

8-BIT SHIFT REGISTER WITH 8-BIT OUTPUT REGISTER

Description

The 74HCT595 is an 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 (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 the

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.

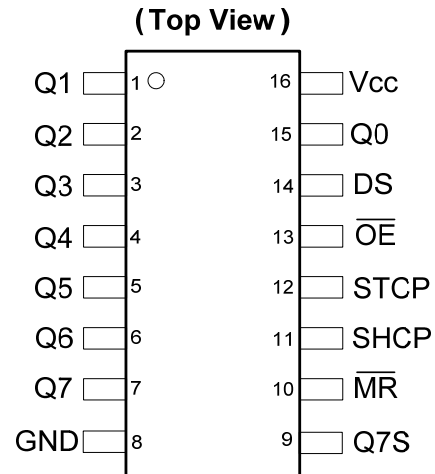
Features

- Supply Voltage Range from 4.5V to 5.5V
- Sinks or sources 8mA at $V_{CC} = 4.5V$
- 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/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.

Pin Assignments



SO-16 / TSSOP-16

Applications

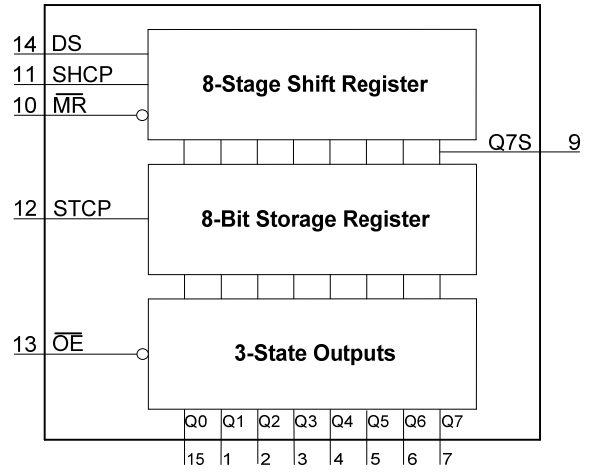
- General Purpose Logic
- Serial to Parallel Data conversion
- Capture and hold data for extended periods of time.
- Allow simple serial bit streams from a microcontroller to control as many peripheral lines as needed.
- Wide array of products such as:
 - Computer peripherals
 - Appliances
 - Industrial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

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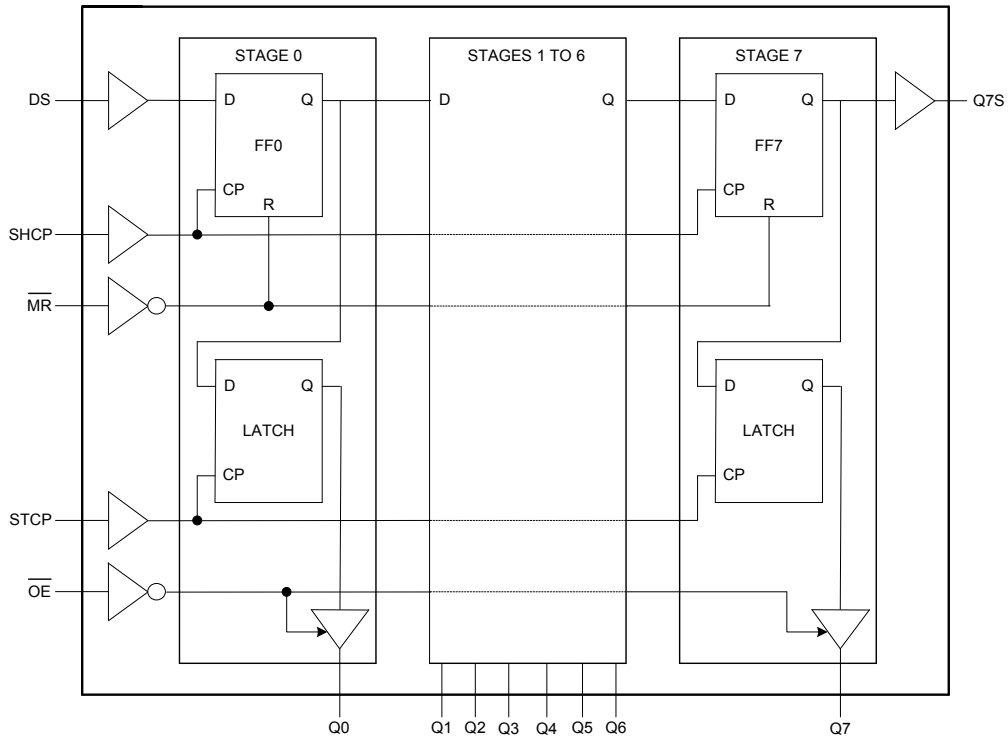
Pin Descriptions

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{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



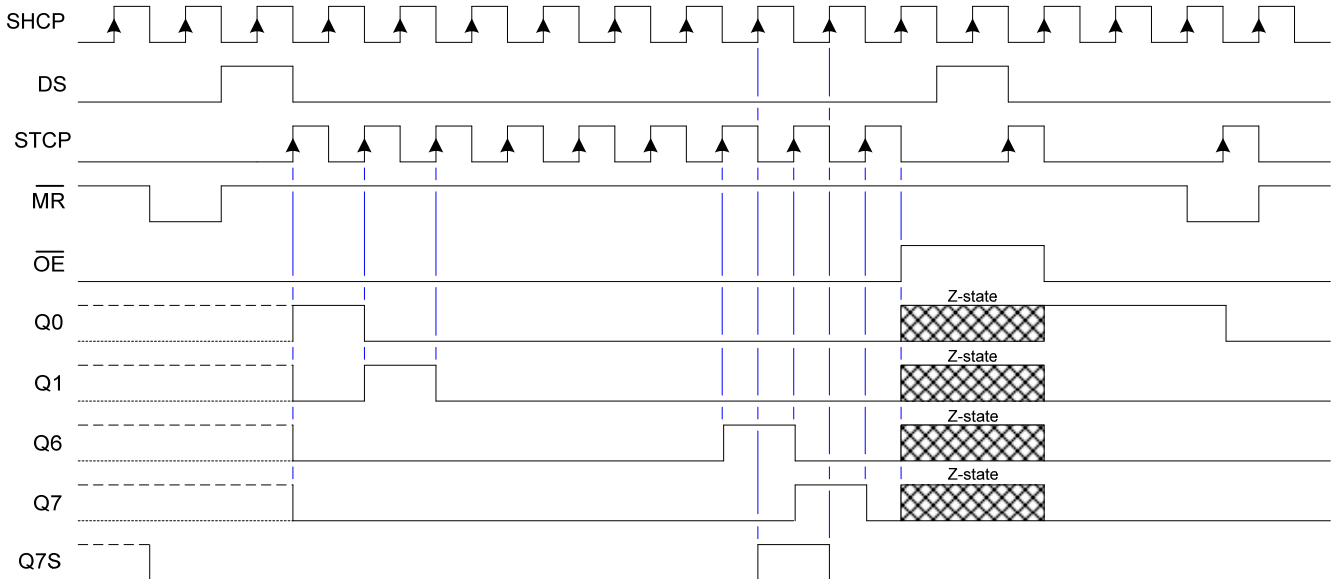
Logic Diagram



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	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) (@ $T_A = +25^{\circ}\text{C}$, 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 $V_I < -0.5\text{V}$	-20	mA	
I_{IK}	Input Clamp Current $V_I > V_{CC} + 0.5\text{V}$	20	mA	
I_{OK}	Output Clamp Current $V_O < -0.5\text{V}$	-20	mA	
I_{OK}	Output Clamp Current $V_O > V_{CC} + 0.5\text{V}$	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} or GND	70	mA	
I_{GND}	Continuous current through V_{CC} or 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	

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) (@ $T_A = +25^{\circ}\text{C}$, 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	$V_{CC} = 4.5\text{V to } 5.5\text{V}$	-	100	ns/V
T_A	Operating free-air temperature	-	-40	125	$^{\circ}\text{C}$

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

Electrical Characteristics (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

Symbol	Parameter	Test Conditions	V_{CC}	$T_A = +25^\circ\text{C}$			$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$		$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$		Unit
				Min	Typ	Max	Min	Max	Min	Max	
V_{IH}	High-Level Input Voltage	–	4.5V to 5.5V	2.0	–	–	2.0	–	2.0	–	V
V_{IL}	Low-Level Input Voltage	–	4.5V to 5.5V	–	–	0.8	–	0.8	–	0.8	V
V_{OH}	High-Level Output Voltage	$I_{OH} = -20\mu\text{A}$ All outputs	4.5V	4.4	4.5	–	4.4	–	4.4	–	V
	Q7S output	$I_{OH} = -4\text{mA}$	4.5V	3.84	4.32	–	4.32	–	3.7	–	
	Qn Bus Outputs	$I_{OH} = -6.0\text{mA}$	4.5V	3.7	4.32	–	4.32	–	3.7	–	
V_{OL}	Low-Level Output Voltage	$I_{OL} = 20\mu\text{A}$ All outputs	4.5V	–	0	0.1	–	0.1	–	0.1	V
	Q7S output	$I_{OL} = 4\text{mA}$	4.5V	–	0.15	0.33	–	0.33	–	0.4	
	Qn Bus Outputs	$I_{OL} = 6.0\text{mA}$	4.5V	–	.016	0.33	–	0.33	–	0.4	
I_I	Input Current	$V_I = \text{GND}$ to 5.5V	5.5V	–	–	± 0.1	–	± 1	–	± 1	μA
I_{OZ}	OFF-state output current	Qn internal high or low. $V_O = V_{CC}$ or Gnd	5.5V	–	–	± 5	–	± 5	–	± 10	μA
I_{CC}	Supply Current	$V_I = \text{GND}$ or V_{CC} $I_O = 0$	5.5V	–	–	8.0	–	80	–	160	μA
ΔI_{CC}	Additional Supply Current per Input	$V_I = V_{CC} - 2.1\text{V}$ $I_O = 0$	4.5V to 5.5V	–	100	450	–	450	–	490	μA
C_i	Input Capacitance	$V_I = V_{CC}$ or GND	5.5V	–	4	10	–	10	–	10	pF

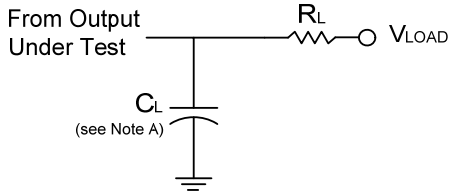
Operating Characteristics (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

Parameter	Test Conditions	$V_{CC} = 5\text{V}$	Unit
		TYP	
C_{pd}	Power dissipation capacitance $f = 1\text{ MHz}$ all outputs switching-no load	42	pF

Switching Characteristics

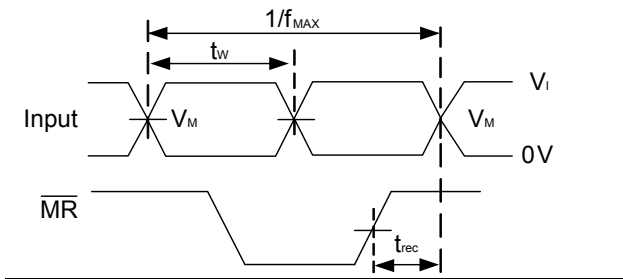
Symbol / Parameter	Pins	Test Conditions	V _{CC}	T _A = +25°C			-40°C to +85°C		-40°C to +125°C		Unit
				Min	Typ.	Max	Min	Max	Min	Max	
f _{MAX} Maximum Frequency	SHCP or STCP	Figure 1	4.5V to 5.5V	30	52	–	24	–	20	–	MHz
t _w Pulse Width	SHCP HIGH or LOW	Figure 1	4.5V to 5.5V	16	6	–	20	–	24	–	ns
	STCP HIGH or LOW	Figure 1	4.5V to 5.5V	16	5	–	20	–	24	–	
	$\overline{\text{MR}}$ LOW	Figure 1	4.5V to 5.5V	20	8	–	25	–	30	–	
t _{su} Set-up Time	DS to SHCP	Figure 1	4.5V to 5.5V	16	5	–	20	–	24	–	ns
	SHCP to STCP	Figure 1	4.5V to 5.5V	16	8	–	20	–	24	–	ns
t _H Hold Time	DS to SHCP	Figure 1	4.5V to 5.5V	3	-2	–	3	–	3	–	ns
t _{REC} Recovery Time	$\overline{\text{MR}}$ to SHCP	Figure 1	4.5V to 5.5V	10	-7	–	13	–	15	–	ns
t _{PD} Propagation Delay	SHCP to Q7S	Figure 1 C _L =50pF	4.5V to 5.5V	–	25	42	–	53	–	63	ns
	STCP to Qn	Figure 1 C _L =50pF	4.5V to 5.5V	–	24	40	–	50	–	60	ns
	$\overline{\text{MR}}$ to Q7S	Figure 1 C _L =50pF	4.5V to 5.5V	–	23	40	–	50	–	60	ns
t _{EN} Enable Time	$\overline{\text{OE}}$ to Qn	Figure 1 C _L =50pF	4.5V to 5.5V	–	21	35	–	44	–	53	ns
t _{DIS} Disable Time	$\overline{\text{OE}}$ to Qn	Figure 1 C _L =50pF	4.5V to 5.5V	–	18	30	–	38	–	45	ns

Parameter Measurement Information

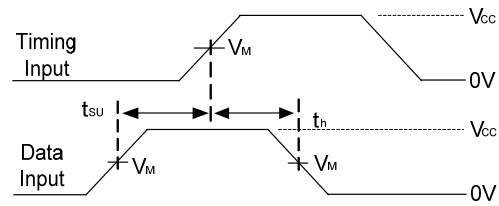


TEST	Vload
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{CC}
t_{PHZ}/t_{PZH}	GND

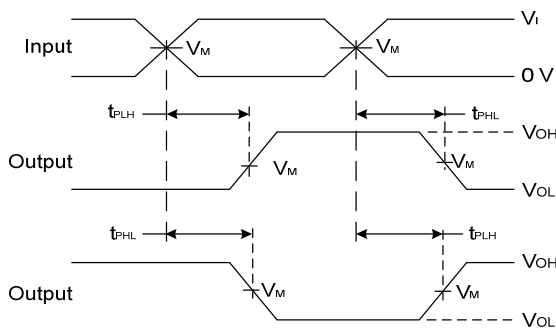
V_{CC}	Inputs		V_M		C_L
	V_I	t_r/t_f	Input	Output	
4.5V to 5.5V	3.0V	3ns	1.5V	$V_{CC}/2$	15pF, 50pF



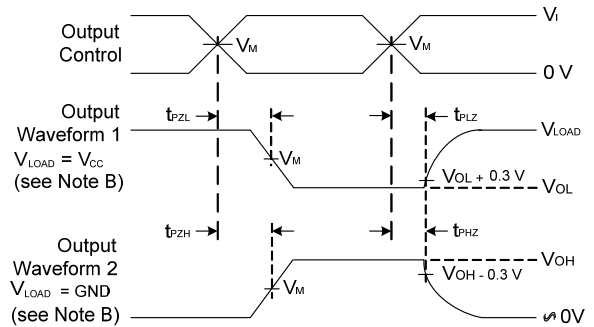
Voltage Waveform Pulse Duration and Recovery Time



Voltage Waveform Set-up and Hold Times



Voltage Waveform Propagation Delay Times Inverting and Non Inverting Outputs

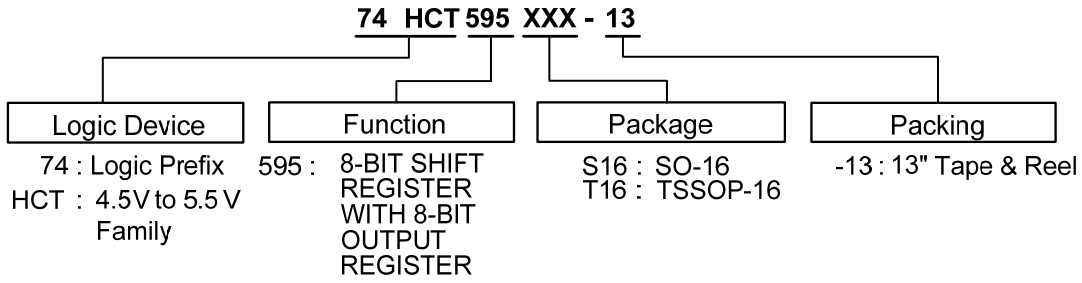


Voltage Waveform Enable and Disable Times

- 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 ≤ 10 MHz
 D. Inputs are measured separately one transition per measurement
 E. t_{PLH} and t_{PHL} are the same as t_{PD}

Figure 1. Load Circuit and Voltage Waveforms

Ordering Information

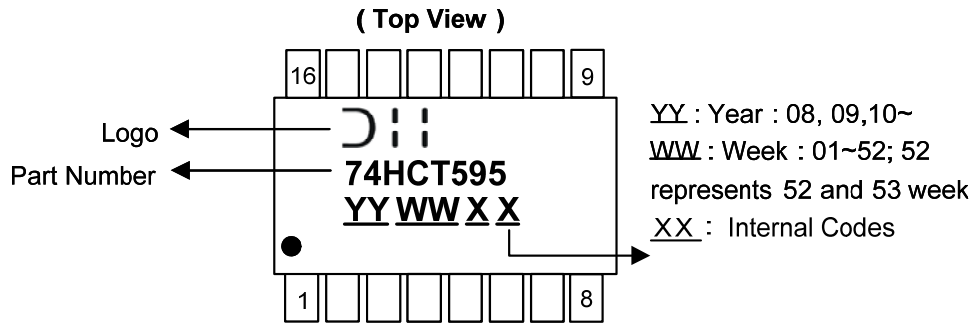


Device	Package Code	Packaging	7" Tape and Reel(Note 6)	
			Quantity	Part Number Suffix
74HCT595S16-13	S16	SO-16	2500/Tape & Reel	-13
74HCT595T16-13	T16	TSSOP-16	2500/Tape & Reel	-13

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

Marking Information

(1) SO-16, TSSOP-16

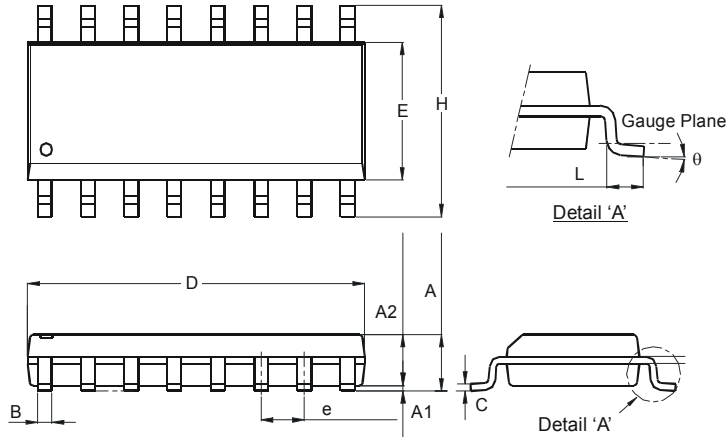


Part Number	Package
74HCT595S16	SO-16
74HCT595T16	TSSOP-16

Package Outline Dimensions (All Dimensions in mm)

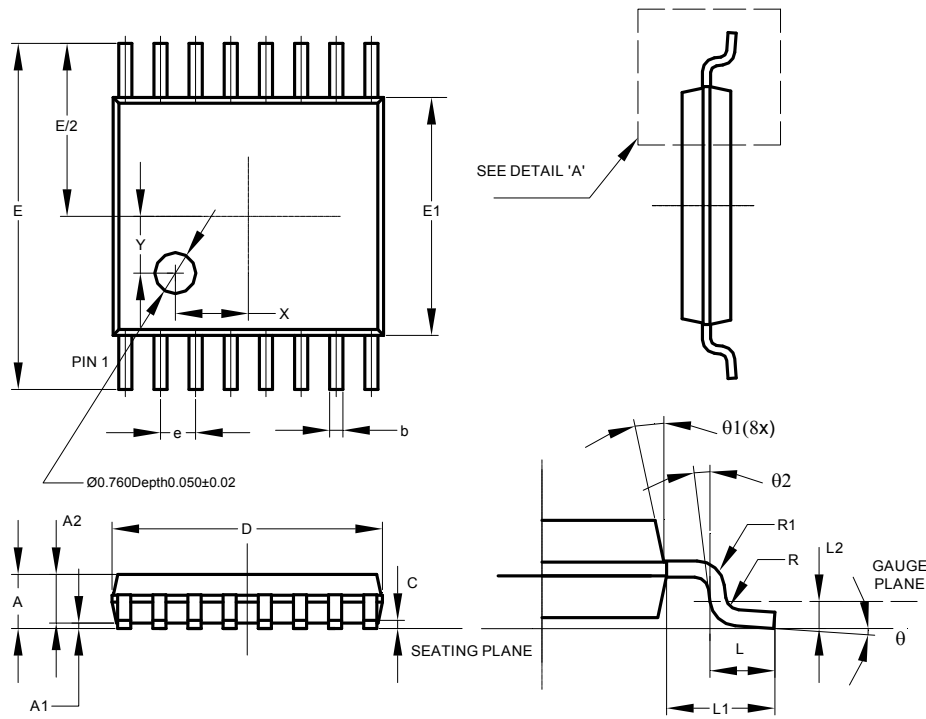
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

(1) Package Type: SO-16



SO-16		
Dim	Min	Max
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		

(2) Package Type: TSSOP-16

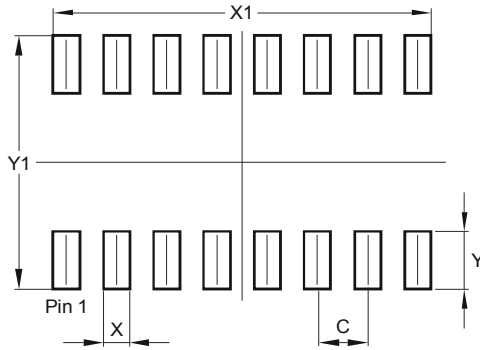


TSSOP-16			
Dim	Min	Max	Typ
A	-	1.08	-
A1	0.05	0.15	-
A2	0.80	0.93	-
b	0.19	0.30	-
c	0.09	0.20	-
D	4.90	5.10	-
E	6.40 BSC		
E1	4.30	4.50	-
e	0.65 BSC		
L	0.45	0.75	-
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	-	-
R1	0.09	-	-
X	-	-	1.350
Y	-	-	1.050
θ	0°	8°	-
θ_1	5°	15°	-
θ_2	0°	-	-
All Dimensions in mm			

Suggested Pad Layout

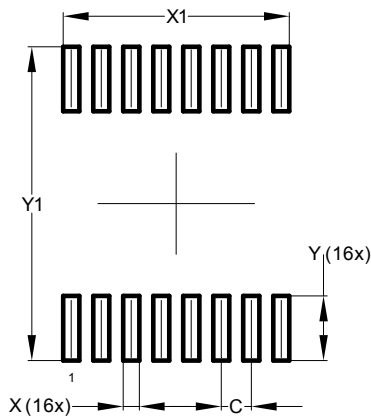
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

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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