Features

Switching Regulator

- Highly efficient energy harvester module
- Two SCP regulated outputs with enables
- Minimal number of external components
- Backup battery input
- Supports Li-on battery or super capacitor as energy storage
- Imminent shutdown warning signal
- -40°C up to +100°C operation without derating

RECOM
DC/DC Converter

REH-3.31.8

LGA Dual Output

3 YEAR warranty



Description

The REH-3.31.8 is dual output energy harvester module designed primarily for photo voltaic (PV) cells, but capable of running from other low voltage DC supplies delivering 50mV or more. This unique and compact (12.19 x 12.19 mm) module contains all the circuitry required to run a low power energy harvesting system, including a Maximum Power Point (MPP) tracking function for the PV cell. The user needs only to add the storage element (user selectable rechargeable battery or super capacitor) and connect the source to make it operational. Two short-circuit protected fixed voltage regulated outputs (1.8V and 3.3V) can be individually enabled/disabled. An imminent shutdown signal warns the application that there is not sufficient energy being harvested to maintain the output voltage and the module is about to power down. After start-up, the harvested energy will be stored on the storage device until the Vready voltage is reached, then the regulated outputs (if enabled) will be switched on, powered from the storage element.

Selection Guide

Part Number	Input Voltage Range (1) [VDC]	Output Voltage 1 [VDC]	Max. Output Current 1 [mA]	Output Voltage 2 [VDC]	Max. Output Current 2 [mA]
REH-3.31.8	0.05 - 5	3.3	80	1.8	20

Notes:

Note1: Cold start operation from 0.38VDC

Model Numbering

REH-3.3 1.8

Output Voltage 1 — Output Voltage 2

Specifications (measured at Ta= 25°C, full load)

BASIC CHARACTERISTICS				
Parameter	**Condition**	**Min.**	**Typ.**	**Max.**
Input Voltage Range	cold start threshold	0.38VDC		5VDC
	normal operation	0.05VDC		
Absolut Max. Input Voltage				5.5VDC
Input Current	min. Vin			100mA
No Load Power Consumption			3µW	
Internal Operating Frequency		10MHz		
Output Ripple and Noise				10mVp-p

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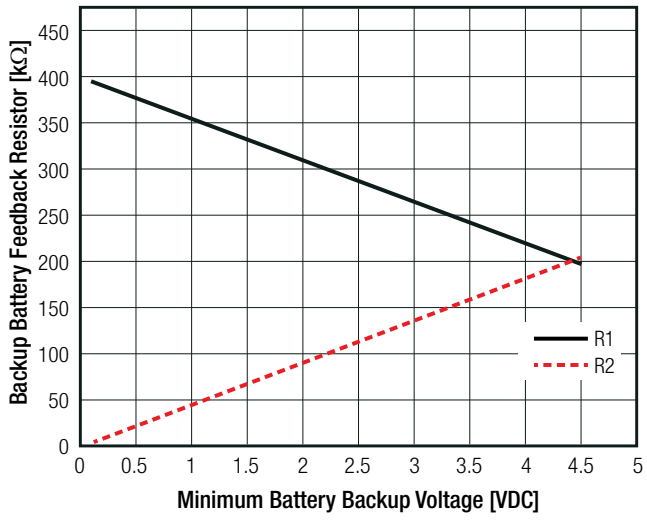
Specifications (measured at Ta= 25°C, full load)

BASIC CHARACTERISTICS (continuous)

Parameter	Condition		Min.	Typ.	Max.
$V_{STORAGE}$ Voltage Range	rechargeable battery		2.2VDC		4.5VDC
	super capacitor		0VDC		
V_{BACKUP} Voltage Range	battery backup voltage		0.6VDC	3VDC	5VDC
V_{REF} Voltage			2VDC	2.2VDC	2.5VDC
SHDN delay	SHDN asserted LOW before imminent shutdown		400ms	600ms	
FB_{VBKP1} (Backup battery feedback voltage)	see below graph		0.15VDC		V_{REF}
3.3V_{OUT} Output Voltage Range	full load		3.135VDC	3.3VDC	3.465VDC
3.3V_{OUT} Output Current Range			0mA		80mA
1.8V_{OUT} Output Voltage Range	full load		1.71VDC	1.8VDC	1.89VDC
1.8V_{OUT} Output Current Range			0mA		20mA
CTRL ON/OFF 3.3V_{OUT}	Pin= EN_3.3VOUT	logic high= enable	1.7VDC	V_{REF}	V_{REF}
		logic low= disable	-0.25VDC	0VDC	0.25VDC
CTRL ON/OFF 1.8V_{OUT}	Pin= EN_1.8VOUT	logic high= enable	1.75VDC	$V_{STORAGE}$	$V_{STORAGE}$
		logic low= disable	-0.25VDC	0VDC	0.25VDC
$V_{STORAGE}$ LOW Thresholds				3.6VDC	
$V_{STORAGE}$ READY Thresholds	rechargeable battery			4VDC	
	super capacitor			3.9VDC	
BACKUP LOW Thresholds	set by external resistor (refer to below graph)				
MPP Tracking Ratio	related to open circuit PV voltage			75%	
PV input open circuit sensing period				5sec	

Minimal V_{BACKUP} Battery Voltage vs. $FB_{VBACKUP}$ resistor

The calculated value for trim resistor in below example are according to standard E96 value; therefore, the specified voltage may slightly vary.



Example:

To set up V_{BACKUP} at ~2.2VDC

R1= 301kΩ

R2= 100kΩ

PROTECTIONS

Parameter	Condition	Value
Short Circuit Protection (SCP)		current limiting
Over Current Protection (OCP)		current limiting
$V_{STORAGE}$ Over Charge Protection	rechargeable battery	4.15VDC
	super capacitor	4.5VDC

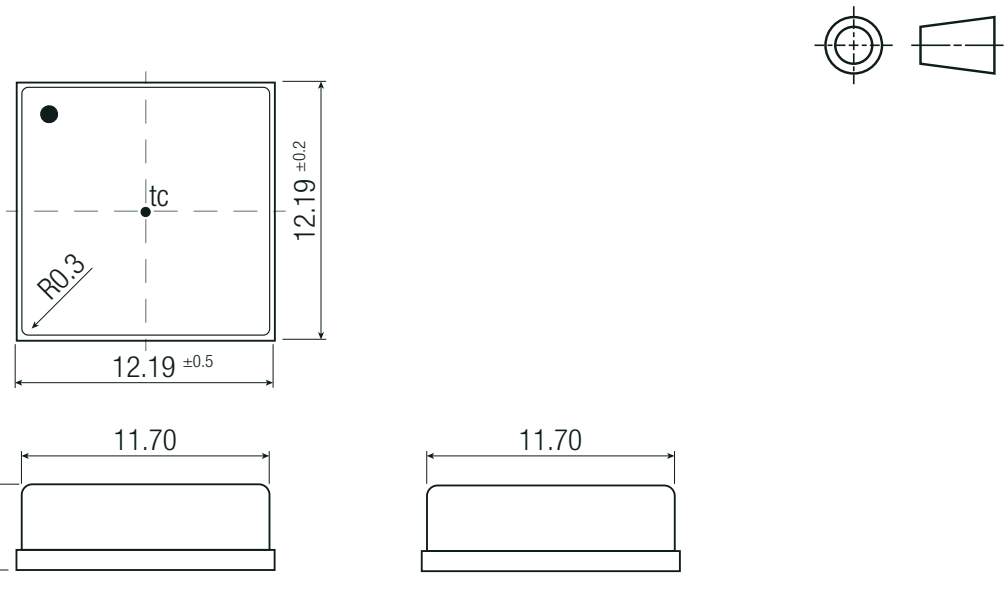
Specifications (measured at Ta= 25°C, full load)

ENVIRONMENTAL		
Parameter	**Condition**	**Value**
Operating Junction Temperature	natural convection	-40°C to +100°C
Humidity	non-condensing	5-95% RH max.

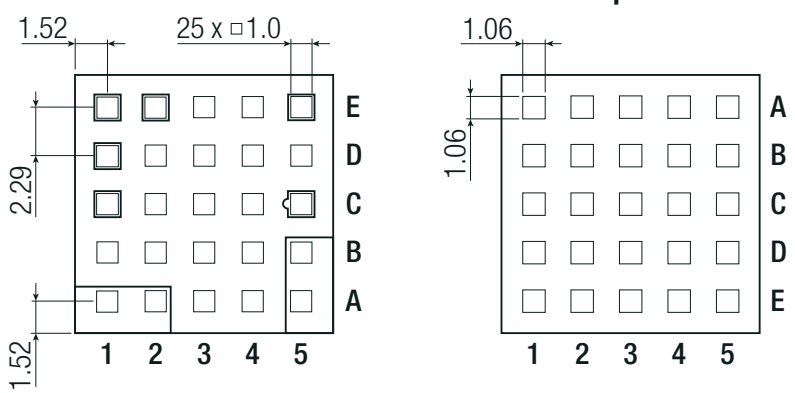
SAFETY AND CERTIFICATIONS	
Certificate Type (Safety)	**Standard**
RoHS2	RoHS 2011/65/EU + AM2015/863

DIMENSION and PHYSICAL CHARACTERISTICS		
Parameter	**Condition**	**Value**
Material	case PCB solder pads	metal FR4, (UL94 V-0) copper with electrolytic nickel-gold
Package Dimension (LxWxH)		12.19 x 12.19 x 3.75mm
Package Weight		1.1g typ.

Dimension Drawing (mm)



Recommended Footprint Details



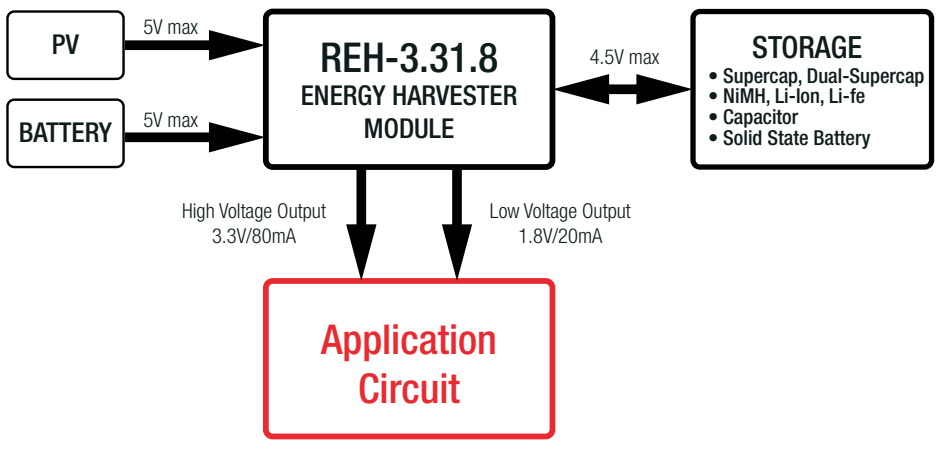
Specifications (measured at Ta= 25°C, full load)

Pinning Information

Pad #	Function	Description	Characteristics
A1	PV	PV cell input pad	0.38V needed to start the module. Maximum PV voltage is 5V.
A2	$V_{STORAGE}$	Storage element (super capacitor or rechargeable battery) input pad.	4.5V maximum operating voltage. Connect either to super capacitor or rechargeable battery. Rechargeable battery - must be charged to 4V to enable the outputs. Completely depleted battery (0V) cannot be connected to $V_{STORAGE}$ pin. Super capacitor - must be charged to 3.9V to enable the outputs. Can be connected at 0V to the $V_{STORAGE}$ pin. Rechargeable battery, super capacitor or at least 150uF capacitance must be connected to this pin before PV or V_{BACKUP} pins are connected to the energy source!
A4	V_{BACKUP}	Optional connection to backup battery (non-rechargeable).	5V maximum operating voltage. 0.6V minimum operating voltage. AA, AA, button cell, etc … Connect to GND if not used.
A3	GND	Ground pad	
A5	3.3VOUT	3.3V output	80mA maximum. Short and overload protected. No external capacitor needed.
B5	1.8VOUT	1.8V output	20mA maximum. Short and overload protected. No external capacitor needed.
C1	SHDN	Status logic output. Asserted HIGH when $V_{STORAGE}$ is below 3.6V and warns the system before shutdown. Both outputs (3.3Vout and 1.8Vout) are disabled after 600ms if the $V_{STORAGE}$ is not restored above 3.6V. Asserted HIGH when V_{BACKUP} is in use.	4.2V maximum voltage.
C5	EN_3.3VOUT	Enable pin for 3.3VOUT (HIGH=enabled)	logic HIGH from 1.75V to V_{REF} / logic LOW less than 0.25Vmax.
D5	EN_1.8VOUT	Enable pin for 1.8VOUT (HIGH=enabled)	logic HIGH from 1.8V to $V_{STORAGE}$ / logic LOW less than 0.25Vmax.
E1	SEL	Storage element selection pin	logic HIGH for super capacitor (max charged voltage 4.5V) logic LOW for rechargeable battery (max charged voltage 4.12V)
B4	FB_VBKP_1	Backup Battery Feedback Voltage 1	Select Minimum Threshold for the Backup Battery Voltage - 0.15V minimum. Refer to ***„Minimal VBACKUP Battery Voltage vs. FBVBACKUP resistor“*** to find appropriate resistor values to set desired threshold voltage. Connect to GND if not used.
C4	FB_VBKP_2	Backup Battery Feedback Voltage 2	
E5	VREF	Reference voltage	Typically 2.2V
others	reserved	Pads reserved for future functions	Do not connect

tc = case temperature measuring point
Pad tolerance= ±0.05mm
Case tolerance= ±0.25mm

BLOCK DIAGRAM

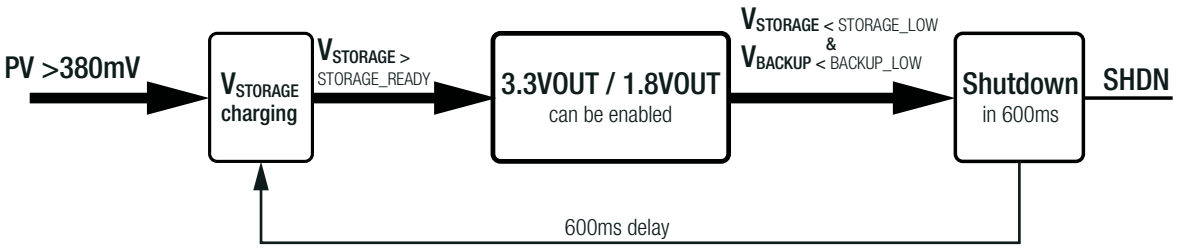


Specifications (measured at Ta= 25°C, full load)

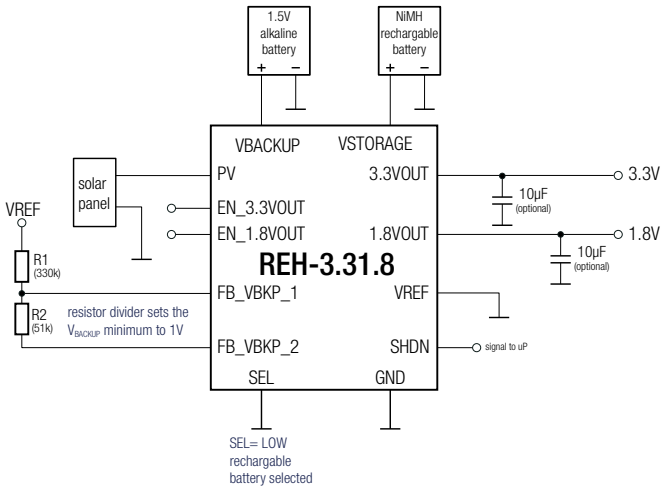
INSTALLATION AND APPLICATION

REH-3.31.8 energy harvester module charges a storage element from a power source capable to deliver at least of 3uW. At start-up, at least 380mV is required on the PV pin. After start-up, the storage element is being charged and the PV voltage can drop to 50mV. When the storage element is charged above the $STORAGE_{_READY}$ level, both outputs can be independently enabled by the independent enable signals. If the storage element voltage drops below $STORAGE_{_LOW}$ level and there is no backup battery connected to V_{BACKUP}, SHDN signal is asserted and the whole module goes to shutdown in about 600ms. If the backup battery is connected to V_{BACKUP}, the module automatically uses the V_{BACKUP} energy to supply the outputs and allows the storage element to be charged again above $STORAGE_{_READY}$ level. In case both the storage element and the backup battery are depleted (below $STORAGE_{_LOW}$ and $BACKUP_{_LOW}$ respectively), SHDN signal is asserted and both outputs are disabled after 600ms (shutdown). Operation is restored by the same process after cold-start.

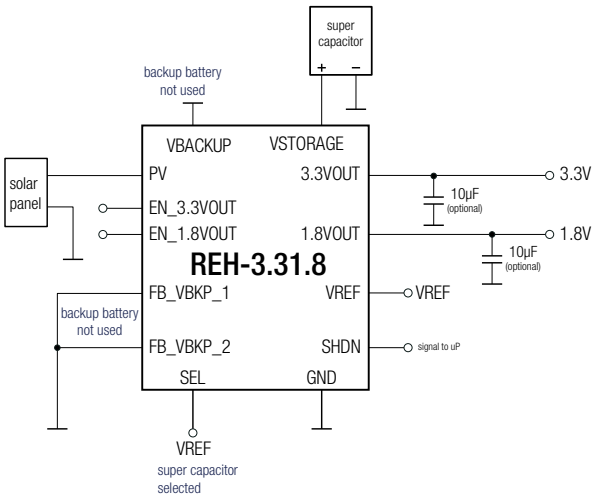
The module can be used as a standard buck-boost regulator when the PV source is always present. In that case the storage element can be replaced by a capacitance of at least 150uF.



Typical application schematic with rechargeable battery and backup battery



Typical application schematic with super capacitor and no backup battery



PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimension (LxWxH)	airbag	150.0 x 100.0 x 30.0mm
Packaging Quantity		1pc
Storage Temperature Range		-40°C to +125°C

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