

## MM74HC175

### Quad D-Type Flip-Flop With Clear

#### General Description

The MM74HC175 high speed D-type flip-flop with complementary outputs utilizes advanced silicon-gate CMOS technology to achieve the high noise immunity and low power consumption of standard CMOS integrated circuits, along with the ability to drive 10 LS-TTL loads.

Information at the D inputs of the MM74HC175 is transferred to the Q and  $\bar{Q}$  outputs on the positive going edge of the clock pulse. Both true and complement outputs from each flip flop are externally available. All four flip-flops are controlled by a common clock and a common CLEAR. Clearing is accomplished by a negative pulse at the CLEAR input. All four Q outputs are cleared to a logical "0" and all four  $\bar{Q}$  outputs to a logical "1."

The 74HC logic family is functionally as well as pin-out compatible with the standard 74LS logic family. All inputs are protected from damage due to static discharge by internal diode clamps to  $V_{CC}$  and ground.

#### Features

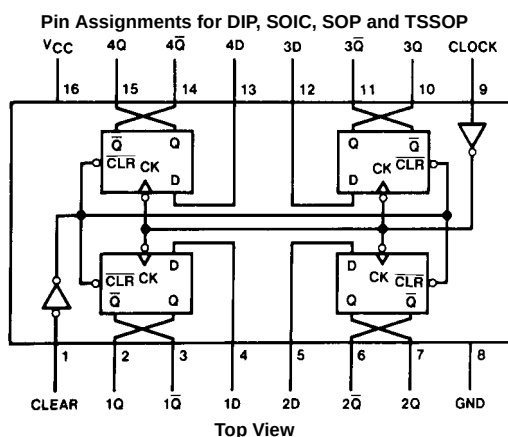
- Typical propagation delay: 15 ns
- Wide operating supply voltage range: 2–6V
- Low input current: 1  $\mu$ A maximum
- Low quiescent supply current: 80  $\mu$ A maximum (74HC)
- High output drive current: 4 mA minimum (74HC)

#### Ordering Code:

| Order Number | Package Number | Package Description                                                          |
|--------------|----------------|------------------------------------------------------------------------------|
| MM74HC175M   | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| MM74HC175SJ  | M16D           | 16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                |
| MM74HC175MTC | MTC16          | 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  |
| MM74HC175N   | N16E           | 16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide       |

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

#### Connection Diagram



#### Truth Table

(Each Flip-Flop)

| Inputs |            | Outputs |       |             |
|--------|------------|---------|-------|-------------|
| Clear  | Clock      | D       | Q     | $\bar{Q}$   |
| L      | X          | X       | L     | H           |
| H      | $\uparrow$ | H       | H     | L           |
| H      | $\uparrow$ | L       | L     | H           |
| H      | L          | X       | $Q_0$ | $\bar{Q}_0$ |

H = HIGH Level (steady state)

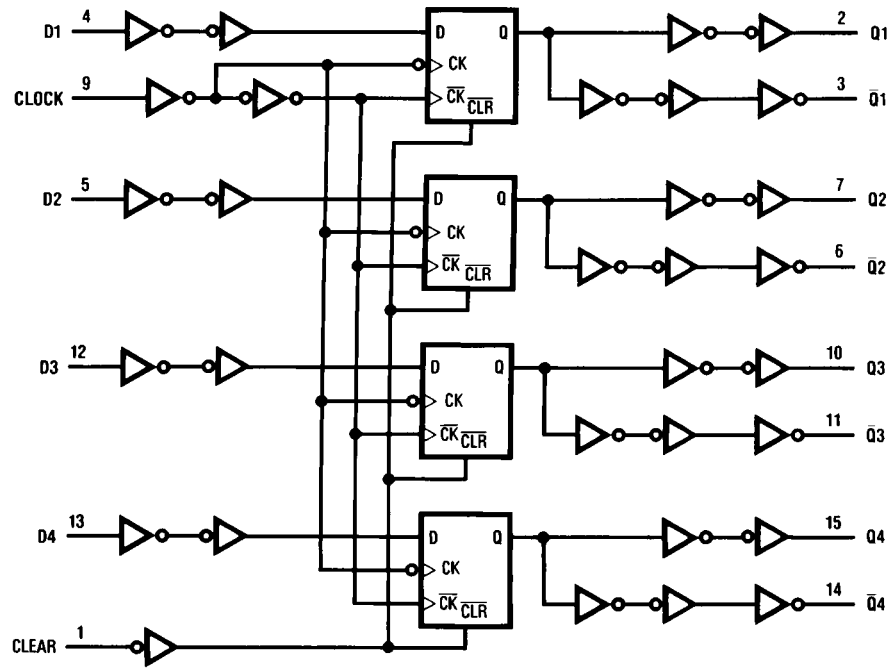
L = LOW Level (steady state)

X = Irrelevant

$\uparrow$  = Transition from LOW-to-HIGH level

$Q_0$  = The level of Q before the indicated steady-state input conditions were established

## Logic Diagram



**Absolute Maximum Ratings**(Note 1)

(Note 2)

|                                                  |                         |
|--------------------------------------------------|-------------------------|
| Supply Voltage ( $V_{CC}$ )                      | −0.5 to +7.0V           |
| DC Input Voltage ( $V_{IN}$ )                    | −1.5 to $V_{CC} + 1.5V$ |
| DC Output Voltage ( $V_{OUT}$ )                  | −0.5 to $V_{CC} + 0.5V$ |
| Clamp Diode Current ( $I_{IK}, I_{OK}$ )         | ±20 mA                  |
| DC Output Current, per pin ( $I_{OUT}$ )         | ±25 mA                  |
| DC $V_{CC}$ or GND Current, per pin ( $I_{CC}$ ) | ±50 mA                  |
| Storage Temperature Range ( $T_{STG}$ )          | −65°C to +150°C         |
| Power Dissipation ( $P_D$ )                      |                         |
| (Note 3)                                         | 600 mW                  |
| S.O. Package only                                | 500 mW                  |
| Lead Temperature ( $T_L$ )                       |                         |
| (Soldering 10 seconds)                           | 260°C                   |

**Recommended Operating Conditions**

|                                                            | Min | Max      | Units |
|------------------------------------------------------------|-----|----------|-------|
| Supply Voltage ( $V_{CC}$ )                                | 2   | 6        | V     |
| DC Input or Output Voltage<br>( $V_{IN}, V_{OUT}$ )        | 0   | $V_{CC}$ | V     |
| Operating Temperature Range ( $T_A$ )                      | −40 | +85      | °C    |
| Input Rise or Fall Times<br>( $t_r, t_f$ ) $V_{CC} = 2.0V$ |     | 1000     | ns    |
| $V_{CC} = 4.5V$                                            |     | 500      | ns    |
| $V_{CC} = 6.0V$                                            |     | 400      | ns    |

**Note 1:** Absolute Maximum Ratings are those values beyond which damage to the device may occur.

**Note 2:** Unless otherwise specified all voltages are referenced to ground.

**Note 3:** Power Dissipation temperature derating — plastic "N" package: − 12 mW/°C from 65°C to 85°C.

**DC Electrical Characteristics** (Note 4)

| Symbol          | Parameter                         | Conditions                                                                                                           | V <sub>CC</sub> | T <sub>A</sub> = 25°C |                   | T <sub>A</sub> = -40 to 85°C | T <sub>A</sub> = -55 to 125°C | Units |
|-----------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------|-------------------|------------------------------|-------------------------------|-------|
|                 |                                   |                                                                                                                      |                 | Typ                   | Guaranteed Limits |                              |                               |       |
| V <sub>IH</sub> | Minimum HIGH Level Input Voltage  |                                                                                                                      | 2.0V            |                       | 1.5               | 1.5                          | 1.5                           | V     |
|                 |                                   |                                                                                                                      | 4.5V            |                       | 3.15              | 3.15                         | 3.15                          | V     |
|                 |                                   |                                                                                                                      | 6.0V            |                       | 4.2               | 4.2                          | 4.2                           | V     |
| V <sub>IL</sub> | Maximum LOW Level Input Voltage   |                                                                                                                      | 2.0V            |                       | 0.5               | 0.5                          | 0.5                           | V     |
|                 |                                   |                                                                                                                      | 4.5V            |                       | 1.35              | 1.35                         | 1.35                          | V     |
|                 |                                   |                                                                                                                      | 6.0V            |                       | 1.8               | 1.8                          | 1.8                           | V     |
| V <sub>OH</sub> | Minimum HIGH Level Output Voltage | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>OUT</sub>   ≤ 20 μA                                  | 2.0V            | 2.0                   | 1.9               | 1.9                          | 1.9                           | V     |
|                 |                                   |                                                                                                                      | 4.5V            | 4.5                   | 4.4               | 4.4                          | 4.4                           | V     |
|                 |                                   |                                                                                                                      | 6.0V            | 6.0                   | 5.9               | 5.9                          | 5.9                           | V     |
|                 |                                   | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>OUT</sub>   ≤ 4.0 mA<br> I <sub>OUT</sub>   ≤ 5.2 mA | 4.5V            | 4.2                   | 3.98              | 3.84                         | 3.7                           | V     |
|                 |                                   |                                                                                                                      | 6.0V            | 5.7                   | 5.48              | 5.34                         | 5.2                           | V     |
|                 |                                   |                                                                                                                      |                 |                       |                   |                              |                               |       |
| 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                                  | 2.0V            | 0                     | 0.1               | 0.1                          | 0.1                           | V     |
|                 |                                   |                                                                                                                      | 4.5V            | 0                     | 0.1               | 0.1                          | 0.1                           | V     |
|                 |                                   |                                                                                                                      | 6.0V            | 0                     | 0.1               | 0.1                          | 0.1                           | V     |
|                 |                                   | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>OUT</sub>   ≤ 4.0 mA<br> I <sub>OUT</sub>   ≤ 5.2 mA | 4.5V            | 0.2                   | 0.26              | 0.33                         | 0.4                           | V     |
|                 |                                   |                                                                                                                      | 6.0V            | 0.2                   | 0.26              | 0.33                         | 0.4                           | V     |
|                 |                                   |                                                                                                                      |                 |                       |                   |                              |                               |       |
| I <sub>IN</sub> | Maximum Input Current             | V <sub>IN</sub> = V <sub>CC</sub> or GND                                                                             | 6.0V            |                       | ±0.1              | ±1.0                         | ±1.0                          | μA    |
| I <sub>CC</sub> | Maximum Quiescent Supply Current  | V <sub>IN</sub> = V <sub>CC</sub> or GND<br>I <sub>OUT</sub> = 0 μA                                                  | 6.0V            |                       | 8                 | 80                           | 160                           | μA    |

**Note 4:** For a power supply of 5V ±10% the worst case output voltages ( $V_{OH}$ , and  $V_{OL}$ ) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case  $V_{IH}$  and  $V_{IL}$  occur at  $V_{CC} = 5.5V$  and 4.5V respectively. (The  $V_{IH}$  value at 5.5V is 3.85V.) The worst case leakage current ( $I_{IN}$ ,  $I_{CC}$ , and  $I_{OZ}$ ) occur for CMOS at the higher voltage and so the 6.0V values should be used.

## AC Electrical Characteristics

$V_{CC} = 5V$ ,  $T_A = 25^\circ C$ ,  $C_L = 15\text{ pF}$ ,  $t_r = t_f = 6\text{ ns}$

| Symbol                | Parameter                                          | Conditions | Typ | Guaranteed Limit | Units |
|-----------------------|----------------------------------------------------|------------|-----|------------------|-------|
| $f_{MAX}$             | Maximum Operating Frequency                        |            | 60  | 35               | MHz   |
| $t_{PHL}$ , $t_{PLH}$ | Maximum Propagation Delay, Clock to Q or $\bar{Q}$ |            | 15  | 25               | ns    |
| $t_{PHL}$ , $t_{PLH}$ | Maximum Propagation Delay, Reset to Q or $\bar{Q}$ |            | 13  | 21               | ns    |
| $t_{REC}$             | Minimum Removal Time, Clear to Clock               |            |     | 20               | ns    |
| $t_S$                 | Minimum Setup Time, Data to Clock                  |            |     | 20               | ns    |
| $t_H$                 | Minimum Hold Time, Data from Clock                 |            |     | 0                | ns    |
| $t_W$                 | Minimum Pulse Width, Clock or Clear                |            | 10  | 16               | ns    |

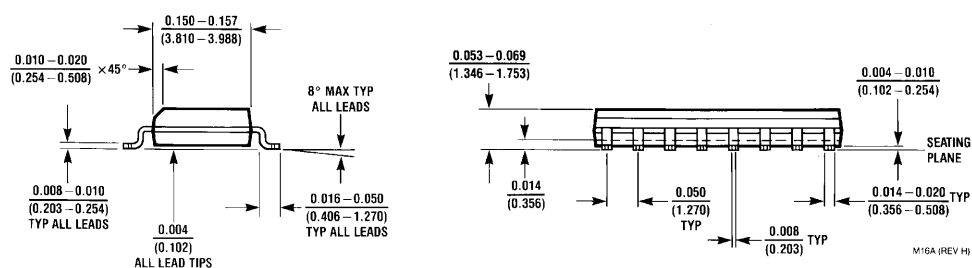
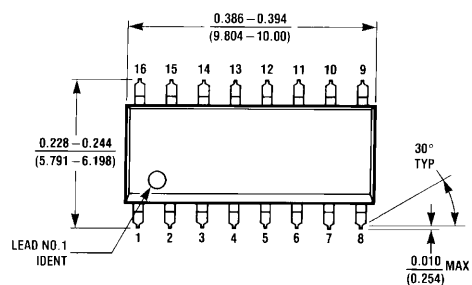
## AC Electrical Characteristics

$V_{CC} = 2.0V$  to  $6.0V$ ,  $C_L = 50\text{ pF}$ ,  $t_r = t_f = 6\text{ ns}$  (unless otherwise specified)

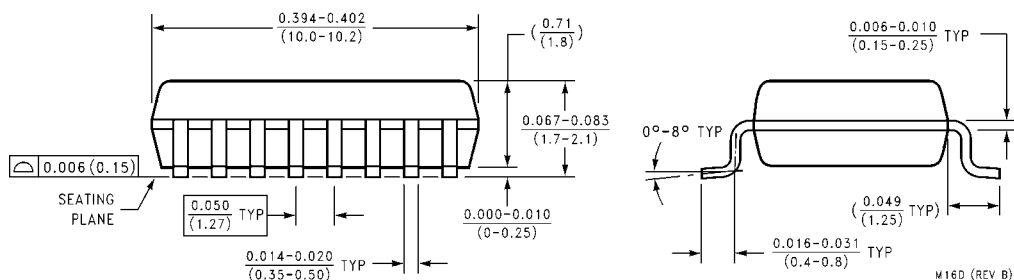
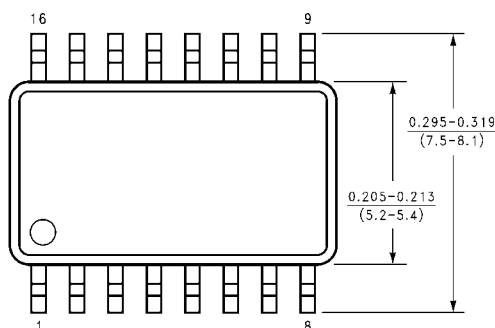
| Symbol                              | Parameter                                               | Conditions    | V <sub>CC</sub> | T <sub>A</sub> = 25°C |                   | T <sub>A</sub> = -40 to 85°C | T <sub>A</sub> = -55 to 125°C | Units |
|-------------------------------------|---------------------------------------------------------|---------------|-----------------|-----------------------|-------------------|------------------------------|-------------------------------|-------|
|                                     |                                                         |               |                 | Typ                   | Guaranteed Limits |                              |                               |       |
| f <sub>MAX</sub>                    | Maximum Operating Frequency                             |               | 2.0V            | 12                    | 6                 | 5                            | 4                             | MHz   |
|                                     |                                                         |               | 4.5V            | 60                    | 30                | 24                           | 20                            | MHz   |
|                                     |                                                         |               | 6.0V            | 70                    | 35                | 28                           | 24                            | MHz   |
| t <sub>PHL</sub> , t <sub>PLH</sub> | Maximum Propagation Delay, Clock to Q or $\overline{Q}$ |               | 2.0V            | 80                    | 150               | 190                          | 225                           | ns    |
|                                     |                                                         |               | 4.5V            | 15                    | 30                | 38                           | 45                            | ns    |
|                                     |                                                         |               | 6.0V            | 13                    | 26                | 32                           | 38                            | ns    |
| t <sub>PHL</sub> , t <sub>PLH</sub> | Maximum Propagation Delay, Reset to Q or $\overline{Q}$ |               | 2.0V            | 64                    | 125               | 158                          | 186                           | ns    |
|                                     |                                                         |               | 4.5V            | 14                    | 25                | 32                           | 37                            | ns    |
|                                     |                                                         |               | 6.0V            | 12                    | 21                | 27                           | 32                            | ns    |
| t <sub>REM</sub>                    | Minimum Removal Time<br>Clear to Clock                  |               | 2.0V            |                       | 100               | 125                          | 150                           | ns    |
|                                     |                                                         |               | 4.5V            |                       | 20                | 25                           | 30                            | ns    |
|                                     |                                                         |               | 6.0V            |                       | 17                | 21                           | 25                            | ns    |
| t <sub>S</sub>                      | Minimum Setup Time<br>Data to Clock                     |               | 2.0V            |                       | 100               | 125                          | 150                           | ns    |
|                                     |                                                         |               | 4.5V            |                       | 20                | 25                           | 30                            | ns    |
|                                     |                                                         |               | 6.0V            |                       | 17                | 21                           | 25                            | ns    |
| t <sub>H</sub>                      | Minimum Hold Time<br>Data from Clock                    |               | 2.0V            |                       | 0                 | 0                            | 0                             | ns    |
|                                     |                                                         |               | 4.5V            |                       | 0                 | 0                            | 0                             | ns    |
|                                     |                                                         |               | 6.0V            |                       | 0                 | 0                            | 0                             | ns    |
| t <sub>W</sub>                      | Minimum Pulse Width<br>Clear or Clock                   |               | 2.0V            | 30                    | 80                | 100                          | 120                           | ns    |
|                                     |                                                         |               | 4.5V            | 9                     | 16                | 20                           | 24                            | ns    |
|                                     |                                                         |               | 6.0V            | 8                     | 14                | 17                           | 20                            | ns    |
| t <sub>r</sub> , t <sub>f</sub>     | Maximum Input Rise and<br>Fall Time                     |               | 2.0V            |                       | 1000              | 1000                         | 1000                          | ns    |
|                                     |                                                         |               | 4.5V            |                       | 500               | 500                          | 500                           | ns    |
|                                     |                                                         |               | 6.0V            |                       | 400               | 400                          | 400                           | ns    |
| t <sub>TLH</sub> , t <sub>THL</sub> | Maximum Output Rise and<br>Fall Time                    |               | 2.0V            | 30                    | 75                | 95                           | 110                           | ns    |
|                                     |                                                         |               | 4.5V            | 9                     | 15                | 19                           | 22                            | ns    |
|                                     |                                                         |               | 6.0V            | 8                     | 13                | 16                           | 19                            | ns    |
| C <sub>PD</sub>                     | Power Dissipation Capacitance (Note 5)                  | (per package) |                 | 150                   |                   |                              |                               | pF    |
| C <sub>IN</sub>                     | Maximum Input Capacitance                               |               |                 | 5                     | 10                | 10                           | 10                            | pF    |

**Note 5:**  $C_{PD}$  determines the no load dynamic power consumption,  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ , and the no load dynamic current consumption,  $I_S = C_{PD} V_{CC} f + I_{CC}$ .

# Physical Dimensions inches (millimeters) unless otherwise noted

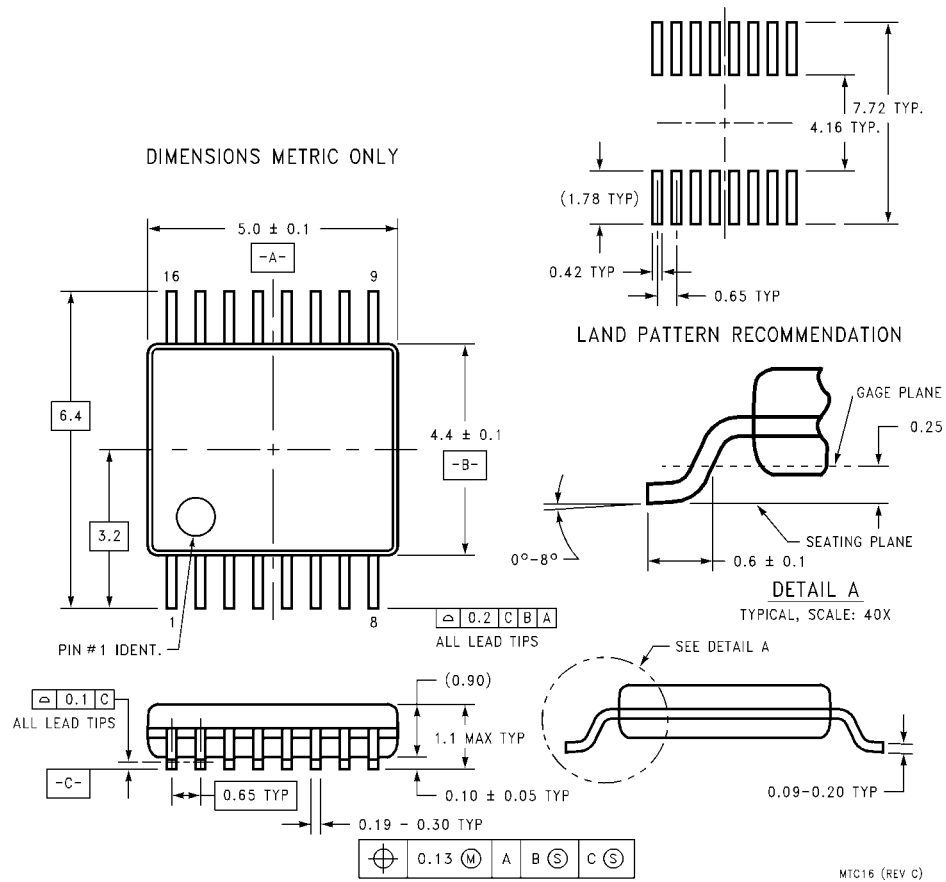


16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow  
Package Number M16A

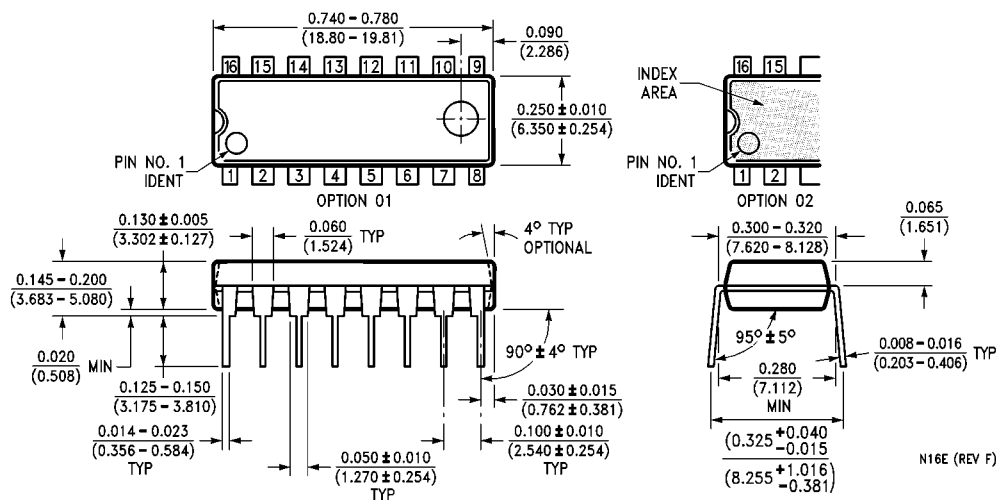


16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide  
Package Number M16D

# Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



# Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide  
Package Number N16E

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