Electronics
Logic Gates: Tri-State Output

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Types of logic gate outputs

- Totem pole
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  Output is **HIGH** or **LOW**.
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- Open collector

Three types of outputs
- Tri-state output
- Tri-state output equivalent circuit
- Tri-state output (inverting)
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  - Output can be **HIGH**, **LOW**, or **floating**.

This requires two inputs; input and select.
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Tri-state outputs

![Tri-state output equivalent circuit](image)

- **input**
- **select**
- **output**

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Tri-state outputs

- **input** is to make output LOW or HIGH,
Tri-state outputs

- **input** is to make output LOW or HIGH,
- **select** is to make output float or follow input
Tri-state output equivalent circuit

The select determines whether the output is floating or not.
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Tri-state output (inverting)
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- Gates can be inverting, like other gates.
Microprocessor buses

- A **bus** is created if several tristate devices are connected together.
- As long as only one is selected at a time, there is no problem.
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Tri-state (I/O) pins

A tri-state (I/O) pin allows both input and output on the same pin. The direction input indicates whether the pin is to serve as an input or output (i.e., floating).
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Tri-state (I/O) pins

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- The **direction** input indicates output or input (i.e. floating).
Tri-state busses

- Tri-state busses allow several devices to input and output on the same lines.
- Uses I/O signal and address decoding
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Here’s what a CMOS tri-state output looks like inside. (Note the top transistor is turned on by a low, but the bottom transistor is turned on by a high.)
When output is enabled, and data out is low, the output will be low. (Only bottom transistor on.)
When output is enabled, and data out is high, the output will be high. (Only top transistor on.)
When output is not enabled, the output will float (to become an input). (Both transistors off.)