Amandla Aluhlaza

Group #26

Andrea Solano-EE

Juan Valera-EE

Manuel Keesee-EE

Randall Lay-EE

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2. Revision A/B

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4. Time Line of Project

5. Group Responsibilities

6. Financials

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Project Motivation: South Africa Pomolong Township

- Supply renewable energy to a small community center located in the Pomolong Township in South Africa

- Impact the lives of many by powering a essential electronics such as computer, a projector, lights, and other devices use for educational purposes

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Pomolong Township Community Center Power Needs

Item	Watts	Quantity	Est. Hours	Total Watt hours	Total Watts
Lights	15	2	5	150	30
Computer charger	65	1	5	325	65
Projector/ TV	300	1	5	1500	300
				Maximum Power	395 Watts
Energy in a single day: ~2 KW·hrs					

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Goals & Objectives

- **Charge a 24V battery bank safely and reliably**

- **Deliver necessary power to the user when demanded**

- **Deliver necessary energy types to the user when demanded (i.e. USB, American standard (110V), and European standard (220V))**

- **Overall robust and reliable energy storage system**

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Design Specifications

- Input Source ~ 24V – 30V (DC)
- System Power Output ~ 2000W
  - AC Voltage: 110Vrms
    &
    220Vrms
  - DC Voltage: 5Vdc (USB port)
- 24V Battery Bank
- Utilization of wind and Solar energy sources

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Components Overview Revision A

PV Panels

MPPT Charge Controller

PM Bypass Circuit

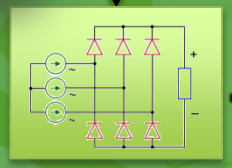
Battery Bank

Inverter

USB

Wind Turbine

Rectifier



Housekeeping Controller

Transformer

Dump Load

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Renewable Energy Sources

Sources provided by the mechanical Engineers:

- **Solar tracking team**
- **Wind tower team**

<u>Lessons Learned:</u>

- **Communication is key**
- **Larger amount of people on a project can add more problems than solve**

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Components Overview Revision A

PV Panels

MPPT Charge Controller

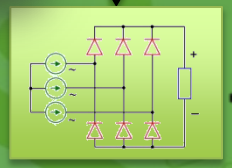
PM Bypass Circuit

Battery Bank

Inverter

Wind Turbine

Rectifier



Housekeeping Controller

Transformer

Dump Load

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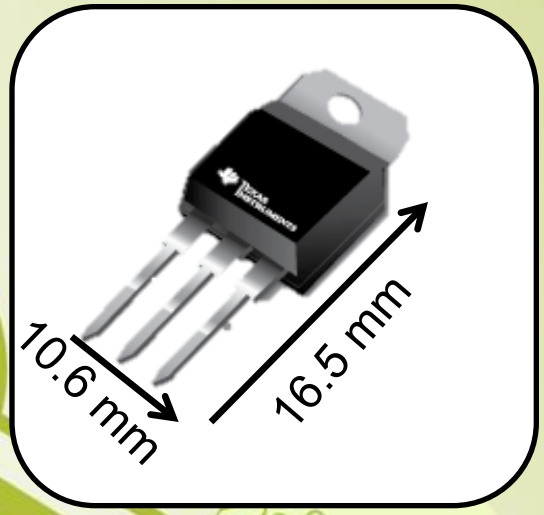
Charge Controller

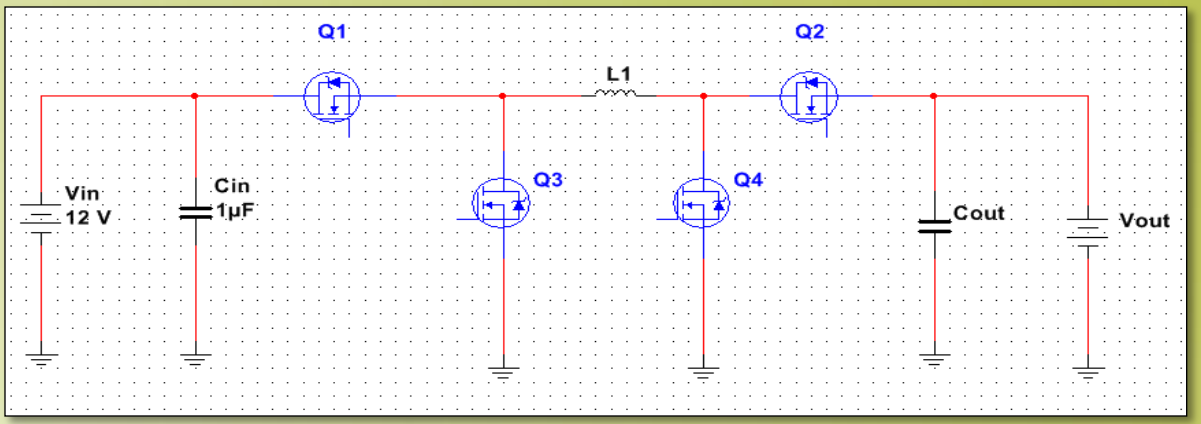
Buck & Boost Converter

Sch has a 12V system needs to be 24V

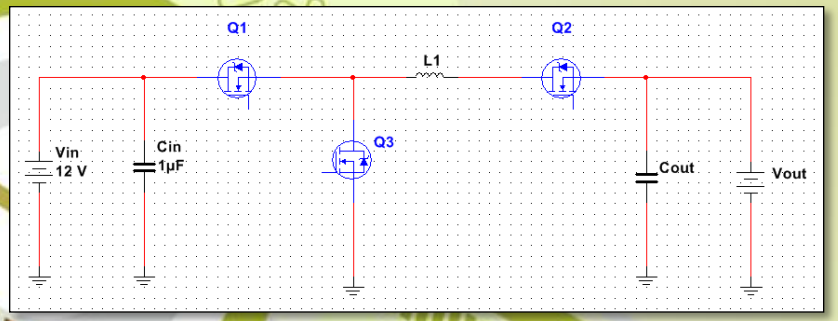
CSD18532KCS

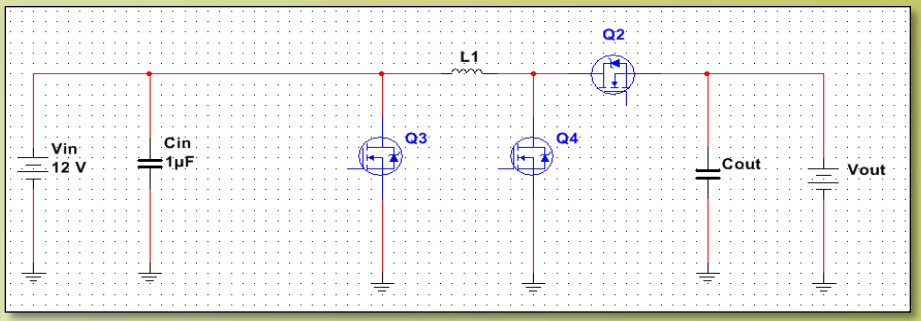
MOSFET 60-V, N-Channel Power MOSFETs





Buck Mode **Boost Mode**





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Charge controller
Buck & Boost Converter

Lessons Learned:

- **Modes of a MOSFET**
  - **Cutoff $V_{GS}<V_{th}$**
  - **Linear Region $V_{GS}>V_{th}$ and $V_{DS} < V_{GS} – V_{th}$**
  - **Saturation $V_{GS}>V_{th}$ and $V_{DS} >= V_{GS} – V_{th}$**
- **Ringing in MOSFET**
  - **High Frequency**
  - **Low Current**
- **Robust and Forgiving**

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Charge Controller

H- Bridge Driver: SM72295

Parameter	SM72295
Switching frequency	220kHz
Analog Supply Voltage	10 V
Digital Supply Voltage	5 V
Peak Output Current	3 A
Operating Temperature	-40°C to 125°C
Other Features	Current Sense Amplifiers

Lessons Learned:

- **Limited ability to sink current**

  i.e. lower the external gate resistor value

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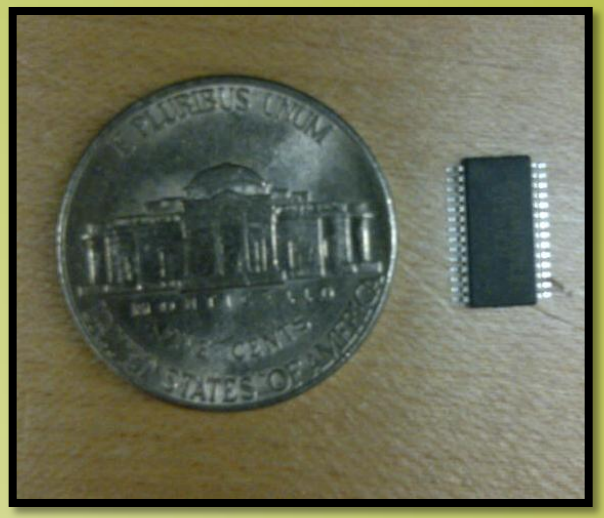
Charge Controller

SM72442

Parameter	SM72442
Analog Supply Voltage	-.3V to 6V
Digital Supply Voltage	-.3 to 6V max
Input Current at any pin	10mA
Package Input Current	20mA
Operating Temperature	-40°C to 105°C



Lessons Learned:

- Sensitive to electrostatic shock and/or any other voltage than the required 5V
- I2C communication (for this device) requires recurring start bit not stop bit then start bit

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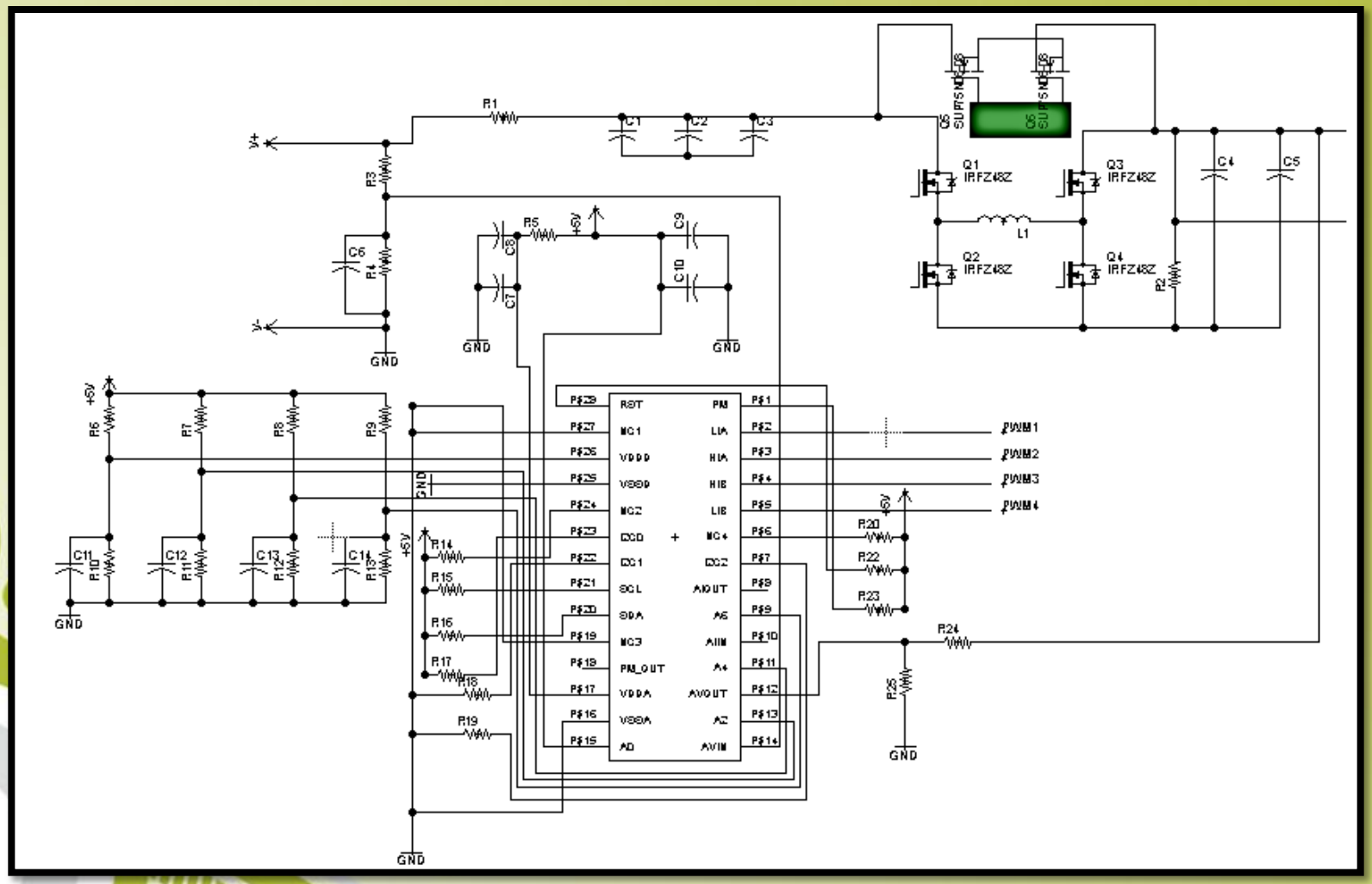
Printed Circuit Board

Data Schematic



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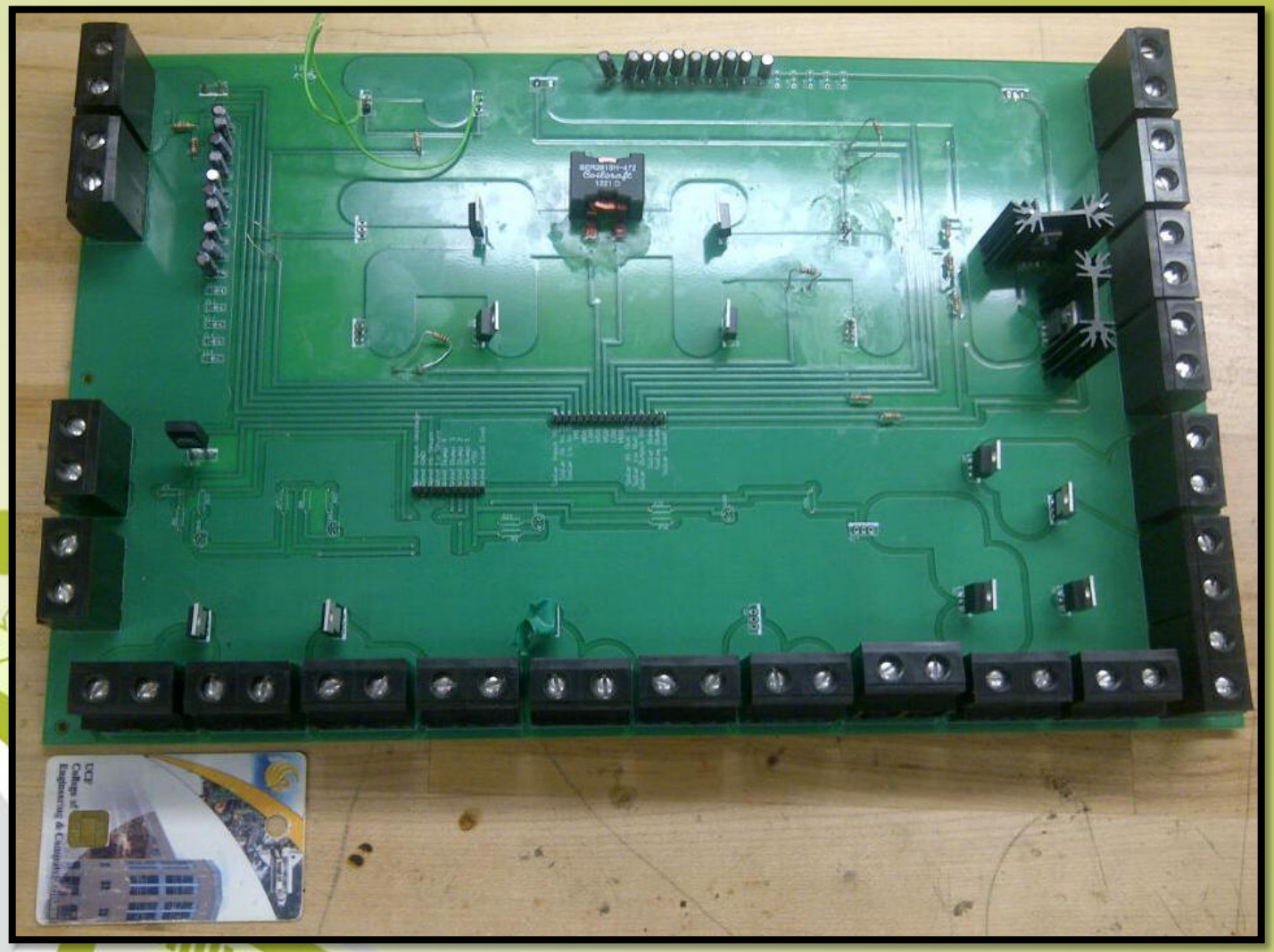
Printed Circuit Board

Data Schematic



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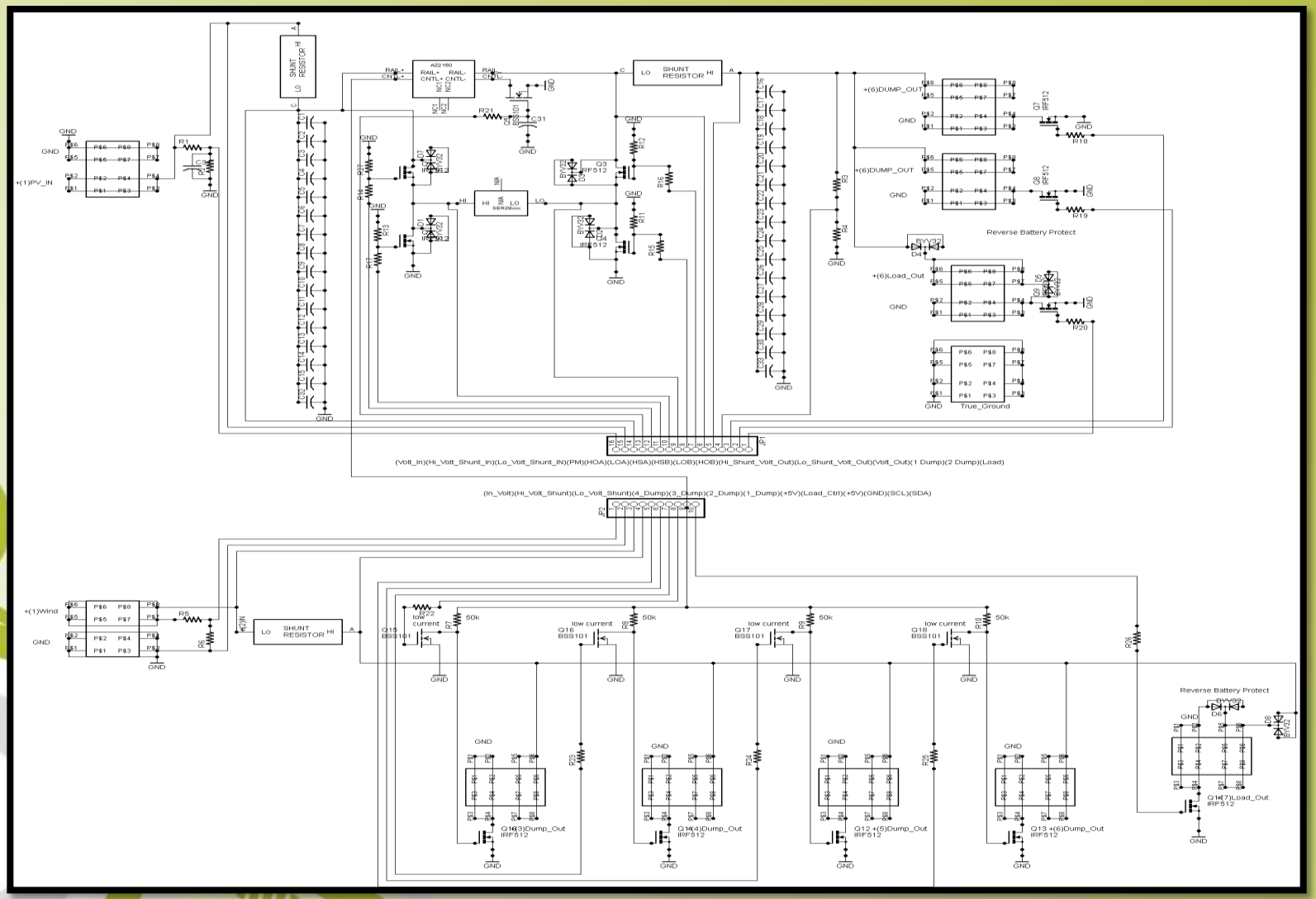
Printed Circuit Board

Power Schematic



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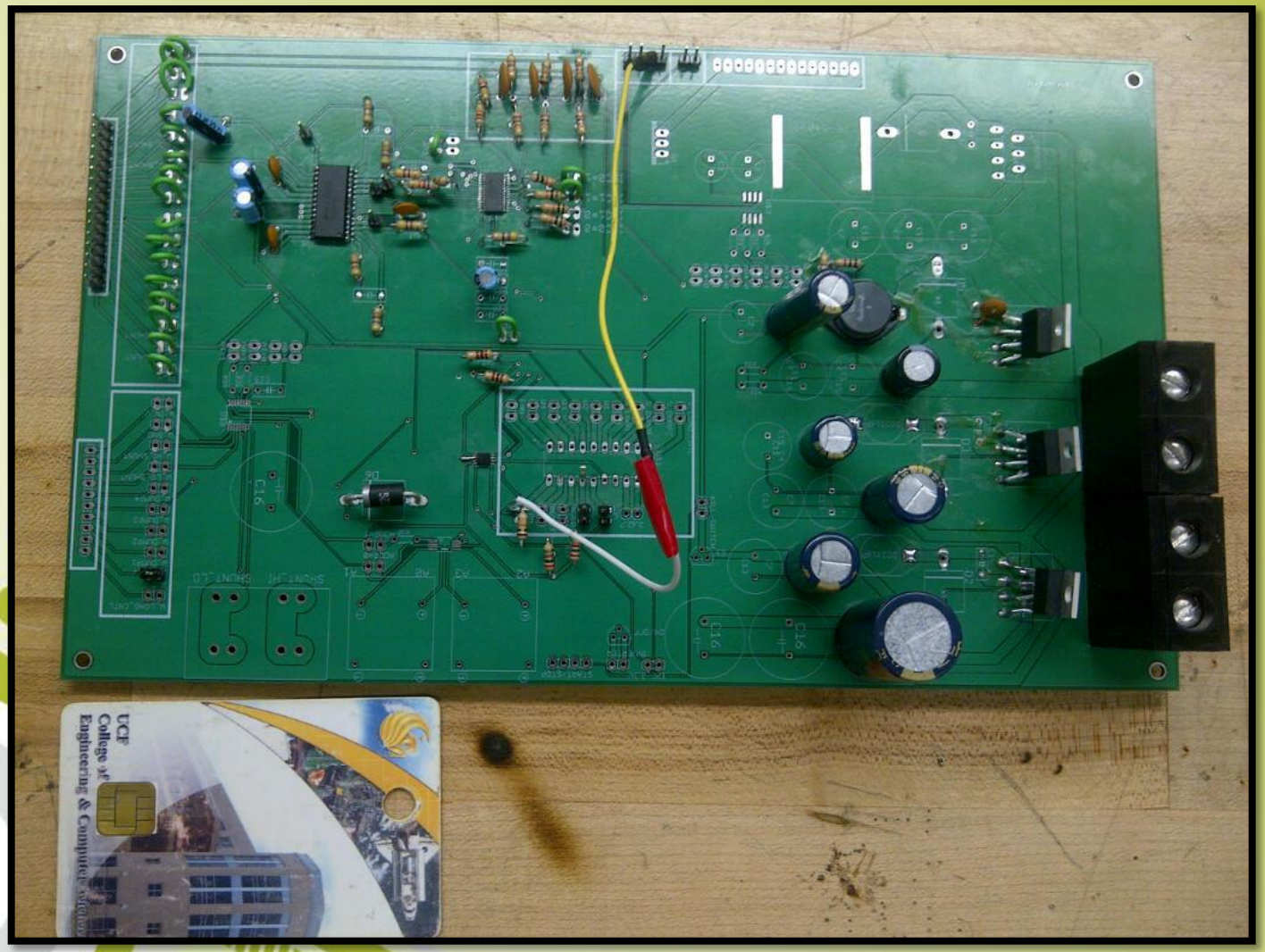
Printed Circuit Board



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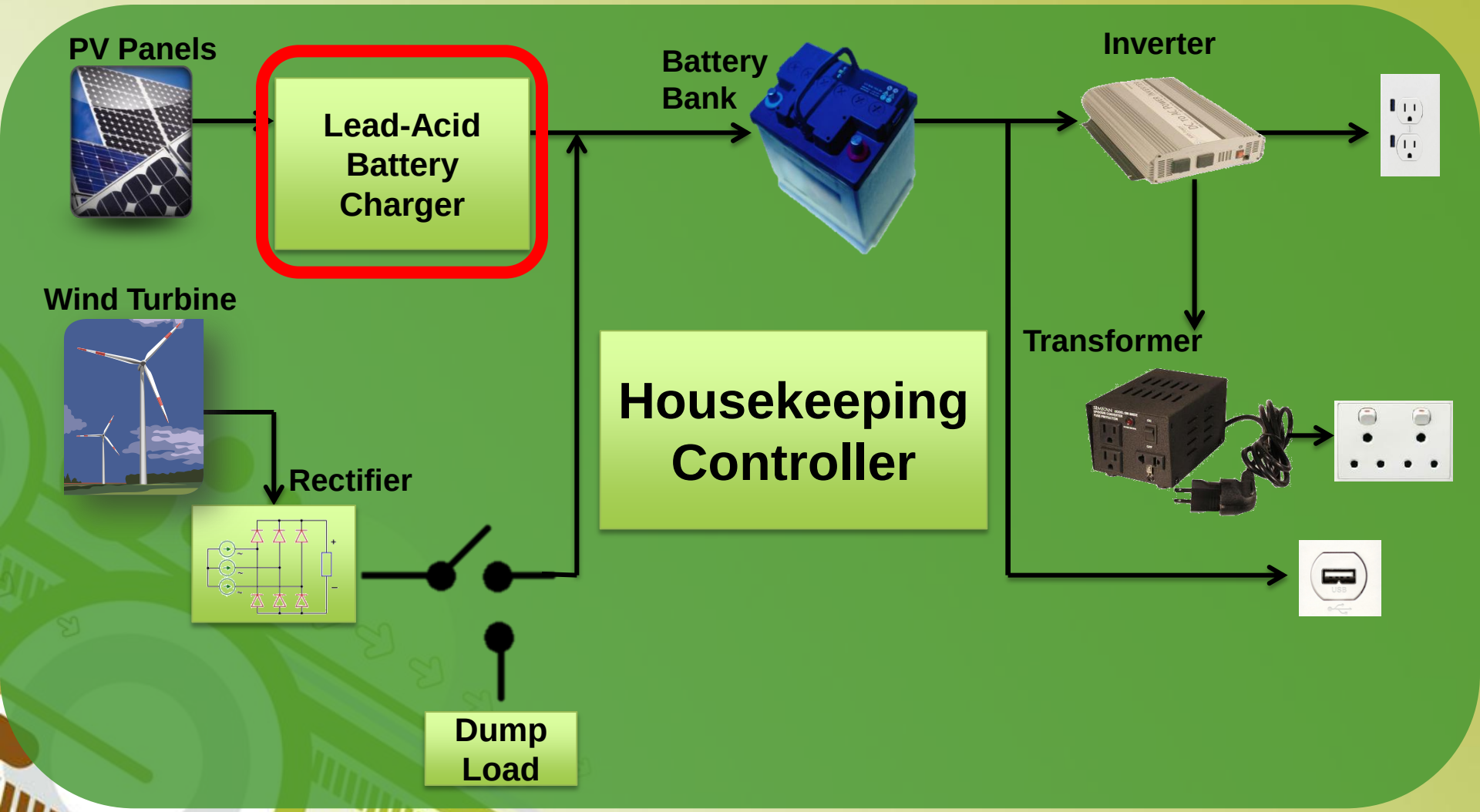
Components Overview
Final Revision



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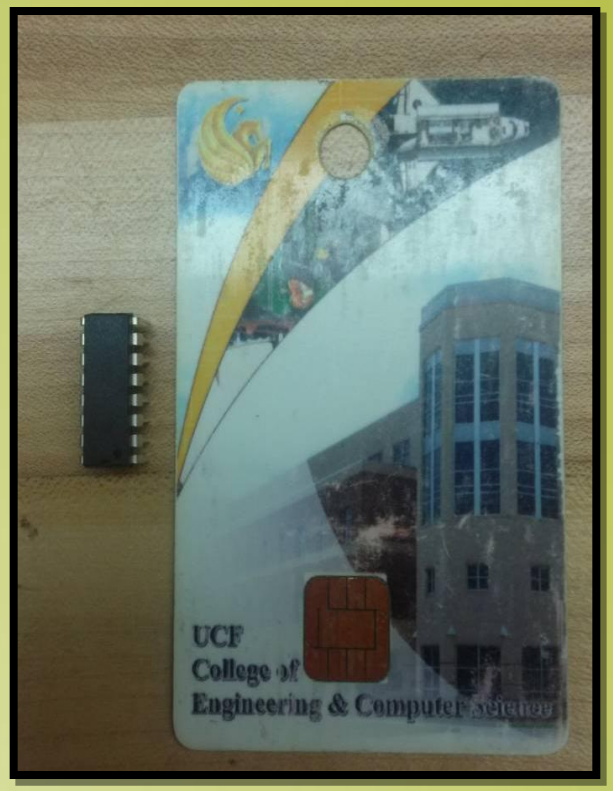
Lead-Acid Battery Charger UC3906

Parameter	UC3906
Input Voltage	<40 Volts
Charging stages	Bulk Absorption Float
Maximum Current to battery	15 Amps
Package	Dip Pin
Power Consumption	16mW – 33 mW



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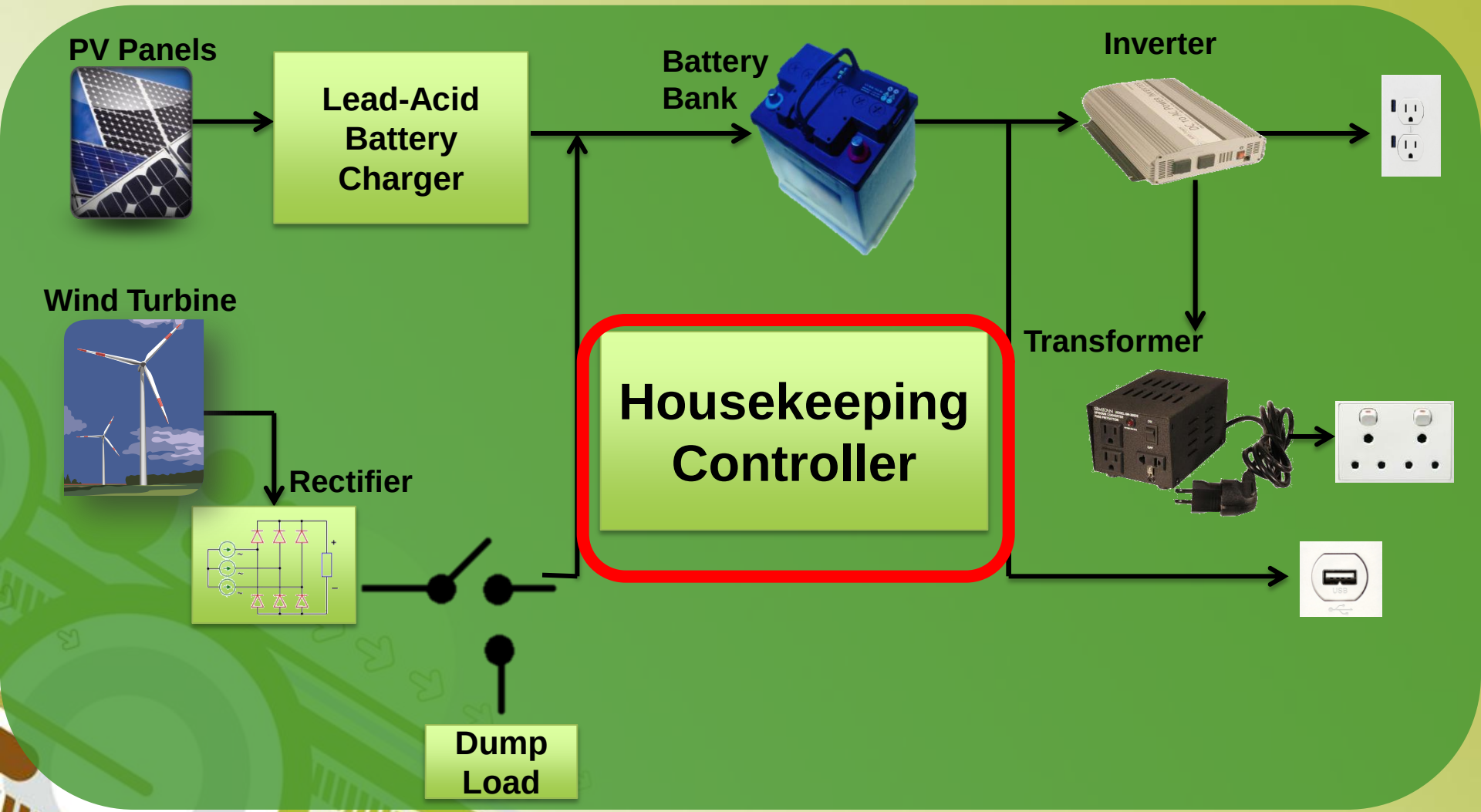
Housekeeping Controller



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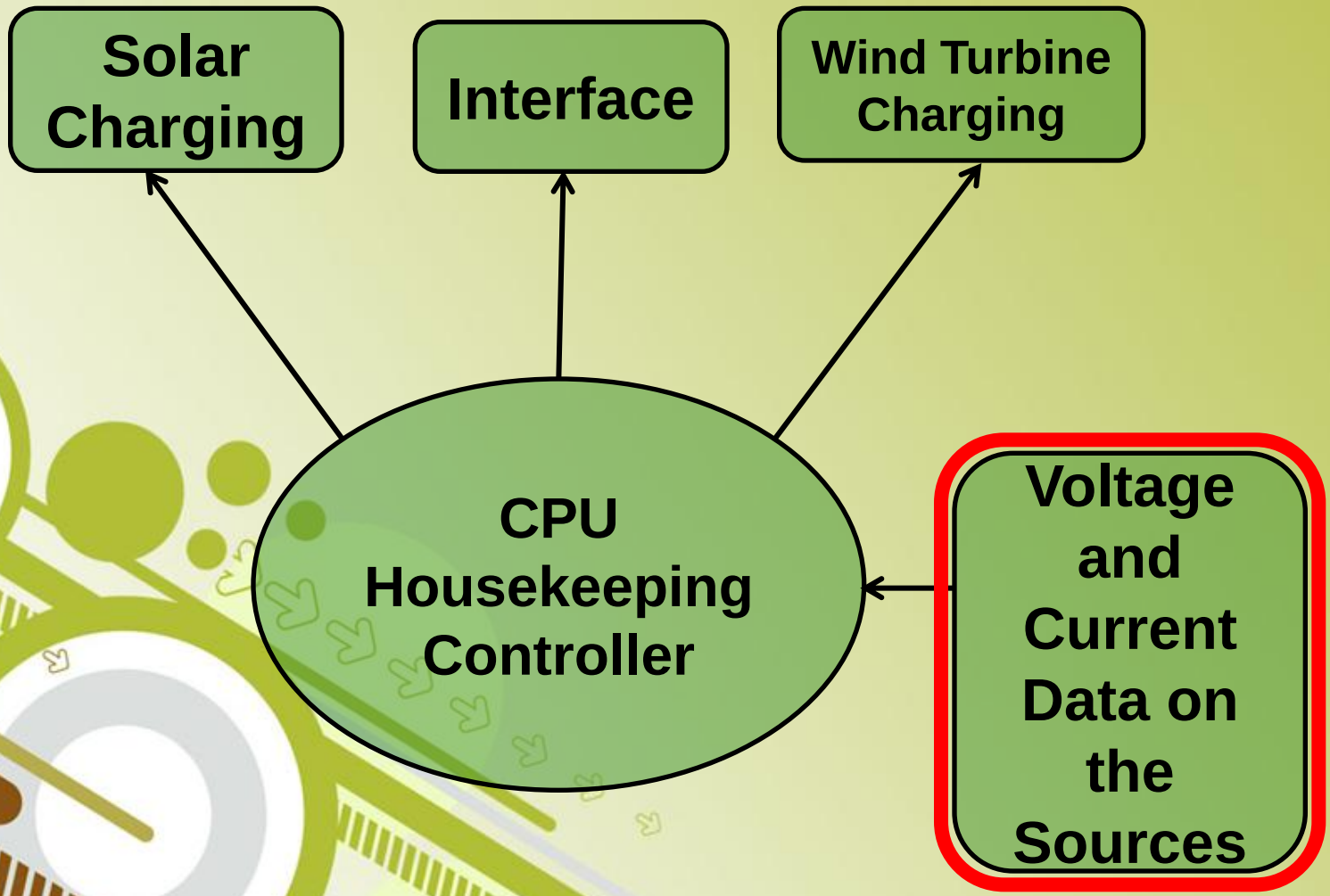
Housekeeping Controller Overview



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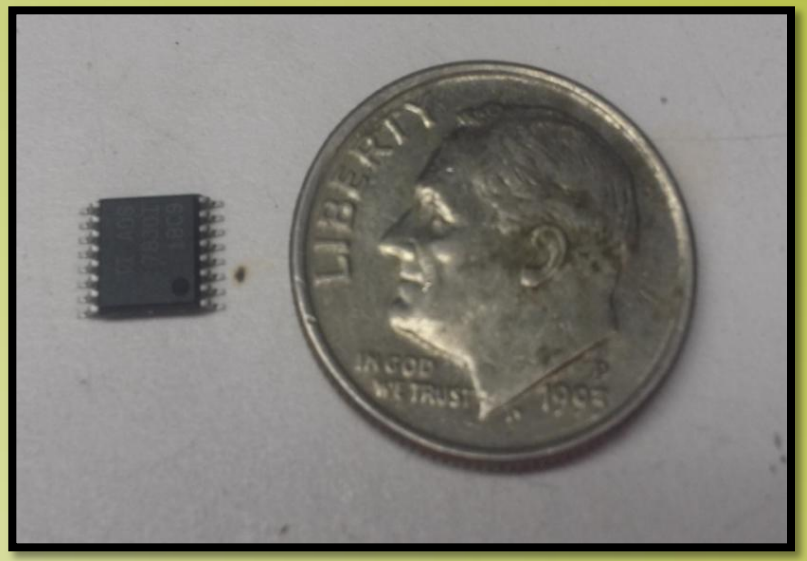
Data Collection

ADS7830

Parameter	ADS7830
package	TSSOP 16
A/D Pins	8 single-ended 4 differential
A/D conversion	8-bit 70-ksps Internal/external reference
Communication Protocols	*I2C
Voltage Supply	2.7V – 5V
Power Consumption	180 uW (Standard Mode)



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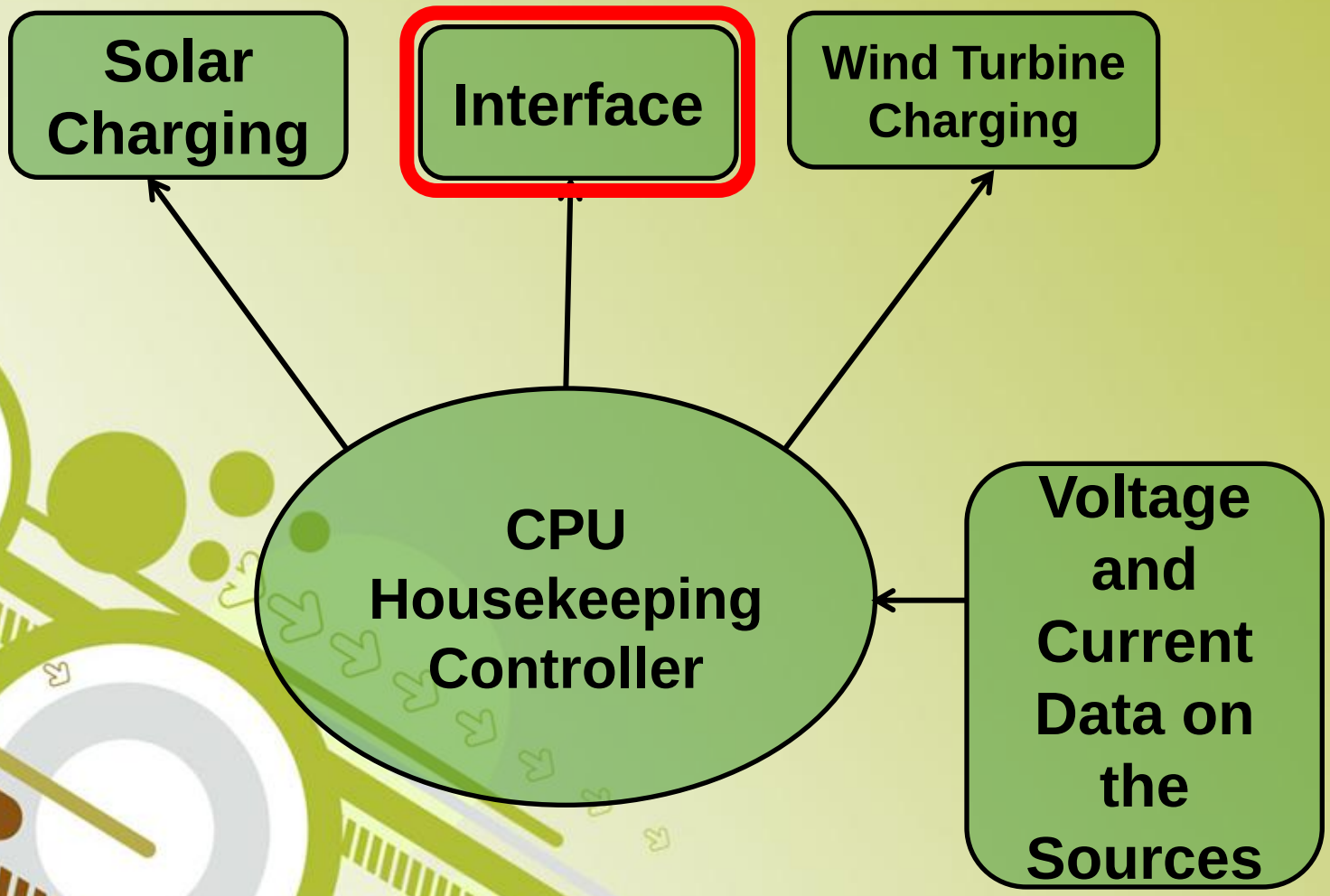
Housekeeping Controller



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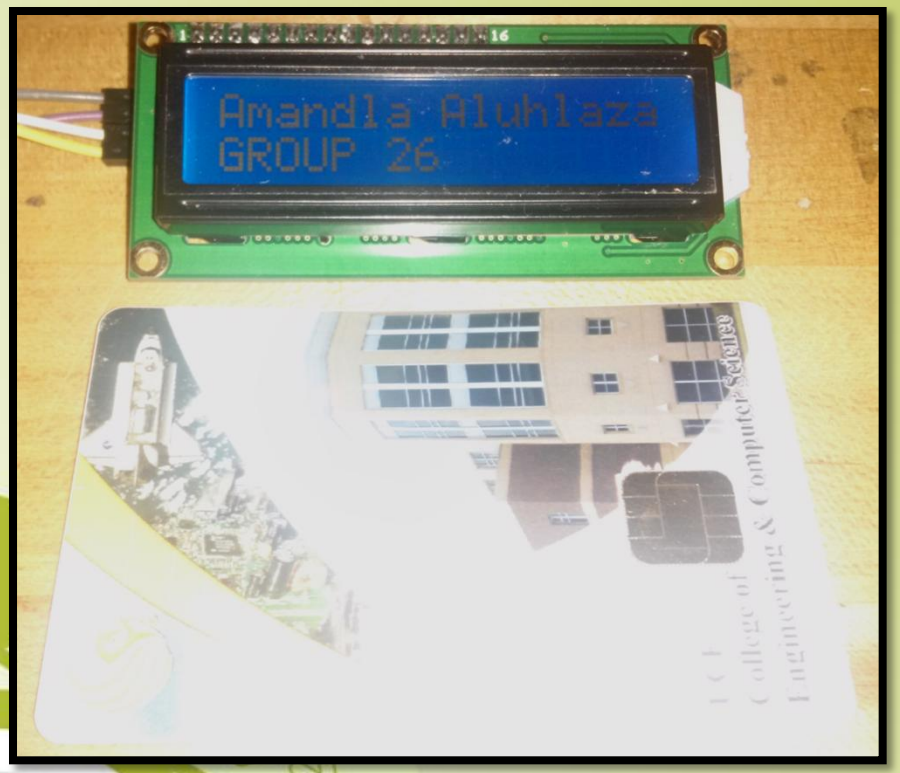
Housekeeping Controller

LCD Screen: LCD-09395



Parameter	16x2 LCD
Communication	*I2C
Operating Voltage	5V
Operating Current	60mA
Power Consumption	~ 300mW
Cost	$10

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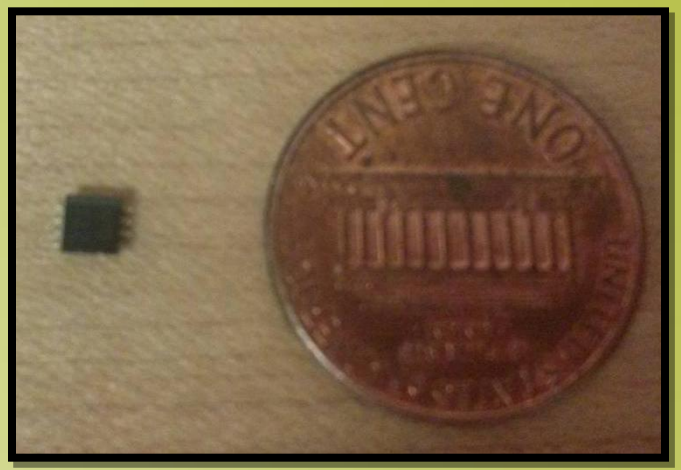
Housekeeping Controller

I2C 3.3V to 5V Voltage Leveler

Parameter	TCA9406
Operating Voltage	Vcca:1.6 V-3.6 V Vccb:2.3 V-5.5 V
Level Translation Range	3.3 V to 5 V
Communication	I2C (For LCD screen)



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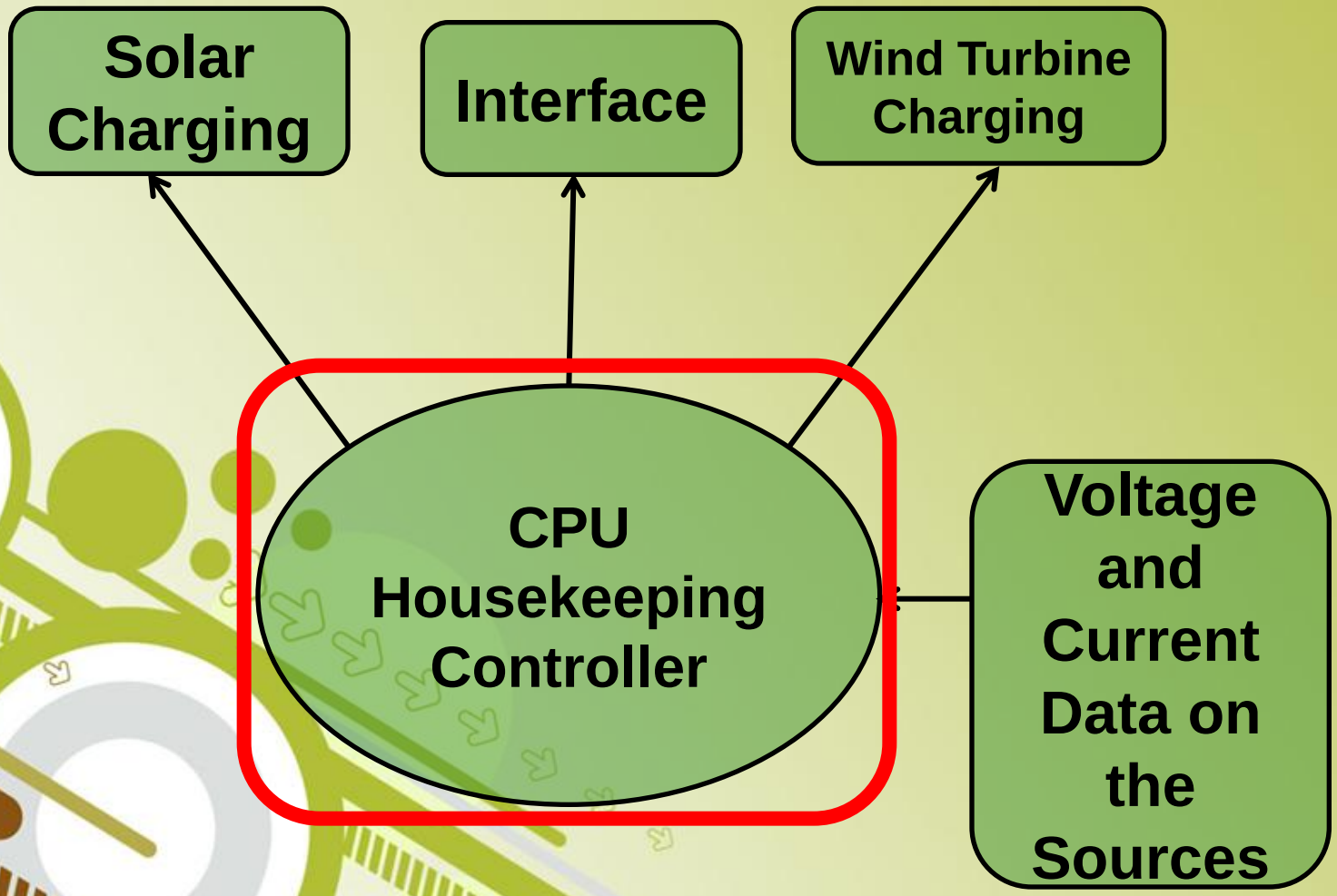
Housekeeping Controller



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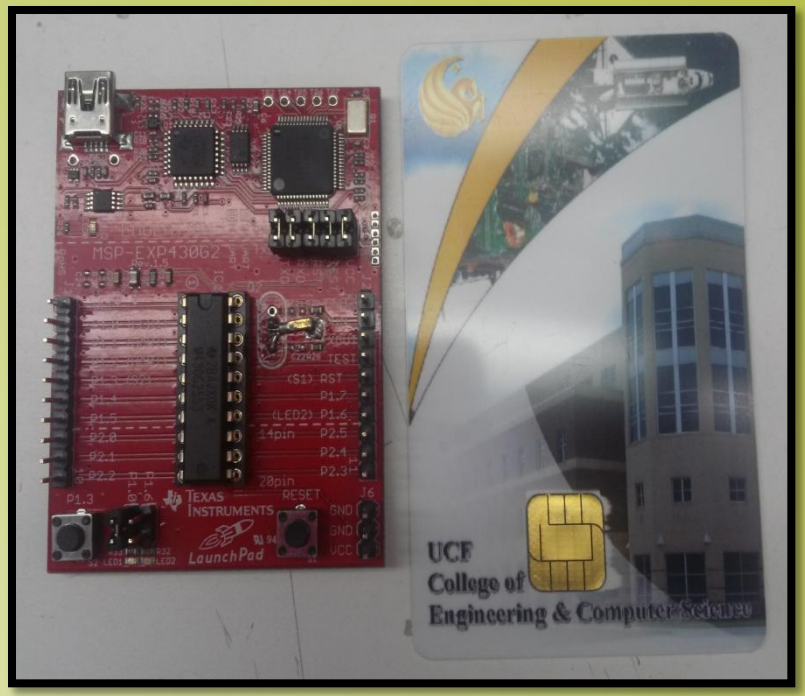
Housekeeping Controller

MSP430G2553

Parameter	MSP430 LaunchPad
Chip	MSP430G2553
I/O Pins	20 pins: P1.0-P1.7 P2.0-P2.5
Analog to Digital Conversion Pins	10-bit 200-ksps
Communication Protocols	*I2C *SPI *UART
Voltage Supply	1.8V – 3.3V
Power Consumption	< 1mW



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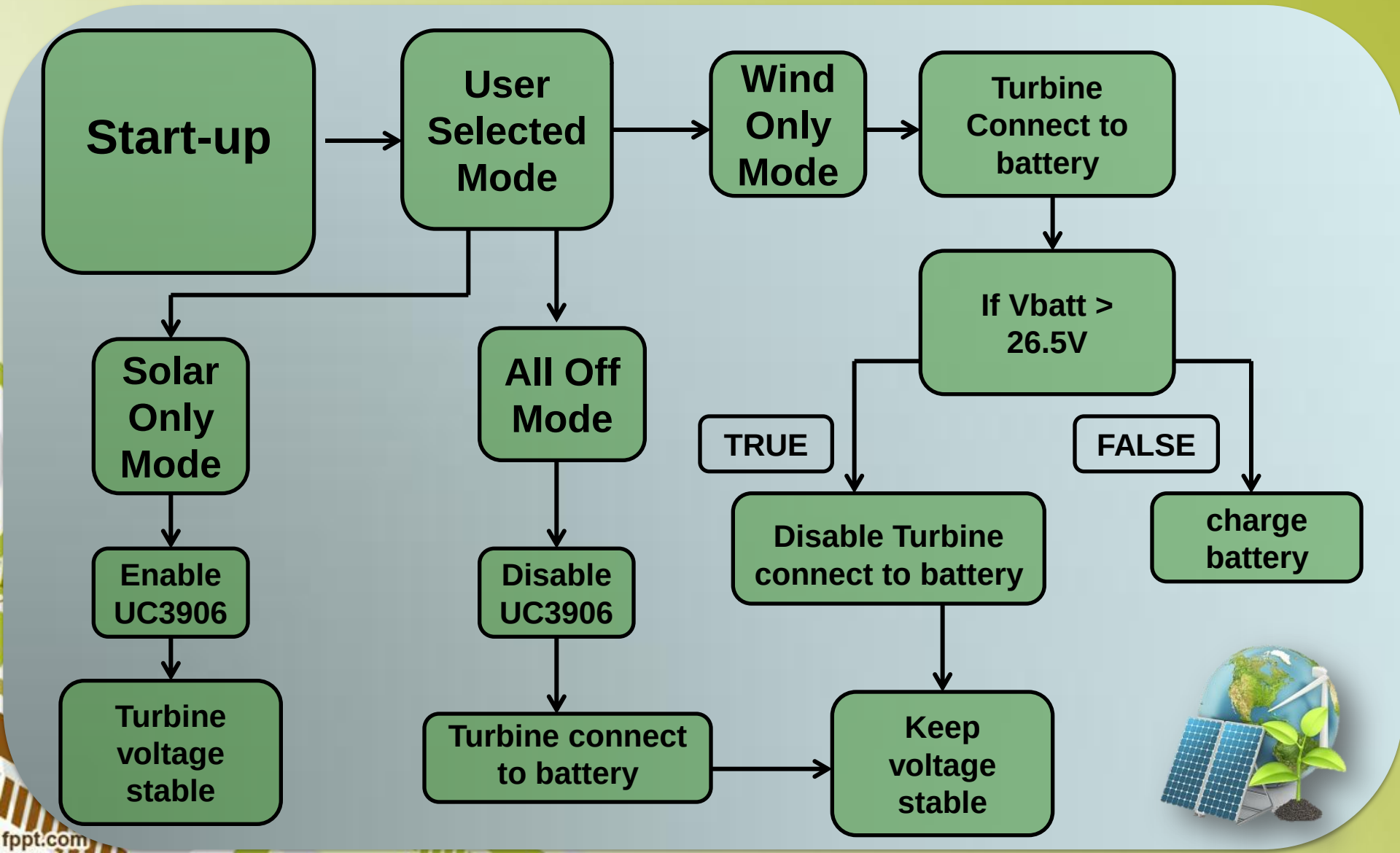
Logic Diagram



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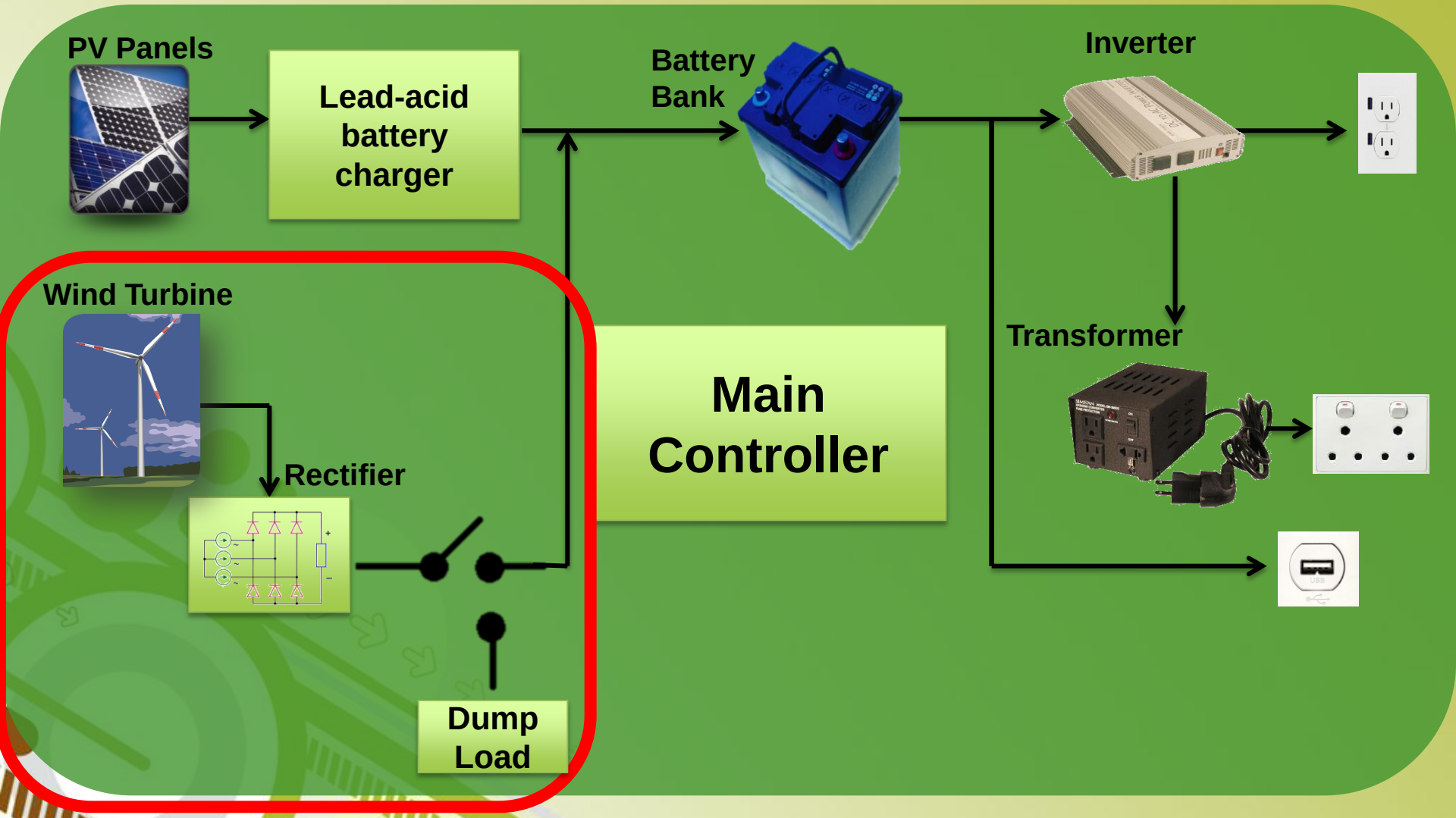
Wind Turbine Control



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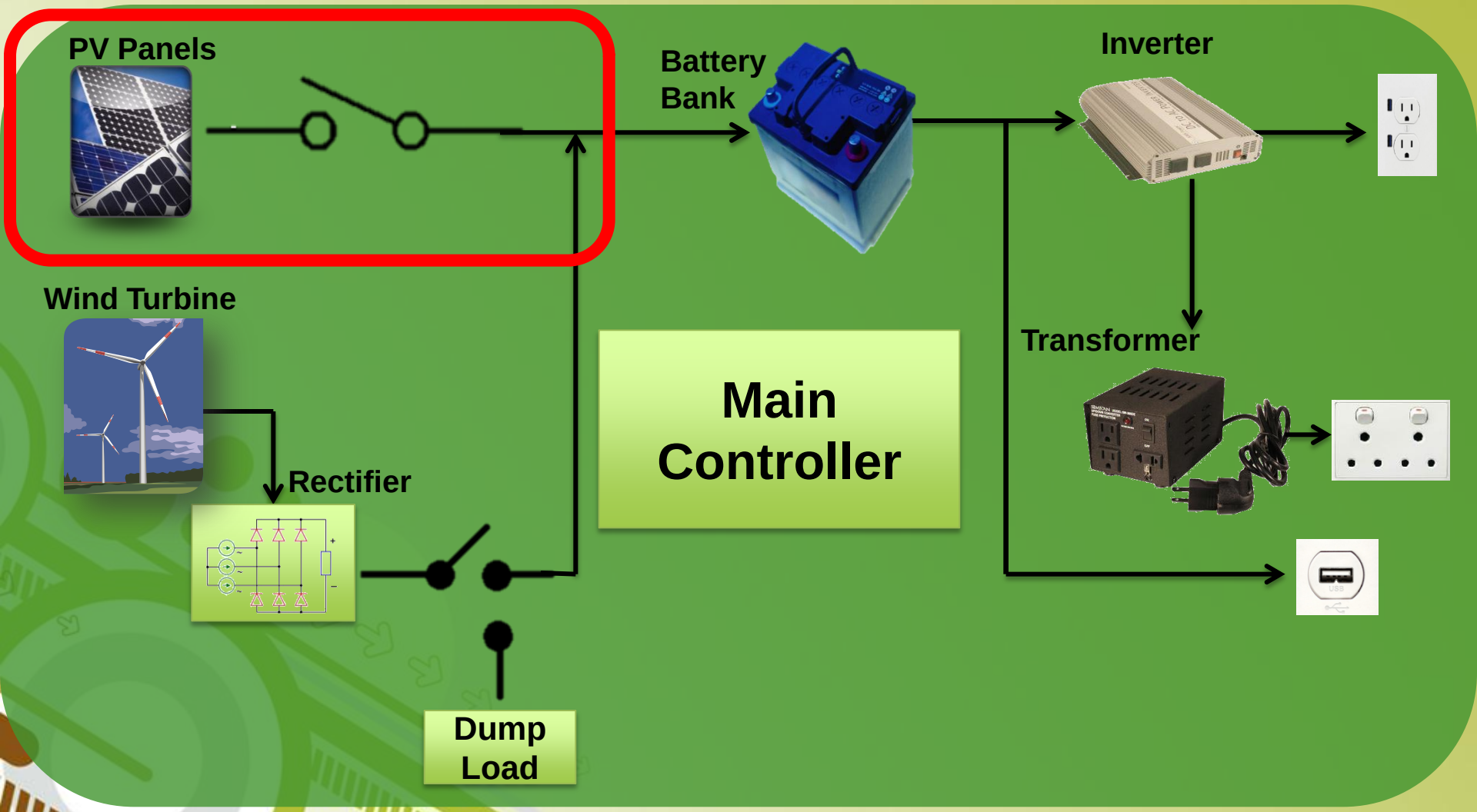
PV Panel Control



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Storage Unit

PV Panels

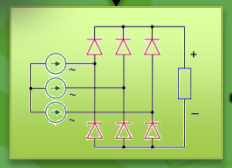
Lead-acid battery charger

Battery Bank

Inverter

Wind Turbine

Rectifier



Main Controller

Transformer

Dump Load

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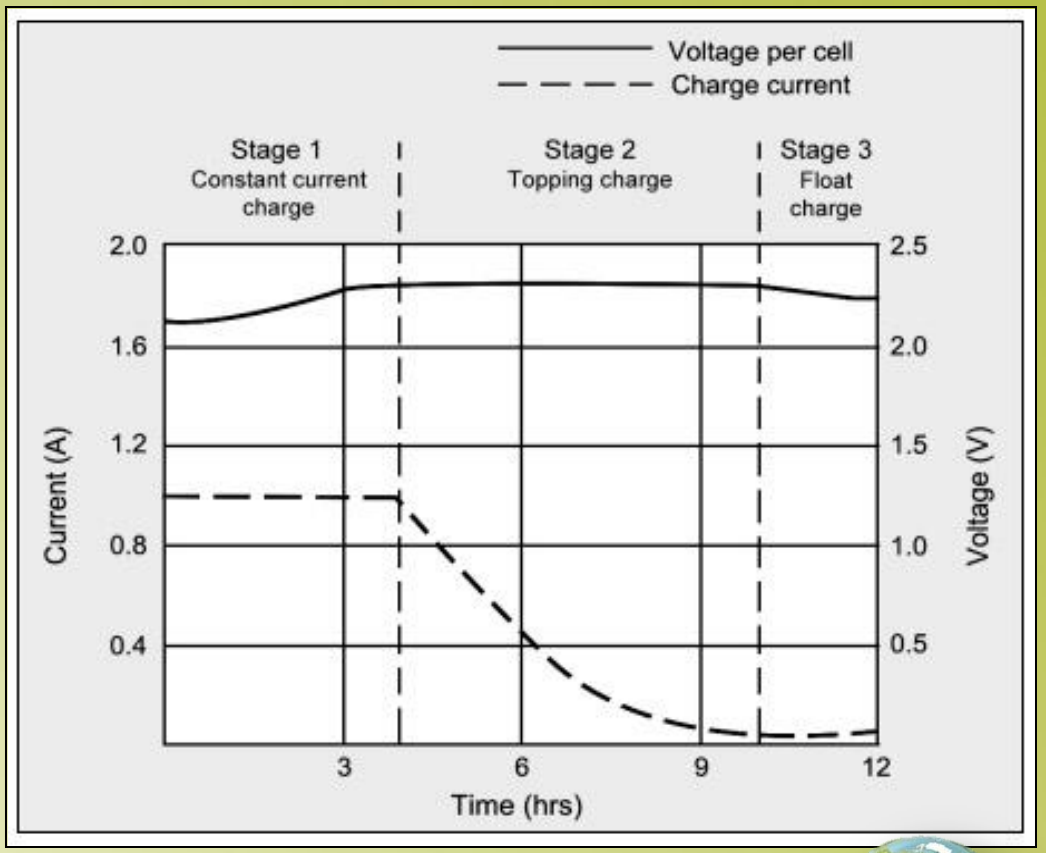
Storage Unit

Lead-Acid Charging Stages

1st Stage: Bulk

2nd Stage: Absorption

3rd Stage: Float



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Load Distribution

PV Panels

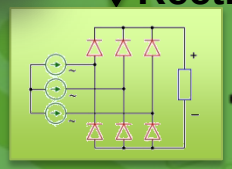
Lead-acid battery charger

Battery Bank

Inverter

Wind Turbine

Rectifier



Housekeeping Controller

Transformer

Dump Load

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Output Component

Inverter Design: Aims PWRINV2.5K24 2500 Watt

Parameter	AIMS
Max. Power	2.5kW
Surge Power	5kW
Wave Output	Modify Sine Wave
Operating Input VDC	20-30 Volts
Full Load Efficiency	90%
Operating Temperature	-15˚C to 55˚C
Weight	14 lbs
Cost	$280

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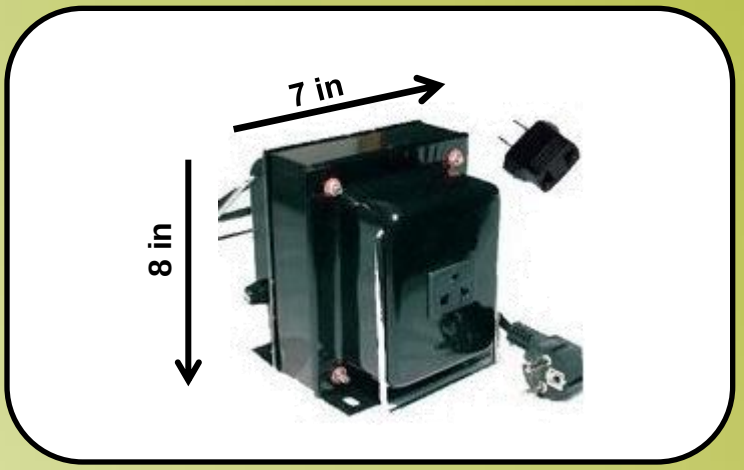
Output Components

AC-AC Transformer: SevenStar THG-1000

Parameter	Dual Step Voltage Transformer
Outlet	3 American Or 2 European
Voltage Conversion	110V to 220V 220V to 110V
Max. Power output	1000Watts
Weight	17 lbs



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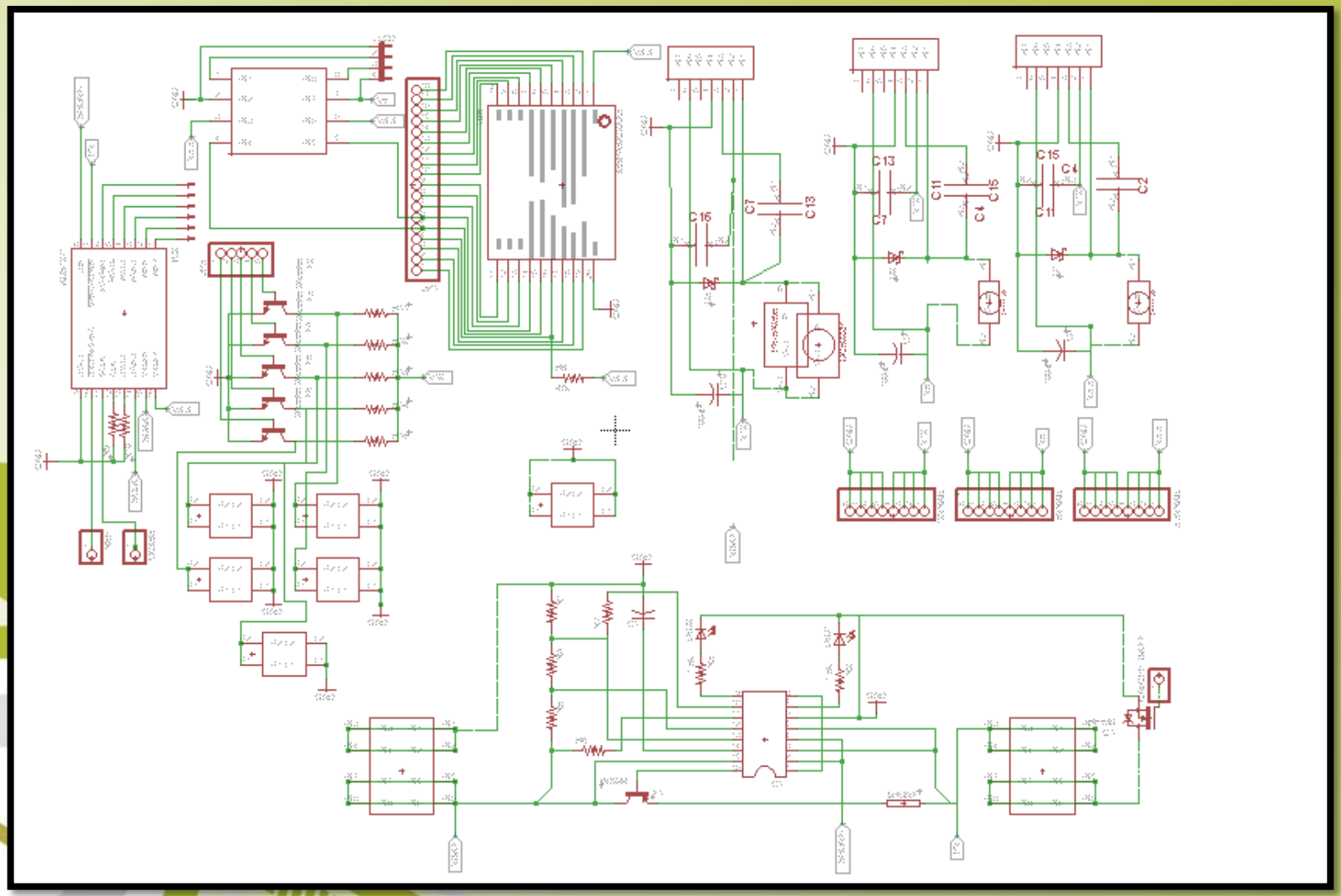
Printed Circuit Board Schematic



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Enclosure

Enclosure box

Add it when everything in it

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Andrea	I2C Communication	User Interfacing
Juan	Lead Acid Battery Charger	Enclosure
Manuel	DC-DC Buck Voltage Regulators	Storage System
Randall	PCB Design	Programming Logic

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Time Line of Project

January

Jan 15th - January 31st
- Purchase IC devices
- Design circuit
- Keep research microcontroller

February

Feb 1st-February 15th
- Prototype design

February 22nd
- CDR Presentation

Feb 23rd – March 1st
- I2C code ready
- Purchase components

March

March 2nd–March 10th
- SPRING BREAK

March 11th –March 30th
- Communication integrate circuits troubleshooting
- Purchase PCBs
- Failed communicating

April

April 1st– April 9th
- Design prototype revision C
- Test prototype
- Purchase PCB
- Successfully communicating

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Budget

Part Number/Device	Cost per Parts	Number Parts	Total Cost
Charge Controller			
Printed Circuit Board	$1,100.00	1	$1,100.00
Circuit Board Components	$100.00	1	$100.00
SchmartBOARD	$30.00	3	$90.00
LCD (Display)	$15.00	1	$15.00
Dummy Load MFJ-263	$99.95	1	$99.95
Battery			
PVX-1080T Battery	$55.00	2	$110.00
Inverter			
Aims 2500 Watt	$250.00	1	$250.00
Transformer			
SevenStar THG-1000	$80.00	1	$80.00
Enclosure			
Wood + Plexiglass	$0.00	1	$0.00
4-port usb charger/ Outlet Socket	$25.00	1	$25.00
USB Fan	$19.00	4	$76.00
Microcontroller			
MSP430G2552	$4.00	2	$8.00
Solar Panel	$0.00	0	$0.00
Miscelaneous	$300.00	1	$300.00
			$0.00
		Total	**$2,253.95**

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Questions?

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