

74ALVC16373

Low-Voltage 1.8/2.5/3.3 V 16-Bit Transparent Latch With 3.6 V-Tolerant Inputs and Outputs (3-State, Non-Inverting)

The 74ALVC16373 is an advanced performance, non-inverting 16-bit transparent latch. It is designed for very high-speed, very low-power operation in 1.8 V, 2.5 V or 3.3 V systems. The ALVC16373 is byte controlled, with each byte functioning identically, but independently. Each byte has separate Output Enable and Latch Enable inputs. These control pins can be tied together for full 16-bit operation.

The 74ALVC16373 contains 16 D-type latches with 3-state 3.6 V-tolerant outputs. When the Latch Enable (LEn) inputs are HIGH, data on the Dn inputs enters the latches. In this condition, the latches are transparent, (a latch output will change state each time its D input changes). When LE is LOW, the latch stores the information that was present on the D inputs a setup time preceding the HIGH-to-LOW transition of LE. The 3-state outputs are controlled by the Output Enable (\overline{OEn}) inputs. When \overline{OE} is LOW, the outputs are enabled. When \overline{OE} is HIGH, the standard outputs are in the high impedance state, but this does not interfere with new data entering into the latches.

- Designed for Low Voltage Operation: $V_{CC} = 1.65\text{--}3.6\text{ V}$
- 3.6V Tolerant Inputs and Outputs
- High Speed Operation:
 - 3.6 ns max for 3.0 to 3.6 V
 - 4.5 ns max for 2.3 to 2.7 V
 - 6.8 ns max for 1.65 to 1.95 V
- Static Drive:
 - $\pm 24\text{ mA}$ Drive at 3.0 V
 - $\pm 12\text{ mA}$ Drive at 2.3 V
 - $\pm 4\text{ mA}$ Drive at 1.65 V
- Supports Live Insertion and Withdrawal
- I_{OFF} Specification Guarantees High Impedance When $V_{CC} = 0\text{ V}^\dagger$
- Near Zero Static Supply Current in All Three Logic States (40 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
- Second Source to Industry Standard 74ALVC16373

† To ensure the outputs activate in the 3-state condition, the output enable pins should be connected to V_{CC} through a pull-up resistor. The value of the resistor is determined by the current sinking capability of the output connected to the OE pin.



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MARKING DIAGRAM



PIN NAMES

Pins	Function
\overline{OEn}	Output Enable Inputs
LEn	Latch Enable Inputs
D0-D15	Inputs
O0-O15	Outputs

ORDERING INFORMATION

Device	Package	Shipping
74ALVC16373DTR	TSSOP	2500/Tape & Reel

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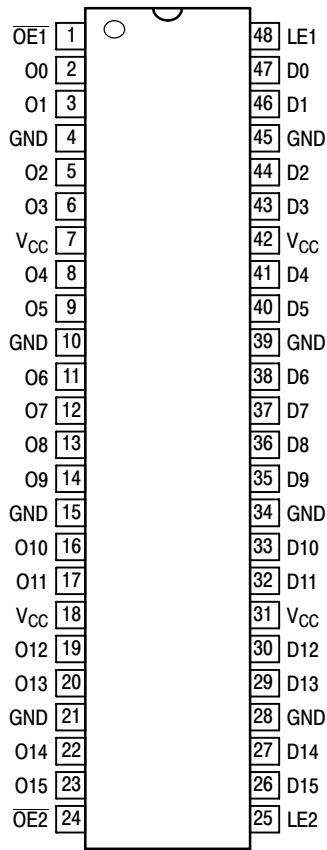


Figure 1. 48-Lead Pinout (Top View)

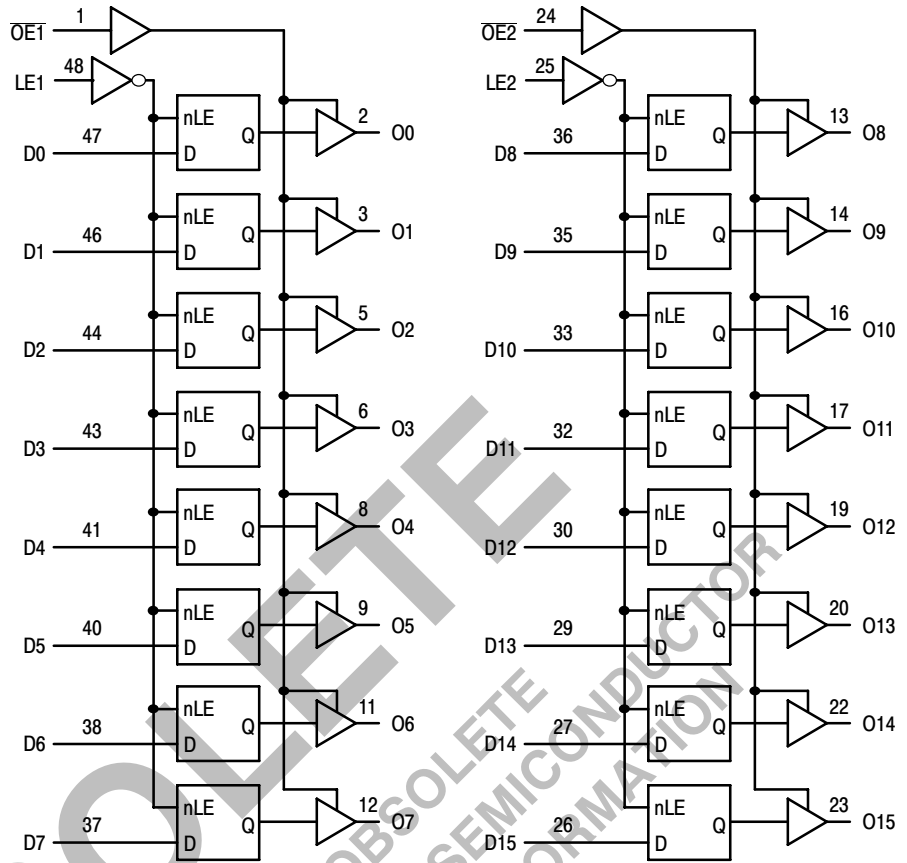


Figure 2. Logic Diagram

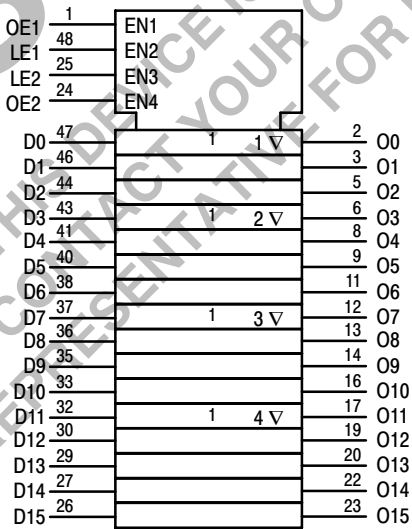


Figure 3. IEC Logic Diagram

Inputs			Outputs	Inputs			Outputs
LE1	OE1	D0:7	O0:7	LE2	OE2	D8:15	O8:15
X	H	X	Z	X	H	X	Z
H	L	L	L	H	L	L	L
H	L	H	H	H	L	H	H
L	L	X	O0	L	L	X	O0

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. O0 = No Change.

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MAXIMUM RATINGS (Note 1)

Symbol	Parameter	Value	Unit
V _{CC}	DC Supply Voltage	-0.5 to +4.6	V
V _I	DC Input Voltage	-0.5 to +4.6	V
V _O	DC Output Voltage	-0.5 to +4.6	V
I _{IK}	DC Input Diode Current V _I < GND	-50	mA
I _{OK}	DC Output Diode Current V _O < GND	-50	mA
I _O	DC Output Sink/Source 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
T _L	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C
T _J	Junction Temperature Under Bias	+150	°C
θ _{JA}	Thermal Resistance (Note 2)	90	°C/W
MSL	Moisture Sensitivity	Level 1	
F _R	Flammability Rating Oxygen Index: 30% - 35%	UL-94 V-0 @ 0.125 in	
V _{ESD}	ESD Withstand Voltage Human Body Model (Note 3) Machine Model (Note 4) Charged Device Model (Note 5)	> 2000 > 200 N/A	V
I _{LATCH-UP}	Latch-Up Performance Above V _{CC} and Below GND at 125°C (Note 6)	±250	mA

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

- I_O absolute maximum rating must be observed.
- Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2-ounce copper trace with no air flow.
- Tested to EIA/JESD22-A114-A.
- Tested to EIA/JESD22-A115-A.
- Tested to JESD22-C101-A.
- Tested to EIA/JESD78.

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 (Note 7)	-0.5		3.6	V	
V _O	Output Voltage (Active State) (3-State)	0		V _{CC}	V	
		0		3.6		
T _A	Operating Free-Air Temperature	-40		+85	°C	
Δt/ΔV	Input Transition Rise or Fall Rate, V _{IN} from 0.8 V to 2.0 V, V _{CC} = 2.5 V ±0.2 V V _{CC} = 3.0 V ±0.3 V	0		20	ns/V	
		0		10		

- Unused inputs may not be left open. All inputs must be tied to a high-logic voltage level or a low-logic input voltage level.

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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 8)	1.65 V ≤ V _{CC} < 2.3 V	0.65 x V _{CC}		V
		2.3 V ≤ V _{CC} ≤ 2.7 V	1.7		
		2.7 V < V _{CC} ≤ 3.6 V	2.0		
V _{IL}	LOW Level Input Voltage (Note 8)	1.65 V ≤ V _{CC} < 2.3 V		0.35 x V _{CC}	V
		2.3 V ≤ V _{CC} ≤ 2.7 V		0.7	
		2.7 V < V _{CC} ≤ 3.6 V		0.8	
V _{OH}	HIGH Level Output Voltage	1.65 V ≤ V _{CC} ≤ 3.6 V; I _{OH} = -100 μA	V _{CC} - 0.2		V
		V _{CC} = 1.65 V; I _{OH} = -4 mA	1.2		
		V _{CC} = 2.3 V; I _{OH} = -6 mA	2.0		
		V _{CC} = 2.3 V; I _{OH} = -12 mA	1.7		
		V _{CC} = 2.7 V; I _{OH} = -12 mA	2.2		
		V _{CC} = 3.0 V; I _{OH} = -12 mA	2.4		
		V _{CC} = 3.0 V; I _{OH} = -24 mA	2.0		
V _{OL}	LOW Level Output Voltage	1.65 V ≤ V _{CC} ≤ 3.6 V; I _{OL} = 100 μA		0.2	V
		V _{CC} = 1.65 V; I _{OL} = 4 mA		0.45	
		V _{CC} = 2.3 V; I _{OL} = 6 mA		0.4	
		V _{CC} = 2.3 V; I _{OL} = 12 mA		0.7	
		V _{CC} = 2.7 V; I _{OL} = 12 mA		0.4	
		V _{CC} = 3.0 V; I _{OL} = 24 mA		0.55	
I _I	Input Leakage Current	1.65 V ≤ V _{CC} ≤ 3.6 V; 0 V ≤ V _I ≤ 3.6 V		±5.0	μA
I _{OZ}	3-State Output Current	1.65 V ≤ V _{CC} ≤ 3.6 V; 0 V ≤ V _O ≤ 3.6 V; V _I = V _{IH} or V _{IL}		±10	μA
I _{OFF}	Power-Off Leakage Current	V _{CC} = 0 V; V _I or V _O = 3.6 V		10	μA
I _{CC}	Quiescent Supply Current (Note 9)	1.65 V ≤ V _{CC} ≤ 3.6 V; V _I = GND or V _{CC}		40	μA
		1.65 V ≤ V _{CC} ≤ 3.6 V; 3.6 V ≤ V _I , V _O ≤ 3.6 V		±40	μA
ΔI _{CC}	Increase in I _{CC} per Input	2.7 V < V _{CC} ≤ 3.6 V; V _{IH} = V _{CC} - 0.6 V		750	μA

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

9. Outputs disabled or 3-state only.

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AC CHARACTERISTICS (Note 10; $t_R = t_F = 2.0$ ns; $C_L = 30$ pF; $R_L = 500$ Ω)

Symbol	Parameter	Waveform	Limits						Unit
			$T_A = -40^\circ\text{C to } +85^\circ\text{C}$						
			$V_{CC} = 3.0\text{ V to } 3.6\text{ V}$		$V_{CC} = 2.3\text{ V to } 2.7\text{ V}$		$V_{CC} = 1.65\text{ to } 1.95\text{ V}$		
			Min	Max	Min	Max	Min	Max	
t_{PLH} t_{PHL}	Propagation Delay Dn to On	1	1.1 1.1	3.6 3.6	1.0 1.0	4.5 4.5	1.5 1.5	6.8 6.8	ns
t_{PLH} t_{PHL}	Propagation Delay LE to On	1	1.0 1.0	3.9 3.9	1.0 1.0	4.9 4.9	1.5 1.5	7.8 7.8	ns
t_{PZH} t_{PZL}	Output Enable Time to High and Low Level	2	1.0 1.0	4.7 4.7	1.0 1.0	6.0 6.0	1.5 1.5	9.2 9.2	ns
t_{PHZ} t_{PLZ}	Output Disable Time From High and Low Level	2	1.4 1.4	4.1 4.1	1.2 1.2	5.1 5.1	1.5 1.5	6.8 6.8	ns
t_s	Setup Time, High or Low Dn to LE	3	1.1		1.0		2.5		ns
t_h	Hold Time, High or Low Dn to LE	3	1.4		1.5		1.0		ns
t_w	LE Pulse Width, High	3	3.3		3.3		4.0		ns
t_{OSHL} t_{OSLH}	Output-to-Output Skew (Note 11)			0.5 0.5		0.5 0.5		0.75 0.75	ns

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

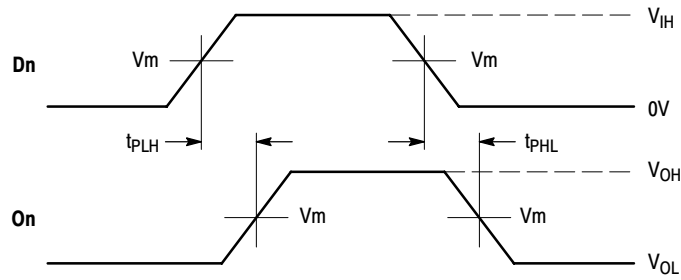
11. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}); parameter guaranteed by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

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Condition	Typical	Unit
C_{IN}	Input Capacitance	Note 12	6	pF
C_{OUT}	Output Capacitance	Note 12	7	pF
C_{PD}	Power Dissipation Capacitance	Note 12, 10 MHz	20	pF

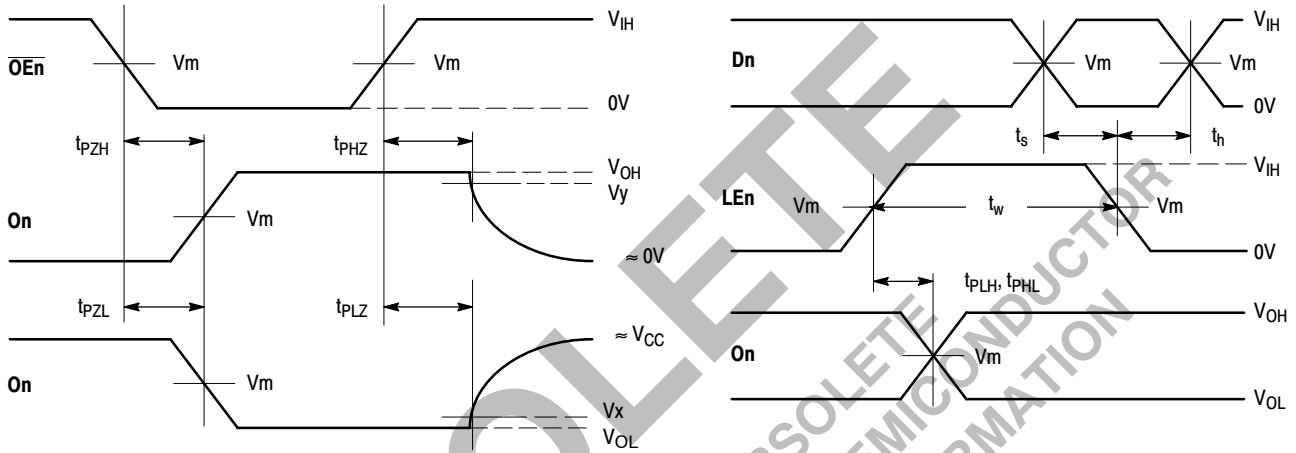
12. $V_{CC} = 1.8, 2.5$ or 3.3 V; $V_I = 0$ V or V_{CC} .

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

Figure 4. AC Waveforms



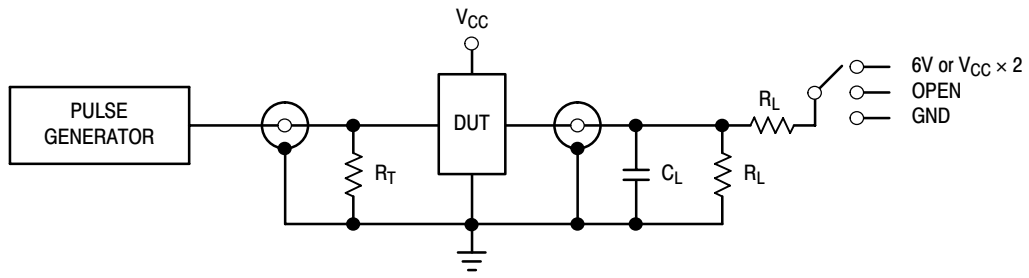
WAVEFORM 2 - OUTPUT ENABLE AND DISABLE TIMES
 $t_R = t_F = 2.0\text{ns}$, 10% to 90%; $f = 1\text{MHz}$; $t_W = 500\text{ns}$

WAVEFORM 3 - LE to On PROPAGATION DELAYS, LE MINIMUM PULSE WIDTH, Dn to LE SETUP AND HOLD TIMES
 $t_R = t_F = 2.0\text{ns}$, 10% to 90%; $f = 1\text{MHz}$; $t_W = 500\text{ns}$ except when noted

Figure 5. AC Waveforms

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

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

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

Figure 6. Test Circuit

OBSOLETE

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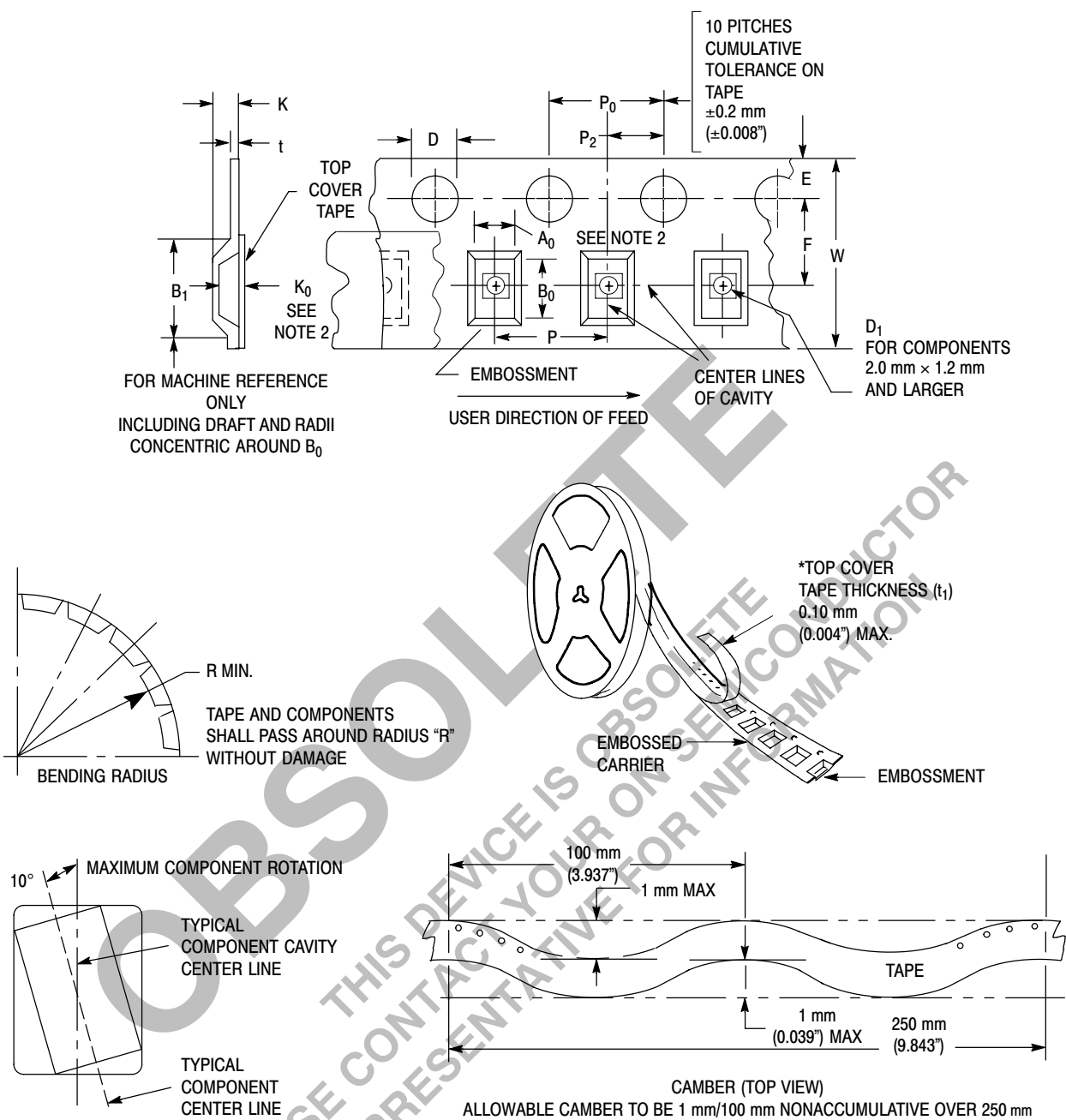


Figure 7. Carrier Tape Specifications

EMBOSSSED 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.

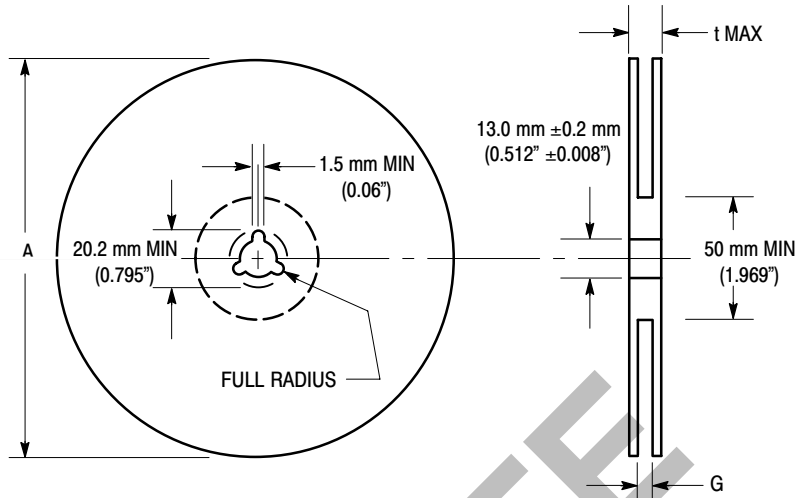


Figure 8. Reel Dimensions

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")

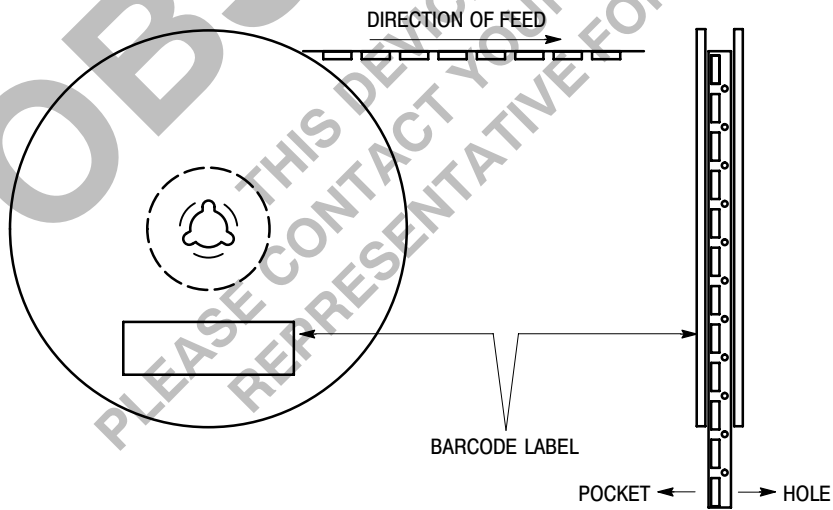


Figure 9. Reel Winding Direction

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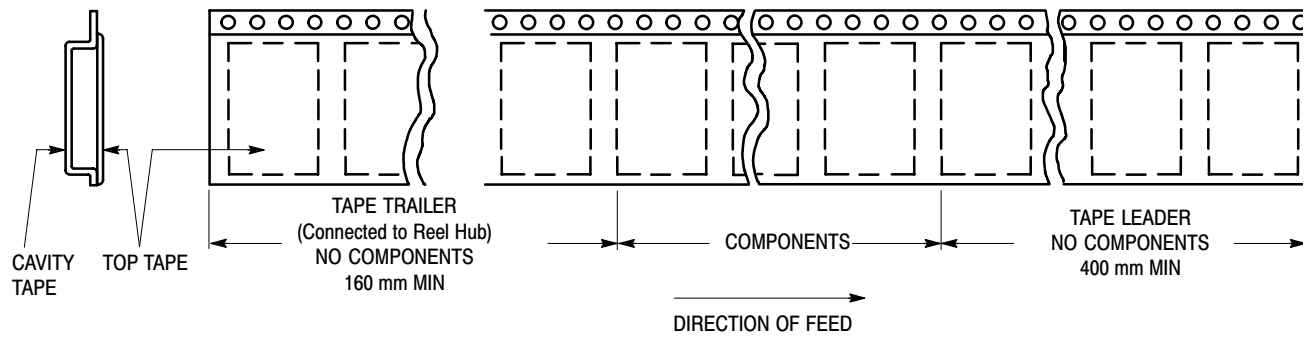


Figure 10. Tape Ends for Finished Goods

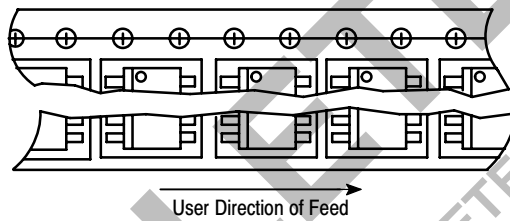


Figure 11. Reel Configuration

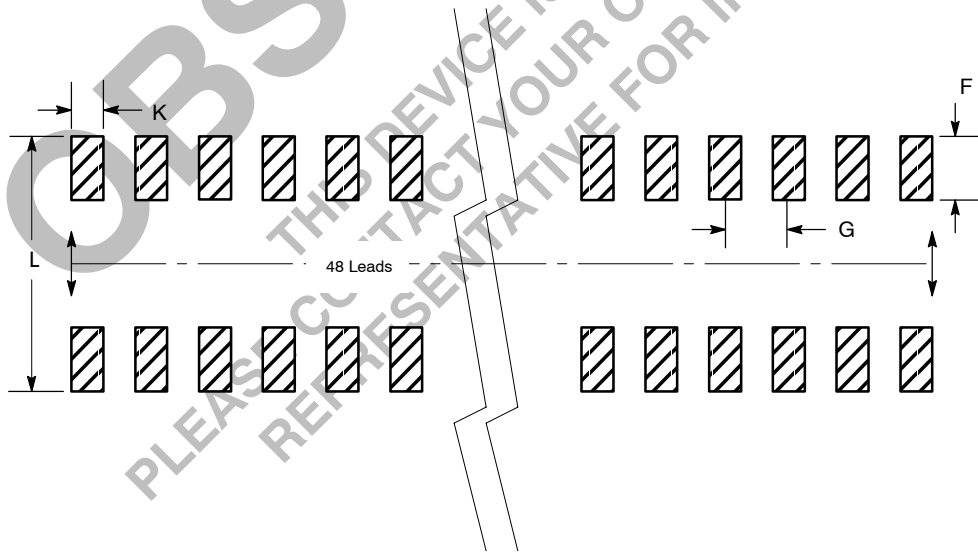
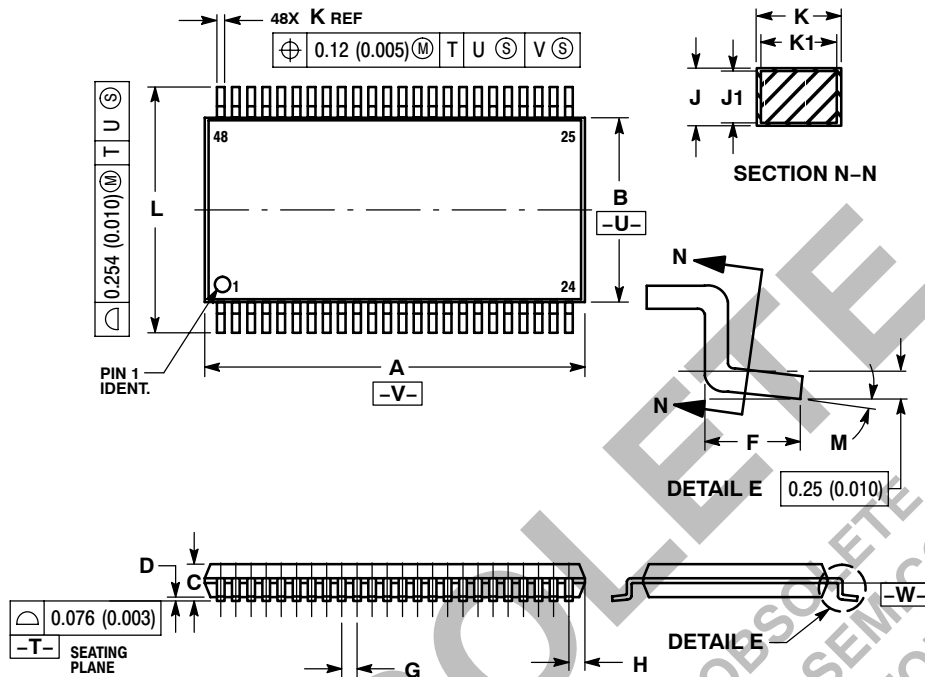


Figure 12. Package Footprint

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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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