

# HD74AC166/HD74ACT166

## 8-bit Shift Register

# HITACHI

ADE-205-375 (Z)  
1st. Edition  
Sep. 2000

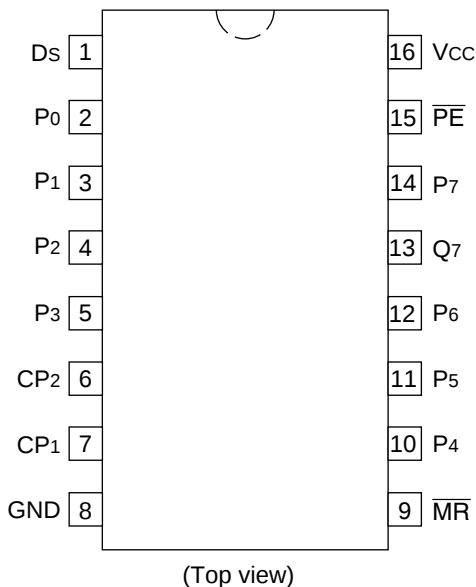
### Description

The HD74AC166/HD74ACT166 is an 8-bit, serial or parallel-in, serial-out shift register using edge triggered D-type flip-flops. Serial and parallel entry are synchronous, with state changes initiated by the rising edge of the clock. An asynchronous Master Reset overrides other inputs and clears all flip-flops. The circuit can be clocked from two sources or one CP input can be used to trigger the other.

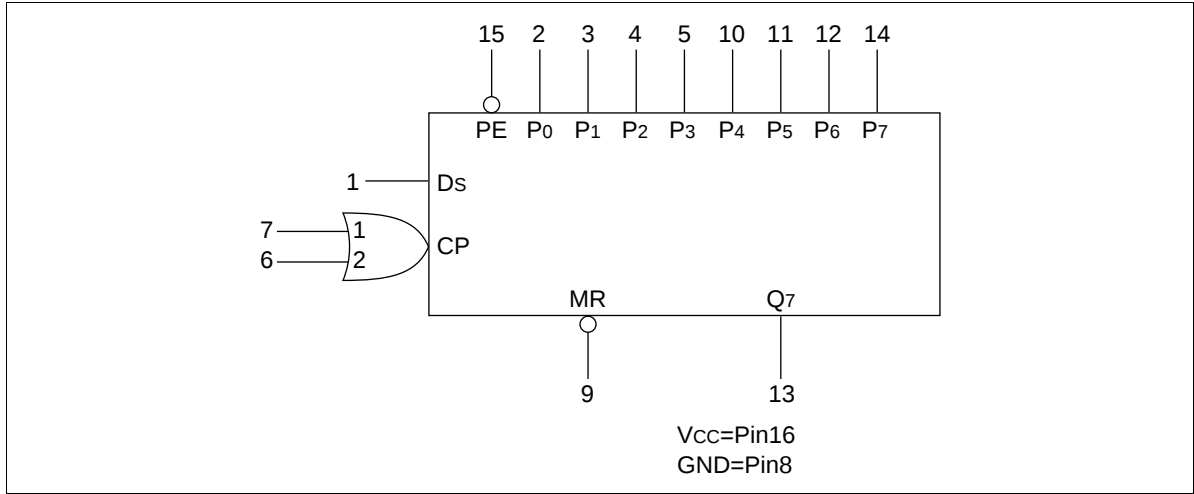
### Features

- Outputs Source/Sink 24 mA
- HD74ACT166 has TTL-Compatible Inputs

### Pin Arrangement



Logic Symbol



Pin Names

- CP<sub>1</sub>, CP<sub>2</sub> Clock Pulse Inputs (Active Rising Edge)
- D<sub>s</sub> Serial Data Input
- $\overline{PE}$  Parallel Enable Input (Active Low)
- P<sub>0</sub> to P<sub>7</sub> Parallel Data Inputs
- $\overline{MR}$  Asynchronous Master Reset Input (Active Low)
- Q<sub>7</sub> Last Stage Output

Functional Description

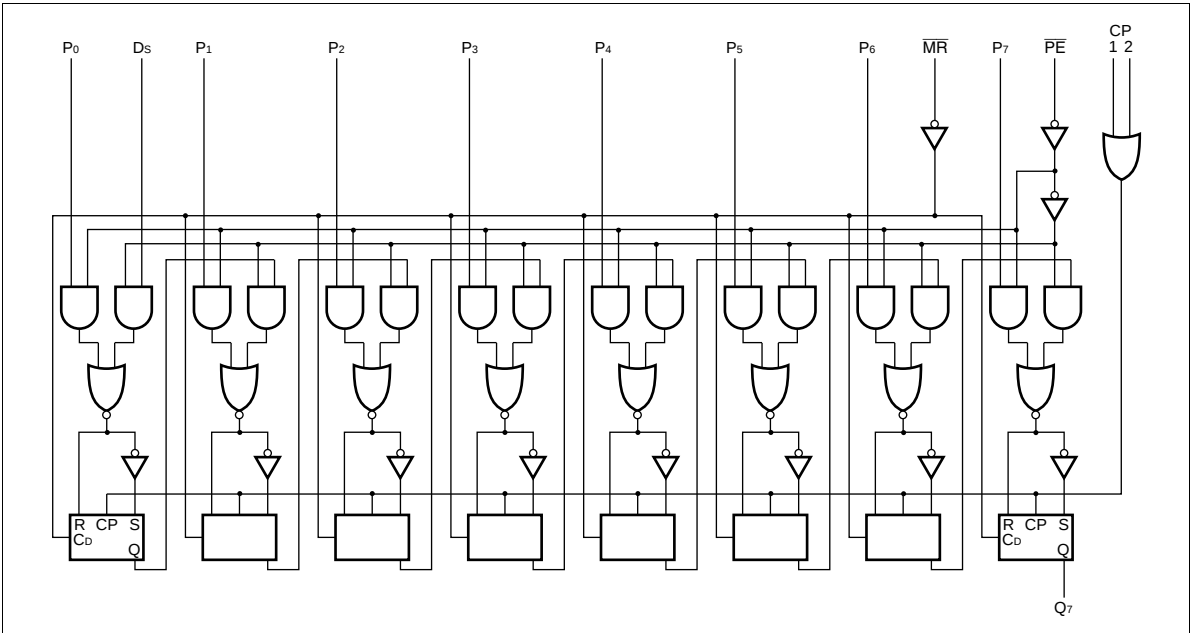
Operation is synchronous (except for Master Reset) and state changes are initiated by the rising edge of either clock input if the other clock input is Low. When one of the clock inputs is used as an active High clock inhibit, it should attain the High state while the other clock is still in the High state following the previous operation. When the Parallel Enable ( $\overline{PE}$ ) input is Low, data is loaded into the register from the Parallel Data (P<sub>0</sub> to P<sub>7</sub>) inputs on the next rising edge of the clock. When  $\overline{PE}$  is High, information is shifted from the Serial Data (D<sub>s</sub>) input to Q<sub>0</sub> and all data in the register is shifted one bit position (i.e., Q<sub>0</sub> → Q<sub>1</sub>, Q<sub>1</sub> → Q<sub>2</sub>, etc.) on the rising edge of the clock.

Truth Table

| Inputs          |                 |        |          |       | Parallel       | Internal Outputs |          | Output   |
|-----------------|-----------------|--------|----------|-------|----------------|------------------|----------|----------|
| $\overline{MR}$ | $\overline{PE}$ | $CP_2$ | $CP_1$   | $D_S$ | $P_0$ to $P_7$ | $Q_0$            | $Q_6$    | $Q_7$    |
| L               | X               | X      | X        | X     | X              | L                | L        | L        |
| H               | X               | L      | L        | X     | X              | $Q_{A0}$         | $Q_{B0}$ | $Q_{H0}$ |
| H               | L               | L      | $\lceil$ | X     | $a \cdots h$   | $a$              | $b$      | $h$      |
| H               | H               | L      | $\lceil$ | H     | X              | H                | $Q_{An}$ | $Q_{Gn}$ |
| H               | H               | L      | $\lceil$ | L     | X              | L                | $Q_{An}$ | $Q_{Gn}$ |
| H               | X               | H      | $\lceil$ | X     | X              | $Q_{A0}$         | $Q_{B0}$ | $Q_{H0}$ |

H : High Voltage Level  
L : Low Voltage Level  
X : Immaterial  
 $\lceil$  : Low-to-High Clock Transition

Logic Diagram



HD74AC166/HD74ACT166

DC Characteristics (unless otherwise specified)

| Item                                                   | Symbol           | Max | Unit | Condition                                                                             |
|--------------------------------------------------------|------------------|-----|------|---------------------------------------------------------------------------------------|
| Maximum quiescent supply current                       | I <sub>CC</sub>  | 80  | μA   | V <sub>IN</sub> = V <sub>CC</sub> or ground, V <sub>CC</sub> = 5.5 V, Ta = Worst case |
| Maximum quiescent supply current                       | I <sub>CC</sub>  | 8.0 | μA   | V <sub>IN</sub> = V <sub>CC</sub> or ground, V <sub>CC</sub> = 5.5 V, Ta = 25°C       |
| Maximum additional I <sub>CC</sub> /input (HD74ACT166) | I <sub>CCT</sub> | 1.5 | mA   | V <sub>IN</sub> = V <sub>CC</sub> – 2.1 V, V <sub>CC</sub> = 5.5 V, Ta = Worst case   |

AC Characteristics: HD74AC166

| Item                                                                   | Symbol           | V <sub>CC</sub> (V)* <sup>1</sup> | Ta = +25°C<br>C <sub>L</sub> = 50 pF |      |      | Ta = –40°C to +85°C<br>C <sub>L</sub> = 50 pF |      | Unit |
|------------------------------------------------------------------------|------------------|-----------------------------------|--------------------------------------|------|------|-----------------------------------------------|------|------|
|                                                                        |                  |                                   | Min                                  | Typ  | Max  | Min                                           | Max  |      |
| Maximum clock frequency                                                | f <sub>max</sub> | 3.3                               | 75                                   | —    | —    | 65                                            | —    | MHz  |
|                                                                        |                  | 5.0                               | 100                                  | —    | —    | 80                                            | —    |      |
| Propagation delay CP <sub>1</sub> or CP <sub>2</sub> to Q <sub>7</sub> | t <sub>PLH</sub> | 3.3                               | 1.0                                  | 11.0 | 14.5 | 1.0                                           | 15.5 | ns   |
|                                                                        |                  | 5.0                               | 1.0                                  | 9.5  | 11.5 | 1.0                                           | 12.5 |      |
| Propagation delay CP <sub>1</sub> or CP <sub>2</sub> to Q <sub>7</sub> | t <sub>PHL</sub> | 3.3                               | 1.0                                  | 10.5 | 14.0 | 1.0                                           | 15.0 |      |
|                                                                        |                  | 5.0                               | 1.0                                  | 9.0  | 11.0 | 1.0                                           | 12.0 |      |
| Propagation delay $\overline{MR}$ to Q <sub>7</sub>                    | t <sub>PHL</sub> | 3.3                               | 1.0                                  | 9.5  | 12.0 | 1.0                                           | 13.0 |      |
|                                                                        |                  | 5.0                               | 1.0                                  | 6.5  | 9.0  | 1.0                                           | 10.0 |      |

Note: 1. Voltage Range 3.3 is 3.3 V ± 0.3 V  
Voltage Range 5.0 is 5.0 V ± 0.5 V

AC Operating Requirements: HD74AC166

| Item                                                                   | Symbol           | V <sub>CC</sub> (V)* <sup>1</sup> | Ta = +25°C             | Ta = −40°C to +85°C    |     | Unit |
|------------------------------------------------------------------------|------------------|-----------------------------------|------------------------|------------------------|-----|------|
|                                                                        |                  |                                   | C <sub>L</sub> = 50 pF | C <sub>L</sub> = 50 pF |     |      |
|                                                                        |                  |                                   | Typ                    | Guaranteed Minimum     |     |      |
| Setup time                                                             | t <sub>su</sub>  | 3.3                               | 3.0                    | 5.5                    | 6.0 | ns   |
| $\overline{PE}$ or P <sub>n</sub> or D <sub>S</sub> to CP <sub>n</sub> |                  | 5.0                               | 2.0                    | 4.0                    | 4.5 |      |
| Hold time                                                              | t <sub>h</sub>   | 3.3                               | −1.5                   | 3.0                    | 3.0 |      |
| CP <sub>n</sub> to $\overline{PE}$ or P <sub>n</sub> or D <sub>S</sub> |                  | 5.0                               | −0.5                   | 3.0                    | 3.0 |      |
| Pulse width                                                            | t <sub>w</sub>   | 3.3                               | 2.0                    | 5.5                    | 7.0 |      |
| CP <sub>n</sub> or $\overline{MR}$                                     |                  | 5.0                               | 2.0                    | 4.5                    | 5.0 |      |
| Recovery time                                                          | t <sub>rec</sub> | 3.3                               | −2.5                   | 0.0                    | 0.0 |      |
| $\overline{MR}$ to CP <sub>n</sub>                                     |                  | 5.0                               | −1.5                   | 0.0                    | 0.0 |      |

Note: 1. Voltage Range 3.3 is 3.3 V ± 0.3 V  
Voltage Range 5.0 is 5.0 V ± 0.5 V

AC Characteristics: HD74ACT166

| Item                                                   | Symbol           | V <sub>CC</sub> (V)* <sup>1</sup> | Ta = +25°C<br>C <sub>L</sub> = 50 pF |      |      | Ta = −40°C to +85°C<br>C <sub>L</sub> = 50 pF |      | Unit |
|--------------------------------------------------------|------------------|-----------------------------------|--------------------------------------|------|------|-----------------------------------------------|------|------|
|                                                        |                  |                                   | Min                                  | Typ  | Max  | Min                                           | Max  |      |
| Maximum clock frequency                                | f <sub>max</sub> | 5.0                               | 100                                  | —    | —    | 80                                            | —    | MHz  |
| Propagation delay<br>CP <sub>n</sub> to Q <sub>7</sub> | t <sub>PLH</sub> | 5.0                               | 1.0                                  | 10.0 | 12.5 | 1.0                                           | 13.5 | ns   |
| Propagation delay<br>CP <sub>n</sub> to Q <sub>7</sub> | t <sub>PHL</sub> | 5.0                               | 1.0                                  | 9.5  | 12.0 | 1.0                                           | 13.0 |      |
| Propagation delay<br>$\overline{MR}$ to Q <sub>7</sub> | t <sub>PHL</sub> | 5.0                               | 1.0                                  | 8.5  | 11.0 | 1.0                                           | 12.0 |      |

Note: 1. Voltage Range 5.0 is 5.0 V ± 0.5 V

AC Operating Requirements: HD74ACT166

| Item                                                                    | Symbol           | V <sub>CC</sub> (V)* <sup>1</sup> | Ta = +25°C             | Ta = −40°C             |     | Unit |
|-------------------------------------------------------------------------|------------------|-----------------------------------|------------------------|------------------------|-----|------|
|                                                                         |                  |                                   | C <sub>L</sub> = 50 pF | to +85°C               |     |      |
|                                                                         |                  |                                   |                        | C <sub>L</sub> = 50 pF |     |      |
| Setup time<br>PE or P <sub>n</sub> or D <sub>S</sub> to CP <sub>n</sub> | t <sub>su</sub>  | 5.0                               | 2.5                    | 7.0                    | 8.0 | ns   |
| Hold time<br>CP <sub>n</sub> to PE or P <sub>n</sub> or D <sub>S</sub>  | t <sub>h</sub>   | 5.0                               | 0.0                    | 1.5                    | 1.5 |      |
| Pulse width CP <sub>n</sub> or MR                                       | t <sub>w</sub>   | 5.0                               | 4.5                    | 7.0                    | 8.0 |      |
| Recovery time MR to CP <sub>n</sub>                                     | t <sub>rec</sub> | 5.0                               | −2.5                   | 0.5                    | 0.5 |      |

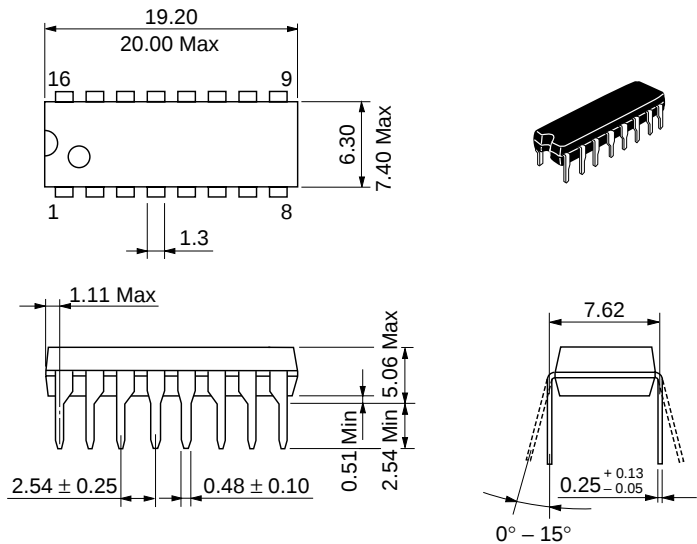
Note: 1. Voltage Range 5.0 is 5.0 V ± 0.5 V

Capacitance

| Item                          | Symbol          | Typ  | Unit | Condition               |
|-------------------------------|-----------------|------|------|-------------------------|
| Input capacitance             | C <sub>IN</sub> | 4.5  | pF   | V <sub>CC</sub> = 5.5 V |
| Power dissipation capacitance | C <sub>PD</sub> | 35.0 | pF   | V <sub>CC</sub> = 5.0 V |

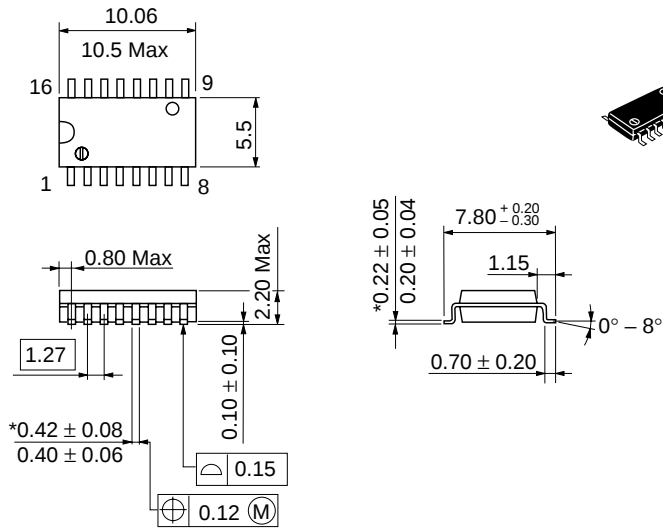
Package Dimensions

Unit: mm



|                        |          |
|------------------------|----------|
| Hitachi Code           | DP-16    |
| JEDEC                  | Conforms |
| EIAJ                   | Conforms |
| Mass (reference value) | 1.07 g   |

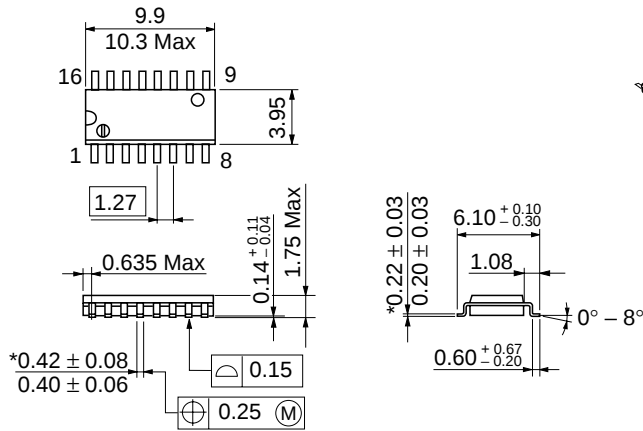
Unit: mm



|                        |          |
|------------------------|----------|
| Hitachi Code           | FP-16DA  |
| JEDEC                  | —        |
| EIAJ                   | Conforms |
| Mass (reference value) | 0.24 g   |

\*Dimension including the plating thickness  
Base material dimension

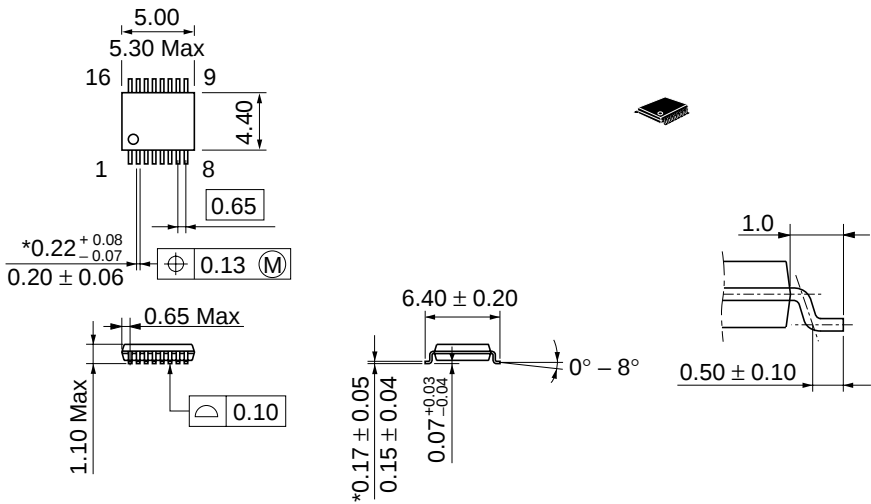
Unit: mm



\*Dimension including the plating thickness  
Base material dimension

|                        |          |
|------------------------|----------|
| Hitachi Code           | FP-16DN  |
| JEDEC                  | Conforms |
| EIAJ                   | Conforms |
| Mass (reference value) | 0.15 g   |

Unit: mm



\*Dimension including the plating thickness  
Base material dimension

|                        |          |
|------------------------|----------|
| Hitachi Code           | TTP-16DA |
| JEDEC                  | —        |
| EIAJ                   | —        |
| Mass (reference value) | 0.05 g   |

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