

## SNx4HC594 8-Bit Shift Registers With Output Registers

### 1 Features

- Wide Operating Voltage Range of 2 V to 6 V
- High-Current Outputs Can Drive up to 15 LSTTL Loads
- Low Power Consumption, 80- $\mu$ A Maximum  $I_{CC}$
- Typical  $t_{pd} = 15$  ns
- $\pm 6$ -mA Output Drive at 5 V
- Low Input Current of 1  $\mu$ A Maximum
- 8-Bit Serial-In, Parallel-Out Shift Registers With Storage
- Independent Direct Overriding Clears on Shift and Storage Registers
- Independent Clocks for Both Shift and Storage Registers

### 2 Applications

- Pro Audio Mixer
- Elevators and Escalators
- Human Machine Interface (HMI): Industrial Monitor
- Entertainment Systems
- Grid Infrastructure: Grid Control
- Access Control and Security: DVR and DVS

### 3 Description

The SNx4HC594 devices contain an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. Separate clocks and direct overriding clear ( $\overline{RCLR}$ ,  $\overline{SRCLR}$ ) inputs are provided on both the shift and storage registers. A serial ( $Q_H$ ) output is provided for cascading purposes.

Both the shift register ( $SRCLK$ ) and storage register ( $RCLK$ ) clocks are positive edge triggered. If both clocks are connected together, the shift register always is one count pulse ahead of the storage register.

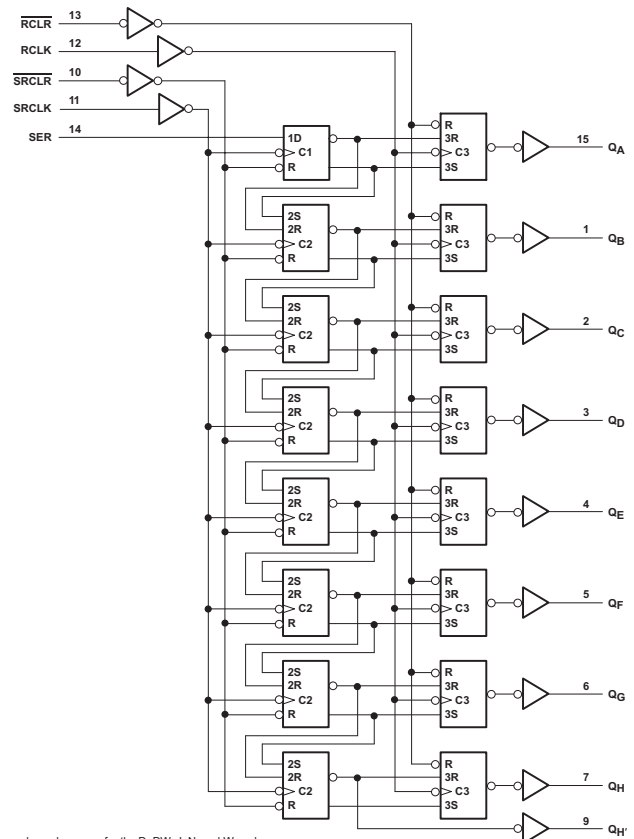
The parallel ( $Q_A - Q_H$ ) outputs have high-current capability.  $Q_H$  is a standard output.

#### Device Information<sup>(1)</sup>

| PART NUMBER | PACKAGE   | BODY SIZE (NOM)    |
|-------------|-----------|--------------------|
| SN74HC594   | PDIP (16) | 19.30 mm x 6.35 mm |
|             | SOIC (16) | 9.00 mm x 9.00 mm  |
|             |           | 10.30 mm x 7.50 mm |

(1) For all available packages, see the orderable addendum at the end of the datasheet.

#### Logic Diagram (Positive Logic)



Pin numbers shown are for the D, DW, J, N, and W packages.



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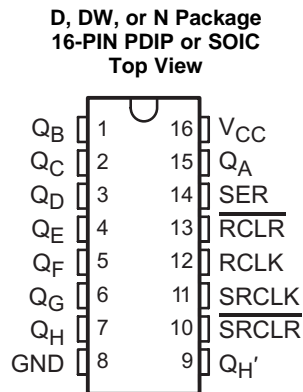
## 4 Revision History

### Changes from Revision F (October 2003) to Revision G

**Page**

|  |   |
|--|---|
| • Added <i>Pin Configuration and Functions</i> section, <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section ..... | 1 |
| • Removed ordering information. ....   | 1 |
| • ESD warning added .....  | 1 |

## 5 Pin Configuration and Functions



### Pin Functions

| PIN |                           | I/O | DESCRIPTION             |
|-----|---------------------------|-----|-------------------------|
| NO. | NAME                      |     |                         |
| 1   | Q <sub>B</sub>            | O   | Output B                |
| 2   | Q <sub>C</sub>            | O   | Output C                |
| 3   | Q <sub>D</sub>            | O   | Output D                |
| 4   | Q <sub>E</sub>            | O   | Output E                |
| 5   | Q <sub>F</sub>            | O   | Output F                |
| 6   | Q <sub>G</sub>            | O   | Output G                |
| 7   | Q <sub>H</sub>            | O   | Output H                |
| 8   | GND                       | –   | Ground                  |
| 9   | Q <sub>H</sub> '          | O   | Q <sub>H</sub> inverted |
| 10  | $\overline{\text{SRCLR}}$ | I   | Serial clear            |
| 11  | SRCLK                     | I   | Serial clock            |
| 12  | RCLK                      | I   | Storage clock           |
| 13  | $\overline{\text{RCLR}}$  | I   | Storage clear           |
| 14  | SER                       | I   | Serial input            |
| 15  | Q <sub>A</sub>            | O   | Output A                |
| 16  | V <sub>CC</sub>           | –   | Power pin               |

## 6 Specifications

### 6.1 Absolute Maximum Ratings<sup>(1)</sup>

over operating free-air temperature range (unless otherwise noted)

|  |  | MIN                         | MAX | UNIT |
|--|--|-----------------------------|-----|------|
| $V_{CC}$                                   | Supply voltage                           | -0.5                        | 7   | V    |
| $I_{IK}$                                   | Input clamp current <sup>(2)</sup>       | $V_I < 0$ or $V_I > V_{CC}$ |     | mA   |
| $I_{OK}$                                   | Output clamp current <sup>(2)</sup>      | $V_O < 0$ or $V_O > V_{CC}$ |     | mA   |
| $I_O$                                      | Continuous output current                | $V_O = 0$ to $V_{CC}$       |     | mA   |
| Continuous current through $V_{CC}$ or GND |  | -70                         | 70  | mA   |
| $\theta_{JA}$                              | Package thermal impedance <sup>(3)</sup> | D package                   |     | °C/W |
|  |  | DW package                  |     |      |
|  |  | N package                   |     |      |
| $T_{stg}$                                  | Storage temperature                      | -60                         | 150 | °C   |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The package thermal impedance is calculated in accordance with JESD 51-7.

### 6.2 ESD Ratings

|             |                         | VALUE  | UNIT |
|-------------|-------------------------|--|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | V    |
|             |                         | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> |      |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 6.3 Recommended Operating Conditions

 over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|          |                                       | SN54HC594 <sup>(2)</sup> |          |      | SN74HC594 |          |     | UNIT |
|----------|---------------------------------------|--------------------------|----------|------|-----------|----------|-----|------|
|          |                                       | MIN                      | NOM      | MAX  | MIN       | NOM      | MAX |      |
| $V_{CC}$ | Supply voltage                        | 2                        | 5        | 6    | 2         | 5        | 6   | V    |
| $V_{IH}$ | High-level input voltage              | $V_{CC} = 2$ V           |          | 1.5  | 1.5       |          | V   |      |
|          |                                       | $V_{CC} = 4.5$ V         |          | 3.15 | 3.15      |          |     |      |
|          |                                       | $V_{CC} = 6$ V           |          | 4.2  | 4.2       |          |     |      |
| $V_{IL}$ | Low-level input voltage               | $V_{CC} = 2$ V           |          | 0.5  | 0.5       |          | V   |      |
|          |                                       | $V_{CC} = 4.5$ V         |          | 1.35 | 1.35      |          |     |      |
|          |                                       | $V_{CC} = 6$ V           |          | 1.8  | 1.8       |          |     |      |
| $V_I$    | Input voltage                         | 0                        | $V_{CC}$ |      | 0         | $V_{CC}$ |     | V    |
| $V_O$    | Output voltage                        | 0                        | $V_{CC}$ |      | 0         | $V_{CC}$ |     | V    |
| $t_t$    | Input transition (rise and fall) rate | $V_{CC} = 2$ V           |          | 1000 | 1000      |          | ns  |      |
|          |                                       | $V_{CC} = 4.5$ V         |          | 500  | 500       |          |     |      |
|          |                                       | $V_{CC} = 6$ V           |          | 400  | 400       |          |     |      |
| $T_A$    | Operating free-air temperature        | -55                      | 125      |      | -40       | 125      |     | °C   |

- (1) All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, [SCBA004](#).
- (2) Product Preview

## 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |  | SN74HC594 |          |           | UNIT |
|-------------------------------|--|-----------|----------|-----------|------|
|                               |  | N (PDIP)  | D (SOIC) | DW (SOIC) |      |
|                               |  | 16 PINS   | 16 PINS  | 16 PINS   |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 41.3      | 72.3     | 71        | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 28        | 33.2     | 32.3      |      |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 21.3      | 29.9     | 35.9      |      |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 12.6      | 5.3      | 6.7       |      |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 21.1      | 29.6     | 35.3      |      |

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

## 6.5 Electrical Characteristics

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER   | TEST CONDITIONS  |                          | V <sub>CC</sub>   | T <sub>A</sub> = 25°C |       |      | SN54HC594 <sup>(1)</sup><br>–55°C to 125°C |     | SN74HC594<br>–40°C to 85°C |      | SN74HC594<br>–40°C to 125°C |     | UNIT |
|---|--|--------------------------|---|-----------------------|-------|------|--|-----|----------------------------|------|-----------------------------|-----|------|
|   |  |                          |   | MIN                   | TYP   | MAX  | MIN  | MAX | MIN                        | MAX  | MIN                         | MAX |      |
| V <sub>OH</sub>   | V <sub>I</sub> = V <sub>IH</sub><br>or V <sub>IL</sub>       | I <sub>OH</sub> = –20 μA | 2 V   | 1.9                   | 1.998 |      | 1.9  |     | 1.9                        |      |                             | V   |      |
|   |  |                          | 4.5 V   | 4.4                   | 4.499 |      | 4.4  |     | 4.4                        |      | 4.4                         |     |      |
|   |  |                          | 6 V   | 5.9                   | 5.999 |      | 5.9  |     | 5.9                        |      | 5.9                         |     |      |
|   |  | 4.5 V                    | Q <sub>H</sub> <sup>†</sup> I <sub>OH</sub> = –4 mA     | 3.98                  | 4.3   |      | 3.7  |     | 3.84                       |      | 3.84                        |     |      |
|   |  |                          | Q <sub>A</sub> – Q <sub>H</sub> I <sub>OH</sub> = –6 mA | 3.98                  | 4.3   |      | 3.7  |     | 3.84                       |      | 3.84                        |     |      |
|   |  |                          | Q <sub>H</sub> <sup>†</sup> I <sub>OH</sub> = –5.2 mA   | 5.48                  | 5.8   |      | 5.2  |     | 5.34                       |      | 5.34                        |     |      |
| Q <sub>A</sub> – Q <sub>H</sub> I <sub>OH</sub> = –7.8 mA | 5.48   | 5.8                      |   |                       | 5.2   |      | 5.34                                       |     | 5.34                       |      |                             |     |      |
| V <sub>OL</sub>   | V <sub>I</sub> = V <sub>IH</sub><br>or V <sub>IL</sub>       | I <sub>OL</sub> = 20 μA  | 2 V   |                       | 0.002 | 0.1  |  |     | 0.1                        |      | 0.1                         | V   |      |
|   |  |                          | 4.5 V   |                       | 0.001 | 0.1  |  |     | 0.1                        |      | 0.1                         |     |      |
|   |  |                          | 6 V   |                       | 0.001 | 0.1  |  |     | 0.1                        |      | 0.1                         |     |      |
|   |  | 4.5 V                    | Q <sub>H</sub> <sup>†</sup> I <sub>OL</sub> = 4 mA      |                       | 0.17  | 0.26 |  |     | 0.4                        |      | 0.33                        |     | 0.33 |
|   |  |                          | Q <sub>A</sub> – Q <sub>H</sub> I <sub>OL</sub> = 6 mA  |                       | 0.17  | 0.26 |  |     | 0.4                        |      | 0.33                        |     | 0.33 |
|   |  |                          | Q <sub>H</sub> <sup>†</sup> I <sub>OL</sub> = 5.2 mA    |                       | 0.15  | 0.26 |  |     | 0.4                        |      | 0.33                        |     | 0.33 |
| Q <sub>A</sub> – Q <sub>H</sub> I <sub>OL</sub> = 7.8 mA  |  | 0.15                     |   | 0.26                  |       |      | 0.4  |     | 0.33                       | 0.33 |                             |     |      |
| I <sub>I</sub>  | V <sub>I</sub> = V <sub>CC</sub> or 0                        | 6 V                      |   | ±0.1                  | ±100  |      | ±1000                                      |     | ±1000                      |      | ±1000                       | nA  |      |
| I <sub>CC</sub>   | V <sub>I</sub> = V <sub>CC</sub><br>or 0, I <sub>O</sub> = 0 | 6 V                      |   |                       | 8     |      | 160  |     | 80                         |      | 80                          | μA  |      |
| C <sub>i</sub>  |  | 2 V to<br>6 V            |   |                       | 3     | 10   |  | 10  |                            | 10   |                             |     | pF   |

(1) Product Preview

## 6.6 Switching Characteristics: $C_L = 50 \text{ pF}$

 over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 4](#))

| PARAMETER | FROM (INPUT)              | TO (OUTPUT) | $V_{CC}$ | $T_A = 25^\circ\text{C}$ |     |     | SN54HC594 <sup>(1)</sup><br>–55°C to 125°C |     | SN74HC594<br>–40°C to 85°C |     | SN74HC594<br>–40°C to 125°C |     | UNIT |
|-----------|---------------------------|-------------|----------|--------------------------|-----|-----|--|-----|----------------------------|-----|-----------------------------|-----|------|
|           |                           |             |          | MIN                      | TYP | MAX | MIN  | MAX | MIN                        | MAX | MIN                         | MAX |      |
| $f_{max}$ |                           |             | 2 V      | 5                        | 8   |     | 3.3  |     | 4                          |     | 4                           | MHz |      |
|           |                           |             | 4.5 V    | 25                       | 35  |     | 17   |     | 20                         |     | 20                          |     |      |
|           |                           |             | 6 V      | 29                       | 40  |     | 20   |     | 24                         |     | 24                          |     |      |
| $t_{pd}$  | SRCLK                     | $Q_H$       | 2 V      |                          | 50  | 150 |  | 225 |                            | 185 |                             | 200 | ns   |
|           |                           |             | 4.5 V    |                          | 20  | 30  |  | 45  |                            | 37  |                             | 42  |      |
|           |                           |             | 6 V      |                          | 15  | 25  |  | 38  |                            | 31  |                             | 36  |      |
|           | RCLK                      | $Q_A - Q_H$ | 2 V      |                          | 50  | 150 |  | 225 |                            | 185 |                             | 200 |      |
|           |                           |             | 4.5 V    |                          | 20  | 30  |  | 45  |                            | 37  |                             | 42  |      |
|           |                           |             | 6 V      |                          | 15  | 25  |  | 38  |                            | 31  |                             | 36  |      |
| $t_{PHL}$ | $\overline{\text{SRCLR}}$ | $Q_H$       | 2 V      |                          | 50  | 150 |  | 225 |                            | 185 |                             | 200 | ns   |
|           |                           |             | 4.5 V    |                          | 20  | 30  |  | 45  |                            | 37  |                             | 42  |      |
|           |                           |             | 6 V      |                          | 15  | 25  |  | 38  |                            | 31  |                             | 36  |      |
|           | $\overline{\text{RCLR}}$  | $Q_A - Q_H$ | 2 V      |                          | 50  | 125 |  | 185 |                            | 155 |                             | 170 |      |
|           |                           |             | 4.5 V    |                          | 20  | 25  |  | 37  |                            | 31  |                             | 36  |      |
|           |                           |             | 6 V      |                          | 15  | 21  |  | 31  |                            | 26  |                             | 31  |      |
| $t_t$     |                           | $Q_H$       | 2 V      |                          | 38  | 75  |  | 110 |                            | 95  |                             | 110 | ns   |
|           |                           |             | 4.5 V    |                          | 8   | 15  |  | 22  |                            | 19  |                             | 21  |      |
|           |                           |             | 6 V      |                          | 6   | 13  |  | 19  |                            | 16  |                             | 18  |      |
|           |                           | $Q_A - Q_H$ | 2 V      |                          | 38  | 60  |  | 90  |                            | 75  |                             | 85  |      |
|           |                           |             | 4.5 V    |                          | 8   | 12  |  | 18  |                            | 15  |                             | 17  |      |
|           |                           |             | 6 V      |                          | 6   | 10  |  | 15  |                            | 13  |                             | 15  |      |

(1) Product Preview

## 6.7 Switching Characteristics: $C_L = 150 \text{ pF}$

 over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 4](#))

| PARAMETER | FROM (INPUT)             | TO (OUTPUT) | $V_{CC}$ | $T_A = 25^\circ\text{C}$ |     |     | SN54HC594 <sup>(1)</sup><br>–55°C to 125°C |     | SN74HC594<br>–40°C to 85°C |     | SN74HC594<br>–40°C to 125°C |     | UNIT |
|-----------|--------------------------|-------------|----------|--------------------------|-----|-----|--|-----|----------------------------|-----|-----------------------------|-----|------|
|           |                          |             |          | MIN                      | TYP | MAX | MIN  | MAX | MIN                        | MAX | MIN                         | MAX |      |
| $t_{pd}$  | RCLK                     | $Q_A - Q_H$ | 2 V      |                          | 90  | 200 |  | 300 |                            | 250 |                             | 270 | ns   |
|           |                          |             | 4.5 V    |                          | 23  | 40  |  | 60  |                            | 50  |                             | 55  |      |
|           |                          |             | 6 V      |                          | 19  | 34  |  | 51  |                            | 43  |                             | 48  |      |
| $t_{PHL}$ | $\overline{\text{RCLR}}$ | $Q_A - Q_H$ | 2 V      |                          | 90  | 200 |  | 300 |                            | 250 |                             | 270 | ns   |
|           |                          |             | 4.5 V    |                          | 23  | 40  |  | 60  |                            | 50  |                             | 55  |      |
|           |                          |             | 6 V      |                          | 19  | 34  |  | 51  |                            | 43  |                             | 48  |      |
| $t_t$     |                          | $Q_A - Q_H$ | 2 V      |                          | 45  | 210 |  | 315 |                            | 265 |                             | 285 | ns   |
|           |                          |             | 4.5 V    |                          | 17  | 42  |  | 63  |                            | 53  |                             | 58  |      |
|           |                          |             | 6 V      |                          | 13  | 36  |  | 53  |                            | 45  |                             | 50  |      |

(1) Product Preview

## 6.8 Timing Requirements

over recommended operating free-air temperature range (unless otherwise noted)

|                                    |                                     | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     | SN54HC594 <sup>(1)</sup><br>–55°C to 125°C |     | SN74HC594<br>–40°C to 85°C |     | SN74HC594<br>–40°C to 125°C |     | UNIT |
|------------------------------------|-------------------------------------|-----------------|-----------------------|-----|--|-----|----------------------------|-----|-----------------------------|-----|------|
|                                    |                                     |                 | MIN                   | MAX | MIN  | MAX | MIN                        | MAX | MIN                         | MAX |      |
| f <sub>clock</sub>                 | Clock frequency                     | 2 V             | 5                     |     | 3.3  |     | 4                          |     | 4                           |     | MHz  |
|                                    |                                     | 4.5 V           | 25                    |     | 17   |     | 20                         |     | 20                          |     |      |
|                                    |                                     | 6 V             | 29                    |     | 20   |     | 24                         |     | 24                          |     |      |
| t <sub>w</sub>                     | SRCLK or RCLK high or low           | 2 V             | 100                   |     | 150  |     | 125                        |     | 130                         | ns  |      |
|                                    |                                     | 4.5 V           | 20                    |     | 30   |     | 25                         |     | 27                          |     |      |
|                                    |                                     | 6 V             | 17                    |     | 25   |     | 21                         |     | 23                          |     |      |
|                                    | SRCLR or RCLR low                   | 2 V             | 100                   |     | 150  |     | 125                        |     | 130                         |     |      |
|                                    |                                     | 4.5 V           | 20                    |     | 30   |     | 25                         |     | 27                          |     |      |
|                                    |                                     | 6 V             | 17                    |     | 25   |     | 21                         |     | 23                          |     |      |
| t <sub>su</sub>                    | SER before SRCLK↑                   | 2 V             | 90                    |     | 135  |     | 110                        |     | 115                         | ns  |      |
|                                    |                                     | 4.5 V           | 18                    |     | 27   |     | 22                         |     | 24                          |     |      |
|                                    |                                     | 6 V             | 15                    |     | 23   |     | 19                         |     | 21                          |     |      |
|                                    | SRCLK↑ before RCLK↑ <sup>(2)</sup>  | 2 V             | 90                    |     | 135  |     | 110                        |     | 115                         |     |      |
|                                    |                                     | 4.5 V           | 18                    |     | 27   |     | 22                         |     | 24                          |     |      |
|                                    |                                     | 6 V             | 15                    |     | 23   |     | 19                         |     | 21                          |     |      |
|                                    | SRCLR low before RCLK↑              | 2 V             | 50                    |     | 75   |     | 63                         |     | 68                          | ns  |      |
|                                    |                                     | 4.5 V           | 10                    |     | 15   |     | 13                         |     | 15                          |     |      |
|                                    |                                     | 6 V             | 9                     |     | 13   |     | 11                         |     | 13                          |     |      |
|                                    | SRCLR high (inactive) before SRCLK↑ | 2 V             | 20                    |     | 20   |     | 20                         |     | 20                          |     |      |
|                                    |                                     | 4.5 V           | 10                    |     | 10   |     | 10                         |     | 10                          |     |      |
|                                    |                                     | 6 V             | 10                    |     | 10   |     | 10                         |     | 10                          |     |      |
| RCLR high (inactive) before SRCLK↑ | 2 V                                 | 5               |                       | 5   |  | 5   |                            | 5   |                             |     |      |
|                                    | 4.5 V                               | 5               |                       | 5   |  | 5   |                            | 5   |                             |     |      |
|                                    | 6 V                                 | 5               |                       | 5   |  | 5   |                            | 5   |                             |     |      |
| t <sub>h</sub>                     | Hold time, SER after SRCLK↑         | 2 V             | 5                     |     | 5  |     | 5                          |     | 5                           | ns  |      |
|                                    |                                     | 4.5 V           | 5                     |     | 5  |     | 5                          |     | 5                           |     |      |
|                                    |                                     | 6 V             | 5                     |     | 5  |     | 5                          |     | 5                           |     |      |

(1) Product Preview

(2) This setup time ensures that the output register receives stable data from the shift-register outputs. The clocks may be tied together, in which case the output register is one clock pulse behind the shift register.

## 6.9 Operating Characteristics

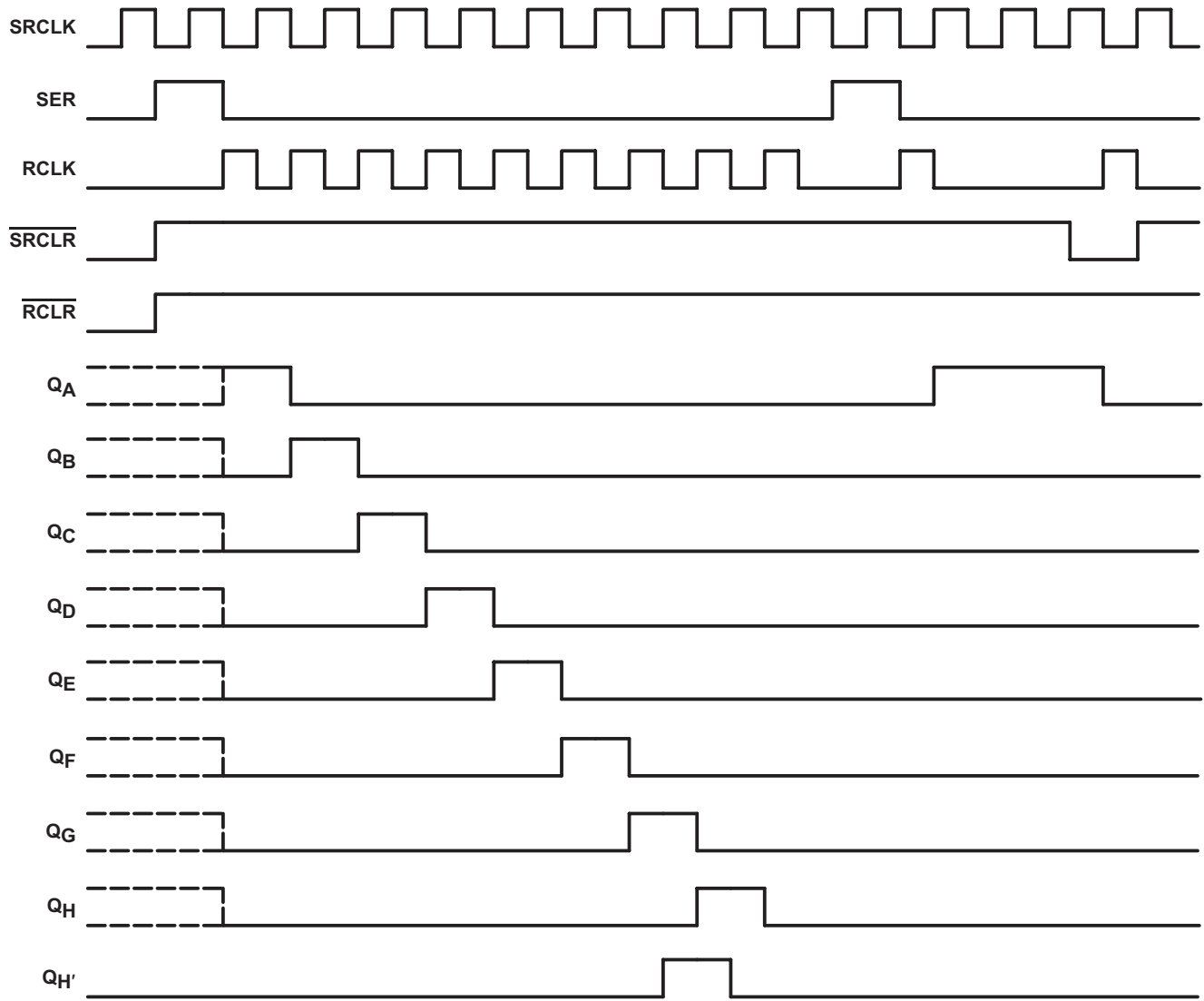
T<sub>A</sub> = 25°C

| PARAMETER                                     | TEST CONDITIONS | TYP | UNIT |
|---|-----------------|-----|------|
| C <sub>pd</sub> Power dissipation capacitance | No load         | 395 | pF   |

**SN54HC594, SN74HC594**

SCLS040G – DECEMBER 1982 – REVISED MARCH 2015

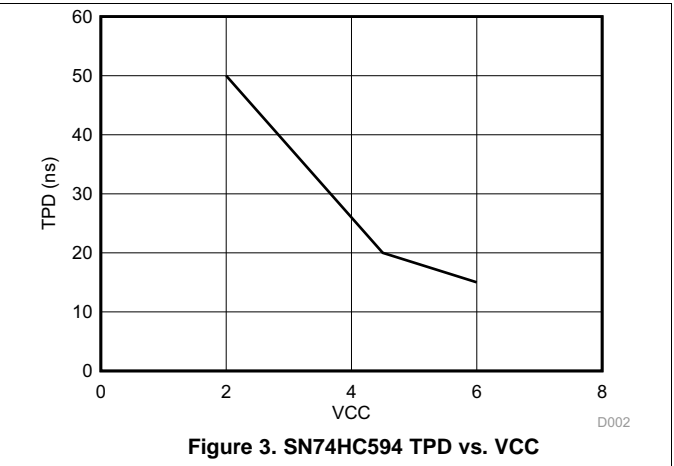
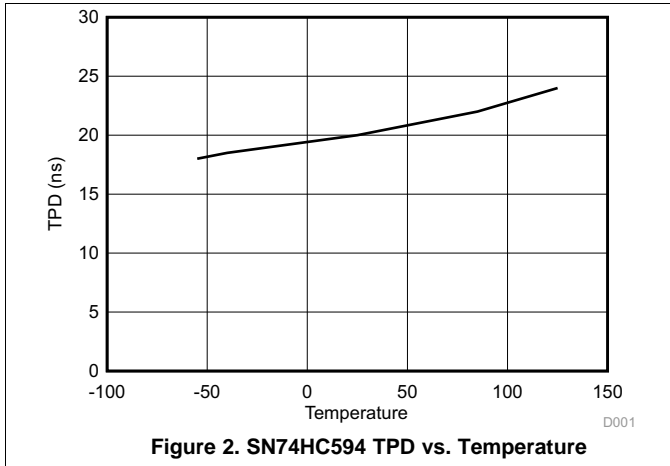
[www.ti.com](http://www.ti.com)



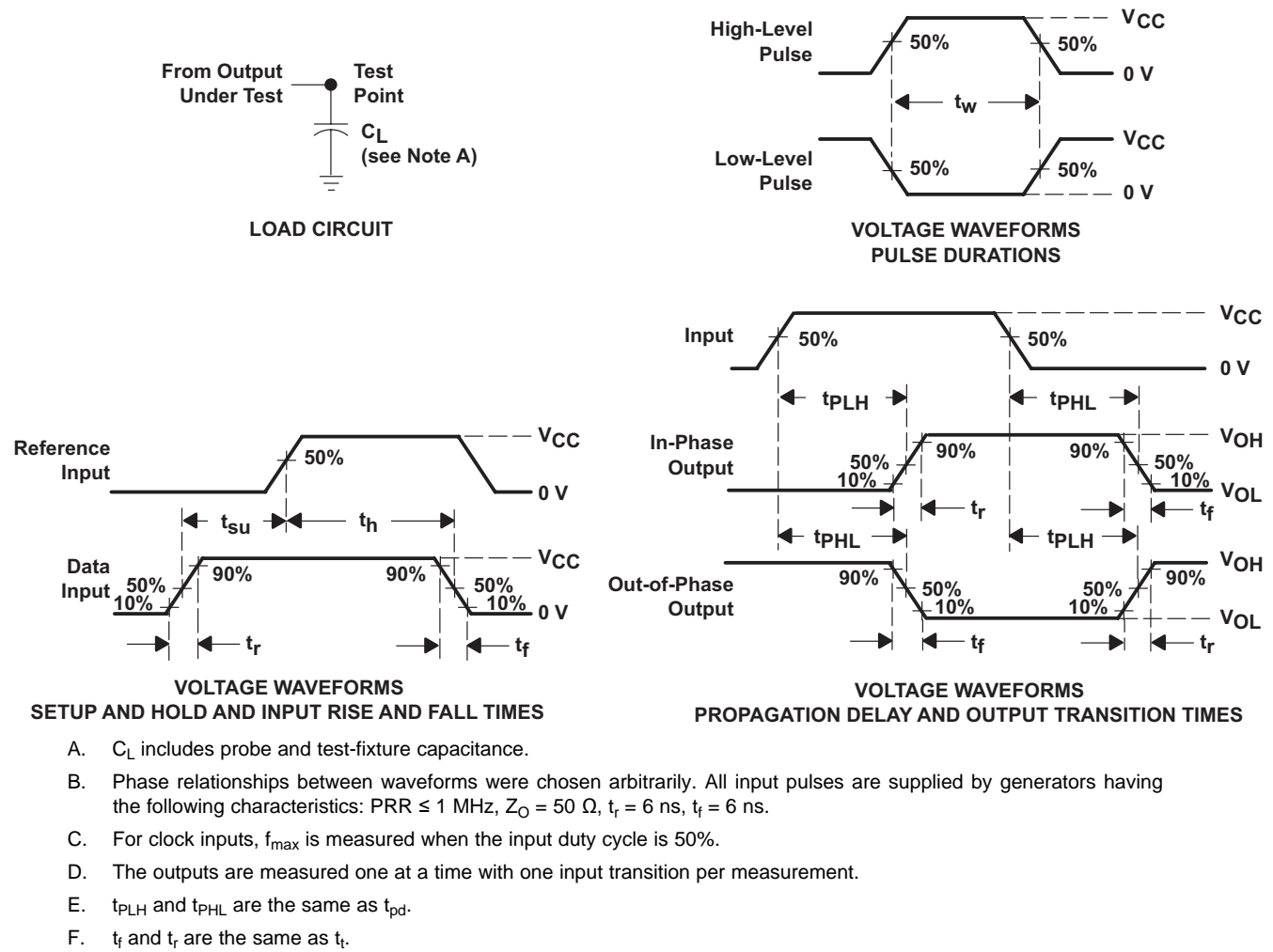
**Figure 1. Timing Diagram**



### 6.10 Typical Characteristics



## 7 Parameter Measurement Information



**Figure 4. Load Circuit and Voltage Waveforms**

- A.  $C_L$  includes probe and test-fixture capacitance.
- B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 6$  ns,  $t_f = 6$  ns.
- C. For clock inputs,  $f_{max}$  is measured when the input duty cycle is 50%.
- D. The outputs are measured one at a time with one input transition per measurement.
- E.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
- F.  $t_f$  and  $t_r$  are the same as  $t_t$ .

## 8 Detailed Description

### 8.1 Overview

The SNx4HC594 devices contain an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. Separate clocks and direct overriding clear ( $\overline{RCLR}$ ,  $\overline{SRCLR}$ ) inputs are provided on both the shift and storage registers. A serial ( $Q_H$ ) output is provided for cascading purposes.

Both the shift register (SRCLK) and storage register (RCLK) clocks are positive edge triggered. If both clocks are connected together, the shift register always is one count pulse ahead of the storage register.

The parallel ( $Q_A - Q_H$ ) outputs have high-current capability.  $Q_H$  is a standard output.

### 8.2 Functional Block Diagram

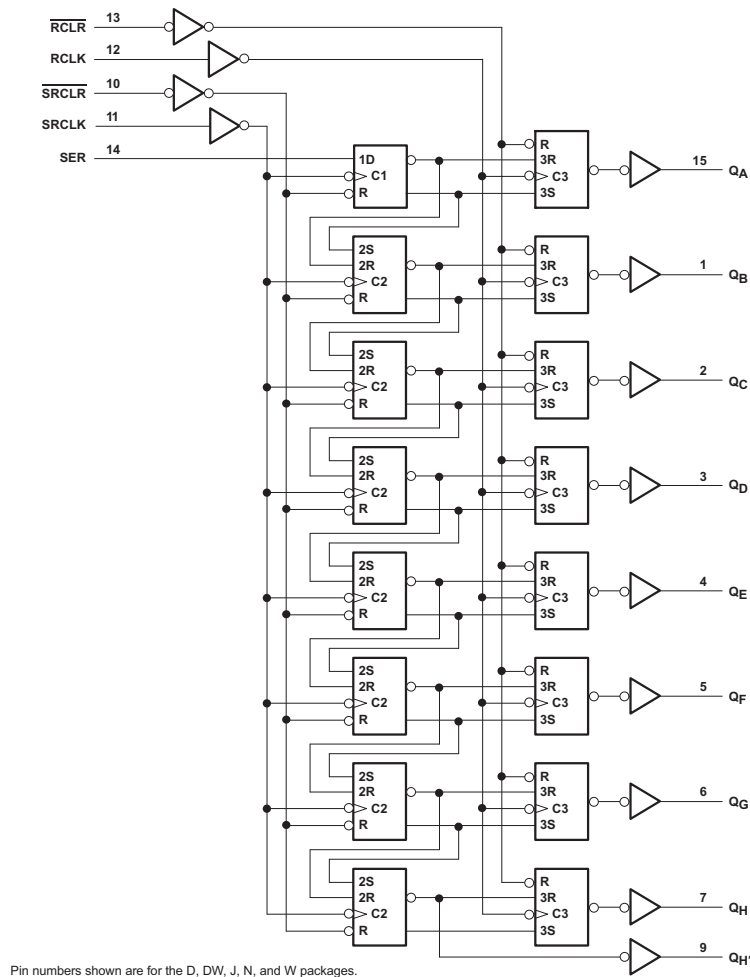


Figure 5. Logic Diagram (Positive Logic)

### 8.3 Feature Description

The wide operating range allows the device to be used in a variety of systems that use different logic levels. The high-current outputs allow the device to drive medium loads without significant drops in output voltage. In addition, the low power consumption makes this device a good choice for portable and battery power-sensitive applications.

## 8.4 Device Functional Modes

**Table 1. Function Table**

| INPUTS |       |       |      |      | FUNCTION   |
|--------|-------|-------|------|------|--|
| SER    | SRCLK | SRCLR | RCLK | RCLR |  |
| X      | X     | L     | X    | X    | Shift register is cleared.   |
| L      | ↑     | H     | X    | X    | First stage of shift register goes low.<br>Other stages store the data of previous stage, respectively.  |
| H      | ↑     | H     | X    | X    | First stage of shift register goes high.<br>Other stages store the data of previous stage, respectively. |
| L      | ↓     | H     | X    | X    | Shift register state is not changed.   |
| X      | X     | X     | X    | L    | Storage register is cleared.   |
| X      | X     | X     | ↑    | H    | Shift register data is stored in the storage register.   |
| X      | X     | X     | ↓    | H    | Storage register state is not changed.   |

## 9 Application and Implementation

### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 9.1 Application Information

The SN74HC594 is a low drive CMOS device that can be used for a multitude of bus interface type applications where output ringing is a concern. The low drive and slow edge rates will minimize overshoot and undershoot on the outputs.

### 9.2 Typical Application

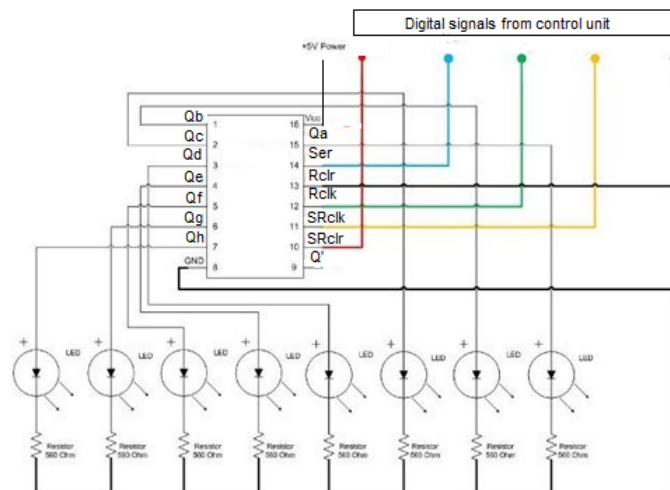


Figure 6. Typical Application Schematic

#### 9.2.1 Design Requirements

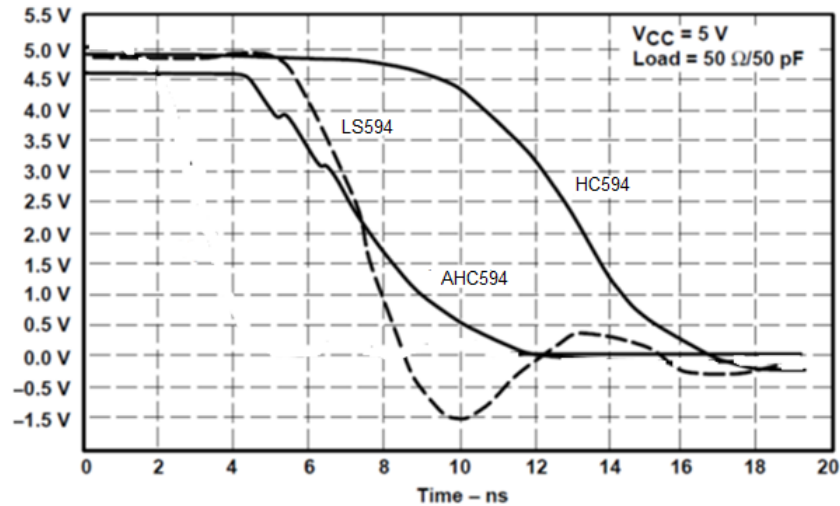
This device uses CMOS technology and has balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits. The high drive will also create fast edges into light loads so consider routing and load conditions to prevent ringing.

## Typical Application (continued)

### 9.2.2 Detailed Design Procedure

- Recommended input conditions:
  - Rise time and fall time specs see  $(\Delta t/\Delta V)$  in *Recommended Operating Conditions* table.
  - Specified High and low levels. See  $V_{IH}$  and  $V_{IL}$  in *Recommended Operating Conditions* table.
  - Inputs are overvoltage tolerant allowing them to go as high as 5.5 V at any valid  $V_{CC}$
- Recommended output conditions:
  - Load currents should not exceed 35 mA per output and 70 mA total for the part
  - Outputs should not be pulled above  $V_{CC}$

### 9.2.3 Application Curves



**Figure 7. Switching Characteristics Comparison**

## 10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the [Recommended Operating Conditions](#).

Each  $V_{CC}$  terminal should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, TI recommends a 0.1- $\mu\text{F}$  capacitor and if there are multiple  $V_{CC}$  terminals then TI recommends a 0.01- $\mu\text{F}$  or 0.022- $\mu\text{F}$  capacitor for each power terminal. Multiple bypass capacitors can be paralleled to reject different frequencies of noise. Frequencies of 0.1  $\mu\text{F}$  and 1  $\mu\text{F}$  are commonly used in parallel. The bypass capacitor should be installed as close as possible to the power terminal for best results.

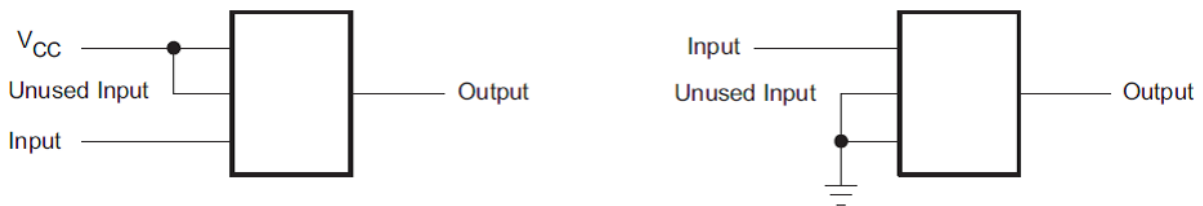
## 11 Layout

### 11.1 Layout Guidelines

When using multiple bit logic devices inputs should not ever float.

In many cases, functions or parts of functions of digital logic devices are unused, for example, when only two inputs of a triple-input AND gate are used or only three of the four buffer gates are used. Such input pins should not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. Specified below are the rules that must be observed under all circumstances. All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. The logic level that should be applied to any particular unused input depends on the function of the device. Generally they will be tied to GND or  $V_{CC}$  whichever make more sense or is more convenient. Floating outputs is generally acceptable, unless the part is a transceiver. If the transceiver has an output enable pin it will disable the outputs section of the part when asserted. This will not disable the input section of the I.O's so they also cannot float when disabled.

### 11.2 Layout Example



**Figure 8. Layout Recommendation**

## 12 Device and Documentation Support

### 12.1 Documentation Support

#### 12.1.1 Related Documentation

For related documentation see the following:

*Implications of Slow or Floating CMOS Inputs*, [SCBA004](#)

### 12.2 Trademarks

All trademarks are the property of their respective owners.

### 12.3 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 12.4 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.



**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---------|
| SN74HC594D       | ACTIVE        | SOIC         | D               | 16   | 40          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HC594                   | Samples |
| SN74HC594DG4     | ACTIVE        | SOIC         | D               | 16   | 40          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HC594                   | Samples |
| SN74HC594DR      | ACTIVE        | SOIC         | D               | 16   | 2500        | RoHS & Green    | NIPDAU   SN                          | Level-1-260C-UNLIM   | -40 to 125   | HC594                   | Samples |
| SN74HC594DT      | ACTIVE        | SOIC         | D               | 16   | 250         | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HC594                   | Samples |
| SN74HC594DW      | ACTIVE        | SOIC         | DW              | 16   | 40          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HC594                   | Samples |
| SN74HC594DWG4    | ACTIVE        | SOIC         | DW              | 16   | 40          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HC594                   | Samples |
| SN74HC594DWR     | ACTIVE        | SOIC         | DW              | 16   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | HC594                   | Samples |
| SN74HC594N       | ACTIVE        | PDIP         | N               | 16   | 25          | RoHS & Green    | NIPDAU                               | N / A for Pkg Type   | -40 to 125   | SN74HC594N              | Samples |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

<sup>(6)</sup> Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74HC594DR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC594DR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.6     | 9.3     | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC594DR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC594DWR | SOIC         | DW              | 16   | 2000 | 330.0              | 16.4               | 10.75   | 10.7    | 2.7     | 12.0    | 16.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74HC594DR  | SOIC         | D               | 16   | 2500 | 340.5       | 336.1      | 32.0        |
| SN74HC594DR  | SOIC         | D               | 16   | 2500 | 366.0       | 364.0      | 50.0        |
| SN74HC594DR  | SOIC         | D               | 16   | 2500 | 356.0       | 356.0      | 35.0        |
| SN74HC594DWR | SOIC         | DW              | 16   | 2000 | 350.0       | 350.0      | 43.0        |

**TUBE**


\*All dimensions are nominal



| Device        | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|---------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| SN74HC594D    | D            | SOIC         | 16   | 40  | 507    | 8      | 3940   | 4.32   |
| SN74HC594DG4  | D            | SOIC         | 16   | 40  | 507    | 8      | 3940   | 4.32   |
| SN74HC594DW   | DW           | SOIC         | 16   | 40  | 506.98 | 12.7   | 4826   | 6.6    |
| SN74HC594DWG4 | DW           | SOIC         | 16   | 40  | 506.98 | 12.7   | 4826   | 6.6    |
| SN74HC594N    | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74HC594N    | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  -  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  -  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4211283-4/E 08/12

- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

## GENERIC PACKAGE VIEW

**DW 16**

**SOIC - 2.65 mm max height**

7.5 x 10.3, 1.27 mm pitch

SMALL OUTLINE INTEGRATED CIRCUIT

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.



4224780/A



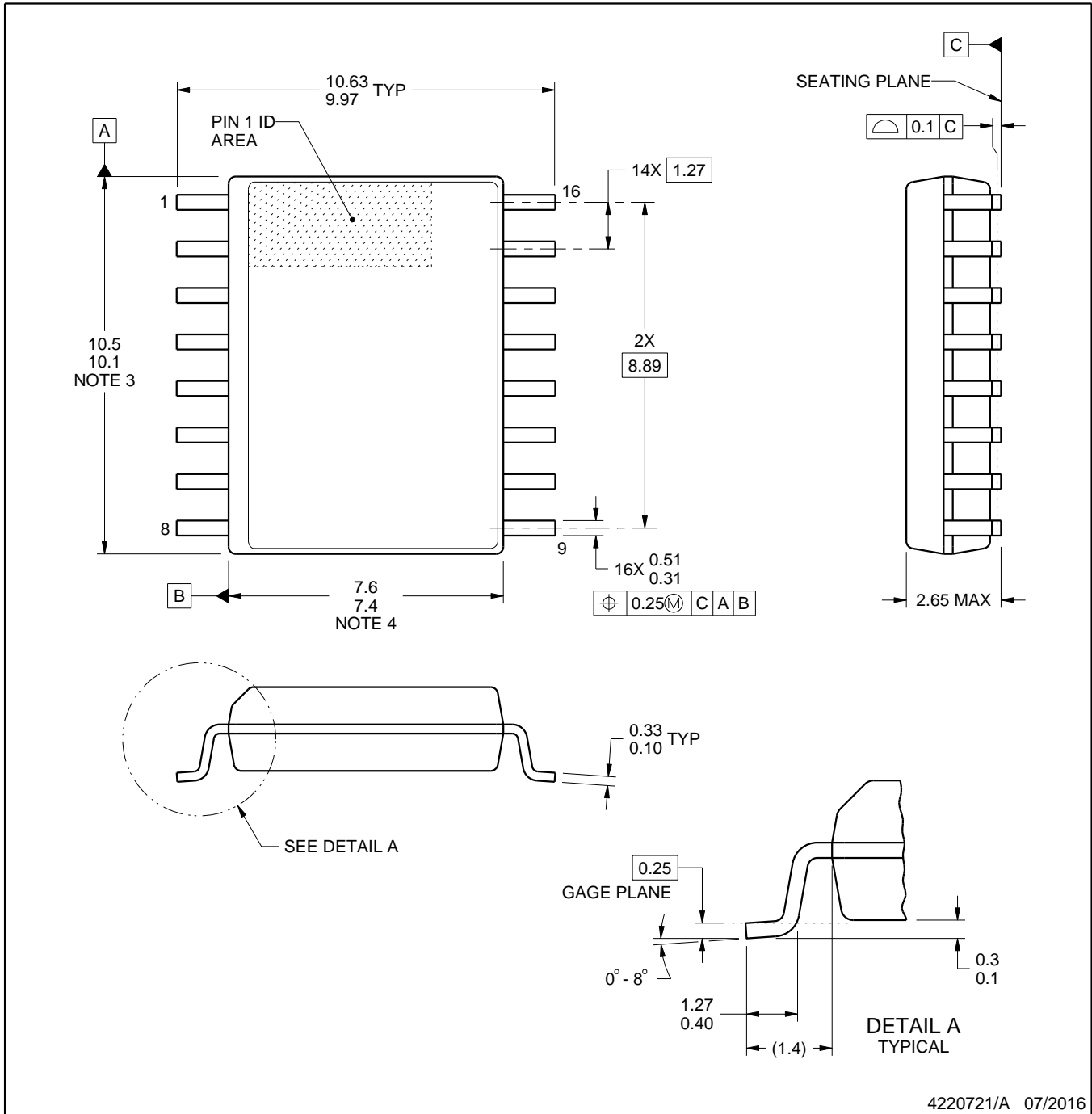


DW0016A

# PACKAGE OUTLINE

SOIC - 2.65 mm max height

SOIC



4220721/A 07/2016

NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.
5. Reference JEDEC registration MS-013.

# EXAMPLE BOARD LAYOUT

DW0016A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:7X



SOLDER MASK DETAILS

4220721/A 07/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DW0016A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:7X

4220721/A 07/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - $\triangle D$  The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002

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