Thermo Life[™]

Thermo Life[™] is a revolutionary micro-technology device that is the culmination of eight years of research and development. Thermo Life[™] is a new, unique, small and compact Low Power Thermoelectric Generator ("LPTG") and viable energy source for low-powered devices such as

micro sensor systems, ZigBee chipsets, wearable electronics, implantable medical devices, active RFID tags and numerous other applications. Wherever a temperature difference exists in any environment, the autonomous device, Thermo LifeTM, is capable of producing an output power. Even small temperature differences of less than 5 Kelvin can provide a source of thermal energy.

Thermo Life[™] converts heat energy to electrical energy through its thermopile couples using the thermopile principle (Seebeck effect). When both heat couple plates are thermally connected with a heat source and a heat sink, heat flows through thermopiles and is converted directly into electrical energy.



Working principle of Thermo Life[™] thermoelectric generators



Thin film high vacuum deposition equipment

Using thin film technology, a miniaturized construction, and a high number of thermopiles in series, a volume less than 0.08 cm³ has been achieved for the first time and its performance is compatible with the requirements of many recent micro systems.

In the summer of 2003 all of the advanced equipment and machinery was moved from

The Thermo Life[™] generators are based on the development of a unique thin film technology for the deposition of highly efficient thermoelectric materials of the Bi₂Te₃-type on thin Kapton foils, which originated at the Martin-Luther-University in Germany and were advanced and developed at the D.T.S. Company in Germany. This technology consists of five general steps:

- Film deposition using high vacuum deposition equipment
- Photo lithography
- Pattern generation
- Wafer foil cutting and
- Device assembly



Enlargement of thermopile structures with a leg width of 50 microns

D.T.S. Company in Germany to the newly constructed Thermo Life[™] Energy Corp. Laboratory in Riverside, CA.

Thermo Life[™] is an autonomous power source for consumer, industrial, commercial, medical, government, military, automotive, space, science, environmental and security applications, such as:

- Micro sensor networks
- Wireless HVAC sensors
- Ammunition safety sensors
- Wearable Electronics (i.e. wrist watches)
- Automobile tire pressure monitors
- Active transponders and RFID tags
- ZigBee Chipsets and related wireless sensor networks
- Autonomous powered temperature displays
- Oil and gas well head sensors
- Temperature and overheating warning systems
- Electronic heat cost allocators
- Recharging of mobile electronics
- Wireless Personal Area Networks (PAN's)
- Implantable medical devices (i.e. cochlear implants and neural stimulators)
- Self-powered toys and novelties

Advantages of the new developed technology:

- Reliable, miniature and compact thin film thermoelectric generators
- Outstanding performance of Thermo Life[™] (i.e. temperature differences of less than 5 Kelvin, such as between 20 °C and 25 °C, can generate nearly 6 V open voltage at matched load 3 V, 10 µA of current, 30 µW of power)
- Continuous renewable power with a twenty to fifty year operating life
- Use of highly efficient semiconductor material for energy conversion, which has the best thermoelectric properties in the range of room temperature
- Design, electrical and thermal parameters of Thermo Life[™] are adjustable to customer specific applications
- Thin film technology allows the ability to scale up to mass production, which results in less expensive devices comparable to batteries
- Technological steps and equipment are similar to those which are well-established in microelectronics
- Low requirements of the production facilities reduce costs of construction and operation

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Thermo Life[™] Energy Corp. Laboratory location in Riverside, CA