

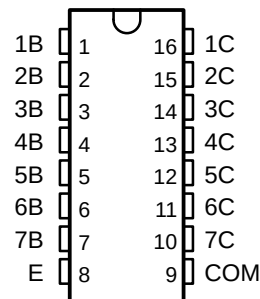
ULQ2003A-Q1, ULQ2004A-Q1, HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAY

SGLS148 – DECEMBER 2002

- Qualification in Accordance With AEC-Q100[†]
- Qualified for Automotive Applications
- Customer-Specific Configuration Control Can Be Supported Along With Major-Change Approval
- ESD Protection Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- 500-mA Rated Collector Current (Single Output)
- High-Voltage Outputs . . . 50 V
- Output Clamp Diodes
- Inputs Compatible With Various Types of Logic
- Relay-Driver Applications

[†] Contact factory for details. Q100 qualification data available on request.

**D PACKAGE
(TOP VIEW)**



description

The ULQ2003A-Q1 and ULQ2004A-Q1 are high-voltage, high-current Darlington transistor arrays. Each consists of seven npn Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of a single Darlington pair is 500 mA. The Darlington pairs can be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers.

The ULQ2003A-Q1 has a 2.7-k Ω series base resistor for each Darlington pair, for operation directly with TTL or 5-V CMOS devices. The ULQ2004A-Q1 has a 10.5-k Ω series base resistor to allow operation directly from CMOS devices that use supply voltages of 6 V to 15 V. The required input current of the ULQ2004A-Q1 is below that of the ULQ2003A-Q1.

AVAILABLE OPTIONS

T _A	D PACKAGES [†]
	SMALL OUTLINE
–40°C to 105°C	ULQ2003ATDQ1 ULQ2003ATDRQ1
	ULQ2004ATDQ1 [‡] ULQ2004ATDRQ1 [‡]

[†] The D package is available taped and reeled. Add the suffix R to device type (e.g., ULQ2003TDADRQ1).

[‡] ULQ2004ATDQ1 and ULQ2004ATDRQ1 are Product Preview only.



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.

This document contains information on products in more than one phase of development. The status of each device is indicated on the page(s) specifying its electrical characteristics.

**TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2002, Texas Instruments Incorporated

SGLS148 – DECEMBER 2002

ULQ2003A-Q1: $R_B = 2.7 \text{ k}\Omega$
 ULQ2004A-Q1: $R_B = 10.5 \text{ k}\Omega$

ULQ2003A-Q1, ULQ2004A-Q1

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

ULQ2003A-Q1, ULQ2004A-Q1, HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAY

SGLS148 – DECEMBER 2002

DISSIPATION RATING TABLE

PACKAGE	$T_A = 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 105^\circ\text{C}$ POWER RATING
D	950 mW	7.6 mW/ $^\circ\text{C}$	494 mW	342 mW

electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS		ULQ2003A-Q1			ULQ2004A-Q1			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V _{I(on)}	On-state input voltage, See Figure 6	V _{CE} = 2 V	I _C = 125 mA						5	V
			I _C = 200 mA				2.7		6	
			I _C = 250 mA				2.9			
			I _C = 275 mA						7	
			I _C = 300 mA				3			
			I _C = 350 mA						8	
V _{CE(sat)}	Collector-emitter saturation voltage, See Figure 5	I _I = 250 μA, I _C = 100 mA		0.9	1.2		0.9	1.1	V	
		I _I = 350 μA, I _C = 200 mA		1	1.4		1	1.3		
		I _I = 500 μA, I _C = 350 mA		1.2	1.7		1.2	1.6		
I _{CEX}	Collector cutoff current	V _{CE} = 50 V, I _I = 0, See Figure 1			100			50	μA	
		V _{CE} = 50 V, See Figure 2	I _I = 0				100			
			V _I = 1 V				500			
V _F	Clamp forward voltage, See Figure 8	I _F = 350 mA			1.7	2.2		1.7	2	V
I _{I(off)}	Off-state input current, See Figure 3	V _{CE} = 50 V, I _C = 500 μA		30	65		50	65		μA
I _I	Input current, see Figure 4	V _I = 3.85 V			0.93	1.35				mA
		V _I = 5 V					0.35	0.5		
		V _I = 12 V					1	1.45		
I _R	Clamp reverse current, See Figure 7	V _R = 50 V, T _A = 25°C			100			50		μA
		V _R = 50 V			100			100		
C _i	Input capacitance	V _I = 0, f = 1 MHz			15	25		15	25	pF

switching characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS	ULQ2003A-Q1, ULQ2004A-Q1			UNIT
		MIN	TYP	MAX	
t_{PLH} Propagation delay time, low-to-high level output	See Figure 9	1			μs
t_{PHL} Propagation delay time, high-to-low level output	See Figure 9	1			μs
V_{OH} High-level output voltage after switching	$V_S = 50\text{ V}$, $I_O \approx 300\text{ mA}$, See Figure 10	$V_S - 500$			mV



ULQ2003A-Q1, ULQ2004A-Q1, HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAY

SGLS148 – DECEMBER 2002

PARAMETER MEASUREMENT INFORMATION

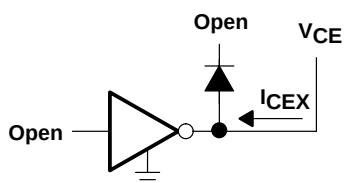


Figure 1. I_{CEX} Test Circuit

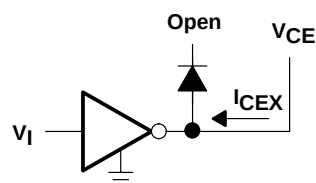


Figure 2. I_{CEX} Test Circuit

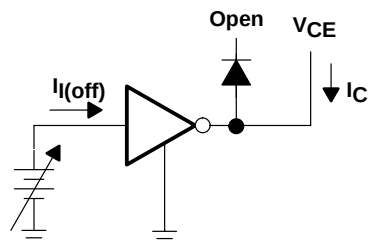


Figure 3. $I_{I(off)}$ Test Circuit

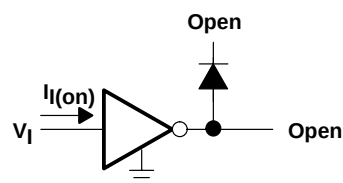
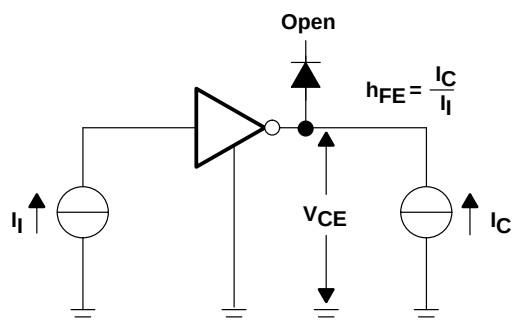


Figure 4. I_I Test Circuit



NOTE: I_I is fixed for measuring $V_{CE(sat)}$, variable for measuring h_{FE} .

Figure 5. h_{FE} , $V_{CE(sat)}$ Test Circuit

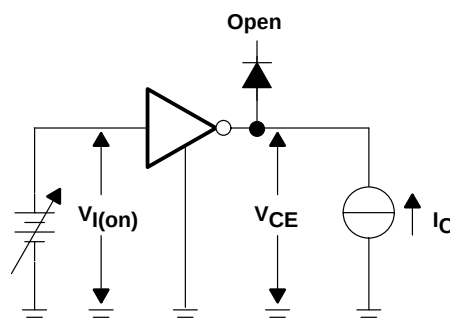


Figure 6. $V_{I(on)}$ Test Circuit

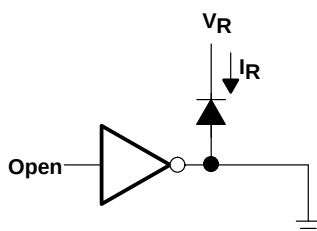


Figure 7. I_R Test Circuit

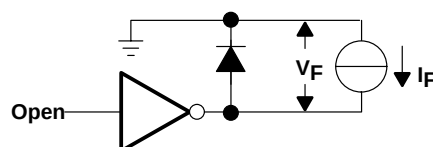


Figure 8. V_F Test Circuit

PARAMETER MEASUREMENT INFORMATION

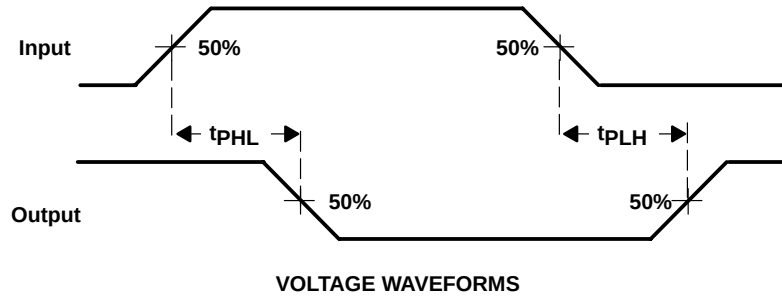
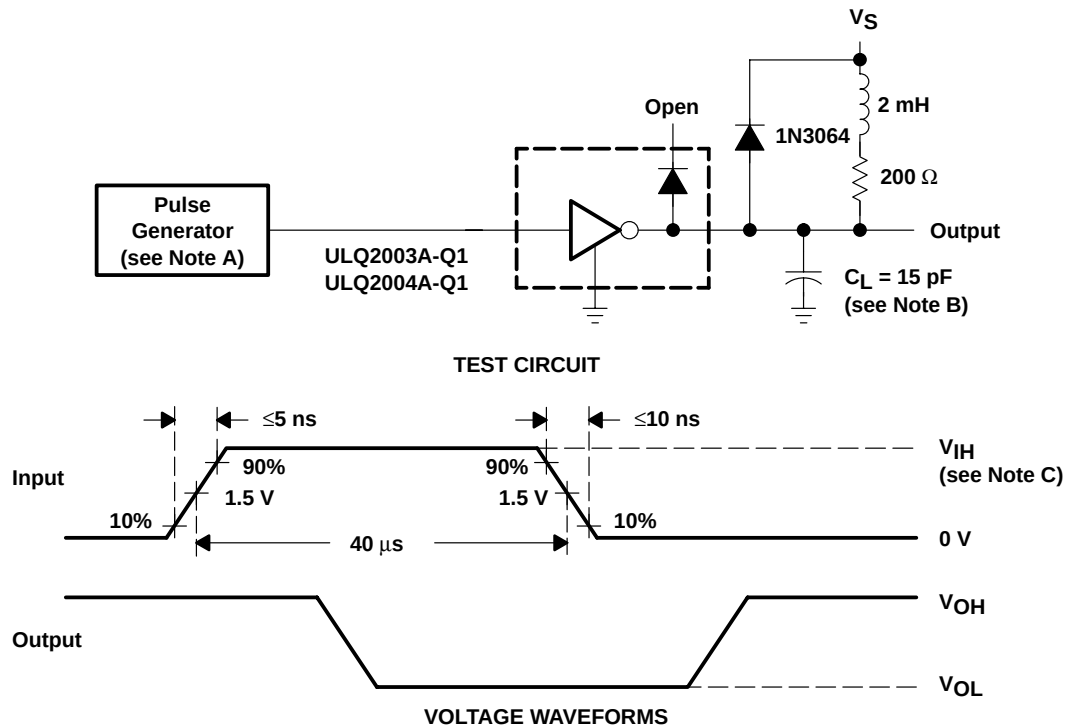


Figure 9. Propagation Delay-Time Waveforms



- NOTES: A. The pulse generator has the following characteristics: PRR = 12.5 kHz, $Z_O = 50 \Omega$.
 B. C_L includes probe and jig capacitance.
 C. For testing the ULQ2003A-Q1, $V_{IH} = 3 \text{ V}$; for the ULQ2004A-Q1, $V_{IH} = 8 \text{ V}$.

Figure 10. Latch-Up Test Circuit and Voltage Waveforms

ULQ2003A-Q1, ULQ2004A-Q1, HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAY

SGLS148 – DECEMBER 2002

TYPICAL CHARACTERISTICS

COLLECTOR-EMITTER SATURATION VOLTAGE

VS
COLLECTOR CURRENT
(ONE DARLINGTON)

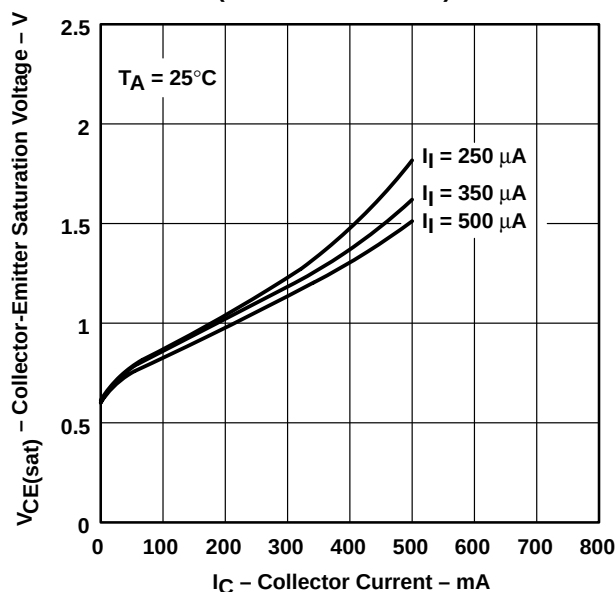


Figure 11

COLLECTOR-EMITTER SATURATION VOLTAGE

VS
TOTAL COLLECTOR CURRENT
(TWO DARLINGTONS IN PARALLEL)

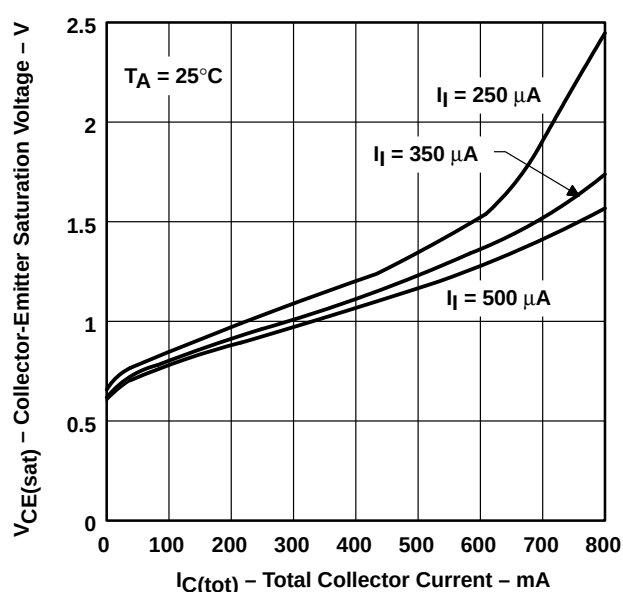


Figure 12

COLLECTOR CURRENT VS INPUT CURRENT

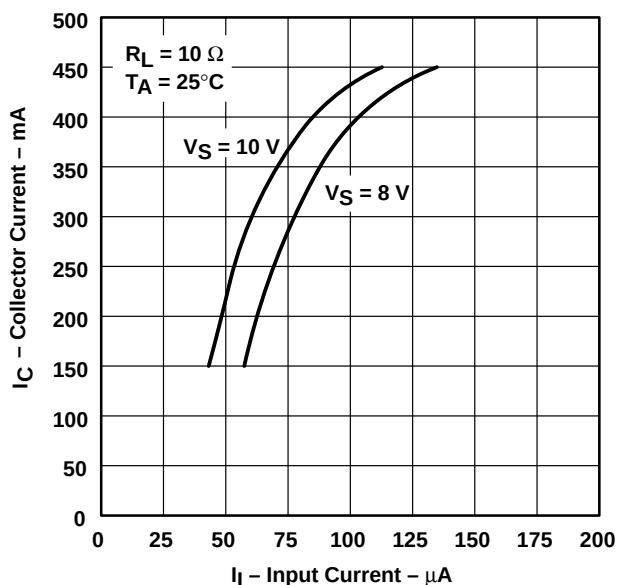


Figure 13

THERMAL INFORMATION

MAXIMUM COLLECTOR CURRENT
vs
DUTY CYCLE

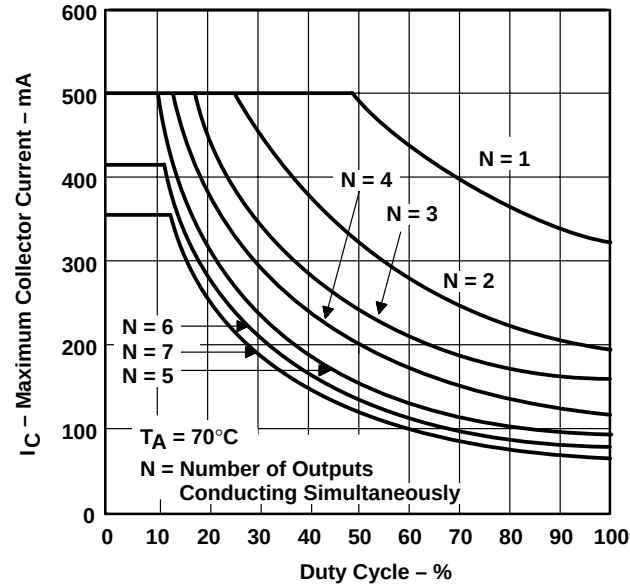


Figure 14

ULQ2003A-Q1, ULQ2004A-Q1, HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAY

SGLS148 – DECEMBER 2002

APPLICATION INFORMATION

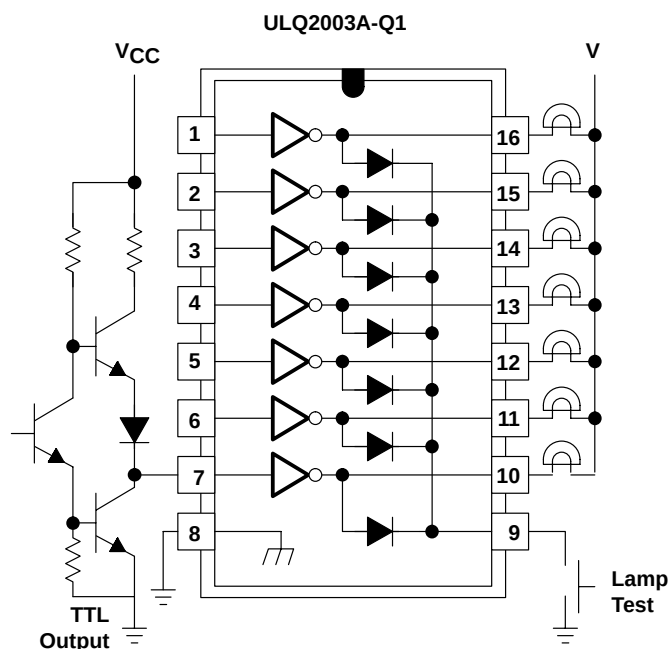


Figure 15. TTL to Load

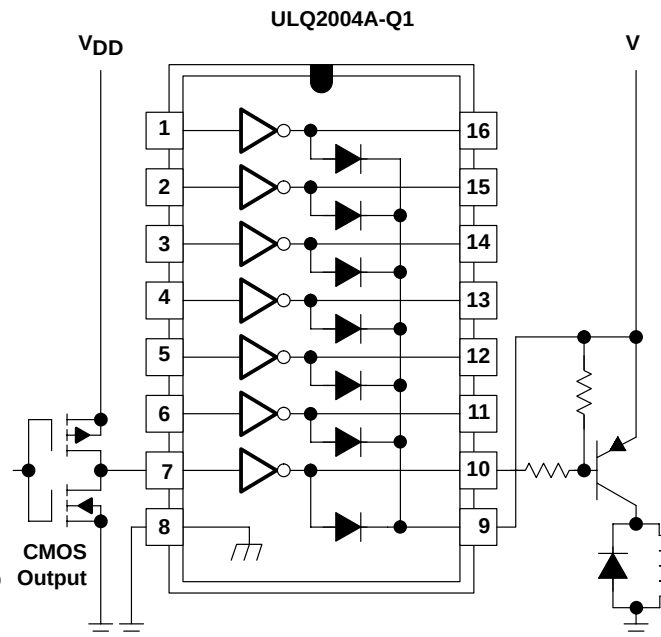


Figure 16. Buffer for Higher Current Loads

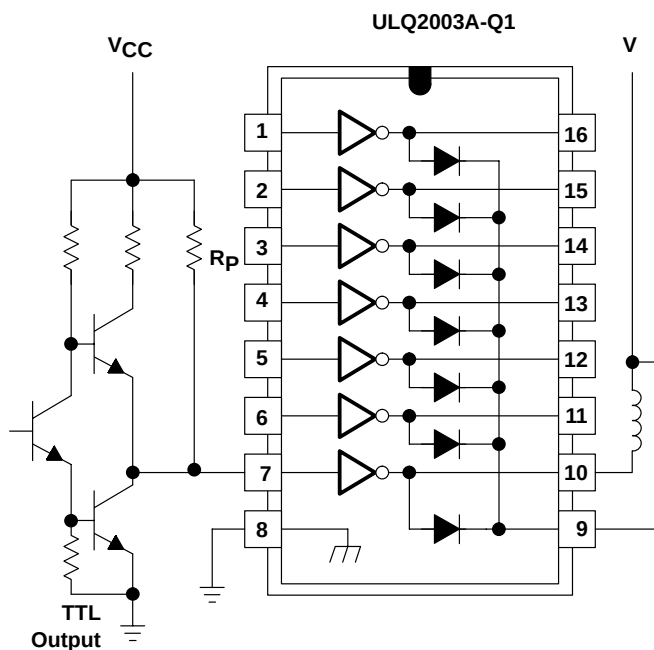


Figure 17. Use of Pullup Resistors
to Increase Drive Current

ULQ2003A-Q1, ULQ2004A-Q1, HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAY

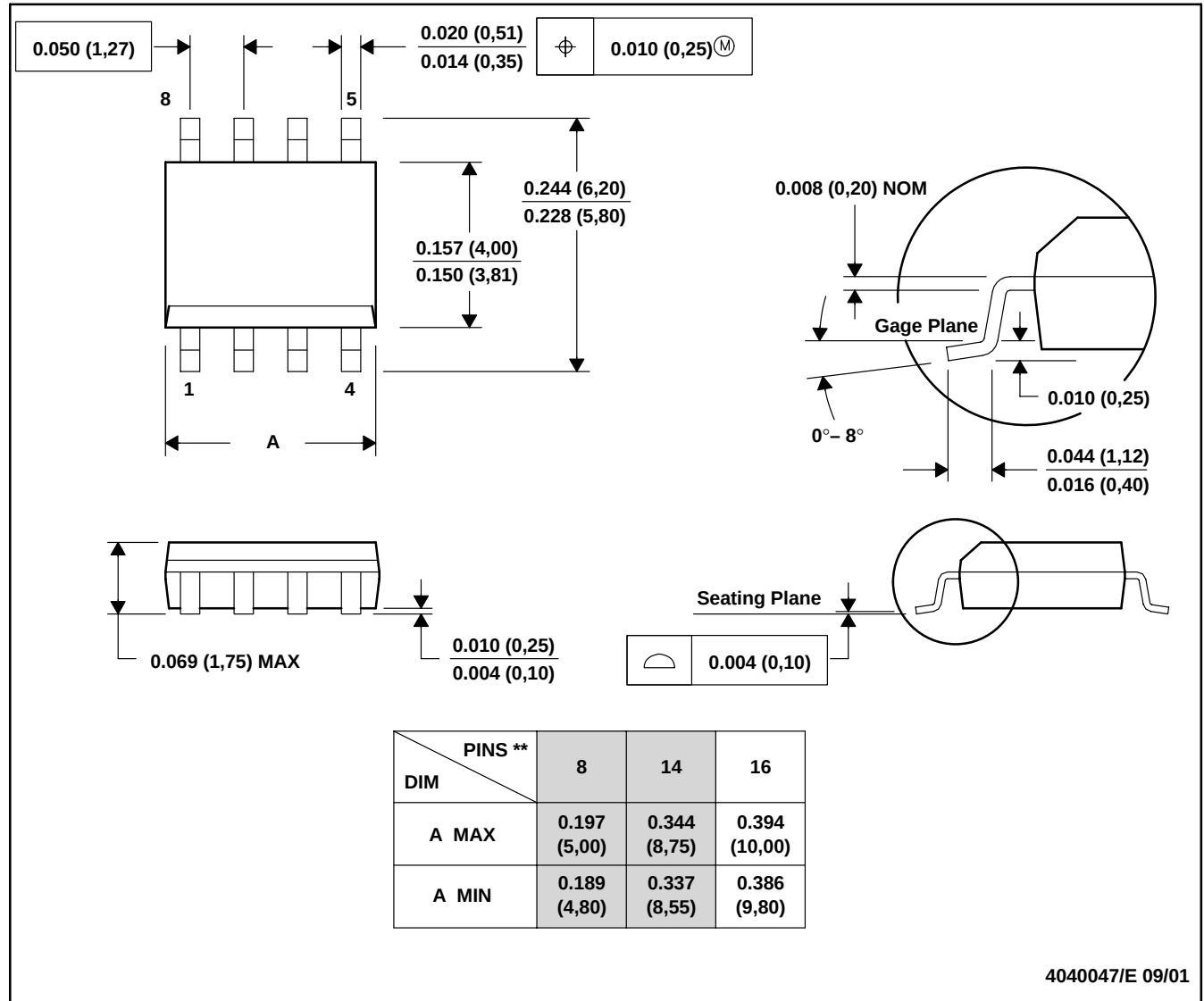
SGLS148 – DECEMBER 2002

MECHANICAL DATA

D (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

8 PINS SHOWN

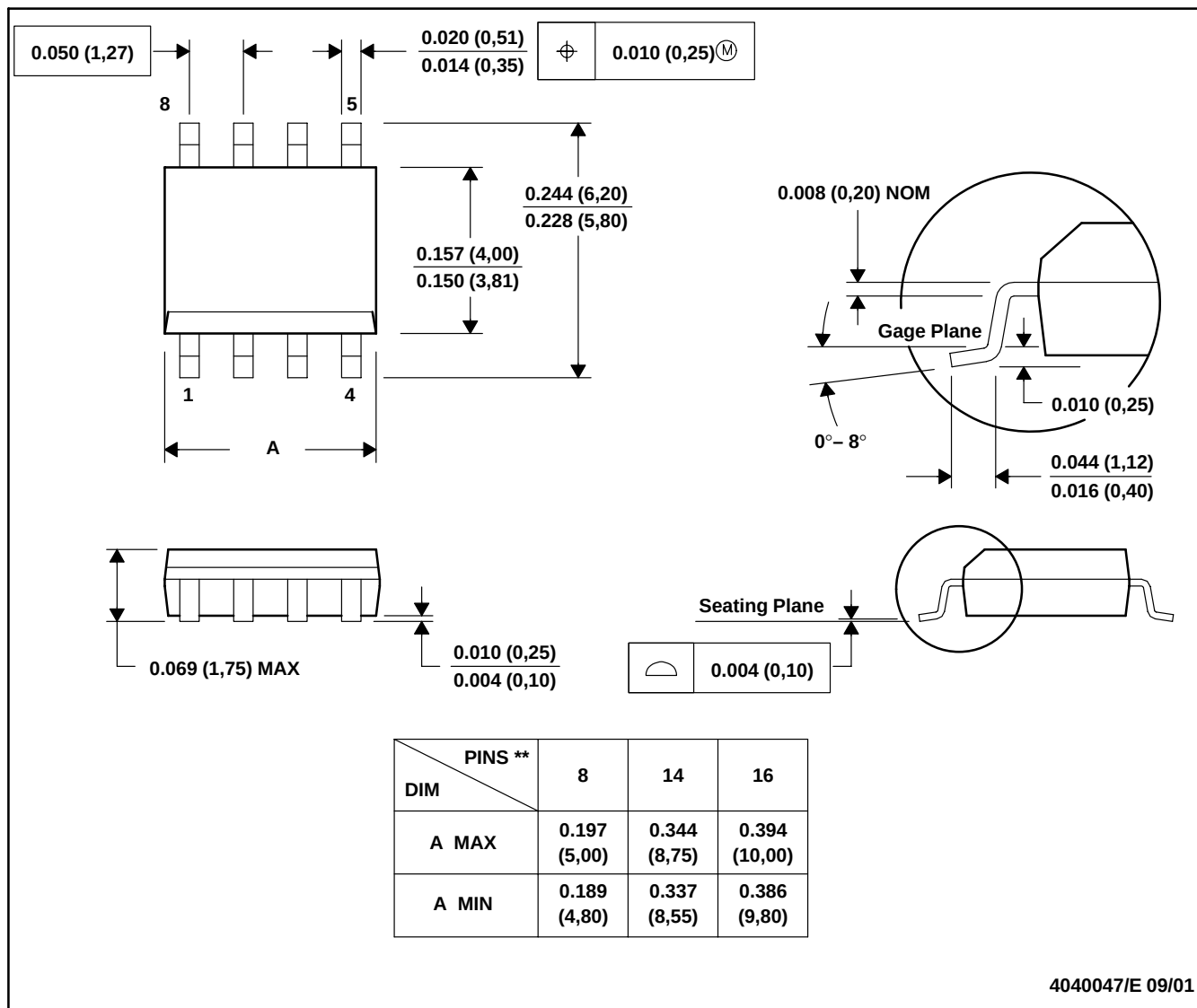


- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
 D. Falls within JEDEC MS-012

D (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

8 PINS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
 D. Falls within JEDEC MS-012

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

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

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265