



### 8-Bit Shift Registers with Output Latches

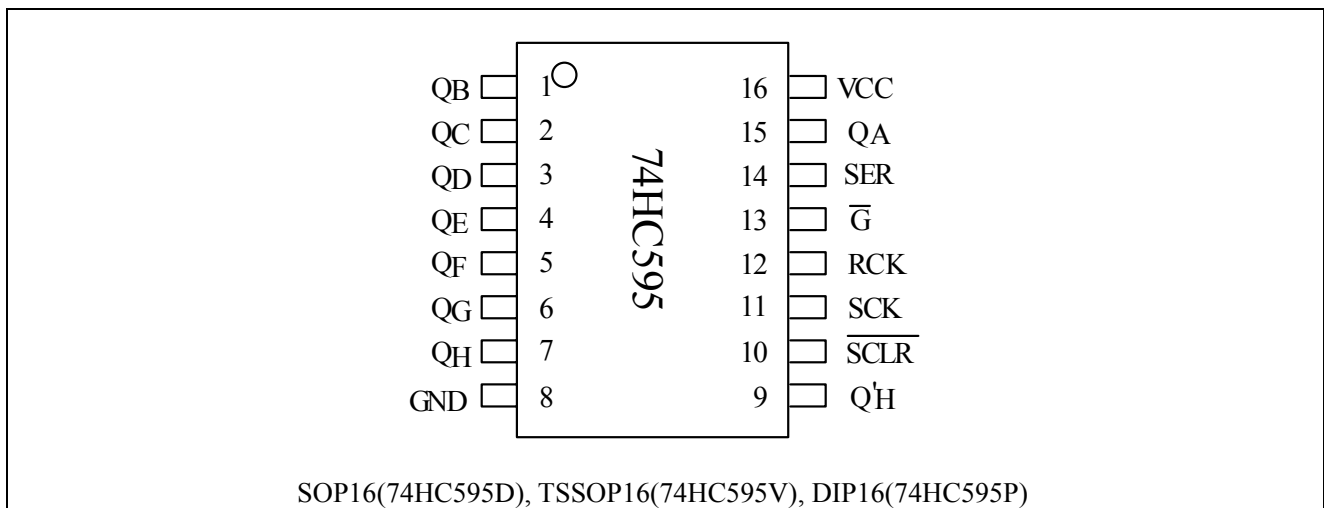
#### General Description

The 74HC595 high speed shift register utilizes advanced silicon-gate CMOS technology. This device possesses the high noise immunity and low power consumption of standard CMOS integrated circuits, as well as the ability to drive 15 LS-TTL loads. This device contains an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. The storage register has 8 3-STATE outputs. Separate clocks are provided for both the shift register and the storage register. The shift register has a direct-overriding clear, serial input, and serial output (standard) pins for cascading. Both the shift register and storage register use positive-edge triggered clocks. If both clocks are connected together, the shift register state will always be one clock pulse ahead of the storage register.

#### Features

- Low quiescent current: 80μA maximum
- Low input current: 1μA maximum
- 8-bit serial-in, parallel-out shift register with storage
- Wide operating voltage range: 2V–6V
- Cascadable
- Shift register has direct clear
- Guaranteed shift frequency: DC to 30 MHz
- Package: SOP16(74HC595D), TSSOP16(74HC595V), DIP16(74HC595P)

#### Connection Diagram



# 74HC595

## Pin Function

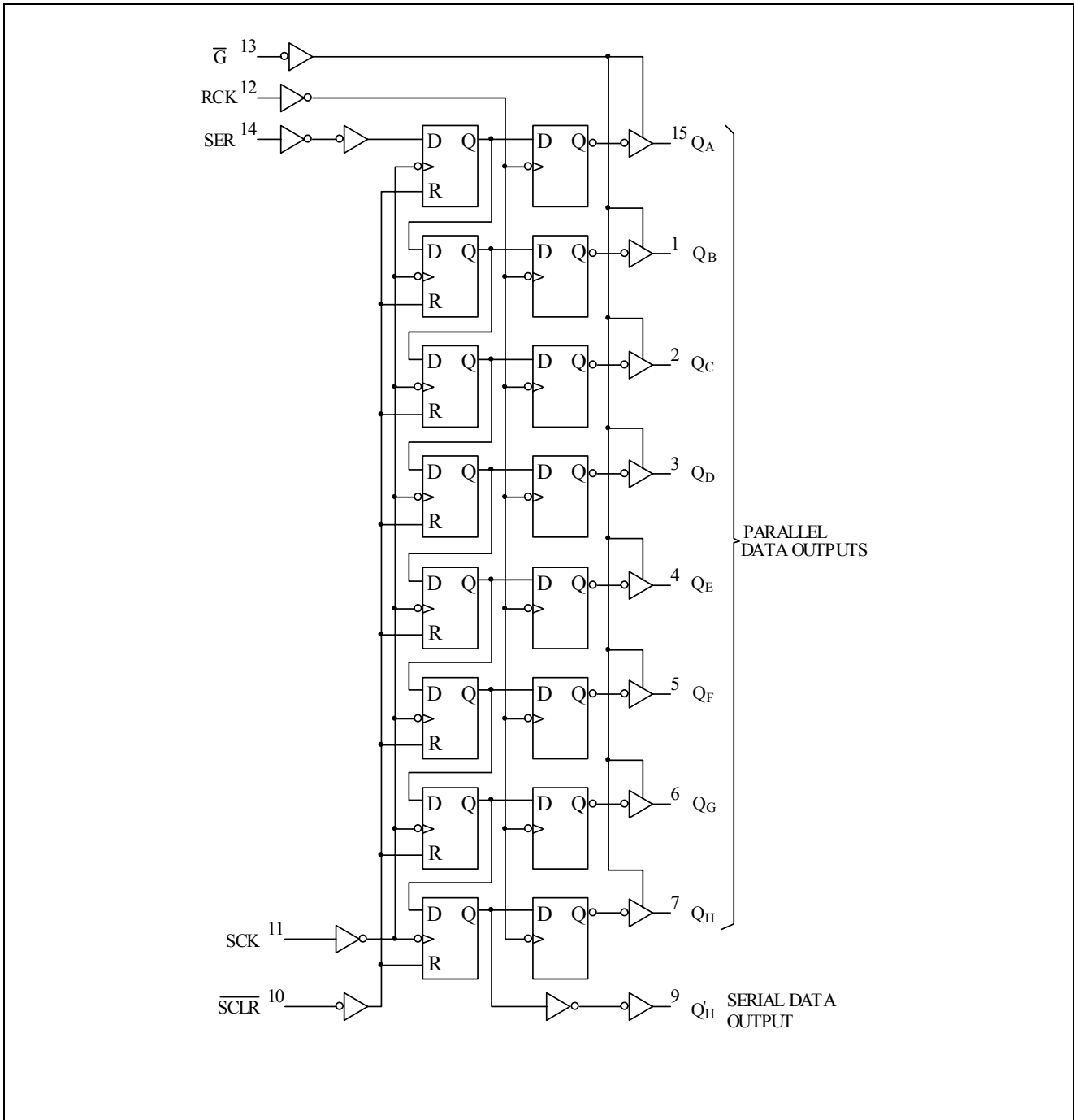
| Pin     | Name                     | I/O | Description             |
|---------|--------------------------|-----|-------------------------|
| 15, 1~7 | QA~QH                    | O   | 8 bit 3-STATE Output    |
| 8, 16   | GND, VCC                 | —   | Grond, Supply           |
| 9       | Q'H                      | O   | Serial Output           |
| 10      | $\overline{\text{SCLR}}$ | I   | Shift Register cleared  |
| 11      | SCK                      | I   | Shift Register clocked  |
| 12      | RCK                      | I   | Output Register clocked |
| 13      | $\overline{\text{G}}$    | I   | Output state control    |
| 14      | SER                      | I   | Data input              |

## Truth Table

| RCK | SCK | $\overline{\text{SCLR}}$ | $\overline{\text{G}}$ | Description  |
|-----|-----|--------------------------|-----------------------|--|
| X   | X   | X                        | H                     | QA to QH = 3-STATE   |
| X   | X   | L                        | L                     | Shift Register cleared, Q'H=0                                |
| X   | ↑   | H                        | L                     | Shift Register clocked, $Q_N = Q_{n-1}$ , $Q_0 = \text{SER}$ |
| ↑   | X   | H                        | L                     | Contents of Shift Register transferred to output latches     |

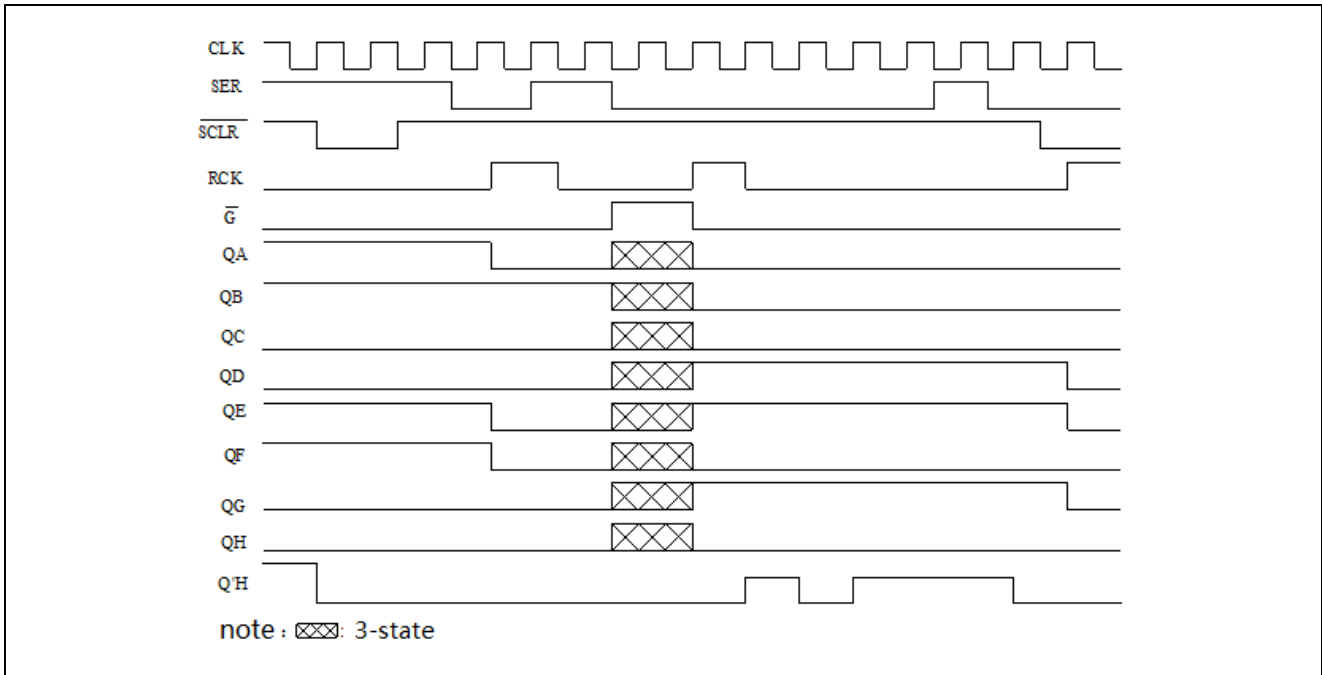
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## Logic Diagram



# 74HC595

## Timing Diagram



## Absolute Maximum Ratings

| Parameter                  | Symbol    | Scope              | Unit |
|----------------------------|-----------|--------------------|------|
| Supply Voltage             | $V_{CC}$  | -0.5~7.0           | V    |
| DC Input Voltage           | $V_{IN}$  | -1.5~ $V_{CC}+1.5$ | V    |
| DC Output Voltage          | $V_{OUT}$ | -0.5~ $V_{CC}+0.5$ | V    |
| DC Output Current          | $I_{OUT}$ | ±35                | mA   |
| DC $V_{CC}$ or GND Current | $I_{CC}$  | ±70                | mA   |
| Power Dissipation          | $P_D$     | 600                | mW   |
| Storage Temperature Range  | $T_{STG}$ | -65~150            | °C   |

## Recommended Operating Conditions

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

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## Electrical Characteristics

### DC Characteristics

| Symbol          | Parameter                         | Condition  | V <sub>CC</sub> | T <sub>A</sub> =25°C |                   | T <sub>A</sub> =25 to 85°C | T <sub>A</sub> =-55 to 125°C | Unit |
|-----------------|-----------------------------------|--|-----------------|----------------------|-------------------|----------------------------|------------------------------|------|
|                 |                                   |  |                 | typ                  | Guaranteed Limits |                            |                              |      |
| V <sub>IH</sub> | Minimum High Level Input Voltage  |  | 2V              |                      | 1.5               | 1.5                        | 1.5                          | V    |
|                 |                                   |  | 4.5V            |                      | 3.15              | 3.15                       | 3.15                         |      |
|                 |                                   |  | 6V              |                      | 4.2               | 4.2                        | 4.2                          |      |
| V <sub>IL</sub> | Maximum Low Level Input Voltage   |  | 2V              |                      | 0.5               | 0.5                        | 0.5                          | V    |
|                 |                                   |  | 4.5V            |                      | 1.35              | 1.35                       | 1.35                         |      |
|                 |                                   |  | 6V              |                      | 1.8               | 1.8                        | 1.8                          |      |
| 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>   ≤ 20μA                                  | 2V              | 2.0                  | 1.9               | 1.9                        | 1.9                          | V    |
|                 |                                   |  | 4.5V            | 4.5                  | 4.4               | 4.4                        | 4.4                          |      |
|                 |                                   |  | 6V              | 6                    | 5.9               | 5.9                        | 5.9                          |      |
|                 | Q <sub>H</sub>                    | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>  I <sub>OUT</sub>   ≤ 4.0mA<br>  I <sub>OUT</sub>   ≤ 5.2mA | 4.5V            | 4.2                  | 3.98              | 3.84                       | 3.7                          | V    |
|                 |                                   |  | 6V              | 5.2                  | 5.48              | 5.34                       | 5.2                          |      |
|                 | Q <sub>A</sub> to Q <sub>H</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>  I <sub>OUT</sub>   ≤ 6.0mA<br>  I <sub>OUT</sub>   ≤ 7.8mA | 4.5V            | 4.2                  | 3.98              | 3.84                       | 3.7                          | V    |
| 6.0V            |                                   |  | 5.7             | 5.48                 | 5.34              | 5.2                        |                              |      |
| 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>   ≤ 20μA                                  | 2V              | 0                    | 0.1               | 0.1                        | 0.1                          | V    |
|                 |                                   |  | 4.5V            | 0                    | 0.1               | 0.1                        | 0.1                          |      |
|                 |                                   |  | 6V              | 0                    | 0.1               | 0.1                        | 0.1                          |      |
|                 | Q <sub>H</sub>                    | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>  I <sub>OUT</sub>   ≤ 4.0mA<br>  I <sub>OUT</sub>   ≤ 5.2mA | 4.5V            | 0.2                  | 0.26              | 0.33                       | 0.4                          | V    |
|                 |                                   |  | 6V              | 0.2                  | 0.26              | 0.33                       | 0.4                          |      |
|                 | Q <sub>A</sub> to Q <sub>H</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>  I <sub>OUT</sub>   ≤ 6.0mA<br>  I <sub>OUT</sub>   ≤ 7.8mA | 4.5V            | 0.2                  | 0.26              | 0.33                       | 0.4                          | V    |
| 6V              |                                   |  | 0.2             | 0.26                 | 0.33              | 0.4                        |                              |      |
| I <sub>IN</sub> | Maximum Input Current             | V <sub>IN</sub> = V <sub>CC</sub> or GND   | 6V              |                      | ±0.1              | ±1.0                       | ±1.0                         | μA   |
| I <sub>OZ</sub> | Maximum 3-STATE Output Leakage    | V <sub>OUT</sub> = V <sub>CC</sub> or GND<br>Ḡ = V <sub>IH</sub>  | 6V              |                      | ±0.5              | ±5.0                       | ±10                          | μA   |
| I <sub>CC</sub> | Maximum Quiescent Supply Current  | V <sub>IN</sub> = V <sub>CC</sub> or GND<br>I <sub>OUT</sub> = 0μA   | 6V              |                      | 8.0               | 80                         | 160                          | μA   |

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**AC Characteristics ( $V_{CC}=5V$ ,  $T_A=25^\circ C$ ,  $t_r=t_f=6ns$ )**

| Symbol              | Parameter  | Condition                    | Typ | Guaranteed Limit | Unit |
|---------------------|--|------------------------------|-----|------------------|------|
| $f_{MAX}$           | Maximum Operating Frequency of SCK                     |                              | 50  | 30               | MHz  |
| $t_{PHL}$ $t_{PLH}$ | Maximum Propagation Delay, SCK to QH'                  | $C_L=45pF$                   | 12  | 20               | ns   |
| $t_{PHL}$ $t_{PLH}$ | Maximum Propagation Delay, RCK to QA thru QH           | $C_L=45pF$                   | 18  | 30               | ns   |
| $t_{PZH}$ $t_{PZL}$ | Maximum Output Enable Time from G to QA thru QH        | $R_L=1k\Omega$<br>$C_L=45pF$ | 17  | 28               | ns   |
| $t_{PHZ}$ $t_{PLZ}$ | Maximum Output Disable Time from $\bar{G}$ to QA to QH | $R_L=1k\Omega$<br>$C_L=5pF$  | 15  | 25               | ns   |
| $t_s$               | Minimum Setup Time from SER to SCK                     |                              |     | 20               | ns   |
| $t_s$               | Minimum Setup Time from SCLR to SCK                    |                              |     | 20               | ns   |
| $t_s$               | Minimum Setup Time from SCK to RCK                     |                              |     | 40               | ns   |
| $t_H$               | Minimum Hold Time from SER to SCK                      |                              |     | 0                | ns   |
| $t_w$               | Minimum Pulse Width of SCK or RCK                      |                              |     | 16               | ns   |

**AC Characteristics ( $V_{CC}=2.0\sim 6.0V$ ,  $C_L=50pF$ ,  $t_r=t_f=6ns$ )**

| Symbol                 | Parameter  | Condition  | $V_{CC}$    | $T_A=25^\circ C$ |                  | $T_A=25$ to $85^\circ C$ | $T_A=-55$ to $125^\circ C$ | Unit |
|------------------------|--|------------|-------------|------------------|------------------|--------------------------|----------------------------|------|
|                        |  |            |             | Typ              | Guaranteed Limit |                          |                            |      |
| $f_{MAX}$              | Maximum Operating Frequency                      | $C_L=50pF$ | 2V          | 10               | 6                | 4.8                      | 4.0                        | MHz  |
|                        |  |            | 4.5V        | 45               | 30               | 24                       | 20                         |      |
|                        |  |            | 6V          | 50               | 35               | 28                       | 24                         |      |
| $t_{PHL}$<br>$t_{PLH}$ | Maximum Propagation Delay from SCK to QH         | $C_L=50pF$ | 2V          | 58               | 210              | 265                      | 315                        | ns   |
|                        |  |            | $C_L=150pF$ | 2V               | 83               | 294                      | 367                        |      |
|                        |  | $C_L=50pF$ | 4.5V        | 14               | 42               | 53                       | 63                         | ns   |
|                        |  |            | $C_L=150pF$ | 4.5V             | 17               | 58                       | 74                         |      |
|                        |  | $C_L=50pF$ | 6V          | 10               | 36               | 45                       | 54                         | ns   |
|                        |  |            | $C_L=150pF$ | 6V               | 14               | 50                       | 63                         |      |
| $t_{PHL}$<br>$t_{PLH}$ | Maximum Propagation Delay from RCK to QA thru QH | $C_L=50pF$ | 2V          | 70               | 175              | 220                      | 265                        | ns   |
|                        |  |            | $C_L=150pF$ | 2V               | 105              | 245                      | 306                        |      |
|                        |  | $C_L=50pF$ | 4.5V        | 21               | 35               | 44                       | 53                         | ns   |
|                        |  |            | $C_L=150pF$ | 4.5V             | 28               | 49                       | 61                         |      |
|                        |  | $C_L=50pF$ | 6V          | 18               | 30               | 37                       | 45                         | ns   |

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|                        |  | $C_L=150\text{pF}$   | 6V   | 26  | 42   | 53   | 63   |    |
|------------------------|--|--|------|-----|------|------|------|----|
| $t_{PHL}$<br>$t_{PLH}$ | Maximum Propagation delay from $\overline{\text{SCLR}}$ to QH        |  | 2V   |     | 175  | 221  | 261  | ns |
|                        |  |  | 4.5V |     | 36   | 44   | 52   |    |
|                        |  |  | 6V   |     | 30   | 37   | 44   |    |
| $t_{PZH}$<br>$t_{PZL}$ | Maximum Output Enable from $\overline{\text{G}}$ to QA thru QH       | $R_L=1\text{k}\Omega$<br>$C_L=50\text{pF}$<br>$C_L=150\text{pF}$ | 2V   | 75  | 175  | 220  | 265  | ns |
|                        |  |  | 2V   | 100 | 245  | 306  | 368  |    |
|                        |  | $C_L=50\text{pF}$<br>$C_L=150\text{pF}$                          | 4.5V | 15  | 35   | 44   | 53   | ns |
|                        |  |  | 4.5V | 20  | 49   | 61   | 74   |    |
|                        |  | $C_L=50\text{pF}$<br>$C_L=150\text{pF}$                          | 6V   | 13  | 30   | 37   | 45   | ns |
|                        |  |  | 6V   | 17  | 42   | 53   | 63   |    |
| $t_{PHZ}$<br>$t_{PLZ}$ | Maximum Output Disable Time from $\overline{\text{G}}$ to QA thru QH | $R_L=1\text{k}\Omega$<br>$C_L=50\text{pF}$                       | 2V   | 75  | 175  | 220  | 265  | ns |
|                        |  |  | 4.5V | 15  | 35   | 44   | 53   |    |
|                        |  |  | 6V   | 13  | 30   | 37   | 45   |    |
| $t_s$                  | Minimum Setup Time from SER to SCK                                   |  | 2V   |     | 100  | 125  | 150  | ns |
|                        |  |  | 4.5V |     | 20   | 25   | 30   |    |
|                        |  |  | 6V   |     | 17   | 21   | 25   |    |
| $t_r$                  | Minimum Removal Time from $\overline{\text{SCLR}}$ to SCK            |  | 2V   |     | 50   | 63   | 75   | ns |
|                        |  |  | 4.5V |     | 10   | 13   | 15   |    |
|                        |  |  | 6V   |     | 9    | 11   | 13   |    |
| $t_s$                  | Minimum Setup Time from SCK to RCK                                   |  | 2V   |     | 100  | 125  | 150  | ns |
|                        |  |  | 4.5V |     | 20   | 25   | 30   |    |
|                        |  |  | 6V   |     | 17   | 21   | 26   |    |
| $t_H$                  | Minimum Hold Time SER to SCK   |  | 2V   |     | 5    | 5    | 5    | ns |
|                        |  |  | 4.5V |     | 5    | 5    | 5    |    |
|                        |  |  | 6V   |     | 5    | 5    | 5    |    |
| $t_w$                  | Minimum Pulse Width of SCK or $\overline{\text{SCLR}}$               |  | 2V   | 30  | 80   | 100  | 120  | ns |
|                        |  |  | 4.5V | 9   | 16   | 20   | 24   |    |
|                        |  |  | 6V   | 8   | 14   | 18   | 22   |    |
| $t_r$ $t_f$            | Maximum Input Rise and Fall Time, Clock                              |  | 2V   |     | 1000 | 1000 | 1000 | ns |
|                        |  |  | 4.5V |     | 500  | 500  | 500  |    |
|                        |  |  | 6V   |     | 400  | 400  | 400  |    |
| $t_{THL}$<br>$t_{TLH}$ | Maximum Output   |  | 2V   | 25  | 60   | 75   | 90   | ns |
|                        |  |  | 4.5V | 7   | 12   | 15   | 18   |    |

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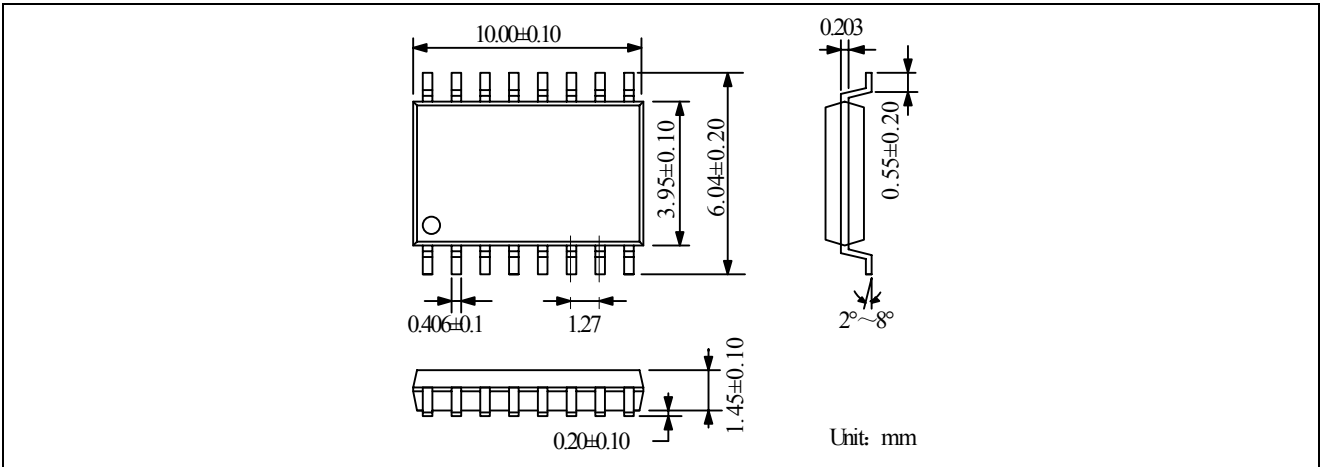
|                        |  |                                   |      |     |    |    |     |    |
|------------------------|--|-----------------------------------|------|-----|----|----|-----|----|
|                        | Rise and Fall Time<br>QA–QH                    |                                   | 6V   | 6   | 10 | 13 | 15  |    |
| $t_{THL}$<br>$t_{TLH}$ | Maximum Output Rise & Fall Time<br>QH          |                                   | 2V   |     | 75 | 95 | 110 | ns |
|                        |  |                                   | 4.5V |     | 15 | 19 | 22  |    |
|                        |  |                                   | 6V   |     | 13 | 16 | 19  |    |
| $C_{PD}$               | Power Dissipation Capacitance, Outputs Enabled | $\bar{G}=V_{CC}$<br>$\bar{G}=GND$ |      | 90  |    |    |     | pF |
|                        |  |                                   |      | 150 |    |    |     |    |
| $C_{IN}$               | Maximum Input Capacitance                      |                                   |      | 5   | 10 | 10 | 10  | pF |
| $C_{OUT}$              | Maximum Output Capacitance                     |                                   |      | 15  | 20 | 20 | 20  | pF |



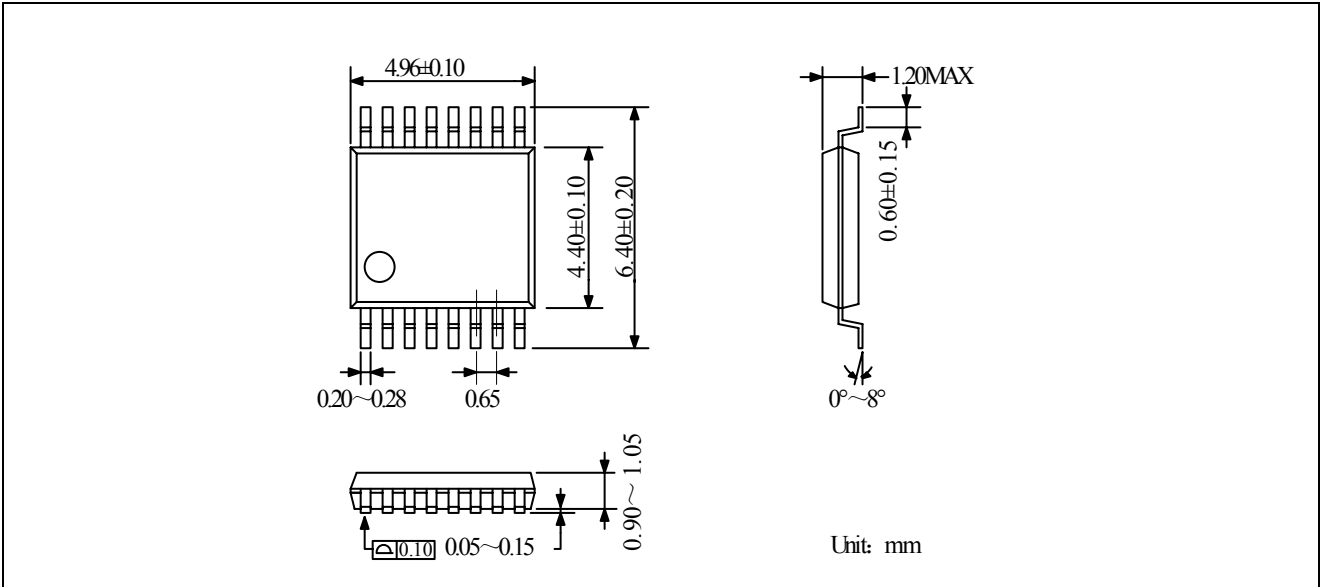
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## Package Dimension

### SOP16



### TSSOP16



### DIP16

