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Group #26

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3. Responsibilities

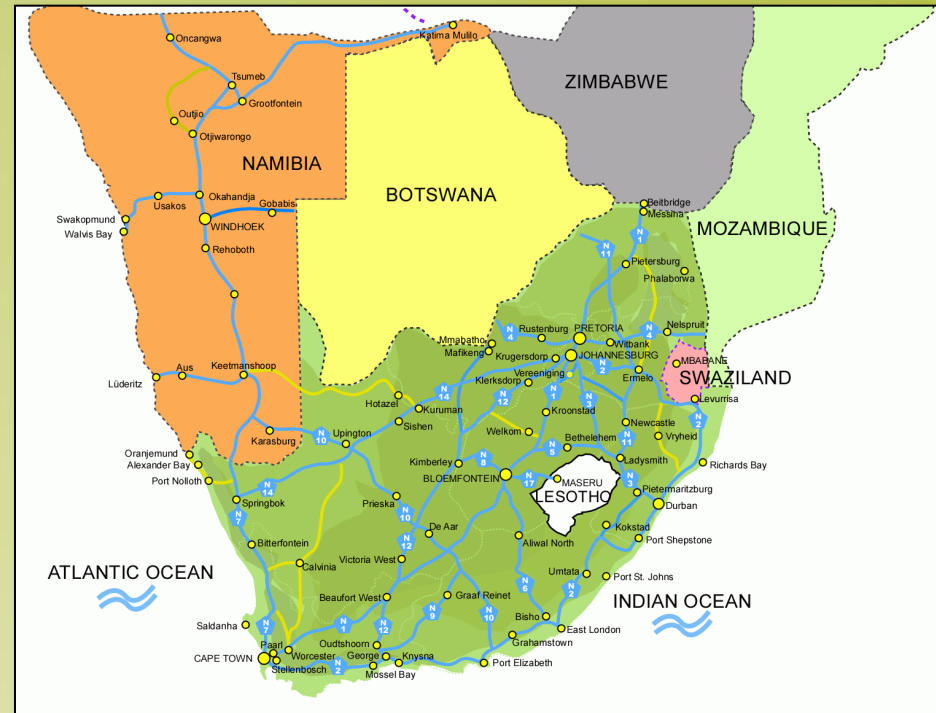
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Project Motivation: South Africa Pomolong Township

- Supply renewable energy to a small community center located in Pomolong Township in South Africa
- Impact the lives of many by powering a computer, a projector, lights, and other electronics that will be used for educational purposes



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 Instantaneous Load					395 Watts
Energy in a single day: ~2 KW-hrs					



Goals & Objectives

- Integration and control of renewable energy sources in an electric power system
- Efficient MPPT Charge Controller
- Overall robust and reliable energy storage system
- Use TI components for the “TI Analog Design Contest 2013”



Design Specifications

- Input Source ~ 20V – 30V (DC)
- System Power Output ~ 2000W
 - AC Voltage: 110Vrms
220Vrms
 - DC Voltage: 5Vdc (USB port)
- 24V Battery Bank
- Aiming for 95% Efficient
- Parallel two renewable energy sources



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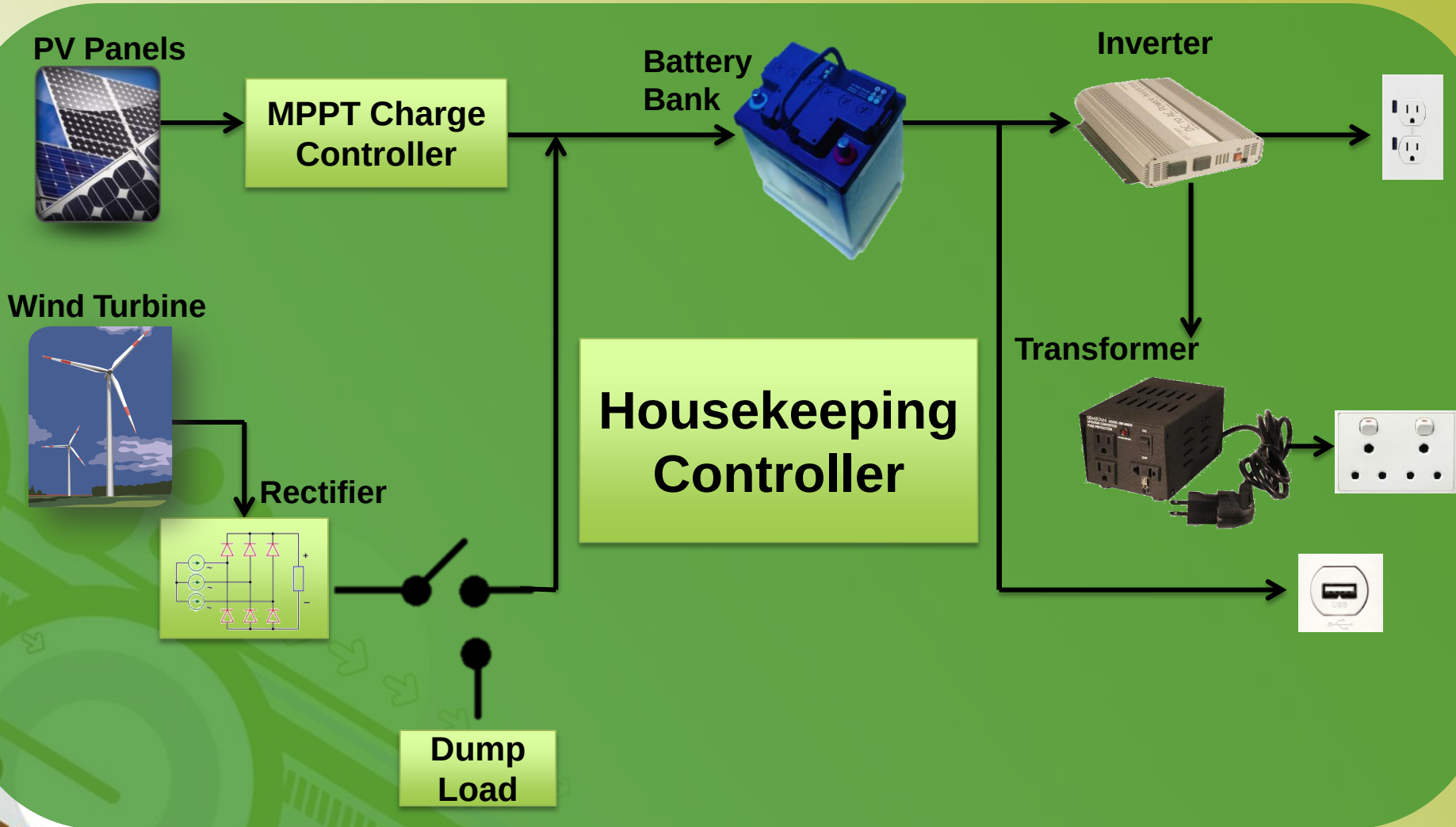
3. Responsibilities

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Components Overview

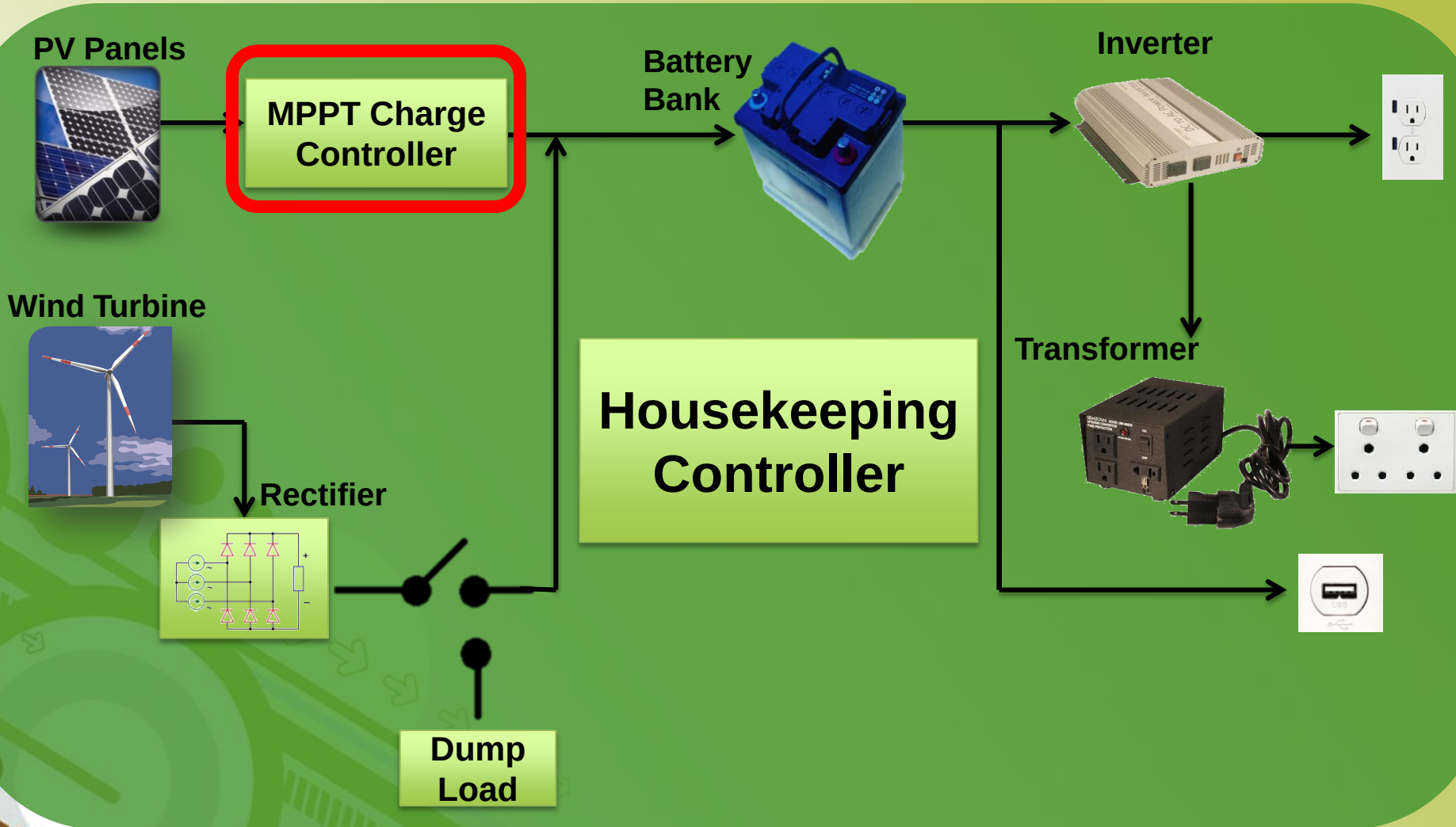


Renewable Energy Sources

- Sources provided by the mechanical engineers
- Solar tracking team
- Wind tower team

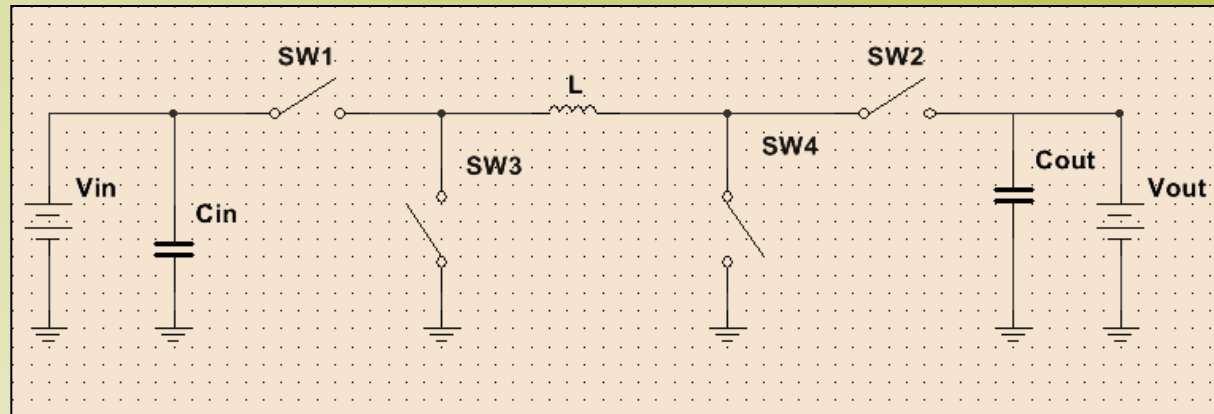


Charge Controller Unit

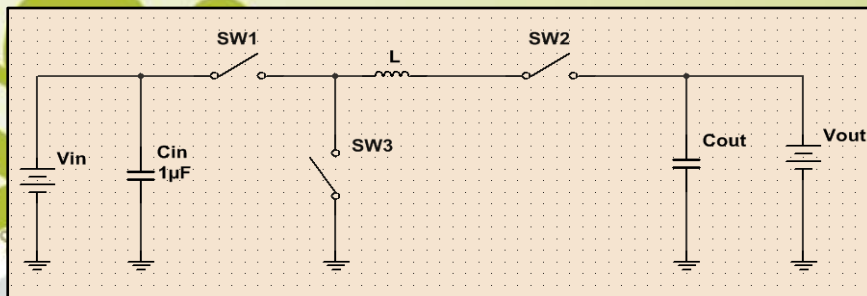


Charge Controller

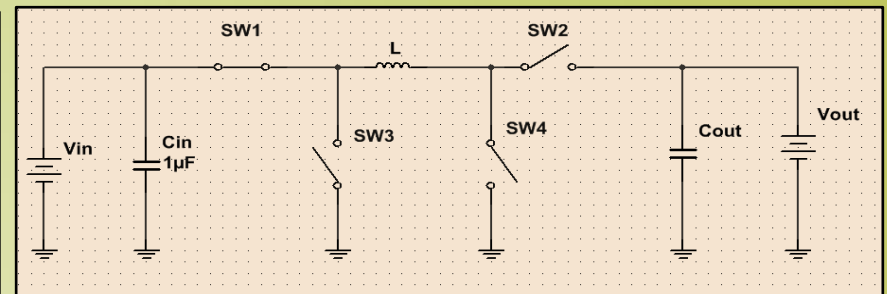
Buck & Boost Converter



Buck Mode



Boost Mode



Charge controller Buck & Boost Converter

Components

Inductor

Buck Mode

$$L > \frac{V_{out} * (V_{inmax} - V_{out})}{K_{ind} * F_{sw} * V_{inmax} * I_{out}}$$

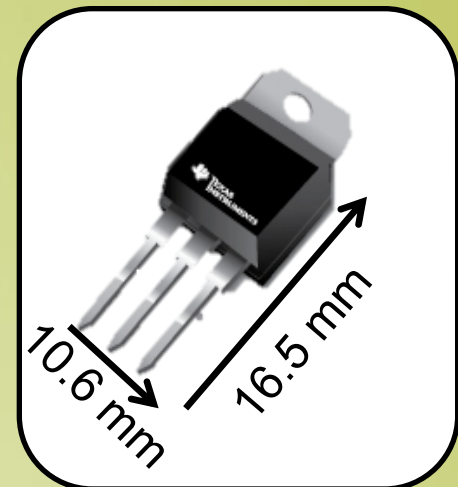
Boost Mode

$$L > \frac{V_{inmin}^2 * (V_{out} - V_{inmin})}{K_{ind} * F_{sw} * I_{out} * V_{out}^2}$$

MOSFET

CSD18532KCS

60-V, N-Channel
Power MOSFETs

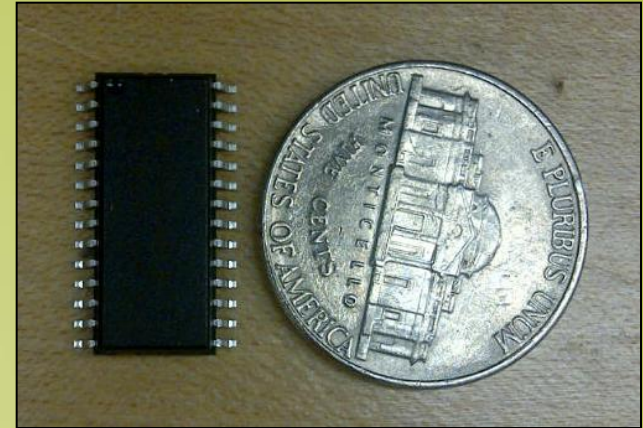


Charge Controller

H- Bridge Driver : SM72295

Specifications

- Switching frequency: 220kHz
- Digital supply voltage: 5V
- Analog supply voltage: 10V
- Current sense amplifiers
- Improved Efficiency
- Fully tested



Charge Controller

SM72442

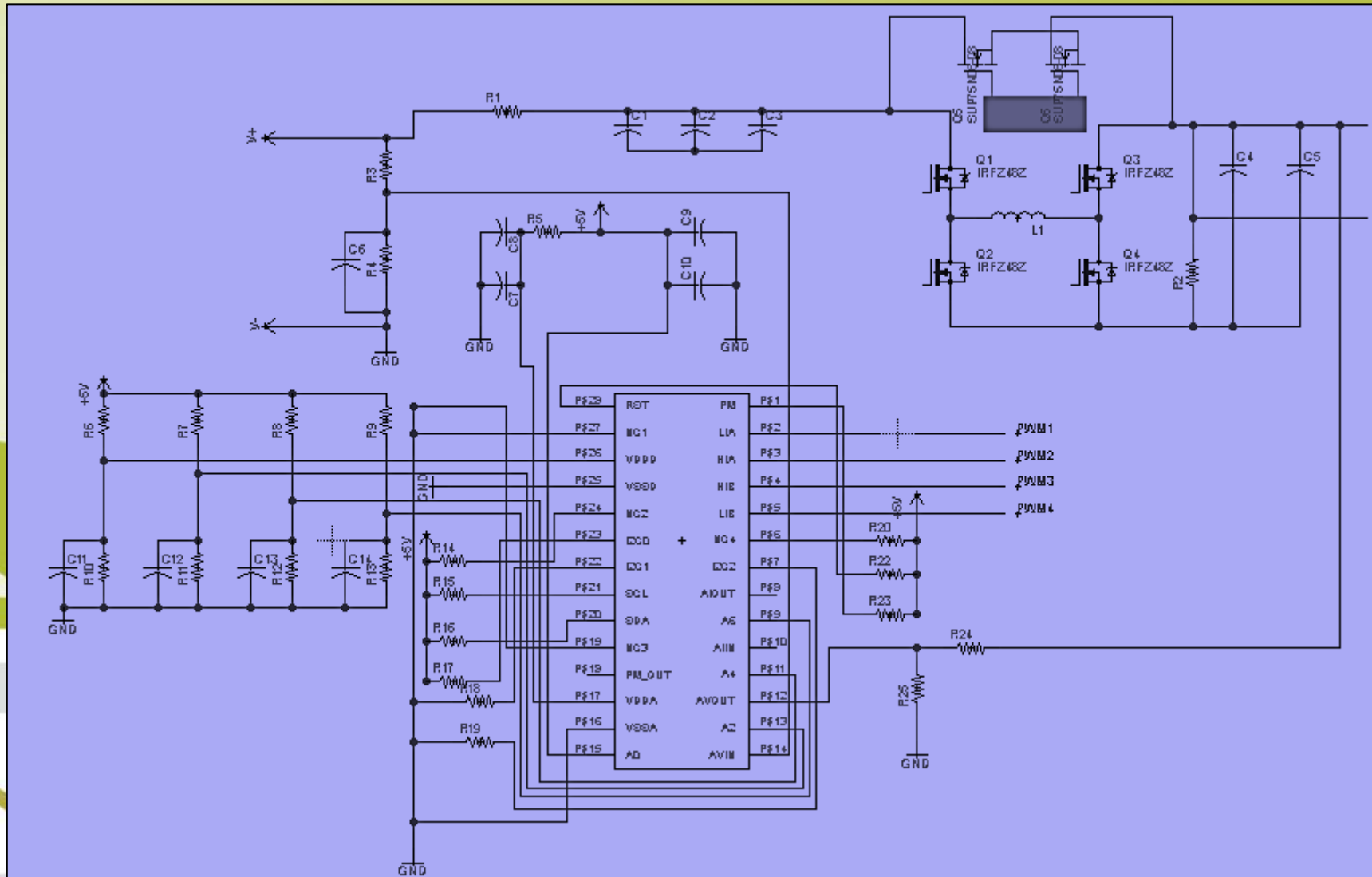
Specifications

- Analog Supply Voltage: -0.3V to 6V
- Digital Supply Voltage: -0.3 to 6V (max)
- Input Current at any pin: $\pm 10\text{mA}$
- Package Input Current: $\pm 20\text{mA}$
- Storage Temperature Range: -65°C to 150°C
- Operating Temperature: -40°C to 105°C
- MPPT algorithm (perturb and observe)

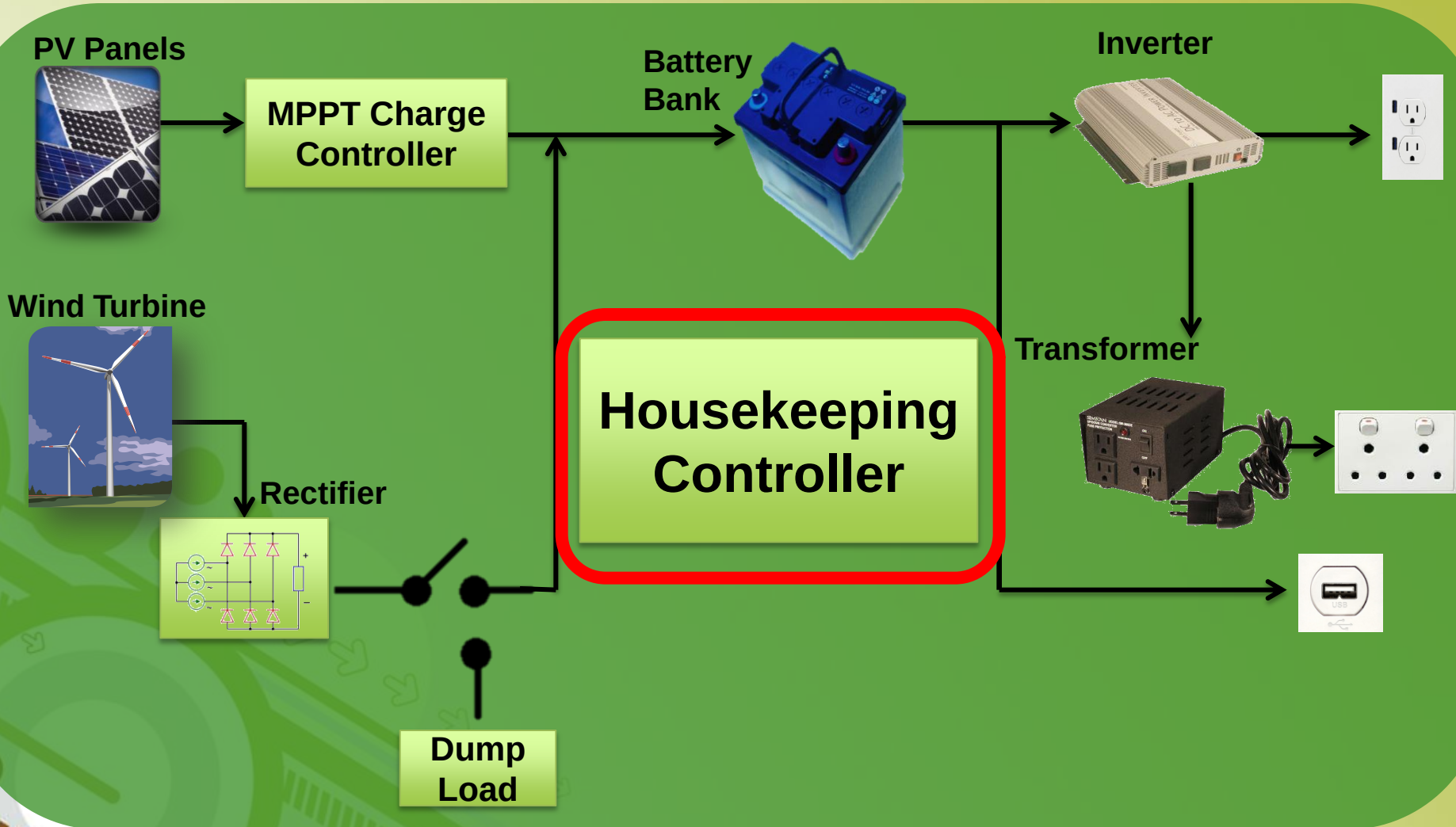


Charge Controller

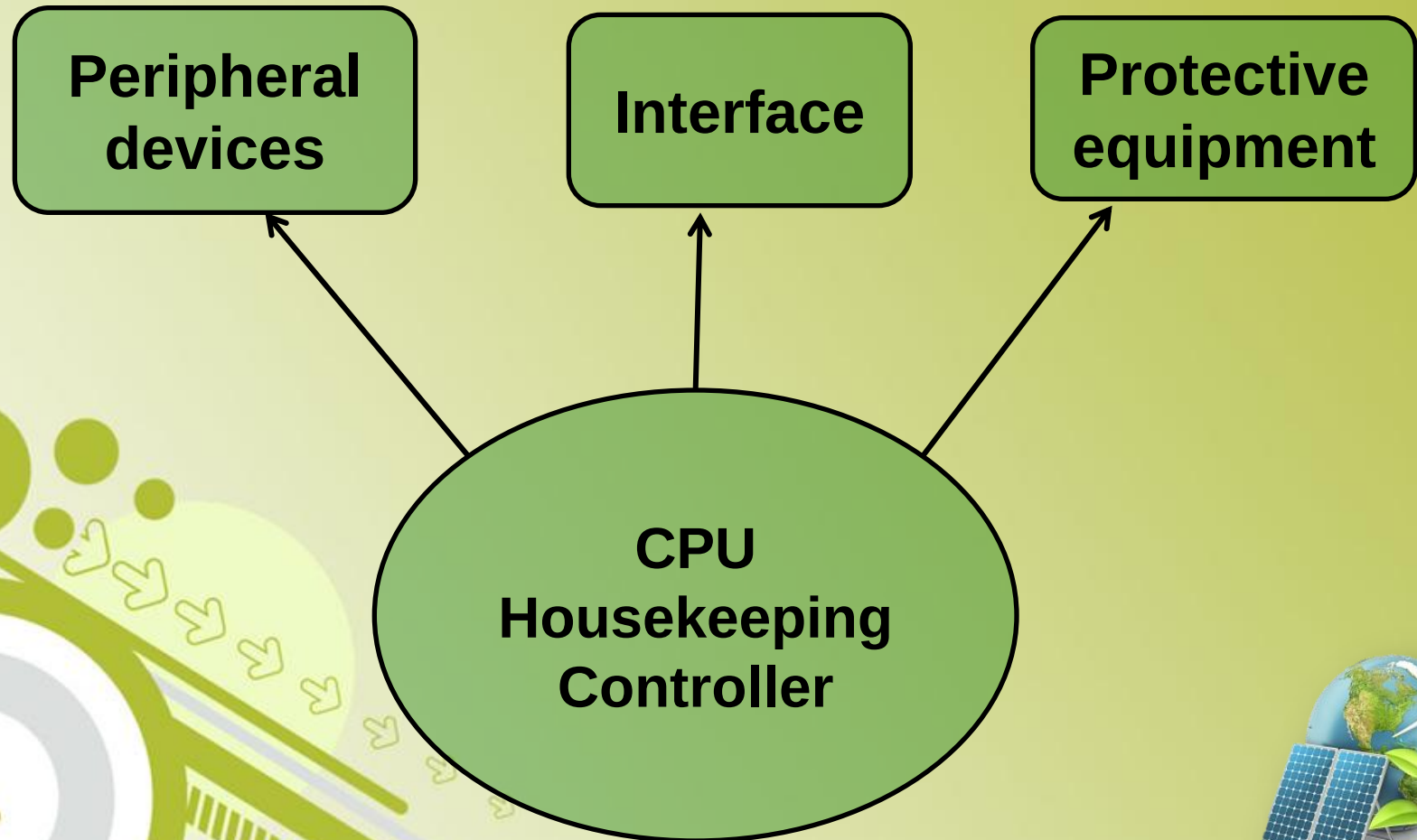
SM72442



Housekeeping Controller



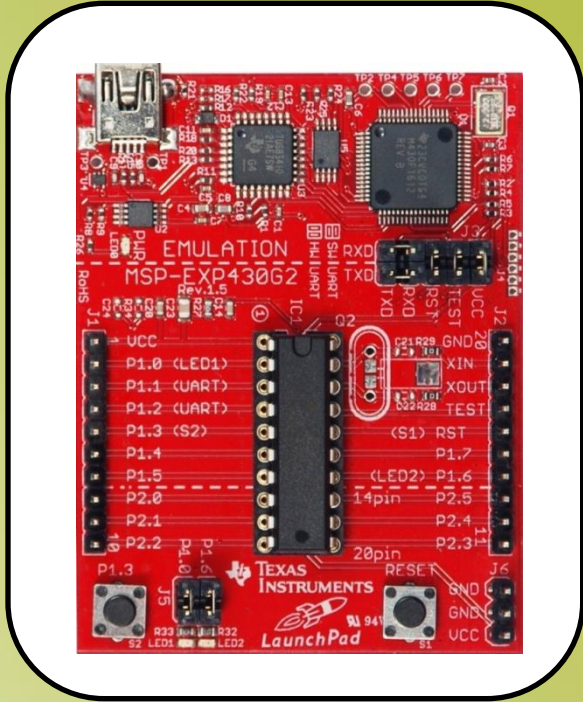
Housekeeping Controller



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



Housekeeping Controller

Thermocouple Type-K

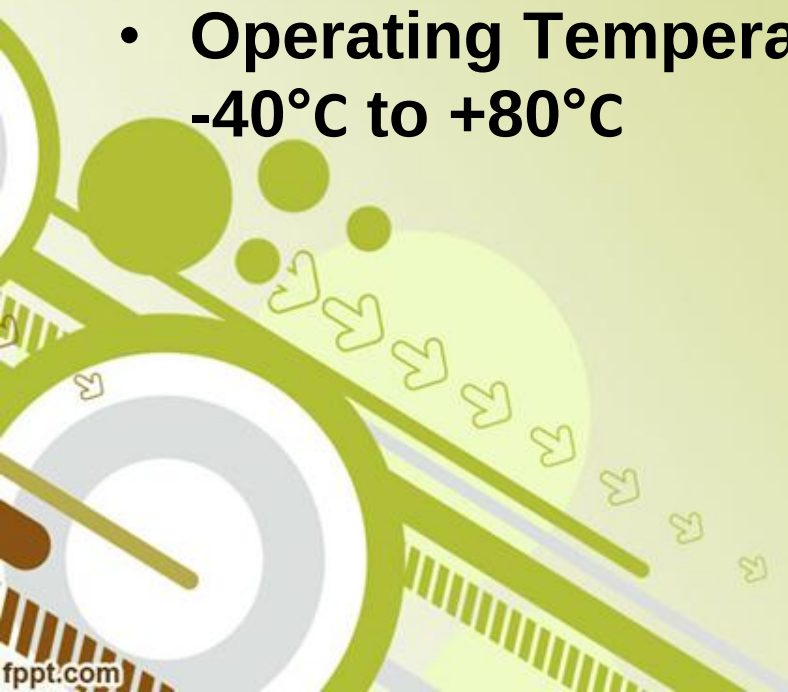
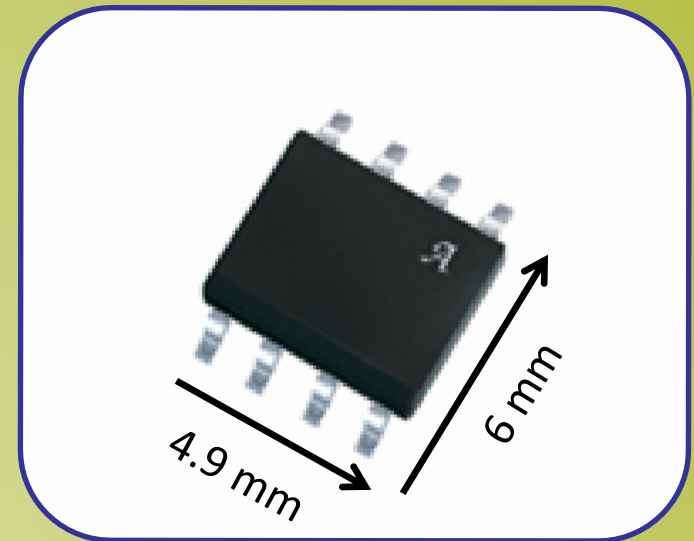
Parameter	Type-K
Sensor Type	Analog Thermocouple
Temperature Range	-180°C – +1300°C
Temperature Tolerance	$\pm 1.5^{\circ}\text{C}$ between -40°C to 375°C ± 0.004 between 375°C and 1000°C
Protocol	A/D Converted then I2C to MCU



Housekeeping Controller

Current Sensor: ACS711ELCTR-12AB-T

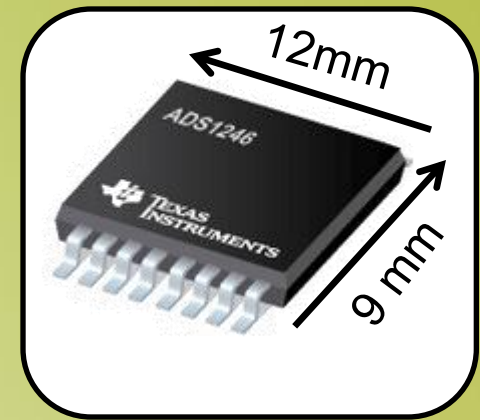
- **Sensor Type:** Hall Effect
- **Operating Voltage:** 3.3 – 5V
- **Current Sensing:** -12 to +12A
- **Operating Temperature:** -40°C to +80°C



Housekeeping Controller

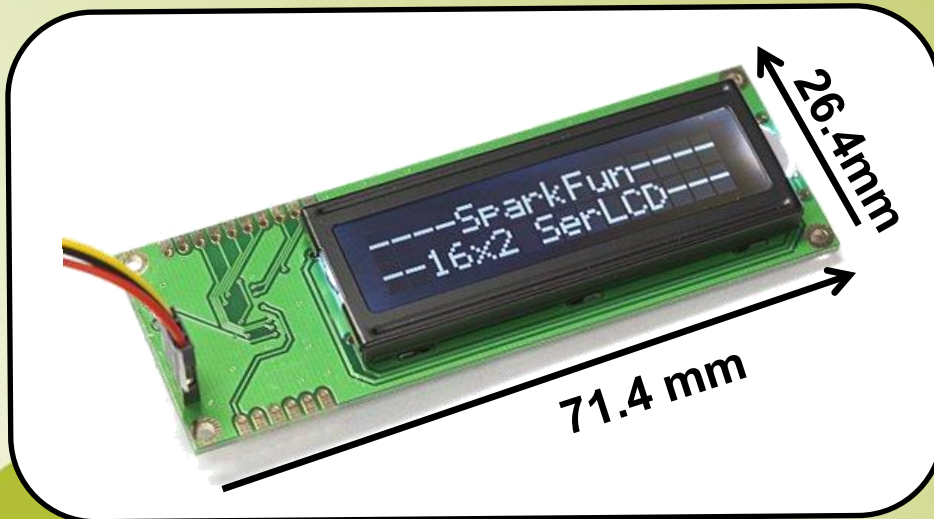
Analog-Digital Converter: ADS 1246

Parameter	Analog to Digital Converter
Chip	ADS 1246
Communication	SPI
Cycle Rate	Single-Cycle for All Data Rates
Operating Temperature	-40°C to +125°C



Housekeeping Controller

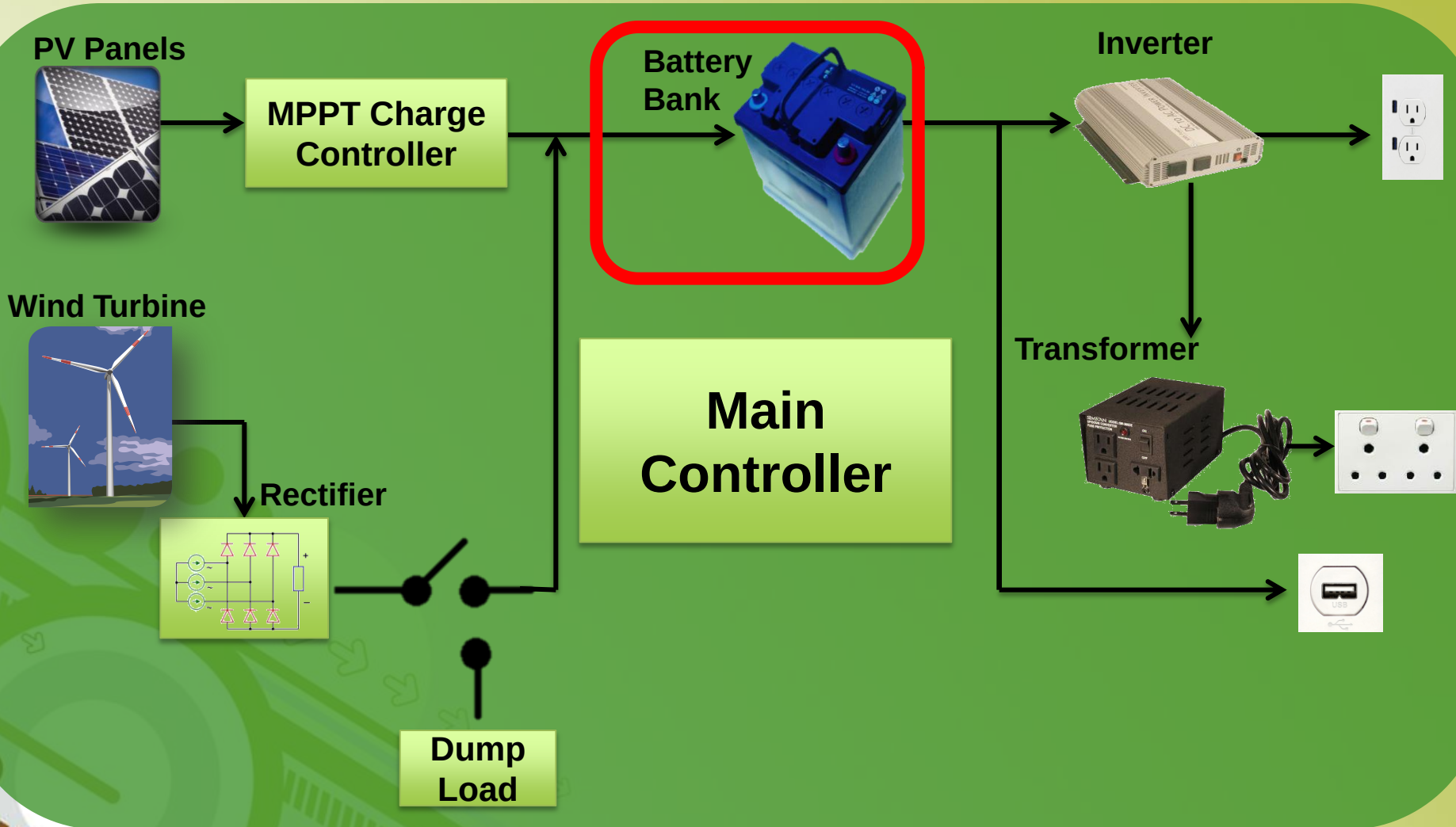
LCD Screen: LCD-09395



Parameter	16x2 LCD
Communication	Serial
Operating Voltage	5V
Operating Current	60mA
Cost	\$25



Storage Unit



Storage Unit

Types of Electrochemistry's

Major

- Lead-Acid
- Lithium-Ion(Li-Ion)
- Molten Salt

Other

- nickel-cadium (NiCd)
- nickel-metal hydride (NiMH)
- lithium-polymer(Li-poly)
- zinc-air



Storage Unit

Types of Lead Acid

- **Starting**
- **Deep Cycle**
 - Flooded
 - Gel
 - Absorbed Glass Matt (AGM)
- **Marine**



Storage Unit

Design Lead Acid

- **Model Name: AGM Intimidator 31M**
- **Nominal Voltage: 12V**
- **Capacity: 105 Ah (20Ah Rated)**
- **Number of Charge Cycles at 50%: Aprox. 800**
- **Operating Temp: -40 C to 60 C**
- **Weight: 85 lbs**
- **Dimensions: 12' X 6' X 9'**
- **Price: \$276.46**



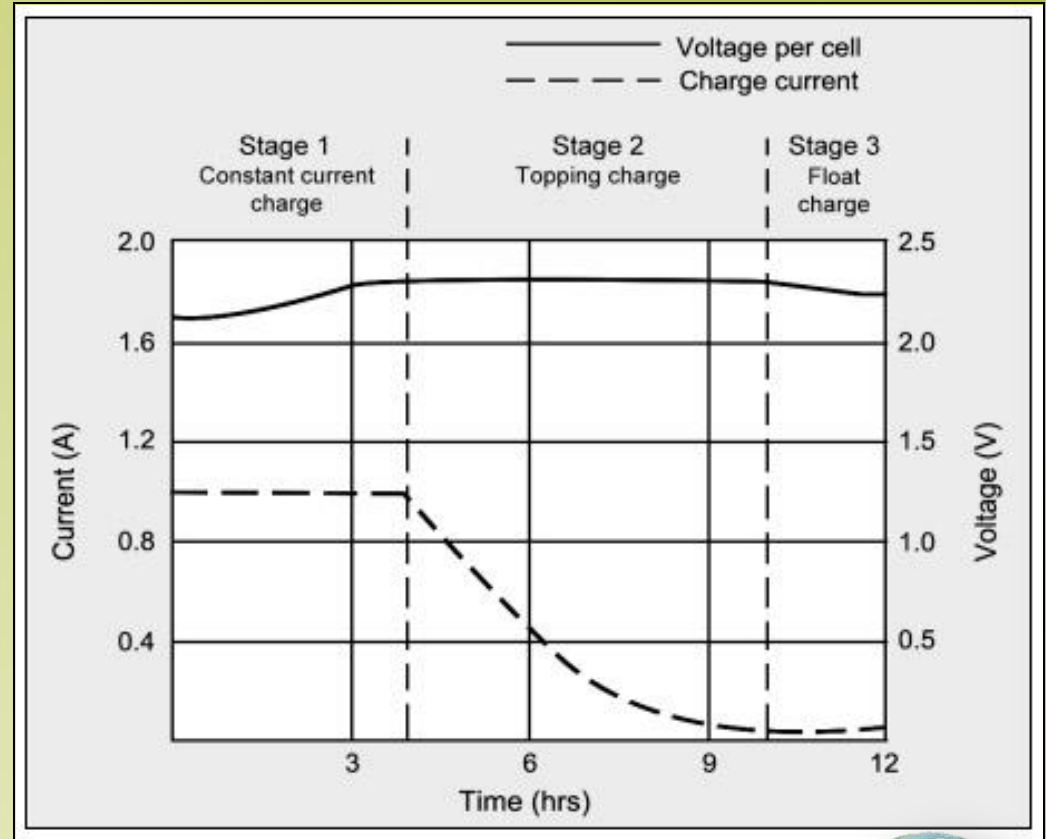
Storage Unit

Lead-Acid Charging Stages

1st Stage: Bulk

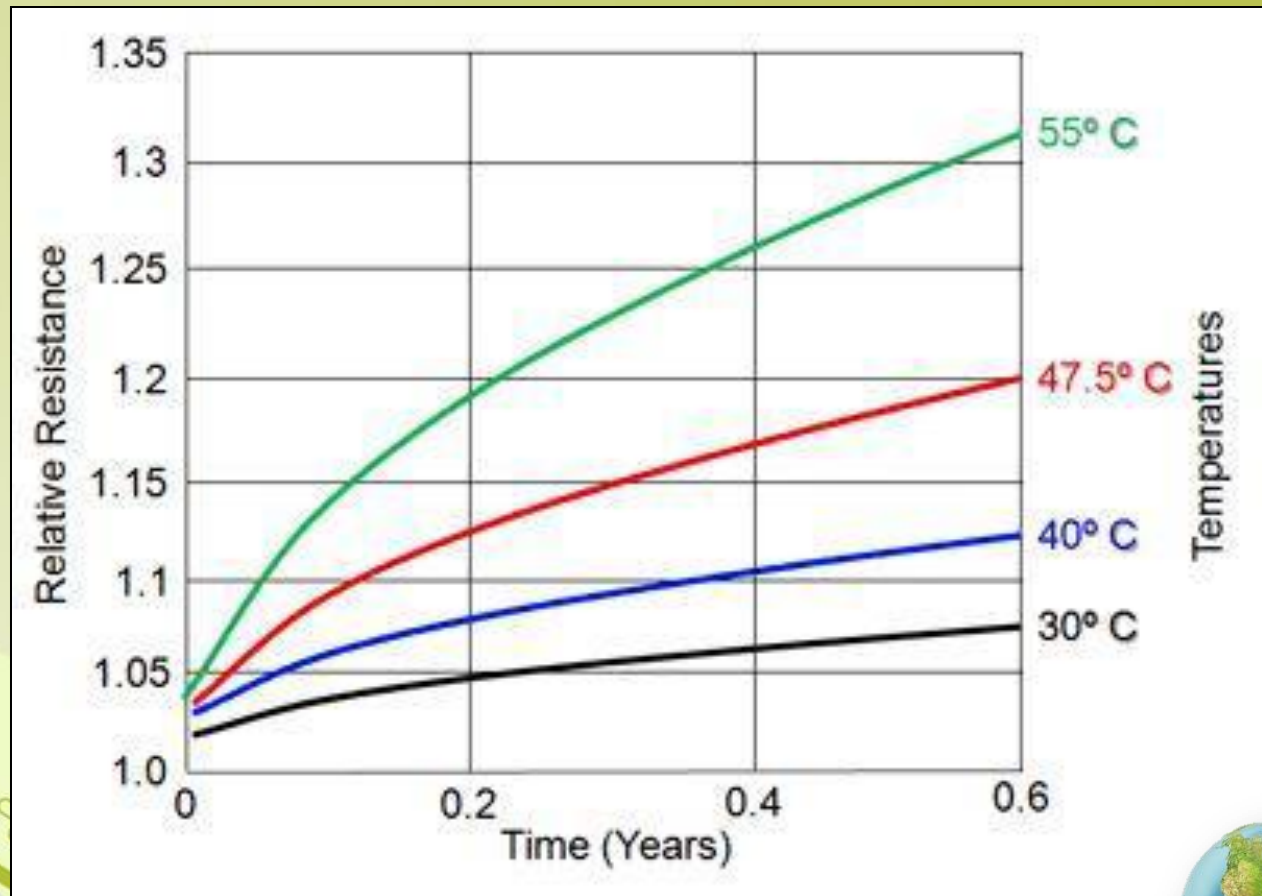
2nd Stage: Absorption

3rd Stage: Float

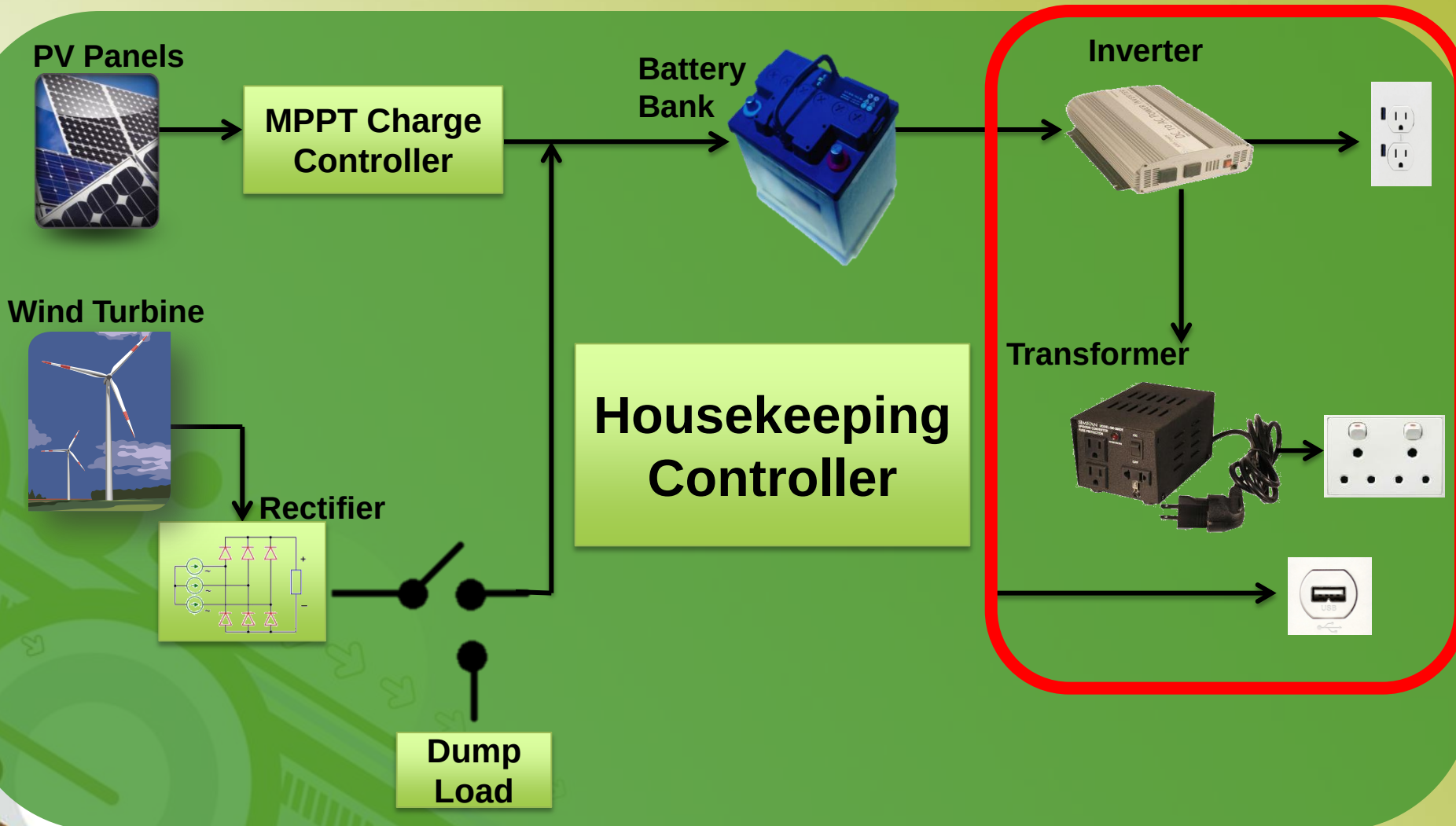


Storage Unit

Temperature Effects



Load Distribution



Output Component

Inverter Comparison

Inverter	Continuous Power (Watts)	Surge Power (Watts)	Input Voltage (VDC)	Peak Efficiency (%)	Cost (dollars)
Cobra	2500	5000	10.4 - 14.4	88	\$320
Samlez	2750	4000	20 - 33	90	\$780
AIMS	2500	5000	20 - 30	95	\$280
Xantrex	2500	3000	10.5 - 15.5	90	\$360
Wagan	2000	4000	10.5 - 15.5	90	\$760



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



Enclosure Components

Dual Step Voltage Transformer Comparison

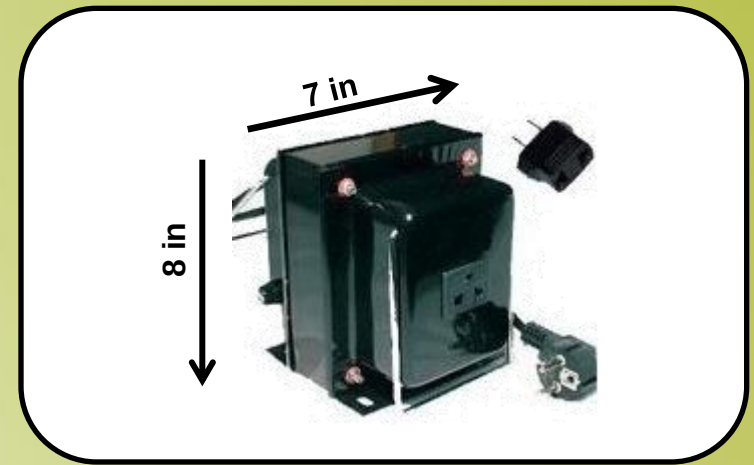
Voltage Transformer	Dimensions	Outlet	Price
Simran AC-1000	7.25"x7.75"x6"	1-U.S 110V 2-European	\$63
VT 1000	12"x 9" x 7"	2-U.S 2-European	\$66
Goldsource STU-1000	10"x 9" x 7"	1-U.S 110V 1-European 1-USB post	\$53
Sevenstar THG-1000	7"x 8" x 6.5"	2 or 3-US 1- European	\$29
Power Bright VC1000W	8.2" x 7.2"x5.9"	1-US 1-European	\$50



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



Enclosure

Enclosure box

Front View



Inside View

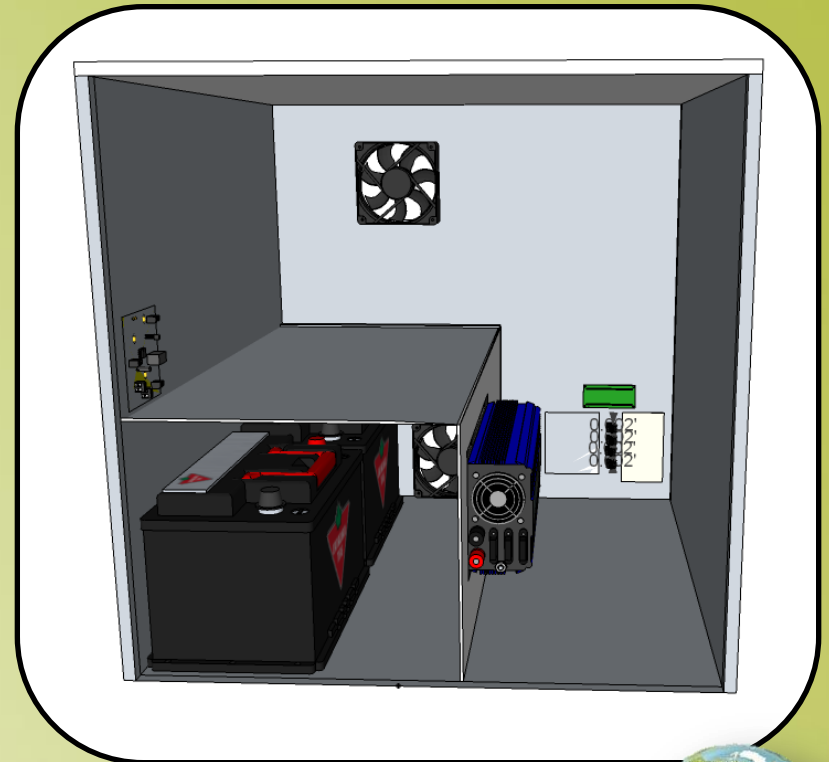


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Andrea

Peripherals

**MCU
Programming**

Juan

Bridge Driver

PCB Design

Manuel

**DC-DC
Buck/Boost
Converter**

**Storage
System**

Randall

**Charge
Controller**

**Housekeeping
Controller**



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Project Progress

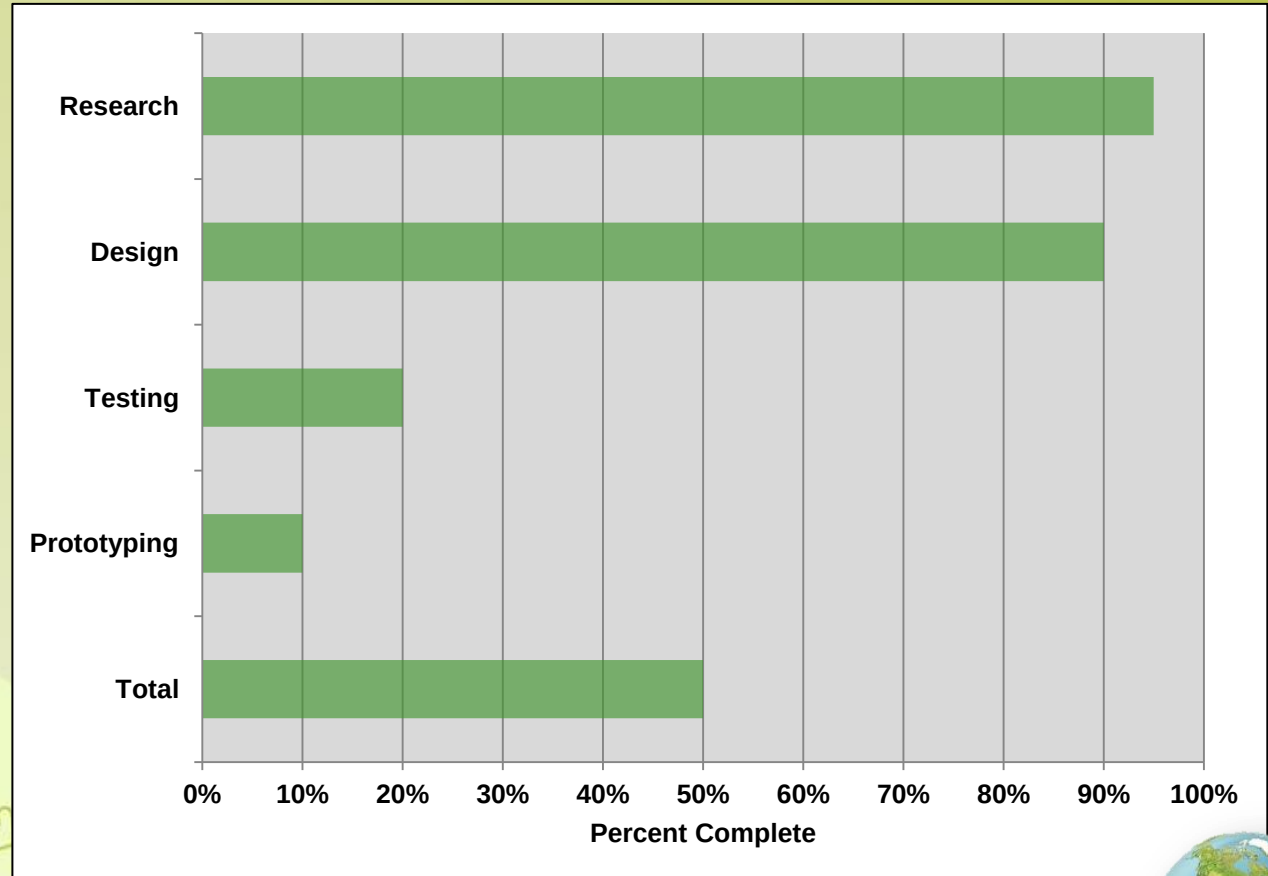


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Budget

Part Number	Cost per Parts	Number Parts	Total Cost
<u>Charge Controller</u>			
Printed Circuit Board	\$33.00	1	\$33.00
Circuit Board Components	\$50.00	1	\$50.00
SchmartBOARD	\$45.00	4	\$180.00
LCD (Display)	\$30.00	1	\$30.00
Temperature Sensor: Thermocouplers	\$1.00	10	\$10.00
Dummy Load MFJ-263	\$99.95	1	\$99.95
<u>Battery</u>			
PVX-1080T Battery	\$250.00	2	\$500.00
<u>Inverter</u>			
Cobra CPI 2575	\$320.00	1	\$320.00
Power Inverter Cable Kit	\$26.48	1	\$26.48
4-port usb charger	\$10.00	1	\$10.00
Fuse Holder	\$7.00	1	\$7.00
Fuses	\$6.50	1	\$6.50
<u>Package</u>			
Portable Box	\$200.00	1	\$200.00
USB Fan	\$19.00	4	\$76.00
<u>Microcontroller</u>			
MSP430G2552	\$4.00	2	\$8.00
Miscellaneous	\$85.00	1	\$250.00
Total			\$1,806.93



Questions?

