

ELECTRICAL MACHINE TRAINER (Model : XPO-EMT)



TECHNICAL SPECIFICATIONS

A] Aluminum profile sturdy flat panel (table top) system, carrying various high voltage components housed in plastic enclosures (panel) to minimise shock possibility.

- ◆ **Input 3 phase DOL Starter panel (EMT1)**
(10 Shrouded Banana)
 - 4 pole MCB of 415 V/4A.
 - DOL 9A Contactor with 230V / 50 Hz / 11VA COIL.
 - Bimetallic thermal O/L relay with range 1.4A - 2.3A.
- ◆ **Integrated AC (3/1 ph.) measurement panel EMT34/EMT 20 Bidirectional optionally with PC interface & multifunction power meter EMT20F [1 ph.]**
(14 Shrouded Banana)
 - Consist of 2 nos of (96x96mm) Digital meters one each for 3 ph. & 1 ph. Measures V, I, PF(0.2 lag unity 0.2 lead), Hz. Hence separate analog wattmeters (3ph., 1ph.) are not needed.
 - Current specs for 3 ph. meter = 5A (Balanced load) and 1A/5A for 1ph. meter (170-250V).
- ◆ **FWD/REV, Star-Delta starter panel (EMT 4)**
(12 Shrouded Banana)
 - FWD/REV, 3 pole 3 way switch with centre OFF, 6A/440V.
 - Star/Delta switch 3 pole, 3 way with centre OFF, 6A/440V.
- ◆ **3 Phase wound Rotor & Sync. Motor panel (EMT 5A/B)**
(8 Shrouded Banana)
 - Rotor resistors of 30E/5A with 3 taps of 15E, 21E, 30E each - 3 Nos.
 - Rotor resistor selector switch, 3 pole. 6 Way .6A/440 V.
 - DC Rotor excitation over current relay (3Amp)
- ◆ **1 ph. Motor, Alternator & Sync. Motor Panel (EMT 16)**
(14 Shrouded Banana)
 - 1 ph. MCBs of 4A/1.6A 1 each.
 - 2 no. 2P2W selector switches to run as 1ph. alternator then as synchronous motor.
 - 8A pushbutton switch to simulate as centrifugal switch.

- ◆ **DC voltmeter and DC ammeter panel (EMT 6A/B)**
(14 Shrouded Banana)
 - a) DC voltmeter(0-300V)
 - b) DC Ammeter (0-5A) with polarity protection diode
 - c) Field failure relay to control Armature supply.
- ◆ **SCR Actuator (variable DC) cum sensor signal conditioning panel (EMT9)** (4 Shrouded Banana)
 - Full bridge SCR based 0V-195V / 3 Amp cosine firing with linear characteristics.
 - Supports signal conditioning circuit for speed, torque in kg wt to output 0-2.5Vdc (FS).
 - 3 Nos. of these supplies required for DC Armature, DC motor field and AC generator field.
- ◆ **Instrumentation Power supply cum Multichannel DPM panel (EMT 8)** (10 Shrouded Banana)
 - (a) ± 12 V, 500 mA (b) +5V, 300mA (c) Unregulated 17VDC /750 mA (d) line synchronizing signal. (e) 13V / 3 Amp. (f) Multi channel DPM for digital display of torque, speed etc.
- ◆ **Resistor Load (EMT14A/B)**
 - (1) **AC Resistors** = 10K/5K/3.5K/2.5K/2K/1.5K/OFF 200W x 3 phases/ 6 taps
 - (2) **DC Resistors** = 750E/600E/300E/212E/162E/ 125E/ 112E/100E/400W /8 taps + OFF + separate 60E tap for DC series Gen.
- ◆ **LC Load (EMT 15A/B) panel**
 - (A) **Inductive load** = 0.15H/0.3H/0.45H/0.6H/0.75H/ 1.5H/3H/400mA X 3Nos.
 - (B) **Capacitive load** = 1.25u /2.5u/5u/415VX 3Nos.
- ◆ **Mechanical Dimension(mm):** 1170(L) x300(W) x990(H)
- ◆ **Net Weight :** 56 kg
- ◆ **Optional Accessories:**
 - (1) Hand held non contact Digital tachometer
 - (2) Analog AC voltmeter (EMT2) and dual range Ammeter (EMT3)
 - (3) EMT34 bidirectional power meter & analyser with RS232C /RS485
 - (4) 3ph. sequence indicator cum protection panel (P30)
 - (5) 1ph. ph. variac 3 Amp rating

Electrical Machine Units offered :

Order one Dynamometer type DC m/c per aluminum Rack with 17 (14+3) panels each (such 8 sets) & one each of following m/c to complete the 8 sets.

M/C type	DC Integrated m/c	3 ph. AC Integrated m/c	3 ph. Salient Pole alternator	1 ph. Synchronous m/c	1 ph. AC Integrated Motor	Universal Motor	Repulsion Motor	3 ph. Squirrel Cage Motor
Voltage	V _{arm} = 180V V _{field} = 180V	415VAC, 50Hz	415VAC, 50Hz	230VAC, 50Hz	230VAC, 50Hz	230VAC, 50Hz / 150Vdc	230VAC, 50Hz	415VAC, 50Hz
Capacity/RPM /Terminals	300W / 2 Pole m/c / 1500RPM 6 terminals	300W / 4 Pole m/c / 1500RPM 10 terminals	300W / 4 Pole m/c / 1500RPM	300W / 4 pole m/c / 1500RPM 4 terminals	300W / 4 Pole m/c / 1500RPM 10 terminals	300W / 4 Pole m/c / 1600 / 1500RPM 4 terminals	300W / 4 Pole m/c / 1500RPM 2 terminals	300W / 4 Pole m/c / 1500RPM 12 terminals
Rotor Construction	Standard commutator / brush arrangement with laminated Stack, brought out on 2 terminals	Star connected, four terminals including star point brought out on 4 slip rings mounted on shaft	Star connected, four terminals including star point brought out on 4 slip rings mounted on shaft	Single phase wound rotor with terminals brought out on two slip rings mounted on shaft.	Diecast Squirrel cage rotor	Standard commutator brush arrangement brought out on 2 terminals	Standard commutator brush but short circuited.	Diecast Squirrel cage rotor
Stator Construction	Separately excited field winding with laminated solid yoke 2 pole and series winding brought out on 4 terminals.	Six terminals to be brought out to start the machine using STAR - DELTA starter.	Separately excited field winding with laminated solid yoke, 4 pole brought out on 2 terminals	One winding will be used to configure synchronous motor & Alternator output when used as single phase generators.	Two windings brought out on 4 terminals for main and auxiliary. These will be used to configure different motors Split phase, CSCR, CSIR.	Stator brought out on 2 terminals to facilitate AC/DC operation & direction change. Built in compensating winding to minimize AR & sparking.	Stator brought out on 2 terminals. Settable handle to rotate brush position w.r.t. Neutral axis.	6x2 terminals brought out to run machine at two speeds using pole changing method (Dahlander Winding)
Frame / Mounting Shaft dia	90 Frame, Chassis mounted 19mm dia. Trunion mounted m/c for use as Dynamometer with torque & speed sensors.	100 Frame, Chassis mounted 19mm dia. with easily swappable gear coupling	100 Frame, Chassis mounted 19 mm dia. with easily swappable gear coupling	100 Frame, Chassis mounted 19 mm dia. with easily swappable gear coupling	100 Frame, Chassis mounted 19 mm dia. with easily swappable gear coupling	100 Frame, Chassis mounted 19 mm dia. with easily swappable gear coupling	100 Frame, Chassis mounted 19 mm dia with gear coupling	100 Frame, Chassis mounted 19 mm dia. with easily swappable gear coupling
Net weight Gross weight	42 kg 62 kg	35 kg 54 kg	35 kg 54 kg	35 kg 54 kg	35 kg 54 kg	35 kg 54 kg	35 kg 54 kg	35 kg 54 kg
Experiments Covered	I] Motors 1) Speed torque curves of Shunt motor a) DC series motor b) Separately excited DC motor c) DC compound motor (Cumulative & Differential) II] Generator (Needs to be driven) 1) V-I, Efficiency curves for a) DC shunt generator b) DC series generator c) DC separately excited generator d) DC compound generator e) OCC of shunt generator III] Armature resistance starter & SCR based soft start mechanism. IV] Efficiency of all above DC m/c	I] Motors a) Speed torque curves of wound rotor induction motor with rotor shorted & with different resistors. b) DOL/Star-Delta starters, rotor resistance starter. c) Application of sync. motor as power factor improvement device / V curve. II] Generator (Needs to be driven) a) Synchronous generators V-I curve of sync. generator. b) Efficiency of all above 3-phase AC machines. III] Paralleling / synchronising of two 3 ph. Alternators (Optional). Needs 2 sets of XPO-EMT & (EMT- 26) A/B panel with 3 x 2 lamps, sync switch, coupled machine sets	Motors a) Speed torque curves of salient pole motor. b) Use of synchronous motor as power factor improvement device. Study of V curves c) Regulation of 3 phase alternator by i) Synchronous Impedance Method ii) ZPF or POTIER Method iii) Actual Load Test d) Paralleling / synchronising of two 3 ph. Alternators (Optional). Needs 2 sets of XPO-EMT & (EMT- 26) panel with 3 x 2 lamps, sync switch, synchroscope and 2 sets of coupled machine sets. Can Parallel with another 3 ph. AC integrated machine set or 3 ph. AC mains supply.	I] Motors a) Speed torque curves of Sync. Motor b) V curve II] Generator (Needs to be driven) a) V-I curves of sync. single phase generator with excitation at rotor slip rings. b) Efficiency of all above single phase AC Gen & Sync. Motor	I] Motors a) Speed torque curves of split phase Ind. motor b) Speed torque curves of CSIR c) Speed torque curves of CSCR a) V-I curves of sync. single phase generator with excitation at rotor slip rings. b) Efficiency of all above single phase AC Gen & Sync. Motor	I] Motor Speed torque curves of universal Motor when operated with a) 220/240V AC b) 180V DC	II] Motor a) Speed torque curves b) Speed control & reversal with brush setting using handle to rotate brush position w.r.t Neutral axis	I] Motors a) Speed torque curves of squirrel cage rotor induction motor at two speeds. b) DOL/Star-Delta / Pole change starters. II] Efficiency of 3 phase AC Squirrel cage motor. III] Induction Generator Torque-Speed curve in both motor as well as generator mode. Needs EMT34 (3 Phase Bidirectional Power cum energy meter panel)

Optional Addons :
 Shaded pole 230V ac 50Hz, 50W 1400 RPM, foot mounted motor with spring balance pulley arrangement for loading.
 Eddy current Brake : 45VDC/3A 400W (Optionally 500 W DC Shunt Machine offered as Electromagnetic brake)
 Swinburn's test : Measurement of NO load losses to determine efficiency of DC shunt motor.
 Hopkin sons test : Back to back test on two identical DC shunt m/cs. Needs 2 nos of DC m/c to be coupled to each other +2nos of EMT6 with DC Ammeters (Second DC mic will be foot mounted)
 Transformer Trainer : Single phase X mer (2 nos.) + 3 Phase X mer (1NO) with additional panel EMT 2, 3 & 6C

- SALIENT FEATURES**
- ◆ Facilitates easy and safe wiring by students due to use of 4mm sturdy **Shrouded** banana patch cords and shrouded socket arrangements.
 - ◆ All machines are mounted on finely painted sturdy base frame with easy machine **interchangeability**. Use of gear coupling facilitates **screwless coupling**.
 - ◆ With due emphasis on student safety machines operate upto 300W power levels and upto 1500 RPM, without compromising on didactic use. Able to draw all graphs.
 - ◆ Trunion mounted DC integrated machine is used as **Dynamometer** for loading other machines (Motors / generators both); unlike magnetic powder brake or eddy current brake which can load only coupled Motors **and not generators**, with facility to measure shaft power using electronic torque / speed measurement