



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:

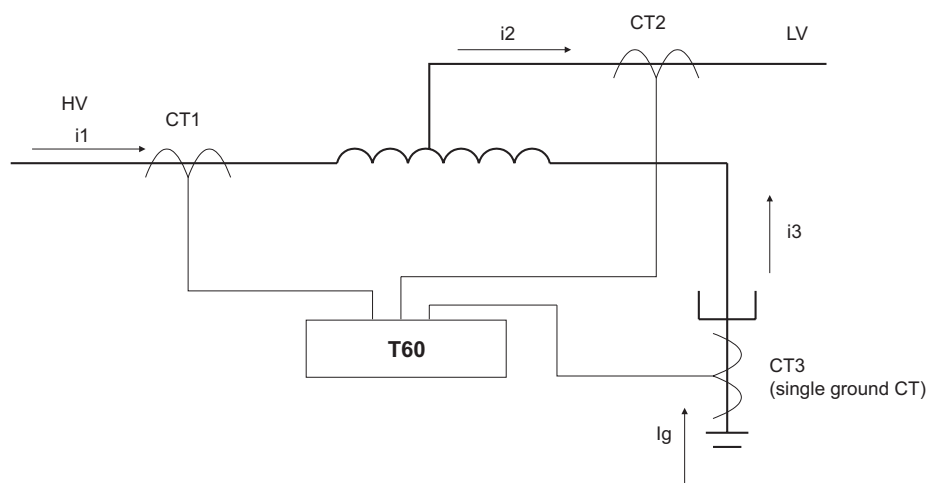


FIGURE 1. Autotransformer Restricted Ground Fault Protection

For the primary currents as shown, the following apply:

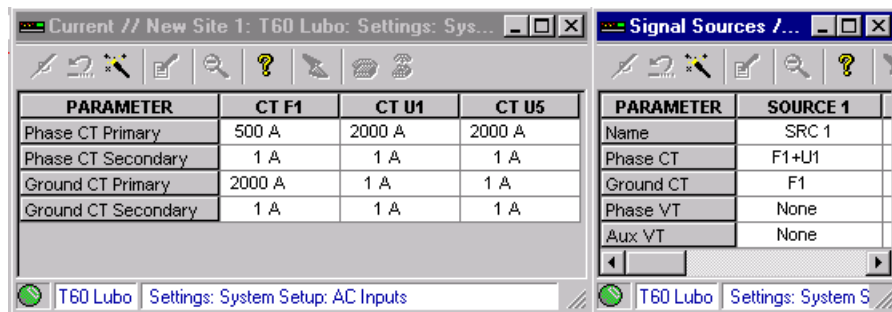
$$i_2 = i_1 + i_3 \quad \text{or} \quad i_2 - i_1 = i_3 \quad (\text{EQ 1})$$

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

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:

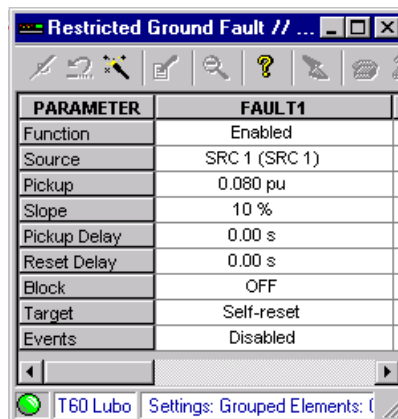


PARAMETER	CT F1	CT U1	CT U5
Phase CT Primary	500 A	2000 A	2000 A
Phase CT Secondary	1 A	1 A	1 A
Ground CT Primary	2000 A	1 A	1 A
Ground CT Secondary	1 A	1 A	1 A

PARAMETER	SOURCE 1
Name	SRC 1
Phase CT	F1+U1
Ground CT	F1
Phase VT	None
Aux VT	None

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:



PARAMETER	FAULT1
Function	Enabled
Source	SRC 1 (SRC 1)
Pickup	0.080 pu
Slope	10 %
Pickup Delay	0.00 s
Reset Delay	0.00 s
Block	OFF
Target	Self-reset
Events	Disabled

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.



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