

SP78, SP79, SP17 standard
 SPJ78, SPJ79, SPJ17 high current

Low Noise Low Impedance
 Bootstrap Powered
 Low Dropout Regulator

FEATURES

- Low noise: 1 to 3 PPM of Vout
- Fast dynamic output
- Two versions—current to 0.5A and 2A
- Very low output impedance
- Self powered reference
- Low drop-out voltage
- Available as positive or negative output
- LM78xx, LM79xx and LM317 pinout
- Sense connection to sense voltage at the load
- No pre-regulator needed

APPLICATIONS

- High resolution D/A and A/D converters
- Audio DACs, preamps, mixers, microphone amplifiers
- Phono preamps
- Guitar effects boxes
- Anywhere a clean, fast, quiet power supply is needed

DESCRIPTION

The Superpower regulator is a high performance voltage regulator with a novel circuit design (patent applied for) to internally power its reference circuit with its own regulated output. A floating reference allows any output voltage from 3.3V to 30V with low noise, low output impedance, high current and fast dynamic performance in a compact circuit that fits a standard IC footprint.

Superpower delivers current to a load with a clean dynamic waveform with minimum ringing or overshoot and settles quickly. Superpower works best *without* a pre-regulator, because a pre-regulator can limit the dynamic current available to the load.

Superpower is also available in a high voltage version (up to 400V). [Contact BelleSon](#) for more information.

Parameter	Conditions	Value	Units
Input voltage maximum	(1*)	35	V
Output voltage SP78, SP37	Standard values (2*)	3.3, 5, 7.5, 9, 10, 12, 15, 18, 24, 30	V
Output voltage SP79	Standard values (2*)	-5, -7.5, -9, -10, -12, -15, -18, -24, -30	V
Output Noise (typ.)	RMS 20Hz – 20KHz	1 to 3	PPM of Vout
Line Rejection (typ.)	60Hz	110	dB
Maximum continuous current	typical, within power dissipation limit SP series SPJ series (high current)	0.5 2	A A
Maximum current	<10mV output shift typical	200	mA
Maximum power dissipation	no heat sink sufficient heat sink	1 20	W
SP series drop-out voltage (typ.)	<u>Load Current</u> 50mA 250mA 500mA	0.5 1 2	V
SPJ series drop-out voltage (typ.)	<u>Load Current</u> 0.5A 1A 2A	0.6 0.8 1	V

*1 Maximum for SP78/SP79. Superpower HV is available with input voltage to 400V.

*2 Other values available, [contact us](#).

**APPLICATION
INFORMATION**

Superpower provides a breakthrough combination of dynamics and low noise. This provides information to allow you to get the best use from your Superpower.

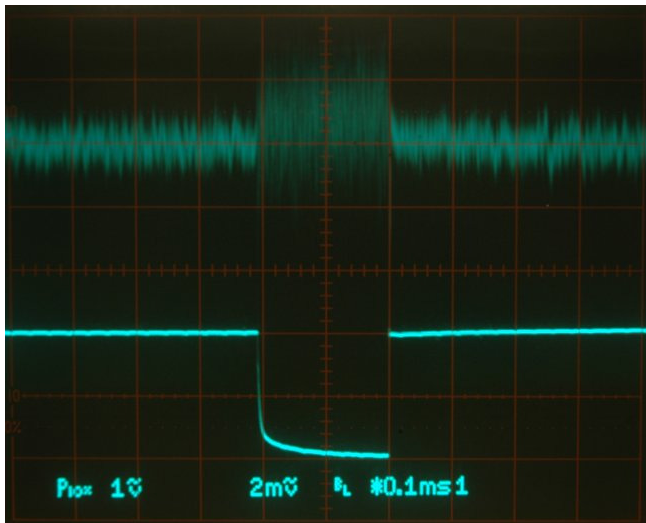
No Output Protection

To deliver the lowest possible output impedance, this circuit has no output current limit. Any short circuit of the output to common may destroy the output device and render the circuit useless.

Superpower regulators are available with a special output current limit that does not affect output impedance but does increase drop-out voltage. Please [contact us](#) for availability.

Input Voltage Pre-regulation

Use of a pre-regulator may adversely affect the dynamic response of Superpower by limiting delivery of current. Best performance is obtained by taking Superpower's input directly from a raw rectified and filtered power supply.



Dynamics

Good dynamic response means supplying a lot of current very quickly. A large capacitor (100+µF) located near the input pins of Superpower provides reserve storage so Superpower can deliver that current. An input capacitor also decreases output noise. Superpower has a 10µF output capacitor on

board, but adding a capacitor near your load may also improve dynamics.

Sense Connection

The sense connection is the 4th (rightmost) pin on the board. It allows the voltage at the *load* to be sensed rather than the voltage at the Superpower output pin. With no sense connection, when load current changes dramatically (e. g. in a circuit with large dynamic range) the voltage drop between the regulator and the load will change as the load current changes — the regulator output will remain constant while the load voltage changes due to IR losses. Use of the sense connection keeps the load voltage more constant.

If you wish to use the sense connection, remove the small shorting component just above the sense pin and connect the 4th pin from the regulator directly to the load. If the sense connection is longer than 10-15 centimeters, check stability as inductance may influence circuit behavior.

Heat Sinking

Superpower can dissipate approximately 1W without heat sinking depending on ambient temperature and air flow. Power dissipation (thus heat) depends on the input to output voltage divided by (output current + 7mA). You can minimize regulator power dissipation by taking advantage of its low drop-out voltage of ½ to 2V (depending on load), i. e. setting the input voltage to 1 or 2 volts higher than the output voltage depending on load current (see below).

To dissipate more than 1W, bolt Superpower to a heat sink or a heat conductive chassis. Use an insulating thermal pad or mica insulator with thermal paste and, for best results, electrically connect the heat sink to a stable, quiet ground point.

Line Rejection and Drop Out Voltage

(This section does not apply when V_{in} is supplied by a switched mode power supply, only to a linear rectified power supply.) As current increases, the minimum value of input ripple goes down and the regulator drop-out voltage goes up. If they meet or overlap, line regulation degrades rapidly. Ripple on the output of a full wave rectifier is calculated as

$$V_r = \frac{I_{dc}}{2fC} \text{ where } V_r \text{ is the peak to peak ripple voltage.}$$

For example, consider a 5V regulator circuit as seen in Figure 1 using a 100uF filter capacitor. At 400mA, the ripple for a 60Hz AC input =

$$\frac{0.4}{2 \times 60 \times (100 \times 10^{-6})} = 33V (!)$$

Clearly 100µF is not enough capacitance for this circuit.

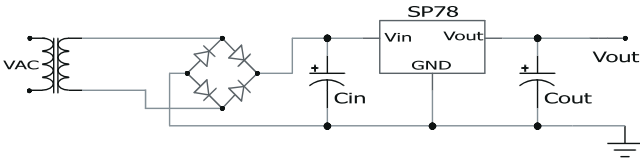


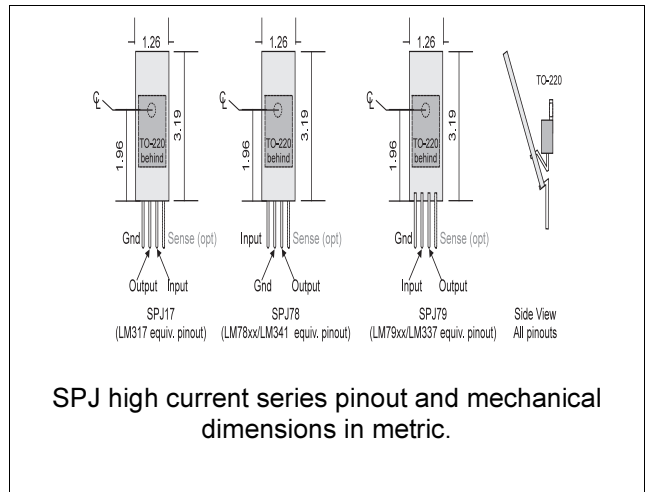
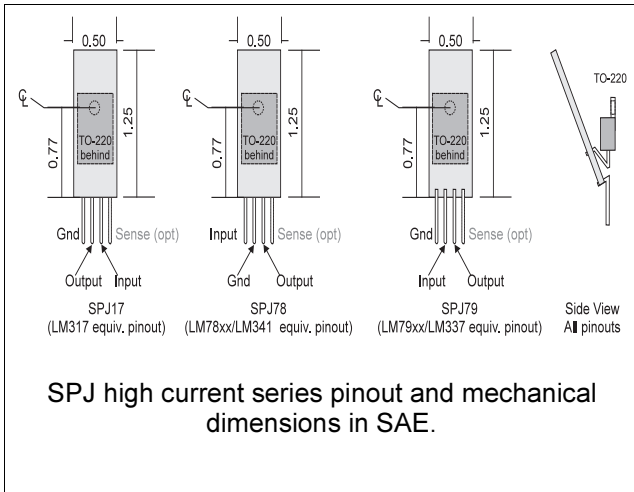
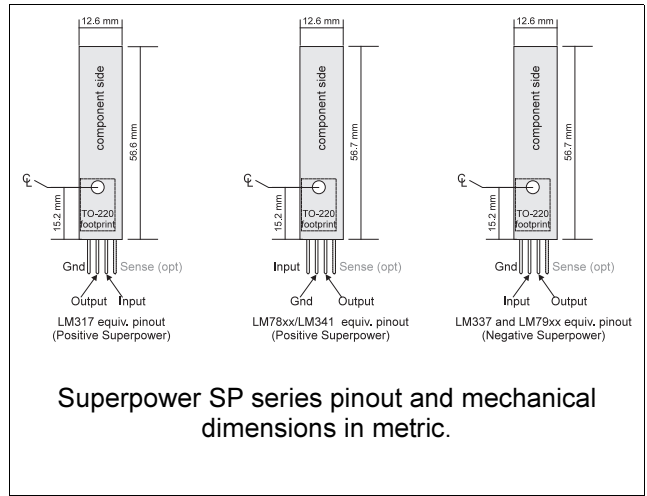
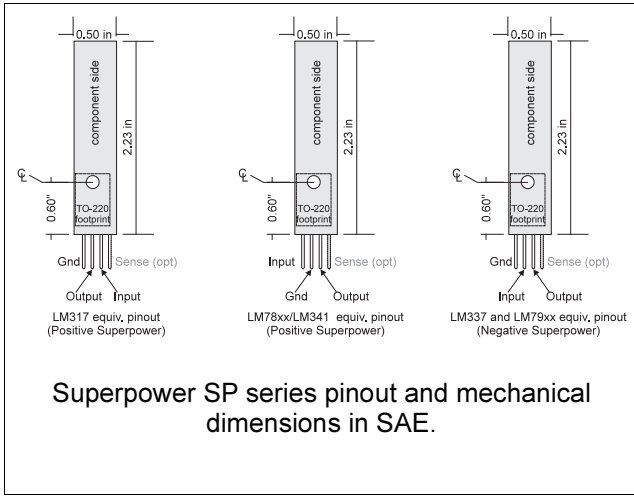
Figure 1: Typical rectified power supply

The same calculation with 4700µF results in a more tolerable 0.7V ripple. If the minimum point of the rectified voltage must be 5V, the DC + ripple at Cin must have a peak of at least 5.7V to deliver 5V out.

However, this does not consider the regulator drop out voltage—the voltage it requires to operate. Superpower needs almost 2V of drop out "head-room" at 400mA. The minimum point of ripple must then be 5V Vout + 2V drop out and Vin must peak at least 0.7V above that. So the absolute minimum voltage supplied by the rectifier at full load must be 7.7V(DC + ripple) to get 5V out and meet the Superpower specification for line regulation. It is best to allow for other factors and supply something higher than minimum, for this example 9V.

The required trade off is increased power dissipation in the regulator. But keep in mind that lost power is not a constant dissipation of (Vin - Vout) * Iload, because Vin is changing by the ripple magnitude.

MECHANICAL SPECIFICATIONS



External dimensions may vary by $\pm 5\%$, mounting hole dimensions by $\pm 0.5\%$.

Legal Information

By using Belleson Superpower regulators, you agree that the devices have no output protection and a short circuit of the output to ground can damage or destroy the regulator. All devices are tested prior to shipment and damaged devices will not be replaced.

You also agree that misuse or misapplication of Belleson products may cause damage where attempted use or application occurs and you as user of the product(s) accept all responsibility for all consequences of use or application of Belleson product(s) and will not hold Belleson responsible for any damage nor injury as a result of use or attempted use of Belleson products.

Belleson products are not authorized for use as critical components in life support devices or systems.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.