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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 $(A_0, A_1 \text{ and } A_2)$ 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

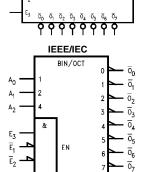
- \blacksquare High Speed: $t_{PD}=5.7ns$ (typ) at $T_A=25^{\circ}C$
- Low power dissipation: $I_{CC} = 4 \mu A \text{ (max.)}$ at $T_A = 25 ^{\circ} C$
- High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min.)
- Power down protection provided on all inputs
- Pin and function compatible with 74HC138

Ordering Code:

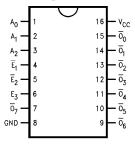
Order Number	Package Number	Package Description
74VHC138M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHC138SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74VHC138MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153,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



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

Truth Table

Inputs					Outputs								
Ē ₁	Ē ₂	E ₃	A ₀	A ₁	A ₂	O ₀	O ₁	O ₂	<u>O</u> 3	<u>O</u> 4	<u>O</u> 5	<u>o</u> 6	<u>0</u> 7
Н	Х	Χ	Х	Х	Х	Н	Н	Н	Н	Н	Н	Н	Н
Х	Н	Х	Х	Х	Х	Н	Н	Н	Н	Н	Н	Н	Н
Х	Х	L	Х	Х	Х	Н	Н	Н	Н	Н	Н	Н	Н
L	L	Н	L	L	L	L	Н	Н	Н	Н	Н	Н	Н
L	L	Н	Н	L	L	Н	L	Н	Н	Н	Н	Н	Н
L	L	Н	L	Н	L	Н	Н	L	Н	Н	Н	Н	Н
L	L	Н	Н	Н	L	Н	Н	Н	L	Н	Н	Н	Н
L	L	Н	L	L	Н	Н	Н	Н	Н	L	Н	Н	Н
L	L	Н	Н	L	Н	Н	Н	Н	Н	Н	L	Н	Н
L	L	Н	L	Н	Н	Н	Н	Н	Н	Н	Н	L	Н
L	L	Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	L

$$\begin{split} & H = \text{HIGH Voltage Level} \\ & L = \text{LOW Voltage Level} \\ & X = \text{Immaterial} \end{split}$$

-40°C to +85°C

Absolute Maximum Ratings(Note 1)

 $\begin{array}{lll} \mbox{Supply Voltage (V$_{CC}$)} & -0.5 \mbox{V to } +7.0 \mbox{V} \\ \mbox{DC Input Voltage (V$_{IN}$)} & -0.5 \mbox{V to } +7.0 \mbox{V} \\ \end{array}$

 $\begin{array}{lll} \text{DC Output Voltage (V_{OUT})} & -0.5 \text{V to V}_{CC} + 0.5 \text{V} \\ \text{Input Diode Current (I}_{IK}) & -20 \text{ mA} \\ \text{Output Diode Current (I}_{OK}) & \pm 20 \text{ mA} \\ \text{DC Output Current (I}_{OUT}) & \pm 25 \text{ mA} \\ \end{array}$

 $\begin{array}{ll} {\rm DC~V_{CC}/GND~Current~(I_{CC})} & \pm 75~{\rm mA} \\ {\rm Storage~Temperature~(I_{STG})} & -65^{\circ}{\rm C~to~+150^{\circ}C} \end{array}$

Lead Temperature (T_L)

(Soldering, 10 seconds) 260°C

Recommended Operating Conditions (Note 2)

 $\begin{array}{lll} \mbox{Supply Voltage (V_{CC})} & 2.0\mbox{V to } +5.5\mbox{V} \\ \mbox{Input Voltage (V_{IN})} & 0\mbox{V to } +5.5\mbox{V} \\ \mbox{Output Voltage (V_{OUT})} & 0\mbox{V to V_{CC}} \end{array}$

Operating Temperature (T_{OPR}) Input Rise and Fall Time ($t_{\rm f},\,t_{\rm f}$)

$$\begin{split} & \text{V}_{\text{CC}} = 3.3 \text{V} \pm 0.3 \text{V} & 0 \sim 100 \text{ ns/V} \\ & \text{V}_{\text{CC}} = 5.0 \text{V} \pm 0.5 \text{V} & 0 \sim 20 \text{ ns/V} \end{split}$$

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.

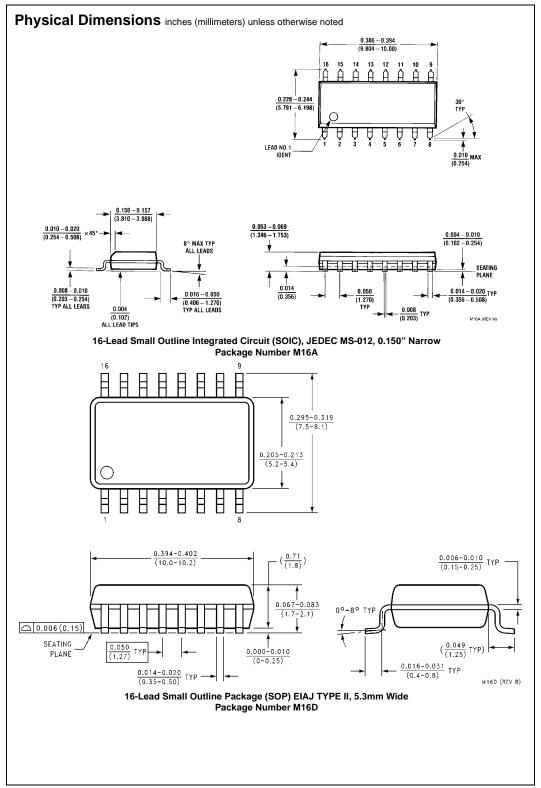
DC Electrical Characteristics

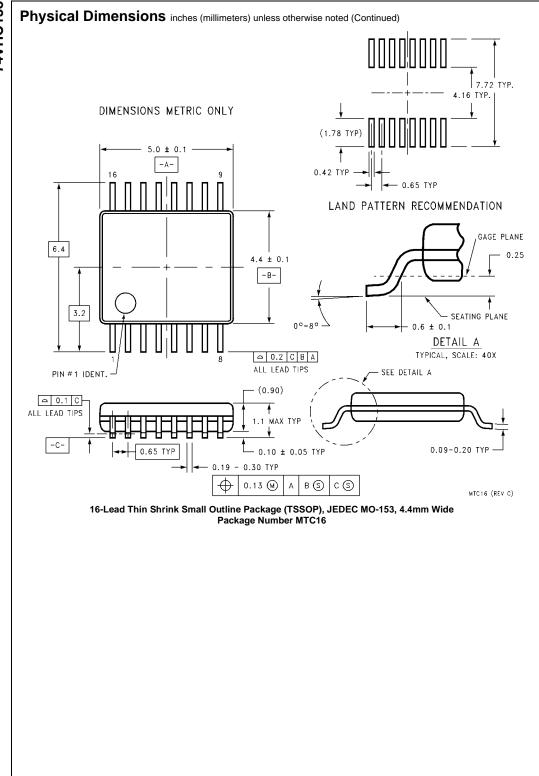
Symbol	Parameter	V _{CC}		$T_A = 25^{\circ}C$;	$T_A = -40^{\circ}C \text{ to } +85^{\circ}C$		Units	Conditions	
- Cynnbol		(V)	Min	Тур	Max	Min	Max	Units	COI	iuitions
V _{IH}	HIGH Level Input Voltage	2.0	1.50			1.50		V		
		3.0 – 5.5	0.7 V _{CC}			0.7 V _{CC}		v		
V _{IL}	LOW Level Input Voltage	2.0			0.50		0.50	V		
		3.0 - 5.5			$0.3 V_{\rm CC}$		$0.3 V_{\rm CC}$	v		
V _{OH}	HIGH Level Output Voltage	2.0	1.9	2.0		1.9			$V_{IN} = V_{IH}$	$I_{OH} = -50 \ \mu A$
		3.0	2.9	3.0		2.9		V	or V _{IL}	
		4.5	4.4	4.5		4.4				
		3.0	2.58			2.48		V	1	$I_{OH} = -4 \text{ mA}$
		4.5	3.94			3.80		v		$I_{OH} = -8 \text{ mA}$
V _{OL}	LOW Level Output Voltage	2.0		0.0	0.1		0.1		$V_{IN} = V_{IH}$	$I_{OL} = 50 \mu A$
		3.0		0.0	0.1		0.1	V	or V _{IL}	
		4.5		0.0	0.1		0.1			
		3.0			0.36		0.44	V	1	$I_{OL} = 4 \text{ mA}$
		4.5			0.36		0.44	· ·		$I_{OL} = 8 \text{ mA}$
I _{IN}	Input Leakage Current	0 – 5.5			±0.1		±1.0	μΑ	$V_{IN} = 5.5V$	or GND
Icc	Quiescent Supply Current	5.5			4.0		40.0	μΑ	$V_{IN} = V_{CC}$	or GND

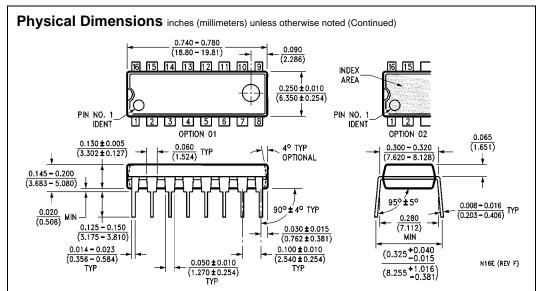
AC Electrical Characteristics

Symbol	Parameter	V _{CC}	$T_A = 25^{\circ}C$			T _A = -40°	C to +85°C	Units	Conditions
		(V)	Min	Тур	Max	Min	Max	Onits	Conditions
t _{PLH}	Propagation Delay	3.3 ± 0.3		8.2	11.4	1.0	13.5		C _L = 15 pF
t _{PHL}	A_n to \overline{O}_n			10.0	15.8	1.0	18.0	ns	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	ns	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	115	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	115	C _L = 50 pF
t _{PLH}	Propagation Delay	3.3 ± 0.3		8.2	11.4	1.0	13.5		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	ns	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	115	C _L = 50 pF
C _{IN}	Input Capacitance			4	10		10	pF	V _{CC} = Open
C _{PD}	Power Dissipation			34				pF	(Note 3)
	Capacitance								

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}.







16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide Package Number N16E

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