

# 74LS138, S138

## Decoders/Demultiplexers

### 1-Of-8 Decoder/Demultiplexer

#### Product Specification

#### Logic Products

#### FEATURES

- Demultiplexing capability
- Multiple input enable for easy expansion
- Ideal for memory chip select decoding
- Direct replacement for Intel 3205

#### DESCRIPTION

The '138 decoder accepts three binary weighted inputs ( $A_0$ ,  $A_1$ ,  $A_2$ ) and when enabled, provides eight mutually exclusive, active LOW outputs ( $\bar{O}_0 - \bar{O}_7$ ). The device features three Enable inputs: two active LOW ( $\bar{E}_1$ ,  $\bar{E}_2$ ) and one active HIGH ( $E_3$ ). Every output will be HIGH unless  $\bar{E}_1$  and  $\bar{E}_2$  are LOW and  $E_3$  is HIGH. This multiple enable function allows easy parallel expansion of the device to a 1-of-32 (5 lines to 32 lines) decoder with just four '138s and one inverter.

The device can be used as an eight output demultiplexer by using one of the active LOW Enable inputs as the Data input and the remaining Enable inputs as strobes. Enable inputs not used must be permanently tied to their appropriate active HIGH or active LOW state.

TYPE	TYPICAL PROPAGATION DELAY	TYPICAL SUPPLY CURRENT (TOTAL)
74LS138	20ns	6.3mA
74S138	7ns	49mA

#### ORDERING CODE

PACKAGES	COMMERCIAL RANGE $V_{CC} = 5V \pm 5\%$ ; $T_A = 0^\circ C$ to $+70^\circ C$
Plastic DIP	N74S138N, N74LS138N
Plastic SO	N74LS138D, N74S138D

#### NOTE:

For information regarding devices processed to Military Specifications see the Signetics Military Products Data Manual.

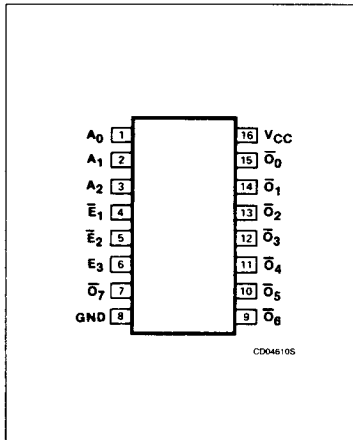
#### INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

PINS	DESCRIPTION	74S	74LS
All	Inputs	1Sul	1LSul
All	Outputs	10Sul	10LSul

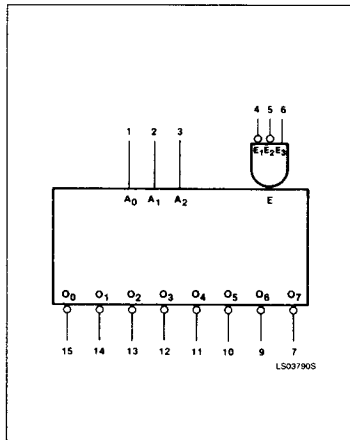
#### NOTE:

Where a 74S unit load (Sul) is  $50\mu A$   $I_{IH}$  and  $-2.0mA$   $I_{IL}$ , and a 74LS unit load (LSul) is  $20\mu A$   $I_{IH}$  and  $-0.4mA$   $I_{IL}$ .

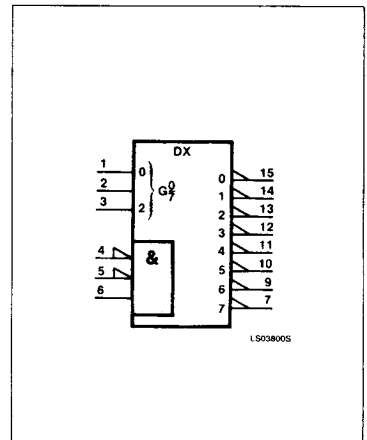
#### PIN CONFIGURATION



#### LOGIC SYMBOL



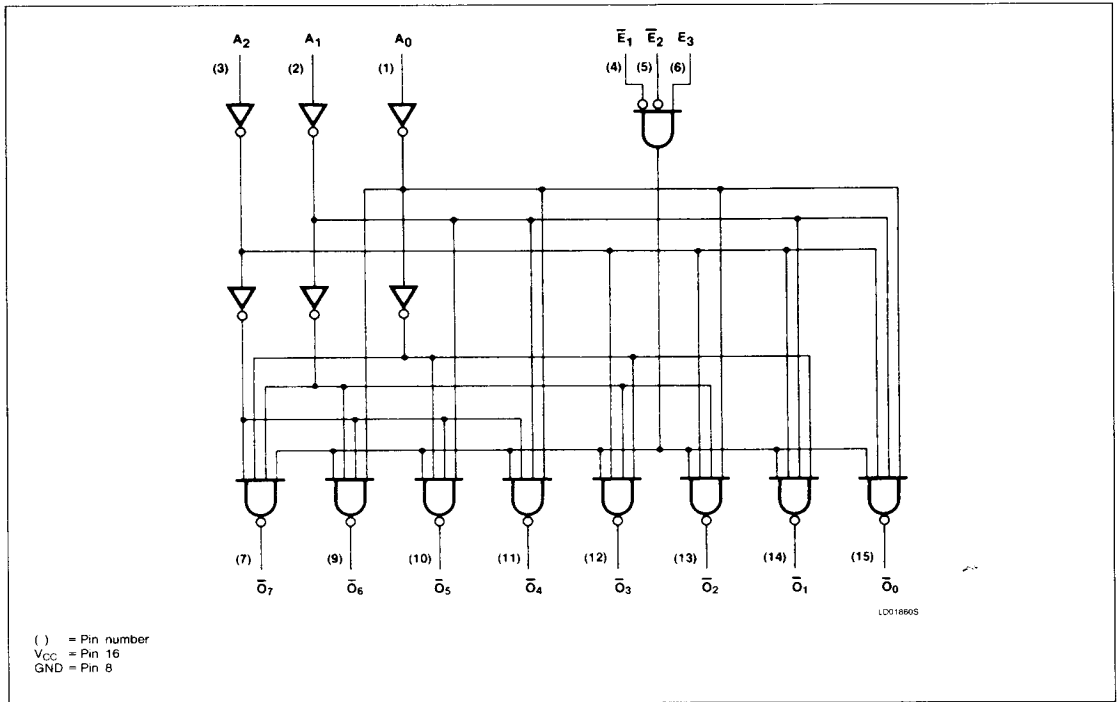
#### LOGIC SYMBOL (IEEE/IEC)



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## LOGIC DIAGRAM



5

## FUNCTION TABLE

INPUTS						OUTPUTS							
$\bar{E}_1$	$\bar{E}_2$	$E_3$	$A_0$	$A_1$	$A_2$	$\bar{O}_0$	$\bar{O}_1$	$\bar{O}_2$	$\bar{O}_3$	$\bar{O}_4$	$\bar{O}_5$	$\bar{O}_6$	$\bar{O}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	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	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

H = HIGH voltage level  
 L = LOW voltage level  
 X = Don't care

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**ABSOLUTE MAXIMUM RATINGS** (Over operating free-air temperature range unless otherwise noted.)

PARAMETER		74LS	74S	UNIT
$V_{CC}$	Supply voltage	7.0	7.0	V
$V_{IN}$	Input voltage	-0.5 to +7.0	-0.5 to +5.5	V
$I_{IN}$	Input current	-30 to +1	-30 to +5	mA
$V_{OUT}$	Voltage applied to output in HIGH output state	-0.5 to + $V_{CC}$	-0.5 to + $V_{CC}$	V
$T_A$	Operating free-air temperature range	0 to 70		°C

**RECOMMENDED OPERATING CONDITIONS**

PARAMETER	74LS			74S			UNIT
	Min	Nom	Max	Min	Nom	Max	
$V_{CC}$	4.75	5.0	5.25	4.75	5.0	5.25	V
$V_{IH}$	2.0			2.0			V
$V_{IL}$			+0.8			+0.8	V
$I_{IK}$			-18			-18	mA
$I_{OH}$			-400			-1000	μA
$I_{OL}$			8			20	mA
$T_A$	0		70	0		70	°C

**DC ELECTRICAL CHARACTERISTICS** (Over recommended operating free-air temperature range unless otherwise noted.)

PARAMETER	TEST CONDITIONS <sup>1</sup>	74LS138			74S138			UNIT
		Min	Typ <sup>2</sup>	Max	Min	Typ <sup>2</sup>	Max	
$V_{OH}$	HIGH-level output voltage $V_{CC} = \text{MIN}$ , $V_{IH} = \text{MIN}$ , $V_{IL} = \text{MAX}$ , $I_{OH} = \text{MAX}$	2.7	3.4		2.7	3.4		V
$V_{OL}$	LOW-level output voltage $V_{CC} = \text{MIN}$ , $V_{IH} = \text{MIN}$ , $V_{IL} = \text{MAX}$		$I_{OL} = \text{MAX}$	0.35	0.5		0.5	V
			$I_{OL} = 4\text{mA}$ (74LS)	0.25	0.4			V
$V_{IK}$	Input clamp voltage $V_{CC} = \text{MIN}$ , $I_I = I_{IK}$			-1.5			-1.2	V
$I_I$	Input current at maximum input voltage $V_{CC} = \text{MAX}$		$V_I = 5.5\text{V}$				1.0	mA
			$V_I = 7.0\text{V}$		0.1			mA
$I_{IH}$	HIGH-level input current $V_{CC} = \text{MAX}$ , $V_I = 2.7\text{V}$				20		50	μA
$I_{IL}$	LOW-level input current $V_{CC} = \text{MAX}$		$V_I = 0.4\text{V}$		-0.4			mA
			$V_I = 0.5\text{V}$				-2	mA
$I_{OS}$	Short-circuit output current <sup>3</sup> $V_{CC} = \text{MAX}$	-20		-100	-40		-100	mA
$I_{CC}$	Supply current <sup>4</sup> (total) $V_{CC} = \text{MAX}$		6.3	10		49	74	mA

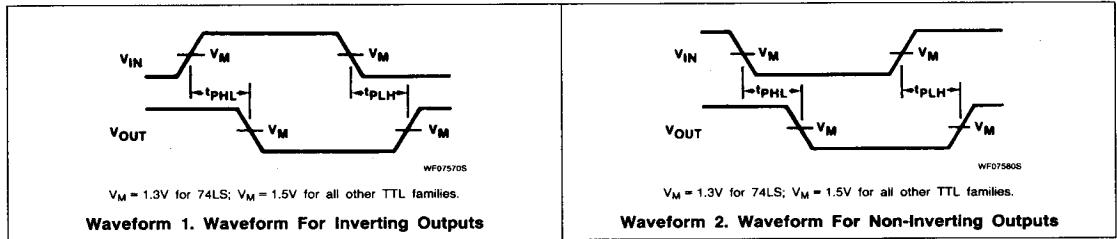
**NOTES:**

- For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
- All typical values are at  $V_{CC} = 5\text{V}$ ,  $T_A = 25^\circ\text{C}$ .
- $I_{OS}$  is tested with  $V_{OUT} = +0.5\text{V}$  and  $V_{CC} = V_{CC\text{ MAX}} + 0.5\text{V}$ . Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.
- To measure  $I_{CC}$ , outputs must be enabled and open.

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## AC WAVEFORMS



## AC ELECTRICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$ , $V_{CC} = 5.0\text{V}$

PARAMETER	TEST CONDITIONS	74LS		74S		UNIT
		$C_L = 15\text{pF}$ , $R_L = 2\text{k}\Omega$		$C_L = 15\text{pF}$ , $R_L = 280\Omega$		
		Min	Max	Min	Max	
$t_{PLH}$ $t_{PHL}$	Propagation delay Address to output	Waveform 2 2 logic levels		20 41	7 10.5	ns
$t_{PLH}$ $t_{PHL}$	Propagation delay Address to output	Waveform 1 3 logic levels		27 39	12 12	ns
$t_{PLH}$ $t_{PHL}$	Propagation delay Enable to output	Waveform 2 2 logic levels		18 32	8 11	ns
$t_{PLH}$ $t_{PHL}$	Propagation delay Enable to output	Waveform 1 3 logic levels		26 38	11 11	ns

5

## TEST CIRCUITS AND WAVEFORMS

