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Line Differential Protection for 2-phase systems with nominal frequency of 50Hz or 60 Hz

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SIPROTEC 5 Application

Line Differential protection [87L] for 2phase systems with nominal frequency of 50Hz or 60Hz

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1 Line Differential protection [87L] for 2-phase systems with nominal frequency of 50Hz or 60Hz

1.1 Introduction

As all SIPROTEC line differential protection devices, also SIPROTEC 5 Line differential protection devices are working phase selective.
SIPROTEC are originally designed for 3-phase power systems but can also be used for 2-phase systems due to the innovative modular and individually configurable concept of SIPROTEC 5.

This application note provides the setting guidance for 2-phase systems with a nominal frequency of 50 Hz or 60 Hz.

1.2 2-phase systems on 3-phase measurements

SIPROTEC 5 Line differential protection devices can easily be adopted for 2-phase systems with nominal frequencies of 50 Hz or 60 Hz. To understand these adoptions following characteristics of 2-phase systems must be considered:

- The two phases show an angle deviation of 180°. Each function, either measurement or protection, based on symmetrical components will not be working properly as this transformation was developed symmetrical for three phase systems.
- All calculated measurements based on symmetrical components must be neglected and should be removed from logs and HMIs.
- All protection functions based on symmetrical components must be deactivated or switched off, as they potentially show unwanted behavior.

1.3 Device supervision function

There are some device internal supervision functions must be switched off, as they would block the device if connected to a 2-phase system. Some others can remain active, as they will not block the protection functions but increase the safety and reliability.

1.3.1 Current supervision functions

Broken wire detection

Broken wire detection must be switched off, as the “missing” third phase would be recognized, and a failure indicated.

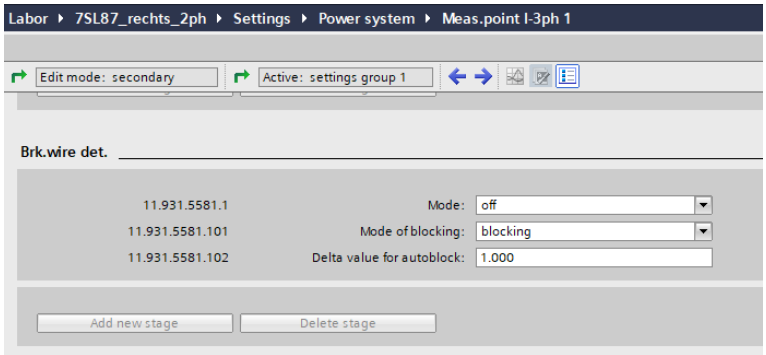


Figure 1 - Broken wire detection

Current balance supervision

Current balance supervision must be switched off, as the third phase would always measure current value of zero. This leads to a constant ratio of I_{min}/I_{max} of zero. Therefore the current balance supervision would always indicate a failure as soon as the currents of the two phases exceed the set threshold at parameter _:931:2491:101.

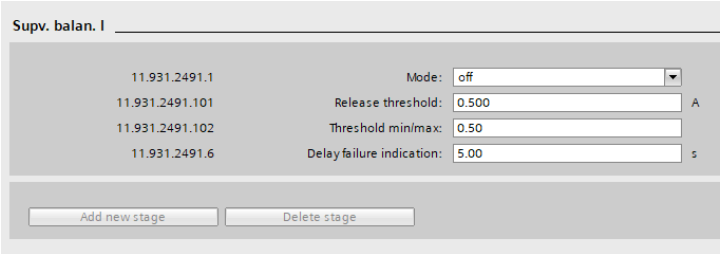


Figure 2 - Current balance supervision

Phase current sequence supervision

The current sequence or "phase rotation" supervision should be switched off, as the unconnected third phase current would block the phase sequence evaluation anyway.

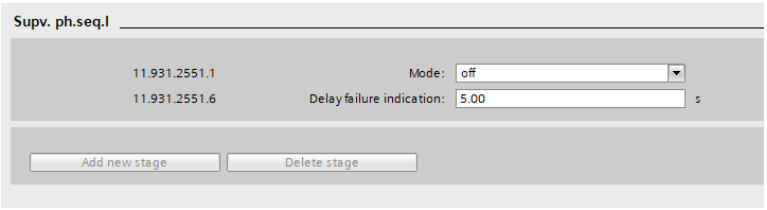


Figure 3 - Phase current sequence supervision

Current summation supervision

Current sum supervision and fast current sum supervision must also be switched off.

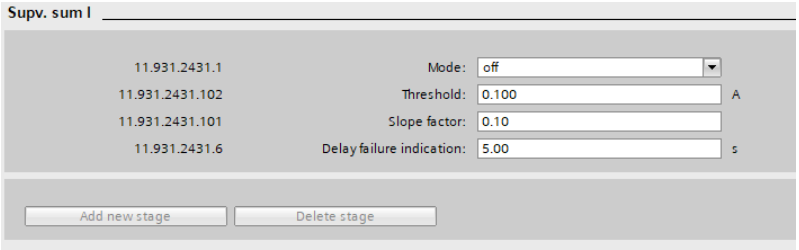


Figure 4 - Current summation supervision

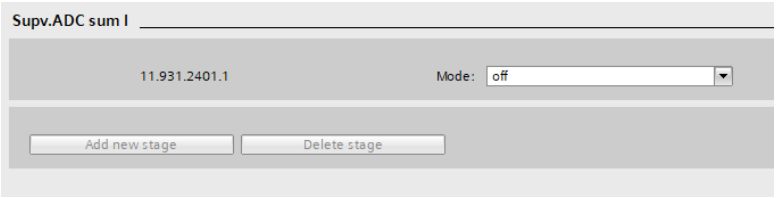


Figure 5 - Sum ADC supervision

1.3.2 Voltage supervision functions

If voltages are connected to the protection device and are needed for additional protection functions, following voltage related supervision functions must also be switched off.

Voltage balance supervision

The voltage balance supervision must be switched off as the not connected third phase to ground voltage would lead to a constant ratio of Vmin/Vmax = 0. This would lead to failure indication.

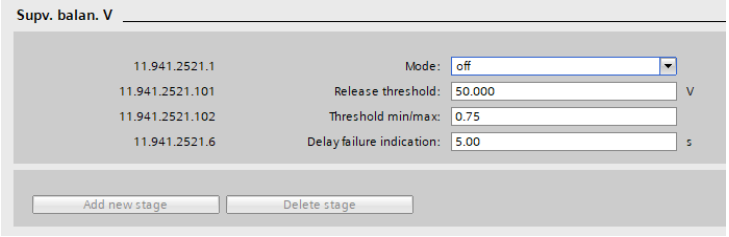
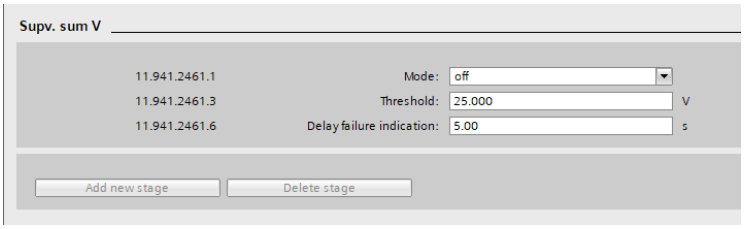


Figure 6 Voltage balance supervision

Voltage sum supervision

The voltage sum supervision can remain active if Neutral voltage is connected to the VN (fourth) voltage measurement input.



Voltage phase sequence supervision

The voltage phase sequence or "phase rotation" rotation supervision must be switched off as the missing third phase to ground voltage leads to wrong evaluation of the phase sequence.

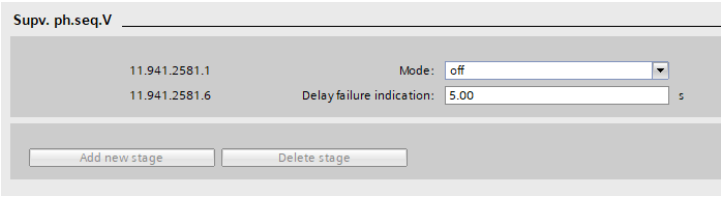


Figure 7 voltage phase sequence supervision

1.4 Conclusion: Perfectly Tailored Fit

By configuring the device supervision according to chapter 1.3, all SIPROTEC 5 Line differential protection devices can be used **without limitations and without further setting specialties** for line protection function [87L] in 2-phase systems either with nominal frequency of 50 Hz as well 60 Hz.

1.5 Abbreviations

[87L]	ANSI code for line differential protection
Hz	Hertz
A	Ampere
V	Volt
s	second

1.6 Documents

Internet: http://w3.siemens.com/smartgrid/global/en/products-systems-solutions/Protection/Pages/overview.aspx

Protection devices → SIPROTEC 5

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