

# MC74HCT4094A

## 8-Bit Shift and Store Register with LSTTL Compatible Inputs

### High-Performance Silicon-Gate CMOS

The MC74HCT4094A is a high speed CMOS 8-bit serial shift and storage register. This device consists of an 8-bit shift register and latch with 3-state output buffers. Data is shifted on positive clock (CP) transitions. The data in the shift register is transferred to the storage register when the Strobe (STR) input is high. The output buffers are enabled when the Output Enable (OE) input is set high. Two serial outputs (QS<sub>1</sub>, QS<sub>2</sub>) are available for cascading multiple devices.

The MC74HCT4094A can be used to interface TTL or CMOS outputs to high speed CMOS inputs.

#### Features

- Wide Operating Voltage Range: 4.5 to 5.5 V
- Low Power Dissipation: I<sub>CC</sub> = < 10 μA
- In Compliance with the Requirements Defined by JEDEC Standard No. 7A
- These are Pb-Free Devices

#### Typical Applications

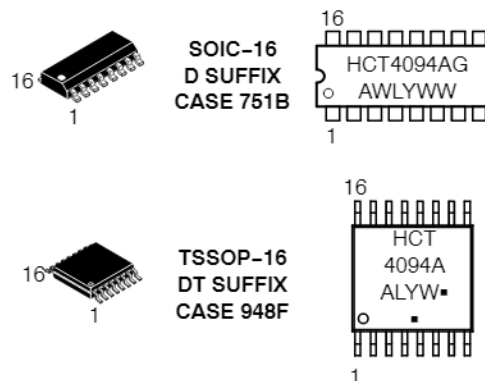
- Serial-to-Parallel Conversion
- Remote Control Storage Register



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#### MARKING DIAGRAMS



A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week  
G, ■ = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

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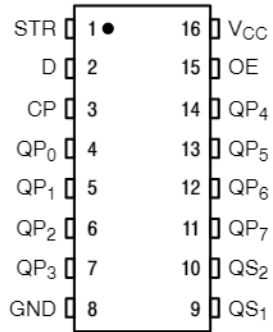


Figure 1. Pin Assignment

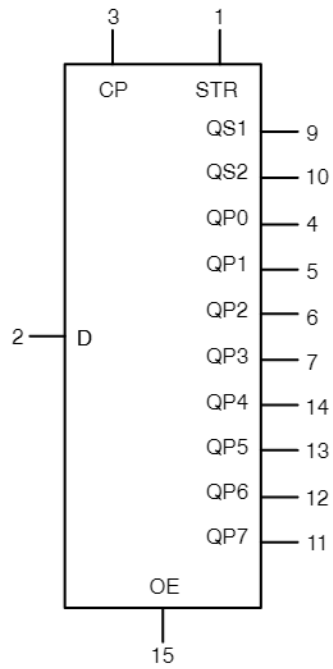


Figure 2. Logic Symbol

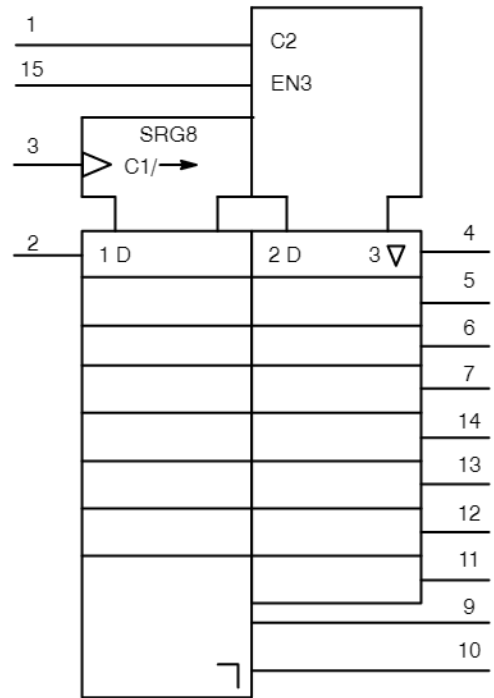


Figure 3. IEC Logic Symbol

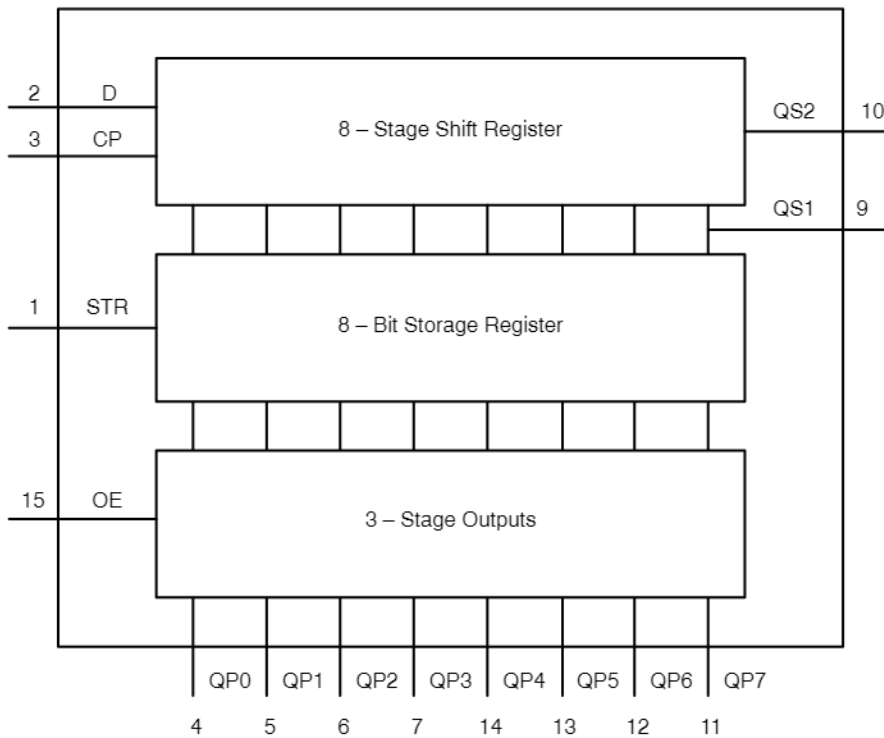


Figure 4. Functional Diagram

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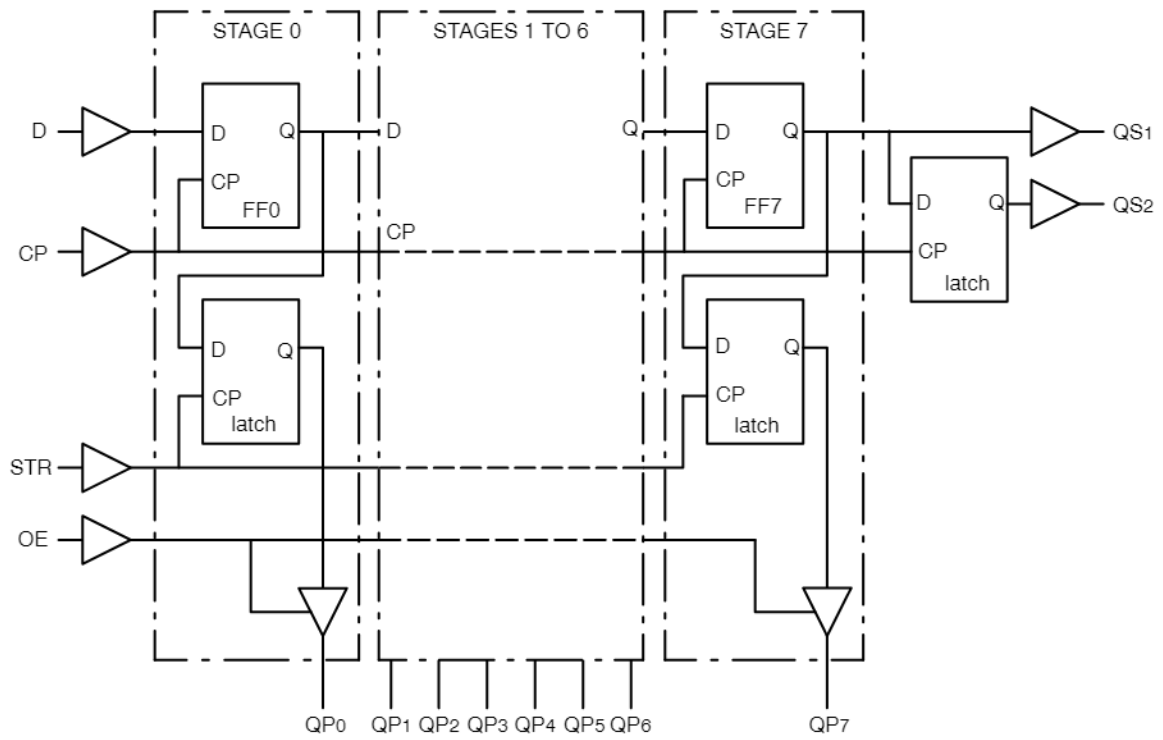


Figure 5. Logic Diagram

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## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CC}$	DC Supply Voltage (Referenced to GND)	- 0.5 to + 7.0	V
$V_{in}$	DC Input Voltage (Referenced to GND)	- 0.5 to $V_{CC} + 0.5$	V
$V_{out}$	DC Output Voltage (Referenced to GND)	- 0.5 to $V_{CC} + 0.5$	V
$I_{in}$	DC Input Current, per Pin	$\pm 20$	mA
$I_{out}$	DC Output Current, per Pin	$\pm 35$	mA
$I_{CC}$	DC Supply Current, $V_{CC}$ and GND Pins	$\pm 75$	mA
$P_D$	Power Dissipation in Still Air, SOIC Package† TSSOP Package†	500 450	mW
$T_{stg}$	Storage Temperature	- 65 to + 150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

†Derating – SOIC Package: - 7 mW/°C from 65° to 125°C  
TSSOP Package: - 6.1 mW/°C from 65° to 125°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$  should be constrained to the range  $GND \leq (V_{in} \text{ or } V_{out}) \leq V_{CC}$ . Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or  $V_{CC}$ ). Unused outputs must be left open.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	DC Supply Voltage (Referenced to GND)	4.5	5.5	V
$V_{in}, V_{out}$	DC Input Voltage, Output Voltage (Referenced to GND)	0	$V_{CC}$	V
$T_A$	Operating Temperature, All Package Types	-55	+125	°C
$t_r, t_f$	Input Rise and Fall Time (Figure 1)	0	500	ns

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## FUNCTIONAL TABLE

INPUTS				PARALLEL OUTPUTS		SERIAL OUTPUTS	
CP	OE	STR	D	QP0	QPn	QS1	QS2
↑	L	X	X	Z	Z	Q'6	NC
↓	L	X	X	Z	Z	NC	QP7
↑	H	L	X	NC	NC	Q'6	NC
↑	H	H	L	L	QPn-1	Q'6	NC
↑	H	H	H	H	QPn-1	Q'6	NC
↓	H	H	H	NC	NC	NC	QP7

### Notes

- H = HIGH voltage level  
 L = LOW voltage level  
 X = don't care  
 Z = high impedance OFF-state  
 NC = no change  
 ↑ = LOW-to-HIGH CP transition  
 ↓ = HIGH-to-LOW CP transition  
 Q'6 = the information in the seventh register stage is transferred to the 8th register stage and QSn output at the positive clock edge

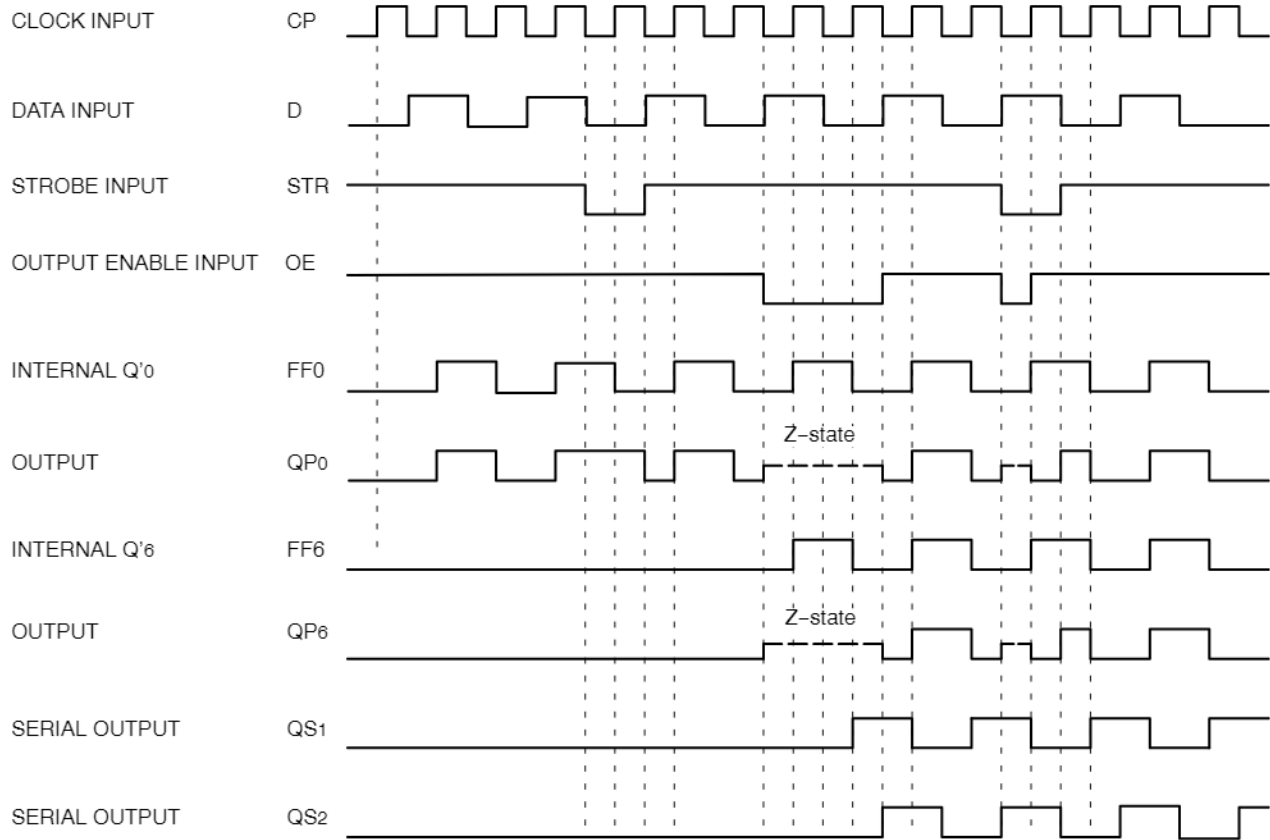


Figure 6. Timing Diagram

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## DC CHARACTERISTICS

Symbol	Parameter	Test Conditions	V <sub>CC</sub> (V)	Guaranteed Limits			Unit
				−55°C to 25°C	≤ 85°C	≤ 125°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> − 0.1 V I <sub>OUT</sub> ≤ 20 μA	4.5	2.0	2.0	2.0	V
			5.5	2.0	2.0	2.0	
V <sub>IL</sub>	Maximum Low-Level Input Voltage	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> − 0.1 V I <sub>OUT</sub> ≤ 20 μA	4.5	0.8	0.8	0.8	V
			5.5	0.8	0.8	0.8	
V <sub>OH</sub>	Minimum High-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OUT</sub> ≤ 20 μA	4.5	4.4	4.4	4.4	V
			5.5	5.4	5.4	5.4	
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , I <sub>OUT</sub> = 6 mA	4.5	4.25	4.2	4.1	
V <sub>OL</sub>	Maximum Low-Level Output Voltage	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , I <sub>OUT</sub> ≤ 20 μA	4.5	0.1	0.1	0.1	V
			5.5	0.1	0.1	0.1	
		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , I <sub>OUT</sub> = 6 mA	4.5	0.25	0.3	0.4	
I <sub>IN</sub>	Maximum Input Leakage Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5	±0.1	±1	±1	μA
I <sub>OZ</sub>	Maximum Tri-State Output Leakage Current	V <sub>IN</sub> = V <sub>CC</sub> or GND V <sub>OUT</sub> = V <sub>CC</sub> or GND	5.5	±0.5	±5	±10	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5	4.0	40	80	μA
ΔI <sub>CC</sub>	Additional Quiescent Supply Current	V <sub>in</sub> = 2.4V, Any One Input V <sub>in</sub> = V <sub>CC</sub> or GND, Other Inputs I <sub>out</sub> = 0μA	5.5	≥ −55°C	25 to 125°C		mA
				2.9	2.4		

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## AC CHARACTERISTICS ( $t_f = t_r = 6 \text{ ns}$ , $C_L = 50 \text{ pF}$ )

Symbol	Parameter	Test Conditions	V <sub>CC</sub> (V)	Guaranteed Limits			Unit
				-55°C to 25°C	≤ 85°C	≤ 125°C	
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay CP to QS <sub>1</sub>	Figure 7	4.5	30	38	45	ns
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay CP to QS <sub>2</sub>	Figure 7	4.5	27	34	41	ns
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay CP to QP <sub>n</sub>	Figure 7	4.5	39	49	59	ns
t <sub>PHL</sub> , t <sub>PLH</sub>	Maximum Propagation Delay STR to QP <sub>n</sub>	Figure 8	4.5	36	45	54	ns
t <sub>PZH</sub> , t <sub>PZL</sub>	Maximum 3-State Output Enable Time OE to QP <sub>n</sub>	Figure 9	4.5	35	44	53	ns
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Maximum 3-State Output Enable Time OE to QP <sub>n</sub>	Figure 9	4.5	25	31	38	ns
t <sub>THL</sub> , t <sub>TLH</sub>	Maximum Output Transition Time	Figure 7	4.5	18	22	25	ns
t <sub>w</sub>	Minimum Clock Pulse Width High or Low	Figure 7	4.5	16	20	24	ns
t <sub>w</sub>	Minimum Strobe Pulse Width High	Figure 8	4.5	16	20	24	ns
t <sub>SU</sub>	Minimum Set-up Time D to CP	Figure 10	4.5	10	13	15	ns
t <sub>SU</sub>	Minimum Set-up Time CP to STR	Figure 8	4.5	20	25	30	ns
t <sub>h</sub>	Minimum Hold Time D to CP	Figure 10	4.5	3	3	3	ns
t <sub>h</sub>	Minimum Hold Time CP to STR	Figure 8	4.5	0	0	0	ns
f <sub>MAX</sub>	Minimum Clock Pulse Frequency	Figure 7	4.5	30	24	20	MHz
C <sub>in</sub>	Maximum Input Capacitance		-	10	10	10	pF
C <sub>out</sub>	Maximum Output Capacitance		-	15	15	15	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Note 2)		-	140	140	140	pF

2. C<sub>PD</sub> is defined as the value of the IC's equivalent capacitance from which the operating current can be calculated from:  
 $I_{CC(\text{operating})} \approx C_{PD} \times V_{CC} \times f_{IN} \times N_{SW}$  where  $N_{SW}$  = total number of outputs switching and  $f_{IN}$  = switching frequency.

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## AC WAVEFORMS

( $V_M = 1.3\text{ V}$ )

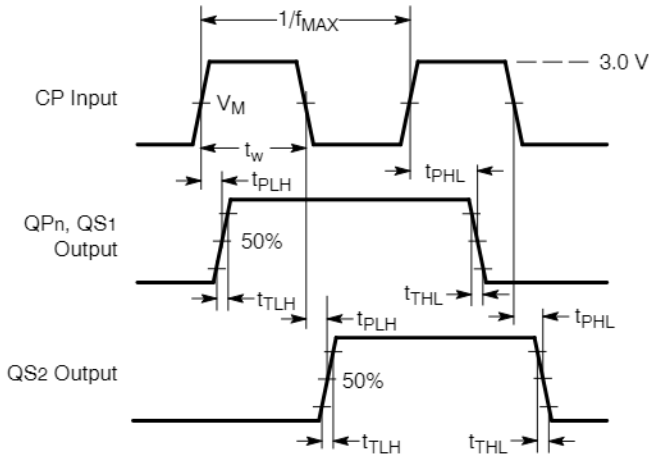


Figure 7. Waveforms showing the clock (CP) to output (QPn, QS1, QS2) propagation delays, the clock pulse width and the maximum clock frequency.

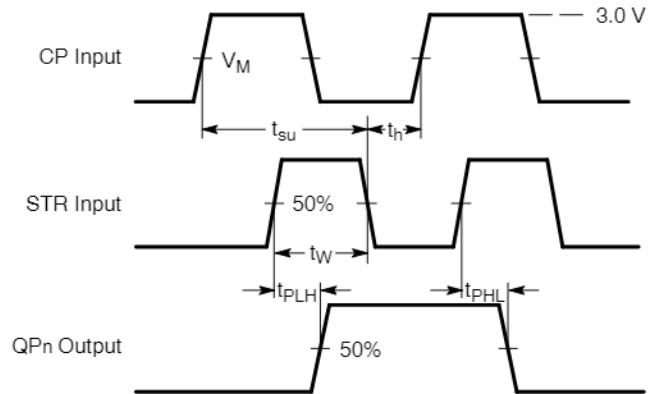


Figure 8. Waveforms showing the strobe (STR) to output (QPn) propagation delays, the strobe pulse width, the clock set-up and hold times for the strobe input.

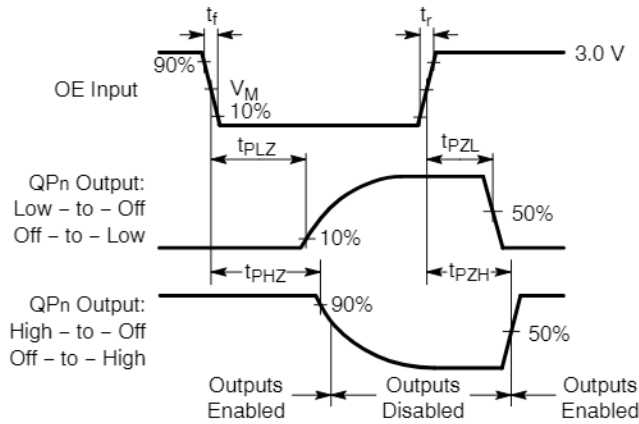
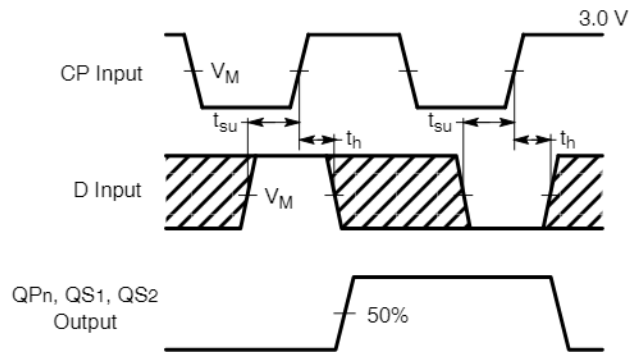


Figure 9. Waveforms showing the 3-state enable and disable times for input OE.



The shaded areas indicate when the input is permitted to change for predictable output performance.

Figure 10. Waveforms showing the data set-up and hold times for the data input.



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## TEST CIRCUITS

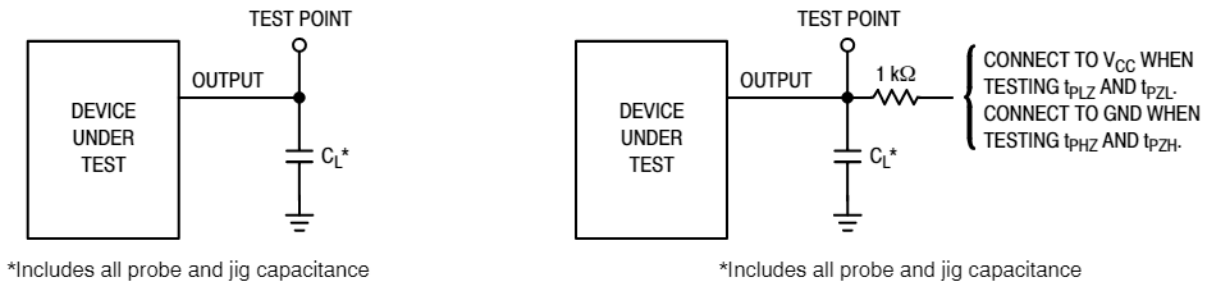


Figure 11. AC Characteristics Load Circuits

### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
MC74HCT4094ADG	SOIC-16 (Pb-Free)	48 Units / Rail
MC74HCT4094ADR2G	SOIC-16 (Pb-Free)	2500 Tape & Reel
MC74HCT4094ADT	TSSOP-16*	96 Units / Rail
MC74HCT4094ADTR2G	TSSOP-16*	2500 Tape & Reel

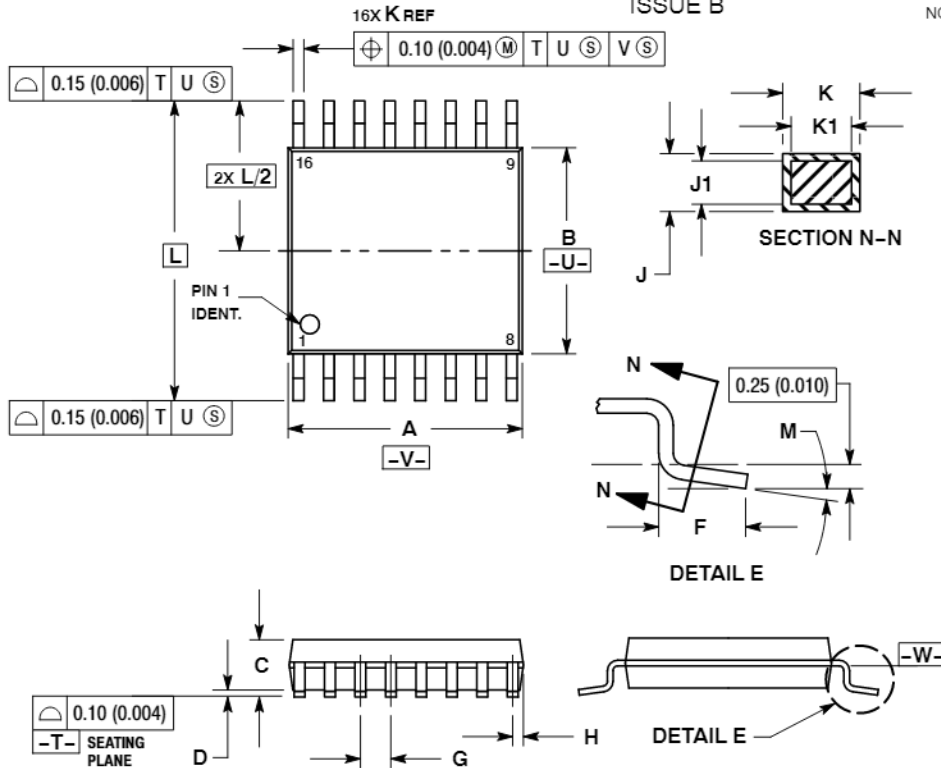
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*This package is inherently Pb-Free.

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## PACKAGE DIMENSIONS

TSSOP-16  
DT SUFFIX  
CASE 948F-01  
ISSUE B

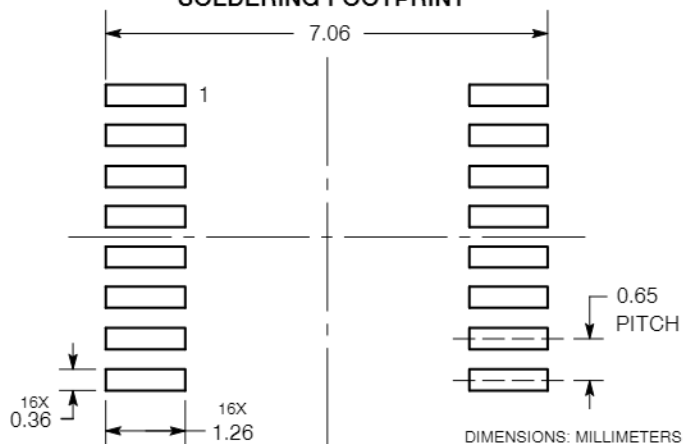


### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

### SOLDERING FOOTPRINT\*

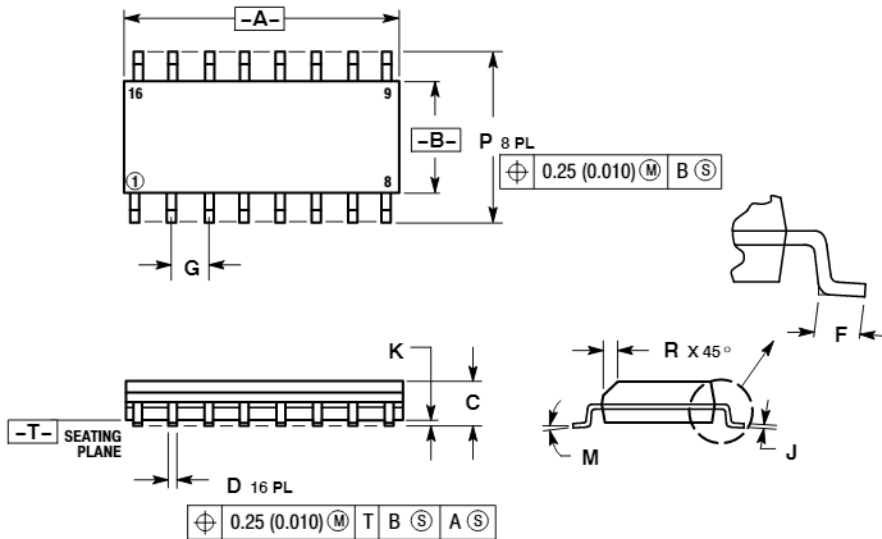


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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## PACKAGE DIMENSIONS

SOIC-16  
CASE 751B-05  
ISSUE K

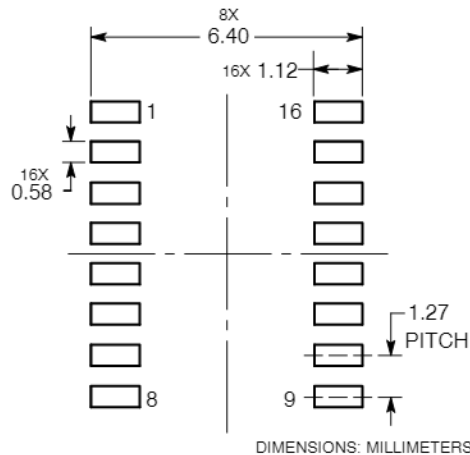


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2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

### SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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