3.3V Step-Up/Step-Down Voltage Regulator w/ Fixed 3V Low-Voltage Cutoff S9V11F3S5C3

Pololu item #: 2873 **242** in stock
Brand: Pololu
Status: Active and Preferred
RoHS 3
Free add-on shipping in USA
Free shipping in USA over $40

Price break	Unit price (US$)
1	5.95
5	4.95
25	4.49
100	4.15

Quantity: 1 Add to cart
backorders allowed Add to wish list

The S9V11F3S5C3 switching step-up/step-down regulator efficiently produces a fixed 3.3 V (default) or 5 V (selectable) output whether it is higher or lower than the input voltage, which can range from 3 V to 16 V. The regulator also has fixed 3 V low-voltage cutoff with hysteresis that can be used to prevent battery over-discharge. The compact (0.5″ × 0.6″) module can supply a typical output current of up to 1.5 A when the input voltage is close to the output voltage.

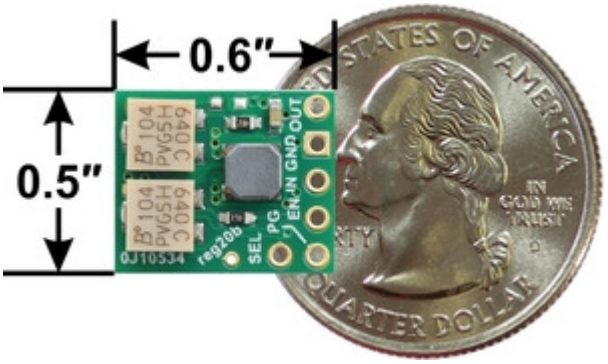
.

Description | Specs (11) | Pictures (14) | Resources (3) | FAQs (0) | On the blog (1)

Overview

The S9V11x family of efficient switching regulators (also called switched-mode power supplies (SMPS) or DC-to-DC converters) use a buck-boost topology to convert both higher and lower input voltages to a regulated output voltage. They take input voltages from 2 V to 16 V and increase or decrease them as necessary, offering a typical efficiency of over 85% and a typical output current of up to 1.5 A. The flexibility in input voltage offered by this family of regulators is especially well-suited for battery-powered applications in which the battery voltage begins above the regulated voltage and drops below as the battery discharges.

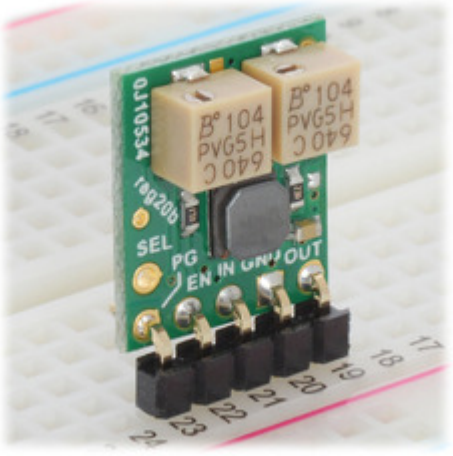
Without the typical restriction on the battery voltage staying above the required voltage throughout its life, new battery packs and form factors can be considered.



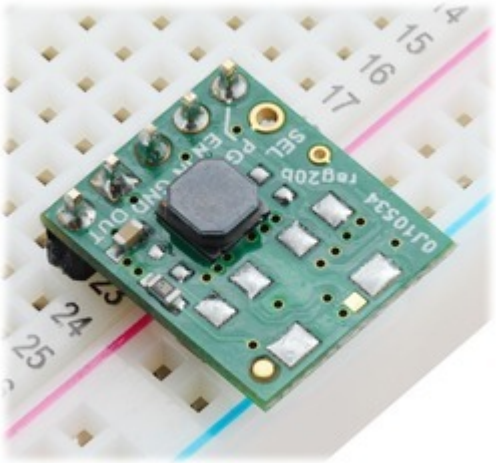
The different members of this family offer different output voltage options, from fixed voltages with selectable alternatives to adjustable voltages that can be set anywhere between 2.5 V and 9 V using a precision 12-turn potentiometer. Some versions also have an adjustable low-voltage cutoff that can be set anywhere in the 2 V to 16 V output voltage range and used to prevent your battery from over-discharging. This is particularly useful for battery chemistries that can be damaged when over-discharged, including Li-ion and LiPo. The chart below lists all the regulators in the S9V11x family along with the key features of each version:

Regulator		Input (V)	Output (V)	Low-voltage cutoff	Size	Price
	#2868 S9V11MACMA	2* – 16	2.5 – 9 (fine-adjust)	fine-adjust	0.50″ × 0.60″ × 0.25″	$11.95
	#2869 S9V11MA		2.5 – 9 (fine-adjust)	–		$8.95
	#2870 S9V11F5S6CMA		5 (6 V selectable)	fine-adjust		$8.95
	#2871 S9V11F3S5CMA		3.3 (5 V selectable)	fine-adjust		$8.95
	#2872 S9V11F3S5		3.3 (5 V selectable)	–	0.50″ × 0.60″ × 0.17″	$5.95
	#2873 S9V11F3S5C3		3.3 (5 V selectable)	3 V (fixed)		$5.95
	#2836 S9V11F5		5	–	0.30″ × 0.45″ × 0.17″	$5.95

* The regulator has a minimum start-up voltage of 3 V, but it can operate down to 2 V after startup. It is disabled when the input voltage is below the low-voltage cutoff.



Step up/step down regulator S9V11MACMA on a breadboard.



Step up/step down regulator S9V11F3S5 on a breadboard.

These regulators have short-circuit protection, and thermal shutdown prevents damage from overheating; they do **not** have reverse-voltage protection. Note that the startup current is limited to approximately 700 mA until the output voltage reaches the nominal voltage; after startup, the available current is a function of the input voltage (see the *Typical efficiency and output current* section below).

Details for item #2873

Features

- Input voltage: 3 V to 16 V
- Fixed 3.3 V output with +5/-3% accuracy (can be changed to 5 V using the SEL pin)
- Typical maximum continuous output current: 1.5 A (when input voltage is close to the output; the *Typical efficiency and output current* section below shows how the achievable continuous output current depends on the input and output voltages)
- Fixed 3 V low-voltage cutoff with hysteresis protects batteries from over-discharging (quiescent current is approximately 10 µA per volt on VIN when regulator is disabled)
- Power-good indicator can be used to tell when the regulator has reached and is maintaining its target output voltage
- Power-saving feature maintains high efficiency at low currents (quiescent current is less than 1 mA while enabled)
- Integrated over-temperature and short-circuit protection
- Small size: 0.5″ × 0.6″ × 0.17″ (12.7 × 15.3 × 4.3 mm)

Using the Regulator

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

Connections

The step-up/step-down regulator has five main connections all located along the same edge of the board: the output voltage (OUT), ground (GND), the input voltage (IN), an enable input (EN), and a power good indicator (PG). A sixth pin, SEL, can optionally be used to change the output voltage from 3.3 V to 5 V.

The output voltage, **VOUT**, defaults to 3.3 V but can be changed to 5 V with output voltage selection pin whose operation is described below.

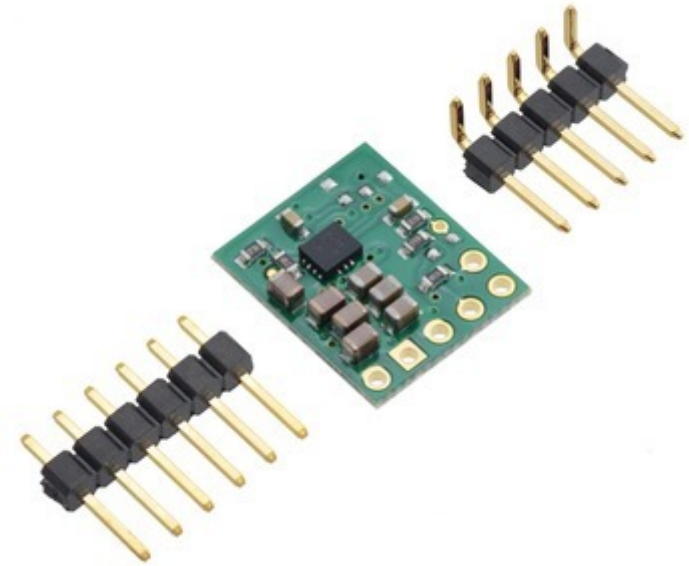
The input voltage, **VIN**, should be between 3 V and 16 V. Lower inputs will shut down the voltage regulator; higher inputs can destroy the regulator, so you should ensure that noise on your input is not excessive, and you should be wary of destructive LC spikes (see below for more information).

The regulator is put in a low-power sleep state when voltage on the **EN** pin falls below 0.7 V, and the regulator is brought out of its low-power state when the voltage on EN rises back above 0.8 V. On this regulator version, the EN pin is tied to VIN through a voltage divider that sets the low-voltage cutoff threshold to 3 V (specifically, there is a 154 kΩ resistor to VIN and a 47 kΩ resistor to ground). Once the input falls below this 3 V threshold, the regulator will stay disabled until the input rises above 3.4 V (which causes the voltage on EN to rise past its hysteresis threshold of 0.8 V). This low-VIN cutoff is useful for battery powered applications where over-discharging the battery could permanently damage it. The quiescent current draw in this sleep mode is dominated by the current in the voltage divider, which is approximately 7 µA per volt on VIN (e.g. approximately 20 µA with 3 V in).

The “power good” indicator, **PG**, is an open-drain output that goes low when the regulator’s output falls below around 90% of the nominal voltage, including when the enable pin is held low. The power good indicator is held low until the output reaches 95% of the nominal voltage when it is powering up or coming out of low-power mode. Otherwise, the PG pin is high-impedance, so an external pull-up resistor is required to use this pin.

The select input, **SEL**, can be driven above 1.1 V (up to 16 V) to change the output voltage of the regulator to 5 V. Driving the pin low or leaving it disconnected sets the output to 3.3 V. To permanently set the output to 5 V, you can solder a piece of wire between SEL and the unpopulated pad next to it, which is pulled up to VIN; the following picture shows an example of this:

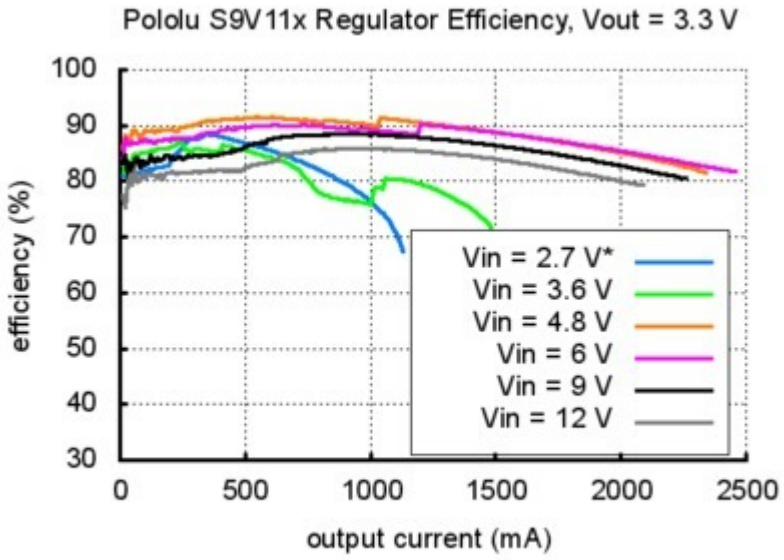
Included hardware



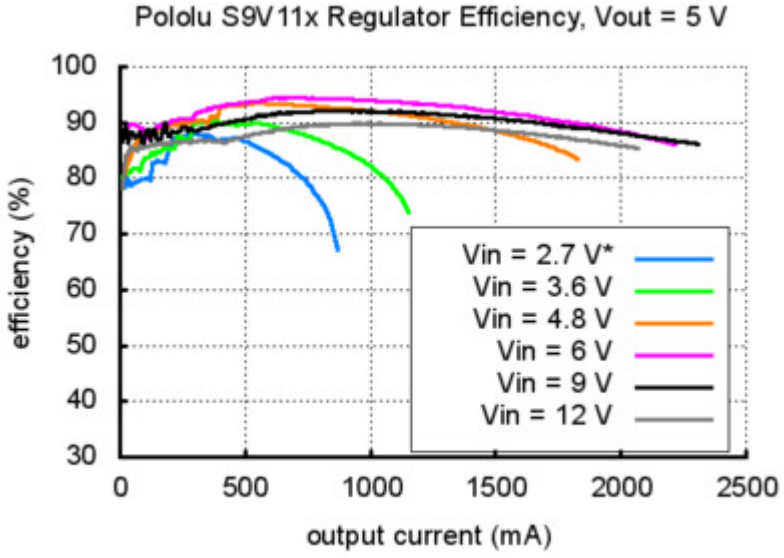
The five main through-holes are arranged with a 0.1″ spacing along the edge of the board for compatibility with standard **solderless breadboards** and perfboards and **connectors** that use a 0.1″ grid. You can solder wires directly to the board or solder in pieces of the included breakaway 6×1 **straight male header strip** or the 5×1 **right-angle male header strip** as desired. The additional straight male header pin can be soldered into the SEL input, though this could prevent the regulator from being used in a breadboard.

Typical efficiency and output current

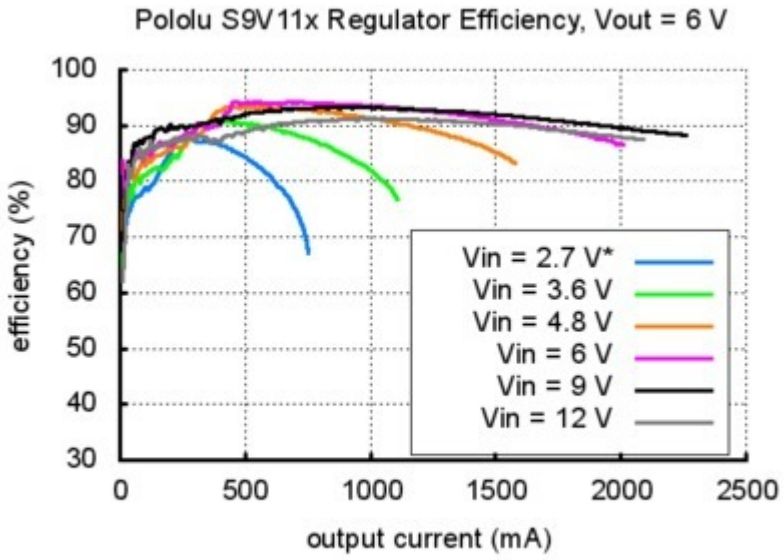
The efficiency of a voltage regulator, defined as (Power out)/(Power in), is an important measure of its performance, especially when battery life or heat are concerns. As shown in the graphs below, this family of switching regulators typically has an efficiency of 85% to 95%. A power-saving feature maintains these high efficiencies even when the regulator current is very low.



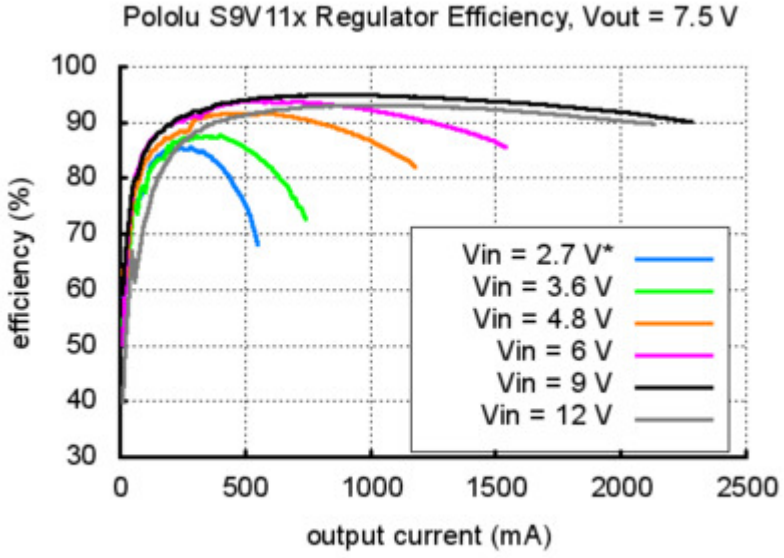
*Minimum startup voltage is 3V; can operate down to 2V after startup.



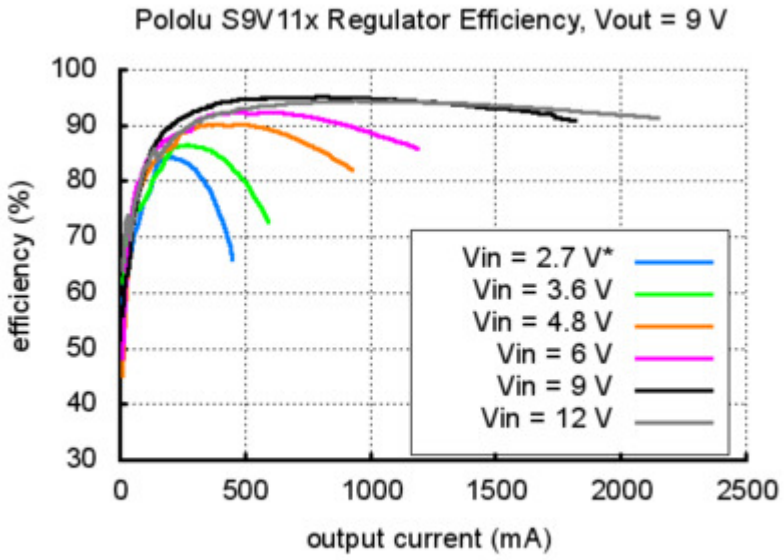
*Minimum startup voltage is 3V; can operate down to 2V after startup.



*Minimum startup voltage is 3V; can operate down to 2V after startup.

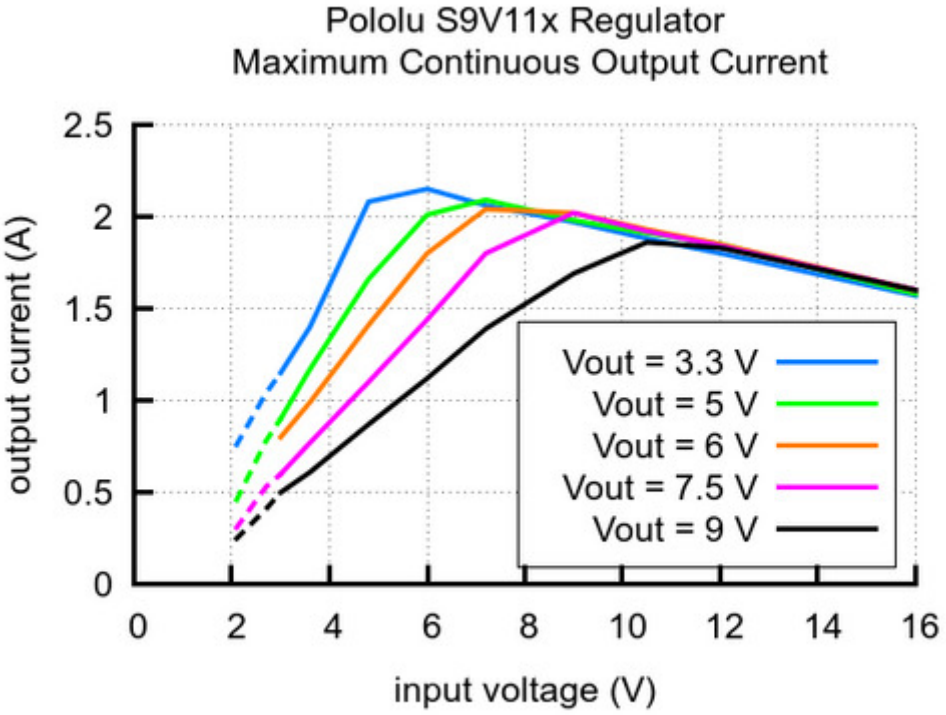


*Minimum startup voltage is 3V; can operate down to 2V after startup.



*Minimum startup voltage is 3V; can operate down to 2V after startup.

The maximum achievable output current of these regulators varies with the input voltage but also depends on other factors, including the ambient temperature, air flow, and heat sinking. The graph below shows maximum output currents that these regulators can deliver continuously at room temperature in still air and without additional heat sinking. Depending on the input and output voltage, these regulators can temporarily deliver over 2 A, though they will typically quickly overheat under such conditions and go into thermal shutdown.



Note: minimum startup voltage is 3V; can operate down to 2V after startup.

Note that the startup current for input voltages above the regulated output voltage is limited to approximately 700 mA, and currents in excess of this are only available after the output has finished stabilizing. For input voltages below the output voltage, the available start up current

decreases linearly with the input voltage to approximately 0.3 A with an input of 3 V. Large capacitive loads will generally not pose a problem because they will gradually charge up even with the current limit active, so while they may increase the time it takes an S9V11x family regulator to start up, the regulator should still eventually stabilize. A purely resistive load, however, could prevent the regulator from ever reaching the desired output voltage. For example, if the output of the regulator is 5V and you put a 5 Ω resistor between VOUT and GND and then apply power to the regulator, the output voltage will never rise past 3.5 V, the voltage at which the current draw reaches the 700 mA limit. As such, this family of regulators is intended for applications like robotics, where any large loads are controllable and can be applied only after the regulator has finished starting up.

LC Voltage Spikes

When connecting voltage to electronic circuits, the initial rush of current can cause voltage spikes that are much higher than the input voltage. If these spikes exceed a regulator's maximum voltage, the regulator can be destroyed. If you are connecting more than about 9 V, using power leads more than a few inches long, or using a power supply with high inductance, we recommend soldering a 33 µF or larger electrolytic capacitor close to the regulator between VIN and GND. The capacitor should be rated for at least 20 V.

More information about LC spikes can be found in our application note, **Understanding Destructive LC Voltage Spikes**.

People often buy this product together with:

2.5-9V Fine-Adjust Step-Up/Step-Down Voltage Regulator w/ Adjustable Low-Voltage Cutoff S9V11MACMA

5V Step-Up/Step-Down Voltage Regulator S9V11F5

2.5-9V Fine-Adjust Step-Up/Step-Down Voltage Regulator S9V11MA