

# POWER ELECTRONICS TRAINER (Model : XPO-PE)



## MASTER UNIT

### Built in power supply

- ◆ DC supply:  $\pm 12V$ , 500mA,
- ◆ Unregulated Power supply 17V / 750mA,
- ◆ Regulated 7 to 14V/3A O/P is provided as 12V Battery charging supply. In absence of battery, same may be used as simulated battery source to run experiments on inverters etc.
- ◆ Isolated DC supply +12V/ 300mA with isolated common.
- ◆ On board Inverter transformer of Primary: & Secondaries: 12-11-0-11-12/3A
- ◆ On board o/p to Isolated Drive Circuit

### AC supply

230V AC line voltage is made available on two banana 4mm sockets as well as 1.5A fuse extender for variac if used.

### Aux DC Power Supply :

(Useful as field / armature supply for DC motor)

- Variable upto 200Vdc/0.5Amp (Phase controlled Thyristor half bridge)
- Field ON/OFF control with **field failure relay** & over current protection circuit.

### OR

### ◆ On board Analog voltmeters (In place of Aux. DC Supply)

- AC voltmeter (0-300V) - 1No.
- DC Voltmeter (0-300V)-1No.

### LSPT Panel consisting of

- ◆ Two pulse transformers of 1:1:1 are provided for isolation & supplying firing pulses along with required DC Power supply to experiment panel under test through 15 pin female 'D' connector.
- ◆ Selector switch of 2 pole 6 way for selecting different types of firing pulses like out of phase inverter firing using LM3525 with dead time, freq. Control in freq variation from 170 Hz to 250Hz, 12.5/25/6.25 Hz Frequency gated with High Frequency (3KHz) for Cycloconverter, line Synchronized UJT firing for converter and pulse width

### R-L-C Load Panel

- ◆ Load resistor of 10ohm/ 40W and 100ohm / 10W - 1No.each
- ◆ Centre tapped 3A choke 4mH/ 16mH each -2Nos.
- ◆ DC choke 0-100-200 mH/750mA- 1No.
- ◆ Commutation capacitors of 10uF/100V - 4Nos.
- ◆ AC Paper capacitor of 4uF/440V - 1No.
- ◆ DC Cap 220uF / 63V- 1No.
- ◆ Diode BYT 71 (5407)- 1 No.
- ◆ On board Lamp load of 15W/ 230VAC provided

### Accessories:

- \* 15 pin D connector cable assembly,
- \* 4mm bannana patchcords : 100mm X 10 Nos & 500mm X 20 Nos.
- \* Optional **power scope** accessory for any Lab CRO for off ground differential measurements upto 1000Vdc to facilitate checking inverter / converter waveform.
- \* Optional Isolation transformer (70VA, I/P 230V, O/P 230Vac) for CRO isolation.

### Mechanical Dimensions:

- Master Unit : 400mm(W), 125mm (H), 270mm(D)  
Net weight : 10Kg. Gross weight : 12Kg.
- Panel : 215mm(W), 165mm(H), 40mm(D)  
Net weight : 700gm approx.

**Operating Voltage:** 230V  $\pm$  10%, 50Hz, 75VA

**Modular experiment panels offered (Select one or more)**

### 1) Power Semiconductor Application Experiment panel I/ P20

(Provided with 29 banana tags.)

Triac lamp dimmer, AC fan regulator, SCR operated light sensitive switch using LDR, SCR operated temperature sensitive switch using thermistor, UJT relaxation oscillator, Half and full wave (Phase shift controlled) rectifier using SCR, Timer using SCR & UJT. Built in Lamp load.

### 2) Power Semiconductor Application Experiment Panel II / P22

(Provided with 16 banana tags.)

SCR phase shift controlled converter using IC555 through opto isolator (Potentiometric), Triac AC power control using IC 555

(Potentiometric) (optoisolated), SCR AC power control using UJT/PUT (Potentiometric), Triac AC power control using UJT/PUT (Potentiometric), SCR/Triac temperature control using thermister, SCR/Triac intensity control using LDR, Opto isolated DC switch & Photo relay & thermal relay (street light control).

### 3) CON / INV Panel / PE1

(Provided with 48 banana tags)

- ◆ **SCR Converters-** Provided with sturdy 800V/12A SCRs (4nos) with uncommitted snubbers, 6A diodes (2nos) commutation switch, 47 /450V cap, Ramp cosine firing circuit. However actual working currents are limited to 3A (max) for safety.
  - Half Wave & Full Wave Fully Controlled converter
  - AC Voltage Controller using Lamp optionally Universal motor foot mounted.
  - SCR Controlled Converter 1 phase with R-L Load
  - Effect of Free Wheeling Diode on SCR converter performance with Inductive load.
  - Study of SCR converter (Open Loop) output with Inductance Input and Capacitance Input filters
  - Effect of Source Impedance on performance of SCR converters.
  - Study of closed loop SCR converters with Resistive Load.
  - Study of closed loop SCR converters with Motor Load (optional). Select motor types from addons below.
  - Study of full wave -half controlled SCR bridge.
  - Resonant DC- DC converter.
- ◆ **Advanced firing Schemes**
  - Study of H.F. gate type SCR triggering.
  - Study of relation between control voltage and SCR converter output DC voltage - using linear resistor controlled synchronized ramp firing (IC815 equivalent).
  - Study of Linear relation between control voltage and SCR converter output- using cosine firing scheme.
- ◆ **SCR forced Commutation Techniques**
  - Study of forced commutation techniques for SCR, Class A,B,C,D,E,F
- ◆ **SCR based Inverters**
  - SCR based Parallel Inverter.
  - SCR based series Inverter .
  - SCR based Bridge Inverter.
  - SCR based McMurray Bedford half bridge inverter.
- ◆ **Cycloconverter**
  - SCR Based cycloconverter
- ◆ **SCR based Chopper**
  - SCR based Jones chopper Resistive load, motor load (optional).
  - SCR based buck (step dn), boost (set up), buck boost chopper
- ◆ **Thyristor drive for DC motors-series shunt motors (optional)**  
**Optional Addons**
  - Optionally provided for closed loop experiments with foot mounting PMDC motor (200W/2000RPM) with Tacho feedback (10V per 1000RPM) loading arrangement using spring balances (10kg). This also may be used for Chopper application. However needs AUX DC 200Vdc /500mA as Armature supply.
  - PMDC Motor (48Vdc, 1500RPM/27W) for chopper application. Operating on 12V DC supply/ battery.
  - UPS battery 12V, 7Ah. Sealed maintenance free Battery for inverter applications.
  - Hand held Digital Tachometer to measure motor speeds.
  - Separately excited DC shunt / series motor (0.5HP, 1500RPM with Spring balance loading arrangement).

- Fractional HP Universal AC/DC motor 230VAC/1/12HP, spring balance loaded chasis mounted.

### 4) Triggering circuit / dv/dt Protection panel / PE2

(Provided with 51 banana tags & 3TPs)

- ◆ **SCR Triggering Schemes / turn ON methods.**
  - Simple Resistance firing circuit for upto 90° SCR firing half wave.
  - Resistance - Capacitor firing circuit with increased control SCR firing - half Wave & full wave.
  - UJT/PUT based SCR Trigger with series/ shunt transistor controlled ramp, resistance controlled Pedestal
- ◆ **TRIAC Triggering Schemes / turn ON methods.**
  - Simple Resistance firing circuit for TRIAC firing Full wave.
  - UJT/PUT based TRIAC Trigger with series/ shunt transistor controlled ramp, resistance controlled Pedestal
- ◆ **dv/dt behaviour of SCR**
  - Study of SCR dv/dt protection using gate termination.
  - Study of SCR dv/dt protection using gate reverse bias with resistance.
  - Study of SCR dv/dt protection using gate reverse bias with resistance and diode.
  - Study of SCR dv/dt protection using polarised snubber.
  - Study of SCR dv/dt protection using polarised RC snubber with discharge resistor.
  - Study of Triac dv/dt protection using RC Snubber.

### 5) SCR Application Panel / PE3

(Provided with 26 banana tags)

- Study of Zero Voltage Line switching & Integral cycle control using SCR.
- Study of SCR based Ring Counter for sequential switching.
- AC voltage control using SCR based transformer tap changer.
- SCR based AC flasher / DC flasher.

### 6) IGBT / MOSFET Inverter Panel / PE6

(Provided with 46 banana tags)

- ◆ **Provided with uncommitted MOSFET (800V/7.8A, 2No.) IGBT (600V/6.5A, 2 No.) brought out on Banana sockets, LM3525 based PWM converter to generate 200/2000Hz inverter frequency as well as duty cycle control, 1 No. optoisolated driver & 1 no. additional opto Drive provided on Topboard for Chopper etc.**
  - Switching characteristics of MOSFET / IGBT
  - MOSFET / IGBT based 4 types of Chopper - Buck, Boost, Buckboost, Cuck.
  - MOSFET / IGBT push pull and half bridge inverter 200/2000Hz.
  - Open and close loop DC motor (200V/200W) PWM speed control, P/PI closed loop control PM DC optional

## SALIENT FEATURES

- ◆ Aesthetically designed injection molded electronic desk.
- ◆ Master unit carrying useful experiment resources like line Synchronized firing circuits, Power supplies, lamp load, RLC loads, Battery charging supply etc. while the central slot will hold replaceable experiment panels.
- ◆ Each multi experiment panel is secured in an ABS molded plastic sturdy enclosure, and has colorful screw less overlay showing circuit & Connection through Sturdy 4mm Banana Sockets & Patch Chords.
- ◆ Set of User Guide provided with each unit.
- ◆ Order 6 Master units and set of 6 panels (PE 1 x 2, PE2, PE3, PE6X2nos)+ Power scope.

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Specifications subject to change without notice