USER MANUAL V2.1

Thermal Energy Harvester
ECT 100 perpetuum® Development Kit

Patent: WO 05/096482, WO 02/095707, further patents pending

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REVISION HISTORY

The following major modifications and improvements have been made to the first version (V1.0) of this document:

No	Major Changes
1.01	
2.0	
2.1	Updated performance of ECT100 stepcode BA and new pin layout

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Important!

This information describes the type of component and shall not be considered as assured characteristics. No responsibility is assumed for possible omissions or inaccuracies. Circuitry and specifications are subject to change without notice. For the latest product specifications, refer to the EnOcean website: http://www.enocean.com.
As far as patents or other rights of third parties are concerned, liability is only assumed for modules, not for the described applications, processes and circuits.
EnOcean does not assume responsibility for use of modules described and limits its liability to the replacement of modules determined to be defective due to workmanship. Devices or systems containing RF components must meet the essential requirements of the local legal authorities.
The modules must not be used in any relation with equipment that supports, directly or indirectly, human health or life or with applications that can result in danger for people, animals or real value.
Components of the modules are considered and should be disposed of as hazardous waste. Local government regulations are to be observed.
Packing: Please use the recycling operators known to you. By agreement we will take packing material back if it is sorted. You must bear the costs of transport. For packing material that is returned to us unsorted or that we are not obliged to accept, we shall have to invoice you for any costs incurred.

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1 GENERAL DESCRIPTION

1.1 Basic Functionality

EnOcean has developed a thermal energy harvester which is able to power wireless sensor nodes from temperature differentials of only a few Kelvin.

This new energy harvester ECT100 is based on a revolutionary DC/DC converter which automatically starts operation at 20mV. For comparison: the leading conventional DC/DC converters need at least 500mV to start operation - a factor of 25 more!

The output power depends on the actual temperature difference between both sides of the Peltier element and the element being used. It ranges from µW to mW at 3.5V. Therefore ECT100 is designed for use with EnOcean radio technology in sensors and actuators.

1.2 Typical Applications

A typical thermo-driven sensor consists of a sensor element, a small Peltier element, a heat sink, the new DC/DC converter and an STM110 radio module from EnOcean. Powered by the temperature differential the STM110 will wake up on a regular basis, e.g. every 10s, acquire sensor values and transmit them via a radio signal over a distance of up to 300m. Typical application areas are home and building automation, automated meter reading, and industrial automation.

1.3 Technical Data

1.3.1 Technical Data DC/DC converter

Supply voltage V_IN	0.02V – 0.25V
Output voltage V_SC1, V_SC2	limited at 4.5V
Efficiency	~30%

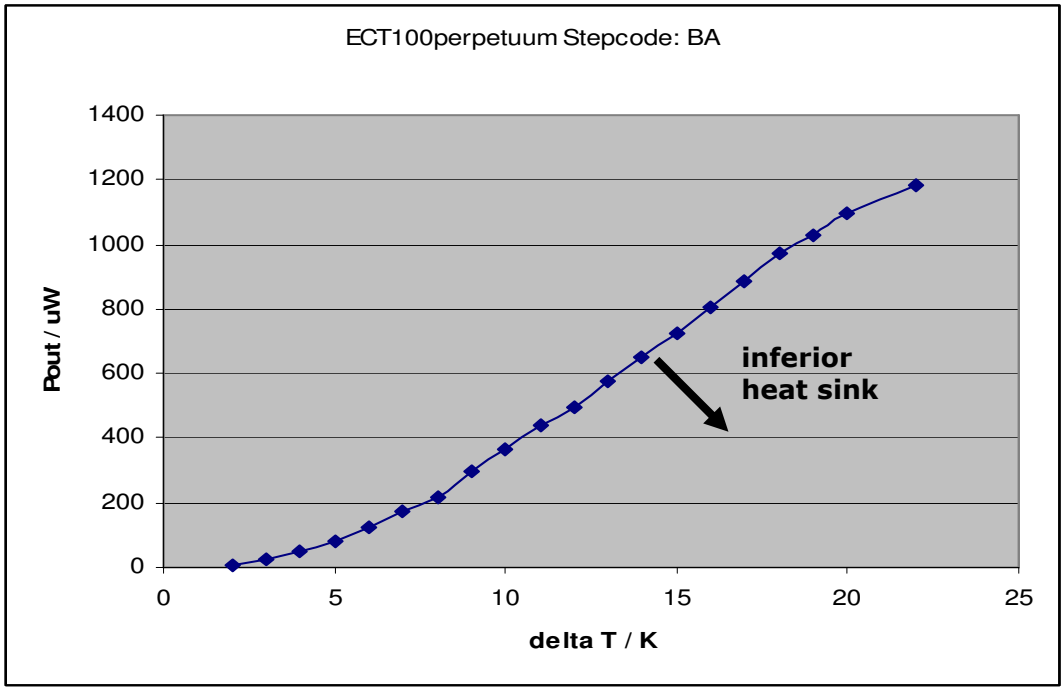
1.3.2 Technical Data Peltier Element

Type	Eureca TEC2L-15-15-5.6/73CS
Temperature coefficient	12.5 mV/K
Internal resistance	1.44 Ω
Thermal conductivity	0.046 W/K

1.3.3 Technical Data Heat Sink

Type	SK 426, 50mm
Thermal resistance	4.5 K/W

1.3.4 Combined Performance of ECT100 and TEC2L-15-15-5.6/73CS

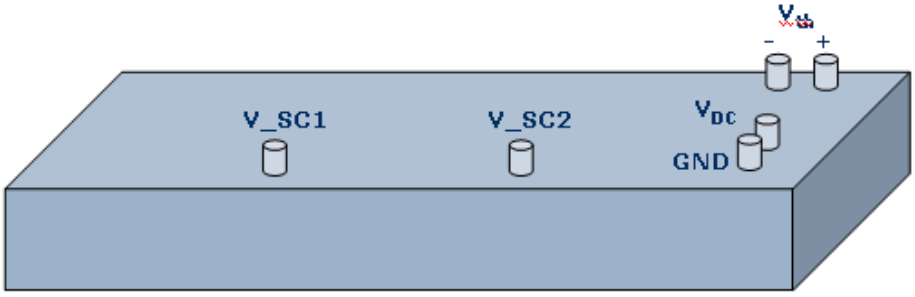


The figure above shows the output power of ECT100 as a function of the temperature differential between both sides of the Peltier element. The output power depends of the performance of the heat sink.

1.4 Physical Dimensions

ECT 100	45mm x 30mm x 15mm (without pins)
Peltier element	15mm x 15mm x 5.6mm
Heat sink	50mm x 50.8mm x 16.51mm

Pinout
DC/DC
Converter



1.5 Environmental Conditions

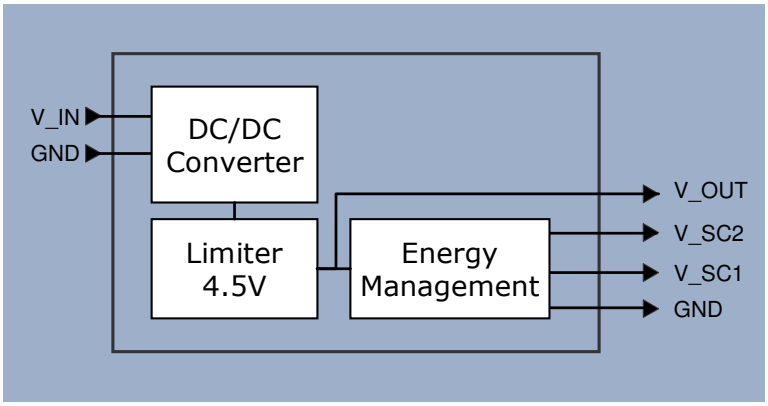
Operating temperature	-0°C … +40 °C
Storage temperature	-25°C up … +65 °C
Humidity	0% … 95% r.h.

1.6 Ordering Information

Type	Ordering Code
ECT 100 Kit	**S3004-P100**

2 FUNCTIONAL DESCRIPTION

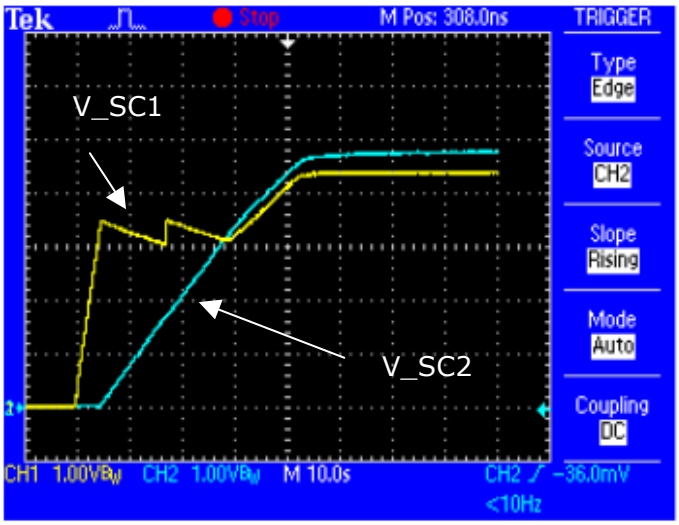
2.1 Block Diagram



ECT100 converts an input voltage in the range of 0.02V to 0.25V to an output voltage in the range of about 4V to 4.5V. The input voltage can e.g. be generated from a temperature differential using a peltier element.

There are two outputs, V_SC1 and V_SC2, which are designed to be used in combination with an STM110 radio module.

First V_SC1 is switched on. It is designed to charge a short term energy storage (small capacitor) on STM110 for a fast start up of the module. As soon as V_SC1 is approximately 3.5V the output V_SC2 is switched on. This output is designed to charge the long term energy storage (gold cap) on STM110. A typical behaviour is shown below.



Switching between V_SC1 and V_SC2

In addition there is an unmanaged output V_OUT.

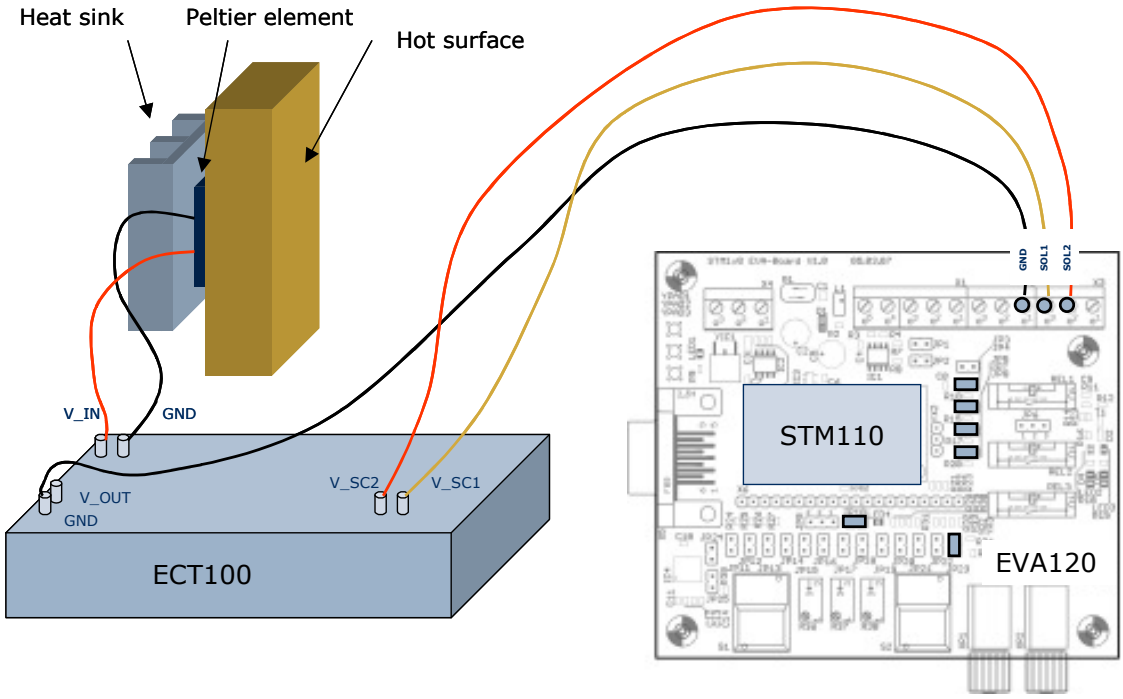
2.2 Pin Description and operational characteristics

Symbol	Function	Operational Characteristics
GND	Ground connection	
V_IN	Input for positive output voltage from Peltier element	Allowed input voltage range 0.02V…0.25V
V_SC1	Output voltage. Connect to STM110 V_SC1 input for fast startup of the module.	V_SC1 is limited at 4.5V
V_SC2	Output voltage. Connect to STM110 V_SC2 input to charge gold cap	V_SC2 is switched on when V_SC1 is approximately 3.5V. V_SC2 is limited at 4.5V
V_OUT	Unmanaged output voltage	V_OUT is limited at 4.5V

Observe precautions!
Electrostatic sensitive devices!

3 APPLICATIONS INFORMATION

3.1 Connecting ECT100 to Peltier element and to STM110



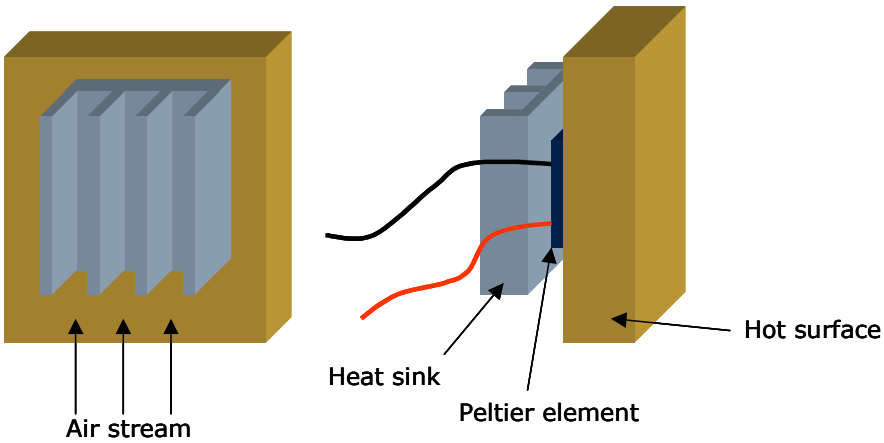
- Use thermal compound to mount the Peltier element to the hot surface!
- Check polarities!

3.2 Design considerations concerning the heat sink

As shown in section 1.3.4 the output power strongly depends on the heat sink.

Important factors are:
- Dimensions and material of heat sink
- Orientation of heat sink

For best performance we recommend to orient the heat sink as shown in the figure below:



- **The heat sink should be placed besides and not above the hot surface**
- **Let the air stream from the bottom up through the heat sink**
- **ECT100 perpetuum® is designed for the conversion of very low voltage in the range of 20mV – 250mV**
- **Voltages higher then 250mV will damage the DC/DC converter**
- **Make sure that there is no temperature difference higher then 20k (12,5mV/K) between the hot and the cold side of the Peltier element**

4 DECLARATION OF CONFORMITY

Will be added when product is released for series production