

# SN54LV138, SN74LV138 3-LINE TO 8-LINE DECODERS/DEMULPLEXERS

SCLS190D – FEBRUARY 1993 – REVISED JULY 1996

- **EPIC™ (Enhanced-Performance Implanted CMOS) 2-μ Process**
- **Typical  $V_{OLP}$  (Output Ground Bounce)  $< 0.8$  V at  $V_{CC}$ ,  $T_A = 25^\circ\text{C}$**
- **Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot)  $> 2$  V at  $V_{CC}$ ,  $T_A = 25^\circ\text{C}$**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using Machine Model ( $C = 200$  pF,  $R = 0$ )**
- **Latch-Up Performance Exceeds 250 mA Per JEDEC Standard JESD-17**
- **Package Options Include Plastic Small-Outline (D), Shrink Small-Outline (DB), Thin Shrink Small-Outline (PW), Ceramic Flat (W) Packages, Chip Carriers (FK), and (J) 300-mil DIPs**

## description

These 3-line to 8-line decoders/demultiplexers are designed for 2.7-V to 5.5-V  $V_{CC}$  operation.

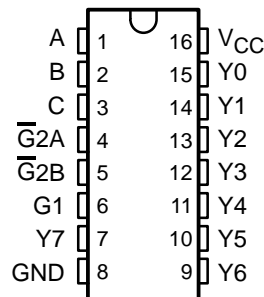
The 'LV138 are designed for high-performance memory-decoding or data-routing applications requiring very short propagation delay times. In high-performance memory systems, this decoder can be used to minimize the effects of system decoding. When employed with high-speed utilizing a fast enable circuit, 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 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.

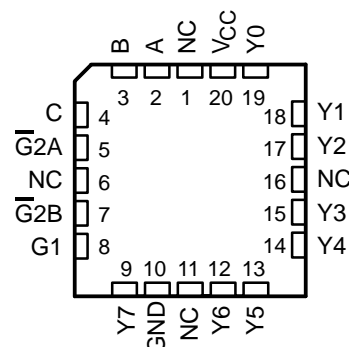
The SN74LV138 is available in TI's shrink small-outline package (DB), which provides the same I/O pin count and functionality of standard small-outline packages in less than half the printed-circuit-board area.

The SN54LV138 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74LV138 is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

SN54LV138 . . . J OR W PACKAGE  
SN74LV138 . . . D, DB, OR PW PACKAGE  
(TOP VIEW)



SN54LV138 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection



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**TEXAS  
INSTRUMENTS**

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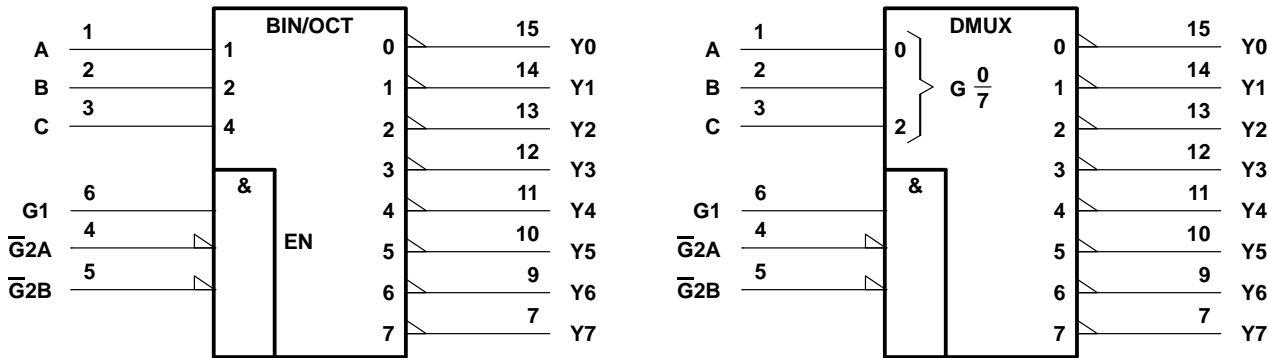
SN54LV138, SN74LV138  
3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

SCLS190D – FEBRUARY 1993 – REVISED JULY 1996

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	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L

logic symbols (alternatives)†

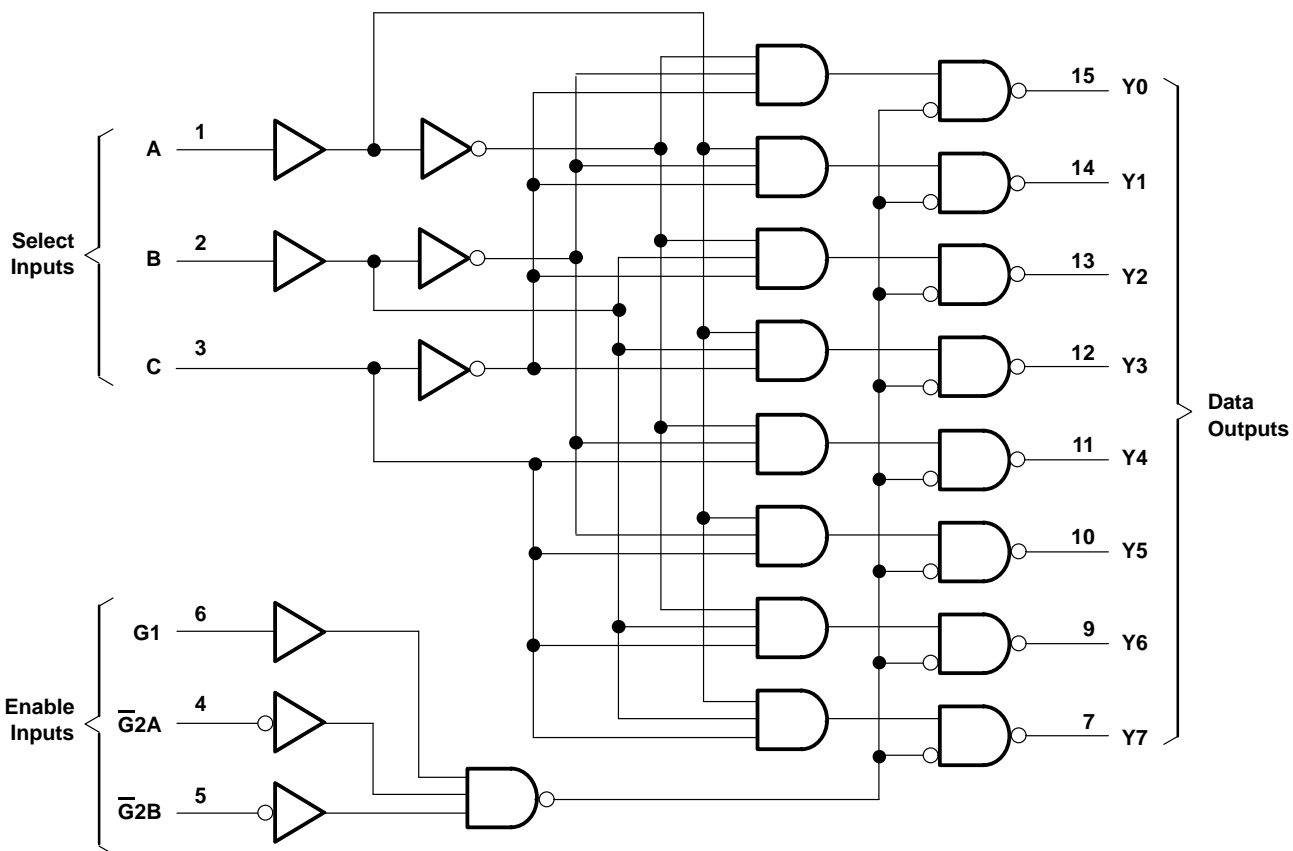


† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.  
Pin numbers shown are for D, DB, J, PW, and W packages.

SN54LV138, SN74LV138  
3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

SCLS190D – FEBRUARY 1993 – REVISED JULY 1996

logic diagram (positive logic)



# SN54LV138, SN74LV138

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

SCLS190D – FEBRUARY 1993 – REVISED JULY 1996

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

Supply voltage range, $V_{CC}$	–0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Output voltage range, $V_O$ (see Notes 1 and 2)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ )	±20 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ )	±50 mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )	±25 mA
Continuous current through $V_{CC}$ or GND	±50 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 3):	
D package	1.3 W
DB package	0.55 W
PW package	0.5 W
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.

NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

2. This value is limited to 7 V maximum.

3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

### recommended operating conditions (see Note 4)

			SN54LV138		SN74LV138		UNIT
			MIN	MAX	MIN	MAX	
V <sub>CC</sub>	Supply voltage		2.7	5.5	2.7	5.5	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 2.7 V to 3.6 V	2		2		V
		V <sub>CC</sub> = 4.5 V to 5.5 V	3.15		3.15		
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 2.7 V to 3.6 V	0.8		0.8		V
		V <sub>CC</sub> = 4.5 V to 5.5 V	1.65		1.65		
V <sub>I</sub>	Input voltage		0	V <sub>CC</sub>	0	V <sub>CC</sub>	V
V <sub>O</sub>	Output voltage		0	V <sub>CC</sub>	0	V <sub>CC</sub>	V
I <sub>OH</sub>	High-level output current	V <sub>CC</sub> = 2.7 V to 3.6 V	–6		–6		mA
		V <sub>CC</sub> = 4.5 V to 5.5 V	–12		–12		
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 2.7 V to 3.6 V	6		6		mA
		V <sub>CC</sub> = 4.5 V to 5.5 V	12		12		
Δt/Δv	Input transition rise or fall rate		0	100	0	100	ns/V
T <sub>A</sub>	Operating free-air temperature		–55	125	–40	85	°C

NOTE 4: Unused inputs must be held high or low to prevent them from floating.

# SN54LV138, SN74LV138

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

SCLS190D – FEBRUARY 1993 – REVISED JULY 1996

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

PARAMETER	TEST CONDITIONS		V <sub>CC</sub> †	SN54LV138			SN74LV138			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V <sub>OH</sub>	I <sub>OH</sub> = –100 μA		MIN to MAX	V <sub>CC</sub> –0.2			V <sub>CC</sub> –0.2			V
	I <sub>OH</sub> = –6 mA		3 V	2.4			2.4			
	I <sub>OH</sub> = –12 mA		4.5 V	3.6			3.6			
V <sub>OL</sub>	I <sub>OL</sub> = 100 μA		MIN to MAX	0.2			0.2			V
	I <sub>OL</sub> = 6 mA		3 V	0.4			0.4			
	I <sub>OL</sub> = 12 mA		4.5 V	0.55			0.55			
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND		3.6 V	±1			±1			μA
			5.5 V	±1			±1			
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	I <sub>O</sub> = 0	3.6 V	20			20			μA
			5.5 V	20			20			
ΔI <sub>CC</sub>	One input at V <sub>CC</sub> – 0.6 V	Other inputs at V <sub>CC</sub> or GND	3 V to 3.6 V	500			500			μA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND		3.3 V	2.5			2.5			pF
			5 V	2.1			2.1			

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

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LV138						UNIT	
			V <sub>CC</sub> = 5 V ± 0.5 V			V <sub>CC</sub> = 3.3 V ± 0.3 V		V <sub>CC</sub> = 2.7 V		
			MIN	TYP	MAX	MIN	TYP	MAX		MIN
t <sub>pd</sub>	A, B, or C	Y	8	16		10	21		26	ns
	Enable		8	19		10	23		29	

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74LV138						UNIT	
			V <sub>CC</sub> = 5 V ± 0.5 V			V <sub>CC</sub> = 3.3 V ± 0.3 V		V <sub>CC</sub> = 2.7 V		
			MIN	TYP	MAX	MIN	TYP	MAX		MIN
t <sub>pd</sub>	A, B, or C	Y	8      16			10      21		26		ns
	Enable		8      19			10      23		29		

operating characteristics, T<sub>A</sub> = 25°C

PARAMETER		TEST CONDITIONS	V <sub>CC</sub>	TYP	UNIT
C <sub>pd</sub>	Power dissipation capacitance per channel	C <sub>L</sub> = 50 pF, f = 10 MHz	3.3 V	47	pF
			5 V	49	

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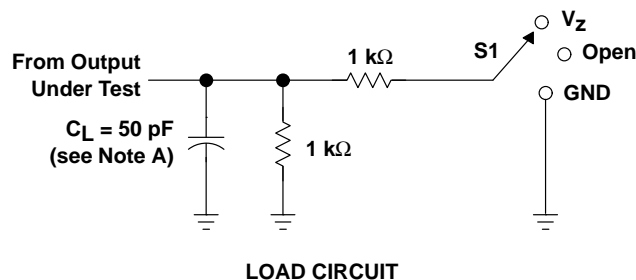


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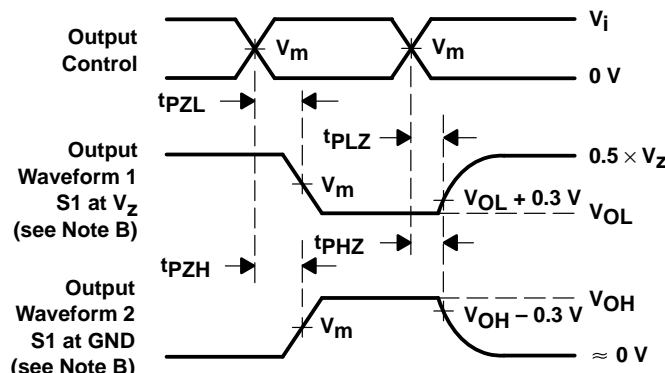
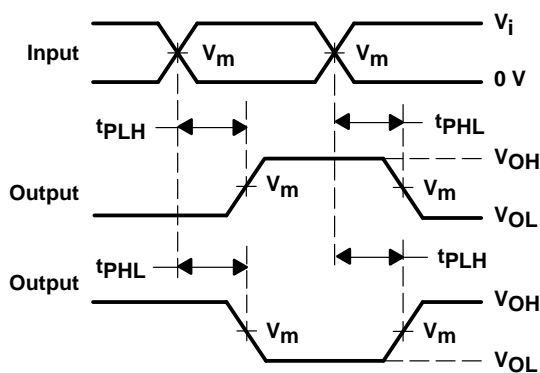
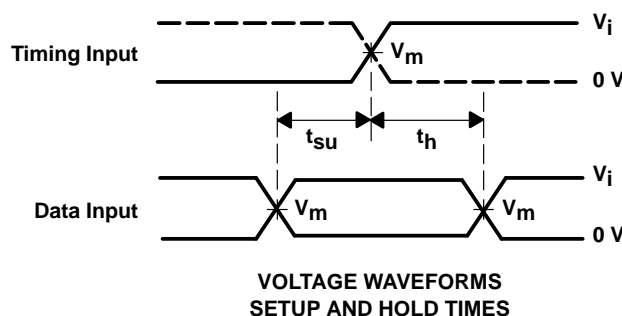
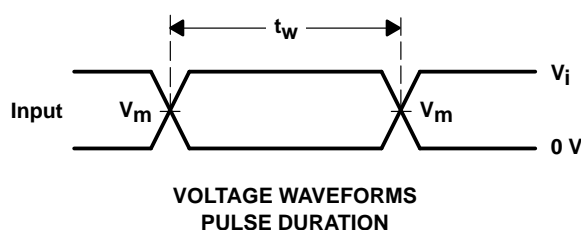
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## PARAMETER MEASUREMENT INFORMATION



TEST	S1
t <sub>PLH</sub> /t <sub>PHL</sub>	Open
t <sub>PLZ</sub> /t <sub>PZL</sub>	V <sub>Z</sub>
t <sub>PHZ</sub> /t <sub>PZH</sub>	GND

WAVEFORM CONDITION	V <sub>CC</sub> = 4.5 V to 5.5 V	V <sub>CC</sub> = 2.7 V to 3.6 V
V <sub>m</sub>	0.5 × V <sub>CC</sub>	1.5 V
V <sub>i</sub>	V <sub>CC</sub>	2.7 V
V <sub>Z</sub>	2 × V <sub>CC</sub>	6 V



- NOTES:
- $C_L$  includes probe and jig 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 ≤ 10 MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .
  - The outputs are measured one at a time with one transition per measurement.
  - t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>dis</sub>.
  - t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.
  - t<sub>PLH</sub> and t<sub>PHL</sub> are the same as t<sub>pd</sub>.

Figure 1. Load Circuit and Voltage Waveforms

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