

# 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

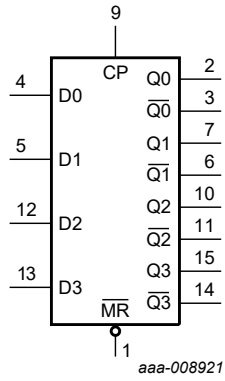


Fig. 1. Logic symbol

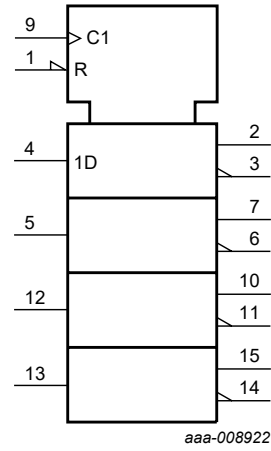


Fig. 2. IEC logic symbol

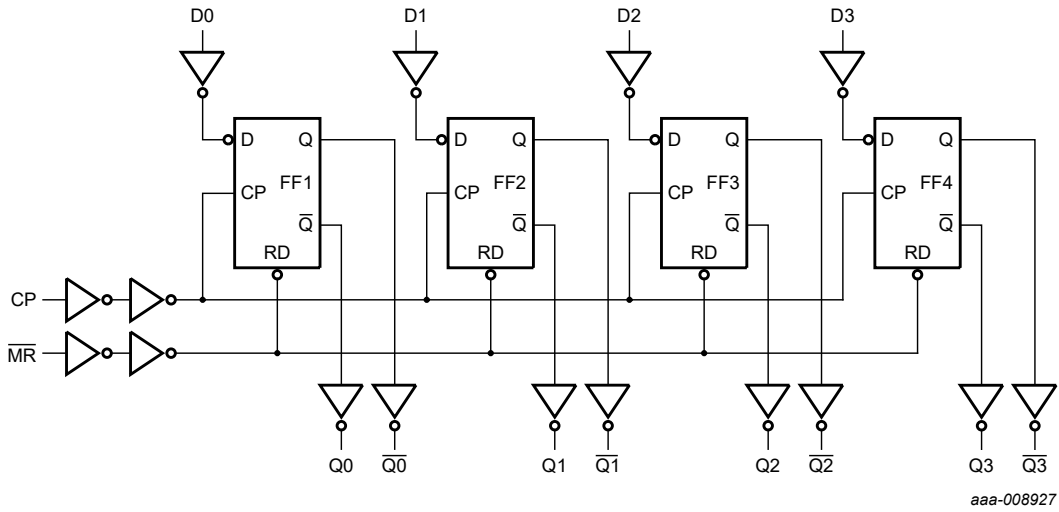


Fig. 3. Logic diagram

## 5. Pinning information

### 5.1. Pinning

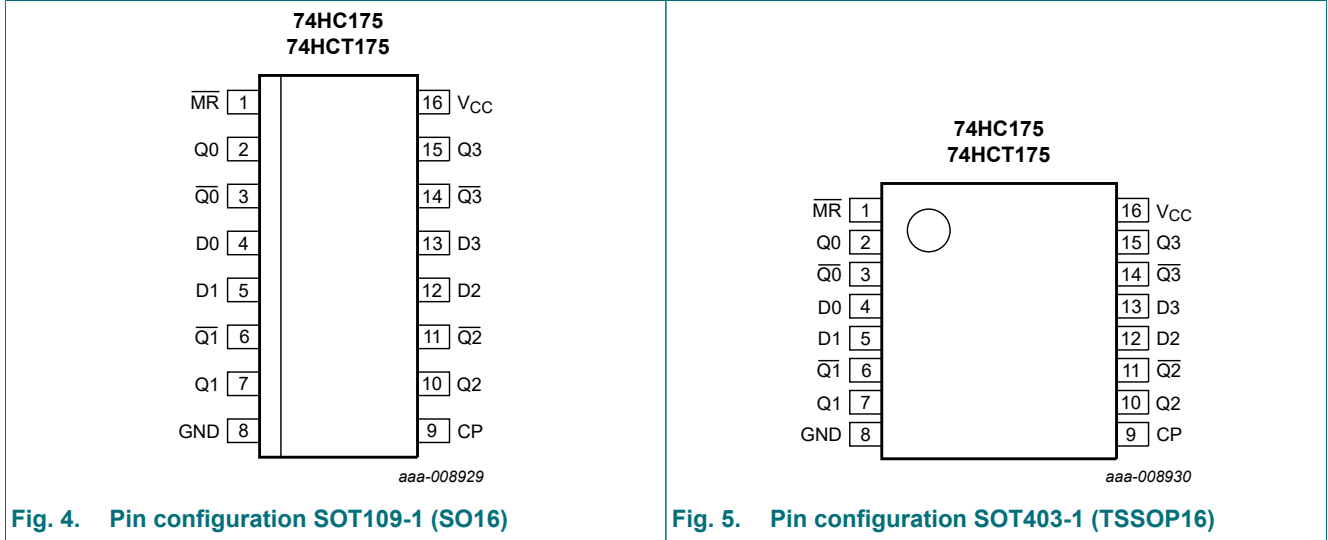


Fig. 4. Pin configuration SOT109-1 (SO16)

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

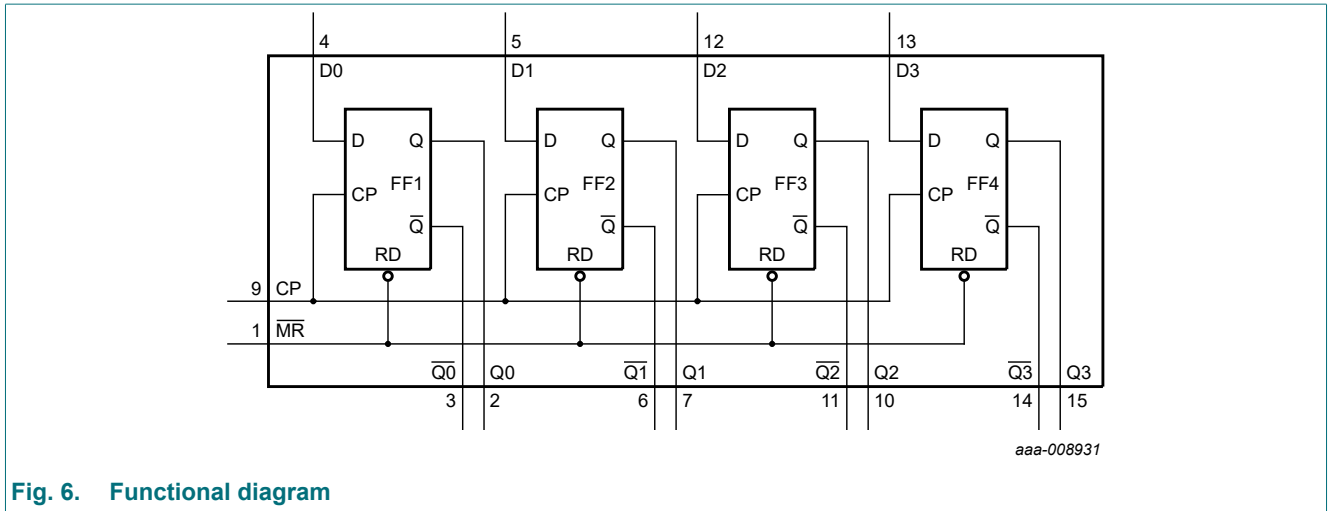


Fig. 6. Functional diagram

## 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	$^{\circ}\text{C}$
$P_{tot}$	total power dissipation	$T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ [1]	-	500	mW

- [1] For SOT109-1 (SO16) package:  $P_{tot}$  derates linearly with 12.4 mW/K above 110  $^{\circ}\text{C}$ .  
 For SOT403-1 (TSSOP16) package:  $P_{tot}$  derates linearly with 8.5 mW/K above 91  $^{\circ}\text{C}$ .

## 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	$^{\circ}\text{C}$
$\Delta t/\Delta V$	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, $\overline{Qn}$ ; 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, $\overline{Qn}$ ; 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, $\bar{Q}n$ ; 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	$\bar{M}R$ 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
		$\bar{M}R$ to $\bar{Q}n$ ; 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
		$\bar{M}R$ input LOW; see Fig. 8								
		V <sub>CC</sub> = 4.5 V	20	11	-	25	-	30	-	ns
t <sub>rec</sub>	recovery time	$\bar{M}R$ 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;

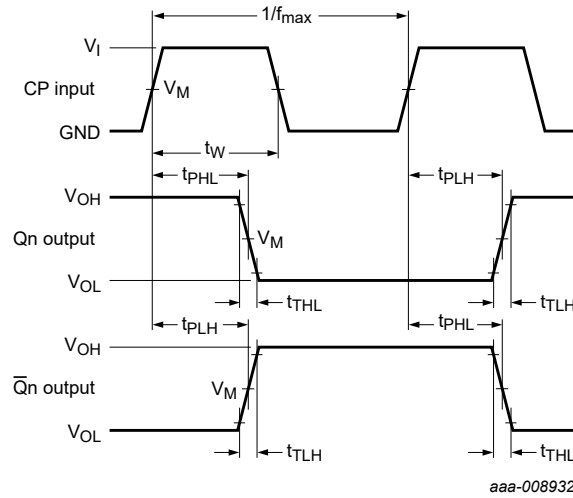
∑ (C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs;

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

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



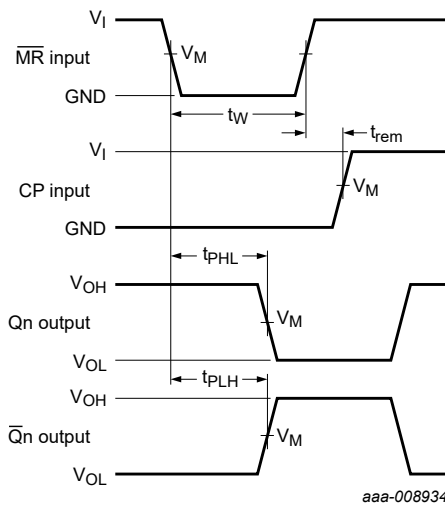
10.1. Waveforms and test circuit



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**

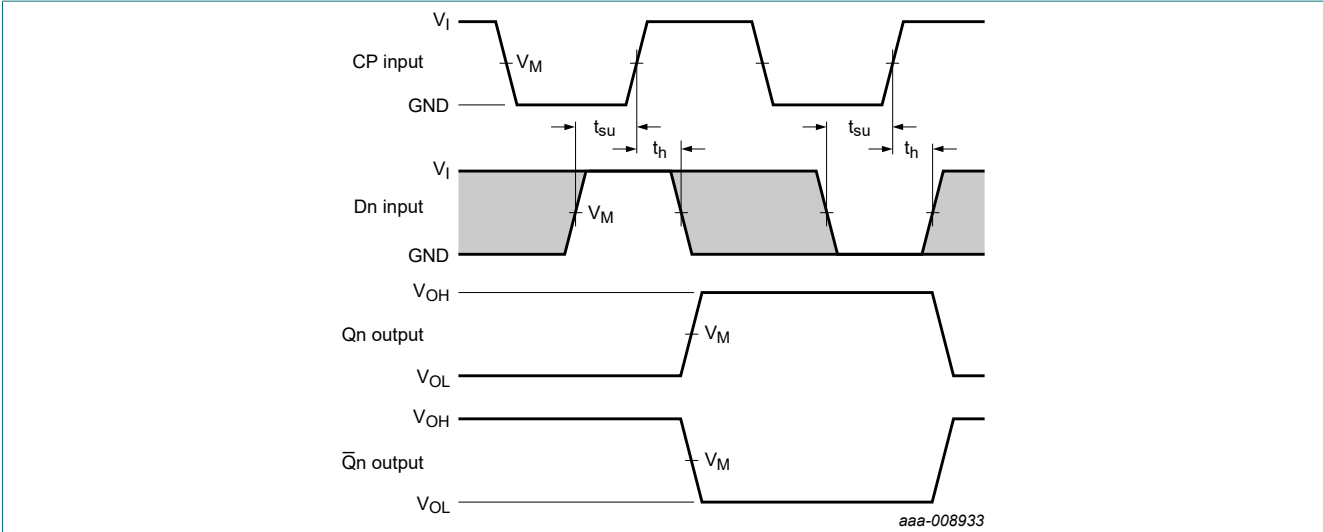


Measurement points are given in [Table 8](#).

$V_{OL}$  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



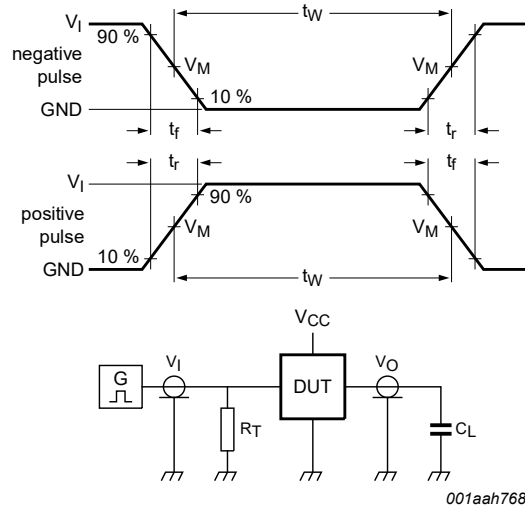
Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.  
 The shaded areas indicate when the input is permitted to change for predictable output performance.

**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

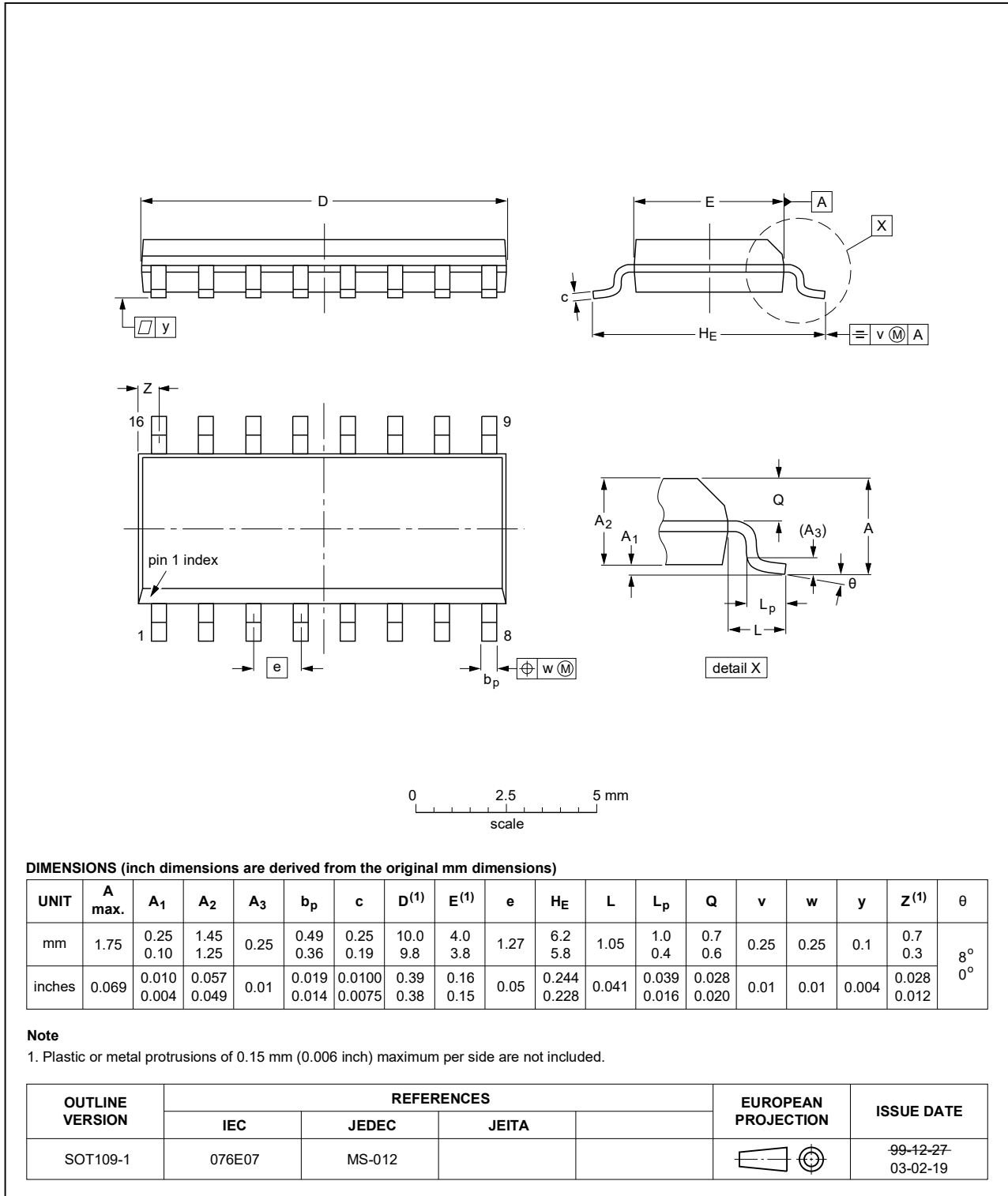


Fig. 11. Package outline SOT109-1 (SO16)

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

SOT403-1

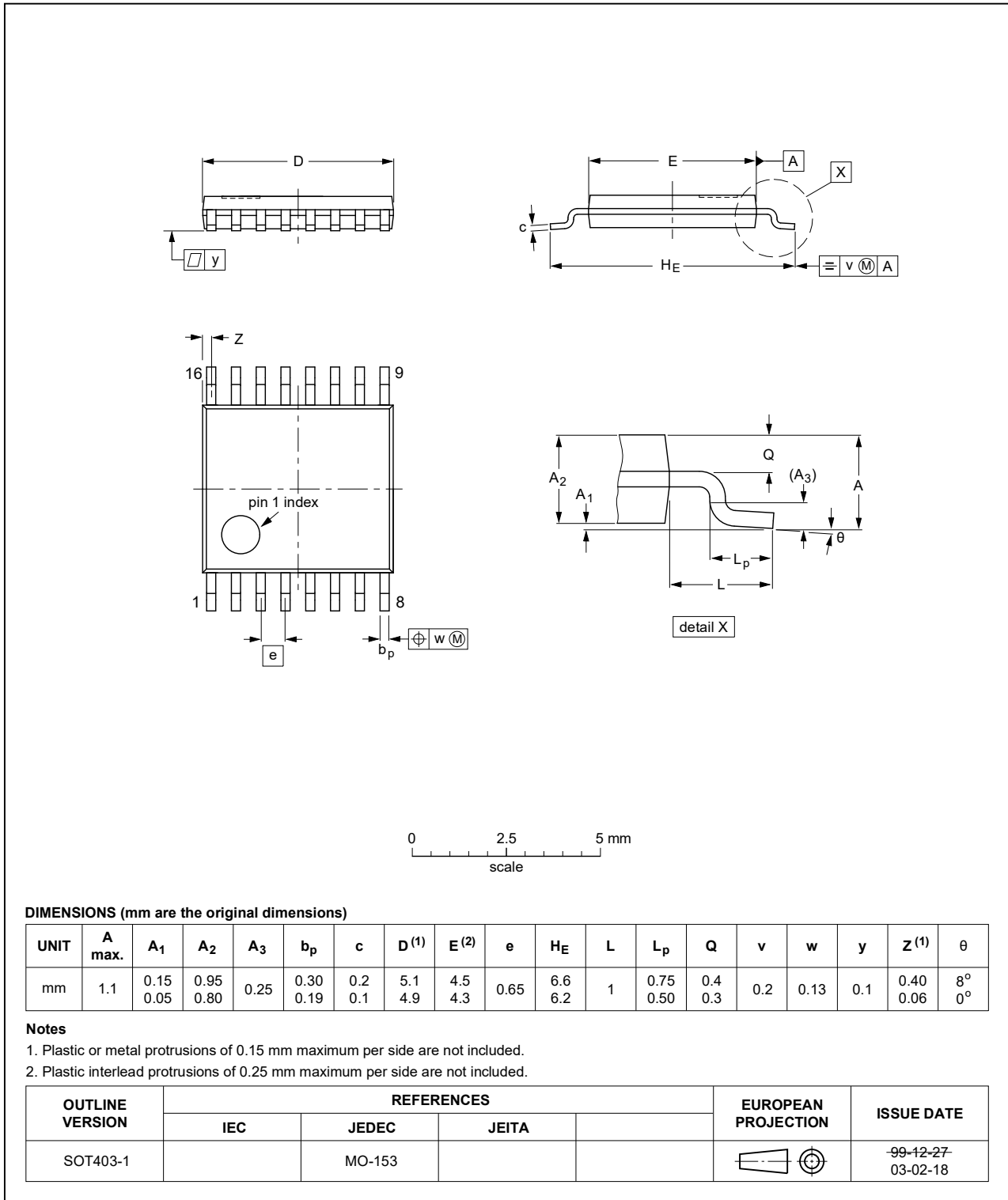


Fig. 12. Package outline SOT403-1 (TSSOP16)

## 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".
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