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Thermo-Electric Generator Evaluation Board

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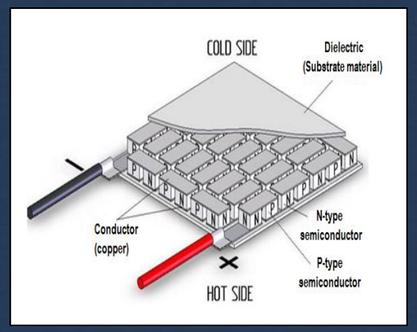
Background

Thermal Energy:

- Renewed and increased interest in harvesting thermal energy
- Potential power harvested is comparable to solar
- "Free" ambient energy
- Less than 2°C temperature difference will generate power

Energy Source	Harvested Power
Vibration/Motion	
Human	4 μW/cm²
Industry	100 μW/cm²
Temperature Difference	
Human	25 μW/cm²
Industry	1–10 mW/cm²
Light	
Indoor	10 μW/cm²
Outdoor	10 mW/cm²
RF	
GSM	0.1 μW/cm²
WiFi	0.001 μW/cm²

From: http://www.ti.com



Thermo-Electric Generators (TEG):

- Highly reliable
- Low Maintenance
- No moving parts
- Perfect for remote applications

From: http://www.engineeringagenda.com/thermoelectric-cooling/

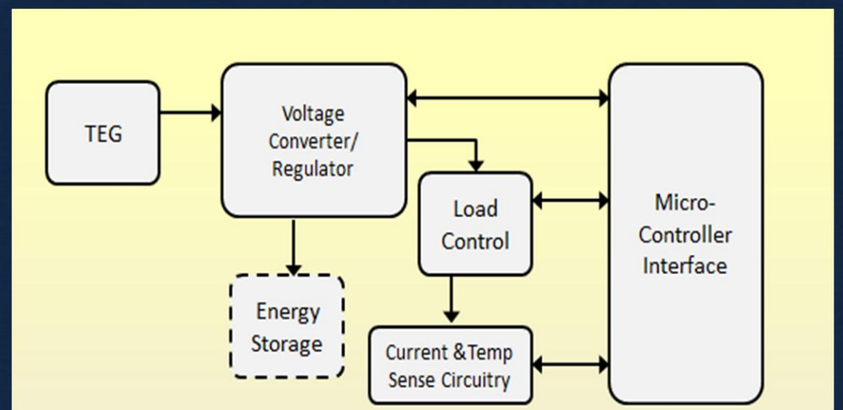
Project Objective:

To build a circuit board for evaluation of different TEGs, as well as the quantification of the maximum power that can be harvested within a certain environment.

Theory

Project Requirements:

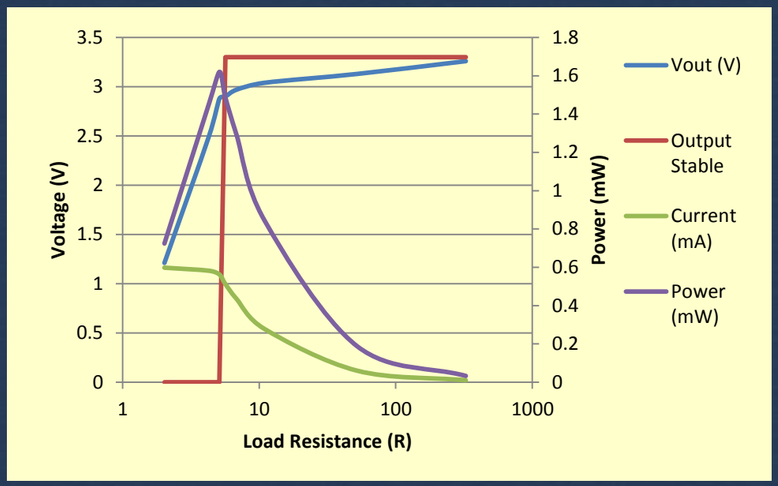
- Use a micro-power harvesting regulator for power conversion
- Load simulation through electronic load control
- Measure output voltage and current
- Measure ambient temperature as well as the temperature on both sides of the TEG
- Log data at a frequency of at least 10 seconds
- Microcontroller interface for process automation



The block diagram above shows the individual blocks implemented to meet the project requirements listed above. The five left-most blocks are used to convert, control, and measure the generated power. The microcontroller interface block on the right is a digital interface to a microprocessor for data processing and logging. Note the optional "Energy Storage" block allowing the user to experiment with a high storage battery or capacitor.

Application

The graph below shows experimental results of the TEG evaluation board. Of note is that the power peaks right around when the system output voltage becomes unstable, which is due to the power transfer being maximized and the TEG driven to its limit.



PCB Specifications:

- 2-layer board for reduced cost
- Hardware interface fits an Arduino or STM32 Discovery board for easy prototyping
- LTC3109 Micro Harvesting Converter
- MAX9611 Current Sensing
- BJT Load Control with adjustable range