

8 Series

889 Advanced Generator Protection Technical Note

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Overview

The Multilin 889 is part of the 8 Series platform that provides comprehensive, high performance protection and control for critical assets in Industrial and utility environments. Utilizing decades of experience in generator protection, GE has implemented ease-of-use features, such as single screen setup and condition-based health monitoring and diagnostics partnered with advanced protection functions providing a comprehensive solution for Industrial generators.

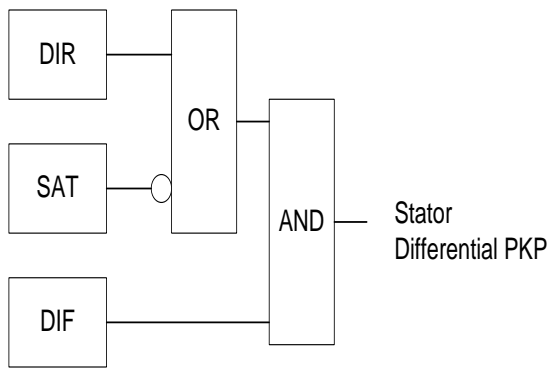
This paper presents the advanced functionality of several innovative 889 protection elements including stator differential, 100% stator ground protection, neutral directional protection, and out-of-step protection.

Stator differential (87S) with direction and saturation detection

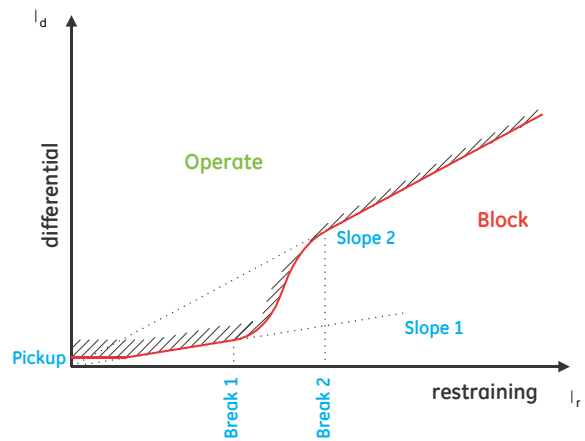
Differential protection can be considered as the first line of protection for internal stator phase-to-phase or phase-to-ground faults in induction and synchronous motors.

The 889 stator differential element offers the following distinct features:

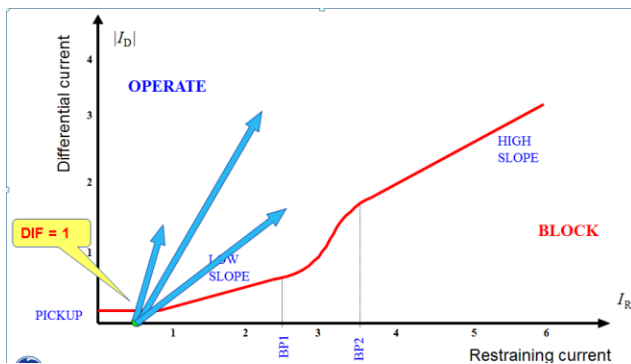
- Sensitivity to phase-to-phase and phase-to-ground faults
- High speed fault detection
- Biased differential, allowing different ratios of terminals and neutral CT nominal.
- Dual slope characteristic to prevent misoperation caused by spurious differential current during external faults with a possible CT saturation.



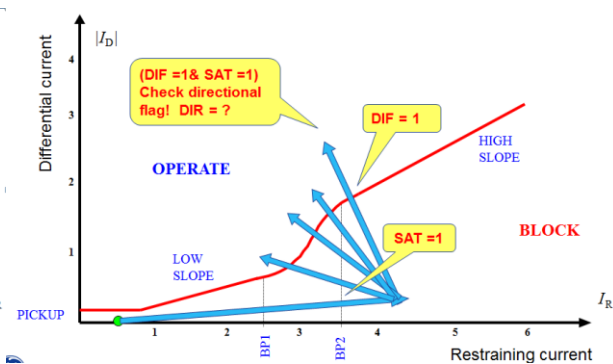
Stator differential logic



Stator differential characteristic



Internal phase fault in stator winding scenario

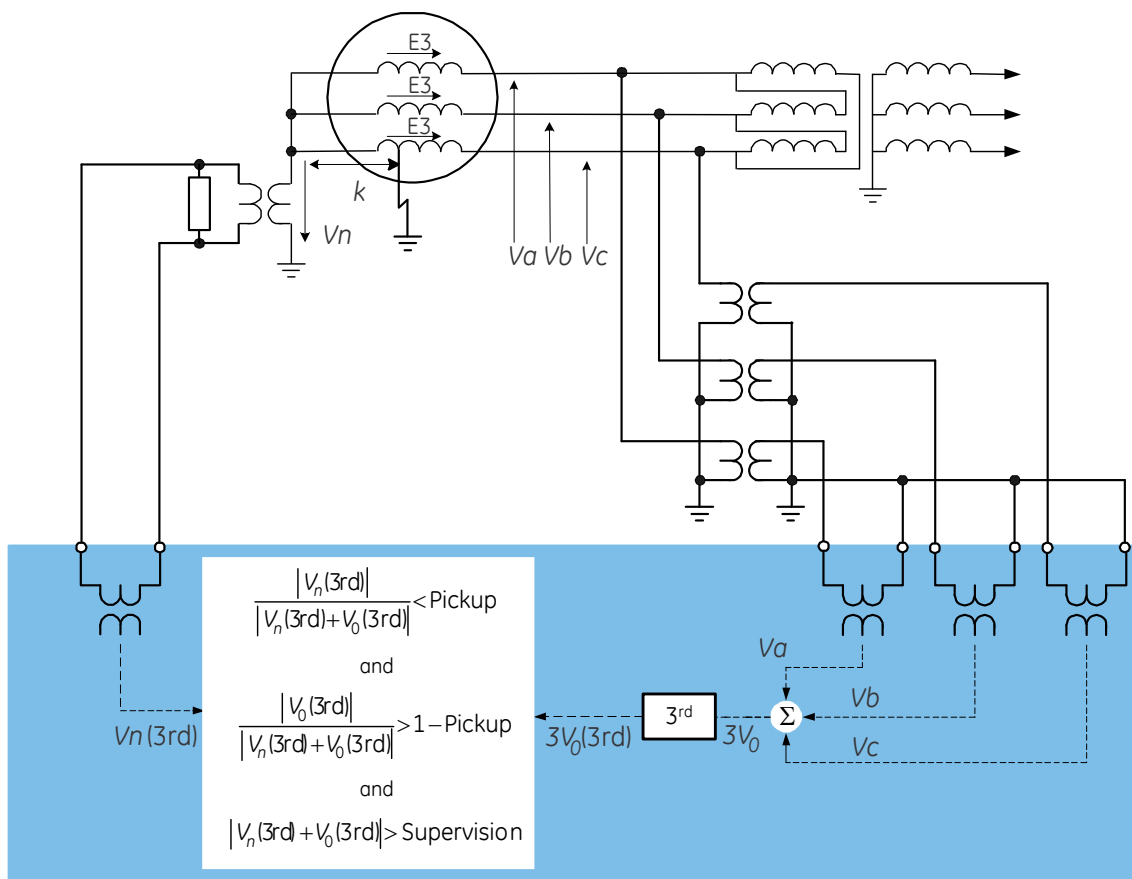


External fault with severe CT saturation

100% Stator ground protection using the 3rd harmonic voltage differential (64TN)

100% stator ground protection is easy to apply using the 3rd harmonic voltage differential (64TN) in conjunction with 59X (auxiliary overvoltage). The 64TN protection function utilizes the fact that for a fault near the neutral, the 3rd harmonic residual voltage at the terminals of a machine increases, while the third harmonic voltage at the neutral decreases. The ratio of the third harmonic residual voltage to the neutral third harmonic may be nearly constant for all load conditions on a healthy machine without faults. This protection function requires phase VTs on the terminal side be connected as WYE.

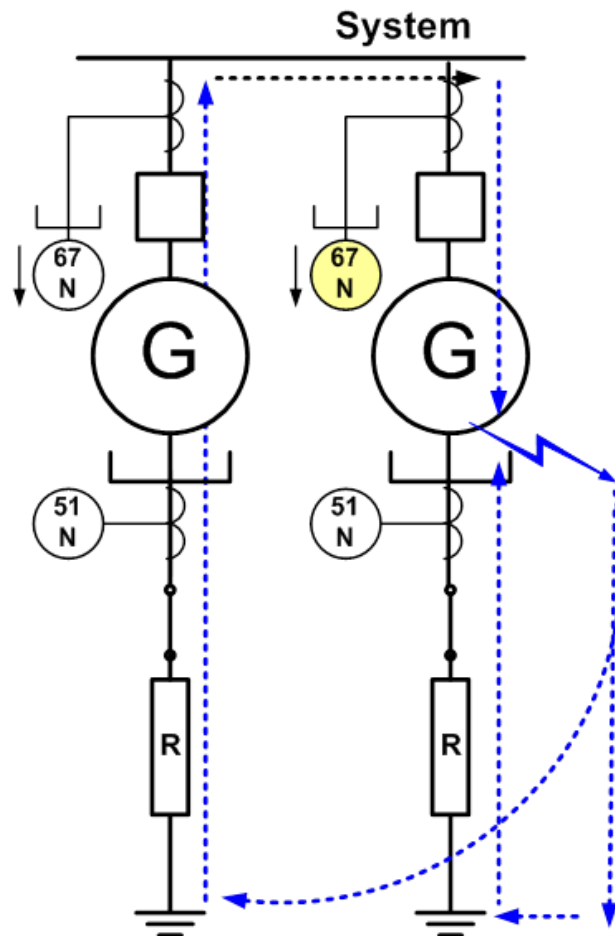
The figure illustrates various protection functions applied for protecting 100% generator stator winding. It also shows 3rd harmonic voltage distribution over the winding in healthy condition (no fault on the stator winding).



Neutral directional protection (67N) for parallel machine ground protection coordination

For the application of low impedance grounded parallel generators, the 889 provides neutral directional (67N) protection function for a secure & selective protection scheme. As illustrated in figure below, for parallel synchronous generators, a ground fault in any one machine causes neutral overcurrent (51N) protection to operate in both generators. With enhanced 67N enabled in both the generators, the faulty generator relay would be identified, and the healthy machine would continue to run as 67N would not pickup although 51N indicates a fault condition.

Therefore, 67N in conjunction with 51N in 889 provides secure and selective protection for parallel operation of synchronous generators connected to the same bus.

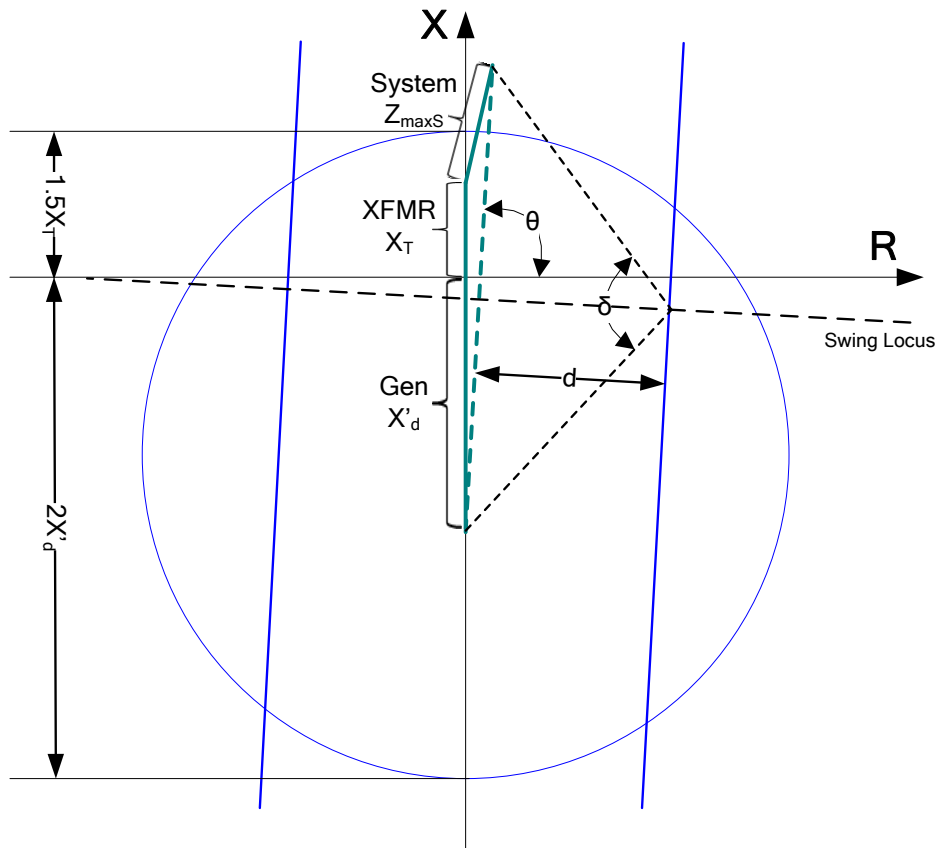


Out-of-step protection – Easy to apply

The out-of-step element provides an out-of-step (loss-of-synchronism or pole slip) tripping function for generators. The element is simplified using a single blinder operating characteristic with an offset mho supervisory. It is easy to apply based on IEEE/ANSI C37.102 guidelines, and an IEEE PES PSRC tutorial on generator protection, which can be accessed at: <http://www.pes-psrc.org/Reports/>. Please follow the tutorial for detailed setting calculation examples.

The purpose of the supervisory mho is to prevent operation on stable swings that pass through both blinders and outside the mho characteristic.

In addition, the out-of-step tripping feature allows a "MHO EXIT" trip mode to reduce stresses on the breaker. The figure below illustrates the single blinder characteristic with a supervisory mho.



For further assistance

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