



# Micron® Small Form Factor PoP Helps Gumstix Create Tiny, Single-Board Computers

*A Micron/Gumstix Case Study*

## Gumstix, Inc.

Founded in 2003, Gumstix makes and markets some of the world's smallest, Linux-based, single-board computers and peripherals to customers located in more than 40 countries worldwide. The company's full-function computers are at the heart of hundreds of commercial products, dozens of exciting scientific experiments, and innumerable robots and educational projects—both enthusiast and commercial.

Gumstix represents the future of hardware design—something the company calls “beyond embedded.” Gumstix computers are smaller than an old fashioned stick of chewing gum, yet are powerful enough to surf the Web, control sensors, and support wireless technologies like Bluetooth and WiFi with the latest in rapid development tools and build packages.

## The Challenge: Ultra-Small Components that Offer Great Performance

When the engineers at Gumstix began developing the Overo™ Earth Motherboard—their most difficult design to date—they set out to design and market a highly functional, high-performance, tiny computer to ride the next wave of innovation. All Gumstix motherboards run a full version of Linux and this new product line would likewise need to have the power to work with customers' latest ideas for wireless engineering and embedded devices.

When the board design shrinks, components and traces become smaller and the layout becomes more complex. Every millimeter matters. The printed circuit board and every component on it must be as small as possible. The

Gumstix engineers knew they wanted to use the Texas Instruments OMAP35x Applications Processors to power their new product line. Next, they needed a memory solution that could measure up and meet their specifications.

## Micron's PoP Provides Performance in a Small Form Factor

Gumstix began the search for a small form factor memory that was flexible, scalable, and fast—and the design team had to have a solution that took up less than 200 square millimeters of board space. Micron has long been a leader in die and package-stacking technology, offering multichip packages (MCPs) and package-on-package (PoP) solutions that minimize power consumption, maximize board space, and increase speed. These solutions take advantage of Micron's prowess in both NAND Flash and DRAM design and manufacture.

“We got great support [from Micron],” said Don Anderson, Gumstix' Executive Vice President of Engineering Services. “We only had to make one minor change from our plan to be able to incorporate Micron's PoP. A very important part of the board is the memory,” Anderson said. “We needed to understand how different combinations of memory [volatile and nonvolatile] would affect the board. And we needed to understand which form factor would work best...Micron has been really good at assisting our engineers. Micron has helped Gumstix meet some very tight deadlines.”

Together, Micron and Gumstix decided on a PoP solution that took just 144 square millimeters of board space and measured only 12mm x 12mm x 1.1mm. This solution helped Gumstix reduce the Overo Earth's total board size. Plus, Micron's PoP configuration places the NAND Flash and Mobile LPDRAM almost in direct



contact, shortening the wires that connect the devices. These shorter interconnections reduce the time it takes for the OMAP processor to communicate with the memory, boosting performance and cutting power consumption.

## Benefits of MCPs and PoPs

Micron MCPs and PoPs combine NAND Flash memory with Mobile low-power DDR. The Gumstix engineering team was able to leverage all of NAND's high-performance and low-power features—like a READ CACHE function for 30 Mb/s streaming and a low 1.8V power supply—and still enjoy great performance in the form of 200 MHz clock and 400 Mb/s throughput.

MCPs and PoPs generally offer a small form factor, great performance, and an optimized solution. And, because Micron manufactures all the memory components within the MCPs and PoPs, every aspect of the design is under tight control—from die layout to quality and function.

## Micron Recognizes Innovation

Gumstix collaborates with design and product experts the world over—constantly listening to comments and suggestions from this loyal user base. This collegial development process means that Gumstix can go from concept to finished design in industry-leading development times. What the Gumstix team needed was an innovative memory supplier that could deliver efficiencies and be very responsive to their deadlines.

"We really like working with companies like Gumstix and Texas Instruments. These innovative companies

have a way of invigorating new concepts and ideas. We like it when our partners have a challenge that we can help resolve. We get to optimize and grow," said Eric Spanneut, Micron's Director of Mobile Marketing.

Gumstix and Micron collaborated on a solution to meet Gumstix' design and supply requirements. "It was clear that Micron recognized our requirements and worked hard to meet them," said Gumstix' Anderson.

## The End Result: Gumstix' Overo Earth Motherboard

With great products and support from Micron, Gumstix was able to launch the Overo Earth computer on time and with a very small, high-performance Micron PoP on board, containing 256Mb of Micron Mobile LPDRAM and 256Mb Micron NAND Flash.

The Overo Earth motherboard is just 17mm x 58mm x 4.2mm, making it the tiniest ARM-based, Linux platform available when it launched in October 2008. The board runs Linux kernel 2.6.27 or higher and features a Texas Instruments OMAP3530 applications processor.

Gumstix Overo Earth is also equipped with a microSD adapter, a 24-pin flex ribbon connector for camera control signals, and two 70-pin AVX 5602-14 connectors for a wide range of expandability options. This well designed motherboard consumes less than 1W on average.

[micron.com](http://micron.com)

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