

**8-BIT SHIFT REGISTER WITH 8-BIT OUTPUT REGISTER**

**Description**

The 74HCT594 is a high speed CMOS device that is designed to be pin compatible with 74LS low power Schottky types.

An eight bit shift register accepts data from the serial input (DS) on each positive transition of the shift register clock (SHCP). When asserted low the shift register reset function ( $\overline{\text{SHR}}$ ) sets all shift register values to zero and is independent of all clocks. Also when asserted low the storage register reset function ( $\overline{\text{STR}}$ ) sets all shift register values to zero and is independent of all clocks

Data from the input serial shift register is placed in the output register with a rising pulse on the storage register clock (STCP). The storage register includes output Q7S which is used for cascading information between devices. As the information moves into the storage register, it is asserted on the push-pull outputs Q0-Q7.

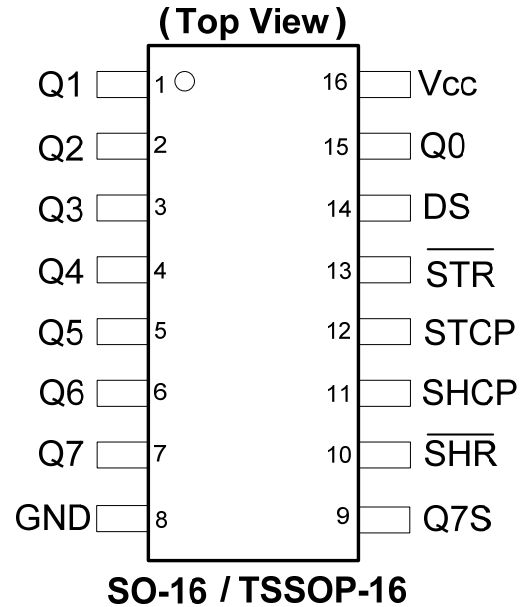
All registers capture data on rising edge and change output on the falling edge. If both clocks are connected together, the input shift register is always one clock cycle ahead of the output register.

**Features**

- Wide Supply Voltage Range from 4.5V to 5.5V
- Sinks or sources 8mA at  $V_{CC} = 4.5V$
- CMOS low power consumption
- Schmitt Trigger Action at All Inputs
- Inputs accept up to 6.0V
- ESD Protection Tested per JESD 22
  - Exceeds 200-V Machine Model (A115-A)
  - Exceeds 2000-V Human Body Model (A114-A)
  - Exceeds 1000-V Charged Device Model (C101C)
- Latch-Up Exceeds 250mA per JESD 78, Class II
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.  
 2. See <http://www.diodes.com> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.  
 3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and < 1000 ppm antimony compounds.

**Pin Assignments**



**Applications**

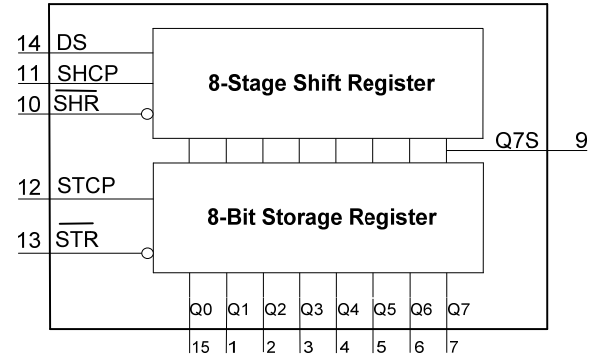
- General Purpose Logic
- Serial to Parallel Data conversion
- Capture and hold data for extended periods of time.
- Allow simple serial bit streams from a microcontroller to control as many peripheral lines as needed.
- Wide array of products such as:
  - Computer peripherals
  - Appliances
  - Industrial control

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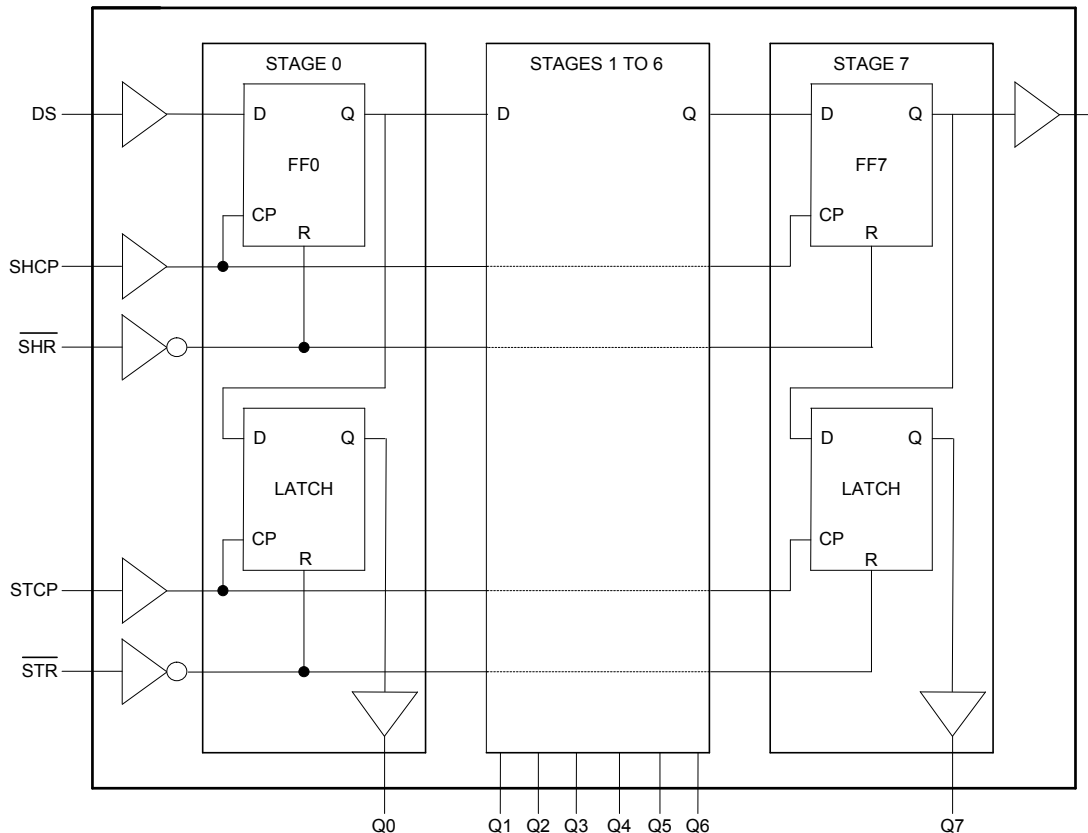
**Pin Descriptions**

| Pin Number | Pin Name                | Description                       |
|------------|-------------------------|-----------------------------------|
| 1          | Q1                      | Parallel Data Output 1            |
| 2          | Q2                      | Parallel Data Output 2            |
| 3          | Q3                      | Parallel Data Output 3            |
| 4          | Q4                      | Parallel Data Output 4            |
| 5          | Q5                      | Parallel Data Output 5            |
| 6          | Q6                      | Parallel Data Output 6            |
| 7          | Q7                      | Parallel Data Output 7            |
| 8          | GND                     | Ground                            |
| 9          | Q7S                     | Serial Data Output                |
| 10         | $\overline{\text{SHR}}$ | Shift Register Reset active low   |
| 11         | SHCP                    | Shift Register Clock Input        |
| 12         | STCP                    | Storage Register Clock Input      |
| 13         | $\overline{\text{STR}}$ | Storage Register Reset active low |
| 14         | DS                      | Serial Data Input                 |
| 15         | Q0                      | Parallel Data Output 0            |
| 16         | Vcc                     | Supply Voltage                    |

**Functional Diagram**



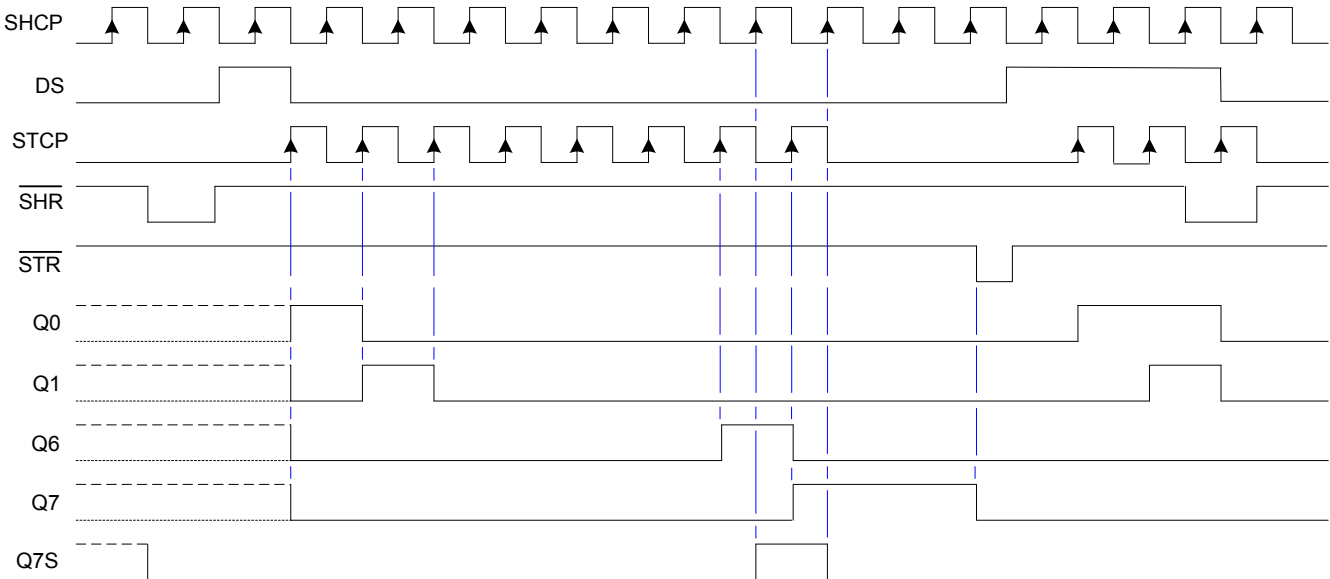
**Logic Diagram**



**Functional Description and Timing Diagram**

| Control                 |                         |      |      | Input  | Output |                | Function   |
|-------------------------|-------------------------|------|------|--------|--------|----------------|--|
| $\overline{\text{SHR}}$ | $\overline{\text{STR}}$ | SHCP | STCP | DS     | Q7S    | Qn             |  |
| L                       | X                       | X    | X    | X      | L      | NC             | Clear Shift Register   |
| X                       | L                       | X    | X    | X      | NC     | L              | Clear Storage Register   |
| H                       | X                       | ↑    | L    | H or L | Q6S    | NC             | Loads DS into shift register stage 0. All Q <sub>S</sub> shifted                         |
| H                       | H                       | X    | ↑    | X      | NC     | Q <sub>S</sub> | Contents of shift register moved to starge register all Q <sub>S</sub> -> Q <sub>N</sub> |
| H                       | H                       | ↑    | ↑    | H or L | Q6S    | QnS            | Shift Register one pulse count ahead of storage register.                                |

H=HIGH voltage state  
 L=LOW voltage state  
 ↑=LOW to HIGH transition  
 X= don't care – high or low (not floating)  
 NC= No change



**Absolute Maximum Ratings** (Note 4) (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

| Symbol    | Description                                    | Rating                 | Unit             |    |
|-----------|--|------------------------|------------------|----|
| ESD HBM   | Human Body Model ESD Protection                | 2                      | KV               |    |
| ESD CDM   | Charged Device Model ESD Protection            | 1                      | KV               |    |
| ESD MM    | Machine Model ESD Protection                   | 200                    | V                |    |
| $V_{CC}$  | Supply Voltage Range                           | -0.5 to 7.0            | V                |    |
| $V_I$     | Input Voltage Range                            | -0.5 to 7.0            | V                |    |
| $V_O$     | Voltage applied to output in high or low state | -0.3 to $V_{CC} + 0.5$ | V                |    |
| $I_{IK}$  | Input Clamp Current $V_I < -0.5V$              | -20                    | mA               |    |
| $I_{IK}$  | Input Clamp Current $V_I > V_{CC} + 0.5V$      | 20                     | mA               |    |
| $I_{OK}$  | Output Clamp Current $V_O < -0.5V$             | -20                    | mA               |    |
| $I_{OK}$  | Output Clamp Current $V_O > V_{CC} + 0.5V$     | 20                     | mA               |    |
| $I_O$     | Continuous output current                      | Q7 standard output     | +/- 25           | mA |
|           |  | Qn bus driver outputs  | +/- 35           | mA |
| $I_{CC}$  | Continuous current through $V_{CC}$            | 70                     | mA               |    |
| $I_{GND}$ | Continuous current through GND                 | -70                    | mA               |    |
| $T_J$     | Operating Junction Temperature                 | -40 to +150            | $^\circ\text{C}$ |    |
| $T_{STG}$ | Storage Temperature                            | -65 to +150            | $^\circ\text{C}$ |    |
| $P_{TOT}$ | Total Power Dissipation                        | 500                    | mW               |    |

Notes: 4. Stresses beyond the absolute maximum may result in immediate failure or reduced reliability. These are stress values and device operation should be within recommend values.

**Recommended Operating Conditions** (Note 5) (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

| Symbol              | Parameter                          | Conditions                | Min | Max      | Unit             |
|---------------------|------------------------------------|---------------------------|-----|----------|------------------|
| $V_{CC}$            | Supply Voltage                     | –                         | 4.5 | 5.5      | V                |
| $V_I$               | Input Voltage                      | –                         | 0   | 5.5      | V                |
| $V_O$               | Output Voltage                     | Active Mode               | 0   | $V_{CC}$ | V                |
| $\Delta t/\Delta V$ | Input transition rise or fall rate | $V_{CC} = 4.5V$ to $5.5V$ | –   | 500      | ns/V             |
| $T_A$               | Operating free-air temperature     | –                         | -40 | +125     | $^\circ\text{C}$ |

Notes: 5. Unused inputs should be held at  $V_{CC}$  or Ground.

**Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Symbol           | Parameter                 | Test Conditions  | V <sub>CC</sub>  | T <sub>A</sub> = +25°C |      |      | -40°C to +85°C |      | -40°C to +125°C |     | Unit |    |
|------------------|---------------------------|--|--|------------------------|------|------|----------------|------|-----------------|-----|------|----|
|                  |                           |  |  | Min                    | Typ  | Max  | Min            | Max  | Min             | Max |      |    |
| V <sub>IH</sub>  | High-level Input Voltage  | –  | 4.5 V to 5.5 V   | 2.0                    | 1.6  | –    | 2.0            | –    | 2.0             | –   | V    |    |
| V <sub>IL</sub>  | Low-level input voltage   | –  | 4.5 V to 5.5 V   | –                      | –    | 0.8  | –              | 0.8  | –               | 0.8 | V    |    |
| V <sub>OH</sub>  | High Level Output Voltage | I <sub>OH</sub> = -20μA<br>All outputs                           | 4.5 V  | 4.4                    | 4.5  | –    | 4.4            | –    | 4.4             | –   | V    |    |
|                  | Q7S output                | I <sub>OH</sub> = -4.0mA   | 4.5 V  | 3.98                   | 4.32 | –    | 3.85           | –    | 3.7             | –   |      |    |
|                  | Qn Bus Outputs            | I <sub>OH</sub> = -6.0 mA  | 4.5 V  | 3.98                   | 4.32 | –    | 3.85           | –    | 3.7             | –   | –    |    |
| V <sub>OL</sub>  | Low-level Output Voltage  | I <sub>OL</sub> = 20μA<br>All outputs                            | 4.5 V  | –                      | 0    | 0.1  | –              | 0.1  | –               | 0.1 | V    |    |
|                  | Q7S output                | I <sub>OL</sub> = 4.0mA  | 4.5 V  | –                      | 0.15 | 0.26 | –              | 0.33 | –               | 0.4 |      |    |
|                  | Qn Bus Outputs            | I <sub>OL</sub> = 6.0mA  | 4.5 V  | –                      | 0.16 | 0.26 | –              | 0.33 | –               | 0.4 | –    |    |
| I <sub>I</sub>   | Input Current             | V <sub>I</sub> = GND to 5.5 V                                    | 5.5 V  | –                      | –    | ±0.1 | –              | ± 1  | –               | ± 1 | μA   |    |
| I <sub>CC</sub>  | Supply Current            | V <sub>I</sub> = GND or V <sub>CC</sub><br>I <sub>O</sub> = 0    | 5.5 V  | –                      | –    | 8.0  | –              | 80   | –               | 160 | μA   |    |
| ΔI <sub>CC</sub> | Additional Supply Current | Test Per Pin   | PINS<br>SHCP<br>SHST<br>$\overline{\text{SHR}}$<br>$\overline{\text{STR}}$ | 4.5V to 5.5 V          | –    | 100  | 240            | –    | 300             | –   | 300  | μA |
|                  |                           | Other  |  |                        |      |      |                |      |                 |     |      |    |
|                  |                           | V <sub>I</sub> = V <sub>CC</sub><br>-2.1 V                       |  |                        |      |      |                |      |                 |     |      |    |
|                  |                           | V <sub>I</sub> = V <sub>CC</sub><br>or GND<br>I <sub>O</sub> = 0 |  |                        |      |      |                |      |                 |     |      |    |
| C <sub>i</sub>   | Input Capacitance         | V <sub>I</sub> = V <sub>CC</sub><br>or GND                       | 5.5 V  | –                      | 3.5  | 10   | –              | –    | 10              | –   | 10   | pF |

**Operating Characteristics**

| Parameter       |                               | Test Conditions   | V <sub>CC</sub> = 5V | Unit |
|-----------------|-------------------------------|---|----------------------|------|
|                 |                               |   | TYP                  |      |
| C <sub>pd</sub> | Power dissipation capacitance | f = 1 MHz all outputs switching-no load<br>V <sub>I</sub> = GND TO V <sub>CC</sub> – 1.5V | 51                   | pF   |

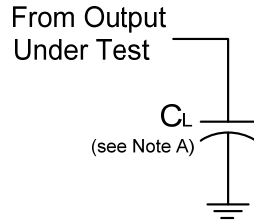
**Switching Characteristics**

| Symbol / Parameter                    | Pins                        | Test Conditions                    | V <sub>cc</sub> | T <sub>A</sub> = +25°C |      |     | -40°C to +85°C |     | -40°C to +125°C |     | Unit |
|---------------------------------------|-----------------------------|------------------------------------|-----------------|------------------------|------|-----|----------------|-----|-----------------|-----|------|
|                                       |                             |                                    |                 | Min                    | Typ. | Max | Min            | Max | Min             | Max |      |
| f <sub>MAX</sub><br>Maximum Frequency | SHCP or STCP                | Figure 2<br>C <sub>L</sub> =15pF   | 5.0 V           | 30                     | 92   | –   | 24             | –   | 20              | –   | MHz  |
| t <sub>w</sub><br>Pulse Width         | SHCP HIGH or LOW            | Figure 2<br>C <sub>L</sub> =50pF   | 4.5 V           | 16                     | 4    | –   | 20             | –   | 24              | –   | ns   |
|                                       | STCP HIGH or LOW            | Figure 2<br>C <sub>L</sub> =50pF   | 4.5 V           | 16                     | 4    | –   | 20             | –   | 24              | –   |      |
|                                       | SHR and STR HIGH or LOW     | Figure 2<br>C <sub>L</sub> =50pF   | 4.5 V           | 16                     | 6    | –   | 20             | –   | 24              | –   |      |
| t <sub>SU</sub><br>Set-up Time        | DS to SHCP                  | Figure 2<br>C <sub>L</sub> =50pF   | 4.5 V           | 20                     | 4    | –   | 25             | –   | 30              | –   | ns   |
|                                       | SHR to STCP                 | Figure 2<br>C <sub>L</sub> =50pF 2 | 4.5 V           | 20                     | 6    | –   | 25             | –   | 30              | –   |      |
|                                       | SHCP to STCP                | Figure 2<br>C <sub>L</sub> =50pF   | 4.5 V           | 20                     | 7    | –   | 25             | –   | 30              | –   |      |
| t <sub>PD</sub><br>Propagation Delay  | SHCP to Q7S                 | Figure 2<br>C <sub>L</sub> =50p    | 4.5 V           | –                      | 18   | 32  | –              | 40  | –               | 48  | ns   |
|                                       |                             | Figure 2<br>C <sub>L</sub> =15pF   | 5.0 V           | –                      | 15   | –   | –              | –   | –               | –   |      |
|                                       | STCP to Qn                  | Figure 2<br>C <sub>L</sub> =50p    | 4.5 V           | –                      | 18   | 32  | –              | 40  | –               | 48  |      |
|                                       |                             | Figure 2<br>C <sub>L</sub> =15p    | 5.0 V           | –                      | 15   | –   | –              | –   | –               | –   |      |
| t <sub>H</sub><br>Hold Time           | DS to SHCP                  | Figure 2                           | 4.5 V           | 5                      | -3   | –   | 6              | –   | 7               | –   | ns   |
| t <sub>REC</sub><br>Recovery Time     | SHR to SHCP and STR to STCP | Figure 2                           | 4.5 V           | 10                     | -5   | –   | 13             | –   | 15              | –   | ns   |

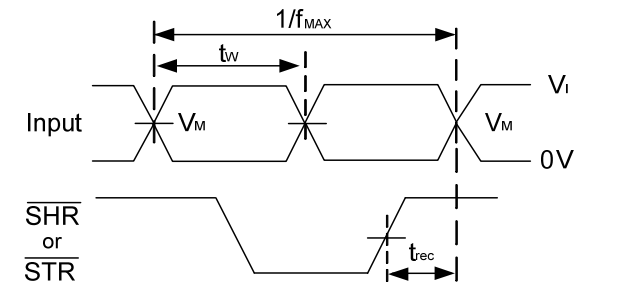
**Switching Characteristics** (cont.)

| Symbol / Parameter                    | Pins                                 | Test Conditions                  | V <sub>CC</sub> | T <sub>A</sub> = +25°C |      |     | -40°C to +85°C |     | -40°C to +125°C |     | Unit |
|---------------------------------------|--------------------------------------|----------------------------------|-----------------|------------------------|------|-----|----------------|-----|-----------------|-----|------|
|                                       |                                      |                                  |                 | Min                    | Typ. | Max | Min            | Max | Min             | Max |      |
| t <sub>PHL</sub><br>Propagation Delay | SHR to Q7S                           | Figure 2<br>C <sub>L</sub> =50pF | 4.5 V           | –                      | 17   | 30  | –              | 38  | –               | 45  | ns   |
|                                       |                                      | Figure 2<br>C <sub>L</sub> =15pF | 5.0 V           | –                      | 14   | –   | –              | –   | –               | –   |      |
|                                       | STR to Qn                            | Figure 2<br>C <sub>L</sub> =50pF | 4.5 V           | –                      | 17   | 30  | –              | 38  | –               | 45  | ns   |
|                                       |                                      | Figure 2<br>C <sub>L</sub> =15pF | 5.0 V           | –                      | 14   | –   | –              | –   | –               | –   |      |
| t <sub>THL</sub>                      | Serial data output Q7S               | Figure 2<br>C <sub>L</sub> =50pF | 4.5 V           | –                      | 7    | 15  | –              | 19  | –               | 22  | ns   |
| t <sub>TLH</sub><br>Transition Times  | Parallel Data Outputs Q <sub>N</sub> | Figure 2<br>C <sub>L</sub> =50pF | 4.5 V           | –                      | 5    | 12  | –              | 15  | –               | 18  | ns   |

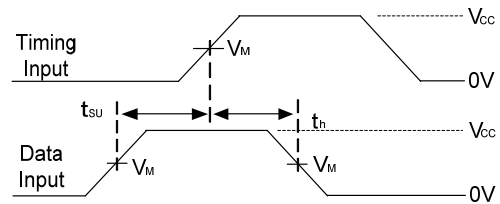
**Parameter Measurement Information**



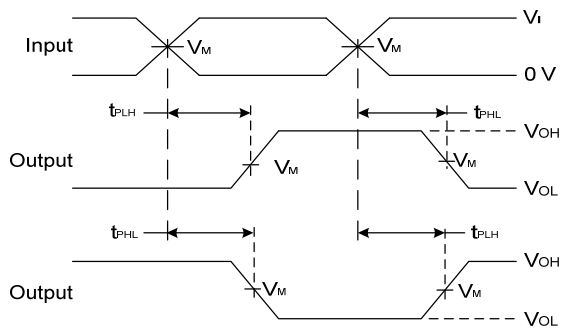
| V <sub>CC</sub> | Inputs          |                                | V <sub>M</sub>     |
|-----------------|-----------------|--------------------------------|--------------------|
|                 | V <sub>I</sub>  | t <sub>r</sub> /t <sub>f</sub> |                    |
| 4.5V            | V <sub>CC</sub> | 6ns                            | V <sub>CC</sub> /2 |
| 5.0V            | V <sub>CC</sub> | 6ns                            | V <sub>CC</sub> /2 |



**Voltage Waveform  
Pulse Duration and Recovery Time**



**Voltage Waveform  
Set-up and Hold Times**



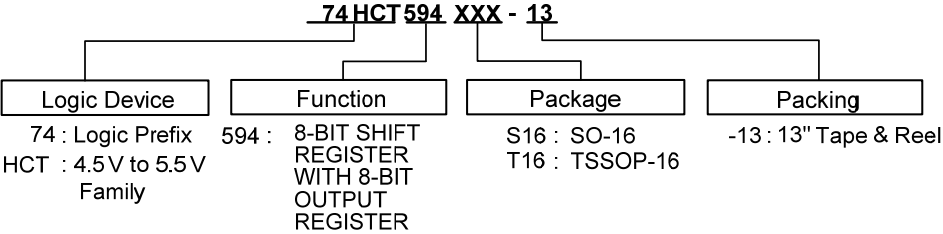
**Voltage Waveform  
Propagation Delay Times  
Inverting and Non Inverting Outputs**

- Notes: A . Includes test lead and test apparatus capacitance.  
 B. All pulses are supplied at pulse repetition rate ≤ 10 MHz  
 C. Inputs are measured separately one transition per measurement  
 D. t<sub>PLH</sub> and t<sub>PHL</sub> are the same as t<sub>PD</sub>

**Figure 2. Load Circuit and Voltage Waveforms**



**Ordering Information**

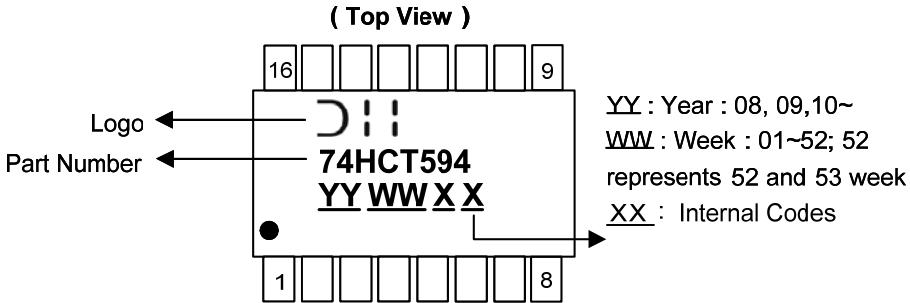


| Device         | Package Code | Packaging | 7" Tape and Reel (Note 6) |                    |
|----------------|--------------|-----------|---------------------------|--------------------|
|                |              |           | Quantity                  | Part Number Suffix |
| 74HCT594S16-13 | S16          | SO-16     | 2500/Tape & Reel          | -13                |
| 74HCT594T16-13 | T16          | TSSOP-16  | 2500/Tape & Reel          | -13                |

Notes: 6. The taping orientation is located on our website at <http://www.diodes.com/datasheets/ap02007.pdf>

**Marking Information**

**(1) SO-16, TSSOP-16**

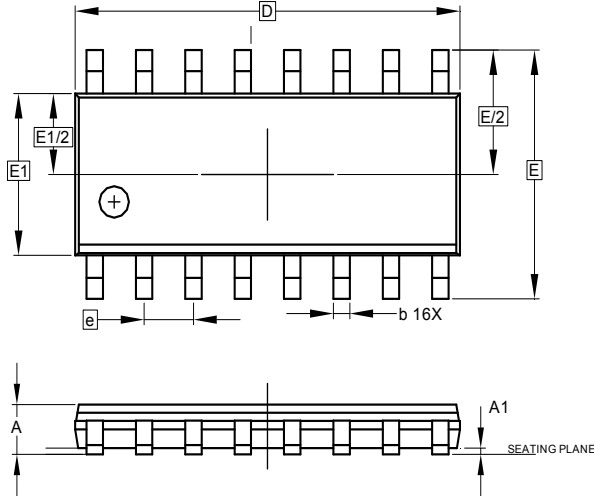


| Part Number | Package  |
|-------------|----------|
| 74HCT594S16 | SO-16    |
| 74HCT594T16 | TSSOP-16 |

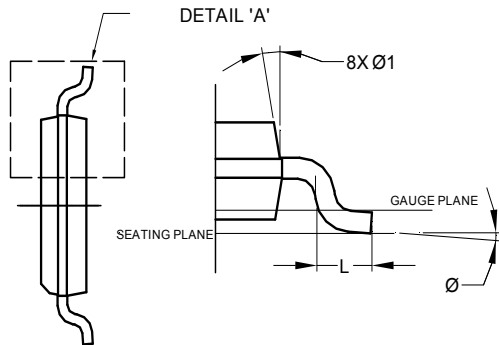
**Package Outline Dimensions** (All Dimensions in mm.)

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

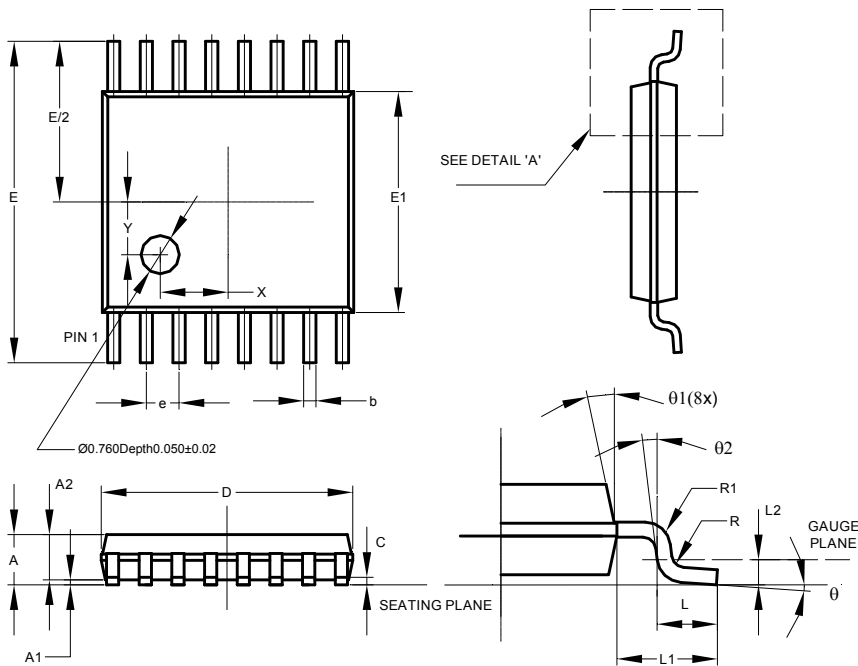
**(1) Package Type: SO-16**



| SOIC-16              |      |       |      |
|----------------------|------|-------|------|
| Dim                  | Min  | Max   | Typ  |
| A                    | —    | 1.75  | —    |
| A1                   | 0.10 | 0.25  | —    |
| b                    | 0.31 | 0.51  | —    |
| c                    | 0.10 | 0.25  | —    |
| D                    | 9.80 | 10.00 | —    |
| E                    | 5.80 | 6.20  | —    |
| E1                   | 3.80 | 4.00  | —    |
| e                    | —    | —     | 1.27 |
| L                    | 0.40 | 1.27  | —    |
| Ø                    | 0°   | 8°    | —    |
| Ø1                   | 5°   | 15°   | —    |
| All Dimensions in mm |      |       |      |



**(2) Package Type: TSSOP-16**

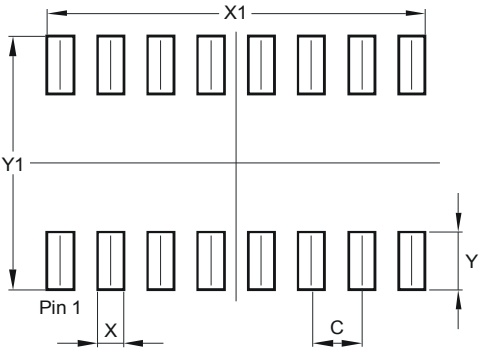


| TSSOP-16             |          |      |       |
|----------------------|----------|------|-------|
| Dim                  | Min      | Max  | Typ   |
| A                    | —        | 1.08 | —     |
| A1                   | 0.05     | 0.15 | —     |
| A2                   | 0.80     | 0.93 | —     |
| b                    | 0.19     | 0.30 | —     |
| c                    | 0.09     | 0.20 | —     |
| D                    | 4.90     | 5.10 | —     |
| E                    | 6.40 BSC |      |       |
| E1                   | 4.30     | 4.50 | —     |
| e                    | 0.65 BSC |      |       |
| L                    | 0.45     | 0.75 | —     |
| L1                   | 1.00 REF |      |       |
| L2                   | 0.25 BSC |      |       |
| R                    | 0.09     | —    | —     |
| R1                   | 0.09     | —    | —     |
| X                    | —        | —    | 1.350 |
| Y                    | —        | —    | 1.050 |
| Ø                    | 0°       | 8°   | —     |
| Ø1                   | 5°       | 15°  | —     |
| Ø2                   | 0°       | —    | —     |
| All Dimensions in mm |          |      |       |

**Suggested Pad Layout**

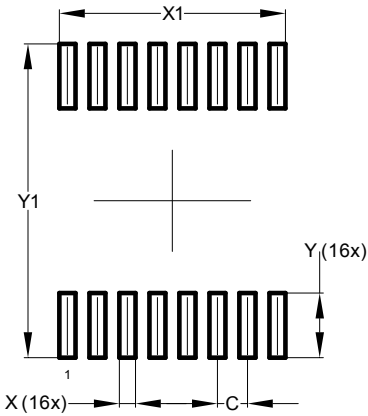
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

**Package Type: SO-16**



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 1.270         |
| X          | 0.670         |
| X1         | 9.560         |
| Y          | 1.450         |
| Y1         | 6.400         |

**Package Type: TSSOP-16**



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 0.650         |
| X          | 0.350         |
| X1         | 4.900         |
| Y          | 1.400         |
| Y1         | 6.800         |

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2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

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