# Off-Grid Inverter with an Integrated VAR Compensator

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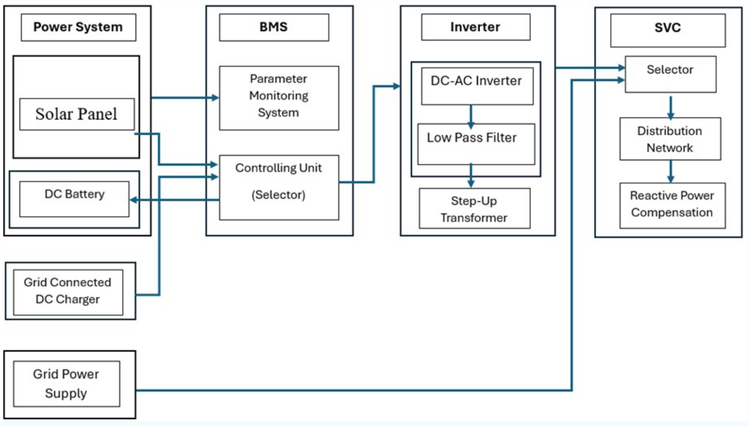
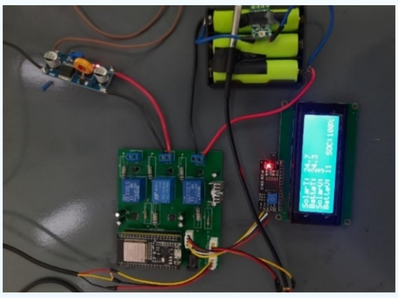
The developed system is an off-grid inverter with an integrated Static VAR Compensator (SVC) for real-time power quality enhancement. By utilizing advanced microcontroller-based control and reactive power compensation, the system optimizes power factor, reduces energy losses, and ensures voltage stability in single-phase AC networks. Through automatic capacitor bank switching and real-time monitoring, the system enhances efficiency and reliability in off-grid and hybrid renewable energy applications.

## System Block Diagram




## Battery Management System (BMS)

A Battery Management System (BMS) monitors and controls the charging and discharging of a battery pack, ensuring safe operation by preventing overcharging, deep discharging, and overheating. It also balances cell voltages to maximize battery lifespan and enhances energy storage stability in off-grid renewable energy systems.

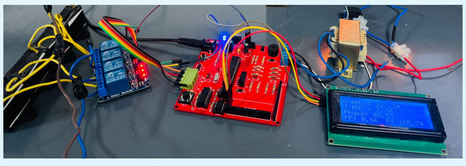


## Off-Grid Inverter

An off-grid inverter converts DC power from a battery or solar panel into AC power for standalone systems, ensuring reliable electricity supply. It operates independently from the main grid, making it essential for remote and renewable energy applications.


## Static VAR Compensator (SVC)

This dynamically corrects power factor by analyzing real-time voltage and current measurements. It utilizes a Zero-Crossing Detector (ZCD) and an ATmega328P microcontroller to compute phase angle, power factor, and reactive power. A 4-channel relay module controls the capacitor bank switching mechanism.



## Final Product

The system was developed to address the challenges of power quality issues and voltage instability in off-grid and hybrid renewable energy systems. The project integrates a Battery Management System (BMS), an off-grid inverter with a Static VAR Compensator (SVC) to enhance power factor correction and reactive power compensation. By optimizing power factor and reducing energy losses, the system improves efficiency and reliability in standalone energy applications.

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