

1. General Description

The 74HC238;74HCT238 decodes three binary weighted address inputs (A0, A1 and A2) to eight mutually exclusive outputs (Y0 to Y7). The device features three enable inputs ($\overline{E}1$ and $\overline{E}2$ and E3). Every output will be LOW unless $\overline{E}1$ and $\overline{E}2$ are LOW and E3 is HIGH. This multiple enable function allows easy parallel expansion to a 1-of-32 (5 to 32 lines) decoder with just four 74HC238;74HCT238 ICs and one inverter. The 74HC238;74HCT238 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. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

2. Features and Benefits

■ Input levels:

For 74HC238: CMOS level

For 74HCT238: TTL level

■ Demultiplexing capability

■ Multiple input enable for easy expansion

■ Ideal for memory chip select decoding

■ Active HIGH mutually exclusive outputs

■ Specified from -40°C to +125°C

■ Packaging information: SOP16/TSSOP16

3. Ordering Information

Table 1. Ordering information

Type number	Package		
	Name	Description	Quantity
74HC238D	SOP-16	plastic small outline package; 16 leads; body width 3.9 mm	2500
74HCT238D			
74HC238PW	TSSOP-16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	2500
74HCT238PW			

4. Function Diagram

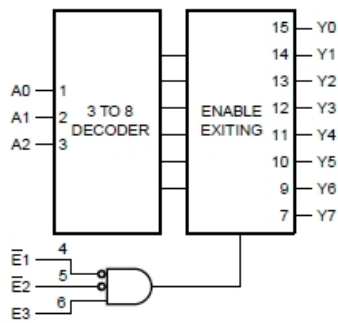


Fig. 1. Functional diagram

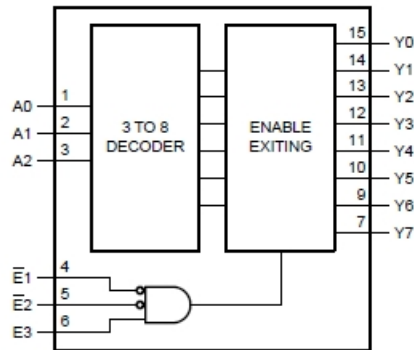


Fig. 2. Functional diagram

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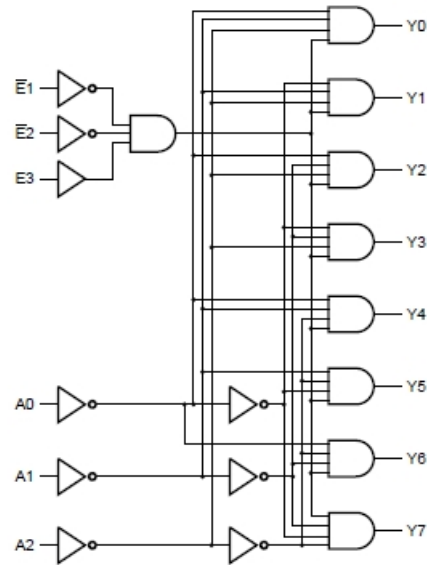
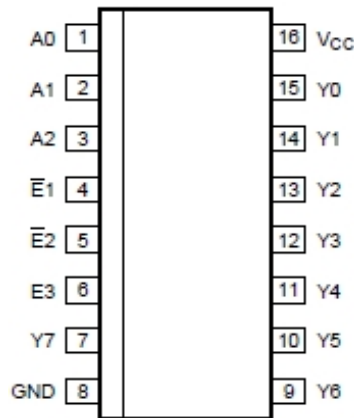


Fig. 3. Logic diagram

5. Pinning Information

5.1. Pinning



Top view pin configuration SOP and TSSOP

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
A0	1	address input
A1	2	address input
A2	3	address input
$\bar{E}1$	4	enable input (active LOW)
$\bar{E}2$	5	enable input (active LOW)
E3	6	enable input (active HIGH)
Y7	7	output (active HIGH)
GND	8	ground (0V)
Y6	9	output (active HIGH)
Y5	10	output (active HIGH)
Y4	11	output (active HIGH)
Y3	12	output (active HIGH)
Y2	13	output (active HIGH)
Y1	14	output (active HIGH)
Y0	15	output (active HIGH)
V _{CC}	16	supply voltage

6. Functional Description

Table 3. Function table

Input						Output							
$\bar{E}1$	$\bar{E}2$	E3	A0	A1	A2	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
H	X	X	X	X	X	L	L	L	L	L	L	L	L
X	H	X	X	X	X	L	L	L	L	L	L	L	L
X	X	L	X	X	X	L	L	L	L	L	L	L	L
L	L	H	L	L	L	H	L	L	L	L	L	L	L
L	L	H	H	L	L	L	H	L	L	L	L	L	L
L	L	H	L	H	L	L	L	H	L	L	L	L	L
L	L	H	H	H	L	L	L	L	H	L	L	L	L
L	L	H	L	L	H	L	L	L	L	H	L	L	L
L	L	H	H	L	H	L	L	L	L	L	H	L	L
L	L	H	L	H	H	L	L	L	L	L	L	H	L
L	L	H	H	H	H	L	L	L	L	L	L	L	H

H = HIGH voltage level; L = LOW voltage level; $\uparrow$ = LOW-to-HIGH transition

7. Absolute Maximum Ratings

(Voltages are referenced to GND (ground = 0 V), unless otherwise specified.)

Table 4. Absolute Maximum Ratings

Symbol	Parameter	Conditions	Min.	Max.	Unit
V_{CC}	supply voltage	-	-0.5	+7.0	V
I_{IK}	input clamping current	$V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$		± 20	mA
I_{OK}	output clamping current	$V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$		± 20	mA
I_O	output current	$-0.5V < V_O < V_{CC} + 0.5V$		± 25	mA
I_{CC}	supply current	-		+50	mA
I_{GND}	ground current	-	-50	-	mA
T_{stg}	storage temperature	-	-65	+150	°C
P_{tot}	total power dissipation	-	-	500	mW
T_L	Soldering temperature	10s	260		°C

8. Recommended Operating Conditions

Table 5. Recommended Operating Conditions

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
74HC238						
V_{CC}	supply voltage	-	2.0	5.0	6.0	V
V_I	input voltage	-	0	-	V_{CC}	V
V_O	output voltage	-	0	-	V_{CC}	V
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC}=2.0V$	-	-	625	ns/V
		$V_{CC}=4.5V$	-	1.67	139	ns/V
		$V_{CC}=6.0V$	-	-	83	ns/V
T_{amb}	ambient temperature	-	-40	-	+125	°C
74HCT238						
V_{CC}	supply voltage	-	4.5	5.0	5.5	V
V_I	input voltage	-	0	-	V_{CC}	V
V_O	output voltage	-	0	-	V_{CC}	V
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC}=4.5V$	-	1.67	139	ns/V
T_{amb}	ambient temperature	-	-40	-	+125	°C

9. Electrical Characteristics

Table 6. DC Characteristics 1

$T_{amb} = 25^{\circ}C$, voltages are referenced to GND (ground=0V), unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
74HC238						
V_{IH}	HIGH-level input voltage	$V_{CC} = 2.0V$	1.5	1.2	-	V
		$V_{CC} = 4.5V$	3.15	2.4	-	V
		$V_{CC} = 6.0V$	4.2	3.2	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 2.0V$	-	0.8	0.5	V
		$V_{CC} = 4.5V$	-	2.1	1.35	V
		$V_{CC} = 6.0V$	-	2.8	1.8	V

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V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}	I _O =-20uA; V _{CC} =2.0V	1.9	2.0	-	V
			I _O =-20uA; V _{CC} =4.5V	4.4	4.5	-	V
			I _O =-20uA; V _{CC} =6.0V	5.9	6.0	-	V
			I _O =-4.0mA; V _{CC} =4.5V	3.98	4.32	-	V
			I _O =-5.2mA; V _{CC} =6.0V	5.48	5.81	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}	I _O =20uA; V _{CC} =2.0V	-	0	0.1	V
			I _O =20uA; V _{CC} =4.5V	-	0	0.1	V
			I _O =20uA; V _{CC} =6.0V	-	0	0.1	V
			I _O =4.0mA; V _{CC} =4.5V	-	0.15	0.26	V
			I _O =5.2mA; V _{CC} =6.0V	-	0.16	0.26	V
I _I	input leakage current	V _I = V _{CC} or GND ; V _{CC} = 6.0 V		-	-	±1.0	uA
I _{CC}	supply current	V _I =V _{CC} or GND; I _O =0A; V _{CC} =6.0V		-	-	8.0	uA
C _I	input capacitance	-		-	3.5	-	pF
74HCT238							
V _{IH}	HIGH-level input voltage	V _{CC} =4.5V to 5.5V		2.0	1.6	-	V
V _{IL}	LOW-level input voltage	V _{CC} =4.5V to 5.5V		-	1.2	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} =4.5V	I _O =-20uA	4.4	4.5	-	V
			I _O =-4.0mA	3.98	4.32	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} =4.5V	I _O =20uA	-	0	0.1	V
			I _O =4.0mA	-	0.16	0.26	V
I _I	input leakage current	V _I =V _{CC} or GND; V _{CC} =5.5V		-	-	±1.0	uA
I _{CC}	supply current	V _I =V _{CC} or GND; I _O =0A; V _{CC} =5.5V		-	-	8.0	uA
ΔI _{CC}	additional supply current	V _I =V _{CC} -2.1V; other inputs at V _{CC} or GN D; I _O =0A; V _{CC} =4.5V to 5.5V	An inputs	-	-	252	uA
			$\overline{E}1, \overline{E}2$ inputs	-	-	144	uA
			E3 input	-	-	522	uA
C _I	input capacitance	-		-	3.5	-	pF

Table 7. DC Characteristics 2

$T_{amb} = -40^\circ C \text{ to } +85^\circ C$, voltages are referenced to GND (ground=0V), unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
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74HC238							
V _{IH}	HIGH-level input voltage	V _{CC} =2.0V		1.5	-	-	V
		V _{CC} =4.5V		3.15	-	-	V
		V _{CC} =6.0V		4.2	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} =2.0V		-	-	0.5	V
		V _{CC} =4.5V		-	-	1.35	V
		V _{CC} =6.0V		-	-	1.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}	I _O =-20uA; V _{CC} =2.0V	1.9	-	-	V
			I _O =-20uA; V _{CC} =4.5V	4.4	-	-	V
			I _O =-20uA; V _{CC} =6.0V	5.9	-	-	V
			I _O =-4.0mA; V _{CC} =4.5V	3.84	-	-	V
			I _O =-5.2mA; V _{CC} =6.0V	5.34	-	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}	I _O =20uA; V _{CC} =2.0V	-	-	0.1	V
			I _O =20uA; V _{CC} =4.5V	-	-	0.1	V
			I _O =20uA; V _{CC} =6.0V	-	-	0.1	V
			I _O =4.0mA; V _{CC} =4.5V	-	-	0.33	V
			I _O =5.2mA; V _{CC} =6.0V	-	-	0.33	V
I _I	input leakage current	V _I =V _{CC} or GND; V _{CC} =6.0V		-	-	±1.0	uA
I _{CC}	supply current	V _I =V _{CC} or GND; I _O =0A; V _{CC} =6.0V		-	-	80	uA
74HCT238							
V _{IH}	HIGH-level input voltage	V _{CC} =4.5V to 5.5V		2.0	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} =4.5V to 5.5V		-	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} =4.5V	I _O =-20uA	4.4	-	-	V
			I _O =-4.0mA	3.84	-	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} =4.5V	I _O =20uA	-	-	0.1	V
			I _O =4.0mA	-	-	0.33	V
I _I	input leakage current	V _I =V _{CC} or GND; V _{CC} =5.5V		-	-	±1.0	uA
I _{CC}	supply current	V _I =V _{CC} or GND; I _O =0A; V _{CC} =5.5V		-	-	80	uA
ΔI _{CC}	additional supply current	V _I =V _{CC} -2.1V; other inputs at V _{CC} or GND; I _O =0A; V _{CC} =4.5V to 5.5V	An inputs	-	-	315	uA
			$\overline{\text{E}}1, \overline{\text{E}}2$ inputs	-	-	180	uA
			E3 input	-	-	653	uA

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Table 8. DC Characteristics 3

Tamb=-40°C to +125°C, voltages are referenced to GND (ground=0V), unless otherwise specified.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
74HC238							
V _{IH}	HIGH-level input voltage	V _{CC} =2.0V		1.5	-	-	V
		V _{CC} =4.5V		3.15	-	-	V
		V _{CC} =6.0V		4.2	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} =2.0V		-	-	0.5	V
		V _{CC} =4.5V		-	-	1.35	V
		V _{CC} =6.0V		-	-	1.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}	I _O =-20uA; V _{CC} =2.0V	1.9	-	-	V
			I _O =-20uA; V _{CC} =4.5V	4.4	-	-	V
			I _O =-20uA; V _{CC} =6.0V	5.9	-	-	V
			I _O =-4.0mA; V _{CC} =4.5V	3.7	-	-	V
			I _O =-5.2mA; V _{CC} =6.0V	5.2	-	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}	I _O =20uA; V _{CC} =2.0V	-	-	0.1	V
			I _O =20uA; V _{CC} =4.5V	-	-	0.1	V
			I _O =20uA; V _{CC} =6.0V	-	-	0.1	V
			I _O =4.0mA; V _{CC} =4.5V	-	-	0.4	V
			I _O =5.2mA; V _{CC} =6.0V	-	-	0.4	V
I _I	input leakage current	V _I =V _{CC} or GND; V _{CC} =6.0V		-	-	±1.0	uA
I _{CC}	supply current	V _I =V _{CC} or GND; I _O =0A; V _{CC} =6.0V		-	-	160	uA
74HCT238							
V _{IH}	HIGH-level input voltage	V _{CC} =4.5V to 5.5V		2.0	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} =4.5V to 5.5V		-	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} =4.5V	I _O =-20uA	4.4	-	-	V
			I _O =-4.0mA	3.7	-	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} =4.5V	I _O =20uA	-	-	0.1	V
			I _O =4.0mA	-	-	0.4	V
I _I	input leakage current	V _I =V _{CC} or GND; V _{CC} =5.5V		-	-	±1.0	uA

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I _{CC}	supply current	V _I =V _{CC} or GND; I _O =0A; V _{CC} =5.5V		-	-	160	uA
ΔI _{CC}	additional supply current	V _I =V _{CC} -2.1V; other inputs at V _{CC} or GND; I _O =0A; V _{CC} =4.5V to 5.5V	An inputs	-	-	343	uA
			$\overline{E}1, \overline{E}2$ inputs	-	-	196	uA
			E3 input	-	-	711	uA

Table 9. AC Characteristics 1

$T_{amb}=25^{\circ}C$, voltages are referenced to GND (ground=0V), unless otherwise specified.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
74HC238							
t _{pd}	propagation delay	An to Yn; see Figure 5	V _{CC} =2.0V	-	47	150	ns
			V _{CC} =4.5V	-	17	30	ns
			V _{CC} =5.0V; C _L =15pF	-	14	-	ns
			V _{CC} =6.0V	-	14	26	ns
		E3 to Yn; see Figure 5	V _{CC} =2.0V	-	52	160	ns
			V _{CC} =4.5V	-	19	32	ns
			V _{CC} =5.0V; C _L =15pF	-	16	-	ns
			V _{CC} =6.0V	-	15	27	ns
		$\overline{E}n$ to Yn; see Figure 6	V _{CC} =2.0V	-	50	155	ns
			V _{CC} =4.5V	-	18	31	ns
			V _{CC} =5.0V; C _L =15pF	-	17	-	ns
			V _{CC} =6.0V	-	14	26	ns
t _t	transition time	see Figure 5, 6	V _{CC} =2.0V	-	19	75	ns
			V _{CC} =4.5V	-	7	15	ns
			V _{CC} =6.0V	-	6	13	ns
C _{PD}	Power dissipation capacitance	per package; V _I =GND to V _{CC}		-	72	-	pF
74HCT238							
t _{pd}	propagation delay	An to Yn; see Figure 5	V _{CC} =4.5V	-	19	35	ns
			V _{CC} =5.0V; C _L =15pF	-	18	-	ns
		E3 to Yn; see Figure 5	V _{CC} =4.5V	-	20	37	ns
			V _{CC} =5.0V; C _L =15pF	-	20	-	ns
		$\overline{E}n$ to Yn; see Figure 6	V _{CC} =4.5V	-	20	35	ns
			V _{CC} =5.0V; C _L =15pF	-	21	-	ns

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t_t	transition time	$V_{CC}=4.5V$; see Figure 5, 6	-	7	15	ns
C_{PD}	power dissipation capacitance	per package; $V_I=GND$ to $V_{CC}-1.5V$	-	76	-	pF

- [1] t_{pd} is the same as t_{PLH} and t_{PHL} ; t_t is the same as t_{THL} and t_{TLH} .
 [2] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
 f_i = input frequency in MHz;
 f_o = output frequency in MHz;
 C_L = output load capacitance in pF;
 V_{CC} = supply voltage in V;
 N = number of inputs switching;
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

Table 10. AC Characteristics 2

$T_{amb}=-40^\circ C$ to $+85^\circ C$, voltages are referenced to GND (ground=0V), unless otherwise specified.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
74HC238							
t _{pd}	propagation delay	An to Yn; see Figure 5	V _{CC} =2.0V	-	-	190	ns
			V _{CC} =4.5V	-	-	38	ns
			V _{CC} =6.0V	-	-	33	ns
		E3 to Yn; see Figure 5	V _{CC} =2.0V	-	-	200	ns
			V _{CC} =4.5V	-	-	40	ns
			V _{CC} =6.0V	-	-	34	ns
		$\overline{E}n$ to Yn; see Figure 6	V _{CC} =2.0V	-	-	195	ns
			V _{CC} =4.5V	-	-	39	ns
			V _{CC} =6.0V	-	-	33	ns
t _t	transition time	see Figure 5, 6	V _{CC} =2.0V	-	-	95	ns
			V _{CC} =4.5V	-	-	19	ns
			V _{CC} =6.0V	-	-	16	ns
74HCT238							
t _{pd}	propagation delay	An to Yn; see Figure 5	V _{CC} =4.5V	-	-	44	ns
		E3 to Yn; see Figure 5	V _{CC} =4.5V	-	-	46	ns
		$\overline{E}n$ to Yn; see Figure 6	V _{CC} =4.5V	-	-	44	ns
t _t	transition time	V _{CC} =4.5V; see Figure 5, 6		-	-	19	ns

- [1] t_{pd} is the same as t_{PLH} and t_{PHL} ; t_t is the same as t_{THL} and t_{TLH} .

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Table 11. AC Characteristics 3

Tamb=-40°C to +125°C, voltages are referenced to GND (ground=0V), unless otherwise specified.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
74HC238							
t _{pd}	propagation delay	An to Yn; see Figure 5	V _{CC} =2.0V	-	-	225	ns
			V _{CC} =4.5V	-	-	45	ns
			V _{CC} =6.0V	-	-	38	ns
		E3 to Yn; see Figure 5	V _{CC} =2.0V	-	-	240	ns
			V _{CC} =4.5V	-	-	48	ns
			V _{CC} =6.0V	-	-	41	ns
		$\overline{E_n}$ to Yn; see Figure 6	V _{CC} =2.0V	-	-	235	ns
			V _{CC} =4.5V	-	-	47	ns
			V _{CC} =6.0V	-	-	40	ns
t _t	transition time	see Figure 5, 6	V _{CC} =2.0V	-	-	110	ns
			V _{CC} =4.5V	-	-	22	ns
			V _{CC} =6.0V	-	-	19	ns
74HCT238							
t _{pd}	propagation delay	An to Yn; see Figure 5	V _{CC} =4.5V	-	-	53	ns
		E3 to Yn; see Figure 5	V _{CC} =4.5V	-	-	56	ns
		$\overline{E_n}$ to Yn; see Figure 6	V _{CC} =4.5V	-	-	53	ns
t _t	transition time	V _{CC} =4.5V; see Figure 5, 6		-	-	22	ns

[1] t_{pd} is the same as t_{PLH} and t_{PHL} ; t_t is the same as t_{THL} and t_{TLH} .

9.1. Waveforms and test circuit

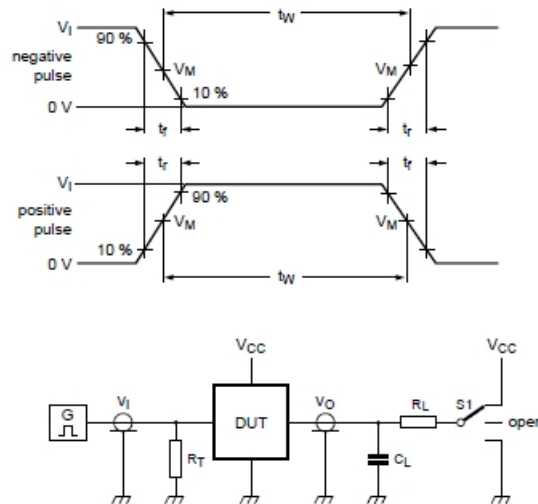


Fig. 4. Test circuit for measuring switching times

Definitions for test circuit:

R_L =Load resistance.

C_L =Load capacitance including jig and probe capacitance.

R_T =Termination resistance should be equal to the output impedance Z_o of the pulse generator.

$S1$ =Test selection switch.

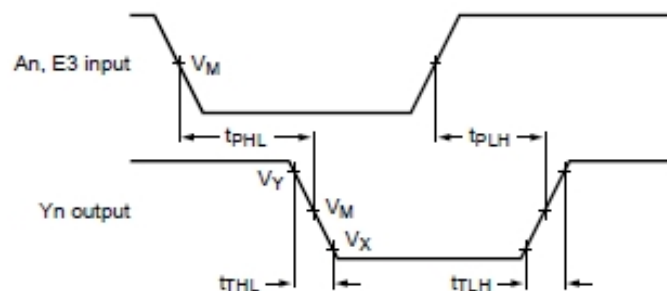


Fig. 5. Input (An, E3) to output (Yn) propagation delays and output transition times

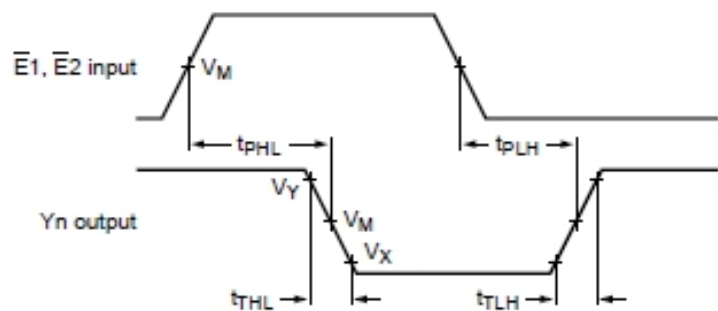


Fig. 6. Input ($\overline{E}1, \overline{E}2$) to output (Y_n) propagation delays and output transition times

Table 12. Measurement points

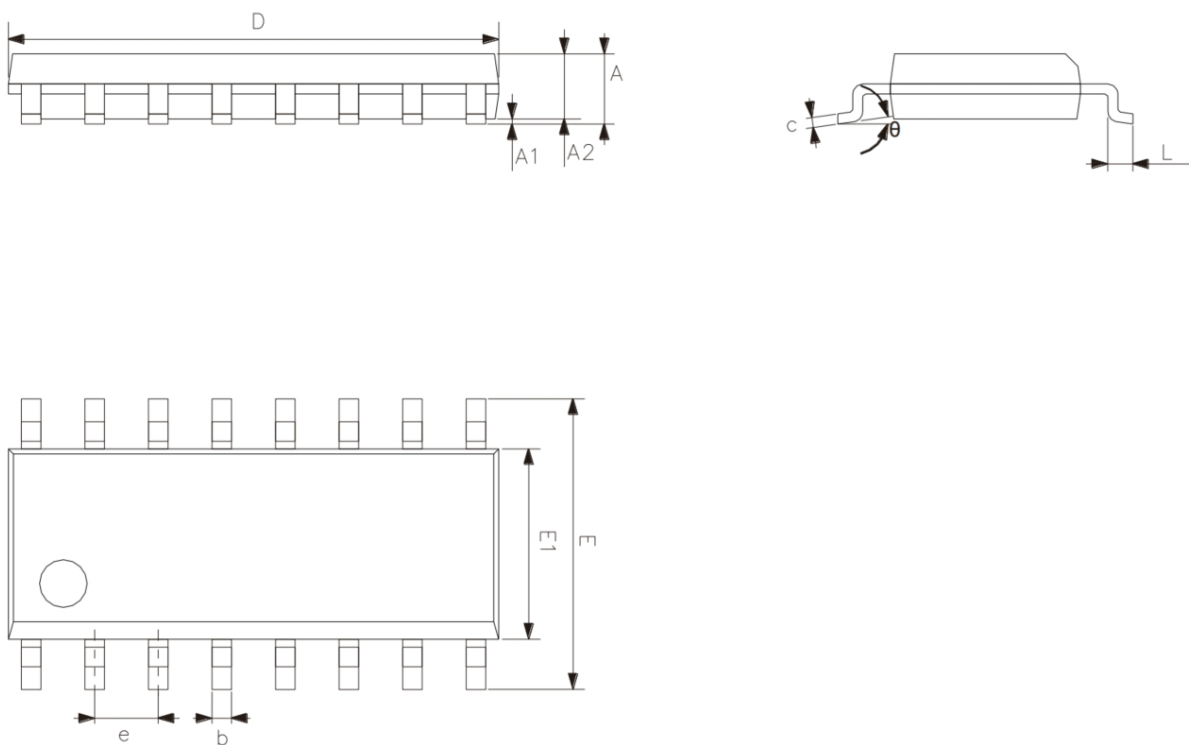
Type	Input	Output	Output	Output
	V_M	V_M	V_X	V_Y
74HC238	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$0.1 \times V_{CC}$	$0.9 \times V_{CC}$
74HCT238	1.3V	1.3V	$0.1 \times V_{CC}$	$0.9 \times V_{CC}$

Table 13. Test data

Type	Input	Input	Load	Load	S1 position
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}
74HC238	V_{CC}	6ns	15pF, 50pF	1k Ω	open
74HCT238	3V	6ns	15pF, 50pF	1k Ω	open

10. Package Outline

SOP-16



Symbol	Dimensions In Millimeters	
	Min.	Max.
A	1.35	1.80
A1	0.10	0.25
A2	1.25	1.55
b	0.33	0.51
c	0.19	0.25
D	9.50	10.10
E	5.80	6.30
E1	3.70	4.10
e	1.27	
L	0.35	0.89
θ	0°	8°

74HC238;74HCT238

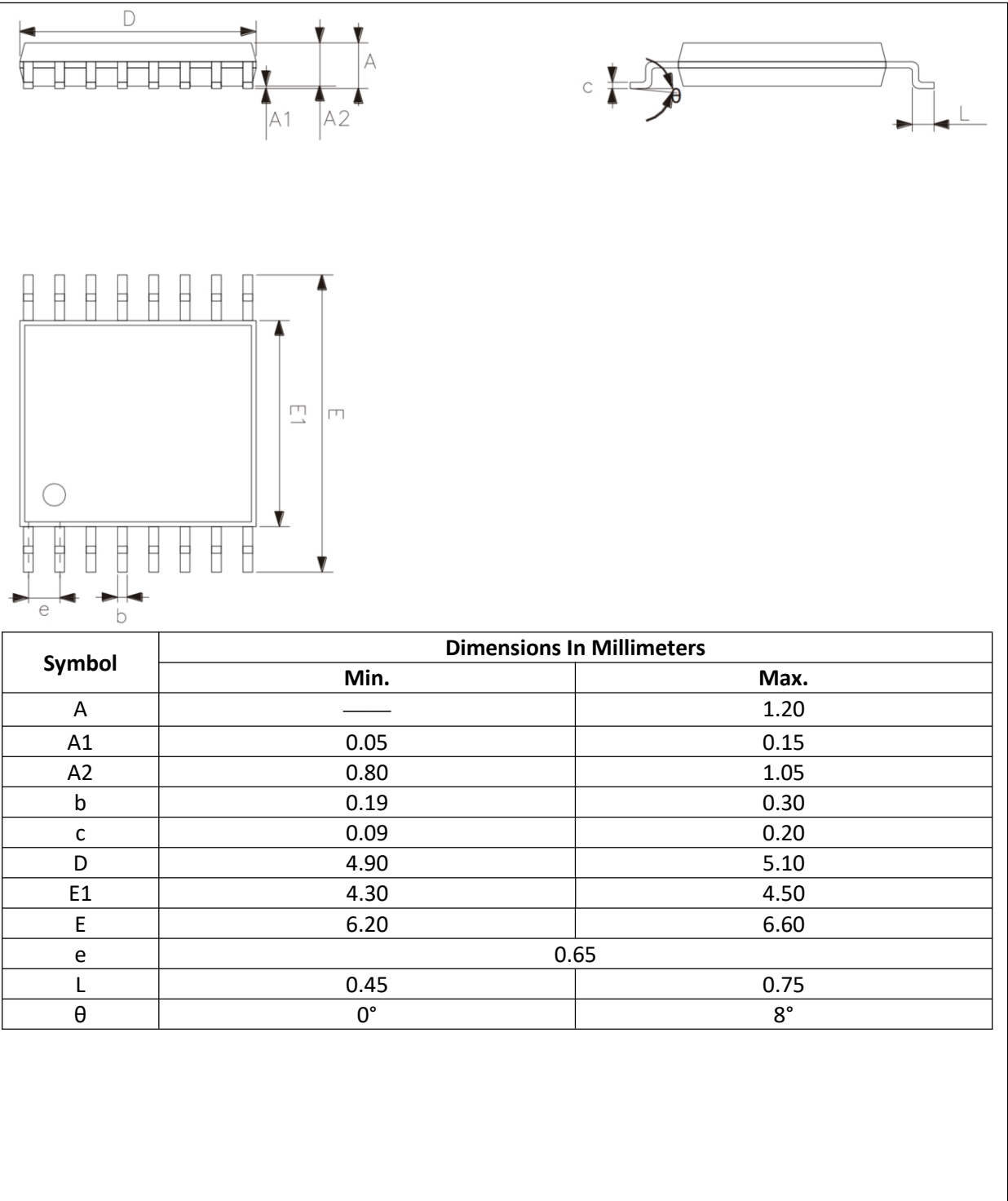


3-to-8 Line Decoder/Demultiplexer

Product datasheet, Rev. 1.0

Aug 08, 2024

TSSOP-16



11. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
CDM	Charged Device Model
TTL	Transistor-Transistor Logic

12. Revision History

Document ID	Release Date	Data sheet status	Change notice	Supersedes
74HC_HCT238 Rev. 1.0	Aug 08, 2024	Product datasheet		