



#### 8-BIT SHIFT REGISTER WITH 8-BIT OUTPUT REGISTER

#### Description

The 74HCT595 is an high speed CMOS device that is designed to be pin compatable with 74LS low power Schottky types.

An eight bit shift register accpets data from the serial input (DS) on each positive transition of the shift register clock (STCP). When asserted low the reset function  $(\overline{\text{MR}})$  sets all shift register values to zero and is indepent of all clocks.

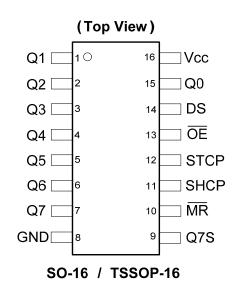
Data from the input serial shift register is placed in the output register with a rising pulse on the storages resister clock (SHCP). With the output enable  $(\overline{OE})$  asserted low the 3-state outputs Q0-Q7 become active and present th

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

- Supply Voltage Range from 4.5V to 5.5V
- Sinks or sources 8mA at V<sub>CC</sub> = 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)

### 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

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 <1000 ppm antimony compounds.

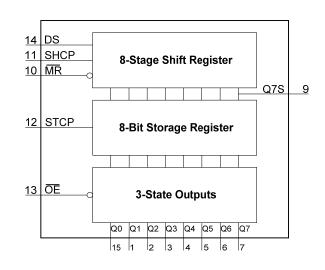
#### **Click for Ordering Information**



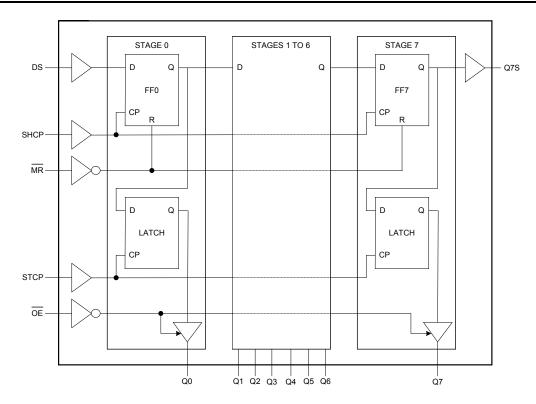
# **Pin Descriptions**

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

# **Functional Diagram**



# Logic Diagram

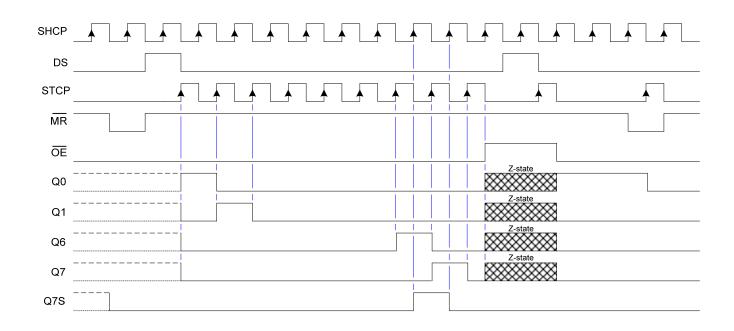




# **Functional Description and Timing Diagram**

	Contr	ol		Input	Οι	utput	Function
SHCP	STCP	OE	MR	DS	Q7S	Qn	Function
x	х	L	L	-	L	NC	Low-level asserted on MR clears shift register Storage register is unchanged
х	↑	L	L	-	L	L	Empty shift register transferred to storage register
х	Х	Н	L	-	L	Z	Shift register remains clear; All Q ouputs in Z state
Î	x	L	Н	_	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	Ţ	L	Н	-	NC	QnS	Contents of shift register copied to storage register With output now in active state, the storage resister contents appear on Q outputs
¢	¢	L	Н	_	Q6S	QnS	Contents of shift register copied to output register then shift register shifted.

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°C, unless otherwise specified.)

Symbol	De	Rating	Unit	
ESD HBM	Human Body Model ESD Protect	ion	2	kV
ESD CDM	Charged Device Model ESD Prot	tection	1	kV
ESD MM	Machine Model ESD Protection		200	V
V <sub>CC</sub>	Supply Voltage Range		-0.5 to +7.0	V
VI	Input Voltage Range		-0.5 to +7.0	V
Vo	Voltage applied to output in high	or low state	-0.3 to V <sub>CC</sub> +0.5	V
l <sub>IK</sub>	Input Clamp Current VI < -0.5	V	-20	mA
l <sub>IK</sub>	Input Clamp Current VI > Vcc	+0.5V	20	mA
Ι <sub>ΟΚ</sub>	Output Clamp Current V <sub>O</sub> < -0.4	5V	-20	mA
Іок	Output Clamp Current Vo > Vo	c + 0.5V	20	mA
		Q7 standard output	+/- 25	mA
Ι <sub>Ο</sub>	Continuous output current	Qn bus driver outputs	+/- 35	mA
Icc	Continuous current through V <sub>CC</sub>	or GND	70	mA
I <sub>GND</sub>	Continuous current through V <sub>CC</sub>	-70	mA	
TJ	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°C, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	Supply Voltage	_	4.5	5.5	V
VI	Input Voltage	_	0	5.5	V
Vo	Output Voltage	Active Mode	0	V <sub>CC</sub>	V
$\Delta t / \Delta V$	Input transition rise or fall rate	$V_{CC}$ = 4.5V to 5.5V	-	100	ns/V
T <sub>A</sub>	Operating free-air temperature	_	-40	125	°C

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



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

Symbol	Parameter	Test Conditions	V <sub>cc</sub>			T <sub>A</sub> = +25°C°C		T <sub>A</sub> = -40°C°C to +85°C°C		T <sub>A</sub> = -40°C°C to +125°C°C		Unit
-				Min	Тур	Max	Min	Max	Min	Max		
V <sub>IH</sub>	High-Level Input Voltage	-	4.5V to 5.5V	2.0	_	-	2.0	-	2.0	-	V	
V <sub>IL</sub>	Low-Level Input Voltage	-	4.5V to 5.5V	_	_	0.8	_	0.8	-	0.8	v	
	High-Level Output Voltage	I <sub>OH</sub> = -20μA All outputs	4.5V	4.4	4.5	-	4.4	_	4.4	-		
V <sub>OH</sub>	Q7S output	I <sub>OH</sub> = -4mA	4.5V	3.84	4.32	-	4.32	-	3.7	-	V	
	Qn Bus Outputs	I <sub>OH</sub> = -6.0mA	4.5V	3.7	4.32	-	4.32	-	3.7	-		
	Low-Level Output Voltage	I <sub>OL</sub> = 20μA All outputs	4.5V	_	0	0.1	-	0.1	-	0.1		
V <sub>OL</sub>	Q7S output	I <sub>OL</sub> = 4mA	4.5V	-	0.15	0.33	_	0.33	-	0.4	V	
	Qn Bus Outputs	I <sub>OL</sub> = 6.0mA	4.5V	_	.016	0.33	_	0.33	-	0.4		
I <sub>I</sub>	Input Current	V <sub>I</sub> =GND to 5.5V	5.5V	_	_	±0.1	_	± 1	-	± 1	μA	
I <sub>OZ</sub>	OFF-state output current	Qn internal high or low. V <sub>o</sub> =Vcc or Gnd	5.5V	_	_	± 5	_	± 5	_	± 10	μA	
Icc	Supply Current	$V_{I} = GND \text{ or } V_{CC}$ $I_{O}=0$	5.5V	_	_	8.0	-	80	_	160	μΑ	
Δlcc	Additional Supply Current per Input	V <sub>I</sub> = V <sub>cc</sub> -2.1V I <sub>O</sub> =0	4.5V to 5.5V	_	100	450	_	450	_	490	μA	
Ci	Input Capacitance	$V_i = V_{CC}$ or GND	5.5V	-	4	10	_	10	_	10	pF	

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

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

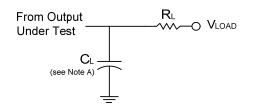


# **Switching Characteristics**

Symbol /	Pins	Test	V <sub>cc</sub>	T	a= +25°℃	°C	-	°C to °C°C	-	°C to °C°C	Unit
Parameter		Conditions		Min	Тур.	Мах	Min	Max	Min	Мах	
f <sub>MAX</sub> Maximum Frequency	SHCP or STCP	Figure 1	4.5V to 5.5V	30	52	_	24	_	20	_	MHz
	SHCP HIGH or LOW	Figure 1	4.5V to 5.5V	16	6	_	20	_	24	_	
t <sub>₩</sub> Pulse Width	STCP HIGH or LOW	Figure 1	4.5V to 5.5V	16	5	-	20	_	24	-	ns
	MR LOW	Figure 1	4.5V to 5.5V	20	8	-	25	-	30	_	
tsu	DS to SHCP	Figure 1	4.5V to 5.5V	16	5	-	20	_	24	_	ns
Set-up Time	SHCP to STCP	Figure 1	4.5V to 5.5V	16	8	_	20	_	24	_	ns
t <sub>н</sub> Hold Time	DS to SHCP	Figure 1	4.5V to 5.5V	3	-2	_	3	-	3	_	ns
t <sub>REC</sub> Recovery Time	MR to SHCP	Figure 1	4.5V to 5.5V	10	-7	-	13	-	15	-	ns
	SHCP to Q7S	Figure 1 C <sub>L</sub> =50pF	4.5V to 5.5V	-	25	42	_	53	_	63	ns
t <sub>PD</sub> Propagation Delay	STCP to Qn	Figure 1 C <sub>L</sub> =50pF	4.5V to 5.5V	-	24	40	-	50	_	60	ns
	MR to Q7S	Figure 1 C <sub>L</sub> =50pF	4.5V to 5.5V	-	23	40	-	50	_	60	ns
t <sub>EN</sub> Enable Time	OE to Qn	Figure 1 C∟=50pF	4.5V to 5.5V	-	21	35	-	44	_	53	ns
t <sub>DIS</sub> Disable Time	OE to Qn	Figure 1 C <sub>L</sub> =50pF	4.5V to 5.5V	-	18	30	-	38	_	45	ns

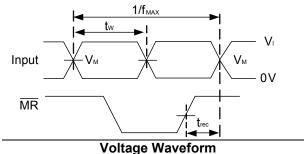


### **Parameter Measurement Information**

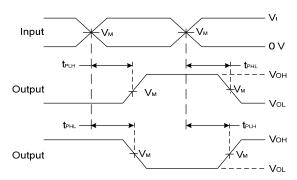


TEST	Vload
t <sub>PLH</sub> /t <sub>PHL</sub>	Open
t <sub>PLZ</sub> /t <sub>PZL</sub>	V <sub>CC</sub>
t <sub>PHZ</sub> /t <sub>PZH</sub>	GND

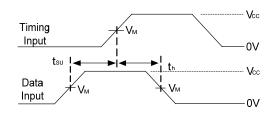
V <sub>cc</sub>	Inputs		v	M	CL
	VI	t <sub>r</sub> /t <sub>f</sub>	Input	Output	
4.5V to 5.5V	3.0V	3ns	1.5V	V <sub>cc</sub> /2	15pF, 50pF



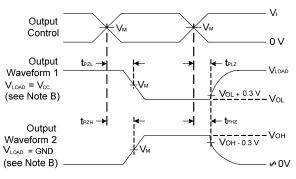
**Pulse Duration and Recovery Time** 



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



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



Voltage Waveform **Enable and Disable Times** 

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.

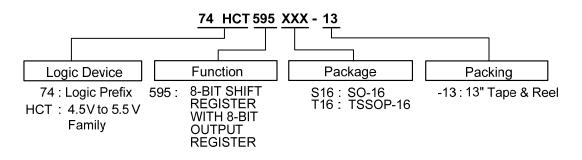
- C. All pulses are supplied at pulse repetition rate  $\leq$  10 MHz
- D. Inputs are measured separately one transition per measurement

E. t<sub>PLH</sub> and t<sub>PHL</sub> are the same as t<sub>PD</sub>

#### Figure 1. Load Circuit and Voltage Waveforms



## Ordering Information

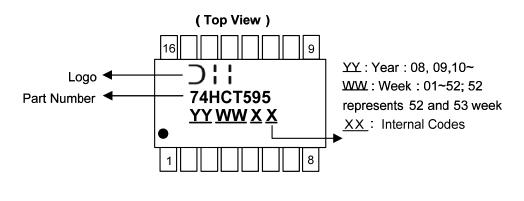


Device	Baakaga Cada	Packaging	7" Tape and	l Reel(Note 6)
Device	Package Code		Quantity	Part Number Suffix
74HCT595S16-13	S16	SO-16	2500/Tape & Reel	-13
74HCT595T16-13	T16	TSSOP-16	2500/Tape & Reel	-13

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

## **Marking Information**

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



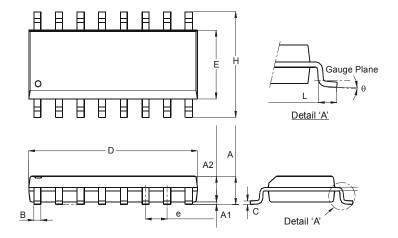
Part Number	Package
74HCT595S16	SO-16
74HCT595T16	TSSOP-16



#### Package Outline Dimensions (All Dimensions in mm)

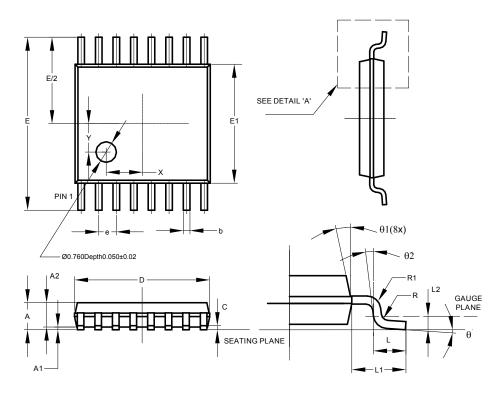
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.

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



	SO-16	
Dim	Min	Max
Α	1.40	1.75
A1	0.10	0.25
A2	1.30	1.50
В	0.33	0.51
С	0.19	0.25
D	9.80	10.00
ш	3.80	4.00
e	1.27	Тур
Н	5.80	6.20
L	0.38	1.27
Θ	0°	8°
All D	imension	s in mm

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



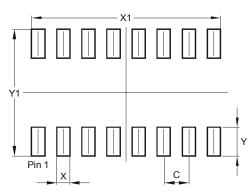
TSSOP-16				
Dim	Min	Max	Тур	
Α	-	1.08	-	
A1	0.05	0.15	-	
A2	0.80	0.93	-	
b	0.19	0.30	-	
с	0.09	0.20	-	
D	4.90	5.10	-	
ш	6.40 BSC			
E1	4.30	4.50	-	
e	0.65 BSC			
L	0.45	0.75	-	
L1	1.00 REF			
L2	0.25 BSC			
R	0.09	-	-	
R1	0.09	-	-	
х	-	-	1.350	
Y	-	-	1.050	
Θ	0°	8°	-	
01	5°	15°	-	
Θ2	0°	-	-	
All Dimensions in mm				



# Suggested Pad Layout

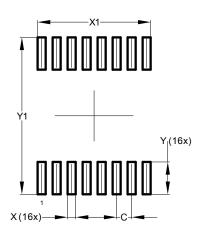
Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for the latest version.

#### Package Type: SO-16



Dimensions	Value (in mm)	
С	1.270	
Х	0.670	
X1	9.560	
Y	1.450	
Y1	6.400	

Package Type: TSSOP-16



Dimensions	Value (in mm)	
С	0.650	
Х	0.350	
X1	4.900	
Y	1.400	
Y1	6.800	



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