



Is Now Part of



ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

FXMA108

Dual-Supply, 8-Bit Signal Translator with Configurable Voltage Supplies and Signals Levels, 3-State Outputs and Auto Direction Sensing

Features

- Bi-Directional Interface between Two Levels from 1.65V to 5.5V
- 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) is Referenced to V_{CCA} Voltage
- Packaged in 20-Terminal DQFN
- Direction Control Not Needed
- 80Mbps Throughput when Translating between 2.5V and 5.0V
- ESD Protection Exceeds:
 - 8kV Human Body Model (B Port I/O to GND) (JESD22-A114 & Mil Std 883e 3015.7)
 - 5kV Human Body Model (A Port I/O to GND) (JESD22-A114 & Mil Std 883e 3015.7)
 - 2kV Charged Device Model (ESD STM 5.3) (JESD22-C101)

Description

The FXMA108 is a configurable dual-voltage supply translator designed for both uni-directional and bi-directional voltage translation between two logic levels. The device allows translation between voltages as high as 5.5V to as low as 1.65V. 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: 1.8V, 2.5V, 3.3V, and 5.0V.

The device remains in 3-state until both V_{CC} s 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 Side by placing them in a 3-state condition. The /OE input is supplied by V_{CCA} .

The FXMA108 supports bi-directional translation without the need for a direction control pin. The two sides 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 Phones, PDA, Digital Camera, Portable GPS, and Storage

Ordering Information

Part Number	Operating Temperature Range	Package	Packing Method
FXMA108BQX	-40 to 85°C	20-Lead, DQFN, JEDEC MO-241, 2.5x4.5mm	3000 Units Tape and Reel

Functional Diagram

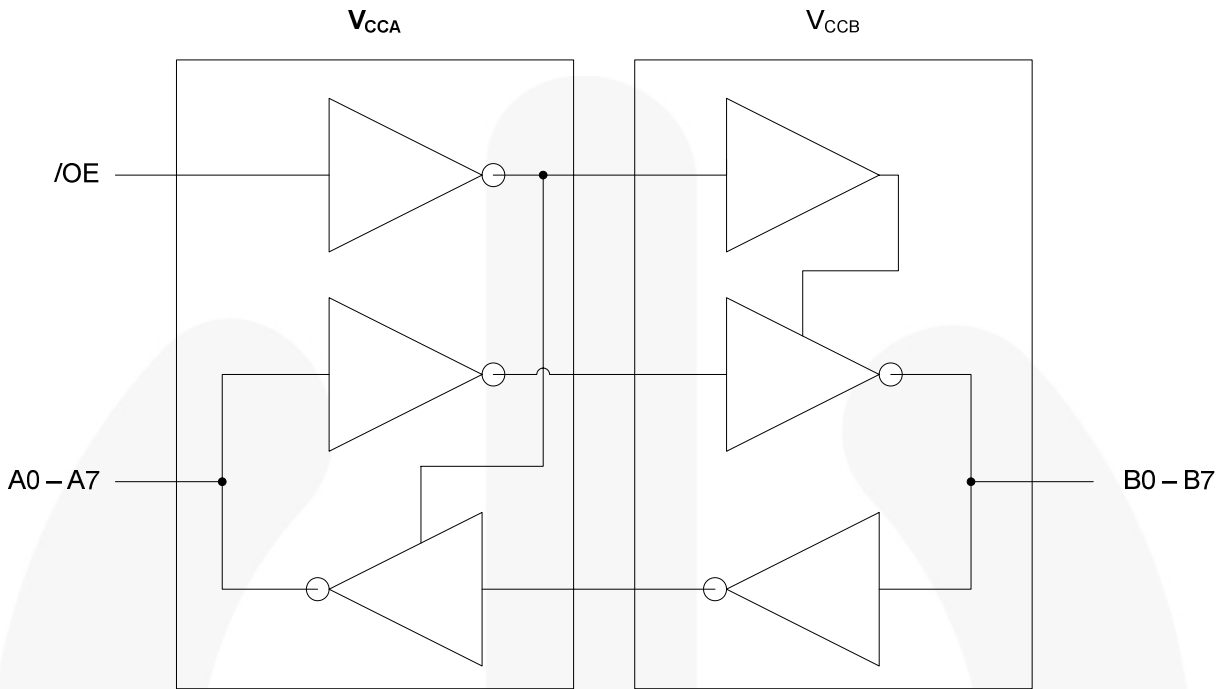


Figure 1. Block Diagram

Functional Table

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

Pin Configuration

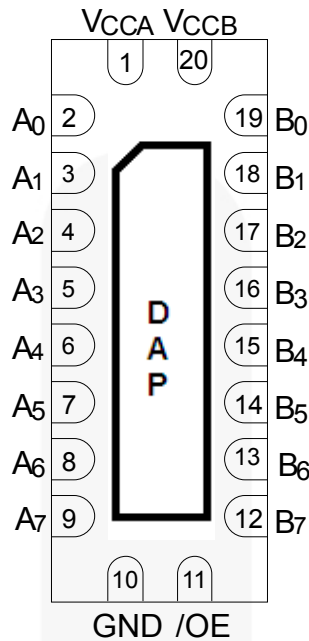


Figure 2. Pin Configuration (Top Through View)

Pin Definitions

Pin #	Name	Description
1	V _{CCA}	A-Side Power Supply
2	A ₀	A-Side Inputs or 3-State Outputs
3	A ₁	A-Side Inputs or 3-State Outputs
4	A ₂	A-Side Inputs or 3-State Outputs
5	A ₃	A-Side Inputs or 3-State Outputs
6	A ₄	A-Side Inputs or 3-State Outputs
7	A ₅	A-Side Inputs or 3-State Outputs
8	A ₆	A-Side Inputs or 3-State Outputs
9	A ₇	A-Side Inputs or 3-State Outputs
10	GND	Ground
11	/OE	Output Enable Input
12	B ₇	B-Side Inputs or 3-State Outputs
13	B ₆	B-Side Inputs or 3-State Outputs
14	B ₅	B-Side Inputs or 3-State Outputs
15	B ₄	B-Side Inputs or 3-State Outputs
16	B ₃	B-Side Inputs or 3-State Outputs
17	B ₂	B-Side Inputs or 3-State Outputs
18	B ₁	B-Side Inputs or 3-State Outputs
19	B ₀	B-Side Inputs or 3-State Outputs
20	V _{CCB}	B-Side Power Supply
DAP	NC	No Connect

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 _{CC}	Supply Voltage		V _{CCA}	-0.5	7.0	V
			V _{CCB}	-0.5	7.0	
V _{IN}	DC Input Voltage		I/O Side A and B	-0.5	7.0	V
			Control Input (/OE)	-0.5	7.0	
V _O	Output Voltage		Output 3-State	-0.5	7.0	V
			Output Active (A _n) ⁽¹⁾	-0.5	V _{CCA} +0.5	
			Output Active (B _n) ⁽¹⁾	-0.5	V _{CCB} +0.5	
I _{IK}	DC Input Diode Current		V _{IN} < 0V		-50	mA
I _{OK}	DC Output Diode Current		V _O < 0V		-50	mA
			V _O > V _{CC}		+50	
I _{OH} /I _{OL}	DC Output Source/Sink Current			-50	+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, and Mil Std 883e 3015.7	B Port I/O to GND		8000	V
		Human Body Model, JESD22-A114 and Mil Std 883e 3015.7	A Port I/O to GND		5000	
		Charged Device Model, JESD22-C101 per ESD STM 5.3				

Note:

- I_O absolute maximum ratings must be observed.

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	Typ.	Max.	Unit
V _{CC}	Power Supply	Operating V _{CCA} or V _{CCB}	1.65	5.50	V
V _{IN}	Input Voltage	Side A and B	0	5.5	V
		Control Input (/OE)	0	V _{CCA}	V
T _A	Operating Temperature, Free Air		-40	+85	°C
dt/dV	Input Edge Rate	V _{CCA/B} =1.65 to 5.5V		10	ns/V

Note:

- All unused inputs and input/outputs must be held at V_{CCI} or GND. V_{CCI} is the V_{CC} associated with the input side.

Power-Up/Power-Down Sequence

Fairchild 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 the other V_{CC} .

Pull-Up/Pull-Down Resistors

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, $I_{I(HOLD)}$ and/or $I_{I(OD)}$ bus-hold currents. The bus-hold feature eliminates the need for extra resistors.

DC Electrical Characteristics

T_A=-40°C to +85°C.

Symbol	Parameter	Conditions	V _{CCA} (V)	V _{CCB} (V)	Min.	Max.	Units
V _{IHA}	High Level Input Voltage	Data Inputs An Control Pin /OE	1.65 - 5.50	1.65 - 5.50	0.65 x V _{CCA}		V
V _{IHB}		Data Inputs Bn	1.65 - 5.50	1.65 - 5.50	0.65 x V _{CCB}		
V _{ILA}	Low Level Input Voltage	Data Inputs An Control Pin /OE	1.65 - 5.50	1.65 - 5.50		0.35 x V _{CCA}	V
V _{ILB}		Data Inputs Bn	1.65 - 5.50	1.65 - 5.50		0.35 x V _{CCB}	
V _{OHA}	High Level Output Voltage ⁽³⁾	I _{OH} =-20μA	1.65 - 5.50	1.65 - 5.50	V _{CCA} - 0.4		V
V _{OHB}		I _{OH} =-20μA	1.65 - 5.50	1.65 - 5.50	V _{CCB} - 0.4		
V _{OLA}	Low Level Output Voltage ⁽³⁾	I _{OL} =20μA	1.65 - 5.50	1.65 - 5.50		0.4	V
V _{OLB}		I _{OL} =20μA	1.65 - 5.50	1.65 - 5.50		0.4	
I _{I(HOLD)}	Bushold Input Minimum Drive Current	V _{IN} =1.60V	4.5	4.5	140		μA
		V _{IN} =2.90V	4.5	4.5	-140		
		V _{IN} =1.05V	3.0	3.0	75		
		V _{IN} =1.95V	3.0	3.0	-75		
		V _{IN} =0.80V	2.3	2.3	45		
		V _{IN} =1.50V	2.3	2.3	-45		
		V _{IN} =0.57V	1.65	1.65	25		
		V _{IN} =1.07V	1.65	1.65	-25		
I _{I(ODH)}	Bushold Input Overdrive High Current ⁽⁴⁾	Data Inputs An, Bn	5.5	5.5	750		μA
			3.6	3.6	450		
			2.7	2.7	300		
			1.95	1.95	200		
I _{I(ODL)}	Bushold Input Overdrive Low Current ⁽⁵⁾	Data Inputs An, Bn	5.5	5.5	-750		μA
			3.6	3.6	-450		
			2.7	2.7	-300		
			1.95	1.95	-200		

Continued on the following page...

DC Electrical Characteristics (Continued)

T_A=-40°C to +85°C.

Symbol	Parameter	Conditions	V _{CCA} (V)	V _{CCB} (V)	Min.	Max.	Units
I _I	Input Leakage Current	Control Inputs /OE V _{IN} =V _{CCA} or GND	1.65 - 5.50	5.5		±1	μA
I _{OFF}	Power Off Leakage Current	An, V _O =0V to 5.5V	0	5.5		±2	μA
		Bn, V _O =0V to 5.5V	5.5	0		±2	
I _{OZ}	3-State Output Leakage	An, Bn V _O =0V or 5.5V, /OE V _{IH}	5.5	5.5		±5	μA
		An, V _O =0V or 5.5V, /OE=GND	5.5	0		±5	
		Bn, V _O =0V or 5.5V, /OE=GND	0	5.5		±5	
I _{CCA/B}	Quiescent Supply Current ^(6,7)	V _{IN} =V _{CCI} or GND, I _O =0 /OE=GND	1.65 - 5.50	1.65 - 5.50		10	μA
I _{CCZ}		V _{IN} =V _{CCI} or GND, I _O =0 /OE=V _{IH}	1.65 - 5.50	1.65 - 5.50		10	μA
I _{CCA}	Quiescent Supply Current ^(6,7)	V _{IN} =V _{CCB} or GND, I _O =0 B-to-A Direction /OE=GND	0	1.65 - 5.50		-10	μA
		V _{IN} =V _{CCA} or GND, I _O =0 A-to-B	1.65 - 5.50	0		10	
I _{CCB}	Quiescent Supply Current	V _{IN} =V _{CCA} or GND, I _O =0 A-to-B Direction /OE=GND	1.65 - 5.50	0		-10	μA
		V _{IN} =V _{CCB} or GND, I _O =0 B-to-A	0	1.65 - 5.50		10	

Notes:

3. This is the output voltage for static conditions.
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. V_{CCI} is the V_{CC} associated with the input side.
7. Reflects current per supply, V_{CCA} or V_{CCB}.

Dynamic Output Electrical Characteristics⁽⁸⁾

A Port (An)

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

Symbol	Parameter	$T_A=-40^\circ\text{C to }+85^\circ\text{C}$				Units
		$V_{CCA}=4.5\text{V to }5.5\text{V}$	$V_{CCA}=3.0\text{V to }3.6\text{V}$	$V_{CCA}=2.3\text{V to }2.7\text{V}$	$V_{CCA}=1.65\text{V to }1.95\text{V}$	
		Max.	Max.	Max.	Max.	
t_{rise}	Output Rise Time A Side ⁽⁹⁾	2.5	3.0	3.5	4.0	ns
t_{fall}	Output Fall Time A Side ⁽¹⁰⁾	2.5	3.0	3.5	4.0	ns

B Port (Bn)

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

Symbol	Parameter	$T_A=-40^\circ\text{C to }+85^\circ\text{C}$				Units
		$V_{CCB}=4.5\text{V to }5.5\text{V}$	$V_{CCB}=3.0\text{V to }3.6\text{V}$	$V_{CCB}=2.3\text{V to }2.7\text{V}$	$V_{CCB}=1.65\text{V to }1.95\text{V}$	
		Max.	Max.	Max.	Max.	
t_{rise}	Output Rise Time B Side ⁽⁹⁾	3.5	3.5	3.5	4.0	ns
t_{fall}	Output Fall Time B Side ⁽¹⁰⁾	3.5	3.5	3.5	4.0	ns

Notes:

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

AC Characteristics

$V_{CCA}=4.5V$ to $5.5V$, Output Load (see Table 2)

Symbol	Parameter	$T_A=-40^{\circ}C$ to $+85^{\circ}C$								Units
		$V_{CCB}=4.5V$ to $5.5V$		$V_{CCB}=3.0V$ to $3.6V$		$V_{CCB}=2.3V$ to $2.7V$		$V_{CCB}=1.65V$ to $1.95V$		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t_{PLH}, t_{PHL}	A-to-B Side	1.5	5.0	1.75	6.0	2.0	6.5	2.6	10.5	ns
	B-to-A Side	1.5	5.0	1.75	6.0	2.0	6.5	2.6	10.5	
t_{PZL}, t_{PZH}	/OE-to-A, /OE-to-B		1.7		1.7		1.7		1.7	μs
t_{skew}	A Port, B Side ⁽¹¹⁾		0.5		0.5		0.5		0.5	ns

Note:

11. Skew is the variation of propagation delay between output signals and applies only to output signals on the same Side (An or Bn) and switching with the same polarity (LOW-to-HIGH or HIGH-to-LOW). Skew is guaranteed, but not tested in production (see Figure 11).

$V_{CCA}=3.0V$ to $3.6V$, Output Load (see Table 2)

Symbol	Parameter	$T_A=-40^{\circ}C$ to $+85^{\circ}C$								Units
		$V_{CCB}=4.5V$ to $5.5V$		$V_{CCB}=3.0V$ to $3.6V$		$V_{CCB}=2.3V$ to $2.7V$		$V_{CCB}=1.65V$ to $1.95V$		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t_{PLH}, t_{PHL}	A-to-B Side	2.0	5.5	2.2	6.5	2.4	7.5	2.6	11.0	ns
	B-to-A Side	2.0	5.5	2.2	6.5	2.4	7.5	2.6	11.0	
t_{PZL}, t_{PZH}	/OE-to-A, /OE-to-B		1.7		1.7		1.7		1.7	μs
t_{skew}	A Side, B Side ⁽¹²⁾		0.7		0.7		0.7		0.7	ns

Note:

12. Skew is the variation of propagation delay between output signals and applies only to output signals on the same Side (An or Bn) and switching with the same polarity (LOW-to-HIGH or HIGH-to-LOW). Skew is guaranteed, but not tested in production (see Figure 11).

AC Characteristics (Continued)

$V_{CCA}=2.3V$ to $2.7V$, Output Load (see Table 2)

Symbol	Parameter	$T_A=-40^{\circ}C$ to $+85^{\circ}C$								Units
		$V_{CCB}=4.5V$ to $5.5V$		$V_{CCB}=3.0V$ to $3.6V$		$V_{CCB}=2.3V$ to $2.7V$		$V_{CCB}=1.65V$ to $1.95V$		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t_{PLH} , t_{PHL}	A-to-B Side	2.0	6.5	2.2	7.7	2.4	8.5	2.6	11.0	ns
	B-to-A Side	2.0	7.0	2.2	7.5	2.4	8.5	2.6	12.0	
t_{PZL} , t_{PZH}	/OE- to-A /OE-to-B		1.7		1.7		1.7		1.7	μs
t_{skew}	A Side, B Side ⁽¹³⁾		0.7		0.7		0.7		0.7	ns

Note:

13. Skew is the variation of propagation delay between output signals and applies only to output signals on the same Side (An or Bn) and switching with the same polarity (LOW-to-HIGH or HIGH-to-LOW). Skew is guaranteed but not tested in production (see Figure 11).

$V_{CCA}=1.65V$ to $1.95V$, Output Load (see Table 2)

Symbol	Parameter	$T_A=-40^{\circ}C$ to $+85^{\circ}C$								Units
		$V_{CCB}=4.5V$ to $5.5V$		$V_{CCB}=3.0V$ to $3.6V$		$V_{CCB}=2.3V$ to $2.7V$		$V_{CCB}=1.65V$ to $1.95V$		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t_{PLH} , t_{PHL}	A-to-B Side	2.0	10.0	2.2	11.0	2.4	12.0	2.6	14.0	ns
	B-to-A Side	2.0	10.0	2.2	10.5	2.4	11.0	2.6	14.0	
t_{PZL} , t_{PZH}	/OE-to-A /OE to B		1.7		1.7		1.7		1.7	μs
t_{skew}	A Side, B Side ⁽¹⁴⁾		1.2		1.2		1.2		1.2	ns

Note:

14. Skew is the variation of propagation delay between output signals and applies only to output signals on the same Side (An or Bn) and switching with the same polarity (LOW-to-HIGH or HIGH-to-LOW). Skew is guaranteed, but not tested in production (see Figure 11).

Maximum Data Rate^(15, 16)

For output load, see Table 2.

V _{CCA}	Direction	T _A =-40°C to +85°C				Units
		V _{CCB} =4.5V to 5.5V	V _{CCB} =3.0V to 3.6V	V _{CCB} =2.3V to 2.7V	V _{CCB} =1.65V to 1.95V	
		Min.	Min.	Min.	Min.	
V _{CCA} =4.5V to 5.5V	A-to-B	100	100	80	60	Mbps
	B-to-A	100	100	80	80	
V _{CCA} =3.0V to 3.6V	A-to-B	100	100	80	60	
	B-to-A	100	100	80	80	
V _{CCA} =2.3V to 2.7V	A-to-B	80	80	60	40	
	B-to-A	80	80	60	60	
V _{CCA} =1.65V to 1.95V	A-to-B	80	80	60	40	
	B-to-A	60	60	40	40	

Notes:

- 15. Maximum data rate is guaranteed, but not tested in production.
- 16. Maximum data rate is specified in megabits per second with all outputs switching, (see Figure 10). It is equivalent to two times the F-toggle frequency, specified in megahertz. For example, 100Mbps is equivalent to 50MHz.

Capacitance

T_A=+25°C.

Symbol	Parameter	Conditions	Typical	Unit
C _{IN}	Input Capacitance, Control Pin / (OE)	V _{CCA} =V _{CCB} =GND	3	pF
C _{I/O}	Input / Output Capacitance	An	4	pF
		Bn	5	
C _{PD}	Power Dissipation Capacitance	V _{CCA} =V _{CCB} =5.0V, V _{IN} =0V or V _{CC} , f=10MHz	28	pF

I/O Architecture Benefit

The FXMA108 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 FXMA108 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 → B, and a LH transition occurs on the B port; the FXMA108 internal I/O architecture automatically changes direction from A → B to B → A.

During HL / LH transitions, or “Dynamic Mode,” a strong (typically 30mA) output driver drives the output channel in parallel with a weak (typically 100µA) 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 overridden (typically 500µA) in the event of a direction change. The strong driver allows the FXMA108 to quickly charge and discharge capacitive transmission lines during dynamic mode. Static mode conserves power, where I_{CC} is typically < 5µA.

Bus Hold Minimum Drive Current

Specifies the minimum amount of current the bus hold driver can source/sink. The bus hold minimum drive current (I_{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 (I_{ODH} , I_{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 captured in Figure 3 (I_{OLH} , I_{OHD}). The plot depicts the FXMA108 typical dynamic output current with a lumped capacitance of 4pF.

Because the strong output driver is turned on only during LH / HL transitions, the actual drive current is difficult to measure directly. Approximate the drive current with the following formula:

$$I_{OHD} \approx (C_{I/O}) \times \frac{\Delta V_{OUT}}{\Delta t} = (C_{I/O}) \times \frac{0.6 * V_{CCO}}{t_{RISE}} \quad (1)$$

where $C_{I/O}$ = the typical lumped capacitance and V_{CCO} is the supply voltage of the output driver.

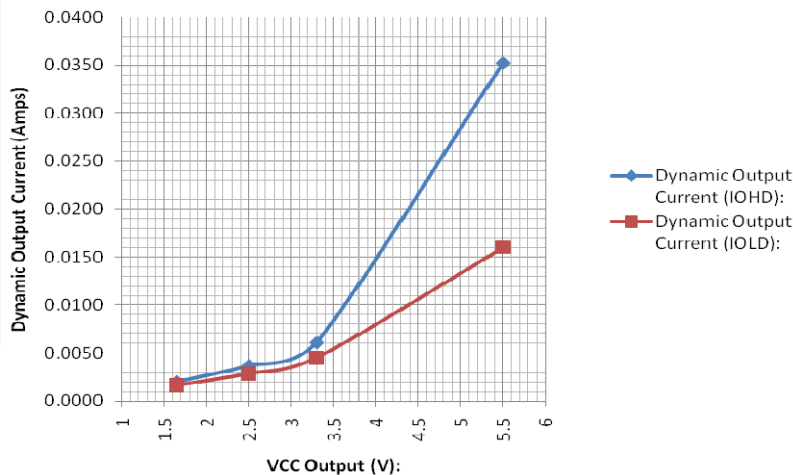


Figure 3. Typical Dynamic Output Current

AC Tests and Waveforms

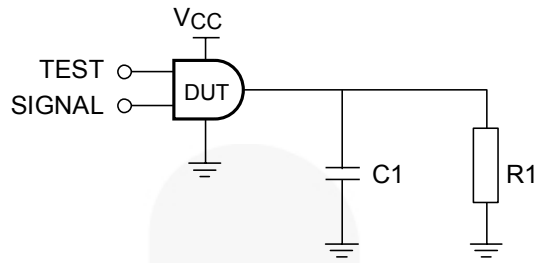


Figure 4. AC Test Circuit

Table 1. Test Circuit Parameters

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 Table

V_{CCO}	C1	R1
$1.8V \pm 0.15V$	15pF	$1M\Omega$
$2.5V \pm 0.2V$	15pF	$1M\Omega$
$3.3 \pm 0.3V$	15pF	$1M\Omega$
$5.0 \pm 0.5V$	15pF	$1M\Omega$

AC Tests and Waveforms

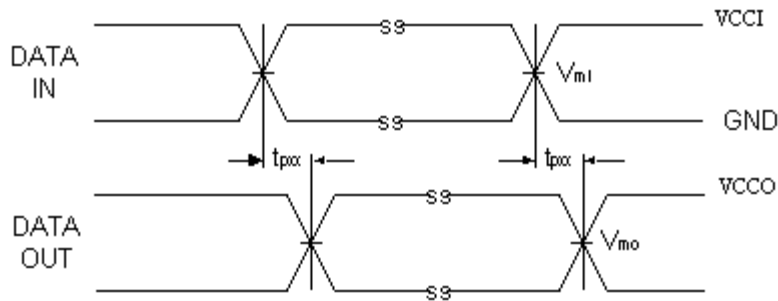


Figure 5. Waveform for Inverting and Non-Inverting Functions

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 $V_{IN} = 3.0\text{V}$ to 5.5V only.

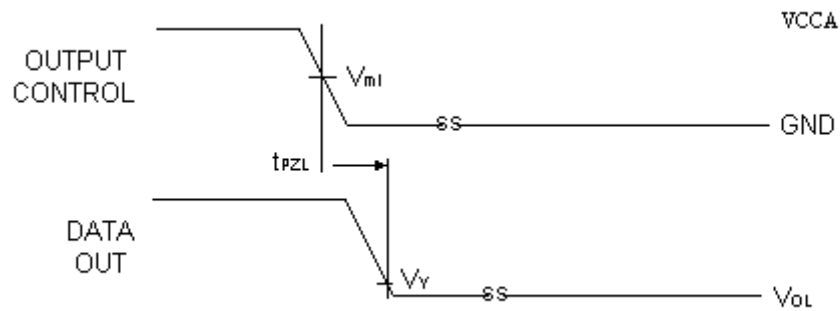


Figure 6. 3-State Output Low Enable Time for Low Voltage Logic

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 $V_{IN} = 3.0\text{V}$ to 5.5V only.

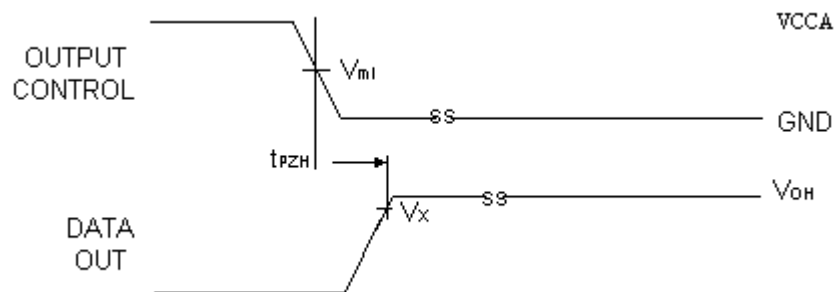


Figure 7. 3-State Output High Enable Time for Low Voltage Logic

Notes:

- 21. Input $t_R = t_F = 2.0\text{ns}$, 10% to 90%.
- 22. Input $t_R = t_F = 2.5\text{ns}$, 10% to 90%, at $V_{IN} = 3.0\text{V}$ to 5.5V only.

AC Tests and Waveforms (Continued)

Symbol	V _{CC}
V _{MI} ⁽²³⁾	V _{CC1} /2
V _{MO}	V _{CC0} /2
V _X	0.9 x V _{CC0}
V _Y	0.1 x V _{CC0}

Note:

23. V_{CC1} = V_{CCA} for control pin /OE or V_{MI} = (V_{CCA} /2).

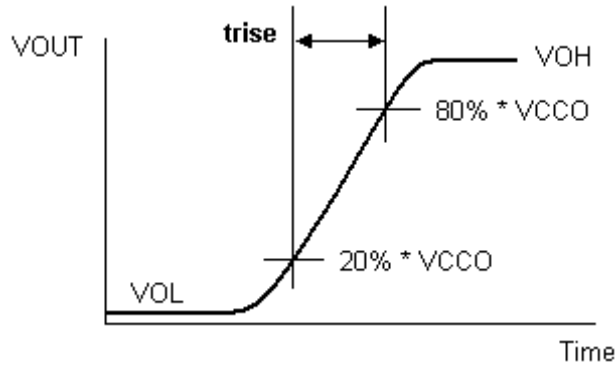


Figure 8. Active Output Rise Time

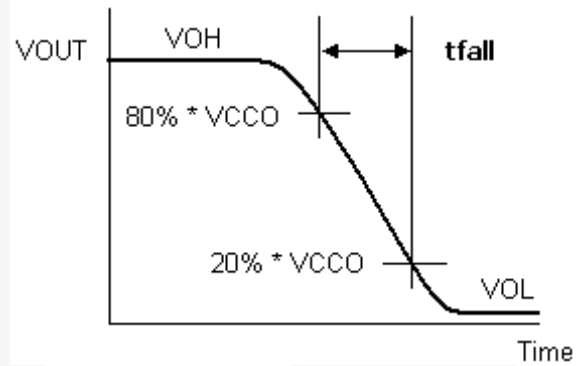


Figure 9. Active Output Fall Time

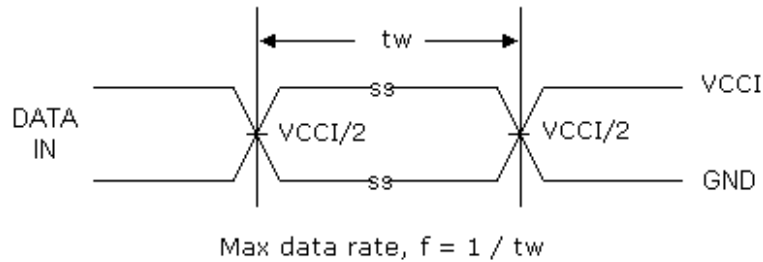


Figure 10. Maximum Data Rate

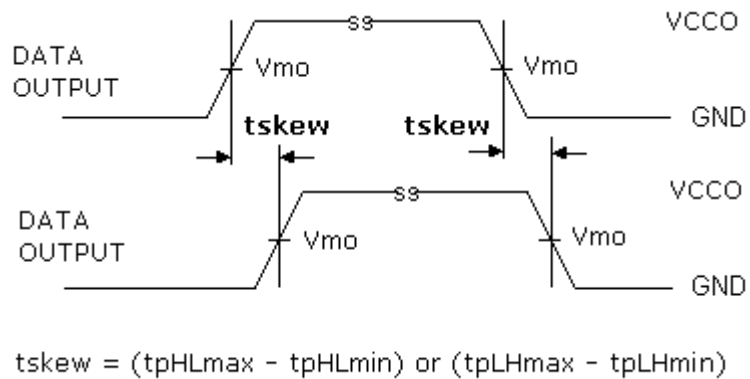
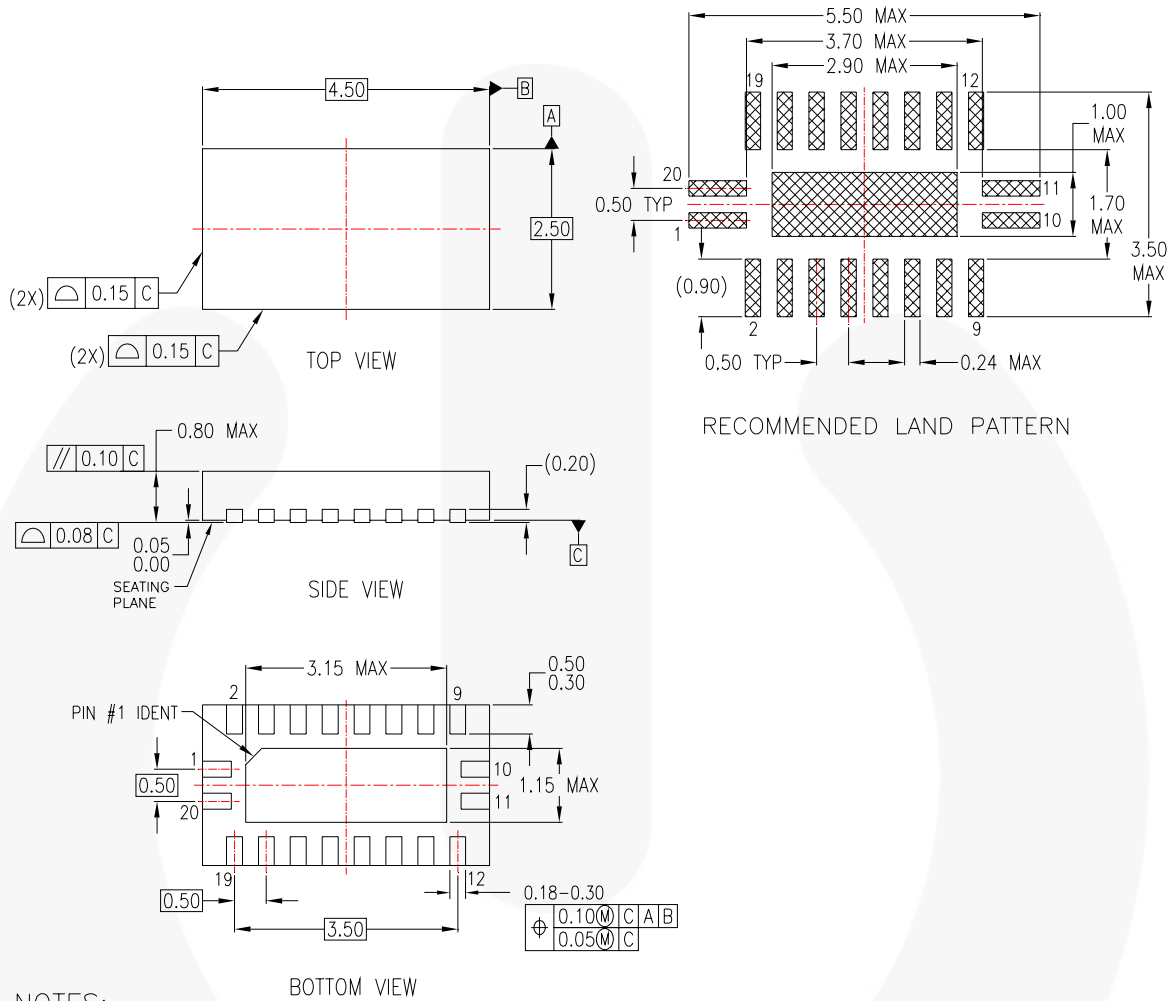


Figure 11. Output Skew Time

Physical Dimensions



NOTES:

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

MLP20BrevA

Figure 12. 20-Lead, DQFN, JEDEC MO-241, 2.5x4.5mm

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:
<http://www.fairchildsemi.com/packaging/>



TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

- | | | | |
|--|--|--|---|
| AccuPower™ | F-PFS™ | Power-SPM™ |  SYSTEM GENERAL |
| Auto-SPM™ | FRFET® | PowerTrench® | The Power Franchise® |
| Build it Now™ | Global Power Resource™ | PowerXST™ |  the power franchise |
| CorePLUSTM | Green FPS™ | Programmable Active Droop™ | TinyBoost™ |
| CorePOWER™ | Green FPS™ e-Series™ | QFET® | TinyBuck™ |
| CROSSVOLT™ | Gmax™ | QS™ | TinyCalc™ |
| CTL™ | GTO™ | Quiet Series™ | TinyLogic® |
| Current Transfer Logic™ | IntelliMAX™ | RapidConfigure™ | TINYOPTO™ |
| DEUXPEED® | ISOPLANAR™ |  TM | TinyPower™ |
| Dual Cool™ | MegaBuck™ | Saving our world, 1mV/WW/KW at a time™ | TinyPWM™ |
| EcoSPARK® | MICROCOUPLER™ | SignalWise™ | TinyWire™ |
| EfficientMax™ | MicroFET™ | SmartMax™ | TriFault Detect™ |
| ESBC™ | MicroPak™ | SMART START™ | TRUECURRENT™* |
|  Fairchild® | MicroPak2™ | SPM® | µSerDes™ |
| Fairchild Semiconductor® | MillerDrive™ | STEALTH™ |  SerDes |
| FACT Quiet Series™ | MotionMax™ | SuperFET™ | UHC® |
| FACT® | MotionMAX™ | SuperSOT™.3 | Ultra FRFET™ |
| FAST® | OptoHIT™ | SuperSOT™.6 | UniFET™ |
| FastvCore™ | OPTOLOGIC® | SuperSOT™.8 | VCXT™ |
| FETBench™ | OPTOPLANAR® | SupreMOS® | VisualMax™ |
| FlashWriter® |  TM | SyncFET™ | XSTM |
| FPS™ | PDP SPM™ | Sync-Lock™ | |

* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

- Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
- A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. 149



ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>
For additional information, please contact your local
Sales Representative