

74LCX138

Low Voltage 1-of-8 Decoder/Demultiplexer with 5V Tolerant Inputs

General Description

The LCX138 is a high-speed 1-of-8 decoder/demultiplexer. This device is ideally suited for high-speed memory chip select address decoding. The multiple input enables allow parallel expansion to a 1-of-24 decoder using just three LCX138 devices or a 1-of-32 decoder using four LCX138 devices and one inverter.

The 74LCX138 is fabricated with advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

Features

- 5V tolerant inputs
- 2.3V to 3.6V V_{CC} specifications provided
- 6.0 ns t_{PD} max ($V_{CC} = 3.3V$), 10 μA I_{CC} max
- Power down high impedance inputs and outputs
- ± 24 mA output drive ($V_{CC} = 3.0V$)
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds 500 mA
- ESD performance:
 - Human body model > 2000V
 - Machine model > 200V
- Leadless DQFN package

Ordering Code:

Order Number	Package Number	Package Description
74LCX138M (Note 1)	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74LCX138SJ (Note 1)	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74LCX138BQX (Note 2)	MLP016E	16-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.5mm
74LCX138MTC (Note 1)	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

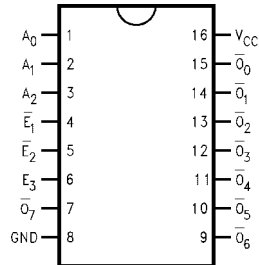
Note 1: Devices also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

Note 2: DQFN package available in Tape and Reel only.

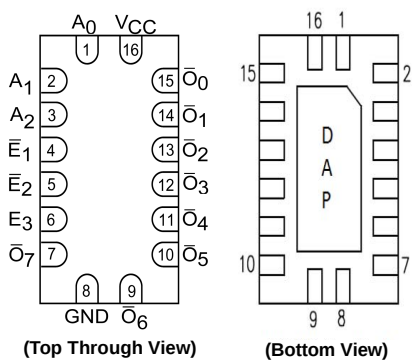
74LCX138 Low Voltage 1-of-8 Decoder/Demultiplexer with 5V Tolerant Inputs

Connection Diagrams

Pin Assignments for SOIC, SOP, and TSSOP



Pad Assignments for DQFN



Pin Descriptions

Pin Names	Description
A_0 – A_2	Address Inputs
$\bar{E}_1$ – $\bar{E}_2$	Enable Inputs
E_3	Enable Input
$\bar{O}_0$ – $\bar{O}_7$	Outputs
DAP	No Connect

Note: DAP (Die Attach Pad)

Functional Description

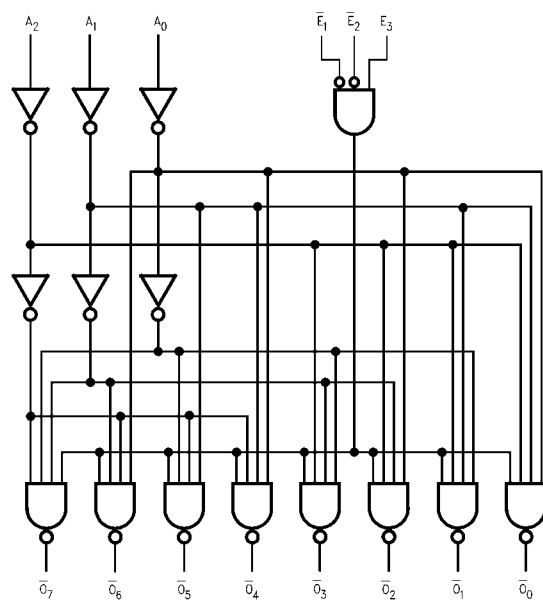
The LCX138 high-speed 1-of-8 decoder/demultiplexer accepts three binary weighted inputs (A_0 , A_1 , A_2) and, when enabled, provides eight mutually exclusive active-LOW outputs ($\bar{O}_0$ – $\bar{O}_7$). The LCX138 features three Enable inputs, two active-LOW ($\bar{E}_1$, $\bar{E}_2$) and one active-HIGH (E_3). All outputs will be HIGH unless $\bar{E}_1$ and $\bar{E}_2$ are LOW and E_3 is HIGH. The LCX138 can be used as an 8-output demultiplexer by using one of the active LOW Enable inputs as the data input and the other Enable inputs as strobes. The Enable inputs which are not used must be permanently tied to their appropriate active-HIGH or active-LOW state.

Truth Table

Inputs						Outputs							
$\bar{E}_1$	$\bar{E}_2$	E_3	A_0	A_1	A_2	$\bar{O}_0$	$\bar{O}_1$	$\bar{O}_2$	$\bar{O}_3$	$\bar{O}_4$	$\bar{O}_5$	$\bar{O}_6$	$\bar{O}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

Logic Diagram



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings(Note 3)

Symbol	Parameter	Value	Conditions	Units
V_{CC}	Supply Voltage	-0.5 to +7.0		V
V_I	DC Input Voltage	-0.5 to +7.0		V
V_O	DC Output Voltage	-0.5 to $V_{CC} + 0.5$	Output in HIGH or LOW State (Note 4)	V
I_{IK}	DC Input Diode Current	-50	$V_I < \text{GND}$	mA
I_{OK}	DC Output Diode Current	-50 +50	$V_O < \text{GND}$ $V_O > V_{CC}$	mA
I_O	DC Output Source/Sink Current	± 50		mA
I_{CC}	DC Supply Current per Supply Pin	± 100		mA
I_{GND}	DC Ground Current per Ground Pin	± 100		mA
T_{STG}	Storage Temperature	-65 to +150		°C

Recommended Operating Conditions (Note 5)

Symbol	Parameter	Min	Max	Units	
V _{CC}	Supply Voltage	Operating	2.0	3.6	V
		Data Retention	1.5	3.6	
V _I	Input Voltage	0.0	5.5	V	
V _O	Output Voltage	HIGH or LOW State	0.0	V _{CC}	V
I _{OH} /I _{OL}	Output Current	V _{CC} = 3.0V to 3.6V		±24.0	mA
		V _{CC} = 2.7V to 3.0V		±12.0	
		V _{CC} = 2.3V to 2.7V		±8.0	
T _A	Free-Air Operating Temperature	−40.0	85.0	°C	
Δt/ΔV	Input Edge Rate, V _{IN} = 0.8V to 2.0V, V _{CC} = 3.0V	0.0	10.0	ns/V	

Note 3: The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Note 4: I_O Absolute Maximum Rating must be observed.

Note 5: Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		Units
				Min	Max	
V_{IH}	HIGH Level Input Voltage		2.3 to 2.7 2.7 to 3.6	1.7 2.0		V
V_{IL}	LOW Level Input Voltage		2.3 to 2.7 2.7 to 3.6		0.7 0.8	V
V_{OH}	HIGH Level Output Voltage	$I_{OH} = -100\ \mu\text{A}$ $I_{OH} = -8\ \text{mA}$ $I_{OH} = -12\ \text{mA}$ $I_{OH} = -18\ \text{mA}$ $I_{OH} = -24\ \text{mA}$	2.3 to 3.6 2.3 2.7 3.0 3.0	$V_{CC} - 0.2$ 1.8 2.2 2.4 2.2		V
V_{OL}	LOW Level Output Voltage	$I_{OL} = 100\ \mu\text{A}$ $I_{OL} = 8\ \text{mA}$ $I_{OL} = 12\ \text{mA}$ $I_{OL} = 16\ \text{mA}$ $I_{OL} = 24\ \text{mA}$	2.3 to 3.6 2.3 2.7 3.0 3.0		0.2 0.6 0.4 0.4 0.55	V
I_I	Input Leakage Current	$0 \leq V_I \leq 5.5\text{V}$	2.3 to 3.6		± 5.0	μA
I_{OFF}	Power-Off Leakage Current	V_I or $V_O = 5.5\text{V}$	0.0		10.0	μA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND $3.6\text{V} \leq V_I \leq 5.5\text{V}$	2.3 to 3.6 2.3 to 3.6		10.0 ± 10.0	μA
ΔI_{CC}	Increase in I_{CC} per Input	$V_{IH} = V_{CC} - 0.6\text{V}$	2.3 to 3.6		500	μA

AC Electrical Characteristics

Symbol	Parameter	T _A = -40°C to +85°C, R _L = 500Ω						Units
		V _{CC} = 3.3V ± 0.3V		V _{CC} = 2.7V		V _{CC} = 2.5V ± 0.2V		
		C _L = 50pF		C _L = 50pF		C _L = 30pF		
		Min	Max	Min	Max	Min	Max	
t _{PHL}	Propagation Delay	1.5	6.0	1.5	7.0	1.5	7.2	ns
t _{PLH}	An to Q̄n	1.5	6.0	1.5	7.0	1.5	7.2	
t _{PHL}	Propagation Delay	1.5	6.5	1.5	7.5	1.5	8.4	ns
t _{PLH}	E3 to Q̄n	1.5	6.5	1.5	7.5	1.5	8.4	
t _{PHL}	Propagation Delay	1.5	6.0	1.5	7.0	1.5	7.2	ns
t _{PLH}	E1 or E2 to Q̄n	1.5	6.0	1.5	7.0	1.5	7.2	
t _{OSHL}	Output to Output Skew (Note 6)		1.0					ns
t _{OSLH}			1.0					

Note 6: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}).

Dynamic Switching Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = 25^{\circ}\text{C}$	Units
				Typical	
V_{OLP}	Quiet Output Dynamic Peak V_{OL}	$C_L = 50\text{ pF}, V_{IH} = 3.3V, V_{IL} = 0V$ $C_L = 30\text{ pF}, V_{IH} = 2.5V, V_{IL} = 0V$	3.3 2.5	0.8 0.6	V
V_{OLV}	Quiet Output Dynamic Valley V_{OL}	$C_L = 50\text{ pF}, V_{IH} = 3.3V, V_{IL} = 0V$ $C_L = 30\text{ pF}, V_{IH} = 2.5V, V_{IL} = 0V$	3.3 2.5	-0.8 -0.6	V

Capacitance

Symbol	Parameter	Conditions	Typical	Units
C_{IN}	Input Capacitance	$V_{CC} = \text{Open}, V_I = 0V \text{ or } V_{CC}$	7.0	pF
C_{OUT}	Output Capacitance	$V_{CC} = 3.3V, V_I = 0V \text{ or } V_{CC}$	8.0	pF
C_{PD}	Power Dissipation Capacitance	$V_{CC} = 3.3V, V_I = 0V \text{ or } V_{CC}, f = 10\text{ MHz}$	25.0	pF

AC Loading and Waveforms Generic for LCX Family

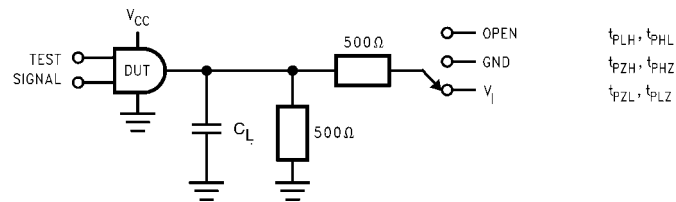
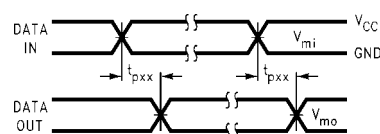
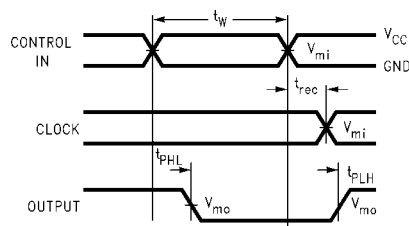


FIGURE 1. AC Test Circuit
(C_L includes probe and jig capacitance)

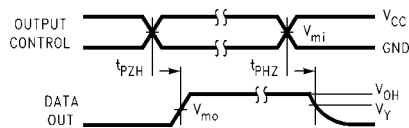
Test	Switch
t_{PLH} , t_{PHL}	Open
t_{PZL} , t_{PLZ}	6V at $V_{CC} = 3.3V \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5V \pm 0.2V$
t_{PZH} , t_{PHZ}	GND



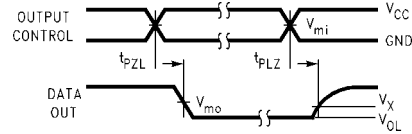
Waveform for Inverting and Non-Inverting Functions



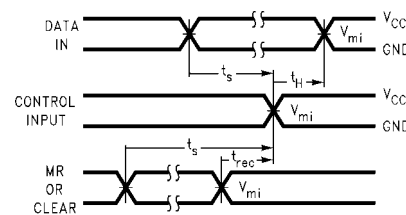
Propagation Delay, Pulse Width and t_{rec} Waveforms



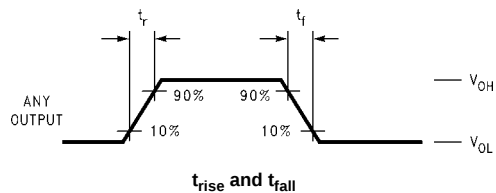
3-STATE Output High Enable and Disable Times for Logic



3-STATE Output Low Enable and Disable Times for Logic



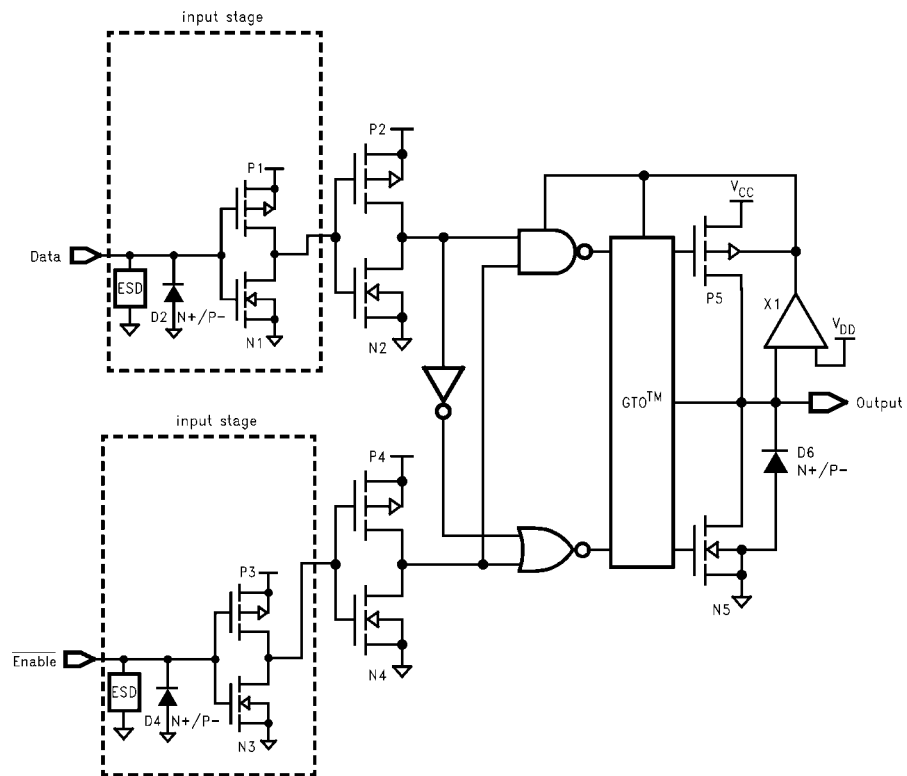
Setup Time, Hold Time and Recovery Time for Logic



Symbol	V_{CC}		
	$3.3V \pm 0.3V$	$2.7V$	$2.5V \pm 0.2V$
V_{mi}	1.5V	1.5V	$V_{CC}/2$
V_{mo}	1.5V	1.5V	$V_{CC}/2$
V_x	$V_{OL} + 0.3V$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$
V_y	$V_{OH} - 0.3V$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$

FIGURE 2. Waveforms
(Input Pulse Characteristics; $f = 1MHz$, $t_r = t_f = 3ns$)

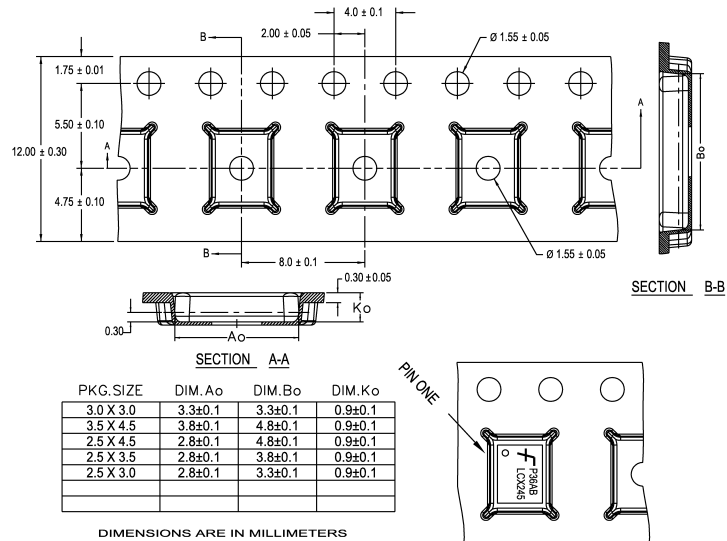
Schematic Diagram Generic for LCX Family



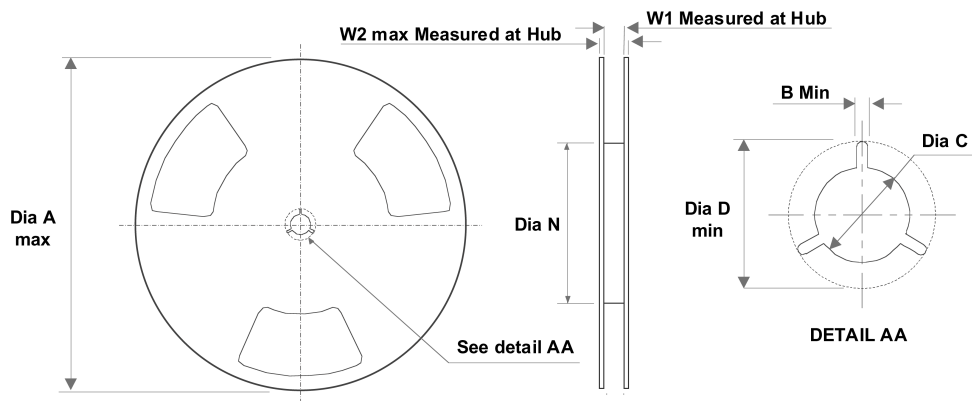
Tape Format for DQFN

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

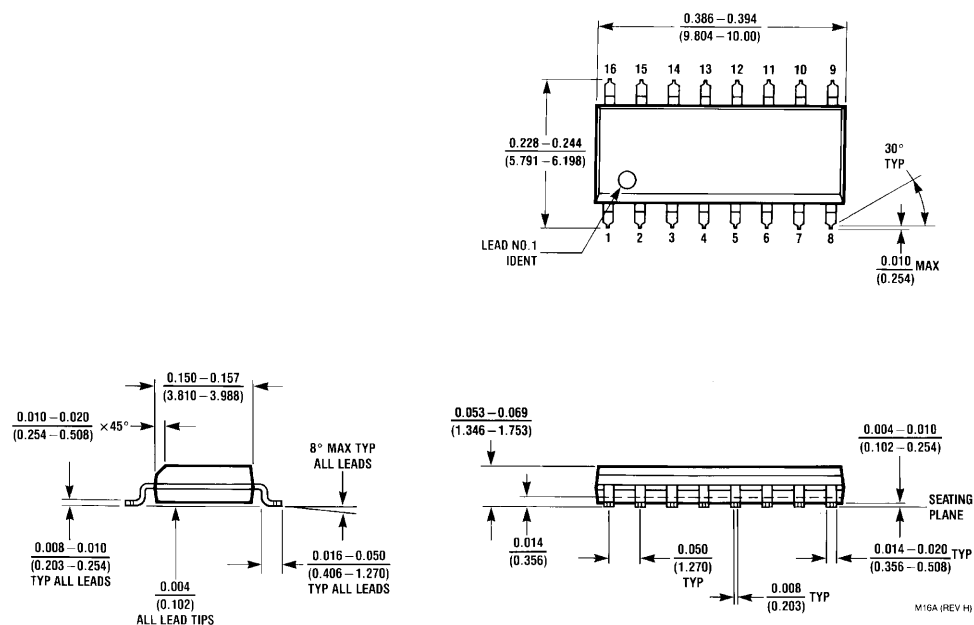
TAPE DIMENSIONS inches (millimeters)



FSC MLP/DQFN CARRIER TAPE SPECIFICATIONS

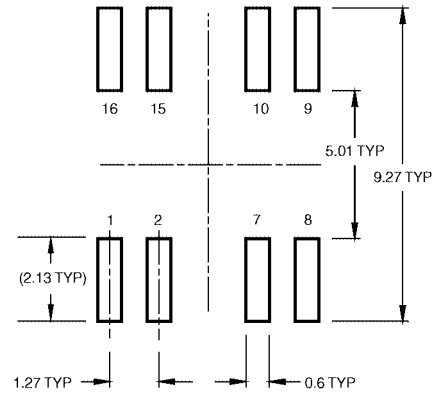
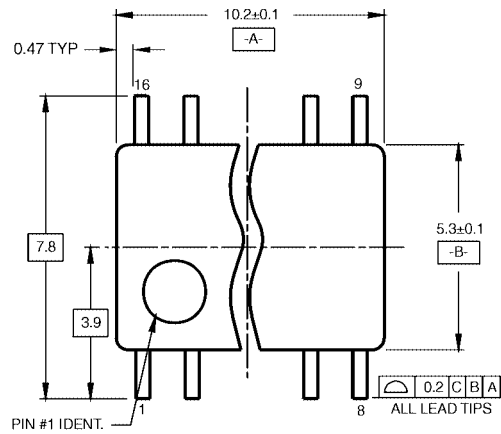
REEL DIMENSIONS inches (millimeters)

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

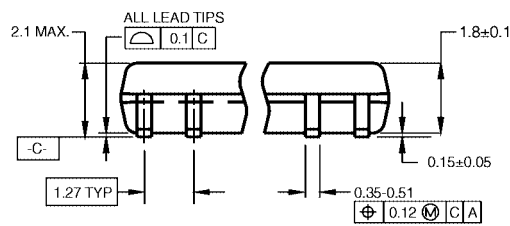
Physical Dimensions inches (millimeters) unless otherwise noted


**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
Package Number M16A**

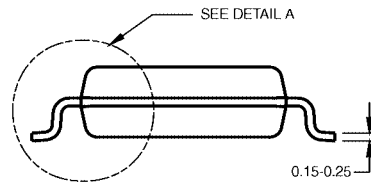
Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



LAND PATTERN RECOMMENDATION



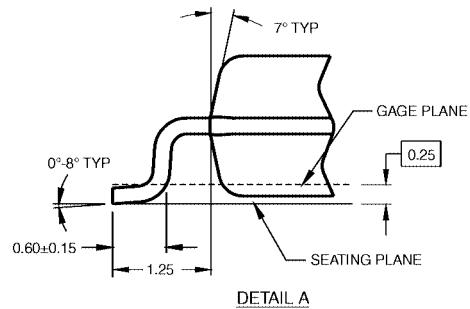
DIMENSIONS ARE IN MILLIMETERS



NOTES:

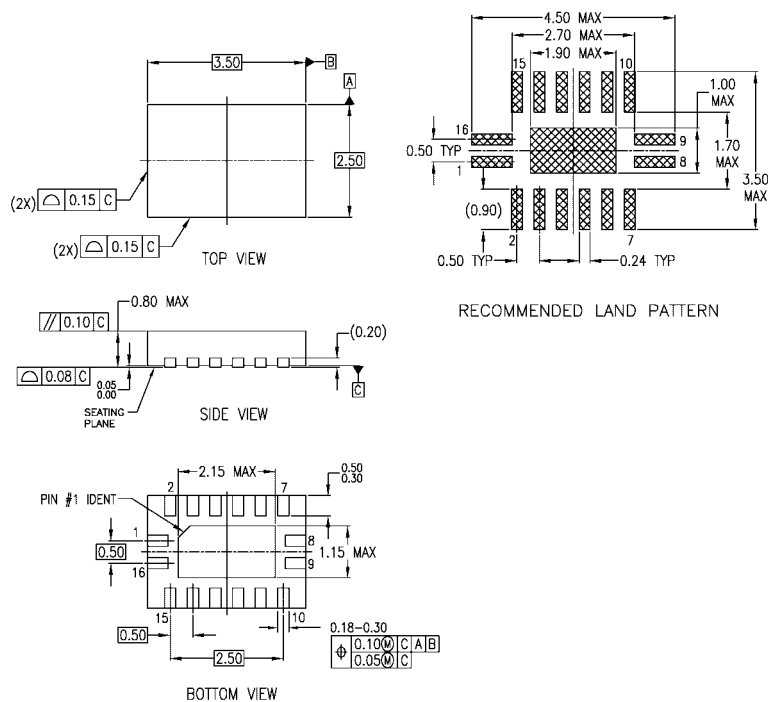
- A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M16DRevB1



DETAIL A

**16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
Package Number M16D**

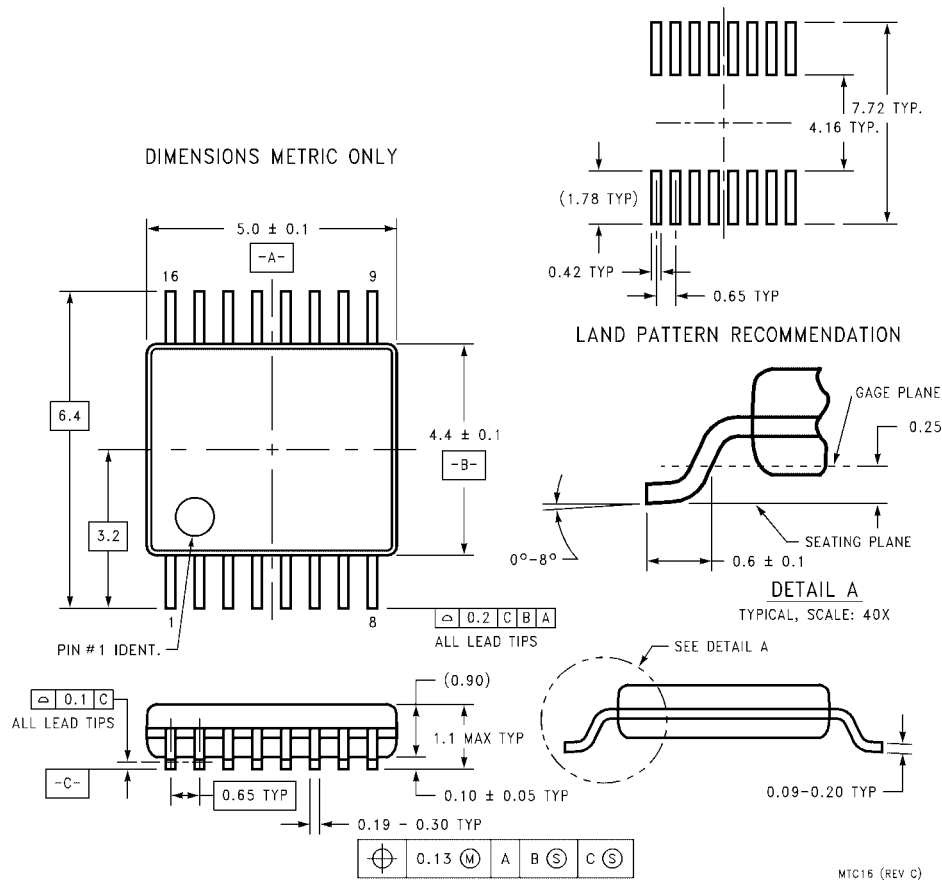
Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

NOTES:

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

MLP016ErevA

**16-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.5mm
Package Number MLP016E**

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



Fairchild does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and Fairchild reserves the right at any time without notice to change said circuitry and specifications.

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 THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. 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 to the user.
2. 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.

www.fairchildsemi.com

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