DATA SHEET

74F164
8-bit serial-in parallel-out shift register

Product specification
Supersedes data of 1995 Sep 22

2000 Dec 18

Philips
Semiconductors

8-bit serial-in parallel-out shift register 74F164

FEATURES

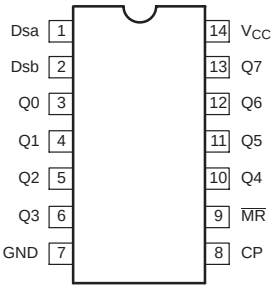
- Gated serial data inputs
- Typical shift frequency of 100MHz
- Asynchronous Master Reset
- Buffered clock and data inputs
- Fully synchronous data transfer
- Industrial temperature range available (–40 to +85 °C)

DESCRIPTION

The 74F164 is an 8-bit edge-triggered shift register with serial data entry and an output from each of the eight stages. Data is entered through one of two inputs (Dsa, Dsb); either input can be used as an active High enable for data entry through the other input. Both inputs must be connected together or an unused input must be tied High.

Data shifts one place to the right on each Low-to-High transition of the clock (CP) input, and enters into Q0 the logical AND of the two data inputs (Dsa, Dsb) that existed one setup time before the rising edge. A Low level on the Master Reset ($\overline{MR}$) input overrides all other inputs and clears the register asynchronously, forcing all outputs Low.

PIN CONFIGURATION



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TYPE	TYPICAL f_{max}	TYPICAL SUPPLY CURRENT (TOTAL)
74F164	100MHz	33 mA

ORDERING INFORMATION

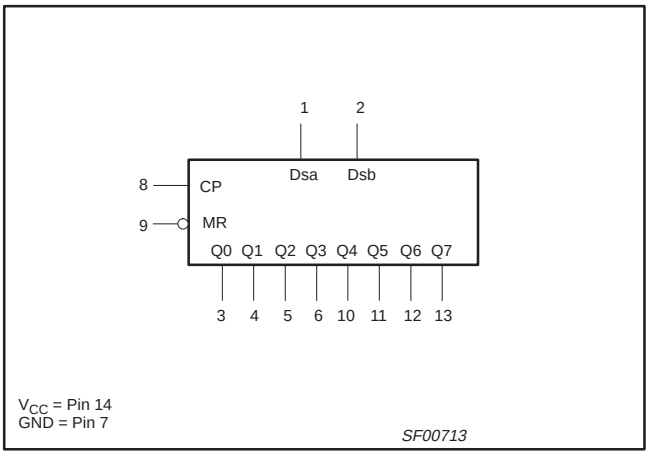
DESCRIPTION	ORDER CODE		DRAWING NUMBER
	COMMERCIAL RANGE V_{CC} = 5 V ±10%, T_{amb} = 0 to +70 °C	INDUSTRIAL RANGE V_{CC} = 5 V ±10%, T_{amb} = –40 to +85 °C	
14-pin plastic DIP	74F164N	I74F164N	SOT27-1
14-pin plastic SO	74F164D	I74F164D	SOT108-1

INPUT AND OUTPUT LOADING AND FAN OUT TABLE

PINS	DESCRIPTION	74F (U.L.) HIGH / LOW	LOAD VALUE HIGH / LOW
Dsa, Dsb	Data inputs	1.0 / 1.0	20 µA / 0.6 mA
CP	Clock pulse input (active rising edge)	1.0 / 1.0	20 µA / 0.6 mA
$\overline{MR}$	Master reset input (active-Low)	1.0 / 1.0	20 µA / 0.6 mA
Q0 – Q7	Data outputs	50 / 33	1.0 mA / 20 mA

One (1.0) FAST unit load is defined as: 20 µA in the High state and 0.6 mA in the Low state.

LOGIC SYMBOL



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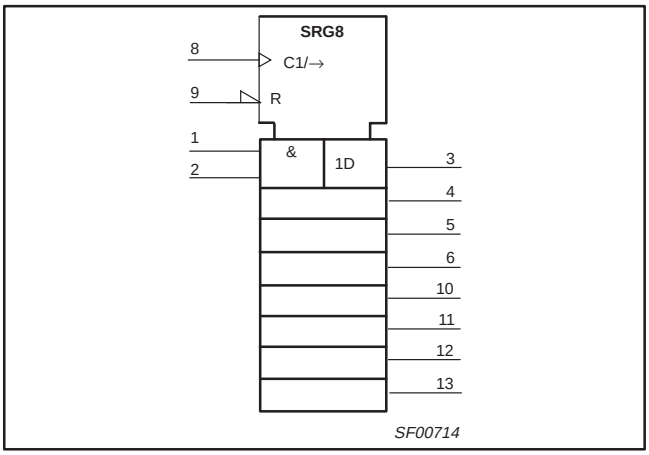
IEC/IEEE SYMBOL



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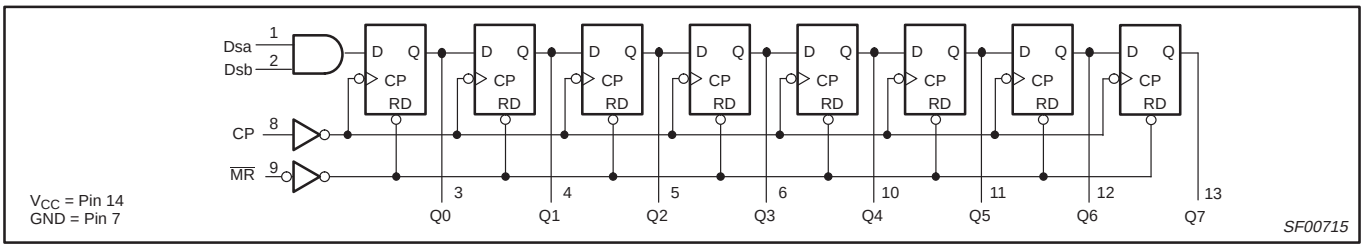
LOGIC DIAGRAM



FUNCTION TABLE

INPUTS				OUTPUTS								OPERATING MODE
$\overline{MR}$	CP	Dsa	Dsb	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7	
L	X	X	X	L	L	L	L	L	L	L	L	Reset (Clear)
H	↑	l	l	L	q0	q1	q2	q3	q4	q5	q6	Shift
H	↑	l	h	L	q0	q1	q2	q3	q4	q5	q6	
H	↑	h	l	L	q0	q1	q2	q3	q4	q5	q6	
H	↑	h	h	H	q0	q1	q2	q3	q4	q5	q6	

H = High voltage level
h = High voltage level one setup time prior to the Low-to-High clock transition.
L = Low voltage level
l = Low voltage level one setup time prior to the Low-to-High clock transition.
qn = Lower case letter indicate the state of the referenced output one setup time prior to the Low-to-High clock transition.
X = Don't care
↑ = Low-to-High clock transition

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		40	mA
T_{amb}	Operating free-air temperature range	Commercial Range	0 to +70	°C
		Industrial Range	–40 to +85	
T_{stg}	Storage temperature range		–65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER		LIMIT			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				–1	mA
I_{OL}	Low-level output current				20	mA
T_{amb}	Operating free-air temperature range	Commercial Range	0		+70	°C
		Industrial Range	–40		+85	

DC ELECTRICAL CHARACTERISTICS

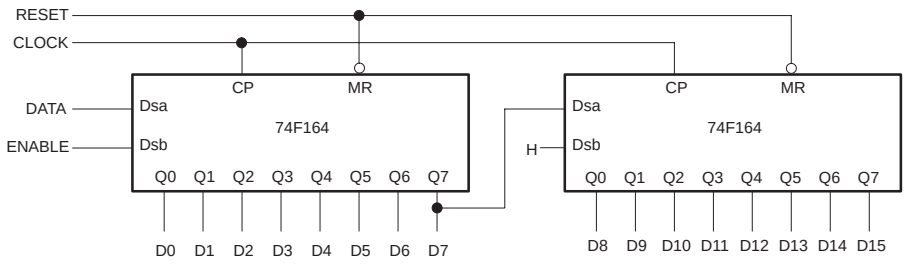
(Over recommended operating free-air temperature range unless otherwise noted.)

SYMBOL	PARAMETER	TEST CONDITIONS[1]		LIMITS			UNIT
				MIN	TYP[2]	MAX	
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IL} = MAX, V_{IH} = MIN, I_{OH} = MAX	±10%V_{CC}	2.5			V
			±5%V_{CC}	2.7	3.4		V
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IL} = MAX, V_{IH} = MIN, I_{OL}= MAX	±10%V_{CC}		0.30	0.50	V
			±5%V_{CC}		0.30	0.50	V
V_{IK}	Input clamp voltage	V_{CC} = MIN, I_I = I_{IK}			–0.73	–1.2	V
I_I	Input current at maximum input voltage	V_{CC} = MAX, V_I = 7.0 V				100	µA
I_{IH}	High-level input current	V_{CC} = MAX, V_I = 2.7 V				20	µA
I_{ILL}	Low-level input current	V_{CC} = MAX, V_I = 0.5 V				–0.6	mA
I_{OS}	Short-circuit output current [3]	V_{CC} = MAX		–60		–150	mA
I_{CC}	Supply current (total) [4]	V_{CC} = MAX			33	55	mA

Notes to DC electrical characteristics

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} = 5 V, T_{amb} = 25 °C.
3. Not more than one output should be shorted at a time. For testing I_{OS}, the use of high-speed test apparatus and/or sample-and-hold techniques are preferable in order to minimize internal heating and more accurately reflect operational values. Otherwise, prolonged shorting of a High output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter test, I_{OS} tests should be performed last.
4. Measure I_{CC} with the serial inputs grounded, the clock input at 2.4 V, and a momentary ground, then applied to Master Reset, and all outputs open.

APPLICATION



The 74F164 can be cascaded to form synchronous shift registers of longer length.
Here, two devices are combined to form a 16-bit shift register.

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AC ELECTRICAL CHARACTERISTICS

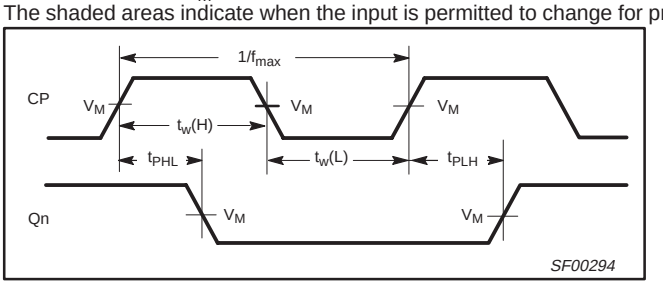
SYMBOL	PARAMETER	TEST CONDITION	LIMITS							UNIT
			T_{amb} = +25 °C V_{CC} = 5 V C_L = 50 pF R_L = 500 Ω			T_{amb} = 0 to +70 °C V_{CC} = +5 V±10% C_L = 50 pF R_L = 500 Ω		T_{amb} = –40 to +85 °C V_{CC} = +5 V±10% C_L = 50 pF R_L = 500 Ω		
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}	Maximum clock frequency	Waveform 1	80	100		80		80		MHz
t_{PLH} t_{PHL}	Propagation delay CP to Qn	Waveform 1	3.0 5.0	5.0 7.0	8.0 10.0	2.5 5.0	9.0 11.0	2.5 5.0	9.0 11.0	ns
t_{PHL}	Propagation delay $\overline{MR}$ to Qn	Waveform 3	5.5	7.5	10.5	5.5	11.5	5.5	11.5	ns

AC SETUP REQUIREMENTS

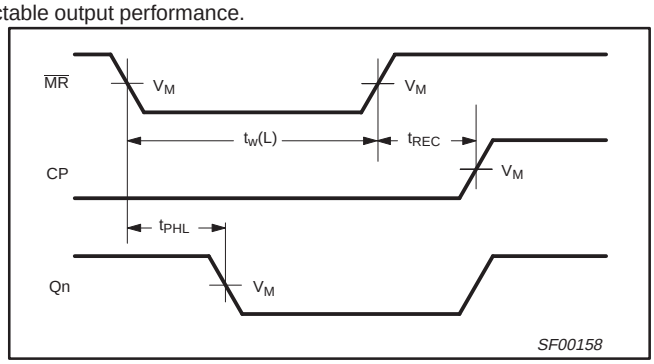
SYMBOL	PARAMETER	TEST CONDITION	LIMITS							UNIT
			T_{amb} = +25 °C V_{CC} = 5 V C_L = 50 pF R_L = 500 Ω			T_{amb} = 0 to +70 °C V_{CC} = +5 V±10% C_L = 50 pF R_L = 500 Ω		T_{amb} = –40 to +85 °C V_{CC} = +5 V±10% C_L = 50 pF R_L = 500 Ω		
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_s(H) t_S(L)	Setup time, High or Low D_n to CP	Waveform 2	7.0 7.0			7.0 7.0		7.0 7.0		ns
t_h(H) t_h(L)	Hold time, High or Low D_n to CP	Waveform 2	1.0 1.0			2.0 2.0		2.0 2.0		ns
t_w(H) t_w(L)	CP Pulse width High or Low	Waveform 1	4.0 7.0			4.0 7.0		4.0 7.0		ns
t_w(L)	$\overline{MR}$ Pulse wicth Low	Waveform 3	7.0			7.0		7.0		ns
t_{REC}	Recovery time $\overline{MR}$ to CP	Waveform 3	7.0			7.0		7.0		ns

AC WAVEFORMS

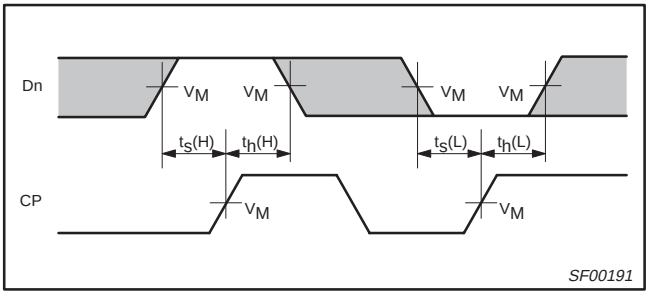
For all waveforms, V_M = 1.5 V.
The shaded areas indicate when the input is permitted to change for predictable output performance.



Waveform 1. Propagation delay for Clock input to output, Clock Pulse width, and maximum Clock frequency

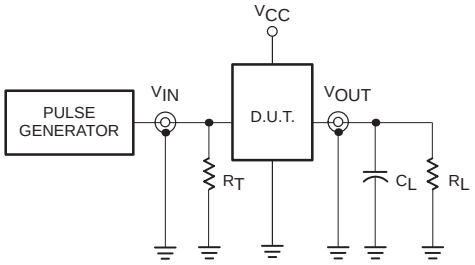


Waveform 3. Master Reset pulse width, Master Reset to output delay and Master Reset to Clock recovery time

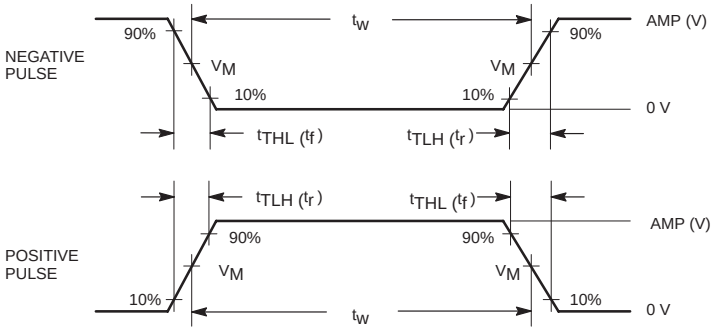


Waveform 2. Data setup and hold times

TEST CIRCUIT AND WAVEFORMS



Test Circuit for Totem-Pole Outputs



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.

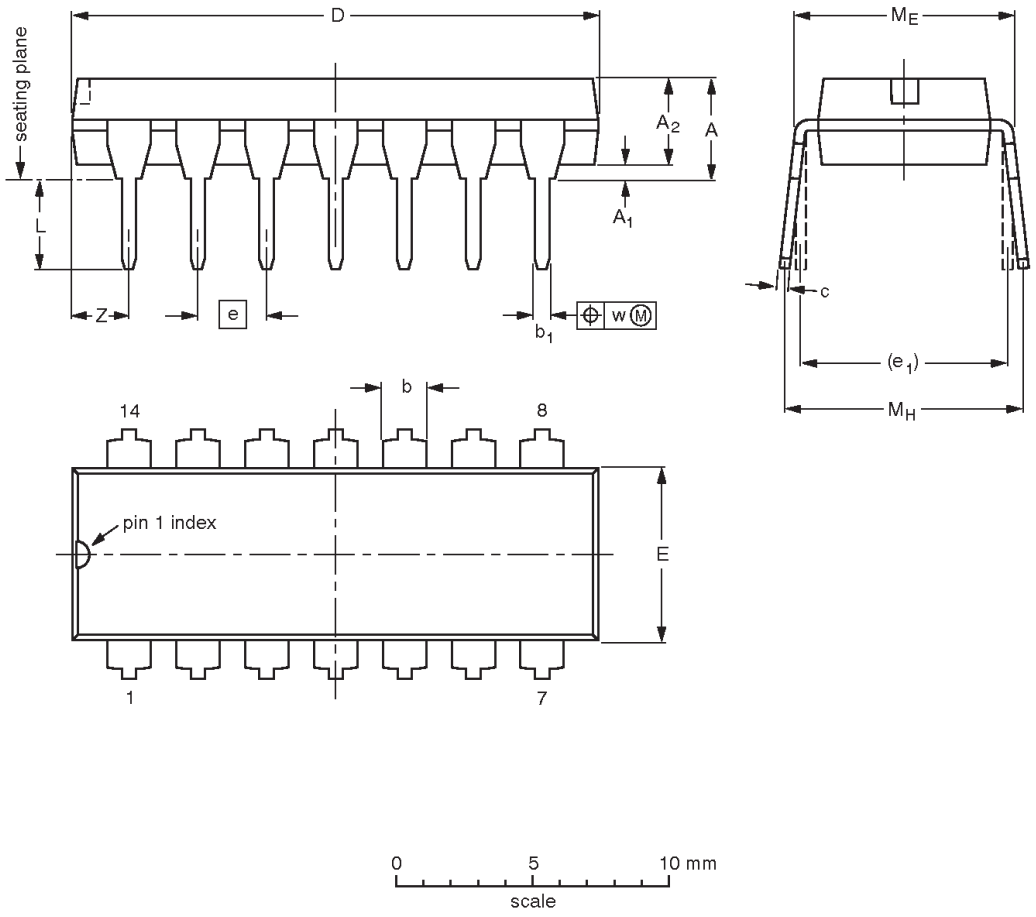
R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

Input Pulse Definition

family	INPUT PULSE REQUIREMENTS					
	amplitude	V_M	rep. rate	t_w	t_{TLH}	t_{THL}
74F	3.0 V	1.5 V	1 MHz	500 ns	2.5 ns	2.5 ns

SF00006

DIP14: plastic dual in-line package; 14 leads (300 mil) SOT27-1



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

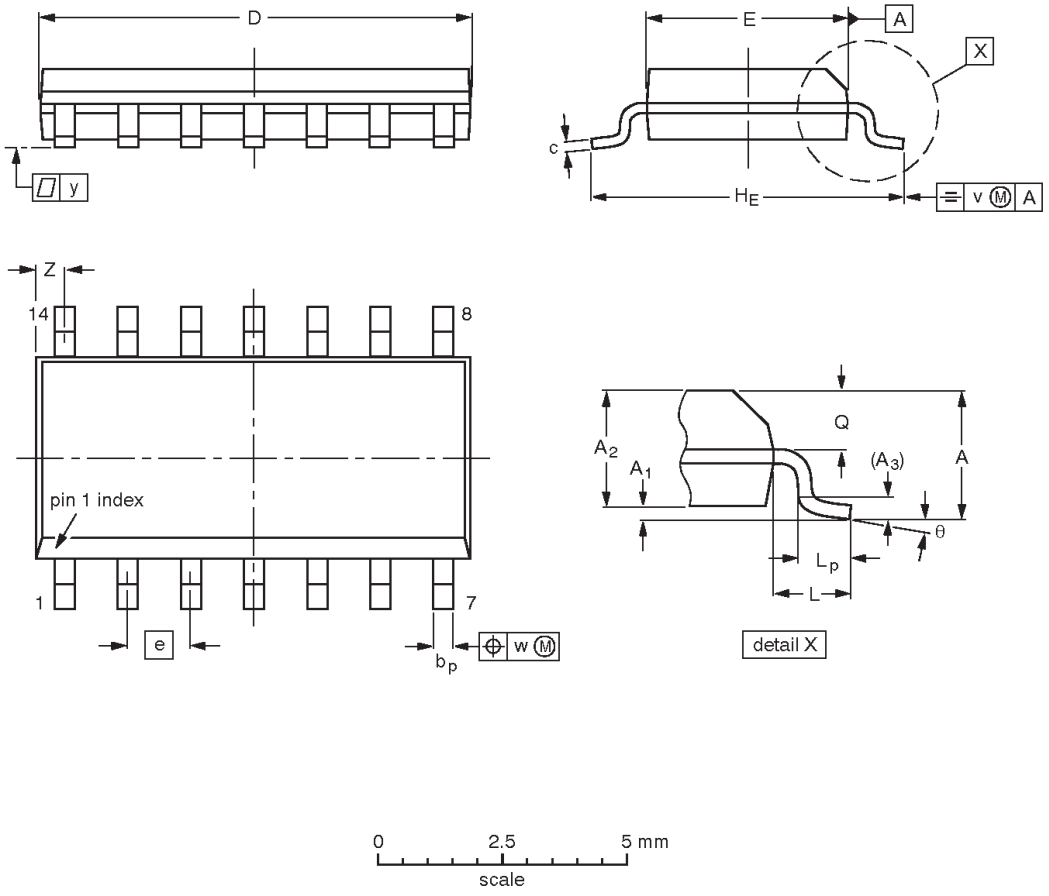
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.13	0.53 0.38	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.2
inches	0.17	0.020	0.13	0.068 0.044	0.021 0.015	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.087

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			
SOT27-1	050G04	MO-001	SC-501-14			~~95-03-11~~ 99-12-27

SO14: plastic small outline package; 14 leads; body width 3.9 mm **SOT108-1**



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	8.75 8.55	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^o 0^o
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.35 0.34	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	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			
SOT108-1	076E06	MS-012				~~97-05-22~~ 99-12-27

NOTES

Data sheet status

Data sheet status	Product status	Definition [1]
Objective specification	Development	This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.
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Product specification	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.

[1] Please consult the most recently issued datasheet before initiating or completing a design.

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