MOTOROLA

Military 54LS138

Single 3-of-8 Line Decoder

ELECTRICALLY TESTED PER:
MIL-M-38510/30701

The 54LS138 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 'LS138's and one inverter. The 'LS138 is fabricated with the Schottky barrier diode process for high speed and is completely compatible with all Motorola TTL families.

- Demultiplexing Capability
- Multiple Input Enable For Easy Expansion
- Typical Power Dissipation of 32 mW
- Active Low Mutually Exclusive Outputs
- Input Clamp Diodes Limit High-Speed Termination Effect

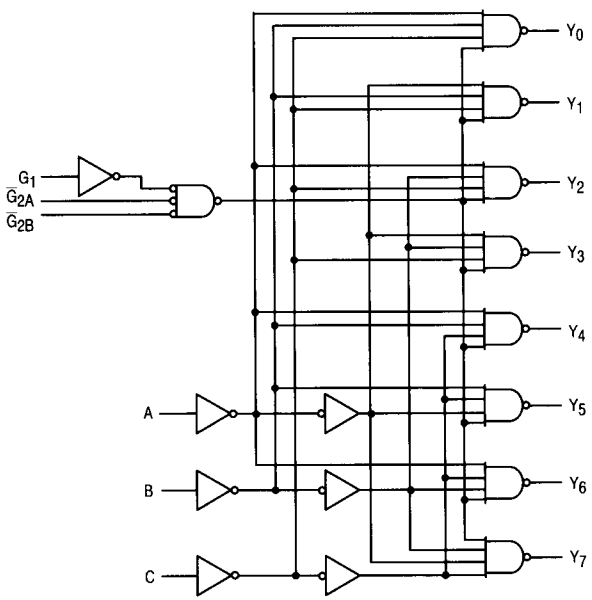
AVAILABLE AS:

1) JAN: JM38510/30701BXA
2) SMD: 760051
3) 883: 54LS138/BXAJC

X = CASE OUTLINE AS FOLLOWS:
PACKAGE: CERDIP: E
CERFLAT: F
LCC: 2

THE LETTER "M" APPEARS BEFORE THE / ON LCC.

LOGIC DIAGRAM



PIN ASSIGNMENTS

FUNCT.	DIL 620-09	FLATS 650-05	LCC 756A-02	BURN-IN (COND. A)
A	1	1	2	V_{CC}
B	2	2	3	V_{CC}
C	3	3	4	V_{CC}
$\overline{G}_{2A}$	4	4	5	V_{CC}
$\overline{G}_{2B}$	5	5	7	V_{CC}
G_1	6	6	8	V_{CC}
Y_7	7	7	9	V_{CC}
GND	8	8	10	GND
Y_6	9	9	12	V_{CC}
Y_5	10	10	13	V_{CC}
Y_4	11	11	14	V_{CC}
Y_3	12	12	15	V_{CC}
Y_2	13	13	17	V_{CC}
Y_1	14	14	18	V_{CC}
Y_0	15	15	19	V_{CC}
V_{CC}	16	16	20	V_{CC}

BURN-IN CONDITIONS:
V_{CC} = 5.0 V MIN/6.0 V MAX

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FUNCTIONAL DESCRIPTION

The 'LS138 is a high-speed dual 1-of-8 Decoder/ Demultiplexer fabricated with the low power Schottky barrier diode process. The decoder accepts three binary weighted inputs (A, B, C) and when enabled provides eight mutually exclusive active LOW outputs ($\overline{Y}_0$, $\overline{Y}_7$). The 'LS138 features three Enable inputs, two active LOW ($\overline{G}_{2A}$, $\overline{G}_{2B}$) and one active HIGH (G_1). All outputs will be HIGH unless $\overline{G}_{2A}$ and $\overline{G}_{2B}$ are LOW and G_1 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 'LS138s and one inverter.

The 'LS138 can be used as an 8-output demultiplexer by using one of the active LOW enable inputs as a 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

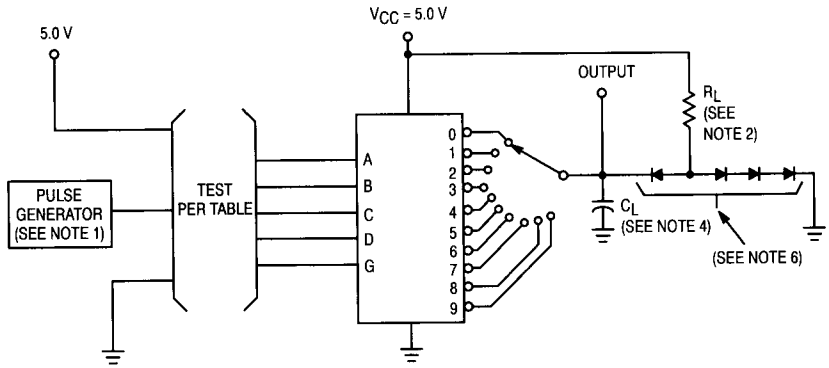
Inputs						Outputs							
$\overline{G}_{2A}$	$\overline{G}_{2B}$	G_1	A	B	C	$\overline{Y}_0$	$\overline{Y}_1$	$\overline{Y}_2$	$\overline{Y}_3$	$\overline{Y}_4$	$\overline{Y}_5$	$\overline{Y}_6$	$\overline{Y}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	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

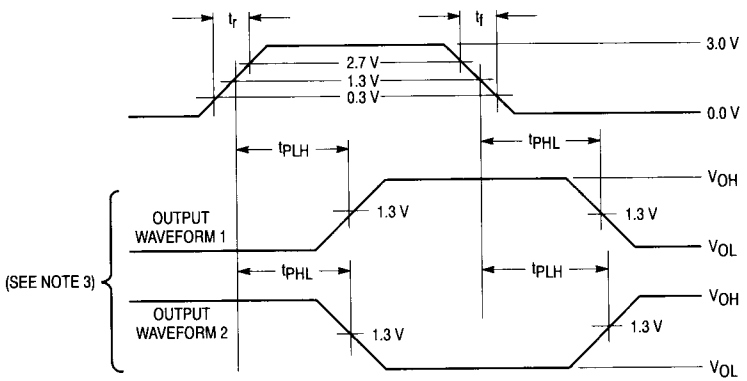
H = HIGH Voltage Levels
L = LOW Voltage Levels
X = Don't Care

Pin Names		Loading (Note a)	
		HIGH	LOW
A, B, C	Address Inputs	0.5 U.L.	0.25 U.L.
$\overline{G}_{2A,B}$	Enable (Active LOW) Input	0.5 U.L.	0.25 U.L.
G_1	Enable (Active HIGH) Inputs	0.5 U.L.	0.25 U.L.
$\overline{Y}_0$, $\overline{Y}_3$	Active Low Outputs	10 U.L.	5(2.5) U.L.

NOTES:
a. One TTL Unit Load (U.L.) = 40 µA HIGH/1.6 mA LOW.
b. The Output LOW drive factor is 2.5 U.L. for Military (54) Temperature Ranges.

TEST CIRCUIT AND WAVEFORM





NOTES:

1. Input pulse has the following characteristics: $t_r \leq 15$ ns, $t_f \leq 6.0$ ns, PRR ≤ 1.0 MHz and minimum duty cycle = 50%.
2. $R_L = 2.0\ k\Omega \pm 10\%$.
3. Input-output waveform combination in accordance with truth table.
4. $C_L = 50\ pF \pm 10\%$, including scope probe, wiring and stray capacitance.
5. Voltage measurements are to be made with respect to network ground terminal.
6. All diodes are 1N3064 or equivalent.
7. The limits specified for $C_L = 15$ pF are guaranteed but not tested.

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Symbol	Parameter	Limits						Unit	Test Condition (Unless Otherwise Specified)
	Static Parameters:	+ 25°C		+ 125°C		− 55°C			
		Subgroup 1		Subgroup 2		Subgroup 3			
		Min	Max	Min	Max	Min	Max		
V_{OH}	Logical "1" Output Voltage	2.5		2.5		2.5		V	V_{CC} = 4.5 V, I_{OH} = −0.4 mA, G_1 = 0.7 V, other inputs are open.
V_{OL}	Logical "0" Output Voltage		0.4		0.4		0.4	V	V_{CC} = 4.5 V, I_{OL} = 4.0 mA, V_{IL} = 0.7 V, V_{IH} = 2.0 V, G_1 = 0.7 V, $\overline{G}_{2A,B}$ = 0.7 V.
V_{IC}	Input Clamping Voltage		−1.5					V	V_{CC} = 4.5 V, I_{IN} = −18 mA, other inputs are open.
I_{IH}	Logical "1" Input Current		20		20		20	µA	V_{CC} = 5.5 V, V_{IH} = 2.7 V (all inputs).
I_{IHH}	Logical "1" Input Current		100		100		100	µA	V_{CC} = 5.5 V, V_{IHH} = 5.5 V (all inputs).
I_{IL}	Logical "0" Input Current	−0.12	−0.36	−0.12	−0.36	−0.12	−0.36	mA	V_{CC} = 5.5 V, V_{IN} = 0.4 V (all inputs).
I_{OS}	Output Short Circuit Current	−15	−100	−15	−100	−15	−100	mA	V_{CC} = 5.5 V, V_{IN} = 5.5 V ($\overline{G}_{2A,B}$), V_{OUT} = GND, other inputs are open.
I_{CC}	Power Supply Current Off		10		10		10	mA	V_{CC} = 5.5 V, V_{IN} = 5.5 V (G_1), $\overline{G}_{2A/B}$ = GND
V_{IH}	Logical "1" Input Voltage	2.0		2.0		2.0		V	V_{CC} = 4.5 V.
V_{IL}	Logical "0" Input Voltage		0.7		0.7		0.7	V	V_{CC} = 4.5 V.
	Functional Tests	Subgroup 7		Subgroup 8A		Subgroup 8B			per Truth Table with V_{CC} = 5.0 V, V_{INL} = 0.4 V, and V_{INH} = 2.5 V.

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Symbol	Parameter	Limits						Unit	Test Condition (Unless Otherwise Specified)
	Switching Parameters:	+ 25°C		+ 125°C		− 55°C			
		Subgroup 9		Subgroup 10		Subgroup 11			
		Min	Max	Min	Max	Min	Max		
t_{PHL2} t_{PHL2}	Propagation Delay /Data-Output High-Low	5.0 —	46 41	5.0 —	69 64	5.0 —	69 64	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
t_{PLH2} t_{PLH2}	Propagation Delay /Data-Output Low-High	5.0 —	25 20	5.0 —	38 33	5.0 —	38 33	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
t_{PHL3} t_{PHL3}	Propagation Delay /Data-Output High-Low	5.0 —	37 39	5.0 —	56 51	5.0 —	56 51	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
t_{PLH3} t_{PLH3}	Propagation Delay /Data-Output Low-High	5.0 —	23 27	5.0 —	35 30	5.0 —	35 30	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
t_{PHL4} t_{PHL4}	Propagation Delay /Data-Output High-Low	5.0 —	54 32	5.0 —	81 76	5.0 —	81 76	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
t_{PLH4} t_{PLH4}	Propagation Delay /Data-Output Low-High	5.0 —	32 18	5.0 —	48 43	5.0 —	48 43	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
t_{PHL5} t_{PHL5}	Propagation Delay /Data-Output High-Low	5.0 —	43 38	5.0 —	65 61	5.0 —	65 61	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.
t_{PLH5} t_{PLH5}	Propagation Delay /Data-Output Low-High	5.0 —	31 26	5.0 —	47 42	5.0 —	47 42	ns	V_{CC} = 5.0 V, C_L = 50 pF, R_L = 2.0 kΩ. V_{CC} = 5.0 V, C_L = 15 pF.