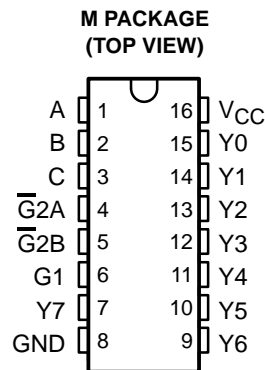


- **AC Types Feature 1.5-V to 5.5-V Operation and Balanced Noise Immunity at 30% of the Supply Voltage**
- **Speed of Bipolar F, AS, and S, With Significantly Reduced Power Consumption**
- **Designed Specifically for High-Speed Memory Decoders and Data-Transmission Systems**
- **Incorporates Three Enable 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 _A	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.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2003, Texas Instruments Incorporated

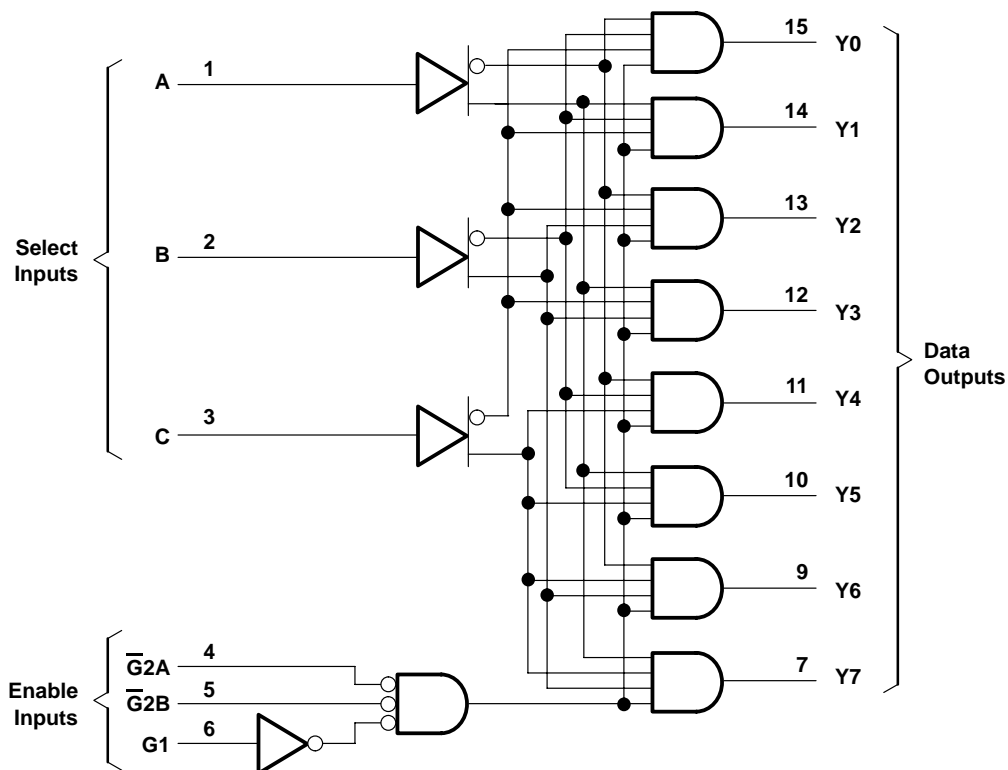
CD74AC238 3-LINE TO 8-LINE DECODER/DEMULTIPLEXER

SCHS331 – FEBRUARY 2003

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)



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

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, θ_{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

SCHS331 – FEBRUARY 2003

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

PARAMETER	TEST CONDITIONS		V _{CC}	T _A = 25°C		-55°C to 125°C		-40°C to 85°C		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
V _{OH}	V _I = V _{IH} or V _{IL}	I _{OH} = -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 _{OH} = -4 mA	3 V	2.58		2.4		2.48		
		I _{OH} = -24 mA	4.5 V	3.94		3.7		3.8		
		I _{OH} = -50 mA†	5.5 V			3.85				
I _{OH} = -75 mA†	5.5 V					3.85				
V _{OL}	V _I = V _{IH} or V _{IL}	I _{OL} = 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 _{OL} = 12 mA	3 V		0.36		0.5			0.44
		I _{OL} = 24 mA	4.5 V		0.36		0.5			0.44
		I _{OL} = 50 mA†	5.5 V				1.65			
I _{OL} = 75 mA†	5.5 V						1.65			
I _I	V _I = V _{CC} or GND		5.5 V		±0.1		±1		±1	μA
I _{CC}	V _I = V _{CC} or GND, I _O = 0		5.5 V		8		160		80	μA
C _i					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_{CC} = 1.5 V, C_L = 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 _{PLH}	A, B, C	Any Y		187		170	ns
t _{PHL}				187		170	
t _{PLH}	G1	Any Y		208		189	ns
t _{PHL}				208		189	
t _{PLH}	G ₂ A, G ₂ B	Any Y		149		135	ns
t _{PHL}				149		135	



CD74AC238

3-LINE TO 8-LINE DECODER/DEMULTIPLEXER

SCHS331 – FEBRUARY 2003

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 _{PLH}	A, B, C	Any Y	5.3	21	5.4	19.1	ns
t _{PHL}			5.3	21	5.4	19.1	
t _{PLH}	G1	Any Y	5.8	23.2	6	21.1	ns
t _{PHL}			5.8	23.2	6	21.1	
t _{PLH}	$\overline{G}2A, \overline{G}2B$	Any Y	4.2	16.7	4.3	15.2	ns
t _{PHL}			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 _{PLH}	A, B, C	Any Y	3.8	15	3.9	13.6	ns
t _{PHL}			3.8	15	3.9	13.6	
t _{PLH}	G1	Any Y	4.2	16.6	4.3	15.1	ns
t _{PHL}			4.2	16.6	4.3	15.1	
t _{PLH}	$\overline{G}2A, \overline{G}2B$	Any Y	3	11.9	3.1	10.7	ns
t _{PHL}			3	11.9	3.1	10.7	

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

PARAMETER		TYP	UNIT
C _{pd}	Power dissipation capacitance	110	pF

CD74AC238 3-LINE TO 8-LINE DECODER/DEMULTIPLEXER

SCHS331 – FEBRUARY 2003

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

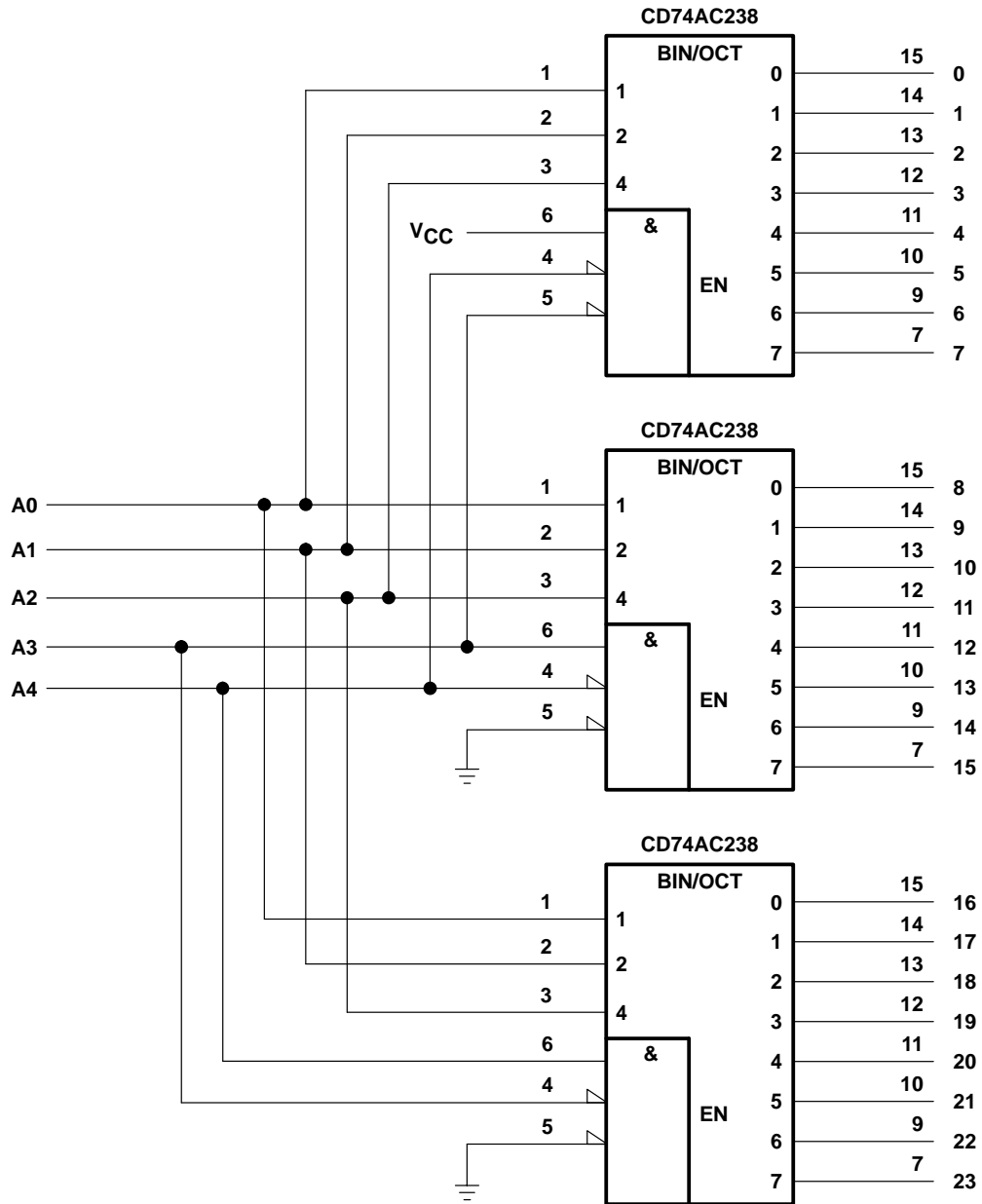


Figure 2. 24-Bit Decoding Scheme

CD74AC238 3-LINE TO 8-LINE DECODER/DEMULTIPLEXER

SCHS331 – FEBRUARY 2003

APPLICATION INFORMATION

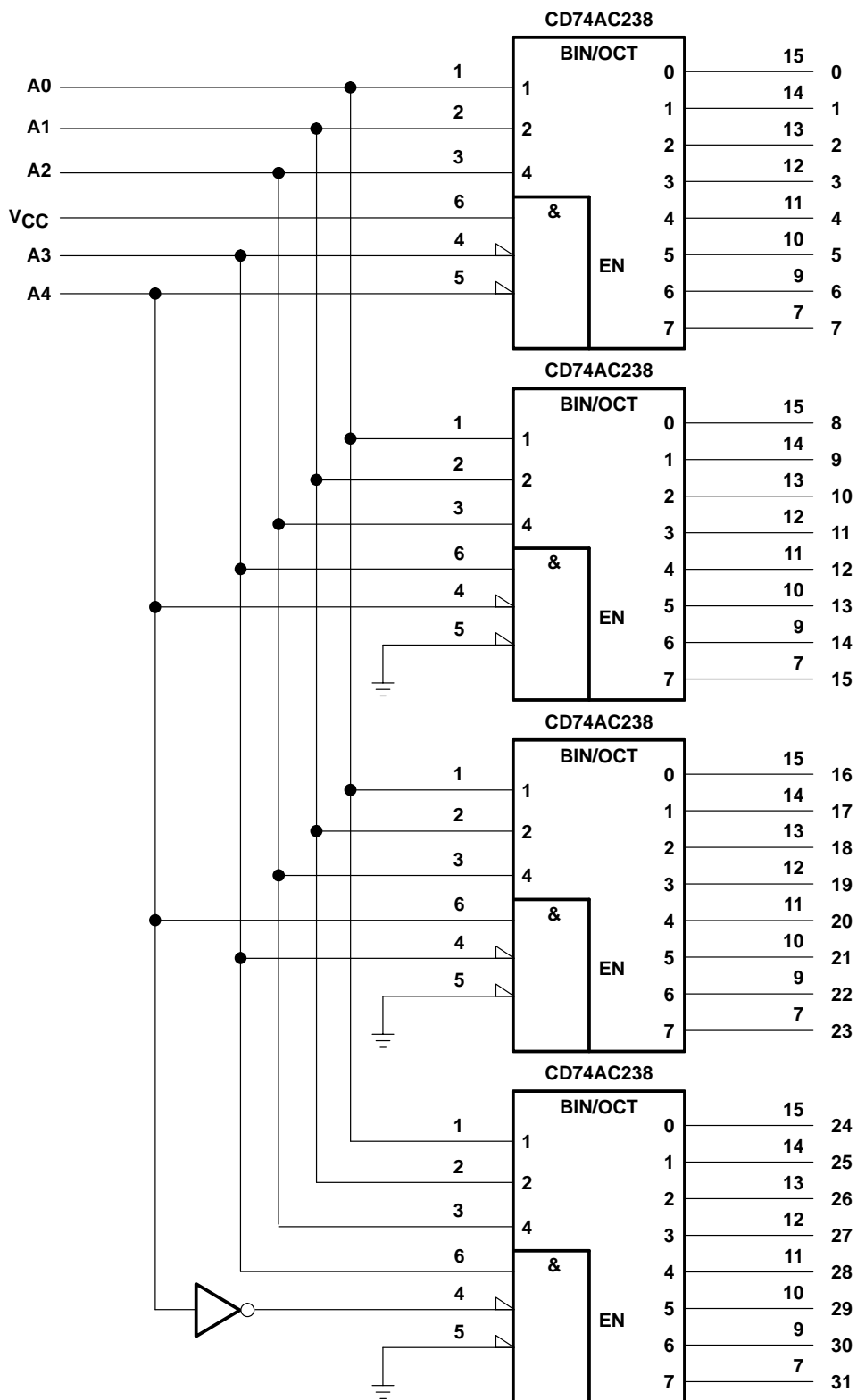


Figure 3. 32-Bit Decoding Scheme



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
CD74AC238M96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74AC238M96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74AC238M96G4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽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.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

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

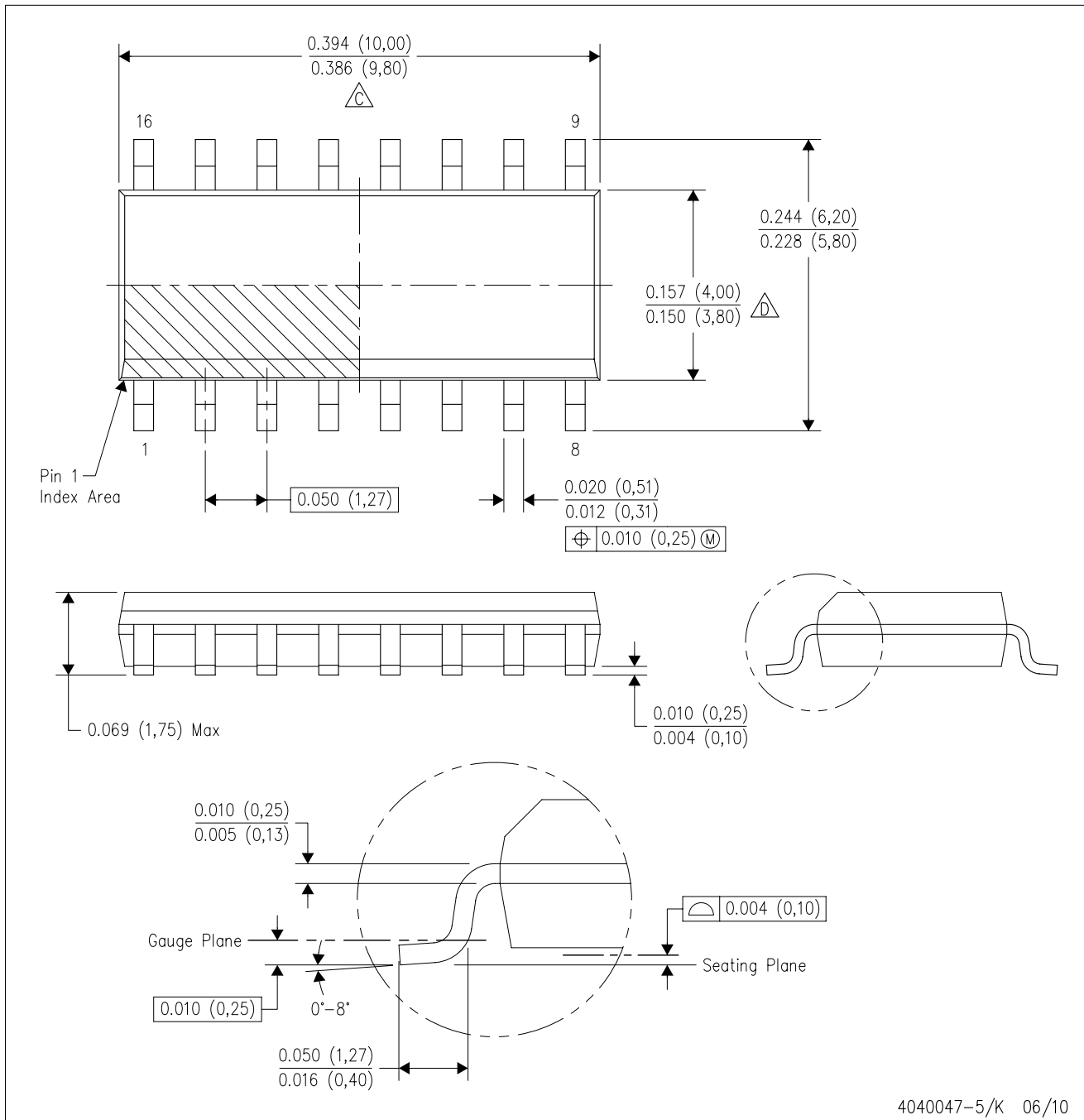


*All dimensions are nominal



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 PACKAGE

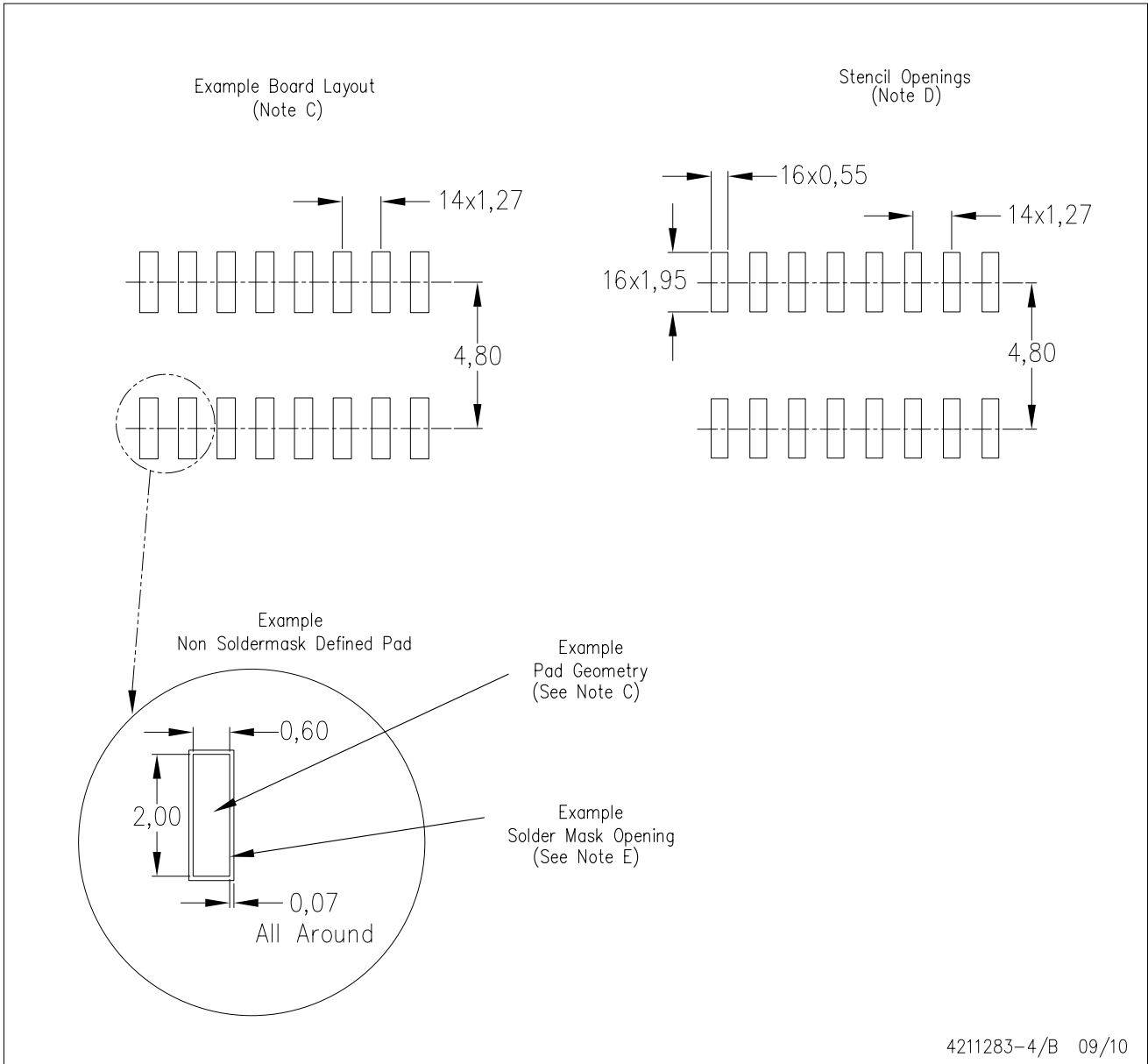


4040047-5/K 06/10

- 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 .006 (0,15) per end.
 -  D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per 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.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DLP® Products	www.dlp.com	Communications and Telecom	www.ti.com/communications
DSP	dsp.ti.com	Computers and Peripherals	www.ti.com/computers
Clocks and Timers	www.ti.com/clocks	Consumer Electronics	www.ti.com/consumer-apps
Interface	interface.ti.com	Energy	www.ti.com/energy
Logic	logic.ti.com	Industrial	www.ti.com/industrial
Power Mgmt	power.ti.com	Medical	www.ti.com/medical
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Space, Avionics & Defense	www.ti.com/space-avionics-defense
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Video and Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless-apps