command of the function.

The following description explains the details of the individual components.

1.3 The Fourier Calculation (Fourier)

This module calculates the basic Fourier current components of the residual current. It is not part of the residual instantaneous overcurrent protection function; it belongs to the preparatory phase.

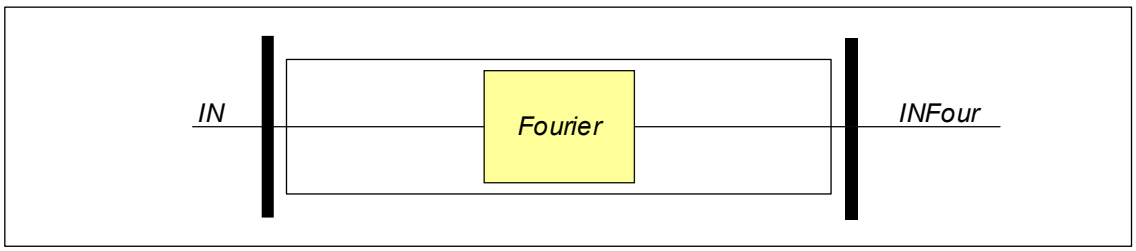

Figure 1-3 Principal scheme of the Fourier calculation

The **inputs** are the sampled values of the residual current (IN).

The **output** is the RMS value of the fundamental Fourier component of the residual current (INFour).

1.4 The Peak Selection (Peak selection)

This module selects the peak values of the residual current.

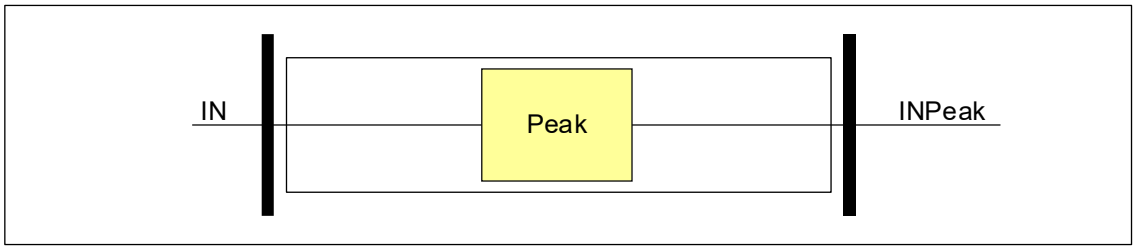

Figure 1-4 Principal scheme of the peak selection

The **inputs** are the sampled values of the residual current (IN).

The **outputs** are the peak values of the analyzed current (INPeak).

1.5 The Instantaneous Decision (Instantaneous decision)

This module generates an internal trip command without additional time delay based on the Fourier components of the residual current, or based on the peak values if the detected values are above the current setting value.

The **inputs** are the basic Fourier components of the residual current (INFour), the peak values (INPeak), parameters and status signals.

The **outputs** are the status signals. These indicate the generated internal trip command if the current is above the current setting value.

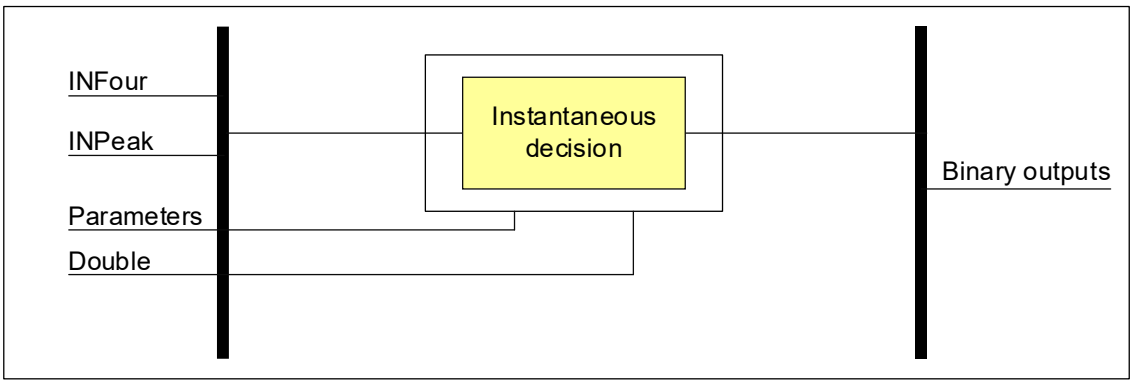

Figure 1-5 Principal scheme of the residual instantaneous characteristic calculation

Enumerated parameters

Table 1-1 The enumerated parameters of the residual IOC protection function

TITLE	DIM	RANGE	STEP	DEFAULT	EXPLANATION
Operation	-	Off, Peak value, Fundamental value	-	Off	Parameter for enabling the function and selection type.

Integer parameters

Table 1-2 The integer parameters of the residual IOC protection function

TITLE	DIM	RANGE	STEP	DEFAULT	EXPLANATION
Start Current	%	10 – 1000*	1	200	Setting value of the function.

**extendable to 3000 when using CT+/5151 module*

Binary status signals

The decision block of the residual instantaneous overcurrent protection function has a binary input signal, which serves the purpose of doubling the setting value of the function**. The conditions are defined by the user, applying the graphic equation editor.**

Table 1-3 The binary input signals for the decision block of the residual IOC protection function

BINARY STATUS SIGNAL	SIGNAL TITLE	EXPLANATION
IOC50N_**Double**_GrO_	Double the setting	Input used to double the value of the parameter “Start Current”.

The **binary output status signal** of the residual instantaneous overcurrent protection function is shown in Table 1-4.

Table 1-4 The binary output status signal of the residual IOC protection function

BINARY OUTPUT SIGNAL	SIGNAL TITLE	EXPLANATION
IOC50N_TrN_	Trip N_i	Internal trip command of the function

1.6 The Decision Logic (Decision logic)

The decision logic module combines the status signal binary and the binary parameter to generate the general trip command of the function.

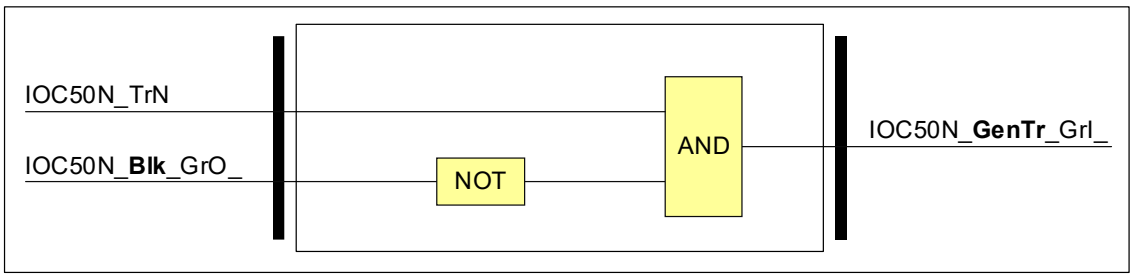

Figure 1-6 The logic scheme of the residual IOC protection function

Table 1-5 The binary input status signal of the residual IOC protection function

BINARY INPUT SIGNAL	SIGNAL TITLE	EXPLANATION
IOC50N_TrN_	Trip N	Internal trip command of the function

Binary status signal

The residual instantaneous overcurrent protection function has a binary input signal, which serves the purpose of disabling the function**. The conditions of disabling are defined by the user, applying the graphic equation editor.**

Table 1-6 The binary input signal of the residual IOC protection function

BINARY STATUS SIGNAL	SIGNAL TITLE	EXPLANATION
IOC50N_**Blk**_GrO_	Block	Input for disabling the function

Table 1-7 The binary output status signal of the decision logic

BINARY OUTPUT SIGNAL	SIGNAL TITLE	EXPLANATION
IOC50N_**GenTr**_Grl_	General Trip	General trip command of the function

2 Residual Instantaneous OC Function Overview

The graphic appearance of the residual instantaneous overcurrent protection function block is shown in Figure 2-1. This block shows all binary input and output status signals that are applicable in the graphic equation editor.

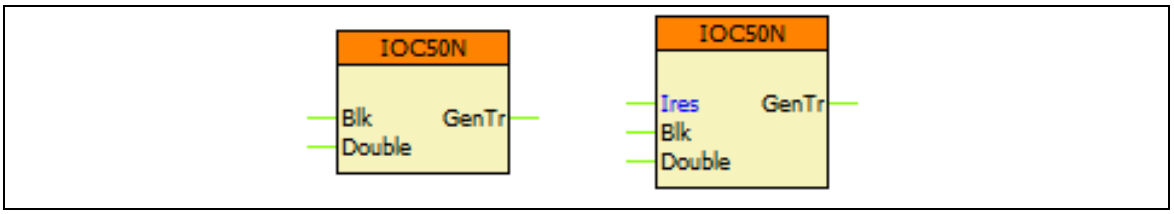

Figure 2-1 The function block of the residual instantaneous overcurrent protection

2.1 Settings

2.1.1 Parameters

The available parameters are listed below in order of their appearance in the *parameters* menu. If the setting range of a parameter should be extended, contact Protecta Support.

Table 2-1 Parameters of the residual instantaneous overcurrent protection function

TITLE	DIM	RANGE	STEP	DEFAULT	EXPLANATION
Operation	-	Off, Peak value, Fundamental value	-	Off	Parameter for enabling the function and selection type.
Start Current	%	10 – 1000*	1	200	Start value of the function, if the current exceeds this value, the function picks up and trips after the minimum operation time of the relay (t_{OP}).

**extendable to 3000 when using CT+/5151 module*

2.2 Function I/O

This section briefly describes the analogue and digital inputs and outputs of the function block.

2.2.1 Analogue inputs

Graphic Analogue inputs ***(only from firmware version 2.10.2.3010 and up)***

The sources of the analogue inputs are defined by the user, applying the graphic equation editor (*Logic Editor*). Parts written in **bold** are seen on the left side of the function block in the Logic editor.

The function uses the following analogue signals as inputs:

Table 2-2 Analogue input signal of the residual IOC function

ANALOGUE INPUT SIGNAL	SIGNAL TITLE	EXPLANATION
IOC50N_**Ires**_AnIn_	Residual current	Input for residual current: • For calculated 3Io, connect 3ph current • For measured 3Io, connect single currents

The applied analogue connectors must be identical to the analogue input type (i.e. voltage to voltage input etc.), Invalid connections are not allowed.

2.2.2 Analogue outputs (measurements)

The function block has no analogue output signals.

2.2.3 Binary input signals (graphed output statuses)

The conditions of the binary inputs are defined by the user, applying the graphic equation editor (*Logic Editor*). Parts written in **bold** are seen on the left side of the function block in the Logic editor.

Table 2-3 The binary input signals of the residual IOC function

BINARY INPUT SIGNAL	EXPLANATION
IOC50N_**Blk**_GrO_	Input for disabling the function
IOC50N_**Double**_GrO_	Input used to double the value of the parameter “Start Current”.

2.2.4 Binary output signals (graphed input statuses)

The binary output status signals of the residual instantaneous overcurrent protection function, parts written in **bold** are seen on the function block in the logic editor.

Table 2-4 The binary output signal of the residual IOC function

BINARY OUTPUT SIGNAL	SIGNAL TITLE	EXPLANATION
IOC50N_**GenTr**_GrI_	General Trip	General trip command of the function

2.2.5 Online data

Visible values on the on-line data page:

Table 2-5 Online data of the residual IOC function

SIGNAL TITLE	DIMENSION	EXPLANATION
General Trip	-	General trip command of the function
Current input assignment	-	*Status of the graphical analogue input (if exists) (Complete if OK, Missing if not connected)*

2.2.6 Events

The following events are generated in the event list, as well as sent to the SCADA according to the configuration.

Table 2-6 Event of the residual IOC function

EVENT	VALUE	EXPLANATION	IEC61850 DATA ATTRIBUTES
General Trip	off, on	General trip command of the function	F1PIOC1STOp

2.3 Technical Data

Table 2-7 Technical data of the residual IOC protection function

FUNCTION	VALUE	ACCURACY
Using peak value calculation		
Operating characteristic ($I > 0.1I_n$)	Instantaneous	< 6%
Reset ratio	0.85	
Operate time at 2*Is	< 15 ms	
Reset time*	< 40 ms	
Transient overreach	85%	
Using Fourier fundamental harmonic calculation		
Operating characteristic ($I > 0.1I_n$)	Instantaneous	< 3%
Reset ratio	0.85	
Operate time at 2*Is	< 25 ms	
Reset time*	< 60 ms	
Transient overreach	15%	

** Measured with signal contacts*

2.4 Notes for Testing

Normally in the EuroProt+ devices the trip contacts are assigned to the Trip Logic function block, and not to the protection function blocks. Because of this, the testing personnel must make sure that the Trip Logic is switched on ('Operation' parameter is set to other than 'Off') before starting the tests, otherwise there will be no physical trip on the relay.

Being an instantaneous function, its connection to the Trip Logic function is done in the Fast Equations (by default) and not in the Logic Editor (usually, there are comments inserted in the Logic Editor if such connections exist). This can be checked in EuroCAP.

As the analogue sources can be changed by the user, it is possible to assign calculated or measured residual current to the input of the function block. This can be checked in the function block properties in EuroCAP.

Additional notes for Graphic Analogue inputs *(only from firmware version 2.10.2.3010 and up):*

Starting from the firmware version **2.10.2.3010**, the majority of the function blocks can be updated to be equipped with graphic analogue inputs which **allow the user to assign the functions' analogue inputs by applying the graphic equation editor**.

The analogue connections of these functions can be checked by examining the source that is connected to their inputs (just like examining the source of a logic signal).

These functions must be placed in the Logic Editor and their graphic analogue inputs must be connected to make them operate. If a connection is intact, the online status of the corresponding analogue input will show "Complete". If it is missing, the status will be "Missing" and the function will not operate.

Note that these graphical inputs do not exist in the earlier firmware/function versions! Checking and modifying the analogue assignments in these cases are done by using the EuroCAP Software Configuration menu.