

# FXLA104

## Low-Voltage Dual-Supply 4-Bit Voltage Translator with Configurable Voltage Supplies and Signal Levels, 3-State Outputs, and Auto Direction Sensing

### Features

- Bi-Directional Interface between Two Levels: from 1.1V to 3.6V
- Fully Configurable: Inputs and Outputs Track  $V_{CC}$
- 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 the Need for Pull-Up Resistors
- Control Input (/OE) Referenced to  $V_{CCA}$  Voltage
- Packaged in 16-Terminal  $\mu$ MLP (1.8mm x 2.6mm)
- Direction Control Not Necessary
- 100Mbps Throughput when Translating Between 1.8V and 2.5V
- ESD Protection Exceeds:
  - 8kV HBM (per JESD22-A114 & Mil Std 883e 3015.7)
  - 2kV CDM (per ESD STM 5.3)

### Description

The FXLA104 is a configurable dual-voltage supply translator for both uni-directional and bi-directional voltage translation between two logic 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. 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 three-state until both  $V_{CCs}$  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 HIGH, disables both the A and B ports by placing them in a 3-state condition. The /OE input is supplied by  $V_{CCA}$ .


The FXLA104 supports bi-directional translation without the need for a direction control pin. The two ports of the device have auto-direction sense capability. Either port may sense an input signal and transfer it as an output signal to the other port.

### Applications

- Cell Phone, PDA, Digital Camera, Portable GPS

### Ordering Information

Part Number	Operating Temperature Range	 Eco Status	Package	Packing Method
FXLA104UMX	-40 to 85°C	Green	16-Terminal $\mu$ MLP 1.8 x2.6mm Package	Tape and Reel

 For Fairchild's definition of "green" Eco Status, please visit: [http://www.fairchildsemi.com/company/green/rohs\\_green.html](http://www.fairchildsemi.com/company/green/rohs_green.html).

## Pin Configuration

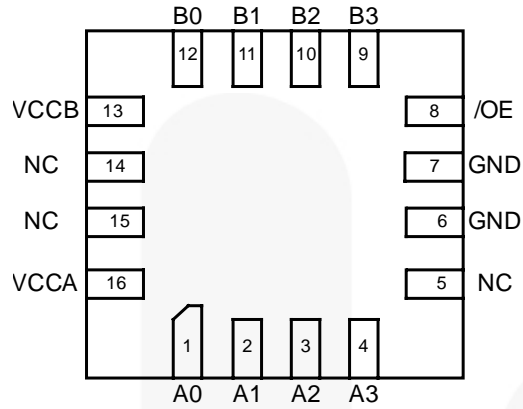


Figure 1. Pin Configuration (Top Through View)

## Pin Definitions

Pin #	Name	Description
1	A0	A-Side Inputs or 3-State Outputs
2	A1	A-Side Inputs or 3-State Outputs
3	A2	A-Side Inputs or 3-State Outputs
4	A3	A-Side Inputs or 3-State Outputs
5	NC	No Connect
6	GND	Ground
7	GND	Ground
8	/OE	Output Enable Input
9	B3	B-Side Inputs or 3-State Outputs
10	B2	B-Side Inputs or 3-State Outputs
11	B1	B-Side Inputs or 3-State Outputs
12	B0	B-Side Inputs or 3-State Outputs
13	VCCB	B-Side Power Supply
14	NC	No Connect
15	NC	No Connect
16	VCCA	A-Side Power Supply

### Functional Diagram

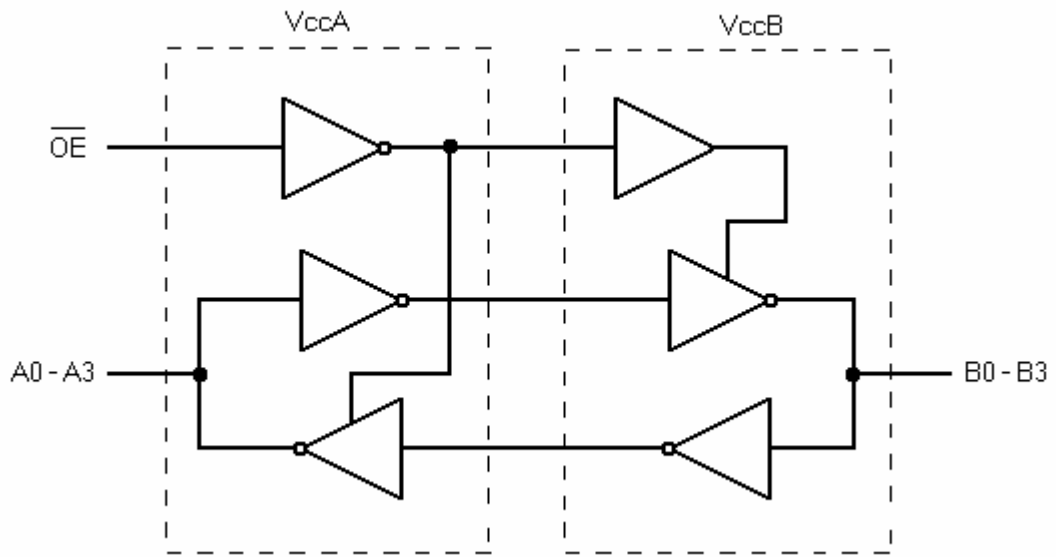


Figure 2. Functional Diagram

### Function Table

Control	Outputs
$\overline{OE}$	
LOW Logic Level	Normal Operation
HIGH Logic Level	3-State

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Conditions	Min.	Max.	Unit
V <sub>CC</sub>	Supply Voltage	V <sub>CCA</sub>	-0.5	4.6	V
		V <sub>CCB</sub>	-0.5	4.6	
V <sub>I</sub>	DC Input Voltage	I/O Ports A and B	-0.5	4.6	V
		Control Input (/OE)	-0.5	4.6	
V <sub>O</sub>	Output Voltage <sup>(2)</sup>	Output 3-State	-0.5	4.6	V
		Output Active (A <sub>n</sub> )	-0.5	V <sub>CCA</sub> + 0.5	
		Output Active (B <sub>n</sub> )	-0.5	V <sub>CCB</sub> + 0.5	
I <sub>IK</sub>	DC Input Diode Current	V <sub>I</sub> < 0V		-50	mA
I <sub>OK</sub>	DC Output Diode Current	V <sub>O</sub> < 0V		-50	mA
		V <sub>O</sub> > V <sub>CC</sub>		+50	
I <sub>OH</sub> /I <sub>OL</sub>	DC Output Source/Sink Current		-50	+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	+150	°C

### Notes:

- I<sub>O</sub> absolute maximum ratings must be observed.
- All unused inputs and input/outputs must be held at V<sub>CCi</sub> or GND.

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Conditions	Min.	Max.	Unit
V <sub>CC</sub>	Power Supply	Operating V <sub>CCA</sub> or V <sub>CCB</sub>	1.1	3.6	V
V <sub>IN</sub>	Input Voltage	Ports A and B	0	3.6	V
		Control Input (/OE)	0	V <sub>CCA</sub>	V
T <sub>A</sub>	Operating Temperature, Free Air		-40	+85	°C
dt/dV	Minimum Input Edge Rate	V <sub>CCA/B</sub> = 1.1 to 3.6V		10	ns/V

## Power-Up/Power-Down Sequence

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 0V, outputs are in a high-impedance state. The control input (/OE) is designed to track the  $V_{CCA}$  supply. A pull-up resistor tying /OE to  $V_{CCA}$  should be used to ensure that bus contention, excessive currents, or oscillations do not occur during power-up or power-down. The size of the pull-up resistor is based upon the current-sinking capability of the device driving the /OE pin.

The recommended power-up sequence is:

1. Apply power to the first  $V_{CC}$ .
2. Apply power to the second  $V_{CC}$ .
3. Drive the /OE input LOW to enable the device.

The recommended power-down sequence is:

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

### DC Electrical Characteristics

T<sub>A</sub> = -40 to 85°C

Symbol	Parameter	Conditions	V <sub>CCA</sub> (V)	V <sub>CCB</sub> (V)	Min.	Typ.	Max.	Units
V <sub>IHA</sub>	High-Level Input Voltage	Data Inputs A <sub>n</sub> Control Pin /OE	2.70 to 3.60	1.10 to 3.60	2.00			V
			2.30 to 2.70		1.60			
			1.65 to 2.30		.65xV <sub>CCA</sub>			
			1.40 to 1.65		.65xV <sub>CCA</sub>			
			1.10 to 1.40		.90xV <sub>CCA</sub>			
V <sub>IHB</sub>	High-Level Input Voltage	Data Inputs B <sub>n</sub>	2.70 to 3.60	1.10 to 3.60	2.00			V
			2.30 to 2.70		1.60			
			1.65 to 2.30		.65xV <sub>CCB</sub>			
			1.40 to 1.65		.65xV <sub>CCB</sub>			
			1.10 to 1.40		.90xV <sub>CCB</sub>			
V <sub>IILA</sub>	Low-Level Input Voltage	Data Inputs A <sub>n</sub> Control Pin /OE	2.70 to 3.60	1.10 to 3.60			.80	V
			2.30 to 2.70				.70	
			1.65 to 2.30				.35xV <sub>CCA</sub>	
			1.40 to 1.65				.35xV <sub>CCA</sub>	
			1.10 to 1.40				.10xV <sub>CCA</sub>	
V <sub>IILB</sub>	Low-Level Input Voltage	Data Inputs B <sub>n</sub>	2.70 to 3.60	1.10 to 3.60			.80	V
			2.30 to 2.70				.70	
			1.65 to 2.30				.35xV <sub>CCB</sub>	
			1.40 to 1.65				.35xV <sub>CCB</sub>	
			1.10 to 1.40				.10xV <sub>CCB</sub>	
V <sub>OHA</sub>	High-Level Output Voltage <sup>(3)</sup>	I <sub>OH</sub> = -4μA	1.10 to 3.60	1.10 to 3.60	V <sub>CCA</sub> - .4			V
V <sub>OHB</sub>		I <sub>OH</sub> = -4μA	1.10 to 3.60	1.10 to 3.60	V <sub>CCB</sub> - .4			
V <sub>OLA</sub>	Low-Level Output Voltage <sup>(3)</sup>	I <sub>OL</sub> = 4μA	1.10 to 3.60	1.10 to 3.60			.4	V
V <sub>OLB</sub>		I <sub>OL</sub> = 4μA	1.10 to 3.60	1.10 to 3.60			.4	
I <sub>I(HOLD)</sub>	Bus-Hold Input Minimum Drive Current	V <sub>IN</sub> = 0.8V	3.00	3.00	75.0			μA
		V <sub>IN</sub> = 2.0V	3.00	3.00	-75.0			
		V <sub>IN</sub> = 0.7V	2.30	2.30	45.0			
		V <sub>IN</sub> = 1.6V	2.30	2.30	-45.0			
		V <sub>IN</sub> = 0.57V	1.65	1.65	25.0			
		V <sub>IN</sub> = 1.07V	1.65	1.65	-25.0			
		V <sub>IN</sub> = 0.49V	1.40	1.40	11.0			
		V <sub>IN</sub> = 0.91V	1.40	1.40	-11.0			
		V <sub>IN</sub> = 0.11V	1.10	1.10		4.0		
		V <sub>IN</sub> = 0.99V	1.10	1.10		-4.0		

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## DC Electrical Characteristics (Continued)

T<sub>A</sub> = -40 to 85°C.

Symbol	Parameter	Conditions	V <sub>CCA</sub> (V)	V <sub>CCB</sub> (V)	Min.	Max.	Units
I <sub>I(ODH)</sub>	Bus-Hold Input Overdrive High Current <sup>(4)</sup>	Data Inputs A <sub>n</sub> , B <sub>n</sub>	3.60	3.60	450.0		μA
			2.70	2.70	300.0		
			1.95	1.95	200.0		
			1.60	1.60	120.0		
			1.40	1.40	80.0		
I <sub>I(ODL)</sub>	Bus-Hold Input Overdrive Low Current <sup>(5)</sup>	Data Inputs A <sub>n</sub> , B <sub>n</sub>	3.60	3.60	-450.0		μA
			2.70	2.70	-300.0		
			1.95	1.95	-200.0		
			1.60	1.60	-120.0		
			1.40	1.40	-80.0		
I <sub>I</sub>	Input Leakage Current	Control Inputs /OE, V <sub>I</sub> =V <sub>CCA</sub> or GND	1.10 to 3.60	3.60		±1.0	μA
I <sub>OFF</sub>	Power-Off Leakage Current	A <sub>n</sub> V <sub>O</sub> =0V to 3.6V	0	3.60		±2.0	μA
		B <sub>n</sub> V <sub>O</sub> =0V to 3.6V	3.60	0		±2.0	
I <sub>OZ</sub>	3-State Output Leakage	A <sub>n</sub> , B <sub>n</sub> V <sub>O</sub> =0V or 3.6V, /OE=V <sub>IH</sub>	3.60	3.60		±5.0	μA
		A <sub>n</sub> V <sub>O</sub> =0V or 3.6V, /OE=GND	3.60	0		±5.0	
		B <sub>n</sub> V <sub>O</sub> =0V or 3.6V, /OE=GND	0	3.60		±5.0	
I <sub>CCA/B</sub>	Quiescent Supply Current <sup>(6,7)</sup>	V <sub>I</sub> =V <sub>CC1</sub> or GND; I <sub>O</sub> =0, /OE=GND	1.10 to 3.60	1.10 to 3.60		10.0	μA
I <sub>CCZ</sub>		V <sub>I</sub> =V <sub>CC1</sub> or GND; I <sub>O</sub> =0, /OE=V <sub>IH</sub>	1.10 to 3.60	1.10 to 3.60		10.0	μA
I <sub>CCA</sub>	Quiescent Supply Current	V <sub>I</sub> =V <sub>CCB</sub> or GND; I <sub>O</sub> =0 B-to-A Direction, /OE=GND	0	1.10 to 3.60		-10.0	μA
		V <sub>I</sub> =V <sub>CCA</sub> or GND; I <sub>O</sub> =0 A-to-B Direction	1.10 to 3.60	0		10.0	
I <sub>CCB</sub>	Quiescent Supply Current	V <sub>I</sub> =V <sub>CCA</sub> or GND; I <sub>O</sub> =0, A-to-B Direction, /OE=GND	1.10 to 3.60	0		-10.0	μA
		V <sub>I</sub> =V <sub>CCB</sub> or GND; I <sub>O</sub> =0 B-to-A Direction	0	1.10 to 3.60		10.0	

### Notes:

- This is the output voltage for static conditions. Dynamic drive specifications are given in the Dynamic Output Electrical Characteristics table.
- An external drive must source at least the specified current to switch LOW-to-HIGH.
- An external drive must source at least the specified current to switch HIGH-to-LOW.
- V<sub>CC1</sub> is the V<sub>CC</sub> associated with the input side.
- Reflects current per supply, V<sub>CCA</sub> or V<sub>CCB</sub>.

## Dynamic Output Electrical Characteristic

### A Port (A<sub>n</sub>)

Output Load: C<sub>L</sub>=15pF, R<sub>L</sub> ≥ MΩ (C<sub>I/O</sub>=4pF), T<sub>A</sub>=-40 to 85°C

Symbol	Parameter	V <sub>CCA</sub> =3.0V to 3.6V		V <sub>CCA</sub> =2.3V to 2.7V		V <sub>CCA</sub> =1.65V to 1.95V		V <sub>CCA</sub> =1.4V to 1.6V		V <sub>CCA</sub> =1.1V to 1.3V	Units
		Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	
t <sub>rise</sub>	Output Rise Time A Port <sup>(9)</sup>		3.0		3.5		4.0		5.0	7.5	ns
t <sub>fall</sub>	Output Fall Time A Port <sup>(10)</sup>		3.0		3.5		4.0		5.0	7.5	ns
I <sub>OHD</sub>	Dynamic Output Current High <sup>(9)</sup>	-11.4		-7.5		-4.7		-3.2		-1.7	mA
I <sub>OLD</sub>	Dynamic Output Current Low <sup>(10)</sup>	+11.4		+7.5		+4.7		+3.2		+1.7	mA

### B Port (B<sub>n</sub>)

Output Load: C<sub>L</sub>=15pF, R<sub>L</sub> ≥ MΩ (C<sub>I/O</sub>=5pF), T<sub>A</sub>=-40 to 85°C

Symbol	Parameter	V <sub>CCB</sub> =3.0V to 3.6V		V <sub>CCB</sub> =2.3V to 2.7V		V <sub>CCB</sub> =1.65V to 1.95V		V <sub>CCB</sub> =1.4V to 1.6V		V <sub>CCB</sub> =1.1V to 1.3V	Units
		Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	Max.	Typ.	
t <sub>rise</sub>	Output Rise Time B Port <sup>(9)</sup>		3.0		3.5		4.0		5.0	7.5	ns
t <sub>fall</sub>	Output Fall Time B Port <sup>(10)</sup>		3.0		3.5		4.0		5.0	7.5	ns
I <sub>OHD</sub>	Dynamic Output Current High <sup>(9)</sup>	-12.0		-7.9		-5.0		-3.4		-1.8	mA
I <sub>OLD</sub>	Dynamic Output Current Low <sup>(10)</sup>	+12.0		+7.9		+5.0		+3.4		+1.8	mA

**Notes:**

- 8. Dynamic output characteristics are guaranteed, but not tested.
- 9. See Figure 7.
- 10. See Figure 8.



## AC Characteristics

$V_{CCA} = 3.0V$  to  $3.6V$ ,  $T_A = -40$  to  $85^\circ C$

Symbol	Parameter	$V_{CCB}=3.0V$ 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 $1.3V$	Units
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Typ.	
$t_{PLH}, t_{PHL}$	A to B	0.2	4.0	0.3	4.2	0.5	5.4	0.6	6.8	6.9	ns
	B to A	0.2	4.0	0.2	4.1	0.3	5.0	0.5	6.0	4.5	ns
$t_{PZL}, t_{PZH}$	/OE to A, /OE to B		1.7		1.7		1.7		1.7	1.7	$\mu s$
$t_{SKEW}$	A Port, B Port <sup>(11)</sup>		0.5		0.5		0.5		1.0	1.0	ns

$V_{CCA} = 2.3V$  to  $2.7V$ ,  $T_A = -40$  to  $85^\circ C$

Symbol	Parameter	$V_{CCB}=3.0V$ 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 $1.3V$	Units
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Typ.	
$t_{PLH}, t_{PHL}$	A to B	0.2	4.1	0.4	4.5	0.5	5.6	0.8	6.9	7.0	ns
	B to A	0.3	4.2	0.4	4.5	0.5	5.5	0.5	6.5	4.8	ns
$t_{PZL}, t_{PZH}$	/OE to A, /OE to B		1.7		1.7		1.7		1.7	1.7	$\mu s$
$t_{SKEW}$	A Port, B Port <sup>(11)</sup>		0.5		0.5		0.5		1.0	1.0	ns

$V_{CCA} = 1.65V$  to  $1.95V$ ,  $T_A = -40$  to  $85^\circ C$

Symbol	Parameter	$V_{CCB}=3.0V$ 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 $1.3V$	Units
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Typ.	
$t_{PLH}, t_{PHL}$	A to B	0.3	5.0	0.5	5.5	0.8	6.7	0.9	7.5	7.5	ns
	B to A	0.5	5.4	0.5	5.6	0.8	6.7	1.0	7.0	5.4	ns
$t_{PZL}, t_{PZH}$	/OE to A, /OE to B		1.7		1.7		1.7		1.7	1.7	$\mu s$
$t_{SKEW}$	A Port, B Port <sup>(11)</sup>		0.5		0.5		0.5		1.0	1.0	ns

### Note:

11. 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 10). Skew is guaranteed, but not tested.

**AC Characteristics** (Continued)

 $V_{CCA} = 1.4V$  to  $1.6V$ ,  $T_A = -40$  to  $85^\circ C$ 

Symbol	Parameter	$V_{CCB}=3.0V$ 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	Units
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Typ.	
$t_{PLH}, t_{PHL}$	A to B	0.5	6.0	0.5	6.5	1.0	7.0	1.0	8.5	7.9	ns
	B to A	0.6	6.8	0.8	6.9	0.9	7.5	1.0	8.5	6.1	ns
$t_{PZL}, t_{PZH}$	/OE to A, /OE to B		1.7		1.7		1.7		1.7	1.7	$\mu s$
$t_{SKEW}$	A Port, B Port <sup>(12)</sup>		1.0		1.0		1.0		1.0	1.0	ns

 $V_{CCA} = 1.1V$  to  $1.3V$ ,  $T_A = -40$  to  $85^\circ C$ 

Symbol	Parameter	$V_{CCB}=3.0V$ 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	Units
		Typ.	Typ.	Typ.	Typ.	Typ.	
$t_{PLH}, t_{PHL}$	A to B	4.6	4.8	5.4	6.2	9.2	ns
	B to A	6.8	7.0	7.4	7.8	9.1	ns
$t_{PZL}, t_{PZH}$	/OE to A, /OE to B	1.7	1.7	1.7	1.7	1.7	$\mu s$
$t_{SKEW}$	A Port, B Port <sup>(12)</sup>	1.0	1.0	1.0	1.0	1.0	ns

**Note:**

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 10). Skew is guaranteed, but not tested.

## Maximum Data Rate<sup>(13, 14)</sup>

$T_A = -40$  to  $85^\circ\text{C}$

$V_{CCA}$	$V_{CCB}=3.0\text{V}$ to $3.6\text{V}$	$V_{CCB}=2.3\text{V}$ to $2.7\text{V}$	$V_{CCB}=1.65\text{V}$ to $1.95\text{V}$	$V_{CCB}=1.4\text{V}$ to $1.6\text{V}$	$V_{CCB}=1.1\text{V}$ to $1.3\text{V}$	Units
	Min.	Min.	Min.	Min.	Typ.	
$V_{CCA}=3.00\text{V}$ to $3.60\text{V}$	140	120	100	80	40	Mbps
$V_{CCA}=2.30\text{V}$ to $2.70\text{V}$	120	120	100	80	40	Mbps
$V_{CCA}=1.65\text{V}$ to $1.95\text{V}$	100	100	80	60	40	Mbps
$V_{CCA}=1.40\text{V}$ to $1.60\text{V}$	80	80	60	60	40	Mbps
$V_{CCA}=1.10\text{V}$ to $1.30\text{V}$	Typ.	Typ.	Typ.	Typ.	Typ.	
	40	40	40	40	40	Mbps

### Notes:

13. Maximum data rate is guaranteed, but not tested.

14. Maximum data rate is specified in megabits per second (see Figure 9). It is equivalent to two times the F-toggle frequency, specified in megahertz. For example, 100Mbps is equivalent to 50MHz.

## Capacitance

Symbol	Parameter	Conditions	$T_A = +25^\circ\text{C}$ Typical	Units	
$C_{IN}$	Input Capacitance Control Pin (/OE)	$V_{CCA}=V_{CCB}=\text{GND}$	3	pF	
$C_{I/O}$	Input/Output Capacitance	$V_{CCA}=V_{CCB}=3.3\text{V}$ , /OE= $V_{CCA}$	$A_n$	4	pF
			$B_n$	5	
$C_{pd}$	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 Diagrams

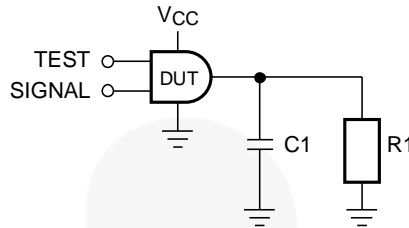


Figure 3. Test Circuit

Table 1. AC Test Conditions

Test	Input Signal	Output Enable Control
$t_{PLH}$ , $t_{PHL}$	Data Pulses	0V
$t_{PZL}$	0V	HIGH to LOW Switch
$t_{PZH}$	$V_{CCI}$	HIGH to LOW Switch

Table 2. AC Load

$V_{CCO}$	C1	R1
$1.2V \pm 0.1V$	15pF	$1M\Omega$
$1.5V \pm 0.1V$	15pF	$1M\Omega$
$1.8V \pm 0.15V$	15pF	$1M\Omega$
$2.5V \pm 0.2V$	15pF	$1M\Omega$
$3.3V \pm 0.3V$	15pF	$1M\Omega$

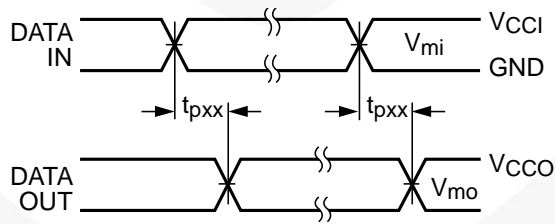


Figure 4. Waveform for Inverting and Non-Inverting Functions

**Notes:**

- 15. Input  $t_R = t_F = 2.0ns$ , 10% to 90%.
- 16. Input  $t_R = t_F = 2.5ns$ , 10% to 90%, at  $V_I = 3.0V$  to  $3.6V$  only.

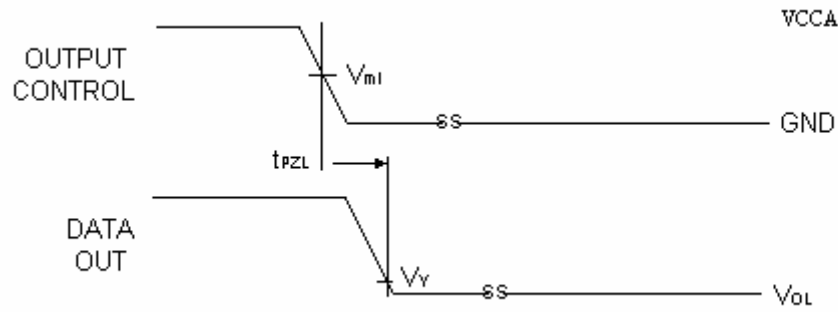


Figure 5. 3-State Output Low Enable Time for Low Voltage Logic

**Notes:**

- 17. Input  $t_R = t_F = 2.0\text{ns}$ , 10% to 90%.
- 18. Input  $t_R = t_F = 2.5\text{ns}$ , 10% to 90%, at  $V_I = 3.0\text{V}$  to  $3.6\text{V}$  only.

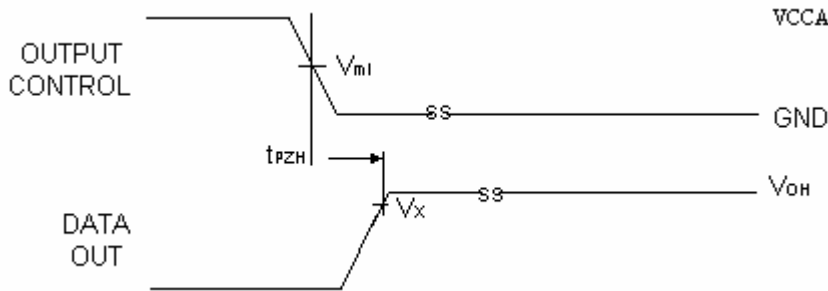


Figure 6. 3-State Output High Enable Time for Low Voltage Logic

**Notes:**

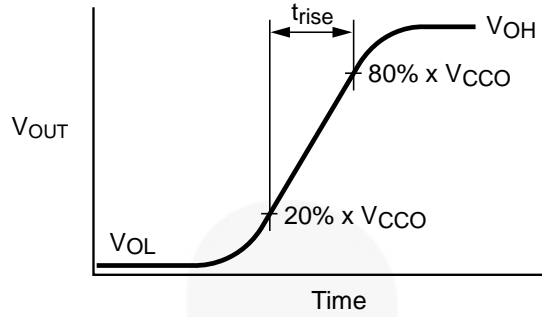
- 19. Input  $t_R = t_F = 2.0\text{ns}$ , 10% to 90%.
- 20. Input  $t_R = t_F = 2.5\text{ns}$ , 10% to 90%, at  $V_I = 3.0\text{V}$  to  $3.6\text{V}$  only.

Table 3. Test Measure Points

Symbol	$V_{DD}$
$V_{M1}^{(21)}$	$V_{CC1} / 2$
$V_{MO}$	$V_{CC0} / 2$
$V_X$	$0.9 \times V_{CC0}$
$V_Y$	$0.1 \times V_{CC0}$

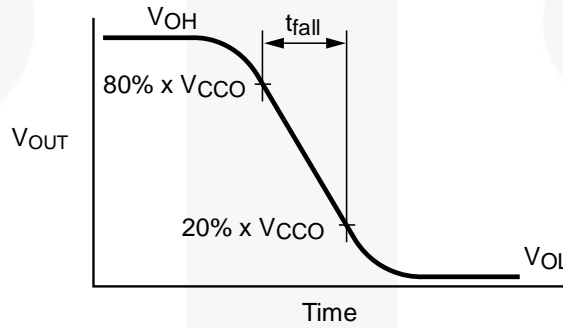
**Note:**

- 21.  $V_{CC1} = V_{CCA}$  for control pin /OE or  $V_{M1}(V_{CCA}/2)$ .



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

Figure 7. Active Output Rise Time and Dynamic Output Current High



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

Figure 8. Active Output Fall Time and Dynamic Output Current Low

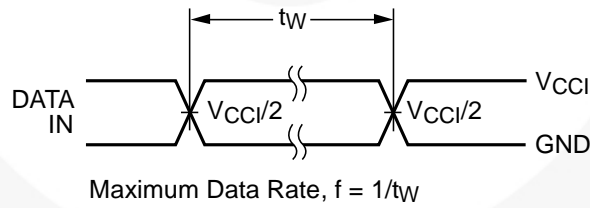


Figure 9. Maximum Data Rate

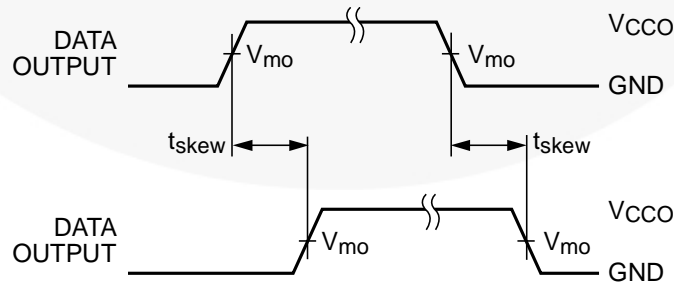
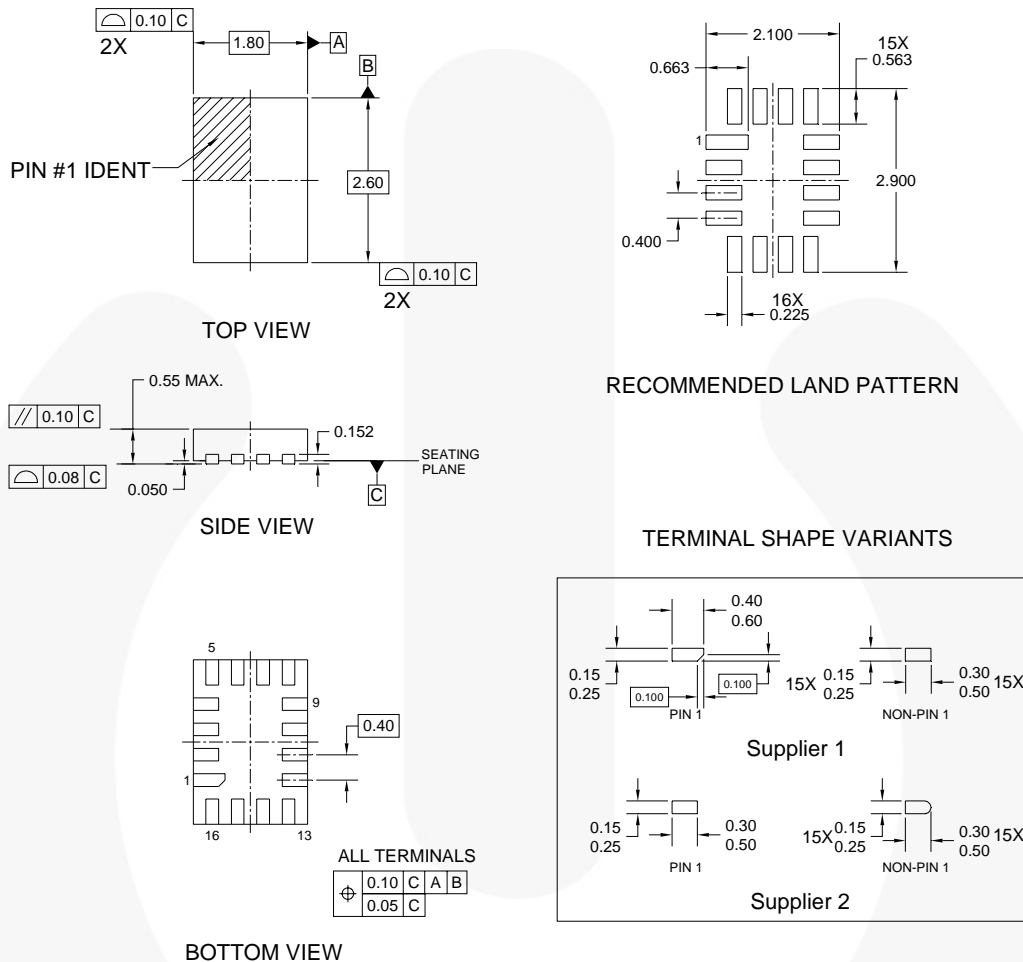


Figure 10. Output Skew Time

**Note:**

22.  $t_{SKEW} = (t_{pHLmax} - t_{pHLmin})$  OR  $(t_{pLHmax} - t_{pLHmin})$

## Physical Dimensions



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- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994
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- E. LAND PATTERN IS A MINIMAL TOE DESIGN
- F. DRAWING FILE NAME : UMLP16AREV3

**Figure 11.16-Terminal μMLP 1.8 x 2.6mm Package**




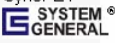
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