

74HC174-Q100; 74HCT174-Q100

Hex D-type flip-flop with reset; positive-edge trigger

Rev. 2 — 26 February 2021

Product data sheet

1. General description

The 74HC174-Q100; 74HCT174-Q100 are hex positive edge-triggered D-type flip-flops with individual data inputs (D_n) and outputs (Q_n). The common clock (CP) and master reset ($\overline{MR}$) inputs load and reset all flip-flops simultaneously. The D-input that meets the set-up and hold time requirements on the LOW-to-HIGH clock transition is stored in the flip-flop and appears at the Q output. A LOW on $\overline{MR}$ causes the flip-flops and outputs to be reset LOW. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

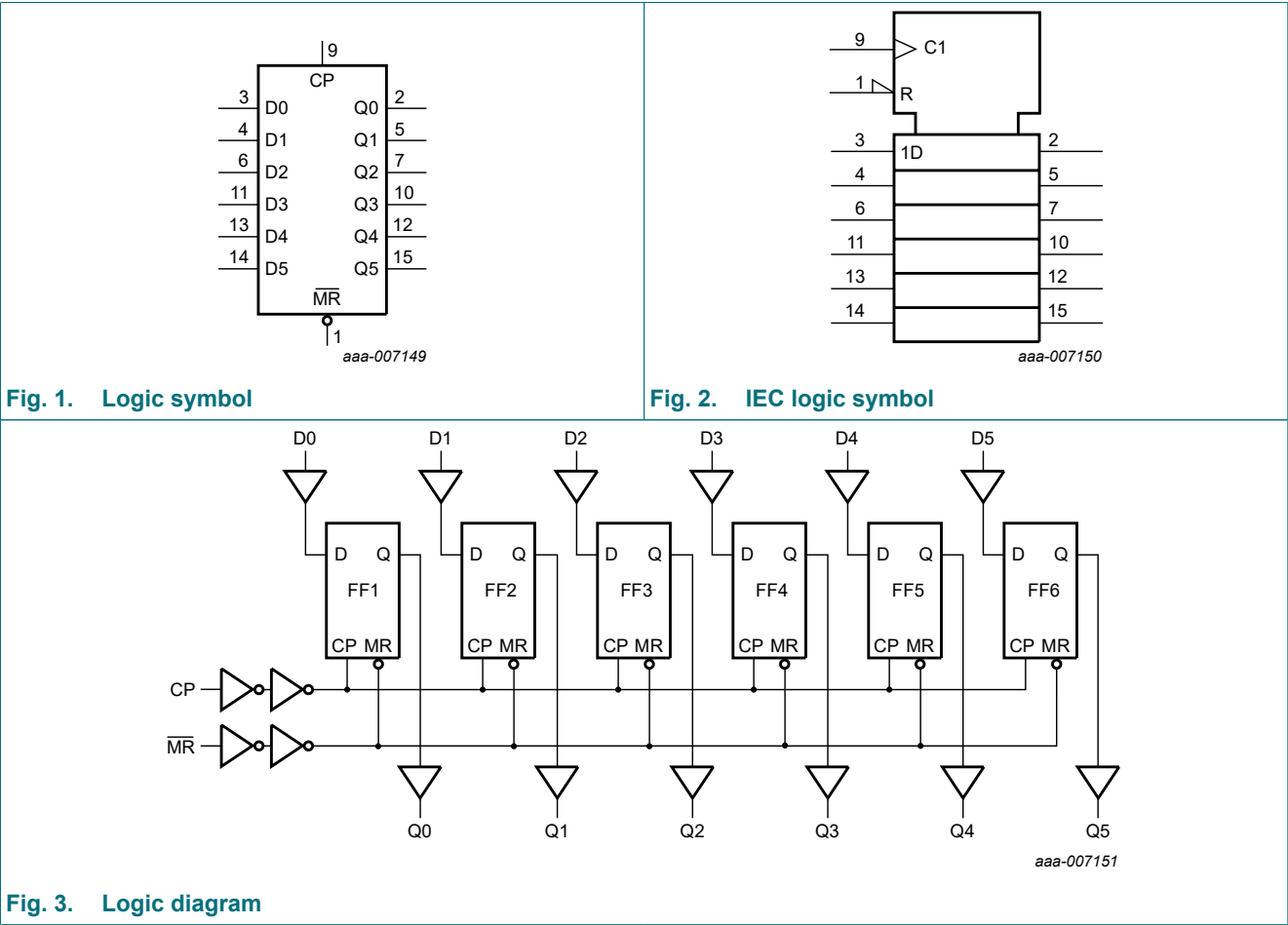
- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
 - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Wide supply voltage range from 2.0 to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Input levels:
 - For 74HC174-Q100: CMOS level
 - For 74HCT174-Q100: TTL level
- Six edge-triggered D-type flip-flops
- Asynchronous master reset
- Complies with JEDEC standards
 - JESD8C (2.7 V to 3.6 V)
 - JESD7A (2.0 V to 6.0 V)
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- ESD protection:
 - MIL-STD-883, method 3015 exceeds 2000 V
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V ($C = 200$ pF, $R = 0$ Ω)

3. Ordering information

Table 1. Ordering information

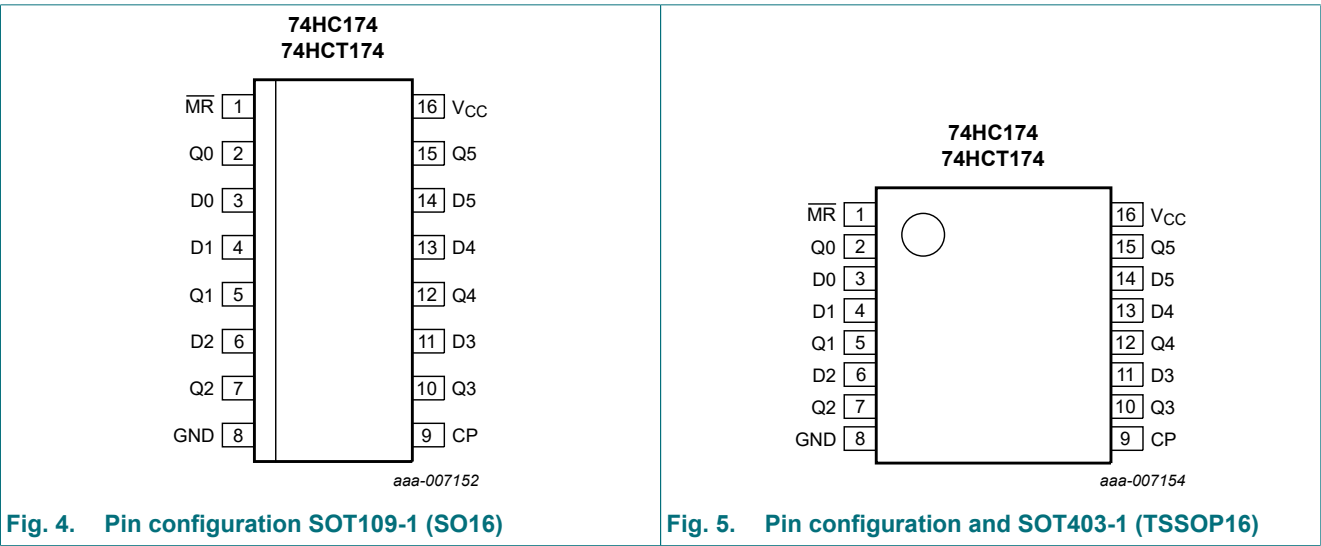
Type number	Package			
	Temperature range	Name	Description	Version
74HC174D-Q100	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HCT174D-Q100				
74HC174PW-Q100	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74HCT174PW-Q100				

4. Functional diagram



5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
MR	1	asynchronous master reset input (active LOW)
Q0, Q1, Q2, Q3, Q4, Q5	2, 5, 7, 10, 12, 15	flip-flop output
D0, D1, D2, D3, D4, D5	3, 4, 6, 11, 13, 14	data input
GND	8	ground (0 V)
CP	9	clock input (LOW-to-HIGH edge-triggered)
V _{CC}	16	positive supply voltage

6. Functional description

Table 3. Function table

H = HIGH voltage level; h = HIGH voltage level one set-up time prior to the LOW-to-HIGH clock transition;

L = LOW voltage level; l = LOW voltage level one set-up time prior to the LOW-to-HIGH clock transition;

X = don't care; ↑ = LOW-to-HIGH clock transition.

Operating modes	Inputs			Outputs
	MR	CP	Dn	Qn
reset (clear)	L	X	X	L
load "1"	H	↑	h	H
load "0"	H	↑	l	L

7. 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	-0.5 V < V _O < V _{CC} + 0.5 V	-	±25	mA
I _{CC}	supply current		-	50	mA
I _{GND}	ground current		-50	-	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.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC174-Q100			74HCT174-Q100			Unit
			Min	Typ	Max	Min	Typ	Max	
V _{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V _I	input voltage		0	-	V _{CC}	0	-	V _{CC}	V
V _O	output voltage		0	-	V _{CC}	0	-	V _{CC}	V
T _{amb}	ambient temperature		-40	-	+125	-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V _{CC} = 2.0 V	-	-	625	-	-	-	ns/V
		V _{CC} = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		V _{CC} = 6.0 V	-	-	83	-	-	-	ns/V

9. 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	
74HC174-Q100										
V _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
		V _{CC} = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V _{CC} = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
		V _{CC} = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		V _{CC} = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = -20 μA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = -20 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -20 μA; V _{CC} = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I _O = -4.0 mA; V _{CC} = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I _O = -5.2 mA; V _{CC} = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}								
		I _O = 20 μA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 20 μA; V _{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 4.0 mA; V _{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I _O = 5.2 mA; V _{CC} = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 6.0 V	-	-	±0.1	-	±1	-	±1	μA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	-	8.0	-	80	-	160	μA
C _I	input capacitance		-	3.5	-	-	-	-	-	pF

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HCT174-Q100										
V _{IH}	HIGH-level input voltage	V _{CC} = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = -20 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -4.0 mA	3.98	4.32	-	3.84	-	3.7	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V								
		I _O = 20 µA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 5.2 mA; V _{CC} = 5.5 V	-	0.15	0.26	-	0.33	-	0.4	V
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 5.5 V	-	-	±0.1	-	±1	-	±1	µA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	8.0	-	80	-	160	µA
ΔI _{CC}	additional supply current	per input pin; V _I = V _{CC} - 2.1 V; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V								
		Dn input	-	25	90	-	112.5	-	122.5	µA
		CP input	-	130	468	-	585	-	637	µA
		MR input	-	125	450	-	562.5	-	612.5	µA
C _I	input capacitance		-	3.5	-	-	-	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

GND (ground = 0 V); $C_L = 50$ pF unless otherwise specified; for test circuit, see Fig. 8

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC174-Q100										
t _{pd}	propagation delay	CP to Qn; see Fig. 6 [1]								
		V _{CC} = 2.0 V	-	55	165	-	205	-	250	ns
		V _{CC} = 4.5 V	-	20	33	-	41	-	50	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	17	-	-	-	-	-	ns
		V _{CC} = 6.0 V	-	16	28	-	35	-	43	ns
t _{PHL}	HIGH to LOW propagation delay	MR to Qn; see Fig. 7								
		V _{CC} = 2.0 V	-	44	150	-	190	-	225	ns
		V _{CC} = 4.5 V	-	16	30	-	38	-	45	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	13	-	-	-	-	-	ns
		V _{CC} = 6.0 V	-	13	26	-	33	-	38	ns
t _t	transition time	Qn output; see Fig. 6 [2]								
		V _{CC} = 2.0 V	-	19	75	-	95	-	110	ns
		V _{CC} = 4.5 V	-	7	15	-	19	-	22	ns
		V _{CC} = 6.0 V	-	6	13	-	16	-	19	ns
t _W	pulse width	CP input HIGH or LOW; see Fig. 6								
		V _{CC} = 2.0 V	80	17	-	100	-	120	-	ns
		V _{CC} = 4.5 V	16	6	-	20	-	24	-	ns
		V _{CC} = 6.0 V	14	5	-	17	-	20	-	ns
		MR input LOW; see Fig. 7								
		V _{CC} = 2.0 V	80	12	-	100	-	120	-	ns
		V _{CC} = 4.5 V	16	4	-	20	-	24	-	ns
		V _{CC} = 6.0 V	14	3	-	17	-	20	-	ns
t _{rec}	recovery time	MR to CP; see Fig. 7								
		V _{CC} = 2.0 V	5	-11	-	5	-	5	-	ns
		V _{CC} = 4.5 V	5	-4	-	5	-	5	-	ns
		V _{CC} = 6.0 V	5	-3	-	5	-	5	-	ns
t _{su}	set-up time	Dn to CP; see Fig. 6								
		V _{CC} = 2.0 V	60	6	-	75	-	90	-	ns
		V _{CC} = 4.5 V	12	2	-	15	-	18	-	ns
		V _{CC} = 6.0 V	10	2	-	13	-	15	-	ns
t _h	hold time	Dn to CP; see Fig. 6								
		V _{CC} = 2.0 V	3	-6	-	3	-	3	-	ns
		V _{CC} = 4.5 V	3	-2	-	3	-	3	-	ns
		V _{CC} = 6.0 V	3	-2	-	3	-	3	-	ns

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
f _{max}	maximum frequency	CP input; see Fig. 6								
		V _{CC} = 2.0 V	6	30	-	5	-	4	-	MHz
		V _{CC} = 4.5 V	30	90	-	24	-	20	-	MHz
		V _{CC} = 6.0 V	35	107	-	28	-	24	-	MHz
		V _{CC} = 5.0 V; C _L = 15 pF	-	99	-	-	-	-	-	MHz
C _{PD}	power dissipation capacitance	per package; V _I = GND to V _{CC} [3]	-	17	-	-	-	-	-	pF
74HCT174-Q100										
t _{pd}	propagation delay	CP to Qn; see Fig. 6 [1]								
		V _{CC} = 4.5 V	-	21	35	-	44	-	53	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	18	-	-	-	-	-	ns
t _{PHL}	HIGH to LOW propagation delay	MR to Qn; see Fig. 7								
		V _{CC} = 4.5 V	-	20	35	-	44	-	53	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	17	-	-	-	-	-	ns
t _t	transition time	Qn output; see Fig. 6 [2]								
		V _{CC} = 4.5 V	-	7	15	-	19	-	22	ns
t _W	pulse width	CP input; see Fig. 6								
		V _{CC} = 4.5 V	16	7	-	20	-	24	-	ns
		MR input LOW; see Fig. 7								
t _{rec}	recovery time	V _{CC} = 4.5 V	20	7	-	25	-	30	-	ns
		MR to CP; see Fig. 7								
t _{su}	set-up time	V _{CC} = 4.5 V	12	-3	-	15	-	18	-	ns
		Dn to CP; see Fig. 6								
t _h	hold time	V _{CC} = 4.5 V	16	4	-	20	-	24	-	ns
		Dn to CP; see Fig. 6								
f _{max}	maximum frequency	V _{CC} = 4.5 V	5	-3	-	5	-	5	-	ns
		CP input; see Fig. 6								
		V _{CC} = 4.5 V	30	63	-	24	-	20	-	MHz
C _{PD}	power dissipation capacitance	V _{CC} = 5.0 V; C _L = 15 pF	-	69	-	-	-	-	-	MHz
		per package; V _I = GND to V _{CC} - 1.5 V [3]	-	17	-	-	-	-	-	pF

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

[2] t_t is the same as t_{THL} and t_{TLH}.

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

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

10.1. Waveforms and test circuit

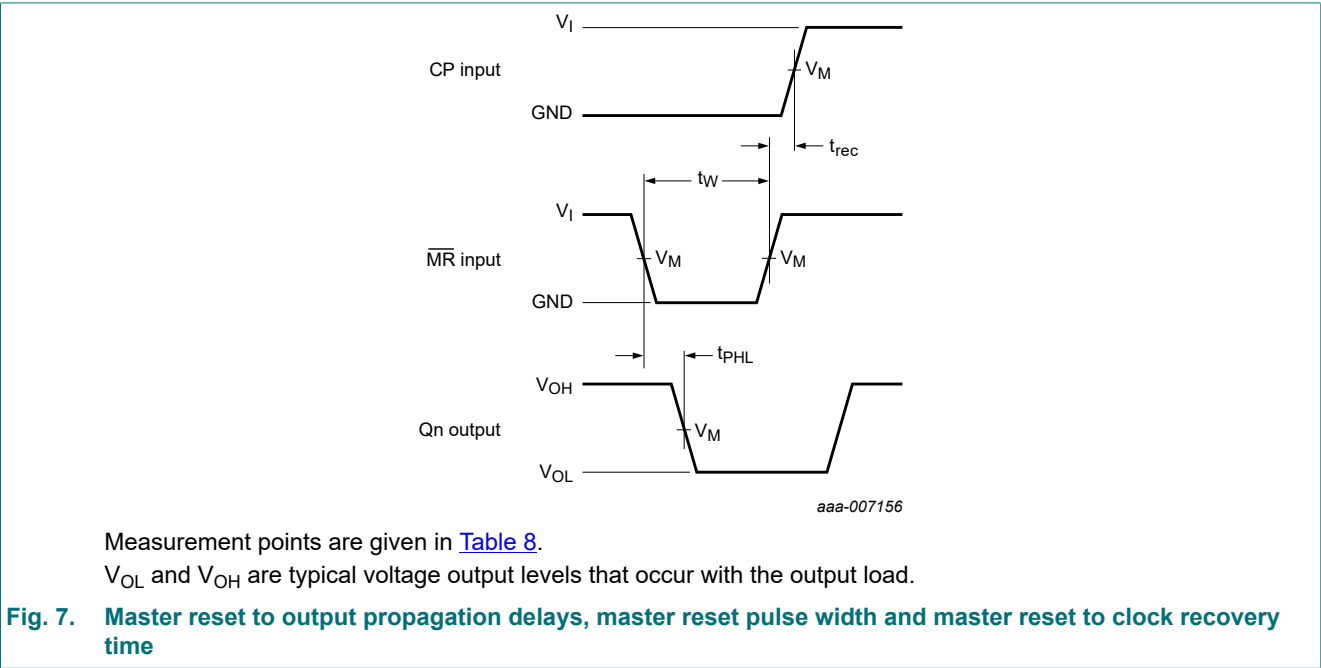
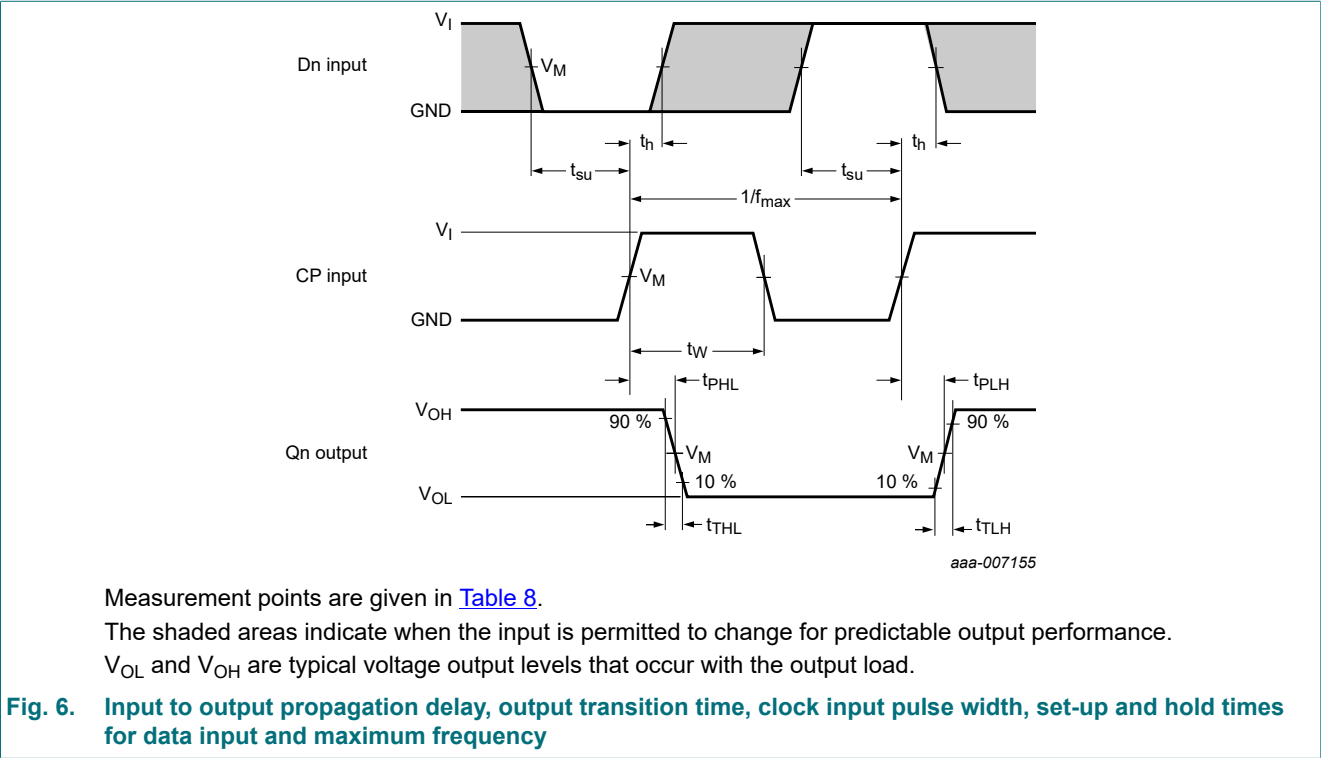


Table 8. Measurement points

Type	Input		Output
	V_I	V_M	V_M
74HC174-Q100	V_{CC}	$0.5V_{CC}$	$0.5V_{CC}$
74HCT174-Q100	3 V	1.3 V	1.3 V

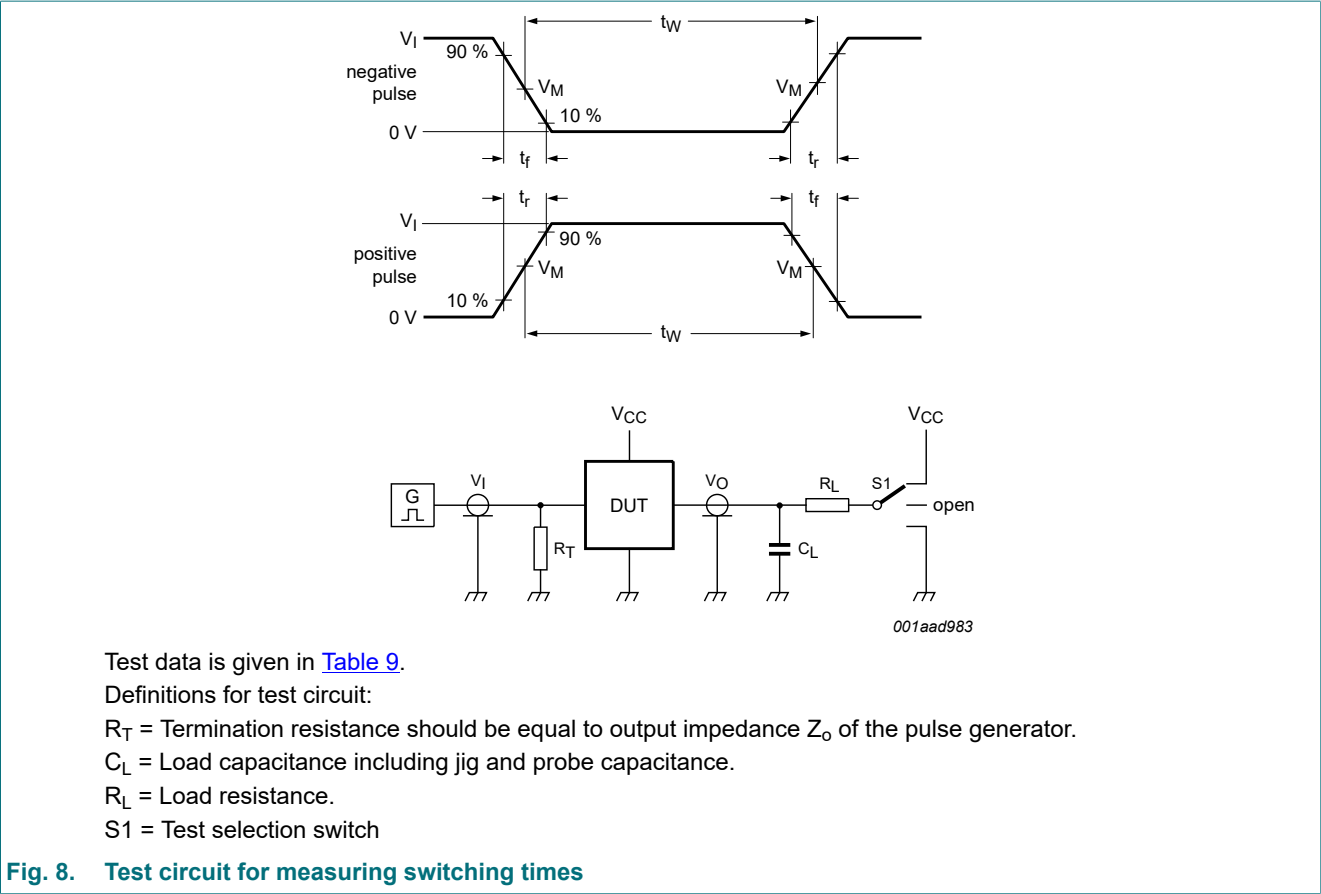


Fig. 8. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Load		S1 position
	V_I	t_r, t_f	C_L	R_L	
74HC174-Q100	V_{CC}	6 ns	15 pF, 50 pF	1 k Ω	open
74HCT174-Q100	3 V	6 ns	15 pF, 50 pF	1 k Ω	open

11. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mmSOT109-1

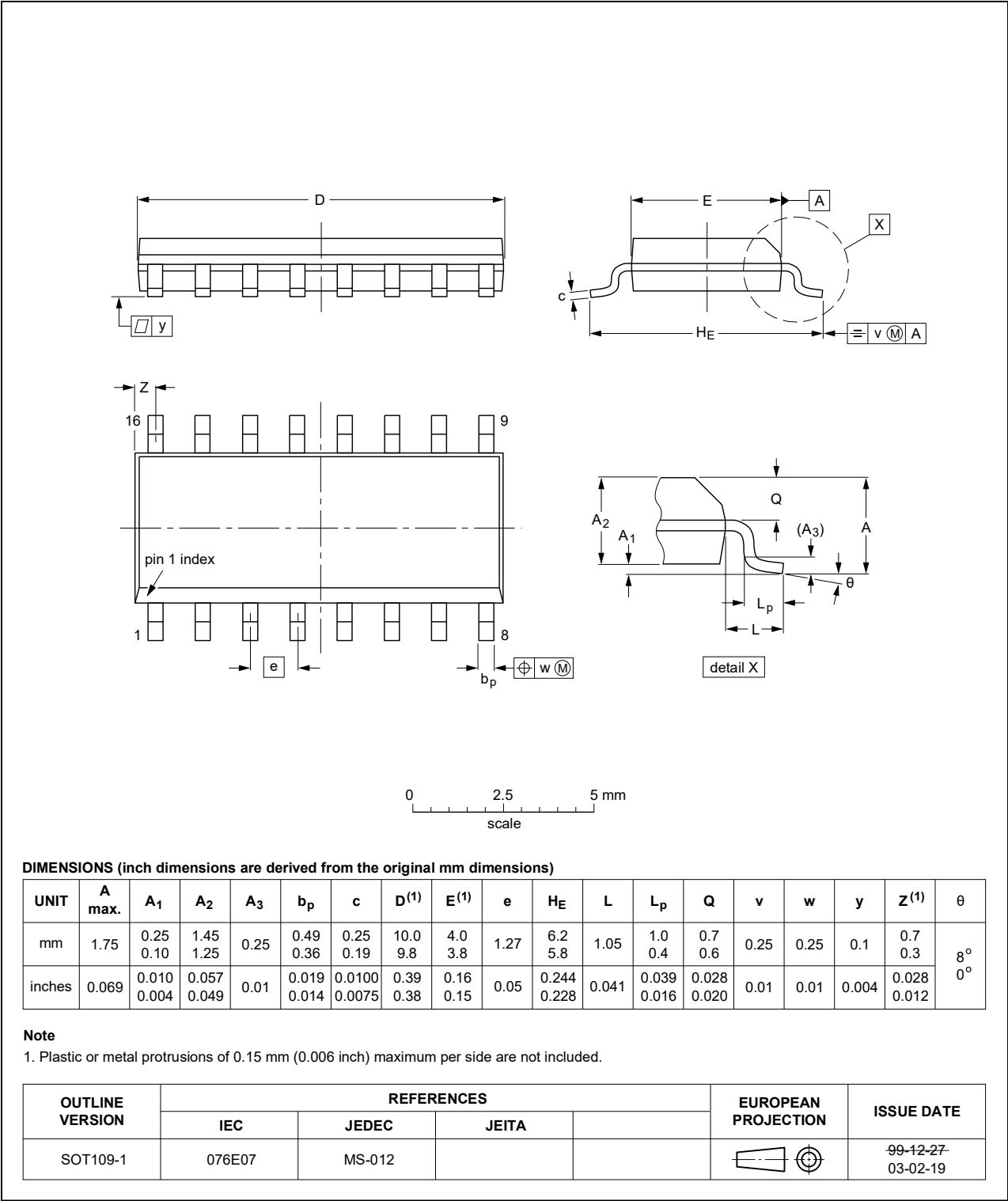


Fig. 9. Package outline SOT109-1 (SO16)

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

SOT403-1

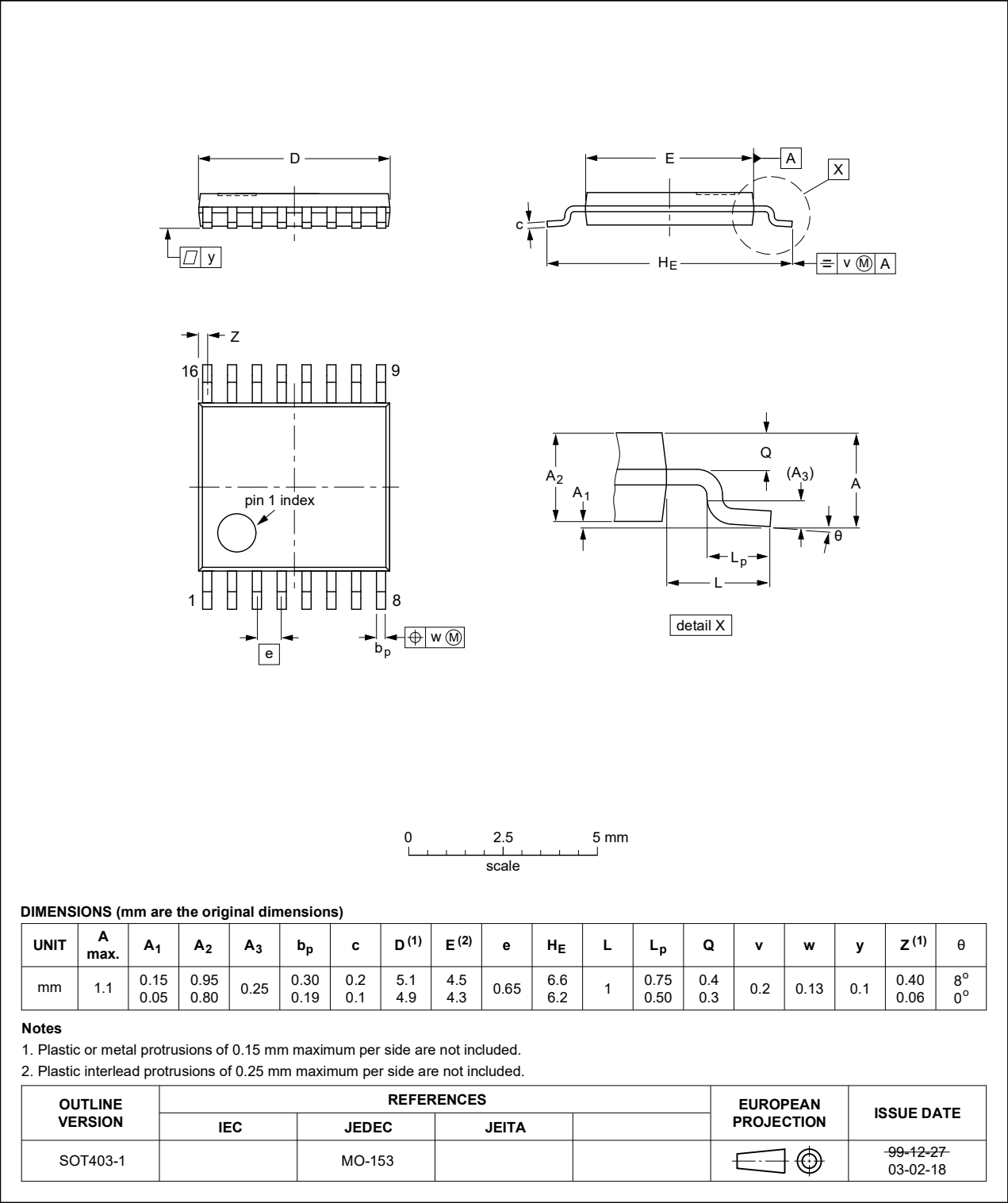


Fig. 10. Package outline SOT403-1 (TSSOP16)

12. Abbreviations

Table 10. Abbreviations

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

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT174_Q100 v.2	20210226	Product data sheet	-	74HC_HCT174_Q100 v.1
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. Section 2 updated. Section 7: Derating values for P_{tot} total power dissipation updated.			
74HC_HCT174_Q100 v.1	20130417	Product data sheet	-	-

14. 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".
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