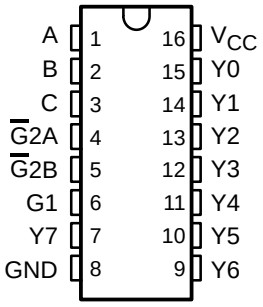
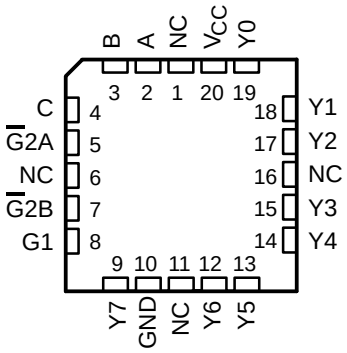
- ***EPIC*™ (Enhanced-Performance Implanted CMOS) 2-μ Process**
- **Typical V_{OLP} (Output Ground Bounce) < 0.8 V at V_{CC}, T_A = 25°C**
- **Typical V_{OHV} (Output V_{OH} Undershoot) > 2 V at V_{CC}, T_A = 25°C**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using 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**

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



SN54LV138 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

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.

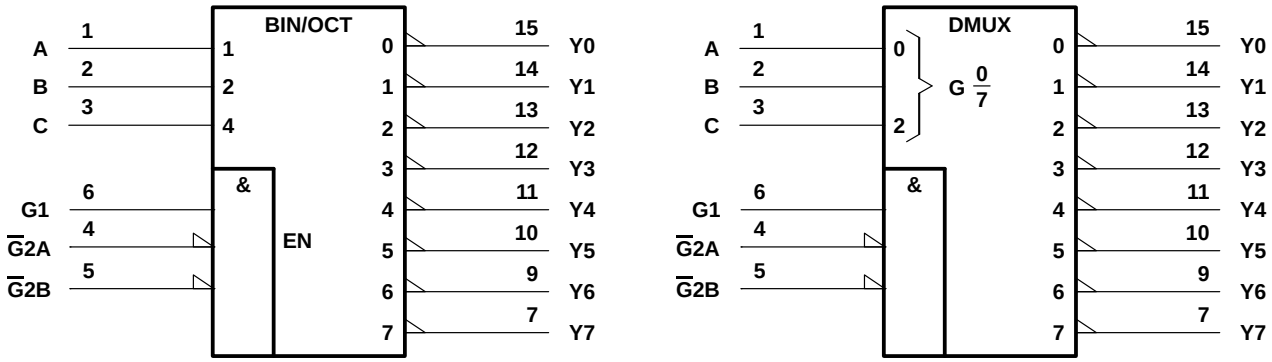
The SN74LV138 is available in TI’s shrink small-outline package (DB), which provides the same I/O pin count and functionality of standard small-outline packages in less than half the printed-circuit-board area.

The SN54LV138 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74LV138 is characterized for operation from –40°C to 85°C.

FUNCTION TABLE

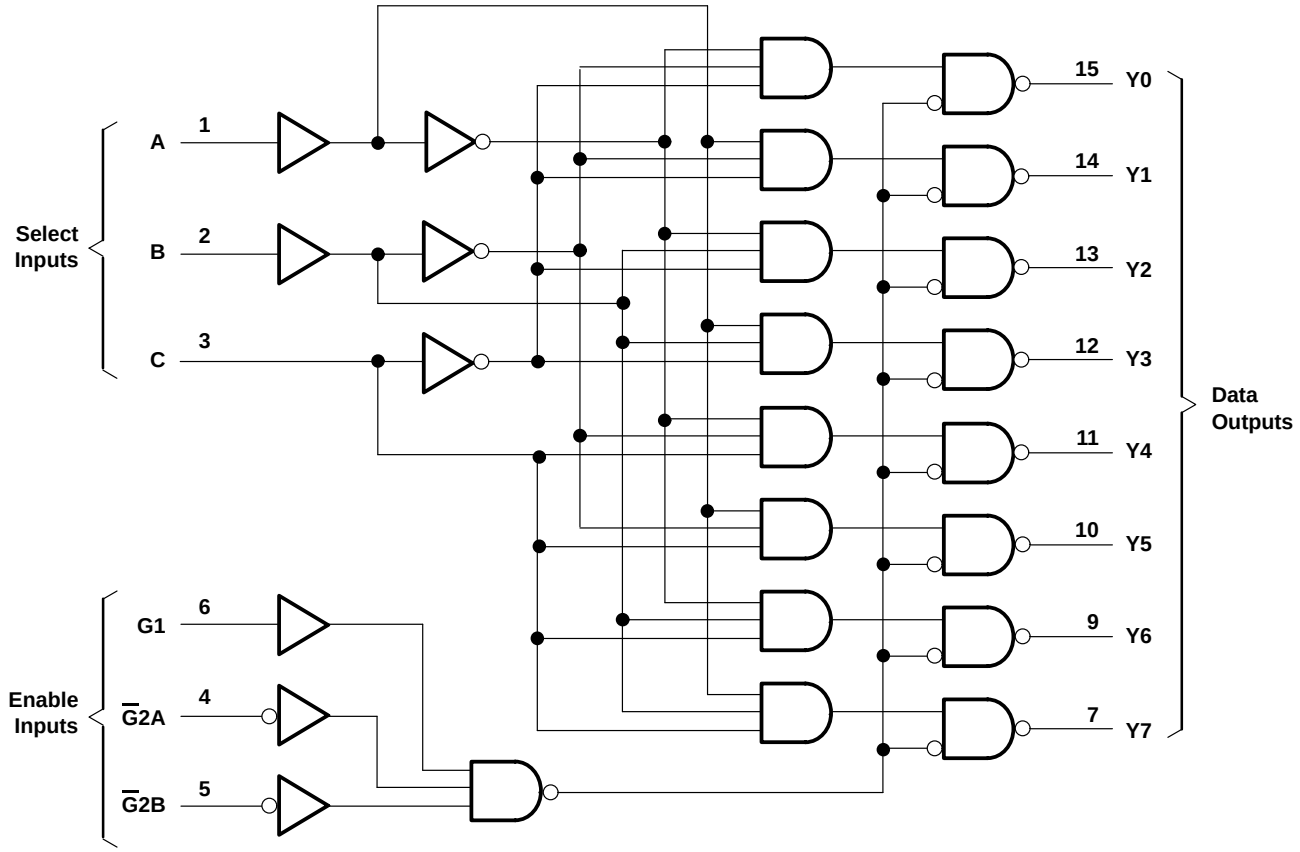
ENABLE INPUTS			SELECT INPUTS			OUTPUTS							
G1	$\overline{G}$2A	$\overline{G}$2B	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	L	H	H	H	H	H	L	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 D, DB, J, PW, and W packages.

logic diagram (positive logic)



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 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°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

† 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_{CC}	Supply voltage		2.7	5.5	2.7	5.5	V
V_{IH}	High-level input voltage	V_{CC} = 2.7 V to 3.6 V	2		2		V
		V_{CC} = 4.5 V to 5.5 V	3.15		3.15		
V_{IL}	Low-level input voltage	V_{CC} = 2.7 V to 3.6 V		0.8		0.8	V
		V_{CC} = 4.5 V to 5.5 V		1.65		1.65	
V_I	Input voltage		0	V_{CC}	0	V_{CC}	V
V_O	Output voltage		0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 2.7 V to 3.6 V		–6		–6	mA
		V_{CC} = 4.5 V to 5.5 V		–12		–12	
I_{OL}	Low-level output current	V_{CC} = 2.7 V to 3.6 V		6		6	mA
		V_{CC} = 4.5 V to 5.5 V		12		12	
$\Delta t/\Delta v$	Input transition rise or fall rate		0	100	0	100	ns/V
T_A	Operating free-air temperature		–55	125	–40	85	°C

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

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

PARAMETER	TEST CONDITIONS		V_{CC}†	SN54LV138			SN74LV138			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{OH}	I_{OH} = –100 μA		MIN to MAX	V_{CC}–0.2			V_{CC}–0.2			V
	I_{OH} = –6 mA		3 V	2.4			2.4			
	I_{OH} = –12 mA		4.5 V	3.6			3.6			
V_{OL}	I_{OL} = 100 μA		MIN to MAX			0.2			0.2	V
	I_{OL} = 6 mA		3 V			0.4			0.4	
	I_{OL} = 12 mA		4.5 V			0.55			0.55	
I_I	V_I = V_{CC} or GND		3.6 V			±1			±1	μA
			5.5 V			±1			±1	
I_{CC}	V_I = V_{CC} or GND	I_O = 0	3.6 V			20			20	μA
			5.5 V			20			20	
ΔI_{CC}	One input at V_{CC} – 0.6 V	Other inputs at V_{CC} or GND	3 V to 3.6 V			500			500	μA
C_i	V_I = V_{CC} 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_L = 50 pF (unless otherwise noted) (see Figure 1)

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

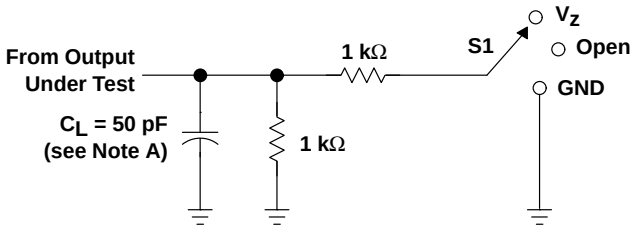
switching characteristics over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted) (see Figure 1)

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

operating characteristics, T_A = 25°C

PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT
C_{pd}	Power dissipation capacitance per channel	C_L = 50 pF, f = 10 MHz	3.3 V	47	pF
			5 V	49	

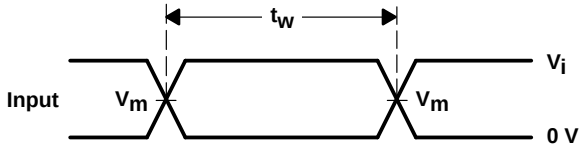
PARAMETER MEASUREMENT INFORMATION



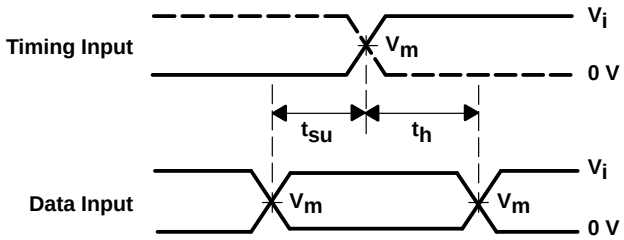
LOAD CIRCUIT

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_z
t_{PHZ}/t_{PZH}	GND

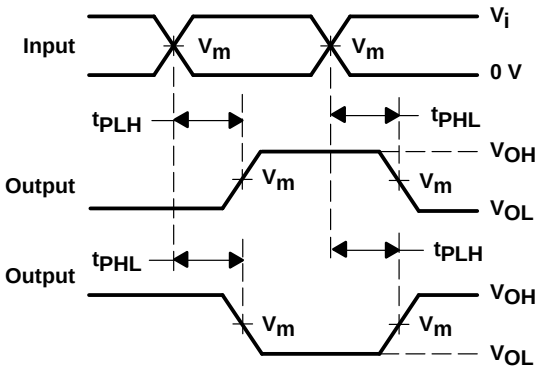
WAVEFORM CONDITION	V_{CC} = 4.5 V to 5.5 V	V_{CC} = 2.7 V to 3.6 V
V_m	$0.5 \times V_{CC}$	1.5 V
V_i	V_{CC}	2.7 V
V_z	$2 \times V_{CC}$	6 V



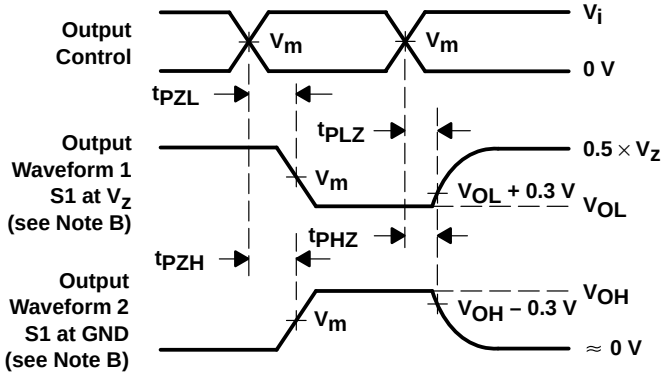
VOLTAGE WAVEFORMS
PULSE DURATION



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 ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
D. The outputs are measured one at a time with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
F. t_{PZL} and t_{PZH} are the same as t_{en}.
G. t_{PLH} and t_{PHL} are the same as t_{pd}.

Figure 1. Load Circuit and Voltage Waveforms

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