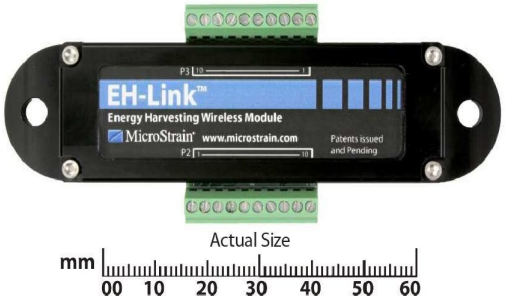
TN-W00XX
Technical Note

EH-Link®



-Preliminary-

Thermoelectric Powered Technical Note

Overview

The EH-Link™ wireless node is a self powered sensor, harvesting energy from ambient energy sources. EH-Link™ is compatible with a wide range of generator types, including piezoelectric, electrodynamic, solar, and thermoelectric generators. In addition to multiple harvesting inputs, the EH-Link features an on-board triaxial accelerometer, relative humidity sensor, temperature sensor, and signal conditioning for a Wheatstone bridge which is compatible with strain gauges, load cells, torque sensors, pressure transducers, and magnetic sensors, all in a miniature package.

This technical note describes the use of EH-Link powered by a Peltier type thermoelectric generator at various temperature differential conditions.

Powering a Wireless Sensor from Thermal Energy

The use of thermoelectric technology as a means of energy generation is dependent on a temperature gradient between the surface that energy is to be harvested from, and ambient air temperature. The energy produced may be in the range of a few tens of microwatts to hundreds of milliwatts depending on the size and specification of the Peltier or thermopile device, and the temperature differential applied across it. Maintaining a temperature differential across the harvester is dependent on airflow, without which the 'hot side' and 'cold side' temperatures will eventually equiliberate due to thermal conduction, and no energy will be generated.

The EH-Link's ultra low voltage input circuitry will accumulate energy produced by a small Peltier device until enough power is available to support a measurement and transmission of sensor data. The thermal harvester will charge an internal capacitor until it reaches the operating threshold voltage. Once it reaches this value, the sensors will be sampled and data transmitted. The sensor will continue to transmit at its pre-programmed sampling interval until the internal capacitor voltage reaches the lower cutoff threshold of operation. Then it will charge back up and repeat the above described cycle. If the input power is greater than that required of the electronics at its sample rate, the unit will continuously transmit data.

EH-Link Starter Kit Thermoelectric Generator (TEG) Harvester

The EH-Link Starter Kit ships with a TEG harvester (Fig 1). The TEG harvester is comprised of a single off-the-shelf Peltier cooler device, mounted in a magnetic attach base with a bolted on heat sink.

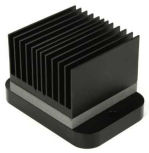
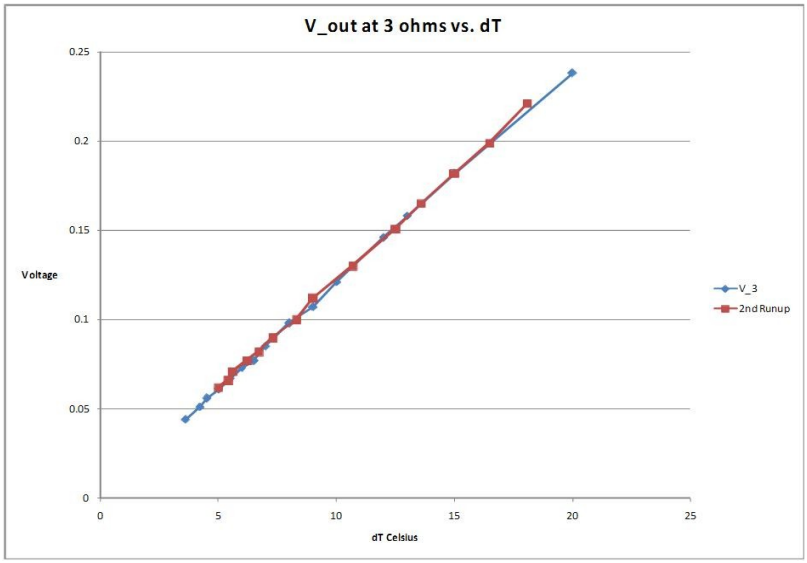


Fig. 1

The typical output voltage versus temperature differential is shown in the graph below.



Functional thresholds using a TEG with an EH-Link

With the TEG sitting on a variable heat source, differential temperature was measured using an Agilent U1242A multimeter (Fig. 2), which has facility for 2 type K thermocouples. The mounting base and the heat sink were measured and the difference monitored while adjusting the heat source temperature. The differential temperatures were noted at the points of intermittent and continuous operation at different sample rates. The results are shown in table 2 below. Above 128 samples per second, continuous operation can not be achieved, however bursts of 1024 samples are possible in intermittent mode when the EH-Link is configured for higher data rate settings. Longer bursts can be accomplished by adding a large external capacitor to the EH-Link “SuperCap” terminals. Adding large capacitors will also increase the charge time before operation starts.

Figure 2. Differential Thermometer

Condition	Measured dT (Celsius)	Operation
Starting up from cold	5	Intermittent
Operating	8	Continuous 32 samples per second
Operating	16.5	Continuous 128 samples per second

Table 2. Functional Thresholds

Conclusion

The EH-Link has been demonstrated to capture and accumulate energy from relatively low temperature gradients, which allows for wireless sensors to be perpetually powered in applications where temperature gradients and minimal airflow exist.

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