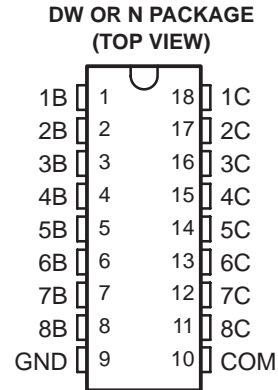


# ULN2803A DARLINGTON TRANSISTOR ARRAY

SLRS049E – FEBRUARY 1997 – REVISED JULY 2006

- 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



## 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-k $\Omega$  series base resistor for each Darlington pair for operation directly with TTL or 5-V CMOS devices.

## ORDERING INFORMATION

TA	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](http://www.ti.com/sc/package).



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PRODUCTION DATA information is 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.

 **TEXAS  
INSTRUMENTS**

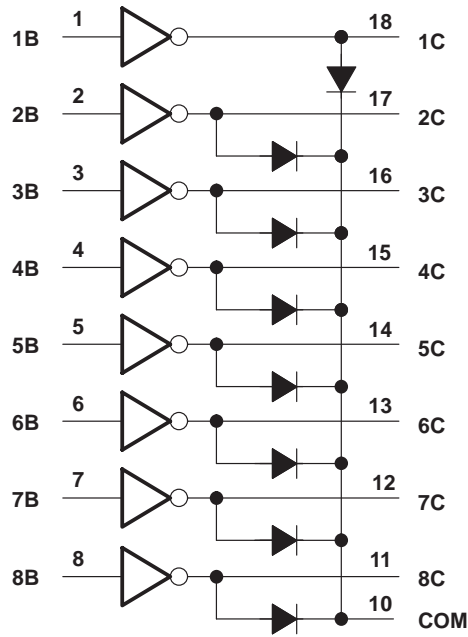
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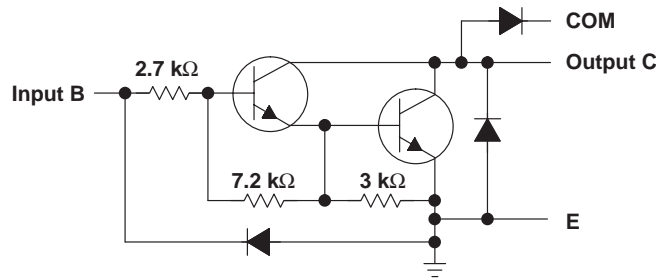
# ULN2803A DARLINGTON TRANSISTOR ARRAY

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## logic diagram



## schematic (each Darlington pair)



**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, $\theta_{JA}$ (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  $T_J(\max)$ ,  $\theta_{JA}$ , 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	$V_{CE} = 50\text{ V}$ , $I_I = 0$ , See Figure 1			50	$\mu\text{A}$	
$I_{I(\text{off})}$	Off-state input current	$V_{CE} = 50\text{ V}$ , $I_C = 500\ \mu\text{A}$ , $T_A = 70^\circ\text{C}$ , See Figure 2	50	65		$\mu\text{A}$	
$I_{I(\text{on})}$	Input current	$V_I = 3.85\text{ V}$ , See Figure 3		0.93	1.35	mA	
$V_{I(\text{on})}$	On-state input voltage	$V_{CE} = 2\text{ V}$ , See Figure 4			2.4	V	
					2.7		
					3		
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$I_I = 250\ \mu\text{A}$ , $I_C = 100\text{ mA}$ , See Figure 5		0.9	1.1	V	
			$I_I = 350\ \mu\text{A}$ , $I_C = 200\text{ mA}$ , See Figure 5		1		1.3
				$I_I = 500\ \mu\text{A}$ , $I_C = 350\text{ mA}$ , See Figure 5			1.3
$I_R$	Clamp diode reverse current	$V_R = 50\text{ V}$ , See Figure 6			50	$\mu\text{A}$	
$V_F$	Clamp diode forward voltage	$I_F = 350\text{ mA}$ , See Figure 7		1.7	2	V	
$C_i$	Input capacitance	$V_I = 0\text{ V}$ , $f = 1\text{ MHz}$		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	$V_S = 50\text{ V}$ , $R_L = 163\ \Omega$ , $C_L = 15\text{ pF}$ , See Figure 8		130		ns
$t_{PHL}$	Propagation delay time, high- to low-level output			20		
$V_{OH}$	High-level output voltage after switching	$V_S = 50\text{ V}$ , See Figure 9	$V_S - 20$			mV

# ULN2803A DARLINGTON TRANSISTOR ARRAY

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## PARAMETER MEASUREMENT INFORMATION

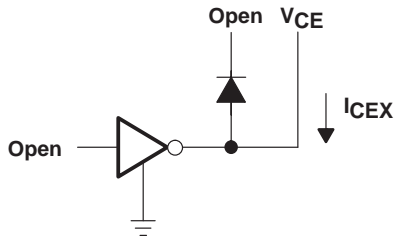


Figure 1.  $I_{CEX}$  Test Circuit

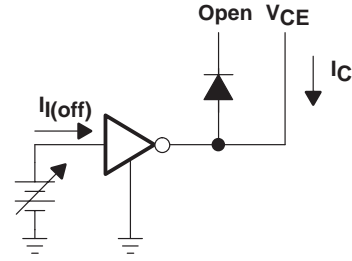


Figure 2.  $I_{I(off)}$  Test Circuit

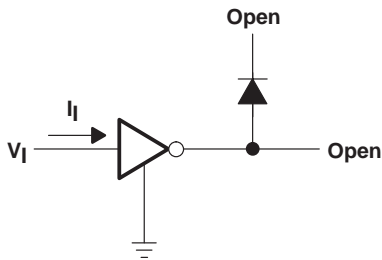


Figure 3.  $I_{I(on)}$  Test Circuit

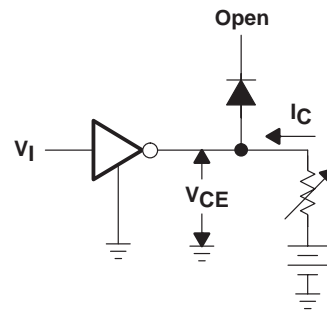


Figure 4.  $V_{I(on)}$  Test Circuit

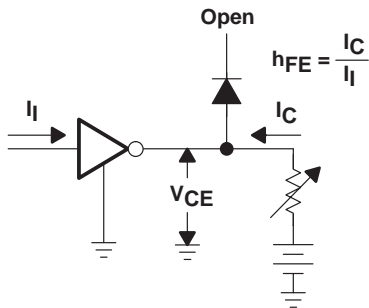


Figure 5.  $h_{FE}$ ,  $V_{CE(sat)}$  Test Circuit

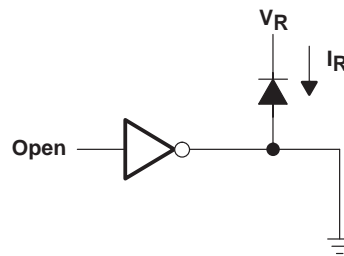


Figure 6.  $I_R$  Test Circuit

PARAMETER MEASUREMENT INFORMATION

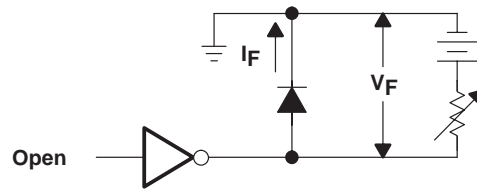
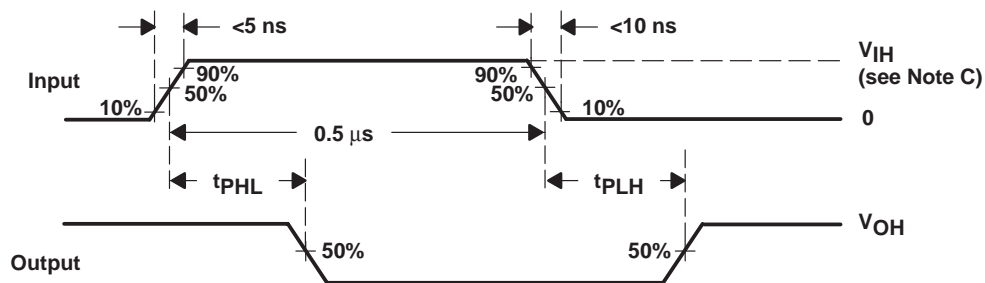
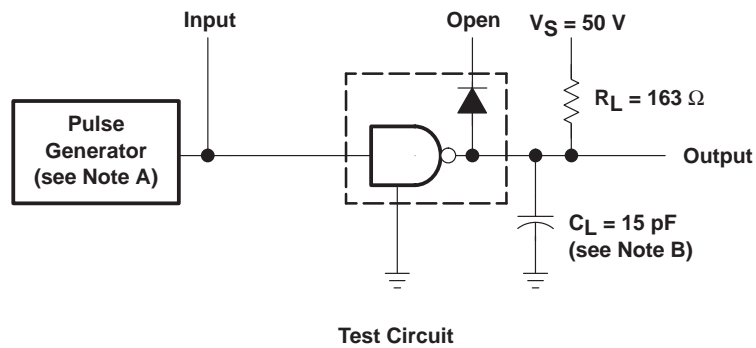


Figure 7.  $V_F$  Test Circuit



Voltage Waveforms

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

Figure 8. Propagation Delay Times

# ULN2803A DARLINGTON TRANSISTOR ARRAY

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## PARAMETER MEASUREMENT INFORMATION



- 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.  $V_{IH} = 3$  V

**Figure 9. Latch-Up Test**

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
ULN2803ADW	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
ULN2803ADWG4	ACTIVE	SOIC	DW	18	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
ULN2803ADWR	ACTIVE	SOIC	DW	18	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
ULN2803ADWRG4	ACTIVE	SOIC	DW	18	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
ULN2803AN	ACTIVE	PDIP	N	18	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
ULN2803ANE4	ACTIVE	PDIP	N	18	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type

<sup>(1)</sup> 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.

**OBSELETE:** TI has discontinued the production of the device.

<sup>(2)</sup> 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)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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## TAPE AND REEL INFORMATION



### 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

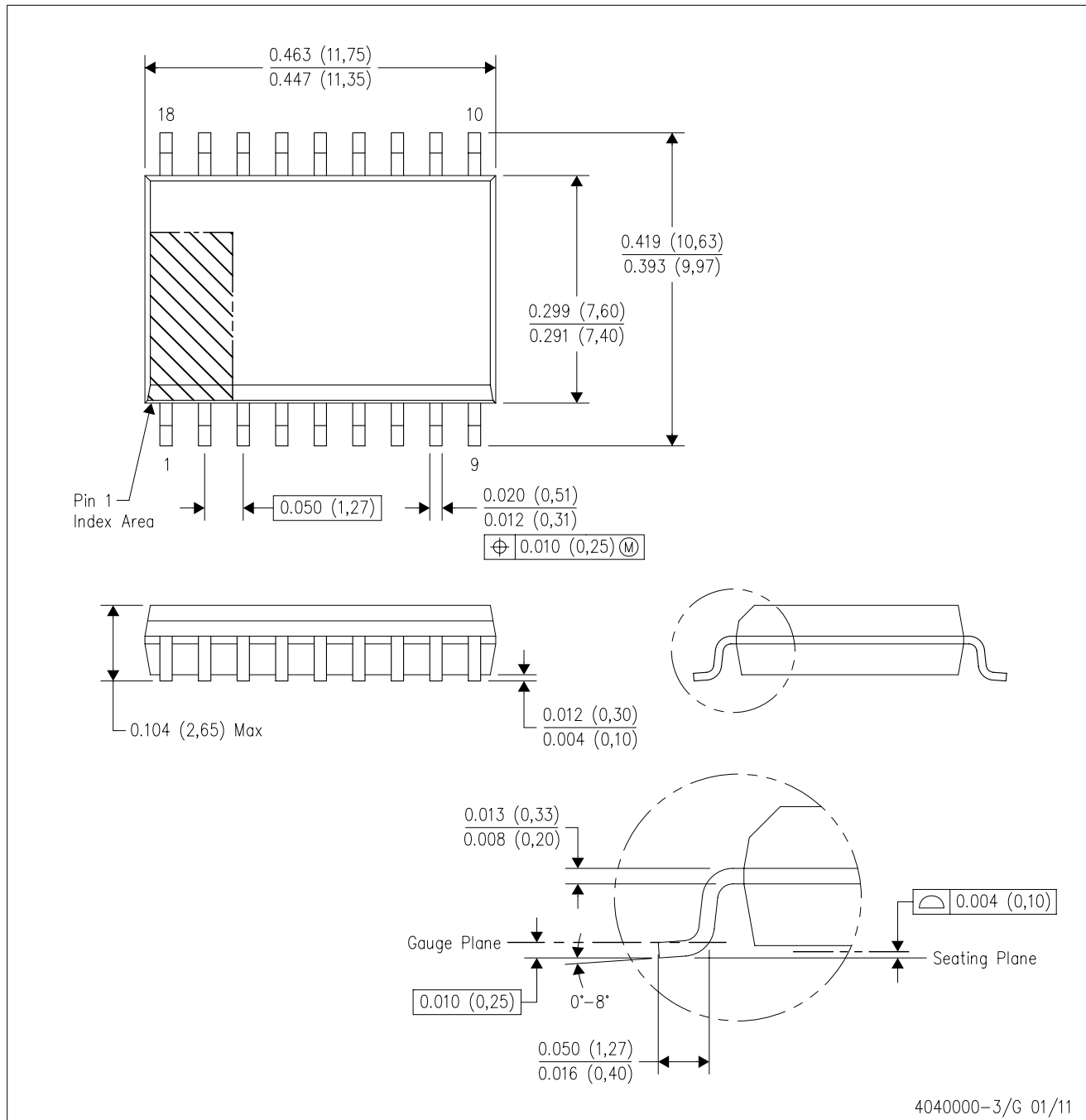


\*All dimensions are nominal

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)

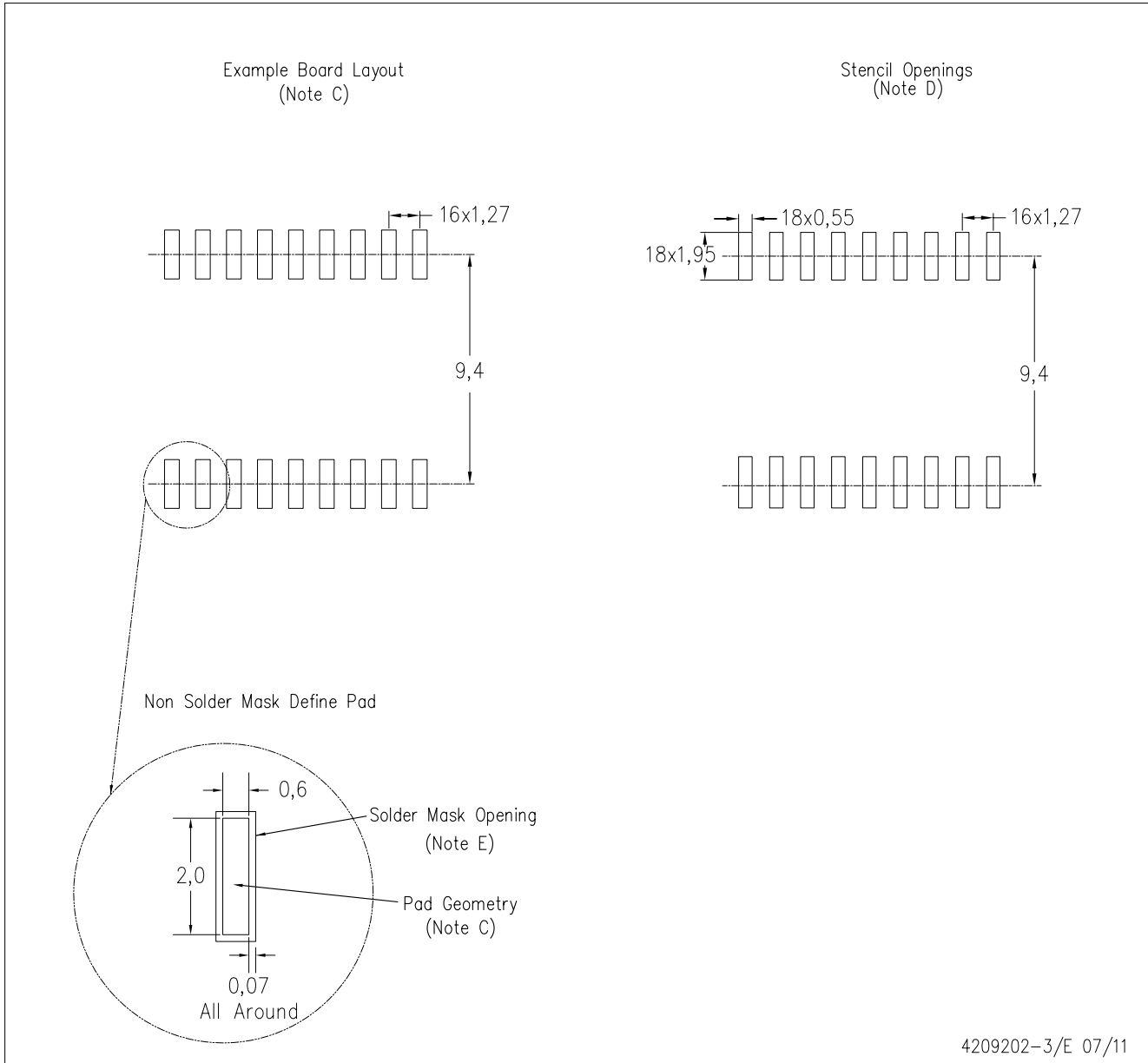
PLASTIC SMALL OUTLINE



- 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



- 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.

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