ADEH-MM-A

Features

- Low voltage startup[1]
  V_{in}=430mV (Power Supply)
  V_{in}=430mV (TEG: ADPD-A)
- Fixed output voltage
  V_{out}=3.3V
- Auxiliary LDO output
  V_{LDO}=3.0V
- Power output
  P_{out} =500mW (V_{in}=2.5V)
  $P_{out\ LDO}$ =30mW (V_{in}=2.5V)
- On-board 30mF super capacitor maintaining V_{out}
- MPPT configuration resistors
- On –board digital power meter (I2C output)
- Breadboard compatible form factor (0.1” pitch)
- Edgeplated connections for easy prototyping
- Additional through-hole solder pads for direct connection of TEG or solar cell wires
- Optional board to board connector on the bottom side (Plugs and receptacles available separately)

Applications

- Main or Auxiliary power for embedded applications featuring low power MCUs
- Low Power Wireless Transceivers
- Energy Harvesting Sensors

Description

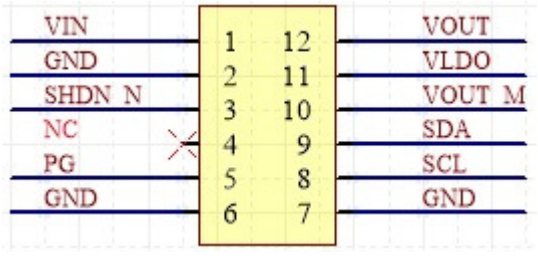
The ADEH-MM-A is a small form factor energy harvester evaluation board targeting low power embedded applications where the main or auxiliary power requirements are fulfilled by means of thermoelectric generator(s) (TEGs) or a photovoltaic device. Low voltage start-up capability enable harvesting operation from high impedance, low voltage ambient sources.

The evaluation board consists of two main blocks:

- Boost MPPT DC-DC converter
- Power meter with digital output

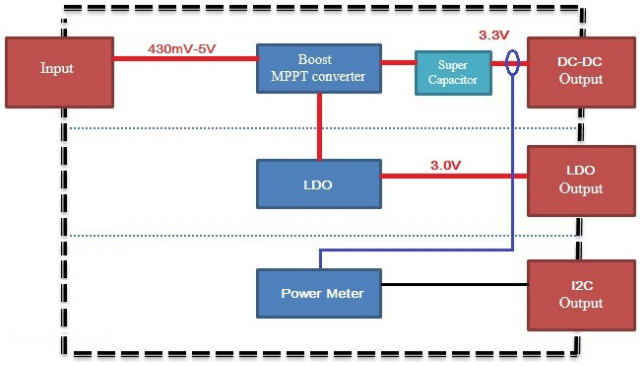
The ADEH-MM-A DC-DC output can be used for battery charging while the on-board LDO provides regulated voltage for low power microcontrollers or sensors. Additional benefit is the low standby current which is typically 10uA in shutdown mode.

Pinout



1: Startup time dependent on available input power and output load conditions. See application information.

Block Diagram



Pin Functions

VIN: Input Supply. Connect a TEG, Solar cell or power supply between this pin and GND. The length of the connection should be as short as possible. This pin has a 10µF decoupling capacitor.

GND: Small Signal and Power Ground for the module. The GND connections should be connected to the external system Ground using the lowest impedance path possible.

SHDN_N: Logic Controlled Shutdown Input. With SHDN open, the module is enabled by an internal 2MΩ pull-up resistor. The SHDN pin should be driven with an open-drain or open-collector pull-down and floated until the harvester has entered normal operation. Excessive loading on this pin may cause a failure to complete start-up. SHDN = Low: Harvester Disabled, SHDN = High: Harvester Enabled

NC: This pin is not connected to the internal circuitry of the module. Can be left open or tied to Ground.

PG: Power Good. This is an open-drain output where pull-down is disabled when VOUT has achieved 3.3V. The pull-down is also disabled while the module is in shutdown or start-up mode.

VOUT: Harvester module Output. This is the connection to the output of the main DC-DC boost converter. A 10µF ceramic and a 30mF super capacitor is connected internally between this pin and GND.

VLDO: LDO Regulator Output. A 4.7µF capacitor is connected internally between LDO and GND.

VOUT_M: Harvester module Monitored Output. This is the connection to the output of the main DC-DC boost via a 1 Ohm shunt resistor.

SDA: Serial Bus Data line of the on-board power meter. This is an I2C and SMBUS compatible bi-directional port. The module is configured as Slave at all times.

SCL: Serial Bus Clock line of the on-board power meter. This is an I2C and SMBUS compatible clock port. The module is configured as Slave at all times and requires external clock signal.

Absolute Maximum Ratings

V_{VIN}	-0.3 to 6	V
V_{VOUT}, V_{VOUT_M}	0 to 3.35	V
V_{SHDN_N}, V_{PG}, V_{LDO}, V_{SDA}, V_{SCL},	-0.3 to 6	V
Operating Temperature	-40 to 85	°C

Electrical Characteristics

V_{VIN}	0.42 to 5	V
V_{VOUT}, V_{VOUT_M}	3.3 ±1%	V
V_{VLDO}	3.0 ±0.5%	V
HIGH V_{SHDN_N}, V_{PG}, V_{LDO}, V_{SDA}, V_{SCL}	1.1	V
LOW V_{SHDN_N}, V_{PG}, V_{LDO}, V_{SDA}, V_{SCL}	0.3	V
Boost Converter Current Limit	0.5 ±2%	A
LDO Current Limit (V_{LDO} 0.5V Below Regulation Voltage)	12	mA
[1]Maximum Power Point Threshold (two additional pre-installed settings)	0.4 (2, 4)	V

[1]The MPP feature dynamically regulates the average inductor current of the Boost Converter to prevent the input voltage from dropping below the MPPC threshold (collapsing the source). When V_{VIN} is greater than the MPP Threshold voltage, the inductor current is increased until V_{VIN} is pulled down to the MPP Threshold set point. If V_{VIN} is less than the MPP Threshold voltage, the inductor current is reduced until V_{VIN} rises to the MPP Threshold set point.

Typical Performance Characteristics

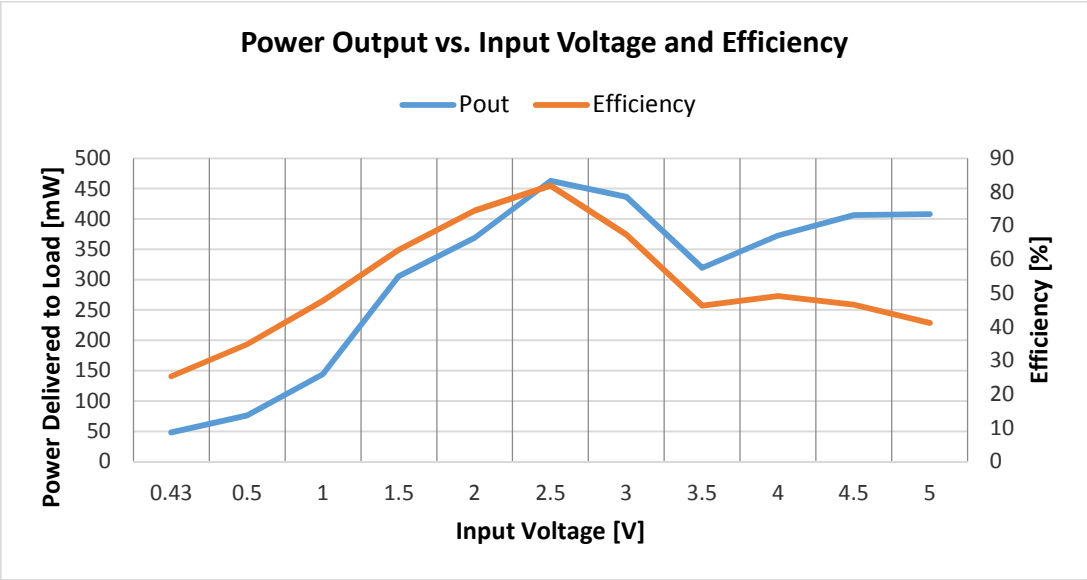


Figure 1. Power and Efficiency Performance vs. Input Voltage

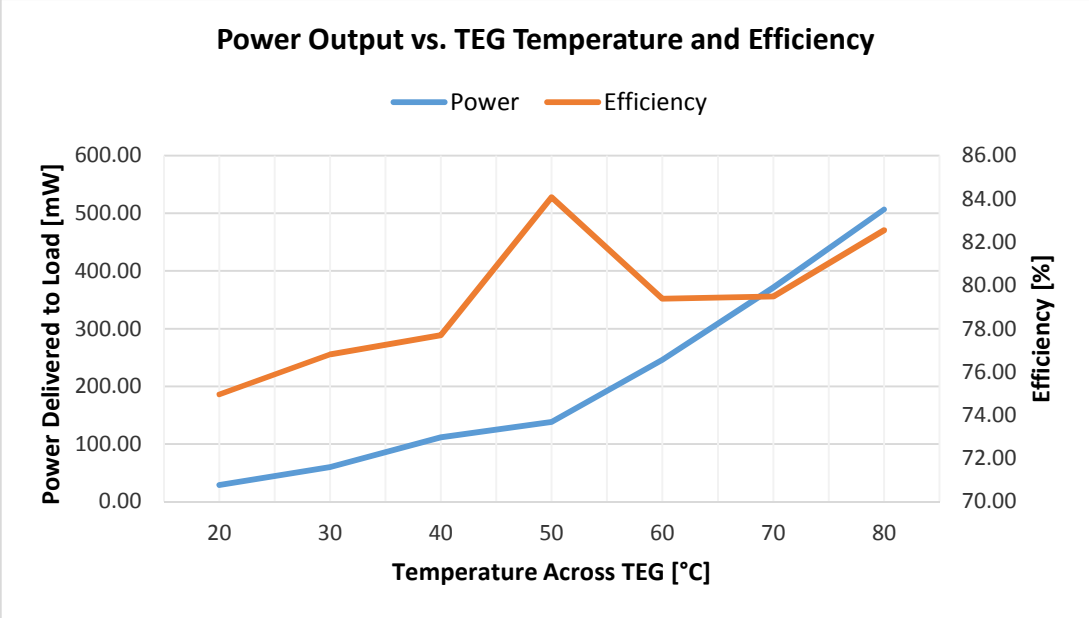


Figure 2. Power and Efficiency Performance vs. TEG Temperature

Application Information

Energy Harvesting

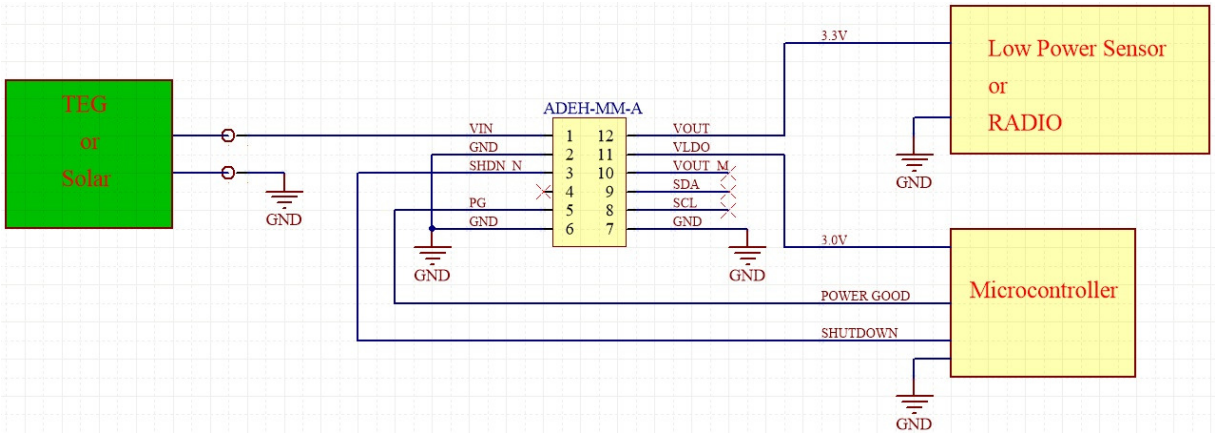


Figure 3. Simple Energy Harvesting Application

- **Maximum Power Point Tracking**

The maximum power point control circuit allows the user to set the optimal input voltage operating point for a given power source. The ADEH-MM-A-DS1 offers three pre-configured settings as shown in Figure 4. The user can select the optimal MPP Threshold voltage by removing and installing the 0 Ohm jumper in a different position on the PCB. The default jumper setting is 0.4V which is optimal for the ADPD-A TEG as a recommended companion product.

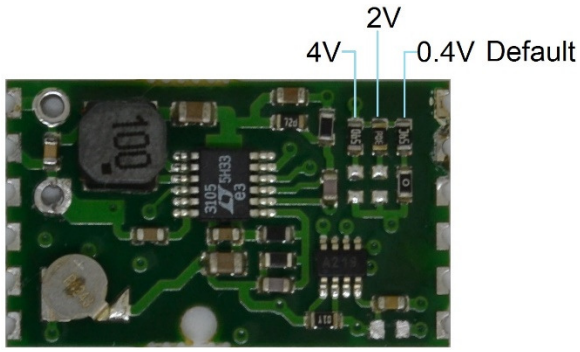


Figure 4. MPP Threshold Configuration Resistors

Power Monitoring Function

The ADEH-MM-A is equipped with an I2C compatible current shunt and power monitor device. The device monitors both shunt voltage drop and power supply voltage. The current monitor can be used without any programming if it is only necessary to read a shunt voltage drop and bus voltage with a default 12-bit resolution. In order to fully utilise the device's capability please refer to the INA219A datasheet.

The device can only be used in slave mode through the I2C pins and can be accessed at fixed address: 1000001 (41h)

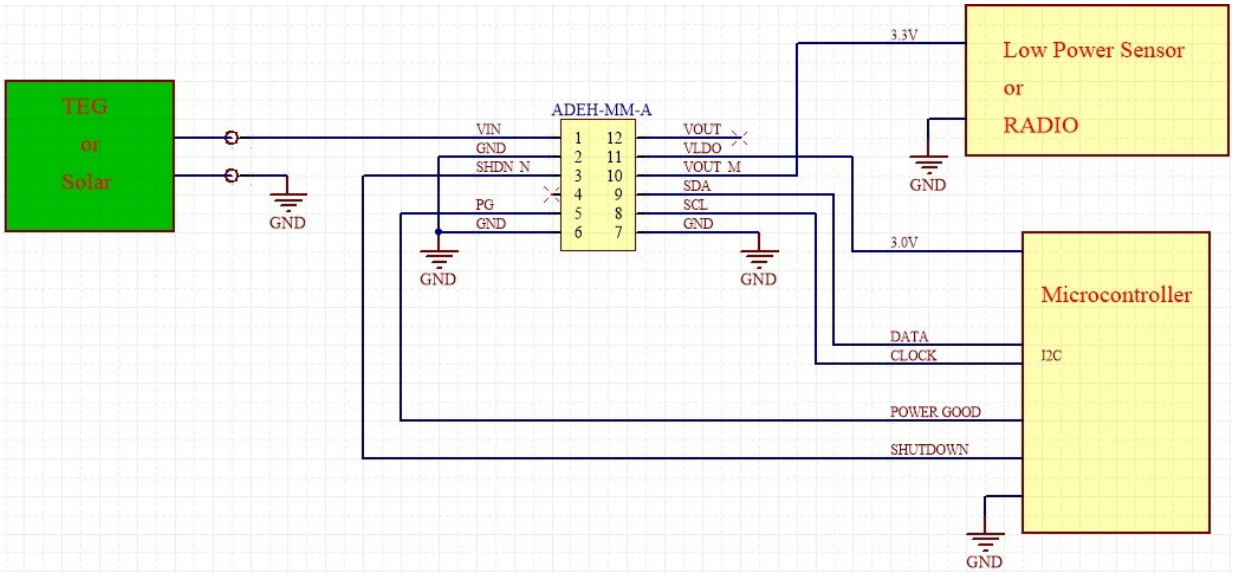


Figure 5. Energy Harvesting with Power Monitoring

Mechanical Information