

74VCX16244

Low-Voltage 1.8/2.5/3.3V 16-Bit Buffer

With 3.6 V–Tolerant Inputs and Outputs (3–State, Non–Inverting)

The 74VCX16244 is an advanced performance, non-inverting 16-bit buffer. It is designed for very high-speed, very low-power operation in 1.8 V, 2.5 V or 3.3 V systems.

When operating at 2.5 V (or 1.8 V) the part is designed to tolerate voltages it may encounter on either inputs or outputs when interfacing to 3.3 V busses. It is guaranteed to be over-voltage tolerant to 3.6 V.

The 74VCX16244 is nibble controlled with each nibble functioning identically, but independently. The control pins may be tied together to obtain full 16-bit operation. The 3-state outputs are controlled by an Output Enable (\overline{OEn}) input for each nibble. When \overline{OEn} is LOW, the outputs are on. When \overline{OEn} is HIGH, the outputs are in the high impedance state.

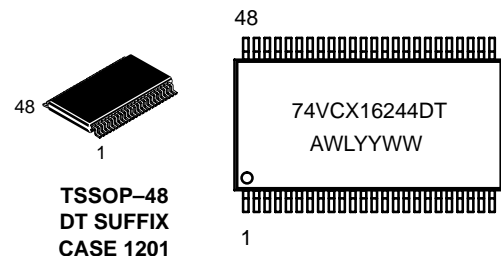
- Designed for Low Voltage Operation: $V_{CC} = 1.65\text{--}3.6\text{ V}$
- 3.6 V Tolerant Inputs and Outputs
- High Speed Operation: 2.5 ns max for 3.0 to 3.6 V
3.0 ns max for 2.3 to 2.7 V
6.0 ns max for 1.65 to 1.95 V
- Static Drive: $\pm 24\text{ mA}$ Drive at 3.0 V
 $\pm 18\text{ mA}$ Drive at 2.3 V
 $\pm 6\text{ mA}$ Drive at 1.65 V
- Supports Live Insertion and Withdrawal
- I_{OFF} Specification Guarantees High Impedance When $V_{CC} = 0\text{ V}$
- Near Zero Static Supply Current in All Three Logic States (20 μA)
Substantially Reduces System Power Requirements
- Latchup Performance Exceeds $\pm 250\text{ mA}$ @ 125°C
- ESD Performance: Human Body Model >2000 V; Machine Model >200 V



ON Semiconductor

<http://onsemi.com>

MARKING DIAGRAM



A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week

ORDERING INFORMATION

| Device | Package | Shipping |
|---------------|---------|-------------|
| 74VCX16244DT | TSSOP | 39 / Rail |
| 74VCX16244DTR | TSSOP | 2500 / Reel |

74VCX16244

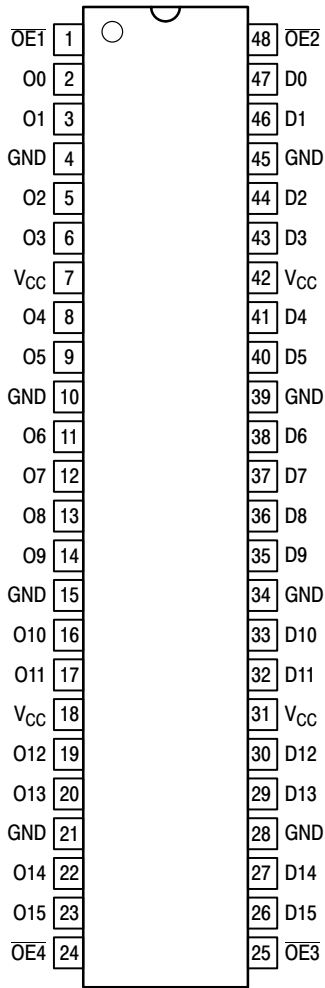


Figure 1. 48-Lead Pinout (Top View)

PIN NAMES

| Pins | Function |
|------------------|----------------------|
| $\overline{OE}n$ | Output Enable Inputs |
| D0–D15 | Inputs |
| O0–O15 | Outputs |

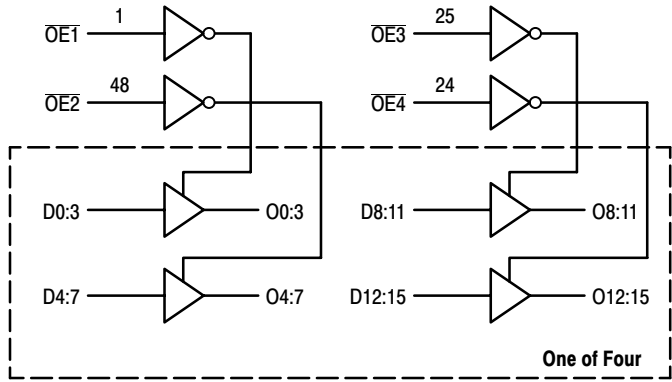


Figure 2. Logic Diagram

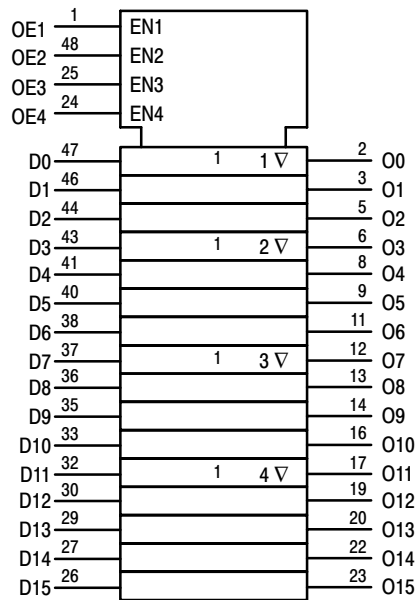


Figure 3. IEC Logic Diagram

| $\overline{OE}1$ | D0:3 | O0:3 | $\overline{OE}2$ | D4:7 | O4:7 | $\overline{OE}3$ | D8:11 | O8:11 | $\overline{OE}4$ | D12:15 | O12:15 |
|------------------|------|------|------------------|------|------|------------------|-------|-------|------------------|--------|--------|
| L | L | L | L | L | L | L | L | L | L | L | L |
| L | H | H | L | H | H | L | H | H | L | H | H |
| H | X | Z | H | X | Z | H | X | Z | H | X | Z |

H = High Voltage Level; L = Low Voltage Level; Z = High Impedance State; X = High or Low Voltage Level and Transitions Are Acceptable, for I_{CC} reasons, DO NOT FLOAT Inputs

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ABSOLUTE MAXIMUM RATINGS*

| Symbol | Parameter | Value | Condition | Unit |
|-----------|----------------------------------|-----------------------------------|-------------------------|------|
| V_{CC} | DC Supply Voltage | -0.5 to +4.6 | | V |
| V_I | DC Input Voltage | $-0.5 \leq V_I \leq +4.6$ | | V |
| V_O | DC Output Voltage | $-0.5 \leq V_O \leq +4.6$ | Output in 3-State | V |
| | | $-0.5 \leq V_O \leq V_{CC} + 0.5$ | Note 1.; Outputs Active | V |
| I_{IK} | DC Input Diode Current | -50 | $V_I < GND$ | mA |
| I_{OK} | DC Output Diode Current | -50 | $V_O < GND$ | mA |
| | | +50 | $V_O > V_{CC}$ | mA |
| I_O | DC Output Source/Sink Current | ± 50 | | mA |
| I_{CC} | DC Supply Current Per Supply Pin | ± 100 | | mA |
| I_{GND} | DC Ground Current Per Ground Pin | ± 100 | | mA |
| T_{STG} | Storage Temperature Range | -65 to +150 | | °C |

* Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute-maximum-rated conditions is not implied.

1. I_O absolute maximum rating must be observed.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Typ | Max | Unit | |
|---------------------|---|---------------------|------|-----|----------|---|
| V_{CC} | Supply Voltage | Operating | 1.65 | 3.3 | 3.6 | V |
| | | Data Retention Only | 1.2 | 3.3 | 3.6 | |
| V_I | Input Voltage | -0.3 | | 3.6 | V | |
| V_O | Output Voltage | (Active State) | 0 | | V_{CC} | V |
| | | (3-State) | 0 | | 3.6 | |
| I_{OH} | HIGH Level Output Current, $V_{CC} = 3.0V - 3.6V$ | | | -24 | mA | |
| I_{OL} | LOW Level Output Current, $V_{CC} = 3.0V - 3.6V$ | | | 24 | mA | |
| I_{OH} | HIGH Level Output Current, $V_{CC} = 2.3V - 2.7V$ | | | -18 | mA | |
| I_{OL} | LOW Level Output Current, $V_{CC} = 2.3V - 2.7V$ | | | 18 | mA | |
| I_{OH} | HIGH Level Output Current, $V_{CC} = 1.65V - 1.95V$ | | | -6 | mA | |
| I_{OL} | LOW Level Output Current, $V_{CC} = 1.65V - 1.95V$ | | | 6 | mA | |
| T_A | Operating Free-Air Temperature | -40 | | +85 | °C | |
| $\Delta t/\Delta V$ | Input Transition Rise or Fall Rate, V_{IN} from 0.8V to 2.0V, $V_{CC} = 3.0V$ | 0 | | 10 | ns/V | |

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DC ELECTRICAL CHARACTERISTICS

| Symbol | Characteristic | Condition | T _A = -40°C to +85°C | | Unit |
|------------------|---------------------------------------|--|---------------------------------|------------------------|------|
| | | | Min | Max | |
| V _{IH} | HIGH Level Input Voltage (Note 2.) | 1.65V ≤ V _{CC} < 2.3V | 0.65 x V _{CC} | | V |
| | | 2.3V ≤ V _{CC} ≤ 2.7V | 1.6 | | |
| | | 2.7V < V _{CC} ≤ 3.6V | 2.0 | | |
| V _{IL} | LOW Level Input Voltage (Note 2.) | 1.65V ≤ V _{CC} < 2.3V | | 0.35 x V _{CC} | V |
| | | 2.3V ≤ V _{CC} ≤ 2.7V | | 0.7 | |
| | | 2.7V < V _{CC} ≤ 3.6V | | 0.8 | |
| V _{OH} | HIGH Level Output Voltage | 1.65V ≤ V _{CC} ≤ 3.6V; I _{OH} = -100μA | V _{CC} - 0.2 | | V |
| | | V _{CC} = 1.65V; I _{OH} = -6mA | 1.25 | | |
| | | V _{CC} = 2.3V; I _{OH} = -6mA | 2.0 | | |
| | | V _{CC} = 2.3V; I _{OH} = -12mA | 1.8 | | |
| | | V _{CC} = 2.3V; I _{OH} = -18mA | 1.7 | | |
| | | V _{CC} = 2.7V; I _{OH} = -12mA | 2.2 | | |
| | | V _{CC} = 3.0V; I _{OH} = -18mA | 2.4 | | |
| V _{OL} | LOW Level Output Voltage | 1.65V ≤ V _{CC} ≤ 3.6V; I _{OL} = 100μA | | 0.2 | V |
| | | V _{CC} = 1.65V; I _{OL} = 6mA | | 0.3 | |
| | | V _{CC} = 2.3V; I _{OL} = 12mA | | 0.4 | |
| | | V _{CC} = 2.3V; I _{OL} = 18mA | | 0.6 | |
| | | V _{CC} = 2.7V; I _{OL} = 12mA | | 0.4 | |
| | | V _{CC} = 3.0V; I _{OL} = 18mA | | 0.4 | |
| | | V _{CC} = 3.0V; I _{OL} = 24mA | | 0.55 | |
| I _I | Input Leakage Current | 1.65V ≤ V _{CC} ≤ 3.6V; 0V ≤ V _I ≤ 3.6V | | ±5.0 | μA |
| I _{OZ} | 3-State Output Current | 1.65V ≤ V _{CC} ≤ 3.6V; 0V ≤ V _O ≤ 3.6V; V _I = V _{IH} or V _{IL} | | ±10 | μA |
| I _{OFF} | Power-Off Leakage Current | V _{CC} = 0V; V _I or V _O = 3.6V | | 10 | μA |
| I _{CC} | Quiescent Supply Current (Note 3.) | 1.65V ≤ V _{CC} ≤ 3.6V; V _I = GND or V _{CC} | | 20 | μA |
| | | 1.65V ≤ V _{CC} ≤ 3.6V; 3.6V ≤ V _I , V _O ≤ 3.6V | | ±20 | μA |
| ΔI _{CC} | Increase in I _{CC} per Input | 2.7V < V _{CC} ≤ 3.6V; V _{IH} = V _{CC} - 0.6V | | 750 | μA |

2. These values of V_I are used to test DC electrical characteristics only.

3. Outputs disabled or 3-state only.

AC CHARACTERISTICS (Note 4.; t_R = t_F = 2.0ns; C_L = 30pF; R_L = 500Ω)

| Symbol | Parameter | Waveform | Limits | | | | | | Unit |
|--|--|----------|---------------------------------|------------|--------------------------------|------------|---------------------------------|--------------|------|
| | | | T _A = -40°C to +85°C | | | | | | |
| | | | V _{CC} = 3.0V to 3.6V | | V _{CC} = 2.3V to 2.7V | | V _{CC} = 1.65 to 1.95V | | |
| | | | Min | Max | Min | Max | Min | Max | |
| t _{PLH} t _{PHL} | Propagation Delay Input to Output | 1 | 0.8 0.8 | 2.5 2.5 | 1.0 1.0 | 3.0 3.0 | 1.5 1.5 | 6.0 6.0 | ns |
| t _{PZH} t _{PZL} | Output Enable Time to High and Low Level | 2 | 0.8 0.8 | 3.5 3.5 | 1.0 1.0 | 4.1 4.1 | 1.5 1.5 | 8.2 8.2 | ns |
| t _{PHZ} t _{PLZ} | Output Disable Time From High and Low Level | 2 | 0.8 0.8 | 3.5 3.5 | 1.0 1.0 | 3.8 3.8 | 1.5 1.5 | 6.8 6.8 | ns |
| t _{OSSL} t _{OSLH} | Output-to-Output Skew (Note 5.) | | | 0.5 0.5 | | 0.5 0.5 | | 0.75 0.75 | ns |

4. For C_L = 50pF, add approximately 300ps to the AC maximum specification.

5. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSSL}) or LOW-to-HIGH (t_{OSLH}); parameter guaranteed by design.

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DYNAMIC SWITCHING CHARACTERISTICS

| Symbol | Characteristic | Condition | T _A = +25°C | |
|------------------|--|---|------------------------|------|
| | | | Typ | Unit |
| V _{OLP} | Dynamic LOW Peak Voltage (Note 6.) | V _{CC} = 1.8V, C _L = 30pF, V _{IH} = V _{CC} , V _{IL} = 0V | 0.25 | V |
| | | V _{CC} = 2.5V, C _L = 30pF, V _{IH} = V _{CC} , V _{IL} = 0V | 0.6 | |
| | | V _{CC} = 3.3V, C _L = 30pF, V _{IH} = V _{CC} , V _{IL} = 0V | 0.8 | |
| V _{OLV} | Dynamic LOW Valley Voltage (Note 6.) | V _{CC} = 1.8V, C _L = 30pF, V _{IH} = V _{CC} , V _{IL} = 0V | -0.25 | V |
| | | V _{CC} = 2.5V, C _L = 30pF, V _{IH} = V _{CC} , V _{IL} = 0V | -0.6 | |
| | | V _{CC} = 3.3V, C _L = 30pF, V _{IH} = V _{CC} , V _{IL} = 0V | -0.8 | |
| V _{OHV} | Dynamic HIGH Valley Voltage (Note 7.) | V _{CC} = 1.8V, C _L = 30pF, V _{IH} = V _{CC} , V _{IL} = 0V | 1.5 | V |
| | | V _{CC} = 2.5V, C _L = 30pF, V _{IH} = V _{CC} , V _{IL} = 0V | 1.9 | |
| | | V _{CC} = 3.3V, C _L = 30pF, V _{IH} = V _{CC} , V _{IL} = 0V | 2.2 | |

6. Number of outputs defined as “n”. Measured with “n-1” outputs switching from HIGH-to-LOW or LOW-to-HIGH. The remaining output is measured in the LOW state.

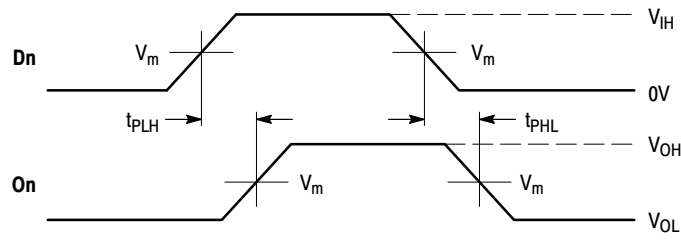
7. Number of outputs defined as “n”. Measured with “n-1” outputs switching from HIGH-to-LOW or LOW-to-HIGH. The remaining output is measured in the HIGH state.

CAPACITIVE CHARACTERISTICS

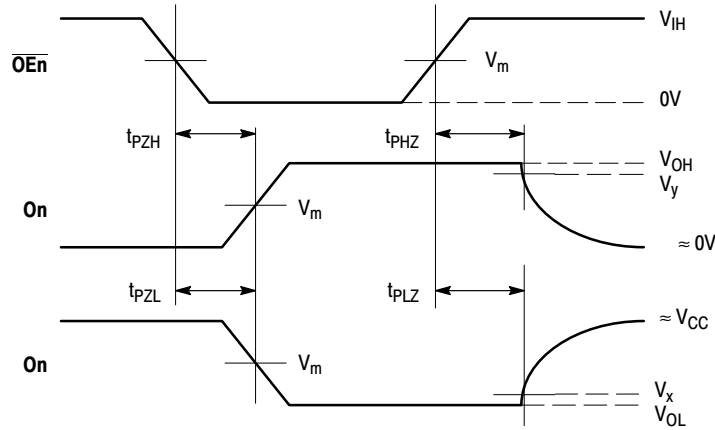
| Symbol | Parameter | Condition | Typical | Unit |
|------------------|-------------------------------|----------------|---------|------|
| C _{IN} | Input Capacitance | Note 8. | 6 | pF |
| C _{OUT} | Output Capacitance | Note 8. | 7 | pF |
| C _{PD} | Power Dissipation Capacitance | Note 8., 10MHz | 20 | pF |

8. V_{CC} = 1.8, 2.5 or 3.3V; V_I = 0V or V_{CC}.

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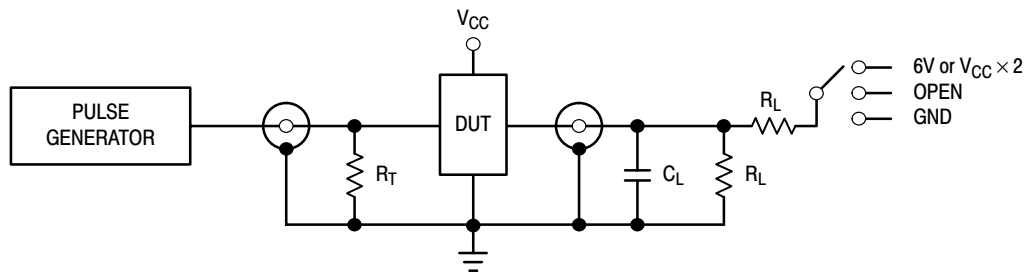
WAVEFORM 1 - PROPAGATION DELAYS
 $t_R = t_F = 2.0\text{ns}$, 10% to 90%; $f = 1\text{MHz}$; $t_W = 500\text{ns}$



WAVEFORM 2 - OUTPUT ENABLE AND DISABLE TIMES
 $t_R = t_F = 2.0\text{ns}$, 10% to 90%; $f = 1\text{MHz}$; $t_W = 500\text{ns}$

Figure 4. AC Waveforms

| Symbol | V_{CC} | | |
|----------|-------------------------------|-------------------------------|--------------------------------|
| | $3.3\text{V} \pm 0.3\text{V}$ | $2.5\text{V} \pm 0.2\text{V}$ | $1.8\text{V} \pm 0.15\text{V}$ |
| V_{IH} | 2.7V | V_{CC} | V_{CC} |
| V_m | 1.5V | $V_{CC}/2$ | $V_{CC}/2$ |
| V_x | $V_{OL} + 0.3\text{V}$ | $V_{OL} + 0.15\text{V}$ | $V_{OL} + 0.15\text{V}$ |
| V_y | $V_{OH} - 0.3\text{V}$ | $V_{OH} - 0.15\text{V}$ | $V_{OH} - 0.15\text{V}$ |

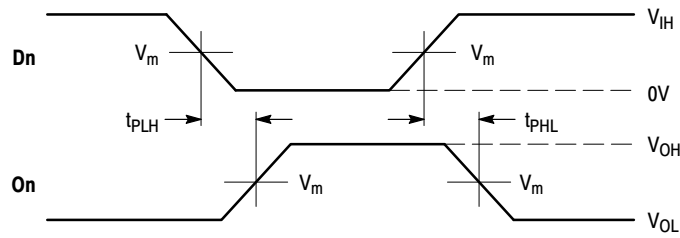


| TEST | SWITCH |
|-----------------------|--|
| t_{PLH} , t_{PHL} | Open |
| t_{PZL} , t_{PLZ} | 6V at $V_{CC} = 3.3 \pm 0.3\text{V}$; $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2\text{V}$; $1.8 \pm 0.15\text{V}$ |
| t_{PZH} , t_{PHZ} | GND |

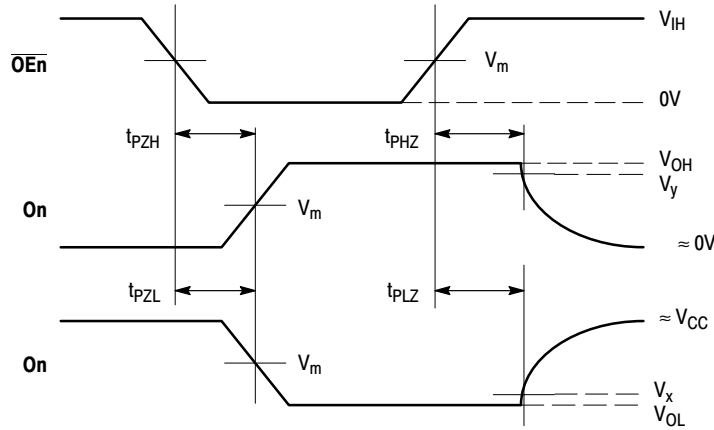
$C_L = 30\text{pF}$ or equivalent (Includes jig and probe capacitance)
 $R_L = 500\Omega$ or equivalent
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Figure 5. Test Circuit

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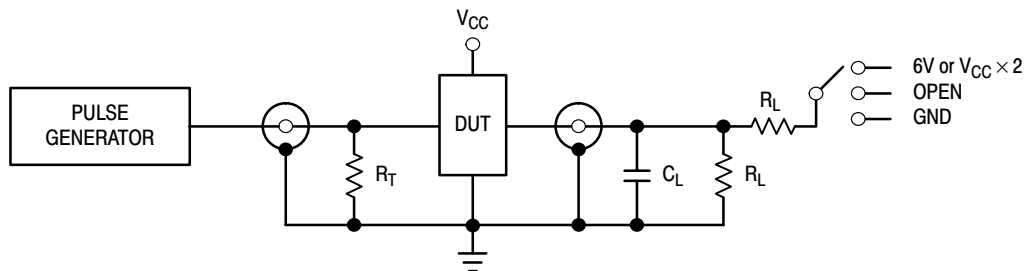
WAVEFORM 3 - PROPAGATION DELAYS
 $t_R = t_F = 2.0\text{ns}$, 10% to 90%; $f = 1\text{MHz}$; $t_W = 500\text{ns}$



WAVEFORM 4 - OUTPUT ENABLE AND DISABLE TIMES
 $t_R = t_F = 2.0\text{ns}$, 10% to 90%; $f = 1\text{MHz}$; $t_W = 500\text{ns}$

Figure 6. AC Waveforms

| Symbol | V_{CC} | |
|----------|-------------------------------|------------------------|
| | $3.3\text{V} \pm 0.3\text{V}$ | 2.7V |
| V_{IH} | 2.7V | 2.7V |
| V_m | 1.5V | 1.5V |
| V_x | $V_{OL} + 0.3\text{V}$ | $V_{OL} + 0.3\text{V}$ |
| V_y | $V_{OH} - 0.3\text{V}$ | $V_{OH} - 0.3\text{V}$ |



| TEST | SWITCH |
|-----------------------|---|
| t_{PLH} , t_{PHL} | Open |
| t_{PZL} , t_{PLZ} | 6V at $V_{CC} = 3.3 \pm 0.3\text{V}$; $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2\text{V}$; $1.8 \pm 0.15\text{V}$ |
| t_{PZH} , t_{PHZ} | GND |

$C_L = 50\text{pF}$ or equivalent (Includes jig and probe capacitance)
 $R_L = 500\Omega$ or equivalent
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Figure 7. Test Circuit

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AC CHARACTERISTICS ($t_R = t_F = 2.0\text{ns}$; $C_L = 50\text{pF}$; $R_L = 500\Omega$)

| Symbol | Parameter | Waveform | Limits | | | | Unit |
|--------------------------|--|----------|---|------------|------------------------|------------|------|
| | | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | | |
| | | | $V_{CC} = 3.0\text{V to } 3.6\text{V}$ | | $V_{CC} = 2.7\text{V}$ | | |
| | | | Min | Max | Min | Max | |
| t_{PLH} t_{PHL} | Propagation Delay Input to Output | 3 | 1.0 1.0 | 3.0 3.0 | | 3.6 3.6 | ns |
| t_{PZH} t_{PZL} | Output Enable Time to High and Low Level | 4 | 1.0 1.0 | 4.4 4.4 | | 5.4 5.4 | ns |
| t_{PHZ} t_{PLZ} | Output Disable Time From High and Low Level | 4 | 1.0 1.0 | 4.1 4.1 | | 4.6 4.6 | ns |
| t_{OSHL} t_{OSLH} | Output-to-Output Skew (Note 9.) | | | 0.5 0.5 | | 0.5 0.5 | ns |

9. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}); parameter guaranteed by design.

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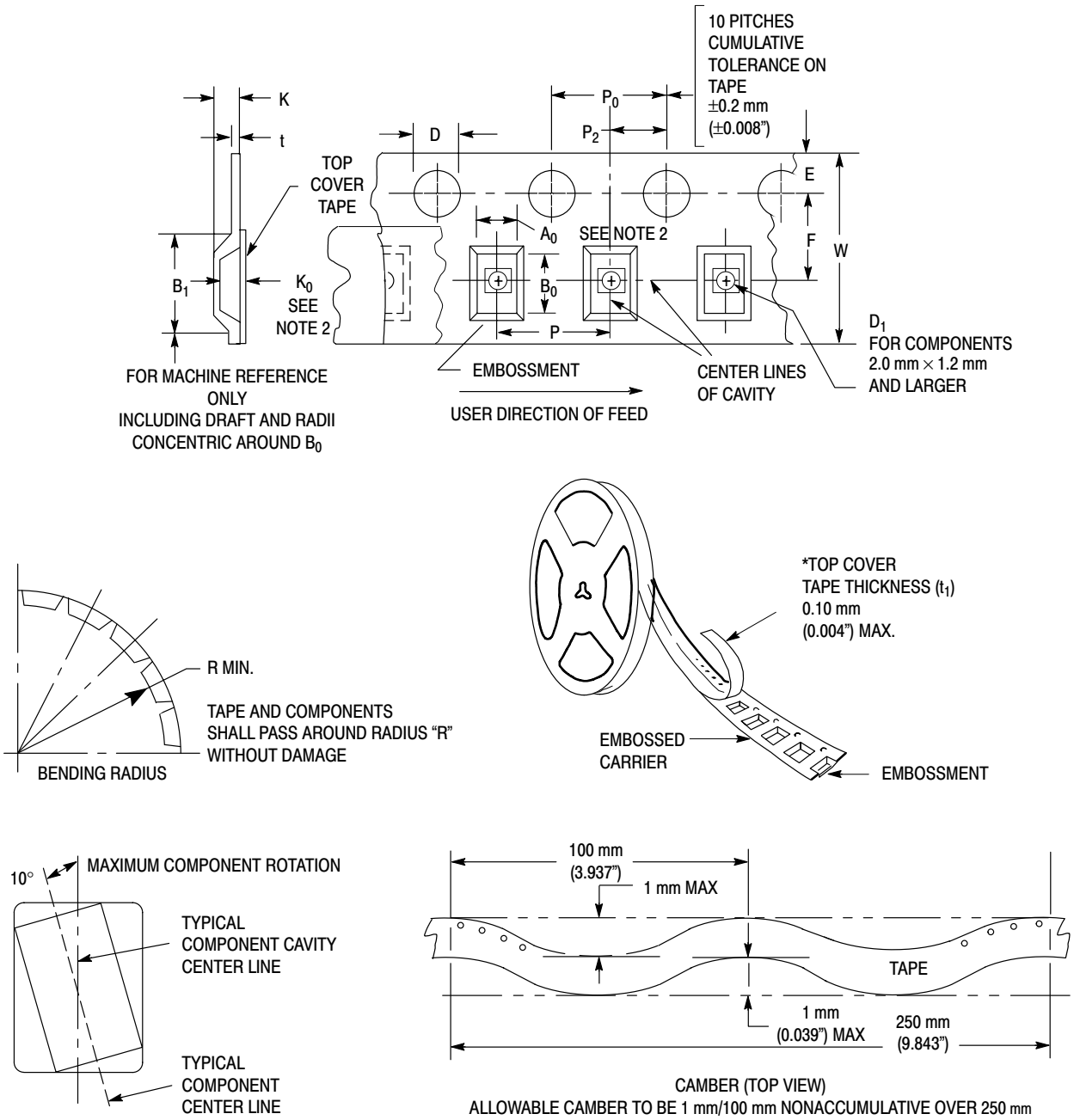


Figure 8. Carrier Tape Specifications

EMBOSSED CARRIER DIMENSIONS (See Notes 1 and 2)

| Tape Size | B ₁ Max | D | D ₁ | E | F | K | P | P ₀ | P ₂ | R | T | W |
|-----------|--------------------|--|--------------------------|---------------------------------------|--|----------------------------|--------------------------------------|--------------------------------------|--------------------------------------|------------------|--------------------|---------------------|
| 24mm | 20.1mm (0.791") | 1.5 + 0.1mm -0.0 (0.059 +0.004" -0.0) | 1.5mm Min (0.060") | 1.75 ±0.1 mm (0.069 ±0.004") | 11.5 ±0.10 mm (0.453 ±0.004") | 11.9 mm Max (0.468") | 16.0 ±0.1 mm (0.63 ±0.004") | 4.0 ±0.1 mm (0.157 ±0.004") | 2.0 ±0.1 mm (0.079 ±0.004") | 30 mm (1.18") | 0.6 mm (0.024") | 24.3 mm (0.957") |

1. Metric Dimensions Govern—English are in parentheses for reference only.
2. A₀, B₀, and K₀ are determined by component size. The clearance between the components and the cavity must be within 0.05 mm min to 0.50 mm max. The component cannot rotate more than 10° within the determined cavity.

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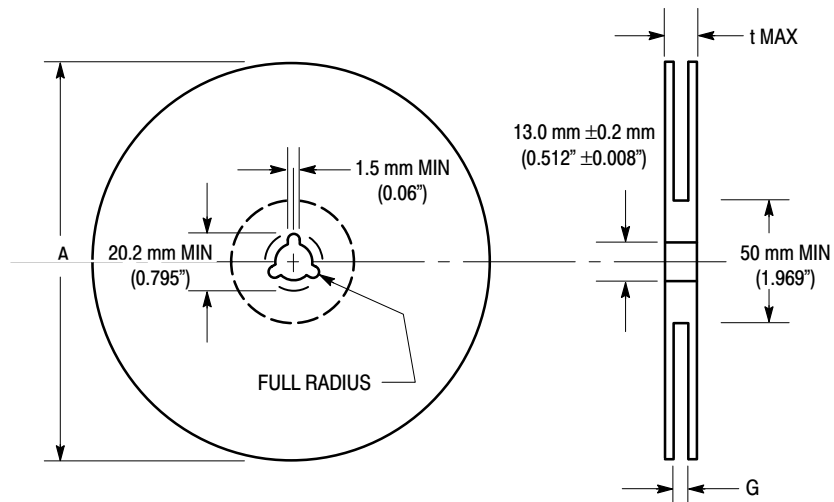


Figure 9. Reel Dimensions

REEL DIMENSIONS

| Tape Size | A Max | G | t Max |
|-----------|---------------------|--|---------------------|
| 24 mm | 360 mm (14.173") | 24.4 mm + 2.0 mm, -0.0 (0.961" + 0.078", -0.00) | 30.4 mm (1.197") |

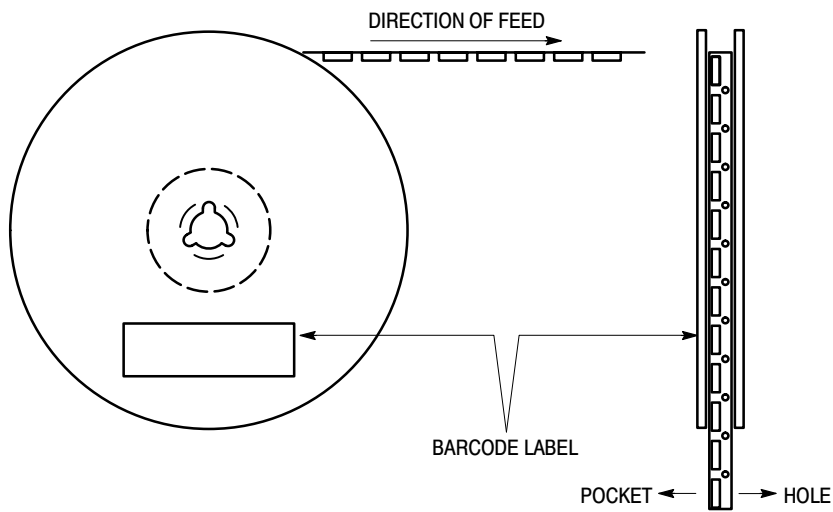


Figure 10. Reel Winding Direction

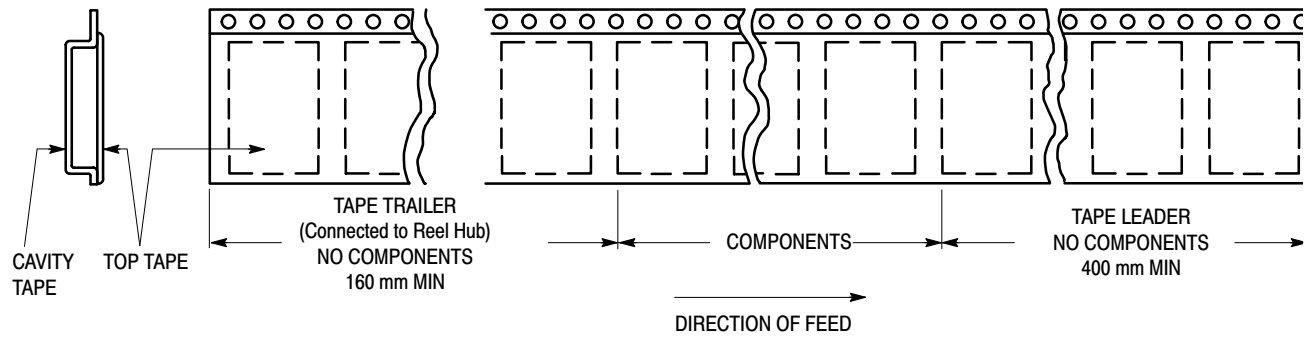


Figure 11. Tape Ends for Finished Goods

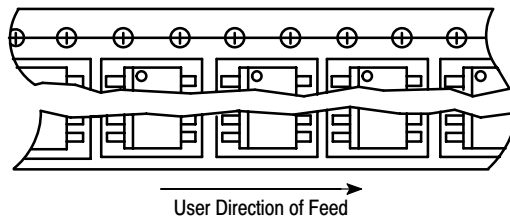


Figure 12. Reel Configuration

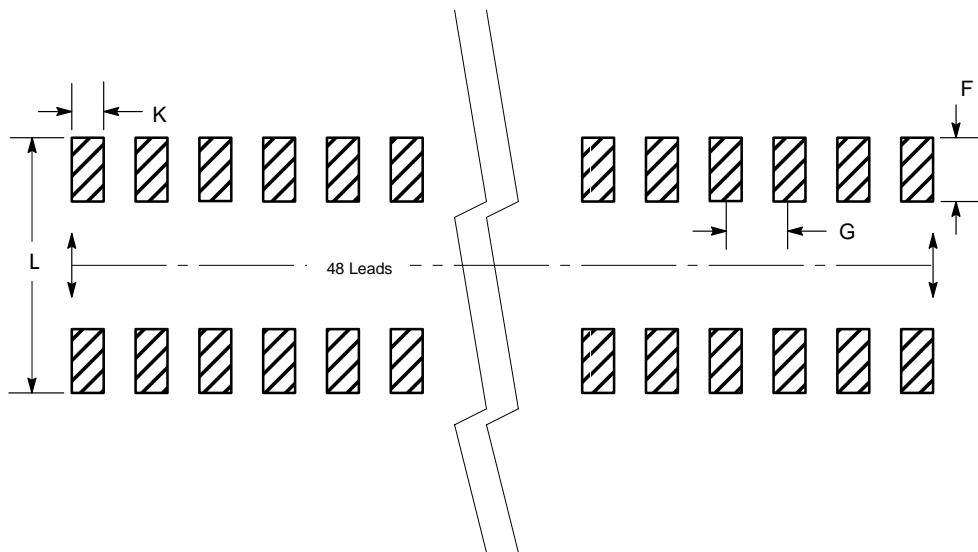
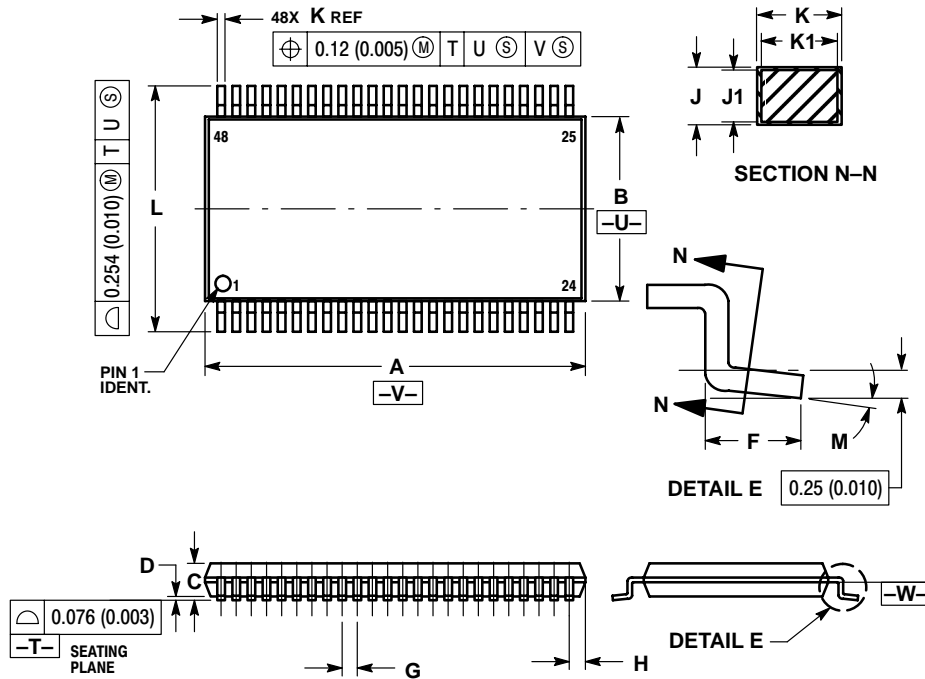


Figure 13. Package Footprint

74VCX16244

PACKAGE DIMENSIONS

TSSOP
DT SUFFIX
CASE 1201-01
ISSUE A



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
6. DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 12.40 | 12.60 | 0.488 | 0.496 |
| B | 6.00 | 6.20 | 0.236 | 0.244 |
| C | --- | 1.10 | --- | 0.043 |
| D | 0.05 | 0.15 | 0.002 | 0.006 |
| F | 0.50 | 0.75 | 0.020 | 0.030 |
| G | 0.50 BSC | | 0.0197 BSC | |
| H | 0.37 | --- | 0.015 | --- |
| J | 0.09 | 0.20 | 0.004 | 0.008 |
| J1 | 0.09 | 0.16 | 0.004 | 0.006 |
| K | 0.17 | 0.27 | 0.007 | 0.011 |
| K1 | 0.17 | 0.23 | 0.007 | 0.009 |
| L | 7.95 | 8.25 | 0.313 | 0.325 |
| M | 0 ° | 8 ° | 0 ° | 8 ° |

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