

3-to-8 Line Decoder

The TC74HC138A is a high speed CMOS 3-TO-8 LINE DECODER fabricated with silicon gate C²MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

When the device is enabled, 3 Binary Select inputs (A, B, and C) determine which one of the outputs (Y₀-Y₇) will go low.

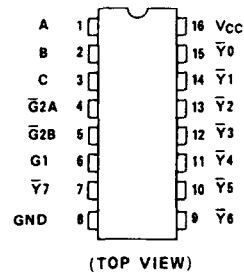
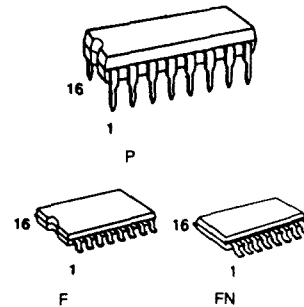
When enable input G1 is held low or either $\overline{G2A}$ or $\overline{G2B}$ is held high, decoding function is inhibited and all outputs go high.

$\overline{G1}$, $\overline{G2A}$, and $\overline{G2B}$ inputs are provided to ease cascade connection and for use as an address decoder for memory systems.

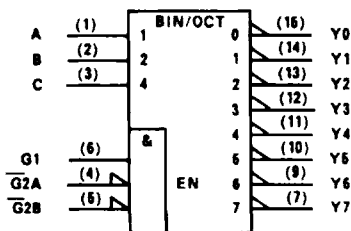
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

Features

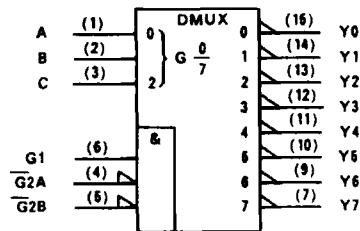
- High Speed: $t_{pd} = 16\text{ns(Typ.)}$ at $V_{CC} = 5\text{V}$
- Low Power Dissipation: $I_{CC} = 4\mu\text{A(Max.)}$ at $T_a = 25^\circ\text{C}$
- High Noise Immunity: $V_{NIH} = V_{NIL} = 28\%V_{CC}(\text{Min.})$
- Output Drive Capability: 10 LSTTL Loads
- Symmetrical Output Impedance: $I_{OH} = I_{OL} = 4\text{mA}(\text{Min.})$
- Balanced Propagation Delays: $t_{PLH} = t_{PHL}$
- Wide Operating Voltage Range: $V_{CC(\text{opr})} = 2\text{V} \sim 6\text{V}$
- Pin and Function Compatible with 74LS138



Pin Assignment



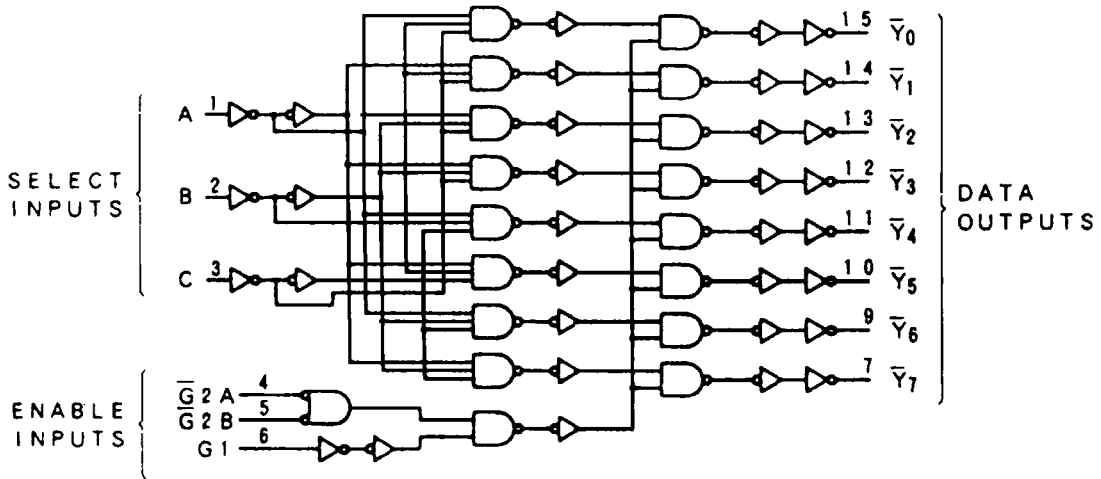
IEC Logic Symbol



Truth Table

Inputs						Outputs							Selected Output	
Enable			Select			Y ₀	Y ₁	Y ₂	Y ₃	Y ₄	Y ₅	Y ₆		Y ₇
G1	G2A	G2B	C	B	A									
L	X	X	X	X	X	H	H	H	H	H	H	H	H	NONE
X	H	X	X	X	X	H	H	H	H	H	H	H	H	NONE
X	X	X	X	X	X	H	H	H	H	H	H	H	H	NONE
H	L	L	L	L	L	L	H	H	H	H	H	H	H	Y ₀
H	L	L	L	L	H	H	L	H	H	H	H	H	H	Y ₁
H	L	L	L	H	L	H	H	L	H	H	H	H	H	Y ₂
H	L	L	L	H	H	H	H	H	L	H	H	H	H	Y ₃
H	L	L	H	L	L	H	H	H	H	L	H	H	H	Y ₄
H	L	L	H	L	H	H	H	H	H	H	L	H	H	Y ₅
H	L	L	H	H	L	H	H	H	H	H	H	L	H	Y ₆
H	L	L	H	H	H	H	H	H	H	H	H	H	L	Y ₇

X: Don't Care



Logic Diagram

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply Voltage Range	V_{CC}	-0.5 ~ 7	V
DC Input Voltage	V_{IN}	-0.5 - V_{CC} + 0.5	V
DC Output Voltage	V_{OUT}	-0.5 - V_{CC} + 0.5	V
Input Diode Current	I_{IK}	±20	mA
Output Diode Current	I_{OK}	±20	mA
DC Output Current	I_{OUT}	±25	mA
DC V_{CC} /Ground Current	I_{CC}	±50	mA
Power Dissipation	P_D	500(DIP)*180(MFP)	mW
Storage Temperature	T_{stg}	-65 ~ 150	°C
Lead Temperature 10sec	T_L	300	°C

*500mW in the range of $T_a = -40^{\circ}\text{C} \sim 65^{\circ}\text{C}$. From $T_a = 65^{\circ}\text{C}$ to 85°C a derating factor of -10mW/°C shall be applied until 300mW.

Recommended Operating Conditions

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	2 ~ 6	V
Input Voltage	V_{IN}	0 - V_{CC}	V
Output Voltage	V_{OUT}	0 - V_{CC}	V
Operating Temperature	T_{opr}	-40 ~ 85	°C
Input Rise and Fall Time	t_r, t_f	0 - 1000($V_{CC} = 2.0\text{V}$) 0 - 500($V_{CC} = 4.5\text{V}$) 0 - 400($V_{CC} = 6.0\text{V}$)	ns

DC Electrical Characteristics

Parameter	Symbol	Test Condition	$T_a = 25^{\circ}\text{C}$				$T_a = -40 \sim 85^{\circ}\text{C}$		Unit	
			V_{CC}	Min	Typ.	Max.	Min.	Max.		
High-Level Input Voltage	V_{IH}	-	2.0	1.5	-	-	1.5	-	V	
			4.5	3.15	-	-	3.15	-		
			6.0	4.2	-	-	4.2	-		
Low-Level Input Voltage	V_{IL}	-	2.0	-	-	0.5	-	0.5	V	
			4.5	-	-	1.35	-	1.35		
			6.0	-	-	1.8	-	1.8		
High-Level Output Voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -20\mu\text{A}$	2.0	1.9	2.0	-	1.9	-	V
				4.5	4.4	4.5	-	4.4	-	
			$I_{OH} = -4\text{mA}$ $I_{OH} = -5.2\text{mA}$	4.5	4.18	4.31	-	4.13	-	
				6.0	5.68	5.80	-	5.63	-	
Low-Level Output Voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 20\mu\text{A}$	2.0	-	0.0	0.1	-	0.1	V
				4.5	-	0.0	0.1	-	0.1	
			$I_{OL} = 4\text{mA}$ $I_{OL} = 5.2\text{mA}$	4.5	-	0.17	0.26	-	0.33	
				6.0	-	0.18	0.26	-	0.33	
Input Leakage Current	I_{IN}	$V_{IN} = V_{CC}$ or GND	6.0	-	-	±0.1	-	±1.0	μA	
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND	6.0	-	-	4.0	-	40.0		

AC Electrical Characteristics ($C_L = 15\text{pF}$, $V_{CC} = 5\text{V}$, $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Output Transition Time	t_{TLH} t_{THL}	–	–	4	8	ns
Propagation Delay Time (A, B, C - \bar{Y})	t_{PLH} t_{PHL}	–	–	16	26	
Propagation Delay Time (G, \bar{G} - \bar{Y})	t_{PLH} t_{PHL}	–	–	15	25	

AC Electrical Characteristics ($C_L = 50\text{pF}$, Input $t_r = t_f = 6\text{ns}$)

Parameter	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40 \sim 85^\circ\text{C}$		Unit	
			V_{CC}	Min	Typ.	Max.	Min.		Max.
Output Transition Time	t_{TLH} t_{THL}	–	2.0	–	30	75	–	95	ns
			4.5	–	8	15	–	19	
			6.0	–	7	13	–	16	
Propagation Delay Time (A, B, C - \bar{Y})	t_{PLH} t_{PHL}	–	2.0	–	70	150	–	190	
			4.5	–	19	30	–	38	
			6.0	–	16	26	–	32	
Propagation Delay Time (G, \bar{G} - \bar{Y})	t_{PLH} t_{PHL}	–	2.0	–	65	145	–	180	
			4.5	–	18	29	–	36	
			6.0	–	15	25	–	31	
Input Capacitance	C_{IN}	–	–	5	10	–	10	pF	
Power Dissipation Capacitance	$C_{PD}(1)$	–	–	47	–	–	–		

Note (1) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation:

$$I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$