



## SPX1585

### 5A Low Dropout Voltage Regulator Adjustable & Fixed Output, Fast Response

#### FEATURES

- Adjustable Output Down To 1.2V
- Fixed Output Voltages 1.5V, 2.5V, 3.3V
- Output Current Of 5A
- Low Dropout Voltage 1.1V Typ @ 5A.
- Extremely Tight Load And Line Regulation
- Current & Thermal Limiting
- Standard 3-Terminal Low Cost TO-263
- Similar To Industry Standard LT1085/LT1585

Now Available in Lead Free Packaging

#### APPLICATIONS

- Powering VGA & Sound Card
- Power PC™ Supplies
- SMPS Post-Regulator
- High Efficiency “Green” Computer Systems
- High Efficiency Linear Power Supplies
- Portable Instrumentation
- Constant Current Regulators
- Adjustable Power Supplies
- Battery charger

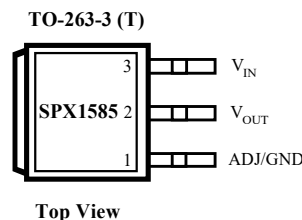
#### PRODUCT DESCRIPTION

The SPX1585 is a low power 5A adjustable and fixed voltage regulator that is very easy to use. It requires only 2 external resistors to set the output voltage for the adjustable version. The SPX1585 devices are designed for low voltage applications that offer lower dropout voltage and faster transient response. This device is an excellent choice for use in powering low voltage microprocessors that require a lower dropout, faster transient response to regulate from +2.5V to 3.8V supplies, and as a post regulator for switching supplies applications. The SPX1585 features low dropout of a maximum 1.2 volts.

The SPX1585 offers full protection against over-current faults, reversed input polarity, reversed load insertion, and positive and negative transient voltage. On-Chip trimming adjusts the reference voltage to 1%. The  $I_Q$  of this device flows into the load, which increases efficiency.

The SPX1585 devices are offered in a 3-pin TO-263 package compatible with other 3 terminal regulators. For an 8A low dropout regulator, refer to the SPX1584 data sheet.

#### PIN CONNECTIONS



Note that TAB is connected to VOUT.

## ABSOLUTE MAXIMUM RATINGS

Lead Temp. (Soldering, 10 Seconds).....	300°C
Storage Temperature Range .....	-65° to +150°C
Operating Junction Temperature Range	
SPX1585 Control Section.....	-45°C +125°C
SPX1585 Power Transistor.....	-45°C +150°C

Input Voltage.....	10V
Input to Output Voltage Differential .....	10V

## ELECTRICAL CHARACTERISTICS (NOTE 1) at $I_{OUT} = 10\text{mA}$ , $T_A = 25^\circ\text{C}$ , unless otherwise specified.

PARAMETER	CONDITIONS	Typ	SPX1585A		SPX1585		UNITS
			Min	Max	Min	Max	
<b>1.5V Version</b>							
Output Voltage (Note 2)	SPX1585-1.5V, $0 < I_{OUT} < 5\text{A}$ , $3.3\text{V} < V_{IN} < 10\text{V}$	1.5	1.485	1.515	1.47	1.53	V
			<b>1.47</b>	<b>1.53</b>	<b>1.455</b>	<b>1.545</b>	
<b>2.5V Version</b>							
Output Voltage (Note 2)	SPX1585-2.5V, $0 < I_{OUT} < 5\text{A}$ , $4.0\text{V} < V_{IN} < 10\text{V}$	2.5	2.475	2.525	2.45	2.55	V
			<b>2.45</b>	<b>2.55</b>	<b>2.425</b>	<b>2.575</b>	
<b>3.3V Version</b>							
Output Voltage (Note 2)	SPX1585-3.3V, $0 < I_{OUT} < 5\text{A}$ , $4.8\text{V} < V_{IN} < 10\text{V}$	3.3	3.267	3.333	3.234	3.366	V
			<b>3.234</b>	<b>3.366</b>	<b>3.069</b>	<b>3.399</b>	
<b>All Voltage Options</b>							
Reference Voltage (Vref)	$V_{IN} \leq 7\text{V}$ , $P \leq P_{MAX}$ $1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq 5.75\text{V}$ , $10\text{mA} \leq I_{OUT} \leq 5\text{A}$	<b>1.250</b>	<b>1.225</b>	<b>1.270</b>	<b>1.225</b>	<b>1.270</b>	V
Min. Load Current (Note 3)	$1.5\text{V} \leq (V_{IN} - V_{OUT}) \leq 5.75\text{V}$	<b>5</b>		<b>10</b>		<b>10</b>	mA
Line Regulation ( $\Delta V_{ref}(V_{in})$ )	$2.75\text{V} \leq V_{IN} \leq 7\text{V}$ , $I_{out} = 10\text{mA}$ , $T_J = 25^\circ\text{C}$ (Note 3)	0.005		0.2		0.2	%
	$V_{IN} \leq 7\text{V}$ , $I_{OUT} = 0\text{mA}$ , $T_J = 25^\circ\text{C}$ (Note 2)	0.005		0.2		0.2	
Load Regulation ( $\Delta V_{ref}(I_{out})$ )	$10\text{mA} \leq I_{OUT} \leq 5\text{A}$ , $(V_{IN} - V_{OUT}) = 3\text{V}$ , $T_J = 25^\circ\text{C}$ (Note 3)	0.05		0.3		0.3	%
	$0 \leq I_{OUT} \leq 5\text{A}$ , $V_{IN} = 7\text{V}$ , $T_J = 25^\circ\text{C}$ (Note 2)	0.05		0.3		0.3	
Dropout Voltage	$\Delta V_{REF} = 1\%$ $I_{OUT} = 5\text{A}$ (Note 3) $I_{OUT} < 5\text{A}$ (Note 2)	1.1		1.2		1.2	
Current Limit Iout(MAX)	$V_{IN} = 7\text{V}$ $1.4\text{V} \leq (V_{IN} - V_{OUT})$ (Note 3)	6	5.2		5.2		A
Long Term Stability	$T_A = 125^\circ\text{C}$ , 1000 Hrs.	0.3 (Note 2)		1		1	%
Thermal Regulation ( $\Delta V_{out}(P_{wr})$ )	$T_A = 25^\circ\text{C}$ , 20 ms pulse	0.01		0.020		0.020	%/W
Temperature Stability ( $\Delta V_{out}(T)$ )		0.25					%
Output Noise, RMS	10Hz to 10kHz $T_A = 25^\circ\text{C}$	0.003					% $V_o$
Thermal Resistance	TO-220      Junction to Tab Junction to Ambient			3.0		3.0	$^\circ\text{C}/\text{W}$
				60		60	
	DD Package      Junction to Tab Junction to Ambient			3.0		3.0	
				60		60	

The Bold specifications apply to the full operating temperature range.

Note 1: Changes in output voltage due to heating effects are covered under the specification for thermal regulation.

Note 2: Fixed Version Only

Note 3: Adjustable Version Only

## APPLICATION HINTS

The SPX1585 incorporates protection against over-current faults, reversed load insertion, over temperature operation, and positive and negative transient voltages. However, the use of an output capacitor is required in order to insure the stability and the performance of the device.

### Stability

The output capacitor is part of the regulator's frequency compensation system. Either a 22 $\mu$ F aluminum electrolytic capacitor or a 10 $\mu$ F solid tantalum capacitor between the output terminal and ground guarantees stable operation for all operating conditions. The recommended value for ESR is 0.5Ohms or less.

However, in order to minimize overshoot and undershoot, and therefore optimize the design, please refer to the section 'Ripple Rejection'.

### Ripple Rejection

Ripple rejection can be improved by adding a capacitor between the ADJ pin and ground. When ADJ pin bypassing is used, the value of the output capacitor required increases to its maximum (220 $\mu$ F for an aluminum electrolytic capacitor, or 47 $\mu$ F for a solid tantalum capacitor). If the ADJ pin is not bypassed, the value of the output capacitor can be lowered to 10 $\mu$ F for an electrolytic aluminum capacitor or 4.7 $\mu$ F for a solid tantalum capacitor.

However the value of the ADJ-bypass capacitor should be chosen with respect to the following equation:

$$C = 1 / ( 6.28 * F_R * R_1 )$$

Where C = value of the capacitor in Farads  
(select an equal or larger standard value),  
F<sub>R</sub> = ripple frequency in Hz,  
R<sub>1</sub> = value of resistor R<sub>1</sub> in Ohms.

If an ADJ-bypass capacitor is used, the amplitude of the output ripple will be independent of the output voltage. If an ADJ-bypass capacitor is not used, the output ripple will be proportional to the ratio of the output voltage to the reference voltage:

$$M = V_{OUT} / V_{REF}$$

Where M = multiplier for the ripple seen when the ADJ pin is optimally bypassed.  
V<sub>REF</sub> = Reference Voltage

### Reducing parasitic resistance and inductance

One solution to minimize parasitic resistance and inductance is to connect in parallel capacitors. This arrangement will improve the transient response of the power supply if your system requires rapidly changing current load condition.

### Thermal Consideration

Although the SPX1585 offers some limiting circuitry for overload conditions, it is necessary not to exceed the maximum junction temperature, and therefore to be careful about thermal resistance. The heat flow will follow the lowest resistance path, which is the Junction-to-case thermal resistance. In order to insure the best thermal flow of the component, a proper mounting is required. Note that the case of the device is electrically connected to the output. If the case must be electrically isolated, a thermally conductive spacer can be used. However do not forget to consider its contribution to thermal resistance.

Assuming:

$$V_{IN} = 10V, V_{OUT} = 5V, I_{OUT} = 1.5A, T_A = 50^{\circ}C/W, \\ \theta_{Heatsink Case} = 6^{\circ}C/W, \theta_{Heatsink Case} = 0.5^{\circ}C/W, \theta_{JC} = 3^{\circ}C/W$$

Power dissipation under this condition

$$P_D = (V_{IN} - V_{OUT}) * I_{OUT} = 7.5W$$

Junction Temperature

$$T_J = T_A + P_D * (\theta_{Case-HS} + \theta_{HS} \theta_{JC})$$

For the Control Section

$$T_J = 50 + 7.5*(0.5 + 6*3) = 121.25^{\circ}C$$

121.25 $^{\circ}$ C < T<sub>J(max)</sub> for the Control & Power Sections.

In both conditions, reliable operation is insured by adequate junction temperature.

## Basic Adjustable Regulator

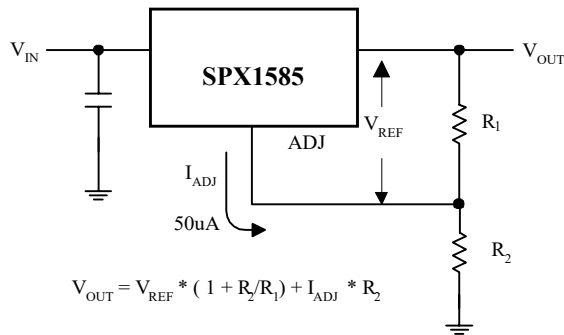


Fig.2 Basic Adjustable Regulator

## Output Voltage

Consider Figure 2. The resistance  $R_1$  generates a constant current flow, normally the specified load current of 10mA. This current will go through the resistance  $R_2$  to set the overall output voltage. The current  $I_{ADJ}$  is very small and constant. Therefore its contribution to the overall output voltage is very small and can generally be ignored.

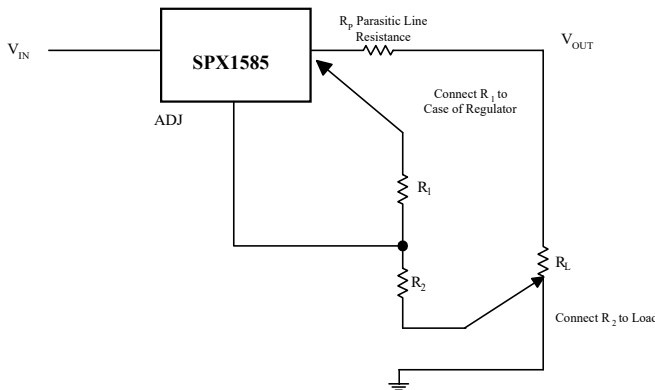
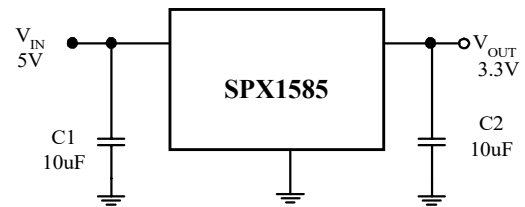


Fig.3 Basic Adjustable Regulator

## Load Regulation

Parasitic line resistance can degrade load regulation. In order not to affect the behavior of the regulator, it is best to connect directly the  $R_1$  resistance from the resistor divider to the case, and not to the load. For the same reason, it is best to connect the resistor  $R_2$  to the Negative side of the load.



Basic Fixed Regulator

## Output Voltage

The fixed voltage LDO voltage regulators are simple to use regulators since the  $V_{OUT}$  is preset to the specifications. It is important, however, to provide the proper output capacitance for stability and improvement. For most operating conditions a capacitance of 22uF tantalum or 100uF electrolytic will ensure stability and prevent oscillation.

## TYPICAL APPLICATIONS

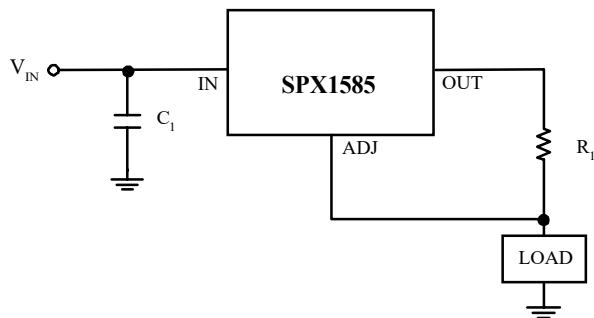


Fig. 4 5A Current output Regulator

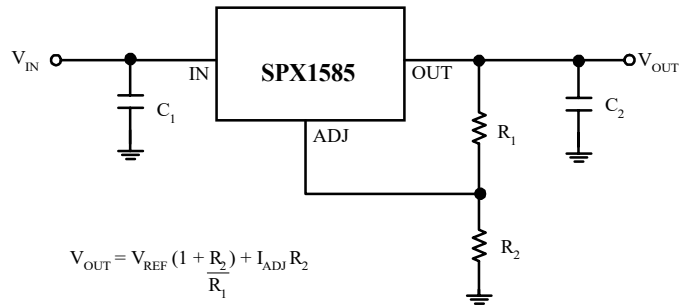


Fig. 5 Typical Adjustable Regulator

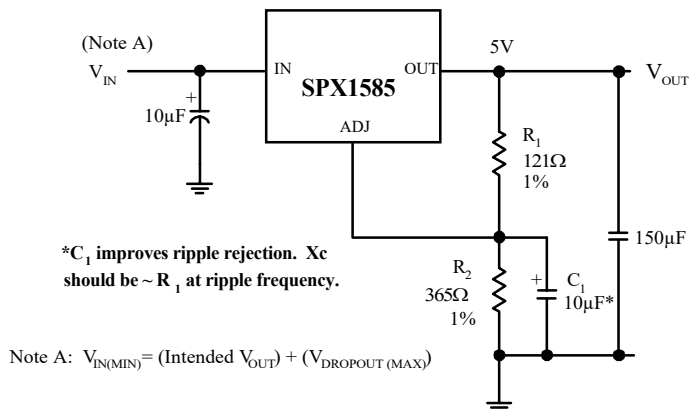


Fig. 6 Improving Ripple Rejection

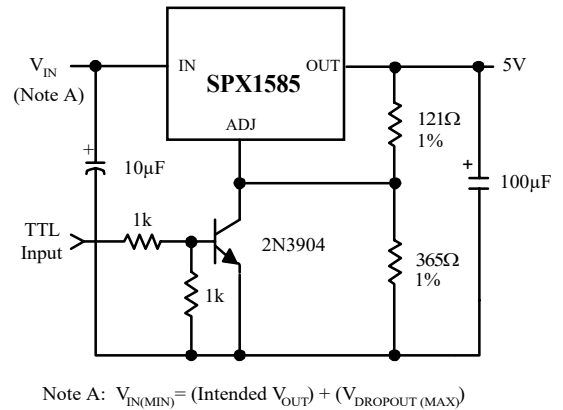
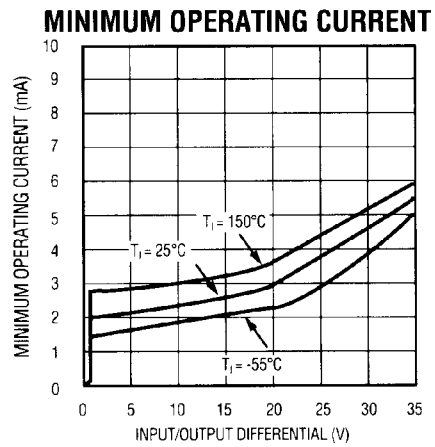
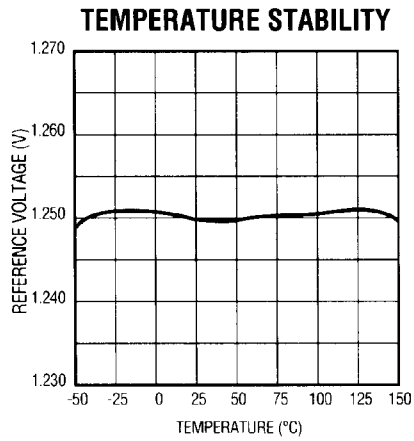
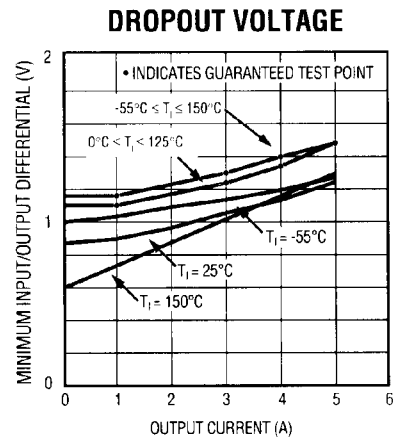
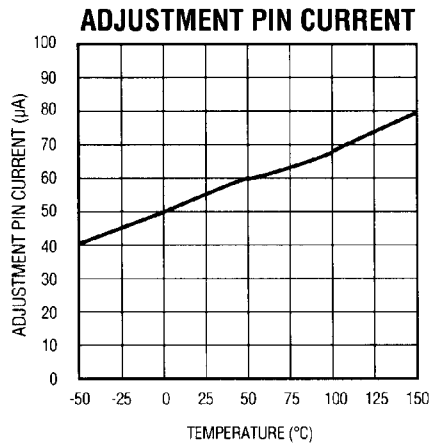
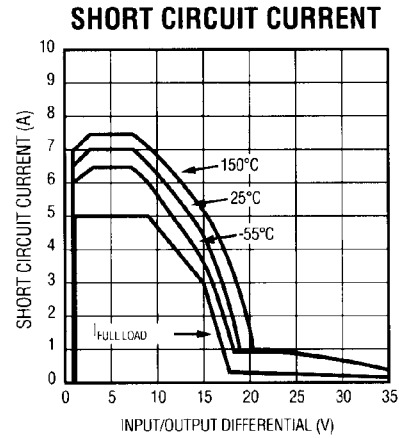
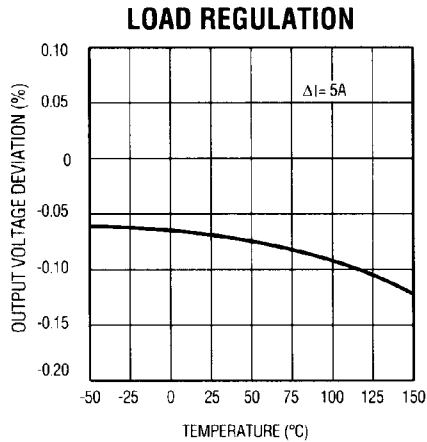


Fig.7 5V Regulator with Shutdown

TYPICAL CHARACTERISTICS

TYPICAL PERFORMANCE CHARACTERISTICS



## ORDERING INFORMATION

<u>Ordering No.</u>	<u>Precision</u>	<u>Output Voltage</u>	<u>Packages</u>
SPX1585AT-L/TR	1%	Adj	3 Lead TO-263
SPX1585AT-L-3-3/TR	1%	3.3V	3 Lead TO-263



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