

1A Low Dropout Linear Regulator

FEATURES

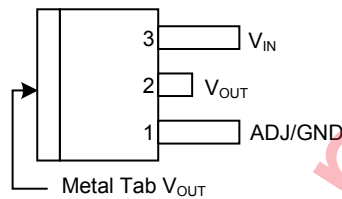
- 1.4V maximum dropout at full load current
- Fast transient response
- Output current limiting
- Built-in thermal shutdown
- Good noise rejection
- Low ESR Ceramic Capacitor(MLCC) Required for Stability

APPLICATIONS

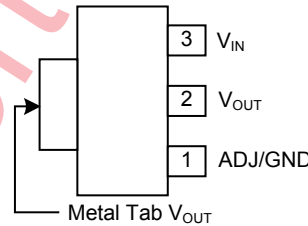
- PC Motherboard
- LCD Monitor
- Graphic Card
- DVD-video player
- NIC/Switch
- Telecom Equipment
- ADSL Modem
- Printer and other Peripheral Equipment

PIN CONFIGURATION

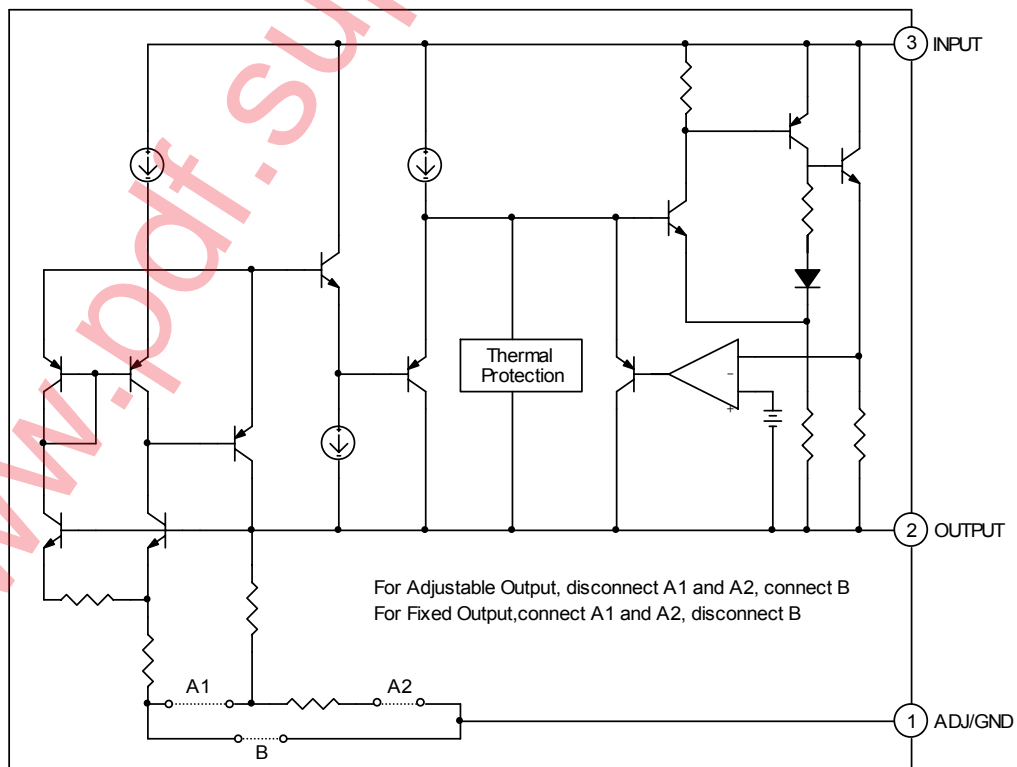
(1) TO252-3L



(2) SOT223



BLOCK DIAGRAM



GENERAL DESCRIPTION

The LSP1117 is a series of low dropout three-terminal regulators with a dropout of 1.4V at 1A output current. The LSP1117 series provides current limiting and thermal shutdown. Its circuit includes a trimmed bandgap reference to assure output voltage accuracy to be within 2% for 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, 5.0V and adjustable versions. Current limit is trimmed to ensure specified output current and controlled short-circuit current. On-chip thermal shutdown provides protection against any combination of overload and ambient temperature that would create excessive junction temperature.

The LSP1117 has an adjustable version that can provide the output voltage from 1.2V to 12V with only two external resistors.

The LSP1117 series is available in the industry standard TO252-3L and SOT223 power packages.

■ ABSOLUTE MAXIMUM RATINGS (NOTE 1)

Symbol	Parameter	Rating	Unit
V_{IN}	Input Voltage	23	V
T_J	Maximum Junction Temperature	150	
T_S	Storage Temperature	-65~150	
T_{LEAD}	Lead Temperature (10 sec.)	300	

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress rating only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

■ RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Rating	Unit
V_{IN}	Input Voltage	20	V
T_J	Operating Junction Temperature Range	-20~125	

■ ELECTRICAL CHARACTERISTICS

Operating Conditions: $V_{IN} \leq 10V$, $T_J = 25^\circ C$, unless otherwise specified

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit	
Reference Voltage	V_{REF}	LSP1117 -Adj $I_O = 10mA, V_{IN} - V_{OUT} = 1.5V$	1.225	1.250	1.275	V	
		$I_O = 10mA, 1.5V \leq V_{IN} - V_{OUT} \leq 8V$	1.225	1.250	1.275		
Output Voltage	V_{OUT}	LSP1117-1.2 $I_O = 10mA, V_{IN} = 3V$	1.188	1.2	1.212	V	
		$I_O = 10mA, 3V \leq V_{IN} \leq 10V$	1.176	1.2	1.224		
		LSP1117 -1.5	$I_O = 10mA, V_{IN} = 3V$	1.485	1.5	1.515	V
			$I_O = 10mA, 3V \leq V_{IN} \leq 10V$	1.470	1.5	1.530	
		LSP1117 -1.8	$I_O = 10mA, V_{IN} = 3.3V$	1.782	1.8	1.818	V
			$I_O = 10mA, 3.3V \leq V_{IN} \leq 10V$	1.764	1.8	1.836	
		LSP1117 -2.5	$I_O = 10mA, V_{IN} = 4V$	2.475	2.5	2.525	V
			$I_O = 10mA, 4V \leq V_{IN} \leq 10V$	2.450	2.5	2.550	
		LSP1117 -3.3	$I_O = 10mA, V_{IN} = 4.8V$	3.267	3.3	3.333	V
			$I_O = 10mA, 4.8V \leq V_{IN} \leq 10V$	3.235	3.3	3.365	
LSP1117 -5.0	$I_O = 10mA, V_{IN} = 6.5V$	4.950	5.0	5.050	V		
	$I_O = 10mA, 6.5V \leq V_{IN} \leq 12V$	4.900	5.0	5.100			
Line Regulation	Reg_{LINE}	LSP1117-XXX $I_O = 10mA, 1.5V \leq V_{IN} - V_{OUT} \leq 7V$		0.1	0.3	%	
		$I_O = 10mA, 1.5V \leq V_{IN} - V_{OUT} \leq 10V$		0.1	0.5		
Load Regulation	Reg_{Load}	LSP1117 -Adj $V_{IN} = 3V, 10mA < I_O < 1A$			1	%	
		LSP1117 -1.2 $V_{IN} = 3V, 10mA < I_O < 1A$		10	12	mV	
		LSP1117 -1.5 $V_{IN} = 3V, 10mA < I_O < 1A$		12	15	mV	
		LSP1117 -1.8 $V_{IN} = 3.3V, 10mA < I_O < 1A$		15	18	mV	
		LSP1117 -2.5 $V_{IN} = 4V, 10mA < I_O < 1A$		20	25	mV	
		LSP1117 -3.3 $V_{IN} = 5V, 10mA < I_O < 1A$		26	33	mV	
		LSP1117 -5.0 $V_{IN} = 6.5V, 10mA < I_O < 1A$		40	50	mV	
Dropout Voltage	$V_{IN} - V_{OUT}$	LSP1117-XXX $I_{OUT} = 1A, \Delta V_{OUT} = 1\% V_{OUT}$		1.3	1.4	V	
Current Limit	I_{LIMIT}	LSP1117-XXX $V_{IN} - V_{OUT} = 3V$	1.1			A	
Ripple Rejection		LSP1117-XXX $F = 120Hz, C_{OUT} = 25\mu F$ Tantalum, $V_{IN} - V_{OUT} = 3V$		60	70	dB	
Temperature Stability		LSP1117-XXX $I_O = 10mA$		0.5		%	

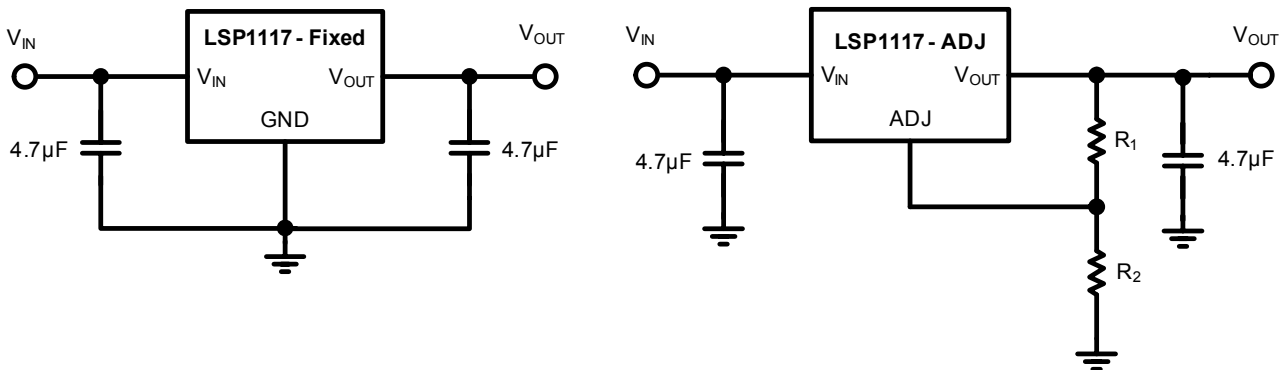
1A Low Dropout Linear Regulator

■ ELECTRICAL CHARACTERISTICS (CONTINUED)

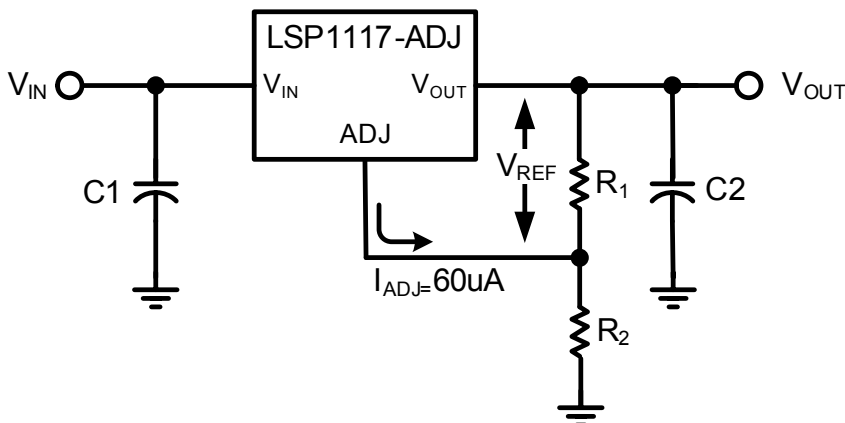
Operating Conditions: $V_{IN} \leq 10V$, $T_J = 25^\circ C$, unless otherwise specified

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Adjust Pin Current		$I_O = 10mA \sim 1A$, $1.5V \leq V_{IN} - V_{OUT} \leq 10V$		60	120	μA
Adjust Pin Current Change		$I_O = 10mA \sim 1A$, $1.4V \leq V_{IN} - V_{OUT} \leq 10V$		0.2	5	μA
Minimum Load Current		LSP1117-Adj $1.5V \leq V_{IN} - V_{OUT} \leq 10V$		5	10	mA
Quiescent Current	I_q	$V_{IN} = V_{OUT} + 1.25V$		5	10	mA
Power Ratio Ripple Rejection	PSRR	$F = 100Hz$, $I_{OUT} = 1A$		60	70	dB
Long-term Stability		$T_A = 125^\circ C$, 1000hrs		0.3		%
RMS Output Noise (% of V_{OUT})		$T_A = 25^\circ C$, $10Hz \leq f \leq 10kHz$		0.003		%
Power Dissipation	P_d	TO252-3L		1.2		W
		SOT223		0.625		W
Thermal Resistance, Junction to Ambient	J_A	TO252-3L		55		/
		SOT223		75		W
Thermal Resistance, Junction to case	J_C	TO252-3L		10		/
		SOT223		15		W
Thermal Shutdown		Junction Temperature		150		
Thermal Shutdown Hysteresis				25		

■ TYPICAL APPLICATIONS



The LSP1117 keeps a constant 1.25V between the output pin and the adjust pin. By placing a resistor R_1 across these two pins a constant current flows through R_1 , adding to the I_{adj} current and into the R_2 resistor producing a voltage equal to the $(1.25/R_1) * R_2 + I_{adj} * R_2$ which will be added to the 1.25V to set the output voltage.

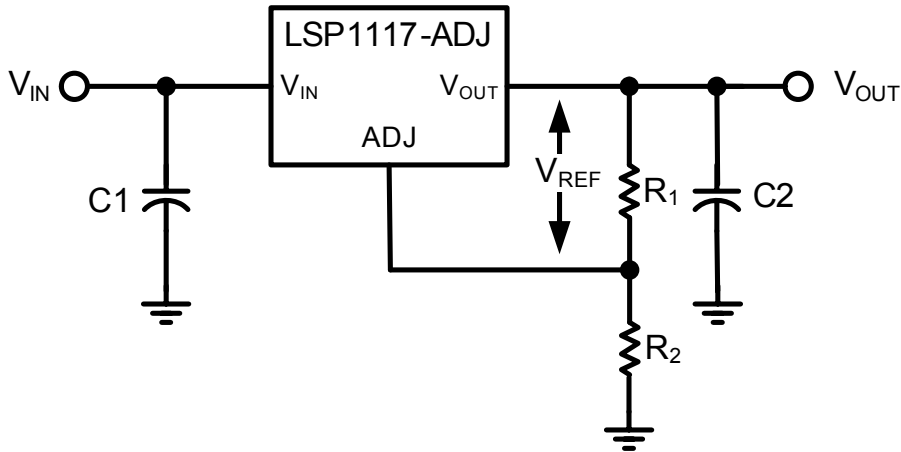


$$V_{OUT} = V_{REF} \times \left(1 + \frac{R_2}{R_1} \right) + I_{ADJ} \times R_2$$

$$V_{REF} = 1.25V$$

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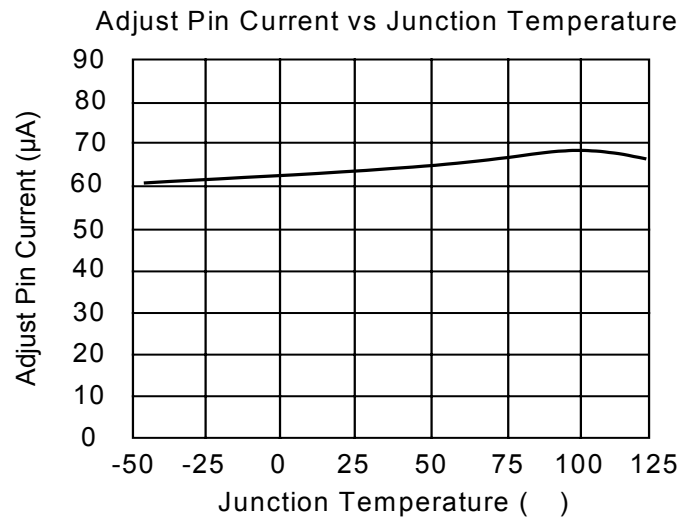
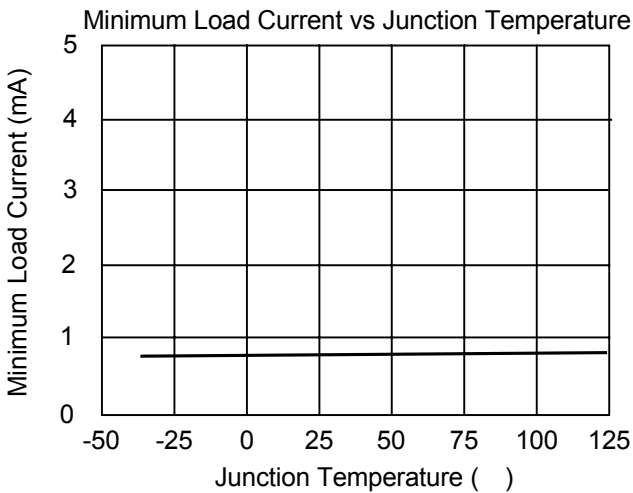
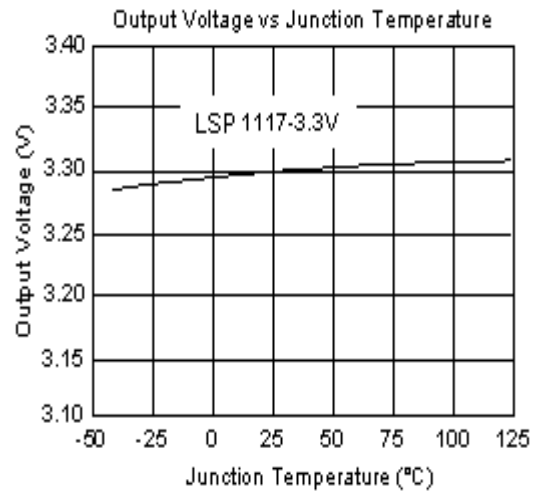
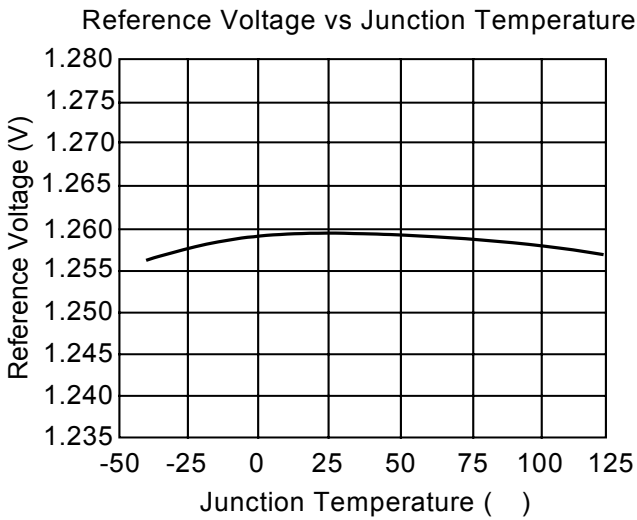
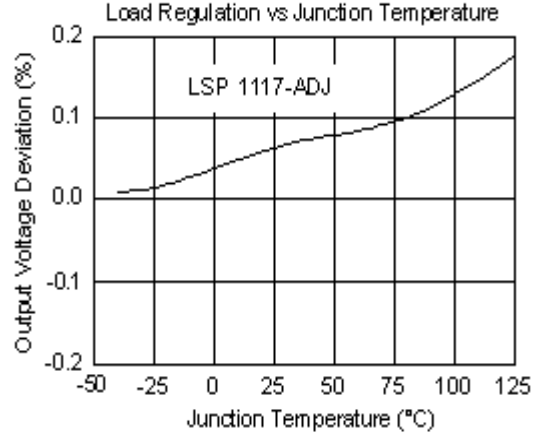
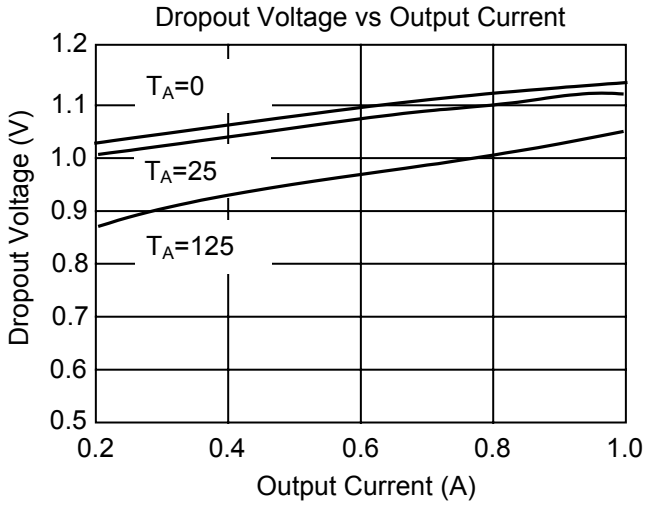
This is summarized in the above equation. Since the minimum load current requirement of the LSP1117 is 10mA, R1 is typically selected to be 121Ω resistor so that it automatically satisfies the minimum current requirement. Notice that since I_{adj} is typically in the range of 60uA it only adds a small error to the output voltage and should only be considered when a very precise output voltage setting is required. For example, in a typical 3.3V application where $R1=121\Omega$ and $R2=200\Omega$ the error due to I_{adj} is only 0.3% of the nominal set point. The C1, C2 capacitor are 4.7uF (Low ESR Ceramic, MLCC), and its ESR should be larger than 15mΩ.



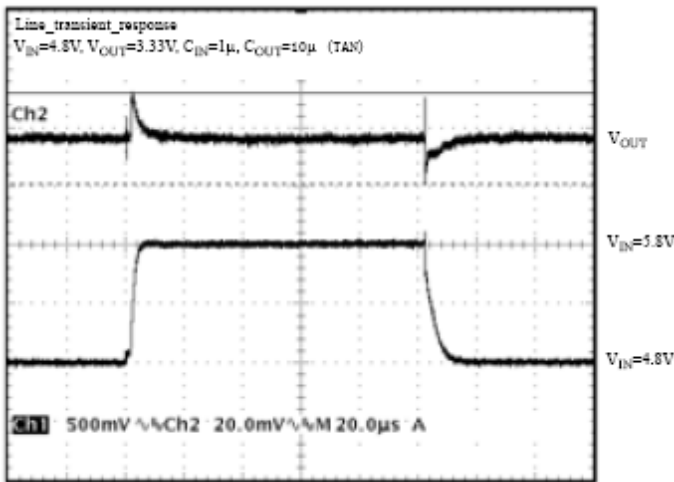
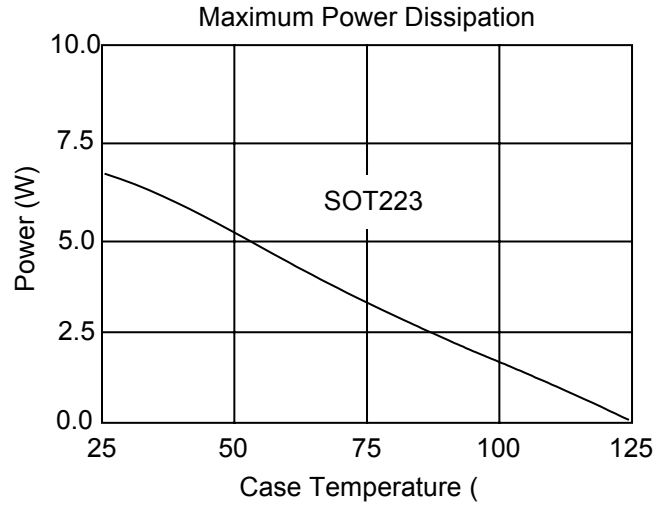
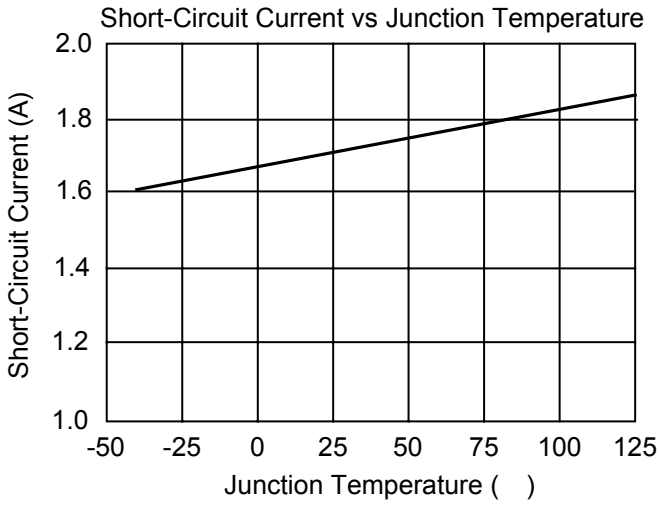
$$V_{OUT} \cong V_{REF} \times \left(1 + \frac{R2}{R1} \right)$$

$$\text{When } \frac{V_{REF}}{R1} = 10mA \gg I_{ADJ}$$

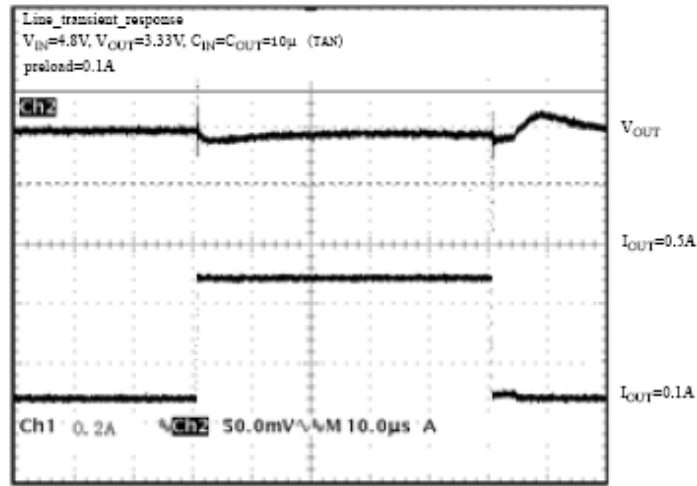
■ TYPICAL PERFORMANCE CHARACTERISTICS



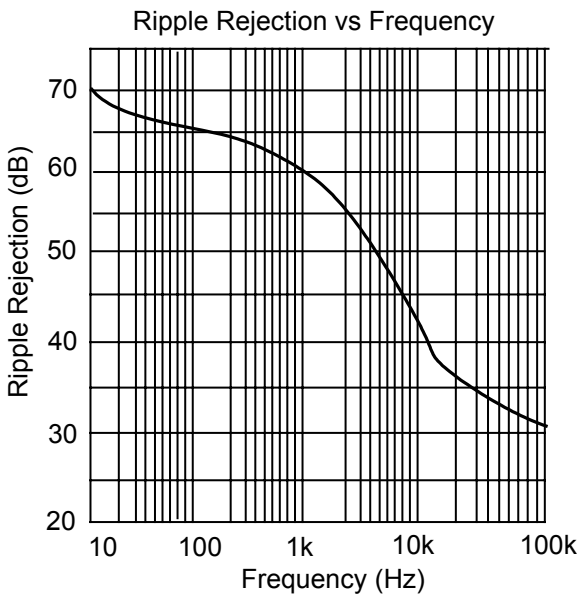
■ TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)



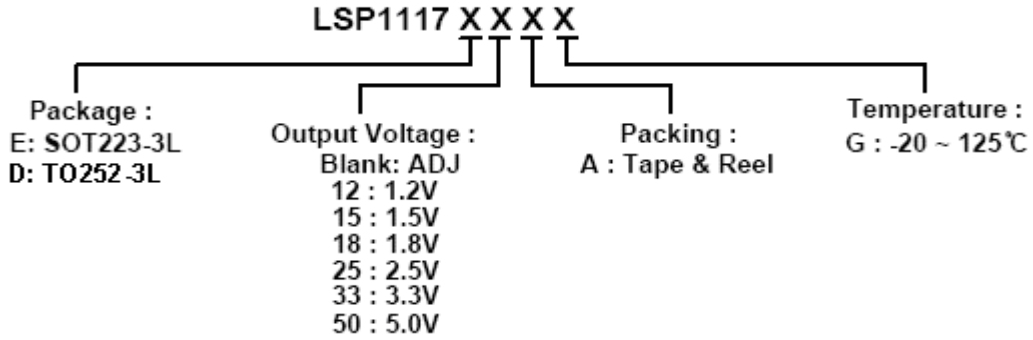
Line Transient Response



Load Transient Response



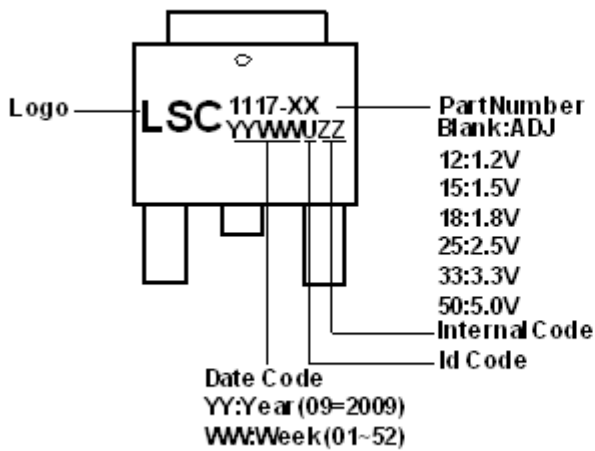
ORDERING INFORMATION



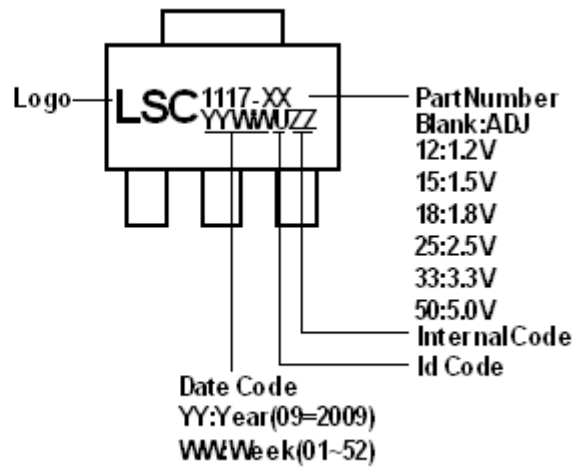
Device	Package Code	Package	Tape & Reel		Temperature
			Quantity	Part Number Suffix	
LSP1117EXXAG	E	SOT223-3L	2500	A	G : -20°C~125°C
LSP1117DXXAG	D	TO252-3L	2500	A	G : -20°C~125°C

MARKING INFORMATION

(1) TO252-3L

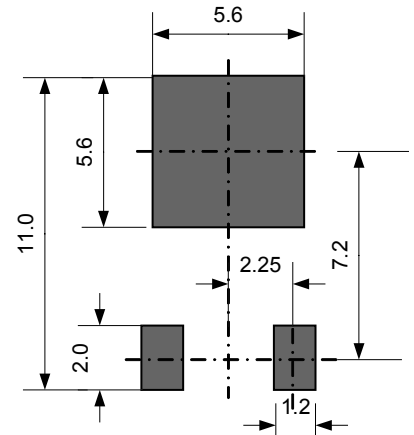
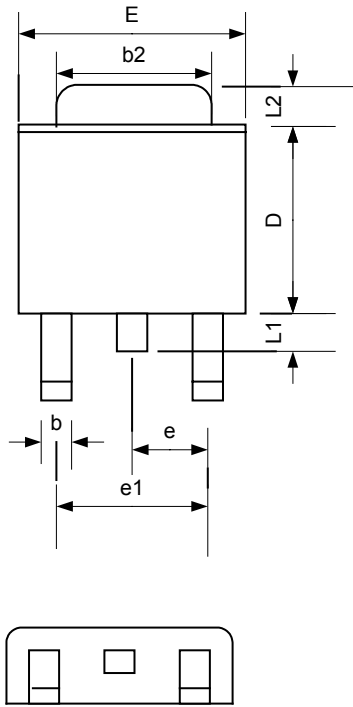


(2) SOT223

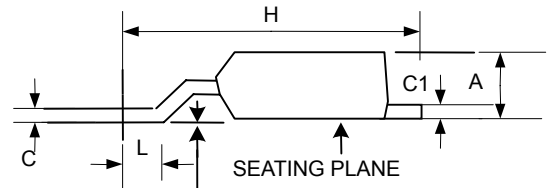


PACKAGE INFORMATION

(1) TO252-3L



Land Pattern Recommendation (Unit : mm)



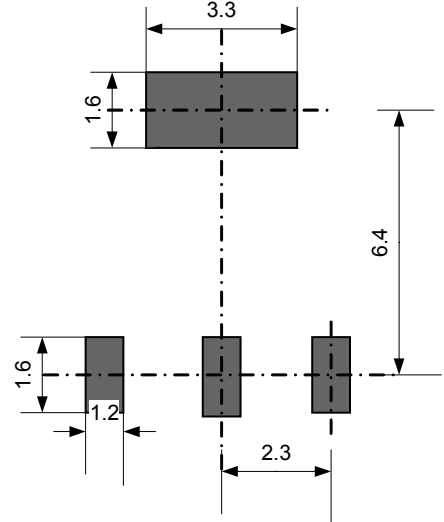
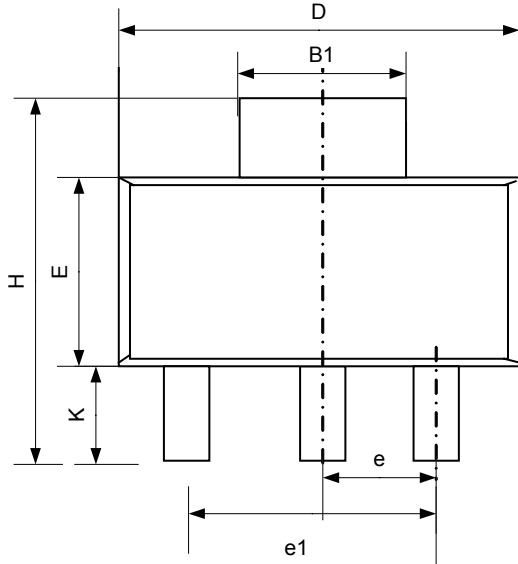
SEE NOTE2

Notes:

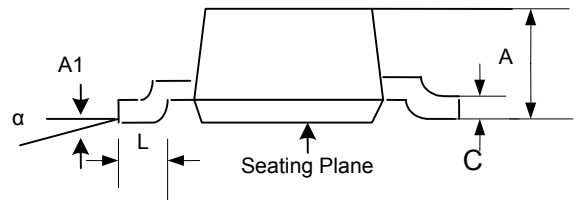
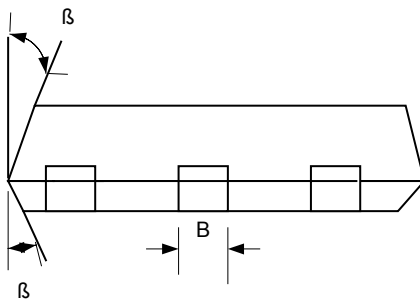
1. JEDEC Outline: TO-252 AB
2. Mils suggested for positive contact at mounting

Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	2.18	2.29	2.39	0.086	0.090	0.094
b	0.635	-	0.889	0.025	-	0.035
b2	4.953	-	5.461	0.195	-	0.215
C	0.52 BSC			0.020 BSC		
C1	0.46	0.52	0.89	0.018	0.020	0.035
D	5.33	5.46	5.59	0.210	0.215	0.220
E	6.35	6.58	6.73	0.250	0.259	0.265
e	2.29 BSC.			0.09 BSC.		
e1	4.58 BSC.			0.18 BSC.		
H	9.4	9.70	10.25	0.37	0.382	0.41
L	1.4	1.52	1.78	0.055	0.06	0.07
L1	0.64	0.83	1.02	0.025	0.033	0.040
L2	1.52	1.78	2.03	0.060	0.070	0.080

(2) SOT223



Land Pattern Recommendation (Unit :mm)



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.50	1.65	1.80	0.059	0.065	0.071
A1	0.02	0.06	0.1	0.001	0.002	0.004
B	0.66	0.76	0.84	0.026	0.03	0.033
B1	2.90	3.0	3.1 (Ref.)	0.114	0.118	0.122(Ref.)
C	0.23	0.30	0.35	0.009	0.012	0.014
D	6.30	6.50	6.70	0.248	0.256	0.264
E	3.30	3.50	3.70	0.130	0.138	0.146
e	2.3Basic			0.091Basic		
e1	4.6Basic			0.181Basic		
H	6.70	7.00	7.30	0.264	0.276	0.287
L	0.75			0.03		
K	1.50	1.75	2.00	0.059	0.069	0.079
α	0°	5°	10°	0°	5°	10°