FUNCTION BLOCK DESCRIPTION

Breaker failure protection

ANSI 50BF

PROTECTA HUNGARY

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VERSION: 2.1
2020-10-03, BUDAPEST

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
1.1	2014-04-28	Minor corrections: it is the version for solidly grounded networks	Seida
1.0MV	2014-04-28	First edition of BRFMV	Seida
1.2	2016-02-14	The minimum setting of the Retrip time delay parameter changed.	Seida
2.0	2020-11-24	Merging version (both BRF functions included in this version, other descriptions are removed) Technical data updated	Tóth
2.1	2022-10-03	Reset ratio updated	Erdős

CONTENTS

USED SYMBOLS

BRF50SP

Information regarding only to the “Single-pole Breaker Failure” protection functions

1 Application

After a protection function generates a trip command, it is expected that the circuit breaker opens and the fault current drops below the pre-defined normal level.

If not, then an additional trip command must be generated for all backup circuit breakers to clear the fault. At the same time, if required, a repeated trip command can be generated to the circuit breaker(s) which are expected to open.

The breaker failure protection function can be applied to perform this task.

In EuroProt+ product family two versions of breaker failure protection function can be applied:

"BRF50" – Breaker Failure:
This version of the breaker failure protection can be applied to perform the task to give command to the backup circuit breakers. It can be applied if only common-phase handling is sufficient, and phase selectivity is not required.

BRF50SP

"BRF50SP" - Single-pole Breaker Failure:
If repeated trip command (retrip) is needed besides the backup trip, this version of breaker failure protection function must be used.

Both versions of breaker failure protection function receive the trip requirements of the protective functions implemented in the device and combines the binary signals and parameters to the outputs of the device.

1.1 Mode of operation

The starting signal of the breaker failure protection function is usually the trip command of any other protection function. The user has the task to define these starting signals using the graphic equation editor as the "General Start" (BRF50_**GenSt**_GrO_), or if the operation of the individual phases is needed, then the start signals for the phases individually.
The phase start signals are: "Start L1" (BRF50_**StL1**_GrO_), "Start L2" (BRF50_**StL2**_GrO_) and "Start L3" (BRF50_**StL3**_GrO_).

Dedicated timers start at the rising edge of the start signals, one for the backup trip command and one for the repeated trip command, separately for operation in the individual phases. During the running time of the timers the function optionally monitors the currents, the closed state of the circuit breakers or both, according to the user's choice. The selection is made using the enumerated parameter "Operation":

- If this parameter setting is "Current", the current limit values "Start Ph Current" and "Start Res Current" must be set correctly. The binary input indicating the status of the circuit breaker has no meaning.

- If this parameter setting is "Contact", the current limit values "Start current Ph" and "Start current N" have no meaning. The binary input indicating the status of the circuit breaker must be programmed correctly using the graphic equation editor.
  - By using "BRF50" variant: the input variable to be programmed is: BRF50_**CBClosed**_GrO_ (CB Closed),

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  - *By using "BRF50SP" variant: the input variables to be programmed are: BRF50_**CBCIL1**_GrO_ (CB closed L1), BRF50_**CBCIL2**_GrO_ (CB closed L2) and BRF50_**CBCIL3**_GrO_ (CB closed L3).*

- If this parameter setting is "Current/Contact", the current parameters and the status signal must be set correctly. The breaker failure protection function resets only if all conditions for faultless state are fulfilled.

- The breaker failure protection function can be disabled by setting this parameter to “Off”.
  If at the end of the running time of the backup timer the currents do not drop below the pre-defined level, and/or the monitored circuit breaker is still in closed position, then a backup trip command is generated. The time delay is defined using the parameter “Backup Time Delay”.

  The pulse duration of the trip command is not shorter than the time defined by setting the parameter “Pulse Duration”.

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If repeated trip command is to be generated for the circuit breakers that are expected to open, then the enumerated parameter “Retrip” must be set to “On”. In this case, at the end of the retrip timer(s) the delay of which is set by the timer parameter “Retrip Time Delay”, a repeated trip command is also generated in the phase(s) where the backup timer(s) run off.

Dynamic blocking is possible using the binary input BRF50_**Blk**_GrO_ (Block). The conditions are to be programmed by the user, using the graphic equation editor.

1.2 Operation principles

The decision logic module combines status signals, binary and enumerated parameters to generate the backup trip signal.

Binary status signals

The breaker failure protection function has binary input signals. **The conditions are defined by the user, applying the graphic equation editor.**

The **binary input status signals** of the breaker failure protection function are listed in Table 1-1.

Table 1-1 The binary input status signals of the decision logic

BINARY STATUS SIGNAL	TITLE	EXPLANATION
BRF50_**Blk**_GrO_	Block	Blocking of the breaker failure protection function
BRF50_**CBClosed**_GrO_	CB closed	Signal indicating the closed state of the circuit breaker
*BRF50SP_**CBCIL1**_GrO_*	*CB closed L1*	*Signal indicating the closed state of the circuit breaker in phase L1*
BRF50SP *BRF50SP_**CBCIL2**_GrO_*	*CB closed L2*	*Signal indicating the closed state of the circuit breaker in phase L2*
*BRF50SP_**CBCIL3**_GrO_*	*CB closed L3*	*Signal indicating the closed state of the circuit breaker in phase L3*
BRF50_**GenSt**_GrO_	General Start	General starting signal
*BRF50SP_**StL1**_GrO_*	*Start L1*	*Starting signal in phase L1*
BRF50SP *BRF50SP_**StL2**_GrO_*	*Start L2*	*Starting signal in phase L2*
*BRF50SP_**StL3**_GrO_*	*Start L3*	*Starting signal in phase L3*
BRF50_**IoSt**_GrO_	Start Io	Starting signal for the residual current
Internal signal:	IL1>	Current in phase L1 is above the preset parameter value
Internal signal:	IL2>	Current in phase L2 is above the preset parameter value
Internal signal:	IL3>	Current in phase L3 is above the preset parameter value
Internal signal:	Io>	Current 3Io is above the preset parameter value
Enumerated parameter	Current/Contact	The monitored condition is current, contact or both

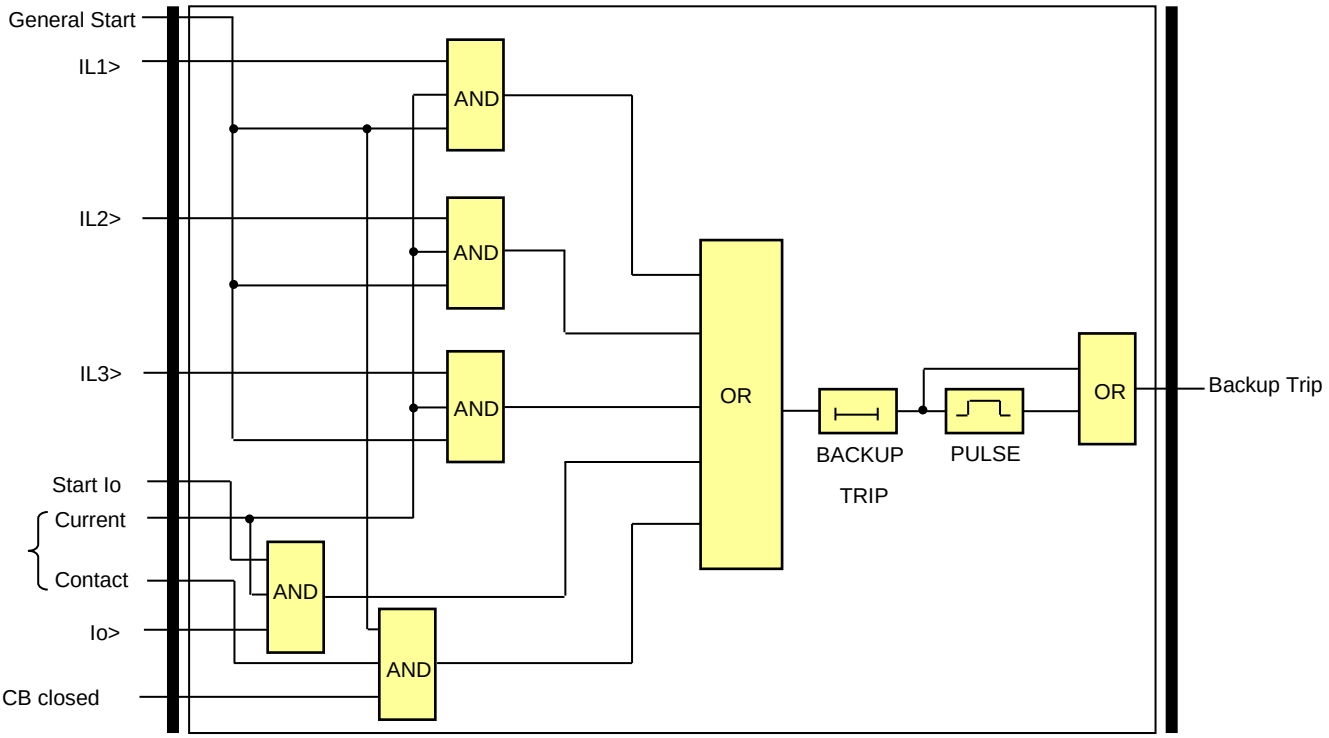

Figure 1-1 The logic scheme of the decision logic of "BRF50" variant

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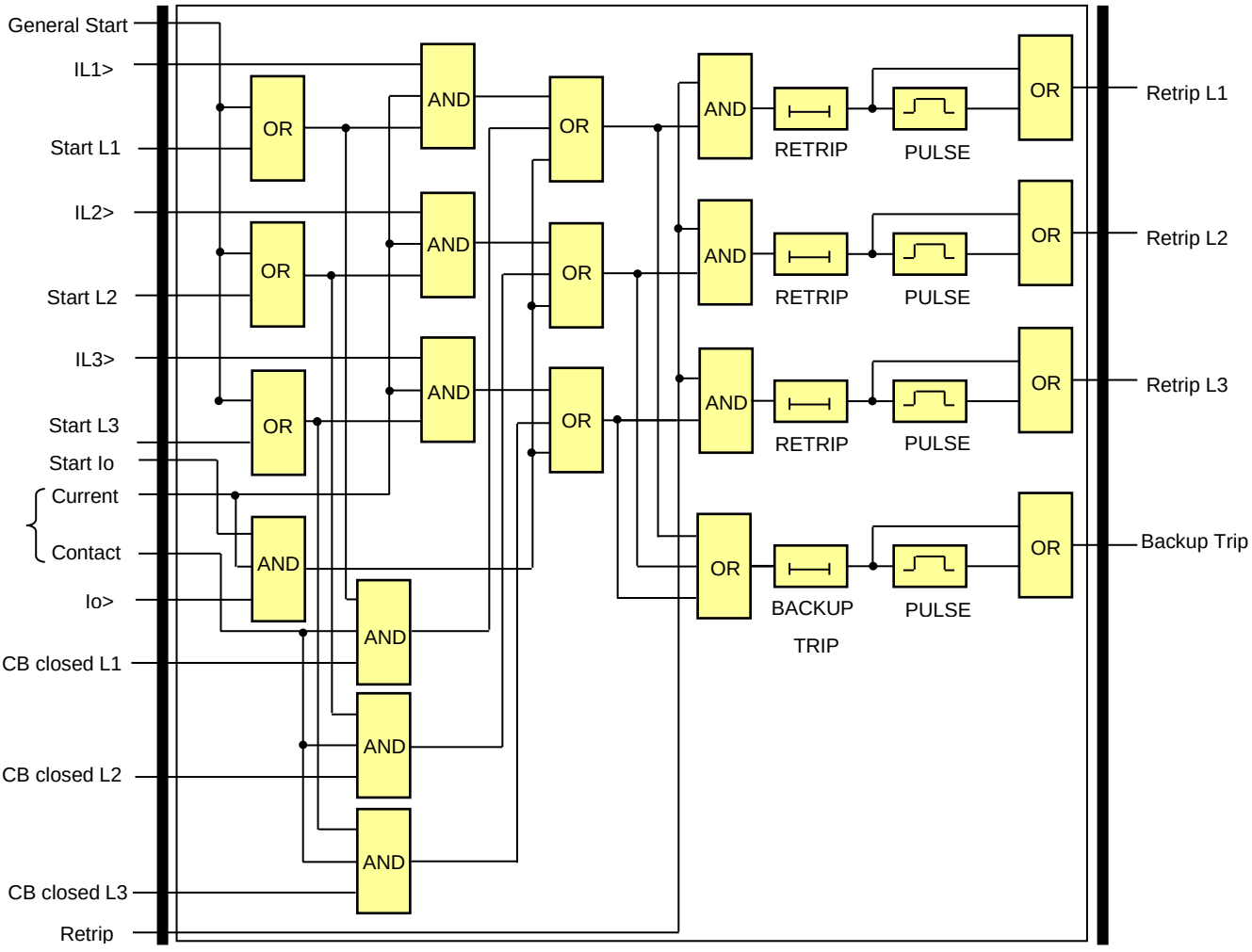

Figure 1-2 The logic scheme of the decision logic of "BRF50SP" variant

The **binary output status signals** of the breaker failure protection function is detailed in Table 1-2.

Table 1-2 The binary output status signal of the decision logic

BINARY STATUS SIGNAL	TITLE	EXPLANATION
BRF50_**BuTr**_GrI_	Backup Trip	Trip command generated for the backup circuit breakers
*BRF50_**TrL1**_GrI_*	*Retrip L1*	*Repeated trip command in phase L1*
*BRF50_**TrL2**_GrI_*	*Retrip L2*	*Repeated trip command in phase L2*
*BRF50_**TrL3**_GrI_*	*Retrip L3*	*Repeated trip command in phase L3*

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2 Breaker failure protection function overview

The graphic appearance of the variants the breaker failure protection function blocks are shown below. The blocks show all binary input and output status signals which are applicable in the graphic equation editor.

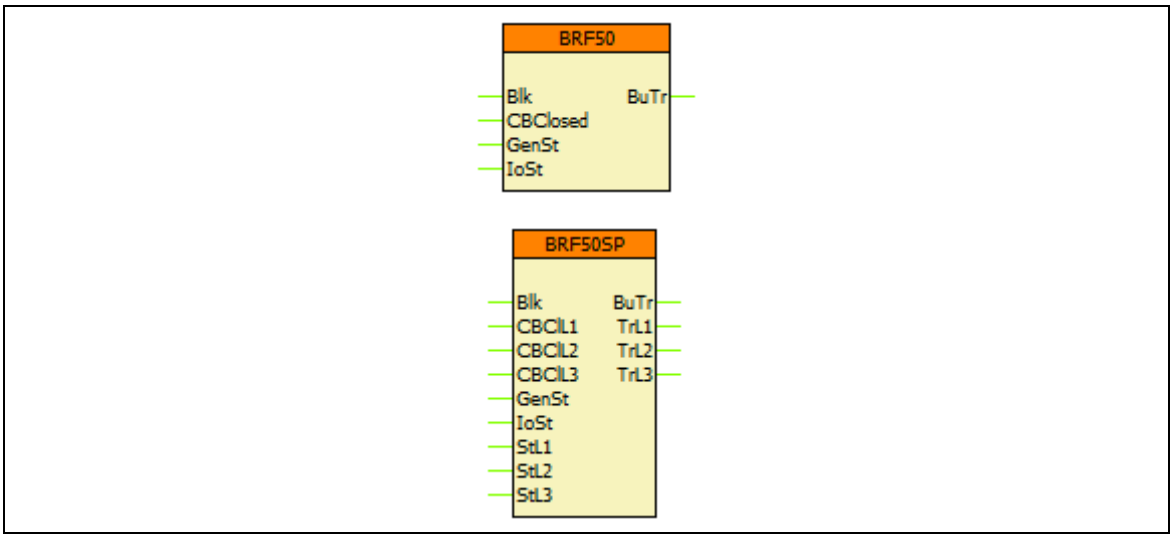

Figure 2-1 Graphic appearance of the variants of the breaker failure protection function block

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 breaker failure protection function

	TITLE	DIM	RANGE	STEP	DEFAULT	EXPLANATION
	Operation	-	Off, Current, Contact, Current/Contact	-	Off	Enabling the function
BRF50SP	*Retrip*	-	*Off, On*	-	*Off*	*Enabling the retrip function*
	Start Ph Current	%	20 – 200	1	30	Phase current setting
	Start Res Current	%	10 – 200	1	20	Residual current setting
BRF50SP	*Retrip Time Delay*	*msec*	*0 – 1000*	*1*	*100*	*Time delay for retrip command generation*
	Backup Time Delay	msec	100 – 60000	1	1000	Time delay for trip command generation for the backup circuit breaker(s)
	Pulse Duration	msec	0 – 60000	1	100	Trip command impulse duration

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

The function uses the sampled values of a current input. This is defined in the configuration.

2.2.2 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 2-2 The binary input signals of the breaker failure protection functions

	BINARY STATUS SIGNAL	TITLE	EXPLANATION
	BRF50_**Blk**_GrO_	Block	Blocking of the breaker failure protection function
	BRF50_**CBClosed**_GrO_	CB closed	Signal indicating the closed state of the circuit breaker
BRF50SP	*BRF50SP_**CBCIL1**_GrO_*	*CB closed L1*	*Signal indicating the closed state of the circuit breaker in phase L1*
BRF50SP	*BRF50SP_**CBCIL2**_GrO_*	*CB closed L2*	*Signal indicating the closed state of the circuit breaker in phase L2*
BRF50SP	*BRF50SP_**CBCIL3**_GrO_*	*CB closed L3*	*Signal indicating the closed state of the circuit breaker in phase L3*
	BRF50_**GenSt**_GrO_	General Start	General starting signal
BRF50SP	*BRF50SP_**StL1**_GrO_*	*Start L1*	*Starting signal in phase L1*
BRF50SP	*BRF50SP_**StL2**_GrO_*	*Start L2*	*Starting signal in phase L2*
BRF50SP	*BRF50SP_**StL3**_GrO_*	*Start L3*	*Starting signal in phase L3*
	BRF50_**IoSt**_GrO_	Start Io	Starting signal for the residual current

2.2.3 Binary output signals (graphed input statuses)

These signals can be used in EuroCAP to assign to LED, user LCD object etc. Parts written in **bold** are seen on the right side of the function block in the *Logic Editor*.

Table 2-3 The binary output signals of the breaker failure protection function

	BINARY STATUS SIGNAL	TITLE	EXPLANATION
	BRF50_**BuTr**_GrI_	Backup Trip	Trip command generated for the backup circuit breakers
BRF50SP	*BRF50_**TrL1**_GrI_*	*Retrip L1*	*Repeated trip command in phase L1*
BRF50SP	*BRF50_**TrL2**_GrI_*	*Retrip L2*	*Repeated trip command in phase L2*
BRF50SP	*BRF50_**TrL3**_GrI_*	*Retrip L3*	*Repeated trip command in phase L3*

2.2.4 Online data

Visible values on the *online data* page.

Table 2-4 Online displayed data of the breaker failure protection function

	SIGNAL TITLE	DIMENSION	EXPLANATION
	Backup Trip	-	Trip command generated for the backup circuit breakers
BRF50SP	*Retrip L1*	-	*Repeated trip command in phase L1*
BRF50SP	*Retrip L2*	-	*Repeated trip command in phase L2*
BRF50SP	*Retrip L3*	-	*Repeated trip command in phase L3*

2.2.5 Events

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

Table 2-5 Generated events of the breaker failure protection function

EVENT	VALUE	EXPLANATION
Backup Trip	off, on	Backup trip command of the function
Retrip L1	off, on	*Repeated trip command in phase L1*
Retrip L2	off, on	*Repeated trip command in phase L2*
Retrip L3	off, on	*Repeated trip command in phase L3*

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2.3 Technical data

Table 2-6 Technical data of the breaker failure protection function

FUNCTION	VALUE	ACCURACY
Pick-up starting accuracy		< 2 %
Operate time accuracy		±5% or ±15 ms, whichever is greater
Retrip time	approx. 15 ms	
Reset ratio	0.9	
Current reset time	16 – 25 ms	

2.4 Notes for testing

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.