

SN54ABT533, SN74ABT533A OCTAL TRANSPARENT D-TYPE LATCHES WITH 3-STATE OUTPUTS

SCBS186D – JANUARY 1991 – REVISED JANUARY 1997

- State-of-the-Art **EPIC-IIB™** BiCMOS Design Significantly Reduces Power Dissipation
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- Typical V_{OLP} (Output Ground Bounce) < 1 V at $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$
- High-Drive Outputs ($-32\text{-mA } I_{OH}$, $64\text{-mA } I_{OL}$)
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model ($C = 200$ pF, $R = 0$)
- Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages, Ceramic Chip Carriers (FK), Plastic (N) and Ceramic (J) DIPs, and Ceramic Flat (W) Package

description

These octal transparent D-type latches with 3-state outputs are designed specifically for driving highly capacitive or relatively low-impedance loads. They are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

When the latch-enable (LE) input is high, the $\overline{Q}$ outputs follow the complements of the data (D) inputs. When LE is taken low, the $\overline{Q}$ outputs are latched at the inverse of the levels at the D inputs.

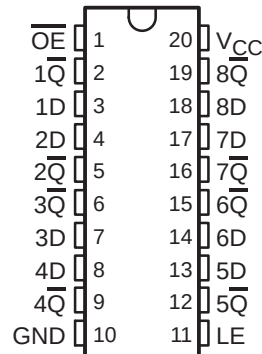
A buffered output-enable ($\overline{OE}$) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased 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. Previously stored data can be retained or new data can be entered while the outputs are in the high-impedance state.

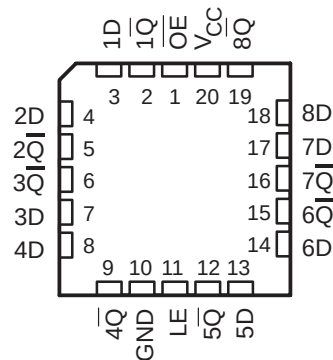
To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN54ABT533 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74ABT533A is characterized for operation from -40°C to 85°C .

SN54ABT533 . . . J OR W PACKAGE
SN74ABT533A . . . DB, DW, N, OR PW PACKAGE
(TOP VIEW)



SN54ABT533 . . . FK PACKAGE
(TOP VIEW)



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SN54ABT533, SN74ABT533A

OCTAL TRANSPARENT D-TYPE LATCHES

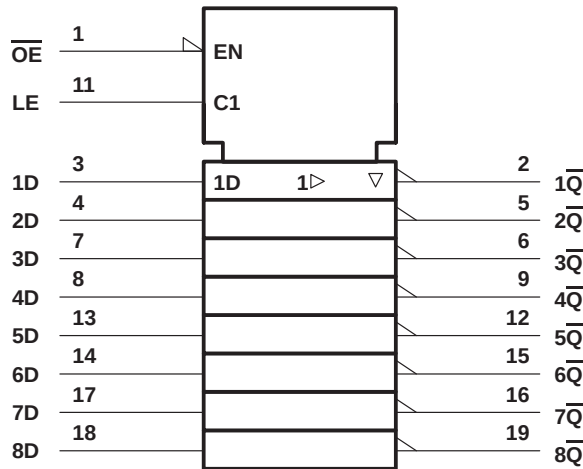
WITH 3-STATE OUTPUTS

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FUNCTION TABLE
(each latch)

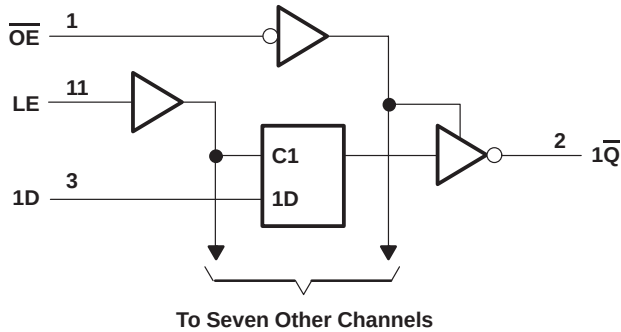
INPUTS			OUTPUT $\overline{Q}$
$\overline{OE}$	LE	D	
L	H	H	L
L	H	L	H
L	L	X	$\overline{Q_0}$
H	X	X	Z

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



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

Supply voltage range, V_{CC}	–0.5 V to 7 V
Input voltage range, V_I (see Note 1)	–0.5 V to 7 V
Voltage range applied to any output in the high or power-off state, V_O	–0.5 V to 5.5 V
Current into any output in the low state, I_O : SN54ABT533	96 mA
SN74ABT533A	128 mA
Input clamp current, I_{IK} ($V_I < 0$)	–18 mA
Output clamp current, I_{OK} ($V_O < 0$)	–50 mA
Package thermal impedance, θ_{JA} (see Note 2): DB package	115°C/W
DW package	97°C/W
N package	67°C/W
PW package	128°C/W
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. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. The package thermal impedance is calculated in accordance with EIA/JEDEC Std JESD51, except for through-hole packages, which use a trace length of zero.

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recommended operating conditions (see Note 3)

		SN54ABT533		SN74ABT533A		UNIT
		MIN	MAX	MIN	MAX	
V _{CC}	Supply voltage	4.5	5.5	4.5	5.5	V
V _{IH}	High-level input voltage	2		2		V
V _{IL}	Low-level input voltage		0.8		0.8	V
V _I	Input voltage	0	V _{CC}	0	V _{CC}	V
I _{OH}	High-level output current		–24		–32	mA
I _{OL}	Low-level output current		48		64	mA
Δt/Δv	Input transition rise or fall rate		10		10	ns/V
T _A	Operating free-air temperature	–55	125	–40	85	°C

NOTE 3: Unused inputs must be held high or low to prevent them from floating.

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

PARAMETER	TEST CONDITIONS		T _A = 25°C			SN54ABT533		SN74ABT533A		UNIT
			MIN	TYP [†]	MAX	MIN	MAX	MIN	MAX	
V _{IK}	V _{CC} = 4.5 V, I _I = −18 mA		−1.2			−1.2		−1.2		V
V _{OH}	V _{CC} = 4.5 V, I _{OH} = −3 mA		2.5			2.5		2.5		V
	V _{CC} = 5 V, I _{OH} = −3 mA		3			3		3		
	V _{CC} = 4.5 V	I _{OH} = −24 mA	2			2				
		I _{OH} = −32 mA	2*					2		
V _{OL}	V _{CC} = 4.5 V	I _{OL} = 48 mA	0.55			0.55				V
		I _{OL} = 64 mA	0.55*					0.55		
V _{hys}			100							mV
I _I	V _{CC} = 5.5 V, V _I = V _{CC} or GND		±1			±1		±1		μA
I _{OZH}	V _{CC} = 5.5 V, V _O = 2.7 V		10			10		10		μA
I _{OZL}	V _{CC} = 5.5 V, V _O = 0.5 V		−10			−10		−10		μA
I _{off}	V _{CC} = 0, V _I or V _O ≤ 4.5 V		±150					±150		μA
I _{CEX}	V _{CC} = 5.5 V, V _O = 5.5 V	Outputs high	50			50		50		μA
I _{O[‡]}	V _{CC} = 5.5 V, V _O = 2.5 V		−50	−140	−180	−50	−180	−50	−180	mA
I _{CC}	V _{CC} = 5.5 V, I _O = 0, V _I = V _{CC} or GND		Outputs high		1	250	250		250	μA
			Outputs low		24	30	30		30	mA
			Outputs disabled		0.5	250	250		250	μA
ΔI _{CC} [§]	V _{CC} = 5.5 V, One input at 3.4 V, Other inputs at V _{CC} or GND		Outputs high		1.5		1.5		1.5	mA
			Outputs low		1.5		1.5		1.5	
			Outputs disabled		1.5		1.5		1.5	
C _i	V _I = 2.5 V or 0.5 V		3.5							pF
C _O	V _O = 2.5 V or 0.5 V		6.5							pF

* On products compliant to MIL-PRF-38535, this parameter does not apply.

[†] All typical values are at V_{CC} = 5 V.

[‡] Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

[§] This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.



SN54ABT533, SN74ABT533A

OCTAL TRANSPARENT D-TYPE LATCHES

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timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)

			SN54ABT533		UNIT
			$V_{CC} = 5\text{ V}$, $T_A = 25^{\circ}\text{C}$		
			MIN	MAX	
t_W	Pulse duration, LE high		3.3	3.3	ns
t_{SU}	Setup time, data before LE↓	High or low	2.1	2.1	ns
t_H	Hold time, data after LE↓	High or low	1.5	1.5	ns

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)

			SN74ABT533A		UNIT		
			V _{CC} = 5 V, T _A = 25°C			MIN	MAX
			MIN	MAX			
t _W	Pulse duration, LE high		3.3	3.3	ns		
t _{SU}	Setup time, data before LE↓	High or low	2.1	2.1	ns		
t _H	Hold time, data after LE↓	High or low	2.1	2.1	ns		

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54ABT533				UNIT	
			V _{CC} = 5 V, T _A = 25°C			MIN		MAX
			MIN	TYP	MAX			
t _{PLH}	D	$\overline{Q}$	1.9	4.2	5.4	1.9	6.7	ns
t _{PHL}			3.1	4.9	6.3	3.1	6.9	
t _{PLH}	LE	$\overline{Q}$	2.7	4.9	6.2	2.7	7.6	ns
t _{PHL}			3.5	5.4	6.8	3.5	7.5	
t _{PZH}	$\overline{OE}$	$\overline{Q}$	1.6	3.7	4.8	1.6	5.8	ns
t _{PZL}			2.4	4.2	6.2	2.4	6.9	
t _{PHZ}	$\overline{OE}$	$\overline{Q}$	2.8	5.1	6.2	2.8	7.2	ns
t _{PLZ}			2	4.1	6	2	6.9	

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switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L = 50$ pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74ABT533A					UNIT
			V _{CC} = 5 V, T _A = 25°C			MIN	MAX	
			MIN	TYP	MAX			
t _{PLH}	D	$\overline{Q}$	1.7	4.2	5.4	1.7	6.4	ns
t _{PHL}			2.6	4.9	6.3	2.6	6.6	
t _{PLH}	LE	$\overline{Q}$	2.7	4.9	6.2	2.7	7.3	ns
t _{PHL}			3.5	5.4	6.8	3.5	7.3	
t _{PZH}	$\overline{OE}$	$\overline{Q}$	1.6	3.7	4.8	1.6	5.7	ns
t _{PZL}			2.4	4.2	6.2	2.4	6.7	
t _{PHZ}	$\overline{OE}$	$\overline{Q}$	1.6	5.1	6.2	1.6	6.9	ns
t _{PLZ}			2	4.1	6	2	6.5	

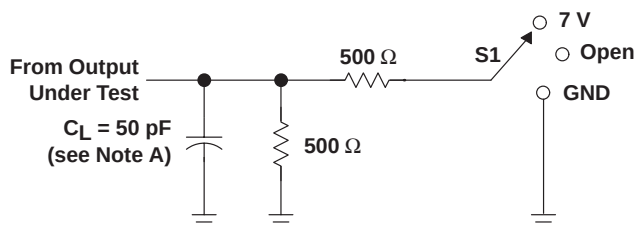
SN54ABT533, SN74ABT533A

OCTAL TRANSPARENT D-TYPE LATCHES

WITH 3-STATE OUTPUTS

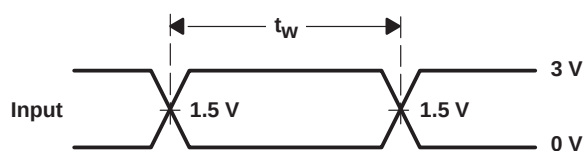
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PARAMETER MEASUREMENT INFORMATION

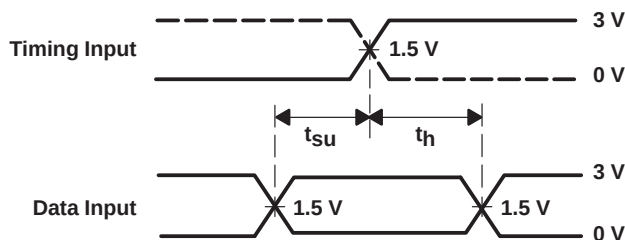


LOAD CIRCUIT

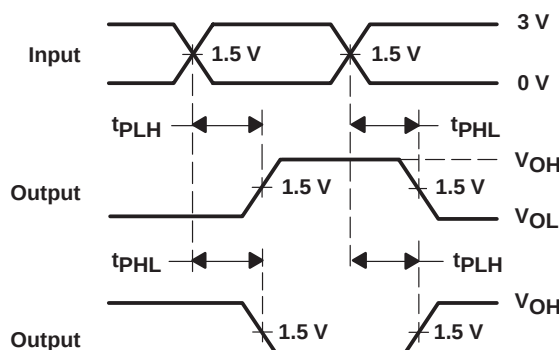
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open



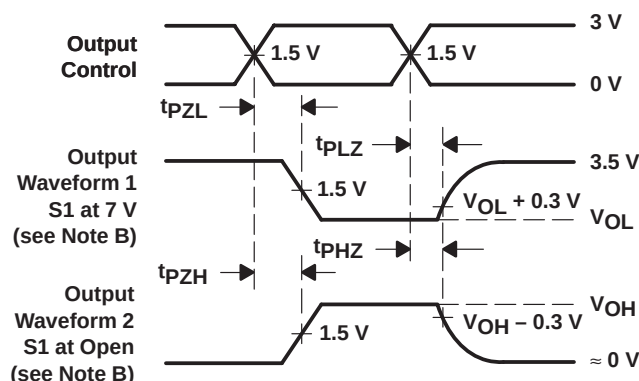
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

- 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: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
5962-9584301Q2A	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Call TI	
5962-9584301QRA	ACTIVE	CDIP	J	20	1	TBD	Call TI	Call TI	
5962-9584301QSA	ACTIVE	CFP	W	20	1	TBD	Call TI	Call TI	
SN74ABT533ADBLE	OBSOLETE	SSOP	DB	20		TBD	Call TI	Call TI	
SN74ABT533ADBR	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT533ADBRE4	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT533ADBRG4	ACTIVE	SSOP	DB	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT533ADW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT533ADWE4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT533ADWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT533AN	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	
SN74ABT533ANE4	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	
SN74ABT533APWLE	OBSOLETE	TSSOP	PW	20		TBD	Call TI	Call TI	
SN74ABT533APWR	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT533APWRE4	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT533APWRG4	ACTIVE	TSSOP	PW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SNJ54ABT533FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	
SNJ54ABT533J	ACTIVE	CDIP	J	20	1	TBD	A42	N / A for Pkg Type	
SNJ54ABT533W	ACTIVE	CFP	W	20	1	TBD	Call TI	N / A for Pkg Type	

⁽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.

OBSELETE: 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.

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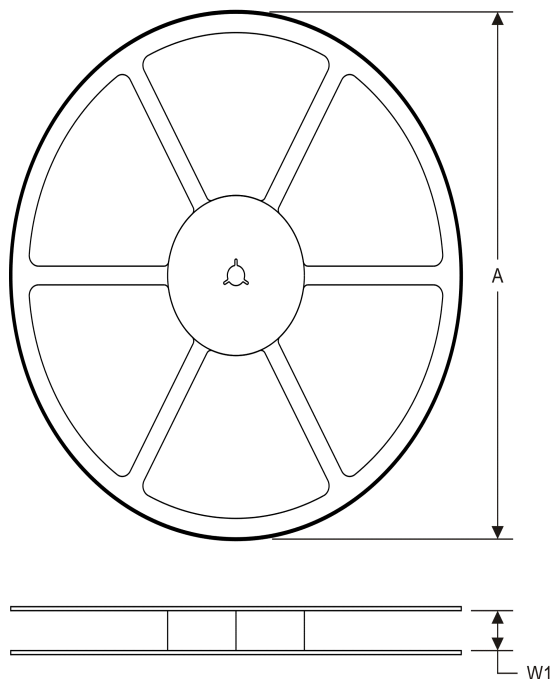
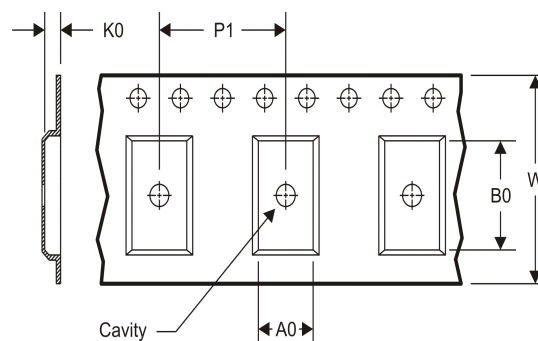
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF SN54ABT533 :

- Catalog: [SN74ABT533](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


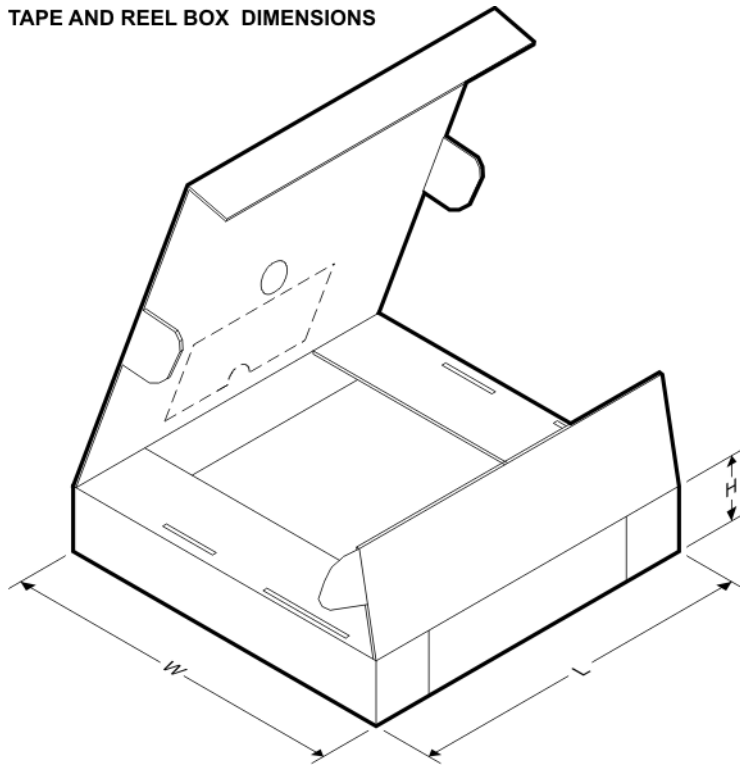
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
SN74ABT533ADBR	SSOP	DB	20	2000	330.0	16.4	8.2	7.5	2.5	12.0	16.0	Q1
SN74ABT533APWR	TSSOP	PW	20	2000	330.0	16.4	6.95	7.1	1.6	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



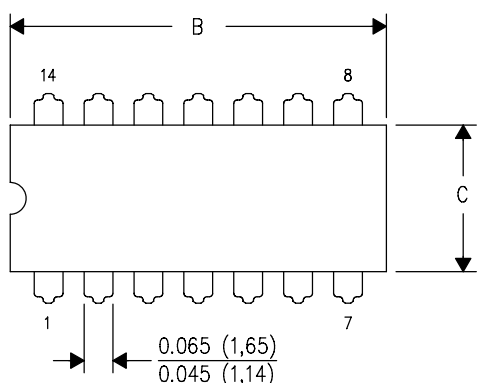
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ABT533ADBR	SSOP	DB	20	2000	367.0	367.0	38.0
SN74ABT533APWR	TSSOP	PW	20	2000	367.0	367.0	38.0

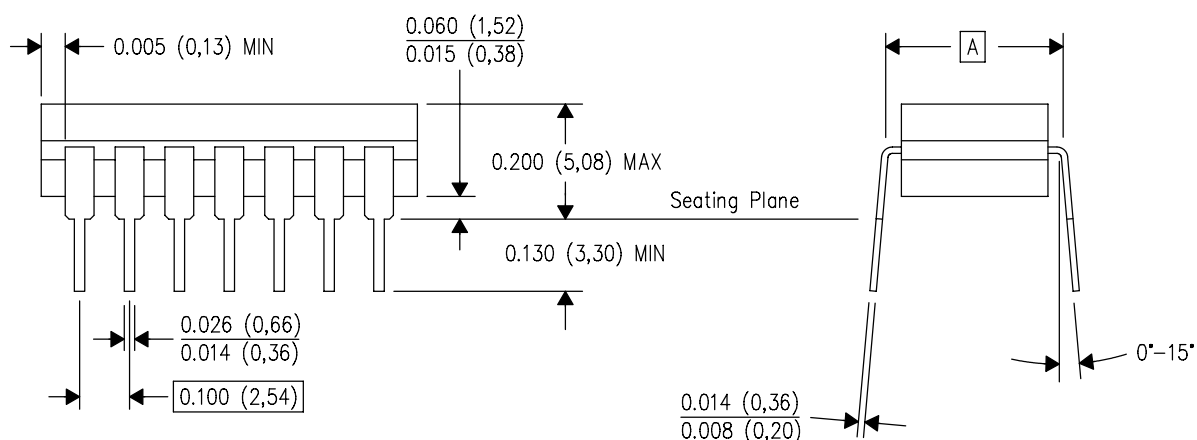
J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)

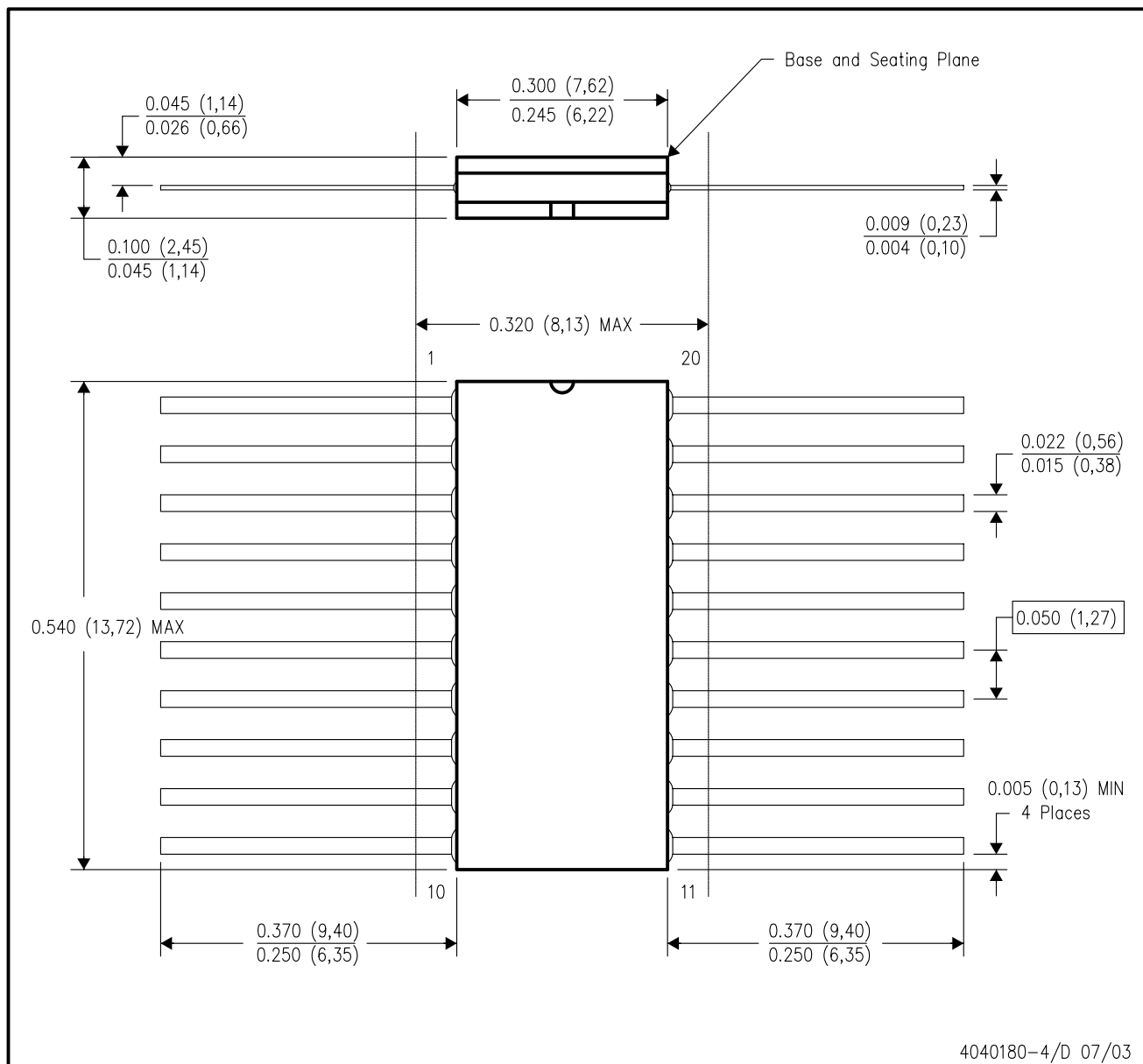


4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package is hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F20)

CERAMIC DUAL FLATPACK

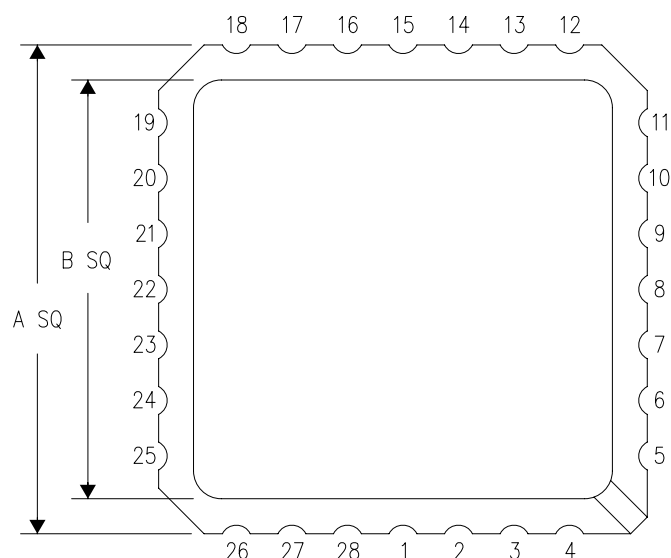


- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only.
 - Falls within Mil-Std 1835 GDFP2-F20

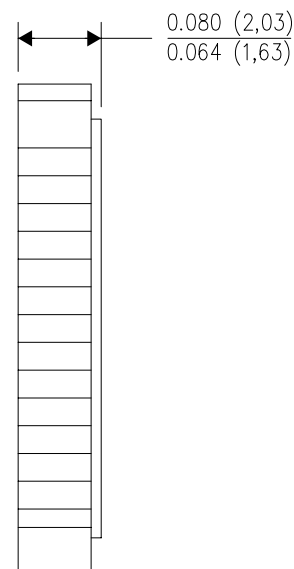
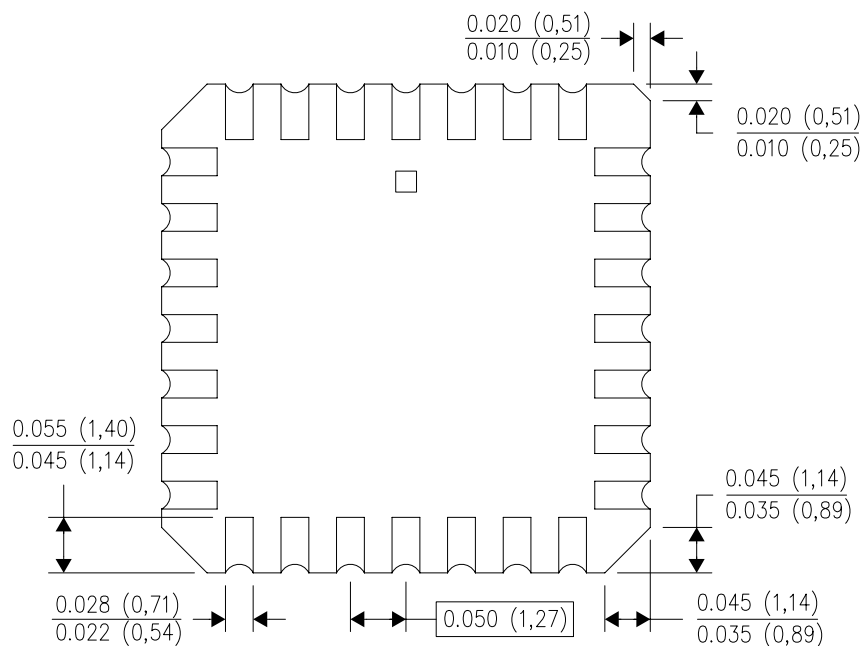
FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



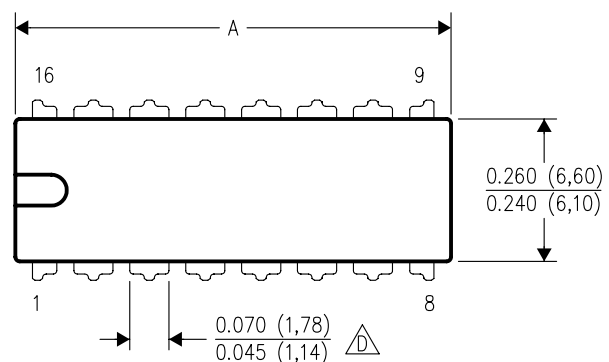
4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a metal lid.
 - Falls within JEDEC MS-004

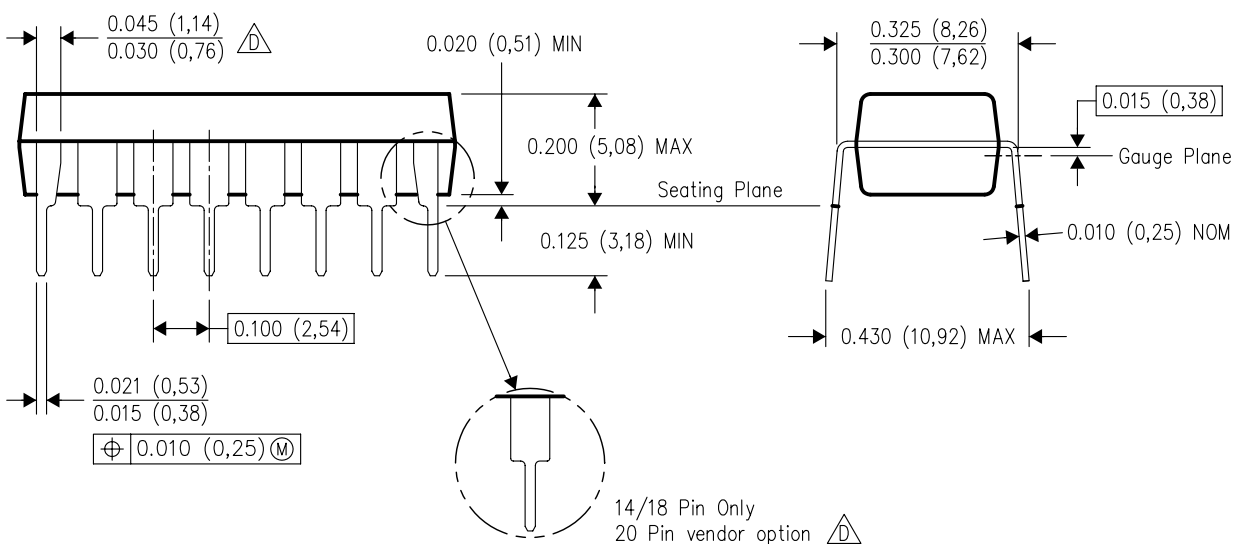
N (R-PDIP-T**)

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



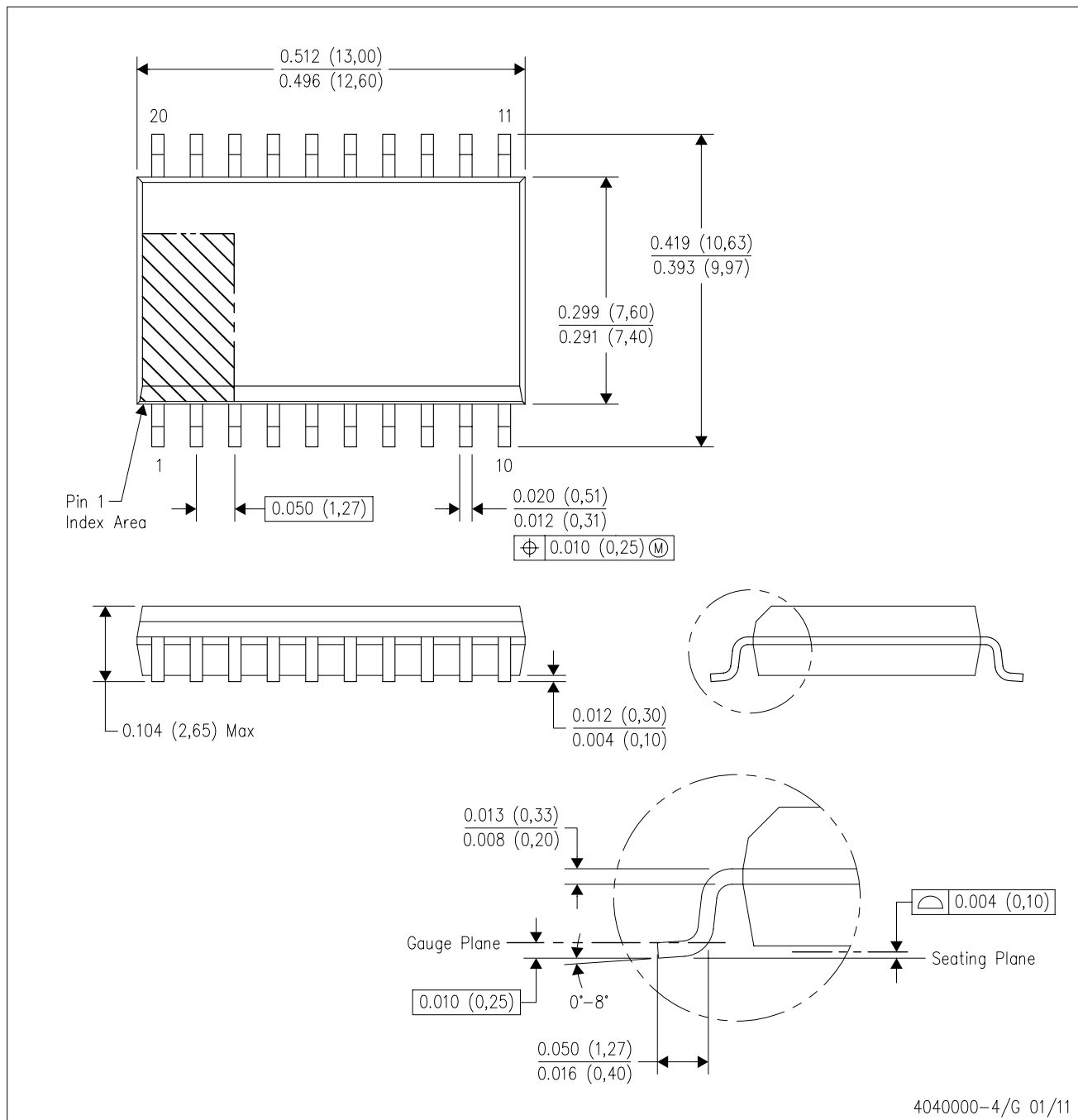
4040049/E 12/2002

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)

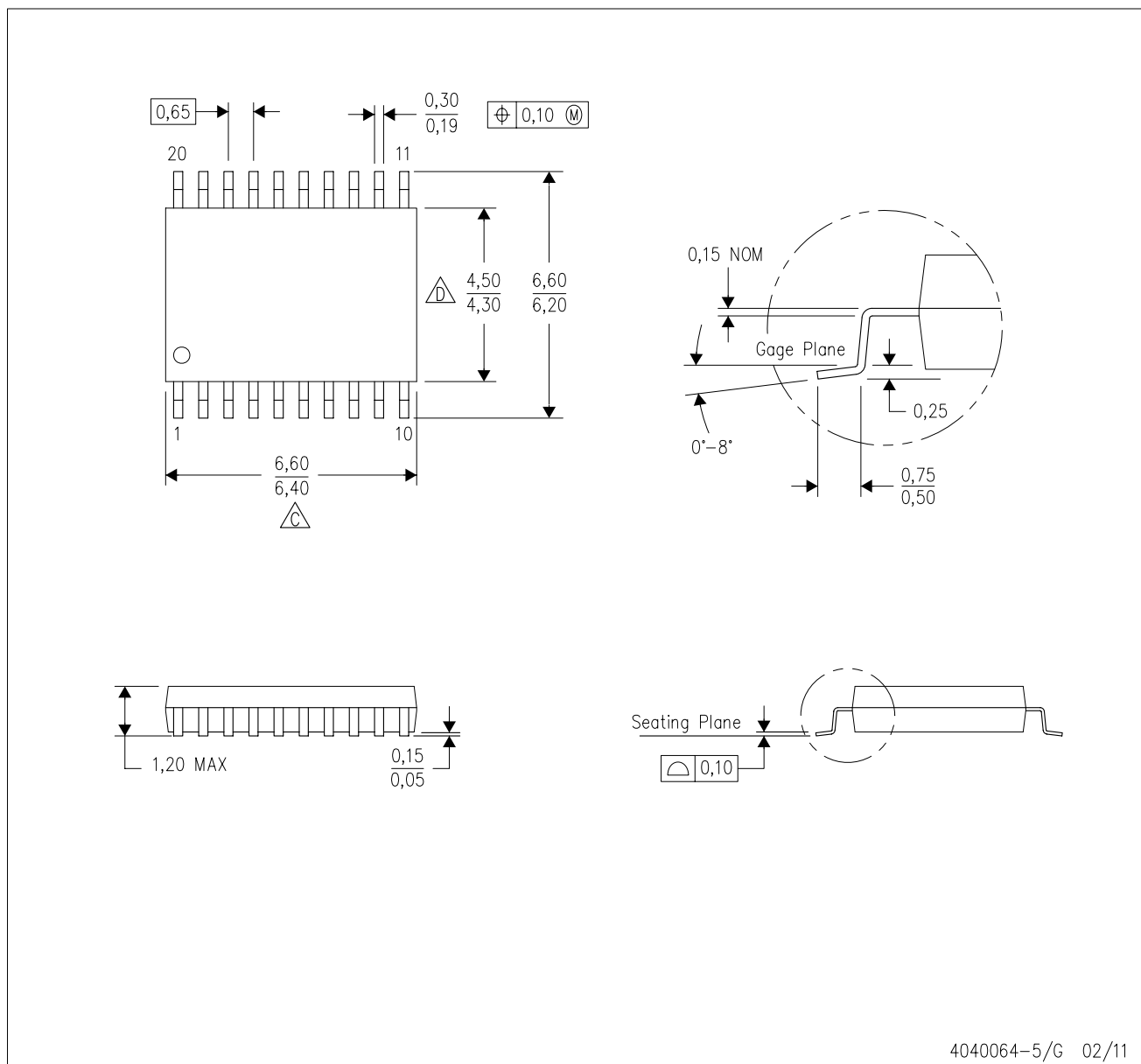
PLASTIC SMALL OUTLINE



- 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)

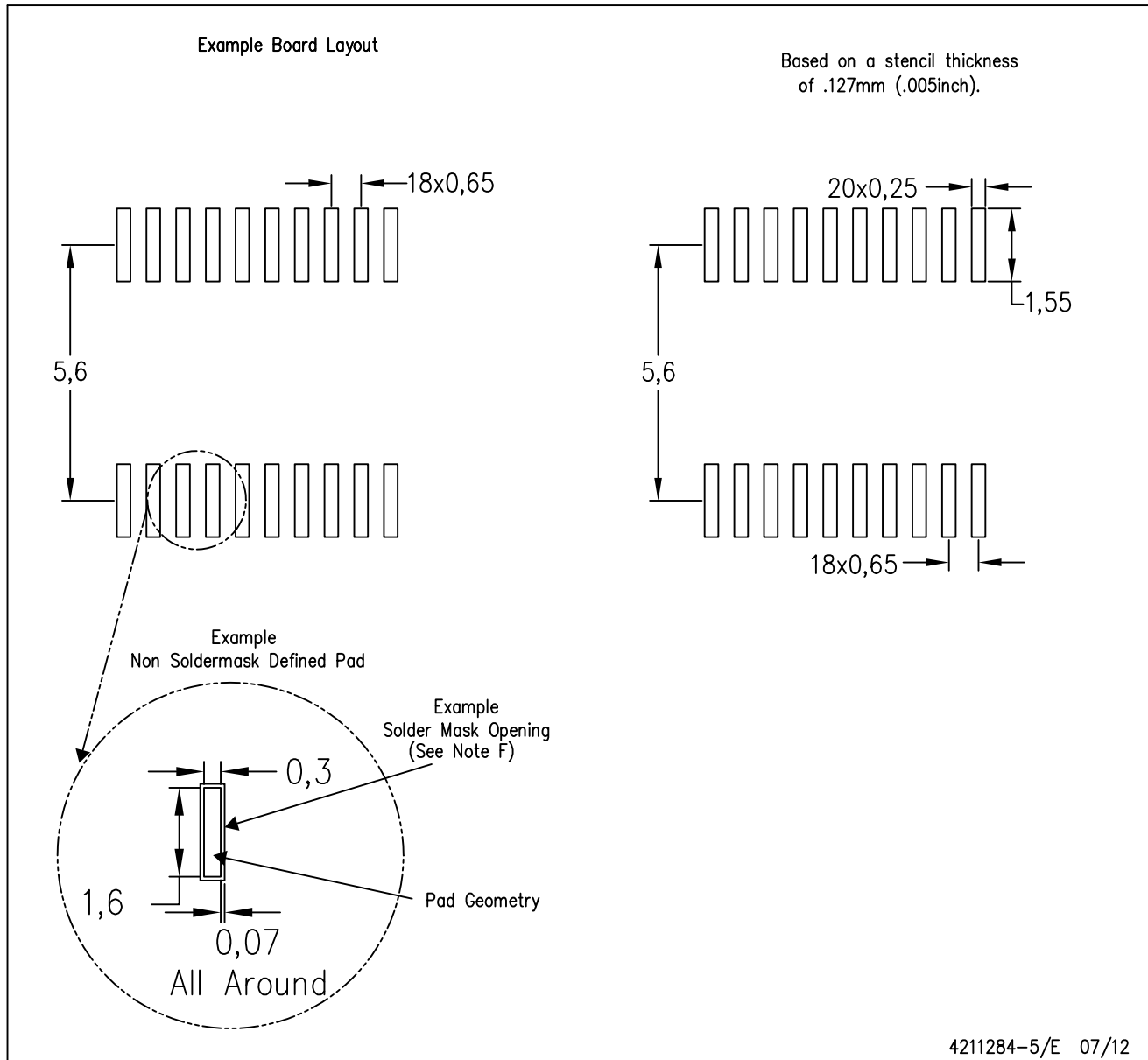
PLASTIC SMALL OUTLINE



- 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

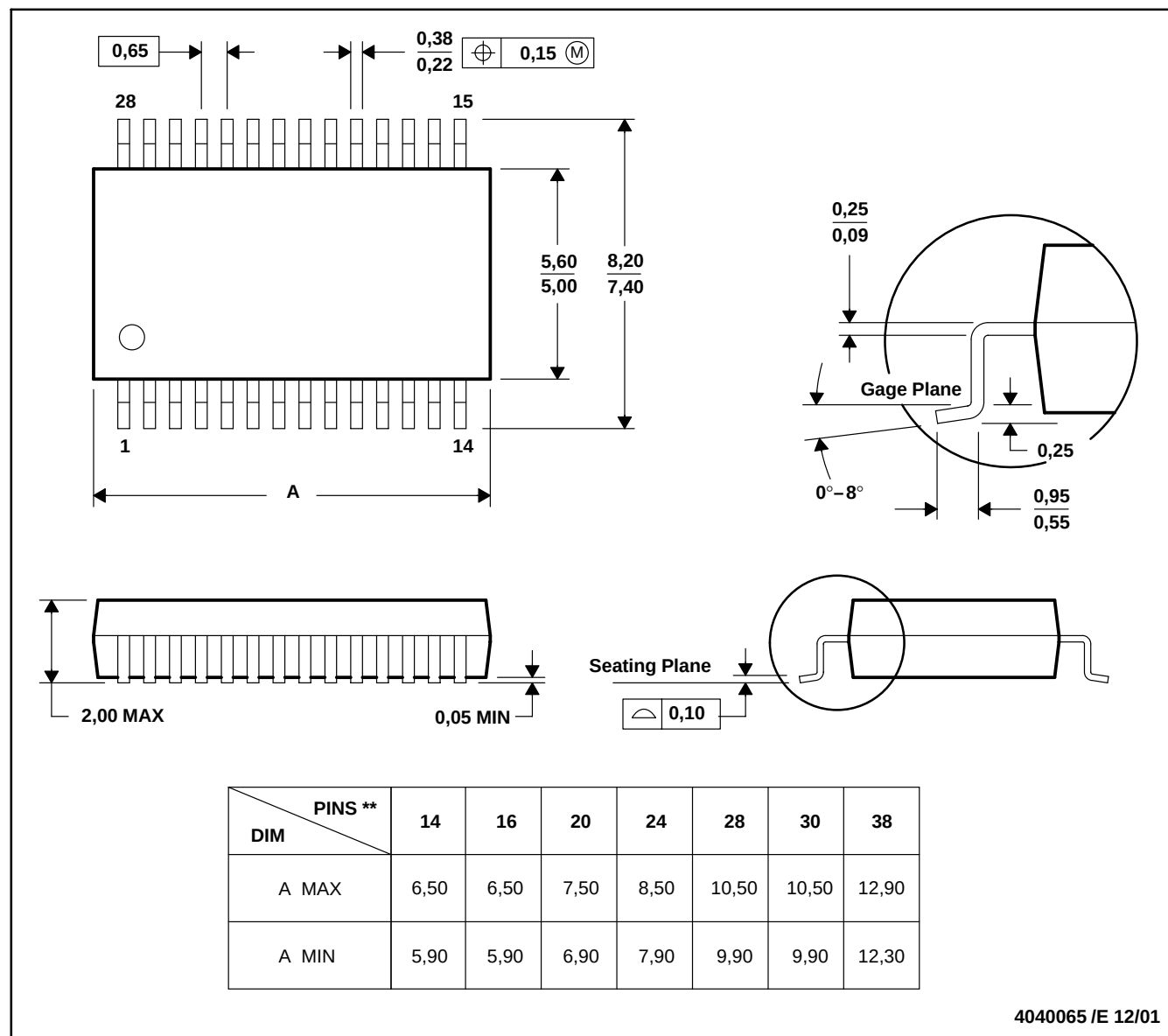


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate design.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should 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.

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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