Low-Voltage CMOS Octal Transparent Latch
With 5V-Tolerant Inputs and Outputs (3-State, Non-Inverting)

MC74LCX373

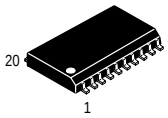
LCX

LOW–VOLTAGE CMOS OCTAL TRANSPARENT LATCH

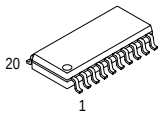
The MC74LCX373 is a high performance, non–inverting octal transparent latch operating from a 2.7 to 3.6V supply. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance. A V_I specification of 5.5V allows MC74LCX373 inputs to be safely driven from 5V devices.

The MC74LCX373 contains 8 D–type latches with 3–state outputs. When the Latch Enable (LE) input is HIGH, data on the Dn inputs enters the latches. In this condition, the latches are transparent, i.e., a latch output will change state each time its D input changes. When LE is LOW, the latches store the information that was present on the D inputs a setup time preceding the HIGH–to–LOW transition of LE. The 3–state standard outputs are controlled by the Output Enable (OE) input. When OE is LOW, the standard outputs are enabled. When OE is HIGH, the standard outputs are in the high impedance state, but this does not interfere with new data entering into the latches.

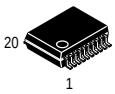
- Designed for 2.7 to 3.6V V_{CC} Operation
- 5V Tolerant — Interface Capability With 5V TTL Logic
- Supports Live Insertion and Withdrawal
- I_{OFF} Specification Guarantees High Impedance When V_{CC} = 0V
- LVTTL Compatible
- LVCMOS Compatible
- 24mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current in All Three Logic States (10μA) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500mA
- ESD Performance: Human Body Model >2000V; Machine Model >200V



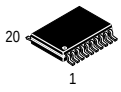
DW SUFFIX
PLASTIC SOIC
CASE 751D–04



M SUFFIX
PLASTIC SOIC EIAJ
CASE 967–01

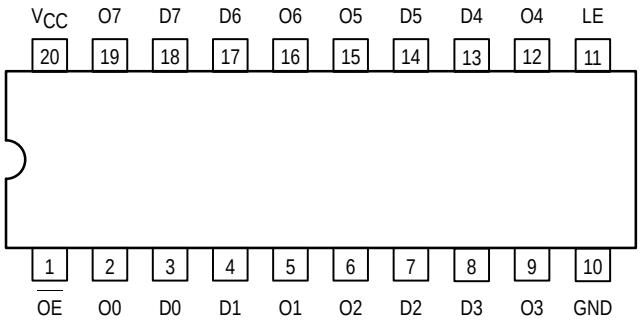


SD SUFFIX
PLASTIC SSOP
CASE 940C–03



DT SUFFIX
PLASTIC TSSOP
CASE 948E–02

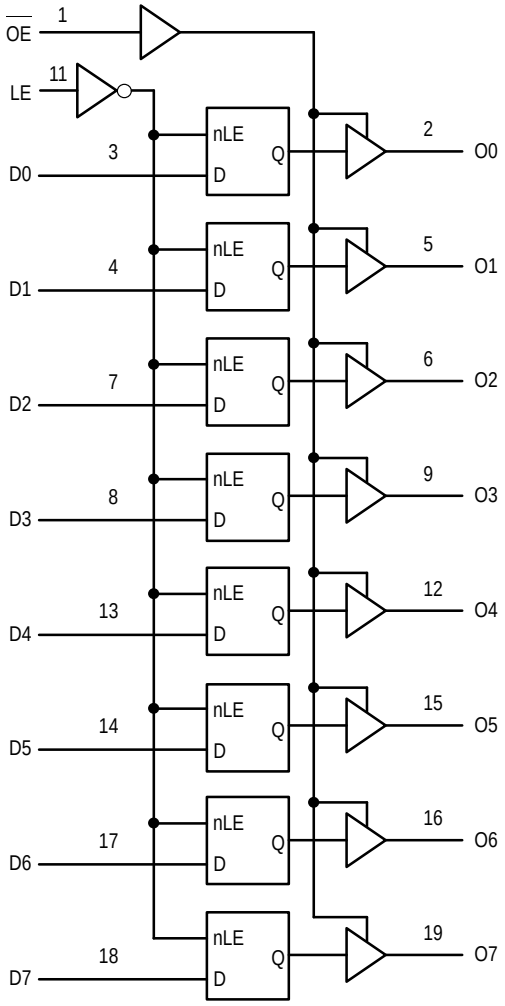
Pinout: 20–Lead (Top View)



PIN NAMES

Pins	Function
$\overline{OE}$	Output Enable Input
LE	Latch Enable Input
D0–D7	Data Inputs
O0–O7	3–State Latch Outputs

LOGIC DIAGRAM



INPUTS			OUTPUTS	OPERATING MODE
OE	**LE**	**Dn**	**On**	
L L	H H	H L	H L	Transparent (Latch Disabled); Read Latch
L L	L L	h l	H L	Latched (Latch Enabled) Read Latch
L	L	X	NC	Hold; Read Latch
H	L	X	Z	Hold; Disabled Outputs
H H	H H	H L	Z Z	Transparent (Latch Disabled); Disabled Outputs
H H	L L	h l	Z Z	Latched (Latch Enabled); Disabled Outputs

H = High Voltage Level; h = High Voltage Level One Setup Time Prior to the Latch Enable High–to–Low Transition; L = Low Voltage Level; l = Low Voltage Level One Setup Time Prior to the Latch Enable High–to–Low Transition; NC = No Change, State Prior to the Latch Enable High–to–Low Transition; X = High or Low Voltage Level or Transitions are Acceptable; Z = High Impedance State; For I_{CC} Reasons DO NOT FLOAT Inputs

ABSOLUTE MAXIMUM RATINGS*

Symbol	Parameter	Value	Condition	Unit
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

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

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Typ	Max	Unit
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} = 3.0V – 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} = 2.7V – 3.0V				–12	mA
I_{OL}	LOW Level Output Current, V_{CC} = 2.7V – 3.0V				12	mA
T_A	Operating Free–Air Temperature		–40		+85	°C
$\Delta t/\Delta V$	Input Transition Rise or Fall Rate, V_{IN} from 0.8V to 2.0V, V_{CC} = 3.0V		0		10	ns/V

DC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Condition	T_A = –40°C to +85°C		Unit
			Min	Max	
V_{IH}	HIGH Level Input Voltage (Note 2.)	$2.7V \le V_{CC} \le 3.6V$	2.0		V
V_{IL}	LOW Level Input Voltage (Note 2.)	$2.7V \le V_{CC} \le 3.6V$		0.8	V
V_{OH}	HIGH Level Output Voltage	$2.7V \le V_{CC} \le 3.6V$; I_{OH} = –100µA	V_{CC} – 0.2		V
		V_{CC} = 2.7V; I_{OH} = –12mA	2.2		
		V_{CC} = 3.0V; I_{OH} = –18mA	2.4		
		V_{CC} = 3.0V; I_{OH} = –24mA	2.2		
V_{OL}	LOW Level Output Voltage	$2.7V \le V_{CC} \le 3.6V$; I_{OL} = 100µA		0.2	V
		V_{CC} = 2.7V; I_{OL}= 12mA		0.4	
		V_{CC} = 3.0V; I_{OL} = 16mA		0.4	
		V_{CC} = 3.0V; I_{OL} = 24mA		0.55	

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

DC ELECTRICAL CHARACTERISTICS (continued)

Symbol	Characteristic	Condition	T_A = –40°C to +85°C		Unit
			Min	Max	
I_I	Input Leakage Current	$2.7V \le V_{CC} \le 3.6V$; $0V \le V_I \le 5.5V$		±5.0	μA
I_{OZ}	3–State Output Current	$2.7 \le V_{CC} \le 3.6V$; $0V \le V_O \le 5.5V$; $V_I = V_{IH}$ or V_{IL}		±5.0	μA
I_{OFF}	Power–Off Leakage Current	$V_{CC} = 0V$; V_I or $V_O = 5.5V$		10	μA
I_{CC}	Quiescent Supply Current	$2.7 \le V_{CC} \le 3.6V$; V_I = GND or V_{CC}		10	μA
		$2.7 \le V_{CC} \le 3.6V$; $3.6 \le V_I$ or $V_O \le 5.5V$		±10	μA
ΔI_{CC}	Increase in I_{CC} per Input	$2.7 \le V_{CC} \le 3.6V$; $V_{IH} = V_{CC} – 0.6V$		500	μA

AC CHARACTERISTICS ($t_R = t_F = 2.5ns$; $C_L = 50pF$; $R_L = 500\Omega$)

Symbol	Parameter	Waveform	Limits				Unit
			T_A = –40°C to +85°C				
			V_{CC} = 3.0V to 3.6V		V_{CC} = 2.7V		
			Min	Max	Min	Max	
t_{PLH} t_{PHL}	Propagation Delay D_n to O_n	1	1.5 1.5	8.0 8.0	1.5 1.5	9.0 9.0	ns
t_{PLH} t_{PHL}	Propagation Delay LE to O_n	3	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 Level	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 Level	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 LE	3	2.5		2.5		ns
t_h	Hold TIme, HIGH or LOW D_n to LE	3	1.5		1.5		ns
t_w	LE Pulse Width, HIGH	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.

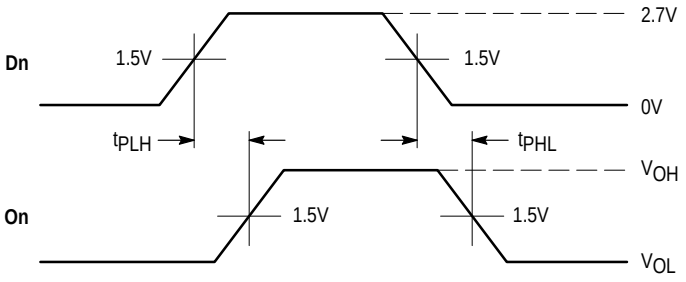
DYNAMIC SWITCHING CHARACTERISTICS

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

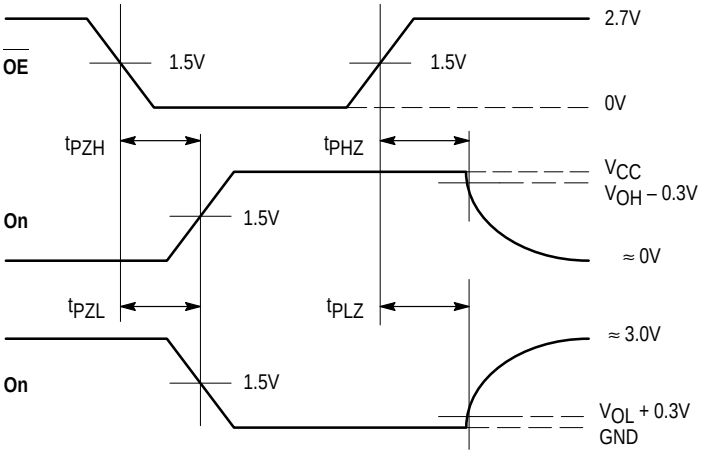
4. Number of outputs defined as “n”. Measured with “n–1” outputs switching from HIGH–to–LOW or LOW–to–HIGH. The remaining output is measured in the LOW state.

CAPACITIVE CHARACTERISTICS

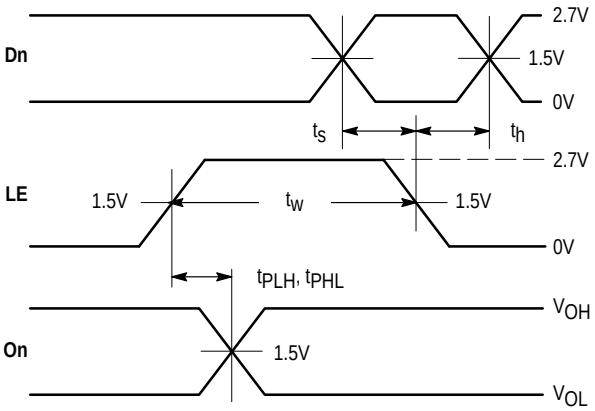
Symbol	Parameter	Condition	Typical	Unit
C_{IN}	Input Capacitance	$V_{CC} = 3.3V$, $V_I = 0V$ or V_{CC}	7	pF
C_{OUT}	Output Capacitance	$V_{CC} = 3.3V$, $V_I = 0V$ or V_{CC}	8	pF
C_{PD}	Power Dissipation Capacitance	10MHz, $V_{CC} = 3.3V$, $V_I = 0V$ or V_{CC}	25	pF



WAVEFORM 1 – PROPAGATION DELAYS
$t_R = t_F$ = 2.5ns, 10% to 90%; f = 1MHz; t_W = 500ns

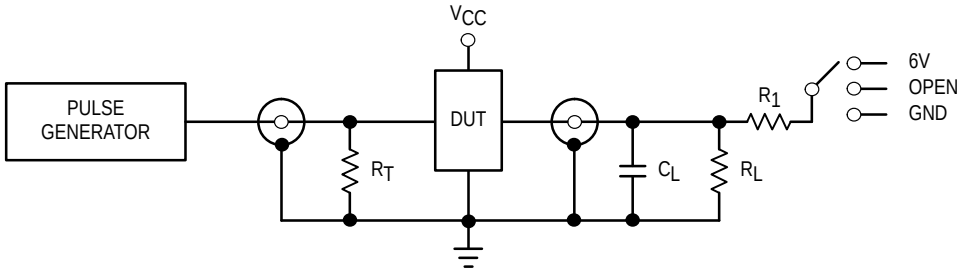


WAVEFORM 2 – OUTPUT ENABLE AND DISABLE TIMES
$t_R = t_F$ = 2.5ns, 10% to 90%; f = 1MHz; t_W = 500ns



WAVEFORM 3 – LE to On PROPAGATION DELAYS, LE MINIMUM PULSE WIDTH, Dn to LE SETUP AND HOLD TIMES
$t_R = t_F$ = 2.5ns, 10% to 90%; f = 1MHz; t_W = 500ns except when noted

Figure 1. AC Waveforms



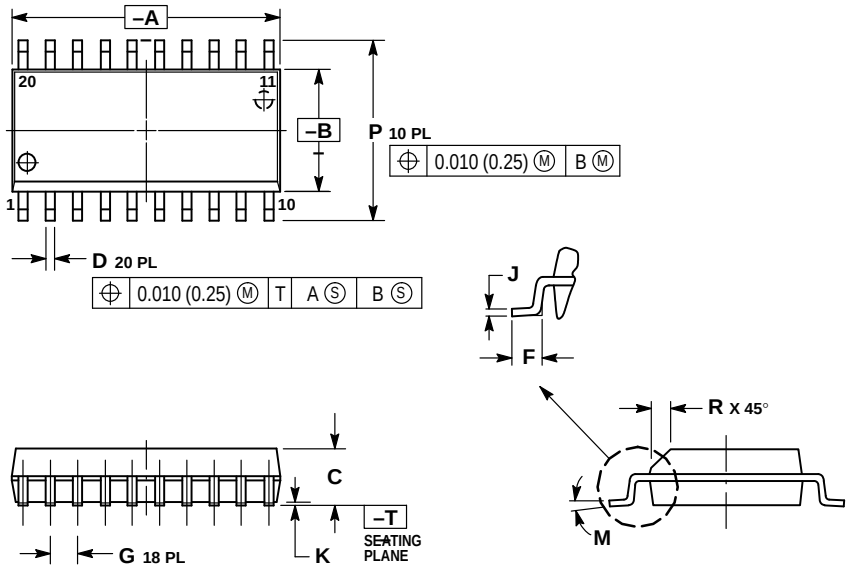
TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V
Open Collector/Drain t_{PLH} and t_{PHL}	6V
t_{PZH}, t_{PHZ}	GND

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

Figure 2. Test Circuit

OUTLINE DIMENSIONS

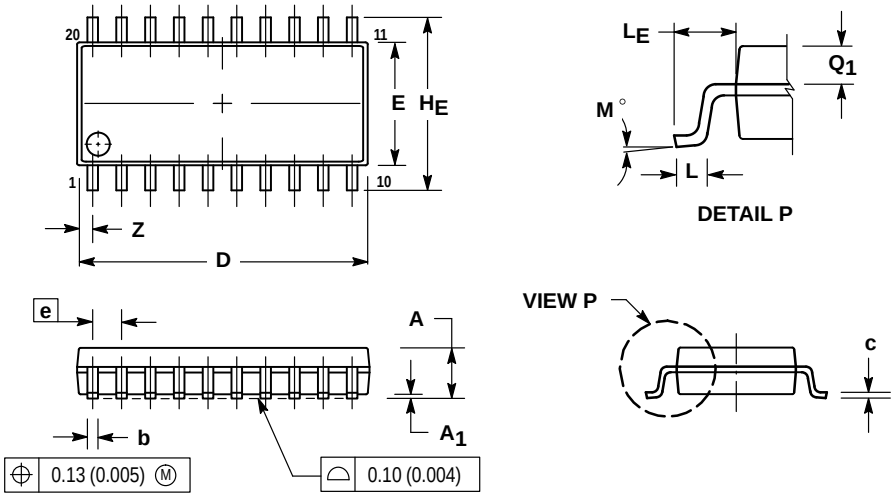
DW SUFFIX
PLASTIC SOIC PACKAGE
CASE 751D–04
ISSUE E



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.150 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	12.65	12.95	0.499	0.510
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.50	0.90	0.020	0.035
G	1.27 BSC		0.050 BSC	
J	0.25	0.32	0.010	0.012
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

M SUFFIX
PLASTIC SOIC EIAJ PACKAGE
CASE 967–01
ISSUE O

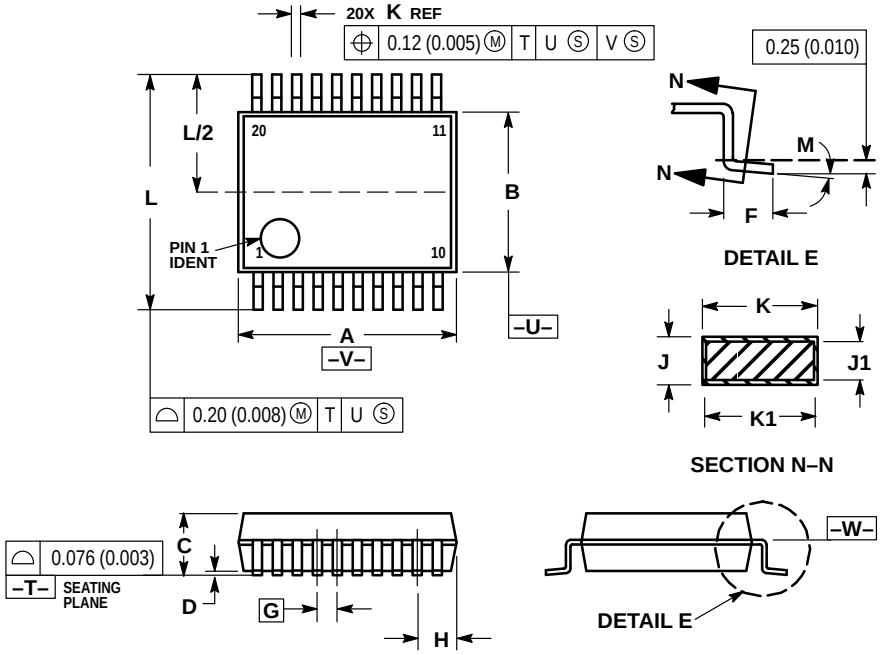


NOTES:
1 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION: MILLIMETER.
3 DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4 TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5 THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A_1	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.18	0.27	0.007	0.011
D	12.35	12.80	0.486	0.504
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
H_E	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L_E	1.10	1.50	0.043	0.059
M	0 °	10 °	0 °	10 °
Q_1	0.70	0.90	0.028	0.035
Z	---	0.81	---	0.032

OUTLINE DIMENSIONS

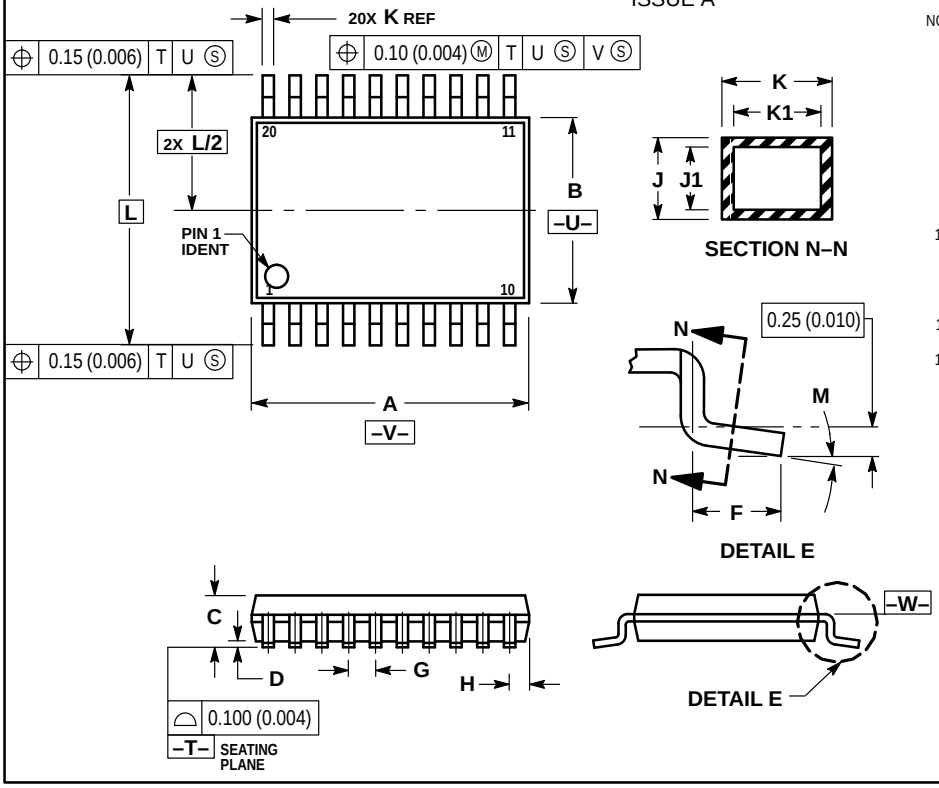
SD SUFFIX
PLASTIC SSOP PACKAGE
CASE 940C–03
ISSUE B



NOTES:
13 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
14 CONTROLLING DIMENSION: MILLIMETER.
15 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.
16 DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
17 DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION/INTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF K DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR INTRUSION SHALL NOT REDUCE DIMENSION K BY MORE THAN 0.07 (0.002) AT LEAST MATERIAL CONDITION.
18 TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
19 DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE –W–.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	7.07	7.33	0.278	0.288
B	5.20	5.38	0.205	0.212
C	1.73	1.99	0.068	0.078
D	0.05	0.21	0.002	0.008
F	0.63	0.95	0.024	0.037
G	0.65 BSC		0.026 BSC	
H	0.59	0.75	0.023	0.030
J	0.09	0.20	0.003	0.008
J1	0.09	0.16	0.003	0.006
K	0.25	0.38	0.010	0.015
K1	0.25	0.33	0.010	0.013
L	7.65	7.90	0.301	0.311
M	0 °	8 °	0 °	8 °

DT SUFFIX
PLASTIC TSSOP PACKAGE
CASE 948E–02
ISSUE A



NOTES:
6 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
7 CONTROLLING DIMENSION: MILLIMETER.
8 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.
9 DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
10 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.
11 TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
12 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°

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