74LV595

8-bit serial-in/serial-out or parallel-out shift register; 3-state

Rev. 5 — 29 September 2021 Product data sheet

1. General description

The 74LV595 is an 8-bit serial-in/serial or parallel-out shift register with a storage register and 3-state outputs. Both the shift and storage register have separate clocks. The device features a serial input (DS) and a serial output (Q7S) to enable cascading and an asynchronous reset $\overline{MR}$ input. A LOW on $\overline{MR}$ will reset the shift register. Data is shifted on the LOW-to-HIGH transitions of the SHCP input. 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. Data in the storage register appears at the output whenever the output enable input ($\overline{OE}$) is LOW. A HIGH on $\overline{OE}$ causes the outputs to assume a high-impedance OFF-state. Operation of the $\overline{OE}$ input does not affect the state of the registers. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess V_{CC}.

2. Features and benefits

- Wide supply voltage range from 1.0 V to 3.6 V
- CMOS low power dissipation
- Direct interface with TTL levels
- Typical output ground bounce < 0.8 V at V_{CC} = 3.3 V and T_{amb} = 25 °C
- Typical HIGH-level output voltage (V_{OH}) undershoot: > 2 V at V_{CC} = 3.3 V and T_{amb} = 25 °C
- Has a shift register with direct clear
- Output capability:
  - Parallel outputs; bus driver
  - Serial output; standard
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standards
  - JESD8-7 (1.65 V to 1.95 V)
  - JESD8-5 (2.3 V to 2.7 V)
  - JESD8C (2.7 V to 3.6 V)
- ESD protection:
  - HBM JESD22-A114E exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to 85 °C and -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			
	Temperature range	Name	Description	Version
74LV595D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74LV595PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1

5. Functional diagram

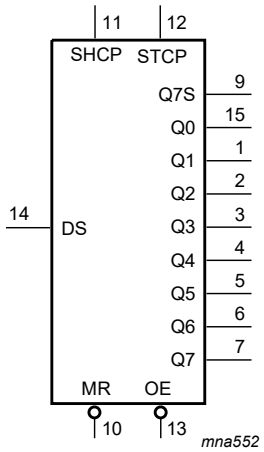


Fig. 1. Logic symbol

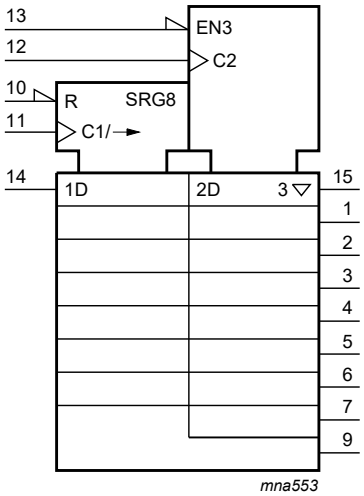


Fig. 2. Logic symbol (IEEE/IEC)

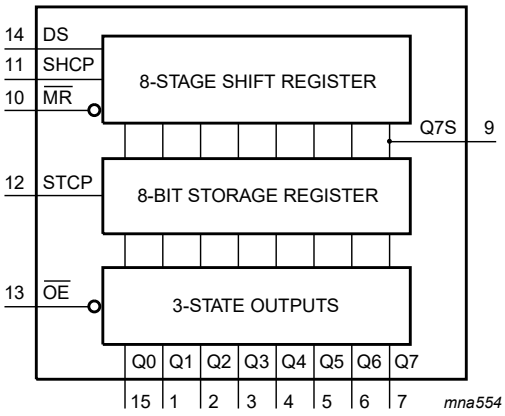


Fig. 3. Functional diagram

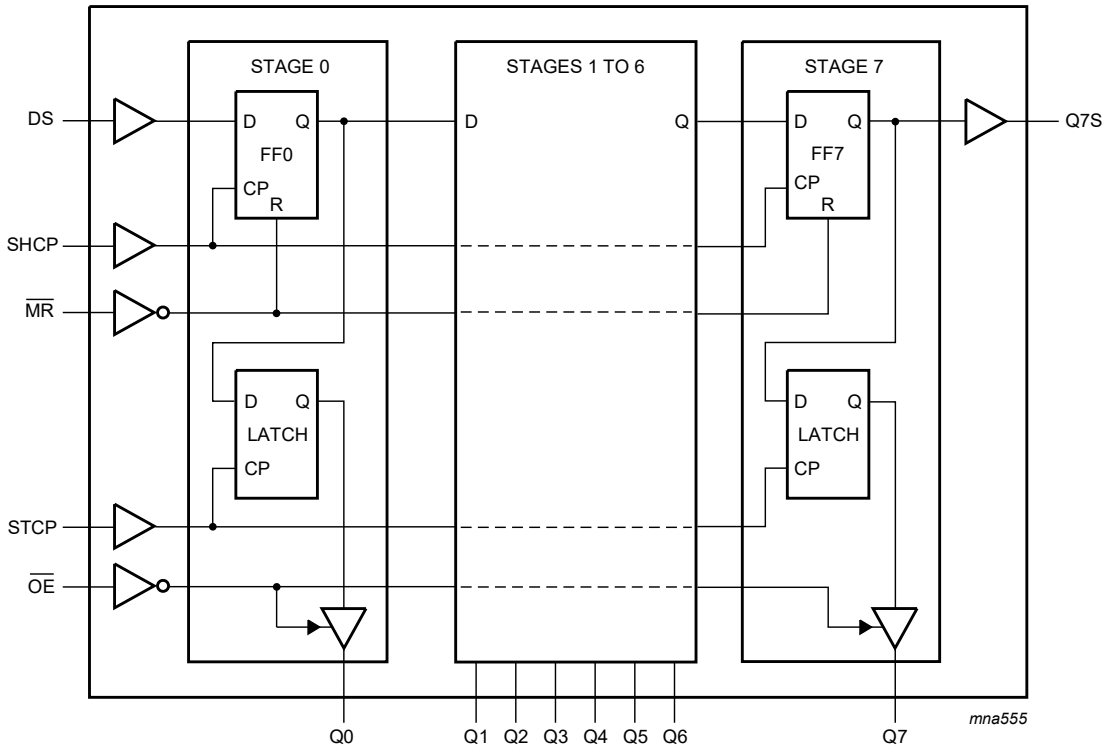


Fig. 4. Logic diagram

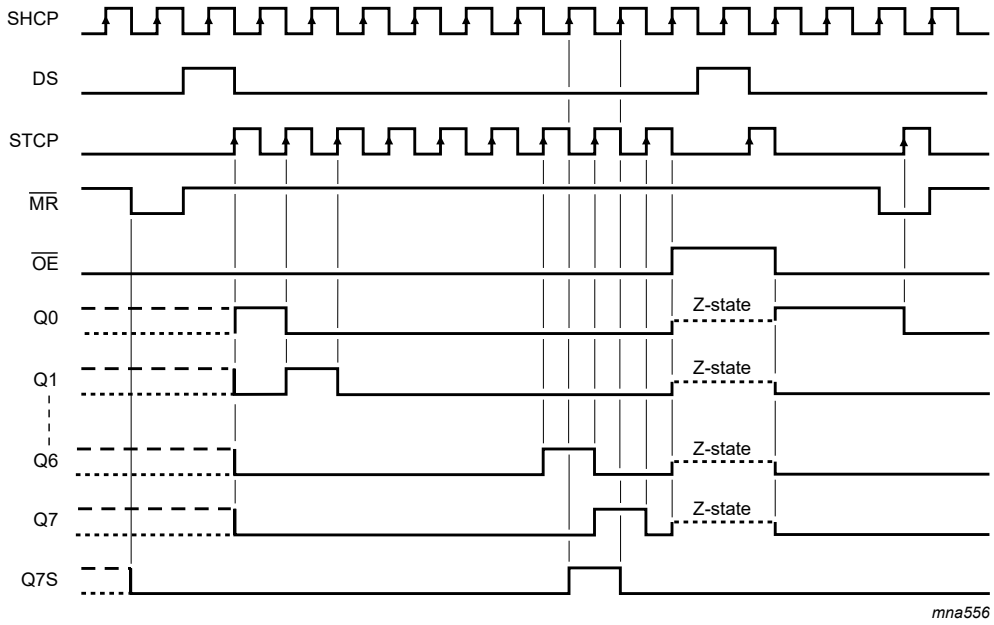


Fig. 5. Timing diagram

6. Pinning information

6.1. Pinning

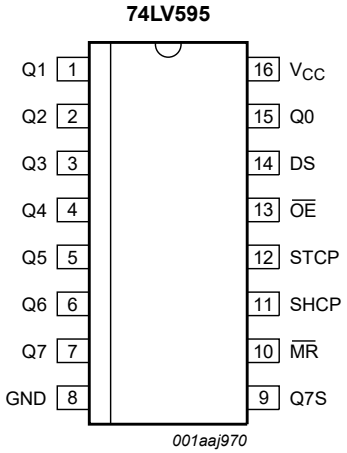


Fig. 6. Pin configuration SOT109-1 (SO16)

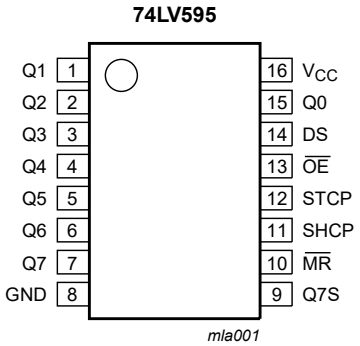


Fig. 7. Pin configuration SOT403-1 (TSSOP16)

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
$\overline{MR}$	10	master reset (active LOW)
SHCP	11	shift register clock input
STCP	12	storage register clock input
$\overline{OE}$	13	output enable 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; Z = high-impedance OFF-state.

Input					Output		Function
SHCP	STCP	$\overline{OE}$	$\overline{MR}$	DS	Q7S	Qn	
X	X	L	L	X	L	NC	a LOW-state on $\overline{MR}$ only affects the shift register
X	↑	L	L	X	L	L	empty shift register loaded into storage register
X	X	H	L	X	L	Z	shift register clear; parallel outputs in high-impedance OFF-state
↑	X	L	H	H	Q6S	NC	logic HIGH-state 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	↑	L	H	X	NC	QnS	contents of shift register stages (internal QnS) are transferred to the storage register and parallel output stages
↑	↑	L	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

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	+4.6	V
I_{IK}	input clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	-	±20	mA
I_{OK}	output clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	-	±50	mA
I_O	output current	-0.5 V $< V_O < V_{CC} + 0.5$ V	-		
		standard driver outputs		25	mA
		bus driver outputs		35	mA
I_{CC}	supply current	standard driver outputs		50	mA
		bus driver outputs		70	mA
I_{GND}	ground current	standard driver outputs	-50		mA
		bus driver outputs	-70		mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	T_{amb} = -40 °C to +125 °C [1]	-	500	mW

[1] 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.

9. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		1.0	3.3	3.6	V
V_I	input voltage		0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CC} = 1.0 V to 2.0 V	-	-	500	ns/V
		V_{CC} = 2.0 V to 2.7 V	-	-	200	ns/V
		V_{CC} = 2.7 V to 3.6 V	-	-	100	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} = 1.2 V	0.9	-	-	0.9	-	V
		V_{CC} = 2.0 V	1.4	-	-	1.4	-	V
		V_{CC} = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 1.2 V	-	-	0.3	-	0.3	V
		V_{CC} = 2.0 V	-	-	0.6	-	0.6	V
		V_{CC} = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V
V_{OH}	HIGH-level output voltage	all outputs; $V_I = V_{IH}$ or V_{IL}; I_O = -100 µA						
		V_{CC} = 1.2 V	-	1.2	-	-	-	V
		V_{CC} = 2.0 V	1.8	2.0	-	1.8	-	V
		V_{CC} = 2.7 V	2.5	2.7	-	2.5	-	V
		V_{CC} = 3.0 V	2.8	3.0	-	2.8	-	V
		standard outputs; $V_I = V_{IH}$ or V_{IL}; I_O = -6 mA; V_{CC} = 3.0 V	2.4	2.82	-	2.2	-	V
		bus outputs; $V_I = V_{IH}$ or V_{IL}; I_O = -8 mA; V_{CC} = 3.0 V	2.4	2.82	-	2.2	-	V
V_{OL}	LOW-level output voltage	all outputs; $V_I = V_{IH}$ or V_{IL}; I_O = 100 µA						
		V_{CC} = 1.2 V	-	0	-	-	-	V
		V_{CC} = 2.0 V	-	0	0.2	-	0.2	V
		V_{CC} = 2.7 V	-	0	0.2	-	0.2	V
		V_{CC} = 3.0 V	-	0	0.2	-	0.2	V
		standard driver outputs V_{CC} = 3.0 V; I_O = 6 mA	-	0.25	0.4	-	0.5	V
		bus driver outputs V_{CC} = 3.0 V; I_O = 8 mA	-	0.20	0.4	-	0.5	V
I_I	input leakage current	V_{CC} = 3.6 V; V_I = 5.5 V or GND	-	-	1.0	-	1.0	µA

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
I_{OZ}	OFF-state output current	$V_I = V_{IH}$ or V_{IL}; $V_O = V_{CC}$ or GND; V_{CC} = 3.6 V	-	-	5	-	10	µA
I_{CC}	supply current	V_{CC} = 3.6 V; $V_I = V_{CC}$ or GND; I_O = 0 A	-	-	20	-	160	µA
ΔI_{CC}	additional supply current	per input pin; V_{CC} = 2.7 V to 3.6 V; $V_I = V_{CC}$ - 0.6 V	-	-	500	-	850	µA
C_I	input capacitance		-	3.5	-	-	-	pF

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °C.

11. Dynamic characteristics

Table 7. Dynamic characteristics

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

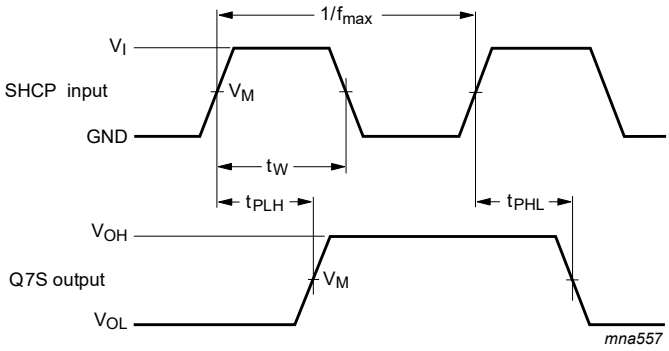
Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t_{pd}	propagation delay	SHCP to Q7S; see Fig. 8 [2]						
		V_{CC} = 1.2 V	-	95	-	-	-	ns
		V_{CC} = 2.0 V	-	32	61	-	75	ns
		V_{CC} = 2.7 V	-	24	45	-	55	ns
		V_{CC} = 3.3 V; C_L = 15 pF	-	15	-	-	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	-	18	36	-	44	ns
		STCP to Qn; see Fig. 9 [2]						
		V_{CC} = 1.2 V	-	100	-	-	-	ns
		V_{CC} = 2.0 V	-	34	65	-	77	ns
		V_{CC} = 2.7 V	-	25	48	-	56	ns
		V_{CC} = 3.3 V; C_L = 15 pF	-	16	-	-	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	-	19	38	-	45	ns
		$\overline{MR}$ to Q7S; see Fig. 11						
		V_{CC} = 1.2 V	-	85	-	-	-	ns
		V_{CC} = 2.0 V	-	29	56	-	66	ns
		V_{CC} = 2.7 V	-	21	41	-	49	ns
		V_{CC} = 3.3 V; C_L = 15 pF	-	14	-	-	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	-	16	33	-	33	ns
t_{en}	enable time	$\overline{OE}$ to Qn; see Fig. 12 [4]						
		V_{CC} = 1.2 V	-	85	-	-	-	ns
		V_{CC} = 2.0 V	-	29	56	-	66	ns
		V_{CC} = 2.7 V	-	21	41	-	49	ns
		V_{CC} = 3.0 V to 3.6 V [3]	-	16	33	-	39	ns
t_{dis}	disable time	$\overline{OE}$ to Qn; see Fig. 12 [5]						
		V_{CC} = 1.2 V	-	65	-	-	-	ns
		V_{CC} = 2.0 V	-	24	40	-	49	ns
		V_{CC} = 2.7 V	-	18	32	-	37	ns
		V_{CC} = 3.0 V to 3.6 V [3]	-	14	26	-	30	ns

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t_W	pulse width	SHCP, HIGH or LOW; see Fig. 8						
		V_{CC} = 2.0 V	34	10	-	41	-	ns
		V_{CC} = 2.7 V	25	8	-	30	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	20	6	-	24	-	ns
		STCP, HIGH or LOW; see Fig. 9						
		V_{CC} = 2.0 V	34	7	-	41	-	ns
		V_{CC} = 2.7 V	25	5	-	30	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	20	4	-	24	-	ns
		$\overline{MR}$ LOW; see Fig. 11						
		V_{CC} = 2.0 V	34	10	-	41	-	ns
		V_{CC} = 2.7 V	25	8	-	30	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	20	6	-	24	-	ns
t_{su}	set-up time	DS to SHCP; see Fig. 10						
		V_{CC} = 1.2 V	-	40	-	-	-	ns
		V_{CC} = 2.0 V	26	14	-	31	-	ns
		V_{CC} = 2.7 V	19	10	-	23	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	15	8	-	18	-	ns
		SHCP to STCP; see Fig. 9						
		V_{CC} = 1.2 V	-	40	-	-	-	ns
		V_{CC} = 2.0 V	26	14	-	31	-	ns
		V_{CC} = 2.7 V	19	10	-	23	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	15	8	-	18	-	ns
t_h	hold time	DS to SHCP; see Fig. 10						
		V_{CC} = 1.2 V	-	-10.0	-	-	-	ns
		V_{CC} = 2.0 V	5.0	-4.0	-	5.0	-	ns
		V_{CC} = 2.7 V	5.0	-3.0	-	5.0	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	5.0	-2.0	-	5.0	-	ns
t_{rec}	recovery time	$\overline{MR}$ to SHCP; see Fig. 11						
		V_{CC} = 1.2 V	-	-35	-	-	-	ns
		V_{CC} = 2.0 V	5.0	-12.0	-	5.0	-	ns
		V_{CC} = 2.7 V	5.0	-9.0	-	5.0	-	ns
		V_{CC} = 3.0 V to 3.6 V [3]	5.0	-7.0	-	5.0	-	ns
f_{max}	maximum frequency	SHCP or STCP; see Fig. 8 and Fig. 9						
		V_{CC} = 2.0 V	14.0	40.0	-	12	-	MHz
		V_{CC} = 2.7 V	19.0	58.0	-	16	-	MHz
		V_{CC} = 3.3 V; C_L = 15 pF	-	77	-	-	-	MHz
		V_{CC} = 3.0 V to 3.6 V [3]	24.0	70.0	-	20	-	MHz

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
C_{PD}	power dissipation capacitance	V_I = GND to V_{CC}; V_{CC} = 3.0 V [6]	-	115	-	-	-	pF

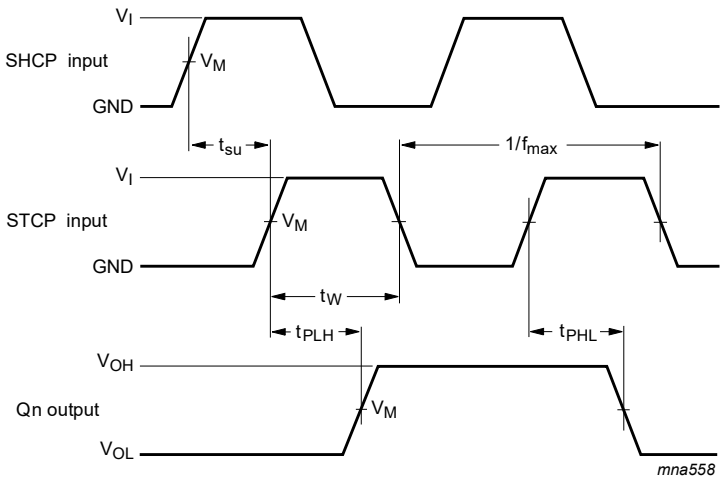
[1] Typical values are measured at T_{amb} = 25 °C.
[2] t_{pd} is the same as t_{PLH} and t_{PHL}.
[3] Typical value measured at V_{CC} = 3.3 V.
[4] t_{en} is the same as t_{PZH} and t_{PZL}.
[5] t_{dis} is the same as t_{PHZ} and t_{PLZ}.
[6] C_{PD} is used to determine the dynamic power dissipation (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;
$\sum(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11.1. Waveforms and test circuit



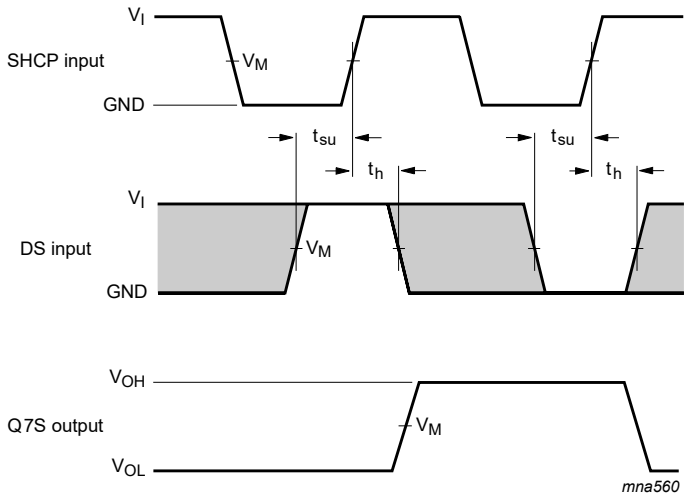
Measurement points are given in Table 8.
V_{OL} and V_{OH} are typical output voltage drops that occur with the output load.

Fig. 8. The shift clock (SHCP) to serial data output (Q7S) propagation delays, the shift clock pulse width and maximum shift clock frequency



Measurement points are given in Table 8.
V_{OL} and V_{OH} are typical output voltage drops that occur with the output load.

Fig. 9. The storage clock (STCP) to parallel data output (Qn) propagation delays, the storage clock pulse width and the shift clock to storage clock set-up time

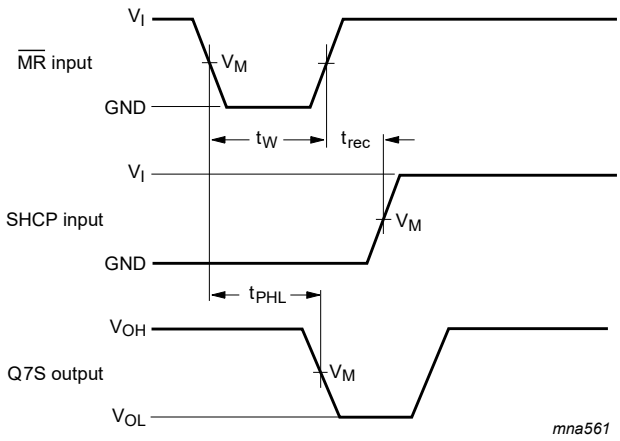


Measurement points are given in Table 8.

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

V_{OL} and V_{OH} are typical output voltage drops that occur with the output load.

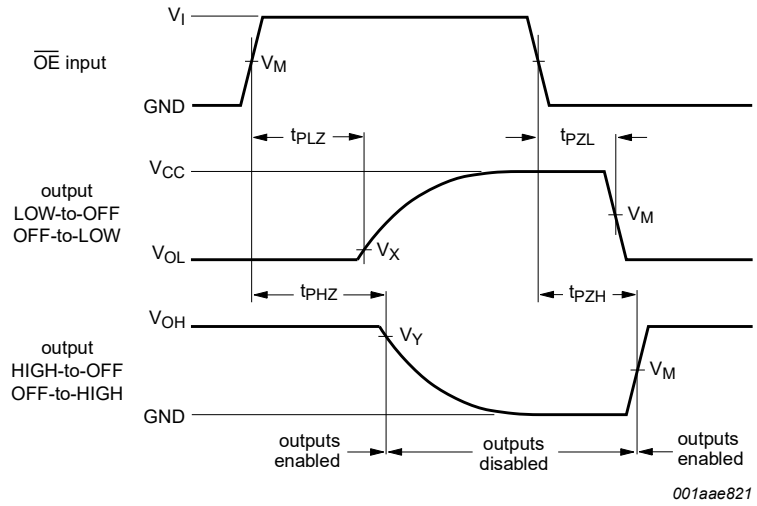
Fig. 10. The data set-up and hold times for the serial data input (DS)



Measurement points are given in Table 8.

V_{OL} and V_{OH} are typical output voltage drops that occur with the output load.

Fig. 11. The master reset ($\overline{MR}$) pulse width, the master reset to serial data output (Q7S) propagation delays and the master reset to shift clock (SHCP) recovery time



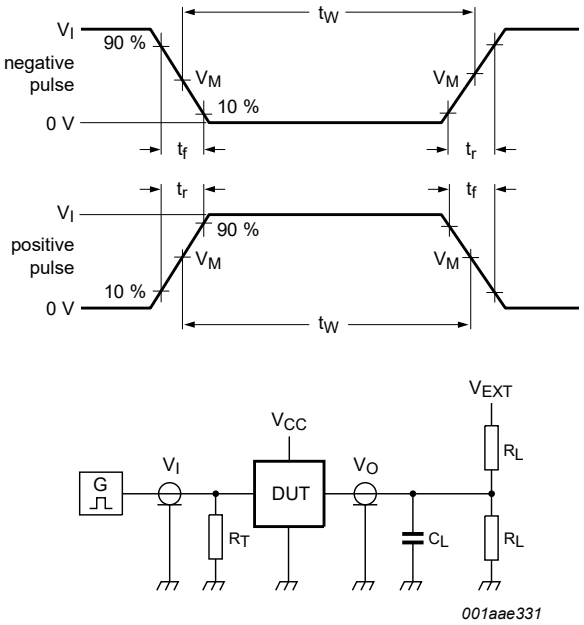
Measurement points are given in Table 8.

V_{OL} and V_{OH} are typical output voltage drops that occur with the output load.

Fig. 12. Enable and disable times

Table 8. Measurement points

Supply voltage	Input	Output		
V_{CC}	V_M	V_M	V_X	V_Y
V_{CC} < 2.7 V	$0.5V_{CC}$	$0.5V_{CC}$	V_{OL} + $0.1V_{CC}$	V_{OH} - $0.1V_{CC}$
V_{CC} ≥ 2.7 V	1.5 V	1.5 V	V_{OL} + 0.3 V	V_{OH} - 0.3 V



Test data is given in Table 9.

Definitions for test circuit:

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

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

V_{EXT} = External voltage for measuring switching times.

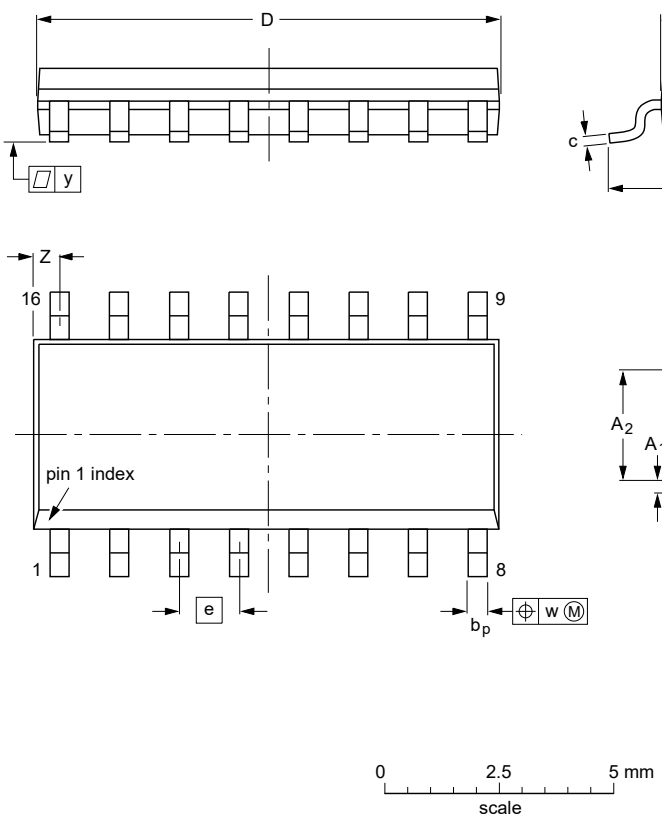
Fig. 13. Test circuit for measuring switching times

Table 9. Test data

Supply voltage	Input		Load		V_{EXT}		
V_{CC}	V_I	t_r, t_f	C_L	R_L	t_{PLH}, t_{PHL}	t_{PLZ}, t_{PZL}	t_{PHZ}, t_{PZH}
< 2.7 V	V_{CC}	≤ 2.5 ns	50 pF	1 kΩ	open	$2V_{CC}$	GND
2.7 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	1 kΩ	open	$2V_{CC}$	GND

12. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm **SOT109-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

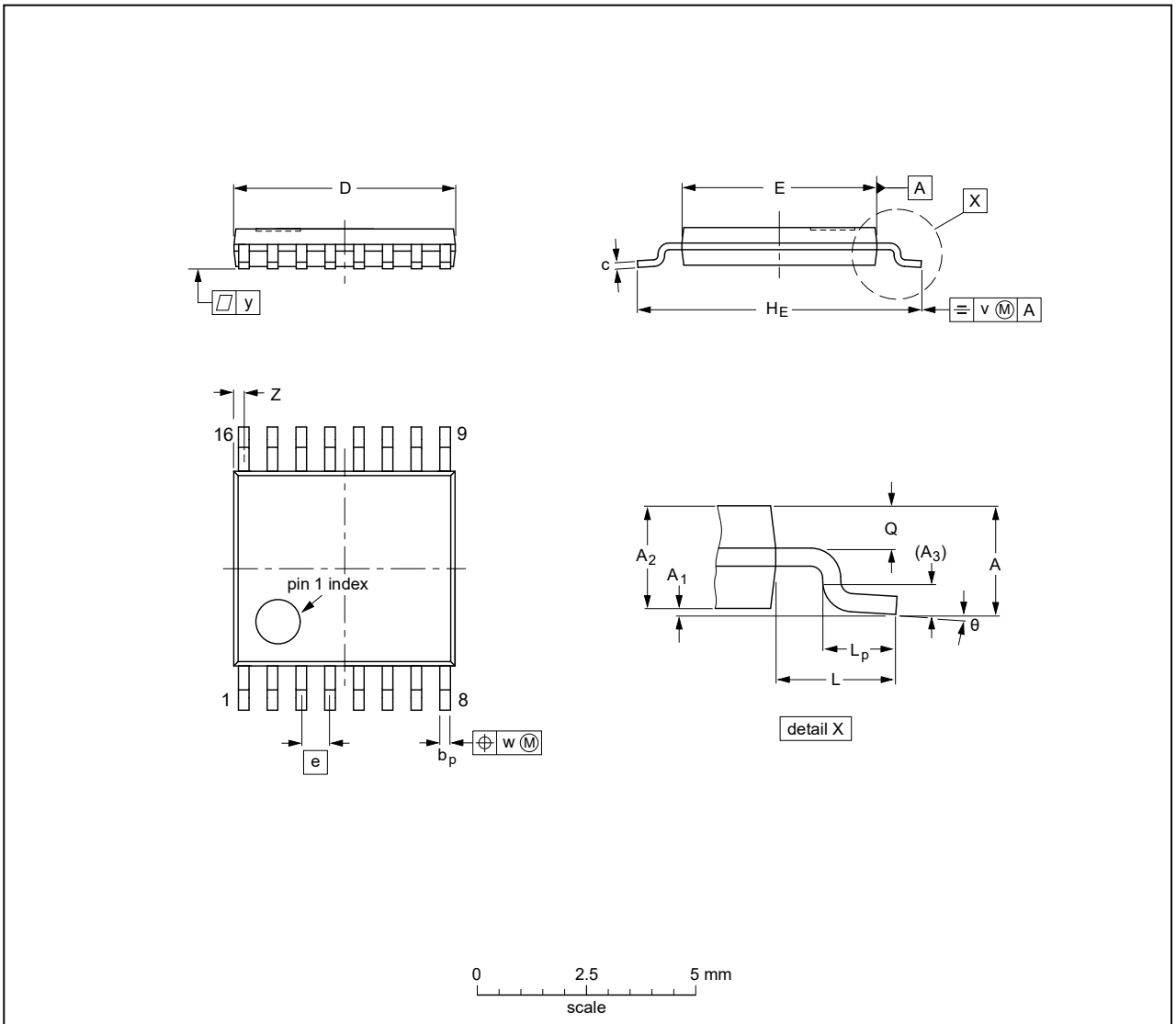
Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT109-1	076E07	MS-012				~~99-12-27~~ 03-02-19

Fig. 14. Package outline SOT109-1 (SO16)

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm **SOT403-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.40 0.06	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT403-1		MO-153				~~99-12-27~~ 03-02-18

Fig. 15. Package outline SOT403-1 (TSSOP16)

13. Abbreviations

Table 10. Abbreviations

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

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LV595 v.5	20210929	Product data sheet	-	74LV595 v.4
Modifications:	• 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. • Type number 74LV595DB (SOT338-1/SSOP16) removed. • Section 1 and Section 2 updated. • Section 8: Derating values for P_{tot} total power dissipation updated.			
74LV595 v.4	20160318	Product data sheet	-	74LV595 v.3
Modifications:	• Type number 74LV595N (SOT38-4) removed.			
74LV595 v.3	20090421	Product data sheet	-	74LV595 v.2
Modifications:	• 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.			
74LV595 v.2	980402	Product data sheet	-	74LV595 v.1
74LV595 v.1	970606	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.

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