



### ReThink Non-Volatile Memory

**Crossbar ReRAM: 100x lower read latency and 1000x faster write performance than Flash**

Crossbar was founded in 2010 to commercialize a radically different approach to non-volatile memory called ReRAM. A unique memory technology that can be integrated inside a System-on-Chip on standard logic CMOS manufacturing lines, or produced as a standalone memory chip, Crossbar ReRAM is playing an important role in enabling a new world of electronics innovation. Compared to traditional Flash memory, Crossbar ReRAM offers much faster, bit/byte-alterable, low power, erase-free operation. It can be architected with smaller pages to reduce read and write latencies, lower energy and increased lifetime of the storage solutions. With ReRAM, designers can create entirely new subsystems – from “persistent memory” which brings data closer to the CPU to “smart memory” that enables in-memory computing without a host CPU.

### ReThink Electronics Innovation

The light bulb. The car. The telephone. All of these inventions had profound impacts on the world and people’s lives. So what’s next? Natural Human-Machine interfaces, autonomous machines, artificial intelligence, bringing yet another wave of invention that will shift the trajectory of society in stunning and positive ways. These systems require instant, ubiquitous access to Data to be alive. Data is becoming the “New Air”, wherever, whenever, always available. But to make Data truly ubiquitous, inventors have to rethink the status quo. New technologies are needed to architect systems with no latency, high energy efficiency, high capacity and screaming fast performance. That’s where Crossbar ReRAM comes in. With ReRAM, designers will create entirely new subsystems from “persistent computing” where integrated data pods never shut down to “smart memory” that learns from every interaction and autonomously retrieves, filters, computes data without the intervention of the CPU.

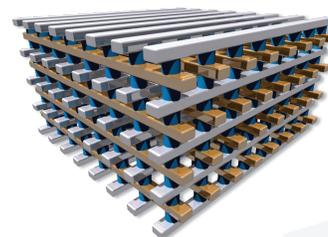
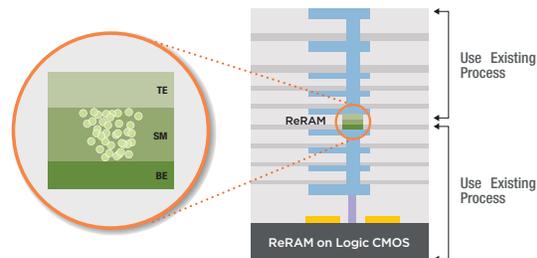
### Rethink Simplicity

ReRAM is based on a simple three-layer structure of metal, amorphous silicon and silicon. Crossbar ReRAM technology uses a silicon-based switching material as the host for a metallic filament formation. When a voltage is applied between the two electrodes, a nano-filament is formed. Because the resistance switching mechanism is based on an electric field, the Crossbar ReRAM cell is very stable, capable of withstanding temperature swings from -40° up to 125°C, and a retention of 10 years at 85°C.

Crossbar ReRAM technology can be stacked in 3D, delivering multiple terabytes of storage on a single chip. Its simplicity, stackability and CMOS compatibility enable logic and memory to be integrated onto a single chip at the latest technology node.

### CROSSBAR KEY FACTS:

- Founded in 2010
- Headquarters in Santa Clara, California
- Leader in patented filament-based non-volatile ReRAM technology
- IP cores licensed for 40nm ready
- Licensed embedded memory IPs for SoC, MCU, FPGA from Kbytes, Mbytes to Gbytes
- Licensed storage memory IPs for standalone memory chips from Mbytes, Gbytes to Terabytes.
- 290 patents filed, with 145 patents already issued
- Collaborative engagements in process to develop custom, ReRAM centric architectures



Crossbar's patented built-in selector allows various memory array configurations in which a single transistor can drive one or thousands of memory cells. This enables Crossbar cells to be organized in super dense 3D cross-point arrays, stackable with the capability to scale below 10nm, paving the way for terabytes on a single die.

## Product Highlights

Crossbar ReRAM is available for licensing at 40nm and is ported to 28nm and below process nodes, enabling even higher density and more tightly integrated devices. Crossbar licenses its technology to SoC and memory companies as off-the-shelf or custom IP cores. Crossbar is also actively growing its eco-system of hardware and software partners to help rethink how new ReRAM-centric architectures can usher in the next wave of innovation.

### P SERIES

Crossbar P series IP cores are an ideal choice in embedded non-volatile memory applications such as Internet of Things (IoT), wearables, tablets, smartphones, consumer electronics, artificial intelligence, industrial, automotive and medical. The P series IP cores can be integrated at the same process nodes of micro-controllers (MCU), System-on-Chip (SoC) and Field Programmable Gate Arrays (FPGA) or used as stand-alone memory chips. Starting at 40nm and scaling below 10nm, the P series enables cost effective, low latency, high performance and low energy code execution and data storage memory solutions.

### T SERIES

Crossbar T series IP cores are an ideal choice for high-density, low-latency memory applications such as data center storage, mobile computing, consumer electronics, and artificial intelligence. They offer high density, low latency, high performance and low power in a non-volatile memory solution. The data integrity and operational characteristics exceed current 3D NAND Flash. Depending on the business model, the IP cores can be provided to customers as hard macros that can be integrated into SoC or FPGA devices or used as stand-alone memory chips. Supported densities are from 8Gbits (1GBytes) to 1 Terabyte, or custom sizes.

### CUSTOM ReRAM

Based on our unique ReRAM technology IP portfolio, Crossbar offers pre-defined or custom IP cores with specific features, size and performance required by strategic partners. Crossbar is able to optimize the key attributes for specific requirements, such as endurance, retention, read/write speed and latency, operating voltages and current, and memory size.

## Memory is Everywhere



### TECHNOLOGY HIGHLIGHTS:

- Proven scalability below 10nm process node
- 100x lower read latency, 20x better energy efficiency and 1000x faster write performance than NAND Flash
- No erase needed, bit/byte level overwrite capability
- Manufactured on standard CMOS production lines
- Capacities of 1TB/chip and more possible

### Contact Crossbar

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