

# Storing and Retrieving Data with High-Density Ferroelectric Memory



Innovators at NASA's Marshall Space Flight Center have developed and patented a novel device for storing and retrieving electronic data. The device stores digital information as a multi-level digital or as an analog signal on a ferroelectric transistor that can be retrieved and converted back to the original digital data. Ferroelectric memory uses an electric field to write a bit of data in the form of an electrical polarization charge to certain types of materials. The memory circuit provides for higher memory density, compensates for environmental and ferroelectric aging, and allows analog values to be directly stored in memory. In addition, the innovation is resistant to degradation from environmental and radiation exposure and relies on commercially available technologies.

## Benefits

- **High capacity:** Technology can store up to a byte of digital data on a memory cell of 2 transistors
- **Robust:** Resistant to degradation from environmental and radiation exposure
- **Simple:** Features a design that relies on commercially available technologies, minimizing complexity
- **Flexible:** Offers dual capacity, storing both analog and digital data on the same device
- **Fast:** Reads and writes in nanoseconds, faster than Flash or Electrically Erasable Programmable Read-Only Memory (EEPROM)



## Technology Details

### *How It Works*

The technology stores multi-level digital or analog data onto a ferroelectric memory cell consisting of two ferroelectric transistors. During the write mode, digital information is written to the first, or data ferroelectric transistor. Up to a byte of data (256 distinct levels) may be written. At the same time, a control level is written to the second, or reference transistor. The control information is used during reading to determine the amount of degradation that occurs on the data transistor. During the read mode, the information stored in the data transistor is interpreted through an algorithm based on the amount of degradation in the reference transistor.

### *Why It Is Better*

The device increases greatly the amount of data that can be stored per square millimeter of chip area. NASA's innovation is also much faster than Flash or EEPROM circuits for writing data and is fast enough to be used directly for storage by a computer CPU. In addition, the ferroelectric transistors can be written to an unlimited number of times, increasing the lifetime of the device.



## Patents

NASA's Marshall Space Flight Center has received patent protection for its Nonvolatile Analog Memory technology: U.S. Patent No.: 7,259,981 B1.

## Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to inquire about licensing possibilities for the Nonvolatile Analog Memory technology (MFS-32208-1) for further development and commercial applications.

## Applications

- High-speed computer RAM and hard drives
- Analog sensor data storage
- Radio Frequency Identification (RFID) systems

## For More Information

If you would like more information about this technology, please contact:

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