3-to-8 Decoder/Demultiplexer

General Description

74HC138 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 $\overline{E}1$ and $\overline{E}2$ 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, $\overline{E}1$ and $\overline{E}2$ 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

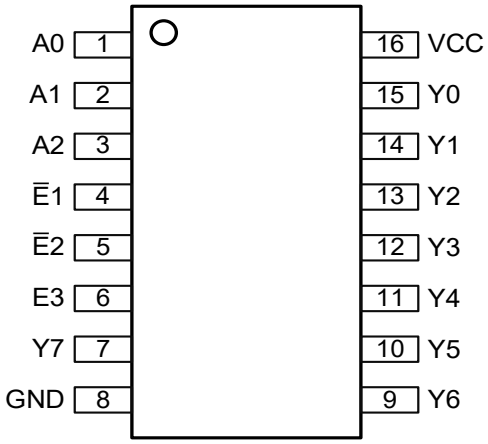
- Designed for 2V to 6V V_{CC} Operation
- Over-voltage Tolerant Inputs Accept Voltages to 6V
- ±5.2mA Balanced Output Sink and Source Capability
- CMOS Low Power Design
- Schmitt Trigger Input Port
- These Devices are Pb-Free and RoHS Compliant
- ESD Protection Complies with JESD22 Standard
  -- HBM: ±4000V Pass (JEDEC JS-001)
  -- CDM: ±2000V Pass (JEDEC JS-002)
- Latch-up Performance Exceeds ±100mA per JEDEC JESD78F
- Part No. and Package Information

Part No.	Package	MSL
74HC138M	SOP16	3
74HC138V	TSSOP16	3

Applications

- Memory Chip Select Decoding
- Data Transmission System

Pin Configuration



SOP16/TSSOP16

Figure1. Pin Configuration

Pin Function

SOP16/TSSOP16

Pin No.	Symbol	Description
1	A0	Address Input 0
2	A1	Address Input 1
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	VCC	Supply Voltage

Block Diagram

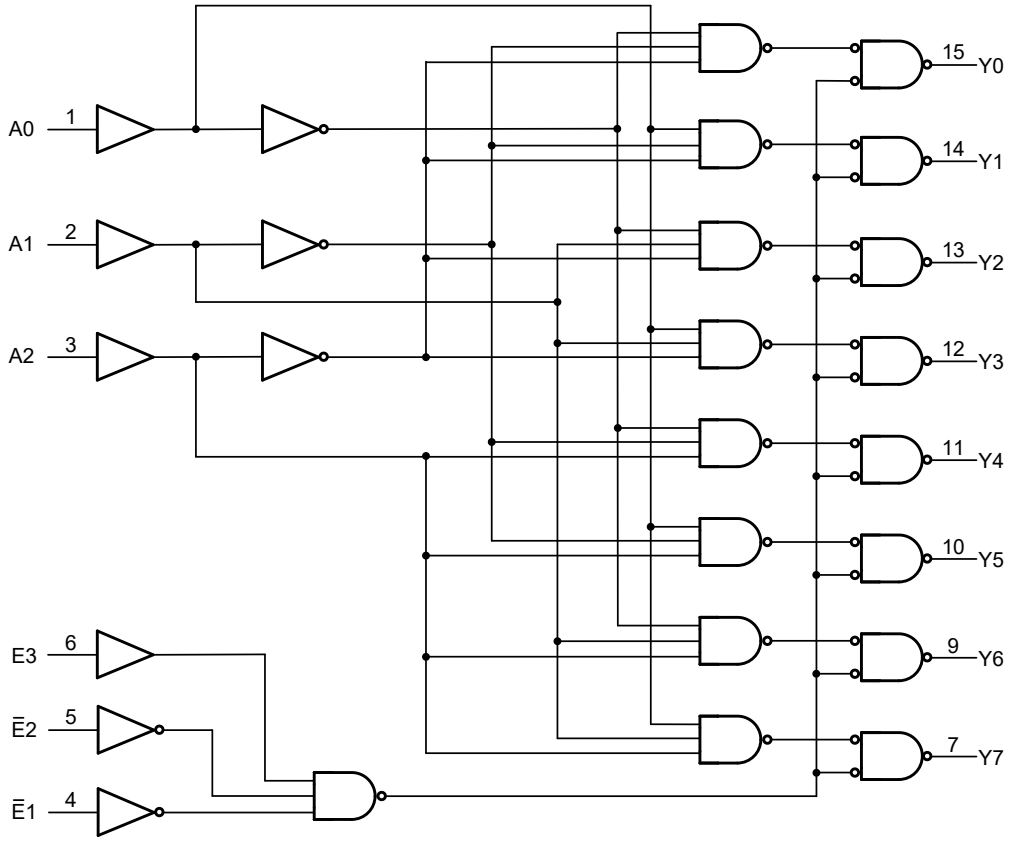


Figure2. Block Diagram

Functional Table

Chip Select			Address			Output							
$\bar{E}1$	$\bar{E}2$	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

H = High voltage level;

L = Low voltage level;

X = Don’t care.

Absolute Maximum Ratings

Symbol	Parameter		Value	Unit
V_{CC}	DC Supply Voltage (VCC Pin)		-0.5 to 6.5	V
I_{IK}	DC Input Diode Current		±20	mA
V_I	DC Input Voltage (1)		$-0.5 \le V_I \le 6.5$	V
I_{OK}	DC Output Diode Current, V_O < GND		±20	mA
V_O	DC Output Voltage Output in Higher or Low State		-0.5 to V_{CC} + 0.5	V
I_O	DC Output Sink Current, V_O = 0V to V_{CC}		±25	mA
I_{CC}	DC Supply Current per Supply Pin		50	mA
I_{GND}	DC Ground Current per Supply Pin		-500	mA
T_J	Max Junction Temperature		150	°C
T_{STG}	Storage Temperature Range		-65 to 150	°C
V_{ESD}	ESD Classification	Human Body Model (2)	±4000	V
		Charged Device Model (3)	±2000	
I_{LU}	Max Latch Up Current Above V_{CC} and GND (4)		±100	mA

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

Note1: I_O absolute maximum rating must be observed.

Note2: HBM tested per JEDEC JS-001;

Note3: CDM tested per JEDEC JS-002;

Note4: Latch Up Current Maximum Rating tested per JEDEC JESD78F.

Recommended operating conditions

Symbol	Parameter		Min	Max	Unit
V_{CC}	DC Supply Voltage Operating		2.0	6.0	V
V_I	DC Input Voltage		0	V_{CC}	V
V_O	DC Output Voltage (High or Low State)		0	V_{CC}	V
$\Delta t/\Delta_V$	Input Transition Rise and Fall Rate	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	125	°C

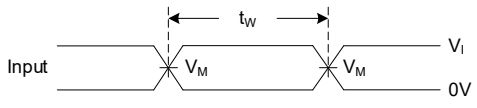
DC Electrical Characteristics

Symbol	Parameter	Condition	V_{CC} (V)	T_A = 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		2.0	1.5	1.2		1.5		1.5		V
			4.5	3.15	2.4		3.15		3.15		
			6.0	4.2	3.2		4.2		4.2		
V_{IL}	Low-Level Input Voltage		2.0		0.8	0.5		0.5		0.5	V
			4.5		2.1	1.0		1.0		1.0	
			6.0		2.8	1.5		1.5		1.5	
V_{OH}	High-Level Output Voltage	I_{OH} = -20μA All Outputs	2.0	1.9	2.0		1.9		1.9		V
			4.5	4.4	4.5		4.4		4.4		
			6.0	5.9	6.0		5.9		5.9		
		I_{OH} = -4mA	2.0	3.98	4.32		3.84		3.7		
		I_{OH} = -5.2mA	4.5	5.48	5.81		5.34		5.2		
V_{OL}	Low-Level Output Voltage	I_{OL} = 20μA All Outputs	2.0		0	0.1		0.1		0.1	V
			4.5		0	0.1		0.1		0.1	
			6.0		0	0.1		0.1		0.1	
		I_{OL} = 4mA	2.0		0.15	0.26		0.33		0.4	
		I_{OL} = 5.2mA	4.5		0.16	0.26		0.33		0.4	
I_I	Input Current	V_I = GND or 6.0V	6.0			±0.1		±1		±1	μA
I_{CC}	Supply Current	V_I = GND or V_{CC}, I_O = 0mA	6.0			8.0		80		160	μA
C_I	Input Capacitance	V_I = V_{CC} or GND	6.0		4	10		10		10	pF

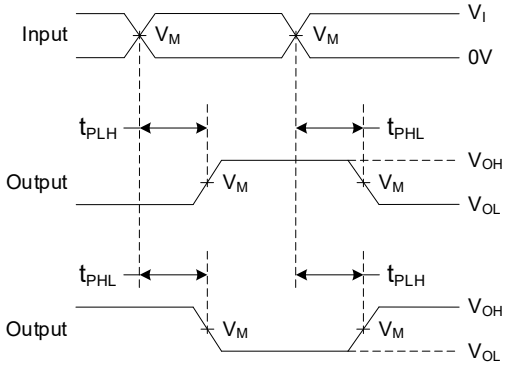
AC Electrical Characteristics

Symbol	Parameter	Condition	V_{CC} (V)	T_A = 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 Yn	Figure1	2.0		41	150		190		225	ns
			4.5		15	30		38		45	
			5.0		12						
			6.0		12	26		33		38	
	E3 to Yn	Figure1	2.0		47	150		190		225	
			4.5		17	30		38		45	
			5.0		14						
			6.0		14	26		33		38	
	$\overline{E}$n to Yn	Figure1	2.0		47	150		190		225	
			4.5		17	30		38		45	
			5.0		14						
			6.0		14	26		33		38	
t_{TLH}, t_{THL} Transition Time	Yn	Figure1	2.0		19	75		95		110	ns
			5.0		7	15		19		22	
			6.0		6	13		16		19	

AC Characteristics Test Waveform



Voltage Waveform
Pulse Duration

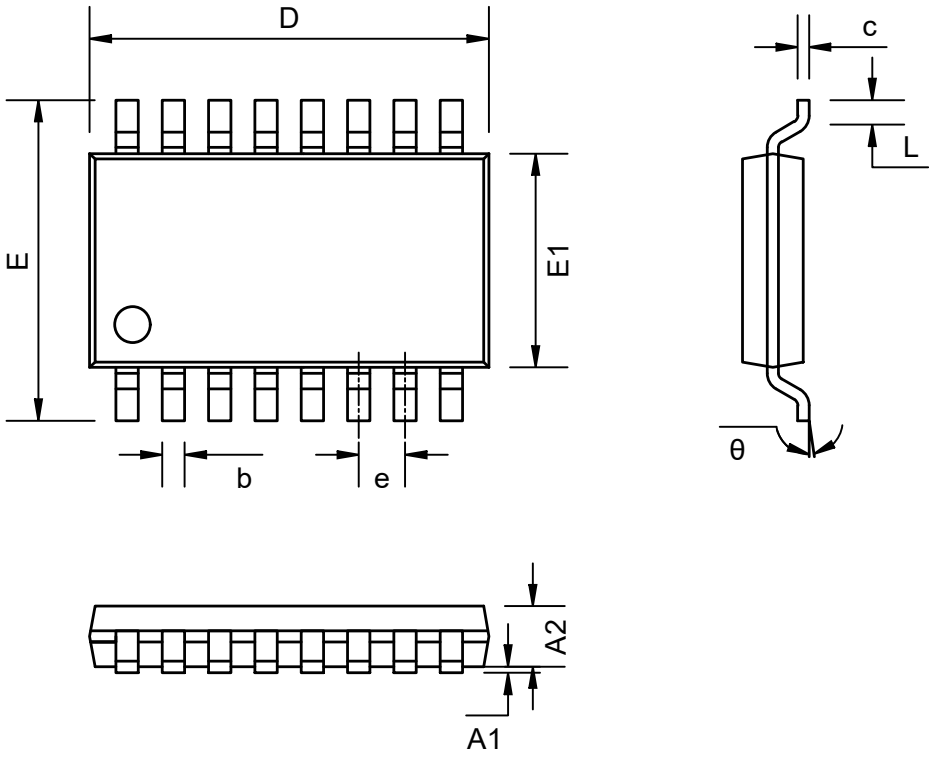


Voltage Waveform
Propagation Delay Times
Inverting and Non Inverting Outputs

Figure3. Test Waveform

Package Dimension

SOP16

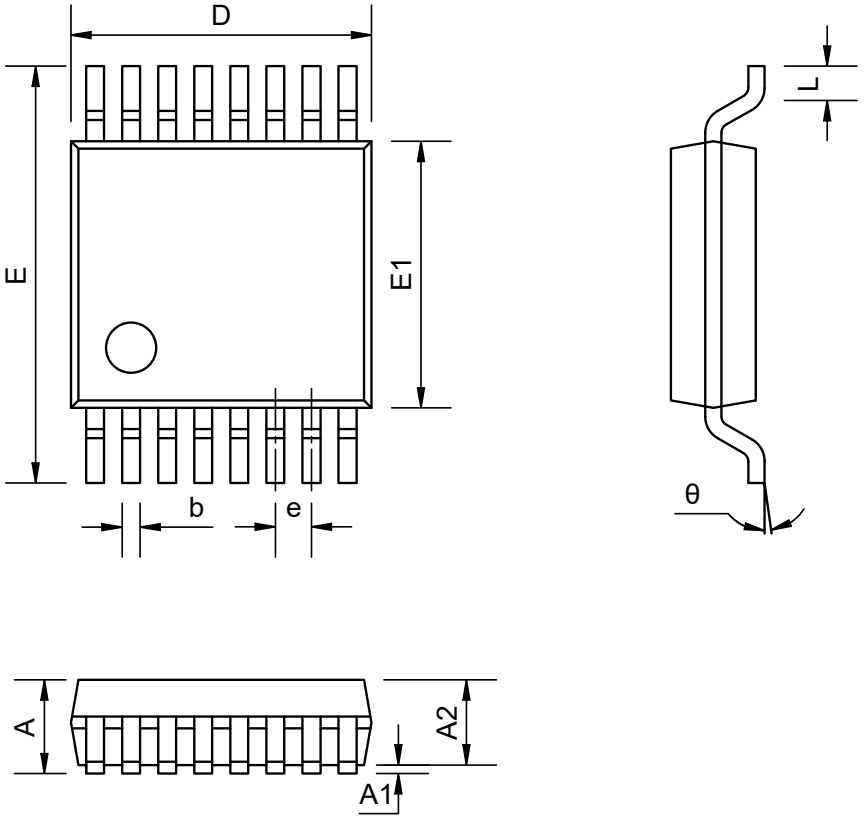


COMMON DIMENSIONS

(Unit: mm)

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

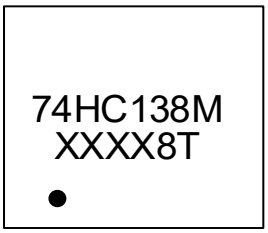


COMMON DIMENSIONS

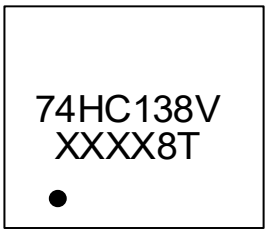
(Unit: mm)

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°

Marking Information



74HC138M = Part Number
XXXX8T = Tracking Number



74HC138V = Part Number
XXXX8T = Tracking Number

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2016-06-23	Original version	Shi liangjun	Shi liangjun	Zhu junli
1.1	2021-02-13	Form version	Shi liangjun	Shi liangjun	Zhu junli
1.2	2022-06-13	Typesetting version	Shi bo	Shi liangjun	Zhu junli
1.2.a	2025-11-19	Add Marking	Yang xiaoxu	Yang xiaoxu	Liu jiaying
1.3	2026-05-14	Add SOP16	Xu tao	Yang xiaoxu	Liu jiaying