

**SN74S1050**  
**12-BIT SCHOTTKY BARRIER DIODE BUS-TERMINATION ARRAY**

SDLS015A D3228, JULY 1989—REVISED MARCH 1990

- Designed to Reduce Reflection Noise
- Repetitive Peak Forward Current . . . 200 mA
- 12-Bit Array Structure Suited for Bus-Oriented Systems
- ESD Protection Exceeds 10 kV Per MIL-STD-883C, Method 3015
- Package Options Include Plastic "Small Outline" Packages and Standard Plastic 300-mil DIPs

**D OR N PACKAGE  
(TOP VIEW)**

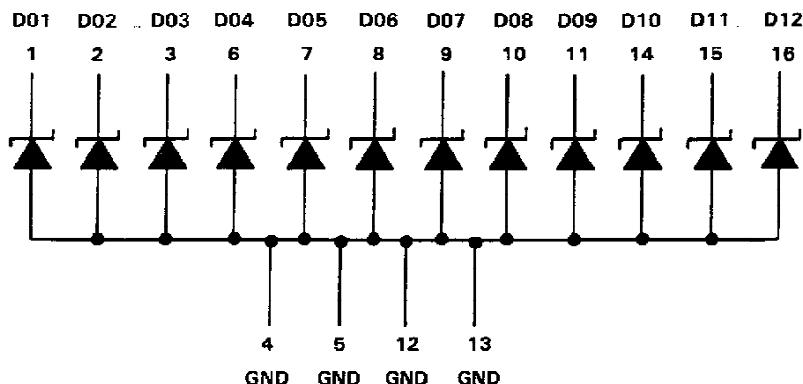
D01	1	16	D12
D02	2	15	D11
D03	3	14	D10
GND	4	13	GND
GND	5	12	GND
D04	6	11	D09
D05	7	10	D08
D06	8	9	D07

**description**

This Schottky barrier diode bus-termination array is designed to reduce reflection noise on memory bus lines. This device consists of a 12-bit high-speed Schottky diode array suitable for a clamp to GND.

The SN74S1050 is characterized for operation from 0°C to 70°C.

**schematic diagram**



**PRODUCTION DATA** documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

Copyright © 1990, Texas Instruments Incorporated

**TEXAS  
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

**SN74S1050**  
**12-BIT SCHOTTKY BARRIER DIODE BUS-TERMINATION ARRAY**

D3228, JULY 1989 - REVISED MARCH 1990

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

<sup>†</sup>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.

<sup>‡</sup>These values apply for  $t_W \leq 100 \mu s$ , duty cycle  $\leq 20\%$ .

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

**single-diode operation (see Note 1)**

PARAMETER		TEST CONDITIONS	MIN	TYP <sup>§</sup>	MAX	UNIT
$I_R$	Static reverse current	$V_R = 7 \text{ V}$		5		$\mu\text{A}$
$V_F$	Static forward voltage	$I_F = 18 \text{ mA}$		0.75	0.95	$\text{V}$
		$I_F = 50 \text{ mA}$		0.95	1.2	
$V_{FM}$	Peak forward voltage	$I_F = 200 \text{ mA}$		1.45		$\text{V}$
$C_T$	Total capacitance	$V_R = 0, \quad f = 1 \text{ MHz}$		5	10	$\text{pF}$
		$V_R = 2 \text{ V}, \quad f = 1 \text{ MHz}$		4	8	

NOTE 1: Test conditions and limits apply separately to each of the diodes. The diodes not under test are open-circuited during the measurement of these characteristics.

### **multiple-diode operation**

PARAMETER		TEST CONDITIONS		MIN	TYP <sup>5</sup>	MAX	UNIT
I <sub>X</sub>	Internal crosstalk current	Total I <sub>F</sub> = 1 A,	See Note 2	0.6	2	0.6	mA
		Total I <sub>F</sub> = 198 mA,	See Note 2	0.02	0.2	0.02	

<sup>5</sup>All typical values are at  $T_A = 25^\circ\text{C}$ .

NOTE 2.  $I_x$  is measured under the following conditions with one diode static and all others switching:

Switching diodes:  $t_{on} = 100 \mu s$ ; duty cycle = 20%; static diode:  $V_B = 5 V$ .

The static diode's input current is the internal crosstalk current ( $I_x$ ).

switching characteristics at 25°C free-air temperature (see Figures 1 and 2)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{rr}$ Reverse recovery time	$I_S = 10 \text{ mA}$ , $I_{BM(BEC)} = 10 \text{ mA}$ , $I_{B(BEC)} = 1 \text{ mA}$ , $R_L = 100 \Omega$	8	16	ns	

SN74S1050  
12-BIT SCHOTTKY BARRIER DIODE BUS-TERMINATION ARRAY

PARAMETER MEASUREMENT INFORMATION

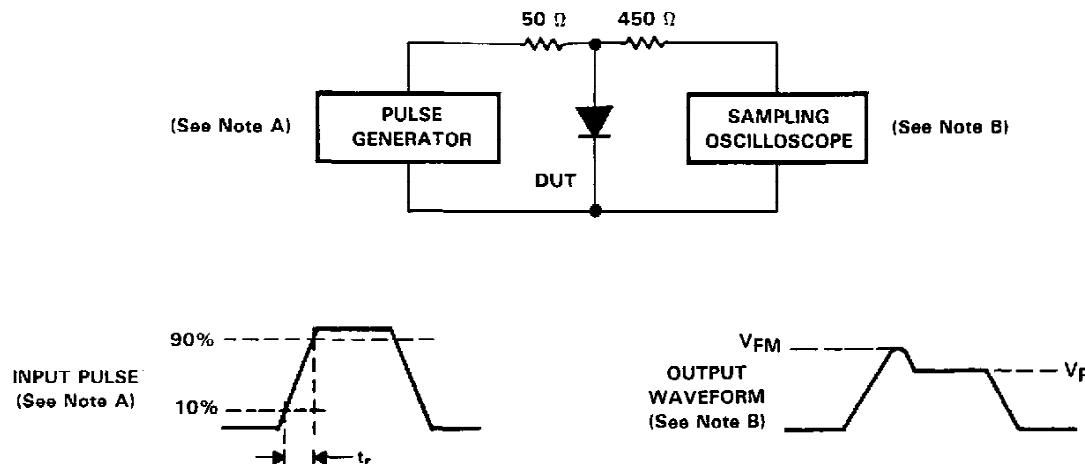


FIGURE 1. FORWARD RECOVERY VOLTAGE

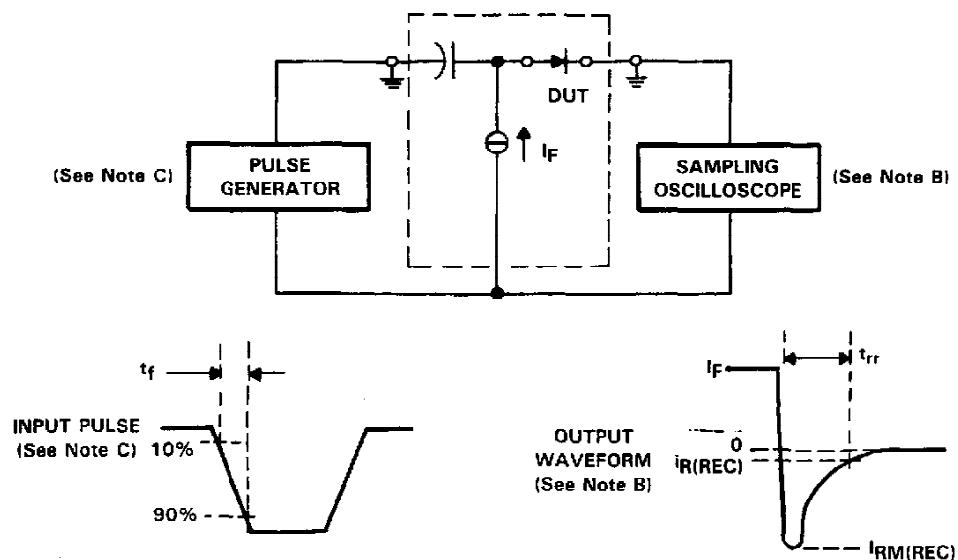


FIGURE 2. REVERSE RECOVERY TIME

NOTES: A. The input pulse is supplied by a pulse generator having the following characteristics:  $t_r = 20$  ns,  $Z_{out} = 50$  Ω,  $f = 500$  Hz, duty cycle = 0.01.  
 B. The output waveform is monitored by an oscilloscope having the following characteristics:  $t_r \leq 350$  ps,  $R_{in} = 50$  Ω,  $C_{in} = \leq 5$  pF.  
 C. The input pulse is supplied by a pulse generator having the following characteristics:  $t_f = 0.5$  ns,  $Z_{out} = 50$  Ω,  $t_w = \geq 50$  ns, duty cycle  $\leq 0.01$ .

# SN74S1050

## 12-BIT SCHOTTKY BARRIER DIODE BUS-TERMINATION ARRAY

### APPLICATION INFORMATION

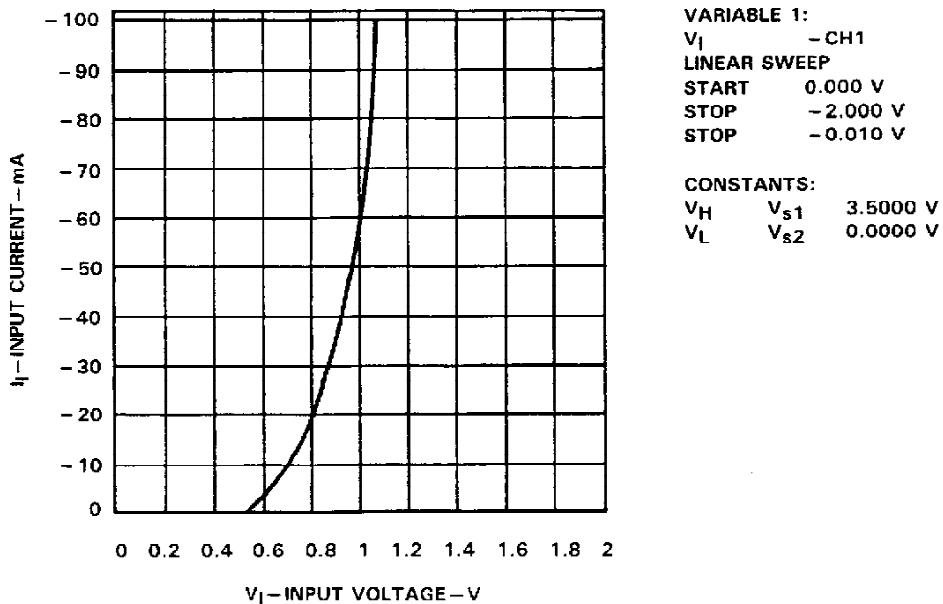
Large negative transients occurring at the inputs of memory devices (DRAMs, SRAMs, EPROMs, etc.), or on the CLOCK lines of many clocked devices can result in improper operation of the device. The SN74S1050 and SN74S1052 diode termination arrays help suppress negative transients caused by transmission line reflections, crosstalk, and switching noise.

Diode terminations have several advantages when compared to resistor termination schemes. Split resistor or Thevenin equivalent termination can cause a substantial increase in power consumption. The use of a single resistor to Ground to terminate a line usually results in degradation of the output high level, resulting in reduced noise immunity. Series damping resistors placed on the outputs of the driver will reduce negative transients, but can also increase propagation delays down the line, as a series resistor reduces the output drive capability of the driving device. Diode terminations have none of these drawbacks.

The operation of the diode arrays in reducing negative transients is explained in the following figures. The diode conducts current whenever the voltage reaches a negative value large enough for the diode to turn on. Suppression of negative transients by the diode tracks the current-voltage characteristic curve for the diode. A typical current-voltage curve for the SN74S1050/S1052 is shown in Figure 3.

To illustrate how the diode arrays act to reduce negative transients at the end of a transmission line, the test setup in Figure 4 was evaluated. The resulting waveforms with and without the diode are shown in Figure 5.

The maximum effectiveness of the diode in suppressing negative transients occurs when they are placed at the end of a line and/or the end of a long stub branching off a main transmission line. The diodes can also be used to reduce the negative transients that occur due to discontinuities in the middle of a line. An example of this is a slot in a backplane that is provided for an add-on card.



#### VARIABLE 1:

V<sub>I</sub> - CH1  
LINEAR SWEEP  
START 0.000 V  
STOP -2.000 V  
STOP -0.010 V

#### CONSTANTS:

V<sub>H</sub> V<sub>s1</sub> 3.5000 V  
V<sub>L</sub> V<sub>s2</sub> 0.0000 V

FIGURE 3. TYPICAL CURRENT-VOLTAGE CURVE

TEXAS  
INSTRUMENTS

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN74S1050  
12-BIT SCHOTTKY BARRIER DIODE BUS-TERMINATION ARRAY

$Z_0 = 50 \Omega$   
LENGTH = 36 IN

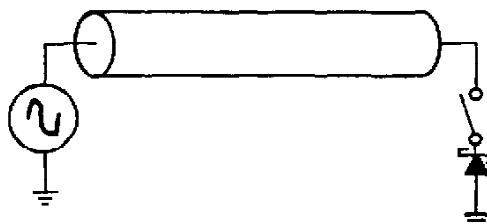


FIGURE 4. DIODE TEST SETUP

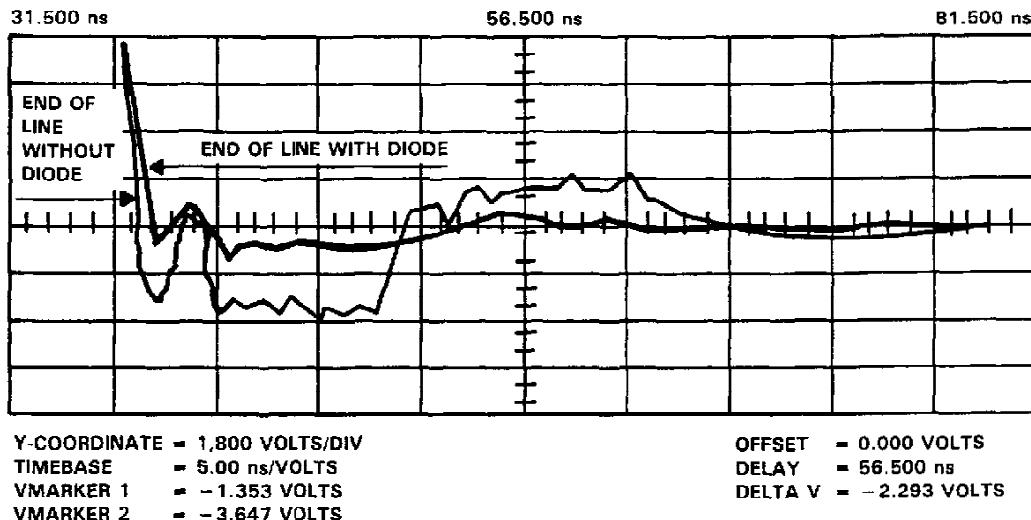


FIGURE 5. SCOPE DISPLAY

TEXAS  
INSTRUMENTS

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74S1050D	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	S1050	<b>Samples</b>

(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.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.



www.ti.com

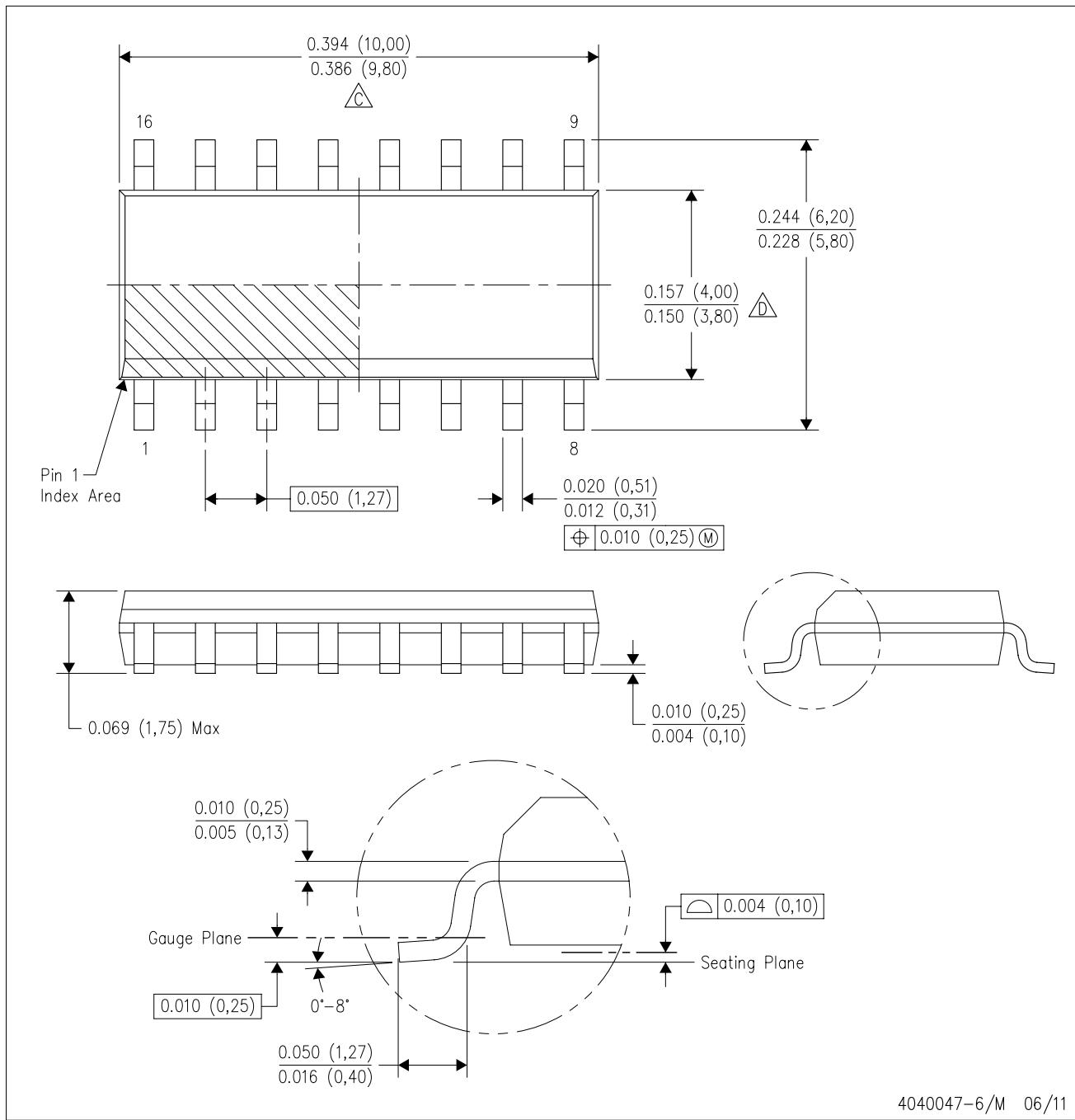
## PACKAGE OPTION ADDENDUM

10-Jun-2014

---

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in inches (millimeters).

B. This drawing is subject to change without notice.

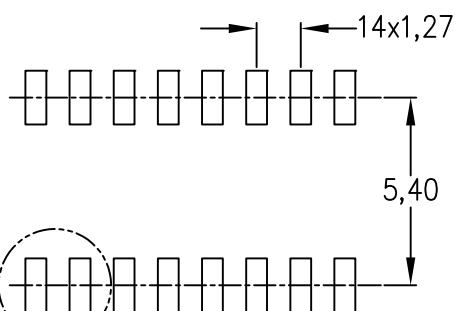
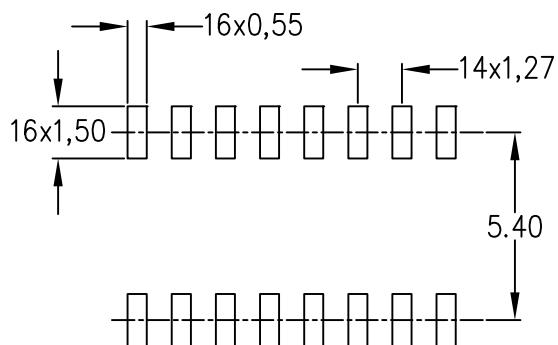
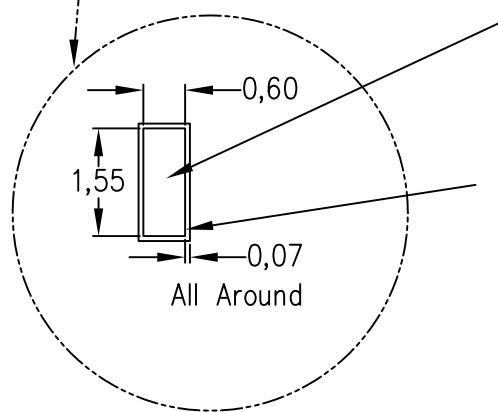
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.

D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.

E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE

Example Board Layout  
(Note C)Stencil Openings  
(Note D)Example  
Non Soldermask Defined PadExample  
Pad Geometry  
(See Note C)Example  
Solder Mask Opening  
(See Note E)

4211283-4/E 08/12

NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Publication IPC-7351 is recommended for alternate designs.
- Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products	Applications
Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>
	<b>TI E2E Community</b>
	<a href="http://e2e.ti.com">e2e.ti.com</a>