

MC74AC138, MC74ACT138

1-of-8 Decoder/Demultiplexer

The MC74AC138/74ACT138 is a high-speed 1-of-8 decoder/demultiplexer. This device is ideally suited for high-speed bipolar memory chip select address decoding.

The multiple input enables allow parallel expansion to a 1-of-24 decoder using just three MC74AC138/74ACT138 devices or a 1-of-32 decoder using four MC74AC138/74ACT138 devices and one inverter.

- Demultiplexing Capability
- Multiple Input Enable for Easy Expansion
- Active LOW Mutually Exclusive Outputs
- Outputs Source/Sink 24 mA
- 'ACT138 Has TTL Compatible Inputs

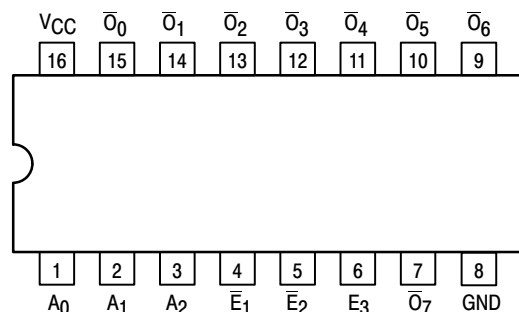


Figure 1. Pinout: 16-Lead Packages Conductors
(Top View)

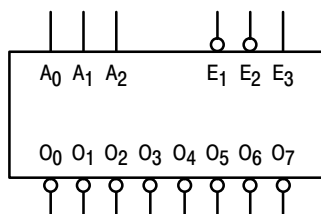


Figure 2. Logic Symbol

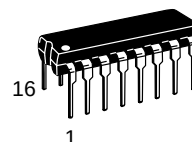
PIN ASSIGNMENT

PIN	FUNCTION
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

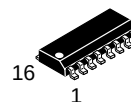


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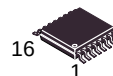
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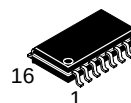
DIP-16
N SUFFIX
CASE 648



SO-16
D SUFFIX
CASE 751B



TSSOP-16
DT SUFFIX
CASE 948F



EIAJ-16
M SUFFIX
CASE 966

ORDERING INFORMATION

Device	Package	Shipping
MC74AC138N	PDIP-16	25 Units/Rail
MC74ACT138N	PDIP-16	25 Units/Rail
MC74AC138D	SOIC-16	48 Units/Rail
MC74ACT138D	SOIC-16	48 Units/Rail
MC74AC138DR2	SOIC-16	2500 Tape & Reel
MC74ACT138DR2	SOIC-16	2500 Tape & Reel
MC74AC138DT	TSSOP-16	96 Units/Rail
MC74ACT138DT	TSSOP-16	96 Units/Rail
MC74AC138DTR2	TSSOP-16	2500 Tape & Reel
MC74ACT138DTR2	TSSOP-16	2500 Tape & Reel
MC74AC138M	EIAJ-16	50 Units/Rail
MC74ACT138M	EIAJ-16	50 Units/Rail
MC74AC138MEL	EIAJ-16	2000 Tape & Reel
MC74ACT138MEL	EIAJ-16	2000 Tape & Reel

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 127 of this data sheet.

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FUNCTIONAL DESCRIPTION

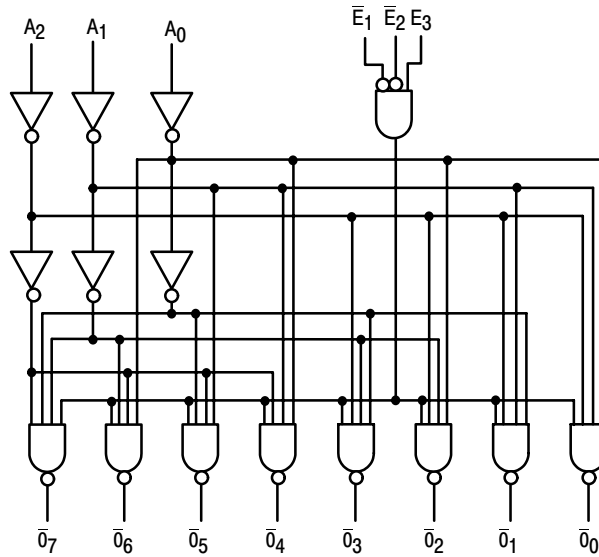
The MC74AC138/74ACT138 high-speed 1-of-8 decoder/demultiplexer accepts three binary weighted inputs (A_0 , A_1 , A_2) and, when enabled, provides eight mutually exclusive active-LOW outputs ($\overline{O}_0$ – $\overline{O}_7$). The MC74AC138/74ACT138 features three Enable inputs, two active-LOW ($\overline{E}_1$, $\overline{E}_2$) and one active-HIGH (E_3). All outputs will be HIGH unless $\overline{E}_1$ and $\overline{E}_2$ are LOW and E_3 is

HIGH. This multiple enabled function allows easy parallel expansion of the device to a 1-of-32 (5 lines to 32 lines) decoder with just four MC74AC138/74ACT138 devices and one inverter (See Figure 4). The MC74AC138/74ACT138 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							
$\overline{E}_1$	$\overline{E}_2$	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



NOTE: This diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Figure 3. Logic Diagram

MC74AC138, MC74ACT138

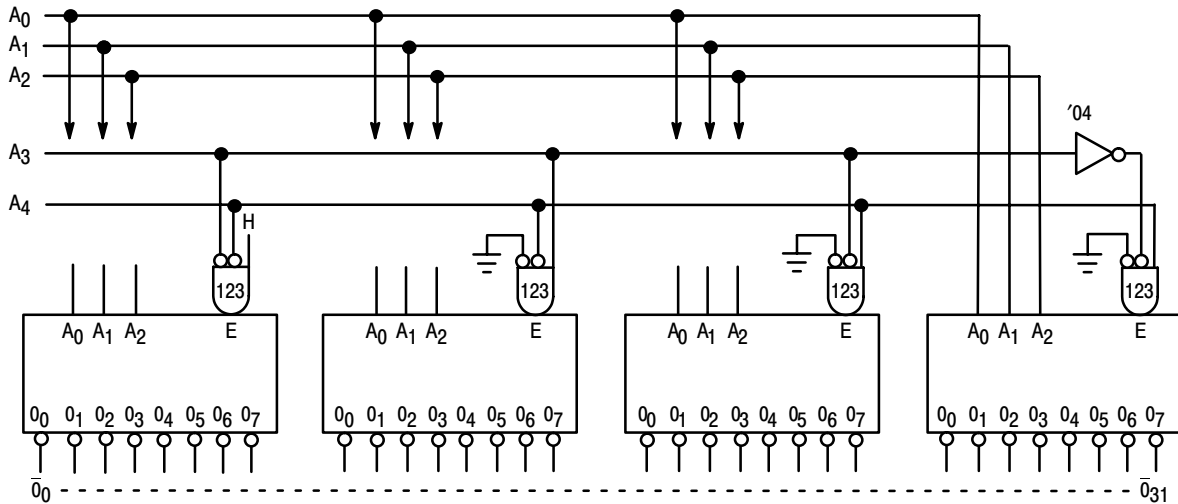


Figure 4. Expansion to 1-of-32 Decoding

MAXIMUM RATINGS*

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)	-0.5 to +7.0	V
V_{IN}	DC Input Voltage (Referenced to GND)	-0.5 to $V_{CC} + 0.5$	V
V_{OUT}	DC Output Voltage (Referenced to GND)	-0.5 to $V_{CC} + 0.5$	V
I_{IN}	DC Input Current, per Pin	± 20	mA
I_{OUT}	DC Output Sink/Source Current, per Pin	± 50	mA
I_{CC}	DC V_{CC} or GND Current per Output Pin	± 50	mA
T_{stg}	Storage Temperature	-65 to +150	°C

*Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Supply Voltage	'AC	2.0	5.0	V
		'ACT	4.5	5.0	
V_{IN}, V_{OUT}	DC Input Voltage, Output Voltage (Ref. to GND)	0	—	V_{CC}	V
t_r, t_f	Input Rise and Fall Time (Note 1) 'AC Devices except Schmitt Inputs	$V_{CC} @ 3.0 \text{ V}$	—	150	ns/V
		$V_{CC} @ 4.5 \text{ V}$	—	40	
		$V_{CC} @ 5.5 \text{ V}$	—	25	
t_r, t_f	Input Rise and Fall Time (Note 2) 'ACT Devices except Schmitt Inputs	$V_{CC} @ 4.5 \text{ V}$	—	10	ns/V
		$V_{CC} @ 5.5 \text{ V}$	—	8.0	
T_J	Junction Temperature (PDIP)	—	—	140	°C
T_A	Operating Ambient Temperature Range	-40	25	85	°C
I_{OH}	Output Current – High	—	—	-24	mA
I_{OL}	Output Current – Low	—	—	24	mA

- V_{IN} from 30% to 70% V_{CC} ; see individual Data Sheets for devices that differ from the typical input rise and fall times.
- V_{IN} from 0.8 V to 2.0 V; see individual Data Sheets for devices that differ from the typical input rise and fall times.

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DC CHARACTERISTICS

Symbol	Parameter	V _{CC} (V)	74AC		74AC	Unit	Conditions
			T _A = +25°C		T _A = –40°C to +85°C		
			Typ	Guaranteed Limits			
V _{IH}	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	V	V _{OUT} = 0.1 V or V _{CC} – 0.1 V
		4.5	2.25	3.15	3.15		
		5.5	2.75	3.85	3.85		
V _{IL}	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	V	V _{OUT} = 0.1 V or V _{CC} – 0.1 V
		4.5	2.25	1.35	1.35		
		5.5	2.75	1.65	1.65		
V _{OH}	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	V	I _{OUT} = –50 μA
		4.5	4.49	4.4	4.4		
		5.5	5.49	5.4	5.4		
		3.0	–	2.56	2.46	V	*V _{IN} = V _{IL} or V _{IH} –12 mA I _{OH} –24 mA –24 mA
		4.5	–	3.86	3.76		
		5.5	–	4.86	4.76		
V _{OL}	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	V	I _{OUT} = 50 μA
		4.5	0.001	0.1	0.1		
		5.5	0.001	0.1	0.1		
		3.0	–	0.36	0.44	V	*V _{IN} = V _{IL} or V _{IH} 12 mA I _{OL} 24 mA 24 mA
		4.5	–	0.36	0.44		
		5.5	–	0.36	0.44		
I _{IN}	Maximum Input Leakage Current	5.5	–	±0.1	±1.0	μA	V _I = V _{CC} , GND
I _{OLD}	†Minimum Dynamic Output Current	5.5	–	–	75	mA	V _{OLD} = 1.65 V Max
I _{OHD}		5.5	–	–	–75	mA	V _{OHD} = 3.85 V Min
I _{CC}	Maximum Quiescent Supply Current	5.5	–	8.0	80	μA	V _{IN} = V _{CC} or GND

*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

NOTE: I_{IN} and I_{CC} @ 3.0 V are guaranteed to be less than or equal to the respective limit @ 5.5 V V_{CC}.

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AC CHARACTERISTICS (For Figures and Waveforms – See Section 3 of the ON Semiconductor FACT Data Book, DL138/D)

Symbol	Parameter	V _{CC} * (V)	74AC			74AC		Unit	Fig. No.
			T _A = +25°C C _L = 50 pF			T _A = −40°C to +85°C C _L = 50 pF			
			Min	Typ	Max	Min	Max		
t _{PLH}	Propagation Delay A _n to $\overline{O}_n$	3.3 5.0	1.5 1.5	8.5 6.5	13.0 9.5	1.5 1.5	15.0 10.5	ns	3–6
t _{PHL}	Propagation Delay A _n to $\overline{O}_n$	3.3 5.0	1.5 1.5	8.0 6.0	12.5 9.0	1.5 1.5	14.0 10.5	ns	3–6
t _{PLH}	Propagation Delay $\overline{E}_1$ or $\overline{E}_2$ to $\overline{O}_n$	3.3 5.0	1.5 1.5	11.0 8.0	15.0 11.0	1.5 1.5	16.0 12.0	ns	3–6
t _{PHL}	Propagation Delay $\overline{E}_1$ or $\overline{E}_2$ to $\overline{O}_n$	3.3 5.0	1.5 1.5	9.5 7.0	13.5 9.5	1.5 1.5	15.0 10.5	ns	3–6
t _{PLH}	Propagation Delay E ₃ to $\overline{O}_n$	3.3 5.0	1.5 1.5	11.0 8.0	15.5 11.0	1.5 1.5	16.5 12.5	ns	3–6
t _{PHL}	Propagation Delay E ₃ to $\overline{O}_n$	3.3 5.0	1.5 1.5	8.5 6.0	13.0 8.0	1.5 1.0	14.0 9.5	ns	3–6

*Voltage Range 3.3 V is 3.3 V ±0.3 V.

*Voltage Range 5.0 V is 5.0 V ±0.5 V.

DC CHARACTERISTICS

Symbol	Parameter	V _{CC} (V)	74ACT		74ACT		Unit	Conditions
			T _A = +25°C		T _A = –40°C to +85°C			
			Typ	Guaranteed Limits				
V _{IH}	Minimum High Level Input Voltage	4.5 5.5	1.5 1.5	2.0 2.0	2.0 2.0		V	V _{OUT} = 0.1 V or V _{CC} – 0.1 V
V _{IL}	Maximum Low Level Input Voltage	4.5 5.5	1.5 1.5	0.8 0.8	0.8 0.8		V	V _{OUT} = 0.1 V or V _{CC} – 0.1 V
V _{OH}	Minimum High Level Output Voltage	4.5 5.5	4.49 5.49	4.4 5.4	4.4 5.4		V	I _{OUT} = –50 μA
		4.5 5.5	– –	3.86 4.86	3.76 4.76		V	*V _{IN} = V _{IL} or V _{IH} –24 mA I _{OH} –24 mA
V _{OL}	Maximum Low Level Output Voltage	4.5 5.5	0.001 0.001	0.1 0.1	0.1 0.1		V	I _{OUT} = 50 μA
		4.5 5.5	– –	0.36 0.36	0.44 0.44		V	*V _{IN} = V _{IL} or V _{IH} 24 mA I _{OL} 24 mA
I _{IN}	Maximum Input Leakage Current	5.5	–	±0.1	±1.0		μA	V _I = V _{CC} , GND
ΔI _{CCT}	Additional Max. I _{CC} /Input	5.5	0.6	–	1.5		mA	V _I = V _{CC} – 2.1 V
I _{OLD}	†Minimum Dynamic Output Current	5.5	–	–	75		mA	V _{OLD} = 1.65 V Max
I _{OHD}		5.5	–	–	–75		mA	V _{OHD} = 3.85 V Min
I _{CC}	Maximum Quiescent Supply Current	5.5	–	8.0	80		μA	V _{IN} = V _{CC} or GND

*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

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AC CHARACTERISTICS (For Figures and Waveforms – See Section 3 of the ON Semiconductor FACT Data Book, DL138/D)

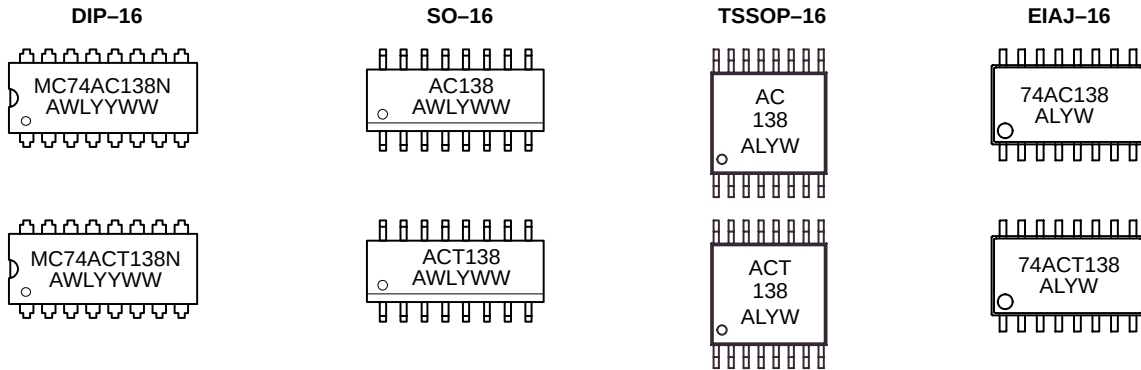
Symbol	Parameter	V _{CC} * (V)	74ACT			74ACT		Unit	Fig. No.
			T _A = +25°C C _L = 50 pF			T _A = –40°C to +85°C C _L = 50 pF			
			Min	Typ	Max	Min	Max		
t _{PLH}	Propagation Delay A _n to $\bar{O}_n$	5.0	1.5	7.0	10.5	1.5	11.5	ns	3–6
t _{PHL}	Propagation Delay A _n to $\bar{O}_n$	5.0	1.5	6.5	10.5	1.5	11.5	ns	3–6
t _{PLH}	Propagation Delay $\bar{E}_1$ or $\bar{E}_2$ to $\bar{O}_n$	5.0	2.5	8.0	11.5	2.0	12.5	ns	3–6
t _{PHL}	Propagation Delay $\bar{E}_1$ or $\bar{E}_2$ to $\bar{O}_n$	5.0	2.0	7.5	11.5	2.0	12.5	ns	3–6
t _{PLH}	Propagation Delay E ₃ to $\bar{O}_n$	5.0	2.5	8.0	12.0	2.0	13.0	ns	3–6
t _{PHL}	Propagation Delay E ₃ to $\bar{O}_n$	5.0	2.0	6.5	10.5	1.5	11.5	ns	3–6

*Voltage Range 5.0 V is 5.0 V ± 0.5 V

CAPACITANCE

Symbol	Parameter	Value Typ	Unit	Test Conditions
C _{IN}	Input Capacitance	4.5	pF	V _{CC} = 5.0 V
C _{PD}	Power Dissipation Capacitance	60	pF	V _{CC} = 5.0 V

MARKING DIAGRAMS



A = Assembly Location
 WL, L = Wafer Lot
 YY, Y = Year
 WW, W = Work Week