

## TC74VHC299F, TC74VHC299FT

### 8-Bit PIPO Shift Register with Asynchronous Clear

The TC74VHC299 is an advanced high speed CMOS 8-BIT PIPO SHIFT REGISTER fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

It has a four modes (HOLD, SHIFT LEFT, SHIFT RIGHT and LOAD DATA) controlled by the two selection inputs (S0, S1).

When one or both enable ( $\overline{G1}$ ,  $\overline{G2}$ ) are high, the eight I/O are forced to the high-impedance state; however, sequential operation or clearing of the register is not affected.

All inputs are equipped with protection circuits against static discharge.

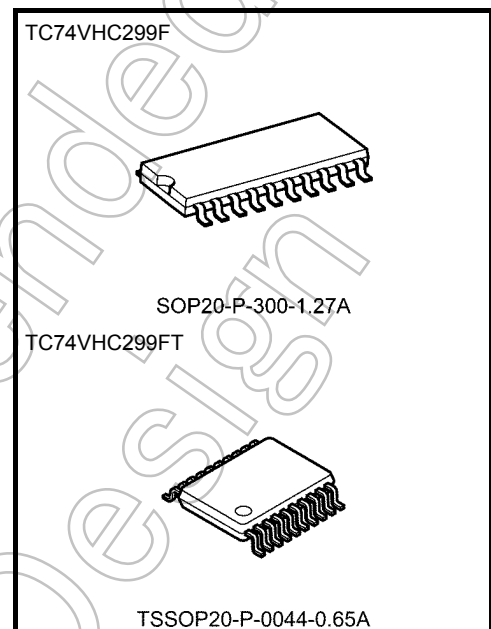
### Features (Note 1) (Note 2) (Note 3)

- High speed:  $f_{max} = 160$  MHz (typ.) at  $V_{CC} = 5$  V
- Low power dissipation:  $I_{CC} = 4$   $\mu$ A (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\%$   $V_{CC}$  (min)
- Balanced propagation delays:  $t_{PLH} \approx t_{PHL}$
- Wide operating voltage range:  $V_{CC} (opr) = 2$  to  $5.5$  V
- Low noise:  $V_{OLP} = 1.2$  V (max)
- Pin and function compatible with 74ALS299

Note 1: Do not apply a signal to A/QA to H/QH bus terminal when it is in the output mode. Damage may result.

Note 2: All floating (high impedance) A/QA to H/QH bus terminals must have their input levels fixed by means of pull up or pull down resistors.

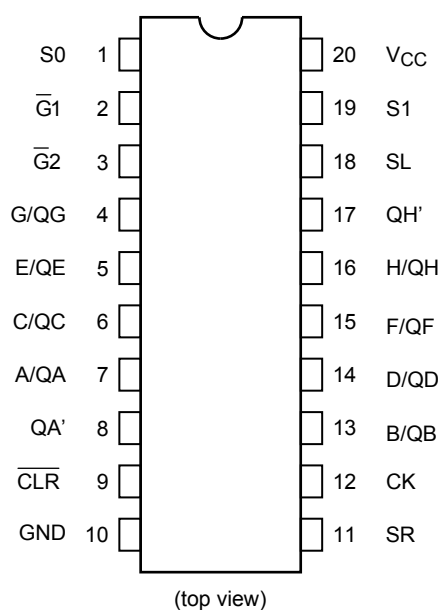
Note 3: A parasitic diode is formed between A/QA to H/QH bus and  $V_{CC}$  terminals. Therefore bus terminal can not be used to interface 5 V to 3 V systems directly.



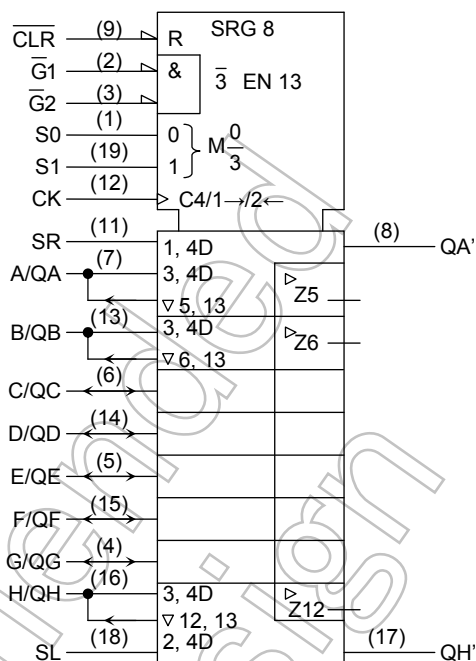
|                      |                 |
|----------------------|-----------------|
| Weight               |                 |
| SOP20-P-300-1.27A    | : 0.22 g (typ.) |
| TSSOP20-P-0044-0.65A | : 0.08 g (typ.) |

Start of commercial production  
1992-10

## Pin Assignment



## IEC Logic Symbol



## Truth Table

| Mode        | Inputs |                 |    |                |              |    |        |    | Inputs /Outputs |                 | Outputs         |                 |
|-------------|--------|-----------------|----|----------------|--------------|----|--------|----|-----------------|-----------------|-----------------|-----------------|
|             | CLR    | Function Select |    | Output Control |              | CK | Serial |    | A/QA            | H/QH            | QA'             | QH'             |
|             |        | S1              | S0 | G1<br>(Note)   | G2<br>(Note) |    | SL     | SR |                 |                 |                 |                 |
| Z           | L      | H               | H  | X              | X            | X  | X      | X  | Z               | Z               | L               | L               |
| Clear       | L      | L               | X  | L              | L            | X  | X      | X  | L               | L               | L               | L               |
|             | L      | X               | L  | L              | L            | X  | X      | X  | L               | L               | L               | L               |
| Hold        | H      | L               | L  | L              | L            | X  | X      | X  | QA <sub>0</sub> | QH <sub>0</sub> | QA <sub>0</sub> | QH <sub>0</sub> |
| Shift Right | H      | L               | H  | L              | L            | ↑  | X      | H  | H               | QG <sub>n</sub> | H               | QG <sub>n</sub> |
|             | H      | L               | H  | L              | L            | ↑  | X      | L  | L               | QG <sub>n</sub> | L               | QG <sub>n</sub> |
| Shift Left  | H      | H               | L  | L              | L            | ↑  | H      | X  | QB <sub>n</sub> | H               | QB <sub>n</sub> | H               |
|             | H      | H               | L  | L              | L            | ↑  | L      | X  | QB <sub>n</sub> | L               | QB <sub>n</sub> | L               |
| Load        | H      | H               | H  | X              | X            | ↑  | X      | X  | a               | h               | a               | h               |

Note: When one or both output controls are high, the eight input/output terminals are in the high-impedance state; however sequential or clearing of the register is not affected.

Z: High impedance

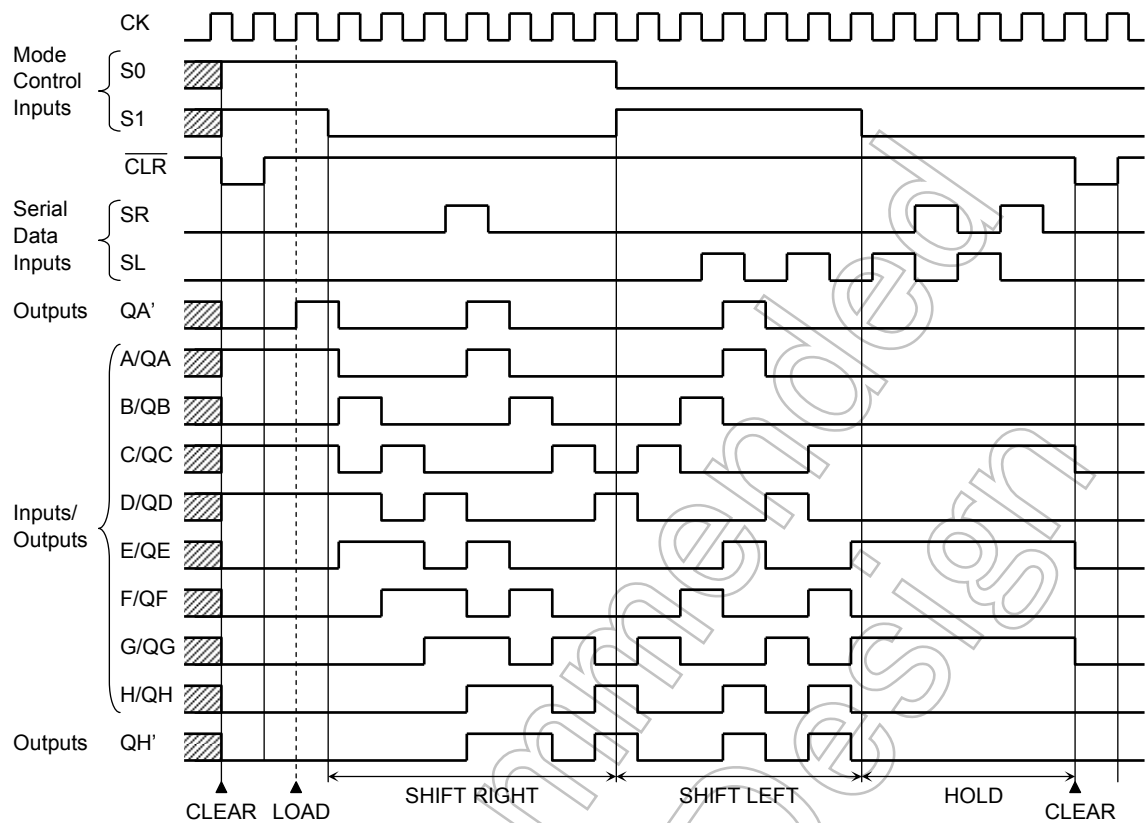
Q<sub>n0</sub>: The level of Q<sub>n</sub> before the indicated steady-state input conditions were established.

Q<sub>nn</sub>: The level of Q<sub>n</sub> before the most recent active transition indicated by ↓ or ↑.

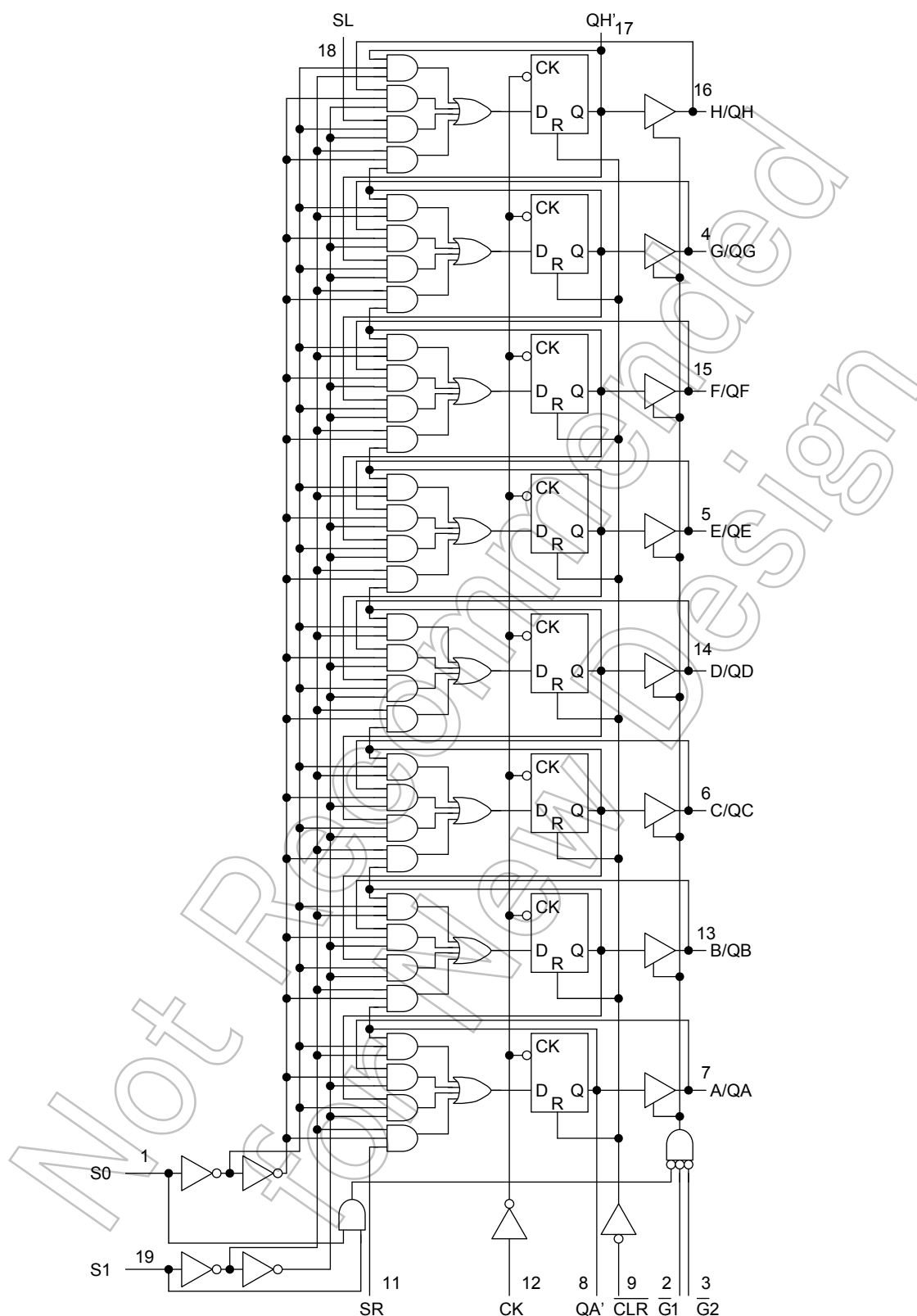
a, h: The level of the steady-state inputs A, H, respectively.

X: Don't care.

Timing Chart



## System Diagram



## Absolute Maximum Ratings (Note)

| Characteristics                       | Symbol       | Rating                 | Unit |
|---------------------------------------|--------------|------------------------|------|
| Supply voltage range                  | $V_{CC}$     | -0.5 to 7.0            | V    |
| DC input voltage                      | $V_{IN}$     | -0.5 to 7.0            | V    |
| DC bus I/O voltage<br>(A/QA to H/QH') | $V_{IN/OUT}$ | -0.5 to $V_{CC} + 0.5$ | V    |
| DC output voltage<br>(QA' to QH')     | $V_{OUT}$    | -0.5 to $V_{CC} + 0.5$ | V    |
| Input diode current                   | $I_{IK}$     | -20                    | mA   |
| Output diode current                  | $I_{OK}$     | $\pm 20$               | mA   |
| DC output current                     | $I_{OUT}$    | $\pm 25$               | mA   |
| DC $V_{CC}$ /ground current           | $I_{CC}$     | $\pm 80$               | mA   |
| Power dissipation                     | $P_D$        | 180                    | mW   |
| Storage temperature                   | $T_{stg}$    | -65 to 150             | °C   |

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

## Operating Ranges (Note)

| Characteristics                      | Symbol       | Rating                                                                    | Unit |
|--------------------------------------|--------------|---------------------------------------------------------------------------|------|
| Supply voltage                       | $V_{CC}$     | 2.0 to 5.5                                                                | V    |
| Input voltage                        | $V_{IN}$     | 0 to 5.5                                                                  | V    |
| DC bus I/O voltage<br>(A/QA to H/QH) | $V_{IN/OUT}$ | 0 to $V_{CC}$                                                             | V    |
| DC output voltage<br>(QA' to QH')    | $V_{OUT}$    | 0 to $V_{CC}$                                                             | V    |
| Operating temperature                | $T_{opr}$    | -40 to 85                                                                 | °C   |
| Input rise and fall time             | $dt/dV$      | 0 to 100 ( $V_{CC} = 3.3 \pm 0.3$ V)<br>0 to 20 ( $V_{CC} = 5 \pm 0.5$ V) | ns/V |

Note: The operating ranges must be maintained to ensure the normal operation of the device.  
Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

### DC Characteristics

| Characteristics                  | Symbol          | Test Condition                                                                                    |                                                    | Ta = 25°C           |                               |        | Ta =<br>-40 to 85°C           |                               | Unit                          |     |
|----------------------------------|-----------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------|---------------------|-------------------------------|--------|-------------------------------|-------------------------------|-------------------------------|-----|
|                                  |                 |                                                                                                   |                                                    | V <sub>CC</sub> (V) | Min                           | Typ.   | Max                           | Min                           |                               | Max |
| High-level input voltage         | V <sub>IH</sub> | —                                                                                                 |                                                    | 2.0<br>3.0 to 5.5   | 1.50<br>V <sub>CC</sub> × 0.7 | —<br>— | —<br>—                        | 1.50<br>V <sub>CC</sub> × 0.7 | —<br>—                        | V   |
| Low-level input voltage          | V <sub>IL</sub> | —                                                                                                 |                                                    | 2.0<br>3.0 to 5.5   | —<br>—                        | —<br>— | 0.50<br>V <sub>CC</sub> × 0.3 | —<br>—                        | 0.50<br>V <sub>CC</sub> × 0.3 | V   |
| High-level output voltage        | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                              | I <sub>OH</sub> = -50 μA                           | 2.0                 | 1.9                           | 2.0    | —                             | 1.9                           | —                             | V   |
|                                  |                 |                                                                                                   |                                                    | 3.0                 | 2.9                           | 3.0    | —                             | 2.9                           | —                             |     |
|                                  |                 |                                                                                                   | I <sub>OH</sub> = -4 mA<br>I <sub>OH</sub> = -8 mA | 4.5                 | 4.4                           | 4.5    | —                             | 4.4                           | —                             |     |
|                                  |                 |                                                                                                   |                                                    | 3.0<br>4.5          | 2.58<br>3.94                  | —<br>— | —<br>—                        | 2.48<br>3.80                  | —<br>—                        |     |
| Low-level output voltage         | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                              | I <sub>OL</sub> = 50 μA                            | 2.0                 | —                             | 0.0    | 0.1                           | —                             | 0.1                           | V   |
|                                  |                 |                                                                                                   |                                                    | 3.0                 | —                             | 0.0    | 0.1                           | —                             | 0.1                           |     |
|                                  |                 |                                                                                                   | I <sub>OL</sub> = 4 mA<br>I <sub>OL</sub> = 8 mA   | 4.5                 | —                             | 0.0    | 0.1                           | —                             | 0.1                           |     |
|                                  |                 |                                                                                                   |                                                    | 3.0<br>4.5          | —<br>—                        | —<br>— | 0.36<br>0.36                  | —<br>—                        | 0.44<br>0.44                  |     |
| 3-state output off-state current | I <sub>OZ</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>OUT</sub> = V <sub>CC</sub> or GND |                                                    | 5.5                 | —                             | —      | ±0.25                         | —                             | ±2.50                         | μA  |
| Input leakage current            | I <sub>IN</sub> | V <sub>IN</sub> = 5.5 V or GND                                                                    |                                                    | 0 to 5.5            | —                             | —      | ±0.1                          | —                             | ±1.0                          | μA  |
| Quiescent supply current         | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                                                          |                                                    | 5.5                 | —                             | —      | 4.0                           | —                             | 40.0                          | μA  |

AC Characteristics (input:  $t_r = t_f = 3 \text{ ns}$ )

| Characteristics                                                | Symbol           | Test Condition        |                     |                     | Ta = 25°C |      |      | Ta =<br>-40 to 85°C |      | Unit |
|----------------------------------------------------------------|------------------|-----------------------|---------------------|---------------------|-----------|------|------|---------------------|------|------|
|                                                                |                  |                       | V <sub>CC</sub> (V) | C <sub>L</sub> (pF) | Min       | Typ. | Max  | Min                 | Max  |      |
| Propagation delay time<br>(CK-QA', QH')                        | t <sub>pLH</sub> | —                     | 3.3 ± 0.3           | 15                  | —         | 12.2 | 17.2 | 1.0                 | 19.8 | ns   |
|                                                                |                  |                       |                     | 50                  | —         | 14.7 | 20.7 | 1.0                 | 23.3 |      |
|                                                                | t <sub>pHL</sub> |                       | 5.0 ± 0.5           | 15                  | —         | 8.5  | 10.8 | 1.0                 | 12.0 |      |
|                                                                |                  |                       |                     | 50                  | —         | 10.0 | 12.8 | 1.0                 | 14.0 |      |
| Propagation delay time<br>( $\overline{\text{CLR}}$ -QA', QH') | t <sub>pHL</sub> | —                     | 3.3 ± 0.3           | 15                  | —         | 13.0 | 19.0 | 1.0                 | 22.0 | ns   |
|                                                                |                  |                       |                     | 50                  | —         | 15.5 | 22.5 | 1.0                 | 25.5 |      |
|                                                                |                  |                       | 5.0 ± 0.5           | 15                  | —         | 9.1  | 11.2 | 1.0                 | 13.5 |      |
|                                                                |                  |                       |                     | 50                  | —         | 10.8 | 13.2 | 1.0                 | 15.5 |      |
| Propagation delay time<br>(CK-QA to QH)                        | t <sub>pLH</sub> | —                     | 3.3 ± 0.3           | 15                  | —         | 10.3 | 14.3 | 1.0                 | 16.6 | ns   |
|                                                                |                  |                       |                     | 50                  | —         | 12.8 | 17.8 | 1.0                 | 20.1 |      |
|                                                                | t <sub>pHL</sub> |                       | 5.0 ± 0.5           | 15                  | —         | 7.3  | 9.1  | 1.0                 | 10.4 |      |
|                                                                |                  |                       |                     | 50                  | —         | 8.8  | 11.1 | 1.0                 | 12.4 |      |
| Propagation delay time<br>( $\overline{\text{CLR}}$ -QA to QH) | t <sub>pHL</sub> | —                     | 3.3 ± 0.3           | 15                  | —         | 10.8 | 17.0 | 1.0                 | 19.5 | ns   |
|                                                                |                  |                       |                     | 50                  | —         | 13.3 | 20.5 | 1.0                 | 23.0 |      |
|                                                                |                  |                       | 5.0 ± 0.5           | 15                  | —         | 7.7  | 10.5 | 1.0                 | 12.0 |      |
|                                                                |                  |                       |                     | 50                  | —         | 9.2  | 12.5 | 1.0                 | 14.0 |      |
| Output enable time                                             | t <sub>pZL</sub> | R <sub>L</sub> = 1 kΩ | 3.3 ± 0.3           | 15                  | —         | 13.3 | 16.5 | 1.0                 | 19.2 | ns   |
|                                                                |                  |                       |                     | 50                  | —         | 14.8 | 19.0 | 1.0                 | 21.7 |      |
|                                                                | t <sub>pZH</sub> |                       | 5.0 ± 0.5           | 15                  | —         | 8.9  | 9.7  | 1.0                 | 11.3 |      |
|                                                                |                  |                       |                     | 50                  | —         | 10.4 | 11.2 | 1.0                 | 12.6 |      |
| Output disable time                                            | t <sub>pLZ</sub> | R <sub>L</sub> = 1 kΩ | 3.3 ± 0.3           | 50                  | —         | 18.0 | 21.3 | 1.0                 | 24.3 | ns   |
|                                                                | t <sub>pHZ</sub> |                       | 5.0 ± 0.5           | 50                  | —         | 11.8 | 13.2 | 1.0                 | 15.0 |      |
| Maximum clock frequency                                        | f <sub>max</sub> | —                     | 3.3 ± 0.3           | 15                  | 65        | 100  | —    | 55                  | —    | MHz  |
|                                                                |                  |                       |                     | 50                  | 55        | 90   | —    | 50                  | —    |      |
|                                                                |                  |                       | 5.0 ± 0.5           | 15                  | 125       | 160  | —    | 110                 | —    |      |
|                                                                |                  |                       |                     | 50                  | 115       | 150  | —    | 100                 | —    |      |
| Input capacitance                                              | C <sub>IN</sub>  | —                     |                     |                     | —         | 4    | 10   | —                   | —    | pF   |
| Bus I/O capacitance<br>(A/QA to H/QH)                          | C <sub>OUT</sub> | —                     |                     |                     | —         | 8    | —    | —                   | —    | pF   |
| Power dissipation capacitance                                  | C <sub>PD</sub>  | (Note)                |                     |                     | —         | 110  | —    | —                   | —    | pF   |

Note:  $C_{\text{PD}}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

$$I_{\text{CC (opr)}} = C_{\text{PD}} \cdot V_{\text{CC}} \cdot f_{\text{IN}} + I_{\text{CC}}$$

Timing Requirements (input:  $t_r = t_f = 3 \text{ ns}$ )

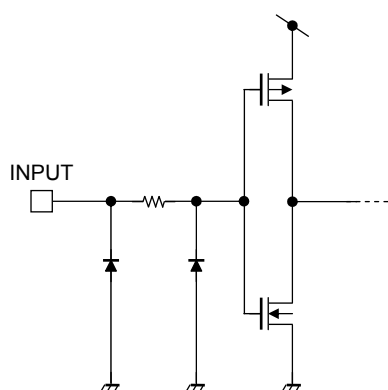
| Characteristics                                     | Symbol           | Test Condition | Ta = 25°C           |      | Ta = -40 to 85°C |       | Unit |
|-----------------------------------------------------|------------------|----------------|---------------------|------|------------------|-------|------|
|                                                     |                  |                | V <sub>CC</sub> (V) | Typ. | Limit            | Limit |      |
| Minimum pulse width<br>(CK)                         | $t_w$ (H)        | —              | $3.3 \pm 0.3$       | —    | 7.0              | 8.0   | ns   |
|                                                     | $t_w$ (L)        |                | $5.0 \pm 0.5$       | —    | 7.0              | 8.0   |      |
| Minimum pulse width<br>( $\overline{\text{CLR}}$ )  | $t_w$ (L)        | —              | $3.3 \pm 0.3$       | —    | 6.0              | 7.0   | ns   |
|                                                     |                  |                | $5.0 \pm 0.5$       | —    | 6.0              | 7.0   |      |
| Minimum set-up time<br>(SL, SR)                     | $t_s$            | —              | $3.3 \pm 0.3$       | —    | 8.5              | 10.0  | ns   |
|                                                     |                  |                | $5.0 \pm 0.5$       | —    | 5.0              | 5.0   |      |
| Minimum set-up time<br>(A to H)                     | $t_s$            | —              | $3.3 \pm 0.3$       | —    | 8.0              | 9.0   | ns   |
|                                                     |                  |                | $5.0 \pm 0.5$       | —    | 4.0              | 4.0   |      |
| Minimum set-up time<br>(S0, S1)                     | $t_s$            | —              | $3.3 \pm 0.3$       | —    | 14.5             | 17.0  | ns   |
|                                                     |                  |                | $5.0 \pm 0.5$       | —    | 7.0              | 8.0   |      |
| Minimum hold time<br>(SL, SR)                       | $t_h$            | —              | $3.3 \pm 0.3$       | —    | 1.0              | 1.0   | ns   |
|                                                     |                  |                | $5.0 \pm 0.5$       | —    | 1.0              | 1.0   |      |
| Minimum hold time<br>(A to H)                       | $t_h$            | —              | $3.3 \pm 0.3$       | —    | 0.5              | 0.5   | ns   |
|                                                     |                  |                | $5.0 \pm 0.5$       | —    | 1.5              | 1.5   |      |
| Minimum hold time<br>(S0, S1)                       | $t_h$            | —              | $3.3 \pm 0.3$       | —    | 0                | 0     | ns   |
|                                                     |                  |                | $5.0 \pm 0.5$       | —    | 0.5              | 0.5   |      |
| Minimum removal time<br>( $\overline{\text{CLR}}$ ) | $t_{\text{rem}}$ | —              | $3.3 \pm 0.3$       | —    | 5.0              | 6.0   | ns   |
|                                                     |                  |                | $5.0 \pm 0.5$       | —    | 4.0              | 4.0   |      |

Noise Characteristics (input:  $t_r = t_f = 3 \text{ ns}$ )

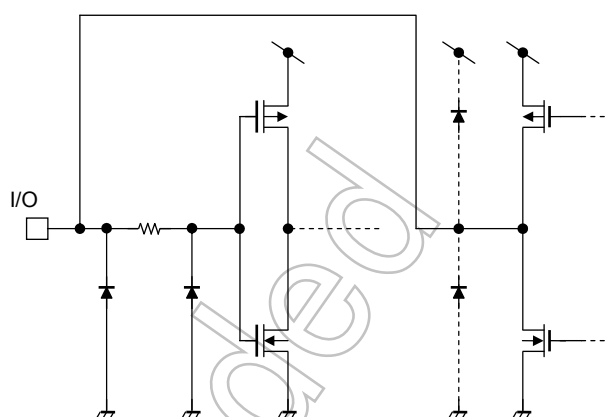
| Characteristics                                 | Symbol           | Test Condition         | Ta = 25°C           |      | Unit |       |
|-------------------------------------------------|------------------|------------------------|---------------------|------|------|-------|
|                                                 |                  |                        | V <sub>CC</sub> (V) | Typ. |      | Limit |
| Quiet output maximum dynamic<br>V <sub>OL</sub> | V <sub>OLP</sub> | C <sub>L</sub> = 50 pF | 5.0                 | 0.9  | 1.2  | V     |
| Quiet output minimum dynamic<br>V <sub>OL</sub> | V <sub>OLV</sub> | C <sub>L</sub> = 50 pF | 5.0                 | −0.9 | −1.2 | V     |
| Minimum high level dynamic input<br>Voltage     | V <sub>IHD</sub> | C <sub>L</sub> = 50 pF | 5.0                 | —    | 3.5  | V     |
| Maximum low high level dynamic<br>input Voltage | V <sub>ILD</sub> | C <sub>L</sub> = 50 pF | 5.0                 | —    | 1.5  | V     |



Input Equivalent Circuit



A/QA to H/QH Bus Terminal Equivalent Circuit

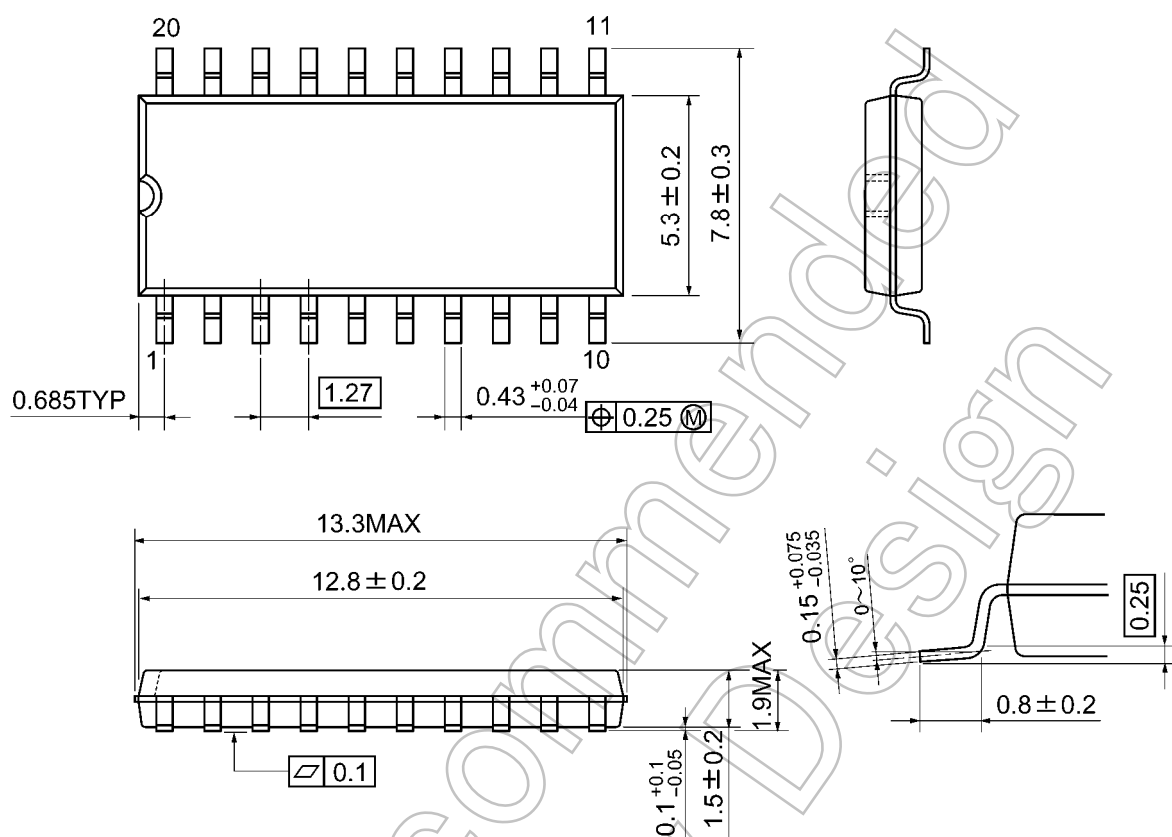


Not Recommended for New Design

## Package Dimensions

SOP20-P-300-1.27A

Unit: mm

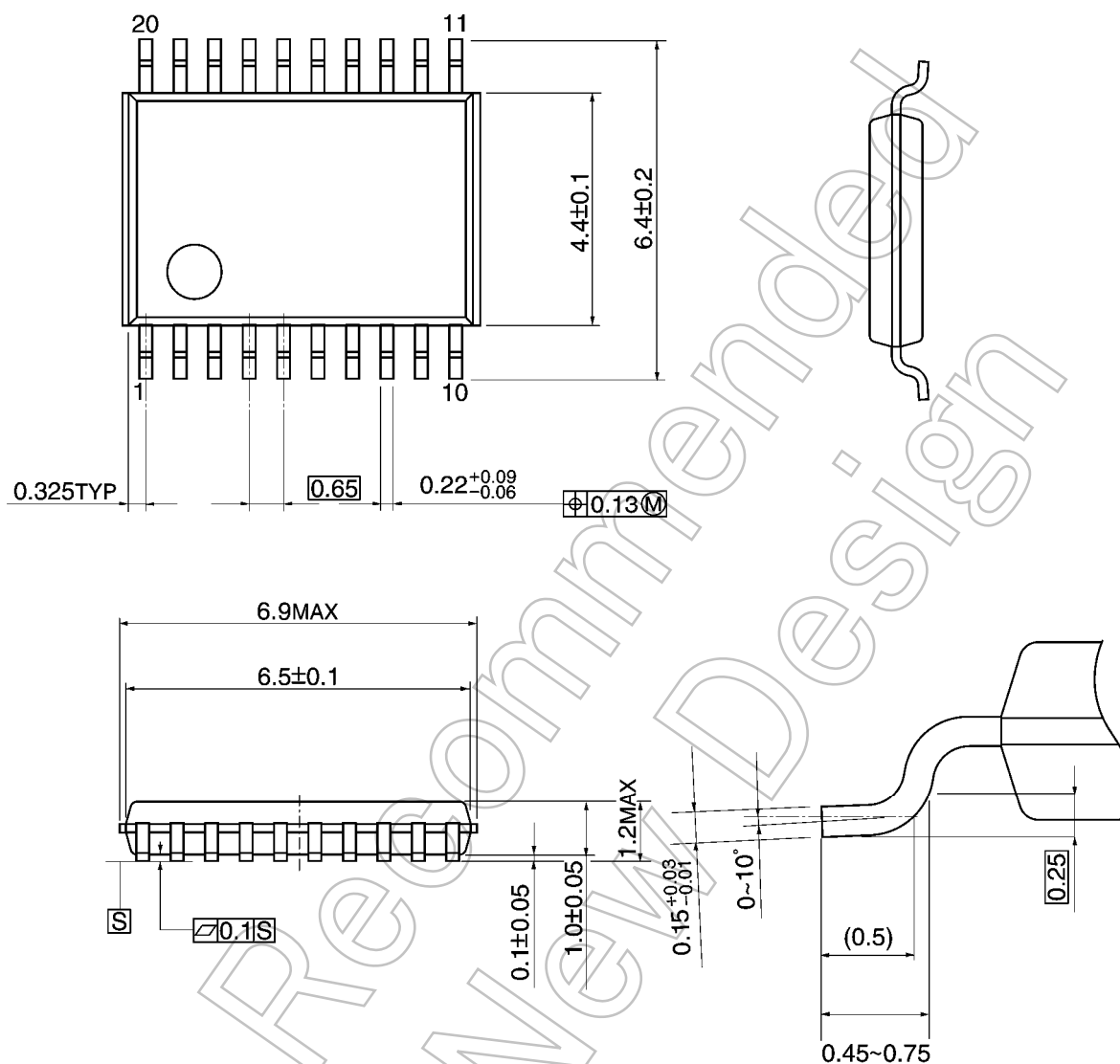


Weight: 0.22 g (typ.)

## Package Dimensions

TSSOP20-P-0044-0.65A

Unit: mm



Weight: 0.08 g (typ.)

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