

74HC107-Q100; 74HCT107-Q100

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

Rev. 1 — 18 November 2013

Product data sheet

1. General description

The 74HC107-Q100; 74HCT107-Q100 is a dual negative edge triggered JK flip-flop featuring individual J and K inputs, clock (\overline{CP}) and reset (\overline{R}) inputs and complementary Q and \overline{Q} outputs. The reset is an asynchronous active LOW input and operates 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} .

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 $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- Input levels:
 - ◆ For 74HC107-Q100: CMOS level
 - ◆ For 74HCT107-Q100: TTL level
- Complies with JEDEC standard no. 7A
- ESD protection:
 - ◆ MIL-STD-883, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pF}$, $R = 0\text{ }\Omega$)
- Multiple package options

3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC107D-Q100 74HCT107D-Q100	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HC107PW-Q100	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1



4. Functional diagram

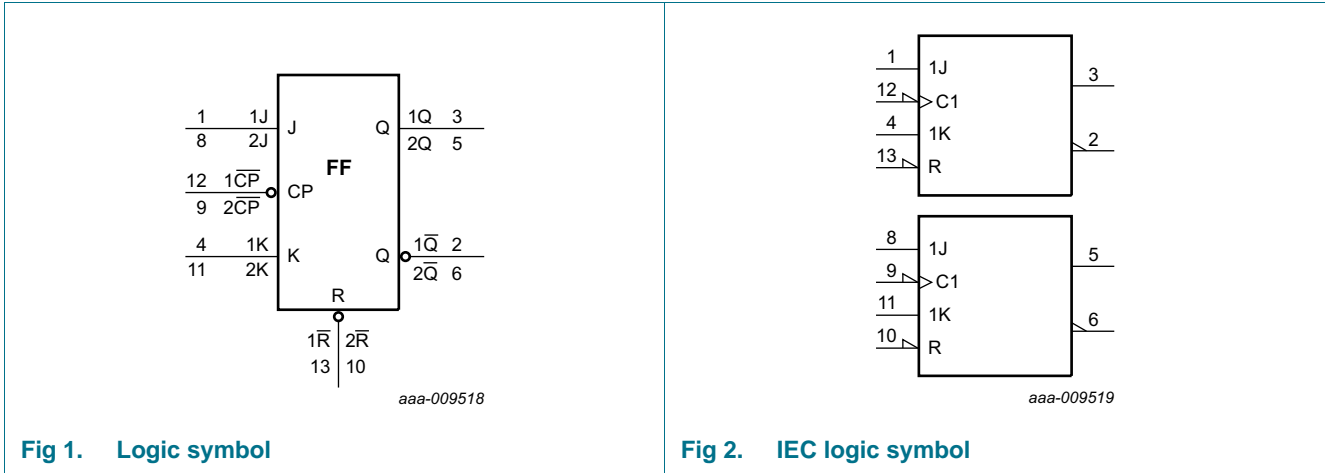


Fig 1. Logic symbol

Fig 2. IEC logic symbol

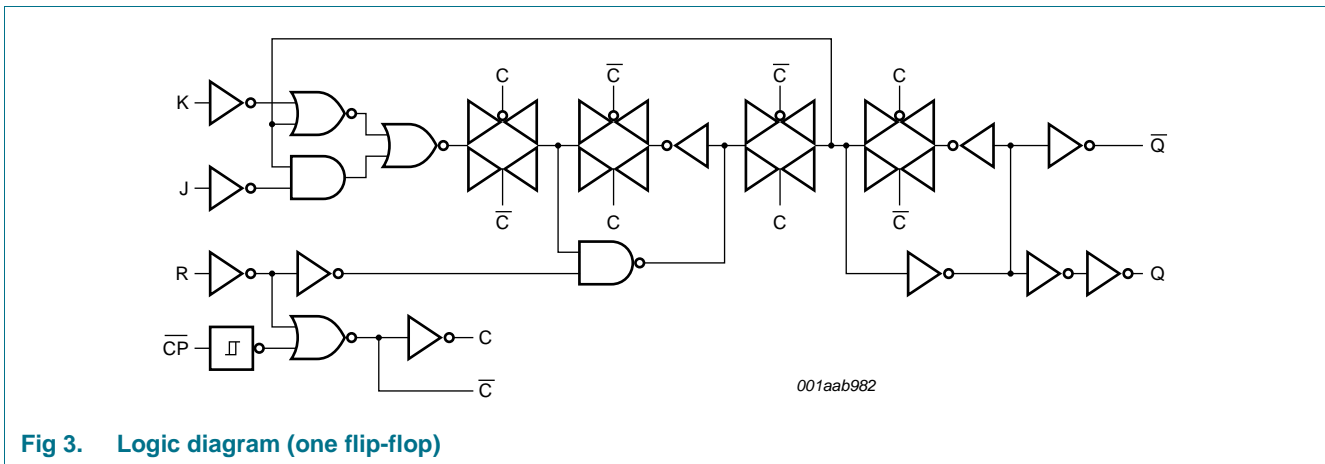
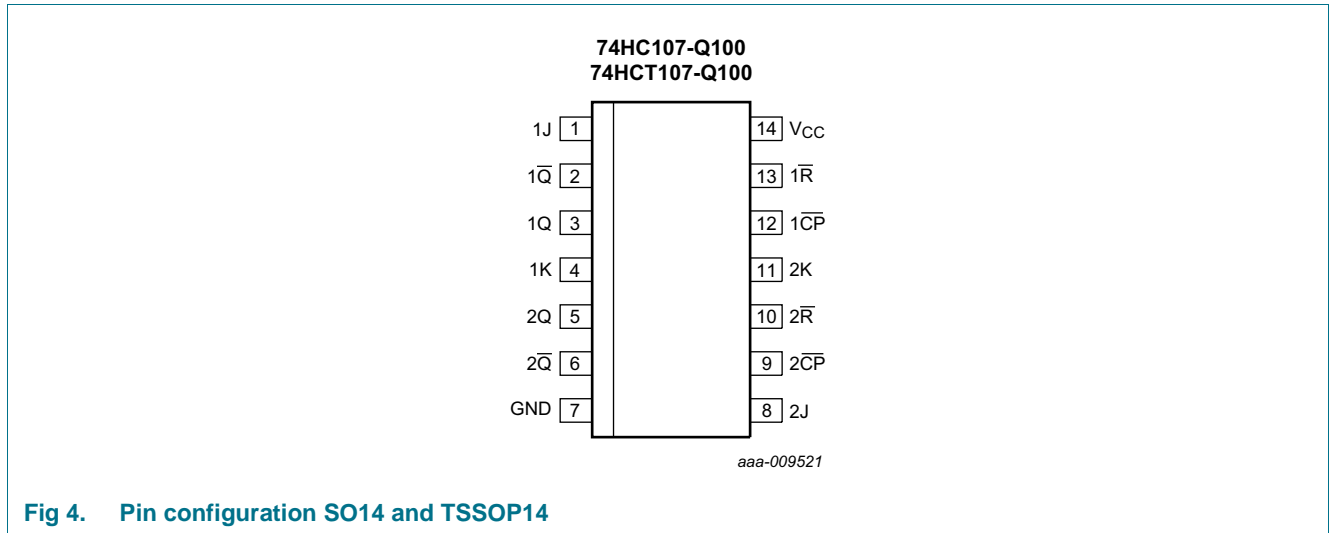


Fig 3. Logic diagram (one flip-flop)

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1J, 2J	1, 8	synchronous J input
1Q̄, 2Q̄	2, 6	complement output
1Q, 2Q	3, 5	true output
1K, 2K	4, 11	synchronous K input
1CP̄, 2CP̄	12, 9	clock input (HIGH-to-LOW edge-triggered)
1R̄, 2R̄	13, 10	asynchronous reset input (active LOW)
GND	7	ground (0 V)
V _{CC}	14	supply voltage

6. Functional description

Table 3. Function table^[1]

Input				Output		Operating mode
R	\overline{CP}	J	K	Q	\overline{Q}	
L	X	X	X	L	H	asynchronous reset
H	↓	h	h	\overline{q}	q	toggle
H	↓	l	h	L	H	load 0 (reset)
H	↓	h	l	H	L	load 1 (set)
H	↓	l	l	q	\overline{q}	hold (no change)

- [1] H = HIGH voltage level;
 h = HIGH voltage level one set-up time prior to the HIGH-to-LOW clock transition;
 L = LOW voltage level;
 l = LOW voltage level one set-up time prior to the HIGH-to-LOW clock transition;
 q = state of referenced output one set-up time prior to 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	+7.0	V
I_{IK}	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	[1] -	±20	mA
I_{OK}	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	[1] -	±20	mA
I_O	output current	$V_O = -0.5\text{ V}$ to $V_{CC} + 0.5\text{ V}$	-	±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	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$			
		SO14 package	[2] -	500	mW
		TSSOP14 package	[3] -	500	mW

- [1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
 [2] P_{tot} derates linearly with 8 mW/K above 70 °C.
 [3] P_{tot} derates linearly with 5.5 mW/K above 60 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC107-Q100			74HCT107-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	+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	
74HC107-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
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 _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	μA
		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
74HCT107-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 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	-	0	0.1	-	0.1	-	0.1	V
		I _O = 4.0 mA	-	0.16	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	-	±1.0	-	±1.0	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; I _O = 0 A; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V								
		pin nCP, nJ	-	100	360	-	450	-	490	μA
		pin nR	-	65	234	-	293	-	319	μA
		pin nK	-	60	216	-	270	-	294	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 [Figure 7](#)

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit		
			Min	Typ	Max	Min	Max	Min	Max			
74HC107-Q100												
t _{pd}	propagation delay	nCP̄ to nQ; see Figure 5 ^[1]										
		V _{CC} = 2.0 V	-	52	160	-	200	-	240	ns		
		V _{CC} = 4.5 V	-	19	32	-	40	-	48	ns		
		V _{CC} = 5.0 V; C _L = 15 pF	-	16	-	-	-	-	-	ns		
		V _{CC} = 6.0 V	-	15	27	-	34	-	41	ns		
		nCP̄ to nQ̄; see Figure 5										
		V _{CC} = 2.0 V	-	52	160	-	200	-	240	ns		
		V _{CC} = 4.5 V	-	19	32	-	40	-	48	ns		
		V _{CC} = 5.0 V; C _L = 15 pF	-	16	-	-	-	-	-	ns		
		V _{CC} = 6.0 V	-	15	27	-	34	-	41	ns		
		nR̄ to nQ, nQ̄; see Figure 6										
		V _{CC} = 2.0 V	-	52	155	-	195	-	235	ns		
		V _{CC} = 4.5 V	-	19	31	-	39	-	47	ns		
		V _{CC} = 5.0 V; C _L = 15 pF	-	16	-	-	-	-	-	ns		
		V _{CC} = 6.0 V	-	15	26	-	33	-	40	ns		
		t _t	transition time	nQ, nQ̄; see Figure 5 ^[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	nCP̄ input, HIGH or LOW; see Figure 5										
		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		
		nR̄ input, 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		
		t _{rec}	recovery time	nR̄ to nCP̄; see Figure 6								
				V _{CC} = 2.0 V	60	19	-	75	-	90	-	ns
V _{CC} = 4.5 V	12			7	-	15	-	18	-	ns		
V _{CC} = 6.0 V	20			6	-	13	-	15	-	ns		
t _{su}	set-up time	nJ, nK to nCP̄; see Figure 5										
		V _{CC} = 2.0 V	100	22	-	125	-	150	-	ns		
		V _{CC} = 4.5 V	20	8	-	25	-	30	-	ns		
		V _{CC} = 6.0 V	17	6	-	21	-	26	-	ns		

Table 7. Dynamic characteristics ...continued
 GND (ground = 0 V); $C_L = 50$ pF unless otherwise specified; for test circuit, see [Figure 7](#)

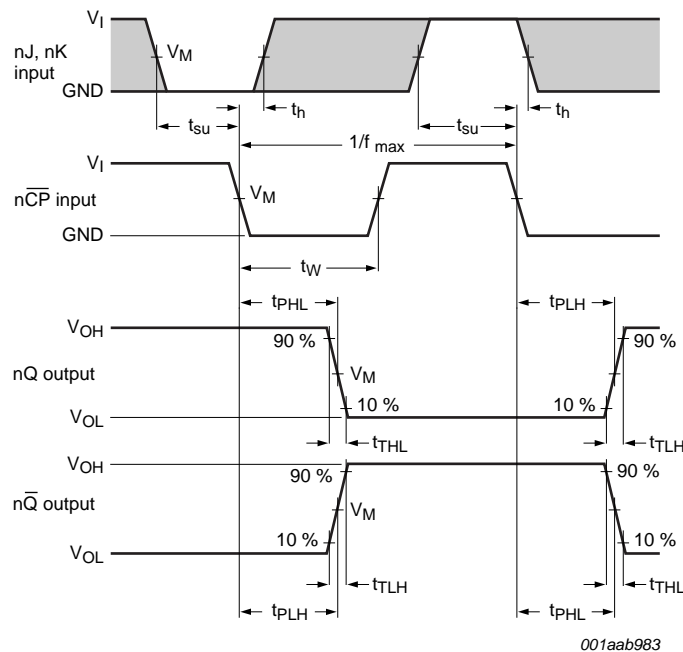
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit		
			Min	Typ	Max	Min	Max	Min	Max			
t_h	hold time	nJ, nK to \overline{nCP} ; see Figure 5										
		$V_{CC} = 2.0$ V	3	-6	-	3	-	3	-	ns		
		$V_{CC} = 4.5$ V	3	-2	-	3	-	3	-	ns		
		$V_{CC} = 6.0$ V	3	-2	-	3	-	3	-	ns		
f_{max}	maximum frequency	\overline{nCP} input; see Figure 5										
		$V_{CC} = 2.0$ V	6	23	-	4.8	-	4.0	-	MHz		
		$V_{CC} = 4.5$ V	30	70	-	24	-	20	-	MHz		
		$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	78	-	-	-	-	-	MHz		
C_{PD}	power dissipation capacitance	per flip-flop; $V_I = GND$ to V_{CC}	[3]	-	30	-	-	-	-	pF		
		74HCT107-Q100										
		t_{pd}	propagation delay	n \overline{CP} to nQ; see Figure 5	[1]							
				$V_{CC} = 4.5$ V	-	19	36	-	45	-	54	ns
$V_{CC} = 5.0$ V; $C_L = 15$ pF	-			16	-	-	-	-	-	ns		
n \overline{CP} to n \overline{Q} ; see Figure 5												
$V_{CC} = 4.5$ V	-			21	36	-	45	-	54	ns		
$V_{CC} = 5.0$ V; $C_L = 15$ pF	-			18	-	-	-	-	-	ns		
n \overline{R} to nQ, n \overline{Q} ; see Figure 6												
$V_{CC} = 4.5$ V	-	20	38	-	48	-	57	ns				
$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	17	-	-	-	-	-	ns				
t_t	transition time	nQ, n \overline{Q} ; see Figure 5	[2]									
		$V_{CC} = 4.5$ V	-	7	15	-	19	-	22	ns		
t_w	pulse width	n \overline{CP} input, HIGH or LOW; see Figure 5										
		$V_{CC} = 4.5$ V	16	9	-	20	-	24	-	ns		
		n \overline{R} input, HIGH or LOW; see Figure 6										
$V_{CC} = 4.5$ V	20	11	-	25	-	30	-	ns				
t_{rec}	recovery time	n \overline{R} to \overline{nCP} ; see Figure 6										
		$V_{CC} = 4.5$ V	14	8	-	18	-	21	-	ns		
t_{su}	set-up time	nJ, nK to \overline{nCP} ; see Figure 5										
		$V_{CC} = 4.5$ V	20	7	-	25	-	30	-	ns		
t_h	hold time	nJ, nK to \overline{nCP} ; see Figure 5										
		$V_{CC} = 4.5$ V	5	-2	-	5	-	5	-	ns		

Table 7. Dynamic characteristics ...continued
 GND (ground = 0 V); $C_L = 50$ pF unless otherwise specified; for test circuit, see [Figure 7](#)

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	nCP input; see Figure 5								
		$V_{CC} = 4.5$ V	30	66	-	24	-	20	-	MHz
		$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	73	-	-	-	-	-	MHz
C_{PD}	power dissipation capacitance	per flip-flop; $V_I = GND$ to V_{CC}	[3]	-	30	-	-	-	-	pF

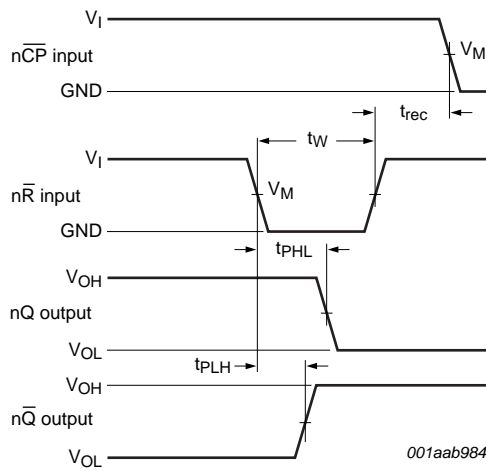
- [1] t_{pd} is the same as t_{PHL} , t_{PLH} .
- [2] t_t is the same as t_{THL} , t_{TLH} .
- [3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$ where:
 f_i = input frequency in MHz;
 f_o = output frequency in MHz;
 C_L = output load capacitance in pF;
 V_{CC} = supply voltage in V;
 N = number of inputs switching;
 $\sum(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11. Waveforms



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

Fig 5. Waveforms showing the clock propagation delays, pulse width, nJ and nK to nCP set-up and hold times, output transition times and maximum clock frequency



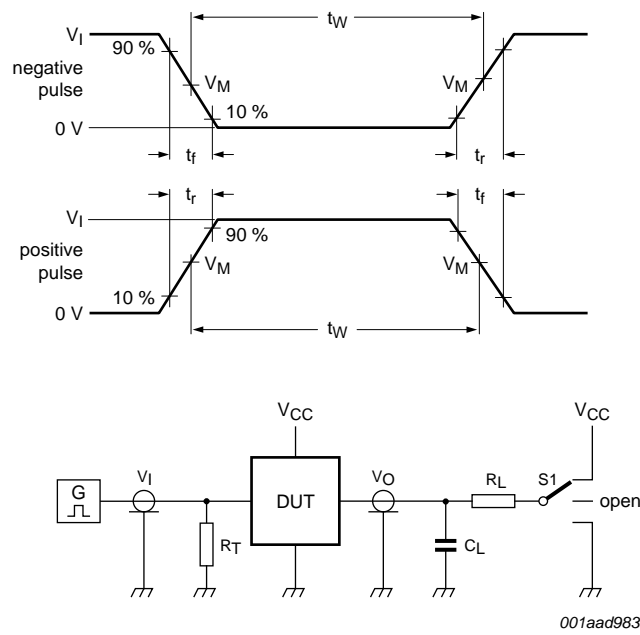
Measurement points are given in [Table 8](#).

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

Fig 6. Waveforms showing reset ($n\overline{R}$) input to output (nQ , $n\overline{Q}$) propagation delays and pulse width, and $n\overline{R}$ to $n\overline{CP}$ recovery time

Table 8. Measurement points

Type	Input		Output
	V_I	V_M	V_M
74HC107-Q100	V_{CC}	$0.5V_{CC}$	$0.5V_{CC}$
74HCT107-Q100	3 V	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.

R_L = Load resistance.

S1 = Test selection switch.

Fig 7. 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	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
74HC107-Q100	V_{CC}	6 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}
74HCT107-Q100	3 V	6 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}

12. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

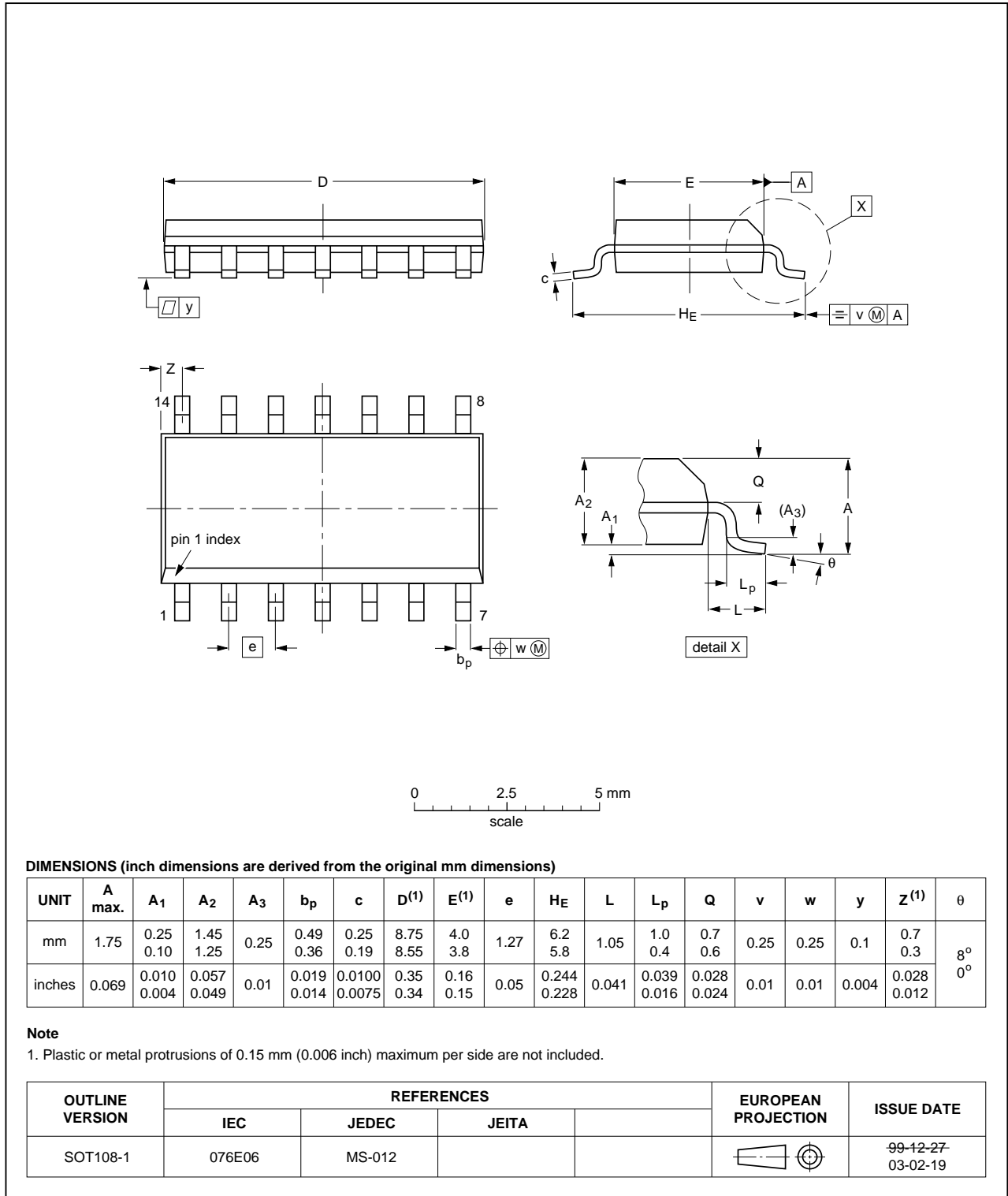


Fig 8. Package outline SOT108-1 (SO14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1

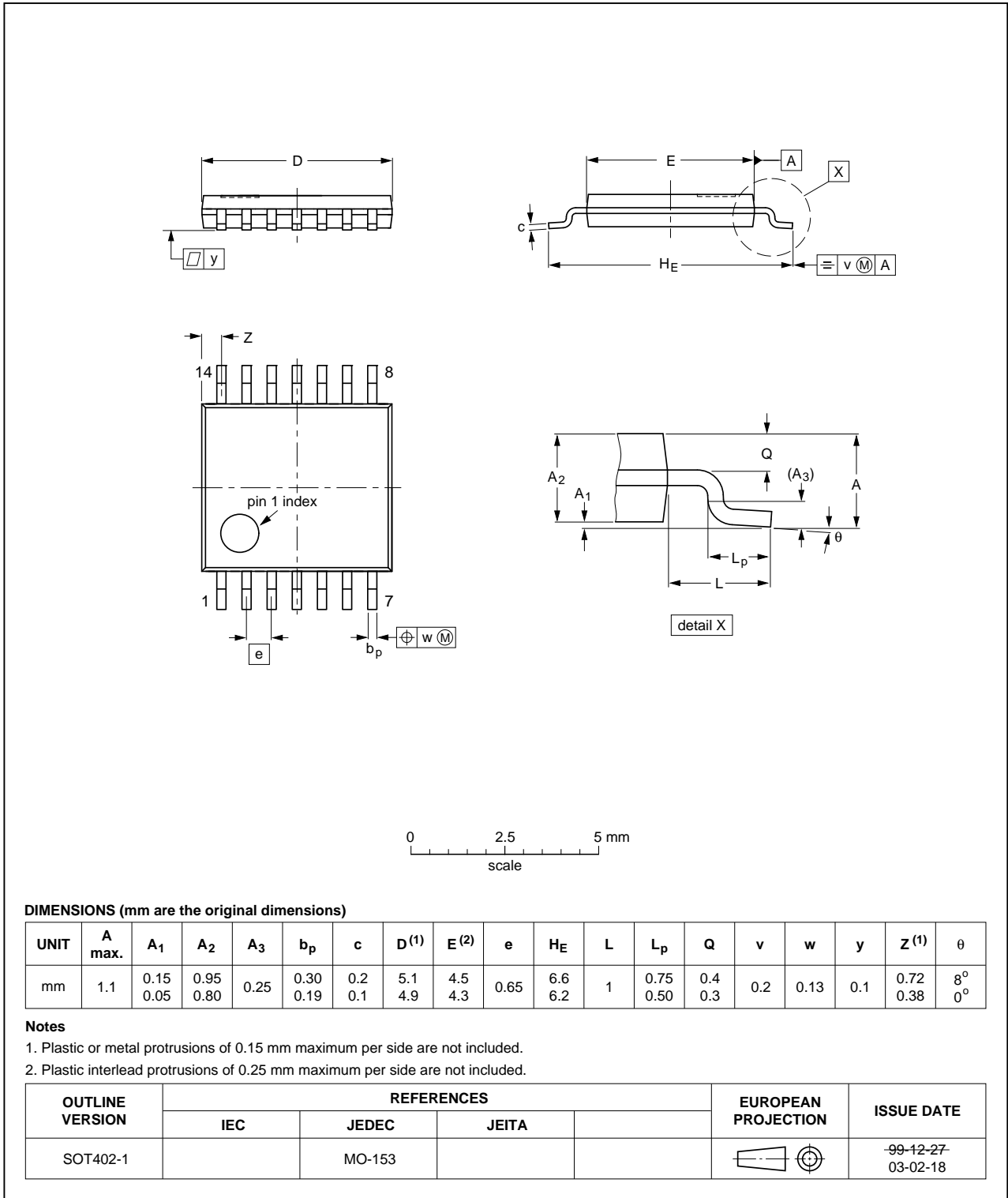


Fig 9. Package outline SOT402-1 (TSSOP14)

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_HCT107_Q100 v.1	20131118	Product data sheet	-	-

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.nxp.com>.

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