Doubly Fed Induction Generation Trainer (Model : XPO-PET/DFIG)

SALIENT FEATURES

2 models: 0.5HP /3HP power ratings
The 3 phase slip ring alternator acts as DFIG coupled to trunnion mounted DC shunt motor simulating variable speed wind power (F1) with electronic torque & speed sensors mounted to determine wind power input accurately.
Manual synchronization with grid provided using 3 lamp method & synchroscope.
Variable frequency & variable amplitude VFD provided using FPGA controller to supply rotor winding of DFIG (F2).
16X2 LCD is provided to observe VFD frequency
Multifunction Measurement AC analysers (MMM) read the rotor input voltage /power and stator voltage /power & frequency.
Experiments with ON grid & OFF grid measurements to verify F1± F2 algebraic addition of shaft frequency & VFD frequency to match supply grid frequency.
Facilitates easy and safe wiring by students due to use of 4mm sturdy Shrouded banana patch cords and shrouded socket arrangements for high voltage circuits
Each panel has ABS molded plastic sturdy enclosure, and colorful screw less overlays showing circuits diagrams & its connection tag numbers for easy understanding and connection
Set of Instructor Guide & Student Workbook..

Technical Specifications

- **Input 3 phase DOL Starter panel (EMT1) X 1 No.**
  - 4 pole MCB of 415 V/20A.
  - DOL 16A Contactor with 230V/50Hz / 11VA COIL
  - Bimetallic thermal O/L relay with range 9A - 15A
  - RYB inputs indicators.
  - Manual start / stop with local trip contact
  - Power ON LED indicator
  - Green SBS5 socket is provided for extend earth
- **Instrumentation power supply cum multichannel DPM panel (EMT 8) X 1 No.**
  - DC Multi Output power supply.
  - Supplies DC power to neighboring signal conditioning circuit panels like EMT9, CIP1, CIP2, MIT12, CE7 etc. through 20 pin FRC cable.
  - Provides 1 Ph. AC supply through 3 MCB's, 4A each to power up other panels in the rack.
  - Optionally Multichannel 4 position DPM for Speed, Torque etc.
  - Green SBS5 socket is provided for extend earth
- Variable AC and DC supply panel (EMT 23) X 2 Nos
  - Input 0-230VAC, 50Hz
  - Variable O/P AC: 0-270V/3A (6A).
  - Variable O/P DC: 0-250V/3A (6A)
- **3 Phase Bidirectional Power cum Energy Meter Panel (EMT34A) X 3 Nos.**
  - Bidirectional Multifunction
  - 3 Phase 3/4 wire, 415VAC, CT Input 5A
  - LCD/LED display, Aux. Supply 230V,45-65Hz, 5W.
  - Measure V.I, Hz, Pf, KVA, KW, KWH.
  - Modbus RTU RS 485 for RTU/SCADA interface.
  - Green SBS5 socket is provided for extend earth
- **Synchronization Panel (EMT26A/B) X 1 No.**
  - Consisting of Synchronization digital meter (Synchroscope)
  - Manual Synchronization switch
  - Manual start / stop with local trip contact
- **DC Voltmeter & DC Ammeter Panel (EMT6B) X 3 Nos.**
  - DC voltmeter: 0-300VDC

- DC ammeter: 5A (20A)
- 4A (12A) circuit breaker.

◆ **8 Nos. of IGBT Power Circuit and sensing panel (PE7A-L/R) X 1 No**

- 1200V/40A IGBT with opto isolated (LV) TTL compatible driver circuit & individual heat sink with built in isolated DC power supply for gate drive - 8 nos.
- 2 nos of push buttons to increment/decrement frequency
- Forced air cooling fans 2 nos
- 1000µf/250V electrolytic capacitor paralleled with 2.2µf/400V film capacitor for DC smoothening & to dampen surge
- Test points are provided to observe gate signals

◆ **FPGA based controller panel (XPO-EST) FPGA-II (XC3S400) X 1 No.**

- 16MHz crystal operated multi-output clock source to operate various resources on Mother Board like CPU, Baud rate, T/C etc.
- 6 LVTTL gate drive outputs to and 6 status feedback inputs from 6 nos IGBT power modules through 26 pin FRC cable.
- 16X2 LCD display to observe VFD frequency
- 8 nos of LEDs to indicate IGBT faults

◆ **SCR Actuator (variable DC) cum sensor signal conditioning panel (EMT 9) X 1 No.**

- Thyristor rating: 10A (25A)
- Full bridge SCR based 0V-220V / 3A (10A) cosine firing with linear characteristics.
- Supports signal conditioning circuit for speed, torque in kg to give output 0-2.5Vdc (FS).
- External control signal (0 - 2.5VDC) to set O/P volt (0-100VDC) to control inverter input voltage.

◆ **LC filter panel (EMT74A/B) X 1 No.**

- Inductors (0.15H-2.5/5A) X 3 nos.
- Capacitors (100µf/440Vac) X 3 nos.

◆ **Single phase supply panel (EMT16A) (3HP) X 1 No.**

- Single phase MCBs of 4A/20A 1each
- Lamp load

◆ **Resistor Load panel (EMT14A/B) for (0.5HP) X 1 No.**

- **AC Resistors** = 10K / 5K / 3.5K / 2.5K / 2K /1.5K / 200W X 3 phases / 6 taps
- **DC Resistors =** 750E / 600E / 300E / 212E / 162E / 125E / 112E / 100E / 400W / 6 taps+OFF+ separate 60E tap for DC series Gen.

OR

◆ **Resistor Load panel (EMT42A) for (3HP) 1 No.**

- 3 nos of 600W resistors with switch selectable 6 nos of taps at 100, 112, 150, 175, 200, 225? & 265? fix

◆ **Diode Bridge & LC Filter Panel (PE8A)**

- Diode bridge : 1000V/35A
- Electrolytic capacitor : 1000uF/250V--- 2 Nos.
- Film capacitor : 2.2uF/400V--- 2 Nos.

Table Top Panel :

◆ **Variable AC and DC supply panel (EMT 23) X 1 Nos.**

- Input 0-230VAC, 50Hz
- Variable O/P AC: 0-270V/3A (6A)
- Variable O/P DC: 0-250V/3A (6A)

◆ **List of experiments:**

1) To verify F1±F2 algebraic addition of delta connected stator of DFIG.
2) To verify F1±F2 algebraic addition of star connected stator of DFIG.
3) To calculate the efficiency of DFIG (delta stator) setup when connected ON grid by manual Synchronization of DFIG with grid supply.
4) To calculate the efficiency of DFIG (star stator) setup when connected ON grid by manual Synchronization of DFIG with grid supply.
5) To study DFIG (delta stator) power sharing between grid & load when grid tied.
6) To study DFIG (star stator) power sharing between grid & load when grid tied.
7) To study active and reactive power control of DFIG (Delta stator) when grid tied.

Setup parameters :

S.N.	Parameters	XPO-PET/DFIG (0.5HP Setup)	XPO-PET/DFIG (3HP Setup)
1.	Prime Mover	0.5HP DC integrated machine Armature: 180V, 2A Field: 180V, 0.45A 1500 RPM	3HP DC separated excited shunt machine Armature: 220V, 12A Field: 220V, 0.6A 1500 RPM
2.	3 Ph. Alternator/ Generator	0.5HP 3 phase AC integrated machine Stator: 415V/0.42A 6 terminals of 3 windings brought out to make star delta Rotor: 70Vdc/2.6A Y connected 3 winding brought out from slip ring	3HP 3 phase AC integrated machine Stator: 415V/4.7A Y connected 3 winding brought out from stator Rotor: 180V/7.5A Y connected 3 winding brought out from slip ring
3.	Mechanical/ Weight (in kg)	Rack: 1165(L) x 300(W) x 990(H) Net Wt.: 65, Gross Wt.:73 Kg Coupled machine: 760(L) x 300(W) x 400(H) Net Wt.: 80 Kg	Rack: 1165(L) x 300(W) x 990(H) Net Wt.: 65, Gross Wt.:73 Kg Coupled machine:1228(L) x 300(W) x 500(H), Net Wt.: 100 Kg EMT42A & EMT74 panel: 600(L)x275(W)x500(H), Net Wt.: 60 Kg