

# SN54ALS138A, SN54AS138, SN74ALS138A, SN74AS138 3-LINE TO 8-LINE DECODERS/DEMULPLEXERS

SDAS055E – APRIL 1982 – REVISED JULY 1996

- Designed Specifically for High-Speed Memory Decoders and Data Transmission Systems
- Incorporate Three Enable Inputs to Simplify Cascading and/or Data Reception
- Package Options Include Plastic Small-Outline (D) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

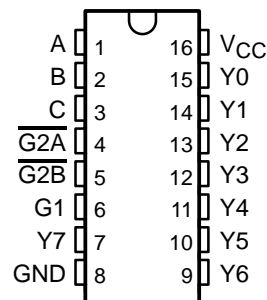
## description

The 'ALS138A and 'AS138 are 3-line to 8-line decoders/demultiplexers designed for high-performance memory-decoding or data-routing applications requiring very short propagation delay times. In high-performance systems, these devices can be used to minimize the effects of system decoding. When employed with high-speed memories with a fast enable circuit, the delay times of the decoder and the enable time of the memory are usually less than the typical access time of the memory. The effective system delay introduced by the Schottky-clamped system decoder is negligible.

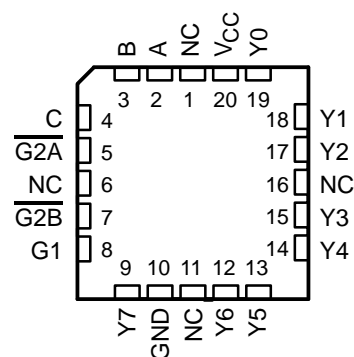
The conditions at the binary-select (A, B, and C) inputs and the three enable ( $\overline{G1}$ ,  $\overline{G2A}$ , and  $\overline{G2B}$ ) inputs select one of eight output lines. Two active-low and one active-high enable inputs reduce the need for external gates or inverters when expanding. A 24-line 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.

The SN54ALS138A and SN54AS138 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ALS138A and SN74AS138 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

SN54ALS138A, SN54AS138 . . . J PACKAGE  
SN74ALS138A, SN74AS138 . . . D OR N PACKAGE  
(TOP VIEW)



SN54ALS138A, SN54AS138 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection



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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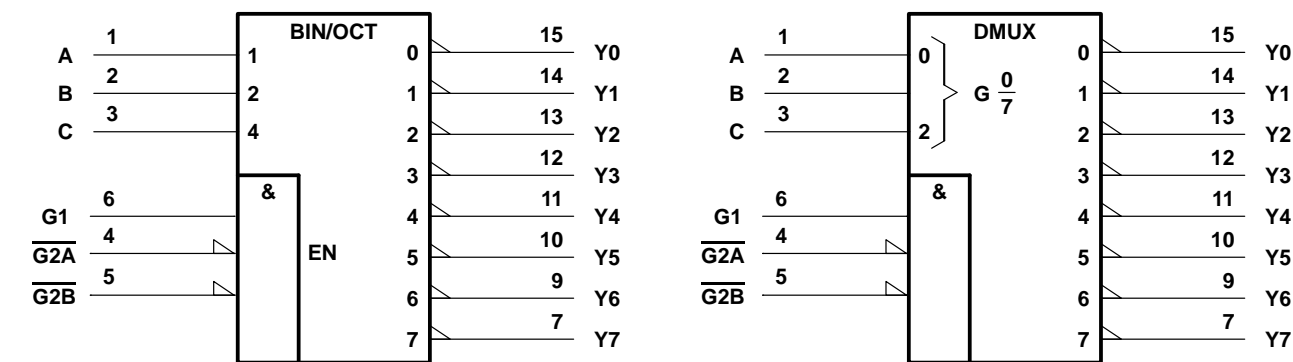
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# SN54ALS138A, SN54AS138, SN74ALS138A, SN74AS138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

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FUNCTION TABLE													
INPUTS						OUTPUTS							
ENABLE			SELECT										
G1	$\overline{\text{G2A}}$	$\overline{\text{G2B}}$	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	H	L	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	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L

## logic symbols (alternatives)†

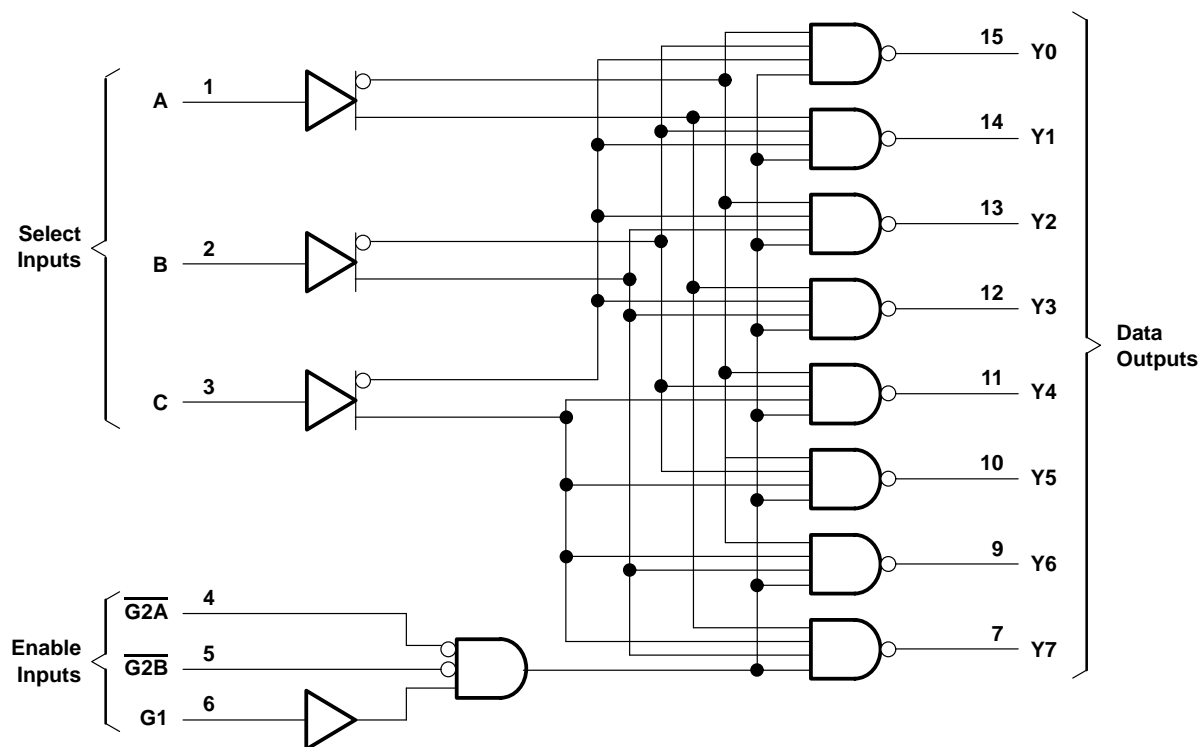


† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.  
Pin numbers shown are for the D, J, and N packages.

# SN54ALS138A, SN54AS138, SN74ALS138A, SN74AS138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

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logic diagram (positive logic)



Pin numbers shown are for the D, J, and N packages.

# SN54ALS138A, SN54AS138, SN74ALS138A, SN74AS138

## 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

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### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

Supply voltage, $V_{CC}$	7 V
Input voltage, $V_I$	7 V
Operating free-air temperature range, $T_A$ : SN54ALS138A	–55°C to 125°C
SN74ALS138A	0°C to 70°C
Storage temperature range, $T_{stg}$	–65°C to 150°C

<sup>†</sup> 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.

### recommended operating conditions

		SN54ALS138A			SN74ALS138A			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
$V_{IH}$	High-level input voltage	2			2			V
$V_{IL}$	Low-level input voltage			0.7			0.8	V
$I_{OH}$	High-level output current			–0.4			–0.4	mA
$I_{OL}$	Low-level output current			4			8	mA
$T_A$	Operating free-air temperature	–55		125	0		70	°C

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

PARAMETER	TEST CONDITIONS		SN54ALS138A			SN74ALS138A			UNIT
			MIN	TYP <sup>‡</sup>	MAX	MIN	TYP <sup>‡</sup>	MAX	
$V_{IK}$	$V_{CC} = 4.5$ V, $I_I = -18$ mA				–1.5			–1.5	V
$V_{OH}$	$V_{CC} = 4.5$ V, $I_{OH} = -0.4$ mA		$V_{CC} - 2$			$V_{CC} - 2$			V
$V_{OL}$	$V_{CC} = 4.5$ V, $I_{OL} = 4$ mA		0.25	0.4		0.25	0.4		V
	$I_{OL} = 8$ mA					0.35	0.5		
$I_I$	$V_{CC} = 5.5$ V, $V_I = 7$ V			0.1			0.1		mA
$I_{IH}$	$V_{CC} = 5.5$ V, $V_I = 2.7$ V			20			20		μA
$I_{IL}$	$V_{CC} = 5.5$ V, $V_I = 0.4$ V			–0.1			–0.1		mA
$I_{OS}^{\S}$	$V_{CC} = 5.5$ V, $V_O = 2.25$ V		–20		–112	–30		–112	mA
$I_{CC}$	$V_{CC} = 5.5$ V		5	10		5	10		mA

<sup>‡</sup> All typical values are at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$ .

<sup>§</sup> The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

### switching characteristics (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω, T <sub>A</sub> = MIN to MAX††				UNIT
			SN54ALS138A		SN74ALS138A		
			MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A, B, C	Any Y	2	28	5	22	ns
t <sub>PHL</sub>			6	22	6	18	
t <sub>PLH</sub>	G or $\overline{G}$	Any Y	2	22	3	17	ns
t <sub>PHL</sub>			4	21	4	17	

<sup>††</sup> For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.



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## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

Supply voltage, $V_{CC}$	7 V
Input voltage, $V_I$	7 V
Operating free-air temperature range, $T_A$ : SN54AS138	–55°C to 125°C
SN74AS138	0°C to 70°C
Storage temperature range, $T_{stg}$	–65°C to 150°C

<sup>†</sup> 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.

## recommended operating conditions

		SN54AS138			SN74AS138			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
$V_{IH}$	High-level input voltage	2			2			V
$V_{IL}$	Low-level input voltage			0.8			0.8	V
$I_{OH}$	High-level output current			–2			–2	mA
$I_{OL}$	Low-level output current			20			20	mA
$T_A$	Operating free-air temperature	–55		125	0		70	°C

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

PARAMETER	TEST CONDITIONS	SN54AS138			SN74AS138			UNIT
		MIN	TYP <sup>‡</sup>	MAX	MIN	TYP <sup>‡</sup>	MAX	
$V_{IK}$	$V_{CC} = 4.5\text{ V}$ , $I_I = -18\text{ mA}$			–1.2			–1.2	V
$V_{OH}$	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$ , $I_{OH} = -2\text{ mA}$	$V_{CC} - 2$			$V_{CC} - 2$			V
$V_{OL}$	$V_{CC} = 4.5\text{ V}$ , $I_{OL} = 20\text{ mA}$		0.35	0.5		0.35	0.5	V
$I_I$	$V_{CC} = 5.5\text{ V}$ , $V_I = 7\text{ V}$			0.1			0.1	mA
$I_{IH}$	$V_{CC} = 5.5\text{ V}$ , $V_I = 2.7\text{ V}$			20			20	μA
$I_{IL}$	$V_{CC} = 5.5\text{ V}$ , $V_I = 0.4\text{ V}$			–0.5			–0.5	mA
$I_{O}^{\S}$	$V_{CC} = 5.5\text{ V}$ , $V_O = 2.25\text{ V}$	–30		–112	–30		–112	mA
$I_{CCH}$	$V_{CC} = 5.5\text{ V}$		12	17.5		12	17.5	mA
$I_{CCL}$	$V_{CC} = 5.5\text{ V}$		14	20		14	20	mA

<sup>‡</sup> All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

<sup>\S</sup> The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .



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3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

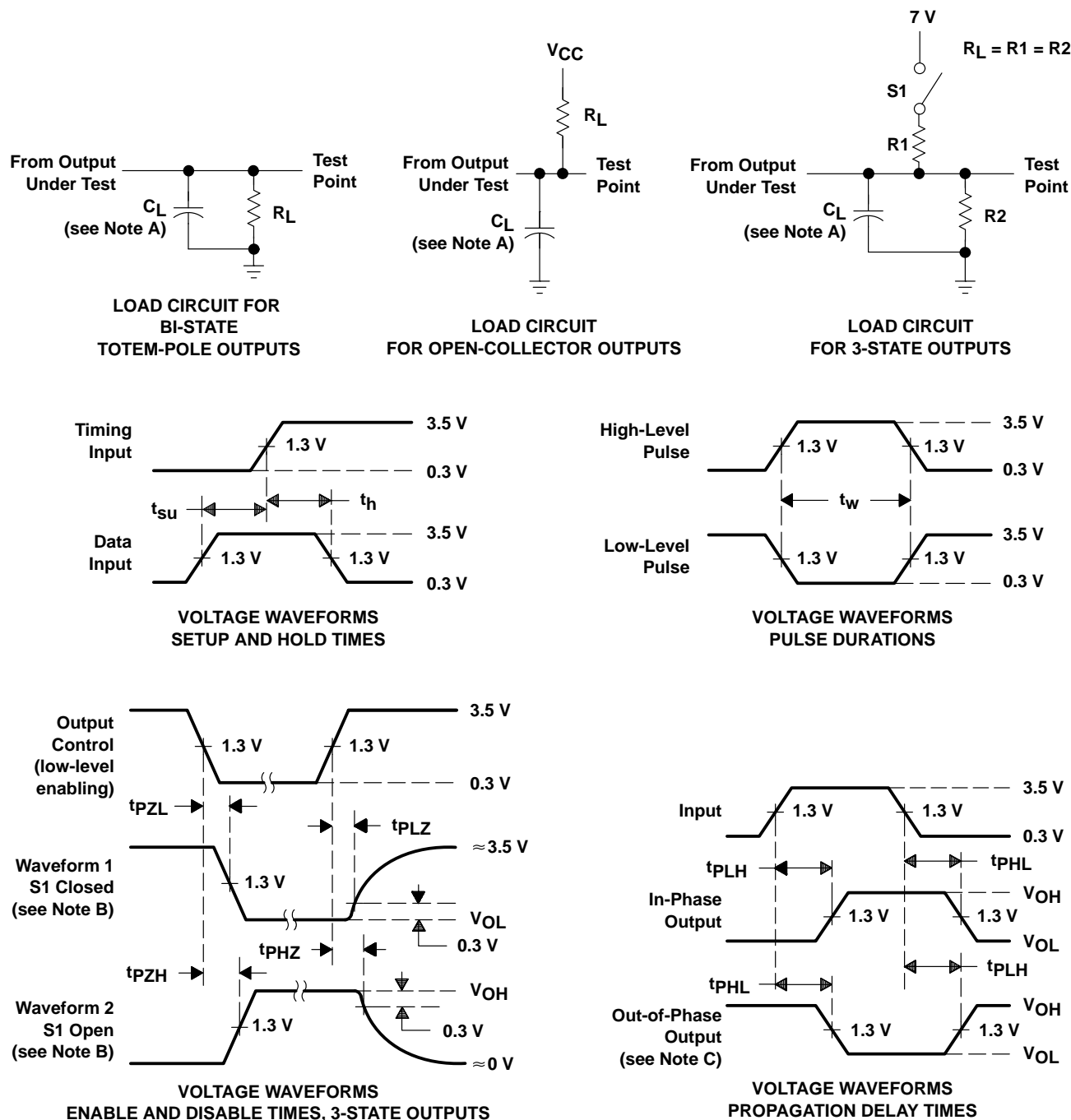
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switching characteristics (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω, T <sub>A</sub> = MIN to MAX†				UNIT
			SN54AS138		SN74AS138		
			MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A, B, C	Any Y	2	11	2	10	ns
t <sub>PHL</sub>			2	11	2	9.5	
t <sub>PLH</sub>	G1	Any Y	2	11.5	2	10	ns
t <sub>PHL</sub>			2	11	2	10	
t <sub>PLH</sub>	$\overline{\text{G2}}$	Any Y	2	9	2	7.5	ns
t <sub>PHL</sub>			2	10	2	8.5	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

PARAMETER MEASUREMENT INFORMATION  
SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



- 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. When measuring propagation delay items of 3-state outputs, switch S1 is open.  
D. All input pulses have the following characteristics:  $PRR \leq 1$  MHz,  $t_r = t_f = 2$  ns, duty cycle = 50%.  
E. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

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