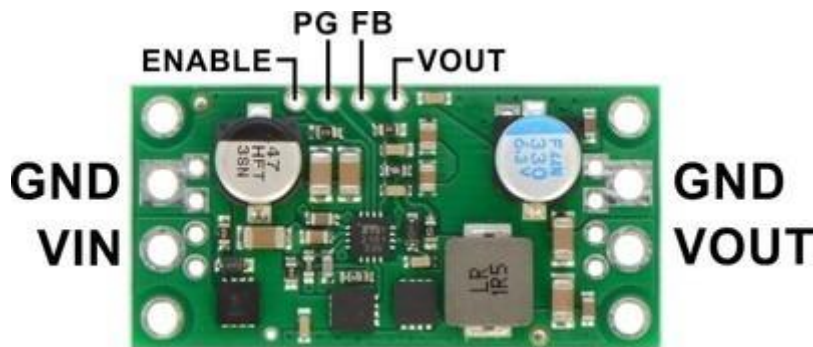


POLOLU 5V, 9A STEP-DOWN VOLTAGE REGULATOR D24V90F5

USER'S GUIDE

CONNECTIONS

This buck regulator has six connections: input voltage (VIN), ground (GND), output voltage (VOUT), feedback (FB), ENABLE, and power good (PG).



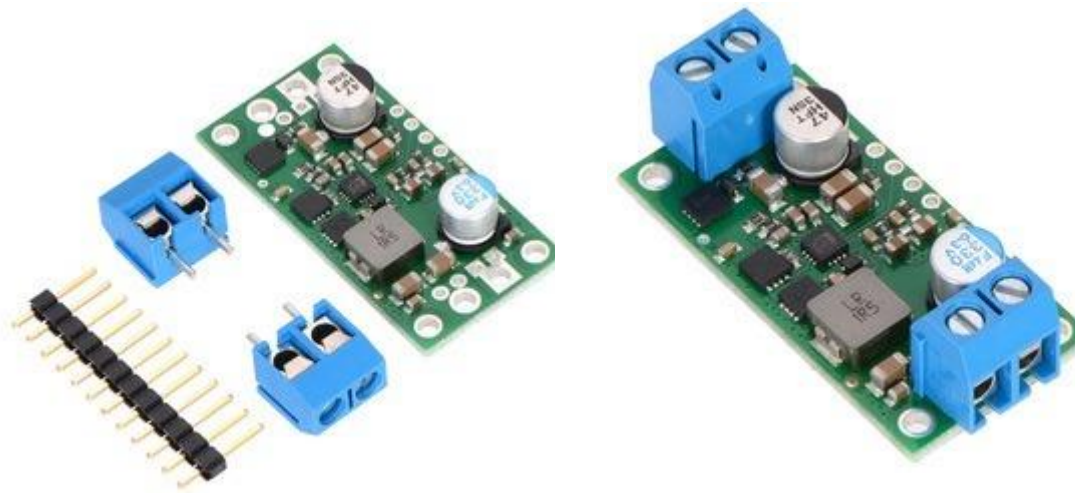
The input voltage, **VIN**, powers the regulator and can be supplied with voltages up to 38V. The effective lower limit of **VIN** is **VOUT** plus the regulator's dropout voltage, which varies approximately linearly with the load from around 500 mV to 1.5 V (see below for a graph of the dropout voltage as a function of the load).

The output voltage, **VOUT**, is set to 5V by default. The output voltage can optionally be lowered by adding a resistor between the **FB** pin and **VOUT** as detailed in the *Decreasing the output voltage* section below.

The regulator is enabled by default: a 100 k Ω pull-up resistor on the board connects the **ENABLE** pin to reverse-protected **VIN**. The **ENABLE** pin can be driven low (under 0.6 V) to put the board into a low-power state. The quiescent current draw in this sleep mode is dominated by the current in the pull-up resistor from **ENABLE** to **VIN** and by the reverse-voltage protection circuit, which will draw between 10 μ A and 20 μ A per

volt on VIN when ENABLE is held low. If you do not need this feature, you should leave the ENABLE pin disconnected.

The “power good” indicator, **PG**, is an open-drain output that goes low when the regulator’s output voltage falls below 90% of what it is set to (i.e. 4.5 V with the default 5 V output setting). An external pull-up resistor is required to use this pin.



Pololu 5V, 9A Step-Down Voltage Regulator D24V90F5 with included hardware.

Pololu 5V, 9A Step-Down Voltage Regulator D24V90F5, assembled with included terminal blocks

The connections are labeled on the back side of the PCB, and the board offers several options for making electrical connections. The eight smaller through-holes on the ends of the board are arranged with a 0.1" spacing for compatibility with solderless breadboards, connectors, and other prototyping arrangements that use a 0.1" grid; you can solder pieces of the included 12×1 [straight male header strip](#) into these smaller holes. Alternatively, you can solder the included 2-pin 5mm-pitch terminal blocks to the two pairs of larger holes on the ends of the board. For the most compact installation, you can solder wires directly to the board.



Pololu Step-Down Voltage Regulator D24V60F5 showing wires soldered directly to the board and passing through the mounting holes for strain relief.

The board has four 0.086" mounting holes intended for #2 or M2 screws. The mounting holes are in the four corners of the board and are separated by 1.4" horizontally and 0.6" vertically. In applications where mounting screws are not used and wires are soldered directly to the board, the insulated part of the wires can be passed through the mounting holes for strain relief. The picture above shows an example of this with the lower-power D24V60F5 and 20 AWG wire, which was close to the limit of what would fit through the mounting holes.

DECREASING THE OUTPUT VOLTAGE

The set voltage can optionally be decreased by adding an external resistor between the FB and the neighboring VOUT pin. The equations below show how the output voltage relates to the value of an external resistor, R :

$$V_{OUT} = \left(\frac{5.24 \cdot R}{16.2 \text{ k}\Omega + R} + 1 \right) \cdot 0.8 \text{ V}$$

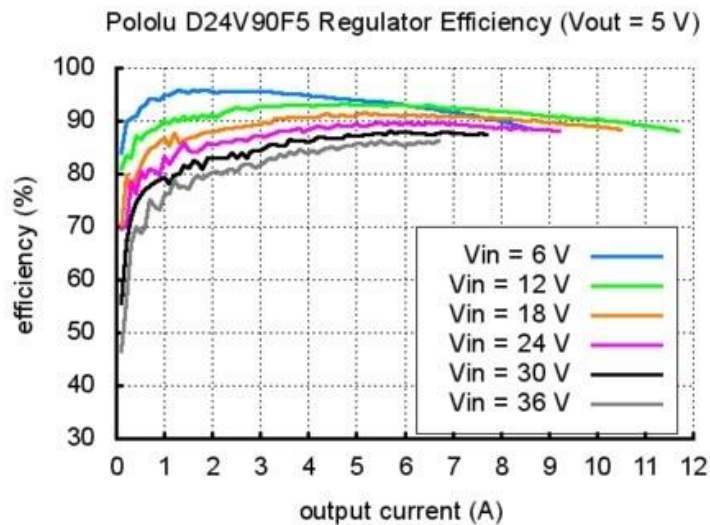
$$R = \left(\frac{V_{OUT} - 0.8 \text{ V}}{5 \text{ V} - V_{OUT}} \right) \cdot 16.2 \text{ k}\Omega$$

For example, to get an output voltage of 3.3 V, you could put a 23.7 kΩ resistor between FB and VOUT.

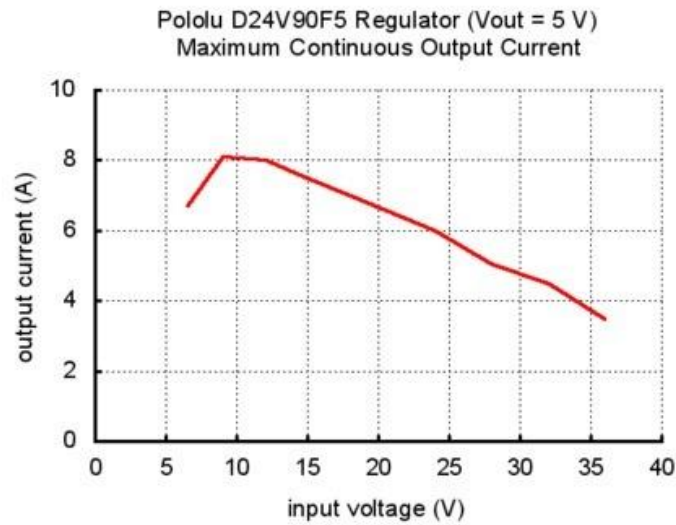
The minimum VOUT for this regulator is 0.8 V. Please note that the small VOUT pin next to FB is not intended to source much current; its purpose is to provide a convenient spot for connecting a voltage-adjustment resistor.

TYPICAL EFFICIENCY AND OUTPUT CURRENT

The efficiency of a voltage regulator, defined as (Power out)/(Power in), is an important measure of its performance, especially when battery life or heat are concerns. As shown in the graph below, these switching regulators have an efficiency of 80% to 95% for most combinations of input voltage, and load.



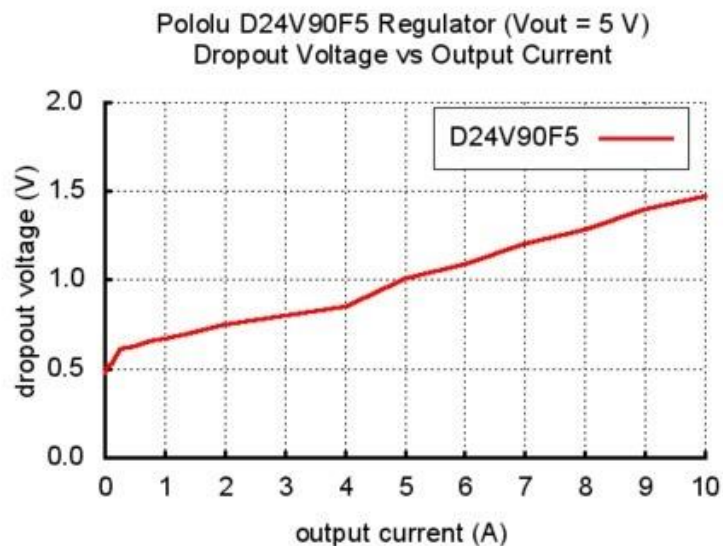
The maximum achievable output current of the board depends on many factors, including the ambient temperature, air flow, heat sinking, and the input and output voltage. The graph below shows the maximum continuous output current this regulator can deliver with no external heat sinking or added air flow.



During normal operation, this product can get hot enough to burn you. Take care when handling this product or other components connected to it.

TYPICAL DROPOUT VOLTAGE

The dropout voltage of a step-down regulator is the minimum amount by which the input voltage must exceed the regulator's target output voltage in order to ensure the target output can be achieved. For example, if a 5 V regulator has a 1 V dropout voltage, the input must be at least 6 V to ensure the output is the full 5 V. The following graph shows the dropout voltage for the D24V60F5 regulator as a function of the output current:



SWITCHING FREQUENCY AND BEHAVIOR UNDER LIGHT LOADS

The regulator generally operates at a switching frequency of around 470 kHz, but the frequency drops when encountering a light load to improve efficiency. This could make it harder to filter out noise on the output caused by switching. This also causes small variations in the output voltage like those shown in the graph below:

