

74HC112; 74HCT112

Dual JK flip-flop with set and reset; negative-edge trigger

Rev. 3 — 9 August 2016

Product data sheet

1. General description

The 74HC112; 74HCT112 is a dual negative-edge triggered JK flip-flop. It features individual J and K inputs, clock ($\overline{nCP}$) set ($\overline{nSD}$) and reset ($\overline{nRD}$) inputs. It also has complementary $\overline{nQ}$ and $\overline{n\overline{Q}}$ outputs. The set and reset are asynchronous active LOW inputs and operate independently of the clock input. The J and K inputs control the state changes of the flip-flops as described in the mode select function table. The J and K inputs must be stable one set-up time prior to the HIGH-to-LOW clock transition for predictable operation. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.

2. Features and benefits

- Input levels:
 - ◆ For 74HC112: CMOS level
 - ◆ For 74HCT112: TTL level
- Asynchronous set and reset
- Specified in compliance with JEDEC standard no. 7A
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC112D	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HCT112D				
74HC112DB	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	SOT338-1
74HCT112DB				
74HC112PW	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74HCT112PW				

4. Functional diagram

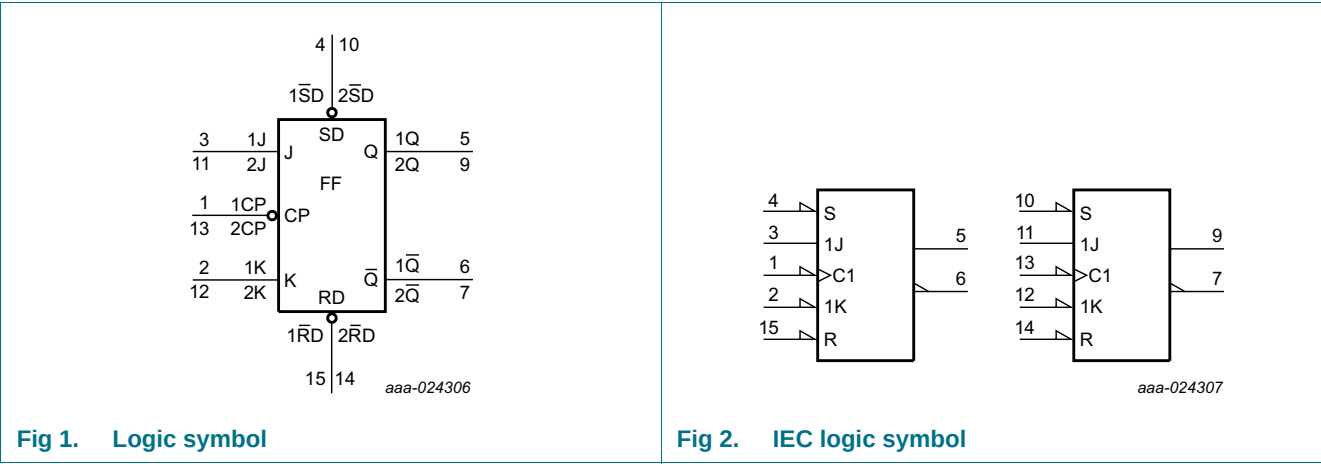


Fig 1. Logic symbol

Fig 2. IEC logic symbol

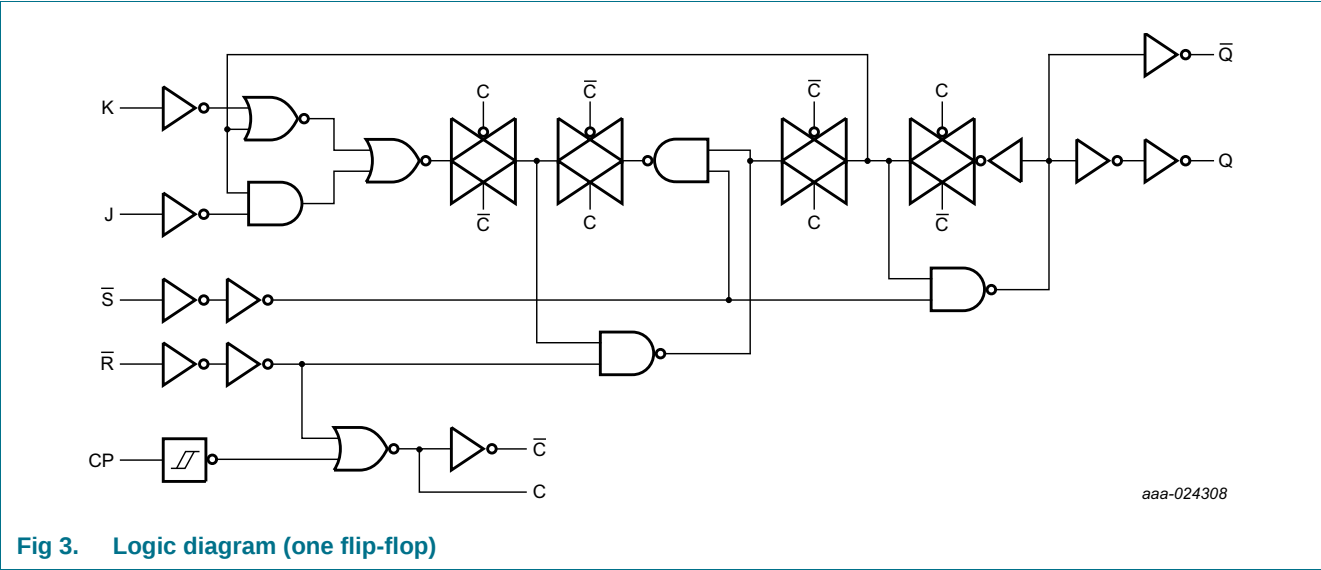


Fig 3. Logic diagram (one flip-flop)

5. Pinning information

5.1 Pinning

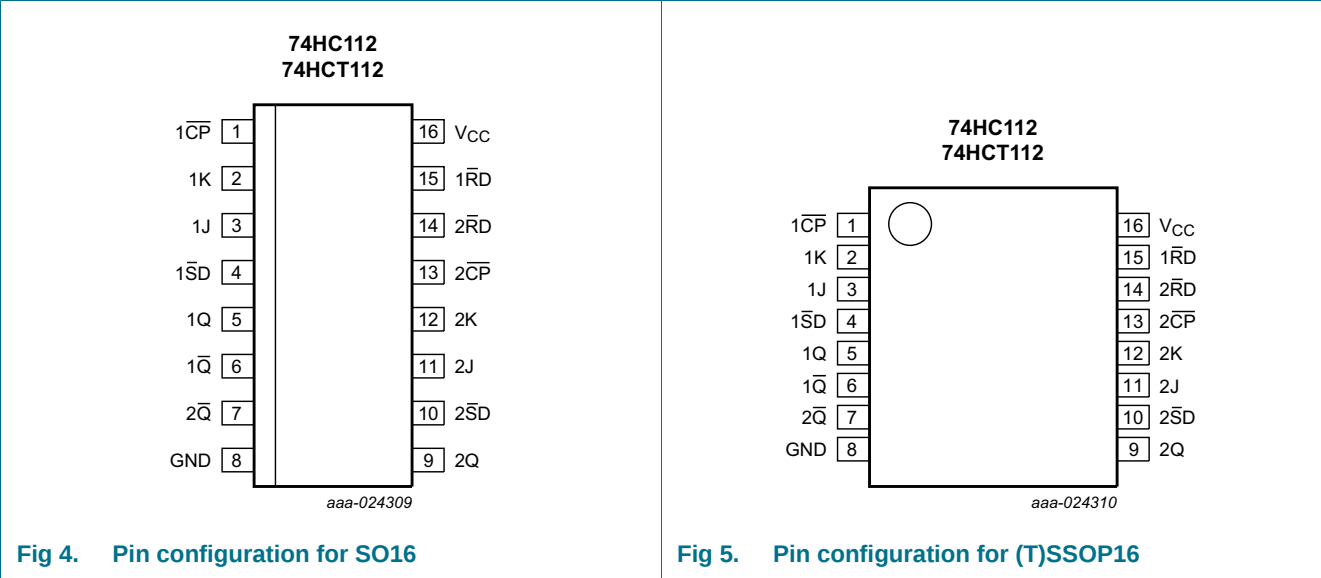


Fig 4. Pin configuration for SO16

Fig 5. Pin configuration for (T)SSOP16

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$\overline{1CP}$, $\overline{2CP}$	1, 13	clock input (HIGH-to-LOW; edge-triggered)
1K, 2K	2, 12	data input
1J, 2J	3, 11	data input
$\overline{1SD}$, $\overline{2SD}$	4, 10	set input (active LOW)
1Q, 2Q	5, 9	true flip-flop output
$\overline{1Q}$, $\overline{2Q}$	6, 7	complement flip-flop output
GND	8	ground (0 V)
$\overline{1RD}$, $\overline{2RD}$	15, 14	reset input (active LOW)
V _{CC}	16	supply voltage

6. Functional description

Table 3. Function selection^[1]

Operating modes	Input					Output	
	nSD	nRD	nCP	nJ	nK	nQ	nQ
Asynchronous set	L	H	X	X	X	H	L
Asynchronous reset	H	L	X	X	X	L	H
Undetermined	L	L	X	X	X	H	L
Toggle	H	H	↓	h	h	$\bar{q}$	q
Load 0 (reset)	H	H	↓	l	h	L	H
Load 1 (set)	H	H	↓	h	l	H	L
Hold no change	H	H	↓	l	l	q	$\bar{q}$

[1] If nSD and nRD simultaneously go from LOW-to-HIGH, the output states are unpredictable.

H = HIGH voltage level

h = HIGH voltage level one set-up time before the HIGH-to-LOW clock transition

L = LOW voltage level

l = LOW voltage level one set-up time before the HIGH-to-LOW clock transition

q = lowercase letters indicate the state of the referenced output one set-up time before the HIGH-to-LOW clock transition

X = don't care

↓ = HIGH-to-LOW clock transition

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	-	±20	mA
I _{OK}	output clamping current	V _O < −0.5 V or V _O > V _{CC} + 0.5 V	-	±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	SO16 and (T)SSOP16 packages ^[1]	-	500	mW

[1] For SO16 packages: above 70 °C, the value of P_{tot} derates linearly with 8 mW/K.

For (T)SSOP16 packages: above 60 °C, the value of P_{tot} derates linearly with 5.5 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC112			74HCT112			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	+25	+125	-40	+25	+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	
74HC112										
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	-	-	4.0	-	40	-	80	μA

Table 6. Static characteristics ...continued

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	
C _I	input capacitance		-	3.5	-	-	-	-	-	pF
74HCT112										
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 = 4.0 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	-	-	4.0	-	40	-	80	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								
		nSD inputs	-	50	180	-	225	-	245	µA
		nK inputs	-	60	216	-	270	-	294	µA
		nRD inputs	-	65	236	-	293	-	319	µA
		nJ, and nCP inputs	-	100	360	-	450	-	490	µA
C _I	input capacitance		-	3.5	-	-	-	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); $C_L = 50$ pF unless otherwise specified; for test circuit, see [Figure 8](#).

Symbol	Parameter	Conditions	25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	Min	Max	
74HC112										
t _{pd}	propagation delay	nCP to nQ; see Figure 6 ^[2]								
		V _{CC} = 2.0 V	-	55	175	-	220	-	265	ns
		V _{CC} = 4.5 V	-	20	35	-	44	-	53	ns
		V _{CC} = 5 V; C _L = 15 pF	-	17	-	-	-	-	-	ns
		V _{CC} = 6.0 V	-	16	30	-	37	-	45	ns
		nCP to nQ; see Figure 6								
		V _{CC} = 2.0 V	-	55	175	-	220	-	265	ns
		V _{CC} = 4.5 V	-	20	35	-	44	-	53	ns
		V _{CC} = 5 V; C _L = 15 pF	-	17	-	-	-	-	-	ns
		V _{CC} = 6.0 V	-	16	30	-	37	-	45	ns
		nRD to nQ, nQ; see Figure 7								
		V _{CC} = 2.0 V	-	58	180	-	225	-	270	ns
		V _{CC} = 4.5 V	-	21	36	-	45	-	54	ns
		V _{CC} = 5 V; C _L = 15 pF	-	18	-	-	-	-	-	ns
		V _{CC} = 6.0 V	-	17	31	-	38	-	46	ns
		nSD to nQ, nQ; see Figure 7								
		V _{CC} = 2.0 V	-	50	155	-	295	-	235	ns
		V _{CC} = 4.5 V	-	18	31	-	39	-	47	ns
		V _{CC} = 5 V; C _L = 15 pF	-	15	-	-	-	-	-	ns
		V _{CC} = 6.0 V	-	14	26	-	33	-	40	ns
t _t	transition time	nQ, nQ; see Figure 6 ^[3]								
		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	nCP HIGH or LOW; see Figure 6								
		V _{CC} = 2.0 V	80	22	-	100	-	120	-	ns
		V _{CC} = 4.5 V	16	8	-	20	-	24	-	ns
		V _{CC} = 6.0 V	14	6	-	17	-	20	-	ns
		nSD, nRD LOW; see Figure 7								
		V _{CC} = 2.0 V	80	22	-	100	-	120	-	ns
		V _{CC} = 4.5 V	16	8	-	20	-	24	-	ns
V _{CC} = 6.0 V	14	6	-	17	-	20	-	ns		

Table 7. Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V); $C_L = 50$ pF unless otherwise specified; for test circuit, see [Figure 8](#).

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_{rec}	recovery time	$\overline{\text{nRD}}$ to $\overline{\text{nCP}}$; see Figure 7								
		$V_{\text{CC}} = 2.0$ V	80	22	-	125	-	150	-	ns
		$V_{\text{CC}} = 4.5$ V	16	8	-	25	-	30	-	ns
		$V_{\text{CC}} = 6.0$ V	14	6	-	21	-	26	-	ns
		$\overline{\text{nSD}}$ to $\overline{\text{nCP}}$; see Figure 7								
		$V_{\text{CC}} = 2.0$ V	80	–19	-	100	-	120	-	ns
		$V_{\text{CC}} = 4.5$ V	16	–7	-	20	-	24	-	ns
		$V_{\text{CC}} = 6.0$ V	14	–6	-	17	-	20	-	ns
t_{su}	set-up time	nJ and nK to $\overline{\text{nCP}}$; see Figure 6								
		$V_{\text{CC}} = 2.0$ V	80	19	-	100	-	120	-	ns
		$V_{\text{CC}} = 4.5$ V	16	7	-	20	-	24	-	ns
		$V_{\text{CC}} = 6.0$ V	14	6	-	17	-	20	-	ns
t_{h}	hold time	nJ and nK to $\overline{\text{nCP}}$; see Figure 6								
		$V_{\text{CC}} = 2.0$ V	0	–11	-	0	-	0	-	ns
		$V_{\text{CC}} = 4.5$ V	0	–4	-	0	-	0	-	ns
		$V_{\text{CC}} = 6.0$ V	0	–3	-	0	-	0	-	ns
f_{max}	maximum frequency	$\overline{\text{nCP}}$; see Figure 6								
		$V_{\text{CC}} = 2.0$ V	6	20	-	4.8	-	4.0	-	MHz
		$V_{\text{CC}} = 4.5$ V	30	60	-	24	-	20	-	MHz
		$V_{\text{CC}} = 5$ V; $C_L = 15$ pF	-	66	-	-	-	-	-	MHz
		$V_{\text{CC}} = 6.0$ V	35	71	-	28	-	24	-	MHz
C_{PD}	power dissipation capacitance	$C_L = 50$ pF; $f = 1$ MHz; $V_I = \text{GND}$ to V_{CC} ^[4]	-	27	-			-	-	pF

Table 7. Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V); $C_L = 50$ pF unless otherwise specified; for test circuit, see [Figure 8](#).

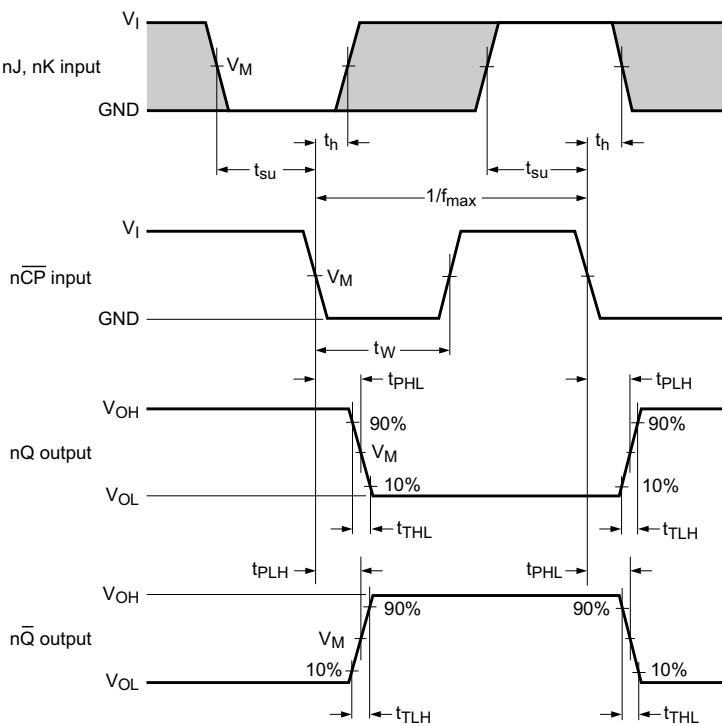
Symbol	Parameter	Conditions	25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	Min	Max	
74HCT112										
t _{pd}	propagation delay	nCP̄ to nQ; see Figure 6 ^[2]								
		V _{CC} = 4.5 V	-	21	35	-	44	-	53	ns
		V _{CC} = 5 V; C _L = 15 pF	-	19	-	-	-	-	-	ns
		nCP̄ to nQ̄; see Figure 6 ^[2]								
		V _{CC} = 4.5 V	-	23	40	-	50	-	60	ns
		V _{CC} = 5 V; C _L = 15 pF	-	19	-	-	-	-	-	ns
		nRD̄ to nQ, nQ̄; see Figure 7								
		V _{CC} = 4.5 V	-	22	37	-	46	-	56	ns
		V _{CC} = 5 V; C _L = 15 pF	-	19	-	-	-	-	-	ns
		nSD̄ to nQ, nQ̄; see Figure 7								
		V _{CC} = 4.5 V	-	18	32	-	40	-	48	ns
		V _{CC} = 5 V; C _L = 15 pF	-	15	-	-	-	-	-	ns
t _t	transition time	nQ, nQ̄; see Figure 6 ^[3]								
		V _{CC} = 4.5 V	-	7	15	-	19	-	22	ns
t _w	pulse width	nCP̄ HIGH or LOW; see Figure 6								
		V _{CC} = 4.5 V	16	8	-	20	-	24	-	ns
		nSD̄, nRD̄ LOW; see Figure 7								
		V _{CC} = 4.5 V	18	10	-	23	-	27	-	ns
t _{rec}	recovery time	nRD̄ to nCP̄; see Figure 7								
		V _{CC} = 4.5 V	20	11	-	25	-	30	-	ns
		nSD̄ to nCP̄; see Figure 7								
		V _{CC} = 4.5 V	20	–8	-	25	-	30	-	ns
t _{su}	set-up time	nJ and nK to nCP̄; see Figure 6								
		V _{CC} = 4.5 V	16	7	-	20	-	24	-	ns
t _h	hold time	nJ and nK to nCP̄; see Figure 6								
		V _{CC} = 4.5 V	0	–7	-	0	-	0	-	ns
f _{max}	maximum frequency	nCP̄; see Figure 6								
		V _{CC} = 4.5 V	30	64	-	24	-	20	-	MHz
		V _{CC} = 5 V; C _L = 15 pF	-	70	-	-	-	-	-	MHz

Table 7. Dynamic characteristics ...continued
Voltages are referenced to GND (ground = 0 V); $C_L = 50\text{ pF}$ unless otherwise specified; for test circuit, see [Figure 8](#).

Symbol	Parameter	Conditions	25 °C			−40 °C to +85 °C		−40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	Min	Max	
C_{PD}	power dissipation capacitance	$C_L = 50\text{ pF}$; $f = 1\text{ MHz}$; $V_I = \text{GND to } V_{CC}$ ^[4]	-	30	-	-	-	-	-	pF

- [1] All typical values are measured at $T_{amb} = 25\text{ °C}$.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL} .
- [3] t_t is the same as t_{THL} and t_{TLH} .
- [4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ 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;
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11. Waveforms



aaa-024311

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

Fig 6. Clock propagation delays, output transition time, pulse width, set-up, hold times, and maximum frequency

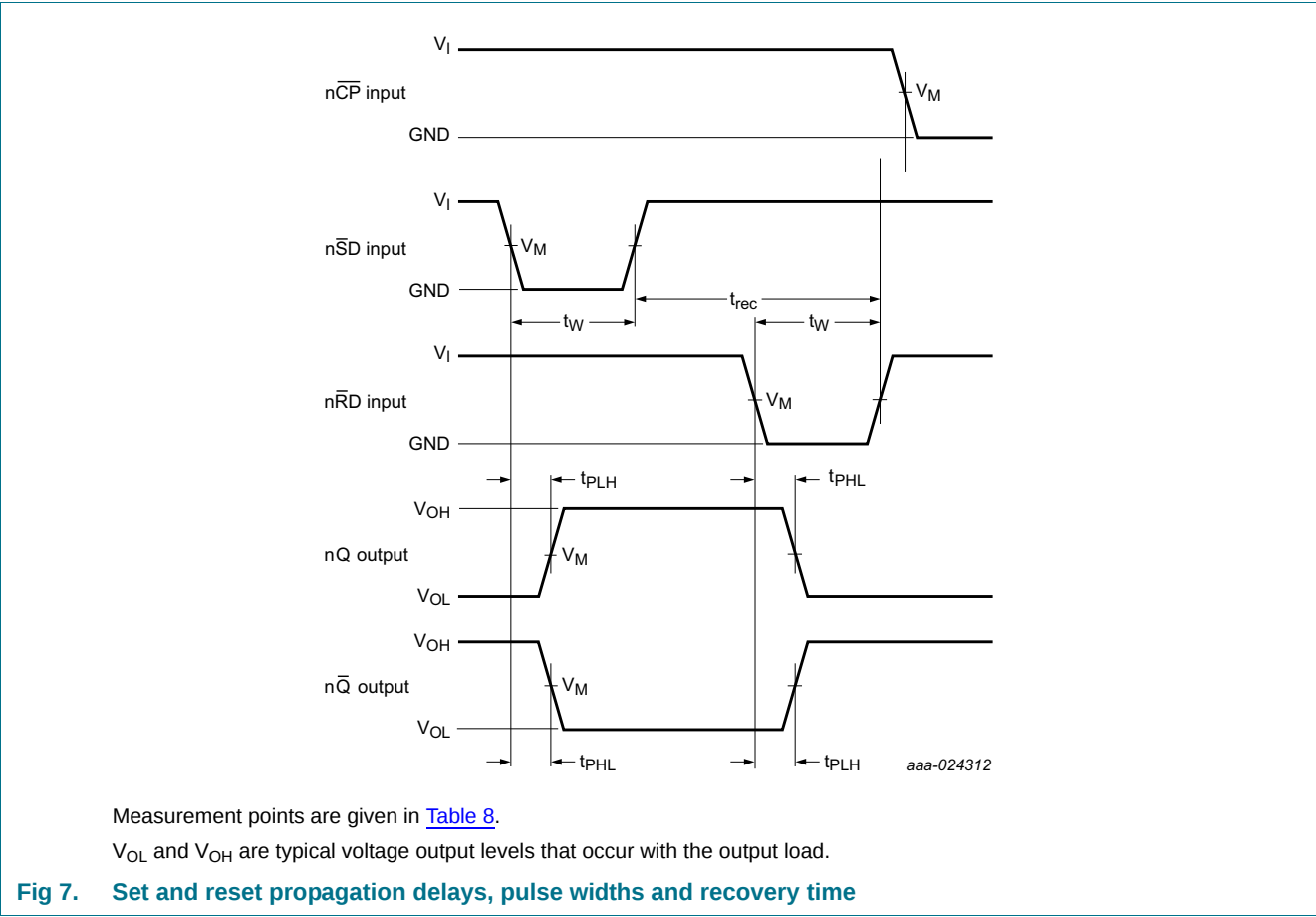
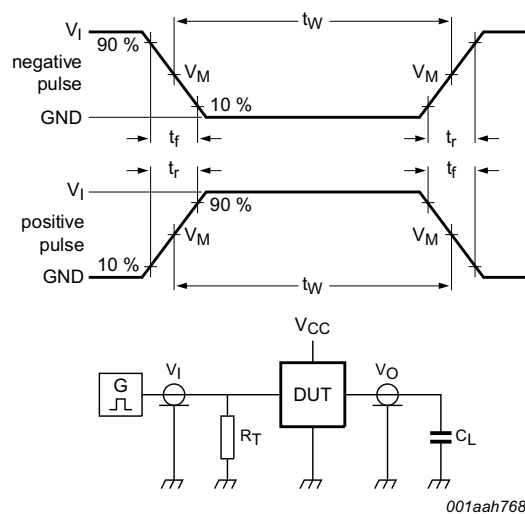


Table 8. Measurement points

Type	Input	Output
	V_M	V_M
74HC112	$0.5V_{CC}$	$0.5V_{CC}$
74HCT112	1.3 V	1.3 V



Test data is given in [Table 9](#).

Definitions 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.

Fig 8. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Load	Test
	V_I	t_r, t_f	C_L	
74HC112	V_{CC}	6 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}
74HCT112	3 V	6 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}

12. Package outline

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

SOT109-1

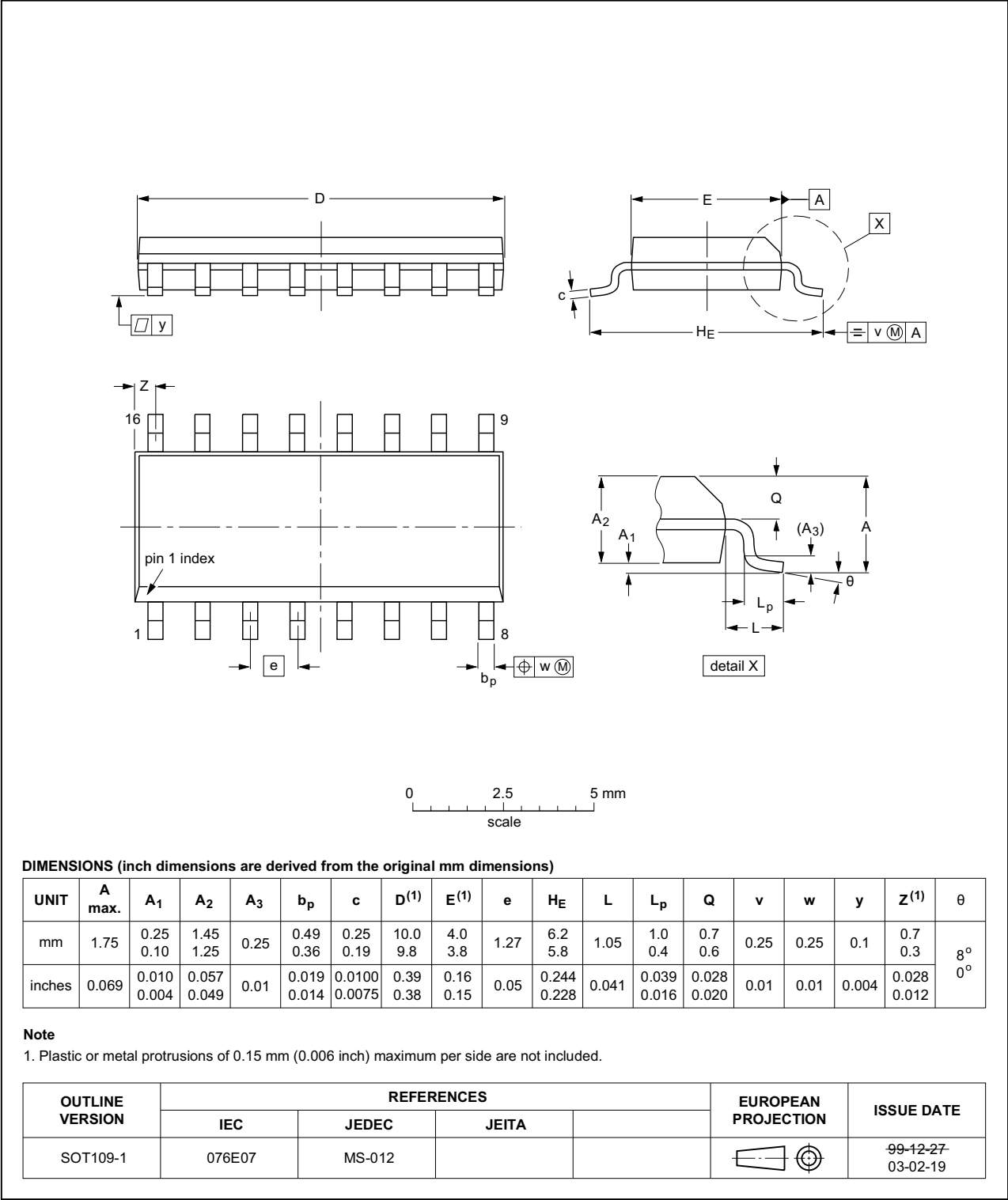


Fig 9. Package outline SOT109-1 (SO16)

SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm

SOT338-1

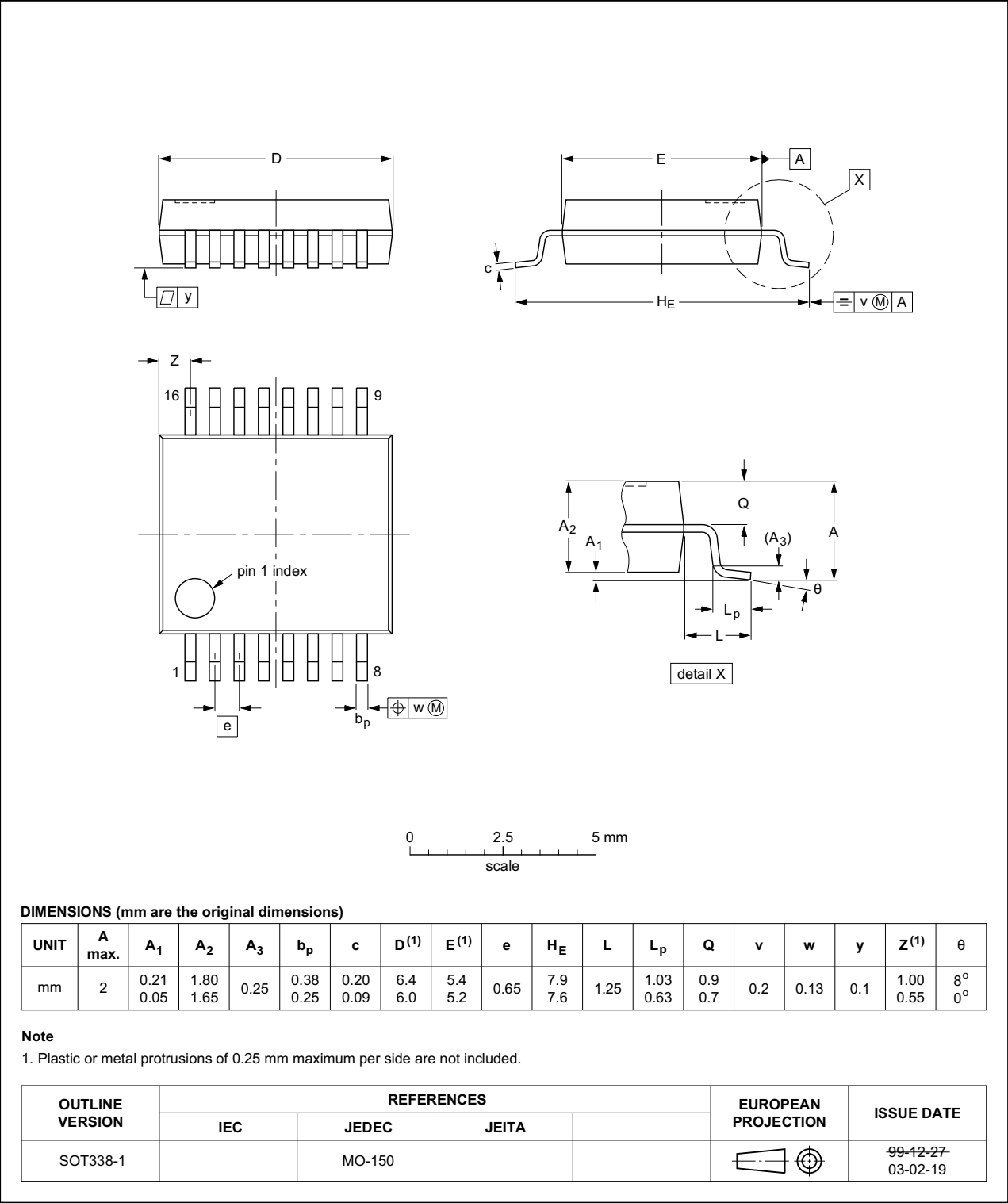


Fig 10. Package outline SOT338-1 (SSOP16)

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

SOT403-1

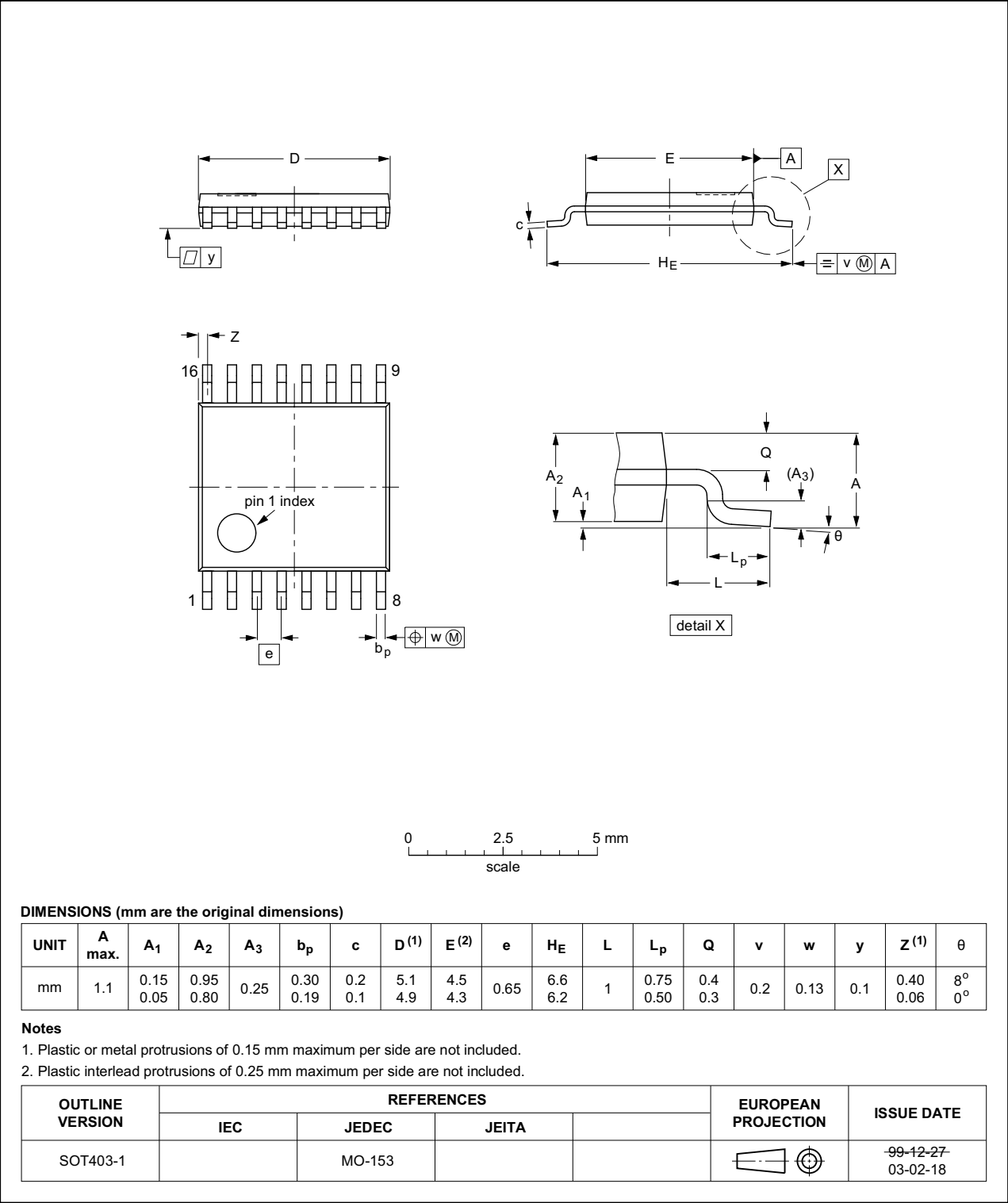


Fig 11. Package outline SOT403-1 (TSSOP16)

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
74HC_HCT112 v.3	20160809	Product data sheet	-	74HC_HCT112_CNV 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. - Type numbers 74HC112N and 74HCT112N removed.			
74HC_HCT112_CNV v.2	19980610	Product specification	-	-

15. Legal information

15.1 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 URL <http://www.nexperia.com>.

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