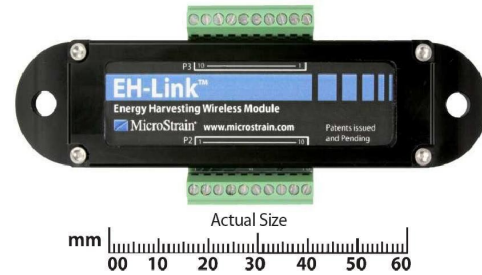


TN-W00XX

Technical Note

**EH-Link<sup>®</sup>**



-Preliminary-

## Indoor Solar 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 solar cell under typical indoor lighting conditions.

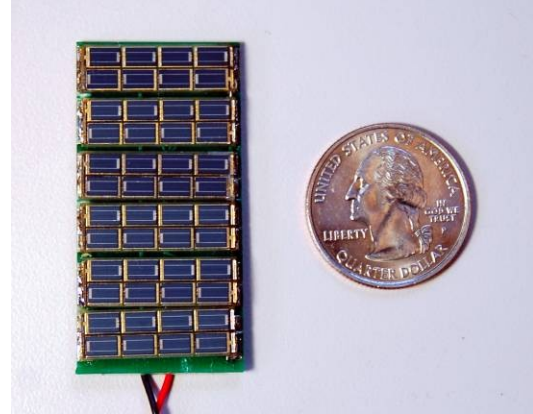
### Powering a Wireless Sensor from Indoor Light

The use of photovoltaic technology as a means of energy generation using *outdoor* light is common as there is high energy content in sunlight. However, indoor fluorescent and incandescent lighting produces many orders of magnitude less power than that of typical outdoor light. The energy produced (typically 10's to 100's of microwatts) from indoor light is too low to instantaneously power a wireless sensor node. However, the EH-Link's ultra low power input circuitry will slowly accumulate the minute amount of energy produced by a small solar cell until enough power is available to support a measurement and transmission of sensor data. The allowable interval between transmissions will be proportional to the energy content in source light.

The solar source will charge the 1000 microfarad input capacitor until it reaches approximately 5.4 volts, once it reaches this the sensors will be sampled and data transmitted. The sensor will continue to transmit at its preprogrammed sampling interval until the capacitor voltage reaches approximately 4.0 volts. 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 Solar Panel

The EH-Link Starter Kit ships with a solar panel (Fig 1). The solar panel is comprised of a number of high voltage micro solar cells connected in series. The open circuit voltage in full outdoor light for this cell is 32 V, and short circuit current under same conditions is approximately 4.0 mA. However, in indoor applications the typical output voltage and current is much lower. By using a high voltage stack of cells, along with a highly efficient step down converter, operation of EH-Link is supported by a wide range of varying light conditions.



**Figure 1. MicroStrain Indoor Solar Harvester**

## Light Intensities for Varying Sources

The units of light intensity used in this technical note are lux. As can be seen from the below chart, the available energy can vary greatly depending on location and type of light source.

Condition	Low Range (lux)	High Range (lux)
Direct Sunlight	30000	130000
Cloudy Outdoors	10000	30000
Dim Outdoors (sunrise/sunset)	400	10000
Bright Indoors (Close to light source)	1000	5000
Normal Indoors (Typical Office Lighting)	300	1000
Dim Indoors (Hallways/Bathrooms)	100	400
Dark Indoors (Corner of room away from light source)	50	100
Very Dark	10	50
Pitch Black	0	10

**Table 1. Range of Light Intensities**

Typically, the minimum light level to charge an EH-link is about 100 Lux, so all conditions except the last two (red text in the above table) are generally supported with the EH-Link.

## Time to Charge Survey using an EH-Link

A survey of EH-Link performance was tested at various light levels in an office environment. The light intensity (in lux) was recorded with a lux meter (Figure 3). The lux level and amount of time to accumulate enough energy (4.2 mJ) to support recording and transmission of multiple sensor points data were recorded (Table 2).



Figure 2. lux meter

Condition	Measured Light Intensity	Time to Full Charge (s)
Corner of a room 10 feet from window, low light condition	100	282
Typical Office Fluorescent (5 feet from light source)	480	132
Outdoor Light	30,000	2.2

Table 2. Time to Full Charge For Varying Light Source Intensities

## Conclusion

The EH-Link has been demonstrated to capture and accumulate energy from extremely low light levels, which allows for wireless sensor to be perpetually powered on low ambient light levels.