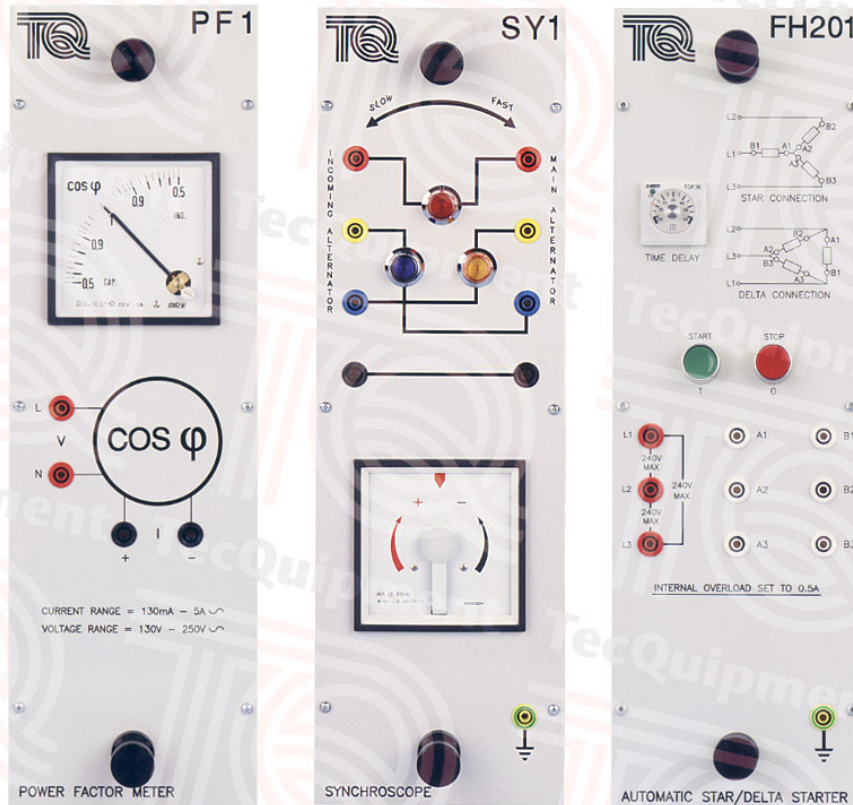


FH2 Instruments and Ancillaries

Part of the Electrical Machines Teaching System, this is a range of optional meters, load banks, transformers and motor starters and controls



Three of the optional modules

- Part of the Electrical Machines Teaching System, these modules fit into the optional Instrument Frame (FH3) for electrical safety, ease of use and a tidy work area
- Includes ammeters, voltmeters, wattmeters and power factor meters for a full range of electrical measurements
- Includes synchroscope for advanced studies of power line synchronising
- Each module has simple, easy-to-use front panels with diagrams to help students understand the circuits they connect
- Most modules include circuit protection
- Includes resistive, capacitive and inductive loads for all types of load conditions
- Includes transformers to vary a.c. voltages and for transformer experiments

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FH2 Instruments and Ancillaries

Description

Part of the Electrical Machines Teaching System, these instrument modules fit into the optional Instrument Frame (FH3) that fits around the Test Bed (FH2). The Instrument Frame metalwork connects to the earth connection of the FH2. This gives an extra safety earth for modules that fit into the frame.

All modules are optional, so you only need to buy those you need for your experiments (see the selection matrix for details).

The meters offer a full range of d.c. and a.c. current, voltage, power and power factor measurements.

The loads offer resistive, capacitive and inductive loads. You can use them together to mimic a real (complex) load, or just use one as a simple resistive load.

The motor starters and controls are extra to those on the Test Bed (FH2) and give you more choices and experiments to start and control the power to and from the optional machines.

The transformers allow you to vary the voltages from the a.c. supplies of the FH2 and to do experiments with transformers.

Note: All ratings are nominal and may vary slightly.

Meters

D.C. Ammeter (A2)

Two separate moving coil ammeters, each with two switched ranges and mirrored scales. Ranges: upper meter 0 to 1.5 A and 0 to 3 A; lower meter 0 to 250 mA and 0 to 500 mA. Accuracy 1.5%. Resettable thermal current cut-outs protect each ammeter.

Three-Phase Triple A.C. Ammeter (A3)

Three separate moving coil ammeters, each with mirrored scales and three switched ranges: 0 to 0.2 A, 0 to 0.5 A and 0 to 2 A. Accuracy 1.5%. Resettable thermal current cut-outs protect each ammeter.

Triple A.C. Ammeter (A30)

Three separate moving coil ammeters, each with mirrored scales. Ranges: 0 to 3 A, 0 to 6 A and 0 to 10 A. Accuracy 1.5%. Resettable thermal current cut-outs protect each ammeter.

D.C. Voltmeter (V2)

Two separate moving coil voltmeters, each having a mirrored scale. Ranges: upper meter has three switched ranges 0 to 15 V, 0 to 75 V and 0 to 150 V; lower meter 0 to 150 V. Accuracy 1.5%. Diode protected.

Triple A.C. Voltmeter (V3)

Three separate moving coil voltmeters, each having a mirrored scale and two switched ranges of 0 to 150 V and 0 to 250 V. Accuracy 1.5%. Diode protected.

A.C. Wattmeters (W1)

Two separate low-power dissipation (approx. 0.5 VA) a.c. electronic wattmeters, each instrument having two switchable ranges: 0 to 100 W and 0 to 500 W. Maximum current input 5 A, maximum voltage input 250 V. Protected by resettable thermal cut-outs. Accuracy 2%.

Speed/Slip Indicator (S1)

Combined triple-range tachometer and dual range slip-speed indicator with variable internal reference. Calibrated to input an analogue speed signal of 1 V/1000 rev.min⁻¹ (from FH2 Test Bed). Slip ranges: 0 to 250 and 0 to 500 rev.min⁻¹. Speed ranges: 0 to 2,500, 0 to 5,000 and 0 to 10,000 rev.min⁻¹. Accuracy 2%. The S1 needs a 240/110 VAC, 1/0.5 A, single-phase supply.

Frequency Meter (F1)

Analogue frequency meter with a 90 degree movement calibrated from 45 to 65 Hz. Voltage input range: 200 to 250 VAC. Accuracy 1%.

Power Factor Meter (PF1)

Power factor meter with a 90 degree movement, calibrated from 0.5 lead (capacitive) to 0.5 lag (inductive). Operating ranges: 200 to 250 V (max), 130 mA to 5 A, 45 to 65 Hz. Accuracy 1% (130 to 200 V, accuracy 5%).

Synchroscope (SY1)

Rotary synchroscope and three cross-connected lamps for use when synchronising two three-phase systems, e.g. an alternator to a mains supply/second alternator.

Synchronising Panel (SY2)

Three cross-connected synchronising lamps for use when synchronising two three-phase systems, e.g. an alternator to a mains supply/second alternator.

Note: The SY2 is the same as the SY1 except that the rotary synchroscope is not included. It gives the same information as the SY1, to show the phase relationship between two three-phase systems. It uses the relative brightness of lamps and shows the apparent direction of phase rotation. The synchroscope is the standard instrument used in industry for synchronising, so you should use the SY1 instead of the SY2 whenever possible.

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FH2 Instruments and Ancillaries

Loading Modules

Resistive Load Bank (R1)

Two separate variable rheostats: upper rheostat 0 to 50 ohms (with an infinity position), 1.5 A; lower rheostat 0 to 2000 ohms (with an infinity position), 0.6 A. Both protected against overload by a resettable thermal cut-out.

Rheostat (R2)

A single rheostat, continuously variable from 0 to 5,000 ohms. Maximum current 170 mA.

Three-Phase Resistive Load Bank (R3L)

Three separate rheostats each independently variable from 1,000 to 6,000 ohms, with an infinity position, and protected against overload by resettable thermal cut-out. Maximum current rating 0.2 A.

A.C. Resistive Load Bank (R5L)

High-dissipation, single-phase, variable-resistance load rated for performing short-circuit tests on a 300 VA transformer. Facilities include a forced-air cooling fan, resettable thermal overload protection and a 0 to 15 V a.c. voltmeter for low-voltage, short-circuit tests. The R5L needs a 240/110 VAC, 0.3/0.6 A, single-phase power supply.

Capacitive Load Bank (C1)

Switched capacitor bank giving 0 to 21 μF in 0.1 μF steps. Rated 300 V, 5 A (a.c. and d.c.). Each capacitor automatically discharges when not selected.

Note: Three C1 modules are necessary for three-phase experiments and capacitor start/run motor experiments.

Inductive Load Bank (L10)

Inductive loading module comprising three separate 2 H inductors loaded through variable transformers. Auxiliary sockets enable connection of external resistive and capacitive loads for constant power factor/variable load experiments. Rated 240 V, 250 mA.

Note: This module, when used with the R3L and three C1 modules, provides the RLC loading facilities needed to study the characteristics of three-phase alternators and transformers, including balanced and unbalanced loads.

Transformer Modules

Transformer (TR1)

Single-phase, double-wound 500 VA transformer with multiple primary and secondary windings and tappings to perform a wide range of experiments including Scott connection. Three modules may be interconnected for three-phase transformer experiments.

0 to 300 VAC maximum voltage across two series primary windings. Five off 48 VAC secondary windings (100 VA each).

Variable Transformer (VTM1)

Single-phase, general-purpose variable transformer to provide a variable 0 to 240 VAC supply from a fixed 240 VAC source (for example, the FH2 supplies). Fully protected against overcurrent. You need three units for three-phase operation.

Starters, Switch and Motor Control Modules

Direct On-Line Starter (FH200)

A three-pole magnetic contactor with overcurrent and no-volt protection. Start/stop push buttons mounted on the clearly labelled front panel.

Remote-Control Unit (FH200/R) – for use with FH200

Control module to illustrate remote stop, start and inch (jog) operation of a three-phase induction motor via a magnetic contactor (FH200 Direct On-Line Starter).

Automatic Star/ Delta Starter (FH201)

Three-phase automatic star/delta starter with variable time delay and overcurrent/no-volt protection. Applicable to three-phase cage rotor induction motor.

Auto-Transformer Starter (FH202)

Three-phase auto-transformer with tappings to provide 0%, 50%, 70% or 100% applied voltage at the output sockets, as selected by a manual switch. The transformers are rated to work with the Cage Rotor Induction Motor (FH90). The maximum input voltage is 220/240 VAC.

Utility Switch (FH203)

A six-pole, three-way, manually operated switch.

Automatic Speed Controller (FH210)

A thyristor three-term closed-loop speed control system using tachogenerator feedback to provide constant speed of rotation for a shunt motor under varying loads. The pre-set speed may be set from 1,000 to 1,800 $\text{rev}\cdot\text{min}^{-1}$. The FH210 works from a 240/110 VAC single-phase supply.

Note: TecEquipment recommends you use this unit to keep constant speed of the D.C. Compound Machine (FH50) when used as the prime mover in a.c./d.c. generator experiments. It works with the tachogenerator signal of the FH2 test bed. This allows the single d.c. power supply of the FH2 to control the generator excitation only.

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