LM317L-N 宽输入电压 100mA 可调节稳压器

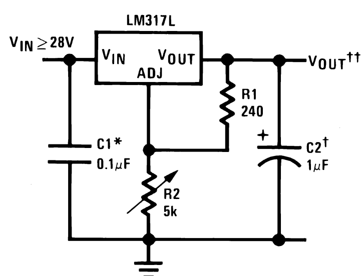
1 特性

- 可调节输出电压低至 1.2V
- 100mA 输出电流
- 能够处理最大 40V 输入电压
- 线路调节 0.01%/V（典型值）
- 负载调节 0.1%/A（典型值）
- 无需输出电容器 (†)
- 电流限制在各种温度下保持恒定
- 无需存储许多电压
- 标准 3 引线晶体管封装
- 80dB 纹波抑制
- 采用 3 引脚 TO-92、8 引脚 SOIC 或 6 引脚 DSBGA 封装
- 输出受到短路保护
- 请参阅 AN-1112 (SNVA009) 中的 DSBGA 注意事项

2 应用

- 汽车 LED 照明
- 电池充电器
- 开关电源的后置稳压
- 恒流稳压器
- 微处理器电源

原理图



在高输入/输出电压下不提供全输出电流
†可选 - 增强瞬态响应
*器件距离滤波电容器超过 6 英寸时需要

$$††V_{OUT} = 1.25V\left(1 + \frac{R2}{R1}\right) + I_{ADJ}(R_2)$$

3 说明

LM317L-N 是一款可调节正电压稳压器，能够在 1.2V 至 37V 输出范围内提供超过 100mA 的电流。LM317L-N 简单易用，并且仅需要 2 个外部电阻器即可设置输出电压。线路和负载调节性能均优越于标准固定稳压器。LM317L-N 采用易于使用的标准 TO-92 晶体管封装。

LM317L-N 提供全过载保护。片上功能包括电流限制、热过载保护和安全区保护。通常不需要使用电容器，除非器件的位置距离输入滤波电容器超过 6 英寸，此时需要使用输入旁路。

LM317L-N 使用*浮动*拓扑并且仅检测输入到输出差分电压，因此，只要不超过最大输入到输出差分电压，就可以调节数百伏特的电源电压。器件将简单的可调节开关稳压器变为一个可编程的输出稳压器，或者通过在调节端和输出端之间连接固定电阻器，LM317L-N 也可用作精密电流调节器。

LM317L-N 采用标准的 3 引脚 TO-92 晶体管封装、8 引脚 SOIC 封装和 6 引脚 DSBGA 封装。LM317L-N 的额定工作温度范围为 −40°C 至 125°C。

器件信息(1)

器件型号	封装	封装尺寸（标称值）
LM317L-N	TO-92 (3)	4.30mm × 4.30mm
	SOIC (8)	3.91mm x 4.90mm
	DSBGA (6)	1.68mm × 1.019mm

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。

目录

4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

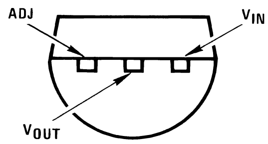
Changes from Revision K (September 2015) to Revision L	Page
• Changed TO-92 package view from top to bottom view	3
• Changed DSBGA package view from bump side down to top view	3
• Removed duplicate *Protection Diodes* section and *Regulator With Protection Diodes* image from the *Device Functional Modes* section	10

Changes from Revision J (March 2013) to Revision K	Page
• 添加了 *ESD 额定值表、特性 说明 部分、器件功能模式、应用和实施 部分、电源相关建议 部分、布局 部分、器件和文档支持 部分以及机械、封装和可订购信息 部分。*	1

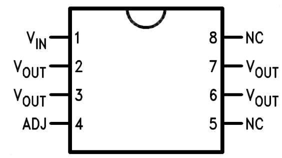
Changes from Revision I (March 2013) to Revision J	Page
• Changed layout of National Data Sheet to TI format	25

5 Pin Configuration and Functions

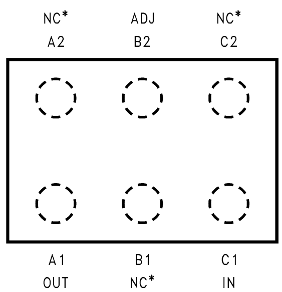
LP Plastic Package
3-Pin TO-92
Bottom View



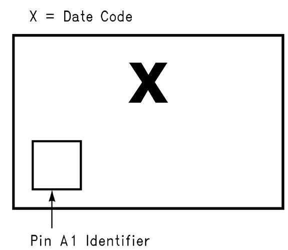
D Package
8-Pin SOIC
Top View



YPB Package
6-Pin DSBGA
Top View



YPB Package
6-Pin DSBGA
Laser Mark



Pin Functions

PIN				I/O	DESCRIPTION
NAME	TO-92	SOIC	DSBGA		
VIN	3	1	C1	I	Supply input pin
VOUT	2	2, 3, 6, 7	A1	O	Voltage output pin
ADJ	1	4	B2	I	Output voltage adjustment pin. Connect to a resistor divider to set V_O.
NC	—	5, 8	B1, A2, C2	—	No connection

6 Specifications

6.1 Absolute Maximum Rating [1][2]

	MIN	MAX	UNIT
Power dissipation	Internally Limited		
Input-output voltage differential		40	V
Operating junction temperature	−40	125	°C
Lead temperature (soldering, 4 seconds)		260	°C
Storage temperature, T_{stg}	−55	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) If Military/Aerospace specified devices are required, contact the Texas Instruments Sales Office/Distributors for availability and specifications.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±2000	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Pins listed as ±2000 V may actually have higher performance.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

	MIN	MAX	UNIT
Operating temperature	−40	125	°C

6.4 Thermal Information

THERMAL METRIC[1]		LM317L-N				UNIT
		TO-92		SOIC	DSBGA	
		3 PINS		8 PINS	6 PINS	
		0.4-in Leads	0.125-in Leads			
$R_{\theta JA}$	Junction-to-ambient thermal resistance	180	160	165	290	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	—	80.6	—	—	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	—	—	—	—	°C/W
ψ_{JT}	Junction-to-top characterization parameter	—	24.7	—	—	°C/W
ψ_{JB}	Junction-to-board characterization parameter	—	135.8	—	—	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	—	—	—	—	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, SPRA953.

6.5 Electrical Characteristics (1)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Line regulation	T_J = 25°C, 3 V ≤ (V_{IN} − V_{OUT}) ≤ 40 V, I_L ≤ 20 mA (2)		0.01	0.04	%/V
Load regulation	T_J = 25°C, 5 mA ≤ I_{OUT} ≤ I_{MAX} (2)		0.1%	0.5%	
Thermal regulation	T_J = 25°C, 10-ms Pulse		0.04	0.2	%/W
Adjustment pin current			50	100	µA
Adjustment pin current change	5 mA ≤ I_L ≤ 100 mA 3 V ≤ (V_{IN} − V_{OUT}) ≤ 40 V, P ≤ 625 mW		0.2	5	µA
Reference voltage	3 V ≤ (V_{IN} − V_{OUT}) ≤ 40 V (3) 5 mA ≤ I_{OUT} ≤ 100 mA, P ≤ 625 mW	1.2	1.25	1.3	V
Line regulation	3 V ≤ (V_{IN} − V_{OUT}) ≤ 40 V, I_L ≤ 20 mA (2)		0.02	0.07	%/V
Load regulation	5 mA ≤ I_{OUT} ≤ 100 mA (2)		0.3%	1.5%	
Temperature stability	T_{MIN} ≤ T_J ≤ T_{MAX}		0.65%		
Minimum load current	(V_{IN} − V_{OUT}) ≤ 40 V		3.5	5	mA
	3 V ≤ (V_{IN} − V_{OUT}) ≤ 15 V		1.5	2.5	
Current limit	3 V ≤ (V_{IN} − V_{OUT}) ≤ 13 V	100	200	300	mA
	(V_{IN} − V_{OUT}) = 40 V	25	50	150	
RMS output noise, % of V_{OUT}	T_J = 25°C, 10 Hz ≤ f ≤ 10 kHz		0.003%		
Ripple rejection ratio	V_{OUT} = 10 V, f = 120 Hz, C_{ADJ} = 0		65		dB
	C_{ADJ} = 10 µF	66	80		
Long-term stability	T_J = 125°C, 1000 Hours		0.3%	1%	

(1) Unless otherwise noted, these specifications apply: −25°C ≤ T_j ≤ 125°C for the LM317L-N; V_{IN} − V_{OUT} = 5 V and I_{OUT} = 40 mA. Although power dissipation is internally limited, these specifications are applicable for power dissipations up to 625 mW. I_{MAX} is 100 mA.
(2) Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specification for thermal regulation.
(3) Thermal resistance of the TO-92 package is 180°C/W junction to ambient with 0.4-inch leads from a PCB and 160°C/W junction to ambient with 0.125-inch lead length to PCB.

6.6 Typical Characteristics

(Output capacitor = 0 μF unless otherwise noted.)

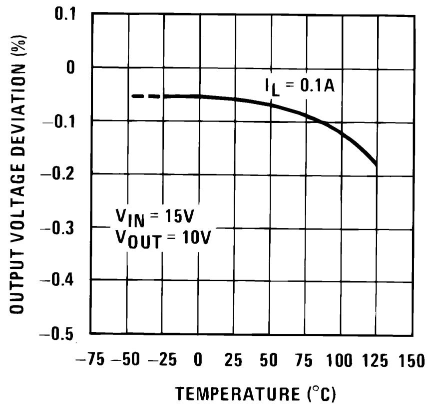


Figure 1. Load Regulation

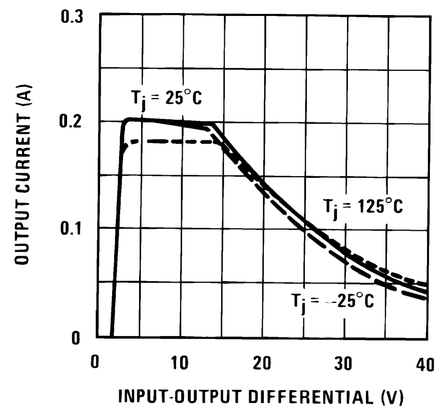


Figure 2. Current Limit

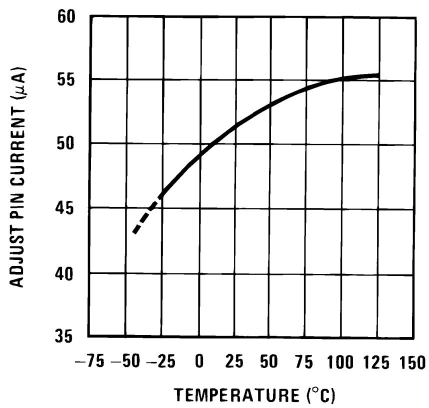


Figure 3. Adjustment Current

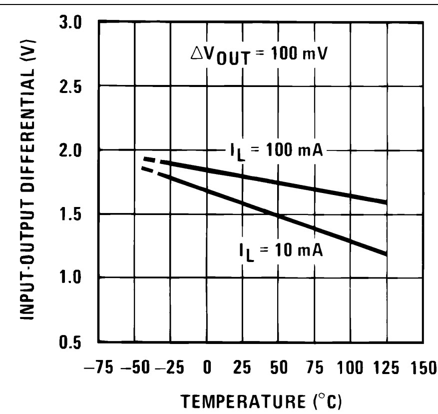


Figure 4. Dropout Voltage

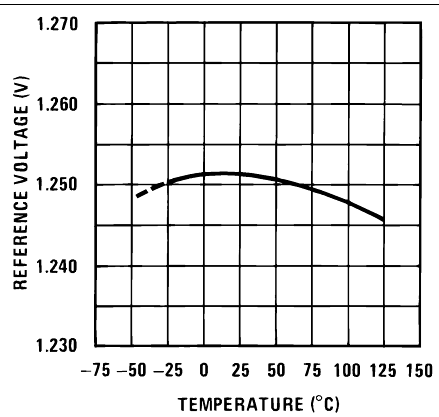


Figure 5. Reference Voltage Temperature Stability

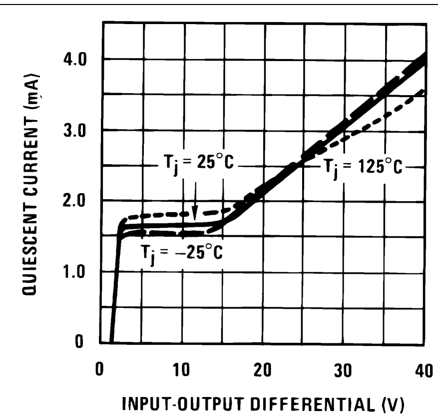


Figure 6. Minimum Operating Current

Typical Characteristics (continued)

(Output capacitor = 0 μF unless otherwise noted.)

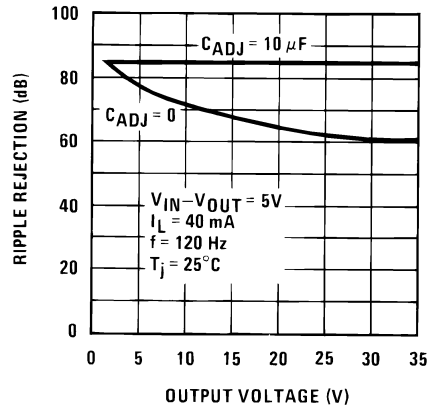


Figure 7. Ripple Rejection

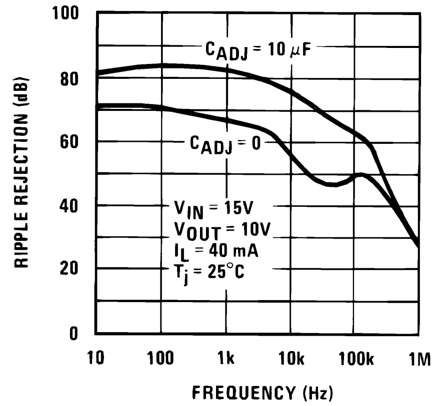


Figure 8. Ripple Rejection

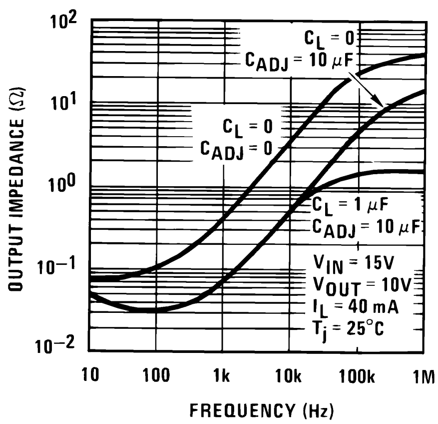


Figure 9. Output Impedance

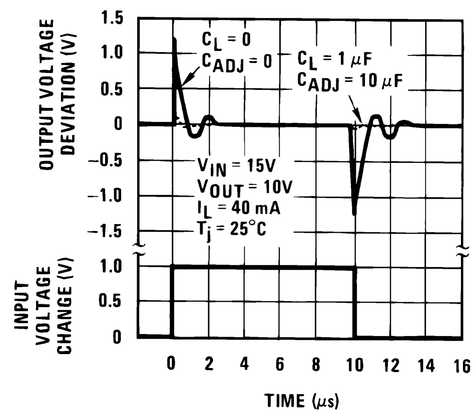


Figure 10. Line Transient Response

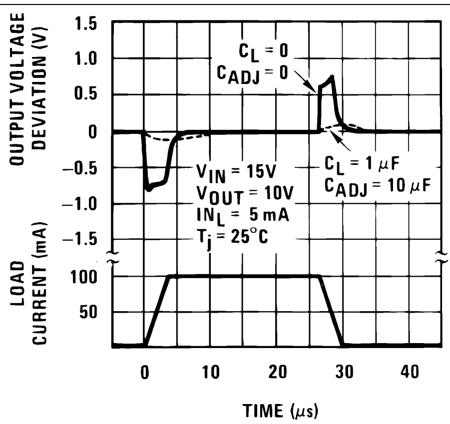


Figure 11. Load Transient Response

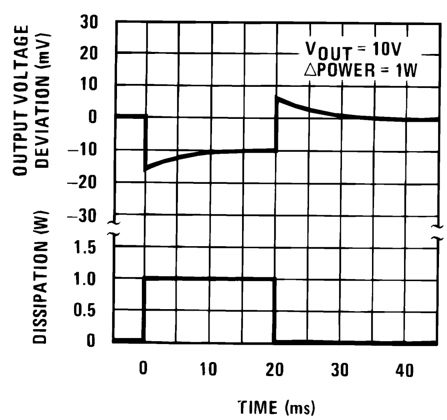


Figure 12. Thermal Regulation

7 Detailed Description

7.1 Overview

In operation, the LM317L-N develops a nominal 1.25-V reference voltage, V_{REF}, between the output and adjustment terminal. The reference voltage is impressed across program resistor R1 and, because the voltage is constant, a constant current I_1 then flows through the output set resistor R2, giving an output voltage of:

$$V_{OUT} = V_{REF}\left(1 + \frac{R2}{R1}\right) + I_{ADJ}(R2) \quad (1)$$

Because the 100-μA current from the adjustment terminal represents an error term, the LM317L-N was designed to minimize I_{ADJ} and make it very constant with line and load changes. To do this, all quiescent operating current is returned to the output establishing a minimum load current requirement. If there is insufficient load on the output, the output will rise.

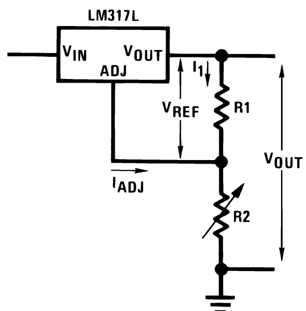
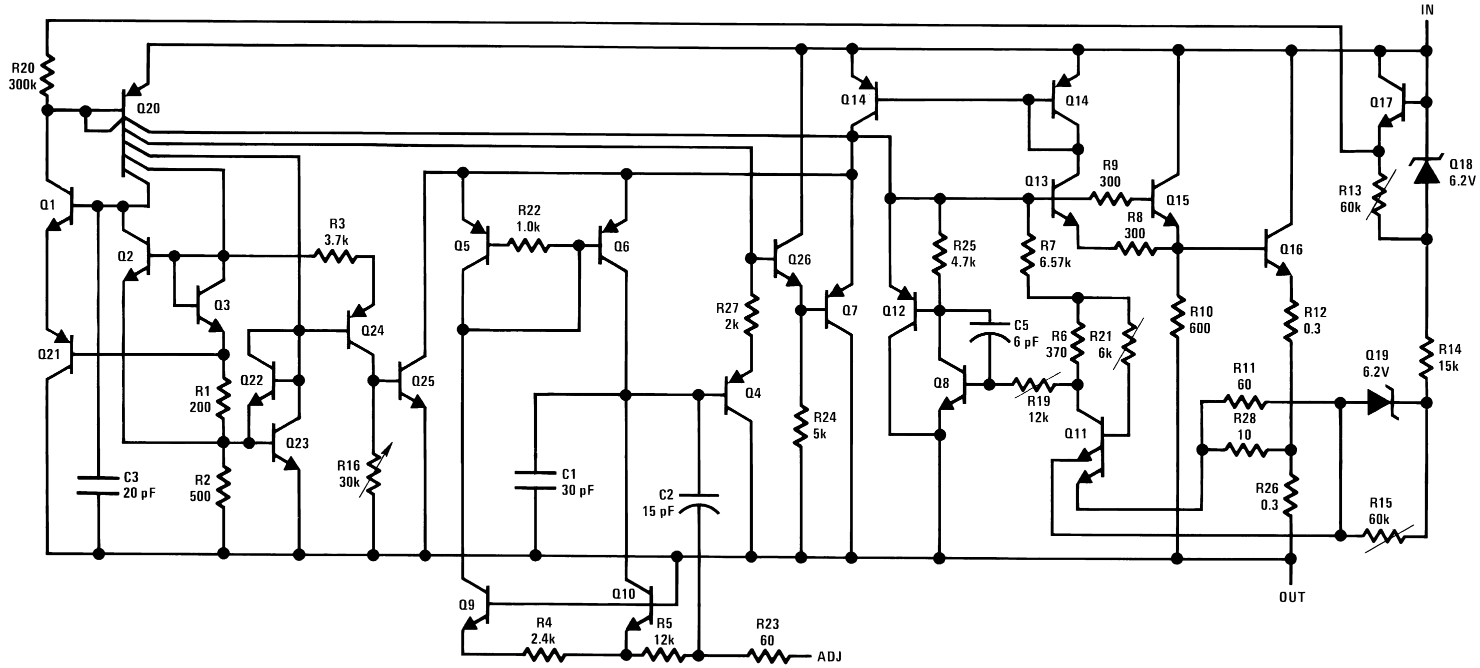


Figure 13. Typical Application Circuit for Adjustable Regulator

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Load Regulation

The LM317L-N is capable of providing extremely good load regulation but a few precautions are needed to obtain maximum performance. The current set resistor connected between the adjustment terminal and the output terminal (usually 240 Ω) must be tied directly to the output of the regulator rather than near the load. This eliminates line drops from appearing effectively in series with the reference and degrading regulation. For example, a 15-V regulator with 0.05-Ω resistance between the regulator and load will have a load regulation due to line resistance of 0.05 Ω × I_L. If the set resistor is connected near the load the effective line resistance will be 0.05 Ω (1 + R2/R1) or in this case, 11.5 times worse.

Figure 14 shows the effect of resistance between the regulator and 240-Ω set resistor.

With the TO-92 package, it is easy to minimize the resistance from the case to the set resistor, by using two separate leads to the output pin. The ground of R2 can be returned near the ground of the load to provide remote ground-sensing and improve load regulation.

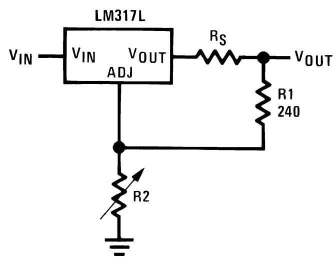


Figure 14. Regulator With Line Resistance in Output Lead

7.4 Device Functional Modes

7.4.1 External Capacitors

An input bypass capacitor is recommended in case the regulator is more than 6 inches away from the usual large filter capacitor. A 0.1-μF disc or 1-μF solid tantalum on the input is suitable input bypassing for almost all applications. The device is more sensitive to the absence of input bypassing when adjustment or output capacitors are used, but the above values will eliminate the possibility of problems.

The adjustment terminal can be bypassed to ground on the LM317L-N to improve ripple rejection and noise. This bypass capacitor prevents ripple and noise from being amplified as the output voltage is increased. With a 10-μF bypass capacitor 80-dB ripple rejection is obtainable at any output level. Increases over 10-μF do not appreciably improve the ripple rejection at frequencies above 120 Hz. If the bypass capacitor is used, it is sometimes necessary to include protection diodes to prevent the capacitor from discharging through internal low current paths and damaging the device.

In general, the best type of capacitors to use is solid tantalum. *Solid tantalum capacitors have low impedance even at high frequencies.* Depending upon capacitor construction, it takes about 25 μF in aluminum electrolytic to equal 1-μF solid tantalum at high frequencies. Ceramic capacitors are also good at high frequencies; but some types have a large decrease in capacitance at frequencies around 0.5 MHz. For this reason, a 0.01-μF disc may seem to work better than a 0.1-μF disc as a bypass.

Although the LM317L-N is stable with no output capacitors, like any feedback circuit, certain values of external capacitance can cause excessive ringing. This occurs with values between 500 pF and 5000 pF. A 1-μF solid tantalum (or 25-μF aluminum electrolytic) on the output swamps this effect and insures stability.

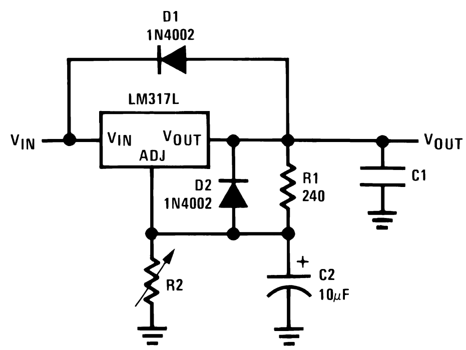
7.4.2 Protection Diodes

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. Most 10-μF capacitors have low enough internal series resistance to deliver 20-A spikes when shorted. Although the surge is short, there is enough energy to damage parts of the IC.

Device Functional Modes (continued)

When an output capacitor is connected to a regulator and the input is shorted, the output capacitor will discharge into the output of the regulator. The discharge current depends on the value of the capacitor, the output voltage of the regulator, and the rate of decrease of V_{IN}. In the LM317L-N, this discharge path is through a large junction that is able to sustain a 2-A surge with no problem. This is not true of other types of positive regulators. For output capacitors of 25 μF or less, the ballast resistors and output structure of the LM317L-N limit the peak current to a low enough level so that there is no need to use a protection diode.

The bypass capacitor on the adjustment terminal can discharge through a low current junction. Discharge occurs when *either* the input or output is shorted. Internal to the LM317L-N is a 50-Ω resistor which limits the peak discharge current. No protection is needed for output voltages of 25 V or less and 10-μF capacitance. Figure 15 shows an LM317L-N with protection diodes included for use with outputs greater than 25 V and high values of output capacitance.



$$V_{OUT} = V_{REF}\left(1 + \frac{R2}{R1}\right) + I_{ADJ}(R2)$$

D1 protects against C1
D2 protects against C2

Figure 15. Regulator With Protection Diodes

7.4.3 DSBGA Light Sensitivity

Exposing the LM317L-N DSBGA package to bright sunlight may cause the V_{REF} to drop. In a normal office environment of fluorescent lighting the output is not affected. The LM317 DSBGA does not sustain permanent damage from light exposure. Removing the light source causes V_{REF} of the LM317L-N to recover to the proper value.

8 Application and Implementation

NOTE

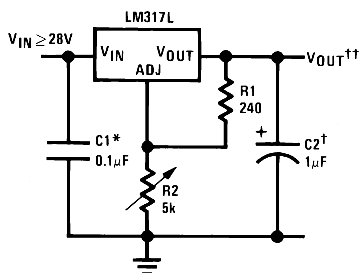
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information

The LM317L-N is a versatile, high-performance, linear regulator with 1% output-voltage accuracy. An output capacitor can be added to further improve transient response, and the ADJ pin can be bypassed to achieve very high ripple-rejection ratios. Its functionality can be used in many different applications that require high performance regulation, such as battery chargers, constant-current regulators, and microprocessor supplies.

8.2 Typical Applications

8.2.1 1.25-V to 25-V Adjustable Regulator



Full output current not available at high input-output voltages
†Optional—improves transient response
*Needed if device is more than 6 inches from filter capacitors

$$\dagger\dagger V_{OUT} = 1.25V \left(1 + \frac{R2}{R1}\right) + I_{ADJ} (R_2)$$

Figure 16. 1.25-V to 25-V Adjustable Regulator

8.2.1.1 Design Requirements

The device component count is very minimal, employing two resistors as part of a voltage-divider circuit and an output capacitor for load regulation. An input capacitor is needed if the device is more than 6 inches from filter capacitors. An optional bypass capacitor across R2 can also be used to improve PSRR.

8.2.1.2 Detailed Design Procedure

The output voltage is set based on the selection of the two resistors, R1 and R2, as shown in Figure 16. For details on capacitor selection, see *External Capacitors*.

Typical Applications (continued)

8.2.1.3 Application Curve

As shown in Figure 17, V_{OUT} rises with V_{IN} minus some dropout voltage. This dropout voltage during start-up will vary with R_{OUT}.

V_{OUT} = 5 V

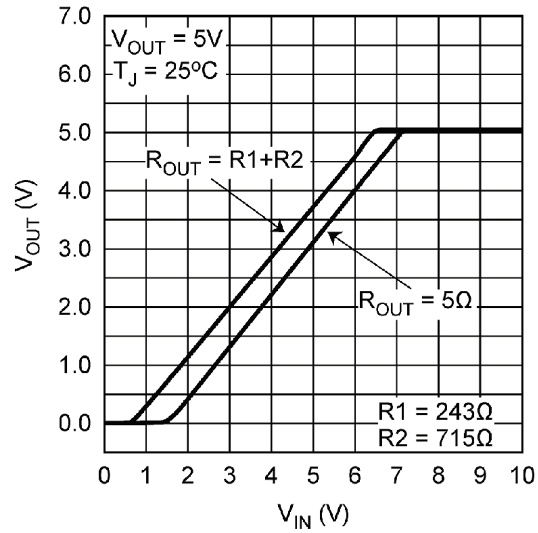
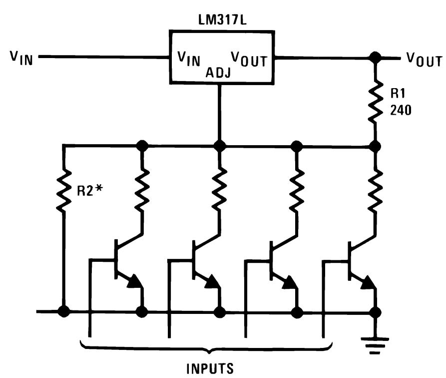


Figure 17. V_{OUT} vs V_{IN}

8.2.2 Digitally-Selected Outputs

Figure 18 demonstrates a digitally-selectable output voltage. In its default state, all transistors are off and the output voltage is set based on R1 and R2. By driving certain transistors, the associated resistor is connected in parallel to R2, modifying the output voltage of the regulator.



*Sets maximum V_{OUT}

Figure 18. Digitally-Selected Outputs

Typical Applications (continued)

8.2.3 High Gain Amplifier

This application uses the LM395 Power Transistor to amplify the input voltage. The LM317L connected to R2 produces a constant current of 1.2V/R2 through the BJT. By altering the base current entering the LM395, the effective resistance can be changed resulting in an appropriate voltage fluctuation at the output.

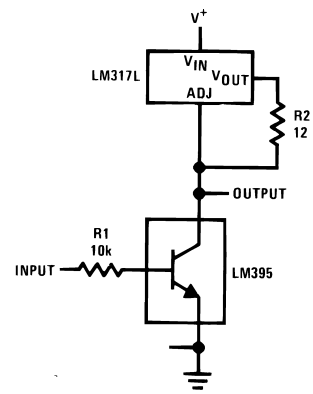
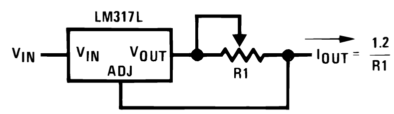


Figure 19. High Gain Amplifier

8.2.4 Adjustable Current Limiter

This application will limit the output current to the I_{OUT} in the diagram. The current limit is determined by adjusting the resistance between the V_{OUT} and V_{ADJ} pins. The 1.2-V reference voltage across R1 generates the maximum current.



12 ≤ R1 ≤ 240

Figure 20. Adjustable Current Limiter

8.2.5 Precision Current Limiter

This application will limit the output current to the I_{OUT} in the diagram. An initial reference current is generated based on the resistance between the V_{OUT} and V_{ADJ} pins. In the case of Figure 21, 1.25 V across 1 kΩ plus half of the 500-Ω resistor results in 1 mA of current, producing 1.5 V total across the two resistors in series. This voltage also appears across R1, making the maximum current the sum of the branch currents.

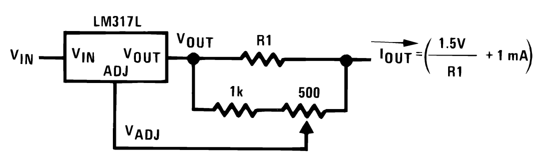


Figure 21. Precision Current Limiter

Typical Applications (continued)

8.2.6 Slow Turnon 15-V Regulator

An application of LM317L-N includes a PNP transistor with a capacitor to implement slow turnon functionality (see Figure 22). As V_{IN} rises, the PNP sinks current from the ADJ rail. The output voltage at start-up is the addition of the 1.25-V reference plus the drop across the base to emitter. While this is happening, the capacitor begins to charge and eventually opens the PNP. At this point, the device functions normally, regulating the output at 15 V. A diode is placed between C1 and V_{OUT} to provide a path for the capacitor to discharge. Such controlled turnon is useful for limiting the in-rush current.

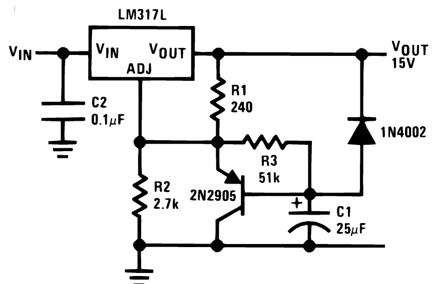
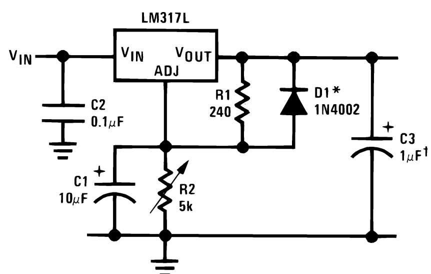


Figure 22. Slow Turnon 15-V Regulator

8.2.7 Adjustable Regulator With Improved Ripple Rejection

To improve ripple rejection, a capacitor is used to bypass the ADJ pin to GND (see Figure 23). This is used to smooth output ripple by cleaning the feedback path and stopping unnecessary noise from being fed back into the device, propagating the noise.



†Solid tantalum
*Discharges C1 if output is shorted to ground

Figure 23. Adjustable Regulator With Improved Ripple Rejection

8.2.8 High Stability 10-V Regulator

This application will regulate to an output voltage of 10 V and will remain stable even with input voltage transients. The LM329 is a precision Zener reference diode that helps maintain stability.

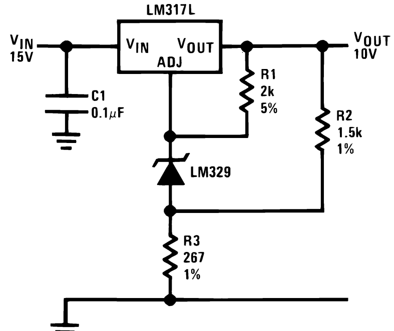
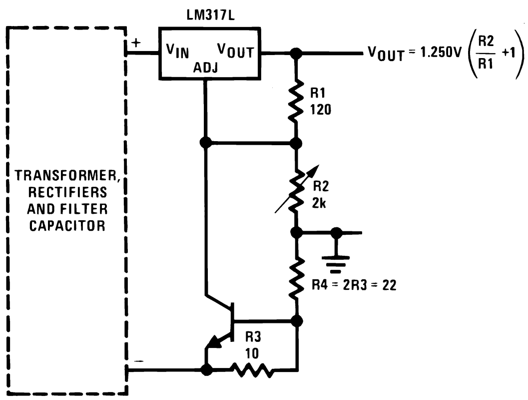


Figure 24. High Stability 10-V Regulator

Typical Applications (continued)

8.2.9 Adjustable Regulator With Current Limiter

This application regulates to an output voltage set by the ratio of R2 and R1 and limits the output current using R3 as shown in Figure 25.

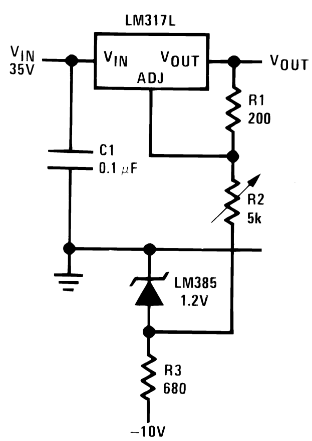


Short circuit current is approximately 600 mV/R3, or 60 mA (compared to LM317L-NZ's 200-mA current limit).
At 25-mA output only 3/4 V of drop occurs in R3 and R4.

Figure 25. Adjustable Regulator With Current Limiter

8.2.10 0-V to 30-V Regulator

This application regulates the output voltage from 0 V to 30 V using the resistor divider at the output. The adjustment pin reference voltage is 1.25 V so select the resistor divider that provides the needed output voltage.



Full output current not available at high input-output voltages

Figure 26. 0-V to 30-V Regulator

Typical Applications (continued)

8.2.11 Regulator With 15-mA Short-Circuit Current

This application regulates to a 10-V output with a 15-mA short-circuit current. The output voltage is set by the resistor divider at the output and the PNP is required to set the short-circuit current.

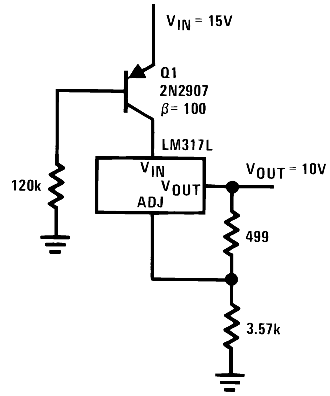


Figure 27. Regulator With 15-mA Short-Circuit Current

8.2.12 Power Follower

This application provides an output voltage that follows the input voltage while providing a current gain. The LM395 is a power transistor that operates as an emitter follower and provides a short-circuit current limit while the LM317 acts as a constant-current load.

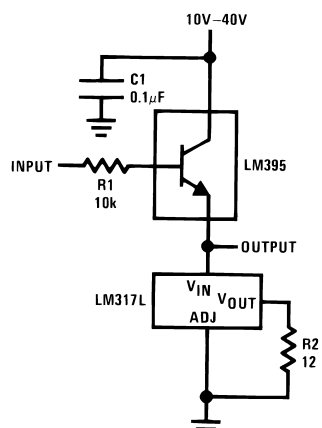
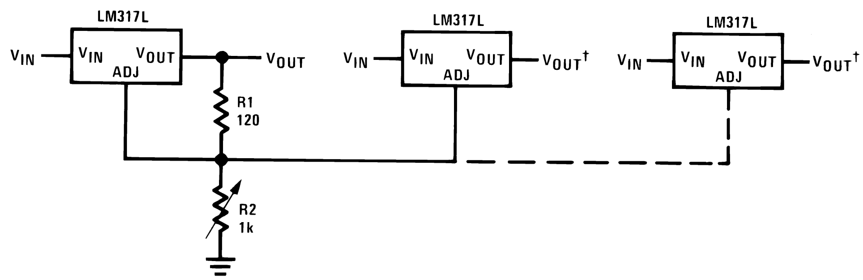


Figure 28. Power Follower

Typical Applications (continued)

8.2.13 Adjusting Multiple On-Card Regulators With Single Control

Figure 29 shows how multiple LM317L-N regulators can be controlled by setting one resistor. Because each device maintains the reference voltage of about 1.25 V between its V_{OUT} and ADJ pins, we can connect each ADJ rail to a single resistor, setting the same output voltage across all devices. This allows for independent outputs, each responding to its corresponding input only. Designers must also consider that by the nature of the circuit, changes to R1 and R2 will affect all regulators.



*All outputs within ± 100 mV
†Minimum load −5 mA

Figure 29. Adjusting Multiple On-Card Regulators With Single Control*

8.2.14 100-mA Current Regulator

This application regulates the output current to maximum of 100 mA as shown in Figure 30.

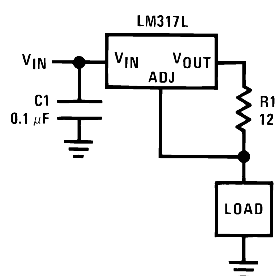
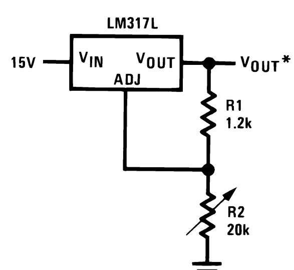


Figure 30. 100-mA Current Regulator

8.2.15 1.2-V to 12-V Regulator With Minimum Program Current

This application regulates the output voltage between 1.2 V and 12 V depending on the resistor divider at the output while allowing minimum programmable load current down to 2 mA as shown in Figure 31.



*Minimum load current ≈ 2 mA

Figure 31. 1.2-V to 12-V Regulator With Minimum Program Current

Typical Applications (continued)

8.2.16 50-mA Constant Current Battery Charger for Nickel-Cadmium Batteries

This application provides a 50-mA constant current at the output which can be used as a constant current battery charger for Nickel-Cadmium batteries. The resistor at the output sets the output current value.

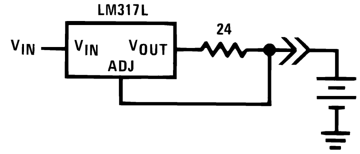
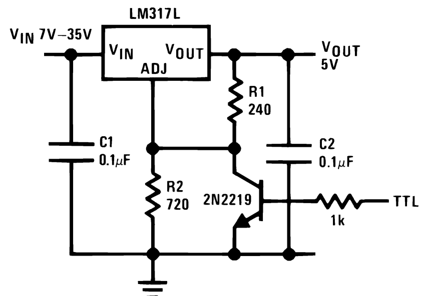


Figure 32. 50-mA Constant Current Battery Charger for Nickel-Cadmium Batteries

8.2.17 5-V Logic Regulator With Electronic Shutdown

Figure 33 shows a variation of the 5-V output regulator application uses the LM317L-N, along with an NPN transistor, to provide shutdown control. The NPN will either block or sink the current from the ADJ pin by responding to the TTL pin logic. When TTL is pulled high, the NPN is on and pulls the ADJ pin to GND, and the LM317L-N outputs about 1.25 V. When TTL is pulled low, the NPN is off and the regulator outputs according to the programmed adjustable voltage.

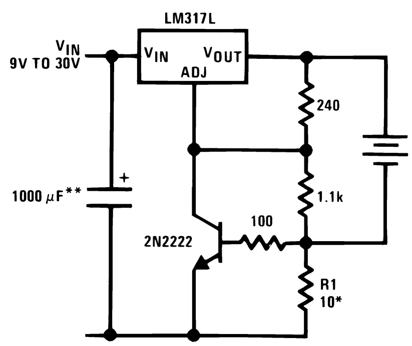


*Minimum output ≈ 1.2 V

Figure 33. 5-V Logic Regulator With Electronic Shutdown*

8.2.18 Current-Limited 6-V Charger

The current in a battery charger application is limited by switching between constant-current and constant-voltage states (see Figure 34). When the battery pulls low current, the drop across the 1-Ω resistor is not substantial and the NPN remains off. A constant voltage is seen across the battery, as regulated by the resistor divider. When current through the battery rises past peak current, the 1 Ω provides enough voltage to turn the transistor on, pulling ADJ close to ground. This results in limiting the maximum current to the battery.



*Sets peak current, I_{PEAK} = 0.6 V/R1
**1000 μF is recommended to filter out any input transients.

Figure 34. Current Limited 6-V Charger

Typical Applications (continued)

8.2.19 Short Circuit-Protected 80-V Supply

This application provides a 80-V output voltage from 0 mA to 20 mA as shown in Figure 35. The Triad provides an AC to DC conversion and the short-circuit protection is provided by the fuse. The output voltage can be adjusted by adjusting the resistor divider at the output.

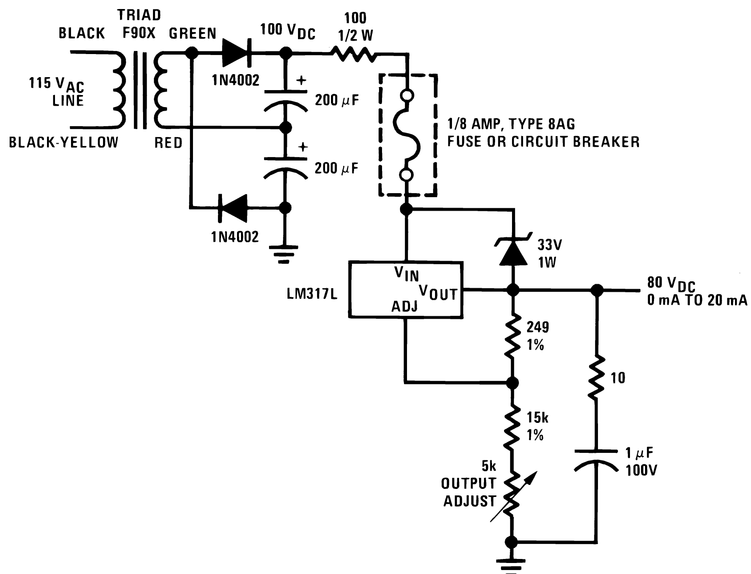
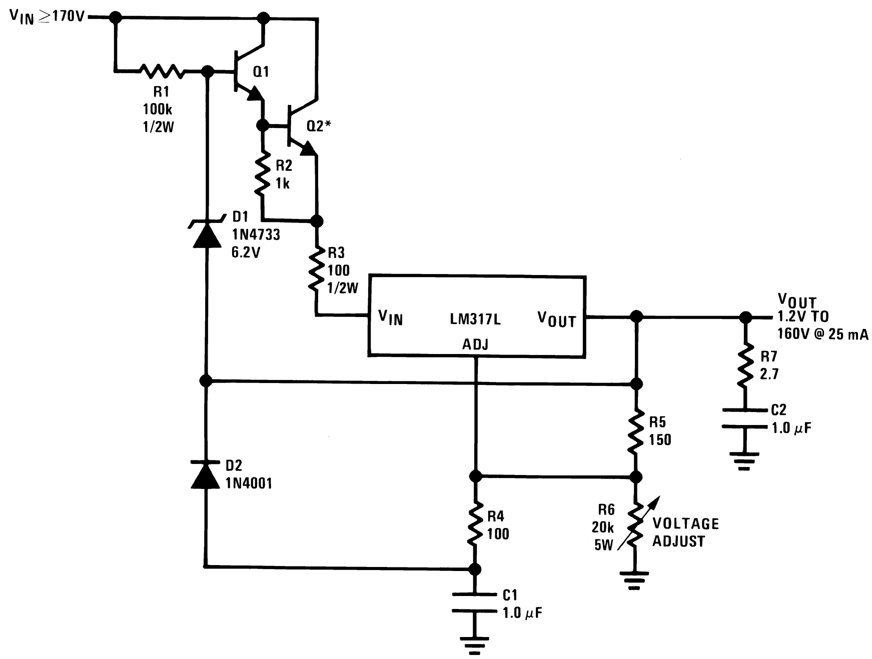


Figure 35. Short Circuit-Protected 80-V Supply

Typical Applications (continued)

8.2.20 Basic High-Voltage Regulator

This application regulates the output voltage from 1.2 V to 160 V at 25 mA as shown in Figure 36. The output voltage is set by the resistor divider at the output. The Darlington pair transistor configuration provides a current gain from the input source to the LM317.



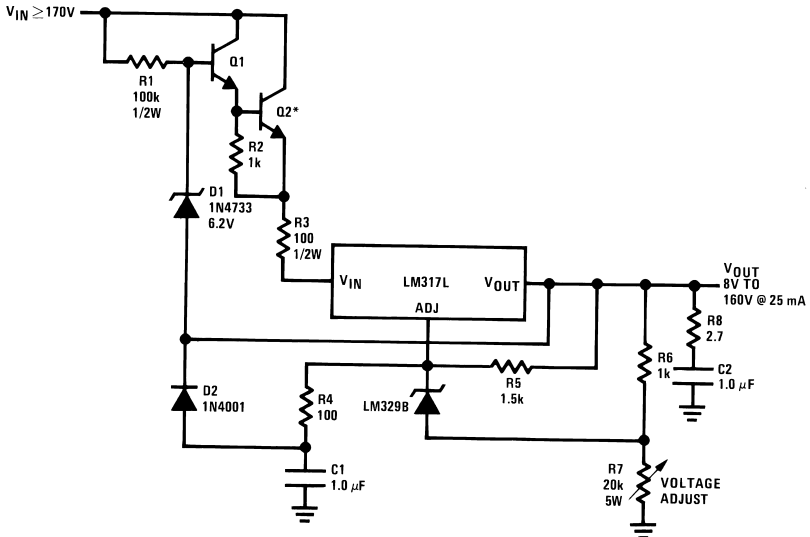
Q1, Q2: NSD134 or similar
C1, C2: 1 µF, 200-V mylar**
*Heat sink

Figure 36. Basic High-Voltage Regulator

Typical Applications (continued)

8.2.21 Precision High-Voltage Regulator

This application regulates the output voltage from 8 V to 160 V at 25 mA as shown in Figure 37. The Zener diode connected from the adjust pin to V_{OUT} provides better precision than the basic high-voltage regulator.

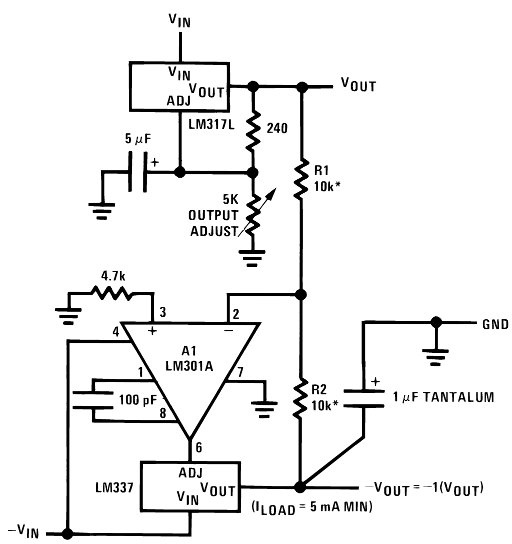


Q1, Q2: NSD134 or similar
C1, C2: 1 µF, 200-V mylar**
*Heat sink
**Mylar is a registered trademark of DuPont Co.

Figure 37. Precision High-Voltage Regulator

8.2.22 Tracking Regulator

This application regulates to an output voltage set by the output resistor divider and also uses the LM301A operational amplifier to provide a negative voltage that tracks the output voltage.



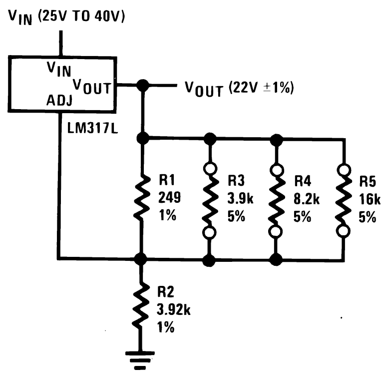
A1 = LM301A, LM307, or LF13741 only
R1, R2 = matched resistors with good TC tracking

Figure 38. Tracking Regulator

Typical Applications (continued)

8.2.23 Regulator With Trimmable Output Voltage

This application provides an output voltage set by the output resistor divider that can be finely tuned to ±1% by removing output resistors. See the trim procedure in Figure 39.



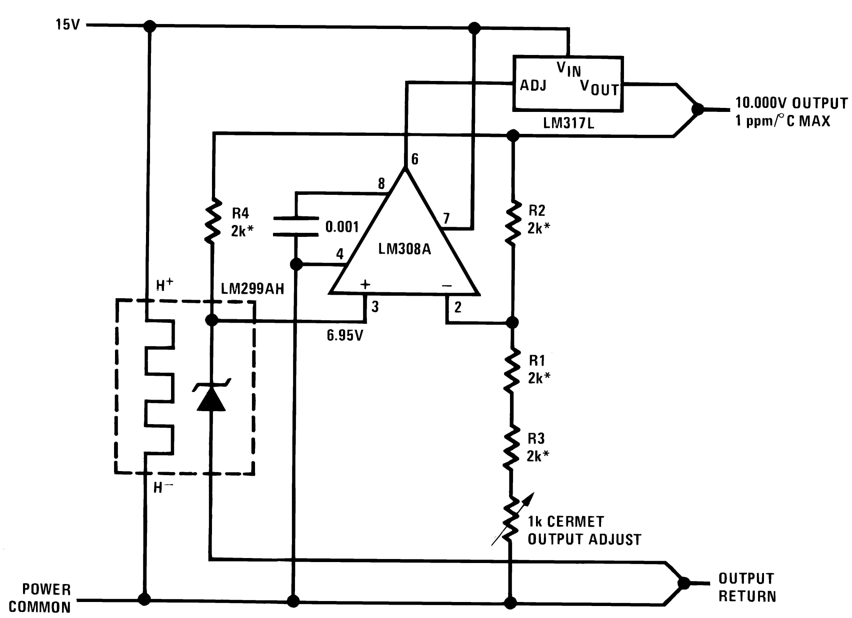
Trim Procedure:

— If V_{OUT} is 23.08 V or higher, cut out R3 (if lower, don't cut it out).
— Then if V_{OUT} is 22.47 V or higher, cut out R4 (if lower, don't).
— Then if V_{OUT} is 22.16 V or higher, cut out R5 (if lower, don't).
This will trim the output to well within ±1% of 22.00 V_{DC}, without any of the expense or uncertainty of a trim pot (see LB-46). This technique can be used at any output voltage level.

Figure 39. Regulator With Trimmable Output Voltage

8.2.24 Precision Reference With Short-Circuit Proof Output

This application provides a precise output voltage with short-circuit protection. The precision results from using the LM308A operational amplifier connected between the adjust pin and output voltage pin as a comparator with the LM299AH precision reference.



*R1–R4 from thin-film network,
Beckman 694-3-R2K-D or similar

Figure 40. Precision Reference With Short-Circuit Proof Output

Typical Applications (continued)

8.2.25 Fully-Protected (Bulletproof) Lamp Driver

This application drives a lamp using a programmable gain instrumentation amplifier at the output.

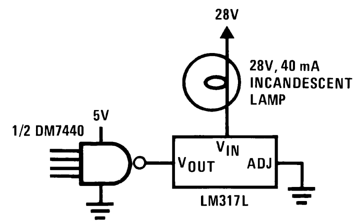
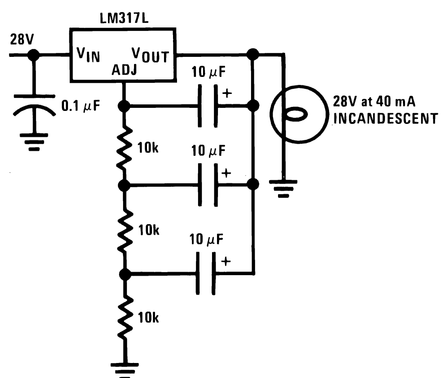


Figure 41. Fully-Protected (Bulletproof) Lamp Driver

8.2.26 Lamp Flasher

This application uses a combination of capacitors and resistors connected between the output voltage pin and the adjust pin to cause the lamp connected at the output voltage pin to flash.



Output rate—4 flashes per second at 10% duty cycle

Figure 42. Lamp Flasher

9 Power Supply Recommendations

The input supply to the LM317L-N must be kept at a voltage level lower than the maximum input-to-output differential voltage of 40 V. When possible, the minimum dropout voltage must also be met with extra headroom to keep the LM317L-N in regulation. TI recommends using an input capacitor, especially when the input pin is located more than 6 inches away from the power supply source. For more information regarding capacitor selection, see *External Capacitors*.

10 Layout

10.1 Layout Guidelines

Some layout guidelines should be followed to ensure proper regulation of the output voltage with minimum noise. Traces carrying the load current must be wide to reduce the amount of parasitic trace inductance and the feedback loop from V_{OUT} to ADJ should be kept as short as possible. To improve PSRR, a bypass capacitor can be placed at the ADJ pin and must be located as close as possible to the IC. In cases when V_{IN} shorts to ground, an external diode should be placed from V_{OUT} to V_{IN} to divert the surge current from the output capacitor and protect the IC. Similarly, in cases when a large bypass capacitor is placed at the ADJ pin and V_{OUT} shorts to ground, an external diode should be placed from ADJ to V_{OUT} to provide a path for the bypass capacitor to discharge. These diodes must be placed close to the corresponding IC pins to increase their effectiveness.

10.2 Layout Examples

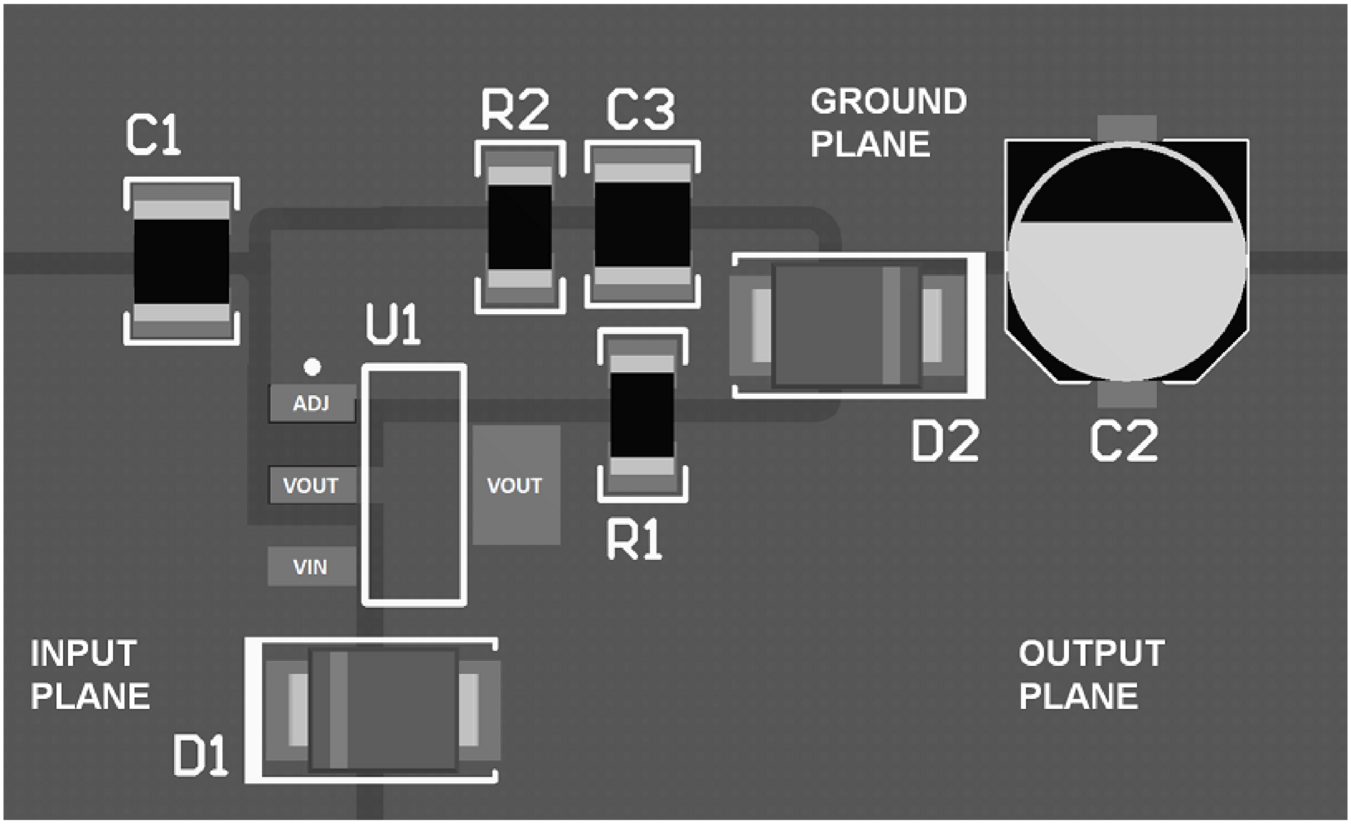


Figure 43. Layout Example (SOT-223)

Layout Examples (continued)

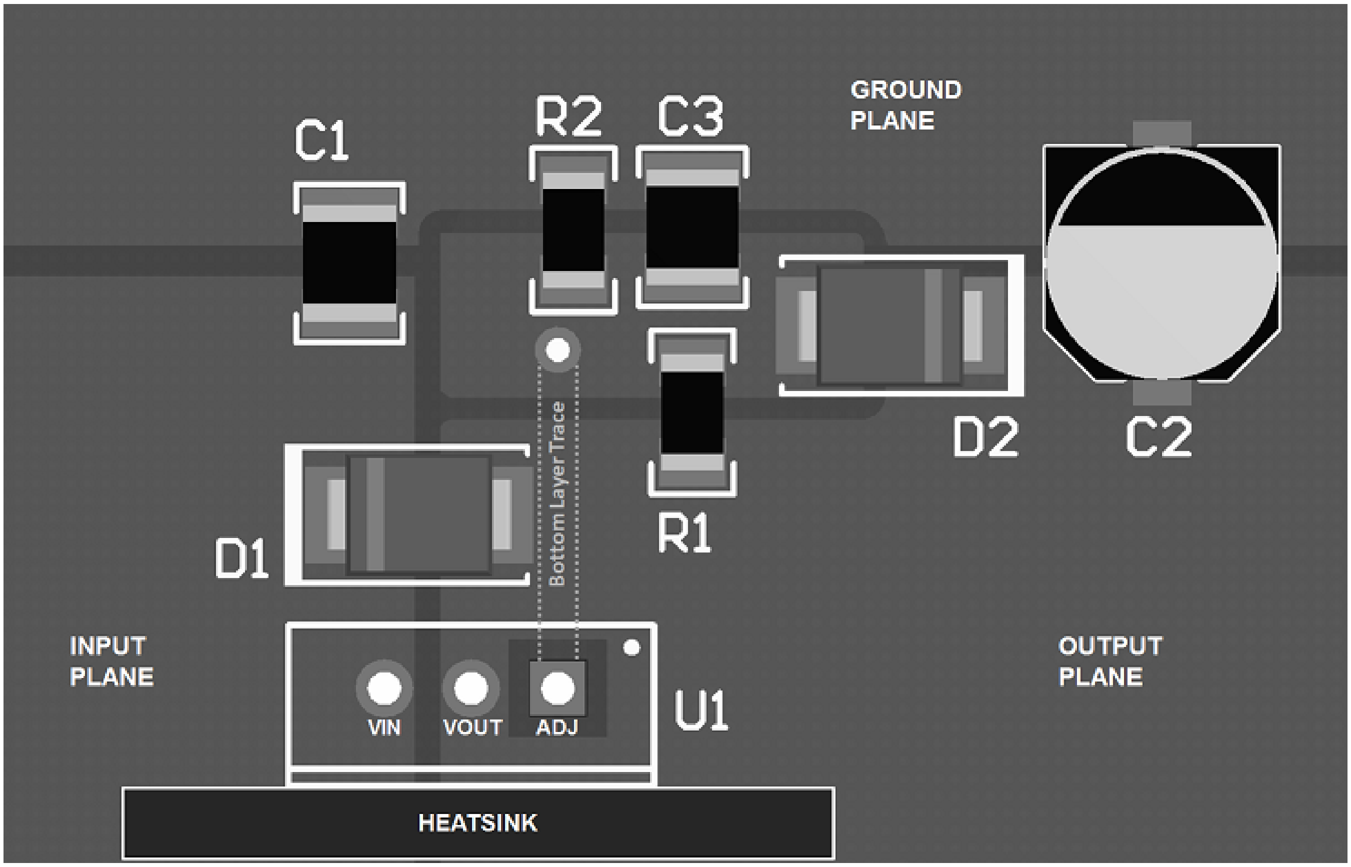


Figure 44. Layout Example (TO-220)

10.3 Thermal Considerations

When power is dissipated in an IC, a temperature gradient occurs across the IC chip affecting the individual IC circuit components. With an IC regulator, this gradient can be especially severe since power dissipation is large. Thermal regulation is the effect of these temperature gradients on output voltage (in percentage output change) per watt of power change in a specified time. Thermal regulation error is independent of electrical regulation or temperature coefficient, and occurs within 5 ms to 50 ms after a change in power dissipation. Thermal regulation depends on IC layout as well as electrical design. The thermal regulation of a voltage regulator is defined as the percentage change of V_{OUT}, per watt, within the first 10 ms after a step of power is applied. The LM317L-N specification is 0.2%/W, maximum.

In Figure 12, a typical output of the LM317L-N changes only 7 mV (or 0.07% of V_{OUT} = −10 V) when a 1-W pulse is applied for 10 ms. This performance is thus well inside the specification limit of 0.2%/W × 1 W = 0.2% maximum. When the 1-W pulse is ended, the thermal regulation again shows a 7-mV change as the gradients across the LM317L-N chip die out.

NOTE

The load regulation error of about 14 mV (0.14%) is additional to the thermal regulation error.

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11 器件和文档支持

11.1 文档支持

11.1.1 相关文档

请参阅如下相关文档：

AN-1112《DSBGA 晶圆级芯片规模封装》（文献编号：SNVA009）

11.2 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 《使用条款》。

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这些装置包含有限的内置 ESD 保护。 存储或装卸时，应将导线一起截短或将装置放置于导电泡棉中，以防止 MOS 门极遭受静电损伤。

11.5 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

12 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。数据如有变更，恕不另行通知和修订此文档。如欲获取此数据表的浏览器版本，请参阅左侧的导航。

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LM317LITP/NOPB	Active	Production	DSBGA (YPB) | 6	250 | SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 125	P 1
LM317LITP/NOPB.B	Active	Production	DSBGA (YPB) | 6	250 | SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 125	P 1
LM317LITPX/NOPB	Active	Production	DSBGA (YPB) | 6	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 125	P 1
LM317LITPX/NOPB.B	Active	Production	DSBGA (YPB) | 6	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 125	P 1
LM317LM/NOPB	Active	Production	SOIC (D) | 8	95 | TUBE	Yes	Call TI | Sn	Level-1-260C-UNLIM	-40 to 125	LM317 LM
LM317LM/NOPB.B	Active	Production	SOIC (D) | 8	95 | TUBE	Yes	Call TI	Level-1-260C-UNLIM	-40 to 125	LM317 LM
LM317LMX/NOPB	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	Call TI | Sn	Level-1-260C-UNLIM	-40 to 125	LM317 LM
LM317LMX/NOPB.B	Active	Production	SOIC (D) | 8	2500 | LARGE T&R	Yes	Call TI	Level-1-260C-UNLIM	-40 to 125	LM317 LM
LM317LZ/LFT1	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-	LM317 LZ
LM317LZ/LFT1.B	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	LM317 LZ
LM317LZ/LFT2	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-	LM317 LZ
LM317LZ/LFT2.B	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	LM317 LZ
LM317LZ/LFT3	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-	LM317 LZ
LM317LZ/LFT3.B	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	LM317 LZ
LM317LZ/LFT4	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-	LM317 LZ
LM317LZ/LFT4.B	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	LM317 LZ

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LM317LZ/LFT7	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-	LM317 LZ
LM317LZ/LFT7.B	Active	Production	TO-92 (LP) | 3	2000 | LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	LM317 LZ
LM317LZ/NOPB	Active	Production	TO-92 (LP) | 3	1800 | BULK	Yes	SN	N/A for Pkg Type	-40 to 125	LM317 LZ
LM317LZ/NOPB.B	Active	Production	TO-92 (LP) | 3	1800 | BULK	Yes	SN	N/A for Pkg Type	-40 to 125	LM317 LZ

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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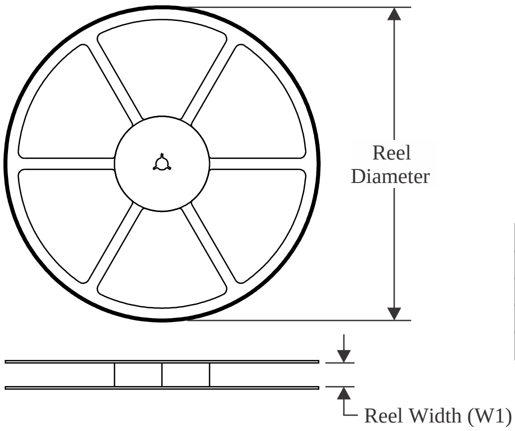
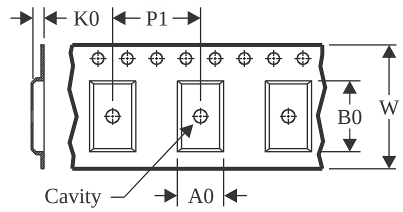
TAPE AND REEL INFORMATION

REEL DIMENSIONS

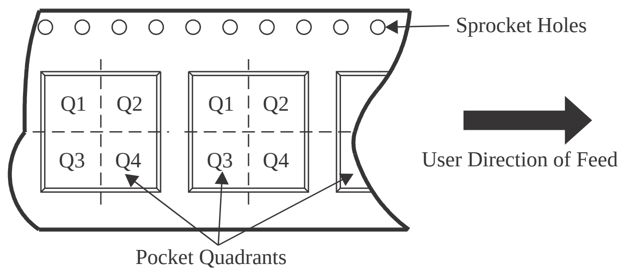


TAPE DIMENSIONS



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

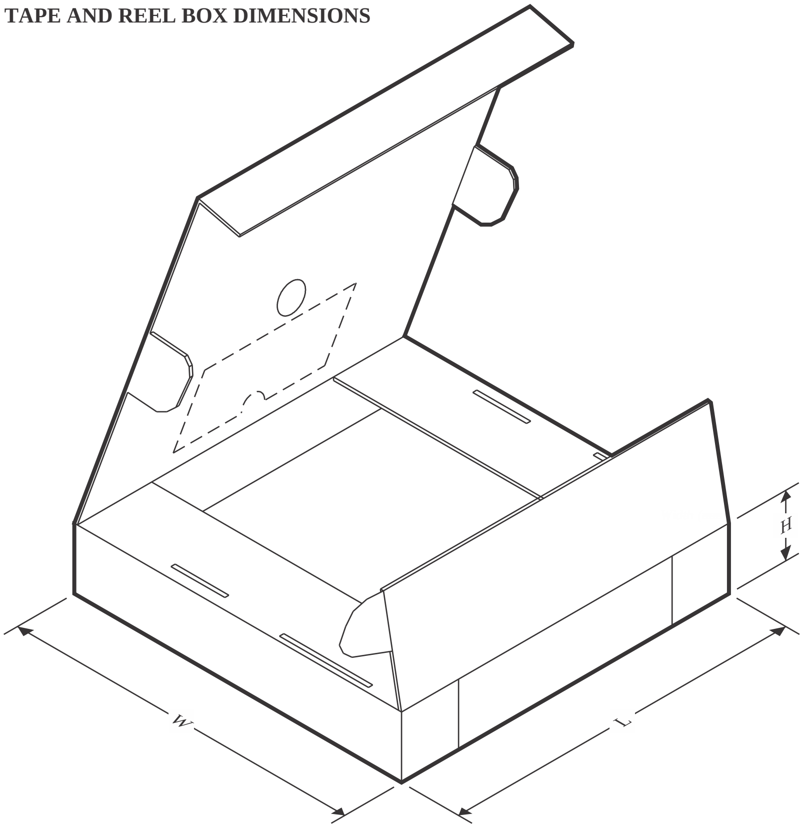
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
LM317LITP/NOPB	DSBGA	YPB	6	250	178.0	8.4	1.09	1.75	0.66	4.0	8.0	Q1
LM317LITPX/NOPB	DSBGA	YPB	6	3000	178.0	8.4	1.09	1.75	0.66	4.0	8.0	Q1
LM317LMX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1

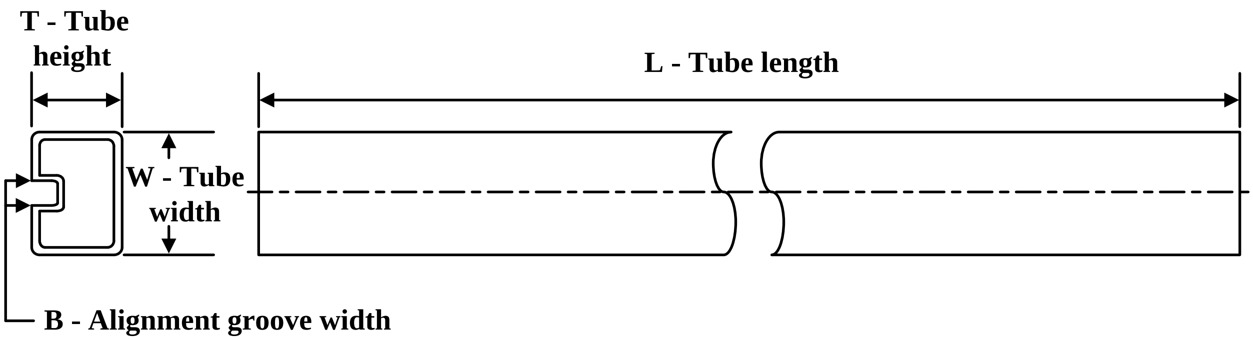
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

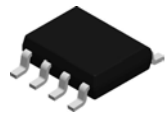
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM317LITP/NOPB	DSBGA	YPB	6	250	208.0	191.0	35.0
LM317LITPX/NOPB	DSBGA	YPB	6	3000	208.0	191.0	35.0
LM317LMX/NOPB	SOIC	D	8	2500	367.0	367.0	35.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
LM317LM/NOPB	D	SOIC	8	95	495	8	4064	3.05
LM317LM/NOPB.B	D	SOIC	8	95	495	8	4064	3.05

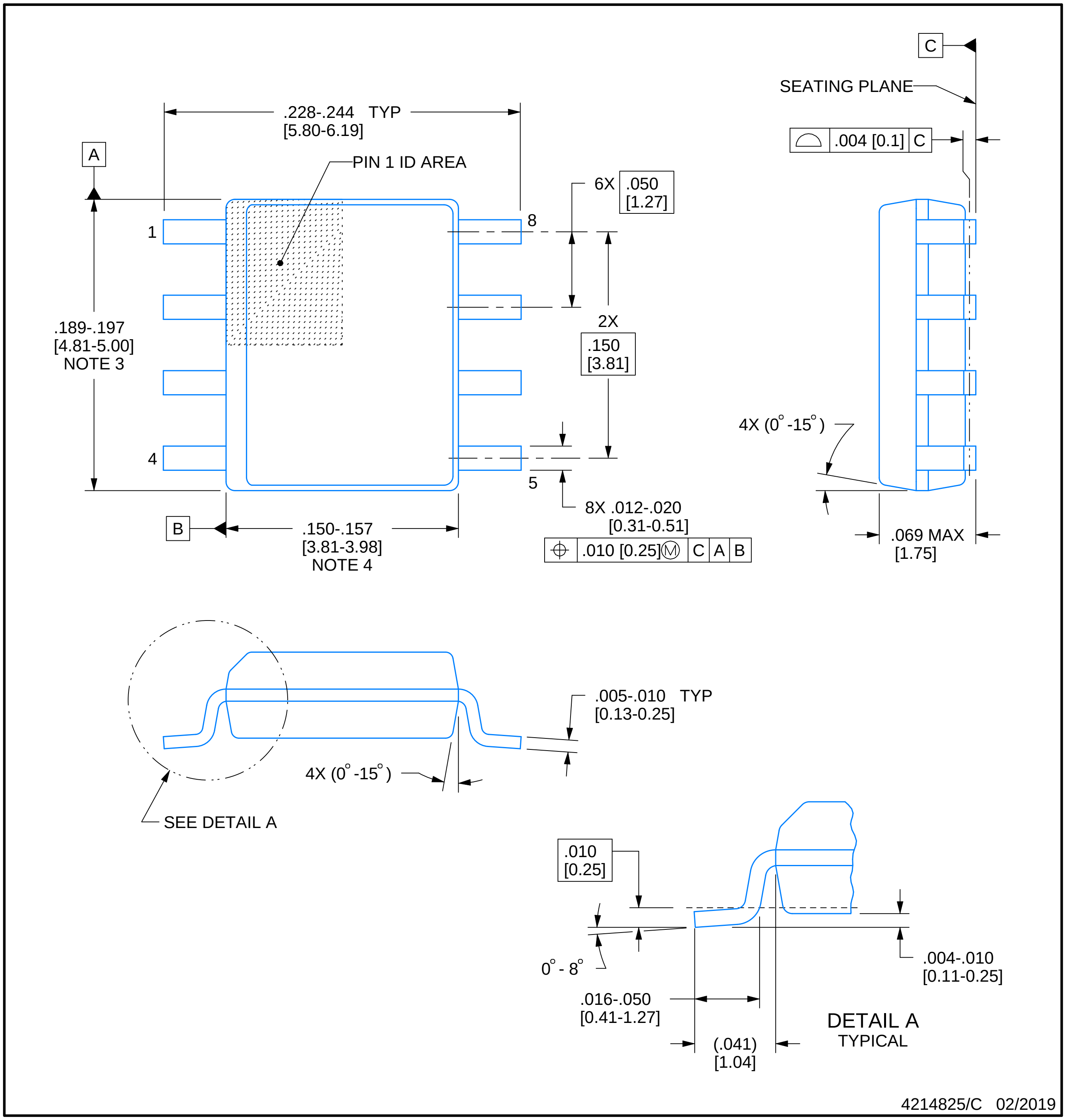


PACKAGE OUTLINE

D0008A

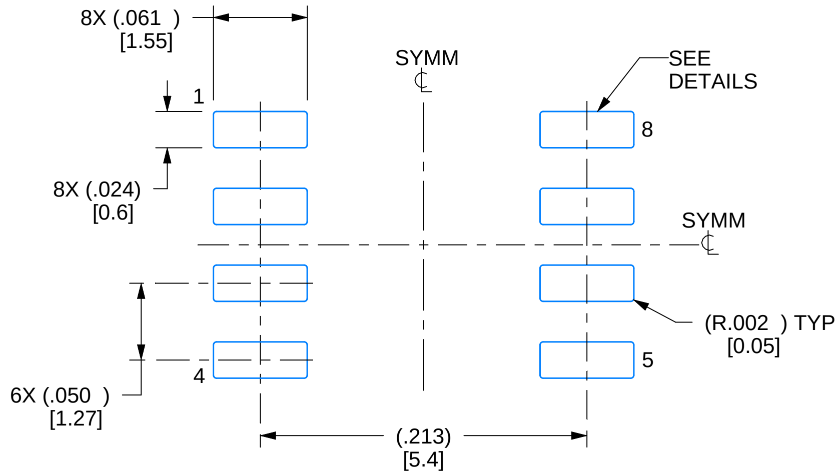
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

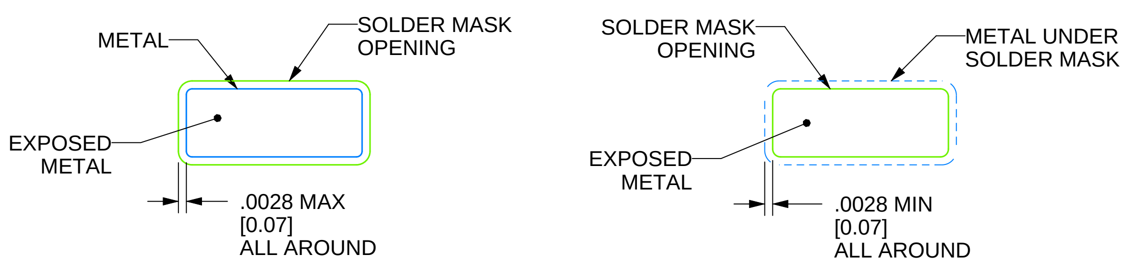


NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



NON SOLDER MASK DEFINED

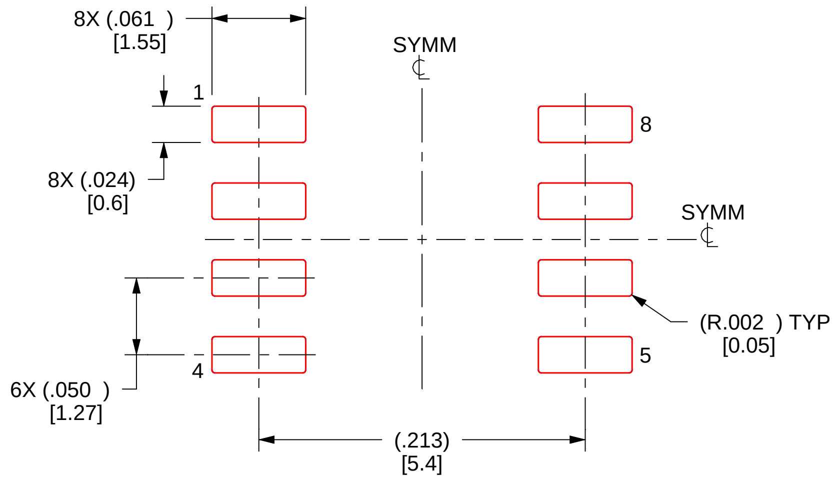
SOLDER MASK DEFINED

SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

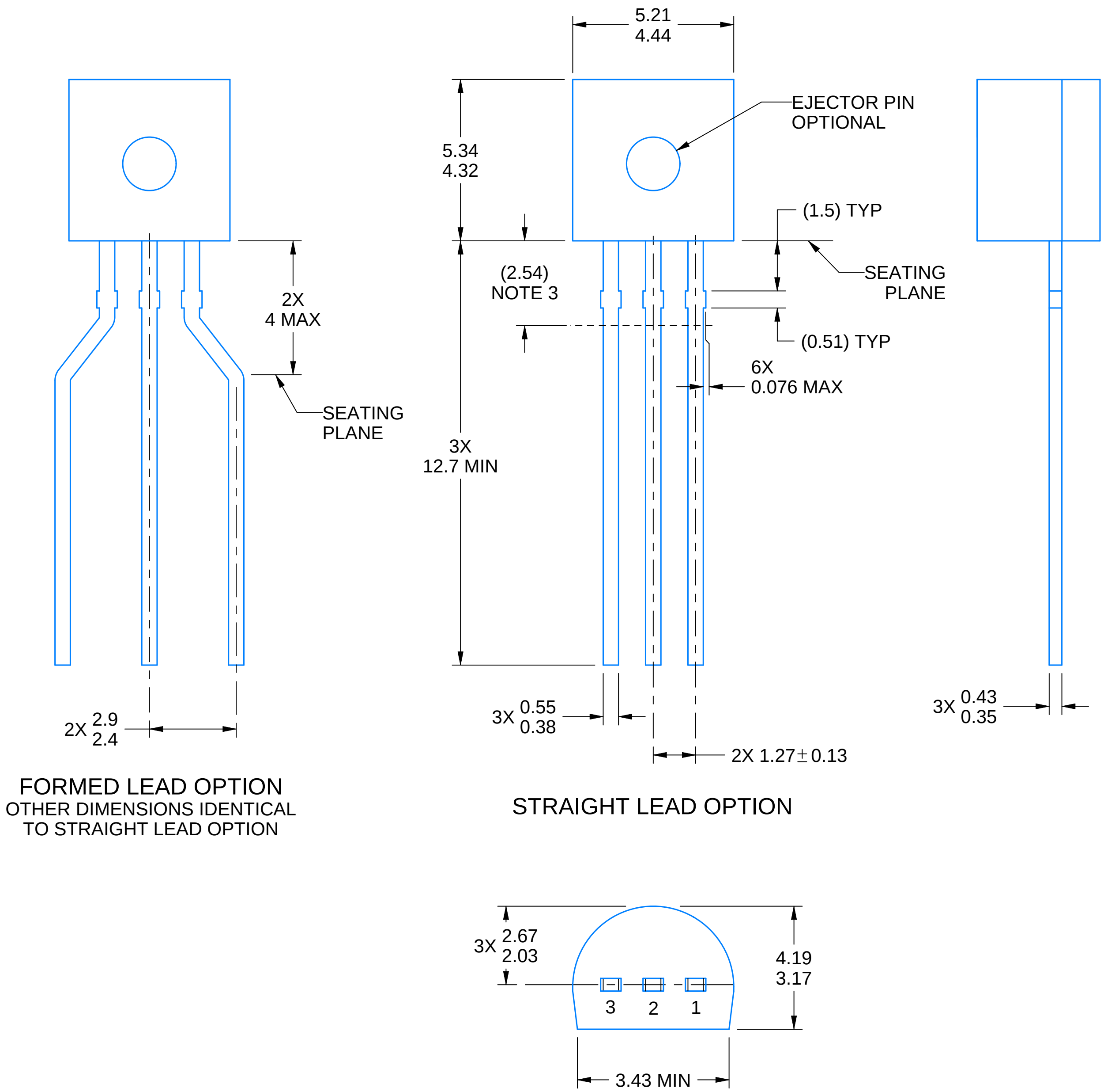


SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

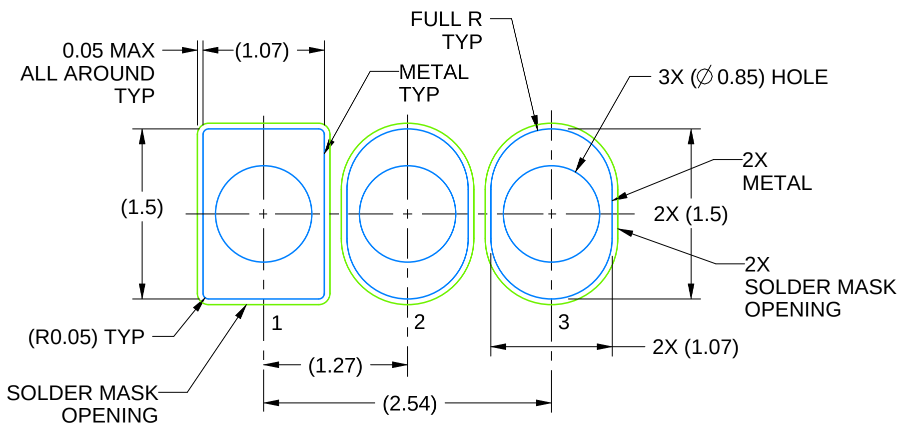
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.



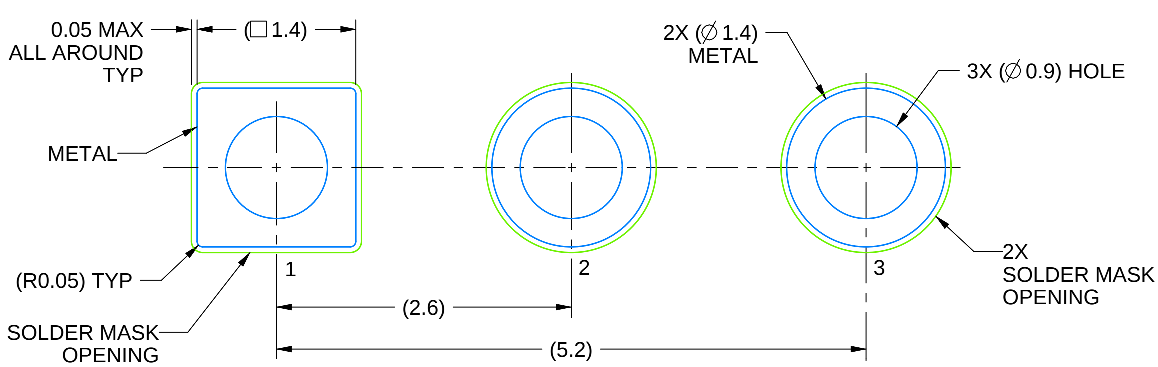
4215214/C 04/2025

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Lead dimensions are not controlled within this area.
4. Reference JEDEC TO-226, variation AA.
5. Shipping method:
   a. Straight lead option available in bulk pack only.
   b. Formed lead option available in tape and reel or ammo pack.
   c. Specific products can be offered in limited combinations of shipping medium and lead options.
   d. Consult product folder for more information on available options.

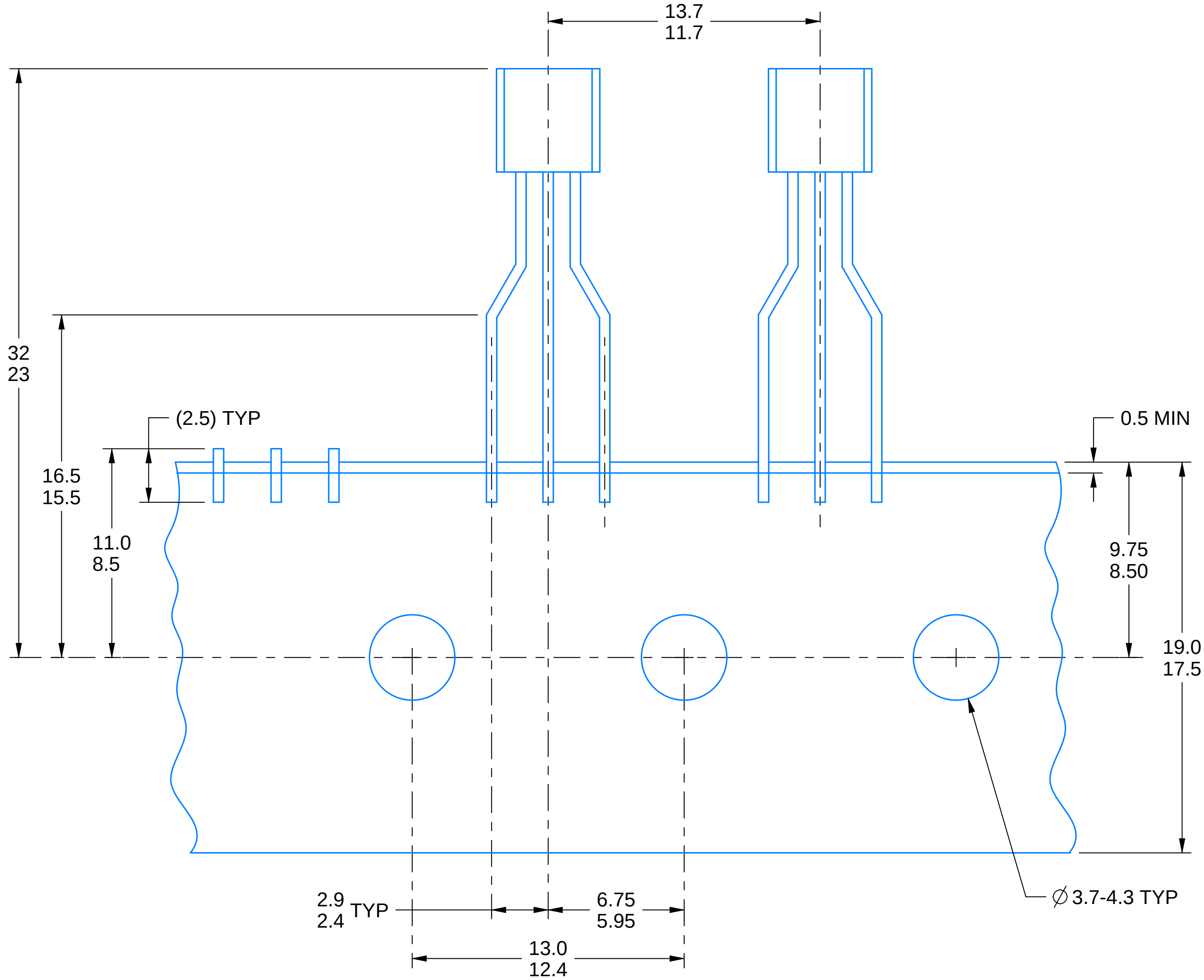


LAND PATTERN EXAMPLE
STRAIGHT LEAD OPTION
NON-SOLDER MASK DEFINED
SCALE:15X



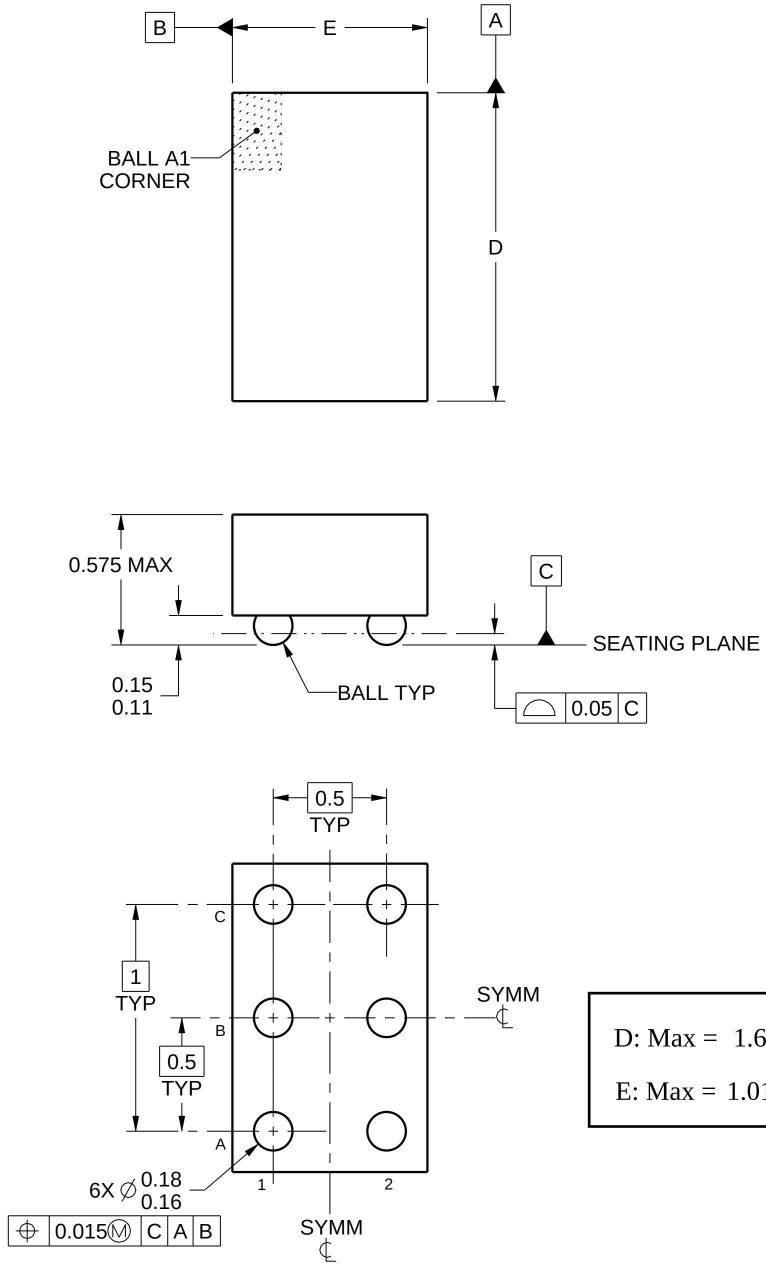
LAND PATTERN EXAMPLE
FORMED LEAD OPTION
NON-SOLDER MASK DEFINED
SCALE:15X

4215214/C 04/2025



FOR FORMED LEAD OPTION PACKAGE

4215214/C 04/2025

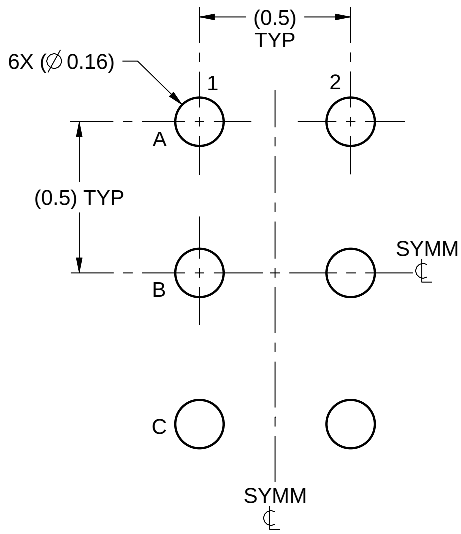


D: Max = 1.68 mm, Min =1.619 mm
E: Max = 1.019 mm, Min =0.958 mm

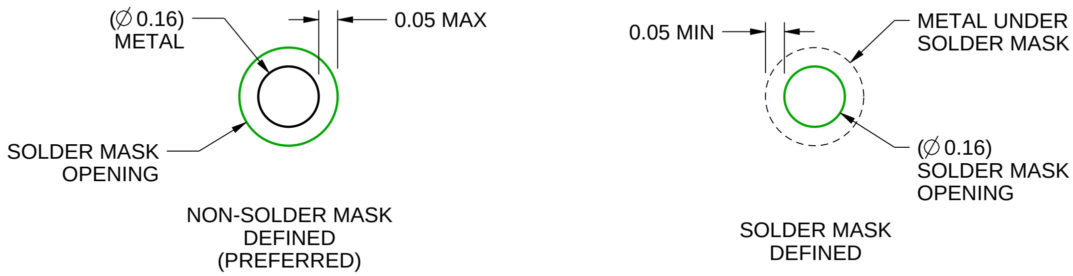
4215099/B 07/2016

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



LAND PATTERN EXAMPLE
SCALE:40X

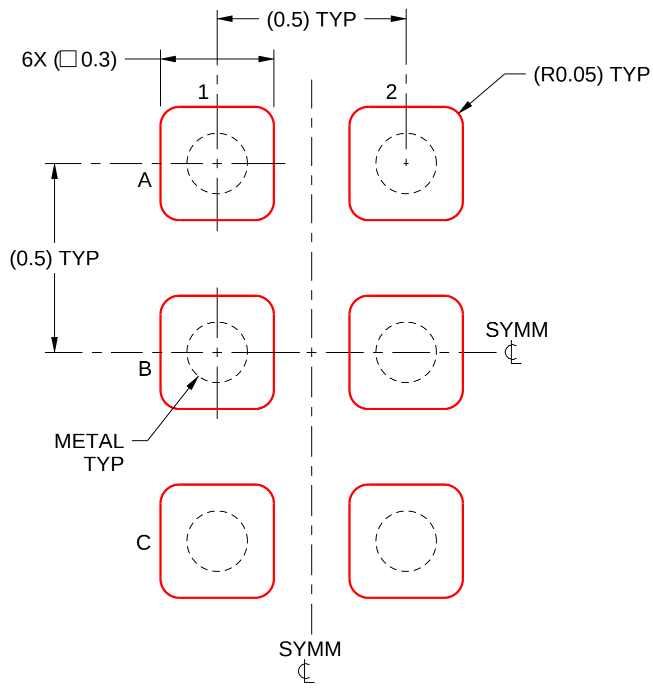


SOLDER MASK DETAILS
NOT TO SCALE

4215099/B 07/2016

NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. See Texas Instruments Literature No. SNVA009 (www.ti.com/lit/snva009).



SOLDER PASTE EXAMPLE
BASED ON 0.125mm THICK STENCIL
SCALE:50X

4215099/B 07/2016

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

重要通知和免责声明

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