



VEBKO ONLINE HELP

Directional Overcurrent

Category	tester
Section	AMT Overcurrent Module
Language	English
Generated	2026-10-18

In DOC protection, the fault direction is detected using the angle between current and voltage. For example, if a fault occurs in phase A, the voltage level might drop so low that the voltage and its angle are no longer reliable for the relay. In such cases, the voltage from the healthy phases is used to determine the fault direction. So, if there is a fault in phase A, the voltage from phase BC is used to determine the fault angle (assuming that the voltage angle in the non-fault phases remains constant).

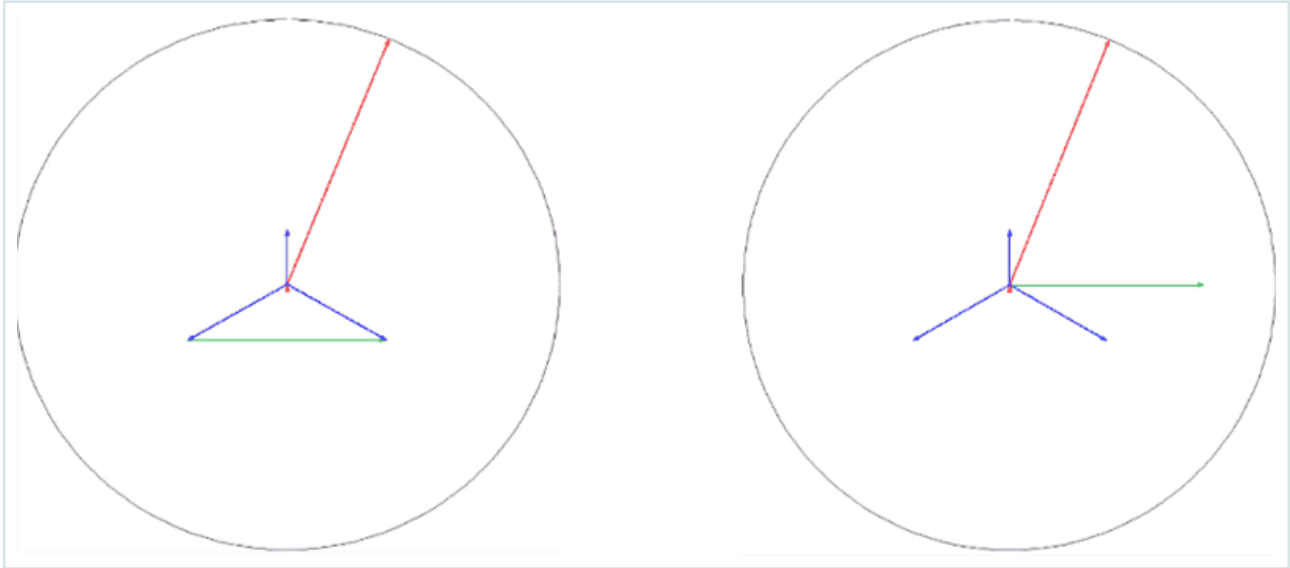


Figure 1

Since a reference angle is needed to detect the fault direction, $V_{BC}(\text{ref})$ must be rotated by an angle ϕ to match the current angle. This ϕ is typically chosen from three values: 30° , 45° , or 60° . At this angle, it can be said that the fault has occurred directly in front of the relay. This angle is referred to as the MTA (Maximum Torque Angle).

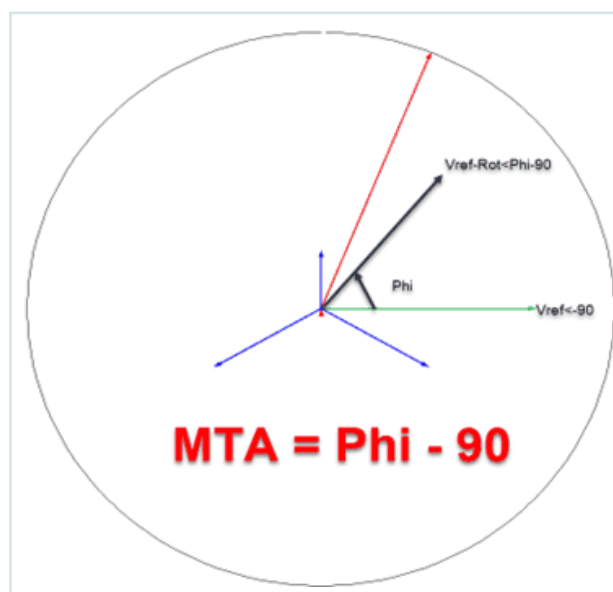


Figure 2

The range from $MTA + 90^\circ$ to $MTA - 90^\circ$ is considered the forward direction. However, due to a measurement error of 4 degrees on both sides, a margin is considered. Therefore, the 'sector opening' for this condition is set from $MTA + 86^\circ$ to $MTA - 86^\circ$, which equals 172° .

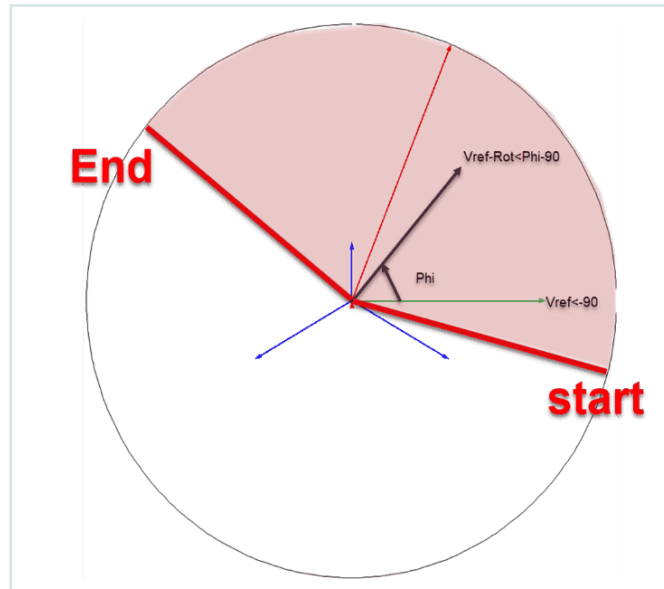


Figure 3

Note on Two-Phase Fault Testing

In two-phase fault testing, to prevent the generation of residual voltage, the angle of the voltages in each phase must be adjusted so that the residual voltage equals zero. Therefore, if the user inputs the phase-to-phase fault voltage (for a BC fault), the relationships shown will apply:

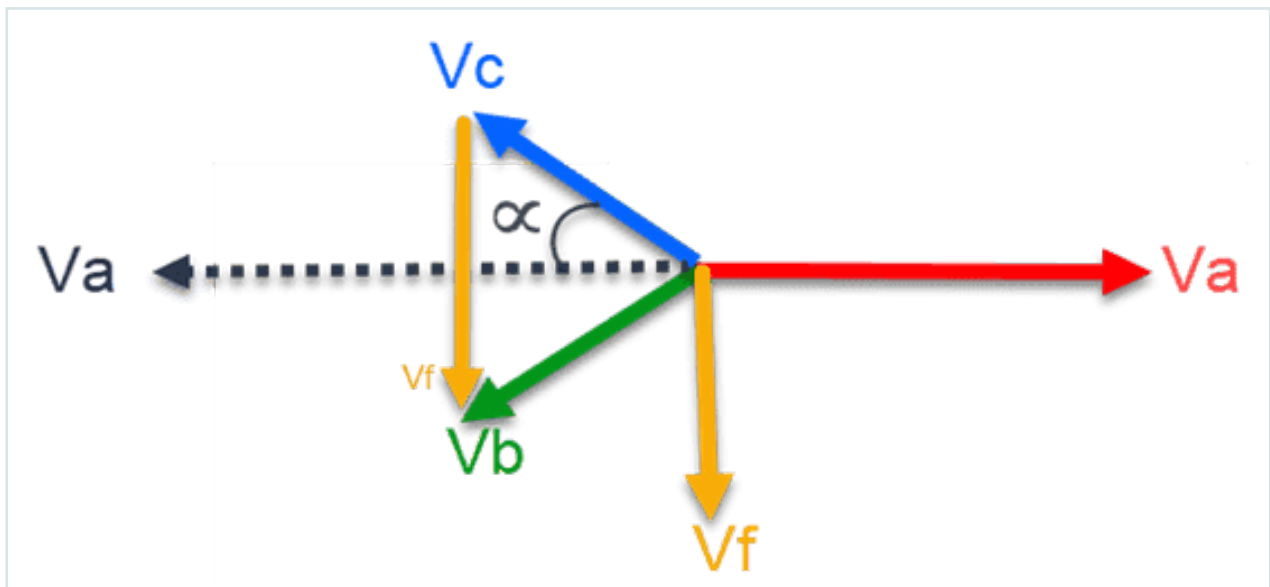


Figure 4

$$V_B - V_C = V_f$$

$$V_B + V_C = V_a$$

$$\tan \alpha = \frac{V_f / 2}{V_a / 2} \Rightarrow \alpha = \tan^{-1} \left(\frac{V_f}{V_a} \right)$$

Figure 5

f the phase-to-phase fault voltage is set to 55V and the nominal voltage is 63.51V, α will be 40.9°

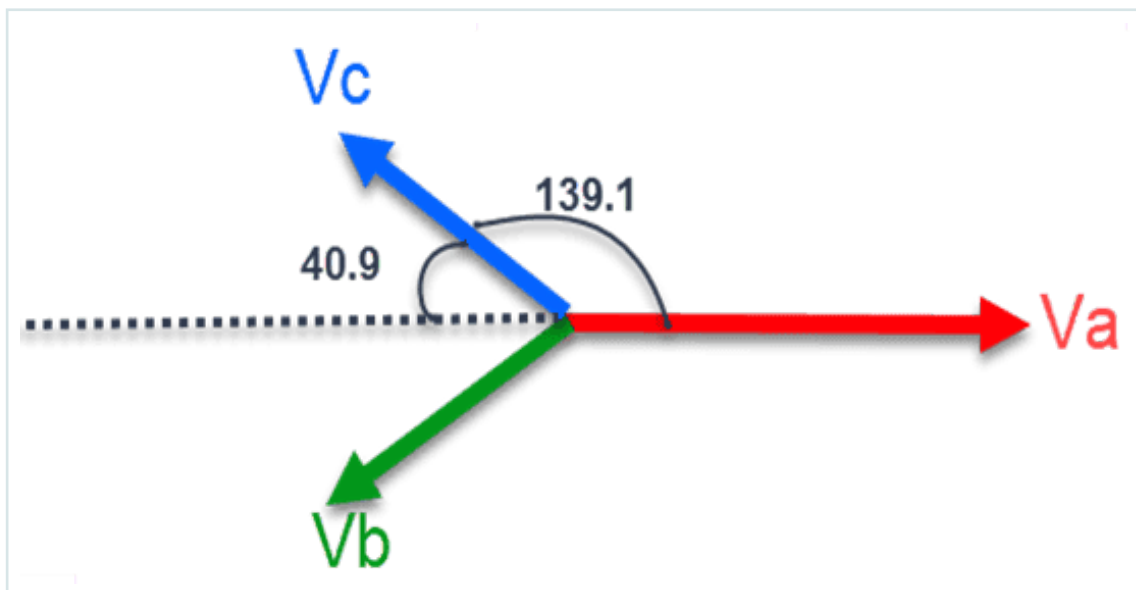


Figure 6

$$V_a \square 0$$

$$V_b \square -139.1$$

$$V_c \square 139.1$$

Figure 7

In this phase-to-phase fault, to detect the fault, we use an OR condition for faults in phases B and C, where MTA and sector opening need to be calculated separately for each phase, and the union of the two should be considered.

For Phase B:

$$\begin{aligned} (I_B, V_{CA}) &\Rightarrow V_C - V_A \Rightarrow 42.01 \angle 139.1 - 63.51 \angle 0 = 99.15 \angle 163.9 \\ &\rightarrow \text{MTA} = 163.9 + \varphi_{\text{rot}} \\ \text{if: } \varphi_{\text{rot}} &= 90 \rightarrow \text{MTA} = 163.9 + 90 = 253.9 \Rightarrow 253.9 - 360 = -106.1 \\ \text{Sector_Opening: } &\begin{cases} \text{Start_Angle: } -16.1 \\ \text{End_Angle: } -196.1 \end{cases} \end{aligned}$$

Figure 8

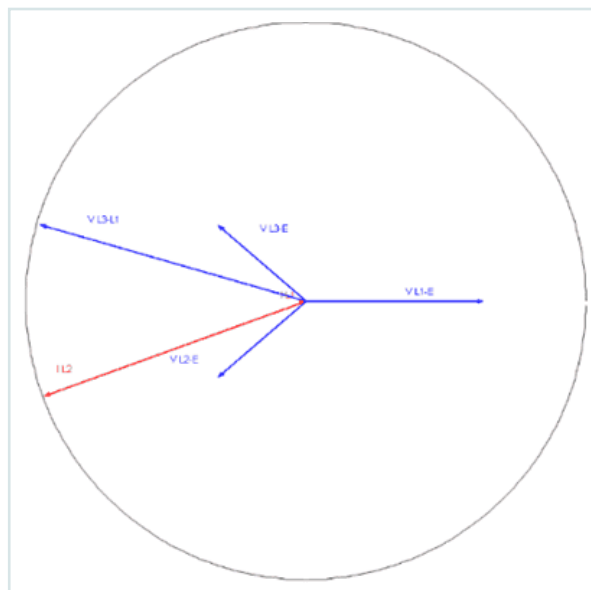


Figure 9

For Phase C:

$$\begin{aligned} (I_B, V_{AB}) &\Rightarrow V_A - V_B \Rightarrow 63.51 \angle 0 - 42.01 \angle -139.1 = 99.15 \angle 16.1 \\ &\rightarrow \text{MTA} = 16.1 + \varphi_{\text{rot}} \\ \text{if: } \varphi_{\text{rot}} &= 90 \rightarrow \text{MTA} = 16.1 + 90 = 106.1 \\ \text{Sector_Opening: } &\begin{cases} \text{Start_Angle: } 16.1 \\ \text{End_Angle: } 196.1 \end{cases} \end{aligned}$$

Figure 10

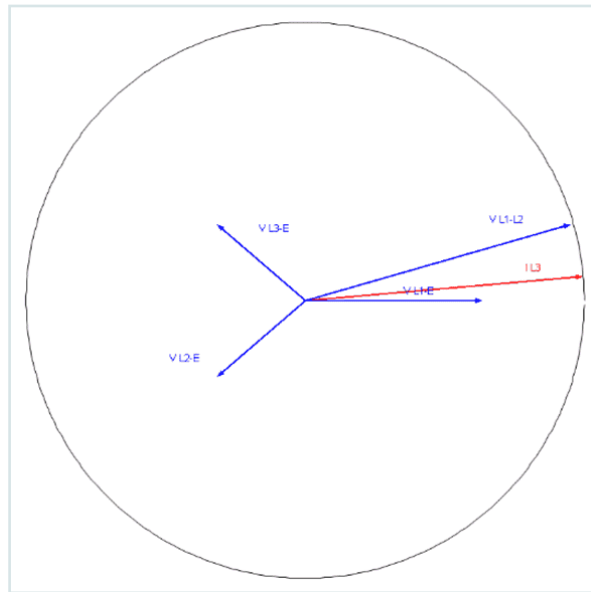


Figure 11

As shown in the diagram, the sector opening exceeds 180° by half of the overlap area, unlike the single-phase fault where the sector opening was 180° or less. In general, if the fault voltage is equal to the nominal value, the sector opening increases by 30° on both sides, and this value decreases linearly with the voltage drop

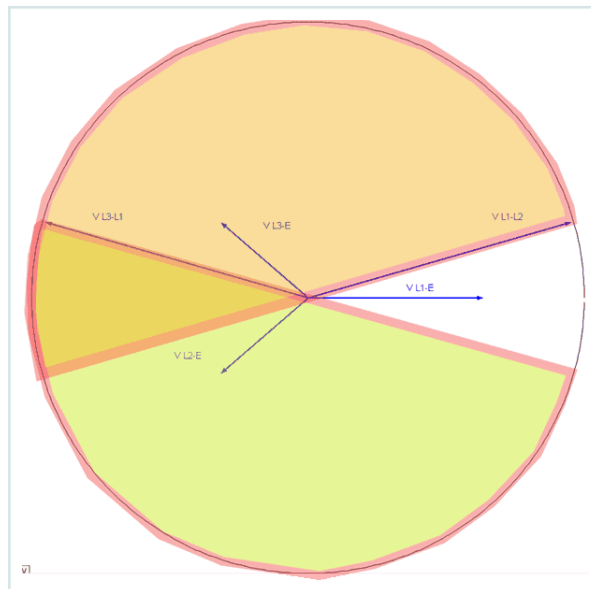


Figure 12

[jg1]Directional_Over_Current