Low-Voltage, Dual-Supply, 8-Bit, Signal Translator with Configurable Voltage Supplies, Signal Levels, and 3-State Outputs

FXL4245

General Description

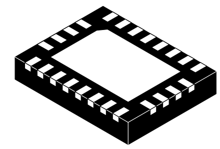
The FXL4245 is a configurable dual-voltage-supply translator designed for bi-directional voltage translation of signals between two voltage levels. The device allows translation between voltages as high as 3.6 V to as low as 1.1 V. The A port tracks the V_{CCA} level and the B port tracks the V_{CCB} level. Both ports are designed to accept supply voltage levels from 1.1 V to 3.6 V. 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}s 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 FXL4245 is designed with the control pins (T/$\overline{R}$ and $\overline{OE}$) supplied by V_{CCA}.

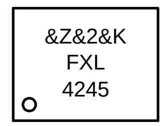
Features

- Bi-Directional Interface between Two Levels from 1.1 V to 3.6 V
- Fully Configurable, Inputs 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
- Control Inputs (T/$\overline{R}$, $\overline{OE}$) Levels are Referenced to V_{CCA} Voltage
- Packaged in 24-Pin MLP
- ESD Protection Exceeds:
  - 4 kV Human Body Model (per JESD22-A114 & Mil Std 883e 3015.7)
  - 8 kV Human Body Model I/O to GND (per JESD22-A114 & Mil Std 883e 3015.7)
  - 1 kV Charge Device Model (per ESD STM 5.3)
  - 200 V Machine Model (per JESD22-A115 & ESD STM5.2)
- This Device is Pb-Free, Halide Free and is RoHS Compliant



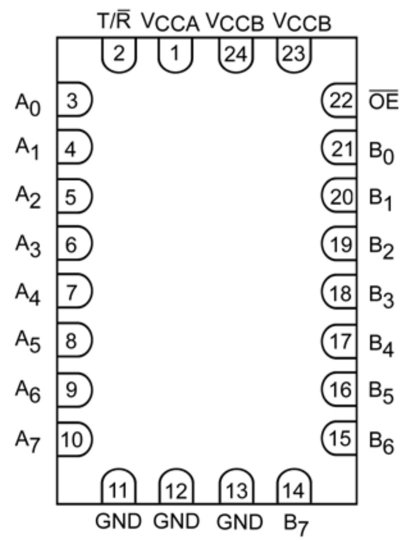
WQFN24 4.5x3.5, 0.5P
CASE 510CE

MARKING DIAGRAM



FXL4245	=	Specific Device Code
&Z	=	Assembly Plant Code
&2	=	2-Digit Date Code
&K	=	2-Digits Lot Run Traceability Code

PIN CONFIGURATION



Top Through View

ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

PIN DESCRIPTIONS

Pin #	Name	Description
1	V_{CCA}	Side-A Power Supply
2	$T/\overline{R}$	Transmit / Receive Input
3, 4, 5, 6, 7, 8, 9, 10	A_0, A_1, A_2, A_3, A_4, A_5, A_6, A_7	Side-A Inputs or 3-State Outputs
11, 12, 13	GND	Ground
14, 15, 16, 17, 18, 19, 20, 21	B_7, B_6, B_5, B_4, B_3, B_2, B_1, B_0	Side-B Inputs or 3-State Outputs
22	$\overline{OE}$	Output Enable Input
23, 24	V_{CCB}	Side-B Power Supply
DAP	No Connect	No Connect

TRUTH TABLE

Inputs		Description
$\overline{OE}$	$T/\overline{R}$	
LOW Voltage Level	LOW Voltage Level	Bus B Data to Bus A
LOW Voltage Level	HIGH Voltage Level	Bus A Data to Bus B
HIGH Voltage Level	Don't Care	3-State

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CCA}	Supply Voltage			−0.5	4.6	V
V_{CCB}				−0.5	4.6	
V_I	DC Input Voltage	I/O Port A		−0.5	4.6	V
		I/O Port B		−0.5	4.6	
		Control Inputs ($T/\overline{R}$, $\overline{OE}$)		−0.5	4.6	
V_O	Output Voltage (Note 1)	Output 3-State		−0.5	4.6	V
		Output Active (A_n)		−0.5 to V_{CCA}	0.5	
		Output Active (B_n)		−0.5 to V_{CCB}	0.5	
I_{IK}	DC Input Diode Current	$V_I < 0$ V		−	−50	mA
I_{OK}	DC Output Diode Current	$V_O < 0$ V		−	−50	mA
		$V_O > V_{CC}$		−	50	
I_{OH}/I_{OL}	DC Output Source/Sink Current			−	±50	mA
I_{CC}	DC V_{CC} or Ground Current per Supply Pin			−	±100	mA
T_{STG}	Storage Temperature Range			−65	+150	°C
ESD	Electrostatic Discharge Capability	Human Body Model, JESD22-A114, Mil Std 883e 3015.7		−	4	kV
			I/O to GND	−	8	
		Charged Device Model, JESD22-C101,STM 5.3		−	1	
		Machine Model, JESD22-A115,STM 5.2		−	200	V

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_O Absolute Maximum Rating must be observed.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CC}	Power Supply	Operating V_{CCA} or V_{CCB}		1.1	3.6	V
V_I	Input Voltage	Port A		0	3.6	V
		Port B		0	3.6	
		Control Inputs (T/$\overline{R}$, $\overline{OE}$)		0	V_{CCA}	
I_{OH}/I_{OL}	Output Current	V_{CC0}	3.0 V to 3.6 V	−	±24	mA
			2.3 V to 2.7 V	−	±18	
			1.65 V to 1.95 V	−	±6	
			1.40 V to 1.65 V	−	±2	
			1.1 V to 1.4 V	−	±0.5	
T_A	Operating Temperature, Free Air			−40	+85	°C
ΔV/Δt	Minimum 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 must be held at V_{CCI} or GND.

ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V_{CCI} (V)	V_{CCO} (V)	Min	Max	Unit
V_{IH}	HIGH Level Input (Note 3)	Data Inputs A_n, B_n	2.70 to 3.60	1.1 to 3.6	2.0	−	V
			2.30 to 2.70		1.6	−	
			1.65 to 2.30		0.65 x V_{CCI}	−	
			1.40 to 1.65		0.65 x V_{CCI}	−	
			1.10 to 1.40		0.9 x V_{CCI}	−	
		Control Pins $\overline{OE}$, T/$\overline{R}$ (Referenced to V_{CCA})	2.70 to 3.6	1.1 to 3.6	2.0	−	
			2.30 to 2.70		1.6	−	
			1.65 to 2.30		0.65 x V_{CCA}	−	
			1.40 to 1.65		0.65 x V_{CCA}	−	
			1.10 to 1.40		0.9 x V_{CCA}	−	
V_{IL}	LOW Level Input (Note 3)	Data Inputs A_n, B_n	2.70 to 3.60	1.1 to 3.6	−	0.8	V
			2.30 to 2.70		−	0.7	
			1.65 to 2.30		−	0.35 x V_{CCI}	
			1.40 to 1.65		−	0.35 x V_{CCI}	
			1.10 to 1.40		−	0.10 x V_{CCI}	
		Control Pins /$\overline{OE}$, T/$\overline{R}$ (Referenced to V_{CCA})	2.70 to 3.60	1.1 to 3.6	−	0.8	
			2.30 to 2.70		−	0.7	
			1.65 to 2.30		−	0.35 x V_{CCI}	
			1.40 to 1.65		−	0.35 x V_{CCI}	
			1.10 to 1.40		−	0.10 x V_{CCI}	

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Conditions	V_{CCI} (V)	V_{CCO} (V)	Min	Max	Unit
V_{OH}	HIGH Level Output (Note 4)	$I_{OH} = -100\ \mu A$	1.1 to 3.6	1.1 to 3.6	$V_{CC0} - 0.2$	–	V
		$I_{OH} = -12$ mA	2.7	2.7	2.2	–	
		$I_{OH} = -18$ mA	3.0	3.0	2.4	–	
		$I_{OH} = -24$ mA	3.0	3.0	2.2	–	
		$I_{OH} = -6$ mA	2.3	2.3	2.0	–	
		$I_{OH} = -12$ mA	2.3	2.3	1.8	–	
		$I_{OH} = -18$ mA	2.3	2.3	1.7	–	
		$I_{OH} = -6$ mA	1.65	1.65	1.25	–	
		$I_{OH} = -2$ mA	1.4	1.4	1.05	–	
		$I_{OH} = -0.5$ mA	1.1	1.1	$0.75 \times V_{CC0}$	–	
V_{OL}	LOW Level Output (Note 4)	$I_{OL} = 100\ \mu A$	1.1 to 3.6	1.1 to 3.6	–	0.2	V
		$I_{OL} = 12$ mA	2.7	2.7	–	0.4	
		$I_{OL} = 18$ mA	3.0	3.0	–	0.4	
		$I_{OL} = 24$ mA	3.0	3.0	–	0.55	
		$I_{OL} = 12$ mA	2.3	2.3	–	0.4	
		$I_{OL} = 18$ mA	2.3	2.3	–	0.6	
		$I_{OL} = 6$ mA	1.65	1.65	–	0.3	
		$I_{OL} = 2$ mA	1.4	1.4	–	0.35	
		$I_{OL} = 0.5$ mA	1.1	1.1	–	$0.3 \times V_{CC0}$	
I_L	Input Leakage Current, Control Pins	$V_I = V_{CCA}$ or GND	1.1 to 3.6	3.6	–	±1.0	μA
I_{OFF}	Power Off Leakage Current	A_n, V_I or V_O = 0 V to 3.6 V	0	3.6	–	±10	μA
		B_n, V_I or V_O = 0 V to 3.6 V	3.6	0	–	±10	
I_{OZ}	3-State Output Leakage ($0 \le V_O \le 3.6$ V, $V_I = V_{IH}$ or V_{IL})	A_n, B_n, /OE = V_{IH}	3.6	3.6	–	±10	μA
		B_n, /OE = Don't Care (Note 5)	0	3.6	–	±10	
		A_n, /OE = Don't Care (Note 5)	3.6	0	–	±10	
$I_{CCA/B}$	Quiescent Supply Current (Note 6)	$V_I = V_{CCI}$ or GND; $I_O = 0$	1.1 to 3.6	1.1 to 3.6	–	20	μA
I_{CCZ}			1.1 to 3.6	1.1 to 3.6	–	20	
I_{CCA}		$V_I = V_{CCA}$ or GND; $I_O = 0$	0	1.1 to 3.6	–	−10	
			1.1 to 3.6	0	–	10	
I_{CCB}		$V_I = V_{CCB}$ or GND; $I_O = 0$	1.1 to 3.6	0	–	−10	
			0	1.1 to 3.6	–	10	
$\Delta I_{CCA/B}$	Increase in I_{CC} per Input; Other Inputs at V_{CC} or GND	$V_{IH} = 3.0$	3.6	3.6	–	500	μA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. V_{CCI} = the V_{CC} associated with the data input under test.
4. V_{CCO} = the V_{CC} associated with the output under test.
5. Don't care = Any valid logic level.
6. Reflects current per supply, V_{CCA} or V_{CCB}.

AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	T_A = −40 °C to +85 °C										Unit
		V_{CCB} = 3.0 V to 3.6 V		V_{CCB} = 2.3 V to 2.7 V		V_{CCB} = 1.65 V to 1.95 V		V_{CCB} = 1.4 V to 1.6 V		V_{CCB} = 1.1 V to 1.3 V		
		Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Typ	
V_{CCA} = 3.0 V to 3.6 V												
t_{PLH}, t_{PHL}	Propagation Delay A to B	0.2	3.5	0.3	3.9	0.5	5.4	0.6	6.8	1.4	22.0	ns
	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}, t_{PZL}	Output Enable /OE to B	0.5	4.0	0.7	4.4	1.0	5.9	1.0	6.4	1.5	17.0	ns
	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}, t_{PLZ}	Output Disable /OE to B	0.2	3.8	0.2	4.0	0.7	4.8	1.5	6.2	2.0	17.0	ns
	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	
V_{CCA} = 2.3 V to 2.7 V												
t_{PLH}, t_{PHL}	Propagation Delay A to B	0.2	3.8	0.4	4.2	0.5	5.6	0.8	6.9	1.4	22.0	ns
	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}, t_{PZL}	Output Enable /OE to B	0.6	4.2	0.8	4.6	1.0	6.0	1.0	6.8	1.5	17.0	ns
	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}, t_{PLZ}	Output Disable /OE to B	0.2	4.1	0.2	4.3	0.7	4.8	1.5	6.7	2.0	17.0	ns
	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	
V_{CCA} = 1.65 V to 1.95 V												
t_{PLH}, t_{PHL}	Propagation Delay A to B	0.3	4.0	0.5	4.5	0.8	5.7	0.9	7.1	1.5	22.0	ns
	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}, t_{PZL}	Output Enable /OE to B	0.6	5.2	0.8	5.4	1.2	6.9	1.2	7.2	1.5	18.0	ns
	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}, t_{PLZ}	Output Disable /OE to B	0.2	5.1	0.2	5.2	0.8	5.2	1.5	7.0	2.0	17.0	ns
	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	
V_{CCA} = 1.4 V to 1.6 V												
t_{PLH}, t_{PHL}	Propagation Delay A to B	0.5	4.3	0.5	4.8	1.0	6.0	1.0	7.3	1.5	22.0	ns
	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}, t_{PZL}	Output Enable /OE to B	1.1	7.5	1.1	7.6	1.3	7.7	1.4	7.9	2.0	20.0	ns
	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}, t_{PLZ}	Output Disable /OE to B	0.4	6.1	0.4	6.2	0.9	6.2	1.5	7.5	2.0	18.0	ns
	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	
V_{CCA} = 1.1 V to 1.3 V												
t_{PLH}, t_{PHL}	Propagation Delay A to B	0.8	13.0	1.0	7.0	1.2	8.0	1.3	9.5	2.0	24.0	ns
	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}, t_{PZL}	Output Enable /OE to B	1.0	12.0	1.0	9.0	2.0	10.0	2.0	11.0	2.0	24.0	ns
	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}, t_{PLZ}	Output Disable /OE to B	1.0	15.0	0.7	7.0	1.0	8.0	2.0	10.0	2.0	20.0	ns
	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 °C	Unit
			Typical	
C_{IN}	Input Capacitance	V_{CCA} = V_{CCB} = 0 V, V_I = 0 V or $V_{CCA/B}$	4	pF
$C_{I/O}$	Input/Output Capacitance	V_{CCA} = V_{CCB} = 3.3 V, V_I = 0 V or $V_{CCA/B}$	5	pF
C_{PD}	Power Dissipation Capacitance	V_{CCA} = V_{CCB} = 3.3 V, V_I = 0 V or V_{CC}, f = 10 MHz	20	pF

AC LOADINGS AND WAVEFORMS

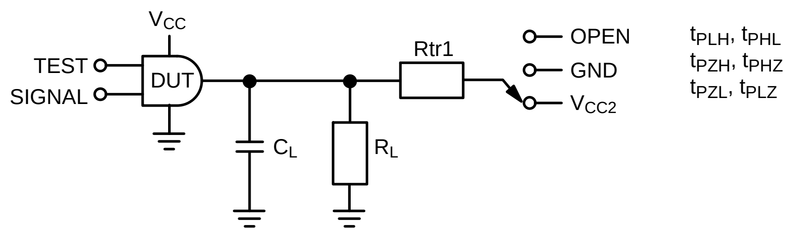
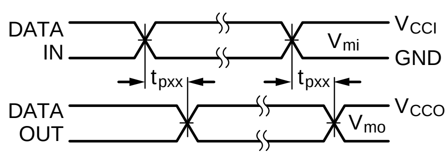


Figure 1. AC Test Circuit

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

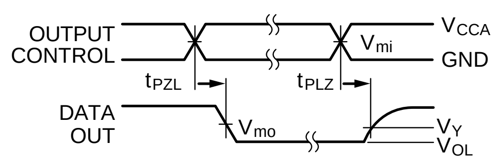
Table 1. AC LOAD TABLE

V_{CC0}	C_L	R_L	Rtr1
1.2 V ±0.1 V	15 pF	2 kΩ	2 kΩ
1.5 V ±0.1 V	15 pF	2 kΩ	2 kΩ
1.8 V ±0.15 V	30 pF	500 kΩ	500 kΩ
2.5 V ±0.2 V	30 pF	500 kΩ	500 kΩ
3.3 V ±0.3 V	30 pF	500 kΩ	500 kΩ



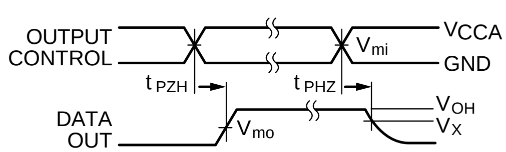
NOTE:
7. Input $t_R = t_F$ = 2.0 ns, 10% to 90%

Figure 2. Waveform for Inverting and Non-Inverting Functions



NOTE:
8. Input $t_R = t_F$ = 2.0 ns, 10% to 90%

Figure 3. 3-State Output Low Enable and Disable for Low Voltage Logic



NOTE:
9. Input $t_R = t_F$ = 2.0 ns, 10% to 90%

Figure 4. 3-State Output High Enable and Disable for Low Voltage Logic

Symbol	V_{CC}				
	3.3 V ±0.3 V	2.5 V ±0.2 V	1.8 V ±0.15 V	1.5 V ±0.1 V	1.2 V ±0.1 V
V_{MI}	V_{CCI} / 2	V_{CCI} / 2	V_{CCI} / 2	V_{CCI} / 2	V_{CCI} / 2
V_{MO}	V_{CCO} / 2	V_{CCO} / 2	V_{CCO} / 2	V_{CCO} / 2	V_{CCO} / 2
V_X	V_{OH} − 0.3 V	V_{OH} − 0.15 V	V_{OH} − 0.15 V	V_{OH} − 0.1 V	V_{OH} − 0.1 V
V_Y	V_{OL} + 0.3 V	V_{OL} + 0.15 V	V_{OL} + 0.15 V	V_{OL} + 0.1 V	V_{OL} + 0.1 V

10. For V_{MI} $V_{CCO} = V_{CCA}$ for Control Pins T/$\overline{R}$ and $\overline{OE}$ or V_{CCA} / 2.

FUNCTIONAL DESCRIPTION

Power-Up/Power-Down Sequencing

FXL translators offer an advantage in that either V_{CC} may be powered up first. This benefit derives from the chip design. When either V_{CC} is at 0 V, outputs are in a High-impedance state. The control inputs (T/$\overline{R}$ and $\overline{OE}$) are designed to track the V_{CCA} supply. A pull-up resistor tying $\overline{OE}$ to V_{CCA} 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 OE driver.

The recommended power-up sequence is:

1. Apply power to either V_{CC}.
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_{CC}.
4. Drive the $\overline{OE}$ input LOW to enable the device.

The recommended power-down sequence is:

1. Drive $\overline{OE}$ input HIGH to disable the device.
2. Remove power from either V_{CC}.
3. Remove power from the other V_{CC}.

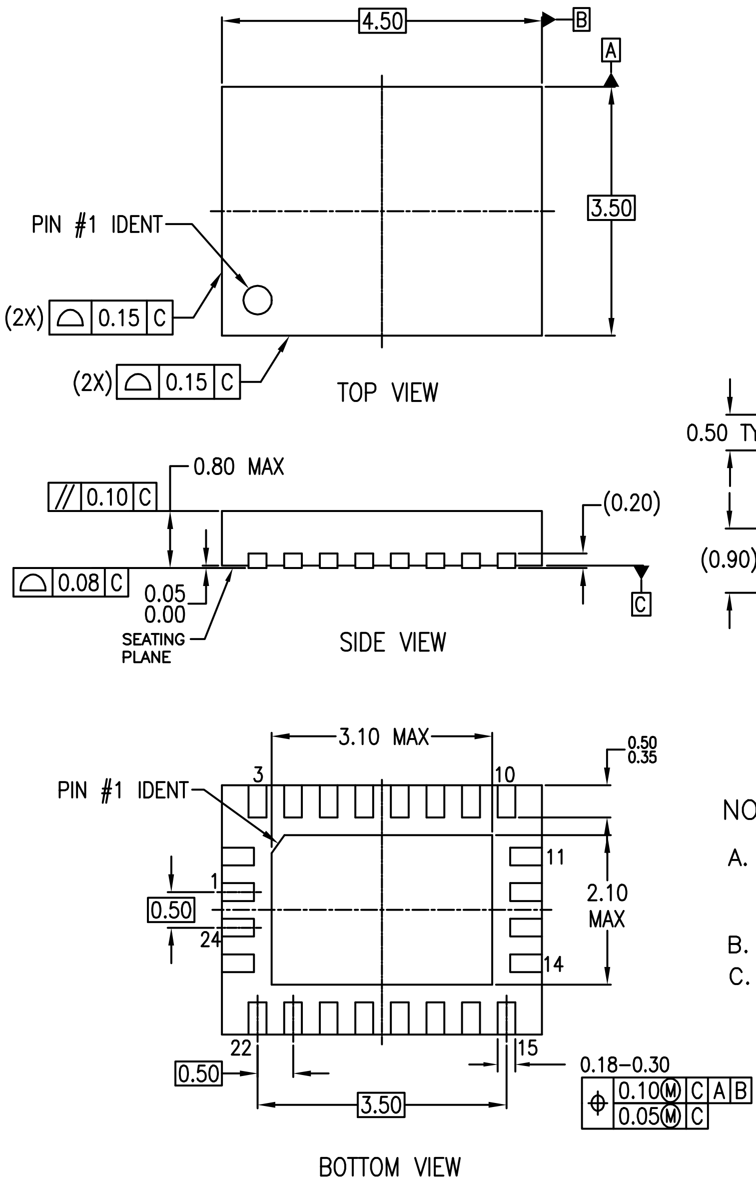
ORDERING INFORMATION

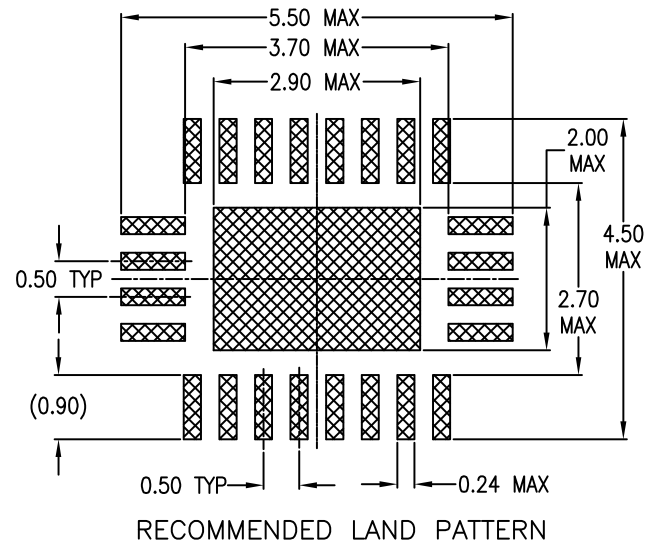
Order Number	Package Description	Shipping†
FXL4245MPX	24-Pin Molded Leadless Package (MLP), JEDEC MO-220, 3.5 x 4.5 mm (Pb-Free, Halide Free)	3000 / Tape & Reel

†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.

WQFN24 4.5x3.5, 0.5P
CASE 510CE
ISSUE O

DATE 31 AUG 2016





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

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