

1-of-8 decoder/demultiplexer

74ALS138

FEATURES

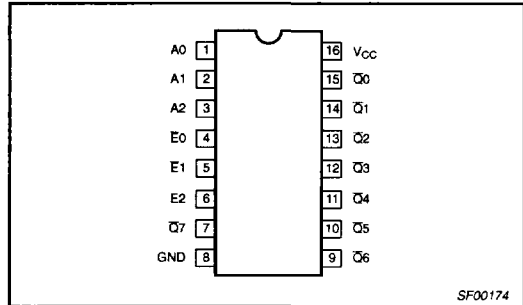
- Demultiplexing capability
- Multiple input enable for easy expansion
- Ideal for memory chip select decoding

DESCRIPTION

The 74ALS138 decoder accepts three binary weighted inputs (A0, A1, A2) and when enabled, provides eight mutually exclusive, active-Low outputs ($\bar{Q}0 - \bar{Q}7$). The device features three Enable inputs; two active-Low ($\bar{E}0, \bar{E}1$) and one active-High (E2). Every output will be High unless $\bar{E}0$ and $\bar{E}1$ are Low and E2 is High. This multiple enable function allows easy parallel expansion of the device to 1-of-32 (5 lines to 32 lines) decoder with just four 74ALS138s 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)
74ALS138	12.0ns	4.0mA

PIN CONFIGURATION



ORDERING INFORMATION

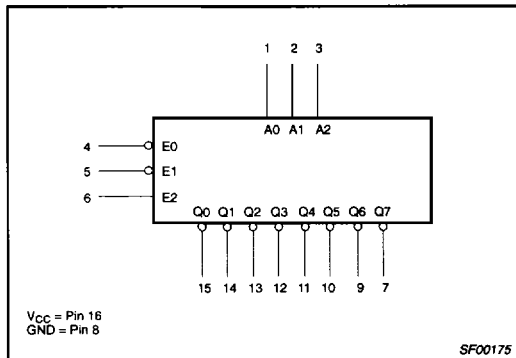
DESCRIPTION	ORDER CODE	DRAWING NUMBER
	COMMERCIAL RANGE $V_{CC} = 5V \pm 10\%$, $T_{amb} = 0^{\circ}C$ to $+70^{\circ}C$	
16-pin plastic DIP	74ALS138N	SOT38-4
16-pin plastic SO	74ALS138D	SOT109-1

INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

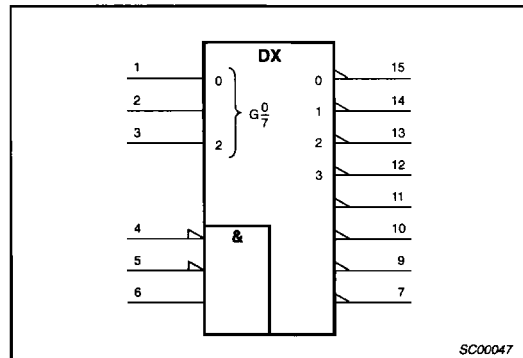
PINS	DESCRIPTION	74ALS (U.L.) HIGH/LOW	LOAD VALUE HIGH/LOW
A0 – A2	Address inputs	1.0/1.0	20 μ A/0.1mA
$\bar{E}0, \bar{E}1$	Enable inputs (active-Low)	1.0/1.0	20 μ A/0.1mA
E2	Enable input (active-High)	1.0/1.0	20 μ A/0.1mA
$\bar{Q}0 - \bar{Q}7$	Data outputs (active-Low)	50/33	1.0mA/20mA

NOTE: One (1.0) ALS unit load is defined as: 20 μ A in the High state and 0.1mA in the Low state.

LOGIC SYMBOL



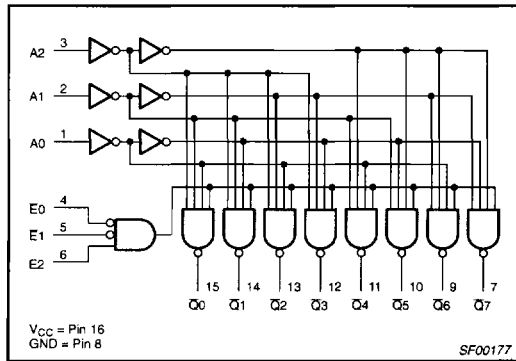
IEC/IEEE SYMBOL



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LOGIC DIAGRAM



FUNCTION TABLE

INPUTS						OUTPUTS							
E0	E1	E2	A0	A1	A2	$\bar{Q}0$	$\bar{Q}1$	$\bar{Q}2$	$\bar{Q}3$	$\bar{Q}4$	$\bar{Q}5$	$\bar{Q}6$	$\bar{Q}7$
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

(Operation beyond the limit set forth in this table may impair the useful life of the device. Unless otherwise noted these limits are over the operating free-air temperature range.)

SYMBOL	PARAMETER	RATING	UNIT
V_{CC}	Supply voltage	-0.5 to +7.0	V
V_{IN}	Input voltage	-0.5 to +7.0	V
I_{IN}	Input current	-30 to +5	mA
V_{OUT}	Voltage applied to output in High output state	-0.5 to V_{CC}	V
I_{OUT}	Current applied to output in Low output state	16	mA
T_{amb}	Operating free-air temperature range	0 to +70	°C
T_{stg}	Storage temperature range	-65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS			UNIT
		MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5.0	5.5	V
V_{IH}	High-level input voltage	2.0			V
V_{IL}	Low-level input voltage			0.8	V
I_{IK}	Input clamp current			-18	mA
I_{OH}	High-level output current			-0.4	mA
I_{OL}	Low-level output current			8	mA
T_{amb}	Operating free-air temperature range	0		+70	°C

DC ELECTRICAL CHARACTERISTICS

(Over recommended operating free-air temperature range unless otherwise noted.)

SYMBOL	PARAMETER	TEST CONDITIONS ¹	LIMITS			UNIT		
			MIN	TYP ²	MAX			
V_{OH}	High-level output voltage	$V_{CC} = \pm 10\%$, $V_{IL} = \text{MAX}$, $V_{IH} = \text{MIN}$	$I_{OH} = -0.4\text{mA}$	$V_{CC} - 2$			V	
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$, $V_{IL} = \text{MAX}$, $V_{IH} = \text{MIN}$	$I_{OL} = 4\text{mA}$		0.25	0.40	V	
			$I_{OL} = 8\text{mA}$		0.35	0.50	V	
V_{IK}	Input clamp voltage	$V_{CC} = \text{MIN}$, $I_I = I_{IK}$			-0.73	-1.5	V	
I_I	Input current at maximum input voltage	$V_{CC} = \text{MAX}$, $V_I = 7.0\text{V}$				0.1	mA	
I_{IH}	High-level input current	$V_{CC} = \text{MAX}$, $V_I = 2.7\text{V}$				20	μA	
I_{IL}	Low-level input current	$V_{CC} = \text{MAX}$, $V_I = 0.4\text{V}$				-0.1	mA	
I_O	Output current ³	$V_{CC} = \text{MAX}$, $V_O = 2.25\text{V}$				-30	mA	
I_{CC}	Supply current (total)	$V_{CC} = \text{MAX}$				4	7	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 $V_{CC} = 5\text{V}$, $T_{amb} = 25^\circ\text{C}$.
- The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS} .

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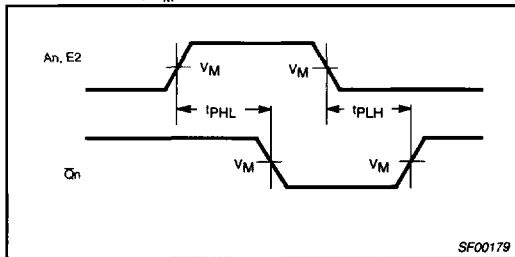
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AC ELECTRICAL CHARACTERISTICS

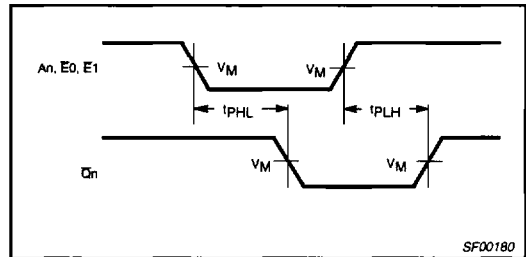
SYMBOL	PARAMETER	TEST CONDITION	LIMITS		UNIT
			$T_{amb} = 0^{\circ}\text{C to } +70^{\circ}\text{C}$ $V_{CC} = +5.0\text{V} \pm 10\%$ $C_L = 50\text{pF}, R_L = 500\Omega$		
			MIN	MAX	
t_{PLH} t_{PHL}	Propagation delay An to Qn	Waveform 1, 2	3.0 3.0	22.0 18.0	ns
t_{PLH} t_{PHL}	Propagation delay E1, E2 to Qn	Waveform 2	3.0 3.0	17.0 17.0	ns
t_{PLH} t_{PHL}	Propagation delay E2 to Qn	Waveform 1	3.0 3.0	17.0 17.0	ns

AC WAVEFORMS

For all waveforms, $V_M = 1.3\text{V}$.



Waveform 1. Propagation Delay for Inverting Outputs



Waveform 2. Propagation Delay for Non-inverting Outputs

TEST CIRCUIT AND WAVEFORMS

Test Circuit for Totem-pole Outputs

Input Pulse Definition

DEFINITIONS:

- R_L = Load resistor; see AC electrical characteristics for value.
- C_L = Load capacitance includes jig and probe capacitance; see AC electrical characteristics for value.
- R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

Family	INPUT PULSE REQUIREMENTS					
	Amplitude	V_M	Rep.Rate	t_w	t_{TLH}	t_{THL}
74ALS	3.5V	1.3V	1MHz	500ns	2.0ns	2.0ns

SC00005