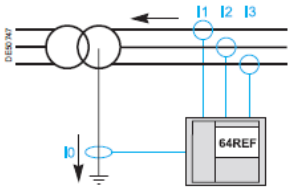
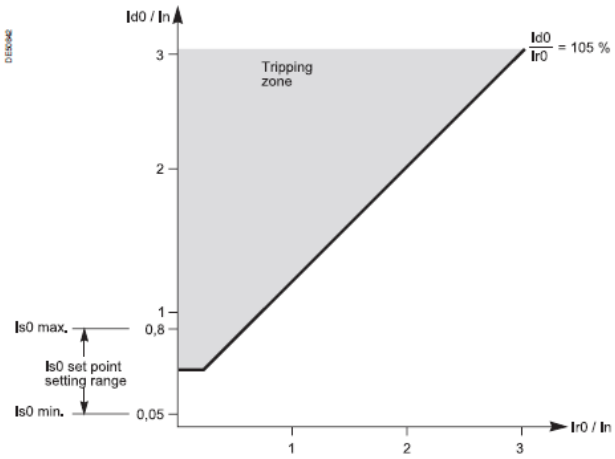
Restricted earth fault differential
ANSI code 64REF

Protection of three-phase windings against phase-to-earth faults.

Description

The restricted earth fault protection function detects phase-to-earth faults on three-phase windings with earthed neutral. This function protects generators and transformers.
The protected zone, depending on the measurement origin and the set parameters, is between:
- the I1, I2, I3 CTs and the neutral point current measurement I0
- the I'1, I'2, I'3 CTs and the neutral point current measurement I'0.





The function is based on the comparison of the residual current calculated using the sum of the three phase currents and the neutral point current. These two currents define the differential residual current and the restrained current:

- differential residual current: $Id0 = |\vec{I0}\Sigma - \vec{I0}|$
- restrained current or through residual current: the value of the restrained current depends on detection of a fault outside the protected zone:
  - without detection of an external fault

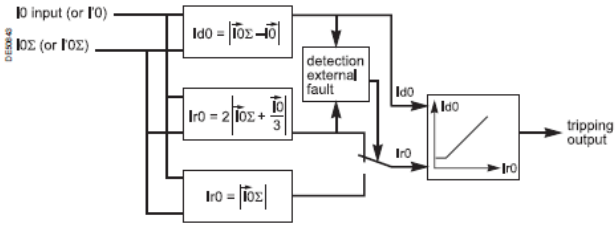
$$Ir0 = |\vec{I0}\Sigma|$$

  - with detection of an external fault: the protection function is insensitive to saturation of the CTs, but its operation is not inhibited.

$$Ir0 = 2 \times \left|\vec{I0}\Sigma + \frac{\vec{I0}}{3}\right|$$

The function picks up if the differential residual current is greater than the operating set point. The set point is defined by:
- the minimum set point Is0
- a tripping characteristic with a slope of 1.05 (differential residual current vs. restrained current).

Block diagram



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Dimensioning current sensors

The primary currents of the current transformers used must comply with the following rule:

0.1 In ⩽ In0 ⩽ 2 In

with In = primary current of phase CTs
and In0 = primary current of the neutral point CT.

Current transformers must be either:

- type 5P, with an accuracy-limit factor ⩾ $\max.\left(20;1.6\frac{I_{3P}}{In};2.4\frac{I_{1P}}{In}\right)$ and an accuracy burden $VA_{CT} \geqslant Rw.in^2$
- or defined by a knee-point voltage $Vk \geqslant (R_{CT} + Rw).\max.\left(20;1.6\frac{I_{3P}}{In};2.4\frac{I_{1P}}{In}\right).in.$

The equation apply to the phase current transformers and the neutral-point current transformer.
in is the CT rated secondary current.
R_{CT} is the CT internal resistance.
Rw is the resistance of the CT load and wiring.
I_{3P} is the maximum current value for a three-phase short-circuit.
I_{1P} is the maximum current value for a phase-to-earth short-circuit.

Characteristics

Settings				
Measurement origin				
Setting range	Main channels (I, I0) Additional channels (I', I'0)			
Is0				
Setting range	0.05 In to 0.8 In for In ⩾ 20 A 0.1 In to 0.8 In for In < 20 A			
Accuracy (1)	5 %			
Resolution	1 A or 1 digit			
Drop out/pick up ratio	93 % ±2 %			
Characteristic times				
Operation time	< 55 ms at Id0 = 2.1 Ir0			
Overshoot time	< 35 ms at Id0 = 2.1 Ir0			
Reset time	< 45 ms at Id0 = 2.1 Ir0			
Inputs				
Designation	**Syntax**	**Equations**	**Logipam**	
Protection reset	P64REF_x_101	■	■	
Protection inhibition	P64REF_x_113	■	■	
Outputs				
Designation	**Syntax**	**Equations**	**Logipam**	**Matrix**
Protection output	P64REF_x_3	■	■	■
Protection inhibited	P64REF_x_16	■	■	

x: unit number.
***(1)** Under reference conditions (IEC 60255-6).*