- **Output Voltage Range Adjustable From 1.2 V to 32 V When Used With an External Resistor Divider**
- **Output Current Capability of 100 mA**
- **Input Regulation Typically 0.01% Per Input-Voltage Change**
- **Output Regulation Typically 0.5%**
- **Ripple Rejection Typically 80 dB**

D OR PW PACKAGE
(TOP VIEW)

INPUT	1	8	NC
OUTPUT	2	7	OUTPUT
OUTPUT	3	6	OUTPUT
ADJUSTMENT	4	5	NC

NC – No internal connection
OUTPUT terminals are all internally connected.

PS PACKAGE
(TOP VIEW)

INPUT	1	8	OUTPUT
NC	2	7	NC
NC	3	6	ADJUSTMENT
NC	4	5	NC

NC – No internal connection

LP PACKAGE
(TOP VIEW)

INPUT
OUTPUT
ADJUSTMENT

description/ordering information

The TL317 is an adjustable three-terminal positive-voltage regulator capable of supplying 100 mA over an output-voltage range of 1.2 V to 32 V. It is exceptionally easy to use and requires only two external resistors to set the output voltage.

In addition to higher performance than fixed regulators, this regulator offers full overload protection available only in integrated circuits. Included on the chip are current-limiting and thermal-overload protection. All overload-protection circuitry remains fully functional, even when ADJUSTMENT is disconnected. Normally, no capacitors are needed unless the device is situated far from the input filter capacitors, in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. ADJUSTMENT can be bypassed to achieve very high ripple rejection, which is difficult to achieve with standard three-terminal regulators.

In addition to replacing fixed regulators, the TL317 regulator is useful in a wide variety of other applications. Since the regulator is floating and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input-to-output differential is not exceeded. Its primary application is that of a programmable output regulator, but by connecting a fixed resistor between ADJUSTMENT and OUTPUT, this device can be used as a precision current regulator. Supplies with electronic shutdown can be achieved by clamping ADJUSTMENT to ground, programming the output to 1.2 V, where most loads draw little current.
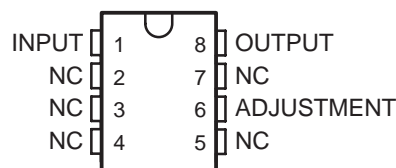
The TL317C is characterized for operation over the virtual-junction temperature range of 0°C to 125°C.
The TL317 is characterized for operation over the virtual-junction temperature range of −20°C to 125°C.
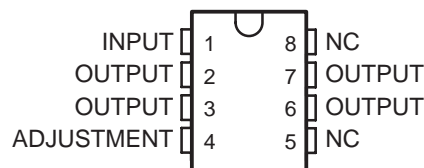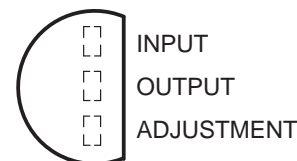
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

TEXAS INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

ORDERING INFORMATION

T$_J$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 125°C	SOIC (D)	Tube of 75	TL317CD	TL317C
		Reel of 2500	TL317CDR	
	TO-226 / TO-92 (LP)	Bulk of 1000	TL317CLP	TL317C
		Reel of 2000	TL317CLPR	
	TSSOP (PW)	Tube of 150	TL317CPW	T317
		Reel of 2000	TL317CPWR	
−20°C to 125°C	TO-226 / TO-92 (LP)	Bulk of 1000	TL317LP	TL317
	SOP (PS)	Tube of 80	TL317PS	T317
		Reel of 2000	TL317PSR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.
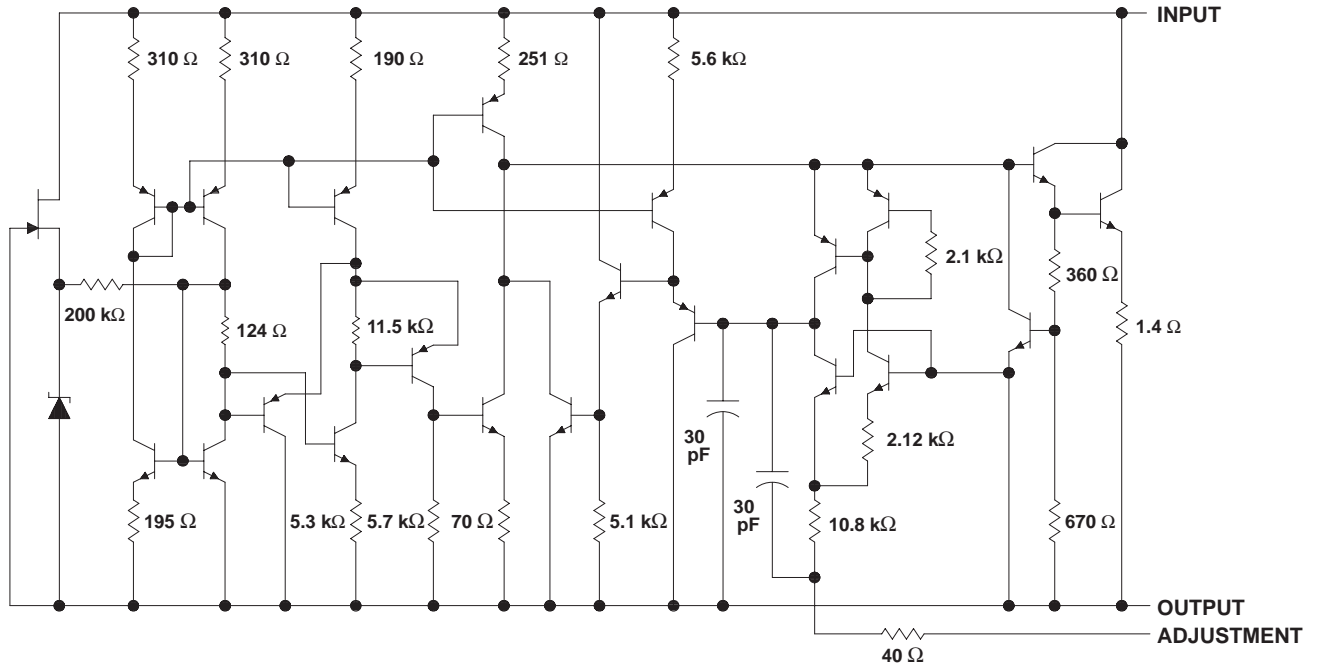
TEXAS
INSTRUMENTS

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

schematic

NOTE A: All component values shown are nominal.

absolute maximum ratings over operating temperature range (unless otherwise noted)†

Input-to-output differential voltage, $V_I - V_O$ .... 35 V
Package thermal impedance, θ_{JA} (see Notes 1 and 2): D package .... 97°C/W
LP package .... 140°C/W
PS package .... 95°C/W
PW package .... 149°C/W
Operating virtual junction temperature, T_J .... 150°C
Storage temperature range, T_{stg} .... −65°C to 150°C

† 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.

NOTES: 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.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

|			MIN	MAX	UNIT
$V_I - V_O$	Input-to-output voltage differential			35	V
I_O	Output current		2.5	100	mA
T_J	Operating virtual-junction temperature	TL317C	0	125	°C
		TL317	−20	125	°C

TL317
3-TERMINAL ADJUSTABLE REGULATOR

electrical characteristics over recommended operating virtual-junction temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS†		TL317C			UNIT
			MIN	TYP	MAX	
Input voltage regulation (see Note 3)	V_I – V_O = 5 V to 35 V	T_J = 25°C		0.01	0.02	%V
		I_O = 2.5 mA to 100 mA		0.02	0.05	
Ripple regulation	V_O = 10 V, f = 120 Hz			65		dB
	V_O = 10 V, 10-µF capacitor between ADJUSTMENT and ground		66	80		
Output voltage regulation	V_I = 5 V to 35 V, I_O = 2.5 mA to 100 mA, T_J = 25°C	V_O ≤ 5 V		25		mV
		V_O ≥ 5 V		5		mV/V
	V_I = 5 V to 35 V, I_O = 2.5 mA to 100 mA	V_O ≤ 5 V		50		mV
		V_O ≥ 5 V		10		mV/V
Output voltage change with temperature	T_J = 0°C to 125°C			10		mV/V
Output voltage long-term drift	After 1000 hours at T_J = 125°C and V_I – V_O = 35 V			3	10	mV/V
Output noise voltage	f = 10 Hz to 10 kHz, T_J = 25°C			30		µV/V
Minimum output current to maintain regulation	V_I – V_O = 35 V			1.5	2.5	mA
Peak output current	V_I – V_O ≤ 35 V		100	200		mA
ADJUSTMENT current				50	100	µA
Change in ADJUSTMENT current	V_I – V_O = 2.5 V to 35 V, I_O = 2.5 mA to 100 mA			0.2	5	µA
Reference voltage (output to ADJUSTMENT)	V_I – V_O = 5 V to 35 V, P ≤ rated dissipation, I_O = 2.5 mA to 100 mA		1.2	1.25	1.3	V

† Unless otherwise noted, these specifications apply for the following test conditions: V_I – V_O = 5 V and I_O = 40 mA. Pulse-testing techniques must be used that maintain the junction temperature as close to the ambient temperature as possible. All characteristics are measured with a 0.1-µF capacitor across the input and a 1-µF capacitor across the output.

NOTE 3:   Input voltage regulation is expressed here as the percentage change in output voltage per 1-V change at the input.

APPLICATION INFORMATION
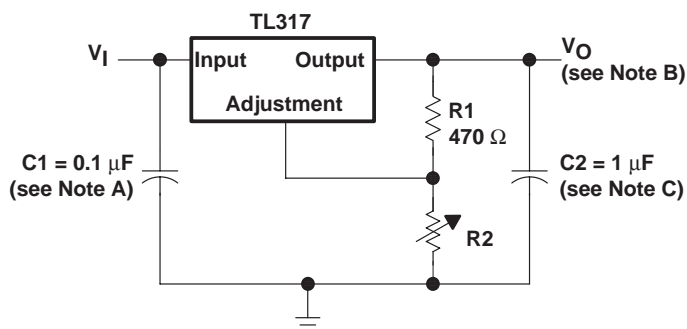
NOTES: A. Use of an input bypass capacitor is recommended if regulator is far from the filter capacitors.
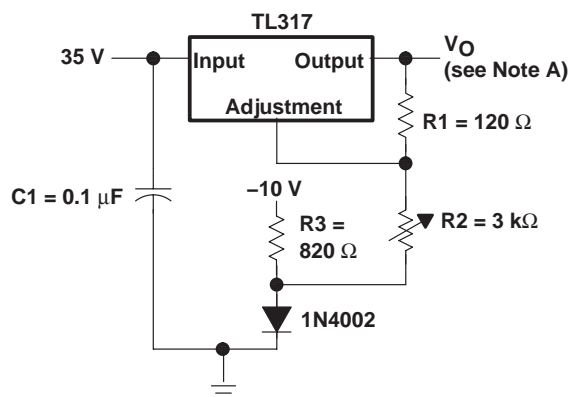
B. Output voltage is calculated from the equation:

$$V_O = V_{ref}\left(1 + \frac{R2}{R1}\right)$$

where: V_{ref} equals the difference between OUTPUT and ADJUSTMENT voltages ($\approx$1.25 V).

C. Use of an output capacitor improves transient response, but is optional.
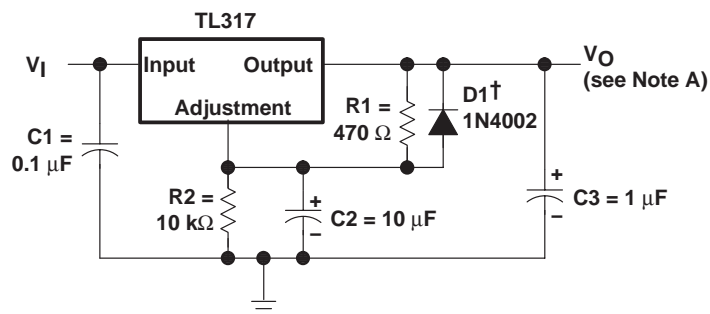
Figure 1. Adjustable Voltage Regulator

NOTE A: Output voltage is calculated from the equation:

$$V_O = V_{ref}\left(1 + \frac{R2 + R3}{R1}\right) - 10\ V$$

where: V_{ref} equals the difference between OUTPUT and ADJUSTMENT voltages ($\approx$1.25 V).

Figure 2. 0-V to 30-V Regulator Circuit

† D1 discharges C2 if output is shorted to ground.

NOTE A: Use of an output capacitor improves transient response, but is optional.

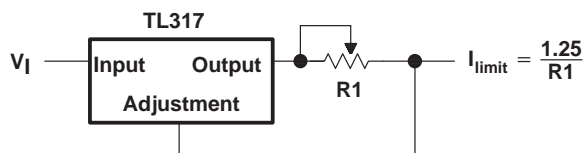**Figure 3. Regulator Circuit**
With Improved Ripple Rejection

Figure 4. Precision Current-Limiter Circuit
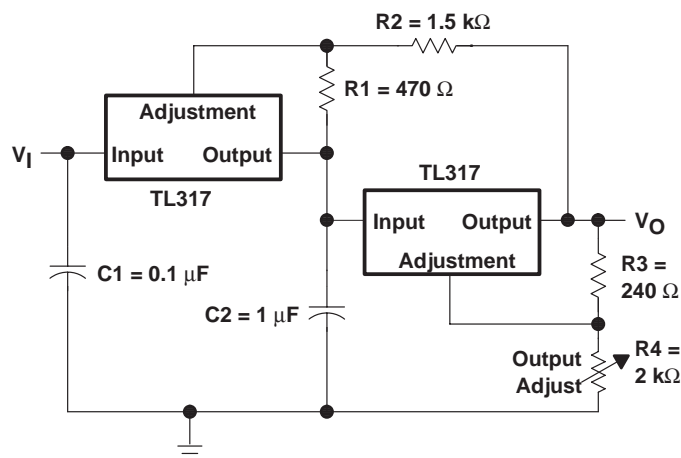
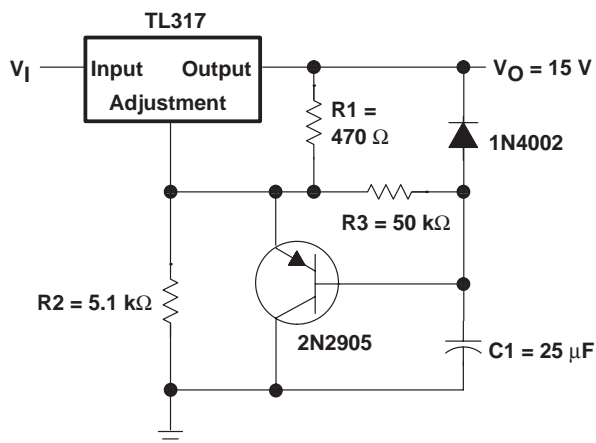## APPLICATION INFORMATION

Figure 5. Tracking Preregulator Circuit

Figure 6. Slow-Turnon 15-V Regulator Circuit
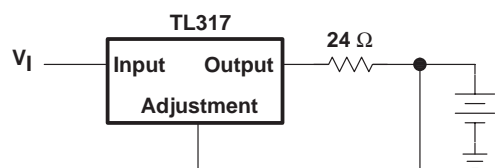
**Figure 7. 50-mA Constant-Current
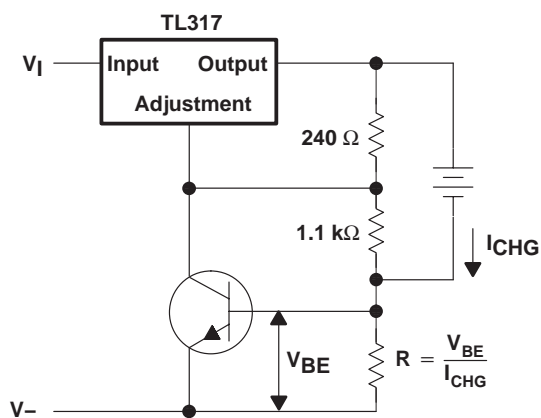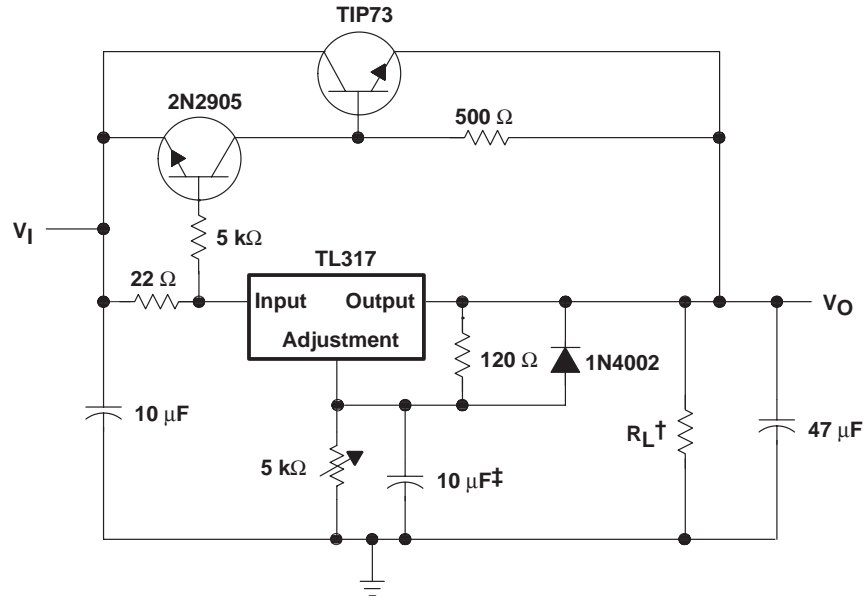Battery-Charger Circuit**

Figure 8. Current-Limited 6-V Charger

$$R = \frac{V_{BE}}{I_{CHG}}$$

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POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265

APPLICATION INFORMATION

† Minimum load current is 30 mA.
‡ Optional capacitor improves ripple rejection.

Figure 9. High-Current Adjustable Regulator

PACKAGE OPTION ADDENDUM

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
TL317CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317CDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317CDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317CLP	ACTIVE	TO-92	LP	3	1000	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
TL317CLPE3	ACTIVE	TO-92	LP	3	1000	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
TL317CLPR	ACTIVE	TO-92	LP	3	2000	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
TL317CLPRE3	ACTIVE	TO-92	LP	3	2000	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
TL317CPW	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317CPWE4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317CPWG4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317CPWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317CPWRE4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317CPWRG4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317PS	ACTIVE	SO	PS	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317PSE4	ACTIVE	SO	PS	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317PSG4	ACTIVE	SO	PS	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317PSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317PSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL317PSRG4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-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), Pb-Free (RoHS Exempt), 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.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
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.

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PACKAGE MATERIALS INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSIONS

A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TL317CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TL317CPWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1
TL317PSR	SO	PS	8	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1

PACKAGE MATERIALS INFORMATION

TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TL317CDR	SOIC	D	8	2500	340.5	338.1	20.6
TL317CPWR	TSSOP	PW	8	2000	346.0	346.0	29.0
TL317PSR	SO	PS	8	2000	346.0	346.0	33.0

D (R−PDSO−G8)   PLASTIC SMALL−OUTLINE PACKAGE
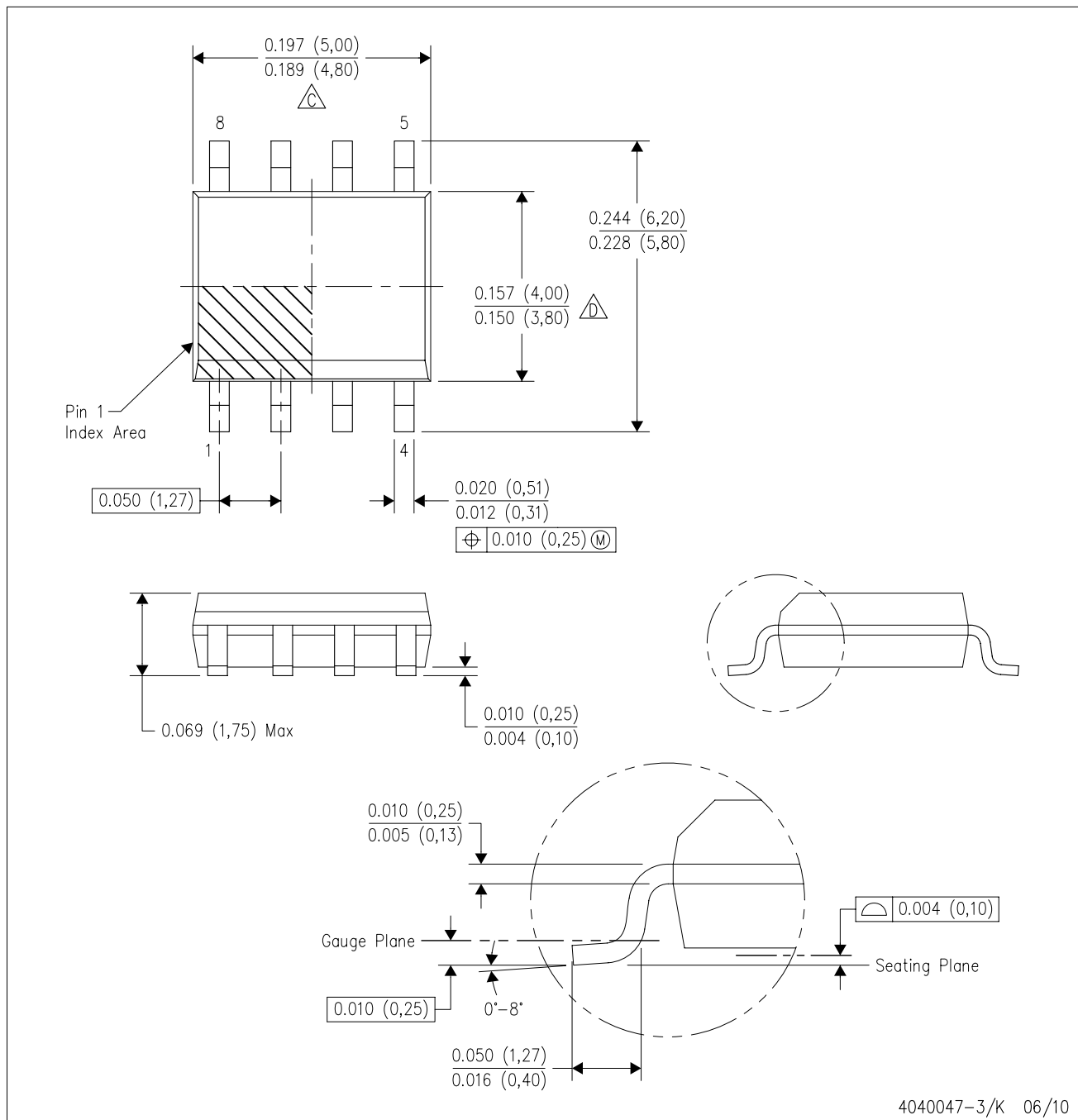
0.197 (5,00)
0.189 (4,80)
△C

8   5

0.244 (6,20)
0.228 (5,80)

0.157 (4,00) △D
0.150 (3,80)

Pin 1
Index Area

1   4

0.050 (1,27)   0.020 (0,51)
                      0.012 (0,31)

⊕ 0.010 (0,25) Ⓜ

0.069 (1,75) Max   0.010 (0,25)
                      0.004 (0,10)

0.010 (0,25)
0.005 (0,13)

Gauge Plane   0.004 (0,10)

                                               Seating Plane

0.010 (0,25)   0°−8°

0.050 (1,27)
0.016 (0,40)

4040047−3/K 06/10

NOTES: A. All linear dimensions are in inches (millimeters).
        B. This drawing is subject to change without notice.
     △C Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall
            not exceed .006 (0,15) per end.
     △D Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
        E. Reference JEDEC MS−012 variation AA.

MECHANICAL DATA

PLASTIC SMALL-OUTLINE PACKAGE

1,27

0,51
0,35 ⊕ 0,25Ⓜ

8   5

5,60   8,20
5,00   7,40

1   4

6,50
5,90

0,15 NOM

Gage Plane

0°–8°

0,25

0,95
0,55

0,15
0,05

2,00 MAX

Seating Plane

△ 0,10

4040063/C 03/03

NOTES: A. All linear dimensions are in millimeters.
        B. This drawing is subject to change without notice.
        C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

LP (O-PBCY-W3)   **PLASTIC CYLINDRICAL PACKAGE**
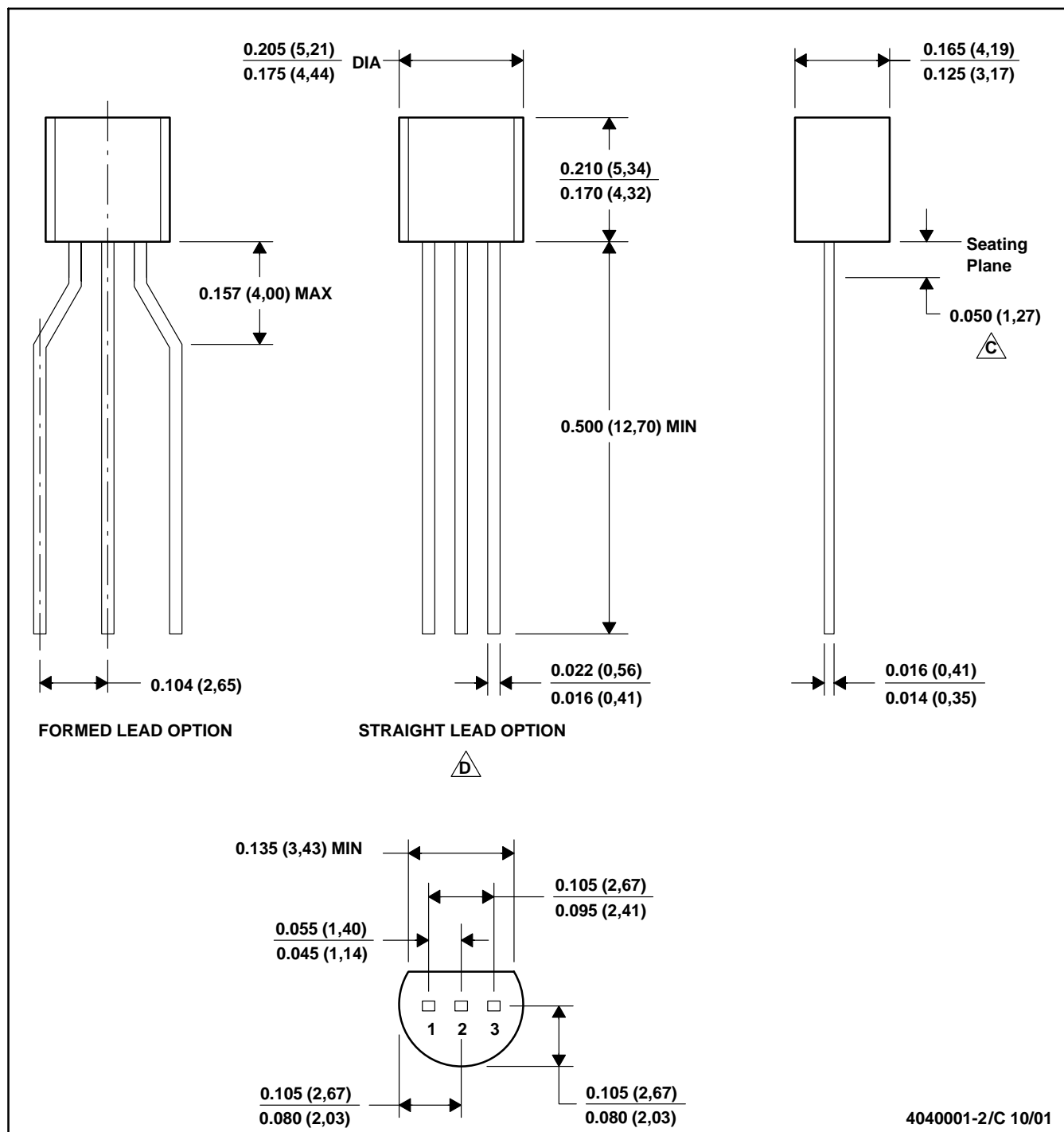
0.205 (5,21)
0.175 (4,44) **DIA**

0.165 (4,19)
0.125 (3,17)

0.210 (5,34)
0.170 (4,32)

0.157 (4,00) MAX

**Seating
Plane**

0.050 (1,27)

△C

0.500 (12,70) MIN

0.104 (2,65)

0.022 (0,56)
0.016 (0,41)

0.016 (0,41)
0.014 (0,35)

FORMED LEAD OPTION   **STRAIGHT LEAD OPTION**

△D

0.135 (3,43) MIN

0.105 (2,67)
0.095 (2,41)

0.055 (1,40)
0.045 (1,14)

1   2   3

0.105 (2,67)
0.080 (2,03)

0.105 (2,67)
0.080 (2,03)

4040001-2/C 10/01

NOTES: A. All linear dimensions are in inches (millimeters).
        B. This drawing is subject to change without notice.
        △C. Lead dimensions are not controlled within this area
        △D. FAlls within JEDEC TO -226 Variation AA (TO-226 replaces TO-92)
        E. Shipping Method:
            Straight lead option available in bulk pack only.
            Formed lead option available in tape & reel or ammo pack.

**TEXAS
INSTRUMENTS**

MECHANICAL DATA

LP (O-PBCY-W3)   **PLASTIC CYLINDRICAL PACKAGE**

0.539 (13,70)
0.460 (11,70)

1.260 (32,00)
0.905 (23,00)

0.650 (16,50)
0.610 (15,50)

0.098 (2,50)

0.020 (0,50) MIN

0.384 (9,75)
0.335 (8,50)

0.433 (11,00)
0.335 (8,50)

0.748 (19,00)
0.217 (5,50)

0.748 (19,00)
0.689 (17,50)

0.114 (2,90)
0.094 (2,40)

0.114 (2,90)
0.094 (2,40)

0.169 (4,30)
0.146 (3,70)   DIA

0.266 (6,75)
0.234 (5,95)

0.512 (13,00)
0.488 (12,40)

TAPE & REEL

4040001-3/C 10/01
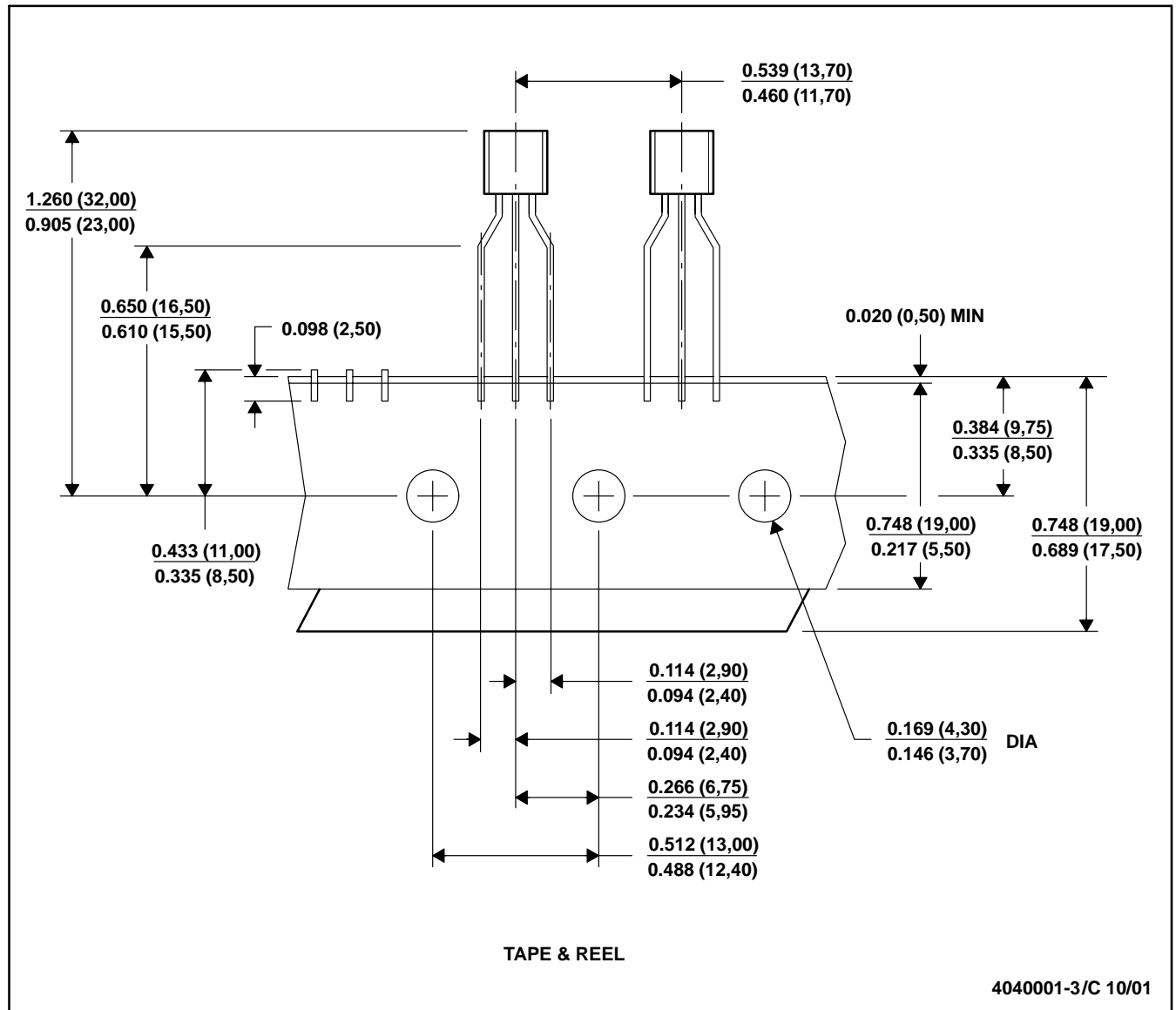
NOTES: A. All linear dimensions are in inches (millimeters).
         B. This drawing is subject to change without notice.
         C. Tape and Reel information for the Format Lead Option package.

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PW (R-PDSO-G**)   **PLASTIC SMALL-OUTLINE PACKAGE**

14 PINS SHOWN

PINS ** DIM	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

4040064/F 01/97

NOTES: A.   All linear dimensions are in millimeters.
B.   This drawing is subject to change without notice.
C.   Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D.   Falls within JEDEC MO-153

IMPORTANT NOTICE