MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input−Output Voltage Differential	V_I-V_O	40	Vdc
Power Dissipation Case 29 (TO−92) T_A = 25°C Thermal Resistance, Junction−to−Ambient Thermal Resistance, Junction−to−Case Case 751 (SOIC−8) (Note 1) T_A = 25°C Thermal Resistance, Junction−to−Ambient Thermal Resistance, Junction−to−Case	 P_D $R_{\theta JA}$ $R_{\theta JC}$ P_D $R_{\theta JA}$ $R_{\theta JC}$	 Internally Limited 160 83 Internally Limited 180 45	 W °C/W °C/W W °C/W °C/W
Operating Junction Temperature Range	T_J	−40 to +150	°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. SOIC−8 Junction−to−Ambient Thermal Resistance is for minimum recommended pad size. Refer to Figure 24 for Thermal Resistance variation versus pad size.
2. This device series contains ESD protection and exceeds the following tests:
   Human Body Model, 2000 V per MIL STD 883, Method 3015.
   Machine Model Method, 200 V.

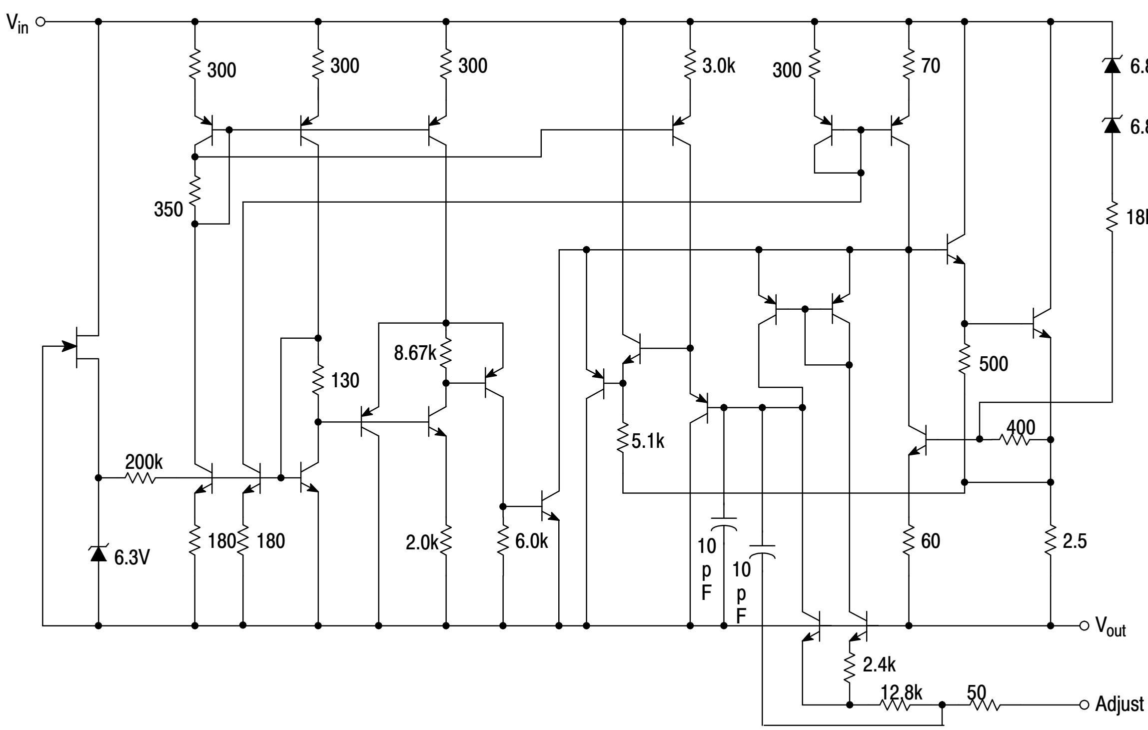


Figure 1. Representative Schematic Diagram

ELECTRICAL CHARACTERISTICS (V_I–V_O = 5.0 V; I_O = 40 mA; T_J = T_{low} to T_{high} (Note 3); I_{max} and P_{max} (Note 4); unless otherwise noted.)

Characteristics	Figure	Symbol	LM317L, LB, NCV317LB Min	Typ	Max	Unit
Line Regulation (Note 5) T_A = 25°C, 3.0 V ≤ V_I – V_O ≤ 40 V	1	Reg_{line}	–	0.01	0.04	%/V
Load Regulation (Note 5), T_A = 25°C 10 mA ≤ I_O ≤ I_{max} – LM317L V_O ≤ 5.0 V V_O ≥ 5.0 V	2	Reg_{load}	 – –	 5.0 0.1	 25 0.5	 mV % V_O
Adjustment Pin Current	3	I_{Adj}	–	50	100	μA
Adjustment Pin Current Change 2.5 V ≤ V_I – V_O ≤ 40 V, P_D ≤ P_{max} 10 mA ≤ I_O ≤ I_{max} – LM317L	1, 2	ΔI_{Adj}	–	0.2	5.0	μA
Reference Voltage 3.0 V ≤ V_I – V_O ≤ 40 V, P_D ≤ P_{max} 10 mA ≤ I_O ≤ I_{max} – LM317L	3	V_{ref}	1.20	1.25	1.30	V
Line Regulation (Note 5), 3.0 V ≤ V_I – V_O ≤ 40 V	1	Reg_{line}	–	0.02	0.07	%/V
Load Regulation (Note 5) 10 mA ≤ I_O ≤ I_{max} – LM317L V_O ≤ 5.0 V V_O ≥ 5.0 V	2	Reg_{load}	 – –	 20 0.3	 70 1.5	 mV % V_O
Temperature Stability (T_{low} ≤ T_J ≤ T_{high})	3	T_S	–	0.7	–	% V_O
Minimum Load Current to Maintain Regulation (V_I – V_O = 40 V)	3	I_{Lmin}	–	3.5	10	mA
Maximum Output Current V_I – V_O ≤ 6.25 V, P_D ≤ P_{max}, Z Package V_I – V_O ≤ 40 V, P_D ≤ P_{max}, T_A = 25°C, Z Package	3	I_{max}	 100 –	 200 20	 – –	mA
RMS Noise, % of V_O T_A = 25°C, 10 Hz ≤ f ≤ 10 kHz	–	N	–	0.003	–	% V_O
Ripple Rejection (Note 6) V_O = 1.2 V, f = 120 Hz C_{Adj} = 10 μF, V_O = 10.0 V	4	RR	 60 –	 80 80	 – –	dB
Thermal Shutdown (Note 7)	–	–	–	180	–	°C
Long Term Stability, T_J = T_{high} (Note 8) T_A = 25°C for Endpoint Measurements	3	S	–	0.3	1.0	%/1.0 k Hrs.

3. T_{low} to T_{high} = 0° to +125°C for LM317L   –40° to +125°C for LM317LB, NCV317LB
4. I_{max} = 100 mA P_{max} = 625 mW
5. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.
6. C_{Adj}, when used, is connected between the adjustment pin and ground.
7. Thermal characteristics are not subject to production test.
8. Since Long–Term Stability cannot be measured on each device before shipment, this specification is an engineering estimate of average stability from lot to lot.

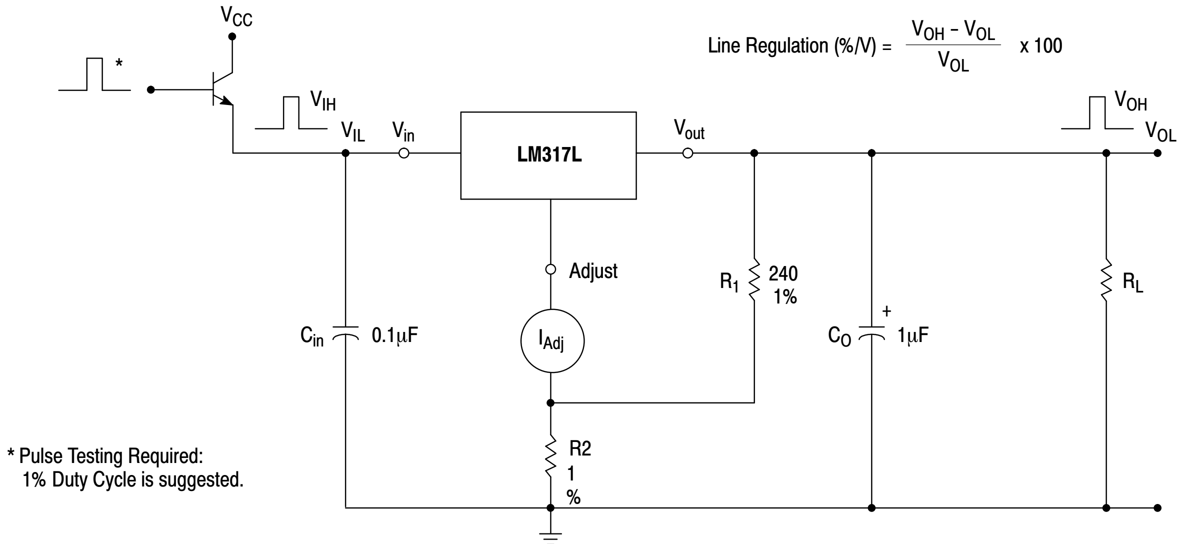


Figure 2. Line Regulation and ΔI_{Adj}/Line Test Circuit

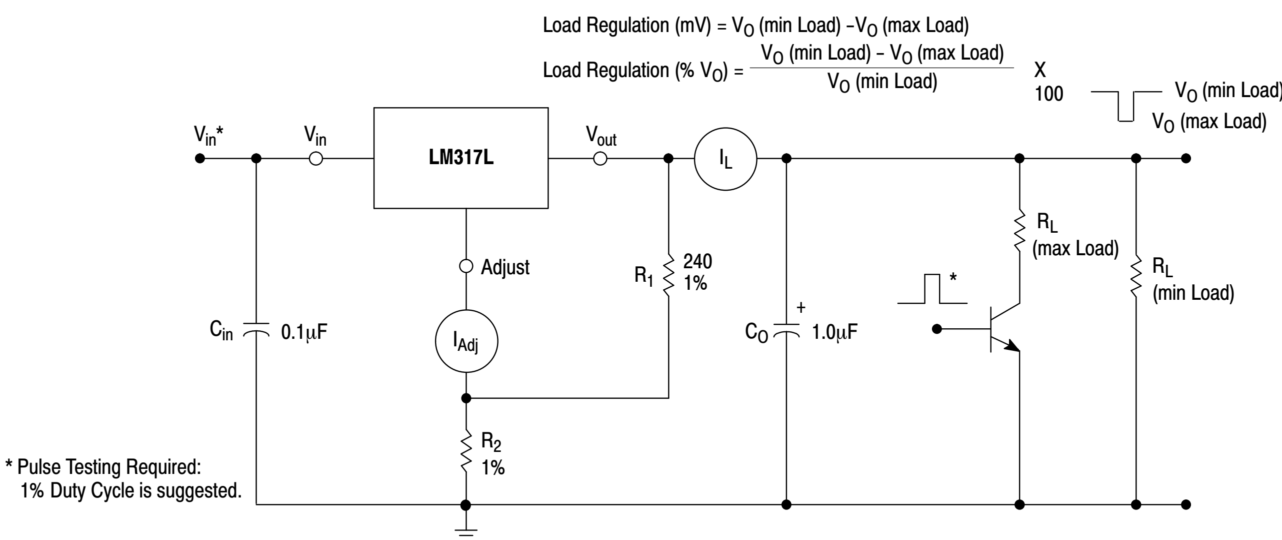


Figure 3. Load Regulation and ΔI_{Adj}/Load Test Circuit

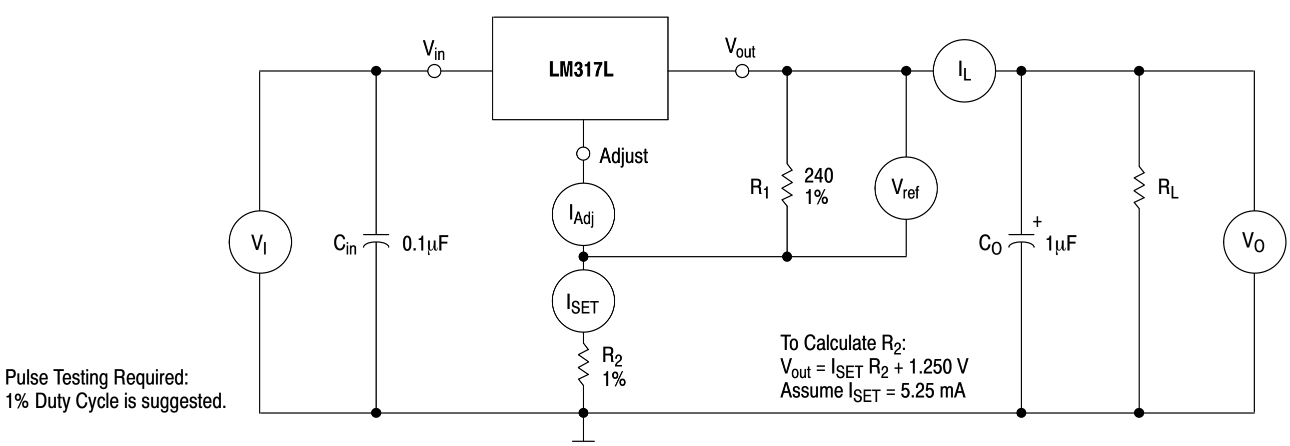


Figure 4. Standard Test Circuit

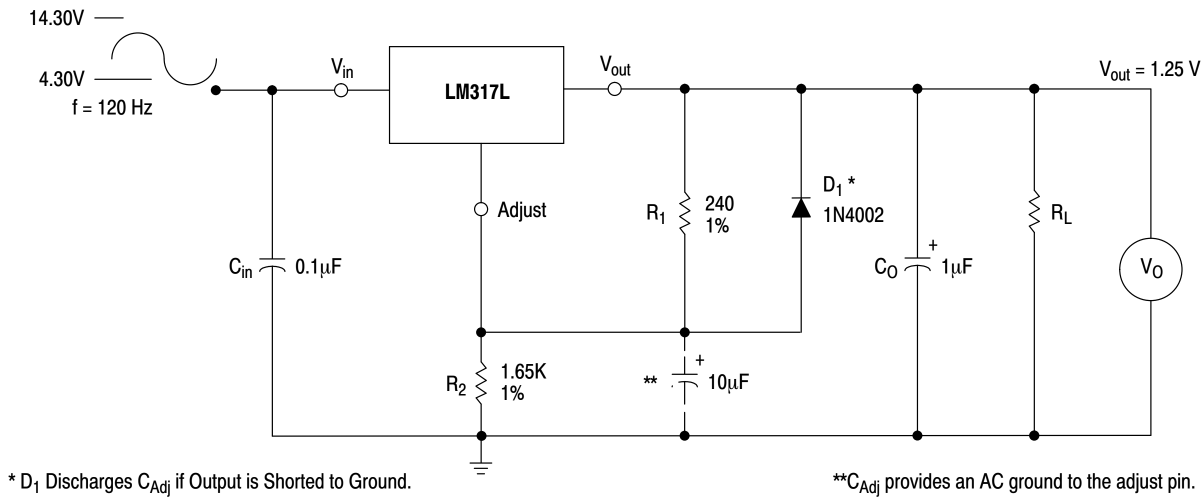


Figure 5. Ripple Rejection Test Circuit

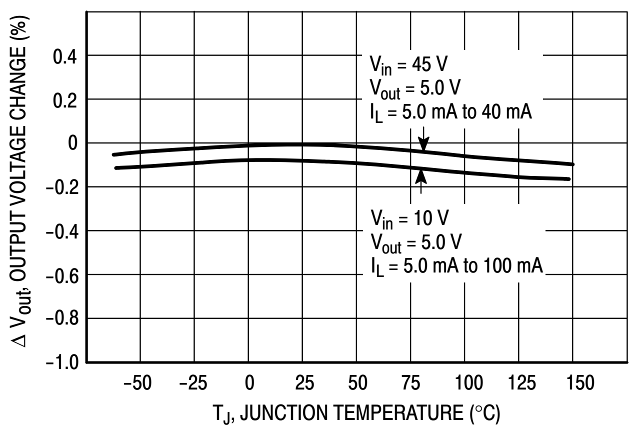


Figure 6. Load Regulation

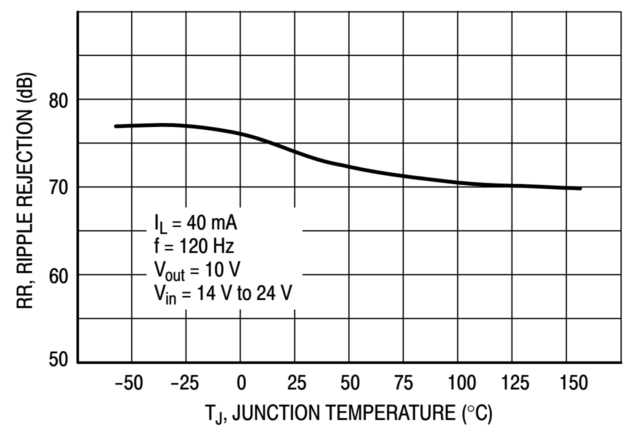


Figure 7. Ripple Rejection

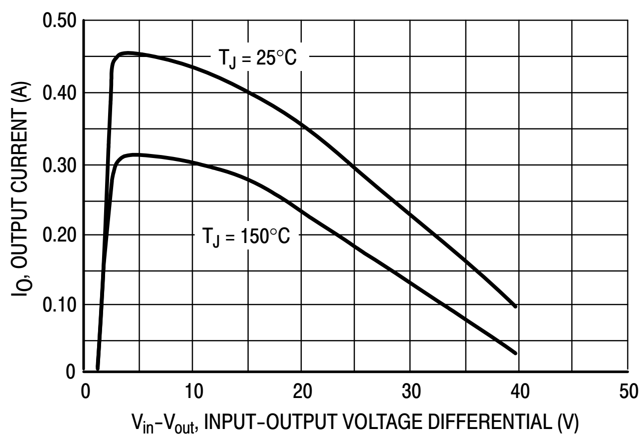


Figure 8. Current Limit

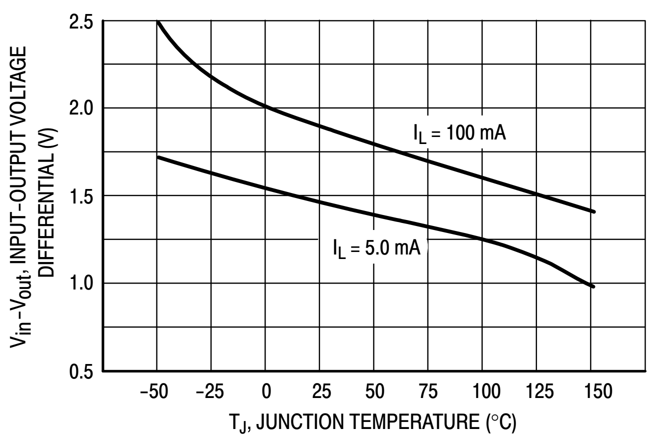


Figure 9. Dropout Voltage

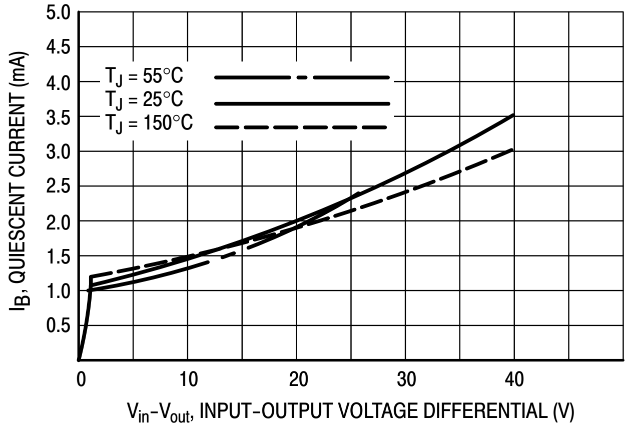


Figure 10. Minimum Operating Current

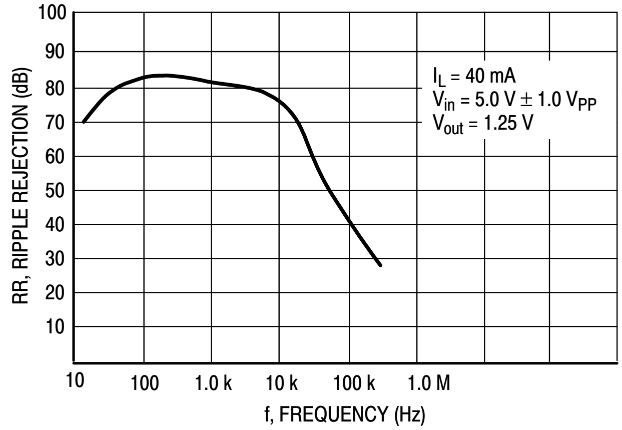


Figure 11. Ripple Rejection versus Frequency

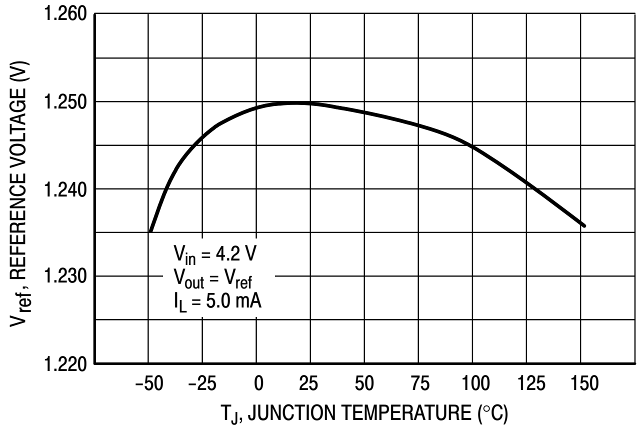


Figure 12. Temperature Stability

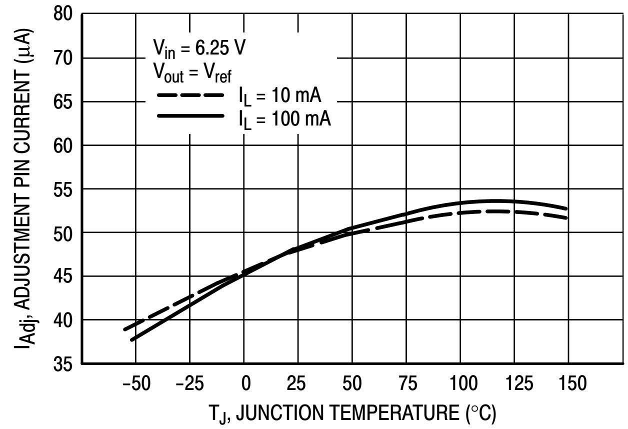


Figure 13. Adjustment Pin Current

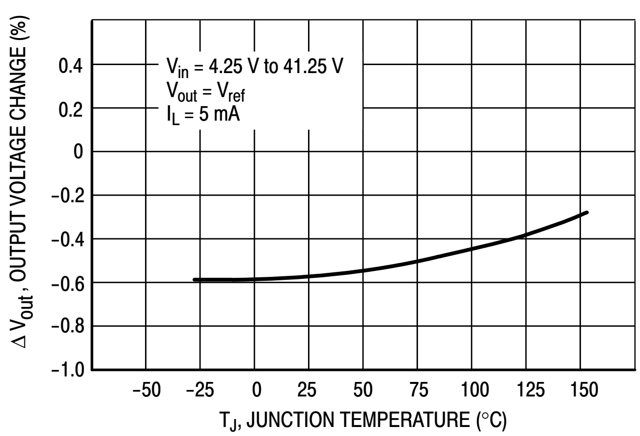


Figure 14. Line Regulation

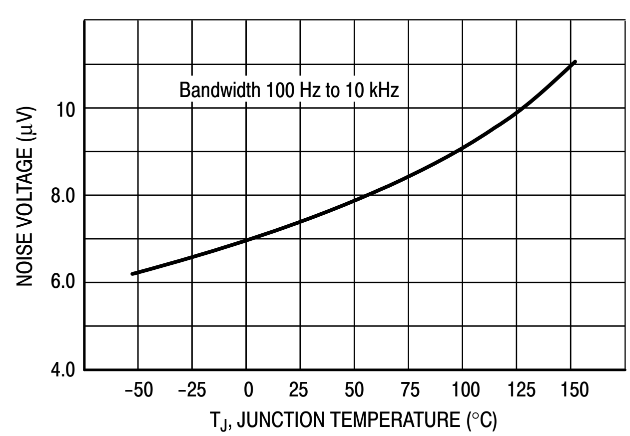


Figure 15. Output Noise

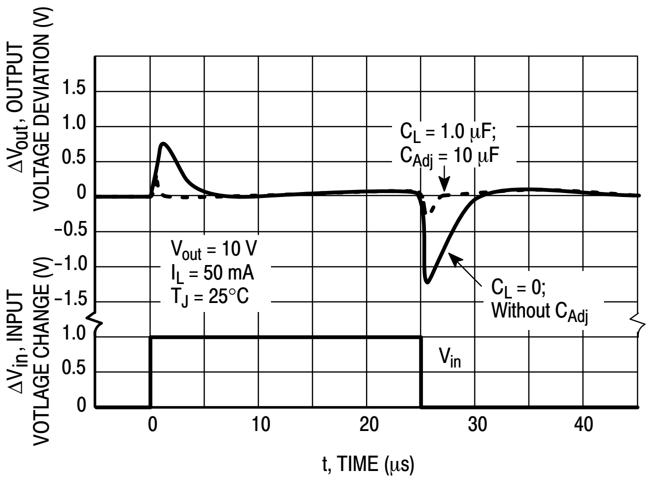


Figure 16. Line Transient Response

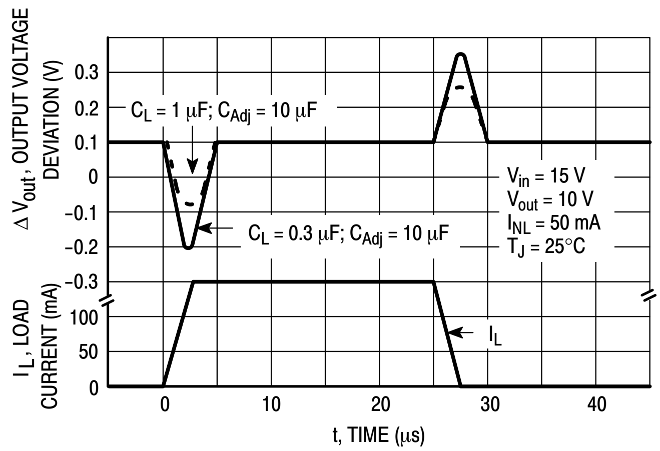


Figure 17. Load Transient Response

APPLICATIONS INFORMATION

Basic Circuit Operation

The LM317L is a 3−terminal floating regulator. In operation, the LM317L develops and maintains a nominal 1.25 V reference (V_{ref}) between its output and adjustment terminals. This reference voltage is converted to a programming current (I_{PROG}) by R_1 (see Figure 13), and this constant current flows through R_2 to ground. The regulated output voltage is given by:

$$V_{out} = V_{ref}\left(1 + \frac{R_2}{R_1}\right) + I_{Adj} R_2$$

Since the current from the adjustment terminal (I_{Adj}) represents an error term in the equation, the LM317L was designed to control I_{Adj} to less than 100 μA and keep it constant. To do this, all quiescent operating current is returned to the output terminal. This imposes the requirement for a minimum load current. If the load current is less than this minimum, the output voltage will rise.

Since the LM317L is a floating regulator, it is only the voltage differential across the circuit which is important to performance, and operation at high voltages with respect to ground is possible.

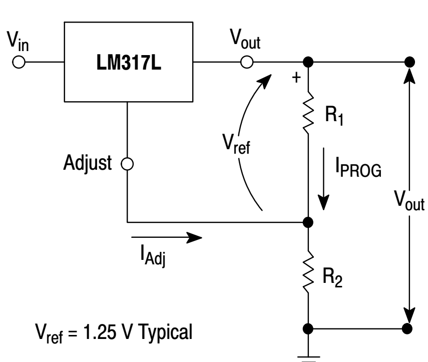


Figure 18. Basic Circuit Configuration

Load Regulation

The LM317L is capable of providing extremely good load regulation, but a few precautions are needed to obtain maximum performance. For best performance, the programming resistor (R1) should be connected as close to the regulator as possible to minimize line drops which effectively appear in series with the reference, thereby degrading regulation. The ground end of R2 can be returned near the load ground to provide remote ground sensing and improve load regulation.

External Capacitors

A 0.1 μF disc or 1.0 μF tantalum input bypass capacitor (C_{in}) is recommended to reduce the sensitivity to input line impedance.

The adjustment terminal may be bypassed to ground to improve ripple rejection. This capacitor (C_{Adj}) prevents ripple from being amplified as the output voltage is increased. A 10 μF capacitor should improve ripple rejection about 15 dB at 120 Hz in a 10 V application.

Although the LM317L is stable with no output capacitance, like any feedback circuit, certain values of external capacitance can cause excessive ringing. An output capacitance (C_O) in the form of a 1.0 μF tantalum or 25 μF aluminum electrolytic capacitor on the output swamps this effect and insures stability.

Protection Diodes

When external capacitors are used with any IC regulator it is sometimes necessary to add protection diodes to prevent the capacitors from discharging through low current points into the regulator.

Figure 14 shows the LM317L with the recommended protection diodes for output voltages in excess of 25 V or high capacitance values (C_O > 10 μF, C_{Adj} > 5.0 μF). Diode D_1 prevents C_O from discharging thru the IC during an input short circuit. Diode D_2 protects against capacitor C_{Adj} discharging through the IC during an output short circuit. The combination of diodes D_1 and D_2 prevents C_{Adj} from discharging through the IC during an input short circuit.

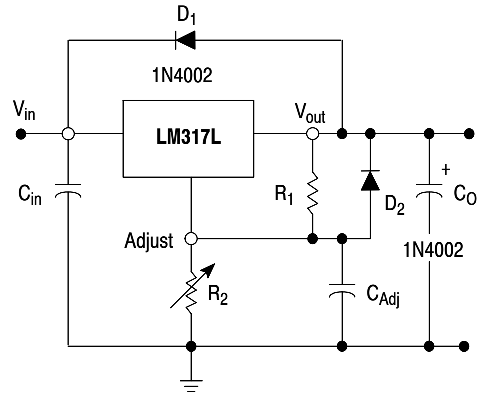


Figure 19. Voltage Regulator with Protection Diodes

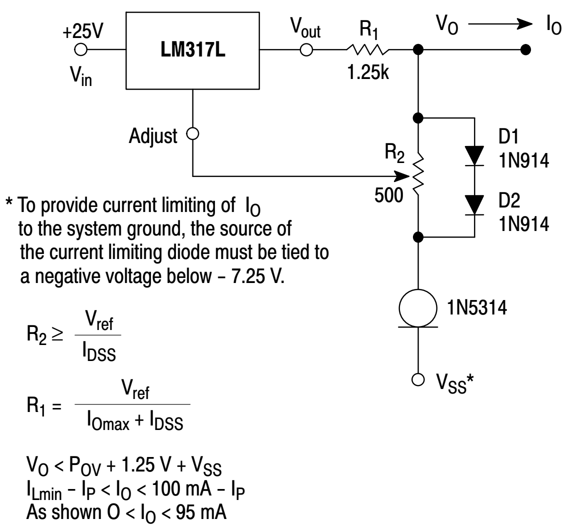


Figure 20. Adjustable Current Limiter

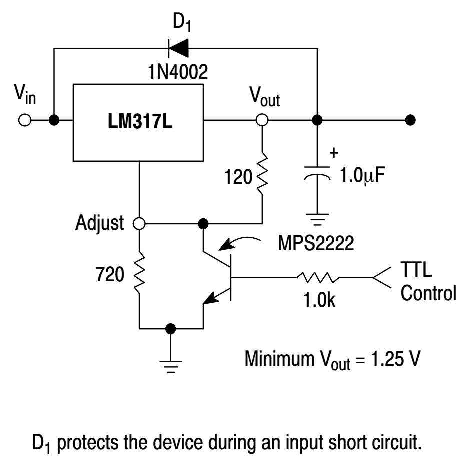


Figure 21. 5.0 V Electronic Shutdown Regulator

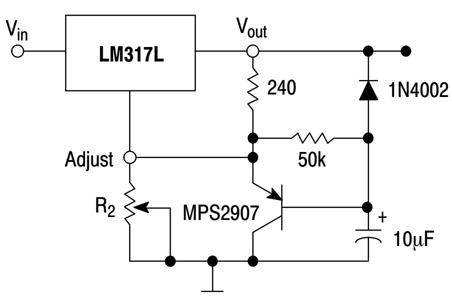
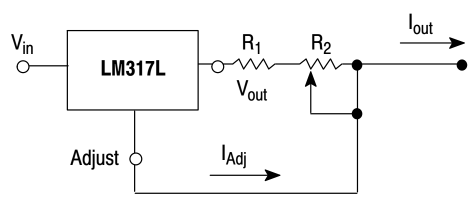


Figure 22. Slow Turn−On Regulator



$$I_{outmax} = \left(\frac{V_{ref}}{R_1}\right) + I_{Adj} \cong \frac{1.25\ V}{R_1}$$

$$I_{outmax} = \left(\frac{V_{ref}}{R_1 + R_2}\right) + I_{Adj} \cong \frac{1.25\ V}{R_1 + R_2}$$

5.0 mA < I_{out} < 100 mA

Figure 23. Current Regulator

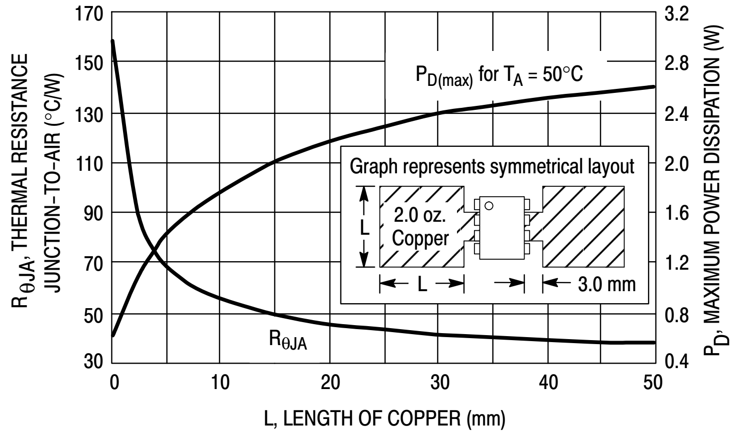


Figure 24. SOP−8 Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length

ORDERING INFORMATION

Device	Operating Temperature Range	Package	Shipping†
LM317LBD	T_J = −40°C to +125°C	SOIC−8	98 Units / Rail
LM317LBDG		SOIC−8 (Pb−Free)	98 Units / Rail
LM317LBDR2		SOIC−8	2500/Tape & Reel
LM317LBDR2G		SOIC−8 (Pb−Free)	2500/Tape & Reel
LM317LBZ		TO−92	2000 Units / Bag
LM317LBZG		TO−92 (Pb−Free)	2000 Units / Bag
LM317LBZRA		TO−92	2000 Tape & Reel
LM317LBZRAG		TO−92 (Pb−Free)	2000 Tape & Reel
LM317LBZRP		TO−92	2000 Ammo Pack
LM317LBZRPG		TO−92 (Pb−Free)	2000 Ammo Pack
NCV317LBDG*		SOIC−8 (Pb−Free)	98 Units / Rail
NCV317LBDR2*		SOIC−8	2500/Tape & Reel
NCV317LBDR2G*		SOIC−8 (Pb−Free)	2500/Tape & Reel
NCV317LBZG*		TO−92 (Pb−Free)	2000 Units / Bag
NCV317LBZRAG*		TO−92 (Pb−Free)	2000 Tape & Reel
LM317LD	T_J = 0°C to +125°C	SOIC−8	98 Units / Rail
LM317LDG		SOIC−8 (Pb−Free)	98 Units / Rail
LM317LDR2		SOIC−8	2500/Tape & Reel
LM317LDR2G		SOIC−8 (Pb−Free)	2500/Tape & Reel
LM317LZ		TO−92	2000 Units / Bag
LM317LZG		TO−92 (Pb−Free)	2000 Units / Bag
LM317LZRA		TO−92	2000 Tape & Reel
LM317LZRAG		TO−92 (Pb−Free)	2000 Tape & Reel
LM317LZRE		TO−92	2000 Tape & Reel
LM317LZREG		TO−92 (Pb−Free)	2000 Tape & Reel
LM317LZRM		TO−92	2000 Ammo Pack
LM317LZRMG		TO−92 (Pb−Free)	2000 Ammo Pack
LM317LZRP		TO−92	2000 Ammo Pack
LM317LZRPG		TO−92 (Pb−Free)	2000 Ammo Pack

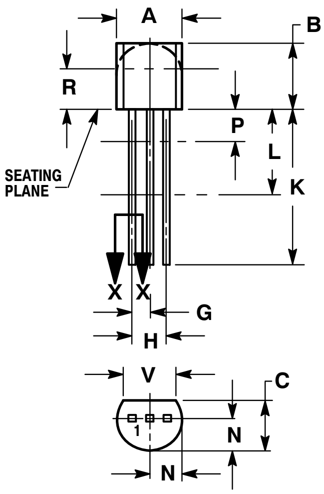
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

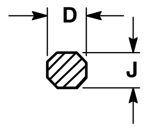
*NCV devices: T_{low} = −40°C, T_{high} = +125°C. Guaranteed by design. NCV prefix is for automotive and other applications requiring site and control change.

PACKAGE DIMENSIONS

TO–92 (TO–226)
Z SUFFIX
CASE 29–11
ISSUE AM

STRAIGHT LEAD
BULK PACK



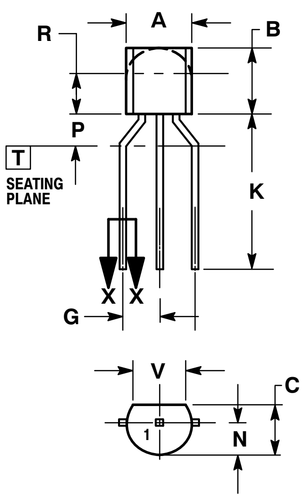


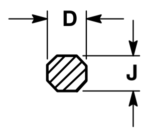
SECTION X–X

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.175	0.205	4.45	5.20
B	0.170	0.210	4.32	5.33
C	0.125	0.165	3.18	4.19
D	0.016	0.021	0.407	0.533
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.015	0.020	0.39	0.50
K	0.500	---	12.70	---
L	0.250	---	6.35	---
N	0.080	0.105	2.04	2.66
P	---	0.100	---	2.54
R	0.115	---	2.93	---
V	0.135	---	3.43	---

BENT LEAD
TAPE & REEL
AMMO PACK





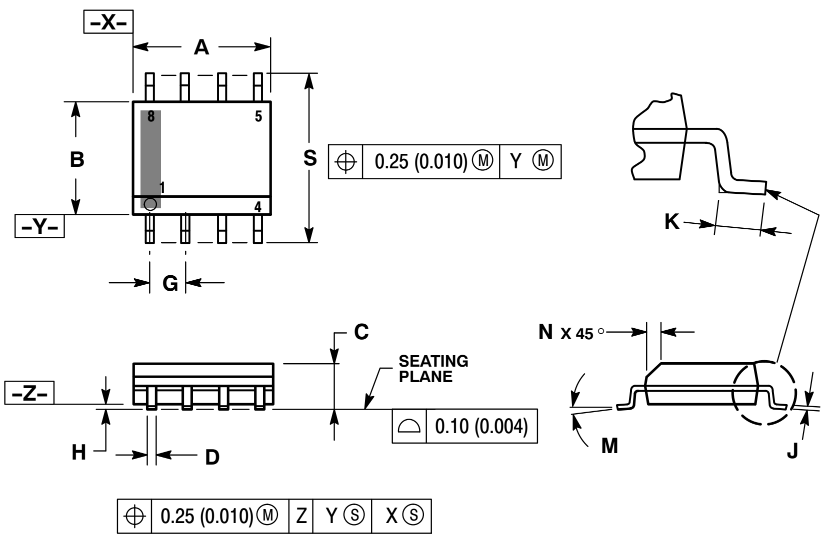
SECTION X–X

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

	MILLIMETERS	
DIM	MIN	MAX
A	4.45	5.20
B	4.32	5.33
C	3.18	4.19
D	0.40	0.54
G	2.40	2.80
J	0.39	0.50
K	12.70	---
N	2.04	2.66
P	1.50	4.00
R	2.93	---
V	3.43	---

PACKAGE DIMENSIONS

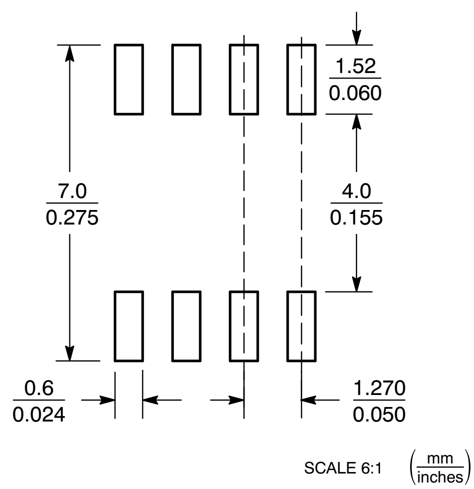
SOIC−8
D SUFFIX
CASE 751−07
ISSUE AJ



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0 °	8 °	0 °	8 °
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

SOLDERING FOOTPRINT*



*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5773−3850

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative