IT138

3-to-8 line decoder/demultiplexer

Feature

- Demultiplexing capability
- Multiple input enable for easy expansion
- Ideal for memory chip select decoding
- Active LOW mutually exclusive outputs
- Complies with JEDEC standard no. 7A
- ESD protection:
  - HBM EIA/JESD22-A114-C exceeds 2000 V
  - MM EIA/JESD22-A115-A exceeds 200 V
- Specified from - 40 °C to +85 °C and from - 40 °C to +125 °C

General Description

The IT138 is a high-speed CMOS device. IT138 decoder accepts three binary weighted address inputs (A0, A1 and A3) and when enabled, provides 8 mutually exclusive active LOW outputs (Y'0 to Y'7). It features three enable inputs: two active LOW (E'1 and E'2) and one active HIGH (E3). Every output will be HIGH unless E'1 and E'2 are LOW and E3 is HIGH. This multiple enable function allows easy parallel expansion of the IT138 to a 1-of-32 (5 lines to 32 lines) decoder with just four IT138 ICs and one inverter. IT138 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. Non-used enable inputs must be tied to appropriate active HIGH- or LOW-state.

Quick reference data

Table 1:

GND=0V, Tamb = 25 °C; tr = tf = 6 ns.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
tPHL/ tPLH	Propagation delay	Vcc=5V; CL=15pF				
	An to Yn			11		ns
	E3 to Yn			13		ns
	En to Yn			13		ns
Ci	Input capacitance			4		pf
CPD	Power dissipation capacitance	VI=GND to Vcc		65		pf

Function diagram

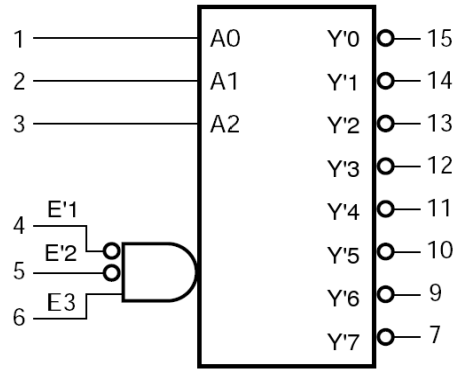


Fig1. Logic symbol

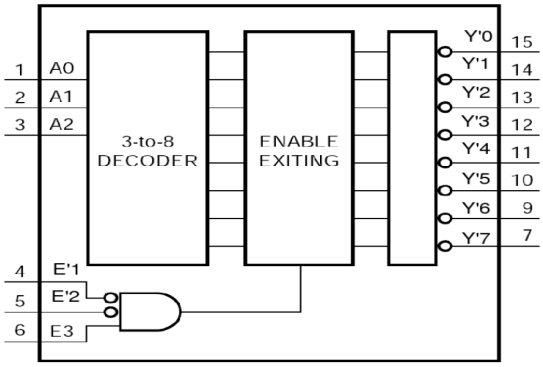


Fig2. Functional diagram

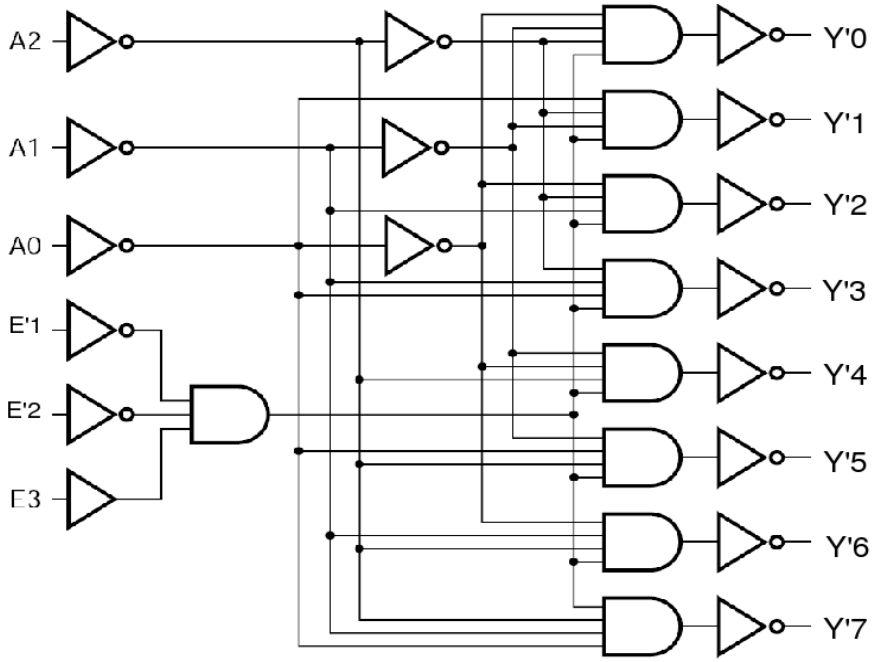


Fig3. Logical diagram

Pin Assignment

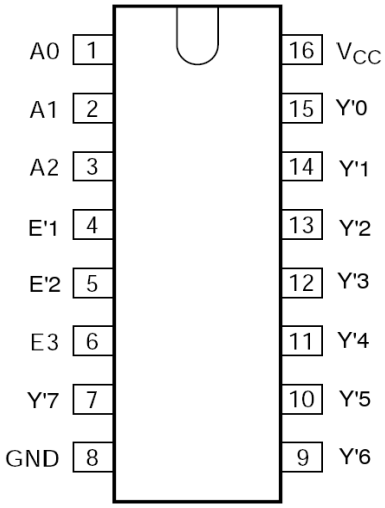


Fig4. Pin configuration in SOP-16L

Pin Description

Table 2:

Symbol	Pin	Description
A0	1	Address input 0
A1	2	Address input 1
A2	3	Address input 2
E'1	4	Enable input 1 (active Low)
E'2	5	Enable input 2 (active Low)
E3	6	Enable input 3 (active High)
Y'7	7	Output 7
GND	8	Ground (0 V)
Y'6	9	Output 6
Y'5	10	Output 5
Y'4	11	Output 4
Y'3	12	Output 3
Y'2	13	Output 2
Y'1	14	Output 1
Y'0	15	Output 0
Vcc	16	Positive supply voltage

Functional Description

Table3 H= HIGH voltage level; L= LOW voltage level; X= don't care.

Control			Input			Output							
E'1	E'2	E3	A2	A1	A0	Y'7	Y'6	Y'5	Y'4	Y'3	Y'2	Y'1	Y'0
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X											
X	X	L											
L	L	H	L	L	L	H	H	H	H	H	H	H	L
			L	L	H	H	H	H	H	H	H	L	H
			L	H	L	H	H	H	H	H	L	H	H
			L	H	H	H	H	H	H	L	H	H	H
			H	L	L	H	H	H	L	H	H	H	H
			H	L	H	H	H	L	H	H	H	H	H
			H	H	L	H	L	H	H	H	H	H	H
			H	H	H	L	H	H	H	H	H	H	H

Limiting Values

Table 4: Voltage are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	Min	Max	Unit
Vcc	Supply voltage		-0.5	7	V
I_{Ik}	Input clamping current	V_I<-0.5V or V_I>Vcc+0.5V	-	± 20	mA
I_{OK}	Output clamping current	V_o<-0.5V or V_o>Vcc+0.5V	-	± 20	mA
Io	Output current	V_o=-0.5V to (Vcc+0.5V)	-	± 25	mA
Icc	Quiescent supply current		-	50	mA
I_{GND}	Ground current		-	-50	mA
T_{stg}	Storage temperature		-65	150	°C
P_{tot}	Total power dissipation		-	500	mW

Recommended operating conditions

Table5:

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vcc	Supply voltage		2	5	6	V
V_I	Input voltage		0	-	Vcc	V
Vo	Output voltage		0	-	Vcc	V
T_{amb}	Ambient temperature		-40	25	125	°C
tr, tf	Input rise and fall time	Vcc=2.0V	-	-	1000	ns
		Vcc=4.5V	-	6	500	ns
		Vcc=6.0V	-	-	400	ns

Static Characteristics

Table6: At recommended operating conditions. Voltage are referenced to GND (ground=0 V)

Ta= 25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IH}	High-state input voltage	Vcc=2.0V	1.2	1.5	-	V
		Vcc=4.5V	2.8	3.15	-	V
		Vcc=6.0V	3.6	4.2	-	V
V_{IL}	LOW-state input voltage	Vcc=2.0V	-	0.5	0.8	V
		Vcc=4.5V	-	1.35	1.8	V
		Vcc=6.0V	-	1.8	2.4	V
V_{OH}	High-state output voltage	V_I=V_{IH} or V_{IL}				
		Io=-20uA;Vcc=2.0V	1.9	2	-	V
		Io=-20uA;Vcc=4.5V	4.4	4.5	-	V
		Io=-20uA;Vcc=6.0V	5.9	6	-	V
		Io=-4mA ;Vcc=4.5V	3.98	4.32	-	V
		Io=-5.2mA;Vcc=6.0V	5.48	5.81	-	V
V_{OL}	LOW-state output voltage	V_I=V_{IH} or V_{IL}				
		Io=20uA;Vcc=2.0V	-	0	0.1	V
		Io=20uA;Vcc=4.5V	-	0	0.1	V
		Io=20uA;Vcc=6.0V	-	0	0.1	V
		Io=4mA ;Vcc=4.5V	-	0.15	0.26	V
		Io=5.2mA;Vcc=6.0V	-	0.16	0.26	V

I_{LI}	input leakage current	V_I=Vcc or GND ;Vcc=6V	-	-	2	uA
I_{OZ}	OFF-state output current	$V_I=V_{IH}$ or V_{IL};Vo=Vcc or GND Vcc=6V.	-	-	2	uA
I_{CC}	quiescent supply current	Io=0A;V_I=Vcc or GND Vcc=6V.	-	-	8	uA
C_i	input capacitance		-	4	-	pF

Ta= -40°C ~ 85°C

V_{IH}	High-state input voltage	Vcc=2.0V	1.2	1.5	-	V
		Vcc=4.5V	2.8	3.15	-	V
		Vcc=6.0V	3.6	4.2	-	V
V_{IL}	LOW-state input voltage	Vcc=2.0V	-	0.5	0.8	V
		Vcc=4.5V	-	1.35	1.8	V
		Vcc=6.0V	-	1.8	2.4	V
V_{OH}	High-state output voltage	$V_I=V_{IH}$ or V_{IL}				
		Io=-20uA;Vcc=2.0V	1.9	-	-	V
		Io=-20uA;Vcc=4.5V	4.4	-	-	V
		Io=-20uA;Vcc=6.0V	5.9	-	-	V
		Io=-4mA ;Vcc=4.5V	3.84	-	-	V
		Io=-5.2mA;Vcc=6.0V	5.34	-	-	V
V_{OL}	LOW-state output voltage	$V_I=V_{IH}$ or V_{IL}				
		Io=20uA;Vcc=2.0V	-	-	0.1	V
		Io=20uA;Vcc=4.5V	-	-	0.1	V
		Io=20uA;Vcc=6.0V	-	-	0.1	V
		Io=4mA ;Vcc=4.5V	-	-	0.33	V
		Io=5.2mA;Vcc=6.0V	-	-	0.33	V
I_{LI}	input leakage current	V_I=Vcc or GND ;Vcc=6V	-	-	2	uA
I_{OZ}	OFF-state output current	$V_I=V_{IH}$ or V_{IL};Vo=Vcc or GND Vcc=6V.	-	-	2	uA
I_{CC}	quiescent supply current	Io=0A;V_I=Vcc or GND Vcc=6V.	-	-	80	uA

Ta= -40°C ~ 125°C

V_{IH}	High-state input voltage	Vcc=2.0V	1.5	1.2	-	V
		Vcc=4.5V	3.15	2.4	-	V
		Vcc=6.0V	4.2	3.2	-	V
V_{IL}	LOW-state input voltage	Vcc=2.0V	-	0.8	0.5	V
		Vcc=4.5V	-	2.1	1.35	V
		Vcc=6.0V	-	2.8	1.8	V
V_{OH}	High-state output voltage	V_I=V_{IH} or V_{IL}				
		Io=-20uA;Vcc=2.0V	1.9	-	-	V
		Io=-20uA;Vcc=4.5V	4.4	-	-	V
		Io=-20uA;Vcc=6.0V	5.9	-	-	V
		Io=-4mA ;Vcc=4.5V	3.84	-	-	V
		Io=-5.2mA;Vcc=6.0V	5.34	-	-	V
V_{OL}	LOW-state output voltage	V_I=V_{IH} or V_{IL}				
		Io=20uA;Vcc=2.0V	-	-	0.1	V
		Io=20uA;Vcc=4.5V	-	-	0.1	V
		Io=20uA;Vcc=6.0V	-	-	0.1	V
		Io=4mA ;Vcc=4.5V	-	-	0.4	V
		Io=5.2mA;Vcc=6.0V	-	-	0.4	V
I_{LI}	input leakage current	V_I=Vcc or GND ;Vcc=6V			2	uA
I_{OZ}	OFF-state output current	V_I=V_{IH} or V_{IL};Vo=Vcc or GND Vcc=6V.	-	-	2	uA
I_{CC}	quiescent supply current	Io=0A;V_I=Vcc or GND Vcc=6V.	-	-	160	uA

Dynamic Characteristics

Table7: Voltages are referenced to GND (ground = 0V); CL=50pF unless otherwise specified.

For test circuit see Figure7.

Ta= 25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
tPLH/tPHL	propagation delay					
	An to Y'n	see Figure 5				

		Vcc=2.0V	-	38	80	ns
		Vcc=4.5V	-	14	28	ns
		Vcc=5V; C_L=15pF	-	12	24	ns
		Vcc=6.0V	-	11	23	ns
	E3 to Y'n	see Figure 5				
		Vcc=2.0V	-	38	80	ns
		Vcc=4.5V	-	16	30	ns
		Vcc=5V; C_L=15pF	-	13	26	ns
		Vcc=6.0V	-	12	24	ns
	E'n to Y'n	see Figure 6				
		Vcc=2.0V	-	38	80	ns
		Vcc=4.5V	-	16	30	ns
		Vcc=5V; C_L=15pF	-	13	26	ns
		Vcc=6.0V	-	12	24	ns
tTLH,/tTHL	output transition time	see Figure 5 and 6				
		Vcc=2.0V	-	18	40	ns
		Vcc=4.5V	-	6.5	13	ns
		Vcc=6.0V	-	5.5	12	ns
CPD	power dissipation capacitance	V_I=GND to Vcc	-	65	-	pF

Ta= -40°C ~ 85°C

tPLH/tPHL	propagation delay					
	An to Y'n	see Figure 5				
		Vcc=2.0V	-	-	150	ns
		Vcc=4.5V	-	-	35	ns
		Vcc=6.0V	-	-	30	ns
	E3 to Y'n	see Figure 5				
		Vcc=2.0V	-	-	150	ns
		Vcc=4.5V	-	-	35	ns
		Vcc=6.0V	-	-	30	ns
	E'n to Y'n	see Figure 6				

		Vcc=2.0V	-	-	150	ns
		Vcc=4.5V	-	-	35	ns
		Vcc=6.0V	-	-	30	ns
tTLH,/tTHL	output transition time	see Figure 5 and 6				
		Vcc=2.0V	-	-	100	ns
		Vcc=4.5V	-	-	20	ns
		Vcc=6.0V	-	-	16	ns

Ta= -40°C ~ 125°C

tPLH/tPHL	propagation delay					
	An to Y'n	see Figure 5				
		Vcc=2.0V	-	-	170	ns
		Vcc=4.5V	-	-	38	ns
		Vcc=6.0V	-	-	33	ns
	E3 to Y'n	see Figure 5				
		Vcc=2.0V	-	-	170	ns
		Vcc=4.5V	-	-	38	ns
		Vcc=6.0V	-	-	33	ns
	E'n to Y'n	see Figure 6				
		Vcc=2.0V	-	-	170	ns
		Vcc=4.5V	-	-	38	ns
		Vcc=6.0V	-	-	33	ns
tTLH,/tTHL	output transition time	see Figure 5 and 6				
		Vcc=2.0V	-	-	120	ns
		Vcc=4.5V	-	-	25	ns
		Vcc=6.0V	-	-	20	ns

Note 1

C_{PD} is used to determine the dynamic power dissipation (P_D in μW)

$P_D = C_{PD} \times V_{CC}^2 \times fi \times N + \Sigma(C_L \times V_{CC}2 \times fo)$ where:

fi = input frequency in MHz;

fo = output frequency in MHz;

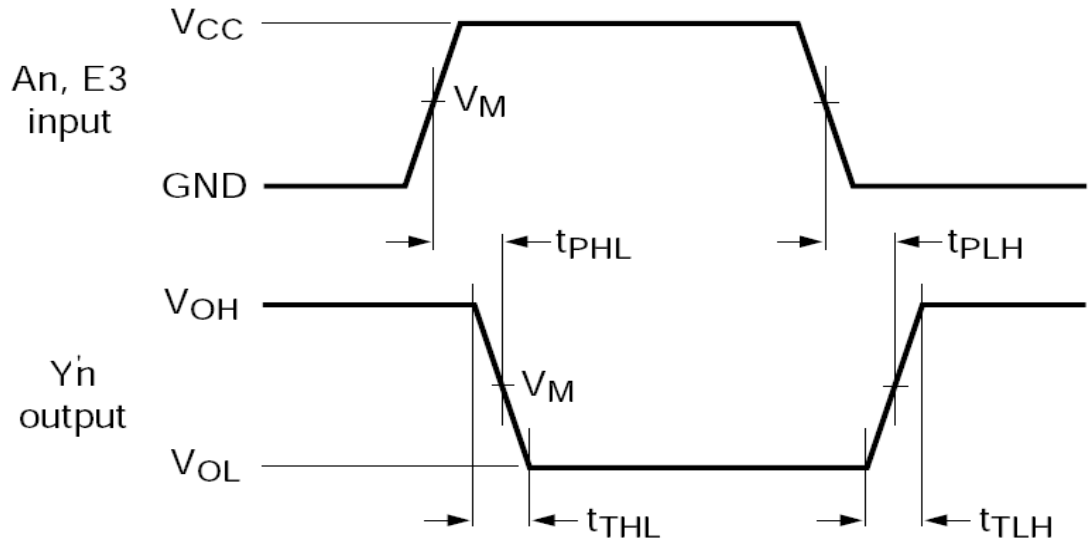
C_L = output load capacitance in pF;

V_{CC} = supply voltage in Volts;

N = total load switching outputs,

$\Sigma(C_L \times V_{CC}^2 \times fo)$ = sum of the outputs.

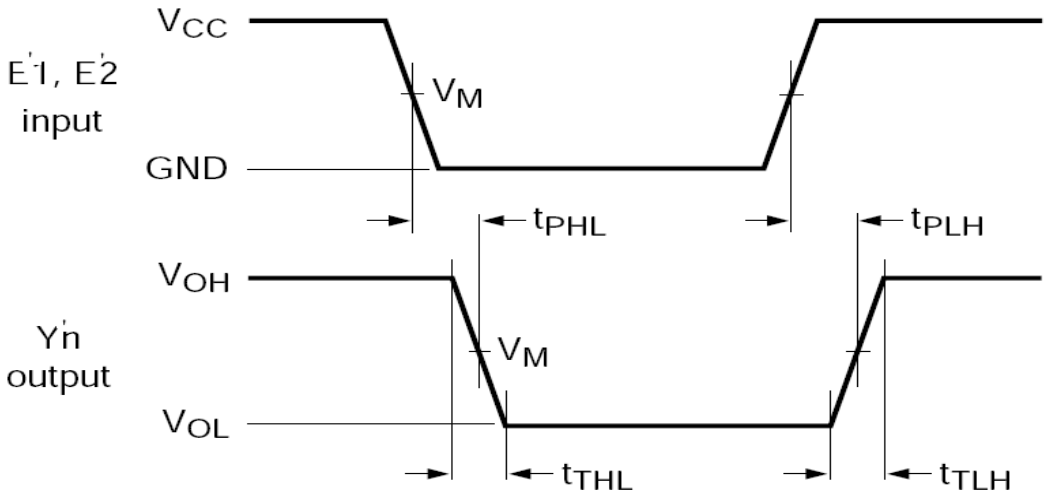
Waveforms



Measurement points are given in Table 8.

VOL and VOH are typical voltage output drop that occur with the output load.

Fig5. Propagation delay input (An) and enable input (E3) to output (Y'n) and transition time output (Y'n)



Measurement points are given in Table 8.

VOL and VOH are typical voltage output drop that occur with the output load.

Fig6. Propagation delay enable input (E'n) to output (Y'n) and transition time output (Y'n)

Table 8: Measurement points

Type	Input	Output
	V_M	V_M
IT138	0.5Vcc	0.5Vcc

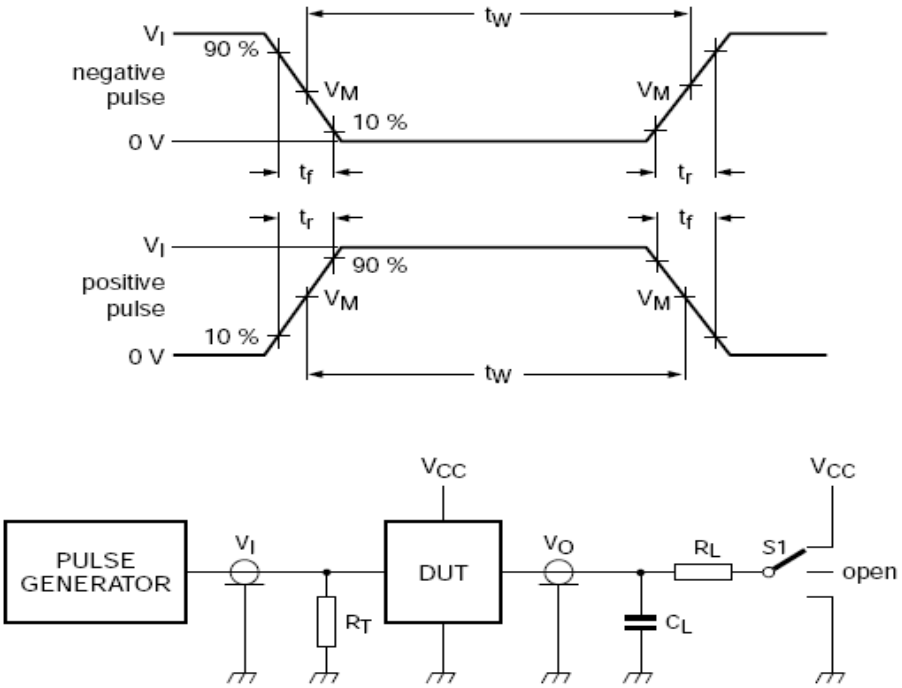


Fig 8. Load circuitry for measuring switching times

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Definitions of test circuit:

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

C_L = Load capacitance including jig and probe capacitance

R_L = Load resistor

S1 = Test selection switch

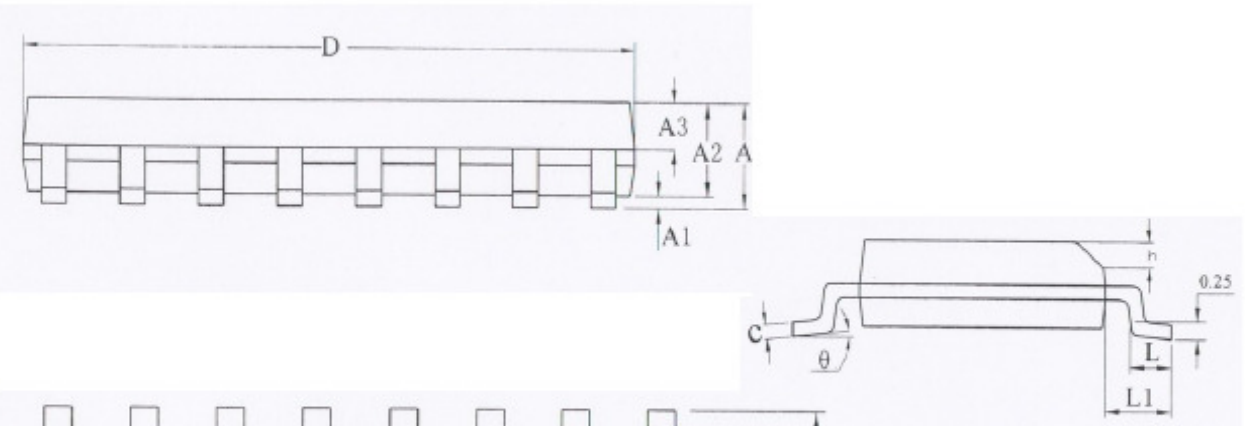
Test data is given in the following table.

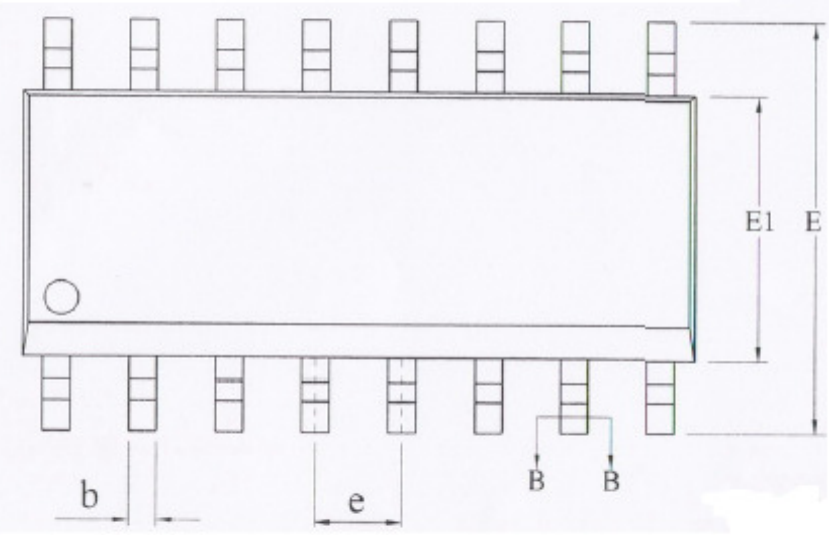
Table 9: Test data

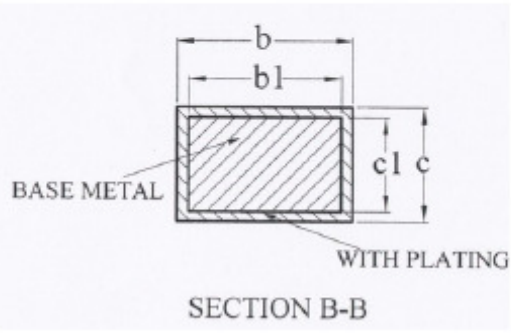
Type	Input		Load		S1 position		
	V_I	tr, tf	C_L	R_L	tPLH, tPHL	tPZH, tPHZ	tPLZ,tPZL
IT138	Vcc	6ns	15pF,50pF	1K ohm	open	GND	Vcc

Package Outlines

SOP16L







SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	—	0.25
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	—	0.48
b1	0.38	0.41	0.43
c	0.21	—	0.26
c1	0.19	0.20	0.21
D	9.70	9.90	10.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
h	0.25	—	0.50
L	0.50	—	0.80
L1	1.05BSC		
θ	0	—	8°
L/F载体尺寸 (mil)	75*75		
	90*110		95*110
	90*180		95*180