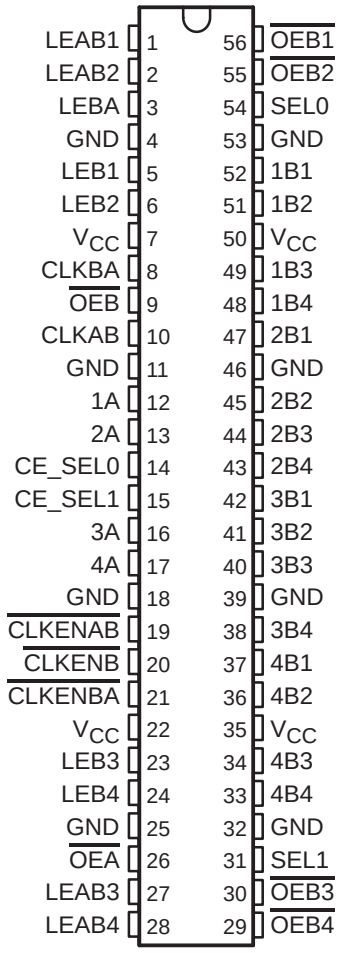
- **Members of the Texas Instruments *Widebus*™ Family**
- **B-Port Outputs Have Equivalent 25-Ω Series Resistors, So No External Resistors Are Required**
- **State-of-the-Art *EPIC*-II*B*™ BiCMOS Design Significantly Reduces Power Dissipation**
- **Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17**
- **Typical V_{OLP} (Output Ground Bounce) < 1 V at V_{CC} = 5 V, T_A = 25°C**
- **High-Impedance State During Power Up and Power Down**
- **Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise**
- **Flow-Through Architecture Optimizes PCB Layout**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**
- **Package Options Include Plastic 300-mil Shrink Small-Outline (DL) Package and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings**

SN54ABTH162460 . . . WD PACKAGE
SN74ABTH162460 . . . DL PACKAGE
(TOP VIEW)



description

The ’ABTH162460 are 4-bit to 1-bit multiplexed registered transceivers used in applications where four separate data paths must be multiplexed onto or demultiplexed from a single data path. Typical applications include multiplexing and/or demultiplexing of address and data information in microprocessor or bus-interface applications. This device also is useful in memory-interleaving applications.

Five 4-bit I/O ports (1A–4A, 1B1–4, 2B1–4, 3B1–4, and 4B1–4) are available for address and/or data transfer. The output-enable ($\overline{OEB}$, $\overline{OEB1}$–$\overline{OEB4}$, and $\overline{OEA}$) inputs control the bus-transceiver functions. These control signals also allow 4-bit or 16-bit control, depending on the $\overline{OEB}$ level.

description (continued)

Address and/or data information can be stored using the internal storage latches/flip-flops. The latch-enable (LEB1–LEB4, LEBA, and LEAB1–LEAB4) and clock/clock-enable (CLK/$\overline{\text{CLKEN}}$) inputs are used to control data storage. When either one of the latch-enable inputs is high, the latch is transparent (clock is a don't care as long as the latch enable is high). When the latch-enable input goes low (providing that the clock does not transit from low to high), the data present at the inputs is latched and remains latched until the latch-enable input is returned high. When the clock enable is low and the corresponding latch enable is low, data can be clocked on the low-to-high transition of the clock. When either the clock enable or the corresponding latch enable is high, the clock is a don't care.

Four select (SEL0, SEL1, CE_SEL0, and CE_SEL1) pins are provided to multiplex data (A port), or to select one of four clock enables (B port). This allows the user the flexibility of controlling one bit at a time.

The B-port outputs, which are designed to sink up to 12 mA, include equivalent 25-Ω series resistors to reduce overshoot and undershoot.

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

When V_{CC} is between 0 and 2.1 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 2.1 V, $\overline{\text{OE}}$ 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 SN54ABTH162460 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74ABTH162460 is characterized for operation from –40°C to 85°C.

Function Tables

A-TO-B OUTPUT ENABLE†

INPUTS		OUTPUT
$\overline{\text{OEB}}$	$\overline{\text{OEBn}}$	Bn
H	H	Z
H	L	Z
L	H	Z
L	L	Active

† n = 1, 2, 3, 4

A-TO-B STORAGE
(assuming $\overline{\text{OEB}}$ = L, $\overline{\text{OEBn}}$ = L)‡

INPUTS								OUTPUTS			
$\overline{\text{CLKENAB}}$	CE_SEL1	CE_SEL0	CLKAB	LEAB1	LEAB2	LEAB3	LEAB4	B1	B2	B3	B4
X	X	X	H or L	H	L	L	L	A	A_0	A_0	A_0
X	X	X	H or L	H	H	H	L	A	A	A	A_0
L	X	X	L	L	L	L	L	A_0	A_0	A_0	A_0
L	L	L	↑	L	L	L	L	A	A_0	A_0	A_0
L	L	H	↑	L	L	L	L	A_0	A	A_0	A_0
L	H	L	↑	L	L	L	L	A_0	A_0	A	A_0
L	H	H	↑	L	L	L	L	A_0	A_0	A_0	A
H	X	X	↑	L	L	L	L	A_0	A_0	A_0	A_0

‡ This table does not cover all the latch-enable cases since they have similar results.

Function Tables (Continued)

B-TO-A STORAGE
(before point P)

INPUTS								P
$\overline{\text{CLKENB}}$	CLKBA	LEB1	LEB2	LEB3	LEB4	SEL1	SEL0	
X	X	H	L	L	L	L	L	B1
X	X	L	H	L	L	L	H	B2
X	X	L	L	H	L	H	L	B3
X	X	L	L	L	H	H	H	B4
L	↑	L	L	L	L	L	L	B1
						L	H	B2
						H	L	B3
						H	H	B4
L	L	L	L	L	L	L	L	$B1_0$†
						L	H	$B2_0$†
						H	L	$B3_0$†
						H	H	$B4_0$†

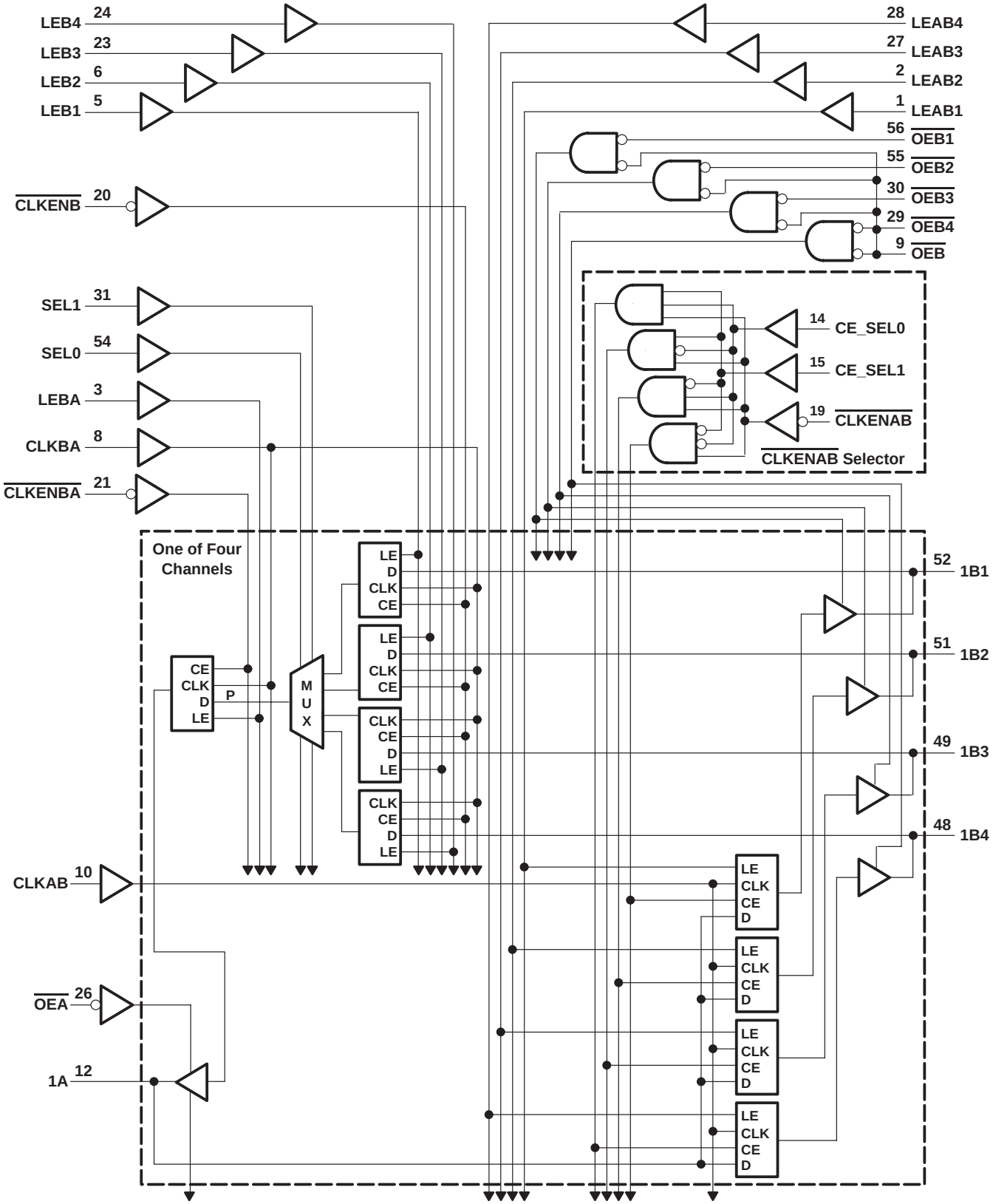
† Output level before the indicated steady-state input conditions were established

B-TO-A STORAGE
(after point P)

INPUTS					OUTPUT A
$\overline{\text{CLKENBA}}$	CLKBA	LEBA	$\overline{\text{OEA}}$	B	
X	X	X	H	X	Z
X	X	H	L	L	L
X	X	H	L	H	H
H	X	L	L	X	A_0†
L	↑	L	L	L	L
L	↑	L	L	H	H
L	L	L	L	X	A_0†

† Output level before the indicated steady-state input conditions were established

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 (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: SN54ABTH162460 (A port) . . . . . 96 mA
SN74ABTH162460 (A port) . . . . . 128 mA
B port . . . . . 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, θ_{JA} (see Note 2): DL package . . . . . 74 °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.

recommended operating conditions (see Note 3)

			SN54ABTH162460			SN74ABTH162460			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		4.5	5	5.5	4.5	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	A port			–24			–32	mA
		B port			–12			–12	
I_{OL}	Low-level output current	A port			48			64	mA
		B port			12			12	
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled			10			10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate		200			200			µs/V
T_A	Operating free-air temperature		–55		125	–40		85	°C

NOTE 3: Unused control pins 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		SN54ABTH162460			SN74ABTH162460			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}	A port	V_{CC} = 5 V,	I_{OH} = –3 mA	3	3.4		3	3.4		V
		V_{CC} = 4.5 V	I_{OH} = –3 mA	2.5	3					
			I_{OH} = –32 mA				2	2.7		
	B port	V_{CC} = 5 V,	I_{OH} = –1 mA	3.8	4.2		3.85			
		V_{CC} = 4.5 V	I_{OH} = –1 mA	3.3	3.7		3.35			
			I_{OH} = –3 mA	3	3.6		3.1			
			I_{OH} = –12 mA				2.6			
V_{OL}	A port	V_{CC} = 4.5 V	I_{OL} = 24 mA		0.25	0.55				V
			I_{OL} = 64 mA					0.3	0.55	
	B port	V_{CC} = 4.5 V	I_{OL} = 8 mA		0.4	0.8		0.4	0.65	
			I_{OL} = 12 mA					0.5	0.8	
V_{hys}					100			100		mV
I_I	Control inputs	V_{CC} = 0 to 5.5 V,	V_I = V_{CC} or GND			±1			±1	µA
	A or B ports	V_{CC} = 2.1 V to 5.5 V,	V_I = V_{CC} or GND			±20			±20	
$I_{I(hold)}$	A or B ports	V_{CC} = 5.5 V,	V_I = 0.8 V	75		500	75		500	µA
		V_{CC} = 4.5 V,	V_I = 2 V	–75		–500	–75		–500	
I_O‡	A port	V_{CC} = 5.5 V,	V_O = 2.5 V	–50	–110	–180	–50		–180	mA
	B port	V_{CC} = 5.5 V	V_O = 2.5 V	–25	–55	–90	–25		–90	
			V_O = 0	–50	–110	–180	–50		–180	
I_{CEX}	Outputs high	V_{CC} = 5.5 V,	V_O = 5.5 V			50			50	µA
I_{off}		V_{CC} = 0,	V_I or V_O ≤ 4.5 V			±100			±100	µA
I_{OZPU}§		V_{CC} = 0 to 2.1 V, V_O = 0.5 V to 2.7 V, $\overline{OE}$ = X				±50			±50	µA
I_{OZPD}§		V_{CC} = 2.1 V to 0, V_O = 0.5 V to 2.7 V, $\overline{OE}$ = X				±50			±50	µA
I_{CC}	Outputs high	V_{CC} = 5.5 V, Outputs open				1.5		0.7	1.5	mA
	A port low					10		6	10	
	B port low					32		18	32	
	Outputs disabled					1.5		0.7	1.5	
ΔI_{CC}¶		V_{CC} = 5.5 V, One input at 3.4 V, Other inputs at V_{CC} or GND				1			1	mA
C_i	Control inputs	V_I = 2.5 V or 0.5 V			3.5			3.5		pF
C_{io}	A or B ports	V_O = 2.5 V or 0.5 V			8			8		pF

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.
§ This parameter is characterized but not production tested.
¶ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

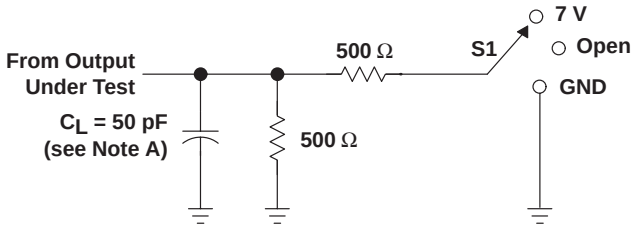
timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)(see Figure 1)

				V_{CC} = 5 V, T_A = 25°C		SN54ABTH162460		SN74ABTH162460		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency			0	160	0	160	0	160	MHz
t_w	Pulse duration	CLKAB high or low		3.8		3.8		3.8		ns
		CLKBA high or low		4.5		4.5		4.5		
		LEAB1, 2, 3, or 4 high		2.8		2.8		2.8		
		LEBA high		2.8		2.8		2.8		
		LEB1, 2, 3, or 4 high		3		3		3		
t_{su}	Setup time	Before CLKAB↑	A bus	2.5		2.5		2.5		ns
			CE_SEL0/1	3.2		3.2		3.2		
			$\overline{\text{CLKENAB}}$	3.2		3.2		3.2		
		Before LEAB1, 2, 3, or 4↓	A bus	3.6		3.6		3.6		
		Before CLKBA↑	B bus	3.8		3.8		3.8		
			$\overline{\text{CLKENB}}$	2.3		2.3		2.3		
			$\overline{\text{CLKENBA}}$	2.5		2.5		2.5		
			LEB1, 2, 3, or 4	4.3		4.3		4.3		
			SEL0/1	4.5		4.5		4.5		
		Before LEB1, 2, 3, or 4↓	B bus	3.2		3.2		3.2		
		Before LEBA↓	B bus	4		4		4		
			LEB1, 2, 3, or 4	4.4		4.4		4.4		
			SEL0/1	4.3		4.3		4.3		
t_h	Hold time	After CLKAB↑	A bus	0.5		0.5		0.5		ns
			CE_SEL0/1	1.1		1.1		1.1		
			$\overline{\text{CLKENAB}}$	0.5		0.5		0.5		
		After LEAB1, 2, 3, or 4↓	A bus	1.2		1.2		1.2		
		After CLKBA↑	B bus	1.3		1.3		1.3		
			$\overline{\text{CLKENB}}$	1		1		1		
			$\overline{\text{CLKENBA}}$	1		1		1		
			SEL0/1	0		0		0		
		After LEB1, 2, 3, or 4↓	B bus	1.5		1.5		1.5		
		After LEBA↓	B bus	0.4		0.4		0.4		
			SEL0/1	0.1		0.1		0.1		

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

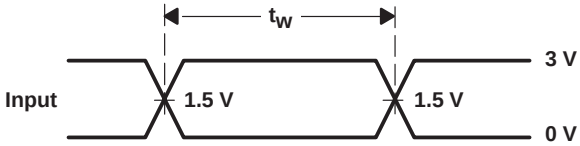
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 5 V, T_A = 25°C			SN54ABTH162460		SN74ABTH162460		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			160			160		160		MHz
t_{PLH}	B	A	2	3.6	5.9	2	7.1	2	6.5	ns
t_{PHL}			2	3.5	5.8	2	6.8	2	6.5	
t_{PZH}	$\overline{OEA}$	A	1.5	2.8	4.8	1.5	5.9	1.5	5.6	ns
t_{PZL}			1.5	2.6	4.8	1.5	5.7	1.5	5.5	
t_{PHZ}	$\overline{OEA}$	A	2	3.8	5.3	2	6	2	5.9	ns
t_{PLZ}			1.5	4	6.1	1.5	7	1.5	6.5	
t_{PLH}	A	B	2	3.3	5.5	2	6.5	2	6.2	ns
t_{PHL}			2	3.7	5.8	2	6.8	2	6.5	
t_{PZH}	$\overline{OEB}$	B	2	3.9	5.8	2	7.1	2	6.8	ns
t_{PZL}			2	3.7	5.6	2	6.6	1.5	6.3	
t_{PHZ}	$\overline{OEB}$	B	2	4	5.6	2	6.4	2	6.2	ns
t_{PLZ}			2	3.7	5.2	2	6.1	2	5.8	
t_{PZH}	$\overline{OEB1}$, $\overline{2}$, $\overline{3}$, $\overline{4}$	B	2	3.7	5.8	2	6.8	2	6.6	ns
t_{PZL}			2	3.5	5.4	2	6.4	2	6.2	
t_{PHZ}	$\overline{OEB1}$, $\overline{2}$, $\overline{3}$, $\overline{4}$	B	1.5	3.3	4.8	1.5	5.4	1.5	5.3	ns
t_{PLZ}			1.5	3.1	4.4	1.5	5.1	1.5	4.9	
t_{PLH}	CLKBA	A	1.5	4.2	6.7	1.5	8.1	1.5	7.4	ns
t_{PHL}			1.5	4.4	6.9	1.5	8.4	1.5	7.7	
t_{PLH}	CLKAB	B	2	3.5	5.8	2	6.9	2	6.5	ns
t_{PHL}			2	3.7	6	2	7	2	6.5	
t_{PLH}	LEBA	A	1.5	3	5.2	1.5	6.3	1.5	5.8	ns
t_{PHL}			1.5	3	5	1.5	6.3	1.5	5.8	
t_{PLH}	LEAB1, 2, 3, 4	B	2	3.4	5.4	2	6.5	2	6.2	ns
t_{PHL}			2	3.6	5.7	2	6.3	2	6.2	
t_{PLH}	LEBA1, 2, 3, 4	A	2	4	6.5	2	7.8	2	7.2	ns
t_{PHL}			2	4	6.1	2	7.5	2	6.8	
t_{PLH}	SEL	A	2	4.1	6.7	2	8.1	2	7.5	ns
t_{PHL}			2	3.8	6.2	2	7.3	2	6.9	

PARAMETER MEASUREMENT INFORMATION

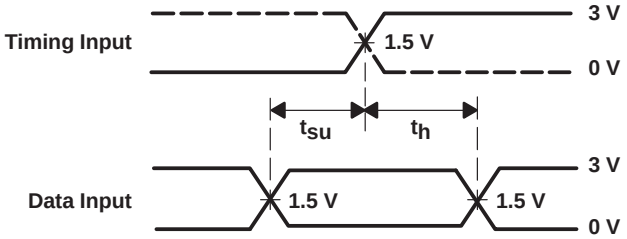


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open

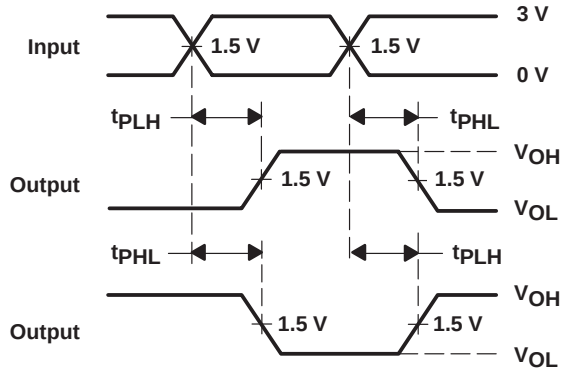
LOAD CIRCUIT



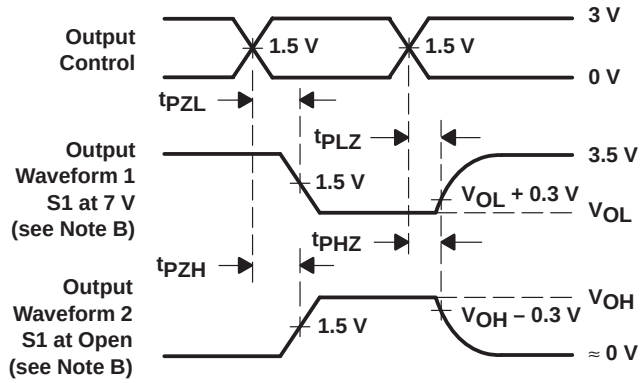
VOLTAGE WAVEFORMS
PULSE DURATION



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 ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 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)
74ABTH162460DGGRE4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ABTH162460DGGRG4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ABTH162460DLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ABTH162460DLRG4	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABTH162460DGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABTH162460DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABTH162460DLR	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

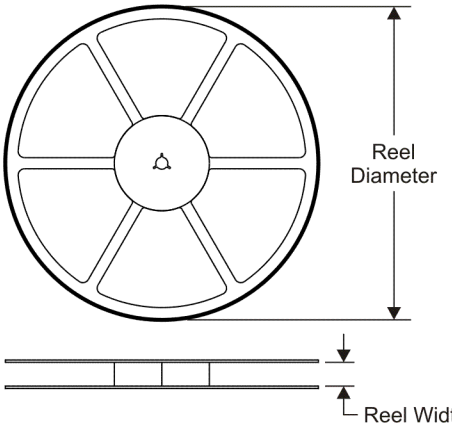
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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) 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)

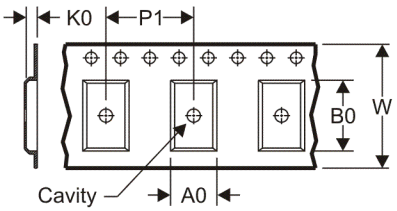
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

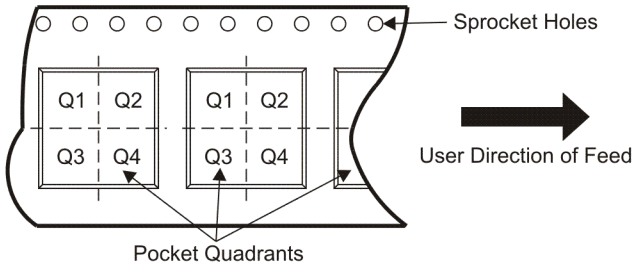


TAPE DIMENSIONS



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

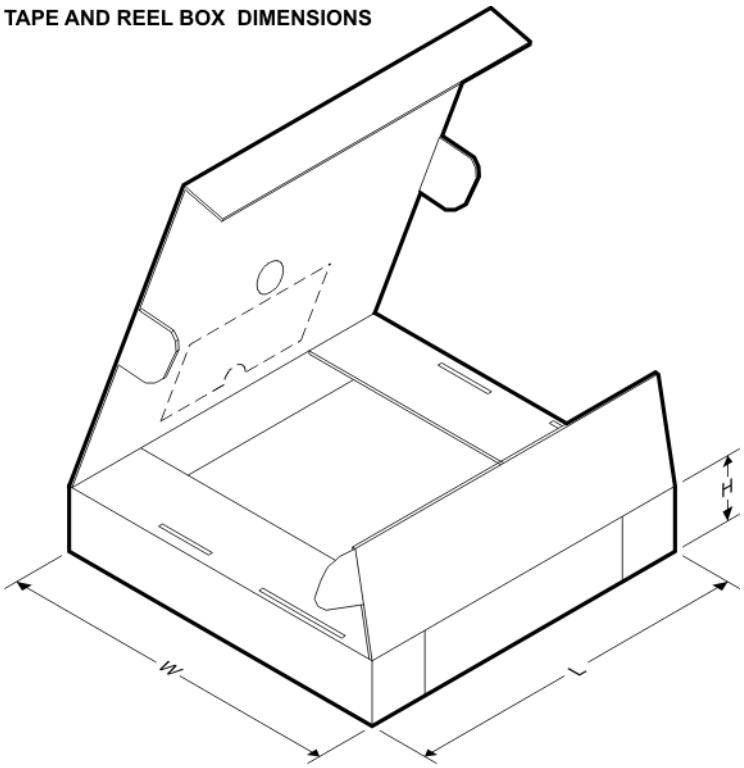
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SN74ABTH162460DGGR	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	12.0	24.0	Q1
SN74ABTH162460DLR	SSOP	DL	56	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1

TAPE AND REEL BOX DIMENSIONS

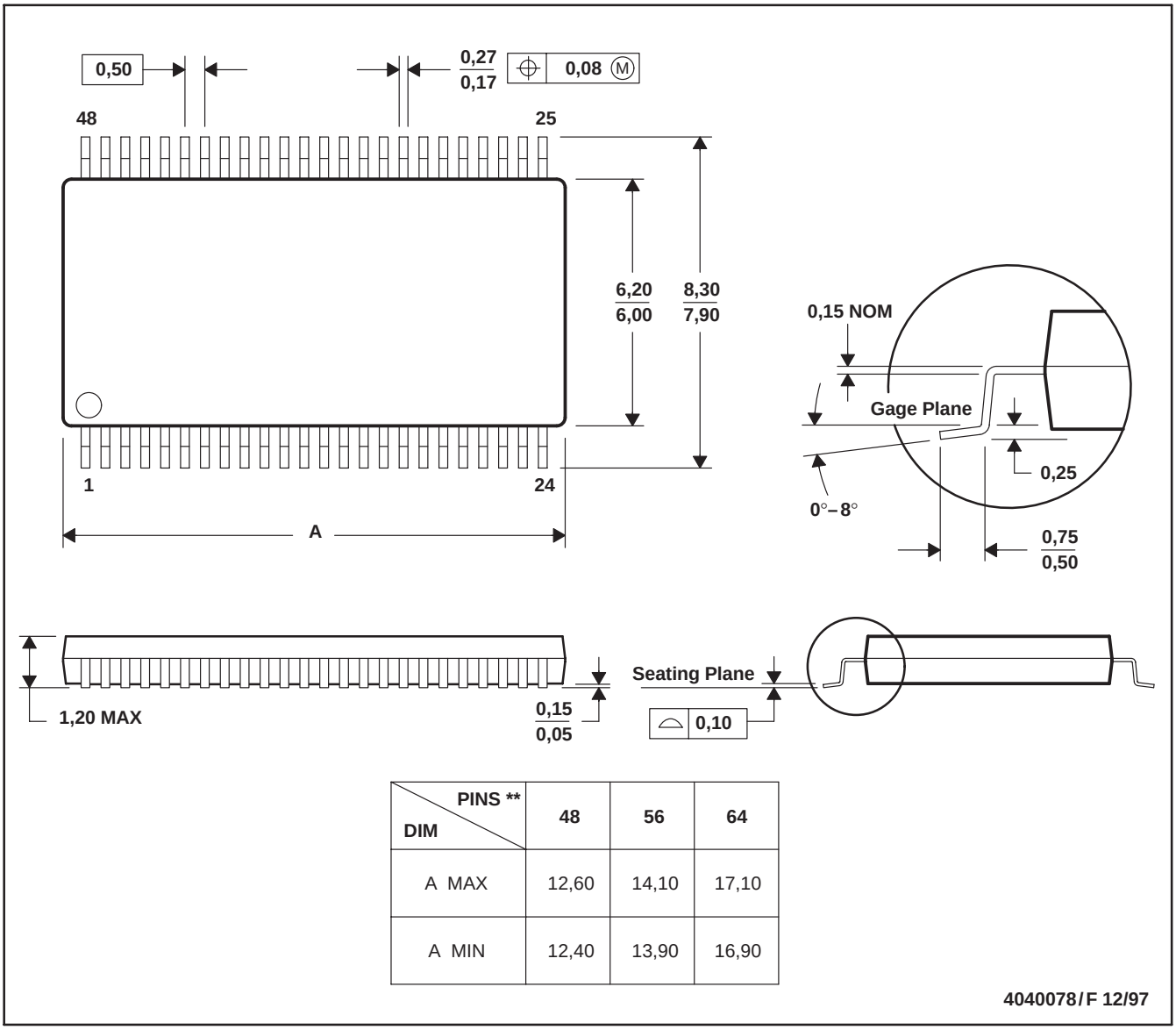


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ABTH162460DGGR	TSSOP	DGG	56	2000	346.0	346.0	41.0
SN74ABTH162460DLR	SSOP	DL	56	1000	346.0	346.0	49.0

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

48 PINS SHOWN

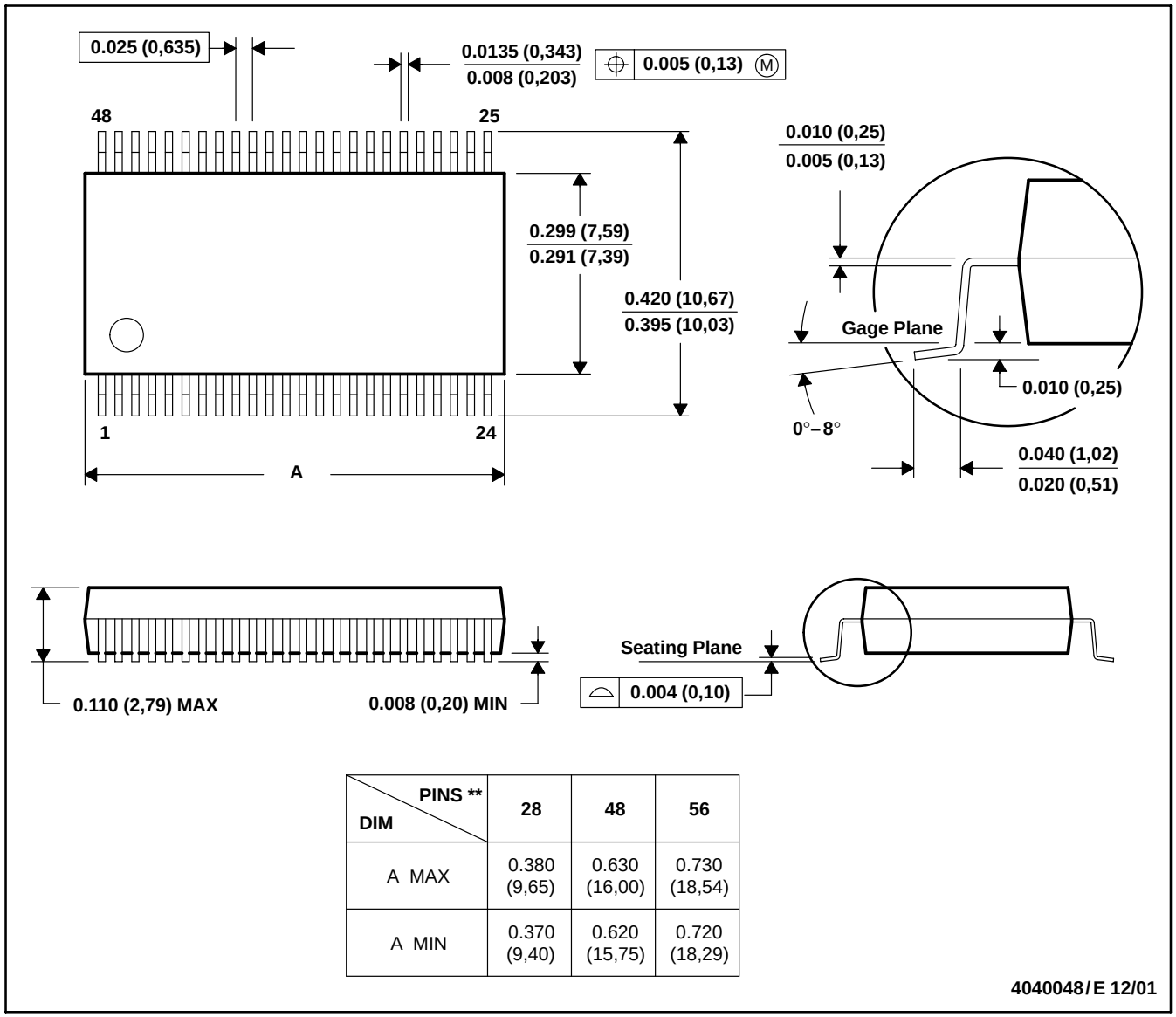


DIM \ PINS **	48	56	64
A MAX	12,60	14,10	17,10
A MIN	12,40	13,90	16,90

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

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

48 PINS SHOWN



DIM \ PINS **	28	48	56
A MAX	0.380 (9,65)	0.630 (16,00)	0.730 (18,54)
A MIN	0.370 (9,40)	0.620 (15,75)	0.720 (18,29)

4040048/E 12/01

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

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