

SOLAR TECHNOLOGY TRAINER (Model : XPO-STT)

Trinity



A) SOLAR CELL EXPT. SETUP
(ST1)



B) Spectral Response &
Carrier life time expt. panel
(ST2)



C) SPV STAND



D) MAIN RACK

SALIENT FEATURES

- i) **Basic model** consisting of ST1 panel mounted in rack above (**without** peltier module) + ST3 + EMT8 & EMT9 panels + 500W lamp.
- ii) **NISE/DGET compliant** consisting of SPV stands (2 nos) with EMT8, EMT9 & Optimised rack with Rheostat + EMT68 (2 nos.) + ST3 + ST4 + EMT6 + ST5 + EMT7 + ST4A (Optional).
- iii) **Advanced model** consisting of (ii) above + (i) (**with** peltier module) and ST2 panel.
- Table top aluminum profile modular flat demo panel rack with tiltable lockable frame 0-90° in steps to mount various types of SPV modules. Employs 1000W halogen lamps as variable intensity sun simulator.
- NISE/DGET curriculum based laboratory experiments supported. Useful for laboratory experimental learning by students in renewable energy basics, energy conservation, charge controller, storage system etc.
- Optional single phase (Stand alone or Grid tied) inverter to demonstrate power export using bidirectional multifunction meter.
- Closed loop temperature control using peltier module to study temperature effect on solar cell characteristics.
- Panels ST1 and ST2 facilitates understanding of underlying physics by measuring carrier life time & spectral response of a solar cell & calibration. Removes dependence on costly pyranometer through use of calibration. Certificate from NISE delhi for solar cell supplied. (optional)
- Optionally table top electro-scope and hand held solar power meter are supplied.
- Optionally IV curve tester & PC interface, **Solar DC pump** setup can be provided.
- Set of Instructor Guide & Student Workbook.

TECHNICAL SPECIFICATIONS

A) Solar cell experiment setup, needs three panels

- ◆ Consists of table top aluminium profile rack (30x30) size:- 970(H) x 700(W) x 300(D) holding various panels
- ◆ **Solar cell experiment panel (ST1)- 1 No.**
 - Mounted on horizontal member.
 - 50 x 50 mm x 2 nos. crystalline silicon solar cells (3V/150mA) mounted in aluminium tray with heatsink and fan.
 - Loading pots (500E and 5K).
 - Series & parallel combination arrangement.
 - Optionally cell temp controlled by Peltier module (40W), Foil type PT100 sensor to measure temperature, 12Vdc cooling Fan to maintain heatsink temp (Range 15°C - 75°C).

Mechanical : 90(H) x 200(W) x 150(D) mm/ Net Wt.:- 8Kg

◆ **Instrumentation power supply cum multichannel DPM panel (EMT8)- 1 No.**

- DC Multi Output power supply.
- Provides 1 Ph. AC supply through 3 MCB's, 4A each to power up other panels in the rack.
- Multi channel DPM for temperature display.
- 20 pin FRC power bus to supply power to neighboring
- Green shrouded socket provided to extend earth

◆ **SCR actuator cum sensor signal conditioning panel (EMT 9)- 1 No.**

- SCR based AC controller to set intensity of halogen lamp.
- Supports signal conditioning circuit for temperature to give output 0-2.5Vdc.
- ◆ **DC Application panel (ST3)**
 - Common 12V DC fan for both solar cell and SPV
 - Separate LED lamps for 3V solar cell and 12V SPV
 - 6V battery mounted from behind for solar cell

List of experiments

- 1) Study of I-V Characteristics of Solar cell.
- 2) Study of series combination of solar cells.
- 3) Study of parallel combination of solar cells.
- 4) Study of dependency of solar cell I-V characteristics on light intensity.
- 5) Study of dependency of solar cell I-V characteristics on temperature.
- 6) Study of shading effect on solar cell parameters.
- 7) Study of Photovoltaic effect in ubiquitous semiconductor PN junction (diode).
- 8) Study of 6V battery charging using solar cell
- 9) Study of 6V battery discharging using DC fan & LED lamp

B) Spectral Response & Carrier Lifetime Measurement setup enables you to study physics of solar cell (ST2)

- Stand alone table top kit with built in +/- 12V power supply.
- 50 x 50 mm x 2 nos. crystalline silicon solar cells mounted in aluminium tray.
- 11 different wavelength LED's @ constant 20 mA current to determine spectral response parameter. 1Pole/2W selector switch to select different wave length LEDs.
- White led bank of 8 LED's to determine carrier life time parameter.

List of experiments

- 1) Measurement of Carrier Lifetime for a solar cell.
- 2) Measurement of Spectral Response for a solar cell.

Mechanical :- 120(H) x 200(W) x 150(D) mm

Net Wt. :- 2.5Kg

C) SPV Stand- 2 Nos.

◆ SPV module details (Specification subject to change)

S. N.	SPV rating W/V/A/No. of cells per module	SPV dim. (HXWXT)	Rack dim. (HXWXD)	Profile size	SPV stands	Series parallel	Max rating	Default
1	20/21/1.2/36	485x350x22	910x530x300	30x30	2	Series	40W/42V	Yes
2	100/21/6.5/36	1150x675x35	1580x915x400	45x45	2	Series	200W/84V	--
3	250/43/9.2/72	1960x990x42	2385x1230x400	45x45	2	Series	500W/216V	--

◆ Instrumentation power supply cum multichannel DPM panel (EMT8)- 2 No.

- +12V, -12V, @500 mA. & +5V@300 mA.
- Multi channel DPM for temperature display.
- 20 pin FRC power bus to supply power to neighboring
- Green shrouded socket provided to extend earth

◆ SCR actuator cum sensor signal conditioning panel (EMT 9)- 2 No.

- SCR based AC controller to set intensity of halogen lamp.
- Supports signal conditioning circuit for temperature to give output 0-2.5Vdc.

D) Main rack - 1 No.

Consists of table top aluminium profile rack (45x45) holding various panels

◆ DC Application panel (ST3)

- Common 12V DC fan for both solar cell and SPV
- Separate LED lamps for 3V solar cell and 12V SPV
- 6V battery mounted from behind for solar cell

◆ DC voltmeter & DC Ammeter panel (EMT68)- 2 nos.

- DC voltmeter (0-50V)
- DC ammeter (0-5A) with polarity protection diode.

◆ Stand-alone Inverter Panel (ST5)- 1 no

- I/P DC voltage-10-15Vdc, O/PAC voltage- 230Vac
- O/P power rating- 210 VA

◆ MPPT Charge Control Panel (ST4)- 1 no

- Rated voltage- 12Vdc, Max current- 6A
- Max PV voltage-15V
- Min PV voltage-10V
- Battery rated voltage- 12V, Capacity- 7Ah
- Battery type- Lead acid

◆ Lamp load panel (EMT7)- 1 no

- 230V/15/40/60/100W x 3 bulbs with individual ON/OFF using 6A toggle switches.

◆ AC voltmeter & AC ammeter panel (EMT6)- 1 no

- Voltmeter: 300V, Ammeter: 0.5A

◆ Rheostat as load for SPV modules (600E/1A)- 1 no

List of experiments : Covers NISE/ DGET course curriculum

- 1) To study the I-V & P-V characteristics of PV module with varying radiation and temperature level
- 2) To study the I-V & P-V characteristics of series combination of PV module
- 3) To study the I-V & P-V characteristics of parallel combination of PV module
- 4) To show the effect of variation in tilt angle on module power
- 5) To demonstrate effect of shading on module output power
- 6) To demonstrate the working of diode as blocking diode
- 7) To draw charging and discharging characteristics of battery
- 8) Observe the O/P waveform of inverter in auto mode
- 9) Workout power flow calculations of standalone PV system AC load with battery
- 10) Workout power flow calculation of standalone PV system DC load with battery
- 11) Find MPP by varying the resistive load across the PV panel
- 12) To study effect of shading on the O/P of solar panel
- 13) To do shading analysis on the site where solar PV systems to be setup

14) Battery characteristics: To study battery characteristics by finding out battery capacity (Ah) based on manufacturers data & discharging curve (Cxx) experimentally.

- 15) To understand difference between MPPT & PWM charge controllers, efficiency of MPPT & PWM charge controller & energy flow in a system involving MPPT & PWM charge controller
- 16) To understand and determine the DC flow in a solar system
- 17) To understand how a solar PV standalone system works
- 18) To determine power flow in a solar system
- 19) To convert normal inverter to a solar inverter system
- 20) To compare the performance of two inverters using electro-scopie (Optional)
- 21) **IV/PV characteristics** of PV module on PC screen using VWB software, MPPT controller or data logger with its built in calculator & graph window/ IV Curve Tester (Optional)
- 22) To perform experiment of MPPT charge controller using **ST8** panel & **VWB** software with following algorithms/ schemes (Optional) i) Incremental Conductance ii) Perturb and Observe iii) 75% of VOC
- 23) Optional **DC solar pump** experiment needs **separate setup** containing DC pump, rotameter, turbine sensor, EMT68 panel.

E) Optional PC interface - STT needs following additional panels: ST8, CIP-II & one more EMT8 panel.

◆ MPPT charge controller Panel (ST8)- 1 no

- 2 IGBT modules, 1st for charging control & 2nd for load ON/OFF
- 5 nos of analog outputs AI (0-2.5V) for RE voltage, RE current, Battery voltage, Irradiance measurement & Load/ battery voltage
- 2 nos of DAC inputs for PWM control and load ON/OFF
- Built in battery- 12V/7Ah, Type: Lead acid

◆ Computer interface Panel (CIP-II)- 1 no

- Connects to PC (Win7/8/10) USB port through USB IO module & type A to mini B cable
- 8 ADC channels I/P: 0 to 2.5V FS with 1 no. input simulation pot. 2 DAC channels O/P 0-2.5V FS
- V to I function block: I/P 0 to 2.5V and O/P 0-20 or 4-20mA (100 ohm load) switch settable.
- I to V function block: I/P 4 to 20mA and O/P 0-2.5V
- USB converter to interface 25 pin D connector on CIP panel to USB enclosed in 25 pin D shell using type A to mini B type cable

◆ Software on CD

- Virtual Workbench (VWB) software package is a USB based software working on windows .net platform coupled with USB IO module useful as general purpose S/W utility which supports different control strategies like graph plotting in XY, MPPT controller etc.

◆ Mechanical : 545(H) x 960(W) x 300(D) mm,

Net Wt. :- 35Kg, Gross Wt. :- 45Kg.