

TYPES SN54LS138, SN54S138, SN74LS138, SN74S138 3-LINE TO 8-LINE DECODERS/DEMULPLEXERS

DECEMBER 1972—REVISED APRIL 1985

- **Designed Specifically for High-Speed: Memory Decoders Data Transmission Systems**
- **3 Enable Inputs to Simplify Cascading and/or Data Reception**
- **Schottky-Clamped for High Performance**

description

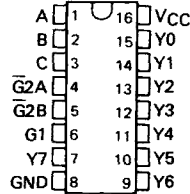
These Schottky-clamped TTL MSI circuits are designed to be used in high-performance memory decoding or data-routing applications requiring very short propagation delay times. In high-performance memory systems these decoders can be used to minimize the effects of system decoding. When employed with high-speed memories utilizing a fast enable circuit the delay times of these decoders and the enable time of the memory 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 'LS138 and 'S138 decode one of eight lines dependent on the conditions at the three binary select inputs and the three enable inputs. 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.

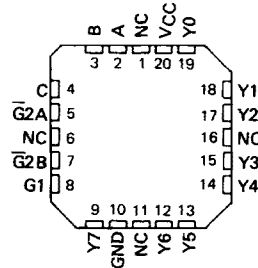
All of these decoder/demultiplexers feature fully buffered inputs, each of which represents only one normalized load to its driving circuit. All inputs are clamped with high-performance Schottky diodes to suppress line-ringing and to simplify system design.

The SN54LS138 and SN54S138 are characterized for operation over the full military temperature range of -55°C to 125°C. The SN74LS138 and SN74S138 are characterized for operation from 0°C to 70°C.

SN54LS138, SN54S138 . . . J OR W PACKAGE
SN74LS138, SN74S138 . . . D, J OR N PACKAGE
(TOP VIEW)

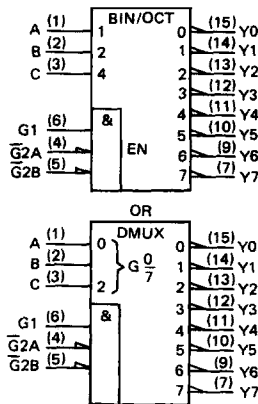


SN54LS138, SN54S138 . . . FK PACKAGE
SN74LS138, SN74S138 . . . FN PACKAGE
(TOP VIEW)



NC - No internal connection

logic symbols



Pin numbers shown on logic notation are for D, J or N packages.

PRODUCTION DATA

This document contains information 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

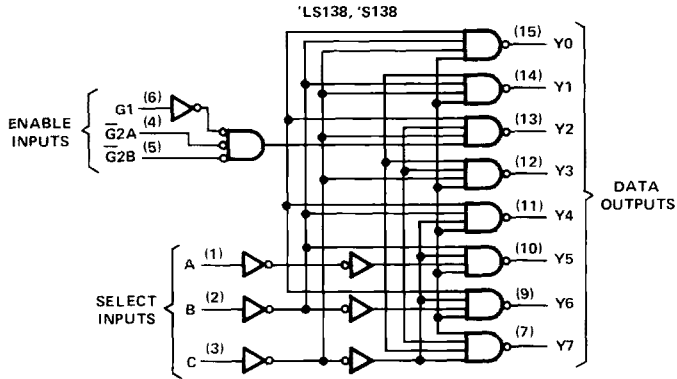
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TYPES SN54LS138, SN54S138, SN74LS138, SN74S138
3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

logic diagram and function table



Pin numbers shown on logic notation are for D, J or N packages.

'LS138, 'S138
 FUNCTION TABLE

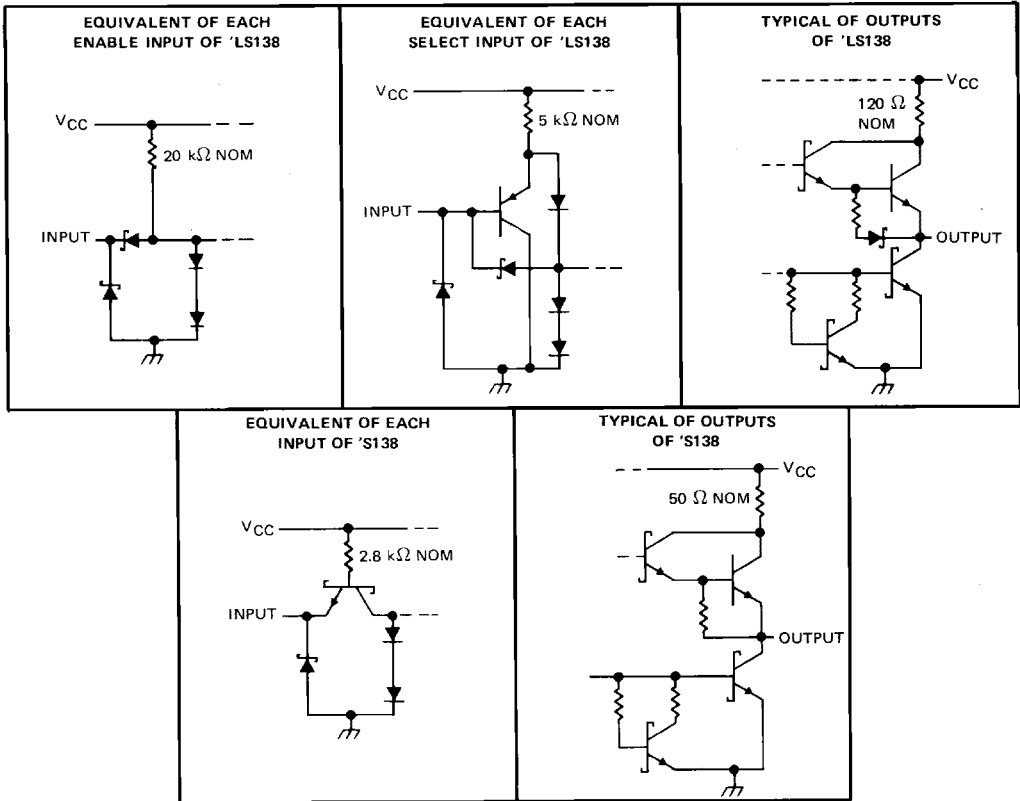
INPUTS					OUTPUTS							
ENABLE		SELECT			Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
G1	G2*	C	B	A								
X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	H	H	H	H	L	H	H	H	H	H
H	L	H	L	L	H	H	H	H	L	H	H	H
H	L	H	L	H	H	H	H	H	H	L	H	H
H	L	H	H	L	H	H	H	H	H	H	L	H
H	L	H	H	H	H	H	H	H	H	H	H	L

*G2 = G2A + G2B

H = high level, L = low level, X = irrelevant

TYPES SN54LS138, SN54S138, SN74LS138, SN74S138
3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

schematics of inputs and outputs



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TYPES SN54LS138, SN74LS138

3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage	7 V
Operating free-air temperature range: SN54LS138	-55°C to 125°C
SN74LS138	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

	SN54LS138			SN74LS138			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC} Supply voltage	4.5	5	5.5	4.75	5	5.25	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 †	SN54LS138		SN74LS138		UNIT
		MIN	TYP ‡	MAX	MIN	
V_{IK}	$V_{CC} = \text{MIN}$, $I_I = -18 \text{ mA}$	-1.5		-1.5		V
V_{OH}	$V_{CC} = \text{MIN}$, $V_{IH} = 2 \text{ V}$, $V_{IL} = \text{MAX}$, $I_{OH} = -0.4 \text{ mA}$	2.5	3.4	2.7	3.4	V
V_{OL}	$V_{CC} = \text{MIN}$, $V_{IH} = 2 \text{ V}$, $V_{IL} = \text{MAX}$	$I_{OL} = 4 \text{ mA}$ $I_{OL} = 8 \text{ mA}$		0.25	0.4	V
I_I	$V_{CC} = \text{MAX}$, $V_I = 7 \text{ V}$	0.1		0.1		mA
I_{IH}	$V_{CC} = \text{MAX}$, $V_I = 2.7 \text{ V}$	20		20		µA
I_{IL}	$V_{CC} = \text{MAX}$, $V_I = 0.4 \text{ V}$	Enable A, B, C		-0.4	-0.4	mA
$I_{OS} §$	$V_{CC} = \text{MAX}$	-20	-100	-20	-100	mA
I_{CC}	$V_{CC} = \text{MAX}$, Outputs enabled and open	6.3	10	6.3	10	mA

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

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

§ Not more than one output should be shorted at a time.

switching characteristics, $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER †	FROM (INPUT)	TO (OUTPUT)	LEVELS OF DELAY	TEST CONDITIONS	SN54LS138 SN74LS138			UNIT
					MIN	TYP	MAX	
t_{PLH}	Binary Select	Any	2	$R_L = 2 \text{ k}\Omega$, $C_L = 15 \text{ pF}$, See Note 2	11	20	ns	
t_{PHL}					18	41	ns	
t_{PLH}			3		21	27	ns	
t_{PHL}					20	39	ns	
t_{PLH}	Enable	Any	2		12	18	ns	
t_{PHL}					20	32	ns	
t_{PLH}			3		14	26	ns	
t_{PHL}					13	38	ns	

† t_{PLH} = propagation delay time, low-to-high-level output; t_{PHL} = propagation delay time, high-to-low-level output.

NOTE 2: See General Information Section for load circuits and voltage waveforms.

TYPES SN54S138, SN74S138

3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage	5.5 V
Operating free-air temperature range: SN54S138	- 55°C to 125°C
SN74S138	0°C to 70°C
Storage temperature range	- 65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

	SN54S138			SN74S138			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC} Supply voltage	4.5	5	5.5	4.75	5	5.25	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	- 1			- 1			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†	SN54S138 SN74S138		UNIT
		MIN	TYP‡	
V_{IK}	$V_{CC} = \text{MIN.}$, $I_I = 18 \text{ mA}$	- 1.2		V
V_{OH}	$V_{CC} = \text{MIN.}$, $V_{IH} = 2 \text{ V.}$ $V_{IL} = 0.8 \text{ V.}$ $I_{OH} = - 1 \text{ mA}$	SN54S' 2.5	SN74S' 3.4	V
V_{OL}	$V_{CC} = \text{MIN.}$, $V_{IH} = 2 \text{ V.}$ $V_{IL} = 0.8 \text{ V.}$ $I_{OL} = 20 \text{ mA}$	0.5		V
I_I	$V_{CC} = \text{MAX.}$, $V_I = 5.5 \text{ V}$	1		mA
I_{IH}	$V_{CC} = \text{MAX.}$, $V_I = 2.7 \text{ V}$	50		µA
I_{IL}	$V_{CC} = \text{MAX.}$, $V_I = 0.5 \text{ V}$	- 2		mA
$I_{OS}§$	$V_{CC} = \text{MAX}$	- 40	- 100	mA
I_{CC}	$V_{CC} = \text{MAX.}$ Outputs enabled and open	SN54S' 60	SN74S' 74	mA
		SN74S' 75	90	

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

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

§Not more than one output should be shorted at a time, and duration of the short circuit test should not exceed one second.

switching characteristics, $V_{CC} = 5 \text{ V,}$ $T_A = 25^\circ\text{C}$

PARAMETER‡	FROM (INPUT)	TO (OUTPUT)	LEVELS OF DELAY	TEST CONDITIONS	SN54S138 SN74S138			UNIT	
					MIN	TYP	MAX		
t_{PLH}	Binary Select	Any	2	$R_L = 280 \Omega,$ $C_L = 15 \mu\text{F,}$ See Note 2	4.5	7	ns		
t_{PHL}					7	10.5			
t_{PLH}			Enable		Any	3	7.5	12	ns
t_{PHL}							8	12	
t_{PLH}	2	3				5	8	ns	
t_{PHL}						7	11		
t_{PLH}	3	3	7		11	ns			
t_{PHL}			7		11				

‡ t_{PLH} = propagation delay time, low-to-high-level output

‡ t_{PHL} = propagation delay time, high-to-low-level output

NOTE 2: See General Information Section for load circuits and voltage waveforms.

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