

## 2.4 GHz Energy Harvesting Wireless Sensor Node



### Features & Benefits

- no batteries required, EH-Link™ is self powered from high impedance AC and DC sources or low voltage DC sources as low as 20 mV
- out-of-the-box wireless sensing capability for most analog sensors
- 2.4 GHz direct sequence spread spectrum IEEE 802.15.4 radio operates in license free band world wide
- communications range up to 70 m line of sight
- supports auxiliary storage options such as supercapacitors or rechargeable thin film batteries (TFB)
- supports multiple nodes at sample rates up to 2048 Hz

### Applications

- environmental monitoring
- conditioned based maintenance (CBM)
- structural health monitoring (SHM)
- HVAC
- building automation
- monitoring industrial processes
- cold storage monitoring

### Sensor Support

- external strain gauges
- bridge sensors (pressure sensors, load cells, etc.)
- pulsed DC excitation pin to provide power for external sensors
- onboard relative humidity & temperature sensor
- onboard three axis accelerometer

### Introduction

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 generators, and thermoelectric generators.

In applications with vibrating machinery or structures under load, the EH-Link™ can be self powered from a tiny generator. The EH-Link™ can operate from high impedance AC or DC sources, in the range of 5.0 V to 20 V.

### System Overview

The ultralow voltage (ULV) input of the EH-Link™ allows powering from Peltier Thermoelectric Generators (TEGs), or thermopiles. This ULV input can power the EH-Link™ from as low as 0.02 Vdc and up to 0.6 Vdc making the wireless sensor node operable from thermal gradients below 8 °C with TEGs.

Using the high impedance 5-20V harvester input, the EH-Link™ can also operate in ambient light levels well below that required for solar cell use with traditional electronics.

Sophisticated energy conversion and conservation methods allow the EH-Link™ to operate with a fraction of the power normally required for a wireless sensor node.

The EH-Link™ wireless sensor node is versatile and is designed to operate as part of MicroStrain's 802.15.4 wireless sensor network. Each node in the wireless network is assigned a unique 16 bit address.

The EH-Link™ Pioneer Kit, MicroStrain part number 6320-0041 includes 1 EH-Link™ wireless sensor node, 1 solar demo harvester and 1 TEG demo harvester, enabling users to set up an Energy Harvesting demo in minutes.

### Harvester Support

#### Standard Voltage Input

- piezoelectric
- inductive
- EM field
- AC or DC sources that produce > 5 V instantaneous open circuit voltage

#### Ultralow Voltage Input

- thermoelectric generators
- low voltage solar cells
- low voltage DC sources (as low as 20 mV)

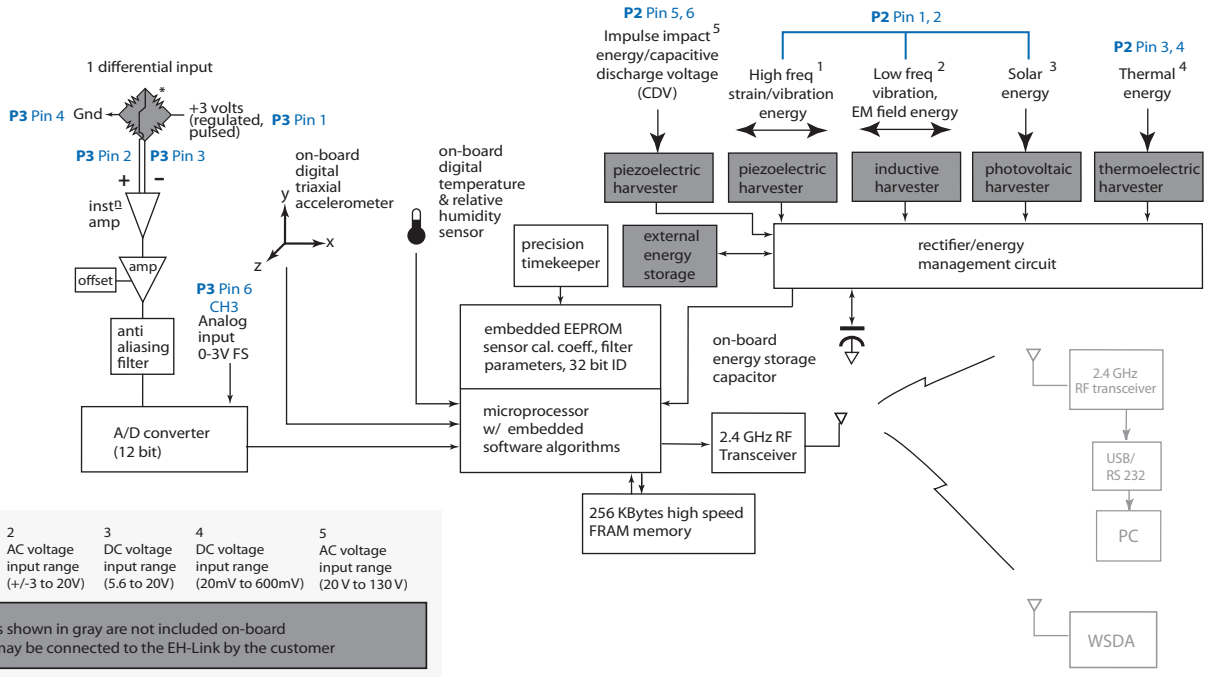


**Specifications**

Energy harvester inputs: Wide range voltage (WRV) Capacitive discharge voltage (CDV) Ultralow voltage (ULV)	5-20V peak AC or DC (piezoelectric, electrodynamic, photovoltaic, electromagnetic) 20-130 VAC (pulsed piezoelectric) 20-600 mVDC (thermoelectric, Peltier, thermopile)
Embedded sensors	onboard triaxial accelerometer, relative humidity and temperature sensor, external single channel differential (Wheatstone bridge) input
DC bridge excitation	regulated +3.0 volts DC at 50 mA maximum (pulsed to sensors)
Analog to digital (A/D) converter	12 bit
Accelerometer range	± 16 g
Accelerometer resolution	4 milli g
Wireless sample rates	1 sample/hour to 2048 Hz, with single RF channel
Sample rate stability	± 3 ppm
Radio frequency (RF) transceiver carrier	IEEE 802.15.4, open communication architecture, 2.4 GHz direct sequence spread spectrum, license free worldwide (2.405 to 2.480 GHz) - 16 channels. radiated power 0dBm (1mW)
Range for bi-directional RF link	70 m line-of-sight with radiated transmit power level of 0 dBm (1 mW)
Energy use	startup: 12 µJ; measurement mode: accel - 105 µJ/measurement, relative humidity sensor - 105 µJ/measurement, Wheatstone bridge - 168 µJ/measurement; data transmission: 92.4 µJ/packet
Operating temperature	-20 °C to +60 °C
Operating humidity	0-95% non-condensing
Maximum acceleration limit	500g standard
Dimensions/weight*	standard configurations: 88 mm x 39 mm x 16 mm , 26 grams
Software	<b>Node Commander®</b> Windows XP/Vista/7 compatible
Compatible base stations	<b>USB, WSDA®, WSDA® -Base</b>

Patents issued and pending.

\*For dimensioned print go to [www.microstrain.com](http://www.microstrain.com)



- 1 AC voltage input range (+/-3 to 20V)
- 2 AC voltage input range (+/-3 to 20V)
- 3 DC voltage input range (5.6 to 20V)
- 4 DC voltage input range (20mV to 600mV)
- 5 AC voltage input range (20V to 130V)

Items shown in gray are not included on-board but may be connected to the EH-Link by the customer

	1	2	3	4	5	6	7	8	9	10
<b>P3</b>	VXC	IN +	IN -	GND	G1 sense	CH3	GND	config	reserved	reserved
<b>P2</b>	PZ1	PZ2	ULV +	ULV -	CDV -	CDV +	Supercap +	GND	SC-HV +	GND

\* Optional on-board bridge completion



**Power Matrix**

Sample Rate [Hz](Eeprom14)	Buffer Count (Eeprom40) [Samples]	Bridge (1k)	Ain	%RH	Temp	AccelA	AccelB	AccelC	Din	Current [uA]	Power [mW]
1, EEPROM Value = 12	1	x								32	0.24
	1	x		x						228	1.71
	1	x		x	x					642	4.815
	1					x	x	x		288	2.16
	1								x	198	1.485
	1	x	x	x	x	x	x	x	x	740	5.55
256, EEPROM Value =4	48	x								644	4.83
	48	x		x						1100	8.25
	48	x		x	x					1456	10.92
	48					x	x	x		1133	8.4975
	48								x	381	2.8575
	48	x	x	x	x	x	x	x	x	2471	18.5325
64, EEPROM Value = 6	48	x								172	1.29
	48	x		x						440	3.3
	48	x		x	x					881	6.6075
	48					x	x	x		365	2.7375
	48								x	102	0.765
	48	x	x	x	x	x	x	x	x	1320	9.9
16, EEPROM Value = 8	48	x								45	0.3375
	48	x		x						256	1.92
	48	x		x	x					680	5.1
	48					x	x	x		170	1.275
	48								x	28	0.21
	48	x	x	x	x	x	x	x	x	876	6.57
1, EEPROM Value = 12	5	x								14	0.105
	10	x		x						180	1.35
	15	x		x	x					351	2.6325
	15					x	x	x		270	2.025
	5								x	179	1.3425
	40	x	x	x	x	x	x	x	x	720	5.4

Readings are taken at 7.5 VDC

