

## Description

The 74HCT138 is a high speed CMOS device that is designed to be pin compatible with 74LS low power Schottky types.

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 remaining seven being high.

There are two active LOW enable inputs  $\bar{E}1$  and  $\bar{E}2$ , and one active HIGH enable input E3. The disabled device state results in all outputs being high. The enable state occurs with  $\bar{E}1$  and  $\bar{E}2$  asserted low and E3 asserted high.

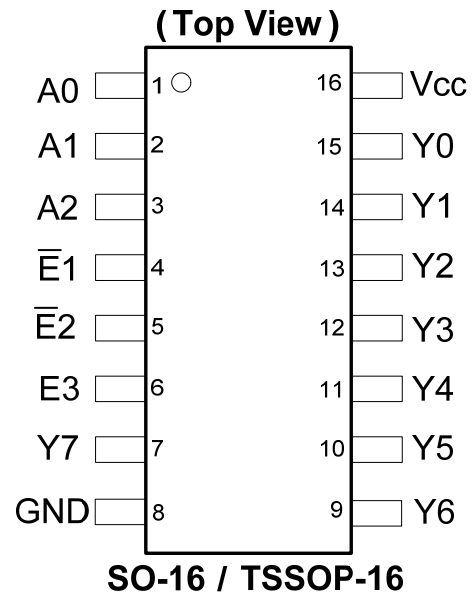
The multiple enable lines allow for the parallel expansion of decoders to create 4-to-16 line versions with no additional parts and 5-to-32 versions with the addition of a single inverter.

## Features

- Wide Supply Voltage Range from 4.5V to 5.5V
- Sinks or sources 8mA 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 250mA per JESD 78, Class II
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

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.

## Pin Assignments



## 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.

[Click here for ordering information, located at the end of datasheet](#)

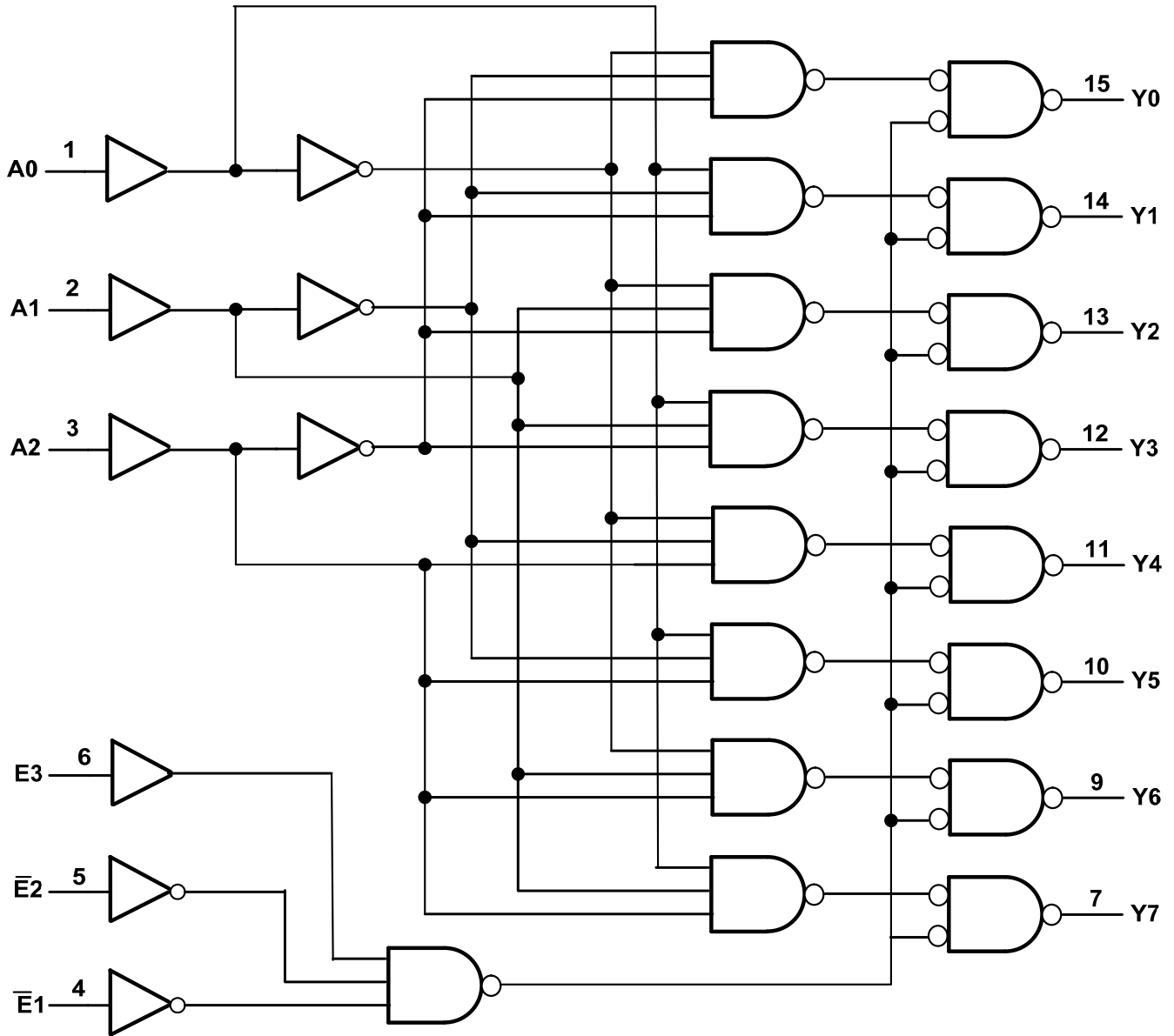
## Pin Descriptions

Pin Number	Pin Name	Description
1	A0	Address Input 0
2	A1	Address Input 1
3	A2	Address Input 2
4	$\bar{E}1$	Enable Input 1 (active LOW)
5	$\bar{E}2$	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 0 (active LOW)
16	V <sub>cc</sub>	Supply Voltage

## Function Table Diagram

Control			Input			Output							
$\bar{E}1$	$\bar{E}2$	E3	A2	A1	A0	$\bar{Y}7$	$\bar{Y}6$	$\bar{Y}5$	$\bar{Y}4$	$\bar{Y}3$	$\bar{Y}2$	$\bar{Y}1$	$\bar{Y}0$
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

Logic Diagram



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**Absolute Maximum Ratings** (Note 4) (@ $T_A = +25^{\circ}\text{C}$ , unless otherwise specified.)
 

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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 $V_{CC}$	V
$I_{IK}$	Input Clamp Current $V_I < -0.5\text{V}$	-20	mA
$I_{IK}$	Input Clamp Current $V_I > V_{CC} + 0.5\text{V}$	20	mA
$I_{OK}$	Output Clamp Current $V_O < -0.5\text{V}$	-20	mA
$I_{OK}$	Output Clamp Current $V_O > V_{CC} + 0.5\text{V}$	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	$^{\circ}\text{C}$
$T_{STG}$	Storage Temperature	-65 to 150	$^{\circ}\text{C}$
$P_{TOT}$	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.

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**Recommended Operating Conditions** (Note 5) (@ $T_A = +25^{\circ}\text{C}$ , unless otherwise specified.)
 

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Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	Supply Voltage	-	4.5	5.5	V
$V_I$	Input Voltage	-	0	$V_{CC}$	V
$V_O$	Output Voltage	Active Mode	0	$V_{CC}$	V
$\Delta t/\Delta V$	Input transition rise or fall rate	$V_{CC} = 4.5\text{V}$	-	100	ns/V
$T_A$	Operating free-air temperature	-	-40	125	$^{\circ}\text{C}$

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

**Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Symbol	Parameter	Test Conditions	Vcc	$T_A = 25^\circ\text{C}$			$-40^\circ\text{C to } 85^\circ\text{C}$		$-40^\circ\text{C to } 125^\circ\text{C}$		Unit	
				Min	Typ	Max	Min	Max	Min	Max		
$V_{IH}$	High-level Input Voltage	–	4.5V to 5.5V	2.0	1.6	–	2.0	–	2.0	–	V	
$V_{IL}$	Low-level input voltage	–	4.5V to 5.5V	–	1.2	0.8	–	0.8	–	0.8	V	
$V_{OH}$	High Level Output Voltage	$I_{OH} = -20 \mu\text{A}$	4.5V	4.4	4.5	–	4.4	–	4.4	–	V	
		$I_{OH} = -4 \text{ mA}$	4.5V	3.98	4.32	–	3.85	–	3.7	–		
$V_{OL}$	Low-level Output Voltage	$I_{OL} = 20 \mu\text{A}$	4.5V	–	0	0.1	–	0.1	–	0.1	V	
		$I_{OL} = 4 \text{ mA}$	4.5V	–	0.15	0.26	–	0.33	–	0.4		
$I_i$	Input Current	$V_i = \text{GND to } 5.5 \text{ V}$	5.5V	–	–	$\pm 0.1$	–	$\pm 1$	–	$\pm 1$	$\mu\text{A}$	
$I_{CC}$	Supply Current	$V_i = \text{GND or } V_{CC}$ $I_o = 0$	5.5V	–	–	8.0	–	80	–	160	$\mu\text{A}$	
$\Delta I_{CC}$	Additional Supply Current	Test Per Pin $V_i = V_{CC} - 2.1 \text{ V}$ Other $V_i = V_{CC}$ or GND $I_o = 0$	PINS An	4.5V to 5.5V	–	150	540	–	675	–	735	$\mu\text{A}$
					PIN $\bar{E}_n$	–	125	450	–	563	–	
		PIN E3	–		100	360	–	450	–	490	$\mu\text{A}$	
$C_i$	Input Capacitance	$V_i = V_{CC}$ or GND	5.5V	–	4	10	–	10	–	10	pF	

**Switching Characteristics**

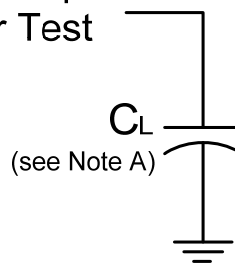
Symbol / Parameter	Pins	Test Conditions	Vcc	$T_A = 25^\circ\text{C}$			$-40^\circ\text{C to } 85^\circ\text{C}$		$-40^\circ\text{C to } 125^\circ\text{C}$		Unit
				Min	Typ.	Max	Min	Max	Min	Max	
$t_{PLH}$ , $t_{PLH}$ Propagation Delay	An to $\bar{Y}_n$	Figure 2	4.5V	–	20	35	–	35	–	45	ns
			5.0V	–	17	–	–	–	–		
	E3 to $\bar{Y}_n$	Figure 2	4.5V	–	18	40	–	40	–	45	
			5.0V	–	19	–	–	–	–		
	$\bar{E}_n$ to $\bar{Y}_n$	Figure 2	4.5V	–	19	40	–	40	–	45	
5.0V			–	19	–	–	–	–			
$t_{TLH}$ , $t_{THL}$ Transition Time	$\bar{Y}_n$	Figure 2	4.5 V	–	7	15	–	15	–	110	ns

**Operating Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

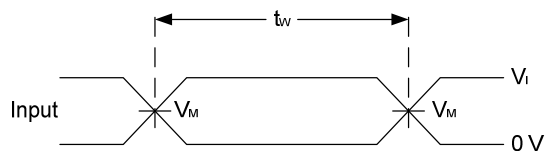
Parameter		Test Conditions	$V_{CC} = 5\text{V}$	Unit
			TYP	
$C_{pd}$	Power Dissipation Capacitance	$f = 1\text{ MHz}$ all outputs switching-no load	21	pF

**Parameter Measurement Information**

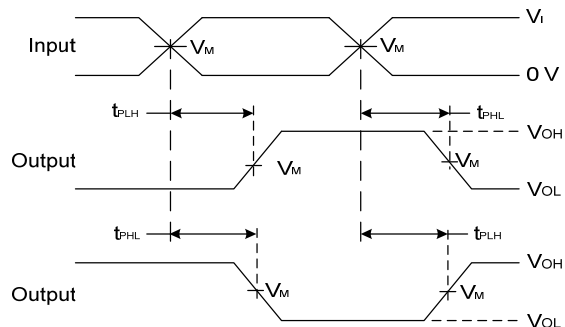
From Output Under Test



$V_{CC}$	Inputs		$V_M$	$C_L$
	$V_I$	$t_r/t_f$		
4.5V	3 V	6ns	$V_{CC}/2$	50pF
5.0V	3 V	6ns	$V_{CC}/2$	15pF used for 5V typical test



**Voltage Waveform Pulse Duration**

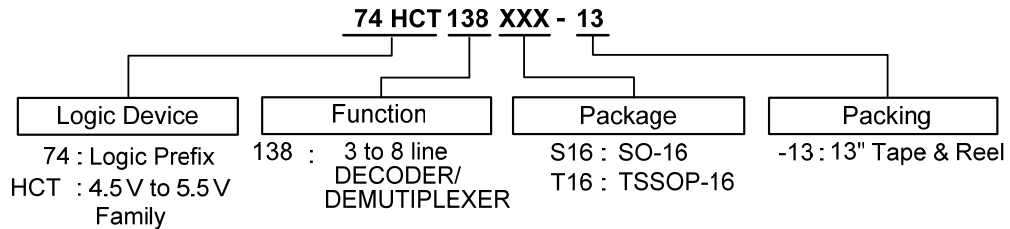


**Voltage Waveform Propagation Delay Times Inverting and Non Inverting Outputs**

- Notes: A . Includes test lead and test apparatus capacitance.
- B. All pulses are supplied at pulse repetition rate  $\leq 10\text{ MHz}$
- 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**

## Ordering Information

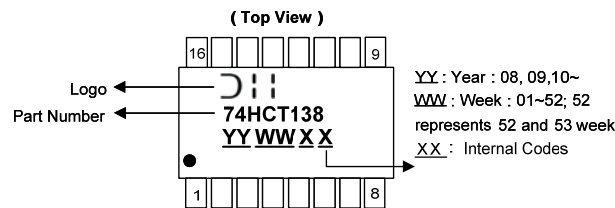


Device	Package Code	Packaging (Note 6)	7" Tape and Reel(Note 7)	
			Quantity	Part Number Suffix
74HCT138S16-13	S16	SO-16	2500/Tape & Reel	-13
74HCT138T16-13	T16	TSSOP-16	2500/Tape & Reel	-13

- Notes:
- 6. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.
  - 7. The taping orientation is located on our website at <http://www.diodes.com/datasheets/ap02007.pdf>

## Marking Information

### (1) SO-16, TSSOP-16

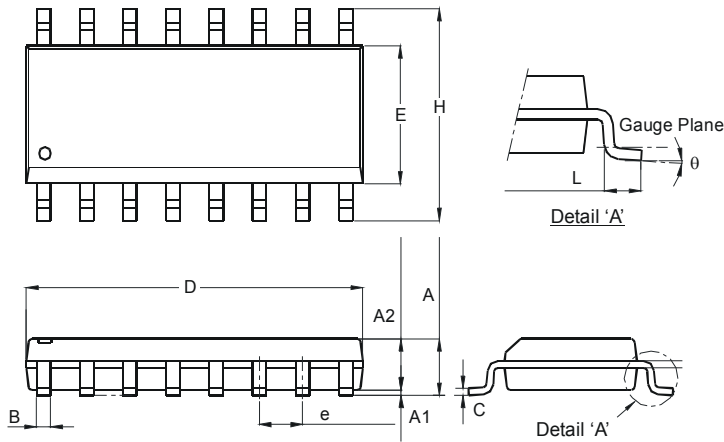


Part Number	Package
74HCT138S16	SO-16
74HCT138T16	TSSOP-16

**Package Outline Dimensions** (All dimensions in mm.)

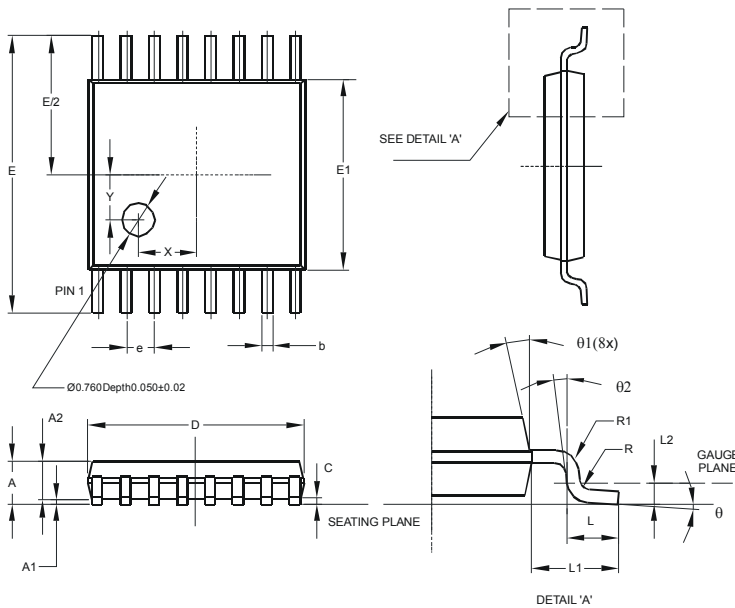
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

**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°
<b>All Dimensions in mm</b>		

**Package Type: TSSOP-16**



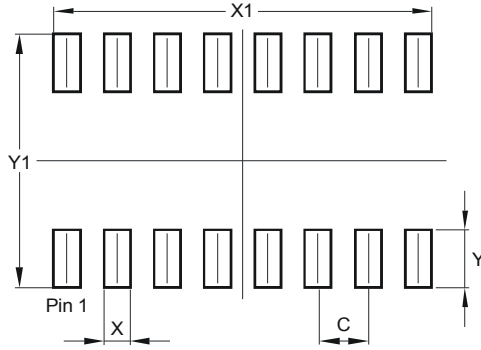
TSSOP-16			
Dim	Min	Max	Typ
A	-	1.08	-
A1	0.05	0.15	-
A2	0.80	0.93	-
b	0.19	0.30	-
c	0.09	0.20	-
D	4.90	5.10	-
E	6.40 BSC		
E1	4.30	4.50	-
e	0.65 BSC		
L	0.45	0.75	-
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	-	-
R1	0.09	-	-
X	-	-	1.350
Y	-	-	1.050
θ	0°	8°	-
θ1	5°	15°	-
θ2	0°	-	-
<b>All Dimensions in mm</b>			



## Suggested Pad Layout

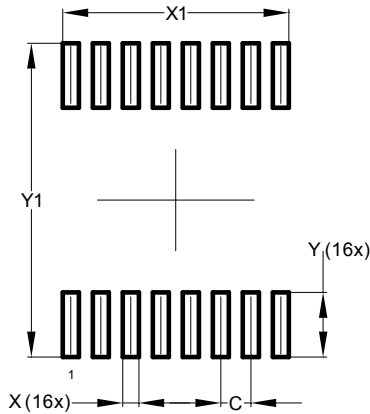
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

### 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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