

# Protective Relaying

FESTO



## Modern, time-efficient, and interactive hands-on training

Protective relaying provides detection of abnormal operating conditions in electrical systems and is needed in order to act quickly to protect circuits, equipment, and the general public.

The theoretical background, as well as practical application, of these protective devices and their protection functions are an important part of the education of power systems for electrical engineers.

Power-utility-grade equipment, Siemens' newest generation the SIPROTEC 5 series, is used in this innovative teaching approach. Example scenarios are created in the accompanying professional

programming tool, DIGSI 5, which allows users to create different setups and simulate possible faults using the built-in relay testing unit. The response of the relay is then analyzed with the relay display and the fault record.

This customizable solution allows perfect alignment for individual teaching needs. The available range of relays and manuals provide coverage of these general topics:

- Overcurrent/Overload Protection
- Directional Protection
- Differential Protection
- Distance Protection

# Protective Relaying

Protective Relay	Courseware (incl. one student manual and instructor guide each)			
	Ovecurrent/Overload Protection (52173)	Directional Protection (52174)	Differential Protection (52175)	Distance Protection (52176)
<b>Numerical Overcurrent Relay (3812)</b>	•	•		
<b>Numerical Distance Relay (3813)</b>	•	•		•
<b>Numerical Differential Relay (3819)</b>	•		•	

## Customization

Individual, cost-effective learning solutions are created by combining a maximum of two hardware relays with the corresponding courseware.

## Comprehensive Courseware

Theoretical knowledge and hands-on training exercises teach students the basic and advanced relay protection functions.

The courseware provides the following topic coverage:

### Overcurrent/Overload Protection

- Evolution of protective relays
- Overcurrent protection
- Overcurrent and overload protection of AC machines and power transformers
- Overcurrent protection of radial feeders

### Directional Protection

- Protection of parallel power lines using overcurrent relays
- Directional overcurrent protection
- Directional comparison protection
- Directional power protection

## Differential Protection

Basic implementation of differential protection:

- Effect of the current measuring error on the sensitivity of current differential protection
- Percentage restrained differential protection
- Application of differential protection

### Distance Protection

- Simplified diagram of a power system
- Conventional time-stepped distance protection
- Distance relay impedance characteristic
- Fault impedance vs. load impedance
- Line protection
- Generator loss-of-excitation protection
- Distance protection using communication-assisted tripping schemes

### State of the art Hardware

The front display and keypad of the relays allow direct user interaction while communication with the PC software is through USB or Ethernet. The units can be used table-top or in an A4 frame. The hardware provides the following ANSI/IEEE protection functions:

## Numerical Overcurrent Relay

- Directional phase overcurrent (67)
- Directional ground overcurrent (67N)
- Directional power (32)
- Instantaneous phase overcurrent (50)
- Instantaneous ground overcurrent (50N)
- Phase overcurrent (51)
- Ground overcurrent (51N)

## Numerical Distance Relay

- Phase distance (21)
- Ground distance (21N)
- Directional phase overcurrent (67)
- Directional ground overcurrent (67N)
- Directional power (32)
- Instantaneous phase overcurrent (50)
- Instantaneous ground overcurrent (50N)
- Phase overcurrent (51)
- Ground overcurrent (51N)

## Numerical Differential Relay

- Numerical Differential Relay
- Transformer differential (87T)
- Instantaneous phase overcurrent (50)
- Instantaneous ground overcurrent (50N)
- Phase overcurrent (51)
- Ground overcurrent (51N)

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