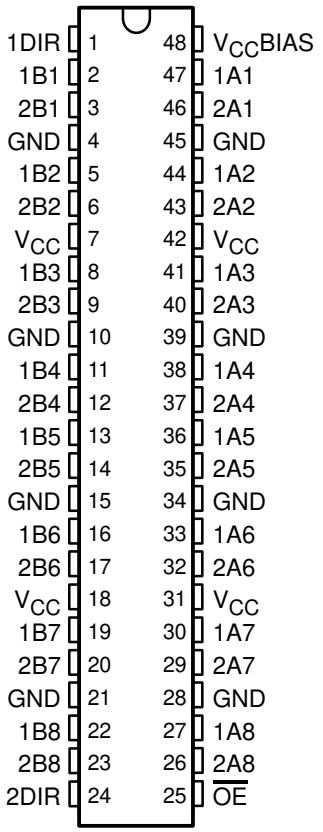
- **Members of the Texas Instruments Widebus™ Family**
- **Support the VME64 ETL Specification**
- **Reduced, TTL-Compatible, Input Threshold Range**
- **High-Drive Outputs (I_{OH} = –60 mA, I_{OL} = 90 mA) Support 25-Ω Incident-Wave Switching**
- **V_{CC}BIAS Pin Minimizes Signal Distortion During Live Insertion**
- **Internal Pullup Resistor on $\overline{OE}$ Keeps Outputs in High-Impedance State During Power Up or Power Down**
- **Distributed V_{CC} and GND Pins Minimize High-Speed Switching Noise**
- **Equivalent 25-Ω Series Damping Resistor on B Port**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**

SN54ABTE16245 . . . WD PACKAGE
SN74ABTE16245 . . . DGG OR DL PACKAGE
(TOP VIEW)



description

The ’ABTE16245 devices are 16-bit (dual-octal) noninverting 3-state transceivers designed for synchronous two-way communication between data buses. The control-function implementation minimizes external timing requirements. These devices can be used as two 8-bit transceivers or one 16-bit transceiver. They allow data transmission from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ($\overline{OE}$) input can be used to disable the device so that the buses are effectively isolated. When $\overline{OE}$ is low, the device is active.

The B port has an equivalent 25-Ω series output resistor to reduce ringing. Active bus-hold inputs also are on the B port to hold unused or floating inputs at a valid logic level.

The A port provides for the precharging of the outputs via V_{CC}BIAS, which establishes a voltage between 1.3 V and 1.7 V when V_{CC} is not connected.

Active bus-hold circuitry holds unused or undriven inputs at a valid logic state. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

ORDERING INFORMATION

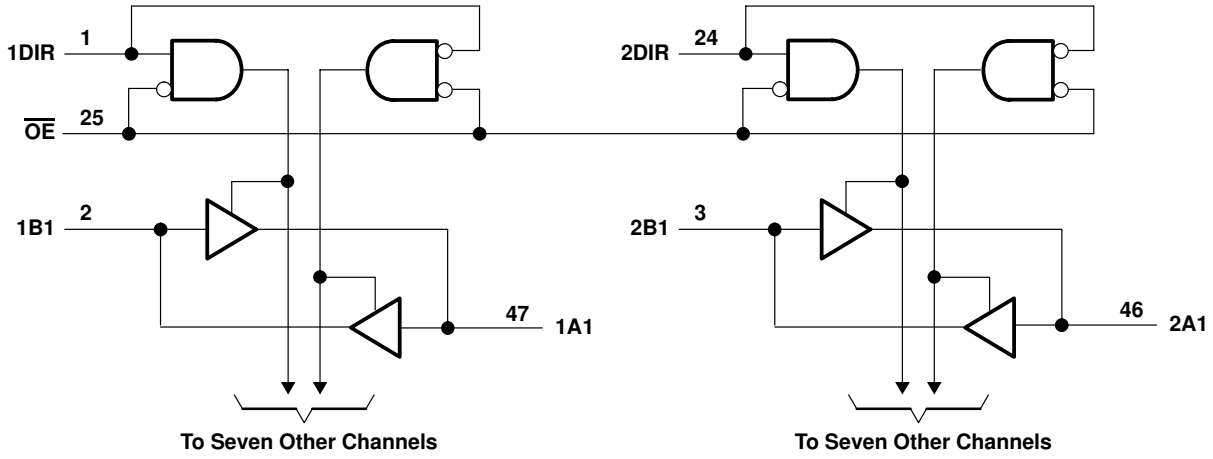
T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SSOP – DL	Tube	SN74ABTE16245DL	ABTE16245
		Tape and reel	SN74ABTE16245DLR	
	TSSOP – DGG	Tape and reel	SN74ABTE16245DGGR	ABTE16245
–55°C to 125°C	CFP – WD	Tube	SNJ54ABTE16245WD	SNJ54ABTE16245WD

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

FUNCTION TABLE
(each 8-bit section)

INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	A data to B bus
L	H	B data to A bus
H	X	Isolation

logic diagram (positive logic)



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

Supply voltage range, V_{CC} and V_{CC}BIAS . . . . . –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 state or power-off state, V_O . . . . . –0.5 V to 5.5 V
Current into any output in the low state, I_O . . . . . 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): DGG package . . . . . 70°C/W
DL package . . . . . 63°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.

recommended operating conditions (see Note 3)

			SN54ABTE16245			SN74ABTE16245			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}, $V_{CC}BIAS$	Supply voltage		4.5	5	5.5	4.5	5	5.5	V
V_{IH}	High-level input voltage	$\overline{OE}$	2			2			V
		Except $\overline{OE}$	1.6			1.6			
V_{IL}	Low-level input voltage	$\overline{OE}$			0.8			0.8	V
		Except $\overline{OE}$			1.4			1.4	
V_I	Input voltage		0		V_{CC}	0		V_{CC}	V
I_{OH}	High-level output current	B bus			–12			–12	mA
		A bus			–24			–60	
I_{OL}	Low-level output current	B bus			12			12	mA
		A bus			64			90	
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled			10			10	ns/V
T_A	Operating free-air temperature		–55		125	–40		85	°C

NOTE 3: All unused control 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		SN54ABTE16245			SN74ABTE16245			UNIT
				MIN	TYP†	MAX	MIN	TYP†	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = –18 mA			–1.2			–1.2	V
V_{OH}	B port	V_{CC} = 5.5 V,	I_{OH} = –100 μA			V_{CC}–0.2			V_{CC}–0.2	V
		V_{CC} = 4.5 V	I_{OH} = –1 mA	2.4			2.4			
			I_{OH} = –12 mA	2			2			
	A port	V_{CC} = 5.5 V,	I_{OH} = –1 mA			4.5			4.5	
		V_{CC} = 4.5 V	I_{OH} = –32 mA	2.4			2.4			
			I_{OH} = –64 mA				2			
V_{OL}	B port	V_{CC} = 4.5 V	I_{OL} = 1 mA			0.4			0.4	V
			I_{OL} = 12 mA						0.8	
	A port	V_{CC} = 4.5 V	I_{OL} = 64 mA			0.55			0.55	
			I_{OL} = 90 mA						0.9	
$I_{I(hold)}$	B port	V_{CC} = 4.5 V	V_I = 0.8 V	100			100			μA
			V_I = 2 V	–100			–100			
		V_{CC} = 5.5 V,	V_I = 0 to 5.5 V			±500			±500	
I_I	Control inputs	V_{CC} = 5.5 V,	V_I = V_{CC} or GND			±1			±1	μA
	A or B ports					±20			±20	
I_{OZH}‡	A port	V_{CC} = 5.5 V,	V_O = 2.7 V			10			10	μA
I_{OZL}‡	A port	V_{CC} = 5.5 V,	V_O = 0.5 V			–10			–10	μA
I_O	A port	V_{CC} = 5.5 V,	V_O = 2.5 V	–50	–120	–180	–50		–180	mA
	B port			–25	–52	–90	–25		–90	
I_{off}		V_{CC} = 0, V_I or $V_O \le$ 4.5 V, V_{CC}BIAS = 0				±100			±100	μA
I_{CC}	A or B ports	V_{CC} = 5.5 V, I_O = 0, V_I = V_{CC} or GND	Outputs high		28	36		28	36	mA
			Outputs low		38	48		38	48	
			Outputs disabled		20	32		20	32	
I_{CCD}	A or B ports	V_{CC} = 5 V, C_L = 50 pF	$\overline{OE}$ high		0.02			0.02		mA/ MHz
			$\overline{OE}$ low		0.33			0.33		
C_i	Control inputs	V_I = 2.5 V or 0.5 V				10		2.5	4	pF
C_{io}	I/O ports	V_O = 2.5 V or 0.5 V				13		4.5	8	pF

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ The parameters I_{OZH} and I_{OZL} include the input leakage current.

live-insertion specifications over recommended operating free-air temperature range

PARAMETER		TEST CONDITIONS			SN54ABTE16245			SN74ABTE16245			UNIT
					MIN	TYP†	MAX	MIN	TYP†	MAX	
I_{CC} (V_{CC}BIAS)		V_{CC} = 0 to 4.5 V, V_{CC}BIAS = 4.5 V to 5.5 V, $I_{O(DC)}$ = 0				250	700		250	700	µA
		V_{CC} = 4.5 V to 5.5 V‡, V_{CC}BIAS = 4.5 V to 5.5 V, $I_{O(DC)}$ = 0					20			20	
V_O	A port	V_{CC} = 0	V_{CC}BIAS = 4.5 V to 5.5 V		1.1	1.5	1.9	1.1	1.5	1.9	V
			V_{CC}BIAS = 4.75 V to 5.25 V		1.3	1.5	1.7	1.3	1.5	1.7	
I_O	A port	V_{CC} = 0,	V_{CC}BIAS = 4.5 V	V_O = 0	–20		–100	–20		–100	µA
				V_O = 3 V	20		100	20		100	µA

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ V_{CC} – 0.5 V < V_{CC}BIAS

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)	V_{CC} = 5 V, T_A = 25°C			SN54ABTE16245		SN74ABTE16245		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B	1.5	3.3	4.2	1.5	5.4	1.5	5.2	ns
t_{PHL}			1.5	3.8	4.6	1.5	5.4	1.5	5.2	
t_{PLH}	B	A	1.5	3	3.8	1.5	4.7	1.5	4.5	ns
t_{PHL}			1.5	3.1	4	1.5	4.7	1.5	4.5	
t_{PZH}	$\overline{OE}$	A	2	3.9	5.3	2	6.4	2	6.2	ns
t_{PZL}			2	4.4	5.9	2	7	2	6.8	
t_{PZH}	$\overline{OE}$	B	2	4.5	6	2	7.3	2	7.1	ns
t_{PZL}			2	5	6.4	2	7.5	2	7.3	
t_{PHZ}	$\overline{OE}$	A	2	4.9	5.9	2	7	2	6.7	ns
t_{PLZ}			2	3.7	4.6	2	5.4	2	5.1	
t_{PHZ}	$\overline{OE}$	B	2	5.2	6.2	2	7.2	2	7	ns
t_{PLZ}			2	4	5	2	5.8	2	5.5	

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

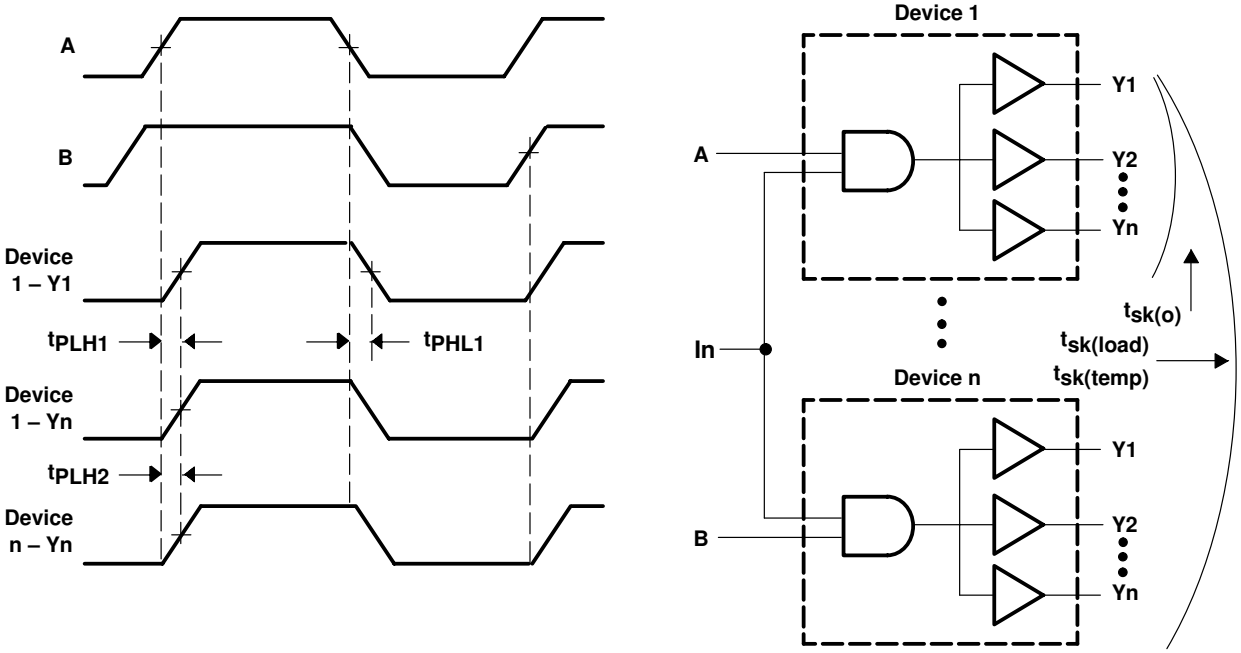
PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD	V_{CC} = 5 V, T_A = 25°C			SN54ABTE16245		SN74ABTE16245		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	B	A	R_X = 13 Ω	1.5	3.2	4	1.5	5	1.5	4.8	ns
t_{PHL}				1.5	3.8	4.7	1.5	5.8	1.5	5.6	
t_{PLH}	B	A	R_X = 26 Ω	1.5	3.1	4	1.5	4.8	1.5	4.6	ns
t_{PHL}				1.5	3.5	4.4	1.5	5.2	1.5	4.9	
t_{PLH}	B	A	R_X = 56 Ω	1.5	3	3.8	1.5	4.7	1.5	4.5	ns
t_{PHL}				1.5	3.3	4.2	1.5	5.1	1.5	4.7	
$t_{sk(p)}$	B	A	R_X = Open		0.1	0.6		2		2	ns
	A	B	R_X = Open		0.4	0.8		2		2	
	B	A	R_X = 26 Ω		0.3	0.8		2		2	
$t_{sk(o)}$	B	A	R_X = Open		0.3	0.7		1.3		1.3	ns
	A	B	R_X = Open		0.7	1.1		1.3		1.3	
	B	A	R_X = 26 Ω		0.5	1		1.3		1.3	
t_t†	B	A	R_X = 26 Ω	0.5	0.8	1.5	0.5	1.5	0.5	1.5	ns
t_t‡	A	B	R_X = Open	3.5	5.5	7.3	3.5	8.1	3.5	7.9	ns

† t_t is measured between 1 V and 2 V of the output waveform.
‡ t_t is measured between 10% and 90% of the output waveform.

extended output characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF (see Figures 1 and 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	LOAD	SN54ABTE16245		SN74ABTE16245		UNIT
					MIN	MAX	MIN	MAX	
$t_{sk(temp)}$	A	B	V_{CC} = constant, ΔT_A = 20°C			3		2.5	ns
	B	A		R_X = 56 Ω		4.5		4	
$t_{sk(load)}$	B	B	V_{CC} = constant, Temperature = constant	R_X = 13, 26, or 56 Ω		4.5		4	ns

PARAMETER MEASUREMENT INFORMATION



NOTES: A. Pulse skew, $t_{sk(p)}$, is defined as the difference in propagation-delay times t_{PLH1} and t_{PHL1} on the same terminal at identical operating conditions.

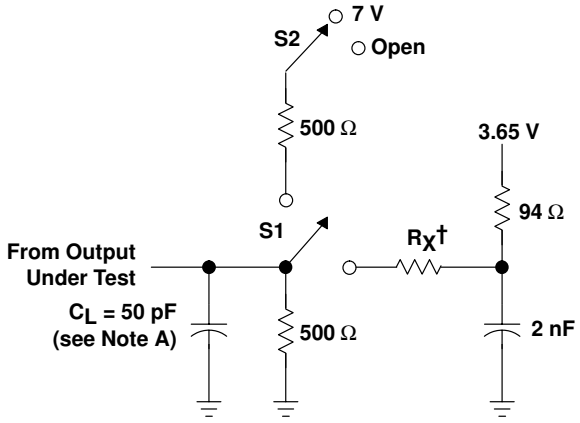
B. Output skew, $t_{sk(o)}$, is defined as the difference in propagation delay of any two outputs of the same device switching in the same direction (e.g., $|t_{PLH1} - t_{PLH2}|$).

C. Temperature skew, $t_{sk(temp)}$, is the output skew of two devices, both having the same value of $V_{CC} \pm 1\%$ and with package temperature differences of 20°C.

D. Load skew, $t_{sk(load)}$, is measured with R_X in Figure 2 at 13 Ω for one unit and 56 Ω for the other unit.

Figure 1. Voltage Waveforms for Extended Characteristics

PARAMETER MEASUREMENT INFORMATION

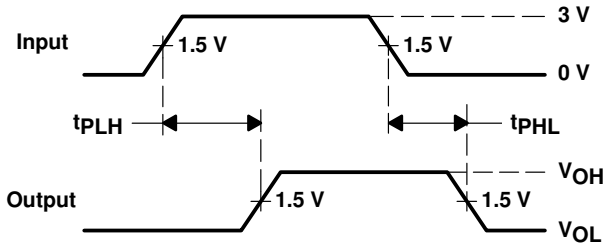


† $R_X = 13, 26, \text{or } 56\ \Omega$

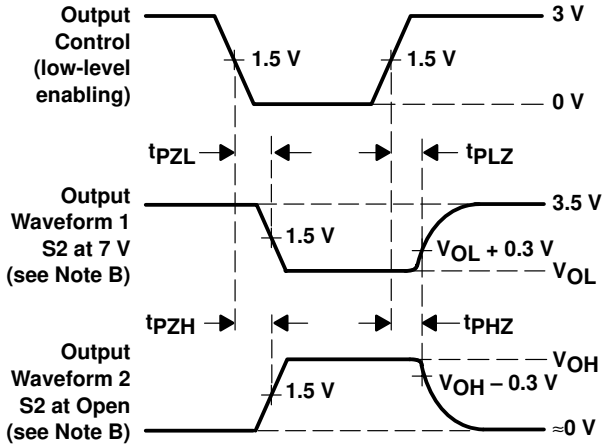
SWITCHING TABLE LOADS	S1	S2
t_{PLH}/t_{PHL} (A and B port)	Up	Open
t_{PLZ}/t_{PZL}	Up	7 V
t_{PHZ}/t_{PZH}	Up	Open

EXTENDED SWITCHING TABLE LOADS	S1	S2
$t_{PLH}/t_{PHL}/t_{sk}$ (A port)	Down	X
$t_{PLH}/t_{PHL}/t_{sk}$ (B port)	Up	Open
t_t (A port) (see Note E)	Down	X
t_t (B port) (see Note F)	Up	Open

LOAD CIRCUIT FOR OUTPUTS



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

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 ≤ 10 MHz, $Z_O = 50\ \Omega$, $t_r \le 2.5$ ns, $t_f \le 2.5$ ns.
D. The outputs are measured one at a time with one transition per measurement.
E. t_t is measured between 1 V and 2 V of the output waveform.
F. t_t is measured between 10% and 90% of the output waveform.

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
SN74ABTE16245DGGR	ACTIVE	TSSOP	DGG	48	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABTE16245	Samples
SN74ABTE16245DL	ACTIVE	SSOP	DL	48	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABTE16245	Samples
SN74ABTE16245DLR	ACTIVE	SSOP	DL	48	1000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ABTE16245	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 <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm 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.

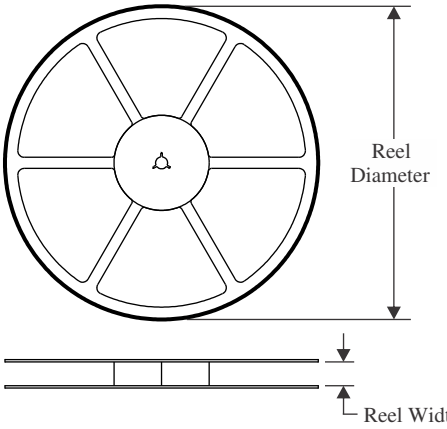
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(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.

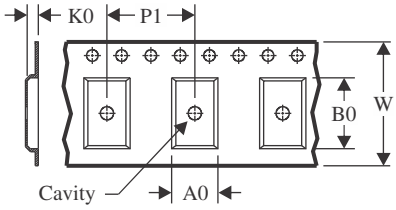
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

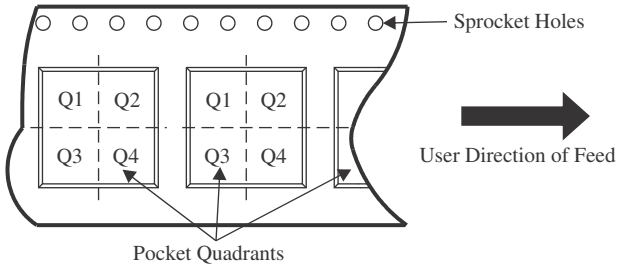


TAPE DIMENSIONS



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

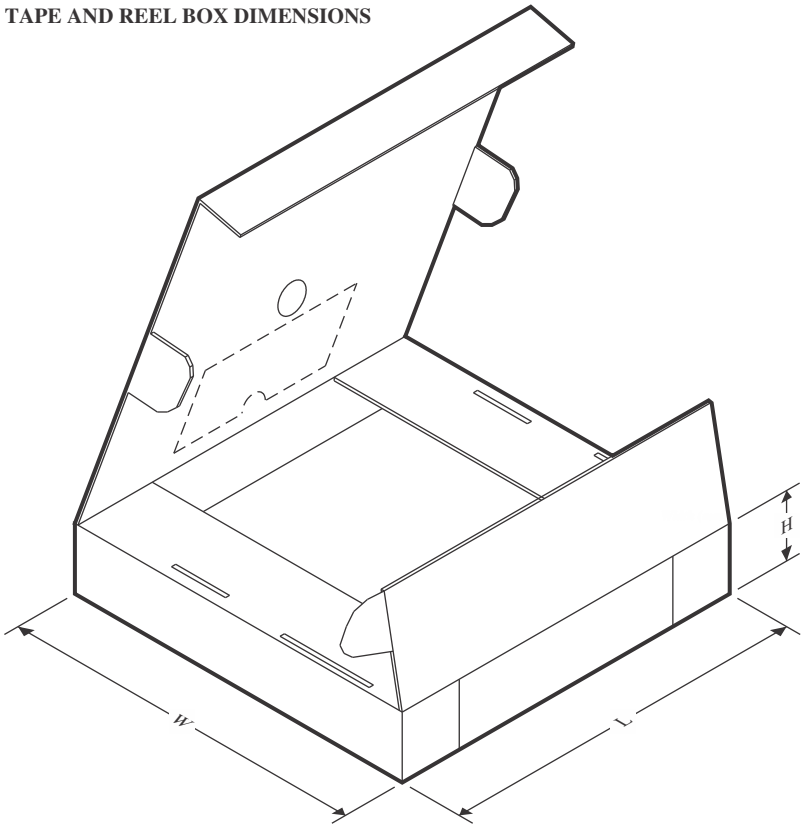
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN74ABTE16245DGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	13.0	1.8	12.0	24.0	Q1
SN74ABTE16245DLR	SSOP	DL	48	1000	330.0	32.4	11.35	16.2	3.1	16.0	32.0	Q1

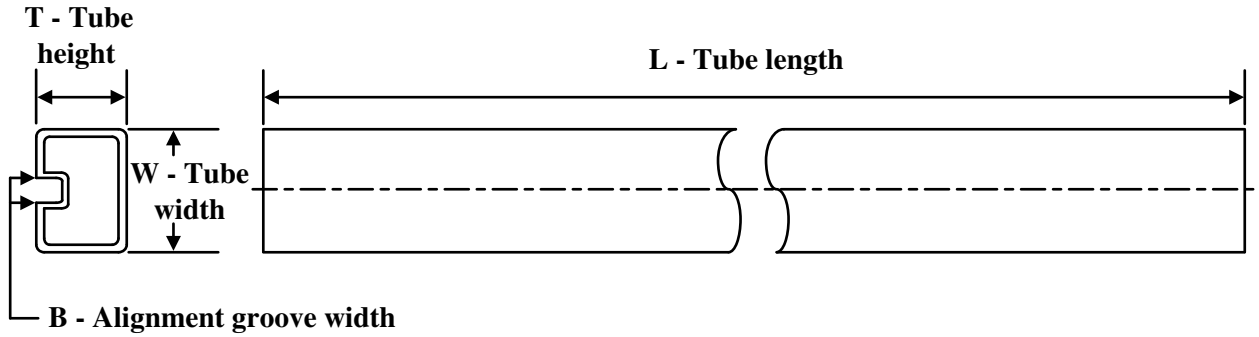
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ABTE16245DGGR	TSSOP	DGG	48	2000	367.0	367.0	45.0
SN74ABTE16245DLR	SSOP	DL	48	1000	367.0	367.0	55.0

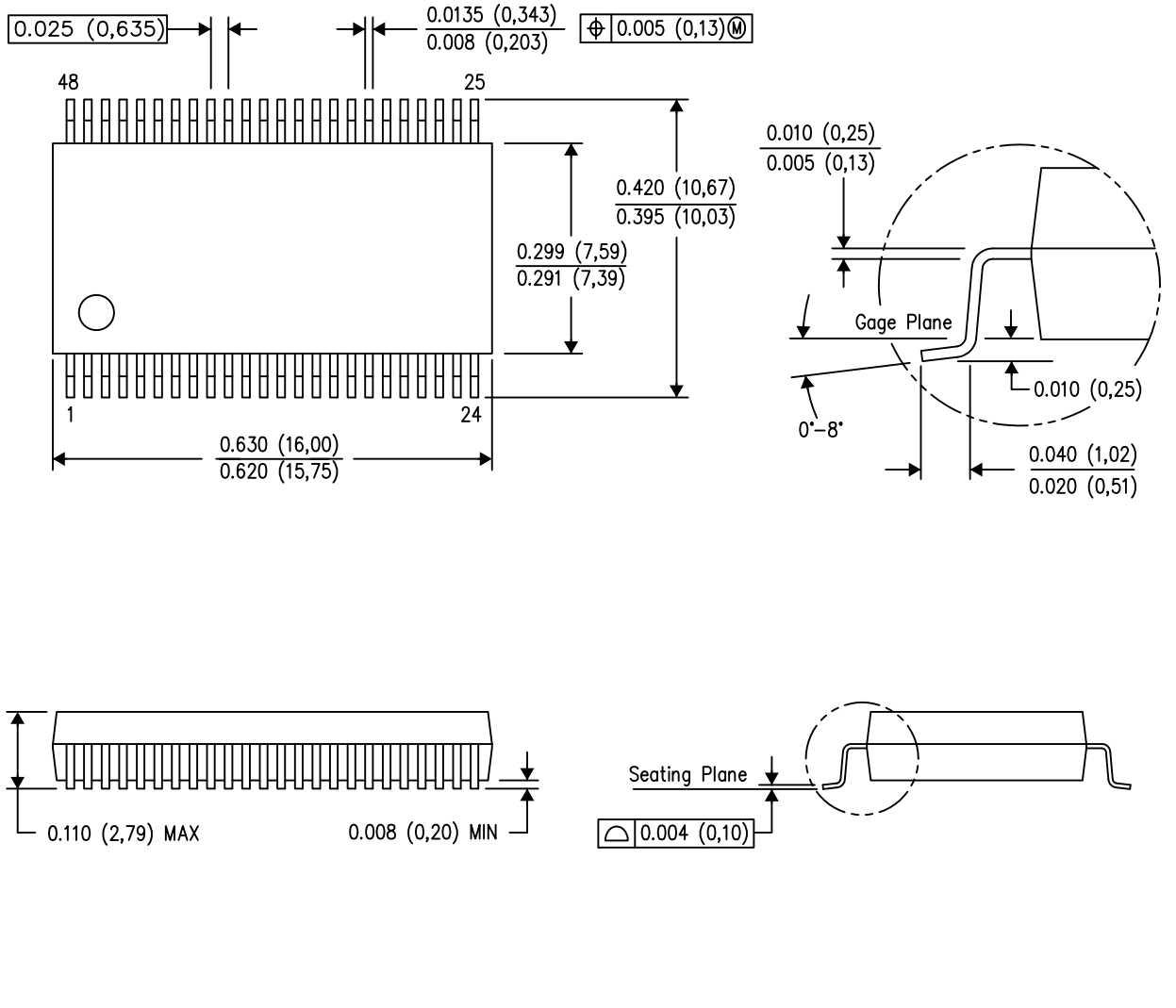
TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
SN74ABTE16245DL	DL	SSOP	48	25	473.7	14.24	5110	7.87

DL (R–PDSO–G48) PLASTIC SMALL–OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
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 MO–118

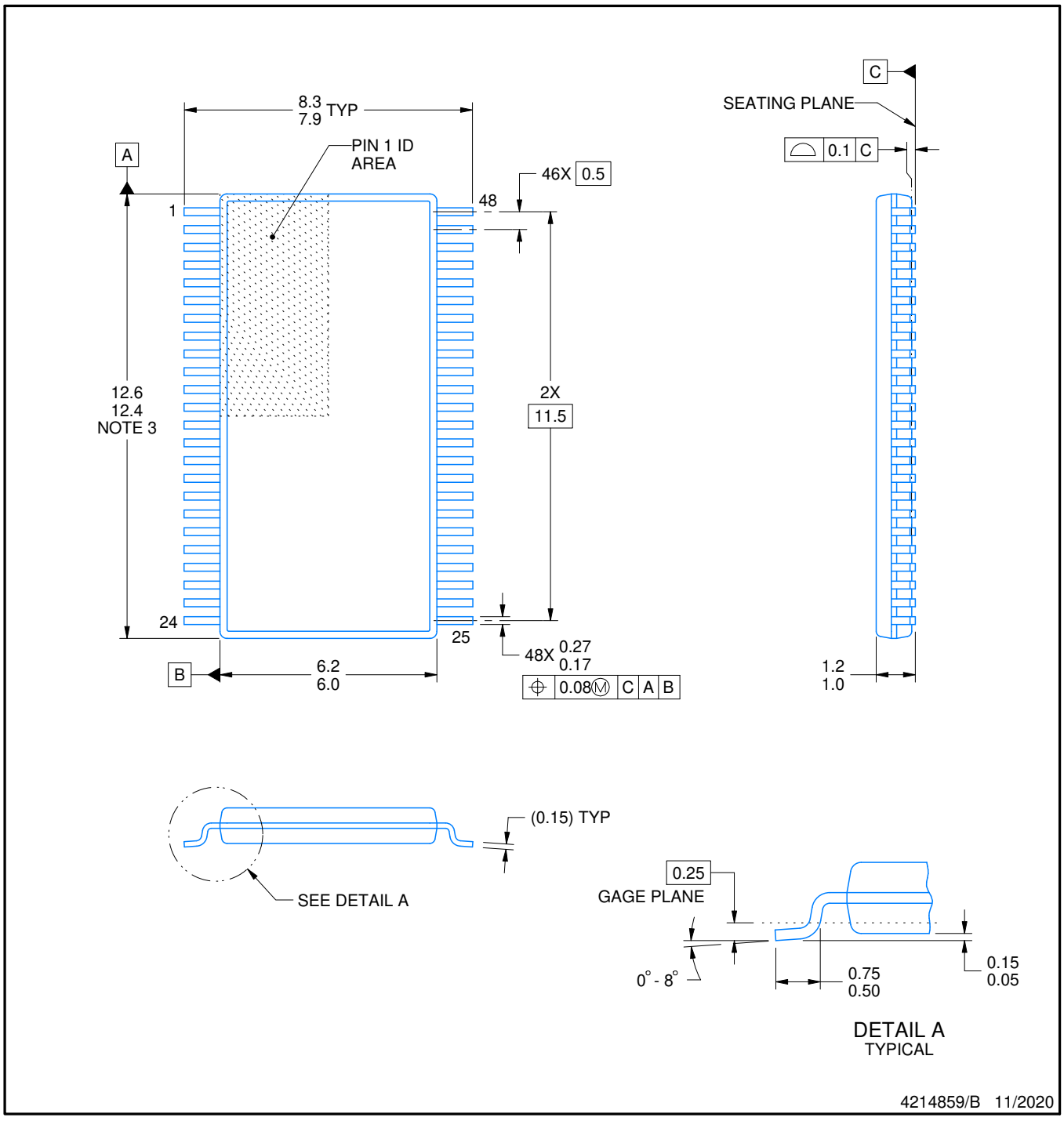
PowerPAD is a trademark of Texas Instruments.

PACKAGE OUTLINE

DGG0048A

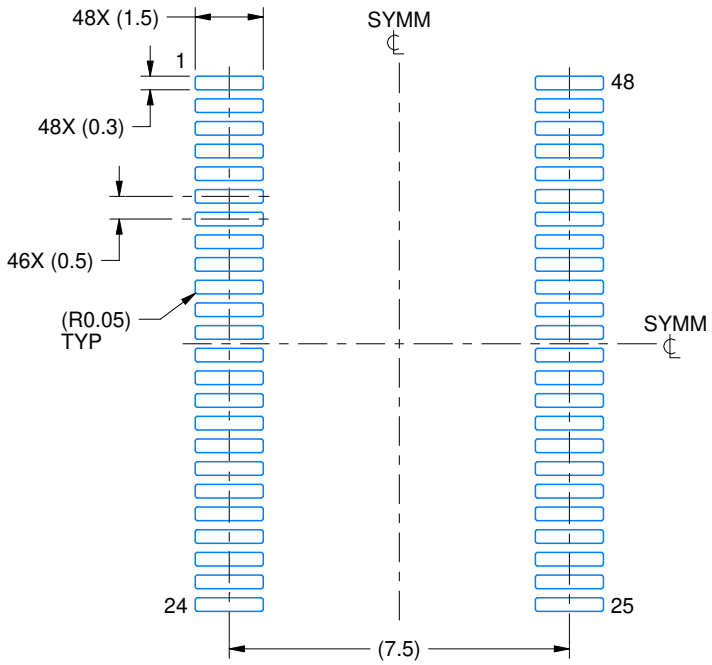
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

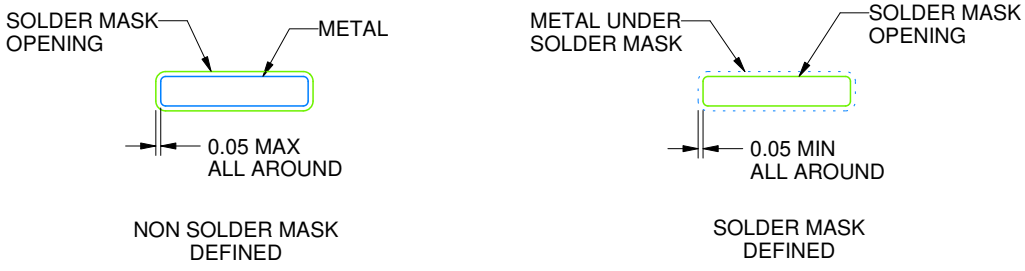


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-153.



LAND PATTERN EXAMPLE
SCALE:6X

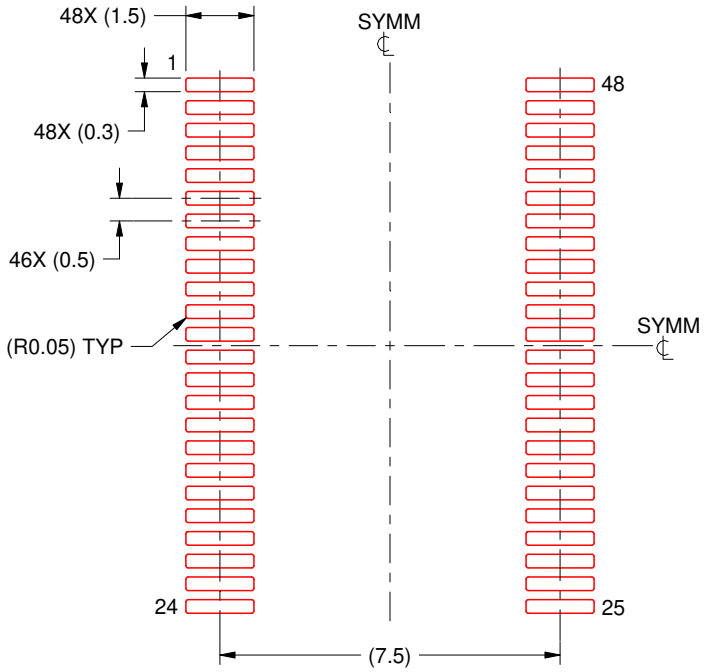


SOLDER MASK DETAILS

4214859/B 11/2020

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

4214859/B 11/2020

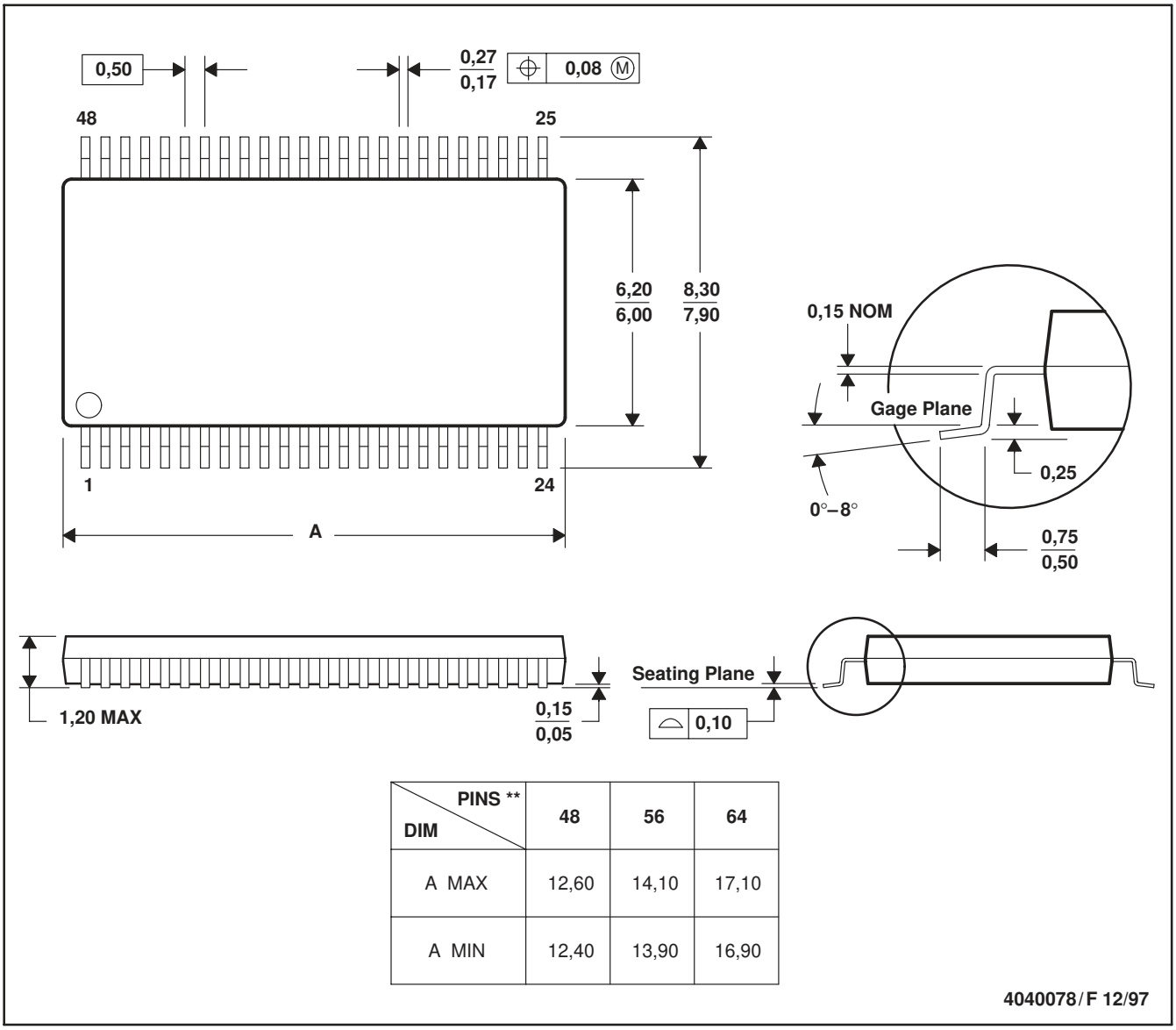
NOTES: (continued)

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

MTSS003D – JANUARY 1995 – REVISED JANUARY 1998

DGG (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

48 PINS SHOWN



DIM \ PINS **	48	56	64
A MAX	12,60	14,10	17,10
A MIN	12,40	13,90	16,90

4040078/F 12/97

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

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