7SG1642 Ohmega 406

Distance Protection 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

Software Revision History

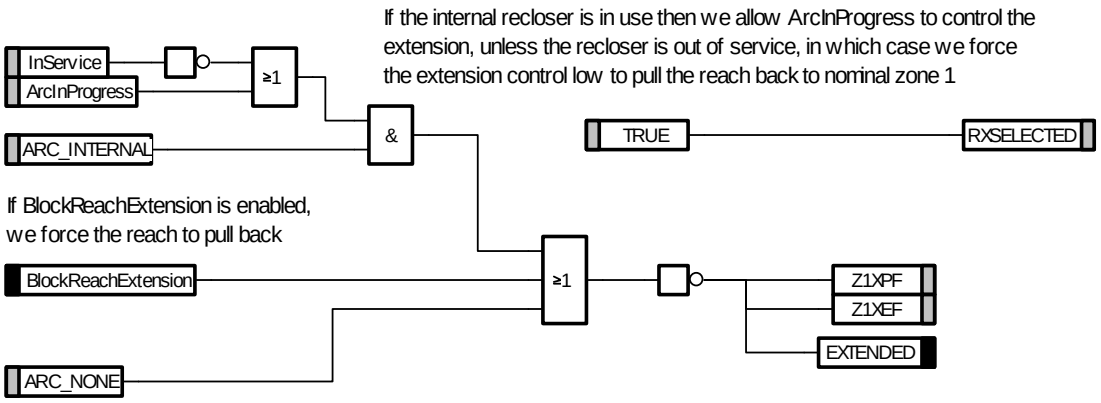
2006/05	2615H80018R33	

Contents

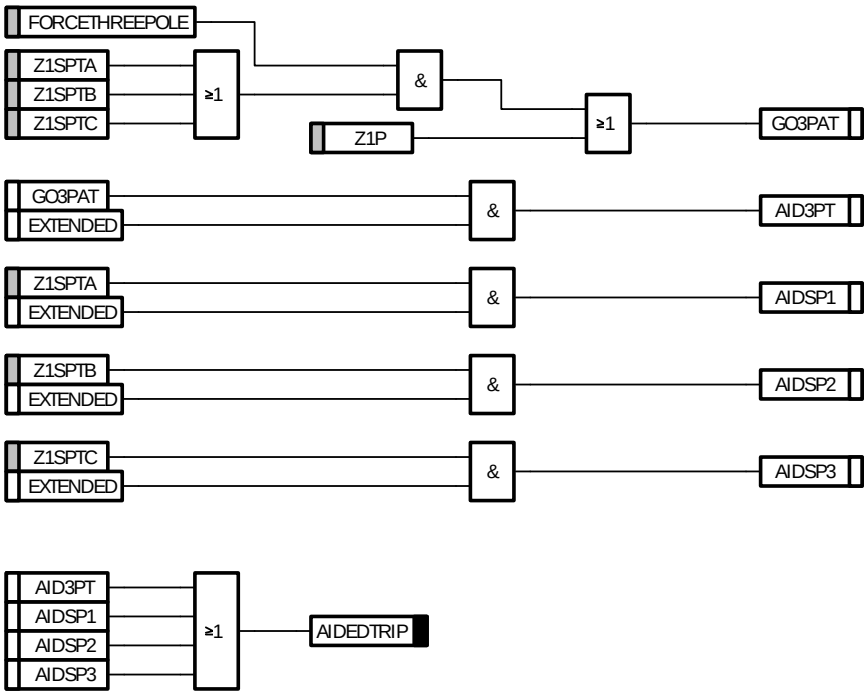
This diagram performs the reach extension logic.

Basically, it directs the inverted ARC in Progress flag at the Z1X enable inputs, so that extension is enabled for first trip, then removed during the autoreclose sequence.

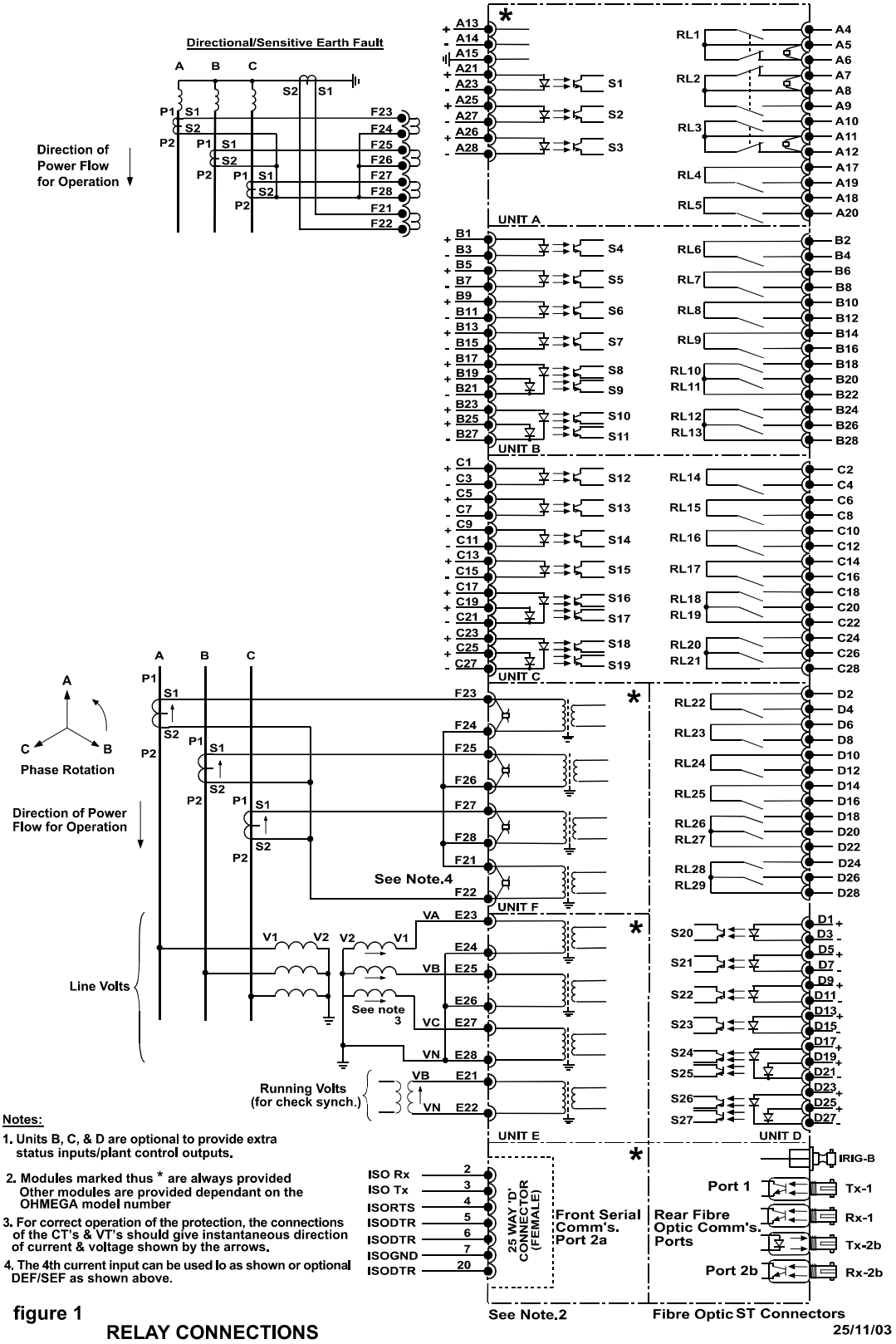
This is an enhanced version of the scheme which now incorporates checks to remove the overreach when the recloser is in local mode and out of service, or when no autorecloser is in use (though Reach Extension should not have been selected with no recloser).



If no recloser is in use then we force the reach back to zone 1.



1 Relay Connections



Notes:

1. Units B, C, & D are optional to provide extra status inputs/plant control outputs.
2. Modules marked thus * are always provided Other modules are provided dependant on the OHMEGA model number
3. For correct operation of the protection, the connections of the CT's & VT's should give instantaneous direction of current & voltage shown by the arrows.
4. The 4th current input can be used Io as shown or optional DEF/SEF as shown above.

figure 1

RELAY CONNECTIONS

2 Overall dimensions and panel drilling for Epsilon E16

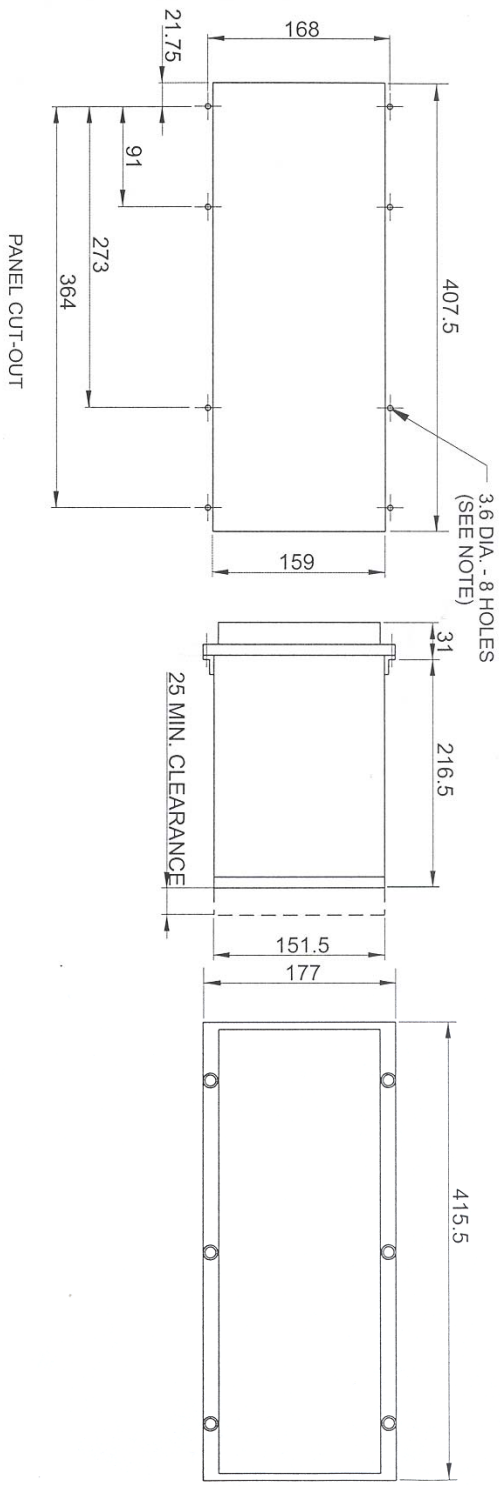


figure 2
OVERALL DIMENSIONS AND PANEL DRILLING FOR EPSILON E16 CASE

NOTE:
THE 3.6 DIA. HOLES ARE FOR M4 THREAD FORMING (TRILOBULAR) SCREWS. THESE ARE SUPPLIED AS STANDARD AND ARE SUITABLE FOR USE IN FERROUS/ALUMINIUM PANELS 1.6mm THICK AND ABOVE. FOR OTHER PANELS, HOLES TO BE M4 CLEARANCE (TYPICALLY 4.5 DIA.) AND RELAYS MOUNTED M4 MACHINE SCREWS, NUTS AND LOCKWASHERS (SUPPLIED IN PANEL FIXING KIT).

24/8/99

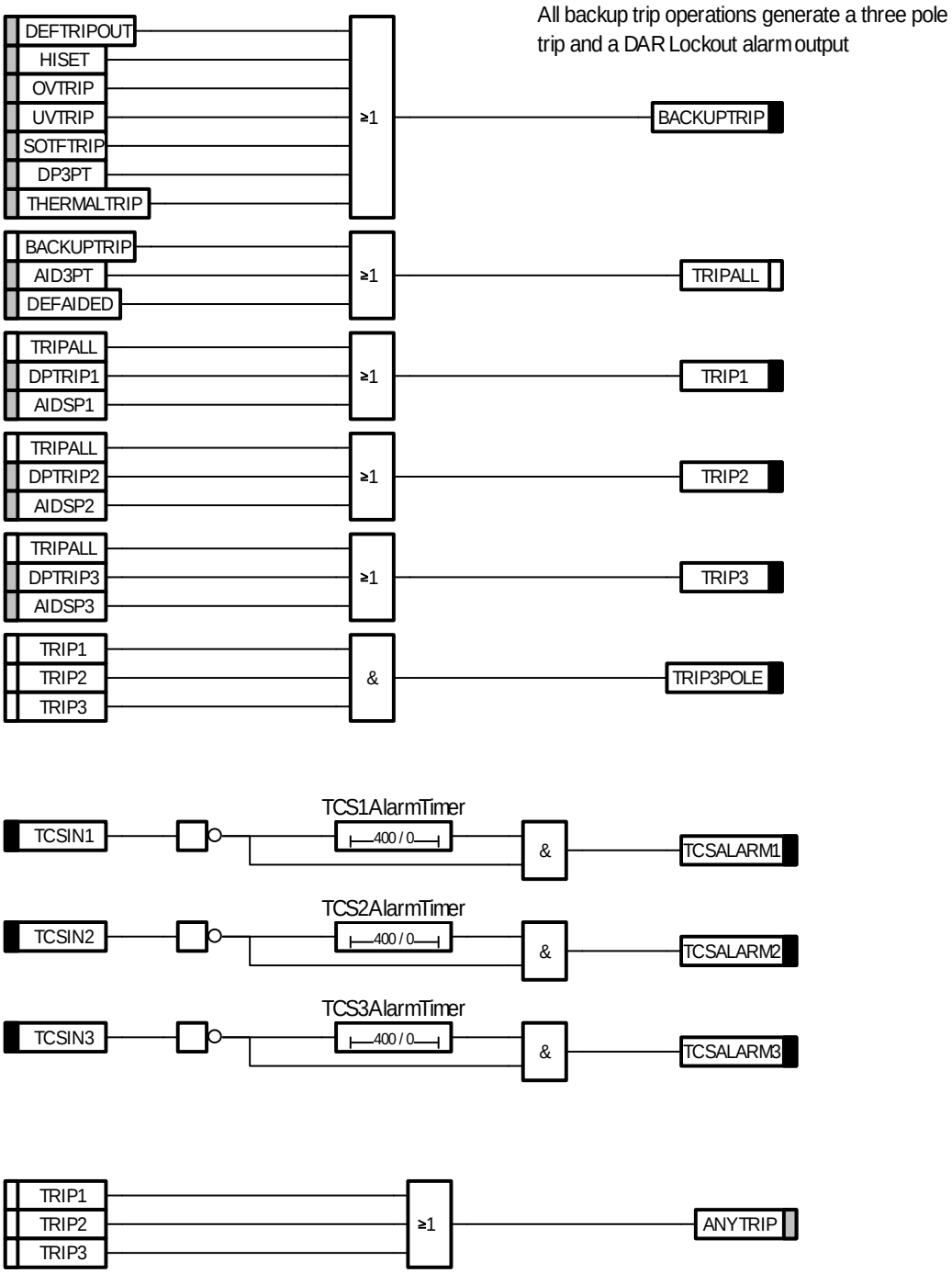
3 Reylogic Diagrams.

The following diagrams show the logic used in the relay. This is split up into three sections – firstly the logic used for the distance protection function, then the auxiliary function logic, then finally the scheme logic.

3.1 Distance Protection

3.1.1 Trip Outputs

This diagram is responsible for final generation of the trip signals. It not only connects the single pole outputs to the matrix, but also generates the 3 pole operation from the TRIPALL boolean. Also contains the trip circuit supervision logic and the general ANYTRIP boolean for connection to the autoreclose logic.

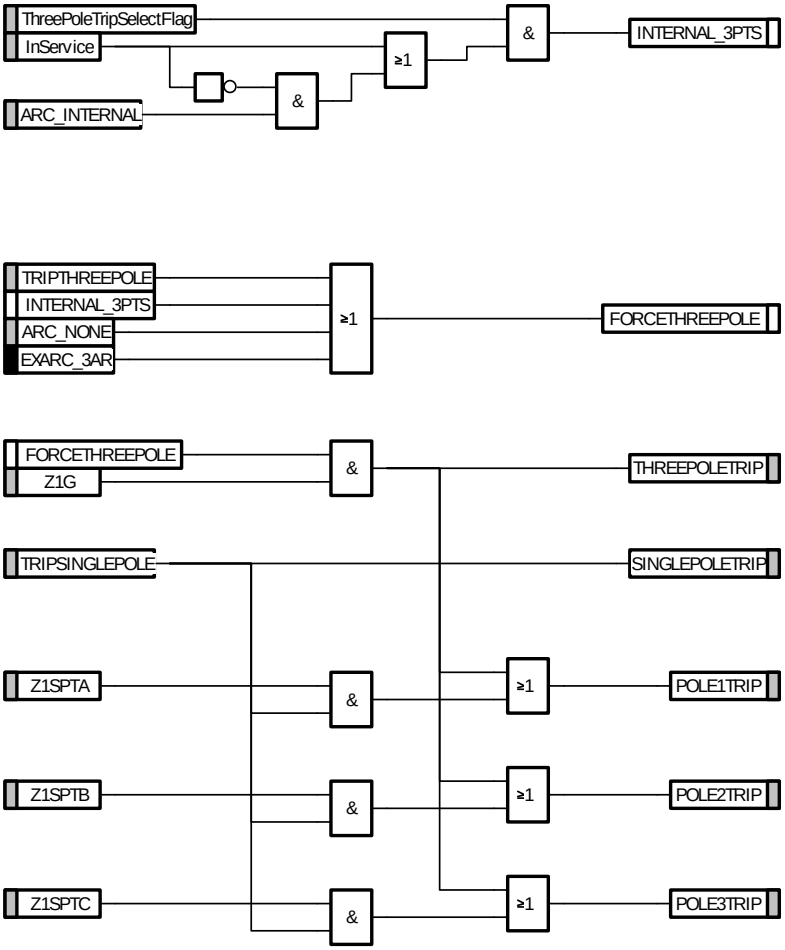


3.1.2 Single Pole Tripping

This diagram provides single pole tripping for distance zone 1, supported by the sequence current check module outputs. The enable/disable setting provides the FORCETHREEPOLE input.

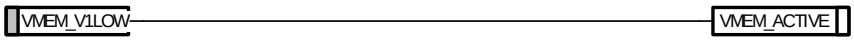
The check module provides the TRIPTHREEPOLE and TRIPSINGLEPOLE bools. If the fault is determined to be three pole, or single pole tripping is disabled, then a three pole trip is forced on operation of any zone 1 comparator. If single pole tripping is enabled and the fault looks like single phase, then single pole tripping is left to the zone 1 logic outputs to be decided.

Additional logic allows the autorecloser to force three pole tripping when it requires it. Also, an external autorecloser can be used with the relay, and we must allow for it to force three pole trips via an external control. If there is no recloser in use at all, then WE MUST FORCE ALL TRIPS TO BE THREE POLE. A setting will provide this functionality. The FORCETHREEPOLE boolean also needs to used within the scheme logic to force three pole tripping as appropriate.

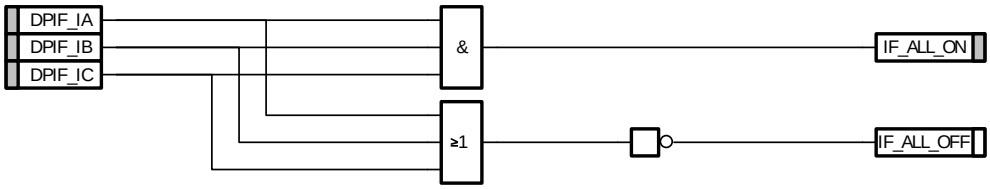


3.1.3 Voltage Memory

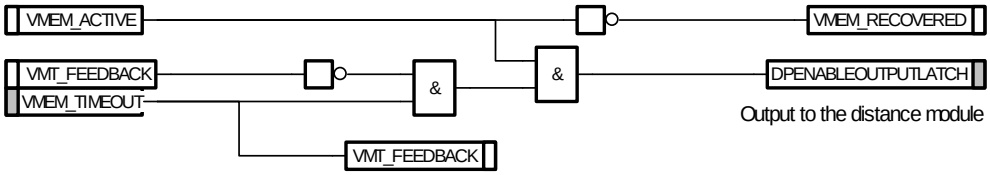
When a heavy three phase fault occurs, the fault voltage will collapse and the voltage memory will start timing out. After approx 100ms, the memory output will clamp off and the memory timeout signal will go active. This applies an inhibit to zone 1 and (where fitted) zone 4. The latch operation is required to prevent dropoff of the trip relays too early because of removal of of the comparator outputs. Reset occurs when memory recovers (voltage back) or the fault current is removed in all phases.



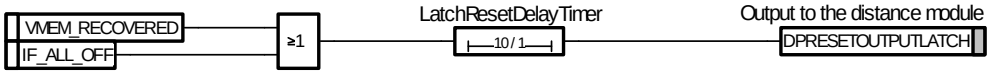
Next, we generate a reset control from the distance fault current detectors



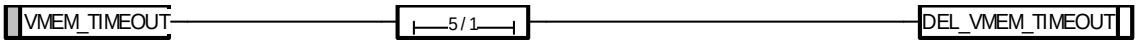
Next, we generate the latch control signals for use by the distance module output latches - first the latch enable



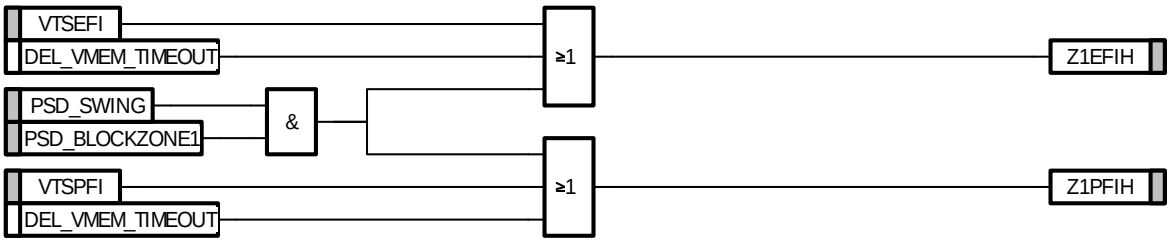
Now the latch reset signal



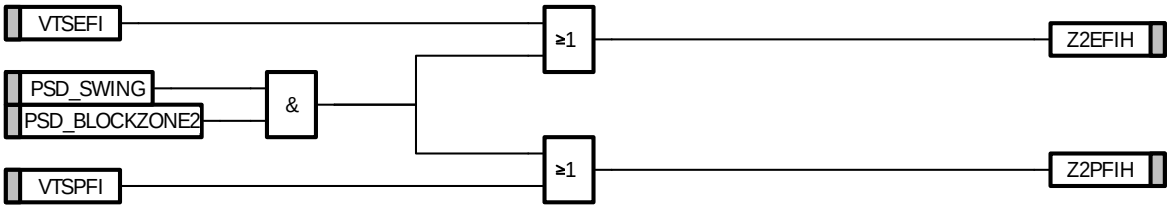
3.1.4 Trip Inhibit Logic



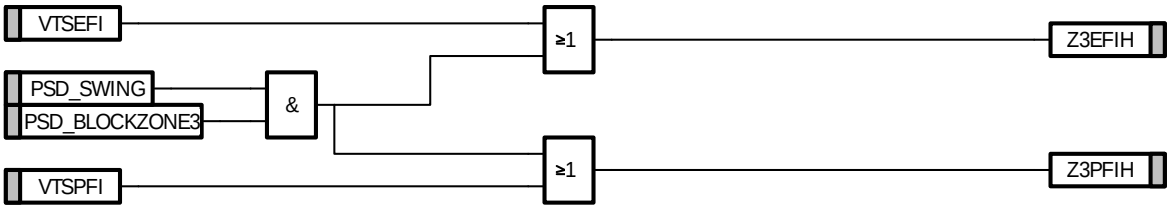
Allow Zone 1 to be inhibited by Power Swing, VTS, or Voltage Memory timing out.



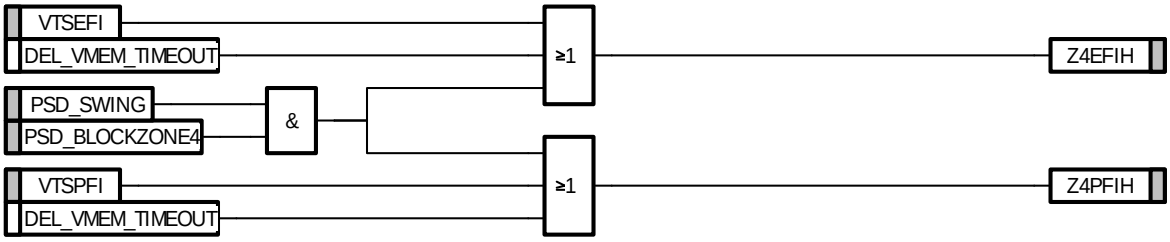
Allow Zone 2 to be inhibited by the same; Power Swing, VTS, or Vmem timed out.



Zone 3 has no memory voltage, so only inhibit from Power Swing and VTS



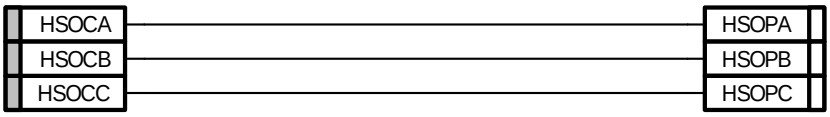
Zone 4 does have memory voltage, so inhibit from all, ie Power Swing, VTS, or Vmem timed out.



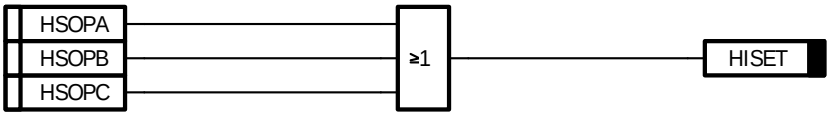
3.2 Auxilary Functions

3.2.1 High Set Overcurrent

Copy the protection output booleans to local bools for speed/safety

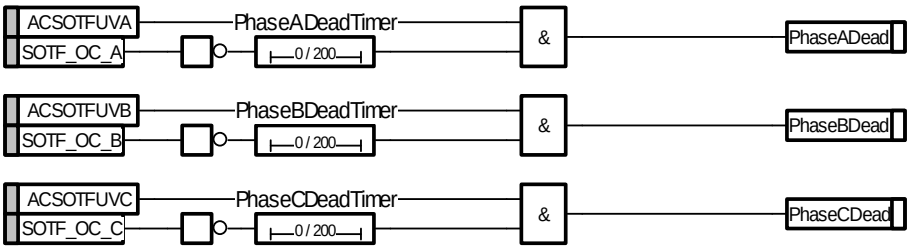


Generate an alarm output for the hiset. This is also used later as a 3 pole trip

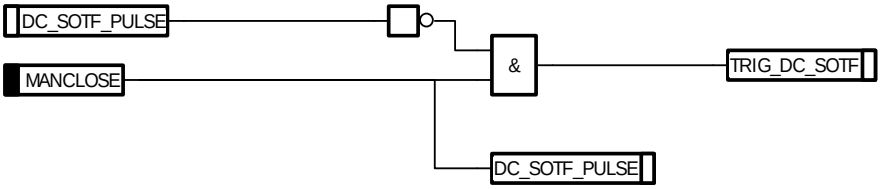


3.2.2 Switch-onto-Fault

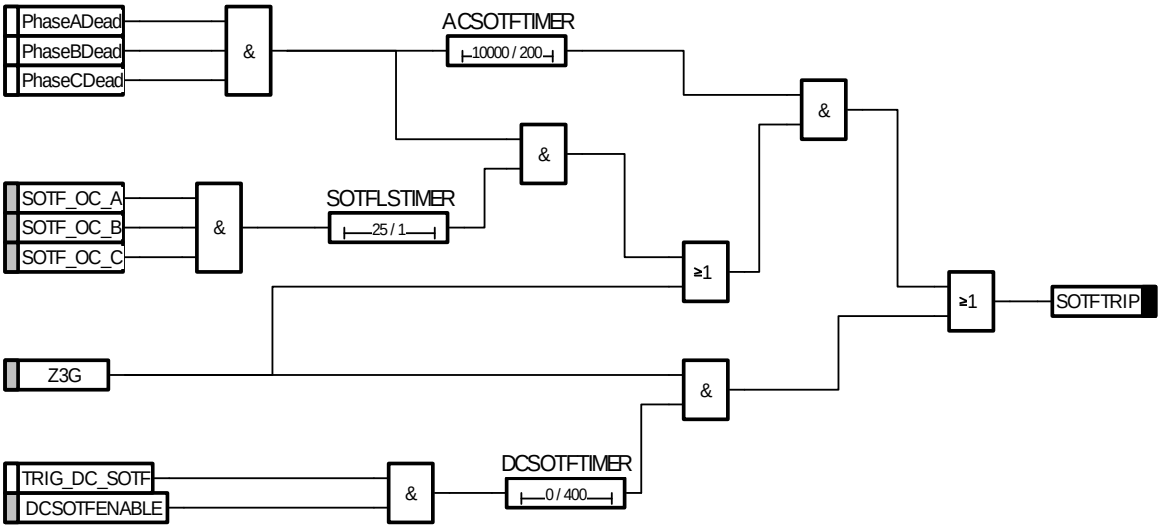
First test each pole to see if it's 'dead'



Generate a pulse from the manual close input.

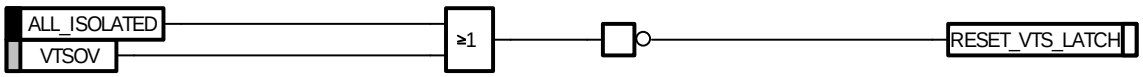


Now use this to evaluate the SOTF logic

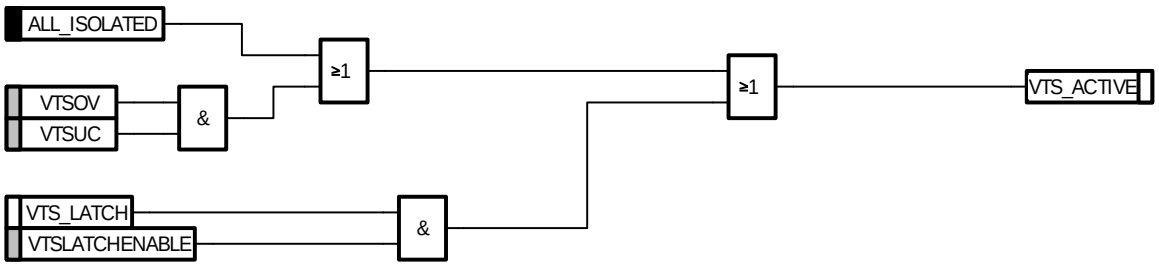


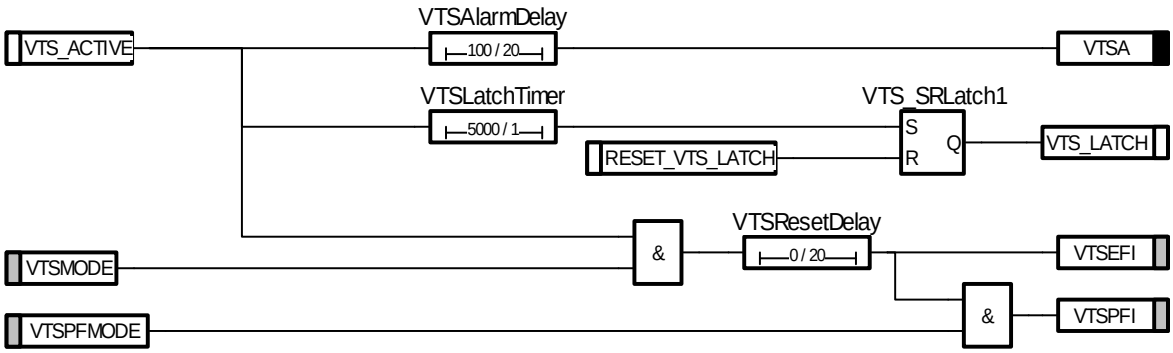
3.2.3 Voltage Transformer Supervision

Generate the latch reset from the voltage recovery



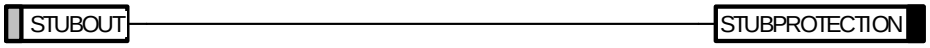
Now the actual VTS logic



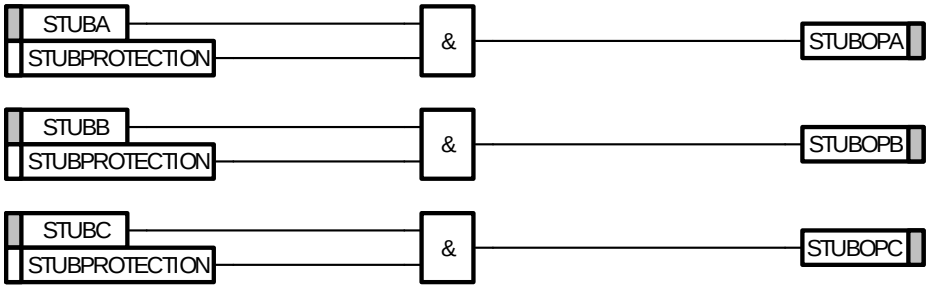


3.2.4 Stub Protection

Generate an alarm/flag output for stub operation



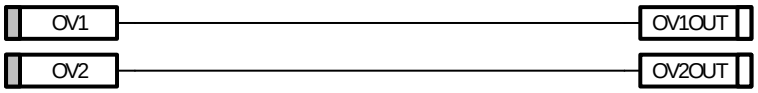
Qualify the stub outputs for flagging.



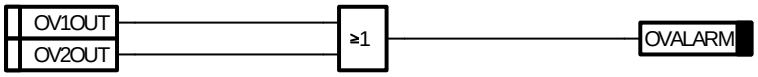
3.2.5 Overvoltage Protection

This diagram provides the indication and trip logic for the Ohmega 400 undervoltage protection

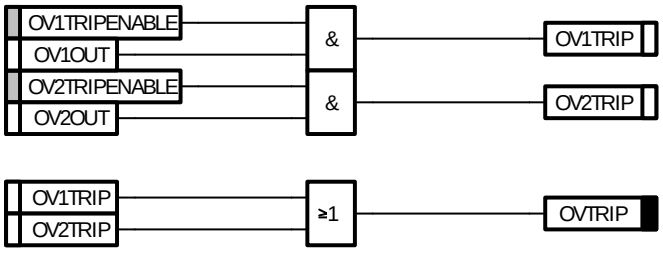
Firstly, copy the OV element operate outputs to the alarm output booleans



Next, create an alarm/flag output



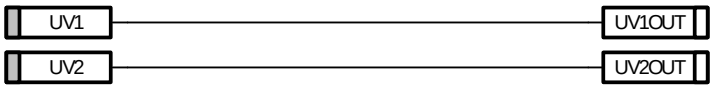
Next, generate a trip signal if UV tripping is enabled. This is used in the trip output diagram



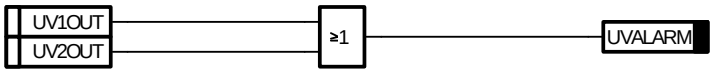
3.2.6 Undervoltage Protection

This diagram provides the indication and trip logic for the Ohmega 400 undervoltage protection

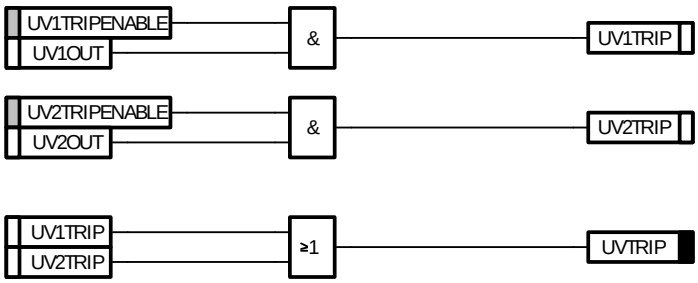
Firstly, copy the UV element operate outputs to the alarm output booleans



Next, create an alarm/flag output



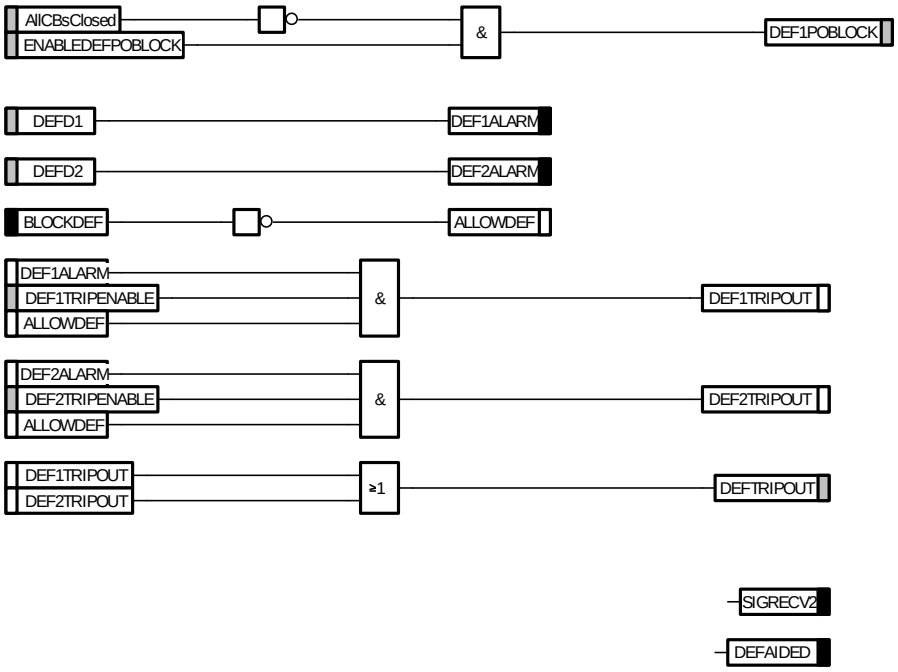
Next, generate a trip signal if UV tripping is enabled. This is used later in the trip output diagram



3.3 DEF

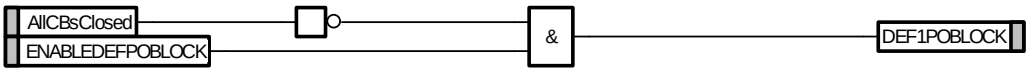
3.3.1 DEF Direct Trip

Allow DEF elements to be blocked if one or more CB poles are open

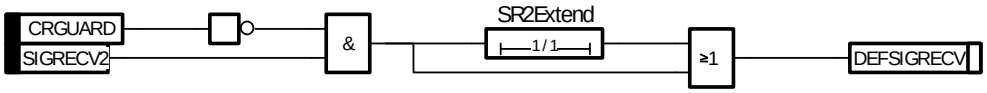


3.3.2 DEF POR

Allow DEF elements to be blocked if one or more CB poles are open

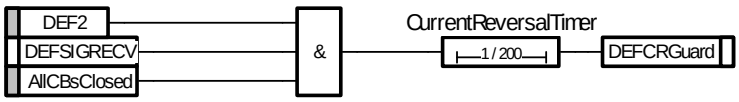


Signal Receive pre-processing



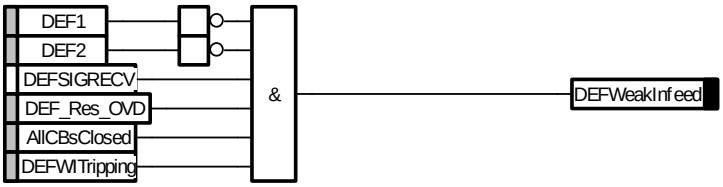
Current Reversal logic

If we have SigRecv, but the fault is behind there's a danger of a current reversal trip.
In this circumstance block DEF until SigRecv goes away.



Weak Infeed

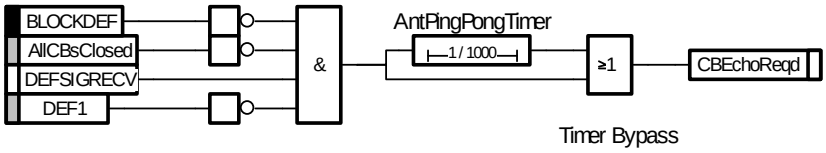
SigRecv with neither forward nor reverse DEF operation could be due to a Weak Infeed fault.
We can use a residual overvoltage detector to detect that there is some sort of earth fault on the system and trip.



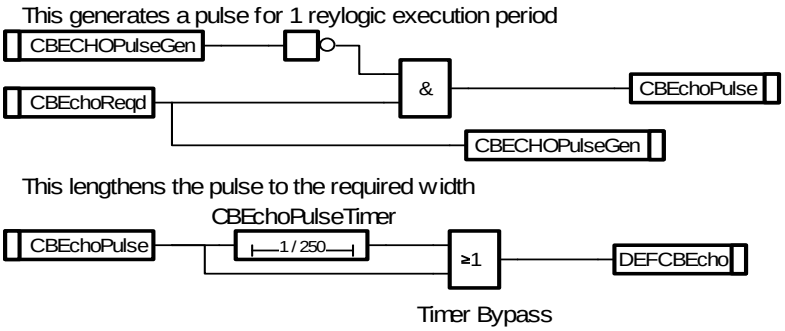
CB Echo

If the circuit breaker at this end is open, and a signal is received,
reflect it straight back to the remote end to allow tripping.

To avoid a lockup situation where the CB Echos at each end reinforce each other and prevent SigSend from dropping off we limit the duration of the CBEcho signal and Keep the CB Echo Required signal asserted until the trigger condition has been absent for 1 second

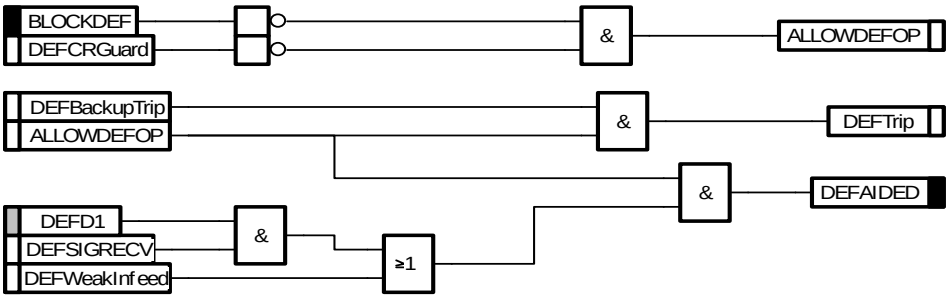


Timer Bypass

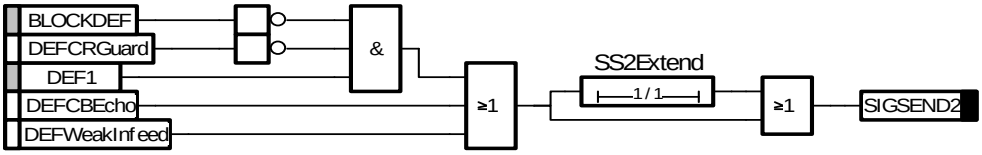


Backup trip

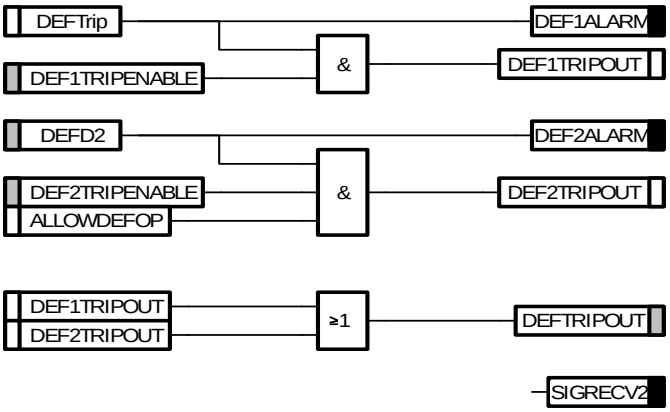
Trip Logic



Signal Send Logic



Indication Logic



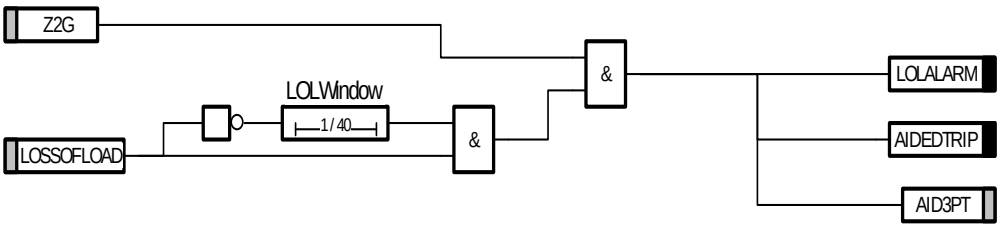
3.4 Protection Schemes

3.4.1 Loss Of Load

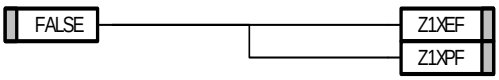
For a Loss Of Load trip to occur, we need to see the removal of current from one or two phases due to the remote end performing a three pole trip for a fault in its zone 1. This removes any load being supplied by us, and so we only see the fault current. If that fault was in our zone 1 then we would trip instantaneously. If it is in the end zone of the line (our Zone 2), then we accelerate the zone 2 operation. The load removal may be just that, ie disconnection of the load at a remote location, so we must see zone 2 pickup within a short time after operation of the LOL detector. Pole scatter at the remote end is catered for by a delay in the detector.

Note that loss of load cannot detect three phase conditions, and also requires a three pole trip at each end.

The Zone 2 protection must pickup within 40ms of the detector output



Clear the reach extension controls as that scheme is not in use.

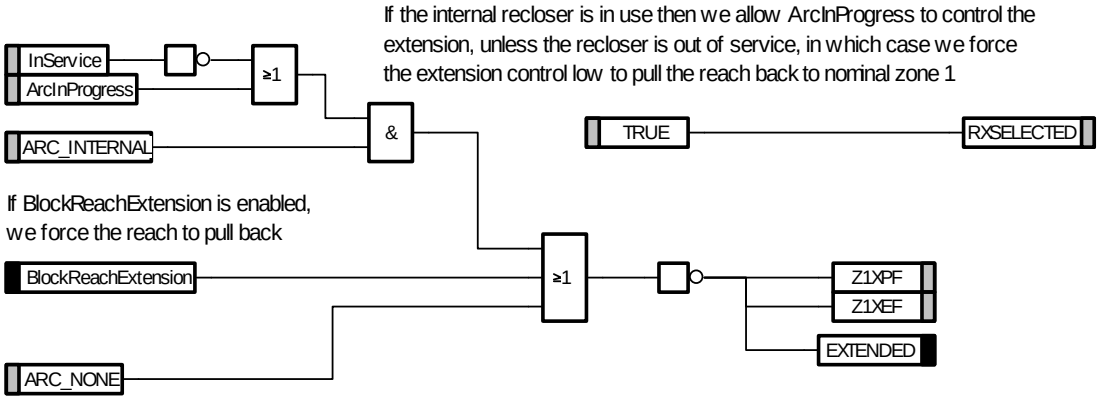


3.4.2 Reach Extension

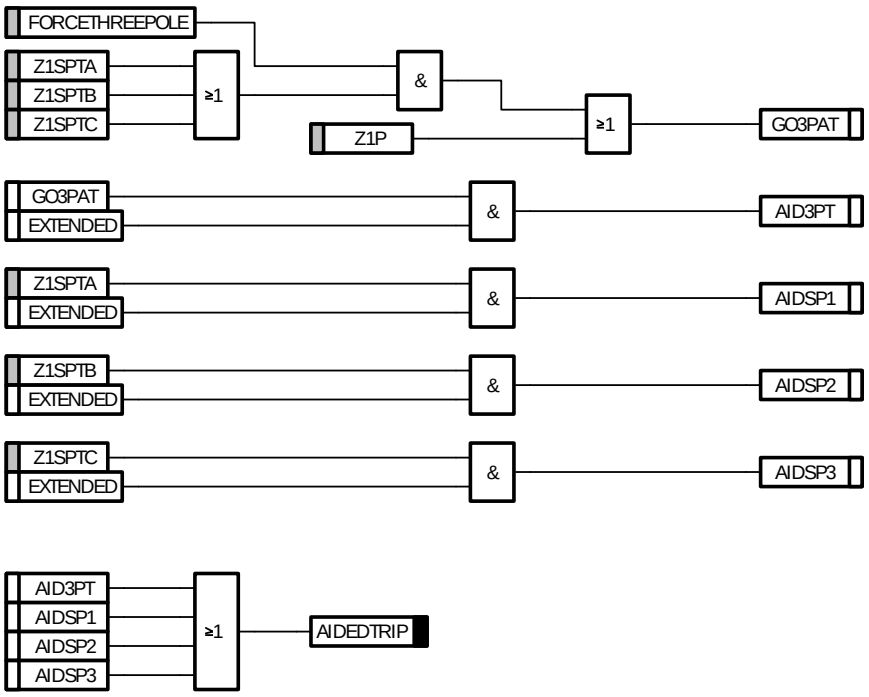
This diagram performs the reach extension logic.

Basically, it directs the inverted ARC in Progress flag at the Z1X enable inputs, so that extension is enabled for first trip, then removed during the autoreclose sequence.

This is an enhanced version of the scheme which now incorporates checks to remove the overreach when the recloser is in local mode and out of service, or when no autorecloser is in use (though Reach Extension should not have been selected with no recloser).

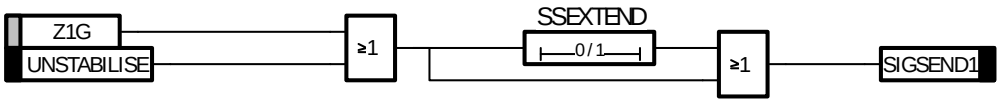


If no recloser is in use then we force the reach back to zone 1.



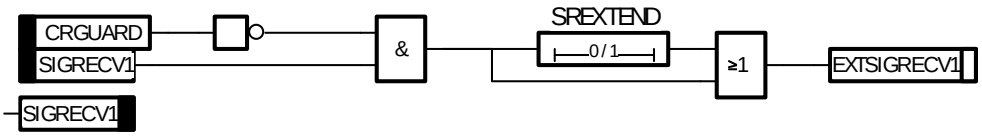
3.4.3 PUR

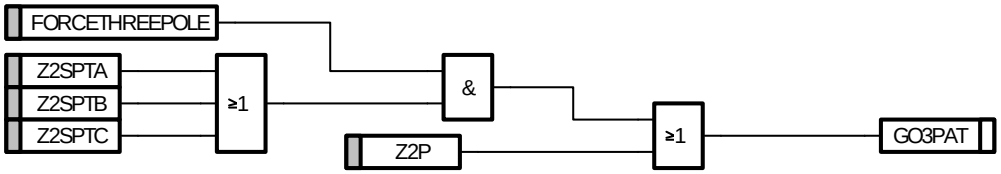
First, generate signal send from Zone 1 instantaneous, or the unstabilising input, which is either a manual operation, or comes from an external protection relay, giving us an intertrip

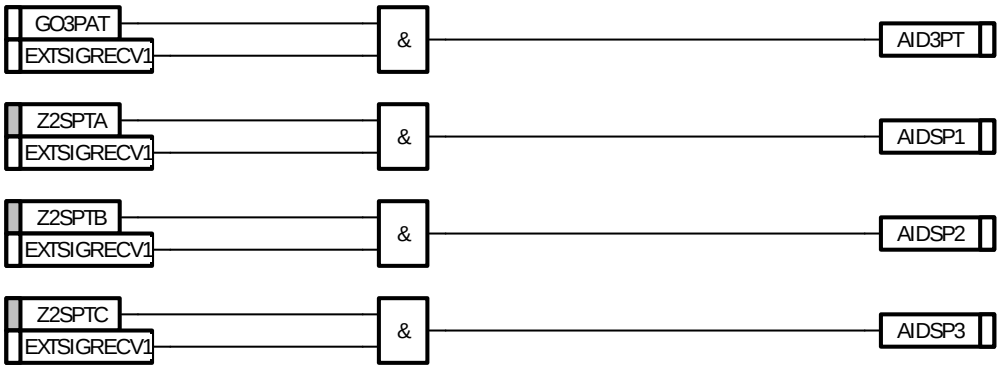


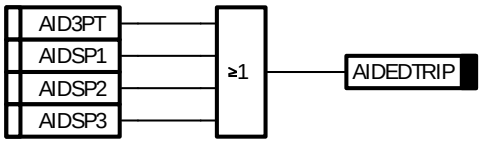
Next, we generate two forms of the aided trip signal; one from the zone 2 phase instantaneous output, and the other a phase segregated version for single pole tripping from the single pole trip logic.

We also generate an output tag for the signal received input.

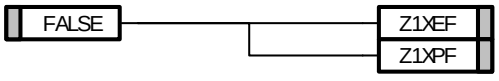






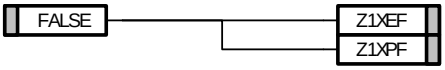


Clear the reach extension control flags - that scheme obviously not in use

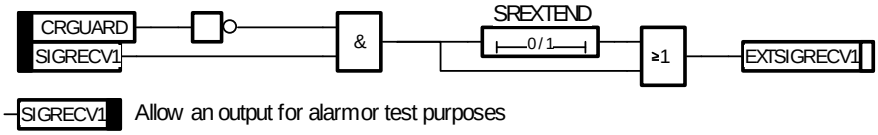


3.4.4 POR 1

Clear the reach extension control flags to ensure that the Zone 1 distance elements are using normal Zone 1 settings

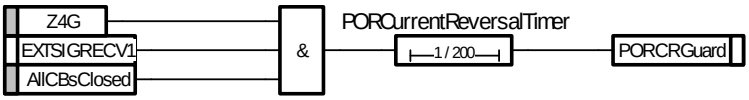


Process Signal Receive 1 first. Carrier receive guard signal from the comms equipment should be high when there is a problem with the carrier equipment. This would then block signal receive and prevent any nuisance operations due to communications channel or equipment failure.



Current Reversal Logic

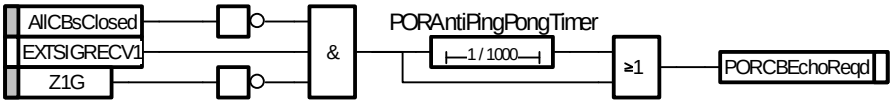
When the relay is applied to a feeder which has another in parallel, then if there is a fault on the adjacent feeder we may see it as a reverse fault. When the CB on the adjacent feeder at this end opens, then if the breaker at the other end operates more slowly, there is a chance that the fault current will reverse and we will see the fault as a forward operation for a time. If we are already receiving a signal from our partner relay at the other end of our feeder, then we are in danger of tripping due to current reversal. To overcome this we use current reversal guard. If we see a reverse fault and a signal, and all of our CBs are closed, then we block operation for a user defined period after the reverse fault has been removed or the signal has dropped off. Zone 4 does the reverse fault detection.



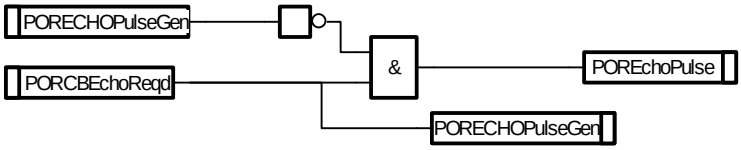
CB Echo

If any of the Circuit Breakers at this end are open, we see SigRx and there is no fault, then reflect the signal straight back to the sending end to allow it to trip.

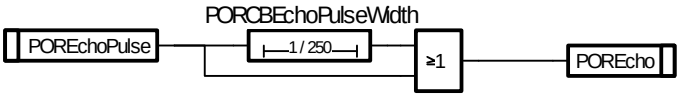
To avoid a lockup situation where the CB Echos at each end reinforce each other and prevent SigSend from dropping off we limit the duration of the CB Echo signal and keep the CB Echo Required signal asserted until the trigger condition has been absent for 1 second.



Generate a pulse for 1 reylogic execution period to start the echo pulse monostable

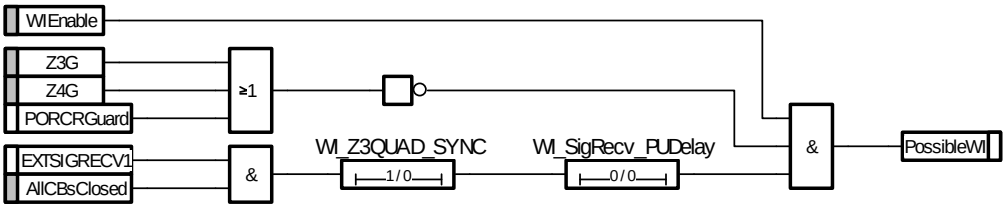


This is the echo pulse monostable. This stretches the single period pulse generated above into one of user specified width (default 250ms).

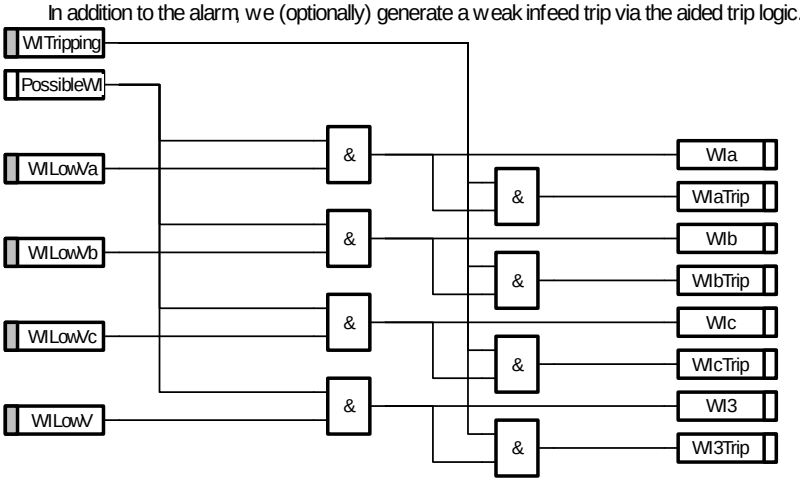


Weak Infeed Logic

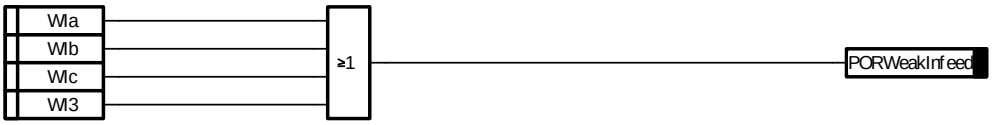
Under certain system conditions, such as on radial systems, or where the source capacity at one end of a line is reduced for some reason, then there may not be sufficient fault current flowing for the relay to determine the fault impedance. Under these circumstances we use weak infeed protection. This uses the fact that the relay at the remote (strong) end can see a fault and so sends us a signal, but we cannot see a fault. In addition, our CBs must be closed. We use these criteria to say that there may be a fault in front of us that we cannot see.



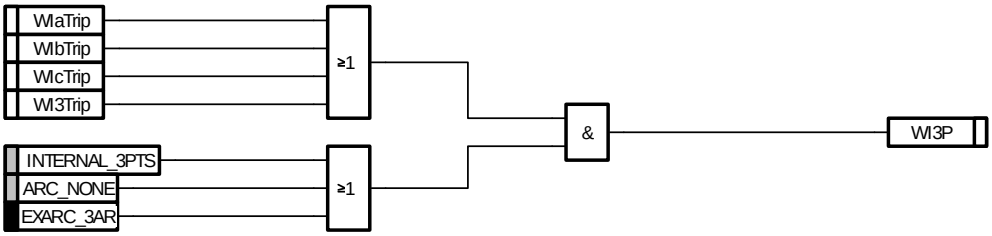
The possibility of a weak infeed condition is then confirmed by the use of phase undervoltage detectors. If there is a weak infeed condition, then we will see only the fault voltage (which will be very small), and so we can generate phase seqregated weak infeed booleans (Wix), and a general weak infeed alarm. For phase to phase conditions, there will be two voltages low, for which the UV detector gives us a general output to use for 3 pole operation. In addition to the alarm, we (optionally) generate a weak infeed trip via the aided trip logic.



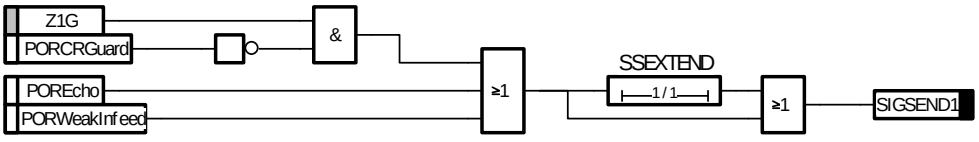
Combine the Wix booleans to give a general weak infeed alarm output.



Combine the WixTrip booleans to give a general weak infeed Trip output.

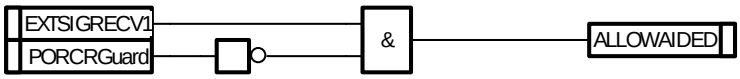


Now the signal send logic. POR1 uses Z1 for SigSend, qualified with no current reversal, and we also send a signal for CB echo and for weak infeed conditions.

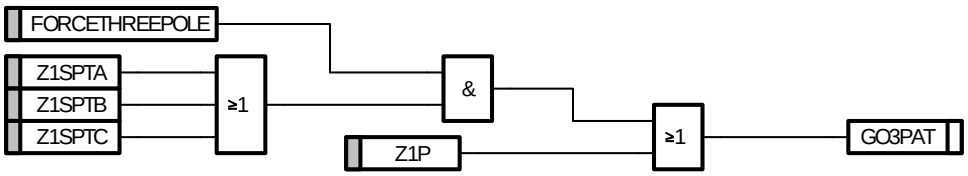


Aided Trip Logic

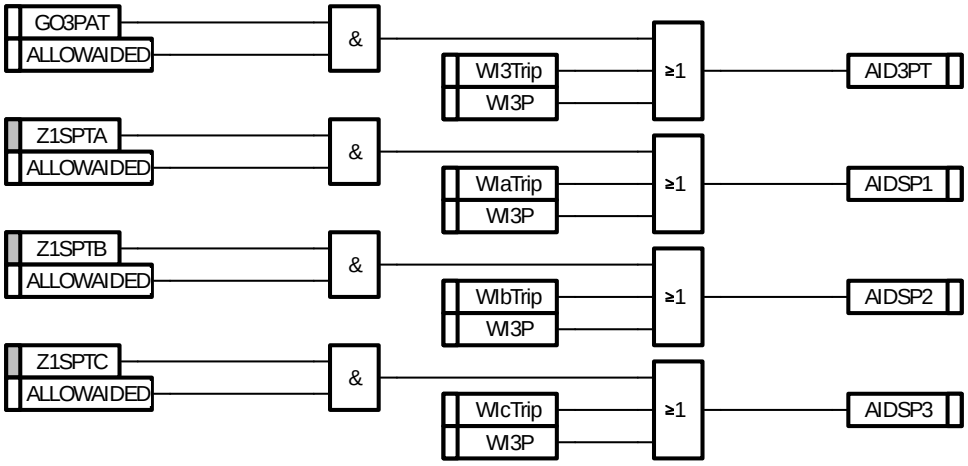
First we generate an enabling signal from SignalRx AND no Current Reversal Guard



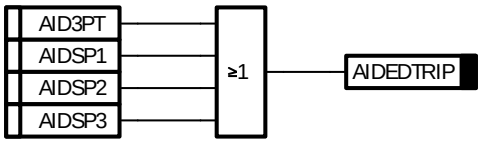
Three pole aided tripping is used for phase faults, or where 3P trips are forced.



Now we generate the aided trip signals. These may be three pole trip or single pole where allowed. These are used within the trip logic diagram

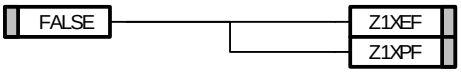


Combine the aided trip signals to give us a general aided trip for alarm and indication

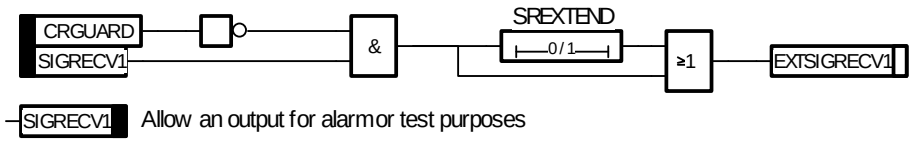


3.4.5 POR2

Clear the reach extension control flags to ensure that the Zone 1 distance elements are using normal Zone 1 settings

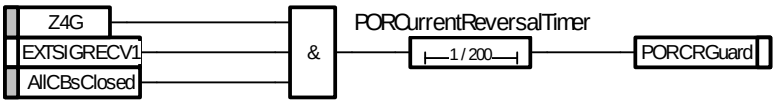


Process Signal Receive 1 first. Carrier receive guard signal from the comms equipment should be high when there is a problem with the carrier equipment. This would then block signal receive and prevent any nuisance operations due to communications channel or equipment failure.



Current Reversal Logic

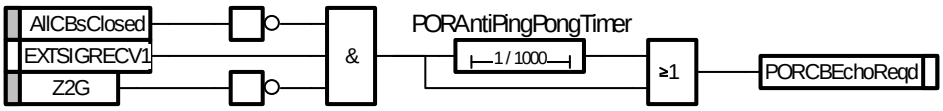
When the relay is applied to a feeder which has another in parallel, then if there is a fault on the adjacent feeder we may see it as a reverse fault. When the CB on the adjacent feeder at this end opens, then if the breaker at the other end operates more slowly, there is a chance that the fault current will reverse and we will see the fault as a forward operation for a time. If we are already receiving a signal from our partner relay at the other end of our feeder, then we are in danger of tripping due to current reversal. To overcome this we use current reversal guard. If we see a reverse fault and a signal, and all of our CBs are closed, then we block operation for a user defined period after the reverse fault has been removed or the signal has dropped off. Zone 4 does the reverse fault detection.



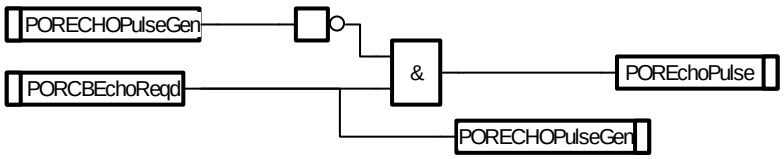
CB Echo

If any of the Circuit Breakers at this end are open, we see SigRx and there is no fault, then reflect the signal straight back to the sending end to allow it to trip.

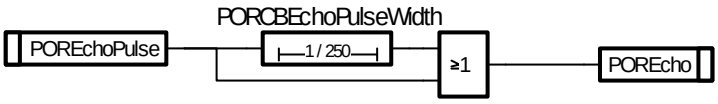
To avoid a lockup situation where the CB Echos at each end reinforce each other and prevent SigSend from dropping off we limit the duration of the CB Echo signal and keep the CB Echo Required signal asserted until the trigger condition has been absent for 1 second.



Generate a pulse for 1 reylogic execution period to start the echo pulse monostable

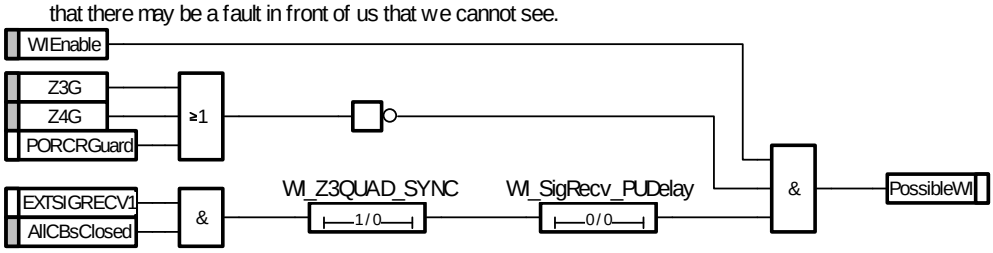


This is the echo pulse monostable. This stretches the single period pulse generated above into one of user specified width (default 250ms).

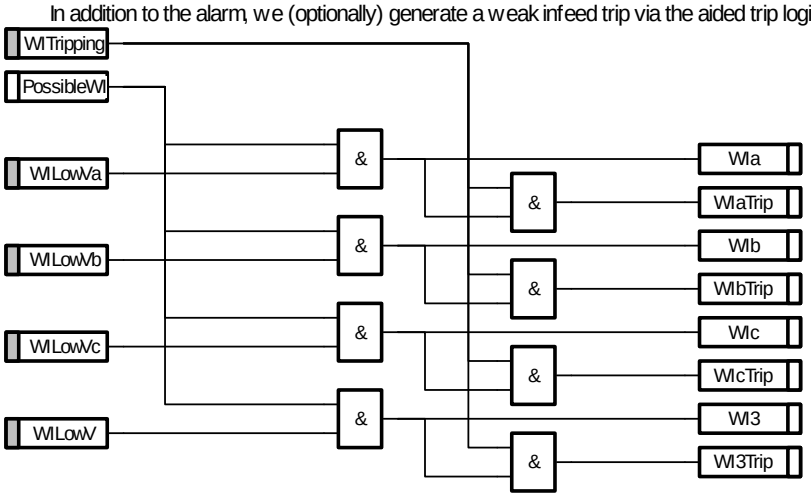


Weak Infeed Logic

Under certain system conditions, such as on radial systems, or where the source capacity at one end of a line is reduced for some reason, then there may not be sufficient fault current flowing for the relay to determine the fault impedance. Under these circumstances we use weak infeed protection. This uses the fact that the relay at the remote (strong) end can see a fault and so sends us a signal, but we cannot see a fault. In addition, our CBs must be closed. We use these criteria to say that there may be a fault in front of us that we cannot see.

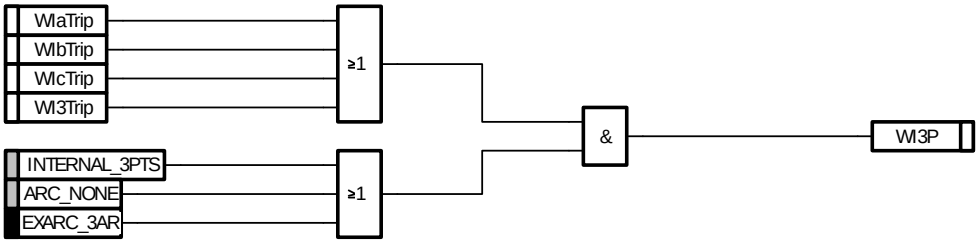


The possibility of a weak infeed condition is then confirmed by the use of phase undervoltage detectors. If there is a weak infeed condition, then we will see only the fault voltage (which will be very small), and so we can generate phase seqregated weak infeed booleans (Wix), and a general weak infeed alarm. For phase to phase conditions, there will be two voltages low, for which the UV detector gives us a general output to use for 3 pole operation. In addition to the alarm, we (optionally) generate a weak infeed trip via the aided trip logic.

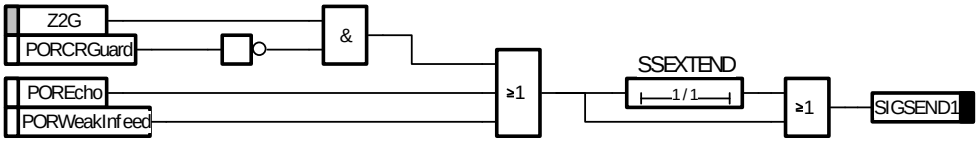


Combine the Wix booleans to give a general weak infeed alarm output.

Combine the WixTrip booleans to give a general weak infeed Trip output.

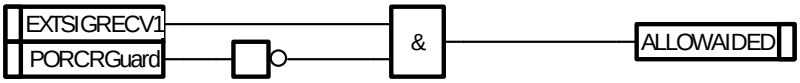


Now the signal send logic. POR2 uses Z2 for SigSend, qualified with no current reversal, and we also send a signal for CB echo and for weak infeed conditions.

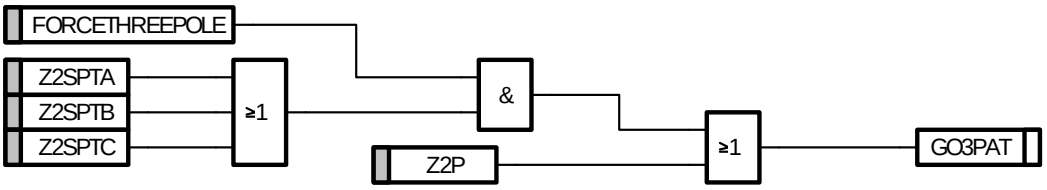


Aided Trip Logic

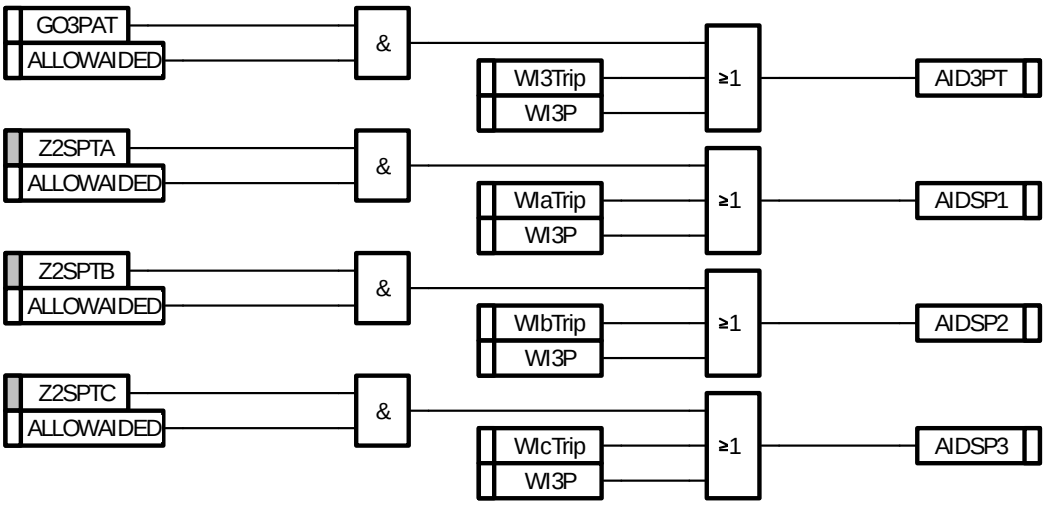
First we generate an enabling signal from SignalRx AND no Current Reversal Guard



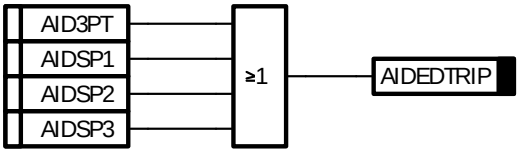
Three pole aided tripping is used for phase faults, or where 3P trips are forced.



Now we generate the aided trip signals. These may be three pole trip or single pole where allowed. These are used within the trip logic diagram.



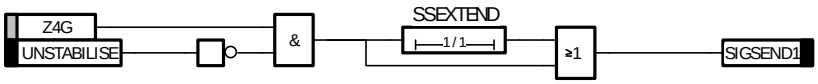
Combine the aided trip signals to give us a general aided trip for alarm and indication



3.4.6 BOR

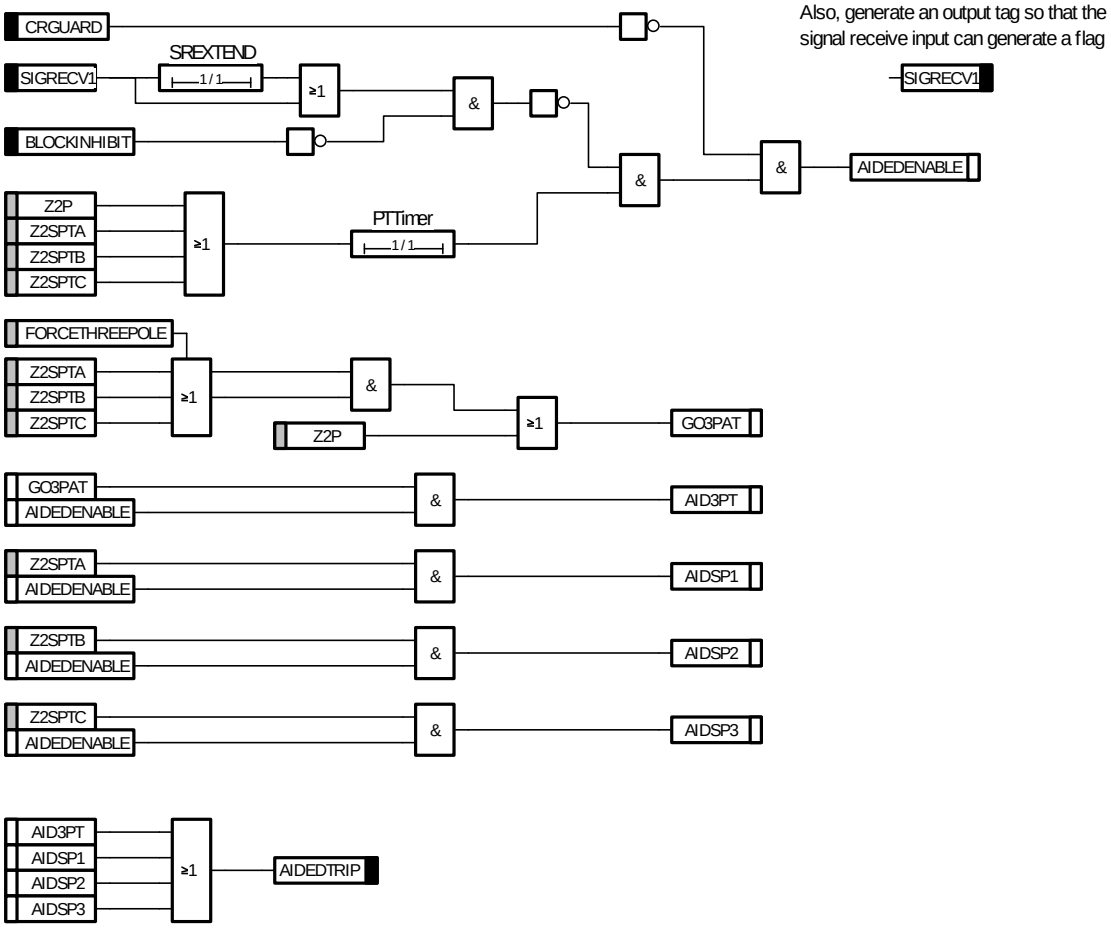
Blocking scheme using zone 4, intended for Ohmega 400 models with single pole tripping.

We generate a blocking signal if Zone 4 operates. Zone 4 is reverse looking, so blocks out-of-zone (reverse) faults
Also, we add the external unstabilise control (Manual/external trip) into the equation to allow it to work with the scheme.



Now we generate the aided trip signal, which is delayed to allow time for blocking, and is blocked if signal receive is active.
Also, we need an inhibit signal (re NGC) to prevent blocking under certain circumstances. And the inclusion of the Carrier Receive Guard means that if the carrier fails we can prevent inadvertant accelerated tripping due to loss fo the blocking signal

Also, generate an output tag so that the signal receive input can generate a flag



Clear the reach extension control flags - that scheme obviously not in use