

# SN54ALS138, SN54AS138, SN74ALS138A, SN74AS138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

SDAS055C – APRIL 1982 – REVISED FEBRUARY 1994

- Designed Specifically for High-Speed Memory Decoders and Data Transmission Systems
- Incorporates 3 Enable inputs to Simplify Cascading and/or Data Reception
- Package Options include Plastic Small-Outline Packages, Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs

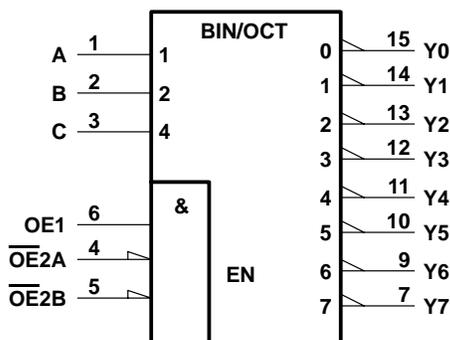
## description

The 54ALS138, 74ALS138A, and 'AS138 circuits are designed to be used in high-performance memory-decoding or data-routing applications requiring 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 with a fast enable circuit, the delay times of this decoder and the enable time of the memory are usually less than the typical access time of the memory. This means that the effective system delay introduced by the Schottky-clamped system decoder is negligible.

The conditions at the binary select inputs and the three enable inputs select one of eight input 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.

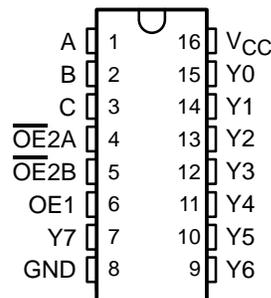
The SN54ALS138 and SN54AS138 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ALS138A and SN74AS138 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

## logic symbols (alternatives)†



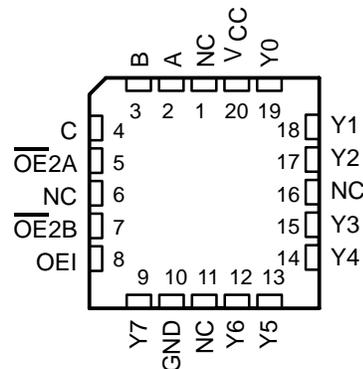
SN54ALS138, SN54AS138 . . . J PACKAGE  
SN74ALS138A, SN74AS138 . . . D OR N PACKAGE

(TOP VIEW)

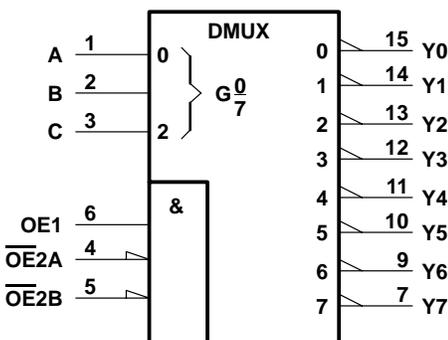


SN54ALS138, SN54AS138 . . . FK PACKAGE

(TOP VIEW)



NC – No internal connection



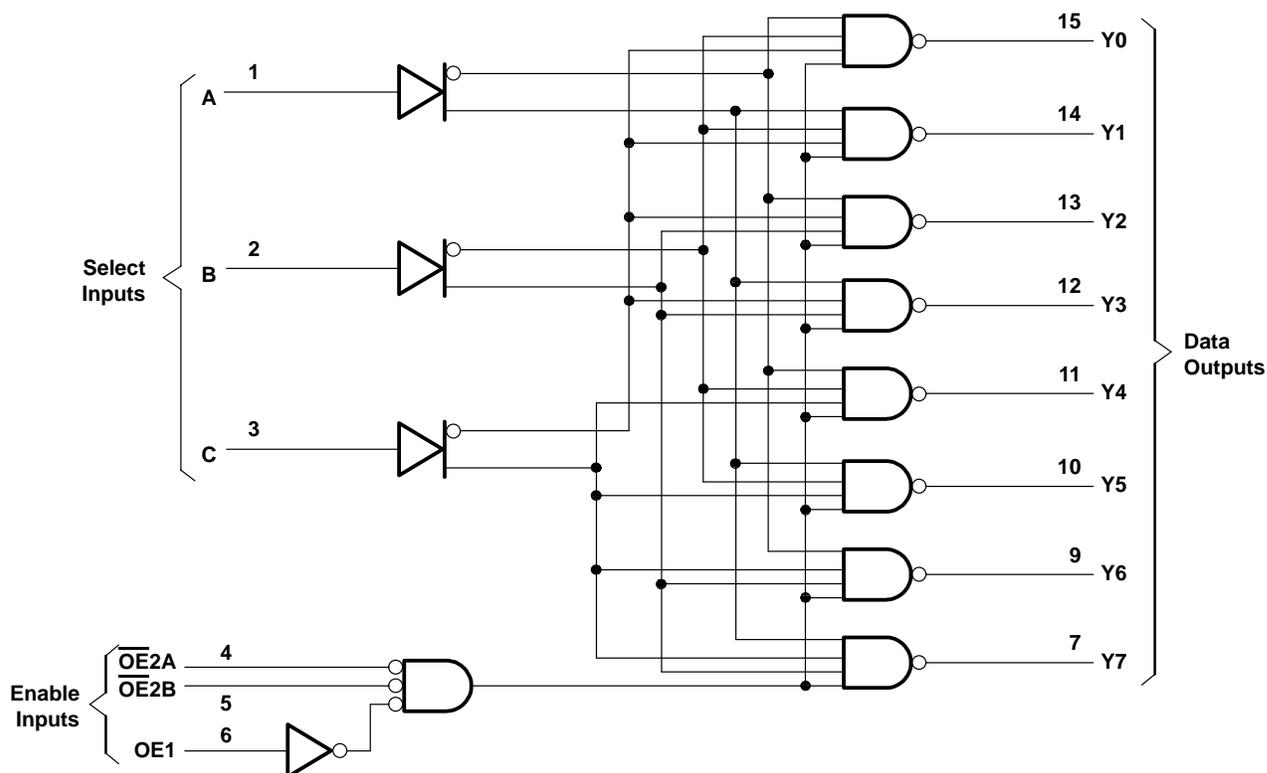
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

# SN54ALS138, SN54AS138, SN74ALS138A, SN74AS138

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

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### logic diagram (positive logic)



† 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.

FUNCTION TABLE

ENABLE INPUTS			SELECT INPUTS			OUTPUTS							
OE1	$\overline{\text{OE2A}}$	$\overline{\text{OE2B}}$	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	H	L	H	H	H	H
H	L	L	L	H	H	H	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	H	H	H	H	H	H	H	H	H	L

# SN54ALS138, 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)

Supply voltage, $V_{CC}$ .....	7 V
Input voltage, $V_I$ .....	7 V
Operating free-air temperature range: SN54ALS138, SN54AS138 .....	– 55°C to 125°C
SN74ALS138A, SN74AS138 .....	0°C to 70°C
Storage temperature range .....	– 65°C to 150°C

## recommended operating conditions

		SN54ALS138			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	SN54ALS138			SN74ALS138A			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
$V_{IK}$	$V_{CC} = 4.5\text{ V}$ , $I_I = -18\text{ mA}$			–1.5			–1.5	V
$V_{OH}$	$V_{CC} = 4.5\text{ V}$ , $I_{OH} = -0.4\text{ mA}$	$V_{CC}-2$			$V_{CC}-2$			V
$V_{OL}$	$V_{CC} = 4.5\text{ V}$ , $I_{OL} = 4\text{ mA}$		0.25	0.4		0.25	0.4	V
	$V_{CC} = 4.5\text{ V}$ , $I_{OL} = 8\text{ mA}$					0.35	0.5	
$I_I$	$V_{CC} = 5.5\text{ V}$ , $V_I = 7\text{ V}$			0.1			0.1	mA
$I_{IH}$	$V_{CC} = 5.5\text{ V}$ , $V_I = 2.7\text{ V}$			20			20	μA
$I_{IL}$	$V_{CC} = 5.5\text{ V}$ , $V_I = 0.4\text{ V}$			–0.1			–0.1	mA
$I_{O†}$	$V_{CC} = 5.5\text{ V}$ , $V_O = 2.25\text{ V}$	–30		–112	–30		–112	mA
$I_{CC}$	$V_{CC} = 5.5\text{ V}$		5	10		5	10	mA

† All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ 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 Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$ , $C_L = 50\text{ pF}$ , $R_L = 500\ \Omega$ , $T_A = \text{MIN to MAX}$				UNIT
			SN54ALS138		SN74ALS138		
			MIN	MAX	MIN	MAX	
$t_{PLH}$	A, B, C	Any Y	2	28	5	22	ns
$t_{PHL}$			6	22	6	18	
$t_{PLH}$	Any OE or $\overline{OE}$	Any Y	2	22	3	17	ns
$t_{PHL}$			4	21	4	17	

NOTE 1: Load circuit and voltage waveforms are shown in Section 1 of ASL/AS Logic Data Book, 1986.



# SN54ALS138, SN54AS138, SN74ALS138A, SN74AS138

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

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### 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†	MAX	MIN	TYP†	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
$I_{O‡}$	$V_{CC} = 5.5\text{ V}$ , $V_O = 2.25\text{ V}$	-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

† All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ 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 Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ , $C_L = 50\text{ pF}$ , $R_L = 500\ \Omega$ , $T_A = \text{MIN to MAX}$				UNIT
			SN54AS138		SN74AS138		
			MIN	MAX	MIN	MAX	
$t_{PLH}$	A, B, C	Any Y	2	11	2	10	ns
$t_{PHL}$			2	11	2	9.5	
$t_{PLH}$	OE1	Any Y	2	11.5	2	10	ns
$t_{PHL}$			2	11	2	10	
$t_{PLH}$	$\overline{\text{OE}}2$	Any Y	2	9	2	7.5	ns
$t_{PHL}$			2	10	2	8.5	

NOTE 1: Load circuit and voltage waveforms are shown in Section 1.



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