



# T60 Restricted Ground Fault Protection on Autotransformers

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The Restricted Ground Fault (RGF) element on the T60 Transformer Management relay can provide protection for autotransformers. Consider the following setup:

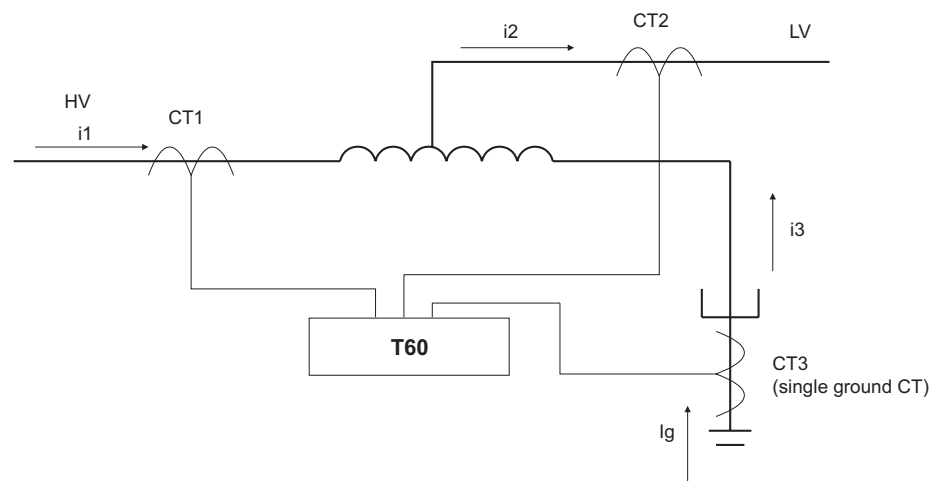


FIGURE 1. Autotransformer Restricted Ground Fault Protection

For the primary currents as shown, the following apply:

$$i_2 = i_1 + i_3 \quad \text{or} \quad i_2 - i_1 = i_3 \quad (\text{EQ 1})$$

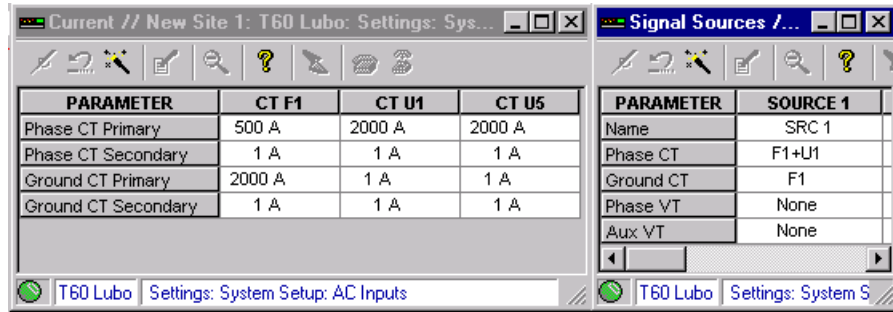
The RGF element adds the residual current  $3I_0$  and the ground current  $I_g$ . An internal fault results in a sum greater than zero since the measured current entering and leaving the transformer is not the same

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During normal load conditions the total residual current ( $3I_0$ ), the ground CT current ( $I_g$ ) and therefore the ground differential current ( $I_{gd}$ ), is zero. Therefore, the RGF element does not operate.

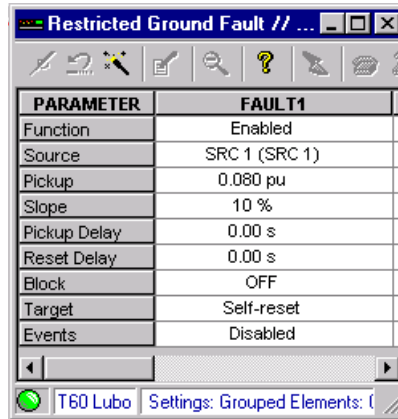
During an external fault, assuming no CT saturation, the  $3I_0$  and  $I_g$  currents are not zero but the sum  $I_{gd}$  current is zero, and therefore the RGF element still does not operate. The  $3I_0$  quantity is calculated from the configured relay source (SRC). In this case, it is the sum of  $i_1$  and  $i_2$ .

The T60 currents summation settings (in URPC) for this case are:



CT 1 and CT 2 from the diagram are the CT F1 and CT U1 Phase CTs, respectively. CT3 from the diagram is the CT F1 Ground CT.

The configured SRC 1 can now be used for RGF element setting:



The per unit (pu) value required in the RGF settings is calculated based on the maximum phase CT primary current as one unit.

An internal fault is detected by the RGF element when the sum of the  $3I_0$  quantity from SRC 1 (F1+U1) and  $I_g$  quantity is not zero.

The sensitivity is controlled by the slope setting which is the ratio of ground differential current to maximum phase current. The time delay setting delays the RGF element operation. This time delay is useful for external faults with CT saturation to allow adjacent protection to operate or for the saturation to subside.