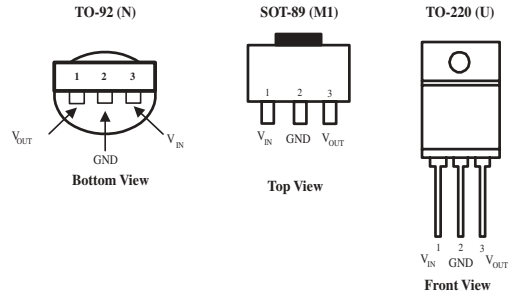


## 150mA Low Dropout Voltage Regulator

### FEATURES

- 3.3V and 3.5V Versions
- Output Current in Excess of 150 mA
- Input-Output Differential is 3.0V at 150mA
- Mirror-Image Insertion Protection
- Internal Thermal Protection
- Available in TO-92, TO-220 and SOT-89 Packages
- Improved Version of the Industry Standard LM2930
- Reverse Battery, Internal Short Circuit, Reverse Transient and 40V Load Dump Protection
- 3% Output Accuracy at 25°C



*Now Available in Lead Free Packaging*

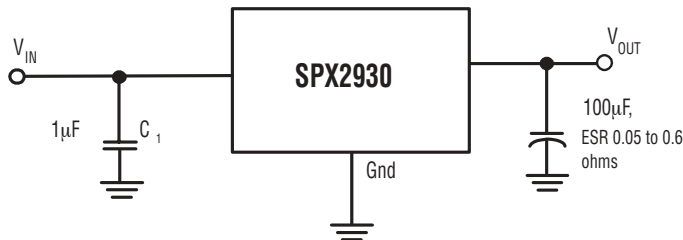
### APPLICATIONS

- Portable Instrumentation
- Cordless Telephones
- Radio Control Systemss
- Portable Consumer Devices
- Toys
- Radio Controlled Systems

### DESCRIPTION

The SPX2930 is a low power, positive voltage regulator. This device is an excellent choice for use in battery-powered applications such as cordless telephones, radio control systems, and portable computers. The SPX2930 features offers very low quiescent currents (0.4 mA), and very low drop output voltage (50 mV at light load and 300 mV at 150 mA). The SPX2930 is offered in a 3-pin TO-92, TO-220 and SOT-89 package.

### BLOCK DIAGRAM



**ABSOLUTE MAXIMUM RATINGS**

Power Dissipation (note 3)	Internally limited
Lead Temp (soldering, 5 seconds)	260°C
Storage Temperature Range	-65°C to +150°C
Input Supply Voltage Range	-0.3 to +30V
ESD Rating (note 4)	2kV

**RECOMMENDED OPERATING CONDITIONS**

Input Supply Voltage Range	3.0 to 26V
Operating Junction Temperature Range	-40°C to 85°C
TO-92 $\theta_{JA}$	110°C/W
TO-220 $\theta_{JA}$	55°C/W

**ELECTRICAL CHARACTERISTICS**

at  $V_{IN}=6V$ ,  $T_A = 25^\circ C$ ,  $I_O = 10\text{ mA}$ ,  $C_{OUT} = 100\ \mu F$ , unless otherwise specified. (Note 1)

PARAMETER	CONDITIONS	Min	Typ	Max	Units
<b>3.3V Version</b>					
Output Voltage (Note 2)	$4V < V_{IN} < 26V$ , $I_O = 150\text{ mA}$ over temp.	3.201 <b>3.135</b>	3.300 <b>3.300</b>	3.399 <b>3.465</b>	V
<b>3.5V Version</b>					
Output Voltage (Note 2)	$4.5V < V_{IN} < 26V$ , $I_O = 150\text{ mA}$ Over Temp.	3.395 <b>3.325</b>	3.500 <b>3.500</b>	3.605 <b>3.675</b>	V
<b>All Voltage Options</b>					
Long Term Stability			20		mV/1000hr
Line Regulation	$9V < V_{IN} < 16V$ , $4.5V < V_{IN} < 26V$		4.0	30	mV
Load Regulation	$5\text{ mA} < I_O < 150\text{ mA}$		14	50	mV
Dropout Voltage	$I_O = 10\text{ mA}$ $I_O = 150\text{ mA}$		0.05 0.3	0.2 0.6	V
Quiescent Current	$I_O = 10\text{ mA}$ , $4.5V < V_{IN} < 26V$ $-40^\circ C < T_J < 85^\circ C$ $I_O = 150\text{ mA}$ , $V_{IN} = 14V$ , $T_J = 25^\circ C$		0.4 15	1.0	mA
Output Noise Voltage	10Hz-100kHz, $C_{OUT} = 100\ \mu F$		500		$\mu V_{RMS}$
Ripple Rejection	$F_O = 120\text{ Hz}$		80		dB
Maximum Operational Input Voltage		26			V
Maximum Line Transient	$R_L = 500\ \Omega$ , 100ms	50	70		V
Reverse Polarity Input Voltage, DC	$V_O > -0.3V$ , $R_L = 500\ \Omega$	-15	-30		V
Reverse Polarity Input Voltage, Transient	1% Duty Cycle, $\tau < 100\text{ ms}$ $R_L = 500\ \Omega$	-50	-80		V
Current Limit		150	400	650	mA

**NOTES:**

Note 1: See TYPICAL APPLICATIONS notes to ensure constant junction temperature, low duty cycle pulse testing used.

Note 2: All limits are at 25°C or over the full operating junction temperature range of -40°C to +85°C.

Note 3: The maximum power dissipation is a function of maximum junction temperature, total thermal resistance, and ambient temperature.

Note 4: Human body model, 100pF discharged through 1.5k $\Omega$ .

# TYPICAL PERFORMANCE CHARACTERISTICS

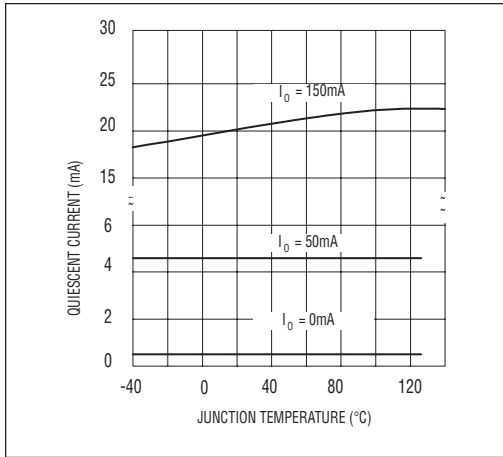


Figure 1. Quiescent Current

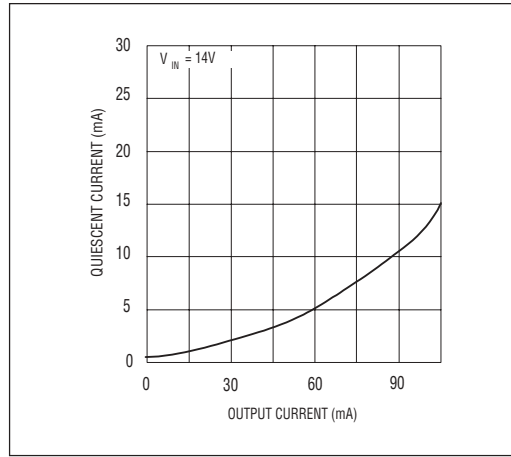


Figure 2. Quiescent Current

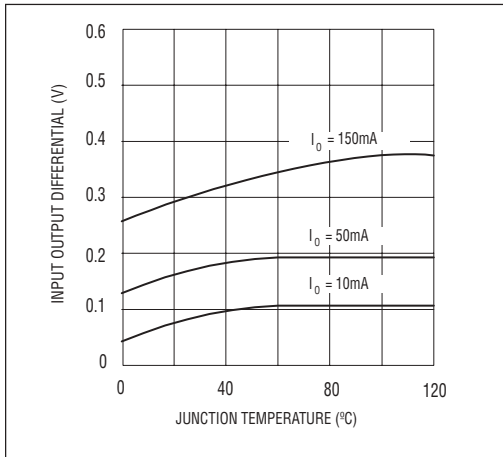


Figure 3. Dropout Voltage

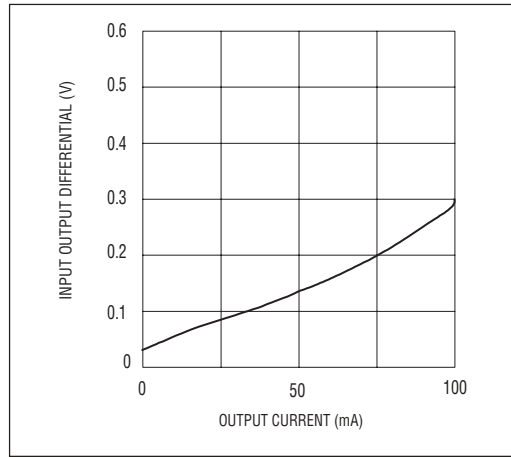


Figure 4. Dropout Voltage

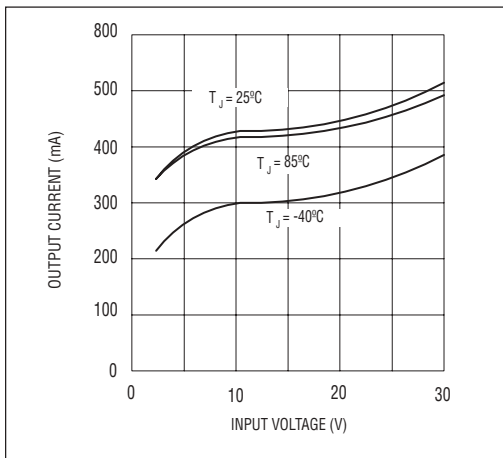


Figure 5. Peak Output Current

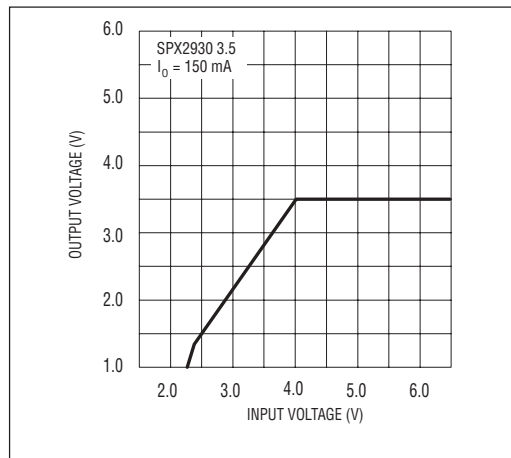


Figure 6. Low Voltage Behavior

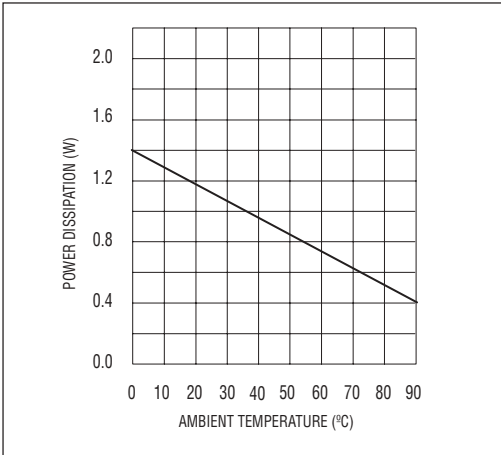


Figure 7. Maximum Power Dissipation (SOT89)

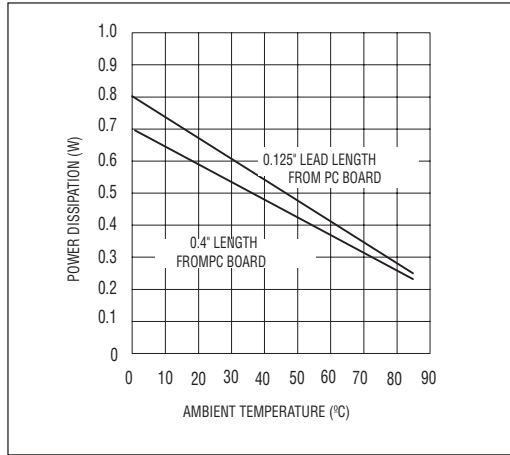


Figure 8. Maximum Power Dissipation (TO-92)

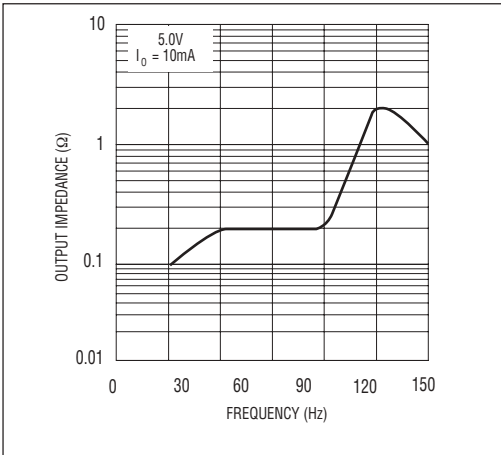


Figure 9. Output Impedance

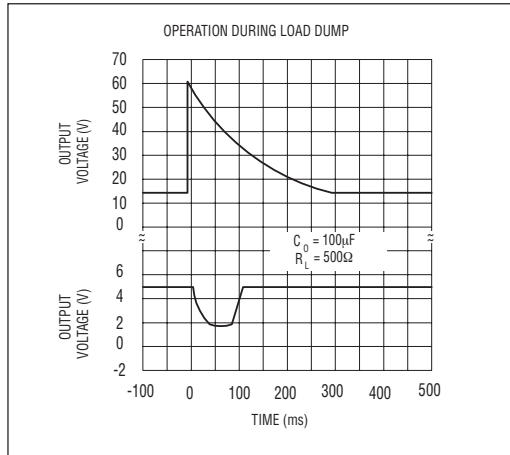


Figure 10. Operation During Load Dump

## APPLICATION INFORMATION

The SPX2930 requires an output capacitor for device stability. The value required varies greatly depending upon the application circuit and other factors. The high frequency characteristics of electrolytic capacitors depend greatly on the type and also on the manufacturer. Sometimes only bench testing is the only means to determine the proper capacitor type and value. The high quality 100µF aluminum electrolytic covers all general application circuits, this stability can be obtained with a tantalum electrolytic value of 47µF.

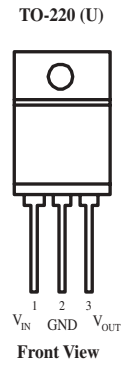
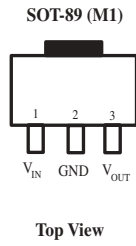
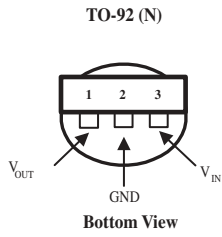
Another critical point of electrolytic characteristics is its performance over temperature. The SPX2930 is designed to operate starting at -40°C which may not be true in the case of electrolytic. Higher temperatures generally no problem. The electrolytic type in aluminum will freeze around -30°C. This could cause an oscillation at output of regulator. At a lower temperature requirement by many applications the capacitor should maintain its performance. So as a result, for an application which regulator junction temperature does not exceed 25°C, the

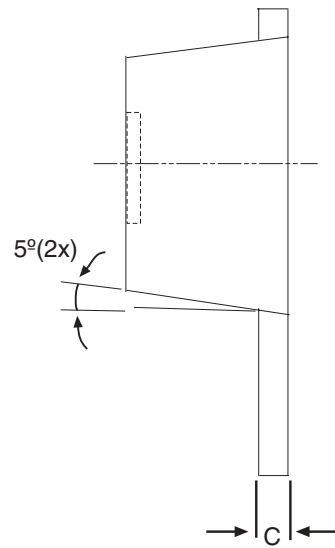
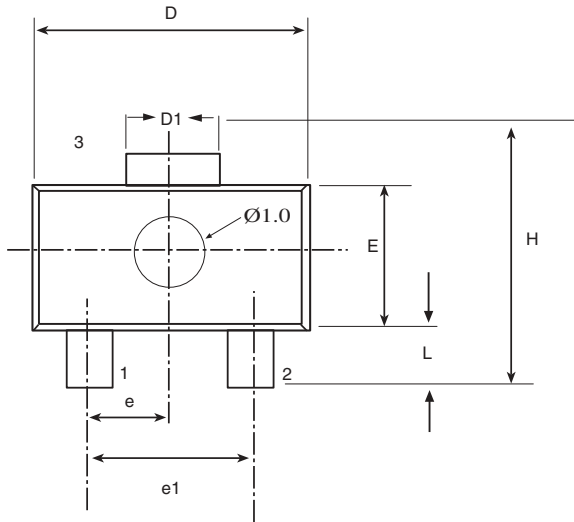
output capacitor can be reduced by the factor of two over the value needed for the entire temperature range.

In most applications the SPX2930 is operating at few milliamps. In these applications the output capacitance can be further reduced. For example, when the regulator is running at 10mA output current the output capacitance value is half compared to the same regulator that is running at 100mA. The value decreases with higher output voltages, since the internal loop gain is reduced.

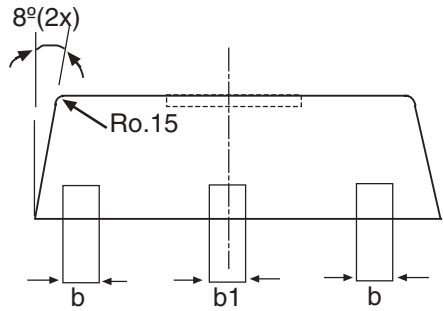
The worst case occurs at the lower temperature and maximum operating currents, the entire circuit and the electrolytic, should be cooled down to the minimum temperature. The minimum of 0.6 volts required at the input of regulator above the output to keep the power dissipation and die heating to its minimum. After the value for the capacitor has been determined for actual use, the value should be doubled.

# PACKAGES

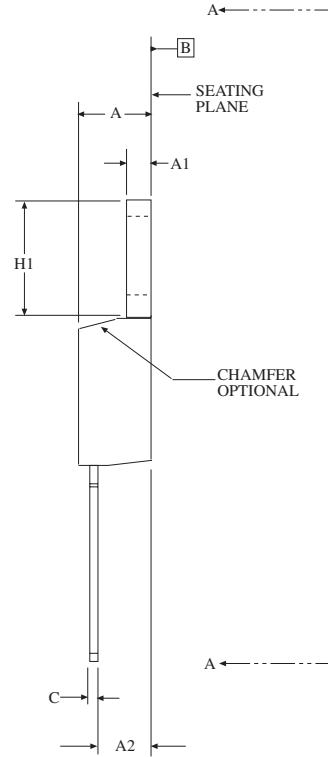
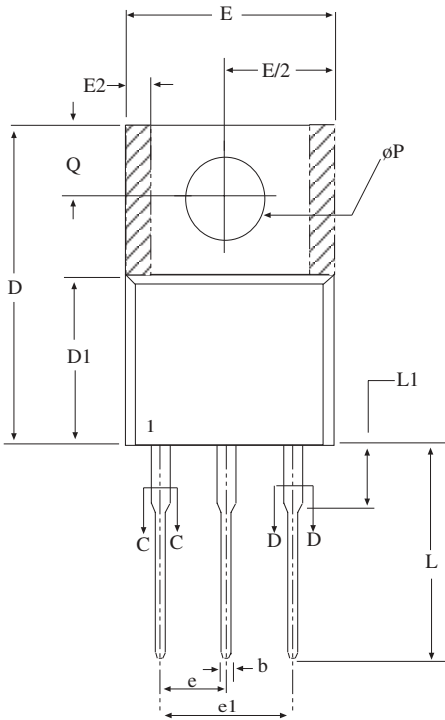




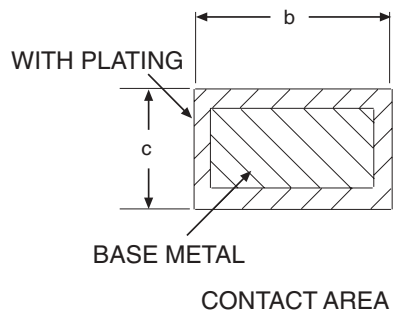
3 PIN SOT-89	Dimensions in (mm)		
	MIN	NOM	MAX
A	1.40	1.50	1.60
b	0.36	0.42	0.48
L	0.80	-	1.20
b1	0.41	0.47	0.53
C	0.38	0.40	0.43
D	4.40	4.50	4.60
D1	1.40	1.60	1.75
H	3.94	-	4.25
E	2.40	2.50	2.60
e	1.45	1.50	1.55
e1	2.90	3.00	3.10



**3 PIN SOT-89**



Dimensions in (mm)	3 PIN TO-220 JEDEC TO-220 (AB) Variation		
	MIN	NOM	MAX
A	.140	-	.190
A1	.020	-	.055
A2	.080	-	.115
b	.015	.027	.040
b2	.045	-	.070
c	.014	-	.024
D	.560	-	.650
D1	.330	-	.355
D2	.480	-	.507
E	.380	-	.420
E1	.270	-	.350
E2	-	-	.030
e	.100 BSC		
e1	.200 BSC		
H1	.230	-	.270
L1	-	-	.250
L2	-	-	-
ΔP	.139	-	.161
Q	.100	-	.135



**3 PIN TO-220**



<b>PART NUMBER</b>	<b>ACC.</b>	<b>OUTPUT VOLTAGE</b>	<b>PACKAGE</b>
SPX2930M1-3.3	3%	3.3V	3 lead SOT-89
SPX2930M1-3.3/TR	3%	3.3V	3 lead SOT-89
SPX2930M1-3.5	3%	3.5V	3 lead SOT-89
SPX2930M1-3.5/TR	3%	3.5V	3 lead SOT-89
SPX2930N-3.3	3%	3.3V	3 lead TO-92
SPX2930N-3.3/TR	3%	3.3V	3 lead TO-92
SPX2930N-3.5	3%	3.5V	3 lead TO-92
SPX2930N-3.5/TR	3%	3.5V	3 lead TO-92
SPX2930U-3.3	3%	3.3V	3 Lead TO-220
SPX2930U-3.5	3%	3.5V	3 Lead TO-220

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SPX2930N-3.3/TR = standard; SPX2930N-L-3.3/TR = lead free

/TR = Tape and Reel

Pack quantity is 2,000 for TO-92 and 2,500 for SOT-89.



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