

# MC74HC175A

## Quad D Flip-Flop with Common Clock and Reset

### High-Performance Silicon-Gate CMOS

The MC74HC175A is identical in pinout to the LS175. The device inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs.

This device consists of four D flip-flops with common Reset and Clock inputs, and separate D inputs. Reset (active-low) is asynchronous and occurs when a low level is applied to the Reset input. Information at a D input is transferred to the corresponding Q output on the next positive going edge of the Clock input.

#### Features

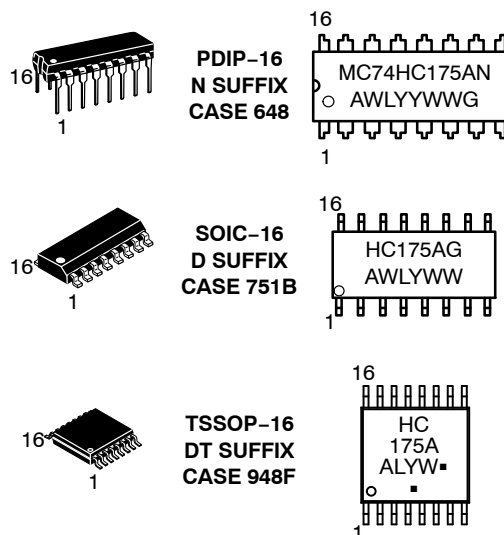
- Output Drive Capability: 10 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2.0 to 6.0 V
- Low Input Current: 1  $\mu$ A
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance with the Requirements Defined by JEDEC Standard No. 7 A
- Chip Complexity 166 FETs or 41.5 Equivalent Gates
- 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



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 2 of this data sheet.

# MC74HC175A

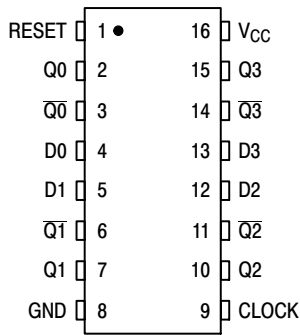


Figure 1. Pin Assignment

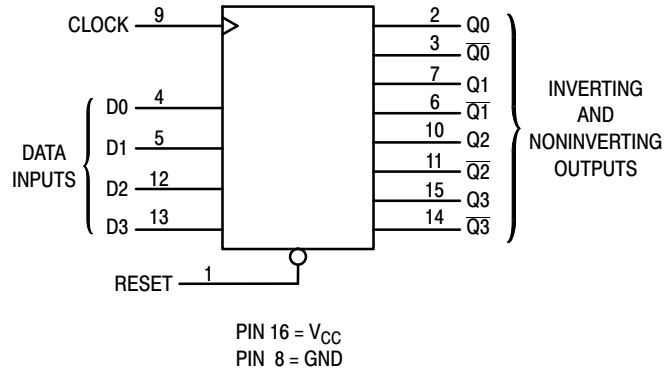


Figure 2. Logic Diagram

## FUNCTION TABLE

| Inputs |       |   | Outputs   |    |
|--------|-------|---|-----------|----|
| Reset  | Clock | D | Q         | Q̄ |
| L      | X     | X | L         | H  |
| H      | ↗     | H | H         | L  |
| H      | ↘     | L | L         | H  |
| H      | L     | X | No Change |    |

## ORDERING INFORMATION

| Device            | Package               | Shipping <sup>†</sup> |
|-------------------|-----------------------|-----------------------|
| MC74HC175ANG      | PDIP-16               | 500 Units / Rail      |
| MC74HC175ADG      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       |
| MC74HC175ADR2G    | SOIC-16<br>(Pb-Free)  | 2500 / Tape & Reel    |
| MC74HC175ADTR2G   | TSSOP-16<br>(Pb-Free) | 2500 / Tape & Reel    |
| NLV74HC175ADTR2G* | TSSOP-16<br>(Pb-Free) | 2500 / Tape & Reel    |

<sup>†</sup>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

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## MAXIMUM RATINGS

| Symbol    | Parameter                                                                               | Value                   | Unit |
|-----------|-----------------------------------------------------------------------------------------|-------------------------|------|
| $V_{CC}$  | DC Supply Voltage (Referenced to GND)                                                   | – 0.5 to + 7.0          | V    |
| $V_{in}$  | DC Input Voltage (Referenced to GND)                                                    | – 0.5 to $V_{CC} + 0.5$ | V    |
| $V_{out}$ | DC Output Voltage (Referenced to GND)                                                   | – 0.5 to $V_{CC} + 0.5$ | V    |
| $I_{in}$  | DC Input Current, per Pin                                                               | $\pm 20$                | mA   |
| $I_{out}$ | DC Output Current, per Pin                                                              | $\pm 25$                | mA   |
| $I_{CC}$  | DC Supply Current, $V_{CC}$ and GND Pins                                                | $\pm 50$                | mA   |
| $P_D$     | Power Dissipation in Still Air,<br>Plastic DIP†<br>SOIC Package†<br>TSSOP Package†      | 750<br>500<br>450       | mW   |
| $T_{stg}$ | Storage Temperature                                                                     | – 65 to + 150           | °C   |
| $T_L$     | Lead Temperature, 1 mm from Case for 10 Seconds<br>(Plastic DIP, SOIC or TSSOP Package) | 260                     | °C   |

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$  should be constrained to the range  $GND \leq (V_{in} \text{ or } V_{out}) \leq V_{CC}$ . 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.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

†Derating — Plastic DIP: – 10 mW/°C from 65° to 125°C  
SOIC Package: – 7 mW/°C from 65° to 125°C  
TSSOP Package: – 6.1 mW/°C from 65° to 125°C

## RECOMMENDED OPERATING CONDITIONS

| Symbol            | Parameter                                            | Min                                                                                                          | Max                            | Unit |
|-------------------|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------|------|
| $V_{CC}$          | DC Supply Voltage (Referenced to GND)                | 2.0                                                                                                          | 6.0                            | V    |
| $V_{in}, V_{out}$ | DC Input Voltage, Output Voltage (Referenced to GND) | 0                                                                                                            | $V_{CC}$                       | V    |
| $T_A$             | Operating Temperature, All Package Types             | – 55                                                                                                         | + 125                          | °C   |
| $t_r, t_f$        | Input Rise and Fall Time<br>(Figure 1)               | $V_{CC} = 2.0 \text{ V}$<br>$V_{CC} = 3.0 \text{ V}$<br>$V_{CC} = 4.5 \text{ V}$<br>$V_{CC} = 6.0 \text{ V}$ | 0<br>1000<br>600<br>500<br>400 | ns   |

## DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

| Symbol   | Parameter                         | Test Conditions                                                                                                                               | $V_{CC}$<br>V            | Guaranteed Limit           |                            |                            | Unit |
|----------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------------------|----------------------------|----------------------------|------|
|          |                                   |                                                                                                                                               |                          | – 55 to<br>25°C            | ≤ 85°C                     | ≤ 125°C                    |      |
| $V_{IH}$ | Minimum High-Level Input Voltage  | $V_{out} = 0.1 \text{ V or } V_{CC} - 0.1 \text{ V}$<br>$ I_{out}  \leq 20 \mu\text{A}$                                                       | 2.0<br>3.0<br>4.5<br>6.0 | 1.5<br>2.1<br>3.15<br>4.2  | 1.5<br>2.1<br>3.15<br>4.2  | 1.5<br>2.1<br>3.15<br>4.2  | V    |
| $V_{IL}$ | Maximum Low-Level Input Voltage   | $V_{out} = 0.1 \text{ V or } V_{CC} - 0.1 \text{ V}$<br>$ I_{out}  \leq 20 \mu\text{A}$                                                       | 2.0<br>3.0<br>4.5<br>6.0 | 0.5<br>0.9<br>1.35<br>1.80 | 0.5<br>0.9<br>1.35<br>1.80 | 0.5<br>0.9<br>1.35<br>1.80 | V    |
| $V_{OH}$ | Minimum High-Level Output Voltage | $V_{in} = V_{IH} \text{ or } V_{IL}$<br>$ I_{out}  \leq 20 \mu\text{A}$                                                                       | 2.0<br>4.5<br>6.0        | 1.9<br>4.4<br>5.9          | 1.9<br>4.4<br>5.9          | 1.9<br>4.4<br>5.9          | V    |
|          |                                   | $V_{in} = V_{IH} \text{ or } V_{IL}$<br>$ I_{out}  \leq 2.4 \text{ mA}$<br>$ I_{out}  \leq 4.0 \text{ mA}$<br>$ I_{out}  \leq 5.2 \text{ mA}$ | 3.0<br>4.5<br>6.0        | 2.48<br>3.98<br>5.48       | 2.34<br>3.84<br>5.34       | 2.20<br>3.70<br>5.20       |      |

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## DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

| Symbol          | Parameter                                      | Test Conditions                                                                                                                                      | V <sub>CC</sub><br>V | Guaranteed Limit |        |         | Unit |
|-----------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------|--------|---------|------|
|                 |                                                |                                                                                                                                                      |                      | – 55 to 25°C     | ≤ 85°C | ≤ 125°C |      |
| V <sub>OL</sub> | Maximum Low-Level Output Voltage               | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 20 μA                                                                  | 2.0                  | 0.1              | 0.1    | 0.1     | V    |
|                 |                                                |                                                                                                                                                      | 4.5                  | 0.1              | 0.1    | 0.1     |      |
|                 |                                                |                                                                                                                                                      | 6.0                  | 0.1              | 0.1    | 0.1     |      |
|                 |                                                | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 2.4 mA<br> I <sub>out</sub>   ≤ 4.0 mA<br> I <sub>out</sub>   ≤ 5.2 mA | 3.0                  | 0.26             | 0.33   | 0.40    |      |
|                 |                                                |                                                                                                                                                      | 4.5                  | 0.26             | 0.33   | 0.40    |      |
|                 |                                                |                                                                                                                                                      | 6.0                  | 0.26             | 0.33   | 0.40    |      |
| I <sub>in</sub> | Maximum Input Leakage Current                  | V <sub>in</sub> = V <sub>CC</sub> or GND                                                                                                             | 6.0                  | ± 0.1            | ± 1.0  | ± 1.0   | μA   |
| I <sub>CC</sub> | Maximum Quiescent Supply Current (per Package) | V <sub>in</sub> = V <sub>CC</sub> or GND<br>I <sub>out</sub> = 0 μA                                                                                  | 6.0                  | 4                | 40     | 160     | μA   |

## AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Symbol                                 | Parameter                                                               | V <sub>CC</sub><br>V | Guaranteed Limit |        |         | Unit |
|----------------------------------------|-------------------------------------------------------------------------|----------------------|------------------|--------|---------|------|
|                                        |                                                                         |                      | – 55 to 25°C     | ≤ 85°C | ≤ 125°C |      |
| f <sub>max</sub>                       | Maximum Clock Frequency (50% Duty Cycle)<br>(Figures 1 and 4)           | 2.0                  | 6                | 4.8    | 4       | MHz  |
|                                        |                                                                         | 3.0                  | 10               | 8.0    | 6       |      |
|                                        |                                                                         | 4.5                  | 30               | 24     | 20      |      |
|                                        |                                                                         | 6.0                  | 35               | 28     | 24      |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, Clock to Q or $\bar{Q}$<br>(Figures 1 and 4) | 2.0                  | 150              | 190    | 225     | ns   |
|                                        |                                                                         | 3.0                  | 75               | 90     | 110     |      |
|                                        |                                                                         | 4.5                  | 26               | 32     | 38      |      |
|                                        |                                                                         | 6.0                  | 22               | 28     | 33      |      |
| t <sub>PHL</sub>                       | Maximum Propagation Delay, Reset to Q or $\bar{Q}$<br>(Figures 2 and 4) | 2.0                  | 125              | 155    | 190     | ns   |
|                                        |                                                                         | 3.0                  | 70               | 85     | 110     |      |
|                                        |                                                                         | 4.5                  | 22               | 27     | 34      |      |
|                                        |                                                                         | 6.0                  | 19               | 24     | 30      |      |
| t <sub>TLH</sub> ,<br>t <sub>THL</sub> | Maximum Output Transition Time, Any Output<br>(Figures 1 and 4)         | 2.0                  | 75               | 95     | 110     | ns   |
|                                        |                                                                         | 3.0                  | 27               | 32     | 36      |      |
|                                        |                                                                         | 4.5                  | 15               | 19     | 22      |      |
|                                        |                                                                         | 6.0                  | 13               | 16     | 19      |      |
| C <sub>in</sub>                        | Maximum Input Capacitance                                               | —                    | 10               | 10     | 10      | pF   |

|                 |                                                |                                         |    |
|-----------------|------------------------------------------------|-----------------------------------------|----|
| C <sub>PD</sub> | Power Dissipation Capacitance (Per Flip-Flop)* | Typical @ 25°C, V <sub>CC</sub> = 5.0 V | pF |
|                 |                                                | 35                                      |    |

\* Used to determine the no-load dynamic power consumption:  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ .

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## TIMING REQUIREMENTS (Input $t_r = t_f = 6$ ns)

| Symbol     | Parameter                                                    | V <sub>CC</sub><br>V | Guaranteed Limit |        |         | Unit |
|------------|--------------------------------------------------------------|----------------------|------------------|--------|---------|------|
|            |                                                              |                      | – 55 to<br>25°C  | ≤ 85°C | ≤ 125°C |      |
| $t_{su}$   | Minimum Setup Time, Data to Clock<br>(Figure 3)              | 2.0                  | 100              | 125    | 150     | ns   |
|            |                                                              | 3.0                  | 45               | 65     | 85      |      |
|            |                                                              | 4.5                  | 20               | 25     | 30      |      |
|            |                                                              | 6.0                  | 17               | 21     | 26      |      |
| $t_h$      | Minimum Hold Time, Clock to Data<br>(Figure 3)               | 2.0                  | 5                | 5      | 5       | ns   |
|            |                                                              | 3.0                  | 3                | 3      | 3       |      |
|            |                                                              | 4.5                  | 3                | 3      | 3       |      |
|            |                                                              | 6.0                  | 3                | 3      | 3       |      |
| $t_{rec}$  | Minimum Recovery Time, Reset Inactive to Clock<br>(Figure 2) | 2.0                  | 100              | 125    | 150     | ns   |
|            |                                                              | 3.0                  | 45               | 65     | 85      |      |
|            |                                                              | 4.5                  | 20               | 25     | 30      |      |
|            |                                                              | 6.0                  | 17               | 21     | 26      |      |
| $t_w$      | Minimum Pulse Width, Clock<br>(Figure 1)                     | 2.0                  | 80               | 100    | 120     | ns   |
|            |                                                              | 3.0                  | 45               | 65     | 85      |      |
|            |                                                              | 4.5                  | 16               | 20     | 24      |      |
|            |                                                              | 6.0                  | 14               | 17     | 20      |      |
| $t_w$      | Minimum Pulse Width, Reset<br>(Figure 2)                     | 2.0                  | 80               | 100    | 120     | ns   |
|            |                                                              | 3.0                  | 45               | 65     | 85      |      |
|            |                                                              | 4.5                  | 16               | 20     | 24      |      |
|            |                                                              | 6.0                  | 14               | 17     | 20      |      |
| $t_r, t_f$ | Maximum Input Rise and Fall Times<br>(Figure 1)              | 2.0                  | 1000             | 1000   | 1000    | ns   |
|            |                                                              | 3.0                  | 800              | 800    | 800     |      |
|            |                                                              | 4.5                  | 500              | 500    | 500     |      |
|            |                                                              | 6.0                  | 400              | 400    | 400     |      |

# MC74HC175A

## SWITCHING WAVEFORMS

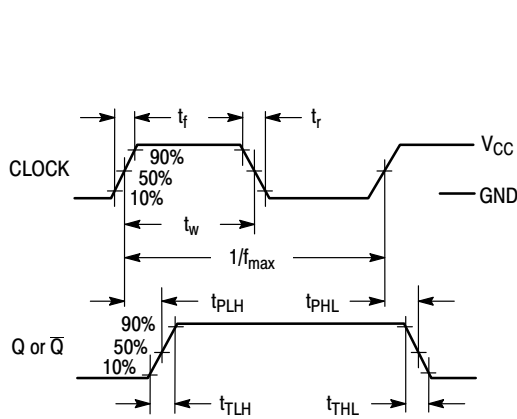


Figure 3.

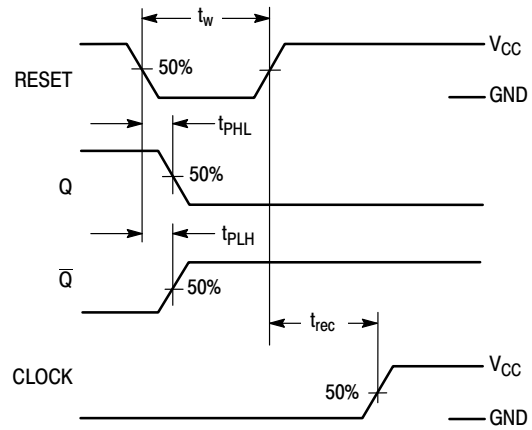


Figure 4.

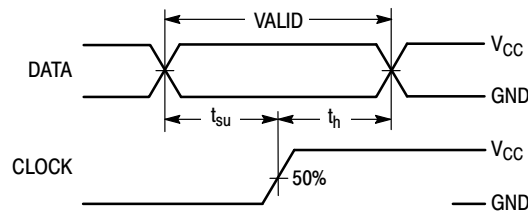
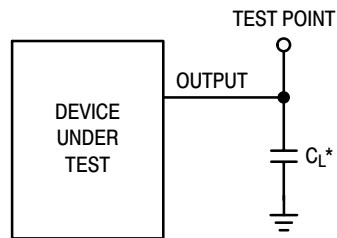


Figure 5.

## TEST CIRCUIT

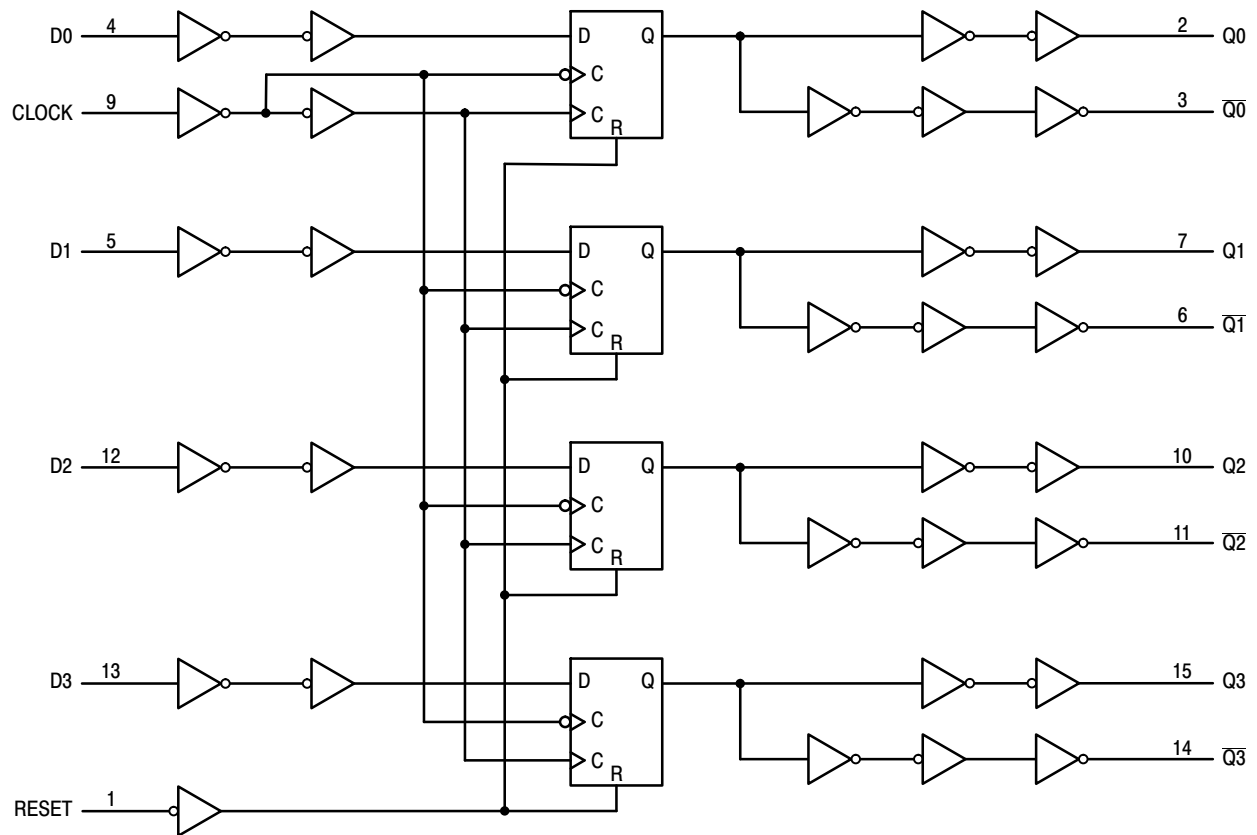


\*Includes all probe and jig capacitance

Figure 6.

# MC74HC175A

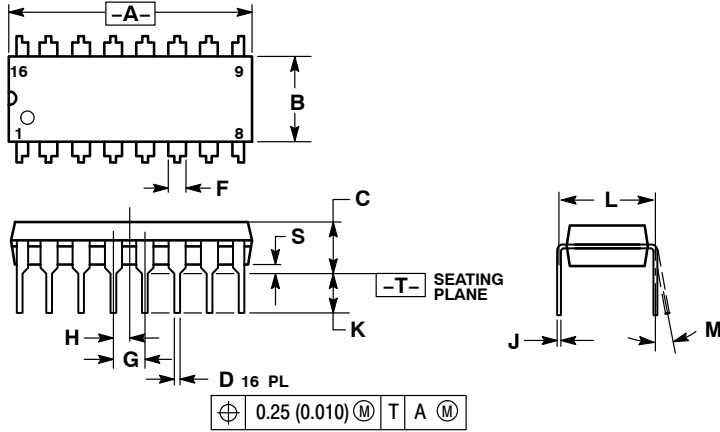
## EXPANDED LOGIC DIAGRAM



# MC74HC175A

## PACKAGE DIMENSIONS

PDIP-16  
CASE 648-08  
ISSUE T



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

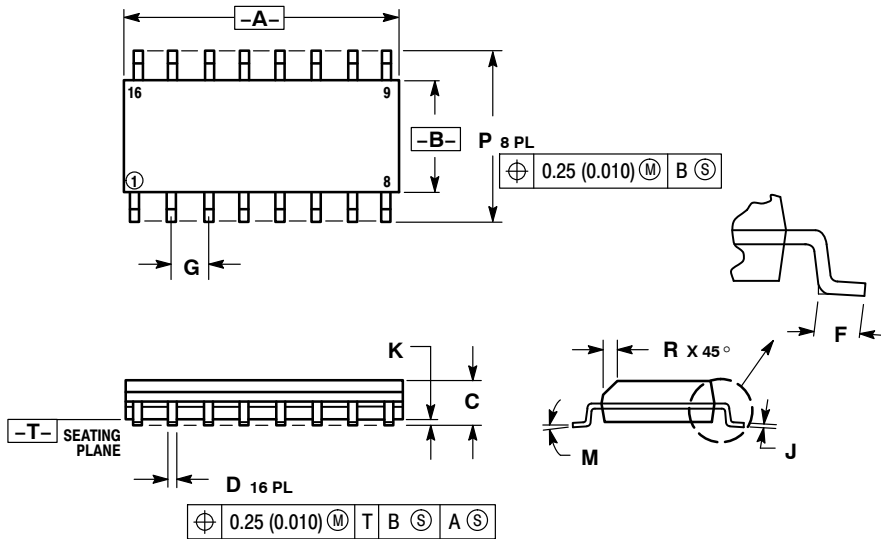
| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.740     | 0.770 | 18.80       | 19.55 |
| B   | 0.250     | 0.270 | 6.35        | 6.85  |
| C   | 0.145     | 0.175 | 3.69        | 4.44  |
| D   | 0.015     | 0.021 | 0.39        | 0.53  |
| F   | 0.040     | 0.70  | 1.02        | 1.77  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.050 BSC |       | 1.27 BSC    |       |
| J   | 0.008     | 0.015 | 0.21        | 0.38  |
| K   | 0.110     | 0.130 | 2.80        | 3.30  |
| L   | 0.295     | 0.305 | 7.50        | 7.74  |
| M   | 0°        |       | 0°          |       |
| S   | 0.020     | 0.040 | 0.51        | 1.01  |



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## PACKAGE DIMENSIONS

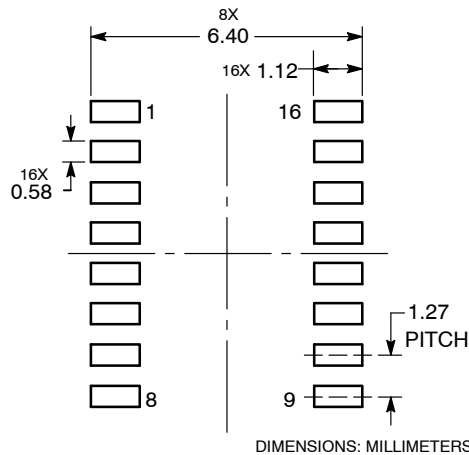
SOIC-16  
CASE 751B-05  
ISSUE K



- 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   | 9.80        | 10.00 | 0.386     | 0.393 |
| 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  | 0.229     | 0.244 |
| R   | 0.25        | 0.50  | 0.010     | 0.019 |

## SOLDERING FOOTPRINT\*



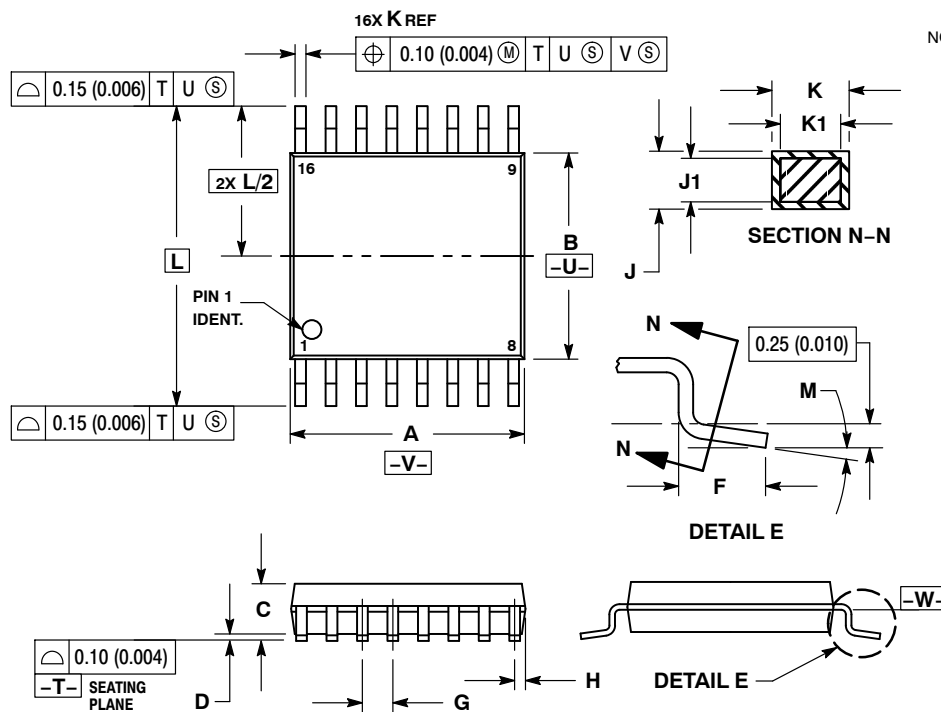
DIMENSIONS: MILLIMETERS

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

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## PACKAGE DIMENSIONS

TSSOP-16  
CASE 948F-01  
ISSUE B

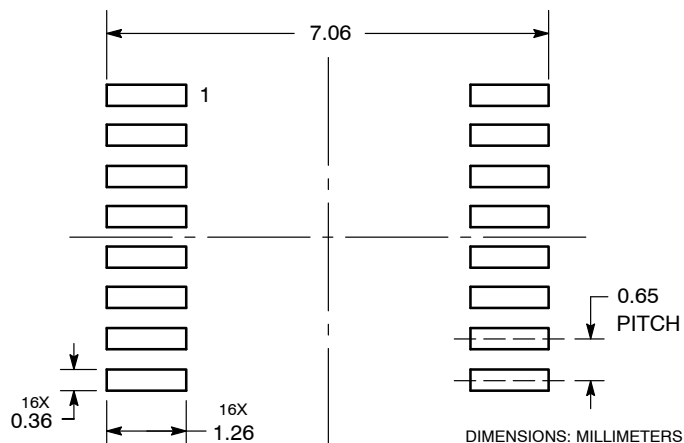


### NOTES:

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   | 0.18        | 0.28 | 0.007     | 0.011 |
| 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\*



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

# MC74HC175A

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