EURO PROT +

Setting guide
to the HV automatic reclosing function

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CONTENTS

1 Guide to the parameters of the HV automatic reclosing function

The operation of the automatic reclosing function is controlled by parameters and binary signals, connected to the REC79HV function block. This chapter explains the effects of the parameter setting. For the influencing binary signals see Chapter 2.

1.1 Enumerated Parameters

Parameter name	Title	Selection range	Default
Switching ON/OFF the HV automatic reclosing function			
REC79_Op_EPar_	Operation	Off, On	On
Selection of the number of reclosing sequences			
REC79_CycEn_EPar_	Reclosing Cycles	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
Selection of behavior in case of evolving fault (block reclosing or perform three-phase automatic reclosing cycle)			
REC79_EvoFlt_EPar_	Evolving Fault	Block Reclosing, Start 3Ph Rec.	Block Reclosing

Table 1-1 *The enumerated parameter of the HV 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 Reclosing Cycles

The function can be configured up to 4 reclosing cycles.

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

Table 1-2 *Setting the number of the reclosing cycles*

1.1.3 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 1-3 *Setting the starting conditions*

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

1.1.4 Evolving Fault

In case of evolving faults (when a single-phase fault detected changes to multi-phase fault), the behavior of the automatic reclosing function is controlled by the preset parameter value REC79_EvoFlt_EPar_ (Evolving fault). The options are

- "Block Reclosing" or
- "Start 3Ph Rec."

If "Block Reclosing" is selected, the HV automatic reclosing function enters dynamic blocked state, and the subsequent reclosing command is not generated.

If "Start 3Ph Rec." is selected, the HV automatic reclosing function goes on performing the subsequent cycle according to the three-phase parameters.

1.2 Timer Parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Dead time setting for the first reclosing cycle for single-phase fault						
REC79_1PhDT1_TPar_	1. Dead Time 1Ph	msec	0	100000	10	500
Dead time setting for the second reclosing cycle for single-phase fault						
REC79_1PhDT2_TPar_	2. Dead Time 1Ph	msec	10	100000	10	600
Dead time setting for the third reclosing cycle for single-phase fault						
REC79_1PhDT3_TPar_	3. Dead Time 1Ph	msec	10	100000	10	700
Dead time setting for the fourth reclosing cycle for single-phase fault						
REC79_1PhDT4_TPar_	4. Dead Time 1Ph	msec	10	100000	10	800
Dead time setting for the first reclosing cycle for multi-phase fault						
REC79_3PhDT1_TPar_1	1. Dead Time 3Ph	msec	0	100000	10	1000
Special dead time setting for the first reclosing cycle for multi-phase fault						
REC79_3PhDT1_TPar_2	1. Special DT 3Ph	msec	0	100000	10	1350
Dead time setting for the second reclosing cycle for multi-phase fault						
REC79_3PhDT2_TPar_	2. Dead Time 3Ph	msec	10	100000	10	2000
Dead time setting for the third reclosing cycle for multi-phase fault						
REC79_3PhDT3_TPar_	3. Dead Time 3Ph	msec	10	100000	10	3000
Dead time setting for the fourth reclosing cycle for multi-phase fault						
REC79_3PhDT4_TPar_	4. Dead Time 3Ph	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_	StartSignal 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 1-4 *Timer parameters of the HV automatic reclosing function*

This Chapter explains the meaning of these timer parameters.

1.2.1 X Dead Time 1Ph, Y Dead Time 3Ph, Special Dead Time 3Ph

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

If, during the cycles, the three-phase dead time is applied once, then all subsequent cycles will consider the three-phase dead time settings, too. About starting three-phase cycles see Chapter 2.1.4.

The different dead time settings can be justified as follows:
In case of a single-phase fault, only the circuit breakers of the faulty phase open. In this case, due to the capacitive and inductive coupling of the healthy phases, the extinction of the secondary electric arc at the fault location can be delayed. Consequently, a longer dead time is needed for the fault current to extinguish than in the case of a three-phase open state, when no coupled voltage can sustain the fault current.

From other point of view, in case of a transmission line connecting two power systems, only a shorter dead time is allowed for the three-phase open state because, due to the possible power unbalance between the interconnected systems, a large angle difference can be reached if the dead time is too long. If only a single phase is open, then the two connected healthy phases and the ground can sustain the synchronous operation of both power systems.

Special dead time can be necessary for the following reason:
Assume a line between substations A and B, and a protection system without tele-protection. In the event of a three-phase fault near substation B, the protection at A generates a trip command according to the second zone's time setting only, and starts measuring the dead time with considerable delay as compared to the protection at B, which generates a trip command immediately due to the close-in fault.

If the three-phase dead time is too short, the HV automatic reclosing at B may attempt to close the circuit breaker during the running time of the second zone trip at A, which means that the fault is not cleared yet. Consequently, a prolonged dead time is needed if the fault was detected in the first zone.

The preset timer parameter value is REC79_3PhDT1_TPar_2 (1. special DT 3Ph). See Chapter 2.1.5 about activating this feature.

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 HV 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, then the HV 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 HV 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 HV 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 HV 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 HV 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 outside 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 parameter REC79_CycEn_EPar_ (Reclosing Cycles) by setting it to "Disabled" (See Chapter 1.1.2);
- 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 HV 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 HV 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 HV 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 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 1.1.3) 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 controller functions wait 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 HV 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_3PhRecBlk_BPar_	Disable 3Ph Rec.	0	Disable three-phase reclosing
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 1-5 *Boolean parameters of the HV 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 HV automatic reclosing function enters "Not Ready" state. See Chapter 1.2.5 above.

1.3.2 Disable 3Ph Rec.

Three-phase reclosing can be disabled by the preset parameter value REC79_3PhRecBlk_BPar_ (Disable 3Ph Rec.). If the value of this parameter is TRUE, then if a three-phase trip command is received, the HV automatic reclosing function enters "Dynamic blocked" state.

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

1.3.3 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.

1.3.4 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 REC79HV function block. This chapter explains the effects of the binary signals.
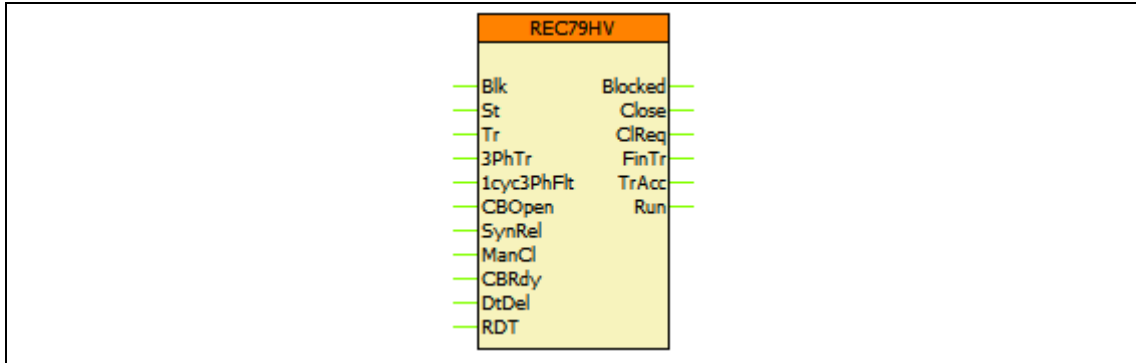

Figure 2-1 The function block of the automatic reclosing function

2.1 The Input Signals

The HV 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 HV 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_**3PhTr**_GrO_	3Ph Trip	Signal of three-phase trip (see Chapter 2.1.4)
REC79_**1cyc3PhFlt**_GrO_	3PhFault for Spec.DT1	Signal for special 1st dead time (see Chapter 2.1.5)
REC79_**CBOpen**_GrO_	CB OPEN single-pole	Circuit breaker is opened at least in one phase (see Chapter 2.1.6)
REC79_**SynRel**_GrO_	SYNC Release	Release signal from synchro-check function (see Chapter 2.1.7)
REC79_**ManCl**_GrO_	Manual Close	Signal of manual close command (see Chapter 2.1.8)
REC79_**CBRdy**_GrO_	CB Ready	Circuit breaker is ready for operation (see Chapter 2.1.9)
REC79_**DtDel**_GrO_	Dead Time Start Delay	Signal for delaying the start of the dead time counter (see Chapter 2.1.10)
REC79_**RDT**_GrO_	Reduced DeadTime	Signal for reducing the dead time (see Chapter 2.1.11)

Table 2-1 *The binary input signal of the HV 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 HV 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 HV 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 HV 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 HV automatic reclosing function waits for the trip command. If no trip command is received, then the HV 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 HV 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 1.1.3) and this signal resets
- "Reclosing Started by" enumerated parameter is set to "CB Open" (See Chapter 1.1.3) and this signal picks up along with the CB Open signal (See Chapter 2.1.6)

2.1.4 3Ph Trip

Connect the three-phase trip signals here. The HV automatic reclosing function is prepared to get the general trip command as programmed to the binary input status variable REC79_**Tr**_GrO_ (AutoReclosing Start) and the three-phase trip signal REC79_**3PhTr**_GrO_ (3Ph Trip). The three-phase cycles are started if both inputs are TRUE.
Note that all subsequent reclosing cycles will run as 3Ph cycles if a 3Ph cycle is started.

2.1.5 3PhFault for Spec.DT1

Connect the signal of Zone1 start of the distance protection here if special DT is needed for the first 3Ph cycle (see Chapter 1.2.1).

2.1.6 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 1.1.3).

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.

2.1.7 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.

2.1.8 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 HV automatic reclosing function (if started) does not start any cycles and always gives final trip if started.

2.1.9 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 feature is not required, connect this input to constant TRUE, otherwise reclosings cannot be performed.

2.1.10 Dead Time St.Delay

The dead time counter of each reclosing cycle is started by the starting signal (See Chapter 1.1.3) 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).

2.1.11 Reduced DeadTime

Dead time reduction may be applicable under the following circumstances:

If healthy voltage is measured in all three phases during the dead time, this means that no fault exists on the line. In this case, the expiry of the normal dead time need not be waited for, a reclosing attempt can be initiated immediately.

The dead time is terminated immediately if this input gets TRUE signal.

3 Examples

3.1 Logic connections of the REC79HV function block

Basic example for the application of the REC79HV function block in a logic diagram is shown in Figure 3-1. This connection is used for the examples below.
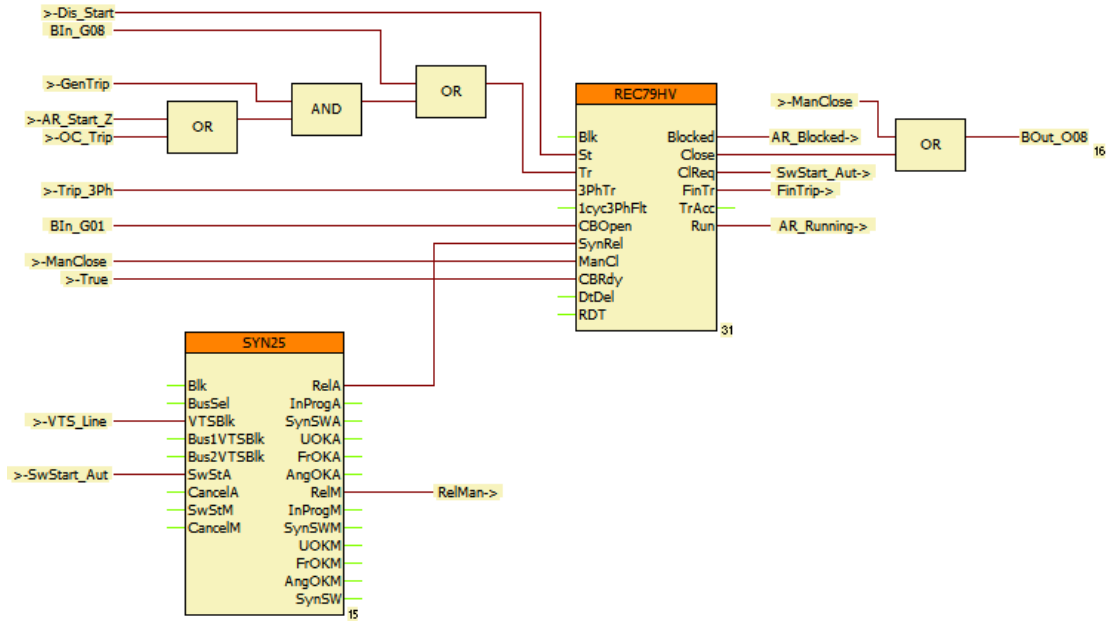

Figure 3-1 Example: The connections of the function block of the AR function

The "**Blk**" input is not connected. The function cannot be disabled externally.

The "**St**" input is connected the general start signal from the distance protection. This means that if the distance protection starts in any zone, 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 a binary input (e.g. external AR start signal) and to the trip signals of the distance and overcurrent protections. 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 "**3PhTr**" input is connected to the three-phase trip command indicator of the "Trip Logic" function block.

The "**1cyc3PhFlt**" input is not connected. No special dead time is used in this configuration.

The "**CBOpen**" input is connected to 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. The ready state of the circuit breaker is out of consideration.

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

The "**RDT**" input is not connected. The dead time is not intended to be reduced 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 HV 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.

HV AutoReclosing	
Operation	On
Reclosing Cycles	1.2. Enabled
Reclosing Started by	CB open
CB State Monitoring	0

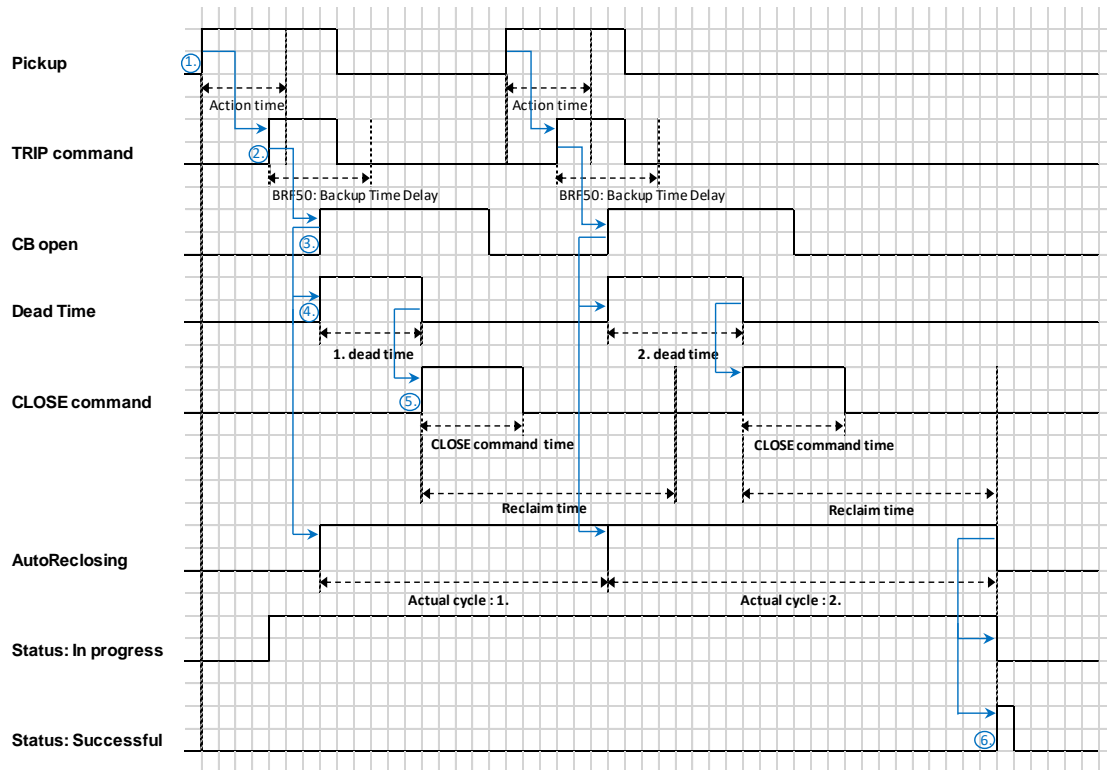*Table 3-1 Example 1, parameter setting*

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 HV 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 HV 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.

At the end of the dead time the HV 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 HV 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).

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 HV 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 HV 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 HV auto reclosing function enters "**Successful**" state (No. 6). The HV 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 HV autoreclosing is same like the previous case.
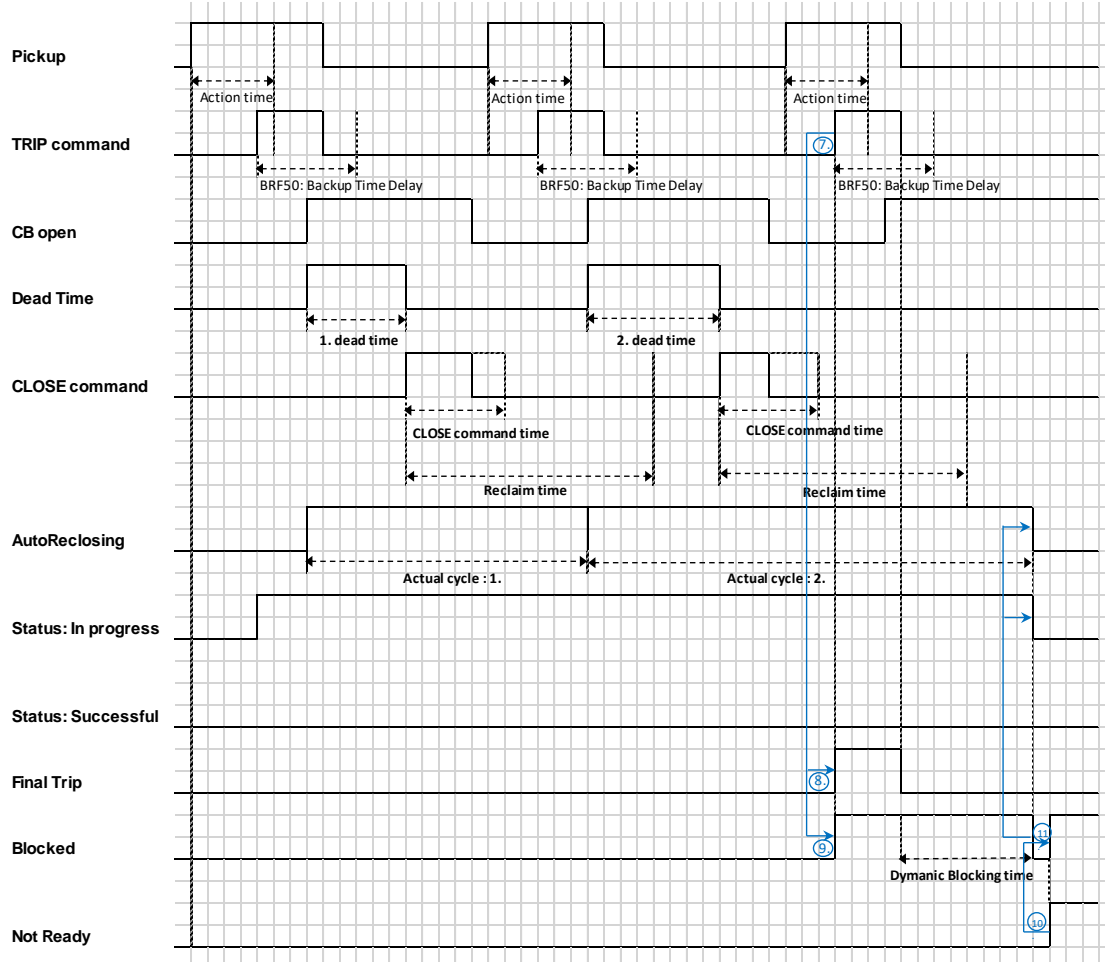

Figure 3-3 Example 2 time diagram

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 HV automatic reclosing function trips and generates the signal for final trip: REC79_**FinTr**_Grl_ (Final Trip) (No. 8). After final trip, the HV 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 HV 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 HV 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.

HV AutoReclosing	
Operation	On
Reclosing Cycles	1.2. Enabled
Reclosing Started by	Trip reset
CB State Monitoring	1
⋮	

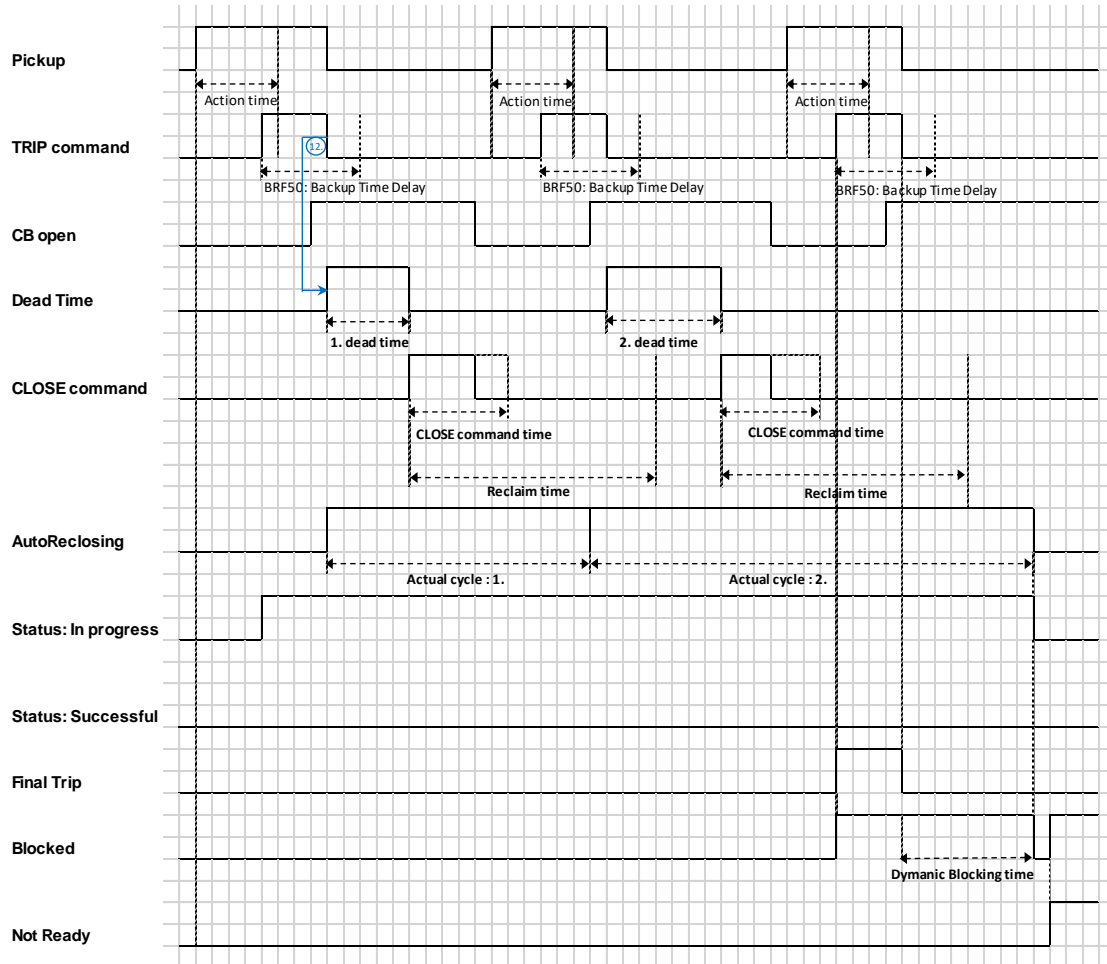*Table 3-2 Example 3, parameter setting*

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 HV 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.

HV AutoReclosing	
Operation	On
Reclosing Cycles	1.2. Enabled
Reclosing Started by	Trip reset
CB State Monitoring	0
⋮	

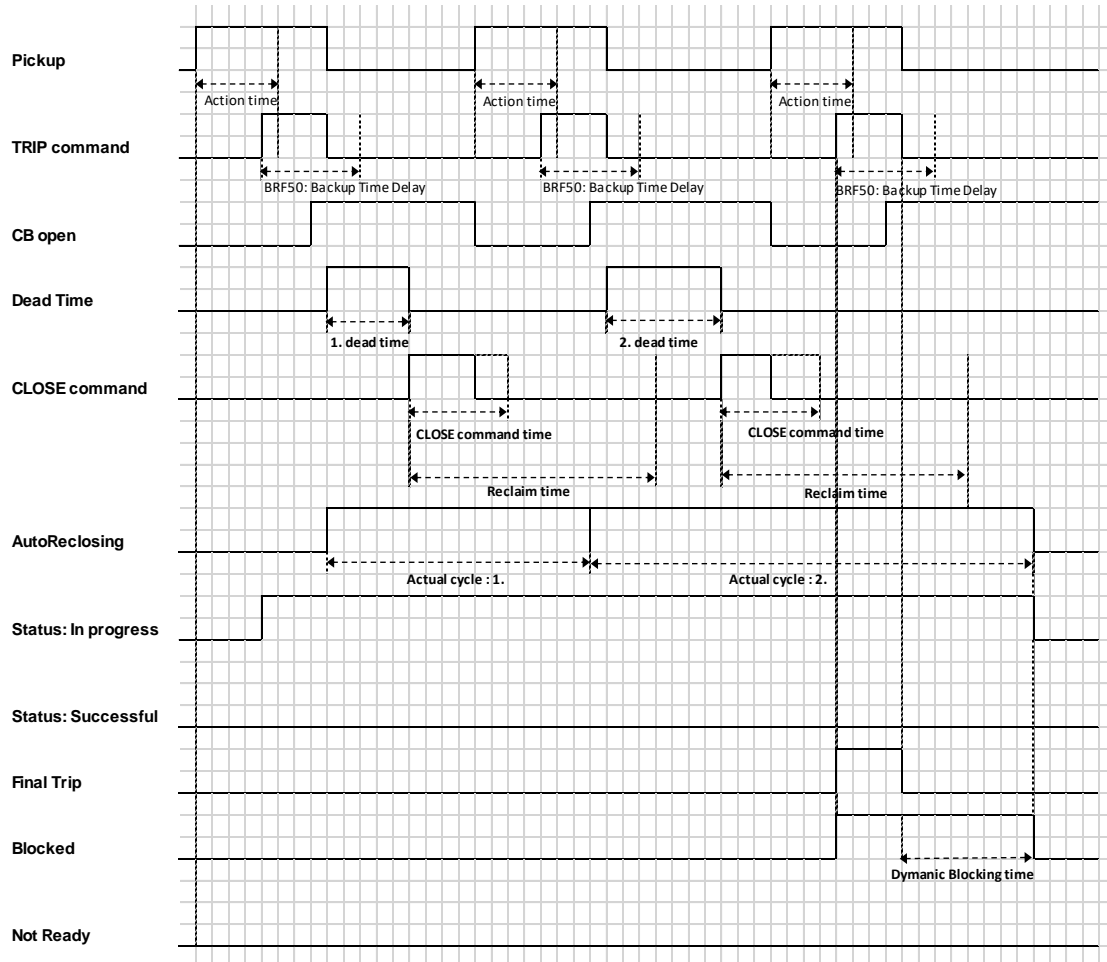*Table 3-3 Example 4, parameter setting*

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 HV 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.