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Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Description

The 74HC138 is a high speed CMOS device.

The device accepts a three bit binary weighted address on input pins A0, A1 and A2 and when enabled will produce one active low output with the remaing seven being high.

There are two active LOW enable inputs $\overline{E}1$ and $\overline{E}2$, and one active HIGH enable input E3. The disabled device state results in all outputs being high. The enable state occurs with $\overline{E}1$ and $\overline{E}2$ asserted low and E3 asserted high.
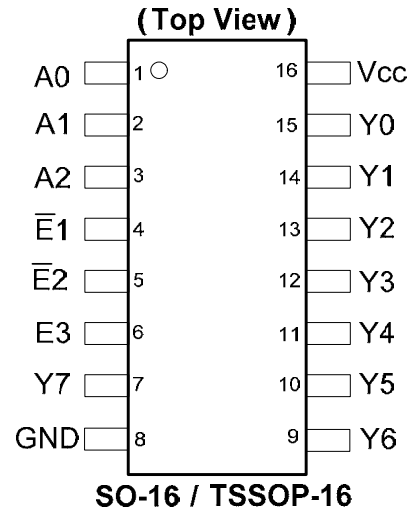
The multiple enable lines allow for the parallel expansion of decoders to create 4-to-16 line versions with no additional parts and 5-to-32 versions with the addition of a single inverter.

Features

- Wide Supply Voltage Range from 2.0V to 6.0V
- Sinks or sources 8 mA at V_{CC} = 4.5V
- CMOS low power consumption
- Schmitt Trigger Action at All Inputs
- Inputs Accept up to 6.0V
- ESD Protection Tested per JESD 22
- Exceeds 200-V Machine Model (A115-A)
- Exceeds 2000-V Human Body Model (A114-A)
- Exceeds 1000-V Charged Device Model (C101C)
- Latch-Up Exceeds 100mA per JESD 78D, Class II
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Pin Assignments

(Top View)

Pin		Pin	
A0	1	16	Vcc
A1	2	15	Y0
A2	3	14	Y1
$\overline{E}1$	4	13	Y2
$\overline{E}2$	5	12	Y3
E3	6	11	Y4
Y7	7	10	Y5
GND	8	9	Y6

SO-16 / TSSOP-16

Applications

- Memory chip select decoding
- Demultiplexing
- Single line peripheral control
- Allow simple serial bit streams from a microcontroller to control as many peripheral lines as needed

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

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Pin Descriptions

Pin Number	Pin Name	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 (active LOW)
8	GND	Ground
9	Y6	Output 6 (active LOW)
10	Y5	Output 5 (active LOW)
11	Y4	Output 4 (active LOW)
12	Y3	Output 3 (active LOW)
13	Y2	Output 2 (active LOW)
14	Y1	Output 1 (active LOW)
15	Y0	Output o (active LOW)
16	Vcc	Supply Voltage

Function Table Diagram

Control			Input			Output							
$\overline{E}1$	$\overline{E}2$	E3	A2	A1	A0	$\overline{Y7}$	$\overline{Y6}$	$\overline{Y5}$	$\overline{Y4}$	$\overline{Y3}$	$\overline{Y2}$	$\overline{Y1}$	$\overline{Y0}$
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

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Logic Diagram
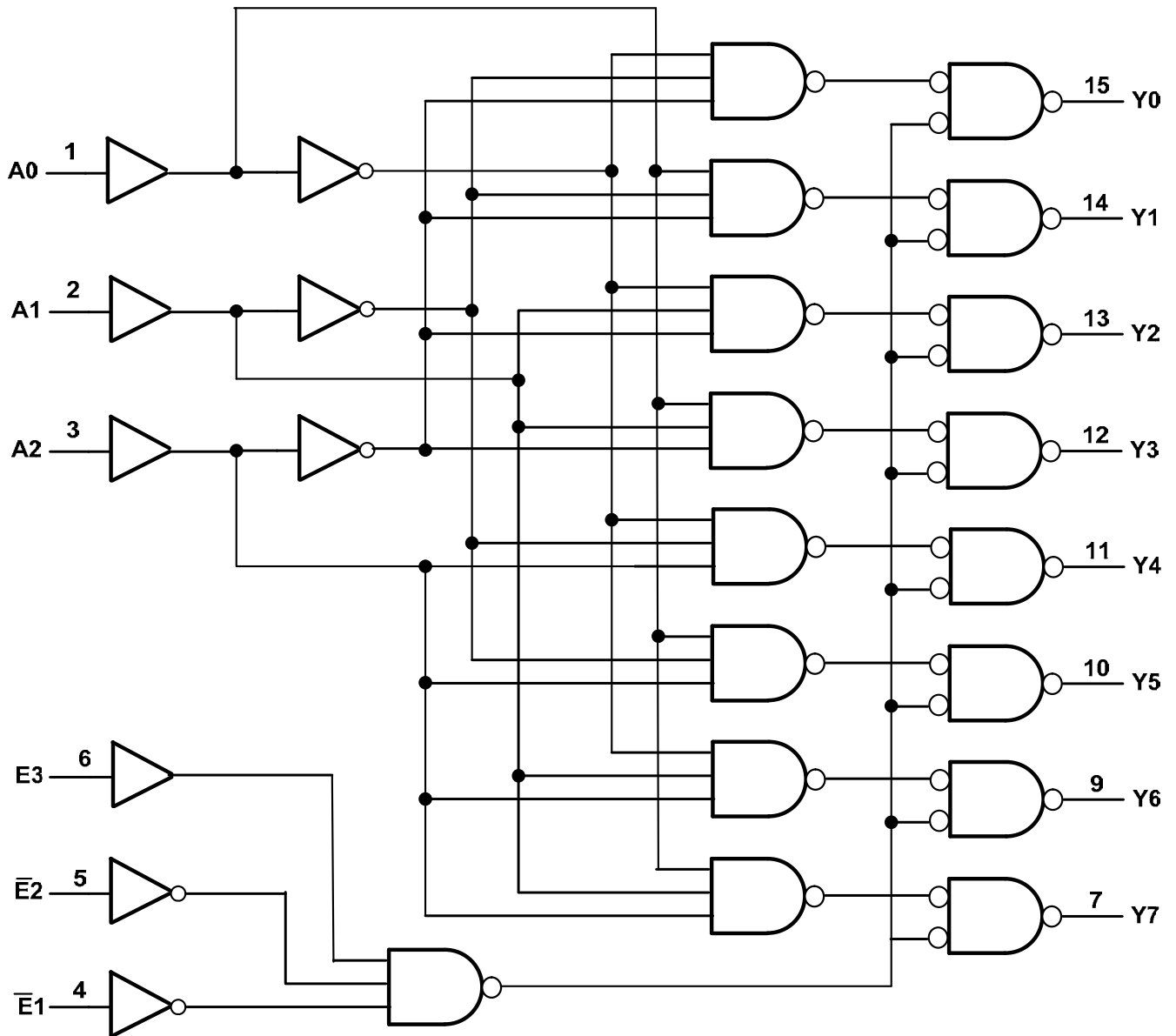
Absolute Maximum Ratings (Note 4) (@T$_A$ = +25°C, unless otherwise specified.)

Symbol	Description	Rating	Unit
ESD HBM	Human Body Model ESD Protection	2	kV
ESD CDM	Charged Device Model ESD Protection	1	kV
ESD MM	Machine Model ESD Protection	200	V
V$_{CC}$	Supply Voltage Range	-0.5 to +7.0	V
V$_I$	Input Voltage Range	-0.5 to +7.0	V
V$_o$	Voltage applied to output in high or low state	-0.3 to V$_{CC}$ +0.5	V
I$_{IK}$	Input Clamp Current V$_I$< -0.5V	-20	mA
I$_{IK}$	Input Clamp Current VI > V$_{CC}$ +0.5V	20	mA
I$_{OK}$	Output Clamp Current V$_O$<-0.5V	-20	mA
I$_{OK}$	Output Clamp Current V$_O$> V$_{CC}$ + 0.5V	20	mA
I$_O$	Continuous output current	±25	mA
I$_{CC}$	Continuous current through V$_{CC}$	50	mA
I$_{GND}$	Continuous current through GND	-50	mA
T$_J$	Operating Junction Temperature	-40 to +150	°C
T$_{STG}$	Storage Temperature	-65 to +150	°C
P$_{TOT}$	Total Power Dissipation	500	mW

Note: 4. Stresses beyond the absolute maximum may result in immediate failure or reduced reliability. These are stress values and device operation should be within recommend values.

Recommended Operating Conditions (Note 5) (@T$_A$ = +25°C, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Max	Unit
V$_{CC}$	Supply Voltage	–	2.0	6.0	V
V$_I$	Input Voltage	–	0	V$_{CC}$	V
V$_O$	Output Voltage	Active Mode	0	V$_{CC}$	V
Δt/ΔV	Input transition Rise or Fall Rate	V$_{CC}$ = 2.0V	–	1000	ns/V
		V$_{CC}$ = 4.5V	–	500	
		V$_{CC}$ = 6.0V	–	400	–
T$_A$	Operating Free-Air Temperature	–	-40	+125	°C

Note: 5. Unused inputs should be held at V$_{CC}$ or Ground.

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Electrical Characteristics (@T$_A$ = +25°C, unless otherwise specified.)

Symbol	Parameter	Test Conditions	V$_{CC}$	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	–	2.0V	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	1.35	–	1.35	–	1.35	
		–	6.0V	–	2.8	1.8	–	1.8	–	1.8	
V$_{OH}$	High-Level Output Voltage	I$_{OH}$ = -20 µA 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$_{OH}$ = -4 mA	4.5V	3.98	4.32	–	3.84	–	3.7	–	
		I$_{OH}$ = -5.2 mA	6.0V	5.48	5.81	–	5.34	–	5.2	–	
V$_{OL}$	Low-Level Output Voltage	I$_{OL}$ = 20 µA 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$_{OL}$ = 4 mA	4.5V	–	0.15	0.26	–	0.33	–	0.4	
		I$_{OL}$ = 5.2 mA	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	V$_i$ = V$_{CC}$ or GND	6.0V	–	4	10	–	10	–	10	pF

Switching Characteristics

Symbol / Parameter	Pins	Test Conditions	V$_{CC}$	T$_A$ = +25°C			-40°C to +85°C		-40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t$_{PLH}$, t$_{PLH}$ Propagation Delay	An to $\overline{Y}$n	Figure 1	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	Figure 1	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	Figure 1	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	Figure 1	2.0V	–	19	75	–	95	–	110	ns
			5.0V	–	7	15	–	19	–	22	
			6.0V	–	6	13	–	16	–	19	

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Operating Characteristics (@T$_A$ = +25°C, unless otherwise specified.)

Parameter		Test Conditions	V$_{CC}$ = 5V	Unit
			Typ	
C$_{pd}$	Power dissipation capacitance	f = 1 MHz all outputs switching-no load	19	pF

Parameter Measurement Information

From Output
Under Test

C$_L$
(see Note A)
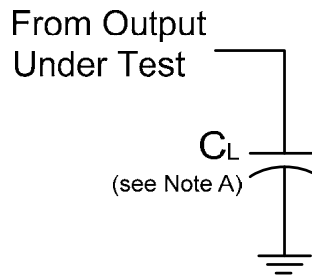
Vcc	Inputs		V$_M$	C$_L$
	V$_I$	t$_r$/t$_f$		
2.0V -6.0V	V$_{CC}$	6 ns	V$_{CC}$/2	50pF
5.0V	V$_{CC}$	6 ns	V$_{CC}$/2	15pF used for 5V typical test

**Voltage Waveform
Pulse Duration**

**Voltage Waveform
Propagation Delay Times
Inverting and Non Inverting Outputs**
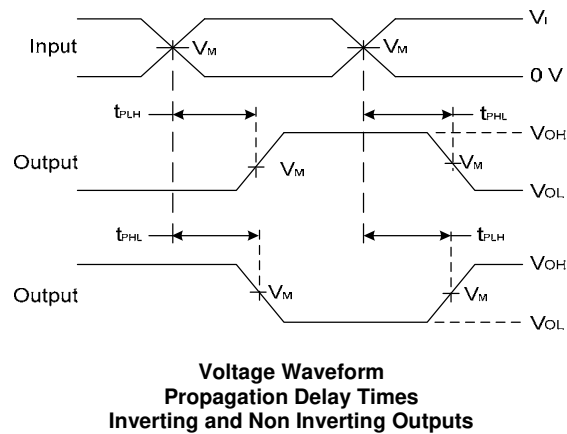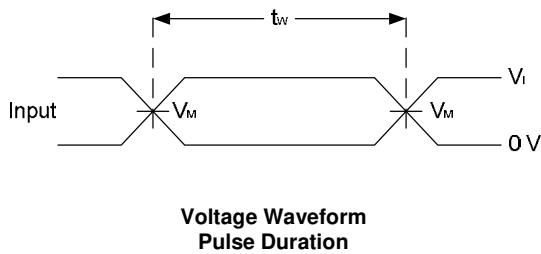
Notes: A. Includes test lead and test apparatus capacitance.
B. All pulses are supplied at pulse repetition rate ≤ 10 MHz.
C. Inputs are measured separately one transition per measurement
D. t$_{PLH}$ and t$_{PHL}$ are the same as t$_{PD}$
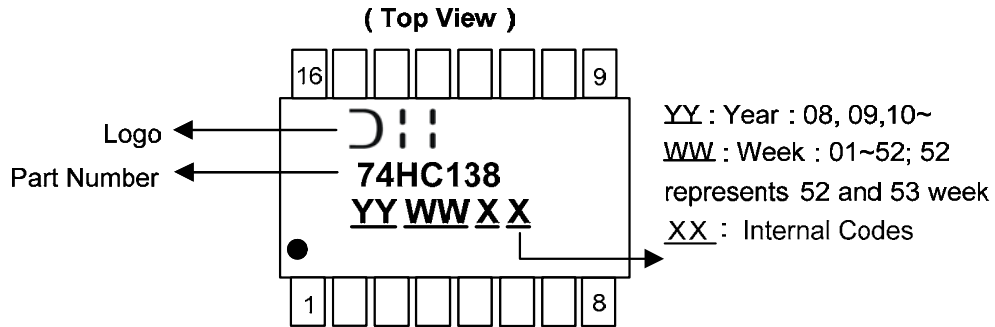
Figure 1 Load Circuit and Voltage Waveforms

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Ordering Information

74 HC 138 XXX - 13

Logic Device	Function	Package	Packing
74 : Logic Prefix HC : 2.0 V to 6.0 V Family	138 : 3 to 8 line DECODER/ DEMUTIPLEXER	S16 : SO-16 T16 : TSSOP-16	-13 : 13" Tape & Reel
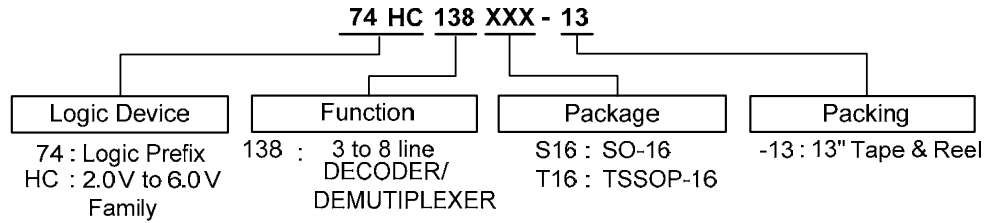
Part Number	Package Code	Packaging	7" Tape and Reel (Note 6)	
			Quantity	Part Number Suffix
74HC138S16-13	S16	SO-16	2500/Tape & Reel	-13
74HC138T16-13	T16	TSSOP-16	2500/Tape & Reel	-13

Notes: 6. The taping orientation is located on our website at http://www.diodes.com/datasheets/ap02007.pdf

Marking Information

(1) SO-16, TSSOP16

(Top View)

Logo ◄

Part Number ◄

74HC138
YY WW X X

YY : Year : 08, 09,10~

WW : Week : 01~52; 52 represents 52 and 53 week

XX : Internal Codes

Part Number	Package
74HC138S16	SO-16
74HC138T16	TSSOP-16

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Package Outline Dimensions (All dimensions in mm.)

Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.

Package Type: SO-16
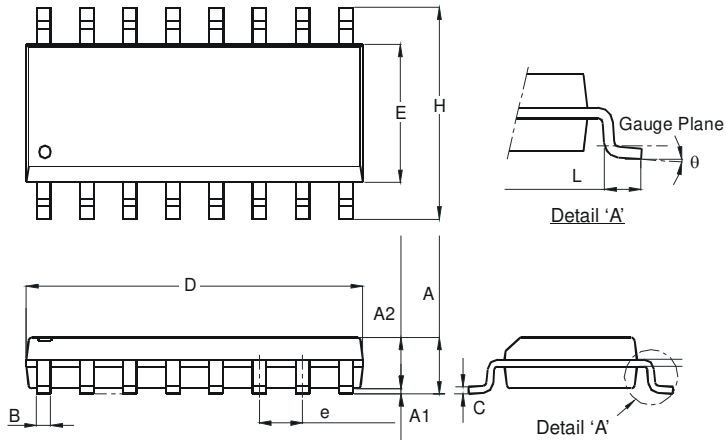
SO-16		
Dim	Min	Max
A	1.40	1.75
A1	0.10	0.25
A2	1.30	1.50
B	0.33	0.51
C	0.19	0.25
D	9.80	10.00
E	3.80	4.00
e	1.27 Typ	
H	5.80	6.20
L	0.38	1.27
Θ	0°	8°
All Dimensions in mm		

Package Type: TSSOP-16
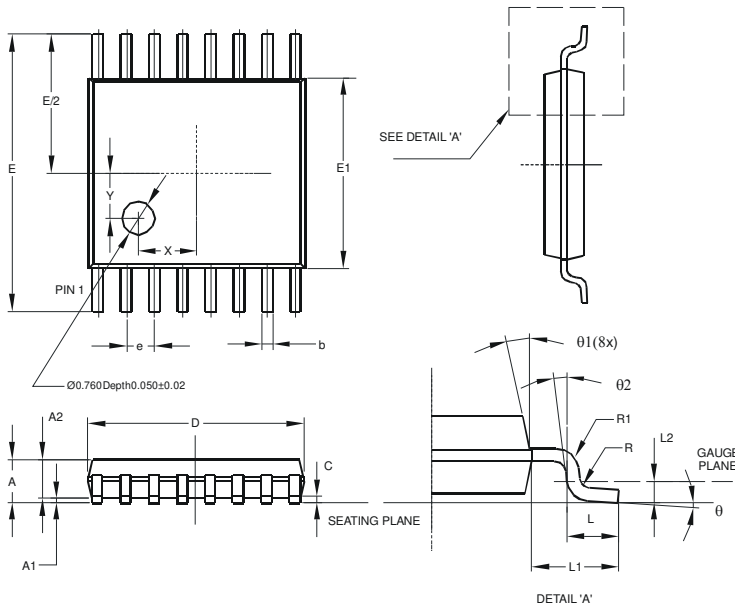
TSSOP-16			
Dim	Min	Max	Typ
A	-	1.08	-
A1	0.05	0.15	-
A2	0.80	0.93	-
b	0.19	0.30	-
c	0.09	0.20	-
D	4.90	5.10	-
E	6.40 BSC		
E1	4.30	4.50	-
e	0.65 BSC		
L	0.45	0.75	-
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	-	-
R1	0.09	-	-
X	-	-	1.350
Y	-	-	1.050
Θ	0°	8°	-
Θ1	5°	15°	-
Θ2	0°	-	-
All Dimensions in mm			

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Suggested Pad Layout

Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for the latest version.

Package Type: SO-16
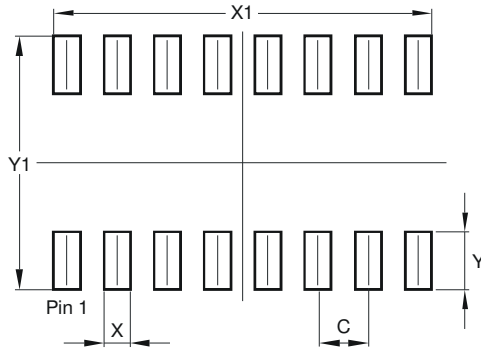
Dimensions	Value (in mm)
C	1.270
X	0.670
X1	9.560
Y	1.450
Y1	6.400

Package Type: TSSOP-16
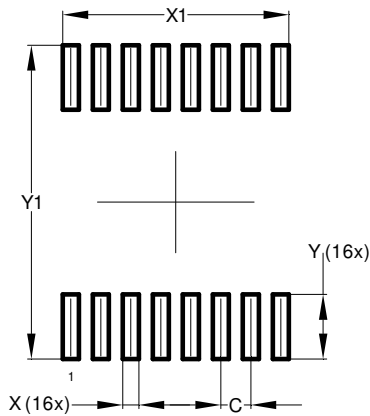
Dimensions	Value (in mm)
C	0.650
X	0.350
X1	4.900
Y	1.400
Y1	6.800

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