

## FXLH42245

### Low Voltage Dual Supply 8-Bit Signal Translator with Configurable Voltage Supplies and Bushold Data Inputs and 3-STATE Outputs and 26Ω Series Resistors in the B Port Outputs

#### General Description

The FXLH42245 is a configurable dual-voltage-supply translator designed for bi-directional voltage translation of signals between two voltage levels. The device allows translation between voltages as high as 3.6V to as low as 1.1V. The A Port tracks the  $V_{CCA}$  level, and the B Port tracks the  $V_{CCB}$  level. Both ports are designed to accept supply voltage levels from 1.1V to 3.6V. This allows for bi-directional voltage translation over a variety of voltage levels: 1.2V, 1.5V, 1.8V, 2.5V, and 3.3V.

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

The Transmit/Receive ( $T/\overline{R}$ ) input determines the direction of data flow through the device. The  $\overline{OE}$  input, when HIGH, disables both the A and B Ports by placing them in a 3-STATE condition. The FXLH42245 is designed so that the control pins ( $T/\overline{R}$  and  $\overline{OE}$ ) are supplied by  $V_{CCA}$ .

#### Features

- Bi-directional interface between any 2 levels from 1.1V to 3.6V
- Fully configurable, inputs track  $V_{CC}$  level
- Non-preferential power-up sequencing; 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
- Bushold on data inputs eliminates the need for external pull-up/pull-down resistors
- 26Ω output series resistors on the B Port to reduce line noise
- Power-off protection
- Control inputs ( $T/\overline{R}$ ,  $\overline{OE}$ ) levels are referenced to  $V_{CCA}$  voltage
- Packaged in 24-terminal MLP
- ESD protection exceeds:
  - 4kV HBM ESD (per JESD22-A114 & Mil Std 883e 3015.7)
  - 8kV HBM I/O to GND ESD (per JESD22-A114 & Mil Std 883e 3015.7)
  - 1kV CDM ESD (per ESD STM 5.3)
  - 200V MM ESD (per JESD22-A115 & ESD STM5.2)

#### Ordering Code:

Order Number	Package Number	Package Description
FXLH42245MPX	MLP024B	24-Terminal Molded Leadless Package (MLP), JEDEC MO-220, 3.5mm x 4.5mm

FXLH42245 Low Voltage Dual Supply 8-Bit Signal Translator with Configurable Voltage Supplies and Bushold Data Inputs and 3-STATE Outputs and 26Ω Series Resistors in the B Port Outputs

## Pin Descriptions

Pin Names	Description
$\overline{OE}$	Output Enable Input
$T/\overline{R}$	Transmit/Receive Input
A <sub>0</sub> - A <sub>7</sub>	Side A Input or 3-STATE Output
B <sub>0</sub> - B <sub>7</sub>	Side B Input or 3-STATE Output
V <sub>CCA</sub>	Side A Power Supply
V <sub>CCB</sub>	Side B Power Supply
GND	Ground

## Truth Table

Inputs		Outputs
$\overline{OE}$	$T/\overline{R}$	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	3-STATE

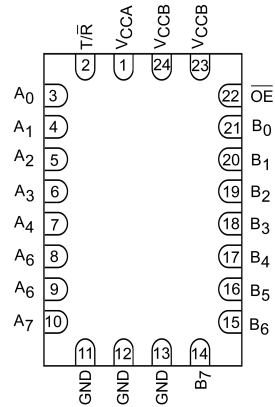
H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Don't Care

## Pin Assignments

Pin Number	Pin Name
1	V <sub>CCA</sub>
2	$T/\overline{R}$
3	A <sub>0</sub>
4	A <sub>1</sub>
5	A <sub>2</sub>
6	A <sub>3</sub>
7	A <sub>4</sub>
8	A <sub>5</sub>
9	A <sub>6</sub>
10	A <sub>7</sub>
11	GND
12	GND

## Connection Diagram

Terminal Assignments for DQFN



(Top Through View)

Pin Number	Pin Name
13	GND
14	B <sub>7</sub>
15	B <sub>6</sub>
16	B <sub>5</sub>
17	B <sub>4</sub>
18	B <sub>3</sub>
19	B <sub>2</sub>
20	B <sub>1</sub>
21	B <sub>0</sub>
22	$\overline{OE}$
23	V <sub>CCB</sub>
24	V <sub>CCB</sub>

## 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 inputs ( $T/\overline{R}$  and  $\overline{OE}$ ) are designed to track the V<sub>CCA</sub> supply. A pull-up resistor tying  $\overline{OE}$  to V<sub>CCA</sub> 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-up resistor is based upon the current-sinking capability of the  $\overline{OE}$  driver.

The recommended power-up sequence is the following:

1. Apply power to either V<sub>CC</sub>.
2. Apply power to the  $T/\overline{R}$  input (Logic HIGH for A-to-B operation; Logic LOW for B-to-A operation) and to the respective data inputs (A Port or B Port). This may occur at the same time as Step 1.
3. Apply power to the other V<sub>CC</sub>.
4. Drive the  $\overline{OE}$  input LOW to enable the device.

The recommended power-down sequence is the following:

1. Drive  $\overline{OE}$  input HIGH to disable the device.
2. Remove power from either V<sub>CC</sub>.
3. Remove power from the other V<sub>CC</sub>.

Absolute Maximum Ratings (Note 1)		Recommended Operating Conditions (Note 3)	
Supply Voltage		Power Supply Operating ( $V_{CCA}$ or $V_{CCB}$ )	1.1V to 3.6V
$V_{CCA}$	-0.5V to +4.6V	Input Voltage	
$V_{CCB}$	-0.5V to +4.6V	Port A	0.0V to $V_{CCA}$
DC Input Voltage ( $V_I$ )		Port B	0.0V to $V_{CCB}$
I/O Port A	-0.5V to $V_{CCA} + 0.5V$	Control Inputs ( $\overline{T/R}$ , $\overline{OE}$ )	0.0V to $V_{CCA}$
I/O Port B	-0.5V to $V_{CCA} + 0.5V$	Output Current in $I_{OH}/I_{OL}$ (A Port)	
Control Inputs ( $\overline{T/R}$ , $\overline{OE}$ )	-0.5V to +4.6V	$V_{CCA}$	
Output Voltage ( $V_O$ ) (Note 2)		3.0V to 3.6V	±24 mA
Outputs 3-STATE	-0.5V to +4.6V	2.3V to 2.7V	±18 mA
Outputs Active ( $A_n$ )	-0.5V to $V_{CCA} + 0.5V$	1.65V to 1.95V	±6 mA
Outputs Active ( $B_n$ )	-0.5V to $V_{CCB} + 0.5V$	1.4V to 1.65V	±2 mA
DC Input Diode Current ( $I_{IK}$ ) $V_I < 0V$	-50 mA	1.1V to 1.4V	±0.5 mA
DC Output Diode Current ( $I_{OK}$ )		Output Current in $I_{OH}/I_{OL}$ (B Port)	
$V_O < 0V$	-50 mA	$V_{CCB}$	
$V_O > V_{CC}$	+50 mA	3.0V to 3.6V	Resistor Outputs ±12 mA
DC Output Source/Sink Current ( $I_{OH}/I_{OL}$ )	-50 mA / +50 mA	2.3V to 2.7V	Resistor Outputs ±8 mA
DC $V_{CC}$ or Ground Current per Supply Pin ( $I_{CC}$ )	±100 mA	1.65V to 1.95V	Resistor Outputs ±3 mA
Storage Temperature Range ( $T_{STG}$ )	-65°C to +150°C	1.4V to 1.65V	Resistor Outputs ±1 mA
		1.1V to 1.4V	Resistor Outputs ±0.25 mA
		Free Air Operating Temperature ( $T_A$ )	-40°C to +85°C
		Minimum Input Edge Rate ( $\Delta V/\Delta t$ )	
		$V_{CCA/B} = 1.1V$ to $3.6V$	10 ns/V

**Note 1:** The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Note 2:**  $I_O$  Absolute Maximum Rating must be observed.

**Note 3:** All unused inputs must be held at  $V_{CCI}$  or GND.

### DC Electrical Characteristics

Symbol	Parameter	Conditions	$V_{CCI}$ (V)	$V_{CCO}$ (V)	Min	Typ	Max	Units
$V_{IH}$ (Note 4)	High Level Input Voltage	Data Inputs $A_n, B_n$	2.7 - 3.6	1.1 - 3.6	2.0			V
			2.3 - 2.7		1.6			
			1.65 - 2.3		0.65 x $V_{CCI}$			
			1.4 - 1.65		0.65 x $V_{CCI}$			
			1.1 - 1.4		0.9 x $V_{CCI}$			
		Control Pins $\overline{OE}, \overline{T/R}$ (Referenced to $V_{CCA}$ )	2.7 - 3.6	1.1 - 3.6	2.0			
			2.3 - 2.7		1.6			
			1.65 - 2.3		0.65 x $V_{CCA}$			
			1.4 - 1.65		0.65 x $V_{CCA}$			
			1.1 - 1.4		0.9 x $V_{CCA}$			

DC Electrical Characteristics (Continued)								
Symbol	Parameter	Conditions	V <sub>CCI</sub> (V)	V <sub>CC0</sub> (V)	Min	Typ	Max	Units
V <sub>IL</sub> (Note 4)	Low Level Input Voltage	Data Inputs A <sub>n</sub> , B <sub>n</sub>	2.7 - 3.6	1.1 - 3.6			0.8	V
			2.3 - 2.7			0.7		
			1.65 - 2.3			0.35 x V <sub>CCI</sub>		
			1.4 - 1.65			0.35 x V <sub>CCI</sub>		
			1.1 - 1.4			0.1 x V <sub>CCI</sub>		
		Control Pins OE, T/R (Referenced to V <sub>CCA</sub> )	2.7 - 3.6	1.1 - 3.6		0.8		
			2.3 - 2.7			0.7		
			1.65 - 2.3			0.35 x V <sub>CCA</sub>		
			1.4 - 1.65			0.35 x V <sub>CCA</sub>		
			1.1 - 1.4			0.1 x V <sub>CCA</sub>		
V <sub>OH</sub> (Note 5)	High Level Output Voltage B Port	I <sub>OH</sub> = -100 μA	1.1 - 3.6	1.1 - 3.6	V <sub>CC0</sub> - 0.2			V
		I <sub>OH</sub> = -6 mA	2.7	2.7	2.2			
		I <sub>OH</sub> = -8 mA	3.0	3.0	2.4			
		I <sub>OH</sub> = -12 mA	3.0	3.0	2.2			
		I <sub>OH</sub> = -4 mA	2.3	2.3	2.0			
		I <sub>OH</sub> = -6 mA	2.3	2.3	1.8			
		I <sub>OH</sub> = -8 mA	2.3	2.3	1.7			
		I <sub>OH</sub> = -3 mA	1.65	1.65	1.25			
		I <sub>OH</sub> = -1 mA	1.4	1.4	1.05			
		I <sub>OH</sub> = -0.25 mA	1.1	1.1	0.75 x V <sub>CC0</sub>			
V <sub>OH</sub> (Note 5)	High Level Output Voltage A Port	I <sub>OH</sub> = -100 μA	1.1 - 3.6	1.1 - 3.6	V <sub>CC0</sub> - 0.2			V
		I <sub>OH</sub> = -12 mA	2.7	2.7	2.2			
		I <sub>OH</sub> = -18 mA	3.0	3.0	2.4			
		I <sub>OH</sub> = -24 mA	3.0	3.0	2.2			
		I <sub>OH</sub> = -6 mA	2.3	2.3	2.0			
		I <sub>OH</sub> = -12 mA	2.3	2.3	1.8			
		I <sub>OH</sub> = -18 mA	2.3	2.3	1.7			
		I <sub>OH</sub> = -6 mA	1.65	1.65	1.25			
		I <sub>OH</sub> = -2 mA	1.4	1.4	1.05			
		I <sub>OH</sub> = -0.5 mA	1.1	1.1	0.75 x V <sub>CC0</sub>			
V <sub>OL</sub> (Note 5)	Low Level Output Voltage B Port	I <sub>OL</sub> = 100 μA	1.1 - 3.6	1.1 - 3.6			0.2	V
		I <sub>OL</sub> = 6 mA	2.7	2.7			0.4	
		I <sub>OL</sub> = 8 mA	3.0	3.0			0.55	
		I <sub>OL</sub> = 12 mA	3.0	3.0			0.8	
		I <sub>OL</sub> = 6 mA	2.3	2.3			0.4	
		I <sub>OL</sub> = 8 mA	2.3	2.3			0.6	
		I <sub>OL</sub> = 3 mA	1.65	1.65			0.3	
		I <sub>OL</sub> = 1 mA	1.4	1.4			0.35	
		I <sub>OL</sub> = 0.25 mA	1.1	1.1			0.3 x V <sub>CC0</sub>	
V <sub>OL</sub> (Note 5)	Low Level Output Voltage A Port	I <sub>OL</sub> = 100 μA	1.1 - 3.6	1.1 - 3.6			0.2	V
		I <sub>OL</sub> = 12 mA	2.7	2.7			0.4	
		I <sub>OL</sub> = 18 mA	3.0	3.0			0.4	
		I <sub>OL</sub> = 24 mA	3.0	3.0			0.55	
		I <sub>OL</sub> = 12 mA	2.3	2.3			0.4	
		I <sub>OL</sub> = 18 mA	2.3	2.3			0.6	
		I <sub>OL</sub> = 6 mA	1.65	1.65			0.3	
		I <sub>OL</sub> = 2 mA	1.4	1.4			0.35	
I <sub>OL</sub> = 0.5 mA	1.1	1.1			0.3 x V <sub>CC0</sub>			
I <sub>I</sub>	Input Leakage Current Control Pins	V <sub>I</sub> = V <sub>CCA</sub> or GND	1.1 - 3.6	3.6			±1.0	μA

DC Electrical Characteristics (Continued)								
Symbol	Parameter	Conditions	V <sub>CCI</sub> (V)	V <sub>CCO</sub> (V)	Min	Typ	Max	Units
I <sub>I(HOLD)</sub>	Bushold Input Minimum Drive Current	V <sub>IN</sub> = 0.8	3.0	3.0	75.0			μA
		V <sub>IN</sub> = 2.0	3.0	3.0	-75.0			
		V <sub>IN</sub> = 0.7	2.3	2.3	45.0			
		V <sub>IN</sub> = 1.6	2.3	2.3	-45.0			
		V <sub>IN</sub> = 0.57	1.65	1.65	25.0			
		V <sub>IN</sub> = 1.07	1.65	1.65	-25.0			
		V <sub>IN</sub> = 0.49	1.4	1.4	11.0		4.0	
		V <sub>IN</sub> = 0.91	1.4	1.4	-11.0		-4.0	
I <sub>I(OD)</sub> (Note 6) (Note 7)	Bushold Input Over-drive Current-to-Change State	(Note 6)	3.6	3.6	450			μA
		(Note 7)	3.6	3.6	-450			
		(Note 6)	2.7	2.7	300			
		(Note 7)	2.7	2.7	-300			
		(Note 6)	1.95	1.95	200			
		(Note 7)	1.95	1.95	-200			
		(Note 6)	1.6	1.6	120			
		(Note 7)	1.6	1.6	-120			
I <sub>OFF</sub>	Power Off Leakage Current	A <sub>n</sub> , V <sub>I</sub> or V <sub>O</sub> = 0V to 3.6V	0	3.6			±10.0	μA
		B <sub>n</sub> , V <sub>I</sub> or V <sub>O</sub> = 0V to 3.6V	3.6	0			±10.0	
I <sub>OZ</sub> (Note 8)	3-STATE Output Leakage V <sub>O</sub> , V <sub>CC</sub> or GND V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	A <sub>n</sub> , B <sub>n</sub> $\overline{OE} = V_{IH}$	3.6	3.6			±10.0	μA
		B <sub>n</sub> , $\overline{OE} = \text{Don't Care}$	0	3.6			+10.0	
		A <sub>n</sub> , $\overline{OE} = \text{Don't Care}$	3.6	0			+10.0	
I <sub>CCA/B</sub> (Note 9)	Quiescent Supply Current	V <sub>I</sub> = V <sub>CCI</sub> or GND; I <sub>O</sub> = 0	1.1 - 3.6	1.1 - 3.6			20.0	μA
I <sub>CCZ</sub> (Note 9)	Quiescent Supply Current	V <sub>I</sub> = V <sub>CCI</sub> or GND; I <sub>O</sub> = 0	1.1 - 3.6	1.1 - 3.6			20.0	μA
I <sub>CCA</sub>	Quiescent Supply Current	V <sub>I</sub> = V <sub>CCA</sub> or GND; I <sub>O</sub> = 0	0	1.1 - 3.6			-10.0	μA
		V <sub>I</sub> = V <sub>CCA</sub> or GND; I <sub>O</sub> = 0	1.1 - 3.6	0			10.0	
I <sub>CCB</sub>	Quiescent Supply Current	V <sub>I</sub> = V <sub>CCB</sub> or GND; I <sub>O</sub> = 0	1.1 - 3.6	0			-10.0	μA
		V <sub>I</sub> = V <sub>CCB</sub> or GND; I <sub>O</sub> = 0	0	1.1 - 3.6			10.0	
ΔI <sub>CCA/B</sub>	Increase in I <sub>CC</sub> per Input; Other Inputs at V <sub>CC</sub> or GND	V <sub>IH</sub> = 3.0	3.6	3.6			500	μA
<p><b>Note 4:</b> V<sub>CCI</sub> = the V<sub>CC</sub> associated with the data input under test.</p> <p><b>Note 5:</b> V<sub>CCO</sub> = the V<sub>CC</sub> associated with the output under test.</p> <p><b>Note 6:</b> An external driver must source at least the specified current to switch LOW-to-HIGH.</p> <p><b>Note 7:</b> An external driver must sink at least the specified current to switch HIGH-to-LOW.</p> <p><b>Note 8:</b> Don't Care = Any valid logic level.</p> <p><b>Note 9:</b> Reflects current per supply, V<sub>CCA</sub> or V<sub>CCB</sub>.</p>								

AC Electrical Characteristics $V_{CCA} = 3.0V$ to $3.6V$												
Symbol	Parameter	$T_A = -40^{\circ}C$ to $+85^{\circ}C$										Units
		$V_{CCB} = 3.0V$ to $3.6V$		$V_{CCB} = 2.3V$ to $2.7V$		$V_{CCB} = 1.65V$ to $1.95V$		$V_{CCB} = 1.4V$ to $1.6V$		$V_{CCB} = 1.1V$ to $1.3V$		
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$t_{PLH}$	Propagation Delay A to B	0.5	3.9	0.5	4.5	0.9	5.9	1.0	7.4	1.6	22.0	ns
$t_{PHL}$	Propagation Delay B to A	0.2	3.5	0.2	3.8	0.3	4.0	0.5	4.3	0.8	13.0	
$t_{PZH}$	Output Enable OE to B	0.7	4.8	1.0	5.1	1.5	6.7	1.5	7.1	2.0	18.0	ns
$t_{PZL}$	Output Enable OE to A	0.5	4.0	0.5	4.0	0.5	4.0	0.5	4.0	0.5	4.0	
$t_{PHZ}$	Output Disable OE to B	0.4	4.3	0.4	4.4	0.9	5.2	1.7	6.8	2.0	19.0	ns
$t_{PLZ}$	Output Disable OE to A	0.2	3.7	0.2	3.7	0.2	3.7	0.2	3.7	0.2	3.7	

AC Electrical Characteristics $V_{CCA} = 2.3V$ to $2.7V$												
Symbol	Parameter	$T_A = -40^{\circ}C$ to $+85^{\circ}C$										Units
		$V_{CCB} = 3.0V$ to $3.6V$		$V_{CCB} = 2.3V$ to $2.7V$		$V_{CCB} = 1.65V$ to $1.95V$		$V_{CCB} = 1.4V$ to $1.6V$		$V_{CCB} = 1.1V$ to $1.3V$		
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$t_{PLH}$	Propagation Delay A to B	0.5	4.3	0.6	4.8	0.9	6.0	1.0	7.6	1.6	22.0	ns
$t_{PHL}$	Propagation Delay B to A	0.3	3.9	0.4	4.2	0.5	4.5	0.5	4.8	1.0	7.0	
$t_{PZH}$	Output Enable OE to B	0.8	5.1	1.0	5.5	1.5	6.9	1.5	7.4	2.0	19.0	ns
$t_{PZL}$	Output Enable OE to A	0.6	4.5	0.6	4.5	0.6	4.5	0.6	4.5	0.6	4.5	
$t_{PHZ}$	Output Disable OE to B	0.4	4.6	0.4	4.8	0.9	5.3	1.7	7.1	2.0	19.0	ns
$t_{PLZ}$	Output Disable OE to A	0.2	4.0	0.2	4.0	0.2	4.0	0.2	4.0	0.2	4.0	

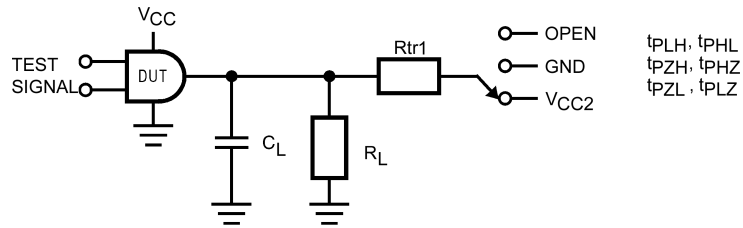
AC Electrical Characteristics $V_{CCA} = 1.65V$ to $1.95V$												
Symbol	Parameter	$T_A = -40^{\circ}C$ to $+85^{\circ}C$										Units
		$V_{CCB} = 3.0V$ to $3.6V$		$V_{CCB} = 2.3V$ to $2.7V$		$V_{CCB} = 1.65V$ to $1.95V$		$V_{CCB} = 1.4V$ to $1.6V$		$V_{CCB} = 1.1V$ to $1.3V$		
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$t_{PLH}$	Propagation Delay A to B	0.5	4.6	0.7	5.1	1.1	6.2	1.1	7.8	1.7	22.0	ns
$t_{PHL}$	Propagation Delay B to A	0.5	5.4	0.5	5.6	0.8	5.7	1.0	6.0	1.2	8.0	
$t_{PZH}$	Output Enable OE to B	0.8	5.4	1.0	5.9	1.5	7.3	1.5	7.7	2.0	20.0	ns
$t_{PZL}$	Output Enable OE to A	1.0	6.7	1.0	6.7	1.0	6.7	1.0	6.7	1.0	6.7	
$t_{PHZ}$	Output Disable OE to B	0.4	4.7	0.4	4.9	1.0	5.4	1.7	7.2	2.0	19.0	ns
$t_{PLZ}$	Output Disable OE to A	0.5	5.0	0.5	5.0	0.5	5.0	0.5	5.0	0.5	5.0	

AC Electrical Characteristics $V_{CCA} = 1.4V$ to $1.6V$												
Symbol	Parameter	$T_A = -40^{\circ}C$ to $+85^{\circ}C$										Units
		$V_{CCB} = 3.0V$ to $3.6V$		$V_{CCB} = 2.3V$ to $2.7V$		$V_{CCB} = 1.65V$ to $1.95V$		$V_{CCB} = 1.4V$ to $1.6V$		$V_{CCB} = 1.1V$ to $1.3V$		
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$t_{PLH}$	Propagation Delay A to B	0.7	4.8	0.8	5.3	1.2	6.4	1.3	7.9	2.0	22.0	ns
$t_{PHL}$	Propagation Delay B to A	0.6	6.8	0.8	6.9	0.9	7.1	1.0	7.3	1.3	9.5	
$t_{PZH}$	Output Enable OE to B	1.1	5.8	1.3	6.3	1.5	7.8	2.0	8.1	2.0	20.0	ns
$t_{PZL}$	Output Enable OE to A	1.0	7.5	1.0	7.5	1.0	7.5	1.0	7.5	1.0	7.5	
$t_{PHZ}$	Output Disable OE to B	0.6	4.8	0.6	5.1	1.1	5.8	2.0	7.7	2.0	20.0	ns
$t_{PLZ}$	Output Disable OE to A	1.0	6.0	1.0	6.0	1.0	6.0	1.0	6.0	1.0	6.0	

AC Electrical Characteristics $V_{CCA} = 1.1V$ to $1.3V$												
Symbol	Parameter	$T_A = -40^{\circ}C$ to $+85^{\circ}C$										Units
		$V_{CCB} = 3.0V$ to $3.6V$		$V_{CCB} = 2.3V$ to $2.7V$		$V_{CCB} = 1.65V$ to $1.95V$		$V_{CCB} = 1.4V$ to $1.6V$		$V_{CCB} = 1.1V$ to $1.3V$		
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$t_{PLH}$	Propagation Delay A to B	1.0	13.8	1.0	7.8	1.0	8.4	1.0	10.4	2.0	24.0	ns
$t_{PHL}$	Propagation Delay B to A	1.4	22.0	1.4	22.0	1.5	22.0	1.5	22.0	2.0	24.0	
$t_{PZH}$	Output Enable OE to B	1.5	12.6	1.5	9.6	1.5	10.6	2.0	11.6	2.0	24.0	ns
$t_{PZL}$	Output Enable OE to A	2.0	22.0	2.0	22.0	2.0	22.0	2.0	22.0	2.0	22.0	
$t_{PHZ}$	Output Disable OE to B	1.2	15.0	0.9	7.6	1.2	8.6	2.0	10.6	3.0	21.0	ns
$t_{PLZ}$	Output Disable OE to A	2.0	15.0	2.0	12.0	2.0	12.0	2.0	12.0	2.0	12.0	
Capacitance												
Symbol	Parameter	Conditions		$T_A = +25^{\circ}C$ Typical	Units							
$C_{IN}$	Input Capacitance Control Pins ( $\overline{OE}$ , $T/\overline{R}$ )	$V_{CCA} = V_{CCB} = 3.3V$ , $V_I = 0V$ or $V_{CCA/B}$		4.0	pF							
$C_{I/O}$	Input/Output Capacitance $A_n$ , $B_n$ Port	$V_{CCA} = V_{CCB} = 3.3V$ , $V_I = 0V$ or $V_{CCA/B}$		5.0	pF							
$C_{PD}$	Power Dissipation Capacitance	$V_{CCA} = V_{CCB} = 3.3V$ , $V_I = 0V$ or $V_{CC}$ , $F = 10$ MHz		20.0	pF							

## AC Loading and Waveforms

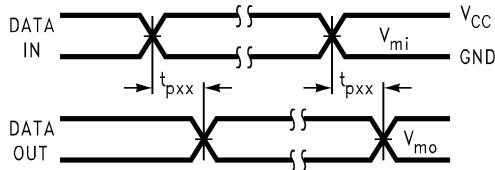


Test	Switch
$t_{PLH}, t_{PHL}$	Open
$t_{PLZ}, t_{PZL}$	$V_{CC0} \times 2$ at $V_{CC0} = 3.3V \pm 0.3V, 2.5V \pm 0.2V, 1.8V \pm 0.15V, 1.5V \pm 0.1V, 1.2V \pm 0.1V$
$t_{PHZ}, t_{PZH}$	GND

FIGURE 1. AC Test Circuit

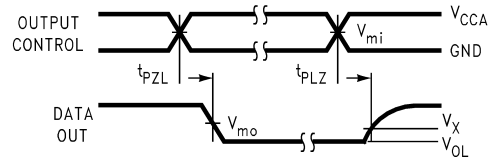
AC Load Table

$V_{CC0}$	$C_L$	$R_L$	$R_{TR1}$
$1.2V \pm 0.1V$	15 pF	2k $\Omega$	2k $\Omega$
$1.5V \pm 0.1V$	15 pF	2k $\Omega$	2k $\Omega$
$1.8V \pm 0.15V$	30 pF	500 $\Omega$	500 $\Omega$
$2.5V \pm 0.2V$	30 pF	500 $\Omega$	500 $\Omega$
$3.3V \pm 0.3V$	30 pF	500 $\Omega$	500 $\Omega$



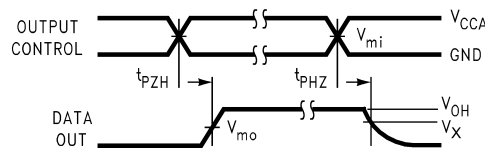
Note: Input  $t_R = t_F = 2.0$  ns, 10% to 90%

FIGURE 2. Waveform for Inverting and Non-Inverting Functions



Note: Input  $t_R = t_F = 2.0$  ns, 10% to 90%

FIGURE 3. 3-STATE Output High Enable and Disable Times for Low Voltage Logic



Note: Input  $t_R = t_F = 2.0$  ns, 10% to 90%

FIGURE 4. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

Symbol	$V_{CC}$	
	$3.3V \pm 0.3V$	$2.5V \pm 0.2V$
$V_{mi}$	$V_{CC}/2$	$V_{CC}/2$
$V_{mo}$	$V_{CC0}/2$	$V_{CC0}/2$
$V_X$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$
$V_Y$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$

Symbol	$V_{CC}$		
	$1.8V \pm 0.15V$	$1.5V \pm 0.1V$	$1.2V \pm 0.1V$
$V_{mi}$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$
$V_{mo}$	$V_{CC0}/2$	$V_{CC0}/2$	$V_{CC0}/2$
$V_X$	$V_{OH} - 0.15V$	$V_{OH} - 0.1V$	$V_{OH} - 0.1V$
$V_Y$	$V_{OL} + 0.15V$	$V_{OL} + 0.1V$	$V_{OL} + 0.1V$

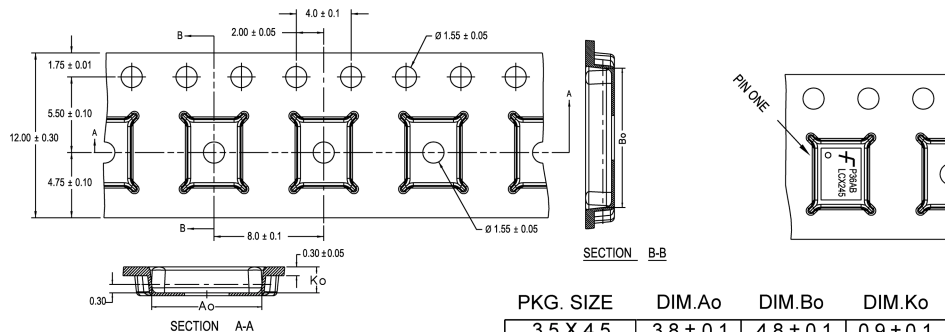
Note: For  $V_{mi}$ :  $V_{CC1} = V_{CCA}$  for control pins  $\overline{T/R}$  and  $\overline{OE}$ , or  $(V_{CCA}/2)$ .

## Tape and Reel Specification

### Tape Format for MLP

Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
MPX	Leader (Start End)	125 (typ)	Empty	Sealed
	Carrier	3000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed

### TAPE DIMENSIONS inches (millimeters)



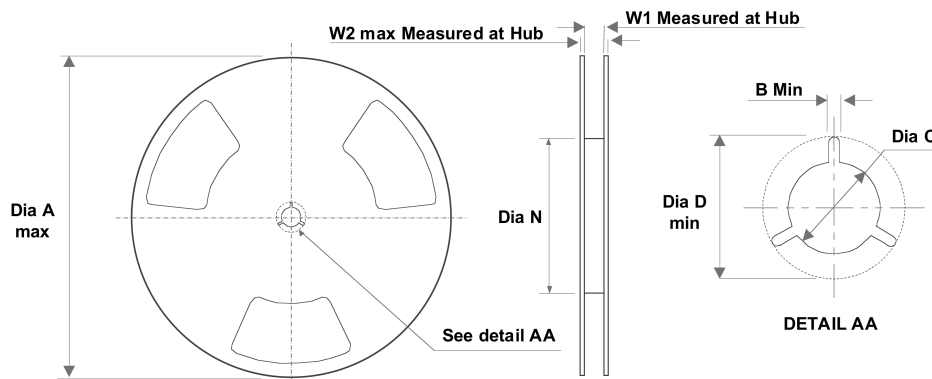
PKG. SIZE	DIM.Ao	DIM.Bo	DIM.Ko
3.5 X 4.5	3.8 ± 0.1	4.8 ± 0.1	0.9 ± 0.1
3.0 X 3.0	3.3 ± 0.1	3.3 ± 0.1	0.9 ± 0.1
2.5 X 4.5	2.8 ± 0.1	4.8 ± 0.1	0.9 ± 0.1
2.5 X 3.5	2.8 ± 0.1	3.8 ± 0.1	0.9 ± 0.1
2.5 X 3.0	2.8 ± 0.1	3.3 ± 0.1	0.9 ± 0.1
2.5 X 2.5	2.8 ± 0.1	2.8 ± 0.1	0.9 ± 0.1

DIMENSIONS ARE IN MILLIMETERS

NOTES: unless otherwise specified

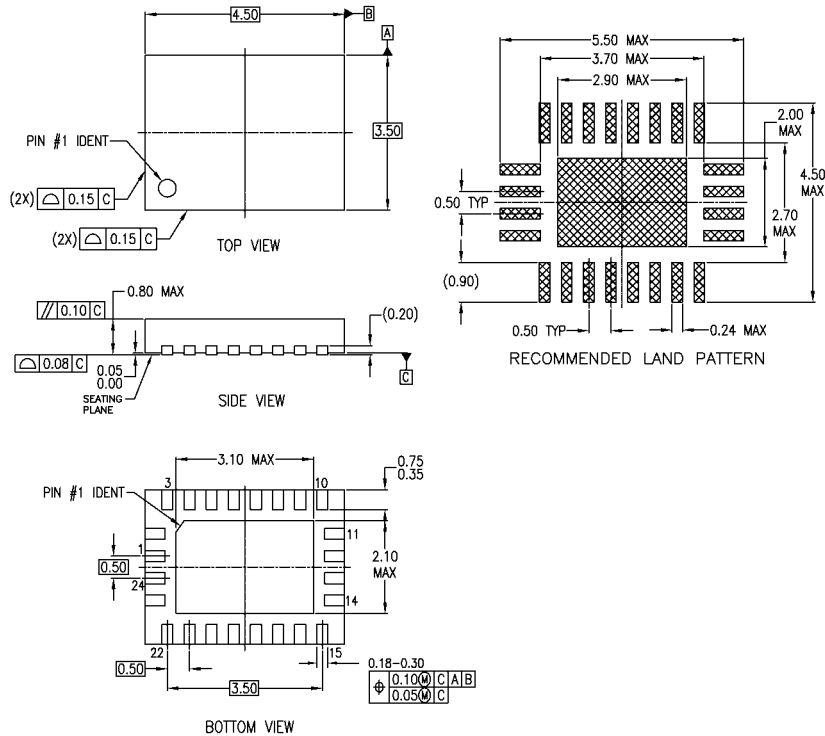
1. Cumulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is  $\pm 0.002[0.05]$  for these dimensions on all 12mm tapes.
5. A<sub>o</sub> and B<sub>o</sub> measured on a plane 0.120[0.30] above the bottom of the pocket.
6. K<sub>o</sub> measured from the inside bottom of the pocket to the top surface of the carrier.
7. Pocket position relative to sprocket hole measured as true position of pocket. Not pocket hole.
8. Controlling dimension is millimeter. Dimension in inches rounded.

### REEL DIMENSIONS inches (millimeters)



Tape Size	A	B	C	D	N	W1	W2
12 mm	13.0 (330.0)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.488 (12.4)	0.724 (18.4)

**Physical Dimensions** inches (millimeters) unless otherwise noted



**NOTES:**

- A. CONFORMS TO JEDEC REGISTRATION MO-220, VARIATION WFSD-2 FOR DIMENSIONS ONLY. PIN NUMBERING DOES NOT COMPLY.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP024RevC

**24-Terminal Molded Leadless Package (MLP), JEDEC MO-220, 3.5mm x 4.5mm  
Package Number MLP024B**

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