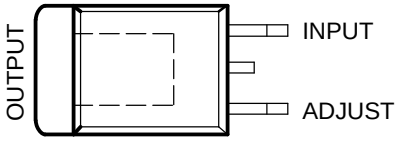
LM317M
3-TERMINAL ADJUSTABLE REGULATOR

SLVS297M – APRIL 2000 – REVISED OCTOBER 2005

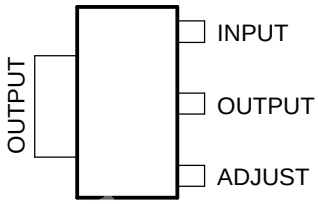
FEATURES

- **Output Voltage Range Adjustable From 1.25 V to 37 V**
- **Output Current Greater Than 500 mA**
- **Internal Short-Circuit Current Limiting**
- **Thermal-Overload Protection**
- **Output Safe-Area Compensation**
- **Q Devices Meet Automotive Performance Requirements**
- **Customer-Specific Configuration Control Can Be Supported for Q Devices Along With Major-Change Approval**

KTP PACKAGE
(TOP VIEW)



DCY PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

The LM317M is an adjustable 3-terminal positive-voltage regulator capable of supplying more than 500 mA over an output-voltage range of 1.25 V to 37 V. The LM317M is exceptionally easy to use and requires only two external resistors to set the output voltage. Furthermore, both line and load regulation are better than standard fixed regulators.

In addition to having higher performance than fixed regulators, the device includes on-chip current limiting, thermal-overload protection, and safe-operating-area protection. All overload protection remains fully functional if the ADJUST terminal is disconnected.

Normally, no capacitors are needed unless the device is more than six inches from the input filter capacitors, in which case an input bypass capacitor is needed. An optional output capacitor can be added to improve transient response. The ADJUST terminal can be bypassed to achieve high ripple-rejection ratios, which are difficult to achieve with standard three-terminal regulators.

ORDERING INFORMATION

T_J	PACKAGE(1)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 125°C	PowerFLEX™ – KTP	Reel of 2000	LM317MKTPR	LM317M
	SOT – DCY	Tube of 80	LM317MDCY	L4
		Reel of 2500	LM317MDCYR	
–40°C to 125°C	PowerFLEX – KTP	Reel of 2000	LM317MQKTPR	317MQ
	SOT – DCY	Reel of 2500	LM317MQDCYR	L5
			LM317MQDCYRG3	L8

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

Absolute Maximum Ratings(1)

over operating temperature range (unless otherwise noted)

			MIN	MAX	UNIT
$V_I - V_O$	Input-to-output differential voltage			40	V
T_J	Operating virtual junction temperature			150	°C
	Lead temperature (within 5 mils of the plastic body for 10 s)	KTP, DCY packages		260	°C
T_{stg}	Storage temperature range		–65	150	°C

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings 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-rated conditions for extended periods may affect device reliability.

Package Thermal Data(1)

PACKAGE	BOARD	θ_{JC}	θ_{JCB}	θ_{JA}
PowerFLEX (KTP)	High K, JESD 51-5		3°C/W	28°C/W
SOT-223 (DCY)	High K, JESD 51-7	30.6°C/W		53°C/W

(1) Maximum power dissipation is a function of $T_J(max)$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.

Recommended Operating Conditions

			MIN	MAX	UNIT
$V_I - V_O$	Input-to-output voltage differential			37	V
I_O	Output current			0.5	A
T_J	Operating virtual junction temperature	No suffix	0	125	°C
		Q suffix	–40	125	

Electrical Characteristics

over recommended operating virtual-junction temperature range, $V_I - V_O$ = 5 V, I_O = 0.1 A (unless otherwise noted)

PARAMETER	TEST CONDITIONS(1)		MIN	TYP	MAX	UNIT
Line regulation(2)	$V_I - V_O$ = 3 V to 40 V	T_J = 25°C		0.01	0.04	%/V
		Full temperature range		0.02	0.07	
Load regulation	I_O = 10 mA to 500 mA	T_J = 25°C		0.1	0.5	%V_O
		Full temperature range		0.3	1.5	
ADJUST terminal current				50	100	µA
Change in ADJUST terminal current	$V_I - V_O$ = 3 V to 40 V,	I_O = 10 mA to 500 mA		0.2	5	µA
Reference voltage	$V_I - V_O$ = 3 V to 40 V,	I_O = 10 mA to 500 mA	1.2	1.25	1.3	V
Output-voltage temperature stability				0.7		%
Minimum load current to maintain regulation				3.5	10	mA
Maximum output current	$V_I - V_O \le$ 15 V		500	900		mA
	$V_I - V_O$ = 40 V, $P_D \le P_{D(max)}$,	T_J = 25°C	150	250		
RMS output noise voltage (% of V_O)	f = 10 Hz to 10 kHz,	T_J = 25°C		0.003		%V_O
Ripple rejection	V_O = 10 V, f = 120 Hz, T_J = 25°C	C_{ADJ} = 0(3)		65		dB
		C_{ADJ} = 10 µF(3)	66	80		
Long-term stability	T_J = 25°C			0.3	1	%/1k hrs

(1) Pulse-testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible.
(2) Line voltage regulation is expressed here as the percentage change in output voltage per 1-V change at the input.
(3) CADJ is connected between the ADJUST terminal and ground.

TYPICAL CHARACTERISTICS

LINE REGULATION vs TEMPERATURE

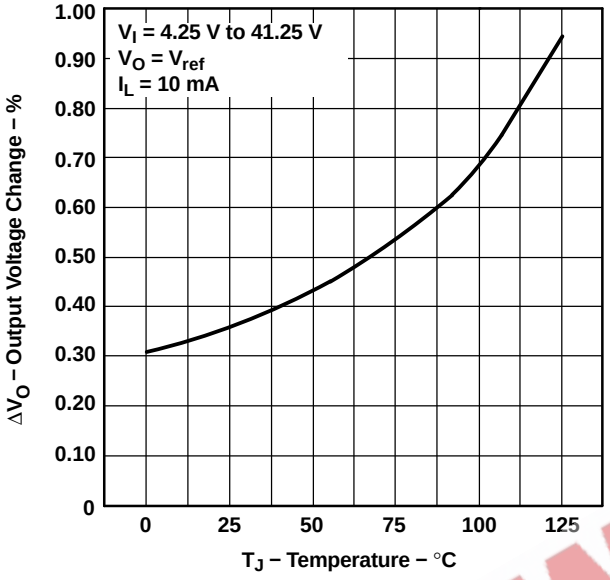


Figure 1.

LOAD REGULATION vs TEMPERATURE

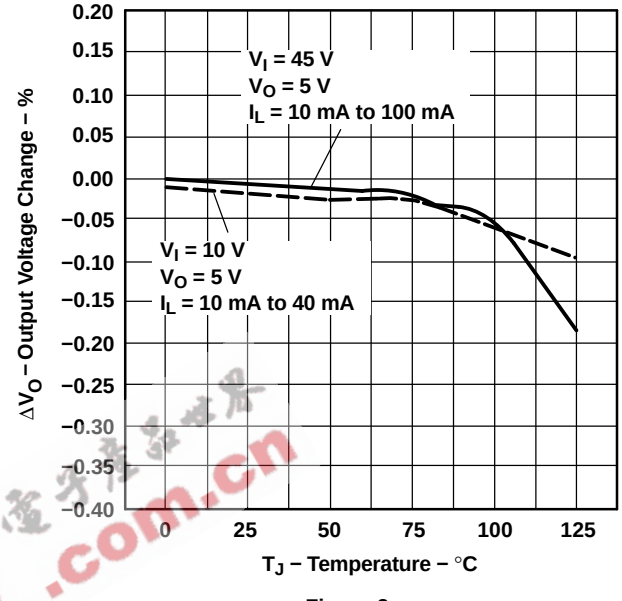


Figure 2.

ADJUST TERMINAL CURRENT vs TEMPERATURE

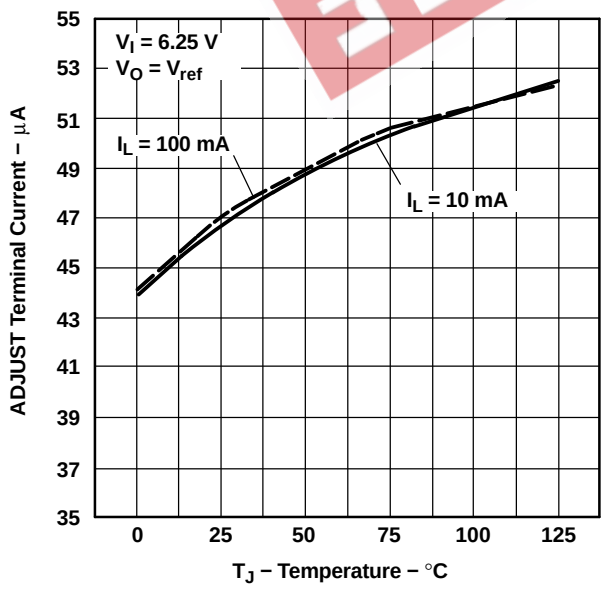


Figure 3.

TEMPERATURE STABILITY vs TEMPERATURE

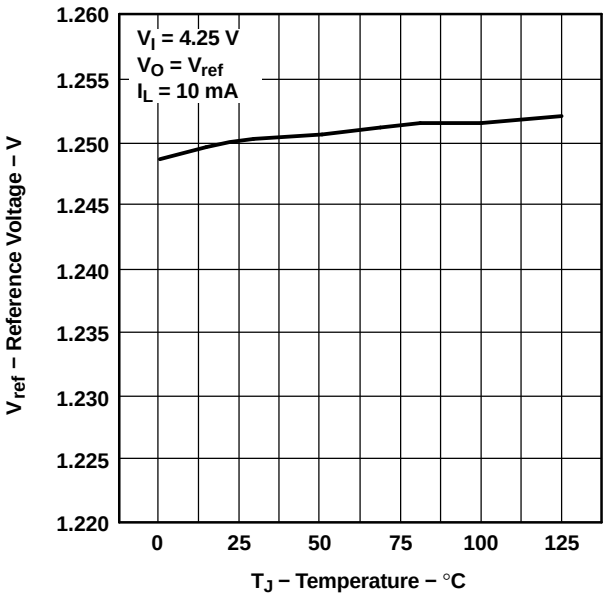


Figure 4.

TYPICAL CHARACTERISTICS (continued)

MINIMUM OPERATING CURRENT
vs
INPUT-OUTPUT DIFFERENTIAL VOLTAGE

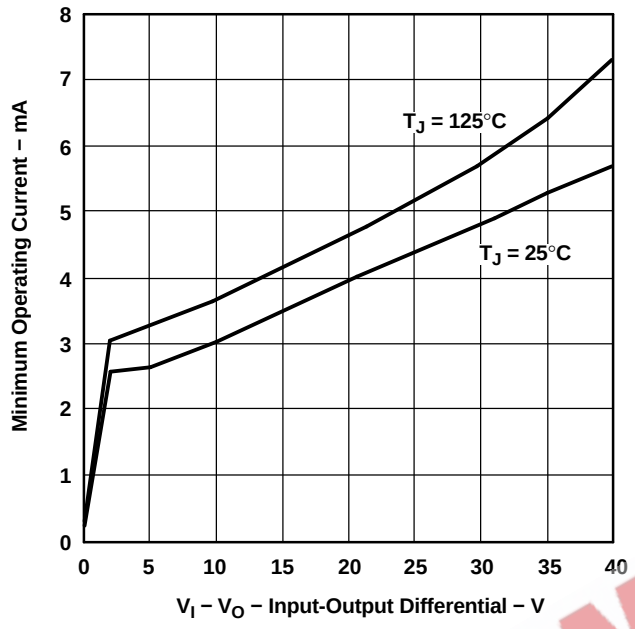


Figure 5.

OUTPUT CURRENT LIMIT
vs
INPUT-OUTPUT DIFFERENTIAL VOLTAGE

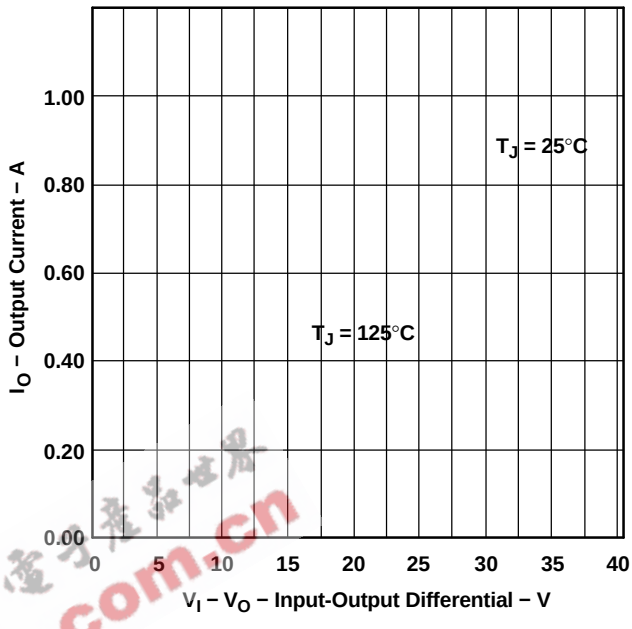


Figure 6.

OUTPUT NOISE VOLTAGE
vs
TEMPERATURE

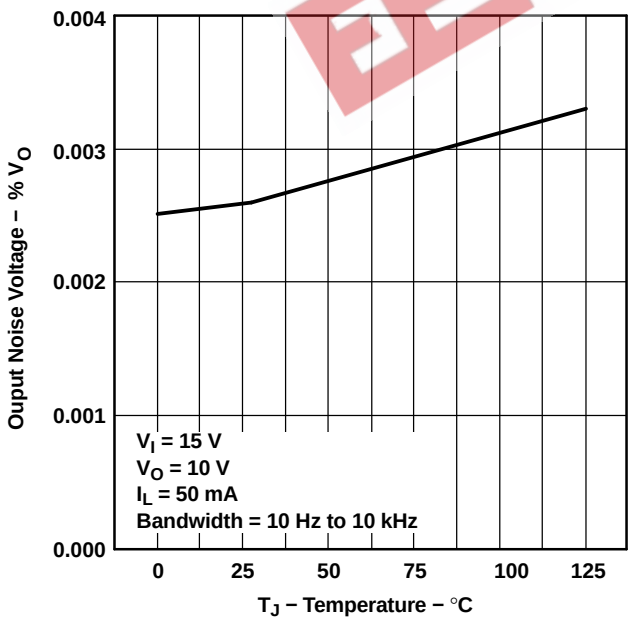


Figure 7.

RIPPLE REJECTION
vs
TEMPERATURE

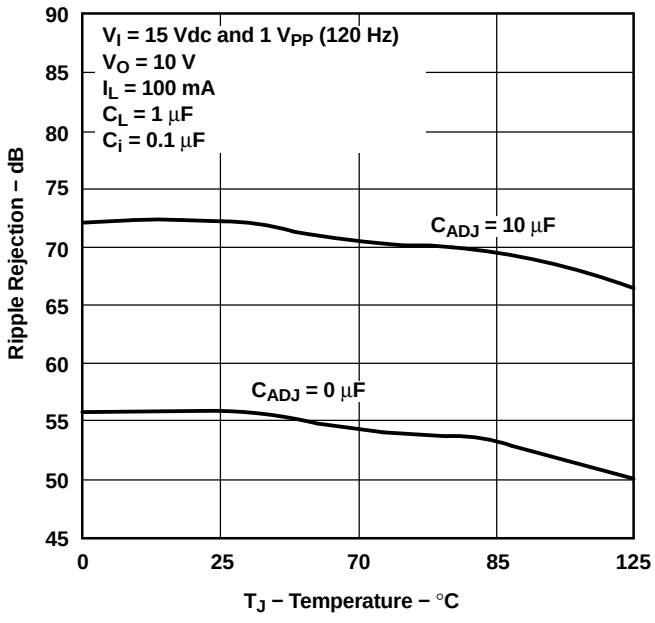


Figure 8.

TYPICAL CHARACTERISTICS (continued)

RIPPLE REJECTION
vs
FREQUENCY

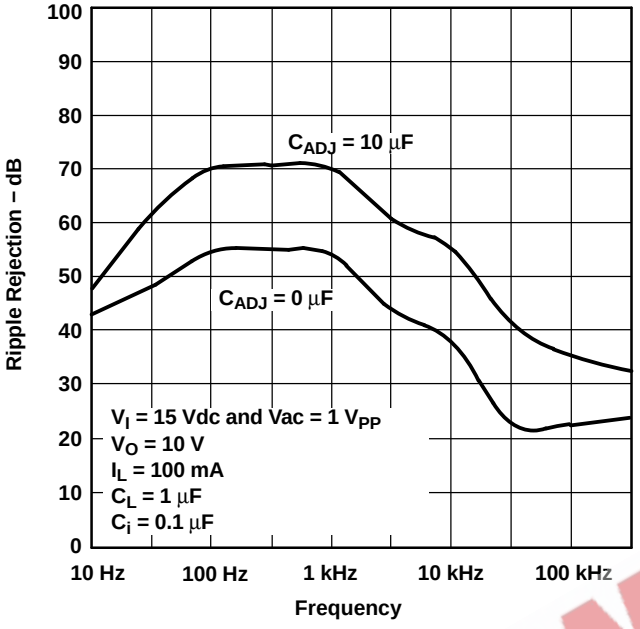


Figure 9.

INPUT-OUTPUT VOLTAGE DIFFERENTIAL
vs
TEMPERATURE

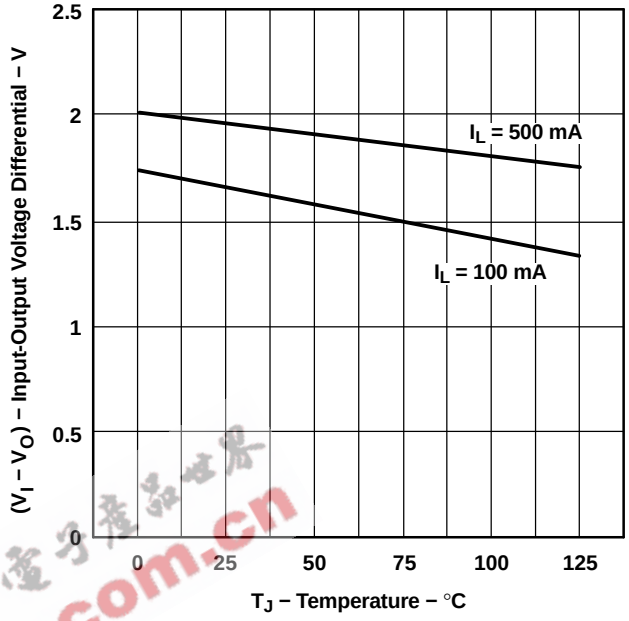


Figure 10.

OUTPUT IMPEDANCE
vs
FREQUENCY

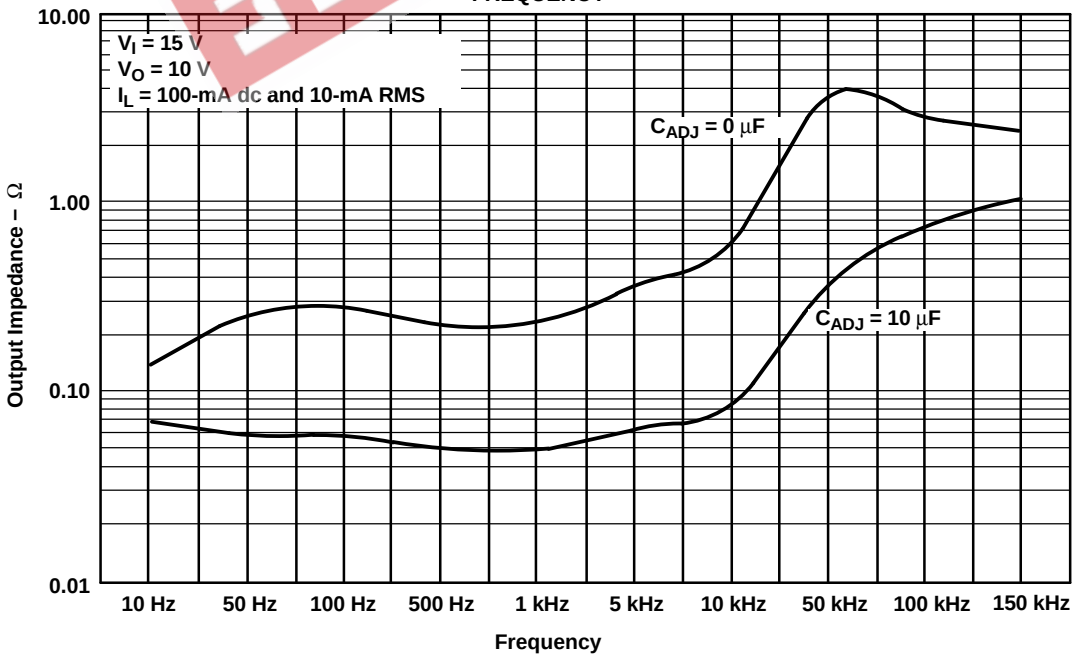


Figure 11.

TYPICAL CHARACTERISTICS (continued)

LINE TRANSIENT RESPONSE
vs
TIME

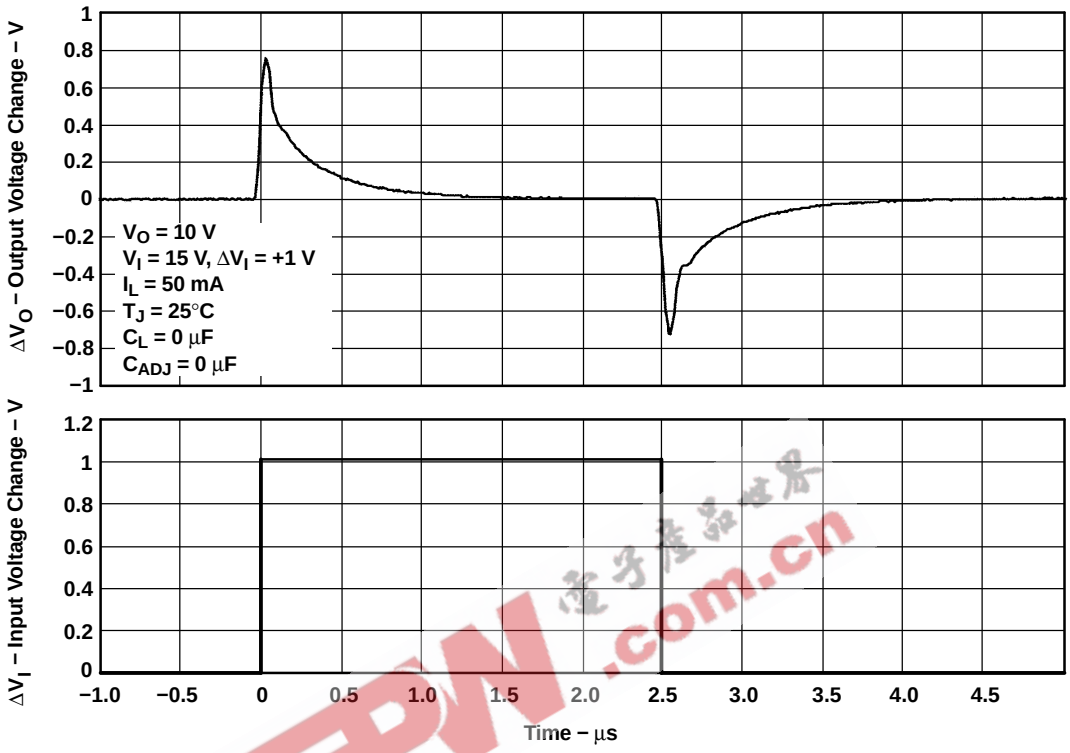


Figure 12.

LOAD TRANSIENT RESPONSE
vs
TIME

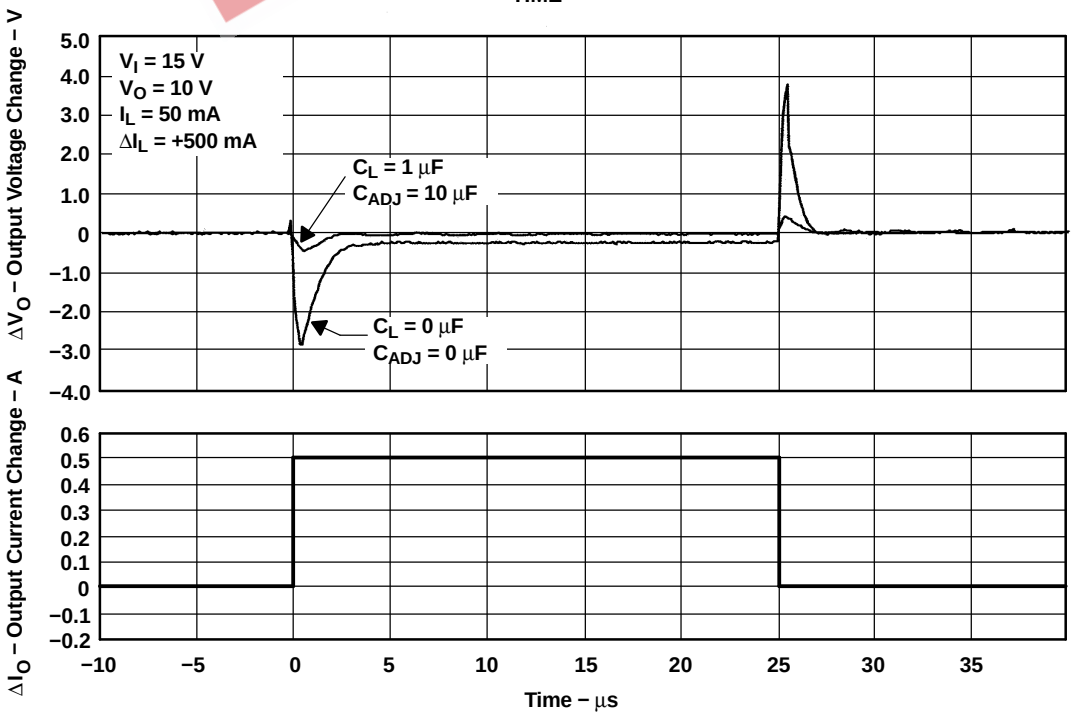
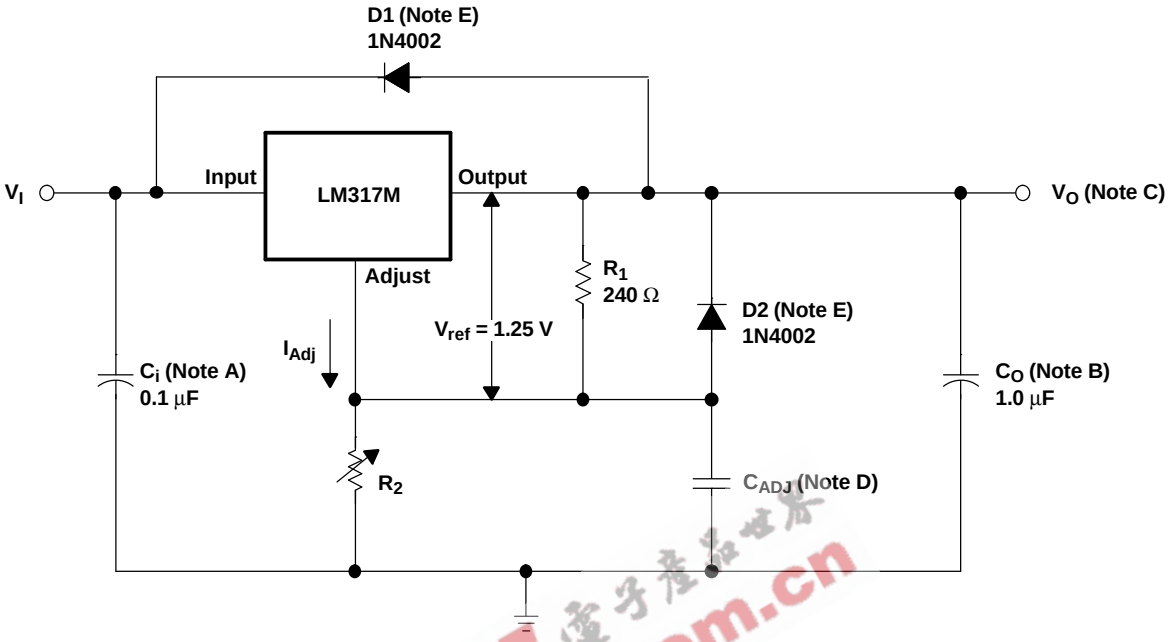


Figure 13.

APPLICATION INFORMATION



NOTES: A. C_i is not required, but is recommended, particularly if the regulator is not in close proximity to the power-supply filter capacitors. A 0.1-μF disc or 1-μF tantalum provides sufficient bypassing for most applications, especially when adjustment and output capacitors are used.

B. C_O improves transient response, but is not needed for stability.

C. V_O is calculated as shown:

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

Because I_{Adj} typically is 50 μA, it is negligible in most applications.

D. C_{ADJ} is used to improve ripple rejection; it prevents amplification of the ripple as the output voltage is adjusted higher. If C_{ADJ} is used, it is best to include protection diodes.

E. If the input is shorted to ground during a fault condition, protection diodes provide measures to prevent the possiblility of external capacitors discharging through low-impedance paths in the IC. By providing low-impedance discharge paths for C_O and C_{ADJ}, respectively, D1 and D2 prevent the capacitors from discharging into the output of the regulator.

Figure 14. Adjustable Voltage Regulator

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
LM317MDCY	ACTIVE	SOT-223	DCY	4	80	TBD	CU SNPB	Level-2-235C-1 YEAR
LM317MDCYG3	ACTIVE	SOT-223	DCY	4	80	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1YEAR
LM317MDCYR	ACTIVE	SOT-223	DCY	4	2500	TBD	CU SNPB	Level-2-235C-1 YEAR
LM317MDCYRG3	ACTIVE	SOT-223	DCY	4	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1YEAR
LM317MKTPR	ACTIVE	PFM	KTP	2	3000	TBD	CU SNPB	Level-1-220C-UNLIM
LM317MKTPRG3	ACTIVE	PFM	KTP	2	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM
LM317MQDCYR	ACTIVE	SOT-223	DCY	4	2500	TBD	SNPB	Level-2-235C-1 YEAR
LM317MQDCYRG3	ACTIVE	SOT-223	DCY	4	2500	Green (RoHS & no Sb/Br)	CU SN	Level-2-260C-1 YEAR
LM317MQKTPR	ACTIVE	PFM	KTP	2	3000	TBD	CU SNPB	Level-1-220C-UNLIM

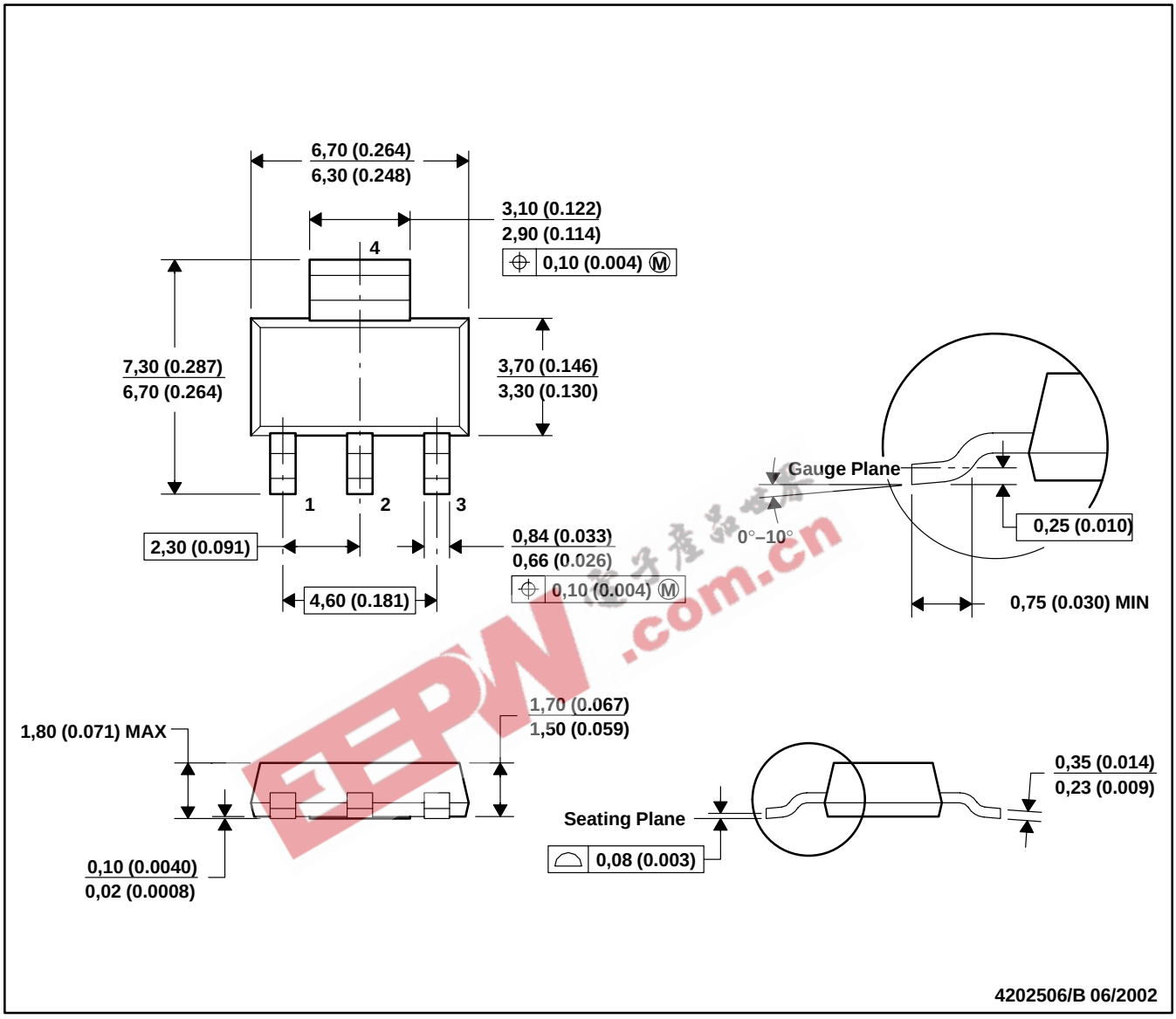
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

MPDS094A – APRIL 2001 – REVISED JUNE 2002

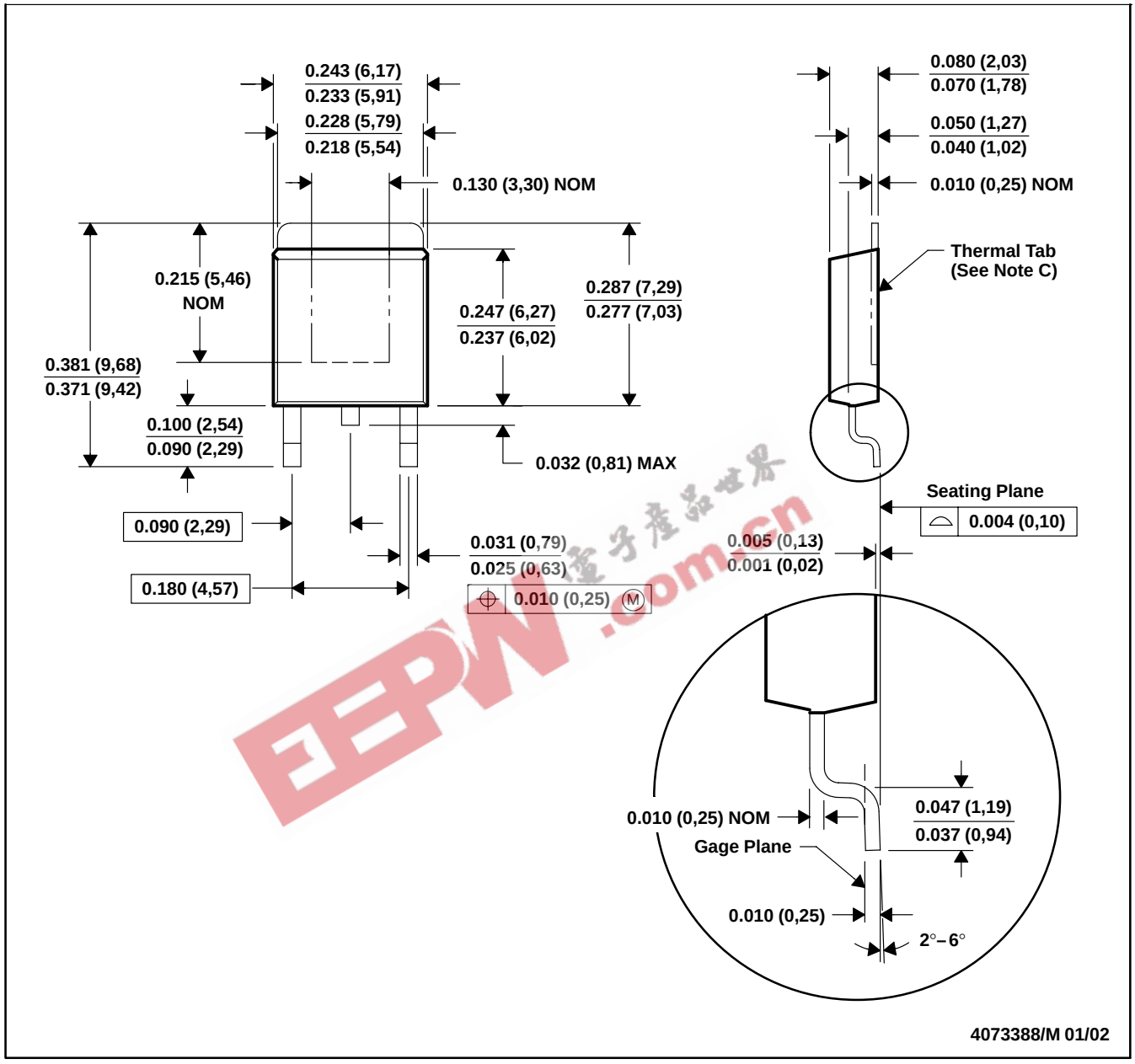
DCY (R-PDSO-G4) **PLASTIC SMALL-OUTLINE**



NOTES:
A. All linear dimensions are in millimeters (inches).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC TO-261 Variation AA.

MPSF001F – JANUARY 1996 – REVISED JANUARY 2002

KTP (R-PSFM-G2) PowerFLEX™ PLASTIC FLANGE-MOUNT PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. The center lead is in electrical contact with the thermal tab.
D. Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).
E. Falls within JEDEC TO-252 variation AC.

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