

March 2012

FXLA0104

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 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; Do Not Use Pull-Up Resistors on A or B Ports
- Control Input (OE) Referenced to V_{CCA} Voltage
- Available in the 12-Lead, 1.7mm x 2.0mm UMLP Package
- Direction Control Not Necessary
- 100Mbps Throughput when Translating Between 1.8V and 2.5V
- ESD Protection Exceeds:
 - 6kV HBM (per JESD22-A114 & Mil Std 883e 3015.7)
 - 2kV CDM (per ESD STM 5.3)

Applications

Cell Phone, PDA, Digital Camera, Portable GPS

Description

The FXLA0104 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 $V_{\rm CCA}$ level and the B port tracks the $V_{\rm CCB}$ 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 as long as either V_{CC} =0V, 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 the A and B ports by placing them in a 3-state condition. The OE input is supplied by $V_{\rm CCA}$.

The FXLA0104 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.

Ordering Information

Part Number	Operating Temperature Range	Top Mark	Package	Packing Method
FXLA0104QFX	-40 to 85°C	XU	12-Lead, 1.7mm x 2.0mm Ultrathin Molded Leadless Package (UMLP)	5K Units Tape and Reel

Pin Configuration

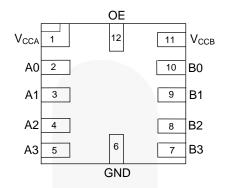


Figure 1. 12-Lead UMLP (Top Through View)

Pin Definitions

Pin #	Name	Description
1	V _{CCA}	A-Side Power Supply
2	A0	A-Side Inputs or 3-State Outputs
3	A1	A-Side Inputs or 3-State Outputs
4	A2	A-Side Inputs or 3-State Outputs
5	A3	A-Side Inputs or 3-State Outputs
6	GND	Ground
7	В3	B-Side Inputs or 3-State Outputs
8	B2	B-Side Inputs or 3-State Outputs
9	B1	B-Side Inputs or 3-State Outputs
10	B0	B-Side Inputs or 3-State Outputs
11	V _{CCB}	B-Side Power Supply
12	OE	Output Enable Input

Functional Diagram

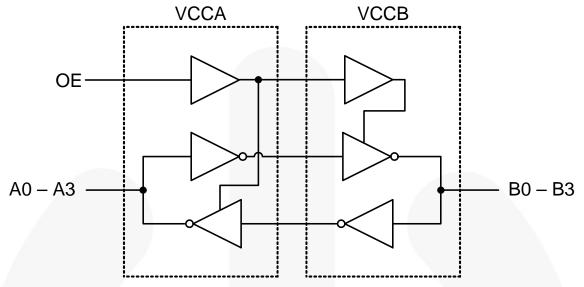


Figure 2. Functional Diagram

Function Table

Control	Outputs
OE	Outputs
LOW Logic Level	3-State
HIGH Logic Level	Normal Operation

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	Condition	Min.	Max.	Unit
V	Cupply Voltogo	V _{CCA}	-0.5	4.6	V
V _{cc}	Supply Voltage	V _{CCB}	-0.5	4.6	V
Vı	DC Input Voltage	I/O Ports A and B	-0.5	4.6	V
٧١	DC Input Voltage	Control Input (OE)	-0.5	4.6	V
		Output 3-State	-0.5	4.6	
Vo	Output Voltage ⁽²⁾	Output Active (A _n)	-0.5	V _{CCA} +0.5	V
		Output Active (B _n)	-0.5	V _{CCB} +0.5	
I _{IK}	DC Input Diode Current	V _{IN} <0V		-50	mA
	DC Output Diada Current	V _O <0V		-50	mA
I _{OK}	DC Output Diode Current	Vo>Vcc		+50	IIIA
I _{OH} /I _{OL}	DC Output Source/Sink Curr	ent	-50	+50	mA
I _{CC}	DC V _{CC} or Ground Current (p	per Supply Pin)		±100	mA
T_{STG}	Storage Temperature Range		-65	+150	°C
P _D	Power Dissipation			17	mW
ESD	Electrostatic Discharge	Human Body Model (per JESD22-A114 & Mil Std 883e 3015.7)		6	kV
ESD	Capability	Charged Device Model (per ESD STM 5.3)		2	ĸV

Notes:

- 1. I_O absolute maximum ratings must be observed.
- 2. All unused inputs and input/outputs must be held at V_{CCi} 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	Condition	Min.	Max.	Unit
Vcc	Power Supply	Operating V _{CCA} or V _{CCB}	1.1	3.6	V
\/	logust Valtage	Ports A and B	0	3.6	V
V_{IN}	Input Voltage	Control Input (OE)	0	V _{CCA}	V
T _A	Operating Temperature, Free Air		-40	+85	°C
dt/dV	Minimum Input Edge Rate	V _{CCA/B} = 1.1 to 3.6V		10	ns/V
ΘЈА	Thermal Resistance: Junction-to-Ambient			300	°C/W
ΘJC	Thermal Resistance: Junction-to-Case			165	°C/W

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.

The recommended power-up sequence is:

- Apply power to the first V_{CC}.
- 2. Apply power to the second V_{CC} .
- 3. Drive the OE input HIGH to enable the device.

The recommended power-down sequence is:

- 1. Drive OE input LOW to disable the device.
- 2. Remove power from either V_{CC} .
- Remove power from other V_{CC}.

Pull-Up/Pull-Down Resistors

 $\underline{\text{Do not use pull-up or pull-down resistors}}.$ This device has bus-hold circuits: pull-up or pull-down resistors are not recommended because they interfere with the output state. The current through these resistors may exceed the hold drive, $I_{\text{I(HOLD)}}$ and/or $I_{\text{I(OD)}}$ bus-hold currents, resulting in data transition and/or auto-direction sensing failures. The bus-hold feature eliminates the need for extra resistors.

DC Electrical Characteristics

T_A=-40 to 85°C

Symbol	Parameter	Condition	V _{CCA} (V)	V _{CCB} (V)	Min.	Тур.	Max.	Unit
			2.70 to 3.60		2.00			
			2.30 to 2.70		1.60			
V_{IHA}		Data Inputs A _n Control Pin OE	1.65 to 2.30	1.10 to 3.60	.65xV _{CCA}			V
	High-Level Input	CONTROL III OL	1.40 to 1.65		.65xV _{CCA}			
			1.10 to 1.40		.90xV _{CCA}			
	Voltage			2.70 to 3.60	2.00			
				2.30 to 2.70	1.60			
V_{IHB}	/інв	Data Inputs B _n	1.10 to 3.60	1.65 to 2.30	.65xV _{CCB}			V
				1.40 to 1.65	.65xV _{CCB}			
				1.10 to 1.40	.90xV _{CCB}			
			2.70 to 3.60				.80	
			2.30 to 2.70	1			.70	
V_{ILA}		Data Inputs A _n Control Pin OE	1.65 to 2.30	1.10 to 3.60			.35xV _{CCA}	V
		Control Fill OE	1.40 to 1.65				.35xV _{CCA}	
	Low-Level Input		1.10 to 1.40				.10xV _{CCA}	
	Voltage			2.70 to 3.60			.80	
		Data Inputs B _n		2.30 to 2.70			.70	
V_{ILB}			1.10 to 3.60	1.65 to 2.30			.35xV _{CCB}	V
				1.40 to 1.65			.35xV _{CCB}	
				1.10 to 1.40			.10xV _{CCB}	
V _{OHA}	High-Level Output	I _{OH} =-4μA	1.10 to 3.60	1.10 to 3.60	V _{CCA} 4			.,
V _{OHB}	Voltage ⁽³⁾	I _{OH} =-4μA	1.10 to 3.60	1.10 to 3.60	V _{CCB} 4			V
V_{OLA}	Low-Level Output	I _{OL} =4µA	1.10 to 3.60	1.10 to 3.60			.4	.,
V_{OLB}	Voltage ⁽³⁾	I _{OL} =4µA	1.10 to 3.60	1.10 to 3.60			.4	V
		V _{IN} =0.8V	3.00	3.00	75.0			
		V _{IN} =2.0V	3.00	3.00	-75.0			
		V _{IN} =0.7V	2.30	2.30	45.0			
		V _{IN} =1.6V	2.30	2.30	-45.0			
	Bus-Hold Input	V _{IN} =0.57V	1.65	1.65	25.0			_
I _{I(HOLD)}	Minimum Drive Current	V _{IN} =1.07V	1.65	1.65	-25.0			μΑ
		V _{IN} =0.49V	1.40	1.40	11.0			
		V _{IN} =0.91V	1.40	1.40	-11.0		7/4	$I \subset$
		V _{IN} =0.11V	1.10	1.10		4.0		5/
		V _{IN} =0.99V	1.10	1.10		-4.0		

Note:

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

Continued on following page...

DC Electrical Characteristics (Continued)

T_A=-40 to 85°C.

Symbol	Parameter	Condition	V _{CCA} (V)	V _{CCB} (V)	Min.	Max.	Unit
			3.60	3.60	450.0		
	Bus-Hold Input		2.70	2.70	300.0		
I _{I(ODH)}	Overdrive High	Data Inputs A _n , B _n	1.95	1.95	200.0		μA
	Current ⁽⁴⁾		1.60	1.60	120.0		
			1.40	1.40	80.0		
			3.60	3.60	-450.0		
	Bus-Hold Input		2.70	2.70	-300.0		
I _{I(ODL)}	Overdrive Low	Data Inputs A _n , B _n	1.95	1.95	-200.0		μA
	Current ⁽⁵⁾		1.60	1.60	-120.0		
			1.40	1.40	-80.0		
l ₁	Input Leakage Current	Control Inputs OE, V _I =V _{CCA} or GND	1.10 to 3.60	3.60		±1.0	μΑ
. /	Power-Off Leakage	A _n V _O =0V to 3.6V	0	3.60		±2.0	
I _{OFF}	Current	B _n V _O =0V to 3.6V	3.60	0		±2.0	μA
		A_n , B_n V_O =0V or 3.6V, OE = V_{IL}	3.60	3.60		±5.0	
l _{OZ}	3-State Output Leakage	$A_n V_O=0V \text{ or } 3.6V,$ $OE=V_{CCA}$	3.60	0		±5.0	μA
		B _n V _O =0V or 3.6V, OE=3.6V	0	3.60		±5.0	
Ісса/в	Quiescent Supply	V _I =V _{CCI} or GND; I _O =0, OE=V _{IH}	1.10 to 3.60	1.10 to 3.60		10.0	μA
I _{CCZ}	Current ^(6, 7)	V _I =V _{CCI} or GND; I _O =0, OE=GND	1.10 to 3.60	1.10 to 3.60		10.0	μA
I _{CCA}		V _I =V _{CCB} or GND; I _O =0 B-to-A Direction, OE=V _{IH}	0	1.10 to 3.60		-10.0	μA
	Quiescent Supply	V _I =V _{CCA} or GND; I _O =0 A-to-B Direction	1.10 to 3.60	0		10.0	
I _{CCB}	Current	V _I =V _{CCA} or GND; I _O =0, A-to-B Direction, OE=V _{IH}	1.10 to 3.60	0		-10.0	μA
		V _I =V _{CCB} or GND; I _O =0 B-to-A Direction	0	1.10 to 3.60		10.0	

Notes:

- 4. An external drive must source at least the specified current to switch LOW-to-HIGH.
- 5. An external drive must source at least the specified current to switch HIGH-to-LOW.
- 6. V_{CCI} is the V_{CC} associated with the input side.
- 7. Reflects current per supply, V_{CCA} or V_{CCB}.

Dynamic Output Electrical Characteristic

A Port (A_n)

Output Load: C_L =15pF, $R_L \ge M\Omega$ ($C_{I/O}$ =4pF), T_A =-40 to 85°C

Symbol	Parameter	V _{CCA} =3.0V to 3.6V		V _{CCA} =2.3V to 2.7V		V _{CCA} =1.65V to 1.95V		V _{CCA} =1.4V to 1.6V		V _{CCA} =1.1V to 1.3V	Unit
		Тур.	Max.	Тур.	Max.	Тур.	Max	Тур.	Max.	Тур.	
t _{rise}	Output Rise Time A Port ⁽⁹⁾		3.0		3.5		4.0		5.0	7.5	ns
t _{fall}	Output Fall Time A Port ⁽¹⁰⁾		3.0		3.5		4.0		5.0	7.5	ns
I _{OHD}	Dynamic Output Current High ⁽⁹⁾	-11.4		-7.5		-4.7		-3.2		-1.7	mA
l _{OLD}	Dynamic Output Current Low ⁽¹⁰⁾	+11.4		+7.5		+4.7		+3.2		+1.7	mA

B Port (B_n)

Output Load: C_L =15pF, $R_L \ge M\Omega$ ($C_{I/O}$ =5pF), T_A =-40 to 85°C

Symbol	Parameter	V _{CCB} =3.0V to 3.6V			V _{CCB} =2.3V to 2.7V		V _{CCB} =1.65V to 1.95V		=1.4V .6V	V _{CCB} =1.1V to 1.3V	Unit
		Тур.	Max.	Тур.	Max.	Тур.	Max	Тур.	Max.	Тур.	
t _{rise}	Output Rise Time B Port ⁽⁹⁾		3.0		3.5		4.0		5.0	7.5	ns
t _{fall}	Output Fall Time B Port ⁽¹⁰⁾		3.0		3.5		4.0		5.0	7.5	ns
I _{OHD}	Dynamic Output Current High ⁽⁹⁾	-12.0		-7.9		-5.0		-3.4		-1.8	mA
I _{OLD}	Dynamic Output Current Low ⁽¹⁰⁾	+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°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	Unit
		Min.	Max.	Min.	Max.	Min.	Max	Min.	Max.	Тур.	
	A to B	0.2	4.0	0.3	4.2	0.5	5.4	0.6	6.8	6.9	ns
t _{PLH} ,t _{PHL}	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	μs
t _{SKEW}	A Port, B Port ⁽¹¹⁾		0.5		0.5		0.5		1.0	1.0	ns

V_{CCA} = 2.3V to 2.7V, T_A =-40 to 85°C

Symbol	Parameter	Parameter V _{CCB} =3.0V to 3.6V			V _{CCB} =2.3V to 2.7V		V _{CCB} =1.65V to 1.95V		=1.4V .6V	V _{CCB} =1.1V to 1.3V	Unit
		Min.	Max.	Min.	Max.	Min.	Max	Min.	Max.	Тур.	
	A to B	0.2	4.1	0.4	4.5	0.5	5.6	0.8	6.9	7.0	ns
t _{PLH} ,t _{PHL}	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	μs
t _{SKEW}	A Port, B Port ⁽¹¹⁾		0.5		0.5		0.5		1.0	1.0	ns

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

Symbol	Parameter	V _{CCB} =3.0V to 3.6V			V _{CCB} =2.3V to 2.7V		V _{CCB} =1.65V to 1.95V		=1.4V .6V	V _{CCB} =1.1V to 1.3V	Unit
		Min.	Max.	Min.	Max.	Min.	Max	Min.	Max.	Тур.	
++	A to B	0.3	5.0	0.5	5.5	0.8	6.7	0.9	7.5	7.5	ns
t _{PLH} ,t _{PHL}	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	1.7	1.7	μs
t _{SKEW}	A Port, B Port ⁽¹¹⁾		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 (An or Bn) 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)

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

Symbol	Parameter	V _{CCB} :	=3.0V 3.6V		=2.3V 2.7V	V _{CCB} =	1.65V .95V		=1.4V .6V	V _{CCB} =1.1V to 1.3V	Unit
		Min.	Max.	Min.	Max.	Min.	Max	Min.	Max.	Тур.	
	A to B	0.5	6.0	0.5	6.5	1.0	7.0	1.0	8.5	7.9	ns
t _{PLH} ,t _{PHL}	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	μs
t _{SKEW}	A Port, B Port ⁽¹²⁾		1.0		1.0		1.0		1.0	1.0	ns

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

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	Unit
		Тур.	Тур.	Тур.	Тур.	Тур.	
	A to B	4.6	4.8	5.4	6.2	9.2	ns
t _{PLH} ,t _{PHL}	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	μs
t _{SKEW}	A Port, B Port ⁽¹²⁾	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 (An or Bn) 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^(13, 14)

T_A=-40 to 85°C

V _{CCA}	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	Unit
	Min.	Min.	Min.	Min.	Тур.	
V _{CCA} =3.00V to 3.60V	140	120	100	80	40	Mbps
V _{CCA} =2.30V to 2.70V	120	120	100	80	40	Mbps
V _{CCA} =1.65V to 1.95V	100	100	80	60	40	Mbps
V _{CCA} =1.40V to 1.60V	80	80	60	60	40	Mbps
V _{CCA} =1.10V to 1.30V	Тур.	Тур.	Тур.	Тур.	Тур.	
VCCA=1.10V to 1.50V	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°C Typical	Unit
C _{IN}	Input Capacitance Control Pin (OE)		V _{CCA} =V _{CCB} =GND	3	pF
C	Input/Output Capacitance	An	V -V -3.3V OE-CND	4	pF
C _{1/O}	C _{I/O} Input/Output Capacitance		V _{CCA} =V _{CCB} =3.3V, OE=GND	5	рг
C _{pd}	Power Dissipation Capacitance		V _{CCA} =V _{CCB} =3.3V, V _I =0V or V _{CC} , f=10MHz	25	pF

I/O Architecture Benefit

The FXLA0104 I/O architecture benefits the end user, beyond level translation, in the following three ways:

Auto Direction without an external direction pin.

Drive Capacitive Loads. Automatically shifts to a higher current drive mode only during "Dynamic Mode" or HL / LH transitions.

Lower Power Consumption. Automatically shifts to low-power mode during "Static Mode" (no transitions), lowering power consumption.

The FXLA0104 does not require a direction pin. Instead, the I/O architecture detects input transitions on both side and automatically transfers the data to the corresponding output. For example, for a given channel, if both A and B side are at a static LOW, the direction has been established as $A \rightarrow B$, and a LH transition occurs on the B port; the FXLA0104 internal I/O architecture automatically changes direction from $A \rightarrow B$ to $B \rightarrow A$.

During HL / LH transitions, or "Dynamic Mode," a strong output driver drives the output channel in parallel with a weak output driver. After a typical delay of approximately 10ns – 50ns, the strong driver is turned off, leaving the weak driver enabled for holding the logic state of the channel. This weak driver is called the "bus

hold." "Static Mode" is when only the bus hold drives the channel. The bus hold can be over ridden in the event of a direction change. The strong driver allows the FXLA0104 to quickly charge and discharge capacitive transmission lines during dynamic mode. Static mode conserves power, where $I_{\rm CC}$ is typically < $5\mu A$.

Bus Hold Minimum Drive Current

Specifies the minimum amount of current the bus hold driver can source/sink. The bus hold minimum drive current (II_{HOLD}) is V_{CC} dependent and guaranteed in the DC Electrical tables. The intent is to maintain a valid output state in a static mode, but that can be overridden when an input data transition occurs.

Bus Hold Input Overdrive Drive Current

Specifies the minimum amount of current required (by an external device) to overdrive the bus hold in the event of a direction change. The bus hold overdrive (II_{ODH} , II_{ODL}) is V_{CC} dependent and guaranteed in the DC Electrical tables.

Dynamic Output Current

The strength of the output driver during LH / HL transitions is referenced on page 8, Dynamic Output Electrical Characteristics, I_{OHD} , and I_{OLD} .

Test Diagrams

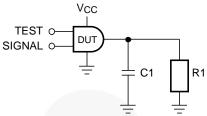


Figure 3. Test Circuit

Table 1. AC Test Conditions

Test	Input Signal	Output Enable Control	
t _{PLH} , t _{PHL}	Data Pulses	VCCA	
t _{PZL}	0V	LOW to HIGH Switch	
t _{PZH}	V _{CCI}	LOW to HIGH Switch	

Table 2. AC Load

V _{cco}	C 1	R1
1.2V± 0.1V	15pF	1ΜΩ
1.5V± 0.1V	15pF	1ΜΩ
1.8V ± 0.15V	15pF	1ΜΩ
2.5V ± 0.2V	15pF	1ΜΩ
3.3V ± 0.3V	15pF	1ΜΩ

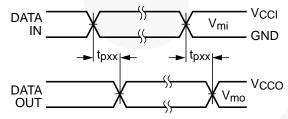


Figure 4. Waveform for Inverting and Non-Inverting Functions

Notes:

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

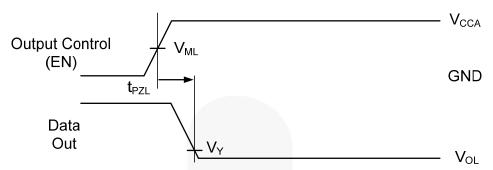


Figure 5. 3-State Output Low Enable

Notes:

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

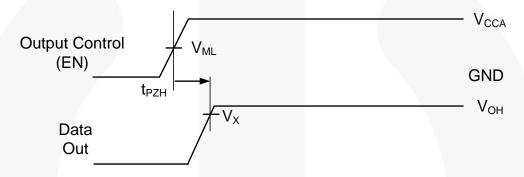


Figure 6. 3-State Output High Enable

Notes:

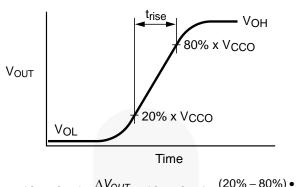
- 19. Input $t_R = t_F = 2.0$ ns, 10% to 90%.
- 20. Input $t_R = t_F = 2.5$ ns, 10% to 90%, at $V_I = 3.0$ V to 3.6V only.

Table 3. Test Measure Points

Symbol	V_{DD}
V _{MI} ⁽²¹⁾	V _{CCI} /2
V _{MO}	V _{CCo} /2
V _X	0.9 x V _{CCo}
V_Y	0.1 x V _{CCo}

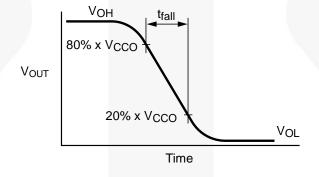
Note:

21. V_{CCI}=V_{CCA} for control pin OE or V_{MI}(V_{CCA}/2).



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

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



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

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

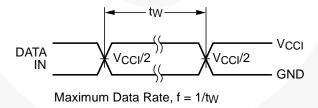


Figure 9. Maximum Data Rate

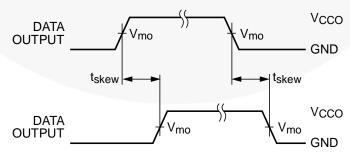
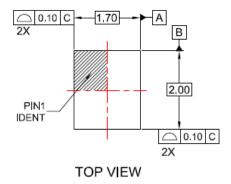


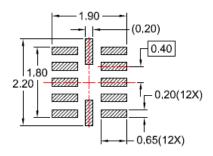
Figure 10. Output Skew Time

Note:

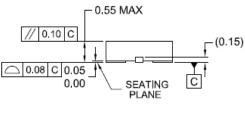
22. $t_{SKEW} = (t_{pHLmax} - t_{pHLmin})$ or $(t_{pLHmax} - t_{pLHmin})$

Physical Dimensions

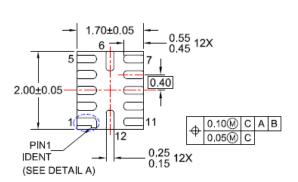




RECOMMENDED LAND PATTERN

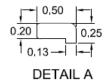


SIDE VIEW



NOTES:

- (A.) PACKAGE DOES NOT FULLY CONFORM TO JEDEC MO-220 REGISTRATION
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
- LAND PATTERN RECOMMENDATION IS BASED ON FSC DESIGN ONLY.
- E. DRAWING FILENAME: MKT-UMLP12Crev1.



BOTTOM VIEW

Figure 11. 12-Lead, Ultrathin Molded Leadless Package (UMLP)

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