

8-BIT SHIFT REGISTER WITH 8-BIT OUTPUT REGISTER

Description

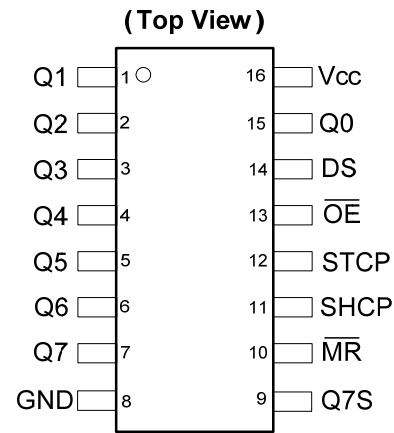
The 74AHC595 is an advanced high speed CMOS device.

An eight bit shift register accepts data from the serial input (DS) on each positive transition of the shift register clock (STCP). When asserted low the reset function (\overline{MR}) 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 (SHCP). With the output enable (\overline{OE}) asserted low the 3-state outputs Q0-Q7 become active and present.

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.

Pin Assignments



SO-16 / TSSOP-16

Features

- Wide Supply Voltage Range from 2.0 V 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 5.5V
- 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)**

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

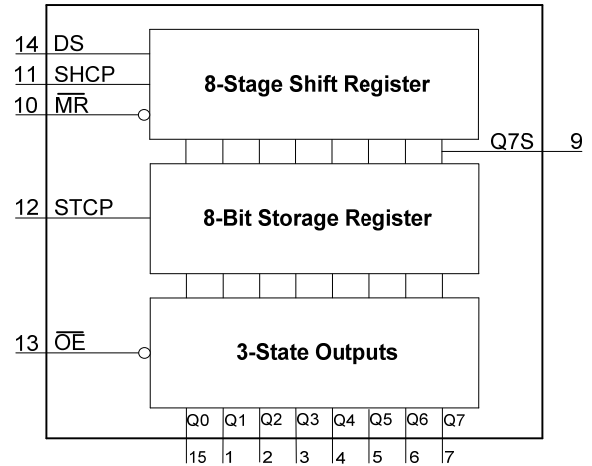
- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
 2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
 3. Halogen- and Antimony-free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

[Click here for ordering information, located at the end of datasheet](#)

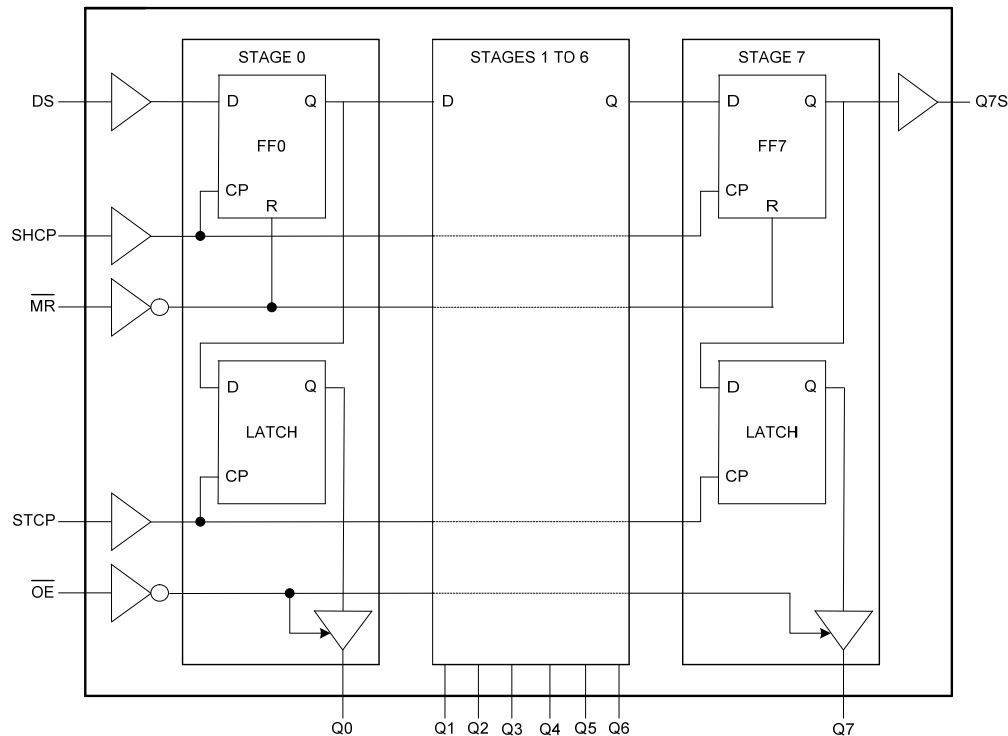
Pin Descriptions

| 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 | $\overline{\text{MR}}$ | Master Reset Input |
| 11 | SHCP | Shift Register Clock Input |
| 12 | STCP | Storage Register Clock Input |
| 13 | $\overline{\text{OE}}$ | Output Enable Input |
| 14 | DS | Serial Data Input |
| 15 | Q0 | Parallel Data Output 0 |
| 16 | Vcc | Supply Voltage |

Functional Diagram



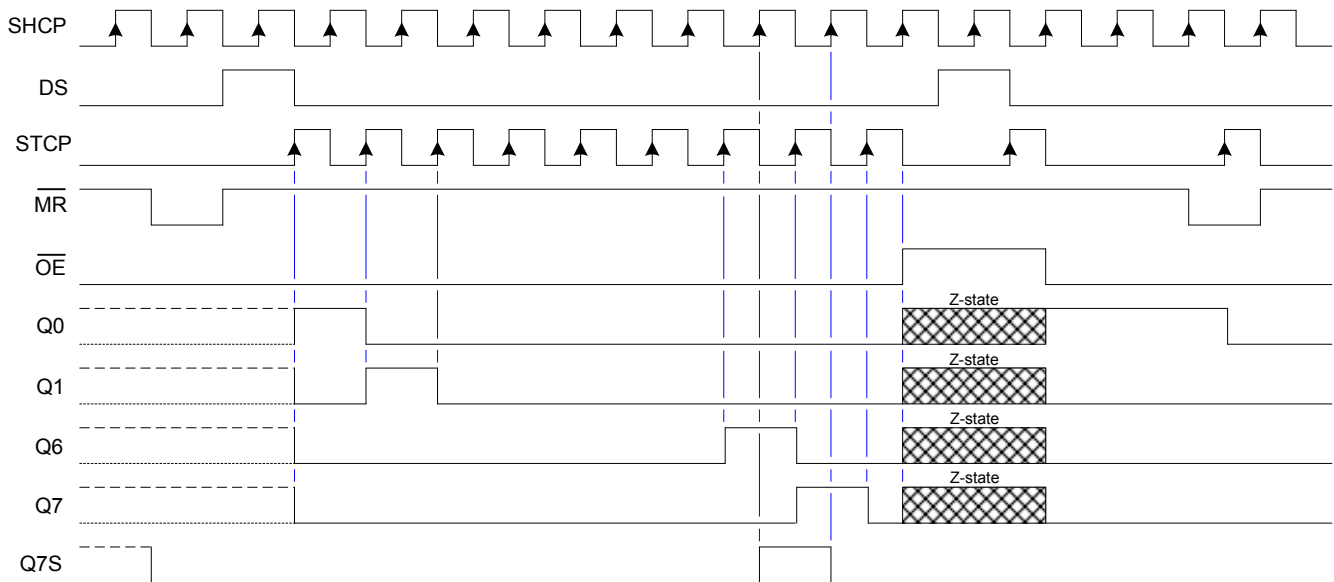
Logic Diagram



Functional Description and Timing Diagram

| Control | | | | Input | Output | | Function |
|---------|------|-----------------|-----------------|-------|--------|-----|---|
| SHCP | STCP | \overline{OE} | \overline{MR} | DS | Q7S | Qn | |
| X | X | L | L | – | L | NC | Low-level asserted on MR clears shift register. Storage register is unchanged |
| X | ↑ | L | L | – | L | L | Empty shift register transferred to storage register |
| X | X | H | L | – | L | Z | Shift register remains clear;: All Q outputs in Z state. |
| ↑ | X | L | H | – | Q6S | NC | HIGH is shifted into first stage of Shift Register Contents of each register shifted to next register The content of Q6S has been shifted to Q7S and now appears on device pin Q7S |
| X | ↑ | L | H | – | NC | QnS | Contents of shift register copied to storage register. With output now in active state the storage register contents appear on Q outputs. |
| ↑ | ↑ | L | H | – | Q6S | QnS | |

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



Absolute Maximum Ratings (Note 4) (@T_A = +25°C, unless otherwise specified.)

| Symbol | Parameter | 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 _{OK} | Output Clamp Current V _O < -0.5V | -20 | mA |
| I _{OK} | Output Clamp Current V _O > V _{CC} + 0.5V | 25 | mA |
| I _O | Continuous output current | +/- 25 | mA |
| I _{CC} | Continuous current through V _{CC} or GND | 75 | mA |
| I _{GND} | Continuous current through V _{CC} or GND | -75 | mA |
| T _J | Operating Junction Temperature | -40 to 150 | °C |
| T _{STG} | Storage Temperature | -65 to 150 | °C |
| P _{TOT} | Total Power Dissipation | 500 | mW |

Note: 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°C, unless otherwise specified.)

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------------|------------------------------------|--------------------------------|-----|-----------------|------|
| V _{CC} | Supply Voltage | – | 2.0 | 5.5 | V |
| V _I | Input Voltage | – | 0 | 5.5 | V |
| V _O | Output Voltage | Active Mode | 0 | V _{CC} | V |
| Δt/ΔV | Input transition Rise or Fall Rate | V _{CC} = 3.0V to 3.6V | – | 100 | ns/V |
| | | V _{CC} = 4.5V to 5.5V | – | 20 | |
| T _A | Operating Free-Air Temperature | – | -40 | +125 | °C |

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

Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)

| Symbol | Parameter | Test Conditions | V _{CC} | T _A = +25°C | | | T _A = -40°C to +85°C | | T _A = -40°C to +125°C | | Unit |
|-----------------|---------------------------|--|-----------------|------------------------|-----|-------|---------------------------------|------|----------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| V _{IH} | High-level Input Voltage | – | 2.0V | 1.5 | – | – | 1.5 | – | 1.5 | – | V |
| | | – | 3.0V | 2.1 | – | – | 2.1 | – | 2.1 | – | |
| | | – | 5.5V | 3.85 | – | – | 3.85 | – | 3.85 | – | |
| V _{IL} | Low-level input voltage | – | 2.0V | – | – | 0.5 | – | 0.5 | – | 0.5 | V |
| | | – | 3.0V | – | – | 0.9 | – | 0.9 | – | 0.9 | |
| | | – | 5.5V | – | – | 1.65 | – | 1.65 | – | 1.65 | |
| V _{OH} | High Level Output Voltage | I _{OH} = -50μA | 2.0V | 1.9 | 2.0 | – | 1.9 | – | 1.9 | – | V |
| | | I _{OH} = -50μA | 3.0V | 2.9 | 3.0 | – | 2.9 | – | 2.9 | – | |
| | | I _{OH} = -50μA | 4.5V | 4.4 | 4.5 | – | 4.4 | – | 4.4 | – | |
| | | I _{OH} = -4mA | 3.0V | 2.58 | – | – | 2.48 | – | 2.40 | – | |
| | | I _{OH} = -8mA | 4.5V | 3.94 | – | – | 3.80 | – | 3.70 | – | |
| V _{OL} | Low-level Output Voltage | I _{OL} = 50μA | 2.0V | – | 0 | 0.1 | – | 0.1 | – | 0.1 | V |
| | | I _{OL} = 50μA | 3.0V | – | 0 | 0.1 | – | 0.1 | – | 0.1 | |
| | | I _{OL} = 50μA | 4.5V | – | 0 | 0.1 | – | 0.1 | – | 0.1 | |
| | | I _{OL} = 4mA | 3.0V | – | – | 0.36 | – | 0.44 | – | 0.55 | |
| | | I _{OL} = 8mA | 4.5V | – | – | 0.36 | – | 0.44 | – | 0.55 | |
| I _I | Input Current | V _I = GND to 5.5V | 5.5V | – | 0.1 | ±0.1 | – | ±1 | – | ±2 | μA |
| I _{OZ} | OFF-state output current | V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND | 5.5V | – | – | ±0.25 | – | ±2.5 | – | ±10 | μA |
| I _{CC} | Supply Current | V _I = GND or V _{CC} I _O = 0 | 5.5V | – | – | 4.0 | – | 40 | – | 80 | μA |
| C _i | Input Capacitance | V _I = V _{CC} or GND | 5.5V | – | 4 | 10 | – | 10 | – | 10 | pF |

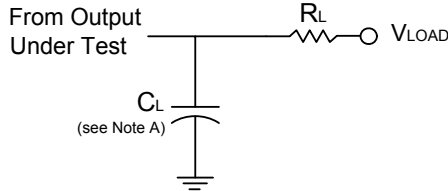
Switching Characteristics

| Symbol / Parameter | Pins | Test Conditions | V _{CC} | T _A = +25°C | | | -40°C to +85°C | | -40°C to +125°C | | Unit |
|---------------------------------------|------------------|-----------------------------------|-----------------|------------------------|-----|------|----------------|------|-----------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| f _{MAX} Maximum Frequency | SHCP or STCP | Figure 2 | 3.0V to 3.6V | 80 | 125 | – | 60 | – | 40 | – | MHz |
| | | | 4.5V to 5.5V | 130 | 70 | – | 110 | – | 90 | – | |
| t _w Pulse Width | SHCP HIGH or LOW | Figure 2 | 3.0V to 3.6V | 5.0 | – | – | 5.0 | – | 5.0 | – | ns |
| | | | 4.5V to 5.5V | 5.0 | – | – | 5.0 | – | 5.0 | – | |
| | STCP HIGH or LOW | Figure 2 | 3.0V to 3.6V | 5.0 | – | – | 5.0 | – | 5.0 | – | |
| | | | 4.5V to 5.5V | 5.0 | – | – | 5.0 | – | 5.0 | – | |
| | MR LOW | Figure 2 | 3.0V to 3.6V | 5.0 | – | – | 5.0 | – | 5.0 | – | |
| | | | 4.5V to 5.5V | 5.0 | – | – | 5.0 | – | 5.0 | – | |
| t _{SU} Set-up Time | DS to SHCP | Figure 2 | 3.0V to 3.6V | 3.5 | – | – | 3.5 | – | 3.5 | – | ns |
| | | | 4.5V to 5.5V | 3.0 | – | – | 3.0 | – | 3.0 | – | |
| | SHCP to STCP | Figure 2 | 3.0V to 3.6V | 8.5 | – | – | 8.5 | – | 8.5 | – | ns |
| | | | 4.5V to 5.5V | 5.0 | – | – | 5.0 | – | 5.0 | – | |
| t _H Hold Time | DS to SHCP | Figure 2 | 3.0V to 3.6V | 1.5 | – | – | 1.5 | – | 1.5 | – | ns |
| | | | 4.5V to 5.5V | 2.0 | – | – | 2.0 | – | 2.0 | – | |
| t _{REC} Recovery Time | MR to SHCP | Figure 2 | 3.0V to 3.6V | 3.0 | – | – | 3.0 | – | 3.0 | – | ns |
| | | | 4.5V to 5.5V | 2.5 | – | – | 2.5 | – | 2.5 | – | |
| t _{PD} Propagation Delay | SHCP to Q7S | Figure 2 C _L = 15pF | 3.0V to 3.6V | – | 5.7 | 13.0 | 1.0 | 15.0 | 1.0 | 16.5 | ns |
| | | | 4.5V to 5.5V | – | 4.0 | 8.2 | 1.0 | 9.4 | 1.0 | 10.5 | |
| | | Figure 2 C _L = 50pF | 3.0V to 3.6V | – | 7.7 | 16.5 | 1.0 | 18.5 | 1.0 | 20.1 | |
| | | | 4.5V to 5.5V | – | 5.4 | 10.0 | 1.0 | 11.4 | 1.0 | 12.5 | |
| | STCP to Qn | Figure 2 C _L = 15pF | 3.0V to 3.6V | – | 5.9 | 11.9 | 1.0 | 13.5 | 1.0 | 15.0 | ns |
| | | | 4.5V to 5.5V | – | 4.2 | 7.4 | 1.0 | 8.5 | 1.0 | 10.5 | |
| | | Figure 2 C _L = 50pF | 3.0V to 3.6V | – | 7.7 | 15.4 | 1.0 | 17.0 | 1.0 | 18.5 | |
| | | | 4.5V to 5.5V | – | 5.5 | 9.0 | 1.0 | 10.5 | 1.0 | 11.5 | |
| | MR to Q7S | Figure 2 C _L = 15pF | 3.0V to 3.6V | – | 5.9 | 12.8 | 1.0 | 13.7 | 1.0 | 15.0 | ns |
| | | | 4.5 V to 5.5V | – | 4.4 | 8.0 | 1.0 | 9.1 | 1.0 | 10.5 | |
| | | Figure 2 C _L = 50pF | 3.0V to 3.6V | – | 7.4 | 16.3 | 1.0 | 17.2 | 1.0 | 18.7 | |
| | | | 4.5V to 5.5V | – | 5.6 | 10.0 | 1.0 | 11.1 | 1.0 | 12.0 | |
| t _{EN} Enable Time | OE to Qn | Figure 2 C _L = 15pF | 3.0V to 3.6V | – | 5.6 | 11.5 | 1.0 | 13.5 | 1.0 | 15.0 | ns |
| | | | 4.5V to 5.5V | – | 4.0 | 8.6 | 1.0 | 10.0 | 1.0 | 10.5 | |
| | | Figure 2 C _L = 50pF | 3.0V to 3.6V | – | 7.4 | 15.0 | 1.0 | 17.0 | 1.0 | 18.5 | |
| | | | 4.5V to 5.5V | – | 5.3 | 10.6 | 1.0 | 12.0 | 1.0 | 13.0 | |
| t _{DIS} Disable Time | OE to Qn | Figure 2 C _L = 15pF | 3.0V to 3.6V | – | 5.4 | 11.0 | 1.0 | 13.0 | 1.0 | 14.5 | ns |
| | | | 4.5V to 5.5V | – | 3.8 | 8.0 | 1.0 | 9.5 | 1.0 | 10.5 | |
| | | Figure 2 C _L = 50pF | 3.0V to 3.6V | – | 8.7 | 15.7 | 1.0 | 16.2 | 1.0 | 17.5 | |
| | | | 4.5V to 5.5V | – | 5.8 | 10.3 | 1.0 | 11.0 | 1.0 | 12.0 | |

Operating Characteristics (@T_A = +25°C, unless otherwise specified.)

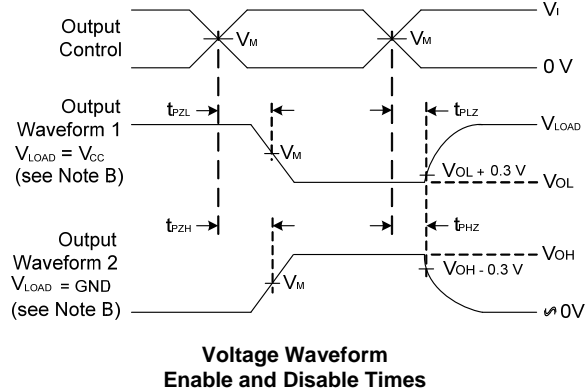
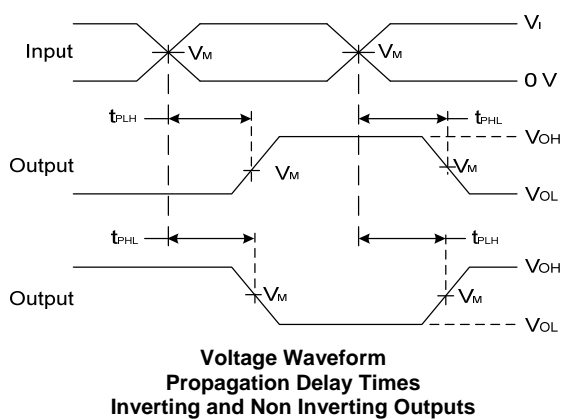
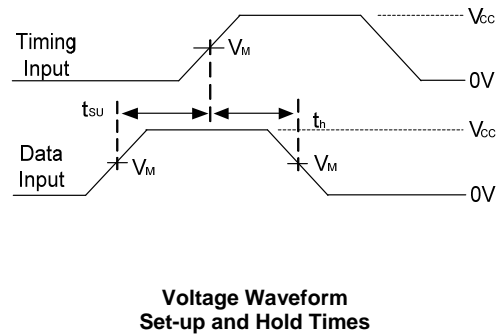
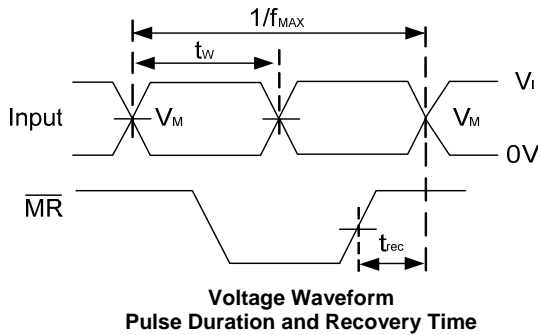
| Parameter | | Test Conditions | V _{CC} = 5V | Unit |
|-----------------|-------------------------------|---|----------------------|------|
| | | | Typ | |
| C _{pd} | Power dissipation capacitance | f = 1 MHz all outputs switching-no load | 42 | pF |

Parameter Measurement Information



| TEST | V_{load} |
|-------------------|------------|
| t_{PLH}/t_{PHL} | Open |
| t_{PLZ}/t_{PZL} | V_{CC} |
| t_{PHZ}/t_{PZH} | GND |

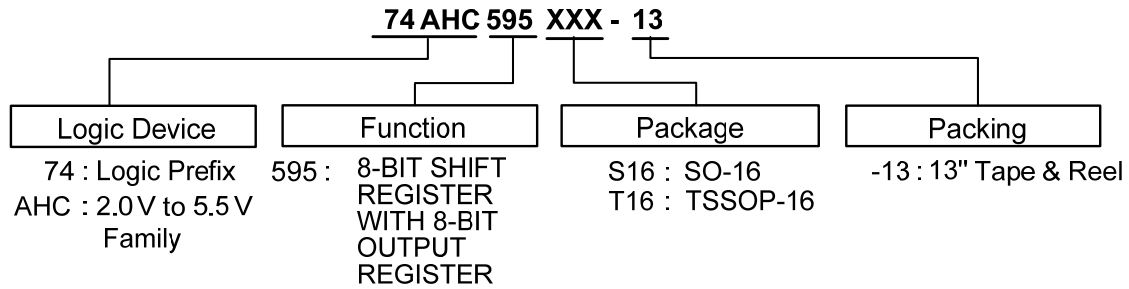
| V_{CC} | Inputs | | V_M | C_L |
|--------------|----------|-----------|------------|------------|
| | V_I | t_r/t_f | | |
| 3.3V - 3.6V | V_{CC} | 3ns | $V_{CC}/2$ | 15pF, 50pF |
| 4.5V to 5.5V | V_{CC} | 3ns | $V_{CC}/2$ | 15pF, 50pF |



- Notes:
- A. Includes test lead and test apparatus capacitance.
 - B. Output Waveform 1 depends on the internal Q_N node being low and behaves in this manner based on OE pin.
Output Waveform 2 depends on the internal Q_N node being high and behaves in this manner based on OE pin.
 - C. All pulses are supplied at pulse repetition rate ≤ 10 MHz
 - D. Inputs are measured separately one transition per measurement
 - E. t_{PLH} and t_{PHL} are the same as t_{PD} .

Figure 2. Load Circuit and Voltage Waveforms

Ordering Information

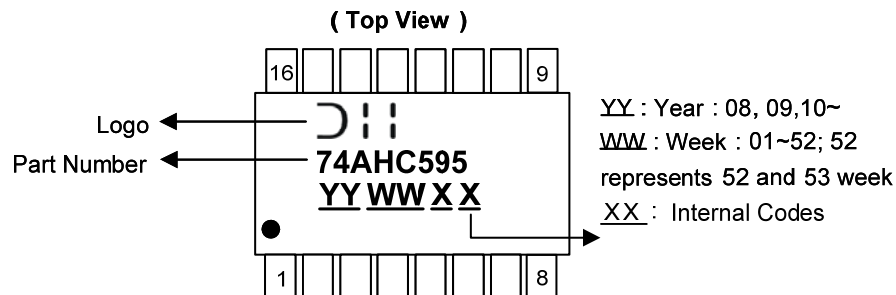


| Part Number | Package Code | Packaging | 7" Tape and Reel (Note 6) | |
|----------------|--------------|-----------|---------------------------|--------------------|
| | | | Quantity | Part Number Suffix |
| 74AHC595S16-13 | S16 | SO-16 | 2500/Tape & Reel | -13 |
| 74AHC595T16-13 | T16 | TSSOP-16 | 2500/Tape & Reel | -13 |

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

Marking Information

(1) SO-16, TSSOP16

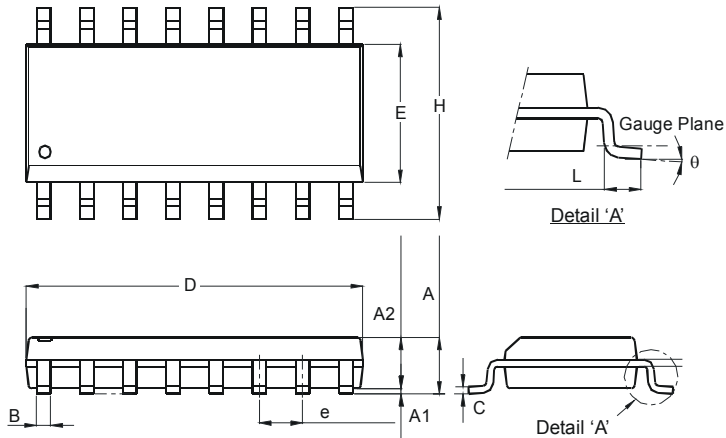


| Part Number | Package |
|-------------|----------|
| 74AHC595S16 | SO-16 |
| 74AHC595T16 | TSSOP-16 |

Package Outline Dimensions (All dimensions in mm.)

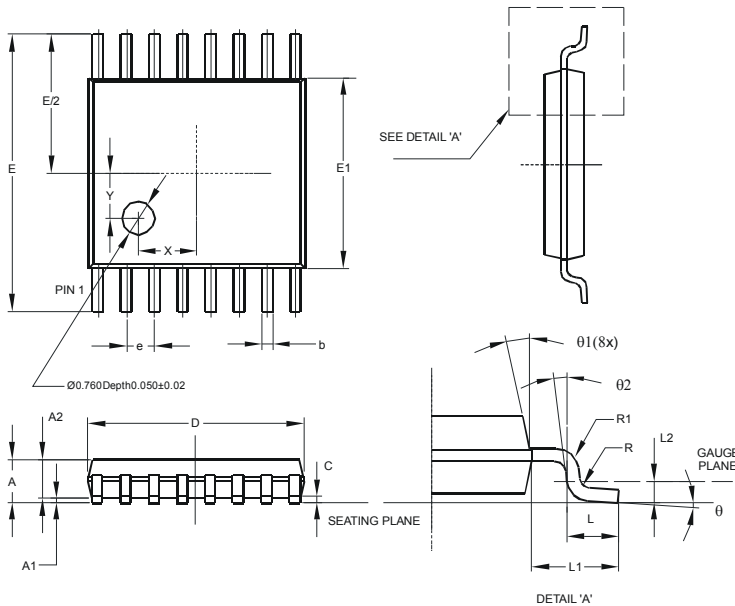
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

Package Type: SO-16



| SO-16 | | |
|----------------------|----------|-------|
| Dim | Min | Max |
| A | 1.40 | 1.75 |
| A1 | 0.10 | 0.25 |
| A2 | 1.30 | 1.50 |
| B | 0.33 | 0.51 |
| C | 0.19 | 0.25 |
| D | 9.80 | 10.00 |
| E | 3.80 | 4.00 |
| e | 1.27 Typ | |
| H | 5.80 | 6.20 |
| L | 0.38 | 1.27 |
| θ | 0° | 8° |
| All Dimensions in mm | | |

Package Type: TSSOP-16

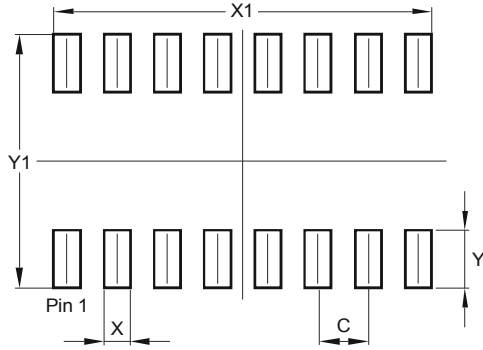


| TSSOP-16 | | | |
|----------------------|----------|------|-------|
| Dim | Min | Max | Typ |
| A | - | 1.08 | - |
| A1 | 0.05 | 0.15 | - |
| A2 | 0.80 | 0.93 | - |
| b | 0.19 | 0.30 | - |
| c | 0.09 | 0.20 | - |
| D | 4.90 | 5.10 | - |
| E | 6.40 BSC | | |
| E1 | 4.30 | 4.50 | - |
| e | 0.65 BSC | | |
| 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 |
| θ | 0° | 8° | - |
| θ1 | 5° | 15° | - |
| θ2 | 0° | - | - |
| All Dimensions in mm | | | |

Suggested Pad Layout

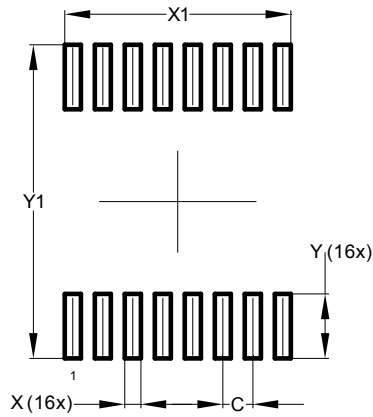
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

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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