7SG13 Delta

Protection and Control Relays

Document Release History

This document is issue 2010/02. The list of revisions up to and including this issue is:

Pre release

2010/02	Document reformat due to rebrand
2004/08	First issue

Software Revision History

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Section 1: Introduction

1.1 Introduction

This document covers the auto-reclose function and its features. A Diagrams and Parameters document which covers each individual model is available, which lists explicitly the functions that are provided and the manner in which they are connected.

- 79, Auto-Reclose

Notes

1. The following notational and formatting conventions are used within the remainder of this document:
- Setting: *Elem Setting name*
- Setting value: value
- Alternatives: [1st] [2nd] [3rd]

2. Separate sections of the User Manual describe how to set up and operate the protection equipment: apply configuration, settings and passwords, view instruments and set default instruments, and retrieve fault data.

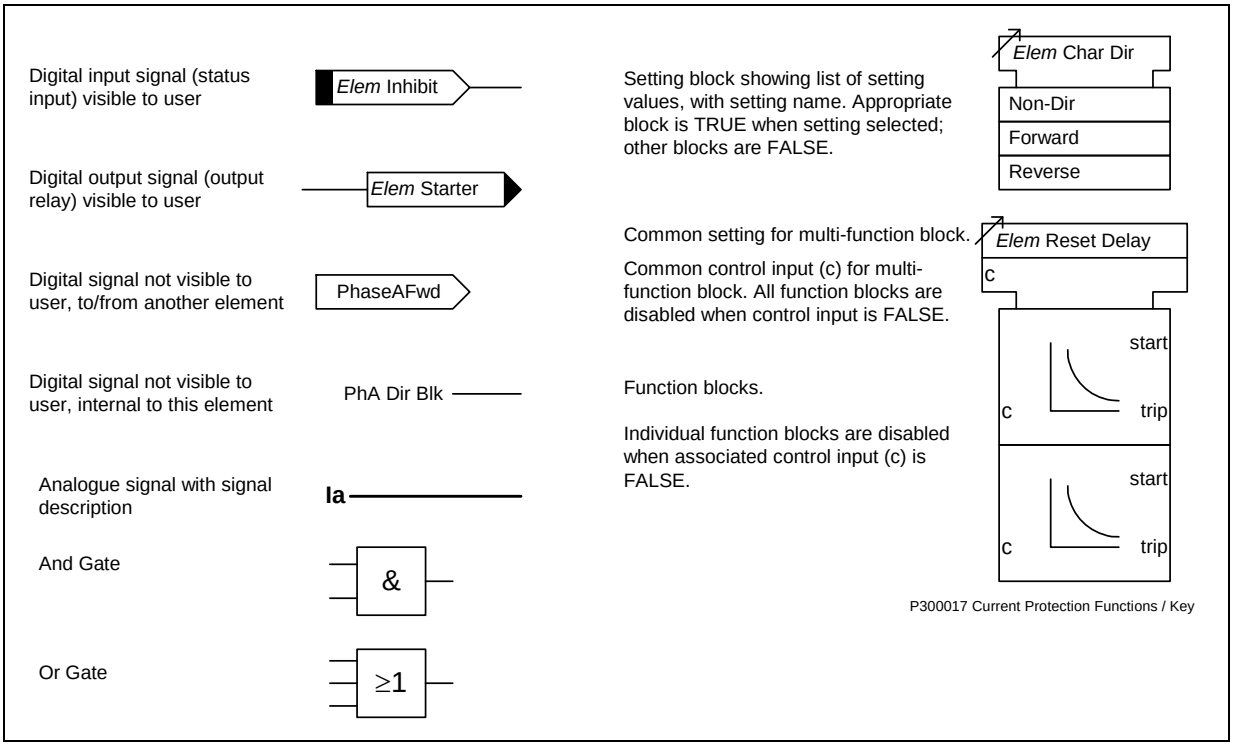

Figure 1-1 Key to Functional Block Diagrams

Section 2: Element Definitions

2.1 Auto-reclose control

Delayed Auto-Reclose (DAR) is initiated by a valid trip relay operation while the associated circuit breaker is in service.

A circuit breaker's service status is determined by its position. The circuit breaker is defined as being in service when it is closed. The in service status has a drop-off delay of 2 sec, this delay is known as the circuit memory time. This functionality prevents autoreclosing when the line is normally de-energised, or normally open.

The transition from DAR started to initiate deadtime takes place when the CB has opened; and the trip relay has reset. If any of these do not occur within the Sequence Fail time the relay will Lockout. This is provided to prevent the DAR being primed indefinitely, or the timer can be switched OFF.

Once a DAR sequence had been initiated, up to 4 unsuccessful recloses (where a closure is followed by a re-trip) may be performed before the DAR feature is locked-out. Each reclosure is preceded by a time delay (dead time) to give transient faults time to clear.

Once a CB has reclosed and remained closed for a specified time period (the Reclaim time), the DAR feature is re-initialised and a Successful Close output issued. A single, common Reclaim time is used.

A count is kept of how many recloses have been performed.

Once lockout has occurred, an alarm is issued and all further Close commands, except manual close, are inhibited for a specified time period (the Minimum Lockout time). A single, common lockout time is used. Lockout can be latched until reset – see Lockout 2.1.14.

There are separate dead-time settings for each of the 4 recloses.

2.1.1 Protection Trip

The protection element which trips the CB is used to prime and start the autoreclose sequence. Internal protection elements that will start the A/R are pre-selected within the relay.

2.1.2 Protection Starter

If, during a sequence, the breaker is closed from another device and a fault is still on the system the starter element will be energised. This is used to allow multi-shot autoreclose sequences to be co-ordinated for adjacent relays, i.e. the number of shots can be kept in step.

2.1.3 External A/R Start

An External A/R Start can be received via a status input. A separate protection device would normally initiate this.

An External A/R Start will be treated the same as a Protection A/R Start by the Relay.

2.1.4 Manual Close

An External Close Command can be received via a status input or communications. This would normally be initiated manually. It causes an instantaneous closure, over-riding any DAR sequence then in operation.

An External Close will initiate Line Check. If a fault appears on the line during the Close Pulse or the Reclaim Time with Line Check set, the Protection relay will initiate a Trip and the A/R relay will Lockout. This prevents a CB being repeatedly closed onto a faulted line.

Repeated Manual Closes are avoided by checking for Positive edge triggers. Even if the Manual Close input is constantly energised the relay will only attempt one close. No Close Pulse will be issued when the Manual Close input is reset.

Manual Close resets Lockout, if the conditions that set Lockout have reset i.e. there is no trip or Lockout input present.

Manual Close cannot proceed if there is a Lockout input or Block Reclose input present.

With the Autoreclose function set to Out of Service the Manual Close control is still active.

2.1.5 In/Out Switching

The DAR feature may be switched out by changing the A/R In Service setting by a number of methods. These are either a keypad change from the front panel, or via a communication, or by an A/R OUT status input. A/R OUT status input has priority over A/R IN. If both are raised the function will be in Out Of Service. Once the relay has been switched to Out Of Service the reverse action A/R IN is required before the function will go back to In Service.

2.1.6 Overall Control

The DAR feature may be disabled by a Lockout command or by an external signal applied to a status input (A/R OUT).

If the Lockout command or A/R OUT are received while a DAR operation is in progress, the feature is immediately locked-out. An External A/R IN command can be received via a status input. This will re-enable the module.

If the Lockout command is received while a Manual Close operation is in progress, the feature is immediately locked-out.

The DAR or Manual Close feature may be paused by an external Block signal applied to a status input. This causes the feature to temporarily halt before it issues the next CB close command and can be used, for example, to delay CB closure until the CB pressure has reached an acceptable level. If the Block signal has not been removed before the end of a defined time, the Reclose Block Delay, the relay is locked-out.

A Block Reclose input active within the deadtime resets the deadtime timer.

2.1.7 CB Close Command pulse

The duration of the CB Close Command pulse is settable to allow a range of CBs to be used. The Close pulse will be terminated if any protection Starter picks-up or a trip occurs. This is to prevent Close and Trip Command pulses existing simultaneously. A Close Onto Fault Output is given if a starter or trip picks-up in the Close Pulse. This can be independently wired to Lockout.

2.1.8 CB Failed To Open and CB Failed to Close

CB Failed To Open and CB Failed to Close features are used to confirm that a CB has not responded correctly to each Trip and Close Command. If a CB fails to operate, the DAR feature can be set to lockout.

2.1.9 CB Closed by Another Device

If, during a dead time period, the Relay detects that the CB has closed (due to an external source) it increments its Reclose count and advances to the next part of the Reclose sequence (begin Reclaim time).

2.1.10 Indications

The relay has a fully programmable output to either output contacts or LEDs, see settings sheet for complete list.

The following are included:
1. A/R Switched Out
2. A/R In Progress
3. Successful Close
4. Line Check
5. Ext Arc Start
6. Lockout
7. CB Failed to Open
8. CB Failed to Close

2.1.11 Trip and Reclose

This is a test function, allowing the operation of the CB to be verified.

The Trip signal should be routed directly to the Circuit Breaker. Once the CB has opened and the Trip and Reclose input is removed the DAR will wait for the first Reclose Delay and then issue a CB Close command.

A Trip and Reclose command will only be accepted if the Relay is in quiescent, or line healthy mode, i.e. no autoreclose sequences are in progress.

During the Trip and Reclose reclosure, Line Check is invoked to ensure that the CB does not repeatedly close onto a faulty line.

2.1.12 Metering

The Status of the DAR operations are displayed in Meters under the instruments Menu.

2.1.13 Dead-time and Reclaim Timing

The Deadtime will start if a Trip has occurred and the CB is Open and the Trip and Starter have then reset and the line has gone dead. Once a trip has occurred if the CB does not open or the Trip does not reset or the starter does not reset then the DAR will Lockout. This could be due to either a CB Fail condition, which would independently notify Lockout, or the Trip or Starter relay contact failing to reset. If the line does not go dead this may signify that the remote end has failed to clear the fault, and the autoreclose will go to Lockout.

A Trip during the deadtime will result in resetting the deadtime and then restarting the deadtime when the trip resets, provided the Sequence Fail Timer has not expired.

The Reclaim time will start once the Close Pulse has timed out and the CB has closed. Lockout is alarmed if the CB is open at the end of the reclaim time.

2.1.14 Lockout

The Lockout state can be reached for a number of reasons. Lockout will occur for the following:

- at the end of the Reclaim time if the CB is in the open position.
- a protection operates during the final Reclaim time.
- if a Close Pulse is given and the CB fails to close.
- The Reclose Lockout status input is active.
- At the end of the Reclose Block Delay due to a persistent Block signal not cleared.
- At the end of the Sync Close Delay due to Synchronism not being achieved.

Once the Lockout condition has been reached, it will be maintained until reset. The following will reset lockout:

- By a Manual Close command, from fascia, comms or a status input.
- By a Reset Lockout signal, provided there is no signal present that will cause Lockout.
- At the end of the Minimum Lockout time if Reset Lockout is selected to be reset by a timer, provided there is no signal present which will cause Lockout.
- if Lockout was entered by an A/R Out signal during an Autoreclose sequence then an A/R In signal must be received before Lockout can reset.
- by the CB Closed, provided there is no signal present which will cause Lockout.

The Lockout condition has a delayed drop-off of 2s.

The Lockout condition will initiate the Lockout indication and alarm contact.

Lockout does not issue a trip signal.

Lockout indicates an abnormal system occurrence, an event that needs to be investigated. When a CB is normally open the A/R relay does not go to Lockout, but using a combination of Trip and CB In Service to start the sequence prevents A/R sequences.

Table 2-1 Typical Settings Auto-Reclose

Setting name	Range (**bold** = default)	Units	Notes
A/R In Service	In, **Out**		
Number Of Shots	**1**..4		
***Shot* Deadtime**	0.0, 0.1…**5.00**…120, 121…900	s	
CB Close Pulse	0.2, 0.3…**2.0**…20	s	
Reclaim Time	OFF, 1…**5**…600	s	
***Elem* Trip**	**Delayed**, Instant		
Line Check Trip	**Delayed**, Instant		
***Elem* TTL**	**OFF**, 1…5		
Rec Block Delay	0, 1…**60**…600	s	
Slow Open Delay	50, 60…**140**…2000	ms	
Seq Fail Timer	**OFF**, 1, 2…600	s	
Min LO Timer	0, 1…**2**…60	s	
Reset LO By Time	Enabled, **Disabled**		

Setting name	Range (**bold** = default)	Units	Notes
Sub-menu: **Output Relays**			
Lockout	_, 1 for each output contact		
A/R Switched Out			
A/R In Progress			
Successful Close			
Line Check			
Ext Arc Start			
CBFailedToOpen			
CBFailedToClose			
Sub-menu: **Status Inputs**			
A/R In	_, 1 for each status input		
A/R Out			
Extern A/R Start			
Block Reclose			
Go To Lockout			
Trip And Reclose			
Trip and Lockout			
Reset Lockout			
Manual Close			

2.1.14.1 Specification

Element Parameters

The element will take the following parameters, unless otherwise specified in the appropriate Diagrams and Parameters document.

	Parameter	**Value**
t_{cycle}	Element cycle time	20 ms
$t_{setting}$	Timer settings	Applied value

Operate Time

	Attribute	**Value**
t_{op}	Operate time following delay	$t_{setting}$, ± 1 % or ± t_{cycle}
	Repeatability	± 1 % or ± t_{cycle}