

# DATA SHEET

## **74ALS109A**

Dual J- $\bar{K}$  positive edge-triggered flip-flop  
with set and reset

Product specification

1991 Feb 08

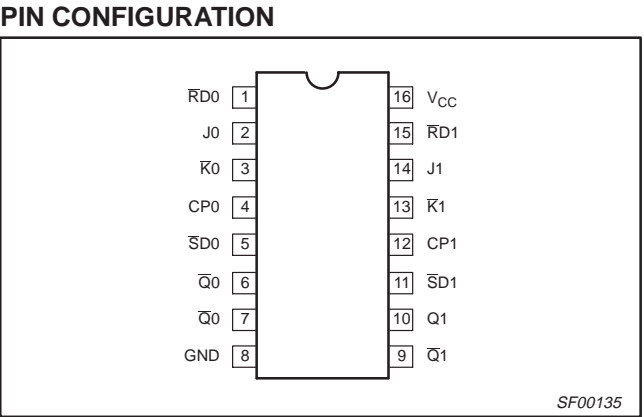
IC05 Data Handbook

Dual J-K positive edge triggered flip-flop  
with set and reset

74ALS109A

**DESCRIPTION**

The 74ALS109A is a dual positive edge-triggered JK-type flip-flop featuring individual J,  $\bar{K}$ , clock, set, and reset inputs; also true and complementary outputs. Set ( $\bar{S}D$ ) and reset ( $\bar{R}D$ ) are asynchronous active-Low inputs and operate independently of the clock (CP) input. The J and  $\bar{K}$  are edge-triggered inputs which control the state changes of the flip-flops as described in the function table. Clock triggering occurs at a voltage level and is not directly related to the transition time of the positive-going pulse. The J and  $\bar{K}$  inputs must be stable just one setup time prior to the Low-to-High transition of the clock for predictable operation. The JK design allows operation as a D flip-flop by tying J and  $\bar{K}$  inputs together. Although the clock input is level sensitive, the positive transition of the clock pulse between the 0.8V and 2.0V levels should be equal to or less than the clock to output delay time for reliable operation.



TYPE	TYPICAL $f_{MAX}$	TYPICAL SUPPLY CURRENT (TOTAL)
74ALS109A	150MHz	3.0mA

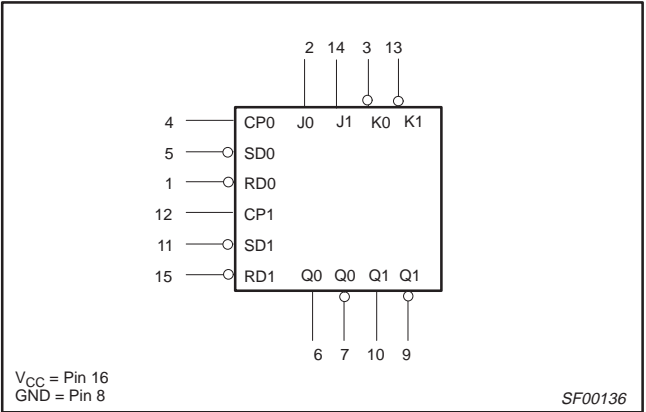
DESCRIPTION	ORDER CODE	DRAWING NUMBER
	COMMERCIAL RANGE $V_{CC} = 5V \pm 10\%$ , $T_{amb} = 0^{\circ}C \text{ to } +70^{\circ}C$	
16-pin plastic DIP	74ALS109AN	SOT38-4
16-pin plastic SO	74ALS109AD	SOT109-1

INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

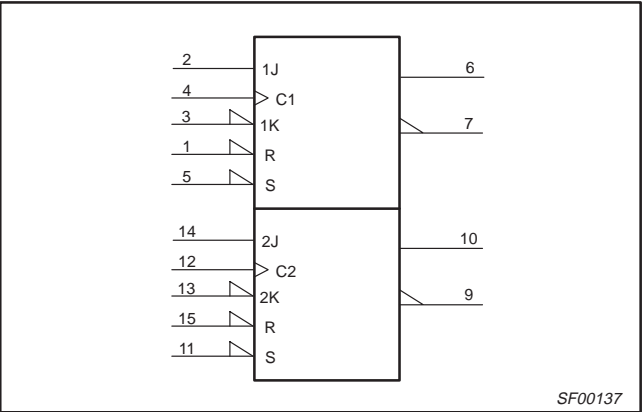
PINS	DESCRIPTION	74ALS (U.L.) HIGH/LOW	LOAD VALUE HIGH/LOW
J0, J1	J inputs	1.0/2.0	20 $\mu$ A/0.2mA
$\bar{K}0, \bar{K}1$	$\bar{K}$ inputs	1.0/2.0	20 $\mu$ A/0.2mA
CP0, CP1	Clock inputs (active rising edge)	1.0/2.0	20 $\mu$ A/0.2mA
$\bar{S}D0, \bar{S}D1$	Set inputs (active-Low)	1.0/4.0	20 $\mu$ A/0.4mA
$\bar{R}D0, \bar{R}D1$	Reset inputs (active-Low)	1.0/4.0	20 $\mu$ A/0.4mA
Q0, Q1, $\bar{Q}0, \bar{Q}1$	Data outputs	20/80	0.4mA/8mA

**NOTE:** One (1.0) ALS unit load is defined as: 20 $\mu$ A in the High state and 0.1mA in the Low state.

LOGIC SYMBOL



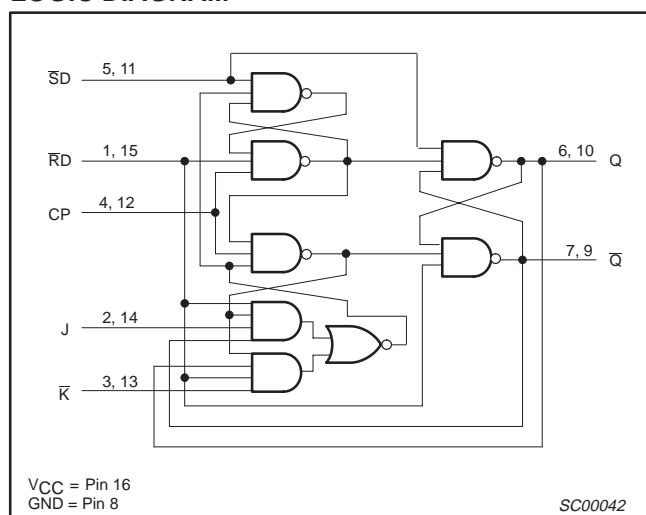
IEC/IEEE SYMBOL



# Dual J- $\bar{K}$ positive edge triggered flip-flop with set and reset

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## LOGIC DIAGRAM



## FUNCTION TABLE

INPUTS					OUTPUTS		OPERATING MODE
S̄D	R̄D	CP	J	K̄	Q	Q̄	
L	H	X	X	X	H	L	Asynchronous set
H	L	X	X	X	L	H	Asynchronous reset
L	L	X	X	X	H*	H*	Undetermined*
H	H	↑	h	l	q̄	q	Toggle
H	H	↑	l	l	L	H	Load "0"
H	H	↑	h	h	H	L	Load "1"
H	H	↑	l	h	q	q̄	Hold "no change"
H	H	L	l	h	q	q̄	Hold "no change"

H = High voltage level

h = High state must be present one setup time prior to Low-to-High clock transition

L = Low voltage level

l = Low state must be present one setup time prior to Low-to-High clock transition

q = Lower case indicate the state of the referenced output prior to the Low-to-High clock transition

X = Don't care

↑ = Low-to-High clock transition

\* = The output levels in this configuration are not guaranteed to meet the minimum levels for  $V_{OH}$  if the set and reset are near  $V_{IN}$  maximum. Furthermore, this configuration is nonstable; that is, it will not remain when either set or reset returns to its inactive (High) level.

## ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limit set forth in this table may impair the useful life of the device.)

Unless otherwise noted these limits are over the operating free-air temperature range.)

SYMBOL	PARAMETER	RATING	UNIT
V <sub>CC</sub>	Supply voltage	-0.5 to +7.0	V
V <sub>IN</sub>	Input voltage	-0.5 to +7.0	V
I <sub>IN</sub>	Input current	-30 to +5	mA
V <sub>OUT</sub>	Voltage applied to output in high output state	-0.5 to V <sub>CC</sub>	V
I <sub>OUT</sub>	Current applied to output in Low output state	16	mA
T <sub>amb</sub>	Operating free-air temperature range	0 to +70	°C
T <sub>stg</sub>	Storage temperature range	-65 to +150	°C

## RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS			UNIT
		MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage	4.5	5.0	5.5	V
V <sub>IH</sub>	High-level input voltage	2.0			V
V <sub>IL</sub>	Low-level input voltage			0.8	V
I <sub>IK</sub>	Input clamp current			-18	mA
I <sub>OH</sub>	High-level output current			-0.4	mA
I <sub>OL</sub>	Low-level output current			8	mA
T <sub>amb</sub>	Operating free-air temperature range	0		+70	°C

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## DC ELECTRICAL CHARACTERISTICS

(Over recommended operating free-air temperature range unless otherwise noted.)

SYMBOL	PARAMETER		TEST CONDITIONS <sup>1</sup>	LIMITS			UNIT
				MIN	TYP <sup>2</sup>	MAX	
$V_{OH}$	High-level output voltage		$V_{CC} = \pm 10\%$ , $V_{IL} = \text{MAX}$ , $V_{IH} = \text{MIN}$	$I_{OH} = -0.4\text{mA}$	$V_{CC} - 2$		V
$V_{OL}$	Low-level output voltage		$V_{CC} = \text{MIN}$ , $V_{IL} = \text{MAX}$ , $V_{IH} = \text{MIN}$	$I_{OL} = 4\text{mA}$		0.25	V
				$I_{OL} = 8\text{mA}$		0.35	V
$V_{IK}$	Input clamp voltage		$V_{CC} = \text{MIN}$ , $I_I = I_{IK}$		-0.73	-1.5	V
$I_I$	Input current at maximum input voltage	Jn, $\bar{K}n$ , CPn	$V_{CC} = \text{MAX}$ , $V_I = 7.0\text{V}$			0.1	mA
		$\bar{S}Dn$ , $\bar{R}Dn$				0.2	mA
$I_{IH}$	High-level input current	Jn, $\bar{K}n$ , CPn	$V_{CC} = \text{MAX}$ , $V_I = 2.7\text{V}$			20	$\mu\text{A}$
		$\bar{S}Dn$ , $\bar{R}Dn$				40	$\mu\text{A}$
$I_{IL}$	Low-level input current	Jn, $\bar{K}n$ , CPn	$V_{CC} = \text{MAX}$ , $V_I = 0.4\text{V}$			-0.2	mA
		$\bar{S}Dn$ , $\bar{R}Dn$				-0.4	mA
$I_O$	Output current <sup>3</sup>		$V_{CC} = \text{MAX}$ , $V_O = 2.25\text{V}$	-30		-112	mA
$I_{CC}$	Supply current (total) <sup>4</sup>		$V_{CC} = \text{MAX}$		3.0	4.0	mA

### NOTES:

- For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
- All typical values are at  $V_{CC} = 5\text{V}$ ,  $T_{\text{amb}} = 25^\circ\text{C}$ .
- The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .
- Measure  $I_{CC}$  with the clock input grounded and all outputs open, then with Q and  $\bar{Q}$  outputs High in turn.

## AC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITION	LIMITS		UNIT
			$T_{\text{amb}} = 0^{\circ}\text{C to } +70^{\circ}\text{C}$ $V_{\text{CC}} = +5.0\text{V} \pm 10\%$ $C_L = 50\text{pF}, R_L = 500\Omega$		
			MIN	MAX	
f <sub>MAX</sub>	Maximum clock frequency	Waveform 1	80		MHz
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay CP <sub>n</sub> to Q <sub>n</sub> or $\overline{\text{Q}}_n$	Waveform 1	3.0 3.0	14.0 14.0	ns
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay $\overline{\text{S}}\text{D}_n$ or $\overline{\text{R}}\text{D}$ to Q <sub>n</sub> or $\overline{\text{Q}}_n$	Waveform 2, 3	1.0 3.0	8.0 10.0	ns

## AC SETUP REQUIREMENTS

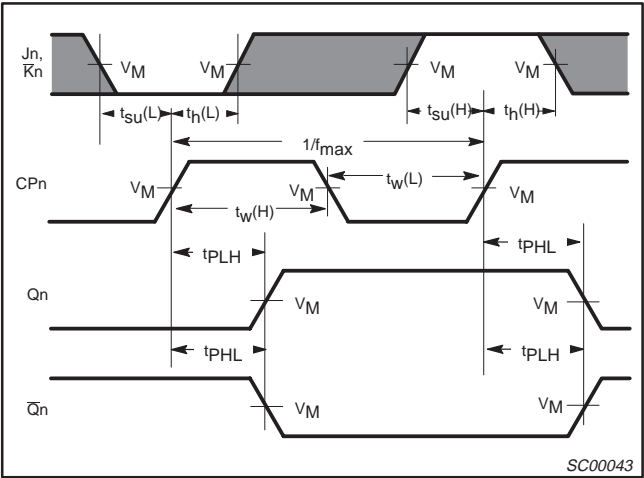
SYMBOL	PARAMETER	TEST CONDITION	LIMITS		UNIT
			$T_{amb} = 0^{\circ}C \text{ to } +70^{\circ}C$ $V_{CC} = +5.0V \pm 10\%$ $C_L = 50pF, R_L = 500\Omega$		
			MIN	MAX	
$t_{su} \text{ (H)}$ $t_{su} \text{ (L)}$	Setup time, High or Low $J_n, \overline{K}_n$ to $CP_n$	Waveform 1	6.0 6.0		ns
$t_h \text{ (H)}$ $t_h \text{ (L)}$	Hold time, High or Low $J_n, \overline{K}_n$ to $CP_n$	Waveform 1	0.0 0.0		ns
$t_w \text{ (H)}$ $t_w \text{ (L)}$	$CP_n$ Pulse width High or Low	Waveform 1	6.0 6.0		ns
$t_w \text{ (L)}$	$\overline{SD}_n$ or $\overline{RD}_n$ Pulse width Low	Waveform 2, 3	6.0		ns
$t_{rec}$	Recovery time, $\overline{SD}_n$ or $\overline{RD}_n$ to $CP_n$	Waveform 2, 3	6.0		ns

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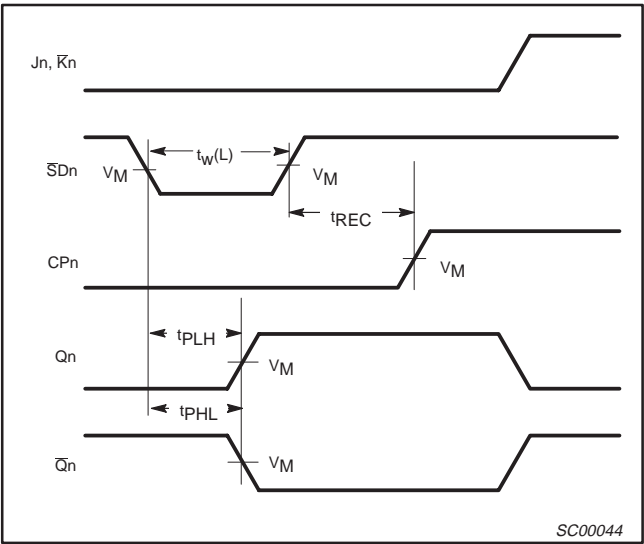
74ALS109A

## AC WAVEFORMS

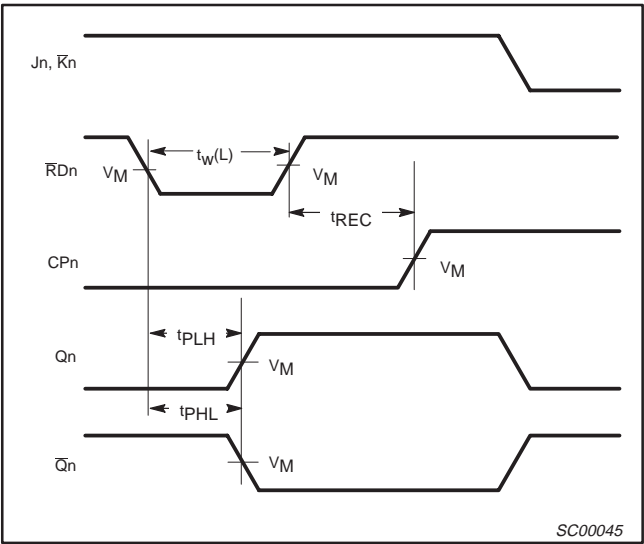
For all waveforms,  $V_M = 1.3V$ .  
The shaded areas indicate when the input is permitted to change for predictable output performance.



**Waveform 1. Propagation Delay for Data to Output, Data Setup Time and Hold Times, Clock Width, and Maximum Clock Frequency**



**Waveform 2. Propagation Delay for Set to Output, Set Pulse Width and Recovery Time for Set to Clock**

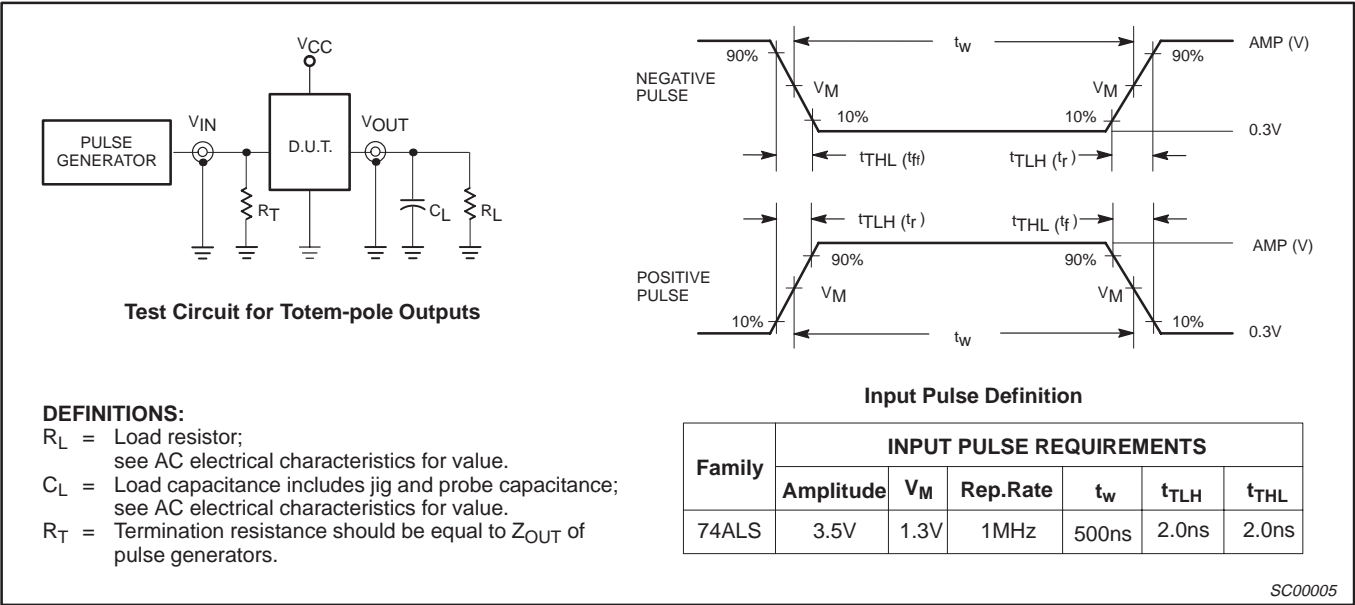


**Waveform 3. Propagation Delay for Reset to Output, Reset Pulse Width and Recovery Time for Reset to Clock**

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TEST CIRCUIT AND WAVEFORMS

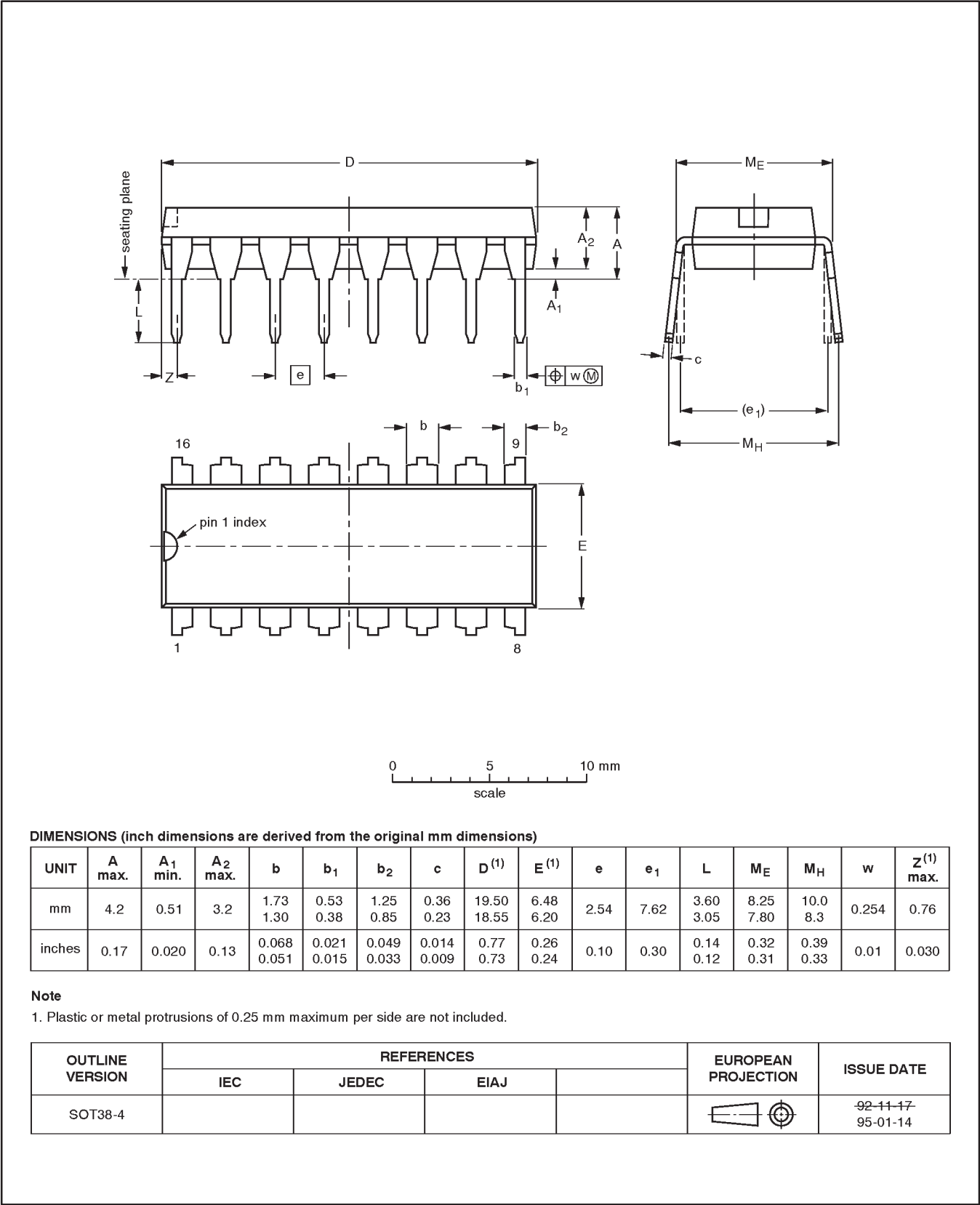


Dual J-K positive edge-triggered flip-flop  
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DIP16: plastic dual in-line package; 16 leads (300 mil)

SOT38-4

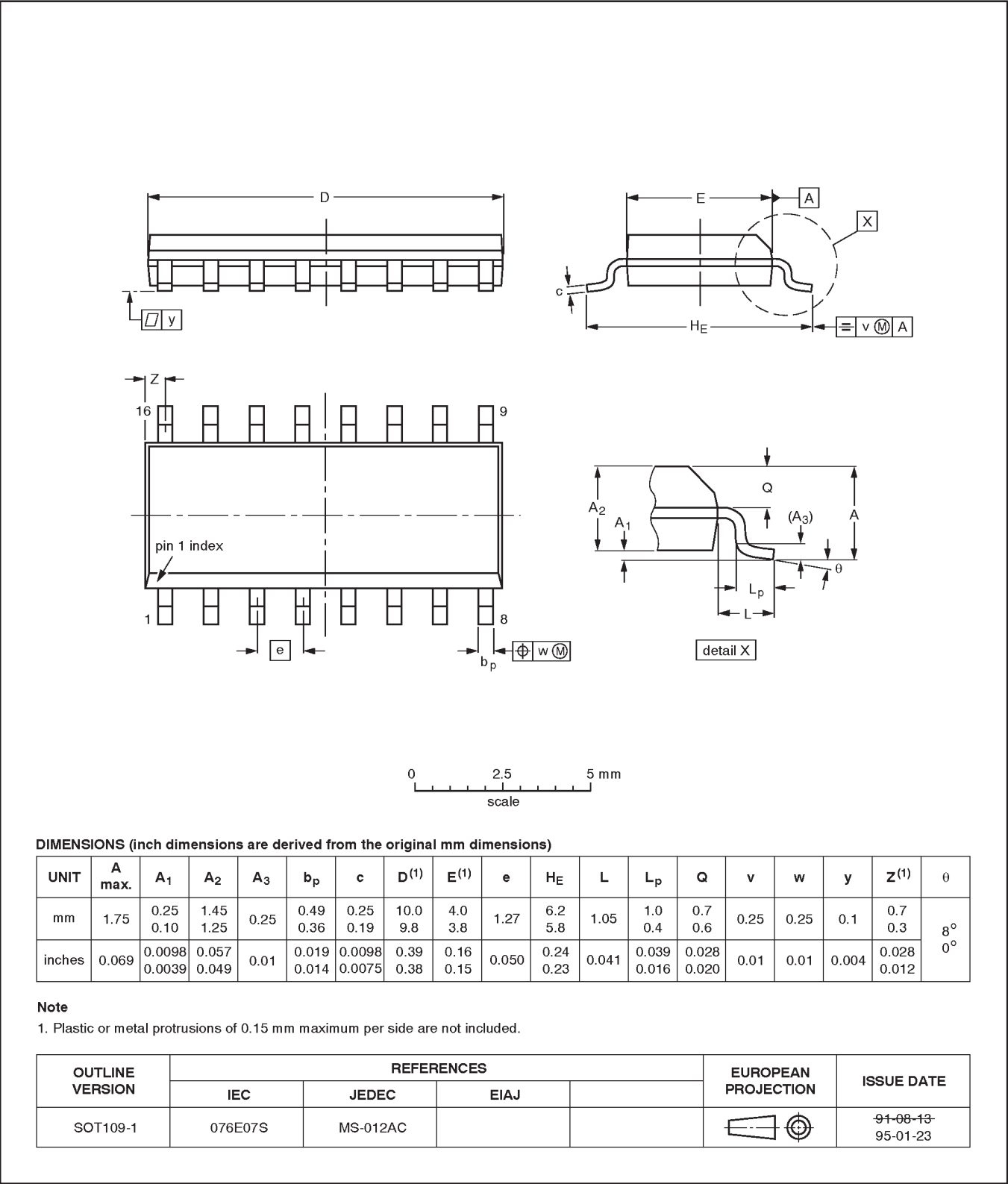


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SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1





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DEFINITIONS		
Data Sheet Identification	Product Status	Definition
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Philips Semiconductors  
811 East Arques Avenue  
P.O. Box 3409  
Sunnyvale, California 94088-3409  
Telephone 800-234-7381

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