

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.

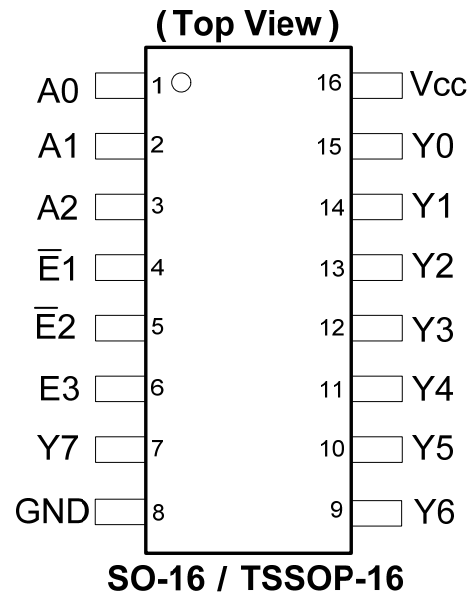
The multiple enable lines allow for the parallel expansion of decoders to create 4-to-16 line versions with no additional parts and 5-to-32 versions with the addition of a single inverter.

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](#)

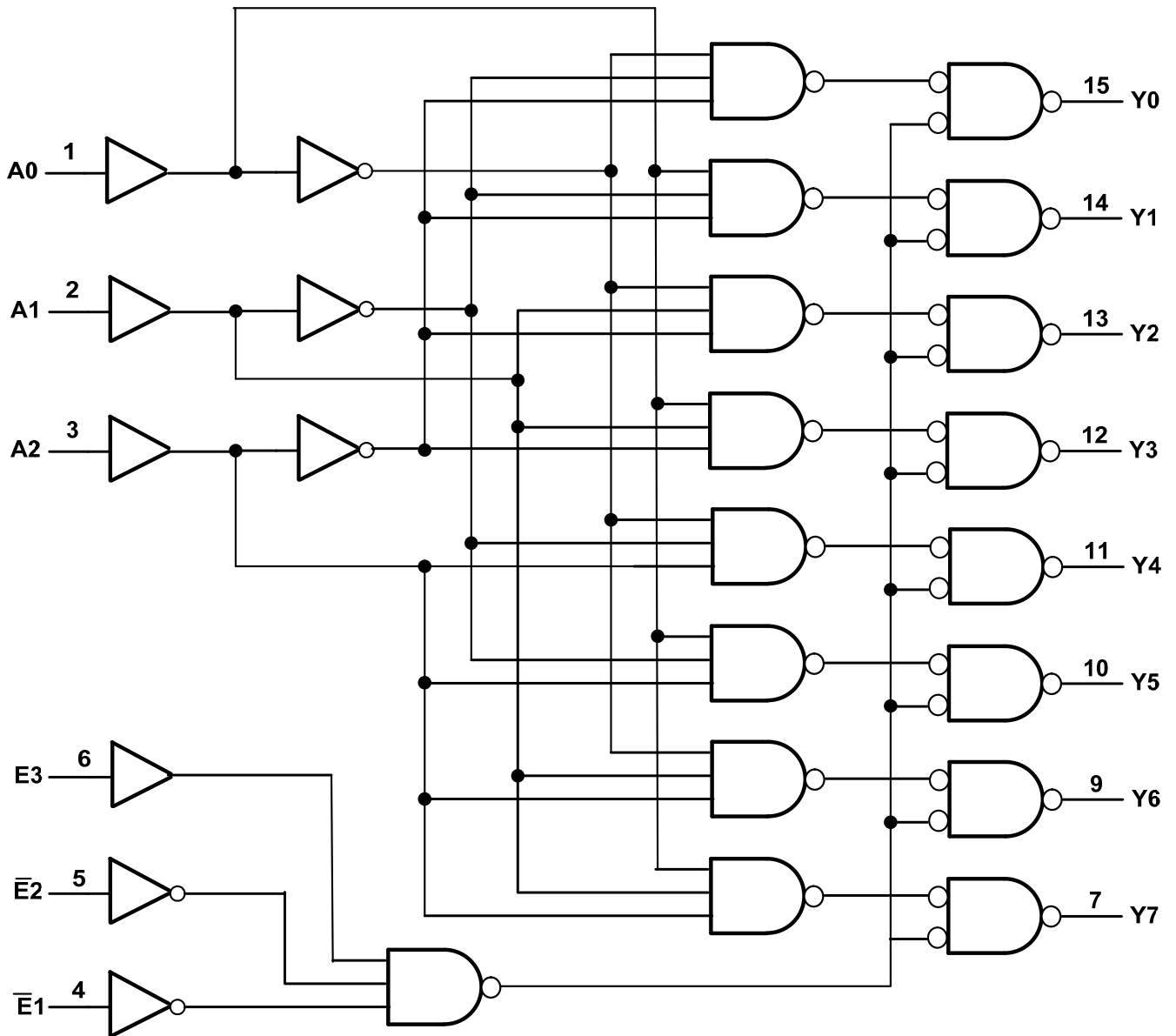
Pin Descriptions

| 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 _{cc} | 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



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

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

| 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 | – | – | ± 0.1 | – | ± 1 | – | ± 1 | μA | |
| I_{CC} | Supply Current | $V_i = \text{GND or } V_{CC}$ $I_o = 0$ | 5.5V | – | – | 8.0 | – | 80 | – | 160 | μA | |
| ΔI_{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 | μA |
| | | | | | PIN \bar{E}_n | – | 125 | 450 | – | 563 | – | |
| | | PIN E3 | – | | 100 | 360 | – | 450 | – | 490 | μA | |
| C_i | Input Capacitance | $V_i = V_{CC}$ or GND | 5.5V | – | 4 | 10 | – | 10 | – | 10 | pF | |

Switching Characteristics

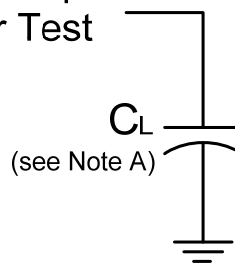
| Symbol / Parameter | Pins | Test Conditions | Vcc | $T_A = 25^\circ\text{C}$ | | | $-40^\circ\text{C to } 85^\circ\text{C}$ | | $-40^\circ\text{C to } 125^\circ\text{C}$ | | Unit |
|---|----------------------------|-----------------|-------|--------------------------|------|-----|--|-----|---|-----|------|
| | | | | 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.)

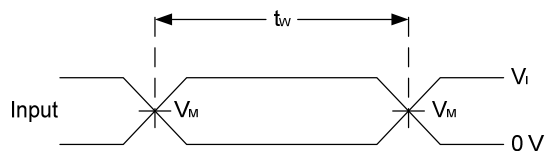
| Parameter | | Test Conditions | $V_{CC} = 5\text{V}$ | Unit |
|-----------|-------------------------------|--|----------------------|------|
| | | | TYP | |
| C_{pd} | Power Dissipation Capacitance | $f = 1\text{ MHz}$ all outputs switching-no load | 21 | pF |

Parameter Measurement Information

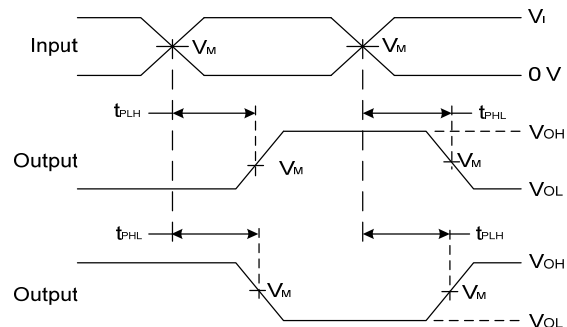
From Output Under Test



| 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

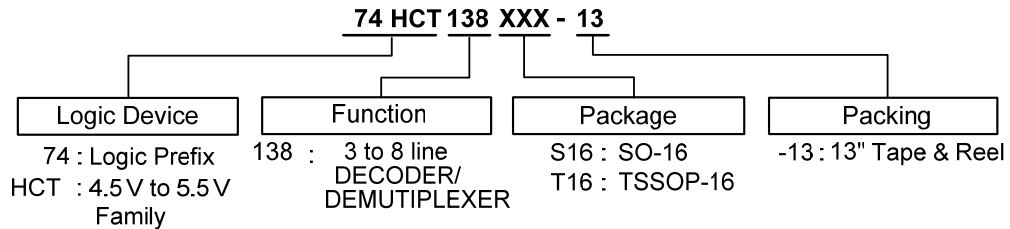


Voltage Waveform Propagation Delay Times Inverting and Non Inverting Outputs

- 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

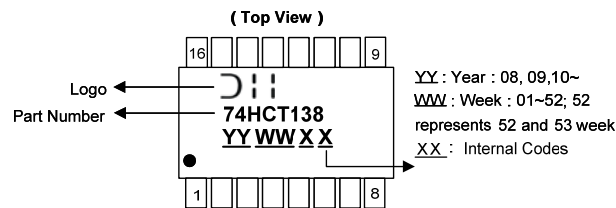


| Device | Package Code | Packaging (Note 6) | 7" Tape and Reel(Note 7) | |
|----------------|--------------|-----------------------|--------------------------|--------------------|
| | | | Quantity | Part Number Suffix |
| 74HCT138S16-13 | S16 | SO-16 | 2500/Tape & Reel | -13 |
| 74HCT138T16-13 | T16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

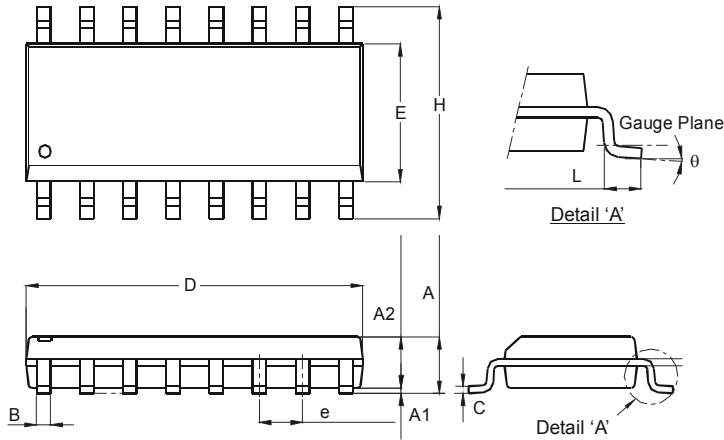


| Part Number | Package |
|-------------|----------|
| 74HCT138S16 | SO-16 |
| 74HCT138T16 | TSSOP-16 |

Package Outline Dimensions (All dimensions in mm.)

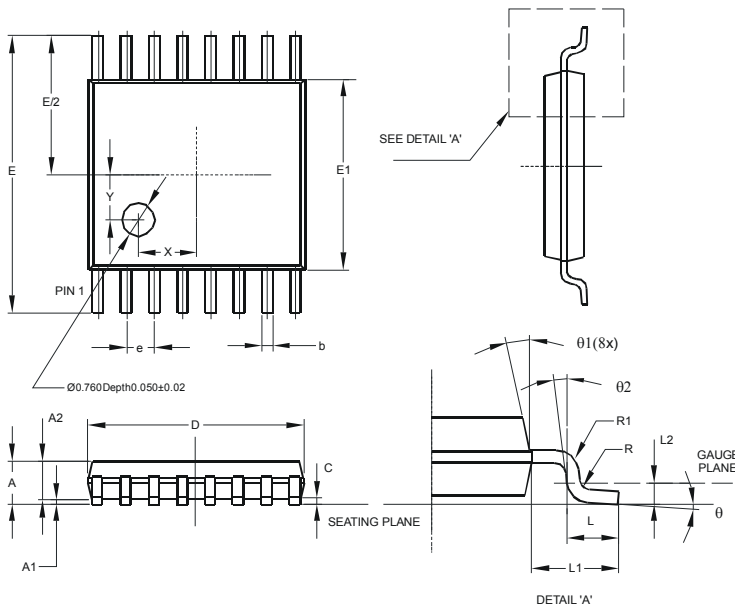
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

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° |
| All Dimensions in mm | | |

Package Type: TSSOP-16

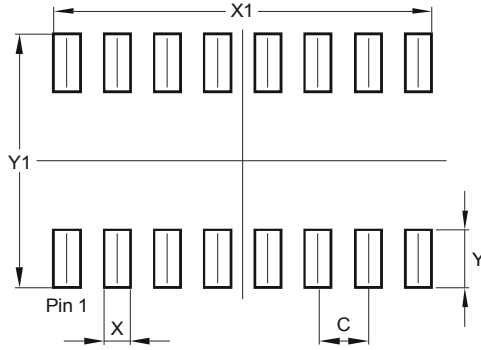


| TSSOP-16 | | | |
|-----------------------------|----------|------|-------|
| Dim | Min | Max | Typ |
| A | - | 1.08 | - |
| A1 | 0.05 | 0.15 | - |
| A2 | 0.80 | 0.93 | - |
| b | 0.19 | 0.30 | - |
| c | 0.09 | 0.20 | - |
| D | 4.90 | 5.10 | - |
| E | 6.40 BSC | | |
| E1 | 4.30 | 4.50 | - |
| e | 0.65 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 | | | |

Suggested Pad Layout

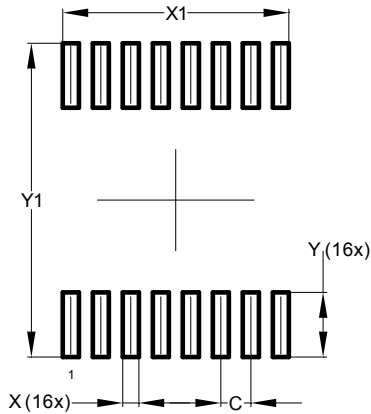
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

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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