# High Voltage Piezoelectric DC-DC Converters

**Use of non-magnetic piezoelectric technology**

**Ultra compact low-profile design**

**Output voltage programmable from 0 to 100%**

**Very high efficiency**

**Three reference modules available: 2kV/4W, 5kV/5W, 10kV/5W**

## World's First Piezoelectric DC-DC Converter

Micromechatronics, Inc. introduces the world's first High Voltage Piezoelectric Converter product line. Three new reference DC-DC converters are introduced: 2kVdc/4W; 5kVdc/5W; 10kVdc/5W. The converters are operated under input voltages of 8 to 14Vdc. The converters are fully regulated against changes of the input voltage and the output load. Furthermore, the output voltage can be programmed from 0 to 100% through a control 0 – 2.1 V control pin.

This new technology uses magnetic-less, low profile, high efficiency and high power density high voltage piezoelectric transformers. Developed through many years of research, development and commercialization of piezoelectric technology, the new converters provide the most compact and efficient high voltage converting solution.

The use of non-magnetic technology to achieve the high voltage generation, make them ideal for medical, military and space applications where magnetic signature could jeopardize the application reliability.

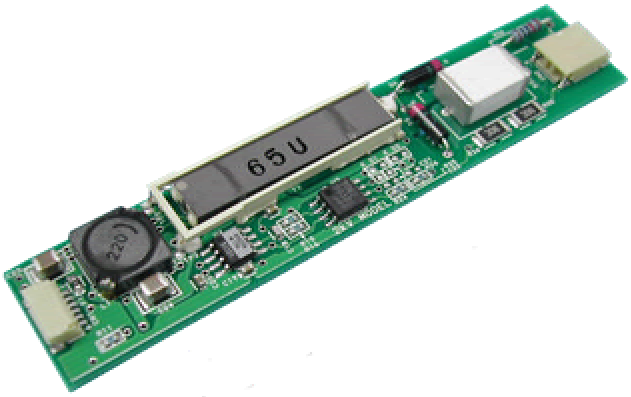
Applications include: Pulse Generators, Ignition Systems, Laser Power Supplies, Night Vision Devices, Spectrometers, Traveling Wave Tubes (TWTs), etc.

Micromechatronics, Inc.

**Micromechatronics, Inc.**
200 Innovation Blvd, Suite 155
State College, Pennsylvania, 16803
Phone: 814-861-5688
Fax: 814-861-1418
www.mmech.com
contact@mmech.com

# 2 kV - 4 W DC-DC PIEZOELECTRIC CONVERTER

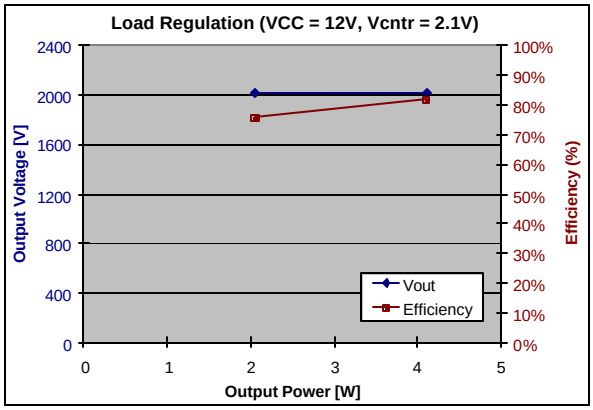
| SPECIFICATIONS | |
|---|---|
| **PRODUCT** | **RESULTS** |
| **Size** | 95 mm x 19 mm (w/ connectors) |
| **Input Voltage (DC)** | 8 V to 14 V |
| **Output Voltage (DC)** | 2 kV |
| **Max Output Power (W)** | 4 W |
| **Max. Efficiency (%)** | > 82 % |
| **Control voltage** | 0 to 2.1 V to reach 0 to 2 kV |

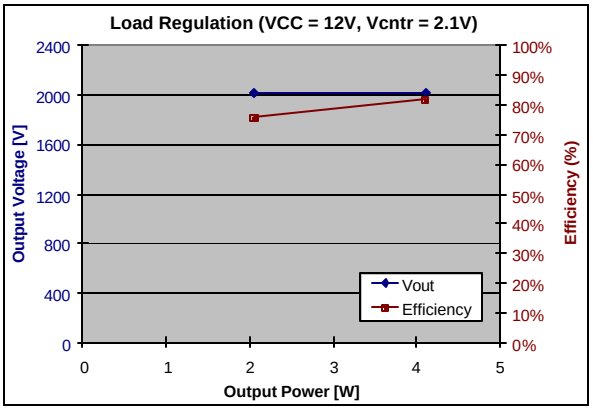


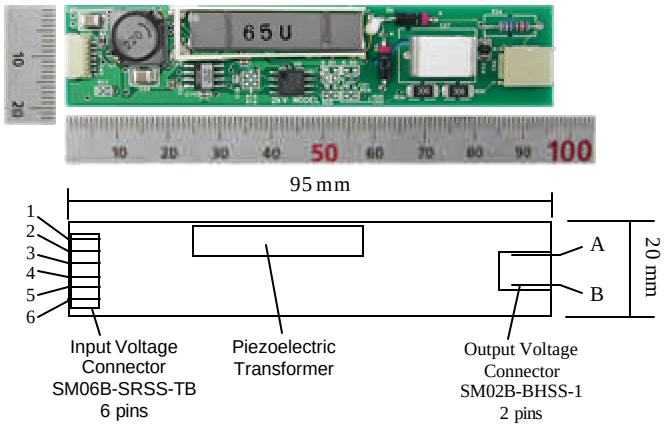

## Features

- Miniature, Surface Mount Construction
- Use of Magnetic-less Transformer Technology
- Output Power: 4 W max
- Wide Input Voltage Regulation (8 Vdc to 14 Vdc)
- 0 to 100% Output Programmable
- Output Short Circuit and Over Voltage Protected
- Operating Temperature: -25 °C to +70 °C
- Low Ripple: 0.1 % of Vout at full Vout
- High Efficiency > 80 %
- Programming Voltage: 0 to 2 Vdc
- Input and Output Connectors for easy plug and play integration.

## Performance



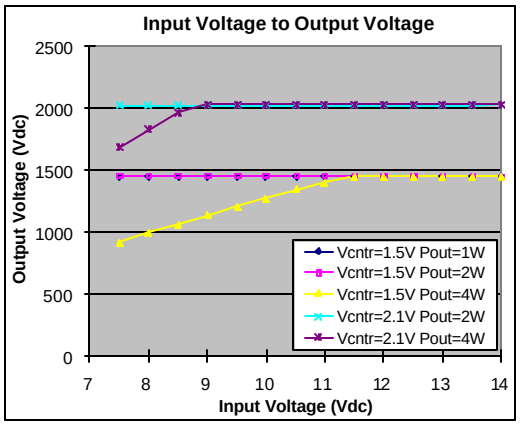

**Input Connector**

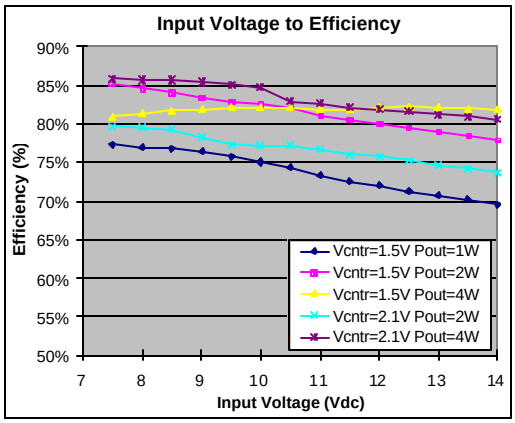
- **PIN 1 (PGND):** Power Ground
- **PIN 2 (VBAT):** Input Voltage, **8 to 14 Vdc**. Nominal voltage is 12 Vdc
- **PIN 3 SGND:** Signal Ground
- **PIN 4 (STBY):** +5V allow on/off control
- **PIN 5 (VCMP):** Programming Voltage Pin. Applying a voltage between 0 to 2.1Vdc to this pin, the output voltage can be controlled within 0 to 100% Vout max.
- **PIN 6 (DI):** Output current detection

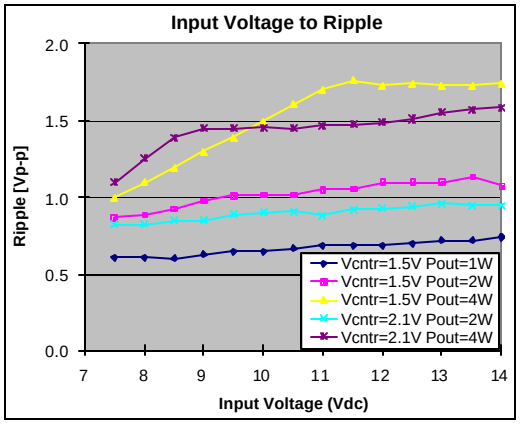
**Output Connector**

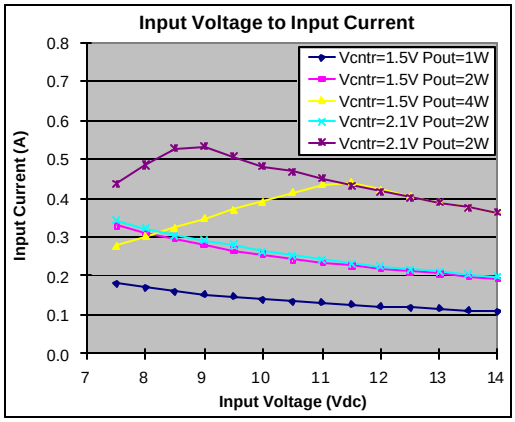
- **PIN A (Out):** No Connected
- **PIN B (GND):** High Voltage Output

## Input Voltage Regulation Response

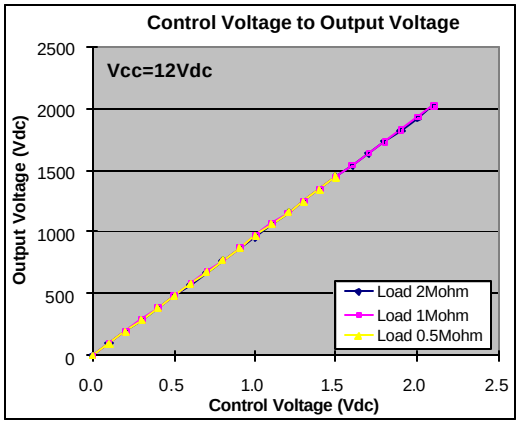


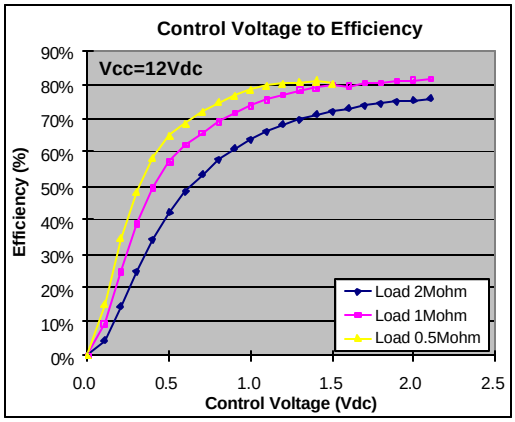



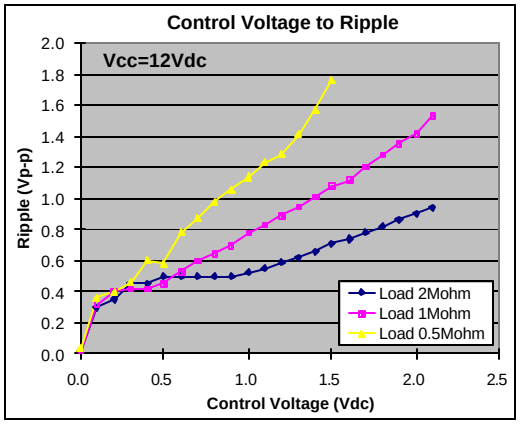



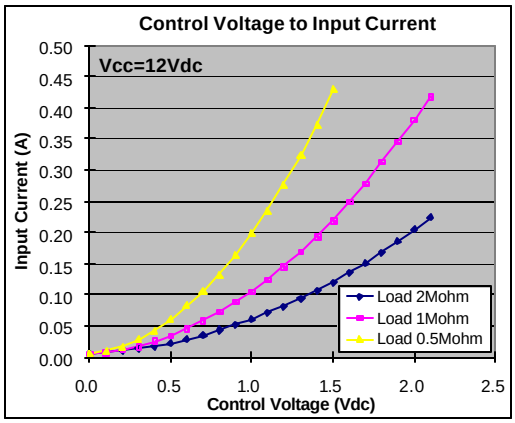




## Control Voltage Response (Vcc=12V)



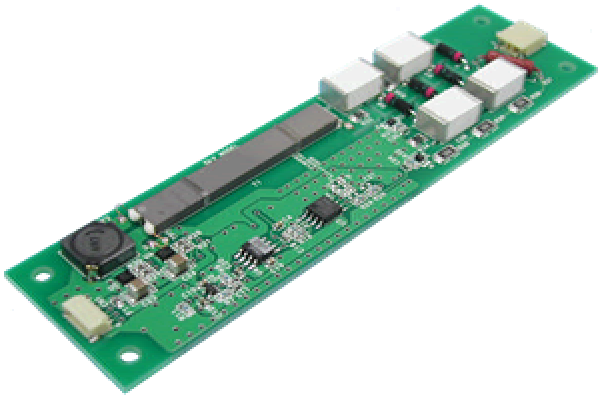



# 5 kV - 5 W DC-DC PIEZOELECTRIC CONVERTER

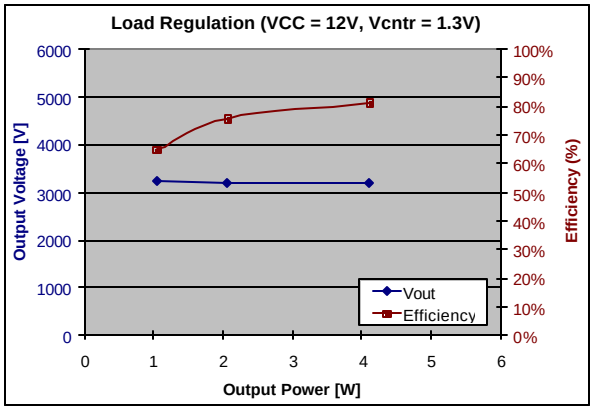
| SPECIFICATIONS | |
|---|---|
| **PRODUCT** | **RESULTS** |
| **Size** | 135 mm x 35 mm (w/connectors) |
| **Input Voltage (DC)** | 8 V to 14 V |
| **Output Voltage (DC)** | 5 kV |
| **Max Output Power (W)** | 5 W |
| **Max. Efficiency (%)** | > 82 % |
| **Control voltage** | 0 to 2.1 V to reach 0 to 5 kV |

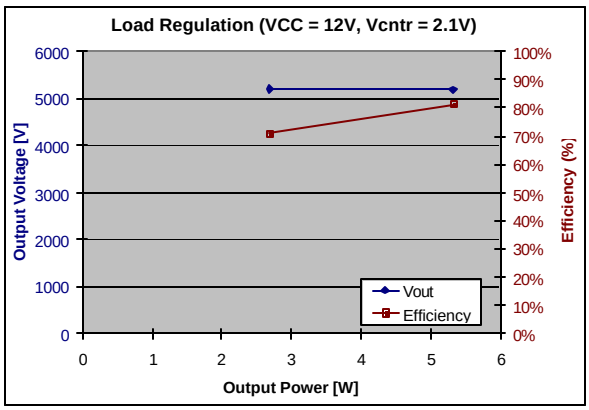


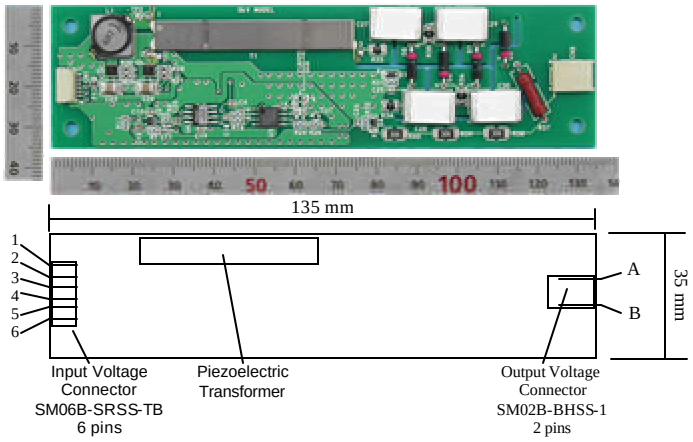
## Features

- Miniature, Surface Mount Construction
- Use of magnetic-less transformer technology
- Output Power: 5 W max
- Wide input voltage regulated (8 Vdc to 14 Vdc)
- 0 to 100% Output Programmable
- Output Short Circuit and Over Voltage Protected
- Operating Temperature: -25 °C to +70 °C
- Low Ripple: 0.1 % of Vout at full Vout
- High Efficiency > 80 %
- Programming Voltage: 0 to 2 Vdc
- Input and output connector for easy plug and play integration.

## Performance



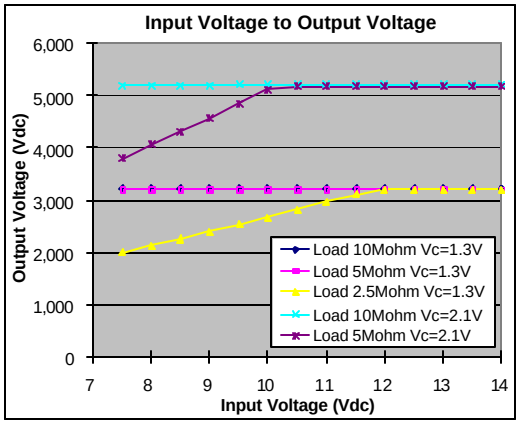

**Input Connector**

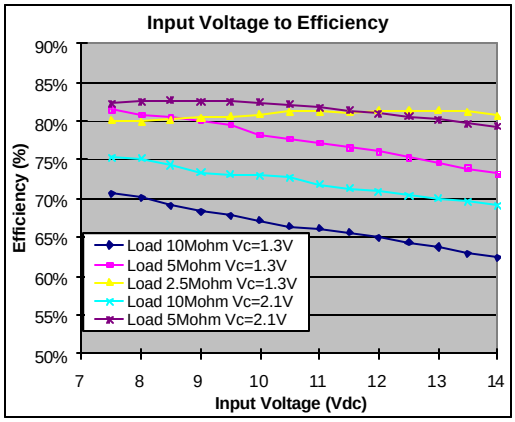
- **PIN 1 (PGND):** Power Ground
- **PIN 2 (VBAT):** Input Voltage, **8 to 14 Vdc**. Nominal voltage is 12 Vdc
- **PIN 3 SGND:** Signal Ground
- **PIN 4 (STBY):** +5V allow on/off control
- **PIN 5 (VCMP):** Programming Voltage Pin. Applying a voltage between 0 to 2.1Vdc to this pin, the output voltage can be controlled within 0 to 100% Vout max.
- **PIN 6 (DI):** Output current detection

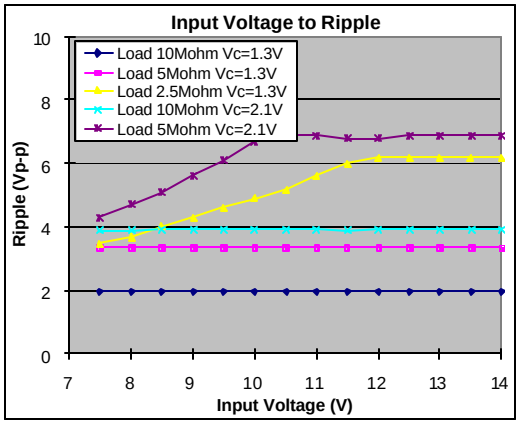
**Output Connector**

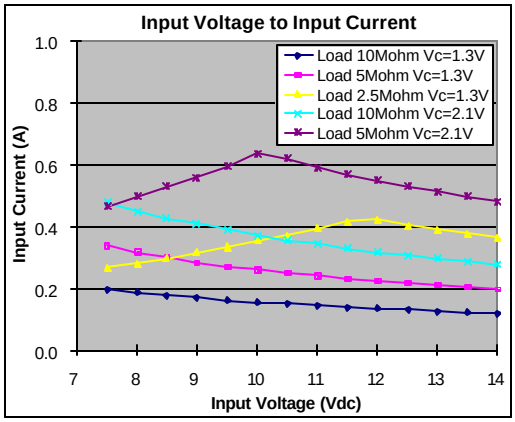
- **PIN A (Out):** No Connected
- **PIN B (GND):** High Voltage Output

## Input Voltage Regulation Response

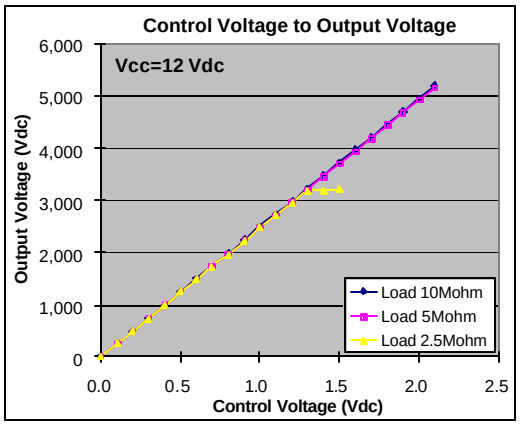


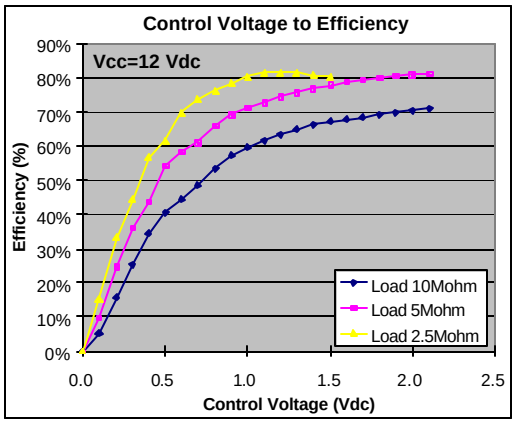



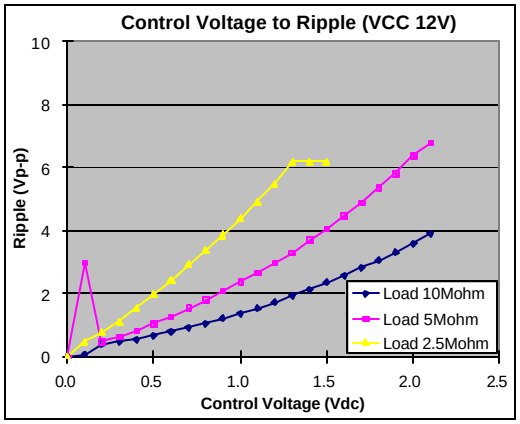



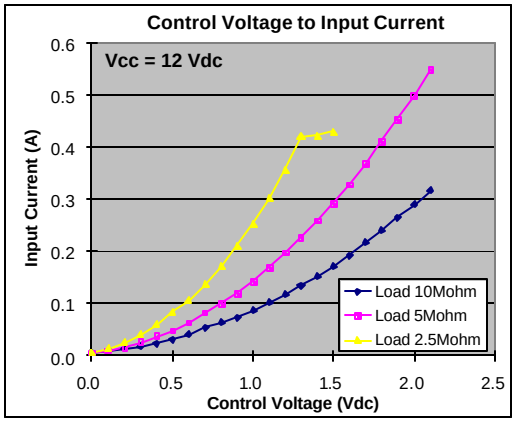




## Control Voltage Response (Vcc=12V)



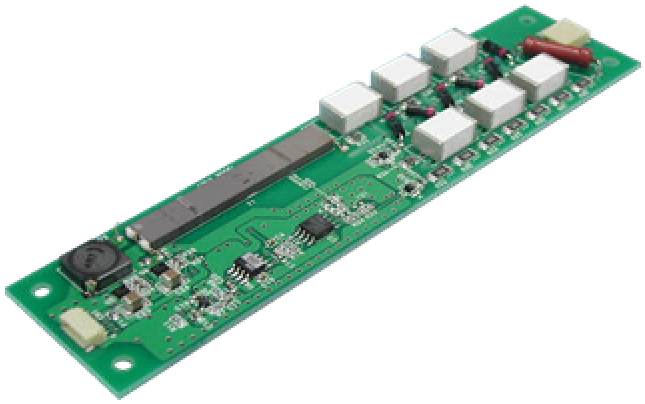



# 10 kV - 5 W DC-DC PIEZOELECTRIC CONVERTER

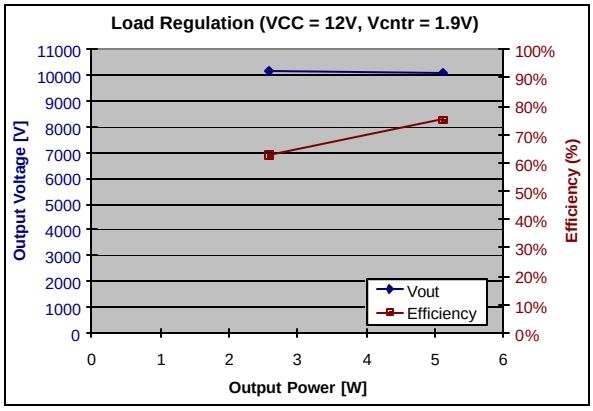
| SPECIFICATIONS | |
|---|---|
| **PRODUCT** | **RESULTS** |
| **Size** | 150 mm x 35 mm (w/ connectors) |
| **Input Voltage (DC)** | 8 V to 14 V |
| **Output Voltage (DC)** | 10 kV |
| **Max Output Power (W)** | 5 W |
| **Max. Efficiency (%)** | > 82 % |
| **Control voltage** | 0 to 2.1 V to reach 0 to 10 kV |

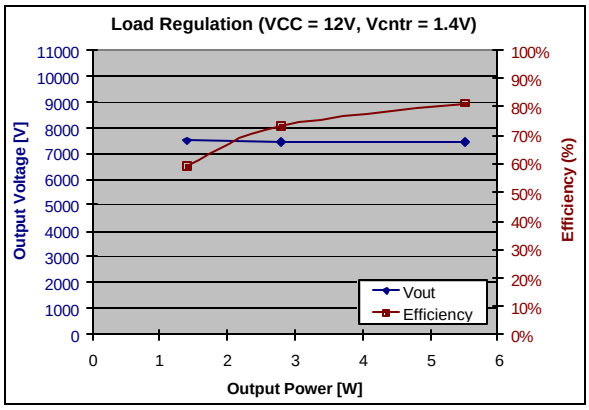


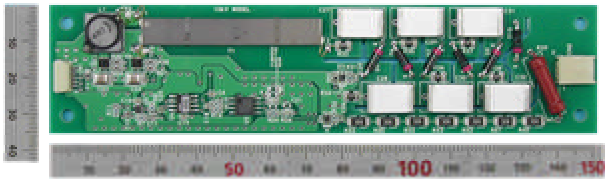
## Features

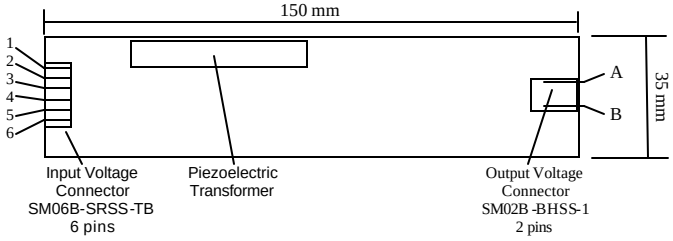
- Miniature, Surface Mount Construction
- Use of magnetic-less transformer technology
- Output Power: 5 W max
- Wide input voltage regulated (8 Vdc to 14 Vdc)
- 0 to 100% Output Programmable
- Output Short Circuit and Over Voltage Protected
- Operating Temperature: -25 °C to +70 °C
- Low Ripple: 0.1 % of Vout at full Vout
- High Efficiency > 80 %
- Programming Voltage: 0 to 2 Vdc
- Input and output connector for easy plug and play integration.

## Performance





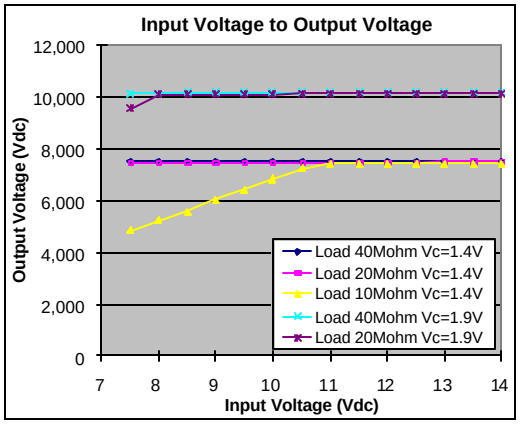

**Input Connector**

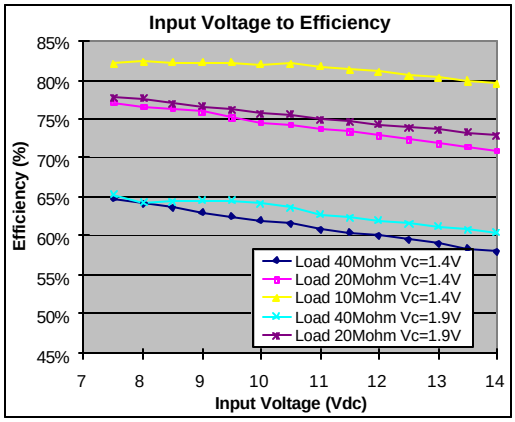
- **PIN 1 (PGND):** Power Ground
- **PIN 2 (VBAT):** Input Voltage, **8 to 14 Vdc**. Nominal voltage is 12 Vdc
- **PIN 3 SGND:** Signal Ground
- **PIN 4 (STBY):** +5V allow on/off control
- **PIN 5 (VCMP):** Programming Voltage Pin. Applying a voltage between 0 to 2.1Vdc to this pin, the output voltage can be controlled within 0 to 100% Vout max.
- **PIN 6 (DI):** Output current detection

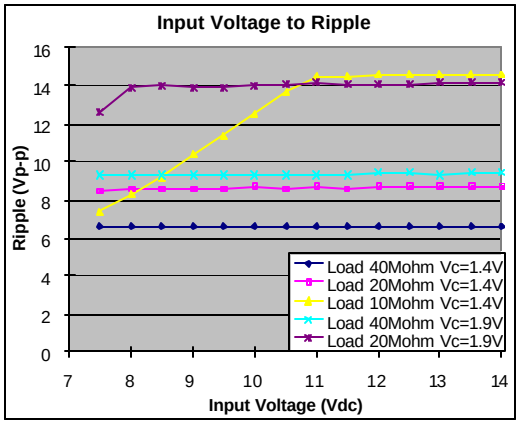
**Output Connector**

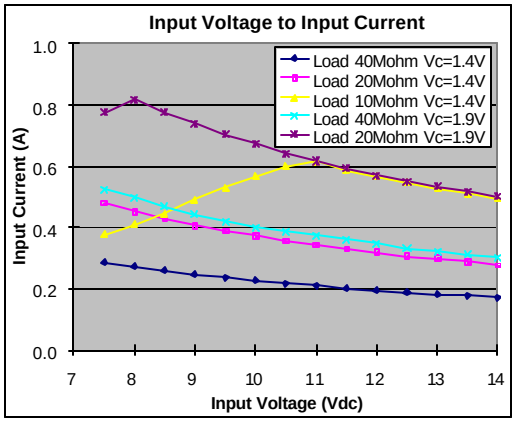
- **PIN A (Out):** No Connected
- **PIN B (GND):** High Voltage Output

## Input Voltage Regulation Response

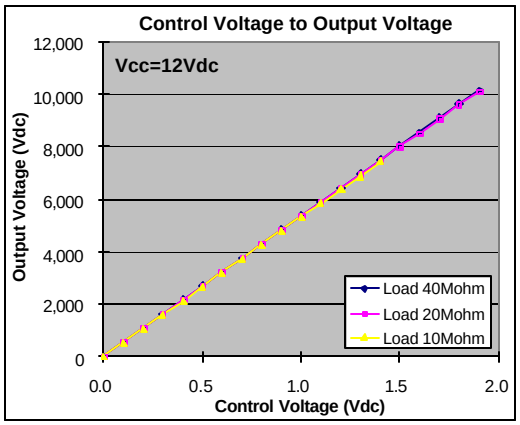


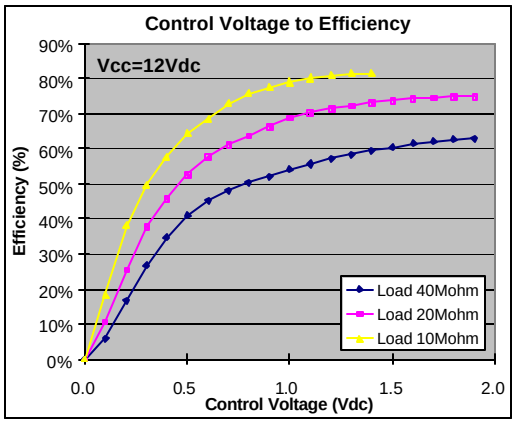



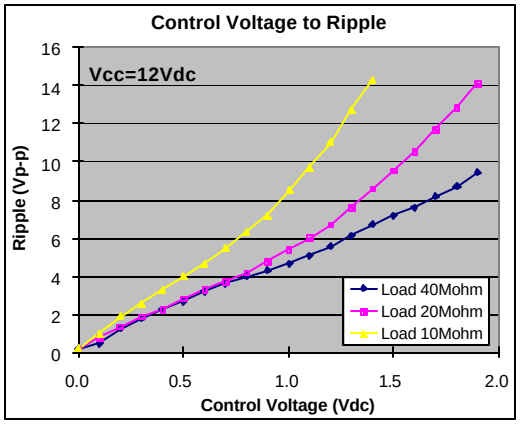



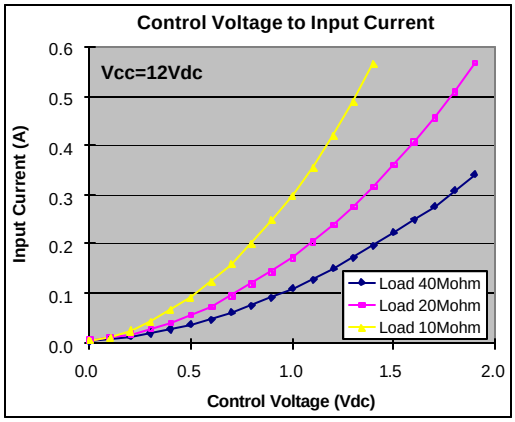




## Control Voltage Response (Vcc=12V)



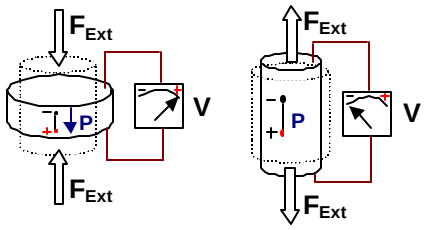



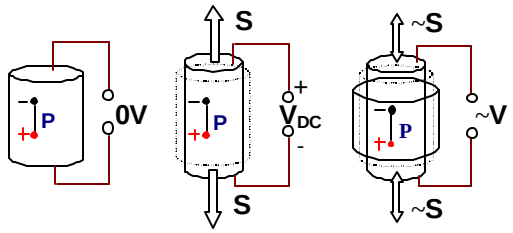
## Piezoelectricity

**Piezoelectricity** is the ability of some materials to generate an electric potential in response to an applied mechanical stress. The word "piezoelectricity" is derived from the Greek *piezein*, which means to squeeze or press.

The piezoelectric effect is reversible in that materials exhibiting the *direct piezoelectric effect* (the production of electricity when stress is applied) also exhibit the *converse piezoelectric effect* (the production of stress and/or strain when an electric field is applied).




Direct effect with the piezoelectric material in open circuit.




Inverse effect. Static (in the middle) and dynamic (right) operation in the inverse effect

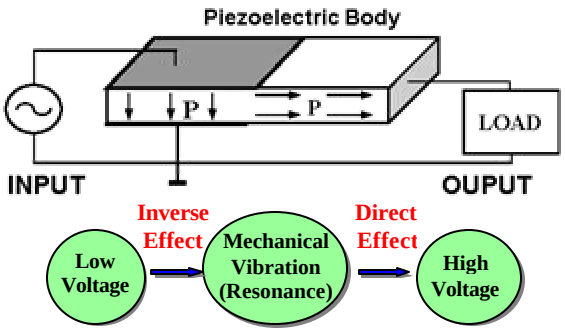
## Piezoelectric Transformers. The use of acoustic energy for converting electrical signals

Piezoelectric transformers combine both the direct and the converse piezoelectric effects. Basically, a piezoelectric transformer consists of an input section and an output section. When the input section is driven by an AC input voltage, a vibration is established in the ceramic body due to the direct piezoelectric effect. This vibration is extended to the output section which in turns generates an output voltage.

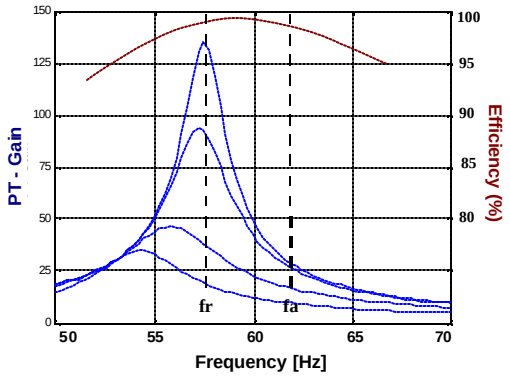
If the piezoelectric transformer is driven in the neighborhood of its resonance frequency, very efficient electrical to electrical conversion is achieved. Through specific design of the input and output section, piezoelectric transformers can be designed for step-up or step-down transformation with efficiencies higher than 95%.

Piezoelectric transformers do not require winding electrodes and all the entire ceramic material is used in the acoustic transfer, thus providing a higher power density than magnetic transformers. Consequently, weight and size is greatly reduced. Furthermore, piezoelectric materials are made of non-magnetic with the significant benefit for applications sensitive to EMI radiation.

This is the core technology used in Micromechatronics' new DC-DC piezoelectric-based high voltage converters. The new DC-DC converters include all the driving electronic components as well as output voltage rectifying parts to achieve a widely input voltage and output load regulated units.




Transformation mechanism used by piezoelectric transformers




Frequency and load response of a typical piezoelectric transformer