

# 74HC175; 74HCT175

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

Rev. 6 — 4 February 2021

Product data sheet

## 1. General description

The 74HC175; 74HCT175 is a quad positive-edge triggered D-type flip-flop with individual data inputs ( $D_n$ ) and complementary outputs ( $Q_n$  and  $\overline{Q}_n$ ). 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 will be stored in the flip-flop and appear 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  $V_{CC}$ .

## 2. Features and benefits

- Input levels:
  - For 74HC175: CMOS level
  - For 74HCT175: TTL level
- Four edge-triggered D-type flip-flops
- Asynchronous master reset
- Complies with JEDEC standard no. 7A
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Specified from -40 °C to +85 °C and -40 °C to +125 °C.

## 3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC175D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HCT175D				
74HC175PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74HCT175PW				

### 4. Functional diagram

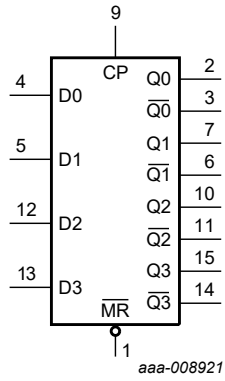


Fig. 1. Logic symbol

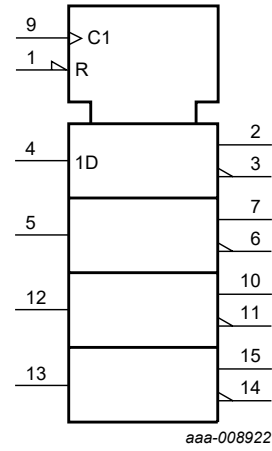


Fig. 2. IEC logic symbol

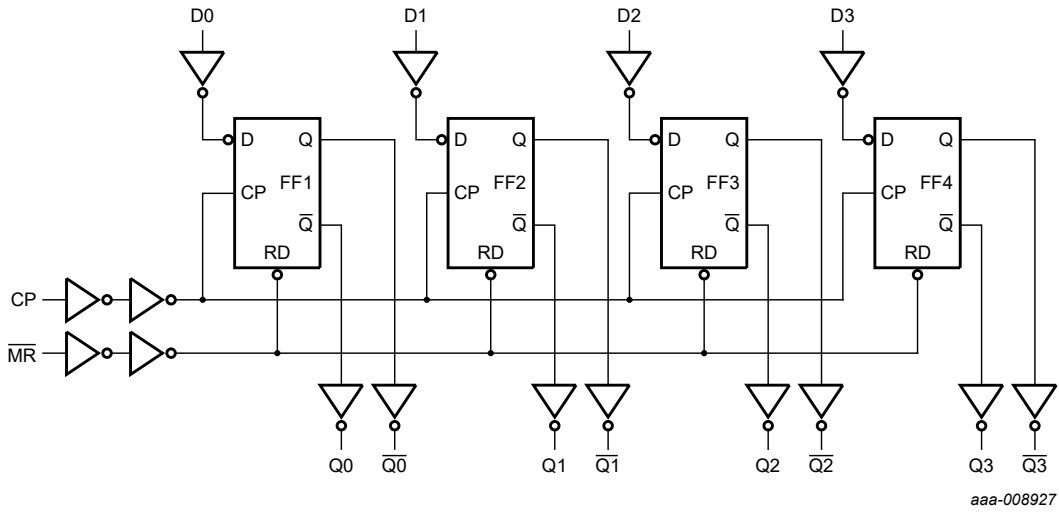


Fig. 3. Logic diagram

## 5. Pinning information

### 5.1. Pinning

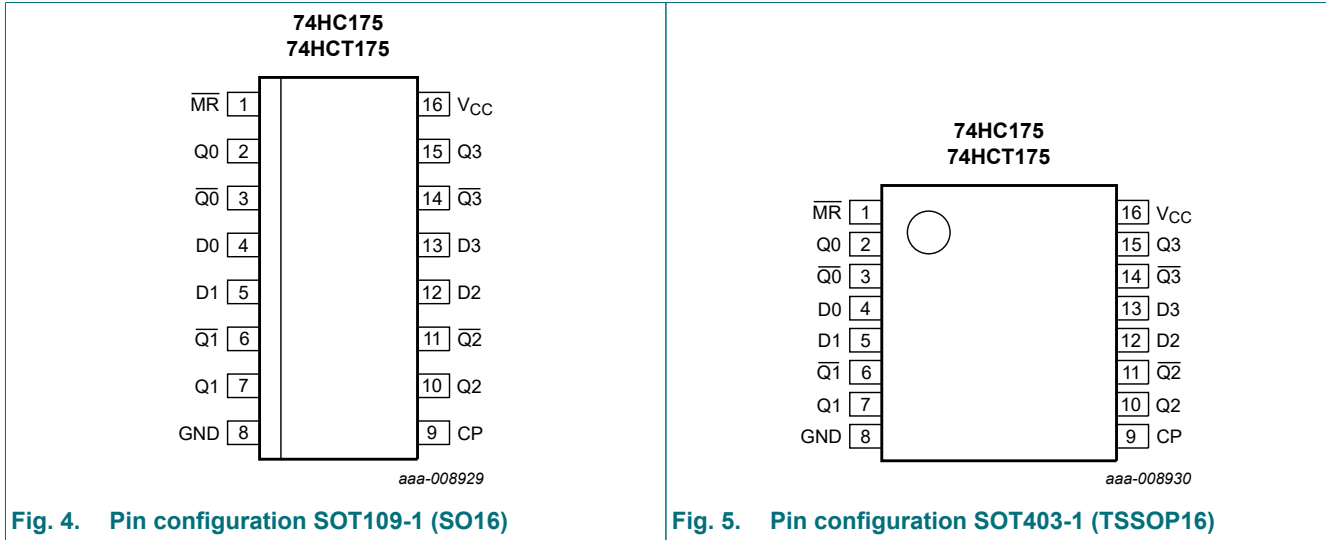


Fig. 4. Pin configuration SOT109-1 (SO16)

Fig. 5. Pin configuration SOT403-1 (TSSOP16)

### 5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
MR	1	asynchronous master reset input (active LOW)
Q0 to Q3	2, 7, 10, 15	flip-flop output
Q0̄ to Q3̄	3, 6, 11, 14	complementary flip-flop output
D0 to D3	4, 5, 12, 13	data input
GND	8	ground (0 V)
CP	9	clock input (LOW-to-HIGH edge-triggered)
V <sub>CC</sub>	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	D <sub>n</sub>	Q <sub>n</sub>	Q <sub>n</sub> ̄
reset (clear)	L	X	X	L	H
load "1"	H	↑	h	H	L
load "0"	H	↑	l	L	H

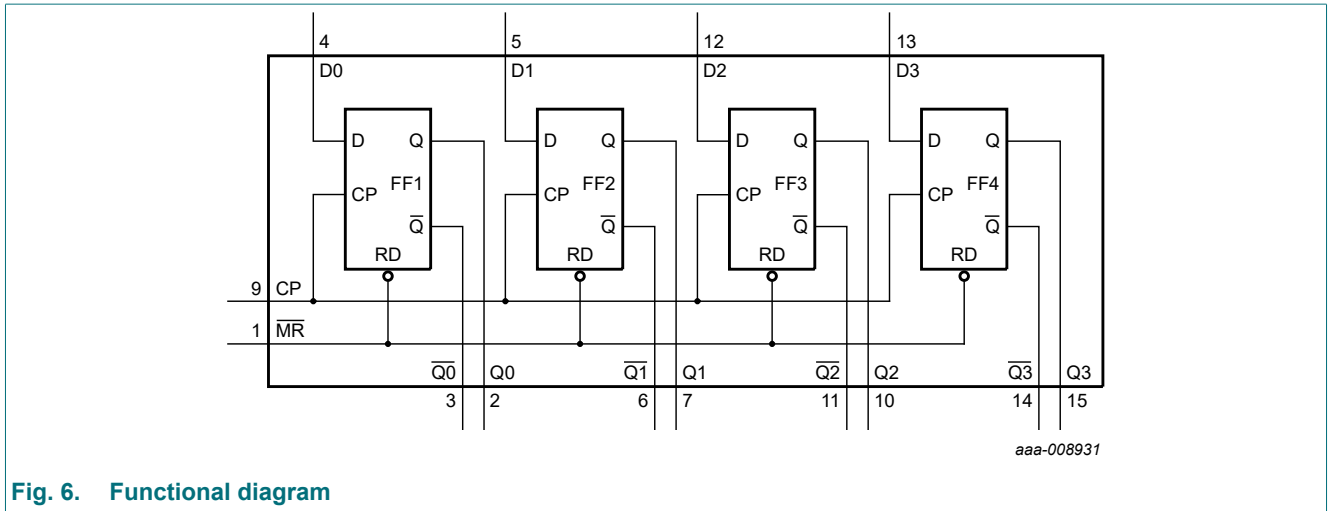


Fig. 6. Functional diagram

## 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	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA
$I_{OK}$	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA
$I_O$	output current	$-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$	-	$\pm 25$	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	$T_{amb} = -40\text{ °C to }+125\text{ °C}$ [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.

## 8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC175			74HCT175			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
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.0\text{ V}$	-	-	625	-	-	-	ns/V
		$V_{CC} = 4.5\text{ V}$	-	1.67	139	-	1.67	139	ns/V
		$V_{CC} = 6.0\text{ V}$	-	-	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	
<b>74HC175</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
		V <sub>CC</sub> = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V		
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V		
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±0.1	-	±1	-	±1	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V	-	-	8.0	-	80	-	160	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

## Quad D-type flip-flop with reset; positive-edge trigger

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HCT175</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = -20 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4.0 mA	3.98	4.32	-	3.84	-	3.7	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = 20 µA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 5.5 V	-	0.15	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±0.1	-	±1	-	±1	µA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	8.0	-	80	-	160	µA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V								
		Dn input	-	40	144	-	180	-	196	µA
		CP input	-	60	216	-	270	-	294	µA
		MR input	-	100	360	-	450	-	490	µA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

## 10. Dynamic characteristics

Table 7. Dynamic characteristics

GND (ground = 0 V); C<sub>L</sub> = 50 pF unless otherwise specified; for test circuit, see Fig. 10

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC175</b>										
t <sub>pd</sub>	propagation delay	CP to Qn, Q̄n; see Fig. 7 [1]								
		V <sub>CC</sub> = 2.0 V	-	55	175	-	220	-	265	ns
		V <sub>CC</sub> = 4.5 V	-	20	35	-	44	-	53	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	17	-	-	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	16	30	-	37	-	45	ns
t <sub>PHL</sub>	HIGH to LOW propagation delay	MR to Qn, Q̄n; see Fig. 8								
		V <sub>CC</sub> = 2.0 V	-	50	150	-	190	-	225	ns
		V <sub>CC</sub> = 4.5 V	-	18	30	-	38	-	45	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	15	-	-	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	-	14	26	-	33	-	38	ns

## Quad D-type flip-flop with reset; positive-edge trigger

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t <sub>t</sub>	transition time	Qn output; see <a href="#">Fig. 7</a> [2]								
		V <sub>CC</sub> = 2.0 V	-	19	75	-	95	-	110	ns
		V <sub>CC</sub> = 4.5 V	-	7	15	-	19	-	22	ns
		V <sub>CC</sub> = 6.0 V	-	6	13	-	16	-	19	ns
t <sub>w</sub>	pulse width	CP input HIGH or LOW; see <a href="#">Fig. 7</a>								
		V <sub>CC</sub> = 2.0 V	80	22	-	100	-	120	-	ns
		V <sub>CC</sub> = 4.5 V	16	8	-	20	-	24	-	ns
		V <sub>CC</sub> = 6.0 V	14	6	-	17	-	20	-	ns
		MR input LOW; see <a href="#">Fig. 8</a>								
		V <sub>CC</sub> = 2.0 V	80	19	-	100	-	120	-	ns
		V <sub>CC</sub> = 4.5 V	16	7	-	20	-	24	-	ns
V <sub>CC</sub> = 6.0 V	14	6	-	17	-	20	-	ns		
t <sub>rec</sub>	recovery time	MR to CP; see <a href="#">Fig. 8</a>								
		V <sub>CC</sub> = 2.0 V	5	-33	-	5	-	5	-	ns
		V <sub>CC</sub> = 4.5 V	5	-12	-	5	-	5	-	ns
		V <sub>CC</sub> = 6.0 V	5	-10	-	5	-	5	-	ns
t <sub>su</sub>	set-up time	Dn to CP; see <a href="#">Fig. 9</a>								
		V <sub>CC</sub> = 2.0 V	80	3	-	100	-	120	-	ns
		V <sub>CC</sub> = 4.5 V	16	1	-	20	-	24	-	ns
		V <sub>CC</sub> = 6.0 V	14	1	-	17	-	20	-	ns
t <sub>h</sub>	hold time	Dn to CP; see <a href="#">Fig. 9</a>								
		V <sub>CC</sub> = 2.0 V	25	2	-	30	-	40	-	ns
		V <sub>CC</sub> = 4.5 V	5	0	-	6	-	8	-	ns
		V <sub>CC</sub> = 6.0 V	4	0	-	5	-	7	-	ns
f <sub>max</sub>	maximum frequency	CP input; see <a href="#">Fig. 7</a>								
		V <sub>CC</sub> = 2.0 V	6	25	-	4.8	-	4	-	MHz
		V <sub>CC</sub> = 4.5 V	30	75	-	24	-	20	-	MHz
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	83	-	-	-	-	-	MHz
		V <sub>CC</sub> = 6.0 V	35	89	-	28	-	24	-	MHz
C <sub>PD</sub>	power dissipation capacitance	per package; V <sub>I</sub> = GND to V <sub>CC</sub> [3]	-	32	-	-	-	-	-	pF

## Quad D-type flip-flop with reset; positive-edge trigger

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HCT175</b>										
t <sub>pd</sub>	propagation delay	CP to Qn, $\overline{Qn}$ ; see Fig. 7 [1]								
		V <sub>CC</sub> = 4.5 V	-	19	33	-	41	-	50	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	16	-	-	-	-	-	ns
t <sub>PHL</sub>	HIGH to LOW propagation delay	$\overline{MR}$ to Qn; see Fig. 8								
		V <sub>CC</sub> = 4.5 V	-	22	38	-	48	-	57	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	19	-	-	-	-	-	ns
		$\overline{MR}$ to $\overline{Qn}$ ; see Fig. 8								
		V <sub>CC</sub> = 4.5 V	-	19	35	-	44	-	53	ns
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	16	-	-	-	-	ns	
t <sub>t</sub>	transition time	Qn output; see Fig. 7 [2]								
		V <sub>CC</sub> = 4.5 V	-	7	15	-	19	-	22	ns
t <sub>W</sub>	pulse width	CP input HIGH or LOW; see Fig. 7								
		V <sub>CC</sub> = 4.5 V	20	12	-	25	-	30	-	ns
		$\overline{MR}$ input LOW; see Fig. 8								
		V <sub>CC</sub> = 4.5 V	20	11	-	25	-	30	-	ns
t <sub>rec</sub>	recovery time	$\overline{MR}$ to CP; see Fig. 8								
		V <sub>CC</sub> = 4.5 V	5	-10	-	5	-	5	-	ns
t <sub>su</sub>	set-up time	Dn to CP; see Fig. 9								
		V <sub>CC</sub> = 4.5 V	16	5	-	20	-	24	-	ns
t <sub>h</sub>	hold time	Dn to CP; see Fig. 9								
		V <sub>CC</sub> = 4.5 V	5	0	-	5	-	5	-	ns
f <sub>max</sub>	maximum frequency	CP input; see Fig. 7								
		V <sub>CC</sub> = 4.5 V	25	49	-	20	-	17	-	MHz
		V <sub>CC</sub> = 5 V; C <sub>L</sub> = 15 pF	-	54	-	-	-	-	-	MHz
C <sub>PD</sub>	power dissipation capacitance	per package; V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V [3]	-	34	-	-	-	-	-	pF

[1] t<sub>pd</sub> is the same as t<sub>PHL</sub> and t<sub>PLH</sub>.

[2] t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.

[3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

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

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

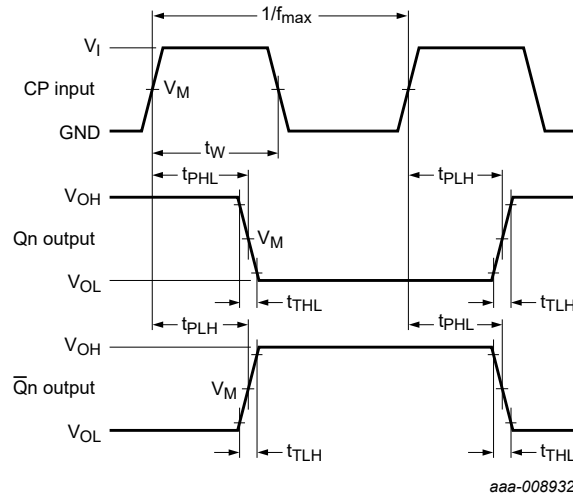
∑ (C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs;

C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in V.



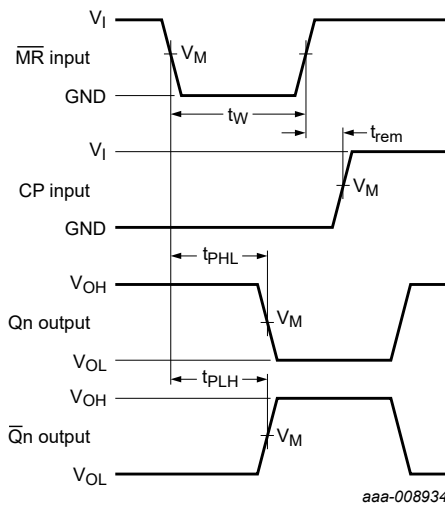
10.1. Waveforms and test circuit



Measurement points are given in [Table 8](#).

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

**Fig. 7. Input to output propagation delay, output transition time, clock input pulse width and maximum frequency**

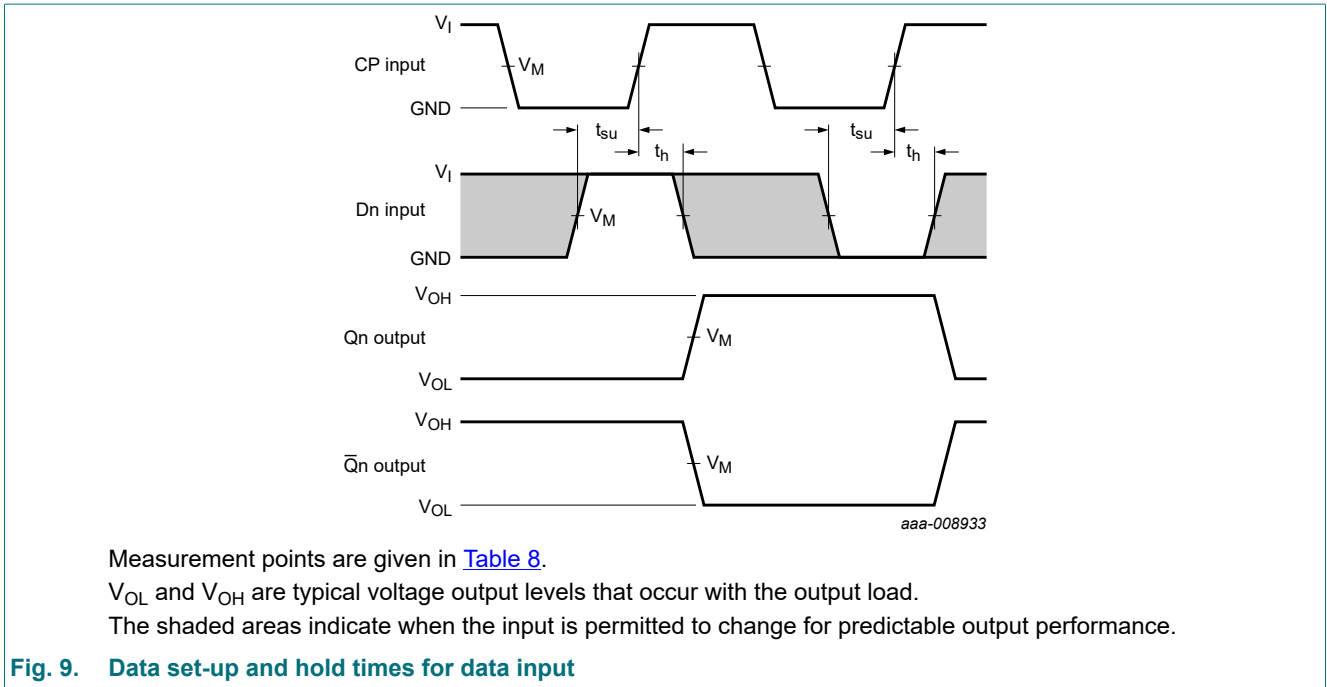


Measurement points are given in [Table 8](#).

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

**Fig. 8. Master reset to output propagation delays, master reset pulse width and master reset to clock recovery time**

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



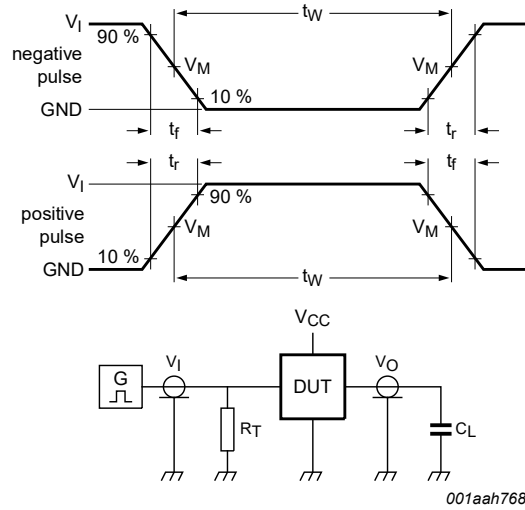
Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.  
 The shaded areas indicate when the input is permitted to change for predictable output performance.

**Fig. 9. Data set-up and hold times for data input**

**Table 8. Measurement points**

Type	Input		Output
	$V_I$	$V_M$	$V_M$
74HC175	$V_{CC}$	$0.5V_{CC}$	$0.5V_{CC}$
74HCT175	3 V	1.3 V	1.3 V

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



001aah768

Test data is given in [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.  
 $R_L$  = Load resistance.

Fig. 10. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Load		Test
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	
74HC175	$V_{CC}$	6 ns	15 pF, 50 pF	1 k $\Omega$	$t_{PLH}, t_{PHL}$
74HCT175	3 V	6 ns	15 pF, 50 pF	1 k $\Omega$	$t_{PLH}, t_{PHL}$

11. Package outline

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

SOT109-1

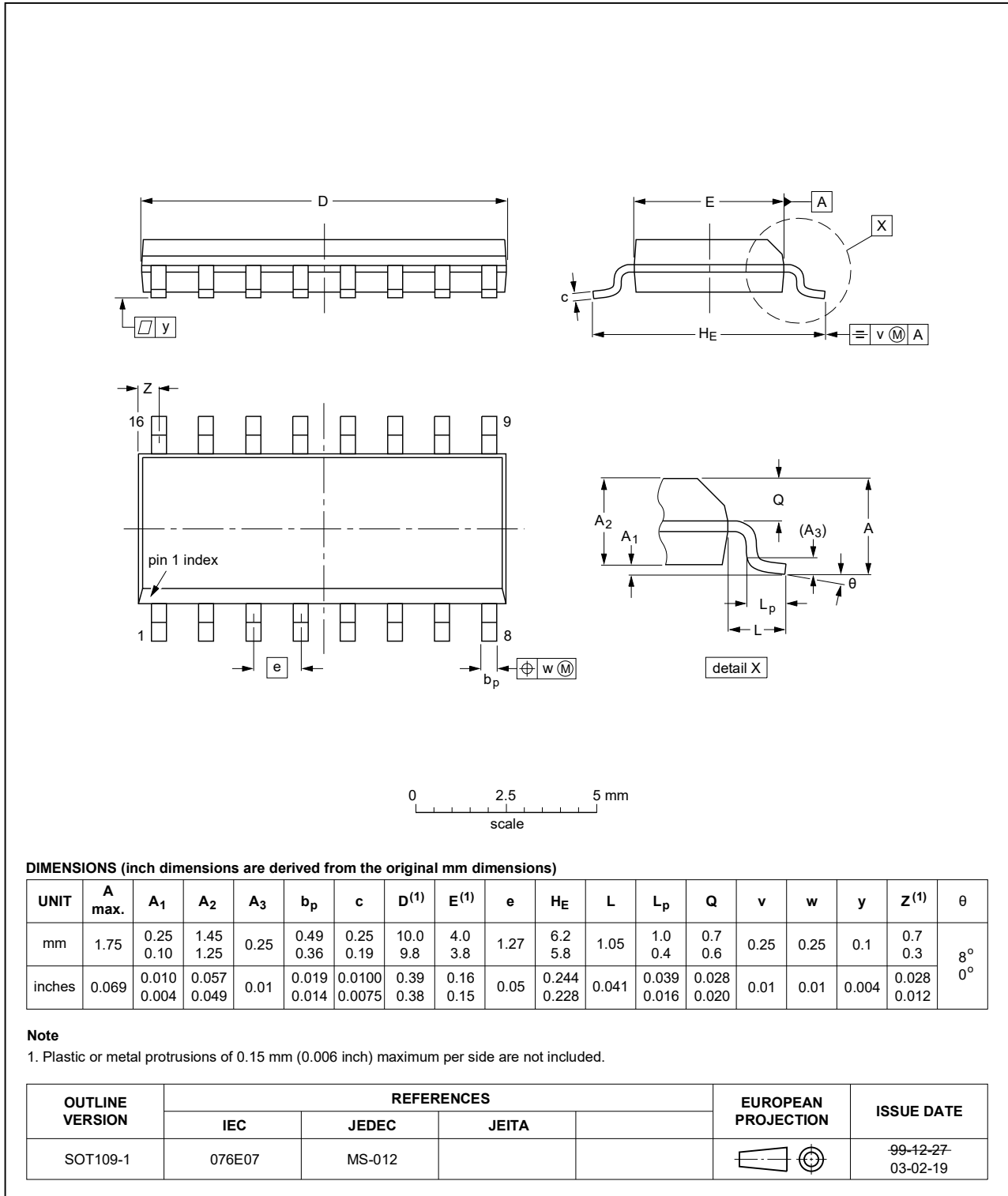


Fig. 11. Package outline SOT109-1 (SO16)

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

SOT403-1

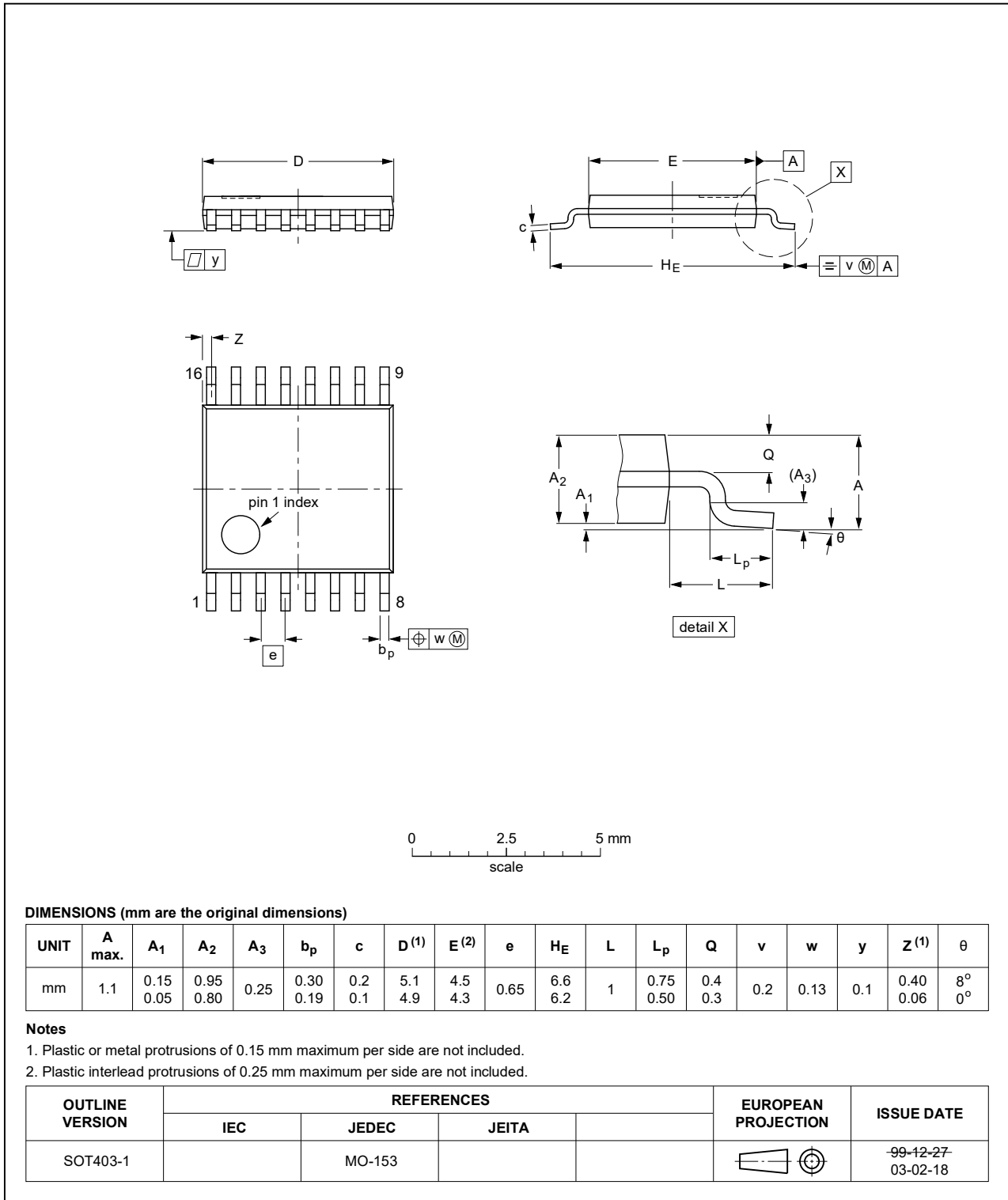


Fig. 12. Package outline SOT403-1 (TSSOP16)

## 12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
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_HCT175 v.6	20210204	Product data sheet	-	74HC_HCT175 v.5
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li>Type numbers 74HC175DB and 74HCT175DB (SOT338-1 / SSOP16) removed.</li> <li><a href="#">Section 7</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> </ul>			
74HC_HCT175 v.5	20160129	Product data sheet	-	74HC_HCT175 v.4
Modifications:	<ul style="list-style-type: none"> <li>Type numbers 74HC175N and 74HCT175N (SOT38-4) removed.</li> </ul>			
74HC_HCT175 v.4	20140408	Product data sheet	-	74HC_HCT175 v.3
Modifications:	<ul style="list-style-type: none"> <li>General description corrected (errata).</li> </ul>			
74HC_HCT175 v.3	20140331	Product data sheet	-	74HC_HCT175_CNV_2
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>			
74HC_HCT175_CNV_2	19980708	Product specification	-	-

## 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".
- [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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For sales office addresses, please send an email to: [salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)

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