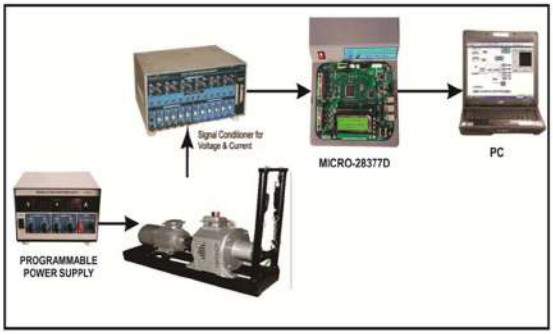
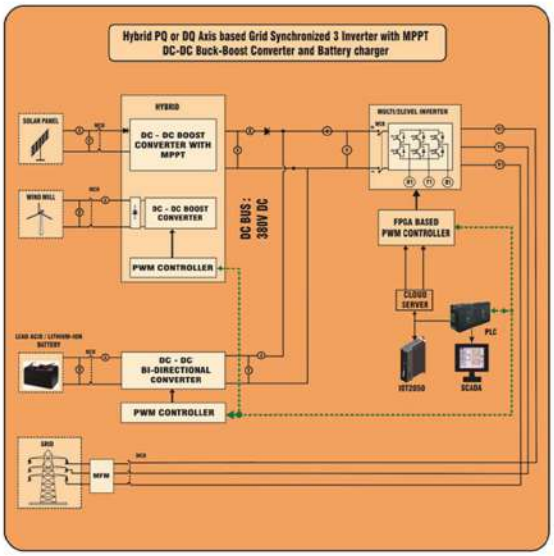
ADVANCED SPECIAL R & D PRODUCTS





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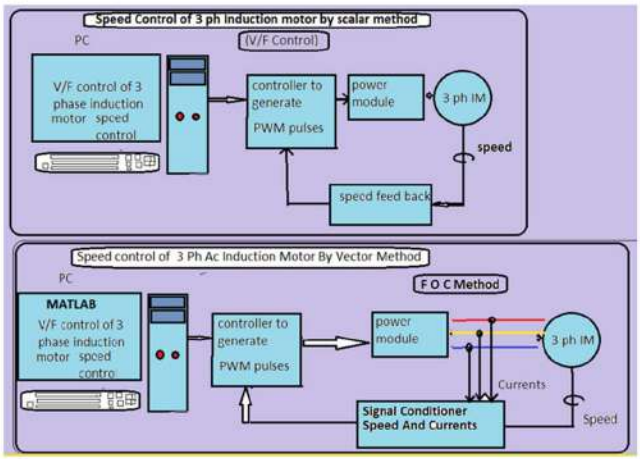
INDEX

1. MATLAB - FOC AND DTC BASED 3ϕ INDUCTION MOTOR DRIVE TRAINER

- One more Innovative Product from our R&D Department: FOC & DTC control of Induction Motor.
- As it is very clear from the block diagram, a V/F control is only a scalar control and having lot of disadvantages, whereas FOC & DTC are vector control and it is much better control of torque and speed for Induction Motor. It would be a very useful tool for Research Students
- We are pleased to introduce our innovative PRODUCT for "MATLAB SIMULINK BASED FOC & DTC CONTROL FOR 3ϕ INDUCTION MOTOR" for YOUR EEE ADVANCED DRIVES LAB. And it would be a ideal set up for Lab Experimentation and Research students, especially for Power Electronics & Drives lab.



Sl.No.	Description of Item	Qty
a.	DUAL CORE DELFINO BASED DSP DEVELOPMENT BOARD	1
b.	IPM BASED POWER MODULE WITH VOLTAGE & CURRENT SENSORS SETUP	1
c.	1 HP THREE PHASE AC MOTOR – SPRING BALANCE LOAD SET UP WITH QEP SENSOR	1
d.	Field Oriental Control Implementation in MATLAB-SIMULINK	1
e.	Direct Torque Control Implementation in MATLAB-SIMULINK	1

a. DUAL CORE DELFINO BASED DEVELOPMENT BOARD (MICRO 28377D)

- The Micro-28377D Trainer kit is intended and developed for advanced closed-loop control applications for Power electronics, Smart grid etc..,
- The inbuilt peripherals of the processor lead to uncomplicated design for the developers in the emerging technology. The onboard Delta Sigma modulator meant for current measurement of Power electronics, Drives, Smart grid & Power systems

Features:

* Dual- Core 32-bit Delfino fixed point Processor
* Operating Speed: 200MHz (For each core)
* 32-bit floating-point unit (FPU) which supports floating point operations
* Trigonometric Math Unit (TMU) to speed up the execution of trigonometric Operations
* Viterbi, Complex Math, and CRC Unit II (VCU-II) to accelerate the performance of FFT's and communications-based algorithms
* Two CLA real-time control co-processors that run at the samespeed as the main CPU's
* Parallel processing capability effectively doubles the computational performance
* 1MB (512KW) of onboard flash memory with error correction code (ECC)
* 204KB (102KW) of SRAM
* 16 Channels (16-bit/12-bit at 1.1 MSPS/3.5 MSPS) Successive Approximation ADCs
  16 Enhanced PWM outputs, 6 Enhanced Capture Inputs
* 3 (12-bit) Buffered DACs
* 2 SDFM with 8 Input Channels and PWM synchronization
* External memory interface 16/32 bit support
  192 dedicated PIE vectors
* MCU/DSP balancing code density & execution time
  Single cycle read-modify-write instruction

ON Board Features:

* 16 Numbers of user LEDs
* 2 Numbers of Limit Switches for user interface
* 4 Numbers of Push-Button Micro Switches
* 1 SPDT Switch for user interface
* 20 × 4 Alphanumeric LCD
* 256MB of SDRAM
* Quadrature Encoder Interface
* Opto-isolated USB Interface
* Opto-isolated USB to Serial Interface
* Opto-isolated on board USB to JTAG Emulator
* PWM Outputs and Capture Inputs are terminated at 34-pin FRC connector
* 16 Channel ADC inputs are terminated at 26-pin
* FRC connector with buffered and protection
* DAC outputs and sigma Delta ADC inputs are terminated in screw type connector.
* External Emulator facility.
* Compatible with MATLAB SIMULINK

b. IPM BASED POWER MODULE

* Power Module is designed for Motor control Applications upto 3 HP by using the 3rd Generation IGBT & DIODE Technology Based IPM.
* Input : 1 Phase /3 phase 50 Hz AC.
  Output : 400V/10A (MAX), AC/DC on each Leg of 3 phase Bridge

IPM (INTELLIGENT POWER MODULE) — MODEL : [PEC16DSMO-1]

* 1200V, 25A, 3 Phase IGBT Inverter Bridge
* 1200V, 10A IGBT for over voltage Breaking
* Built - in over voltage, under voltage, over current & over Temperature Protection

ADDITIONAL FEATURES

* 1200V, 25A Converter Bridge for AC-DC power conversion
* 4 Nos of Hall Effect current sensors to sense the DC Link current & 3 output current of the Inverter Bridge
* 1 No of Hall Effect Voltage sensor to sense DC Link voltage
* All the PWM signals are isolated using Opto Isolator
* Protection circuit for over current with LED indication
* Optically Isolated Fault signal from the IPM is given to the Embedded/DSP controllers for protection.
* Independent Power supplies for all Isolated circuits.
* 0-900V Voltmeter to Indicate the DC Link Voltage
* All current, PWMS & Feedbacks are terminated at Front panel
* FRC Connectors are provided to Interface with the Embedded/DSP controllers
* All the Input/ Output Lines are terminated at Banana sockets.

c. 1 HP THREE PHASE AC MOTOR – SPRING BALANCE LOAD SET UP WITH QEP SENSOR — MODEL : [PEC165ACSQ1]

This set up consists of one number of (1) Three phase AC motor coupled (2) Mechanical spring balance load set-up (3) Quadrature Optical encoder (512 PPR)

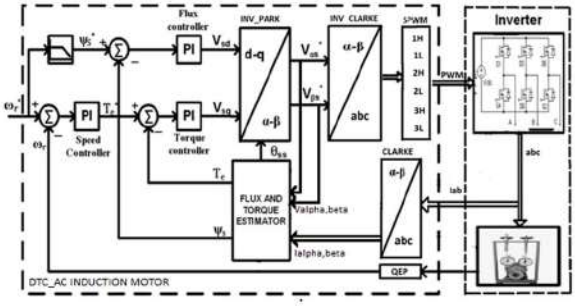
AC MOTOR SPECIFICATIONS :

Three phase squirrel cage induction motor.

Power	:	1hp (.75kw)
Current	:	2 Amp, star connection
Three phase 200Vac 50Hz input		
Speed	:	1390 rpm
Make	:	Siemens

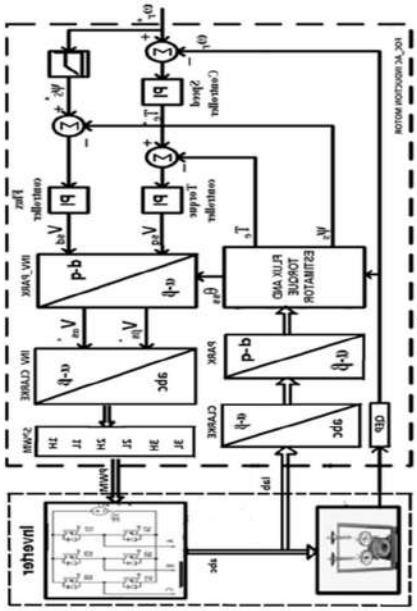
Quadrature Optical encoder for Speed feedback

d. Direct Torque Control Implementation



* Flux and torque estimated using voltage model
* To sense the speed & position QEP512ppr sensor used
* Minimum running speed : 100rpm
* Motor can run in both direction
* Vd,Vq, Id, Iq speed flux theta and Torque parameters will be displayed in PC
* User can give Ref speed command from PC
* Speed, Torque and flux regulation done with PI controller
* Set Speed, Actual Speed and Torque are made available at 3 DAC Outputs for Monitoring on DSO.
  * A set speed profile can be set using SIGNAL FILTER of MATLAB for the Research Scholars to test the performance of DTC implementation

e. Field Oriental Control

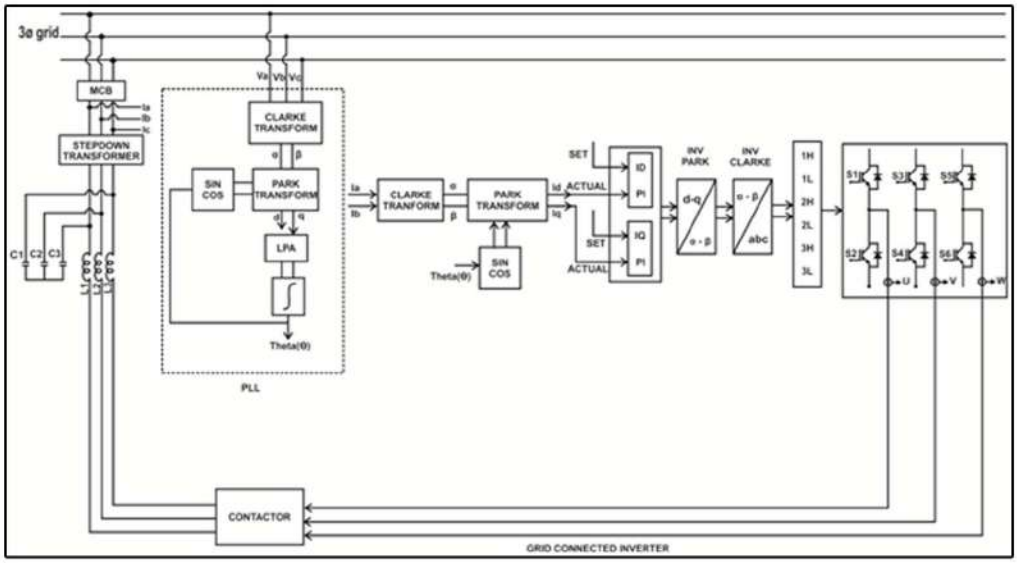


* Algorithm based on Rotor-flex-oriented control
* Sensored control utilizing a voltage source inverter
* Dynamic independent control of speed and torque
* Having minimum running speed of 100 RPM
* Four Quadrant operations.
  * The 3-phase stator currents are measured. This measurement provides ia, ib and ic. The rotor velocity is also measured.
  * The 3-phase currents are converted to a 2-axis system. This conversion provides the variables iα and iβ from the measured ia, ib and ic values. iα and iβ are time varying quadrature current values as viewed from the perspective of the stator.
  * The 2-axis coordinate system is rotated to align with the rotor flux using a transformation angle information calculated at the last iteration of the control loop. This conversion provides the Id and Iq variables from iα and iβ. Id and Iq are the quadrature currents transformed to the rotating coordinate system. For steady state conditions, Id and Iq will be constant.
  * Error signals are formed using Id, Iq and reference values for each. The Id reference controls rotor magnetizing flux. The Iq reference controls the torque output of the motor. The error signals are input to PI controllers. The output of the controllers provide Vd and Vq, which is a voltage vector that will be sent to the motor.
  * The Vd and Vq output values from the PI controllers are rotated back to the stationary reference frame using the angle. This calculation provides quadrature voltage values Vα and Vβ.
  * The Vα and Vβ values are transformed back to 3-phase values Va, Vb and Vc. The 3-Phase voltage values are used to calculate new PWM duty cycle values that generate the desired voltage vector.
  * The entire process of transforming, PI iteration, transforming back and generating PWM is Illustrated in the Figure.

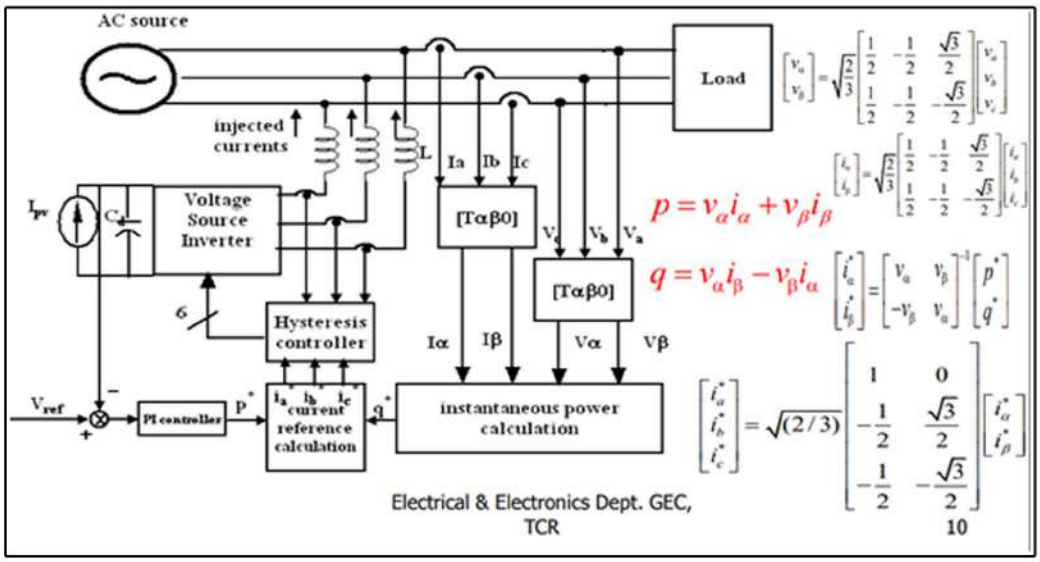
2. Hybrid PQ or DQ Axis based Grid Synchronized 3ϕ Inverter with MPPT DC-DC Buck-Boost Converter and Battery charger

- We offer Grid Connected/Synchronized 3ϕ Inverter Trainer with 2 types of Grid Synchronizing Techniques
  - i. PQ Theory Based Instantaneous real and reactive power control
  - ii. DQ Based abc-dq controller with SPWM, for Hybrid PV System, Wind Turbine & Battery System
- The main objective of this trainer is to demonstrate to achieve high-performance decoupled control of the active and reactive powers injected to the grid from Hybrid Solar, Wind & Battery energy resources by 2 types of Grid Synchronizing Techniques. .The VSI employs PQ Theory or dq axis control technique to independently control (Decoupled) the active and reactive power flow to the three-phase grid. This demonstrates the Control Schemes of Grid Interactive Inverter Systems

The following figure shows the implemetation of dq axis control technique.

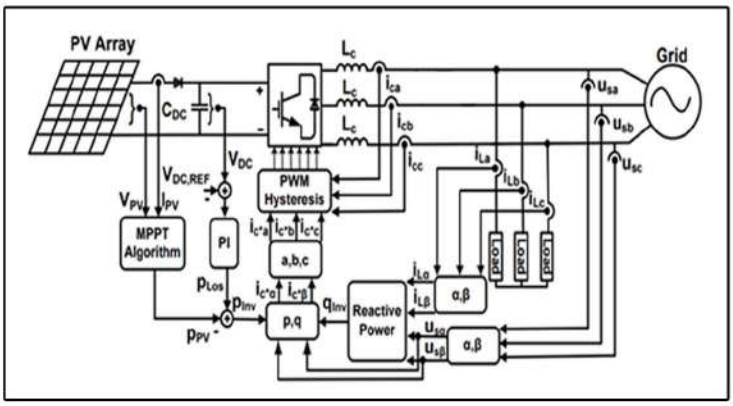


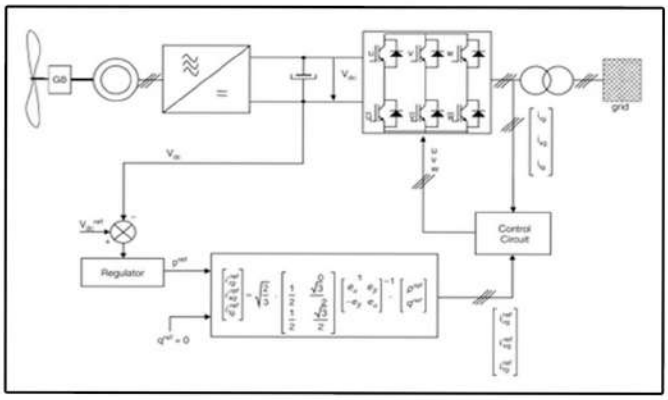
The following Figure shows the implementation of Instantaneous reactive power (PQ theory) which controls the active and reactive power in the output of the inverter

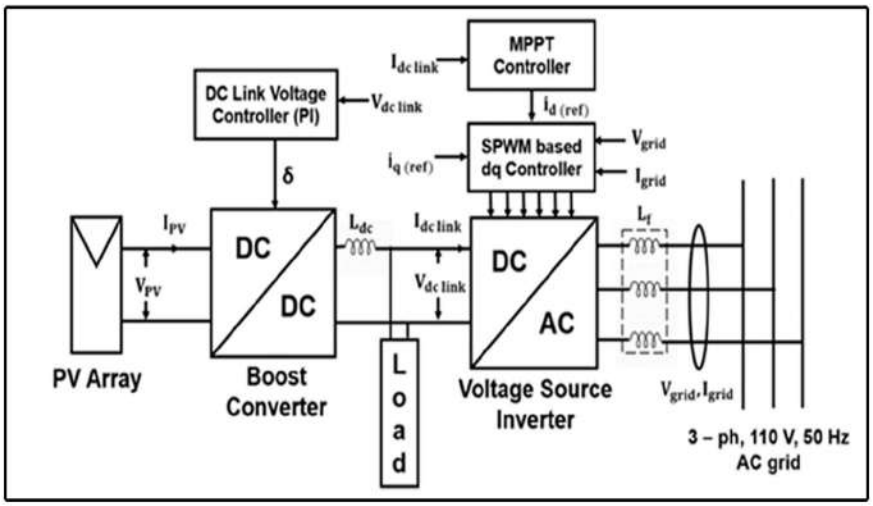


- *A three-phase inverter controlled by Instantaneous real and reactive power theory (PQ theory) based PI controllers.*
- *Three Phase Grid Connected Photovoltaic System with Active and Reactive Power Control Using "Instantaneous Reactive Power Theory"*
- *The photovoltaic (P/V) system, with maximum power Point tracking (MPPT), connected to a three phase grid is also incorporated. Instantaneous reactive power (PQ theory) which controls the active and reactive power in the output of the inverter*
- *The VSI also employs dq axis control technique to independently control the active and reactive power flow to the three-phase grid.*

- *A simple two stage power electronic interface using boost converter and voltage source inverter for grid tied PV array system has been modelled and tested.*
- *Experiments can been conducted on a PV array of 1000W and a 3-phase utility grid of 415V,50 Hz.*
- *The I-V and P-V characteristics of the constructed PV array can be obtained under different irradiations through experiments.*
- *A dq controller has been developed for the VSI using which autonomous control of both real and reactive power fed to the grid is achieved with MPPT.*
- *The dc link voltage is maintained constant at 120V by the DC-DC Boost Converter for PV and Wind.*
- *A DC-DC Buck Boost Bidirectional Converter provided for the 120V Battery and charging from the DC Link Bus and will be energy source during PV and Wind non availabity.*
- *The gate pulses for the IGBTs used in boost converter for PV & Wind, Bidirectional DC-DC Buck –Boost Converter and*
- *VSI are generated using 800MIPS, Dual Core DSP Processor TMS320F28377D.*
- *The hardware of the complete system is implemented with 1000W PV array, 1000W Wind Turbine and 120V,26A Battery System feeding a three-phase 415V,50 Hz grid. Both simulation and experimental results are furnished to demonstrate the efficacy of this developed Trainer.*
- *abc-dq controller with SPWM technique is implementation for the control of inverter*
- *The output of the inverter is synchronized with the grid through a Phase Lock Loop (PLL) circuit.*
- *The VSI converts the dc link voltage into 3-phase ac supply to feed power to the utility grid.*
- *In order to achieve independent control of real and reactive power at the inverter output terminal, SPWM based dq controller is employed*
- *To extract maximum power at any irradiation, a reference current, id(ref) is to be determined which is achieved by the MPPT controller with Incremental conductance algorithm*



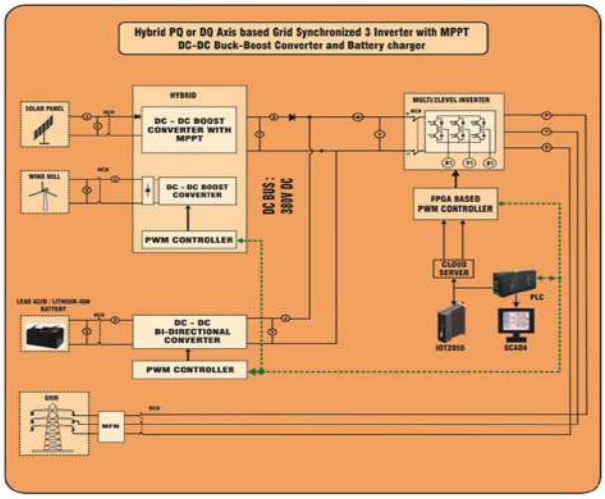




- Two Front End Boost converters for Solar & Wind, one Buck-Boost Converter for Battery Charging – Boosting the battery voltage to DC Bus, IPM based 3Φ Inverter, PQ Theory based instantaneous power Control & DQ Axis based Grid Synchronization are provided to study the Renewable solar & wind based MPPT and Grid connected 3Φ Solar PV & Power wind turbine Generation

- Arrangement provided so that each section, MPPT algorithm, DC-DC Boost Converter, DC-DC Buck- Boost conversion for battery, DQ based 3Φ Inverter, DSP Controller techniques can also be studied using MATLAB SIMULINK Blocks.

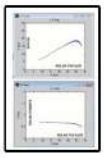
* Three phase grid synchronized inverter for solar PV panels & Wind Turbine
  * PLL based grid synchronization
  * Control algorithm based on instantaneous power theory; and operation of Grid Synchronized inverter
  * A TMS320F28377D based DSP Controller provided to implement DQ Axis algorithm with Space Vector Modulation.
  * AC output voltage: 415V ±10%, Three Phase, 50Hz
  * Power rating: 1 kVA(max



2nd IPM Power Module Provided for Solar Boost Converter Section. Wind Turbine Boost Converter Section & Battery Charging Section

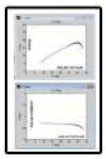
Solar Boost Converter Section

* One LEG of 2 IGBT provided for Boosting the Solar Panel output to 120V DC Bus.
* Output power 1000W,
* Input 80-120V from Solar Panel & Output 120V DC
* Switching frequency < 20kHz
* Designed for Solar Panel: 1000W
* Boost convertor operation in open loop & close loop mode
* Two MPPT algorithm Perturb & Observe
* Real time P-V and I-V curve can be updated and analyzed anytime



Wind Turbine Boost Converter Section

* One LEG of 2 IGBT provided for Boosting the wind Turbine output to 120V DC Bus.
* Output power 200W,
* Input 30-60V from Wind Turbine & Output 120V DC
* Switching frequency < 20kHz
* Designed for Wind Turbine : 1000W
* Boost convertor operation in open loop & close loop mode
* Two MPPT algorithm Perturb & Observe
* Real time P-V and I-V curve can be updated and analyzed anytime



IPM BASED POWER MODULE SECTION AS INVERTER

* Power Module is designed for Motor control Applications upto 3 HP by using the 3rd Generation IGBT & DIODE Technology Based IPM.
* Input : 1 Phase /3 phase 50 Hz AC.
  Output : 400V/10A (MAX), AC/DC on each Leg of 3 phase Bridge

IPM (INTELLIGENT POWER MODULE)

* 1200V, 25A, 3 Phase IGBT Inverter Bridge
* 1200V, 10A IGBT for over voltage Breaking
* Built - in over voltage, under voltage, over current & over Temperature Protection

ADDITIONAL FEATURES

* 1200V, 25A Converter Bridge for AC-DC power conversion
* 4 Nos of Hall Effect current sensors to sense the DC Link current & 3 output current of the Inverter Bridge
* 1 No of Hall Effect Voltage sensor to sense DC Link voltage
* All the PWM signals are isolated using Opto Isolator
* Protection circuit for over current with LED indication
* Optically Isolated Fault signal from the IPM is given to the Embedded/DSP controllers for protection.
* Independent Power supplies for all Isolated circuits.
* 0-900V Voltmeter to Indicate the DC Link Voltage
* All current, PWMS & Feedbacks are terminated at Front panel
* FRC Connectors are provided to Interface with the Embedded/DSP controllers
* All the Input/Output Lines are terminated at Banana sockets.

2. 1000W Solar panel

Make	:	Reputed approved by MNRI
No of Panels	:	For 500W, 100W - 5Nos.
Peak Power of Module	:	1000 Watts
Temperature	:	-40 to 90°c
Wind Load	:	UP to 200kmph
Humidity	:	0 to 100%
Type of cell	:	Poly crystalline silicon
Lamination Type	:	Vacuum Laminated Glass to ladler
Voc of each module	:	21 Volts
Voc of 1KW setup	:	210 Volts
Fixing mechanical setup		

2. 1000W Wind Turbine fixed in the roof

- 48V Wind Generation
- 1KW Wind Turbine
- Three Blades
- Nominal Voltage 48V
- Maximum Power 1000W
- Start Wind speed 2m/s
- Rated Wind Speed 13m/s
- Rated revolution 450r/m
- Security wind speed 50m/s
- Wind wheel diameter 2.4m
- Lead number : 3
- Blade material : Nylon Fibre
- Generator : Three phase Permanent magnet Synchronous Generator.
- Wind mill tower height 12 feet with stay wire

4. DUAL CORE DELFINO BASED DEVELOPMENT BOARD (MICRO 28377D)

◆ The Micro-28377D Trainer kit is intended and developed for advanced closed-loop control applications for Power electronics, Smart grid etc.., It is also focused for students to learn the multi-processor architecture and the inter processor communication mechanisms. The inbuilt peripherals of the processor lead to uncomplicated design for the developers in the emerging technology. The onboard Delta Sigmamodulator meant for current measurement of Power electronics, Drives, Smart grid & Power systems.

Features

- Dual- Core 32-bit Delfino fixed point Processor
- Operating Speed: 200MHz (For each core)
- 32-bit floating-point unit (FPU) which supports floating point operations
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  - Two CLA real-time control co-processors that run at the same speed as the main CPU's Parallel processing capability effectively doubles the computational performance
- 1MB (512KW) of onboard flash memory with error correction code (ECC)
- 204KB (102KW) of SRAM
  - 16 Channels (16-bit/12-bit at 1.1 MSPS/3.5 MSPS) Successive Approximation ADCs 16 Enhanced PWM outputs, 6 Enhanced Capture Inputs
  - 3 (12-bit) Buffered DACs & 2 SDFM with 8 Input Channels and PWM
- synchronization
- External memory interface 16/32 bit support
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- 256MB of SDRAM
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- Opto-isolated USB to Serial Interface
- Opto-isolated on board USB to JTAG Emulator
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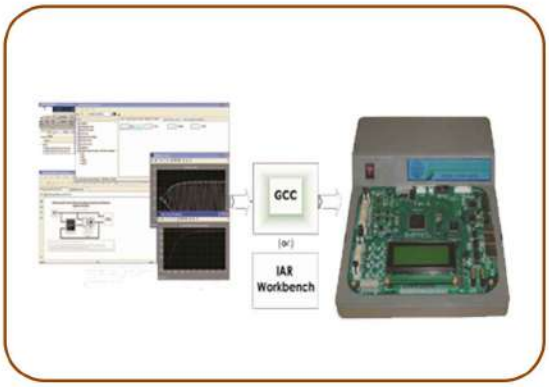
- 16 Channel ADC inputs are terminated at 26-pin FRC connector with buffered and protection
- DAC outputs and sigma Delta ADC inputs are terminated in screw type connector.
- External Emulator facility.
- Compatible with MATLAB SIMULINK



Battery Charging Section

a. Power Circuit

- One LEG of 2 IGBT provided for Charging the Battery in BUCK Mode
- IGBT will act in BOOST Mode and converts the Battery Voltage of 120V DC to 120V DC Bus.

b. 12V Battery Bank - 12V/26AH x 10 Nos

- 12V / 26AH - 10Nos connected in Series.
- 120 volt output to the Inverter.

3. 10 CHANNEL DATA AQUIZITION SYSTEM FOR AC INDUCTION MOTOR

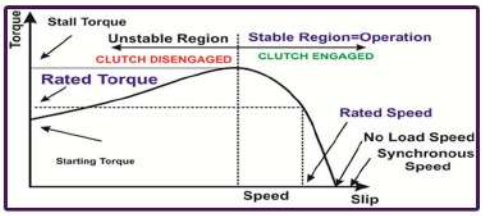
This Analyzer consists of 10 Channels for Current, Voltage, Speed, Torque measurement module, Signal Conditioning Module for Voltage and Current waveforms of AC Supply to AC Induction Motor. The Conditioned outputs are applied to a powerful DSP Board and then to PC, where a Powerful MATLAB –SIMULINK Based software displays all parameters and various waveforms of all the Voltage & Current and Draw various Characteristic Plots like Load Vs Speed, Torque Vs Speed of ACIM, Harmonics, on PC

SENSORS:

- 3 Hall effect 3Phase Voltage Sensors
- 3 Hall effect 3 Phase Current Sensors
- Proximity Sensor Input for Speed Measurement
- Load Cell to Measure torque.

AC- DC Signal Conditioning Module with 25 KHz frequency Band width

- 3 Phase measurement using Hall effect sensor up to 25 KHz Voltage inputs (500V AC & DC, 25 KHz) and 3 AC & DC current input (0.... 25 A, 25KHz)
- After signal conditioned, Voltage outputs and Current outputs are terminated at connectors
- Power input from the AC Machines are connected through banana socket with fuse protection.
- Housed in a powder coated stickered cabinet.

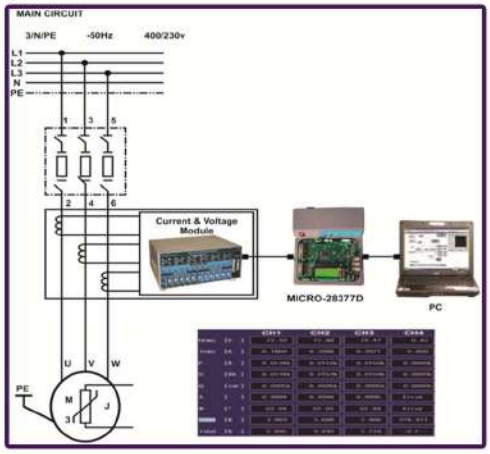


Features

- 1Hp AC Motor Coupled with a Eddy Current Load.
  - One Digitally Controlled DC Power Supply with PC Interface for
  - Discreetly Vary the DC Output to the Eddy Current Load.
- 3 Phase Supply to Stator of AC IM.
- 3 Phase Voltage & Current Waveforms AC.
- Numeric value for 3 phase Voltage & Current.
- Numeric value for RMS Voltage & Current.
- Numeric value for power factor, active power and reactive power.
- Harmonic measurement and FFT.
- 3 Phase peak voltage and current

Ploting:

- Load Vs Speed
- Load Vs Torque
- Speed Vs Torque
- Efficiency



1. 1 HP THREE PHASE AC MOTOR EDDY CURRENT LOAD SET UP WITH PROXIMITY SENSOR AND LOAD CELL

- This set up consists of one number of (1) three phase AC motor (2) mechanically coupled with Eddy load with load cell (3) Proximity Sensor (4) Load cell for Torque measurement

AC MOTOR SPECIFICATIONS :

- Three phase squirrel cage induction motor.
  - Power : 1hp(.75kw)
  - Current : 1.8amp,star connection
- Three phase 415vac 50hz input
  - Make : Siemens (4 Pole Motor)
- Proximity sensor as a Speed Sensor

EDDY CURRENT LOAD SET-UP:

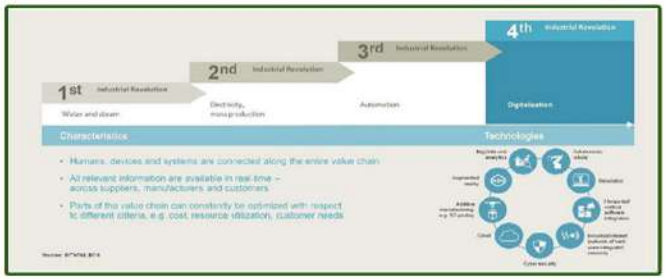
- 1.5 HP rating
- 0-30V, 2Amp current rating
- 1500 rpm speed
- Electronic DC voltage controller provided for torque variation
- Load cell with signal conditioner
- Load Cell Provide for Torque Calculation.

Vi Microsystems Pvt. Ltd.

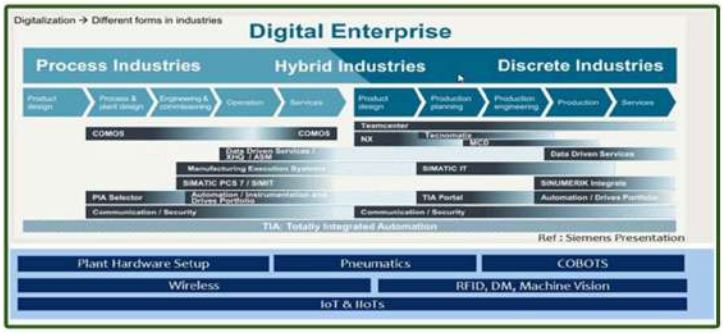
4. Industrial DCS-COMOS-SIMIT TRAINER FOR DIGITAL TWIN

siemens Diditalization-Leveraging digital technology trends for concrete customer benefit

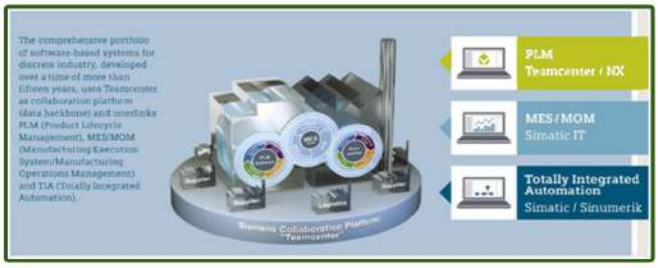
- Our World is becoming ever more connected. Billions of intelligent devices and machines generate massive amount of data, creating a bridge between real and virtual worlds. Turning these vast amounts of data into value is a key success factor. In addition to regular automation, digital solutions are helping plant owners and operators to increase productivity, efficiency and create progressively innovative products. We are already able to offer the technologies of tomorrow – both hardware and software, for more efficiency, sustainability, and security
- Digitalization starts with the layout and design of the production process. Using an optimum software solution is essential to minimize design cost and time and provide for consistent data management. This digital thread is continued during installation and commissioning. Virtual testing and pre-commissioning of all automation and technological functions using state-of-the art simulation tools reduces setup times and failures alike.



Industry 4.0 – The next level of Manufacturing



Digital Enterprise Software Suite

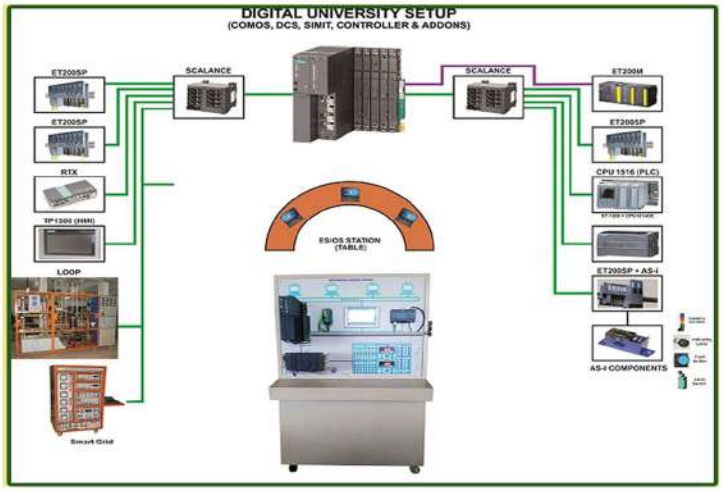


Integrated Engineering: Virtual and Physical environments are being brought together.

- With COMOS, SIMATIC PCS 7 & SIMIT, Siemens is the only company in the world to offer the process industry a software solution for the integrated management of plant projects – from engineering and operations to modernization as well as dismantling
- COMOS ensures that engineers and operators can access all project-relevant data at all times, across all company levels and in all project phases. SIMATIC PCS 7 is more than a DCS; it is Powerful, Flexible and Scalable. SIMIT is the automation simulation tool to simulate the automation and the process of any complex plant.

Based on Siemens DCS Software PCS7 with its AS410 controller, a Industrial DCS has been designed. The basic unit consists of following Components.

i) Virtual Design/Simulation /Implementation Software
   SIMIT : Simulation Software for Virtual Commissioning of a Plant
   DCS Software : SIMATIC PCS7 Version 9.0
ii) Distributed Control System-SIMATIC PCS 7 Controller
   AS410 Smart DCS Single/Redundant Controllerfor PCS7.
iii) Distributed I/Os
   ET200PA – Distributed I/O Module



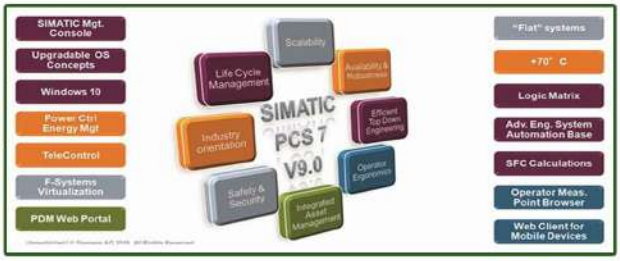
i) DCS Software SIMATIC PCS 7 Ver9.0 (3 Licenses)

* Ideal Software for control system in various infrastructures that can be implemented in Energy, Power Plant, Transportation,Pharmaceutical, University etc.,

* Supports Profinet for Industrial Networking in Digital Transformation of Discrete & Process Industry by providing plant wide communication in realtime for BigData.

List of PCS 7 Software Packages

- Advanced ES V9.0 (FL)
- AS RT PO (CO: 2000, FL)
- AS Engineering V9.0 (FL)
- BATCH Units (CR: 10, SL)
- BATCH Single Station User V9.0 (SL)
- BATCH Single Station System V9.0 (SL)
- BCE V9.0 (FL)
- IEA V9.0 (FL)
- Maintenance ES V9.0 (FL)
- Maintenance RT (CR: 200, SL)
- Management Console V9.0 (SL)
- Management Agent (CR: 10, FL)
- OpenPCS 7 Station / OS V9.0 (SL)
- OS Engineering V9.0 (FL)
- OS RT PO (CR: 2000, SL)
- OS Server V9.0 (SL)
- OS Single Station Basic V9.0 (SL)
- OS Web Server Basic V9.0 (SL)
- PDM Basic V9.1 (FL)
- PDM Extended V9.1 (FL)
- PDM Integration in STEP 7 V9.1 (FL)
- PDM Routing V9.1 (FL)
- PDM Server V9.1 (SL)
- PDM TAG (CR:100, FL)
- Route Control Routes (CR: 10, SL)
- Route Control Center V9.0 (FL)
- Route Control Engineering V9.0 (FL)
- Route Control Server V9.0 (SL)
- S7-PLCSIM V5.4 (FL)
- SFC-Visualization V9.0 (FL)
- SNMP-OPC-Server Basic V14.0 (SL)
- SNMP-OPC-Server Power Pack V14.0 (SL)
- Version Cross Manager V9.0 (FL)
- Version Trail V9.0 (FL)
- Logic matrix V9.0
- OS Web Server (CR: 5, SL)



ii) Distributed Control System – Simatic PCS 7 Controller

AS410 Smart DCS Single/Redundant Controller for PCS7.

SIMATIC PCS7 AS 410 SMART UC PO800,CPU410 smart process Automation for S7-400 and S7-400H with 1X 120/230V UC 4A power supply, with UR2(9 slots) steel sub Rack, with system expansion card up to 800 process objects, already assembled and tested.

- Supply voltage : 5 VDC @1.7A
- Ram For program : 4 MB For Data: 4 MB
- Load Memory, Integrated : 48 MB
- Number of S7 Connections : 120
- Interface X1 : PROFIBUS DP
- CPU : Multiprocessor, 450MHz
- Interface X5 : PROFINET IO WITH 2 PORTS
- Interface IF1 : Sync module slot
- Interface IF2 : Sync module slot

iii) ET200PA –Distributed I/O Module

ET200PA is a Scalable and extremely flexible distributed I/O system for connections of Process Signals to PCS7 via Profibus

i) D/I Module – 32Channel
ii) D/O Module – 32Channel
iii) AI Module – 8 Channels
iv) AO Module – 8 Channels

iv) SIMIT – Siemens Solution for Automation Process Simulator

Simulation is one of the key essential tools in Process Automation, which helps to address all customer needs during project execution phase. This is mainly required to:

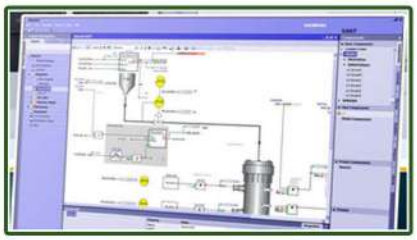
- Reduces risk and time during commissioning phase
- Improves Program code quality by pre-testing and analysis
- Assures shorter Time-to-market; as it shortens project duration and delivery time

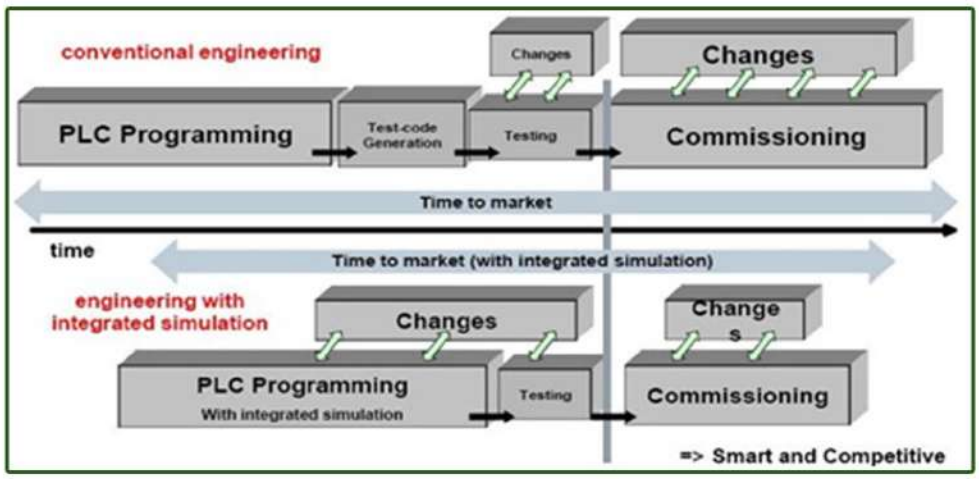
Why SIMIT Simulation

- With training simulators one can repeat the steps as many times to keep updated with mandatory knowledge of safe plant operation.
- Training on simulator is much safer and less costly than on actual plant
- Extreme situations can only be trained on a simulator as training on an actual plant might result in loss of people and equipment.
- Supports import of schematic from COMOS and PCS7
- Provided with Chem basic library for chemical and pharmaceutical plant simulation
- Integration of various 3D designing software like NX with flexible interfacing option like SHM coupling
- To Improve automation engineering & easy configuration of PLC Sim Advanced
- An ideal tool to study the Switch gear components
- Tight Integration of COMOS, SIMIT, PCS7 & NX (CAD,CAM,CAE)

SIMIT provides real time dynamic simulation for S7/PCS 7 projects, with or without hardware availability. Typical simulation purposes:

- I/Os and connection check Logic and Control loop check
- Alarm and messaging test
- Sequence test
- Interlock check
- HMI controls and visualization test
- Acts as Virtual Controller
- Operator training system
- For simple to complex processes
- Virtual commissioning and operator training of challenging automation projects and plant operation.
- Faster commissioning of complex projects
- Tight integration of SIMIT is connected to proper actuators and sensors.





Optional:

COMOS Plant Simulation Software

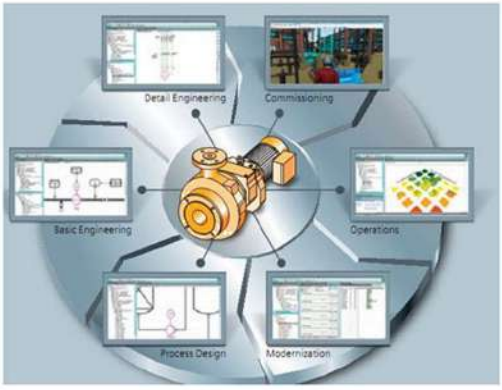
Integrated software solution for EI & C and fluidics as well as function and automation planning in a single system.

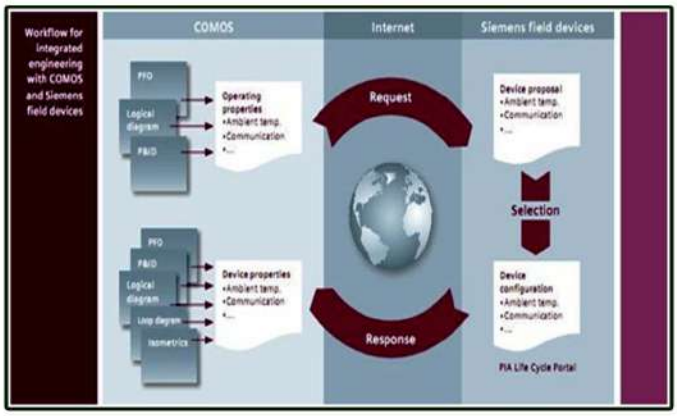
Electrical, instrumentation and control engineering as well as the automation of processes represent important parts of plant engineering and may comprise of a large amount of data. The safe and reliable transfer of this data necessitates optimum integration of the individual disciplines

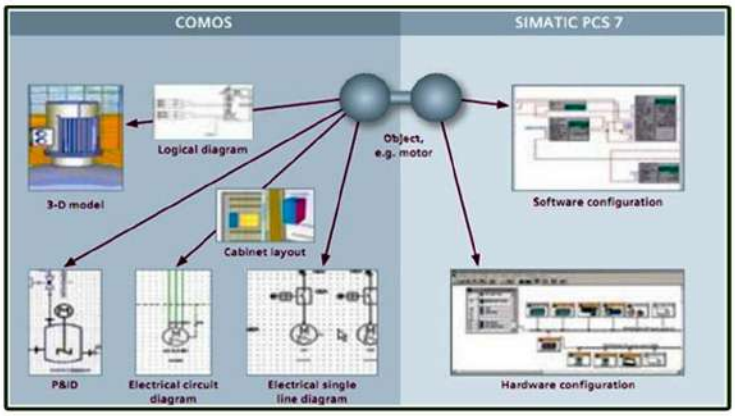
This is where COMOS Automation comes in as the ideal software solution as it guarantees seamless data consistency from the electrical engineering right down to the full automation of complete systems. With COMOS EI&C, COMOS Fluidics and COMOS Logical, all areas of EI&C technology, control technology, fluidics, function planning and automation are covered and optimally interlinked.

This facilitates consistently controlled bidirectional data flows between the individual disciplines. Also optimum interlinking with the COMOS Process and COMOS Operations modules is ensured. This results in improved quality, minimized expenditures and increased productivity.

COMOS: Comprehensive Information Management Life Cycle with PCS7 & SIMIT Integration







The complete plant information is stored in a central database. As a result, COMOS allows all disciplines and departments involved in the engineering and operating phases to always access the same data for a given object. Objects can be processed in COMOS bidirectional on data sheets as well as in technical drawings. This means that changes to objects or documents are always available to every user worldwide, whatever the time zone, and that they are up-to-date and consistent. The entire plant, right down to the individual components, can be examined and further developed from a functional and interdisciplinary perspective

The open system architecture of COMOS can be adapted to exactly meet company-specific requirements, allows links to third-party systems and can be integrated into existing EDP (Electronic Data Processing) landscapes.

The Add on unit consists of

SIEMENS IoT 2040 Gateway based IoT Development System

SIMATIC IoT 2040 is an Industrial IoT Gateway, reliable open platform for collecting, Processing and transmission data. It helps the students to get the industrial IoT experience and develop Industry 4.0 Projects rapidly.

IOT 2040 Gatway

- PLC and sensors of many brands can be integrated through Ethernet & Serial ports.
- Open Protocols: Modbus, Profinet, REST or MQTT, AMQP, OPC UA
- Based on Intel Quark X1020 , (x86)@400MHz
- Compatible With Open Source Software Arduino IDE and Yocto Linux
- High level language support : Java, Python, C/C++
- 1 GB RAM, 8MB Flash ,256KB SRAM
- Micro SD card Slot up to 32GB
- Arduino Uno – R3 Compatible
- Intel Wi-Fi + Bluetooth Module for 300MB data rate

Add on Modules in IoT2040

* 2Nos of RS485 slave modules with feature like
  - 2 Nos of Digital Inputs and 2 Nos of Digital Outputs
* 1No of RS232 module with feature like
  - 2 Nos of Digital Inputs and 2 Nos of Digital Outputs
* 802.11 b/g/n standard
* 1Mbps data rate

Zigbee End Device with sensor

* 802.15.4 protocol
* 250Kbps data rate

LoRaWAN End with sensor

* LoRaWAN uses lower radio frequencies with 8 longer range
* LoRaWAN uses the 863-870 MHz

Wi-Fi Bluetooth Card

* Dual-stream (2x2) & Dual-band.
* Wi-Fi plus Bluetooth 4.0 product with Wi-Fi Direct combines faster speeds (up to 300 Mbps).

5. LV SWITCH GEAR & PROTECTION TRAINING MODULES

1. SCADA BASED SWITCHGEAR APPLICATION TRAINER

This Trainer consists of i) A Powerful PLC, S7-1200 ii) PLC Programming Software

iii) SCADA Software iv) A Switch Gear Panel.

S7 - 1200 PLC

This Training kit based on Siemens S7-1200 controller which is modulator, versatile, scalable & flexible with integrated PROFINET interface. Many features like Pulse Outputs, PWM etc for speed and position control of stepper and servo motors make it as an Ideal PLC for advanced training purpose.

Specification:

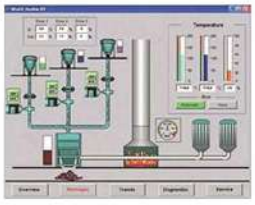
* Make : Siemens
* PLC : S7-1200
* Model : CPU 1214C-DC/DC/DC
* Digital Input : 14 Nos
* Digital Output : 10 Nos
* Analog Input : 2 Nos
* Analog Output : 1 No
* Bit processing speed 0.1 Microcontroller
* Ethernet communication interface (TCP/IP Native, ISO on TCP)

PLC Programming Software

* Windows based powerful software provided to write program in Ladder Language & FBD (Function Block Diagram)
* Siemens PLC programming software, IEC 61131 standard
* Simatic Step 7 - Version 12 software has been used for develop the functional blocks and ladder diagram programming in PLC S7-1200

Wincc SCADA Software

* Functionality and user – friendly user interface
* An Integrated Database and plant intelligence
* Numerous options and add-ons
* A Scalable process Visualization system



Switch Gear Panel

- 3 Nos of 4 pole contactors, 8Amp One Industrial Timer Module
- One Electronic Overload Relay, 0.3Amp to 7Amp settable One in MCCB, 8Amp used for stall protection
- One 1hp AC induction motor with Spring Balance load
- Fixed on a frame so that students can correctly wire these components for conducting many Experiments

Switch Gear Panel

This Experimental Panel is fitted with 3 nos of Contactor, One Electronic Overload Relay to conduct many Experiments.

* 4 Pole Contactors
  - Integrated suppressor Diode
  - Screw type Terminals, Size : S00
  - Suitable for PLC outputs
  - Control Supply Voltage : 230V AC
  - Auxiliary Contacts : 4 Nos.
  - 230V AC, 6Amp.
* Electronic solid state Over Load Relay
  - 1....4A for Protection : Size S.
  - Class 5....30 adjustable
  - Screw type Terminals
  - NC/ NO Aux Contacts – 1no each.
* Overload Protection phase feature protection & unbalance protection
* Intelligent ground fault detection.
* Industrial Timer Module

3RP1531-1AQ30
Industrial Timer

3RH1140-1AB00
Contactor

3RB2113-4PB0
Electronic Overload Relay

Experiments: (12 Nos)

1. Configure as Star Delta Starter
2. Configure for Forward Running of Motor
3. Configure for Reverse Running of Motor
4. Configure for Over Load Tripping.
5. Study of solid state Relays features.

2. LV SWITCH GEAR & PROTECTION COMPONENTS STUDY TRAINER

- Vi Microsystems Pvt. Ltd., Pioneer in Designing & Manufacturing Engineering Lab Equipments for 30 years, proudly brings out another few special Innovative Technology Solutions for Power Electronics & Drives, Power Systems, Smart Grid, etc., to give in depth knowledge.
- We are happy to introduce the following Demo kits which can help the students & Staff to understand the components of Siemens contactor, Timer, MCB, MCCB with ETU etc., for Switch Gear and Protection Lab of EEE Department.
- Contactor and MCCB are one of the popular components for Switch gear and protection. Using contactor and Timer, a Star-Delta Starter can be designed, so that the student can wire these switch gear components to implement a Star-Delta starter. Optionally, a PLC can be also used to integrator these switch gear components.

Sl.No	Siemens Switch Gear Components for Experimentation	Qty
1	3VL Series MCCB	01
2	3VT 1Series MCCB for line protection	02
3	HRC Fuse, Size00, 125Amp	03
4	Motor Protection Circuit Breaker (MPCB) a. 3VU13 MPCB 1NO+1NC Aux contacts, 32Amp, 3Poles b. 3VU16 MPCB 1NO+NC Aux contacts, 10Amp, 3Poles c. 3VU13 MPCB 1NO+1NC Aux contacts, 415V, 6Amp	02
5	Bi-metal Thermal Overload Relay Kit a. 3UA Series OLR, Siemens b. 3 Pole Adjustable Bi-metal over load Relay c. Can be used for direct mounting to the 3TF series Relay # Power Relay contactor 3TF Series - Contactor size : 0, 3 Pole - Rated current : 12A - Auxiliary Contactor : 1 No	01
6	3RB2 – Microprocessor based overload Relay	01
7	3RU – Microprocessor based Thermal overload Relay	02
8	3RW30 Digital soft starter for 1HP Motor	01
9	5SL6, 2 Pole, 6Amp MCB	03
10	5SL6, 3 Pole, 6Amp MCB	01
11	Residual current breaker operator – RCBO * Instant protection against electrical shocks & fires * Current operated mechanism * Fit to 35mm DJN rails * Betagard 5SU43, 25Amp rated current * 30Amp rated residual current	03
12	S-D Starter Star Delta Starters Assembles (3TE02]	01
13	3RT20 – Power RLT contactors for AC3 motor applications with Remaining Life Time (RLT)	01
14	Reverse DOL Starter (RDOL) 3RE13	01
15	3 Phase 1HP Electric Motor with Accessories	01
16	3 Phase 3HP Electric Motor with Accessories	01
17	PAC3200 Meters	06

3Φ Current Injection Source (0-100A) for Testing the MCCB

* Three auto transformer provided for current adjustment.
* Three loading transformer used for current source.
* Current output terminated in the banana-sockets.
* Three digital meter used to indicate current.
* Specification : Current range: 0-100Amp AC (Continuously variable)
* One no. of Digital timer

Sample Experiment: Star Delta Starter Design using 3 Contactor, Timer & MCCB

* 3 Contactors of 8Amp
* One Industrial Timer module.
* Fixed on the Frame to correct wiring of contactors, timers and motor. # One MCCB , 8Amp is used for stall protection

3RH2140-1KB40

3RV2

3RA2423

3RB2133-4QW1
Electric overload relay

3RW3013

3RW4024

PAC3200

List of Experiments

- Design of Star – Delta Starter using contactors and Timer for 1/3hp motor
- Configure a Soft Starter for 1hp Induction Motor
- Wire 2 contactor for forward & reverse of motor direction.
- Characteristic of class 5/10/20/30 type thermal overload Relay
- Characteristic of class 5/10/20/30 type thermal magnetic overload Relay
- Characteristic of class 5/10/20/30 type adjustable thermal magnetic over load
- Characteristic of class 5/10/20/30 type Electronic over load relay.
- Test setup for overload protection of 1/2/3 HP AC motor using 3RH contactor & 3RB Electronic Relay
- Characteristic of MCCB with fixed thermal magnetic Trip unit
- Characteristic of MCCB with adjustable thermal magnetic Trip unit
- Characteristic of MCCB for motor starter Protection
- Characteristic of MCCB with Microprocessor Trip unit

3. INTELLIGENT MCCB TRAINER

The new generation of circuit breaker from Siemens 3VA1 and 3VA2 family offers many unique features like Intelligent Power Distribution, Communicative capable, Integrated Measuring Functions and Integration with DCS PLC Software etc.

This Trainer uses a 3VA2 MCCB with addition of many addons, facilitates the students to conduct many experiments on this new technology.

Features:

* One 25Amp MCCB (3VA2) with microprocessor Trip unit
* 3VA2 MCCB could very well used in the process and automation industries, in Industrial Buildings etc.
* Communication capable 3VA2 MCCBs are suitable for a variety of applications.
* Can retrieve all information about MCCB directly at your smart phone via QR Code.
* Can identify potential energy savings.
* It can reliably reports i) System status
  ii) Measured values through ETU series to PLC /SCADA /PCS 7 DCS software.
* Tripping characteristics can be set via ETU.
* Both setting Parameters and the measured values clearly visible on the display.
* 3VA2 has integrated acquisition of current, voltage and energy values using ETU 8 series.
* The Circuit breaker status (ON, OFF, TRIP) and limit values are also acquired.
* 3VA2 MCCB measure power consumption and support load management,
* Useful for keeping a close watch of the Switch Gear Implementation.

Advanced features:

* 3 VA2 can be connected to higher level power management via Profinet.
* One Residual current Device (RCD) (Optional).
* EFB300 external function box for connecting to ETU
* Integrated measuring value display
* Measuring function: Voltage, current & energy values.
* Communication capable PROFINET / MODBUS RTU
* RCD continuously detect fault and differential currents and ensure disconnection in the event of emergency.
* Communication Modules:
    * COM 060 connection module is mounted on the right-hand side of 3VA2 # It establish the connection to the 3VA2 MCCB Via T-connectors.
    * This is used to transmit measured Data to Com 100
* COM 100 Data Concentrator:
    * Can monitor one 3VA2 MCCBs.
    * For connecting 3VA2 MCCB Breakers to standard PLC/SCADA/DCS Systems.
    * It collects Data from the MCCB.
    * Integrated Ethernet Interface to interface local display etc.,
    * 7KM PAC switched Ethernet PROFINET to connect to Simatic PLC: S7-1200 by means of plug – in to COM 100
* One External Display DSP 800
    * For displaying status, measured values and parameters
    * Connection to COM100 Breaker data server via Ethernet.

S 7-1200 PLC DC/DC/RELAY

CPU Module

- Make : Siemens, Simatic S7 Family
- Model : CPU 1214C, 24V, Input supply
- Timers & Counters : 256 Nos Each
- Digital Inputs : 14 Nos (24V DC)
- Digital outputs : 10 Nos (Relay)
- Analog Inputs : 2 Nos (0-10)V DC
- Program Data Memory : 50 KB / 1MB
- High speed counters : 1 Nos [3 at 100KHz, 3 at 30KHZ]
- PWM outputs : 1 channels at 100KHz
- PID controller upto 16 PID control loops with Auto tuning facility
- Ethernet Communication Interface
- PID controller, Floating, Timer, Counters etc instruction are available

Unique features :

* 3VA2 MCCB provided with open interfaces and standard protocols like (PROFIBUS, PROFINET, Modbus TCP, Modbus RTU)

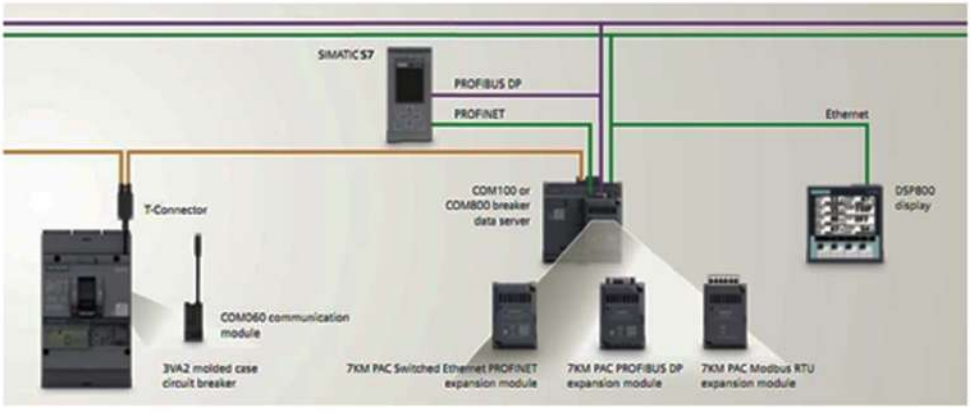
* 3VA2 molded case circuit breakers can be seamlessly integrated into an existing technical infrastructure and automation environment, ensuring that the processes in your plant will always be transparent.

* 3VA2 molded case circuit breakers provide specific information about your system's capacity utilization and status, providing perfect plant monitoring and maximum system availability.

* 3VA2 molded case circuit breakers constantly record consumption values and indicate where power usage by individual loads is disproportionately high. The result: targeted energy and cost efficiency.

* The integrated measuring function allows the 3VA2 molded case circuit breakers to prevent costly plant downtimes and mechanical damage.

* 3VA2 molded case circuit breakers provide a complete overview of all energy- relevant data. This ensures end-to-end monitoring, evaluation, documentation, and control.



3Φ Current Injection Source (0-100A) for Testing the MCCB

* Three auto transformers used for current adjustment.
* Three loading transformer used for current source.
* Current output terminated in the banana-sockets.
* Three digital meter used to indicate current.
* Current range: 0-100Amp AC (Continuously variable)
* One no. of Digital timer

S.NO	ITEMS	QTY
1	3VA2, 25-100Amp MCCB with motor operator for Remote Operation.	1
2	Com 60 Communication Module	1
3	Com 100 Breaker Data Server with Ethernet.	1
4	DSP800 Display	1
4	Sentron Power Configuration Software.	1
5	S7-1200 PLC with Profinet for remote operation of 3 VA2 motor operator.	
6	6 Amp MCB	3
7	3Φ Current Injection Source (0-100A) for Testing the MCCB	

4. INTELLIGENT MCCB ENERGY MANAGEMENT TRAINER

The new generation of circuit breaker from Siemens 3VA1 and 3VA2 family offers many unique features like Intelligent Power Distribution, Communicative capable and Integrated Measuring Functions etc

This Trainer uses a 3VA2 MCCB with addition of many addons, facilitates the students to conduct many experiments on this new technology with advanced features:

One 25Amp MCCB (3VA20) with microprocessor Trip unit

* Communication capable 3VA2 MCCBs are suitable for a variety of applications.
* Can retrieve all information about MCCB directly at your smart phone via QR Code.
* Can identify potential energy savings.
* It can reliably reports i) System status
  ii) Measured values through ETU series to PLC /SCADA /PCS 7 DCS software.
* Manual Rotary operators with illumination kit or motor operator for remote operation
* 3VA2 has integrated acquisition of current, voltage and energy values using ETU 8 series.
* Tripping characteristics can be set via ETU.
* Both setting Parameters and the measured values clearly visible on the display.
* The Circuit breaker status (ON, OFF, TRIP) and limit values are also acquired.
* 3VA2 MCCB measure power consumption and support load management,
* Useful for keeping a close watches of the Switch Gear Implementation.
* 3 VA2 can be connected to higher level power management via Profinet.
* EFB300 external function box for connecting to ETU
* Communication capable PROFINET / MODBUS RTU
* Communication Modules:
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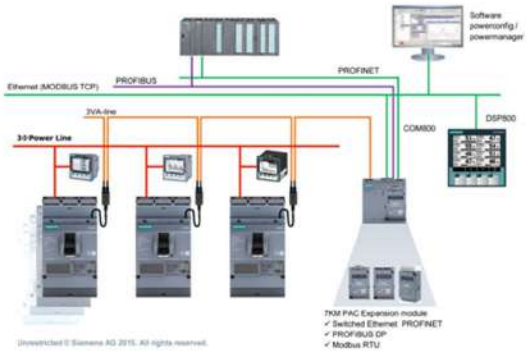
  * This is used to transmit measured Data to Com 100
* Com 100 Data Concentrator:
  * Can monitor one 3VA2 MCCBs.
  * For connecting 3VA2 MCCB Breakers to standard PLC/DCS Systems. # It collects Data from these MCCBs.
  * Integrated Ethernet Interface.
  * 7KM PAC switched Ethernet PROFINET to connect to Simatic PLC: S7-1200 by means of plug – in to com 100
* One External Display DSP 800
  * For displaying status, measured values and parameters
  * Connection to com100 Breaker data server via Ethernet.

S7-1200 PLC DC/DC/RELAY

- Model : CPU 1214C, 24V, Input supply
- Timers & Counters : 256 Nos Each
- Digital Inputs : 14 Nos (24V DC)
- Digital outputs : 10 Nos (Relay)
- Analog Inputs : 2 Nos (0-10)V DC
- Program/Data Memory : 50 KB / 1MB
- Ethernet Communication Interface

Unique features:



- 3VA2 MCCB with standard protocols (PROFIBUS, PROFINET, Modbus TCP, Modbus RTU), for interfacing SCADA & PCS7.
- 3VA2 molded case circuit breakers provide specific information about your system's capacity utilization and status, providing perfect plant monitoring and maximum system availability.
- 3VA2 molded case circuit breakers constantly record consumption values and indicate where power usage by individual loads is disproportionately high. The result: targeted energy and cost efficiency.
- The integrated measuring function allows the 3VA2 molded case circuit breakers to prevent costly plant downtimes and mechanical damage.
- 3VA2 molded case circuit breakers provide a complete overview of all energy- relevant data. This ensures end-to-end monitoring, evaluation, documentation, and control.

3Φ Current Injection Source (0-100A) for Testing the MCCB

* Three auto transformer used for current adjustment.
* Three loading transformer used for current source.
* Current output terminated in the banana-sockets.
* Three digital meter used to indicate current.
* Specification : Current range: 0-100Amp AC (Continuously variable)
* One no. of Digital timer

SI.NO	ITEM	QTY
1	3VA2, 25-100Amp MCCB with motor operator for Remote Operation.	1
2	Com 60 Communication Module	1
3	Com 100 Breaker Data Server with Ethernet.	1
4	DSP800 Display	1
4	Sentron Power Configuration Software.	1
5	S7-1200 PLC with Profinet for remote operation of 3 VA2 motor operator.	1
6	6 Amp MCB	3
7	3Φ Current Injection Source (0-100A) for Testing the MCCB	1

SI.NO	ITEM	QTY
1	RESIDUAL CURRENT DEVICE (RCD)	1
2	SIMATIC POWER RATE (POWER MANAGER) SOFTWARE	1
3	a) 3VA2 fixed at 3 Buildings/Departments b) COM800 Breaker Data server for support of 8 Nos of 3VA2 MCCBs	3 1
4	Fibre Cable based Remote Long Distance Operation; a) Scalance long Distance Switch with FC Port X 204 – 2LD b) Fibre Cable 500meter c) Fibre Cable 2000 meter d) Fibre Cable 4000 meter e) Fibre Cable 5000 meter	 2 1 1 1 2
5	**PAC 3200** Control panel instrument, 96 x 96 mm Screw connections for current and voltage connection AC/DC wide-range power supply unit 95 … 240 V AC ± 10 %, 50/60 Hz Measuring inputs Ue: max. 690/400 V 3 AC, 50/60 Hz Ie: /1 A or /5 A • Communication : Ethernet – Modbus TCP	1

SI.NO	ITEM	QTY
6	**PAC 4200** Control panel instrument, 96 x 96 mm Screw connections for current and voltage connection AC/DC wide-range power supply unit 95 … 240 V AC ± 10 %, 50/60 Hz; Input Measuring inputs Ue: max. 690/400 V 3 AC, 50/60 Hz Ie: /1 A or /5 A • Communication : Profinet	1
7	**PAC 5200** Control panel instrument, 96 x 96 mm Screw connections for current and voltage connection 110 … 230 V AC ± 10 %, 50/60 Hz Measuring inputs Ue: max. 690/400 V 3 AC, 50/60 Hz Ie: /1 A or /5 A • Measurement upto 40th Harmonic of Current & Voltage • Measured value capture in accordance with power quality standard IEC 61000-4-30 • Recording of power quality anomalies like sag, swell and interruption. • Integrated web server to set parameters and display measured values on HTML pages. • Communication : Ethernet – Modbus TCP	1
8	TD500 TEST DEVICE	1

5. 3Φ, AC MOTOR MANAGEMENT SYSTEMS: SIMOCODE PRO

Motor Management System: Simocode PRO	01	▶ Basic Unit Simocode Pro V; with Profinet interface. ▶ With addition of 3 Contactors, the basic unit can perform Star Delta, Starter, Reversing Starter and Direct Starter. ▶ It offers Extensive protection, Monitoring, Safety and control functions between motor starter and PLC/DCS in single compact system. ▶ Transmission Rate 100 Mbits/S, 2 Bus Connection via Rj 45	1
	02	▶ Current/voltage measure Module. ▶ Set Current 0,3...3A ▶ Voltage Detection up to 690V ▶ Straight-through CT	1
	03	Connection Cable, Length 0,5M, Flat, Connection of basic unit to current measuring module, current/voltage measure. Module & Operator panel	1
	04	Operator panel with Display	1
	05	Contactors	1
	06	Cabinet	3
Simocode Engineering Software	07	Powerful Software for communication, operations & diagnostics of Simocode Pro PN Hardware. ▶ Operation, Diagnostics & testing of motor ▶ Access via Profinet ▶ Many control circuits like soft starter, can be implemented. ▶ Can present the trend of upto 5 different measured values. ▶ Evolution of Startup characteristic of a motor or at various loads	1
	08	▶ 3ϕ squirrel cage induction motor, ▶ Power : 1 hp ▶ Current : 1.8 amp, Star Connection, Speed : 1390 rpm ▶ Three phase 415V AC 50Hz input.	1
PLC with SCADA Software	09	PLC with ETHERNET. PLC Programming Software SCADA software(Simatic WinCC Flexible) PLC with ETHERNET ▶ Make : Siemens ▶ PLC : S7-1200 ▶ Model : CPU 1214C-DC/DC/DC ▶ Digital Input : 14 Nos ▶ Digital Output : 10 Nos ▶ Analog Input : 2 Nos ▶ Analog Output : 1 No ▶ Bit processing speed 0.1 microcontroller ▶ Ethernet communication interface(TCP/IP Native, ISO on TCP) PLC Programming Software ▶ Windows based powerful software provided to write program in Ladder Language & FBD(Function Block Diagram) ▶ Siemens PLC programming software, IEC 61131 standard ▶ Simatic Step 7 - Version 12 software has been used for develop the functional blocks and ladder diagram programming in PLC S7-1200	1
	10	SCADA software(Simatic WinCC Flexible) ▶ Wincc - Flexible 2008 - SP3 has been used for developed the graphical representation, Analysation & control for process in SCADA ▶ To study SCADA principle simatic its applications in Power Systems we offer most popular Supervisory Control (SCADA) package "Simatic WinCC Flexible"from SIEMENS. This is very rich in feature and offers all drivers to interface with any PLC available in the market. ▶ The SCADA software can access all data from PLC through Ethernet.	1

6. MICRO CONTROLLER BASED PROTECTION RELAYS

The following 4 Protection relays are provided for conducting individual experiments on each relay. Also, these relays can be introduced whenever needed in the "SMART GRID" setup for proper protection operation in the Grid

a. Micro Controller Based Over Current Relay
b. Micro Controller Based Over Voltage / Under Voltage Relay
c. Micro Controller Based Over/ Under Frequency Relay
d. Micro Controller Based Earth Fault Relay

Optional:-

* All the relays is provided with USB port to interface with PC

7. SIEMENS NUMERIC PROTECTION RELAYS

a. Multi Function Protection Relay

* Motor Protection
* Inrush resistant
* Time - Over current protection
* Over Load Protection
* Negative Sequence Protection
* Auto Reclosure
* Modbus/Profibus

b. Test Setup

* Current and Voltage Source
* Timer
* Multi function meter

8. SIMIT: Simulation Software for all the Switch gear components Study

SIMIT – Siemens Solution for Automation Process Simulator

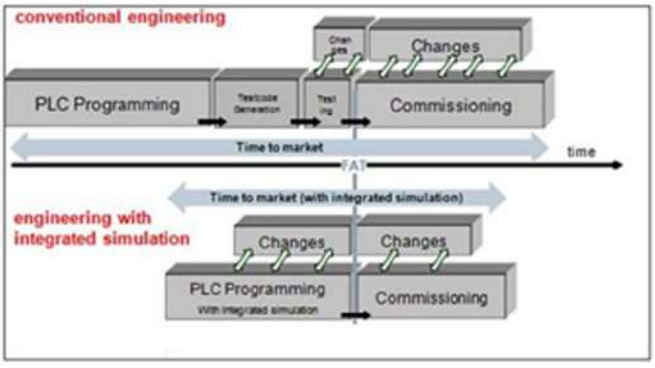
Simulation is one of the key essential tools in Process Automation, which helps to address all customer needs during project execution phase. This is mainly required to:

- Reduces risk and time during commissioning phase
- Improves Program code quality by pre-testing and analysis
- Assures shorter Time-to-market; as it shortens project duration and delivery time

Why SIMIT Simulation

With training simulators one can repeat the steps as many times to keep updated with mandatory knowledge of safe plant operation.
* Training on simulator is much safer and less costly than on actual plant
* Extreme situations can only be trained on a simulator as training on an actual plant might result in loss of people and equipment.
* upports import of schematic from COMOS and PCS7
* Provided with Chem basic library for chemical and pharmaceutical plant simulation
* Integration of various 3D designing software like NX with flexible interfacing option like SHM coupling
* To improve automation engineering & easy configuration of PLC Sim Advanced
* An ideal tool to study the Switch gear components
* Tight Integration of COMOS, SIMIT, PCS7 & NX (CAD, CAM, CAE)

SIMIT provides real time dynamic simulation for S7/PCS 7 projects, with or without `



hardware availability. Typical simulation purposes :

- I/Os and connection checkLogic and Control loop check
- Alarm and messaging test
- Sequence test
- Interlock check
- HMI controls and visualization test
- Acts as Virtual Controller
- Operator training system
- For simple to complex processes
- Virtual commissioning and operator training of challenging automation projects and plant operation.
- Faster commissioning of complex projects
- Tight integration of SIMIT is connected to proper actuators and sensors.

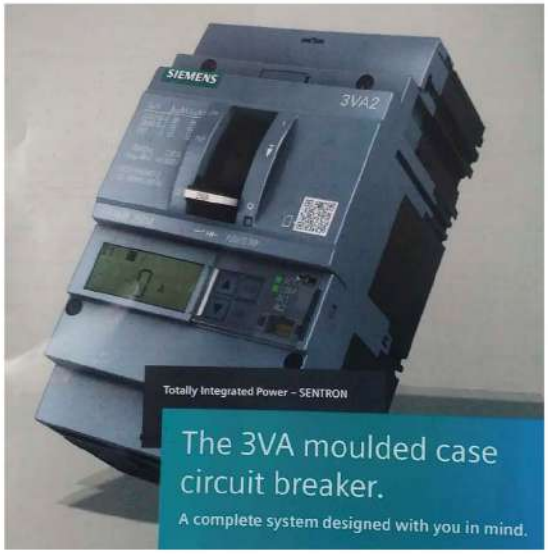
6. INTELLIGENT SWITCH GEAR TRAINER

- The new generation of circuit breaker from Siemens 3VA1 and 3VA2 family offers many unique features like Intelligent Power Distribution, Communicative capable with SCADA, DCS, Integrated Measuring Functions & etc, Remote Motorized Control

- This Trainer uses a 3VA2 MCCB with addition of many add on, facilitates the students to conduct many experiments on this new technology. It consists of i. 3VA2, 63A, MCCB ii. COM60 communication module iii. Microprocessor Trip Unit iv. integrated acquisition of current, voltage and energy values v. External Display DSP 800 with many Protocol options vi Remote Motorized Control vii. 30KW Three Phase Resistive load

Advanced features:

* One 63Amp MCCB (3VA20) with microprocessor Trip unit
* 3VA2 MCCB could very well used in the process and automation industries, in Industrial Buildings etc.
* Communication capable 3VA2 MCCBs are suitable for a variety of applications.
* Can retrieve all information about MCCB directly at your smart phone via QR Code.
* Can identify potential energy savings.
* It can reliably reports
  i) System status
  ii)Measured values through ETU series to PLC /SCADA /PCS 7 DCS software.
* Manual Rotary operators with illumination kit or motor operator.
* Tripping characteristics can be set via ETU.
* Both setting Parameters and the measured values clearly visible on the display.
* 3VA2 has integrated acquisition of current, voltage and energy values using ETU 8 series.
* The Circuit breaker status (ON, OFF, TRIP) and limit values are also acquired.
* 3VA2 MCCB measure power consumption and support load management,
* Useful for keeping a close watch of the Switch Gear Implementation.
* 3 VA2 can be connected to higher level power management via Profinet.
* One Residual current Device (RCD) provided.
* EFB300 external function box for connecting to ETU
* Integrated measuring value display
* Measuring function: Voltage, current & energy values.
* Communication capable PROFINET / MODBUS RTU
* RCD continuously detect fault and differential currents and ensure disconnection in the event of emergency.
* Communication Modules:
  - Com 060 connection module is mounted on the right-hand side of 3VA2
  - It establish the connection to the 3VA2 MCCB Via T-connectors.
  - This is used to transmit measured Data to Com 100



* Com 100 Data Concentrator:
  - Can monitor one 3VA2 MCCBs.
  - For connecting 3VA2 MCCB Breakers to standard PLC/DCS Systems.
  - It collects Data from these MCCBs.
  - Integrated Ethernet Interface.
  - 7KM PAC switched Ethernet PROFINET to connect to Simatic PLC: S7-1200 by means of plug – in to com 100
* One External Display DSP 800
  - For displaying status, measured values and parameters
  - Connection to com100 Breaker data server via Ethernet.

Unique features :

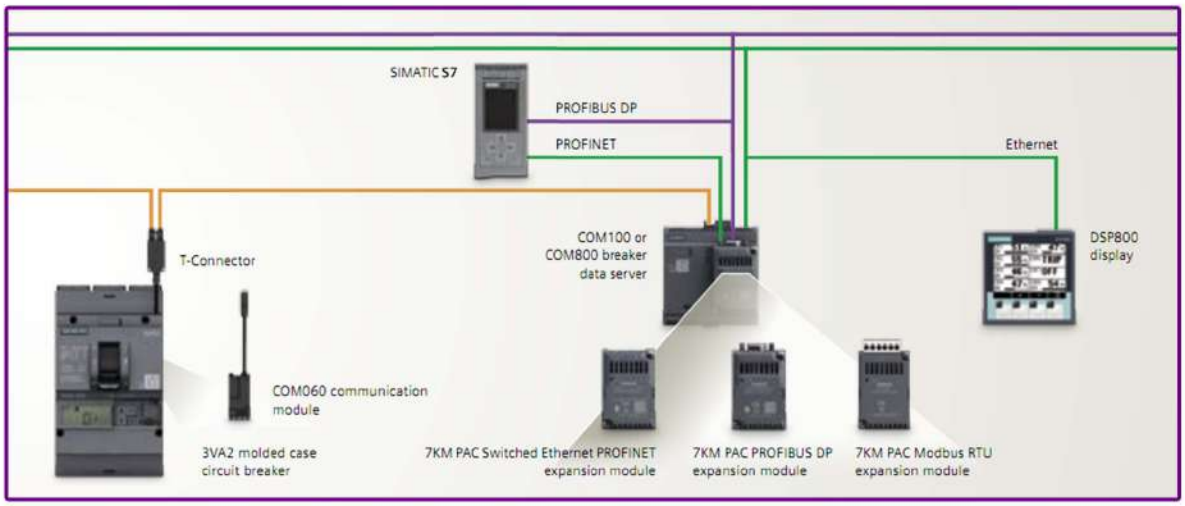
* 3VA2 MCCB with open interfaces and standard protocols (PROFIBUS, PROFINET, Modbus TCP, Modbus RTU), 3VA2 molded case circuit breakers can be seamlessly integrated into an existing technical infrastructure and automation environment, ensuring that the processes in your plant will always be transparent.

* 3VA2 molded case circuit breakers provide specific information about your system's capacity utilization and status, providing perfect plant monitoring and maximum system availability.

* 3VA2 molded case circuit breakers constantly record consumption values and indicate where power usage by individual loads is disproportionately high. The result: targeted energy and cost efficiency.

* The integrated measuring function allows the 3VA2 molded case circuit breakers to prevent costly plant downtimes and mechanical damage.

* 3VA2 molded case circuit breakers provide a complete overview of all energy- relevant data. This ensures end-to-end monitoring, evaluation, documentation, and control.



30KW Three Phase Resistive load

* Rotary switch provided to vary the load for continuous loading upto 40Amps
* For voltage and current sensing to 3VA2 MCCB and used to experiment the TRIP action of the 3VA2 MCCB
* 20 tapping for setting the current
* 415Volt AC Input

7. Universal Numerical Relay Development Test Bench (VPL-108)

In utility and industrial electric power transmission and distribution systems, a numerical protective relay is a computer-based system with software-based protection algorithms for the detection of electrical faults.

Such relays are also termed as microprocessor type protective relays. They are functional replacements for electromechanical protective relays and may include many protection functions in one unit, as well as providing metering, communication, and self-test functions.

The numerical protective relay is a protective relay that uses a microprocessor to analyze power system voltages, currents or other process quantities for the purpose of detection of faults in an electric power system or industrial process system.

This Universal Numerical Relay Development system consists of a Power Signal Conditioner and a Powerful 32 bit DSP Controller

Features

- 8 Analog Input Channels configurable as Voltage and Current channels
- 4 Digital Binary programmable I / O Channels
- 4 Relay based potential free programmable Outputs
- 4 LED based programmable indicators
- 3 Inbuilt Keys programmable
- In system hard reset option
- Programmable RS 232 communication port
- Programmable display through 4 X 20 LCD
- Power Supply – Included
- DAC Setup for Lab based simulation
- CT PT Card for Real Scenario implementation

Application of Numerical Relay Development Test Bench

- Any relay algorithm can be implemented and tested for applicability in real time environment.
- Use of software simulated data as inputs. Hence any condition can be simulated.
- Suitable for research activities.

Numerical Relay Development Test Bench

- Once the Relay Algorithm is developed and coded using a PC, same will be saved and use it for future.
- LCD Display, Soft push buttons and Status Indicator LED's all are programmable using RS232 port provided for data exchange
- Required Voltage and Current Waveform can be generated using Computer software and DAC Card provided
- Relay operation for respective algorithm and Analog Inputs can be seen using LCD Display and LED Status indicators.
- There is also a provision for stopping input signal
- Relay trip command.
- Digital input is provided to take external trigger command if required by the algorithm.

Hardware Components of Numerical Relay Development Test Bench

- DAC card to convert the output of PC-based waveform into analog signals
- 100k sample/s and voltage range of +/- 10 Vp
- PC based waveform can be generated
- Data acquisition is carried out through 8 analog input channels
- Two 3Ø channels
- Two 1Ø channels (can be any analog data)

The A/D converts analog signal into samples and the Fourier technique is applied to compute the magnitude of the signal Implementation is based on very high speed DSP controller Serial interface for programming the relay algorithm

Output options

- 4x20 LCD Display
- 4 Status LED
- 4 Digital trip command (will stop the input signal)
- Digital trip command can also be configured to PC through the DAC card
- Waveform capture – similar to disturbance recorder in relays
- Variable capture – to save the variable in algorithm. Will help to access the performance of the scheme
- Serial port to exchange the files in Flash memory

Digital inputs

- The algorithm can take external trigger command through this

Software Components of Numerical Relay Development Test Bench

- Option to generate steady state waveforms
- Option to read simulation data from text file
- Platform for developing the relay algorithm (embedded C language) Pre-defined Firmware libraries
- Instantaneous and RMS value of all channels
- Real and Imaginary components of all channels
- Phase angle computation
- 1ms counter.
- LCD display function
- LED indication function
- Relay trip command function
- External trigger input function

Deliverables

Complete System Integration with the following:

- Concept Relay Hardware Test Bench
- Programmer
- Test Setup Testing Software

8.Advanced solar wind Grid connected 3ϕ,2KW smart Grid xperiment Setup

Advanced Solar Wind Grid Connected 3Φ, 2KW Smart Grid Experimental Setup

This consists of 2 Microgrids of 2000 watts and 1000 watts of power generation connected to a main Power Grid with all the components needed to convert a traditional Grid to a Smart Grid so that many experiments can be conducted on this "Smart Grid". A 3Φ 3KW isolation transformer with power input from utility grid will act as main grid to which 2 Microgrid will be connected through synchronizing panel. Optionally a commercial 3Φ, 2.5KVA Grid Commercial Solar Power Inverter can be added to this experimental setup.

By adding 3Φ, 2.5KVA commercial solar inverter, when the experimental setup is not used by student, it could be used to generate power.

This Advanced Smart Grid Experimental Setup Consists of

I) 2 Micro Grids, each 1000 watts of power generation using Solar, Wind or Hybrid
II) An Isolation Transformer Coupled to the utility Grid, acts as Main Grid to this Setup
III) Various other Power Sources
IV) Commercial 3Φ 5KVA Grid Connected Inverter (Optional)
V) Optional Components for the Smart Grid Setup
VI) DSP /FPGA Controller for PE, SG, PS Applications
VII) Other Add ons
VIII) Components for Building 10/25KW Smart Grid Power Generation
IX) IoT Based Data Acquisition.

I) i. Micro Grid -I

(Solar Wind Grid Connected 3Φ, 2KW Smart Micro Grid)

1. Main Frame
2. 1KW Solar PV Module with Stand
3. Wind Turbine
   a) 1KW Wind Turbine with Tower
   (or)
   b) 300W Wind Turbine with Blower setup
4. DC-DC Boost Converter
   a) 2KW Hybrid DC-DC Buck-Boost Converter
   (or)
   b1) 1KW DC-DC Boost Converter for Solar (or)
   b2) 1KW DC-DC Boost Converter for Wind
5. 120V Battery Bank - 12V x 100AH x 10 Nos
6. 2KW Bi-Directional DC-DC Buck-Boost Converter for Charging battery
7. 2KW 3Φ Inverters
   a) 2KW 3Φ 2 level Inverter
   (or)
   b) 2KW 3Φ 3 Level Inverter
8. DSP/FPGA Controller
9. Microcontroller based Protection Relays
10. Smart Energy Meter
11. Synchronizing Panel
12. Three Phase RL Load 2KW
13. PLC with SCADA Software
14. 14 Channel PC based Power Quality Analyzer (Optional)

ii. Micro Grid -II

(Solar Grid Connected 3Φ, 1KW Smart Micro Grid)

1. Main Frame
2. 1KW Solar PV Module with Stand
3. 1KW DC-DC Buck-Boost Converter
4. 120V Battery Bank - 12V x 100AH x 10 Nos
5. 1KW Bi-Directional DC-DC Buck-Boost Converter
6. 2KW 3Φ Inverters
   a) 2KW 3Φ 2 level Inverter
   (or)
   b) 2KW 3Φ 3 Level Inverter (Optional)
7. DSP/FPGA Controller
8. Microcontroller based Protection Relays
9. Smart Energy Meter
10. Synchronizing Panel
11. Three Phase RL Load 2KW

II) An Isolation Transformer Coupled to the utility Grid, acts as Main Grid to this Setup

Three phase 3KVA isolation transformer with power input from utility grid will act as main grid to which 2 microgrids and commercial grid connected solar inverter etc will be connected through synchronizing panel

III) Various Other Power Sources

i) A Three Phase Power Source
ii) 2KW DFIG Setup with 5KVA IGBT based Converter - Inverter System
iii) 2HP DC motor coupled with 3Ø 1KVA Alternator based Power Source

IV) Commercial 3Φ 2.5KVA Grid Connected Inverter (Optional)

V) Optional Components for the Smart Grid Setup

a. 300watts Wind Turbine with Blower
b. Solar Array Simulator (500W)
c. Wind Turbine Simulator using 3HP DC motor Coupled with 1KW PMSG
d. Weather Station

VI) DSP /FPGA Controller for PE, SG, PS Applications

i) dsPIC 33EF814 Controller
ii) TMS320F28335 DSP Controller
iii) Piccolo DSP Controller
iv) Spartan-6 FPGA Controller
v) Advanced Cyclone-IV FPGA Controller
vi) Cyclone-IV Based FPGA Controller
vii) St-Cortex-M4 Controller Board
viii) Dual Core Delfino DSP Controller

VII) Smart Grid Simulator

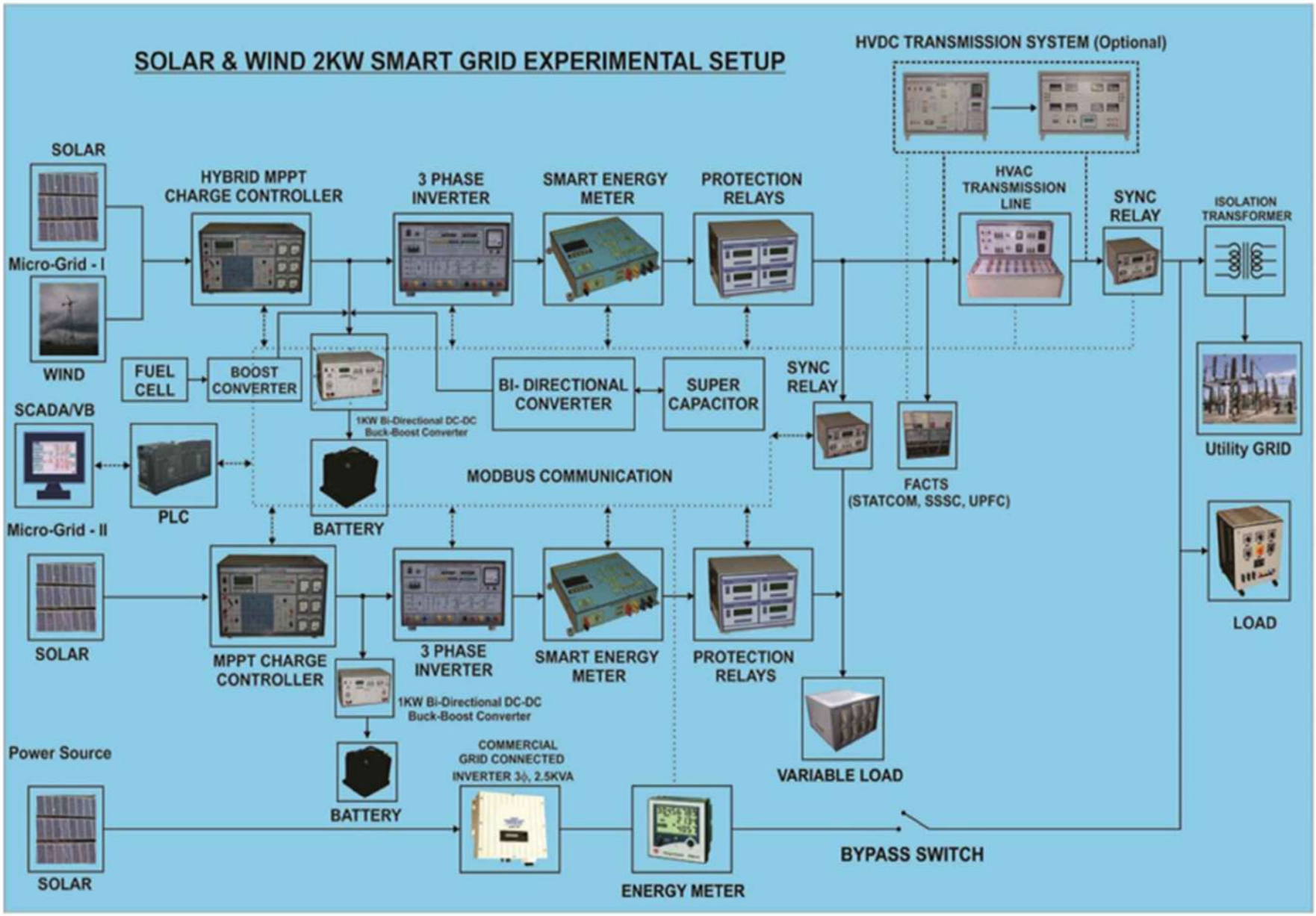
VIII) Components for Building 10/25KW Smart Grid Power Generation

i) 10KW IGBT Based Power Module
ii) 25KW Power Module for Multilevel Inverter

IX) IoT Based Data Acquisition

X) Other Add ons

i) Fuel Cell
ii) Super Capacitor
iii) Load Controller
iv) Battery Charger


SOLAR & WIND 2KW SMART GRID EXPERIMENTAL SETUP
HVDC TRANSMISSION SYSTEM (Optional)
SOLAR
Micro-Grid - I
WIND
HYBRID MPPT CHARGE CONTROLLER
3 PHASE INVERTER
SMART ENERGY METER
PROTECTION RELAYS
HVAC TRANSMISSION LINE
SYNC RELAY
ISOLATION TRANSFORMER
Utility GRID
FUEL CELL
BOOST CONVERTER
1KW Bi-Directional DC-DC Buck-Boost Converter
BI- DIRECTIONAL CONVERTER
SUPER CAPACITOR
SYNC RELAY
SCADA/VB
PLC
BATTERY
MODBUS COMMUNICATION
FACTS (STATCOM, SSSC, UPFC)
Micro-Grid - II
SOLAR
MPPT CHARGE CONTROLLER
3 PHASE INVERTER
SMART ENERGY METER
PROTECTION RELAYS
LOAD
1KW Bi-Directional DC-DC Buck-Boost Converter
VARIABLE LOAD
Power Source
BATTERY
COMMERCIAL GRID CONNECTED INVERTER 3ϕ, 2.5KVA
SOLAR
ENERGY METER
BYPASS SWITCH

I) i & ii) SOLAR WIND GRID CONNECTED 3Φ, 2KW SMART MICRO GRID

Smart Grid getting popular every year. Power Sources form solar and wind are also becoming popular due to lot of technology evolvement. Hence a laboratory setup of "Solar and Wind based Smart Grid" which consists of all components of Smart Grid like MPPT based DC-DC converter, 3 phase inverter, switch Gear with modbus communication, 3Φ Artificial Transmission line, FACTS model, HVDC model, Load etc.,

This unit consists of

1. Main Frame
2. 1KW Solar PV Module with Stand
3. Wind Turbine
   a) 1KW Wind Turbine with Tower
   (or)
   b) 300W wind Turbine with Blower setup
4. DC-DC Boost Converter
   a) 2KW Hybrid DC-DC Boost Converter
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   b1) 1KW DC-DC Boost Converter for Solar
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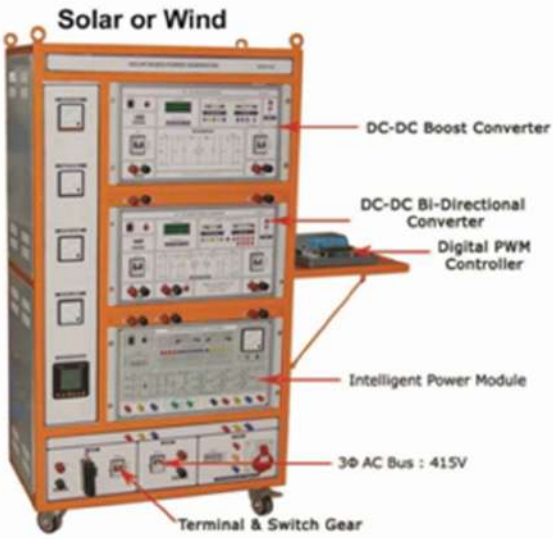
10. Smart Energy Meter
11. Synchronizing Panel
12. Three Phase RL Load 2KW
13. PLC with SCADA Software
14. 14 Channel PC based Power Quality Analyzer (Optional)



Hybrid

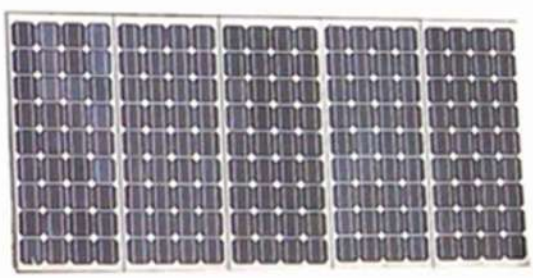
Technical Details as below

1. Main Frame

- Designed to house all the modules
- DPMs fixed on the Front Panel
  - # Voltage for Solar & Battery
  - # Current of Solar & Battery
  - # 1no of multifunction meter for inverter output
- One LC filter provided at the Inverter output
- One step-up transformer provided the output of inverter
- Termination provided for solar input with MCB & Fuse Protection.
- Termination provided for Battery input with MCB & Fuse Protection.
- 1no of industrial power socket provided for inverter output with MCB Protection.
- External 230V AC 1Φ required to meet the power supply of control circuits.

2. 1KW Solar PV Module with Stand

* Make	:	Reputed approved by MNRI
* No of Panels	:	For 1KW, 100W - 10Nos.
* Peak Power of Module	:	1000 Watts
* Temperature	:	-40 to 90˚c
* Wind Load	:	UP to 200kmph
* Humidity	:	0 to 100%
* Type of cell	:	Poly crystalline silicon
* Lamination Type	:	Vacume Laminated Glass to ladler
* Voc of each module	:	21 Volts
* Voc of 1KW setup	:	210 Volts

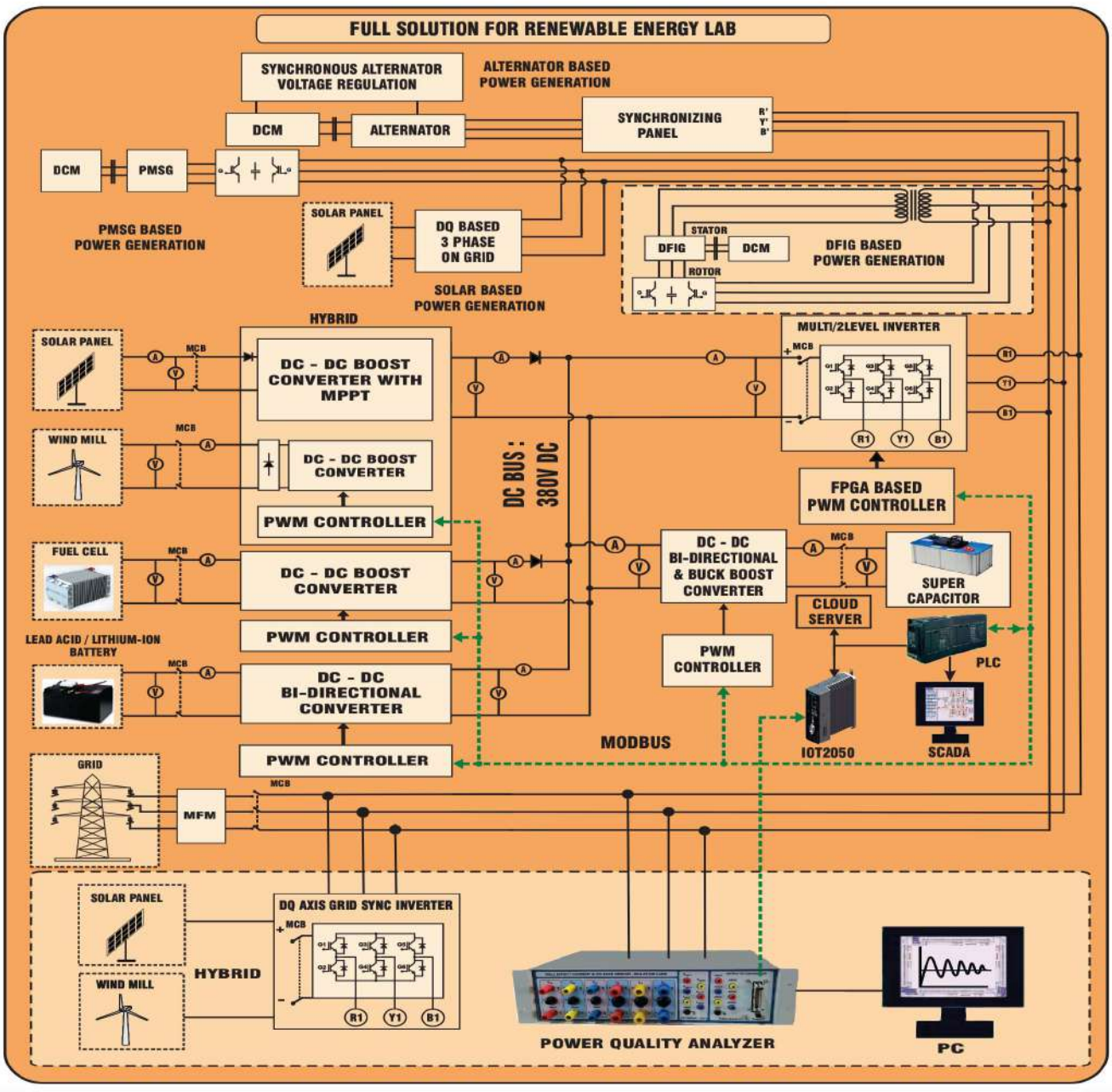


3. Wind Turbine

a) 1KW Wind Turbine with Tower

- 48V Wind Generation
- 1KW Wind Turbine
- Three Blades
- Nominal Voltage 48V
- Maximum Power 1000W
- Start Wind speed 2m/s
- Rated Wind Speed 13m/s
- Rated revolution 450r/m
- Security wind speed 50m/s
- Wind wheel diameter 2.4m

- Lead number : 3
- Blade material : Nylon Fiber
- Generator : Three phase Permanent magnet synchronous generator



b. 300W Wind Turbine with Blower Setup

Performance Parameter

* Rated Electrical Power : 1KW@8.2m/s
* Rated Wind Speed : 11.5m/s
* Cut-in : 3.5m/s
* Shut-down (High Wind) : 23m/s
* Peak (Survival) : 60m/s

Rotor

* Type of Hub : Fixed pitch
* Rotor Diameter : 1.5m
* Swept Area : 12.5m2
* Number of Blades : 3
* Rotor Speed @ rated wind speed : 250 RPM
* Location Relative to tower : UP wind
* Rotor Tip Speed : 52m/s
* Design Tip Speed : 7.00

Blade

* Material : Glass Fiber
* Airfoil (type) : NACA 23015 modified
* Twist : 14° outer blade
* Blade Trailing Edge : Parabolic

4. DC-DC Buck-Boost Converter

a) 2KW Hybrid DC-DC Buck-Boost Converter

* Microcontroller based Buck-Boost with MPPT algorithm
* Switching device IGBT
* I/P voltage range
  # 120V DC-210V DC
* O/P voltage range
  # 380V DC / 3A
* All the I/P & O/P are sensed through isolated sensors
* 4Nos of ADC feedback provided to sense
  - I/P Voltage of Solar, I/P Current of Solar
  - O/P Voltage & Current of Converer
* Proper termination provided for input & output with MCB protection.
* 4 keys provided to select the type of control program
* 20x4 LCD displays all the I/P / O/P datas
* Over current, over voltage & temperature protection.
* 34pin FRC & 26 pin FRC provided for external controller interface.
* dv/dt protection is available for IGBT (Snubber Circuit)
* One RS232/RS485 port provided to Interface with PC/PLC

b1) 1KW DC-DC Boost Converter for Solar

* Microcontroller based Boost with MPPT algorithm
* Switching device IGBT (Semikron)
* I/P voltage range : 120V, -210V DC
* O/P voltage range : 380V DC / 3A
* All the I/P & O/P are sensed through isolated sensors
* 4Nos of ADC feedback provided to sense
  - I/P Voltage of Solar, I/P Current of Solar
  - O/P Voltage & Current of Converer
* 4 keys provided to select the type of control program
* Banana connector termination provided for input & output with MCB protection.
* 20x4 LCD displays all the I/P / O/P datas
* Over current, over voltage & temperature protection.
* 34pin FRC & 26 pin FRC provided for external controller interface.
* dv/dt protection is available for IGBT (Snubber Circuit)
* One RS232/RS485 port provided to Interface with PC/PLC

b2) 1KW DC-DC Boost Converter for Wind

* Microcontroller based Boost with MPPT algorithm
* Switching device IGBT (Semikron)
* I/P voltage range : 120V DC-210V DC
* O/P voltage range : 380V DC / 3A
* All the I/P & O/P are sensed through isolated sensors
* 4Nos of ADC feedback provided to sense
  - I/P Voltage of Solar, I/P Current of Solar
  - O/P Voltage & Current of Converer
* Proper termination provided for input & output with MCB protection.
* 4 keys provided to select the type of control program
* 20x4 LCD displays all the I/P / O/P datas
* Over current, over voltage & temperature protection.
* 34pin FRC & 26 pin FRC provided for external controller interface.
* dv/dt protection is available for IGBT (Snubber Circuit)
* One RS232/RS485 port provided to Interface with PC/PLC

5. Battery Bank - 12V/100AH x 10 Nos

* 12V / 100AH - 10Nos connected in series.
* 120 volt output to the Inverter.
* Ammeter, Voltmeter, MCB provided in the stand
* Maintenance free battery
* Battery Stand with wheel arrangement

6. 2KW Bi-Directional DC-DC Buck-Boost Converter for Charging Battery

* Microcontroller based DC - DC Controller
* 2 Nos of High Speed MOSFET / IGBT
* 2 Nos of Isolated High Speed Driver circuits
* 2 Nos of Current Sensor for sensing the input and output current of the converter
* 2 Nos of Voltage Sensor for sensing the input and output voltage of the converter
* In Boost mode I/P is 120V and O/P is 380V DC
* In Buck mode I/P is 380V and O/P is 120V DC
* Power Rating is 2000Watts
* dv/dt protection is available for all MOSFET (Snubber Circuit)
* 20x4 Alpha Numeric LCD display
* One RS232/RS485 provided to Interface PC or PLC
* Test points provided in control section for wave form measurement in CRO

7. 2KW 3Φ Inverters

a) 2KW 3Φ 2 Level Inverter

* I/P Voltage : 380V DC
* O/P Voltage: 415V AC / 1KVA (max)
* Sine wave output (LC Filter)
* 34pin FRC & 24 pin FRC provided for controller interface
* 6 Numbers of High speed Opto - isolator provided for PWM isolation
* 6 Number of IGBT with Heat sink provided as power circuit
* Hall Effect current sensor provided for output current & DC current measurement & protection
* 1no of hall effect voltage sensor provided for input DC voltage measurement and protection.
* Op-amp signal conditioner circuit provided for current, voltage sensors & output terminated in front panel for measurement.
* Over current / voltage / Temperature Trip circuit provided for protection.
* One number of LED provided to indicate TRIP Status
* One number of Reset Switch provided to reset the Trip Function
* Test points provided for PWM & Current, Voltage wave form measurement in CRO

Note: One DSP/FPGA controller needed externally.

b) 2KW 3Φ 3 Level Inverter

* I/P Voltage : 380V DC
* O/P Voltage: 415V AC / 1KVA (max)
* Sine wave output (LC Filter)
* 34 pin FRC & 26 pin FRC provided for controller interface
* 12 Numbers of High speed Opto - isolator provided for PWM isolation
* 12 nos of IGBT 1200V / 25A / 50A into 6 IGBT modules. Each leg having 2 IGBT modules. 3 legs form 3 phase Multilevel Power Circuit.
* 6 nos of Diodes 1200V/25A/50A into 3 diode modules are connected across each leg to form Diode Clamped Multilevel Inverter.
* Hall Effect Voltage Sensor provided for DC Voltage measurement & protection
* Hall Effect current sensor provided for output current & DC current measurement & protection
* Op-amp signal conditioner circuit provided for current sensors & output terminated in front panel for current wave measurement.
* Over current Trip circuit provided for over load protection.
* One number of LED provided to indicate TRIP Status
* One number of Reset Switch provided to reset the Trip Function
* Test points provided in control section for wave form measurement in CRO

Note : One DSP/FPGA Controller needed externally

8. DSP/FPGA Controller

One of these controllers should be purchased to drive Inverter

a) dsPIC 30F4011 Based Controller (Not Suitable for 3 level inverter)

Microchips dsPIC30F4011 16 Bit digital signal controller operating at 20 MIPS

Memory On Chip:

* 48KB Flash Program Memory
* 1KB Data EEPROM
* 24KB RAM for data Memory

PWM Capture & Timers

* 16 bit timer / Counter
* 6 motor control / PWMs with Programmable dead band terminated at 34 pin FRC Connector
* 2 capture inputs terminated at 34 Pin FRC connector
* 1 Quadrature encoder interface terminated at 34 Pin FRC Connector

ADC & DAC

* 6 channel 10 bit, 0-5V ADC buffered and terminated at 26 pin FRC connector
* 4 Channel 12 bit , 0-5V ADC external DAC provided and terminated at 26 pin FRC connector

LCD, Keypad & Serial Port

* 20x4 Alphanumeric LCD display
* 3 switches provided for user inputs
* Reset switch provided for hardware reset
* One UART is terminated at 9 Pin Connector (RS232) it can operate up to 115200bps Baud rate

Power Supply

* Input : 230V / 50Hz AC
* Output :+5V / 3A & ± 12 V/ 500mA

b) SPARTAN 6 FPGA Controller (VPE-SPARTAN 6)

* XC6SLX25-2FT256
* 136kB Distributed RAM
* 576Kb Block RAM
* 8 User LEDs, Switches
* Opto Isolated USB - Serial Port
* 20x4 Alpha numeric LCD display
* PE & Drives compactable Signals Terminated at 34 pin FRC connector
  - # 16 motor control PWM with Programmable dead band signals
  - # 8 captures input signals
  - # 1 Quadrature encoder interface
* ADC Signals Terminated at 26 pin FRC connector
  - # 8 channel 12 Bit ADC
  - # 2 MSPS Sampling rate
* 4 Channel DAC terminated at J801 Connector
* 2 Limit switches are provided for General purpose usage in the software. (Factory configured as Increment, Decrement switches)

c) TMS320F28335 Based DSP Controller

- Processor: TMS320F28335 floating point
- Operating Speed: 150MHz
- 256KB on chip Flash Memory
- 34KB on chip SARAM
- 256KB external RAM for program / data
- On board isolated USB-JTAG emulator
- 20x4 LCD interface
- Opto Isolated onboard USB to Serial port
- 34 pin Interface connector for motor control
  - # 18 Motor Control PWM
  - # 6 capture I/P signals
  - # 2 Quadrature Encoder Interface
- 26 pin ADC I/F connector
- 4 channel 12 bit DAC terminated at J801 connector

d) CYCLONE IV FPGA Controller (VPE-CYIV)

- Based on Altera family Cyclone IV, Device : EP4CE30
- One 34 pin header used for IPM Interface.
  - 16 PWM output
  - 8 capture inputs.
- One 26 pin header ADC.
  - 4 channel 1MSPS ADC.
  - Total 8 channel using 2 Nos of ADC.
  - 12 bit resolution.
  - Input range -10V to 10V / -5V to 5V. (Software Programable)
- One 5 pin phoenix connector DAC
  - 4 channel DAC, 12 bit resolution.
  - Output range -10V to 10V / -5V to 5V. (Software Programable)
- 8 output Light Emitting Diodes (LEDs).
- 8 input slide Switches.
- 4 user push button switches.
- 2-user limit switch.
- 20 x 4 Alphanumeric LCD display.

e) Advanced Cyclone - IV FPGA Controller (VPE-CYIVAD)

- Based on Altera family Cyclone - IV
- 8 User LEDs & Switches
- 20 x 4 Alpha numeric LCD display
- One isolated USB to serial port
- 2 limit switches are provided for general purpose usage in the software
- Termination of 84 PWMs at 5V level in 2nos of 50 pin FRC connector
- PE & Drives compatible signals terminated at 34 pin FRC connector
  - # PWM outputs are terminated at 34 pin FRC connector
  - # 16 motor control PWM with programmable dead band signals
  - # 8 captures input signals / 1 quadrature encoder interface
- ADC signals terminated at 26 pin FRC connector
  - # 16 Channel ADC inputs
  - # 1 MSPS sampling rate
  - # Input Range : ±10V, ±5V programmable
- DAC outputs terminated at J801 connector
  - # 4 channel DAC output
  - # Output range : ±10V, ±5V programmable
- On board isolated USB to JTAG port
- On board USB 2.0 interface with TMC standard
- Unique Features

11. Synchronizing Panel

- It synchronizes inverter output and grid input. It sense inverter voltage, phase and frequency as well as grid voltage, grid phase and frequency
- 16bit microcontroller provided to measure current & voltages and controlling all operation.
- 20x4 LCD Display to display voltages phase & frequency.
- Front panel have two 3pole MCB to switch ON/OFF the grid and inverter voltage inputs.
- One contactor provides to automatic synchronizing grid and inverter
- Contactor current rating: 16 A/4 pole
- 6 voltage signal Conditioner provided to measure the voltages
- 6No's of ZCD provided to sense the frequency as well as phase
- Input and output terminated at proper terminals

12. Three Phase RL Load (2KW)

a. **Three Phase Inductive Load**
   - 120mH, 4Amp rating - 3Nos
   - With 0, 12,24,36,60,90,108, 120mH tapping
   - Iron core type
   - Banana connector provided for all inputs

b. **Lamp Load (1KW)**
   - Different Switches provided for selection of load
   - Enclosed in a powder coated cabinet

c. **Resistive Load (1KW)**
   - Different Switches provided for selection of load
   - Enclosed in a powder coated cabinet

13. PLC with SCADA Software (VPST-100HVSC-F)

This consist of

i. PLC with MODBUS
ii. PLC Programming Software
iii. SCADA Software (Simatic WinCC Flexible)
iv. Application Software for SCADA Software

The PLC with MODBUS Communication can interface with all the Intelligent Electronic Devices (IEDs) which in turn can be connected to SCADA Software for better monitoring and controlling of the "Smart Grid".

i. PLC with MODBUS

- Make : Siemens,
- Model : CPU 1212C – DC / DC / DC
- PLC : S7-1200
- Bit processing speed 0.1 micro
- Ethernet communication interface (TCP/IP Native, ISO on TCP)
- In built Real Time Clock
- This PLC acts as Master for Serial Communication in MODBUS Protocol
- MODBUS is used to communicates Master (PLC) and Slaves (RTU)

ii. PLC Programming Software

- Windows based powerful software provided to write program in Ladder Language & FBD (Function Block Diagram)
- Siemens PLC programming software, IEC 61131 standard
- Simatic Step 7 - Version 12 software has been used for develop the functional blocks and ladder diagram programming in PLC S7-1200

iii. SCADA Software (Simatic WinCC Flexible)

* Wincc - Flexible 2008 - SP3 has been used for developed the graphical representation, Analysation & control for process in SCADA
* To study SCADA principle simatic its applications in Power Systems we offer most popular Supervisory Control (SCADA) package "Simatic WinCC Flexible" from SIEMENS. This is very rich in feature and offers all drivers to interface with any PLC available in the market.
* The SCADA software can access all data from PLC through Ethernet where PLC communicates with RTU device through MODBUS protocol

iv. Application Software for SCADA software

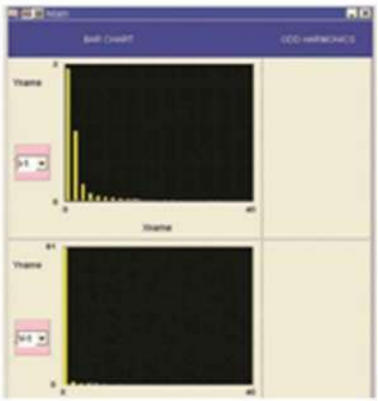
* SCADA Based Applications software written to integrate
  # Hybrid DC-DC Buck-Boost Converter
  # Bi-Directional Buck-Boost Converter
  # 2KW Inverters
  # DSP/FPGA Controller
  # Microcontroller based Protection Relays
  # Synchronizing Panel

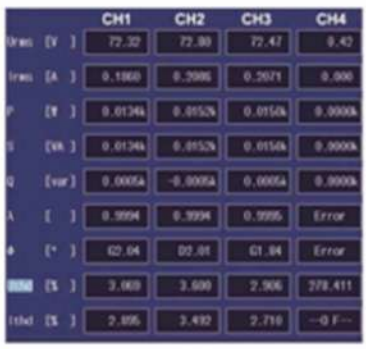
NOTE:

* All civil and wiring works should be taken care by the customer during the installation
* Wind velocity to be measured by customer before order

14. 14Channel, PC based Power Quality Analyzer (Optional)

* Based on FPGA based DAS for 14 channel with signal conditioners
* 7 no's of Hall Effect Current Sensors for AC/DC current measurement
* 7 no's of Hall Effect Voltage Sensors for AC/DC voltage measurement
* 14 Channel will be useful to analyze a 3Φ inverter i) Input 3Φ Voltages & Currents ii) Output 3Φ Voltages & Currents iii) DC Link Voltage & Current
* VEE PRO based runtime environment will be provided.
* Provided with Laptop with Windows7.





II) An Isolation Transformer Coupled to the utility Grid, acts as main Grid to this Setup

Three phase 3KVA isolation transformer with power input from utility grid will act as main grid to which 2 microgrids and commercial grid connected solar inverter etc will be connected through synchronizing panell

III) Various Other Power Sources

i) A Three Phase Power Sources

This unit is used to generate 3phase output with frequency and voltage controllable. The output voltage can vary from 48Hz to 52Hz.
It consists of one controller to generate PWM for voltage Source and one 3 phase voltage source inverter power module.

* dsPIC4011 based controller to generates PWM.
* IPM based Power module for voltage source inverter
* Output is filtered and isolated through LC and isolation transformer.
* MFM provided to read all the output parameter
* MCB provided to switch ON/OFF the Power Source
* Safety Power socket provided to give input and output.
* Input 3phase/440V AC/50Hz
* Output variable 440V AC/ 1KW. Variable frequency 48Hz to 52Hz.

ii) 2KW DFIG Setup with 5KVA IGBT based converter - Inverter System

a) Dc motor Coupled with 2KW Slip Ring Induction Motor
b) dsPIC30F4011 based PWM Controller
c) Power Module for DC Drive
d) Power Module for Doubly Fed Induction Generator
e) TMS320F28335 based DSP Controller (Micro - 28335)

(Refer Page : 18)

iii) 2HP DC Motor Coupled with 3Ø 1KVA Alternator based Power Source

* Proximity sensor provided as speed sensor
* Converter with 6 IGBT provided to from 3 legs for control the power source.
* 2 Leg to from H Bridge to control the armature of DC motor.
* One Leg to generate variable DC voltage for field coil of alternator
* Dspic4011 based open & closed loop control of DC motor.
* Over current protection provided
* Switches provided for increase & Decrease the speed.

IV)Commercial 3Φ 2.5KVA Grid Connected Inverter (Optional)

* Solar Module : 1020W
* Grid - tie Inverter - 2.5KVA
* Solar Panel
* AC Distribution box

V) Optional Components for the Smart Grid Setup

a. 300 Watts Wind Turbine with Blower

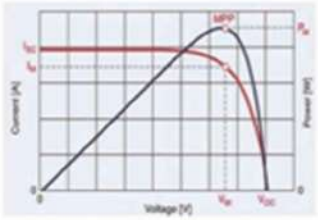
* 300W PMSG Wind Turbine provided
* Wind Turbine & Generator Fixed in a mechanical frame
* Safety grill arrangement provided to avoid physical damage to the student
* 1 no of Blower provided as Wind Blower for indoor power generator & Experimentation.
* Maximum Output in MPPT mode : 300W
* Continuous Power Delivery : 300W

b. Solar/Wind Array Simulator

Input voltage range : 250V AC @50HZ
Power Ratings : 500W (max)

* Max. power : 500W
* Open circuit voltage Voc : 0-60V
* Short Circuit Current Isc : 0-20A
* Peak power Voltage Vm : 0-55V
* Peak power Current Im : 0-18A

Solar Array Simulator IV & PV Curves



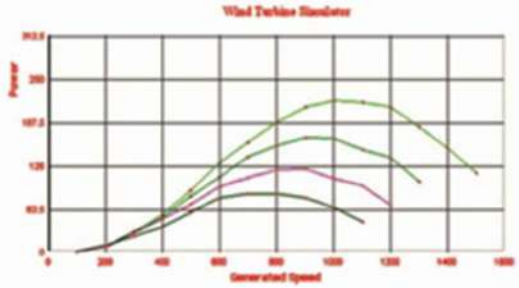
Interface

* USB Interface with PC based VB-GUI
* Realtime Simulation of IV & PV Characteristics.

c. Wind Turbine Simulator using DC Motor Coupled with PMSG

Wind Power Generation gaining importance for its advantage. As a result, a great deal of Research and Laboratory experiments have been focused at the college level. The investigation of Wind Power Generation may not be possible by installing a Real Wind Turbine Tower at all Institutions in India, where sufficient wind speed may not be there and wind speed is also seasonal, which leads to the need of a "Wind Turbine Simulator" at the college.

The PMSG Wind Turbine Simulator has been designed such that it's Static and Dynamic characteristic is as close to Real Wind Turbine. This Simulator consists of a DC shunt motor, a PMSG, TMS320F28335 based DC chopper etc to simulate the Wind Turbine



It Consists of,

a. TMS320F28335 Based DSP Controller
b. IPM Based Power Module (3hp) for PMSG - 2 Nos
c. 1 HP DC Shunt Motor Coupled with 1HP PMSG Motor with Sensor
d. Prime over drive

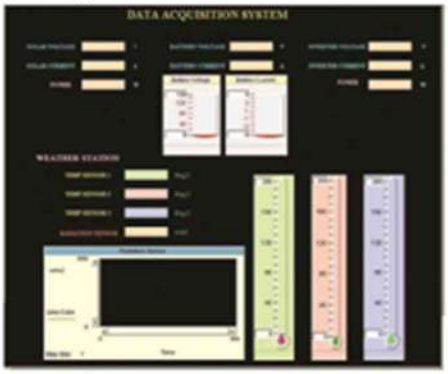
d) Weather Station Experimental Setup

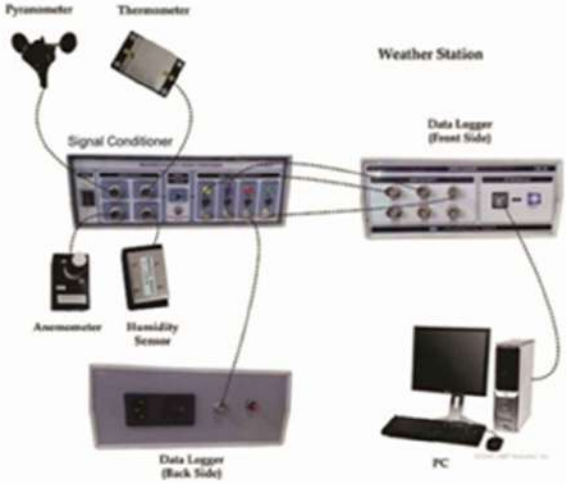
This setup is used to sense and plot various Parameters like Temperature, Humidity, wind speed and solar radiation. This unit consists of High speed Data Acquisition, Temperature, Humidity, Hall Effect, Wind Anemometer and pyranometer sensor and its signal conditioner.

SENSOR MODULES

i. Hall Effect Wind Anemometer

* Polycarbonate, 3-cup anemomenter, which is calibrated.
* Uses a Hall Effect Digital Switch to directly drive digital circuitry.
* Producer pulse based on input voltage.
* Swept Diameter : 7.5"
* Diameter Housing : 2.0"
* Overall Height : 3.2"
* Weight : 3.0 oz





ii. Temperature Sensor module

* Temperature sensor by using glass bead thermistor
* Output in 5 pin socket

iii. Humidity Sensor

* Senses the Humidity of the Atmosphere
* Output in mic socket

iv. Pyramo Meter Sensor

* Measures the Atmosphere Pressure
* Output in mic socket

SIGNAL CONDITIONER MODULE

A separate Signal Conditioner module provided to signal conditon various sensor & outputs.

* It consists of 4 input terminals in 5 pin mic socket
* 4nos of output terminals in BNC female connector
* One no of ON/OFF switch (IRS)
* 8Nos BS2 connectors to read the signals in scope
* The conditioned output are applied to the Data Logger

DATA LOGGER

* It is used to interface the PC and signal conditioner
* 6 Analog input terminals in BNC female connector
* One USB port to interface PC front end GUI
* One Digital input at the Back side and BNC female connector termination.

GUI

* VEEPRO based front END GUI

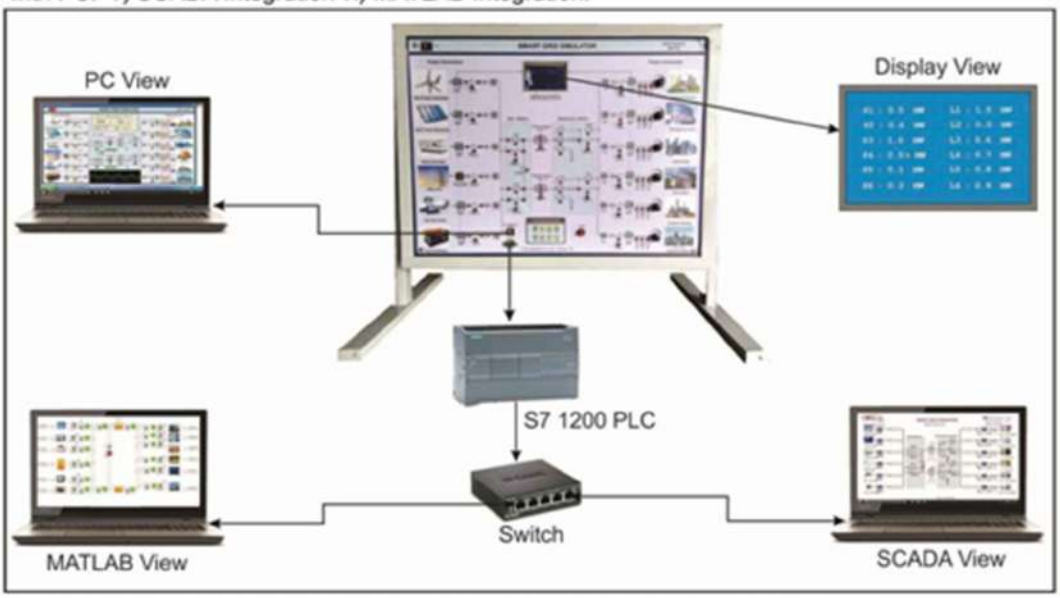
VI) DSP /FPGA Controller for PE, SG, PS Applications

i) dsPIC 33EF814 Controller
ii) TMS320F28335 DSP Controller
iii) Piccolo DSP Controller
iv) Spartan-6 FPGA Controller
v) Advanced Cyclone-IV FPGA Controller
vi) Cyclone-IV Based FPGA Controller
vii) St-Cortex-M4 Controller Board
viii) Dual Core Delfino DSP Controller

(Refere Page No. 39)

VII) SMART GRID SIMULATOR (VPST-SGS-01)

Smart Grid Simulator (VPST-SGS-01) is a convenient solution for studying the basic Architecture. As Smart Grid is gaining momentum in Power Generation, Transmission Line & Distribution, Vi Micro has designed a simple system which can simulate a Smart Grid. It consists of i) 6 types of Generation ii) 2 Nos Transmission Line iii) Six types of loads iv) Communication through USB with PC. v) SCADA Integration vi) MATLAB Integration.



All the components are mounted in a powder coated metal box with stand and stickered front plate.

Features

- MODBUS interface with PLC, Ethernet interface with SCADA & MATLAB.
- Six different generating simulated station (up to 5MW)-Wind, Solar, Diesel, Bio-Gas, Fuel-Cell & UtilityGrid.
- Two separate Transmission Lines (2.5 MW Each) – TL - 1, TL - 2.
- Six different power consumers (Up to 10 MW) – Gen.Industry, Emergency, Urban Area, Rural Area, Cement, Chemical Industry.
- Six analog pot-meters for the power consumption control.
- Graphics LCD & Keypad based configuration & monitoring of smart grid.
- On board LCD & PC based GUI for easy understanding of the smart grid operation.
- Automatic Smart Grid Control algorithm implemented for transmission line control, over current relay & automatic load sharing/adjustment in case of over loading.

Units	Capacity	Qty.	Details
Generating Station (Simulated)	5MW (TOTAL) (Programmable)	6	Wind, Solar, Diesel, Bio-Gas Fuel-Cell, Utility Grid
Transmission Line Simulated	2.5MW EACH (Programmable)	2	TXN Line-1, TXN Line - 2
Power Consumer Simulated	5MW (TOTAL) (Programmable)	6	Gen.Industry, Emergency, Urban Area, Rural Area, Cement, Chemical Industry
Energy Meters Simulated	- -	6 + 6	Generating + Consumption Uni-directional - 11 + Bi-directional - 1
Monitoring & Control	- -	1 + 1	Graphics LCD, Keypad & PC
Interface	- -	1	USB2.0 based PC Interface/MODBUS/Ethernet

Experiments on SMART GRID

1. Smart Grid Simulator Basic Architecture & Operation study and analysis.
2. Study of different Generating Stations, Utility Grid, Sub-Stations, Transmission Line, Distribution Station and different Consumers in SMART-GRID.
3. Study of Energy Meter Network, Power flow Monitoring & Control over generating stations, transmission lines, distributing stations & different power consumers.
4. Study of Transmission Line Overload/fault generation & correction and its automatic Bypass Operation.
5. Study of Automatic Load balancing & Priority based Consumer Power Shut-Down.
6. Study of Advanced Monitoring & Control used in SMART-GRID.
7. Study of Monitoring smart grid on Visual Basic Screen in PC
8. Study of PLC S7_1200 based Monitoring Smart grid on SCADA screen & MATLAB screen in PC

VIII) Components for Building 10/25KW Smart Grid Power Generation

i)10KW IGBT Based Power Module

ii) 25KW Power Module for Multilevel Inverter

Specification

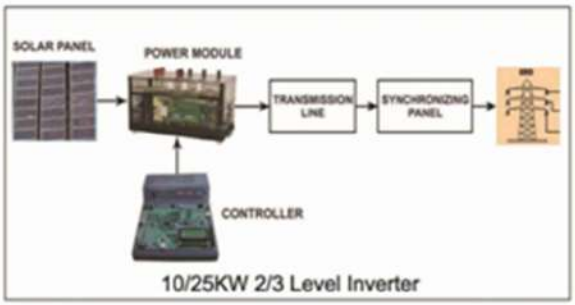
* 1200V/ 75A, Peak Semikron based IGBT module
* 8 Nos of IGBT's provided with independent eight driver (inbuild opto isolator)
* All the collector and emitter terminals are brought out in proper connector for power circuit connection
* All the gate and emitter terminals are brought out and terminated on front panel to view driver output fault output
* Indicator LED provided for PWM input and power supply input
* Proper heat sink provided for all the IGBTs with cooling fan provision
* All are enclosed by viewable acrylic cabinet
* Temperature sensor provided for over temperature Protection
* PWM inputs are brought out on Front Panel, you may connect any controller for interface
* One common +15V Power supply for all the driver circuit, Inbuilt isolated power supply provided.
* Over current protection and short circuit protection provided for all individual IGBT module
* Reset circuit provided and terminated to clear the fault
* Snubber capacitor provided for dv/dt protection for all IGBT module
* 60A 3 phase bridge rectifier and filter circuit available for power circuit input.

3 phase 3 level MLI Specification

* 600V/200A Peak MLI IGBT based power module
* 4nos of IGBT with 2nos of diode module in single pack
* 12nos of independent HLPC 316J based opto isolated IGBT driver
* 1no of 150A bridge rectifier provided for power circuit input and 1600±50µF capacitor [3300uF/450V x 2 capacitors in series in DC link (Ph-LL9 long life grade)] provided for filter circuit.
* Snubber capacitor provided (0.6uF/1000VDC/Ref.IEC61071 in each leg) for dv/dt protection
* Heat sink for all IGBTs with cooling fan provision.
* Sandwiched platted DC link structure
* Powerex based isolated DC-DC converter for driver power supply (VLA106-15242)
* Separate externally Power supply for all the driver circuit is derived from 230V AC - 15V DC.
* 4 hall effect current sensor (50A) with signal conditioner for sensing the DC link current and each output phase current.
* Over temperature protection @ 75°C
* Device short circuit protection for all the IGBT module
* PWM interlock protection for each phase
* Over current protection for each phase and DC link current Indicator LED proved for Fault outputs/power supply input and PWM inputs.
* PWM inputs are brought out on front panel for external controller and Dspace interface.
* Reset circuit with LED indication provided and terminated to clear the fault.
* All are enclosed in transparent acrylic sheets with power terminals (Three terminals of DC bus, 3 phase input and 3 phase output) available for connection with standard high power rated banana connectors.

Suggested Controllers

1. TMS320F2812 based DSP controller (Micro-2812)
2. TMS320F28335 based DSP controller (Micro-28335)
3. Piccolo based DSP Controller (Micro-28069)
4. dsPIC 30F6015 based controller (Micro-6015)
5. dsPIC 33EP814 based controller (VPE-33EP)
6. Spartan 3A Based FPGA controller (VPE-Spartan 3A DSP)
7. Spartan 6 Based FPGA Controller (VPE-Spartan 6)
8. AD-Spartan 6 FPGA Based Controller (VPE - SP6AD)
9. Cyclone IV Based FPGA controller (VPE-CYIV)
10. Cyclone V FPGA Development Board (DE1-SoC)
11. AD-CortexM4 Based Embedded-DSP Controller (VPE-Ad m4)
12. ST-Cortex-M4 Based Embedded-DSP Controller (VPE-St m4)



10/25KW 2/3 Level Inverter

IX) i) IoT Based Wireless Data Acquisition

It consists of IoT 2040 Gateway to connect to Siemens SCADA or DCS Software PCS7 or to a cloud server through WiFi.

* It can interface RS485 with modbus of various modules of Smart Grid.
* With WiFi add on module, IoT 2040 can also interface with Internet for cloud based application.
* Open platform for collecting, processing and transferring data directly during operation.
* It transfers Data from the Smart Grid unit to the cloud and vice versa.
* With varied communication protocols and HLL programming allows Tailored Solutions.
* IoT 2040 can easily be integrated into the existing plant, SCADA, PCS7.

ii) i5 - 6 Core Cloud Server

* i5- 8th Generation, 6 core @ 2.8 GHz
* 16GB RAM
* 2 TB Hard Disk
* Mouse and Keyboard
* Open Source Virtualization Software

X) Other Add Ons

ii) Fuel Cell

* Fuel cell - 200W x 5 Nos
* Total Power - 1000W
* Rated Power/Cell - 200W
* Rated Performance/Cell - 24V/8.3A
* Low Voltage Protection - 20V
* Over Current Protectiom - 12A
* Over temperature Protection - 65°C
* 5Nos connected in series

1KW DC-DC Buck - Boost Converter for Fuel Cell

* Microcontroller based Buck - Boost with MPPT algorithm
* Switching device IGBT/ MOSFET
* I/P voltage range : 120V -210V DC
* O/P voltage range : 380V DC / 3A
* All the I/P & O/P are sensed through isolated sensors
* 4Nos of ADC feedback provided to sense
  - I/P Voltage of Solar, I/P Current of fuel cell
  - O/P Voltage & Current of Converter
* 4 keys provided to select the type of control program
* Banana connector termination provided for input & output with MCB protection.
* 20x4 LCD displays all the I/P / O/P data
* Over current, over voltage & temperature protection.
* dv/dt protection is available for IGBT (Snubber Circuit)
* One RS232/RS485 port provided to Interface with PC/PLC

iii) Super Capacitor

* Rated Capacitance per super capacitor - 500F
* Test Current for Capacitance and ESR DC - 100A
* Maximum Voltage - 17V
* Rated Voltage - 16.2V
* Total Voltage : 162V DC Max.
* 16V working Voltage
* Resistive or active cell balancing available
* 10Nos connected in series

Bi-Directional Buck-Boost Converter for Super Capacitor

* Microcontroller based DC - DC Controller
* 2 Nos of High Speed MOSFET/IGBT
* 2 Nos of Isolated High Speed Driver circuits
* 2 Nos of Current Sensor for sensing the input and output current of the converter
* 2 Nos of Voltage Sensor for sensing the input and output voltage of the converter
* In Boost mode I/P is 162V DC and O/P is 380V DC
* In Buck mode I/P is 380V and O/P is 162V DC
* Power Rating is 1000 Watts
* dv/dt protection is available for all IGBT (Snubber Circuit)
* 20x4 Alpha Numeric LCD display
* One USB/RS485 provided to Interface PC or PLC
* Test points provided in control section for wave form measurement in CRO

iv) Load Controller

* Microcontroller dsPIC4011 based load controller
* Load can be controlled through RS485 input
* Five no of relays used to switch ON/OFF load, depends on input from MODBUS.
* 20x4 LCD displays the current status of load.
* Input and output terminals provided in the front/back panels
* This will work with resistive load.

v) Battery Charger

* Power factor controlled battery charger
* Input 230V AC
* Output voltage 96V DC
* Output current 12A DC

9. DUAL CORE DELFINO BASED DEVELOPMENT BOARD (MICRO 28377D)

- The Micro-28377D Trainer kit is intended and developed for advanced closed-loop control applications for Power electronics, Smart grid etc..,
- It is also focused for students to learn the multi-processor architecture and the inter processor communication mechanisms.

Features:

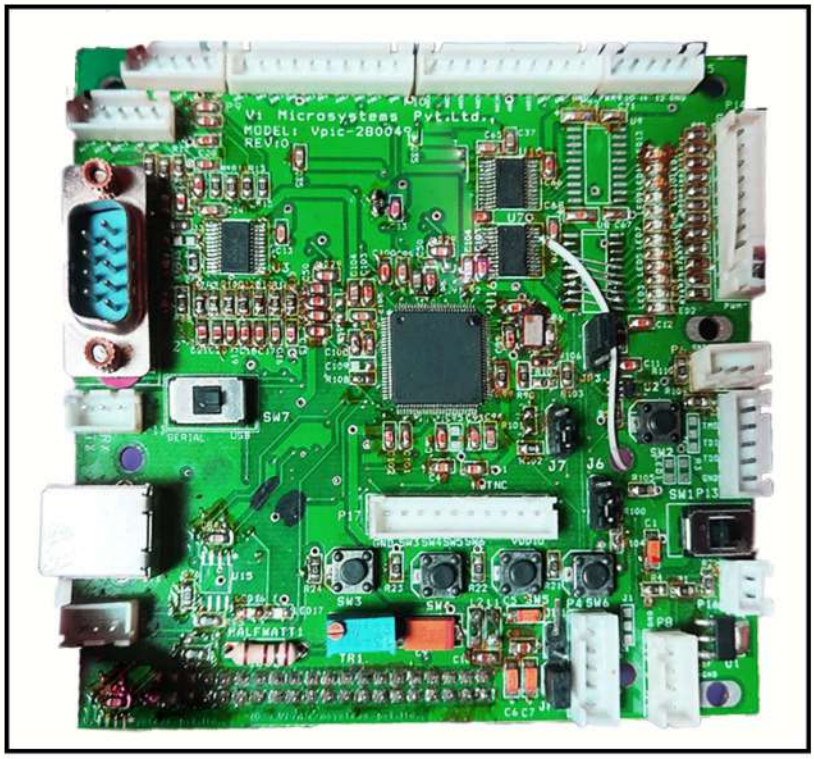
- Dual- Core 32-bit Delfino fixed point Processor
- Operating Speed: 200MHz (For each core) & 32-bit floating-point unit (FPU)
- 1MB (512KW) flash memory with ECC, 204KB (102KW) of SRAM
- 16 Channels (16-bit/12-bit at 1.1 MSPS/3.5 MSPS) Successive Approximation ADCs
- 16 Enhanced PWM outputs, 6 Enhanced Capture Inputs
- 2 SDFM with 8 Input Channels and PWM synchronization

ON Board Features:

- 16 Numbers of user LEDs
- 2 Numbers of Limit Switches for user interface
- 4 Numbers of Push-Button Micro Switches
- 1 SPDT Switch for user interface
- 20 × 4 Alphanumeric LCD , Quadrature Encoder Interface
- Opto-isolated USB, Seial & JTAG Interface
- PWM Outputs and Capture Inputs are terminated at 34-pin FRC connector
- 16 Channel ADC inputs are terminated at 26-pin FRC connector with buffered and protection
- DAC outputs are terminated in screw type connector.
- Compatible with MATLAB SIMULINK

10. TMS320F280049 DSP Based PWM Controller

As DSP based Controllers become more and more awareness among students, Vi Micro has designed another innovative PWM Controller, based on Texas Instrument TMS320F280049 Processor, which provides 32Bit F2812 DSP Core , 16 PWMs, ADC, etc, to build many Power Electronics Applications.



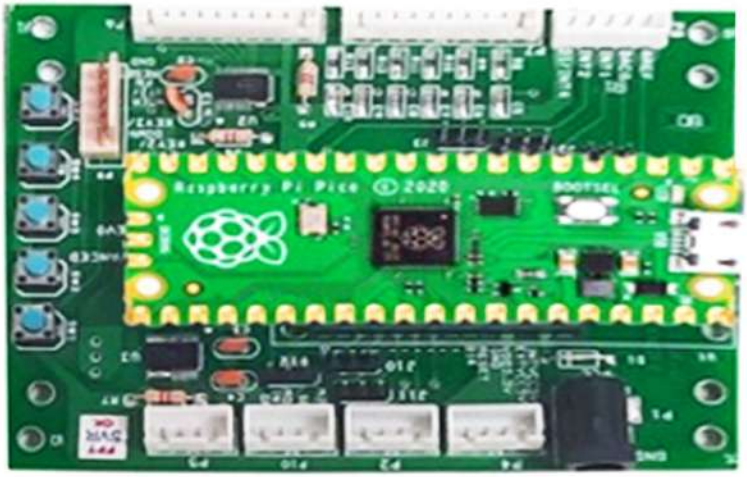
Hardware Features

- TMS320F280049C: 100 MHz C28x CPU with FPU and TMU, 256 KB Flash,
- 3x 12-bit ADC, CAN, encoder, FSI, UART, and more
- Programmable Control Law Accelerator (CLA)
- 3.45-MSPS, 12-bit Analog-to-Digital Converters
- Power domain isolation for real-time debug and flash programming
- CAN transceiver
- Two encoder interface connectors
- 3-nos of Analog Inputs are terminated at P2 connector
- 1-no of Digital to Analog is terminated at P5 connector
- 6 PWM Signals terminated at P3 connector.
- 3-nos of Capture are terminated at P4 connector for Proximity sensor and Quadrature Encoder Sensor interfacing.
- Buffer Provider for the PWM and Capture signals
- RS232 - Com Port interface with PC
- 20X4 Alphanumeric LCD Display
- 4 Push Button switches for user applications and its expansion available in P8 connector.

11. RP2040 Dual Core Based PWM Controller

As Raspberry based embedded Controllers become more and more awareness among students, Vi Micro has designed another innovative PWM Controller, based on Raspberry RP2040 Processor, which provides Dual Core Cortex M0+ Microcontroller, 16 PWMs, ADC, etc, to build many Power Electronics Applications.

- The RP2040 Dual Core Processor is used to build this PWM Controller,
- which consists of Dual Core Cortex M0+ Microcontroller with Flash Ram, PWM, ADC and many on board features.



Features:

- Based on Raspberry RP2040 Dual Core Cortex M0+ MCU
- Digital I/O Pins: 22 headers
- UART, SPI, I2C
- Memory: Flash :2 MB, SDRAM: 264KB
- Clock Speed: up to 133 MHz
- Microcontroller:Dual Core Cortex-M0+ 32bit ARM MCU
- Digital I/O Pins: 8 nos.
- PWM Pins: 6nos.
- Analog Inputs: 6no, 12bit

Carrier Board Features:

- 3-nos of Analog Inputs are terminated at P2 connector
- 12bits, 350Ksps
- 1-no of Digital toAnalog is terminated at P5 connector
- 6 PWM Signals terminated at P3 connector.
- 3-nos of Capture are terminated at P4 connector for Proximity sensor and Quadrature Encoder Sensor interfacing.
- Buffer Provider for the PWM and Capture signals
- RS232 - Com Port interface with PC
- 20X4 Alphanumeric LCD Display
- 4 Push Button switches for user applications and its expansion available in P8 connector.
- PMOD connector provided for Hardware expansion.

12. ARDUINO Based FPGA CYCLONE 10 PWM Controller

- As Arduino based embedded Controller become more awareness among students, Vi Micro has designed another innovative PWM Controller based on Arduino Vidor 4000 Controller, which provide a Cortex M0+ Microcontroller and a Cyclone 10 FPGA to build many Power Electronics Applications.

Features:

- Based on Arduino Vidor with FPGA & 32 bit Cortex M0+ Embedded Controller.
- FPGA : Intel Cyclone 10CL016
- Digital I/O Pins : 22 headers + 25 Mini PCI Express UART, SPI, I2C
- Memory : Flash :2 MB, SDRAM: 8MB
- Clock Speed : 48 MHz - up to 200 MHz
- Microcontroller : Cortex-M0+ 32bit ARM MCU
- Digital I/O Pins : 8 nos.
- PWM Pins : 6 no
- Memory : Flash : 256KB, SDRAM : 32KB
- Analog Inputs : 6 no, 12bit
- Analog Outputs : 1 no, 10bit
- Clock Speed : 48MHz – 200Mhz.

Carrier Board Features:

- 6-nos of Analog Inputs are terminated at P2 connector 12 bit, 350Ks/s
- 1-no of Digital to Analog is terminated at P5 connector
- 6 PWM Signals terminated at P3 Connector
- 3-nos of Capture are terminated at P4 connector for sensor interfacing.
- Buffer Provided for the PWM and Capture signals
- RS232 - Com Port interface with PC
- 20X4 Alphanumeric LCD Display fixed in the Front Panel.
- 4 Push Type Switches for user applications and fixed in the Front Panel.

13. DSP Processor Based DATA ACQUISITION SYSTEM [VDAS-02]

- DUAL CORE 32 bit DSP Processor BASED Data Acquisition System is developed for advanced closed-Process loop control applications for Process Control Trainers. It is also focused for students to learn the multi-processor architecture and the inter processor communication mechanisms.

- Many Control Algorithm like

ON/OFF Control | **PID Control** | **Fuzzy Logic Control** | **Reinforcement Learning Control** | **Model Predictive Control**

can be implemented using this powerful 32 bit DSP Processor. A choice of Digital Filtering for each channel is an added advantage for the Data Acquisition.

MATLAB Simulink Based | **Digital Filtering for each Channel**

Features:

- **Dual- Core 32-bit Delfino fixed point Processor : TMS320F377D Based**
- **Operating Speed: 200MHz (For each core) & 32-bit floating-point unit (FPU)**
- **1MB (512KW) flash memory with ECC, 204KB (102KW) of SRAM**
- **8 Channels (16-bit/12-bit at 1.1 MSPS/3.5 MSPS) Successive Approximation ADCs**
- **Enhanced Capture Inputs**

ON Board Features:

- **20 × 4 Alphanumeric LCD , Quadrature Encoder Interface**
- **Opto-isolated USB Serial Interface**
- **Compatible with MATLAB SIMULINK**
- **8 Digital Input & 8 Digital Output**
- **Two channel current to voltage converter provided**
- **Two channel voltage to current converter provided**
- **Optional additional 2 Channel Current to Voltage. and 2 Channel Voltage to Current.**

- **In-Built IC regulated power supply**
- **ADC/DAC signals and I/O lines are terminated at a 25 pin 'D' Male connector**

16/12 bit ADC & 12 bit DAC

- **Analog Input : 8 Channel**
- **Resolution & Rate : 16 bit @ 1.1MSPS &2 bit @ 3.5MSPS**
- **Range : 0 to 5V**

- **Analog output : 2 Channel**
- **Analog Output (Optional) : 2 Channel**
- **Resolution : 12 bit**
- **Range : 0 to 5V**

I/V and V/I converter

- No. of I/V : 2 Channel
- Input range : (4-20)mA
- Output Range : (0-5)V
- No. of V/I : 2 Channel
- Input range : (0-5)V
- Output Range : (4-20)mA

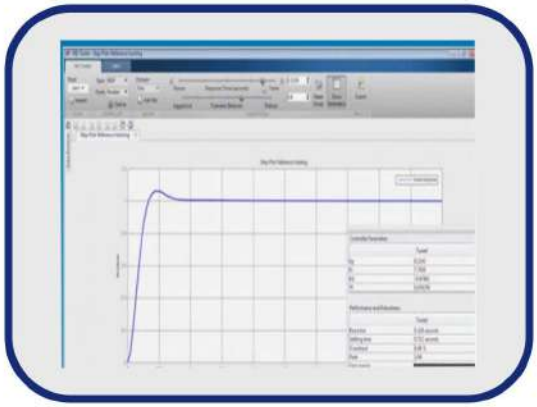
Two channel of ADC & DAC is configured as I/V & V/I converter

I/V and V/I converter (Optional)

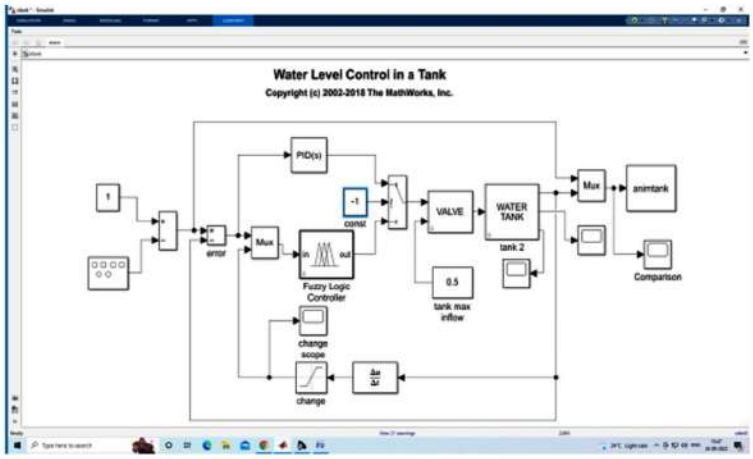
- No. of I/V : 2 Channel
- Input range : (4-20)mA
- Output Range : (0-5)V
- No. of V/I : 2 Channel
- Input range : (0-5)V
- Output Range : (4-20)mA

- **Model Based Software developed using MATLAB-SIMULINK. Good GUI support is provided which helps in learning the principles of process control. Different experiments can easily be selected, studied and conducted. The software is easy to use, flexible & with features like Data access, trend plots, Data logging, Printing, Data export.**

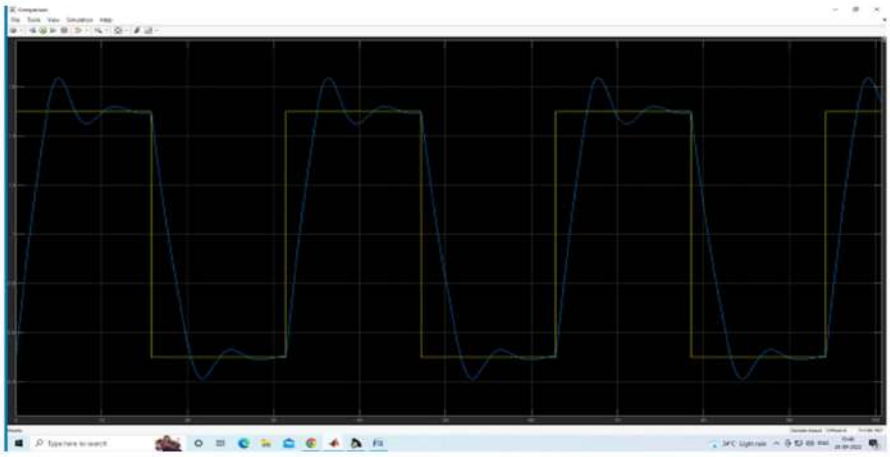
- **You can validate your design by verifying rise time, overshoot, settling time, gain and phase margins, and other requirements**



On/off control, Pid Controland Optional Fuzzy Logic Control, Reinforcement Learning Control and Model Predictive Control

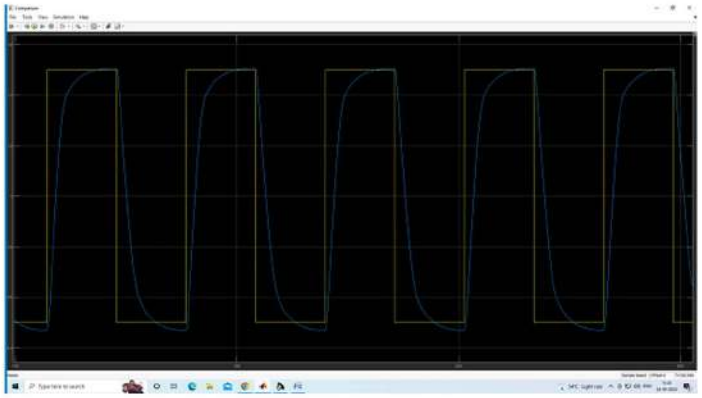


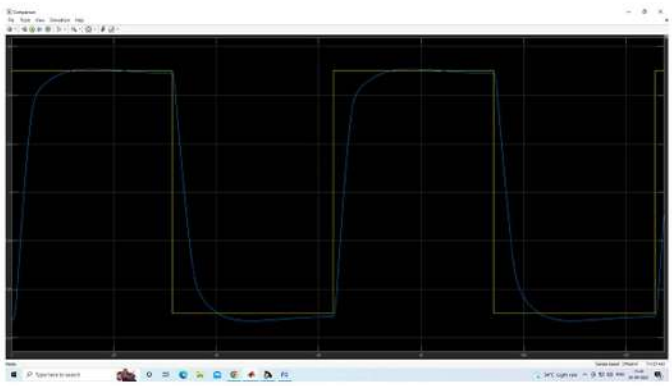
Waveform for PID response of water tank level control



Wave forms for fuzzy logic water level control

Against 2 Set point & actual water level





Vi Microsystems Pvt. Ltd.
No : 75 ,Electronics Estate,Perungudi,Chennai - 96, India

14. DIGITAL HYBRID TANK PROCESS CONTROL UNIT

- This Plant consist of SS Conical tank, SS Spherical tank, Two Nos of Rotameter, two number of control valve with smart positioner, Two Nos of Level Transmitter, These Devices are based on PROFINET and PROFIBUS Based Digital Bus, such that a Digital Bus based Process control system can be established
- Two Nos of Pump with electric motor, Two Nos of Flow Transmitter with orifice plate, DP/PA COUPLER with ACTIVE FIELD DISTRIBUTOR for Profibus based positioner to existing DCS (PCS 7) system.
- The above components provided to build a Digital Hybrid Tank Non Linear Process Control Plant.The closed loop control systems will be implemented using the existing AS410 controller + ET 200 Distrubuted I/ O and PCS 7 (DCS) software to build a Digital Twin .COMOS, SIMIT and PCS7 can be used to build the Digital Twin of this Process control System
- A DUAL CORE 32 bit DSP Processor BASED Data Acquisition System can be provided for PC – MATHLAB – SIMULINK Based Control of Hybrid Tank Process control Trainer. Using this the student can study a simple ON/OFF to most complex advanced MODEL PREDICTIVE CONTROL.
- A PLC S7-1200 can be provided for PC – SCADA Based Control of Hybrid Tank Process control Trainer

SS Spherical tank as a Non-Linear Process

Body Material	: SS304
Diameter	: 500mm
End Connection	: 3/4" BSP Thread
Capacity	: 25/30 Liter

SS Conical tank as a Non-Linear process

Body Material	: SS304
Top Diameter	: 500mm
Bottom Diameter	: 25mm
Height	: 500mm

Two Nos of Rotameter to visualize the flow rate

Type	: Variable area
Range	: (44-440)LPH
End Connection	: Flanged
Float Material	: SS316

One number of control valve with smart positioner provided to control flow of water.

Make	: Positioner(Siemens) + Valve (RK Control) + Profibus (PA)
Type	: Single seated globe with intelligent positioner.
Characteristics	: Equal %.
Body	: CS Body.
Trim Size	: ¾ "
Trim Mat	: SS316
CV	: 2(or)5.
Connection	: 3/4" flanged.
Feedback	: (4-20)mA ouput

Profibus can be connected to AS410 Controller through a Adapter of DCS (PCS7) available at the department

Two Nos of Level Transmitter to sense the tank level

Make	: Siemens/ABB
Type	: DPT(Two wire system)
Supply	: 24V DC
Range	: (0-6500)mmwc
Output	: (4-20) mA

Two Nos of Flow Transmitter with orifice plate to sense the flow of the pipe line

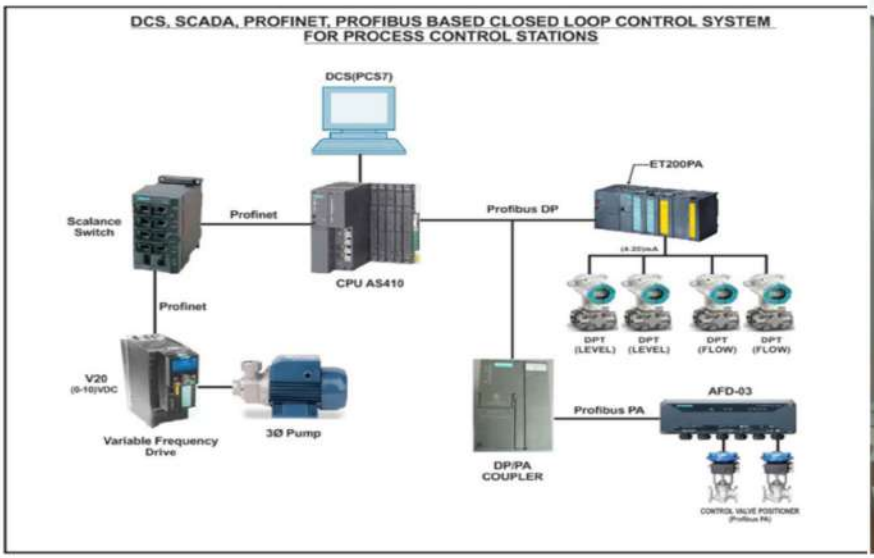
Make	: Siemens/ABB
Type	: DPT(Two wire system)
Supply	: 24V DC
Range	: (0-6500)mmwc
Output	: (4-20) mA

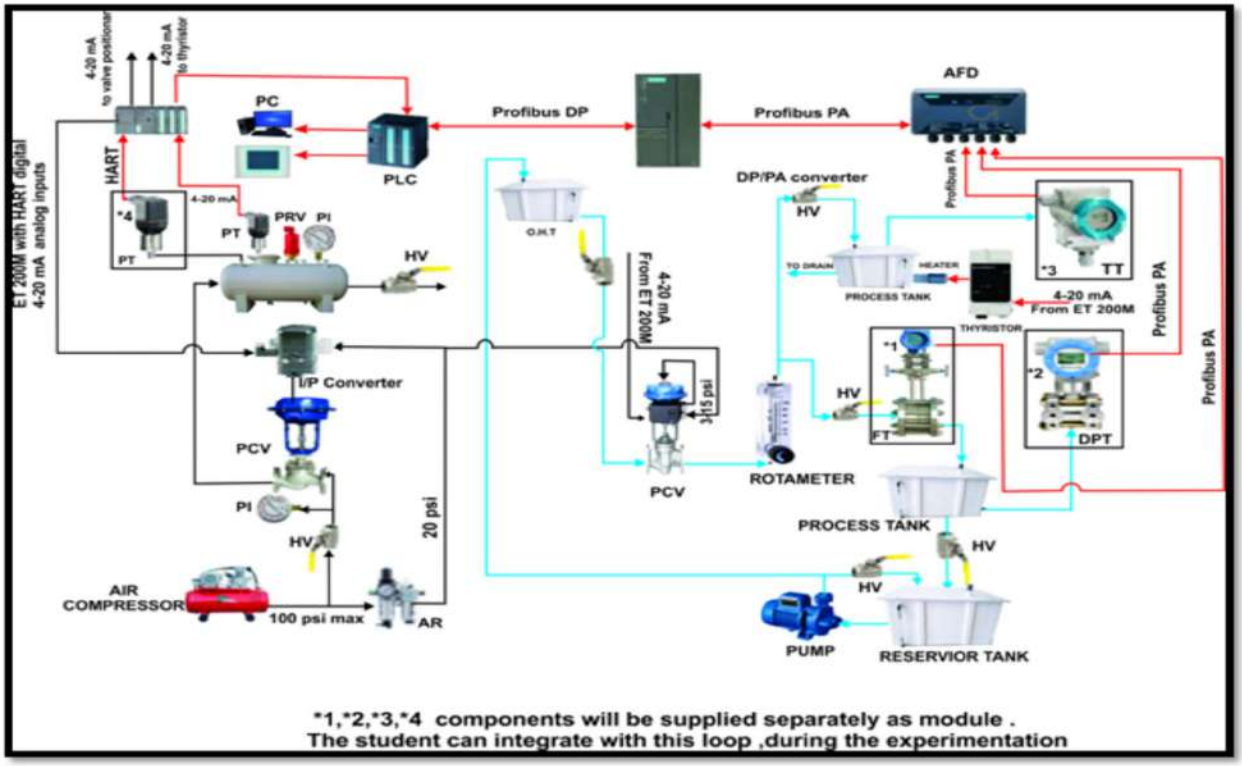
Two Nos of Centrifugal Pump with electric motor to circulate the water

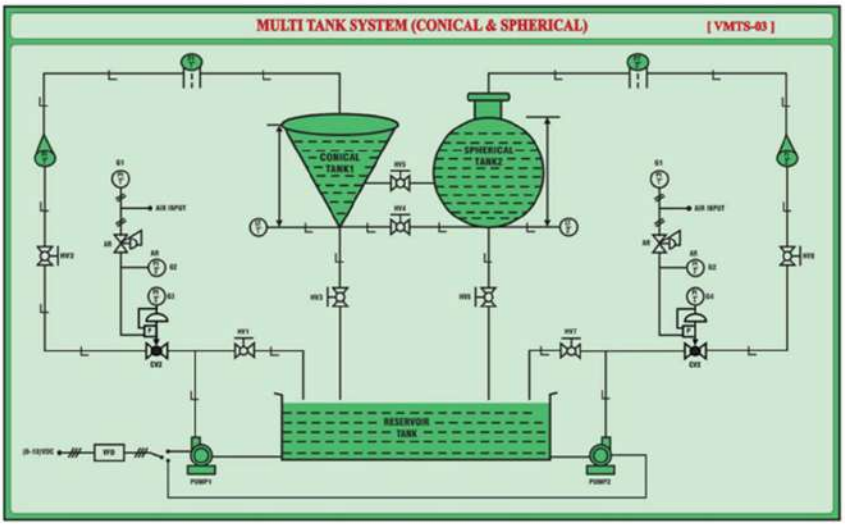
Type	: Centrifugal Pump
Supply	: 230V AC/50Hz / 3Phase
Power	: 0.5HP
Mounting	: Foot Mounting

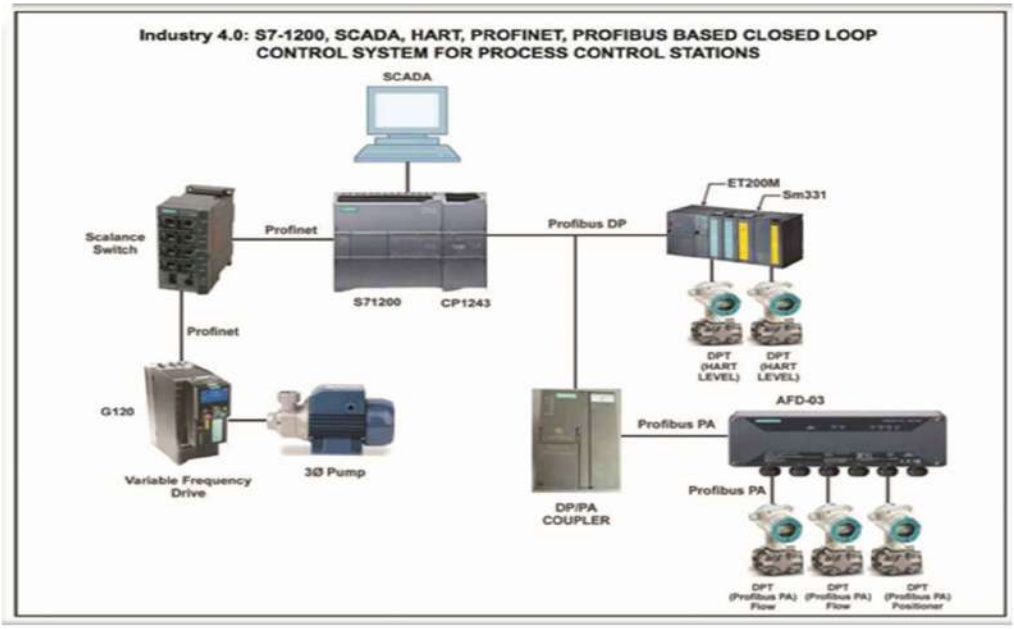
Air Regulator with filter to regulate the air

Supply	: 100Psi Maximum
Output	: (0-30)Psi


DCS, SCADA, PROFINET, PROFIBUS BASED CLOSED LOOP CONTROL SYSTEM
FOR PROCESS CONTROL STATIONS
DCS(PCS7)
Scalance Switch
Profinet
CPU AS410
Profibus DP
ET200PA
Profinet
V20
(0-10)VDC
Variable Frequency Drive
3Ø Pump
DPT (LEVEL)
DPT (LEVEL)
DPT (FLOW)
DPT (FLOW)
DP/PA COUPLER
Profibus PA
AFD-03


ET 200M with HART digital 4-20 mA analog inputs
4-20 mA to valve positioner
4-20 mA to thyristor
HART
PC
PLC
Profibus DP
Profibus PA
AFD
DP/PA converter
HV
PRV
PI
PT
*4
4-20 mA
O.H.T
From ET 200M
4-15 psi
PCV
I/P Converter
PCV
PI
HV
20 psi
AIR COMPRESSOR
100 psi max
AR
TO DRAIN
HEATER
PROCESS TANK
THYRISTOR
*3
TT
4-20 mA From ET 200M
*1
*2
FT
DPT
ROTAMETER
PROCESS TANK
PUMP
RESERVIOR TANK
*1,*2,*3,*4 components will be supplied separately as module .
The student can integrate with this loop ,during the experimentation


MULTI TANK SYSTEM (CONICAL & SPHERICAL)
[VMTS-03]
CONICAL TANK1
SPHERICAL TANK2
RESERVOIR TANK



DP/PA COUPLER

* Converts Profibus DP to Profibus PA
* Provide Detailed Network Diagnostics
* The Physical link between Profibus DP and Profibus PA Devices
* Suitable hand valves (1/2" & 3/4") with indication
* Sight glasses with fittings
* Plumbing lines are SS304 pipes
* Regulated variable voltage power supply

VFD DRIVE SPECIFICATION:

Make	: Siemens
Model No	: Sinamics V20 Drive
Input	: Single Phase (230V AC)
Output	: 3 Phase
Power	: 0.5HP, 0.75KW
Variable Voltage	: (0-10)V DC

Sump tank to store the water

Capacity	: 80 liter
Size	: 600x400x350
Material	: SS304

ACTIVE FIELD DISTRIBUTOR

* Connects upto 4 PA Field Devices
* AFD Distribute Profibus PA via spur lines to the PA field devices like positioner, DPT etc.,
* PA field device (e.g) Measuring instruments, Sensors like DPT, Temperature Transmitter etc. can be connects to the AFD
* It supports Ring Redendany
* Automatic bus termination
* Short circuit proof spur lines

DSP Processor Based DATA ACQUISITION SYSTEM [VDAS-02]

- DUAL CORE 32 bit DSP Processor BASED Data Acquisition System is developed for advanced closed-Process loop control applications for Process Control Trainers. It is also focused for students to learn the multi-processor architecture and the inter processor communication mechanisms.
- Many Control Algorithm like On/Off, PID, Fuzzy Logic, Reinforcement Learning, Model Predictive Control can be implemented using this powerful 32 bit DSP Processor. A choice of Digital Filtering for each channel is an added advantage for the Data Acquisition.

Features:

- Dual- Core 32-bit Delfino fixed point Processor : TMS320F377D Based
- Operating Speed: 200MHz (For each core) & 32-bit floating-point unit (FPU)
- 1MB (512KW) flash memory with ECC, 204KB (102KW) of SRAM
- 8 Channels (16-bit/12-bit at 1.1 MSPS/3.5 MSPS) Successive Approximation ADCs
- Enhanced Capture Inputs

ON Board Features:

- 20 × 4 Alphanumeric LCD , Quadrature Encoder Interface
- Opto-isolated USB Serial Interface
- Compatible with MATLAB SIMULINK
- 8 Digital Input & 8 Digital Output
- Two channel current to voltage converter provided
- Two channel voltage to current converter provided
- Optional additional 2 Channel Current to Voltage. and 2 Channel Voltage to Current.
- In-Built IC regulated power supply
- ADC/DAC signals and I/O lines are terminated at a 25 pin 'D' Male connector

16/12 bit ADC & 12 bit DAC

Analog Input	: 8 Channel
Resolution & Rate	: 16 bit @ 1.1MSPS & 12 bit @ 3.5MSPS
Range	: 0 to 5V
Analog output	: 2 Channel
Analog Output (Optional)	: 2 Channel
Resolution	: 12 bit
Range	: 0 to 5V

I/V and V/I converter

No. of I/V	: 2 Channel
Input range	: (4-20)mA
Output Range	: (0-5)V
No. of V/I	: 2 Channel
Input range	: (0-5)V
Output Range	: (4-20)mA

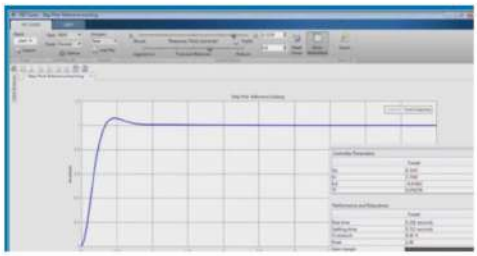
Two channel of ADC & DAC is configured as I/V & V/I converter

I/V and V/I converter (Optional)

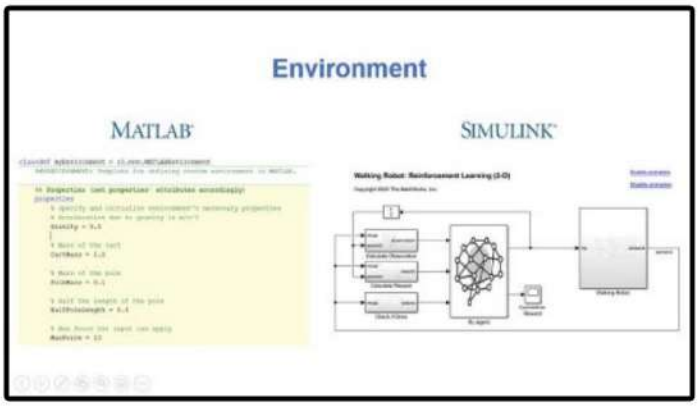
No. of I/V	: 2 Channel
Input range	: (4-20)mA
Output Range	: (0-5)V
No. of V/I	: 2 Channel
Input range	: (0-5)V
Output Range	: (4-20)mA

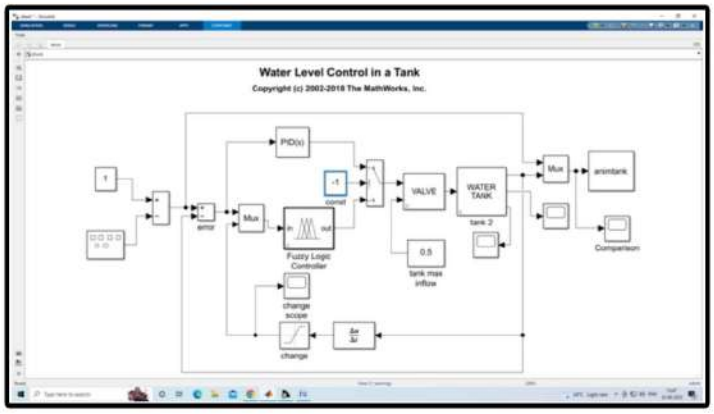
You can validate your design by verifying rise time, overshoot, settling time, gain and phase margins, and other requirements

On/off control, pid and Optional Fuzzy Logic, Reinforcement Learning and Model Predictive Control

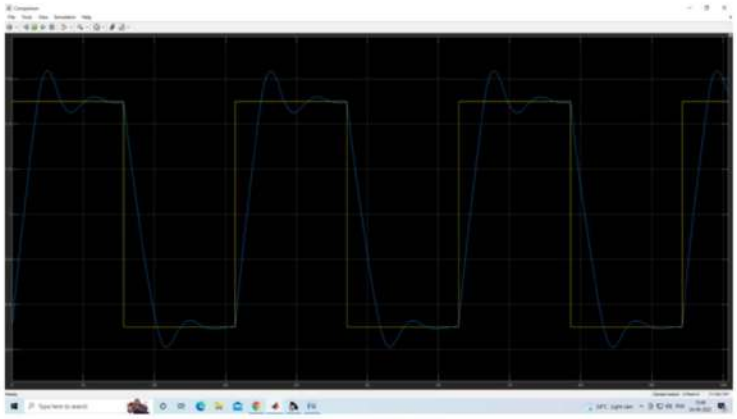


On/off control, pid and Optional Fuzzy Logic, Reinforcement Learning and Model Predictive Control

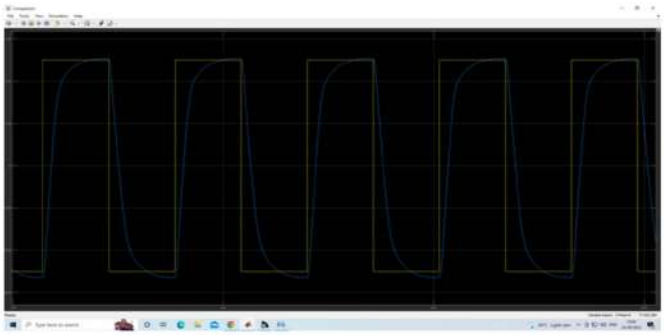


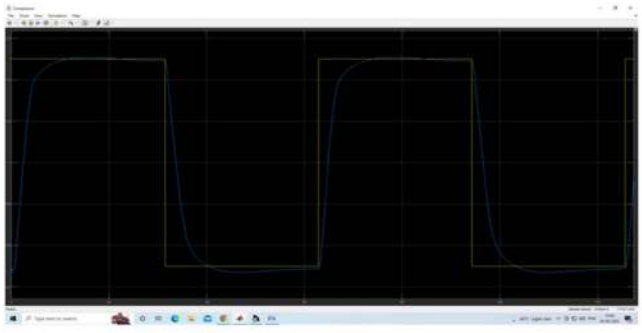


Waveform for PID response of water tank level control



Wave forms for fuzzy logic water level control Against 2 Set point & actual water level





NOTE: PC (i5-12th Gen-16GB RAM, 1TB Nvme SSD), AIR COMPRESSOR TO BE PROVIDED BY THE INSTITUTION AT THE TIME OF INSTALLATION

15. 1/3ϕ 1kw Mini IPM Based Inverters

We offer 4 types of Inverters, listed below, based on 15A, Mini IPM using IGBT & SiC and2 types of PWM Controllers: i. ARDUINO Based FPGA CYCLONE 10 PWM Controller ii. DUAL CORE DELFINO BASED DEVELOPMENT BOARD (MICRO 28377D).

- 1/3ϕ IGBT Mini IPM based Inverter with built in Controller (Vdr-inv01-igbt).
- 1/3ϕ SiC Mini IPM based Inverter with built in Controller (Vdr-inv01-SiC)
- 1/3ϕ IGBT Mini IPM based Inverter with External Controller (Vdr-inv02-igbt)
- 1/3ϕ SiC Mini IPM based Inverter with External Controller (Vdr-inv02-SiC)

1.1/3ϕ Mini IPM based Inverter with built in Controller (Vdr-inv01-igbt) & (Vdr-inv01-SiC)

This trainer consists of a IGBT or SiC Based Mini Intelligent Power Module and a built in PWM Controller and can be used to build

i.. 1Ø Inverter , ii. 3Ø Inverter , iii. DC Chopper
iv. Speed Control of AC Motor , v. Speed Control of DC Motor
vi. Speed Control of BLDC Motor, vii. Speed Control of PMSM Motor.

i. ARDUINO Based FPGA CYCLONE 10 PWM Controller.

- As Arduino based embedded Controller become more awareness among students, Vi Micro has designed another innovative PWM Controller based on Arduino Vidor 4000 Controller, which provide a Cortex M0+ Microcontroller and a Cyclone 10 FPGA to build many Power Electronics Applications.

Features:

- Based on Arduino Vidor with FPGA & 32 bit Cortex M0+ Embedded Controller.
- FPGA : Intel Cyclone 10CL016
- Digital I/O Pins : 22 headers + 25 Mini PCI Express UART, SPI, I2C
- Memory : Flash :2 MB, SDRAM: 8MB
- Clock Speed : 48 MHz - up to 200 MHz
- Microcontroller : Cortex-M0+ 32bit ARM MCU
- Digital I/O Pins : 8 nos.
- PWM Pins : 6 no
- Memory : Flash : 256KB, SDRAM : 32KB
- Analog Inputs : 6 no, 12bit
- Analog Outputs : 1 no, 10bit
- Clock Speed : 48MHz – 200Mhz.

Carrier Board Features:

- 6-nos of Analog Inputs are terminated at P2 connector 12 bit, 350Ks/s
- 1-no of Digital to Analog is terminated at P5 connector
- 6 PWM Signals terminated at P3 Connector
- 3-nos of Capture are terminated at P4 connector for sensor interfacing.
- Buffer Provided for the PWM and Capture signals
- RS232 - Com Port interface with PC
- 20X4 Alphanumeric LCD Display fixed in the Front Panel.
- 4 Push Type Switches for user applications and fixed in the Front Panel.

ii. 3ØIGBT Based Mini IPM Power Circuit. (Vmipm- Lcd01)

The Power Circuit of this Trainer consists of Six Numbers of IGBT with gate driver in a Single Chip Called Mini Intelligent Power Module. & pwm isolator IC'S.
The PWM signals are given from the ARDUINO Based FPGA CYCLONE 10 PWM Controller.
It can be used for high voltage single phase / Three phase inverter, chopper, motor control applications

Six Numbers of High speed opto - isolator provided for PWM isolation

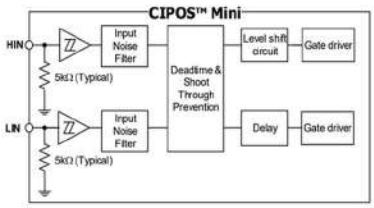
* Power Circuit : One Number of IGBT based Mini IPM - IGCM15F60GA (6 IGBT- 3 Legs)-with suitable snubber circuit & Heat sink provided .
* Rating of device is 600V@ 15AMP
* Isolated +15 Vdc@1amp provided for control ic's
* One number of Single phase diode rectifier (600V, 35Amp) with filter capacitor provided for input ac rectification and for power circuit input with fuse protection
* One number of Analog voltmeter provided for DC-Link voltage measurement.
* Four Number of Hall Effect current sensors provided for output current & DC-Link Current Measurement & Protection
* Four number of op-amp signal conditioner circuit provided for all current sensors & output terminated in front panel for current wave form measurement.
* Over current Trip circuit provided for Over Load protection.
* One number of LED provided to indicate TRIP Status
* One number of Reset Switch provided to reset the Trip Function
* Six Numbers of banana connector termination provided in power circuit Input & external load interface
* 12 Numbers of test points provided in control section for wave form measurement in CRO
* All are mounted in attractive powder coated cabinet with front panel sticker with mimic diagram indication.
* 230V AC input, one number of power on / off switch with indication.

iii. 3Ø SiC Based Mini IPM Power Circuit. (Vmipm- Lcd02)

The Power Circuit of this Trainer consists of Six Numbers of SiC with gate driver in a Single Chip Called Mini Intelligent Power Module, fully isolated Dual In-Line molded module with 1200 V MOSFET & PWM isolator IC's . The PWM Signals are given from the ARDUINO Based FPGA CYCLONE 10 PWM Controller. It can be used for high voltage single phase / Three phase inverter, chopper, motor control applications

Six Numbers of High speed opto - isolator provided for pwm isolation

* Power Circuit : One Number of SiC based Mini IPM (6 SiC MOSFET - 3 Legs) with suitable snubber circuit & Heat sink provided .
* Rating of device is 1200V@ 15AMP
* Isolated +15 Vdc@1amp provided for control ic's
* One number of Single phase diode rectifier (1200V, 35Amp) with filter capacitor provided for input ac rectification and for power circuit input with fuse protection
* One number of Analog voltmeter provided for DC-Link voltage measurement.
* Four Number of Hall Effect current sensors provided for output current & DC-Link Current Measurement & Protection
* Four number of op-amp signal conditioner circuit provided for all current sensors & output terminated in front panel for current wave form measurement.
* Over current Trip circuit provided for Over Load protection.
* Improved heat dissipation › Rugged 1200 V SOI gate driver technology , Integrated bootstrap functionality , Over current shutdown , Independent temperature thermistor , Under-voltage lockout at all channels, Low side pins accessible for all phase current monitoring
* One number of LED provided to indicate TRIP Status
* One number of Reset Switch provided to reset the Trip Function
* Six Numbers of banana connector termination provided in power circuit Input & external load interface
* 12 Numbers of test points provided in control section for wave form measurement in CRO
* All are mounted in attractive powder coated cabinet with front panel sticker with mimic diagram indicat
* 230V AC input, one number of power on / off switch with indication.



2. 1Ø/3Ø Mini IPM based Inverter with external controller (Vdr –inv02-igbt) & (Vdr-inv02-SiC)

This trainer consists of a IGBT or SiC Based Mini Intelligent Power Module with an External PWM Controller and can be used to build.

I. 1Ø Inverter
II. 3Ø Inverter
III. DC Chopper
IV. Speed Control of AC Motor
V. Speed Control of DC Motor
VI. Speed Control of BLDC Motor
VII. Speed Control of PMSM Motor

a. 3Ø IGBT BASED Mini IPM POWER MODULE (Vmipm-106B)

This module consists of Six Numbers of IGBT with gate driver in A Single Chip Called Mini Intelligent Power Module. & PWM isolator IC'S. The PWM signals are given from an external PWM Controller :DUAL CORE DELFINO BASED DEVELOPMENT BOARD (MICRO 28377D). It can be used for high voltage single phase / three phase inverter, chopper, motor control applications.

Features

Six Numbers of High speed opto - isolator provided for pwm isolation

* Power Circuit : One Number of IGBT based Mini IPM - IGCM15F60GA (6 IGBT- 3 Legs)-with suitable snubber circuit & Heat sink provided .
* Rating of device is 600V@ 15AMP
* Isolated +15vdc@1amp provided for control ic's
* One number of Single phase diode rectifier (600V, 35Amp) with filter capacitor provided for input ac rectification and for power circuit input with fuse protection
* One number of Analog voltmeter provided for DC-Link voltage measurement.
* Four Number of Hall Effect current sensors provided for output current & DC-Link Current Measurement & Protection
* Four number of op-amp signal conditioner circuit provided for all current sensors & output terminated in front panel for current wave form measurement.
* Over current Trip circuit provided for Over Load protection.
* One number of LED provided to indicate TRIP Status
* One number of Reset Switch provided to reset the Trip Function
* Six Numbers of banana connector termination provided in power circuit Input & external load interface
* One numbers of 34 pin & 1 no of 26 Pin FRC connectors provided for External PWM Controller Interface.
* 10 Numbers of test points provided in control section for wave form measurement in CRO
* All are mounted in attractive powder coated cabinet with front panel sticker with mimic diagram indication.
* 230V AC input, one number of power on / off switch with indication.

SPECIFICATION :

Power circuit input	:	230V AC / 300V DC@ 4amp (externally)
Power Circuit Output	:	Suitable for 1HP AC/DC/BLDC/PMSM motor
PWM input	:	6 Numbers of PWM – 5VDC level
Protection	:	5Amp.

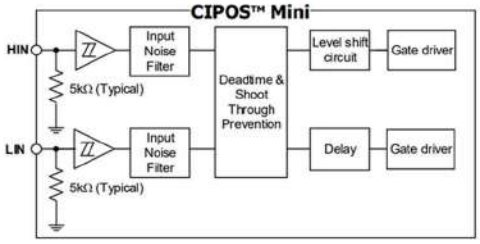
b. 3Ø SiC BASED Mini IPM POWER MODULE (Vmipm-106C)

This module consists of Six Numbers of SiC with gate driver in A Single Chip Called Mini Intelligent Power Module. & PWM isolator IC'S. Fully isolated Dual In-Line molded module with 1200 V CoolSiC MOSFET. The PWM signals are given from an external PWM Controller : DUAL CORE DELFINO BASED DEVELOPMENT BOARD (MICRO 28377D). It can be used for high voltage single phase / three phase inverter, chopper, motor control applications.

Features

Six Numbers of High speed opto - isolator provided for pwm isolation

* Power Circuit : One Number of SiC based Mini IPM (6 SiC MOSFET- 3 Legs)-with suitable snubber circuit & Heat sink provided .
* Rating of device is 1200V@ 15AMP
* Isolated +15 Vdc@1amp provided for control IC's
* One number of Single phase diode rectifier (1200V, 35Amp) with filter capacitor provided for input ac rectification and for power circuit input with fuse protection
* One number of Analog voltmeter provided for DC-Link voltage measurement.
* Four Number of Hall Effect current sensors provided for output current & DC-Link Current Measurement & Protection
* Four number of op-amp signal conditioner circuit provided for all current sensors & output terminated in front panel for current wave form measurement.
* Over current Trip circuit provided for Over Load protection.
* Improved heat dissipation › Rugged 1200 V SOI gate driver technology , Integrated bootstrap functionality , Over current shutdown , Independent temperature thermistor , Under-voltage lockout at all channels, Low side pins accessible for all phase current monitoring
* One number of LED provided to indicate TRIP Status
* One number of Reset Switch provided to reset the Trip Function
* Six Numbers of banana connector termination provided in power circuit Input & external load interface
* One numbers of 34 pin & 1 no of 26 Pin FRC connectors provided for External PWM Controller Interface.
* 10 Numbers of test points provided in control section for wave form measurement in CRO
* All are mounted in attractive powder coated cabinet with front panel sticker with mimic diagram indication.
* 230V AC input, one number of power On / Off switch with indication.



SPECIFICATION :

Power circuit input	:	230V AC / 300V DC@ 4amp (externally)
Power Circuit Output	:	Suitable for 1HP AC/DC/BLDC/PMSM motor
PWM input	:	6 Numbers of PWM – 5VDC level
Protection	:	5Amp.

C. DUAL CORE DELFINO BASED DEVELOPMENT BOARD (MICRO 28377D)

The Micro-28377D Trainer kit is intended and developed for advanced closed-loop control applications for Power electronics, Smart grid etc..,
It is also focused for students to learn the multi-processor architecture and the inter processor communication mechanisms.
The inbuilt peripherals of the processor lead to uncomplicated design for the developers in the emerging technology.

Features:

- Dual- Core 32-bit Delfino fixed point Processor
- Operating Speed: 200MHz (For each core)
- 32-bit floating-point unit (FPU) which supports floating point operations
- Trigonometric Math Unit (TMU) to speed up the execution of trigonometric operations
- Viterbi, Complex Math, and CRC Unit II (VCU-II) to accelerate the performance of FFT's and communications-based algorithms
- Two CLA real-time control co-processors that run at the same speed as the main CPU's
- Parallel processing capability effectively doubles the computational performance
- 1MB (512KW) of onboard flash memory with error correction code (ECC)
- 204KB (102KW) of SRAM
- 16 Channels (16-bit/12-bit at 1.1 MSPS/3.5 MSPS) Successive Approximation ADCs
- 16 Enhanced PWM outputs, 6 Enhanced Capture Inputs
- 3 (12-bit) Buffered DACs
- 2 SDFM with 8 Input Channels and PWM synchronization
- External memory interface 16/32 bit support
- 192 dedicated PIE vectors
- MCU/DSP balancing code density & execution time
- Single cycle read-modify-write instruction.

ON Board Features:

- 16 Numbers of user LEDs
- 2 Numbers of Limit Switches for user interface
- 4 Numbers of Push-Button Micro Switches
- 1 SPDT Switch for user interface
- 20 × 4 Alphanumeric LCD
- 256MB of SDRAM
- Quadrature Encoder Interface
- Opto-isolated USB Interface
- Opto-isolated USB to Serial Interface
- Opto-isolated on board USB to JTAG Emulator
- PWM Outputs and Capture Inputs are terminated at 34-pin FRC connector
- 16 Channel ADC inputs are terminated at 26-pin FRC connector with buffered and protection
- DAC outputs and sigma Delta ADC inputs are terminated in screw type connector.
- External Emulator facility.
- Compatible with MATLAB SIMULINK

3Ø Resistive and Motor Loads for the above 4 Types of Inverters.

1. One number of 3Ø, 500W Resistive load

- 500W rating
  - * Three phase input
- Different selector switch provided for current Selection
- Fuse provided for input protection
- All are mounted on a moveable cabinet
- Banana connector provided for load input

THREE PHASE LOADING RHEOSTAT

MAKE : Vi Microsystems
MODEL : PEC HV AC- C1C

2a. 1 HP DC SHUNT MOTOR – SPRING BALANCE LOAD SET UP WITH PROXIMITY SENSOR

This set up consists of (1) DC Shunt Motor (2) mechanical spring balance load set-up (3) PROXIMITY SENSOR

DC MOTOR SPECIFICATIONS:

Power	:	1HP(.75KW)
Armature voltage	:	180VDC, 5.1Amp
Field voltage	:	220VDC, 0.3Amp
Speed	:	1500 rpm
Double side shaft extension.		
Make	:	BENN/ Equivalent

MAKE : Vi Microsystems
MODEL: PEC16MO-DC-P1-00

b. 1 HP THREE PHASE AC MOTOR – SPRING BALANCE LOAD SET UP WITH PROXIMITY SENSOR

This set up consists of one number of (1) three phase AC Motor (2) mechanical spring balance load set-up (3) PROXIMITY SENSOR

AC MOTOR SPECIFICATIONS :

Three phase squirrel cage induction motor.

Power	:	1hp(.75kw)
Current	:	1.8A, star connection
Three phase 415VAC, 50Hz input		
Speed	:	1440 rpm
Make	:	Siemens/BENN
PROXIMITY SENSOR		

MODEL : PEC16MO-SQ-P1-00

c. 1HP BLDC MOTOR – SPRING BALANCE LOAD SETUP

Rated Power	-	940W
Phase	-	3φ Input
Rated Voltage	-	310 VDC
Rated current	-	4A
Rated Torque	-	3Nm
Rated Speed	-	3000 RPM
No. of poles	-	8 Poles
Position Sensor	-	Hall effect A, B, & C
Back EMF	-	Trapezoidal EMF
Supplied by	-	Vi Microsystems (Imported Motor)

MAKE : Vi Microsystems
MODEL : PEC16MO-BL-H1-8P

d. 1HP PMSM MOTOR – SPRING BALANCE LOAD SET UP

Speed	-	3000RPM (Max)
Rated Voltage	-	200-230 VAC / 3 Phase
Rated current	-	2.7 A
Rated Torque	-	2.39 N-M
Power	-	1 HP (750W)
Speed/Position Feedback – Rotary Encoder 512 PPR/Quadrature Encoder		
Rotor pole	-	4 Poles
Phase	-	3φ
Back EMF	-	Sinusoidal
Spring balance load setup		

MAKE : Vi Microsystems
MODEL : PEC16MO-PS-Q1-4P

16. 2.2KW DFIG SETUP WITH IGBT BASED CONVERTER - INVERTER SYSTEM

Doubly fed Induction Generator (DFIG) for variable speed Wind Turbines have more control flexibility and improve system efficiency & Power quality.

We have implemented DFIG using

i) 1KW Slip ring Induction Motor coupled with 2HP DC Shunt Motor
ii) Cortex M4 Embedded DSP Controller for DC Motor Control.
iii) IGBT based Single Quadrant Chopper to Drive DC Motor.
iv) DSP based Rotor side converter and Grid side Converter
v) DUAL CORE DELFINO DSP BASED DEVELOPMENT BOARD (or) vi) ZYNQ ULTRASCALE MPSOC based FPGA Dev Board

i. DC Motor Coupled With 1KW Slip Ring Induction Motor

DC Motor as Prime Mover

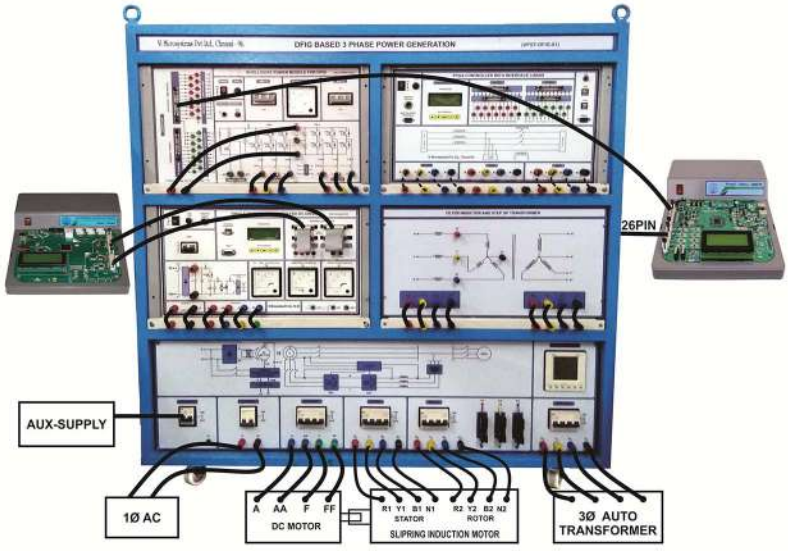
Power	:	2HP
Armature voltage	:	220V / 8A
Field voltage	:	220V DC / 0.5A
Speed	:	1500 RPM
Make	:	Benn
Double side shaft extension		

Slip Ring Motor (Working as a generator)

Type	:	3phase slip ring indu
Power	:	1KW
Stator voltage	:	Three phase 415V A
Rotor voltage	:	Three phase 230V A
Speed	:	1410 RPM
Make	:	Benn

Main Frame

* Designed to house all the modules
* Analog Meter/MFM Provided to Display
    * Output Voltage & Current of Stator (Grid)
    * Voltage & Current of Wind Emulator
* Analog voltage meter for voltage of DC motor
* Analog Ammeter Armature for Armature Current
* 1no of LC filter provided at the Inverter output
* One step-up transformer provided at the output of inverter
* 2 nos of MCBs provided for over current protection of Wind Generator and Grid.
* Banana connector termination for Wind & Grid



ii. ST Cortex - M4 EmbEdded DSP Controller (VSCM4) for DC Motor Control

* High performance 32bit ARM Cortex M4 (STM32F407VGT6 Micro controller).
* Operating upto 168MHz
* 196Kbytes of SRAM
* 1MB On-Chip Flash.
* 8 Nos. of User LEDs & 4 Nos. of push button
* USB to Serial Interface
* 16x2 LCD interface
* 10/100Mbps Ethernet Interface

* IPM Interface Connector
    # 16PWM Lines
    # 8 Capture lines
* ADC Interface Connector
    # 8 Channel ADC
    # Input range o to 3.3.V
    # Sampling rate : 2.4msps
    # 12 bit resolution
    # Inputs are buffered and protected
* 2 Channel DAC
* On board Isolated USB to JTAG Programmer

iii) IGBT based Single Quadrant Chopper to Drive DC Motor

* 1200V/50A, Peak, Semikron based IGBT with driver circuit
* 2Nos of IGBT's module provided One driver (inbuilt opto isolator)
* Over Current Protection
* Over Voltage protection
* Short Circuit Protecion
* Fixed Field Supply with field failure protection
* Single Phase Input.
* 2 Pole MCB for input Power
* 3Nos of Analog meters provided for DC motor voltage and current.

iv) DSP based Rotor Side Converter and Grid Side Converter

DFIG are widely used in Wind Turbine with Induction Generators interfaced to the Grid through the Rotor Side Power Converter and Grid Side Power Converter,

IGBT Based Power Module for Rotor Side & Grid Side Converter

Converter Power Module

* 1200V/ 100A Peak, Semikron based IGBT module
* 12Nos of IGBT's provided in 3nos of IGBT module,
* 12Nos driver with inbuilt opto isolator
* Snubber capacitor provided for dv/dt protection for all IGBT module
* Proper heat sink provided for all the IGBTs with cooling fan provision
* Temperature sensor provided for over temperature Protection
* Over current protection and short circuit protection provided for all individual IGBT module
* PWM inputs are brought out on Front Panel, you may connect any controller for interface
* One common +15V Power supply for all the driver circuit, Inbuilt isolated power supply provided.
* Reset circuit provided and terminated to clear the fault
* Filter circuit available for power circuit input.
* 7Nos Current sensor provided for DC link current and Output line current
* 1No Voltage sensor provided for DC link voltage
* One NO of 34 pin connector & 24 pin connector provided in the front panel for PWM input and feedback signals to controller.

v. DUAL CORE DELFINO DSP BASED DEVELOPMENT BOARD Model: (MICRO 28377D)

The Micro-28377D Trainer kit is intended and developed for advanced closed-loop control applications for Power electronics, Smart grid, DFIG, etc.., It is also focused for students to learn the multi-processor architecture and the inter processor communication mechanisms. The inbuilt purpose built peripherals of the processor lead to implementation of many POC for the Research Scholars in the emerging technology.

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- Dual- Core 32-bit Delfino fixed point Processor
- Operating Speed: 200MHz (For each core)
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- Viterbi, Complex Math, and CRC Unit II (VCU-II) to accelerate the performance of FFT's and communications-based algorithms
- Two CLA real-time control co-processors that run at the same speed as the main CPU's
- Parallel processing capability effectively doubles the computational performance
- 1MB (512KW) of onboard flash memory with error correction code (ECC)
- 204KB (102KW) of SRAM
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- 2 SDFM with 8 Input Channels and PWM synchronization
- External memory interface 16/32 bit support
- 192 dedicated PIE vectors
- MCU/DSP balancing code density & execution time
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ON Board Features:

- 16 Numbers of user LEDs
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- 4 Numbers of Push-Button Micro Switches
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- 20 × 4 Alphanumeric LCD
- 256MB of SDRAM
- Quadrature Encoder Interface
- Opto-isolated USB Interface
- Opto-isolated USB to Serial Interface
- Opto-isolated on board USB to JTAG Emulator
- PWM Outputs and Capture Inputs are terminated at 34-pin FRC connector
- 16 Channel ADC inputs are terminated at 26-pin FRC connector with buffered and protection
- DAC outputs and sigma Delta ADC inputs are terminated in screw type connector.
- External Emulator facility.
- Compatible with MATLAB SIMULINK
- Software will be provided for
- Wind Emulator
- DFIG Based with Generation

17. WIRED & WIRELESS LAN TRAINER KIT- ViLaN-04

An indigenous design of LAN Trainer for wired &wireless to study for all topologies like star, bus, mesh and ring has been introduced. All protocolssuch as Stop&Wait; Go Back to N, Selective Repeat, Token Ring, Token Bus, CSMA / CD, CSMA / CA can be experimented using ViLaN-04.

A Microcontroller with 2 Ethernet ports forms one Station. There are 4 such stations and one station connected to a PC for Graphical Representation of all experiments.

MAKE : VI MICROSYSTEMS
MODEL : ViLaN-04

All topologies are implemented using 10/100Mbps Ethernet ports for real feel of Networking. ViLaN-04 can conduct all experiments as per Anna University Syllabus of ECE Department.Data transmission speed – 10/100 Mbps. Packet Size: 128,512,1024, 2048,4096,8192,16384, Inter packet delay: 1000-5000ms, Acknowledgement lost, bad packet, Error Generation & Error Correction.

Wireless LAN experiments are implemented using ESP8266 in each Node.

List of Experiments

- Topology
  i) Star ii) Bus iii) Ring iv) Mesh
- Protocols Supported
- Stop & Wait
- Go Back to N
- Selective Repeat
- Token Ring
- Token Bus
- CSMA / CD
- CSMA / CA
- Serial -to- Serial communication for two PCS

Software

- C/C++ Compiler, . net,
- Vi Rtsim Software
- Network simulator like NS2/NS3/Glomosim/OPNET

Vi Rtsim Software

- Vi Rtsim Softwareis developed to provide basic understanding and implementation of various fundamentals, advanced concepts on networking. The software provides an opportunity to understand network fundamental through wired & Wireless. ViRtSim also includes programming exercises for students to get hands on practice on networkingparameters

FEATURES

- Graphic representation of data packets
- Packet to be transmitted.
- Packet being transmitted.
- Packet transmitted with acknowledgment.
- Packet with acknowledgment lost error.
- Packet with bad packet error.
- Packet which is discarded or resend.
- Data Encryption & Decryption.
- Peer to Peer, Star, Bus and Ring & Mesh Topologies.
- Ethernet LAN Protocols.
- User selectable packet size.
- Manual Error generation.
- Built in Protocol, Network and graph analysis.
- Sample 'C' & .net Programs files provided for project purposes.
- Data encryption & decryption
- Complete analysis of Network & Protocols
- Graphic representation of data on s/w screen with packet details
- Network details indication of computer name, IP address, Port number, status of network, MAC address and OS on computer.

- Indication of packet serial number, file name, file size, file number, receiver name, Workgroup, receiver IP address, total packets, packet length, time out, protocol, topology, receiver, MAC address, port number, file send start time, file sent completion time, transmission time data rate(Mbps), error.

HARDWARE

LAN Trainer ViLaN-04

- One Microcontroller with 2 Ethernet Port provided in Each Node
- These 2 Ethernet ports for implementing RING Toplogy.
- These 2 ports are terminated using commercial D-Link Face Plate 2 Dual or 4 outlets Ethernet terminals for giving the students a commercial feel of NETWORKING
- Total of 4 Nodes provided to conduct many experiments.
- One ESP8266 in each node is provided to conduct all Wi-Fi Experiments
- 4 Port Ethernet switch provided with D-Link Face Plate 4 Outlets to cable various Ethernet connections for experimentation.
- 16x2 LCD Display provided in each Node to display various parameters of Topology & Protocol in WiFi
- 128x64 Resolution OLED Display Provided in each Node to display various parameters of Topology & Protocol in Wired LAN
- All components are housed in a sleek cabinet.

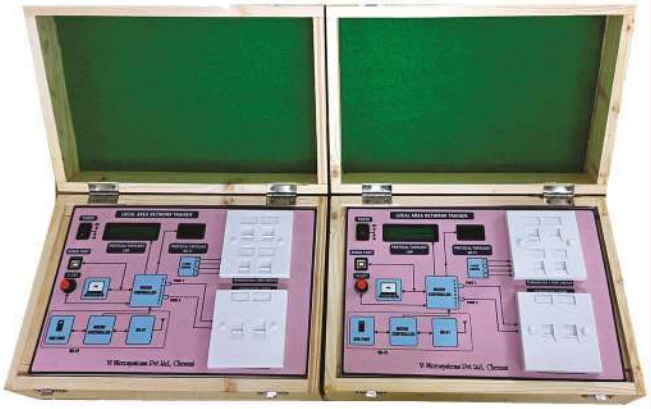
REAL TIME INTERFACE

- Vi Rtsim Software can be directly interfaced to ViLAN-02
- Trainer to monitor many parameters of Networking.

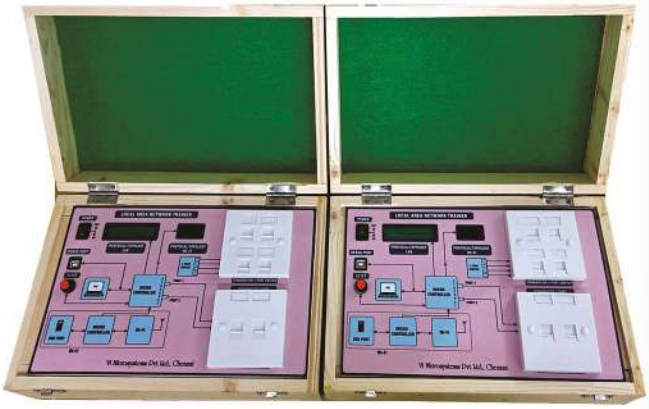
D LINK

- D-Link Face Plate 2 Dual or 4 outlets are used in this trainer for establishing the NETWORKING, as these Face Plates are used in implementing large computers to be physically connected to the router & switches in the structured networking.
- The student can learn the real computer networking experience by using these types of Face Plate.
- This facility will help the student to study and implementation of cable designs, cable routing and making cable with RJ45 connectors in networking.

Node 3 **Node 4**



Node 1 **Node 2**



THEORY TOPICS COVERED

* Data Transmission types.
* Frame format, overheads and working of the protocols.
* MAC Addressing & MAC Protocols.
* Transport layer - Port Addressing.
* Transmission Control Protocol.
* Windowing concept - Sliding window, Silly Windows Problems.
* Routing protocols-Distance vector algorithm, Link state algorithm

Simulation Software – Open Source – NS2

Network fundamentals through animation

* Encryption and decryption
* Star, bus & Ring Topologies
* Ethernet LAN protocols
* User selectable packet size
* Manual Error generation
* Sample 'c' program files provided
* Real Time Interface

LAN Trainer front end	PC based GUI, Provides a menu-driven interface
'C' library	Programming interface to ViLAN-04
Stand-alone programs	For Level1 experiments. Source code provided for study and analysis
Saving	Saving of experiment results to a file
Display	128x64 Graphical display in OLED 16x2 LCD Alpha numeric Display
Data rates	10/100Mbps
Topology	Peer to Peer, Bus, Ring, Star , Mesh
Delay	0 to 15 bits between each pair of nodes
Error Generators between one pair of nodes	Bit Error – 0 to 10-6 Frame Error – 0 to 10-5
Nodes	1+3 nodes , expandable to 16 nodes
MAC Layer support	ALOHA, CSMA, CSMA /CD, Token Bus, Token Ring
Power supply	220V, 50Hz /2A

Experiments that can be performed

- Study & implementation of cable designs in networking
- Implementation of PC to PC with IEEE 802.3
- Implementation of PC to PC with IEEE 802.11 b
- Implementation of Bus topology with IEEE 802.4
- Study of protocols
- Study of flow control
- Stop-N-wait
- Go back to N
- Selective repeat

Experiment List : Anna University in ECE Department, NETWORK LAB- EC8563

All the EC8563 experiments can be done using ViLaN-02 and many experiments beyond the syllabus also can be done.

LIST OF EXPERIMENTS

1. **Implementation of Error Detection / Error Correction Techniques**
2. **Implementation of Stop and Wait Protocol and sliding window**
3. **Implementation and study of Goback-N and selective repeat protocols**
4. **Implementation of High Level Data Link Control**
5. **Implementation of IP Commands such as ping, Trace route, nslookup.**
6. **Implementation of IP address configuration.**
7. **To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.**
8. **Network Topology - Star, Bus, Ring**
9. **Implementation of distance vector routing algorithm.**
10. **Implementation of Link state routing algorithm.**
11. **Study of Network simulator (NS) and simulation of Congestion Control Algorithms using NS**
12. **Implementation of Encryption and Decryption Algorithms using any programming language**

BEYOND THE SYLLABUS

13. **Mesh Networking**
14. **Ethernet Based Ring Topology**
15. **Wireless Networking**