

OPTIMAL DESIGN OF A WASTE HEAT ELECTRICITY GENERATION SYSTEM BY TEG

INTRODUCTION

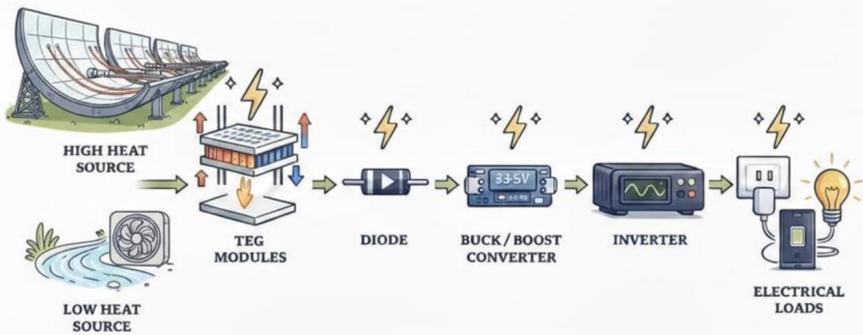
Waste energy generated from thermal processes is an underutilized energy resource. This project aims to recover a portion of this energy and **convert it into electricity** using thermoelectric generators (TEGs) which rely on the **temperature difference** between the hot and cold sides to **generate voltage**. This system utilizes several TEG units with a hybrid cooling system that combines active and passive cooling using water and fans to improve cooling efficiency and increase the temperature difference, thereby enhancing the efficiency of **generating energy from waste heat**.

OBJECTIVES

- 1- Recover wasted heat energy and convert it into useful electrical energy using thermoelectric generator (TEG) modules.
- 2- Increase the temperature difference (ΔT) across the TEG modules to enhance the generated voltage and efficiency.
- 3- Use power electronic converters such as buck and boost converters to regulate and utilize the generated electrical power.

SYSTEM OVERVIEW

THERMOELECTRIC POWER GENERATION



SYSTEM COMPONENTS

- Thermoelectric Generator Modules (TEG)
- Heat Sinks
- Water Cooling Box
- Cooling Fans
- Rock wool thermal insulation
- Power Electronics
- Thermal paste
- Oil box acts as a thermal storage tank
- Small square mirror
- Mineral Oils
- Parabolic solar dish
- Connecting wires

SYSTEM OPERATION

- 1- The hot side of the TEG units is heated to simulate a waste heat source.
- 2- The cold side is cooled using a hybrid cooling system.
- 3- Some of this heat is transferred through the Thermoelectric Generator (TEG) units to the cold side causing a temperature difference (ΔT) between the two sides.
- 4- As a result of this temperature difference TEG units generate an electrical voltage based on the Seebeck Effect phenomenon.
- 5- The voltage generated by the TEG units is protected using a FUSE and sent to the power electronics circuits :
 - Buck Converter for fan power supply
 - Boost Converter for voltage boosting
- 6- After regulating the voltage the resulting energy can be used to operate electrical loads or an inverter to obtain a suitable electrical output.



THIS IS THE SHAPE OF THE 3X5

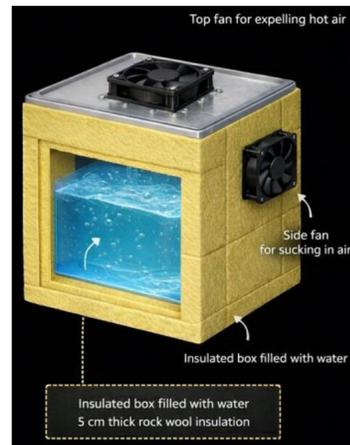
SYSTEM PERFORMANCE FROM THE DATA SHEET

Model	TEG1-199-3.5-6
Origin	China
Size	40 mm × 40 mm × 3.5 mm
Weight	~25 g
Maximum Cold-side temperature	40 °C
Maximum Hot-side temperature	250 °C
Ceramic plate material	Alumina (Al ₂ O ₃)
Electrical terminals	Copper tabs
Open circuit voltage	10 V
Matching load voltage	5 V
Matching power	5 W



COOLING SECTION

Hybrid (Active + Passive)



TO EXPLAIN, THERE IS WATER INSIDE THE BOX.

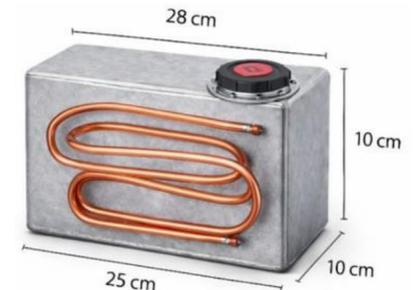


COOL SIDE DESIGN OUTSIDE

HEATING SECTION

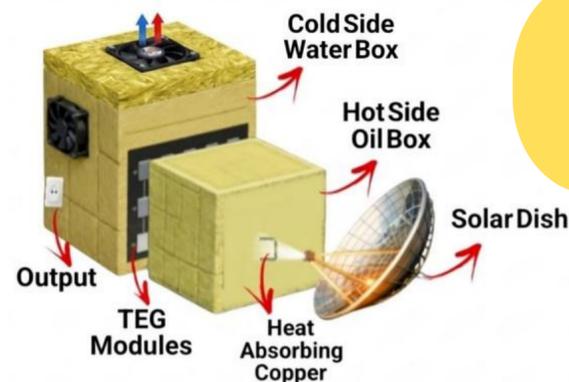


THIS IS THE FORM AFTER THE PRACTICAL PART.



THIS IS A ROUGH SKETCH BEFORE THE START OF THE PRACTICAL WORK.

COMPLETED SYSTEM



THE ELECTRICAL OUTLET CAN BE AC OR DC. THIS IS A SIMPLE PROJECT BUT WITH AN UNUSUAL CONCEPT THAT CAN BE FURTHER DEVELOPED.

SUPERVISOR AND TEAM

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