YwRobot Power Module

Overview

This device allows you to supply power to your breadboard projects from a variety of sources through its barrel jack. The module down-steps the voltage to 5V or 3.3V (selectable with jumpers).

The power module comes with an on/off switch, and a set of header pins that can be used to wire power to other places.

The module is made to fit on a standard breadboard, where the output pins align directly onto the power rails of the breadboard.

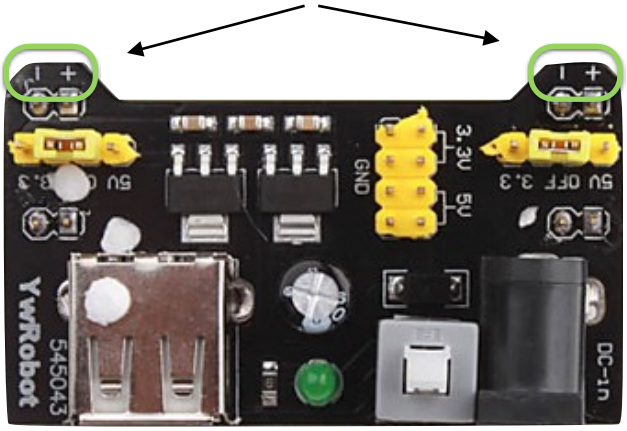
Be sure to align the positive and negative markings on the module with their matching power rails!

Note that this part is not technically part of any schematic, and simply acts as a voltage source within a schematic.

Variations

- On some boards the USB jack can be used as an power input, and on some it is a power output only.
- The popularity of this module has prompted a number of manufacturers to build similar devices with a variety of shapes and input/output methods.

Align these with the +/- power rails on your breadboard



Pin Configuration

The power module connects directly to your breadboard. Each side can be independently selected for 3.3V or 5V power via jumpers.

In the middle is a set of male headers for 3.3V, 5V, and ground.

Limitations

- Minimum input voltage: 6.5V (DC)
- Maximum input voltage: 12V (DC)
- Output voltage: 3.3/5V (selectable)
- Maximum output current: 700 mA
- Barrel jack plug size: 5.5mm x 2.1mm

555 Timer

Overview

The 555 timer is a collection of components that can be configured to provide timings and oscillations.

It uses two voltage levels—one-third supply voltage and two-thirds supply voltage. Internally, it consists of:

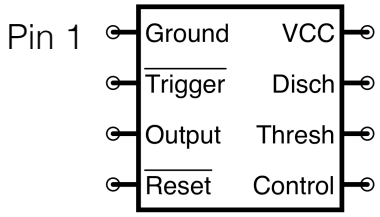
- Two comparators (one for each voltage level)
- A flip-flop (single bit storage) to know what state it is in and to switch states at the appropriate time
- An output driver
- A reset input

The timer relies on external circuitry (such as an RC time circuit) to supply timings.

The timer effectively has two states. In the "charging" state, when the **Discharge** pin is disconnected, and the **Threshold** pin is waiting for a high (2/3) voltage. In the "discharging" state, the **Discharge** pin is connected to ground, and the **Trigger** pin is waiting for a low (1/3) voltage. The typical usage is to provide an oscillating circuit.

Variations

- Can be implemented using CMOS/FETs or BJTs. FET implementation consumes less power, but can source less output
- Many variations in maximum oscillation frequency



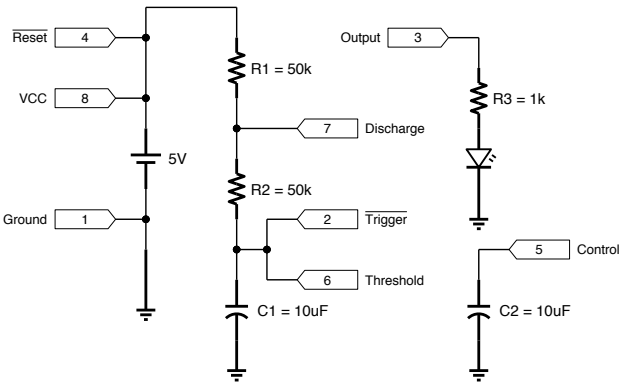
Pin Configuration

- **Trigger** and **Threshold** detect going below 1/3 and above 2/3 voltage, respectively
- **Discharge** provides a ground that is only attached when the chip is in the discharging state.
- **Output** supplies a high voltage when the chip is in the charging state, and a low voltage when it is in the discharging state.
- **Reset** should be normally tied to a positive supply - it resets the circuit when it goes low.
- **Control** is normally connected to ground with a capacitor (10 µF recommended).

Specifications

- Supply Voltage: Usually 2V to 15V
- Output current: 100mA—200mA

Implementation Example



LM393 and LM339 Voltage Comparator

Overview

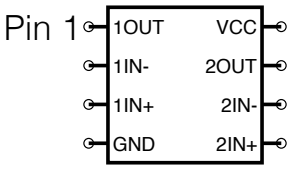
The LM393 is a dual voltage comparator. Each channel has two inputs—designated IN+ and IN-. When the voltage at IN+ is greater than the voltage at IN- the output (OUT) is positive (actually, it is disconnected; see more later). Otherwise, the output is connected to ground.

The output is called an "open collector" output, which means that the "positive" state has no output current, and is essentially disconnected. However, in the negative state the output is connected to ground. This means that to use the output, you need to provide your own positive voltage through a pull-up resistor (this allows you to set your own output voltage).

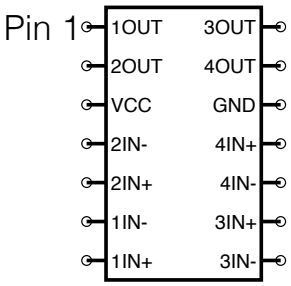
The LM339 is identical except that it has four channels instead of two.

Variations

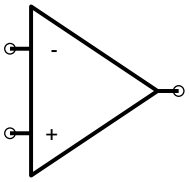
Various chips differ in the amount of current they can sink, how fast they respond to changes in input voltage, how smooth the transition is from one state to the other, and the minimum amount of difference required to trigger.



LM393



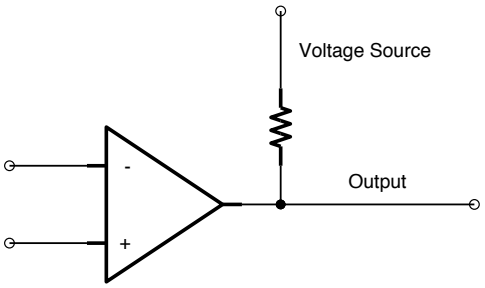
LM339



Schematic Symbol
(per channel)

Specifications

- Supply voltage: 2V to 36V
- Input voltage: -0V to 1.5V less than supply voltage.
- Maximum sink current: 20mA (when output is grounded)
- Input impedance: high (inputs use very negligible amounts of current)
- Quiescent chip current: 1mA



Usage of the Comparator
with a pull-up resistor

CD4081 & 7408 Quad AND Gate

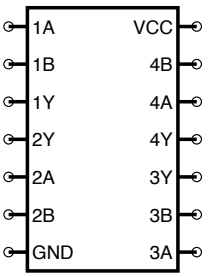
Overview

The quad AND gate is a set of four AND logic gates on a single chip. The output (Y) will be high only if *both* inputs (A & B) are high.

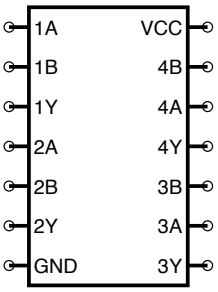
The required voltages for low and high on input and the guaranteed voltages for low and high on output are listed in the specifications section.

For the output to be high, both A & B must be high. Otherwise, the output (Y) will be low.

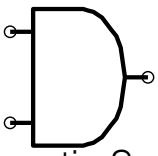
The 7408 and the CD4081 are the TTL and CMOS versions of the chip, respectively.



CD4081



7408


Schematic Symbol
(per channel)

Specifications (CD4081)

- Supply voltage: 3V to 15V
- Input (high) voltage: > 2/3 supply
- Output (high) voltage: supply - 0.05
- Input (low) voltage: < 1/3 supply
- Output (low) voltage: 0V - 0.5V
- Maximum output current: ~5mA

Specifications (7408)

- Supply voltage: 5V
- Input (high) voltage: > 2V
- Output (high) voltage: > 2.7V
- Input (low) voltage: < 0.8V
- Output (low) voltage: < 0.4V
- Maximum output current: 100mA

Variations

- 74HC08 - pin-compatible with the 7408; voltage and current characteristics of the CD4081
- 74HCT08 - pin-compatible and voltage-level compatible with 7408; similar current usage as the CD4081
- 74LS08 - fast-switching version of the 7408

CD4071 & 7432 Quad OR Gate

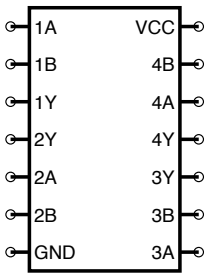
Overview

The quad OR gate is a set of four OR logic gates on a single chip. The output (Y) will be high if *either or both* inputs (A & B) are high.

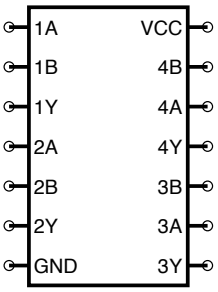
The required voltages for low and high on input and the guaranteed voltages for low and high on output are listed in the specifications section.

For the output to be high, either A or B (or both) must be high. Otherwise, the output (Y) will be low.

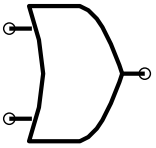
The 7432 and the CD4071 are the TTL and CMOS versions of the chip, respectively.



CD4071



7432


Schematic Symbol
(per channel)

Specifications (CD4071)

- Supply voltage: 3V to 15V
- Input (high) voltage: > 2/3 supply
- Output (high) voltage: supply - 0.05
- Input (low) voltage: < 1/3 supply
- Output (low) voltage: 0V - 0.5V
- Maximum output current: ~5mA

Specifications (7432)

- Supply voltage: 5V
- Input (high) voltage: > 2V
- Output (high) voltage: > 2.7V
- Input (low) voltage: < 0.8V
- Output (low) voltage: < 0.4V
- Maximum output current: 100mA

Variations

- 74HC32 - pin-compatible with the 7432; voltage and current characteristics of the CD4071
- 74HCT32 - pin-compatible and voltage-level compatible with 7432; similar current usage as the CD4071
- 74LS32 - fast-switching version of the 7432

CD4001 & 7402 Quad NOR Gate

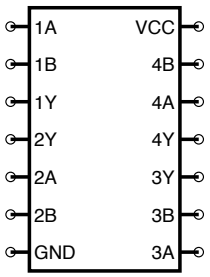
Overview

The quad NOR gate is a set of four NOR logic gates on a single chip. The output (Y) will be high if *both* inputs (A & B) are high or if *both* inputs are low.

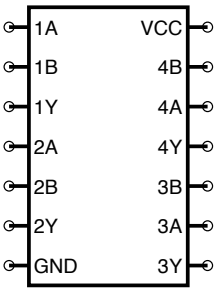
The required voltages for low and high on input and the guaranteed voltages for low and high on output are listed in the specifications section.

For the output to be high, either both A and B must be high or neither must be high. Otherwise, the output (Y) will be low.

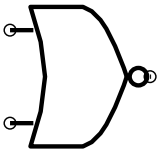
The 7402 and the CD4001 are the TTL and CMOS versions of the chip, respectively.



CD4001



7402



Schematic Symbol
(per channel)

Specifications (CD4001)

- Supply voltage: 3V to 15V
- Input (high) voltage: > 2/3 supply
- Output (high) voltage: supply - 0.05
- Input (low) voltage: < 1/3 supply
- Output (low) voltage: 0V - 0.5V
- Maximum output current: ~5mA

Specifications (7402)

- Supply voltage: 5V
- Input (high) voltage: > 2V
- Output (high) voltage: > 2.7V
- Input (low) voltage: < 0.8V
- Output (low) voltage: < 0.4V
- Maximum output current: 100mA

Variations

- 74HC02 - pin-compatible with the 7402; voltage and current characteristics of the CD4001
- 74HCT02 - pin-compatible and voltage-level compatible with 7402; similar current usage as the CD4001
- 74LS02 - fast-switching version of the 7402

CD4011 & 7400 Quad NAND Gate

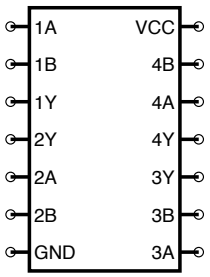
Overview

The quad NAND gate is a set of four NAND logic gates on a single chip. The output (Y) will be low unless *both* inputs (A & B) are high.

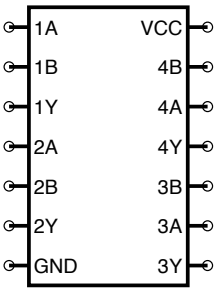
The required voltages for low and high on input and the guaranteed voltages for low and high on output are listed in the specifications section.

For the output to be high, A and B can be anything as long as they are not both high. Otherwise, the output (Y) will be low.

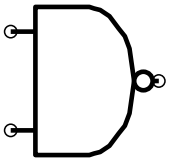
The 7400 and the CD4011 are the TTL and CMOS versions of the chip, respectively.



CD4011



7400


Schematic Symbol
(per channel)

Specifications (CD4011)

- Supply voltage: 3V to 15V
- Input (high) voltage: > 2/3 supply
- Output (high) voltage: supply - 0.05
- Input (low) voltage: < 1/3 supply
- Output (low) voltage: 0V - 0.5V
- Maximum output current: ~5mA

Specifications (7400)

- Supply voltage: 5V
- Input (high) voltage: > 2V
- Output (high) voltage: > 2.7V
- Input (low) voltage: < 0.8V
- Output (low) voltage: < 0.4V
- Maximum output current: 100mA

Variations

- 74HC00 - pin-compatible with the 7400; voltage and current characteristics of the CD4011
- 74HCT00 - pin-compatible and voltage-level compatible with 7400; similar current usage as the CD4011
- 74LS00 - fast-switching version of the 7400

CD4070 & 7486 Quad XOR Gate

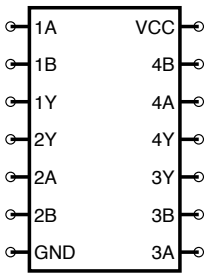
Overview

The quad XOR (exclusive-OR) gate is a set of four XOR logic gates on a single chip. The output (Y) will be high if either input (A or B) *but not both* are high.

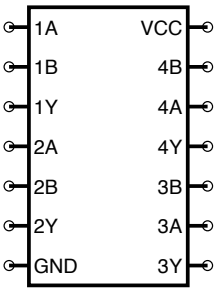
The required voltages for low and high on input and the guaranteed voltages for low and high on output are listed in the specifications section.

For the output to be high, either A or B must be high but not both of them. Otherwise, the output (Y) will be low.

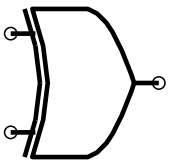
The 7486 and the CD4070 are the TTL and CMOS versions of the chip, respectively.



CD4011



7400



Schematic Symbol
(per channel)

Specifications (CD4070)

- Supply voltage: 3V to 15V
- Input (high) voltage: > 2/3 supply
- Output (high) voltage: supply - 0.05
- Input (low) voltage: < 1/3 supply
- Output (low) voltage: 0V - 0.5V
- Maximum output current: ~5mA

Specifications (7486)

- Supply voltage: 5V
- Input (high) voltage: > 2V
- Output (high) voltage: > 2.7V
- Input (low) voltage: < 0.8V
- Output (low) voltage: < 0.4V
- Maximum output current: 100mA

Variations

- 74HC86 - pin-compatible with the 7486; voltage and current characteristics of the CD4070
- 74HCT86 - pin-compatible and voltage-level compatible with 7486; similar current usage as the CD4070
- 74LS86 - fast-switching version of the 7486

LM78xx Voltage Regulator

Overview

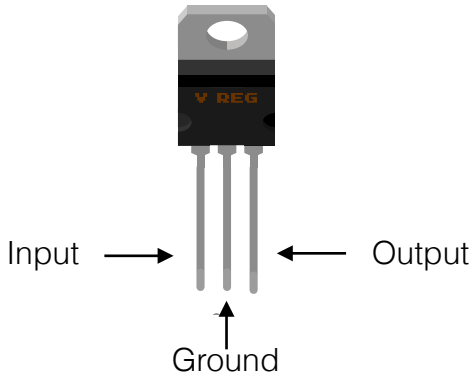
The LM78xx voltage regulator is actually a series of chips to provide a consistent voltage output from a variety of voltage inputs. Each chip is named with the number of volts it supplies in its output. For instance, the LM7805 outputs a constant 5V and the LM 7812 outputs a constant 12V.

These chips are linear voltage regulators, which means that they regulate voltage by dissipating excess power as heat. If significant heat develops, the LM78xx can have a heat sink attached to the back plate, which also serves as a second ground.

The LM78xx requires an input voltage at least 2.5V above the regulated voltage. This is known as the "drop-out" voltage of the chip.

Variations

- The 78xxSR is a line of switching regulators, meaning that they do not dissipate significant power when regulating (they operate by turning the power on and off quickly rather than dissipating excess power). They waste significantly less current but do have a significant cost.
- The TL750Mxx chips are similar to the LM78xx chips, but have a very low "drop-out" voltage (~0.6V).
- The LM79xx chips are similar to the LM78xx chips, but act as *negative* voltage supplies (-5V, etc).



Specifications

- Maximum input voltage: 35V
- Maximum output current: 1A
- Built-in overcurrent protection
- Protection against short circuits
- Overheating protection (shuts off when overheating)

Usage Notes

- The specifications require two capacitors for operation—a 330nF capacitor on the input and a 100nF capacitor on the output (see below).
- These capacitors are generally not required for very simple projects—you can simply hook the input directly to your positive power source, the ground to your ground, and the output to your project.