

## Description

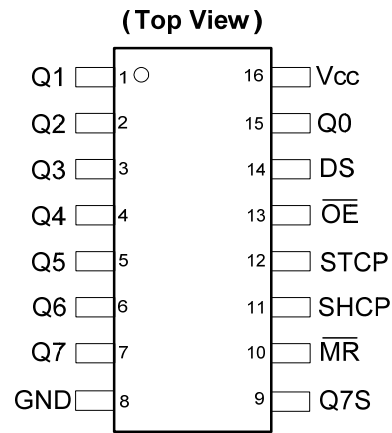
The 74AHC595 is an advanced high speed CMOS device.

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

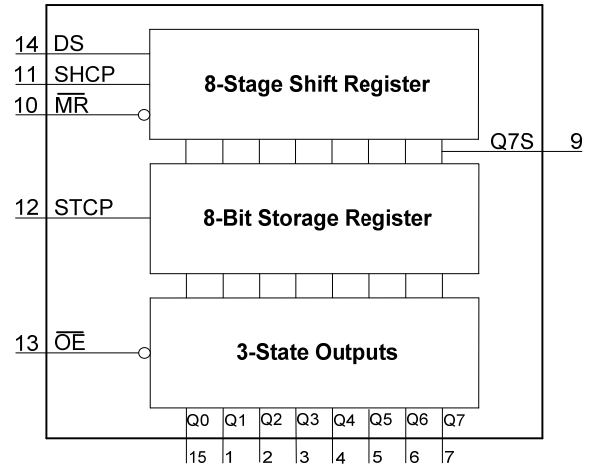
- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "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](#)

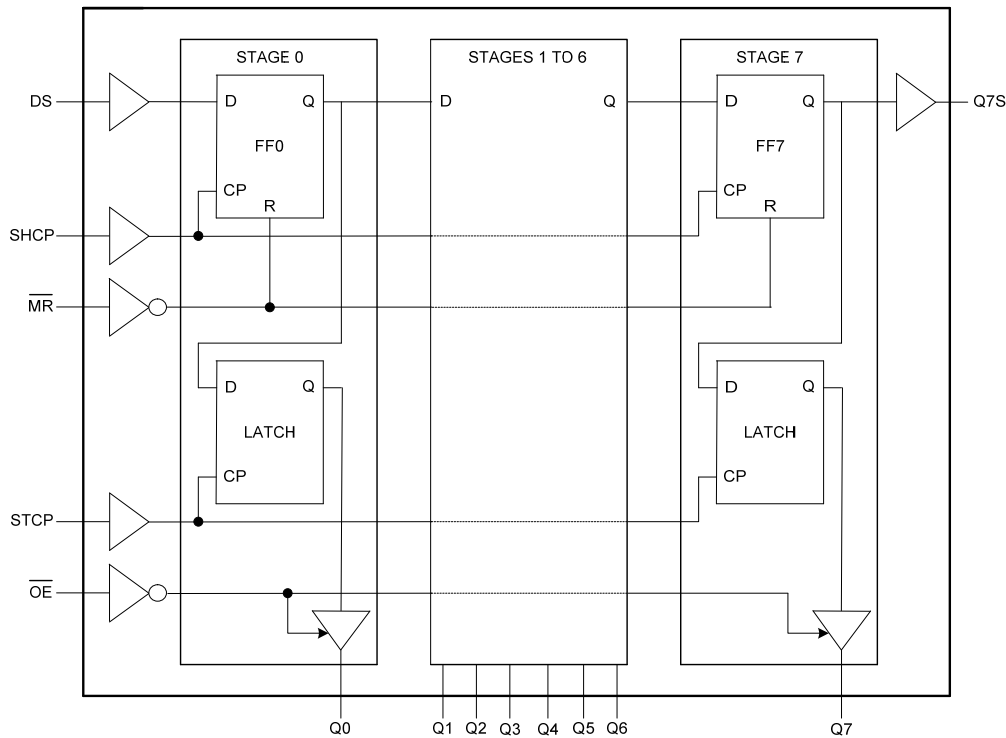
## Pin Descriptions

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

## Functional Diagram



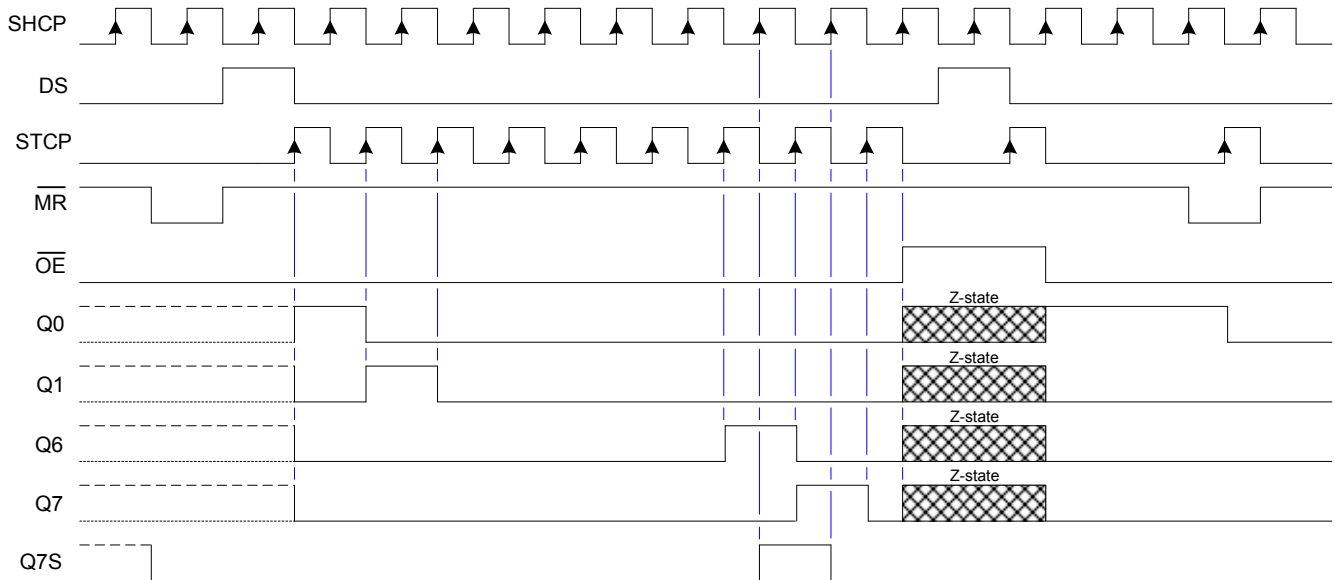
## Logic Diagram



## 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<sub>A</sub> = +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 <sub>CC</sub>	Supply Voltage Range	-0.5 to 7.0	V
V <sub>I</sub>	Input Voltage Range	-0.5 to 7.0	V
V <sub>O</sub>	Voltage applied to output in high or low state	-0.3 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	Input Clamp Current V <sub>I</sub> < -0.5V	-20	mA
I <sub>OK</sub>	Output Clamp Current V <sub>O</sub> < -0.5V	-20	mA
I <sub>OK</sub>	Output Clamp Current V <sub>O</sub> > V <sub>CC</sub> + 0.5V	25	mA
I <sub>O</sub>	Continuous output current	+/- 25	mA
I <sub>CC</sub>	Continuous current through V <sub>CC</sub> or GND	75	mA
I <sub>GND</sub>	Continuous current through V <sub>CC</sub> or GND	-75	mA
T <sub>J</sub>	Operating Junction Temperature	-40 to 150	°C
T <sub>STG</sub>	Storage Temperature	-65 to 150	°C
P <sub>TOT</sub>	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<sub>A</sub> = +25°C, unless otherwise specified.)**

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	Supply Voltage	-	2.0	5.5	V
V <sub>I</sub>	Input Voltage	-	0	5.5	V
V <sub>O</sub>	Output Voltage	Active Mode	0	V <sub>CC</sub>	V
Δt/ΔV	Input transition Rise or Fall Rate	V <sub>CC</sub> = 3.0V to 3.6V	-	100	ns/V
		V <sub>CC</sub> = 4.5V to 5.5V	-	20	
T <sub>A</sub>	Operating Free-Air Temperature	-	-40	+125	°C

Note: 5. Unused inputs should be held at V<sub>CC</sub> 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			T <sub>A</sub> = -40°C to +85°C		T <sub>A</sub> = -40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
V <sub>IH</sub>	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 <sub>IL</sub>	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 <sub>OH</sub>	High Level Output Voltage	I <sub>OH</sub> = -50μA	2.0V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>OH</sub> = -50μA	3.0V	2.9	3.0	-	2.9	-	2.9	-	
		I <sub>OH</sub> = -50μA	4.5V	4.4	4.5	-	4.4	-	4.4	-	
		I <sub>OH</sub> = -4mA	3.0V	2.58	-	-	2.48	-	2.40	-	
		I <sub>OH</sub> = -8mA	4.5V	3.94	-	-	3.80	-	3.70	-	
V <sub>OL</sub>	Low-level Output Voltage	I <sub>OL</sub> = 50μA	2.0V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>OL</sub> = 50μA	3.0V	-	0	0.1	-	0.1	-	0.1	
		I <sub>OL</sub> = 50μA	4.5V	-	0	0.1	-	0.1	-	0.1	
		I <sub>OL</sub> = 4mA	3.0V	-	-	0.36	-	0.44	-	0.55	
		I <sub>OL</sub> = 8mA	4.5V	-	-	0.36	-	0.44	-	0.55	
I <sub>I</sub>	Input Current	V <sub>I</sub> = GND to 5.5V	5.5V	-	0.1	±0.1	-	±1	-	±2	μA
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND	5.5V	-	-	±0.25	-	±2.5	-	±10	μA
I <sub>CC</sub>	Supply Current	V <sub>I</sub> = GND or V <sub>CC</sub> I <sub>O</sub> = 0	5.5V	-	-	4.0	-	40	-	80	μA
C <sub>i</sub>	Input Capacitance	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5V	-	4	10	-	10	-	10	pF

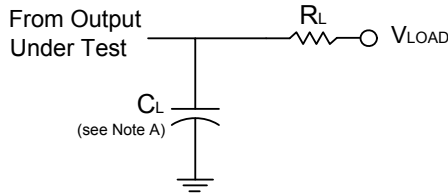
## Switching Characteristics

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> 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 <sub>w</sub> 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 <sub>SU</sub> 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 <sub>H</sub> 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 <sub>REC</sub> 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 <sub>PD</sub> Propagation Delay	SHCP to Q7S	Figure 2	C <sub>L</sub> = 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		
		C <sub>L</sub> = 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 <sub>L</sub> = 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	
		C <sub>L</sub> = 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 <sub>L</sub> = 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	
		C <sub>L</sub> = 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 <sub>EN</sub> Enable Time	OE to Qn	Figure 2	C <sub>L</sub> = 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	
		C <sub>L</sub> = 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 <sub>DIS</sub> Disable Time	OE to Qn	Figure 2	C <sub>L</sub> = 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	
		C <sub>L</sub> = 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<sub>A</sub> = +25°C, unless otherwise specified.)

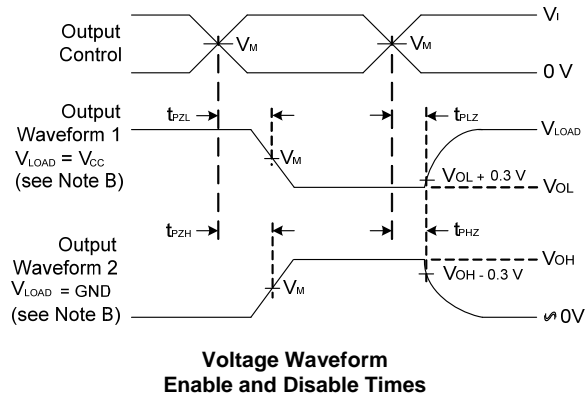
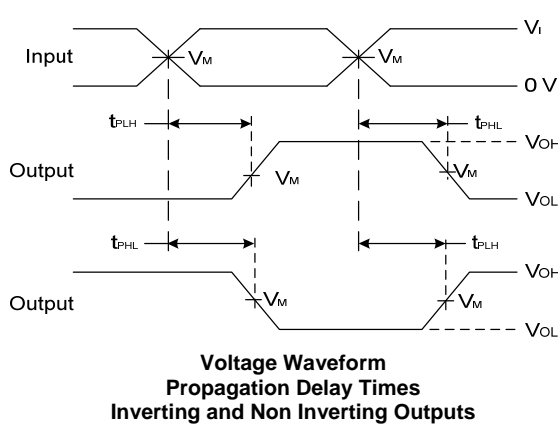
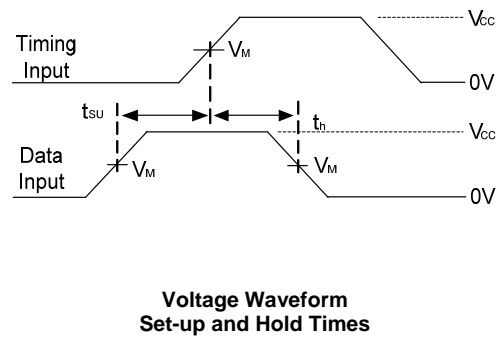
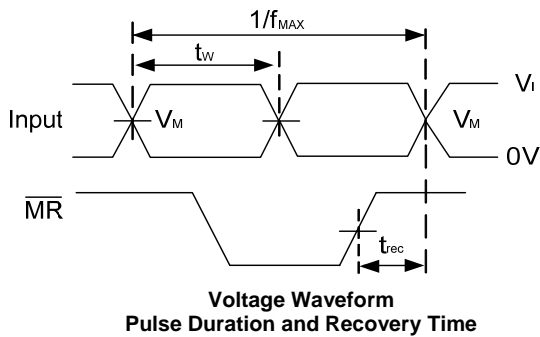
Parameter		Test Conditions	V <sub>CC</sub> = 5V	Unit
			Typ	
C <sub>pd</sub>	Power dissipation capacitance	f = 1 MHz all outputs switching-no load	42	pF

**Parameter Measurement Information**



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

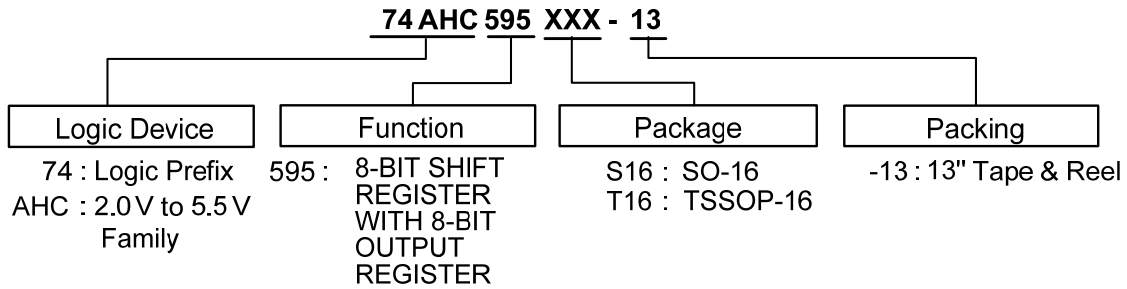
$V_{CC}$	Inputs		$V_M$	$C_L$
	$V_I$	$t_r/t_f$		
3.3V - 3.6V	$V_{CC}$	3ns	$V_{CC}/2$	15pF, 50pF
4.5V to 5.5V	$V_{CC}$	3ns	$V_{CC}/2$	15pF, 50pF



- 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  $\leq 10$  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

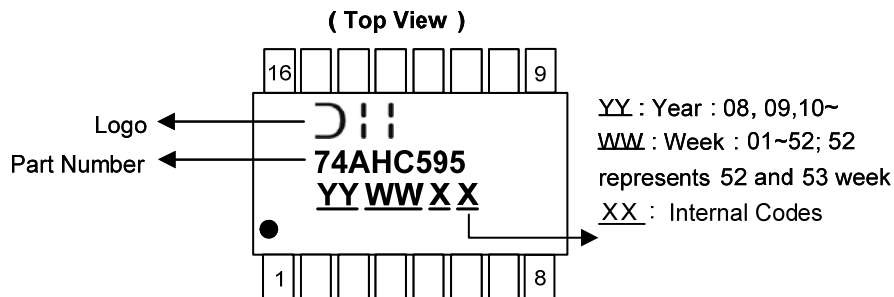


Part Number	Package Code	Packaging	7" Tape and Reel (Note 6)	
			Quantity	Part Number Suffix
74AHC595S16-13	S16	SO-16	2500/Tape & Reel	-13
74AHC595T16-13	T16	TSSOP-16	2500/Tape & Reel	-13

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.)

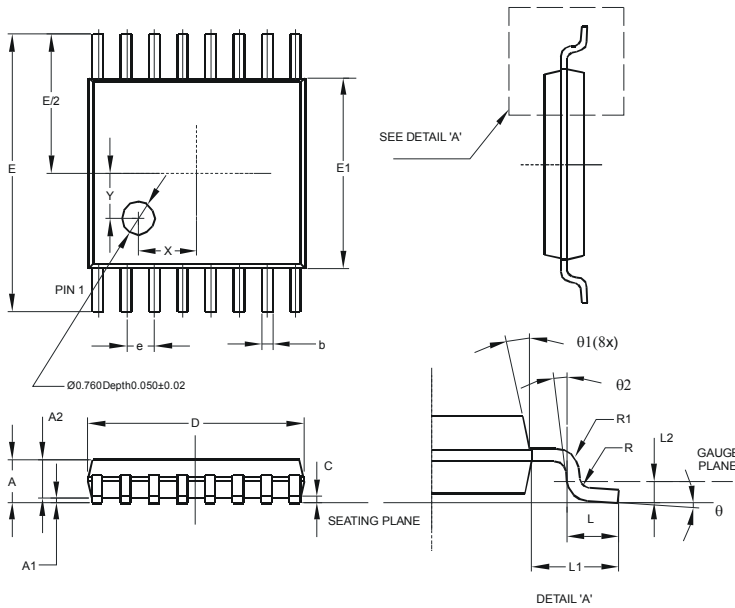
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

**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°
<b>All Dimensions in mm</b>		

**Package Type: TSSOP-16**



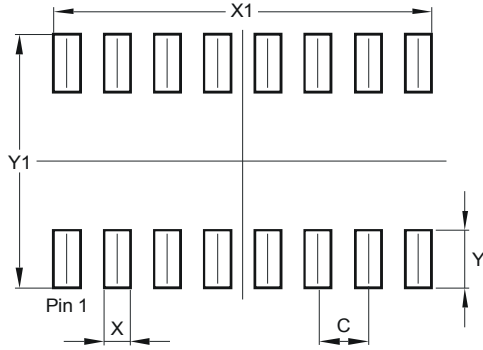
TSSOP-16			
Dim	Min	Max	Typ
A	-	1.08	-
A1	0.05	0.15	-
A2	0.80	0.93	-
b	0.19	0.30	-
c	0.09	0.20	-
D	4.90	5.10	-
E	6.40 BSC		
E1	4.30	4.50	-
e	0.65 BSC		
L	0.45	0.75	-
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	-	-
R1	0.09	-	-
X	-	-	1.350
Y	-	-	1.050
θ	0°	8°	-
θ1	5°	15°	-
θ2	0°	-	-
<b>All Dimensions in mm</b>			



**Suggested Pad Layout**

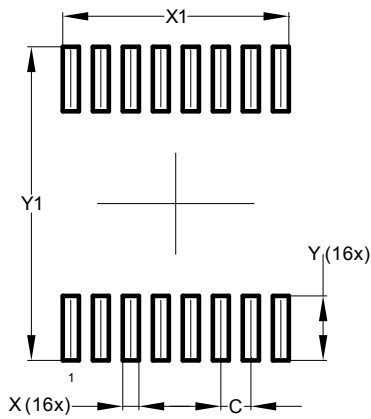
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

**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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