

1. General Description

The EM74HC594 is an 8-bit serial-in/serial or parallel-out shift register with a storage register. Separate clock and reset inputs are provided on both shift and storage registers. The device features a serial input (DS) and a serial output (Q7S) to enable cascading. Data is shifted on the LOW-to-HIGH transitions of the SHCP input, and the data in the shift register is transferred to the storage register on a LOW-to-HIGH transition of the STCP input. If both clocks are connected together, the shift register will always be one clock pulse ahead of the storage register. A LOW level on one of the two register reset pins ($\overline{\text{SHR}}$ and $\overline{\text{STR}}$) will clear the corresponding register. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

2. Features and Benefits

- Synchronous serial input and output
- 8-bit parallel output
- Shift and storage registers have independent direct clear and clocks
- Independent clocks for shift and storage registers
- Wide supply voltage range from 2.0 V to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Latch-up performance exceeds 250 mA
- Complies with JEDEC standard:
 - JESD8C(2.7 V to 3.6 V)
 - JESD7A(2.0 V to 6.0 V)
- ESD protection:
 - HBM ANSI/ESDA/JEDEC JS-001 Class 2 exceeds 3500 V
 - CDM ANSI/ESDA/JEDEC JS-002 Class C3 exceeds 2000 V
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Applications

- Serial-to-parallel data conversion
- Remote control holding register

EM74HC594

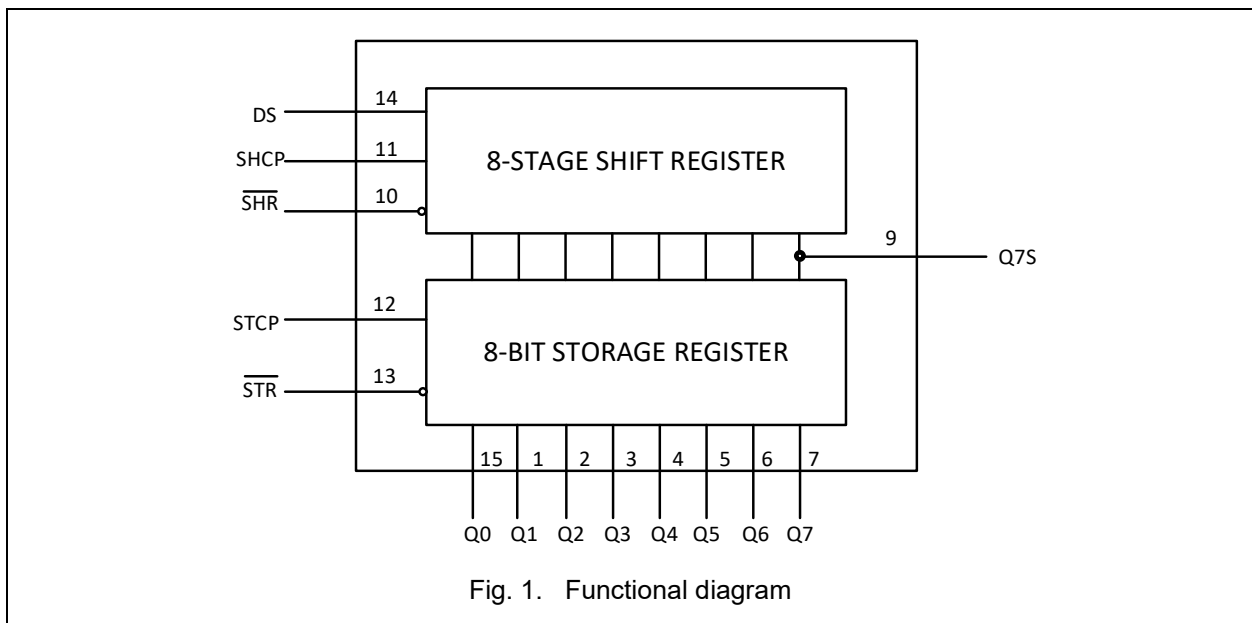
8-bit shift register with output register

4. Ordering Information

Table 1. Ordering information

Type number	Package		
	Name	Description	Quantity
EM74HC594D	SOP-16L	plastic small outline package; 16 leads; body width 3.9 mm	3000
EM74HC594PW	TSSOP-16L	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	3000

5. Function Diagram



EM74HC594

8-bit shift register with output register

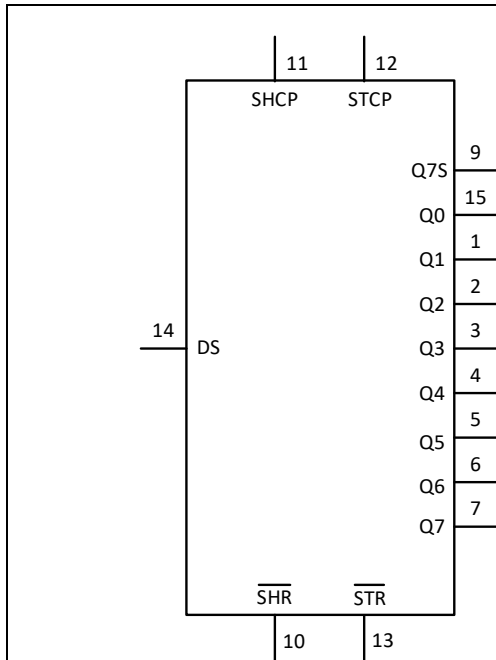


Fig. 2. Logic symbol

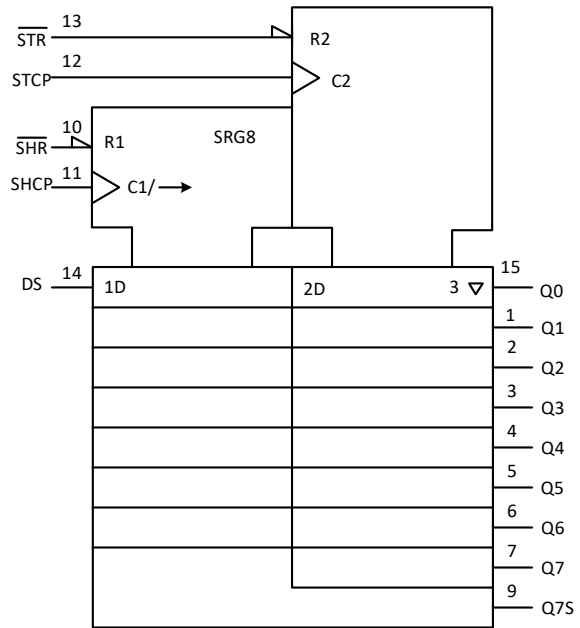


Fig. 3. IEC logic symbol

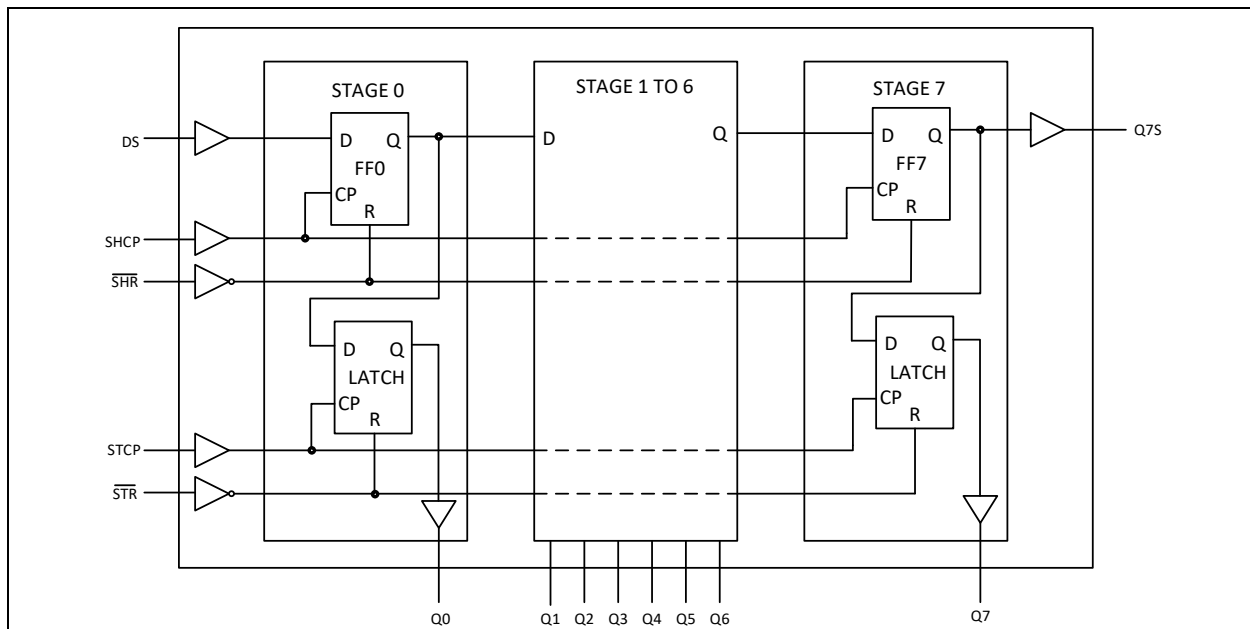
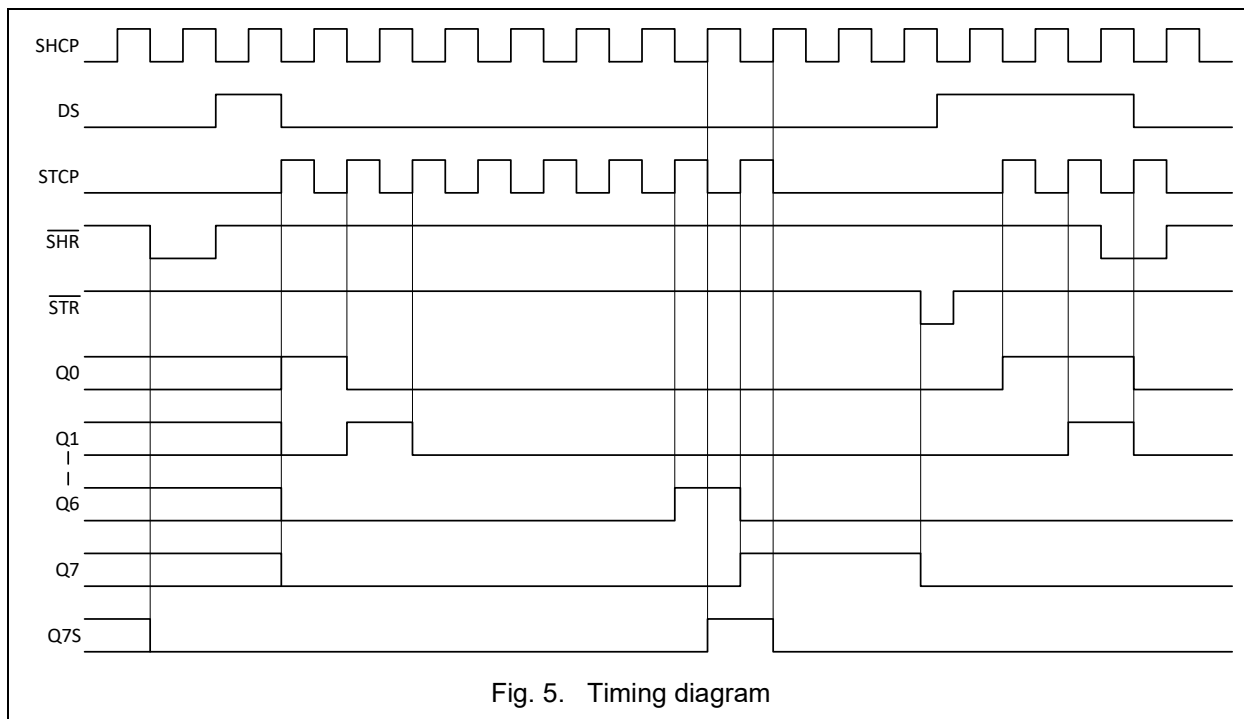


Fig. 4. Logic diagram

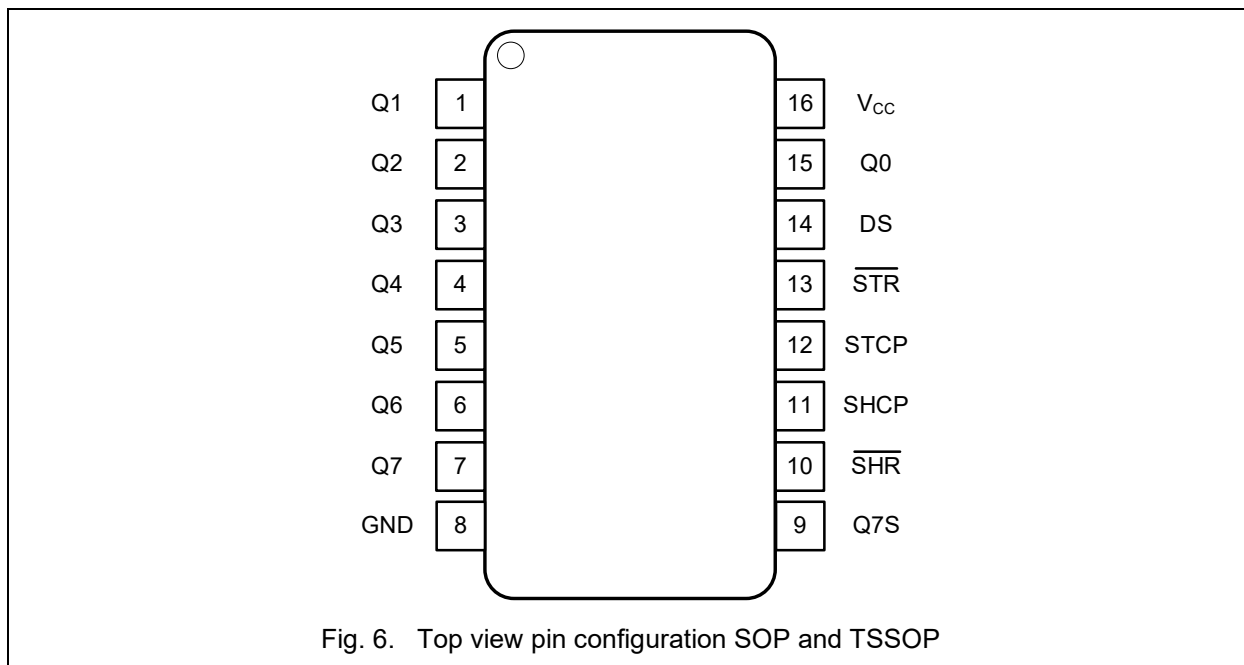
EM74HC594

8-bit shift register with output register



6. Pinning Information

6.1. Pinning



EM74HC594

8-bit shift register with output register

6.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
Q0, Q1, Q2, Q3, Q4, Q5, Q6, Q7	15, 1, 2, 3, 4, 5, 6, 7	Parallel data output
GND	8	Ground (0V)
Q7S	9	Serial data output
$\overline{\text{SHR}}$	10	Shift register reset (active LOW)
SHCP	11	Shift register clock input
STCP	12	Storage register clock input
$\overline{\text{STR}}$	13	Storage register reset (active LOW)
DS	14	Serial data input
V _{CC}	16	Supply voltage

7. Functional Description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; ↑ = LOW-to-HIGH transition; X = don't care.

Input					Function
$\overline{\text{SHR}}$	$\overline{\text{STR}}$	SHCP	STCP	DS	
L	X	X	X	X	Clear shift register
X	L	X	X	X	Clear storage register
H	X	↑	X	H or L	Load DS into shift register stage 0, advance previous stage data to the next stage
X	H	X	↑	X	Transfer shift register data to storage register and outputs Qn
H	H	↑	↑	X	Shift register one count pulse ahead of storage register

8. Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Table 4. Absolute Maximum Ratings

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND.

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-0.5	7.0	V
I_{IK}	input clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1]		± 20	mA
I_{OK}	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1]		± 20	mA
I_O	output current	$-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$		± 35	mA
I_{CC}	supply current			70	mA
I_{GND}	ground current		-70		mA
P_{tot}	total power dissipation	$T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$		500	mW
T_{stg}	storage temperature		-65	150	$^{\circ}\text{C}$

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

9. Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. EnergyMath does not recommend exceeding them or designing to Absolute Maximum Ratings.

Table 5. Recommended Operating Conditions

Symbol	Parameter	Conditions	EM74HC594			Unit
			Min	Typ	Max	
V_{CC}	supply voltage		2.0	5.0	6.0	V
V_I	input voltage		0		V_{CC}	V
V_O	output voltage		0		V_{CC}	V
T_{amb}	ambient temperature		-40	+25	+125	$^{\circ}\text{C}$
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.0\text{ V}$			625	ns/V
		$V_{CC} = 4.5\text{ V}$		1.67	139	ns/V
		$V_{CC} = 6.0\text{ V}$			83	ns/V

10. Static Characteristics

Table 6. Static characteristics

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
V_{IH}	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5			1.5		V
		$V_{CC} = 4.5\text{ V}$	3.15			3.15		V
		$V_{CC} = 6.0\text{ V}$	4.2			4.2		V
V_{IL}	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$			0.5		0.5	V
		$V_{CC} = 4.5\text{ V}$			1.35		1.35	V
		$V_{CC} = 6.0\text{ V}$			1.8		1.8	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}						
		all outputs						
		$I_O = -20\mu\text{A}$; $V_{CC} = 2.0\text{ V}$	1.9			1.9		V
		$I_O = -20\mu\text{A}$; $V_{CC} = 4.5\text{ V}$	4.4			4.4		V
		$I_O = -20\mu\text{A}$; $V_{CC} = 6.0\text{ V}$	5.9			5.9		V
		Q7S output						
		$I_O = -4.0\text{ mA}$; $V_{CC} = 4.5\text{ V}$	3.84			3.7		V
		$I_O = -5.2\text{ mA}$; $V_{CC} = 6.0\text{ V}$	5.34			5.2		V
		Qn bus driver outputs						
		$I_O = -6.0\text{ mA}$; $V_{CC} = 4.5\text{ V}$	3.84			3.7		V
		$I_O = -7.8\text{ mA}$; $V_{CC} = 6.0\text{ V}$	5.34			5.2		V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}						
		all outputs						
		$I_O = 20\mu\text{A}$; $V_{CC} = 2.0\text{ V}$			0.1		0.1	V
		$I_O = 20\mu\text{A}$; $V_{CC} = 4.5\text{ V}$			0.1		0.1	V
		$I_O = 20\mu\text{A}$; $V_{CC} = 6.0\text{ V}$			0.1		0.1	V
		Q7S output						
		$I_O = 4.0\text{ mA}$; $V_{CC} = 4.5\text{ V}$			0.33		0.4	V
		$I_O = 5.2\text{ mA}$; $V_{CC} = 6.0\text{ V}$			0.33		0.4	V
		Qn bus driver outputs						
		$I_O = 6.0\text{ mA}$; $V_{CC} = 4.5\text{ V}$			0.33		0.4	V
		$I_O = 7.8\text{ mA}$; $V_{CC} = 6.0\text{ V}$			0.33		0.4	V

EM74HC594

8-bit shift register with output register

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
I_I	input leakage current	$V_I = V_{CC}$ or GND ; $V_{CC} = 6.0$ V			± 1		± 1	μA
I_{CC}	supply current	$V_I = V_{CC}$ or GND ; $I_O = 0$ A ; $V_{CC} = 6.0$ V			20		40	μA
C_i	input capacitance			6.5				pF

[1] All typical values are measured at $T_{amb} = 25^\circ C$.

11. Dynamic Characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 13.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
t_{pd}	propagation delay	SHCP to Q7S; see Fig. 7 [2]						
		$V_{CC} = 2.0$ V			60		65	ns
		$V_{CC} = 4.5$ V			20		25	ns
		$V_{CC} = 6.0$ V			15		18	ns
		STCP to Qn; see Fig. 8						
		$V_{CC} = 2.0$ V			90		100	ns
		$V_{CC} = 4.5$ V			25		30	ns
		$V_{CC} = 6.0$ V			20		25	ns
t_{PHL}	HIGH to LOW propagation delay	$\overline{SHR}$ to Q7S; see Fig. 11						
		$V_{CC} = 2.0$ V			60		65	ns
		$V_{CC} = 4.5$ V			19		22	ns
		$V_{CC} = 6.0$ V			16		19	ns
		$\overline{STR}$ to Qn; see Fig. 12						
		$V_{CC} = 2.0$ V			60		65	ns
		$V_{CC} = 4.5$ V			19		22	ns
		$V_{CC} = 6.0$ V			16		19	ns

EM74HC594

8-bit shift register with output register

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
t_{THL}	HIGH to LOW output transition time	Q7S; see Fig. 7						
		$V_{CC} = 2.0\text{ V}$			35		37	ns
		$V_{CC} = 4.5\text{ V}$			14		17	ns
		$V_{CC} = 6.0\text{ V}$			13		16	ns
		Qn						
		$V_{CC} = 2.0\text{ V}$			35		37	ns
		$V_{CC} = 4.5\text{ V}$			14		17	ns
		$V_{CC} = 6.0\text{ V}$			13		16	ns
t_{TLH}	LOW to HIGH output transition time	Q7S; see Fig. 7						
		$V_{CC} = 2.0\text{ V}$			35		37	ns
		$V_{CC} = 4.5\text{ V}$			14		17	ns
		$V_{CC} = 6.0\text{ V}$			13		16	ns
		Qn						
		$V_{CC} = 2.0\text{ V}$			35		37	ns
		$V_{CC} = 4.5\text{ V}$			14		17	ns
		$V_{CC} = 6.0\text{ V}$			13		16	ns
t_w	pulse width	SHCP HIGH or LOW; see Fig. 7						
		$V_{CC} = 2.0\text{ V}$	100			110		ns
		$V_{CC} = 4.5\text{ V}$	20			24		ns
		$V_{CC} = 6.0\text{ V}$	17			20		ns
		STCP HIGH or LOW; see Fig. 8						
		$V_{CC} = 2.0\text{ V}$	100			110		ns
		$V_{CC} = 4.5\text{ V}$	20			24		ns
		$V_{CC} = 6.0\text{ V}$	17			20		ns
		$\overline{SHR}$ and $\overline{STR}$ LOW; see Fig.11 and Fig. 12						
		$V_{CC} = 2.0\text{ V}$	100			110		ns
		$V_{CC} = 4.5\text{ V}$	20			24		ns
		$V_{CC} = 6.0\text{ V}$	17			20		ns
t_{su}	set up time	DS to SHCP; see Fig.9						
		$V_{CC} = 2.0\text{ V}$	125			150		ns
		$V_{CC} = 4.5\text{ V}$	25			30		ns
		$V_{CC} = 6.0\text{ V}$	21			26		ns
		$\overline{SHR}$ to STCP; see Fig. 10						
		$V_{CC} = 2.0\text{ V}$	125			150		ns
		$V_{CC} = 4.5\text{ V}$	25			30		ns
		$V_{CC} = 6.0\text{ V}$	21			26		ns
		SHCP to STCP; see Fig.8						
		$V_{CC} = 2.0\text{ V}$	125			150		ns
		$V_{CC} = 4.5\text{ V}$	25			30		ns
		$V_{CC} = 6.0\text{ V}$	21			26		ns

EM74HC594

8-bit shift register with output register

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
t_h	hold time	DS to SHCP; see Fig.9						
		$V_{CC} = 2.0 \text{ V}$	30			35		ns
		$V_{CC} = 4.5 \text{ V}$	6			7		ns
		$V_{CC} = 6.0 \text{ V}$	5			6		ns
t_{rec}	recovery time	$\overline{SHR}$ to SHCP and $\overline{STR}$ to STCP; see Fig. 11 and Fig. 12						
		$V_{CC} = 2.0 \text{ V}$	65			75		ns
		$V_{CC} = 4.5 \text{ V}$	13			15		ns
		$V_{CC} = 6.0 \text{ V}$	11			13		ns
f_{max}	maximum frequency	SHCP or STCP; see Fig. 7 and Fig. 8						
		$V_{CC} = 2.0 \text{ V}$	4.8			4		MHz
		$V_{CC} = 4.5 \text{ V}$	24			20		MHz
		$V_{CC} = 6.0 \text{ V}$	28			24		MHz
C_{PD}	power dissipation capacitance	$f_i = 1 \text{ MHz};$ $V_I = \text{GND to } V_{CC};$ [3]		115				pF

[1] Typical values are measured at $T_{amb} = 25 \text{ °C}$.

[2] t_{pd} is the same as t_{PLH} and t_{PHL} .

[3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:

f_i = input frequency in MHz;

f_o = output frequency in MHz;

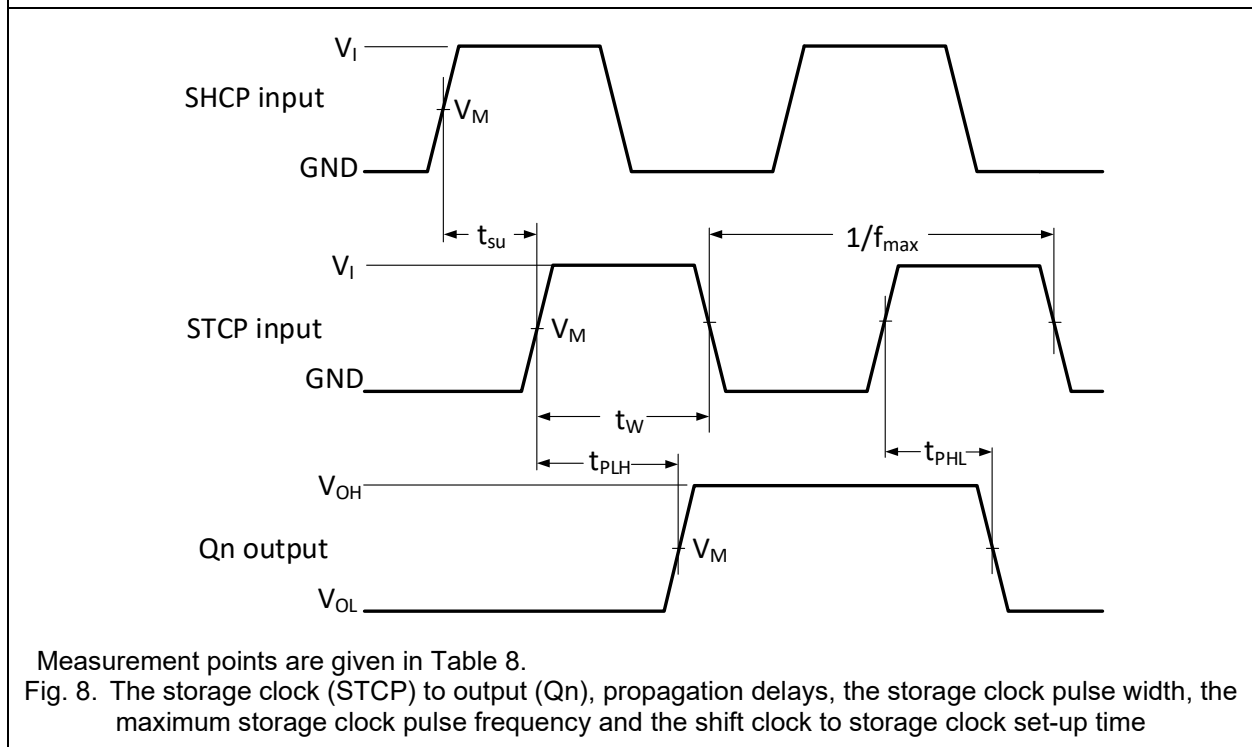
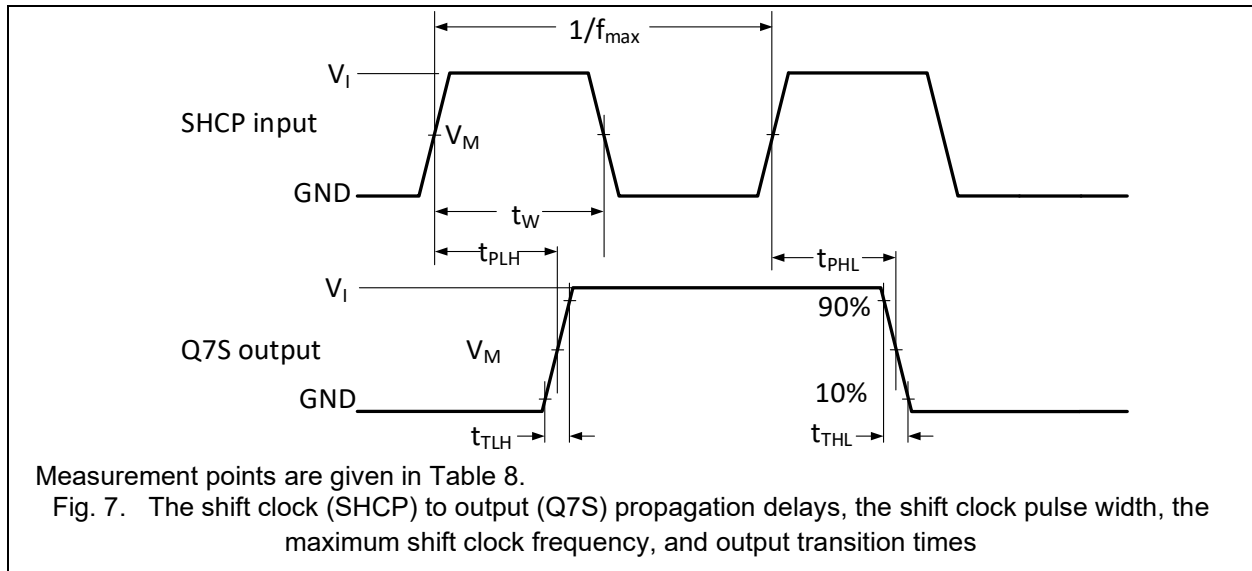
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

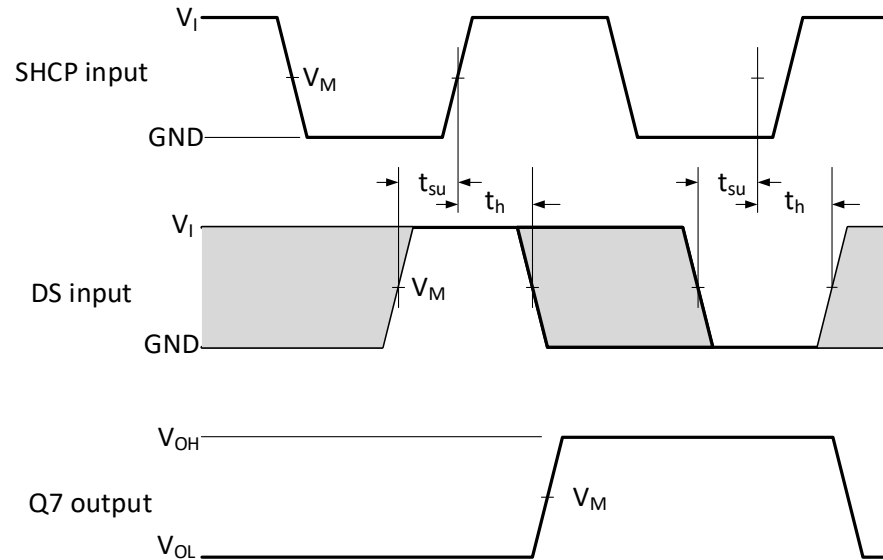
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11.1. Waveforms and test circuit



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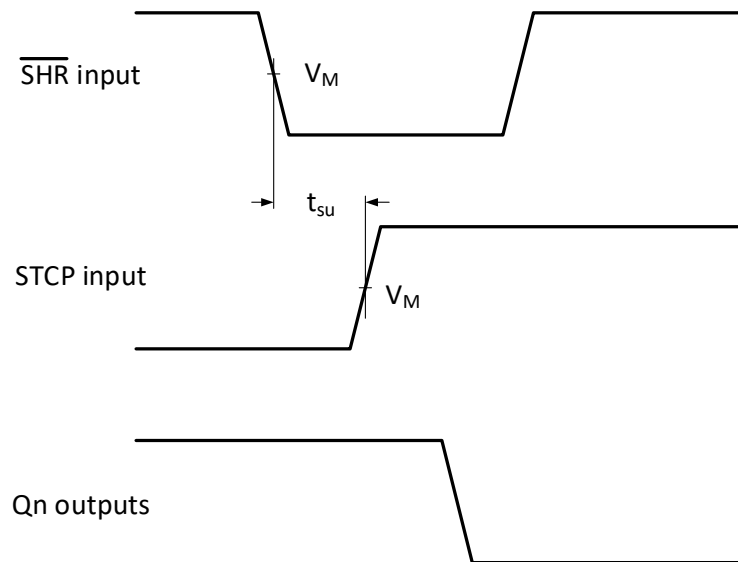
8-bit shift register with output register



Measurement points are given in Table 8.

The shaded areas indicate when the input is permitted to change for predictable output performance.

Fig. 9. Data set up and hold times

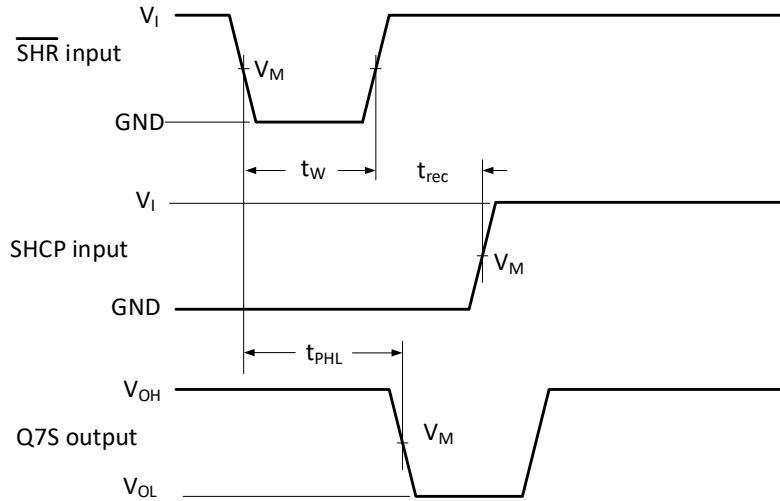


Measurement points are given in Table 8.

Fig. 10. The set-up time shift reset ($\overline{SHR}$) to storage clock (STCP)

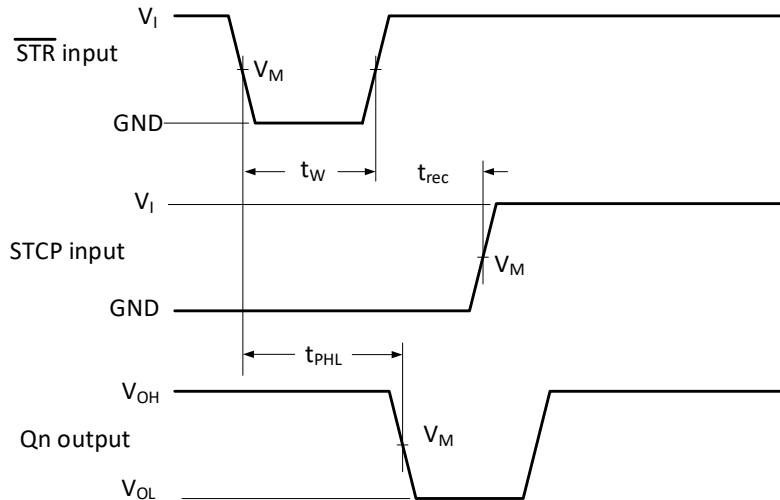
EM74HC594

8-bit shift register with output register



Measurement points are given in Table 8.

Fig. 11. The shift reset ($\overline{\text{SHR}}$) pulse width, the shift reset to output (Q7S) propagation delay and the shift reset to shift clock (SHCP) recovery time



Measurement points are given in Table 8.

Fig. 12. The shift reset ($\overline{\text{STR}}$) pulse width, the shift reset to output (Qn) propagation delay and the shift reset to shift clock (STCP) recovery time

Table 8. Measurement points

Type	Input	Output
	V_M	V_M
EM74HC594	$0.5V_{CC}$	$0.5V_{CC}$

EM74HC594

8-bit shift register with output register

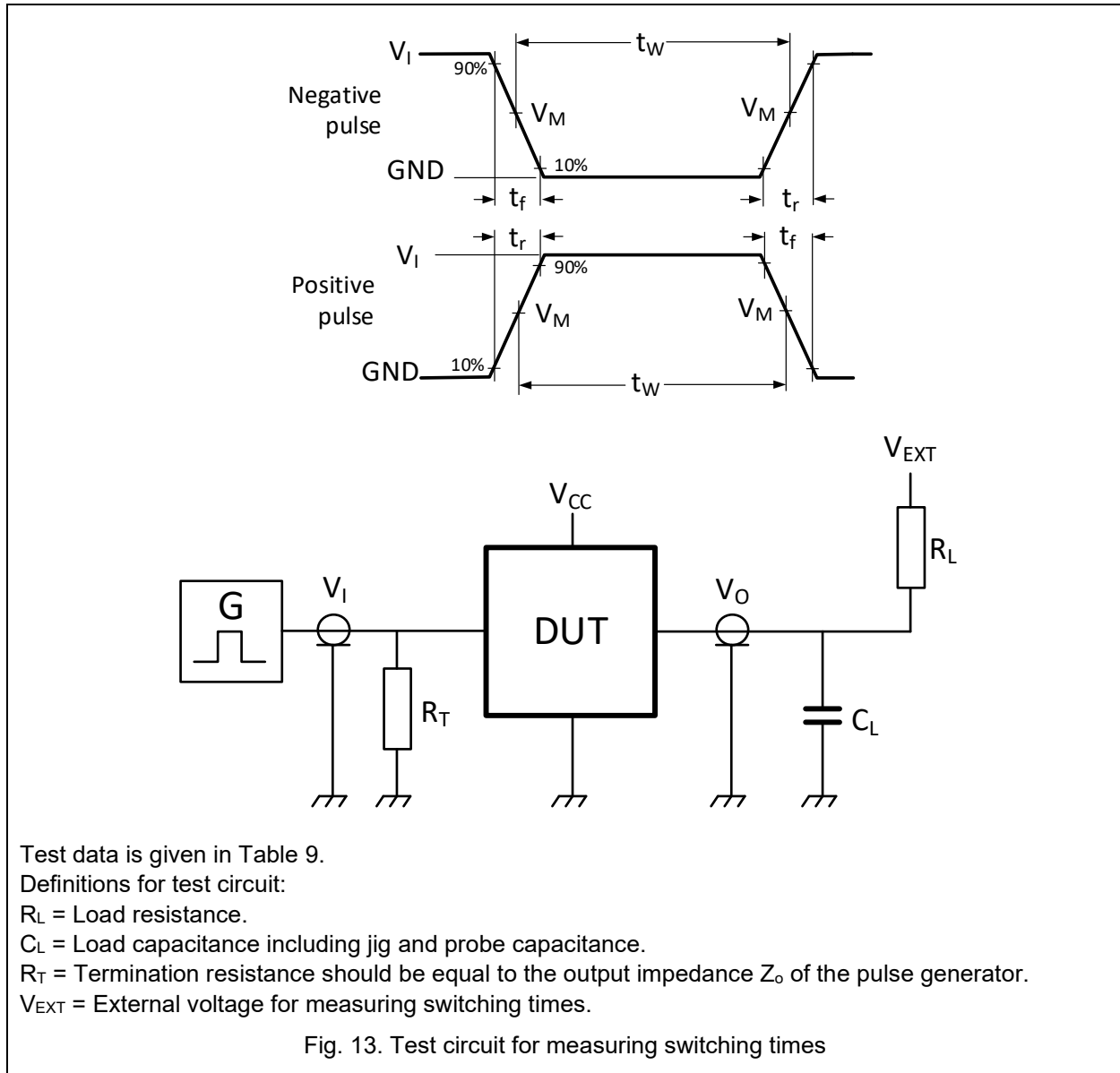
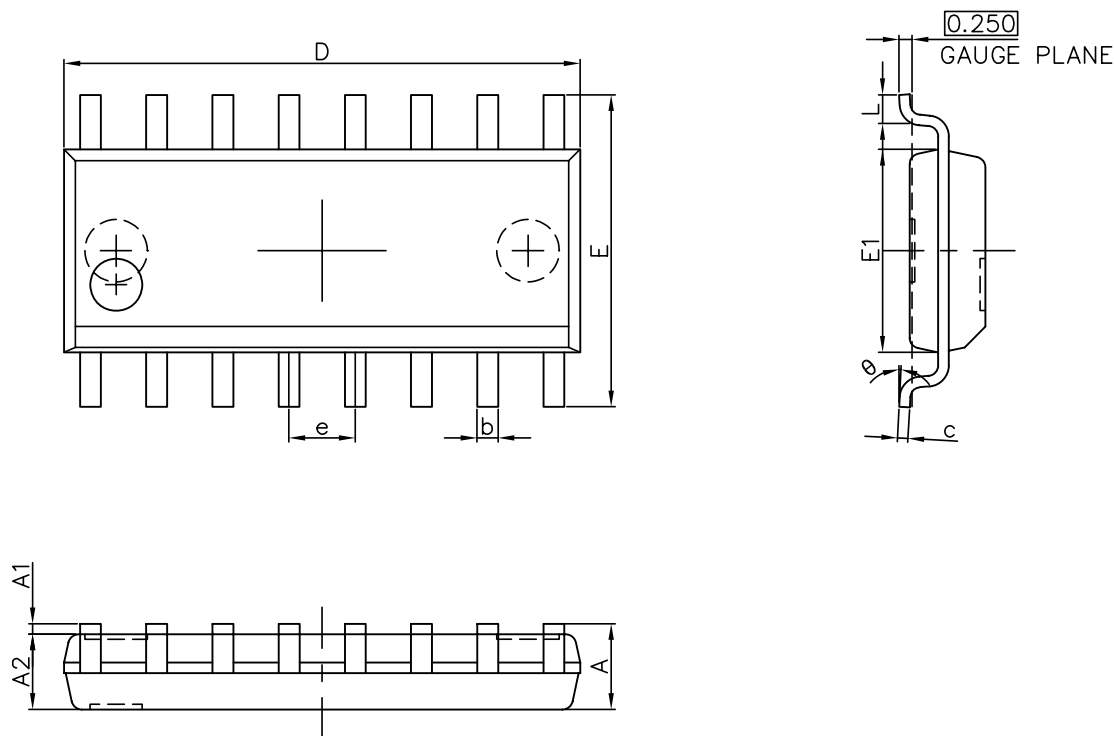


Table 9. Test data

Type	Input		Load		V_{EXT}		
	V_I	$t_r = t_f$	C_L	R_L	t_{PZL}, t_{PLZ}	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}
EM74HC594	V_{CC}	2.5 ns	15 pF	500 Ω	V_{CC}	Open	GND

12. Package Outline

SOP-16L

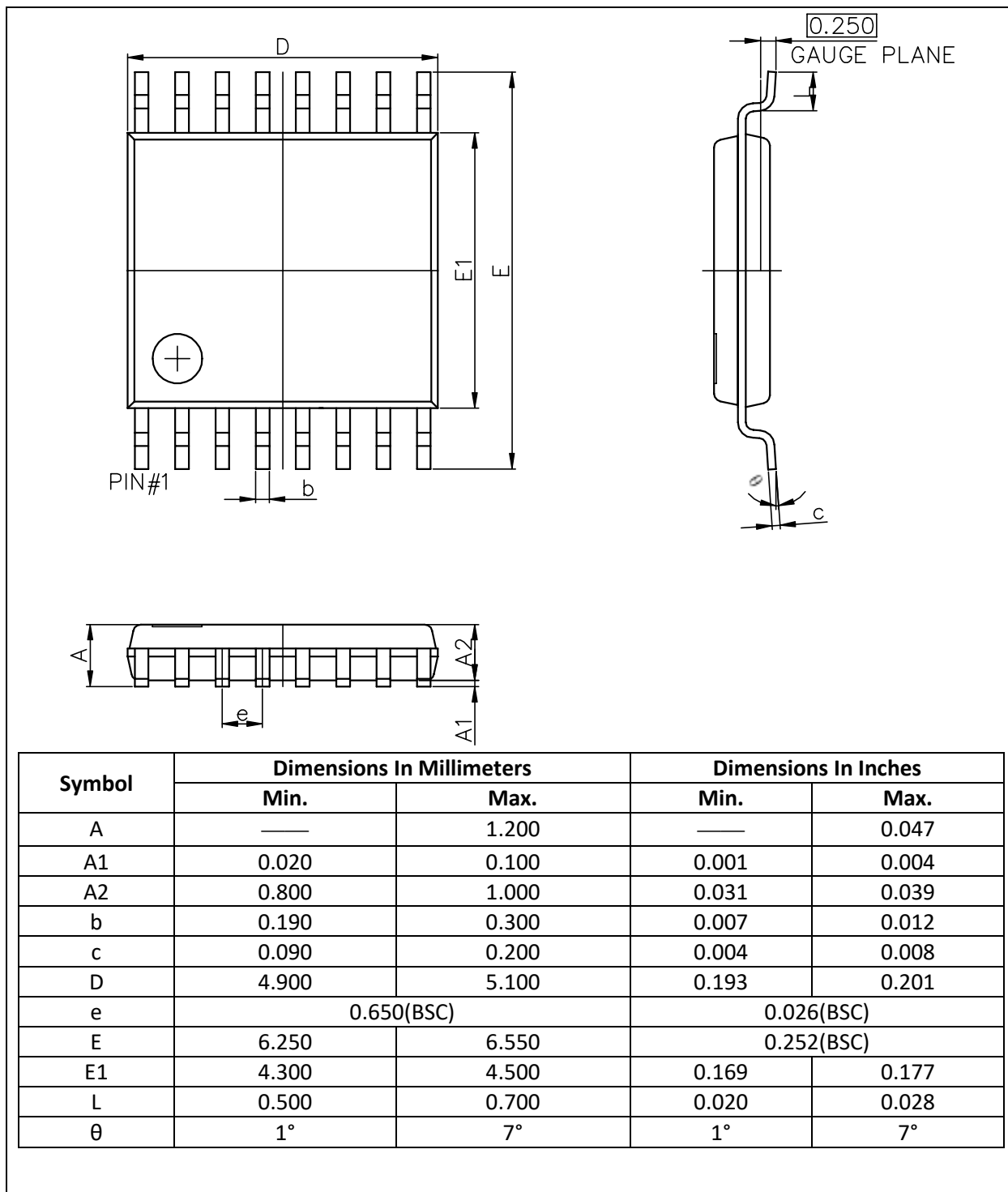


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	—	1.750	—	0.069
A1	0.150	0.250	0.006	0.010
A2	1.400	1.500	0.055	0.059
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	9.800	10.000	0.386	0.394
e	1.270(BSC)		0.050(BSC)	
E	5.900	6.100	0.232	0.240
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

EM74HC594

8-bit shift register with output register

TSSOP-16L



13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
CDM	Charged Device Model

14. Revision History

Table 11. Revision history

Document ID	Release Date	Data sheet status	Change notice	Supersedes
EM74HC594 Rev. 0.9	Aug 20, 2024	Draft datasheet		