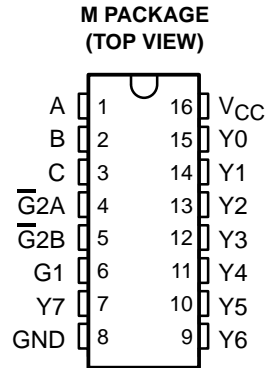




- **AC Types Feature 1.5-V to 5.5-V Operation and Balanced Noise Immunity at 30% of the Supply Voltage**
- **Speed of Bipolar F, AS, and S, With Significantly Reduced Power Consumption**
- **Designed Specifically for High-Speed Memory Decoders and Data-Transmission Systems**
- **Incorporates Three Enable Inputs to Simplify Cascading and/or Data Reception**
- **Balanced Propagation Delays**
- **±24-mA Output Drive Current**  
– Fanout to 15 F Devices
- **SCR-Latchup-Resistant CMOS Process and Circuit Design**
- **Exceeds 2-kV ESD Protection Per MIL-STD-883, Method 3015**



### description/ordering information

The CD74AC238 decoder/demultiplexer is designed for high-performance memory-decoding and data-routing applications that require very short propagation-delay times. In high-performance memory systems, this decoder can be used to minimize the effects of system decoding. When employed with high-speed memories utilizing a fast enable circuit, the delay times of this decoder and the enable time of the memory usually are less than the typical access time of the memory. This means that the effective system delay introduced by the decoder is negligible.

The conditions at the binary-select inputs and the three enable inputs select one of eight output lines. Two active-low and one active-high enable inputs reduce the need for external gates or inverters when expanding. A 24-line decoder can be implemented without external inverters, and a 32-line decoder requires only one inverter. An enable input can be used as a data input for demultiplexing applications (see Application Information).

### ORDERING INFORMATION

T <sub>A</sub>	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–55°C to 125°C	SOIC – M	Tape and reel	CD74AC238M96	AC238M

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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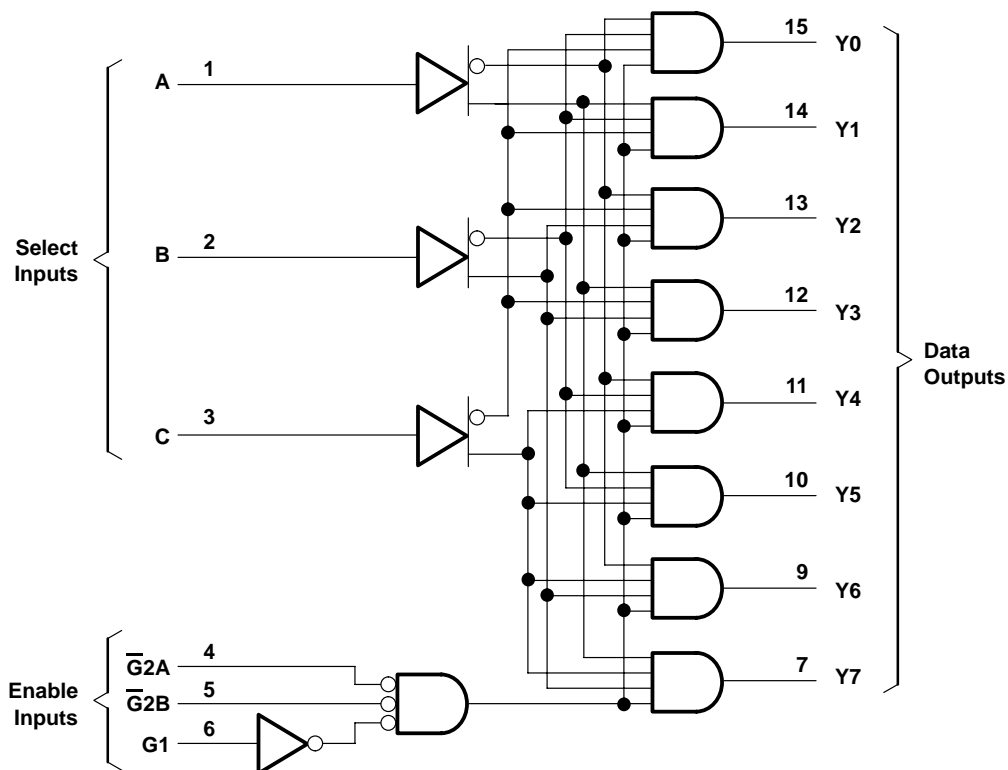
# CD74AC238 3-LINE TO 8-LINE DECODER/DEMULTIPLEXER

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FUNCTION TABLE

ENABLE INPUTS			SELECT INPUTS			OUTPUTS							
G1	$\overline{G2A}$	$\overline{G2B}$	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	H	X	X	X	X	L	L	L	L	L	L	L	L
X	X	H	X	X	X	L	L	L	L	L	L	L	L
L	X	X	X	X	X	L	L	L	L	L	L	L	L
H	L	L	L	L	L	H	L	L	L	L	L	L	L
H	L	L	L	L	H	L	H	L	L	L	L	L	L
H	L	L	L	H	L	L	L	H	L	L	L	L	L
H	L	L	L	H	H	L	L	L	H	L	L	L	L
H	L	L	H	L	L	L	L	L	L	H	L	L	L
H	L	L	H	L	H	L	L	L	L	L	H	L	L
H	L	L	H	H	L	L	L	L	L	L	L	H	L
H	L	L	H	H	H	L	L	L	L	L	L	L	H

logic diagram (positive logic)



**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†**

Supply voltage range, $V_{CC}$ .....	–0.5 V to 6 V
Input clamp current, $I_{IK}$ ( $V_I < 0$ V or $V_I > V_{CC}$ ) (see Note 1) .....	±20 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ V or $V_O > V_{CC}$ ) (see Note 1) .....	±50 mA
Continuous output current, $I_O$ ( $V_O > 0$ V or $V_O < V_{CC}$ ) .....	±50 mA
Continuous current through $V_{CC}$ or GND .....	±200 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2) .....	73°C/W
Storage temperature range, $T_{stg}$ .....	–65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51-7.

**recommended operating conditions (see Note 3)**

		$T_A = 25^\circ\text{C}$		$-55^\circ\text{C to } 125^\circ\text{C}$		$-40^\circ\text{C to } 85^\circ\text{C}$		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
$V_{CC}$	Supply voltage	1.5	5.5	1.5	5.5	1.5	5.5	V
$V_{IH}$	High-level input voltage	$V_{CC} = 1.5$ V		1.2		1.2		V
		$V_{CC} = 3$ V		2.1		2.1		
		$V_{CC} = 5.5$ V		3.85		3.85		
$V_{IL}$	Low-level input voltage	$V_{CC} = 1.5$ V			0.3		0.3	V
		$V_{CC} = 3$ V			0.9		0.9	
		$V_{CC} = 5.5$ V			1.65		1.65	
$V_I$	Input voltage	0	$V_{CC}$	0	$V_{CC}$	0	$V_{CC}$	V
$V_O$	Output voltage	0	$V_{CC}$	0	$V_{CC}$	0	$V_{CC}$	V
$I_{OH}$	High-level output current	$V_{CC} = 4.5$ V to 5.5 V		–24		–24		mA
$I_{OL}$	Low-level output current	$V_{CC} = 4.5$ V to 5.5 V		24		24		mA
$\Delta t/\Delta v$	Input transition rise or fall rate	$V_{CC} = 1.5$ V to 3 V		50		50		ns/V
		$V_{CC} = 3.6$ V to 5.5 V		20		20		

NOTE 3: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

# CD74AC238

## 3-LINE TO 8-LINE DECODER/DEMULTIPLEXER

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS		V <sub>CC</sub>	T <sub>A</sub> = 25°C		-55°C to 125°C		-40°C to 85°C		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50 μA	1.5 V	1.4		1.4		1.4	V	
			3 V	2.9		2.9		2.9		
			4.5 V	4.4		4.4		4.4		
		I <sub>OH</sub> = -4 mA	3 V	2.58		2.4		2.48		
		I <sub>OH</sub> = -24 mA	4.5 V	3.94		3.7		3.8		
		I <sub>OH</sub> = -50 mA†	5.5 V			3.85				
I <sub>OH</sub> = -75 mA†	5.5 V					3.85				
V <sub>OL</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50 μA	1.5 V		0.1		0.1		V	
			3 V		0.1		0.1			0.1
			4.5 V		0.1		0.1			0.1
		I <sub>OL</sub> = 12 mA	3 V		0.36		0.5			0.44
		I <sub>OL</sub> = 24 mA	4.5 V		0.36		0.5			0.44
		I <sub>OL</sub> = 50 mA†	5.5 V				1.65			
I <sub>OL</sub> = 75 mA†	5.5 V						1.65			
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND		5.5 V		±0.1		±1		±1	μA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0		5.5 V		8		160		80	μA
C <sub>i</sub>					10		10		10	pF

† Test one output at a time, not exceeding 1-second duration. Measurement is made by forcing indicated current and measuring voltage to minimize power dissipation. Test verifies a minimum 50-Ω transmission-line drive capability at 85°C and 75-Ω transmission-line drive capability at 125°C.

switching characteristics over recommended operating free-air temperature range, V<sub>CC</sub> = 1.5 V, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	-55°C to 125°C		-40°C to 85°C		UNIT
			MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A, B, C	Any Y		187		170	ns
t <sub>PHL</sub>				187		170	
t <sub>PLH</sub>	G1	Any Y		208		189	ns
t <sub>PHL</sub>				208		189	
t <sub>PLH</sub>	G <sub>2A</sub> , G <sub>2B</sub>	Any Y		149		135	ns
t <sub>PHL</sub>				149		135	



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## 3-LINE TO 8-LINE DECODER/DEMULTIPLEXER

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switching characteristics over recommended operating free-air temperature range,  
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ ,  $C_L = 50\text{ pF}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	–55°C to 125°C		–40°C to 85°C		UNIT
			MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A, B, C	Any Y	5.3	21	5.4	19.1	ns
t <sub>PHL</sub>			5.3	21	5.4	19.1	
t <sub>PLH</sub>	G1	Any Y	5.8	23.2	6	21.1	ns
t <sub>PHL</sub>			5.8	23.2	6	21.1	
t <sub>PLH</sub>	$\overline{G}2A, \overline{G}2B$	Any Y	4.2	16.7	4.3	15.2	ns
t <sub>PHL</sub>			4.2	16.7	4.3	15.2	

switching characteristics over recommended operating free-air temperature range,  
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ ,  $C_L = 50\text{ pF}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	–55°C to 125°C		–40°C to 85°C		UNIT
			MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A, B, C	Any Y	3.8	15	3.9	13.6	ns
t <sub>PHL</sub>			3.8	15	3.9	13.6	
t <sub>PLH</sub>	G1	Any Y	4.2	16.6	4.3	15.1	ns
t <sub>PHL</sub>			4.2	16.6	4.3	15.1	
t <sub>PLH</sub>	$\overline{G}2A, \overline{G}2B$	Any Y	3	11.9	3.1	10.7	ns
t <sub>PHL</sub>			3	11.9	3.1	10.7	

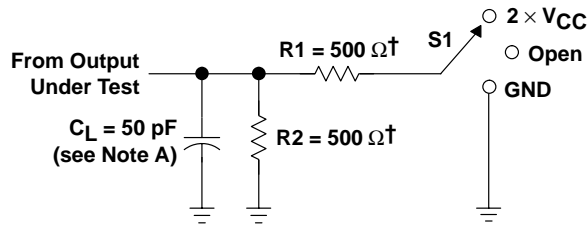
operating characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER		TYP	UNIT
C <sub>pd</sub>	Power dissipation capacitance	110	pF

# CD74AC238 3-LINE TO 8-LINE DECODER/DEMULTIPLEXER

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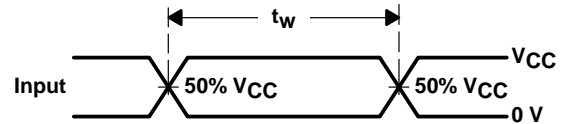
## PARAMETER MEASUREMENT INFORMATION



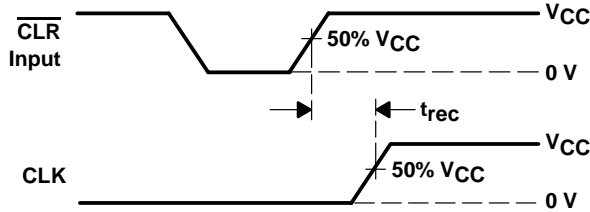
† When  $V_{CC} = 1.5\text{ V}$ ,  $R1 = R2 = 1\text{ k}\Omega$

LOAD CIRCUIT

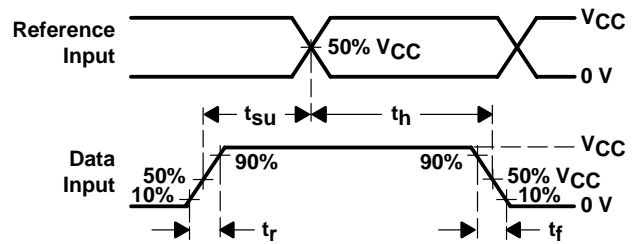
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$2 \times V_{CC}$
$t_{PHZ}/t_{PZH}$	GND



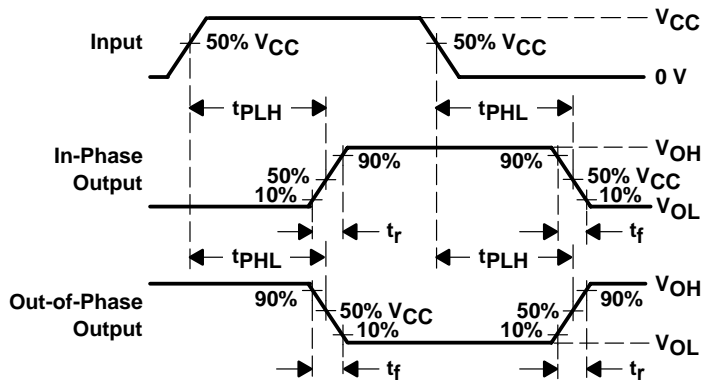
VOLTAGE WAVEFORMS  
PULSE DURATION



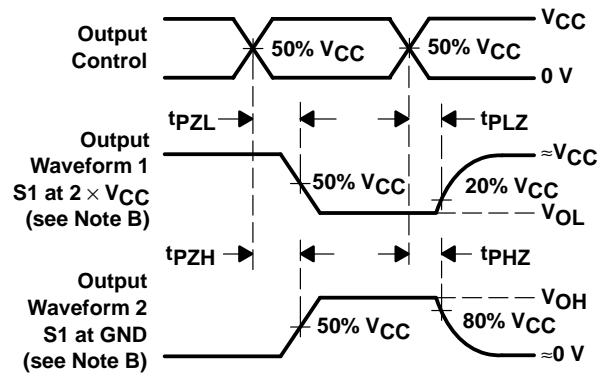
VOLTAGE WAVEFORMS  
RECOVERY TIME



VOLTAGE WAVEFORMS  
SETUP AND HOLD AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES

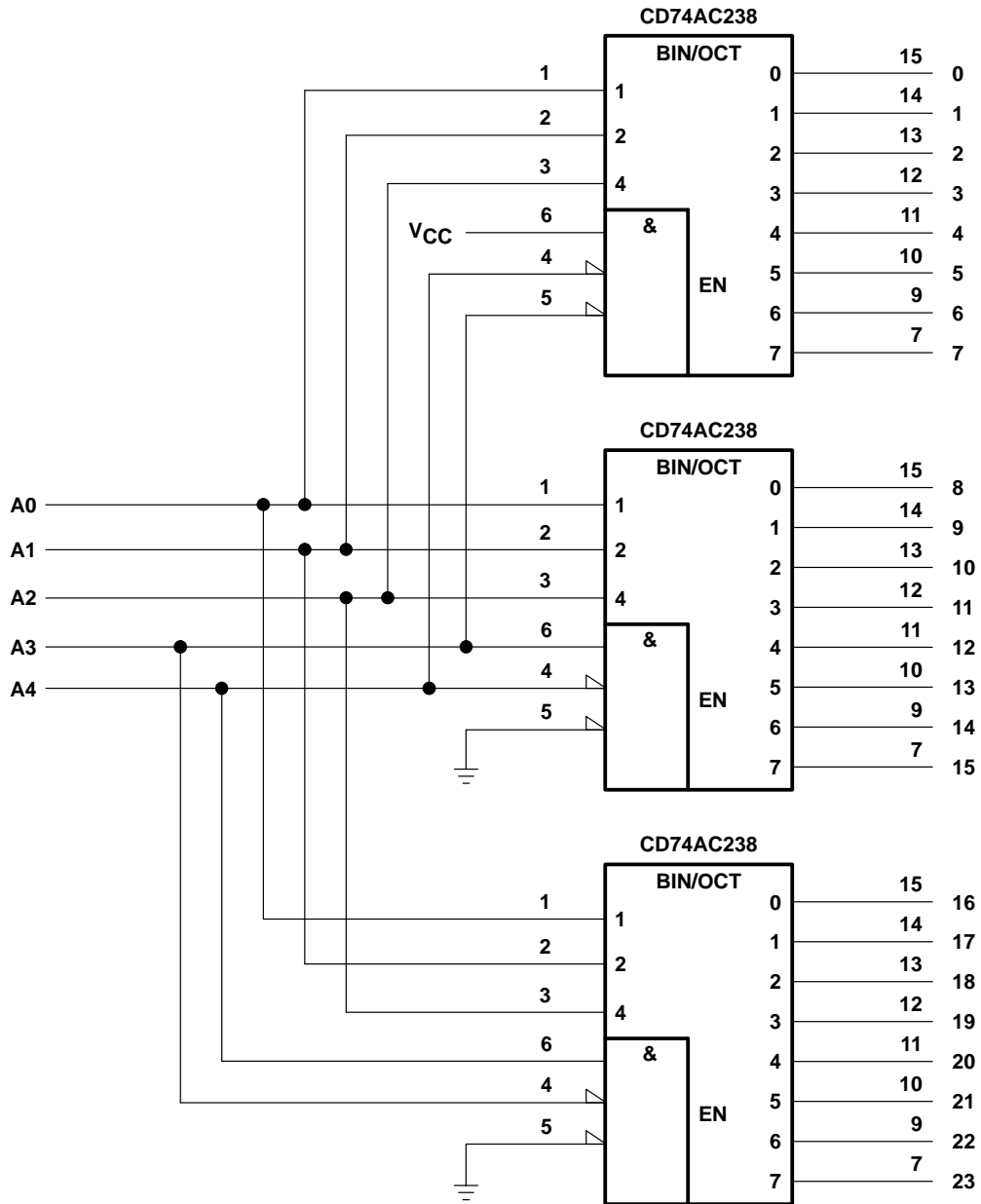


VOLTAGE WAVEFORMS  
OUTPUT ENABLE AND DISABLE TIMES

- NOTES:
- $C_L$  includes probe and test-fixture capacitance.
  - Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r = 3\text{ ns}$ ,  $t_f = 3\text{ ns}$ . Phase relationships between waveforms are arbitrary.
  - For clock inputs,  $f_{max}$  is measured with the input duty cycle at 50%.
  - The outputs are measured one at a time with one input transition per measurement.
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

**APPLICATION INFORMATION**



**Figure 2. 24-Bit Decoding Scheme**

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## APPLICATION INFORMATION

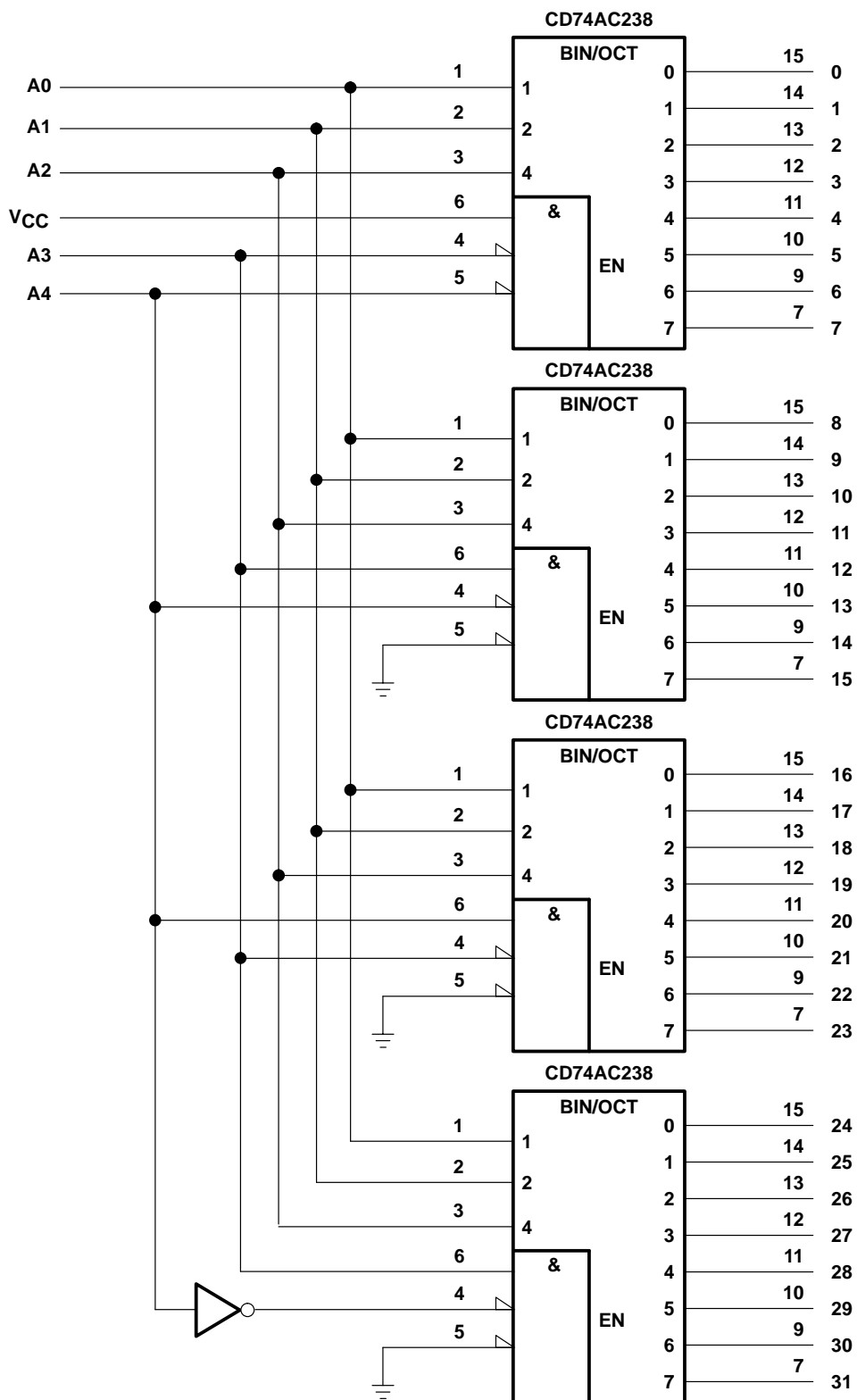


Figure 3. 32-Bit Decoding Scheme



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**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
CD74AC238M96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC238M	<a href="#">Samples</a>
CD74AC238M96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC238M	<a href="#">Samples</a>
CD74AC238M96G4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC238M	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

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## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD74AC238M96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74AC238M96	SOIC	D	16	2500	333.2	345.9	28.6

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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