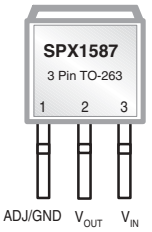
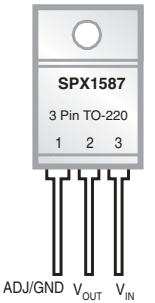
3A Low Dropout Voltage Regulator

FEATURES

- Guaranteed 3A Output Current
- Three Terminal Adjustable or Fixed 1.5V, 1.8V, 2.5V, 3.3V and 5.0V
- Low Quiescent Current
- Low Dropout Voltage: 1.1V at 3A
- Line Regulation: 0.1%
- Load Regulation: 0.1%
- Stable with 10uF Ceramic Capacitor
- Overcurrent and Thermal Protection
- Available Packages: TO-252, TO-220, and TO-263
- Similar to Industry Standard LT1085/ LT1585





Now Available in Lead Free Packaging

APPLICATIONS

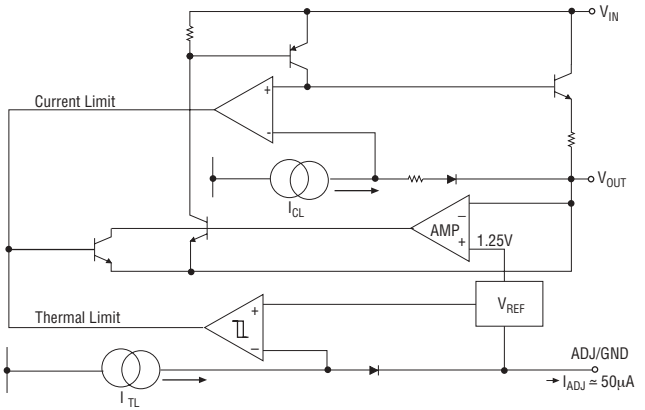
- Desktop PC's Servers
- Powering VGA and Sound Cards
- Cordless Phones
- Battery Chargers
- Adjustable Power Supplies
- Portable Instrumentation
- SMPS Post-Regulator

DESCRIPTION

The SPX1587 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 SPX1587 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. SPX1587 is available in adjustable or fixed 1.5V, 1.8V, 2.5V, 3.3V and 5.0V output voltages.

The SPX1587 is offered in several 3-pin surface mount packages: TO-252, TO-220 and TO-263. An output capacitor of 10μF 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

Specifications are at $V_{IN}=V_{OUT}+1.5V$, $T_A=25°C$, $C_{IN}=C_{OUT}=10\mu F$, $I_{OUT}=10mA$, unless otherwise specified. The ♦ denotes the specifications which apply full operating temperature range -40°C to +85°C, unless otherwise specified.

PARAMETER	MIN	TYP	MAX	MIN	TYP	MAX	UNITS		CONDITIONS
1.5V Version		**SPX1587A**			**SPX1587**				
Output Voltage	1.485 1.470	1.500	1.515 1.530	1.470 1.455	1.500	1.530 1.545	V	 ♦	I_{OUT} = 10mA, V_{IN} =3.5V 10mA ≤ I_{OUT} ≤ 3A, 3.0V ≤ V_{IN} ≤ 10V
1.8V Version									
Output Voltage	1.782 1.764	1.800	1.818 1.836	1.764 1.746	1.800	1.836 1.854	V	 ♦	I_{OUT} = 10mA, V_{IN} =3.8V 10mA ≤ I_{OUT} ≤ 3A, 3.3V ≤ V_{IN} ≤ 10V
2.5V Version									
Output Voltage	2.475 2.450	2.500	2.525 2.550	2.450 2.425	2.500	2.550 2.575	V	 ♦	I_{OUT} = 10mA, V_{IN} =4.5V 10mA ≤ I_{OUT} ≤ 3A, 4.25V ≤ V_{IN} ≤ 10V
3.3V Version									
Output Voltage	3.267 3.234	3.300	3.333 3.366	3.234 3.201	3.300	3.366 3.399	V	 ♦	I_{OUT} = 10mA, V_{IN} =5V 10mA ≤ I_{OUT} ≤ 3A, 4.75V ≤ V_{IN} ≤ 10V
5.0V Version									
Output Voltage	4.950 4.900	5.000	5.050 5.100	4.900 4.850	5.000	5.100 5.150	V	 ♦	I_{OUT}=10mA, V_{IN}=7V 10mA ≤ I_{OUT} ≤ 3A, 6.50V ≤ V_{IN} ≤ 10V
All Voltage Options									
Reference Voltage	1.238 1.225	1.250	1.262 1.275	1.225 1.212	1.250	1.275 1.287	V	 ♦	I_{OUT}=10mA, (V_{IN} - V_{OUT})= 2V 10mA≤I_{OUT}≤ 3A, 1.5V≤(V_{IN}-V_{OUT})≤ 10V
Output Voltage Temperature Stability		0.3			0.5		%		
Line Regulation		0.1 0.1 0.1 0.1 0.1	0.2 0.2 0.2 0.2 0.2		0.1 0.1 0.1 0.1 0.1	0.2 0.2 0.2 0.2 0.2	%		3.0V≤V_{IN}≤ 10V,V_{OUT}=1.5V 3.3V≤V_{IN}≤ 10V,V_{OUT}=1.8V 4.25V≤V_{IN}≤ 10V,V_{OUT}=2.5V 4.75V≤V_{IN}≤ 10V,V_{OUT}=3.3V 6.50V≤V_{IN}≤ 10V,V_{OUT}=5.0V
Load Regulation		0.1 0.1 0.1 0.1 0.1	0.3 0.3 0.3 0.3 0.3		0.1 0.1 0.1 0.1 0.1	0.3 0.3 0.3 0.3 0.3	%		10mA≤I_{OUT}≤ 3A, V_{OUT}=1.5V 10mA≤I_{OUT}≤ 3A, V_{OUT}=1.8V 10mA≤I_{OUT}≤ 3A, V_{OUT}=2.5V 10mA≤I_{OUT}≤ 3A, V_{OUT}=3.3V 10mA≤I_{OUT}≤ 3A, V_{OUT}=5.0V
Dropout Voltage (Note 2)		1.00 1.05 1.10	 1.2		1.00 1.05 1.10	 1.2	V		I_{OUT}=1A I_{OUT}=2A I_{OUT}=3A
Minimum Load Current (Note 4)		4	10		4	10	mA		
Quiescent Current		4	10		4	10	mA		Fixed voltage versions
Adjust Pin Current		50	 120		50	 120	μA	 ♦	
Current Limit	3.2	5		3.2	5		A		(V_{IN}-V_{OUT})=2V
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≤f≤10kHz
Thermal Resistance		3 60 3 60 6 126			3 60 3 60 6 126		°C/W		TO-220 Junction to Case, at Tab TO-220 Junction to Ambient TO-263 Junction to Case, at Tab TO-263 Junction to Ambient TO-252 Junction to Case, at Tab TO-252 Junction to Ambient

ELECTRICAL CHARACTERISTICS: Continued (Notes)

NOTES:

Note 1: Output temperature coefficient is defined as the worst case voltage change divided by the total temperature range

Note 2: Dropout voltage is defined as the input to output differential at which the output voltage drops 100mV below its nominal value measured at 1V differential at very low values of programmed output voltage, the minimum input supply voltage of 2V (2.3V over temperature) must be taken into account.

Note 3: Thermal regulation is defined as the change in output voltage at a time T after a change in power dissipation is applied. excluding load or line regulation effect.

Note 4: Adjustable Version Only.

TYPICAL PERFORMANCE CHARACTERISTICS

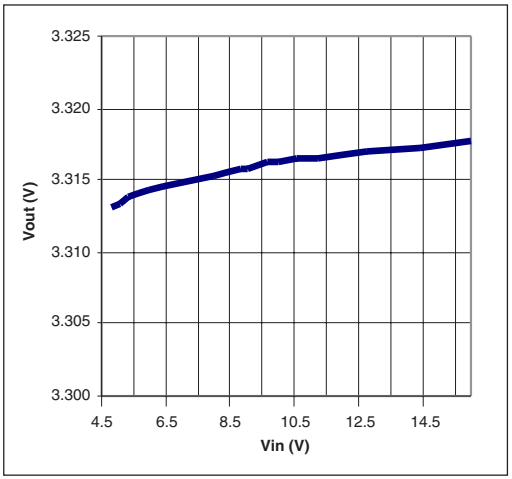


Figure 1. Line Regulation for SPX1587U-3.3; I_{OUT}=10mA

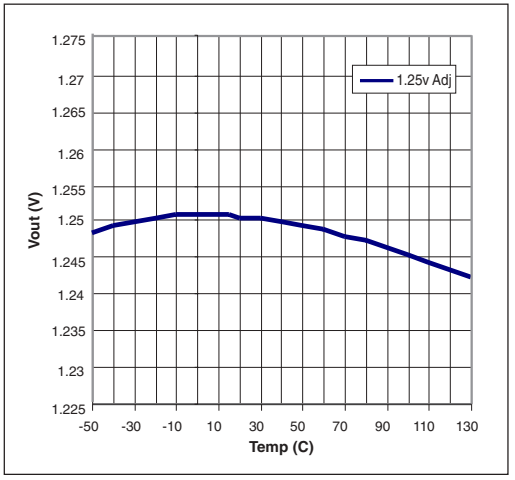


Figure 2. V_{OUT} vs Temperature, V_{IN}=2.5V, I_{OUT}=10mA

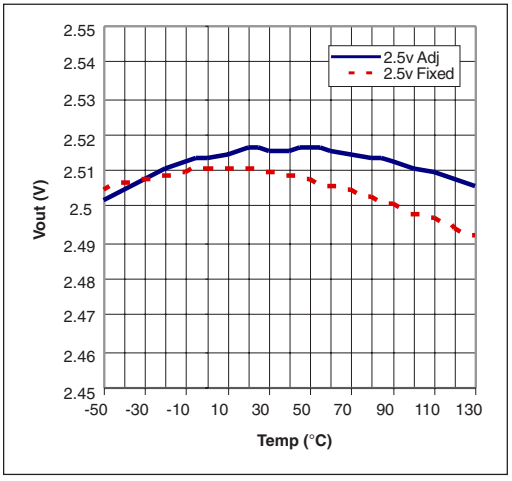


Figure 3. V_{IN}=4.0V, I_{OUT}=10mA

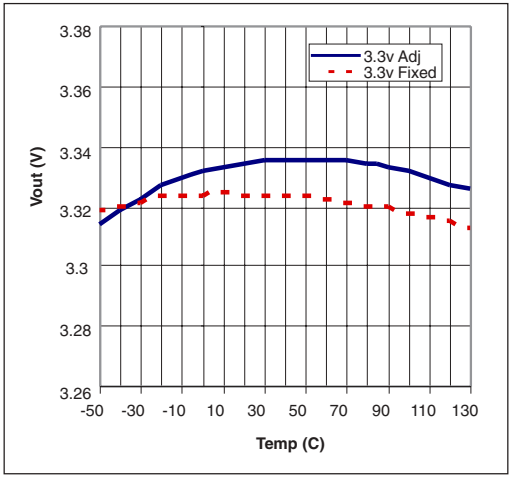


Figure 4. V_{IN}=5.0V, I_{OUT}=10mA

Output Capacitor

To ensure the stability of the SPX1587, an output capacitor of at least 10µF (ceramic or tantalum) or 22µF (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 0.5Ω or less. A larger value of output capacitance (up to 100µF) can improve the load transient response.

Soldering Methods

The SPX1587 die is attached to the heatsink lead which exits opposite the input, output, and ground pins.

Thermal Characteristics

The SPX1587 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°C. Thermal protection is activated at >179°C and deactiviated at <165 °C.

The thermal interaction from other components in the application can effect the thermal resistance of the SPX1587. The actual thermal resistance can be determined with experimentation.

SPX1587 power dissipation is calculated as follows:

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

Maximum Junction Temperature range:

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

Maximum junction temperature must not exceed the 125°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_R = ripple frequency in Hz,
R_1 = 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.

$$V_{REF} = 1.25V$$

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_{OUT} 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_1 and R_2, since the adjustable pin current (approx 50µA) flows through R_2. When I_{ADJ} 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_1 directly to V_{OUT} as illustrated in Figure 13. For the same reason, R_2 should be connected to the negative side of the load.

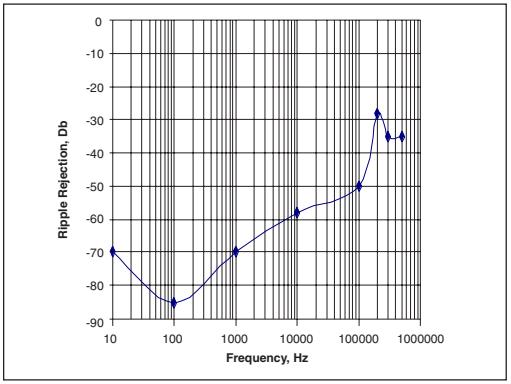


Figure 5. Ripple Rejection; Vin=3.3V, Vout=1.8V (adj.), Iload=200mA

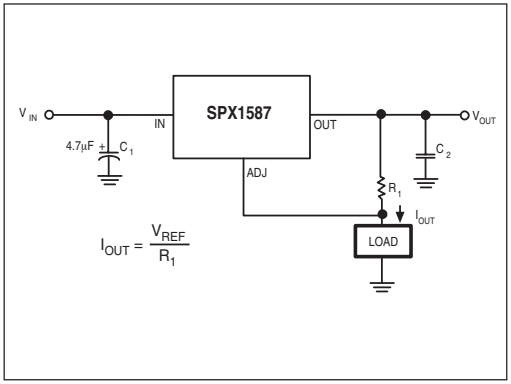


Figure 6. Current Source

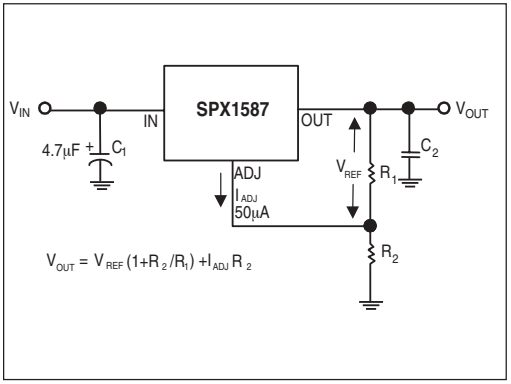


Figure 7. Typical Adjustable Regulator

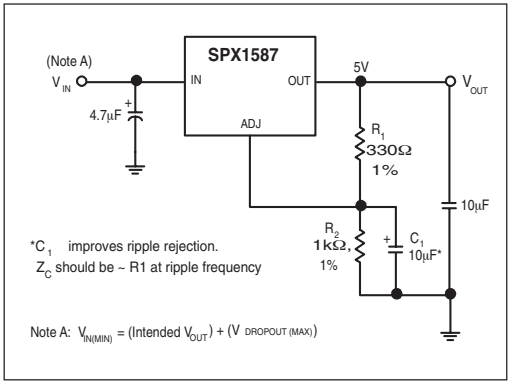


Figure 8. Improving Ripple Rejection

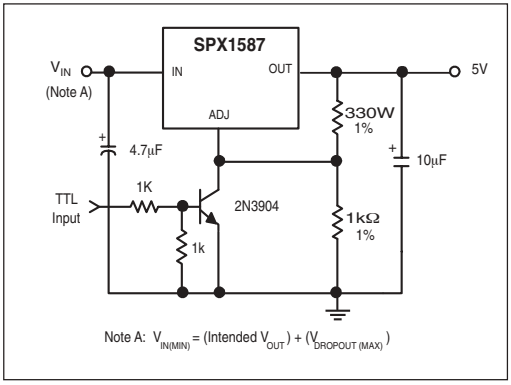


Figure 9. 5V Regulator with Shutdown

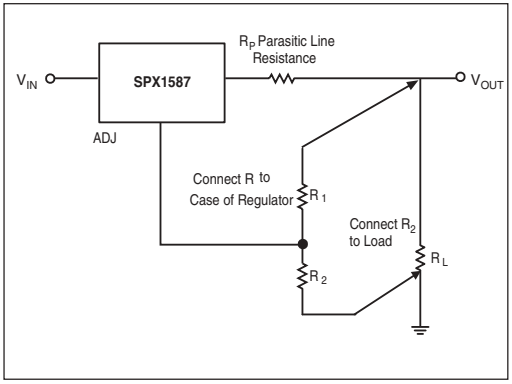
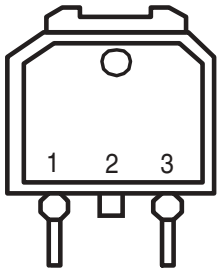


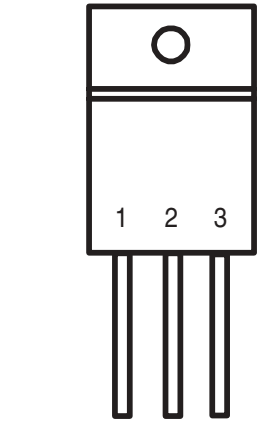
Figure 10. Recommended Connections for Best Results

TO-252 (R)



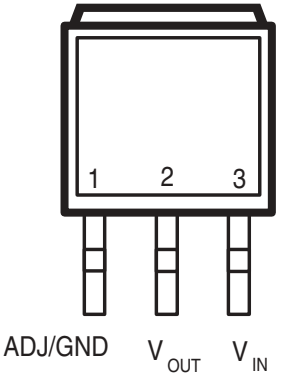
Front View

TO-220-3 (U)

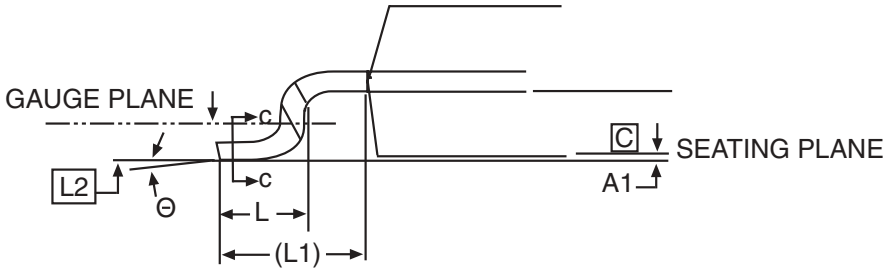


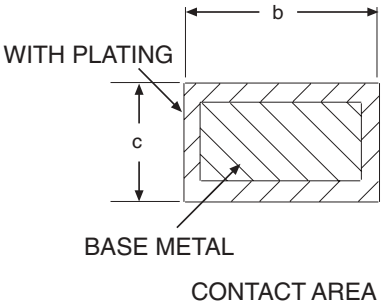
Front View

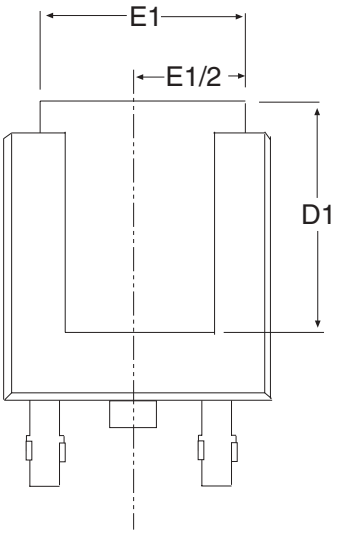
TO-263-3 (T)



Top View

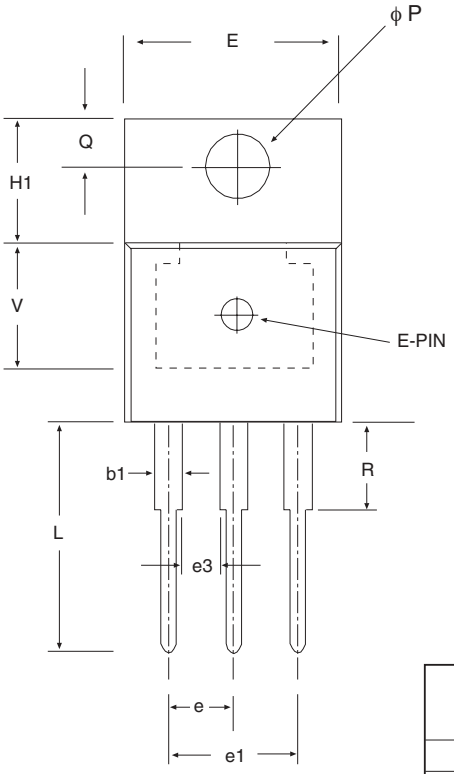


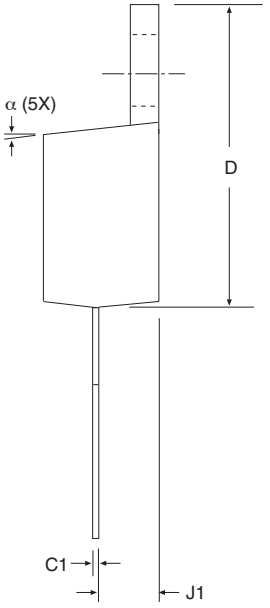


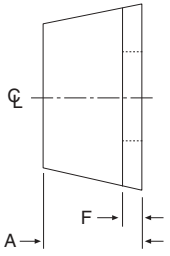


3 PIN TO-252 JEDEC TO-252 (AA) Variation	Dimensions in inches		
	MIN	NOM	MAX
A1	-	-	.005
c	.018	-	.024
D1	.205	-	-
E1	.170	-	-
H	.370	-	.410
L	.055	.060	.070
L1	.108 REF		
L2	.020 BSC		

3 PIN TO-252

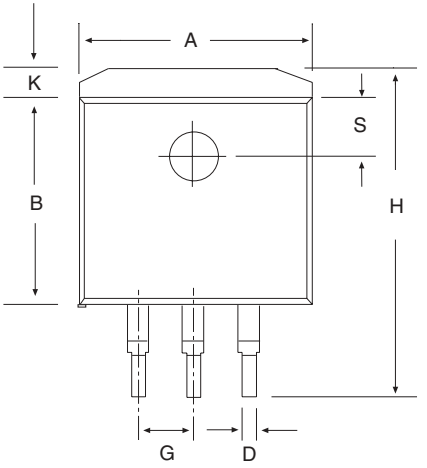


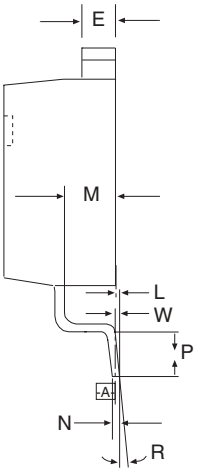


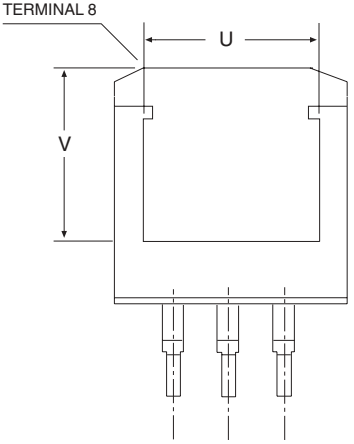


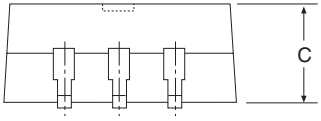
DIMENSIONS in inches		
SYMBOL	**MIN**	**MAX**
A	0.160	0.190
b	0.025	0.040
C1	0.015	0.022
D	0.560	0.590
E	0.385	0.415
e	0.090	0.110
e1	0.190	0.210
e3	0.045	0.055
F	0.045	0.055
H1	0.234	0.258
J1	0.090	0.115
ϕ P	0.146	0.156
Q	0.103	0.113
L	0.540	0.560
α	3° typ	7° typ
b1	0.450	0.060
R	0.243 REF	6.170 REF
U	0.300 REF	7.620 REF
V	0.240 REF	6.100 REF

3 Pin TO-220









DIMENSIONS in inches		
SYMBOL	**MIN**	**MAX**
A	.396	0.406
B	0.326	0.336
C	0.170	0.180
D	0.026	0.036
E	0.045	0.055
G	0.100 REF	0.100 REF
H	0.580	0.620
K	0.055	0.066
L	.000	.010
M	0.098	0.108
N	.017	.023
P	.090	.110
R	0°	8°
S	.095	.105
U	.30 REF	.30 REF
V	.305 REF	.305 REF
W	.010	.010

3 Pin TO-263

ORDERING INFORMATION

PART NUMBER	ACC.	OUTPUT VOLTAGE	PACKAGE
SPX1587AR	1%	Adj	3 lead TO-252
SPX1587AR/TR	1%	Adj	3 lead TO-252
SPX1587AR-1.5	1%	1.5V	3 lead TO-252
SPX1587AR-1.5/TR	1%	1.5V	3 lead TO-252
SPX1587AR-1.8	1%	1.8V	3 lead TO-252
SPX1587AR-1.8/TR	1%	1.8V	3 lead TO-252
SPX1587AR-2.5	1%	2.5V	3 lead TO-252
SPX1587AR-2.5/TR	1%	2.5V	3 lead TO-252
SPX1587AR-3.3	1%	3.3V	3 lead TO-252
SPX1587AR-3.3/TR	1%	3.3V	3 lead TO-252
SPX1587AR-5.0	1%	5.0V	3 lead TO-252
SPX1587AR-5.0/TR	1%	5.0V	3 lead TO-252
SPX1587AT	1%	Adj	3 lead TO-263
SPX1587AT/TR	1%	Adj	3 lead TO-263
SPX1587AT-1.5	1%	1.5V	3 lead TO-263
SPX1587AT-1.5/TR	1%	1.5V	3 lead TO-263
SPX1587AT-1.8	1%	1.8V	3 lead TO-263
SPX1587AT-1.8/TR	1%	1.8V	3 lead TO-263
SPX1587AT-2.5	1%	2.5V	3 lead TO-263
SPX1587AT-2.5/TR	1%	2.5V	3 lead TO-263
SPX1587AT-3.3	1%	3.3V	3 lead TO-263
SPX1587AT-3.3/TR	1%	3.3V	3 lead TO-263
SPX1587AT-5.0	1%	5.0V	3 lead TO-263
SPX1587AT-5.0/TR	1%	5.0V	3 lead TO-263
SPX1587AU	1%	Adj	3 lead TO-220
SPX1587AU-1.5	1%	1.5V	3 lead TO-220
SPX1587AU-1.8	1%	1.8V	3 lead TO-220
SPX1587AU-2.5	1%	2.5V	3 lead TO-220
SPX1587AU-3.3	1%	3.3V	3 lead TO-220
SPX1587AU-5.0	1%	5.0V	3 lead TO-220

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

Example: SPX1587AT-5.0/TR = standard; SPX1587AT-L-5.0/TR = lead free

/TR = Tape and Reel

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

Sipex Corporation

ANALOG EXCELLENCE

Sipex Corporation

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FAX: (408) 935-7600

PART NUMBER	ACC.	OUTPUT VOLTAGE	PACKAGE
SPX1587R	2%	Adj	3 lead TO-252
SPX1587R/TR	2%	Adj	3 lead TO-252
SPX1587R-1.5	2%	1.5V	3 lead TO-252
SPX1587R-1.5/TR	2%	1.5V	3 lead TO-252
SPX1587R-1.8	2%	1.8V	3 lead TO-252
SPX1587R-1.8/TR	2%	1.8V	3 lead TO-252
SPX1587R-2.5	2%	2.5V	3 lead TO-252
SPX1587R-2.5/TR	2%	2.5V	3 lead TO-252
SPX1587R-3.3	2%	3.3V	3 lead TO-252
SPX1587R-3.3/TR	2%	3.3V	3 lead TO-252
SPX1587R-5.0	2%	5.0V	3 lead TO-252
SPX1587R-5.0/TR	2%	5.0V	3 lead TO-252
SPX1587T	2%	Adj	3 lead TO-263
SPX1587T/TR	2%	Adj	3 lead TO-263
SPX1587T-1.5	2%	1.5V	3 lead TO-263
SPX1587T-1.5/TR	2%	1.5V	3 lead TO-263
SPX1587T-1.8	2%	1.8V	3 lead TO-263
SPX1587T-1.8/TR	2%	1.8V	3 lead TO-263
SPX1587T-2.5	2%	2.5V	3 lead TO-263
SPX1587T-2.5/TR	2%	2.5V	3 lead TO-263
SPX1587T-3.3	2%	3.3V	3 lead TO-263
SPX1587T-3.3/TR	2%	3.3V	3 lead TO-263
SPX1587T-5.0	2%	5.0V	3 lead TO-263
SPX1587T-5.0/TR	2%	5.0V	3 lead TO-263
SPX1587U	2%	Adj	3 lead TO-220
SPX1587U-1.5	2%	1.5V	3 lead TO-220
SPX1587U-1.8	2%	1.8V	3 lead TO-220
SPX1587U-2.5	2%	2.5V	3 lead TO-220
SPX1587U-3.3	2%	3.3V	3 lead TO-220
SPX1587U-5.0	2%	5.0V	3 lead TO-220

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

Example: SPX1587AT-5.0/TR = standard; SPX1587AT-L-5.0/TR = lead free

/TR = Tape and Reel

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

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