EUROPROT +

Setting guide
to the MV automatic reclosing function

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CONTENTS

1 Guide to the parameters of the MV automatic reclosing function

The operation of the automatic reclosing function is controlled by parameters and binary signals, connected to the REC79MV function block. This chapter explains the effects of the parameter setting. For the binary signals see Chapter 2.

1.1 Enumerated parameters

Parameter name	Title	Selection range	Default
Switching ON/OFF the MV automatic reclosing function			
REC79_Op_EPar_	Operation	Off, On	On
Selection of the number of reclosing sequences in case of earth faults			
REC79_EFCycEn_EPar_	EarthFault RecCycle	Disabled, 1. Enabled, 1.2. Enabled, 1.2.3. Enabled, 1.2.3.4. Enabled	1. Enabled
Selection of the number of reclosing sequences in case of line-to-line faults			
REC79_PhFCycEn_EPar_	PhaseFault RecCycle	Disabled, 1. Enabled, 1.2. Enabled, 1.2.3. Enabled, 1.2.3.4. Enabled	1. Enabled
Selection of triggering the dead time counter (trip signal reset or circuit breaker open position)			
REC79_St_EPar_	Reclosing Started by	Trip reset, CB open	Trip reset

Table 1-1 *The enumerated parameter of the MV automatic reclosing function*

This chapter explains the meaning of these enumerated parameters.

1.1.1 Operation

This parameter enables or disables the automatic reclosing function. For operation, set this parameter to „On".

Note: for operation, the binary input „Blk" of the function block may not receive an active signal. Additionally the function can be dynamically blocked. For the blocking conditions see Chapter 1.2.4 below.

1.1.2 EarthFault RecCycle

For earth faults, using this parameter, the function can be separately disabled, or it can be configured up to 4 reclosing cycles.

Parameter value	Explanation
Disabled	No automatic reclosing is selected for earth faults,
1. Enabled	Only one automatic reclosing cycle is selected for earth faults,
1.2. Enabled	Two automatic reclosing cycles are activated for earth faults,
1.2.3. Enabled	Three automatic reclosing cycles are activated for earth faults,
1.2.3.4. Enabled	All automatic reclosing cycles are activated for earth faults.

Table 1-2 *Setting the number of the reclosing cycles for earth faults*

Note: the separation of the earth faults and phase faults for the operation of the automatic reclosing function is based on the binary input „PhFlt" of the automatic reclosing function. If this input gets an active signal then the function uses the parameters related to phase faults (See Chapter 1.1.3 below). In inactive state the parameters for the earth faults are considered.

1.1.3 PhaseFault RecCycle

For phase faults the function can be either separately disabled or configured up to 4 reclosing cycles.

Parameter value	Explanation
Disabled	No automatic reclosing is selected for phase faults,
1. Enabled	Only one automatic reclosing cycle is selected for phase faults,
1.2. Enabled	Two automatic reclosing cycles are activated for phase faults,
1.2.3. Enabled	Three automatic reclosing cycles are activated for phase faults,
1.2.3.4. Enabled	All automatic reclosing cycles are activated for phase faults.

Table 1-3 *Setting the number of the reclosing cycles for phase faults*

Note: the separation of the earth faults and phase faults for the operation of the automatic reclosing function is based on the binary input „PhFlt" of the automatic reclosing function. If this input gets an active signal then the function uses the parameters related to phase faults. In inactive state the parameters for the earth faults are considered (See Chapter 1.1.2 above).

1.1.4 Reclosing Started by

Parameter value	Explanation
Trip reset	When selecting this parameter value, the automatic reclosing cycle is started by the falling edge of the trip signal. The trip command is to be connected to the binary input „Tr" of the function block, using the graphic logic editor.
CB open	When selecting this parameter value, the automatic reclosing cycle is started by the open state of the circuit breaker. For this kind of operation, connect the opened status signal of the CB to the binary input „CB Open" of the function block, using the graphic logic editor.

Table 1-4 *Setting the starting conditions*

Note: for application of the binary signal for starting the automatic reclosing function see Chapters 2 and 3.

1.2 Timer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Dead time setting for the first reclosing cycle for line-to-line fault						
REC79_PhDT1_TPar_	1. Dead Time Ph	msec	0	100000	10	500
Dead time setting for the second reclosing cycle for line-to-line fault						
REC79_PhDT2_TPar_	2. Dead Time Ph	msec	10	100000	10	600
Dead time setting for the third reclosing cycle for line-to-line fault						
REC79_PhDT3_TPar_	3. Dead Time Ph	msec	10	100000	10	700
Dead time setting for the fourth reclosing cycle for line-to-line fault						
REC79_PhDT4_TPar_	4. Dead Time Ph	msec	10	100000	10	800
Dead time setting for the first reclosing cycle for earth fault						
REC79_EFDT1_TPar_	1. Dead Time EF	msec	0	100000	10	1000
Dead time setting for the second reclosing cycle for earth fault						
REC79_ EF DT2_TPar_	2. Dead Time EF	msec	10	100000	10	2000
Dead time setting for the third reclosing cycle for earth fault						
REC79_ EF DT3_TPar_	3. Dead Time EF	msec	10	100000	10	3000
Dead time setting for the fourth reclosing cycle for earth fault						
REC79_ EF DT4_TPar_	4. Dead Time EF	msec	10	100000	10	4000
Reclaim time setting						
REC79_Rec_TPar_	Reclaim Time	msec	100	100000	10	2000
Impulse duration setting for the CLOSE command						
REC79_Close_TPar_	Close Command Time	msec	10	10000	10	100
Setting of the dynamic blocking time						
REC79_DynBlk_TPar_	Dynamic Blocking Time	msec	10	100000	10	1500
Setting of the blocking time after manual close command						
REC79_MC_TPar_	Block after Man Close	msec	0	100000	10	1000
Setting of the action time						
REC79_Act_TPar_	Action Time	msec	0	20000	10	1000
Limitation of the starting signal						
REC79_MaxSt_TPar_	Start Signal Max Time	msec	0	10000	10	1000
Delaying the start of the dead-time counter						
REC79_DtDel_TPar_	DeadTime Max Delay	msec	0	100000	10	3000
Waiting time for circuit breaker ready signal						
REC79_CBTO_TPar_	CB Supervision Time	msec	10	100000	10	1000
Waiting time for synchronous state signal						
REC79_SYN1_TPar_	SynCheck Max Time	msec	500	100000	10	10000
Waiting time for synchronous switching						
REC79_SYN2_TPar_	SynSW Max Time	msec	500	100000	10	10000

Table 1-5 *Timer parameters of the MV automatic reclosing function*

This Chapter explains the meaning of these timer parameters.

1.2.1 X Dead Time Ph, Y Dead Time EF

Related to these parameters „X" refers to the serial number (1..4) of the reclosing cycles for phase faults and „Y" refers to the serial number (1..4) of the reclosing cycles for earth faults. The dead times can be set individually for all fault types and for each cycles. For the values no general rules can be defined. Set these parameters according to the local requirements.

The different dead time settings can be justified as follows: the medium voltage networks are usually compensated by Petersen coil or they are resistance earthed. Consequently, in case of a single-phase fault, the currents are relatively low, the electric arc regenerates quickly at the fault location.

In case of line-to-line faults, the currents are high, so a longer dead time is needed for the air insulation to regenerate around the fault location.

1.2.2 Reclaim Time

When the close command is generated, a timer is started to measure the "Reclaim time". The duration is defined by the parameter value REC79_Rec_TPar_ (Reclaim time), but it is prolonged up to the reset of the close command (if the close command duration is longer than the reclaim time setting value). If the fault is detected again during this time, then the sequence of the MV automatic reclosing cycles continues. If no fault is detected, then at the expiry of the reclaim time the reclosing is evaluated as successful and the function resets. If fault is detected after the expiry of this timer, then the cycles restart with the first reclosing cycle. Set this parameter long enough so that the closing time of the circuit breaker and up to one network period of the algorithm starting time should be covered with this time delay.

If the user programmed the binary status variable REC79_**St**_GrO_ (Protection Start) and it gets TRUE during the Reclaim time, the MV automatic reclosing function continues even if the trip command is received after the expiry of the Reclaim time.

1.2.3 Close Command Time

The "Close" impulse is generated as one of the output status signals of the MV automatic reclosing function REC79_**Close**_GrI_ (Close command). This signal is common to all three phases. The impulse duration is defined by the user setting the timer parameter REC79_Close_TPar_ (Close Command Time). Set this parameter long enough so that the circuit breaker could reliably start the closing procedure.

1.2.4 Dynamic Blocking Time

This parameter serves the prolongation of the „dynamic blocked" state, when all dynamic blocking conditions are reset. There are several conditions to result dynamic blocked state of the MV automatic reclosing function. This state becomes valid if any of the conditions of the dynamic blocking gets TRUE during the running time of any of the reclosing cycles.

At the time of all blocking conditions reset, a timer is started, the running duration of which is defined by the time parameter REC79_DynBlk_TPar_ (Dynamic Blocking Time). During its running time, no reclosing command is generated. After expiry of this timer the automatic reclosing function resets. If it is needed then the first reclosing cycle is started.

The conditions to start the dynamic blocked state are:
- There is no trip command during the "Action time" (See Chapter 1.2.6 below).
- The duration of the starting impulse for the MV automatic reclosing function is too long (See chapter 1.2.7 below).
- If no "CB ready" signal is received at the intended time of reclosing command (See Chapter 1.2.9 below)

- The dead time is prolonged further than the preset parameter value REC79_DtDel_TPar_ (DeadTime Max.Delay) (See Chapter 1.2.8 below).
- The waiting time for the "SYNC Release" signal is too long (See Chapter 1.2.10 and 1.2.11)
- After the final trip command.
- Automatic reclosing is started during the blocking time after a manual close command (See chapter 1.2.5 below)
- While *CB State Monitoring* is on, a manual open command (the status variable REC79_**CBOpen**_GrO_ (CB OPEN) gets TRUE without REC79_**Tr**_GrO_ (AutoReclosing Start)).
- Automatic reclosing is started during a general block, i.e. the device is blocked.

In a dynamic blocked state, the REC79_**Blocked**_GrI_ (Blocked) status signal is TRUE.

1.2.5 Block after Man Close

This parameter defines the duration of the blocked state due to manual close command.
This state of manual close command is signaled by the binary variable REC79_**ManCl**_GrO_ (Manual Close). The conditions are defined by the user applying the graphic logic editor. This signal is usually assigned to a dedicated binary input.

After a manual close command, the MV automatic reclosing function enters "Not Ready" state for the time period defined by parameter REC79_MC_TPar_ (Block after Man.Close). The role of this delay time is to prevent starting the reclosing cycles if the manual close command is switching onto fault. Set this parameter long enough so that the closing time of the circuit breaker and up to one network period of the algorithm starting time should be covered with this time delay.

The "Not Ready" state can be the consequence also of several other conditions:
This state becomes valid if any of the conditions of the blocking gets TRUE when the automatic reclosing is not running.
- Reclosing is disabled by the parameter REC79_Op_EPar_ (Operation) if it is selected to "Off". (See Chapter 1.1.1 above);
- No reclosing cycles are selected by the parameters REC79_EFCycEn_EPar_ (Earth Fault Rec.Cycle) and REC79_PhFCycEn_EPar_ (PhaseFault Rec.Cycle) by setting them to "Disabled" (See Chapters 1.1.2 and 1.1.3);
- The circuit breaker is not ready for operation: the result of the graphic programming of the binary variable REC79_**CBRdy**_GrO_ (CB Ready) is FALSE. (See Chapter 2.1.6. below);
- After a manual close command (Described in this Chapter) for the defined time span;
- If the parameter REC79_CBState_BPar_ (CB State Monitoring) is set to TRUE and the circuit breaker is in Open state, i.e., the value of the REC79_**CBOpen**_GrO_ (CB OPEN position) status variable gets TRUE;
- The starting signal for automatic reclosing is selected by parameter REC79_St_EPar_ (Reclosing started by) to be "CB open" and the circuit breaker is in Open state;
- In case of a general block (the device is blocked, see Chapter 1.2.4 above).

In a "Not ready" state, the REC79_**Blocked**_GrI_ (Blocked) status signal is TRUE.

If the manual close command is received during the running time of any of the cycles, then the MV automatic reclosing function enters "Dynamic blocked" state and resets.

For further information about the dynamic blocked state, see Chapter 1.2.4 above.

1.2.6 Action Time

The user can compose the binary status variable REC79_**St**_GrO_ (Protection Start) to indicate the start of the protection functions, whose operations are related to the MV automatic reclosing function. This signal starts the "Action time", the duration of which is defined by the preset parameter value REC79_Act_TPar_ (Action time). During the running time, the MV automatic reclosing function waits for the trip command. If no trip command is received, then the MV automatic reclosing function enters "Dynamic blocked" state.

For further information about the dynamic blocked state, see Chapter 1.2.4 above.

Set this parameter long enough to cover the delay time of any protection functions (time delay between starting and trip command generation) assigned to start automatic reclosing.

1.2.7 Start Signal Max Time

The MV automatic reclosing function gets the trip commands of the protection functions intended to trigger the reclosing function. The conditions for detecting the triggered state of the protection functions are defined by the user applying the graphic logic editor.

The binary input status variable to be programmed is: REC79_**Tr**_GrO_ (AutoReclosing Start). This signal starts a dedicated timer, the elapsed time of which is compared to the preset parameter value REC79_MaxSt_TPar_ (Start Signal Max.Time). After the expiry of this timer the function gets in "Dynamic blocked" state.

For further information about the dynamic blocked state, see Chapter 1.2.4 above.

Set this parameter in correlation of the breaker failure protection function (if it is applied).

1.2.8 DeadTime Max Delay

In the base case, the dead time counter of any reclosing cycle is started by the starting signal (See Chapter 1.1.4) but starting can be delayed. The delay is activated if the value of the REC79_**DtDel**_GrO_ (Dead Time St.Delay) status signal gets TRUE. The conditions are defined by the user applying the graphic logic editor. This delay is limited by the timer parameter REC79_DtDel_TPar_ (DeadTime Max.Delay).

Set this parameter in consideration of the remote end fault clearing time.

1.2.9 CB Supervision Time

At the end of the dead time, reclosing is possible only if the circuit breaker can perform the command. The binary variable REC79_**CBRdy**_GrO_ (CB Ready) indicates this state. The conditions are defined by the user applying the graphic equation editor.

If the circuit breaker is not ready, the function waits for a pre-programmed time for this state. The waiting time is defined by the user as parameter value REC79_CBTO_TPar_ (CB Supervision time). If this condition is not fulfilled during the waiting time, the MV automatic reclosing function enters "Dynamic blocked" state.

Set this delay (and the dead times accordingly) long enough so that the circuit breaker gets sufficient time to accumulate energy for the subsequent possible trip command.

1.2.10 SynCheck Max Time

Reclosing is possible only if the conditions required by the *Synchro-check, synchro-switch* function are fulfilled. This state is signaled by the binary variable REC79_**SynRel**_GrO_ (SYNC Release) from the *Synchro-check, synchro-switch* function. The conditions are defined by the

user applying the graphic equation editor. The MV automatic reclosing function waits for a pre-programmed time for this signal. This time is defined by the user as parameter value REC79_SYN1_TPar_ (SynCheck Max Time). If the "SynRel" signal is not received during the running time of this timer, then the "synchronous switch" operation is started (see Chapter 1.2.11 below) and the binary output signal REC79_**ClReq**_GrI_ (CloseRequ.SynSwitch) is generated which is connected to the *Synchro-check, synchro-switch* function.

Set this time delay long enough to assure recognition of the synchronous state of the voltage at both sides of the circuit breaker.

1.2.11 SynSW Max Time

If the conditions of the synchronous state are not fulfilled, another timer starts. This waiting time is defined by the user as parameter value REC79_SYN2_TPar_ (SynSW Max Time).

The separate *Synchro-check, synchro-switch* function controls the generation of the close command in case of relatively rotating voltage vectors on both sides of the circuit breaker to make contact at the synchronous state of the rotating vectors. For this calculation, the closing time of the circuit breaker must be defined in that function.

This mode of operation is indicated by the output variable REC79_**ClReq**_GrI_ (CloseRequ. SynSwitch).

If no switching is possible during the running time of this timer, then the MV automatic reclosing function enters "Dynamic blocked" state and resets.

For further information about the dynamic blocked state, see Chapter 1.2.4 above.

1.3 Boolean parameters

Parameter name	Title	Default	Explanation
REC79_CBState_BPar_	CB State Monitoring	0	Enable CB state monitoring for "Not Ready" state
REC79_Acc1_BPar_	Accelerate 1.Trip	0	Accelerate trip command starting cycle 1
REC79_Acc2_BPar_	Accelerate 2.Trip	0	Accelerate trip command starting cycle 2
REC79_Acc3_BPar_	Accelerate 3.Trip	0	Accelerate trip command starting cycle 3
REC79_Acc4_BPar_	Accelerate 4.Trip	0	Accelerate trip command starting cycle 4
REC79_Acc5_BPar_	Accelerate FinTrip	0	Accelerate final trip command

Table 1-6 *Boolean parameters of the MV automatic reclosing function*

This Chapter explains the meaning of these boolean parameters.

1.3.1 CB State Monitoring

Enable CB state monitoring for "Not Ready" state. There are several conditions that must be satisfied before the MV automatic reclosing function enters "Not Ready" state. See Chapter 1.2.5 above.

1.3.2 Accelerate N.Trip

If the reclosing results in switching onto fault, the trip command can be accelerated in each cycle. Here "N." is for the serial number of the cycles. Depending on this binary parameter setting, the automatic reclosing function can accelerate trip commands before the individual reclosing cycles. This means that the output "TrAcc" of the function block gets active for the first starting state of the protection function, if the dedicated parameter enables acceleration. This signal needs user-programmed graphic logic to generate the accelerated trip command.

1.3.3 Accelerate FinTrip

The final trip command can also be accelerated. Depending on this Boolean parameter setting, the automatic reclosing function can accelerate the final trip command. This means that the output "TrAcc" of the function gets active for the first starting state of the protection function, if the dedicated parameter enables acceleration. This signal needs user-programmed graphic logic to generate the accelerated trip command.

2 The function block of the automatic reclosing function

The operation of the automatic reclosing function is controlled by parameters and binary signals, connected to the Rec79MV function block. This chapter explains the effects of the binary signals.
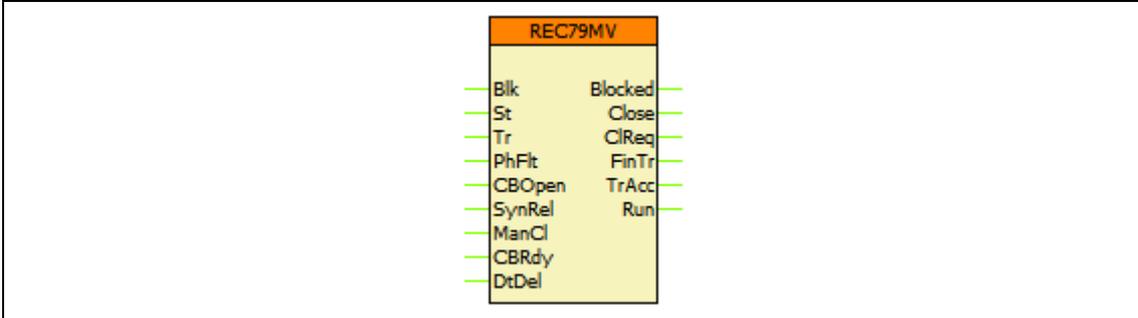

Figure 2-1 The function block of the automatic reclosing function

2.1 The input signals

The MV automatic reclosing function has binary input status signals**.** These signals can basically influence the operation. **The conditions are defined by the user applying the graphic equation editor.**

The **binary input status signals** of the MV automatic reclosing function are listed in Table *2-1*

Binary status signal	Title	Explanation
REC79_**Blk**_GrO_	Block	Signal for blocking the automatic reclosing function externally (see Chapter 2.1.1)
REC79_**St**_GrO_	Protection Start	Start signal of a protection function (see Chapter 2.1.2)
REC79_**Tr**_GrO_	AutoReclosing Start	Signal to start the automatic reclosing function (see Chapter 2.1.3)
REC79_**PhFlt**_GrO_	PhaseFault Start	Start signal of a phase fault protection function (see Chapter 2.1.4)
REC79_**CBOpen**_GrO_	CB OPEN position	Circuit breaker is opened (see Chapter 2.1.5)
REC79_**SynRel**_GrO_	SYNC Release	Release signal from synchro-check function (see Chapter 2.1.6)
REC79_**ManCl**_GrO_	Manual Close	Signal of manual close command (see Chapter 2.1.7)
REC79_**CBRdy**_GrO_	CB Ready	Circuit breaker is ready for operation (see Chapter 2.1.8)
REC79_**DtDel**_GrO_	Dead Time St.Delay	Signal for delaying the start of the dead time counter (see Chapter 2.1.9)

Table 2-1 The binary input signal of the MV automatic reclosing function

2.1.1 Block

The function can be switched Off /On using the parameter REC79_Op_EPar_ (Operation).

The user can also block the MV automatic reclosing function **applying the graphic logic editor.** The binary status variable to be programmed is REC79_**Blk**_GrO_ (Block).
Additionally, if the device is generally blocked, then the MV automatic reclosing function is also blocked.

2.1.2 Protection Start

This status variable is to indicate the start of the protection functions, the operation of which is related to the MV automatic reclosing function. The signal starts the "Action time", the duration of which is defined by the preset parameter value REC79_Act_TPar_ (Action time). During the running time, the MV automatic reclosing function waits for the trip command. If no trip command is received, then the MV automatic reclosing function enters "Dynamic blocked" state.

If the user programmed the status variable REC79_**St**_GrO_ (Protection Start) and it gets TRUE during the "Reclaim time", the MV automatic reclosing function waits for the trip command until the expiry of the "Action time" (see above) even if it happens after the expiry of the "Reclaim time" (the reclaim time is extended).

2.1.3 AutoReclosing Start

Connect here the trip command of the protection functions assigned to start the automatic reclosing function. The cycles start if
- "Reclosing Started by" enumerated parameter is set to "Trip reset" (See Chapter 1.1.4) and this signal resets
- "Reclosing Started by" enumerated parameter is set to "CB Open" (See Chapter 1.1.4) and this signal picks up along with the CB Open signal (See Chapter 2.1.5)

2.1.4 Phase Fault Start

The separation of the earth faults and phase faults for the operation of the automatic reclosing function is based on the binary input „PhFlt" (Phase Fault Start). If this input gets TRUE then the function uses the parameters related to phase faults (See Chapter 1.1.3). In FALSE state the parameters for the earth faults are considered.

2.1.5 CB OPEN position

Connect the open state signal of the circuit breaker here if CB state monitoring is required (see Chapter 1.3.1) or the reclosing function is to be started by the open position of the circuit breaker (see Chapter 1.1.4).

If any of the features above is enabled and this input gets TRUE while the reclosing function is not started, the function gets in "Not Ready" state.

2.1.6 SYNC Release

Connect the release signal of the synchronous state supervision function (external function block, named SYN25) here. If this function is not applied, connect this input to steady TRUE.

2.1.7 Manual Close

Connect the manual close command here, which is usually a dedicated binary input of the device. After a manual close command there is a time period (defined by parameter REC79_MC_TPar_ (Block after Man.Close)) when the MV automatic reclosing function (if started) does not start any cycles and always gives final trip if started.

2.1.8 CB Ready

Connect the CB ready signal here, which is usually a dedicated binary input of the device. If the circuit breaker is not ready for the possible subsequent trip command at the moment of the intended reclosing, then reclosing is not performed, see Chapter 1.2.9. If this function is not applied, connect this input to steady TRUE.

2.1.9 Dead Time St.Delay

The dead time counter of any reclosing cycle is started by the starting signal (See Chapter 1.1.4) but the starting can be delayed. The delay is activated if this input gets TRUE signal. The delay is limited by the timer parameter REC79_DtDel_TPar_ (DeadTime Max.Delay).

3 Examples

3.1 Logic connections of the REC79MV function block

Basic example for the application of the REC79MV function block in a logic diagram is shown in Figure 3-1. This connection is used for the examples below.
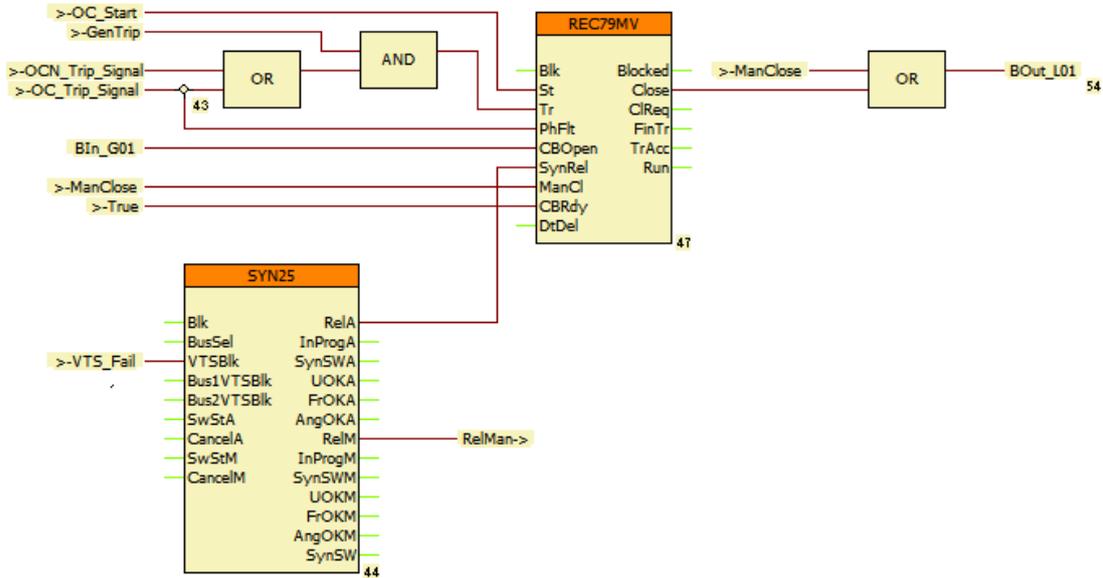

Figure 3-1 Example: The connections of the function block of the automatic reclosing function

The "**Blk**" input is not connected. This means that the blocking possibility using a binary signal is not applied.

The "**St**" input is connected the general start signals of the overcurrent protections. This means that if an overcurrent protection picks up, the automatic reclosing function will wait for the trip signal to come on the "**Tr**" input (see Chapter 1.2.6)

The "**Tr**" input is connected to the trip command of the phase overcurrent and the residual overcurrent protection functions. The AND connection of the "GenTrip" command prevents the starting if the "Trip Logic" function block (not shown here) disables the operation of the trip contacts.

The "**PhFlt**" input is connected to the trip command of the phase overcurrent protection functions. Trip signal from these protections will result in starting phase fault reclosing cycles.

The "**CBOpen**" input is connected to a dedicated binary input which receives the open state signal from the circuit breaker.

The "**SynRel**" input is connected to the release output of the synchro-check/synchro-switch function. This input disables the reclosing in case of asynchronous state of the voltage vectors.

The "**ManCl**" input is connected to a signal that indicates the manual close command

The "**CBRdy**" input is connected to fix TRUE signal. This means that in this configuration the ready state of the circuit breaker is out of consideration.

The "**DtDel**" input is not connected. This means that the dead time is not intended to be delayed externally.

3.2 Example1: Time diagram with two reclosing shots (first unsuccessful, second successful)

The following timing diagram shows two reclosing cycles. The first cycle is unsuccessful, the second one is successful. The relevant parameter set of the MV autoreclosing operation are listed in the Table 3-1 below. The effect of this parameter set is shown in the first time diagram of Figure 3-2.

MV AutoReclosing	
Operation	On
EarthFault RecCycle	1.2. Enabled
PhaseFault RecCycle	1.2. Enabled
Reclosing Started by	CB open
CB State Monitoring	0

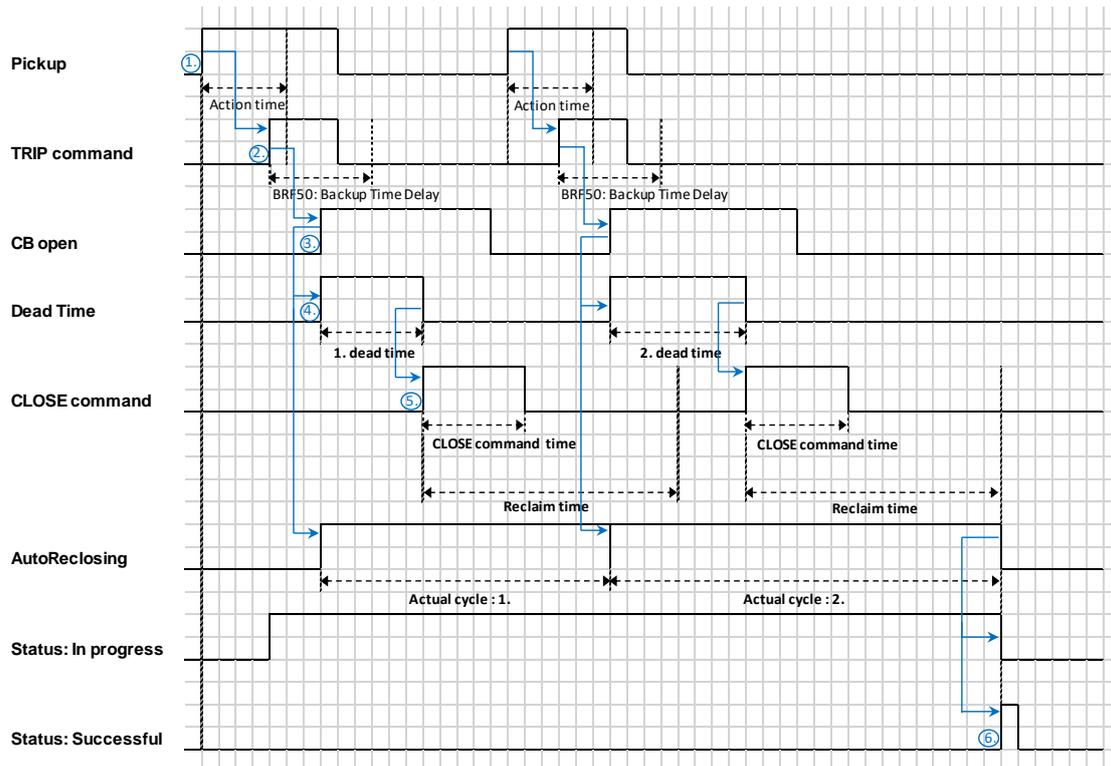*Table 3-1 Example 1, parameter setting*

Figure 3-2 Example 1 time diagram

After a pickup of the protection function (No. 1), a timer starts to measure the "**Action time**" (the duration of which depends on parameter setting REC79_Act_TPar_ (Action time)). The trip command must be generated (No. 2) within this time to start reclosing cycles, or else the MV automatic function enters dynamic blocked state.

The automatic reclosing function is triggered if a protection function generates a trip command to the circuit breaker and the protection function resets because the fault current drops to zero and/or the auxiliary contact of the circuit breaker signals open state. Depending on the preset parameter value REC79_St_EPar_ (Reclosing started by), the MV automatic reclosing function can be started either by resetting of the TRIP command (setting: Trip reset) or by the binary

signal indicating the open state of the circuit breaker (No. 3) (setting: CB open) – in the above example, the "Reclosing started by" parameter is set: "CB Open".

According to the preset parameter values, either of these two conditions starts the timer for counting the „**Dead time**" (No. 4). For all four reclosing cycles, separate dead times can be defined for line-to-line faults and for earth faults.

The different dead time settings can be justified as follows: the medium voltage networks are usually compensated by Petersen coil or they are resistance earthed. Consequently, in case of a single-phase fault, the currents are relatively low, the electric arc regenerates quickly at the fault location. In case of line-to-line faults, the currents are high, so a longer dead time is needed for the air insulation to regenerate around the fault location.

At the end of the dead time the MV automatic reclosing function generates a close command automatically (No. 5). The "**Close command**" impulse is generated as one of the output status signals of the MV automatic reclosing function REC79_**Close**_Grl_ (Close command). This signal is common to all three phases. The impulse duration is defined by the user setting the timer parameter REC79_Close_TPar_ (Close command time).

When the close command is generated, a timer is started to measure the "**Reclaim time**". The duration is defined by the parameter value REC79_Rec_TPar_ (Reclaim time), but it is prolonged up to the reset of the close command (if the close command duration is longer than the reclaim time set).

If the fault is detected again during this time, then the sequence of the MV automatic reclosing cycles continues, the above example showing this case. If no fault is detected, then at the expiry of the reclaim time the reclosing is evaluated as successful and the function resets. If a fault is detected after the expiry of this timer, then the cycles restart with the first reclosing cycle. (If the user programmed the status variable REC79_**St**_GrO_ (Protection Start) and it gets TRUE during the Reclaim time, then the MV automatic reclosing function continues even if the trip command is received after the expiry of the Reclaim time.)

After the second reclosing cycle no pickup is detected within the reclaim time, the MV auto reclosing function enters "**Successful**" state (No. 6). The MV automatic reclosing cycle resets and a new fault will start the procedure with the first cycle again.

3.3 Example2: Timing diagram with two reclosing shots (both unsuccessful)

The following timing diagram shows two unsuccessful reclosing cycles. The relevant parameter set of the MV autoreclosing is same like the previous case.
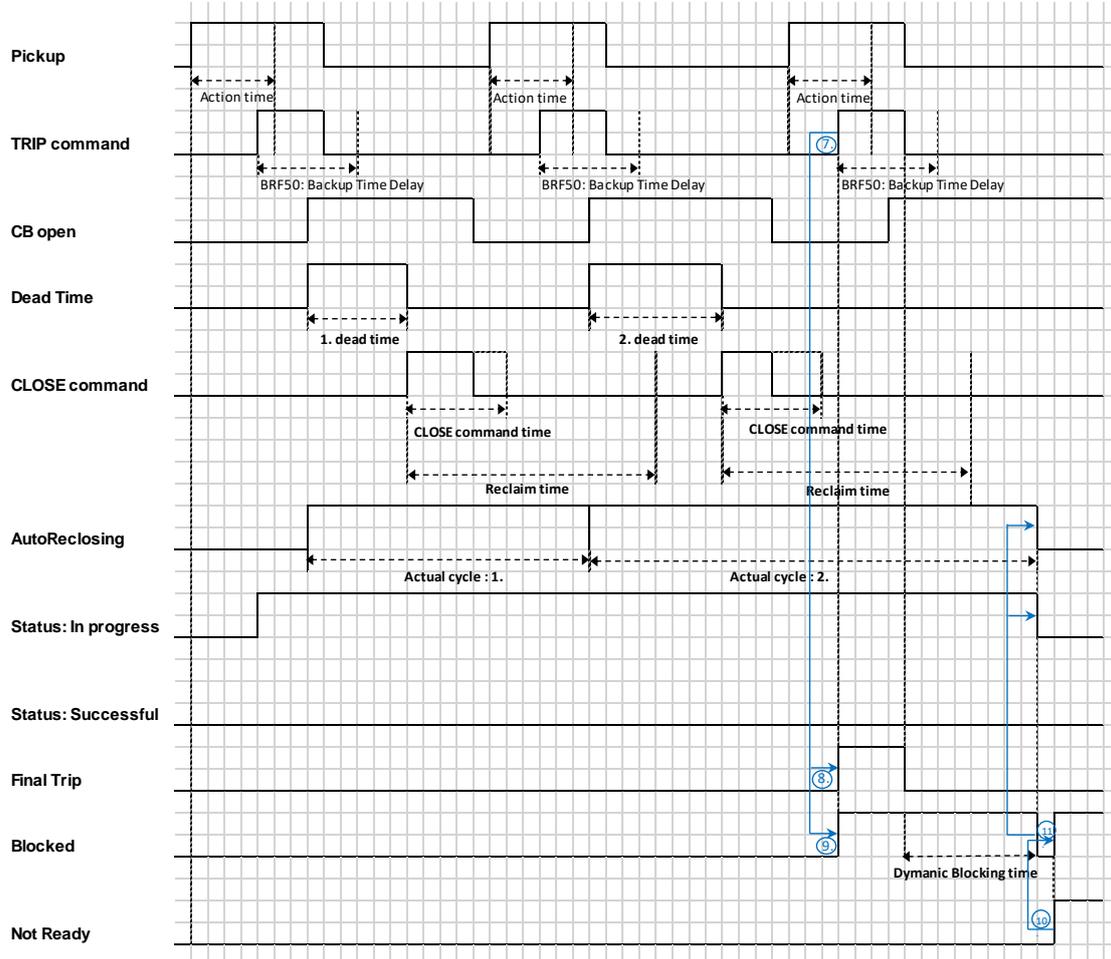

Figure 3-3 Example 2 time diagram

These events are similar to those of the previous case, but there are differences after the second reclosing attempt. The differences are written in the next Chapter.

The fault still exists at the end of the last cycle, therefore the protection function trips again (No. 7), and the MV automatic reclosing function trips and generates the signal for final trip: REC79_**FinTr**_Grl_ (Final Trip) (No. 8). After final trip, the MV automatic reclosing function enters "Dynamic blocked" state (No. 9). (A final trip command is also generated if a fault is detected again during the dead time.)

After the dynamic blocking, the MV automatic reclosing function gets "Not Ready" condition (No. 10), because the starting signal for automatic reclosing is selected by parameter REC79_St_EPar_ (Reclosing started by) to be "CB open" and the circuit breaker is in Open state and the "In progress" state of the function is not TRUE.

In a "Not ready" state, the REC79_**Blocked**_Grl_ (Blocked) status signal is TRUE, so the MV automatic reclosing function is blocked (No. 11).

3.4 Example3 Timing diagram with two reclosing shots (both unsuccessful)

The following timing diagram shows two unsuccessful reclosing cycles. The parameter setting of Table 3-2 are applied for the following timing diagram.

MV AutoReclosing	
Operation	On
EarthFault RecCycle	1.2. Enabled
PhaseFault RecCycle	1.2. Enabled
Reclosing Started by	Trip reset
CB State Monitoring	1
⋮	

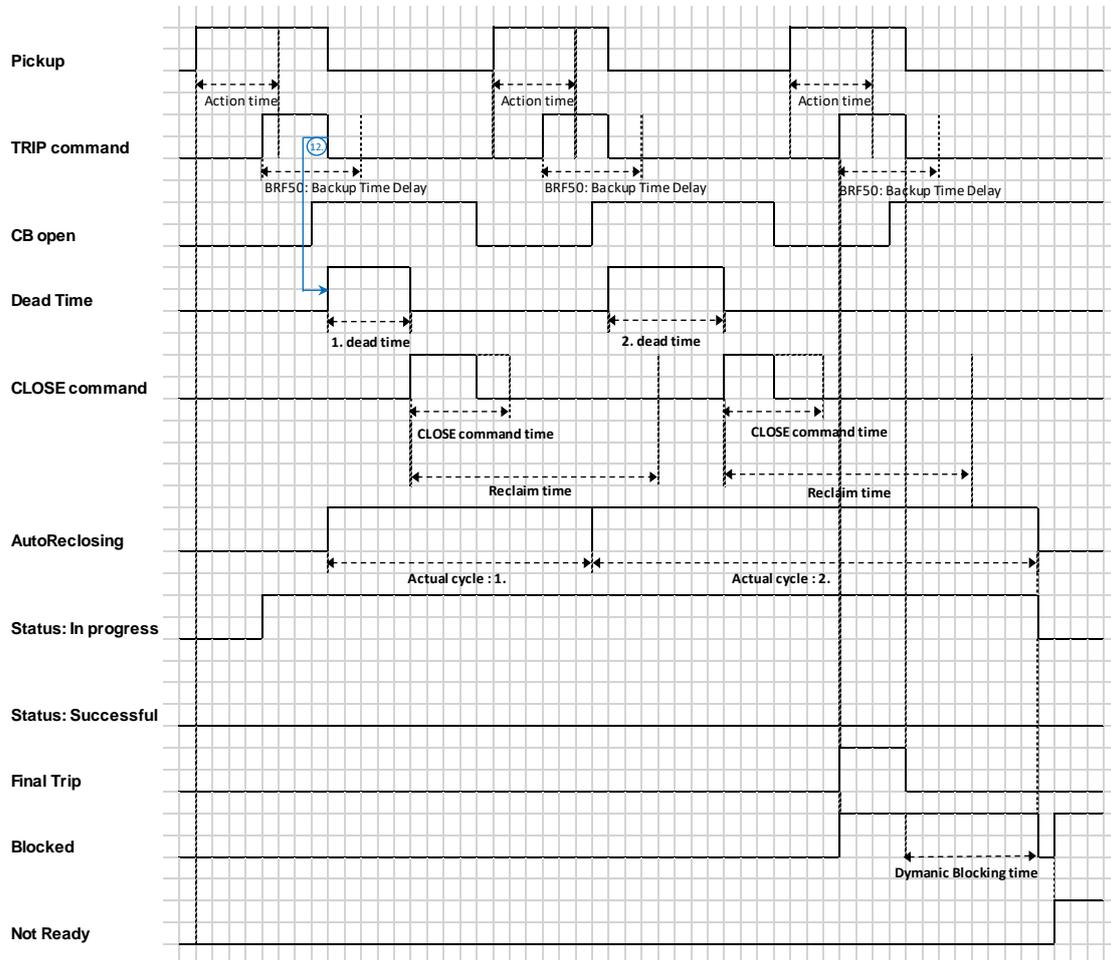*Table 3-2 Example 3, parameter setting*

Figure 3-4 Example 3 time diagram

The timing diagram is similar to that of the previous case (Example2), the difference is caused by the starting of the MV automatic reclosing function. Here it is started by resetting of the TRIP command (setting: Trip reset) (No. 12).

3.5 Example4 Timing diagram with two reclosing shots (both unsuccessful)

The following timing diagram shows two unsuccessful reclosing cycles. The actual parameter set can be seen in the table below.

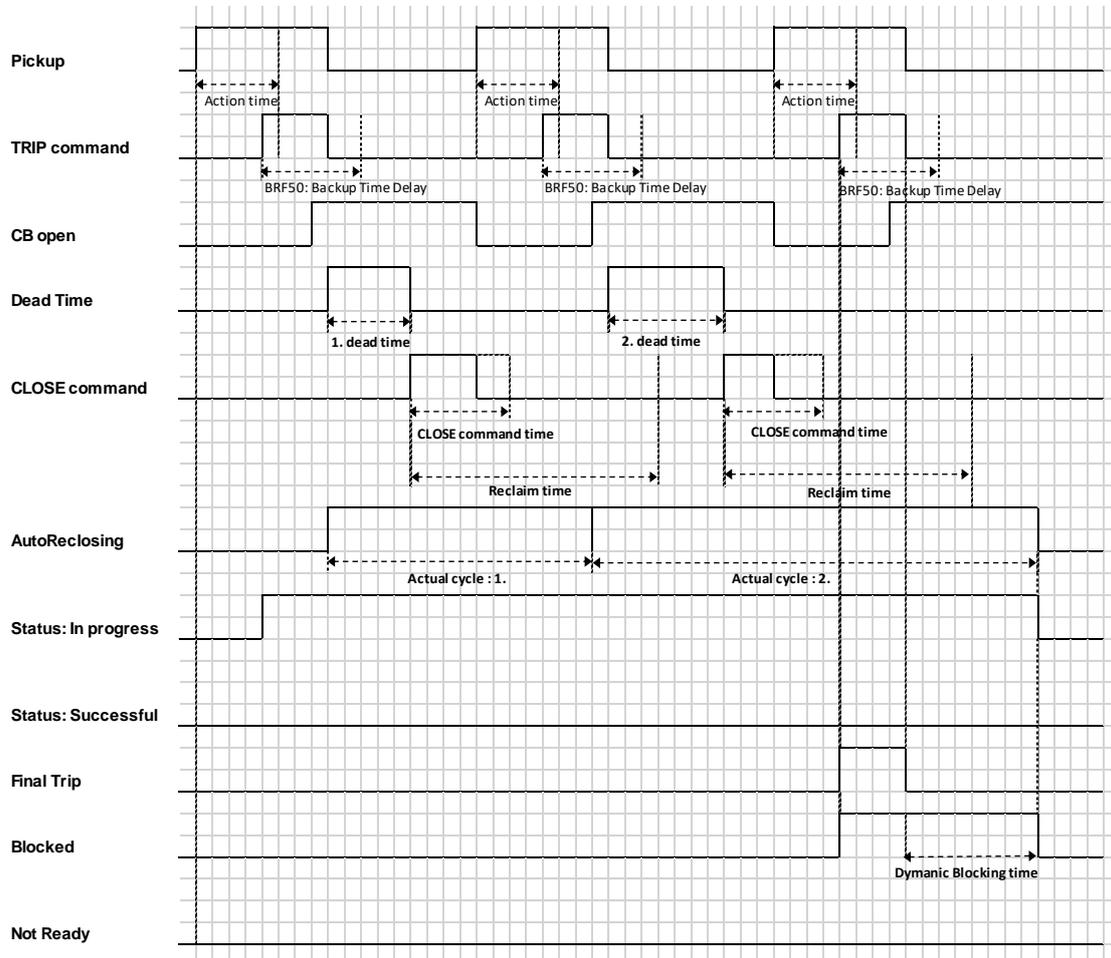| MV AutoReclosing	
Operation	On
EarthFault RecCycle	1.2. Enabled
PhaseFault RecCycle	1.2. Enabled
Reclosing Started by	Trip reset
CB State Monitoring	0
⋮	

Table 3-3 Example 4, parameter setting

Figure 3-5 Example 4 time diagram

One difference can be seen if it is compared to the previous one.

After the "Dynamic Blocking" state the MV automatic reclosing function does not enter "Not Ready" state, because the "Not Ready" condition is not satisfied due to the parameter REC79_CBState_BPar_ (CB State Monitoring) is set to FALSE.