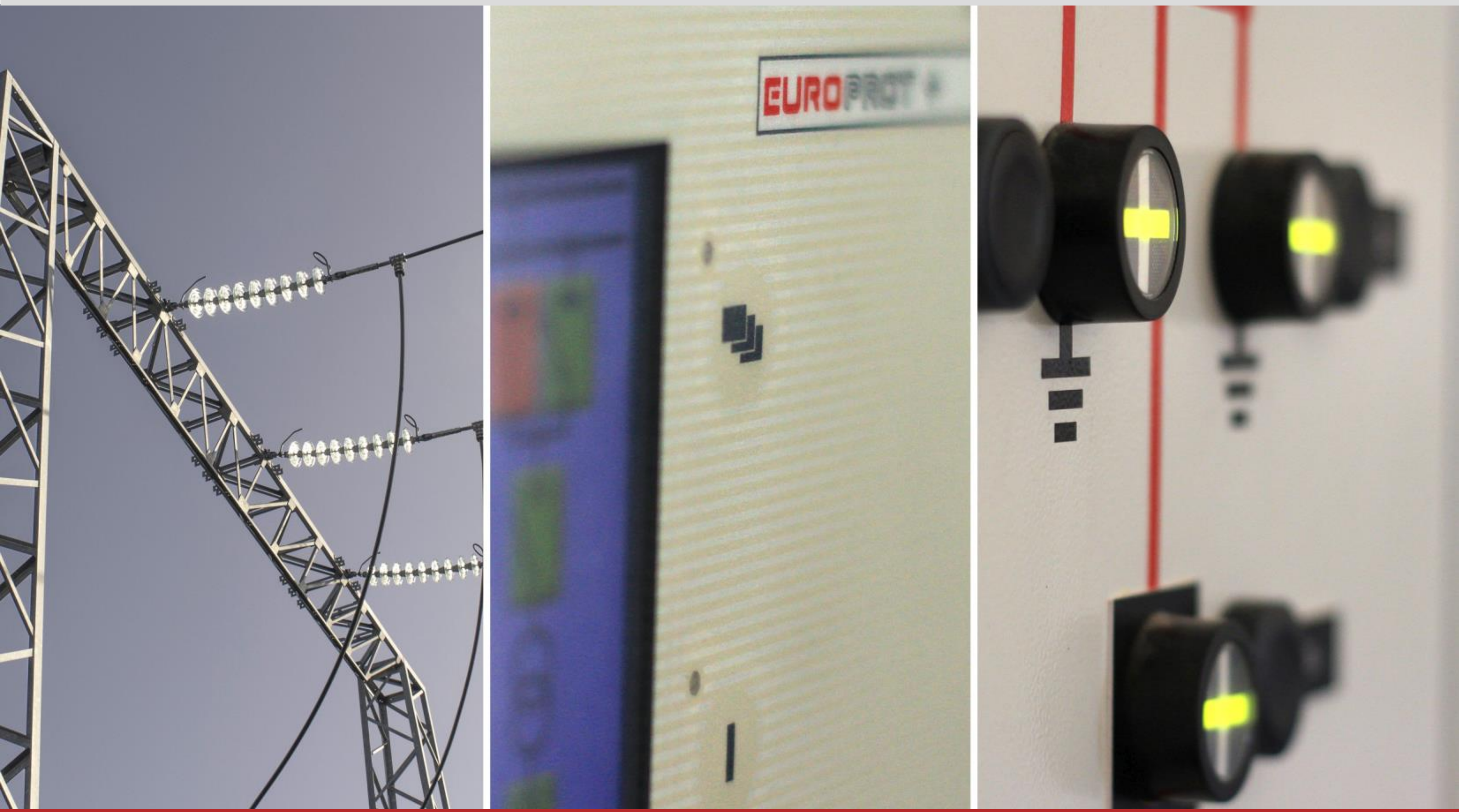

Function block description

Current unbalance protection

(Current Transformer supervision)

ANSI 60

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Protection, automation and control for power industry

VERSION INFORMATION

VERSION	DATE	MODIFICATION	COMPILED BY
Preliminary	2009-11-24	Preliminary version, without technical information	Petri
	2010-10-05	Naming revision	Csipke
1.0	2010-11-11	First edition	Petri
2.0	2020-06-25	New documentation design, on-line data added, event listing added;	Tóth
3.0	2024-12-20	Analogue inputs added, IEC61850 info added	Ádám, Erdős

CONTENTS

1 Application

The current unbalance protection function can be applied to detect unexpected asymmetry in current measurement.

1.1 Mode of operation

The applied method selects maximum and minimum phase currents (RMS values of the fundamental Fourier components). If the difference between them is above the setting limit, the function generates a start signal. It is a necessary precondition of start signal generation that the maximum of the currents be above 10 % of the rated current and below 150% of the rated current.

The function can be disabled by parameter setting, and by an input signal programmed by the user with the graphic programming tool.

The trip command is generated after the defined time delay if trip command is enabled by parameter setting.

1.2 Operation principles

Figure 1-1 shows the structure of the current unbalance protection algorithm.

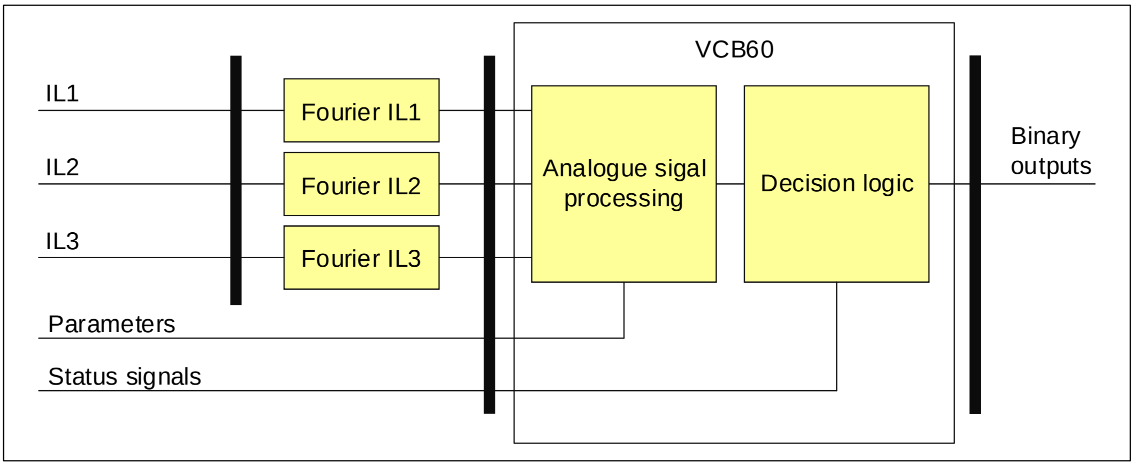

Figure 1-1 Structure of the current unbalance protection algorithm

The **inputs** of the preparatory phase are

- the three phase currents,

The **outputs** of the preparatory phase are

- the RMS values of the fundamental Fourier component of three phase currents.

The **inputs** of the current unbalance function are

- the RMS values of the fundamental Fourier component of three phase currents,
- parameters,
- status signals.

The **outputs** are

- the binary output status signals.

The **software modules** of the current unbalance function:

Fourier calculations

These modules calculate the RMS values of the basic Fourier current components of the phase currents individually (not part of the VCB60 function).

Analogue signal processing

This module processes the RMS values of the Fourier components of the phase currents to prepare the signals for the decision.

Decision logic

The decision logic module combines the status signals to generate the starting signal and the trip command of the function.

The following description explains the details of the individual components.

1.3 The Fourier calculation (Fourier)

These modules calculate the RMS values of the fundamental Fourier components of the phase currents individually. They are not part of the VCB60 function; they belong to the preparatory phase.

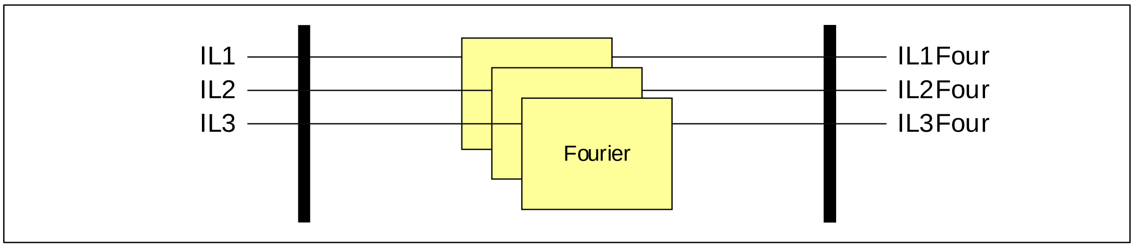

Figure 1-2 Principal scheme of the Fourier calculation

The **inputs** are the sampled values of the three phase currents (IL1, IL2, IL3)

The **outputs** are the RMS values of the fundamental Fourier components of the phase currents (IL1Four, IL2Four, IL3Four).

1.4 The Analogue signal processing

This module processes the Fourier components of the phase currents to prepare the signals for the decision.

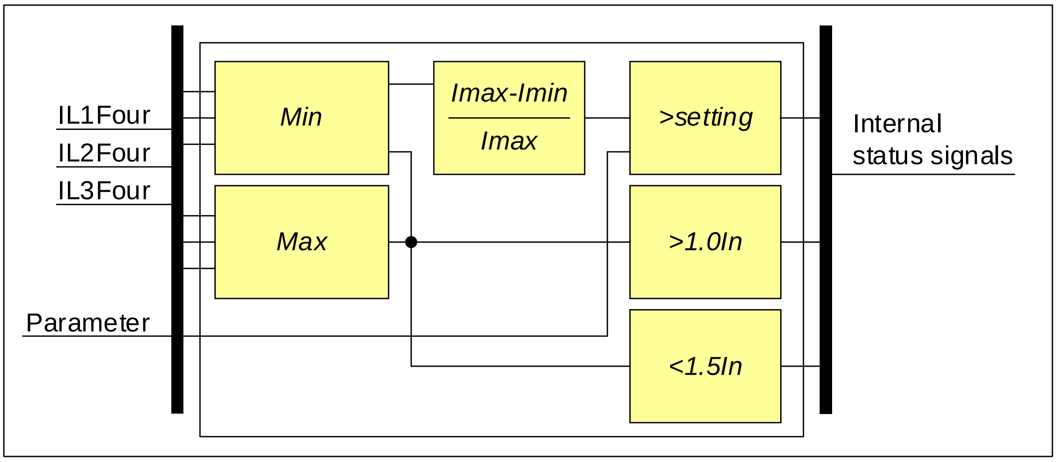

Figure 1-3 Principal scheme of the analogue signal processing

The **inputs** are the fundamental Fourier components of the analyzed currents (IL1Four, IL2Four, IL3Four)

The **outputs** are internal binary signals:

- ΔI> The difference between the maximum and minimum of the RMS values of the fundamental Fourier components of the phase currents as a percentage of the maximum of these values is above the limit defined by the preset parameter “Start current”;
- Imax>0.1In The maximum of the RMS values of the fundamental Fourier components of the phase currents is sufficient for evaluation;
- Imax<1.5In The maximum of the RMS values of the fundamental Fourier components of the phase currents is not considered as a fault current.

1.5 The decision logic (Decision logic)

The decision logic module combines the status signals, binary and enumerated parameters to generate the trip command of the function.

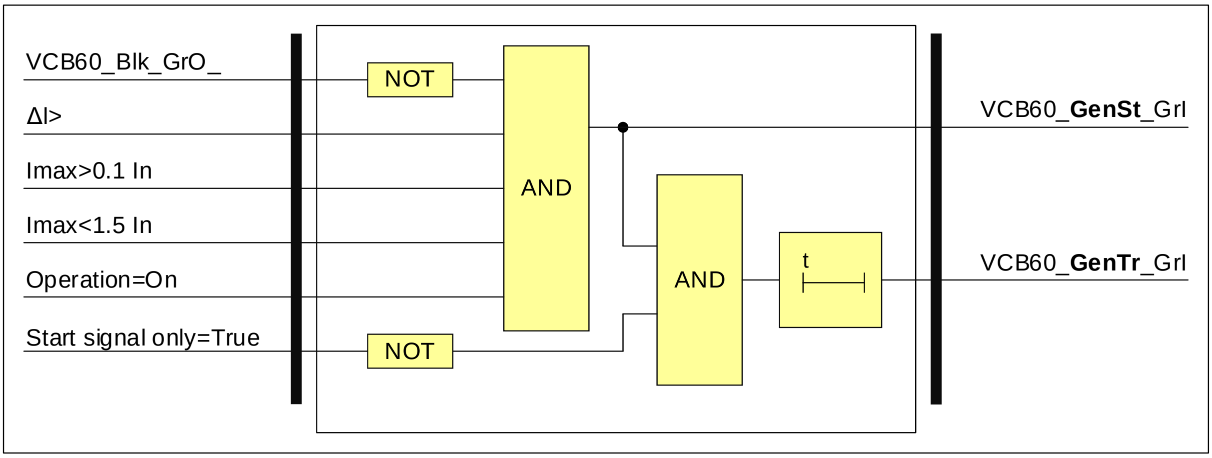

Figure 1-4 The logic scheme of the current unbalance function

The **inputs** are internal binary signals:

- ΔI> the difference between the maximum and minimum of the RMS values of the fundamental Fourier components of the phase currents as a percentage of the maximum of these values is above the limit defined by parameter setting “Start Current Diff”;
- Imax>0.1In the maximum of the RMS values of the fundamental Fourier components of the phase currents is sufficient for evaluation;
- Imax<1.5In the maximum of the RMS values of the fundamental Fourier components of the phase currents is not considered as a fault current.

2 Current unbalance protection function overview

The graphic appearance of the function block of the current unbalance protection function is shown below. The block shows all binary input and output status signals which are applicable in the graphic equation editor.

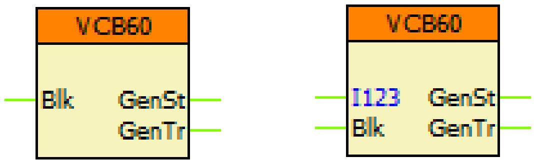

Figure 2-1 Graphic appearance of the function block of the current unbalance protection function

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 current unbalance protection function

TITLE	DIM	RANGE	STEP	DEFAULT	EXPLANATION
Operation	-	Off, On	-	Off	Enabling the function
Start Signal Only	-	FALSE, TRUE	-	FALSE	When checked, the function provides start signal only, and no trip signal.
Start Current	%	10 – 90	1	50	Phase difference current setting
Time Delay	msec	100 – 60000	100	1000	Time delay (including the algorithm time, see Chapter 2.4 for more explanation)

2.2 Function I/O

This section describes briefly 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 loss of excitation function

ANALOGUE INPUT SIGNAL	SIGNAL TITLE	EXPLANATION
VCB60_**I123**_AnIn_	3phase current	Input for three-phase current

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 function block in the Logic editor.

Table 2-3 The binary input signal of the current unbalance protection function

BINARY OUTPUT SIGNAL	EXPLANATION
VCB60_**Blk**_GrO_	Blocking input of the function

2.2.4 Binary output signals (graphed input statuses)

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

Table 2-4 The binary output signals of the current unbalance protection function

BINARY OUTPUT SIGNAL	SIGNAL TITLE	EXPLANATION
VCB60_**GenSt**_GrI_	General Start	General start signal of the function
VCB60_**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 displayed data of the current unbalance protection function

SIGNAL TITLE	DIMENSION	EXPLANATION
General Start	-	General start signal of the function
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 Generated events of the current unbalance protection function

EVENT	VALUE	EXPLANATION	IEC61850 DATA ATTRIBUTES
General Start	off, on	General start of the function	F1PTOC1STStr
General Trip	off, on	General trip command of the function	F1PTOC1STOp

2.3 Technical data

Table 2-7 Technical data of the current unbalance protection function

FUNCTION	VALUE	ACCURACY
Pick-up starting accuracy at In		< 2 %
Reset ratio	0,95	
Operate time	70 ms	

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.

Note that the time delay parameter incorporates the algorithm time as well, so the time delay *does **not** mean the time difference between the appearance of the start and trip signals* of the function. In other words: it is not the delay between the detection of the fault and the trip that follows it. This should be taken into consideration when checking the disturbance records.

Instead the time delay parameter defines the elapsed time from the appearance of the faulty state to the trip. Because of this, while testing, the delay measurement should start *from the moment of the fault injection* until the trip signal.

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.