

74HCS595

8-bit shift register with Schmitt-trigger inputs and 3-state output registers

Rev. 1.12 — 6 November 2024

Objective data sheet

1. General description

The 74HCS595 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 MR input. A LOW on 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 of V_{CC} .

All inputs are Schmitt-trigger inputs, capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

2. Features and benefits

- Wide supply voltage range from 2.0 V to 6.0 V
- Schmitt-trigger inputs
- Low power consumption
 - Typical supply current (I_{CC}) of 100 nA
 - Typical input leakage current (I_I) of ± 100 nA
- ± 7.8 mA output drive at 6 V
- 8-bit serial input and 8-bit serial or parallel output
- Storage register with 3-state outputs
- Shift register with direct clear
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standards:
 - JESD7A (2.0 V to 6.0 V)
- ESD protection:
 - HBM ANSI/ESDA/JEDEC JS-001 class 3A exceeds 4000 V
 - CDM ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1500 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
- Output expansion
- LED matrix control
- 7-segment display control
- 8-bit data storage

4. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HCS595D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HCS595PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74HCS595BQ	-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

5. Functional diagram

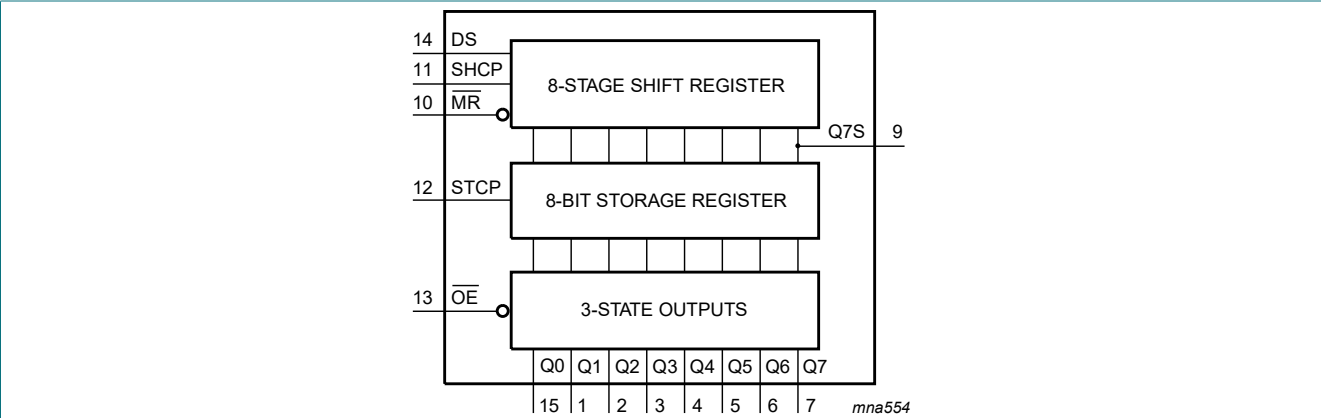


Fig. 1. Functional diagram

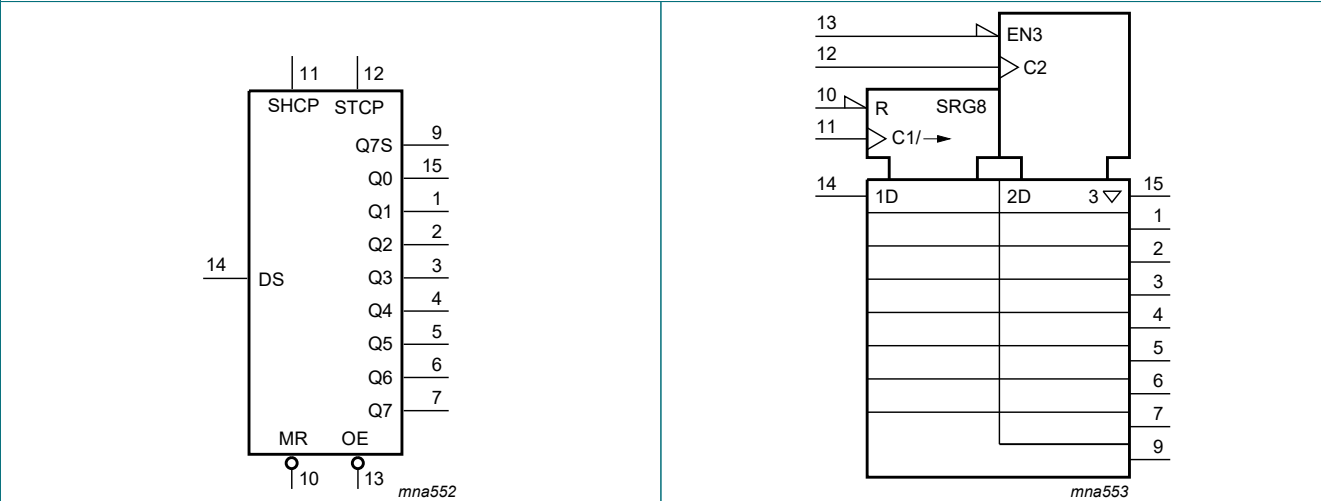


Fig. 2. Logic symbol

Fig. 3. IEC logic symbol

8-bit shift register with Schmitt-trigger inputs and 3-state output registers

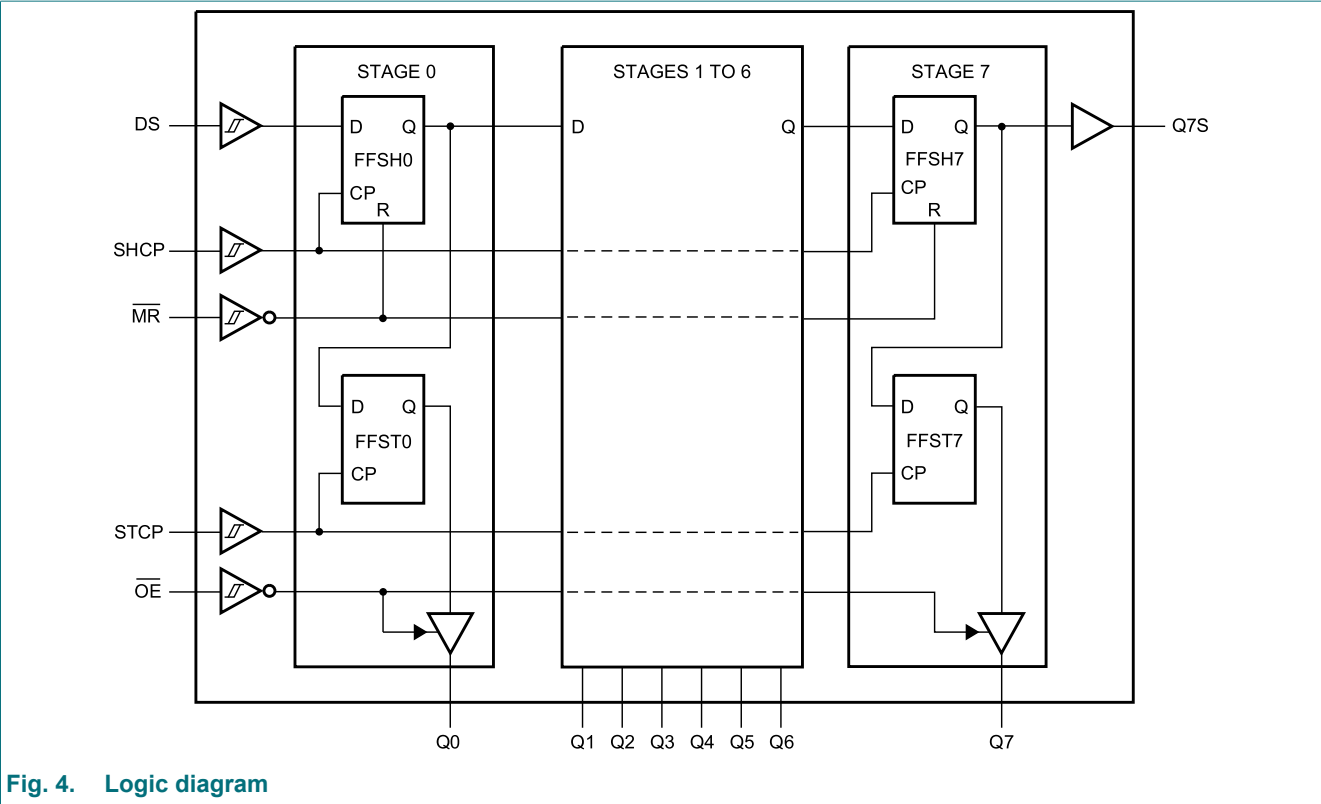
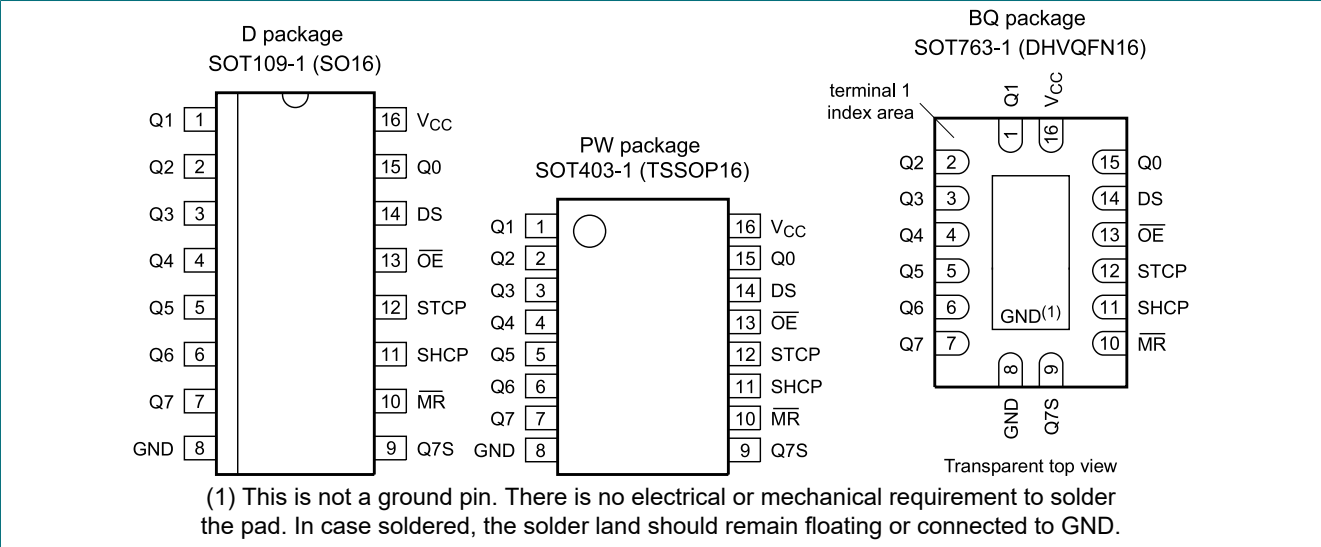


Fig. 4. Logic diagram

6. Pinning information

6.1. Pinning



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 outputs
GND	8	ground (0 V)
Q7S	9	serial data output, can be used for cascading
MR	10	master reset, clears shift register (active LOW)
SHCP	11	shift register clock, rising edge triggered
STCP	12	storage register clock, rising edge triggered
OE	13	output enable (active LOW)
DS	14	serial data input
VCC	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.

Control				Input	Output		Function
SHCP	STCP	OE	MR	DS	Q7S	Qn	
X	X	L	L	X	L	NC	a LOW-level on $\overline{\text{MR}}$ only affects the shift registers
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-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	↑	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

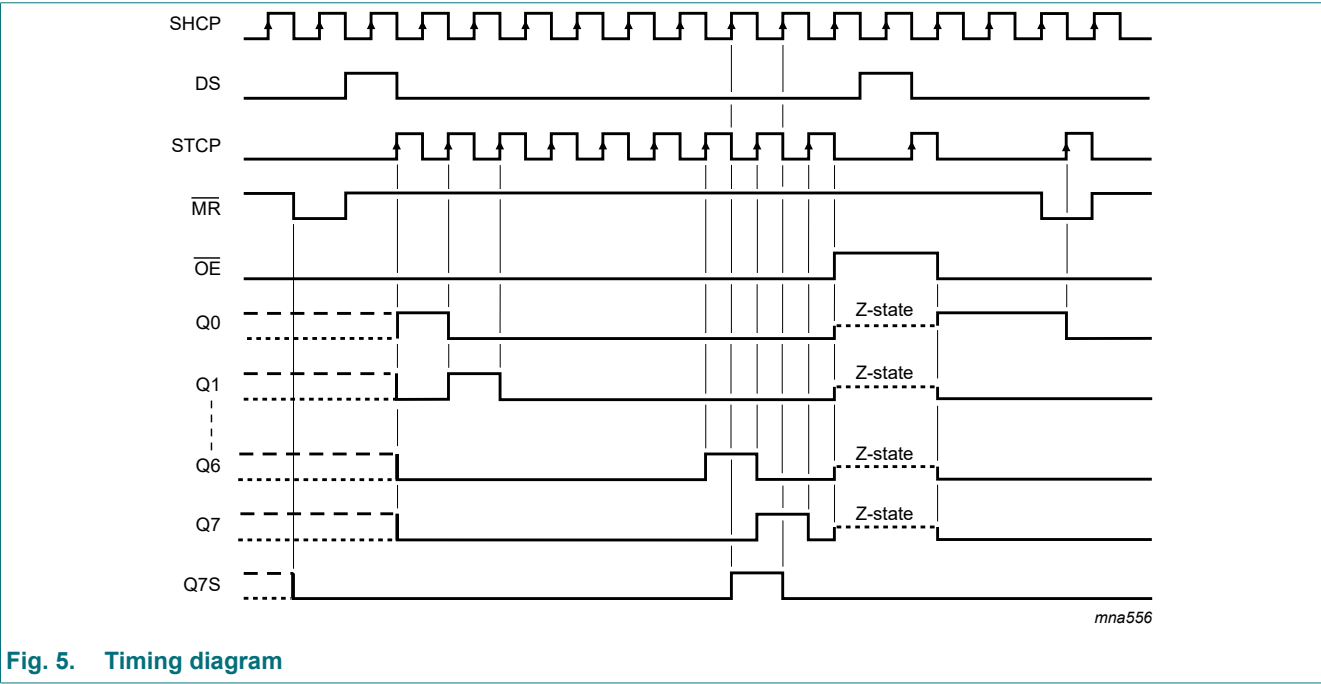


Fig. 5. Timing diagram

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	V
I _{IK}	input clamping current	V _I < -0.5 V or V _I > V _{CC} + 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	mA
I _O	output current	V _O = 0 V to V _{CC}	-	±35	mA
I _{CC}	supply current		-	70	mA
I _{GND}	ground current		-70	-	mA
T _j	junction temperature	[2]	-	+150	°C
T _{stg}	storage temperature		-65	+150	°C
V _{ESD}	electrostatic discharge	HBM ANSI/ESDA/JEDEC JS-001 Class 3A exceeds 4000 V	-	±4000	V
		CDM ANSI/ESDA/JEDEC JS-002 Class C3 exceeds 1500 V	-	±1500	V
P _{tot}	total power dissipation	[3]	-	500	mW

- [1] The minimum input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] Guaranteed by design.
[3] 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. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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	°C

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	
V _{T+}	positive-going threshold voltage	see Fig. 6 and Fig. 7								
		V _{CC} = 2.0 V	0.7	-	1.5	0.7	1.5	0.7	1.5	V
		V _{CC} = 4.5 V	1.7	-	3.15	1.7	3.15	1.7	3.15	V
		V _{CC} = 6 V	2.1	-	4.2	2.1	4.2	2.1	4.2	V
		V _{CC} = 3.0 V to 3.6 V	0.4V _{CC}	-	0.7V _{CC}	0.4V _{CC}	0.7V _{CC}	0.4V _{CC}	0.7V _{CC}	V
		V _{CC} = 4.5 V to 5.5 V	0.38V _{CC}	-	0.7V _{CC}	0.38V _{CC}	0.7V _{CC}	0.38V _{CC}	0.7V _{CC}	V
V _{T-}	negative-going threshold voltage	see Fig. 6 and Fig. 7								
		V _{CC} = 2.0 V	0.3	-	1.0	0.3	1.0	0.3	1.0	V
		V _{CC} = 4.5 V	0.9	-	2.2	0.9	2.2	0.9	2.2	V
		V _{CC} = 6 V	1.2	-	3.0	1.2	3.0	1.2	3.0	V
		V _{CC} = 3.0 V to 3.6 V	0.2V _{CC}	-	0.5V _{CC}	0.2V _{CC}	0.5V _{CC}	0.2V _{CC}	0.5V _{CC}	V
		V _{CC} = 4.5 V to 5.5 V	0.2V _{CC}	-	0.49V _{CC}	0.2V _{CC}	0.49V _{CC}	0.2V _{CC}	0.49V _{CC}	V
V _H	hysteresis voltage ^[1]	see Fig. 6 and Fig. 7								
		V _{CC} = 2.0 V	0.2	0.52	1.0	0.2	1.0	0.2	1.0	V
		V _{CC} = 4.5 V	0.4	0.85	1.4	0.4	1.4	0.4	1.4	V
		V _{CC} = 6 V	0.6	1.1	1.6	0.6	1.6	0.6	1.6	V
		V _{CC} = 3.0 V to 3.6 V	0.1V _{CC}	0.72	0.38V _{CC}	0.1V _{CC}	0.38V _{CC}	0.1V _{CC}	0.38V _{CC}	V
		V _{CC} = 4.5 V to 5.5 V	0.09V _{CC}	0.94	0.29V _{CC}	0.09V _{CC}	0.29V _{CC}	0.09V _{CC}	0.29V _{CC}	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}								
		I _{OH} = -20 µA; V _{CC} = 2.0 V to 6 V	V _{CC} -0.1	V _{CC} -0.002	-	V _{CC} -0.1	-	V _{CC} -0.1	-	V
		I _{OH} = -4 mA; V _{CC} = 3.0 V	2.7	2.85	-	2.7	-	2.7	-	V
		I _{OH} = -6 mA; V _{CC} = 4.5 V	4.0	4.3	-	4.0	-	4.0	-	V
		I _{OH} = -7.8 mA; V _{CC} = 6.0 V	5.48	5.75	-	5.4	-	5.4	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}								
		I _{OL} = 20 µA; V _{CC} = 2.0 V to 6 V	-	0.002	0.1	-	0.1	-	0.1	V
		I _{OL} = 4 mA; V _{CC} = 3.0 V	-	0.14	0.25	-	0.25	-	0.25	V
		I _{OL} = 6 mA; V _{CC} = 4.5 V	-	0.18	0.26	-	0.30	-	0.30	V
		I _{OL} = 7.8 mA; V _{CC} = 6.0 V	-	0.22	0.26	-	0.33	-	0.33	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 6.0 V	-	±0.01	±0.1	-	±0.25	-	±1.0	µA
I _{OZ}	OFF-state output current	V _{CC} = 6.0 V; V _O = V _{CC} or GND	-	±0.05	±0.25	-	±1.0	-	±5.0	µA

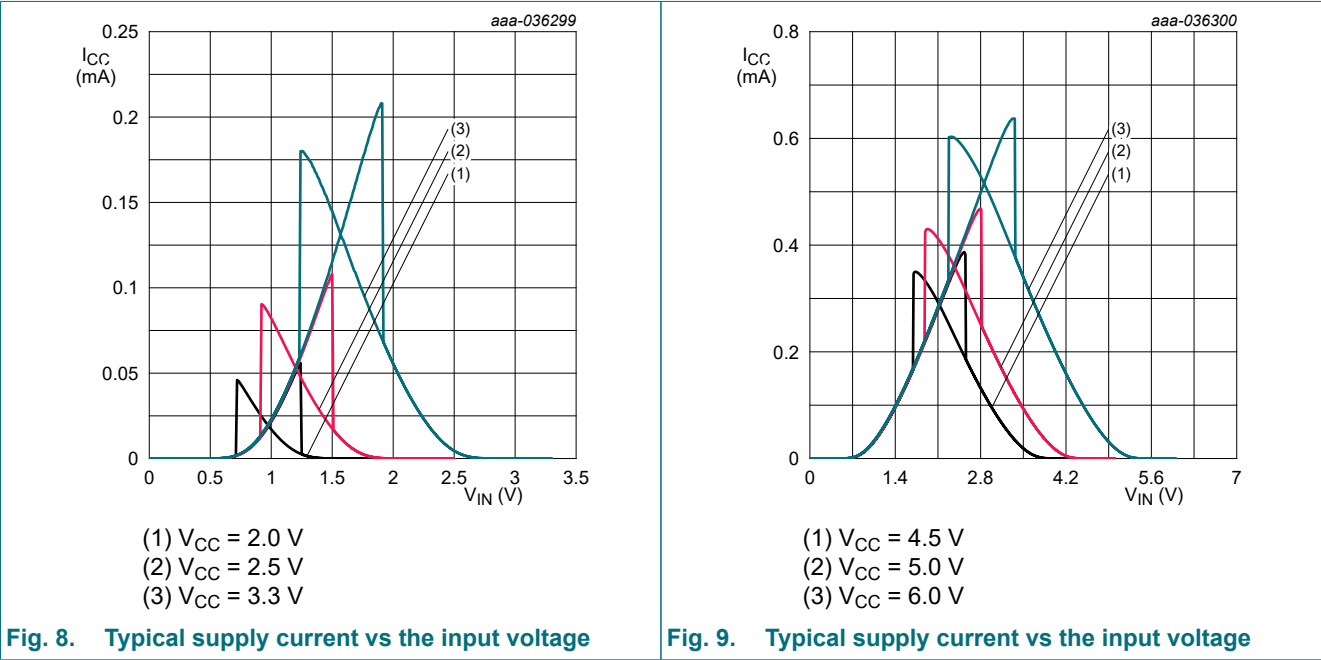
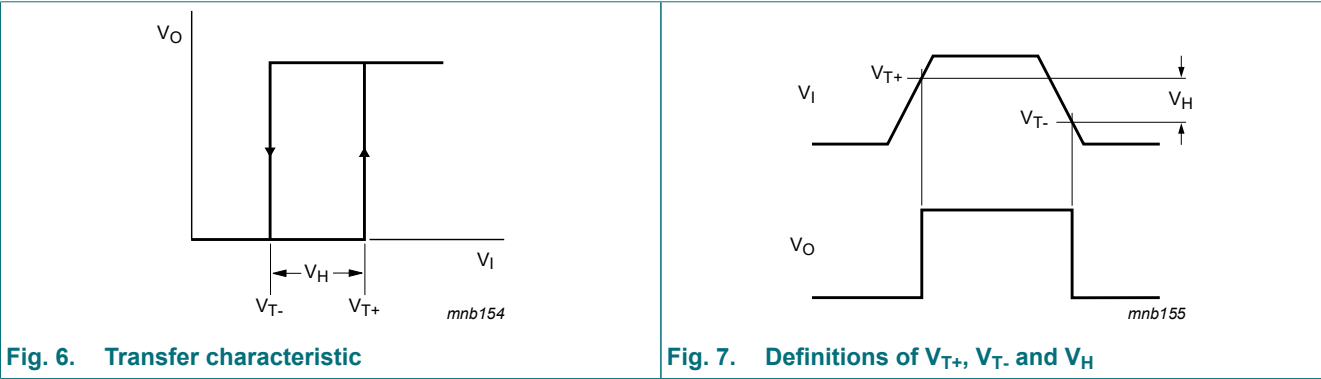
8-bit shift register with Schmitt-trigger inputs and 3-state output registers

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	0.01	0.1	-	0.5	-	2.0	µA

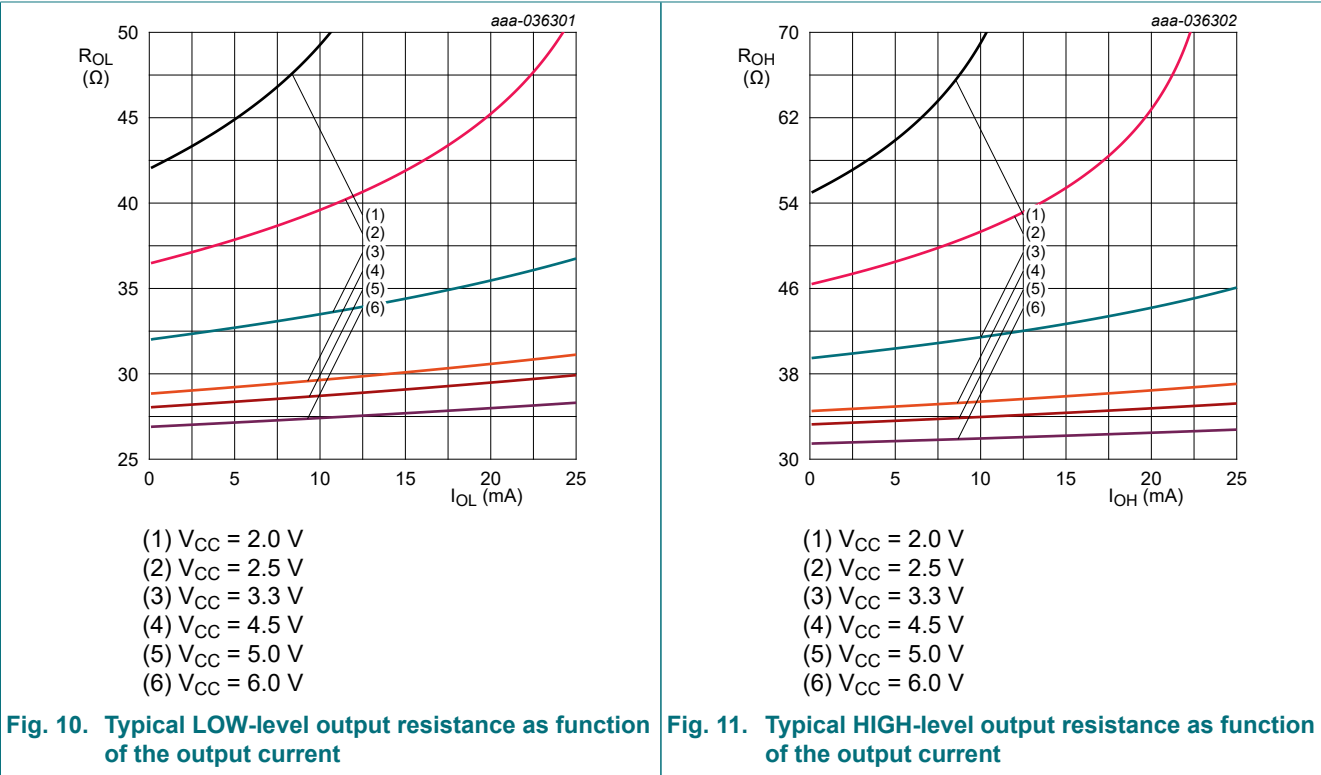
[1] Guaranteed by design.

10.1. Transfer characteristic waveforms and graphs

10.1.1. For inputs



10.1.2. For outputs



11. Dynamic characteristics

Table 7. Dynamic characteristics
Voltages are referenced to GND (ground = 0 V); for test circuit see Section 11.1.

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_{pd}	propagation delay	SHCP to Q7S; see Fig. 12 [2]								
		$V_{CC} = 2\text{ V}$	-	14	19	-	25	-	28	V
		$V_{CC} = 4.5\text{ V}$	-	6	8	-	9	-	10	V
		$V_{CC} = 6\text{ V}$	-	5	7	-	8	-	9	V
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	tbd	tbd	-	tbd	-	tbd	V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	tbd	8	-	9	-	10	V
		STCP to Qn; see Fig. 13 [2]								
		$V_{CC} = 2\text{ V}$	-	16	21	-	33	-	37	ns
		$V_{CC} = 4.5\text{ V}$	-	6	9	-	11	-	12	ns
		$V_{CC} = 6\text{ V}$	-	6	8	-	9	-	10	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	tbd	tbd	-	tbd	-	tbd	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	tbd	9	-	11	-	12	ns

8-bit shift register with Schmitt-trigger inputs and 3-state output registers

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	MR to Q7S; see Fig. 15								
		V _{CC} = 2 V	-	13	19	-	24	-	27	ns
		V _{CC} = 4.5 V	-	6	8	-	10	-	11	ns
		V _{CC} = 6 V	-	6	8	-	9	-	10	ns
		V _{CC} = 3.0 V to 3.6 V	-	7	tbd	-	tbd	-	tbd	ns
		V _{CC} = 4.5 V to 5.5 V	-	tbd	8	-	10	-	11	ns
t _{en}	enable time	OE to Qn; see Fig. 16 [3]								
		V _{CC} = 2 V	-	12	18	-	26	-	27	ns
		V _{CC} = 4.5 V	-	6	9	-	12	-	13	ns
		V _{CC} = 6 V	-	5	8	-	10	-	11	ns
		V _{CC} = 3.0 V to 3.6 V	-	tbd	tbd	-	tbd	-	tbd	ns
		V _{CC} = 4.5 V to 5.5 V	-	tbd	9	-	12	-	13	ns
t _{dis}	disable time	OE to Qn; see Fig. 16 [4]								
		V _{CC} = 2 V	-	13	16	-	18	-	20	ns
		V _{CC} = 4.5 V	-	9	11	-	12	-	13	ns
		V _{CC} = 6 V	-	8	10	-	11	-	12	ns
		V _{CC} = 3.0 V to 3.6 V	-	tbd	tbd	-	tbd	-	tbd	ns
		V _{CC} = 4.5 V to 5.5 V	-	tbd	11	-	11	-	13	ns
t _w	pulse width	SHCP, STCP, HIGH or LOW; see Fig. 12 and Fig. 13								
		V _{CC} = 2 V	7	-	-	8	-	9	-	ns
		V _{CC} = 4.5 V	7	-	-	7	-	7	-	ns
		V _{CC} = 6 V	7	-	-	7	-	7	-	ns
		V _{CC} = 3.0 V to 3.6 V	tbd	-	-	7	-	7	-	ns
		V _{CC} = 4.5 V to 5.5 V	7	-	-	7	-	7	-	ns
		MR LOW; see Fig. 15								
		V _{CC} = 2 V	8	-	-	9	-	10	-	ns
		V _{CC} = 4.5 V	7	-	-	7	-	7	-	ns
		V _{CC} = 6 V	7	-	-	7	-	7	-	ns
		V _{CC} = 3.0 V to 3.6 V	tbd	-	-	7	-	7	-	ns
		V _{CC} = 4.5 V to 5.5 V	7	-	-	7	-	7	-	ns

8-bit shift register with Schmitt-trigger inputs and 3-state output registers

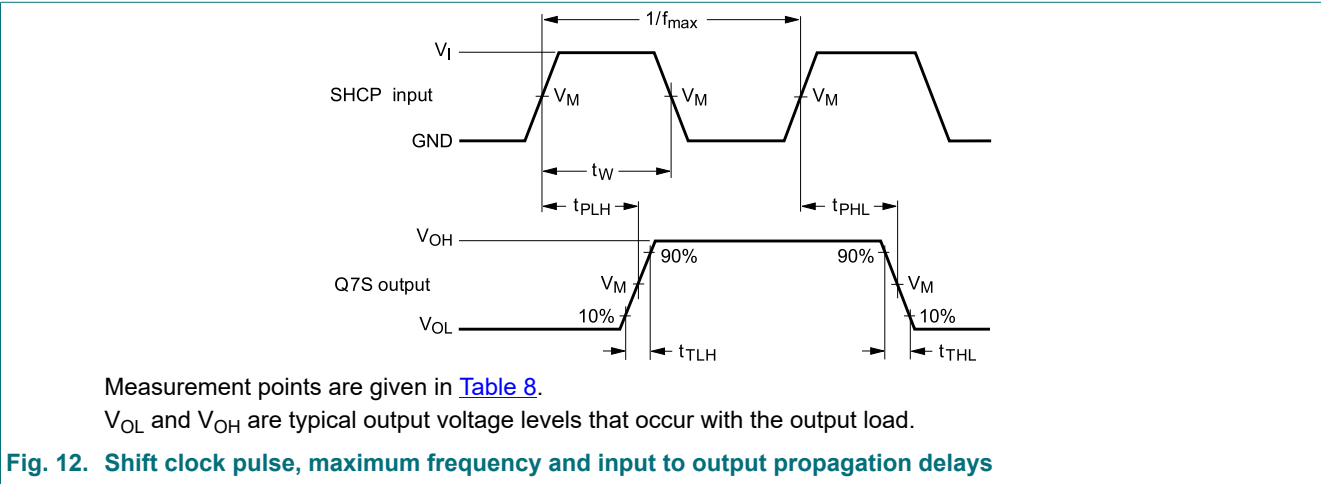
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
t _{su}	set-up time	DS to SHCP; see Fig. 14								
		V _{CC} = 2 V	8	-	-	11	-	13	-	ns
		V _{CC} = 4.5 V	4	-	-	5	-	5	-	ns
		V _{CC} = 6 V	3	-	-	4	-	4	-	ns
		V _{CC} = 3.0 V to 3.6 V	tbd	-	-	tbd	-	tbd	-	ns
		V _{CC} = 4.5 V to 5.5 V	tbd	-	-	tbd	-	tbd	-	ns
		SHCP to STCP; see Fig. 13								
		V _{CC} = 2 V	11	-	-	16	-	18	-	ns
		V _{CC} = 4.5 V	5	-	-	6	-	7	-	ns
		V _{CC} = 6 V	4	-	-	5	-	6	-	ns
		V _{CC} = 3.0 V to 3.6 V	tbd	-	-	tbd	-	tbd	-	ns
		V _{CC} = 4.5 V to 5.5 V	tbd	-	-	tbd	-	tbd	-	ns
		MR to SHCP; see Fig. 15								
		V _{CC} = 2 V	8	-	-	11	-	13	-	ns
		V _{CC} = 4.5 V	4	-	-	5	-	6	-	ns
		V _{CC} = 6 V	4	-	-	5	-	5	-	ns
		V _{CC} = 3.0 V to 3.6 V	tbd	-	-	tbd	-	tbd	-	ns
		V _{CC} = 4.5 V to 5.5 V	tbd	-	-	tbd	-	tbd	-	ns
t _h	hold time	DS to SHCP; see Fig. 14								
		V _{CC} = 2 V	0	-	-	0	-	0	-	ns
		V _{CC} = 4.5 V	0	-	-	0	-	0	-	ns
		V _{CC} = 6 V	0	-	-	0	-	0	-	ns
		V _{CC} = 3.0 V to 3.6 V	0	-	-	0	-	0	-	ns
		V _{CC} = 4.5 V to 5.5 V	0	-	-	0	-	0	-	ns
t _{rec}	recovery time	MR to SHCP; see Fig. 15								
		V _{CC} = 2 V	8	-	-	11	-	13	-	ns
		V _{CC} = 4.5 V	4	-	-	5	-	6	-	ns
		V _{CC} = 6 V	4	-	-	5	-	5	-	ns
		V _{CC} = 3.0 V to 3.6 V	tbd	-	-	tbd	-	tbd	-	ns
		V _{CC} = 4.5 V to 5.5 V	tbd	-	-	tbd	-	tbd	-	ns
f _{max}	maximum frequency	SHCP, STCP; see Fig. 12 and Fig. 13								
		V _{CC} = 2 V	35	-	-	23	-	19	-	MHz
		V _{CC} = 4.5 V	110	-	-	70	-	60	-	MHz
		V _{CC} = 6 V	130	-	-	82	-	75	-	MHz
		V _{CC} = 3.0 V to 3.6 V	tbd	-	-	tbd	-	tbd	-	MHz
		V _{CC} = 4.5 V to 5.5 V	110	-	-	70	-	60	-	MHz

8-bit shift register with Schmitt-trigger inputs and 3-state output registers

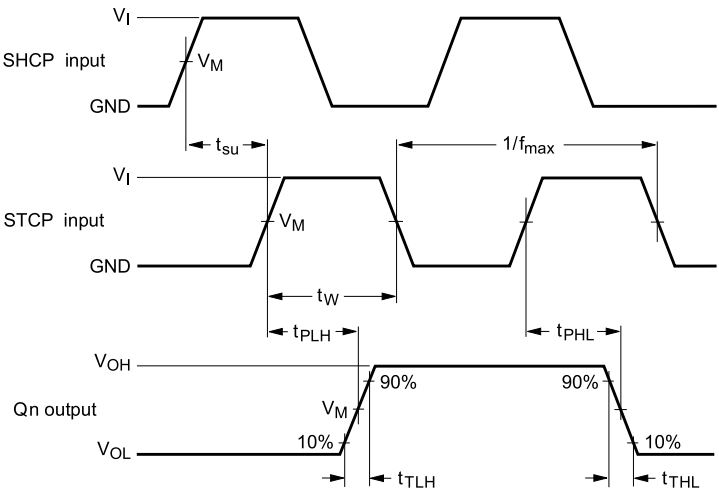
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
t _t	transition time	Qn and Q7S; see Fig. 12 and Fig. 13 [5]								
		V _{CC} = 2 V	-	9	13	-	15	-	16	ns
		V _{CC} = 4.5 V	-	5	7	-	8	-	8	ns
		V _{CC} = 6 V	-	4	6	-	7	-	7	ns
		V _{CC} = 3.0 V to 3.6 V	-	5	8	-	9	-	10	ns
		V _{CC} = 4.5 V to 5.5 V	-	4	7	-	8	-	8	ns
C _I	input capacitance		-	1.5	-	-	5	-	5	pF
C _{PD}	power dissipation capacitance	f _i = 1 MHz; C _L = 0 pF; V _I = GND to V _{CC} ; V _{CC} = 2.0 V to 6.0 V [6][7]	-	52	-	-	-	-	-	pF

- [1] Typical values are measured at nominal supply voltage.
- [2] t_{pd} is the same as t_{PHL} and t_{PLH}.
- [3] t_{en} is the same as t_{PZL} and t_{PZH}.
- [4] t_{dis} is the same as t_{PLZ} and t_{PHZ}.
- [5] t_t is the same as t_{THL} and t_{TLH}.
- [6] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
P_D = C_{PD} × V_{CC}² × f_i + Σ(C_L × V_{CC}² × f_o) where:
f_i = input frequency in MHz;
f_o = output frequency in MHz;
Σ(C_L × V_{CC}² × f_o) = sum of outputs;
C_L = output load capacitance in pF;
V_{CC} = supply voltage in V.
- [7] All 9 outputs switching.

11.1. Waveforms and test circuit

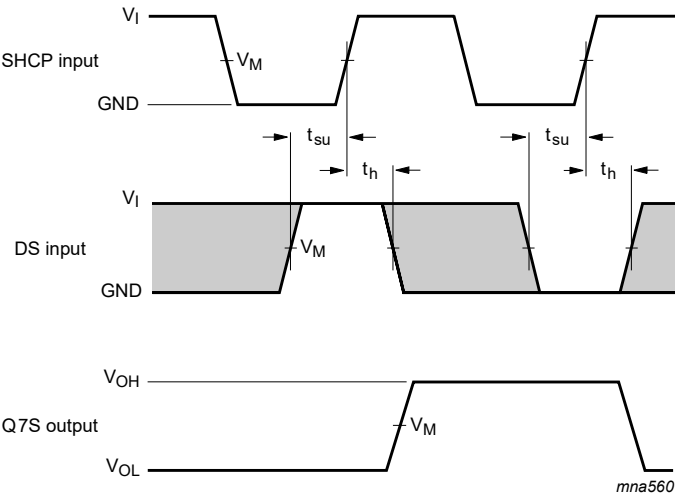


8-bit shift register with Schmitt-trigger inputs and 3-state output registers



Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 13. Storage clock to output propagation delays



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 levels that occur with the output load.

Fig. 14. Data set-up and hold times

8-bit shift register with Schmitt-trigger inputs and 3-state output registers

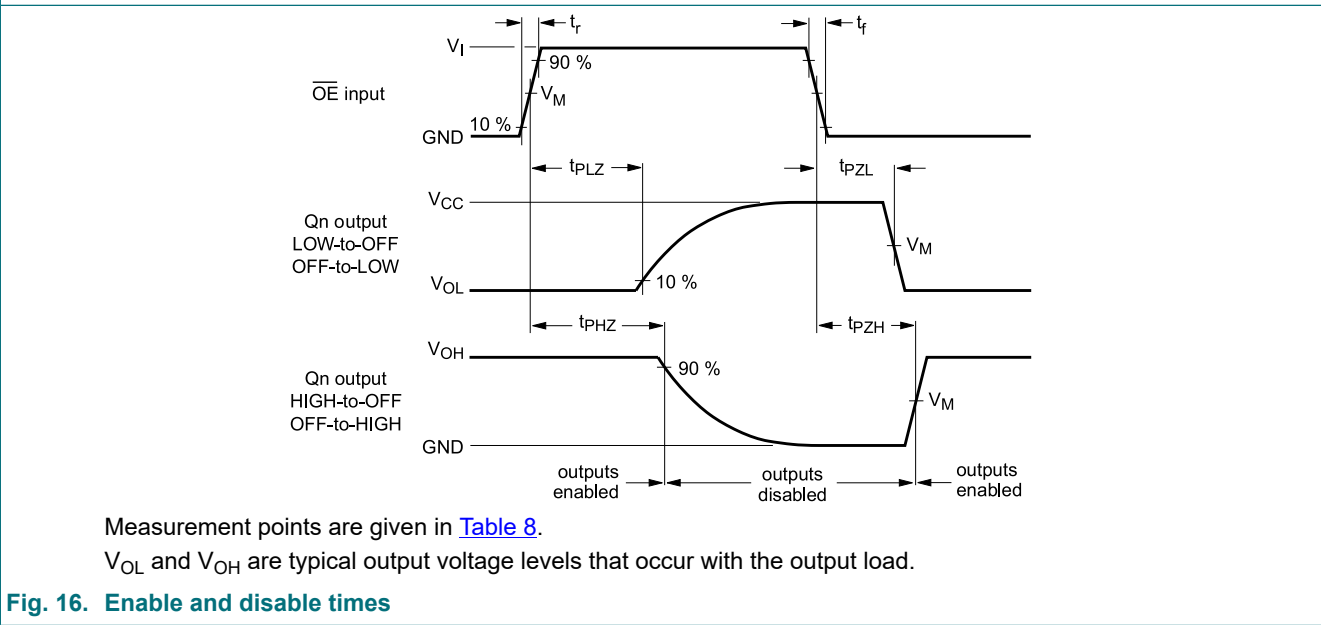
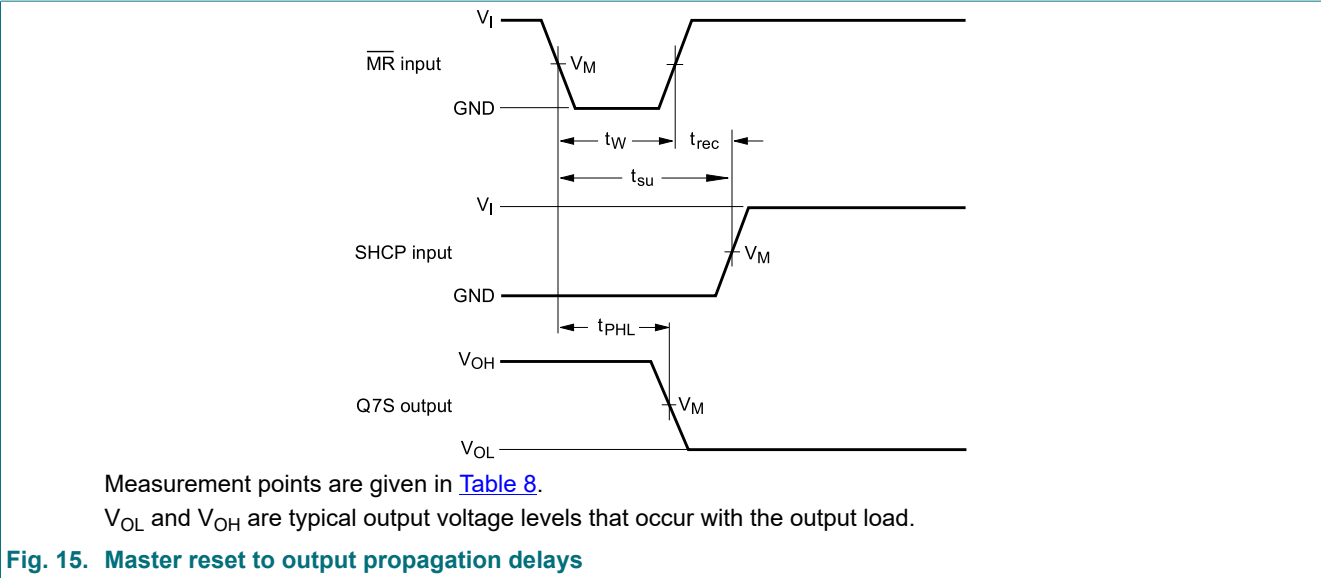


Table 8. Measurement points

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

8-bit shift register with Schmitt-trigger inputs and 3-state output registers

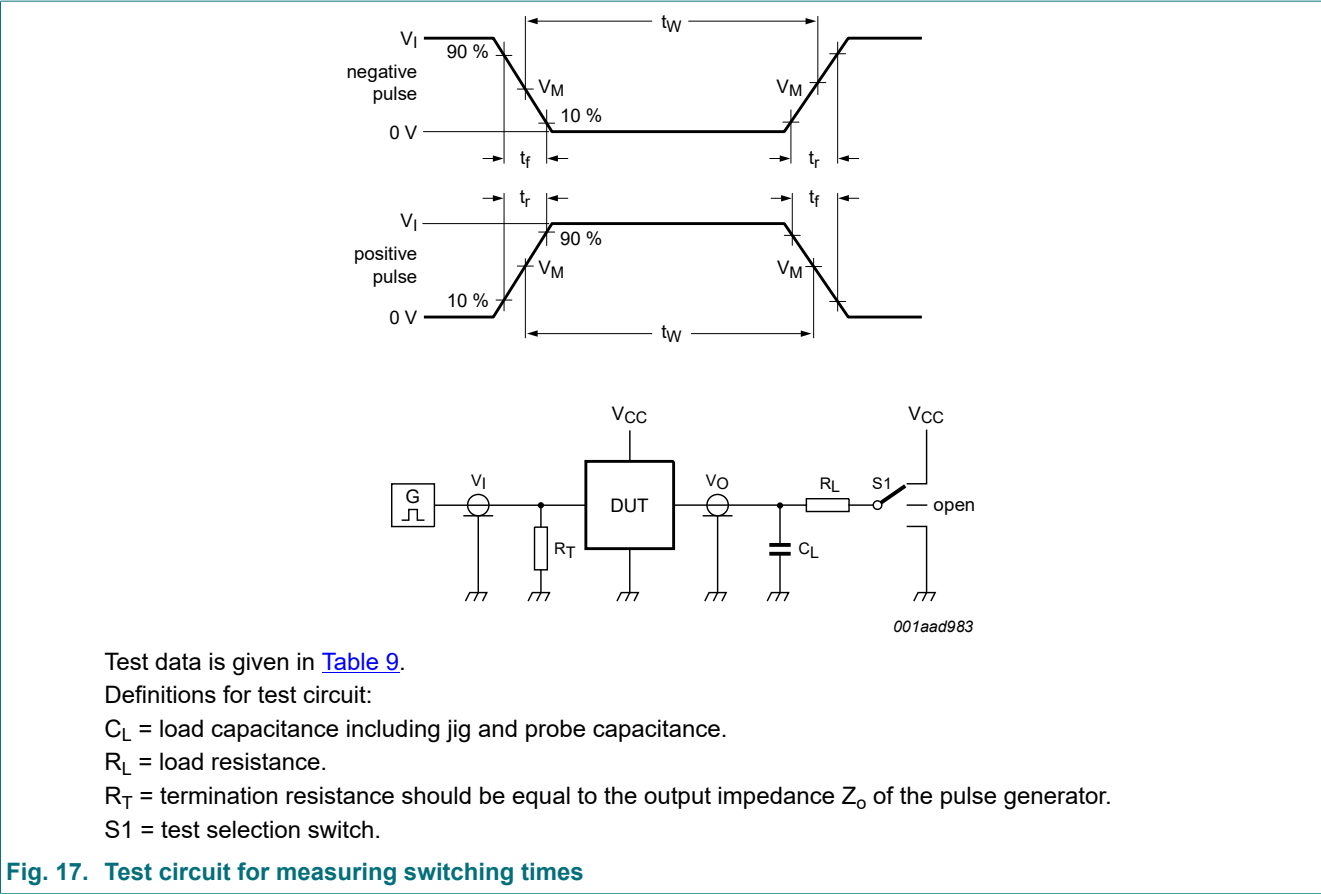


Fig. 17. Test circuit for measuring switching times

Table 9. Test data

Input		Load		S1 position		
V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
V_{CC}	2.5 ns	50 pF	1 kΩ	open	GND	V_{CC}

12. Package outline

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

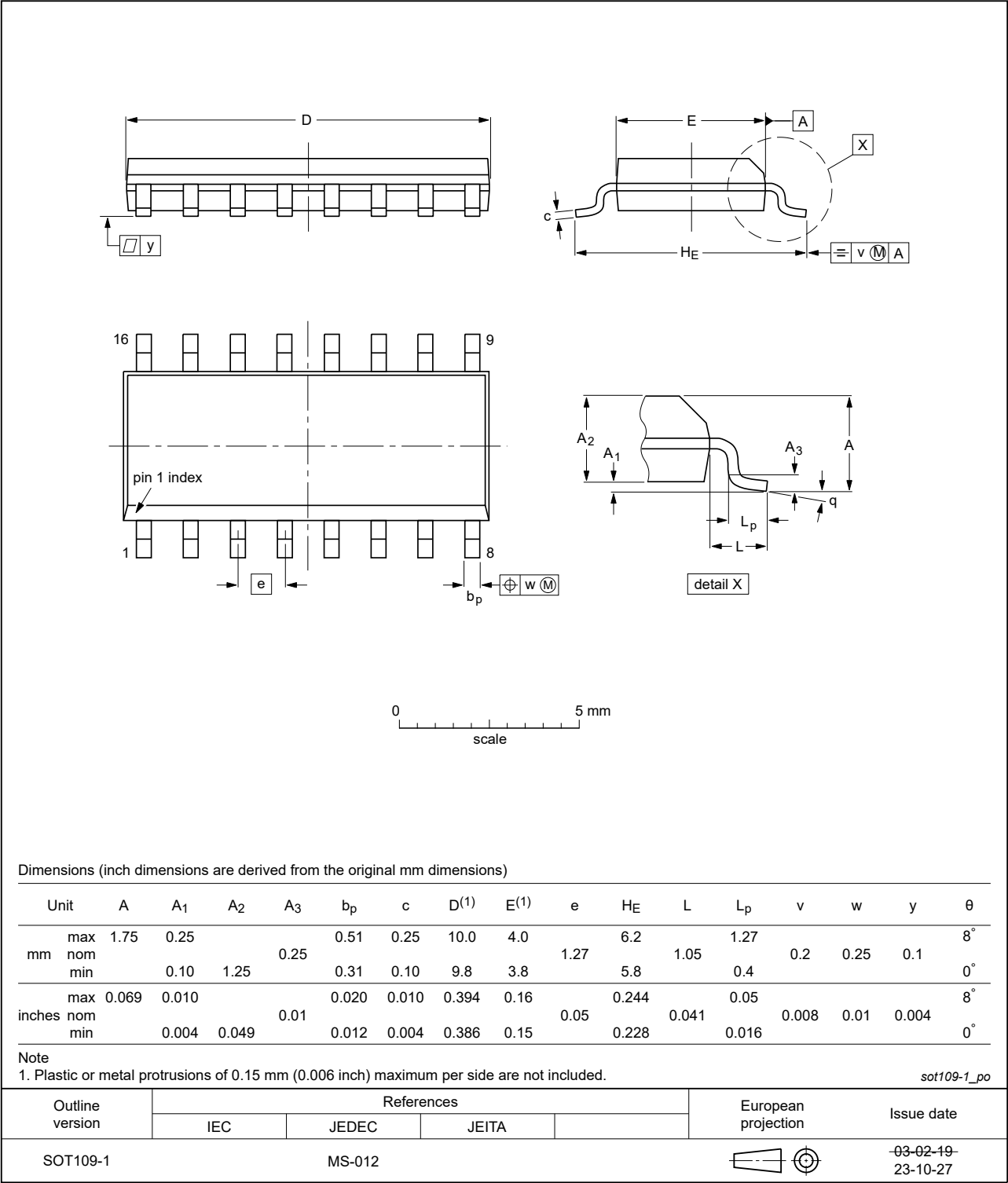


Fig. 18. Package outline SOT109-1 (SO16)

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

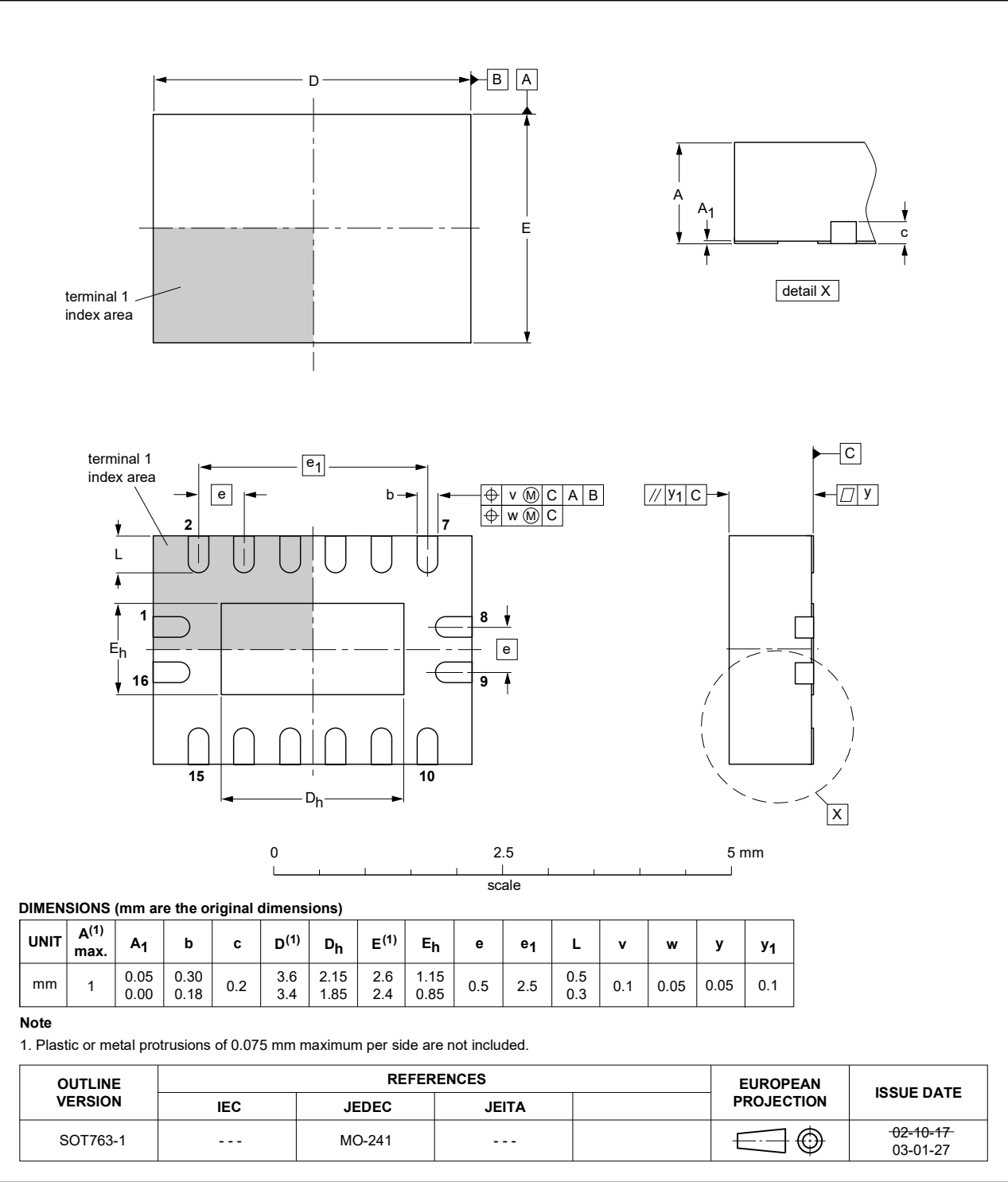


Fig. 20. Package outline SOT763-1 (DHVQFN16)

13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charge Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HCS595 v.1.12	20241106	Objective 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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