DFIG based Wind Energy Emulator Module with Grid Synchronization

Specification

- **Wind Emulator Machine Details.**

220V, 2.5KW, 1500 rpm DC shunt Motor Coupled to 415V, 2.2 KW 1000 rpm 6 pole Three phase slip ring induction motor, 1024 ppr encoder included.

- **Three phase IGBT based Inverter details (Rectifier + Inverter + Brake Chopper) (For DC Motor Drive)**

- **Semikron IGBT based Converter (For RSC & GSC)**

I/P AC Voltage: - 415 Volt	DC Voltage: - 600 Volt
O/P AC Voltage: - 415 Volt	O/P AC Current 30 Amp
Switching Frequency 20 kHz	Fundamental Frequency 50 Hz
Type of Cooling: - Forced Air	Ambient Temp: - 40 Deg
Duty Class: - Class I	

- **WAVECT - FPGA Based Controller Details**

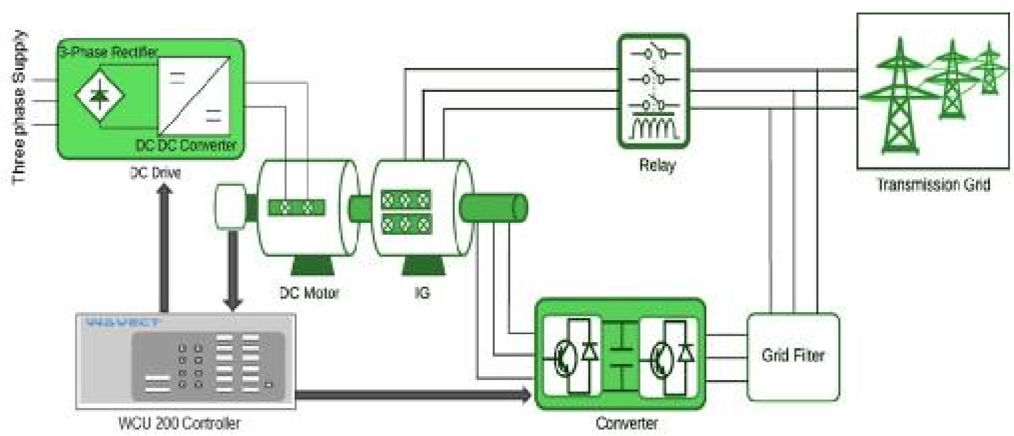
It has Xilinx FPGA Zynq™-7000 SoC XC7Z020-CLG484-1with Dual ARM® Cortex™-A9 MPCore™Which have capability Up to 667 MHz operation along with NEON™ Processing / FPU Engines.

Memory allocation in the board is given by 512 MB DDR3 and 256 Mb Quad-SPI Flash with Full size

Isolated Voltage (8) and current (8) sensors for feedback

PWM Card 3.3/5 to 15 V Level Shifting of 12x2 PWM Out with optical isolation.

Dedicated I/O with for encoder and Hall sensors with 5V supply and Differential noise reduction.



EXPERIMENTS LIST

For Undergraduate

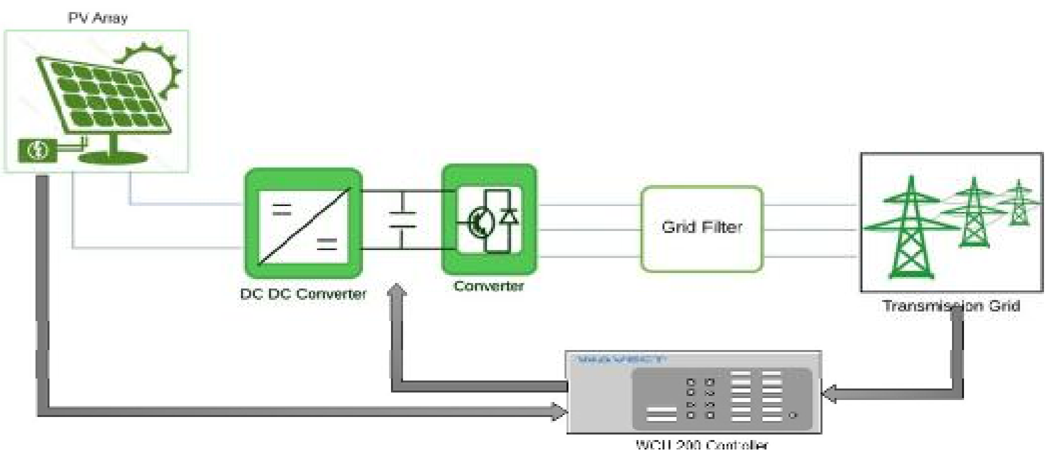
1. Familiarization of wind emulator.
    - DC as wind turbine (Prime mover of shaft).
    - Power conversion required at GSC.
    - Different control and conversion methods.
    - Possible fault occurrence.
2. Emulate the wind characteristics using the DC machine.
    - And obtain power for different speed, plot the data.
    - Plot P vs. Velocity Characteristics of emulator.
3. Obtain the efficiency plot of emulator and compare it w system.
4. Study of MPPT system.
    - Run and test MPPT algorithm.
    - Compare the Results with and without MPPT
5. Control of output power.
    - Frequency maintaining, with the help of DC machi
    - Voltage maintaining with the help of DFIG.
6. Analysis and characterization of wind stand alone system.

For Postgraduate

7. Introduction to graphical programming and control al development.
8. Create simple MPPT algorithm and run machine.
9. Frequency maintaining, with the help of controller.
10. Test of AC-AC converter control at generation end.
11. Test inverter for different operating condition such as load (AC and DC), wind.
12. Analysis and characterization of grid connected system
13. Change the system into a micro grid.
    - Control algorithm development for micro grid.
    - Converter working in synchronisation mode.
14. Control of converter for DFIG at both rotor end stator end (de on from where the power is fed).
15. Control of power output.
    - Obtain required Frequency, Voltage, Phase S using wind emulator and DFIG.

Solar Energy Module with Grid Synchronisation

Specification
v Three phase IGBT based Inverter details. I/P AC Voltage: - 415 VoltDC Voltage: - 600 Volt O/P AC Voltage: - 415 VoltO/P AC Current 30 Amp Switching Frequency 20 kHzFundamental Frequency 50 Hz Type of Cooling: - Forced AirAmbient Temp: - 40 Deg Duty Class: - Class I
v Boost Converter Specifications I/P DC Voltage: - 200 VoltO/P DC Voltage: - 600 Volt O/P DC Current upto 10 AmpsSwitching Frequency upto 20 kHz Fundamental Frequency 50 HzType of Cooling: - Forced Air Ambient Temp: - 40 DegDuty Class: - Class I
v Solar Panel: The panel will be provided with suitable mounting arrangement along with 30m of cabling. The power rating of the panel is 2500W.
v WAVECT - FPGA Based Controller Details: It is a Xilinx FPGA Zynq™-7000 SoC XC7Z020-CLG484-1with Dual ARM® Cortex™-A9 MPCore™Which have capability Up to 667 MHz operation along with NEON™ Processing / FPU Engines. Memory allocation in the board is given by 512 MB DDR3 and 256 Mb Quad-SPI Flash with Full size Isolated Voltage (8) and current (8) sensors for feedback Dual, 200 KSPS-1MSPS 16 bit 4x2 channel Simultaneous sampling for ADC 15 V, 36 PWM Out



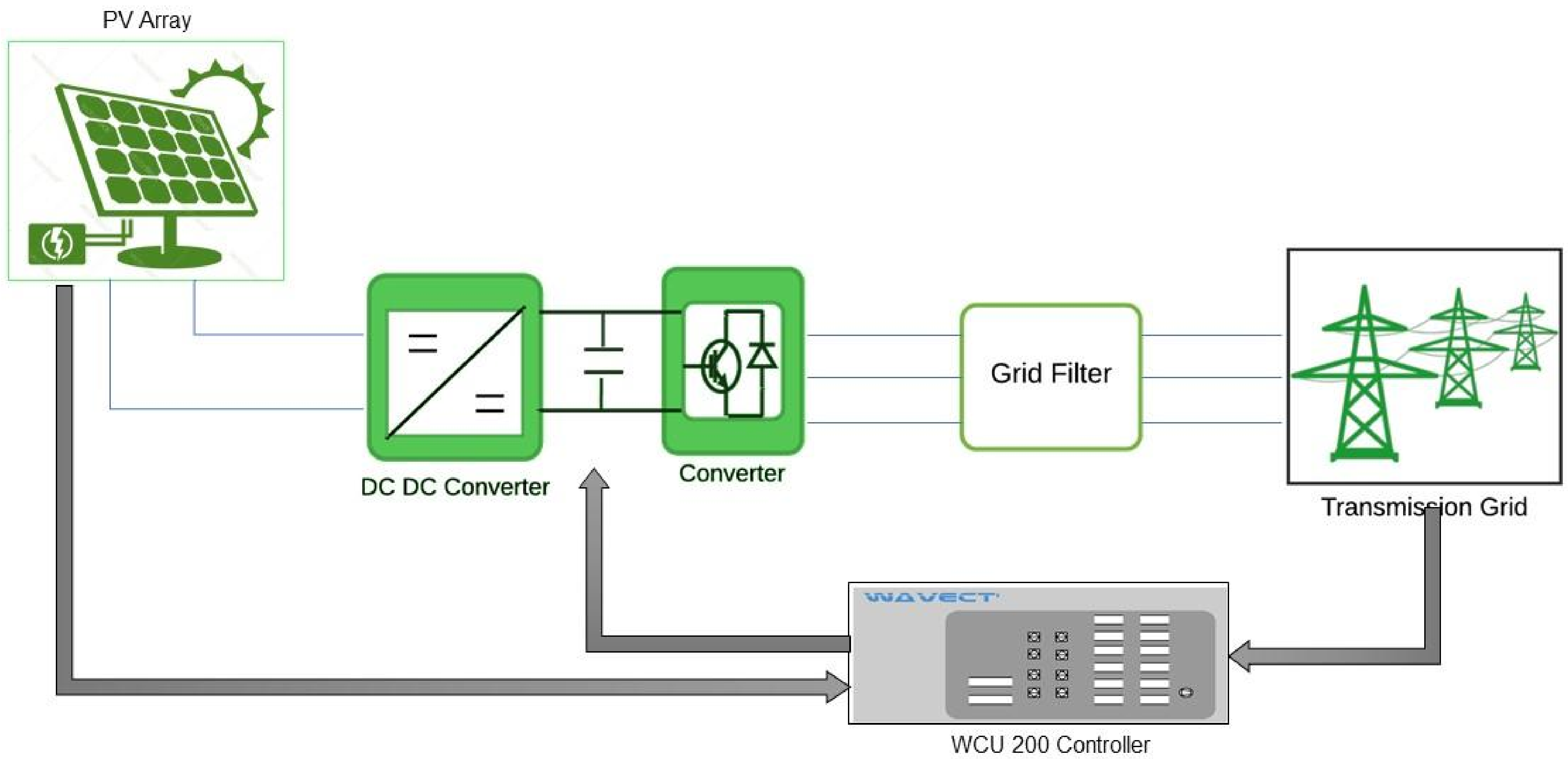
EXPERIMENTS LIST

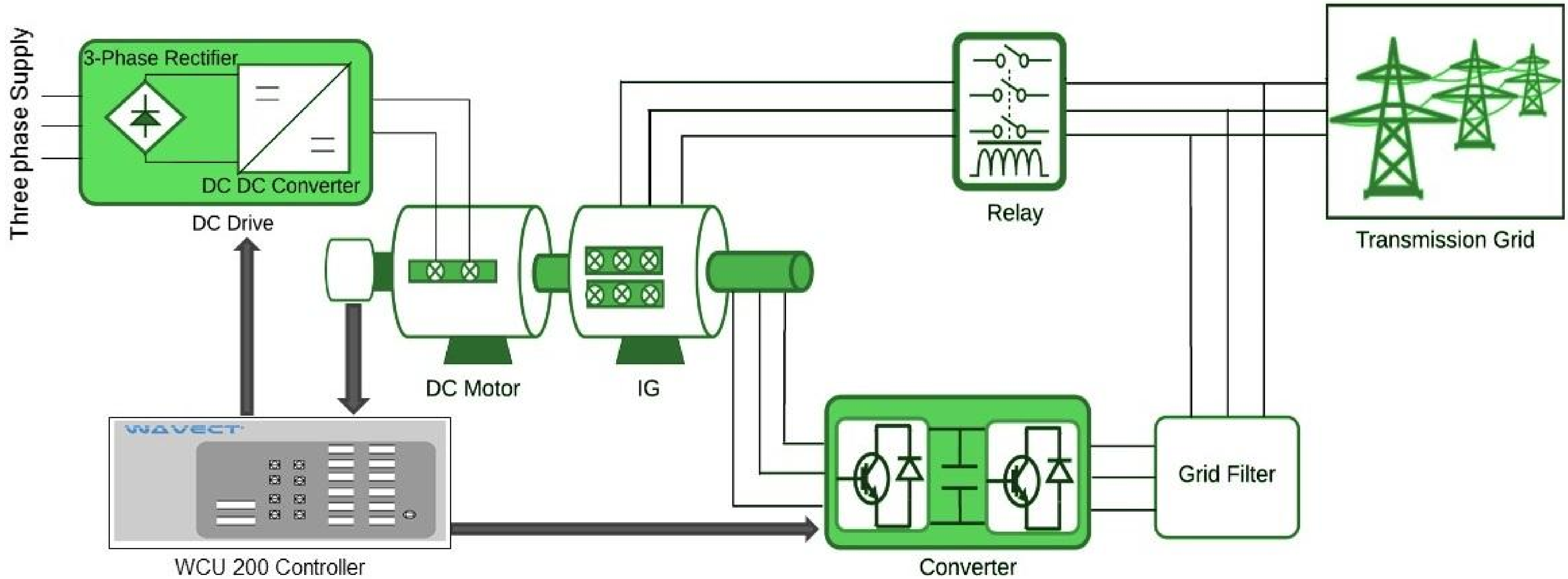
For Undergraduate

1. To illustrate the I-V and P-V characteristics of PV module with radiation and temperature level
2. To show the effect of variation in tilt angle on PV module powe
3. To demonstrate the effect of shading on module output power.
4. To demonstrate the working of diode as Bypass diode and diode.
5. Workout power flow calculations of standalone PV system of D
6. Workout power flow calculations of standalone PV system of A
7. Workout power flow calculations of standalone PV system of AC load
8. Run the full system and
   - Draw the charging and discharging characteristics of ba
9. Find the MPP manually by varying the resistive load across panel.
10. Find the MPP by varying the duty cycle of DC-DC converter.

For Postgraduate

11. Workout power flow calculations of standalone PV system of with battery.
12. Workout power flow calculations of standalone PV system of with battery.
13. Workout power flow calculations of standalone PV system of AC load with battery.
14. Observe the Vm, Im, Pm and duty cycle at which MPP occu MPP algorithm.
15. Observe the waveforms of output voltage of inverter manually degree and 180 degree conduction mode
16. Observation of Current Waveform for Linear & Nonlinear Lo Calculations.
17. Impact of Transmission Line Inductance on Voltage Quality at P
18. Power factor improvement using capacitor bank and its impact o quality at PCC.
19. Grid Synchronization of Solar PV Inverter and it Performance A
20. Evaluation of Active, Reactive & Apparent power Flow betwe Tied Inverter, Grid & Load and Net Metering concept.
21. Demonstration of Anti-Islanding protection of Grid-Tied Inv Sudden Grid Failure and running the system using virtual grid


PV Array
DC DC Converter
Converter
Grid Filter
Transmission Grid
WAVECT
WCU 200 Controller


Three phase Supply
3-Phase Rectifier
DC DC Converter
DC Drive
DC Motor
IG
Relay
Transmission Grid
WAVECT
WCU 200 Controller
Converter
Grid Filter