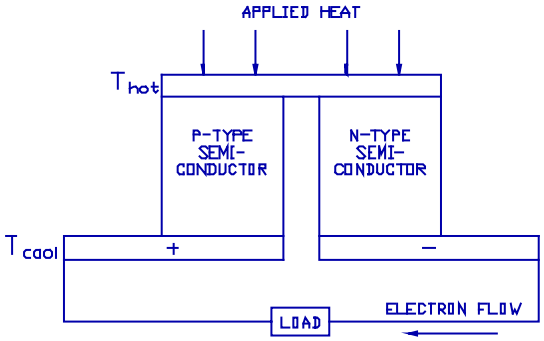
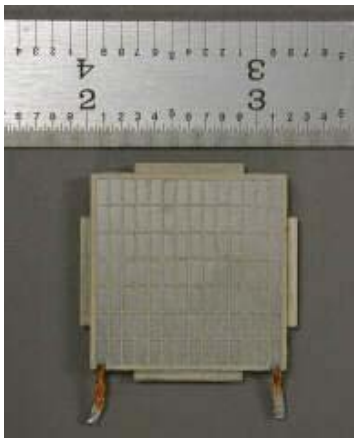


HZ-2 Thermoelectric Module

Produces 2.5 Watts and 3.3 Volts at matched Load
Uses Bismuth Telluride Based Semiconductors

Solid State Conversion of Heat to Electricity

Generate a highly reliable source of electrical power from any source of heat. For these and other applications:



POWER SUPPLIES

- Convert any source of heat to a reliable supply of electrical power in remote locations
- Convert heat from the combustion of hydrocarbon fuels to electricity creating a reliable power supply of remote unmanned stations.
- Small portable power supply
- To achieve 10 Watts and 12 Volts directly, 4 modules can be used in series.
- 1 Module with a DC/DC converter can also deliver 12 Volts (or more) DC.

SELF POWERED DEVICES

- Portable Computers
- Telecommunications
- Process Control
- Fans
- Instrumentation
- Power for Wireless Instrumentation Systems

WASTE HEAT RECOVERY

- Engine power supply from small engine exhaust
- Industrial operations such as cement plants, refineries, glass manufacturing, foundries, *etc.*
- Other heated components

RENEWABLE ENERGY

- Wood burning stoves
- Geothermal
- Solar salt ponds
- Solar concentrators

THE HZ-2 THERMOELECTRIC MODULE

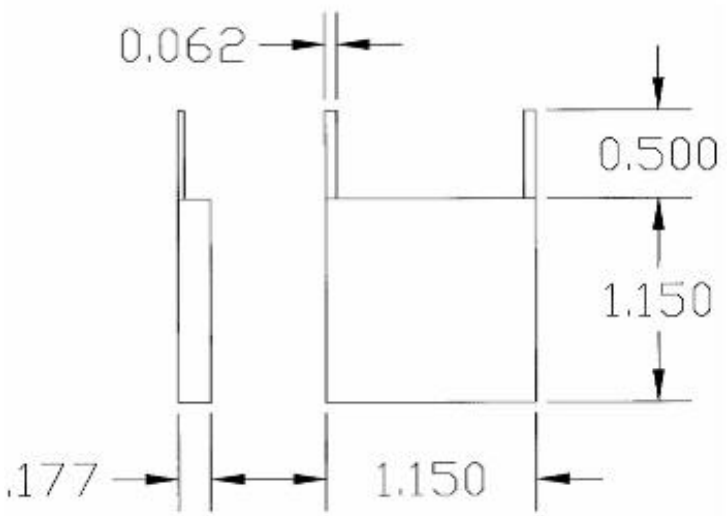
The HZ-2 module consists of 97 thermocouples arranged electrically in series and thermally in parallel. The thermocouples consist of Bismuth Telluride based, semiconductors to provide the highest efficiency at most waste heat temperatures as well as high strength capable of enduring rugged applications. The bonded metal conductors enable the HZ-2 module to operate continuously at temperatures as high as 250°C (480°F) and intermittently as high as 400°C(750°F) without degrading the module.

While the HZ-2 is well suited for waste heat recovery, its reversible properties make it ideal as a thermoelectric cooler, especially for high temperature applications where sensitive electronic equipment must be cooled to below the ambient temperatures.

Properties of the 2.5 Watt Module, HZ-2

Physical Properties	**Value**	**Tolerance**
Width and Length	1.15 in. (2.90 cm)	±0.01 (0.025)
Thickness	0.2 in. (0.508 cm)	±0.01 (0.025)
Special Order		±0.002 (0.005)
Weight	13.5 grams	±2 grams
Compressive Yield Stress	3 ksi (20 MPa)	Minimum
Number of active couples	97 couples	--
Thermal Properties		
Recommended Design Hot Side Temperature	230°C(450°F)	±10 (20)
Design Cold Side Temperature	30°C(85°F)	±5 (10)
Maximum Continuous Temperature	250°C(480°F)	--
Maximum Intermittent Temperature	400°C(750°F)	--
Thermal Conductivity[1]	0.024 W/cm K	+0.001
Heat Flux[1]	9.54 W/cm^2	±0.5
Electrical Properties (as a generator)[1]		
Power[2] Typically $\geq$ 2.5 Watts	2.5 Watts	Minimum
Load Voltage	3.3 Volts	±0.1
Internal resistance	4.0 Ohms	±0.05
Current	0.8 Amps	±1
Open Circuit Voltage	6.53 Volts	±0.3
Efficiency	4.5%	minimum

[1]At design temperatures
[2]At matched load, please refer to the graphs for properties at various operating temperatures and conditions.



Note: Power leads are braided copper wire.
All dimensions are ±0.005 inch

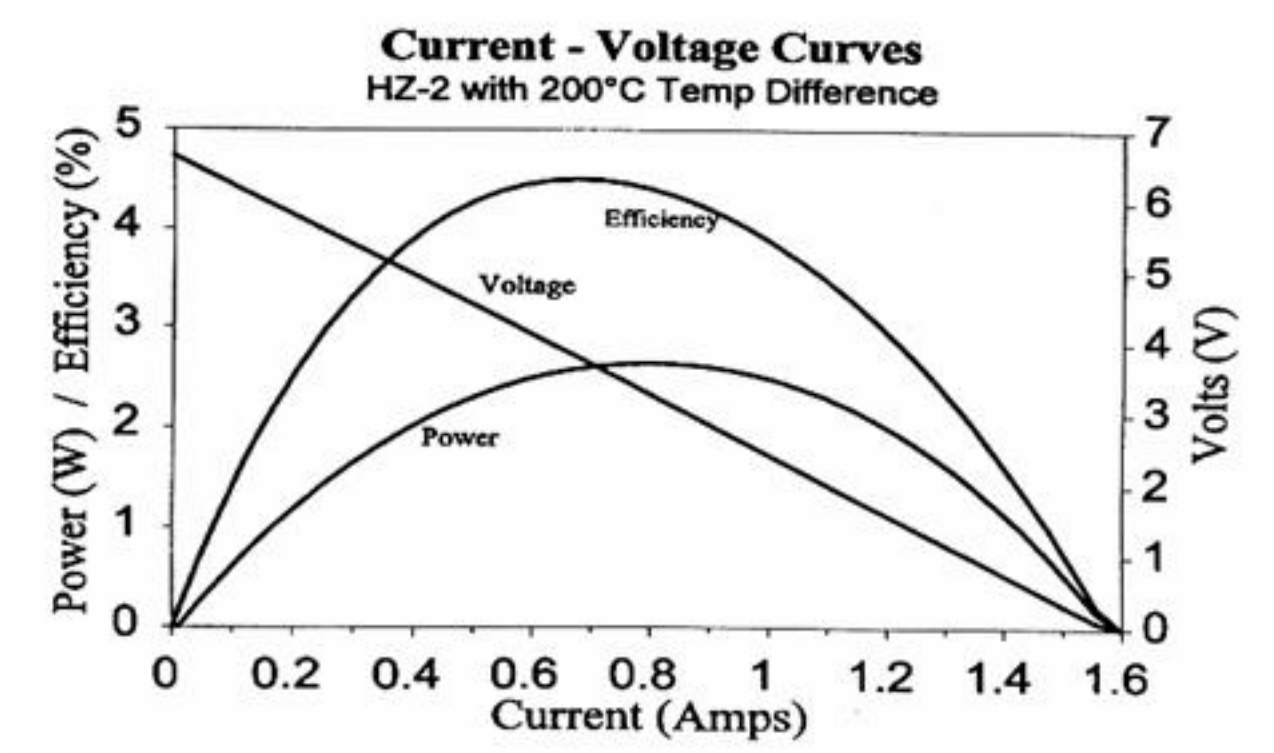
Module Dimensions

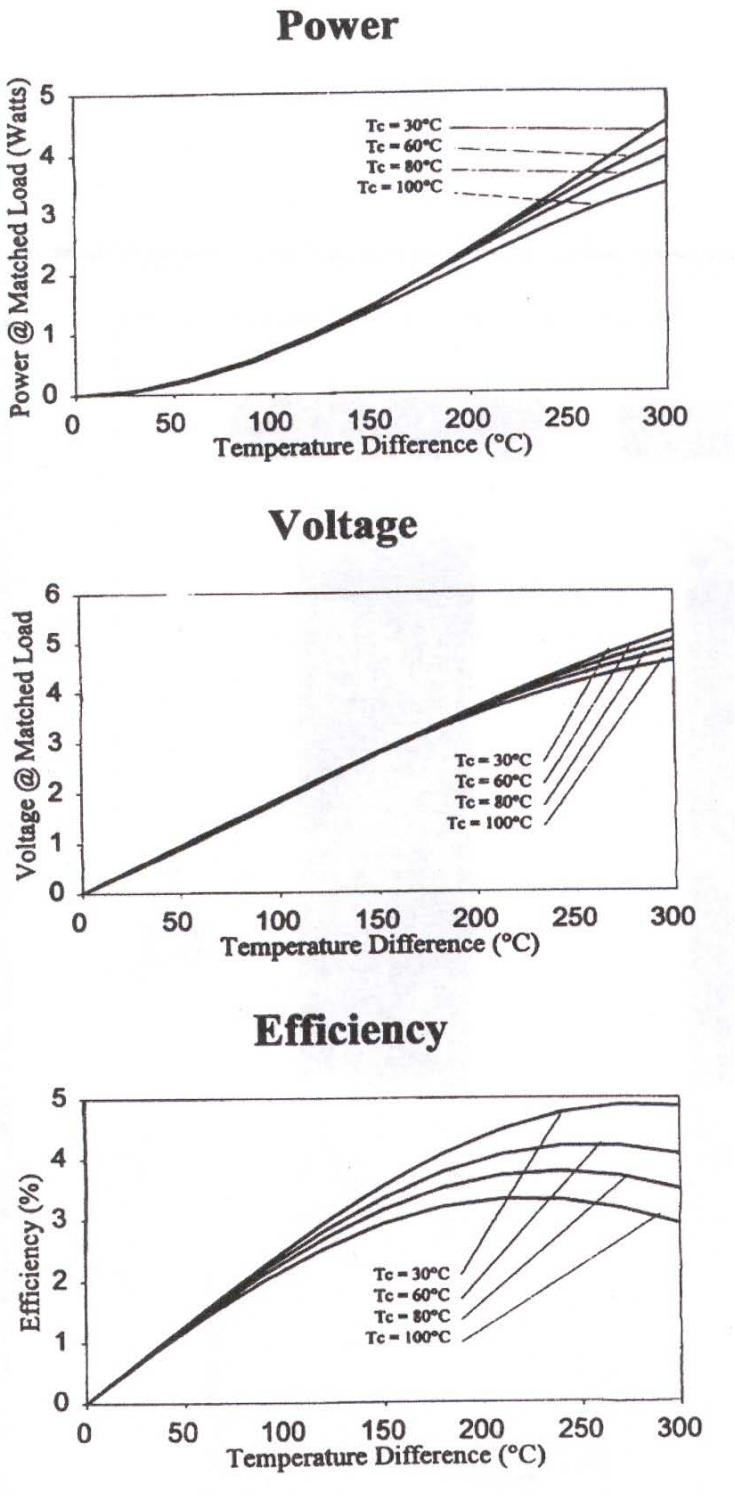
ELECTRICAL PROPERTIES

Many of the electrical properties of the HZ-2 are dependant upon the load to which it is connected. The Current-Voltage curve (I-V Curve) below exhibits the dependence of these properties as a function of the current.

It should be noted that the load at which maximum efficiency is obtained occurs at a higher voltage than does the point at which maximum power is achieved.

The Current-Voltage Curve displayed below illustrates the modules properties when the hot surface of the module is at 230°C (450°F) and the cold surface of the module is at 30°C (90°F). For a Current-Voltage Curve at other temperatures, please contact Hi-Z Technology.





T_C = Temperature of module cold surface
Temperature difference is between module hot and cold surfaces

TEMPERATURE DEPENDENCE

All thermoelectric devices are very temperature dependent.

The figures shown to the left illustrate how key thermoelectric properties of the HZ-2 module vary as the hot and cold surface temperatures are varied.

AVAILABLE OPTIONS:

- DC-DC converter
  - Input 3 V-15V
  - Output 15 V (adjustable)
  - 5 Watts
- Heat Sink
  - Fan Cooled
  - Free Convection
  - Water Cooled
- Heat Transfer Grease
- Ceramic, Electrically Insulating Wafers
- Silicone, Thermally conductive Pads

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