ULN2803A
DARLINGTON TRANSISTOR ARRAY

- **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**
- **Compatible with ULN2800A Series**

DW OR N PACKAGE
(TOP VIEW)

1B	1	18	1C
2B	2	17	2C
3B	3	16	3C
4B	4	15	4C
5B	5	14	5C
6B	6	13	6C
7B	7	12	7C
8B	8	11	8C
GND	9	10	COM
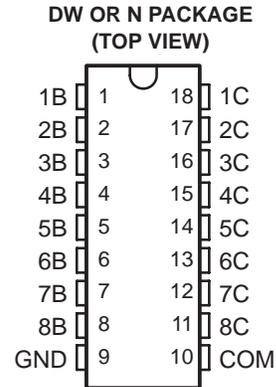
description/ordering information

The ULN2803A is a high-voltage, high-current Darlington transistor array. The device consists of eight npn Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of each Darlington pair is 500 mA. The Darlington pairs may be connected in parallel for higher current capability.

Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers. The ULN2803A has a 2.7-kΩ series base resistor for each Darlington pair for operation directly with TTL or 5-V CMOS devices.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 85°C	PDIP (N)	Tube of 20	ULN2803AN	ULN2803AN
	SOIC (DW)	Tube of 40	ULN2803ADW	ULN2803A
		Reel of 2000	ULN2803ADWR	

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

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.

Copyright © 2006, Texas Instruments Incorporated

TEXAS INSTRUMENTS

ULN2803A
DARLINGTON TRANSISTOR ARRAY

SLRS049E – FEBRUARY1997 – REVISED JULY 2006

logic diagram

1B	1	18 1C
2B	2	17 2C
3B	3	16 3C
4B	4	15 4C
5B	5	14 5C
6B	6	13 6C
7B	7	12 7C
8B	8	11 8C
		10 COM
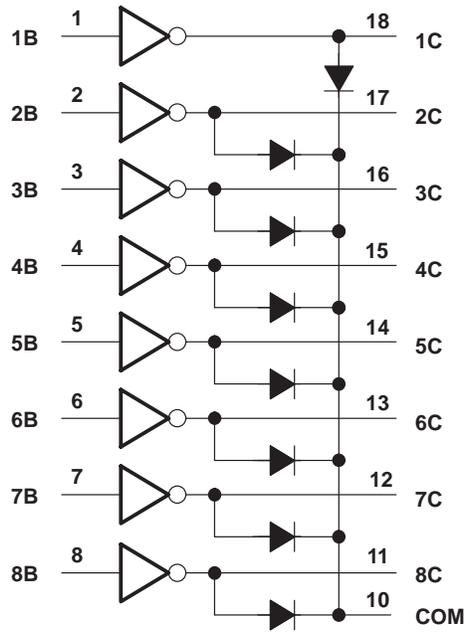
schematic (each Darlington pair)

COM
Output C

Input B
2.7 kΩ

7.2 kΩ   3 kΩ

E

TEXAS INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265
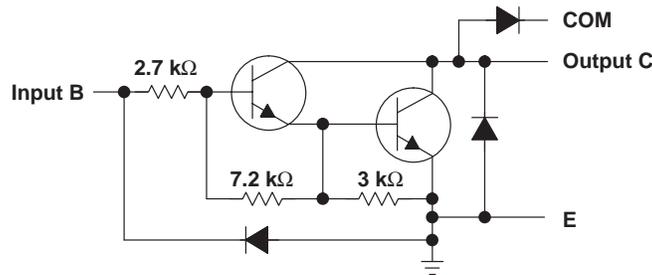
absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)†

Collector-emitter voltage . . . . 50 V

Input voltage (see Note 1) . . . . 30 V

Continuous collector current . . . . 500 mA

Output clamp diode current . . . . 500 mA

Total substrate-terminal current . . . . −2.5 A

Package thermal impedance, θ_{JA} (see Notes 2 and 3): DW package . . . . 73.14°C/W

N package . . . . 62.66°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. All voltage values, unless otherwise noted, are with respect to the emitter/substrate terminal GND.
2. 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.
3. The package thermal impedance is calculated in accordance with JESD 51-7.

electrical characteristics at 25°C free-air temperature (unless otherwise noted)

	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_{CEX}	Collector cutoff current	$V_{CE} = 50$ V, See Figure 1	$I_I = 0$,			50	µA
$I_{I(off)}$	Off-state input current	$V_{CE} = 50$ V, $T_A = 70$°C,	$I_C = 500$ µA, See Figure 2	50	65		µA
$I_{I(on)}$	Input current	$V_I = 3.85$ V,	See Figure 3		0.93	1.35	mA
$V_{I(on)}$	On-state input voltage	$V_{CE} = 2$ V, See Figure 4	$I_C = 200$ mA			2.4	V
			$I_C = 250$ mA			2.7	
			$I_C = 300$ mA			3	
$V_{CE(sat)}$	Collector-emitter saturation voltage	$I_I = 250$ µA, See Figure 5	$I_C = 100$ mA,		0.9	1.1	V
		$I_I = 350$ µA, See Figure 5	$I_C = 200$ mA,		1	1.3	
		$I_I = 500$ µA, See Figure 5	$I_C = 350$ mA,		1.3	1.6	
I_R	Clamp diode reverse current	$V_R = 50$ V,	See Figure 6			50	µA
V_F	Clamp diode forward voltage	$I_F = 350$ mA,	See Figure 7		1.7	2	V
C_i	Input capacitance	$V_I = 0$ V,	$f = 1$ MHz		15	25	pF

switching characteristics at 25°C free-air temperature

	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time, low- to high-level output	$V_S = 50$ V, $C_L = 15$ pF,	$R_L = 163$ Ω, See Figure 8		130		ns
t_{PHL}	Propagation delay time, high- to low-level output				20		
V_{OH}	High-level output voltage after switching	$V_S = 50$ V, See Figure 9	$I_O \approx 300$ mA,	$V_S – 20$			mV

TEXAS INSTRUMENTS

PARAMETER MEASUREMENT INFORMATION
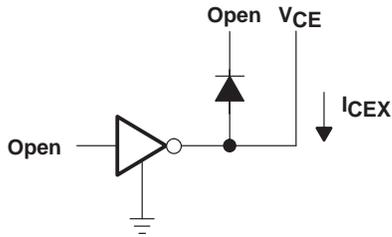
Figure 1. I_{CEX} Test Circuit
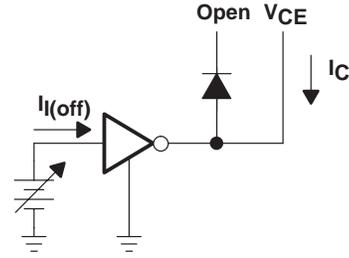
Figure 2. $I_{I(off)}$ Test Circuit
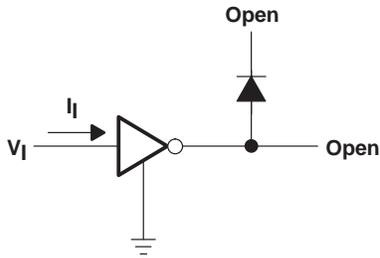
Figure 3. $I_{I(on)}$ Test Circuit
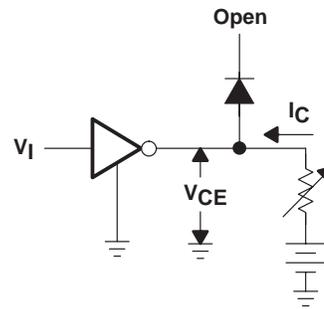
Figure 4. $V_{I(on)}$ Test Circuit

$$h_{FE} = \frac{I_C}{I_I}$$
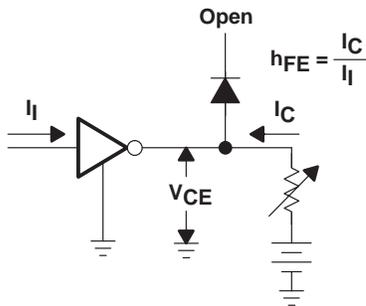
Figure 5. h_{FE}, $V_{CE(sat)}$ Test Circuit

Figure 6. I_R Test Circuit

TEXAS
INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265
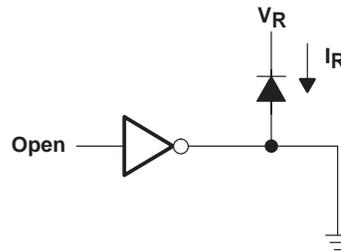
PARAMETER MEASUREMENT INFORMATION
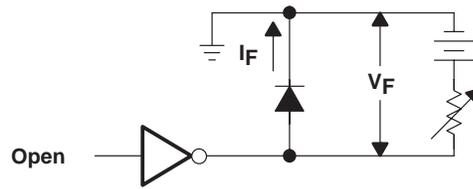
Figure 7. V_F Test Circuit

Test Circuit
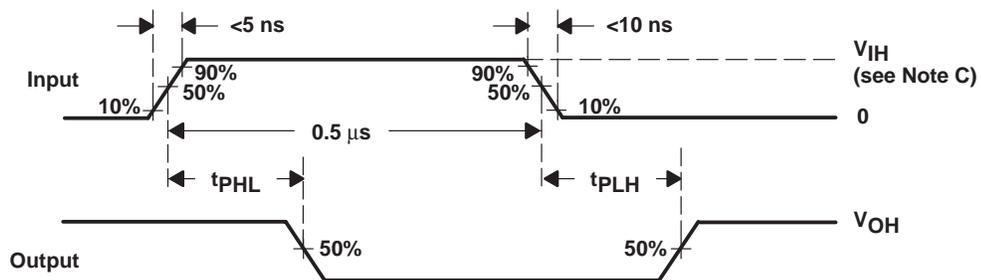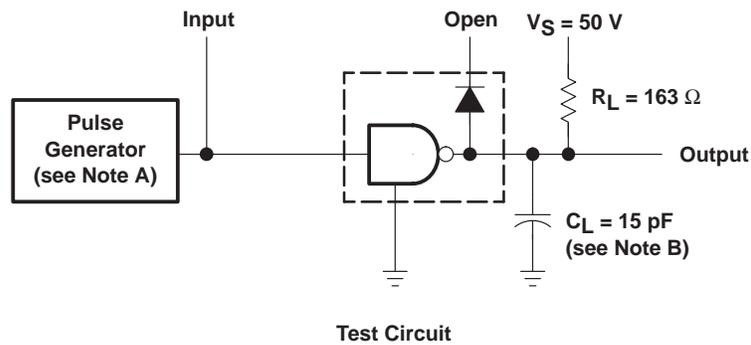
Voltage Waveforms

NOTES: A. The pulse generator has the following characteristics: PRR = 1 MHz, Z_O = 50 Ω.
B. C_L includes probe and jig capacitance.
C. V_{IH} = 3 V

Figure 8. Propagation Delay Times

PARAMETER MEASUREMENT INFORMATION

Test Circuit

Voltage Waveforms
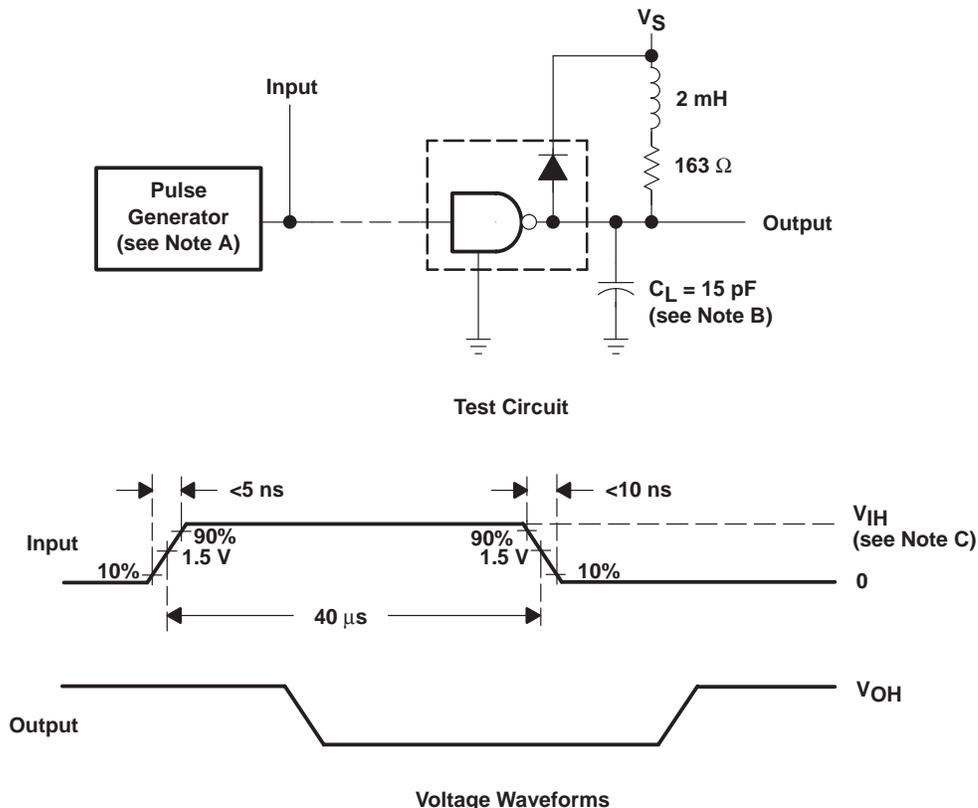
NOTES: A. The pulse generator has the following characteristics: PRR = 12.5 KHz, Z_O = 50 Ω.
     B. C_L includes probe and jig capacitance.
     C. V_{IH} = 3 V

Figure 9. Latch-Up Test

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	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
ULN2803ADW	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	ULN2803A	Samples
ULN2803ADWG4	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	ULN2803A	Samples
ULN2803ADWR	ACTIVE	SOIC	DW	18	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	ULN2803A	Samples
ULN2803ADWRG4	ACTIVE	SOIC	DW	18	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	ULN2803A	Samples
ULN2803AN	ACTIVE	PDIP	N	18	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	ULN2803AN	Samples
ULN2803ANE4	ACTIVE	PDIP	N	18	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	ULN2803AN	Samples

(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) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

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.

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
ULN2803ADWR	SOIC	DW	18	2000	330.0	24.4	10.9	12.0	2.7	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
ULN2803ADWR	SOIC	DW	18	2000	370.0	355.0	55.0

DW (R−PDSO−G18)   PLASTIC SMALL OUTLINE

0.463 (11,75)
0.447 (11,35)

18   10

0.419 (10,63)
0.393 (9,97)

0.299 (7,60)
0.291 (7,40)

1   9

Pin 1
Index Area

0.050 (1,27)

0.020 (0,51)
0.012 (0,31)

⌖ 0.010 (0,25) Ⓜ

0.104 (2,65) Max

0.012 (0,30)
0.004 (0,10)

0.013 (0,33)
0.008 (0,20)

0.004 (0,10)

Gauge Plane

Seating Plane

0.010 (0,25)   0°−8°

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

4040000−3/G 01/11
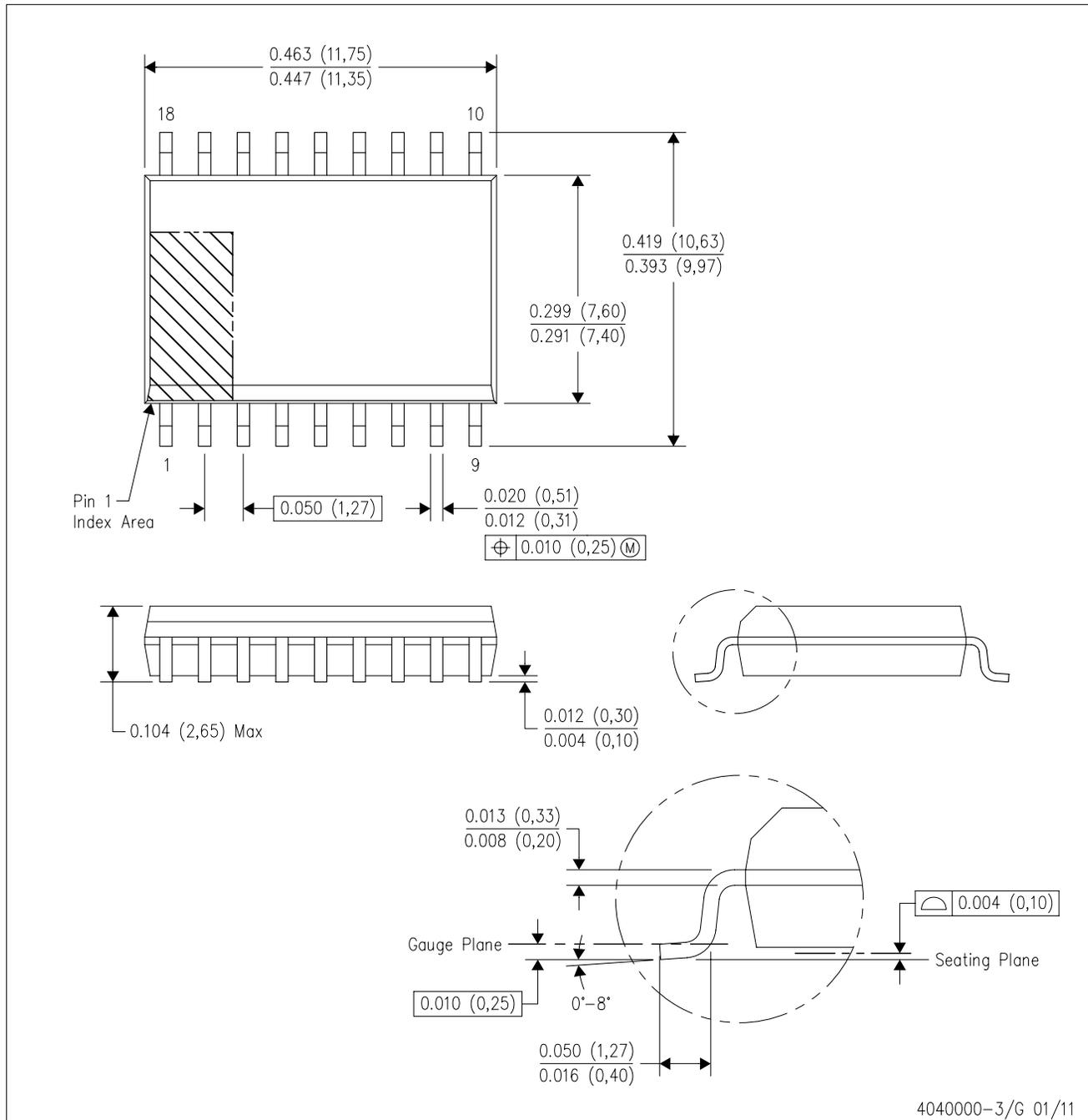
NOTES: A.   All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M−1994.
          B.   This drawing is subject to change without notice.
          C.   Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
          D.   Falls within JEDEC MS−013 variation AB.

DW (R−PDSO−G18)   PLASTIC SMALL OUTLINE

Example Board Layout
(Note C)

Stencil Openings
(Note D)

16x1,27

18x0,55   16x1,27

18x1,95

9,4

9,4

Non Solder Mask Define Pad

0,6

Solder Mask Opening
(Note E)

2,0

Pad Geometry
(Note C)

0,07
All Around

4209202−3/E 07/11
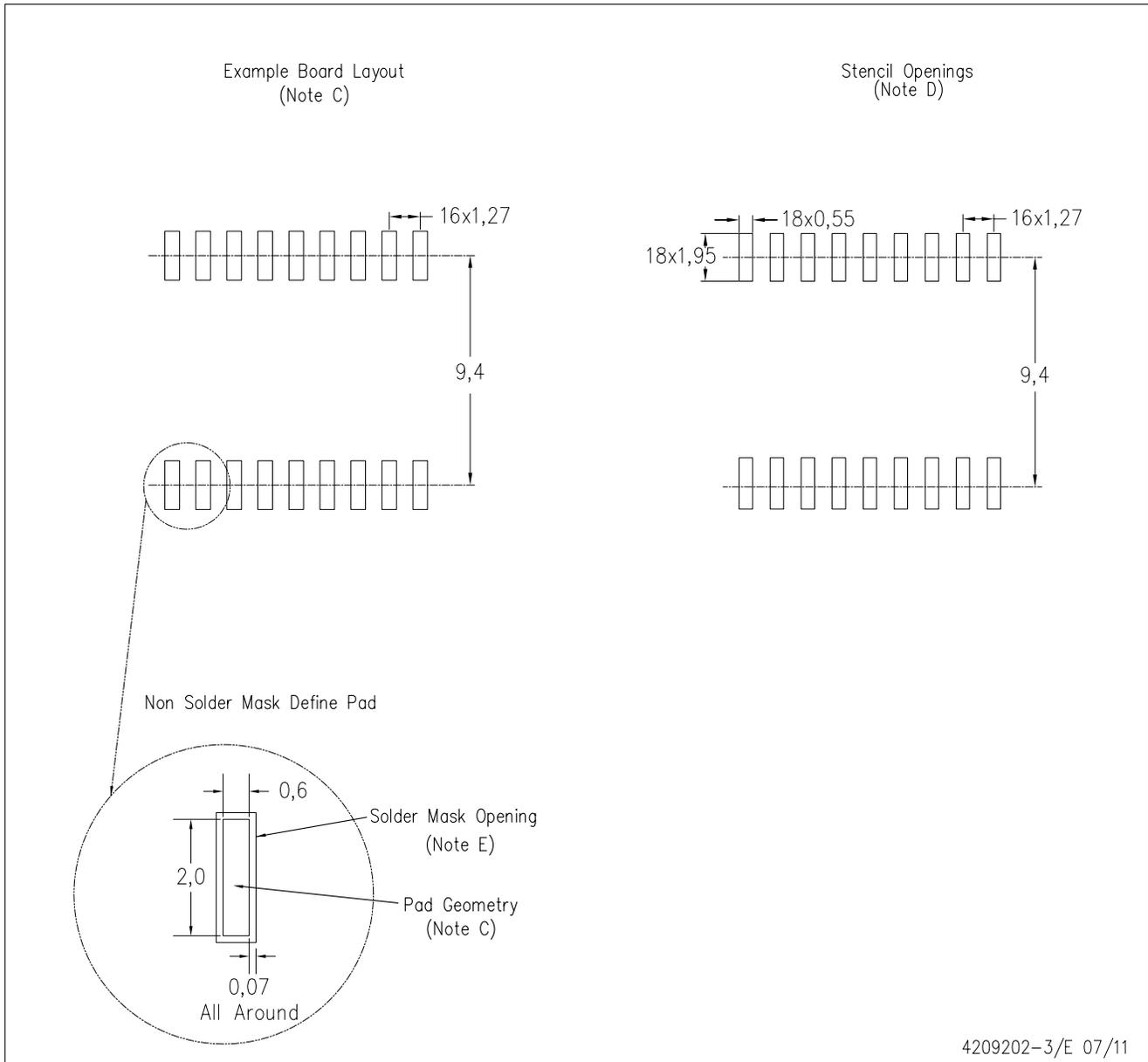
NOTES: A. All linear dimensions are in millimeters.
         B. This drawing is subject to change without notice.
         C. Refer to IPC7351 for alternate board design.
         D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should
             contact their board assembly site for stencil design recommendations. Refer to IPC−7525
         E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Products		Applications	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		