

# SINGLE BIT DUAL POWER SUPPLY TRANSLATING TRANSCEIVER WITH 3 STATE OUTPUTS

## Description

The 74AVCH1T45 is a single bit, dual supply transceiver with 3-state outputs suitable for transmitting a single logic bit across different voltage domains. The 74AVCH1T45 is a variant of the 74AVC1T45 that includes a bus hold feature at each input. The A input/output pin is designed to track  $V_{CCA}$  while the B input/output tracks  $V_{CCB}$ . This arrangement allows for universal low-voltage translation between any voltages from 1.2V to 3.6V. The Direction pin (DIR) controls the direction of the transceiver and in a logic voltage related to  $V_{CCA}$ . When a high logic level is applied to DIR the A pin becomes an input and the B pin becomes the output. Conversely the roles of A and B are reversed when DIR is asserted low.

The 3-state feature occurs when either of the power supply voltages are zero. This is also an Ioff feature and allows for the output to remain in a high impedance state with both power supplies at 0V preventing damaging backflow currents and providing power down electrical isolation up to 3.6 V as not to interfere with any logic activity on pin A or B.

The bus hold feature maintains the previous logic level therefore a valid logic level is always present eliminating the need for additional resistors for an unused or disconnected inputs.

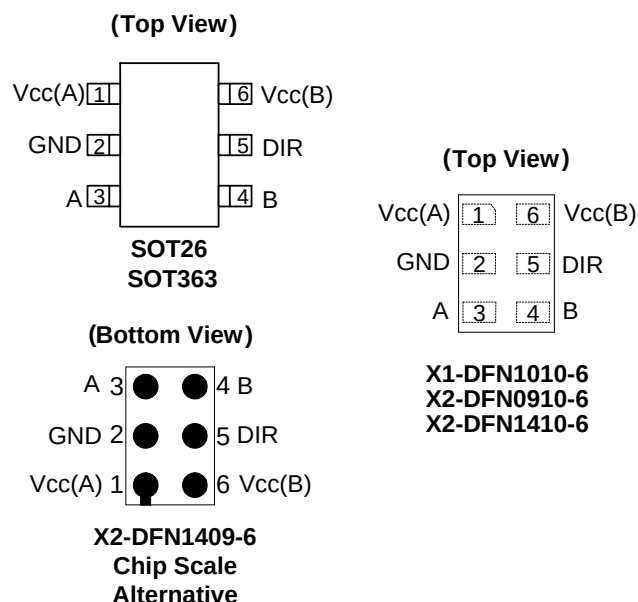
## Features

- Wide Supply Voltage Range:
  - $V_{CC}(A)$ : from 1.2V to 3.6V
  - $V_{CC}(B)$ : from 1.2V to 3.6V
- $\pm 12\text{mA}$  Output Drive at 3.3V
- High Noise Immunity - (100mV hysteresis typical)
- I<sub>OFF</sub> Supports Partial-Power-Down Mode Operation
- I<sub>OFF</sub> controlled by either  $V_{CC}$  being at 0V
- Inputs accept up to 4.6V
- ESD Protection Exceeds JESD 22
  - 200-V Machine Model (A115)
  - 2000-V Human Body Model (A114)
  - 1000 V Charged Device Model (C101)
- Latch-Up Exceeds 100mA per JESD 78, Class I
- X2-DFN1409-6 package designed as a direct replacement for chip scale packaging.
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- Halogen and Antimony Free. "Green" Device (Note 3)**

Notes:

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

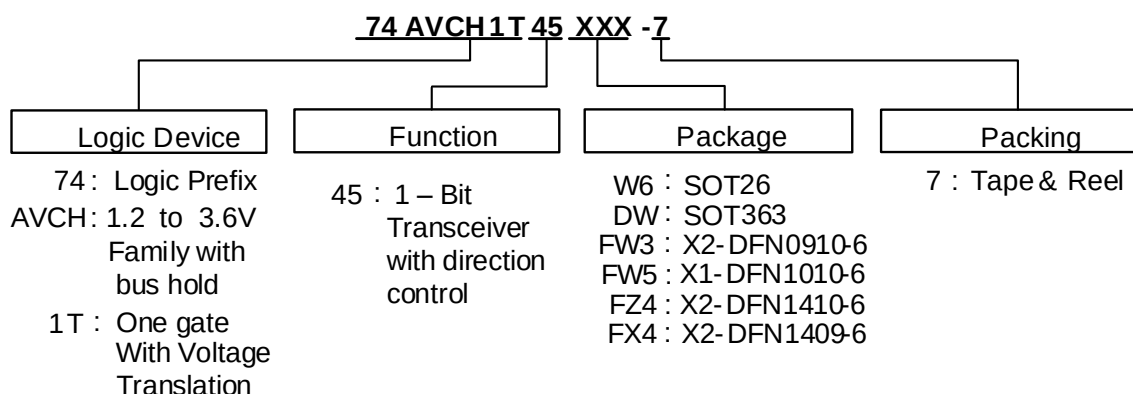
## Pin Assignments



## Applications

- Voltage Level Translation:  
Well suited to join logic types operating at different voltages
- Power Down Signal Isolation:  
If either voltage domain is turned off the signal is isolated and there is no loading on signal lines
- Wide array of products such as:
  - Cell Phones, Tablets, E-Readers
  - PCs, Notebooks, Netbooks, Ultrabooks
  - Networking, Routers, Gateways
  - Computer Peripherals, Hard Drives, CD/DVD ROMs
  - TVs, DVDs, DVRs, Set Top Boxes
  - Personal Navigation / GPS
  - MP3 players, Cameras, Video Recorders

## Ordering Information



| Part Number     | Package Code | Packaging    | 7" Tape and Reel (Note 7) |                    |
|-----------------|--------------|--------------|---------------------------|--------------------|
|                 |              |              | Quantity                  | Part Number Suffix |
| 74AVCH1T45W6-7  | W6           | SOT26        | 3,000/Tape & Reel         | -7                 |
| 74AVCH1T45DW-7  | DW           | SOT363       | 3,000/Tape & Reel         | -7                 |
| 74AVCH1T45FW3-7 | FW3          | X2-DFN0910-6 | 5,000/Tape & Reel         | -7                 |
| 74AVCH1T45FW5-7 | FW5          | X1-DFN1010-6 | 5,000/Tape & Reel         | -7                 |
| 74AVCH1T45FZ4-7 | FZ4          | X2-DFN1410-6 | 5,000/Tape & Reel         | -7                 |
| 74AVCH1T45FX4-7 | FX4          | X2-DFN1409-6 | 5,000/Tape & Reel         | -7                 |

Notes: 4. The taping orientation is located on our website at <http://www.diodes.com/datasheets/ap02007.pdf>

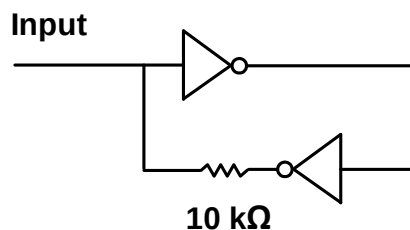
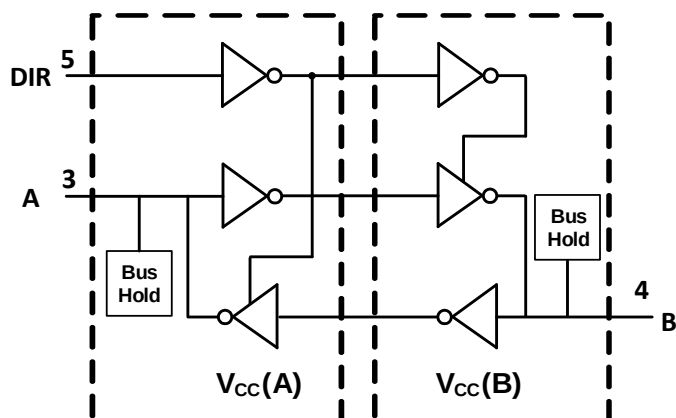
## Pin Descriptions

| Pin Name | Pin | Function                                   |
|----------|-----|--------------------------------------------|
| VCC(A)   | 1   | Supply for I/O pin A and reference for DIR |
| GND      | 2   | Ground                                     |
| A        | 3   | Data Input/Output                          |
| B        | 4   | Data Input/Output                          |
| DIR      | 5   | Direction Control                          |
| VCC(B)   | 6   | Supply for I/O pin B                       |

## Function Table

| Supply voltage                          | Input               | Input/Output |       |
|-----------------------------------------|---------------------|--------------|-------|
| V <sub>CC(A)</sub> , V <sub>CC(B)</sub> | DIR (Direction Pin) | A            | B     |
| 1.2 V to 3.6 V                          | L                   | A=B          | input |
| 1.2 V to 3.6 V                          | H                   | input        | B=A   |
| GND                                     | X                   | Z            | Z     |

### Logic Diagram



## Bus Hold Circuit

**Previous Input is Latched**  
**Input Signals must be strong**  
**enough to override 10k $\Omega$**

### Absolute Maximum Ratings (Note 5) (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Symbol                                  | Parameter                                                             |       | 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 <sub>CC(A)</sub> , V <sub>CC(B)</sub> | Supply Voltage Range                                                  |       | -0.5 to +4.6                    | V    |
| V <sub>I</sub>                          | Input Voltage Range                                                   |       | -0.5 to +4.6                    | V    |
| V <sub>O</sub>                          | Voltage Applied to Output in High Impedance or I <sub>OFF</sub> State |       | -0.5 to +4.6                    | V    |
| V <sub>O</sub>                          | Voltage Applied to Output in High or Low State                        | A pin | -0.5 to V <sub>CC(A)</sub> +0.5 | V    |
|                                         |                                                                       | B pin | -0.5 to V <sub>CC(B)</sub> +0.5 | V    |
| I <sub>IK</sub>                         | Input Clamp Current V <sub>I</sub> <0                                 |       | -50                             | mA   |
| I <sub>OK</sub>                         | Output Clamp Current                                                  |       | -50                             | mA   |
| I <sub>O</sub>                          | Continuous Output Current                                             |       | ±50                             | mA   |
|                                         | Continuous Current Through V <sub>CC</sub> or GND                     |       | ±100                            | mA   |
| T <sub>J</sub>                          | Operating Junction Temperature                                        |       | -40 to +150                     | °C   |
| T <sub>STG</sub>                        | Storage Temperature                                                   |       | -65 to +150                     | °C   |

Note: 5. 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 Condition** (Notes 6, 7 & 8) (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Symbol             | Parameter                          |                                       | V <sub>CCI</sub> | V <sub>CCO</sub> | Min                       | Max                       | Units |
|--------------------|------------------------------------|---------------------------------------|------------------|------------------|---------------------------|---------------------------|-------|
| V <sub>CC(A)</sub> | Operating Voltage                  |                                       | —                | —                | 1.2                       | 3.6                       | V     |
| V <sub>CC(B)</sub> | Operating Voltage                  |                                       | —                | —                | 1.2                       | 3.6                       | V     |
| V <sub>IH</sub>    | High-Level Input Voltage           | Data Inputs                           | 1.2 to 1.95V     | 1.2 to 3.6V      | 0.65 x V <sub>CC(A)</sub> | —                         | V     |
|                    |                                    |                                       | 1.95 to 2.7V     | 1.2 to 3.6V      | 1.6                       | —                         |       |
|                    |                                    |                                       | 2.7V to 3.6V     | 1.2 to 3.6V      | 2                         | —                         |       |
| V <sub>IL</sub>    | Low-Level Input Voltage            | Data Inputs                           | 1.2 to 1.95V     | 1.2 to 3.6V      | —                         | 0.35 x V <sub>CC(A)</sub> | V     |
|                    |                                    |                                       | 1.95 to 2.7V     | 1.2 to 3.6V      | —                         | 0.7                       |       |
|                    |                                    |                                       | 2.7V to 3.6V     | 1.2 to 3.6V      | —                         | 0.8                       |       |
| V <sub>IH</sub>    | High-Level Input Voltage           | DIR (referenced to V <sub>CCA</sub> ) | 1.2 to 1.95V     | 1.2 to 3.6V      | 0.65 x V <sub>CC(B)</sub> | —                         | V     |
|                    |                                    |                                       | 1.95 to 2.7V     | 1.2 to 3.6V      | 1.6                       | —                         |       |
|                    |                                    |                                       | 2.7 to 3.6V      | 1.2 to 3.6V      | 2                         | —                         |       |
| V <sub>IL</sub>    | Low-Level Input Voltage            | DIR (referenced to V <sub>CCA</sub> ) | 1.2 to 1.95V     | 1.2 to 3.6V      | —                         | 0.35 x V <sub>CC(B)</sub> | V     |
|                    |                                    |                                       | 1.95 to 2.7V     | 1.2 to 3.6V      | —                         | 0.7                       |       |
|                    |                                    |                                       | 2.7 to 3.6V      | 1.2 to 3.6V      | —                         | 0.8                       |       |
| V <sub>I</sub>     | Input Voltage                      |                                       | —                | —                | 0                         | 3.6                       | V     |
| V <sub>O</sub>     | Output Voltage                     | Active state                          | —                | —                | 0                         | V <sub>CCO</sub>          | V     |
|                    |                                    | 3-state                               | —                | —                | 0                         | 3.6                       | V     |
| I <sub>OH</sub>    | High-Level Output Current          |                                       | 1.2 to 3.6V      | 1.2V             | —                         | -3                        | mA    |
|                    |                                    |                                       | 1.2 to 3.6V      | 1.4 to 1.6V      | —                         | -6                        |       |
|                    |                                    |                                       | 1.2 to 3.6V      | 1.65 to 1.95V    | —                         | -8                        |       |
|                    |                                    |                                       | 1.2 to 3.6V      | 2.3 to 2.7V      | —                         | -9                        |       |
|                    |                                    |                                       | 1.2 to 3.6V      | 3 to 3.6V        | —                         | -12                       |       |
| I <sub>OL</sub>    | Low-Level Output Current           |                                       | 1.2 to 3.6V      | 1.2V             | —                         | 3                         | mA    |
|                    |                                    |                                       | 1.2 to 3.6V      | 1.4 to 1.6V      | —                         | 6                         |       |
|                    |                                    |                                       | 1.2 to 3.6V      | 1.65 to 1.95V    | —                         | 8                         |       |
|                    |                                    |                                       | 1.2 to 3.6V      | 2.3 to 2.7V      | —                         | 9                         |       |
|                    |                                    |                                       | 1.2 to 3.6V      | 3 to 3.6V        | —                         | 12                        |       |
| Δt/ΔV              | Input Transition Rise or Fall Rate |                                       | 1.2 to 3.6V      | 1.2 to 3.6V      | —                         | 5                         | ns/V  |
| T <sub>A</sub>     | Operating Free-Air Temperature     |                                       |                  |                  | -40                       | +85                       | °C    |

- Note:
6. V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.
  7. V<sub>CCI</sub> is the V<sub>CC</sub> associated with the input port.
  8. All unused inputs of the device must be held at V<sub>CCI</sub> of GND.

**Electrical Characteristics** (Notes 9 & 10) (@T<sub>A</sub> = +40°C to +85°C, unless otherwise specified.)

| Symbol                              | Parameter                  | Test Conditions                                                | V <sub>CC</sub> (A)                          | V <sub>CC</sub> (B) | T <sub>A</sub> = +25°C |       |      | T <sub>A</sub> = -40°C to +85°C |      | Unit |
|-------------------------------------|----------------------------|----------------------------------------------------------------|----------------------------------------------|---------------------|------------------------|-------|------|---------------------------------|------|------|
|                                     |                            |                                                                |                                              |                     | Min                    | Typ   | Max  | Min                             | Max  |      |
| V <sub>OH</sub>                     | High Level Output Voltage  | I <sub>OH</sub> = -100μA                                       | 1.2 to 3.6V                                  | 1.2V to 3.6V        | —                      | —     | —    | V <sub>CC</sub> - 0.2           | —    | V    |
|                                     |                            | I <sub>OH</sub> = -3mA                                         | 1.2V                                         | 1.2V                | —                      | 0.95  | —    | —                               | —    |      |
|                                     |                            | I <sub>OH</sub> = -6mA                                         | 1.4V                                         | 1.4V                | —                      | —     | —    | 1.05                            | —    |      |
|                                     |                            | I <sub>OH</sub> = -8mA                                         | 1.65V                                        | 1.65V               | —                      | —     | —    | 1.2                             | —    |      |
|                                     |                            | I <sub>OH</sub> = -9mA                                         | 2.3V                                         | 2.3V                | —                      | —     | —    | 1.75                            | —    |      |
|                                     |                            | I <sub>OH</sub> = -12mA                                        | 3V                                           | 3V                  | —                      | —     | —    | 2.3                             | —    |      |
| V <sub>OL</sub>                     | Low-Level Output Voltage   | I <sub>OL</sub> = 100μA                                        | 1.2 to 3.6V                                  | 1.2V to 3.6V        | —                      | —     | —    | —                               | 0.2  | V    |
|                                     |                            | I <sub>OL</sub> = 3mA                                          | 1.2V                                         | 1.2V                | —                      | 0.15  | —    | —                               | —    |      |
|                                     |                            | I <sub>OL</sub> = 6mA                                          | 1.4V                                         | 1.4V                | —                      | —     | —    | —                               | 0.35 |      |
|                                     |                            | I <sub>OL</sub> = 8mA                                          | 1.65V                                        | 1.65V               | —                      | —     | —    | —                               | 0.45 |      |
|                                     |                            | I <sub>OL</sub> = 9mA                                          | 2.3V                                         | 2.3V                | —                      | —     | —    | —                               | 0.55 |      |
|                                     |                            | I <sub>OL</sub> = 12mA                                         | 3V                                           | 3V                  | —                      | —     | —    | —                               | 0.7  |      |
| I <sub>I</sub>                      | Input Current              | DIR V <sub>I</sub> = V <sub>CC</sub> (A) or GND                | 1.2 to 3.6V                                  | 1.2 to 3.6V         | -0.25                  | ±0.25 | 0.25 | -1                              | 1    | μA   |
| I <sub>OFF</sub>                    | Power Down Leakage Current | A Pin                                                          | V <sub>I</sub> or V <sub>O</sub> = 0 to 3.6V | 0V                  | -1                     | ±0.1  | 1    | -5                              | 5    | μA   |
|                                     |                            | B Pin                                                          |                                              | 0 to 3.6V           | -1                     | ±0.1  | 1    | -5                              | 5    |      |
| I <sub>OZ</sub>                     | 3-State Leakage Current    | B Pin                                                          | V <sub>O</sub> = V <sub>CCO</sub> or Gnd     | 0V                  | -2.5                   | ±0.5  | 2.5  | -5                              | 5    | μA   |
|                                     |                            | A Pin                                                          | V <sub>I</sub> = V <sub>CCI</sub> or Gnd     | 0 to 3.6V           | -2.5                   | ±0.5  | 2.5  | -5                              | 5    |      |
| I <sub>CCA</sub>                    | Supply Current             | V <sub>I</sub> = V <sub>CCI</sub> or GND<br>I <sub>O</sub> = 0 | 1.2 to 3.6V                                  | 11.2 to 3.6V        | —                      | —     | —    | —                               | 10   | μA   |
|                                     |                            |                                                                | 3.6V                                         | 0V                  | —                      | —     | —    | —                               | -2   |      |
|                                     |                            |                                                                | 0V                                           | 3.6V                | —                      | —     | —    | —                               | 10   |      |
| I <sub>CCB</sub>                    | Supply Current             | V <sub>I</sub> = V <sub>CCi</sub> or GND<br>I <sub>O</sub> = 0 | 1.2 to 3.6V                                  | 1.2 to 3.6V         | —                      | —     | —    | —                               | 10   | μA   |
|                                     |                            |                                                                | 0V                                           | 3.6V                | —                      | —     | —    | —                               | 10   |      |
|                                     |                            |                                                                | 3.6V                                         | 0V                  | —                      | —     | —    | —                               | -2   |      |
| I <sub>CCA</sub> + I <sub>CCB</sub> | Supply Current             | V <sub>I</sub> = V <sub>CCi</sub> or GND<br>I <sub>O</sub> = 0 | 1.2 to 3.6V                                  | 1.2 to 3.6V         | —                      | —     | —    | —                               | 20   | μA   |
| C <sub>I</sub>                      | Input Capacitance          | DIR V <sub>I</sub> = V <sub>CC</sub> (A) or GND                | 3.3V                                         | 3.3V                | —                      | 2.5   | —    | —                               | —    | pF   |
| C <sub>IO</sub>                     | Input/Output Capacitance   | A or B pin V <sub>I</sub> = V <sub>CC</sub> (A)/(B) or GND     | 3.3V                                         | 3.3V                | —                      | 6.0   | —    | —                               | —    | pF   |

Notes: 9. V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.  
10. V<sub>CCi</sub> is the V<sub>CC</sub> associated with the input port.

## Package Characteristics (V<sub>CC</sub> = 3.3V, T<sub>A</sub> = +25°C, unless otherwise specified.)

| Symbol        | Parameter                              | Package      | Test Conditions | Min | Typ | Max | Unit |
|---------------|----------------------------------------|--------------|-----------------|-----|-----|-----|------|
| $\theta_{JA}$ | Thermal Resistance Junction-to-Ambient | SOT26        | (Note 11)       | —   | 166 | —   | °C/W |
|               |                                        | SOT363       |                 | —   | 371 | —   |      |
|               |                                        | X2-DFN0910-6 |                 | —   | 530 | —   |      |
|               |                                        | X2-DFN1410-6 |                 | —   | 430 | —   |      |
|               |                                        | X2-DFN1409-6 |                 | —   | 450 | —   |      |
|               |                                        | X1-DFN1010-6 |                 | —   | 510 | —   |      |
| $\theta_{JC}$ | Thermal Resistance Junction-to-Case    | SOT26        | (Note 11)       | —   | 46  | —   | °C/W |
|               |                                        | SOT363       |                 | —   | 143 | —   |      |
|               |                                        | X2-DFN0910-6 |                 | —   | 260 | —   |      |
|               |                                        | X2-DFN1410-6 |                 | —   | 190 | —   |      |
|               |                                        | X2-DFN1409-6 |                 | —   | 200 | —   |      |
|               |                                        | X1-DFN1010-6 |                 | —   | 250 | —   |      |

Note: 11. Test condition for all packages: Device mounted on FR-4 substrate PC board, 2oz copper with minimum recommended pad layout.

## Switching Characteristics

V<sub>CC</sub> (A) = 1.2V, T<sub>A</sub> = -40°C to +85°C, See Figure 1

| Parameter          | From (Input) | To (Output) | V <sub>CC</sub> (B) = 1.2V | V <sub>CC</sub> (B) = 1.5V ±0.1 | V <sub>CC</sub> (B) = 1.8V ±0.15V | V <sub>CC</sub> (B) = 2.5V ±0.2V | V <sub>CC</sub> (B) = 3.3V ±0.3V | Unit |
|--------------------|--------------|-------------|----------------------------|---------------------------------|-----------------------------------|----------------------------------|----------------------------------|------|
|                    |              |             | TYP                        | TYP                             | TYP                               | TYP                              | TYP                              |      |
| t <sub>PLH</sub>   | A            | B           | 3.3                        | 2.7                             | 2.4                               | 2.3                              | 2.4                              | ns   |
| t <sub>PHL</sub>   |              |             | 3.3                        | 2.7                             | 2.4                               | 2.3                              | 2.4                              |      |
| t <sub>PLH</sub>   | B            | A           | 3.3                        | 3.1                             | 2.9                               | 2.8                              | 2.7                              | ns   |
| t <sub>PHL</sub>   |              |             | 3.3                        | 3.1                             | 2.9                               | 2.8                              | 2.7                              |      |
| t <sub>PHZ</sub>   | DIR          | A           | 5.1                        | 5.2                             | 5.3                               | 5.2                              | 3.7                              | ns   |
| t <sub>PLZ</sub>   |              |             | 5.1                        | 5.2                             | 5.3                               | 5.2                              | 3.7                              |      |
| t <sub>PHZ</sub>   | DIR          | B           | 5.3                        | 4.3                             | 4.0                               | 3.3                              | 3.7                              | ns   |
| t <sub>PLZ</sub>   |              |             | 5.3                        | 4.3                             | 4.0                               | 3.3                              | 3.7                              |      |
| t <sub>PZH</sub> * | DIR          | A           | 8.6                        | 7.3                             | 6.8                               | 6.1                              | 6.4                              | ns   |
| t <sub>PZL</sub> * |              |             | 8.6                        | 7.3                             | 6.8                               | 6.1                              | 6.4                              |      |
| t <sub>PZH</sub> * | DIR          | B           | 8.3                        | 7.8                             | 7.7                               | 7.5                              | 5.8                              | ns   |
| t <sub>PZL</sub> * |              |             | 8.3                        | 7.8                             | 7.7                               | 7.5                              | 5.8                              |      |

\*Enable times are calculated vales see table at end of switching characteristics.

V<sub>CC</sub> (A) = 1.5V ± 0.1V, T<sub>A</sub> = -40°C to +85°C, See Figure 1

| Parameter          | From (Input) | To (Output) | V <sub>CC</sub> (B) = 1.2V | V <sub>CC</sub> (B) = 1.5V ±0.1 |      | V <sub>CC</sub> (B) = 1.8V ±0.15V |      | V <sub>CC</sub> (B) = 2.5V ±0.2V |      | V <sub>CC</sub> (B) = 3.3V ±0.3V |      | Unit |
|--------------------|--------------|-------------|----------------------------|---------------------------------|------|-----------------------------------|------|----------------------------------|------|----------------------------------|------|------|
|                    |              |             | TYP                        | Min                             | Max  | Min                               | Max  | Min                              | Max  | Min                              | Max  |      |
| t <sub>PLH</sub>   | A            | B           | 2.9                        | 0.7                             | 5.6  | 0.6                               | 5.2  | 0.5                              | 4.2  | 0.5                              | 3.8  | ns   |
| t <sub>PHL</sub>   |              |             | 2.9                        | 0.7                             | 5.6  | 0.6                               | 5.2  | 0.5                              | 4.2  | 0.5                              | 3.8  |      |
| t <sub>PLH</sub>   | B            | A           | 2.6                        | 0.6                             | 5.5  | 0.4                               | 5.3  | 0.3                              | 4.9  | 0.3                              | 4.8  | ns   |
| t <sub>PHL</sub>   |              |             | 2.6                        | 0.6                             | 5.5  | 0.4                               | 5.3  | 0.3                              | 4.9  | 0.3                              | 4.8  |      |
| t <sub>PHZ</sub>   | DIR          | A           | 3.8                        | 1.6                             | 6.7  | 1.5                               | 6.8  | 0.3                              | 6.9  | 0.9                              | 6.9  | ns   |
| t <sub>PLZ</sub>   |              |             | 3.8                        | 1.6                             | 6.7  | 1.5                               | 6.8  | 0.3                              | 6.9  | 0.9                              | 6.9  |      |
| t <sub>PHZ</sub>   | DIR          | B           | 5.1                        | 1.8                             | 8.1  | 1.6                               | 7.1  | 1.1                              | 4.7  | 1.4                              | 4.5  | ns   |
| t <sub>PLZ</sub>   |              |             | 5.1                        | 1.8                             | 8.1  | 1.6                               | 7.1  | 1.1                              | 4.7  | 1.4                              | 4.5  |      |
| t <sub>PZH</sub> * | DIR          | A           | 7.7                        | —                               | 13.6 | —                                 | 12.4 | —                                | 9.6  | —                                | 9.3  | ns   |
| t <sub>PZL</sub> * |              |             | 7.7                        | —                               | 13.6 | —                                 | 12.4 | —                                | 9.6  | —                                | 9.3  |      |
| t <sub>PZH</sub> * | DIR          | B           | 6.7                        | —                               | 12.3 | —                                 | 12   | —                                | 11.1 | —                                | 10.7 | ns   |
| t <sub>PZL</sub> * |              |             | 6.7                        | —                               | 12.3 | —                                 | 12   | —                                | 11.1 | —                                | 10.7 |      |

\*Enable times are calculated vales see table at end of switching characteristics.

## Switching Characteristics (Continued)

$V_{CC}(A) = 1.8V \pm 0.15V$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ , See Figure 1

| Parameter   | From (Input) | To (Output) | $V_{CC}(B) = 1.2V$ | $V_{CC}(B) = 1.5V \pm 0.1$ |      | $V_{CC}(B) = 1.8V \pm 0.15V$ |      | $V_{CC}(B) = 2.5V \pm 0.2V$ |     | $V_{CC}(B) = 3.3V \pm 0.3V$ |     | Unit |
|-------------|--------------|-------------|--------------------|----------------------------|------|------------------------------|------|-----------------------------|-----|-----------------------------|-----|------|
|             |              |             | TYP                | Min                        | Max  | Min                          | Max  | Min                         | Max | Min                         | Max |      |
| $t_{PLH}$   | A            | B           | 2.7                | 0.6                        | 5.3  | 0.5                          | 5.0  | 0.4                         | 3.9 | 0.4                         | 3.4 | ns   |
| $t_{PHL}$   |              |             | 2.7                | 0.6                        | 5.3  | 0.5                          | 5.0  | 0.4                         | 3.9 | 0.4                         | 3.4 |      |
| $t_{PLH}$   | B            | A           | 2.3                | 0.5                        | 5.2  | 0.4                          | 5.0  | 0.3                         | 4.6 | 0.2                         | 4.4 | ns   |
| $t_{PHL}$   |              |             | 2.3                | 0.5                        | 5.2  | 0.4                          | 5.0  | 0.3                         | 4.6 | 0.2                         | 4.4 |      |
| $t_{PHZ}$   | DIR          | A           | 3.8                | 1.6                        | 5.9  | 1.6                          | 5.9  | 1.6                         | 5.9 | 0.5                         | 6.0 | ns   |
| $t_{PLZ}$   |              |             | 3.8                | 1.6                        | 5.9  | 1.6                          | 5.9  | 1.6                         | 5.9 | 0.5                         | 6.0 |      |
| $t_{PHZ}$   | DIR          | B           | 5.0                | 1.8                        | 7.7  | 1.4                          | 6.8  | 1.0                         | 4.4 | 1.4                         | 5.3 | ns   |
| $t_{PLZ}$   |              |             | 5.0                | 1.8                        | 7.7  | 1.4                          | 6.8  | 1.0                         | 4.4 | 1.4                         | 5.3 |      |
| $t_{PZH}^*$ | DIR          | A           | 7.3                | —                          | 12.9 | —                            | 11.8 | —                           | 9.0 | —                           | 8.7 | ns   |
| $t_{PZL}^*$ |              |             | 7.3                | —                          | 12.9 | —                            | 11.8 | —                           | 9.0 | —                           | 8.7 |      |
| $t_{PZH}^*$ | DIR          | B           | 6.5                | —                          | 11.2 | —                            | 10.9 | —                           | 9.8 | —                           | 9.4 | ns   |
| $t_{PZL}^*$ |              |             | 6.5                | —                          | 11.2 | —                            | 10.9 | —                           | 9.8 | —                           | 9.4 |      |

\*Enable times are calculated vales see table at end of switching characteristics.

$V_{CC}(A) = 2.5V \pm 0.2V$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ , See Figure 1

| Parameter   | From (Input) | To (Output) | $V_{CC}(B) = 1.2V$ | $V_{CC}(B) = 1.5V \pm 0.1$ |      | $V_{CC}(B) = 1.8V \pm 0.15V$ |      | $V_{CC}(B) = 2.5V \pm 0.2V$ |     | $V_{CC}(B) = 3.3V \pm 0.3V$ |     | Unit |
|-------------|--------------|-------------|--------------------|----------------------------|------|------------------------------|------|-----------------------------|-----|-----------------------------|-----|------|
|             |              |             | TYP                | Min                        | Max  | Min                          | Max  | Min                         | Max | Min                         | Max |      |
| $t_{PLH}$   | A            | B           | 2.6                | 0.5                        | 4.9  | 0.4                          | 4.6  | 0.3                         | 3.4 | 0.3                         | 3.0 | ns   |
| $t_{PHL}$   |              |             | 2.6                | 0.5                        | 4.9  | 0.4                          | 4.6  | 0.3                         | 3.4 | 0.3                         | 3.0 |      |
| $t_{PLH}$   | B            | A           | 2.2                | 0.4                        | 4.2  | 0.3                          | 3.8  | 0.2                         | 3.4 | 0.2                         | 3.3 | ns   |
| $t_{PHL}$   |              |             | 2.2                | 0.4                        | 4.2  | 0.3                          | 3.8  | 0.2                         | 3.4 | 0.2                         | 3.3 |      |
| $t_{PHZ}$   | DIR          | A           | 2.8                | 0.3                        | 3.8  | 0.8                          | 3.8  | 0.4                         | 3.8 | 0.5                         | 3.8 | ns   |
| $t_{PLZ}$   |              |             | 2.8                | 0.3                        | 3.8  | 0.8                          | 3.8  | 0.4                         | 3.8 | 0.5                         | 3.8 |      |
| $t_{PHZ}$   | DIR          | B           | 4.9                | 2.0                        | 7.6  | 1.5                          | 6.5  | 0.6                         | 4.1 | 1.0                         | 4.0 | ns   |
| $t_{PLZ}$   |              |             | 4.9                | 2.0                        | 7.6  | 1.5                          | 6.5  | 0.6                         | 4.1 | 1.0                         | 4.0 |      |
| $t_{PZH}^*$ | DIR          | A           | 7.1                | —                          | 11.8 | —                            | 10.3 | —                           | 7.5 | —                           | 7.3 | ns   |
| $t_{PZL}^*$ |              |             | 7.1                | —                          | 11.8 | —                            | 10.3 | —                           | 7.5 | —                           | 7.3 |      |
| $t_{PZH}^*$ | DIR          | B           | 5.4                | —                          | 8.6  | —                            | 8.1  | —                           | 7.0 | —                           | 6.6 | ns   |
| $t_{PZL}^*$ |              |             | 5.4                | —                          | 8.6  | —                            | 8.1  | —                           | 7.0 | —                           | 6.6 |      |

\*Enable times are calculated vales see table at end of switching characteristics.

$V_{CC}(A) = 3.3V \pm 0.3V$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ , See Figure 1

| Parameter   | From (Input) | To (Output) | $V_{CC}(B) = 1.2V$ | $V_{CC}(B) = 1.5V \pm 0.1$ |      | $V_{CC}(B) = 1.8V \pm 0.15V$ |     | $V_{CC}(B) = 2.5V \pm 0.2V$ |     | $V_{CC}(B) = 3.3V \pm 0.3V$ |     | Unit |
|-------------|--------------|-------------|--------------------|----------------------------|------|------------------------------|-----|-----------------------------|-----|-----------------------------|-----|------|
|             |              |             | TYP                | Min                        | Max  | Min                          | Max | Min                         | Max | Min                         | Max |      |
| $t_{PLH}$   | A            | B           | 2.6                | 0.4                        | 4.7  | 0.3                          | 4.4 | 0.2                         | 3.3 | 0.2                         | 2.8 | ns   |
| $t_{PHL}$   |              |             | 2.6                | 0.4                        | 4.7  | 0.3                          | 4.4 | 0.2                         | 3.3 | 0.2                         | 2.8 |      |
| $t_{PLH}$   | B            | A           | 2.2                | 0.4                        | 3.8  | 0.3                          | 3.4 | 0.2                         | 3   | 0.1                         | 2.8 | ns   |
| $t_{PHL}$   |              |             | 2.2                | 0.4                        | 3.8  | 0.3                          | 3.4 | 0.2                         | 3   | 0.1                         | 2.8 |      |
| $t_{PHZ}$   | DIR          | A           | 3.1                | 1.3                        | 4.3  | 1.3                          | 4.3 | 1.3                         | 4.3 | 1.3                         | 4.3 | ns   |
| $t_{PLZ}$   |              |             | 3.1                | 1.3                        | 4.3  | 1.3                          | 4.3 | 1.3                         | 4.3 | 1.3                         | 4.3 |      |
| $t_{PHZ}$   | DIR          | B           | 4                  | 0.7                        | 7.4  | 0.6                          | 6.5 | 0.7                         | 4   | 1.5                         | 4.9 | ns   |
| $t_{PLZ}$   |              |             | 4                  | 0.7                        | 7.4  | 0.6                          | 6.5 | 0.7                         | 4   | 1.5                         | 4.9 |      |
| $t_{PZH}^*$ | DIR          | A           | 6.2                | —                          | 11.2 | —                            | 9.9 | —                           | 7   | —                           | 6.7 | ns   |
| $t_{PZL}^*$ |              |             | 6.2                | —                          | 11.2 | —                            | 9.9 | —                           | 7   | —                           | 6.7 |      |
| $t_{PZH}^*$ | DIR          | B           | 5.7                | —                          | 8.9  | —                            | 8.5 | —                           | 7.2 | —                           | 6.8 | ns   |
| $t_{PZL}^*$ |              |             | 5.7                | —                          | 8.9  | —                            | 8.5 | —                           | 7.2 | —                           | 6.8 |      |

\*Enable times are calculated vales see table at end of switching characteristics.

## Enable Time Calculations

Enable times can be calculated as follows:

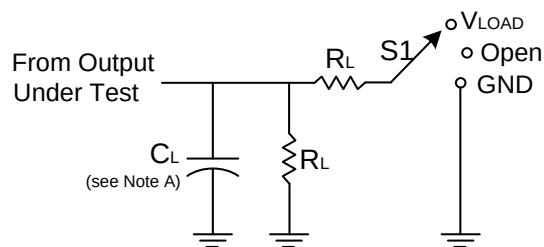
- $t_{PZH} \text{ (DIR to A)} = t_{PLZ} \text{ (DIR to B)} + t_{PLH} \text{ (B to A)}$
- $t_{PZL} \text{ (DIR to A)} = t_{PHZ} \text{ (DIR to B)} + t_{PHL} \text{ (B to A)}$
- $t_{PZH} \text{ (DIR to B)} = t_{PLZ} \text{ (DIR to A)} + t_{PLH} \text{ (A to B)}$
- $t_{PZL} \text{ (DIR to B)} = t_{PHZ} \text{ (DIR to A)} + t_{PHL} \text{ (A to B)}$

These times represent the length of time from a direction change plus the propagation time through the part.  
A new input signal should not be applied until the new input pin has been disabled.

## Operating Characteristics (T<sub>A</sub> = +25°C, unless otherwise specified.)

| Parameter<br>Power Dissipation Capacitance |                     | Test<br>Conditions                                    | V <sub>CC</sub> (A) =<br>V <sub>CC</sub> (B) = 1.8V | V <sub>CC</sub> (A) =<br>V <sub>CC</sub> (B) = 2.5V | V <sub>CC</sub> (A) =<br>V <sub>CC</sub> (B) = 3.3V | V <sub>CC</sub> (A) =<br>V <sub>CC</sub> (B) = 5V | Unit |
|--------------------------------------------|---------------------|-------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|---------------------------------------------------|------|
|                                            |                     |                                                       | Typ                                                 | Typ                                                 | Typ                                                 | Typ                                               |      |
| C <sub>PD</sub> (A)                        | A- input, B- output | C <sub>L</sub> = 0 pF<br>f = 10 MHz<br>tr = tf = 1 ns | 3                                                   | 4                                                   | 4                                                   | 4                                                 | pF   |
|                                            | B- input, A- output |                                                       | 18                                                  | 19                                                  | 20                                                  | 21                                                |      |
| C <sub>PD</sub> (B)                        | A- input, B- output | C <sub>L</sub> = 0 pF<br>f = 10 MHz<br>tr = tf = 1 ns | 18                                                  | 19                                                  | 20                                                  | 21                                                | pF   |
|                                            | B- input, A- output |                                                       | 3                                                   | 4                                                   | 4                                                   | 4                                                 |      |

## Parameter Measurement Information



| TEST              | S1    |
|-------------------|-------|
| $t_{PLH}/t_{PHL}$ | Open  |
| $t_{PLZ}/t_{PZL}$ | Vload |
| $t_{PHZ}/t_{PZH}$ | GND   |

| $V_{CC}$         | Inputs    |                     | $V_M$       | $V_{LOAD}$         | $C_L$ | $R_L$       | $V_{\Delta}$ |
|------------------|-----------|---------------------|-------------|--------------------|-------|-------------|--------------|
|                  | $V_I$     | $t_R/t_F$           |             |                    |       |             |              |
| 1.2V             | $V_{CCI}$ | $\leq 2\text{ns}$   | $V_{CCO}/2$ | $2 \times V_{CCO}$ | 15pF  | 2K $\Omega$ | 0.15V        |
| 1.8V $\pm$ 0.15V | $V_{CCI}$ | $\leq 2\text{ns}$   | $V_{CCO}/2$ | $2 \times V_{CCO}$ | 15pF  | 2K $\Omega$ | 0.15V        |
| 2.5V $\pm$ 0.2V  | $V_{CCI}$ | $\leq 2\text{ns}$   | $V_{CCO}/2$ | $2 \times V_{CCO}$ | 15pF  | 2K $\Omega$ | 0.15V        |
| 3.3V $\pm$ 0.3V  | $V_{CCI}$ | $\leq 2.5\text{ns}$ | $V_{CCO}/2$ | $2 \times V_{CCO}$ | 15pF  | 2K $\Omega$ | 0.3V         |

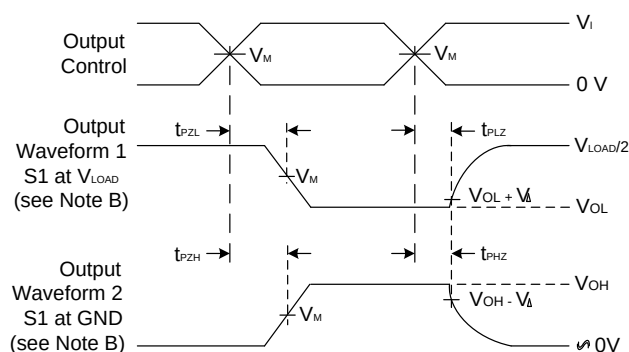
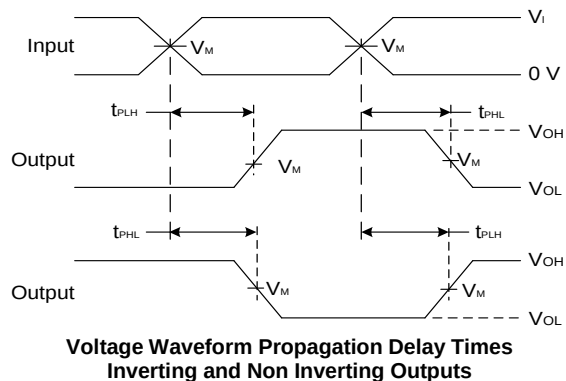
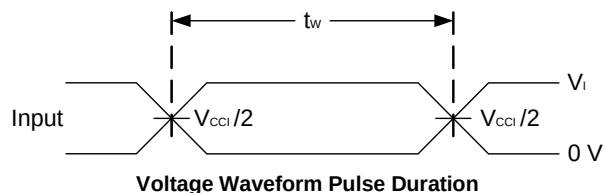
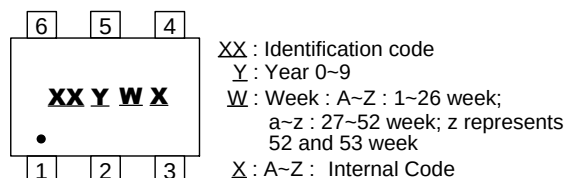


Figure 1 Load Circuit and Voltage Waveforms

- Notes:
- A. Includes test lead and test apparatus capacitance.
  - B. Waveform 1 is for an output with input set up as a low and device coming out or into 3-state via DIR control.  
Waveform 2 is for an output with input set up as a high and device coming out or into 3-state via DIR control.
  - C. All pulses are supplied at pulse repetition rate  $\leq 10$  MHz.
  - D.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{DIS}$ .
  - E.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{EN}$ .
  - F.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{PD}$ .
  - G.  $V_{CCI}$  is the  $V_{CC}$  associated with the input.
  - F.  $V_{CCO}$  is the  $V_{CC}$  associated with the output.

## Marking Information

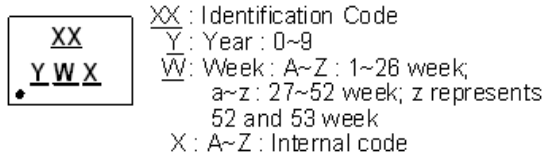
### (1) SOT26, SOT363



| Part Number    | Package | Identification Code |
|----------------|---------|---------------------|
| 74AVCH1T45W6-7 | SOT26   | VT                  |
| 74AVCH1T45DW-7 | SOT363  | VR                  |

### (2) X2-DFN0910-6, X2-DFN1010-6, X2-DFN1410-6, and X2-DFN1409-6

#### (Top View)

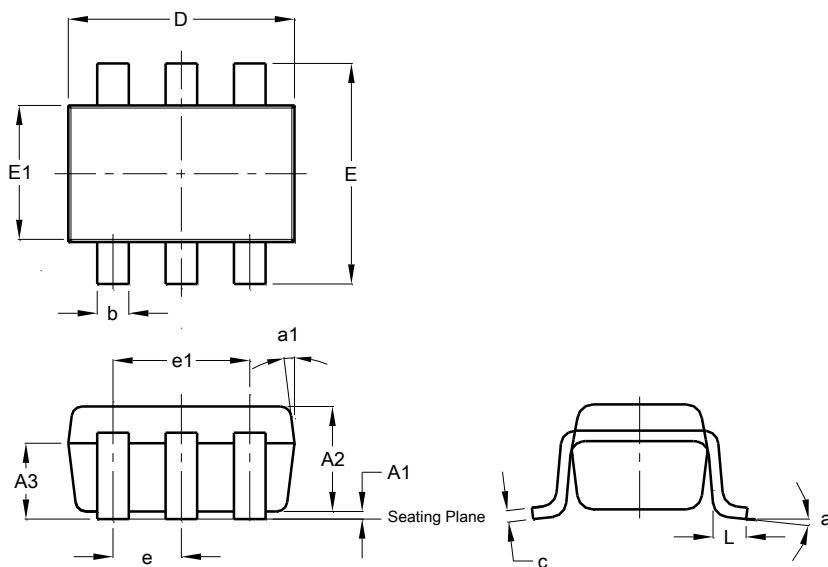


| Part Number     | Package      | Identification Code |
|-----------------|--------------|---------------------|
| 74AVCH1T45FW3-7 | X2-DFN0910-6 | ZR                  |
| 74AVCH1T45FW5-7 | X1-DFN1010-6 | VR                  |
| 74AVCH1T45FX4-7 | X2-DFN1409-6 | VT                  |
| 74AVCH1T45FZ4-7 | X2-DFN1410-6 | VS                  |

## Package Outline Dimensions

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### SOT26

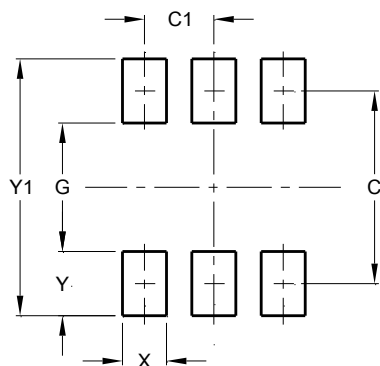


| SOT26                |       |      |      |
|----------------------|-------|------|------|
| Dim                  | Min   | Max  | Typ  |
| A1                   | 0.013 | 0.10 | 0.05 |
| A2                   | 1.00  | 1.30 | 1.10 |
| A3                   | 0.70  | 0.80 | 0.75 |
| b                    | 0.35  | 0.50 | 0.38 |
| c                    | 0.10  | 0.20 | 0.15 |
| D                    | 2.90  | 3.10 | 3.00 |
| e                    | -     | -    | 0.95 |
| e1                   | -     | -    | 1.90 |
| E                    | 2.70  | 3.00 | 2.80 |
| E1                   | 1.50  | 1.70 | 1.60 |
| L                    | 0.35  | 0.55 | 0.40 |
| a                    | -     | -    | 8°   |
| a1                   | -     | -    | 7°   |
| All Dimensions in mm |       |      |      |

## Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### SOT26

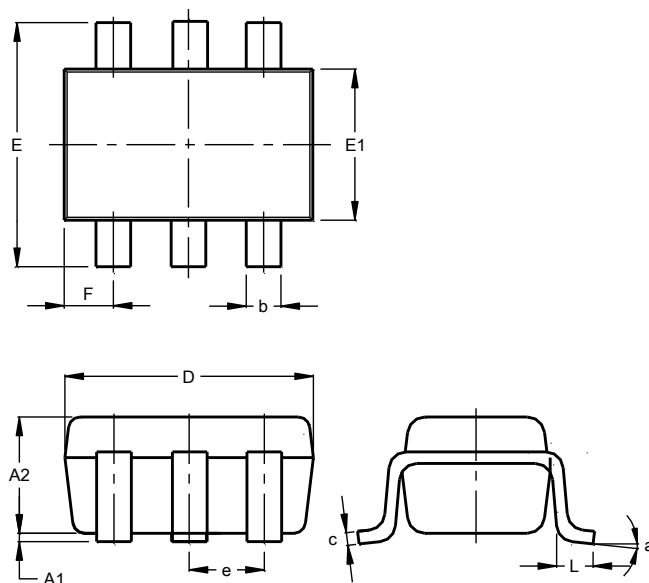


| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 2.40          |
| C1         | 0.95          |
| G          | 1.60          |
| X          | 0.55          |
| Y          | 0.80          |
| Y1         | 3.20          |

## Package Outline Dimensions (Cont.)

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### SOT363

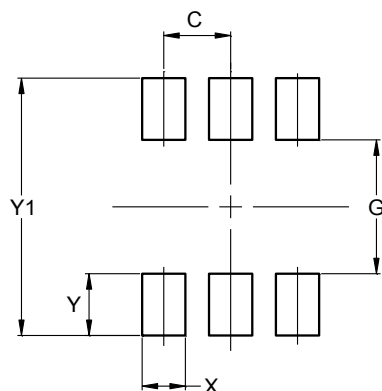


| SOT363               |           |      |       |
|----------------------|-----------|------|-------|
| Dim                  | Min       | Max  | Typ   |
| A1                   | 0.00      | 0.10 | 0.05  |
| A2                   | 0.90      | 1.00 | 1.00  |
| b                    | 0.10      | 0.30 | 0.25  |
| c                    | 0.10      | 0.22 | 0.11  |
| D                    | 1.80      | 2.20 | 2.15  |
| E                    | 2.00      | 2.20 | 2.10  |
| E1                   | 1.15      | 1.35 | 1.30  |
| e                    | 0.650 BSC |      |       |
| F                    | 0.40      | 0.45 | 0.425 |
| L                    | 0.25      | 0.40 | 0.30  |
| a                    | 0°        | 8°   | --    |
| All Dimensions in mm |           |      |       |

## Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### SOT363

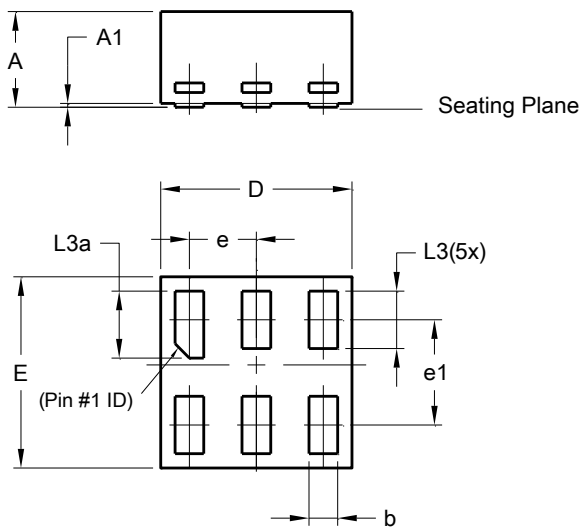


| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 0.650         |
| G          | 1.300         |
| X          | 0.420         |
| Y          | 0.600         |
| Y1         | 2.500         |

## Package Outline Dimensions

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

X1-DFN1010-6 (Type B)

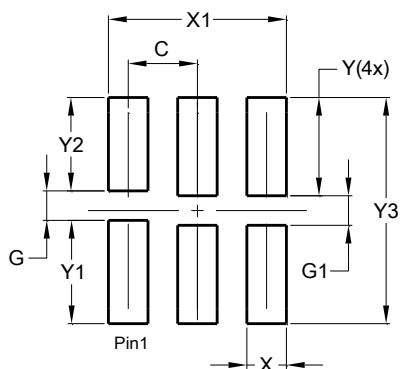


| X1-DFN1010-6<br>(Type B) |          |       |      |
|--------------------------|----------|-------|------|
| Dim                      | Min      | Max   | Typ  |
| A                        | -        | 0.50  | 0.39 |
| A1                       | -        | 0.04  | -    |
| b                        | 0.12     | 0.20  | 0.15 |
| D                        | 0.95     | 1.050 | 1.00 |
| E                        | 0.95     | 1.050 | 1.00 |
| e                        | 0.35 BSC |       |      |
| e1                       | 0.55 BSC |       |      |
| L3                       | 0.27     | 0.30  | 0.30 |
| L3a                      | 0.32     | 0.40  | 0.35 |
| All Dimensions in mm     |          |       |      |

## Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

X1-DFN1010-6 (Type B)

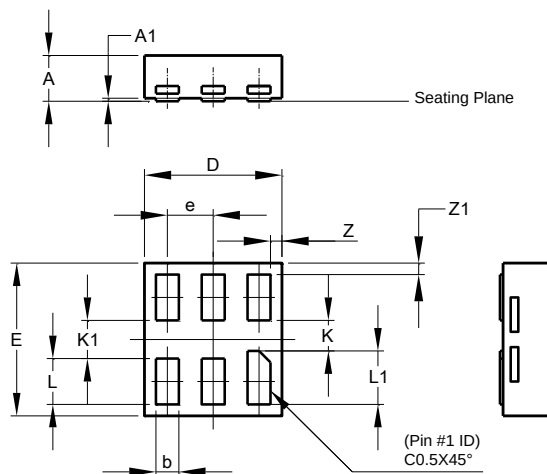


| Dimensions | Value<br>(in mm) |
|------------|------------------|
| C          | 0.350            |
| G          | 0.150            |
| G1         | 0.150            |
| X          | 0.200            |
| X1         | 0.900            |
| Y          | 0.500            |
| Y1         | 0.525            |
| Y2         | 0.475            |
| Y3         | 1.150            |

## Package Outline Dimensions

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### X2-DFN0910-6

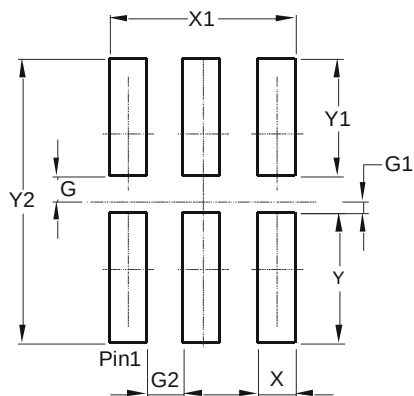


| X2-DFN0910-6         |      |      |       |
|----------------------|------|------|-------|
| Dim                  | Min  | Max  | Typ   |
| A                    | -    | 0.35 | 0.30  |
| A1                   | 0    | 0.03 | 0.02  |
| b                    | 0.10 | 0.20 | 0.15  |
| D                    | 0.85 | 0.95 | 0.90  |
| E                    | 0.95 | 1.05 | 1.00  |
| e                    | -    | -    | 0.30  |
| K                    | 0.20 | -    | -     |
| K1                   | 0.25 | -    | -     |
| L                    | 0.25 | 0.35 | 0.30  |
| L1                   | 0.30 | 0.40 | 0.35  |
| Z                    | -    | -    | 0.075 |
| Z1                   | -    | -    | 0.075 |
| All Dimensions in mm |      |      |       |

## Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### X2-DFN0910-6

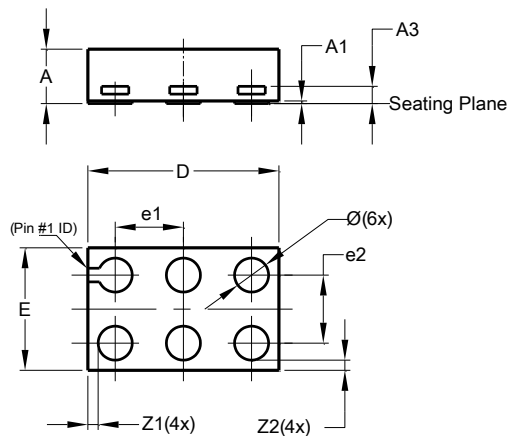


| Dimensions | Value (in mm) |
|------------|---------------|
| G          | 0.100         |
| G1         | 0.050         |
| G2         | 0.150         |
| X          | 0.150         |
| X1         | 0.750         |
| Y          | 0.525         |
| Y1         | 0.475         |
| Y2         | 1.150         |

## Package Outline Dimensions (Cont.)

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

**X2-DFN1409-6**

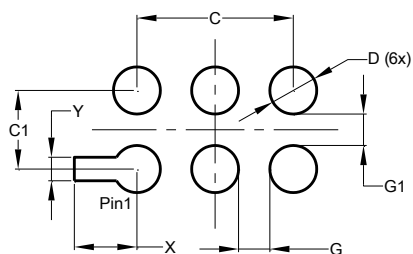


| X2-DFN1409-6         |      |      |       |
|----------------------|------|------|-------|
| Dim                  | Min  | Max  | Typ   |
| A                    | -    | 0.40 | 0.39  |
| A1                   | 0    | 0.05 | 0.02  |
| A3                   | -    | -    | 0.13  |
| Ø                    | 0.20 | 0.30 | 0.25  |
| D                    | 1.35 | 1.45 | 1.40  |
| E                    | 0.85 | 0.95 | 0.90  |
| e1                   | -    | -    | 0.50  |
| e2                   | -    | -    | 0.50  |
| Z1                   | -    | -    | 0.075 |
| Z2                   | -    | -    | 0.075 |
| All Dimensions in mm |      |      |       |

## Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

**X2-DFN1409-6**

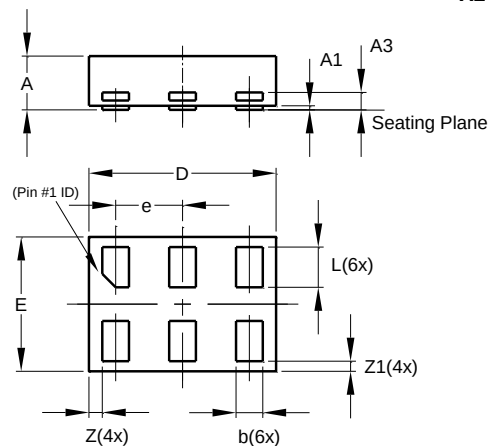


| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 1.000         |
| C1         | 0.500         |
| D          | 0.300         |
| G          | 0.200         |
| G1         | 0.200         |
| X          | 0.400         |
| Y          | 0.150         |

## Package Outline Dimensions (Cont.)

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

**X2-DFN1410-6**

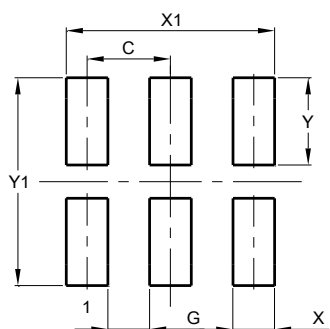


| X2-DFN1410-6         |       |       |       |
|----------------------|-------|-------|-------|
| Dim                  | Min   | Max   | Typ   |
| A                    | —     | 0.40  | 0.39  |
| A1                   | 0.00  | 0.05  | 0.02  |
| A3                   | —     | —     | 0.13  |
| b                    | 0.15  | 0.25  | 0.20  |
| D                    | 1.35  | 1.45  | 1.40  |
| E                    | 0.95  | 1.05  | 1.00  |
| e                    | —     | —     | 0.50  |
| L                    | 0.25  | 0.35  | 0.30  |
| Z                    | —     | —     | 0.10  |
| Z1                   | 0.045 | 0.105 | 0.075 |
| All Dimensions in mm |       |       |       |

## Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

**X2-DFN1410-6**



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 0.500         |
| G          | 0.250         |
| X          | 0.250         |
| X1         | 1.250         |
| Y          | 0.525         |
| Y1         | 1.250         |

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