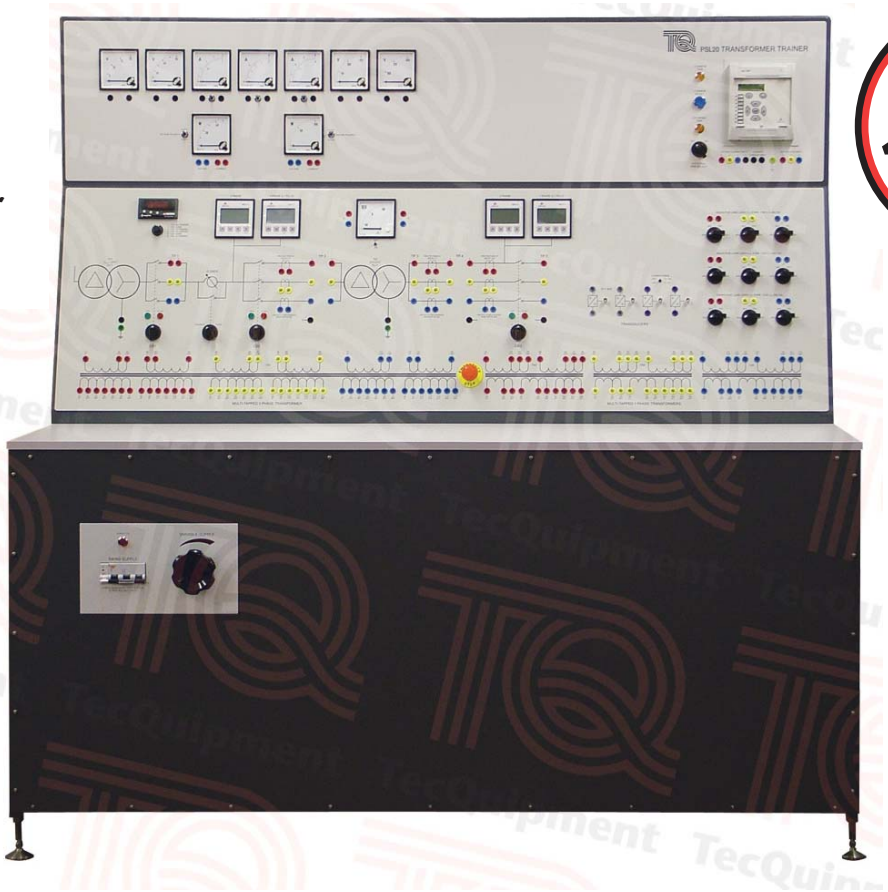
PSL20

Transformer Trainer

Investigates the principles and operating characteristics of single-phase and three-phase power and distribution transformers



Key Features

- Educational transformers with fully accessible and unique one-volt-per-turn primary, secondary and tertiary windings
- Built-in industrial-standard digital protection relay gives wide range of functions – module also includes an extra socket for additional relays to give more experiments
- Separate single and three-phase educational transformers, with an additional delta-star transformer
- Includes supplies, circuit protection, internal load banks, instruments and controls
- Thermocouples included in transformer windings for thermal tests

Learning Outcomes*

- Voltage and turns ratios
- Parallel and series windings, delta, star and interstar
- Open and short circuit tests to find transformer properties, including losses and efficiency
- Balanced and unbalanced loads
- Phase differences in popular three phase transformer connections
- Three to two-phase connections (Scott and Le Blanc)

Key Specifications

- Three single-phase transformers
- One three-phase transformer
- Resistive, inductive and capacitive loads
- Fixed ratio delta-star transformer
- Overcurrent protection relay

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Description

The Transformer Trainer module fully examines single-phase and three-phase power and distribution transformers.

The fully instrumented unit includes:

- One three-phase educational transformer
- Three single-phase educational transformers with tertiary windings
- One three-phase delta-star transformer

All windings of the educational transformers connect to colour-coded shrouded sockets on the control panel. The educational transformers work at one volt each turn, so the no-load output voltages are the same as the number of secondary turns.

An adjustable autotransformer allows lower voltage experiments (for example - with the educational transformers). The module includes a second fixed ratio delta-star transformer for extra experiments.

The control panel includes all the analogue and digital meters and transducers needed to measure electrical voltage, current and power for all transformer tests. Also included are selectable resistive, inductive and capacitive loads, which can connect in parallel, series, delta or star connection.

Thermocouples are fixed to one set of windings and core of the three-phase educational transformer. They are also fixed to one of the single-phase educational transformers. The thermocouples connect to a digital temperature indicator to provide direct readings of core and winding temperatures.

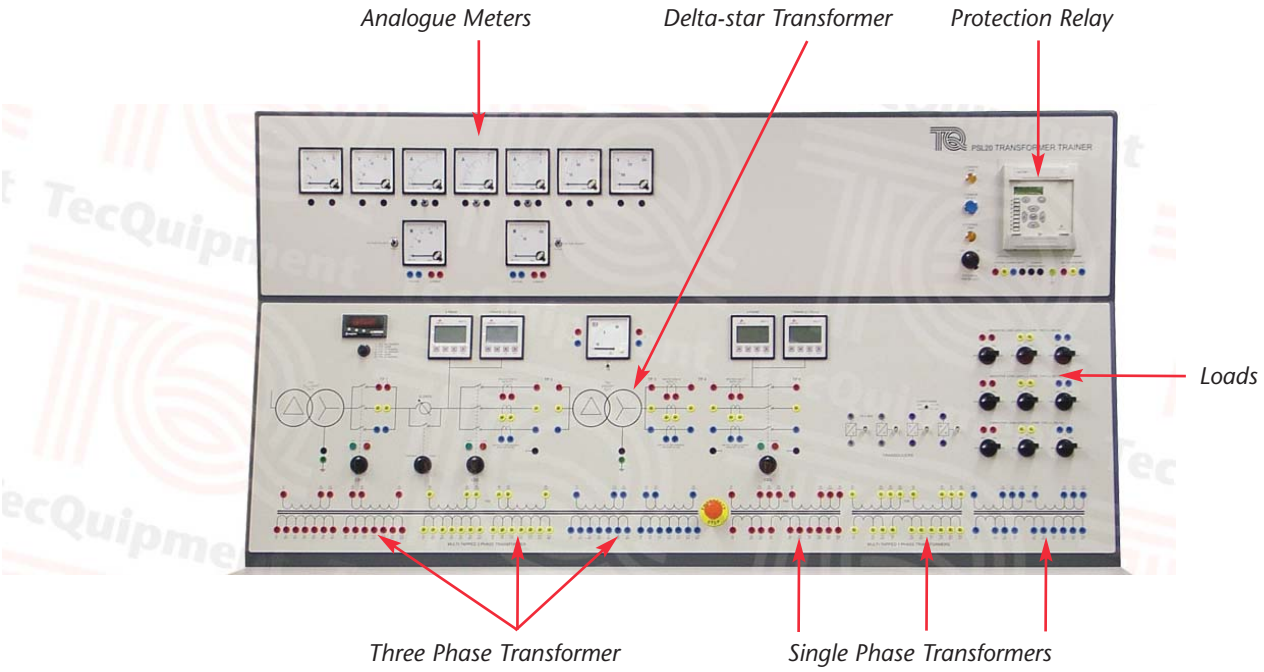
For protection tests, the three-phase circuits include current transformers to link to an industrial standard protection relay. The user connects and sets the protection relay to detect line and earth currents, voltage and frequency faults. The relay also monitors and measures fault events and disturbances for fault analysis. The user sets the relay from its local control panel or by a cable link to a suitable computer (computer not included) and software (included). When the user applies a circuit fault, the relay opens 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.

An extra socket on the equipment supplies power and control for any optional relays (available separately) for use with the module, for example TecQuipment's Differential Protection Relay (PSA15).

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.

***Other possible experiments (not detailed in TecQuipment's manuals)**

- Core and winding temperatures in a three phase transformer (thermal tests)
- The effect of core-type construction in a three-phase transformer
- Differential protection of a delta-star connected transformer, when used with the Differential Protection Relay (PSA15)



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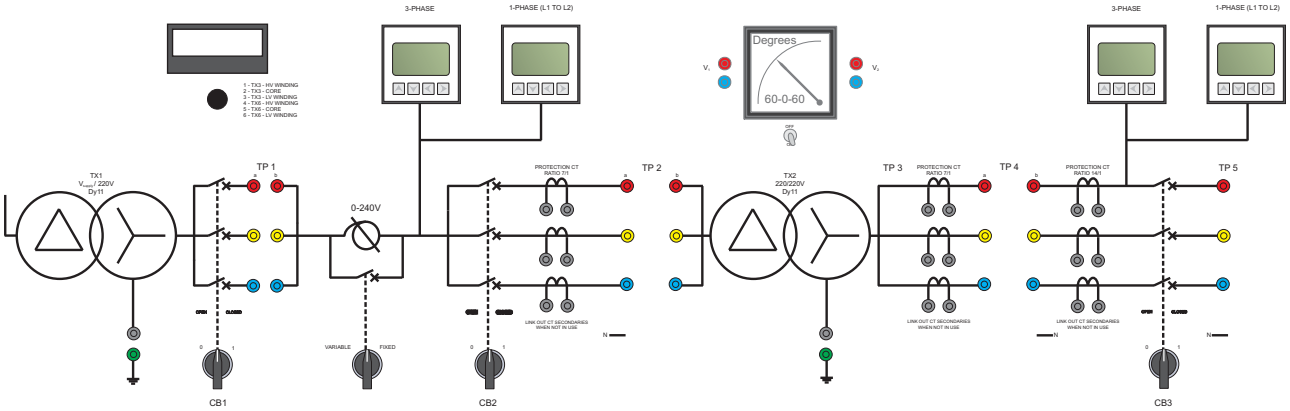
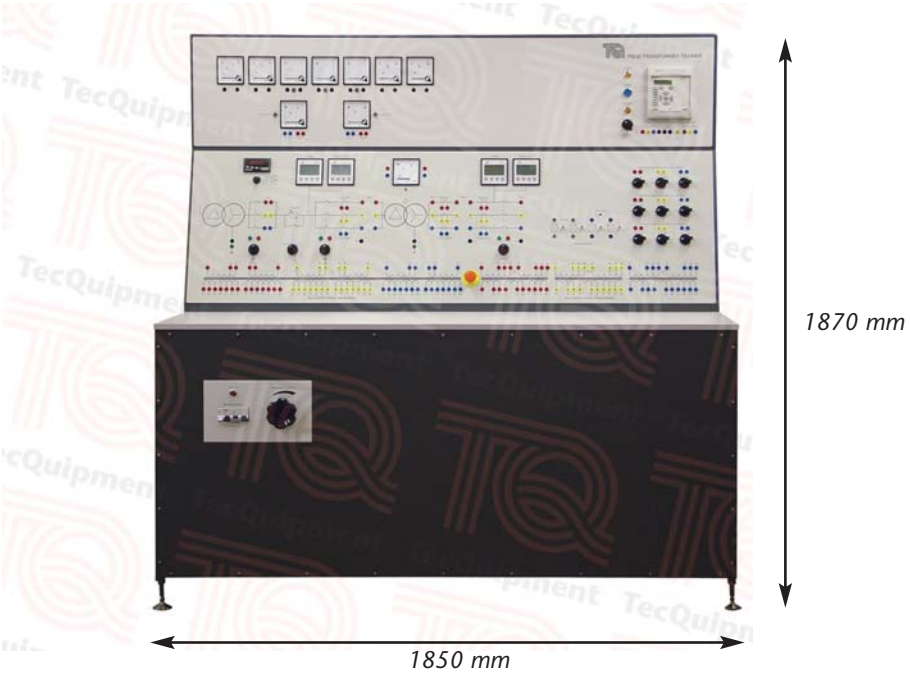


Main circuits (schematic)



Standard Features

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

Recommended Ancillaries

- Oscilloscope (OS2)
- Differential Protection Relay (PSA15)

Differential Protection Relay (PSA15)

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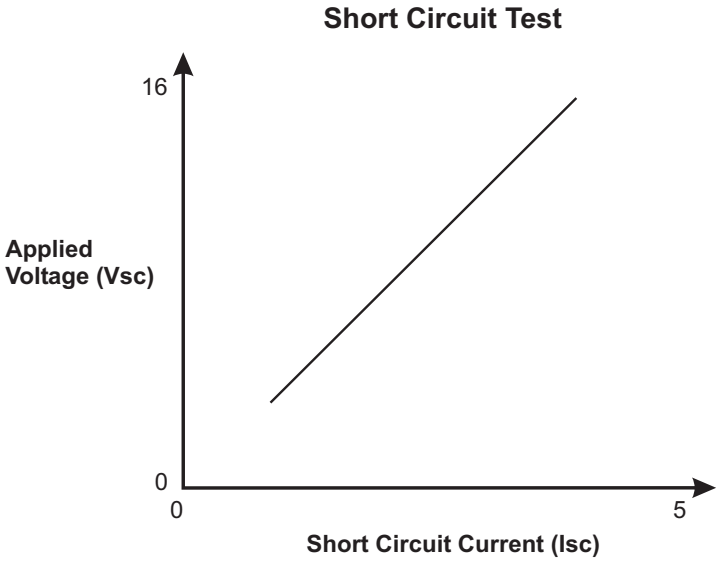
Typical Work Assignments

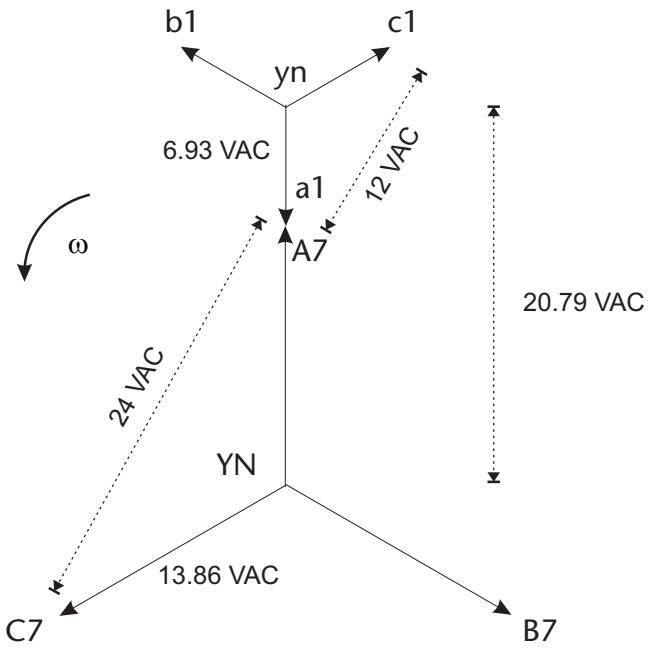
Short Circuit Tests

This test measures the losses due to the copper windings in the single phase transformers, and produces charts of voltage and power against current.



Single Phase Transformer Yy6 Connection

This test connects one of the single phase transformers in the Yy6 connection and measures the input and output voltages to produce the phasor diagram.



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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 790 kg

Approximate packed volume and weight:

5 m^3 and 950 kg

Delta-star transformer:

5 kVA 220/220 VAC three-phase delta to star (Dy11)

Single-phase educational transformers:

Three x one volt per turn transformers rated at 1 kVA and 240 V with multi-tapped primary, secondary and tertiary windings. One transformer has thermocouples to its windings and core.

Three-phase educational transformers:

3 kVA nominal (1 kVA each phase) three-limb three-phase transformer with multi-tapped primary and secondary windings. One phase has thermocouples to its windings and core.

Instruments:

- Single and three-phase multi-function meters for a.c. measurements (voltage, current, and power)
- Phase angle meter
- Thermocouple temperature indicator
- Analogue voltage, current and power meters
- Voltage and current transducers

Protection relay:

Overcurrent protection relay.

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)