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**MicroGen's piezo-MEMS vibration energy harvesters enable Linear Technology SmartMesh IP wireless sensor network**

**BOLT Power Cells use Linear's LTC3588-1 piezoelectric energy harvesting conversion chip to power Dust Networks' motes**

ROCHESTER, NY – June 25, 2013 – MicroGen Systems, Inc. ("MicroGen") announced today that vibration energy harvesting *BOLT™ Power Cells* (see Figure 1) enabled a live wireless sensor network (WSN) using Linear Technology's ("Linear") Dust Networks [LTC5800-IPM](#) SmartMesh™ IP mote-on-chip at the *Sensors Expo and Conference* exhibition in Rosemont, IL on June 5-6, 2013 (see similar demonstration video – [Linear Demo](#)). The Linear mote was powered by MicroGen's piezoelectric Micro Electro Mechanical Systems (piezo-MEMS) vibrational energy harvester or micro-power generator (MPG) technology.



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**Figure 1.**

Shown are MicroGen's piezo-MEMS based micro-power AC generator, *Power Cells* (9 Volt battery form-factor) with 3.3 Volt DC output, and plug-in *Energy Cells* that use either an ultra-capacitor or a rechargeable battery (solid-state or Li-ion coin batteries available) for additional energy storage capacity.

The Linear WSN consisted of four (4) motes, and their WSN software for efficient power managed communication was used. The self-powered motes were enabled by electronic shakers set at typical industrial vibrations levels of 120 Hz and acceleration G-level 0.2 g ( $g = 9.8 \text{ m/s}^2$ ). MicroGen placed vibration powered motes at the Linear booth and at the X-FAB MEMS Foundry booth. These motes were on the order of 20-30 meters away from MicroGen's booth. This was the first fully MEMS energy harvesting powered WSN completed by a commercial company.

Inside MicroGen's *BOLT Power Cell* is a small semiconductor MEMS chip fabricated using similar techniques as the computer chip industry. This chip is a  $\sim 1.0 \text{ cm}^2$  piezo-MEMS MPG containing one end-mass loaded micro-cantilever containing a piezoelectric thin film. As the MPG's cantilever bends up and down due to the external vibrational force it produces alternating current (AC) electricity. At resonance the AC power output is maximized, where it is  $\sim 100$  microWatts at 120 Hz and  $\approx 0.1 \text{ g}$ , and  $\sim 900$  microWatts at 600 Hz &  $\approx 0.5 \text{ g}$ .

The AC electricity is efficiently converted to direct current (DC) using Linear Technology's [LTC3588-1](#) piezoelectric energy harvesting AC to DC converter. After the energy is scavenged it is temporarily stored on a 300 microFarad capacitor. The output of the *Power Cell* ranges from 25-500 microWatts at 3.3 Volts DC, depending upon configuration and frequency. The *BOLT Power Cell* is intended to enable a wireless sensor mote from many different manufacturers.

The bottom-line is that the *BOLT Power Cell* is simply a battery replacement unit that uses vibrational energy instead of chemical energy produced by environmentally unfriendly materials. The intent is to eliminate or extend the lifetime of primary cells or rechargeable batteries in WSN industrial and building applications, where the labor to frequently

change batteries is cost prohibitive for a WSN to be installed. *Power cells* will be offered at 50/60 Hz harmonics between 100-1500 Hz. MicroGen's MPGs and *Power Cells* are very sensitive to low levels of G. At G-levels < 0.1-0.5 g (depends upon frequency) at a specific industrial signature frequency, then the *Power Cell* will enable the WS mote attached. In volume the MPG and *Power Cell* production cost are estimated be on the order of \$0.50 and \$1.00 each, respectively.

Joy Weiss, President of the Dust Networks product group at Linear Technology stated, "I am pleased to see the progress that MicroGen is bringing to energy harvesting to enable self-powered SmartMesh wireless sensors."



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Linear Technology's Boston Design Center's Director, Sam Nork added, "MicroGen's demonstration of its piezo-harvesting chip integrated with Linear Technology's LTC3588 piezo conversion chip is a perfect match to efficiently produce DC electricity for WSN applications."

MicroGen's CEO, Robert Andosca stated, "We are very pleased that we were able to show a low cost energy harvester solution to enable Linear Technology's SmartMesh wireless motes. Our goal is to provide piezo-MEMS harvesters in a form-factor that can be used by all wireless sensor products currently on the market. Our *BOLT Power Cell* is the first example of doing so with a commercial MEMS-based energy harvesting generator component."

MicroGen unveiled their *BOLT™* product line at the Sensors Expo this month. MicroGen plans to announce the availability of their products late summer 2013. Initially, MicroGen will offer MPGs and *BOLT Power Cells* at frequencies 100, 120 and 600 Hz. For extra energy storage, plug-in *BOLT Energy Cells* will be available with (a) 22 milliFarad Panasonic ultra-capacitor, (b) 50 microAmp-hr Cymbet Corporation solid-state battery, and (c) 7.0 milliAmp-hr Panasonic rechargeable coin cell. Please see [BOLT products webpage](#), which contains links to all MicroGen product data-sheets.

### About MicroGen Systems, Inc.

MicroGen is bringing to market a suite of products based on its proprietary piezo-MEMS platform technology at X-FAB Silicon Foundries AG ([www.xfab.com](http://www.xfab.com)) production facility located north of Hamburg, Germany. MicroGen's first piezo-MEMS component is a small (volume < 1.0 cm<sup>3</sup>; smaller than a green pea) vibrational energy harvester or MPG. The MPG is the 'heart' of MicroGen's *BOLT™ Power Cell* DC power source. These low cost, long lifetime products scavenge otherwise wasted ambient vibrational energy will replace or extend the lifetime of batteries in wireless sensor and other microelectronic applications.

MicroGen's primary target market is the industrial and building markets (e.g. process automation, machinery monitoring, lighting control, HVAC, smart utility metering, and many others). Longer term, the secondary market is transportation systems (e.g. planes, trains and automobiles, civil infrastructure monitoring, asset tracking and numerous others).

MicroGen located in Rochester, NY developed its core piezoelectric platform technology at Cornell University ([www.cnf.cornell.edu](http://www.cnf.cornell.edu)). MicroGen is led by a strong international management team, Board of Directors and Advisory Board with significant semiconductor and MEMS industry and start-up company experience.

For more information, visit [www.microgensystems.com](http://www.microgensystems.com).

### About Linear Technology

Linear Technology Corporation, a member of the S&P 500, has been designing, manufacturing and marketing a broad line of high performance analog integrated circuits for major companies worldwide for over three decades. The Company's products provide an essential bridge between our analog world and the digital electronics in communications, networking, industrial, automotive, computer, medical, instrumentation, consumer, and military and

aerospace systems. Linear Technology produces power management, data conversion, signal conditioning, RF and interface ICs, µModule® subsystems, and wireless sensor network products.

For more information, visit [www.linear.com](http://www.linear.com).

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