

# Sensitive, digital transient ground fault function

Testing and experiencing the innovative function in SIPROTEC 5

## Description

Low-impedance ground faults are generally managed reliably with protection devices like the SIPROTEC 7SN60. The high sampling rate of SIPROTEC 5 devices allows for the integration of new, sensitive digital procedures for the reliable detection of high-impedance ground faults. The parts of the signal which are caused by the discharging and charging of the ground capacitances of the grid are of particular interest here.

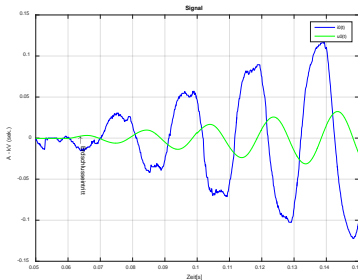
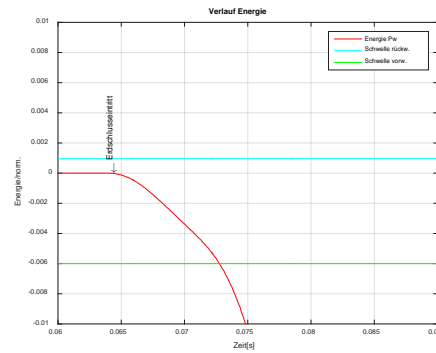
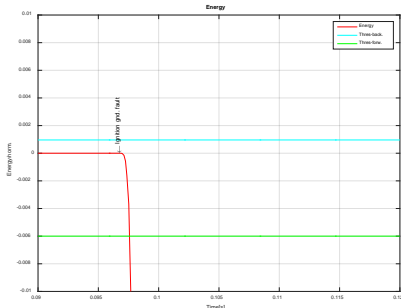


Figure: High-impedance ground fault

The active power in the zero-sequence system is a good criterion to detect the direction of the ground fault. As the charging takes place over a longer period of time with high-impedance ground faults, this part of the active power is available during this time period and can be integrated right from the ignition of the fault. This results in the active energy in the zero-sequence system.



Figures: Energy characteristic, low and high-impedance

Radial systems do not pose a problem for determining the direction. In meshed systems, operational zero-sequence currents can falsify the resulting direction. These operational zero-sequence currents are eliminated by the new algorithm in order to determine the correct direction.

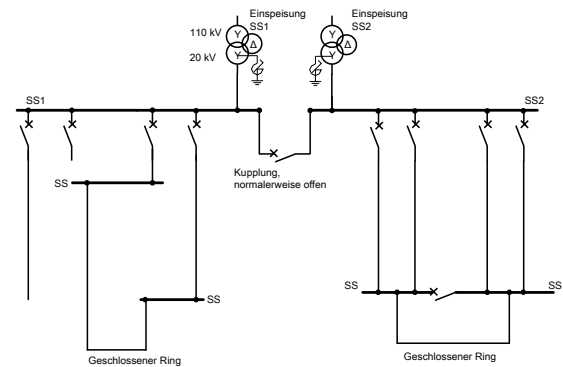


Figure: Meshed systems / loops

# Integrated and sensitive

## Tests in the customer system

The algorithm was developed based on simulations and fault records and was tested in a pilot application in a specific system section. The test system was transferred to a simulation and further examinations were carried out based on it.

## Examinations with simulation data

Fault location and fault-contact resistance on line La, for example, were modified systematically in the simulation to be able to estimate the limits of the procedure. This showed that ground faults with fault-contact resistances of 5 kohms can be detected reliably.

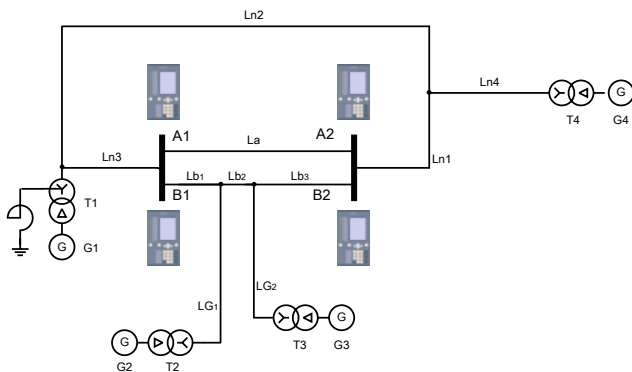


Figure: System configuration for the simulation

## Results

The reliability of the new digital function was impressively confirmed during the system and simulation operation.

- *"Evaluation and comparison with other installed systems have shown good compliance. The results have been very good so far."*

Operating experiences since 7SJ85 V3.00

- *"...extensive 110 kV grid... with at the moment 13 SIPROTEC 5 devices with transient ground fault detection... Approx. 240 transient ground faults have occurred in the first 10 operating months and all of them were detected 100% correctly, in forward as well as in reverse direction."*

Excerpt from customer feedback

## Benefits of the innovative transient ground fault function

- Cost savings thanks to integration in SIPROTEC 5
- Very high sensitivity - detection of high-impedance faults with fault resistances of up to 5 kohms
- Detection of very short ground faults of few milliseconds
- Ideally suited for closed loops or meshed systems, as not impacted by operational zero-sequence currents
- Easy setup of the function



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