

# SN54AC533, SN74AC533 OCTAL TRANSPARENT D-TYPE LATCHES WITH 3-STATE OUTPUTS

SCAS555C – NOVEMBER 1995 – REVISED OCTOBER 2003

- 2-V to 6-V  $V_{CC}$  Operation
- Inputs Accept Voltages to 6 V
- Max  $t_{pd}$  of 10.5 ns at 5 V
- 3-State Inverting Outputs Drive Bus Lines Directly
- Full Parallel Access for Loading

## description/ordering information

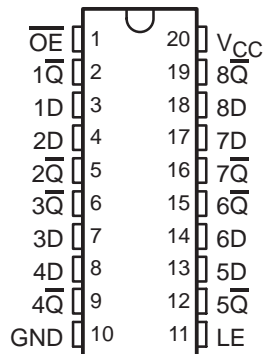
The 'AC533 devices are octal transparent D-type latches with 3-state outputs. When the latch-enable (LE) input is high, the  $\bar{Q}$  outputs follow the complements of the data (D) inputs. When LE is taken low, the  $\bar{Q}$  outputs are latched at the inverse logic levels set up at the D inputs.

A buffered output-enable ( $\overline{OE}$ ) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or the high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capability to drive bus lines without need for interface or pullup components.

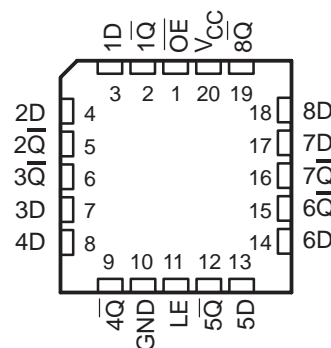
$\overline{OE}$  does not affect the internal operations of the latches. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

SN54AC533 . . . J OR W PACKAGE  
SN74AC533 . . . DB, DW, N, NS, OR PW PACKAGE  
(TOP VIEW)



SN54AC533 . . . FK PACKAGE  
(TOP VIEW)



## ORDERING INFORMATION

T <sub>A</sub>	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	PDIP – N	Tube	SN74AC533N	SN74AC533N
	SOIC – DW	Tube	SN74AC533DW	AC533
		Tape and reel	SN74AC533DWR	
	SOP – NS	Tape and reel	SN74AC533NSR	AC533
	SSOP – DB	Tape and reel	SN74AC533DBR	AC533
	TSSOP – PW	Tube	SN74AC533PW	AC533
Tape and reel		SN74AC533PWR		
–55°C to 125°C	CDIP – J	Tube	SNJ54AC533J	SNJ54AC533J
	CFP – W	Tube	SNJ54AC533W	SNJ54AC533W
	LCCC – FK	Tube	SNJ54AC533FK	SNJ54AC533FK

† 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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**TEXAS  
INSTRUMENTS**

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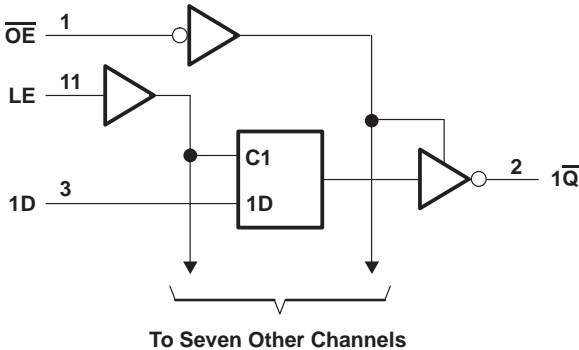
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FUNCTION TABLE  
(each latch)

INPUTS			OUTPUT $\overline{Q}$
$\overline{OE}$	LE	D	
L	H	H	L
L	H	L	H
L	L	X	$\overline{Q}_0$
H	X	X	Z

logic diagram (positive logic)



## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

Supply voltage range, $V_{CC}$	–0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Output voltage range, $V_O$ (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ )	±20 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ )	±20 mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )	±50 mA
Continuous current through $V_{CC}$ or GND	±200 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2):	
DB package	70°C/W
DW package	58°C/W
N package	69°C/W
NS package	60°C/W
PW package	83°C/W

Storage temperature range, $T_{stg}$	–65°C to 150°C
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<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.

NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51-7.

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## recommended operating conditions (see Note 3)

			SN54AC533		SN74AC533		UNIT
			MIN	MAX	MIN	MAX	
V <sub>CC</sub>	Supply voltage		2	6	2	6	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 3 V	2.1		2.1		V
		V <sub>CC</sub> = 4.5 V	3.15		3.15		
		V <sub>CC</sub> = 5.5 V	3.85		3.85		
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 3 V	0.9		0.9		V
		V <sub>CC</sub> = 4.5 V	1.35		1.35		
		V <sub>CC</sub> = 5.5 V	1.65		1.65		
V <sub>I</sub>	Input voltage		0	V <sub>CC</sub>	0	V <sub>CC</sub>	V
V <sub>O</sub>	Output voltage		0	V <sub>CC</sub>	0	V <sub>CC</sub>	V
I <sub>OH</sub>	High-level output current	V <sub>CC</sub> = 3 V	−12		−12		mA
		V <sub>CC</sub> = 4.5 V	−24		−24		
		V <sub>CC</sub> = 5.5 V	−24		−24		
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 3 V	12		12		mA
		V <sub>CC</sub> = 4.5 V	24		24		
		V <sub>CC</sub> = 5.5 V	24		24		
Δt/Δv	Input transition rise or fall rate		8		8		ns/V
T <sub>A</sub>	Operating free-air temperature		−55	125	−40	85	°C

NOTE 3: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

PARAMETER	TEST CONDITIONS	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54AC533		SN74AC533		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$V_{OH}$	$I_{OH} = -50\text{ }\mu\text{A}$	3 V	2.9			2.9		2.9		V
		4.5 V	4.4			4.4		4.4		
		5.5 V	5.4			5.4		5.4		
	$I_{OH} = -12\text{ mA}$	3 V	2.56			2.4		2.46		
		4.5 V	3.86			3.7		3.76		
		5.5 V	4.86			4.7		4.76		
$V_{OL}$	$I_{OL} = 50\text{ }\mu\text{A}$	3 V			0.1		0.1		0.1	V
		4.5 V			0.1		0.1		0.1	
		5.5 V			0.1		0.1		0.1	
	$I_{OL} = 12\text{ mA}$	3 V			0.36		0.5		0.44	
		4.5 V			0.36		0.5		0.44	
		5.5 V			0.36		0.5		0.44	
$I_{OZ}$	$V_O = V_{CC}$ or GND	5.5 V			$\pm 0.25$		$\pm 5$		$\pm 2.5$	$\mu\text{A}$
$I_I$	$V_I = V_{CC}$ or GND	5.5 V			$\pm 0.1$		$\pm 1$		$\pm 1$	$\mu\text{A}$
$I_{CC}$	$V_I = V_{CC}$ or GND, $I_O = 0$	5.5 V			4		80		40	$\mu\text{A}$
$C_i$	$V_I = V_{CC}$ or GND	5 V		4.5						pF

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# SN54AC533, SN74AC533

## OCTAL TRANSPARENT D-TYPE LATCHES

### WITH 3-STATE OUTPUTS

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timing requirements over recommended operating free-air temperature range,  $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  (unless otherwise noted) (see Figure 1)

		$T_A = 25^\circ\text{C}$		SN54AC533		SN74AC533		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
$t_W$	Pulse duration, LE high	6		8		6.5		ns
$t_{SU}$	Setup time, data before LE↓	5.5		7.5		6		ns
$t_H$	Hold time, data after LE↓	1.5		2.5		1		ns

timing requirements over recommended operating free-air temperature range,  $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted) (see Figure 1)

		$T_A = 25^\circ\text{C}$		SN54AC533		SN74AC533		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
$t_W$	Pulse duration, LE high	4.5		6.5		5		ns
$t_{SU}$	Setup time, data before LE↓	4		6		4.5		ns
$t_H$	Hold time, data after LE↓	1.5		2.5		1		ns

switching characteristics over recommended operating free-air temperature range,  $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$		SN54AC533		SN74AC533		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$	D	$\overline{Q}$	2	14	1	17.5	1.5	16	ns
$t_{PHL}$			2	13	1	16	1.5	14.5	
$t_{PLH}$	LE	$\overline{Q}$	2	14.5	1	18	1.5	16.5	ns
$t_{PHL}$			2	13	1	16	1.5	14.5	
$t_{PZH}$	$\overline{OE}$	$\overline{Q}$	2	12.5	1	15.5	1.5	14	ns
$t_{PZL}$			2	12.5	1	15.5	1.5	14	
$t_{PHZ}$	$\overline{OE}$	$\overline{Q}$	2	13	1	16	1.5	14.5	ns
$t_{PLZ}$			2	13	1	16	1.5	14.5	

switching characteristics over recommended operating free-air temperature range,  $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$		SN54AC533		SN74AC533		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$	D	$\overline{Q}$	2	10	1	12.5	1.5	11	ns
$t_{PHL}$			2	9.5	1	12	1.5	10.5	
$t_{PLH}$	LE	$\overline{Q}$	2	10.5	1	13	1.5	11.5	ns
$t_{PHL}$			2	10	1	13	1.5	11	
$t_{PZH}$	$\overline{OE}$	$\overline{Q}$	2	9.5	1	12	1.5	10.5	ns
$t_{PZL}$			2	9.5	1	12	1.5	10.5	
$t_{PHZ}$	$\overline{OE}$	$\overline{Q}$	2	10	1	12.5	1.5	11	ns
$t_{PLZ}$			2	10	1	12.5	1.5	11	

operating characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS		TYP	UNIT
$C_{pd}$	Power dissipation capacitance	$C_L = 50\text{ pF}$ ,	$f = 1\text{ MHz}$	40	pF

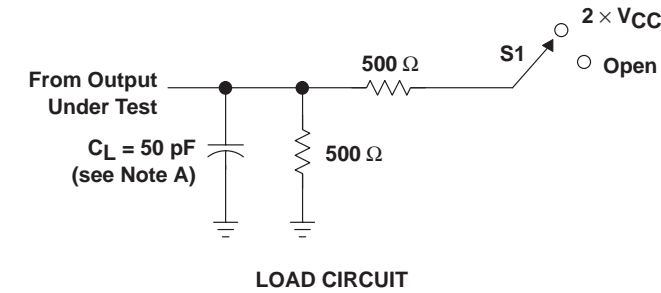
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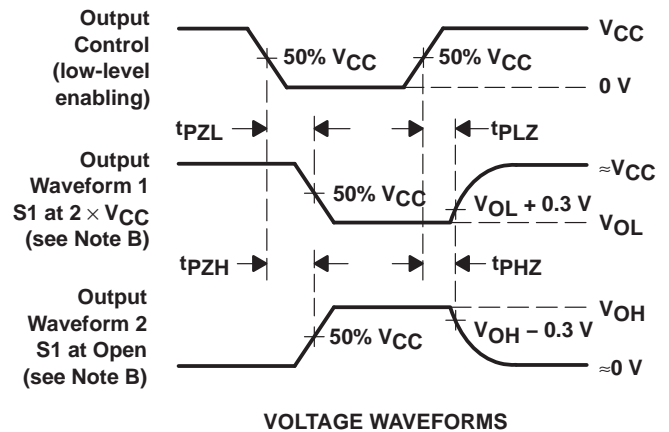
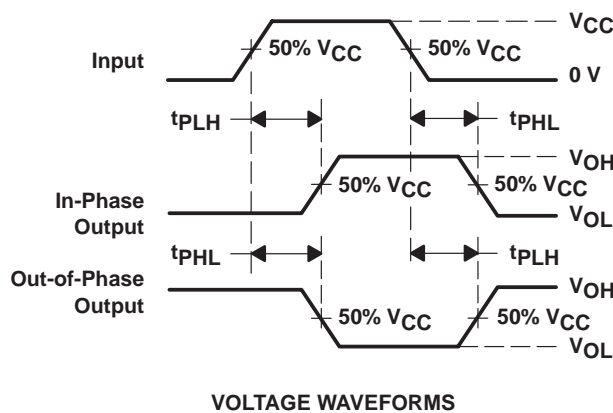
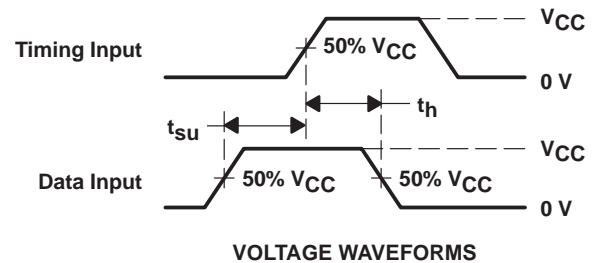
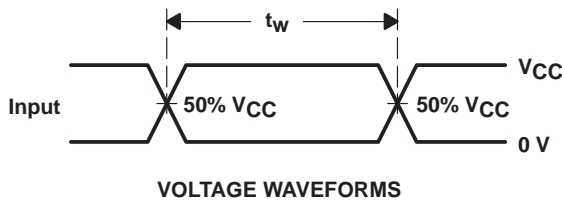
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## PARAMETER MEASUREMENT INFORMATION



TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$2 \times V_{CC}$
$t_{PHZ}/t_{PZH}$	Open



NOTES: A.  $C_L$  includes probe and jig capacitance.

B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control.

Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.

C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .

D. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

**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>	Samples (Requires Login)
SN74AC533DBLE	OBSOLETE	SSOP	DB	20		TBD	Call TI	Call TI	
SN74AC533DBR	ACTIVE	SSOP	DB	20		TBD	Call TI	Call TI	
SN74AC533DBRE4	ACTIVE	SSOP	DB	20		TBD	Call TI	Call TI	
SN74AC533DBRG4	ACTIVE	SSOP	DB	20		TBD	Call TI	Call TI	
SN74AC533DW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74AC533DWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74AC533DWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74AC533DWRE4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74AC533DWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74AC533N	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	
SN74AC533NE4	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	
SN74AC533NSR	ACTIVE	SO	NS	20		TBD	Call TI	Call TI	
SN74AC533NSRE4	ACTIVE	SO	NS	20		TBD	Call TI	Call TI	
SN74AC533NSRG4	ACTIVE	SO	NS	20		TBD	Call TI	Call TI	
SN74AC533PW	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74AC533PWE4	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74AC533PWG4	ACTIVE	TSSOP	PW	20	70	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74AC533PWLE	OBSOLETE	TSSOP	PW	20		TBD	Call TI	Call TI	

<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.

**OBSOLETE:** 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**
**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

**TAPE AND REEL INFORMATION**

\*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
SN74AC53DWR	SOIC	DW	20	2000	330.0	24.4	10.8	13.0	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)
SN74AC533DWR	SOIC	DW	20	2000	367.0	367.0	45.0

N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



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NOTES:

- A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).  
 The 20 pin end lead shoulder width is a vendor option, either half or full width.

DW (R-PDSO-G20)

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 AC.

PW (R-PDSO-G20)

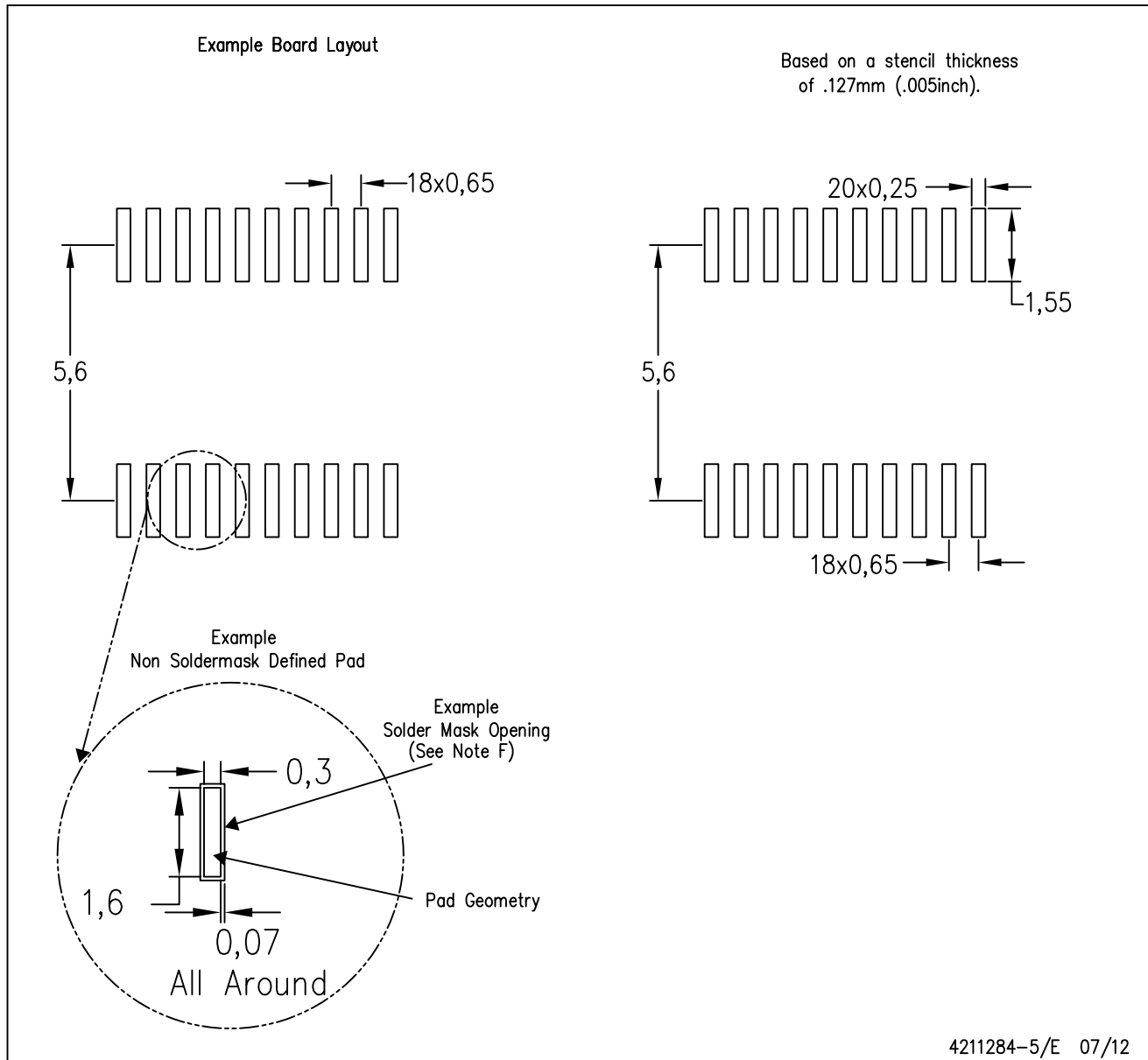
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - 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 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate 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 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

## DB (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-150

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