

74AHC594; 74AHCT594

8-bit shift register with output register

Rev. 4 — 7 July 2021

Product data sheet

1. General description

The 74AHC594; 74AHCT594 is a high-speed Si-gate CMOS device and is pin compatible with Low-Power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard No. 7-A.

The 74AHC594; 74AHCT594 is an 8-bit, non-inverting, serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. Separate clocks (SHCP and STCP) and direct overriding clears ($\overline{\text{SHR}}$ and $\overline{\text{STR}}$) are provided on both the shift and storage registers. A serial output (Q7S) is provided for cascading purposes.

Both the shift and storage register clocks are positive-edge triggered. If the user wishes to connect both clocks together, the shift register will always be one count pulse ahead of the storage register.

2. Features and benefits

- Wide supply voltage range from 2.0 V to 5.5 V
- Balanced propagation delays
- All inputs have Schmitt-trigger action
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- CMOS low power dissipation
- 8-bit serial-in, parallel-out shift register with storage
- Independent direct overriding clears on shift and storage registers
- Independent clocks for shift and storage registers
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level A
- Input levels:
 - For 74AHC594: CMOS level
 - For 74AHCT594: TTL level
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V
 - CDM JESD22-C101E exceeds 1000 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

4. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74AHC594D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74AHCT594D				
74AHC594PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74AHCT594PW				
74AHC594BQ	-40 °C to +125 °C	DHVQFN16	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm	SOT763-1
74AHCT594BQ				

5. Functional diagram

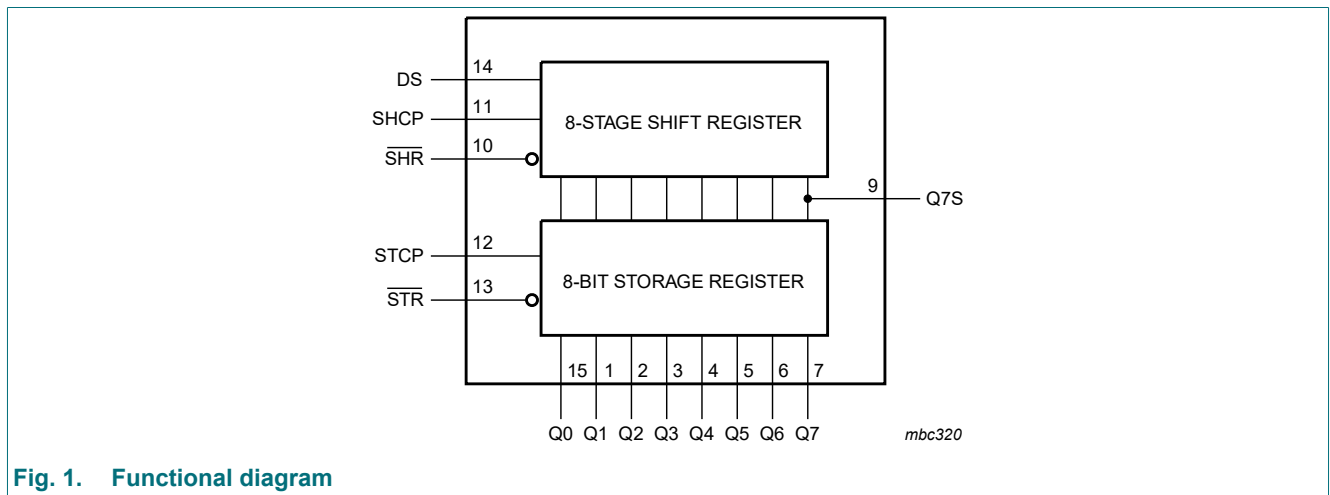


Fig. 1. Functional diagram

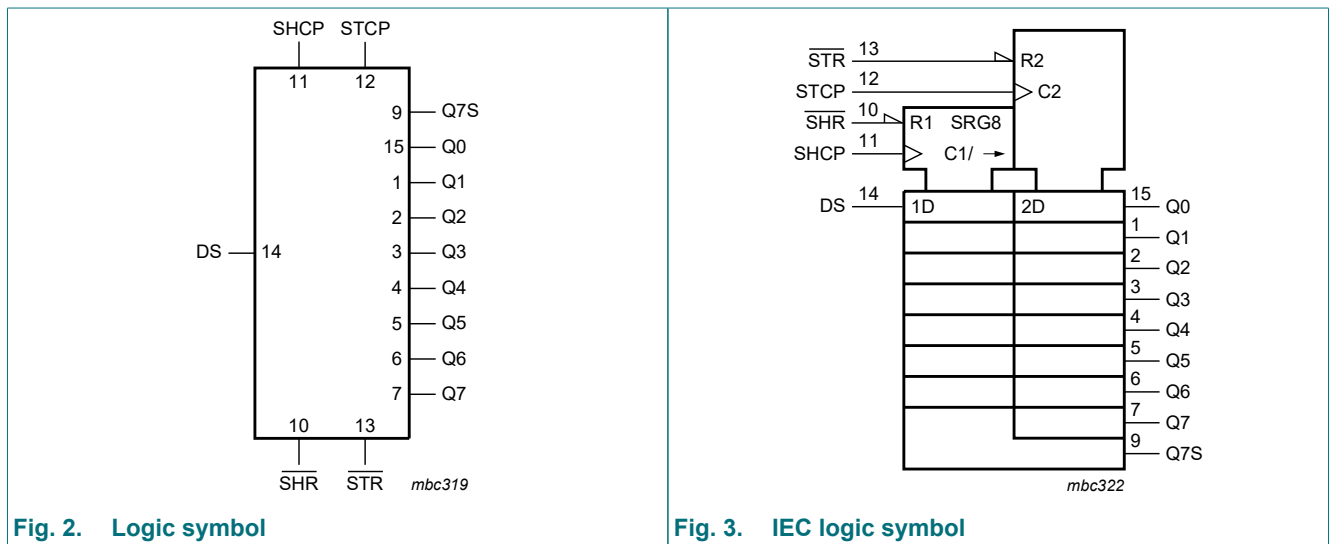


Fig. 2. Logic symbol

Fig. 3. IEC logic symbol

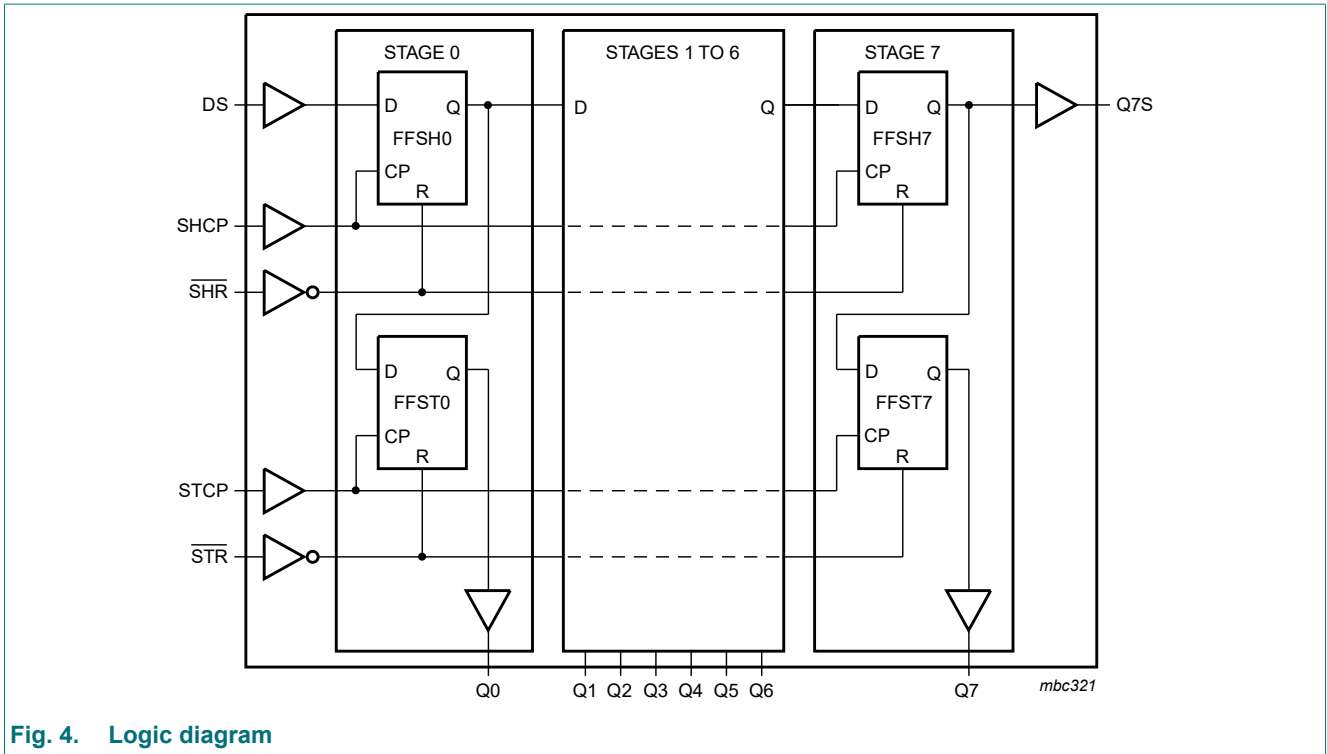


Fig. 4. Logic diagram

6. Pinning information

6.1. Pinning

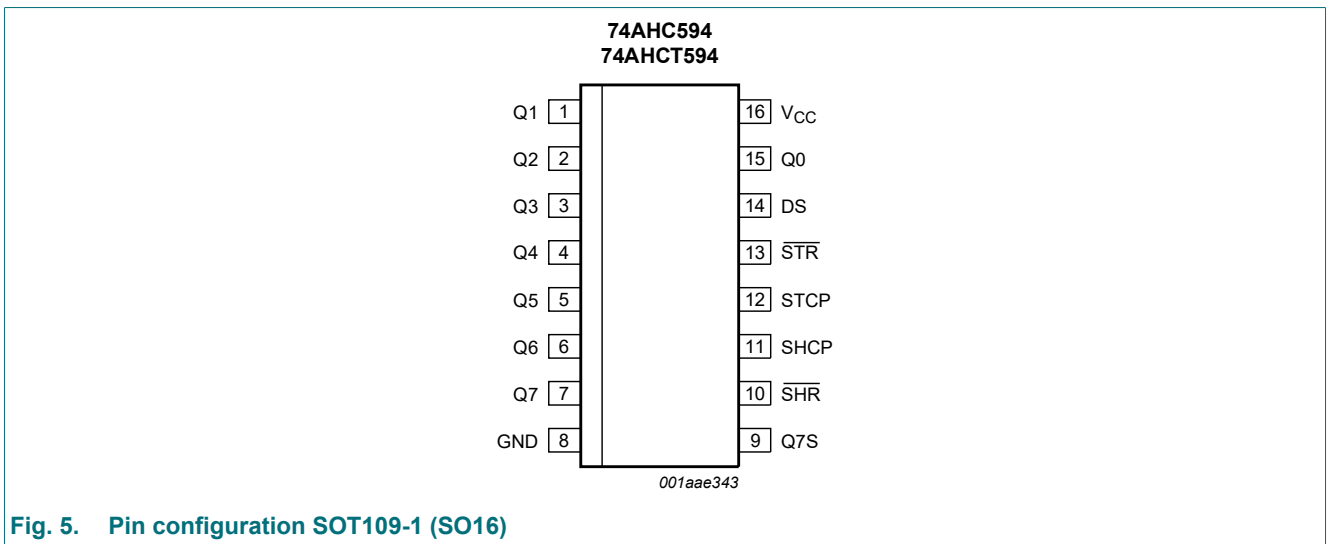


Fig. 5. Pin configuration SOT109-1 (SO16)

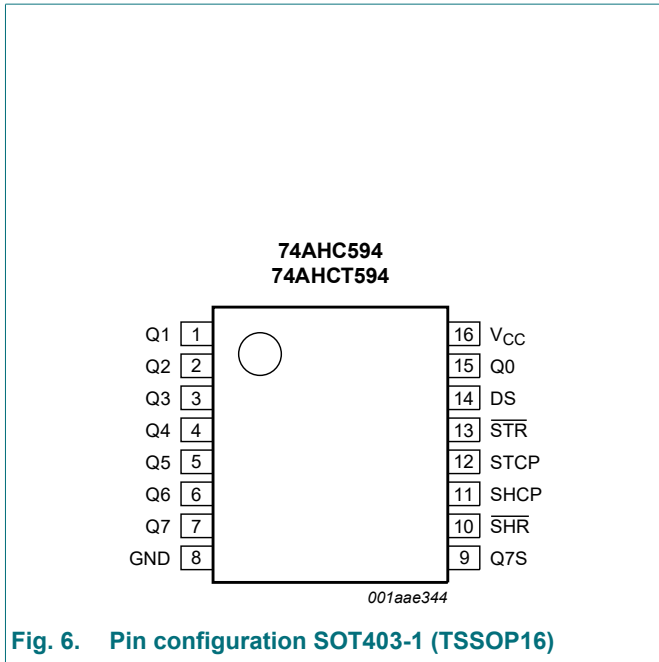


Fig. 6. Pin configuration SOT403-1 (TSSOP16)

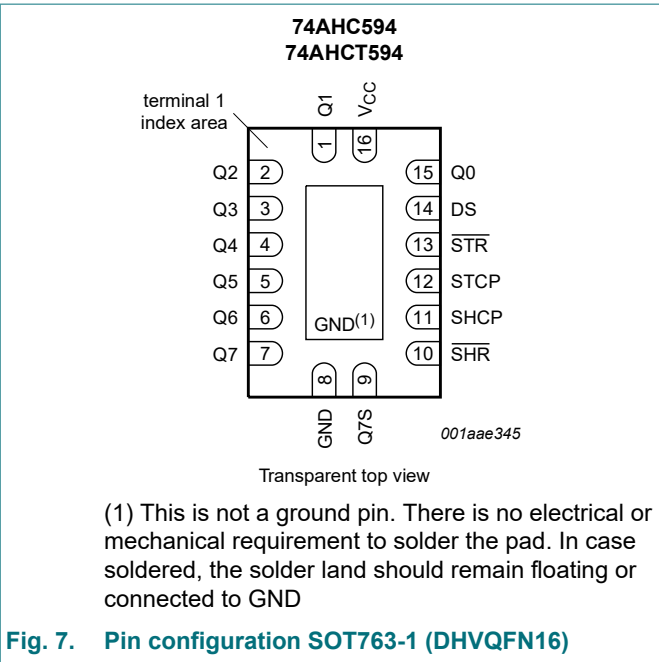


Fig. 7. Pin configuration SOT763-1 (DHVQFN16)

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 (0 V)
Q7S	9	serial data output
SHR	10	shift register reset input (active LOW)
SHCP	11	shift register clock input
STCP	12	storage register clock input
STR	13	storage register reset input (active LOW)
DS	14	serial data input
V _{CC}	16	supply voltage

7. Functional description

Table 3. Function table

H = HIGH voltage state; L = LOW voltage state; ↑ = LOW to HIGH transition; X = don't care; NC = no change.

Input					Output		Function
SHCP	STCP	SHR	STR	DS	Q7S	Qn	
X	X	L	X	X	L	NC	a LOW-state on $\overline{\text{SHR}}$ only affects the shift register
X	X	X	L	X	NC	L	a LOW-state on $\overline{\text{STR}}$ only affects the storage register
X	↑	L	H	X	L	L	empty shift register loaded into storage register
↑	X	H	X	H	Q6S	NC	logic HIGH level shifted into shift register stage 0. Contents of all shift register stages shifted through, e.g. previous state of stage 6 (internal Q6S) appears on the serial output (Q7S).
X	↑	H	H	X	NC	QnS	contents of shift register stages (internal QnS) are transferred to the storage register and parallel output stages
↑	↑	H	H	X	Q6S	QnS	contents of shift register shifted through; previous contents of the shift register is transferred to the storage register and the parallel output stages

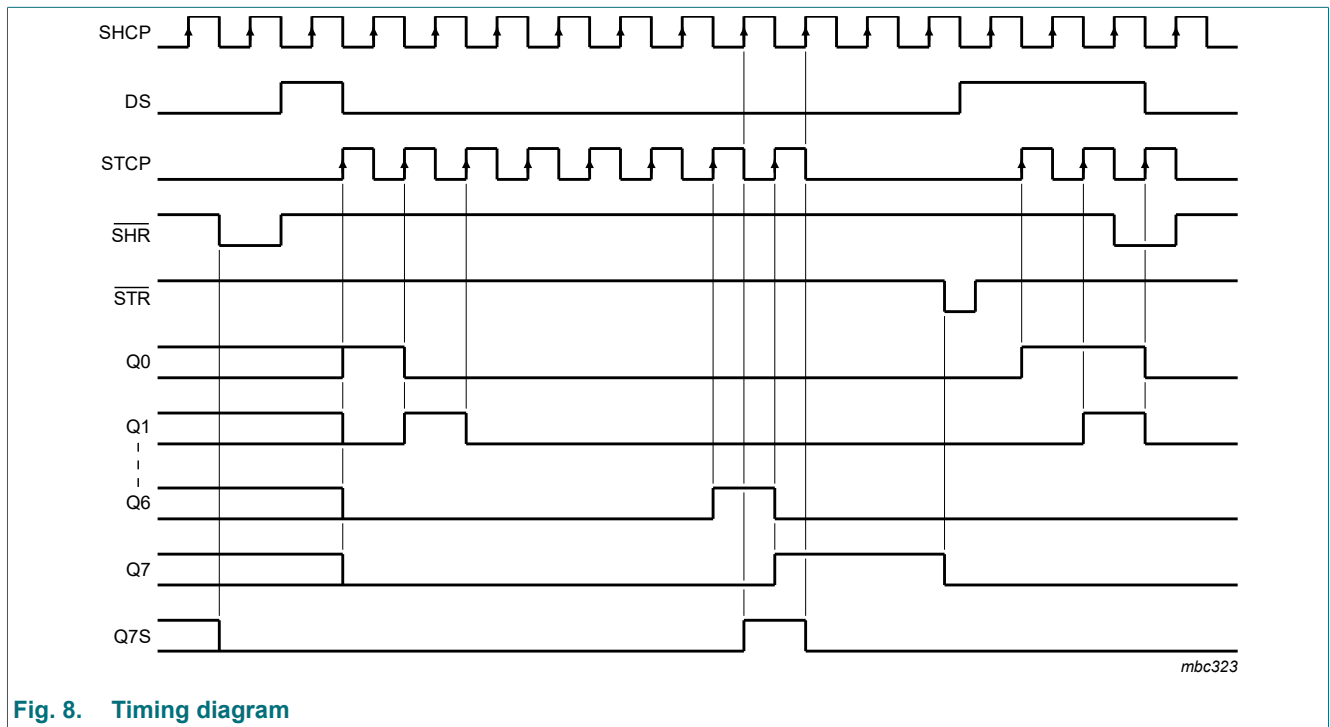


Fig. 8. Timing diagram

8. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-0.5	+7.0	V
V_I	input voltage		-0.5	+7.0	V
I_{IK}	input clamping current	$V_I < -0.5$ V [1]	-20	-	mA
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V [1]	-20	+20	mA
I_O	output current	$V_O = -0.5$ V to $(V_{CC} + 0.5$ V)	-25	+25	mA
I_{CC}	supply current		-	+75	mA
I_{GND}	ground current		-75	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40$ °C to $+125$ °C [2]	-	500	mW

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

[2] For SOT109-1 (SO16) package: P_{tot} derates linearly with 12.4 mW/K above 110 °C.
 For SOT403-1 (TSSOP16) package: P_{tot} derates linearly with 8.5 mW/K above 91 °C.
 For SOT763-1 (DHVQFN16) package: P_{tot} derates linearly with 11.2 mW/K above 106 °C.

9. Recommended operating conditions

Table 5. Operating conditions

Symbol	Parameter	Conditions	74AHC594			74AHCT594			Unit
			Min	Typ	Max	Min	Typ	Max	
V_{CC}	supply voltage		2.0	5.0	5.5	4.5	5.0	5.5	V
V_I	input voltage		0	-	5.5	0	-	5.5	V
V_O	output voltage		0	-	V_{CC}	0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	+25	+125	-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 3.0$ V to 3.6 V	-	-	100	-	-	-	ns/V
		$V_{CC} = 4.5$ V to 5.5 V	-	-	20	-	-	20	ns/V

10. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74AHC594										
V _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.5	-	-	1.5	-	1.5	-	V
		V _{CC} = 3.0 V	2.1	-	-	2.1	-	2.1	-	V
		V _{CC} = 5.5 V	3.85	-	-	3.85	-	3.85	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	-	0.5	-	0.5	-	0.5	V
		V _{CC} = 3.0 V	-	-	0.9	-	0.9	-	0.9	V
		V _{CC} = 5.5 V	-	-	1.65	-	1.65	-	1.65	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = -50 μA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = -50 μA; V _{CC} = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I _O = -50 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -4.0 mA; V _{CC} = 3.0 V	2.58	-	-	2.48	-	2.40	-	V
		I _O = -8.0 mA; V _{CC} = 4.5 V	3.94	-	-	3.80	-	3.70	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = 50 μA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 μA; V _{CC} = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 4 mA; V _{CC} = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
		I _O = 8 mA; V _{CC} = 4.5 V	-	-	0.36	-	0.44	-	0.55	V
I _I	input leakage current	V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	μA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	4.0	-	40	-	80	μA
C _I	input capacitance	V _I = V _{CC} or GND	-	3	10	-	10	-	10	pF

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74AHCT594										
V _{IH}	HIGH-level input voltage	V _{CC} = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 4.5 V to 5.5 V	-	-	0.8	-	0.8	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = -50 µA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -8.0 mA; V _{CC} = 4.5 V	3.94	-	-	3.80	-	3.70	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = 50 µA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 8 mA; V _{CC} = 4.5 V	-	-	0.36	-	0.44	-	0.55	V
I _I	input leakage current	V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	µA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	4.0	-	40	-	80	µA
ΔI _{CC}	additional supply current	per input pin; V _I = V _{CC} - 2.1 V; other pins at V _{CC} or GND; I _O = 0 A; V _{CC} = 4.5 V to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
C _I	input capacitance	V _I = V _{CC} or GND	-	3	10	-	10	-	10	pF

11. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 15.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
74AHC594										
t _{PLH}	LOW to HIGH propagation delay	SHCP to Q7S; see Fig. 9								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	5.2	8.5	2.2	9.7	2.2	10.6	ns
		C _L = 50 pF	-	7.4	11.5	3.0	13.2	3.0	14.3	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	3.8	6.3	1.7	7.2	1.7	7.8	ns
		C _L = 50 pF	-	4.8	8.0	2.4	9.1	2.4	10.0	ns
		STCP to Qn; see Fig. 10								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	5.1	8.3	2.3	9.5	2.3	10.6	ns
		C _L = 50 pF	-	7.3	11.9	3.3	13.6	3.3	14.7	ns
		V _{CC} = 4.5 V to 5.5 V								
C _L = 15 pF	-	3.5	5.7	1.8	6.5	1.8	7.1	ns		
C _L = 50 pF	-	4.8	7.8	2.6	9.0	2.6	9.8	ns		

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
t _{PHL}	HIGH to LOW propagation delay	SHCP to Q7S; see Fig. 9								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	5.5	8.9	2.3	10.2	2.3	11.0	ns
		C _L = 50 pF	-	7.4	12.1	3.0	13.9	3.0	15.1	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	4.1	6.7	1.9	7.6	1.9	8.2	ns
		C _L = 50 pF	-	5.4	8.8	2.5	10.1	2.5	11.0	ns
		STCP to Qn; see Fig. 10								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	5.5	9.1	2.4	10.4	2.4	11.3	ns
		C _L = 50 pF	-	7.3	12.0	3.2	13.8	3.2	15.0	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	3.7	6.0	1.9	6.9	1.9	7.5	ns
		C _L = 50 pF	-	5.2	8.5	2.6	9.7	2.6	10.5	ns
		SHR to Q7S; see Fig. 13								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	5.7	9.5	2.3	10.8	2.3	11.7	ns
		C _L = 50 pF	-	7.5	12.2	3.6	14.0	3.6	15.2	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	4.1	6.7	2.0	7.6	2.0	8.2	ns
C _L = 50 pF	-	5.4	8.8	2.8	10.1	2.8	11.0	ns		
f _{max}	maximum frequency	SHCP or STCP; see Fig. 9 and Fig. 10								
		V _{CC} = 3.0 V to 3.6 V	80	125	-	70	-	65	-	MHz
		V _{CC} = 4.5 V to 5.5 V	90	170	-	80	-	70	-	MHz
		STR to Qn; see Fig. 12								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	5.8	9.6	2.8	11.0	2.8	12.0	ns
t _W	pulse width	C _L = 50 pF	-	7.7	12.5	3.8	14.4	3.8	15.6	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	4.1	7.2	2.2	8.2	2.2	8.9	ns
		C _L = 50 pF	-	5.4	9.4	3.0	10.7	3.0	11.6	ns
		SHR and STR HIGH or LOW; see Fig. 13 and Fig. 12								
		V _{CC} = 3.0 V to 3.6 V	5.0	-	-	5.0	-	5.5	-	ns
V _{CC} = 4.5 V to 5.5 V	5.0	-	-	5.2	-	5.7	-	ns		

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
t _{su}	set-up time	DS to SHCP; see Fig. 11								
		V _{CC} = 3.0 V to 3.6 V	3.5	-	-	3.5	-	4.0	-	ns
		V _{CC} = 4.5 V to 5.5 V	3.0	-	-	3.0	-	3.5	-	ns
		SHR to STCP; see Fig. 14								
		V _{CC} = 3.0 V to 3.6 V	8.0	-	-	9.0	-	9.5	-	ns
		V _{CC} = 4.5 V to 5.5 V	5.0	-	-	5.0	-	5.5	-	ns
		SHCP to STCP; see Fig. 10								
		V _{CC} = 3.0 V to 3.6 V	8.0	-	-	8.5	-	9.0	-	ns
V _{CC} = 4.5 V to 5.5 V	5.0	-	-	5.0	-	5.5	-	ns		
t _h	hold time	DS to SHCP; see Fig. 11								
		V _{CC} = 3.0 V to 3.6 V	1.5	-	-	1.5	-	2.0	-	ns
		V _{CC} = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.5	-	ns
t _{rec}	recovery time	SHR to SHCP; see Fig. 13								
		V _{CC} = 3.0 V to 3.6 V	4.2	-	-	4.8	-	5.3	-	ns
		V _{CC} = 4.5 V to 5.5 V	2.9	-	-	3.3	-	3.8	-	ns
		STR to STCP; see Fig. 12								
		V _{CC} = 3.0 V to 3.6 V	4.6	-	-	5.3	-	5.8	-	ns
V _{CC} = 4.5 V to 5.5 V	3.2	-	-	3.7	-	4.3	-	ns		
C _{PD}	power dissipation capacitance	f _i = 1 MHz; V _i = GND to V _{CC} [2]	-	55	-	-	-	-	-	pF
74AHCT594; V_{CC} = 4.5 V to 5.5 V										
t _{PLH}	LOW to HIGH propagation delay	SHCP to Q7S; see Fig. 9								
		C _L = 15 pF	-	3.8	6.3	1.7	7.2	1.7	7.8	ns
		C _L = 50 pF	-	4.8	8.0	2.2	9.1	2.2	9.9	ns
		STCP to Qn; see Fig. 10								
		C _L = 15 pF	-	3.5	5.7	1.8	6.5	1.8	7.1	ns
C _L = 50 pF	-	4.6	7.7	2.6	8.8	2.6	9.6	ns		
t _{PHL}	HIGH to LOW propagation delay	SHCP to Q7S; see Fig. 9								
		C _L = 15 pF	-	4.1	6.7	1.8	7.6	1.8	8.3	ns
		C _L = 50 pF	-	5.4	8.8	2.4	10.1	2.4	11.0	ns
		STCP to Qn; see Fig. 10								
		C _L = 15 pF	-	3.7	6.1	1.9	6.9	1.9	7.2	ns
		C _L = 50 pF	-	5.2	8.5	2.6	9.7	2.6	10.5	ns
		SHR to Q7S; see Fig. 13								
		C _L = 15 pF	-	4.3	7.0	2.4	8.0	2.4	8.7	ns
		C _L = 50 pF	-	5.4	8.8	2.7	10.1	2.7	11.0	ns
		STR to Qn; see Fig. 12								
C _L = 15 pF	-	4.5	7.4	2.3	8.4	2.3	9.2	ns		
C _L = 50 pF	-	5.7	9.4	3.1	10.7	3.1	11.7	ns		
f _{max}	maximum frequency	SHCP or STCP; see Fig. 9 and Fig. 10	90	160	-	80	-	70	-	MHz

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
t _W	pulse width	SHCP and STCP HIGH or LOW; see Fig. 9 and Fig. 10	5.5	-	-	6.0	-	6.5	-	ns
		SHR and STR HIGH or LOW; see Fig. 13 and Fig. 12	5.2	-	-	5.5	-	6.0	-	ns
t _{su}	set-up time	DS to SHCP; see Fig. 11	3.0	-	-	3.0	-	3.5	-	ns
		SHR to STCP; see Fig. 14	5.0	-	-	5.0	-	5.5	-	ns
		SHCP to STCP; see Fig. 10	5.0	-	-	5.0	-	5.5	-	ns
t _h	hold time	DS to SHCP; see Fig. 11	2.0	-	-	2.0	-	2.5	-	ns
t _{rec}	recovery time	SHR to SHCP; see Fig. 13	2.9	-	-	3.3	-	3.8	-	ns
		STR to STCP; see Fig. 12	3.4	-	-	3.8	-	4.3	-	ns
C _{PD}	power dissipation capacitance	f _i = 1 MHz; V _i = GND to V _{CC} [2]	-	55	-	-	-	-	-	pF

[1] Typical values are measured at nominal supply voltage (V_{CC} = 3.3 V and V_{CC} = 5.0 V).

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

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

where:

f_i = input frequency in MHz;

f_o = output frequency in MHz;

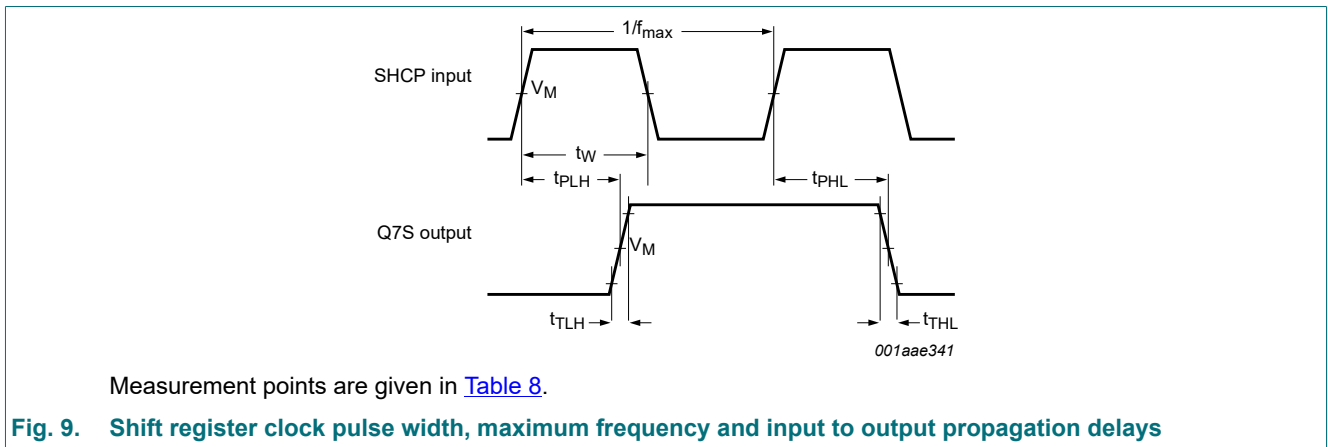
C_L = output load capacitance in pF;

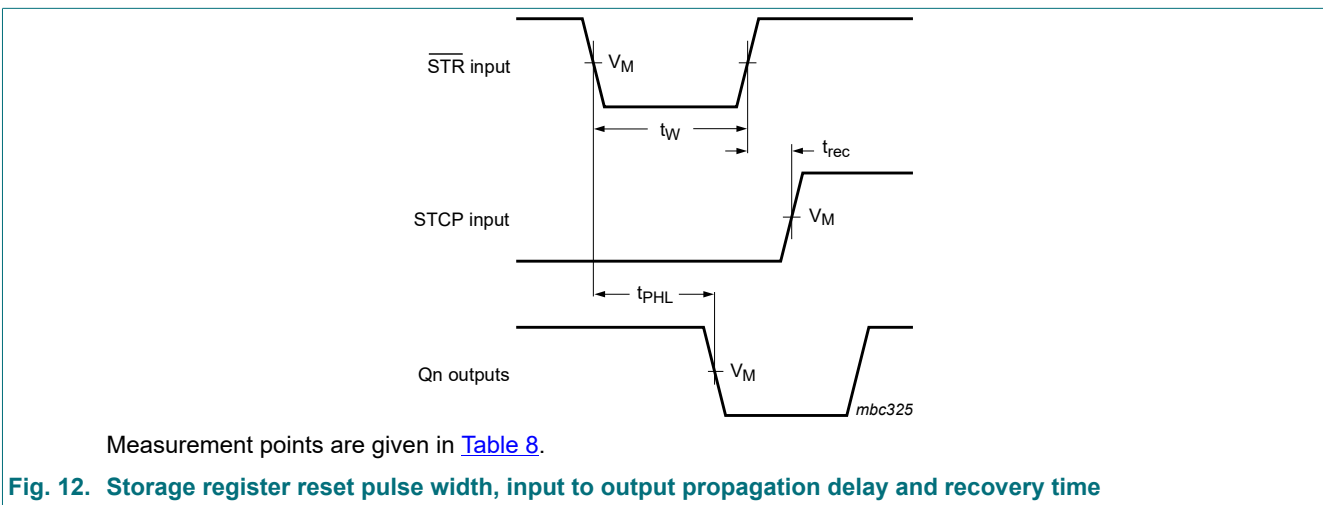
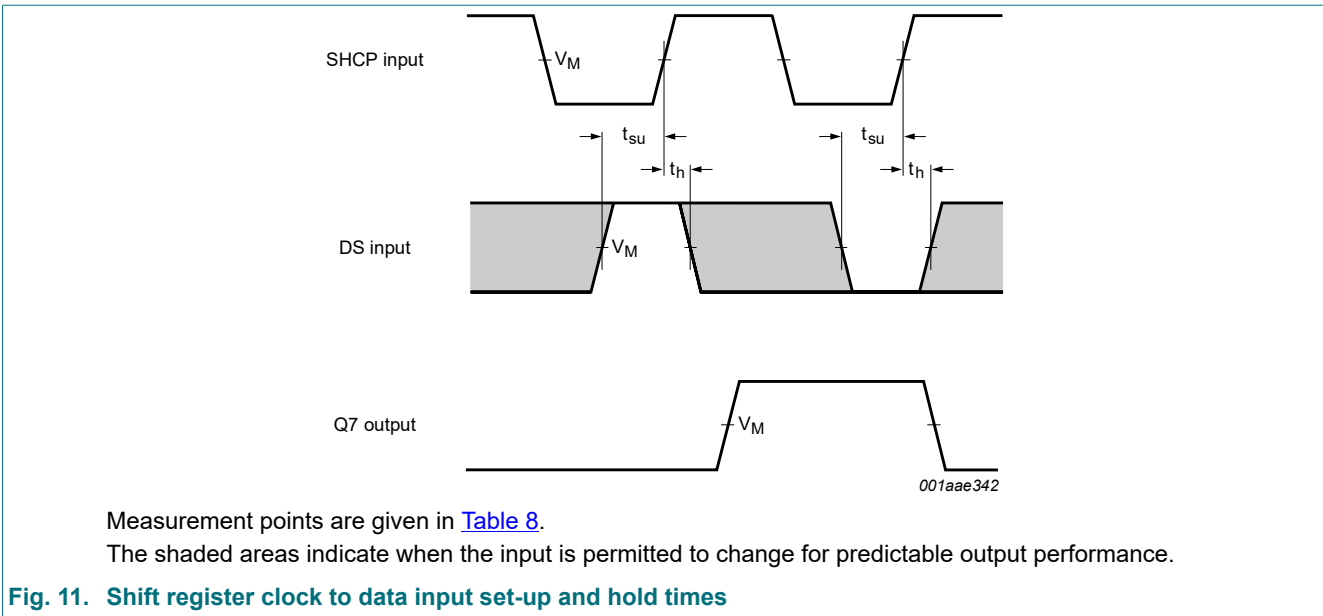
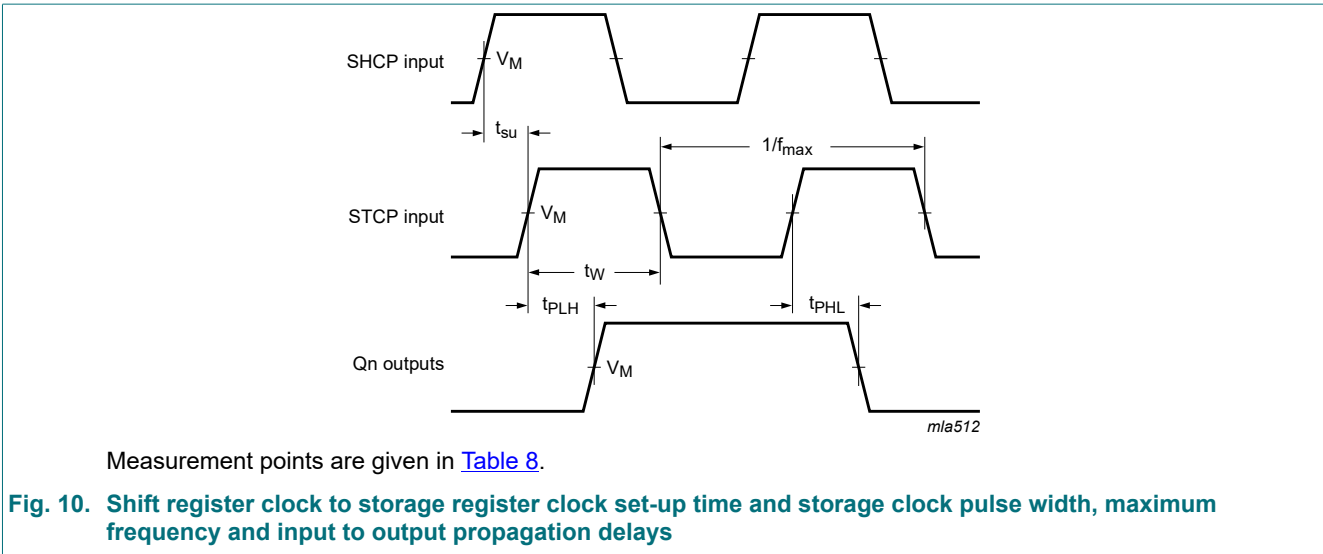
V_{CC} = supply voltage in V;

N = number of inputs switching;

∑(C_L × V_{CC}² × f_o) = sum of the outputs.

11.1. Waveforms and test circuit





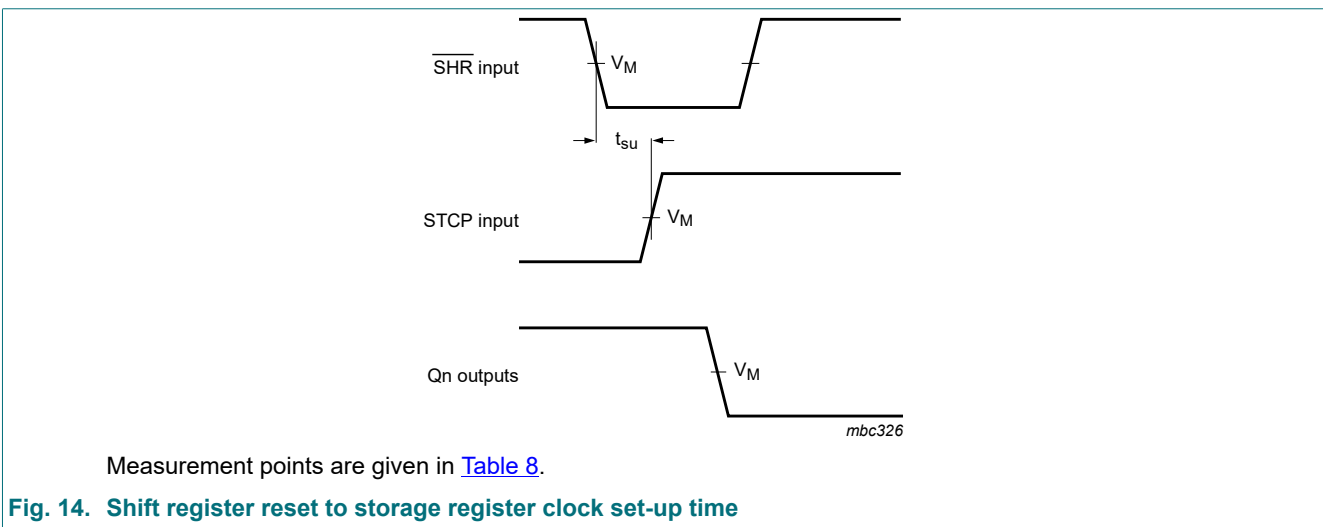
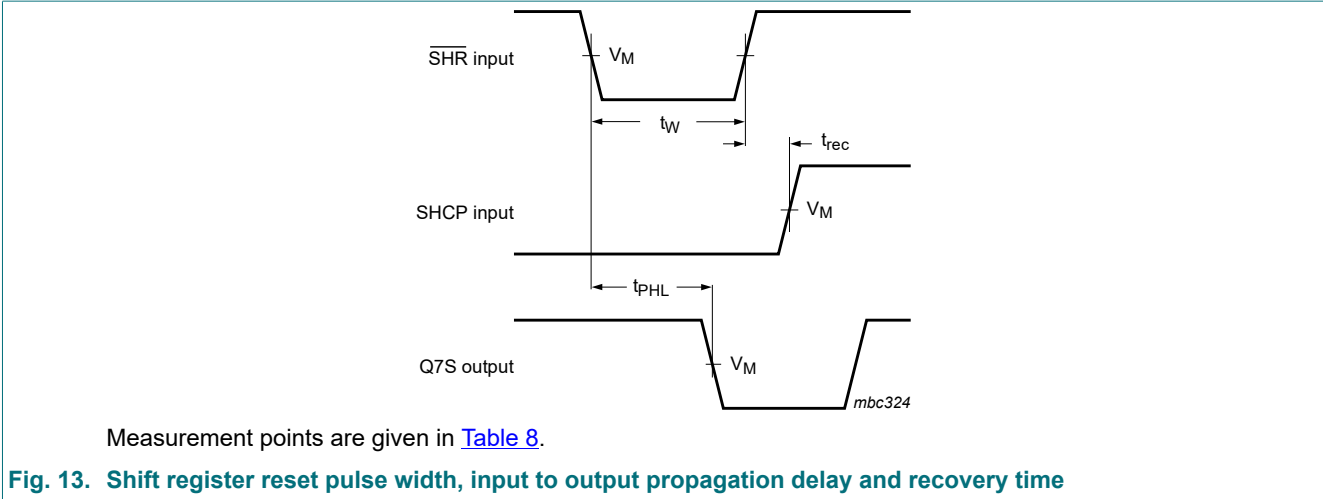


Table 8. Measurement points

Type	Input	Output
	V _M	V _M
74AHC594	0.5 x V _{CC}	0.5 x V _{CC}
74AHCT594	1.5 V	0.5 x V _{CC}



For test data see [Table 9](#).

Definitions for test circuit:

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

C_L = Load capacitance including jig and probe capacitance.

Fig. 15. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Load	Test
	V_I	t_r, t_f	C_L	
74AHC594	V_{CC}	≤ 3.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}
74AHCT594	3.0 V	≤ 3.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}

12. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



Fig. 16. Package outline SOT109-1 (SO16)

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1

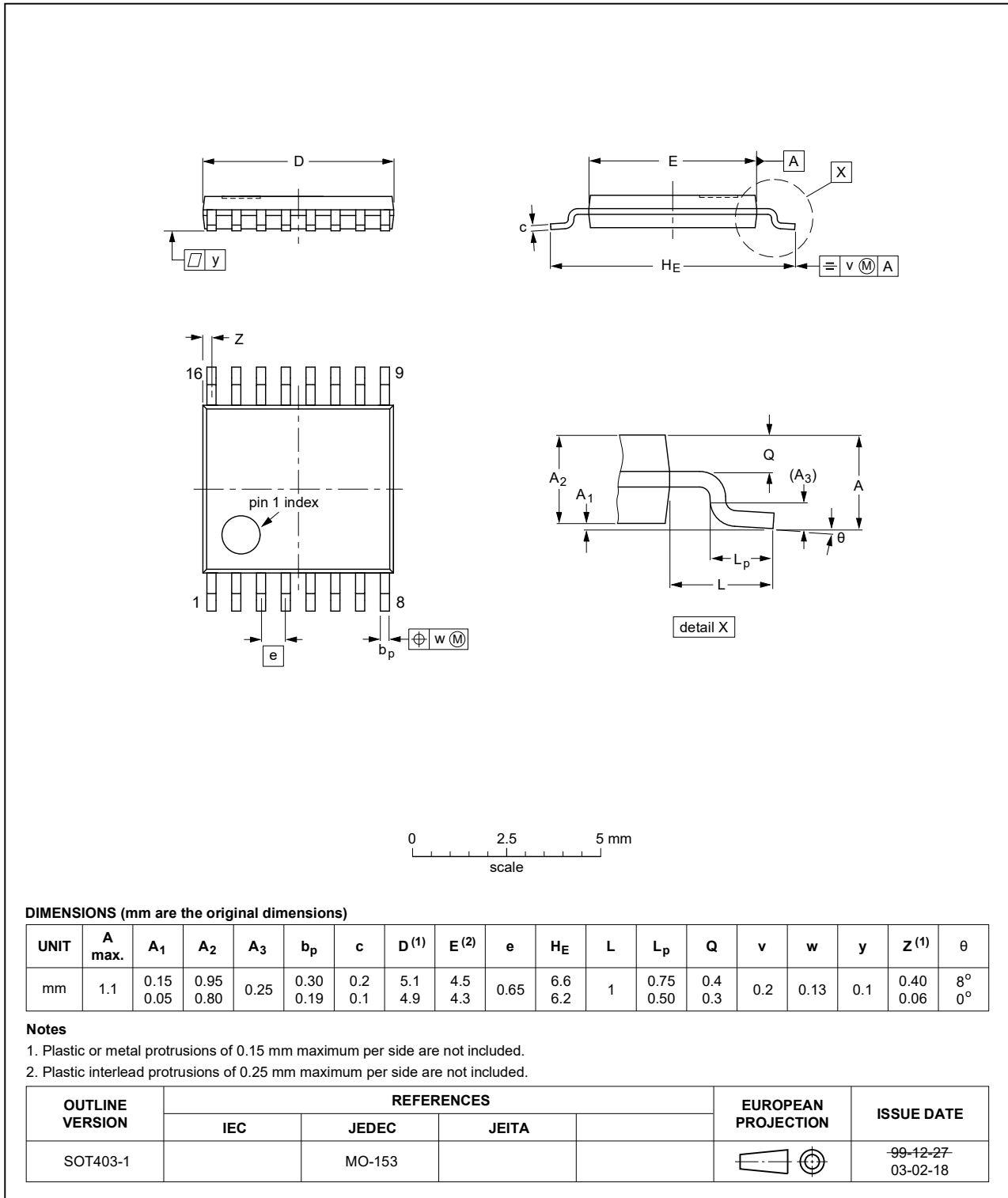


Fig. 17. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm

SOT763-1



Fig. 18. Package outline SOT763-1 (DHVQFN16)

13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
LSTTL	Low-power Schottky Transistor-Transistor Logic
MM	Machine Model
TTL	Transistor-Transistor Logic

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT594 v.4	20210707	Product data sheet	-	74AHC_AHCT594 v.3
Modifications:	<ul style="list-style-type: none"> Type numbers 74AHC594DB and 74AHCT594DB (SOT338-1/SSOP16) removed. 			
74AHC_AHCT594 v.3	20200625	Product data sheet	-	74AHC_AHCT594 v.2
Modifications:	<ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Section 2 updated. Table 4: Derating values for P_{tot} total power dissipation updated. 			
74AHC_AHCT594 v.2	20080609	Product data sheet	-	74AHC_AHCT594 v.1
Modifications:	<ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate. Table 6: the conditions for input leakage current have been changed. 			
74AHC_AHCT594 v.1	20060704	Product data sheet	-	-

15. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <https://www.nexperia.com>.

Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Nexperia takes no responsibility for the content in this document if provided by an information source outside of Nexperia.

In no event shall Nexperia be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Nexperia's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of Nexperia.

Right to make changes — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — Nexperia products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an Nexperia product can reasonably be expected to result in personal

injury, death or severe property or environmental damage. Nexperia and its suppliers accept no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Nexperia does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Nexperia products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Nexperia does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nexperia.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Non-automotive qualified products — Unless this data sheet expressly states that this specific Nexperia product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Nexperia accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Nexperia's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond Nexperia's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Nexperia for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Nexperia's standard warranty and Nexperia's product specifications.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.