Electrically Variable Resistive Memory Devices
Data are written or read using larger or smaller current pulses, respectively.

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Nonvolatile electronic memory devices that store data in the form of electrical-resistance values, and memory circuits based on such devices, have been invented. These devices and circuits exploit an electrically-variable-resistance phenomenon that occurs in thin films of certain oxides that exhibit the colossal magnetoresistive (CMR) effect. It is worth emphasizing that, as stated in the immediately preceding article, these devices function at room temperature and do not depend on externally applied magnetic fields.

A device of this type is basically a thin-film resistor: it consists of a thin film of a CMR material located between, and in contact with, two electrical conductors. The application of a short-duration, low-voltage current pulse via the terminals changes the electrical resistance of the film. The amount of the change in resistance depends on the size of the pulse. The direction of change (increase or decrease of resistance) depends on the polarity of the pulse. Hence, a datum can be written (or a prior datum overwritten) in the memory device by applying a pulse of size and polarity tailored to set the resistance at a value that represents a specific numerical value. To read the datum, one applies a smaller pulse — one that is large enough to enable accurate measurement of resistance, but small enough so as not to change the resistance.

In writing, the resistance can be set to any value within the dynamic range of the CMR film. Typically, the value would be one of several discrete resistance values that represent logic levels or digits. Because the number of levels can exceed 2, a memory device of this type is not limited to binary data. Like other memory devices, devices of this type can be incorporated into a memory integrated circuit by laying them out on a substrate in rows and columns, along with row and column conductors for electrically addressing them individually or collectively.

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