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Inventor(s)

Ramaswamy; Durai Vishak Nirmal et al.

DIFFERENTIAL STORAGE IN MEMORY ARRAYS

Abstract

Methods, systems, and devices for differential storage in memory arrays are described. A memory device may include pairs of memory cells configured to store a single logic state (e.g., a single bit of information). Additionally, the memory device may include sense amplifiers configured to sense the logic state based on a difference between a voltage of a first ferroelectric memory cell of the pair of memory cells and a voltage of a second ferroelectric memory cell of the pair of memory cells. In one example, the memory device may include pairs of memory cells within a single memory array on a single level. Here, each memory cell pair may include a memory cells that are each coupled with a same word line and plate line. Additionally, each memory cell pair may include memory cells each coupled with different digit lines.

Inventors: Ramaswamy; Durai Vishak Nirmal (Boise, ID), Servalli; Giorgio (Fara Gera d'Adda, IT), Visconti; Angelo (Appiano Gentile, IT), Mariani; Marcello (Milano, IT), Calderoni; Alessandro (Boise, ID)

Applicant: Micron Technology, Inc. (Boise, ID)

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Background/Summary

CROSS REFERENCE [0001] The present Application for Patent is a continuation of U.S. patent application Ser. No. 18/047,568 by Ramaswamy et al., entitled “DIFFERENTIAL STORAGE IN MEMORY ARRAYS,” filed Oct. 18, 2022, assigned to the assignee hereof, and is expressly incorporated by reference in its entirety herein.

FIELD OF TECHNOLOGY

[0002] The following relates to one or more systems for memory, including differential storage in memory arrays.

BACKGROUND

[0003] Memory devices are widely used to store information in various electronic devices such as computers, user devices, wireless communication devices, cameras, digital displays, and the like. Information is stored by programming memory cells within a memory device to various states. For example, binary memory cells may be programmed to one of two supported states, often denoted by a logic 1 or a logic 0. In some examples, a single memory cell may support more than two states, any one of which may be stored. To access the stored information, a component may read (e.g., sense, detect, retrieve, identify, determine, evaluate) a stored state in the memory device. To store information, a component may write (e.g., program, set, assign) the state in the memory device.

[0004] Various types of memory devices exist, including magnetic hard disks, random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), self-selecting memory, chalcogenide memory technologies, not-or (NOR) and not-and (NAND) memory devices, and others. Memory cells may be described in terms of volatile configurations or non-volatile configurations. Memory cells configured in a non-volatile configuration may maintain stored logic states for extended periods of time even in the absence of an external power source. Memory cells configured in a volatile configuration may lose stored states when disconnected from an external power source. FeRAM may be able to achieve densities similar to volatile memory but may have non-volatile properties due to the use of a ferroelectric capacitor as a storage device.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1 illustrates an example of a system that supports differential storage in memory arrays in accordance with examples as disclosed herein.

[0006] FIG. 2 illustrates an example of a memory die that supports differential storage in memory arrays in accordance with examples as disclosed herein.

[0007] FIGS. 3A and 3B illustrate examples of hysteresis curves that support differential storage in memory arrays in accordance with examples as disclosed herein.

[0008] FIGS. 4 through 6 illustrate examples of memory array configurations that support differential storage in memory arrays in accordance with examples as disclosed herein.

[0009] FIGS. 7 and 8 illustrate examples of memory dies that support differential storage in memory arrays in accordance with examples as disclosed herein.

DETAILED DESCRIPTION

[0010] A memory device may include one or more memory arrays to store data. In some examples, the memory device may store a logic state at a memory cell in the memory array. In some examples (e.g., due to manufacturing and physical characteristic deviations), a threshold voltage of one memory cell storing a logic state may be different than a threshold voltage of another memory cell storing the same logic state. Accordingly, memory cells within an array that each store a given logic state may be associated with a range or distribution of respective threshold voltages. In some examples, a distribution of threshold voltages for memory cells storing the first logic state may overlap with a distribution for memory cells storing the second logic state. In such examples, applying a reference voltage to determine if a memory cell is storing a first logic state or a second logic state may be difficult (e.g., the reference voltage may be below a lowest threshold voltage of a memory cell storing the first logic state and above a highest threshold voltage of a memory cell storing the second logic state). This may cause inaccurate sensing of memory cells in the memory device.

[0011] As described herein, a memory device may include pairs of memory cells that store a single bit of information or data. In such examples, the memory device may include a sense amplifier configured to sense a logic state based on a difference between a voltage of a first memory cell of the pair of memory cells and a voltage of a second memory cell of the pair of memory cells. Accordingly, the memory device may activate both the first memory cell and the second memory cell and transfer charge to a first digit line coupled with the first memory cell and charge to a second digit line coupled with the second memory cell. The digit lines may carry the charge to the sense amplifier, which may detect a single bit of information stored by the first memory cell and the second memory cell based on the difference between the voltage on the first digit line and the second digit line. The position of the memory cells in the pair of memory cells relative to each other in the memory array may impact the accuracy of sensing the states. For example, the closer in proximity the two memory cells of the pair of memory cells are in the memory array may cause the cells to share similar variations that may occur during processing. In such examples, each of the two cells may have similar characteristics, which may lead to them storing information in a similar manner and increasing the accuracy of the stored information. In other examples, if memory cells of the pair of memory cells share common access lines, it may increase the accuracy of the stored information.

[0012] In some cases, the memory device may include pairs of memory cells within a single memory array (e.g., that is on a single level). In this case, each memory cell in the memory cell pair may be coupled with a same word line and a same plate line and a first memory cell in the pair may be coupled with a first digit line and a second memory cell in the pair may be coupled with a second digit line (e.g., different than the first digit line). In some other cases, the memory device may include pairs of memory cells including a first memory cell in a first memory array and a second memory cell in a second memory array. In one example, each memory cell pair may include a first memory cell in a first memory array and a second memory cell in a second memory array positioned adjacent to the first memory array (e.g., and on a same level as the first memory array). In this example, each memory cell pair may include memory cells coupled with different word line, plate line, and digit line. In another example, each memory cell pair may include a first memory cell in a first memory array a second memory cell in as second memory array positioned above the first memory array (e.g., and on a different level than the first memory array). In this example, each memory cell in the memory cell pair may be coupled with a same word line and a first memory cell in the pair may be coupled with a first digit line and a first plate line and a second memory cell in the pair may be coupled with a second digit line and a second plate line (e.g., different than the first digit line and first plate line).

[0013] Features of the disclosure are initially described in the context of systems and dies with reference to FIGS. 1 and 2. Features of the disclosure are described in the context of hysteresis

curves, memory array configurations, and memory dies with reference to FIGS. 3 through 8.

[0014] FIG. 1 illustrates an example of a system **100** that supports differential storage in memory arrays in accordance with examples as disclosed herein. The system **100** may include a host device **105**, a memory device **110**, and a plurality of channels **115** coupling the host device **105** with the memory device **110**. The system **100** may include one or more memory devices **110**, but aspects of the one or more memory devices **110** may be described in the context of a single memory device (e.g., memory device **110**).

[0015] The system **100** may include portions of an electronic device, such as a computing device, a mobile computing device, a wireless device, a graphics processing device, a vehicle, or other systems. For example, the system **100** may illustrate aspects of a computer, a laptop computer, a tablet computer, a smartphone, a cellular phone, a wearable device, an internet-connected device, a vehicle controller, or the like. The memory device **110** may be a component of the system **100** that is operable to store data for one or more other components of the system **100**. In some cases, the memory device **110** may be referred to as a memory subsystem or a memory system.

[0016] Portions of the system **100** may be examples of the host device **105**. The host device **105** may be an example of a processor (e.g., circuitry, processing circuitry, a processing component) within a device that uses memory to execute processes, such as within a computing device, a mobile computing device, a wireless device, a graphics processing device, a computer, a laptop computer, a tablet computer, a smartphone, a cellular phone, a wearable device, an internet-connected device, a vehicle controller, a system on a chip (SoC), or some other stationary or portable electronic device, among other examples. In some examples, the host device **105** may refer to the hardware, firmware, software, or any combination thereof that implements the functions of an external memory controller **120**. In some examples, the external memory controller **120** may be referred to as a host (e.g., host device **105**).

[0017] A memory device **110** may be an independent device or a component that is operable to provide physical memory addresses/space that may be used or referenced by the system **100**. In some examples, a memory device **110** may be configurable to work with one or more different types of host devices. Signaling between the host device **105** and the memory device **110** may be operable to support one or more of: modulation schemes to modulate the signals, various pin configurations for communicating the signals, various form factors for physical packaging of the host device **105** and the memory device **110**, clock signaling and synchronization between the host device **105** and the memory device **110**, timing conventions, or other functions.

[0018] The memory device **110** may be operable to store data for the components of the host device **105**. In some examples, the memory device **110** (e.g., operating as a secondary-type device to the host device **105**, operating as a dependent-type to the host device **105**) may respond to and execute commands provided by the host device **105** through the external memory controller **120**. Such commands may include one or more of a write command for a write operation, a read command for a read operation, a refresh command for a refresh operation, or other commands.

[0019] The host device **105** may include one or more of an external memory controller **120**, a processor **125**, a basic input/output system (BIOS) component **130**, or other components such as one or more peripheral components or one or more input/output controllers. The components of the host device **105** may be coupled with one another using a bus **135**.

[0020] The processor **125** may be operable to provide functionality (e.g., control functionality) for the system **100** or the host device **105**. The processor **125** may be a general-purpose processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination of these components. In such examples, the processor **125** may be an example of a central processing unit (CPU), a graphics processing unit (GPU), a general purpose GPU (GPGPU), or an SoC, among other examples. In some examples, the external memory controller **120** may be implemented by or be a part of the processor **125**.

[0021] The BIOS component **130** may be a software component that includes a BIOS operated as firmware, which may initialize and run various hardware components of the system **100** or the host device **105**. The BIOS component **130** may also manage data flow between the processor **125** and the various components of the system **100** or the host device **105**. The BIOS component **130** may include instructions (e.g., a program, software) stored in one or more of read-only memory (ROM), flash memory, or other non-volatile memory.

[0022] The memory device **110** may include a device memory controller **155** and one or more memory dies **160** (e.g., memory chips) to support a capacity (e.g., a desired capacity, a specified capacity) for data storage. Each memory die **160** (e.g., memory die **160-a**, memory die **160-b**, memory die **160-N**) may include a local memory controller **165** (e.g., local memory controller **165-a**, local memory controller **165-b**, local memory controller **165-N**) and a memory array **170** (e.g., memory array **170-a**, memory array **170-b**, memory array **170-N**). A memory array **170** may be a collection (e.g., one or more grids, one or more banks, one or more tiles, one or more sections) of memory cells, with each memory cell being operable to store one or more bits of data. A memory device **110** including two or more memory dies **160** may be referred to as a multi-die memory or a multi-die package or a multi-chip memory or a multi-chip package.

[0023] A memory die **160** may be an example of a two-dimensional (2D) array of memory cells or may be an example of a three-dimensional (3D) array of memory cells. In some examples, a 2D memory die **160** may include a single memory array **170**. In some examples, a 3D memory die **160** may include two or more memory arrays **170**, which may be stacked on top of one another or positioned next to one another (e.g., relative to a substrate). In some examples, memory arrays **170** in a 3D memory die **160** may be referred to as or otherwise include different sets (e.g., decks, levels, layers, dies). A 3D memory die **160** may include any quantity of stacked memory arrays **170** (e.g., two high, three high, four high, five high, six high, seven high, eight high). In some 3D memory dies **160**, different decks may share a common access line such that some decks may share one or more of a word line, a digit line, or a plate line.

[0024] A memory die **160** may include pairs of memory cells that store a single bit of information or data. In such examples, the memory die **160** may include a sense amplifier configured to sense a logic state based on a difference between a voltage of a first memory cell **180-a** of the pair **175-a** of memory cells and a voltage of a second memory cell **180-b** of the pair **175-a** of memory cells. Accordingly, the memory die **160** may activate both the first memory cell **180-a** and the second memory cell **180-b** and transfer charge to a first digit line coupled with the first memory cell **180-a** and charge to a second digit line coupled with the second memory cell **180-b**. The digit lines may carry the charge to the sense amplifier, which may detect a single bit of information stored by the first memory cell **180-a** and the second memory cell **180-b** based on the difference between the voltage on the first digit line and the second digit line.

[0025] In some cases, the memory die **160** may include pairs **175** of memory cells within a single memory array **170** (e.g., within a 2D array of memory cells, within a single memory array **170** of a 3D memory die **160**). In this case, each memory cell **180** in the memory cell pair **175-a** may be coupled with a same word line and a same plate line and a first memory cell **180-a** in the pair may be coupled with a first digit line and a second memory cell **180-b** in the pair may be coupled with a second digit line (e.g., different than the first digit line). In some other cases, the memory die **160** may include pairs **175** of memory cells including a first memory cell **180-a** in a first memory array **170** and a second memory cell **180-b** in a second memory array **170**. In one example, each memory cell pair **175** may include a first memory cell **180-a** in a first memory array **170** and a second memory cell **180-b** in a second memory array **170** positioned adjacent to the first memory array **170** (e.g., and on a same level as the first memory array **170**). In this example, each memory cell pair **175** may include memory cells **180** coupled with different word line, plate line, and digit line. In another example, each memory cell pair **175** may include a first memory cell **180-a** in a first memory array **170** a second memory cell **180-b** in as second memory array **170** positioned above

the first memory array **170** (e.g., and on a different level than the first memory array **170**). In this example, each memory cell **180** in the memory cell pair **175** may be coupled with a same word line and a first memory cell **180-a** in the pair may be coupled with a first digit line and a first plate line and a second memory cell **180-b** in the pair may be coupled with a second digit line and a second plate line (e.g., different than the first digit line and first plate line).

[0026] The device memory controller **155** may include components (e.g., circuitry, logic) operable to control operation of the memory device **110**. The device memory controller **155** may include hardware or firmware (e.g., which may include instructions) that enable the memory device **110** to perform various operations and may be operable to receive, transmit, or execute commands or data (e.g., including control information) related to the components of the memory device **110**. The device memory controller **155** may be operable to communicate with one or more of the external memory controller **120**, the one or more memory dies **160**, or the processor **125**. In some examples, the device memory controller **155** may control operation of the memory device **110** described herein in conjunction with the local memory controller **165** of the memory die **160**.

[0027] A local memory controller **165** (e.g., local to a memory die **160**) may include components (e.g., circuitry, logic) operable to control operation of the memory die **160**. In some examples, a local memory controller **165** may be operable to communicate (e.g., receive or transmit data or commands or both) with the device memory controller **155**. In some examples, a memory device **110** may not include a device memory controller **155**, and a local memory controller **165** or the external memory controller **120** may perform various functions described herein. As such, a local memory controller **165** may be operable to communicate with the device memory controller **155**, with other local memory controllers **165**, or directly with the external memory controller **120**, or the processor **125**, or any combination thereof. Examples of components that may be included in the device memory controller **155** or the local memory controllers **165** or both may include receivers for receiving signals (e.g., from the external memory controller **120**), transmitters for transmitting signals (e.g., to the external memory controller **120**), decoders for decoding (e.g., including demodulating) received signals, encoders for encoding (e.g., including modulating) signals to be transmitted, or various other components operable for supporting described operations of the device memory controller **155** or local memory controller **165** or both.

[0028] The external memory controller **120** may be operable to enable communication of information (e.g., data, commands, or both) between components of the system **100** (e.g., between components of the host device **105**, such as the processor **125**, and the memory device **110**). The external memory controller **120** may process (e.g., convert, translate) communications exchanged between the components of the host device **105** and the memory device **110**. In some examples, the external memory controller **120**, or other component of the system **100** or the host device **105**, or its functions described herein, may be implemented by the processor **125**. For example, the external memory controller **120** may be hardware, firmware, or software, or some combination thereof implemented by the processor **125** or other component of the system **100** or the host device **105**. Although the external memory controller **120** is depicted as being external to the memory device **110**, in some examples, the external memory controller **120**, or its functions described herein, may be implemented by one or more components of a memory device **110** (e.g., a device memory controller **155**, a local memory controller **165**) or vice versa.

[0029] The components of the host device **105** may exchange information with the memory device **110** using one or more channels **115**. The channels **115** may be operable to support communications between the external memory controller **120** and the memory device **110**. Each channel **115** may be an example of a transmission medium that carries information between the host device **105** and the memory device **110**. Each channel **115** may include one or more signal paths (e.g., a transmission medium, a conductor) between terminals associated with the components of the system **100**. A signal path may be an example of a conductive path operable to carry a signal. For example, a channel **115** may be associated with a first terminal (e.g., including one or more pins, including one

or more pads) at the host device **105** and a second terminal at the memory device **110**. A terminal may be an example of a conductive input or output point of a device of the system **100**, and a terminal may be operable to act as part of a channel.

[0030] Channels **115** (and associated signal paths and terminals) may be dedicated to communicating one or more types of information. For example, the channels **115** may include one or more command and address (CA) channels **186**, one or more clock signal (CK) channels **188**, one or more data (DQ) channels **190**, one or more other channels **192**, or any combination thereof. In some examples, signaling may be communicated over the channels **115** using single data rate (SDR) signaling or double data rate (DDR) signaling. In SDR signaling, one modulation symbol (e.g., signal level) of a signal may be registered for each clock cycle (e.g., on a rising or falling edge of a clock signal). In DDR signaling, two modulation symbols (e.g., signal levels) of a signal may be registered for each clock cycle (e.g., on both a rising edge and a falling edge of a clock signal).

[0031] FIG. 2 illustrates an example of a memory die **200** that supports differential storage in memory arrays in accordance with examples as disclosed herein. The memory die **200** may be an example of the memory dies **160** described with reference to FIG. 1. In some examples, the memory die **200** may be referred to as a memory chip, a memory device, or an electronic memory apparatus. The memory die **200** may include one or more memory cells **205** that may each be programmable to store different logic states (e.g., programmed to one of a set of two or more possible states). For example, a memory cell **205** may be operable to store one bit of information at a time (e.g., a logic 0 or a logic 1). In some examples, a memory cell **205** (e.g., a multi-level memory cell) may be operable to store more than one bit of information at a time (e.g., a logic 00, logic 01, logic 10, a logic 11). In some examples, the memory cells **205** may be arranged in an array, such as a memory array **170** described with reference to FIG. 1.

[0032] In some examples, a memory cell **205** may store a state (e.g., a polarization state, a dielectric charge) representative of the programmable states in a capacitor. The memory cell **205** may include a logic storage component, such as capacitor **240**, and a switching component **245** (e.g., a cell selection component). A first node of the capacitor **240** may be coupled with the switching component **245** and a second node of the capacitor **240** may be coupled with a plate line **220**. The switching component **245** may be an example of a transistor or any other type of switch device that selectively establishes or de-establishes electronic communication between two components. In FeRAM architectures, the memory cell **205** may include a capacitor **240** (e.g., a ferroelectric capacitor) that includes a ferroelectric material to store a charge (e.g., a polarization) representative of the programmable state.

[0033] The memory die **200** may include access lines (e.g., word lines **210**, digit lines **215**, plate lines **220**) arranged in a pattern, such as a grid-like pattern. An access line may be a conductive line coupled with a memory cell **205** and may be used to perform access operations on the memory cell **205**. In some examples, word lines **210** may be referred to as row lines. In some examples, digit lines **215** may be referred to as column lines or bit lines. References to access lines, row lines, column lines, word lines, digit lines, bit lines, or plate lines, or their analogues, are interchangeable without loss of understanding. Memory cells **205** may be positioned at intersections of the word lines **210**, the digit lines **215**, or the plate lines **220**.

[0034] Operations such as reading and writing may be performed on memory cells **205** by activating access lines such as a word line **210**, a digit line **215**, or a plate line **220**. By biasing a word line **210**, a digit line **215**, and a plate line **220** (e.g., applying a voltage to the word line **210**, digit line **215**, or plate line **220**), a single memory cell **205** may be accessed at their intersection. The intersection of a word line **210** and a digit line **215** in a two-dimensional or in a three-dimensional configuration may be referred to as an address of a memory cell **205**. Activating a word line **210**, a digit line **215**, or a plate line **220** may include applying a voltage to the respective line.

[0035] Accessing the memory cells **205** may be controlled through a row decoder **225**, a column decoder **230**, or a plate driver **235**, or any combination thereof. For example, a row decoder **225** may receive a row address from the local memory controller **265** and activate a word line **210** based on the received row address. A column decoder **230** may receive a column address from the local memory controller **265** and activate a digit line **215** based on the received column address. A plate driver **235** may receive a plate address from the local memory controller **265** and activate a plate line **220** based on the received plate address.

[0036] Selecting or deselecting the memory cell **205** may be accomplished by activating or deactivating the switching component **245**. The capacitor **240** may be in electronic communication with the digit line **215** using the switching component **245**. For example, the capacitor **240** may be isolated from digit line **215** when the switching component **245** is deactivated, and the capacitor **240** may be coupled with digit line **215** when the switching component **245** is activated.

[0037] A word line **210** may be a conductive line in electronic communication with a memory cell **205** that is used to perform access operations on the memory cell **205**. In some architectures, the word line **210** may be in electronic communication with a gate of a switching component **245** of a memory cell **205** and may be operable to control the switching component **245** of the memory cell. In some architectures, the word line **210** may be in electronic communication with a node of the capacitor of the memory cell **205** and the memory cell **205** may not include a switching component.

[0038] A digit line **215** may be a conductive line that couples the memory cell **205** with a sense component **250**. In some architectures, the memory cell **205** may be selectively coupled with the digit line **215** during portions of an access operation. For example, the word line **210** and the switching component **245** of the memory cell **205** may be operable to selectively couple or isolate the capacitor **240** of the memory cell **205** and the digit line **215**. In some architectures, the memory cell **205** may be in electronic communication (e.g., constant) with the digit line **215**.

[0039] A plate line **220** may be a conductive line in electronic communication with a memory cell **205** that is used to perform access operations on the memory cell **205**. The plate line **220** may be in electronic communication with a node (e.g., the cell bottom) of the capacitor **240**. The plate line **220** may cooperate with the digit line **215** to bias the capacitor **240** during access operation of the memory cell **205**.

[0040] The sense component **250** may determine a state (e.g., a polarization state, a charge) stored on the capacitor **240** of the memory cell **205** and determine a logic state of the memory cell **205** based on the detected state. The sense component **250** may include one or more sense amplifiers to amplify the signal output of the memory cell **205**. The sense component **250** may compare the signal received from the memory cell **205** across the digit line **215** to a reference **255** (e.g., a reference voltage, a reference line). The detected logic state of the memory cell **205** may be provided as an output of the sense component **250** (e.g., to an input/output **260**), and may indicate the detected logic state to another component of a memory device (e.g., a memory device **110**) that includes the memory die **200**.

[0041] The local memory controller **265** may control the operation of memory cells **205** through the various components (e.g., row decoder **225**, column decoder **230**, plate driver **235**, and sense component **250**). The local memory controller **265** may be an example of the local memory controller **165** described with reference to FIG. 1. In some examples, one or more of the row decoder **225**, column decoder **230**, and plate driver **235**, and sense component **250** may be co-located with the local memory controller **265**. The local memory controller **265** may be operable to receive one or more of commands or data from one or more different memory controllers (e.g., an external memory controller **120** associated with a host device **105**, another controller associated with the memory die **200**), translate the commands or the data (or both) into information that can be used by the memory die **200**, perform one or more operations on the memory die **200**, and communicate data from the memory die **200** to a host (e.g., a host device **105**) based on performing the one or more operations. The local memory controller **265** may generate row signals and column

address signals to activate the target word line **210**, the target digit line **215**, and the target plate line **220**. The local memory controller **265** also may generate and control various signals (e.g., voltages, currents) used during the operation of the memory die **200**. In general, the amplitude, the shape, or the duration of an applied voltage or current discussed herein may be varied and may be different for the various operations discussed in operating the memory die **200**.

[0042] The local memory controller **265** may be operable to perform one or more access operations on one or more memory cells **205** of the memory die **200**. Examples of access operations may include a write operation, a read operation, a refresh operation, a precharge operation, or an activate operation, among others. In some examples, access operations may be performed by or otherwise coordinated by the local memory controller **265** in response to various access commands (e.g., from a host device **105**). The local memory controller **265** may be operable to perform other access operations not listed here or other operations related to the operating of the memory die **200** that are not directly related to accessing the memory cells **205**.

[0043] The memory die **200** may include pairs of memory cells **205** that store a single bit of information or data. In such examples, the memory die **200** may include a sense amplifier configured to sense a logic state based on a difference between a voltage of a first memory cell **205-a** of the pair **275-a** of memory cells **205** and a voltage of a second memory cell **205-b** of the pair **275-a** of memory cells. Accordingly, the memory die **200** may activate both the first memory cell **205-a** and the second memory cell **205-b** and transfer charge to a first digit line **215** coupled with the first memory cell **205-a** and charge to a second digit line **215** coupled with the second memory cell **205-b**. The digit lines **215** may carry the charge to the sense component **250** (e.g., a sense amplifier such as a differential amplifier), which may detect a single bit of information stored by the first memory cell **205-a** and the second memory cell **205-b** based on the difference between the voltage on the first digit line **215** and the second digit line **215**.

[0044] In some cases, the memory die **200** may include pairs of memory cells **205** within a single memory array (e.g., within a 2D array of memory cells, within a single memory array of a 3D memory die **200**). In this case, each memory cell **205** in the memory cell pair **275-a** may be coupled with a same word line **210** and a same plate line **220** and a first memory cell **205-a** in the pair may be coupled with a first digit line **215** and a second memory cell **205-b** in the pair may be coupled with a second digit line **215** (e.g., different than the first digit line **215**). In some other cases, the memory die **200** may include pairs **275** of memory cells **205** including a first memory cell **205-a** in a first memory array and a second memory cell **205-b** in a second memory array. In one example, each memory cell pair **275** may include a first memory cell **205-a** in a first memory array and a second memory cell **205-b** in a second memory array positioned adjacent to the first memory array (e.g., and on a same level as the first memory array). In this example, each memory cell pair **275** may include memory cells **205** coupled with different word line **210**, plate line **220**, and digit line **215**. In another example, each memory cell pair **275** may include a first memory cell **205-a** in a first memory array a second memory cell **205-b** in as second memory array positioned above the first memory array (e.g., and on a different level than the first memory array). In this example, each memory cell **205** in the memory cell pair **275** may be coupled with a same word line **210** and a first memory cell **205-a** in the pair may be coupled with a first digit line **215** and a first plate line **220** and a second memory cell **205-b** in the pair may be coupled with a second digit line **215** and a second plate line **220** (e.g., different than the first digit line **215** and first plate line **220**).

[0045] FIGS. 3A and 3B illustrate examples of non-linear electrical properties of a ferroelectric memory cell with hysteresis curves **300-a** and **300-b** that support differential storage in memory arrays in accordance with examples as disclosed herein. Hysteresis curves **300-a** and **300-b** illustrate an example ferroelectric memory cell writing and reading process, respectively.

Hysteresis curves **300-a** and **300-b** depict the charge, Q , stored on a ferroelectric capacitor (e.g., capacitor **240** described with reference to FIG. 2) as a function of a voltage difference, V .

[0046] A ferroelectric material is characterized by a spontaneous electric polarization, that is, it

maintains a non-zero electric polarization in the absence of an electric field. Example ferroelectric materials include barium titanate (BaTiO₃), lead titanate (PbTiO₃), lead zirconium titanate (PZT), and strontium bismuth tantalate (SBT). The ferroelectric capacitors described herein may include these or other ferroelectric materials. Electric polarization within a ferroelectric capacitor results in a net charge at the ferroelectric material's surface and attracts opposite charge through the capacitor terminals. Thus, charge is stored at the interface of the ferroelectric material and the capacitor terminals. Because the electric polarization may be maintained in the absence of an externally applied electric field for relatively long times, even indefinitely, charge leakage may be significantly decreased as compared with, for example, capacitors employed in DRAM arrays. This may reduce a quantity of refresh operations used to refresh the logic states stored in memory cells. [0047] Hysteresis curves **300-a** and **300-b** may be understood from the perspective of a single terminal of a capacitor. By way of example, if the ferroelectric material has a negative polarization, positive charge accumulates at the terminal. Likewise, if the ferroelectric material has a positive polarization, negative charge accumulates at the terminal. Additionally, the voltages in hysteresis curves **300-a** and **300-b** represent a voltage difference across the capacitor and are directional. For example, a positive voltage may be realized by applying a positive voltage to the terminal in question (e.g., a cell plate) and maintaining the second terminal (e.g., a cell bottom) at ground (or approximately zero volts (0V)). A negative voltage may be applied by maintaining the terminal in question at ground and applying a positive voltage to the second terminal—i.e., positive voltages may be applied to negatively polarize the terminal in question. Similarly, two positive voltages, two negative voltages, or any combination of positive and negative voltages may be applied to the appropriate capacitor terminals to generate the voltage difference shown in hysteresis curves **300-a** and **300-b**.

[0048] As depicted in hysteresis curve **300-a**, the ferroelectric material may maintain a positive or negative polarization with a zero-voltage difference, resulting in two possible charged states: a charge state **305** and a charge state **310**. According to the examples of FIGS. 3A and 3B, charge state **305** represents a logic 0 and charge state **310** represents a logic 1. In some examples, the logic values of the respective charge states may be reversed to accommodate other schemes for operating a memory cell.

[0049] A logic 0 or 1 may be written to the memory cell by controlling the electric polarization of the ferroelectric material, and thus the charge on the capacitor terminals, by applying voltage. For example, applying a net positive voltage **315** across the capacitor results in charge accumulation until charge state **305-a** is reached. Upon removing voltage **315**, charge state **305-a** follows path **320** until it reaches charge state **305** at zero voltage. Similarly, charge state **310** is written by applying a net negative voltage **325**, which results in charge state **310-a**. After removing negative voltage **325**, charge state **310-a** follows path **330** until it reaches charge state **310** at zero voltage. Charge states **305-a** and **310-a** may also be referred to as the remnant polarization (Pr) values, i.e., the polarization (or charge) that remains upon removing the external bias (e.g., voltage). The coercive voltage is the voltage at which the charge (or polarization) is zero.

[0050] In some examples, each memory cell may be part of a memory cell pair configured to store a single bit of information (e.g., a logic 0 or 1). Here, each memory cell in the pair may be written to store opposite states. For example, a logic 0 may be written to a first memory cell of the pair and a logic 1 may be written to a second memory cell of the pair.

[0051] To read (e.g., sense) the stored state of the ferroelectric capacitor, a voltage may be applied across the capacitor. In response, the stored charge, Q, changes, and the degree of the change depends on the initial charge state—i.e., the final stored charge (Q) depends on whether charge state **305-b** or **310-b** was initially stored. For example, hysteresis curve **300-b** illustrates two possible stored charge states **305-b** and **310-b**. Voltage **335** may be applied across the capacitor **240** as discussed with reference to FIG. 2. In other cases, a fixed voltage may be applied to the cell plate and, although depicted as a positive voltage, voltage **335** may be negative. In response to

voltage **335**, charge state **305-b** may follow path **340**. Likewise, if charge state **310-b** was initially stored, then it follows path **345**. The final position of charge state **305-c** and charge state **310-c** depend on one or more factors, including the specific sensing scheme and circuitry.

[0052] In some cases, the final charge may depend on the intrinsic capacitance of the digit line connected to the memory cell. For example, if the capacitor is electrically connected to the digit line and voltage **335** is applied, the voltage of the digit line may rise due to its intrinsic capacitance. A voltage measured at a sense component may not equal voltage **335** and instead may depend on the voltage of the digit line. The position of final charge states **305-c** and **310-c** on hysteresis curve **300-b** may thus depend on the capacitance of the digit line and may be determined through a load-line analysis—i.e., charge states **305-c** and **310-c** may be defined with respect to the digit line capacitance. As a result, the voltage of the capacitor, voltage **350** or voltage **355**, may be different and may depend on the initial state of the capacitor.

[0053] In cases that each memory cell stores a single bit of information (e.g., a logic 0 or 1), the initial state of the capacitor may be determined by comparing the digit line voltage to a reference voltage. The digit line voltage may be the difference between voltage **335** and the final voltage across the capacitor, voltage **350** or voltage **355**—i.e., the difference between the voltage **335** and the voltage **350** or the difference between the voltage **335** and the voltage **355**. A reference voltage may be generated such that its magnitude is between the two possible voltages of the two possible digit line voltages to determine the stored logic state—i.e., if the digit line voltage is higher or lower than the reference voltage. Upon comparison by the sense component, the sensed digit line voltage may be determined to be higher or lower than the reference voltage, and the stored logic value of the ferroelectric memory cell (i.e., a logic 0 or 1) may be determined.

[0054] In cases that a memory cell is part of a memory cell pair storing a single bit of information, the initial state of the capacitors (e.g., corresponding to the memory cells in the memory cell pair) may be determined by comparing a first voltage on a first digit line coupled with a first memory cell of the pair and a second voltage on a second digit line coupled with a second memory cell of the pair. The difference between the first voltage and the second voltage may be compared to determine the stored logic state. For example, the sense component may detect a first logic state if the first voltage (e.g., on the first digit line that is coupled with the first memory cell of the pair) is greater than the second voltage (e.g., on the second digit line that is coupled with the second memory cell of the pair). Additionally, the sense component may detect a second logic state if the first voltage is less than the second voltage.

[0055] In some cases, differential sensing may be associated with a larger read window (e.g., a difference between compared voltages) as compared to sensing operations that are based on a comparing a single digit line voltage with a reference voltage. For example, differential sensing may be associated with a read window that is twice as large as a read window associated with a sensing operation that is based on comparing the single digit line voltage with a reference voltage. Additionally, differential sensing may be associated with less common mode noise and variability as compared to sensing operations based on comparing a single digit line voltage with a reference voltage. Thus, differential sensing may be associated with increased reliability as compared to sensing operations that are based on comparing a single digit line voltage with a reference voltage. Differential sensing (sometimes referred to as differential storage) may include storing two complementary states in two memory cells of a pair of memory cells. The combination of the two complementary states (e.g., the differential pair) may reduce a likelihood of errors in the resulting information.

[0056] In some cases, a ferroelectric memory cell may maintain the initial logic state after a read operation. For example, if charge state **305-b** is stored, the charge state may follow path **340** to charge state **305-c** during a read operation and, after removing voltage **335**, the charge state may return to initial charge state **305-b** by following path **340** in the opposite direction. In some cases, a ferroelectric memory cell may lose its initial logic state after a read operation. For example, if

charge state **310-b** is stored, the charge state may follow path **345** to charge state **305-c** during a read operation and, after removing voltage **335**, the charge state may relax to the charge state **305-b** by following path **340**.

[0057] Hysteresis curve **300-b** illustrates an example of reading a memory cell that is configured to store the charge state **305-b** and the charge state **310-b**. A read voltage **335** may be applied, for example, as a voltage difference via a digit line **215** and a plate line **220** as described with reference to FIG. 2. Hysteresis curve **300-b** may illustrate read operations where the read voltage **335** is negative voltage difference V_{cap} (e.g., where $V_{bottom} - V_{plate}$ is negative). A negative read voltage across the capacitor may be referred to as a “plate high” read operation, where a plate line **220** is taken initially to a high voltage, and a digit line **215** is initially at a low voltage (e.g., a ground voltage). Although read voltage **335** is shown as a negative voltage across the ferroelectric capacitor **240**, in alternative operations a read voltage may be a positive voltage across the ferroelectric capacitor **240**, which may be referred to as a “plate low” read operation.

[0058] The read voltage **335** may be applied across the ferroelectric capacitor **240** when a memory cell **205** is selected (e.g., by activating a switching component **245** as described with reference to FIG. 2). Upon applying the read voltage **335** to the ferroelectric capacitor **240**, charge may flow into or out of the ferroelectric capacitor **240** via the digit line **215** and plate line **220**, and different charge states may result depending on whether the ferroelectric capacitor **240** was at charge state **305-a** (e.g., a logic 1) or at charge state **310-a** (e.g., a logic 0).

[0059] FIG. 4 illustrates an example of a memory array configuration **400** that supports differential storage in memory arrays in accordance with examples as disclosed herein. The memory array configuration **400** may include aspects of the systems, memory dies, and hysteresis curves as described with reference to FIGS. 1 through 3. For example, the memory array **470**, memory cell **405**, word lines **410**, digit lines **415**, and plate lines **420** may be examples of memory arrays, memory cells, word lines, digit lines, and plate lines, respectively, as described with reference to FIGS. 1 through 3. The memory array configuration **400** may additionally include memory cell pairs **430**, which may be programmed and sensed as described with reference to FIGS. 3A and 3B. The memory array configuration **400** may additionally include a sense amplifier **450**, which may be an example of sense amplifiers and sense components as described with reference to FIGS. 1 through 3.

[0060] The memory array **470** may be included on a memory die (e.g., as described with reference to FIGS. 1 and 2). In some cases, the memory array **470** may be a 2D memory array **470** or the memory array **470** may be a portion of a 3D memory array (e.g., positioned above or below one or more additionally memory arrays **470**). Here, the 3D memory array may include two or more memory arrays **470** (e.g., similar to the memory array **470** illustrated in the memory array configuration **400**) positioned vertically over one another.

[0061] The memory array **470** may include memory cells **405** positioned at intersections of the word lines **410** and the digit lines **415** and the plate lines **420**. In some cases, each memory cell **405** may include a capacitor and a switching component (e.g., as described with reference to FIG. 2). Additionally, each memory cell **405** may be a part of a memory cell pair **430**. That is, each memory cell **405** may, in conjunction with another memory cell **405** that is a part of a same memory cell pair **430**, store a single bit of information **425**. For example, if a first memory cell **405** in the memory cell pair **430** stores one logic state (e.g., a 0), the second memory cell **405** in the memory cell pair **430** may store an opposite logic state (e.g., a 1). In some examples, storing states in two memory cells of a memory cell pair to store a single bit of information may be an example of differential storage or differential signaling. In differential storage, the states stored on the two memory cells of the memory cell pair may be configured to reduce a likelihood of experiencing errors in the single bit of information.

[0062] In the example of the memory array **470**, each memory cell **405** in a memory cell pair **430** may be coupled with a same word line **410**. For example, both memory cells **405** in the memory

cell pair **430** may be coupled with the word line **WL_M**. Additionally, each memory cell **405** in a memory cell pair **430** may include a first memory cell **405** coupled with one digit line **415** and a second memory cell **405** coupled with another digit line **415**. For example, one memory cell **405** in the memory cell pair **430** may be coupled with the digit line **DL_2** and another memory cell **405** in the memory cell pair **430** may be coupled with another digit line **DL_3**. In some cases, the digit lines **415** may be coupled with the memory cells **405** in each memory cell pair **430** may be adjacent (e.g., next to one another, neighboring digit lines **415**). Additionally, or alternatively, the memory cells **405** in each memory cell pair **430** may be separated by one, two, or more digit lines **415**. For example, each memory cell pair **430** may include memory cells **405** separated by one digit line **415** (e.g., a memory cell pair **430** may include a first memory cell **405** coupled with the digit line **DL_0** and a second memory cell coupled with the digit line **DL_2**).

[0063] In some cases, the memory cells **405** in each memory cell pair **430** being coupled with a same word line **410** may decrease differences (e.g., charge drift, threshold drift, access differences, voltage characteristics) between the memory cells **405** in each memory cell pair **430** (e.g., as compared to memory cells **405** in a memory cell pair **430** that are each coupled with different word lines **410**). Additionally, the memory cells **405** in each memory cell pair **430** being coupled with adjacent digit lines **415** may decrease differences (e.g., charge drift, threshold drift, access differences, voltage characteristics) between the memory cells **405** in each memory cell pair **430** (e.g., as compared to memory cells **405** in a memory cell pair **430** that are each coupled with digit lines **415** that are separated by more physical distance).

[0064] In some cases, the memory cells **405** in each memory cell pair **430** may be coupled with different plate lines **420**. For example, each of the plate lines **420** (e.g., **PL_0**, **PL_1**, **PL_2**, **PL_3**, and **PL_M**) may be isolated from one another. Additionally, or alternatively, subsets of the plate lines **420** may be contiguous. That is, a single contiguous layer of conductive material may correspond to more than one plate line **420** (e.g., more than one adjacent plate lines **420**). For example, the plate lines **PL_2** and **PL_3** may correspond to a single plate line **420** (e.g., comprising a single contiguous conductive material). In some examples, the memory cells **405** in each memory cell pair **430** may be coupled with a same plate line **420**. In some cases, the memory cells **405** in each memory cell pair **430** being coupled with a same plate line **420** may decrease differences (e.g., charge drift, threshold drift, access differences, voltage characteristics) between the memory cells **405** in each memory cell pair **430** (e.g., as compared to memory cells **405** in a memory cell pair **430** that are each coupled with different plate lines **420**).

[0065] The memory array **470** may be coupled with a set of sense amplifiers **450**. For example, the memory array configuration **400** may include sense amplifiers **450** each coupled with two digit lines **415**. That is, each sense amplifier **450** may be coupled with a first digit line **415** associated with a first set of memory cells **405** and a second (e.g., different) digit line **415** associated with a second set of memory cells **405**. Here, each sense amplifier **450** may be configured to detect single bits of information **425** stored by memory cell pairs **430** each including one memory cell **405** from the first set of memory cells **405** (e.g., coupled with the first digit line **415**) and another memory cell **405** from the second set of memory cells **405** (e.g., coupled with the second digit line **415**). For example, the sense amplifier **450** may be coupled with a first set of memory cells **405** via a first digit line **415** (e.g., digit line **DL_2**) and coupled with a second set of memory cells **405** via second digit line **415** (e.g., digit line **DL_3**).

[0066] In some cases, each memory cell pair **430** may correspond to a single address. For example, one address may indicate the memory cell pair **430** including two memory cells **405**. Here, the memory device may receive access commands (e.g., write commands, read commands) indicating a single address that corresponds to the memory cell pair **430** (e.g., including two memory cells **405**). To access a memory cell pair **430**, the memory device may activate (e.g., by applying a voltage to) the word line **410** coupled with both memory cells **405** in the memory cell pair **430**, both digit lines **415** each coupled with one of the memory cells **405** in the memory cell pair **430**, and the one or

more plate lines **420** coupled with each of the memory cells **405** in the memory cell pair **430**. In some cases, a digit line driver may be coupled with both digit lines **415** (e.g., associated with the single address), and a plate line driver may be coupled with both plate lines **420** (e.g., associated with the single address). Here, to access a memory cell pair associated with the single address, the digit line driver and plate line driver may activate the corresponding digit lines **415** and plate lines **420**, respectively.

[0067] To determine a logic state of a single bit of information **425** stored by a memory cell pair **430**, a first memory cell **405** in the memory cell pair **430** may transfer a first charge to a first digit line **415** and a second memory cell **405** in the memory cell pair **430** may transfer a second charge to a second digit line **415**. Then, the sense amplifier **450** may detect the single bit of information **425** stored by the memory cell pairs **430** based on a difference between a voltage (e.g., charge) on the first digit line **415** and the second digit line **415**. For example, the sense amplifier **450** may determine that the single bit of information **425** is a first logic state in cases that a voltage on the first digit line **415** is greater than a voltage on the second digit line. Additionally, or alternatively, the sense amplifier **450** may determine that the single bit of information **425** is a second logic state in cases that the voltage on the first digit line **415** is less than the voltage on the second digit line **415**.

[0068] FIG. 5 illustrates an example of a memory array configuration **500** that supports differential storage in memory arrays in accordance with examples as disclosed herein. The memory array configuration **500** may include aspects of the systems, memory dies, and hysteresis curves as described with reference to FIGS. 1 through 3. For example, the memory arrays **570**, memory cell **505**, word lines **510**, digit lines **515**, and plate lines **520** may be examples of memory arrays, memory cells, word lines, digit lines, and plate lines, respectively, as described with reference to FIGS. 1 through 3. The memory array configuration **500** may additionally include memory cell pairs **530**, which may be programmed and sensed as described with reference to FIGS. 3A and 3B. The memory array configuration **500** may additionally include a sense amplifier **550**, which may be an example of sense amplifiers and sense components as described with reference to FIGS. 1 through 3.

[0069] The memory arrays **570** may be included on a memory die (e.g., as described with reference to FIGS. 1 and 2). Additionally, or alternatively, the memory arrays **570** may be part of a 2D memory array **570** or the memory arrays **570** may be a portion of a 3D memory array. In cases that the memory arrays **570** are part of a 3D memory array, the memory array configuration **500** may be positioned above or below one or more similar memory array configurations. That is, the memory array configuration **500** may be positioned on a first level (e.g., deck) of the memory array and one or more additionally memory array configurations **500** may be positioned on other levels (e.g., decks).

[0070] The memory array configuration **500** may include memory cells **505** positioned at intersections of the word lines **510** and the digit lines **515** and the plate lines **520**. In some cases, each memory cell **505** may include a capacitor and a switching component (e.g., as described with reference to FIG. 2). Additionally, each memory cell **505** may be a part of a memory cell pair **530**. That is, each memory cell **505** may, in conjunction with another memory cell **505** that is a part of a same memory cell pair **530**, store a single bit of information **525**. For example, if a first memory cell **505** in the memory cell pair **530** stores one logic state (e.g., a 0), the second memory cell **505** in the memory cell pair **530** may store an opposite logic state (e.g., a 1).

[0071] The memory array configuration **500** may include multiple memory arrays **570** positioned on a same level (e.g., on a same level with respect to a y-axis, on a same vertical level). For example, the memory array configuration **500** may include a first memory array **570-a** that is adjacent (e.g., next to, adjoined) to a second memory array **570-b**. Additionally, each memory cell pair **530** may include a first memory cell **505** from the memory array **570-a** and a second memory cell **505** from the memory array **570-b**. In some cases, the memory cells **505** in each memory cell

pair **530** being on a same level may decrease differences (e.g., charge drift, threshold drift, access differences, voltage characteristics) between the memory cells **505** in each memory cell pair **530** (e.g., as compared to memory cells **505** in a memory cell pair **530** that are on different levels of a 3D memory array).

[0072] The memory cells **505** in each memory cell pair **530** may include a first memory cell **505** coupled with one digit line **515** and a second memory cell **505** coupled with another digit line **515** (e.g., a first digit line **515** in the memory array **570-a** and a second digit line **515** in the memory array **570-b**). For example, one memory cell **505** in the memory cell pair **530** may be coupled with the digit line **DL_0** and another memory cell **505** in the memory cell pair **530** may be coupled with another digit line **DL_0'**. Additionally, the memory cells **505** in each memory cell pair **530** may be coupled with different word lines **510** (e.g., a first word line **510** in the memory array **570-a** and a second word line **510** in the memory array **570-b**). For example, the memory cell **505** in the memory cell pair **530** in the may be coupled with the word line **WL_0** (e.g., in the memory array **570-a**) and another memory cell **505** in the memory cell pair **530** may be coupled with another word line **WL_0'** (e.g., in the memory array **570-b**). In some cases, the memory cells **505** in each memory cell pair **530** may be coupled with different plate lines **520**.

[0073] The memory array **570** may be coupled with a set of sense amplifiers **550**. For example, the memory array configuration **500** may include sense amplifiers **550** each coupled with two digit lines **515**. That is, each sense amplifier **550** may be coupled with a first digit line **515** associated with a first set of memory cells **505** in one memory array **570-a** and a second (e.g., different) digit line **515** associated with a second set of memory cells **505** in another memory array **570-b**. Here, each sense amplifier **550** may be configured to detect single bits of information **525** stored by memory cell pairs **530** each including one memory cell **505** from the first set of memory cells **505** (e.g., coupled with the first digit line **515** in the memory array **570-a**) and another memory cell **505** from the second set of memory cells **505** (e.g., coupled with the second digit line **515** in the memory array **570-b**). For example, the sense amplifier **550** may be coupled with a first set of memory cells **505** in the memory array **570-a** via a first digit line **515** (e.g., digit line **DL_0**) and coupled with a second set of memory cells **505** in the memory array **570-b** via second digit line **515** (e.g., digit line **DL_0'**).

[0074] In some cases, the memory cells **505** in each memory cell pair **530** may be separated from the sense amplifier **550** by equivalent distances (e.g., physical distances, electrical distances). For example, the memory cells **505** in each memory cell pair **530** may be separated from the sense amplifier **550** by a same quantity of word lines **510**. That is, both memory cells **505** in the memory cell pair **530** may be coupled with the word line **510** (e.g., word lines **WL_0** and **WL_0'**) that is closest to the sense amplifier **550** (e.g., separated from the sense amplifier **550** by no word lines **510**). In another example, another memory cell pair **530** may include a first memory cell **505** from the memory array **570-a** coupled with the word line **WL_2** and a second memory cell **505** from the memory array **570-b** coupled with the word line **WL_2'**. Here, both memory cells **505** in the memory cell pair **530** may be separated from the sense amplifier **550** by two word lines **510** (e.g., by word lines **WL_0** and **WL_1** in the memory array **570-a** and word lines **WL_0'** and **WL_1'** in the memory array **570-b**). In some cases, the memory cells **505** in each memory cell pair **530** being separated from the sense amplifier **550** by equivalent distances (such as similar electrical distances) may decrease differences (e.g., charge drift, threshold drift, access differences, voltage characteristics) between the memory cells **505** in each memory cell pair **530** (e.g., as compared to memory cells **505** in a memory cell pair **530** that are separated from the sense amplifier **550** by different electrical distances). The term electrical distance may refer to differences of electrical conditions that a first signal may experience over a first conductive path as compared with electrical conditions that a second signal may experience over a second conductive path. Signals with similar electrical distances may experience similar electrical conditions over their respective paths.

[0075] In some cases, each memory cell pair **530** may correspond to a single address. For example, one address may indicate the memory cell pair **530** including two memory cells **505**. Here, the memory device may receive access commands (e.g., write commands, read commands) indicating a single address that corresponds to the memory cell pair **530** including two memory cells **505**. Here, each address may correspond to two word lines **510**, two digit lines **515**, and two plate lines **520**. To access a memory cell pair **530**, the memory device may activate (e.g., by applying a voltage to) both word lines **510** each coupled with one of the memory cells **505** in the memory cell pair **530**, both digit lines **515** each coupled with one of the memory cells **505** in the memory cell pair **530**, and both plate lines **520** each coupled with one of the memory cells **505** in the memory cell pair **530**. In some cases, a word line driver may be coupled with both word lines **510** (e.g., associated with the single address), a digit line driver may be coupled with both digit lines **515** (e.g., associated with the single address), and a plate line driver may be coupled with both plate lines **520** (e.g., associated with the single address). Here, to access a memory cell pair associated with the single address, the word line driver, digit line driver, and plate line driver may activate the corresponding word lines **510**, digit lines **515**, and plate lines **520**, respectively.

[0076] To determine a logic state of a single bit of information **525** stored by a memory cell pair **530**, a first memory cell **505** in the memory cell pair **530** may transfer a first charge to a first digit line **515** in the memory array **570-a** and a second memory cell **505** in the memory cell pair **530** may transfer a second charge to a second digit line **515** in the memory array **570-b**. Then, the sense amplifier **550** may detect the single bit of information **525** stored by the memory cell pairs **530** based on a difference between a voltage (e.g., charge) on the first digit line **515** and the second digit line **515**. For example, the sense amplifier **550** may determine that the single bit of information **525** is a first logic state in cases that a voltage on the first digit line **515** is greater than a voltage on the second digit line. Additionally, or alternatively, the sense amplifier **550** may determine that the single bit of information **525** is a second logic state in cases that the voltage on the first digit line **515** is less than the voltage on the second digit line **515**.

[0077] FIG. **6** illustrates an example of a memory array configuration **600** that supports differential storage in memory arrays in accordance with examples as disclosed herein. The memory array configuration **500** may include aspects of the systems, memory dies, and hysteresis curves as described with reference to FIGS. **1** through **3**. For example, the memory arrays **670**, memory cell **605**, word lines **610**, digit lines **615**, and plate lines **620** may be examples of memory arrays, memory cells, word lines, digit lines, and plate lines, respectively, as described with reference to FIGS. **1** through **3**. The memory array configuration **600** may additionally include memory cell pairs **630**, which may be programmed and sensed as described with reference to FIGS. **3A** and **3B**. The memory array configuration **600** may additionally include a sense amplifier **650**, which may be an example of sense amplifiers and sense components as described with reference to FIGS. **1** through **3**.

[0078] The memory array configuration **600** may include memory cells **605** positioned at intersections of the word lines **610** and the digit lines **615** and the plate lines **620**. In some cases, each memory cell **605** may include a capacitor and a switching component (e.g., as described with reference to FIG. **2**). Additionally, each memory cell **605** may be a part of a memory cell pair **630**. That is, each memory cell **605** may, in conjunction with another memory cell **605** that is a part of a same memory cell pair **630**, store a single bit of information **625**. For example, if a first memory cell **605** in the memory cell pair **630** stores one logic state (e.g., a 0), the second memory cell **605** in the memory cell pair **630** may store an opposite logic state (e.g., a 1).

[0079] The memory array configuration **600** may include multiple memory arrays **670** positioned on different levels (e.g., on a different levels with respect to a y-axis, on different decks). For example, the memory array configuration **600** may include a first memory array **670-a** that is positioned over a second memory array **670-b** (e.g., with respect to a substrate). Additionally, each memory cell pair **630** may include a first memory cell **605** from the memory array **670-a** and a

second memory cell **605** from the memory array **670-b**.

[0080] The memory cells **605** in each memory cell pair **630** may be coupled a same word line **610** (e.g., that is coupled with memory cells **605** in the memory array **670-a** and the memory array **670-b**). For example, the memory cell pair **630** may include a memory cell **605** in the memory array **670-a** and a memory cell **605** in the memory array **670-b** that are each coupled with the word line **WL_M**. In some cases, the memory cells **605** in each memory cell pair **630** being coupled with a same word line **610** may decrease differences (e.g., charge drift, threshold drift, access differences, voltage characteristics) between the memory cells **605** in each memory cell pair **630** (e.g., as compared to memory cells **605** in a memory cell pair **630** that are coupled with different word lines **610**).

[0081] Additionally, the memory cells **605** in each memory cell pair **630** may include a first memory cell **605** coupled with one digit line **615** and a second memory cell **605** coupled with another digit line **615** (e.g., a first digit line **615** in the memory array **670-a** and a second digit line **615** in the memory array **670-b**). For example, one memory cell **605** in the memory cell pair **630** may be coupled with the digit line **DL_0** and another memory cell **605** in the memory cell pair **630** may be coupled with another digit line **DL_0'**. Additionally, the memory cells **605** in each memory cell pair **630** may be coupled with different plate lines **620**. For example, one memory cell **605** in the memory cell pair **630** may be coupled with the plate line **PL_0** and another memory cell **605** in the memory cell pair **630** may be coupled with another plate line **PL_0'**.

[0082] The memory cells **605** in each memory cell pair **630** may be positioned above one another. That is, the memory cells **605** in each memory cell pair **630** may be coupled with digit lines **615** that are positioned similarly with respect to a substrate (e.g., the digit line **615** coupled with one memory cell **605** in a memory cell pair **630** in the memory array **670-a** may be positioned above the digit line **615** coupled with another memory cell **605** in the memory cell pair **630** in the memory array **670-b**). Additionally, the memory cells **605** in each memory cell pair **630** may be coupled with plate lines **620** that are positioned similarly with respect to a substrate (e.g., the plate line **620** coupled with one memory cell **605** in a memory cell pair **630** in the memory array **670-a** may be positioned above the plate line **620** coupled with another memory cell **605** in the memory cell pair **630** in the memory array **670-b**). In some cases, the memory cells **605** in each memory cell pair **630** being positioned above one another decrease differences (e.g., charge drift, threshold drift, access differences, voltage characteristics) between the memory cells **605** in each memory cell pair **630** (e.g., as compared to memory cells **605** in a memory cell pair **630** that are not positioned above one another).

[0083] The memory array **670** may be coupled with a set of sense amplifiers **650**. For example, the memory array configuration **600** may include sense amplifiers **650** each coupled with two digit lines **615**. That is, each sense amplifier **650** may be coupled with a first digit line **615** associated with a first set of memory cells **605** in one memory array **670-a** and a second (e.g., different) digit line **615** associated with a second set of memory cells **605** in another memory array **670-b**. Here, each sense amplifier **650** may be configured to detect single bits of information **625** stored by memory cell pairs **630** each including one memory cell **605** from the first set of memory cells **605** (e.g., coupled with the first digit line **615** in the memory array **670-a**) and another memory cell **605** from the second set of memory cells **605** (e.g., coupled with the second digit line **615** in the memory array **670-b**). For example, the sense amplifier **650** may be coupled with a first set of memory cells **605** in the memory array **670-a** via a first digit line **615** (e.g., digit line **DL_0**) and coupled with a second set of memory cells **605** in the memory array **670-b** via second digit line **615** (e.g., digit line **DL_0'**).

[0084] In some cases, each memory cell pair **630** may correspond to a single address. For example, one address may indicate the memory cell pair **630** including two memory cells **605**. Here, the memory device may receive access commands (e.g., write commands, read commands) indicating a single address that corresponds to the memory cell pair **630** including two memory cells **605**. Here,

each address may correspond to one word line **610**, two digit lines **615**, and two plate lines **620**. To access a memory cell pair **630**, the memory device may activate (e.g., by applying a voltage to) the word line **610** coupled with both of the memory cells **605** in the memory cell pair **630**, both digit lines **615** each coupled with one of the memory cells **605** in the memory cell pair **630**, and both plate lines **620** each coupled with one of the memory cells **605** in the memory cell pair **630**. In some cases, a digit line driver may be coupled with both digit lines **615** (e.g., associated with the single address), and a plate line driver may be coupled with both plate lines **620** (e.g., associated with the single address). Here, to access a memory cell pair associated with the single address, the digit line driver and plate line driver may activate the corresponding digit lines **615** and plate lines **620**, respectively.

[0085] To determine a logic state of a single bit of information **625** stored by a memory cell pair **630**, a first memory cell **605** in the memory cell pair **630** may transfer a first charge to a first digit line **615** in the memory array **670-a** and a second memory cell **605** in the memory cell pair **630** may transfer a second charge to a second digit line **615** in the memory array **670-b**. Then, the sense amplifier **650** may detect the single bit of information **625** stored by the memory cell pairs **630** based on a difference between a voltage (e.g., charge) on the first digit line **615** and the second digit line **615**. For example, the sense amplifier **650** may determine that the single bit of information **625** is a first logic state in cases that a voltage on the first digit line **615** is greater than a voltage on the second digit line. Additionally, or alternatively, the sense amplifier **650** may determine that the single bit of information **625** is a second logic state in cases that the voltage on the first digit line **615** is less than the voltage on the second digit line **615**.

[0086] FIG. 7 illustrates an example of a memory die **700** that supports differential storage in memory arrays in accordance with examples as disclosed herein. The memory die **700** may include aspects of the systems, memory dies, hysteresis curves, and memory array configurations as described with reference to FIGS. 1 through 6. For example, the word lines **710**, digit lines **715**, and plate lines **720** may be examples of word lines, digit lines, and plate lines, respectively, as described with reference to FIGS. 1 through 6. The memory die **700** may additionally include memory cell pairs, which may be programmed and sensed as described with reference to FIGS. 3A and 3B. The memory die **700** may additionally include sense amplifiers **750**, which may be an example of sense amplifiers and sense components as described with reference to FIGS. 1 through 6.

[0087] The memory die **700** may include a set of memory cells formed along dielectric walls **755** (e.g., including a dielectric material) extending in the x-direction. In some cases, the dielectric walls **755** may be positioned above (e.g., in the z-direction) and between rows of contacts **735**. Each memory cell may include an electrode segment **745** (e.g., a bottom electrode). In some cases, an electrode segment **745** may include a sidewall formed on and in contact with a sidewall of a dielectric wall **755** and a lower surface (e.g., perpendicular to the sidewall) formed on and in contact with a substrate **740**. The memory die **700** may include a set of plate lines **720** extending in the x-direction over rows of electrode segments **745**. A plate line **720** may be configured as an upper electrode for the electrode segments **745**, which may form a set of capacitors corresponding to the memory cells. In some cases, the memory die **700** may include a layer of ferroelectric material between the electrode segments **745** and the plate line **720**. That is, the ferroelectric material may conformally line surfaces of the electrode segments **745** and the dielectric walls **755**. Each memory cell may be programmed to store one or more logic states by applying a voltage across a selected electrode segment **745** and a plate line **720**, which may store charge (e.g., a polarization state, a dielectric charge) across the ferroelectric material.

[0088] In some cases, a memory die **700** may include a contiguous layer of a conductive material corresponding to a single plate line **720** over each of the rows of electrode segments **745** on the memory die **700**. Here, the plate line **720** may be associated with a relatively large capacitance, which may increase a latency associated with accessing memory cells on the memory die **700**. In

the example of the memory die **700**, the layer of the conductive material corresponding to the plate lines **720** may not be contiguous over the memory die **700**. In some cases, the plate line **720-a** include one portion of conductive material that is distinct from (e.g., noncontiguous from) another portion of the conductive material corresponding to the plate line **720-b**. In some cases, the memory die **700** may additionally include a dielectric material coupled with the plate lines **720-a** and **720-b** (e.g., acting as a barrier between the plate lines **720-a** and **720-b** to isolate the plate line **720-a** from the plate line **720-b**). Thus, the memory die **700** may include plate lines **720** that are coupled with less than each of the rows of electrode segments **745** on the memory die **700**. For example, each plate line **720** may be coupled with four, eight, or sixteen rows of electrode segments **745** (e.g., each associated with a digit line **715**). In some cases, decreasing a size of each plate line **720** may decrease a capacitance of the plate lines **720**, which may result in a decreased latency of the memory die **700**.

[0089] The memory die **700** illustrates plate lines **720** that are orthogonal to the word lines **710** (e.g., and parallel to the digit lines **715**). In some other examples, the plate lines **720** may instead be parallel to the word lines **710** (e.g., and orthogonal to the digit lines **715**). Here, each plate line **720** may be coupled with less than each of the word lines **710** (e.g., via the transistors **705** and electrode segments **745**) and may similarly result in a decreased plate capacitance and decreased latency.

[0090] In some examples, forming the memory die **700** may include a forming at least a portion of an electrode on a sidewall (e.g., according to a CIS architecture). That is, some examples of memory dies may be formed based on forming a vertical stud (e.g., a vertical columns positioned above a substrate) or based on forming a well. Alternatively, the memory die **700** may be formed based on forming at least a portion of an electrode on a sidewall (e.g., the electrode segments **745** are formed at least partially on the sidewalls of the dielectric walls **755**). Additionally, to form the memory die **700**, after depositing a contiguous layer of conductive material over the rows of electrode segments **745** that corresponds to the plate lines **720**, a manufacturing process of the memory die **700** may additionally include patterning (e.g., selectively etching) portions of the conductive material to form more than one plate line **720**. In some cases, patterning portions of the conductive material to form the multiple plate lines **720** may additionally include patterning the ferroelectric material (e.g., coupling the plate lines **720** with the electrode segments **745**). Thus, the memory die **700** may include multiple plate lines **720** and multiple portions of distinct (e.g., noncontiguous) ferroelectric material. After patterning the plate lines **720**, a dielectric material may be deposited over the conductive material forming the plate lines **720** (e.g., and between the plate lines **720**).

[0091] The memory die **700** may further include the substrate **740** to support access operations for memory cells positioned on the substrate **740**. The substrate **740** may include a set of digit lines **715** extending in the x-direction and a set of word lines **710** extending in the y-direction and configured to selectively couple a set of memory cells with a set of digit lines **715**. The substrate **740** may further include a set of transistors **705** arranged in one or more rows extending in the x-direction and one or more columns extending in the y-direction. A transistor **705** may be operable to selectively couple an electrode segment **745** with a digit line **715**. For example, a word line **710** may be configured to bias a gate of the transistor **705** to couple a source terminal and a drain terminal of the transistors **705**. In some cases, each transistor **705** may include a contact **735** (e.g., a terminal, such as the source terminal or drain terminal) arranged on an upper surface of the substrate **740**, where each electrode segment **745** may be positioned above and in contact with one of the contacts **735**. Here, each contact **735** may be in electronic communication with one of the word lines **710** and one of the digit lines **715** (e.g., the word line **710** and the digit line **715** that are configured to bias the gate of the transistor **705** including the contact **735**). In some cases, the substrate **740** may include a set of shield lines **730** (e.g., barrier lines) extending in the y-direction arranged between alternating columns of transistors **705**. A shield line **730** may act as barrier between pairs of columns of transistors **705**, which may mitigate undesirable effects on a first word

line **710** if an adjacent second word line **710** is biased, such as a voltage of the second word line **710** activating a transistor **705** coupled with the first word line **710**.

[0092] The memory cells on the memory die **700** may each be a part of a memory cell pair. That is, each memory cell may, in conjunction with another memory cell that is a part of a same memory cell pair, store a single bit of information **725**. For example, if a first memory cell in a memory cell pair stores one logic state (e.g., a 0), the second memory cell in the memory cell pair may store an opposite logic state (e.g., a 1). In the example of the memory die **700**, the memory cells in each memory cell pair may be included on the same level and within a single memory array (e.g., as described with reference to FIG. 4). That is, each word line **710** may be coupled with a set of memory cell pairs (e.g., including both memory cells in each memory cell pair).

[0093] Additionally, each memory cell in a memory cell pair may include a first memory cell coupled with one digit line **715** and a second memory cell coupled with another digit line **715**. In the example of the memory die **700**, the memory cells in each memory cell pair may be separated by one digit line **715**. For example, the digit line **715-a** may be coupled with a first set of memory cells and the digit line **715-c** may be coupled with a second set of memory cells. Additionally, the memory die **700** may include memory cell pairs with one memory cell from the first set (e.g., coupled with the digit line **715-a**) and another memory cell from the second set (e.g., coupled with the digit line **715-c**). Here, each memory cell pair may be separated by the digit line **715-b**. In the example of the memory die **700**, the memory cells in each memory cell pair may be formed along a same side of the dielectric walls **755**. That is, the memory cells in each memory cell pair may each include an electrode segment **745** (e.g., a bottom electrode) with a sidewall formed on and in contact with a sidewall of the dielectric wall **755** that is facing a same direction. In some cases, the memory cells in each memory cell pair being coupled with sidewalls of the dielectric walls **755** that are facing a same direction may decrease differences (e.g., charge drift, threshold drift, access differences, voltage characteristics) between the memory cells in each memory cell pair (e.g., as compared to memory cells in a memory cell pair that are each coupled sidewalls of the dielectric walls **755** that face different directions).

[0094] Each memory cell in a memory cell pair may additionally be coupled with a same plate line **720** (e.g., via a ferroelectric material). For example, the plate line **720-a** may be coupled with electrode segments **745** (e.g., via the ferroelectric material) in a first row (e.g., positioned above the digit line **715-a**) and with electrode segments **745** in a second row (e.g., positioned above the digit line **715-c**). That is, the plate line **720-a** may be in contact with the ferroelectric material, and the ferroelectric material may be positioned between the plate line **720-a** and the electrode segments **745** in the first row and the electrode segments **745** in the second row. Here, the memory die **700** may include memory cell pairs including a first memory cell coupled with the digit line **715-a** and a second memory cell coupled with the digit line **715-c**. In some cases, each memory cell in a pair being coupled with a same plate line **720** may decrease differences (e.g., charge drift, threshold drift, access differences, voltage characteristics) between the memory cells in each memory cell pair (e.g., as compared to memory cells in a memory cell pair that are each coupled with different plate lines **720**).

[0095] The memory die **700** may include a set of sense amplifiers **750**. Additionally, each of the sense amplifiers **750** may be coupled with two digit lines **715**. That is, each sense amplifier **750** may be coupled with a first digit line **715** associated with a first set of memory cells and a second (e.g., different) digit line **715** associated with a second set of memory cells. Here, each sense amplifier **750** may be configured to detect single bits of information **725** stored by memory cell pairs each including one memory cell from the first set of memory cells (e.g., coupled with the first digit line **715**) and another memory cell from the second set of memory cells (e.g., coupled with the second digit line **715**). For example, the sense amplifier **750-c** may be coupled with a first set of memory cells via the digit line **715-d** and coupled with a second set of memory cells via second digit line **715-f**. Here, the sense amplifier **750-c** may detect single bits of information **725-c** stored

by memory cell pairs including a memory cell coupled with the digit line **715-d** and a memory cell coupled with the digit line **715-f**.

[0096] FIG. **8** illustrates an example of a memory die **800** that supports differential storage in memory arrays in accordance with examples as disclosed herein. The memory die **800** may include aspects of the systems, memory dies, hysteresis curves, and memory array configurations as described with reference to FIGS. **1** through **7**. For example, the word lines **810**, digit lines **815**, and plate lines **820** may be examples of word lines, digit lines, and plate lines, respectively, as described with reference to FIGS. **1** through **7**. The memory die **800** may additionally include memory cell pairs, which may be programmed and sensed as described with reference to FIGS. **3A** and **3B**. The memory die **800** may additionally include sense amplifiers **850**, which may be an example of sense amplifiers and sense components as described with reference to FIGS. **1** through **7**.

[0097] The memory die **800** may include a set of memory cells formed along dielectric walls **855** (e.g., including a dielectric material) extending in the x-direction. In some cases, the dielectric walls **855** may be positioned above (e.g., in the z-direction) and between rows of contacts **835**. Each memory cell may include an electrode segment **845** (e.g., a bottom electrode). In some cases, an electrode segment **845** may include a sidewall formed on and in contact with a sidewall of a dielectric wall **855** and a lower surface (e.g., perpendicular to the sidewall) formed on and in contact with a substrate **840**. The memory die **800** may include a set of plate lines **820** extending in the x-direction over rows of electrode segments **845**. The plate lines **820** may be configured as an upper electrode for the electrode segments **845**, which may form a set of capacitors corresponding to the memory cells. In some cases, the memory die **800** may include a layer of ferroelectric material between the electrode segments **845** and the plate line **820**. That is, the ferroelectric material may conformally line surfaces of the electrode segments **845** and the dielectric walls **855**. Each memory cell may be programmed to store one or more logic states by applying a voltage across a selected electrode segment **845** and a plate line **820**, which may store charge (e.g., a polarization state, a dielectric charge) across the ferroelectric material.

[0098] In the example of the memory die **800**, the layer of the conductive material corresponding to the plate lines **820** may not be contiguous over the memory die **800**. That is, the memory die **800** may include plate lines **820** (e.g., portions of the conductive material) that are each positioned above and electrically coupled with two rows of electrode segments **845**. For example, each plate line **820** may be coupled with one row of electrode segments **845** coupled with a first dielectric wall **855** (e.g., and extending above one digit line **815**) and a second row of electrode segments **845** coupled with a second dielectric wall **855** (e.g., and extending above another digit line **815** adjacent to the first digit line **815**). In one example, the plate line **820-b** may be coupled with the row of electrode segments **845** that are coupled with the digit line **815-b** and the row of electrode segments **845** that are coupled with the digit line **815-c** (e.g., adjacent to the digit line **815-b**). Here, the rows of electrode segments **845** (e.g., coupled with the digit lines **815-b** and **815-c**) may be coupled with the plate line **820-b** via a contiguous portion of ferroelectric material. That is, the plate line **820-b** may be in contact with the ferroelectric, and the ferroelectric material may be positioned between the plate line **820-b** and the rows of the electrode segments **845** positioned above the digit lines **815-b** and **815-c**.

[0099] The memory die **800** illustrates plate lines **820** that are orthogonal to the word lines **810** (e.g., and parallel to the digit lines **815**). In some other examples, the plate lines **820** may instead be parallel to the word lines **810** (e.g., and orthogonal to the digit lines **815**). Here, each plate line **820** may be coupled with less than each of the word lines **810** (e.g., via the transistors **805** and electrode segments **845**) and may similarly result in a decreased plate capacitance and decreased latency.

[0100] In some examples, forming the memory die **800** may include a forming at least a portion of an electrode on a sidewall (e.g., according to a CIS architecture). That is, some examples of memory dies may be formed based on forming a vertical stud (e.g., a vertical columns positioned

above a substrate) or based on forming a well. Alternatively, the memory die **800** may be formed based on forming at least a portion of an electrode on a sidewall (e.g., the electrode segments **845** are formed at least partially on the sidewalls of the dielectric wall **855**). Additionally, to form the memory die **800**, after depositing a contiguous layer of conductive material over the rows of electrode segments **845** that corresponds to the plate lines **820**, a manufacturing process of the memory die **800** may additionally include patterning (e.g., selectively etching) portions of the conductive material to form more than one plate line **820**. In some cases, patterning portions of the conductive material to form the multiple plate lines **820** may additionally include patterning the ferroelectric material (e.g., coupling the plate lines **820** with the electrode segments **845**). Thus, the memory die **800** may include multiple plate lines **820** and multiple portions of distinct (e.g., noncontiguous) ferroelectric material. After patterning the plate lines **820**, a dielectric material may be deposited over the conductive material forming the plate lines **820** (e.g., and between the plate lines **820**). Thus, the memory die **800** may additionally include a dielectric material acting as a barrier between the plate lines **820** to isolate the plate lines **820** from other plate lines **820**.

[0101] The memory die **800** may further include the substrate **840** to support access operations for memory cells positioned on the substrate **840**. The substrate **840** may include a set of digit lines **815** extending in the x-direction and a set of word lines **810** extending in the y-direction and configured to selectively couple a set of memory cells with a set of digit lines **815**. The substrate **840** may further include a set of transistors **805** arranged in one or more rows extending in the x-direction and one or more columns extending in the y-direction. A transistor **805** may be operable to selectively couple an electrode segment **845** with a digit line **815**. For example, a word line **810** may be configured to bias a gate of the transistor **805** to couple a source terminal and a drain terminal of the transistors **805**. In some cases, each transistor **805** may include a contact **835** (e.g., a terminal, such as the source terminal or drain terminal) arranged on an upper surface of the substrate **840**, where each electrode segment **845** may be positioned above and in contact with one of the contacts **835**. Here, each contact **835** may be in electronic communication with one of the word lines **810** and one of the digit lines **815** (e.g., the word line **810** and the digit line **815** that are configured to bias the gate of the transistor **805** including the contact **835**). In some cases, the substrate **840** may include a set of shield lines **830** (e.g., barrier lines) extending in the y-direction arranged between alternating columns of transistors **805**. A shield line **830** may act as barrier between pairs of columns of transistors **805**, which may mitigate undesirable effects on a first word line **810** if an adjacent second word line **810** is biased, such as a voltage of the second word line **810** activating a transistor **805** coupled with the first word line **810**.

[0102] The memory cells on the memory die **800** may each be a part of a memory cell pair. That is, each memory cell may, in conjunction with another memory cell that is a part of a same memory cell pair, store a single bit of information **825**. For example, if a first memory cell in a memory cell pair stores one logic state (e.g., a 0), the second memory cell in the memory cell pair may store an opposite logic state (e.g., a 1). In the example of the memory die **800**, the memory cells in each memory cell pair may be included on the same level and within a single memory array (e.g., as described with reference to FIG. 4). That is, each word line **810** may be coupled with a set of memory cell pairs (e.g., including both memory cells in each memory cell pair).

[0103] Additionally, each memory cell in a memory cell pair may include a first memory cell coupled with one digit line **815** and a second memory cell coupled with an adjacent digit line **815**. In the example of the memory die **800**, the memory cells in each memory cell pair may be separated by one digit line **815**. For example, the digit line **815-d** may be coupled with a first set of memory cells and the digit line **815-e** may be coupled with a second set of memory cells.

Additionally, the memory die **800** may include memory cell pairs with one memory cell from the first set (e.g., coupled with the digit line **815-d**) and another memory cell from the second set (e.g., coupled with the digit line **815-e**). In some cases, the memory cells in each memory cell pair being coupled with adjacent digit lines **815** may decrease differences (e.g., charge drift, threshold drift,

access differences, voltage characteristics) between the memory cells in each memory cell pair (e.g., as compared to memory cells in a memory cell pair that are each coupled with digit lines **815** that are separated by one or more other digit lines **815**).

[0104] Each memory cell in a memory cell pair may additionally be coupled with a same plate line **820** (e.g., via a ferroelectric material). For example, the plate line **820-b** may be coupled with electrode segments **845** (e.g., via the ferroelectric material) in a first row (e.g., positioned above the digit line **815-b**) and with electrode segments **845** in a second row (e.g., positioned above the digit line **815-c**). Here, the memory die **800** may include memory cell pairs including a first memory cell coupled with the digit line **815-b** and a second memory cell coupled with the digit line **815-c**. In some cases, each memory cell in a pair being coupled with a same plate line **820** may decrease differences (e.g., charge drift, threshold drift, access differences, voltage characteristics) between the memory cells in each memory cell pair (e.g., as compared to memory cells in a memory cell pair that are each coupled with different plate lines **820**).

[0105] The memory die **800** may include a set of sense amplifiers **850**. Additionally, each of the sense amplifiers **850** may be coupled with two digit lines **815**. That is, each sense amplifier **850** may be coupled with a first digit line **815** associated with a first set of memory cells and a second (e.g., different) digit line **815** associated with a second set of memory cells. Here, each sense amplifier **850** may be configured to detect single bits of information **825** stored by memory cell pairs each including one memory cell from the first set of memory cells (e.g., coupled with the first digit line **815**) and another memory cell from the second set of memory cells (e.g., coupled with the second digit line **815**). For example, the sense amplifier **850-c** may be coupled with a first set of memory cells via the digit line **815-d** and coupled with a second set of memory cells via second digit line **815-e**. Here, the sense amplifier **850-c** may detect single bits of information **825-c** stored by memory cell pairs including a memory cell coupled with the digit line **815-d** and a memory cell coupled with the digit line **815-e**.

[0106] It should be noted that the methods described herein are possible implementations, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible. Furthermore, portions from two or more of the methods may be combined.

[0107] An apparatus is described. The following provides an overview of aspects of the apparatus as described herein:

[0108] Aspect 1: An apparatus, including: a memory array on a first level, where a memory cell pair is configured to store a single bit of information and includes a first ferroelectric memory cell and a second ferroelectric memory cell from the memory array; a first digit line coupled with a first plurality of memory cells in the memory array that includes the first ferroelectric memory cell of the memory cell pair; a second digit line coupled with a second plurality of memory cells in the memory array that includes the second ferroelectric memory cell of the memory cell pair; a word line coupled with a third plurality of memory cells in the memory array that includes the first ferroelectric memory cell and the second ferroelectric memory cell of the memory cell pair; and a sense amplifier coupled with the first digit line and the second digit line, and configured to detect the single bit of information stored by the memory cell pair.

[0109] Aspect 2: The apparatus of aspect 1, where the first digit line and the second digit line are associated with a same address of the memory array.

[0110] Aspect 3: The apparatus of any of aspects 1 through 2, where the first digit line coupled with the sense amplifier is adjacent to the second digit line coupled with the sense amplifier in the memory array.

[0111] Aspect 4: The apparatus of any of aspects 1 through 3, where the first ferroelectric memory cell of the memory cell pair is adjacent to the second ferroelectric memory cell of the memory cell pair in the memory array.

[0112] Aspect 5: The apparatus of any of aspects 1 through 4, further including: a second memory

array on a second level positioned above the first level, where a second memory cell pair includes a third ferroelectric memory cell and a fourth ferroelectric memory cell from the second memory array, and where the second memory cell pair is configured to store a second single bit of information.

[0113] Aspect 6: The apparatus of aspect 5, further including: a third digit line coupled with a fourth plurality of memory cells in the second memory array including the third ferroelectric memory cell of the second memory cell pair; a fourth digit line coupled with a fifth plurality of memory cells in the second memory array including the fourth ferroelectric memory cell of the second memory cell pair; a second word line coupled with a sixth plurality of memory cells in the second memory array including the third ferroelectric memory cell and the fourth ferroelectric memory cell of the second memory cell pair; and a second sense amplifier coupled with the third digit line and the fourth digit line and configured to detect the second single bit of information stored by the second memory cell pair.

[0114] Aspect 7: The apparatus of any of aspects 1 through 6, where: the first ferroelectric memory cell includes a first switching component and a first capacitor; and the second ferroelectric memory cell includes a second switching component and a second capacitor.

[0115] Aspect 8: The apparatus of any of aspects 1 through 7, where the sense amplifier is configured to: receive a first voltage from the first digit line corresponding to the first ferroelectric memory cell; and receive a second voltage from the second digit line corresponding to the second ferroelectric memory cell, where detecting the single bit of information stored by the memory cell pair is based at least in part on a difference between the first voltage and the second voltage.

[0116] An apparatus is described. The following provides an overview of aspects of the apparatus as described herein:

[0117] Aspect 9: An apparatus, including: a first memory array on a first level; a second memory array on the first level, where a memory cell pair is configured to store a single bit of information and includes a first ferroelectric memory cell from the first memory array and a second ferroelectric memory cell from the second memory array; a first digit line coupled with a first plurality of memory cells in the first memory array that includes the first ferroelectric memory cell of the memory cell pair; a second digit line coupled with a second plurality of memory cells in the second memory array that includes the second ferroelectric memory cell in the memory cell pair; a first word line associated with an address and coupled with a third plurality of memory cells in the first memory array that includes the first ferroelectric memory cell of the memory cell pair; a second word line associated with the address and coupled with a fourth plurality of memory cells in the second memory array that includes the second ferroelectric memory cell of the memory cell pair; and a sense amplifier coupled with the first digit line and the second digit line, and configured to detect the single bit of information stored by the memory cell pair.

[0118] Aspect 10: The apparatus of aspect 9, where the first digit line and the second digit line are associated with a same address of the apparatus.

[0119] Aspect 11: The apparatus of any of aspects 9 through 10, where: a first distance between the first ferroelectric memory cell and the sense amplifier is equivalent to a second distance between the second ferroelectric memory cell and the sense amplifier.

[0120] Aspect 12: The apparatus of any of aspects 9 through 11, further including: a third memory array on a second level positioned above the first level; and a fourth memory array on the second level, where a second memory cell pair includes a third ferroelectric memory cell from the third memory array and a fourth ferroelectric memory cell from the fourth memory array, and where the second memory cell pair is configured to store a second single bit of information.

[0121] Aspect 13: The apparatus of aspect 12, further including: a third digit line coupled with a fifth plurality of memory cells in the third memory array including the third ferroelectric memory cell of the second memory cell pair; a fourth digit line coupled with a sixth plurality of memory cells in the fourth memory array including the fourth ferroelectric memory cell in the second

memory cell pair; a third word line associated with a second address and coupled with a seventh plurality of memory cells in the third memory array including the third ferroelectric memory cell of the second memory cell pair; a fourth word line associated with the second address and coupled with a eighth plurality of memory cells in the fourth memory array including the fourth ferroelectric memory cell of the second memory cell pair; and a second sense amplifier coupled with the third digit line and the fourth digit line and configured to detect the second single bit of information stored by the second memory cell pair.

[0122] Aspect 14: The apparatus of any of aspects 9 through 13, where: the first ferroelectric memory cell includes a first switching component and a first capacitor; and the second ferroelectric memory cell includes a second switching component and a second capacitor.

[0123] Aspect 15: The apparatus of any of aspects 9 through 14, where the sense amplifier is configured to: receive a first voltage from the first digit line corresponding to the first ferroelectric memory cell; and receive a second voltage from the second digit line corresponding to the second ferroelectric memory cell, where detecting the single bit of information stored by the memory cell pair is based at least in part on a difference between the first voltage and the second voltage.

[0124] An apparatus is described. The following provides an overview of aspects of the apparatus as described herein:

[0125] Aspect 16: An apparatus, including: a first memory array on a first level; a second memory array on a second level different than the first level, where a memory cell pair is configured to store a single bit of information and includes a first ferroelectric memory cell from the first memory array and a second ferroelectric memory cell from the second memory array; a first digit line coupled with a first plurality of memory cells in the first memory array that includes the first ferroelectric memory cell of the memory cell pair; a second digit line coupled with a second plurality of memory cells in the second memory array that includes the second ferroelectric memory cell of the memory cell pair; a word line coupled with a third plurality of memory cells in the first memory array that includes the first ferroelectric memory cell of the memory cell pair and a fourth plurality of memory cells in the second memory array that includes the second ferroelectric memory cell of the memory cell pair; and a sense amplifier coupled with the first digit line and the second digit line, and configured to detect the single bit of information stored by the memory cell pair.

[0126] Aspect 17: The apparatus of aspect 16, where the first digit line and the second digit line are associated with a same address of the apparatus.

[0127] Aspect 18: The apparatus of any of aspects 16 through 17, further including: a digit line driver coupled with both the first digit line of the first level and the second digit line of the second level and configured to drive a signal over the first digit line and the second digit line in response to receiving a command associated with a single address.

[0128] Aspect 19: The apparatus of any of aspects 16 through 18, where the sense amplifier is configured to: receive a first voltage from the first digit line corresponding to the first ferroelectric memory cell; and receive a second voltage from the second digit line corresponding to the second ferroelectric memory cell, where detecting the single bit of information stored by the memory cell pair is based at least in part on a difference between the first voltage and the second voltage.

[0129] An apparatus is described. The following provides an overview of aspects of the apparatus as described herein:

[0130] Aspect 20: An apparatus, including: a plurality of contacts in electronic communication with one of a plurality of digit lines extending in a first direction and with one of a plurality of word lines extending in a second direction; a plurality of electrodes positioned above the plurality of contacts, the plurality of electrodes comprising a lower surface covering a portion of a respective one of the plurality of contacts and a sidewall perpendicular to the lower surface; a first portion of a dielectric material extending above the plurality of contacts in the first direction between a first row of the plurality of electrodes positioned above a first digit line and a second row of the plurality of

electrodes positioned above a second digit line adjacent to the first digit line, where the first portion of the dielectric material is in contact with sidewalls of the plurality of electrodes in the first row and the plurality of electrodes in the second row; a first portion of a conductive material extending above the plurality of contacts in the first direction and in contact with a first portion of a ferroelectric material that is positioned between the first portion of the conductive material and the plurality of electrodes in the first row; and a second portion of the conductive material extending above the plurality of contacts in the first direction and in contact with a second portion of the ferroelectric material that is distinct from the first portion of the ferroelectric material and positioned between the second portion of the conductive material and the plurality of electrodes in the second row, where the second portion of the conductive material is isolated from the first portion of the conductive material.

[0131] Aspect 21: The apparatus of aspect 20, further including: a second portion of the dielectric material extending above the plurality of contacts in the first direction between a third row of the plurality of electrodes positioned above a third digit line adjacent to the second digit line and a fourth row of the plurality of electrodes positioned above a fourth digit line adjacent to the third digit line, where the second portion of the dielectric material is in contact with sidewalls of the plurality of electrodes in the third row and sidewalls of the plurality of electrodes in the fourth row, where: the second portion of the conductive material is in contact with the second portion of the ferroelectric material that is positioned between the second portion of the conductive material and the plurality of electrodes in the third row; and the second portion of the conductive material is in contact with a third portion of the ferroelectric material that is distinct from the second portion of the ferroelectric material and positioned between the second portion of the conductive material and the plurality of electrodes in the fourth row.

[0132] Aspect 22: The apparatus of aspect 21, further including: a sense amplifier in electronic communication with the second digit line and the fourth digit line and configured to detect a single bit of information stored in a memory cell pair based at least in part on a difference between a first voltage of the second digit line and a second voltage of the fourth digit line.

[0133] Aspect 23: The apparatus of any of aspects 20 through 22, further including: a third row of the plurality of electrodes positioned above a third digit line adjacent to the second digit line, where: the second portion of the ferroelectric material conformally lines lower surfaces and sidewalls of the plurality of electrodes in the second row and the third row; and the second portion of the conductive material is in contact with the second portion of the ferroelectric material that is positioned between the second portion of the conductive material and the plurality of electrodes in the third row.

[0134] Aspect 24: The apparatus of aspect 23, further including: a sense amplifier in electronic communication with the second digit line and the third digit line and configured to detect a single bit of information stored in a memory cell pair based at least in part on a difference between a first voltage of the second digit line and a second voltage of the third digit line.

[0135] Aspect 25: The apparatus of any of aspects 20 through 24, further including: a second portion of the dielectric material extending above the first portion of the dielectric material and isolating the first portion of the conductive material from the second portion of the conductive material.

[0136] Information and signals described herein may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof. Some drawings may illustrate signals as a single signal; however, the signal may represent a bus of signals, where the bus may have a variety of bit widths.

[0137] The terms “electronic communication,” “conductive contact,” “connected,” and “coupled” may refer to a relationship between components that supports the flow of signals between the

components. Components are considered in electronic communication with (e.g., in conductive contact with, connected with, coupled with) one another if there is any electrical path (e.g., conductive path) between the components that can, at any time, support the flow of signals (e.g., charge, current voltage) between the components. At any given time, a conductive path between components that are in electronic communication with each other (e.g., in conductive contact with, connected with, coupled with) may be an open circuit or a closed circuit based on the operation of the device that includes the connected components. A conductive path between connected components may be a direct conductive path between the components or the conductive path between connected components may be an indirect conductive path that may include intermediate components, such as switches, transistors, or other components. In some examples, the flow of signals between the connected components may be interrupted for a time, for example, using one or more intermediate components such as switches or transistors.

[0138] The term “coupling” refers to condition of moving from an open-circuit relationship between components in which signals are not presently capable of being communicated between the components (e.g., over a conductive path) to a closed-circuit relationship between components in which signals are capable of being communicated between components (e.g., over the conductive path). When a component, such as a controller, couples other components together, the component initiates a change that allows signals to flow between the other components over a conductive path that previously did not permit signals to flow.

[0139] The term “isolated” refers to a relationship between components in which signals are not presently capable of flowing between the components. Components are isolated from each other if there is an open circuit between them. For example, two components separated by a switch that is positioned between the components are isolated from each other when the switch is open. When a controller isolates two components from one another, the controller affects a change that prevents signals from flowing between the components using a conductive path that previously permitted signals to flow.

[0140] The terms “layer” and “level” used herein refer to an organization (e.g., a stratum, a sheet) of a geometrical structure (e.g., relative to a substrate). Each layer or level may have three dimensions (e.g., height, width, and depth) and may cover at least a portion of a surface. For example, a layer or level may be a three dimensional structure where two dimensions are greater than a third, e.g., a thin-film. Layers or levels may include different elements, components, or materials. In some examples, one layer or level may be composed of two or more sublayers or sublevels.

[0141] As used herein, the term “electrode” may refer to an electrical conductor, and in some examples, may be employed as an electrical contact to a memory cell or other component of a memory array. An electrode may include a trace, a wire, a conductive line, a conductive layer, or the like that provides a conductive path between components of a memory array.

[0142] The devices discussed herein, including a memory array, may be formed on a semiconductor substrate, such as silicon, germanium, silicon-germanium alloy, gallium arsenide, gallium nitride, etc. In some examples, the substrate is a semiconductor wafer. In other cases, the substrate may be a silicon-on-insulator (SOI) substrate, such as silicon-on-glass (SOG) or silicon-on-sapphire (SOS), or epitaxial layers of semiconductor materials on another substrate. The conductivity of the substrate, or sub-regions of the substrate, may be controlled through doping using various chemical species including, but not limited to, phosphorous, boron, or arsenic. Doping may be performed during the initial formation or growth of the substrate, by ion-implantation, or by any other doping means.

[0143] A switching component (e.g., a transistor) discussed herein may represent a field-effect transistor (FET), and may comprise a three-terminal component including a source (e.g., a source terminal), a drain (e.g., a drain terminal), and a gate (e.g., a gate terminal). The terminals may be connected to other electronic components through conductive materials (e.g., metals, alloys). The

source and drain may be conductive, and may comprise a doped (e.g., heavily-doped, degenerate) semiconductor region. The source and drain may be separated by a doped (e.g., lightly-doped) semiconductor region or channel. If the channel is n-type (e.g., majority carriers are electrons), then the FET may be referred to as a n-type FET. If the channel is p-type (e.g., majority carriers are holes), then the FET may be referred to as a p-type FET. The channel may be capped by an insulating gate oxide. The channel conductivity may be controlled by applying a voltage to the gate. For example, applying a positive voltage or negative voltage to an n-type FET or a p-type FET, respectively, may result in the channel becoming conductive. A transistor may be “on” or “activated” when a voltage greater than or equal to the transistor's threshold voltage is applied to the transistor gate. The transistor may be “off” or “deactivated” when a voltage less than the transistor's threshold voltage is applied to the transistor gate.

[0144] The description set forth herein, in connection with the appended drawings, describes example configurations and does not represent all the examples that may be implemented or that are within the scope of the claims. The term “exemplary” used herein means “serving as an example, instance, or illustration,” and not “preferred” or “advantageous over other examples.” The detailed description includes specific details to providing an understanding of the described techniques. These techniques, however, may be practiced without these specific details. In some instances, well-known structures and devices are shown in block diagram form to avoid obscuring the concepts of the described examples.

[0145] In the appended figures, similar components or features may have the same reference label. Further, various components of the same type may be distinguished by following the reference label by a dash and a second label that distinguishes among the similar components. If just the first reference label is used in the specification, the description is applicable to any one of the similar components having the same first reference label irrespective of the second reference label.

[0146] The functions described herein may be implemented in hardware, software executed by a processor, firmware, or any combination thereof. If implemented in software executed by a processor, the functions may be stored on or transmitted over as one or more instructions (e.g., code) on a computer-readable medium. Other examples and implementations are within the scope of the disclosure and appended claims. For example, due to the nature of software, functions described herein can be implemented using software executed by a processor, hardware, firmware, hardwiring, or combinations of any of these. Features implementing functions may also be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations.

[0147] For example, the various illustrative blocks and modules described in connection with the disclosure herein may be implemented or performed with a processor, such as a DSP, an ASIC, an FPGA, discrete gate logic, discrete transistor logic, discrete hardware components, other programmable logic device, or any combination thereof designed to perform the functions described herein. A processor may be an example of a microprocessor, a controller, a microcontroller, a state machine, or any type of processor. A processor may also be implemented as a combination of computing devices (e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration).

[0148] As used herein, including in the claims, “or” as used in a list of items (for example, a list of items prefaced by a phrase such as “at least one of” or “one or more of”) indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase “based on” shall not be construed as a reference to a closed set of conditions. For example, an exemplary step that is described as “based on condition A” may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase “based on” shall be construed in the same manner as the phrase “based at least in part on.”

[0149] Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that can be accessed by a computer. By way of example, and not limitation, non-transitory computer-readable media can comprise RAM, ROM, electrically erasable programmable read-only memory (EEPROM), compact disk (CD) ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other non-transitory medium that can be used to carry or store desired program code means in the form of instructions or data structures and that can be accessed by a computer, or a processor. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, include CD, laser disc, optical disc, digital versatile disc (DVD), floppy disk and Blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above are also included within the scope of computer-readable media.

[0150] The description herein is provided to enable a person skilled in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to those skilled in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

Claims

1. An apparatus, comprising: a memory array, wherein a memory cell pair is configured to store one or more bits of information and comprises a first memory cell and a second memory cell from the memory array; a first access line coupled with the first memory cell of the memory cell pair; a second access line coupled with the second memory cell of the memory cell pair; a third access line coupled with the first memory cell and the second memory cell of the memory cell pair; one or more dedicated shield lines between one or more sets of switching components associated with the memory array; and a sense amplifier coupled with the first access line and the second access line, and configured to detect the one or more bits of information stored by the memory cell pair.
2. The apparatus of claim 1, wherein: the first access line and the second access line are associated with a same address of the memory array; or the first access line coupled with the sense amplifier is adjacent to the second access line coupled with the sense amplifier in the memory array; or both.
3. The apparatus of claim 1, wherein the first memory cell of the memory cell pair is adjacent to the second memory cell of the memory cell pair in the memory array.
4. The apparatus of claim 1, further comprising: a second memory array on a second level, the second level positioned above a first level on which the memory array is positioned, wherein a second memory cell pair comprises a third memory cell and a fourth memory cell from the second memory array, and wherein the second memory cell pair is configured to store one or more second bits of information.
5. The apparatus of claim 1, wherein the sense amplifier is configured to: receive a first voltage from the first access line corresponding to the first memory cell; and receive a second voltage from the second access line corresponding to the second memory cell, wherein detecting the one or more bits of information stored by the memory cell pair is based at least in part on a difference between the first voltage and the second voltage.
6. An apparatus, comprising: a first memory array; a second memory array, wherein a memory cell

pair is configured to store one or more bits of information and comprises a first memory cell from the first memory array and a second memory cell from the second memory array; a first access line coupled with the first memory cell of the memory cell pair; a second access line coupled with the second memory cell in the memory cell pair; a third access line associated with an address and coupled with the first memory cell of the memory cell pair; a fourth access line associated with the address and coupled with the second memory cell of the memory cell pair; one or more dedicated shield lines between one or more sets of switching components associated with the first memory array, the second memory array, or both; and a sense amplifier coupled with the first access line and the second access line, and configured to detect the one or more bits of information stored by the memory cell pair.

7. The apparatus of claim 6, wherein the first access line and the second access line are associated with a same address of the apparatus.

8. The apparatus of claim 6, wherein: a first distance between the first memory cell and the sense amplifier is equivalent to a second distance between the second memory cell and the sense amplifier.

9. The apparatus of claim 6, further comprising: a third memory array on a second level, the second level positioned above a first level on which the first memory array and the second memory array are positioned; and a fourth memory array on the second level, wherein a second memory cell pair comprises a third memory cell from the third memory array and a fourth memory cell from the fourth memory array, and wherein the second memory cell pair is configured to store one or more second bits of information.

10. The apparatus of claim 6, wherein the sense amplifier is configured to: receive a first voltage from the first access line corresponding to the first memory cell; and receive a second voltage from the second access line corresponding to the second memory cell, wherein detecting the one or more bits of information stored by the memory cell pair is based at least in part on a difference between the first voltage and the second voltage.

11. An apparatus, comprising: a first memory array on a first level; a second memory array on a second level different than the first level, wherein a memory cell pair is configured to store one or more bits of information and comprises a first memory cell from the first memory array and a second memory cell from the second memory array; a first access line coupled with the first memory cell of the memory cell pair; a second access line coupled with the second memory cell of the memory cell pair; a third access line coupled with the first memory cell of the memory cell pair and the second memory cell of the memory cell pair; one or more dedicated shield lines between one or more sets of switching components associated with the first memory array, the second memory array, or both; and a sense amplifier coupled with the first access line and the second access line, and configured to detect the one or more bits of information stored by the memory cell pair.

12. The apparatus of claim 11, wherein the first access line and the second access line are associated with a same address of the apparatus.

13. The apparatus of claim 11, further comprising: an access line driver coupled with both the first access line of the first level and the second access line of the second level and configured to drive a signal over the first access line and the second access line in response to receiving a command associated with a single address.

14. The apparatus of claim 11, wherein the sense amplifier is configured to: receive a first voltage from the first access line corresponding to the first memory cell; and receive a second voltage from the second access line corresponding to the second memory cell, wherein detecting the one or more bits of information stored by the memory cell pair is based at least in part on a difference between the first voltage and the second voltage.

15. An apparatus, comprising: a plurality of electrodes positioned above a first access line and a second access line; a first portion of a dielectric material between a first row of the plurality of

electrodes positioned above the first access line and a second row of the plurality of electrodes positioned above the second access line adjacent to the first access line, wherein the first portion of the dielectric material is in contact with sidewalls of the plurality of electrodes in the first row and the plurality of electrodes in the second row; a first plate line in contact with a first portion of a storage material that is positioned between the first plate line and the plurality of electrodes in the first row; and a second plate line in contact with a second portion of the storage material that is distinct from the first portion of the storage material and positioned between the second plate line and the plurality of electrodes in the second row, wherein the first plate line and the second plate line form an open circuit based at least in part on the second plate line being isolated from the first plate line.

16. The apparatus of claim 15, further comprising: a second portion of the dielectric material between a third row of the plurality of electrodes positioned above a third access line adjacent to the second access line and a fourth row of the plurality of electrodes positioned above a fourth access line adjacent to the third access line, wherein the second portion of the dielectric material is in contact with sidewalls of the plurality of electrodes in the third row and sidewalls of the plurality of electrodes in the fourth row, wherein: the second plate line is in contact with the second portion of the storage material that is positioned between the second plate line and the plurality of electrodes in the third row; and the second plate line is in contact with a third portion of the storage material that is distinct from the second portion of the storage material and positioned between the second plate line and the plurality of electrodes in the fourth row.

17. The apparatus of claim 16, further comprising: a sense amplifier in electronic communication with the second access line and the fourth access line and configured to detect one or more bits of information stored in a memory cell pair based at least in part on a difference between a first voltage of the second access line and a second voltage of the fourth access line.

18. The apparatus of claim 15, further comprising: a third row of the plurality of electrodes positioned above a third access line adjacent to the second access line, wherein: the second portion of the storage material conformally lines lower surfaces and sidewalls of the plurality of electrodes in the second row and the third row; and the second plate line is in contact with the second portion of the storage material that is positioned between the second plate line and the plurality of electrodes in the third row.

19. The apparatus of claim 18, further comprising: a sense amplifier in electronic communication with the second access line and the third access line and configured to detect one or more bits of information stored in a memory cell pair based at least in part on a difference between a first voltage of the second access line and a second voltage of the third access line.

20. The apparatus of claim 15, further comprising: a second portion of the dielectric material extending above the first portion of the dielectric material and isolating the first plate line from the second plate line.
