

***DESIGN AND CONSTRUCTION OF A PELTIER COOLING SYSTEM
(TEC1-12706) USING AN ARDUINO CONTROL SYSTEM TO IMPROVE
THE EFFICIENCY OF SOLAR PANEL WORK***

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ABSTRACT

An increase in the operating temperature of solar panels can significantly reduce their electrical power conversion efficiency. To address this issue, this study aims to design and construct an active cooling system based on Peltier elements (Thermo-Electric Cooling / TEC1-12706) integrated with an automatic control system utilizing an Arduino Uno microcontroller. The engineering design focuses on cooling the rear surface of the solar panel through threshold-based temperature control. The research was conducted experimentally by evaluating control responsiveness, temperature reduction characteristics, and thermal distribution mapping (heat map) at the contact interface between the Peltier elements and the photovoltaic panel. The results demonstrate that the control system effectively triggers the cooling mechanism automatically when the panel temperature reaches the designated operational limit (40°C) and deactivates it once the temperature normalizes. The integration of the Peltier cooling system proves effective in reducing the solar panel's operating temperature and maintaining stable electrical power output. This study provides a responsive active cooling design to optimize the thermal performance of photovoltaic panels under outdoor operating conditions.

Keywords: Arduino Uno, Heat Map, Peltier TEC1-12706, Solar Panel Efficiency, System Design.