



# MC74AC113 MC74ACT113

## Dual JK Negative Edge-Triggered Flip-Flop

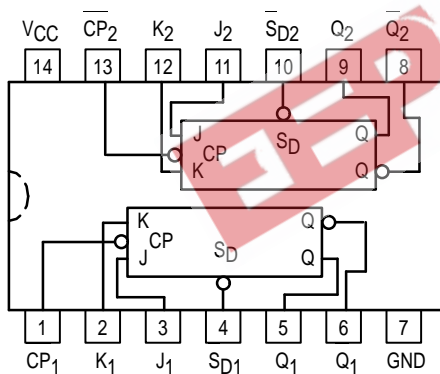
The MC74AC113/74ACT113 consists of two high-speed completely independent transition clocked JK flip-flops. The clocking operation is independent of rise and fall times of the clock waveform. The JK design allows operation as a D flip-flop (refer to MC74AC74/74ACT74 data sheet) by connecting the J and K inputs together.

### Asynchronous Inputs:

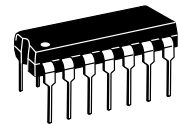
- LOW input to  $S_D$  (Set) sets Q to HIGH level
- Set is independent of clock

- Outputs Source/Sink 24 mA
- 'ACT113 Has TTL Compatible Inputs

### CONNECTION DIAGRAM



DUAL JK NEGATIVE  
EDGE-TRIGGERED  
FLIP-FLOP

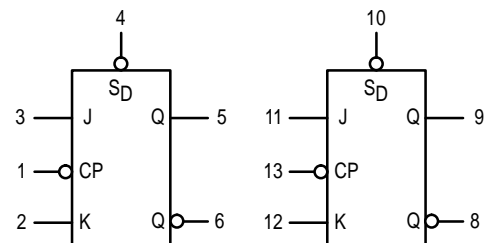


N SUFFIX  
CASE 646-06  
PLASTIC



D SUFFIX  
CASE 751A-03  
PLASTIC

### LOGIC SYMBOL



VCC = PIN 14  
GND = PIN 7

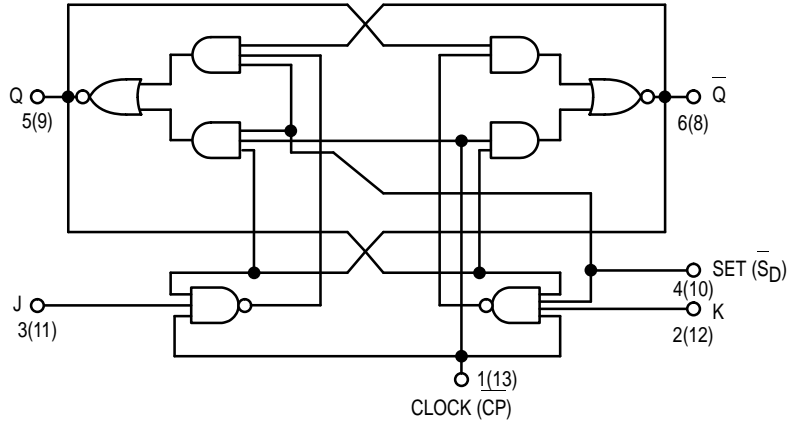
### MODE SELECT — TRUTH TABLE

| Operating Mode   | Inputs |   |   | Outputs |   |
|------------------|--------|---|---|---------|---|
|                  | $S_D$  | J | K | Q       | Q |
| Set              | L      | X | X | H       | L |
| Toggle           | H      | h | h | q       | q |
| Load "0" (Reset) | H      | l | h | L       | H |
| Load "1" (Set)   | H      | h | l | H       | L |
| Hold             | H      | l | l | q       | q |

H, h = HIGH Voltage Level  
L, l = LOW Voltage Level  
X = Don't Care  
l, h (q) = Lower case letters indicate the state of the referenced input (or output) one set-up time prior to the HIGH to LOW clock transition.

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## LOGIC DIAGRAM (Each Flip-Flop)



### MAXIMUM RATINGS\*

| Symbol           | Parameter  | Value                        | Unit |
|------------------|--|------------------------------|------|
| V <sub>CC</sub>  | DC Supply Voltage (Referenced to GND)            | -0.5 to +7.0                 | V    |
| V <sub>in</sub>  | DC Input Voltage (Referenced to GND)             | -0.5 to V <sub>CC</sub> +0.5 | V    |
| V <sub>out</sub> | DC Output Voltage (Referenced to GND)            | -0.5 to V <sub>CC</sub> +0.5 | V    |
| I <sub>in</sub>  | DC Input Current, per Pin                        | ±20                          | mA   |
| I <sub>out</sub> | DC Output Sink/Source Current, per Pin           | ±50                          | mA   |
| I <sub>CC</sub>  | DC V <sub>CC</sub> or GND Current per Output Pin | ±50                          | mA   |
| T <sub>stg</sub> | Storage Temperature                              | -65 to +150                  | °C   |

\* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

### RECOMMENDED OPERATING CONDITIONS

| Symbol                             | Parameter   | Min                     | Typ | Max             | Unit |      |
|------------------------------------|---|-------------------------|-----|-----------------|------|------|
| V <sub>CC</sub>                    | Supply Voltage  | 'AC                     | 2.0 | 5.0             | 6.0  | V    |
|                                    |   | 'ACT                    | 4.5 | 5.0             | 5.5  |      |
| V <sub>in</sub> , V <sub>out</sub> | DC Input Voltage, Output Voltage (Ref. to GND)                          | 0                       |     | V <sub>CC</sub> | V    |      |
| t <sub>r</sub> , t <sub>f</sub>    | Input Rise and Fall Time (Note 1)<br>'AC Devices except Schmitt Inputs  | V <sub>CC</sub> @ 3.0 V |     | 150             |      | ns/V |
|                                    |   | V <sub>CC</sub> @ 4.5 V |     | 40              |      |      |
|                                    |   | V <sub>CC</sub> @ 5.5 V |     | 25              |      |      |
| t <sub>r</sub> , t <sub>f</sub>    | Input Rise and Fall Time (Note 2)<br>'ACT Devices except Schmitt Inputs | V <sub>CC</sub> @ 4.5 V |     | 10              |      | ns/V |
|                                    |   | V <sub>CC</sub> @ 5.5 V |     | 8.0             |      |      |
| T <sub>J</sub>                     | Junction Temperature (PDIP)   |                         |     | 140             | °C   |      |
| T <sub>A</sub>                     | Operating Ambient Temperature Range                                     | -40                     | 25  | 85              | °C   |      |
| I <sub>OH</sub>                    | Output Current — High   |                         |     | -24             | mA   |      |
| I <sub>OL</sub>                    | Output Current — Low  |                         |     | 24              | mA   |      |

1. V<sub>in</sub> from 30% to 70% V<sub>CC</sub>; see individual Data Sheets for devices that differ from the typical input rise and fall times.
2. V<sub>in</sub> from 0.8 V to 2.0 V; see individual Data Sheets for devices that differ from the typical input rise and fall times.

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## DC CHARACTERISTICS

| Symbol           | Parameter                         | V <sub>CC</sub><br>(V) | 74AC                   |                   | 74AC                            |    | Unit  | Conditions |
|------------------|-----------------------------------|------------------------|------------------------|-------------------|---------------------------------|----|---|------------|
|                  |                                   |                        | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> = -40°C to +85°C |    |   |            |
|                  |                                   |                        | Typ                    | Guaranteed Limits |                                 |    |   |            |
| V <sub>IH</sub>  | Minimum High Level Input Voltage  | 3.0                    | 1.5                    | 2.1               | 2.1                             | V  | V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V   |            |
|                  |                                   | 4.5                    | 2.25                   | 3.15              | 3.15                            |    |   |            |
|                  |                                   | 5.5                    | 2.75                   | 3.85              | 3.85                            |    |   |            |
| V <sub>IL</sub>  | Maximum Low Level Input Voltage   | 3.0                    | 1.5                    | 0.9               | 0.9                             | V  | V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V   |            |
|                  |                                   | 4.5                    | 2.25                   | 1.35              | 1.35                            |    |   |            |
|                  |                                   | 5.5                    | 2.75                   | 1.65              | 1.65                            |    |   |            |
| V <sub>OH</sub>  | Minimum High Level Output Voltage | 3.0                    | 2.99                   | 2.9               | 2.9                             | V  | I <sub>OUT</sub> = -50 μA   |            |
|                  |                                   | 4.5                    | 4.49                   | 4.4               | 4.4                             |    |   |            |
|                  |                                   | 5.5                    | 5.49                   | 5.4               | 5.4                             |    |   |            |
|                  |                                   | 3.0                    |                        | 2.56              | 2.46                            | V  | *V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>-12 mA<br>I <sub>OH</sub> -24 mA<br>-24 mA |            |
|                  |                                   | 4.5                    |                        | 3.86              | 3.76                            |    |   |            |
|                  |                                   | 5.5                    |                        | 4.86              | 4.76                            |    |   |            |
| V <sub>OL</sub>  | Maximum Low Level Output Voltage  | 3.0                    | 0.002                  | 0.1               | 0.1                             | V  | I <sub>OUT</sub> = 50 μA  |            |
|                  |                                   | 4.5                    | 0.001                  | 0.1               | 0.1                             |    |   |            |
|                  |                                   | 5.5                    | 0.001                  | 0.1               | 0.1                             |    |   |            |
|                  |                                   | 3.0                    |                        | 0.36              | 0.44                            | V  | *V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>12 mA<br>I <sub>OL</sub> 24 mA<br>24 mA    |            |
|                  |                                   | 4.5                    |                        | 0.36              | 0.44                            |    |   |            |
|                  |                                   | 5.5                    |                        | 0.36              | 0.44                            |    |   |            |
| I <sub>IN</sub>  | Maximum Input Leakage Current     | 5.5                    |                        | ±0.1              | ±1.0                            | μA | V <sub>I</sub> = V <sub>CC</sub> , GND  |            |
| I <sub>OLD</sub> | †Minimum Dynamic Output Current   | 5.5                    |                        |                   | 75                              | mA | V <sub>OLD</sub> = 1.65 V Max   |            |
| I <sub>OHD</sub> |                                   | 5.5                    |                        |                   | -75                             | mA | V <sub>OHD</sub> = 3.85 V Min   |            |
| I <sub>CC</sub>  | Maximum Quiescent Supply Current  | 5.5                    |                        | 4.0               | 40                              | μA | V <sub>IN</sub> = V <sub>CC</sub> or GND  |            |

\* All outputs loaded; thresholds on input associated with output under test.

† Maximum test duration 2.0 ms, one output loaded at a time.

Note: I<sub>IN</sub> and I<sub>CC</sub> @ 3.0 V are guaranteed to be less than or equal to the respective limit @ 5.5 V V<sub>CC</sub>.

## AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

| Symbol           | Parameter  | V <sub>CC</sub> *<br>(V) | 74AC   |     |              | 74AC  |              | Unit | Fig. No. |
|------------------|--|--------------------------|--|-----|--------------|---|--------------|------|----------|
|                  |  |                          | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |     |              | T <sub>A</sub> = -40°C to +85°C<br>C <sub>L</sub> = 50 pF |              |      |          |
|                  |  |                          | Min  | Typ | Max          | Min   | Max          |      |          |
| f <sub>max</sub> | Maximum Clock Frequency  | 3.3<br>5.0               | 145<br>145                                       |     |              | 125<br>125  |              | MHz  | 3-3      |
| t <sub>PLH</sub> | Propagation Delay<br>C <sub>Pn</sub> to Q <sub>n</sub> or Q <sub>n</sub> | 3.3<br>5.0               | 1.0<br>1.0                                       |     | 14.5<br>12.0 | 1.0<br>1.0  | 16.0<br>13.0 | ns   | 3-6      |
| t <sub>PHL</sub> | Propagation Delay<br>C <sub>Pn</sub> to Q <sub>n</sub> or Q <sub>n</sub> | 3.3<br>5.0               | 1.0<br>1.0                                       |     | 14.5<br>12.5 | 1.0<br>1.0  | 15.5<br>13.0 | ns   | 3-6      |
| t <sub>PLH</sub> | Propagation Delay<br>S <sub>Dn</sub> to Q <sub>n</sub>                   | 3.3<br>5.0               | 1.0<br>1.0                                       |     | 10.0<br>9.0  | 1.0<br>1.0  | 11.0<br>9.5  | ns   | 3-6      |
| t <sub>PHL</sub> | Propagation Delay<br>S <sub>Dn</sub> to Q <sub>n</sub>                   | 3.3<br>5.0               | 1.0<br>1.0                                       |     | 13.0<br>11.0 | 1.0<br>1.0  | 14.0<br>11.5 | ns   | 3-6      |

\* Voltage Range 3.3 V is 3.3 V ±0.3 V.

Voltage Range 5.0 V is 5.0 V ±0.5 V.

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## AC OPERATING REQUIREMENTS

| Symbol           | Parameter   | V <sub>CC</sub> *<br>(V) | 74AC   |                    | Unit | Fig. No. |  |  |
|------------------|---|--------------------------|--|--------------------|------|----------|--|--|
|                  |   |                          | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |                    |      |          | T <sub>A</sub> = -40°C<br>to +85°C<br>C <sub>L</sub> = 50 pF |  |
|                  |   |                          | Typ  | Guaranteed Minimum |      |          |  |  |
| t <sub>s</sub>   | Set-up Time, HIGH or LOW<br>J <sub>N</sub> or K <sub>N</sub> to CP <sub>N</sub> | 3.3                      |  | 6.5                | 7.5  | ns       | 3-9  |  |
|                  |   | 5.0                      |  | 4.5                | 5.0  |          |  |  |
| t <sub>h</sub>   | Hold Time, HIGH or LOW<br>J <sub>N</sub> or K <sub>N</sub> to CP <sub>N</sub>   | 3.3                      |  | 0                  | 0    | ns       | 3-9  |  |
|                  |   | 5.0                      |  | 0                  | 0    |          |  |  |
| t <sub>w</sub>   | Pulse Width<br>Clock  | 3.3                      |  | 5.0                | 5.5  | ns       | 3-6  |  |
|                  |   | 5.0                      |  | 4.0                | 4.5  |          |  |  |
| t <sub>w</sub>   | Pulse Width<br>S <sub>Dn</sub>  | 3.3                      |  | 5.5                | 6.0  | ns       | 3-6  |  |
|                  |   | 5.0                      |  | 5.0                | 5.5  |          |  |  |
| t <sub>rec</sub> | Recovery Time<br>S <sub>Dn</sub> to CP  | 3.3                      |  | 0                  | 0    | ns       | 3-9  |  |
|                  |   | 5.0                      |  | 0                  | 0    |          |  |  |

\* Voltage Range 3.3 V is 3.3 V ± 0.3 V.  
Voltage Range 5.0 V is 5.0 V ± 0.5 V.

## DC CHARACTERISTICS

| Symbol            | Parameter                              | V <sub>CC</sub><br>(V) | 74ACT                  |                   | 74ACT                           |    | Unit   | Conditions |
|-------------------|--|------------------------|------------------------|-------------------|---------------------------------|----|--|------------|
|                   |  |                        | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> = -40°C to +85°C |    |  |            |
|                   |  |                        | Typ                    | Guaranteed Limits |                                 |    |  |            |
| V <sub>IH</sub>   | Minimum High Level<br>Input Voltage    | 4.5                    | 1.5                    | 2.0               | 2.0                             | V  | V <sub>OUT</sub> = 0.1 V<br>or V <sub>CC</sub> - 0.1 V                                       |            |
|                   |  | 5.5                    | 1.5                    | 2.0               | 2.0                             |    |  |            |
| V <sub>IL</sub>   | Maximum Low Level<br>Input Voltage     | 4.5                    | 1.5                    | 0.8               | 0.8                             | V  | V <sub>OUT</sub> = 0.1 V<br>or V <sub>CC</sub> - 0.1 V                                       |            |
|                   |  | 5.5                    | 1.5                    | 0.8               | 0.8                             |    |  |            |
| V <sub>OH</sub>   | Minimum High Level<br>Output Voltage   | 4.5                    | 4.49                   | 4.4               | 4.4                             | V  | I <sub>OUT</sub> = -50 μA  |            |
|                   |  | 5.5                    | 5.49                   | 5.4               | 5.4                             |    |  |            |
|                   |  | 4.5                    |                        | 3.86              | 3.76                            | V  | *V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>-24 mA<br>I <sub>OH</sub><br>-24 mA |            |
|                   |  | 5.5                    |                        | 4.86              | 4.76                            |    |  |            |
| V <sub>OL</sub>   | Maximum Low Level<br>Output Voltage    | 4.5                    | 0.001                  | 0.1               | 0.1                             | V  | I <sub>OUT</sub> = 50 μA   |            |
|                   |  | 5.5                    | 0.001                  | 0.1               | 0.1                             |    |  |            |
|                   |  | 4.5                    |                        | 0.36              | 0.44                            | V  | *V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>24 mA<br>I <sub>OL</sub><br>24 mA   |            |
| 5.5               |  | 0.36                   | 0.44                   |                   |                                 |    |  |            |
| I <sub>IN</sub>   | Maximum Input<br>Leakage Current       | 5.5                    |                        | ±0.1              | ±1.0                            | μA | V <sub>I</sub> = V <sub>CC</sub> , GND   |            |
| ΔI <sub>CCT</sub> | Additional Max. I <sub>CC</sub> /Input | 5.5                    | 0.6                    |                   | 1.5                             | mA | V <sub>I</sub> = V <sub>CC</sub> - 2.1 V   |            |
| I <sub>OLD</sub>  | †Minimum Dynamic<br>Output Current     | 5.5                    |                        |                   | 75                              | mA | V <sub>OLD</sub> = 1.65 V Max  |            |
| I <sub>OHD</sub>  |  | 5.5                    |                        |                   | -75                             | mA | V <sub>OHD</sub> = 3.85 V Min  |            |
| I <sub>CC</sub>   | Maximum Quiescent<br>Supply Current    | 5.5                    |                        | 4.0               | 40                              | μA | V <sub>IN</sub> = V <sub>CC</sub> or GND   |            |

\* All outputs loaded; thresholds on input associated with output under test.  
† Maximum test duration 2.0 ms, one output loaded at a time.

## MC74AC113 MC74ACT113

### AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

| Symbol           | Parameter  | V <sub>CC</sub> *<br>(V) | 74ACT  |     |      | 74ACT  |      | Unit | Fig. No. |
|------------------|--|--------------------------|--|-----|------|--|------|------|----------|
|                  |  |                          | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |     |      | T <sub>A</sub> = -40°C<br>to +85°C<br>C <sub>L</sub> = 50 pF |      |      |          |
|                  |  |                          | Min  | Typ | Max  | Min  | Max  |      |          |
| f <sub>max</sub> | Maximum Clock Frequency  | 5.0                      | 145  |     |      | 125  |      | MHz  | 3-3      |
| t <sub>PLH</sub> | Propagation Delay<br>CP <sub>n</sub> to Q <sub>n</sub> or Q <sub>n</sub> | 5.0                      | 1.0  |     | 14.0 | 1.0  | 15.5 | ns   | 3-6      |
| t <sub>PHL</sub> | Propagation Delay<br>CP <sub>n</sub> to Q <sub>n</sub> or Q <sub>n</sub> | 5.0                      | 1.0  |     | 13.5 | 1.0  | 15.0 | ns   | 3-6      |
| t <sub>PLH</sub> | Propagation Delay<br>SD <sub>n</sub> to Q <sub>n</sub>                   | 5.0                      | 1.0  |     | 11.5 | 1.0  | 12.5 | ns   | 3-6      |
| t <sub>PHL</sub> | Propagation Delay<br>SD <sub>n</sub> to Q <sub>n</sub>                   | 5.0                      | 1.0  |     | 13.0 | 1.0  | 14.0 | ns   | 3-6      |

\* Voltage Range 5.0 V is 5.0 V ±0.5 V.

### AC OPERATING REQUIREMENTS

| Symbol           | Parameter   | V <sub>CC</sub> *<br>(V) | 74ACT  |                    | 74ACT  |    | Unit | Fig. No. |
|------------------|---|--------------------------|--|--------------------|--|----|------|----------|
|                  |   |                          | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |                    | T <sub>A</sub> = -40°C<br>to +85°C<br>C <sub>L</sub> = 50 pF |    |      |          |
|                  |   |                          | Typ  | Guaranteed Minimum |  |    |      |          |
| t <sub>s</sub>   | Set-up Time, HIGH or LOW<br>J <sub>n</sub> or K <sub>n</sub> to CP <sub>n</sub> | 5.0                      |  | 2.0                | 2.5  | ns | 3-9  |          |
| t <sub>h</sub>   | Hold Time, HIGH or LOW<br>J <sub>n</sub> or K <sub>n</sub> to CP <sub>n</sub>   | 5.0                      |  | 2.0                | 2.0  | ns | 3-9  |          |
| t <sub>w</sub>   | Pulse Width<br>Clock  | 5.0                      |  | 5.0                | 6.0  | ns | 3-6  |          |
| t <sub>w</sub>   | Pulse Width<br>SD <sub>n</sub>  | 5.0                      |  | 5.5                | 6.0  | ns | 3-6  |          |
| t <sub>rec</sub> | Recovery Time<br>SD <sub>n</sub> to CP  | 5.0                      |  | 0                  | 0  | ns | 3-9  |          |

\* Voltage Range 5.0 V is 5.0 V ±0.5 V.

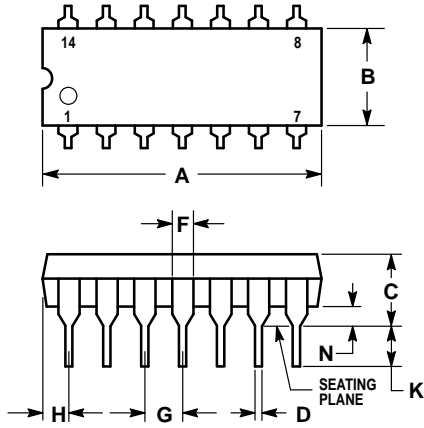
### CAPACITANCE

| Symbol          | Parameter                     | Value<br>Typ | Unit | Test Conditions         |
|-----------------|-------------------------------|--------------|------|-------------------------|
| C <sub>IN</sub> | Input Capacitance             | 4.5          | pF   | V <sub>CC</sub> = 5.0 V |
| CPD             | Power Dissipation Capacitance | 35           | pF   | V <sub>CC</sub> = 5.0 V |

# MC74AC113 MC74ACT113

## OUTLINE DIMENSIONS

### N SUFFIX PLASTIC DIP PACKAGE CASE 646-06 ISSUE L

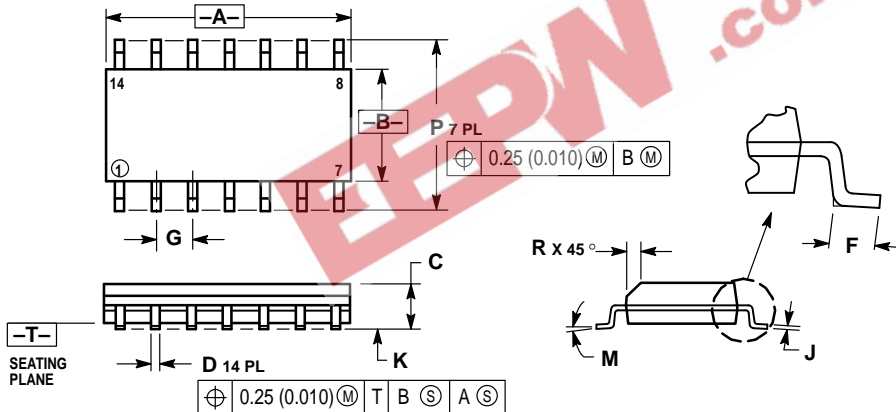


NOTES:

- LEADS WITHIN 0.13 (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
- DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIMENSION B DOES NOT INCLUDE MOLD FLASH.
- ROUNDED CORNERS OPTIONAL.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.715     | 0.770 | 18.16       | 19.56 |
| B   | 0.240     | 0.260 | 6.10        | 6.60  |
| C   | 0.145     | 0.185 | 3.69        | 4.69  |
| D   | 0.015     | 0.021 | 0.38        | 0.53  |
| F   | 0.040     | 0.070 | 1.02        | 1.78  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.052     | 0.095 | 1.32        | 2.41  |
| J   | 0.008     | 0.015 | 0.20        | 0.38  |
| K   | 0.115     | 0.135 | 2.92        | 3.43  |
| L   | 0.300 BSC |       | 7.62 BSC    |       |
| M   | 0°        | 10°   | 0°          | 10°   |
| N   | 0.015     | 0.039 | 0.39        | 1.01  |

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



NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
- 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 |

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**How to reach us:**

**USA/EUROPE:** Motorola Literature Distribution;  
P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447

**JAPAN:** Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, Toshikatsu Otsuki,  
6F Seibu-Butsuryu-Center, 3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-3521-8315

**MFAX:** RMFAX0@email.sps.mot.com -TOUCHTONE (602) 244-6609  
**INTERNET:** http://Design-NET.com

**HONG KONG:** Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,  
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298



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