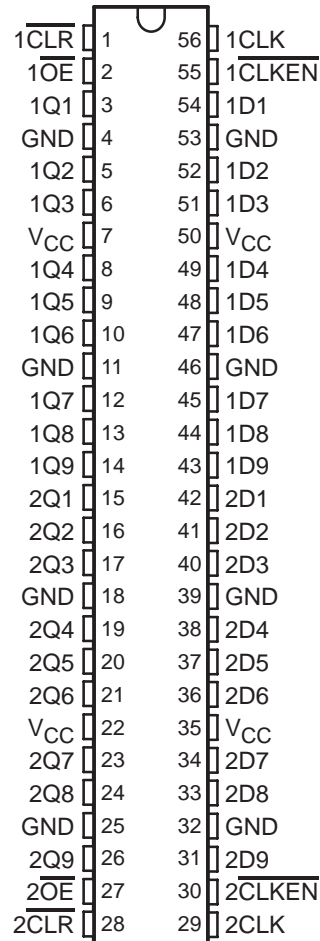


# SN54ABT162823A, SN74ABT162823A 18-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

SCBS666B – JULY 1996 – REVISED JUNE 2004

- Members of the Texas Instruments Widebus™ Family
- Output Ports Have Equivalent 25-Ω Series Resistors So No External Resistors Are Required
- Typical  $V_{OLP}$  (Output Ground Bounce)  $<1$  V at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$
- High-Impedance State During Power Up and Power Down
- $I_{off}$  and Power-Up 3-State Support Hot Insertion
- Distributed  $V_{CC}$  and GND Pins Minimize High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout

SN54ABT162823A . . . WD PACKAGE  
SN74ABT162823A . . . DGG OR DL PACKAGE  
(TOP VIEW)



## description/ordering information

These 18-bit bus-interface flip-flops feature 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. They are particularly suitable for implementing wider buffer registers, I/O ports, bidirectional bus drivers with parity, and working registers.

The 'ABT162823A devices can be used as two 9-bit flip-flops or one 18-bit flip-flop. With the clock-enable (CLKEN) input low, the D-type flip-flops enter data on the low-to-high transitions of the clock. Taking CLKEN high disables the clock buffer, thus latching the outputs. Taking the clear (CLR) input low causes the Q outputs to go low independently of the clock.

## ORDERING INFORMATION

T <sub>A</sub>	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	SSOP – DL	Tube	SN74ABT162823ADL	ABT162823A
		Tape and reel	SN74ABT162823ADLR	
	TSSOP – DGG	Tape and reel	SN74ABT162823ADGGR	ABT162823A
-55°C to 125°C	CFP – WD	Tube	SNJ54ABT162823AWD	SNJ54ABT162823AWD

† 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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**SN54ABT162823A, SN74ABT162823A**  
**18-BIT BUS-INTERFACE FLIP-FLOPS**  
**WITH 3-STATE OUTPUTS**

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**description/ordering information (continued)**

A buffered output-enable ( $\overline{OE}$ ) input places the nine outputs in either a normal logic state (high or low level) 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 interface or pullup components.  $\overline{OE}$  does not affect the internal operation of the flip-flops. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The outputs, which are designed to source or sink up to 12 mA, include equivalent 25- $\Omega$  series resistors to reduce overshoot and undershoot.

These devices are fully specified for hot-insertion applications using  $I_{off}$  and power-up 3-state. The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down. The power-up 3-state circuitry places the outputs in the high-impedance state during power up and power down, which prevents driver conflict.

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  shall 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.

**FUNCTION TABLE**  
 (each 9-bit flip-flop)

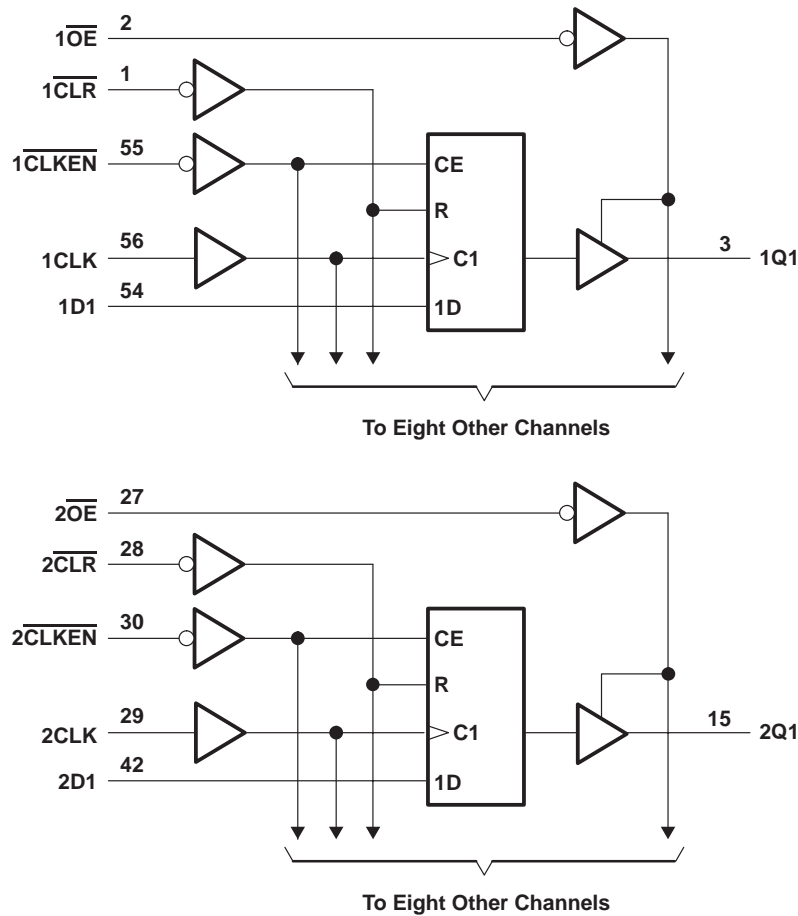
INPUTS					OUTPUT
$\overline{OE}$	$\overline{CLR}$	$\overline{CLKEN}$	CLK	D	Q
L	L	X	X	X	L
L	H	L	$\uparrow$	H	H
L	H	L	$\uparrow$	L	L
L	H	L	L	X	$Q_0$
L	H	H	X	X	$Q_0$
H	X	X	X	X	Z



# SN54ABT162823A, SN74ABT162823A 18-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

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## 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 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, $I_O$ .....	30 mA
Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....	-18 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....	-50 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): DGG package .....	64°C/W
DL package .....	56°C/W
Storage temperature range, $T_{stg}$ .....	-65°C to 150°C

<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 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.

# SN54ABT162823A, SN74ABT162823A

## 18-BIT BUS-INTERFACE FLIP-FLOPS

### WITH 3-STATE OUTPUTS

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#### recommended operating conditions (see Note 3)

		SN54ABT162823A		SN74ABT162823A		UNIT
		MIN	MAX	MIN	MAX	
V <sub>CC</sub>	Supply voltage	4.5	5.5	4.5	5.5	V
V <sub>IH</sub>	High-level input voltage	2		2		V
V <sub>IL</sub>	Low-level input voltage		0.8		0.8	V
V <sub>I</sub>	Input voltage	0	V <sub>CC</sub>	0	V <sub>CC</sub>	V
I <sub>OH</sub>	High-level output current		-3		-12	mA
I <sub>OL</sub>	Low-level output current		8		12	mA
Δt/Δv	Input transition rise or fall rate	Outputs enabled		10	10	ns/V
Δt/ΔV <sub>CC</sub>	Input transition rise or fall rate	200		200		μs/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<sub>CC</sub> 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	T <sub>A</sub> = 25°C			SN54ABT162823A		SN74ABT162823A		UNIT	
		MIN	TYP†	MAX	MIN	MAX	MIN	MAX		
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA			-1.2		-1.2		-1.2	V	
V <sub>OH</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -1 mA			2.5		2.5		2.5	V	
	V <sub>CC</sub> = 5 V, I <sub>OH</sub> = -1 mA			3		3		3		
	V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -3 mA			2.4		2.4		2.4		
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 8 mA			0.4		0.8		0.65	V	
		I <sub>OL</sub> = 12 mA			0.8*		0.8			0.8
I <sub>I</sub>	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND			±1		±1		±1	μA	
I <sub>OZPU</sub>	V <sub>CC</sub> = 0 to 2.1 V, V <sub>O</sub> = 0.5 V to 2.7 V, $\overline{OE} = X$			±50		±50		±50	μA	
I <sub>OZPD</sub>	V <sub>CC</sub> = 2.1 V to 0, V <sub>O</sub> = 0.5 V to 2.7 V, $\overline{OE} = X$			±50		±50		±50	μA	
I <sub>OZH</sub> ‡	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.7 V			10		10		10	μA	
I <sub>OZL</sub> ‡	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0.5 V			-10		-10		-10	μA	
I <sub>off</sub>	V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> ≤ 4.5 V			±100				±100	μA	
I <sub>CEX</sub>	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 5.5 V, Outputs high			50		50		50	μA	
I <sub>O</sub> §	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.5 V	-25	-55	-100		-25	-100	-25	-100	mA
I <sub>CC</sub>	V <sub>CC</sub> = 5.5 V, I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>CC</sub> or GND	Outputs high		0.5		0.5		0.5	mA	
		Outputs low		80		80		80		
		Outputs disabled		0.5		0.5		0.5		
ΔI <sub>CC</sub> ¶	V <sub>CC</sub> = 5.5 V, One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND			1.5		1.5		1.5	mA	
C <sub>i</sub>	V <sub>I</sub> = 2.5 V or 0.5 V			3.5					pF	
C <sub>O</sub>	V <sub>O</sub> = 2.5 V or 0.5 V			9					pF	

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

† All typical values are at V<sub>CC</sub> = 5 V.

‡ The parameters I<sub>OZH</sub> and I<sub>OZL</sub> include the input leakage current.

§ 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<sub>CC</sub> or GND.

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# SN54ABT162823A, SN74ABT162823A 18-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

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

		$V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$		SN54ABT162823A		SN74ABT162823A		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
$f_{\text{clock}}$	Clock frequency	150		150		150		MHz
$t_w$	Pulse duration	$\overline{\text{CLR}}$ low	3.3	3.3	3.3	3.3	3.3	ns
		CLK high or low	3.3	3.3	3.3	3.3		
$t_{\text{su}}$	Setup time before CLK $\uparrow$	$\overline{\text{CLR}}$ inactive	1.6	2	1.6	1.6	ns	
		Data	2	2	2			
		$\overline{\text{CLKEN}}$ low	2.8	2.8	2.8			
$t_h$	Hold time after CLK $\uparrow$	Data	1.2	1.2	1.2	ns		
		$\overline{\text{CLKEN}}$ low	0.6	0.6	0.6			

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)	$V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$			SN54ABT162823A		SN74ABT162823A		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{\text{max}}$			150			150		150	MHz	
$t_{\text{PLH}}$	CLK	Q	2.3	4.6	6.2	2.3	8.4	2.3	7.5	ns
$t_{\text{PHL}}$			2.8	4.6	6.1	2.8	7.1	2.8	6.7	
$t_{\text{PHL}}$	$\overline{\text{CLR}}$	Q	2.8	5	6.3	2.8	7.2	2.8	7	ns
$t_{\text{PZH}}$	$\overline{\text{OE}}$	Q	1.7	3.8	5	1.7	5.8	1.7	5.9	ns
$t_{\text{PZL}}$			3	5	6.1	3	7.2	3	7	
$t_{\text{PHZ}}$	$\overline{\text{OE}}$	Q	2.6	4.8	6.1	2.6	7.3	2.6	6.6	ns
$t_{\text{PLZ}}$			1.9	4.6	6.7	1.9	10.2	1.9	9	

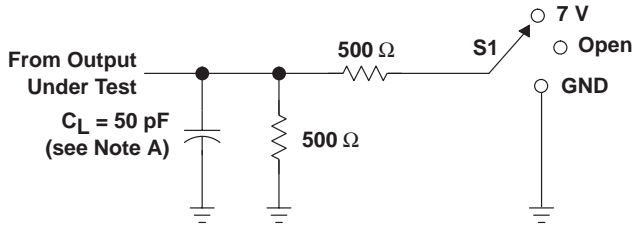
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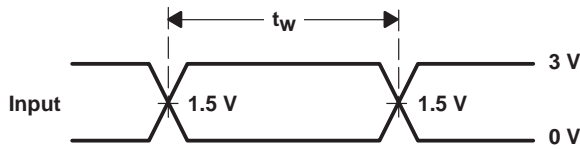
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## PARAMETER MEASUREMENT INFORMATION

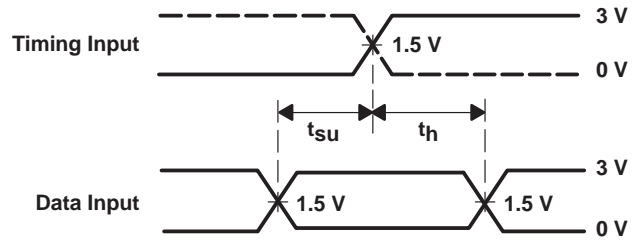


LOAD CIRCUIT

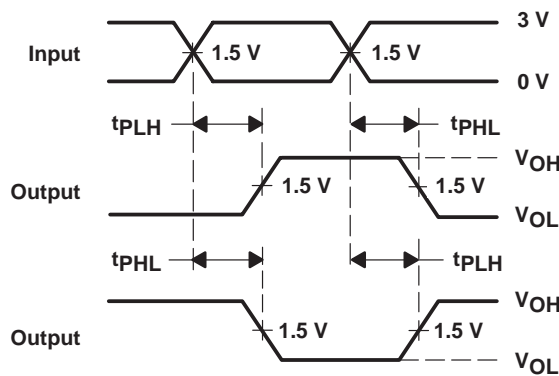
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	Open



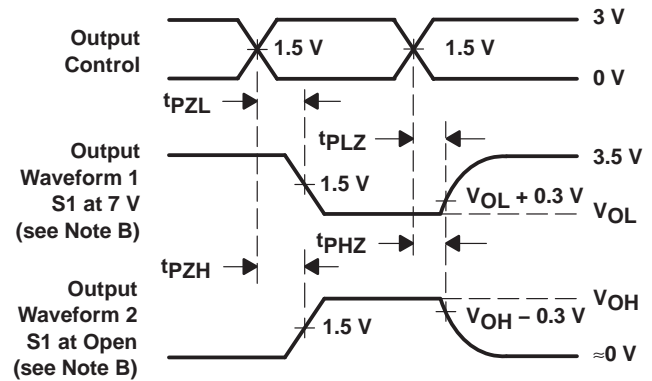
VOLTAGE WAVEFORMS  
PULSE DURATION



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

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)
74ABT162823ADGGRE4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
74ABT162823ADGGRG4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
74ABT162823ADLRG4	ACTIVE	SSOP	DL	56		TBD	Call TI	Call TI	
SN74ABT162823ADGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT162823ADL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74ABT162823ADLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	

<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



### 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
SN74ABT162823ADGGR	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	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)
SN74ABT162823ADGGR	TSSOP	DGG	56	2000	346.0	346.0	41.0

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

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN

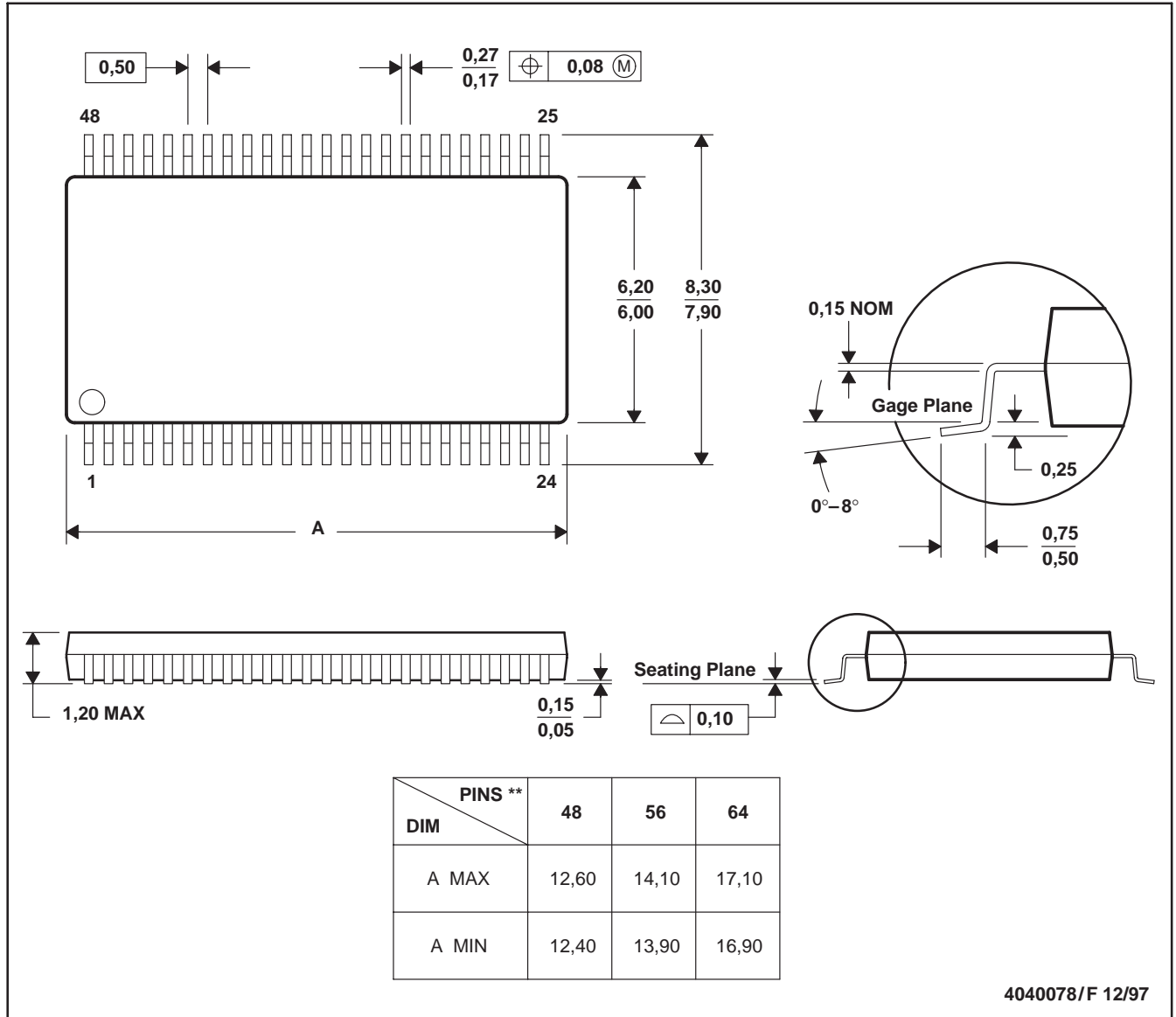


- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).  
 D. Falls within JEDEC MO-118

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

PLASTIC SMALL-OUTLINE PACKAGE

48 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 protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

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DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
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RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
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