Electronics
Logic Gates: Tri-State Output

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May 20, 2011

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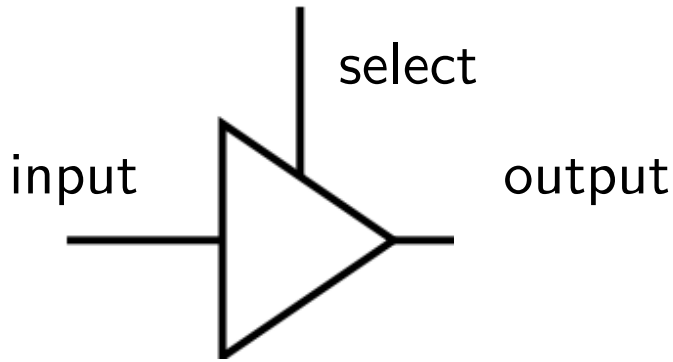
Tri-state outputs



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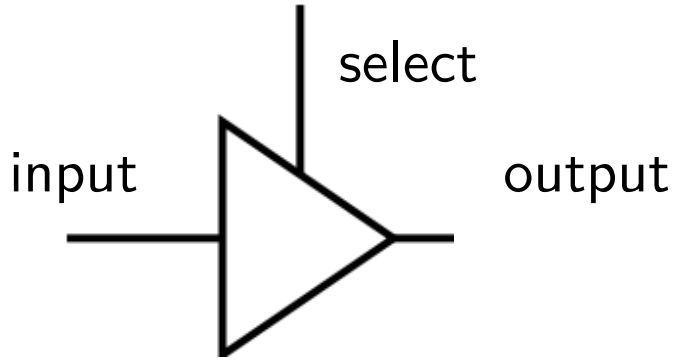

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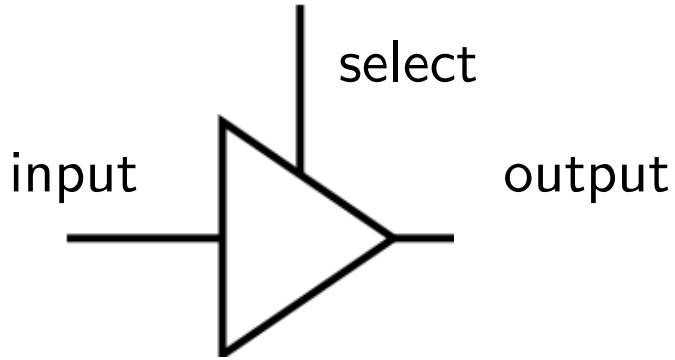
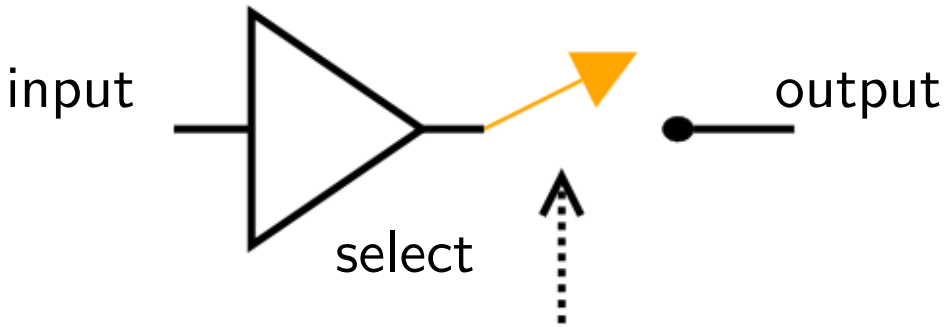


- input is to make output LOW or HIGH,
- select is to make output float or follow input

Tri-state output equivalent circuit



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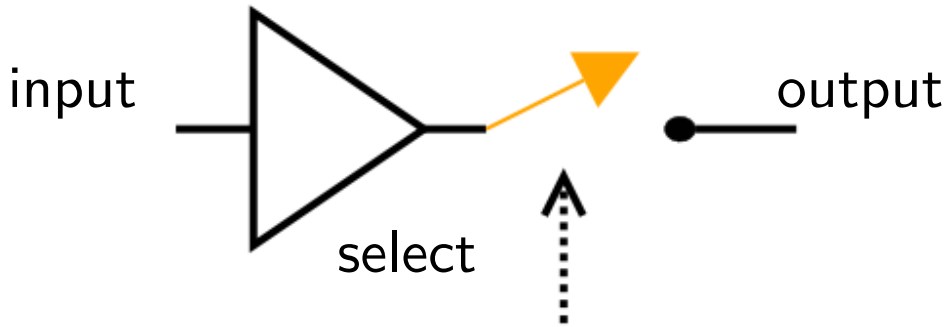
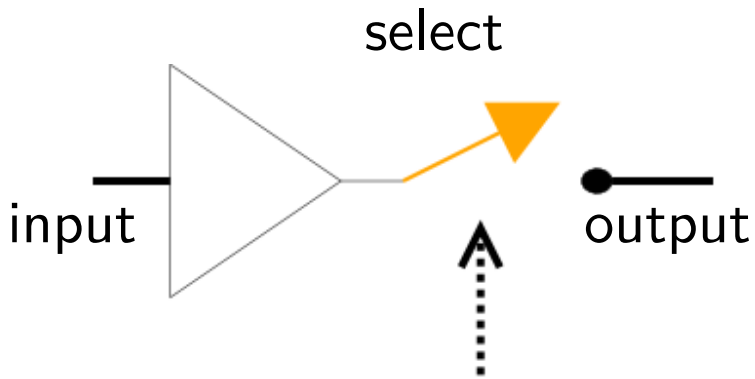
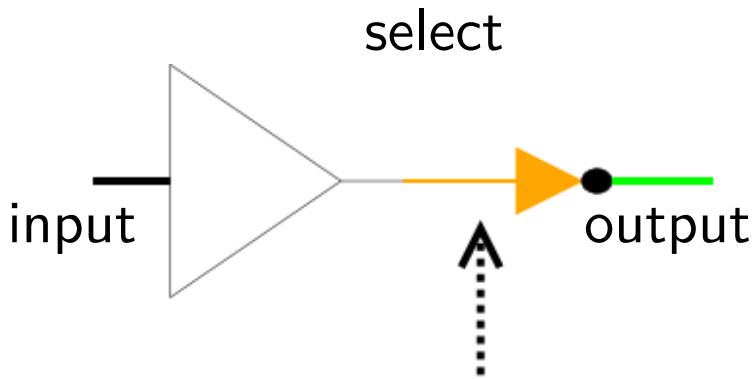


- The **select** determines whether the output is floating or not.


select
input
output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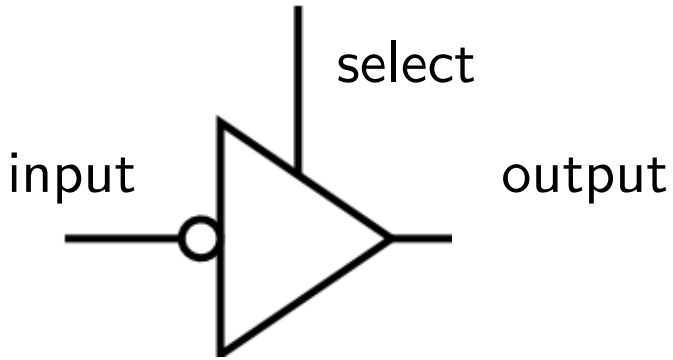
Tri-state output (inverting)



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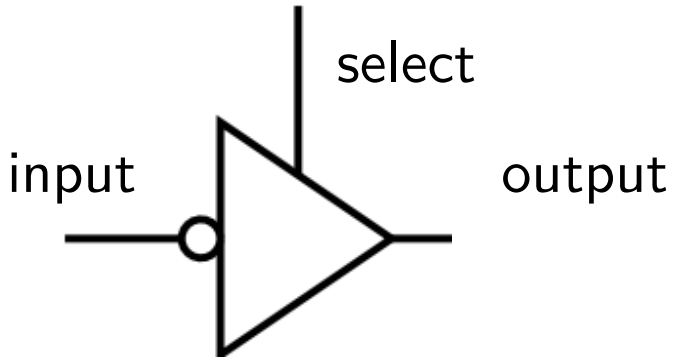
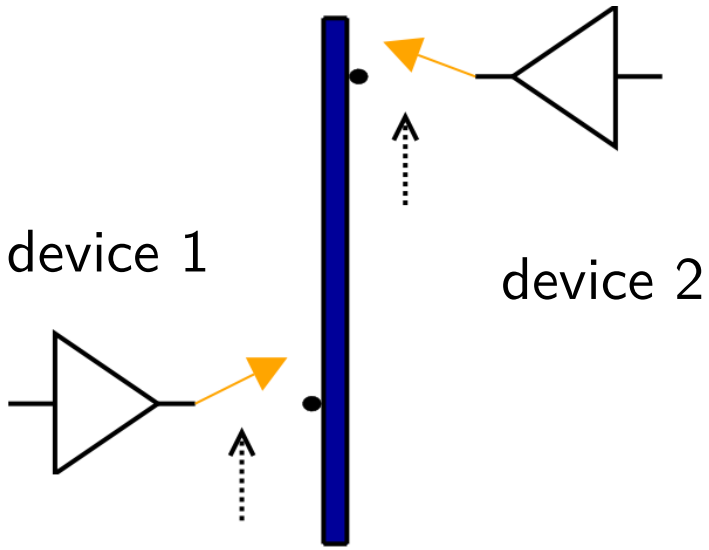


- Gates can be inverting, like other gates.

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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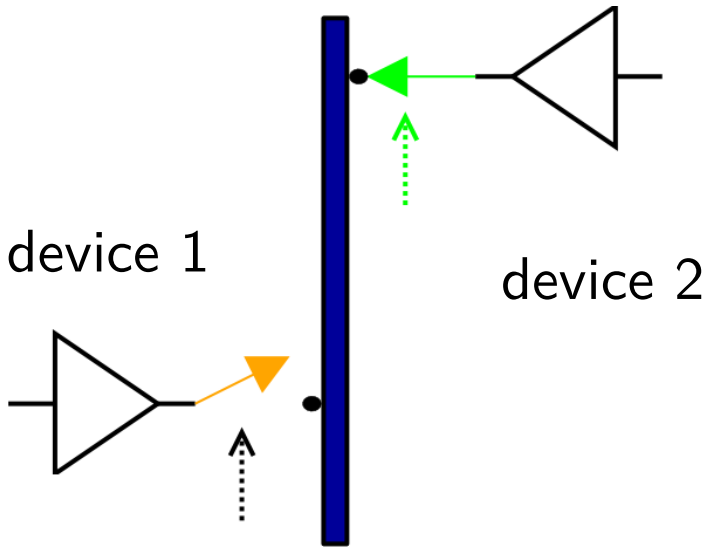

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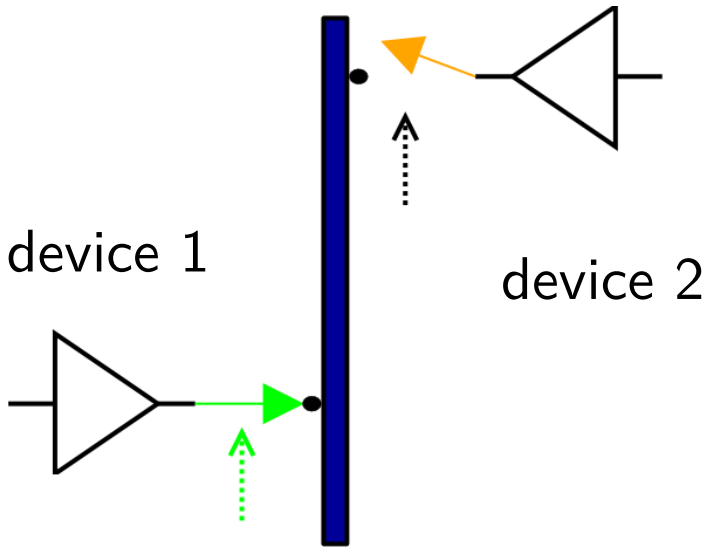

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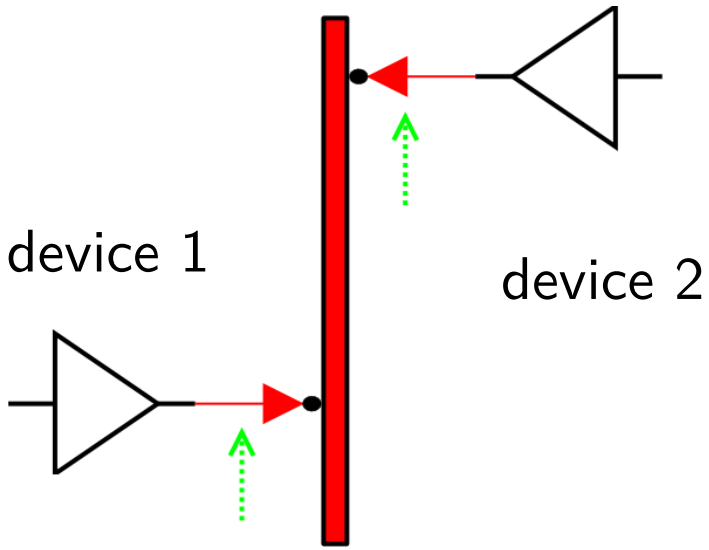

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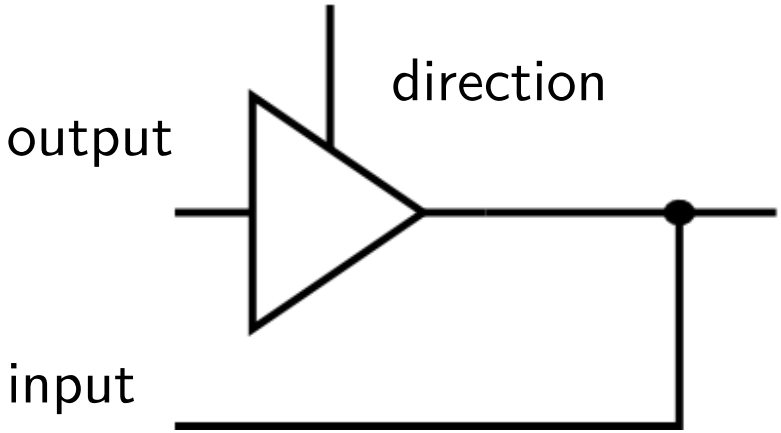
Tri-state (I/O) pins



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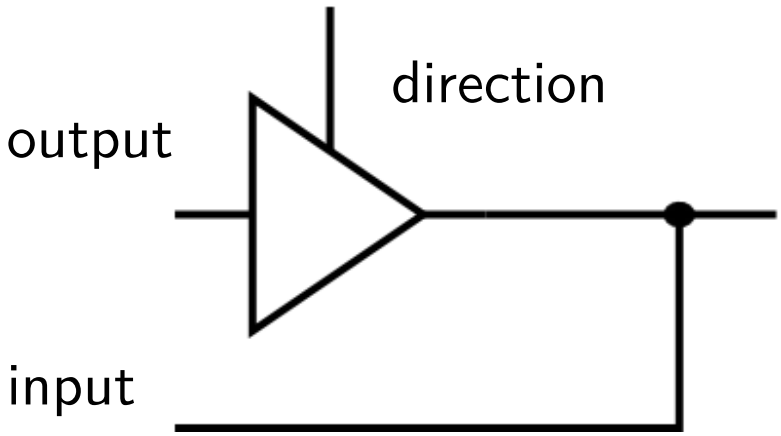

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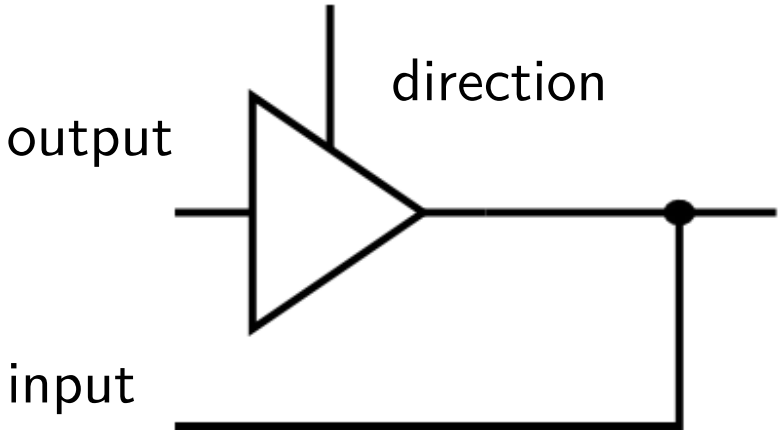
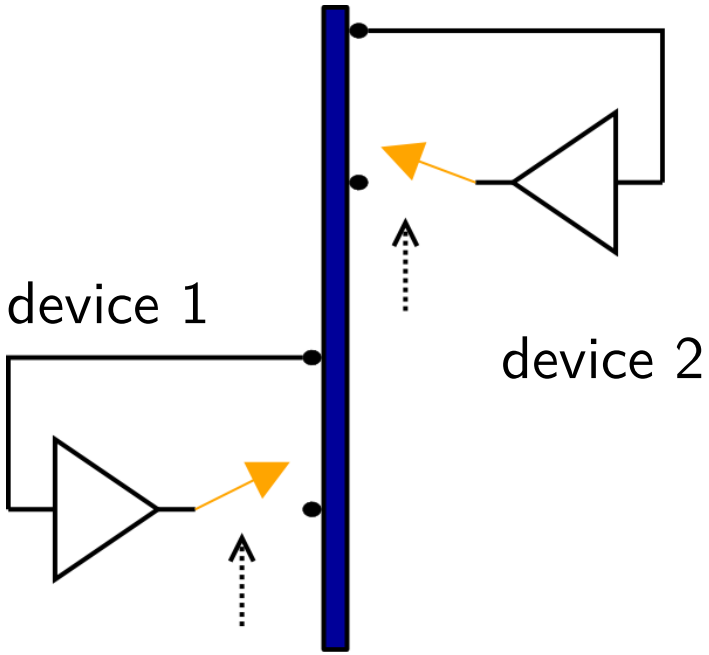


- Tri-state pins allow input and output on the same pin.
- The **direction** input indicates output or input (i.e. floating).

Tri-state busses



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- Uses I/O signal and address decoding

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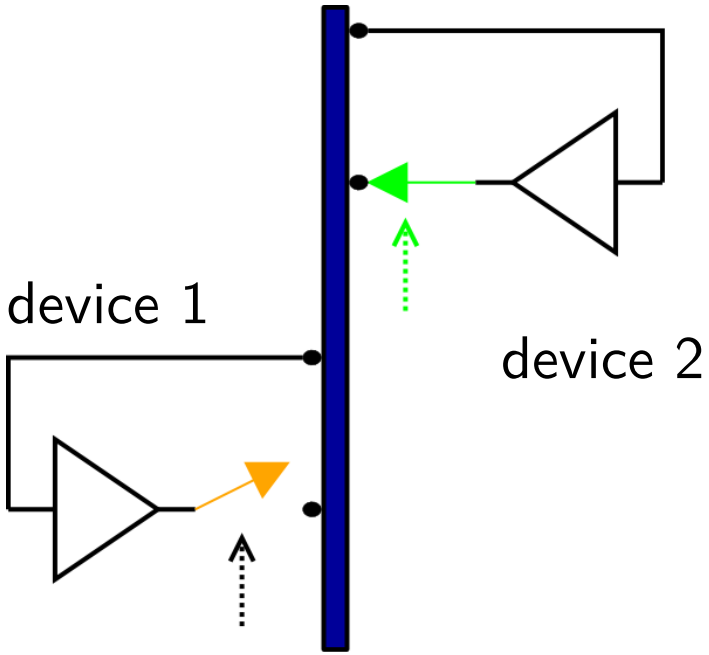

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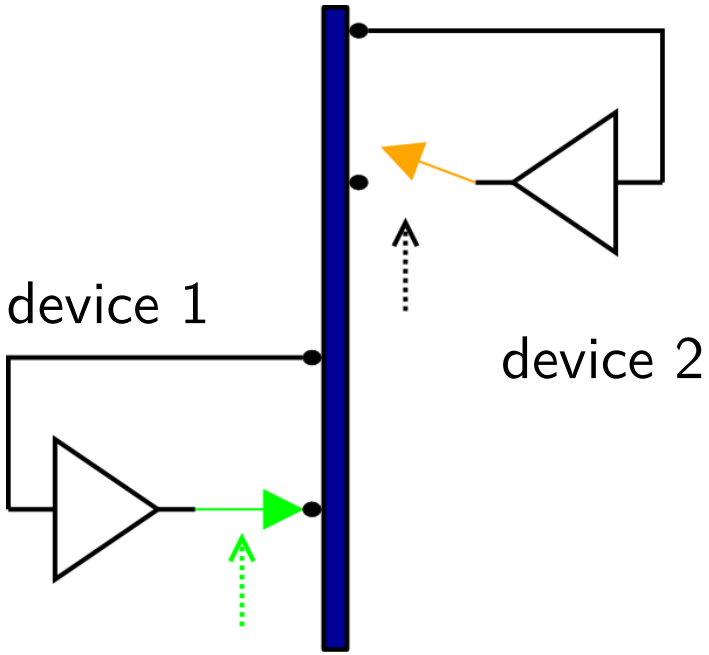

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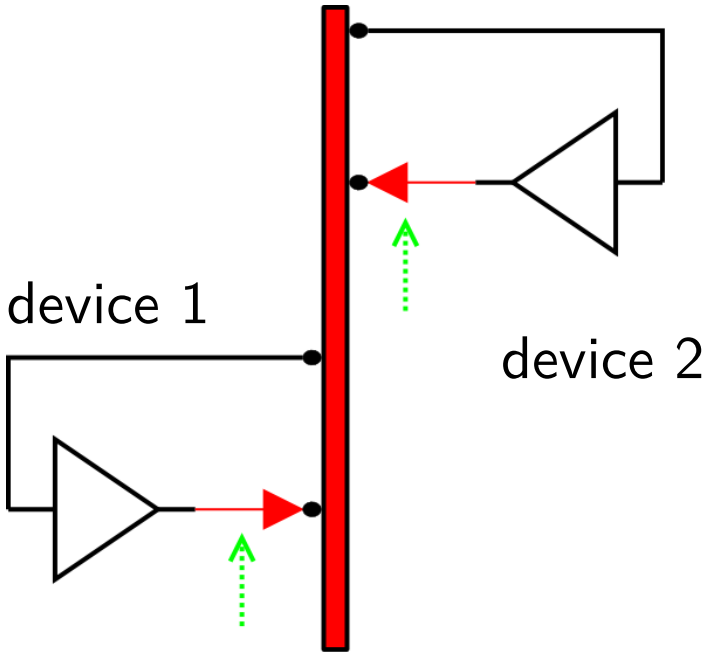

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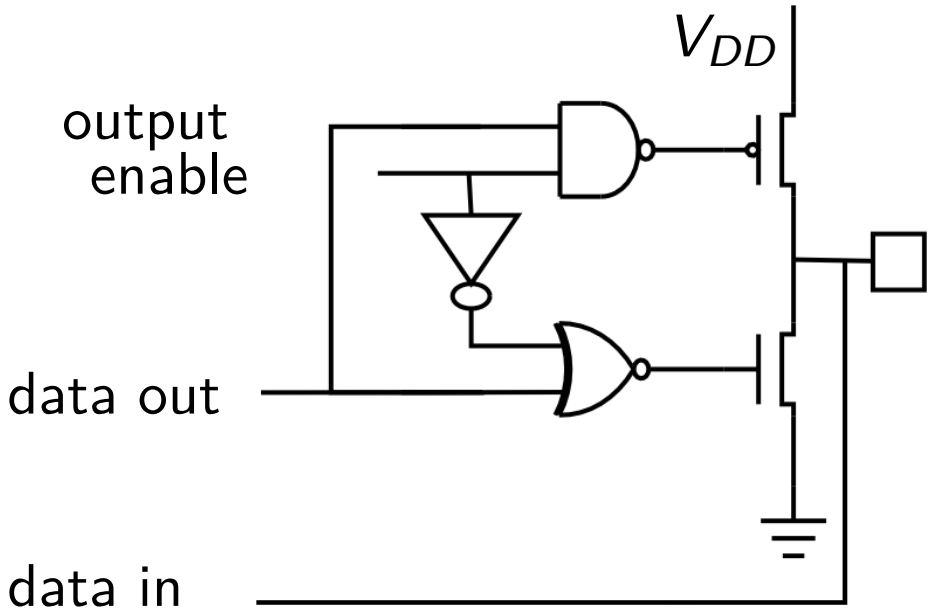
Internal view (CMOS)



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.)

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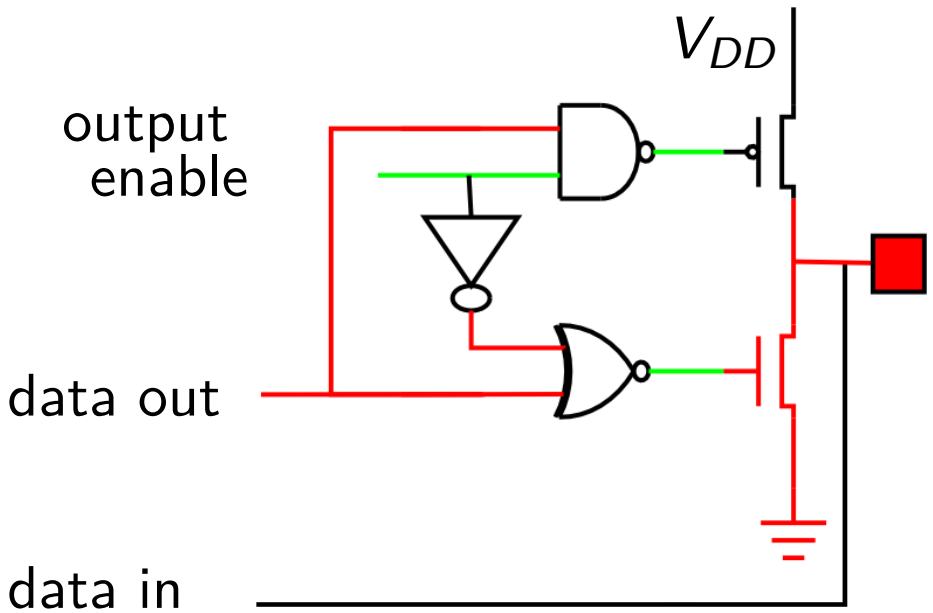

When output is enabled, and data out is low,

the output will be low. (Only bottom transistor on.)

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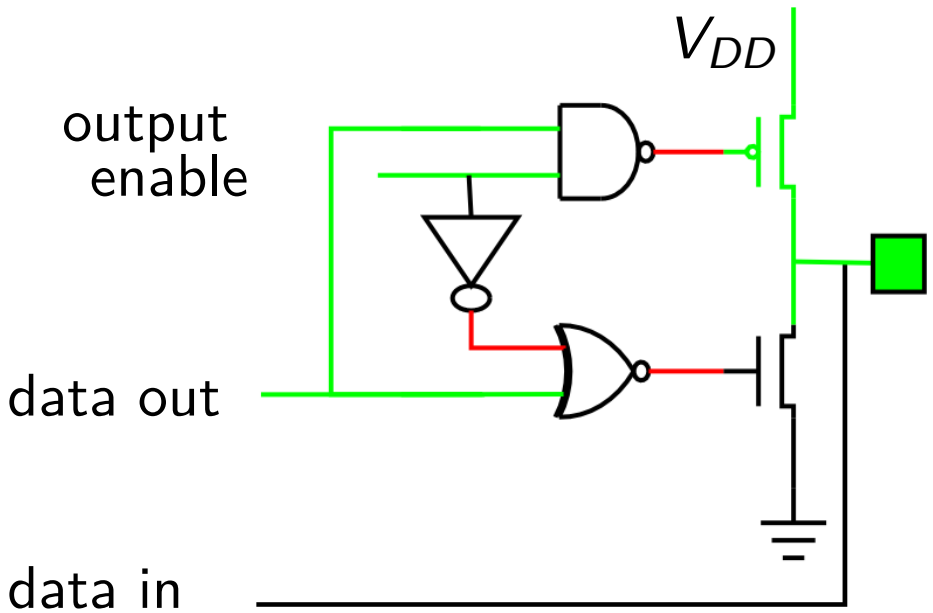

When output is enabled, and data out is high,

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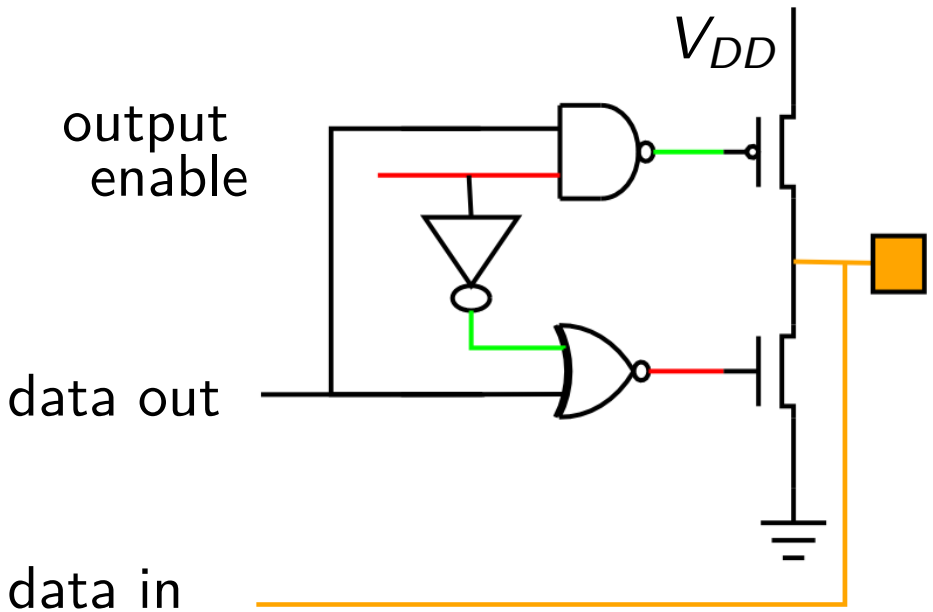

When output is not enabled,

the output will float (to become an input). (Both transistors off.)