

Low-Voltage CMOS 16-Bit D-Type Flip-Flop

With 5 V-Tolerant Inputs and Outputs (3-State, Non-Inverting)

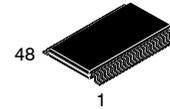
MC74LCX16374

The MC74LCX16374 is a high performance, non-inverting 16-bit D-type flip-flop operating from a 1.65 V to 5.5 V supply. The device is byte controlled. Each byte has separate Output Enable and Clock Pulse inputs. These control pins can be tied together for full 16-bit operation. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance. A V_I specification of 5.5 V allows MC74LCX16374 inputs to be safely driven from 5.0 V devices.

The MC74LCX16374 consists of 16 edge-triggered flip-flops with individual D-type inputs and 5.0 V-tolerant 3-state true outputs. The buffered clocks (CPn) and buffered Output Enables ($\overline{OE}n$) are common to all flip-flops within the respective byte. The flip-flops will store the state of individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition. With the \overline{OE} LOW, the contents of the flip-flops are available at the outputs. When the \overline{OE} is HIGH, the outputs go to the high impedance state. The \overline{OE} input level does not affect the operation of the flip-flops.

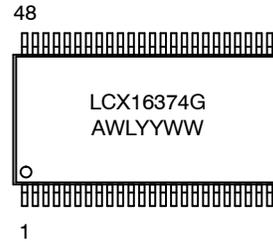
Features

- Designed for 1.65 to 5.5 V V_{CC} Operation
- 6.2 ns Maximum t_{pd}
- 5.0 V Tolerant – Interface Capability With 5.0 V TTL Logic
- Supports Live Insertion and Withdrawal
- I_{OFF} Specification Guarantees High Impedance When $V_{CC} = 0$ V
- LVTTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability at $V_{CC} = 3$ V
- Near Zero Static Supply Current in All Three Logic States (20 μ A) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 100 mA
- ESD Performance:
 - ◆ Human Body Model >2000 V
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant



TSSOP-48
DT SUFFIX
CASE 1201

MARKING DIAGRAM



- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

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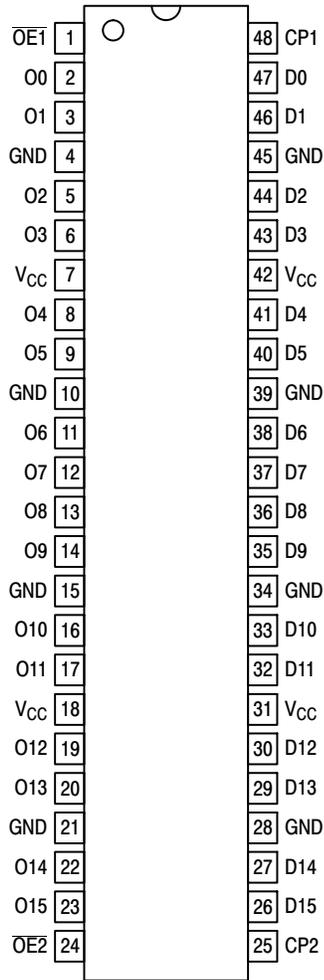


Figure 1. Pinout: 48-Lead (Top View)

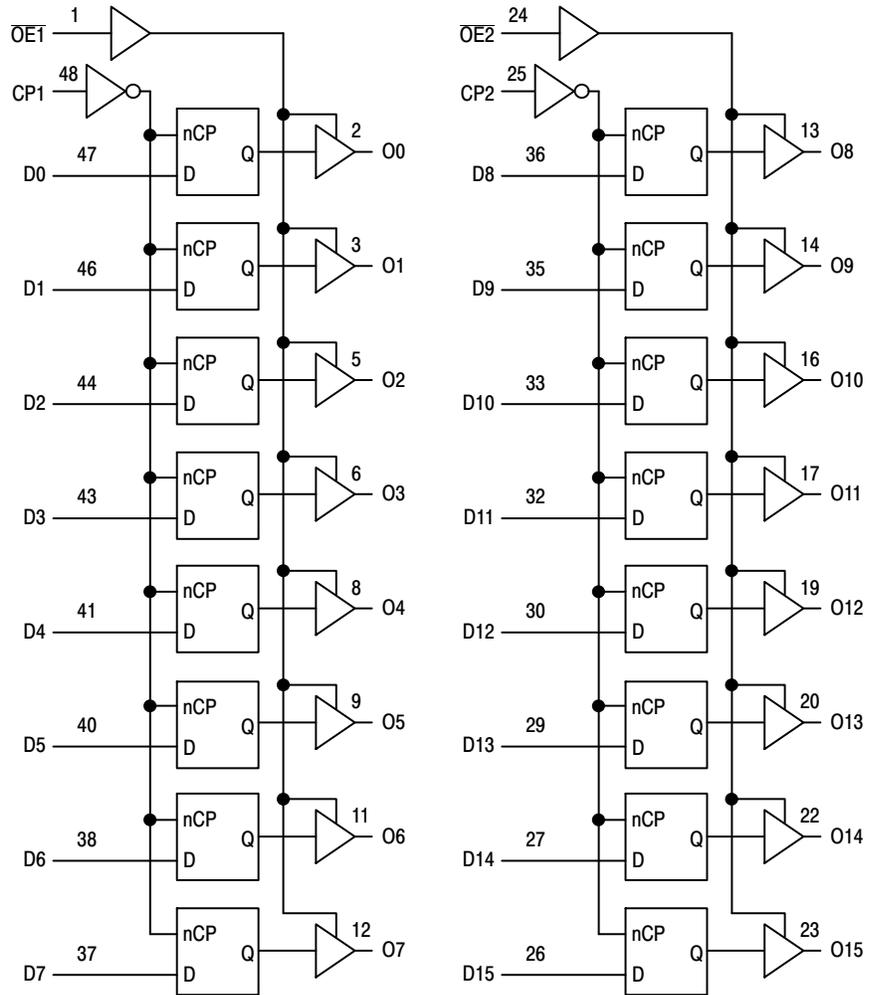


Figure 2. Logic Diagram

Table 1. PIN NAMES

Pins	Function
$\overline{OE}n$	Output Enable Inputs
CPn	Clock Pulse Inputs
D0-D15	Inputs
O0-O15	Outputs

TRUTH TABLE

Inputs			Outputs	Inputs			Outputs
CP1	$\overline{OE}1$	D0:7	O0:7	CP2	$\overline{OE}2$	D8:15	O8:15
↑	L	H	H	↑	L	H	H
↑	L	L	L	↑	L	L	L
L	L	X	O0	L	L	X	O0
X	H	X	Z	X	H	X	Z

H = High Voltage Level

L = Low Voltage Level

Z = High Impedance State

↑ = Low-to-High Transition

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

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MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage	-0.5 to +6.5	V
V_{IN}	DC Input Voltage (Note 1)	-0.5 to +6.5	V
V_{OUT}	DC Output Voltage (Note 1) Active-Mode (High or Low State) Tri-State Mode Power-Down Mode ($V_{CC} = 0$ V)	-0.5 to $V_{CC} + 0.5$ -0.5 to +6.5 -0.5 to +6.5	V
I_{IK}	DC Input Diode Current $V_{IN} < GND$	-50	mA
I_{OK}	DC Output Diode Current $V_{OUT} < GND$	-50	mA
I_O	DC Output Source/Sink Current	± 50	mA
I_{CC}	DC Supply Current per Supply Pin	± 100	mA
I_{GND}	DC Supply Current per Ground Pin	± 100	mA
T_{STG}	Storage Temperature Range	-65 to +150	$^{\circ}C$
T_L	Lead Temperature, 1 mm from Case for 10 secs	260	$^{\circ}C$
T_J	Junction Temperature Under Bias	+150	$^{\circ}C$
θ_{JA}	Thermal Resistance (Note 2)	71	$^{\circ}C/W$
P_D	Power Dissipation in Still Air	1765	mW
MSL	Moisture Sensitivity	Level 1	
F_R	Flammability Rating Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in	
V_{ESD}	ESD Withstand Voltage (Note 3) Human Body Model Charged Device Model	>2000 N/A	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- I_O absolute maximum rating must be observed.
- Measured with minimum pad spacing on an FR4 board, using 76 mm-by-114 mm, 2-ounce copper trace no air flow per JESD51-7.
- HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Supply Voltage Operating Data Retention Only	1.65 1.5	2.5, 3.3 2.5, 3.3	5.5 5.5	V
V_{IN}	Digital Input Voltage	0		5.5	V
V_{OUT}	Output Voltage Active Mode (High or Low State) Tri-State Mode Power Down Mode ($V_{CC} = 0$ V)	0 0 0		V_{CC} 5.5 5.5	V
T_A	Operating Free-Air Temperature	-55		+125	$^{\circ}C$
t_r, t_f	Input Rise or Fall Rate $V_{CC} = 1.65$ V to 1.95 V $V_{CC} = 2.3$ V to 2.7 V V_{IN} from 0.8 V to 2.0 V, $V_{CC} = 3.0$ V $V_{CC} = 4.5$ V to 5.5 V	0 0 0 0		20 20 10 5	ns/V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

- Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

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DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V _{CC} (V)	T _A = -40 °C to +85 °C		T _A = -55 °C to +125 °C		Unit
				Min	Max	Min	Max	
V _{IH}	High-Level Input Voltage		1.65 to 1.95	0.65 x V _{CC}		0.65 x V _{CC}		V
			2.3 to 2.7	1.7		1.7		
			2.7 to 3.6	2.0		2.0		
			4.5 to 5.5	0.7 x V _{CC}		0.7 x V _{CC}		
V _{IL}	Low-Level Input Voltage		1.65 to 1.95		0.35 x V _{CC}		0.35 x V _{CC}	V
			2.3 to 2.7		0.7		0.7	
			2.7 to 3.6		0.8		0.8	
			4.5 to 5.5		0.3 x V _{CC}		0.3 x V _{CC}	
V _{OH}	High-Level Output Voltage	V _I = V _{IH} or V _{IL} I _{OH} = -100 μA I _{OH} = -4 mA I _{OH} = -8 mA I _{OH} = -12 mA I _{OH} = -16 mA I _{OH} = -24 mA I _{OH} = -32 mA	1.65 to 5.5	V _{CC} - 0.1		V _{CC} - 0.1		V
			1.65	1.2		1.2		
			2.3	1.8		1.8		
			2.7	2.2		2.2		
			3.0	2.4		2.4		
			3.0	2.2		2.2		
V _{OL}	Low-Level Output Voltage	V _I = V _{IH} or V _{IL} I _{OH} = -100 μA I _{OH} = -4 mA I _{OH} = -8 mA I _{OH} = -12 mA I _{OH} = -16 mA I _{OH} = -24 mA I _{OH} = -32 mA	1.65 to 5.5		0.1		0.1	V
			1.65		0.45		0.45	
			2.3		0.6		0.6	
			2.7		0.4		0.4	
			3.0		0.4		0.4	
			3.0		0.55		0.55	
I _I	Input Leakage Current	V _I = 0 to 5.5 V	3.6		±5.0		±5.0	μA
I _{OZ}	3-State Output Leakage Current	V _I = V _{IH} or V _{IL} , V _O = 0 V to 5.5 V	3.6		±5.0		±5.0	μA
I _{OFF}	Power Off Leakage Current	V _I = 5.5 V or V _O = 5.5 V	0		10		10	μA
I _{CC}	Quiescent Supply Current	V _I = 5.5 V or GND	3.6		10		10	μA
ΔI _{CC}	Increase in I _{CC} per Input	V _{IH} = V _{CC} - 0.6 V	2.3 to 3.6		500		500	μA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Condition	V _{CC} (V)	T _A = -40 °C to +85 °C		T _A = -55 °C to +125 °C		Unit
				Min	Max	Min	Max	
f _{max}	Clock Pulse Frequency	See Figures 3 and 4	1.65 to 1.95					MHz
			2.3 to 2.7					
			2.7					
			3.0 to 3.6	170		170		
			4.5 to 5.5					
t _{PLH} , t _{PHL}	Propagation Delay, CP to O _n	See Figures 3 and 4, Waveform 1	1.65 to 1.95		TBD		TBD	ns
			2.3 to 2.7		7.4		7.4	
			2.7		6.5		6.5	
			3.0 to 3.6		6.2		6.2	
			4.5 to 5.5		TBD		TBD	
t _{PZH} , t _{PZL}	Output Enable Time, OE to O	See Figures 3 and 4, Waveform 2	1.65 to 1.95		TBD		TBD	ns
			2.3 to 2.7		7.9		7.9	
			2.7		6.3		6.3	
			3.0 to 3.6		6.1		6.1	
			4.5 to 5.5		TBD		TBD	
t _{PHZ} , t _{PLZ}	Output Disable Time, OE to O	See Figures 3 and 4, Waveform 2	1.65 to 1.95		TBD		TBD	ns
			2.3 to 2.7		7.2		7.2	
			2.7		6.2		6.2	
			3.0 to 3.6		6.0		6.0	
			4.5 to 5.5		TBD		TBD	
t _s	Setup Time, High or Low D _n to LE	See Figures 3 and 4, Waveform 1	1.65 to 1.95	TBD		TBD		ns
			2.3 to 2.7	3.0		3.0		
			2.7	2.5		2.5		
			3.0 to 3.6	2.5		2.5		
			4.5 to 5.5	TBD		TBD		
t _h	Hold Time, High or Low D _n to LE	See Figures 3 and 4, Waveform 1	1.65 to 1.95	TBD		TBD		ns
			2.3 to 2.7	2.0		2.0		
			2.7	1.5		1.5		
			3.0 to 3.6	1.5		1.5		
			4.5 to 5.5	TBD		TBD		
t _w	LE Pulse Width, High	See Figures 3 and 4, Waveform 3	1.65 to 1.95	TBD		TBD		ns
			2.3 to 2.7	3.5		3.5		
			2.7	3.0		3.0		
			3.0 to 3.6	3.0		3.0		
			4.5 to 5.5	TBD		TBD		
t _{OSHL} , t _{OSLH}	Output to Output Skew (Note 5)		1.65 to 1.95					ns
			2.3 to 2.7					
			2.7					
			3.0 to 3.6		1.0		1.0	
			4.5 to 5.5					

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_{OSHL}) or LOW-to-HIGH (t_{OSLH}); parameter guaranteed by design.

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DYNAMIC SWITCHING CHARACTERISTICS

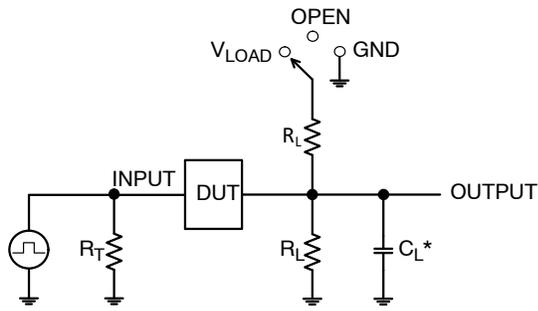
Symbol	Characteristic	Condition	T _A = +25 °C			Units
			Min	Typ	Max	
V _{OLP}	Dynamic LOW Peak Voltage (Note 6)	V _{CC} = 3.3 V, C _L = 50 pF, V _{IH} = 3.3 V, V _{IL} = 0 V V _{CC} = 2.5 V, C _L = 30 pF, V _{IH} = 2.5 V, V _{IL} = 0 V		0.8 0.6		V
V _{OLV}	Dynamic LOW Valley Voltage (Note 6)	V _{CC} = 3.3 V, C _L = 50 pF, V _{IH} = 3.3 V, V _{IL} = 0 V V _{CC} = 2.5 V, C _L = 30 pF, V _{IH} = 2.5 V, V _{IL} = 0 V		-0.8 -0.6		V

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.

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Condition	Typical	Units
C _{IN}	Input Capacitance	V _{CC} = 3.3 V, V _I = 0 V or V _{CC}	7	pF
C _{OUT}	Output Capacitance	V _{CC} = 3.3 V, V _I = 0 V or V _{CC}	8	pF
C _{PD}	Power Dissipation Capacitance	10 MHz, V _{CC} = 3.3 V, V _I = 0 V or V _{CC}	20	pF

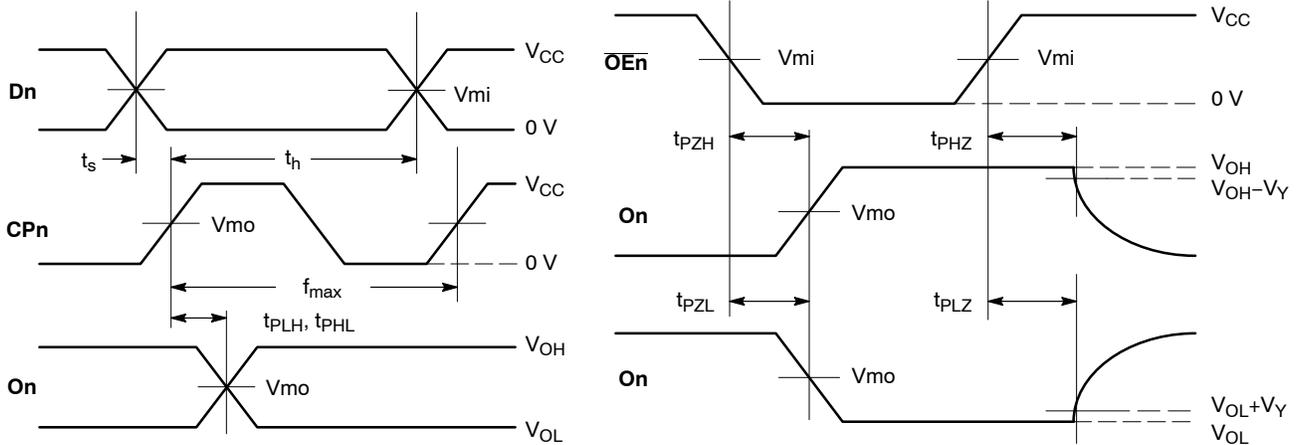
MC74LCX16374



C_L includes probe and jig capacitance
 R_T is Z_{OUT} of pulse generator (typically 50 Ω)
 $f = 1$ MHz

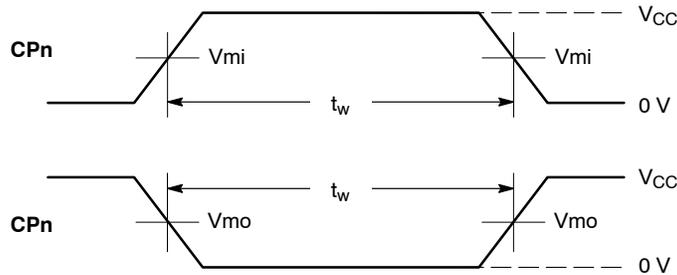
Test	Switch Position
t_{PLH} / t_{PHL}	Open
t_{PLZ} / t_{PZL}	V_{LOAD}
t_{PHZ} / t_{PZH}	GND

Figure 3. Test Circuit



WAVEFORM 1 - PROPAGATION DELAYS, SETUP AND HOLD TIMES
 $t_R = t_F = 2.5$ ns, 10% to 90%; $f = 1$ MHz; $t_W = 500$ ns

WAVEFORM 2 - OUTPUT ENABLE AND DISABLE TIMES
 $t_R = t_F = 2.5$ ns, 10% to 90%; $f = 1$ MHz; $t_W = 500$ ns



WAVEFORM 3 - PULSE WIDTH
 $t_R = t_F = 2.5$ ns (or fast as required) from 10% to 90%;
 Output requirements: $V_{OL} \leq 0.8$ V, $V_{OH} \geq 2.0$ V

Figure 4. AC Waveforms

V_{CC} , V	R_L , Ω	C_L , pF	V_{LOAD}	V_{mi} , V	V_{mo} , V	V_Y , V
1.65 to 1.95	500	30	$2 \times V_{CC}$	$V_{CC}/2$	$V_{CC}/2$	0.15
2.3 to 2.7	500	30	$2 \times V_{CC}$	$V_{CC}/2$	$V_{CC}/2$	0.15
2.7	500	50	6 V	1.5	1.5	0.3
3.0 to 3.6	500	50	6 V	1.5	1.5	0.3
4.5 to 4.5	500	50	$2 \times V_{CC}$	$V_{CC}/2$	$V_{CC}/2$	0.3

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ORDERING INFORMATION

Device	Package	Shipping [†]
MC74LCX16374DTR2G	TSSOP-48 (Pb-Free)	2500 / Tape & Reel

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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REVISION HISTORY

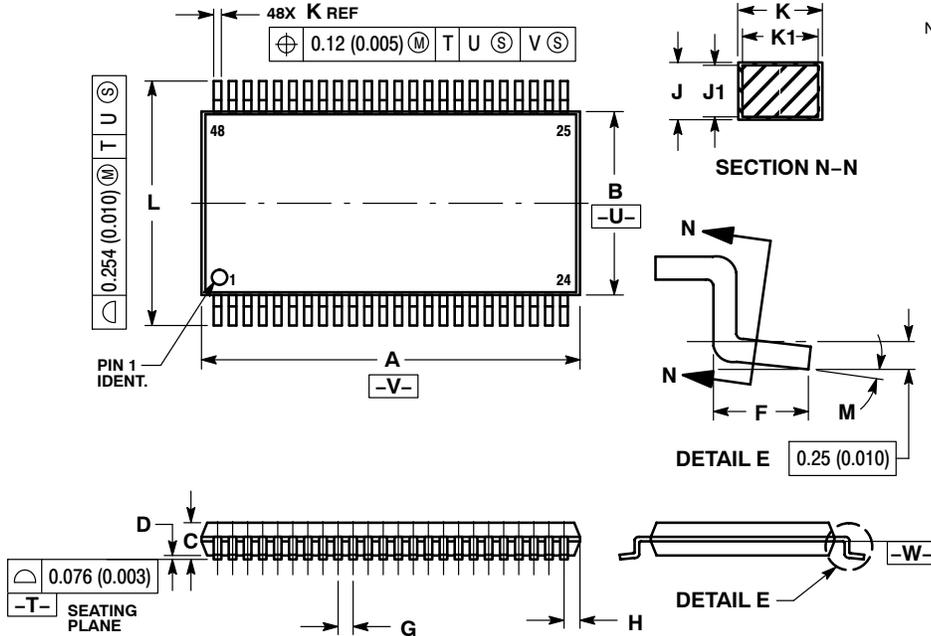
Revision	Description of Changes	Date
12	Five page 1 value edits, delete one bullet and edit another, edit and move the order info table, replace all table on pages 3 and 4, add a new figure 3 and edit figure 4 and replace its table	10/27/2025

This document has undergone updates prior to the inclusion of this revision history table. The changes tracked here only reflect updates made on the noted approval dates.



TSSOP-48
CASE 1201
ISSUE B

DATE 06 JUL 2010

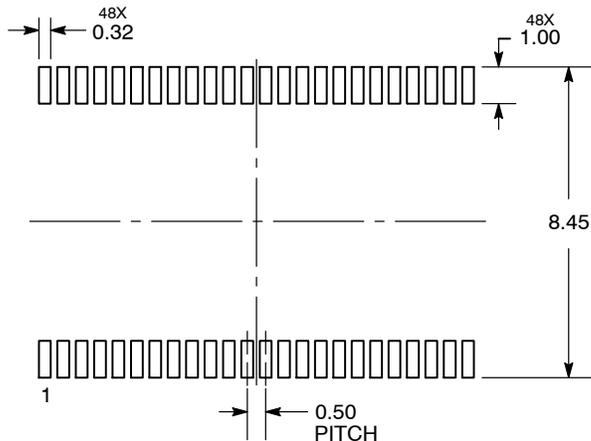


NOTES:

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°

RECOMMENDED
SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC
MARKING DIAGRAM*



- XXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

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