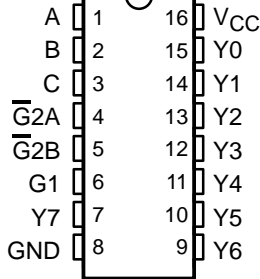


SN54AHC138, SN74AHC138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

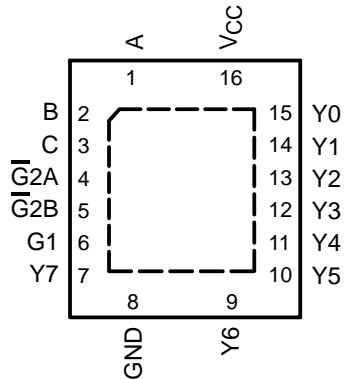
SCLS258L – DECEMBER 1995 – REVISED JULY 2003

- Operating Range 2-V to 5.5-V V_{CC}
- Designed Specifically for High-Speed Memory Decoders and Data-Transmission Systems
- Incorporate Three Enable Inputs to Simplify Cascading and/or Data Reception
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

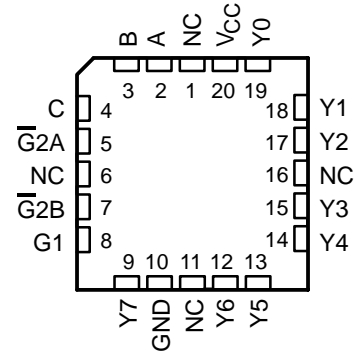
SN54AHC138 . . . J OR W PACKAGE
SN74AHC138 . . . D, DB, DGV, N, NS,
OR PW PACKAGE
(TOP VIEW)



SN74AHC138 . . . RGY PACKAGE
(TOP VIEW)



SN54AHC138 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description/ordering information

The 'AHC138 decoders/demultiplexers are designed for high-performance memory-decoding and data-routing applications that require very short propagation-delay times. In high-performance memory systems, these decoders 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 these decoders 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 decoders is negligible.

ORDERING INFORMATION

TA	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	QFN – RGY	Tape and reel	SN74AHC138RGYR	HA138
	PDIP – N	Tube	SN74AHC138N	SN74AHC138N
	SOIC – D	Tube	SN74AHC138D	AHC138
		Tape and reel	SN74AHC138DR	
	SOP – NS	Tape and reel	SN74AHC138NSR	AHC138
	SSOP – DB	Tape and reel	SN74AHC138DBR	HA138
	TSSOP – PW	Tube	SN74AHC138PW	HA138
		Tape and reel	SN74AHC138PWR	
TVSOP – DGV	Tape and reel	SN74AHC138DGVR	HA138	
–55°C to 125°C	CDIP – J	Tube	SNJ54AHC138J	SNJ54AHC138J
	CFP – W	Tube	SNJ54AHC138W	SNJ54AHC138W
	LCCC – FK	Tube	SNJ54AHC138FK	SNJ54AHC138FK

† 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.

 **TEXAS
INSTRUMENTS**

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SN54AHC138, SN74AHC138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

SCLS258L – DECEMBER 1995 – REVISED JULY 2003

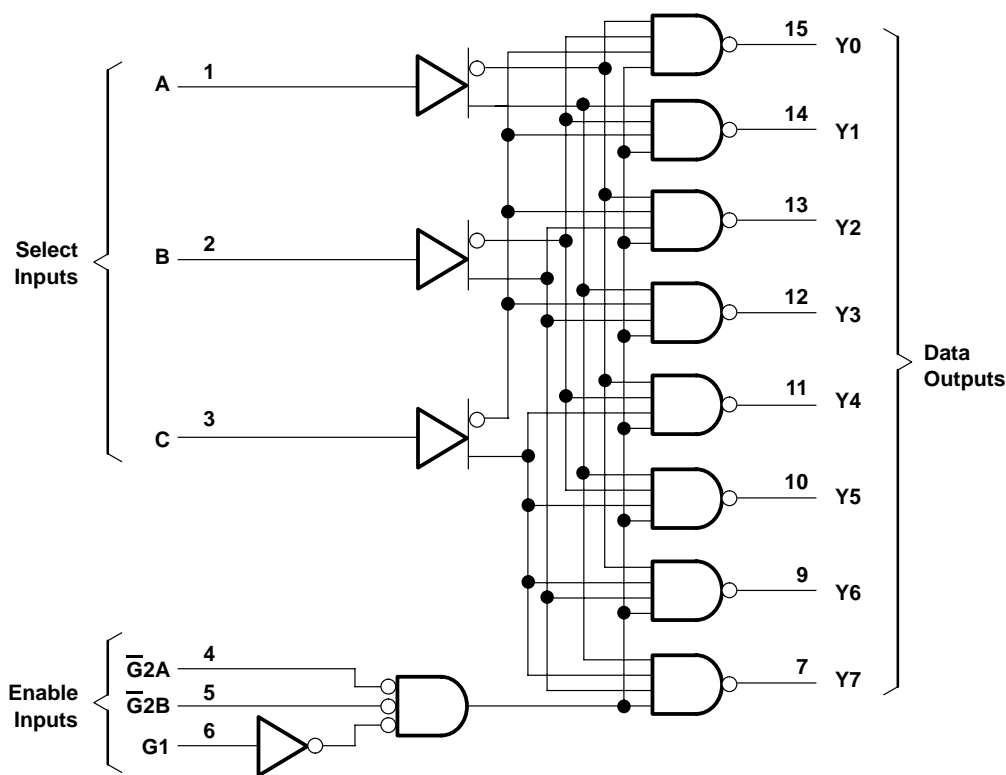
description/ordering information (continued)

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.

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	H	H	H	H	H	H	H	H
X	X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	L	H	H	H	H	L	H	H	H	H	H
H	L	L	H	L	L	H	H	H	H	L	H	H	H
H	L	L	H	L	H	H	H	H	H	H	L	H	H
H	L	L	H	H	L	H	H	H	H	H	L	H	H
H	L	L	H	H	H	H	H	H	H	H	H	L	L

logic diagram (positive logic)



Pin numbers shown are for the D, DB, DGV, J, N, NS, PW, RGY, and W packages.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN54AHC138, SN74AHC138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

SCLS258L – DECEMBER 1995 – REVISED JULY 2003

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

Supply voltage range, V_{CC}	–0.5 V to 7 V
Input voltage range, V_I (see Note 1)	–0.5 V to 7 V
Output voltage range, V_O (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$)	–20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$)	±20 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC})	±25 mA
Continuous current through V_{CC} or GND	±75 mA
Package thermal impedance, θ_{JA} (see Note 2): D package	73°C/W
(see Note 2): DB package	82°C/W
(see Note 2): DGV package	120°C/W
(see Note 2): N package	67°C/W
(see Note 2): NS package	64°C/W
(see Note 2): PW package	108°C/W
(see Note 3): RGY package	39°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.

3. The package thermal impedance is calculated in accordance with JESD 51-5.

recommended operating conditions (see Note 4)

		SN54AHC138		SN74AHC138		UNIT
		MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage	2	5.5	2	5.5	V
V_{IH}	High-level input voltage	$V_{CC} = 2$ V		1.5		V
		$V_{CC} = 3$ V		2.1		
		$V_{CC} = 5.5$ V		3.85		
V_{IL}	Low-level input voltage	$V_{CC} = 2$ V		0.5		V
		$V_{CC} = 3$ V		0.9		
		$V_{CC} = 5.5$ V		1.65		
V_I	Input voltage	0	5.5	0	5.5	V
V_O	Output voltage	0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current	$V_{CC} = 2$ V		–50		μ A
		$V_{CC} = 3.3$ V ± 0.3 V		–4		
		$V_{CC} = 5$ V ± 0.5 V		–8		
I_{OL}	Low-level output current	$V_{CC} = 2$ V		50		μ A
		$V_{CC} = 3.3$ V ± 0.3 V		4		
		$V_{CC} = 5$ V ± 0.5 V		8		
$\Delta t/\Delta v$	Input transition rise or fall rate	$V_{CC} = 3.3$ V ± 0.3 V		100		ns/V
		$V_{CC} = 5$ V ± 0.5 V		20		
T_A	Operating free-air temperature	–55	125	–40	85	°C

NOTE 4: 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.



SN54AHC138, SN74AHC138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

SCLS258L – DECEMBER 1995 – REVISED JULY 2003

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

PARAMETER	TEST CONDITIONS	V _{CC}	T _A = 25°C			SN54AHC138		SN74AHC138		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V _{OH}	I _{OH} = -50 μA	2 V	1.9	2		1.9		1.9	V	
		3 V	2.9	3		2.9		2.9		
		4.5 V	4.4	4.5		4.4		4.4		
	I _{OH} = -4 mA	3 V	2.58			2.48		2.48		
	I _{OH} = -8 mA	4.5 V	3.94			3.8		3.8		
V _{OL}	I _{OL} = 50 μA	2 V			0.1		0.1	0.1	V	
		3 V			0.1		0.1	0.1		
		4.5 V			0.1		0.1	0.1		
	I _{OL} = 4 mA	3 V			0.36		0.5	0.44		
	I _{OL} = 8 mA	4.5 V			0.36		0.5	0.44		
I _I	V _I = 5.5 V or GND	0 V to 5.5 V			±0.1		±1*	±1	μA	
I _{CC}	V _I = V _{CC} or GND, I _O = 0	5.5 V			4		40	40	μA	
C _i	V _I = V _{CC} or GND	5 V			2	10		10	pF	

* On products compliant to MIL-PRF-38535, this parameter is not production tested at V_{CC} = 0 V.

switching characteristics over recommended operating free-air temperature range, V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T _A = 25°C			SN54AHC138		SN74AHC138		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t _{PLH}	A, B, C	Any Y	C _L = 15 pF	8.2**	11.4**		1**	13**	1	13	ns
t _{PHL}				8.2**	11.4**		1**	13**	1	13	
t _{PLH}	G1	Any Y	C _L = 15 pF	8.1**	12.8**		1**	15**	1	15	ns
t _{PHL}				8.1**	12.8**		1**	15**	1	15	
t _{PLH}	G̅2A, G̅2B	Any Y	C _L = 15 pF	8.2**	11.4**		1**	13.5**	1	13.5	ns
t _{PHL}				8.2**	11.4**		1**	13.5**	1	13.5	
t _{PLH}	A, B, C	Any Y	C _L = 50 pF	10	15.8		1	18	1	18	ns
t _{PHL}				10	15.8		1	18	1	18	
t _{PLH}	G1	Any Y	C _L = 50 pF	10.6	16.3		1	18.5	1	18.5	ns
t _{PHL}				10.6	16.3		1	18.5	1	18.5	
t _{PLH}	G̅2A, G̅2B	Any Y	C _L = 50 pF	10.7	14.9		1	17	1	17	ns
t _{PHL}				10.7	14.9		1	17	1	17	

** On products compliant to MIL-PRF-38535, this parameter is not production tested.



SN54AHC138, SN74AHC138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

SCLS258L – DECEMBER 1995 – REVISED JULY 2003

**switching characteristics over recommended operating free-air temperature range,
V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T _A = 25°C			SN54AHC138		SN74AHC138		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t _{PLH}	A, B, C	Any Y	C _L = 15 pF	5.7*	8.1*	1*	9.5*	1	9.5	ns	
t _{PHL}				5.7*	8.1*	1*	9.5*	1	9.5		
t _{PLH}	G1	Any Y	C _L = 15 pF	5.6*	8.1*	1*	9.5*	1	9.5	ns	
t _{PHL}				5.6*	8.1*	1*	9.5*	1	9.5		
t _{PLH}	$\overline{G}2A, \overline{G}2B$	Any Y	C _L = 15 pF	5.8*	8.1*	1*	9.5*	1	9.5	ns	
t _{PHL}				5.8*	8.1*	1*	9.5*	1	9.5		
t _{PLH}	A, B, C	Any Y	C _L = 50 pF	7.2	10.1	1	11.5	1	11.5	ns	
t _{PHL}				7.2	10.1	1	11.5	1	11.5		
t _{PLH}	G1	Any Y	C _L = 50 pF	7.1	10.1	1	11.5	1	11.5	ns	
t _{PHL}				7.1	10.1	1	11.5	1	11.5		
t _{PLH}	$\overline{G}2A, \overline{G}2B$	Any Y	C _L = 50 pF	7.3	10.1	1	11.5	1	11.5	ns	
t _{PHL}				7.3	10.1	1	11.5	1	11.5		

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

operating characteristics, V_{CC} = 5 V, T_A = 25°C

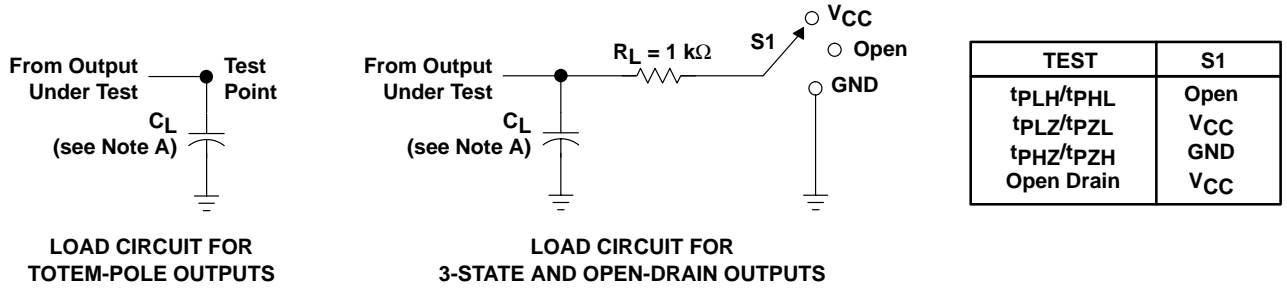
PARAMETER	TEST CONDITIONS	TYP	UNIT
C _{pd} Power dissipation capacitance	No load, f = 1 MHz	13	pF



SN54AHC138, SN74AHC138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

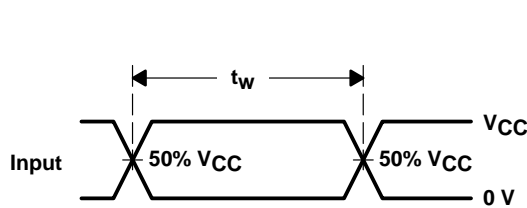
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PARAMETER MEASUREMENT INFORMATION

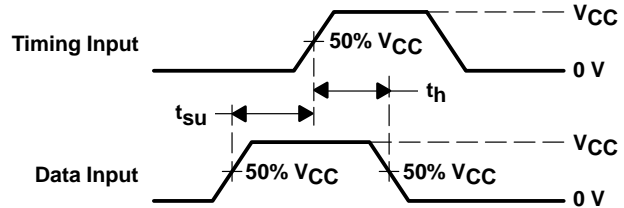


LOAD CIRCUIT FOR
TOTEM-POLE OUTPUTS

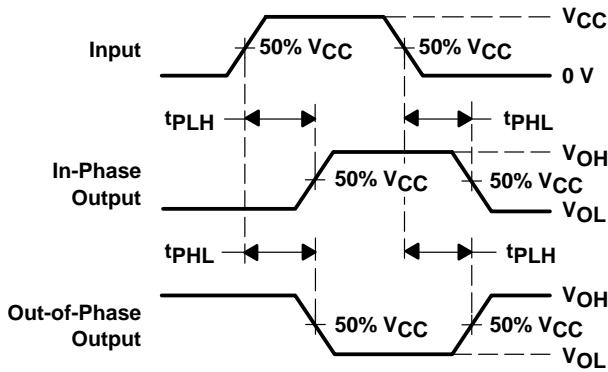
LOAD CIRCUIT FOR
3-STATE AND OPEN-DRAIN OUTPUTS



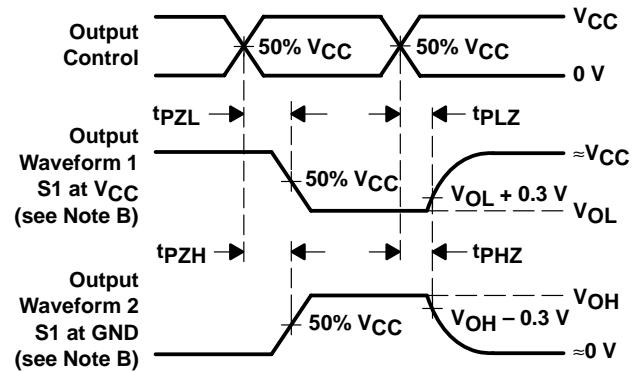
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

- NOTES: A. C_L includes probe and jig capacitance.
 B. 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.
 C. All input pulses are supplied by generators having the following characteristics: PRR \leq 1 MHz, $Z_O = 50 \Omega$, $t_r \leq 3$ ns, $t_f \leq 3$ ns.
 D. The outputs are measured one at a time with one input transition per measurement.
 E. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

SN54AHC138, SN74AHC138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

SCLS258L – DECEMBER 1995 – REVISED JULY 2003

APPLICATION INFORMATION

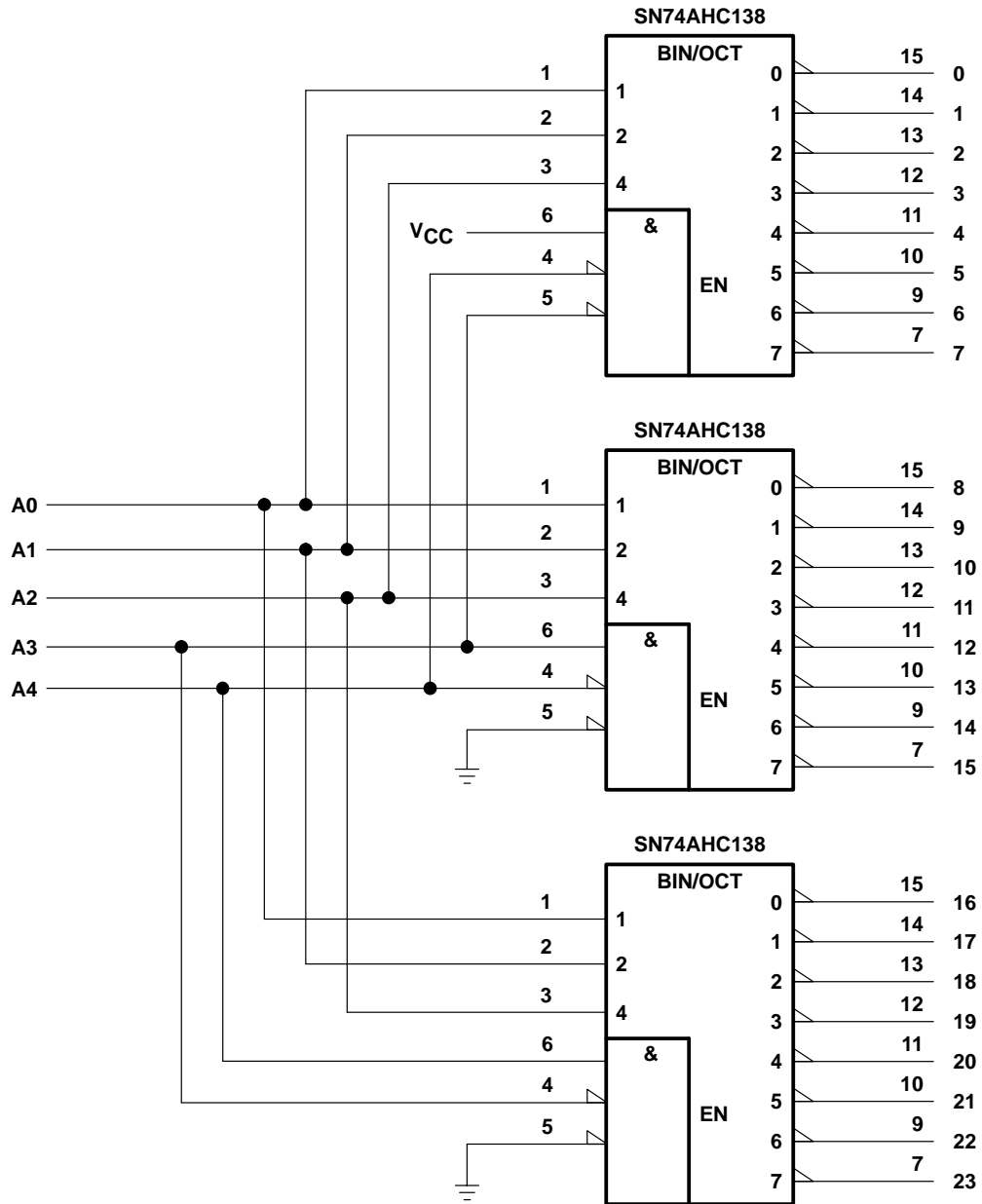


Figure 2. 24-Bit Decoding Scheme

SN54AHC138, SN74AHC138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

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APPLICATION INFORMATION

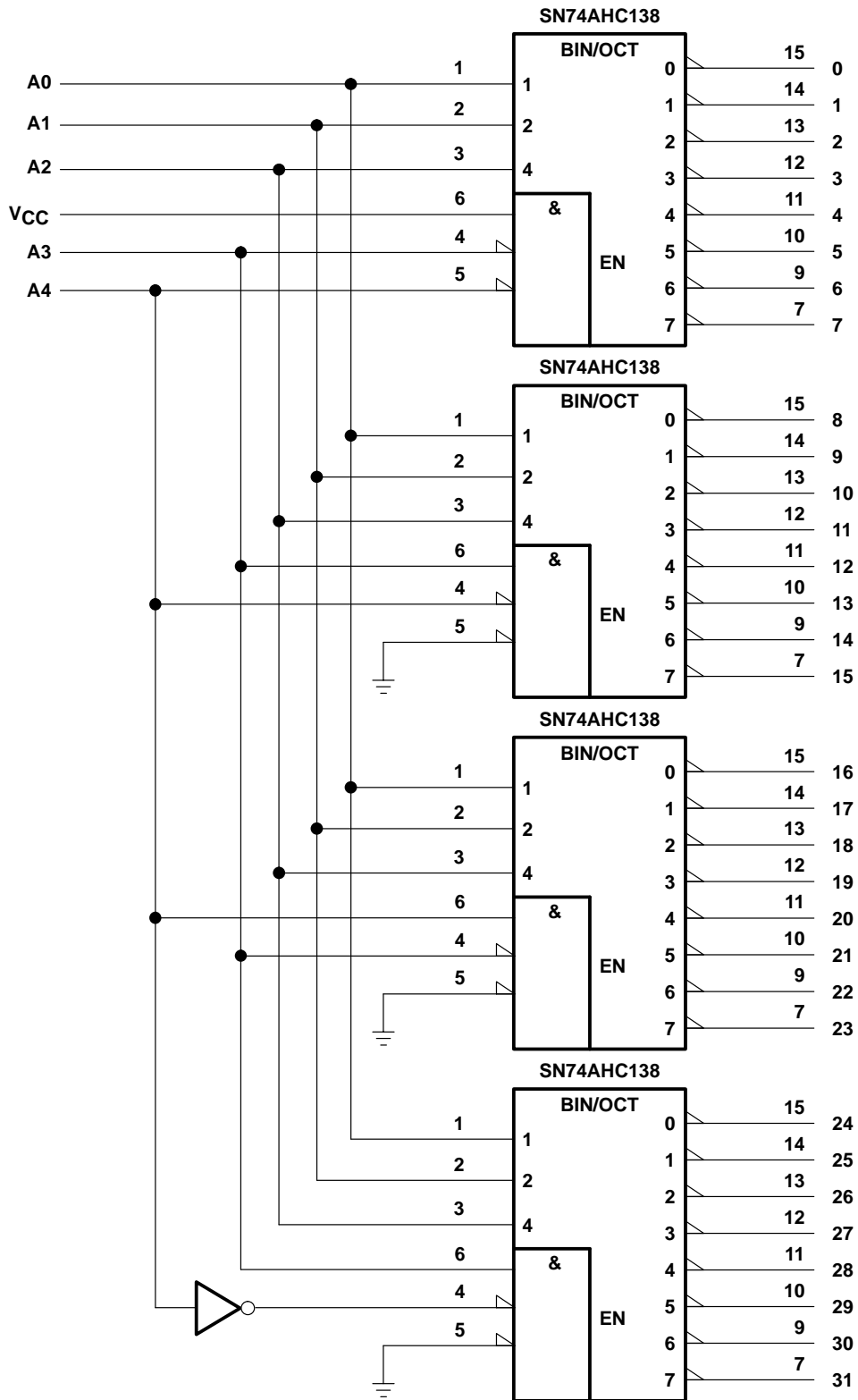


Figure 3. 32-Bit Decoding Scheme

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
5962-9851601Q2A	ACTIVE	LCCC	FK	20	1	None	Call TI	Level-NC-NC-NC
5962-9851601QEA	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
5962-9851601QFA	ACTIVE	CFP	W	16	1	None	Call TI	Level-NC-NC-NC
SN74AHC138D	ACTIVE	SOIC	D	16	40	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74AHC138DBLE	OBSOLETE	SSOP	DB	16		None	Call TI	Call TI
SN74AHC138DBR	ACTIVE	SSOP	DB	16	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74AHC138DGVR	ACTIVE	TVSOP	DGV	16	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74AHC138DR	ACTIVE	SOIC	D	16	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74AHC138N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74AHC138NSR	ACTIVE	SO	NS	16	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74AHC138PW	ACTIVE	TSSOP	PW	16	90	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74AHC138PWLE	OBSOLETE	TSSOP	PW	16		None	Call TI	Call TI
SN74AHC138PWR	ACTIVE	TSSOP	PW	16	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
SN74AHC138RGYR	ACTIVE	QFN	RGY	16	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
SNJ54AHC138FK	ACTIVE	LCCC	FK	20	1	None	Call TI	Level-NC-NC-NC
SNJ54AHC138J	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
SNJ54AHC138W	ACTIVE	CFP	W	16	1	None	Call TI	Level-NC-NC-NC

⁽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 - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

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.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

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

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J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package is hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only.
 - E. Falls within MIL STD 1835 GDFP1-F16 and JEDEC MO-092AC

FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a metal lid.
 - D. The terminals are gold plated.
 - E. Falls within JEDEC MS-004

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - $\triangle D$ The 20 pin end lead shoulder width is a vendor option, either half or full width.

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



4073251/E 08/00

- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

D (R-PDSO-G16)

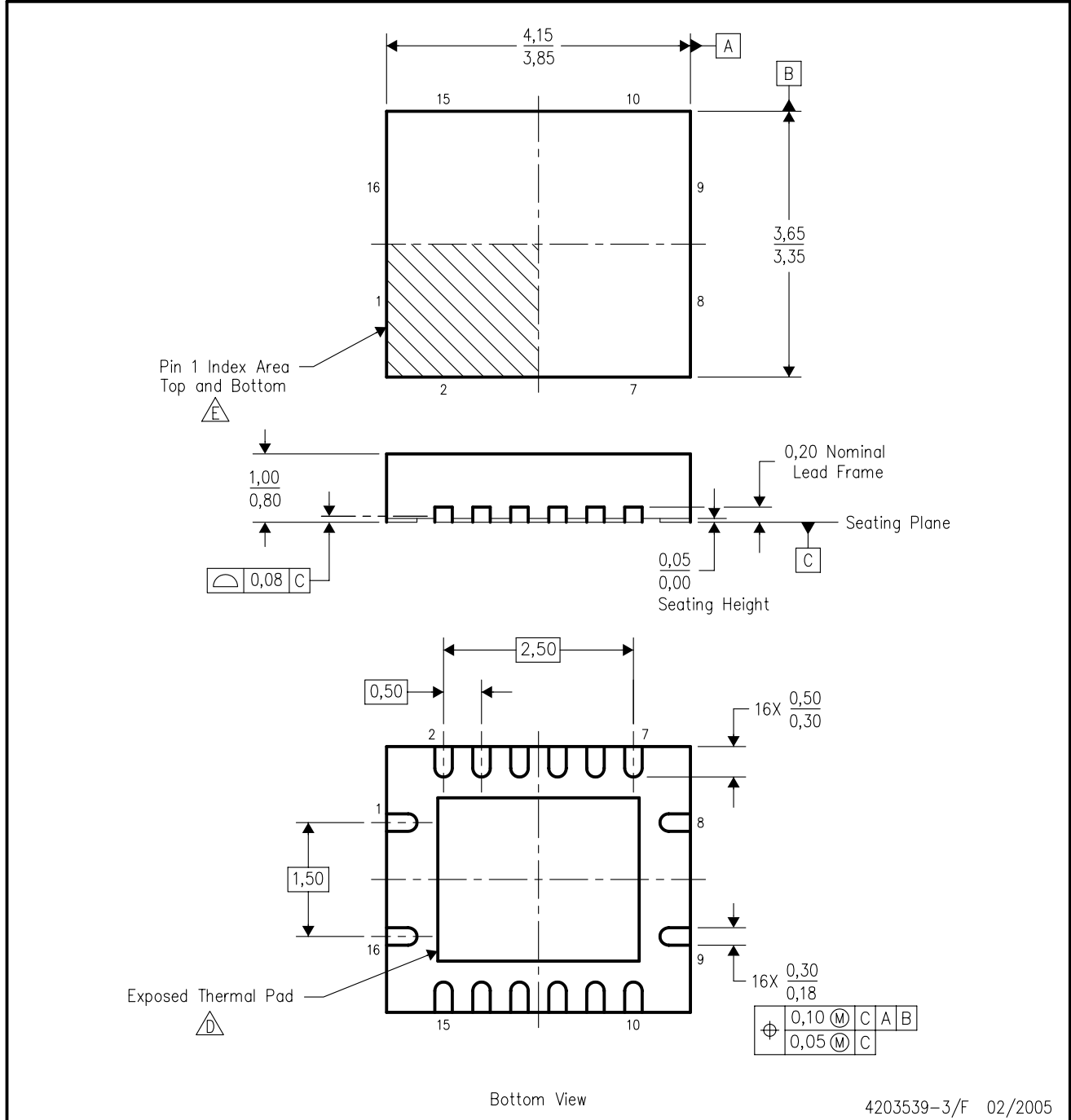
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-012 variation AC.

RGY (R-PQFP-N16)

PLASTIC QUAD FLATPACK



4203539-3/F 02/2005

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. QFN (Quad Flatpack No-Lead) package configuration.
 - The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.
 - Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
 - F. Package complies to JEDEC MO-241 variation BB.

MECHANICAL DATA

NS (R-PDSO-G)**

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

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