VPL-PVT-IGMS

Intelligent Grid Management System

Intelligent Grid Management System which includes the following as a minimum

- 3 phase Double Bus Bar Distribution system with transmission line system and protection relay
- Energy Management system with Static and Dynam ic loads
- SCADA Panel Designer
- SCADA PLC
- 3 Phase Grid tied Photovoltaic system
- Industrial Battery storage systems which integrates into grid and remote-control using SCADA

Topics covered by the system as a minimum Hardware training Requirement of the intelligent Grid System:

Intelligent Grid System

Training contents:

- Basic circuits of a three-pole, double busbar system
- Three-phase, double busbar system with load
- Busbar changeover without interruption of the branch
- Preparation of algorithms for various switching operations
- Busbar coupling

Investigations on Three-phase Transmission Lines

Training contents:

- Voltage increases on open-circuit lines
- Voltage drop as a function of line length
- Voltage drop as a function of cos-phi
- Capacitive and inductive power losses on a line as a function of V and I
- Phase shift on a line

Ove rcurrent time protection for lines

Training contents:

- Designing and parameterizing overcurrent time protection
- Determining the reset ratio in the case of single-, double- and triple-pole short circuit
- Determining a relay's shortest release time
- Checking a circuit breaker's release behavior in the event of a failure

Training contents:

- Three-phase consumers with star and delta connections (R, L, C, RL, RC and RLC loads)
- Measurement with active and reactive energy meters:
  - for symmetric and asymmetric RL loads
  - in the event of a phase failure
  - in the event of over-compensation (RC load)
  - for active loads
  - in the event of energy-flow reversal
- Determination of the first and second power maxima
- Determination of the power maximum in the event of an asymmetric load
- Recording of load profiles

Training contents:

- Dynamic, three-phase load (asynchronous motor)

  Power measurement in the case of energy-flow reversal

Training contents:

- Operating an asynchronous machine and recording its characteristic parameters
- Calculating parameters for compensation capacitors
- Compensation using various capacitors
- Determining stage power
- Manual compensation of reactive power
- Automatic identification of a reactive power controller's connections
- Automatic compensation of reactive power

Training contents:

- Recording of module response over days and years
- Testing optimum alignment of solar modules (to increase energy output)

Note: Images given are for representation only and the final equipment can change according to its specifications.

INTELLIGENT GRID MANAGEMENT SYSTEM — VPL-PVT-IGMS

- Installation of photovoltaic systems
- Set-up and testing of a photovoltaic system with feed to the power grid
- Measurement of energy generated by photovoltaic systems
- Maximum Power Point (MPP) Tracking
- Limiting the power of the photovoltaic inverter (derating)
- Provision of reactive power
- Determining the efficiency of the power grid inverter
- Response to control of the power grid inverter
- Recording output data using sun passage emulator
- Investigating the response of a photovoltaic system when there is a power outage on the grid
- Lightning protecting for photovoltaic systems
- Economic benefits of photovoltaic systems
- Local-area network transformer
- Limiting the power of the photovoltaic inverter (derating)
- Automatic voltage control in a local power grid
- Operation and monitoring using SCADA
- Design and installation of the battery storage unit
- Putting the storage unit into operation
- Interaction between PV systems and storage units
- Boosting intrinsic consumption
- Remote control of energy storage units using SCADA software
- Optimizing operating response through smart consumers (loads)
- Storage unit integration into a smart grid
- Recording characteristics of solar modules

Hardware Equipment to include as a minimum Double busbar unit, three-phase, incoming I outgoing feeder (4 units)

- Switch elements:
  - 2x Isolators, with remote switching mechanism and auxiliary contact
  - 1x Circuit breaker 5A, with remote switching mechanism and auxiliary contact
- Indicators: status lamps for the isolators and the circuit breaker
- controlled by pushbuttons, control inputs or ethernet interface
- Inputs/outputs: 4mm safety sockets
- 2 Ethernet ports
- Acoustic alarm for warning and alarm signals
- Three-phase current measurement up to 5A
- 3 x three-phase voltage measurement up to 500 V
- Integrated monitors:
- Over-current, over-voltage, phase angle, voltage differential
- Control voltage: 24 V

Double busbar unit, three-Phase, coupler Panel

- Switch elements:
  - 2x disconnectors, with remote switching mechanism and auxiliary contact
  - 1 x heavy-duty switches 1 OA, with remote switching mechanism and auxiliary contact controlled by pushbuttons, control input or RS485 interface
- Indicators: status lamps for the power switches
- Inputs/outputs: 4mm safety sockets
- Control voltage: 24V

Transmission line Model 150 km / 300 km

- Resistance per phase: 3,60hm 7,2 Ohm
- Inductance per phase: 150mH 300mH
- Capacity per phase:
  - Line-to-line: 2 x 150nF 300nF
  - Line-to-ground: 2 x 0,551JF 1, 1IJF
- Max power consumption: 1 kW
- Voltage: 3x 400V; 50/60Hz
- Current: 2A

Time Overcurrent Relay

- Nominal frequency: 50 to 60 Hz
- Power consumption in the circuit path: 0.1 VA at IN=1A
- Thermal load capacity of current circuit:
- Surge current (half-wave) 250x IN
  - for 1 s 100x IN
  - for 1 Os 30x IN
  - continuous 4x IN
- Output relay:
  - Switch-on current: 20A
  - Nominal current: 5A
  - Max. contact rating:
  - 1250 VAIDC; 120WIDC, ohmic 500VA/AC; 75WIDC, inductive
- Trip parameters:
  - I > 0.5-2x IN
  - 1>1-15xIN
  - tl > 0-1 OOs
  - tl > 0-2.5s
- LED indicators:
  - "ON" for ready
  - I> and I» starting (flashing)
  - I> and I» tripping (permanently ON)
- Controls:
  - "TEST" button to initiate the self-test 6 potentiometers for adjusting operate and trip times 8 DIP switches for adjusting the characteristics
  - Adjustments for time factors and nominal data

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Ohmic load 3x 560 Ohm

- for parallel, series, star and delta circuits
- Resistance: 3 x 560 Ohm
- Current: 3 x 0,5 A

Adjustable 3-Phase Power supply, 0- 400V/2A

- Mains connection: 230/400V, 50/60Hz
- Output voltage: 3x 0 .. .400V, 50/60Hz variable by means of 3-phase regulating transformer (tolerance 0.5%)
- DC output 0 ... 250V
- Output current: 2.0A
- 4mm safety sockets (L 1, L2, L3, N, PE, L-, L +)
- 1 Voltmeter 0 .. .450V (moving iron instrument)
- 1 Ammeter 0 ... 3A (moving iron instrument)
- 3 Phase control lights
- 1 Measuring point selector switch L 1-N, L2-N, L3-N, L 1-L2, L 1-L3, L2-L3
- 1 Measuring point selector switch 11, 12, 13
- Protection: 3 thermo-magnetic device circuit breakers Motor protection switch adjustable from 1.6 ... 2.5A Undervoltage trip

Power switch module

- Nominal voltage: 230/400 V, 50/60 Hz
- Control voltage: 24 V
- Nominal operating current: 16A, ohmic
- Functions: 2 pushbutton switches and remote control for switch-off relay
- Indicators: signal lamps for "on" and "off"
- Contacts: 3 n.o. & 2 auxiliary

Three Phase Power Quality Meter with display and long-term memory

- Three-phase measurement of current and voltage 3x400 V/5 A
- Measurement of phase voltages, line-to line voltages and currents
- Determination of the apparent, active and reactive power
- Determination of active, reactive and apparent work
- Determination of the frequency and distortion factors for current and voltage
- Detection of mains harmonic oscillations and neutral conductor current
- Pulse measurement
- Peak and mean value detection
- Event logging
- Real-time clock
- Large-scale, contrast-rich graphic display with background illumination
- Display in tables, diagrams and vector diagrams
- Digital input and output for free configuration including functions
- Ethernet interface

Max. measurement values:

- Voltage P-P: 690 V
- Current: 5A

Fault tolerances:

- Voltage 0.2%
- Current 0.2%
- Apparent power 0.5%
- Active power 0.2%
- Reactive power 1 %
- Active energy Class 0.2
- Reactive energy Class 2
- Operating voltage: 110 V-230 V, 50/60 Hz

Lamp board 230 V

- Light bulp: 25 W
- Energy saving lamp: 4 W
- LED-bulp4 W
- Operating Voltage: 230VI 50/60 Hz
- 3 sockets E27

Inductive load, three-phase, 1kW

Consist of three inductive loads with the following taps:

- 1 ,2H (0,65A), 1 ,6H (0,5A), 2H (0,45A), 2,4H (0,35A), 2,8H (0,30A), 3,2H (0,25A)

Capacitive load, three-phase, 1kW

- capacity: 3 x 2/4/8/30 µF, 450 V

Ohmic load, three-phase, 1 kW

- Three synchronously adjustable circular rheostats
- Resistance: 3 x 750 Ohm
- Current: 3 x 2 A

Three-phase asynchronous motor, squirrelcage, 1kW

Three-phase asynchronous machine industrial model with pronounced pull-out torque

- Nominal power: 1.1 kW
- IE3, '1: 84,4%
- Nominal speed: 1445rpm
- Nominal voltage: 690/400, 50 Hz
- Nominal current: 1.45/2.55A
- cos phi: 0.75

Motor data must be provided via an electronic Interface

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Star-Delta switch

- Switch positions: 0 - star - delta (rotary switch)
- Contact rating: 690V, 12A, max

Reactive Power controller

- Operating voltage: 200-400V
- Frequency: 50/60Hz (48 to 62Hz)
- Control contacts: 6 floating relay contacts
- Load rating of the control contacts:
- Switch voltage according to VDE 0110 group S, 400V/AC;
- according to VDE 0110 group C, 250V/AC
- Switching current: 5A, maximum
- Rating: 1800VA, maximum

Switchable Capacitor Battery

- Capacitance values:
- State 1: 3 x 2 !-IF, 450 V, 50 Hz
- State 2: 3 x 4 !-IF, 450 V, 50 Hz
- State 3: 3 x 8 !-IF, 400 V, 50 Hz
- State 4: 3 x 16 !-IF, 400 V, 50 Hz
- Compensating reactive power: max. 1546 var

Machine test bench equipment set for servo-drive/ braking system

The servo-machine test bench iss a complete testing system for examining electrical machines and drives. It consist of a digital controller, a brake and control software.

The system allows manual and automated synchronization to be carried out.

The controller has the following features:

- Dynamic and static four-quadrant operation
- 13 selectable operating modes/machine models (torque control, speed control, flywheel, lifting drive, roller/calander, fan, pump, compressor, winding gear, arbitrarily defined time-dependent load, manual and automated network synchronization)
- Testing for the presence of a shaft cover.
- Disconnection of the supply voltage of the motor under test in the absence of shaft cover
- Interface for reading electronic nameplates EDD of the machines under test
- Integrated galvanically isolated amplifier for voltage and current measurement
- 5" colour touch display
- Four-quadrant monitor
- Isolated USB interface
- Thermal monitoring of the machine under test
- Connection voltage: 400V, 45 ... 65Hz
- Maximum power output: 10kVA

The brake is a self-cooled asynchronous servo-brake with resolver.

The machine has thermal monitoring and in conjunction with the controller, it constitute a driving and braking system that is free of drift and requires no calibration.

- Maximum speed: 4000rpm
- Maximum torque 30Nm
- Temperature monitoring: continuous temperature sensor (PT1000)
- Resolver resolution: 65536 pulses/revolution

The system is accompanied with a software for recording characteristics of machines and for determining dynamic and static operating points. It emulate eight different loads (fly-wheel, pump, fan, calander, lifting drive, compressor, winding gear, arbitrarily configurable time-dependent load) for which the parameters are able to be individually configured.

Some of the features include

- Measurement, calculation and display of mechanical and electrical variables
- (Speed, torque, mechanical power output, current, voltage, active, apparent and reactive power, efficiency, power factor)
- Simultaneous display of measured and calculated values (e.g. instant display of efficiency)
- Measurement of voltage and current (including RMS values even for nonsinusoidal waveforms)
- Configuration of settings via electronic nameplates EDD of the DUTs
- Speed or torque-controlled operation
- Recording of variables over time
- Programming of limiting values of speed or torque to prevent inappropriate loading of the machine under test.
- Operation in all four quadrants (display of generated torque)
- Arbitrarily defined ramp functions for PC-controlled load experiments
- Display of characteristics from several experiments to better illustrate the effect of parameter changes
- Export of graphics and measurements

Rubber coupling sleeve, 1kW

- Coupling guard, 1 kW, with LED lights as protection of rotating shafts between machies

Three-phase supply for electrical machines

- Outputs:
  - Three phase: L 1, L2, L3, N from 4-mm safety sockets
- Protective systems:
  - Motor protection switch adjustable from 6.3 ... 16A
  - Under voltage trip
  - Safety cut-out

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Motor protection switch, 3 pole, 1.8-2.5A

Power circuit breaker incorporating thermal overload trip and undelayed current trip.

- Contact rating: 500 VAC at 10A
- Nominal current: 1.8A ... 2.5A adjustable

Power switch module

- Nominal voltage: 230/400 V, 50160 Hz
- Control voltage: 24 V
- Nominal operating current: 16A, ohmic
- Functions: 2 pushbutton switches and remote control for switch-off relay
- Indicators: signal lamps for "on" and "off"
- Contacts: 3 n.o. & 2 auxiliary

Three Phase Power Quality Meter with display and long-term memory

Digital/analog multimeter, wattmeter, power-factor incl. Software

- Electrically indestructible up to 20 Al600 V
- Independent inputs for current and voltage
- Touch colour graphic display (5.7")
- Large-scale display or display of up to four values
- Digital display with bar graph
- Isolated USB port
- Internal resistance: current measuring circuit 10mOhm, voltage measuring circuit 10M Ohm

TRMS multimeter

- Voltage ranges: 30; 300; 600 V
- Current ranges: 1; 10; 20A
- Simultaneous waveform-dependent measurement of voltage and current (up to 600 V, 20 A) (Measurement of switched-mode voltage»
- Precision: 2%
- Automatic or manual selection of measuring range
- Demonstration meter for mains operation 230 V, 50 Hz
- Measurement of overall RMS value (RMS-AC+DC), RMS AC values (RMSAC) and arithmetic mean (AV-AC+DC)

Wattmeter

- Calculates actual, apparent and reactive power
- 0 - 10 AAC/DC, 0 - 600 V AC/DC

Power factor meter

- Power factor 0 - 1 - 0

PC-supported measurement

- Oscilloscope display of voltage, current and power
- Consumption meter to display power consumed and output
- Data logger for 14 different variables
- Data export for data logger

Solar module with solar altitude emulator

The solar module rack consists of a solar module and a halogen spotlight as solar simulator. Various rooftop angles able to be emulated using the tilt adjustment of the solar module. The halogen spotlight mounted in a manner to permit it to simulate the progression of the sun over a whole day/year.

Technical data - halogen spotlight:

- Power: 500W
- Power supply: 230 V

Technical data - solar module:

- No-load voltage: 21 V
- Short-circuit current: 650 rnA
- Peak power: 10 Wp

Load unit 1 kOhm, 500W

- Resistor: 0 ... 1 kOhm /500 W
- continuously adjustable, with stepped winding
- Current:
  - 0-50 Ohm max. 6A
  - 51 - 200 Ohm max 2A
  - 201- 1 k Ohm max 0.6A

Variable Ohmic load, three-phase, 1kW

- Resistance: 3 x 750 Ohm
- Current: 3 x 2 A

Solar panel emulator, 1.5 kW, 500 V

The solar panel emulator configurable to allow for realistic emulation of response.

The solar module emulator has the following features:

- It is configurable
- Able to configure partial shading of the solar panel
- Light intensity can be adjusted from 0% ... 100%
- It is possible to configure light intensity curves which change over time
- Open-circuit voltage: 500 V
- Closed-circuit current: 10 A
- Power output: 1500 W

3-phase industrial photovoltaic inverter

- Photovoltaic inverter consisting of an actual inverter, a monitoring unit and a DC circuit breaker
- Feed management conforming to EEG2012 via separate communications interface
- Power reduction adjustable from 0 to 100% in 1 % steps
- Adjustable power factor from 0.8 capacitive to 0.8 inductive
- Integrated web server user interface
- USB port for remote operation via SCADA Power Lab
- Integrated DC circuit breaker
- Overload voltage protection for photovoltaic and bus terminals

Note: Images given are for representation only and the final equipment can change according to its specifications.

- DC input voltage range: 250-1000V
- Output voltage: 3x400 V
- Power output: 3200 W

Isolating transformer, Three-phase, 1kW

- Input voltages: 3 x 400V
- Output voltage 1: 3 x 400V, 2 A
- Output voltage 2: 3 x 30V, 1.25A
- Power rating: 1000 VA, for a short time: 2000VA
- Vector group: Dyn5
- Protection: 1 automatic circuit breaker 1.8-2.5A, adjustable

Three-phase variable transformer with motor drive

- Primary: 3x up to 400 V windings
- Secondary: 3x 0 ... 450 V, 2 A windings
- Nominal power: 1000 VA
- Frequency: 50/60 HZ
- Vector group: Yan0
- 24 V input/"Increase voltage" button
- 24 V input/"Decrease voltage" button
- Protection: 1 automatic circuit breaker, (adjustable)

Photovoltaics Battery with Inverter and Battery Management

The training system consist of a 3- phase multidirectional inverter with battery storage that can inject and extract electrical power into the grid. In addition, the inverter has to have a 3-phase output as an un interruptible power supply (UPS), designed as an online UPS to supply critical systems.

The battery storage system has the following features:

- NMC Li-Ion battery
  - Battery voltage: 48 V
  - Nominal capacity 50 Ah 12434 Wh
  - Calendar Life @ 80% SOC: 20 years
- Multidirectional converter
  - Rated voltage: 3x 230 V
  - Rated power: 9 kVA
  - Frequency: 50 160 Hz
- Online UPS
- Touch Display
- Interface: Ethernet
- Power meter
- Programmable controller

SCADA SOFTWARE

The program is designed for the control and monitoring of power engineering systems. In the software all measured values and operating states displayed on existing system instrumentation in real time.

Furthermore, important parameters and signals are able to be controlled by the software. The measured values and equipment operating states able to be selected, recorded, depicted with respect to time and finally evaluated and exported.

Software functionality include as minimum:

- Symbolic equipment arrangement of all Hardware equipment on the screen
- Standardised electronic circuit symbols for the circuit visualisation
- Freely configurable circuit setup
- Individually configurable tabular list of as many measurement values as desired
- Real-time display of measured values and operating states
- Recording and plotting of measured values in diagrams
- Processing, analysing and export of diagrams
- Integrated soft PLC
- SCADA Viewer
- SCADA Panel Designer
- SCADA Remote Client / Server
- SCADA OPC DA 2.02 Client
- SCADA IEC 61850 Client
- Implementation and analysis of intelligent grids

The systems provided with all the necessary connection leads and connectors

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VPL-PVT-WET

Solar/Wind Energy Training System

The Solar/Wind Energy Training System has the capability to train students in photovoltaic, small wind turbines, solar and wind hybrid systems, and the electronic components required to support these electricity-generating devices. The system allow the student to install, operate, and maintain photovoltaic and small wind systems, as well as learn troubleshooting techniques through the use of instructor-inserted faults.

The training system contain the following equipment:

Mobile Workstation (Assembled):- 1 Qty.

- The Solar/Wind Energy Mobile Workstation consists of a sturdy, Welded Steel frame painted using powder coated paint for a durable surface.
- The unit is mounted on four swivel casters with a locking mechanism that allow easy motion and stable operation.
- The workstation includes two perforated work surfaces for module installation and operation.

Power Usage Monitor 1 Qty

Digital Multimeter 1Qty

- Type Digital, handheld (portable)
- Functions AC/DC voltage, dc current, resistance, continuity diode test, and battery test
- Accuracy ±2.0% or better
- Display 3% digit, liquid-crystal
- Safety-recessed test lead connections, low battery indication, audible continuity, overload protection, mounted on a base that clamps to the work surface using quick-lock fixations

Power Inverter with Remote Control 1 Qty.

- The Power Inverter with Remote Control consists of a 1 kW dc-to-ac
- Converter that converts 12 V dc power to 120 V ac power
- Type Pure sinusoidal power inverter (with remote)
- Input Rating 12 V dc
- Output Rating 120 V ac
- Power Rating 1 kW

Battery Bank 1Qty

- The Battery Bank consists of a 12 V dc, 110 A-h, deep-cycle, sealed, lead-acid, absorptive glass mat (AGM) storage battery designed to store electrical energy produced from renewable energy sources such as solar power and wind power

Solar Charge Controller 1Qty

- Type PWM series battery charging (not shunt), with temperature sensor Rating 12 V dc, 30 A dc

Battery Bank Junction Box 1Qty.

- The Battery Bank Junction Box contains a 30 A dc circuit breaker and a 0.5 A dc ground-fault protection device (GFPO).

Stop Switch 4Qty.

- The Stop Switch consists of a 50 A SPDT "break-before-make" switch used for stopping the mechanical rotation of the wind turbine generator shaft during servicing or maintenance. The Stop Switch first disconnects the battery bank, then short-circuits the generator output
- AC Outlet 3Qty.
- The Electrical AC Outlet consists of a 120 Vac electrical outlet that is used to provide a power source for devices requiring a standard, NEMA-type electrical outlet.

DC Lamp Socket 3 Qty.

- Rating 12 V dc, 5 A dc

Ammeter 1 Qty.

- Power Outputs: Ratings 12 V dc, 5 A dc
- Quantity: - 4 pairs of +/- power output terminals
- Power Input: Ratings 12 V dc, 5 A dc
- Fault Switches 4
- Fuse Protection: -Rating 250 V dc, 5 A dc

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Photovoltaic Module Assembly 1 Qty.

- The Photovoltaic (PV) Module Assembly consists of a solar photovoltaic module that operates at a voltage of 12 V dc and generates a nominal amount of 85 W of electrical power from solar energy.

DC Power Distribution Panel 1 Qty.

- Power Outputs: Ratings 12 V dc, 5 A dc
- Quantity: 4 pairs of +/- power output terminals
- Power Input: - Ratings 12 V dc, 5 A dc
- Fault Switches 4
- Fuse Protection: - Rating 250 V dc, 5 A dc

Wind Turbine Generator with DC Motor 2 Qty.

- The Wind Turbine Generator with DC Motor comprises a 90 V permanent magnet dc motor operating at 1800 rpm. This motor is mechanically linked to the wind turbine shaft in order to simulate wind energy. A version comprising a 180 V dc motor is also available.

Disconnection Switch (Horizontal Mount) 1Qty.

- The Horizontal-Mount Disconnect Switch consists of a 40 A SPST horizontally mounted disconnect switch used for a multitude of purposes in conjunction with the Solar/Wind Energy Training Systems, such as opening the connection between the battery bank and the solar module, the wind turbine, the dump load, and the power inverter

Solar Array Junction Box 2 Qty.

- DC Disconnect: -
  - Maximum System Voltage 27.4 V
  - Maximum System Current 8.07 A
  - Rated Maximum Power-Point Voltage 17.9 V
  - Rated Maximum Power-Point Current 4.84 A
  - Rated Charge Controller Output Current 30 A
- Solar Array Disconnect/Circuit Breaker: -150 V dC,8A dc, resettable.

Disconnection Switch (Vertical Mount) 1Qty.

- The Vertical-Mount Disconnect Switch consists of a 40 A SPST vertically mounted disconnect switch used for a multitude of purposes in conjunction with the Solar/Wind Energy Training Systems, such as opening the connection between the battery bank and the solar module, the wind turbine, the dump load, and the power inverter.

Sun Simulator Assembly 1Qty.

- Power Requirements: Current 5A
- Service Installation Standard single-phase outlet
- Lamp: -
  - Type Quartz flood, with a five-minute timer switch
  - Rating 120 V ac, 600 W

Diversion Load Controller 1 Qty.

- The Dump Load consists of a resistor used to convert into heat the excess electrical energy produced by the Solar/Wind Energy Training Systems once the battery bank is fully charged.
- Dump Resistor 0.5 n, 100 W

DC Motor Controller 1 Qty.

- The DC Motor Controller, a component of the Wind Simulator, is used to vary the speed of the dc motor to which it is connected
- Power Requirements: Current 5A
- Service Installation Standard single-phase ac outlet
- Controller: -
  - Type Variable speed
  - Input Rating 115 V ac, 50/60 Hz
  - Output Rating 0-90 V dc, 3.5 A dc

Dump Load 1Qty

- The Dump Load consists of a resistor used to convert into heat the excess electrical energy produced by the Solar/Wind Energy Training Systems once the battery bank is fully charged.
- Dump Resistor 0.5 n, 100 W
- Accessories Package 3 Qty.
- Outlet Bulb Socket: Quantity 4
- Lamp: -
  - 1 LED at 120 V ac and 2.5 W
  - 1 LED at 12 V dc and 2.5 W
  - 1 fluorescent lamp at 120 V ac and 13 W
  - 1 fluorescent lamp at 12 V dc and 13 W
  - 1 pack of 4 incandescent lamps at 120 V ac and 60W
  - 1 incandescent lamp at 12 V dc and 25 W
- Battery Charger: -
  - Type, Voltage, Quantity Smart, 12 V dc, 1 Power Requirements for the Battery Charger:-
  - Current 2.4 A
  - Service Installation Standard single-phase outlet
- 4 mm Safety Plug Leads: -
  - 7 green of 30 cm (11.81 in)
  - 3 green of 90 cm (35.43 in)
  - 5 black of 90 cm (35.43 in)
  - 5 black of 120 cm (47.24 in)
  - 10 white of 120 cm (47.24 in)
  - 2 mm Banana Plug Leads: -
  - 10 red of 60 cm (23.62 in), 1 0 black of 60 cm (23.62 in)

DC Circuit Breaker 1Qty.

- The DC Circuit Breaker consists of a resettable 50 A dc circuit breaker used to protect low voltage devices.

Photovoltaic Systems Textbook 1Qty.

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kWh Meters with AC Circuit Breaker Box 1Qty.

- The kWh Meters with AC Circuit Breaker Box consists of two kWh meters and a circuit breaker box. One of the kWh meters is used to measure the power transmission to/from the utility grid, while the other is used to measure the power transmission tol from the electrical power source (e.g., solar panels, wind turbine).
- The circuit-breaker box contains three resettable ac circuit breakers.
- Type Analog
- Rating 120 V ac
- Circuit-Breaker Box
- Two-pole circuit breaker 120 V ac, 30 A ac, resettable, quantity: 1
- One-pole circuit breakers 120 V ac, 15 A ac, resettable, quantity: 2
- Wind Power Textbook 4 Qty.
- AC/DC Wall Switch 1 Qty.
- The AC/DC Wall Switch consists of an ac/dc toggle switch for turning power on or off to any electrical device connected to the module terminals. A switch on the rear of the module allows selection of the type of current (ac or dc) supplied by the wall switch. The ac and dc circuits of the wall switch are electrically isolated one from the other.
- Type SPST
- Rating (DC) 120 V, 5 A
- Rating (AC) 120 V, 11 A
- Fault Switches 1

Connection Cables Kit 1 Set

- The Connection Cables Kit provides all the connection cables required to connect the different components of the Solar/Wind Energy Training System

Lockout/Tagout Module 1Qty.

- The Lockout/Tagout Module consists of an SPST switch used to teach students the principles of safety procedures when working with electrical equipment.
- Student and Instructor Manuals 1

Power Bus Bar

- The Power Bus Bar consists of a 12 V dc power bus bar fitted with positive and negative rails used for distributing electrical power to/from the battery bank. Terminal screws on the positive and negative rails allow connection to the bus bar.
- Terminals Positive and negative terminal screws
- Rating 48 V dc, 150 A dc

COURSEWARE:

The system courseware cover the following topics:

Energy Fundamentals

- Sources of Energy
- Power and Work
- Measurements and Units

Trainer Familiarization and Safety

- Trainer Components
- Safety Practices
- Lockout/Tagout Procedure
- Proper Grounding
- Equipment Protection

Solar Module

- Siting
- Photovoltaic Module
- Charge Controller
- Loading
- Battery Bank

Wind Turbine

- Siting
- Turbine Generator
- Stop Switch
- Loading
- Battery Bank

Solar/Wind Systems

- Diversion Load and Controller
- DC to AC Inverter
- Power Consumption
- Power Efficiency
- Power Transmission and Distribution
- On/Off Grid Operation
- Hybrid Generator
- Troubleshooting

Going Green

- Solar Energy History
- Wind Energy History
- Solar/Wind Energy Careers

HARDWARE DESCRIPTIONS:

Power Requirements

- Voltage: 120 V - 60 Hz/220 V-50 HzI240 V-50 Hz
- Current: 15 A for 220 V/1 0 A for 240 V

System Physical Characteristics

- Dimensions (H x Wx D): 86.4 x 43.2 x 40.6 cm (34 x 17 x 16 in)

Mobile Workstation

- The Mobile Workstation is constructed of heavy-gauge steel finished with baked, scuff-resistant enamel paint.
- The workstation provide sufficient space for performing the exercises and for storing all components when not in operation.

Note: Images given are for representation only and the final equipment can change according to its specifications.

SOLAR/WIND ENERGY TRAINING SYSTEM VPL-PVT-WET

- The workstation occupy a volume comprised by the following dimensions: (W x H x D) 92.75 x 88 x 33.5 in (235.6 x 223.5 x 85.1 cm).

Solar Module

The Solar module include at least the following components:

- One (1) Battery Bank with Sealed Lead- Acid Battery
- One (1) Battery Bank Junction Box
- One (1) Diversion Load Controller
- One (1) Dump Load
- One (1) Lockout/Tagout Module
- One (1) Power Bus Bar
- One (1) Solar Charge Controller
- One (1) Power Inverter with Remote Control
- One (1) Junction Box
- One (1) Photovoltaic panel enclosed in a protective cover that can be tilted
- One (1) 600 W projector lamp that is used to simulate the sun
- One (1) 5-minute timer switch to turn off the projector lamp and protect the photovoltaic panel from overheating

Wind Module

The Wind module include at least the following components:

One (1) Wind Turbine Generator driven by a DC Motor

- Energy Approximately 30 kWh/mo at 5.8 m/s (13 mph)
- Swept Area 1.07 m2 (11.5 ft2)
- Rotor Diameter 1.17 m (46 in)
- Startup Wind Speed 3.58 m/s (8 mph)
- Voltage 12, 24, and 48 V dc
- Turbine Controller Microprocessor based smart controller
- Body Permanent mold-cast aluminium
- Blades Three blades, injection-molded composite
- Synchronous Generator Permanent magnet brushless
- Overspeed Protection Electronic torque Control
- Survival Wind Speed 49.2 mls (110 mph)
- Mount 1.5 in schedule 40 pipe with a 48 mm (1.9 in) outer diameter
- Wind Speed Operating Range 3.6-22 mls (8-49 mph)
- Optimum Wind Speed Range 11-15 m/s (25-32 mph)
- One (1) DC Motor Controller
- One (1) 50A SPDT stop switch for stopping turbine rotation of the wind turbine generator

Accessories

Accessories include at least:

- Thirty (30) with 4mm, safety plug
- Twenty (20) with 2mm, banana plug
- One (1) 12 V DC Battery Charger

VPL-HTEG

Hydro Turbine Energy Generator

FEATURES:

- A complete demonstration of conversion of Mechanical Energy into Electrical Energy
- Good quality Pelton wheel in double hemispherical cup/ bucket
- Compact Hydro Turbine with digital voltage and current measurement
- Various load applications like resistive bulb and fan are provided with the product
- Robust and transparent casing to observe Pelton wheel rotation with changing water flow
- 304 grade SS tank for storing water
- Easily transportable

TECHNICAL SPECIFICATIONS:

- Water Pump: 0.5HP, Single Phase, 50Hz
- Ammeter: 0 to 2A
- Voltmeter: 0 to 100V
- Load Resistance SOU
- DC output: 20V, 1A
- Pelton wheel PCD: 100mm
- Nozzle Diameter: 5mm

Note: Images given are for representation only and the final equipment can change according to its specifications.

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VPL-KNX-HATS

KNX Controlled Home Automation Training System

FEATURES:

- This System included different KNX component e.g. Power Supply module, USB module, line coupler module, push button with multifunction module 4 fold, push button with multifunction module 2 fold, output actuator module, 4 fold with current detection, dimming actuator module 2 fold, shutter actuator module, 4 fold and different types of load like lamp load, curtain.
- ETS software is provided for configuration and programming of different KNX devices.
- User friendly, self explanatory system.
- Practice troubleshooting skills.
- Experiments configurable through patch board.
- Enhanced electrical safety considerations.
- Caster wheel (with locking mechanism) at the legs of Work-bench for easy movement.
- MCB provided with AC supply for safety purpose.

TECHNICAL SPECIFICATIONS:

Protection module: 1 no.

- Protection module: Combined 10A DP MCD and RCD (RCBO), 30mA.

Power Supply, 640mA module: 1 no.

- Power: 230V ± 10%
- Output voltage: 28 to 31V
- Output current: 640mA
- Additional output: 30V DC auxiliary voltage

USB module (Din rail mounted): 1 no.

- Operating voltage: 21-32V
- Operating temperature: -5 to 45?C

Line coupler module: 1 no.

- Operating voltage: 21 to 31V
- Operating temperature: -5 to 45?C
- Functions: Can be used as line/area coupler

Push button with multifunction module, 4 fold: 1 no.

- Operating voltage: 21 to 31V
- Operating temperature: -5 to 45?C
- Operation: Programmable button 4/8

Push button with multifunction module, 2 fold: 1 no.

- Operating voltage: 21 to 31V
- Operating temperature: -5 to 45?C
- Operation: Programmable button 2/4

Output actuator module, 4 fold with current detection: 1 no.

- Operating voltage over bus: 21 to 31V
- Auxiliary voltage: 230V
- Resistive load: 20AI230VAC, 20AI24VDC
- Manual operation button: 4 no. of mechanical bypass

Dimming actuator module, 2 fold: 1 no.

- Operating voltage over bus: 21-32V
- Control voltage: 230V
- Electronic transformer: 400W per channel
- Operating temperature: -5 to 45?C
- Output channel: 2 nos

Shutter actuator module, 4 fold: 1 no.

- Operating voltage over bus: 21-32VDC
- Auxiliary voltage: 230V

Bulb load: 1 no.

- Power: 5W

Tube light load: 1 no.

- Power: 5W
- Curtain: 1 no.

Experiments:

Study and use of:

- Engineering Tool Software (ETS) (License free)
- Programming and configuration of KNX devices using ETS software
- Protection module
- Power supply module
- USB module (din rail mounted)
- Line coupler module
- Push button with multifunction module, 4 fold
- Push button with multifunction module, 2 fold
- Output actuator module, 4 fold with current detection
- Dimming actuator module, 2 fold
- Shutter actuator module, 4 fold
- On/Off the bulb load using output actuator module 4 fold, binary switch with manual switch
- On/Off the bulb load using output actuator module 4 fold and pushbutton module 2 fold.
- Control curtain up/down movement using of shutter actuator module 4-fold and pushbutton module 2 fold.
- Control dimming and onloff action of bulb load using dimming actuator module 2-fold and pushbutton module 4 fold.

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