

# 1.5A Low Dropout Voltage Regulator

## FEATURES

- Guaranteed 1.5A Output Current
- Three Terminal Adjustable or Fixed 2.5V, 3.3V and 5.0V
- Low Quiescent Current
- Low Dropout Voltage of 1.1V at 1.5A
- 0.1% Line and 0.1% Load Regulation
- Stable with 10uF Ceramic Capacitor
- Overcurrent and Thermal Protection
- Available Packages: TO-252, TO-220, and TO-263
- Similar to Industry Standard LT1086/LT1586

## APPLICATIONS

- Desktop PC's Servers
- Powering VGA and Sound Cards
- Cordless Phones
- Battery Chargers
- Adjustable Power Supplies
- Portable Instrumentation
- SMPS Post-Regulator
- Constant Current Regulators
- Disk Drives

Refer to Page 5 for Pinouts

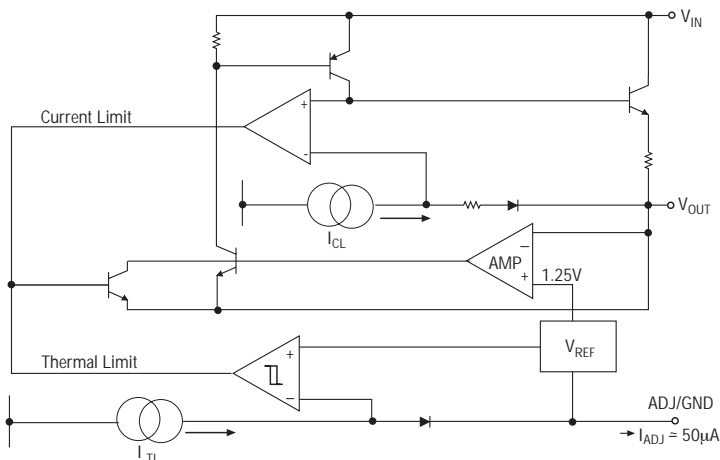
*Now Available in Lead Free Packaging*

## DESCRIPTION

The SPX2815 is a low power positive-voltage regulator designed to satisfy moderate power requirements with a cost effective, small footprint solution. This device is an excellent choice for use in battery-powered applications and portable computers. The SPX2815 features very low quiescent current and a low dropout voltage of 1.1V at a full load. As output current decreases, quiescent current flows into the load, increasing efficiency. SPX2815 is available in adjustable or fixed 2.5V, 3.3V and 5.0V output voltages.

The SPX2815 is offered in several 3-pin surface mount packages: TO-252, TO-220 and TO-263. An output capacitor of 10 $\mu$ F ceramic or tantalum provides unconditional stability.

## FUNCTIONAL DIAGRAM (Adjustable)



## ABSOLUTE MAXIMUM RATINGS

Power Dissipation.....Internally Limited  
 Lead Temperature (soldering, 5 seconds) .....260°C  
 Storage Temperature Range.....-65°C to +150°C

Operating Junction Temperature Range....-40°C to +125°C  
 Input Supply Voltage ..... +10V  
 Input to Output Voltage ..... +8.8V  
 ESD Rating ..... 2kV min

## ELECTRICAL CHARACTERISTICS

at  $V_{IN}=V_{OUT} + 1.5V$ ,  $T_A = 25^\circ C$ ,  $C_{IN} = C_{OUT} = 10\mu F$ ,  $I_{OUT}=10mA$ , unless otherwise specified. The Boldface applies over the full operating temperature range.

PARAMETER	MIN	TYP	MAX	MIN	TYP	MAX	UNITS	CONDITIONS
<b>2.5V Version</b>	<b>SPX2815A</b>			<b>SPX2815</b>				
Output Voltage	2.475 <b>2.450</b>	2.500	2.525 <b>2.550</b>	2.450 <b>2.425</b>	2.500	2.550 <b>2.575</b>	V	$I_{OUT} = 10mA$ , $V_{IN} = 4.5V$ $10mA \leq I_{OUT} \leq 3A$ , $4.25V \leq V_{IN} \leq 10V$
<b>3.30V Version</b>								
Output Voltage	3.267 <b>3.234</b>	3.300	3.333 <b>3.366</b>	3.234 <b>3.201</b>	3.300	3.366 <b>3.399</b>	V	$I_{OUT} = 10mA$ , $V_{IN} = 5V$ $10mA \leq I_{OUT} \leq 3A$ , $4.75V \leq V_{IN} \leq 10V$
<b>5.0V Version</b>								
Output Voltage	4.950 <b>4.900</b>	5.000	5.050 <b>5.100</b>	4.900 <b>4.850</b>	5.000	5.100 <b>5.150</b>	V	$I_{OUT}=10mA$ , $V_{IN}=7V$ $10mA \leq I_{OUT} \leq 3A$ , $6.50V \leq V_{IN} \leq 10V$
<b>All Voltage Options</b>								
Reference Voltage	1.238 <b>1.225</b>	1.250	1.262 <b>1.275</b>	1.225 <b>1.212</b>	1.250	1.275 <b>1.287</b>	V	$I_{OUT}=10mA$ , $(V_{IN} - V_{OUT}) = 2V$ $10mA \leq I_{OUT} \leq 3A$ , $1.5V \leq (V_{IN} - V_{OUT}) \leq 10V$
Output Voltage Temperature Stability		0.3			0.5		%	
Line Regulation		0.1 0.1 0.1	0.2 0.2 0.2		0.1 0.1 0.1	0.2 0.2 0.2	%	$4.25V \leq V_{IN} \leq 10V$ , $V_{OUT}=2.5V$ , $I_{OUT}=10mA$ $4.75V \leq V_{IN} \leq 10V$ , $V_{OUT}=3.3V$ , $I_{OUT}=10mA$ $6.50V \leq V_{IN} \leq 10V$ , $V_{OUT}=5.0V$ , $I_{OUT}=10mA$
Load Regulation		0.1 0.1 0.1	0.3 0.3 0.3		0.1 0.1 0.1	0.3 0.3 0.3	%	$10mA \leq I_{OUT} \leq 1.5A$ , $V_{OUT}=2.5V$ $10mA \leq I_{OUT} \leq 1.5A$ , $V_{OUT}=3.3V$ $10mA \leq I_{OUT} \leq 1.5A$ , $V_{OUT}=5.0V$
Dropout Voltage (Note 2)		1.00 1.10	1.2		1.00 1.10	1.2	V	$I_{OUT}=0.5A$ $I_{OUT}=1.5A$
Quiescent Current		4	10		4	10	mA	Fixed voltage versions
Adjust Pin Current		50	<b>120</b>		50	<b>120</b>	$\mu A$	
Current Limit	2.5			2.5			A	$(V_{IN} - V_{OUT}) = 5V$
Thermal Regulation		0.01	0.1		0.01	0.1	%/W	25°C, 30mS pulse
Ripple Rejection	60	75		60	75		dB	$f_{RIPPLE}=120Hz$ , $(V_{IN} - V_{OUT})=2V$ , $V_{RIPPLE}=1V_{PP}$
Long Term Stability		0.03			0.03		%	125°C, 1000Hrs
RMS Output Noise		0.003			0.003		%	% of $V_{OUT}$ , $10Hz \leq f \leq 10kHz$

## TYPICAL PERFORMANCE CHARACTERISTICS

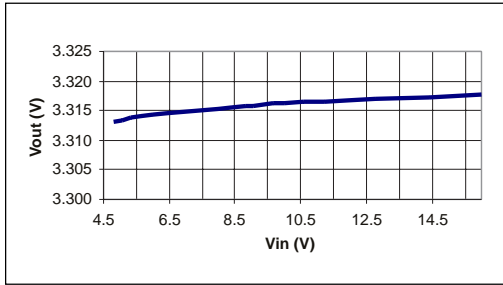


Figure 1. Line Regulation for SPX2815U-3.3;  $I_{OUT}=10mA$

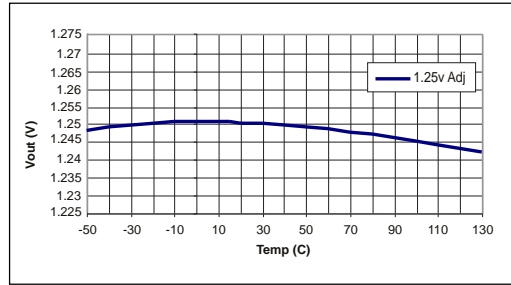


Figure 2.  $V_{OUT}$  vs Temperature,  $V_{IN}=2.5V$ ,  $I_{OUT}=10mA$

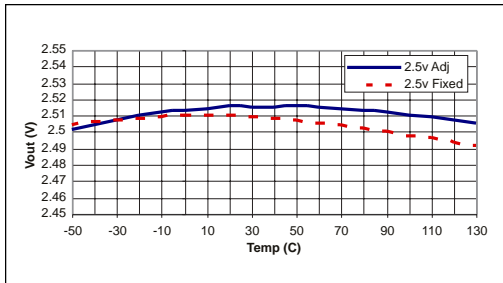


Figure 3.  $V_{IN}=4.0V$ ,  $I_{OUT}=10mA$

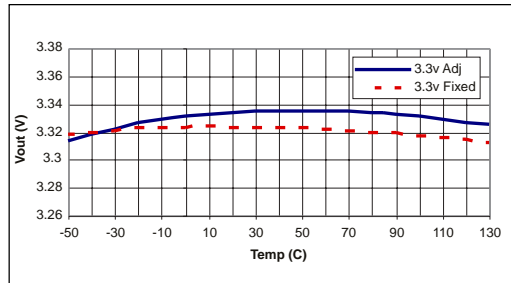


Figure 4.  $V_{IN}=5.0V$ ,  $I_{OUT}=10mA$

## APPLICATION INFORMATION

### Output Capacitor

To ensure the stability of the SPX2815, an output capacitor of at least  $10\mu F$  (ceramic or tantalum) or  $22\mu F$  (aluminum) is required. The value may change based on the application requirements of the output load or temperature range. The value of ESR can vary based on the type of capacitor used in the applications to guarantee stability. The recommended value for ESR is  $0.5\Omega$  or less. A larger value of output capacitance (up to  $100\mu F$ ) can improve the load transient response.

### Soldering Methods

The SPX2815 die is attached to the heatsink lead which exits opposite the input, output, and ground pins.

### Thermal Characteristics

The SPX2815 features the internal thermal limiting to protect the device during overload conditions. Special care needs to be taken during

continuous load conditions such that the maximum junction temperature does not exceed  $125^{\circ}C$ . Thermal protection is activated at  $>179^{\circ}C$  and deactivated at  $<165^{\circ}C$ .

The thermal interaction from other components in the application can effect the thermal resistance of the SPX2815. The actual thermal resistance can be determined with experimentation.

SPX2815 power dissipation is calculated as follows:

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

Maximum Junction Temperature range:

$$T_J = T_A(\max) + P_D * \text{thermal resistance (junction-to-ambient)}$$

Maximum junction temperature must not exceed the  $125^{\circ}C$ .

**Ripple Rejection**

Ripple rejection can be improved by adding a capacitor between the ADJ pin and ground as shown in Figure 8. When ADJ pin bypassing is used, the value of the output capacitor required increases to its maximum. If the ADJ pin is not bypassed, the value of the output capacitor can be lowered to 22μF for an electrolytic aluminum capacitor or 10μF for a solid tantalum capacitor (Fig 7).

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 R1 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.

$$V_{REF} = 1.25V$$

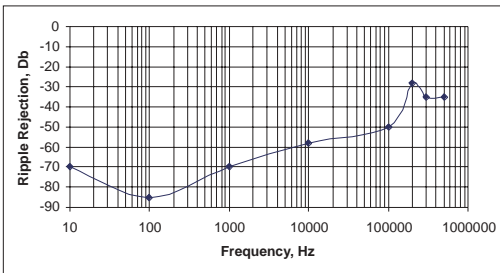


Figure 5. Ripple Rejection; Vin=3.3V, Vout=1.8V (adj.), Iload=200mA

Ripple rejection for the adjustable version is shown in Figure 5.

**Output Voltage**

The output of the adjustable regulator can be set to any voltage between 1.25V and 15V. The value of V<sub>OUT</sub> can be quickly approximated using the formula

$$V_{OUT} = 1.25 * (R_1 + R_2) / R_1$$

A small correction to this formula is required depending on the values of resistors R<sub>1</sub> and R<sub>2</sub>, since the adjustable pin current (approx 50μA) flows through R<sub>2</sub>. When I<sub>ADJ</sub> is taken into account, the formula becomes

$$V_{OUT} = V_{REF} (1 + (R_2 / R_1)) + I_{ADJ} * R_2$$

where

$$V_{REF} = 1.25V$$

**Layout Considerations**

Parasitic line resistance can degrade load regulation. In order to avoid this, connect R<sub>1</sub> directly to V<sub>OUT</sub> as illustrated in Figure 13. For the same reason, R<sub>2</sub> should be connected to the negative side of the load.

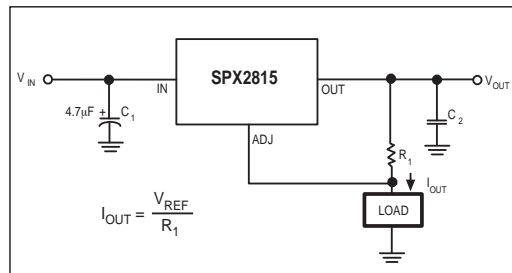


Figure 6. Current Source

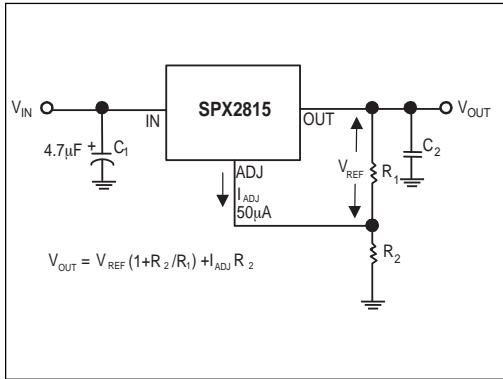


Figure 7. Typical Adjustable Regulator

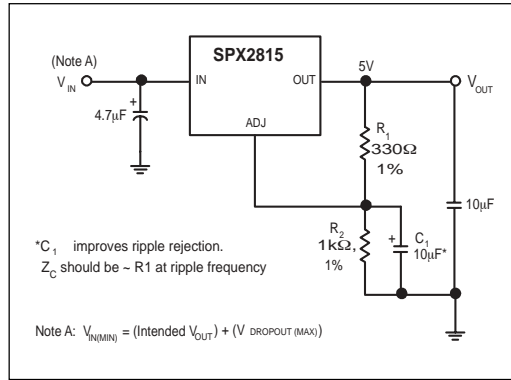


Figure 8. Improving Ripple Rejection

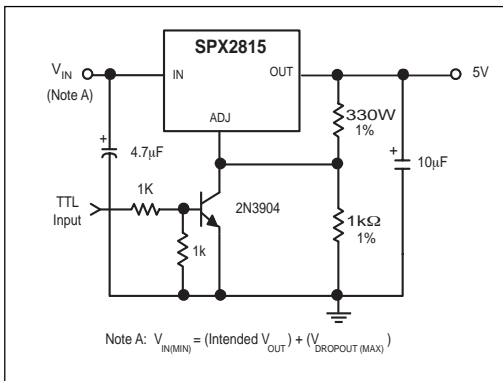


Figure 9. 5V Regulator with Shutdown

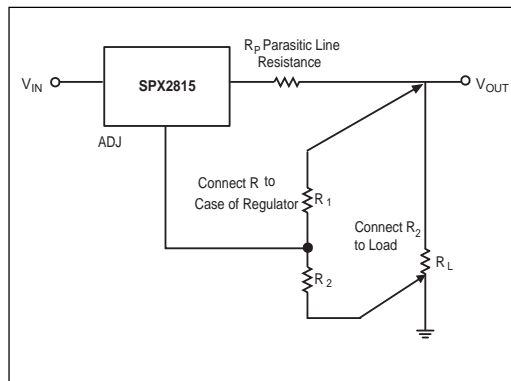
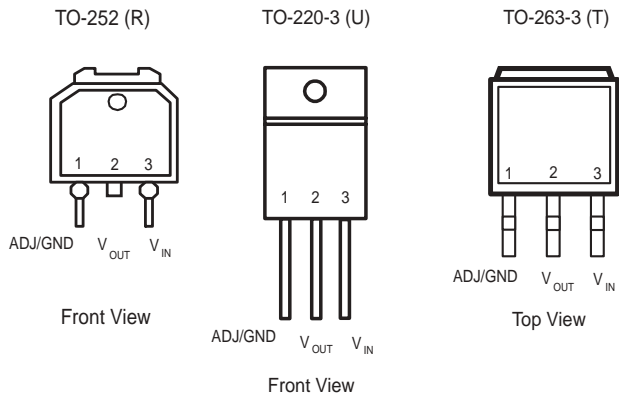
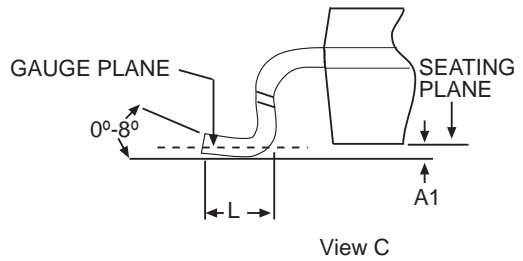
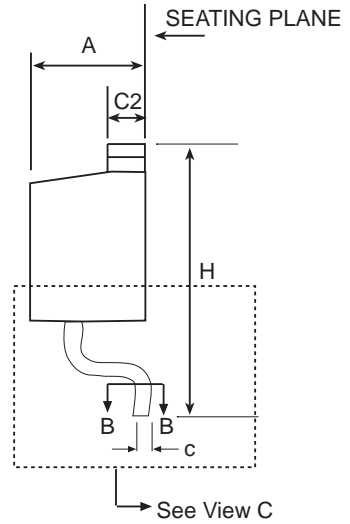
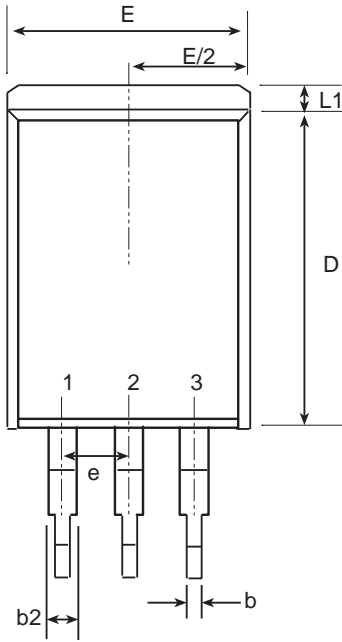


Figure 10. Recommended Connections for Best Results

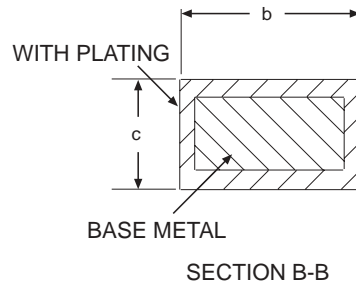
PINOUTS

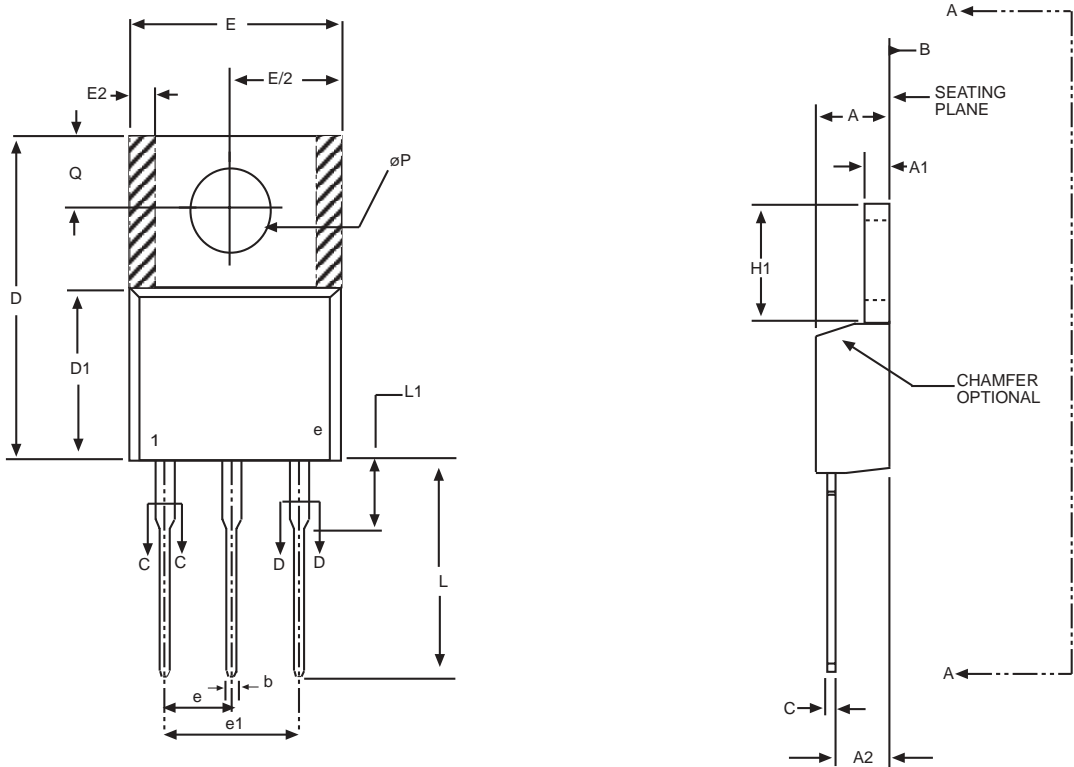




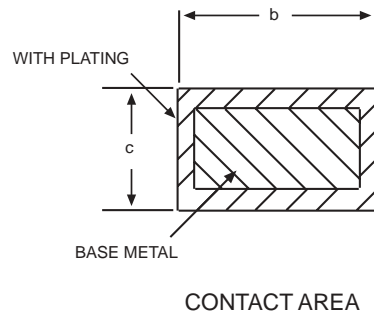
3 Pin TO-263 JEDEC TO-263 (AA) Variation			
SYMBOL	MIN	NOM	MAX
A	0.16	-	0.19
A1	0	-	0.01
b	0.02	-	0.039
c	0.015	-	0.029
D	0.33	-	0.28
D1	0.27	-	-
E	0.38	-	0.42
E1	0.245	-	-
e	.100 BSC		
H	0.575	-	0.625
L	0.07	-	0.11
L1	-	-	0.066
L2	-	-	0.07
L3	.010 BSC		

Note: Dimensions in (mm)

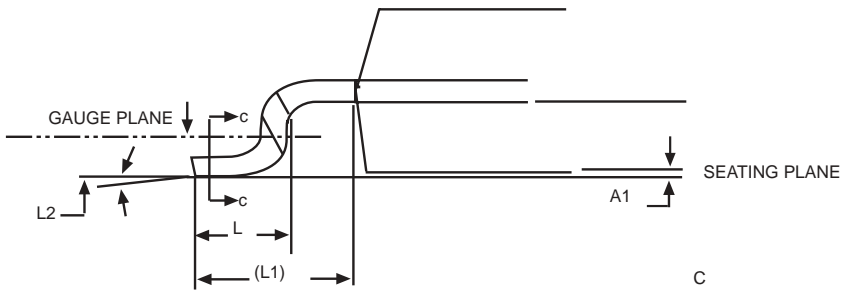




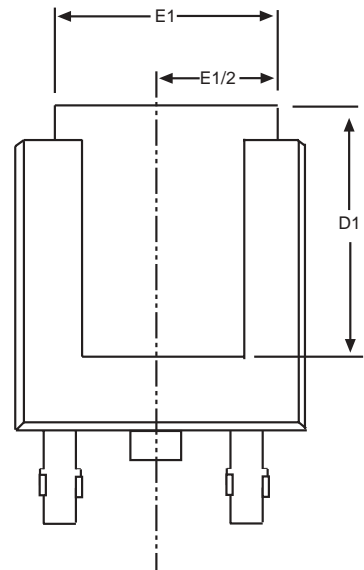
3 Pin TO-220 JEDEC TO-220 (AB) Variation			
SYMBOL	MIN	NOM	MAX
A	1.4	-	0.19
A1	0.02	-	0.055
A2	0.08	-	0.115
b	0.015	0.027	0.04
b2	0.045	-	0.07
c	0.014	-	0.024
D	0.56	-	0.65
D1	0.33	-	0.355
D2	0.48	-	0.507
E	0.38	-	0.42
E1	0.27	-	0.35
E2	-	-	0.03
e	.100 BSC		
e1	.100 BSC		
H1	0.23	-	0.27
L1	-	-	0.25
L2	-	-	-
ΔP	0.139	-	0.161
Q	0.1	-	0.135



Note: Dimensions in (mm)

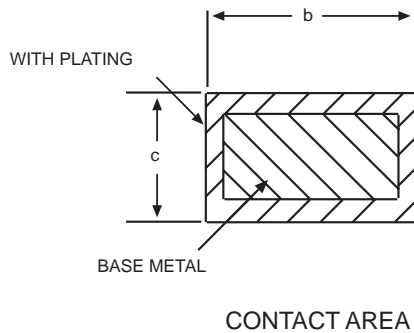


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3 Pin TO-252 JEDEC TO-252 (AA) Variation			
SYMBOL	MIN	NOM	MAX
A1	-	-	0.005
c	0.018	-	0.024
D1	0.205	-	-
E1	0.17	-	-
H	0.37	-	0.41
L	0.055	0.06	0.07
L1	.108 REF		
L2	.020 BSC		

Note: Dimensions in (mm)





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**ORDERING INFORMATION**

<b>PART NUMBERS</b>	<b>ACC.</b>	<b>TOP MARK</b>	<b>OUTPUT VOLTAGE</b>	<b>PACKAGE</b>
SPX2815AR .....	1% .....	SPX2815ARYYYWW.....	Adj.....	3 lead TO-252
SPX2815AR/TR .....	1% .....	SPX2815ARYYYWW.....	Adj.....	3 lead TO-252
SPX2815AR-2.5 .....	1% .....	SPX2815AR25YYWW.....	Adj.....	3 lead TO-252
SPX2815AR-2.5/TR .....	1% .....	SPX2815AR25YYWW.....	Adj.....	3 lead TO-252
SPX2815AR-3.3 .....	1% .....	SPX2815AR33YYWW.....	Adj.....	3 lead TO-252
SPX2815AR-3.3/TR .....	1% .....	SPX2815AR33YYWW.....	Adj.....	3 lead TO-252
SPX2815AR-5.0 .....	1% .....	SPX2815AR50YYWW.....	Adj.....	3 lead TO-252
SPX2815AR-5.0/TR .....	1% .....	SPX2815AR50YYWW.....	Adj.....	3 lead TO-252
SPX2815AT .....	1% .....	SPX2815ATYYWW.....	Adj.....	3 lead TO-263
SPX2815AT/TR .....	1% .....	SPX2815ATYYWW.....	Adj.....	3 lead TO-263
SPX2815AT-2.5 .....	1% .....	SPX2815AT25YYWW.....	Adj.....	3 lead TO-263
SPX2815AT-2.5/TR .....	1% .....	SPX2815AT25YYWW.....	Adj.....	3 lead TO-263
SPX2815AT-3.3 .....	1% .....	SPX2815AT33YYWW.....	Adj.....	3 lead TO-263
SPX2815AT-3.3/TR .....	1% .....	SPX2815AT33YYWW.....	Adj.....	3 lead TO-263
SPX2815AT-5.0 .....	1% .....	SPX2815AT50YYWW.....	Adj.....	3 lead TO-263
SPX2815AT-5.0/TR .....	1% .....	SPX2815AT50YYWW.....	Adj.....	3 lead TO-263
SPX2815AU .....	1% .....	SPX2815AUYYWW.....	Adj.....	3 lead TO-220
SPX2815AU-2.5 .....	1% .....	SPX2815AU25YYWW.....	Adj.....	3 lead TO-220
SPX2815AU-3.3 .....	1% .....	SPX2815AU33YYWW.....	Adj.....	3 lead TO-220
SPX2815AU-5.0 .....	1% .....	SPX2815AU50YYWW.....	Adj.....	3 lead TO-220

/TR = Tape and Reel

Pack quantity is 500 for TO-263 and 2,000 for TO-252.

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<b>PART NUMBERS</b>	<b>ACC.</b>	<b>TOP MARK</b>	<b>OUTPUT VOLTAGE</b>	<b>PACKAGE</b>
SPX2815R .....	2% .....	SPX2815RYYWW.....	Adj .....	3 lead TO-252
SPX2815R/TR .....	2% .....	SPX2815RYYWW.....	Adj .....	3 lead TO-252
SPX2815R-2.5 .....	2% .....	SPX2815R25YYWW.....	Adj .....	3 lead TO-252
SPX2815R-2.5/TR .....	2% .....	SPX2815R25YYWW.....	Adj .....	3 lead TO-252
SPX2815R-3.3 .....	2% .....	SPX2815R33YYWW.....	Adj .....	3 lead TO-252
SPX2815R-3.3/TR .....	2% .....	SPX2815R33YYWW.....	Adj .....	3 lead TO-252
SPX2815R-5.0 .....	2% .....	SPX2815R50YYWW.....	Adj .....	3 lead TO-252
SPX2815R-5.0/TR .....	2% .....	SPX2815R50YYWW.....	Adj .....	3 lead TO-252
SPX2815T .....	2% .....	SPX2815TYYWW.....	Adj .....	3 lead TO-263
SPX2815T/TR .....	2% .....	SPX2815TYYWW.....	Adj .....	3 lead TO-263
SPX2815T-2.5 .....	2% .....	SPX2815T25YYWW.....	Adj .....	3 lead TO-263
SPX2815T-2.5/TR .....	2% .....	SPX2815T25YYWW.....	Adj .....	3 lead TO-263
SPX2815T-3.3 .....	2% .....	SPX2815T33YYWW.....	Adj .....	3 lead TO-263
SPX2815T-3.3/TR .....	2% .....	SPX2815T33YYWW.....	Adj .....	3 lead TO-263
SPX2815T-5.0 .....	2% .....	SPX2815T50YYWW.....	Adj .....	3 lead TO-263
SPX2815T-5.0/TR .....	2% .....	SPX2815T50YYWW.....	Adj .....	3 lead TO-263
SPX2815U .....	2% .....	SPX2815UYYYWW.....	Adj .....	3 lead TO-220
SPX2815U-2.5 .....	2% .....	SPX2815U25YYWW.....	Adj .....	3 lead TO-220
SPX2815U-3.3 .....	2% .....	SPX2815U33YYWW.....	Adj .....	3 lead TO-220
SPX2815U-5.0 .....	2% .....	SPX2815U50YYWW.....	Adj .....	3 lead TO-220

/TR = Tape and Reel

Pack quantity is 500 for TO-263 and 2,000 for TO-252.

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