



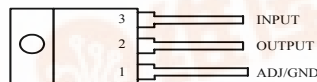
SP1086

## 1.5A Low Dropout Linear Regulator

### Features

- Low Dropout Voltage: Typical 1.3V at 1.5A
- Current Limiting and Thermal Protection
- Output Current: 1.5A
- Current Limit: 2.3A
- Operating Junction Temperature: 0 to 125°C
- Line Regulation: 0.015% (Typical)
- Load Regulation: 0.1% (Typical)
- Available in RoHS Compliant, Lead Free Packaging

TO-220



### Applications

- High Efficiency Linear Regulators
- Battery Charger
- Post Regulation for Switching Supply
- Microprocessor Supply
- Motherboard Power Supply
- Cable and ADSL Modem
- DVD-Video Player
- Telecom Equipment
- Set Top Boxes and Web Boxes Modules' Supply

### General Description

The SP1086 is a series of low dropout positive voltage regulators with a maximum dropout of 1.5V at 1.5A of load current. The series features on-chip thermal shutdown. It also includes a bandgap reference and a current limiting circuit. The SP1086 is available in 1.5V, 1.8V, 2.5V, 3V, 3.3V, and 5.0V versions. The fixed versions integrate the adjust resistors. It is also available in an adjustable version, which can set the output voltage with only two external resistors. The SP1086 series is available in standard packages of TO-263-3, TO-220, and TO-252.

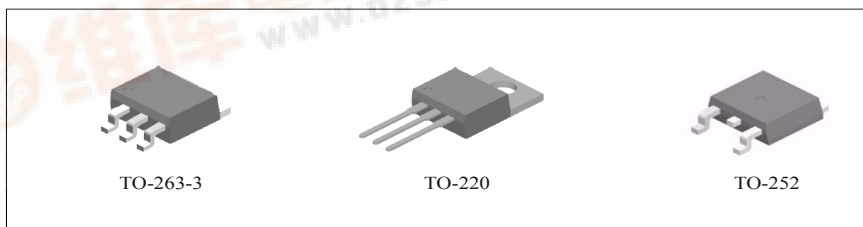


Figure 1. Package Types of SP1086

## Pin Configuration

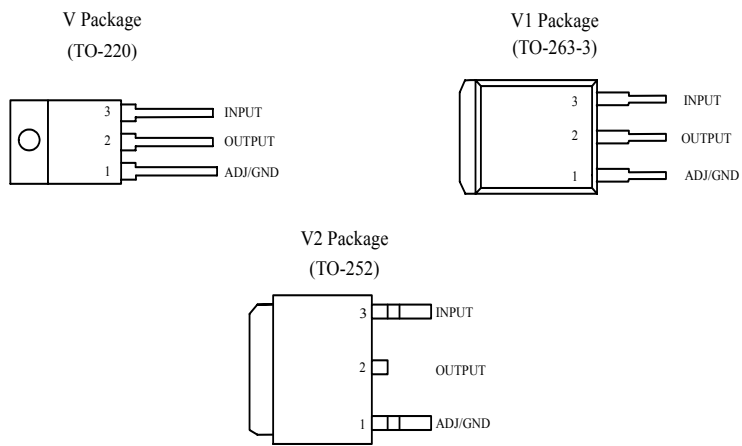


Figure 2. Pin Configuration of SP1086 (Top View)

## Functional Block Diagram

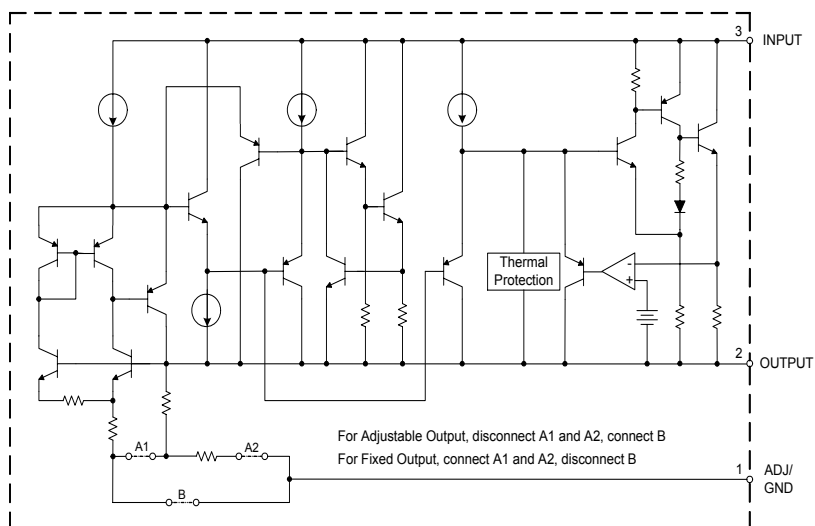


Figure 3. Functional Block Diagram of SP1086

## Electrical Characteristics

(Typical and limits apply for  $T_j=25^\circ\text{C}$  unless otherwise noted.)

Parameter	Test Circuit	Symbol	Conditions	Min	Typ	Max	Unit
Reference Voltage	0.5%	4	$V_{\text{REF}}$ $V_{\text{KA}}=V_{\text{REF}}, I_{\text{KA}}=10\text{mA}$	1.234	1.240	1.246	V
	1%			1.228	1.240	1.252	
Deviation of Reference Voltage Over-Temperature	4	$\Delta V_{\text{REF}}$	$V_{\text{KA}}=V_{\text{REF}}, I_{\text{KA}}=10\text{mA}$	0°C to 70°C	2	10	mV
				-40°C to 85°C	3	10	
Ratio of Change in $V_{\text{REF}}$ to the Change in Cathode Voltage	5	$\frac{\Delta V_{\text{REF}}}{\Delta V_{\text{KA}}}$	$I_{\text{KA}}=10\text{mA}, \Delta V_{\text{KA}} \cdot V_{\text{REF}}$ to 16V		-0.5	-1.5	mV/V
Reference Input Current	5	$I_{\text{REF}}$	$I_{\text{KA}}=10\text{mA}, R1=10\text{K}\Omega, R2=\infty$		0.15	0.4	$\mu\text{A}$
Deviation of Reference Current Over Full Temperature Range	5	$\Delta I_{\text{REF}}$	$I_{\text{KA}}=10\text{mA}, R1=10\text{K}\Omega, R2=\infty, T_A=-40$ to 85°C		0.1	0.4	$\mu\text{A}$
Minimum Cathode Current for Regulation	4	$I_{\text{KA}}$ (MIN)	$V_{\text{KA}}=V_{\text{REF}}$		55	80	$\mu\text{A}$
Off-State Cathode Current	6	$I_{\text{KA}}$ (OFF)	$V_{\text{REF}}=0, V_{\text{KA}}=18\text{V}$		0.04	0.10	$\mu\text{A}$
			$V_{\text{KA}}=6, V_{\text{REF}}=0$		0.01	0.05	
Dynamic Impedance	4	$Z_{\text{KA}}$	$V_{\text{KA}}=V_{\text{REF}}, I_{\text{KA}}=1$ to 100mA $f \leq 1.0\text{kHz}$		0.05	0.15	$\Omega$

## Electrical Characteristics

Typicals and limits appearing in normal type apply for  $T_J = 25^\circ\text{C}$ . Limits appearing in **Boldface** type apply over the entire junction temperature range for operation,  $0^\circ\text{C}$  to  $125^\circ\text{C}$ . ( $P_D \leq$  maximum power dissipation, see Note 2.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Reference Voltage	$V_{REF}$	SP1086-ADJ, $I_{OUT} = 10\text{mA}$ , $V_{IN} - V_{OUT} = 2\text{V}$ , $T_J = 25^\circ\text{C}$ , $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $1.4\text{V} \leq V_{IN} - V_{OUT} \leq 6\text{V}$	1.238 <b>1.225</b>	1.250 <b>1.250</b>	1.262 <b>1.270</b>	V
Output Voltage	$V_{OUT}$	SP1086-1.5, $I_{OUT} = 10\text{mA}$ , $V_{IN} = 3.5\text{V}$ , $T_J = 25^\circ\text{C}$ , $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $3\text{V} \leq V_{IN} \leq 10\text{V}$	1.485 <b>1.47</b>	1.5 <b>1.5</b>	1.515 <b>1.53</b>	V
		SP1086-1.8, $I_{OUT} = 10\text{mA}$ , $V_{IN} = 3.8\text{V}$ , $T_J = 25^\circ\text{C}$ , $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $3.2\text{V} \leq V_{IN} \leq 10\text{V}$	1.782 <b>1.746</b>	1.8 <b>1.8</b>	1.818 <b>1.854</b>	V
		SP1086-2.5, $I_{OUT} = 10\text{mA}$ , $V_{IN} = 4.5\text{V}$ , $T_J = 25^\circ\text{C}$ , $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $3.9\text{V} \leq V_{IN} \leq 10\text{V}$	2.475 <b>2.45</b>	2.5 <b>2.5</b>	2.525 <b>2.55</b>	V
		SP1086-3.0, $I_{OUT} = 10\text{mA}$ , $V_{IN} = 4.5\text{V}$ , $T_J = 25^\circ\text{C}$ , $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $4.9\text{V} \leq V_{IN} \leq 10\text{V}$	2.97 <b>2.94</b>	3.0 <b>3.0</b>	3.03 <b>3.06</b>	V
		SP1086-3.3, $I_{OUT} = 10\text{mA}$ , $V_{IN} = 5\text{V}$ , $T_J = 25^\circ\text{C}$ , $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $4.75\text{V} \leq V_{IN} \leq 10\text{V}$	3.267 <b>3.235</b>	3.3 <b>3.3</b>	3.333 <b>3.365</b>	V
		SP1086-5.0, $I_{OUT} = 10\text{mA}$ , $V_{IN} = 7\text{V}$ , $T_J = 25^\circ\text{C}$ , $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $6.5\text{V} \leq V_{IN} \leq 10\text{V}$	4.95 <b>4.9</b>	5 <b>5</b>	5.05 <b>5.1</b>	V
Line Regulation	$\Delta V_{OUT}$	SP1086-ADJ, $I_{OUT} = 10\text{mA}$ , $1.5\text{V} \leq V_{IN} - V_{OUT} \leq 10\text{V}$		0.015 <b>0.035</b>	0.2 <b>0.2</b>	%
		SP1086-1.5, $I_{OUT} = 10\text{mA}$ , $1.5\text{V} \leq V_{IN} - V_{OUT} \leq 10\text{V}$		0.3 <b>0.6</b>	6 <b>6</b>	mV
		SP1086-1.8, $I_{OUT} = 10\text{mA}$ , $1.5\text{V} \leq V_{IN} - V_{OUT} \leq 10\text{V}$		0.3 <b>0.6</b>	6 <b>6</b>	mV
		SP1086-2.5, $I_{OUT} = 10\text{mA}$ , $1.5\text{V} \leq V_{IN} - V_{OUT} \leq 10\text{V}$		0.3 <b>0.6</b>	6 <b>6</b>	mV
		SP1086-3.0, $I_{OUT} = 10\text{mA}$ , $1.5\text{V} \leq V_{IN} - V_{OUT} \leq 10\text{V}$		0.3 <b>0.6</b>	6 <b>6</b>	mV
		SP1086-3.3, $I_{OUT} = 10\text{mA}$ , $1.5\text{V} \leq V_{IN} - V_{OUT} \leq 10\text{V}$		0.5 <b>1</b>	10 <b>10</b>	mV
		SP1086-5.0, $I_{OUT} = 10\text{mA}$ , $1.5\text{V} \leq V_{IN} - V_{OUT} \leq 10\text{V}$		0.5 <b>1</b>	10 <b>10</b>	mV

## Electrical Characteristics (Continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Load Regulation	$\Delta V_{OUT}$	SP1086-ADJ, $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $V_{IN} - V_{OUT} = 2\text{V}$		0.1 <b>0.2</b>	0.3 <b>0.4</b>	%
		SP1086-1.5, $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $V_{IN} - V_{OUT} = 2\text{V}$		3 <b>6</b>	12 <b>20</b>	mV
		SP1086-1.8, $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $V_{IN} - V_{OUT} = 2\text{V}$		3 <b>6</b>	12 <b>20</b>	mV
		SP1086-2.5, $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $V_{IN} - V_{OUT} = 2\text{V}$		3 <b>6</b>	12 <b>20</b>	mV
		SP1086-3.0, $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $V_{IN} - V_{OUT} = 2\text{V}$		3 <b>7</b>	15 <b>20</b>	mV
		SP1086-3.3, $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $V_{IN} - V_{OUT} = 2\text{V}$		3 <b>7</b>	15 <b>20</b>	mV
		SP1086-5.0, $10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $V_{IN} - V_{OUT} = 2\text{V}$		5 <b>10</b>	20 <b>35</b>	mV
Dropout Voltage		$I_O = 1.5\text{A}$ , $\Delta V_{REF} = 1\%$		1.3	1.5	V
Current Limit	$I_{LIMIT}$	$V_{IN} - V_{OUT} = 2\text{V}$ ,	1.5	2.3		A
Minimum Load Current		$1.4\text{V} \leq V_{IN} - V_{OUT} \leq 10\text{V}$ (For ADJ)		<b>2</b>	<b>5</b>	mA
Quiescent Current		$V_{IN} = V_{OUT} + 1.3\text{V}$		<b>5</b>	<b>10</b>	mA
Ripple Rejection		$f_{RIPPLE} = 120\text{Hz}$ , $C_{OUT} = 25\mu\text{F}$ Tantalum, $I_{OUT} = 1.5\text{A}$ , $V_{IN} - V_{OUT} = 3\text{V}$	<b>60</b>	<b>75</b>		dB
Adjust Pin Current				60	<b>120</b>	$\mu\text{A}$
Adjust Pin Current Change		$10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$ , $1.4\text{V} \leq V_{IN} - V_{OUT} \leq 10\text{V}$		<b>0.2</b>	<b>5</b>	$\mu\text{A}$
Temperature Stability				<b>0.5</b>		%
RMS Noise (% of $V_{OUT}$ )		$T_A = 25^\circ\text{C}$ , $10\text{Hz} \leq f \leq 10\text{kHz}$		0.003		%
Thermal Shutdown		Junction Temperature		165		$^\circ\text{C}$
Thermal Shutdown Hysteresis				30		$^\circ\text{C}$
Thermal Resistance Junction-to-Case	$\theta_{JC}$	TO - 252 TO - 263 TO - 220		4 4 4		$^\circ\text{C}/\text{W}$

Note 2: Maximum power dissipation see Figure 5.

## Typical Performance Characteristics

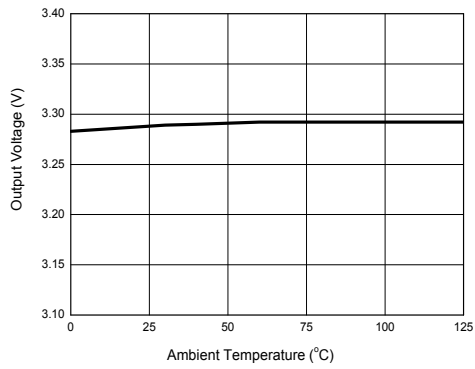


Figure 4. Output Voltage vs. Temperature

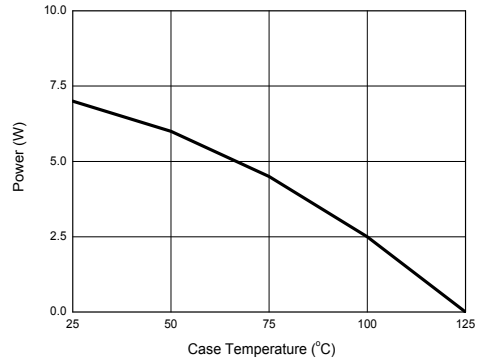


Figure 5. Maximum Power Dissipation

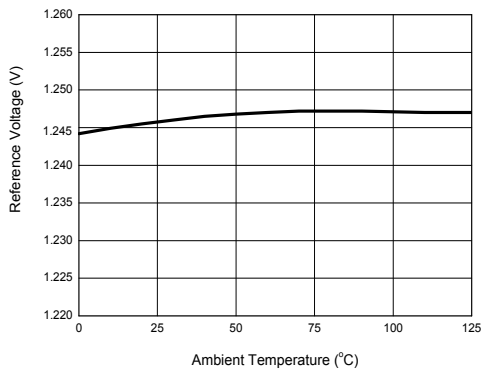


Figure 6. Reference Voltage vs. Temperature

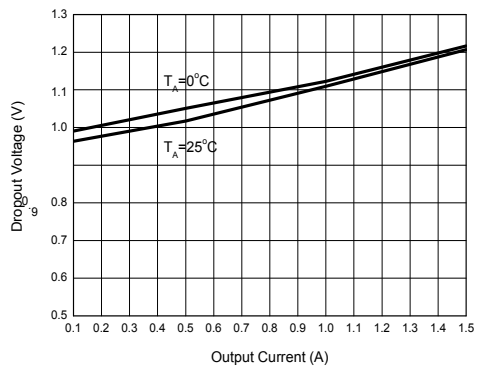


Figure 7. Dropout Voltage vs. Output Current

## Typical Performance Characteristics (Continued)

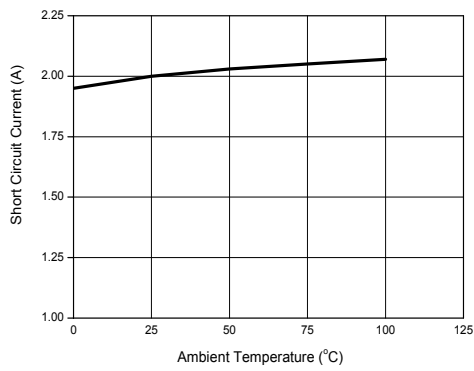


Figure 8. Short Circuit Current vs. Temperature

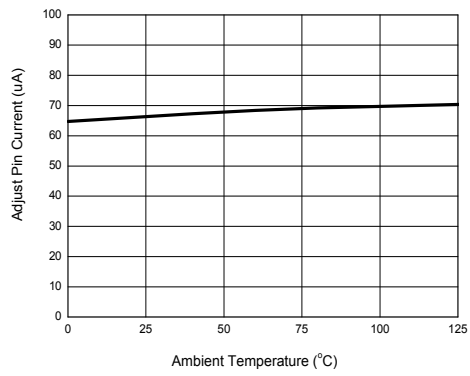


Figure 9. Adjust Pin Current vs. Temperature

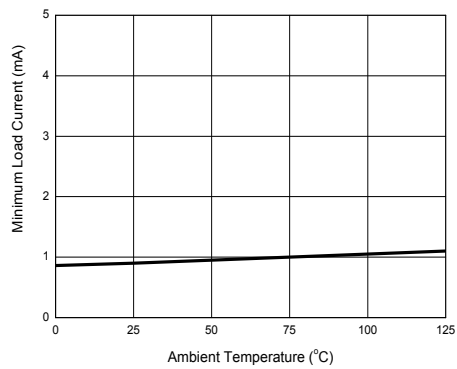


Figure 10. Minimum Load Current vs. Temperature

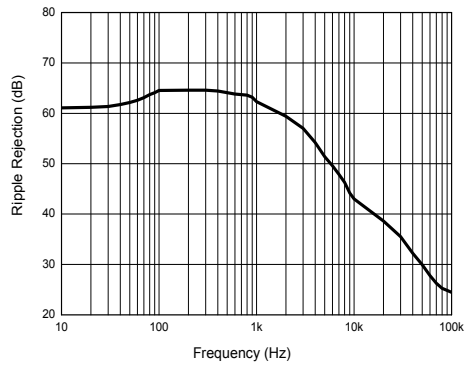
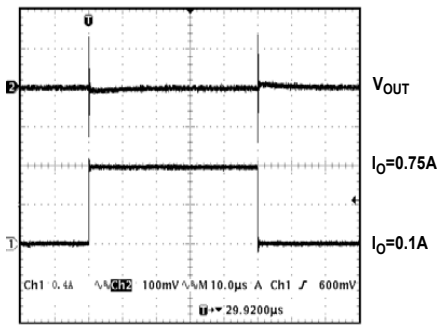


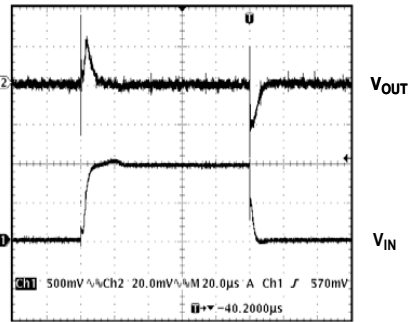
Figure 11. Ripple Rejection vs. Frequency

## Typical Performance Characteristics (Continued)



SP1086V Load transient response

$V_{IN}=4.8V$ ,  $V_{OUT}=3.3V$ ,  $I_O=0.1A$  to  $0.75A$ ,  $C_{IN}=C_{OUT}=10\mu$  (tan)



SP1086V Line transient response

$V_{IN}=4.8V$ ,  $V_{OUT}=3.3V$ ,  $I_O=0.1A$ ,  $C_{IN}=1\mu$  (tan),  $C_{OUT}=10\mu$  (tan)

Figure 12. Load Transient Response

Figure 13. Line Transient Response

## Typical Application

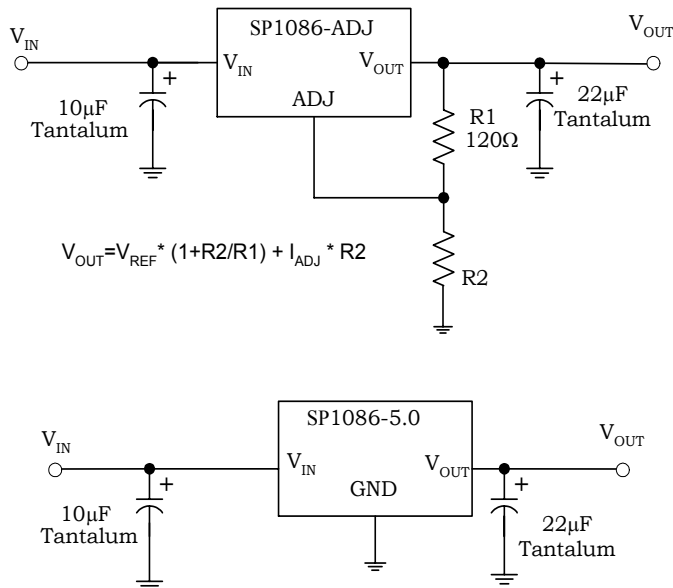


Figure 14. Typical Applications of SP1086

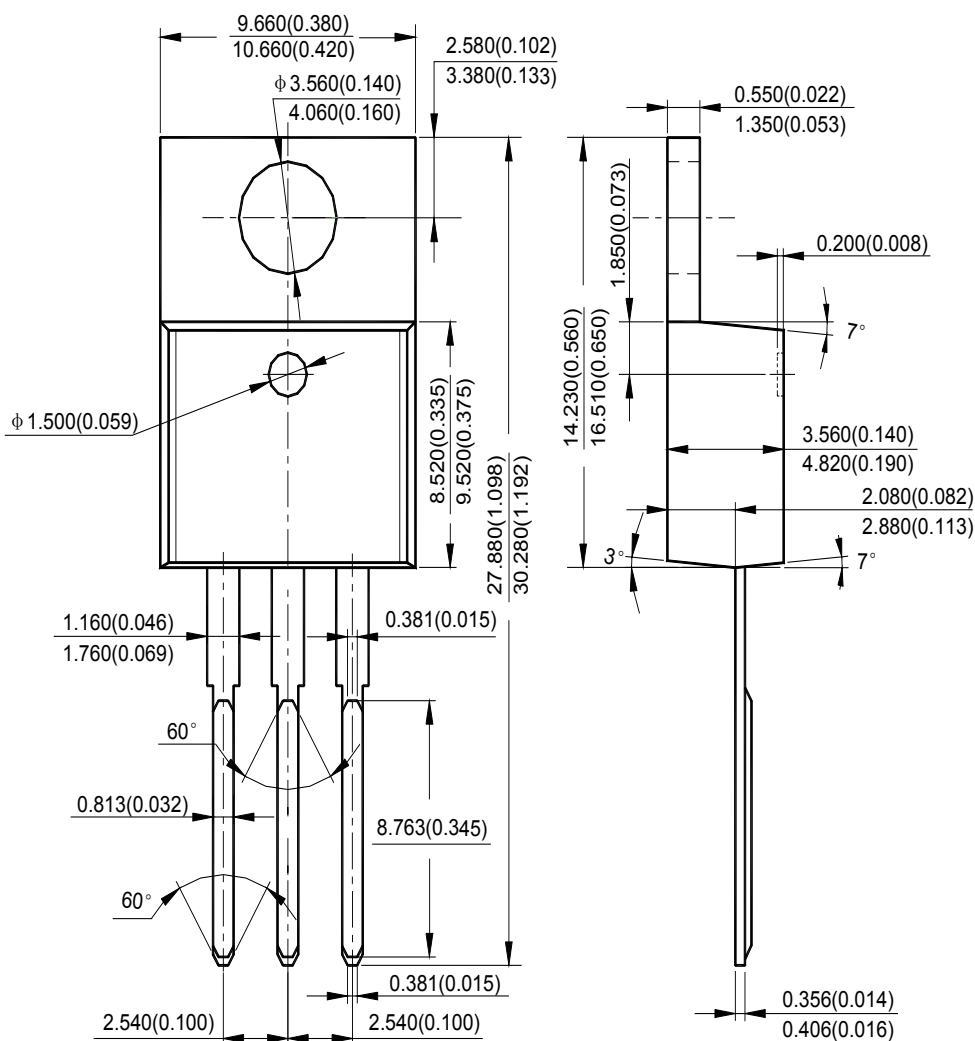




Mechanical Dimensions (Continued)

TO-220

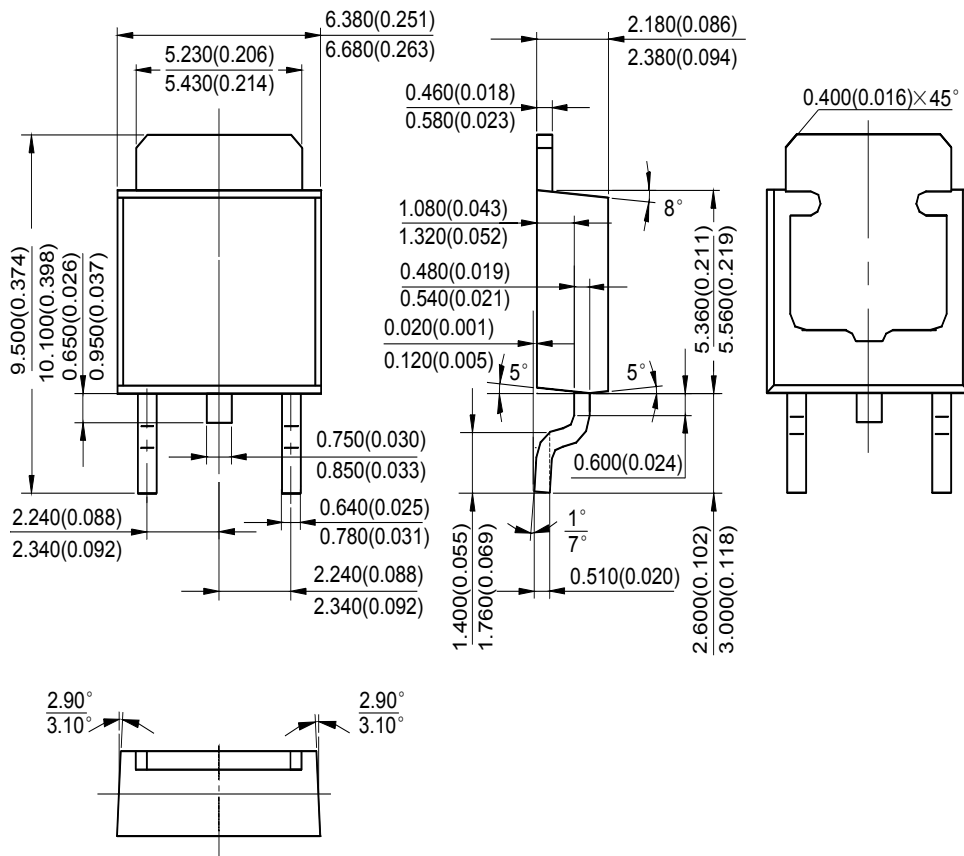
Unit: mm(inch)



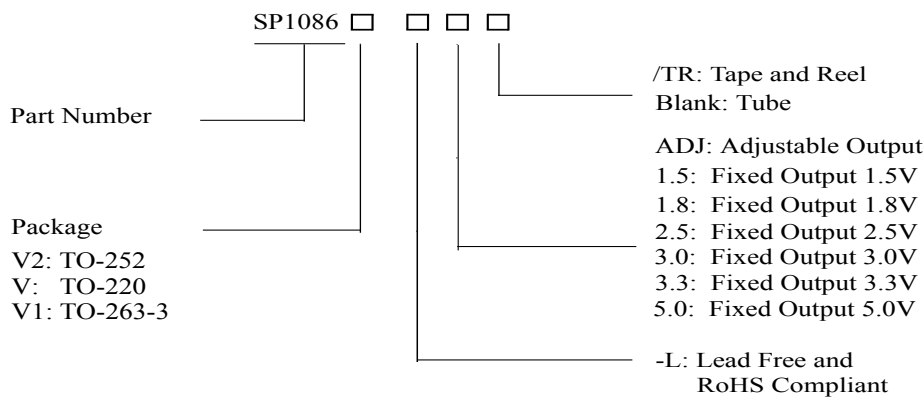
Mechanical Dimensions (Continued)

TO-252

Unit: mm(inch)



## ORDERING INFORMATION



Part Number	Voltage Range	Temperature Range	Package	Pin Count	Pack Qty
SP1086V2-L/TR	Adj	0°C to +125°C	TO-252	3	2,500/TR
SP1086V2-L-1-5/TR	1.5V	0°C to +125°C	TO-252	3	2,500/TR
SP1086V2-L-1-8/TR	1.8V	0°C to +125°C	TO-252	3	2,500/TR
SP1086V2-L-2-5/TR	2.5V	0°C to +125°C	TO-252	3	2,500/TR
SP1086V2-L-3-0/TR	3V	0°C to +125°C	TO-252	3	2,500/TR
SP1086V2-L-3-3/TR	3.3V	0°C to +125°C	TO-252	3	2,500/TR
SP1086V2-L-5-0/TR	5V	0°C to +125°C	TO-252	3	2,500/TR
SP1086V1-L/TR	Adj	0°C to +125°C	TO-263	3	800/TR
SP1086V1-L-1-5/TR	1.5V	0°C to +125°C	TO-263	3	800/TR
SP1086V1-L-1-8/TR	1.8V	0°C to +125°C	TO-263	3	800/TR
SP1086V1-L-2-5/TR	2.5V	0°C to +125°C	TO-263	3	800/TR
SP1086V1-L-3-0/TR	3V	0°C to +125°C	TO-263	3	800/TR
SP1086V1-L-3-3/TR	3.3V	0°C to +125°C	TO-263	3	800/TR
SP1086V1-L-5-0/TR	5V	0°C to +125°C	TO-263	3	800/TR
SP1086V-L	Adj	0°C to +125°C	TO-220	3	50/TUBE
SP1086V-L-1-5	1.5V	0°C to +125°C	TO-220	3	50/TUBE
SP1086V-L-1-8	1.8V	0°C to +125°C	TO-220	3	50/TUBE
SP1086V-L-2-5	2.5V	0°C to +125°C	TO-220	3	50/TUBE
SP1086V-L-3-0	3V	0°C to +125°C	TO-220	3	50/TUBE
SP1086V-L-3-3	3.3V	0°C to +125°C	TO-220	3	50/TUBE
SP1086V-L-5-0	5V	0°C to +125°C	TO-220	3	50/TUBE



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