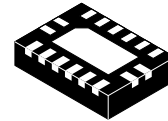


# Low-Voltage Dual-Supply 6-Bit Voltage Translator with Auto-Direction Sensing

## FXL2SD106


WQFN16 3.5x2.5, 0.5P  
CASE 510CC

### General Description

The FXL2SD106 is a configurable dual-voltage-supply translator designed for both uni-directional and bidirectional voltage translation between two logic levels. The device allows translation between voltages as high as 3.6 V to as low as 1.1 V. The A port tracks the  $V_{CCA}$  level and the B port tracks the  $V_{CCB}$  level. This allows for bi-directional voltage translation over a variety of voltage levels: 1.2 V, 1.5 V, 1.8 V, 2.5 V, and 3.3 V.

The device remains in 3-state until both  $V_{CC}$  reach active levels, allowing either  $V_{CC}$  to be powered-up first. Internal power-down control circuits place the device in 3-state if either  $V_{CC}$  is removed.

The OE input, when low, disables both A and B ports by placing them in a 3-state condition. The FXL2SD106 is designed so that OE and CLK IN are supplied by  $V_{CCA}$ .

The device senses an input signal on A or B port automatically. The input signal is transferred to the other port.

The FXL2SD106 is not designed for SD card applications. The internal bus hold circuitry conflicts with pull-up resistors. SD cards have internal pull-up resistors on the CD/DAT3 pins.

### Features

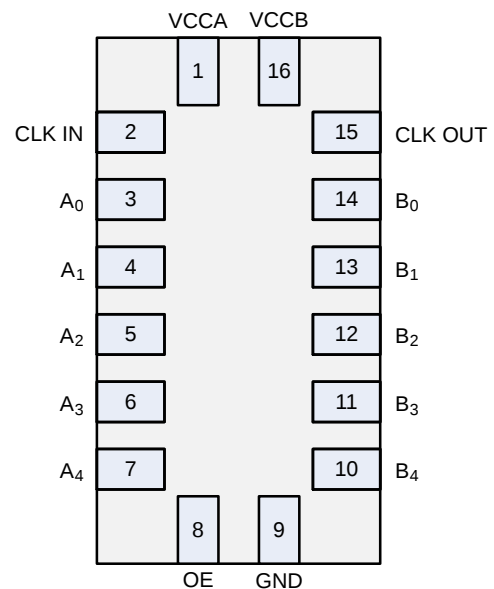
- Bi-Directional Interface between Two Levels: 1.1 V and 3.6 V
- Fully Configurable: Inputs and Outputs Track  $V_{CC}$  Level
- Non-Preferential Power-up; Either  $V_{CC}$  May Be Powered-up First
- Outputs Remain in 3-State until Active  $V_{CC}$  Level is Reached
- Outputs Switch to 3-State if Either  $V_{CC}$  is at GND
- Power-Off Protection
- Bus hold on Data Inputs Eliminates Need for Pull-up Resistors (Do NOT Use Resistors on the A or B Ports)
- OE and CLK IN are Referenced to  $V_{CCA}$  Voltage
- Packaged in 16-Terminal DQFN (2.5 mm x 3.5 mm)
- Direction Control Not Needed
- 80 Mbps Throughput Translating between 1.8 V and 2.5 V
- ESD Protection Exceeds:
  - ◆ 12 kV HBM (B port I/O to GND)  
(per JESD22-A114 & Mil Std 883e 3015.7)
  - ◆ 8 kV HBM (A port I/O to GND)  
(per JESD22-A114 & Mil Std 883e 3015.7)
  - ◆ 1 kV CDM (per ESD STM 5.3)

### MARKING DIAGRAM

&Z&2&K  
2SD106

2SD106 = Specific Device Code  
 &Z = Assembly Plant Code  
 &2 = 2-Digit Date Code  
 &K = 2-Digits Lot Run Traceability Code

### CONNECTION DIAGRAM



### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

# FXL2SD106

## PIN DESCRIPTION

| Number | Name                           | Description                      |
|--------|--------------------------------|----------------------------------|
| 1      | V <sub>CCA</sub>               | A-Side Power Supply              |
| 2      | CLK IN                         | A-Side Input                     |
| 3–7    | A <sub>0</sub> –A <sub>4</sub> | A-Side Inputs or 3-State Outputs |
| 8      | OE                             | Output Enable Input              |
| 9      | GND                            | Ground                           |
| 10–14  | B <sub>4</sub> –B <sub>0</sub> | B-Side Inputs or 3-State Outputs |
| 15     | CLK OUT                        | 3-State Output                   |
| 16     | V <sub>CCB</sub>               | B-Side Power Supply              |

## Functional Diagram

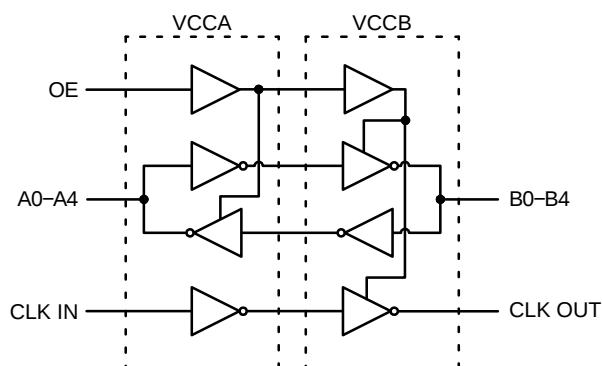


Figure 1. Functional Diagram

## FUNCTIONAL TABLE

| Control          | Outputs          |
|------------------|------------------|
| OE               |                  |
| LOW Logic Level  |                  |
| HIGH Logic Level | Normal Operation |

## Power-Up/Power-Down Sequencing

FXL translators offer an advantage in that either V<sub>CC</sub> may be powered up first. This benefit derives from the chip design. When either V<sub>CC</sub> is at 0 volts, outputs are in a high-impedance state. The control input (OE) is designed to track the V<sub>CCA</sub> supply. A pull-down resistor tying OE to GND should be used to ensure that bus contention, excessive currents, or oscillations do not occur during power-up / power-down. The size of the pull-down resistor is based upon the current-sinking capability of the device driving the OE pin.

The recommended power-up sequence is the following:

1. Apply power to the first V<sub>CC</sub>.
2. Apply power to the second V<sub>CC</sub>.
3. Drive the OE input high to enable the device.

The recommended power-down sequence is the following:

1. Drive OE input low to disable the device.
2. Remove power from either V<sub>CC</sub>.
3. Remove power from other V<sub>CC</sub>.

## ABSOLUTE MAXIMUM RATINGS

| Symbol                              | Parameter                                                                                                                   | Rating                                                                                       |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| V <sub>CCA</sub> , V <sub>CCB</sub> | Supply Voltage                                                                                                              | –0.5 V to +4.6 V                                                                             |
| V <sub>I</sub>                      | DC Input Voltage<br>I/O Port A<br>I/O Port B<br>OE, CLK IN                                                                  | –0.5 V to +4.6 V<br>–0.5 V to +4.6 V<br>–0.5 V to +4.6 V                                     |
| V <sub>O</sub>                      | Output Voltage (Note 1)<br>Outputs 3-STATE<br>Outputs Active (A <sub>n</sub> )<br>Outputs Active (B <sub>n</sub> , CLK OUT) | –0.5 V to +4.6 V<br>–0.5 V to V <sub>CCA</sub> + 0.5 V<br>–0.5 V to V <sub>CCB</sub> + 0.5 V |
| I <sub>IK</sub>                     | DC Input Diode Current at V <sub>I</sub> < 0 V                                                                              | –50 mA                                                                                       |
| I <sub>OK</sub>                     | DC Output Diode Current at<br>V <sub>O</sub> < 0 V<br>V <sub>O</sub> > V <sub>CC</sub>                                      | –50 mA<br>+50 mA                                                                             |
| I <sub>OH</sub> / I <sub>OL</sub>   | DC Output Source/Sink Current                                                                                               | –50 mA / +50 mA                                                                              |
| I <sub>CC</sub>                     | DC V <sub>CC</sub> or Ground Current per Supply Pin                                                                         | ±100 mA                                                                                      |
| T <sub>STG</sub>                    | Storage Temperature Range                                                                                                   | –65 °C to +150 °C                                                                            |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. I<sub>O</sub> Absolute Maximum Rating must be observed.

# FXL2SD106

## RECOMMENDED OPERATING CONDITIONS (Note 2)

| Symbol                 | Parameter                                                                                                                                               | Rating                                                                         |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| $V_{CCA}$ or $V_{CCB}$ | Power Supply Operating                                                                                                                                  | 1.1 V to 3.6 V                                                                 |
|                        | Input Voltage<br>Port A<br>Port B<br>OE, CLK IN                                                                                                         | 0.0 V to 3.6 V<br>0.0 V to 3.6 V<br>0.0 V to $V_{CCA}$                         |
|                        | Dynamic Output Current in $I_{OH}/I_{OL}$ with $V_{CC}$ at<br>3.0 V to 3.6 V<br>2.3 V to 2.7 V<br>1.65 V to 1.95 V<br>1.4 V to 1.65 V<br>1.1 V to 1.4 V | $\pm 18.0$ mA<br>$\pm 11.8$ mA<br>$\pm 7.4$ mA<br>$\pm 5.0$ mA<br>$\pm 2.6$ mA |
|                        | Static Output Current $I_{OH}/I_{OL}$ with $V_{CC}$ at 1.1 V to 3.6 V                                                                                   | $\pm 20.0$ $\mu$ A                                                             |
| $T_A$                  | Free Air Operating Temperature                                                                                                                          | -40 °C to +85 °C                                                               |
| $\Delta t / \Delta V$  | Maximum Input Edge Rate $V_{CCA/B} = 1.1$ V to 3.6 V                                                                                                    | 10 ns/V                                                                        |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

2. All unused inputs and I/O pins must be held at  $V_{CCI}$  or GND.

## DC ELECTRICAL CHARACTERISTICS ( $T_A = -40$ °C to 85 °C)

| Symbol                   | Parameter                            | $V_{CCA}$ (V) | $V_{CCB}$ (V) | Conditions                                    | Min                   | Typ | Max                   | Unit    |
|--------------------------|--------------------------------------|---------------|---------------|-----------------------------------------------|-----------------------|-----|-----------------------|---------|
| $V_{IH}$                 | High Level Input Voltage             | 1.4–3.6       | 1.1–3.6       | Data inputs $A_n$ , CLK IN, OE                | $0.6 \times V_{CCA}$  | –   | –                     | V       |
|                          |                                      | 1.1–1.4       | 1.1–3.6       |                                               | $0.9 \times V_{CCA}$  | –   | –                     |         |
|                          |                                      | 1.1–3.6       | 1.4–3.6       | Data inputs $B_n$                             | $0.6 \times V_{CCB}$  | –   | –                     |         |
|                          |                                      | 1.1–3.6       | 1.1–1.4       |                                               | $0.9 \times V_{CCB}$  | –   | –                     |         |
| $V_{IL}$                 | Low Level Input Voltage              | 1.4–3.6       | 1.1–3.6       | Data inputs $A_n$ , CLK IN, OE                | –                     | –   | $0.35 \times V_{CCA}$ | V       |
|                          |                                      | 1.1–1.4       | 1.1–3.6       |                                               | –                     | –   | $0.1 \times V_{CCA}$  |         |
|                          |                                      | 1.1–3.6       | 1.4–3.6       | Data inputs $B_n$                             | –                     | –   | $0.35 \times V_{CCB}$ |         |
|                          |                                      | 1.1–3.6       | 1.1–1.4       |                                               | –                     | –   | $0.1 \times V_{CCB}$  |         |
| $V_{OH}$<br>(Note 3)     | High Level Output Voltage            | 1.65–3.6      | 1.1–3.6       | Data outputs $A_n$ , $I_{HOLD} = -20$ $\mu$ A | $0.75 \times V_{CCA}$ | –   | –                     | V       |
|                          |                                      | 1.1–1.4       | 1.1–3.6       |                                               | –                     | 0.8 | –                     |         |
|                          |                                      | 1.1–3.6       | 1.65–3.6      | Data outputs $B_n$ , $I_{HOLD} = -20$ $\mu$ A | $0.75 \times V_{CCB}$ | –   | –                     |         |
|                          |                                      | 1.1–3.6       | 1.1–1.4       |                                               | –                     | 0.8 | –                     |         |
| $V_{OL}$<br>(Note 3)     | Low Level Output Voltage             | 1.65–3.6      | 1.1–3.6       | Data outputs $A_n$ , $I_{HOLD} = 20$ $\mu$ A  | –                     | –   | $0.2 \times V_{CCA}$  | V       |
|                          |                                      | 1.1–1.4       | 1.1–3.6       |                                               | –                     | 0.3 | –                     |         |
|                          |                                      | 1.1–3.6       | 1.65–3.6      | Data outputs $B_n$ , $I_{HOLD} = 20$ $\mu$ A  | –                     | –   | $0.2 \times V_{CCB}$  |         |
|                          |                                      | 1.1–3.6       | 1.1–1.4       |                                               | –                     | 0.3 | –                     |         |
| $I_{I(ODH)}$<br>(Note 4) | Bushold Input Overdrive High Current | 3.6           | 3.6           | Data inputs $A_n$ , $B_n$                     | 450                   | –   | –                     | $\mu$ A |
|                          |                                      | 2.7           | 2.7           |                                               | 300                   | –   | –                     |         |
|                          |                                      | 1.95          | 1.95          |                                               | 200                   | –   | –                     |         |
|                          |                                      | 1.6           | 1.6           |                                               | 120                   | –   | –                     |         |
|                          |                                      | 1.4           | 1.4           |                                               | 80                    | –   | –                     |         |
| $I_{I(ODL)}$<br>(Note 5) | Bushold Input Overdrive Low Current  | 3.6           | 3.6           | Data inputs $A_n$ , $B_n$                     | –450                  | –   | –                     | $\mu$ A |
|                          |                                      | 2.7           | 2.7           |                                               | –300                  | –   | –                     |         |
|                          |                                      | 1.95          | 1.95          |                                               | –200                  | –   | –                     |         |
|                          |                                      | 1.6           | 1.6           |                                               | –120                  | –   | –                     |         |
|                          |                                      | 1.4           | 1.4           |                                               | –80                   | –   | –                     |         |
| $I_I$                    | Input Leakage Current                | 1.1–3.6       | 3.6           | OE, CLK IN, $V_I = V_{CCA}$ or GND            | –                     | –   | $\pm 1.0$             | $\mu$ A |

# FXL2SD106

## DC ELECTRICAL CHARACTERISTICS ( $T_A = -40\text{ }^{\circ}\text{C}$ to $85\text{ }^{\circ}\text{C}$ ) (continued)

| Symbol                     | Parameter                 | $V_{CCA}$ (V) | $V_{CCB}$ (V) | Conditions                                                                       | Min | Typ | Max       | Unit          |
|----------------------------|---------------------------|---------------|---------------|----------------------------------------------------------------------------------|-----|-----|-----------|---------------|
| $I_{OFF}$                  | Power Off Leakage Current | 0             | 3.6           | $A_n, V_O = 0\text{ V to } 3.6\text{ V}$                                         | –   | –   | $\pm 2.0$ | $\mu\text{A}$ |
|                            |                           | 3.6           | 0             | $B_n, \text{CLK OUT}, V_O = 0\text{ V to } 3.6\text{ V}$                         | –   | –   | $\pm 2.0$ |               |
| $I_{OZ}$<br>(Note 6)       | 3-State Output Leakage    | 3.6           | 3.6           | $A_n, B_n, \text{CLK OUT}, V_O = 0\text{ V or } 3.6\text{ V}, OE = V_{IL}$       | –   | –   | $\pm 2.0$ | $\mu\text{A}$ |
|                            |                           | 3.6           | 0             | $A_n, V_O = 0\text{ V or } 3.6\text{ V}, OE = \text{Don't Care}$                 | –   | –   | $\pm 2.0$ |               |
|                            |                           | 0             | 3.6           | $B_n, \text{CLK OUT}, V_O = 0\text{ V or } 3.6\text{ V}, OE = \text{Don't Care}$ | –   | –   | $\pm 2.0$ |               |
| $I_{CCA/B}$<br>(Note 7, 8) | Quiescent Supply Current  | 1.1–3.6       | 1.1–3.6       | $V_I = V_{CC1}$ or GND, $I_O = 0$                                                | –   | –   | 5.0       | $\mu\text{A}$ |
| $I_{CCZ}$<br>(Note 7)      | Quiescent Supply Current  | 1.1–3.6       | 1.1–3.6       | $V_I = V_{CC1}$ or GND, $I_O = 0, OE = V_{IL}$                                   | –   | –   | 5.0       | $\mu\text{A}$ |
| $I_{CCA}$<br>(Note 7)      | Quiescent Supply Current  | 0             | 1.1–3.6       | $V_I = V_{CCB}$ or GND; $I_O = 0$                                                | –   | –   | –2.0      | $\mu\text{A}$ |
|                            |                           | 1.1–3.6       | 0             | $V_I = V_{CCA}$ or GND; $I_O = 0$                                                | –   | –   | 2.0       |               |
| $I_{CCB}$<br>(Note 7)      | Quiescent Supply Current  | 1.1–3.6       | 0             | $V_I = V_{CCB}$ or GND; $I_O = 0$                                                | –   | –   | –2.0      | $\mu\text{A}$ |
|                            |                           | 0             | 1.1–3.6       | $V_I = V_{CCA}$ or GND; $I_O = 0$                                                | –   | –   | 2.0       |               |

3. This is the output voltage for static conditions. Dynamic drive specifications are given in “Dynamic Output Electrical Characteristics”.

4. An external driver must source at least the specified current to switch LOW-to-HIGH.

5. An external driver must source at least the specified current to switch HIGH-to-LOW.

6. “Don't Care” indicates any valid logic level.

7.  $V_{CC1}$  is the  $V_{CC}$  associated with the input side.

8. Reflects current per supply,  $V_{CCA}$  or  $V_{CCB}$ .

## DYNAMIC OUTPUT ELECTRICAL CHARACTERISTICS (Note 9)

### A PORT ( $A_n$ )

Output Load:  $C_L = 15\text{ pF}$ ,  $R_L > 1\text{ M}\Omega$

| Symbol                  | Parameter                   | $T_A = -40\text{ }^{\circ}\text{C to } +85\text{ }^{\circ}\text{C}, V_{CCA} =$ |     |                |     |                  |     |                |     |                | Unit |
|-------------------------|-----------------------------|--------------------------------------------------------------------------------|-----|----------------|-----|------------------|-----|----------------|-----|----------------|------|
|                         |                             | 3.0 V to 3.6 V                                                                 |     | 2.3 V to 2.7 V |     | 1.65 V to 1.95 V |     | 1.4 V to 1.6 V |     | 1.1 V to 1.3 V |      |
|                         |                             | Typ                                                                            | Max | Typ            | Max | Typ              | Max | Typ            | Max | Typ            |      |
| $t_{rise}$<br>(Note 10) | Output Rise Time A Port     | –                                                                              | 3.0 | –              | 3.5 | –                | 4.0 | –              | 5.0 | 7.5            | ns   |
| $t_{fall}$<br>(Note 11) | Output Fall Time A Port     | –                                                                              | 3.0 | –              | 3.5 | –                | 4.0 | –              | 5.0 | 7.5            | ns   |
| $I_{OHD}$<br>(Note 10)  | Dynamic Output Current High | –18.0                                                                          | –   | –11.8          | –   | –7.4             | –   | –5.0           | –   | –2.6           | mA   |
| $I_{OLD}$<br>(Note 11)  | Dynamic Output Current Low  | +18.0                                                                          | –   | +11.8          | –   | +7.4             | –   | +5.0           | –   | +2.6           | mA   |

### B PORT ( $B_n, \text{CLK OUT}$ )

Output Load:  $C_L = 15\text{ pF}$ ,  $R_L > 1\text{ M}\Omega$

| Symbol                  | Parameter                   | $T_A = -40\text{ }^{\circ}\text{C to } +85\text{ }^{\circ}\text{C}, V_{CCB} =$ |     |                |     |                  |     |                |     |                | Unit |
|-------------------------|-----------------------------|--------------------------------------------------------------------------------|-----|----------------|-----|------------------|-----|----------------|-----|----------------|------|
|                         |                             | 3.0 V to 3.6 V                                                                 |     | 2.3 V to 2.7 V |     | 1.65 V to 1.95 V |     | 1.4 V to 1.6 V |     | 1.1 V to 1.3 V |      |
|                         |                             | Typ                                                                            | Max | Typ            | Max | Typ              | Max | Typ            | Max | Typ            |      |
| $t_{rise}$<br>(Note 10) | Output Rise Time B Port     | –                                                                              | 3.0 | –              | 3.5 | –                | 4.0 | –              | 5.0 | 7.5            | ns   |
| $t_{fall}$<br>(Note 11) | Output Fall Time B Port     | –                                                                              | 3.0 | –              | 3.5 | –                | 4.0 | –              | 5.0 | 7.5            | ns   |
| $I_{OHD}$<br>(Note 10)  | Dynamic Output Current High | –18.0                                                                          | –   | –11.8          | –   | –7.4             | –   | –5.0           | –   | –2.6           | mA   |
| $I_{OLD}$<br>(Note 11)  | Dynamic Output Current Low  | +18.0                                                                          | –   | +11.8          | –   | +7.4             | –   | +5.0           | –   | +2.6           | mA   |

9. Dynamic Output Characteristics are guaranteed, but not tested.

10. See Figure 6.

11. See Figure 7.

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## AC CHARACTERISTICS

| Symbol | Parameter | $T_A = -40\text{ }^{\circ}\text{C to }+85\text{ }^{\circ}\text{C}, V_{CCB} =$ |     |               |     |                 |     |               |     |               | Unit |
|--------|-----------|-------------------------------------------------------------------------------|-----|---------------|-----|-----------------|-----|---------------|-----|---------------|------|
|        |           | 3.0 V – 3.6 V                                                                 |     | 2.3 V – 2.7 V |     | 1.65 V – 1.95 V |     | 1.4 V – 1.6 V |     | 1.1 V – 1.3 V |      |
|        |           | Typ                                                                           | Max | Typ           | Max | Typ             | Max | Typ           | Max | Typ           |      |

### $V_{CCA} = 3.0\text{ V to }3.6\text{ V}$

|                         |                   |     |     |     |     |     |     |     |     |      |               |
|-------------------------|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|---------------|
| $t_{PLH}, t_{PHL}$      | A to B            | 0.2 | 3.5 | 0.3 | 3.9 | 0.5 | 5.4 | 0.6 | 6.8 | 22.0 | ns            |
|                         | B to A            | 0.2 | 3.5 | 0.2 | 3.8 | 0.3 | 5.0 | 0.5 | 6.0 | 15.0 | ns            |
| $t_{PLH}, t_{PHL}$      | CLK IN to CLK OUT | –   | 3.0 | –   | 3.5 | –   | 4.5 | –   | 6.0 | 15.0 | ns            |
| $t_{PZL}, t_{PZH}$      | OE to A, OE to B  | –   | 1.7 | –   | 1.7 | –   | 1.7 | –   | 1.7 | 1.7  | $\mu\text{s}$ |
| $t_{skew}$<br>(Note 12) | A Port, B Port    | –   | 0.5 | –   | 0.5 | –   | 0.5 | –   | 1.0 | 1.0  | ns            |

### $V_{CCA} = 2.3\text{ V to }2.7\text{ V}$

|                         |                   |     |     |     |     |     |     |     |     |      |               |
|-------------------------|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|---------------|
| $t_{PLH}, t_{PHL}$      | A to B            | 0.2 | 3.8 | 0.4 | 4.2 | 0.5 | 5.6 | 0.8 | 6.9 | 22.0 | ns            |
|                         | B to A            | 0.3 | 3.9 | 0.4 | 4.2 | 0.5 | 5.5 | 0.5 | 6.5 | 15.0 | ns            |
| $t_{PLH}, t_{PHL}$      | CLK IN to CLK OUT | –   | 3.5 | –   | 4.0 | –   | 4.5 | –   | 6.5 | 15.0 | ns            |
| $t_{PZL}, t_{PZH}$      | OE to A, OE to B  | –   | 1.7 | –   | 1.7 | –   | 1.7 | –   | 1.7 | 1.7  | $\mu\text{s}$ |
| $t_{skew}$<br>(Note 12) | A Port, B Port    | –   | 0.5 | –   | 0.5 | –   | 0.5 | –   | 1.0 | 1.0  | ns            |

### $V_{CCA} = 1.65\text{ V to }1.95\text{ V}$

|                         |                   |     |     |     |     |     |     |     |     |      |               |
|-------------------------|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|---------------|
| $t_{PLH}, t_{PHL}$      | A to B            | 0.3 | 5.0 | 0.5 | 5.5 | 0.8 | 6.7 | 0.9 | 7.5 | 22.0 | ns            |
|                         | B to A            | 0.5 | 5.4 | 0.5 | 5.6 | 0.8 | 6.7 | 1.0 | 7.0 | 15.0 | ns            |
| $t_{PLH}, t_{PHL}$      | CLK IN to CLK OUT | –   | 4.5 | –   | 4.5 | –   | 6.3 | –   | 6.7 | 15.0 | ns            |
| $t_{PZL}, t_{PZH}$      | OE to A, OE to B  | –   | 1.7 | –   | 1.7 | –   | 1.7 | –   | 1.7 | 1.7  | $\mu\text{s}$ |
| $t_{skew}$<br>(Note 12) | A Port, B Port    | –   | 0.5 | –   | 0.5 | –   | 0.5 | –   | 1.0 | 1.0  | ns            |

### $V_{CCA} = 1.4\text{ V to }1.6\text{ V}$

|                         |                   |     |     |     |     |     |     |     |     |      |               |
|-------------------------|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|---------------|
| $t_{PLH}, t_{PHL}$      | A to B            | 0.5 | 6.0 | 0.5 | 6.5 | 1.0 | 7.0 | 1.0 | 8.5 | 22.0 | ns            |
|                         | B to A            | 0.6 | 6.8 | 0.8 | 6.9 | 0.9 | 7.5 | 1.0 | 8.5 | 15.0 | ns            |
| $t_{PLH}, t_{PHL}$      | CLK IN to CLK OUT | –   | 6.0 | –   | 6.5 | –   | 6.7 | –   | 8.5 | 15.0 | ns            |
| $t_{PZL}, t_{PZH}$      | OE to A, OE to B  | –   | 1.7 | –   | 1.7 | –   | 1.7 | –   | 1.7 | 1.7  | $\mu\text{s}$ |
| $t_{skew}$<br>(Note 12) | A Port, B Port    | –   | 1.0 | –   | 1.0 | –   | 1.0 | –   | 1.0 | 1.0  | ns            |

12. Skew is the variation of propagation delay between output signals and applies only to output signals on the same port ( $A_n$  or  $B_n$ ) and switching with the same polarity (Low-to-High or High-to-Low). See Figure 9.

## MAXIMUM DATA RATE (Note 13, 14)

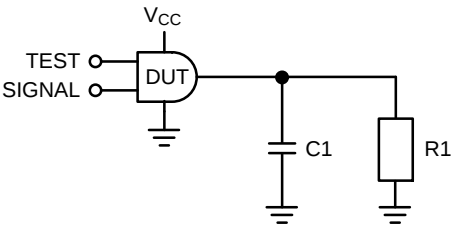
| $V_{CCA}$                                  | $T_A = -40\text{ }^{\circ}\text{C to }+85\text{ }^{\circ}\text{C}, V_{CCB} =$ |                |                  |                |                | Unit |
|--------------------------------------------|-------------------------------------------------------------------------------|----------------|------------------|----------------|----------------|------|
|                                            | 3.0 V to 3.6 V                                                                | 2.3 V to 2.7 V | 1.65 V to 1.95 V | 1.4 V to 1.6 V | 1.1 V to 1.3 V |      |
|                                            | Min                                                                           | Min            | Min              | Min            | Min            |      |
| $V_{CCA} = 3.0\text{ V to }3.6\text{ V}$   | 100                                                                           | 100            | 80               | 60             | 20             | Mbps |
| $V_{CCA} = 2.3\text{ V to }2.7\text{ V}$   | 100                                                                           | 100            | 80               | 60             | 20             | Mbps |
| $V_{CCA} = 1.65\text{ V to }1.95\text{ V}$ | 80                                                                            | 80             | 60               | 40             | 20             | Mbps |
| $V_{CCA} = 1.4\text{ V to }1.6\text{ V}$   | 60                                                                            | 60             | 40               | 40             | 20             | Mbps |
|                                            | Typ                                                                           | Typ            | Typ              | Typ            | Typ            |      |
| $V_{CCA} = 1.1\text{ V to }1.3\text{ V}$   | 20                                                                            | 20             | 20               | 20             | 20             | Mbps |

13. Maximum data rate is guaranteed but not tested.

14. Maximum data rate is specified in megabits per second. See Figure 8. It is equivalent to two times the F-toggle frequency, specified in megahertz. For example, 100 Mbps is equivalent to 50 MHz.

CAPACITANCE

| Symbol    | Parameter                     |                 | Conditions                                                                                | $T_A = +25\text{ }^{\circ}\text{C}$ | Unit |
|-----------|-------------------------------|-----------------|-------------------------------------------------------------------------------------------|-------------------------------------|------|
|           |                               |                 |                                                                                           | Typical                             |      |
| $C_{IN}$  | Input Capacitance, OE, CLK IN |                 | $V_{CCA} = V_{CCB} = \text{GND}$                                                          | 4                                   | pF   |
| $C_{I/O}$ | Input/Output Capacitance      | $A_n$           | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ , $\text{OE} = V_{CCA}$                                | 5                                   | pF   |
|           |                               | $B_n$ , CLK OUT |                                                                                           | 6                                   |      |
| $C_{PD}$  | Power Dissipation Capacitance |                 | $V_{CCA} = V_{CCB} = 3.3\text{ V}$ , $V_i = 0\text{ V}$ or $V_{CC}$ , $f = 10\text{ MHz}$ | 25                                  | pF   |

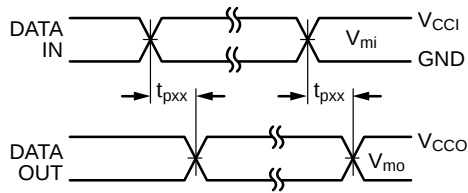


| Test                  | Input Signal | Output Enable Control |
|-----------------------|--------------|-----------------------|
| $t_{PLH}$ , $t_{PHL}$ | Data Pulses  | $V_{CCA}$             |
| $t_{PZL}$             | 0 V          | Low to High Switch    |
| $t_{PZH}$             | $V_{CCI}$    | Low to High Switch    |

Figure 2. AC Test Circuit

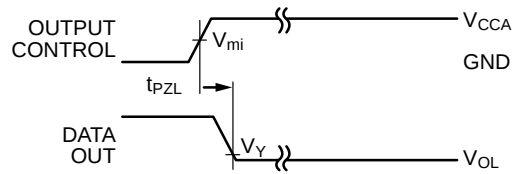
AC LOAD TABLE

| $V_{CCO}$          | CI    | RI           |
|--------------------|-------|--------------|
| 1.2 V $\pm 0.1$ V  | 15 pF | 1 M $\Omega$ |
| 1.5 V $\pm 0.1$ V  | 15 pF | 1 M $\Omega$ |
| 1.8 V $\pm 0.15$ V | 15 pF | 1 M $\Omega$ |
| 2.5 V $\pm 0.2$ V  | 15 pF | 1 M $\Omega$ |
| 3.3 V $\pm 0.3$ V  | 15 pF | 1 M $\Omega$ |



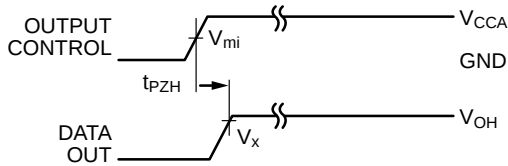
Input  $t_R = t_F = 2.0$  ns, 10% to 90%  
Input  $t_R = t_F = 2.5$  ns, 10% to 90%, @  $V_i = 3.0$  V to 3.6 V only

**Figure 3. Waveform for Inverting and Non-inverting Functions**



Input  $t_R = t_F = 2.0$  ns, 10% to 90%  
Input  $t_R = t_F = 2.5$  ns, 10% to 90%, @  $V_i = 3.0$  V to 3.6 V only

**Figure 4. 3-STATE Output Low Enable Time for Low Voltage Logic**

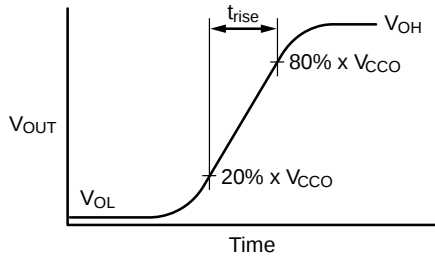


Input  $t_R = t_F = 2.0$  ns, 10% to 90%  
Input  $t_R = t_F = 2.5$  ns, 10% to 90%, @  $V_i = 3.0$  V to 3.6 V only

**Figure 5. 3-STATE Output High Enable Time for Low Voltage Logic**

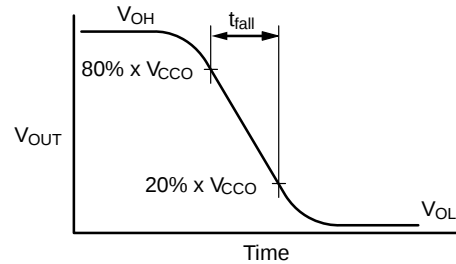
| Symbol        | Vcc                  |
|---------------|----------------------|
| Vmi (Note 15) | $V_{CC1} / 2$        |
| Vmo           | $V_{CC0} / 2$        |
| VX            | $0.9 \times V_{CC0}$ |
| VY            | $0.1 \times V_{CC0}$ |

15.  $V_{CC1} = V_{CCA}$  for control pin OE or  $V_{mi} = (V_{CCA} / 2)$ .



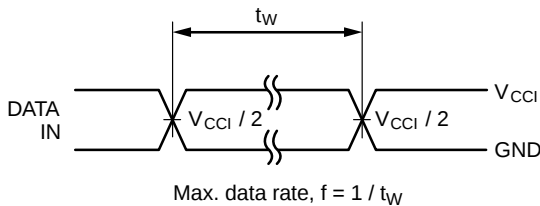
$$I_{OHD} \approx (C_L + C_{I/O}) \times \frac{\Delta V_{OUT}}{\Delta t} = (C_L + C_{I/O}) \times \frac{(20\% - 80\%) \times V_{CC0}}{t_{RISE}}$$

**Figure 6. Active Output Rise Time and Dynamic Output Current High**



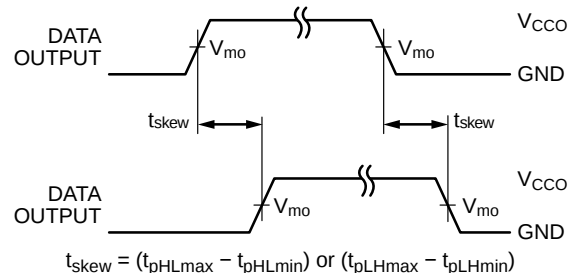
$$I_{OLD} \approx (C_L + C_{I/O}) \times \frac{\Delta V_{OUT}}{\Delta t} = (C_L + C_{I/O}) \times \frac{(80\% - 20\%) \times V_{CC0}}{t_{FALL}}$$

**Figure 7. Active Output Fall Time and Dynamic Output Current Low**



Max. data rate,  $f = 1 / t_W$

**Figure 8. Maximum Data Rate**



$t_{skew} = (t_{pHLmax} - t_{pHLmin})$  or  $(t_{pLHmax} - t_{pLHmin})$

**Figure 9. Output Skew Time**

## FXL2SD106

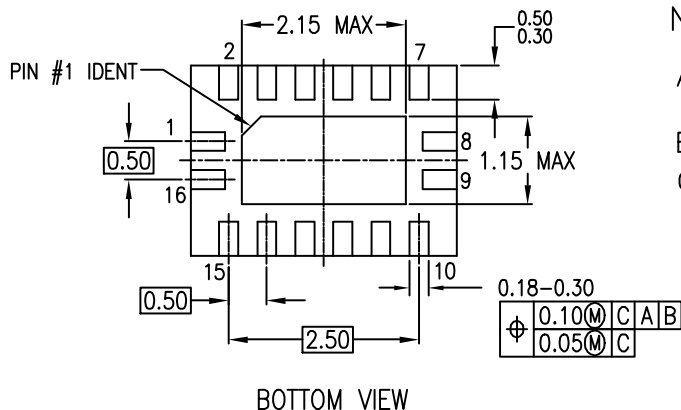
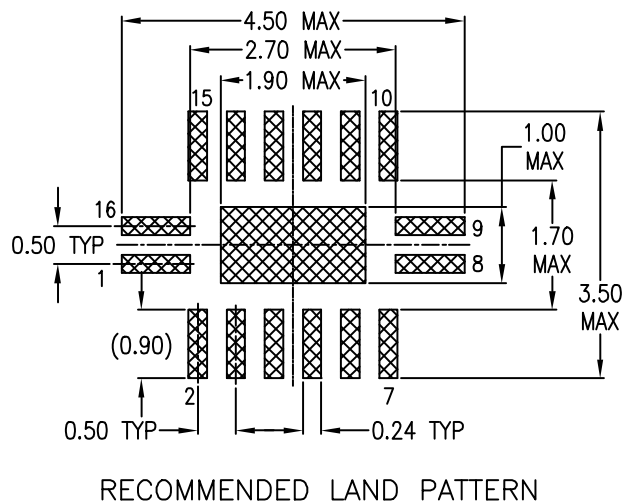
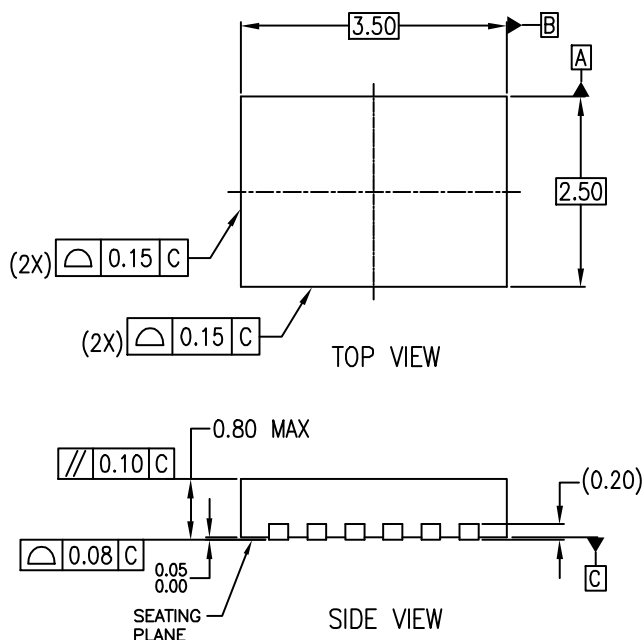
### ORDERING INFORMATION

| Order Number | Package Number | Package Description                                                                                                           | Shipping <sup>†</sup> |
|--------------|----------------|-------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| FXL2SD106BQX | MLP16E         | 16-Terminal Depopulated Quad Very-Thin Flat Pack,<br>No Leads (DQFN), JEDEC MO-241, 2.5 mm x 3.5 mm<br>(Pb-Free, Halide Free) | 3000 / Tape & Reel    |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

WQFN16 3.5x2.5, 0.5P  
CASE 510CC  
ISSUE O

DATE 31 AUG 2016



NOTES:

- A. CONFORMS TO JEDEC REGISTRATION  
MO-241, VARIATION AB
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER  
ASME Y14.5M, 1994

|                         |                             |                                                                                                                                                                                     |
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