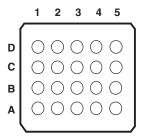
# 8-BIT BIDIRECTIONAL VOLTAGE-LEVEL TRANSLATOR FOR OPEN-DRAIN AND PUSH-PULL APPLICATIONS

#### **FEATURES**

- No Direction-Control Signal Needed
- Max Data Rates
  - 60 Mbps (Push Pull)
  - 2 Mbps (Open Drain)
- 1.2 V to 3.6 V on A Port and 1.65 V to 5.5 V on B Port (V<sub>CCA</sub> ≤ V<sub>CCB</sub>)
- No Power-Supply Sequencing Required Either V<sub>CCA</sub> or V<sub>CCB</sub> Can Be Ramped First
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22 (A Port)
  - 2000-V Human-Body Model (A114-B)
  - 150-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

- IEC 61000-4-2 ESD (B Port)
  - ±8-kV Contact Discharge
  - ±6-kV Air-Gap Discharge

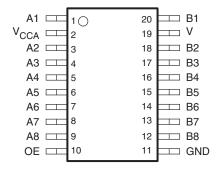
ZXY PACKAGE (BOTTOM VIEW)



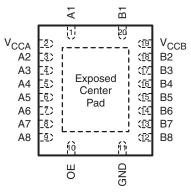
#### **TERMINAL ASSIGNMENTS**

|   | 1                | 2  | 3  | 4  | 5   |
|---|------------------|----|----|----|-----|
| D | V <sub>CCB</sub> | B2 | B4 | В6 | B8  |
| С | B1               | В3 | B5 | B7 | GND |
| В | A1               | А3 | A5 | A7 | OE  |
| Α | V <sub>CCA</sub> | A2 | A4 | A6 | A8  |

# PW PACKAGE (TOP VIEW)



# RGY PACKAGE (TOP VIEW)



The exposed center pad, if used, must be connected as a secondary ground or left electrically open.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



#### **DESCRIPTION/ORDERING INFORMATION**

This 8-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 1.2 V to 3.6 V. The B port is designed to track  $V_{CCB}$ .  $V_{CCB}$  accepts any supply voltage from 1.65 V to 5.5 V. This allows for low-voltage bidirectional translation between any of the 1.2-V, 1.5-V, 1.8-V, 2.5-V, 3.3-V, and 5-V voltage nodes.

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

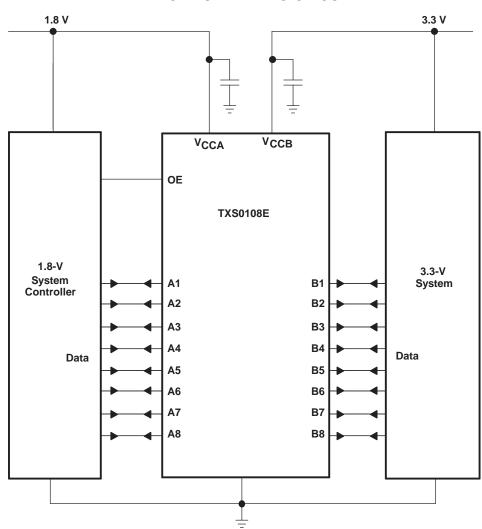
To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

#### **ORDERING INFORMATION**

| T <sub>A</sub> | PACKAGE <sup>(1)(2)</sup> |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|---------------------------|--------------|-----------------------|------------------|
|                | QFN – RGY                 | Reel of 1000 | TXS0108ERGYR          | YF08E            |
| -40°C to 85°C  | TSSOP – PW                | Reel of 2000 | TXS0108EPWR           | YF08E            |
|                | UFBGA – ZXY               | Reel of 2500 | TXS0108EZXYR          | YF08E            |

- (1) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
- (2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

#### TYPICAL OPERATING CIRCUIT



# ABSOLUTE MAXIMUM RATINGS(1)

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

|                  |   |                    | MIN  | MAX  | UNIT |
|------------------|---|--------------------|------|--|------|
| $V_{CCA}$        | Complex selfence and an   |                    | -0.5 | 4.6  | V    |
| $V_{CCB}$        | the high-impedance or power-off state <sup>(2)</sup> B port  A port  B port  B port  B port  B port |                    | -0.5 | 5.5  | V    |
| 1/               | Input voltage range (2)   | A port             | -0.5 | 4.6  | V    |
| VI               | input voltage range —   | B port             | -0.5 | 6.5  | V    |
| 1/               | Voltage range applied to any output   | A port             | -0.5 | 4.6  | V    |
| Vo               | in the high-impedance or power-off state (2)  | B port             | -0.5 | 5 5.5<br>5 4.6<br>5 6.5<br>5 4.6<br>5 6.5<br>5 V <sub>CCA</sub> + 0.5<br>5 V <sub>CCB</sub> + 0.5<br>-50<br>-50<br>±50<br>±100 | V    |
| \ /              | Valta and annual field to annual to the label and annual (2)(3)                                     | A port             | -0.5 | V <sub>CCA</sub> + 0.5   | V    |
| Vo               | voltage range applied to any output in the high or low state  | B port             | -0.5 | V <sub>CCB</sub> + 0.5   | V    |
| I <sub>IK</sub>  | Input clamp current   | V <sub>I</sub> < 0 |      | -50  | mA   |
| I <sub>OK</sub>  | Output clamp current  | V <sub>O</sub> < 0 |      | -50  | mA   |
| Io               | Continuous output current   |                    |      | ±50  | mA   |
|                  | Continuous current through V <sub>CCA</sub> , V <sub>CCB</sub> , or GND                             |                    |      | ±100   | mA   |
| T <sub>stg</sub> | Storage temperature range   |                    | -65  | 150  | °C   |

<sup>(1)</sup> Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

#### THERMAL IMPEDANCE RATINGS

|               |                           |                            |      | UNIT |
|---------------|---------------------------|----------------------------|------|------|
|               |                           | PW package <sup>(1)</sup>  | 70   |      |
| $\theta_{JA}$ | Package thermal impedance | RGY package (2)            | 80.9 | °C/W |
|               |                           | ZXY package <sup>(1)</sup> | 47   |      |

<sup>(1)</sup> The package thermal impedance is calculated in accordance with JESD 51-5.

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<sup>(2)</sup> The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

<sup>(3)</sup> The value of V<sub>CCA</sub> and V<sub>CCB</sub> are provided in the recommended operating conditions table.

<sup>(2)</sup> The package thermal impedance is calculated in accordance with JESD 51-7.



# **RECOMMENDED OPERATING CONDITIONS**(1)(2)

|                  |                                    |                                  | V <sub>CCA</sub> | V <sub>CCB</sub>  | MIN                     | MAX                     | UNIT |
|------------------|------------------------------------|----------------------------------|------------------|-------------------|-------------------------|-------------------------|------|
| $V_{CCA}$        | Supply voltage <sup>(3)</sup>      |                                  |                  |                   | 1.2                     | 3.6                     | V    |
| V <sub>CCB</sub> | Supply Voltage (7)                 |                                  |                  |                   | 1.65                    | 5.5                     | V    |
|                  |                                    | A-Port I/Os                      | 1.2 V to 1.95 V  | 1.65 V to 5.5 V   | V <sub>CCI</sub> - 0.2  | $V_{CCI}$               |      |
| V                | Lligh lovel input voltage          | A-POIL I/OS                      | 1.95 V to 3.6 V  | 1.65 V 10 5.5 V   | V <sub>CCI</sub> - 0.4  | $V_{CCI}$               | V    |
| V <sub>IH</sub>  | High-level input voltage           | B-Port I/Os                      | 1.2 V to 3.6 V   | 1.65 V to 5.5 V   | V <sub>CCI</sub> - 0.4  | $V_{CCI}$               | V    |
|                  |                                    | OE                               | 1.2 V 10 3.6 V   | 1.05 V 10 5.5 V   | V <sub>CCA</sub> × 0.65 | 5.5                     |      |
|                  |                                    | A-Port I/Os                      | 1.2 V to 1.95 V  | 1 65 \/ to 5 5 \/ | 0                       | 0.15                    |      |
| V                | Low lovel input voltage            | A-POIL I/OS                      | 1.95 V to 3.6 V  | 1.65 V to 5.5 V   | 0                       | 0.15                    | V    |
| $V_{IL}$         | Low-level input voltage            | B-Port I/Os                      | 4.0.1/40.0.1/    | 4.05.1/+- 5.5.1/  | 0                       | 0.15                    | V    |
|                  |                                    | OE                               | 1.2 V to 3.6 V   | 1.65 V to 5.5 V   | 0                       | V <sub>CCA</sub> × 0.35 |      |
|                  |                                    | A-Port I/Os<br>push-pull driving |                  |                   |                         |                         |      |
| Δt/Δν            | Input transition rise or fall rate | B-Port I/Os<br>push-pull driving | 1.2 V to 3.6 V   | 1.65 V to 5.5 V   |                         | 10                      | ns/V |
|                  |                                    | Control input                    |                  |                   |                         |                         |      |
| T <sub>A</sub>   | Operating free-air temperature     |                                  |                  |                   | -40                     | 85                      | °C   |

 $<sup>\</sup>begin{array}{lll} \hbox{(1)} & V_{CCI} \ \hbox{is the} \ V_{CC} \ \hbox{associated with the data input port.} \\ \hbox{(2)} & V_{CCO} \ \hbox{is the} \ V_{CC} \ \hbox{associated with the output port.} \\ \hbox{(3)} & V_{CCA} \ \hbox{must be less than or equal to} \ V_{CCB}, \ \hbox{and} \ V_{CCA} \ \hbox{must not exceed 3.6 V.} \\ \end{array}$ 

# ELECTRICAL CHARACTERISTICS (1)(2)(3)

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

| DA               | RAMETER        | TEST   | V                | V.               |     | $T_A = 25^{\circ}C$     |      | -40°C to 8              | 5°C  | UNIT |
|------------------|----------------|--|------------------|------------------|-----|-------------------------|------|-------------------------|------|------|
| PA               | RANETER        | CONDITIONS   | V <sub>CCA</sub> | V <sub>CCB</sub> | MIN | TYP                     | MAX  | MIN                     | MAX  | UNII |
| \/               |                | $I_{OH} = -20 \mu A$ ,                               | 1.2 V            | 1.65 V to 5.5 V  |     | V <sub>CCA</sub> × 0.67 |      |                         |      | V    |
| V <sub>OHA</sub> |                | $V_{IB} \ge V_{CCB} - 0.4 \text{ V}$                 | 1.4 V to 3.6 V   | 1.03 V to 3.3 V  |     |                         |      | $V_{CCA} \times 0.67$   |      | V    |
|                  |                | $I_{OL} = 135 \mu A,$<br>$V_{IB} \le 0.15 V$         | 1.2 V            |                  |     |                         | 0.25 |                         |      |      |
|                  |                | $I_{OL} = 180 \mu A,$<br>$V_{IB} \le 0.15 V$         | 1.4 V            |                  |     |                         |      |                         | 0.4  |      |
| $V_{OLA}$        |                | $I_{OL} = 220 \mu A,$<br>$V_{IB} \le 0.15 \text{ V}$ | 1.65 V           | 1.65 V to 5.5 V  |     |                         |      |                         | 0.4  | V    |
|                  |                | $I_{OL} = 300 \mu A,$<br>$V_{IB} \le 0.15 \text{ V}$ | 2.3 V            |                  |     |                         |      |                         | 0.4  |      |
|                  |                | $I_{OL} = 400 \mu A,$<br>$V_{IB} \le 0.15 V$         | 3 V              |                  |     |                         |      |                         | 0.55 |      |
| V <sub>OHB</sub> |                | $I_{OH} = -20 \mu A$ ,                               | 1.2 V            | 1.65 V to 5.5 V  |     |                         |      |                         |      | V    |
| * OHB            |                | $V_{IA} \ge V_{CCA} - 0.2 \text{ V}$                 | 1.4 V to 3.6 V   | 1.00 1 10 0.0 1  |     |                         |      | V <sub>CCB</sub> × 0.67 |      | v    |
|                  |                | $I_{OL} = 220 \mu A,$<br>$V_{IA} \le 0.15 \text{ V}$ |                  | 1.65 V           |     |                         |      |                         | 0.4  |      |
| V <sub>OLB</sub> |                | $I_{OL} = 300 \ \mu A,$<br>$V_{IA} \le 0.15 \ V$     | 1.2 V to 3.6 V   | 2.3 V            |     |                         |      |                         | 0.4  | V    |
| VOLB             |                | $I_{OL} = 400 \mu A,$<br>$V_{IA} \le 0.15 \text{ V}$ | 1.2 V to 3.0 V   | 3 V              |     |                         |      |                         | 0.55 | V    |
|                  |                | $I_{OL} = 620 \mu A,$<br>$V_{IA} \le 0.15 \text{ V}$ |                  | 4.5 V            |     |                         |      |                         | 0.55 |      |
| l <sub>l</sub>   | OE             | $V_I = V_{CCI}$ or GND                               | 1.2 V            | 1.65 V to 5.5 V  |     |                         | ±1   |                         | 2    | μΑ   |
| oz               | A or<br>B port |  | 1.2 V            | 1.65 V to 5.5 V  |     |                         | ±1   |                         | ±2   | μΑ   |
|                  |                |  | 1.2 V            | 1.65 V to 5.5 V  |     | 1.5                     |      |                         | ±2   |      |
|                  |                | $V_I = V_O = Open,$                                  | 1.4 V to 3.6 V   | 2.3 V to 5.5 V   |     |                         |      |                         | 2    | μА   |
| CCA              |                | $I_0 = 0$  | 3.6 V            | 0 V              |     |                         |      |                         | 2    | μΛ   |
|                  |                |  | 0 V              | 5.5 V            |     |                         |      |                         | -1   |      |
|                  |                |  | 1.2 V            | 1.65 V to 5.5 V  |     | 1.5                     |      |                         |      |      |
|                  |                | $V_I = V_O = Open,$                                  | 1.4 V to 3.6 V   | 2.3 V to 5.5 V   |     |                         |      |                         | 6    |      |
| CCB              |                | $I_{O} = 0$  | 3.6 V            | 0 V              |     |                         |      |                         | -1   | μΑ   |
|                  |                |  | 0 V              | 5.5 V            |     |                         |      |                         | 1    |      |
|                  | 1              | $V_I = V_{CCI}$ or GND,                              | 1.2 V            | 2.3 V to 5.5 V   |     | 3                       |      |                         |      |      |
| CCA +            | ICCB           | $I_{O} = 0$  | 1.4 V to 3.6 V   | 2.3 V 10 5.5 V   |     |                         |      |                         | 8    | μΑ   |
|                  |                | $V_I = V_O = Open,$                                  | 1.2 V            | 4.05.1/4- 5.5.1/ |     | 0.05                    |      |                         |      |      |
| CCZA             |                | $I_0 = 0$ , OE = GND                                 | 1.4 V to 3.6 V   | 1.65 V to 5.5 V  |     |                         |      |                         | 2    | μА   |
|                  |                | $V_I = V_O = Open,$                                  | 1.2 V            | 4.05.1/: 5.5.1   |     | 4                       |      |                         |      |      |
| CCZB             |                | $I_O = 0$ , OE = GND                                 | 1.4 V to 3.6 V   | 1.65 V to 5.5 V  |     |                         |      |                         | 6    | μΑ   |
| C <sub>i</sub>   | OE             |  | 3.3 V            | 3.3 V            |     | 4.5                     |      |                         | 5.5  | pF   |
|                  | A port         |  | 0.01/            | 2.21/            |     | 6                       |      |                         | 7    |      |
| $C_{io}$         | B port         |  | 3.3 V            | 3.3 V            |     | 5.5                     |      |                         | 6    | pF   |

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 $<sup>\</sup>begin{array}{ll} \text{(1)} & \text{$V_{\text{CCO}}$ is the $V_{\text{CC}}$ associated with the output port.} \\ \text{(2)} & \text{$V_{\text{CCI}}$ is the $V_{\text{CC}}$ associated with the input port.} \\ \text{(3)} & \text{$V_{\text{CCA}}$ must be less than or equal to $V_{\text{CCB}}$, and $V_{\text{CCA}}$ must not exceed 3.6 V.} \\ \end{array}$ 



#### **TIMING REQUIREMENTS**

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

|                |                   |                    |             | V <sub>CCB</sub> = 1.8 V | V <sub>CCB</sub> = 2.5 V | V <sub>CCB</sub> = 3.3 V | V <sub>CCB</sub> = 5 V | LINUT |
|----------------|-------------------|--------------------|-------------|--------------------------|--------------------------|--------------------------|------------------------|-------|
|                |                   |                    |             | TYP                      | TYP                      | TYP                      | TYP                    | UNII  |
|                | Push-pull driving |                    |             | 20                       | 20                       | 20                       | 20                     | Mbna  |
|                | Data fate         | Open-drain driving |             | 2                        | 2                        | 2                        | TYP TYP  20 20 Mbps    |       |
|                | Push-pull driving |                    | Data innuta | 50                       | 50                       | 50                       | 50                     | 20    |
| ı <sub>w</sub> | Pulse duration    | Open-drain driving | Data inputs | 500                      | 500                      | 500                      | 500                    | ns    |

#### **TIMING REQUIREMENTS**

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

|                |                |                    |             | V <sub>CCB</sub> = ± 0.1 |     | V <sub>CCB</sub> = ± 0.2 |     | V <sub>CCB</sub> =<br>± 0.3 |     | V <sub>CCB</sub> =<br>± 0.5 |     | UNIT   |
|----------------|----------------|--------------------|-------------|--------------------------|-----|--------------------------|-----|-----------------------------|-----|-----------------------------|-----|--------|
|                |                |                    |             | MIN                      | MAX | MIN                      | MAX | MIN                         | MAX | MIN                         | MAX |        |
|                | Data rate      | Push-pull driving  |             |                          | 40  |                          | 60  |                             | 60  |                             | 50  | Mbps   |
|                |                | Open-drain driving |             |                          | 2   |                          | 2   |                             | 2   |                             | 2   | IVIDPS |
| t <sub>w</sub> | Dulas duration | Push-pull driving  | Data innuta | 25                       |     | 16.7                     |     | 16.7                        |     | 20                          |     | 20     |
|                | Pulse duration | Open-drain driving | Data inputs | 500                      |     | 500                      |     | 500                         |     | 500                         |     | ns     |

#### TIMING REQUIREMENTS

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

|         |                             |                    |             | V <sub>CCB</sub> = 0.15 | 1.8 V<br>5 V | V <sub>CCB</sub> = 2<br>± 0.2 |     | V <sub>CCB</sub> = 3<br>± 0.3 |     | V <sub>CCB</sub> = 5 V<br>± 0.5 V |      | UNIT |
|---------|-----------------------------|--------------------|-------------|-------------------------|--------------|-------------------------------|-----|-------------------------------|-----|-----------------------------------|------|------|
|         |                             |                    |             | MIN                     | MAX          | MIN                           | MAX | MIN                           | MAX | MIN                               | MAX  |      |
|         | Data rate Push-pull driving |                    |             | 40                      |              | 60                            |     | 60                            |     | 60                                | Mbps |      |
|         |                             | Open-drain driving |             |                         | 2            |                               | 2   |                               | 2   |                                   | 2    | MDPS |
| $t_{w}$ | Pulse duration              | Push-pull driving  | Data innuta | 25                      |              | 16.7                          |     | 16.7                          |     | 16.7                              |      | 20   |
|         | Pulse duration              | Open-drain driving | Data inputs | 500                     |              | 500                           |     | 500                           |     | 500                               |      | ns   |

#### **TIMING REQUIREMENTS**

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

|                |                |                                      |             | V <sub>CCB</sub> = 2<br>± 0.2 \ |     | V <sub>CCB</sub> = 3<br>± 0.3 |     | V <sub>CC</sub> = 9<br>± 0.5 |     | UNIT  |
|----------------|----------------|--------------------------------------|-------------|---------------------------------|-----|-------------------------------|-----|------------------------------|-----|-------|
|                |                |                                      |             | MIN                             | MAX | MIN                           | MAX | MIN                          | MAX |       |
|                | Data rata      | Push-pull driving                    |             |                                 | 60  |                               | 60  |                              | 60  | Maria |
|                | Data rate      | Open-drain driving                   |             |                                 | 2   |                               | 2   |                              | 2   | Mbps  |
|                | Dulas duration | Push-pull driving                    | Data inputa | 16.7                            |     | 16.7                          |     | 16.7                         |     | 20    |
| ι <sub>w</sub> | Pulse duration | Open-drain driving  Data inputs  500 |             |                                 | 500 |                               | 500 |                              | ns  |       |

#### **TIMING REQUIREMENTS**

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

|                |   |                    |               | V <sub>CCB</sub> = 3<br>± 0.3 |     | V <sub>CC</sub> = 5<br>± 0.5 |     | UNIT   |
|----------------|---|--------------------|---------------|-------------------------------|-----|------------------------------|-----|--------|
|                |   |                    |               | MIN                           | MAX | MIN                          | MAX |        |
|                | Push-pull driving                           |                    |               |                               | 60  |                              | 60  | Mbps   |
|                | Data fate                                   | Open-drain driving |               |                               | 2   |                              | 2   | IVIDPS |
|                | Dulas duration                              | Push-pull driving  | -pull driving |                               |     | 16.7                         |     | 20     |
| ı <sub>w</sub> | t <sub>w</sub> Pulse duration Open-drain dr | Open-drain driving | Data inputs   | 500                           |     | 500                          |     | ns     |

# **SWITCHING CHARACTERISTICS**

over recommended operating free-air temperature range,  $V_{CCA} = 1.2 \text{ V}$  (unless otherwise noted)

| PARAMETER          | FROM<br>(INPUT) | TO<br>(OUTPUT)        | TEST<br>CONDITIONS | V <sub>CCB</sub> = 1.8 V<br>± 0.15 V | V <sub>CCB</sub> = 2.5 V<br>± 0.2 V | V <sub>CCB</sub> = 3.3 V<br>± 0.3 V | V <sub>CCB</sub> = 5 V<br>± 0.5 V  | UNIT |
|--------------------|-----------------|-----------------------|--------------------|--------------------------------------|-------------------------------------|-------------------------------------|--|------|
|                    | (INPUT)         | (001701)              | CONDITIONS         | TYP                                  | TYP                                 | TYP                                 | ± 0.5 V  TYP  5.5  11.1  6.6  152  5.6  5.9  3.2  132  200  13.5  6.4  127  1.5  60  3.8  3.5  1.9  1.9  1 |      |
|                    |                 |                       | Push-pull driving  | 6.5                                  | 5.9                                 | 5.7                                 | 5.5  |      |
| t <sub>PHL</sub>   | Α               | В                     | Open-drain driving | 11.9                                 | 11.1                                | 11.0                                | 11.1   |      |
| 4                  | A               | Б                     | Push-pull driving  | 7.1                                  | 6.3                                 | 6.2                                 | 6.6  | ns   |
| t <sub>PLH</sub>   |                 |                       | Open-drain driving | 293                                  | 236                                 | 197                                 | 152  |      |
|                    |                 |                       | Push-pull driving  | 6.4                                  | 6                                   | 5.8                                 | 5.6  |      |
| t <sub>PHL</sub>   | В               | A                     | Open-drain driving | 8.5                                  | 6.8                                 | 6.2                                 | 5.9  |      |
|                    | В               | A                     | Push-pull driving  | 5.6                                  | 4.1                                 | 3.6                                 | 3.2  | ns   |
| t <sub>PLH</sub>   |                 |                       | Open-drain driving | 312                                  | 248                                 | 192                                 | 132  |      |
| t <sub>en</sub>    | OE              | A or B                | Push-pull driving  | 200                                  | 200                                 | 200                                 | 200  | ns   |
| t <sub>dis</sub>   | OE              | A or B                | Push-pull driving  | 16.8                                 | 13.9                                | 13.2                                | 13.5   | ns   |
|                    | A nor           | t rice time           | Push-pull driving  | 7.9                                  | 6.7                                 | 6.5                                 | 6.4  | 20   |
| $t_{rA}$           | A-por           | t rise time           | Open-drain driving | 296                                  | 238                                 | 185                                 | 127  | ns   |
|                    | P nor           | t rise time           | Push-pull driving  | 6.3                                  | 3.3                                 | 1.8                                 | 1.5  | 20   |
| $t_{rB}$           | Б-рог           | t rise time           | Open-drain driving | 236                                  | 164                                 | 115                                 | 60   | ns   |
|                    | A 200           | rt fall time          | Push-pull driving  | 5.8                                  | 4.8                                 | 4.3                                 | 3.8  |      |
| $t_fA$             | А-ро            | it iall lille         | Open-drain driving | 5.9                                  | 4.7                                 | 4.1                                 | 3.5  | 20   |
|                    | Pino            | rt fall time          | Push-pull driving  | 4.6                                  | 2.8                                 | 2.2                                 | 1.9  | ns   |
| $t_fB$             | <b>Б-</b> роі   | it iall lille         | Open-drain driving | 4.5                                  | 2.7                                 | 2.2                                 | 1.9  |      |
| t <sub>SK(O)</sub> |                 | el-to-channel<br>skew | Push-pull driving  | 1                                    | 1                                   | 1                                   | 1  | ns   |
| May data rete      | ,               | l or D                | Push-pull driving  | 20                                   | 20                                  | 20                                  | 20   | Mbn- |
| Max data rate      |                 | A or B                | Open-drain driving | 2                                    | 2                                   | 2                                   | 2  | Mbps |

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# **SWITCHING CHARACTERISTICS**

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

| PARAMETER          | FROM<br>(INPUT)  | TO<br>(OUTPUT)     | TEST<br>CONDITIONS | V <sub>CCB</sub> = ± 0.15 |      | V <sub>CCB</sub> = ± 0.2 |      | V <sub>CCB</sub> = 3<br>± 0.3 |      | V <sub>CCB</sub> = ± 0.5 |      | UNIT |  |
|--------------------|------------------|--------------------|--------------------|---------------------------|------|--------------------------|------|-------------------------------|------|--------------------------|------|------|--|
|                    | (INFUT)          | (001701)           | CONDITIONS         | MIN                       | MAX  | MIN                      | MAX  | MIN                           | MAX  | MIN                      | MAX  |      |  |
|                    |                  |                    | Push-pull driving  |                           | 11   |                          | 9.2  |                               | 8.6  |                          | 8.6  |      |  |
| t <sub>PHL</sub>   | ٨                | В                  | Open-drain driving | 4                         | 14.4 | 3.6                      | 12.8 | 3.5                           | 12.2 | 3.5                      | 12   | ns   |  |
|                    | Α                | Ь                  | Push-pull driving  |                           | 12   |                          | 10   |                               | 9.8  |                          | 9.7  | 115  |  |
| t <sub>PLH</sub>   |                  |                    | Open-drain driving | 182                       | 720  | 143                      | 554  | 114                           | 473  | 81                       | 384  |      |  |
|                    |                  |                    | Push-pull driving  |                           | 12.7 |                          | 11.1 |                               | 11   |                          | 12   |      |  |
| t <sub>PHL</sub>   | В                | Α                  | Open-drain driving | 3.4                       | 13.2 | 3.1                      | 9.6  | 2.8                           | 8.5  | 2.5                      | 7.5  |      |  |
|                    | Б                | A                  | Push-pull driving  |                           | 9.5  |                          | 6.2  |                               | 5.1  |                          | 1.6  | ns   |  |
| t <sub>PLH</sub>   |                  |                    | Open-drain driving | 186                       | 745  | 147                      | 603  | 118                           | 519  | 84                       | 407  |      |  |
| t <sub>en</sub>    | OE               | A or B             | Push-pull driving  |                           | 200  |                          | 200  |                               | 200  |                          | 200  | ns   |  |
| t <sub>dis</sub>   | OE               | A or B             | Push-pull anving   |                           | 28.1 |                          | 22   |                               | 20.1 |                          | 19.6 | ns   |  |
|                    | A nort           | riaa tima          | Push-pull driving  | 3.5                       | 13.1 | 3                        | 9.8  | 3.1                           | 9    | 3.2                      | 8.3  |      |  |
| t <sub>rA</sub>    | A-port rise time |                    | Open-drain driving | 147                       | 982  | 115                      | 716  | 92                            | 592  | 66                       | 481  | ns   |  |
|                    | P port           | rise time          | Push-pull driving  | 2.9                       | 11.4 | 1.9                      | 7.4  | 0.9                           | 4.7  | 0.7                      | 2.6  | ns   |  |
| t <sub>rB</sub>    | Б-роп            | lise unie          | Open-drain driving | 135                       | 1020 | 91                       | 756  | 58                            | 653  | 20                       | 370  | 115  |  |
|                    | A nom            | t fall time        | Push-pull driving  | 2.3                       | 9.9  | 1.7                      | 7.7  | 1.6                           | 6.8  | 1.7                      | 6    |      |  |
| $t_fA$             | A-por            | t fall time        | Open-drain driving | 2.4                       | 10   | 2.1                      | 7.9  | 1.7                           | 7    | 1.5                      | 6.2  | no   |  |
| 4                  | Phon             | t fall time        | Push-pull driving  | 2                         | 8.7  | 1.3                      | 5.5  | 0.9                           | 3.8  | 0.8                      | 3.1  | ns   |  |
| t <sub>fB</sub>    | <b>Б-</b> рог    | ı iali tillie      | Open-drain driving | 1.2                       | 11.5 | 1.3                      | 8.6  | 1                             | 9.6  | 0.5                      | 7.7  |      |  |
| t <sub>SK(O)</sub> |                  | -to-channel<br>kew | Push-pull driving  |                           | 1    | 1                        | 1    |                               | 1.1  |                          | 1    | ns   |  |
| Max data rate      | ^                | or P               | Push-pull driving  | 40                        |      | 60                       |      | 60                            |      | 50                       |      | Mb   |  |
| iviax data rate    | А                | or B               | Open-drain driving | 2                         |      | 2                        |      | 2                             |      | 2                        |      | s    |  |

# **SWITCHING CHARACTERISTICS**

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

| PARAMETER          | FROM             | то            | TEST               | V <sub>CCB</sub> = 1<br>± 0.15 |      | V <sub>CCB</sub> = 2<br>± 0.2 |      | V <sub>CCB</sub> = ± 0.3 |      | V <sub>CCB</sub> = ± 0.5 | 5 V<br>V | UNIT    |  |
|--------------------|------------------|---------------|--------------------|--------------------------------|------|-------------------------------|------|--------------------------|------|--------------------------|----------|---------|--|
| PARAMETER          | (INPUT)          | (OUTPUT)      | CONDITIONS         | MIN                            | MAX  | MIN                           | MAX  | MIN                      | MAX  | MIN                      | MA<br>X  | UNIT    |  |
|                    |                  |               | Push-pull driving  |                                | 8.2  |                               | 6.4  |                          | 5.7  |                          | 5.6      |         |  |
| t <sub>PHL</sub>   | A                | В             | Open-drain driving | 3.6                            | 11.4 | 3.2                           | 9.9  | 3.1                      | 9.3  | 3.1                      | 8.9      |         |  |
|                    | A                | Б             | Push-pull driving  |                                | 9    |                               | 2.1  |                          | 6.5  |                          | 6.3      | ns      |  |
| t <sub>PLH</sub>   |                  |               | Open-drain driving | 194                            | 729  | 155                           | 584  | 126                      | 466  | 90                       | 346      |         |  |
|                    |                  |               | Push-pull driving  |                                | 9.8  |                               | 8    |                          | 7.4  |                          | 7        |         |  |
| t <sub>PHL</sub>   | D                | ٨             | Open-drain driving | 3.4                            | 12.1 | 2.8                           | 8.5  | 2.5                      | 7.3  | 2.1                      | 6.2      |         |  |
|                    | B A              |               | Push-pull driving  |                                | 10.2 |                               | 7    |                          | 5.8  |                          | 5        | ns      |  |
| t <sub>PLH</sub>   |                  |               | Open-drain driving | 197                            | 733  | 159                           | 578  | 129                      | 459  | 93                       | 323      |         |  |
| t <sub>en</sub>    | OE               | A or B        | Push-pull driving  |                                | 200  |                               | 200  |                          | 200  |                          | 200      | ns      |  |
| t <sub>dis</sub>   | OE               | A or B        | Push-pull driving  |                                | 25.1 |                               | 18.8 |                          | 16.5 |                          | 15.3     | ns      |  |
|                    | A-port rise time |               | Push-pull driving  | 3.1                            | 11.9 | 2.6                           | 8.6  | 2.7                      | 7.8  | 2.8                      | 7.2      |         |  |
| t <sub>rA</sub>    | A-pon            | rise time     | Open-drain driving | 155                            | 996  | 124                           | 691  | 100                      | 508  | 72                       | 350      | ns<br>0 |  |
|                    | D                | -141          | Push-pull driving  | 2.8                            | 10.5 | 1.8                           | 7.2  | 1.2                      | 5.2  | 0.7                      | 2.7      |         |  |
| t <sub>rB</sub>    | B-pon            | rise time     | Open-drain driving | 132                            | 1001 | 106                           | 677  | 73                       | 546  | 32                       | 323      | ns      |  |
|                    | A nor            | t fall time   | Push-pull driving  | 2.1                            | 8.8  | 1.6                           | 6.6  | 1.4                      | 5.7  | 1.4                      | 4.9      |         |  |
| t <sub>fA</sub>    | A-por            | t fall time   | Open-drain driving | 2.2                            | 9    | 1.7                           | 6.7  | 1.4                      | 5.8  | 1.2                      | 5.2      |         |  |
|                    | D                | t fall time   | Push-pull driving  | 2                              | 8.3  | 1.3                           | 5.4  | 0.9                      | 3.9  | 0.7                      | 3        | ns      |  |
| t <sub>fB</sub>    | B-por            | t fall time   | Open-drain driving | 0.8                            | 10.5 | 0.7                           | 10.7 | 1                        | 9.6  | 0.6                      | 7.8      |         |  |
| t <sub>SK(O)</sub> | Channel-to       | -channel skew | Push-pull driving  |                                | 1    |                               | 1    |                          | 1    |                          | 1        | ns      |  |
| May data ret-      |                  | or D          | Push-pull driving  | 40                             |      | 60                            |      | 60                       |      | 60                       |          | Mhna    |  |
| Max data rate      | A                | or B          | Open-drain driving | 2                              |      | 2                             |      | 2                        |      | 2                        |          | Mbps    |  |



# **SWITCHING CHARACTERISTICS**

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

| PARAMETER          | FROM<br>(INPUT)  | TO<br>(OUTPUT)     | TEST<br>CONDITIONS | V <sub>CCB</sub> = 2<br>± 0.2 |      | V <sub>CCB</sub> = 3<br>± 0.3 |      | V <sub>CCB</sub> = ± 0.5 |      | UNIT |  |
|--------------------|------------------|--------------------|--------------------|-------------------------------|------|-------------------------------|------|--------------------------|------|------|--|
|                    | (INFUT)          | (001701)           | CONDITIONS         | MIN                           | MAX  | MIN                           | MAX  | MIN                      | MAX  |      |  |
|                    |                  |                    | Push-pull driving  |                               | 5    |                               | 4    |                          | 3.7  |      |  |
| t <sub>PHL</sub>   | Α                | В                  | Open-drain driving | 2.4                           | 6.9  | 2.3                           | 6.3  | 2.2                      | 5.8  | ns   |  |
|                    | Λ   Β            |                    | Push-pull driving  |                               | 5.2  |                               | 4.3  |                          | 3.9  | 113  |  |
| t <sub>PLH</sub>   |                  |                    | Open-drain driving | 149                           | 592  | 125                           | 488  | 93                       | 368  |      |  |
|                    |                  |                    | Push-pull driving  |                               | 5.4  |                               | 4.7  |                          | 4.2  |      |  |
| t <sub>PHL</sub>   | В А              | Open-drain driving | 2.5                | 7.3                           | 2.2  | 6                             | 1.8  | 4.9                      |      |      |  |
|                    |                  | A                  | Push-pull driving  |                               | 5.9  |                               | 4.4  |                          | 3.5  | ns   |  |
| t <sub>PLH</sub>   |                  |                    | Open-drain driving | 150                           | 595  | 126                           | 481  | 94                       | 345  |      |  |
| t <sub>en</sub>    | OE               | A or B             | Duch hull driving  |                               | 200  |                               | 200  |                          | 200  | ns   |  |
| t <sub>dis</sub>   | OE               | A or B             | Push-pull driving  |                               | 15.7 |                               | 12.9 |                          | 11.2 | ns   |  |
|                    | A-port rise time |                    | Push-pull driving  | 2                             | 7.3  | 2.1                           | 6.4  | 2.2                      | 5.8  |      |  |
| t <sub>rA</sub>    | А-рог            | t rise time        | Open-drain driving | 110                           | 692  | 93                            | 529  | 68                       | 369  | ns   |  |
|                    | Dinar            | t riag time        | Push-pull driving  | 1.8                           | 6.5  | 1.3                           | 5.1  | 0.7                      | 3.4  |      |  |
| t <sub>rB</sub>    | Б-рог            | t rise time        | Open-drain driving | 107                           | 693  | 79                            | 483  | 41                       | 304  | ns   |  |
|                    | Λ 200            | rt fall time       | Push-pull driving  | 1.5                           | 5.7  | 1.2                           | 4.7  | 1.3                      | 3.8  |      |  |
| t <sub>fA</sub>    | A-poi            | rt fall time       | Open-drain driving | 1.5                           | 5.6  | 1.2                           | 4.7  | 1.1                      | 4    |      |  |
|                    | D no             | rt fall time       | Push-pull driving  | 1.4                           | 5.4  | 0.9                           | 4.1  | 0.7                      | 3    | ns   |  |
| t <sub>fB</sub>    | <b>D-</b> poi    | rt fall time       | Open-drain driving | 0.4                           | 14.2 | 0.5                           | 19.4 | 0.4                      | 3    |      |  |
| t <sub>SK(O)</sub> | Channel-to       | o-channel skew     | Push-pull driving  |                               | 1    |                               | 1.2  |                          | 1    | ns   |  |
| Many data as t     | ,                | D                  | Push-pull driving  | 60                            |      | 60                            |      | 60                       |      | Mhma |  |
| Max data rate      | F                | A or B             | Open-drain driving | 2                             |      | 2                             |      | 2                        |      | Mbps |  |

#### **SWITCHING CHARACTERISTICS**

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

| PARAMETER          | FROM        | TO            | TEST                  | V <sub>CCB</sub> = 3<br>± 0.3 | 3.3 V<br>V | V <sub>CCB</sub> = ± 0.5 | 5 V<br>V | UNIT |  |
|--------------------|-------------|---------------|-----------------------|-------------------------------|------------|--------------------------|----------|------|--|
|                    | (INPUT)     | (OUTPUT)      | CONDITIONS            | MIN                           | MAX        | MIN                      | MAX      |      |  |
|                    |             |               | Push-pull driving     |                               | 3.8        |                          | 3.1      |      |  |
| t <sub>PHL</sub>   | ^           | Б             | Open-drain driving    | 2                             | 5.3        | 1.9                      | 4.8      |      |  |
|                    | Α           | В             | Push-pull driving     |                               | 3.9        |                          | 3.5      | ns   |  |
| t <sub>PLH</sub>   |             |               | Open-drain driving    | 111                           | 439        | 87                       | 352      |      |  |
|                    |             |               | Push-pull driving     |                               | 4.2        |                          | 3.8      |      |  |
| t <sub>PHL</sub>   | В           |               | Open-drain driving    | 2.1                           | 5.5        | 1.7                      | 4.5      |      |  |
|                    | В           | Α             | Push-pull driving     |                               | 3.8        |                          | 4.3      | ns   |  |
| t <sub>PLH</sub>   |             |               | Open-drain driving    | 112                           | 449        | 86                       | 339      |      |  |
| t <sub>en</sub>    | OE          | A or B        | Durah multi dati da a |                               | 200        |                          | 200      | ns   |  |
| t <sub>dis</sub>   | OE          | A or B        | Push-pull driving     |                               | 11.9       |                          | 9.8      | ns   |  |
| 4                  | A at        | win n 4:      | Push-pull driving     | 1.8                           | 5.7        | 1.9                      | 5        |      |  |
| t <sub>rA</sub>    | А-роп       | rise time     | Open-drain driving    | 75                            | 446        | 57                       | 337      | ns   |  |
| 4                  | D = ===     | win n 4imm n  | Push-pull driving     | 1.5                           | 5          | 1                        | 3.6      |      |  |
| t <sub>rB</sub>    | в-роп       | rise time     | Open-drain driving    | 72                            | 427        | 40                       | 290      | ns   |  |
| 4                  | Δ           | t fall time a | Push-pull driving     | 1.2                           | 4.5        | 1.1                      | 3.5      |      |  |
| t <sub>fA</sub>    | A-pon       | t fall time   | Open-drain driving    | 1.1                           | 4.4        | 1                        | 3.7      |      |  |
| 4                  | D           | t fall time a | Push-pull driving     | 1.1                           | 4.2        | 0.8                      | 3.1      | ns   |  |
| t <sub>fB</sub>    | в-роп       | t fall time   | Open-drain driving    | 1                             | 4.2        | 0.8                      | 3.1      |      |  |
| t <sub>SK(O)</sub> | Channel-to- | -channel skew | Push-pull driving     |                               | 1          |                          | 1        | ns   |  |
|                    | Δ.          | D             | Push-pull driving     | 60                            |            | 60                       |          | Mana |  |
| Max data rate      | A or B      |               | Open-drain driving    | 2                             |            | 2                        |          | Mbps |  |

#### **OPERATING CHARACTERISTICS**

 $T_A=25$ °C

|                  |                                |  |                  |       |       | V <sub>CCA</sub> |       |       |              |     |  |  |
|------------------|--------------------------------|--|------------------|-------|-------|------------------|-------|-------|--------------|-----|--|--|
|                  |                                |  | 1.2 V            | 1.2 V | 1.5 V | 1.8 V            | 2.5 V | 2.5 V | 3.3 V        |     |  |  |
|                  | PARAMETER                      | TEST CONDITIONS  | V <sub>CCB</sub> |       |       |                  |       |       |              |     |  |  |
|                  |                                |  | 5 V              | 1.8 V | 1.8 V | 1.8 V            | 2.5 V | 5 V   | 3.3 V to 5 V |     |  |  |
|                  |                                |  | TYP              | TYP   | TYP   | TYP              | TYP   | TYP   | TYP          |     |  |  |
| <u> </u>         | A-port input,<br>B-port output |  | 5.9              | 5.7   | 5.9   | 5.9              | 6.7   | 6.9   | 8            |     |  |  |
| C <sub>pdA</sub> | B-port input,<br>A-port output | $C_L = 0, f = 10 \text{ MHz}, t_r = t_r = 1 \text{ ns},$ | 10.2             | 10.3  | 9.9   | 9.7              | 9.7   | 9.4   | 9.8          | n.E |  |  |
| 0                | A-port input,<br>B-port output | OE = V <sub>CCA</sub> (outputs enabled)                  | 29.9             | 22.2  | 21.5  | 20.8             | 21    | 23.4  | 23           | pF  |  |  |
| C <sub>pdB</sub> | B-port input,<br>A-port output |  | 22.9             | 16.7  | 16.7  | 16.8             | 17.8  | 20.8  | 20.9         |     |  |  |
|                  | A-port input,<br>B-port output |  | 0.01             | 0.01  | 0.01  | 0.01             | 0.01  | 0.01  | 0.01         |     |  |  |
| C <sub>pdA</sub> | B-port input,<br>A-port output | $C_L = 0, f = 10 \text{ MHz}, t_f = t_f = 1 \text{ ns},$ | 0.06             | 0.01  | 0.01  | 0.01             | 0.01  | 0.01  | 0.01         | n.E |  |  |
| _                | A-port input,<br>B-port output | OE = GND (outputs disabled)                              | 0.06             | 0.01  | 0.01  | 0.01             | 0.01  | 0.03  | 0.02         | pF  |  |  |
| C <sub>pdB</sub> | B-port input,<br>A-port output |  | 0.06             | 0.01  | 0.01  | 0.01             | 0.01  | 0.03  | 0.02         |     |  |  |

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#### PRINCIPLES OF OPERATION

#### **Applications**

The TXS0108E can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The TXS0108E is ideal for use in applications where an open-drain driver is connected to the data I/Os. The TXS0108E can also be used in applications where a push-pull driver is connected to the data I/Os, but the TXB0104 might be a better option for such push-pull applications. The TXS0108E device is a semi-buffered auto-direction-sensing voltage translator design is optimized for translation applications (e.g. MMC Card Interfaces) that require the system to start out in a low-speed open-drain mode and then switch to a higher speed push-pull mode.

#### **Architecture**

To address these application requirements, a semi-buffered architecture design is used and is illustrated below (see Figure 1). Edge-rate accelerator circuitry (for both the high-to-low and low-to-high edges), a High-Ron n-channel pass-gate transistor (on the order of 300  $\Omega$  to 500  $\Omega$ ) and pull-up resistors (to provide DC-bias and drive capabilities) are included to realize this solution. A direction-control signal (to control the direction of data flow from A to B or from B to A) is not needed. The resulting implementation supports both low-speed open-drain operation as well as high-speed push-pull operation.

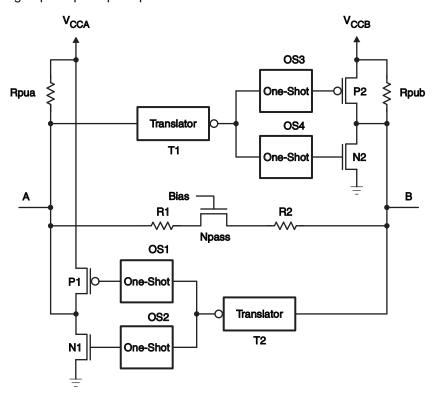


Figure 1. Architecture of a TXS01xx Cell

When transmitting data from A to B ports, during a rising edge the One-Shot (OS3) turns on the PMOS transistor (P2) for a short-duration and this speeds up the low-to-high transition. Similarly, during a falling edge, when transmitting data from A to B, the One-Shot (OS4) turns on NMOS transistor (N2) for a short-duration and this speeds up the high-to-low transition. The B-port edge-rate accelerator consists of one-shots OS3 and OS4, Transistors P2 and N2 and serves to rapidly force the B port high or low when a corresponding transition is detected on the A port.

When transmitting data from B to A ports, during a rising edge the One-Shot (OS1) turns on the PMOS transistor

(P1) for a short-duration and this speeds up the low-to-high transition. Similarly, during a falling edge, when transmitting data from B to A, the One-Shot (OS2) turns on NMOS transistor (N1) for a short-duration and this speeds up the high-to-low transition. The A-port edge-rate accelerator consists of one-shots OS1 and OS2, Transistors P1 and N1 components and form the edge-rate accelerator and serves to rapidly force the A port high or low when a corresponding transition is detected on the B port.

#### **Power Up**

During operation, ensure that  $V_{CCA} \le V_{CCB}$  at all times. During power-up sequencing,  $V_{CCA} \ge V_{CCB}$  does not damage the device, so any power supply can be ramped up first.

#### **Enable and Disable**

The TXS0108E has an OE input that is used to disable the device by setting OE low, which places all I/Os in the Hi-Z state. The disable time  $(t_{dis})$  indicates the delay between the time 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.

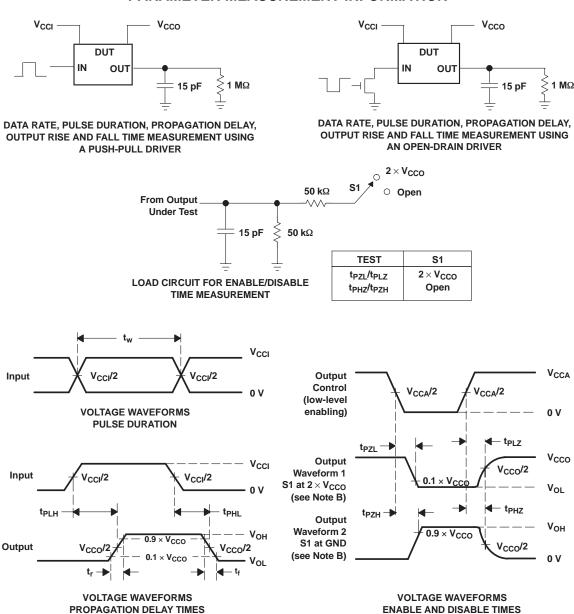
#### Pullup or Pulldown Resistors on I/O Lines

Each A-port I/O has a pull-up resistor ( $R_{pua}$ ) to  $V_{CCA}$  and each B-port I/O has a pull-up resistor ( $R_{pub}$ ) to  $V_{CCB}$ .  $R_{pua}$  and  $R_{pub}$  have a value of 40 k $\Omega$  when the output is driving low.  $R_{pua}$  and  $R_{pub}$  have a value of 4 k $\Omega$  when the output is driving high.  $R_{pua}$  and  $R_{pub}$  are disabled when OE = Low.

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#### PARAMETER MEASUREMENT INFORMATION



- A. C<sub>L</sub> includes probe and jig capacitance.
- B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
- C. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  10 MHz,  $Z_{\Omega}$  = 50  $\Omega$ ,  $dv/dt \geq$  1 V/ns.
- D. The outputs are measured one at a time, with one transition per measurement.
- E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
- F. t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.
- G. t<sub>PLH</sub> and t<sub>PHL</sub> are the same as t<sub>pd</sub>.
- H.  $V_{CCI}$  is the  $V_{CC}$  associated with the input port.
- I.  $V_{CCO}$  is the  $V_{CC}$  associated with the output port.
- J. All parameters and waveforms are not applicable to all devices.

Figure 2. Load Circuit and Voltage Waveforms





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#### **PACKAGING INFORMATION**

| Orderable Device | Status (1) | Package Type               | Package<br>Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>    | Lead/<br>Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login) |
|------------------|------------|----------------------------|--------------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| TXS0108EPWR      | ACTIVE     | TSSOP                      | PW                 | 20   | 2000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TXS0108EPWRG4    | ACTIVE     | TSSOP                      | PW                 | 20   | 2000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TXS0108ERGYR     | ACTIVE     | VQFN                       | RGY                | 20   | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-2-260C-1 YEAR          |                             |
| TXS0108EZXYR     | ACTIVE     | BGA<br>MICROSTAR<br>JUNIOR | ZXY                | 20   | 2500        | Green (RoHS<br>& no Sb/Br) | SNAGCU               | Level-1-260C-UNLIM           |                             |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free** (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes. **Pb-Free** (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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# PACKAGE MATERIALS INFORMATION

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# TAPE AND REEL INFORMATION

#### **REEL DIMENSIONS**



#### **TAPE DIMENSIONS**



| A0 | Dimension designed to accommodate the component width     |
|----|---|
| В0 | Dimension designed to accommodate the component length    |
| K0 | Dimension designed to accommodate the component thickness |
| W  | Overall width of the carrier tape                         |
| P1 | Pitch between successive cavity centers                   |

#### TAPE AND REEL INFORMATION

#### \*All dimensions are nominal

| Device       | Package<br>Type                  | Package<br>Drawing |    | SPQ  | Reel<br>Diameter<br>(mm) | Reel<br>Width<br>W1 (mm) | A0<br>(mm) | B0<br>(mm) | K0<br>(mm) | P1<br>(mm) | W<br>(mm) | Pin1<br>Quadrant |
|--------------|----------------------------------|--------------------|----|------|--------------------------|--------------------------|------------|------------|------------|------------|-----------|------------------|
| TXS0108EPWR  | TSSOP                            | PW                 | 20 | 2000 | 330.0                    | 16.4                     | 6.95       | 7.1        | 1.6        | 8.0        | 16.0      | Q1               |
| TXS0108ERGYR | VQFN                             | RGY                | 20 | 3000 | 330.0                    | 12.4                     | 3.8        | 4.8        | 1.6        | 8.0        | 12.0      | Q1               |
| TXS0108EZXYR | BGA MI<br>CROSTA<br>R JUNI<br>OR | ZXY                | 20 | 2500 | 330.0                    | 12.4                     | 2.8        | 3.3        | 1.0        | 4.0        | 12.0      | Q2               |

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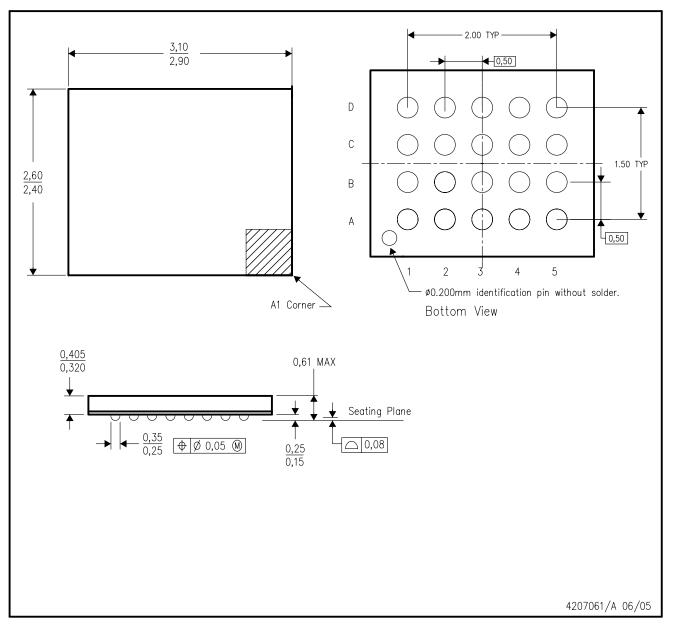


#### \*All dimensions are nominal

| Device       | Package Type            | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|-------------------------|-----------------|------|------|-------------|------------|-------------|
| TXS0108EPWR  | TSSOP                   | PW              | 20   | 2000 | 346.0       | 346.0      | 33.0        |
| TXS0108ERGYR | VQFN                    | RGY             | 20   | 3000 | 346.0       | 346.0      | 29.0        |
| TXS0108EZXYR | BGA MICROSTAR<br>JUNIOR | ZXY             | 20   | 2500 | 340.5       | 338.1      | 20.6        |

# ZXY (S-PBGA-N20)

# PLASTIC BALL GRID ARRAY



NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. This package is a lead-free solder ball design.



PW (R-PDSO-G20)

# PLASTIC SMALL OUTLINE



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.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
- E. Falls within JEDEC MO-153





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.
- 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-N20)

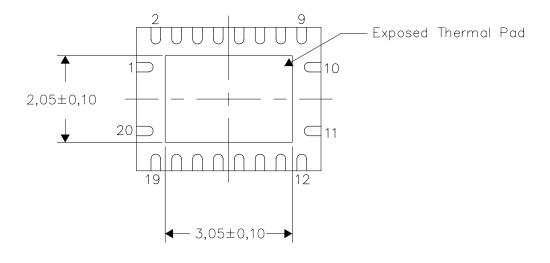
#### PLASTIC QUAD FLATPACK NO-LEAD

#### 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

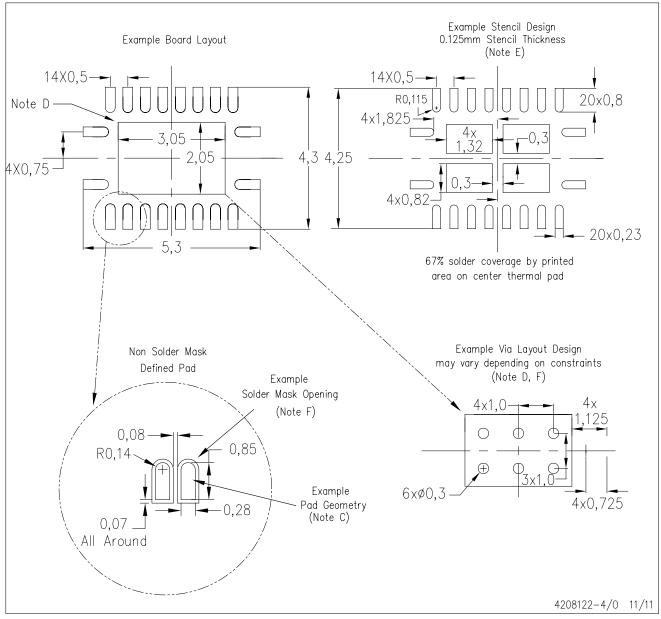
4206353-4/0 11/11

NOTE: All linear dimensions are in millimeters



# RGY (R-PVQFN-N20)

# PLASTIC QUAD FLATPACK NO-LEAD



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 <a href="https://www.ti.com">http://www.ti.com</a>.
- 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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