3-to-8 Decoder/Demultiplexer

General Description

ET74HC138 is a high speed CMOS decoder circuit, it accepts a three bit binary weighed address on input pins A0, A1, A2 and when enabled will produce one active low output and other seven output high level.

In addition, the circuit has two low-level enable pins $\overline{E1}$ and $\overline{E2}$ and high-level enable pin E3. When the circuit is in the non enable state, all output pins output high level; When the circuit is enabled, $\overline{E1}$ and $\overline{E2}$ are low level and E3 is high level.

The circuit uses multiple enable signals to realize the expansion of the decoder. Without using additional devices, it can be expanded into a 4 to 16 decoder, while expanding 5 to 32 decoding requires an inverter.

Features

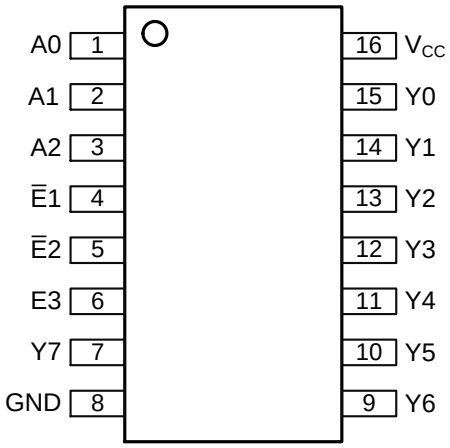
- Designed for 2 to 6V V_{CC} Operation
- Provide 8mA current with V_{CC}=4.5V
- CMOS low power design
- Schmitt trigger input port
- ESD Performance:
  - Human Body Model >2000V
  - Machine Model >200V
- These Devices are Pb. Free, Halogen Free/BFR Free and are RoHS Compliant
- Product name and package

Product Name	Package
ET74HC138M	SOP16
ET74HC138V	TSSOP16

Applications

- Memory chip select decoding
- Data transmission system

Pin Configuration

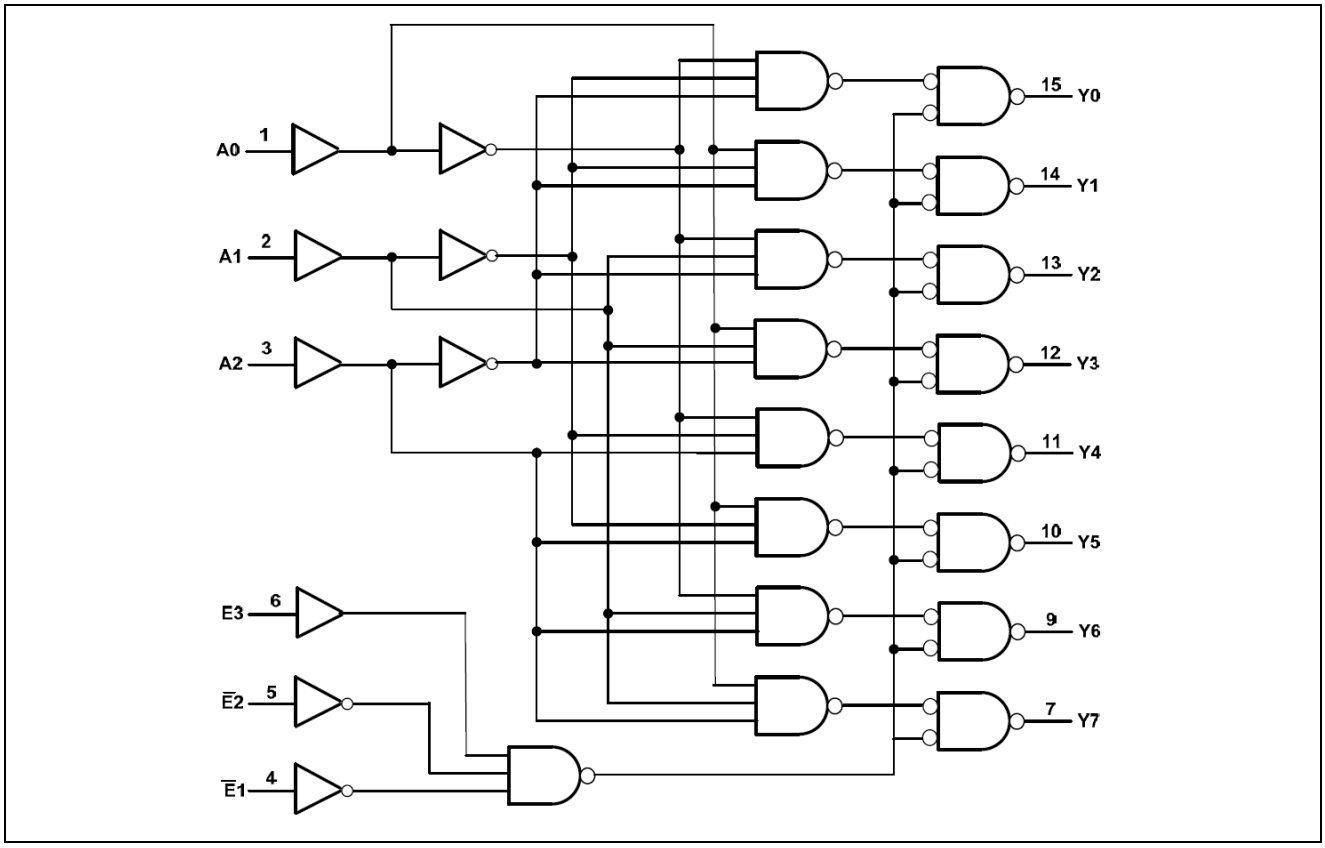


Top view

Pin Function

Pin No.	Symbol	Description
1	A0	Address input 0
2	A1	Address input1
3	A2	Address input 2
4	$\overline{E}$1	Enable input 1（Active Low）
5	$\overline{E}$2	Enable input 2（Active Low）
6	E3	Enable input 3（Active High）
7	Y7	Output 7
8	GND	GND
9	Y6	Output 6
10	Y5	Output 5
11	Y4	Output 4
12	Y3	Output 3
13	Y2	Output 2
14	Y1	Output 1
15	Y0	Output 0
16	V_{CC}	Supply Voltage

Block Diagram



Functional Description

Chip Select			Address			Output							
$\overline{E1}$	$\overline{E2}$	E3	A2	A1	A0	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0
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	H	H	H	H	H	H	H	L
L	L	H	L	L	H	H	H	H	H	H	H	L	H
L	L	H	L	H	L	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	L	H	H	H
L	L	H	H	L	L	H	H	H	L	H	H	H	H
L	L	H	H	L	H	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	L	H	H	H	H	H	H
L	L	H	H	H	H	L	H	H	H	H	H	H	H

Note: H = High voltage level;
L = Low voltage level;
X = Don't care.

Absolute Maximum Ratings

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	Supply Voltage		-0.5	7.0	V
V_I	Input Voltage		-0.5	7.0	V
V_O	Output Voltage		-0.3	V_{CC}+0.5	V
I_{IK}	Input Diode Current	V_I<-0.5V		-20	mA
		V_I>V_{CC}+0.5V		20	mA
I_{OK}	Output Diode Current	V_O<-0.5V		-20	mA
		V_O>V_{CC}+0.5V		20	mA
I_O	Output Source/Sink Current			±25	mA
I_{CC}	Supply Current Per Supply Pin			50	mA
I_{GND}	Ground Current Per Ground Pin			-50	mA
T_A	Operate Temperature Range		-40	85	°C
T_{STG}	Storage Temperature Range		-65	150	°C

Recommended operating conditions

Symbol	Parameter		Min	Max	Unit
V_{CC}			2.0	6.0	V
V_I	Input Voltage		0	V_{CC}	V
V_O	Enable state		0	V_{CC}	V
$\Delta t/\Delta_V$	Input signal swing	V_{CC}=2.0V		1000	ns/V
		V_{CC}=4.5V		500	ns/V
		V_{CC}=6.0V		400	ns/V
T_A	Operating Free-Air Temperature		-40	85	°C

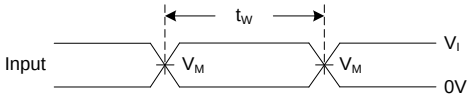
DC Electrical Characteristics

Symbol	Parameter	Test Condition	VCC (V)	TA=+25°C			T_A = -40°C to +85°C		T_A = -40°C to +125°C		Unit
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{IH}	High-Level Input Voltage	-	2.0V	1.5	1.2	-	1.5	-	1.5	-	V
		-	4.5V	3.15	2.4	-	3.15	-	3.15	-	
		-	6.0V	4.2	3.2	-	4.2	-	4.2	-	
V_{IL}	Low-Level Input Voltage	-	2.0V	-	0.8	0.5	-	0.5	-	0.5	V
		-	4.5V	-	2.1	1.0	-	1.0	-	1.0	
		-	6.0V	-	2.8	1.5	-	1.5	-	1.5	
V_{OH}	High-Level Output Voltage	I_{OH} =-20μA All outputs	2.0V	1.9	2.0	-	1.9	-	1.9	-	V
			4.5V	4.4	4.5	-	4.4	-	4.4	-	
			6.0V	5.9	6.0	-	5.9	-	5.9	-	
		I_{OH}=-4mA	4.5V	3.98	4.32	-	3.84	-	3.7	-	
		I_{OH}=-5.2mA	6.0V	5.48	5.81	-	5.34	-	5.2	-	
V_{OL}	Low-Level Output Voltage	I_{OL} = 20μA All outputs	2.0V	-	0	0.1	-	0.1	-	0.1	V
			4.5V	-	0	0.1	-	0.1	-	0.1	
			6.0V	-	0	0.1	-	0.1	-	0.1	
		I_{OL}=4mA	4.5V	-	0.15	0.26	-	0.33	-	0.4	
		I_{OL}=5.2mA	6.0V	-	0.16	0.26	-	0.33	-	0.4	
I_I	Input Current	V_I=GND or 6.0V	6.0V	-	-	±0.1	-	±1	-	±1	μA
I_{CC}	Supply Current	V_I = GND or V_{CC} I_O = 0	6.0V	-	-	8.0	-	80	-	160	μA
C_i	Input Capacitance	Vi=VCC or GND	6.0V	-	4	10	-	10	-	10	pF

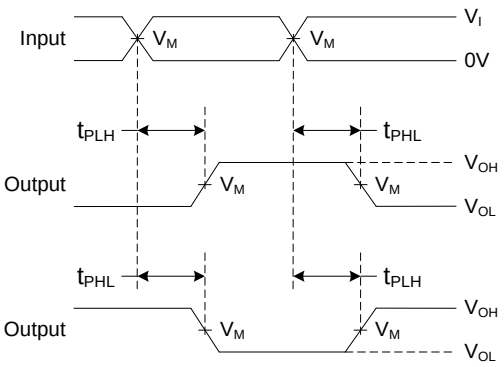
AC Characteristics

Symbol	Parameter	Test Condition	VCC (V)	TA=+25°C			T_A = -40°C to +85°C		T_A = -40°C to +125°C		Unit
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH}, t_{PLH} Propagation Delay	An to $\overline{Y}$n	Figure1	2.0V	-	41	150	-	190	-	225	ns
			4.5V	-	15	30	-	38	-	45	
			5.0V	-	12	-	-	-	-	-	
			6.0V	-	12	26	-	33	-	38	
	E3 to $\overline{Y}$n	Figure1	2.0V	-	47	150	-	190	-	225	
			4.5V	-	17	30	-	38	-	45	
			5.0V	-	14	-	-	-	-	-	
			6.0V	-	14	26	-	33	-	38	
	$\overline{E}$n to $\overline{Y}$n	Figure1	2.0V	-	47	150	-	190	-	225	
			4.5V	-	17	30	-	38	-	45	
			5.0V	-	14	-	-	-	-	-	
			6.0V	-	14	26	-	33	-	38	
t_{TLH},t_{THL} Transition Time	$\overline{Y}$n	Figure1	2.0V	-	19	75	-	95	-	110	ns
			5.0V	-	7	15	-	19	-	22	
			6.0V	-	6	13	-	16	-	19	

AC Characteristics Test Waveform



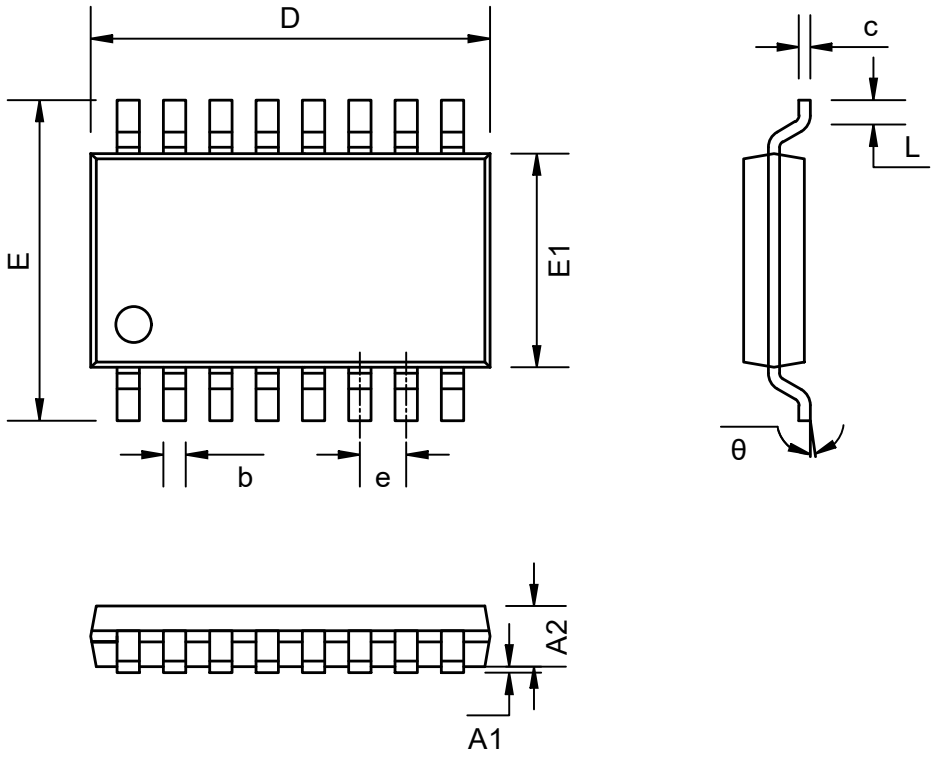
Voltage Waveform
Pulse Duration



Voltage Waveform
Propagation Delay Times
Inverting and Non Inverting Outputs

Package Dimension

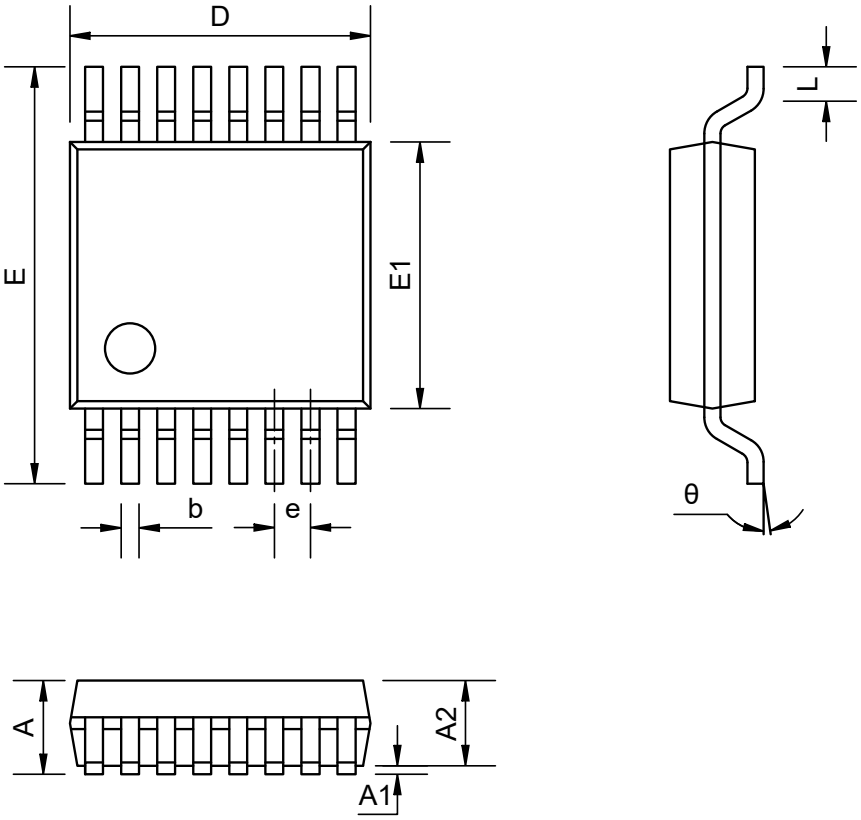
SOP16



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A1	0.10	0.20	0.30
A2	1.35	1.45	1.55
b	0.306	0.406	0.506
c	--	0.203	--
D	9.90	10.00	10.10
E	5.84	6.04	6.24
E1	3.85	3.95	4.05
e	1.27BSC		
L	0.35	0.55	0.75
θ	2°	--	8°

TSSOP16



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	--	--	1.20
A1	0.05	--	0.15
A2	0.90	--	1.05
b	0.20	--	0.28
D	4.86	4.96	5.06
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	0.60	0.75
θ	0°	--	8°

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2016-06-23	Original version	Shi Liang Jun	Shi Liang Jun	Zhu Jun Li
1.1	2021-02-13	Form version	Shi Liang Jun	Shi Liang Jun	Zhu Jun Li
1.2	2022-06-13	Typesetting version	Shi Bo	Shi Liang Jun	Zhu Jun Li