TCS – monTE ™ Datasheet – rev A ~ ver 5

193 couples: 1.45 mm side / 1.5mm height

Test Conditions

General Accuracy on temperature difference: ±0.25˚C.

Cold-side temperature between 19 ˚C and 25 ˚C unless otherwise specified.

Clamping force: between 172kg and 176kg.

Optimum performance is obtained after cycling the device to high temperature to reduce thermal resistances.

All data presented in this datasheet is obtained experimentally

Mechanical and Thermal

Dimensions:

40mm x 40mm x 4mm (l x w x h). Wire length each: 150mm.

Wiring Diagram:

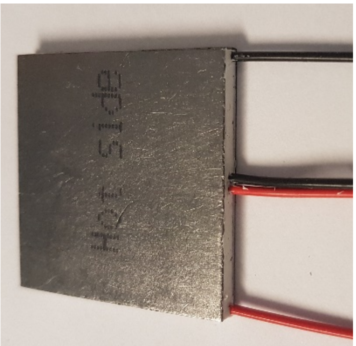

Figure 1 Picture of the monTE ™ device. *Hot side labelled as shown on device.*

← Black Wire: Negative Connection to load

←Black Centre Wire: positive connection for measurement

←Red Centre Wire: negative connection for measurement

←Red Wire: Positive Connection to load

Thermal Resistance:

The open-circuit thermal resistance is 1.03 °C/W. Note that the effective thermal resistance varies depending on the current generated, e.g., see Figure 6. This is due to the Peltier effect, which is unwanted in power generation mode. The effective thermal resistance reduces considerably with the load current.

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Constant Temperature Difference TEG Characteristics

ΔT from 50K to 300K

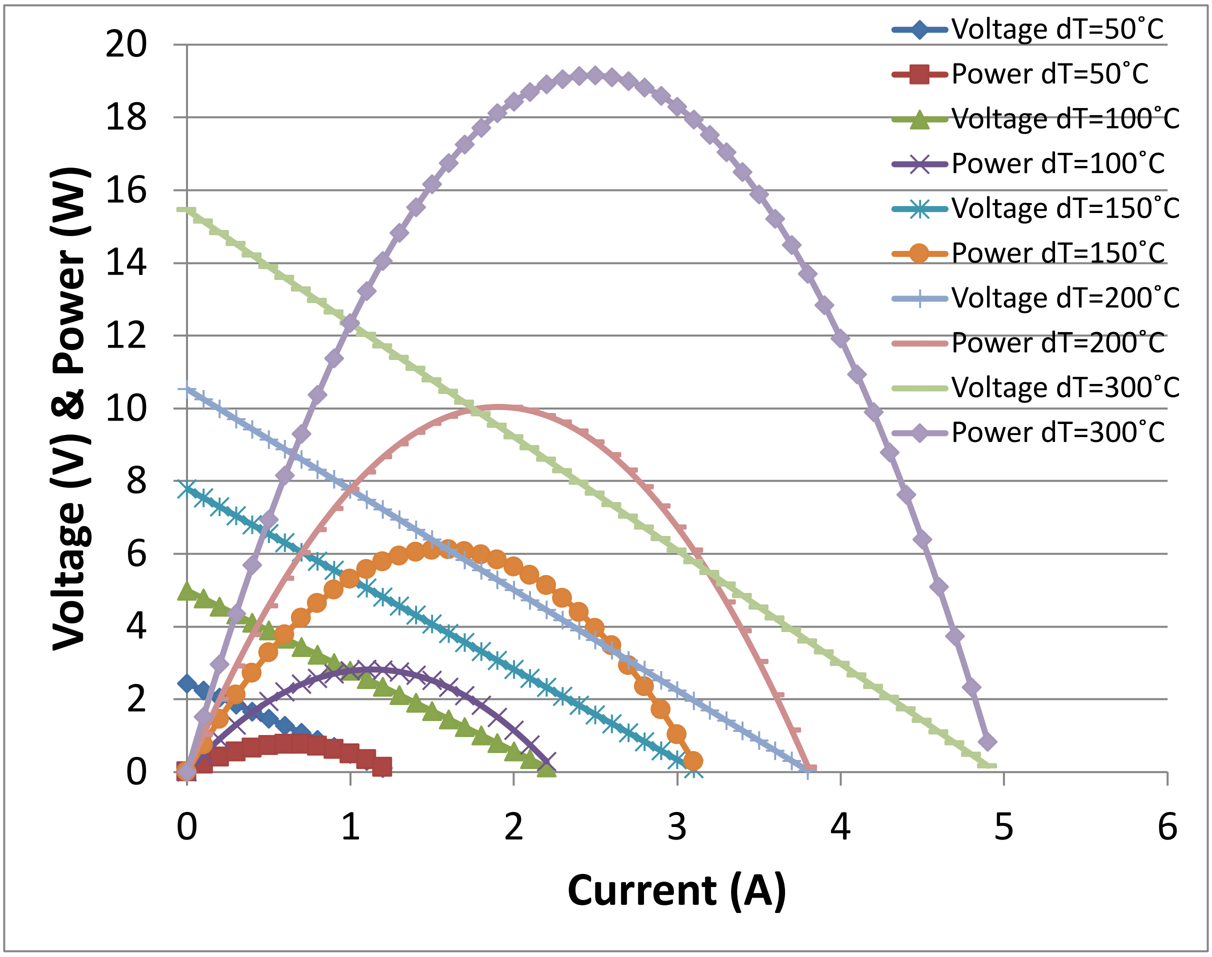

Figure 2 Voltage (V) and Power (W) vs Current (A). See Fig.

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ΔT=230K, 250K with Tc between 80 and 85 ˚C

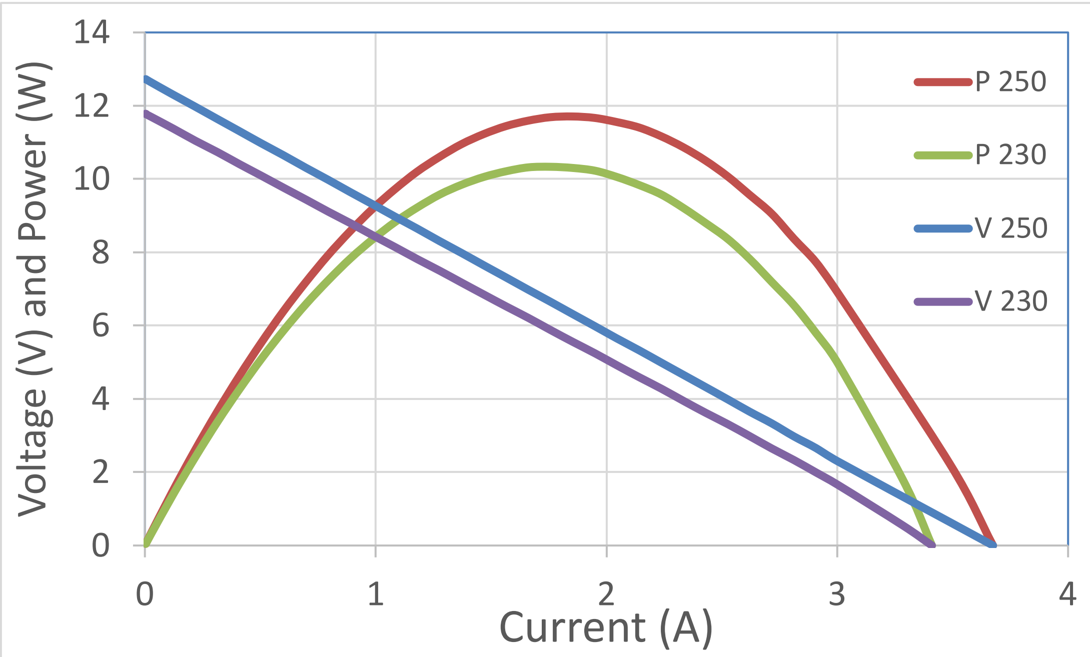

Figure 3 Voltage (V) and Power (W) vs Current (A). Cold-side temperature maintained between 80 and 85 ˚C.

Variation of Open-Circuit Voltage with Temperature

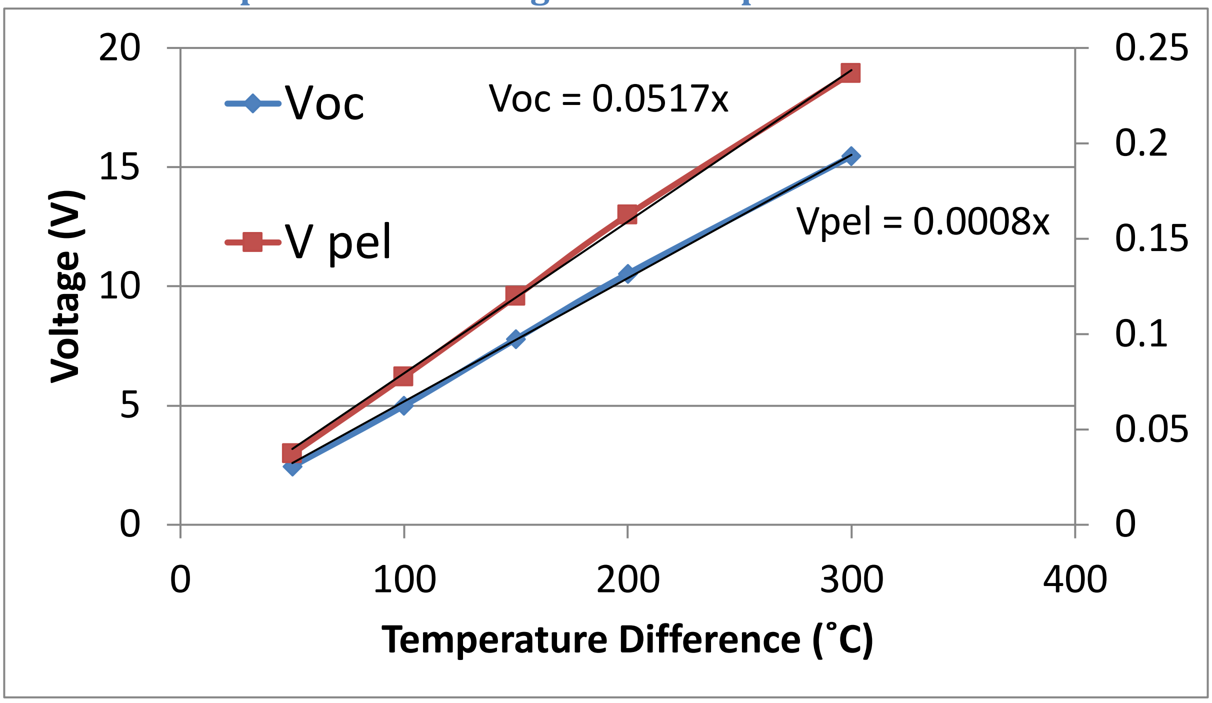

Figure 4 Open-circuit Voltage from the main circuit (Red) and from the measurement sensor (Blue) vs temperature difference (˚C). The mathematical relationship is also shown.

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Variation of Short-Circuit Current and Internal Resistance with Temperature

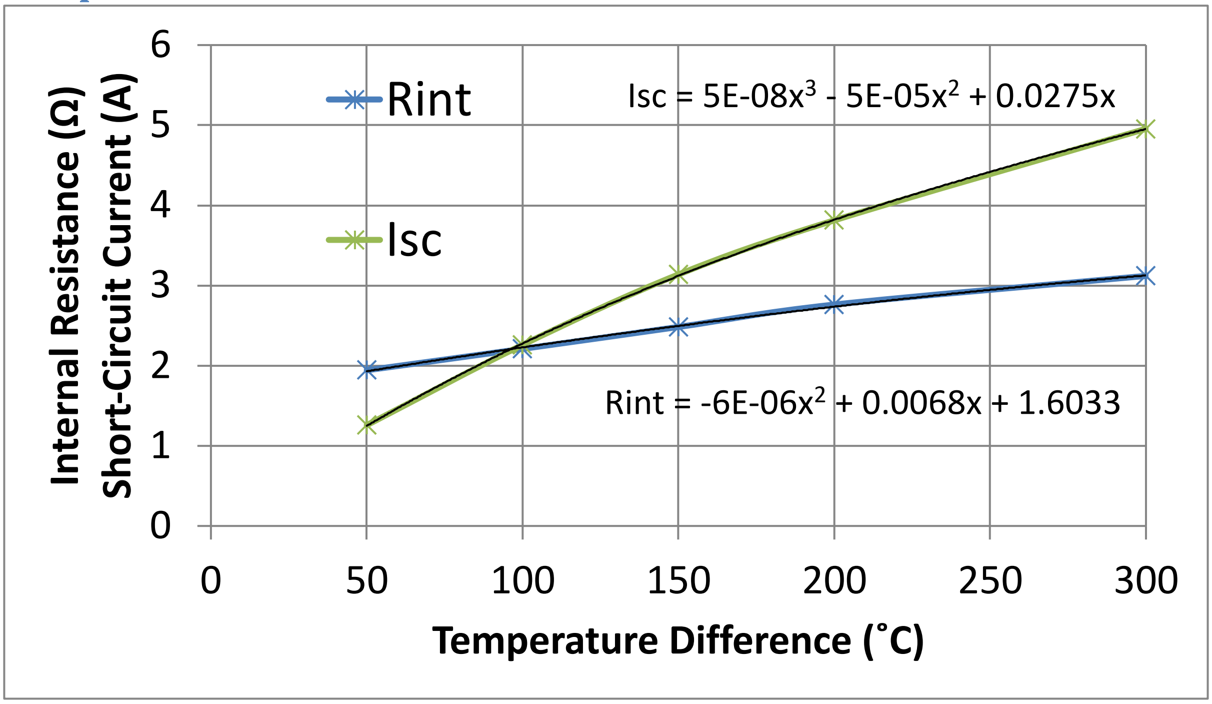

Figure 5 Short-circuit Current (Green) and Internal Resistance (Blue) of the main circuit vs temperature difference (˚C). The mathematical relationship is also shown.

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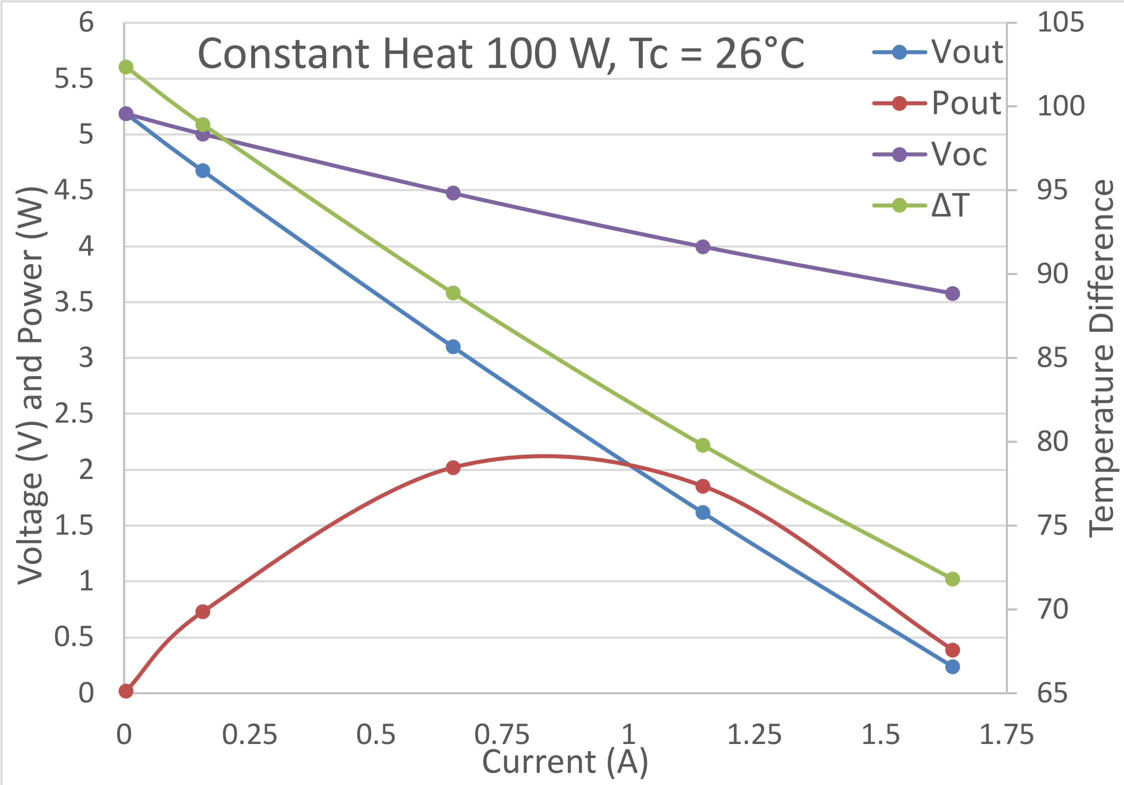
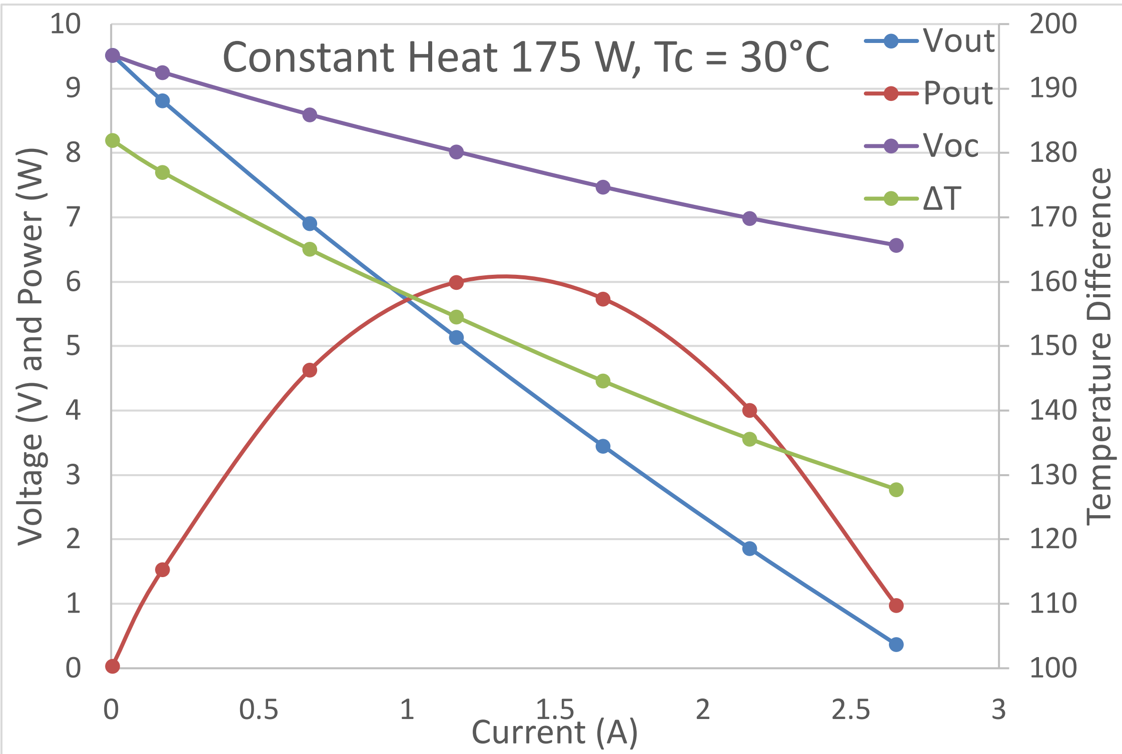
Constant Temperature Difference TEG Characteristics





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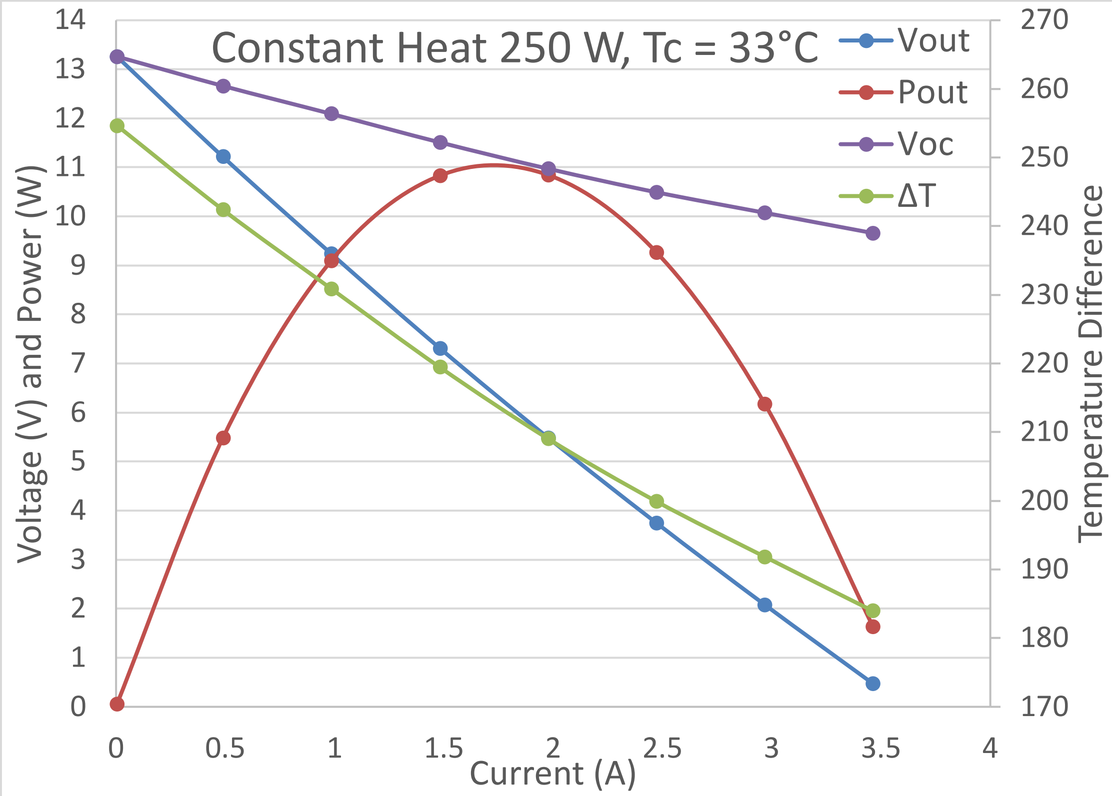

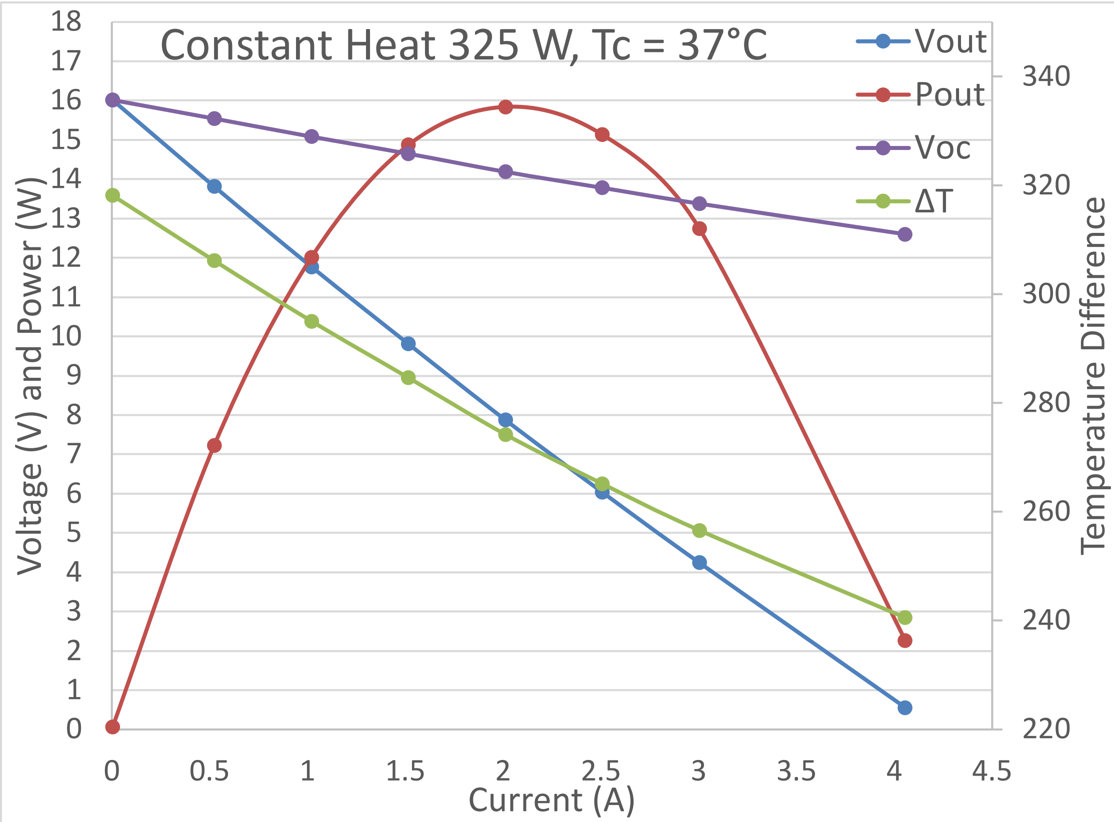

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Figure 6 Electrical characteristics for constant heat through the TEG. The temperature difference varies depending on the effective thermal resistance of the TEG. Voc is not measured and related to ΔT.

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Mounting Considerations

In order to get the best possible performance from the monTE ™ range of thermoelectric generators correct mounting of the device in the thermal system is essential. The following general guidelines should be followed:

- The hot- and cold-side heat exchangers should be flat (< 0.05mm) and polished for heat transfer (roughness < 1µm). Both surfaces should be parallel to one another.
- The recommended clamping pressure is 1.1MPa (175kg for a 40x40mm module)
- The clamping force should be applied evenly across the surface of the module. The use of Belleville or Thackery washers is recommended for torqued fixings to ensure the clamping force does not vary over the operating temperature range of the heat exchangers.
- Avoid introducing thermal short-circuits with the clamping mechanism. This may substantially reduce module power output and decrease system efficiency.
- Graphite coating offers the best long-term performance since it does not dry out at high temperature. Modules are available without a graphite coating if thermal grease is to be used. This offers a slight (< 3%) reduction in output power but with a half the clamping pressure.
- Gap fillers with a thermal conductivity of < 2W/m.K are not recommended and are likely to lead to significantly reduced output power.

Typical Applications

The monTE ™ range of thermoelectric power generation (TEG) modules is intended for use where high power output is required when the cold-side temperature is higher than for typical TEG systems. The modules also feature a continuous hot-side maximum temperature of up to 340°C with short-term transients of up to 400°C. Typical applications include:

- **Automotive:** exhaust gas energy recovery systems,
- **Domestic:** direct-contact stove power generators,
- **Industrial and Aerospace:** radiant heat or exhaust systems,
- **Space:** Radioisotope Thermoelectric Generator (RTGs),
- Other combustion-type appliances.
- The temperature sensing circuit can also be used for TEG condition monitoring.

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monTE ™ Temperature Sensing

The two central wires of the monTE ™ device allow to indirectly obtain useful information about the temperature difference across the device and its actual open-circuit voltage.

An internal temperature sensing circuit is contained within each module. This does not affect normal module operation if left open-circuit.

The voltage provided, when measured with a high-impedance circuit and scaled accordingly as per Fig. 4, allows measurement of the temperature difference across the device and the voltage that would be provided by the device in open-circuit.

When the monTE ™ device is used in conjunction to a compatible TCS power converter an enhanced Maximum Power Point Tracking (MPPT) algorithm will be automatically selected that can increase system efficiency and energy output. This algorithm can also protect the monTE ™ module if excess operating temperature is detected.

The internal circuit is also useful in heat pumping (Peltier cooling) mode.

Thermal Cycling Test

The monTE ™ device was tested under thermal and electrical cycles for 30h of continuous operation. The hot-side temperature was cycled between 75 and 235 ˚C. The electrical load was varied between open-circuit and short-circuit conditions.

During this test, the variations recorded between maximum and minimum values obtained at identical thermal conditions are:

	Open-Circuit Voltage	Short-Circuit Current	Maximum Power
ΔT = 50˚C	0.53%	0.25%	1.35%
ΔT = 100˚C	0.30%	0.31%	0.59%
ΔT = 150˚C	0.40%	0.48%	0.46%
ΔT = 200˚C	0.05%	0.72%	0.19%

It should be noted that during the test performance did not degrade. Some values were greater during later tests.

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Individual I-V,P Characteristics at Constant ΔT

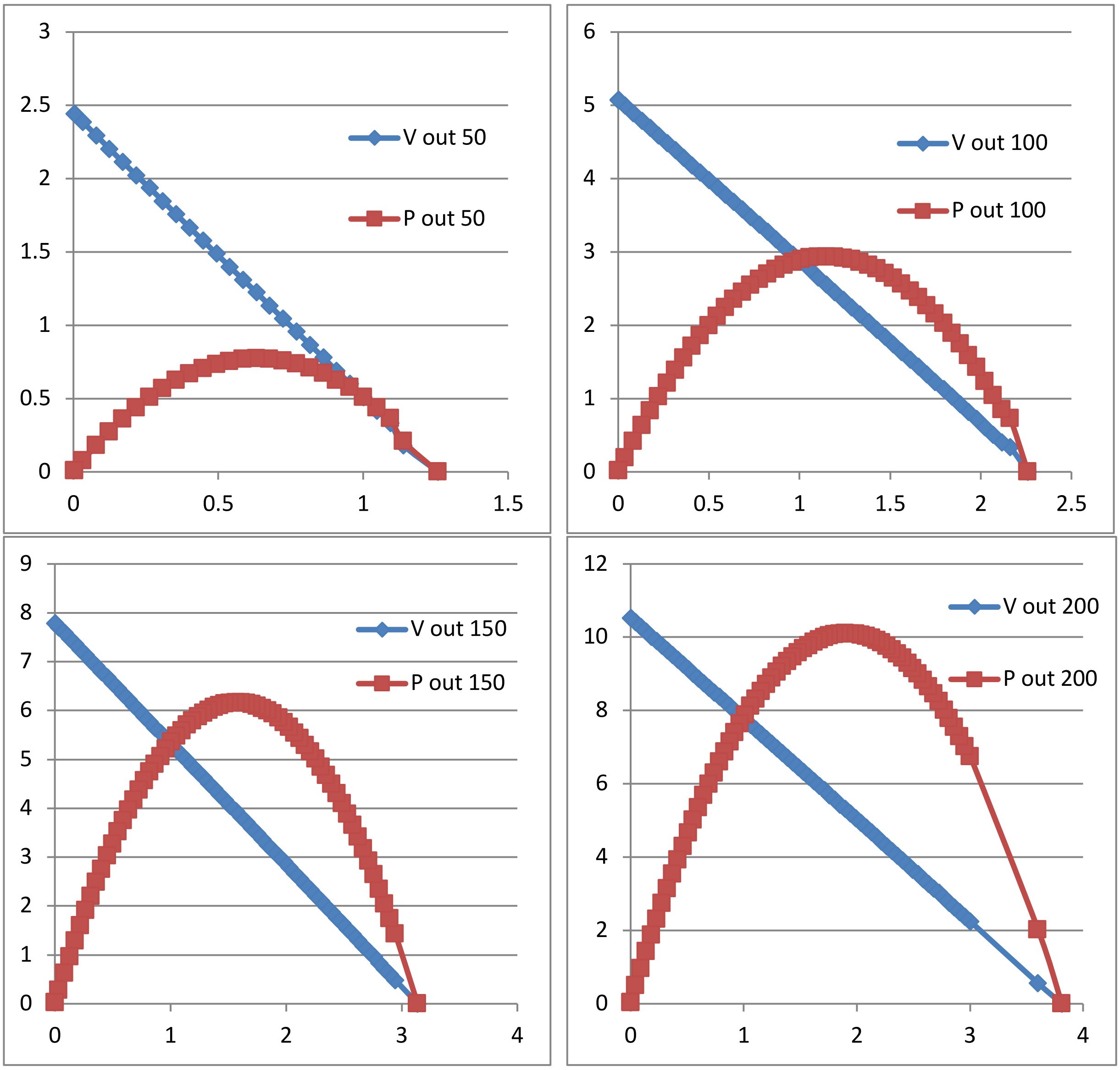

Figure 7 Individual plots for ΔT = 50, 100, 150, 200 degrees Celsius. Voltage (V, Blue) and Power (W, Red) versus Current (A).

These data were measured on TCS automated test measurement system for thermoelectric devices. TCS cannot guarantee that same performance will be obtained on the customer's system. TCS reserves the right at any time without notice to change any specification and performance is subject to change without prior notice. TCS does not assume any responsibility for use of any device described. This TCS product is not authorised for use as critical component in life support devices.

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