CLAIMS

1. A semiconductor device comprising:

a first transistor, a channel region of the first transistor comprising an oxide semiconductor;

a second transistor;

a capacitor, one electrode of the capacitor electrically connected to one of a source and a drain of the first transistor and a gate of the second transistor;

a word line electrically connected to a gate of the first transistor;

a first wiring electrically connected to one of a source and a drain of the second transistor;

a bit line electrically connected to the other of the source and the drain of the first transistor and the other of the source and the drain of the second transistor;

a capacitor line electrically connected to the other electrode of the capacitor; and

an A/D converter electrically connected to the first wiring.

2. The semiconductor device according to claim 1,

wherein the A/D converter configured to converting a potential of the first wiring into a digital value and outputting the digital value outside.

3. The semiconductor device according to claim 1,

wherein the second transistor is an n-channel transistor.

4. The semiconductor device according to claim 1,

wherein the second transistor is a p-channel transistor.

5. The semiconductor device according to claim 1,

wherein a channel region of the second transistor includes silicon.

6. A method for driving a semiconductor device including a first transistor whose channel region includes an oxide semiconductor, a second transistor, and a

capacitor whose one electrode electrically connected to one of a source and a drain of the first transistor and a gate of the second transistor, the method comprising:

applying a low voltage to a bit line and a first wiring, applying a high voltage to a word line to turn on the first transistor, and applying a low voltage to a capacitor line, thereby turning on the second transistor, wherein:

the word line is electrically connected to a gate of the first transistor,

the first wiring is electrically connected to one of a source and a drain of the second transistor,

the bit line is electrically connected to the other of the source and the drain of the first transistor and the other of the source and the drain of the second transistor, and

the capacitor line is electrically connected to the other electrode of the capacitor;

applying a first voltage to the first wiring and stopping the application of the low voltage to the bit line so that a voltage corresponding to the first voltage is applied to the gate of the second transistor from the first wiring through the source and the drain of the second transistor, the bit line, and the source and the drain of the first transistor;

applying a low voltage to the word line to turn off the first transistor, applying a low voltage to the bit line and the first wiring, and applying a high voltage to the capacitor line to turn off the second transistor;

applying a high voltage to the first wiring; and

stopping the application of the high voltage to the first wiring, and applying a low voltage to the capacitor line so that a voltage of the first wiring changes from the high voltage to the first voltage.

7. The method according to claim 6,

wherein a channel region of the second transistor includes silicon.

8. The method according to claim 6,

further comprising converting a potential of the first wiring into digital value and outputting the digital value outside,

wherein an A/D converter electrically connected to the first wiring converts the potential of the first wiring.

9. A method for driving a semiconductor device including a first transistor whose channel region includes an oxide semiconductor, a second transistor, a third transistor, and a capacitor whose one electrode electrically connected to one of a source and a drain of the first transistor and a gate of the second transistor, the method comprising:

applying a low voltage to a bit line and a first wiring, applying a high voltage to a first word line to turn on the first transistor, applying the low voltage of the bit line to the gate of the second transistor to turn on the second transistor, and applying a low voltage to a second word line to turn on the third transistor, wherein:

the first word line is electrically connected to a gate of the first transistor,

the second word line is electrically connected to a gate of the third transistor,

the first wiring is electrically connected to one of a source and a drain of the second transistor

one of a source and a drain of the third transistor is electrically connected to the other of the source and the drain of the second transistor,

the bit line is electrically connected to the other of the source and the drain of the first transistor and the other of the source and the drain of the third transistor, and

a low voltage is applied to the other electrode of the capacitor;

applying a first voltage to the first wiring, and stopping the application of the low voltage to the bit line so that a voltage corresponding to the first voltage is applied to the gate of the second transistor from the first wiring through the source and the drain of the second transistor, the source and the drain of the third transistor, the bit line, and the source and the drain of the first transistor;

applying a low voltage to the first word line to turn off the first transistor, applying a low voltage to the bit line and the first wiring, and applying a high voltage to the second word line to turn off the third transistor;

applying a high voltage to the first wiring; and

stopping the application of the high voltage to the first wiring, and applying a low voltage to the second word line to turn on the third transistor so that a voltage of the first wiring changes from the high voltage to the first voltage.

10. The method according to claim 9,

wherein a channel region of the second transistor includes silicon.

11. The method according to claim 9,

wherein a channel region of the second transistor includes silicon, and

wherein a channel region of the third transistor includes silicon.

12. The method according to claim 9, further comprising converting a potential of the first wiring into a digital value and outputting the digital value outside,

wherein an A/D converter electrically connected to the first wiring converts the potential of the first wiring.

13. A method for driving a semiconductor device including a first transistor whose channel region includes an oxide semiconductor, a second transistor, and a capacitor whose one electrode electrically connected to one of a source and a drain of the first transistor and a gate of the second transistor, the method comprising:

applying a high voltage to a bit line and a first wiring, applying a high voltage to a word line to turn on the first transistor, and applying a high voltage to a capacitor line , thereby turning on the second transistor, wherein:

the word line is electrically connected to a gate of the first transistor,

the first wiring is electrically connected to one of a source and a drain of the second transistor,

the bit line is electrically connected to the other of the source and the drain of the first transistor and the other of the source and the drain of the second transistor, and

the capacitor line is electrically connected to the other electrode of the capacitor;

applying a first voltage to the first wiring and stopping application of the high voltage to the bit line so that a voltage corresponding to the first voltage is applied to the gate of the second transistor from the first wiring through the source and the drain of the second transistor, the bit line, and the source and the drain of the first transistor;

applying a low voltage to the word line to turn off the first transistor, applying a high voltage to the bit line and the first wiring, and applying a low voltage to the capacitor line to turn off the second transistor;

applying a low voltage to the first wiring; and

stopping the application of the low voltage to the first wiring, and applying a high voltage to the capacitor line so that a voltage of the first wiring changes from the low voltage to the first voltage.

14. The method according to claim 13,

wherein a channel region of the second transistor includes silicon.

15. The method according to claim 13, further comprising converting a potential of the first wiring into a digital value and outputting the digital value outside,

wherein an A/D converter electrically connected to the first wiring converts the potential of the first wiring.

16. A method for driving a semiconductor device including a first transistor whose channel region includes an oxide semiconductor, a second transistor, a third transistor, and a capacitor whose one electrode electrically connected to one of a source and a drain of the first transistor and a gate of the second transistor, the method comprising:

applying a high voltage to a bit line and a first wiring, applying a high voltage to a first word line to turn on the first transistor, applying the high voltage of the bit line to the gate of the second transistor to turn on the second transistor, and applying a high voltage to a second word line to turn on the third transistor, wherein:

the first word line is electrically connected to a gate of the first transistor,

the second word line is electrically connected to a gate of the third transistor,

the first wiring is electrically connected to one of a source and a drain of the second transistor

one of a source and a drain of the third transistor is electrically connected to the other of the source and the drain of the second transistor,

the bit line is electrically connected to the other of the source and the drain of the first transistor and the other of the source and the drain of the third transistor, and

a low voltage is applied to the other electrode of the capacitor;

applying a first voltage to the first wiring, and stopping the application of the high voltage to the bit line so that a voltage corresponding to the first voltage is applied to the gate of the second transistor from the first wiring through the source and the drain of the second transistor, the source and the drain of the third transistor, the bit line, and the source and the drain of the first transistor;

applying a low voltage to the first word line to turn off the first transistor, applying a high voltage to the bit line and the first wiring, and applying a low voltage to the second word line to turn off the third transistor;

applying a low voltage to the first wiring; and

stopping the application of the low voltage to the first wiring, and applying a high voltage to the second word line to turn on the third transistor so that a voltage of the first wiring changes from the high voltage to the first voltage.

17. The method according to claim 16,

wherein a channel region of the second transistor includes silicon.

18. The method according to claim 16,

wherein a channel region of the second transistor includes silicon, and

wherein a channel region of the third transistor includes silicon.

19. The method according to claim 16, further comprising converting a potential of the first wiring into a digital value and outputting the digital value outside,

wherein an A/D converter electrically connected to the first wiring converts the potential of the first wiring.

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CLAIMS

1. A semiconductor device comprising:

a first transistor, a channel region of the first transistor comprising an oxide semiconductor;

a second transistor;

a capacitor, one electrode of the capacitor electrically connected to one of a source and a drain of the first transistor and a gate of the second transistor;

a word line electrically connected to a gate of the first transistor;

a first wiring electrically connected to one of a source and a drain of the second transistor;

a bit line electrically connected to the other of the source and the drain of the first transistor and the other of the source and the drain of the second transistor;

a capacitor line electrically connected to the other electrode of the capacitor; and

an A/D converter electrically connected to the first wiring.

2. The semiconductor device according to claim 1,

wherein the A/D converter is configured to convert a potential of the first wiring into a digital value and output the digital value outside.

3. The semiconductor device according to claim 1,

wherein the second transistor is an n-channel transistor.

4. The semiconductor device according to claim 1,

wherein the second transistor is a p-channel transistor.

5. The semiconductor device according to claim 1,

wherein a channel region of the second transistor includes silicon.

6. The semiconductor device according to claim 1, comprising:

a driver comprising a decoder,

wherein the decoder is electrically connected to the first wiring.

7. A method for driving a semiconductor device including a first transistor whose channel region includes an oxide semiconductor, a second transistor, and a capacitor whose one electrode electrically connected to one of a source and a drain of the first transistor and a gate of the second transistor, the method comprising:

applying a low voltage to a bit line and a first wiring, applying a high voltage to a word line to turn on the first transistor, and applying a low voltage to a capacitor line, thereby turning on the second transistor, wherein:

the word line is electrically connected to a gate of the first transistor,

the first wiring is electrically connected to one of a source and a drain of the second transistor,

the bit line is electrically connected to the other of the source and the drain of the first transistor and the other of the source and the drain of the second transistor, and

the capacitor line is electrically connected to the other electrode of the capacitor;

applying a first voltage to the first wiring and stopping the application of the low voltage to the bit line so that a voltage corresponding to the first voltage is applied to the gate of the second transistor from the first wiring through the second transistor, the bit line, and the first transistor;

applying a low voltage to the word line to turn off the first transistor, applying a low voltage to the bit line and the first wiring, and applying a high voltage to the capacitor line to turn off the second transistor;

applying a high voltage to the first wiring; and

stopping the application of the high voltage to the first wiring, and applying a low voltage to the capacitor line so that a voltage of the first wiring changes from the high voltage to the first voltage.

8. A method for driving a semiconductor device including a first transistor whose channel region includes an oxide semiconductor, a second transistor, a third transistor, and a capacitor whose one electrode electrically connected to one of a source and a drain of the first transistor and a gate of the second transistor, the method comprising:

applying a low voltage to a bit line and a first wiring, applying a high voltage to a first word line to turn on the first transistor, thereby applying the low voltage of the bit line to the gate of the second transistor and turning on the second transistor, and applying a low voltage to a second word line to turn on the third transistor, wherein:

the first word line is electrically connected to a gate of the first transistor,

the second word line is electrically connected to a gate of the third transistor,

the first wiring is electrically connected to one of a source and a drain of the second transistor

one of a source and a drain of the third transistor is electrically connected to the other of the source and the drain of the second transistor,

the bit line is electrically connected to the other of the source and the drain of the first transistor and the other of the source and the drain of the third transistor, and

a low voltage is applied to the other electrode of the capacitor;

applying a first voltage to the first wiring, and stopping the application of the low voltage to the bit line so that a voltage corresponding to the first voltage is applied to the gate of the second transistor from the first wiring through the second transistor, the third transistor, the bit line, and the first transistor;

applying a low voltage to the first word line to turn off the first transistor, applying a low voltage to the bit line and the first wiring, and applying a high voltage to the second word line to turn off the third transistor;

applying a high voltage to the first wiring; and

stopping the application of the high voltage to the first wiring, and applying a low voltage to the second word line to turn on the third transistor so that a voltage of the first wiring changes from the high voltage to the first voltage.

9. A method for driving a semiconductor device including a first transistor whose channel region includes an oxide semiconductor, a second transistor, and a capacitor whose one electrode electrically connected to one of a source and a drain of the first transistor and a gate of the second transistor, the method comprising:

applying a high voltage to a bit line and a first wiring, applying a high voltage to a word line to turn on the first transistor, and applying a high voltage to a capacitor line, thereby turning on the second transistor, wherein:

the word line is electrically connected to a gate of the first transistor,

the first wiring is electrically connected to one of a source and a drain of the second transistor,

the bit line is electrically connected to the other of the source and the drain of the first transistor and the other of the source and the drain of the second transistor, and

the capacitor line is electrically connected to the other electrode of the capacitor;

applying a first voltage to the first wiring and stopping application of the high voltage to the bit line so that a voltage corresponding to the first voltage is applied to the gate of the second transistor from the first wiring through the second transistor, the bit line, and the first transistor;

applying a low voltage to the word line to turn off the first transistor, applying a high voltage to the bit line and the first wiring, and applying a low voltage to the capacitor line to turn off the second transistor;

applying a low voltage to the first wiring; and

stopping the application of the low voltage to the first wiring, and applying a high voltage to the capacitor line so that a voltage of the first wiring changes from the low voltage to the first voltage.

10. A method for driving a semiconductor device including a first transistor whose channel region includes an oxide semiconductor, a second transistor, a third

transistor, and a capacitor whose one electrode electrically connected to one of a source and a drain of the first transistor and a gate of the second transistor, the method comprising:

applying a high voltage to a bit line and a first wiring, applying a high voltage to a first word line to turn on the first transistor, thereby applying the high voltage of the bit line to the gate of the second transistor and turning on the second transistor, and applying a high voltage to a second word line to turn on the third transistor, wherein:

the first word line is electrically connected to a gate of the first transistor,

the second word line is electrically connected to a gate of the third transistor,

the first wiring is electrically connected to one of a source and a drain of the second transistor

one of a source and a drain of the third transistor is electrically connected to the other of the source and the drain of the second transistor,

the bit line is electrically connected to the other of the source and the drain of the first transistor and the other of the source and the drain of the third transistor, and

a low voltage is applied to the other electrode of the capacitor;

applying a first voltage to the first wiring, and stopping the application of the high voltage to the bit line so that a voltage corresponding to the first voltage is applied to the gate of the second transistor from the first wiring through the second transistor, the third transistor, the bit line, and the first transistor;

applying a low voltage to the first word line to turn off the first transistor, applying a high voltage to the bit line and the first wiring, and applying a low voltage to the second word line to turn off the third transistor;

applying a low voltage to the first wiring; and

stopping the application of the low voltage to the first wiring, and applying a high voltage to the second word line to turn on the third transistor so that a voltage of the first wiring changes from the low voltage to the first voltage.

11. The method according to any one of claims 7-10,

wherein a channel region of the second transistor includes silicon.

12. The method according to claim 8 or claim 10,

wherein a channel region of the second transistor includes silicon, and

wherein a channel region of the third transistor includes silicon.

13. The method according to any one of claims 7-10, further comprising converting a potential of the first wiring into a digital value and outputting the digital value outside,

wherein an A/D converter electrically connected to the first wiring converts the potential of the first wiring.