



## EH300/EH301 EPAD® ENERGY HARVESTING™ Modules

### GENERAL DESCRIPTION

EH300/EH301 Series EPAD® ENERGY HARVESTING™ Modules can accept energy from many types of electrical energy sources and store this energy to power conventional 3.3V and 5.0V electrical circuits and systems. EH300/EH301 Series Modules are completely self-powered and always in the active mode. They are intended for low power intermittent duty cycle sampled data or condition-based monitoring/extreme lifespan applications. These Modules can accept instantaneous input voltages ranging from 0.0V to +/-500V AC or DC, and input currents from 200nA to 400mA from energy harvesting sources that produce electrical energy in either a steady or an intermittent and irregular manner with varying source impedances. EH300/EH301 Series Modules condition the stored energy to provide power at output voltage and current levels that are within the limits of a particular electronic system power supply specifications. For example, 1.8V and 3.6V is a useful voltage range for many types of I.C. circuits such as microprocessors.

EH300/EH301 Series Modules are designed to continuously and actively operate to capture, accumulate and conserve energy from an external energy source. Each individual EH300/EH301 Series Module is set to operate between two supply voltage thresholds, +V\_low DC and +V\_high DC, corresponding to the minimum (VL) and maximum (VH) supply voltage values for the intended application. When an energy source starts to inject energy into the inputs of an EH300/EH301 Series Module in the form of electrical charge impulses, these charge packets are collected, accumulated and stored onto an internal storage capacitor bank. For most common energy harvesting applications, the electrical energy charge packets arrives in the form of input voltage spikes that are uncontrolled and unpredictable. Often these cover a wide range of voltages, currents and timing waveforms. EH300/EH301 Series Modules are designed to accommodate such conditions with exceptional efficiency and effectiveness. As an example, EH300 Series Module can cycle within 4 minutes at an average input current of 10 µA and within 40 minutes at an average input current of just 1.0 µA.

### ORDERING INFORMATION

Part Number	Description
EH300 EH300A	4.6 mJ Module / 1.8V to 3.6V operation 30 mJ Module / 1.8V to 3.6V operation
EH301 EH301A	8.3 mJ Module / 3.1V to 5.2V operation 55 mJ Module / 3.1V to 5.2V operation
EHJ1C EHJ2C	6 inch cable / J1connector (Input) 6 inch cable / J2 connector (Output)

Note: EH300A and EH301A are high energy output versions

### SPECIFICATIONS

#### EH300/EH300A/EH301/EH301A

Input/Output Electrical Specifications @25° C

- Max. Instantaneous Input Voltage: +/- 500V
- Max. Instantaneous Input Current: 400mA
- Max. Input Power: 500mW
- Min. Input: 0.0V@1nA
- Min. Charging Input (Max. Power Dissipation):

- EH300 4.0V@200nA(800nW)
- EH301 6.0V@300nA(1800nW)
- EH300A 4.0V@500nA(2µW)
- EH301A 6.0V@500nA(3µW)

- Internal Voltage Clamp: 7.0V@10mA
- Max. Output Current: 1 amp
- Operating Life Cycles: Virtually unlimited
- Logic Compatibility: CMOS

#### EH300

- VL=1.8V VH=3.6V
- Useful Energy Output@ 4.6mJ
- Output On-Time Rating: 68msec@25mA

#### EH300A

- VL=1.8V VH=3.6V
- Useful Energy Output@ 30mJ
- Output On-Time Rating: 75msec@150mA

#### EH301

- VL=3.1V VH=5.2V
- Useful Energy Output@ 8.3mJ
- Output On-Time Rating: 80msec@25mA

#### EH301A

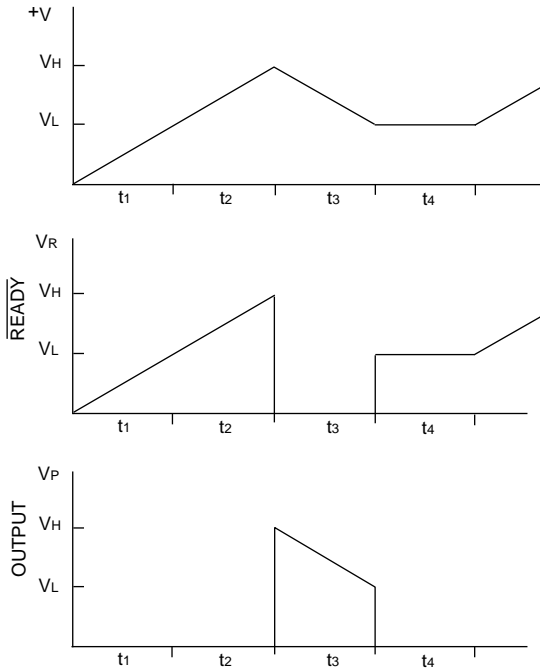
- VL=3.1V VH=5.2V
- Useful Energy Output@ 55mJ
- Output On-Time Rating: 88msec@150mA

### FUNCTIONAL DESCRIPTION

EH300/EH301 Series Modules' voltage on the onboard storage capacitor bank is +V, which is also the positive supply voltage switched to power the output power load. Initially, +V voltage on an EH300/EH301 Series Module starts at 0.0V. During the initial charge period, +V starts charging from 0.0V. The internal circuit of the Module monitors and detects this +V voltage. When +V reaches VH, the Module output (VP) is enabled and turned to the ON state and is then able to supply power

to a power load, such as a microprocessor and/or a sensor circuit. The amount of useful energy available is a function of the capacity of the storage capacitor bank. Meanwhile, an EH300/EH301 Series Module continue to accumulate any energy generated by external energy sources. If external energy input availability is high, output VP remains in an ON state continuously, until such time that external energy availability is lower than the power demand required by the power load. As external energy input exceeds power loading, +V increases until internal voltage clamp circuits limit it to a maximum clamp voltage.

### EH300/EH301 Waveforms



During normal operation, as power is drawn from an EH300/EH301 Series Module, +V decreases in voltage. When +V reaches  $V_L$ , output VP switches to an OFF state and stops supplying any further power to the power load. With built-in hysteresis circuits within the Module, VP now remains in the OFF state even when the external energy source starts charging the capacitor bank again by importing fresh new impulses of electrical energy. Once  $V_H$  level is reached again, output VP is then turned to the ON state again. Hence +V voltage cycles between  $V_H$  to  $V_L$  voltage levels and then to the OFF state. When in the ON state, VP can supply up to 1A of current for a limited time period as determined by the stored useful energy and the energy demand by the power load. An optional input/output pin VR functions as VP on/off control (external input through 1KOhm) or as READY logical control (output) signal preceding output VP switching.

Input energy charging times  $t_1$  and  $t_2$  are limited by input energy available minus energy loss by an EH300/EH301 Series Module. The energy output time period  $t_3$  is determined by the rate of energy used by the power load as a function of energy stored. Low input energy hold time  $t_4$  is typically many orders of magnitude greater than the sum of  $t_1$ ,  $t_2$  and  $t_3$ .

### Mechanical Specifications

- Outline Dimensions: W x L x H : 0.55 in. x 2.00 in. x 0.70 in.
- 4 Mounting Holes: 0.085 in. diameter
- Weight: 0.5 ounce (14 grams) nominal

### EH300/EH301 Top View

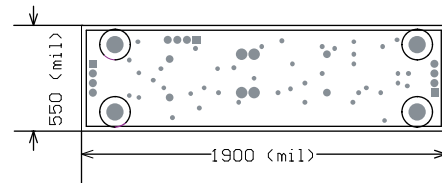


Socket Adapter Cable:

J1: Hirose Socket, 2 Position P/N : DF13-2S

J2: Hirose Socket, 4 Position P/N : DF13-4S

### Module Dimensions



### Environmental Specifications

- Leadfree (ROHS) compliant
- Operating Temperature Range: 0 to 70° C
- Max. Average Operating Temperature : 50° C
- Storage Temperature: -40 to +85° C
- Humidity: To 90% (no condensation)
- Protection: Conformal and Epoxy coated

### Initial Setup & Calibration

EH300/EH301 Series Modules are setup and calibrated at the factory to standard specifications and settings. No user setup is required. Optional user control signal and connection to external capacitor or battery storage banks are available at the output port. All EH300/EH301 Series Modules are shipped Ready to Use.

### EH300/EH301 Typical Application

