DATA SHEET

74ALS112A
Dual J-K negative edge-triggered flip-flop

Product specification

IC05 Data Handbook

1996 June 27

Philips
Semiconductors

PHILIPS

Dual J-K negative edge-triggered flip-flop 74ALS112A

DESCRIPTION

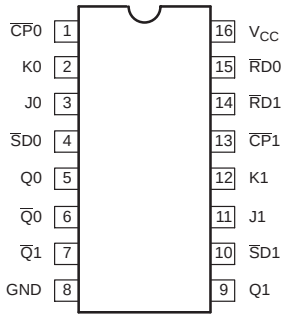
The 74ALS112A, dual negative edge-triggered JK-type flip-flop features individual J, K, clock ($\overline{CP}n$), set ($\overline{SD}$), and reset ($\overline{RD}$) inputs, true (Qn) and complementary ($\overline{Q}n$) outputs.

The $\overline{SD}$ and $\overline{RD}$ inputs, when Low, set or reset the outputs as shown in the function table regardless of the level at the other inputs.

A High level on the clock ($\overline{CP}n$) input enables the J and K inputs and data will be accepted. The logic levels at the J and K inputs may be allowed to change while the $\overline{CP}n$ is High and the flip-flop will perform according to the function table as long as minimum setup and hold times are observed. Output changes are initiated by the High-to-Low transition of the $\overline{CP}n$.

TYPE	TYPICAL f_{MAX}	TYPICAL SUPPLY CURRENT (TOTAL)
74ALS112A	50MHz	3.0mA

PIN CONFIGURATION



SF00103

ORDERING INFORMATION

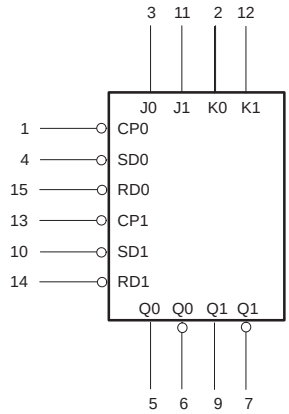
DESCRIPTION	ORDER CODE: COMMERCIAL RANGE V_{CC} = 5V ±10%, T_{amb} = 0°C to +70°C	DRAWING NUMBER
16-pin plastic DIP	74ALS112AN	SOT38-4
16-pin plastic SO	74ALS112AD	SOT109-1

INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

PINS	DESCRIPTION	74ALS (U.L.) HIGH/LOW	LOAD VALUE HIGH/LOW
$\overline{CP}$0, $\overline{CP}$1	Clock Pulse input (active falling edge)	1.0/1.0	20µA/0.1mA
J0, J1	J inputs	1.0/2.0	20µA/0.2mA
K0, K1	K inputs	1.0/2.0	20µA/0.2mA
$\overline{SD}$0, $\overline{SD}$1	Set inputs (active-Low)	1.0/2.0	20µA/0.2mA
$\overline{RD}$0, $\overline{RD}$1	Reset inputs (active-Low)	1.0/2.0	20µA/0.2mA
Q0, Q1, $\overline{Q}$0, $\overline{Q}$1	Data outputs	20/80	0.4mA/8mA

NOTE: One (1.0) ALS unit load is defined as: 20µA in the High state and 0.1mA in the Low state.

LOGIC SYMBOL



V_{CC} = Pin 16
GND = Pin 8

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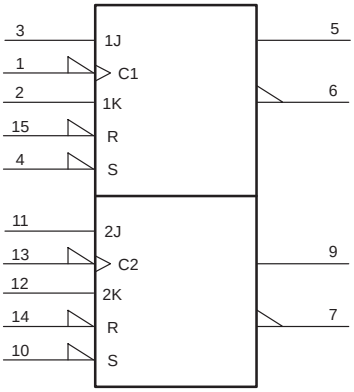
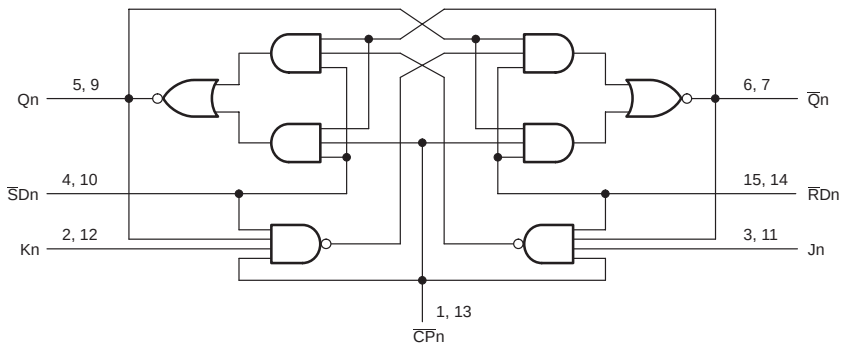
IEC/IEEE SYMBOL



SF00105

LOGIC DIAGRAM



V_{CC} = Pin 16
GND = Pin 8

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FUNCTION TABLE

INPUTS					OUTPUTS		OPERATING MODE
$\overline{SD}$	$\overline{RD}$	$\overline{CP}$	J	K	Q	$\overline{Q}$	
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	h	$\overline{q}$	q	Toggle
H	H	↓	h	l	H	L	Load “1” (Set)
H	H	↓	l	h	L	H	Load “0” (Reset)
H	H	↓	l	l	q	$\overline{q}$	Hold “no change”
H	H	H	X	X	q	$\overline{q}$	Hold “no change”

H = High voltage level
h = High state must be present one setup time prior to High-to-Low clock transition
L = Low voltage level
l = Low state must be present one setup time prior to High-to-Low clock transition
q = Lower case indicate the state of the referenced output prior to the High-to-Low clock transition
X = Don’t care
↓ = High-to-Low clock transition
* = Both outputs will be High while both $\overline{S}$D and $\overline{R}$D are Low, but the output states are unpredictable if $\overline{S}$D and $\overline{R}$D go High simultaneously
Asynchronous inputs: Low input to $\overline{S}$D sets Q to High level, Low input to $\overline{R}$D sets Q to Low level. Set and reset are independent of clock. Simultaneous Low on both $\overline{S}$D and $\overline{R}$D makes both Q and $\overline{Q}$ High.

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_{CC}	Supply voltage	–0.5 to +7.0	V
V_{IN}	Input voltage	–0.5 to +7.0	V
I_{IN}	Input current	–30 to +5	mA
V_{OUT}	Voltage applied to output in High output state	–0.5 to V_{CC}	V
I_{OUT}	Current applied to output in Low output state	16	mA
T_{amb}	Operating free-air temperature range	0 to +70	°C
T_{stg}	Storage temperature range	–65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS			UNIT
		MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5.0	5.5	V
V_{IH}	High-level input voltage	2.0			V
V_{IL}	Low-level input voltage			0.8	V
I_{Ik}	Input clamp current			–18	mA
I_{OH}	High-level output current			–0.4	mA
I_{OL}	Low-level output current			8	mA
T_{amb}	Operating free-air temperature range	0		+70	°C

DC ELECTRICAL CHARACTERISTICS

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

SYMBOL	PARAMETER		TEST CONDITIONS[1]		LIMITS			UNIT
					MIN	TYP[2]	MAX	
V_{OH}	High-level output voltage		V_{CC} = ±10%, V_{IL} = MAX, V_{IH} = MIN	I_{OH} = –0.4mA	V_{CC} – 2			V
V_{OL}	Low-level output voltage		V_{CC} = MIN, V_{IL} = MAX,	I_{OL} = 4mA		0.25	0.40	V
			V_{IH} = MIN	I_{OL} = 8mA		0.35	0.50	V
V_{IK}	Input clamp voltage		V_{CC} = MIN, I_I = I_{IK}			–0.73	–1.5	V
I_I	Input current at maximum input voltage		V_{CC} = MAX, V_I = 7.0V				0.1	mA
I_{IH}	High-level input current		V_{CC} = MAX, V_I = 2.7V				20	µA
I_{IL}	Low-level input current	$\overline{CP}$n	V_{CC} = MAX, V_I = 0.4V				–0.1	mA
		$\overline{S}$Dn, $\overline{R}$Dn, Jn, Kn					–0.2	mA
I_O	Output current[3]		V_{CC} = MAX, V_O = 2.25V		–30		–112	mA
I_{CC}	Supply current (total)		V_{CC} = MAX			2.5	4.5	mA

NOTES:
1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at V_{CC} = 5V, T_{amb} = 25°C.
3. The output conditions have been chosen to produce a current that closely approximates one half of the true short–circuit output current, I_{OS}.

AC ELECTRICAL CHARACTERISTICS

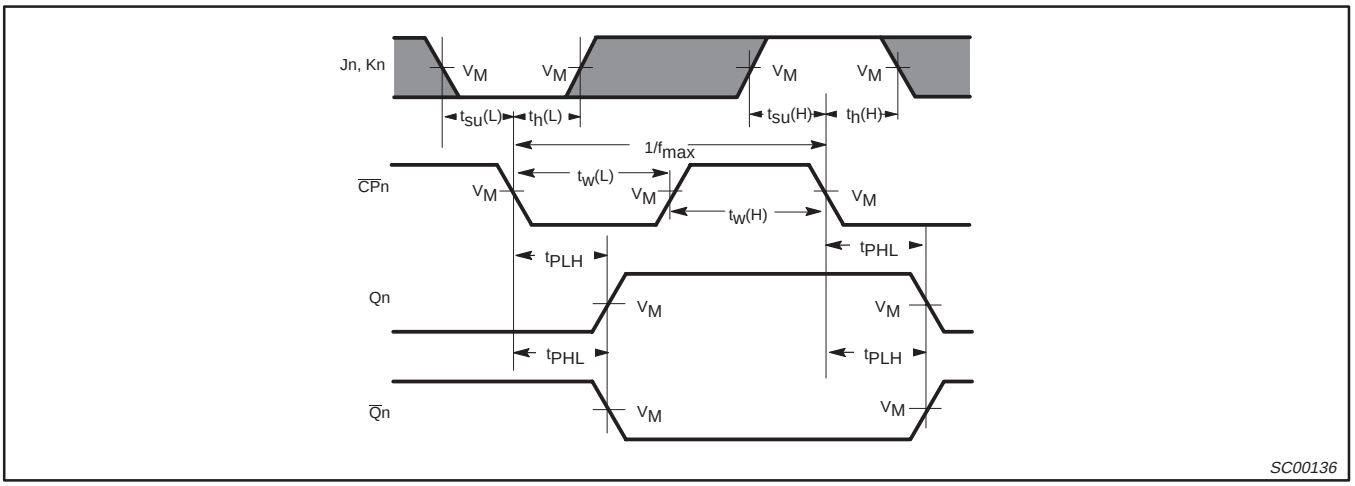
SYMBOL	PARAMETER	TEST CONDITION	LIMITS		UNIT
			T_{amb} = 0°C to +70°C V_{CC} = +5.0V ± 10% C_L = 50pF, R_L = 500Ω		
			MIN	MAX	
f_{MAX}	Maximum clock frequency	Waveform 1	35		MHz
t_{PLH} t_{PHL}	Propagation delay $\overline{CP}$n to Qn or $\overline{Q}$n	Waveform 1	2.0 4.0	10.0 10.5	ns
t_{PLH} t_{PHL}	Propagation delay $\overline{S}$Dn or $\overline{R}$D to Qn or $\overline{Q}$n	Waveform 2, 3	1.5 3.5	8.0 9.5	ns

AC SETUP REQUIREMENTS

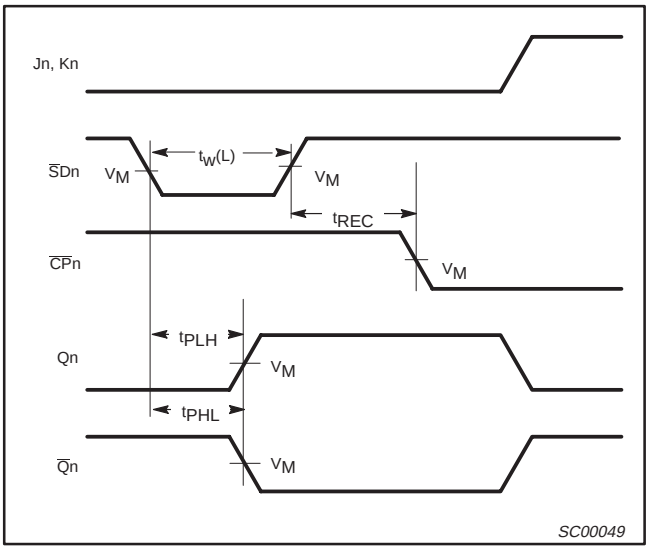
SYMBOL	PARAMETER	TEST CONDITION	LIMITS		UNIT
			T_{amb} = 0°C to +70°C V_{CC} = +5.0V ± 10% C_L = 50pF, R_L = 500Ω		
			MIN	MAX	
t_{su} (H) t_{su} (L)	Setup time, High or Low Jn, Kn to $\overline{CP}$n	Waveform 1	8.0 8.0		ns
t_h (H) t_h (L)	Hold time, High or Low Jn, Kn to $\overline{CP}$n	Waveform 1	0.0 0.0		ns
t_w (H) t_w (L)	$\overline{CP}$n Pulse width high or Low	Waveform 1	11.0 8.0		ns
t_w (L)	$\overline{S}$Dn or $\overline{R}$Dn Pulse width Low	Waveform 2, 3	6.0		ns
t_{REC}	Recovery time, $\overline{S}$Dn or $\overline{R}$Dn to $\overline{CP}$n	Waveform 2, 3	8.0		ns

AC WAVEFORMS

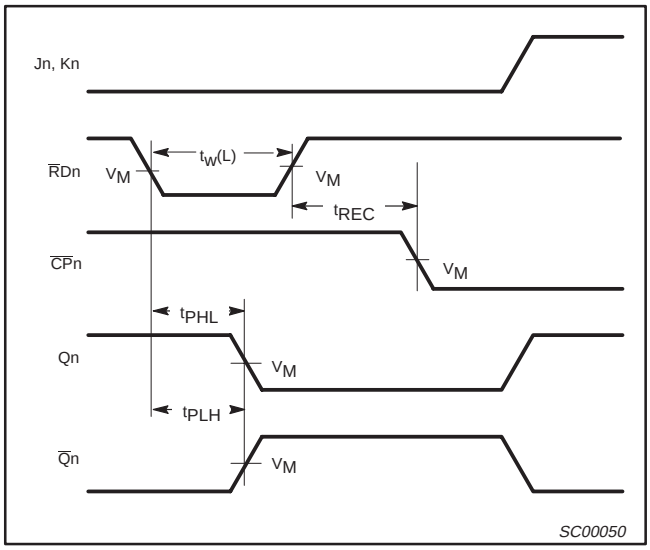
For all waveforms, V_M = 1.3V.
The sahded areas indicate when the input is permitted to change for predictable output performance.



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

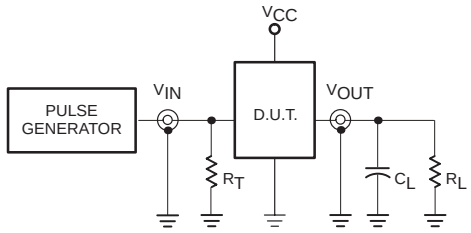


Waveform 2. Propagation Delay for Set to Output, Set Pulse Width, and Recovery Time for Set to Clock

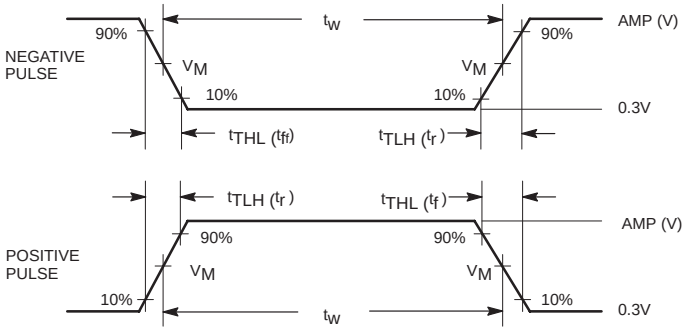


Waveform 3. Propagation Delay for Reset to Output, Reset Pulse Width, and Recovery Time for Reset to Clock

TEST CIRCUIT AND WAVEFORMS



Test Circuit for Totem-pole Outputs



Input Pulse Definition

DEFINITIONS:

R_L = Load resistor; see AC electrical characteristics for value.

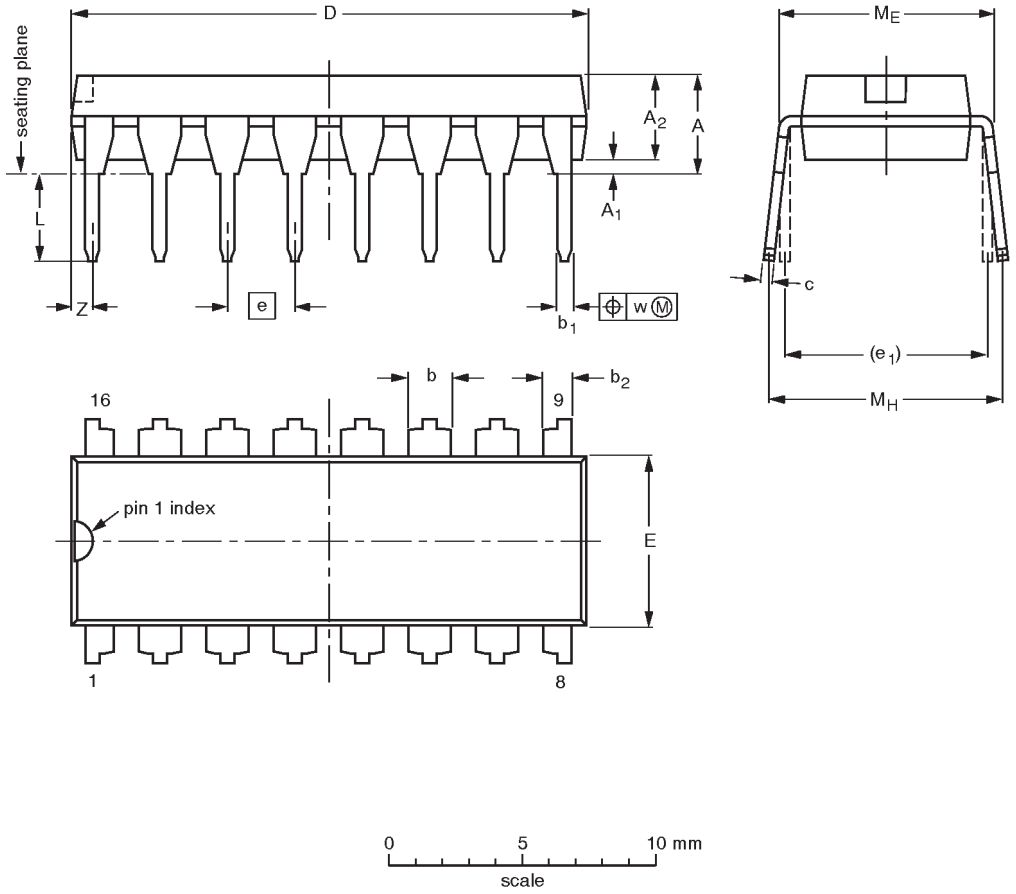
C_L = Load capacitance includes jig and probe capacitance; see AC electrical characteristics for value.

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

Family	INPUT PULSE REQUIREMENTS					
	Amplitude	V_M	Rep.Rate	t_w	t_{TLH}	t_{THL}
74ALS	3.5V	1.3V	1MHz	500ns	2.0ns	2.0ns

SC00005

DIP16: plastic dual in-line package; 16 leads (300 mil) **SOT38-4**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

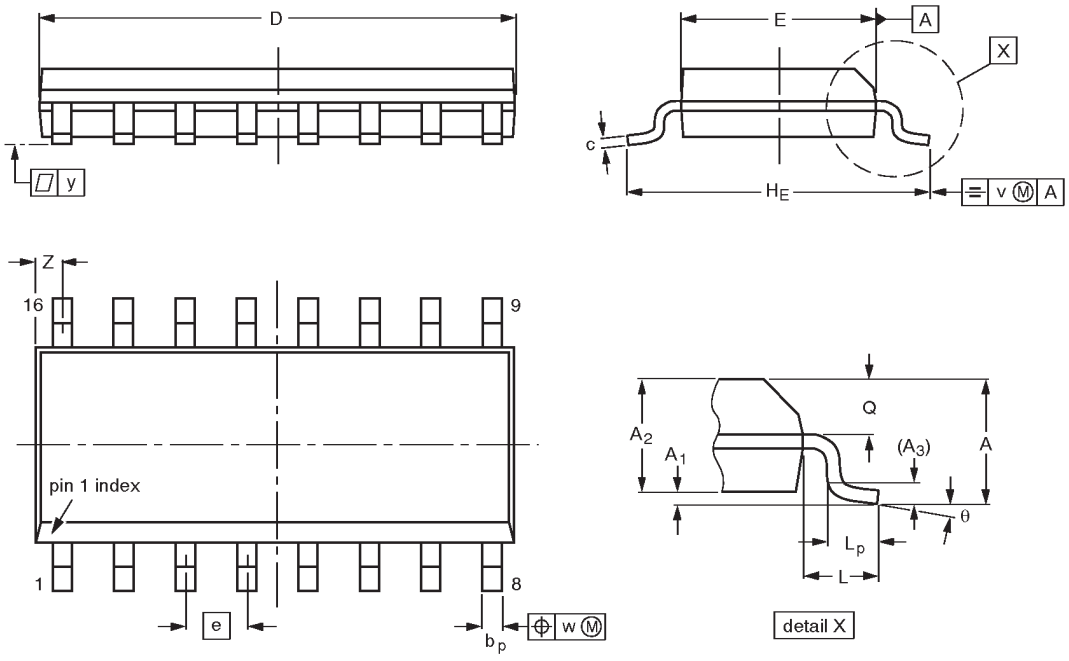
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.030

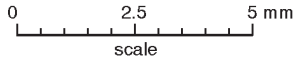
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-4						~~92-11-17~~ 95-01-14

SO16: plastic small outline package; 16 leads; body width 3.9 mm **SOT109-1**





DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.0098 0.0039	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.39 0.38	0.16 0.15	0.050	0.24 0.23	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT109-1	076E07S	MS-012AC				~~91-08-13~~ 95-01-23

DEFINITIONS

Data Sheet Identification	Product Status	Definition
Objective Specification	Formative or in Design	This data sheet contains the design target or goal specifications for product development. Specifications may change in any manner without notice.
Preliminary Specification	Preproduction Product	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
Product Specification	Full Production	This data sheet contains Final Specifications. Philips Semiconductors reserves the right to make changes at any time without notice, in order to improve design and supply the best possible product.

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