

TXB0106 6-Bit Bidirectional Level-Shifting and Voltage Translator With Auto-Direction Sensing and $\pm 15\text{kV}$ ESD Protection

1 Features

- 1.2V to 3.6V on A port and 1.65 to 5.5V on B Port ($V_{CCA} \leq V_{CCB}$)
- V_{CC} isolation feature – if either V_{CC} input is at GND, all outputs are in the high-impedance state
- OE input circuit referenced to V_{CCA}
- Low-power consumption, 4 μA max I_{CC}
- I_{off} supports partial-power-down mode operation
- Latch-up performance exceeds 100mA per JESD 78, class II
- ESD protection exceeds JESD 22
 - A port
 - 2500V human body model (A114-B)
 - 150V machine model (A115-A)
 - 1500V charged-device model (C101)
 - B port
 - $\pm 15\text{kV}$ human body model (A114-B)
 - 150V machine model (A115-A)
 - 1500V charged-device model (C101)

to track V_{CCB} . V_{CCB} accepts any supply voltage from 1.65V to 5.5V. This allows for universal low-voltage bidirectional translation between any of the 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, and 5V voltage nodes. V_{CCA} must not exceed V_{CCB} .

When the output-enable (OE) input is low, all outputs are placed in the high-impedance state.

The TXB0106 is designed so that the OE input circuit is supplied by V_{CCA} .

This device is fully specified for partial-power-down applications using I_{off} . The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device during power down.

To verify the high-impedance state during power up or power down, tie the OE to the GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

2 Applications

- Headset
- Smartphone
- Tablet
- Desktop PC

3 Description

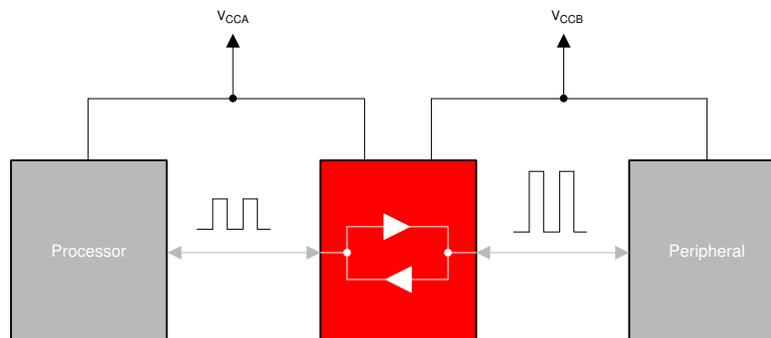
This 6-bit noninverting translator uses two separate configurable power-supply rails. The A port is designed to track V_{CCA} . V_{CCA} accepts any supply voltage from 1.2V to 3.6V. The B port is designed

Package Information

| PART NUMBER | PACKAGE ⁽¹⁾ | PACKAGE SIZE ⁽²⁾ |
|-------------|------------------------|-----------------------------|
| TXB0106 | PW (TSSOP, 16) | 5.00mm × 4.40mm |
| | RGY (VQFN, 16) | 4.00mm × 3.50mm |
| | RSV (UQFN, 16) | 2.60mm × 1.80mm |
| | BQB (WQFN, 16) | 3.50mm × 2.50mm |
| | DYY (SOT, 16) | 4.20mm × 2.00mm |

(1) For more information, see [Section 11](#).

(2) The package size (length × width) is a nominal value and includes pins, where applicable.



Typical Application Block Diagram for TXB010X



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4 Pin Configuration and Functions

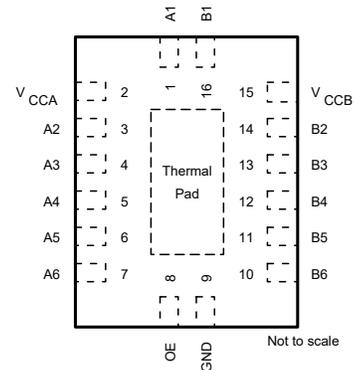
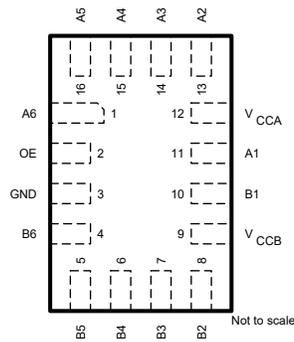


Figure 4-1. RSV Package, 16-Pin UQFN (Top View)

Figure 4-2. BQB Package, 16-Pin WQFN With Exposed Thermal Pad (Top View)

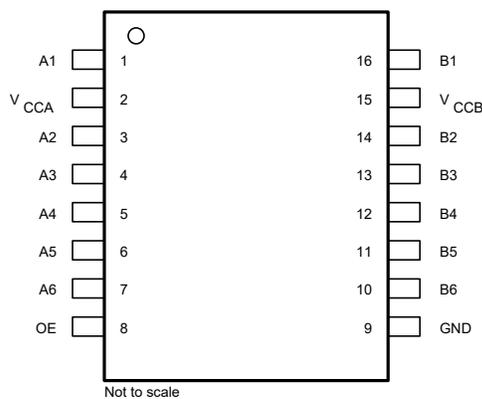


Figure 4-3. DYY Package, 16-Pin SOT (Top View)

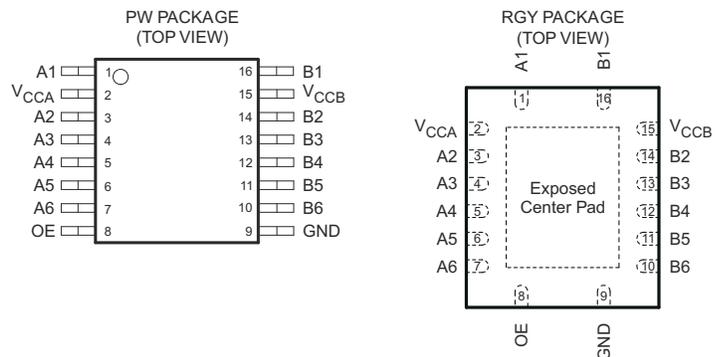


Figure 4-4. PW, RGY Package (Top View)

- The exposed center pad, if used, must be connected as a secondary ground or left electrically open.
- Pull up resistors are not required on both sides for Logic I/O.
- If pull up or pull down resistors are needed, the resistor value must be over 50kΩ.
- 50kΩ is a safe recommended value, if the user can accept higher V_{OL} or lower V_{OH} , smaller pull up or pull down resistor is allowed, the draft estimation is $V_{OL} = V_{CCOUT} \times 4.5k \div (4.5k + R_{PU})$ and $V_{OH} = V_{CCOUT} \times R_{DW} \div (4.5k + R_{DW})$.
- If pull up resistors are needed, please refer to the TXS0108 (different package with TXB0106), or contact TI.
- For detailed information, please refer to the [A Guide to Voltage Translation With TXB-Type Translators](#) application note.

Table 4-1. Pin Functions

| PIN | | | I/O | DESCRIPTION |
|-----|--------------|-----------|-----|--|
| NO. | NO. (RSV) | NAME | | |
| 1 | 11 | A1 | | Input/output 1. Referenced to V_{CCA} . |
| 2 | 12 | V_{CCA} | - | A-port supply voltage. $1.2V \leq V_{CCA} \leq 3.6V$, $V_{CCA} \leq V_{CCB}$. |
| 3 | 13 | A2 | I/O | Input/output 2. Referenced to V_{CCA} . |
| 4 | 14 | A3 | I/O | Input/output 3. Referenced to V_{CCA} . |
| 5 | 15 | A4 | I/O | Input/output 4. Referenced to V_{CCA} . |
| 6 | 16 | A5 | I/O | Input/output 5. Referenced to V_{CCA} . |
| 7 | 1 | A6 | I/O | Input/output 6. Referenced to V_{CCA} . |
| 8 | 2 | OE | - | Output enable. Pull OE low to place all outputs in tri-state mode. Referenced to V_{CCA} . |
| 9 | 3 | GND | - | Ground |
| 10 | 4 | B6 | I/O | Input/output 6. Referenced to V_{CCB} . |
| 11 | 5 | B5 | I/O | Input/output 5. Referenced to V_{CCB} . |
| 12 | 6 | B4 | I/O | Input/output 4. Referenced to V_{CCB} . |
| 13 | 7 | B3 | I/O | Input/output 3. Referenced to V_{CCB} . |
| 14 | 8 | B2 | I/O | Input/output 2. Referenced to V_{CCB} . |
| 15 | 9 | V_{CCB} | - | B-port supply voltage. $1.65V \leq V_{CCB} \leq 5.5V$. |
| 16 | 10 | B1 | I/O | Input/output 1. Referenced to V_{CCB} . |

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT | |
|------------------|---|----------|------|------------------------|---|
| V _{CCA} | Supply voltage | -0.5 | 4.6 | V | |
| V _{CCB} | Supply voltage | -0.5 | 6.5 | V | |
| V _I | Input voltage ⁽²⁾ | -0.5 | 6.5 | V | |
| V _O | Voltage applied to any output in the high-impedance or power-off state ⁽²⁾ | -0.5 | 6.5 | V | |
| V _O | Voltage applied to any output in the high or low state ^{(2) (3)} | A inputs | -0.5 | V _{CCA} + 0.5 | V |
| | | B inputs | -0.5 | V _{CCB} + 0.5 | |
| I _{IK} | Input clamp current | | -50 | mA | |
| I _{OK} | Output clamp current | | -50 | mA | |
| I _O | Continuous output current | | ±50 | mA | |
| | Continuous current through V _{CCA} , V _{CCB} , or GND | | ±100 | mA | |
| T _J | Junction Temperature | -40 | 150 | °C | |
| T _{stg} | Storage temperature | -65 | 150 | °C | |

- (1) 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.
- (2) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The value of V_{CCA} and V_{CCB} are provided in the recommended operating conditions table.

5.2 ESD Ratings

| | | | VALUE | UNIT | | |
|--------------------|-------------------------|--|--------|--------|---|--|
| V _(ESD) | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | A Port | 2500 | V | |
| | | | B Port | ±15000 | | |
| | | Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ | A Port | 1500 | | |
| | | | B Port | | | |
| | | Machine model (A115-A) | A Port | 150 | | |
| | | | B Port | | | |

- (1) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process.

5.3 Recommended Operating Conditions

| | | V _{CCA} | V _{CCB} | MIN | MAX | UNIT | |
|------------------|------------------------------------|------------------|------------------|---------------|--|--|------|
| V _{CCA} | Supply voltage | | | 1.2 | 3.6 | V | |
| | | V _{CCB} | | 1.65 | 5.5 | | |
| V _{IH} | High-level input voltage | Data inputs | 1.2V to 3.6V | 1.65V to 5.5V | V _{CCI} × 0.65 ⁽¹⁾ | V _{CCI} | V |
| | | OE | | | V _{CCA} × 0.65 | 5.5 | |
| V _{IL} | Low-level input voltage | Data inputs | 1.2V to 5.5V | 1.65V to 5.5V | 0 | V _{CCI} × 0.35 ⁽¹⁾ | V |
| | | OE | | | 1.2V to 3.6V | 0 | |
| Δt/Δv | Input transition rise or fall rate | A-port inputs | 1.2V to 3.6V | 1.65V to 5.5V | | 40 | ns/V |
| | | B-port inputs | 1.2V to 3.6V | 1.65V to 3.6V | | 40 | |
| | | | | 4.5V to 5.5V | | 30 | |
| T _A | Operating free-air temperature | | | -40 | 85 | °C | |

- (1) V_{CCI} is the supply voltage associated with the input port.

5.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | TXB0106 | | | | | UNIT |
|-------------------------------|--|------------|------------|------------|-----------|-----------|------|
| | | PW (TSSOP) | RGY (VQFN) | RSV (UQFN) | BQB(WQFN) | DYY (SOT) | |
| | | 16 PINS | 16 PINS | 16 PINS | 16 PINS | 16 PINS | |
| R _{θJA} | Junction-to-ambient thermal resistance | 107.2 | 40.7 | 134.5 | 63.4 | 132.0 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 34.9 | 54.1 | 58.0 | 64.3 | 65.4 | °C/W |
| R _{θJB} | Junction-to-board thermal resistance | 13.3 | 20.9 | 62.5 | 33.6 | 63.5 | °C/W |
| ψ _{JT} | Junction-to-top characterization parameter | 0.5 | 1.1 | 1.8 | 2.8 | 4.0 | °C/W |
| ψ _{JB} | Junction-to-board characterization parameter | 13.3 | 20.9 | 62.3 | 33.6 | 63.3 | °C/W |
| R _{θJC(bot)} | Junction-to-case (bottom) thermal resistance | 2.7 | 6.7 | N/A | 16.2 | N/A | °C/W |

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application note.

5.5 Electrical Characteristics (BQB/RSV/DYY)

over recommended operating free-air temperature range (unless otherwise noted)^{(1) (2)}

| PARAMETER | TEST CONDITIONS | V _{CCA} | V _{CCB} | T _A = 25°C | | | -40°C to 85°C | | UNIT |
|-------------------------------------|--|------------------|------------------|------------------------|-----|-----|------------------------|-----|------|
| | | | | MIN | TYP | MAX | MIN | MAX | |
| V _{OHA} | I _{OH} = -20μA | 1.2V | | 1.1 | | | V _{CCA} - 0.4 | V | |
| | | 1.4V to 3.6V | | | | | | | |
| V _{OLA} | I _{OL} = 20μA | 1.2V | | 0.9 | | | 0.4 | V | |
| | | 1.4V to 3.6V | | | | | | | |
| V _{OHB} | I _{OH} = -20μA | | 1.65V to 5.5V | V _{CCB} - 0.4 | | | V | | |
| V _{OLB} | I _{OL} = 20μA | | 1.65V to 5.5V | 0.4 | | | V | | |
| I _I | OE | 1.2V to 3.6V | 1.65V to 5.5V | ±1 | | | ±2 | μA | |
| I _{off} | A port | 0V | 0V to 5.5V | ±1 | | | ±2 | μA | |
| | B port | 0V to 3.6V | 0V | ±1 | | | ±2 | | |
| I _{OZ} | A or B port | OE = GND | 1.2V to 3.6V | 1.65V to 5.5V | ±1 | | | ±2 | μA |
| I _{CCA} | V _I = V _{CC1} or GND, I _O = 0 | 1.2V | 1.65V to 5.5V | 0.4 | | | 5 | μA | |
| | | 1.4V to 3.6V | | | | | | | |
| | | 3.6V | 0V | 2.75 | | | | | |
| | | 0V | 5.5V | -2 | | | | | |
| I _{CCB} | V _I = V _{CC1} or GND, I _O = 0 | 1.2V | 1.65V to 5.5V | 3.4 | | | 7.75 | μA | |
| | | 1.4V to 3.6V | | | | | | | |
| | | 3.6V | 0V | -2 | | | | | |
| | | 0V | 5.5V | 7.1 | | | | | |
| I _{CCA} + I _{CCB} | V _I = V _{CC1} or GND, I _O = 0 | 1.2V | 1.65V to 5.5V | 3.5 | | | 10.4 | μA | |
| | | 1.4V to 3.6V | | | | | | | |
| I _{CCZA} | V _I = V _{CC1} or GND, I _O = 0, OE = GND | 1.2V | 1.65V to 5.5V | 0.4 | | | 5 | μA | |
| | | 1.4V to 3.6V | | | | | | | |
| I _{CCZB} | V _I = V _{CC1} or GND, I _O = 0, OE = GND | 1.2V | 1.65V to 5.5V | 3.3 | | | 7.6 | μA | |
| | | 1.4V to 3.6V | | | | | | | |
| C _I | OE | 1.2V to 3.6V | 1.65V to 5.5V | 5 | | | 6.5 | pF | |
| C _{io} | A port | 1.2V to 3.6V | 1.65V to 5.5V | 5 | | | 6.5 | pF | |
| | B port | | | 8 | | | 13.1 | | |

5.6 Electrical Characteristics (Other Packages)

over recommended operating free-air temperature range (unless otherwise noted)^{(1) (2)}

| PARAMETER | | TEST CONDITIONS | V _{CCA} | V _{CCB} | T _A = 25°C | | | -40°C to 85°C | | UNIT |
|-------------------------------------|-------------|--|------------------|------------------|-----------------------|-----|-----|------------------------|-----|------|
| | | | | | MIN | TYP | MAX | MIN | MAX | |
| V _{OHA} | | I _{OH} = -20μA | 1.2V | | 1.1 | | | V _{CCA} - 0.4 | | V |
| | | | 1.4V to 3.6V | | | | | | | |
| V _{OLA} | | I _{OL} = 20μA | 1.2V | | 0.9 | | | 0.4 | | V |
| | | | 1.4V to 3.6V | | | | | | | |
| V _{OHB} | | I _{OH} = -20μA | | 1.65V to 5.5V | | | | V _{CCB} - 0.4 | | V |
| V _{OLB} | | I _{OL} = 20μA | | 1.65V to 5.5V | | | | 0.4 | | V |
| I _I | OE | | 1.2V to 3.6V | 1.65V to 5.5V | ±1 | | | ±2 | | μA |
| I _{off} | A port | | 0V | 0V to 5.5V | ±1 | | | ±2 | | μA |
| | B port | | 0V to 3.6V | 0V | ±1 | | | ±2 | | |
| I _{OZ} | A or B port | OE = GND | 1.2V to 3.6V | 1.65V to 5.5V | ±1 | | | ±2 | | μA |
| I _{CCA} | | V _I = V _{CC1} or GND, I _O = 0 | 1.2V | 1.65V to 5.5V | 0.06 | | | 5 | | μA |
| | | | 1.4V to 3.6V | | | | | | | |
| | | | 3.6V | 0V | | | | 2 | | |
| | | | 0V | 5.5V | | | | 2 | | |
| I _{CCB} | | V _I = V _{CC1} or GND, I _O = 0 | 1.2V | 1.65V to 5.5V | 3.4 | | | 5 | | μA |
| | | | 1.4V to 3.6V | | | | | | | |
| | | | 3.6V | 0V | | | | -2 | | |
| | | | 0V | 5.5V | | | | 2 | | |
| I _{CCA} + I _{CCB} | | V _I = V _{CC1} or GND, I _O = 0 | 1.2V | 1.65V to 5.5V | 3.5 | | | 10 | | μA |
| | | | 1.4V to 3.6V | | | | | | | |
| I _{CCZA} | | V _I = V _{CC1} or GND, I _O = 0, OE = GND | 1.2V | 1.65V to 5.5V | 0.05 | | | 5 | | μA |
| | | | 1.4V to 3.6V | | | | | | | |
| I _{CCZB} | | V _I = V _{CC1} or GND, I _O = 0, OE = GND | 1.2V | 1.65V to 5.5V | 3.3 | | | 5 | | μA |
| | | | 1.4V to 3.6V | | | | | | | |
| C _I | OE | | 1.2V to 3.6V | 1.65V to 5.5V | 5 | | | 5.5 | | pF |
| C _{io} | A port | | 1.2V to 3.6V | 1.65V to 5.5V | 5 | | | 6.5 | | pF |
| | B port | | | | 8 | | | 10 | | |

- (1) V_{CC1} is the supply voltage associated with the input port.
(2) V_{CC0} is the supply voltage associated with the output port.

5.7 Timing Requirements: V_{CCA} = 1.2V

T_A = 25°C, V_{CCA} = 1.2V

| | | | V _{CCB} = 1.8V | V _{CCB} = 2.5V | V _{CCB} = 3.3V | V _{CCB} = 5V | UNIT |
|----------------|----------------|-------------|-------------------------|-------------------------|-------------------------|-----------------------|------|
| | | | NOM | NOM | NOM | NOM | |
| Data rate | | | 20 | 20 | 20 | 20 | Mbps |
| t _w | Pulse duration | Data inputs | 50 | 50 | 50 | 50 | ns |

5.8 Timing Requirements: $V_{CCA} = 1.5V \pm 0.1V$

over recommended operating free-air temperature range, $V_{CCA} = 1.5V \pm 0.1V$ (unless otherwise noted)

| | | | $V_{CCB} = 1.8V \pm 0.15V$ | | $V_{CCB} = 2.5V \pm 0.2V$ | | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|-----------|----------------|-------------|----------------------------|-----|---------------------------|-----|---------------------------|-----|-------------------------|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| Data rate | | | 50 | | 50 | | 50 | | 50 | | Mbps |
| t_w | Pulse duration | Data inputs | 20 | | 20 | | 20 | | 20 | | ns |

5.9 Timing Requirements: $V_{CCA} = 1.8V \pm 0.15V$

over recommended operating free-air temperature range, $V_{CCA} = 1.8V \pm 0.15V$ (unless otherwise noted)

| | | | $V_{CCB} = 1.8V \pm 0.15V$ | | $V_{CCB} = 2.5V \pm 0.2V$ | | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|-----------|----------------|-------------|----------------------------|-----|---------------------------|-----|---------------------------|-----|-------------------------|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| Data rate | | | 52 | | 60 | | 60 | | 60 | | Mbps |
| t_w | Pulse duration | Data inputs | 19 | | 17 | | 17 | | 17 | | ns |

5.10 Timing Requirements: $V_{CCA} = 2.5V \pm 0.2V$

over recommended operating free-air temperature range, $V_{CCA} = 2.5V \pm 0.2V$ (unless otherwise noted)

| | | | $V_{CCB} = 2.5V \pm 0.2V$ | | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|-----------|----------------|-------------|---------------------------|-----|---------------------------|-----|-------------------------|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| Data rate | | | 70 | | 100 | | 100 | | Mbps |
| t_w | Pulse duration | Data inputs | 14 | | 10 | | 10 | | ns |

5.11 Timing Requirements: $V_{CCA} = 3.3V \pm 0.3V$

over recommended operating free-air temperature range, $V_{CCA} = 3.3V \pm 0.3V$ (unless otherwise noted)

| | | | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|-----------|----------------|-------------|---------------------------|-----|-------------------------|-----|------|
| | | | MIN | MAX | MIN | MAX | |
| Data rate | | | 100 | | 100 | | Mbps |
| t_w | Pulse duration | Data inputs | 10 | | 10 | | ns |

5.12 Switching Characteristics: $V_{CCA} = 1.2V$ (BQB/RSV/DYY)

$T_A = 25^\circ C$, $V_{CCA} = 1.2V$

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.8V$ | $V_{CCB} = 2.5V$ | $V_{CCB} = 3.3V$ | $V_{CCB} = 5V$ | UNIT |
|---------------------|----------------------------|-------------|------------------|------------------|------------------|----------------|---------|
| | | | TYP | TYP | TYP | TYP | |
| t_{pd} | A | B | 9.5 | 7.9 | 7.6 | 8.5 | ns |
| | B | A | 9.2 | 8.8 | 8.4 | 8 | |
| t_{en} | OE | A | 1 | 1 | 1 | 1 | μs |
| | | B | 1 | 1 | 1 | 1 | |
| t_{dis} | OE | A | 392 | 392 | 392 | 392 | ns |
| | | B | 392 | 392 | 392 | 392 | |
| t_{rA} , t_{fA} | A-port rise and fall times | | 4.1 | 4.4 | 4.1 | 3.9 | ns |
| t_{rB} , t_{fB} | B-port rise and fall times | | 5 | 5 | 5.1 | 5.1 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | 2.4 | 1.7 | 1.9 | 7 | ns |
| Max data rate | | | 20 | 20 | 20 | 20 | Mbps |

5.13 Switching Characteristics: $V_{CCA} = 1.2V$ (Other Packages)

$T_A = 25^\circ C$, $V_{CCA} = 1.2V$

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.8V$ | $V_{CCB} = 2.5V$ | $V_{CCB} = 3.3V$ | $V_{CCB} = 5V$ | UNIT |
|------------------|----------------------------|-------------|------------------|------------------|------------------|----------------|---------|
| | | | TYP | TYP | TYP | TYP | |
| t_{pd} | A | B | 9.5 | 7.9 | 7.6 | 8.5 | ns |
| | B | A | 9.2 | 8.8 | 8.4 | 8 | |
| t_{en} | OE | A | 1 | 1 | 1 | 1 | μs |
| | | B | 1 | 1 | 1 | 1 | |
| t_{dis} | OE | A | 20 | 17 | 17 | 18 | ns |
| | | B | 20 | 16 | 15 | 15 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 4.1 | 4.4 | 4.1 | 3.9 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 5 | 5 | 5.1 | 5.1 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | 2.4 | 1.7 | 1.9 | 7 | ns |
| Max data rate | | | 20 | 20 | 20 | 20 | Mbps |

5.14 Switching Characteristics: $V_{CCA} = 1.5V \pm 0.1V$ (BQB/RSV/DYY)

over recommended operating free-air temperature range, $V_{CCA} = 1.5V \pm 0.1V$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.8V \pm 0.15V$ | | $V_{CCB} = 2.5V \pm 0.2V$ | | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|------------------|----------------------------|-------------|----------------------------|------|---------------------------|-----|---------------------------|------|-------------------------|------|---------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| | | | t_{pd} | A | B | 1.4 | 12.9 | 1.2 | 10.1 | 1.1 | |
| | B | A | 0.9 | 14.2 | 0.7 | 12 | 0.4 | 11.7 | 0.3 | 13.7 | |
| t_{en} | OE | A | 1 | | 1 | | 1 | | 1 | | μs |
| | | B | 1 | | 1 | | 1 | | 1 | | |
| t_{dis} | OE | A | 278 | 390 | 236 | 305 | 236 | 305 | 236 | 305 | ns |
| | | B | 278 | 390 | 236 | 305 | 236 | 305 | 236 | 305 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 0.8 | 6.5 | 0.8 | 6.3 | 0.8 | 6.3 | 0.8 | 6.3 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 1 | 7.3 | 0.7 | 4.9 | 0.7 | 4.6 | 0.6 | 4.6 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | 2.6 | | 1.9 | | 1.6 | | 1.3 | | ns |
| Max data rate | | | 50 | | 50 | | 50 | | 50 | | Mbps |

5.15 Switching Characteristics: $V_{CCA} = 1.5V \pm 0.1V$ (Other Packages)

over recommended operating free-air temperature range, $V_{CCA} = 1.5V \pm 0.1V$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.8V \pm 0.15V$ | | $V_{CCB} = 2.5V \pm 0.2V$ | | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|------------------|----------------------------|-------------|----------------------------|------|---------------------------|------|---------------------------|------|-------------------------|------|---------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| | | | t_{pd} | A | B | 1.4 | 12.9 | 1.2 | 10.1 | 1.1 | |
| | B | A | 0.9 | 14.2 | 0.7 | 12 | 0.4 | 11.7 | 0.3 | 13.7 | |
| t_{en} | OE | A | 1 | | 1 | | 1 | | 1 | | μs |
| | | B | 1 | | 1 | | 1 | | 1 | | |
| t_{dis} | OE | A | 6.6 | 33 | 6.4 | 25.3 | 6.1 | 23.1 | 5.9 | 24.6 | ns |
| | | B | 6.6 | 35.6 | 5.8 | 25.6 | 5.5 | 22.1 | 5.6 | 20.6 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 0.8 | 6.5 | 0.8 | 6.3 | 0.8 | 6.3 | 0.8 | 6.3 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 1 | 7.3 | 0.7 | 4.9 | 0.7 | 4.6 | 0.6 | 4.6 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | 2.6 | | 1.9 | | 1.6 | | 1.3 | | ns |
| Max data rate | | | 50 | | 50 | | 50 | | 50 | | Mbps |

5.16 Switching Characteristics: $V_{CCA} = 1.8V \pm 0.15V$ (BQB/RSV/DYY)

over recommended operating free-air temperature range, $V_{CCA} = 1.8V \pm 0.15V$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.8V \pm 0.15V$ | | $V_{CCB} = 2.5V \pm 0.2V$ | | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|------------------|----------------------------|-------------|----------------------------|-----|---------------------------|-----|---------------------------|-----|-------------------------|-----|---------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{pd} | A | B | 1.6 | 11 | 1.4 | 7.7 | 1.3 | 6.8 | 1.2 | 6.5 | ns |
| | B | A | 1.5 | 12 | 1.2 | 8.4 | 0.8 | 7.6 | 0.5 | 7.1 | |
| t_{en} | OE | A | | 1 | | 1 | | 1 | | 1 | μs |
| | | B | | 1 | | 1 | | 1 | | 1 | |
| t_{dis} | OE | A | 278 | 389 | 191 | 253 | 190 | 248 | 189 | 248 | ns |
| | | B | 278 | 389 | 191 | 253 | 190 | 248 | 189 | 248 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 0.7 | 5.1 | 0.7 | 5 | 1 | 5 | 0.7 | 5 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 1 | 7.3 | 0.7 | 5 | 0.7 | 3.9 | 0.6 | 3.8 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | | 0.8 | | 0.7 | | 0.6 | | 0.6 | ns |
| Max data rate | | | 52 | | 60 | | 60 | | 60 | | Mbps |

5.17 Switching Characteristics: $V_{CCA} = 1.8V \pm 0.15V$ (Other Packages)

over recommended operating free-air temperature range, $V_{CCA} = 1.8V \pm 0.15V$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 1.8V \pm 0.15V$ | | $V_{CCB} = 2.5V \pm 0.2V$ | | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|------------------|----------------------------|-------------|----------------------------|------|---------------------------|------|---------------------------|------|-------------------------|------|---------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{pd} | A | B | 1.6 | 11 | 1.4 | 7.7 | 1.3 | 6.8 | 1.2 | 6.5 | ns |
| | B | A | 1.5 | 12 | 1.2 | 8.4 | 0.8 | 7.6 | 0.5 | 7.1 | |
| t_{en} | OE | A | | 1 | | 1 | | 1 | | 1 | μs |
| | | B | | 1 | | 1 | | 1 | | 1 | |
| t_{dis} | OE | A | 5.9 | 26.7 | 5.6 | 21.6 | 5.4 | 18.9 | 4.8 | 18.7 | ns |
| | | B | 6.1 | 33.9 | 5.2 | 23.7 | 5 | 19.9 | 5 | 17.6 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 0.7 | 5.1 | 0.7 | 5 | 1 | 5 | 0.7 | 5 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 1 | 7.3 | 0.7 | 5 | 0.7 | 3.9 | 0.6 | 3.8 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | | 0.8 | | 0.7 | | 0.6 | | 0.6 | ns |
| Max data rate | | | 52 | | 60 | | 60 | | 60 | | Mbps |

5.18 Switching Characteristics: $V_{CCA} = 2.5V \pm 0.2V$ (BQB/RSV/DYY)

over recommended operating free-air temperature range, $V_{CCA} = 2.5V \pm 0.2V$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 2.5V \pm 0.2V$ | | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|------------------|----------------------------|-------------|---------------------------|-----|---------------------------|-----|-------------------------|-----|---------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{pd} | A | B | 1.1 | 6.4 | 1 | 5.3 | 0.9 | 4.7 | ns |
| | B | A | 1 | 7 | 0.6 | 5.6 | 0.3 | 4.4 | |
| t_{en} | OE | A | | 1 | | 1 | | 1 | μs |
| | | B | | 1 | | 1 | | 1 | |
| t_{dis} | OE | A | 190 | 252 | 137 | 184 | 133 | 169 | ns |
| | | B | 190 | 252 | 137 | 184 | 133 | 169 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 0.8 | 3.6 | 0.6 | 3.6 | 0.5 | 3.5 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 0.6 | 4.9 | 0.7 | 3.9 | 0.6 | 3.2 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | | 0.4 | | 0.3 | | 0.3 | ns |

over recommended operating free-air temperature range, $V_{CCA} = 2.5V \pm 0.2V$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 2.5V \pm 0.2V$ | | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|---------------|--------------|-------------|---------------------------|-----|---------------------------|-----|-------------------------|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| Max data rate | | | 70 | | 100 | | 100 | | Mbps |

5.19 Switching Characteristics: $V_{CCA} = 2.5V \pm 0.2V$ (Other Packages)

over recommended operating free-air temperature range, $V_{CCA} = 2.5V \pm 0.2V$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 2.5V \pm 0.2V$ | | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|------------------|----------------------------|-------------|---------------------------|------|---------------------------|------|-------------------------|------|---------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| t_{pd} | A | B | 1.1 | 6.4 | 1 | 5.3 | 0.9 | 4.7 | ns |
| | B | A | 1 | 7 | 0.6 | 5.6 | 0.3 | 4.4 | |
| t_{en} | OE | A | | 1 | | 1 | | 1 | μs |
| | | B | | 1 | | 1 | | 1 | |
| t_{dis} | OE | A | 5 | 16.9 | 4.9 | 15 | 4.5 | 13.8 | ns |
| | | B | 4.8 | 21.8 | 4.5 | 17.9 | 4.4 | 15.2 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 0.8 | 3.6 | 0.6 | 3.6 | 0.5 | 3.5 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 0.6 | 4.9 | 0.7 | 3.9 | 0.6 | 3.2 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | | 0.4 | | 0.3 | | 0.3 | ns |
| Max data rate | | | 70 | | 100 | | 100 | | Mbps |

5.20 Switching Characteristics: $V_{CCA} = 3.3V \pm 0.3V$ (BQB/RSV/DYY)

over recommended operating free-air temperature range, $V_{CCA} = 3.3V \pm 0.3V$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|------------------|----------------------------|-------------|---------------------------|-----|-------------------------|-----|---------|
| | | | MIN | MAX | MIN | MAX | |
| t_{pd} | A | B | 0.9 | 4.9 | 0.8 | 4 | ns |
| | B | A | 0.5 | 5.4 | 0.2 | 4 | |
| t_{en} | OE | A | | 1 | | 1 | μs |
| | | B | | 1 | | 1 | |
| t_{dis} | OE | A | 137 | 183 | 97.6 | 127 | ns |
| | | B | 137 | 183 | 97.6 | 127 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 0.5 | 3 | 0.5 | 3 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 0.7 | 3.9 | 0.6 | 3.2 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | | 0.4 | | 0.3 | ns |
| Max data rate | | | 100 | | 100 | | Mbps |

5.21 Switching Characteristics: $V_{CCA} = 3.3V \pm 0.3V$ (Other Packages)

over recommended operating free-air temperature range, $V_{CCA} = 3.3V \pm 0.3V$ (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CCB} = 3.3V \pm 0.3V$ | | $V_{CCB} = 5V \pm 0.5V$ | | UNIT |
|------------------|----------------------------|-------------|---------------------------|------|-------------------------|------|---------|
| | | | MIN | MAX | MIN | MAX | |
| t_{pd} | A | B | 0.9 | 4.9 | 0.8 | 4 | ns |
| | B | A | 0.5 | 5.4 | 0.2 | 4 | |
| t_{en} | OE | A | | 1 | | 1 | μs |
| | | B | | 1 | | 1 | |
| t_{dis} | OE | A | 4.5 | 13.9 | 4.1 | 12.4 | ns |
| | | B | 4.1 | 17.3 | 4 | 14.4 | |
| t_{rA}, t_{fA} | A-port rise and fall times | | 0.5 | 3 | 0.5 | 3 | ns |
| t_{rB}, t_{fB} | B-port rise and fall times | | 0.7 | 3.9 | 0.6 | 3.2 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | | 0.4 | | 0.3 | ns |
| Max data rate | | | 100 | | 100 | | Mbps |

5.22 Operating Characteristics

$T_A = 25^\circ C$

| PARAMETER | TEST CONDITIONS | V_{CCA} | | | | | | | UNIT | |
|-----------|-----------------------------|---|------|------|------|------|------|------------|------|----|
| | | 1.2V | 1.2V | 1.5V | 1.8V | 2.5V | 2.5V | 3.3V | | |
| | | V_{CCB} | | | | | | | | |
| | | 5V | 1.8V | 1.8V | 1.8V | 2.5V | 5V | 3.3V to 5V | | |
| | | TYP | TYP | TYP | TYP | TYP | TYP | | | |
| C_{pdA} | A-port input, B-port output | $C_L = 0, f = 10MHz,$ $t_r = t_f = 1ns,$ OE = V_{CCA} (outputs enabled) | 9 | 8 | 7 | 7 | 7 | 7 | 8 | pF |
| | B-port input, A-port output | | 12 | 11 | 11 | 11 | 11 | 11 | 11 | |
| C_{pdB} | A-port input, B-port output | | 35 | 26 | 27 | 27 | 27 | 27 | 28 | |
| | B-port input, A-port output | | 26 | 19 | 18 | 18 | 18 | 20 | 21 | |
| C_{pdA} | A-port input, B-port output | $C_L = 0, f = 10MHz,$ $t_r = t_f = 1ns,$ OE = GND (outputs disabled) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | pF |
| | B-port input, A-port output | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | |
| C_{pdB} | A-port input, B-port output | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.03 | |
| | B-port input, A-port output | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.03 | |

5.23 Typical Characteristics

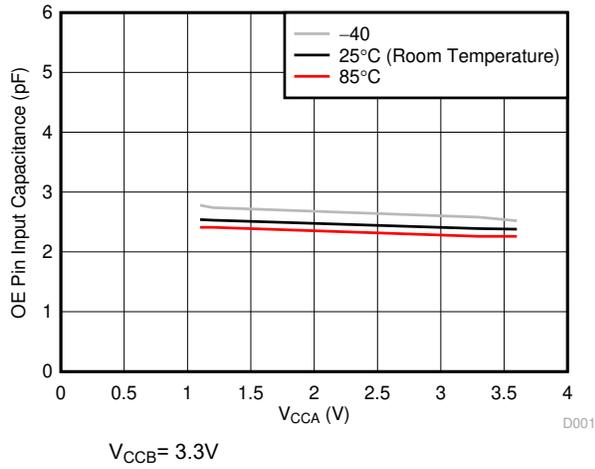


Figure 5-1. Input capacitance for OE pin (C_I) vs Power Supply (V_{CCA})

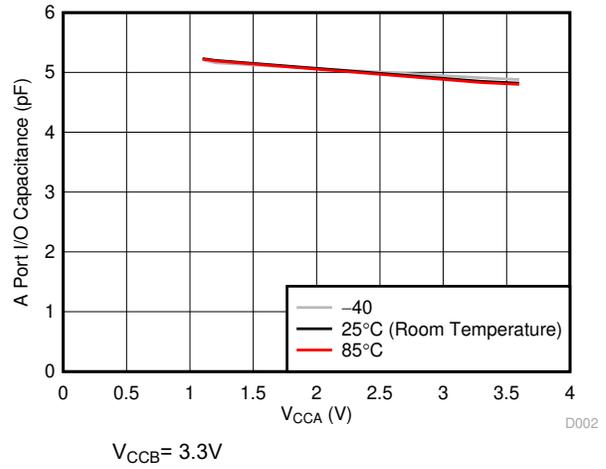


Figure 5-2. Capacitance for A port I/O pins (C_{IO}) vs Power Supply (V_{CCA})

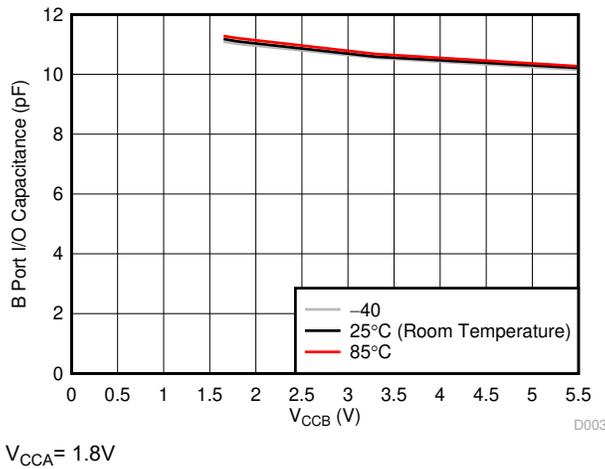


Figure 5-3. Capacitance for B port I/O pins (C_{IO}) vs Power Supply (V_{CCB})

6 Parameter Measurement Information

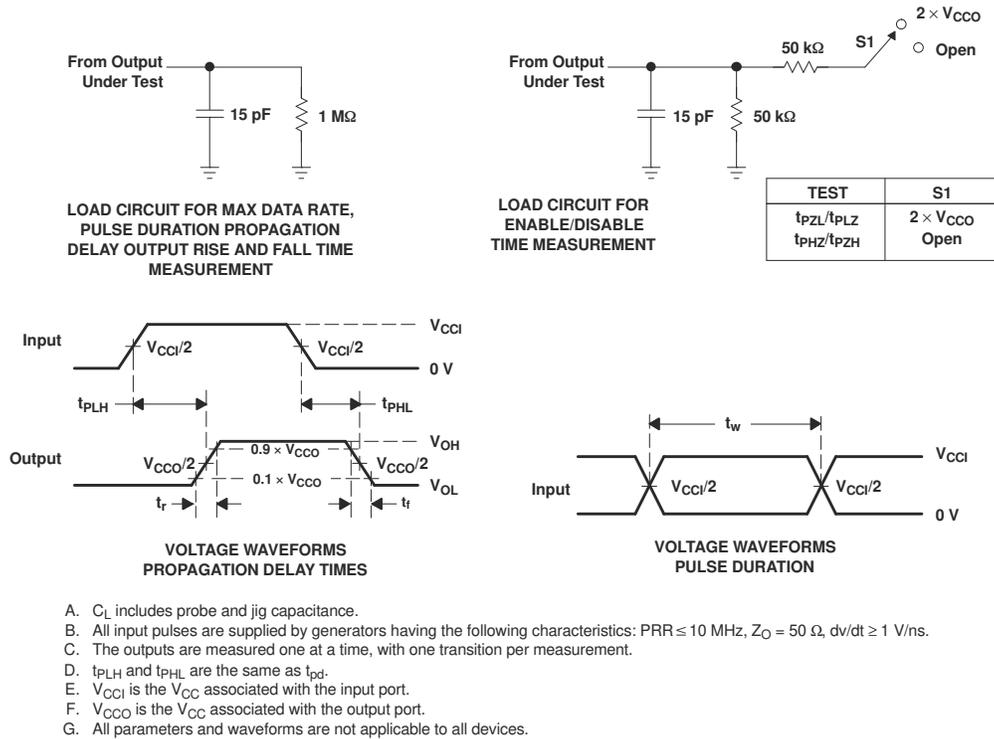


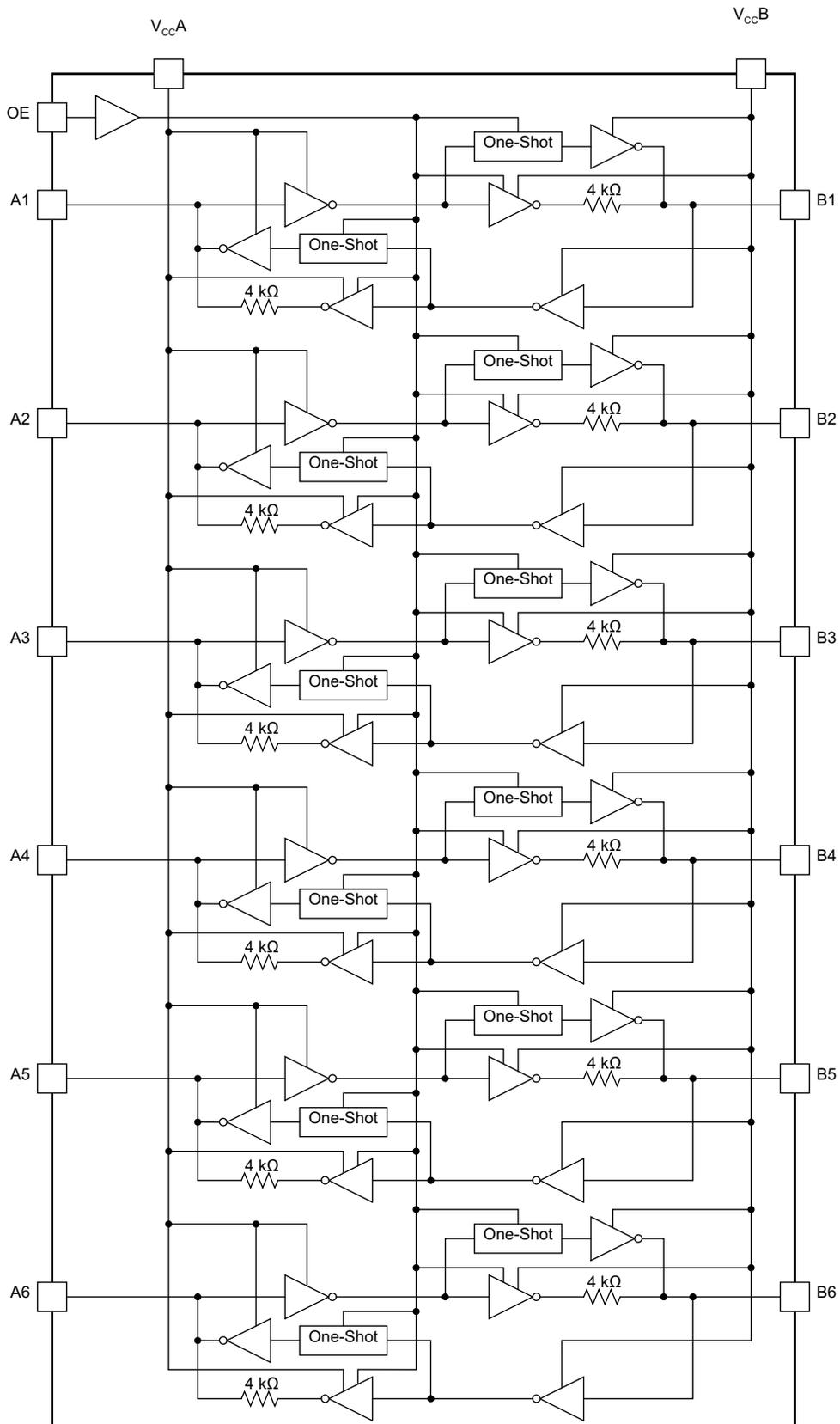
Figure 6-1. Load Circuits and Voltage Waveforms

7 Detailed Description

7.1 Overview

The TXB0106 device is a 6-bit, directionless voltage-level translator specifically designed for translating logic voltage levels. The A port is able to accept I/O voltages ranging from 1.2V to 3.6V, while the B port can accept I/O voltages from 1.65V to 5.5V. The device is a buffered architecture with edge-rate accelerators (one-shots) to improve the overall data rate. This device can only translate push-pull CMOS logic outputs. If for open-drain signal translation, please refer to TI's TXS010X products.

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Architecture

The TXB0106 architecture (see [Figure 7-1](#)) does not require a direction-control signal to control the direction of data flow from A to B or from B to A. In a DC state, the output drivers of the TXB0106 maintain a high or low and are designed to be weak, so that an external driver can overdrive the output drivers when data on the bus starts flowing the opposite direction.

The output one-shots detect rising or falling edges on the A or B ports. During a rising edge, the one-shot turns on the PMOS transistors (T1, T3) for a short duration, which speeds up the low-to-high transition. Similarly, during a falling edge, the one-shot turns on the NMOS transistors (T2, T4) for a short duration, which speeds up the high-to-low transition. The typical output impedance during output transition is 70Ω at $V_{CCO} = 1.2V$ to 1.8V, 50Ω at $V_{CCO} = 1.8V$ to 3.3V, and 40Ω at $V_{CCO} = 3.3V$ to 5V.

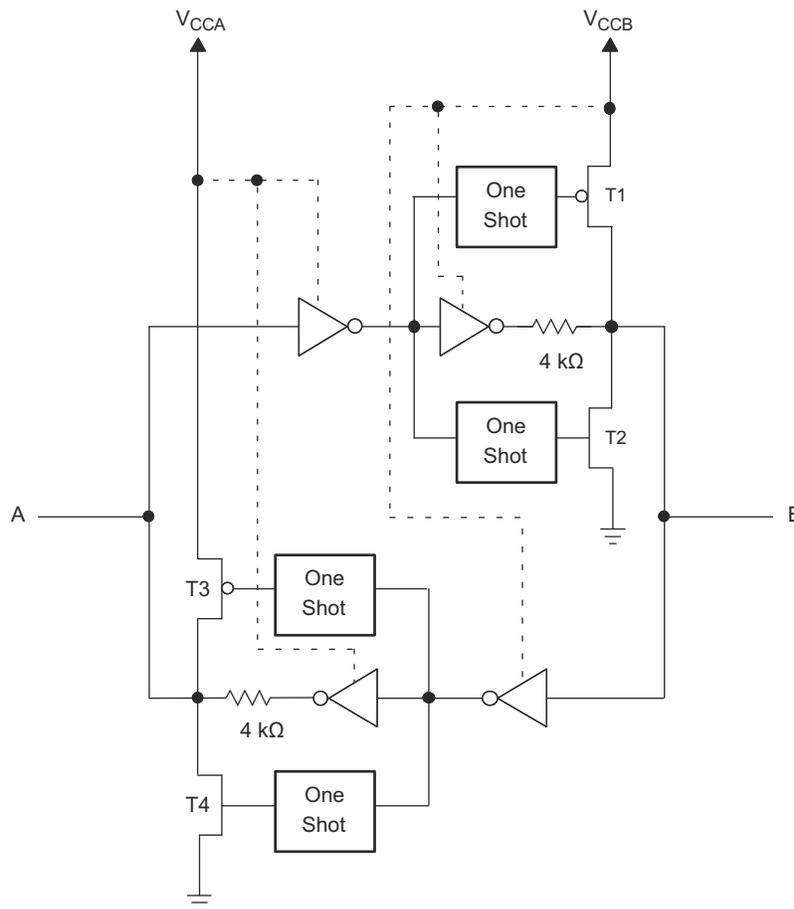
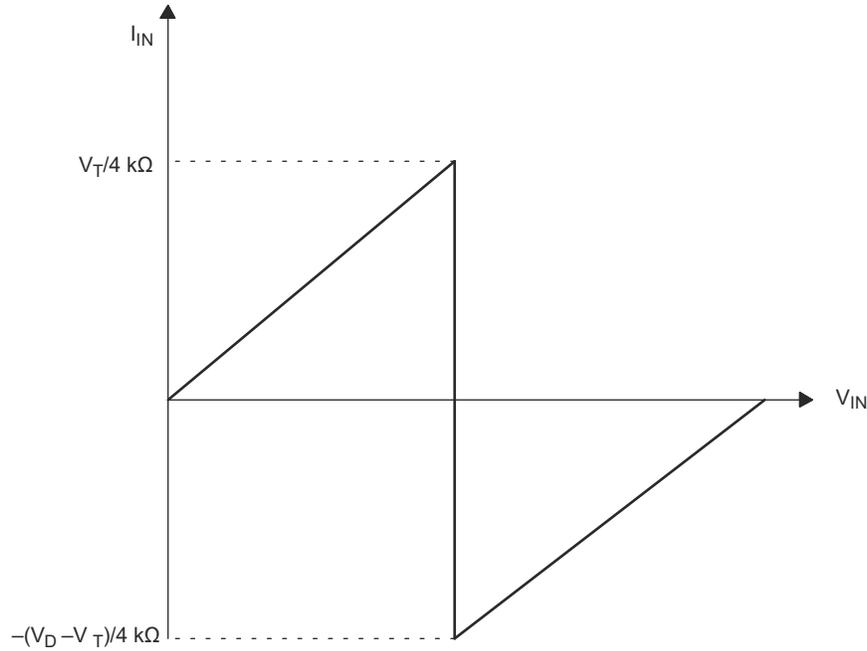


Figure 7-1. Architecture of TXB0106 I/O Cell

7.3.2 Input Driver Requirements

Typical I_{IN} vs V_{IN} characteristics of the TXB0106 are shown in [Figure 7-2](#). For proper operation, the device driving the data I/Os of the TXB0106 must have drive strength of at least $\pm 2mA$.



- A. V_T is the input threshold voltage of the TXB0106 (typically $V_{CC}/2$).
- B. V_D is the supply voltage of the external driver.

Figure 7-2. Typical I_{IN} vs V_{IN} Curve

7.3.3 Power Up

During operation, ensure that $V_{CCA} \leq V_{CCB}$ at all times. During power-up sequencing, $V_{CCA} \geq V_{CCB}$ does not damage the device, so any power supply can be ramped up first. The TXB0106 has circuitry that disables all output ports when either V_{CC} is switched off ($V_{CCA/B} = 0V$).

7.3.4 Output Load Considerations

TI recommends careful PCB layout practices with short PCB trace lengths to avoid excessive capacitive loading and to establish that proper O.S. triggering takes place. Keep PCB signal trace-lengths short enough so that the round trip delay of any reflection is less than the one-shot duration. This improves signal integrity by ensuring that any reflection sees a low impedance at the driver. The O.S. circuits are designed to stay on for approximately 10ns. The maximum capacitance of the lumped load that can be driven also depends directly on the one-shot duration. With very heavy capacitive loads, the one-shot can time-out before the signal is driven fully to the positive rail. The O.S. duration has been set to best optimize trade-offs between dynamic ICC, load driving capability, and maximum bit-rate considerations. Both PCB trace length and connectors add to the capacitance that the TXB0106 output undergoes, so it is recommended that this lumped-load capacitance be considered to avoid O.S. retriggering, bus contention, output signal oscillations, or other adverse system-level affects.

7.3.5 Enable and Disable

The TXB0106 has an OE input that is used to disable the device by setting OE = low, which places all I/Os in the high-impedance (Hi-Z) state. The disable time (t_{dis}) indicates the delay between when OE goes low and when the outputs actually get disabled (Hi-Z). The enable time (t_{en}) indicates the amount of time the user must allow for the one-shot circuitry to become operational after OE is taken high.

7.3.6 Pullup or Pulldown Resistors on I/O Lines

The TXB0106 is designed to drive capacitive loads of up to 70pF. The output drivers of the TXB0106 have low dc drive strength. If pullup or pulldown resistors are connected externally to the data I/Os, keep values higher than 50kΩ to establish that they do not contend with the output drivers of the TXB0106.

For the same reason, do not use the TXB0106 in applications such as I²C or 1-Wire where an open-drain driver is connected on the bidirectional data I/O. For these applications, use a device from the TI TXS01xx series of level translators.

7.4 Device Functional Modes

The TXB0106 device has two functional modes, enabled and disabled. To disable the device, set the OE input to low, which places all I/Os in a high impedance state. Setting the OE input to high will enable the device.

8 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information

The TXB0106 can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The TXB0106 can only translate push-pull CMOS logic outputs. If for open-drain signal translation, refer to TI TXS010X products. Any external pulldown or pullup resistors are recommended larger than 50kΩ.

8.2 Typical Application

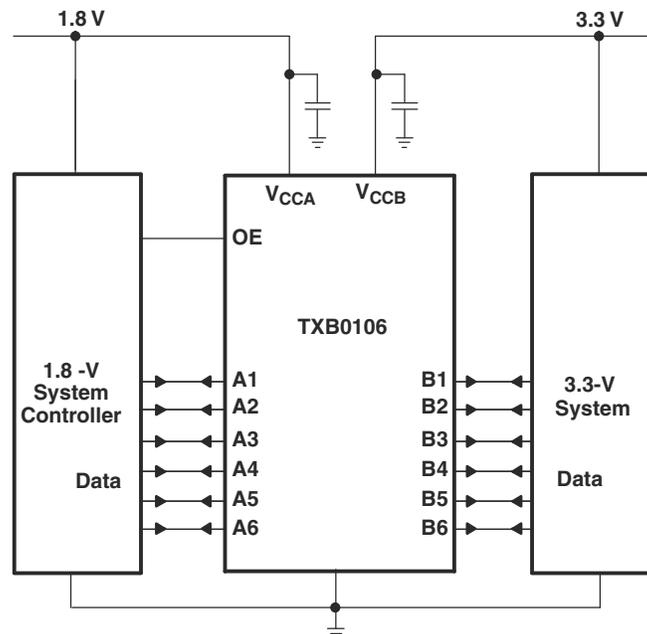


Figure 8-1. Typical Operating Circuit

8.2.1 Design Requirements

For this design example, use the parameters listed in [Table 8-1](#). Check that $V_{CCA} \leq V_{CCB}$.

Table 8-1. Design Parameters

| DESIGN PARAMETERS | EXAMPLE VALUE |
|----------------------|---------------|
| Input voltage range | 1.2V to 3.6V |
| Output voltage range | 1.65V to 5.5V |

8.2.2 Detailed Design Procedure

To begin the design process, determine the following:

- Input voltage range
 - Use the supply voltage of the device that is driving the TXB0106 device to determine the input voltage range. For a valid logic high the value must exceed the V_{IH} of the input port. For a valid logic low the value must be less than the V_{IL} of the input port.
- Output voltage range
 - Use the supply voltage of the device that the TXB0106 device is driving to determine the output voltage range.
 - External pullop and pulldown resistors are not recommended. If the pullup and pulldown resistors are mandatory, the value must not be larger than 50k Ω .
- An external pulldown or pullup resistor decreases the output V_{OH} and V_{OL} . Use the below equations to draft estimate the V_{OH} and V_{OL} as a result of an external pulldown and pullup resistor.

$$V_{OH} = V_{CCx} \times R_{PD} \div (R_{PD} + 4.5k\Omega) \quad (1)$$

$$V_{OH} = V_{CCx} \times 4.5k\Omega \div (R_{PU} + 4.5k\Omega) \quad (2)$$

where

- V_{CCx} is the output port supply voltage on either V_{CCA} or V_{CCB}
- R_{PD} is the value of the external pull down resistor
- R_{PU} is the value of the external pull up resistor
- 4.5k Ω is the counting the variation of the serial resistor 4k Ω in the I/O line

8.2.3 Application Curves

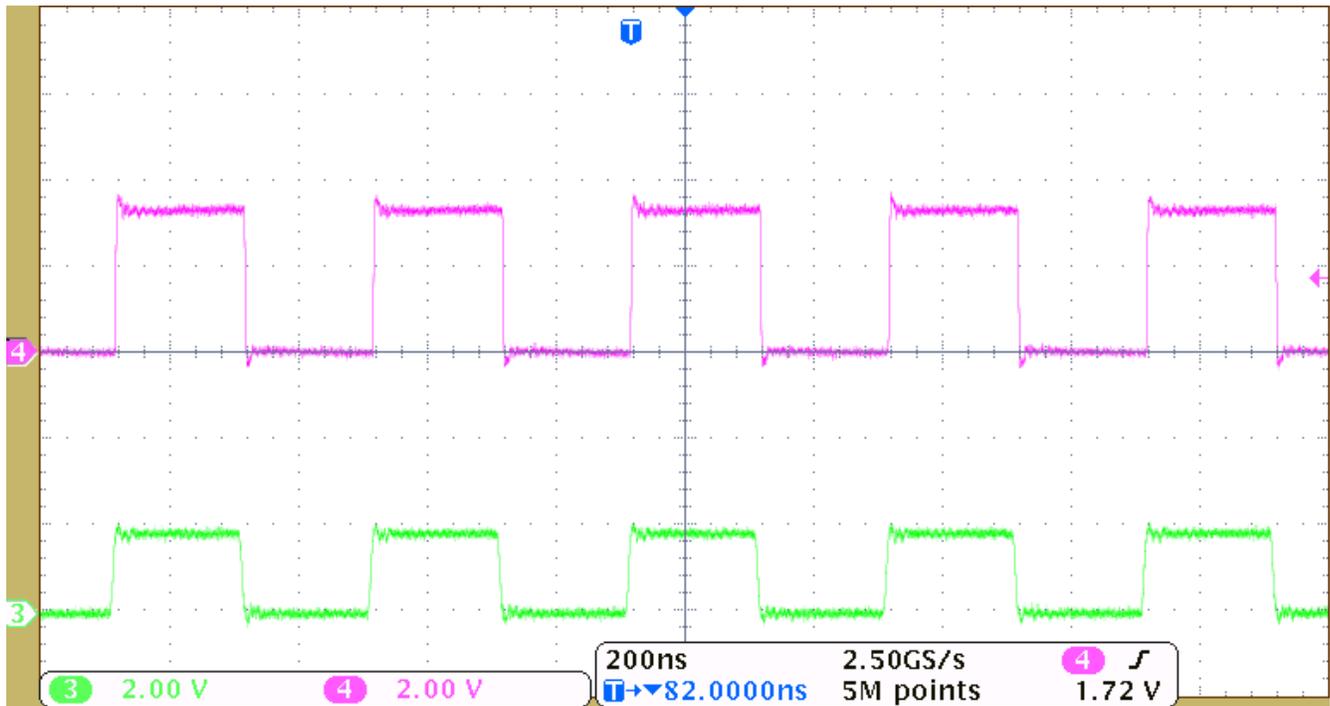


Figure 8-2. 2.5MHz Signal Level Translation

8.3 Power Supply Recommendations

During operation, ensure that $V_{CCA} \leq V_{CCB}$ at all times. During power-up sequencing, $V_{CCA} \geq V_{CCB}$ does not damage the device, so any power supply can be ramped up first. The TXB0106 has circuitry that disables all output ports when either V_{CC} is switched off ($V_{CCA/B} = 0V$). The output-enable (OE) input circuit is designed so that it is supplied by V_{CCA} and when the (OE) input is low, all outputs are placed in the high-impedance state. To verify that the high-impedance state of the outputs during power up or power down, the OE input pin must be tied to GND through a pull-down resistor and must not be enabled until V_{CCA} and V_{CCB} are fully ramped and stable. The minimum value of the pull-down resistor to ground is determined by the current-sourcing capability of the driver.

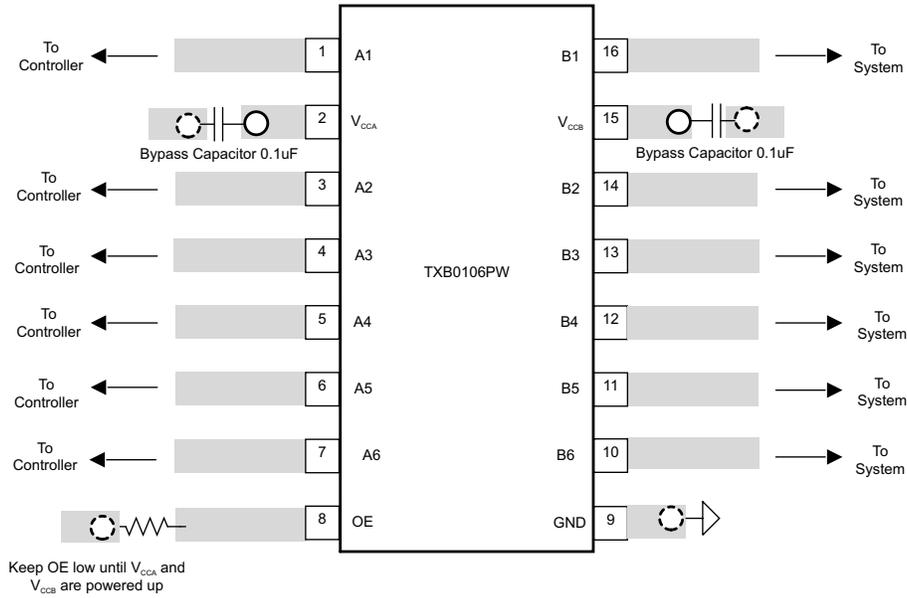
8.4 Layout

8.4.1 Layout Guidelines

To confirm reliability of the device, following common printed-circuit board layout guidelines is recommended.

- Use bypass capacitors on power supplies. Place bypass capacitors as close as possible to the V_{CCA} , V_{CCB} pin, and GND pin.
- Use short trace-lengths to avoid excessive loading.
- Keep PCB signal trace-lengths short enough so that the round-trip delay of any reflection is less than the one-shot duration, approximately 10ns, establishing that any reflection encounters low impedance at the source driver.

8.4.2 Layout Example



9 Device and Documentation Support

9.1 Documentation Support

9.1.1 Related Documentation

Texas Instruments, [A Guide to Voltage Translation With TXB-Type Translators application report](#)

Texas Instruments, [Semiconductor and IC Package Thermal Metrics application note](#)

9.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

9.3 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

9.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

9.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

9.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

10 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision B (February 2015) to Revision C (May 2025) | Page |
|---|-------------|
| • Updated the numbering format for tables, figures, and cross-references throughout the document..... | 1 |
| • Added thermal information for BQB, RSV and DYY packages..... | 6 |
| • Added <i>Related Documentation</i> section..... | 23 |

| Changes from Revision A (April 2012) to Revision B (February 2015) | Page |
|---|-------------|
| • Added <i>Pin Configuration and Functions</i> section, <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section..... | 1 |

| Changes from Revision * (September 2008) to Revision A (April 2012) | Page |
|--|-------------|
| • Added notes to pin out graphics..... | 3 |

11 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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) |
|-----------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TXB0106BQBR | Active | Production | WQFN (BQB) 16 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | YE06 |
| TXB0106PWR | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YE06 |
| TXB0106PWR.A | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YE06 |
| TXB0106PWR.B | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YE06 |
| TXB0106PWRG4 | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YE06 |
| TXB0106PWRG4.A | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YE06 |
| TXB0106PWRG4.B | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | YE06 |
| TXB0106RGYR | Active | Production | VQFN (RGY) 16 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | YE06 |
| TXB0106RGYR.A | Active | Production | VQFN (RGY) 16 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | YE06 |
| TXB0106RGYR.B | Active | Production | VQFN (RGY) 16 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | YE06 |
| TXB0106RGYRG4 | Active | Production | VQFN (RGY) 16 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | YE06 |
| TXB0106RGYRG4.A | Active | Production | VQFN (RGY) 16 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | YE06 |
| TXB0106RGYRG4.B | Active | Production | VQFN (RGY) 16 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | YE06 |

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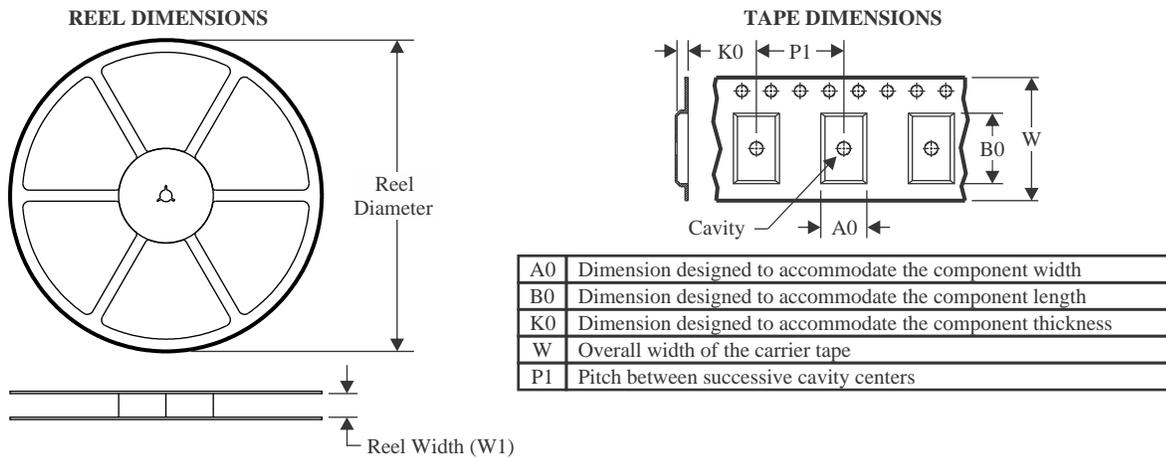
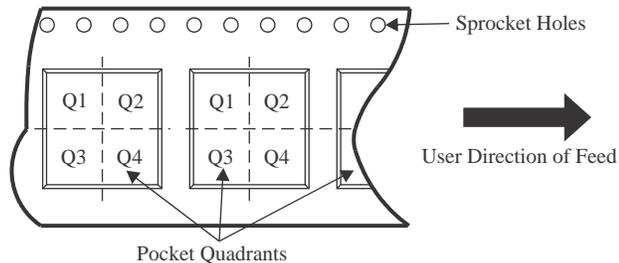
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF TXB0106 :

- Automotive : [TXB0106-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TXB0106BQBR | WQFN | BQB | 16 | 3000 | 180.0 | 12.4 | 2.8 | 3.8 | 1.2 | 4.0 | 12.0 | Q1 |
| TXB0106PWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| TXB0106PWRG4 | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| TXB0106RGYR | VQFN | RGY | 16 | 3000 | 330.0 | 12.4 | 3.8 | 4.3 | 1.5 | 8.0 | 12.0 | Q1 |
| TXB0106RGYRG4 | VQFN | RGY | 16 | 3000 | 330.0 | 12.4 | 3.8 | 4.3 | 1.5 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TXB0106BQBR | WQFN | BQB | 16 | 3000 | 210.0 | 185.0 | 35.0 |
| TXB0106PWR | TSSOP | PW | 16 | 2000 | 353.0 | 353.0 | 32.0 |
| TXB0106PWRG4 | TSSOP | PW | 16 | 2000 | 353.0 | 353.0 | 32.0 |
| TXB0106RGYR | VQFN | RGY | 16 | 3000 | 353.0 | 353.0 | 32.0 |
| TXB0106RGYRG4 | VQFN | RGY | 16 | 3000 | 353.0 | 353.0 | 32.0 |

GENERIC PACKAGE VIEW

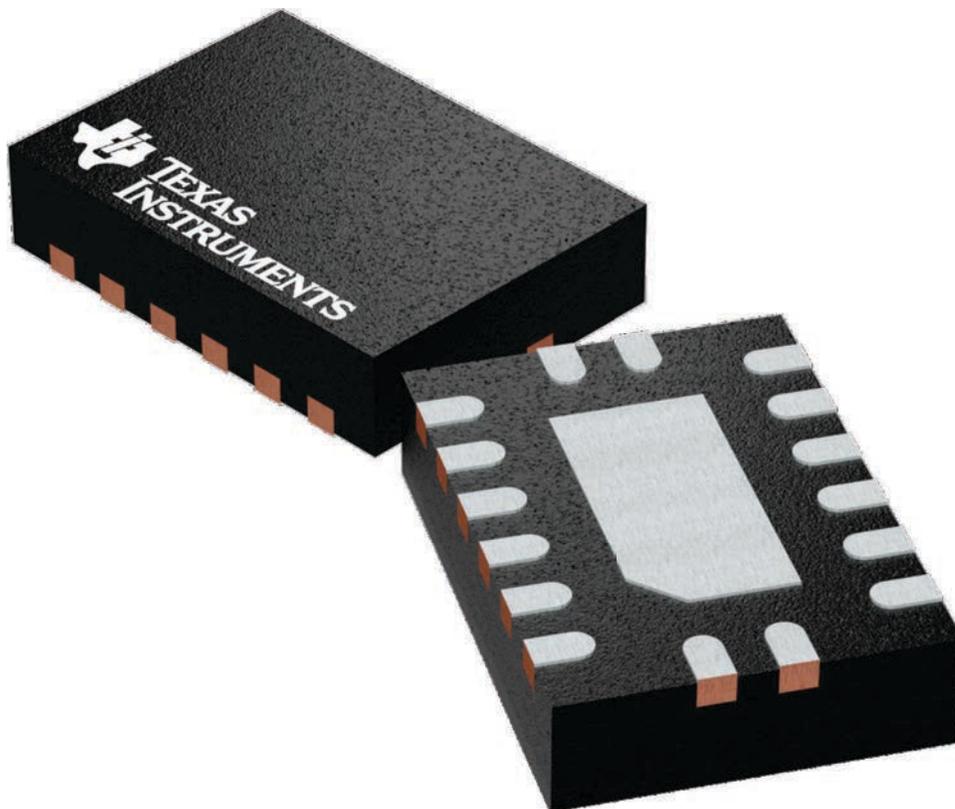
BQB 16

WQFN - 0.8 mm max height

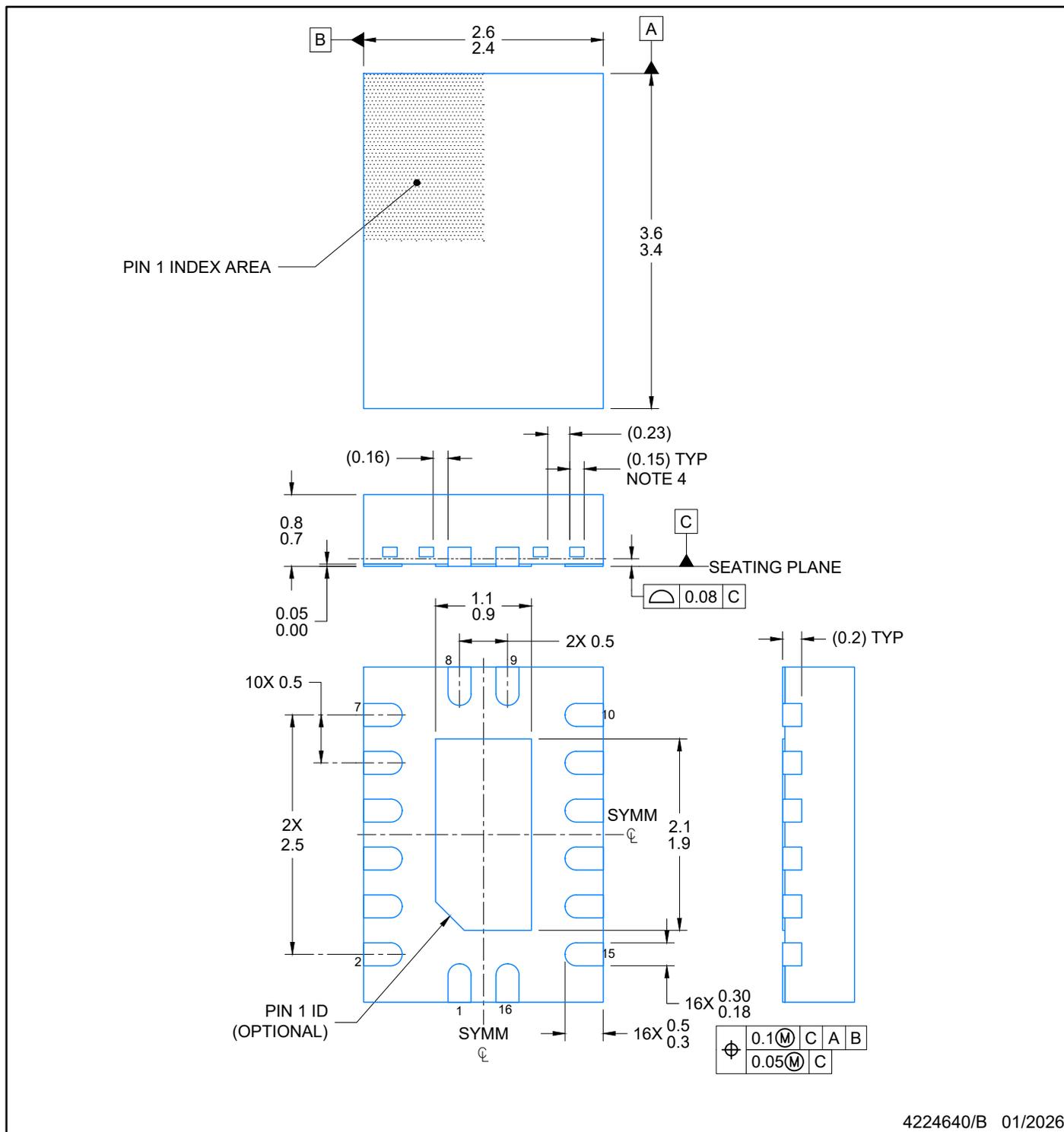
2.5 x 3.5, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



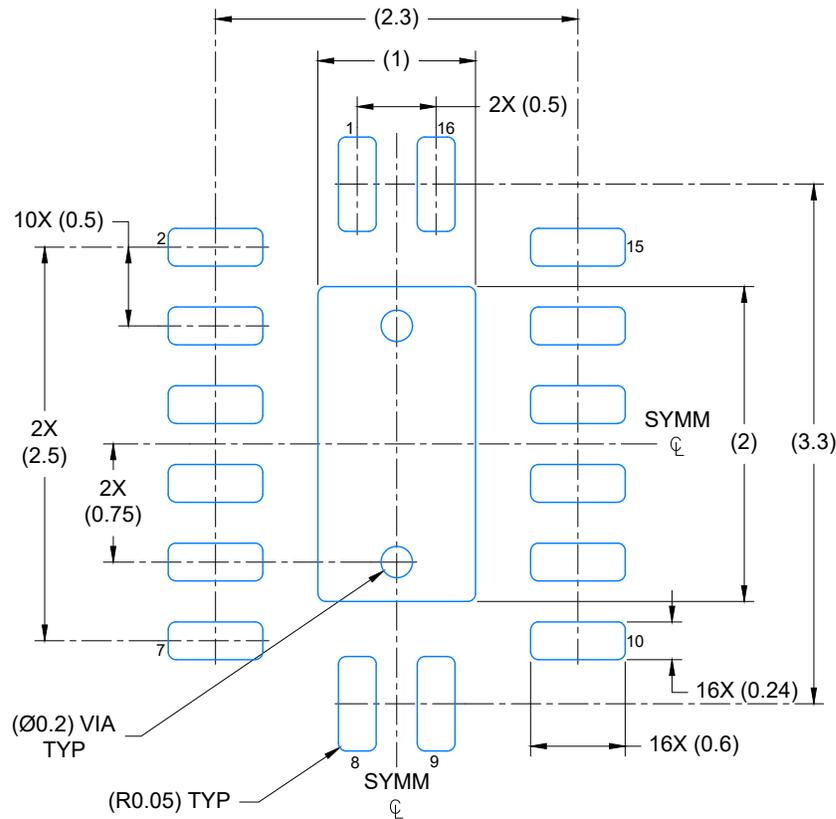
4226161/A



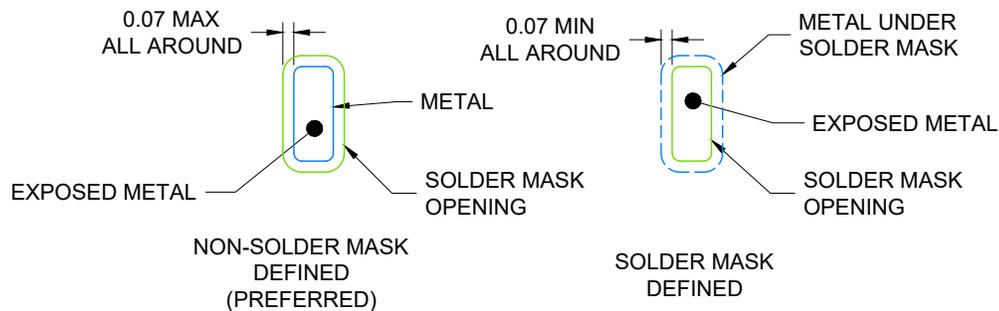
4224640/B 01/2026

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. The package thermal pad must be soldered to the printed circuit board for optimal thermal and mechanical performance.
4. Features may differ or may not be present



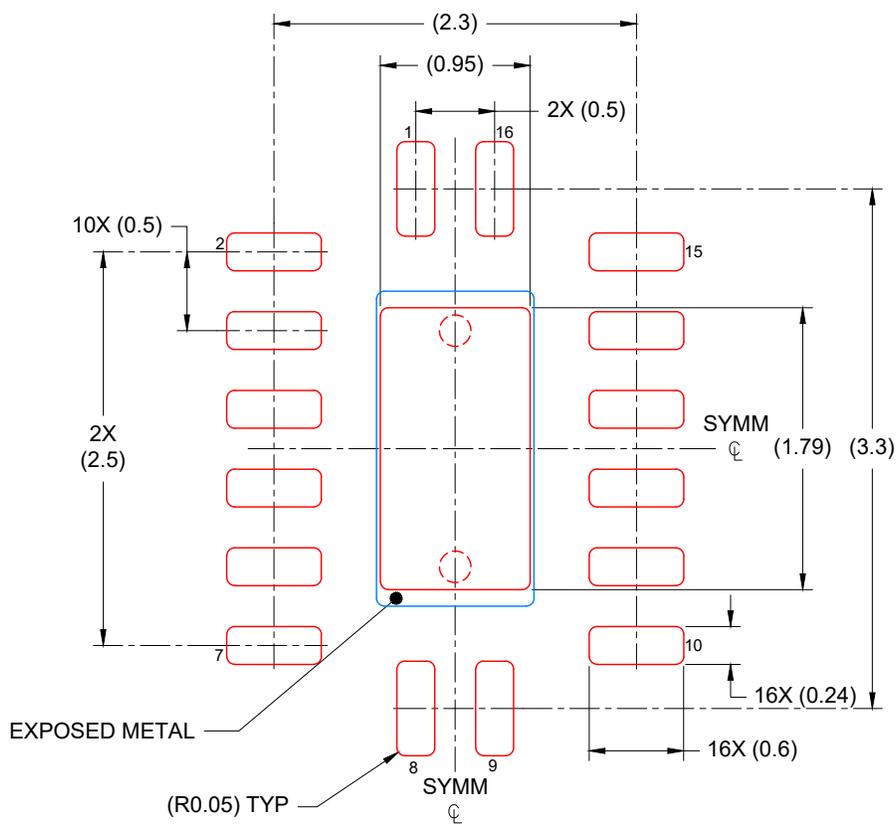
LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



4224640/B 01/2026

1. NOTES: (continued)

5. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
6. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



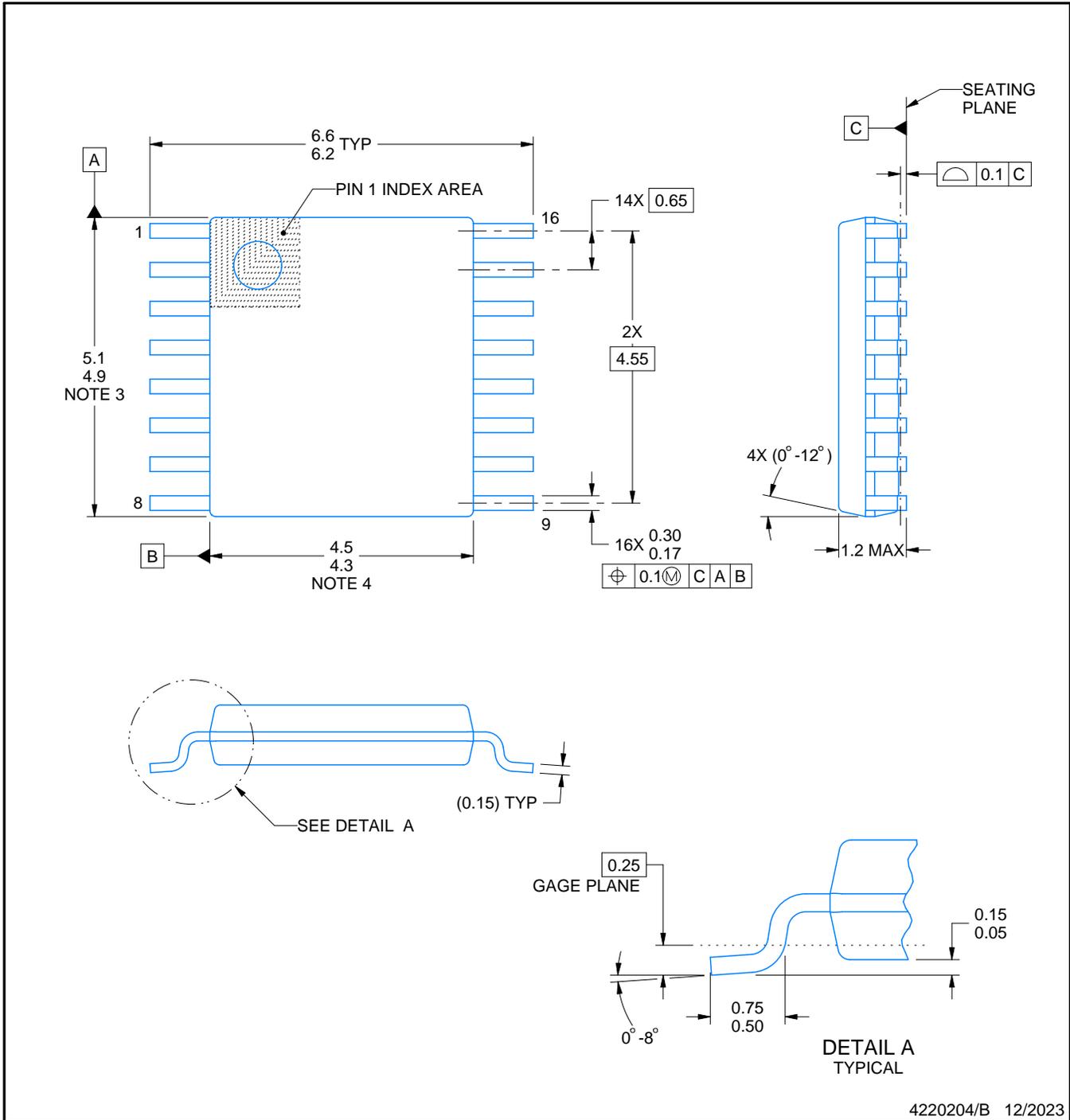
SOLDER PASTE EXAMPLE
 BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
 85% PRINTED COVERAGE BY AREA
 SCALE: 20X

4224640/B 01/2026

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.



4220204/B 12/2023

NOTES:

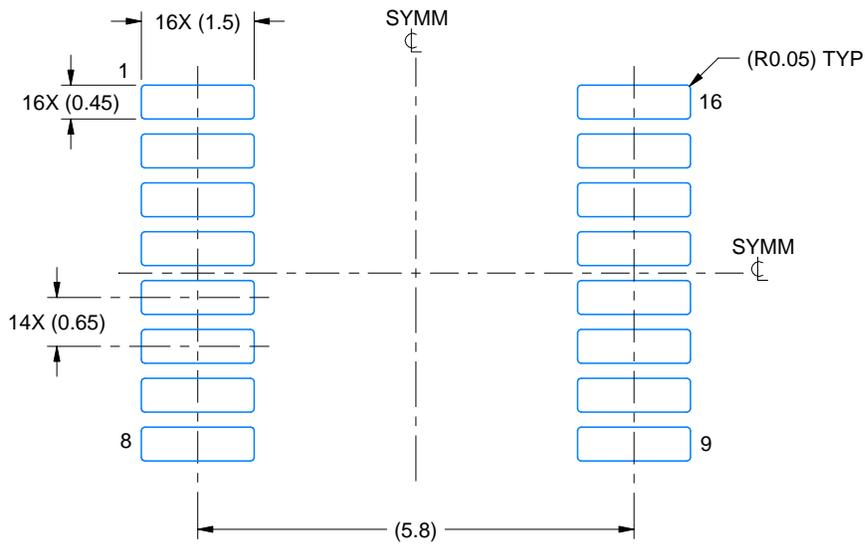
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

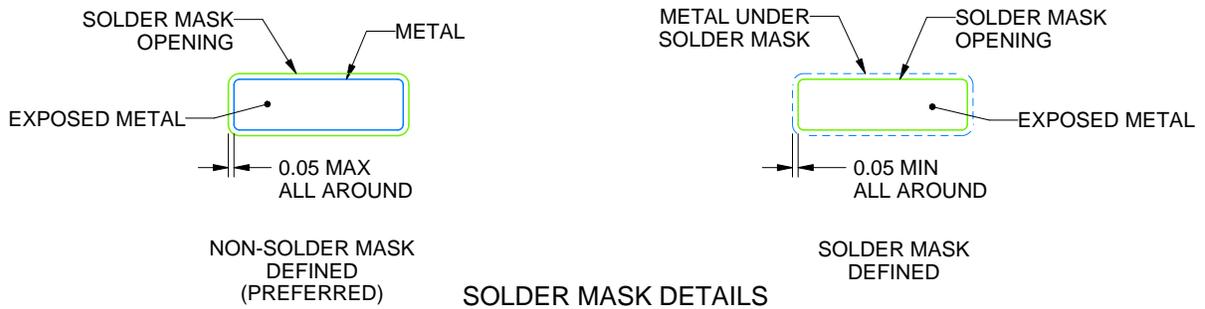
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220204/B 12/2023

NOTES: (continued)

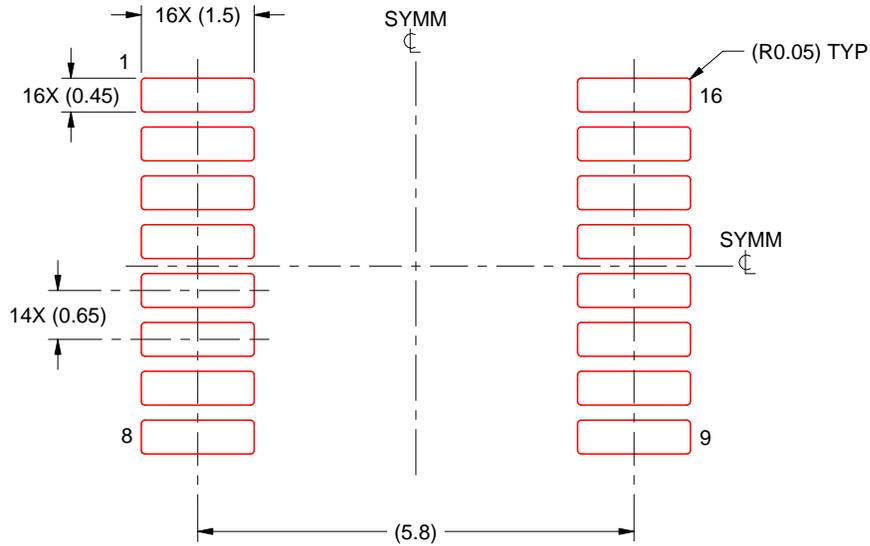
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

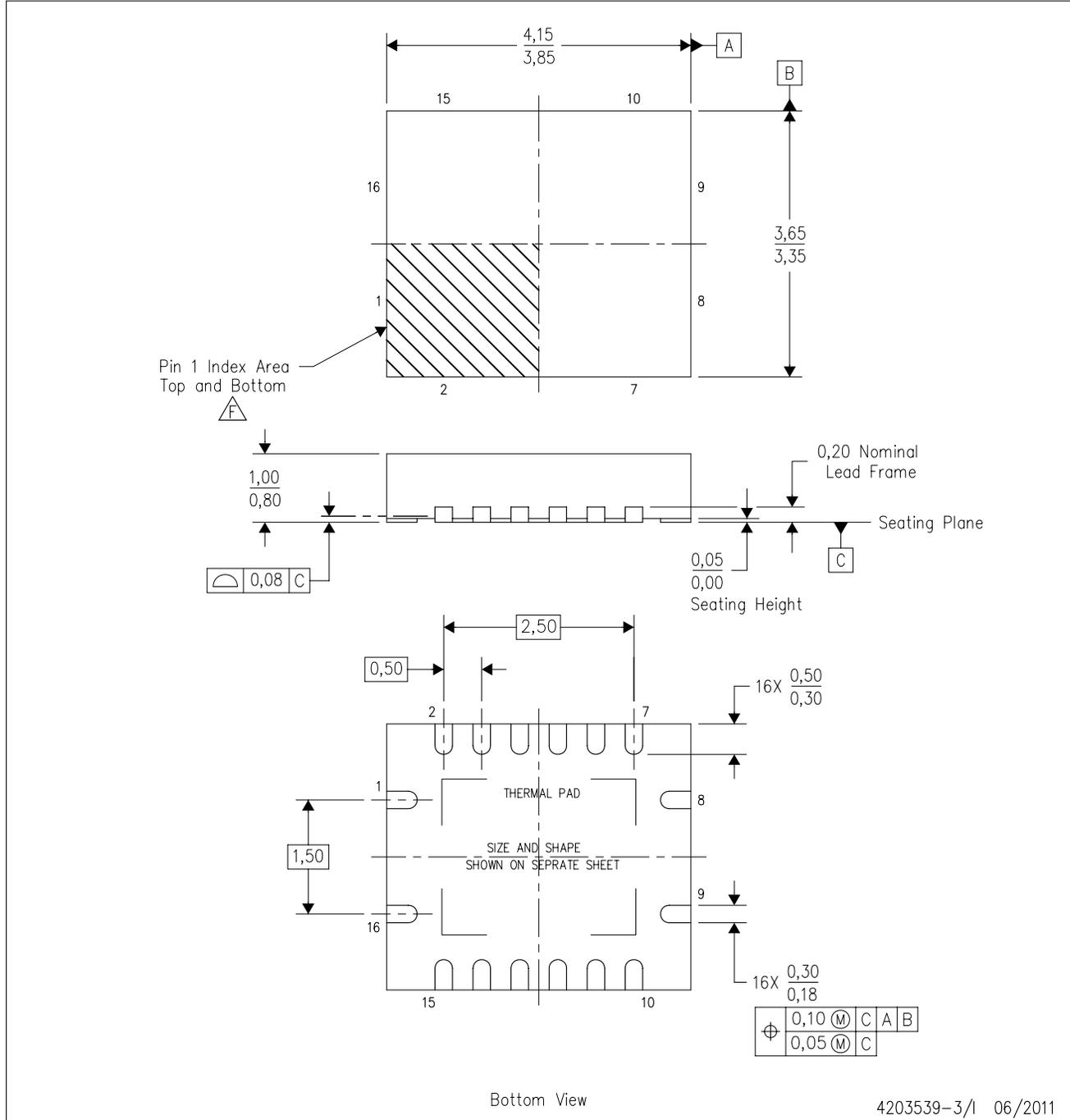
4220204/B 12/2023

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.

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. QFN (Quad Flatpack No-Lead) package configuration.
 - D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
 - E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
 - F. Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
 - G. Package complies to JEDEC MO-241 variation BA.

RGY (R-PVQFN-N16)

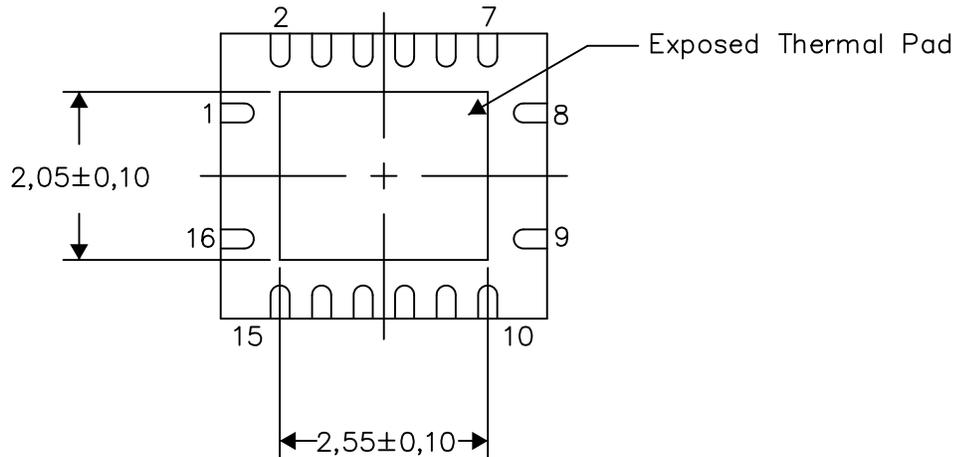
PLASTIC QUAD FLATPACK NO-LEAD

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

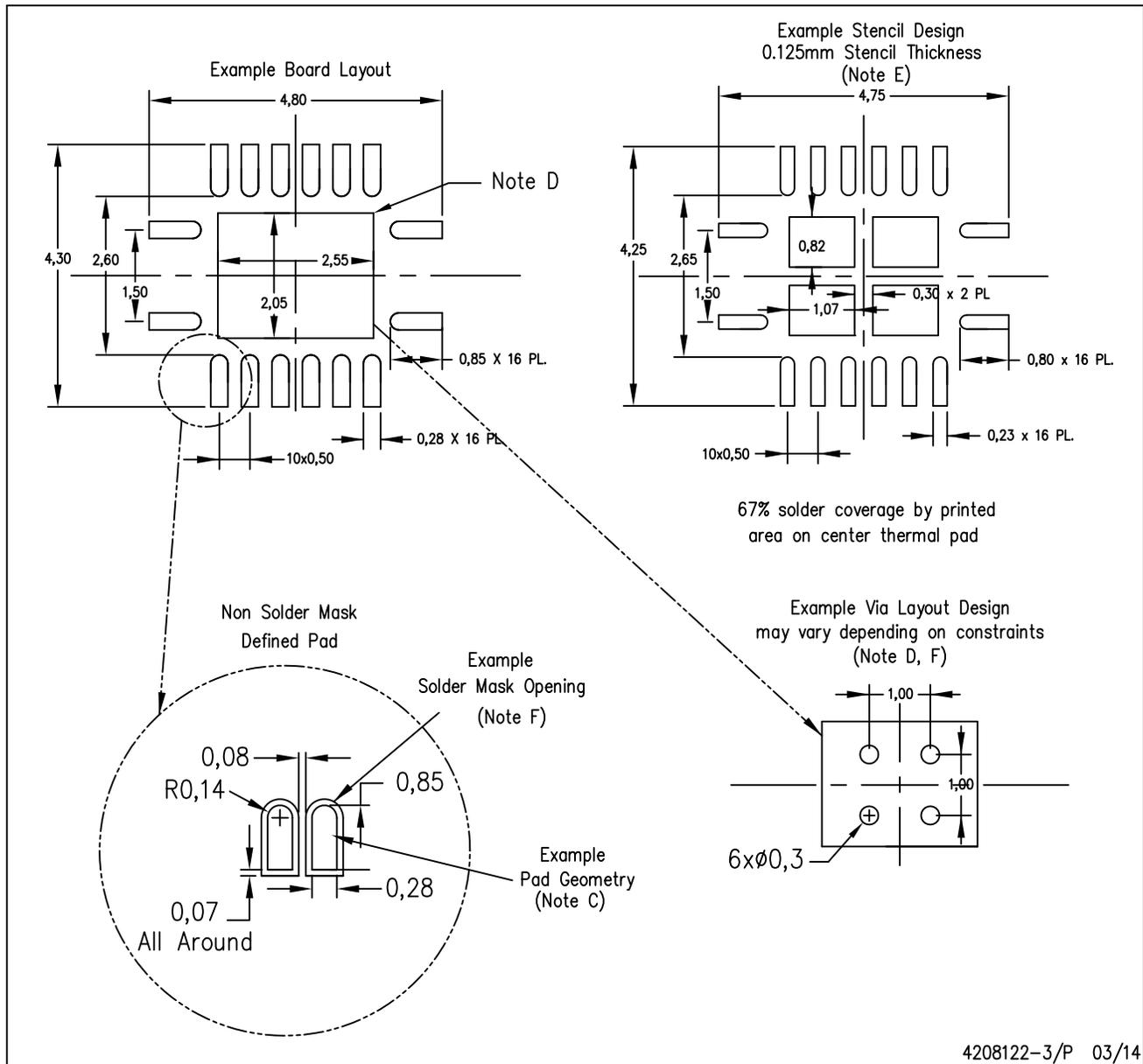
Exposed Thermal Pad Dimensions

4206353-3/P 03/14

NOTE: All linear dimensions are in millimeters

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



4208122-3/P 03/14

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <<http://www.ti.com>>.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
 - F. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.

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