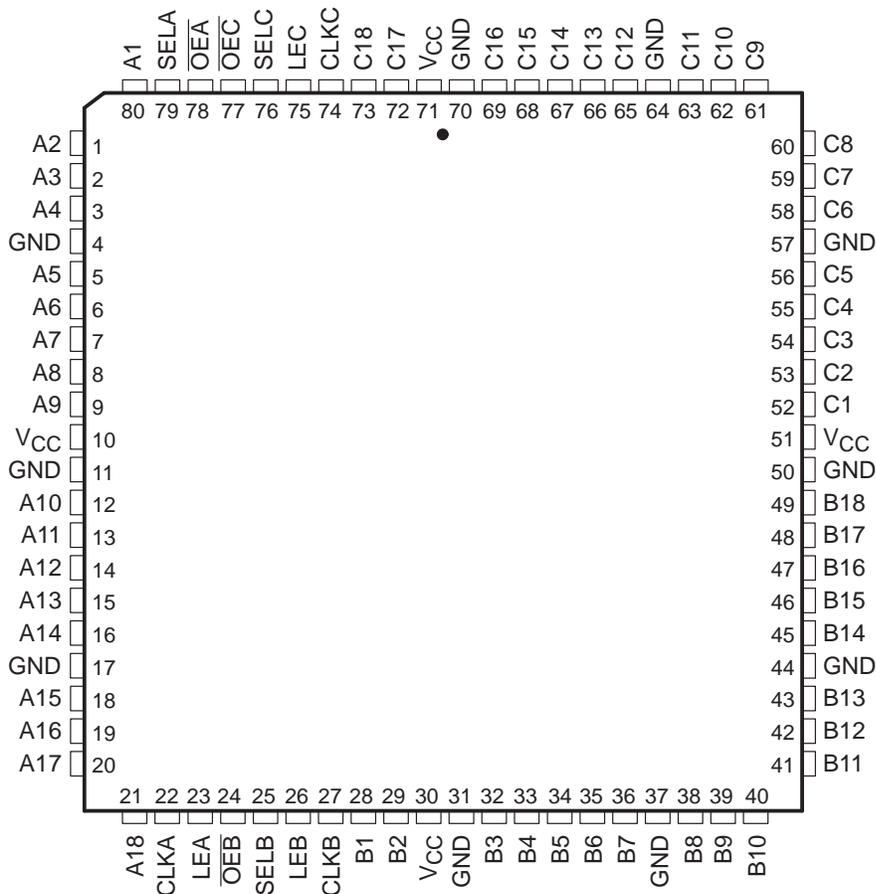


SN54ABTH32318, SN74ABTH32318 18-BIT TRI-PORT UNIVERSAL BUS EXCHANGERS

SCBS180E – JUNE 1992 – REVISED MAY 1997

- **Members of the Texas Instruments Widebus+™ Family**
- **State-of-the-Art EPIC-II^B™ BiCMOS Design Significantly Reduces Power Dissipation**
- **UBE™ (Universal Bus Exchanger) Combines D-Type Latches and D-Type Flip-Flops for Operation in Transparent, Latched, or Clocked Mode**
- **Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17**
- **Typical V_{OLP} (Output Ground Bounce) < 0.8 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**
- **High-Drive Outputs (–32-mA I_{OH}, 64-mA I_{OL})**
- **Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors**
- **Package Options Include 80-Pin Plastic Thin Quad Flat (PN) Package With 12 × 12-mm Body Using 0.5-mm Lead Pitch and 84-Pin Ceramic Quad Flat (HT) Package**

SN74ABTH32318 . . . PN PACKAGE
(TOP VIEW)



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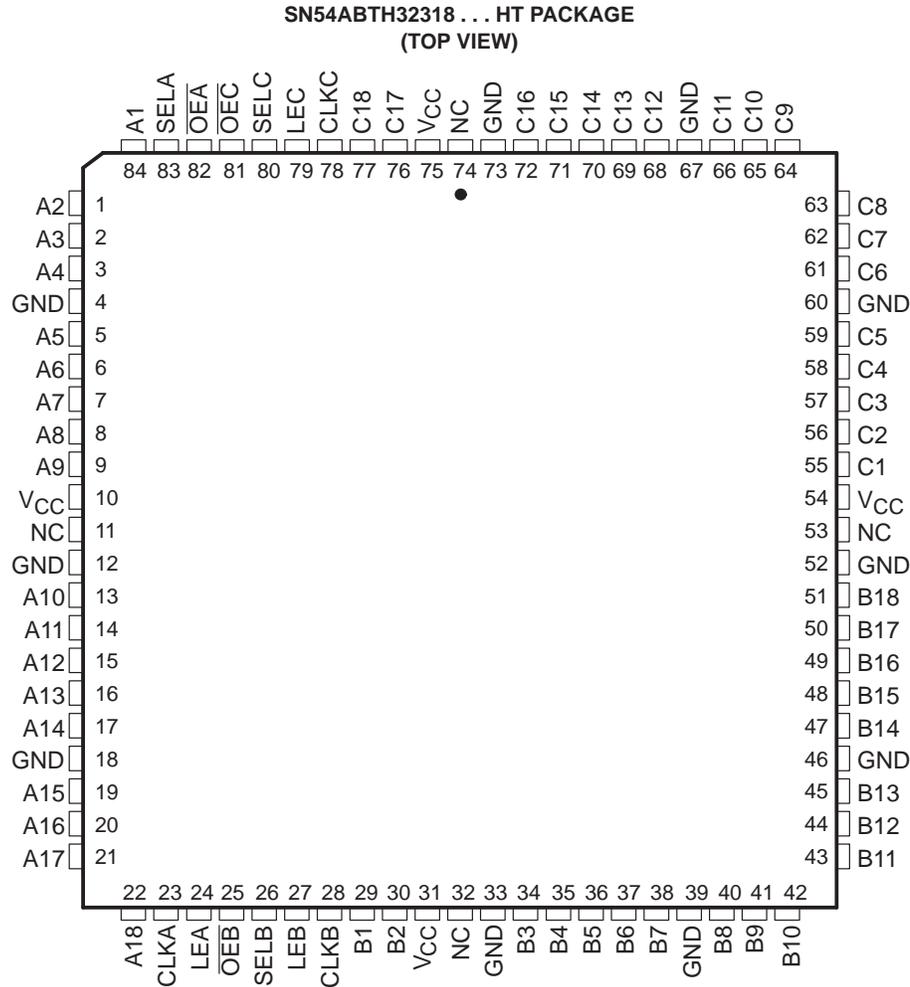


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SN54ABTH32318, SN74ABTH32318 18-BIT TRI-PORT UNIVERSAL BUS EXCHANGERS

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NC – No internal connection

description

The 'ABTH32318 consist of three 18-bit registered input/output (I/O) ports. These registers combine D-type latches and flip-flops to allow data flow in transparent, latch, and clock modes. Data from one input port can be exchanged to one or more of the other ports. Because of the universal storage element, multiple combinations of real-time and stored data can be exchanged among the three ports.

Data flow in each direction is controlled by the output-enable ($\overline{OE_A}$, $\overline{OE_B}$, and $\overline{OE_C}$), select-control (SELA, SELB, and SELC), latch-enable (LEA, LEB, and LEC), and clock (CLKA, CLKB, and CLKC) inputs. The A data register operates in the transparent mode when LEA is high. When LEA is low, data is latched if CLKA is held at a high or low logic level. If LEA is low, data is stored on the low-to-high transition of CLKA. Output data selection is accomplished by the select-control pins. All three ports have active-low output enables, so when the output-enable input is low, the outputs are active; when the output-enable input is high, the outputs are in the high-impedance state.

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{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.

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



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description (continued)

The SN54ABTH32318 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74ABTH32318 is characterized for operation from –40°C to 85°C.

Function Tables

STORAGE†

| INPUTS | | | OUTPUT |
|--------|-----|---|------------------|
| CLKA | LEA | A | |
| ↑ | L | L | L |
| ↑ | L | H | H |
| H | L | X | Q ₀ ‡ |
| L | L | X | Q ₀ ‡ |
| X | H | L | L |
| X | H | H | H |

† A-port register shown. B and C ports are similar but use CLKB, CLKC, LEB, and LEC.

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

A-PORT OUTPUT

| INPUTS | | OUTPUT A |
|------------------|------|----------------------|
| \overline{OEA} | SELA | |
| H | X | Z |
| L | H | Output of C register |
| L | L | Output of B register |

B-PORT OUTPUT

| INPUTS | | OUTPUT B |
|------------------|------|----------------------|
| \overline{OEB} | SELB | |
| H | X | Z |
| L | H | Output of A register |
| L | L | Output of C register |

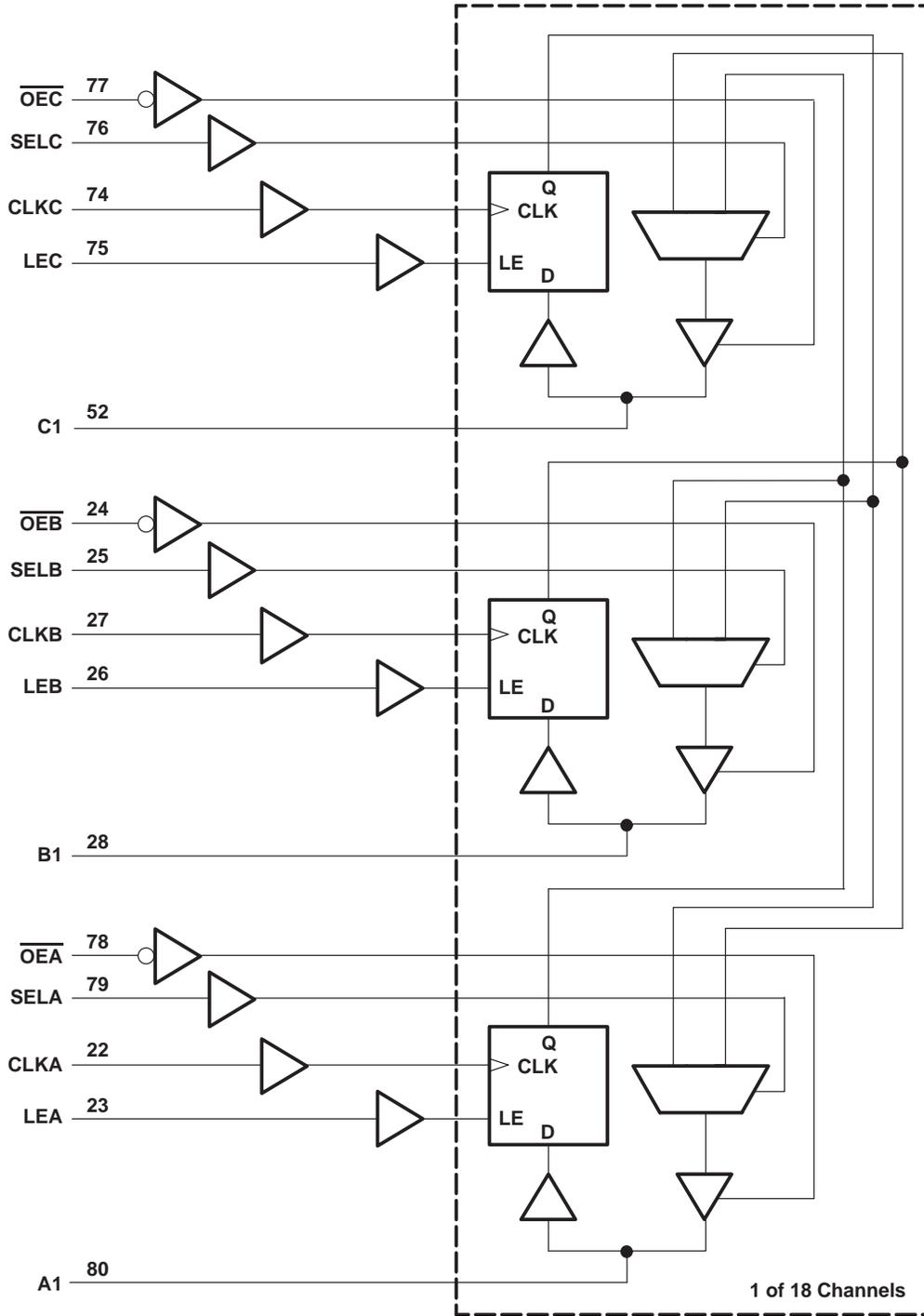
C-PORT OUTPUT

| INPUTS | | OUTPUT C |
|------------------|------|----------------------|
| \overline{OEC} | SELC | |
| H | X | Z |
| L | H | Output of B register |
| L | L | Output of A register |

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logic diagram (positive logic)



Pin numbers shown are for the PN package.

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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} : SN54ABTH32318 | 96 mA |
| SN74ABTH32318 | 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): PN package | 62°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)

| | | SN54ABTH32318 | | SN74ABTH32318 | | 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 | Outputs enabled | | | 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.

SN54ABTH32318, SN74ABTH32318 18-BIT TRI-PORT UNIVERSAL BUS EXCHANGERS

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

| PARAMETER | | TEST CONDITIONS | | SN54ABTH32318 | | | SN74ABTH32318 | | | 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} | | V _{CC} = 4.5 V, I _{OH} = -3 mA | | 2.5 | | | 2.5 | | | V |
| | | V _{CC} = 5 V, I _{OH} = -3 mA | | 3 | | | 3 | | | |
| | | V _{CC} = 4.5 V | | 2 | | | 2 | | | |
| V _{OL} | | V _{CC} = 4.5 V | | I _{OL} = 48 mA | | | 0.55 | | | V |
| | | | | I _{OL} = 64 mA | | | 0.55 | | | |
| 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, B, or C ports | V _{CC} = 2.1 V to 5.5 V, V _I = V _{CC} or GND | | ±20 | | | ±20 | | | |
| I _I (hold) | A, B, or C ports | V _{CC} = 4.5 V | | V _I = 0.8 V | | | 100 | | | μA |
| | | | | V _I = 2 V | | | -100 | | | |
| 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 _{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 | | | μA |
| I _O § | | V _{CC} = 5.5 V, V _O = 2.5 V | | -50 | -100 | -180 | -50 | -100 | -180 | mA |
| I _{CC} | | V _{CC} = 5.5 V, I _O = 0, V _I = V _{CC} or GND | | Outputs high | | | 2 | | | mA |
| | | | | Outputs low | | | 45 | | | |
| | | | | Outputs disabled | | | 1 | | | |
| ΔI _{CC} ¶ | | V _{CC} = 5.5 V, One input at 3.4 V, Other inputs at V _{CC} or GND | | 0.5 | | | 0.5 | | | mA |
| C _i | Control inputs | V _I = 2.5 V or 0.5 V | | 3 | | | 3 | | | pF |
| C _{io} | A, B, or C ports | V _O = 2.5 V or 0.5 V | | 11.5 | | | 11.5 | | | pF |

† All typical values are at V_{CC} = 5 V, T_A = 25°C.

‡ This parameter is specified by characterization.

§ 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 1)

| | | SN54ABTH32318 | | SN74ABTH32318 | | UNIT |
|--------------------|-----------------|------------------------|-----|---------------|-----|------|
| | | MIN | MAX | MIN | MAX | |
| f _{clock} | Clock frequency | 150 | | 150 | | MHz |
| t _w | Pulse duration | LE high | | 3.3 | | ns |
| | | CLK high or low | | 3.3 | | |
| t _{su} | Setup time | A, B, or C before CLK↑ | | 2.4 | | ns |
| | | A, B, or C before LE↓ | | 2.1 | | |
| t _h | Hold time | A, B, or C after CLK↑ | | 1.4 | | ns |
| | | A, B, or C after LE↓ | | 2.1 | | |

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



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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) | SN54ABTH32318 | | SN74ABTH32318 | | UNIT |
|-----------|-----------------|----------------|---------------|-----|---------------|-----|------|
| | | | MIN | MAX | MIN | MAX | |
| f_{max} | | | 150 | | 150 | | MHz |
| t_{PLH} | A, B, or C | C, B, or A | 1.4 | 6.5 | 1.4 | 6.1 | ns |
| t_{PHL} | | | 1.1 | 6.8 | 1.1 | 6.6 | |
| t_{PLH} | SEL | A, B, or C | 1.4 | 6.7 | 1.4 | 6.5 | ns |
| t_{PHL} | | | 1.8 | 6.8 | 1.8 | 6.5 | |
| t_{PLH} | LE | A, B, or C | 2.6 | 8 | 2.6 | 7.5 | ns |
| t_{PHL} | | | 2.6 | 7.4 | 2.6 | 6.9 | |
| t_{PLH} | CLK | A, B, or C | 2.5 | 8 | 2.5 | 7.4 | ns |
| t_{PHL} | | | 2.5 | 7.2 | 2.5 | 6.7 | |
| t_{PZH} | \overline{OE} | A, B, or C | 1.4 | 6.9 | 1.4 | 6.8 | ns |
| t_{PZL} | | | 2.4 | 7.2 | 2.4 | 7.1 | |
| t_{PHZ} | \overline{OE} | A, B, or C | 1 | 6.4 | 1 | 6.2 | ns |
| t_{PLZ} | | | 2 | 6.4 | 2 | 6 | |

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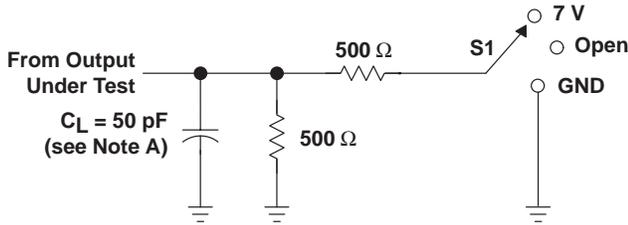


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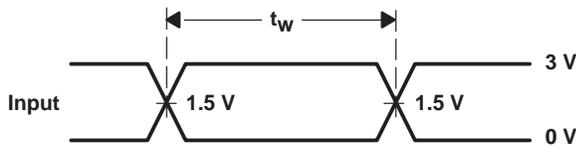
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PARAMETER MEASUREMENT INFORMATION

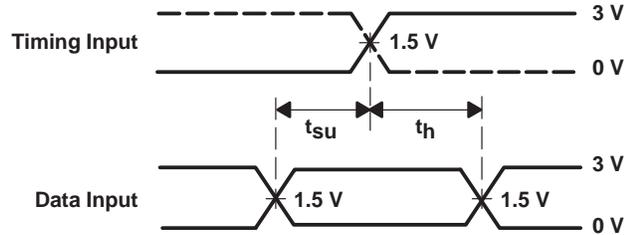


LOAD CIRCUIT

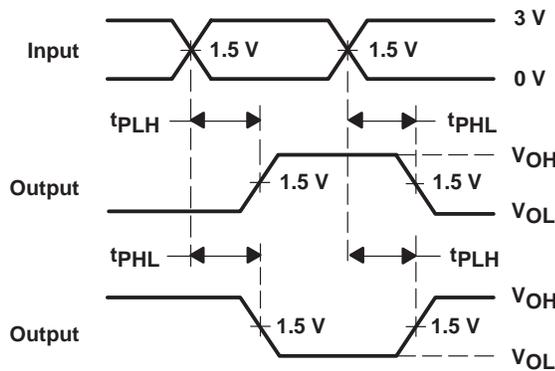
| TEST | S1 |
|-------------------|------|
| t_{PLH}/t_{PHL} | Open |
| t_{PLZ}/t_{PZL} | 7 V |
| t_{PHZ}/t_{PZH} | Open |



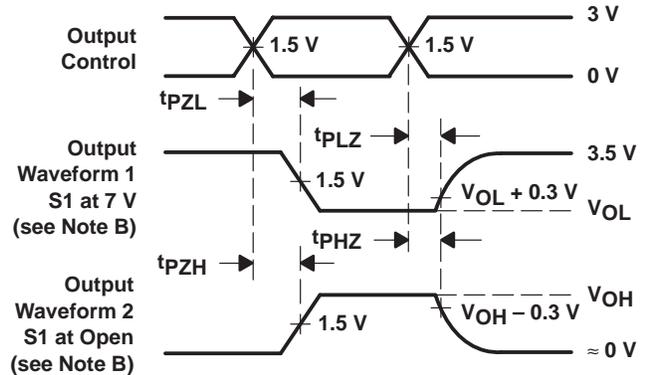
VOLTAGE WAVEFORMS
PULSE DURATION



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.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---------------------------------|---------------|----------------------|----------------|-------------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| SN74ABTH32318PN | Active | Production | LQFP (PN) 80 | 119 JEDEC TRAY (10+1) | Yes | NIPDAU | Level-3-260C-168 HR | -40 to 85 | ABTH32318 |
| SN74ABTH32318PN.B | Active | Production | LQFP (PN) 80 | 119 JEDEC TRAY (10+1) | Yes | NIPDAU | Level-3-260C-168 HR | -40 to 85 | ABTH32318 |

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

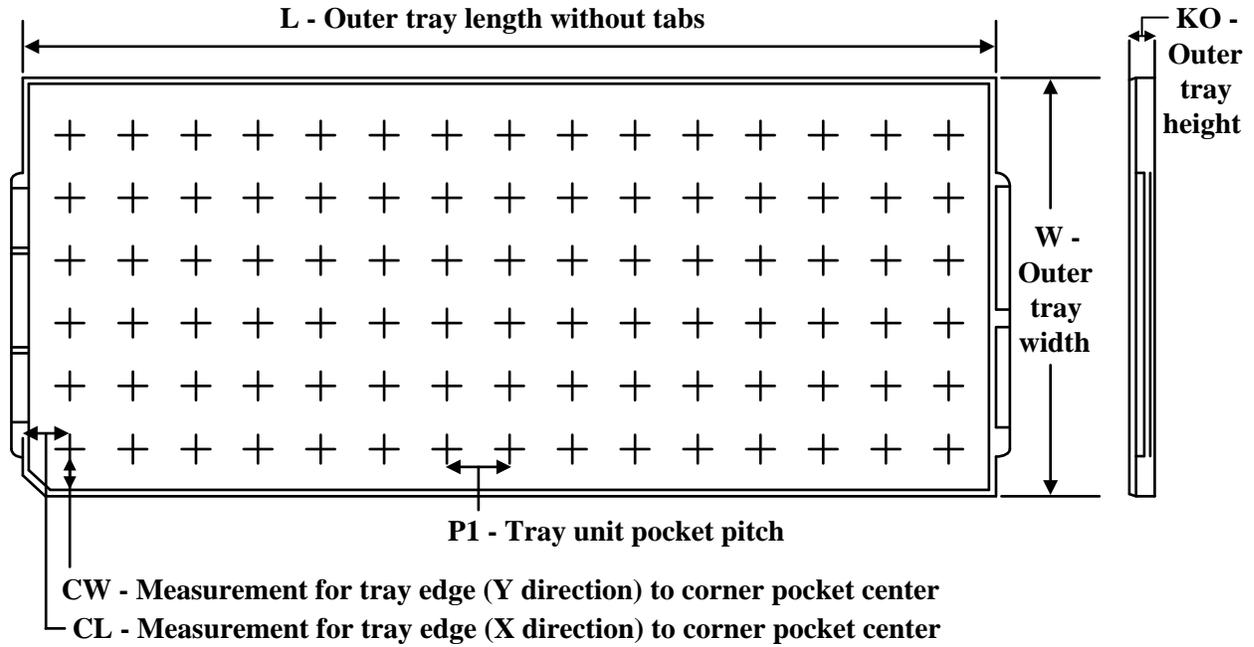
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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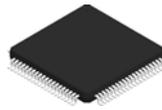
TRAY


Chamfer on Tray corner indicates Pin 1 orientation of packed units.

*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | Unit array matrix | Max temperature (°C) | L (mm) | W (mm) | K0 (µm) | P1 (mm) | CL (mm) | CW (mm) |
|-------------------|--------------|--------------|------|-----|-------------------|----------------------|--------|--------|---------|---------|---------|---------|
| SN74ABTH32318PN | PN | LQFP | 80 | 119 | 7 x 17 | 150 | 315 | 135.9 | 7620 | 17.9 | 14.3 | 13.95 |
| SN74ABTH32318PN.B | PN | LQFP | 80 | 119 | 7 x 17 | 150 | 315 | 135.9 | 7620 | 17.9 | 14.3 | 13.95 |

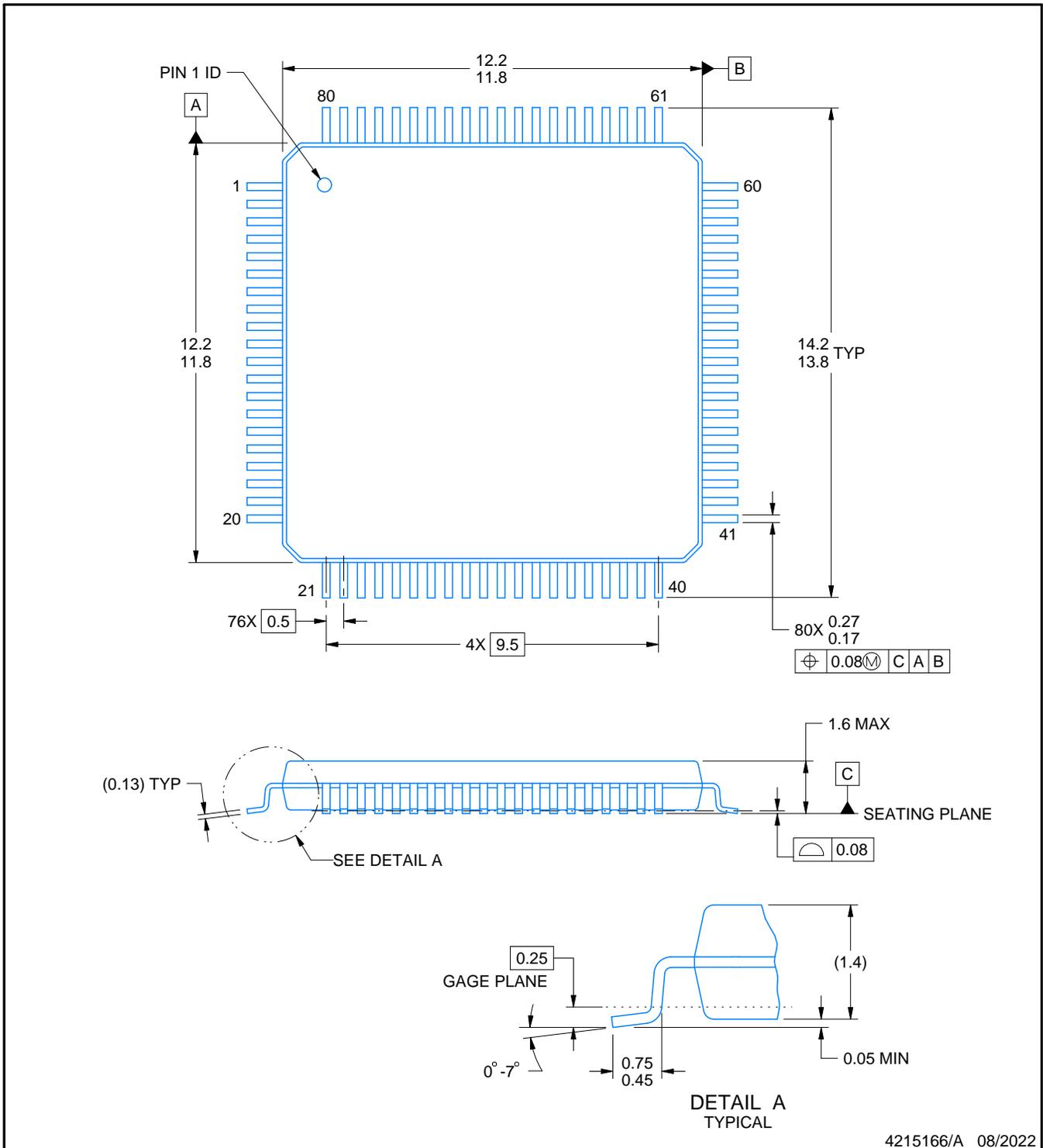
PN0080A



PACKAGE OUTLINE

LQFP - 1.6 mm max height

PLASTIC QUAD FLATPACK



NOTES:

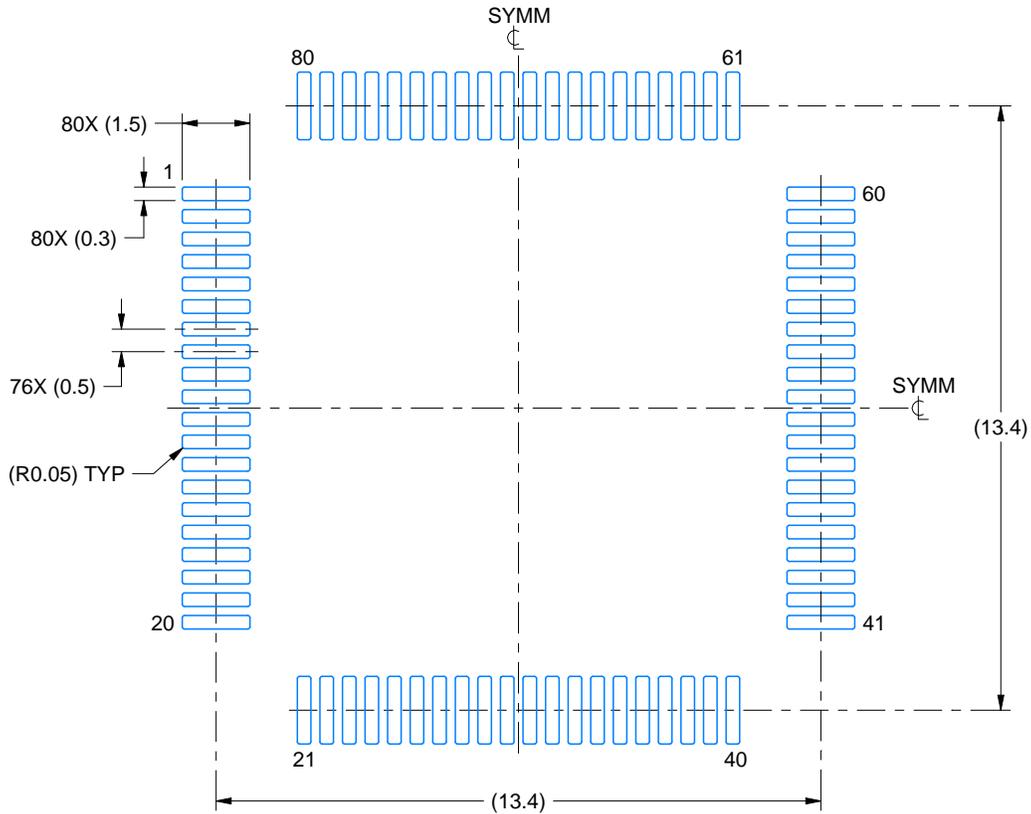
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration MS-026.

EXAMPLE BOARD LAYOUT

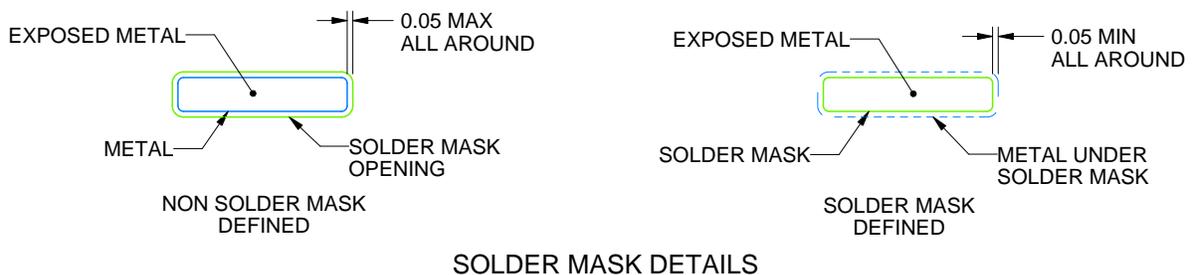
PN0080A

LQFP - 1.6 mm max height

PLASTIC QUAD FLATPACK



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:6X



SOLDER MASK DETAILS

4215166/A 08/2022

NOTES: (continued)

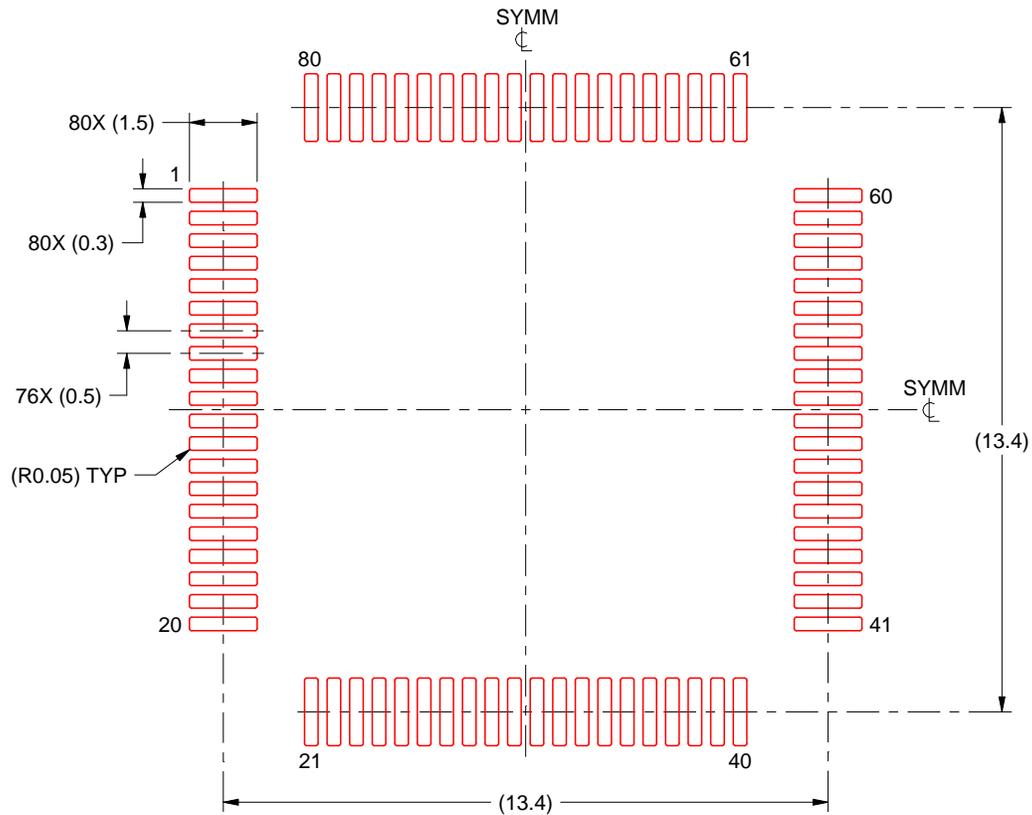
4. Publication IPC-7351 may have alternate designs.
5. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
6. For more information, see Texas Instruments literature number SLMA004 (www.ti.com/lit/slma004).

EXAMPLE STENCIL DESIGN

PN0080A

LQFP - 1.6 mm max height

PLASTIC QUAD FLATPACK



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE:6X

4215166/A 08/2022

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.

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