Testing directional-earth-fault

There are two main types of directional earth fault detection:

- Type 1 – cos phi measuring
  Used in an impedant or compensated neutral system.
- Type 2 – angle measuring
  Used in impedant or solidly earthed system.

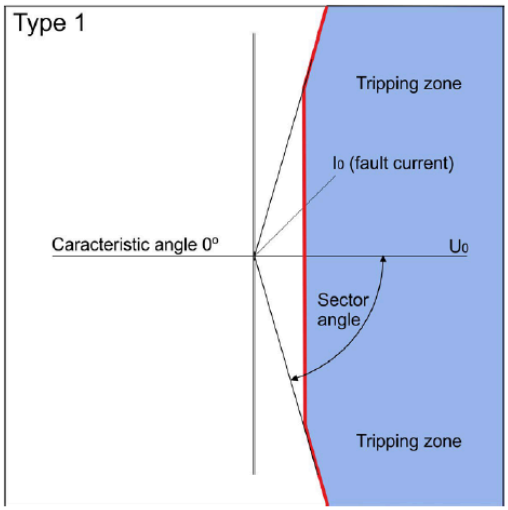
A tripping zone is limited by characteristic angle, sector angle and setting level. Protection relays has different setting possibilities for the characteristic angle and sector angle, see manual for specific relay tested.

For Type 1 the trip level is measured from the resistive value and for Type 2 it is measured from the impedance value. This means that if both types has setting 1 A and fault angle is 45°.

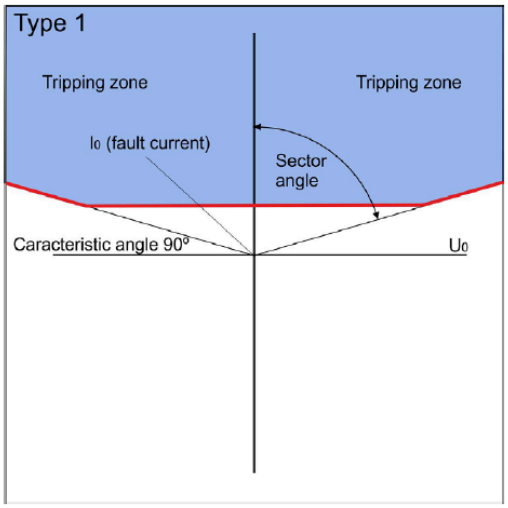
- Type 1 will trip at 1 A
- Type 2 will trip at cos45x1=0,71 A.

For selectivity reason it is not recommended to mix the two types in the same station and voltage level.

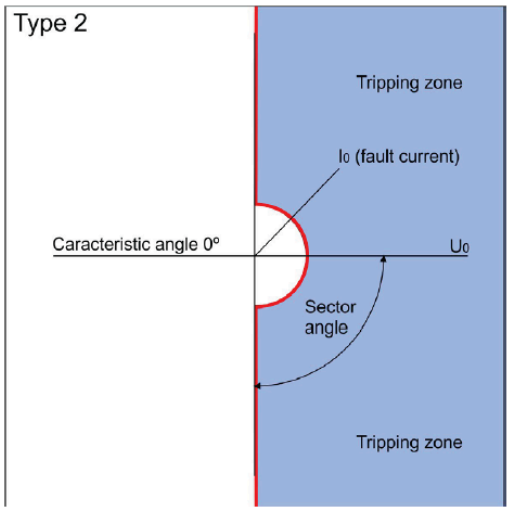
It can be different direction reference depending of protection, always check what is the correct direction for trip (see pictures with explanation on next pages)



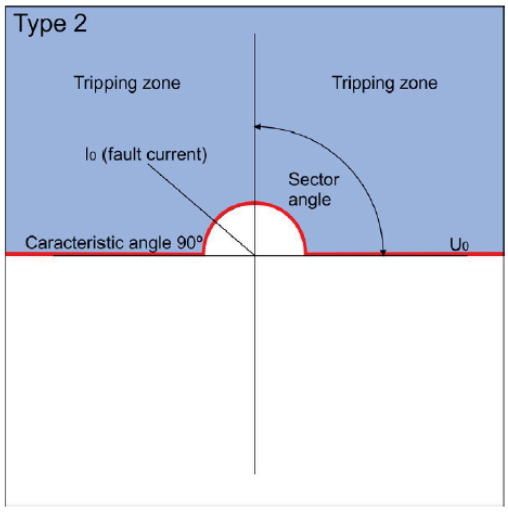
Type 1 – cos phi measuring, 0°



Type 1 – cos phi measuring, 90°



Type 1 – angle measuring, 0°

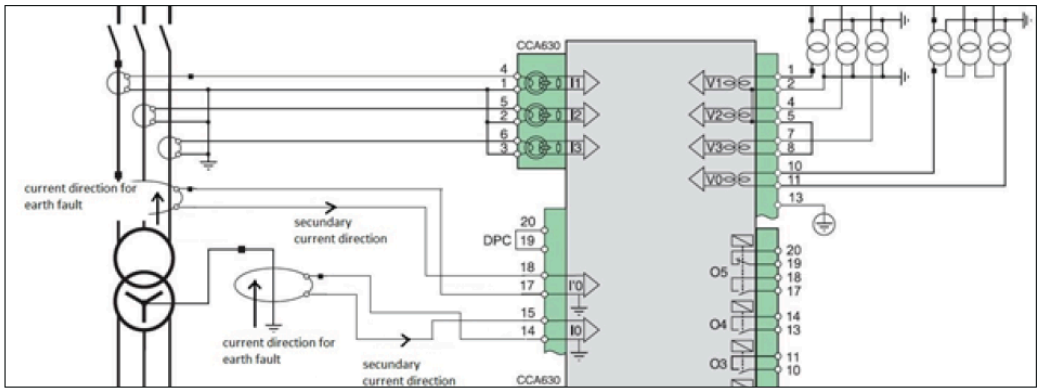


Type 1 – angle measuring, 90°

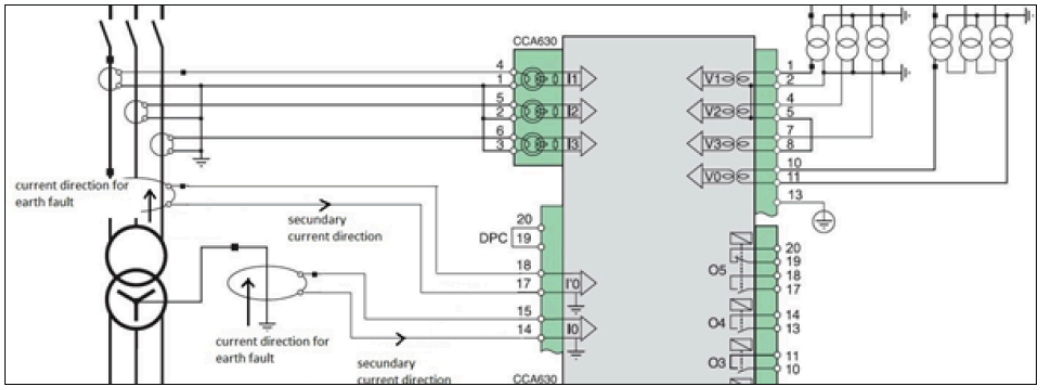
Testing directional-earth-fault

Connecting

Example of connection drawings for CT and VT to protection



Connection 1: The normal load reference are marked with a square, but the connection are made according to earth fault current flooting at fault. This makes 0 angle between current and voltage.



Connection 2: The normal load reference are marked with a square, but the connection are not changed according to earth fault current flooting at fault. This makes 180° angle between current and voltage.

Testing directional-earth-fault

Testing

Important
Read and comply with the safety instructions in the User's manual.

In this example the directional earth fault protection for outgoing feeders (Sepam S84) is used.

1] Connect according to picture below.

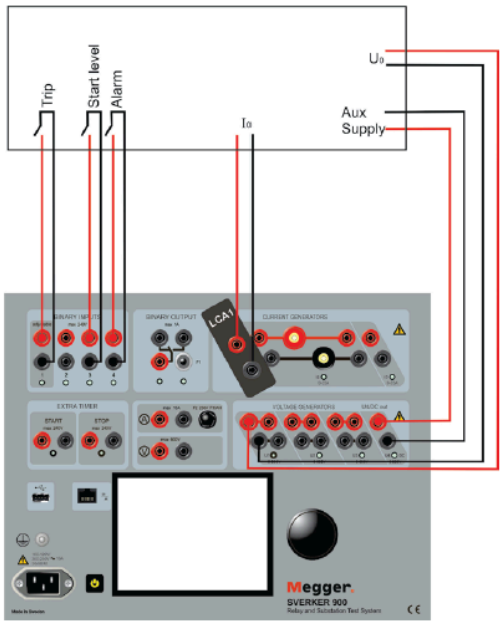


Bild på koppling till Sverker samt en bild på LCA med omsättning och max ström .

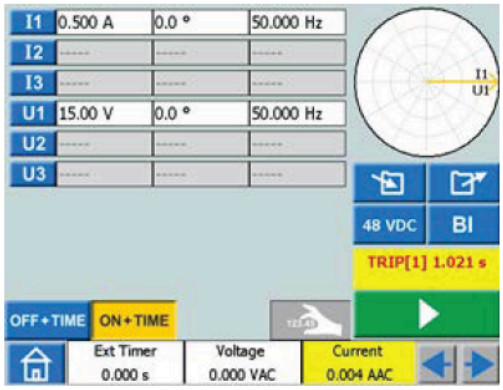
Settings

Settings for connection 1 and 2 (see above).

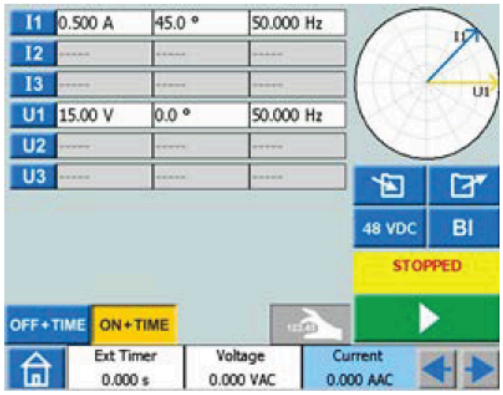
- Protection primary values:
  I = 1.5 A
  Uo = 10% Unp
  Time = 1 s
- Characteristic angle = 0°
  Sector degree for type 1 = 86
  Sector degree for type 2 = 90°
- Ratio for zero current input = 470/1
  Set SVERKER 900 to 0.5 A. Out from LCA 1 will be 4 mA.
  Protection calculates it to primary current
  470 x 0.004 = 1.88 A

Tripping behavior for Type 1 with connection 1 between protection and sensors

Tripping zone is in quadrant 1 and 2.

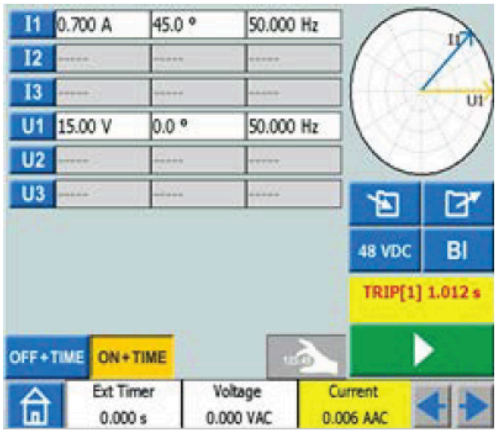


Protection trips for 0.5A and 0°.



Protection does not trip for 0.5A and 45°.

Testing directional-earth-fault



Protection trips for 0.7A and 45°.

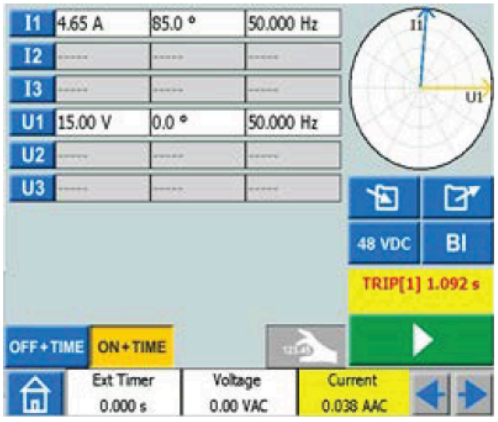
Example for testing with connection 1

For Type 1 the protection needs more apparent current to reach the setting level of active current.

To test the sector ±86° a much higher current then setting level is needed, in this case 4.65A.

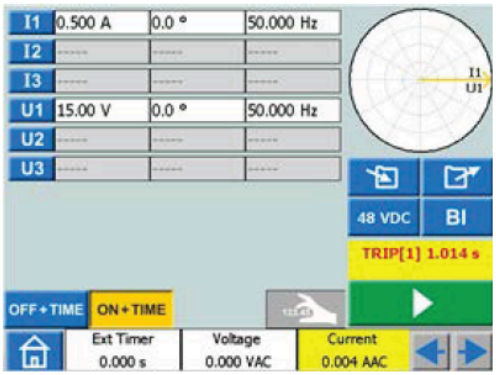
1] Following calculation gives us what the protection receives 470 x 0.038 = 17.86A. This is how much bigger the setting of the current has to be to make the protection trip at 86°.

2] The zone can be checked by marking the angle and turn the knob 360°°.

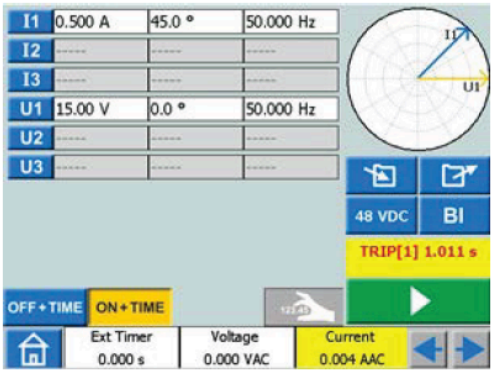


Tripping behavior for Type 2 with connection 1 between protection and sensors

Tripping zone is in quadrant 1and 2.

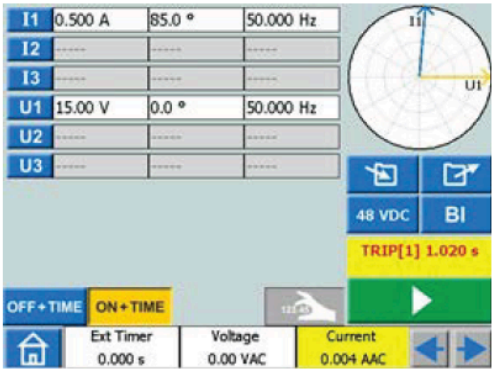


Protection trips for 0.5 A and 0°.



Protection trips for 0.5A and 45°.

For Type 2 the protection trips for the same value of apparent current between ±90°.



For the angle 85° the value of current is the same for trip, check the zone as above.

Example for testing with connection 2

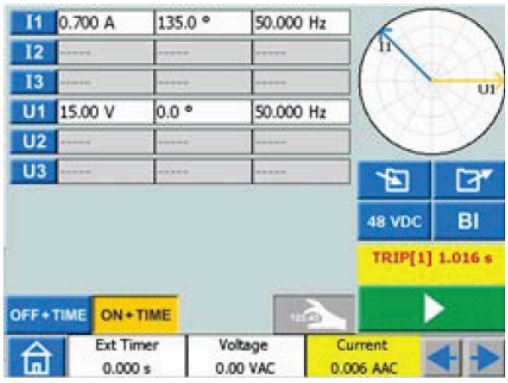
The different in Type 1 and Type 2 is the same but with 180° phase shift between current and voltage, see below.

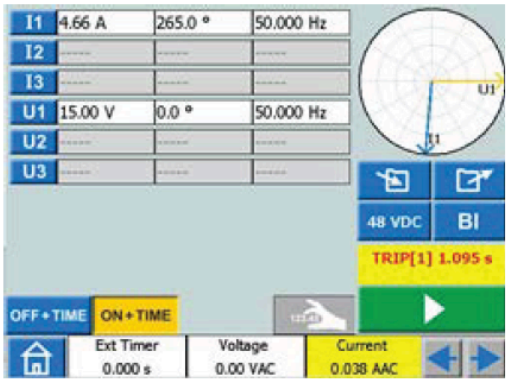
The angle 135° corresponds to 45° above and 265° to 85°.

Tripping zone is in quadrant 3 and 4.

Testing directional-earth-fault

Type 1





Type 2