

# TXB0106-Q1 6-Bit Bidirectional Voltage-Level Translator With Auto-Direction Sensing and $\pm 10\text{kV}$ ESD Protection

## 1 Features

- Qualified for Automotive Applications
- 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  $V_{CCA}$
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- ESD Protection Exceeds AEC-Q100
  - A Port
    - 2000V Human-Body Model
    - 1500V Charged-Device Model
  - B Port
    - $\pm 10\text{kV}$  Human-Body Model
    - 1500V Charged-Device Model

## 2 Applications

- Heating and Cooling
- Telematics
- Radar

## 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 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.  $V_{CCA}$  should not exceed  $V_{CCB}$ .

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

The TXB0106-Q1 device is designed so that the OE input circuit is supplied by  $V_{CCA}$ .

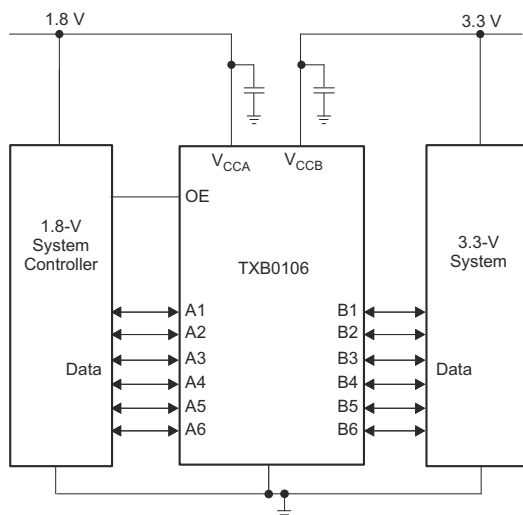
This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

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

### Package Information

| PART NUMBER | PACKAGE (1) | BODY SIZE (NOM) |
|-------------|-------------|-----------------|
| TXB0106-Q1  | TSSOP (16)  | 5.00mm × 4.40mm |
| TXB0106-Q1  | WQFN (16)   | 3.50mm x 2.50mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.



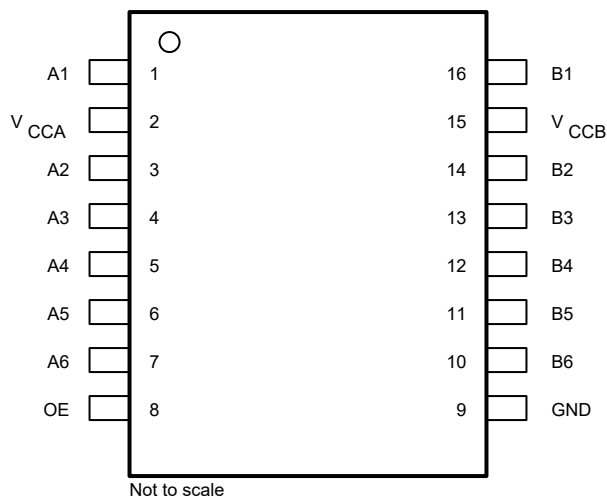
**Typical Operating Circuit**



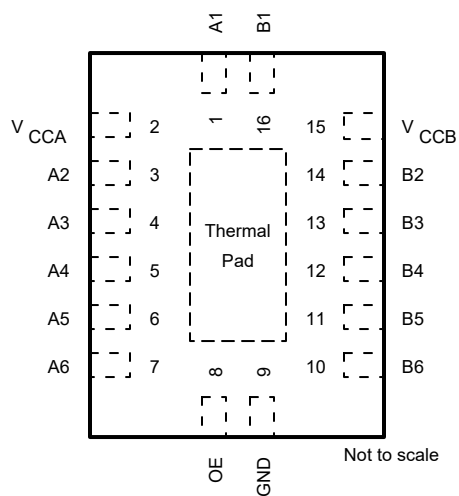
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## 4 Pin Configuration and Functions



**Figure 4-1. PW Package 16-Pin TSSOP Top View**



**Figure 4-2. BQB Package 16-Pin WCSP Top View**

## Pin Functions

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

## 5 Specifications

### 5.1 Absolute Maximum Ratings

over operating ambient temperature range (unless otherwise noted)

|           |   |           | MIN  | MAX             | UNIT |
|-----------|---|-----------|------|-----------------|------|
| $V_{CCA}$ | Supply voltage range  |           | –0.5 | 4.6             | V    |
| $V_{CCB}$ | Supply voltage range  |           | –0.5 | 6.5             | V    |
| $V_I$     | Input voltage range <sup>(1)</sup>  |           | –0.5 | 6.5             | V    |
| $V_O$     | Voltage range applied to any output in the high-impedance or power-off state <sup>(1)</sup> |           | –0.5 | 6.5             | V    |
|           | Voltage range applied to any output in the high or low state <sup>(1) (2)</sup>             | A inputs  | –0.5 | $V_{CCA} + 0.5$ | V    |
|           |   | B inputs  | –0.5 | $V_{CCB} + 0.5$ |      |
| $I_{IK}$  | Input clamp current   | $V_I < 0$ |      | –50             | mA   |
| $I_{OK}$  | Output clamp current  | $V_O < 0$ |      | –50             | mA   |
| $I_O$     | Continuous output current   |           |      | ±50             | mA   |
|           | Continuous current through $V_{CCA}$ , $V_{CCB}$ , or GND                                   |           |      | ±100            | mA   |
| $T_J$     | Junction temperature  |           |      | 150             | °C   |
| $T_{stg}$ | Storage temperature range   |           | –65  | 150             | °C   |

(1) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

(2) The values 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 AEC Q100-002 <sup>(1)</sup> | ±2000 | V    |
|             |                         | Charged-device model (CDM), per AEC Q100-011            | ±1500 |      |

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

### 5.3 Recommended Operating Conditions

|                  |  |               | V <sub>CCA</sub> | V <sub>CCB</sub> | MIN                                    | MAX                                    | UNIT |
|------------------|--|---------------|------------------|------------------|--|--|------|
| V <sub>CCA</sub> | Supply voltage                           |               |                  |                  | 1.2                                    | 3.6                                    | V    |
| V <sub>CCB</sub> |  |               |                  |                  | 1.65                                   | 5.5                                    |      |
| V <sub>IH</sub>  | High-level input voltage                 | Data inputs   | 1.2V to 3.6V     | 1.65V to 5.5V    | V <sub>CCI</sub> × 0.65 <sup>(1)</sup> | V <sub>CCI</sub>                       | V    |
|                  |  | OE            |                  |                  | V <sub>CCA</sub> × 0.65                | 5.5                                    |      |
| V <sub>IL</sub>  | Low-level input voltage                  | Data inputs   | 1.2V to 5.5V     | 1.65V to 5.5V    | 0                                      | V <sub>CCI</sub> × 0.35 <sup>(1)</sup> | V    |
|                  |  | OE            | 1.2V to 3.6V     |                  | 0                                      | V <sub>CCA</sub> × 0.35                |      |
| 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                           |  |      |
| T <sub>A</sub>   | Operating ambient temperature (TXB0106I) |               |                  |                  | −40                                    | 85                                     | °C   |
|                  | Operating ambient temperature (TXB0106)  |               |                  |                  | −40                                    | 125                                    | °C   |

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

## 5.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |  | TXB0106-Q1 |            | UNIT |
|-------------------------------|--|------------|------------|------|
|                               |  | PW (TSSOP) | BQB (WQFN) |      |
|                               |  | 16 PINS    | 16 PINS    |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 107.5      | 63.4       | °C/W |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance    | 42.3       | 64.3       | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 52.6       | 33.6       | °C/W |
| $\Psi_{JT}$                   | Junction-to-top characterization parameter   | 4.2        | 2.8        | °C/W |
| $\Psi_{JB}$                   | Junction-to-board characterization parameter | 52         | 33.6       | °C/W |
| $R_{\theta JC(bot)}$          | Junction-to-case (bottom) thermal resistance | -          | 16.2       | °C/W |

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

## 5.5 Electrical Characteristics (TXB0106I)

over recommended operating ambient temperature range (unless otherwise noted)<sup>(1) (2)</sup>

| PARAMETER                           |  |                           | TEST CONDITIONS  | V <sub>CCA</sub> | V <sub>CCB</sub> | T <sub>A</sub> = 25°C |     |     | −40°C to 85°C          |     | UNIT |    |
|-------------------------------------|--|---------------------------|--|------------------|------------------|-----------------------|-----|-----|------------------------|-----|------|----|
|                                     |  |                           |  |                  |                  | MIN                   | TYP | MAX | MIN                    | MAX |      |    |
| V <sub>OHA</sub>                    | Output high voltage, A port                    |                           | I <sub>OH</sub> = −20μA  | 1.2V             |                  | 1.1                   |     |     |                        |     | V    |    |
|                                     |  |                           |  | 1.4V to 3.6V     |                  |                       |     |     | V <sub>CCA</sub> − 0.4 |     |      |    |
| V <sub>OLA</sub>                    | Output low voltage, A port                     |                           | I <sub>OL</sub> = 20μA   | 1.2V             |                  | 0.9                   |     |     |                        |     | V    |    |
|                                     |  |                           |  | 1.4V to 3.6V     |                  |                       |     |     | 0.4                    |     |      |    |
| V <sub>OHB</sub>                    | Output high voltage, B port                    |                           | I <sub>OH</sub> = −20μA  |                  | 1.65V to 5.5V    |                       |     |     | V <sub>CCB</sub> − 0.4 |     | V    |    |
| V <sub>OLB</sub>                    | Output low voltage, B port                     |                           | I <sub>OL</sub> = 20μA   |                  | 1.65V to 5.5V    |                       |     |     | 0.4                    |     | V    |    |
| I <sub>lkg(l)</sub>                 | OE   | Input leakage current     |  | 1.2V to 3.6V     | 1.65V to 5.5V    | ±1                    |     |     | ±2                     |     | μA   |    |
| I <sub>lkg(off)</sub>               | A port   | Off-state leakage current |  | 0V               | 0V to 5.5V       | ±1                    |     |     | ±2                     |     | μA   |    |
|                                     | B port   |                           | 0V to 3.6V   | 0V               | ±1               |                       |     | ±2  |                        |     |      |    |
| I <sub>OZ</sub>                     | A or B port                                    |                           | High-impedance output current  | OE = GND         | 1.2V to 3.6V     | 1.65V to 5.5V         | ±1  |     |                        | ±2  |      | μA |
| I <sub>CCA</sub>                    | V <sub>CCA</sub> supply current                |                           | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0           | 1.2V             | 1.65V to 5.5V    | 0.06                  |     |     |                        |     | μA   |    |
|                                     |  |                           |  | 1.4V to 3.6V     |                  |                       |     |     | 9                      |     |      |    |
|                                     |  |                           |  | 3.6V             | 0V               |                       |     |     | 2                      |     |      |    |
|                                     |  |                           |  | 0V               | 5.5V             |                       |     |     | 2                      |     |      |    |
| I <sub>CCB</sub>                    | V <sub>CCB</sub> supply current                |                           | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0           | 1.2V             | 1.65V to 5.5V    | 3.4                   |     |     |                        |     | μA   |    |
|                                     |  |                           |  | 1.4V to 3.6V     |                  |                       |     |     | 9                      |     |      |    |
|                                     |  |                           |  | 3.6V             | 0V               |                       |     |     | −2                     |     |      |    |
|                                     |  |                           |  | 0V               | 5.5V             |                       |     |     | 2                      |     |      |    |
| I <sub>CCA</sub> + I <sub>CCB</sub> | Combined supply current                        |                           | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0           | 1.2V             | 1.65V to 5.5V    | 3.5                   |     |     |                        |     | μA   |    |
|                                     |  |                           |  | 1.4V to 3.6V     |                  |                       |     |     | 18                     |     |      |    |
| I <sub>CCZA</sub>                   | High-impedance V <sub>CCA</sub> supply current |                           | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0, OE = GND | 1.2V             | 1.65V to 5.5V    | 0.05                  |     |     |                        |     | μA   |    |
|                                     |  |                           |  | 1.4V to 3.6V     |                  |                       |     |     | 5                      |     |      |    |
| I <sub>CCZB</sub>                   | High-impedance V <sub>CCB</sub> supply current |                           | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0, OE = GND | 1.2V             | 1.65V to 5.5V    | 3.3                   |     |     |                        |     | μA   |    |
|                                     |  |                           |  | 1.4V to 3.6V     |                  |                       |     |     | 5                      |     |      |    |

over recommended operating ambient temperature range (unless otherwise noted)<sup>(1) (2)</sup>

| PARAMETER       |        |                   | TEST CONDITIONS | V <sub>CCA</sub> | V <sub>CCB</sub> | T <sub>A</sub> = 25°C |     |     | –40°C to 85°C |     | UNIT |
|-----------------|--------|-------------------|-----------------|------------------|------------------|-----------------------|-----|-----|---------------|-----|------|
|                 |        |                   |                 |                  |                  | MIN                   | TYP | MAX | MIN           | MAX |      |
| C <sub>I</sub>  | OE     | Input capacitance |                 | 1.2V to 3.6V     | 1.65V to 5.5V    | 5                     |     |     | 5.5           |     | pF   |
| C <sub>io</sub> | A port |                   |                 | 1.2V to 3.6V     | 1.65V to 5.5V    | 5                     |     |     | 6.5           |     | pF   |
|                 | B port |                   |                 |                  |                  | 8                     |     |     | 10            |     |      |

- (1) V<sub>CCI</sub> is the supply voltage associated with the input port.  
(2) V<sub>CCO</sub> is the supply voltage associated with the output port.

## 5.6 Electrical Characteristics (TXB0106)

over recommended operating ambient temperature range (unless otherwise noted)<sup>(1) (2)</sup>

| PARAMETER                           |  |                               | TEST CONDITIONS  | V <sub>CCA</sub> | V <sub>CCB</sub> | T <sub>A</sub> = 25°C |     |     | –40°C to 125°C         |     | UNIT |
|-------------------------------------|--|-------------------------------|--|------------------|------------------|-----------------------|-----|-----|------------------------|-----|------|
|                                     |  |                               |  |                  |                  | MIN                   | TYP | MAX | MIN                    | MAX |      |
| V <sub>OHA</sub>                    | Output high voltage, A port                    |                               | I <sub>OH</sub> = –20μA  | 1.2V             |                  | 1.1                   |     |     | V <sub>CCA</sub> – 0.4 |     | V    |
|                                     |  |                               |  | 1.4V to 3.6V     |                  |                       |     |     |                        |     |      |
| V <sub>OLA</sub>                    | Output low voltage, A port                     |                               | I <sub>OL</sub> = 20μA   | 1.2V             |                  | 0.9                   |     |     | 0.4                    |     | V    |
|                                     |  |                               |  | 1.4V to 3.6V     |                  |                       |     |     |                        |     |      |
| V <sub>OHB</sub>                    | Output high voltage, B port                    |                               | I <sub>OH</sub> = –20μA  |                  | 1.65V to 5.5V    |                       |     |     | V <sub>CCB</sub> – 0.4 |     | V    |
| V <sub>OLB</sub>                    | Output low voltage, B port                     |                               | I <sub>OL</sub> = 20μA   |                  | 1.65V to 5.5V    |                       |     |     | 0.4                    |     | V    |
| I <sub>Ikg(I)</sub>                 | OE   | Input leakage current         |  | 1.2V to 3.6V     | 1.65V to 5.5V    | ±1                    |     |     | ±2                     |     | μA   |
| I <sub>Ikg(off)</sub>               | A port   | Off-state leakage current     |  | 0V               | 0V to 5.5V       | ±1                    |     |     | ±2                     |     | μA   |
|                                     | B port   |                               |  | 0V to 3.6V       | 0V               | ±1                    |     |     | ±2                     |     |      |
| I <sub>OZ</sub>                     | A or B port                                    | High-impedance output current | OE = GND   | 1.2V to 3.6V     | 1.65V to 5.5V    | ±1                    |     |     | ±2                     |     | μA   |
| I <sub>CCA</sub>                    | V <sub>CCA</sub> supply current                |                               | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0           | 1.2V             | 1.65V to 5.5V    | 0.4                   |     |     |                        |     | μA   |
|                                     |  |                               |  | 1.4V to 3.6V     |                  |                       |     |     |                        |     |      |
|                                     |  |                               |  | 3.6V             | 0V               |                       |     |     | 7.5                    |     |      |
|                                     |  |                               |  | 0V               | 5.5V             |                       |     |     | –2                     |     |      |
| I <sub>CCB</sub>                    | V <sub>CCB</sub> supply current                |                               | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0           | 1.2V             | 1.65V to 5.5V    | 3.4                   |     |     |                        |     | μA   |
|                                     |  |                               |  | 1.4V to 3.6V     |                  |                       |     |     |                        |     |      |
|                                     |  |                               |  | 3.6V             | 0V               |                       |     |     | –2                     |     |      |
|                                     |  |                               |  | 0V               | 5.5V             |                       |     |     | 30.5                   |     |      |
| I <sub>CCA</sub> + I <sub>CCB</sub> | Combined supply current                        |                               | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0           | 1.2V             | 1.65V to 5.5V    | 3.5                   |     |     |                        |     | μA   |
|                                     |  |                               |  | 1.4V to 3.6V     |                  |                       |     |     |                        |     |      |
| I <sub>CCZA</sub>                   | High-impedance V <sub>CCA</sub> supply current |                               | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0, OE = GND | 1.2V             | 1.65V to 5.5V    | 0.4                   |     |     |                        |     | μA   |
|                                     |  |                               |  | 1.4V to 3.6V     |                  |                       |     |     |                        |     |      |
| I <sub>CCZB</sub>                   | High-impedance V <sub>CCB</sub> supply current |                               | V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0, OE = GND | 1.2V             | 1.65V to 5.5V    | 3.3                   |     |     |                        |     | μA   |
|                                     |  |                               |  | 1.4V to 3.6V     |                  |                       |     |     |                        |     |      |
| C <sub>I</sub>                      | OE   | Input capacitance             |  | 1.2V to 3.6V     | 1.65V to 5.5V    | 5                     |     |     | 6.5                    |     | pF   |

**TXB0106-Q1**

SCES791B – AUGUST 2009 – REVISED AUGUST 2025

over recommended operating ambient temperature range (unless otherwise noted)<sup>(1) (2)</sup>

| PARAMETER       |        |  | TEST CONDITIONS | V <sub>CCA</sub> | V <sub>CCB</sub> | T <sub>A</sub> = 25°C |     |     | –40°C to 125°C |     | UNIT |
|-----------------|--------|--|-----------------|------------------|------------------|-----------------------|-----|-----|----------------|-----|------|
|                 |        |  |                 |                  |                  | MIN                   | TYP | MAX | MIN            | MAX |      |
| C <sub>io</sub> | A port |  |                 | 1.2V to 3.6V     | 1.65V to 5.5V    | 5                     |     |     | 6.5            |     | pF   |
|                 | B port |  |                 |                  |                  | 8                     |     |     | 13.5           |     |      |

(1) V<sub>CCI</sub> is the supply voltage associated with the input port.

(2) V<sub>CCO</sub> is the supply voltage associated with the output port.

**5.7 Timing Requirements – V<sub>CCA</sub> = 1.2V, T<sub>A</sub> = 25°C**

|                |                |             | V <sub>CCB</sub> = 1.8V | V <sub>CCB</sub> = 2.5V | V <sub>CCB</sub> = 3.3V | V <sub>CCB</sub> = 5V | UNIT |
|----------------|----------------|-------------|-------------------------|-------------------------|-------------------------|-----------------------|------|
|                |                |             | TYP                     | TYP                     | TYP                     | TYP                   |      |
| Data rate      |                |             | 20                      | 20                      | 20                      | 20                    | Mbps |
| t <sub>w</sub> | Pulse duration | Data inputs | 50                      | 50                      | 50                      | 50                    | ns   |

**5.8 Timing Requirements – V<sub>CCA</sub> = 1.5V ± 0.1V**

over recommended operating ambient temperature range (unless otherwise noted)

|                |                |             | V <sub>CCB</sub> = 1.8V<br>± 0.15V |     | V <sub>CCB</sub> = 2.5V<br>± 0.2V |     | V <sub>CCB</sub> = 3.3V<br>± 0.3V |     | V <sub>CCB</sub> = 5V<br>± 0.5V |     | UNIT |
|----------------|----------------|-------------|------------------------------------|-----|-----------------------------------|-----|-----------------------------------|-----|---------------------------------|-----|------|
|                |                |             | MIN                                | MAX | MIN                               | MAX | MIN                               | MAX | MIN                             | MAX |      |
| Data rate      |                |             | 50                                 |     | 50                                |     | 50                                |     | 50                              |     | Mbps |
| t <sub>w</sub> | Pulse duration | Data inputs | 20                                 |     | 20                                |     | 20                                |     | 20                              |     | ns   |

**5.9 Timing Requirements – V<sub>CCA</sub> = 1.8V ± 0.15V**

over recommended operating ambient temperature range (unless otherwise noted)

|                |                |             | V <sub>CCB</sub> = 1.8V<br>± 0.15V |     | V <sub>CCB</sub> = 2.5V<br>± 0.2V |     | V <sub>CCB</sub> = 3.3V<br>± 0.3V |     | V <sub>CCB</sub> = 5V<br>± 0.5V |     | UNIT |
|----------------|----------------|-------------|------------------------------------|-----|-----------------------------------|-----|-----------------------------------|-----|---------------------------------|-----|------|
|                |                |             | MIN                                | MAX | MIN                               | MAX | MIN                               | MAX | MIN                             | MAX |      |
| Data rate      |                |             | 52                                 |     | 60                                |     | 60                                |     | 60                              |     | Mbps |
| t <sub>w</sub> | Pulse duration | Data inputs | 19                                 |     | 17                                |     | 17                                |     | 17                              |     | ns   |

**5.10 Timing Requirements – V<sub>CCA</sub> = 2.5V ± 0.2V**

over recommended operating ambient temperature range (unless otherwise noted)

|                |                |             | V <sub>CCB</sub> = 2.5V<br>± 0.2V |     | V <sub>CCB</sub> = 3.3V<br>± 0.3V |     | V <sub>CCB</sub> = 5V<br>± 0.5V |     | UNIT |
|----------------|----------------|-------------|-----------------------------------|-----|-----------------------------------|-----|---------------------------------|-----|------|
|                |                |             | MIN                               | MAX | MIN                               | MAX | MIN                             | MAX |      |
| Data rate      |                |             | 70                                |     | 100                               |     | 100                             |     | Mbps |
| t <sub>w</sub> | Pulse duration | Data inputs | 14                                |     | 10                                |     | 10                              |     | ns   |

**5.11 Timing Requirements – V<sub>CCA</sub> = 3.3V ± 0.3V**

over recommended operating ambient temperature range (unless otherwise noted)

|                |                |             | V <sub>CCB</sub> = 3.3V<br>± 0.3V |     | V <sub>CCB</sub> = 5V<br>± 0.5V |     | UNIT |
|----------------|----------------|-------------|-----------------------------------|-----|---------------------------------|-----|------|
|                |                |             | MIN                               | MAX | MIN                             | MAX |      |
| Data rate      |                |             | 100                               |     | 100                             |     | Mbps |
| t <sub>w</sub> | Pulse duration | Data inputs | 10                                |     | 10                              |     | ns   |



## 5.12 Switching Characteristics – $V_{CCA} = 1.2V$ , $T_A = 25^\circ C$

| PARAMETER        | FROM<br>(INPUT)            | TO<br>(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              | $\mu s$ |
|                  |                            | B              | 1                | 1                | 1                | 1              |         |
| $t_{dis}^{(1)}$  | 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    |

(1) Test procedure uses a 25MHz sine wave on the input.

## 5.13 Switching Characteristics – $V_{CCA} = 1.5V \pm 0.1V$ (TXB0106I)

over recommended operating ambient temperature range (unless otherwise noted)

| PARAMETER        | FROM<br>(INPUT)            | TO<br>(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                        | 13.5 | 1.2                       | 10.5 | 1.1                       | 10.5 | 0.8                     | 10.1 | ns      |
|                  | B                          | A              | 0.9                        | 15.2 | 0.7                       | 13.8 | 0.4                       | 13.8 | 0.3                     | 13.7 |         |
| $t_{en}$         | OE                         | A              |                            | 1    |                           | 1    |                           | 1    |                         | 1    | $\mu s$ |
|                  |                            | B              |                            | 1    |                           | 1    |                           | 1    |                         | 1    |         |
| $t_{dis}^{(1)}$  | 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    |

## 5.14 Switching Characteristics – $V_{CCA} = 1.5V \pm 0.1V$ (TXB0106)

over recommended operating ambient temperature range (unless otherwise noted)

| PARAMETER        | FROM<br>(INPUT)            | TO<br>(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                        | 13.5 | 1.2                       | 10.5 | 1.1                       | 10.5 | 0.8                     | 10.1 | ns      |
|                  | B                          | A              | 0.9                        | 15.2 | 0.7                       | 13.8 | 0.4                       | 13.8 | 0.3                     | 13.7 |         |
| $t_{en}$         | OE                         | A              |                            | 1    |                           | 1    |                           | 1    |                         | 1    | $\mu s$ |
|                  |                            | B              |                            | 1    |                           | 1    |                           | 1    |                         | 1    |         |
| $t_{dis}^{(1)}$  | OE                         | A              | 278                        | 394  | 236                       | 305  | 236                       | 305  | 236                     | 305  | ns      |
|                  |                            | B              | 278                        | 394  | 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 – $V_{CCA} = 1.8V \pm 0.15V$ (TXB0106I)

over recommended operating ambient temperature range (unless otherwise noted)

| PARAMETER        | FROM<br>(INPUT)            | TO<br>(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                        | 12   | 1.4                       | 7.7  | 1.3                       | 6.8  | 1.2                     | 6.5  | ns      |
|                  | B                          | A              | 1.5                        | 13.5 | 1.2                       | 10   | 0.8                       | 8.2  | 0.5                     | 8    |         |
| $t_{en}$         | OE                         | A              |                            | 1    |                           | 1    |                           | 1    |                         | 1    | $\mu s$ |
|                  |                            | B              |                            | 1    |                           | 1    |                           | 1    |                         | 1    |         |
| $t_{dis}^{(1)}$  | 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    |

### 5.16 Switching Characteristics – $V_{CCA} = 1.8V \pm 0.15V$ (TXB0106)

over recommended operating ambient temperature range (unless otherwise noted)

| PARAMETER        | FROM<br>(INPUT)            | TO<br>(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                        | 12   | 1.4                       | 7.7 | 1.3                       | 6.8 | 1.2                     | 6.5 | ns      |
|                  | B                          | A              | 1.5                        | 13.5 | 1.2                       | 10  | 0.8                       | 8.2 | 0.5                     | 8   |         |
| $t_{en}$         | OE                         | A              |                            | 1    |                           | 1   |                           | 1   |                         | 1   | $\mu s$ |
|                  |                            | B              |                            | 1    |                           | 1   |                           | 1   |                         | 1   |         |
| $t_{dis}^{(1)}$  | OE                         | A              | 278                        | 393  | 191                       | 256 | 190                       | 248 | 189                     | 248 | ns      |
|                  |                            | B              | 278                        | 393  | 191                       | 256 | 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 – $V_{CCA} = 2.5V \pm 0.2V$ (TXB0106I)

over recommended operating ambient temperature range (unless otherwise noted)

| PARAMETER        | FROM<br>(INPUT)            | TO<br>(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                       | 6.7  | 1                         | 5.7  | 0.9                     | 5    | ns      |
|                  | B                          | A              | 1                         | 8.5  | 0.6                       | 7    | 0.3                     | 7    |         |
| $t_{en}$         | OE                         | A              |                           | 1    |                           | 1    |                         | 1    | $\mu s$ |
|                  |                            | B              |                           | 1    |                           | 1    |                         | 1    |         |
| $t_{dis}^{(1)}$  | 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    |

## 5.18 Switching Characteristics – $V_{CCA} = 2.5V \pm 0.2V$ (TXB0106)

over recommended operating ambient temperature range (unless otherwise noted)

| PARAMETER        | FROM<br>(INPUT)            | TO<br>(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                       | 6.7 | 1                         | 5.7 | 0.9                     | 5   | ns      |
|                  | B                          | A              | 1                         | 8.5 | 0.6                       | 7   | 0.3                     | 7   |         |
| $t_{en}$         | OE                         | A              |                           | 1   |                           | 1   |                         | 1   | $\mu s$ |
|                  |                            | B              |                           | 1   |                           | 1   |                         | 1   |         |
| $t_{dis}^{(1)}$  | OE                         | A              | 190                       | 255 | 137                       | 185 | 133                     | 169 | ns      |
|                  |                            | B              | 190                       | 255 | 137                       | 185 | 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      |
| Max data rate    |                            |                | 70                        |     | 100                       |     | 100                     |     | Mbps    |

## 5.19 Switching Characteristics – $V_{CCA} = 3.3V \pm 0.3V$ (TXB0106I)

over recommended operating ambient temperature range (unless otherwise noted)

| PARAMETER        | FROM<br>(INPUT)            | TO<br>(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                       | 5.5  | 0.8                     | 4.5  | ns      |
|                  | B                          | A              | 0.5                       | 6.5  | 0.2                     | 6    |         |
| $t_{en}$         | OE                         | A              |                           | 1    |                         | 1    | $\mu s$ |
|                  |                            | B              |                           | 1    |                         | 1    |         |
| $t_{dis}^{(1)}$  | 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    |

## 5.20 Switching Characteristics – $V_{CCA} = 3.3V \pm 0.3V$ (TXB0106)

over recommended operating ambient temperature range (unless otherwise noted)

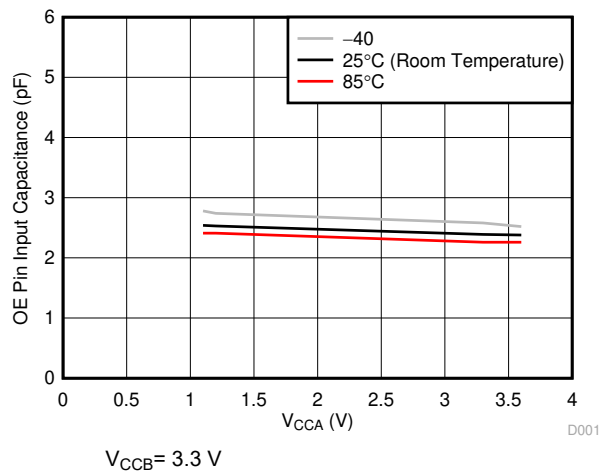
| PARAMETER        | FROM<br>(INPUT)            | TO<br>(OUTPUT) | $V_{CCB} = 3.3V \pm 0.3V$ |     | $V_{CCB} = 5V \pm 0.5V$ |     | UNIT    |
|------------------|----------------------------|----------------|---------------------------|-----|-------------------------|-----|---------|
|                  |                            |                | MIN                       | MAX | MIN                     | MAX |         |
| $t_{pd}$         | A                          | B              | 0.9                       | 5.5 | 0.8                     | 4.5 | ns      |
|                  | B                          | A              | 0.5                       | 6.5 | 0.2                     | 6   |         |
| $t_{en}$         | OE                         | A              |                           | 1   |                         | 1   | $\mu s$ |
|                  |                            | B              |                           | 1   |                         | 1   |         |
| $t_{dis}^{(1)}$  | OE                         | A              | 137                       | 185 | 97.6                    | 127 | ns      |
|                  |                            | B              | 137                       | 185 | 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 Operating Characteristics

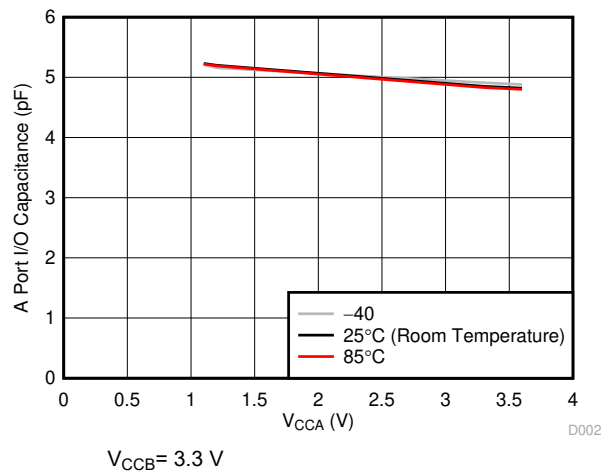
$T_A = 25^\circ\text{C}$

| PARAMETER        |                             | TEST CONDITIONS  | V <sub>CCA</sub> |      |      |      |      |      |            |    | UNIT |
|------------------|-----------------------------|--|------------------|------|------|------|------|------|------------|----|------|
|                  |                             |  | 1.2V             | 1.2V | 1.5V | 1.8V | 2.5V | 2.5V | 3.3V       |    |      |
|                  |                             |  | V <sub>CCB</sub> |      |      |      |      |      |            |    |      |
|                  |                             |  | 5V               | 1.8V | 1.8V | 1.8V | 2.5V | 5V   | 3.3V to 5V |    |      |
|                  |                             |  | TYP              | TYP  | TYP  | TYP  | TYP  | TYP  | TYP        |    |      |
| C <sub>pdA</sub> | A-port input, B-port output | C <sub>L</sub> = 0, f = 10MHz,<br>t <sub>r</sub> = t <sub>f</sub> = 1ns,<br>OE = V <sub>CCA</sub><br>(outputs enabled) | 9                | 8    | 7    | 7    | 7    | 7    | 8          | pF |      |
|                  | B-port input, A-port output |  | 12               | 11   | 11   | 11   | 11   | 11   | 11         |    |      |
| C <sub>pdB</sub> | A-port input, B-port output |  | 35               | 26   | 27   | 27   | 27   | 27   | 28         | pF |      |
|                  | B-port input, A-port output |  | 26               | 19   | 18   | 18   | 18   | 20   | 21         |    |      |
| C <sub>pdA</sub> | A-port input, B-port output | C <sub>L</sub> = 0, f = 10MHz,<br>t <sub>r</sub> = t <sub>f</sub> = 1ns,<br>OE = GND<br>(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 <sub>pdB</sub> | A-port input, B-port output |  | 0.01             | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.03       | pF |      |
|                  | B-port input, A-port output |  | 0.01             | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.03       |    |      |

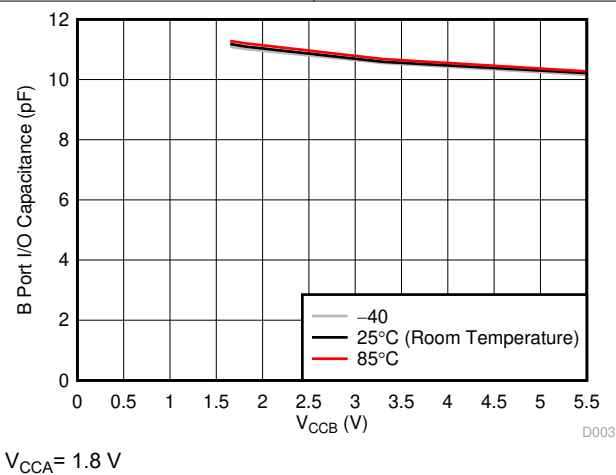
## 5.22 Typical Characteristics



**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 ( $V_{CCA}$ )**



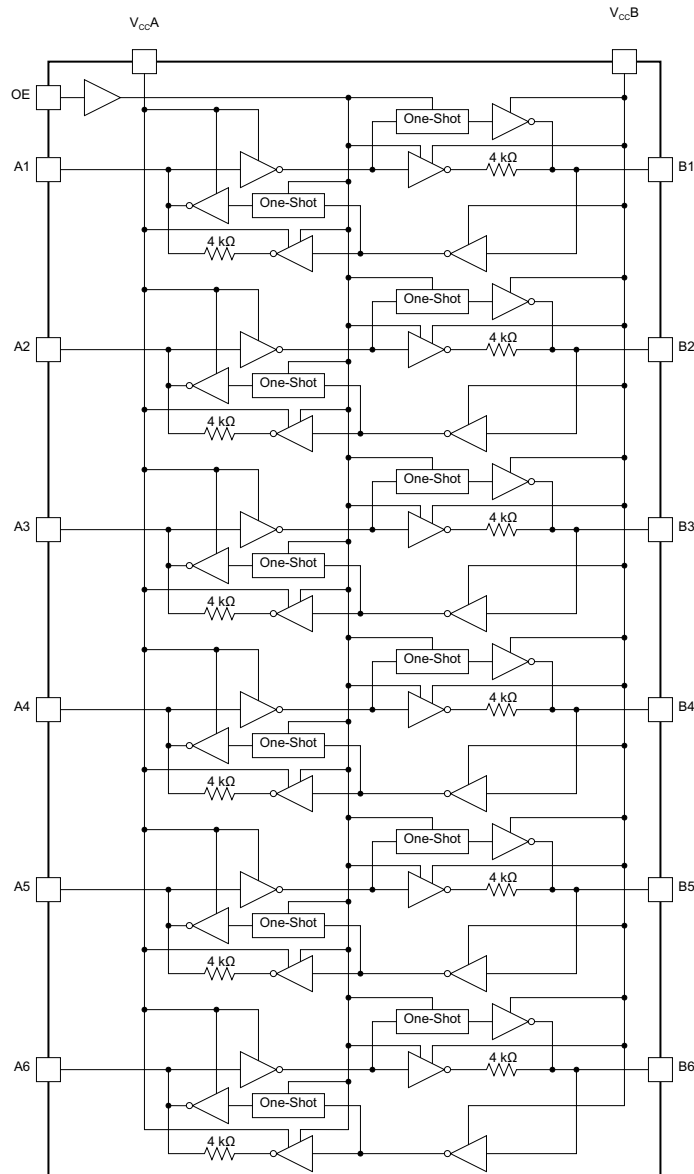
**Figure 5-3. Capacitance for B port I/O pins ( $C_{IO}$ ) vs Power Supply ( $V_{CCB}$ )**

## 6 Detailed Description

### 6.1 Overview

The TXB0106-Q1 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. For open-drain signal translation, see TI's TXS family of products.

### 6.2 Functional Block Diagram

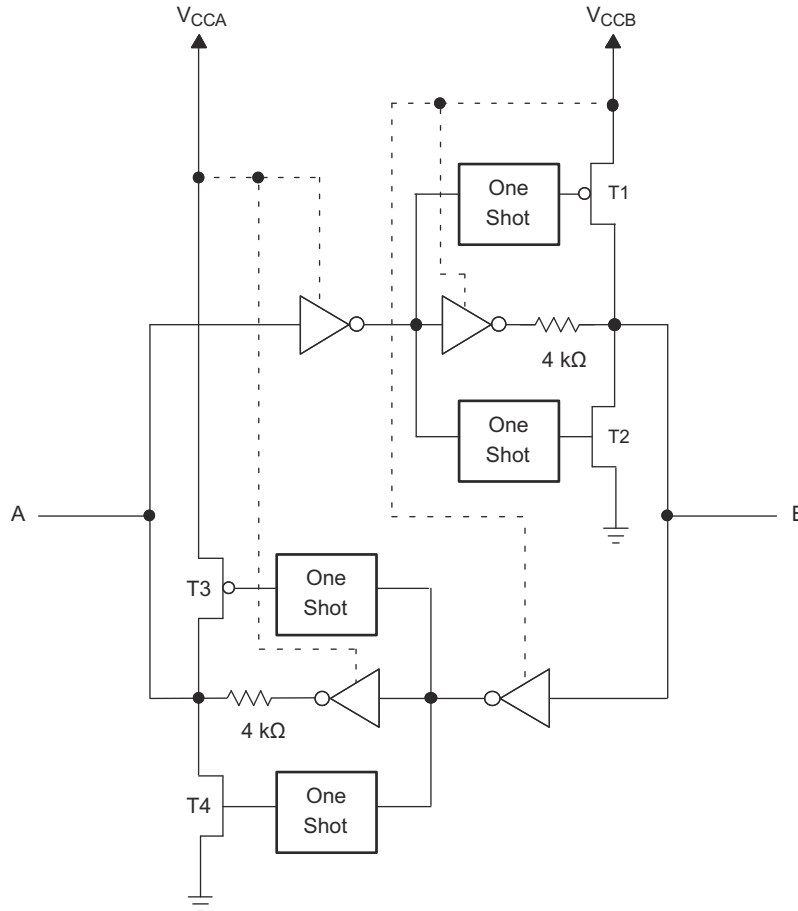


### 6.3 Feature Description

#### 6.3.1 Architecture

The TXB0106-Q1 architecture (see [Figure 6-1](#)) 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-Q1 device can maintain a high or low, but are designed to be weak, so that they can be overdriven by an external driver when data on the bus starts flowing in 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  $V_{CCO} = 1.2\text{V}$  to 1.8V, 50Ω at  $V_{CCO} = 1.8\text{V}$  to 3.3V, and 40Ω at  $V_{CCO} = 3.3\text{V}$  to 5V.

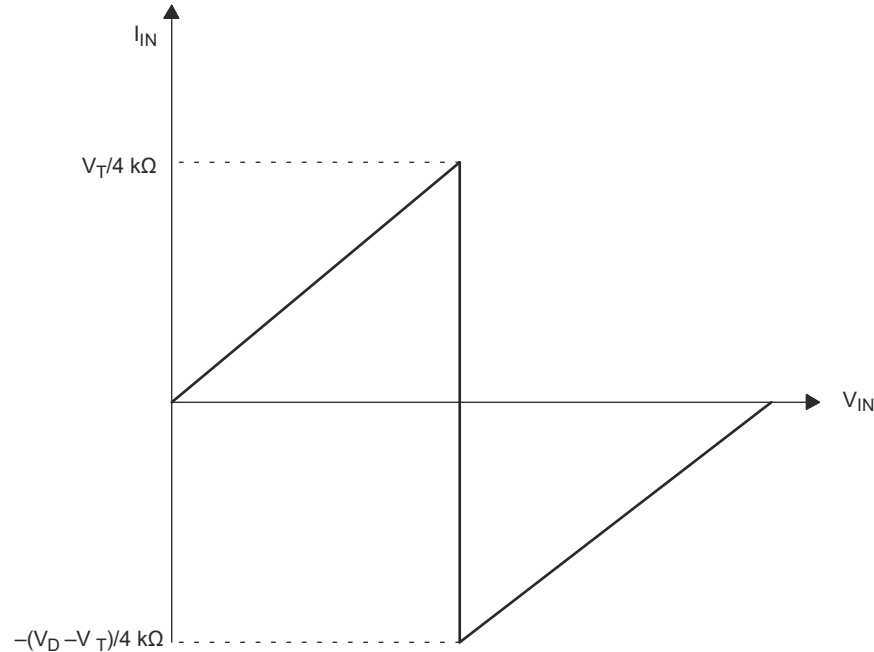


**Figure 6-1. Architecture of the TXB0106-Q1 I/O Cell**

### 6.3.2 Input Driver Requirements

Typical  $I_{IN}$  vs  $V_{IN}$  characteristics of the TXB0106-Q1 device are shown in [Figure 6-2](#). For proper operation, the device driving the data I/Os of the TXB0106-Q1 device must have drive strength of at least  $\pm 2\text{mA}$ .





- A.  $V_T$  is the input threshold voltage of the TXB0106-Q1 device (typically  $V_{CCI} / 2$ ).
- B.  $V_D$  is the supply voltage of the external driver.

**Figure 6-2. Typical  $I_{IN}$  vs  $V_{IN}$  Curve**

### 6.3.3 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-Q1 device has circuitry that disables all output ports when either  $V_{CC}$  is switched off ( $V_{CCA/B} = 0V$ ).

### 6.3.4 Output Load Considerations

TI recommends careful PCB layout practices with short PCB trace lengths to avoid excessive capacitive loading and to ensure that proper one-shot (O.S.) triggering takes place. PCB signal trace-lengths should be kept short enough such that the round trip delay of any reflection is less than the O.S. duration. This improves signal integrity by ensuring that any reflection sees a low impedance at the driver. The O.S. circuits have been designed to stay on for approximately 10ns. The maximum capacitance of the lumped load that can be driven also depends directly on the O.S. duration. With very heavy capacitive loads, the O.S. 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  $I_{CC}$ , load driving capability, and maximum bit-rate considerations. Both PCB trace length and connectors add to the capacitance that the TXB0106-Q1 output sees, 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.

### 6.3.5 Enable and Disable

The TXB0106-Q1 device 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 O.S. circuitry to become operational after OE is taken high.

### 6.3.6 Pullup or Pulldown Resistors on I/O Lines

The TXB0106-Q1 device is designed to drive capacitive loads of up to 70pF. The output drivers of the TXB0106-Q1 device have low dc drive strength. If pullup or pulldown resistors are connected externally to the data I/Os,

their values must be kept higher than 50k $\Omega$  to ensure that they do not contend with the output drivers of the TXB0106-Q1 device.

For the same reason, the TXB0106-Q1 device should not be used in applications such as I<sup>2</sup>C or 1-Wire where an open-drain driver is connected on the bidirectional data I/O. For these applications, use a device from TI's TXS family of level translators.

## 6.4 Device Functional Modes

The TXB0106-Q1 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.

## 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.

## 1 Application Information

The TXB0106-Q1 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. It can only translate push-pull CMOS logic outputs. For open-drain signal translation, see TI's TXS products. Any external pulldown or pullup resistors are recommended to be larger than 50 k $\Omega$ .

## 2 Typical Application

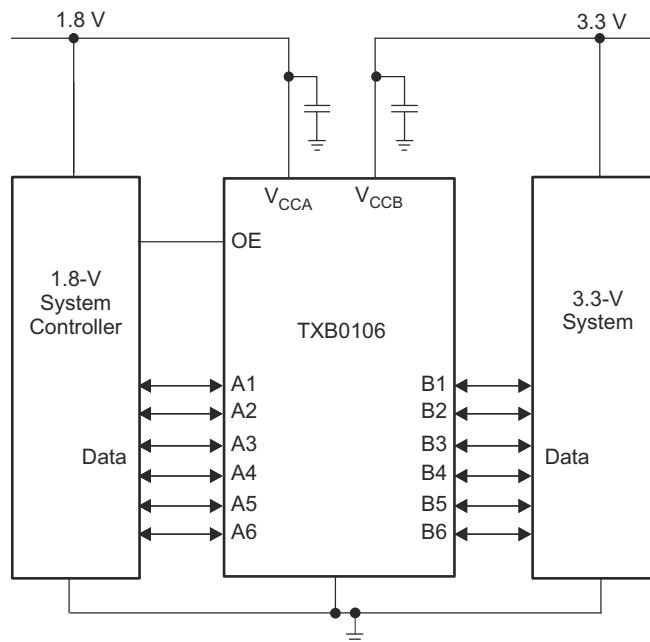


Figure 7-1. Typical Operating Circuit

### 2.1 Design Requirements

For this design example, use the parameters listed in [Table 7-1](#). And make sure that  $V_{CCA} \leq V_{CCB}$ .

**Table 7-1. Design Parameters**

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

## 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-Q1 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-Q1 device is driving to determine the output voltage range.
  - Avoid the use of external pullup or pulldown resistors, if possible. If not possible, it is recommended the value should be larger than 50 k $\Omega$ .
  - An external pulldown or pullup resistor decreases the output  $V_{OH}$  and  $V_{OL}$ . Use the following equations to estimate the  $V_{OH}$  and  $V_{OL}$  as a result of an external pulldown and pullup resistor. See [Effects of External Pullup and Pulldown Resistors on TXS and TXB Devices](#) and [Factors Affecting VOL for TXS and LSF Auto-bidirectional Translation Devices](#).

$$V_{OH} = V_{CCX} \times R_{PD} / (R_{PD} + 4.5 \text{ k}\Omega)$$

$$V_{OL} = V_{CCX} \times 4.5 \text{ k}\Omega / (R_{PU} + 4.5 \text{ k}\Omega)$$

Where

- $V_{CCX}$  is the output port supply voltage on either  $V_{CCA}$  or  $V_{CCB}$
- $R_{PD}$  is the value of the external pulldown resistor
- $R_{PU}$  is the value of the external pullup resistor
- 4.5 k $\Omega$  accounts for the tolerance of the serial 4-k $\Omega$  resistor in the I/O line.

## 2.3 Application Curve

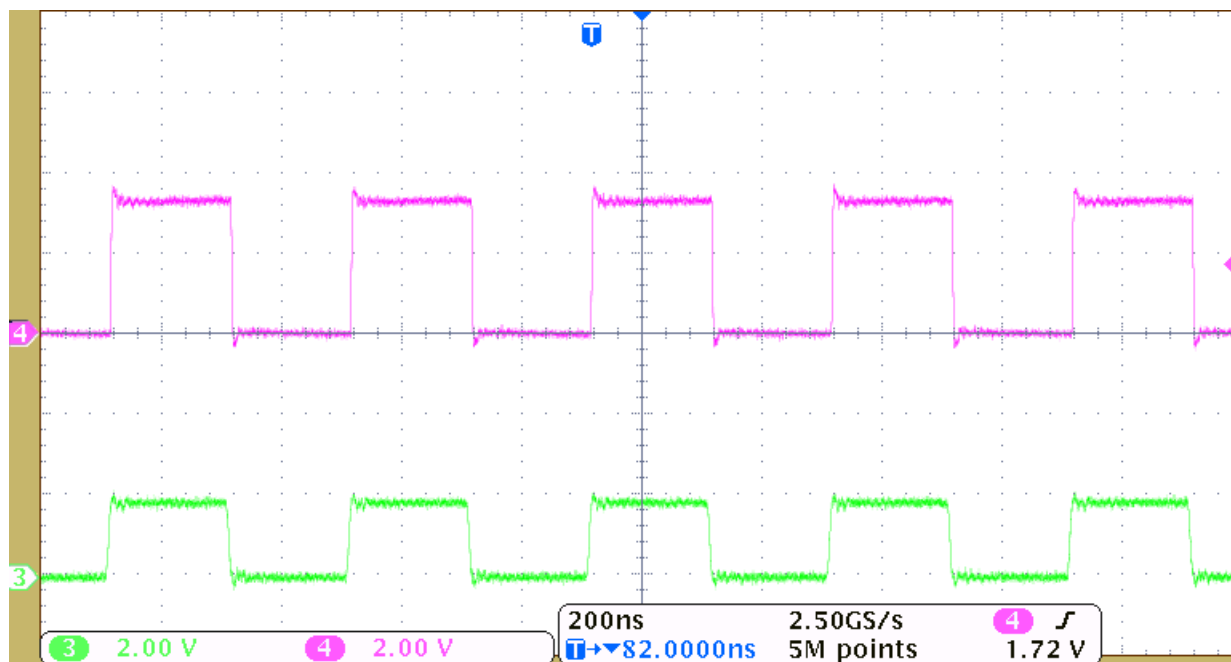


Figure 7-2. Level Translation of a 2.5MHz Signal

## 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-Q1 device has circuitry that disables all output ports when either  $V_{CC}$  is switched off ( $V_{CCA}$  or  $V_{CCB} = 0V$ ). 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 ensure the high-impedance state of the outputs during power up or power down, the OE input pin must be tied to GND through a pulldown resistor and must not be enabled until  $V_{CCA}$  and  $V_{CCB}$  are fully ramped and stable. The minimum value of the pulldown resistor to ground is determined by the current-sourcing capability of the driver.

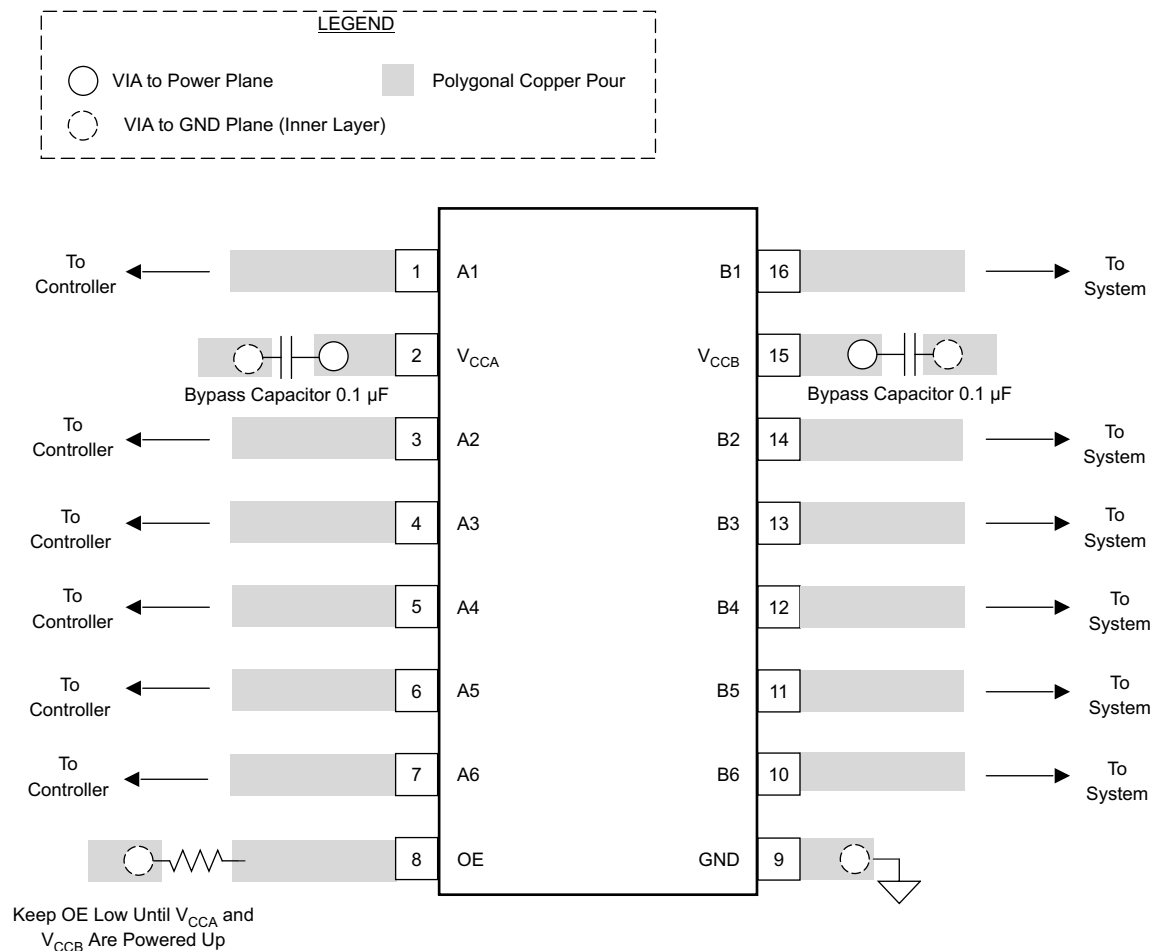
## 4 Layout

### 4.1 Layout Guidelines

To ensure reliability of the device, the following common printed-circuit board layout guidelines are recommended:

- Bypass capacitors should be used on power supplies, and should be placed as close as possible to the  $V_{CCA}$  and  $V_{CCB}$  pins and the GND pin
- Short trace-lengths should be used to avoid excessive loading.
- PCB signal trace-lengths must be kept short enough so that the round-trip delay of any reflection is less than the O.S. duration, approximately 10ns, ensuring that any reflection encounters low impedance at the source driver.

## 4.2 Layout Example



## 7 Device and Documentation Support

### 7.1 Third-Party Products Disclaimer

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### 7.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.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.

### 7.3 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.

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### 7.4 Trademarks

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### 7.5 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.

### 7.6 Glossary

[TI Glossary](#)

This glossary lists and explains terms, acronyms, and definitions.

## 8 Revision History

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

| Changes from Revision A (April 2018) to Revision B (August 2025) | Page |
|--|------|
| • Added Operating ambient temperature for TXB0106-Q1.....        | 5    |
| • Added BQB column in <a href="#">Section 5.4</a> .....          | 6    |
| • Added <a href="#">Section 5.6</a> for TXB0106Q1.....           | 7    |
| • Added <a href="#">Section 5.14</a> for TXB0106-Q1.....         | 9    |
| • Added <a href="#">Section 5.16</a> for TXB0106-Q1.....         | 10   |
| • Added <a href="#">Section 5.18</a> for TXB0106-Q1.....         | 11   |
| • Added <a href="#">Section 5.20</a> for TXB0106-Q1.....         | 12   |

| Changes from Revision * (August 2009) to Revision A (April 2018)  | Page |
|---|------|
| • Added <i>Applications</i> section, <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> section, <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    |
| • Changed the entry in the TYPE column from "—" to "I" for $V_{CCA}$ and $V_{CCB}$ .....  | 4    |
| • Added row for junction temperature to <i>Absolute Maximum Ratings</i> .....   | 5    |
| • Added parameter descriptions to <i>Electrical Characteristics</i> table .....   | 6    |
| • Added "-Q1" to the device name throughout the document.....   | 15   |
| • Changed I to $I_{CC}$ in <a href="#">Section 6.3.4</a> .....  | 17   |
| • Changed TXS01xx series to TXS family in <a href="#">Section 6.3.6</a> .....   | 17   |
| • Changed TXS010X to TXS in <a href="#">Section 7.1</a> .....   | 18   |
| • Clarified wording of sentences and added references to two application reports.....   | 19   |

| DATE        | REVISION | NOTES           |
|-------------|----------|-----------------|
| August 2009 | *        | Initial Release |

## 9 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 device. This data is subject to change without notice and without revision of this document. For browser-based versions of this data sheet, see the left-hand navigation pane.

## PACKAGING INFORMATION

| Orderable part number         | Status<br>(1) | Material type<br>(2) | Package   Pins  | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C)      | Part marking<br>(6) |
|-------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|-------------------|---------------------|
| <a href="#">TXB0106IPWRQ1</a> | Active        | Production           | TSSOP (PW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85         | YE06Q1              |
| TXB0106IPWRQ1.A               | Active        | Production           | null (null)     | 2000   LARGE T&R      | -           | NIPDAU                               | Level-1-260C-UNLIM                | See TXB0106IPWRQ1 | YE06Q1              |
| TXB0106IPWRQ1.B               | Active        | Production           | null (null)     | 2000   LARGE T&R      | -           | NIPDAU                               | Level-1-260C-UNLIM                | See TXB0106IPWRQ1 | YE06Q1              |

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

<sup>(2)</sup> **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.

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

<sup>(4)</sup> **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.

<sup>(5)</sup> **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.

<sup>(6)</sup> **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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### OTHER QUALIFIED VERSIONS OF TXB0106-Q1 :

- Catalog : [TXB0106](#)



NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

## TAPE AND REEL INFORMATION



\*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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TXB0106IPWRQ1 | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 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) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TXB0106IPWRQ1 | TSSOP        | PW              | 16   | 2000 | 353.0       | 353.0      | 32.0        |



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## 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



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.

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