MC74LCX374

Low-Voltage CMOS Octal D-Type Flip-Flop

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

The MC74LCX374 is a high performance, non−inverting octal D−type flip−flop operating from a 2.3 to 3.6 V supply. 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 MC74LCX374 inputs to be safely driven from 5 V devices.

The MC74LCX374 consists of 8 edge−triggered flip−flops with individual D−type inputs and 3−state true outputs. The buffered clock and buffered Output Enable ($\overline{OE}$) are common to all flip−flops. The eight 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 eight 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 2.3 to 3.6 V V_{CC} Operation
- 5 V Tolerant − Interface Capability With 5 V TTL Logic
- Supports Live Insertion and Withdrawal
- I_{OFF} Specification Guarantees High Impedance When V_{CC} = 0 V
- LVTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current in All Three Logic States (10 μA) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500 mA
- ESD Performance:
  - Human Body Model >2000 V
  - Machine Model >200 V
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

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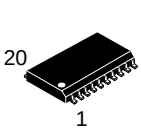
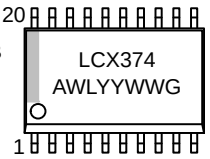
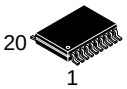
MARKING DIAGRAMS

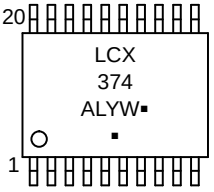


SOIC−20 WB
DW SUFFIX
CASE 751D





TSSOP−20
DT SUFFIX
CASE 948E



A	=	Assembly Location
L, WL	=	Wafer Lot
Y, YY	=	Year
W, WW	=	Work Week
G or ▪	=	Pb−Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

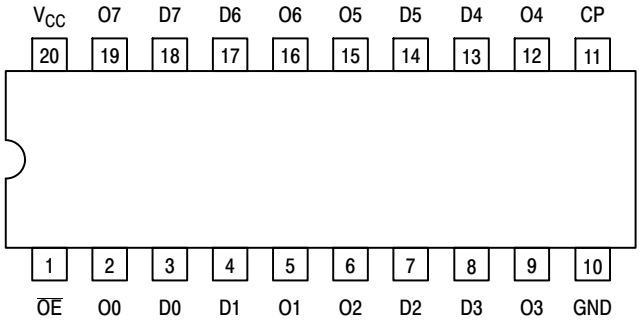


Figure 1. Pinout: 20−Lead (Top View)

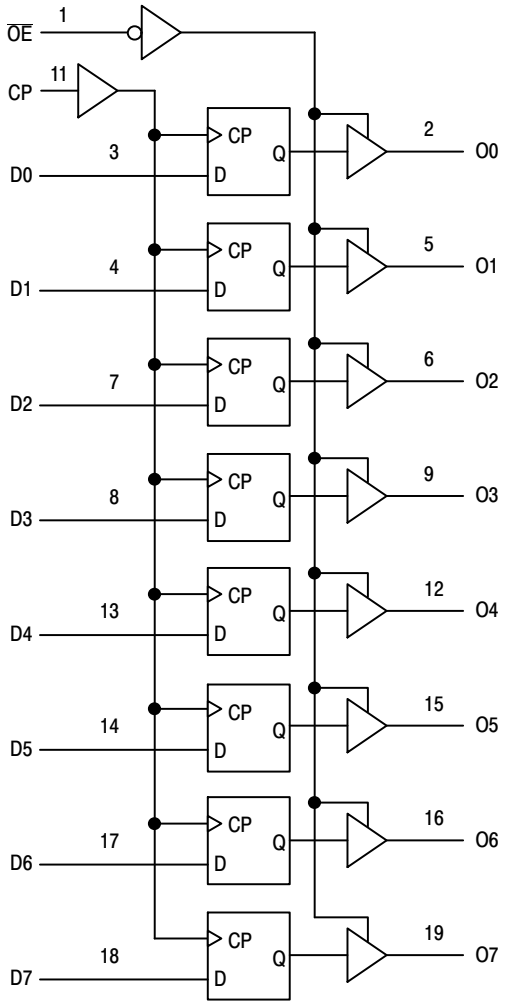


Figure 2. LOGIC DIAGRAM

PIN NAMES

Pins	Function
$\overline{OE}$	Output Enable Input
CP	Clock Pulse Input
D0−D7	Data Inputs
O0−O7	3−State Outputs

TRUTH TABLE

INPUTS			OUTPUTS	
$\overline{OE}$	CP	Dn	On	OPERATING MODE
L L	↑ ↑	l h	L H	Load and Read Register
L	↥	X	NC	Hold and Read Register
H	↥	X	Z	Hold and Disable Outputs
H H	↑ ↑	l h	Z Z	Load Internal Register and Disable Outputs

H = High Voltage Level
h = High Voltage Level One Setup Time Prior to the Low−to−High Clock Transition
L = Low Voltage Level
l = Low Voltage Level One Setup Time Prior to the Low−to−High Clock Transition
NC = No Change, State Prior to Low−to−High Clock Transition
X = High or Low Voltage Level and Transitions are Acceptable
Z = High Impedance State
↑ = Low−to−High Transition
↥ = Not a Low−to−High Transition; For I_{CC} Reasons, DO NOT FLOAT Inputs

MAXIMUM RATINGS

Symbol	Parameter	Value	Condition	Units
V_{CC}	DC Supply Voltage	−0.5 to +7.0		V
V_I	DC Input Voltage	$-0.5 \le V_I \le +7.0$		V
V_O	DC Output Voltage	$-0.5 \le V_O \le +7.0$	Output in 3−State	V
		$-0.5 \le V_O \le V_{CC} + 0.5$	(Note 1)	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
MSL	Moisture Sensitivity		Level 1	

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.

1. Output in HIGH or LOW State. I_O absolute maximum rating must be observed.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Units
V_{CC}	Supply Voltage Operating Data Retention Only	 2.0 1.5	 3.3 3.3	 3.6 3.6	V
V_I	Input Voltage	0		5.5	V
V_O	Output Voltage (HIGH or LOW State) (3−State)	 0 0		 V_{CC} 5.5	V
I_{OH}	HIGH Level Output Current, V_{CC} = 3.0 V − 3.6 V			−24	mA
I_{OL}	LOW Level Output Current, V_{CC} = 3.0 V − 3.6 V			24	mA
I_{OH}	HIGH Level Output Current, V_{CC} = 2.7 V − 3.0 V			−12	mA
I_{OL}	LOW Level Output Current, V_{CC} = 2.7 V − 3.0 V			12	mA
T_A	Operating Free−Air Temperature	−40		+85	°C
$\Delta t/\Delta V$	Input Transition Rise or Fall Rate, V_{IN} from 0.8 V to 2.0 V, V_{CC} = 3.0 V	0		10	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.

ORDERING INFORMATION

Device	Package	Shipping†
MC74LCX374DWR2G	SOIC−20 WB (Pb−Free)	1000 / Tape & Reel
MC74LCX374DTR2G	TSSOP−20 (Pb−Free)	2500 / Tape & Reel
NLV74LCX374DTR2G*	TSSOP−20 (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.

*NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable.

DC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Condition	T_A = −40°C to +85°C		Units
			Min	Max	
V_{IH}	HIGH Level Input Voltage (Note 2)	2.7 V ≤ V_{CC} ≤ 3.6 V	2.0		V
V_{IL}	LOW Level Input Voltage (Note 2)	2.7 V ≤ V_{CC} ≤ 3.6 V		0.8	V
V_{OH}	HIGH Level Output Voltage	2.7 V ≤ V_{CC} ≤ 3.6 V; I_{OH} = −100 μA	V_{CC} − 0.2		V
		V_{CC} = 2.7 V; I_{OH} = −12 mA	2.2		
		V_{CC} = 3.0 V; I_{OH} = −18 mA	2.4		
		V_{CC} = 3.0 V; I_{OH} = −24 mA	2.2		
V_{OL}	LOW Level Output Voltage	2.7 V ≤ V_{CC} ≤ 3.6 V; I_{OL} = 100 μA		0.2	V
		V_{CC} = 2.7 V; I_{OL} = 12 mA		0.4	
		V_{CC} = 3.0 V; I_{OL} = 16 mA		0.4	
		V_{CC} = 3.0 V; I_{OL} = 24 mA		0.55	
I_{OZ}	3−State Output Current	V_{CC} = 3.6 V, V_{IN} = V_{IH} or V_{IL}, V_{OUT} = 0 to 5.5 V		±5	μA
I_{OFF}	Power Off Leakage Current	V_{CC} = 0, V_{IN} = 5.5 V or V_{OUT} = 5.5 V		10	μA
I_{IN}	Input Leakage Current	V_{CC} = 3.6 V, V_{IN} = 5.5 V or GND		±5	μA
I_{CC}	Quiescent Supply Current	V_{CC} = 3.6 V, V_{IN} = 5.5 V or GND		10	μA
ΔI_{CC}	Increase in I_{CC} per Input	2.3 ≤ V_{CC} ≤ 3.6 V; V_{IH} = V_{CC} − 0.6 V		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.

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

AC CHARACTERISTICS (t_R = t_F = 2.5 ns; C_L = 50 pF; R_L = 500 Ω)

Symbol	Parameter	Waveform	Limits				Units
			T_A = −40°C to +85°C				
			V_{CC} = 3.0 V to 3.6 V		V_{CC} = 2.7 V		
			Min	Max	Min	Max	
f_{max}	Clock Pulse Frequency	1	150				MHz
t_{PLH} t_{PHL}	Propagation Delay CP to O_n	1	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t_{PZH} t_{PZL}	Output Enable Time to HIGH and LOW Levels	2	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t_{PHZ} t_{PLZ}	Output Disable Time from HIGH and LOW Levels	2	1.5 1.5	7.5 7.5	1.5 1.5	8.5 8.5	ns
t_s	Setup TIme, HIGH or LOW D_n to CP	1	2.5		2.5		ns
t_h	Hold TIme, HIGH or LOW D_n to CP	1	1.5		1.5		ns
t_w	CP Pulse Width, HIGH or LOW	3	3.3		3.3		ns
t_{OSHL} t_{OSLH}	Output−to−Output Skew (Note 3)			1.0 1.0			ns

3. 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.

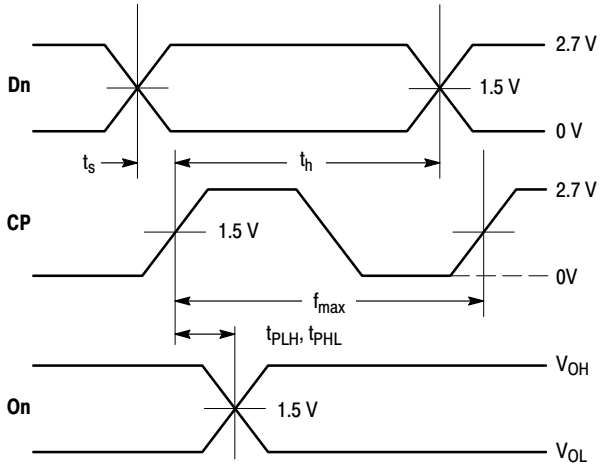
DYNAMIC SWITCHING CHARACTERISTICS

Symbol	Characteristic	Condition	T_A = +25°C			Units
			Min	Typ	Max	
V_{OLP}	Dynamic LOW Peak Voltage (Note 4)	V_{CC} = 3.3 V, C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V		0.8		V
V_{OLV}	Dynamic LOW Valley Voltage (Note 4)	V_{CC} = 3.3 V, C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V		0.8		V

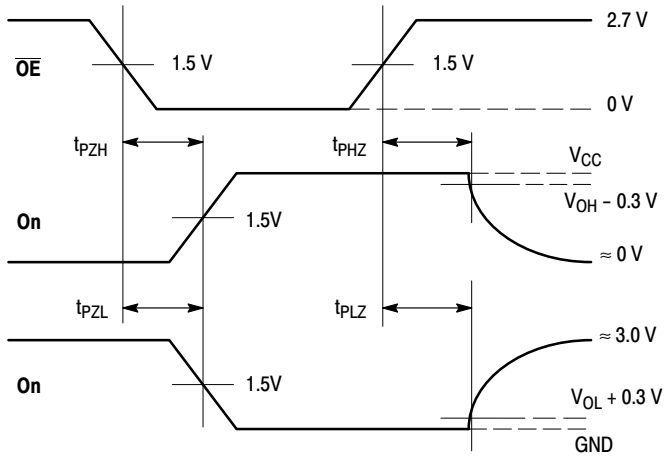
4. Number of outputs defined as “n”. Measured with “n−1” outputs switching from HIGH−to−LOW or LOW−to−HIGH. The remaining output is measured in the LOW state.

CAPACITIVE CHARACTERISTICS

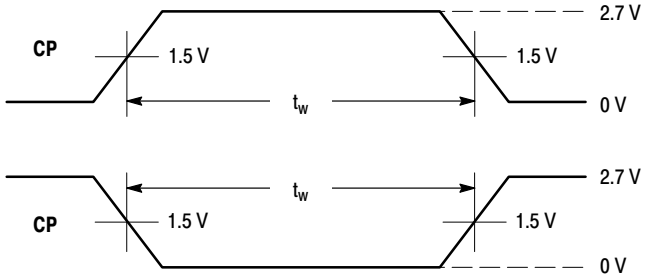
Symbol	Parameter	Condition	Typical	Units
C_{IN}	Input Capacitance	V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	7	pF
C_{OUT}	Output Capacitance	V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	8	pF
C_{PD}	Power Dissipation Capacitance	10 MHz, V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	25	pF



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

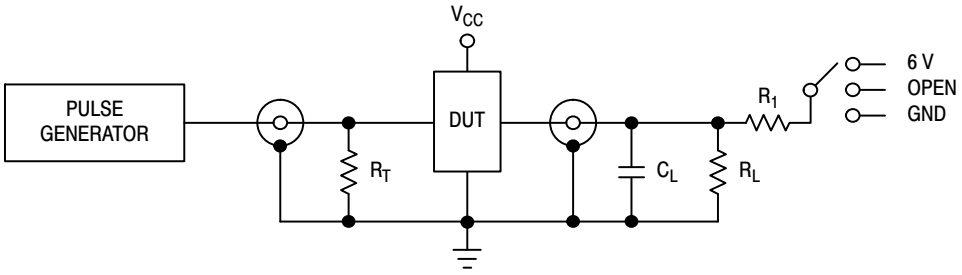


WAVEFORM 2 – OUTPUT ENABLE AND DISABLE TIMES
$t_R = t_F$ = 2.5 ns, 10% to 90%; f = 1 MHz; t_W = 500 ns



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

Figure 3. AC Waveforms



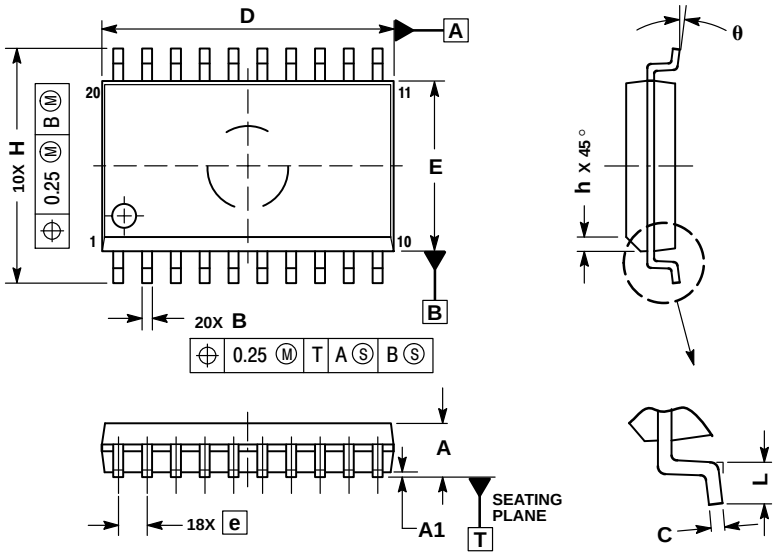
TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6 V
Open Collector/Drain t_{PLH} and t_{PHL}	6 V
t_{PZH}, t_{PHZ}	GND

C_L = 50 pF or equivalent (Includes jig and probe capacitance)
$R_L = R_1$ = 500 Ω or equivalent
$R_T = Z_{OUT}$ of pulse generator (typically 50 Ω)

Figure 4. Test Circuit

PACKAGE DIMENSIONS

SOIC−20 WB
DW SUFFIX
CASE 751D−05
ISSUE G

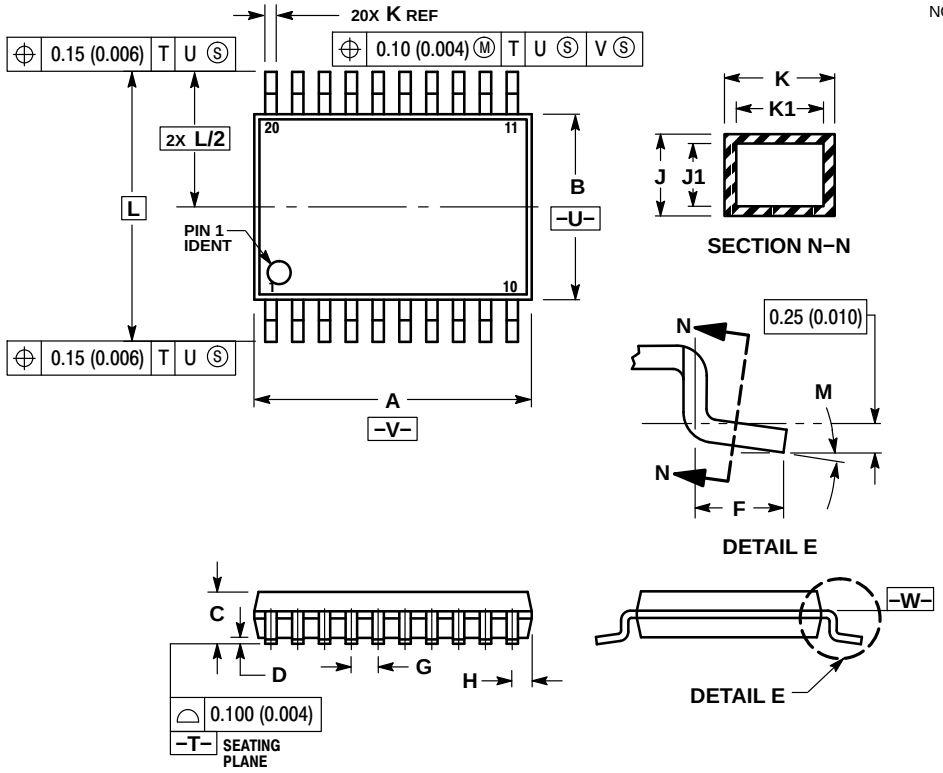


NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
B	0.35	0.49
C	0.23	0.32
D	12.65	12.95
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
θ	0°	7°

PACKAGE DIMENSIONS

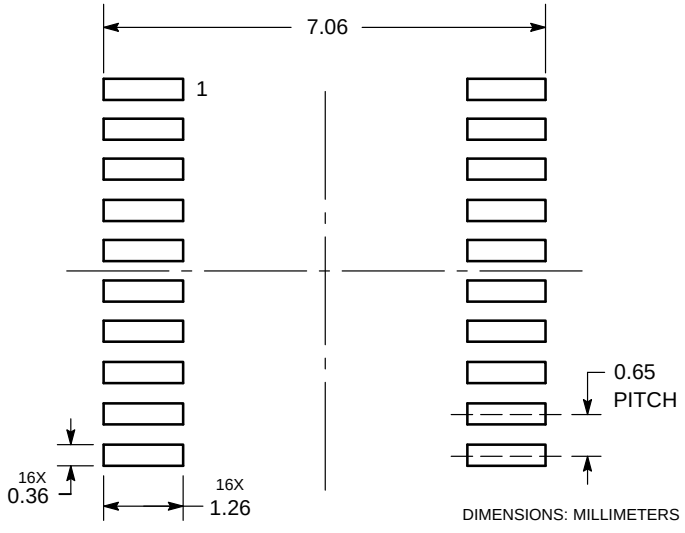
TSSOP−20
DT SUFFIX
CASE 948E−02
ISSUE C



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. 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.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

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MC74LCX374/D