

## 1-OF-8 DECODER/DEMULTIPLEXER

### DESCRIPTION

The T54LS138/T74LS138 is a high speed 1-of-8 Decoder/Demultiplexer. This device is ideally suited for high speed bipolar memory chip select address decoding. The multiple input enables allow parallel expansion to a 1-of-24 decoder using just three LS138 devices or to a 1-of-32 decoder using four LS138s and one inverter. The LS138 is fabricated with the Schottky barrier diode process for high speed and is compatible with all SGS TTL families.

- DEMULTIPLEXING CAPABILITY
- MULTIPLE INPUT ENABLE FOR EASY EXPANSION
- TYPICAL POWER DISSIPATION OF 32mW
- ACTIVE LOW MUTUALLY EXCLUSIVE OUTPUTS
- INPUT CLAMP DIODES LIMIT HIGH SPEED TERMINATION EFFECTS
- FULLY TTL AND CMOS COMPATIBLE

### PIN NAMES

$A_0$ - $A_2$	Address Inputs
$\bar{E}_1$ - $\bar{E}_2$	Enable (Active LOW) Inputs
$E_3$	Enable (Active HIGH) Input
$\bar{O}_0$ - $\bar{O}_7$	Active LOW Outputs

**B1**  
Plastic Package

**D1/D2**  
Ceramic Package

**M1**  
Micro Package

**C1**  
Plastic Chip Carrier

**ORDERING NUMBERS:**  
T54LS138 D2      T74LS138 C1  
T74LS138 D1      T74LS138 M1  
T74LS138 B1

### PIN CONNECTION (top view)

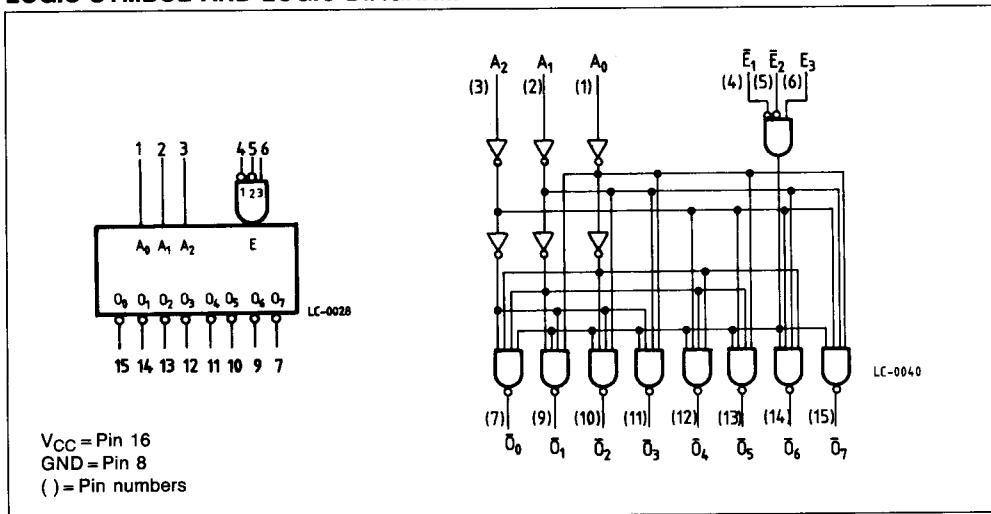
**DUAL IN LINE**

**CHIP CARRIER**

NC = No Internal Connection



## LOGIC SYMBOL AND LOGIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

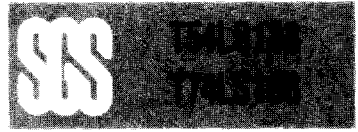
Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage	-0.5 to 7	V
$V_I$	Input Voltage, Applied to Input	-0.5 to 5.5	V
$V_O$	Output Voltage, Applied to Output	-0.5 to 10	V
$I_I$	Input Current, Into Inputs	-30 to 5	mA
$I_O$	Output Current, Into Outputs	50	mA

Stresses in excess of those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions in excess of those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## GUARANTEED OPERATING RANGES

Part Numbers	Supply Voltage			Temperature
	Min	Typ	Max	
T54LS138D2	4.5 V	5.0 V	5.5 V	-55°C to +125°C
T74LS138XX	4.75 V	5.0 V	5.25 V	0°C to +70°C

XX = package type.



## FUNCTIONAL DESCRIPTION

The LS138 is a high speed 1-of-8 Decoder/Demultiplexer fabricated with the low power Schottky barrier diode process. The decoder accepts three binary weighted inputs ( $A_0, A_1, A_2$ ) and when enable provides eight mutually exclusive active LOW outputs ( $\bar{O}_0-\bar{O}_7$ ). The LS138 features three Enable inputs two active LOW ( $\bar{E}_1, \bar{E}_2$ ) and one active HIGH ( $E_3$ ). All outputs 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 of a 1-of-32 (5 lines to 32) decoded with just four LS138s and one inverter. (See Figure 1). The LS138 can be used as an 8-output demultiplexer by using one of the active LOW Enable Inputs as the data input and the other Enable inputs as strobes. The Enable inputs which are not used must be permanently tied to their appropriate active HIGH or active LOW state.

## TRUTH TABLE

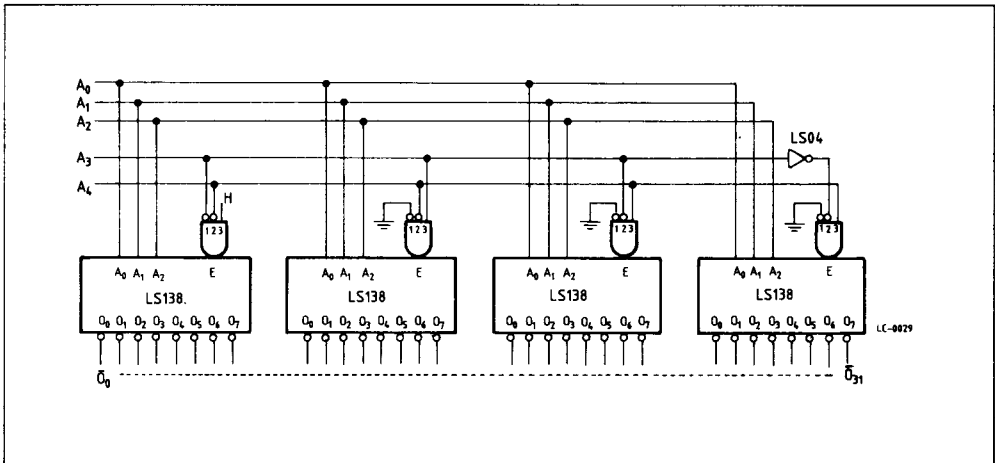
INPUTS						OUTPUTS							
$\bar{E}_1$	$\bar{E}_2$	$E_3$	$A_0$	$A_1$	$A_2$	$\bar{O}_0$	$\bar{O}_1$	$\bar{O}_2$	$\bar{O}_3$	$\bar{O}_4$	$\bar{O}_5$	$\bar{O}_6$	$\bar{O}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H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

Fig. 1





## DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE

Symbol	Parameter		Limits			Test Conditions (Note 1)	Units
			Min.	Typ.	Max.		
V <sub>IH</sub>	Input HIGH Voltage		2.0			Guaranteed input HIGH Treshold Voltage for all Inputs	V
V <sub>IL</sub>	Input LOW Voltage	54			0.7	Guaranteed input LOW Tresh. Voltage for all Inputs	V
		74			0.8		
V <sub>CD</sub>	Input Clamp Diode Voltage			-0.65	-1.5	V <sub>CC</sub> = MIN, I <sub>IN</sub> = -18mA	V
V <sub>OH</sub>	Output HIGH Voltage	54	2.5	3.4		V <sub>CC</sub> = MIN, I <sub>OH</sub> = -400μA, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> per Truth Table	V
		74	2.7	3.4			
V <sub>OL</sub>	Output LOW Voltage	54,74		0.25	0.4	I <sub>OL</sub> = 4.0mA V <sub>CC</sub> = MIN V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> per Truth Table	V
		74		0.35	0.5		
I <sub>IH</sub>	Input HIGH Current			1.0	20	V <sub>CC</sub> = MAX, V <sub>IN</sub> = 2.7V V <sub>CC</sub> = MAX, V <sub>IN</sub> = 7.0V	μA mA
I <sub>IL</sub>	Input LOW Current				-0.4	V <sub>CC</sub> = MAX, V <sub>IN</sub> = 0.4V	mA
I <sub>OS</sub>	Output Short Circuit Current (Note 2)		-20		-100	V <sub>CC</sub> = MAX, V <sub>OUT</sub> = 0V	mA
I <sub>CC</sub>	Power Supply Current			6.0	10	V <sub>CC</sub> = MAX	mA

## AC CHARACTERISTICS: (T<sub>A</sub> = 25°C)

Symbol	Parameter	Level of Delay	Limits			Test Conditions	Units
			Min.	Typ.	Max.		
t <sub>PLH</sub>	Propagation Delay, Address to Output	2		13	20	V <sub>CC</sub> = 5.0V C <sub>L</sub> = 15pF	ns
t <sub>PHL</sub>		2		27	41		
t <sub>PLH</sub>	Propagation Delay, Address to Output	3		18	27		ns
t <sub>PHL</sub>		3		26	39		
t <sub>PLH</sub>	Propagation Delay, E to Any Output	2		12	18		ns
t <sub>PHL</sub>		2		21	32		
t <sub>PLH</sub>	Propagation Delay, E to Any Output	3		17	26	ns	
t <sub>PHL</sub>		3		25	38		

### Notes:

- 1) Conditions shown as MIN or MAX, use the appropriate value specified under guaranteed operating ranges.
- 2) Not more than one output should be shorted at a time.
- 3) Typical Values are V<sub>CC</sub> = 5.0V, T<sub>A</sub> = 25°C

## AC WAVEFORMS

