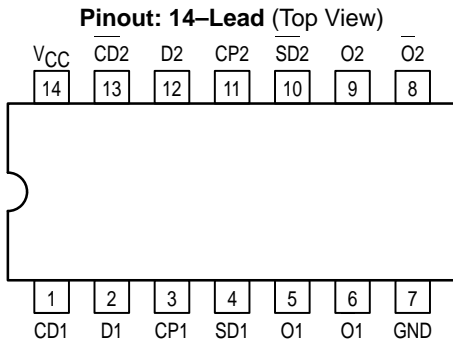


Low-Voltage CMOS Dual D-Type Flip-Flop With 5V-Tolerant Inputs

The MC74LCX74 is a high performance, dual D-type flip-flop with asynchronous clear and set inputs and complementary (O, O) outputs. It operates 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 MC74LCX74 inputs to be safely driven from 5V devices.

The MC74LCX74 consists of 2 edge-triggered flip-flops with individual D-type inputs. The flip-flop will store the state of individual D inputs, that meet the setup and hold time requirements, on the LOW-to-HIGH Clock (CP) transition.

- Designed for 2.7 to 3.6V V_{CC} Operation
- 5V Tolerant Inputs — Interface Capability With 5V TTL Logic
- LVTTTL Compatible
- LVCMOS Compatible
- 24mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current in All Three Logic States (10 μ A) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500mA
- ESD Performance: Human Body Model >2000V; Machine Model >200V



MC74LCX74

LCX

**LOW-VOLTAGE CMOS
DUAL D-TYPE FLIP-FLOP**

D SUFFIX
PLASTIC SOIC
CASE 751A-03

M SUFFIX
PLASTIC SOIC EIAJ
CASE 965-01

SD SUFFIX
PLASTIC SSOP
CASE 940A-03

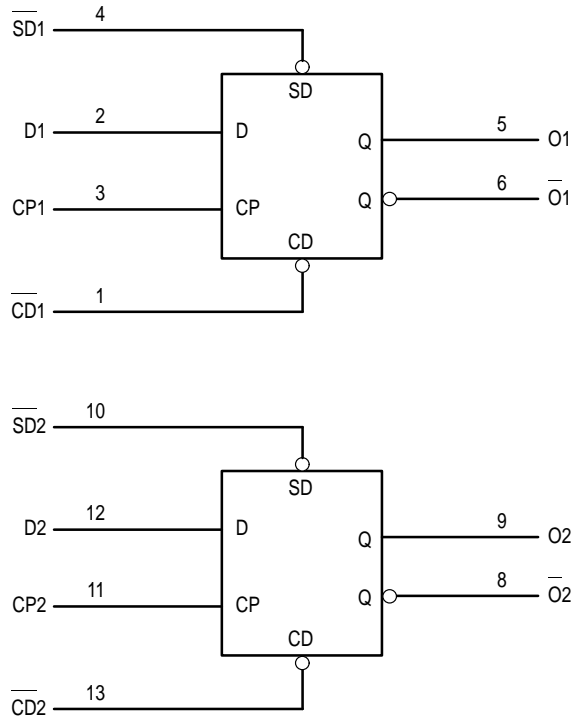
DT SUFFIX
PLASTIC TSSOP
CASE 948G-01

PIN NAMES

| Pins | Function |
|---------------------------------|---------------------|
| CP1, CP2 | Clock Pulse Inputs |
| D1, D2 | Data Inputs |
| CD1, CD2 | Direct Clear Inputs |
| SD1, SD2 | Direct Set Inputs |
| O _n , O _n | Outputs |

MC74LCX74

LOGIC DIAGRAM



| INPUTS | | | | OUTPUTS | | OPERATING MODE |
|--------|-----|------------|----|---------|----|------------------------|
| SDn | CDn | CPn | Dn | On | On | |
| L | H | X | X | H | L | Asynchronous Set |
| H | L | X | X | L | H | Asynchronous Clear |
| L | L | X | X | H | H | Undetermined |
| H | H | \uparrow | h | H | L | Load and Read Register |
| H | H | \uparrow | l | L | H | |
| H | H | ∇ | X | NC | NC | Hold |

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; X = High or Low Voltage Level or Transitions are Acceptable; \uparrow = Low-to-High Transition; ∇ = Not a Low-to-High Transition; 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 ≤ V _I ≤ +7.0 | | V |
| V _O | DC Output Voltage | -0.5 ≤ V _O ≤ 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 | 2.0 | 3.3 | 3.6 | V |
| | | Data Retention Only | 1.5 | 3.3 | 3.6 | |
| V _I | Input Voltage | 0 | | 5.5 | V | |
| V _O | Output Voltage (HIGH or LOW State) | 0 | | V _{CC} | 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 | |
| Δt/ΔV | 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 ≤ V _{CC} ≤ 3.6V | 2.0 | | V |
| V _{IL} | LOW Level Input Voltage (Note 2.) | 2.7V ≤ V _{CC} ≤ 3.6V | | 0.8 | V |
| V _{OH} | HIGH Level Output Voltage | 2.7V ≤ V _{CC} ≤ 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 ≤ V _{CC} ≤ 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.

MC74LCX74

DC ELECTRICAL CHARACTERISTICS (continued)

| Symbol | Characteristic | Condition | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | Unit |
|-----------------|--------------------------------|---|---|-----------|---------------|
| | | | Min | Max | |
| I_I | Input Leakage Current | $2.7\text{V} \leq V_{CC} \leq 3.6\text{V}; 0\text{V} \leq V_I \leq 5.5\text{V}$ | | ± 5.0 | μA |
| I_{CC} | Quiescent Supply Current | $2.7 \leq V_{CC} \leq 3.6\text{V}; V_I = \text{GND or } V_{CC}$ | | 10 | μA |
| | | $2.7 \leq V_{CC} \leq 3.6\text{V}; 3.6 \leq V_I \leq 5.5\text{V}$ | | ± 10 | μA |
| ΔI_{CC} | Increase in I_{CC} per Input | $2.7 \leq V_{CC} \leq 3.6\text{V}; V_{IH} = V_{CC} - 0.6\text{V}$ | | 500 | μA |

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

| 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 | |
| f_{max} | Clock Pulse Frequency | 1 | 150 | | | | MHz |
| t_{PLH} t_{PHL} | Propagation Delay CPn to On or On | 1 | 1.5 | 7.0 | | 8.0 | ns |
| | | | 1.5 | 7.0 | | 8.0 | |
| t_{PLH} t_{PHL} | Propagation Delay — SDn or CDn to On or On | 2 | 1.5 | 7.0 | | 8.0 | ns |
| | | | 1.5 | 7.0 | | 8.0 | |
| t_s | Setup Time, HIGH or LOW Dn to CPn | 1 | 2.5 | | 2.5 | | ns |
| t_h | Hold Time, HIGH or LOW Dn to CPn | 1 | 1.5 | | 1.5 | | ns |
| t_w | CPn Pulse Width, HIGH or LOW | 1 | 3.3 | | 3.3 | | ns |
| | SDn or CDn Pulse Width, LOW | 3 | 3.3 | | 3.6 | | ns |
| t_{rec} | Recovery Time SDn or CDn to CPn | 1 | 2.5 | | 3.0 | | ns |
| t_{OSHL} t_{OSLH} | Output-to-Output Skew (Note 3.) | | | 1.0 | | | ns |
| | | | | 1.0 | | | |

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.

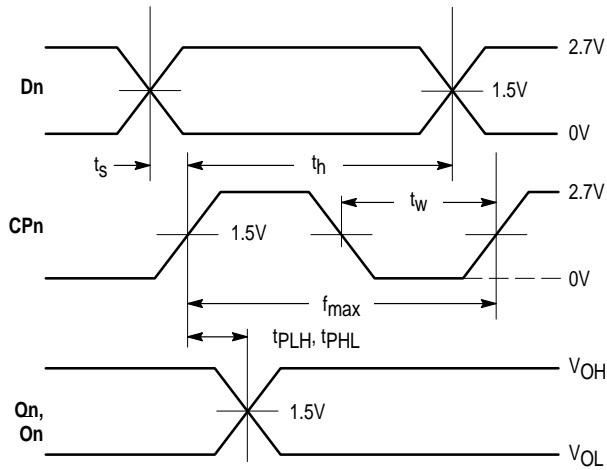
DYNAMIC SWITCHING CHARACTERISTICS

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

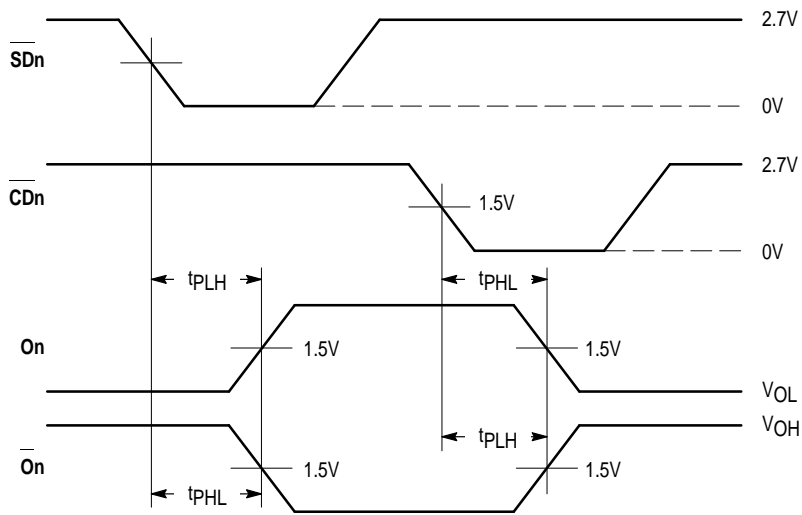
4. Number of outputs defined as "n". Measured with "n-1" outputs switching from HIGH-to-LOW or LOW-to-HIGH. The remaining output is measured in the LOW state.

CAPACITIVE CHARACTERISTICS

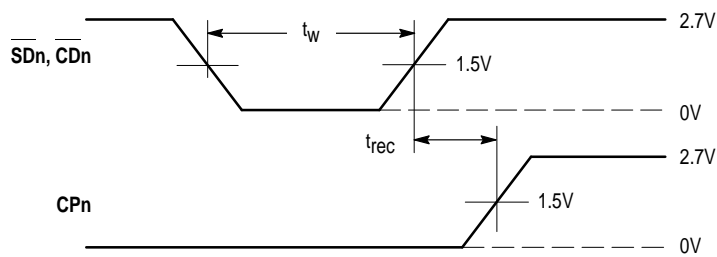
| Symbol | Parameter | Condition | Typical | Unit |
|------------------|-------------------------------|---|---------|------|
| C_{IN} | Input Capacitance | $V_{CC} = 3.3\text{V}, V_I = 0\text{V or } V_{CC}$ | 7 | pF |
| C_{OUT} | Output Capacitance | $V_{CC} = 3.3\text{V}, V_I = 0\text{V or } V_{CC}$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



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

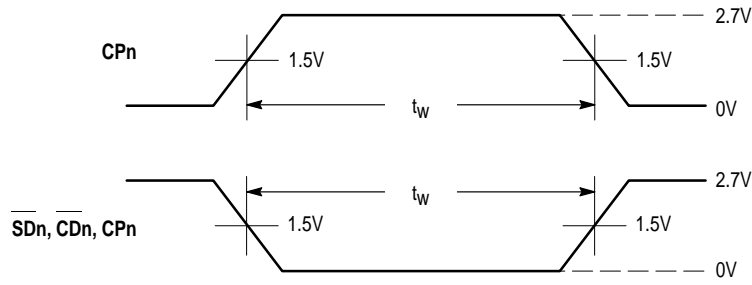


WAVEFORM 2 – PROPAGATION DELAYS
 $t_R = t_F = 2.5\text{ns}$, 10% to 90%; $f = 1\text{MHz}$; $t_W = 500\text{ns}$



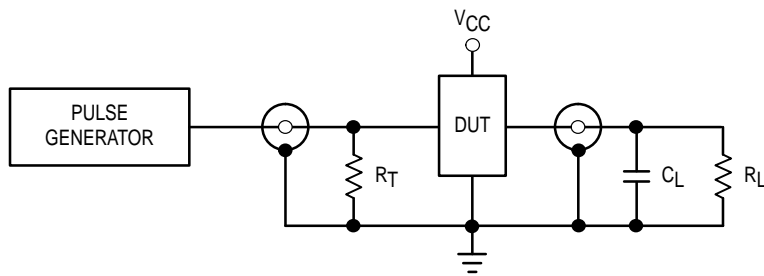
WAVEFORM 3 – RECOVERY TIME
 $t_R = t_F = 2.5\text{ns}$ from 10% to 90%; $f = 1\text{MHz}$; $t_W = 500\text{ns}$

Figure 1. AC Waveforms



WAVEFORM 4 – PULSE WIDTH
 $t_R = t_F = 2.5\text{ns}$ (or fast as required) from 10% to 90%;
 Output requirements: $V_{OL} \leq 0.8\text{V}$, $V_{OH} \geq 2.0\text{V}$

Figure 1. AC Waveforms (continued)

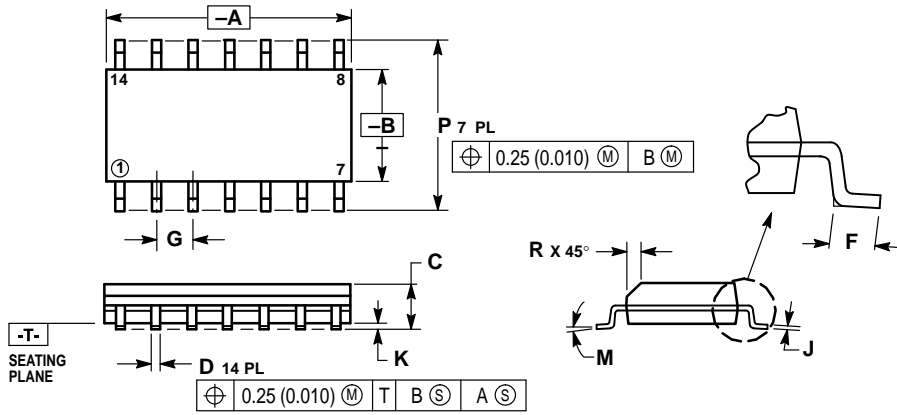


$C_L = 50\text{pF}$ or equivalent (Includes jig and probe capacitance)
 $R_L = R_1 = 500\Omega$ or equivalent
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Figure 2. Test Circuit

OUTLINE DIMENSIONS

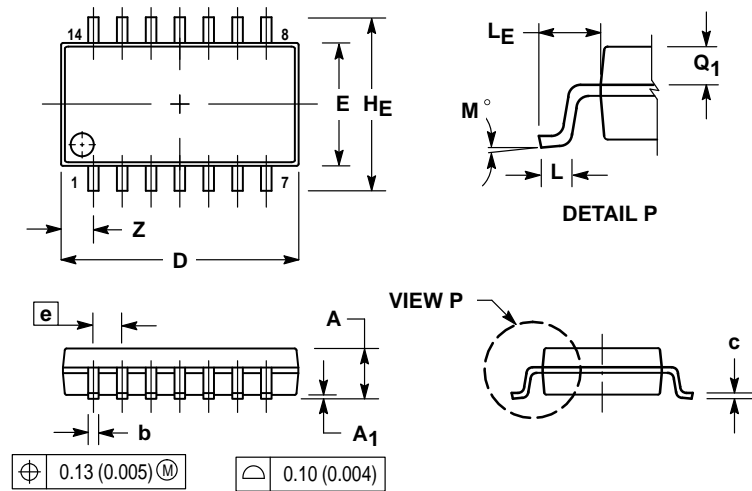
D SUFFIX
 PLASTIC SOIC PACKAGE
 CASE 751A-03
 ISSUE F



- 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 0.15 (0.006) PER SIDE.
 5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 8.55 | 8.75 | 0.337 | 0.344 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.19 | 0.25 | 0.008 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 5.80 | 6.20 | 0.228 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

M SUFFIX
 PLASTIC SOIC EIAJ PACKAGE
 CASE 965-01
 ISSUE O

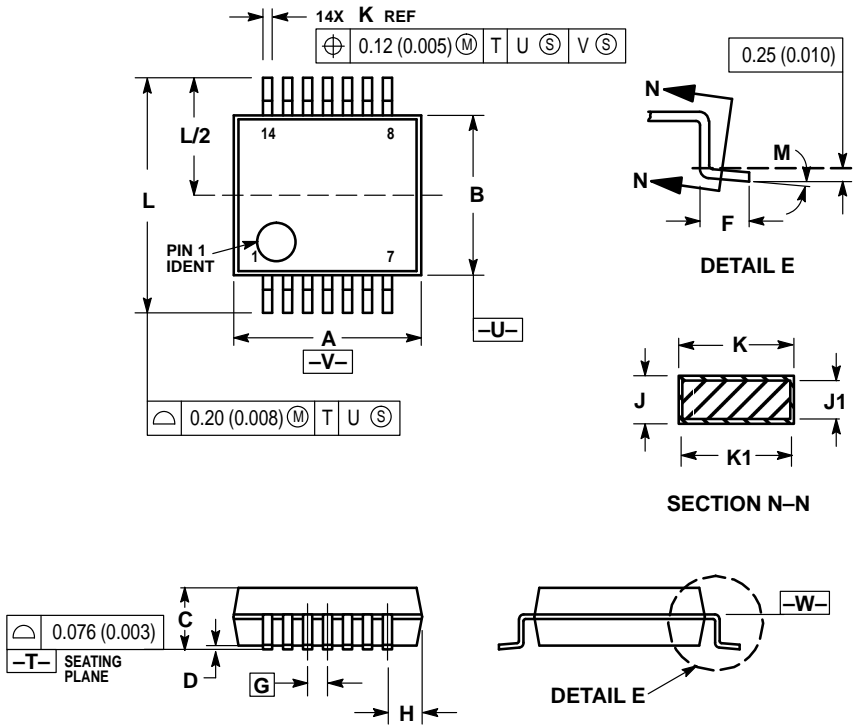


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
 4. TERMINAL NUMBERS ARE SHOWN 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).

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | --- | 2.05 | --- | 0.081 |
| A1 | 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 | 9.90 | 10.50 | 0.390 | 0.413 |
| E | 5.10 | 5.45 | 0.201 | 0.215 |
| e | 1.27 BSC | | 0.050 BSC | |
| HE | 7.40 | 8.20 | 0.291 | 0.323 |
| L | 0.50 | 0.85 | 0.020 | 0.033 |
| LE | 1.10 | 1.50 | 0.043 | 0.059 |
| M | 0° | 10° | 0° | 10° |
| Q1 | 0.70 | 0.90 | 0.028 | 0.035 |
| Z | --- | 1.42 | --- | 0.056 |

OUTLINE DIMENSIONS

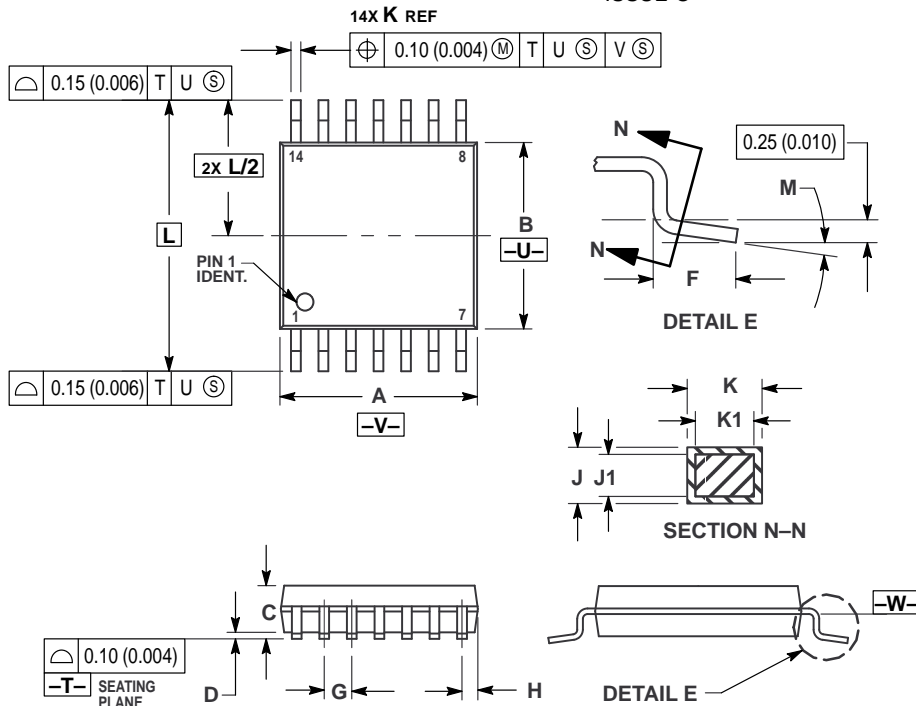
SD SUFFIX
 PLASTIC SSOP PACKAGE
 CASE 940A-03
 ISSUE B



- 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 0.15 (0.006) PER SIDE.
 - 10 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.
 - 11 TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
 - 12 DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.


| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 6.07 | 6.33 | 0.238 | 0.249 |
| 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 | 1.08 | 1.22 | 0.042 | 0.048 |
| 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 948G-01
 ISSUE O



- 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-.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.90 | 5.10 | 0.193 | 0.200 |
| 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 | 0.50 | 0.60 | 0.020 | 0.024 |
| 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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