

7SG1641 Ohmega 402 50

Distance Protection Relay

Document Release History

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Pre release

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| 2010/02 | Document reformat due to rebrand |
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Software Revision History

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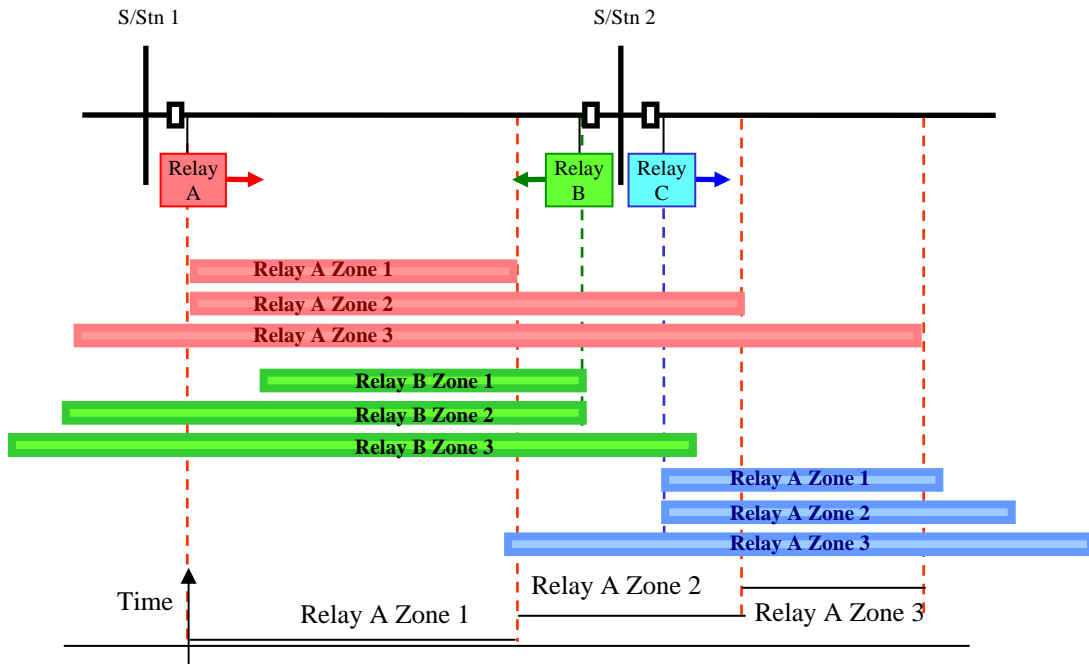
Section 1: Protection Schemes

1.1 Basic Protection Schemes

1.1.1 Time Stepped Distance

1.1.1.1 Scheme Operation

A TIME-STEPPED DISTANCE scheme is normally applied when there is no signalling available between relays. Generally, the Zone 1 elements are set to operate for faults up to 80% of the line length. The Zone 2 elements operate up to 120% of the line length after a time delay. The Zone 3 elements are set with a longer reach than the Zone 2 elements, and often have a degree of reverse reach (i.e. an offset characteristic) to provide a further level of back up protection. The Zone 3 time delay is set to be longer than the Zone 2 time delay.



The disadvantage of such a scheme is that faults in the last 20% of the line are cleared after the Zone 2 time delay. This may be acceptable for lower voltage distribution systems, but for important circuits or higher voltage systems additional schemes are available to improve the tripping of the relay.

1.1.1.2 Settings

Distance Scheme: TIME-STEPPED

Status Inputs: N/A

Relay Outputs: N/A

1.2 Schemes Incorporating a Signalling Channel

Where a signalling channel is available between ends, the coverage of the relays can be improved. When these Protection Schemes are used, the Zone 1, 2 and 3 are arranged to trip as in the time stepped distance scheme. In addition to this, the relay is also capable of carrying out what is known as a “Carrier Aided Trip”, where the time delay on one of the Zones is removed when the conditions at the remote end, as indicated by the signalling channel meet certain criteria.

The distance protection signalling schemes use the relay outputs *Signal Send 1* and status input *Signal Received 1* for the signalling channel. It is possible to configure these channels with delay using the settings SS pickup, SS Dropoff and SR Dropoff.

1.2.1 Permissive Underreach

1.2.1.1 Scheme Operation

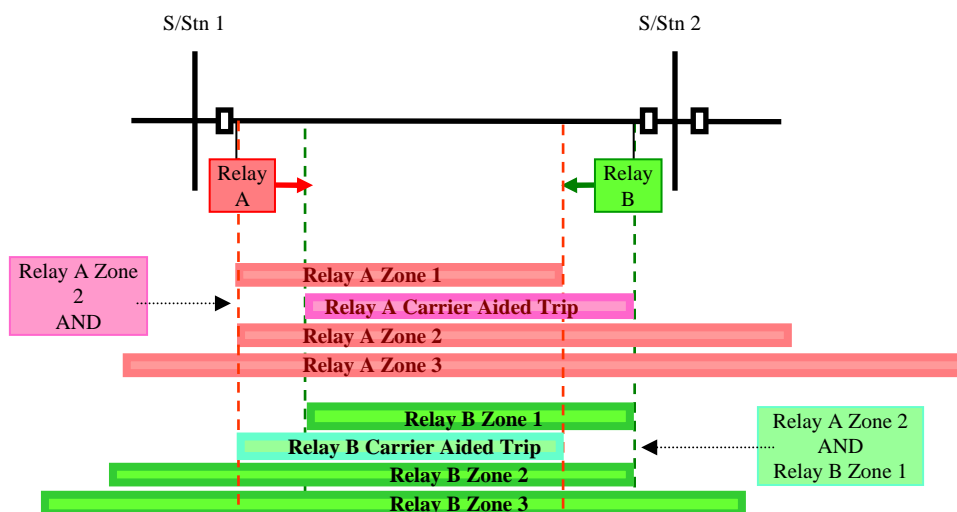
Typically (as for the time stepped scheme) the Zone 1 is set to 80% of the line length, Zone 2 to 120% of the line length and Zone 3 as delayed back up protection to cover at least the longest adjacent line.

The fault must be in the zone between the two relays (i.e. on the line section) if;

Zone 1 element operates, or

Remote end Zone 1 operates AND local Zone 2 element operates.

This is shown in the diagram below:



The relay is arranged to send a signal when its Zone 1 picks up.

The relay will trip instantaneously for a Zone 1 fault. If a signal is received from the remote end, the time delay will be removed from the Zone 2 element, allowing it to trip instantaneously. The name of the scheme comes from the fact that a Permissive signal is being sent by the Underreaching Zone 1.

Where the signalling equipment has an output which indicates that the signalling channel is out of service, this can be connected to a Status Input called *Carrier Recv Guard*. On energisation of this status input the relay will revert to a time stepped distance scheme.

In this scheme, only a single signalling channel is required for two-way signalling, since if the zone 1 elements at both operate, the permissive signal will not be required (since both ends will trip instantaneously in Zone 1).

The scheme also incorporates an *Unstabilise Relay* status input which can be used for intertripping. Energisation of this status input will initiate a signal send

1.2.1.2 Settings

| | |
|------------------------|-------------------------|
| <i>Distance Scheme</i> | PUR |
| <i>SS Pickup</i> | 0..60000 (0ms) |
| <i>SS Dropoff</i> | 0..60000 (1ms) |

SR Dropoff 0..60000 (1ms)

Status Inputs: UNSTABILISE RELAY, CARRIER RECV GUARD

Relay Outputs: AIDED TRIP

1.2.2 Permissive Overreach Zone 1 – POR1.

1.2.2.1 Scheme Operation

This scheme differs from the other relay schemes, in that it requires that the Zone 1 element to be set with a time delay. Typically the Zone 1 is set to 120% of the line length, Zone 2 to 120% of the line length and Zone 3 as delayed back up protection to cover at least the longest adjacent line. The Zone 1 time delay is usually set the same as the Zone 2 time delay.

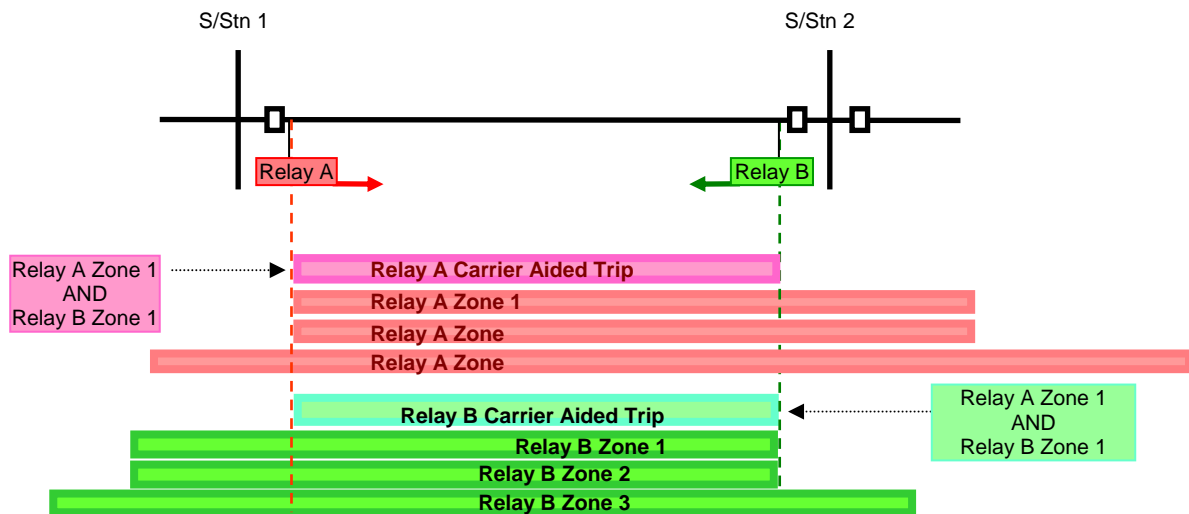
The Zone 1 elements are arranged to overreach and the relay is arranged to send a Permissive signal send when any Overreaching Zone 1 element operates. When a signal is received from the remote end the relay will remove the Zone 1 time delay allowing the relays at both ends of the line to trip after a small time delay for an in-zone fault. Relay operation can be seen the diagram below;

Where the signalling equipment has an output which indicates that the signalling channel is out of service, this can be connected to a Status Input called *Carrier Recv Guard*. On energisation of this status input the relay will revert to a time stepped distance scheme.

1.2.2.2 Settings

| | |
|------------------------|----------------|
| <i>Distance Scheme</i> | POR1 |
| <i>SS Pickup</i> | 0..60000 (0ms) |
| <i>SS Dropoff</i> | 0..60000 (1ms) |
| <i>SR Dropoff</i> | 0..60000 (1ms) |

Status Inputs: CARRIER RECV GUARD



Relay Outputs: AIDED TRIP

1.2.3 Permissive Overreach Zone 2 – POR2.

1.2.3.1 Scheme Operation

Typically (as for the time stepped and PUR schemes) the Zone 1 is set to 80% of the line length, Zone 2 to 120% of the line length and Zone 3 as delayed back up protection to cover at least the longest adjacent line. Zone 1 has no time delay, Zone 2 has a time delay, and the Zone 3 has a larger time delay.

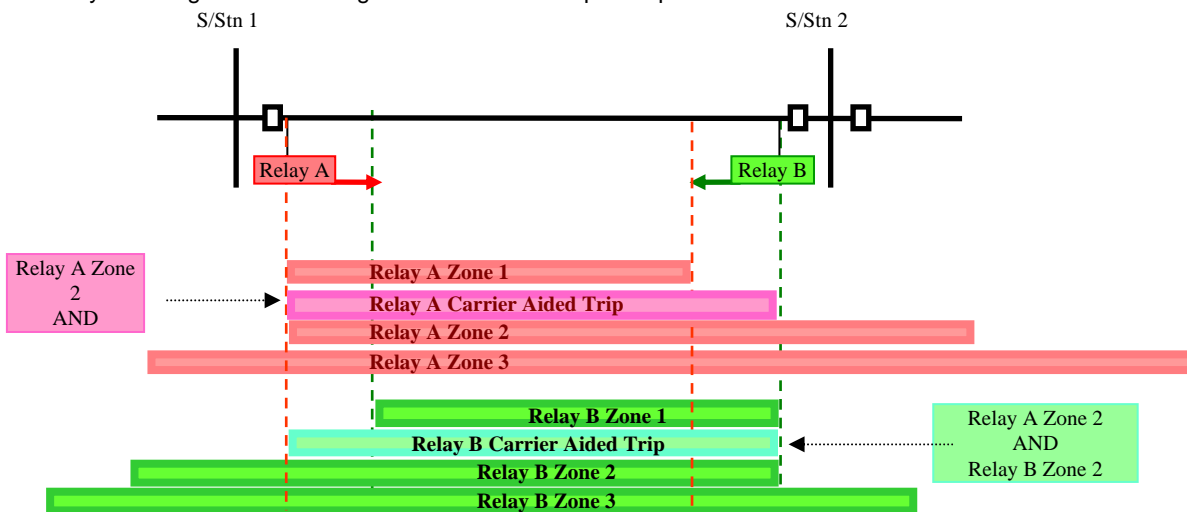
The fault must be in the region between the two relays (i.e. on the line section) if;

Zone 1 element operates, or

Remote end Zone 2 operates AND local Zone 2 element operates.

This is shown in the diagram below:

The relay is arranged to send a signal when its Zone 2 picks up.



The relay will trip instantaneously for a Zone 1 fault. If a signal is received from the remote end, the time delay will be removed from the Zone 2 element, allowing it to trip instantaneously. The name of the scheme comes from the fact that a Permissive signal is being sent by the Overreaching Zone 2

This scheme may be used if the Zone 1 reach does not give sufficient resistive coverage, and may be useful on short lines. Note that when using POR 2, two signalling channels must be available (one in each direction) since the Zone 2 elements which initiate the signal send will both operate for a fault on the line section.

Where the signalling equipment has an output which indicates that the signalling channel is out of service, this can be connected to a Status Input called *Carrier Recv Guard*. On energisation of this status input the relay will revert to a time stepped distance scheme.

1.2.3.2 Settings

| | |
|------------------------|----------------|
| <i>Distance Scheme</i> | POR2 |
| <i>SS Pickup</i> | 0..60000 (0ms) |
| <i>SS Dropoff</i> | 0..60000 (1ms) |
| <i>SR Dropoff</i> | 0..60000 (1ms) |

Status Inputs: **CARRIER RECV GUARD**
 Relay Outputs: **AIDED TRIP**

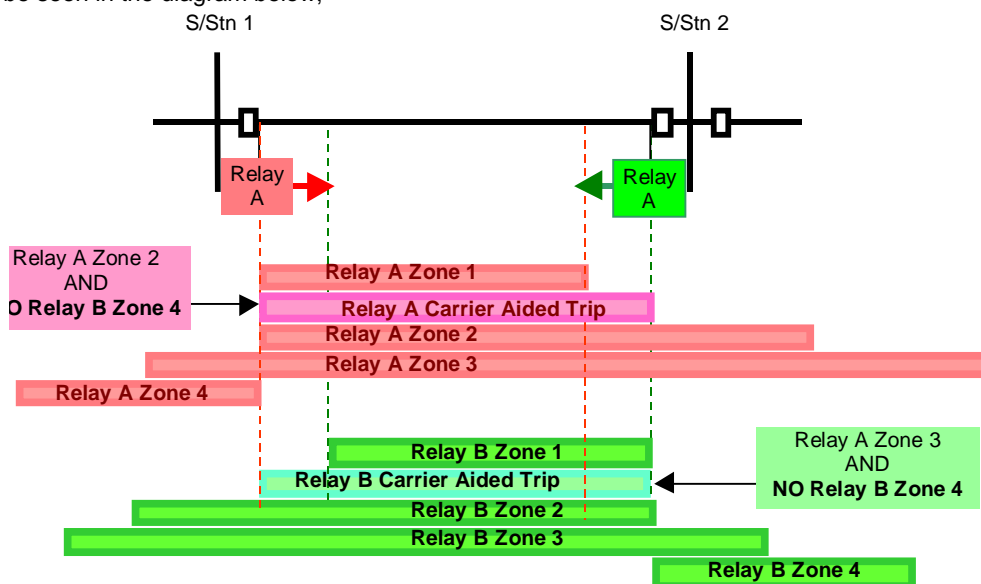
1.2.4 Blocked Overreach

1.2.4.1 Scheme Operation

This requires a reverse-looking element to allow the sending of a blocking signal.

The fault must be in the region between the two relays (i.e. on the line section) if;

The overreaching Zone 2 element operates and a reverse looking zone at the remote end has **not** operated. This can be seen in the diagram below;



When the Zone 2 instantaneous element picks up, the relay waits for a “blocking signal” to be received. If no blocking signal is received during a set time delay (known as the Permissive Trip Time) the relay will carry out a “Carrier Aided Trip”. If, during this time delay, a blocking signal is received, the Zone 2 time delay will remain in place, and the relay will carry out a Zone 2 trip after the Zone 2 Time delay.

If the fault is in the last section of the line (i.e. outside the Zone 1 reach) the Zone 2 element will operate, but the remote end relay Zone 4 element not see the fault. Thus, no blocking signal will be sent, and the relay will carry out a “Carrier Aided Trip” after the *Permissive Trip Time*.

Obviously when applying this scheme the reverse reach of the Zone 4 element must be further than the overreach of the remote end Zone 2 element.

Where the signalling equipment has an output which indicates that the signalling channel is out of service, this can be connected to a Status Input called *Carrier Recv Guard*. On energisation of this status input the relay will revert to a time stepped distance scheme.

The scheme also incorporates an *Unstabilise Relay* status input which can be used for intertripping. Energisation of this status input will initiate a signal send.

1.2.4.2 Settings

| | |
|-----------------------------|----------------|
| <i>Distance Scheme</i> | BOR |
| <i>Permissive Trip Time</i> | 0..60000 (1ms) |
| <i>SS Pickup</i> | 0..60000 (0ms) |
| <i>SS Dropoff</i> | 0..60000 (1ms) |
| <i>SR Dropoff</i> | 0..60000 (1ms) |

Status Inputs: BLOCK MODE INHIBIT, CARRIER RECV GUARD, UNSTABILISE RELAY

Relay Outputs: N/A