PSL40

Distribution Trainer

Shows how electricity is distributed and protected – investigates distribution through transformers, radial and ring-main circuits, and efficiency and regulation

Key Features

- Investigations both radial and ring-main distribution circuits
- Examines transmission efficiency, voltage drop and voltage regulation, effect of cable size, and the effect of transformation
- Shows effect of line length losses and relationship between useful and transmitted power
- Built-in industrial-standard digital protection relays give wide range of functions – module also includes extra socket for additional relay to give more experiments
- Includes supplies, circuit protection, internal loads, instruments and controls

Key Specifications

- Separate AC/DC transmission line
- Three overcurrent protection relays
- Multi-tapped Dy11 Transformer
- Resistive, inductive and capacitive loads

Learning Outcomes

- AC/DC transmission
- Radial and ring systems with different load types
- Distribution losses and efficiency
- Voltage control through reactive power compensation
- Use of a tapped distribution transformer for load voltage control
- Three-phase distribution system with balanced and unbalanced loads
- Effect of an open-circuited neutral conductor on voltage across a single-phase load
- Effect on line current of improved power factor
- Distribution system under faults
- Relay discrimination

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Description

The Distribution Trainer examines different parts of electrical power distribution, from basic circuits to balanced and unbalanced three-phase systems.

The console has two working sections:

- an upper panel that shows the basics of distribution, and
- a lower panel that shows more advanced three-phase power distribution.

The upper panel includes low-voltage a.c and d.c supplies, a set of lamps and variable resistances. The resistances simulate a feeder cable and the lamps simulate loads. Students may connect the feeder circuit to learn the principles of ring main and radial circuits. The low-voltage a.c supplies may be connected to show the principles of regulation.

The lower panel includes connections to two three-phase transformers, lines and loads to simulate industrial power distribution. One transformer reduces the voltage from the incoming supply to the correct value for the experiments. This is the 'line power' transformer. The other transformer reduces the line voltage down to 110 V and acts as the 'line receive' transformer. Its primary tappings are adjustable and its secondary winding star point can be connected to earth.

The panels include all current, voltage and power meters needed for the experiments.

For protection tests, the circuits include current transformers to connect to the protection relays fitted to the control panels.

The user connects and sets the protection relays to detect line and earth currents. The relays also monitor and measure fault events and disturbances for fault analysis. The user sets the two most simple relays from their local control panels. The more complex relay is set from its local panel, or by a cable link to a suitable computer (computer not included) and software (included). When the user applies a circuit fault, the relays open circuit-breakers in the test circuits. The circuit-breakers also include hand-operated switches, and lamps. The lamps show whether the circuit-breakers are open or closed.

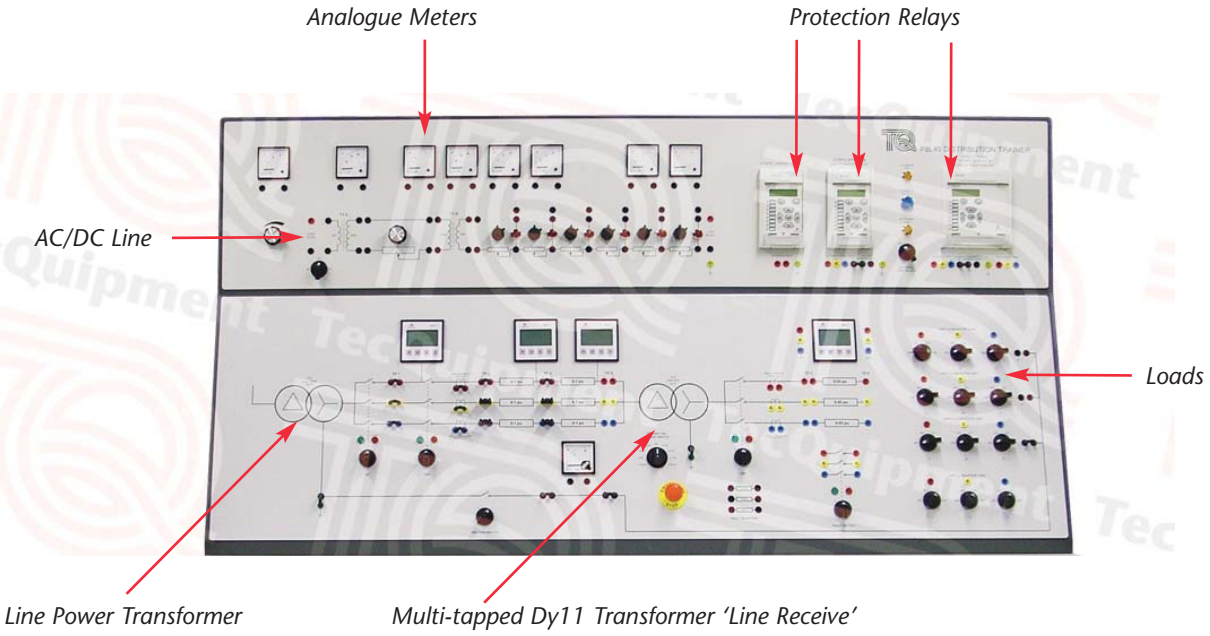
Supplied with the equipment is a set of shrouded leads for the user to connect the test circuits together.

The unit includes an emergency switch, a mains supply isolator and protection fuses.

Supplied with a comprehensive user guide which includes equipment descriptions, theory and experiments. Also, the open and flexible structure of the equipment makes it ideal for student projects and for lecturers to create their own experiments.

Standard Features

- Supplied with comprehensive user guide
- Five-year warranty
- Manufactured in accordance with the latest European Union directives
- ISO9001 certified manufacturer



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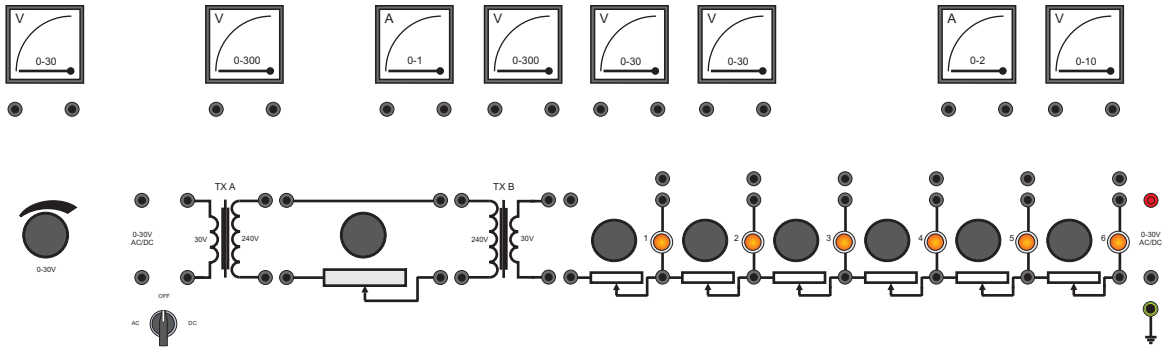

AC/DC Line (schematic)

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Recommended Ancillaries

- Overcurrent and Earth Fault Relay (PSA10)
- Differential Protection Relay (PSA15)
- Directional/Non-directional Overcurrent Relay (PSA20)
- Feeder Management Relay (PSA25)

Overcurrent and Earth Fault Relay (PSA10)

Differential Protection Relay (PSA15)

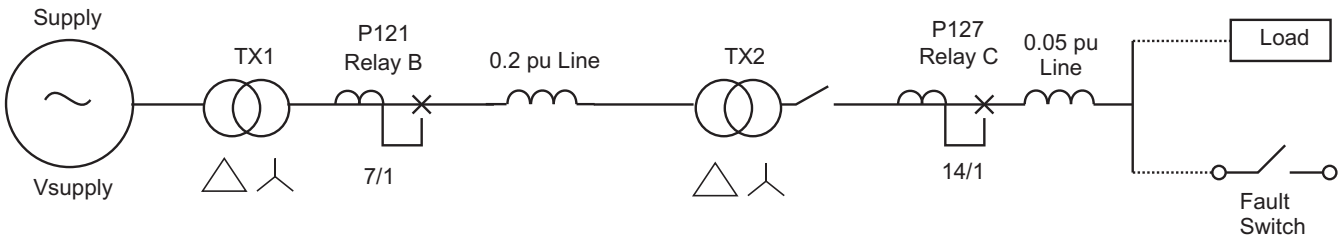
Directional/Non-directional Overcurrent Relay (PSA20)

Feeder Management Relay (PSA25)

Typical Work Assignments

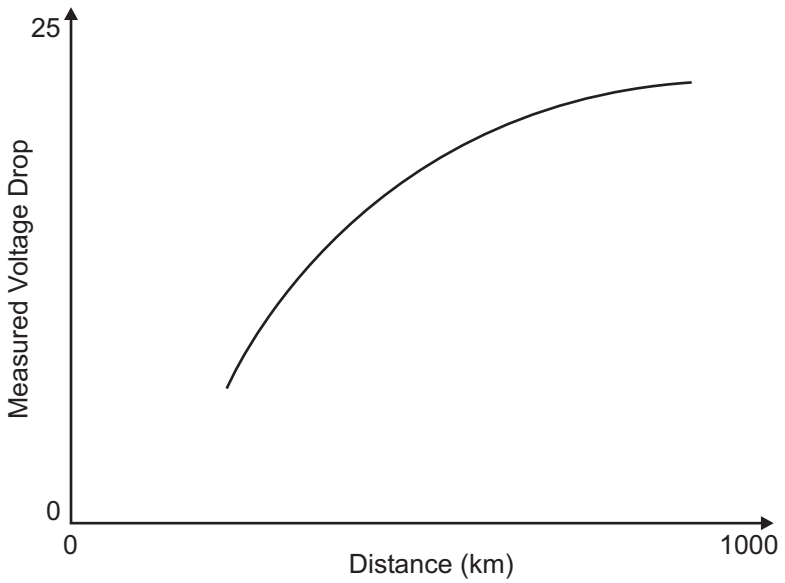
Relay discrimination under fault conditions

This experiment shows how to set two relays, each at different positions along a transmission line, to operate in different ways according to the fault.



Voltage and current in a radial system

This experiment measures the voltage drop due to each section of the AC/DC line connected as a radial system. The resistance of each section is calculated in terms of distance along a transmission line.



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Detailed Specifications

TecQuipment is committed to a programme of continuous improvement; hence we reserve the right to alter the design and product specification without prior notice.

Nett dimensions and weight:

1850 mm long x 1870 mm high x 960 mm front to back and 670 kg

Packed volume and weight:

5 m^3 and 800 kg

Protection relays:

- 1 x single phase overcurrent
- 1 x three phase overcurrent
- 1 x three-phase overcurrent with voltage

Low voltage supplies:

0–30 volts d.c. or 0–30 volts a.c.

Transformers:

- 2 x low-voltage single-phase (one step up 30 V:240 V, the other step down 240 V:30 V)
- 1 x line power 5 kVA three-phase delta-star Dy11 – reduces the incoming supply down to 220/230 V
- 1 x line receive 3 kVA three-phase delta-star Dy11 with star point link to earth 220 V/110 V three-phase. Includes tap selection on its primary windings of ±10%, ±7.5%, ±5%, ±2.5%, and 0%.

Three-phase loads:

- 220 V star-connected resistive, inductive and capacitive
- 110 V delta-connected resistive

Essential Services

Electrical supply:

Three-phase 5 kVA, 50 Hz or 60 Hz (specify on order)

50 Hz needs 380 - 440 VAC

60 Hz needs 200 - 240 VAC

Floor space needed:

Approximately 3 m x 2 m of solid, level floor

Operating Conditions

Operating environment:

Laboratory

Storage temperature range:

–25°C to +55°C (when packed for transport).

Operating temperature range:

+5°C to +40°C

Operating relative humidity range:

80% at temperatures < 31°C decreasing linearly to 50% at 40°C

Sound Levels

Less than 70 dB(A)