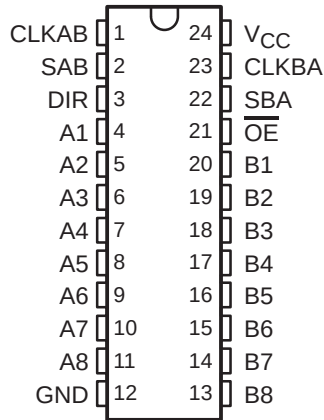


SN54ABT646A, SN74ABT646A OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

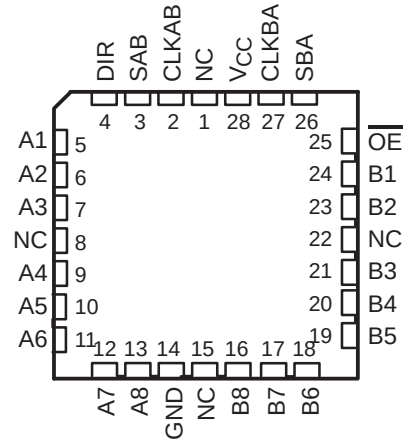
SCBS069H - JULY 1991 - REVISED MAY 2004

- Typical V_{OLP} (Output Ground Bounce) <1 V at $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$
- High-Drive Outputs ($-32\text{-mA } I_{OH}$, $64\text{-mA } I_{OL}$)
- I_{off} Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)

SN54ABT646A . . . JT OR W PACKAGE
SN74ABT646A . . . DB, DGV, DW, NS, NT, OR PW PACKAGE
(TOP VIEW)



SN54ABT646A . . . FK PACKAGE
(TOP VIEW)



NC - No internal connection

description/ordering information

These devices consist of bus-transceiver circuits, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal registers. Data on the A or B bus is clocked into the registers on the low-to-high transition of the appropriate clock (CLKAB or CLKBA) input. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the 'ABT646A devices.

ORDERING INFORMATION

T_A	PACKAGE [†]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	PDIP - NT	Tube	SN74ABT646ANT	SN74ABT646ANT
	SOIC - DW	Tube	SN74ABT646ADW	ABT646A
		Tape and reel	SN74ABT646ADWR	
	SOP - NS	Tape and reel	SN74ABT646ANSR	ABT646A
	SSOP - DB	Tape and reel	SN74ABT646ADBR	AB646A
	TSSOP - PW	Tube	SN74ABT646APW	AB646A
		Tape and reel	SN74ABT646APWR	
-55°C to 125°C	TVSOP - DGV	Tape and reel	SN74ABT646ADGVR	AB646A
	CDIP - JT	Tube	SNJ54ABT646AJT	SNJ54ABT646AJT
	CFP - W	Tube	SNJ54ABT646AW	SNJ54ABT646AW
	LCCC - FK	Tube	SNJ54ABT646AFK	SNJ54ABT646AFK

[†] 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.

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.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2004, Texas Instruments Incorporated
On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

SN54ABT646A, SN74ABT646A OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

SCBS069H – JULY 1991 – REVISED MAY 2004

description/ordering information(continued)

Output-enable ($\overline{OE}$) and direction-control (DIR) inputs are provided to control the transceiver functions. In the transceiver mode, data present at the high-impedance port can be stored in either register or in both.

The select-control (SAB and SBA) inputs can multiplex stored and real-time (transparent mode) data. The direction control (DIR) determines which bus receives data when $\overline{OE}$ is low. In the isolation mode ($\overline{OE}$ high), A data can be stored in one register and/or B data can be stored in the other register.

When an output function is disabled, the input function still is enabled and can be used to store and transmit data. Only one of the two buses, A or B, can be driven at a time.

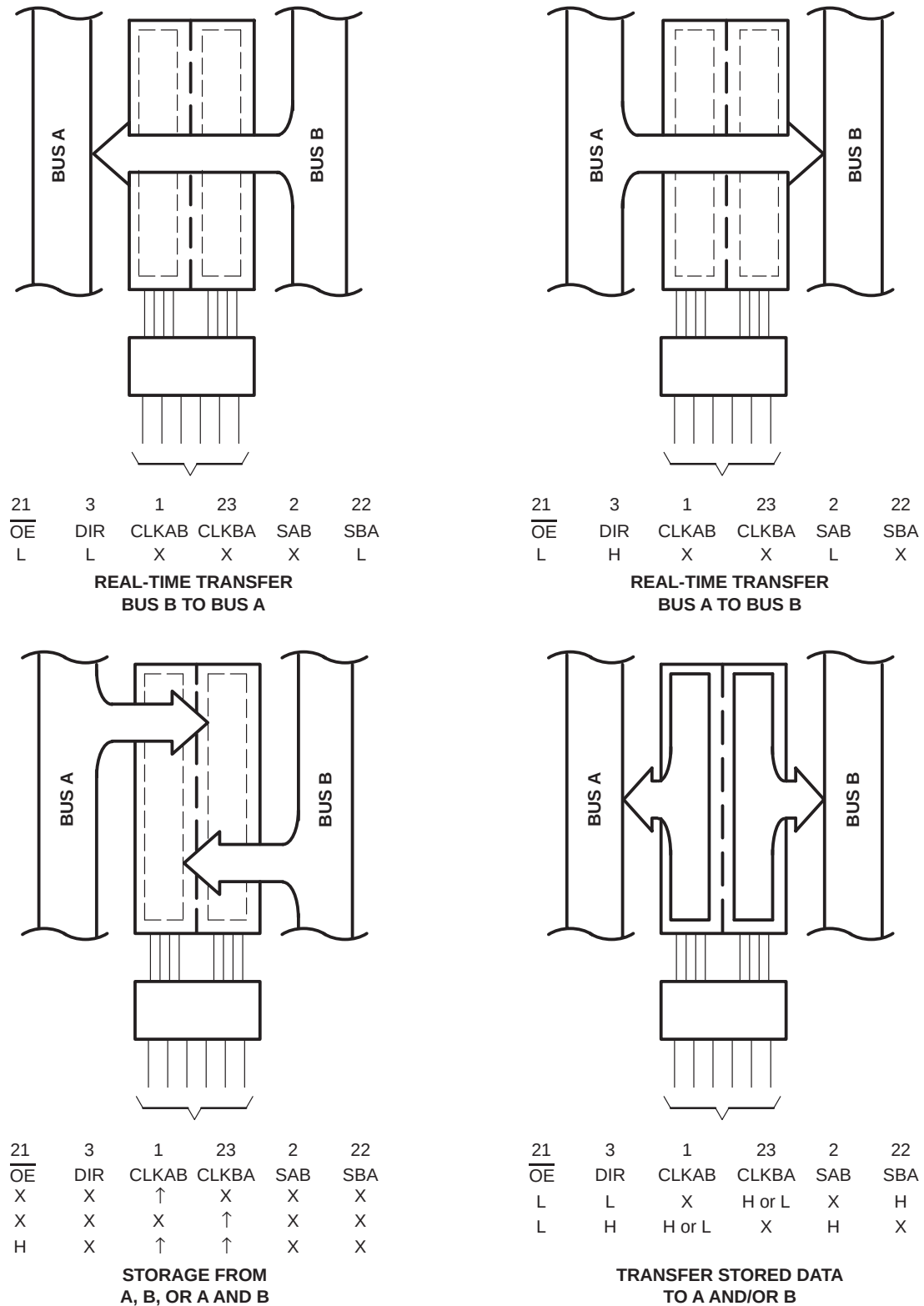
These devices are fully specified for partial-power-down applications using I_{off} . The I_{off} circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down.

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.



SN54ABT646A, SN74ABT646A OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

SCBS069H - JULY 1991 - REVISED MAY 2004



Pin numbers shown are for the DB, DGV, DW, JT, NS, NT, PW, and W packages.

Figure 1. Bus-Management Functions

SN54ABT646A, SN74ABT646A
OCTAL BUS TRANSCEIVERS AND REGISTERS
WITH 3-STATE OUTPUTS

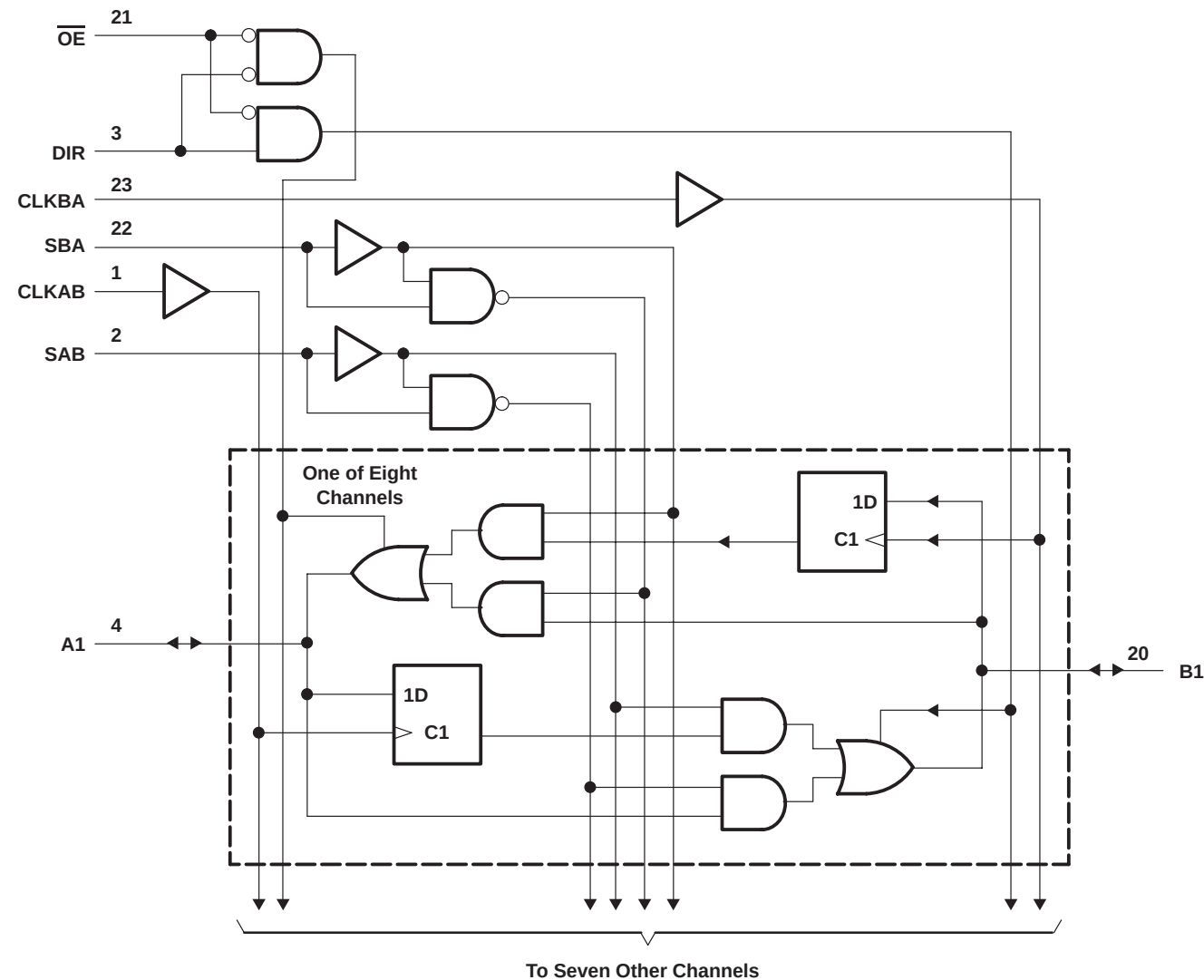
SCBS069H – JULY 1991 – REVISED MAY 2004

FUNCTION TABLE

INPUTS						DATA I/Os		OPERATION OR FUNCTION
$\overline{OE}$	DIR	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
X	X	$\uparrow$	X	X	X	Input	Unspecified [†]	Store A, B unspecified [†]
X	X	X	$\uparrow$	X	X	Unspecified [†]	Input	Store B, A unspecified [†]
H	X	$\uparrow$	$\uparrow$	X	X	Input	Input	Store A and B data
H	X	H or L	H or L	X	X	Input disabled	Input disabled	Isolation, hold storage
L	L	X	X	X	L	Output	Input	Real-time B data to A bus
L	L	X	H or L	X	H	Output	Input	Stored B data to A bus
L	H	X	X	L	X	Input	Output	Real-time A data to B bus
L	H	H or L	X	H	X	Input	Output	Stored A data to B bus

[†] The data-output functions can be enabled or disabled by various signals at $\overline{OE}$ and DIR. Data-input functions always are enabled, i.e., data at the bus terminals is stored on every low-to-high transition of the clock inputs.

logic diagram (positive logic)



Pin numbers shown are for the DB, DGV, DW, JT, NS, NT, PW, and W packages.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN54ABT646A, SN74ABT646A OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

SCBS069H – JULY 1991 – REVISED MAY 2004

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 (except I/O ports) (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 : SN54ABT646A	96 mA
SN74ABT646A	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	63°C/W
(see Note 2): DGV package	86°C/W
(see Note 2): DW package	46°C/W
(see Note 2): NS package	65°C/W
(see Note 3): NT package	67°C/W
(see Note 2): PW package	88°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 JESD 51-7.
3. The package thermal impedance is calculated in accordance with JESD 51-3.

recommended operating conditions (see Note 4)

	SN54ABT646A		SN74ABT646A		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
$\Delta t/\Delta v$ Input transition rise or fall rate		5		5	ns/V
T_A Operating free-air temperature	–55	125	–40	85	°C

NOTE 4: 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.



SN54ABT646A, SN74ABT646A

OCTAL BUS TRANSCEIVERS AND REGISTERS

WITH 3-STATE OUTPUTS

SCBS069H – JULY 1991 – REVISED MAY 2004

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

PARAMETER		TEST CONDITIONS		T _A = 25°C			SN54ABT646A		SN74ABT646A		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	Control inputs	V _{CC} = 5.5 V, V _I = V _{CC} or GND		±1			±1		±1		µA		
	A or B ports			±100			±100		±100				
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		±100					±100		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	-100	-180	-50	-180	-50	-180	mA		
I _{CC}		V _{CC} = 5.5 V, I _O = 0, V _I = V _{CC} or GND		Outputs high		250			250		250	µA	
				Outputs low		30			30		30		mA
				Outputs disabled		250			250		250		µA
ΔI _{CC} [#]		V _{CC} = 5.5 V, One input at 3.4 V, Other inputs at V _{CC} or GND		1.5			1.5		1.5		mA		
C _i	Control inputs	V _I = 2.5 V or 0.5 V		7							pF		
C _{i0}	A or B ports	V _O = 2.5 V or 0.5 V		12							pF		

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

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

‡ The parameters I_{OZH} and I_{OZL} include the input leakage current.

§ This data-sheet limit may vary among suppliers.

¶ 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.

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 2)

		SN54ABT646A		UNIT		
		V _{CC} = 5 V, T _A = 25°C			MIN	MAX
		MIN	MAX			
f _{clock}	Clock frequency	125		125	MHz	
t _W	Pulse duration, CLK high or low	4		4	ns	
t _{su}	Setup time, A or B before CLKAB↑ or CLKBA↑	3		3.5	ns	
t _h	Hold time, A or B after CLKAB↑ or CLKBA↑	1.5		1.5	ns	



SN54ABT646A, SN74ABT646A

OCTAL BUS TRANSCEIVERS AND REGISTERS

WITH 3-STATE OUTPUTS

SCBS069H - JULY 1991 - REVISED MAY 2004

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 2)

		SN74ABT646A		UNIT		
		V _{CC} = 5 V, T _A = 25°C			MIN	MAX
		MIN	MAX			
f _{clock}	Clock frequency	125		125	MHz	
t _W	Pulse duration, CLK high or low	4		4	ns	
t _{su}	Setup time, A or B before CLKAB↑ or CLKBA↑	3		3	ns	
t _h	Hold time, A or B after CLKAB↑ or CLKBA↑	0		0	ns	

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54ABT646A				UNIT	
			V _{CC} = 5 V, T _A = 25°C			MIN		MAX
			MIN	TYP	MAX			
f _{max}			125			125	MHz	
t _{PLH}	CLKBA or CLKAB	A or B	2.2	4	5.1	2.2	6.7	ns
t _{PHL}			1.7	4	5.1	1.2	6.7	
t _{PLH}	A or B	B or A	1.5	3	4.3	1.5	5	ns
t _{PHL}			1.5	3.3	4.6	1.5	5.6	
t _{PLH}	SAB or SBA [†]	B or A	1.5	4	5.7	1.5	7.8	ns
t _{PHL}			1.5	3.6	4.9	1.5	6.2	
t _{PZH}	$\overline{\text{OE}}$	A or B	1.5	4.3	5.3	1.5	7	ns
t _{PZL}			3	5.8	8	3	10.5	
t _{PHZ}	$\overline{\text{OE}}$	A or B	1.5	3.5	5.8	1	7.3	ns
t _{PLZ}			1.5	3	4	1.5	5.7	
t _{PZH}	DIR	A or B	1.5	4.5	5.7	1.5	7.3	ns
t _{PZL}			2.5	6.5	9	2.5	11	
t _{PHZ}	DIR	A or B	1.5	3.8	6.5	1	9	ns
t _{PLZ}			1.5	3.8	4.7	1.2	6.7	

† These parameters are measured with the internal output state of the storage register opposite that of the bus input.

SN54ABT646A, SN74ABT646A

OCTAL BUS TRANSCEIVERS AND REGISTERS

WITH 3-STATE OUTPUTS

SCBS069H – JULY 1991 – REVISED MAY 2004

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $C_L = 50$ pF (unless otherwise noted) (see Figure 2)

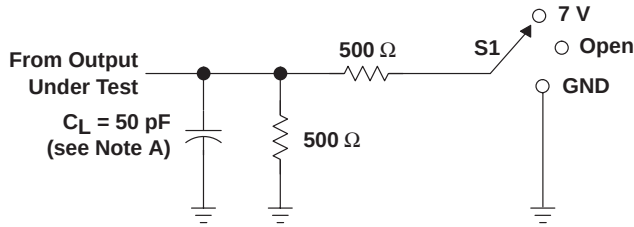
PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74ABT646A					UNIT
			V _{CC} = 5 V, T _A = 25°C			MIN	MAX	
			MIN	TYP	MAX			
f _{max}			125			125		MHz
t _{PLH}	CLKBA or CLKAB	A or B	2.2	4	5.1	2.2	5.6	ns
t _{PHL}			1.7	4	5.1	1.7	5.6	
t _{PLH}	A or B	B or A	1.5	3	4.3	1.5	4.8	ns
t _{PHL}			1.5	3.3	4.6	1.5	5.4	
t _{PLH}	SAB or SBA†	B or A	1.5	4	5.1	1.5	6.5	ns
t _{PHL}			1.5	3.6	4.9	1.5	5.9	
t _{PZH}	$\overline{\text{OE}}$	A or B	1.5	4.3	5.3	1.5	6.3	ns
t _{PZL}			3	5.8	7.4	3	8.8	
t _{PHZ}	$\overline{\text{OE}}$	A or B	1.5	3.5	4.5	1.5	5	ns
t _{PLZ}			1.5	3	4	1.5	4.5	
t _{PZH}	DIR	A or B	1.5	4.5	5.7	1.5	6.7	ns
t _{PZL}			2.5	6.5	9	2.5	9.5	
t _{PHZ}	DIR	A or B	1.5	3.8	5	1.5	5.7	ns
t _{PLZ}			1.5	3.8	4.7	1.5	6	

[†] These parameters are measured with the internal output state of the storage register opposite that of the bus input.

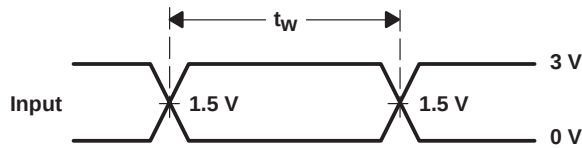
SN54ABT646A, SN74ABT646A OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

SCBS069H - JULY 1991 - REVISED MAY 2004

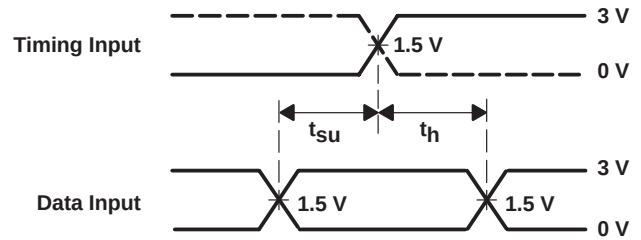
PARAMETER MEASUREMENT INFORMATION



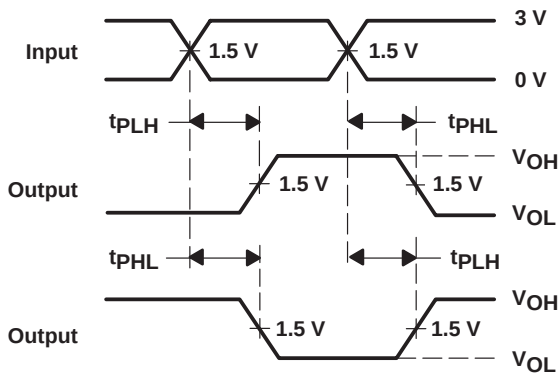
LOAD CIRCUIT



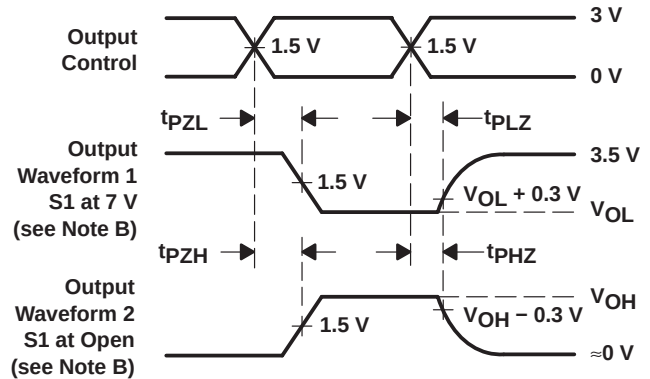
VOLTAGE WAVEFORMS
PULSE DURATION



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.
 - E. All parameters and waveforms are not applicable to all devices.

Figure 2. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-9457702Q3A	ACTIVE	LCCC	FK	28	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962- 9457702Q3A SNJ54ABT 646AFK	Samples
5962-9457702QLA	ACTIVE	CDIP	JT	24	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962-9457702QL A SNJ54ABT646AJT	Samples
SN74ABT646ADBR	ACTIVE	SSOP	DB	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AB646A	Samples
SN74ABT646ADW	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT646A	Samples
SN74ABT646ADWG4	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT646A	Samples
SN74ABT646ADWR	ACTIVE	SOIC	DW	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT646A	Samples
SN74ABT646ANSR	ACTIVE	SO	NS	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABT646A	Samples
SN74ABT646APW	ACTIVE	TSSOP	PW	24	60	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AB646A	Samples
SNJ54ABT646AFK	ACTIVE	LCCC	FK	28	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962- 9457702Q3A SNJ54ABT 646AFK	Samples
SNJ54ABT646AJT	ACTIVE	CDIP	JT	24	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962-9457702QL A SNJ54ABT646AJT	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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of ≤ 1000 ppm threshold. Antimony trioxide based flame retardants must also meet the ≤ 1000 ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device 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 Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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.

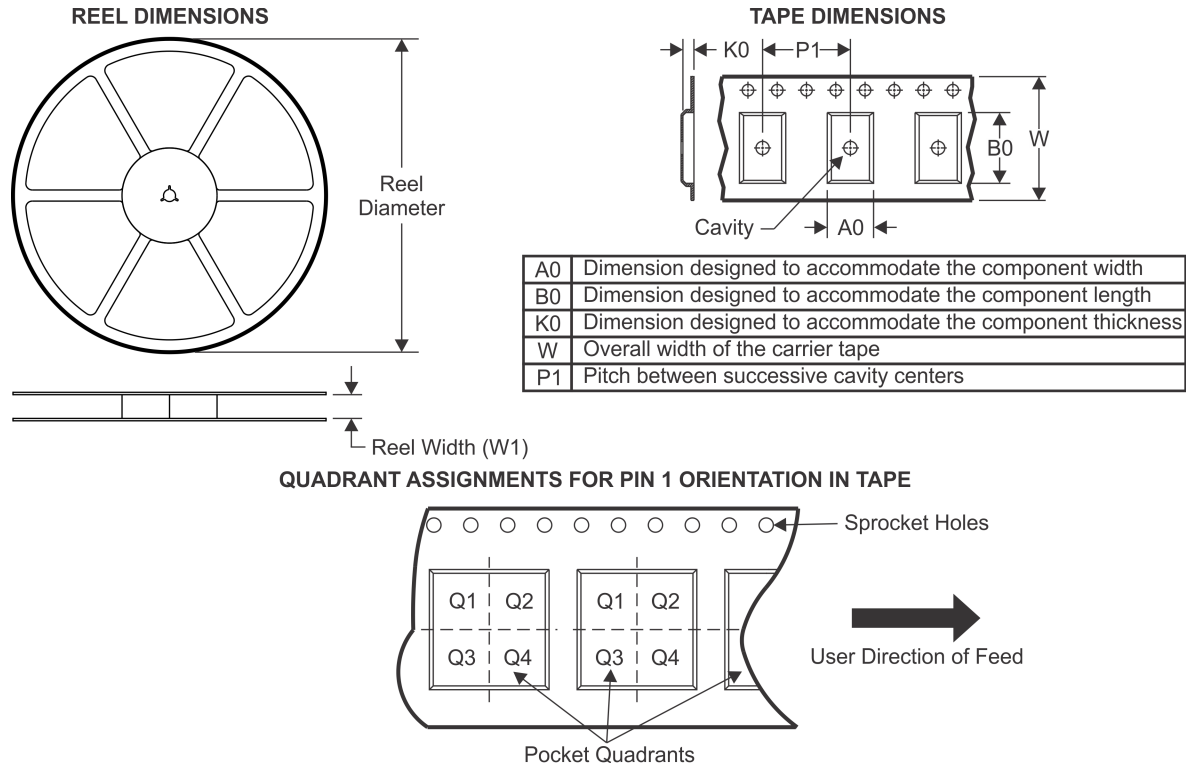
OTHER QUALIFIED VERSIONS OF SN54ABT646A, SN74ABT646A :

- Catalog: [SN74ABT646A](#)
- Military: [SN54ABT646A](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

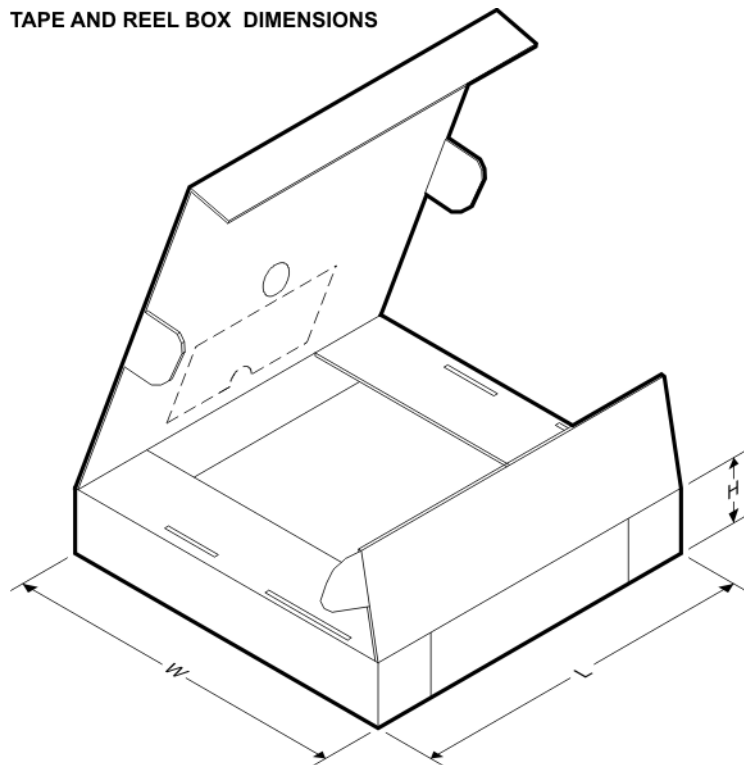
TAPE AND REEL INFORMATION



*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
SN74ABT646ADBR	SSOP	DB	24	2000	330.0	16.4	8.2	8.8	2.5	12.0	16.0	Q1
SN74ABT646ADWR	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1
SN74ABT646ANSR	SO	NS	24	2000	330.0	24.4	8.3	15.4	2.6	12.0	24.0	Q1

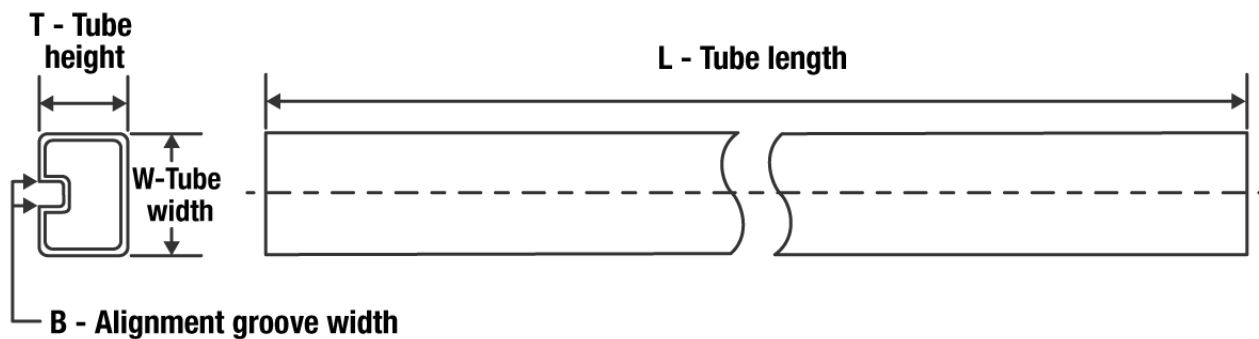
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ABT646ADBR	SSOP	DB	24	2000	853.0	449.0	35.0
SN74ABT646ADWR	SOIC	DW	24	2000	350.0	350.0	43.0
SN74ABT646ANSR	SO	NS	24	2000	367.0	367.0	45.0

TUBE

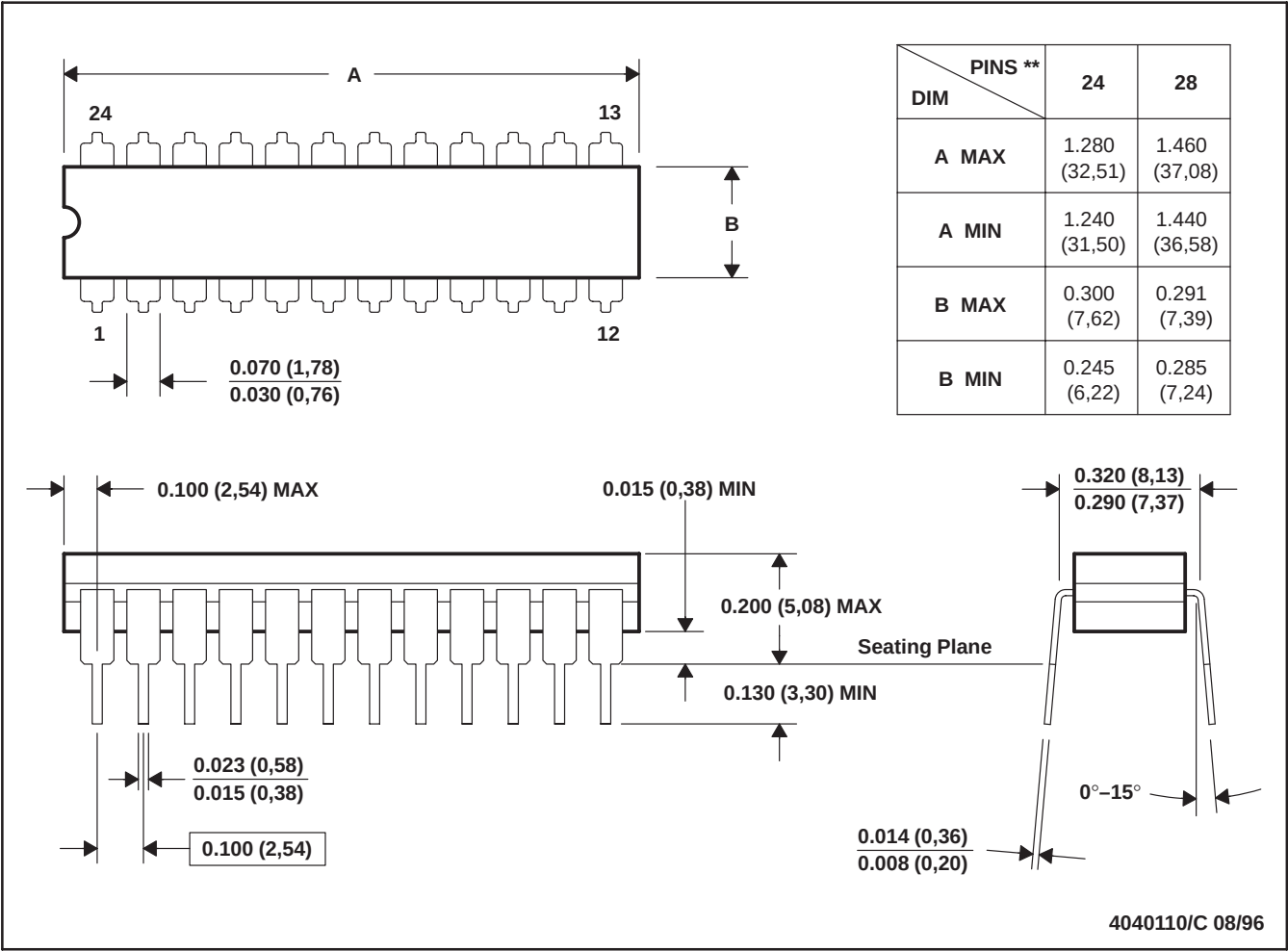


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN74ABT646ADW	DW	SOIC	24	25	506.98	12.7	4826	6.6
SN74ABT646ADWG4	DW	SOIC	24	25	506.98	12.7	4826	6.6
SN74ABT646APW	PW	TSSOP	24	60	530	10.2	3600	3.5

JT (R-GDIP-T**) 24 LEADS SHOWN

CERAMIC DUAL-IN-LINE

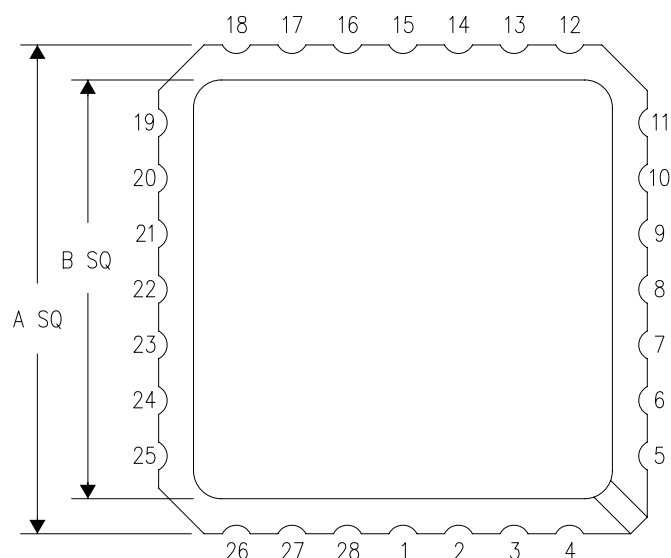


- NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification.
E. Falls within MIL STD 1835 GDIP3-T24, GDIP4-T28, and JEDEC MO-058 AA, MO-058 AB

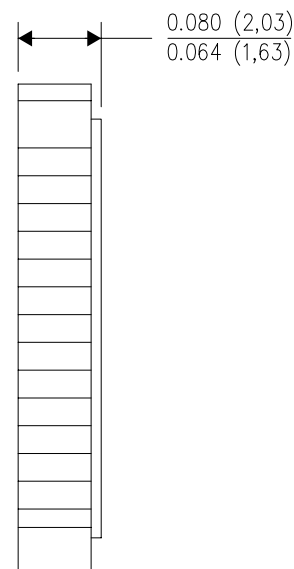
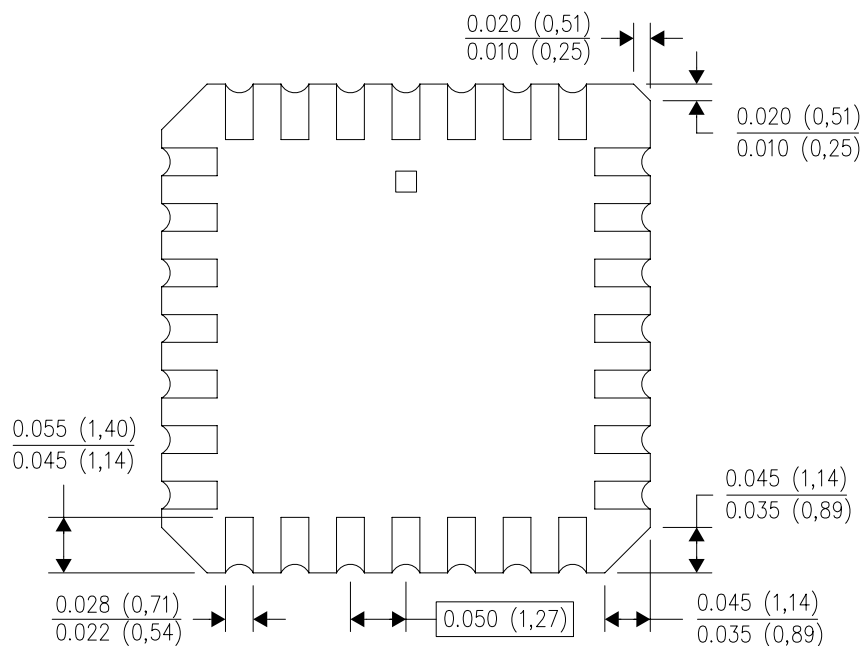
FK (S-CQCC-N**)

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

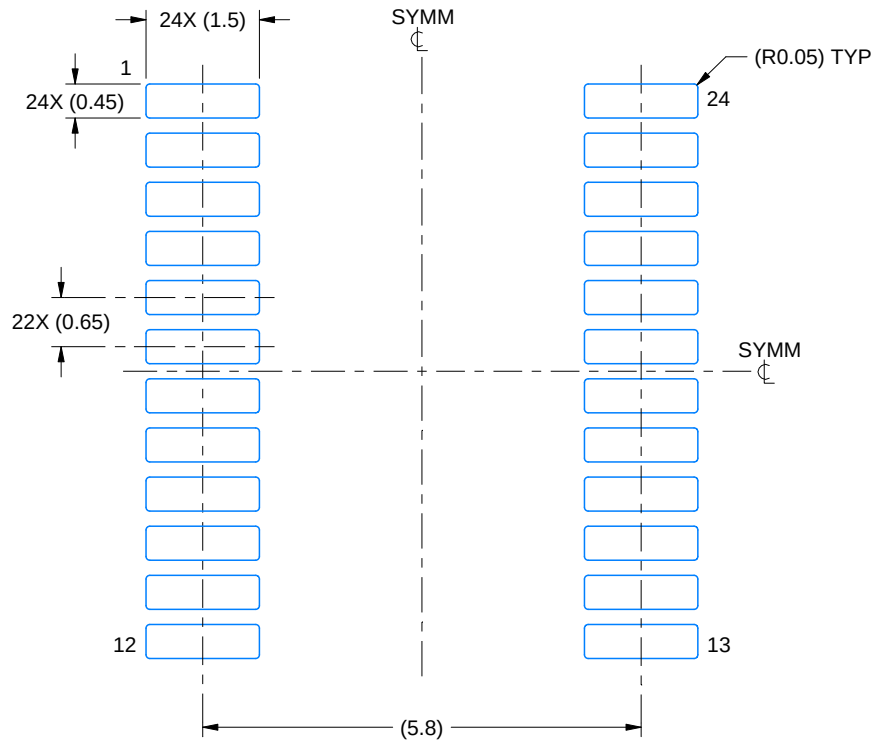
- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a metal lid.
 - Falls within JEDEC MS-004

EXAMPLE BOARD LAYOUT

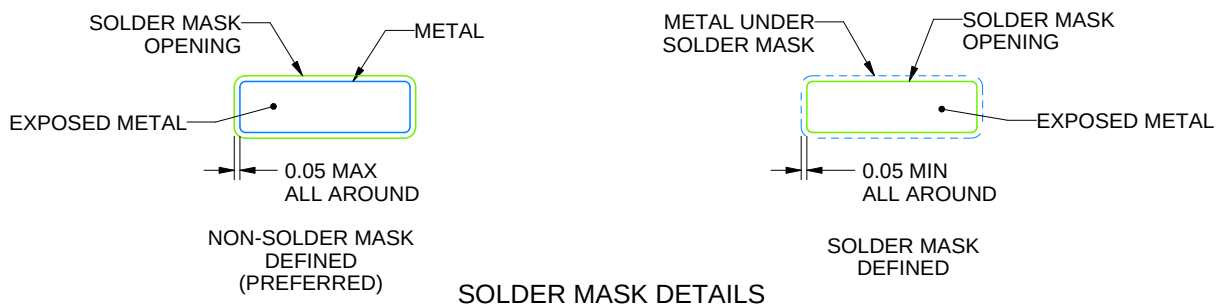
PW0024A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220208/A 02/2017

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

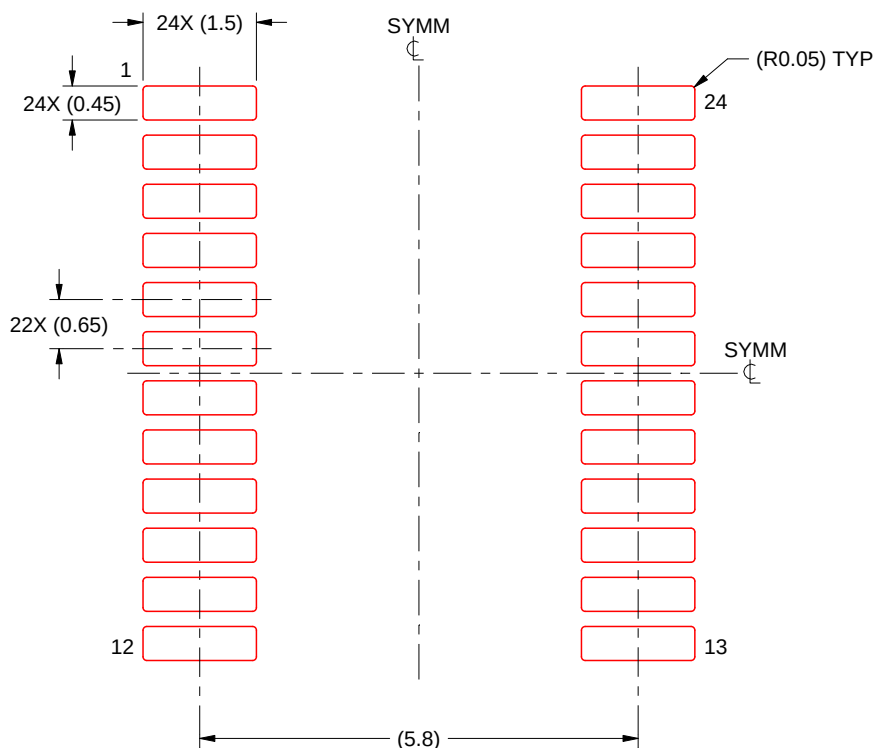
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0024A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220208/A 02/2017

NOTES: (continued)

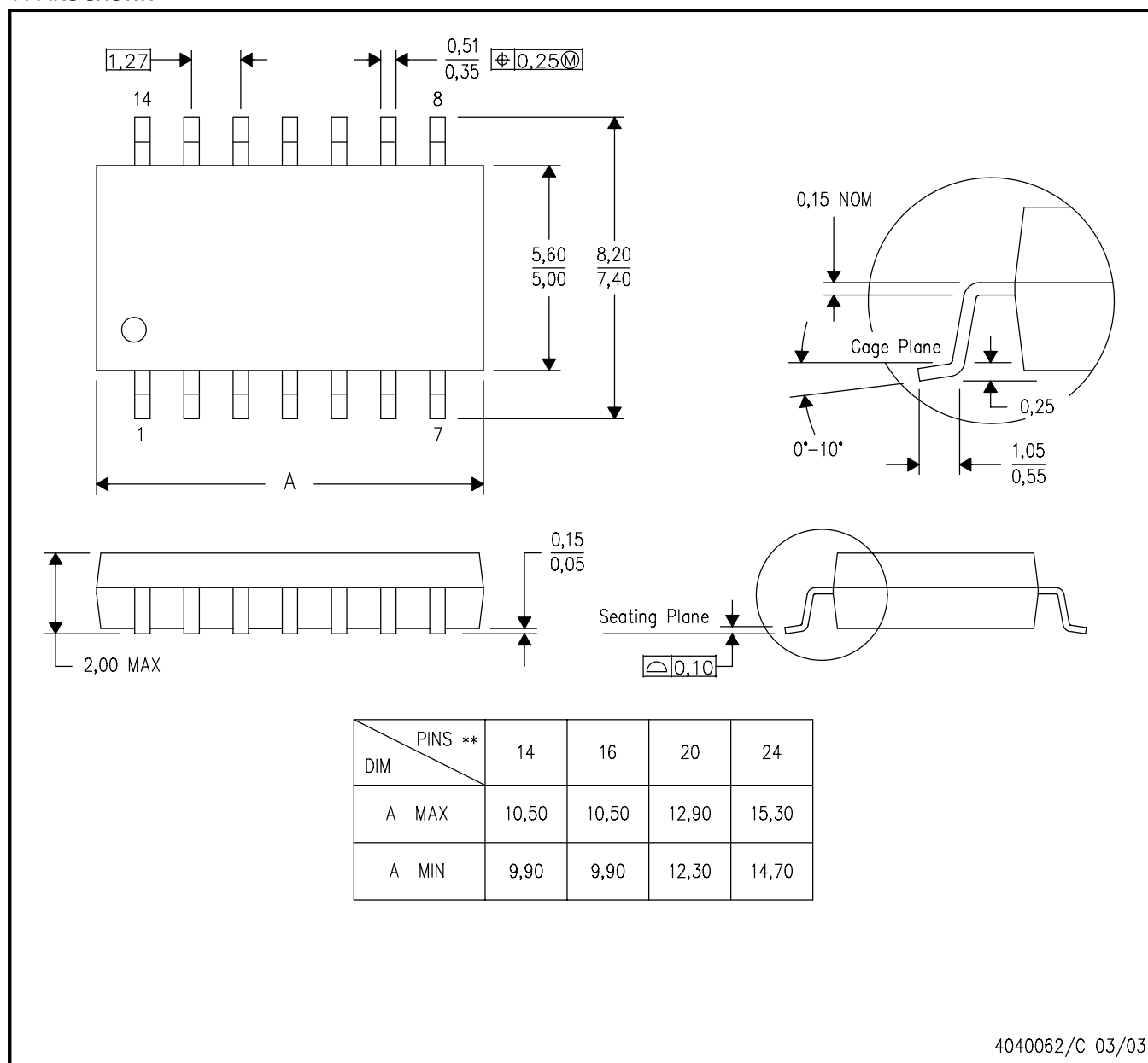
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

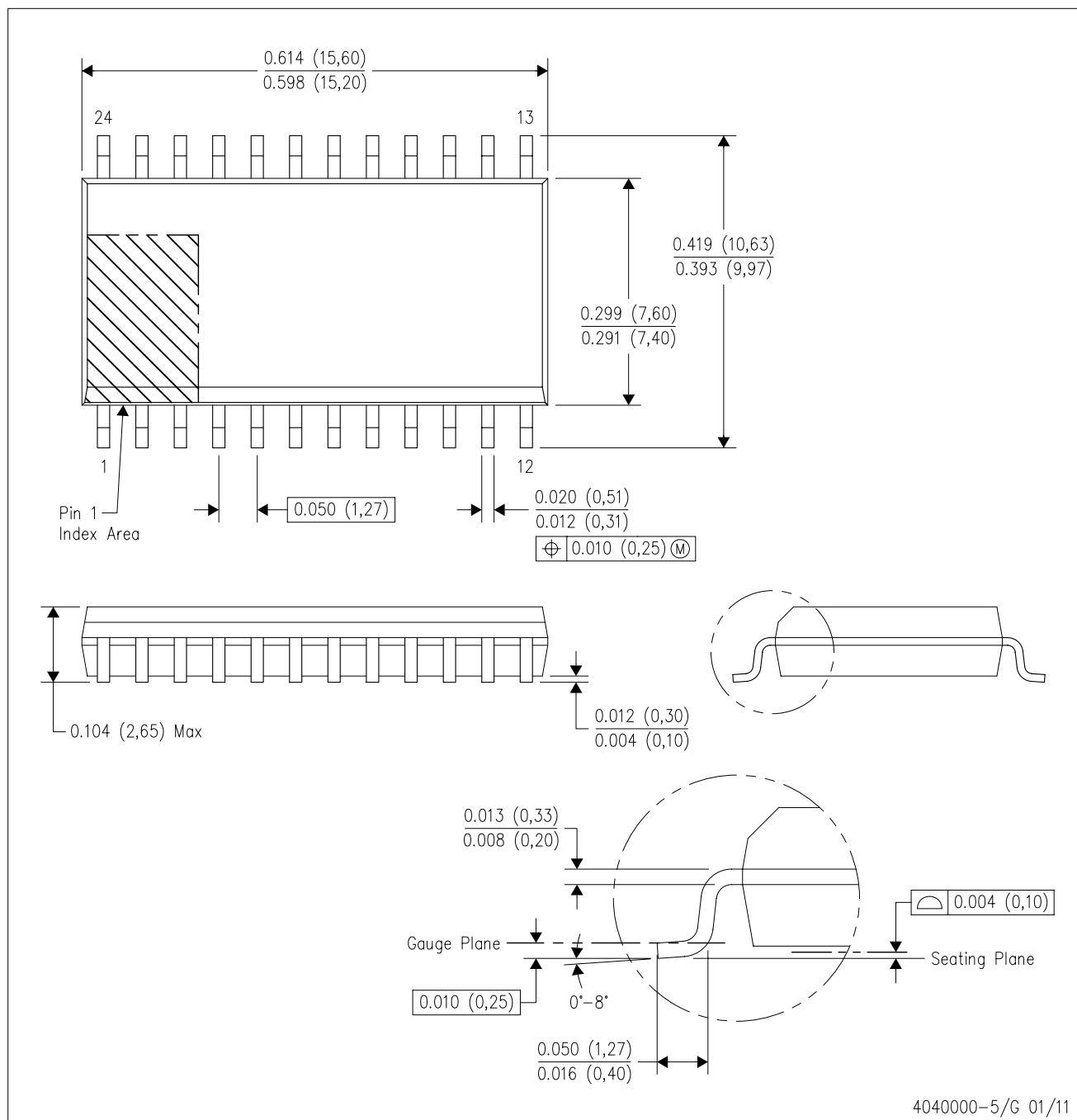
14-PINS SHOWN



- 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.

DW (R-PDSO-G24)

PLASTIC SMALL OUTLINE

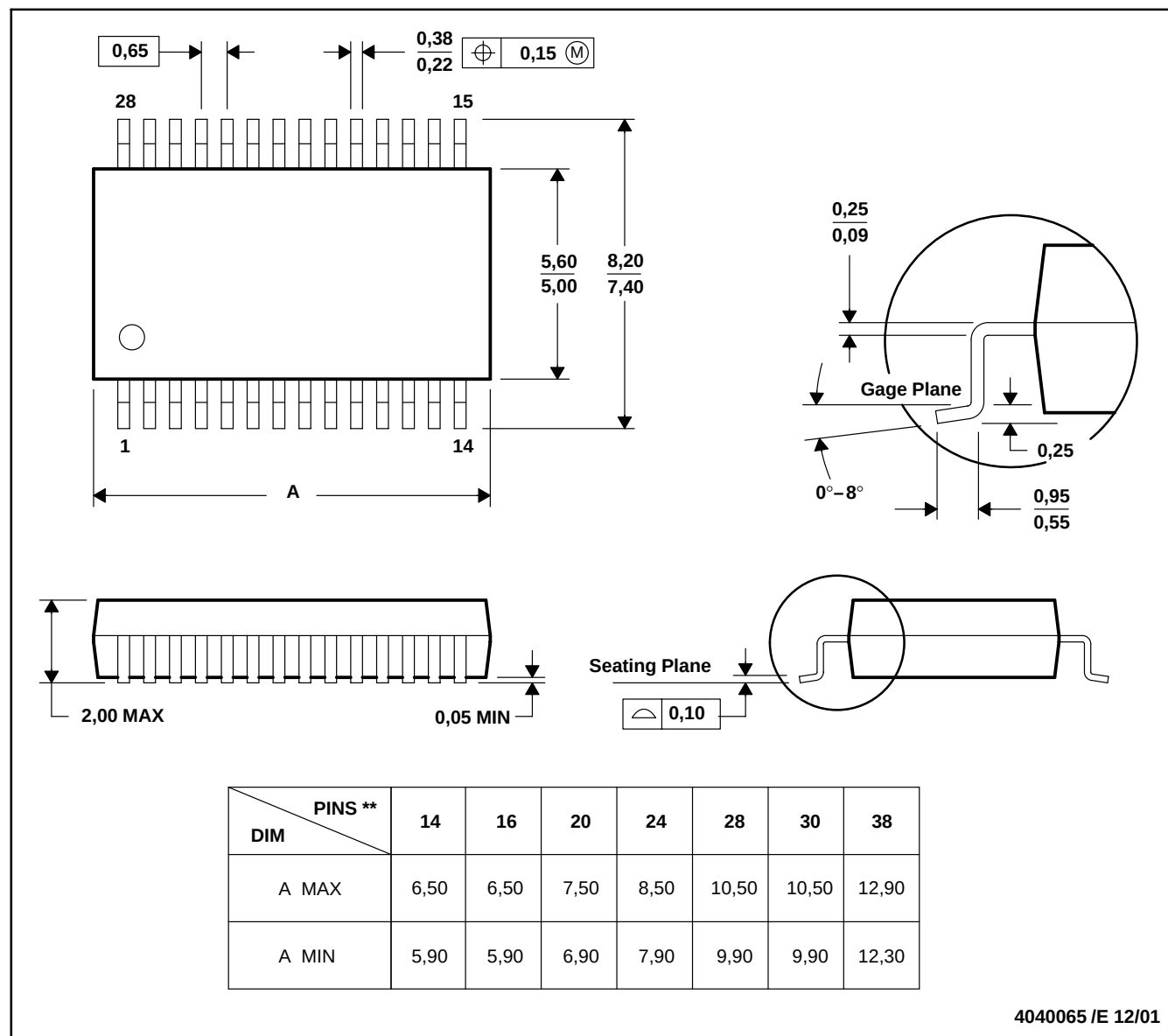


- NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-013 variation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

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

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](#) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2022, Texas Instruments Incorporated