FAIRCHILD™

Is Now Part of

ON Semiconductor®

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

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

FAIRCHILD

SEMICONDUCTOR ™

November 1992
Revised April 1999

74VHC138
3-to-8 Decoder/Demultiplexer

General Description

The VHC138 is an advanced high speed CMOS 3-to-8 decoder/demultiplexer fabricated with silicon gate CMOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

When the device is enabled, 3 binary select inputs (A_0, A_1 and A_2) determine which one of the outputs ($\overline{O}_0$–$\overline{O}_7$) will go LOW. When enable input E_3 is held LOW or either $\overline{E}_1$ or $\overline{E}_2$ is held HIGH, decoding function is inhibited and all outputs go HIGH. E_3, $\overline{E}_1$ and $\overline{E}_2$ inputs are provided to ease cascade connection and for use as an address decoder for memory systems. An input protection circuit ensures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

Features

- High Speed: t_{PD} = 5.7ns (typ) at T_A = 25°C
- Low power dissipation: I_{CC} = 4 μA (max.) at T_A = 25°C
- High noise immunity: V_{NIH} = V_{NIL} = 28% V_{CC} (min.)
- Power down protection provided on all inputs
- Pin and function compatible with 74HC138

Ordering Code:

Order Number	Package Number	Package Description
74VHC138M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHC138SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74VHC138MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74VHC138N	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Logic Symbols

IEEE/IEC
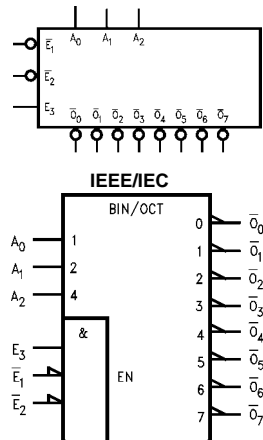
Connection Diagram
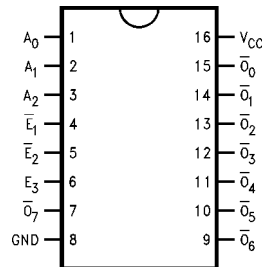
Pin Descriptions

Pin Names	Description
A_0–A_2	Address Inputs
$\overline{E}_1$–$\overline{E}_2$	Enable Inputs
E_3	Enable Input
$\overline{O}_0$–$\overline{O}_7$	Outputs

© 1999 Fairchild Semiconductor Corporation   DS011537.prf   www.fairchildsemi.com

Truth Table

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

Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Voltage (V_{IN})	−0.5V to +7.0V
DC Output Voltage (V_{OUT})	−0.5V to V_{CC} + 0.5V
Input Diode Current (I_{IK})	−20 mA
Output Diode Current (I_{OK})	±20 mA
DC Output Current (I_{OUT})	±25 mA
DC V_{CC}/GND Current (I_{CC})	±75 mA
Storage Temperature (T_{STG})	−65°C to +150°C
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260°C

Recommended Operating Conditions (Note 2)

Supply Voltage (V_{CC})	2.0V to +5.5V
Input Voltage (V_{IN})	0V to +5.5V
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_{OPR})	−40°C to +85°C
Input Rise and Fall Time (t_r, t_f)	
V_{CC} = 3.3V ± 0.3V	0 ~ 100 ns/V
V_{CC} = 5.0V ± 0.5V	0 ~ 20 ns/V

Note 1: Absolute Maximum Ratings are values beyond which the device may be damaged or have its useful life impaired. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation outside databook specifications.

Note 2: Unused inputs must be held HIGH or LOW. They may not float.
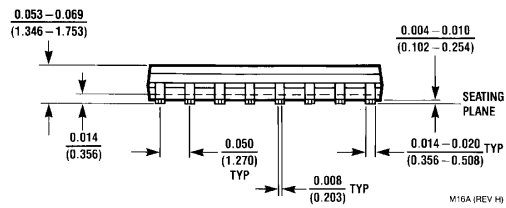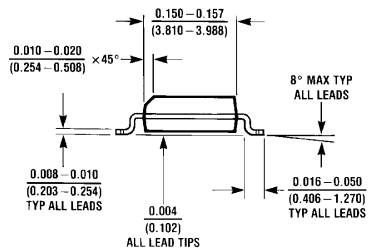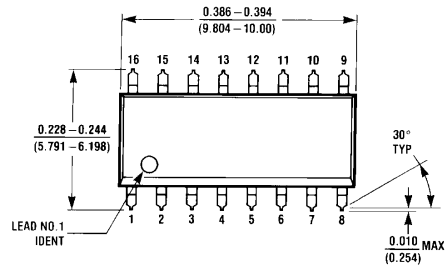
DC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	T_A = 25°C Min	T_A = 25°C Typ	T_A = 25°C Max	T_A = −40°C to +85°C Min	T_A = −40°C to +85°C Max	Units	Conditions	
V_{IH}	HIGH Level Input Voltage	2.0	1.50			1.50		V		
		3.0 – 5.5	0.7 V_{CC}			0.7 V_{CC}				
V_{IL}	LOW Level Input Voltage	2.0			0.50		0.50	V		
		3.0 – 5.5			0.3 V_{CC}		0.3 V_{CC}			
V_{OH}	HIGH Level Output Voltage	2.0	1.9	2.0		1.9		V	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −50 μA
		3.0	2.9	3.0		2.9				
		4.5	4.4	4.5		4.4				
		3.0	2.58			2.48		V		I_{OH} = −4 mA
		4.5	3.94			3.80				I_{OH} = −8 mA
V_{OL}	LOW Level Output Voltage	2.0		0.0	0.1		0.1	V	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA
		3.0		0.0	0.1		0.1			
		4.5		0.0	0.1		0.1			
		3.0			0.36		0.44	V		I_{OL} = 4 mA
		4.5			0.36		0.44			I_{OL} = 8 mA
I_{IN}	Input Leakage Current	0 – 5.5			±0.1		±1.0	μA	V_{IN} = 5.5V or GND	
I_{CC}	Quiescent Supply Current	5.5			4.0		40.0	μA	V_{IN} = V_{CC} or GND	

www.fairchildsemi.com

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	$T_A = 25°C$			$T_A = -40°C$ to $+85°C$		Units	Conditions
			Min	Typ	Max	Min	Max		
t_{PLH}	Propagation Delay	3.3 ± 0.3		8.2	11.4	1.0	13.5	ns	$C_L = 15$ pF
t_{PHL}	A_n to $\overline{O}_n$			10.0	15.8	1.0	18.0		$C_L = 50$ pF
		5.0 ± 0.5		5.7	8.1	1.0	9.5	ns	$C_L = 15$ pF
				7.2	10.1	1.0	11.5		$C_L = 50$ pF
t_{PLH}	Propagation Delay	3.3 ± 0.3		8.1	12.8	1.0	15.0	ns	$C_L = 15$ pF
t_{PHL}	E_3 to $\overline{O}_n$			10.6	16.3	1.0	18.5		$C_L = 50$ pF
		5.0 ± 0.5		5.6	8.1	1.0	9.5	ns	$C_L = 15$ pF
				7.1	10.1	1.0	11.5		$C_L = 50$ pF
t_{PLH}	Propagation Delay	3.3 ± 0.3		8.2	11.4	1.0	13.5	ns	$C_L = 15$ pF
t_{PHL}	$\overline{E}_1$ or $\overline{E}_2$ to $\overline{O}_n$			10.7	14.9	1.0	17.0		$C_L = 50$ pF
		5.0 ± 0.5		5.8	8.1	1.0	9.5	ns	$C_L = 15$ pF
				7.3	10.1	1.0	11.5		$C_L = 50$ pF
C_{IN}	Input Capacitance			4	10		10	pF	$V_{CC} = $ Open
C_{PD}	Power Dissipation Capacitance			34				pF	(Note 3)

Note 3: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I_{CC} (opr.) $= C_{PD} * V_{CC} * f_{IN} + I_{CC}$.

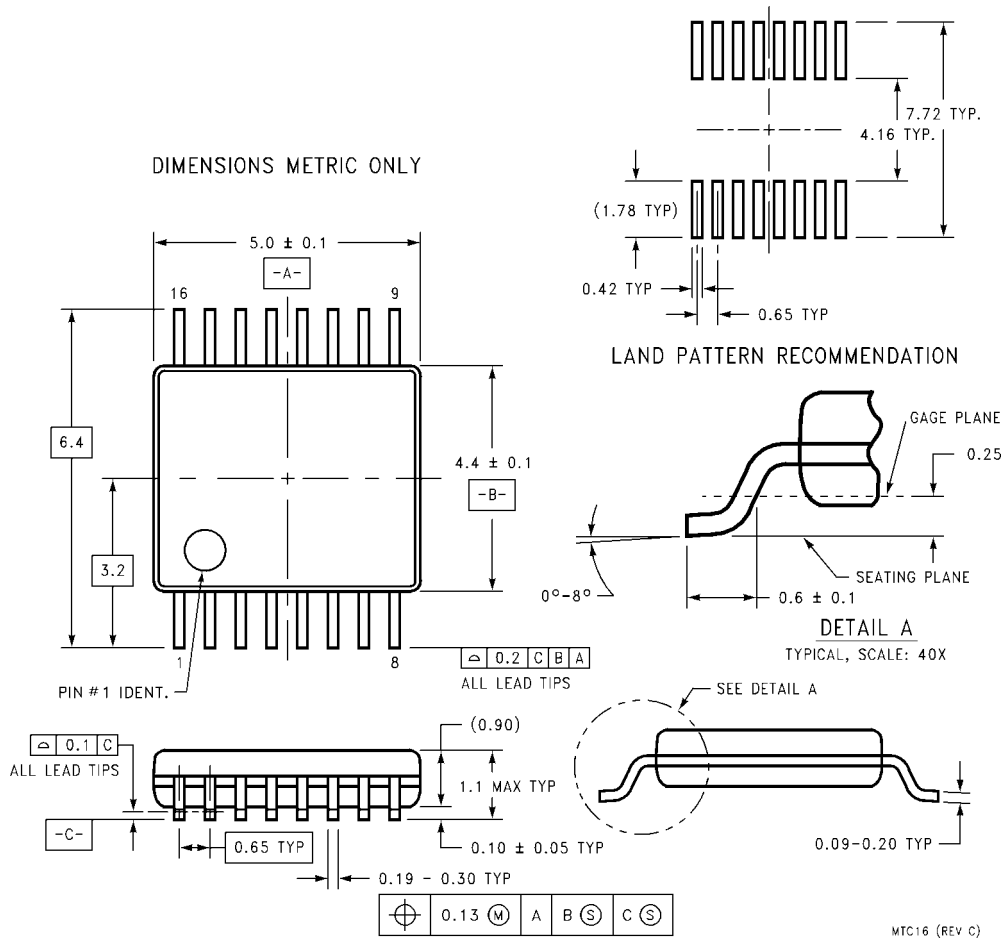# Physical Dimensions inches (millimeters) unless otherwise noted

0.386 − 0.394
(9.804 − 10.00)

16 15 14 13 12 11 10 9

0.228 − 0.244
(5.791 − 6.198)

30°
TYP

LEAD NO.1
IDENT

1   2   3   4   5   6   7   8

0.010 MAX
(0.254)

0.010 − 0.020
(0.254 − 0.508) ×45°

0.150 − 0.157
(3.810 − 3.988)

8° MAX TYP
ALL LEADS

0.008 − 0.010
(0.203 − 0.254)
TYP ALL LEADS

0.004
(0.102)
ALL LEAD TIPS

0.016 − 0.050
(0.406 − 1.270)
TYP ALL LEADS

0.053 − 0.069
(1.346 − 1.753)

0.004 − 0.010
(0.102 − 0.254)

SEATING
PLANE

0.014
(0.356)

0.050
(1.270)
TYP

0.008
(0.203) TYP

0.014 − 0.020
(0.356 − 0.508) TYP

M16A (REV H)

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

16   9

0.295-0.319
(7.5-8.1)

0.205-0.213
(5.2-5.4)

1   8

0.394-0.402
(10.0-10.2)

(0.71)
(1.8)

0.006-0.010
(0.15-0.25) TYP

0.067-0.083
(1.7-2.1)

0°-8° TYP

0.006 (0.15)

SEATING
PLANE

0.050
(1.27) TYP

0.000-0.010
(0-0.25)

0.014-0.020
(0.35-0.50) TYP

(0.049 TYP)
(1.25)

0.016-0.031
(0.4-0.8) TYP

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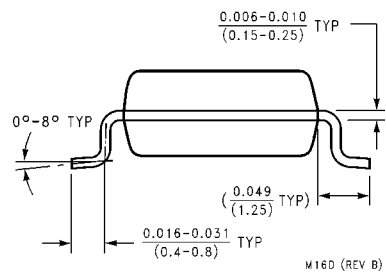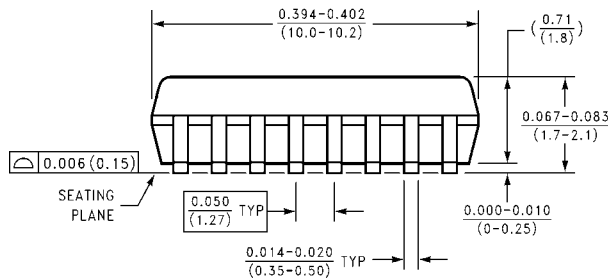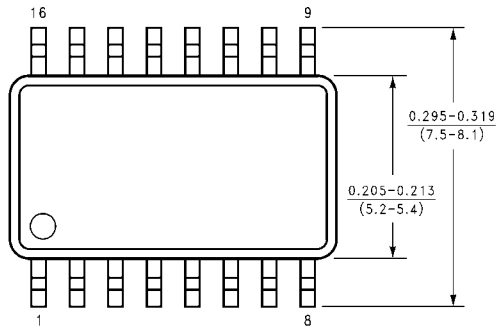
16-Lead Small Outline Package (SOP) EIAJ TYPE II, 5.3mm Wide
Package Number M16D

www.fairchildsemi.com

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

DIMENSIONS METRIC ONLY

LAND PATTERN RECOMMENDATION

7.72 TYP.

4.16 TYP.

(1.78 TYP)

0.42 TYP

0.65 TYP

5.0 ± 0.1

−A−

16   9

6.4

3.2

4.4 ± 0.1

−B−

1   8

PIN # 1 IDENT.

| ⌀ | 0.2 | C | B | A |

ALL LEAD TIPS

GAGE PLANE

0.25

0°−8°

0.6 ± 0.1

SEATING PLANE

DETAIL A

TYPICAL, SCALE: 40X

SEE DETAIL A

| ⌀ | 0.1 | C |

ALL LEAD TIPS

−C−

(0.90)

1.1 MAX TYP

0.10 ± 0.05 TYP

0.65 TYP

0.19 − 0.30 TYP

0.09−0.20 TYP

| ⊕ | 0.13 Ⓜ | A | B Ⓢ | C Ⓢ |

MTC16 (REV C)

**16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
Package Number MTC16**

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)
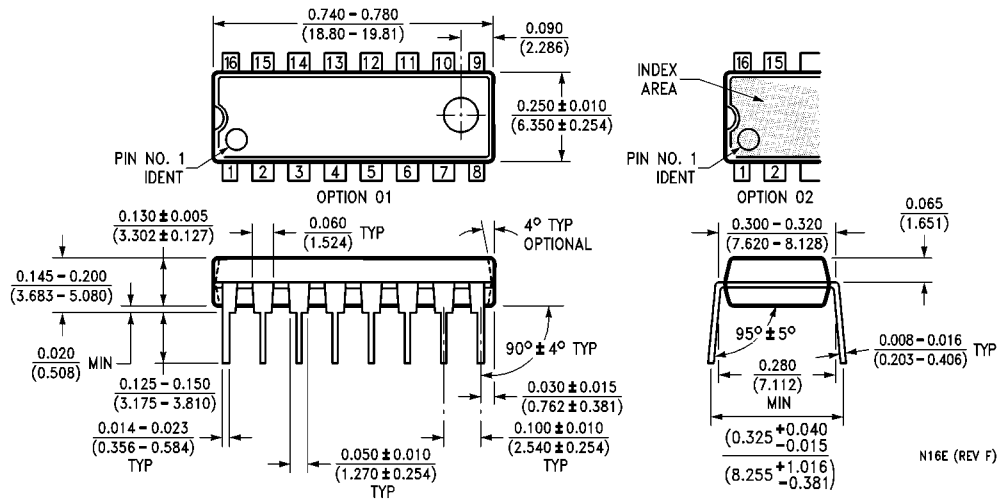
16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
Package Number N16E

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

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.

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

© Semiconductor Components Industries, LLC

www.onsemi.com