

# Microprocessor Based Relay Testing - Transformer Protection

4.5 Days, 3.2 CEUs

This hands-on course is designed for test technicians and other persons involved in setting, testing, and diagnosing microprocessor-based relays that protect transformers. NETA and NFPA 70B maintenance and testing standards recommend testing relays either every two years or at other regular intervals. This course will present the fundamentals of microprocessor-based transformer protection, combined with hands-on testing of selected elements of the protective relays.

## Pre-Requisites:

Student must bring a laptop and have full administration rights to install software, to complete the class labs. Laptop must have Windows XP/Vista/7/8, 600+ MHz processor, 4+GB hard drive space, 1+GB RAM, a CD-ROM drive. iPads and tablets without CD-ROM or USB ports are not acceptable.

Upon enrollment confirmation, an email containing instructions to install required software will be sent to the participant prior to attending the course. Please make sure you install the required software before attending the class.

## Lab and Classroom Attire

AVO Training Institute is committed to the personal safety of each participant and require long pants and ANSI rated "safety-toe" work shoes for lab activities. Lecture courses may involve a tour of a work or shop area and for this reason open-toe shoes and shorts are not considered appropriate attire for the classroom.

## Learning Objectives:

To receive 3.2 CEUs, participants must attend 4.5 days of class (32 contact hours) and attain a minimum average grade of 80% (overall grade will consist of 50% lab practice and 50% final exam). Upon completion of this course and lab practice, the participant will demonstrate that he/she is able to:

- Outline how the relay is applied in the power system and identify critical components.
- Interpret external wiring connections and internal logic functions.
- Follow NETA standards when performing tasks with the microprocessor based relays.
- Establish communication with the relay.
- Verify proper operation of relay indicators and output operation.
- Connect relay test set and perform metering check and field tests.
- Perform the following relay element tests and interpret the results:
  - Percent Differential (pickup and slope)
  - Instantaneous Differential
  - Second Harmonic Restraint
  - Phase Time Overcurrent
  - Phase Instantaneous Overcurrent
  - Phase Directional
  - Ground Time Overcurrent
  - Ground Instantaneous Overcurrent
  - Restricted Ground Fault
  - Neutral Time Overcurrent
  - Neutral Instantaneous Overcurrent
  - Phase Undervoltage
  - Phase Overvoltage
  - Neutral Overvoltage
  - Volts per Hertz
  - Underfrequency
  - Overfrequency
  - Synchrocheck

Note: Relays used in lab exercises will be SEL-787, GE-URT60, and ABB RET615.

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## SCOPE

### Day 1\* (7 contact hours)

#### I. Introduction (0.5 hour)

- A. Schedule
- B. Course Outline

#### II. Introduction to Transformer Protection Fundamentals (3.5 hours)

- A. Causes of Faults
- B. Protection Requirements
- C. Transformer Protection Application
- D. Transformer Protection Components

#### AM BREAK (15 min)

- E. Instrument Transformers
- F. Protective Relay Elements
- G. Protective Relay Testing

#### LUNCH (60 min)

#### III. SEL-787 (3.5 hours)

- A. Relay Connections
- B. Establish Communications
- C. Event Record Data Management

#### PM BREAK (15 min)

- D. Verify Operation of Front Panel LED's
- E. Verify Date and Time
- F. Conduct Meter Check

### Day 2 (7 contact hours)

#### III. SEL 787 (cont'd) (7 hours)

- G. Protective Element Testing

#### AM BREAK (15 min)

- H. Clear Event Record

#### LUNCH (60 min)

- I. Restore Relay Settings

#### PM BREAK (15 min)

- I. Restore Relay Settings

### Day 3 (7 contact hours)

#### IV. GE-URT60 (7 hours)

- A. Relay Connections
- B. Establish Communications

#### AM BREAK (15 min)

- C. Event Record Data Management
- D. Verify Operation of Front Panel LED's

#### LUNCH (60 min)

- E. Verify Date and Time
- F. Conduct Meter Check
- G. Protective Element Testing

#### PM BREAK (15 min)

- H. Clear Event Record
- I. Restore Relay Settings

### Day 4 (7 contact hours)

#### V. ABB RET615 (7 hours)

- A. Relay Connections
- B. Establish Communications
- C. Event Record Data Management

#### AM BREAK (15 min)

- D. Verify Operation of Front Panel LED's
- E. Verify Date and Time

#### LUNCH (60 min)

- F. Conduct Meter Check
- G. Protective Element Testing

#### PM BREAK (15 min)

- H. Clear Event Record
- I. Restore Relay Settings

### Day 5 - 1/2 Day (4 contact hours)

#### VI. Conclusion (4 hours)

- A. Review

#### AM BREAK (15 min)

- B. Final Exam

\*Class scheduling times may vary based on discussions and size of class

**STANDARD EQUIPMENT LIST  
MICROPROCESSOR-BASED RELAY TESTING  
TRANSFORMER PROTECTION (MBRT-TP)**

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REVISED 02/11/19, BY: RALPH PARRETT  
COURSE NUMBER: 554  
NUMBER OF DAYS: 4.5

\*INDICATES WHICH EQUIPMENT MUST BE PROVIDED BY CLIENT,  
EVERYTHING ELSE IS PROVIDED BY AVO

**TEXT**

1/ STUDENT MBRT-TP COURSE 554, JANUARY 2019

**EQUIPMENT**

1 / 2 STUDENT	SMRT 410 WITH ACCESSORY KIT
1 / 2 STUDENT	SEL 787
1 / 2 STUDENT	GE UR-T60
1 / 2 STUDENT	ABB RET615
1 / STUDENT	SCIENTIFIC CALCULATOR
1 / STUDENT	AVO LOGO MINI-SCREWDRIVER

**MISCELLANEOUS EQUIPMENT (INSTRUCTOR CONTROLLED TOOL KIT)**

6 EA.	RS232 SERIAL 6FT. (RS232 DB9 MALE TO DB9 FEMALE)
6 EA.	RS232 SERIAL (FEMALE) TO USB 2.0 CABLE & DRIVER SOFTWARE
6 EA.	RS232 NULL MODEM ADAPTER (MALE TO FEMALE)
6 EA.	POWER STRIP EXTENSION CORD 6FT.
3 EA.	POWER EXTENSION CORD 25FT.
60 EA.	SPADE CONNECTORS (SMALL 30 RED AND 30 BLK)
6 EA.	SCREWDRIVER 5 IN 1 (KLEIN TOOL)
6 EA.	ETHERNET TO USB CONVERTER
6 EA.	CAT 5E ETHERNET CABLE 6 FT