

# 8-Bit Serial or Parallel-Input/Serial-Output Shift Register

High-Performance Silicon-Gate CMOS

## MC74HC165A, MC74HCT165A

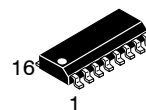
The MC74HC165A/MC74HCT165A is identical in pinout to the LS165. The MC74HC165A inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs. The MC74HCT165A may be used as a level converter for interfacing TTL or NMOS outputs to High-Speed CMOS inputs.

This device is an 8-bit shift register with complementary outputs from the last stage. Data may be loaded into the register either in parallel or in serial form. When the SERIAL SHIFT/PARALLEL LOAD input is low, the data is loaded asynchronously in parallel. When the SERIAL SHIFT/PARALLEL LOAD input is high, the data is loaded serially on the rising edge of either Clock or Clock Inhibit (see the Function Table).

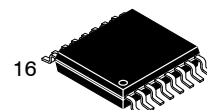
The 2-input NOR clock may be used either by combining two independent clock sources or by designating one of the clock inputs to act as a clock inhibit.

### Features

- Output Drive Capability: 10 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2.0 to 6.0 V (HC), 4.5 to 5.5 V (HCT)
- Low Input Current: 1  $\mu$ A
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance with the Requirements Defined by JEDEC Standard No. 7 A
- Chip Complexity: 286 FETs or 71.5 Equivalent Gates
- -Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant



SOIC-16  
D SUFFIX  
CASE 751B

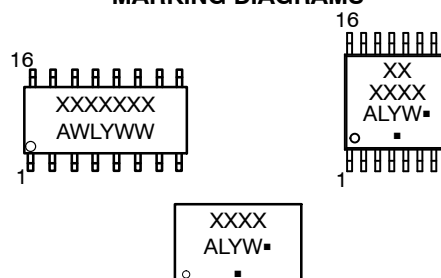


TSSOP-16  
DT SUFFIX  
CASE 948F



QFN16  
MN SUFFIX  
CASE 485AW

### MARKING DIAGRAMS



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

(Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering and shipping information on page 11 of this data sheet.

# MC74HC165A, MC74HCT165A

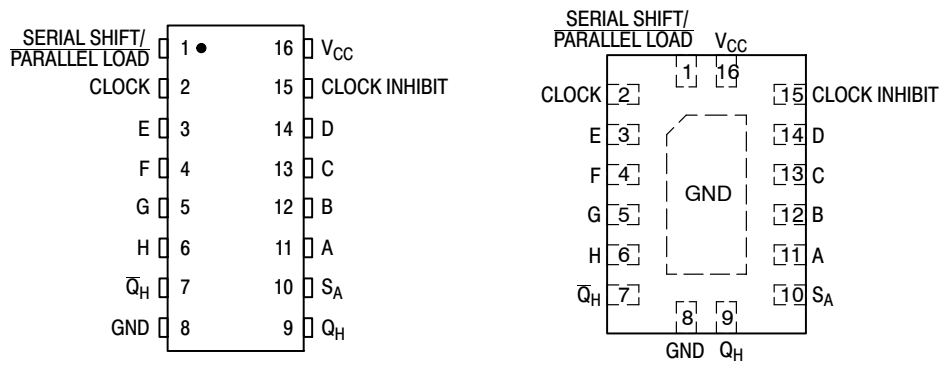


Figure 1. Pin Assignments

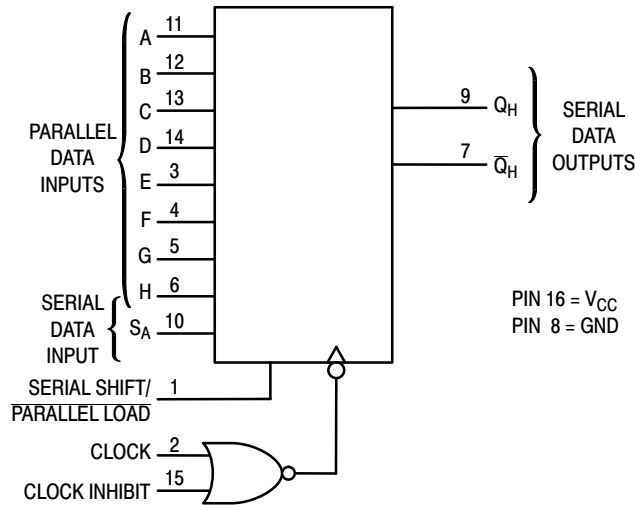


Figure 2. Logic Diagram

## FUNCTION TABLE

Inputs					Internal Stages		Output	Operation
Serial Shift/ Parallel Load	Clock	Clock Inhibit	SA	A – H	QA	QB	QH	
L	X	X	X	a ... h	a	b	h	Asynchronous Parallel Load
H	↗	L	L	X	L	QAn	QGn	Serial Shift via Clock
H	↗	L	H	X	H	QAn	QGn	
H	L	↗	L	X	L	QAn	QGn	Serial Shift via Clock Inhibit
H	L	↗	H	X	H	QAn	QGn	
H	X	H	X	X	No Change			Inhibited Clock
H	H	X	X	X	No Change			No Clock

X = don't care

QAn – QGn = Data shifted from the preceding stage

# MC74HC165A, MC74HCT165A

## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	DC Supply Voltage	−0.5 to +6.5	V
V <sub>IN</sub>	DC Input Voltage	−0.5 to V <sub>CC</sub> + 0.5	V
V <sub>OUT</sub>	DC Output Voltage	−0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IN</sub>	DC Input Current, per Pin	±20	mA
I <sub>OUT</sub>	DC Output Current, per Pin	±25	mA
I <sub>CC</sub>	DC Supply Current, V <sub>CC</sub> and GND Pins	±50	mA
I <sub>IK</sub>	Input Clamp Current (V <sub>IN</sub> < 0 or V <sub>IN</sub> > V <sub>CC</sub> )	±20	mA
I <sub>OK</sub>	Output Clamp Current (V <sub>OUT</sub> < 0 or V <sub>OUT</sub> > V <sub>CC</sub> )	±20	mA
T <sub>STG</sub>	Storage Temperature	−65 to +150	°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C
T <sub>J</sub>	Junction Temperature Under Bias	±150	°C
θ <sub>JA</sub>	Thermal Resistance (Note 1) <div>SOIC−16 QFN16 TSSOP−16</div>	126 118 159	°C/W
P <sub>D</sub>	Power Dissipation in Still Air at 25°C <div>SOIC−16 QFN16 TSSOP−16</div>	995 1062 787	mW
MSL	Moisture Sensitivity	Level 1	–
F <sub>R</sub>	Flammability Rating <div>Oxygen Index: 28 to 34</div>	UL 94 V−0 @ 0.125 in	–
V <sub>ESD</sub>	ESD Withstand Voltage (Note 2) <div>Human Body Model Charged Device Model</div>	2000 N/A	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Measured with minimum pad spacing on an FR4 board, using 76 mm-by-114 mm, 2-ounce copper trace no air flow per JESD51-7.
2. HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
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### MC74HC

$V_{CC}$	DC Supply Voltage	2.0	6.0	V
$V_{IN}, V_{OUT}$	DC Input, Output Voltage (Note 3)	0	$V_{CC}$	V
$T_A$	Operating Free-Air Temperature	-55	+125	°C
$t_r, t_f$	Input Rise or Fall Time	$V_{CC} = 2.0$ V $V_{CC} = 3.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	0 1000 600 500 400	ns

### MC74HCT

$V_{CC}$	DC Supply Voltage	4.5	5.5	V
$V_{IN}, V_{OUT}$	DC Input, Output Voltage (Note 3)	0	$V_{CC}$	V
$T_A$	Operating Free-Air Temperature	-55	+125	°C
$t_r, t_f$	Input Rise or Fall Time	0	500	ns

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

3. 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.

# MC74HC165A, MC74HCT165A

## DC ELECTRICAL CHARACTERISTICS (MC74HC165A)

Symbol	Parameter	Test Conditions	V <sub>CC</sub> V	Guaranteed Limit			Unit
				-55 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	2.0 3.0 4.5 6.0	1.5 2.1 3.15 4.2	1.5 2.1 3.15 4.2	1.5 2.1 3.15 4.2	V
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	2.0 3.0 4.5 6.0	0.5 0.9 1.35 1.80	0.5 0.9 1.35 1.80	0.5 0.9 1.35 1.80	V
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	2.0 4.5 6.0	1.9 4.4 5.9	1.9 4.4 5.9	1.9 4.4 5.9	V
		V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 2.4 mA  I <sub>out</sub>   ≤ 4.0 mA  I <sub>out</sub>   ≤ 5.2 mA	3.0 4.5 6.0	2.48 3.98 5.48	2.34 3.84 5.34	2.20 3.70 5.20	V
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	2.0 4.5 6.0	0.1 0.1 0.1	0.1 0.1 0.1	0.1 0.1 0.1	V
		V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 2.4 mA  I <sub>out</sub>   ≤ 4.0 mA  I <sub>out</sub>   ≤ 5.2 mA	3.0 4.5 6.0	0.26 0.26 0.26	0.33 0.33 0.33	0.40 0.40 0.40	V
I <sub>in</sub>	Maximum Input Leakage Current	V <sub>in</sub> = V <sub>CC</sub> or GND	6.0	±0.1	±1.0	±1.0	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current (per Package)	V <sub>in</sub> = V <sub>CC</sub> or GND I <sub>out</sub> = 0 μA	6.0	4	40	160	μA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## AC ELECTRICAL CHARACTERISTICS (MC74HC165A)

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit
			-55 to 25°C	≤ 85°C	≤ 125°C	
f <sub>max</sub>	Maximum Clock Frequency (50% Duty Cycle) (Figures 3 and 4)	2.0 3.0 4.5 6.0	6 18 30 35	4.8 17 24 28	4 15 20 24	MHz
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Clock (or Clock Inhibit) to Q <sub>H</sub> or $\overline{Q}_H$ (Figures 3 and 4)	2.0 3.0 4.5 6.0	150 52 30 26	190 63 38 33	225 65 45 38	ns
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Serial Shift/Parallel Load to Q <sub>H</sub> or $\overline{Q}_H$ (Figures 3 and 5)	2.0 3.0 4.5 6.0	175 58 35 30	220 70 44 37	265 72 53 45	ns
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Input H to Q <sub>H</sub> or $\overline{Q}_H$ (Figures 3 and 6)	2.0 3.0 4.5 6.0	150 52 30 26	190 63 38 33	225 65 45 38	ns
t <sub>TLH</sub> , t <sub>THL</sub>	Maximum Output Transition Time, Any Output (Figures 3 and 4)	2.0 3.0 4.5 6.0	75 27 15 13	95 32 19 16	110 36 22 19	ns
C <sub>in</sub>	Maximum Input Capacitance	–	10	10	10	pF

C <sub>PD</sub>	Power Dissipation Capacitance (Per Package)*	Typical @ 25°C, V <sub>CC</sub> = 5.0 V	pF
		40	

\*Used to determine the no-load dynamic power consumption:  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ .

# MC74HC165A, MC74HCT165A

## TIMING REQUIREMENTS (MC74HC165A)

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit
			−55 to 25°C	≤ 85°C	≤ 125°C	
t <sub>su</sub>	Minimum Setup Time, Parallel Data Inputs to Serial Shift/Parallel Load (Figure 7)	2.0	75	95	110	ns
		3.0	30	40	55	
		4.5	15	19	22	
		6.0	13	16	19	
t <sub>su</sub>	Minimum Setup Time, Input S <sub>A</sub> to Clock (or Clock Inhibit) (Figure 8)	2.0	75	95	110	ns
		3.0	30	40	55	
		4.5	15	19	22	
		6.0	13	16	19	
t <sub>su</sub>	Minimum Setup Time, Serial Shift/Parallel Load to Clock (or Clock Inhibit) (Figure 9)	2.0	75	95	110	ns
		3.0	30	40	55	
		4.5	15	19	22	
		6.0	13	16	19	
t <sub>su</sub>	Minimum Setup Time, Clock to Clock Inhibit (Figure 10)	2.0	75	95	110	ns
		3.0	30	40	55	
		4.5	15	19	22	
		6.0	13	16	19	
t <sub>h</sub>	Minimum Hold Time, Serial Shift/Parallel Load to Parallel Data Inputs (Figure 7)	2.0	5	5	5	ns
		3.0	5	5	5	
		4.5	5	5	5	
		6.0	5	5	5	
t <sub>h</sub>	Minimum Hold Time, Clock (or Clock Inhibit) to Input S <sub>A</sub> (Figure 8)	2.0	5	5	5	ns
		3.0	5	5	5	
		4.5	5	5	5	
		6.0	5	5	5	
t <sub>h</sub>	Minimum Hold Time, Clock (or Clock Inhibit) to Serial Shift/Parallel Load (Figure 9)	2.0	5	5	5	ns
		3.0	5	5	5	
		4.5	5	5	5	
		6.0	5	5	5	
t <sub>rec</sub>	Minimum Recovery Time, Clock to Clock Inhibit (Figure 10)	2.0	75	95	110	ns
		3.0	30	40	55	
		4.5	15	19	22	
		6.0	13	16	19	
t <sub>w</sub>	Minimum Pulse Width, Clock (or Clock Inhibit) (Figure 4)	2.0	70	90	100	ns
		3.0	27	32	36	
		4.5	15	19	22	
		6.0	13	16	19	
t <sub>w</sub>	Minimum Pulse width, Serial Shift/Parallel Load (Figure 5)	2.0	70	90	100	ns
		3.0	27	32	36	
		4.5	15	19	22	
		6.0	13	16	19	
t <sub>r</sub> , t <sub>f</sub>	Maximum Input Rise and Fall Times (Figure 4)	2.0	1000	1000	1000	ns
		3.0	800	800	800	
		4.5	500	500	500	
		6.0	400	400	400	

# MC74HC165A, MC74HCT165A

## DC ELECTRICAL CHARACTERISTICS (MC74HCT165A)

Symbol	Parameter	Test Conditions	V <sub>CC</sub> V	Guaranteed Limit			Unit
				-55 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 5.5	2.0 2.0	2.0 2.0	2.0 2.0	V
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 5.5	0.8 0.8	0.8 0.8	0.8 0.8	V
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 5.5	4.4 5.4	4.4 5.4	4.4 5.4	V
		V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 4.0 mA	4.5	3.98	3.84	3.7	
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 5.5	0.1 0.1	0.1 0.1	0.1 0.1	V
		V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 4.0 mA	4.5	0.26	0.33	0.4	
I <sub>in</sub>	Maximum Input Leakage Current	V <sub>in</sub> = V <sub>CC</sub> or GND	5.5	±0.1	±1.0	±1.0	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current (per Package)	V <sub>in</sub> = V <sub>CC</sub> or GND I <sub>out</sub> = 0 μA	5.5	4.0	40	160	μA

ΔI <sub>CC</sub>	Additional Quiescent Supply Current	V <sub>in</sub> = 2.4 V, Any One Input V <sub>in</sub> = V <sub>CC</sub> or GND, Other Inputs I <sub>out</sub> = 0 μA	5.5	≥-55°C	25°C to 125°C	mA
				2.9	2.4	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## AC ELECTRICAL CHARACTERISTICS (MC74HCT165A)

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit
			-55 to 25°C	≤85°C	≤125°C	
f <sub>max</sub>	Maximum Clock Frequency (50% Duty Cycle) (Figures 3 and 4)	4.5 5.5	30 35	24 28	20 24	MHz
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Clock (or Clock Inhibit) to Q <sub>H</sub> or $\bar{Q}_H$ (Figures 3 and 4)	4.5 5.5	30 26	38 33	45 38	ns
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Serial Shift/Parallel Load to Q <sub>H</sub> or $\bar{Q}_H$ (Figures 3 and 5)	4.5 5.5	35 30	44 37	53 45	ns
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Input H to Q <sub>H</sub> or $\bar{Q}_H$ (Figures 3 and 6)	4.5 5.5	30 26	38 33	45 38	ns
t <sub>TLH</sub> , t <sub>THL</sub>	Maximum Output Transition Time, Any Output (Figures 3 and 4)	4.5 5.5	15 13	19 16	22 19	ns
C <sub>in</sub>	Maximum Input Capacitance	—	10	10	10	pF

C <sub>PD</sub>	Power Dissipation Capacitance (Per Package)*	Typical @ 25°C, V <sub>CC</sub> = 5.0 V	pF
		40	

\*Used to determine the no-load dynamic power consumption: P<sub>D</sub> = C<sub>PD</sub> V<sub>CC</sub><sup>2</sup>f + I<sub>CC</sub> V<sub>CC</sub>.

# MC74HC165A, MC74HCT165A

## TIMING REQUIREMENTS (MC74HCT165A)

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit
			–55 to 25°C	≤ 85°C	≤ 125°C	
t <sub>su</sub>	Minimum Setup Time, Parallel Data Inputs to Serial Shift/Parallel Load (Figure 7)	4.5 5.5	15 13	19 16	22 19	ns
t <sub>su</sub>	Minimum Setup Time, Input S <sub>A</sub> to Clock (or Clock Inhibit) (Figure 8)	4.5 5.5	15 13	19 16	22 19	ns
t <sub>su</sub>	Minimum Setup Time, Serial Shift/Parallel Load to Clock (or Clock Inhibit) (Figure 9)	4.5 5.5	15 13	19 16	22 19	ns
t <sub>su</sub>	Minimum Setup Time, Clock to Clock Inhibit (Figure 10)	4.5 5.5	15 13	19 16	22 19	ns
t <sub>h</sub>	Minimum Hold Time, Serial Shift/Parallel Load to Parallel Data Inputs (Figure 7)	4.5 5.5	5 5	5 5	5 5	ns
t <sub>h</sub>	Minimum Hold Time, Clock (or Clock Inhibit) to Input S <sub>A</sub> (Figure 8)	4.5 5.5	5 5	5 5	5 5	ns
t <sub>h</sub>	Minimum Hold Time, Clock (or Clock Inhibit) to Serial Shift/Parallel Load (Figure 9)	4.5 5.5	5 5	5 5	5 5	ns
t <sub>rec</sub>	Minimum Recovery Time, Clock to Clock Inhibit (Figure 10)	4.5 5.5	15 13	19 16	22 19	ns
t <sub>w</sub>	Minimum Pulse Width, Clock (or Clock Inhibit) (Figure 4)	4.5 5.5	15 13	19 16	22 19	ns
t <sub>w</sub>	Minimum Pulse width, Serial Shift/Parallel Load (Figure 5)	4.5 5.5	15 13	19 16	22 19	ns
t <sub>r</sub> , t <sub>f</sub>	Maximum Input Rise and Fall Times (Figure 4)	4.5 5.5	500 400	500 400	500 400	ns

# MC74HC165A, MC74HCT165A

## SWITCHING WAVEFORMS

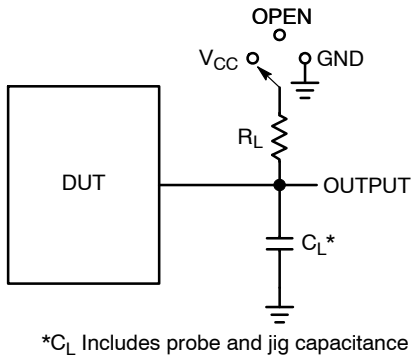


Figure 3. Test Circuit

Test	Switch Position	C <sub>L</sub>	R <sub>L</sub>
t <sub>PLH</sub> / t <sub>PHL</sub>	Open	50 pF	1 kΩ
t <sub>PLZ</sub> / t <sub>PZL</sub>	V <sub>CC</sub>		
t <sub>PHZ</sub> / t <sub>PZH</sub>	GND		

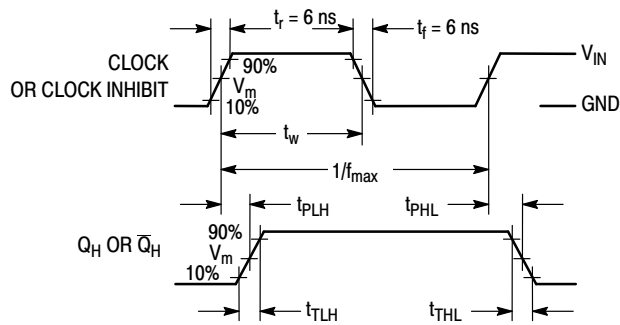


Figure 4. Serial-Shift Mode

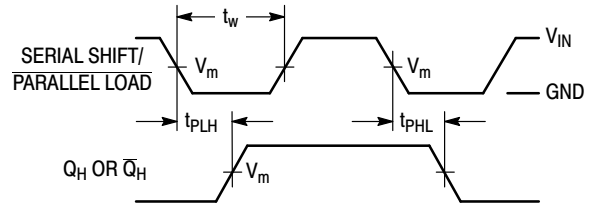


Figure 5. Parallel-Load Mode

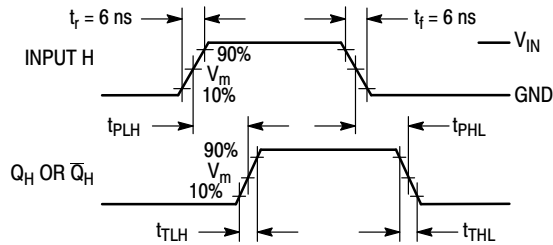


Figure 6. Parallel-Load Mode

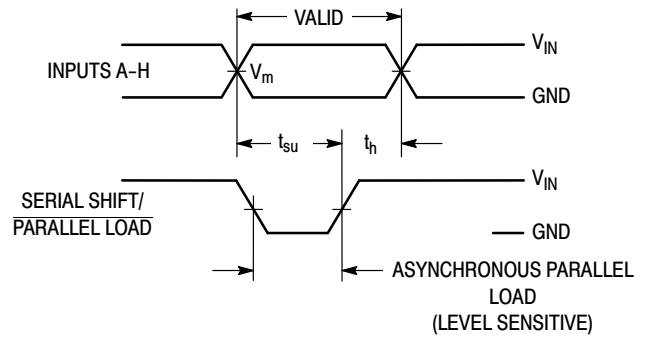


Figure 7. Parallel-Load Mode



# MC74HC165A, MC74HCT165A

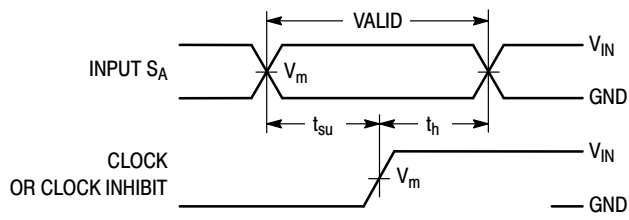


Figure 8. Serial-Shift Mode

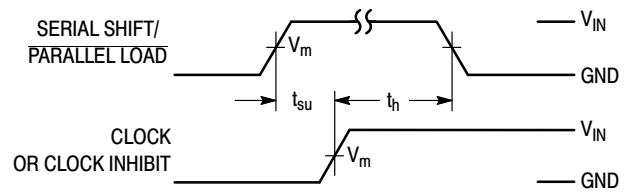


Figure 9. Serial-Shift Mode

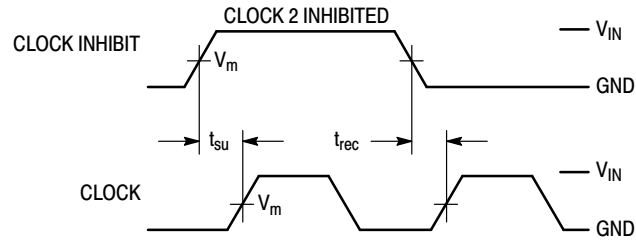


Figure 10. Serial-Shift, Clock-Inhibit Mode

## PIN DESCRIPTIONS

### INPUTS

#### A, B, C, D, E, F, G, H (Pins 11, 12, 13, 14, 3, 4, 5, 6)

Parallel Data inputs. Data on these inputs are asynchronously entered in parallel into the internal flip-flops when the Serial Shift/Parallel Load input is low.

#### SA (Pin 10)

Serial Data input. When the Serial Shift/Parallel Load input is high, data on this pin is serially entered into the first stage of the shift register with the rising edge of the Clock.

### CONTROL INPUTS

#### Serial Shift/Parallel Load (Pin 1)

Data-entry control input. When a high level is applied to this pin, data at the Serial Data input ( $S_A$ ) are shifted into the register with the rising edge of the Clock. When a low level

is applied to this pin, data at the Parallel Data inputs are asynchronously loaded into each of the eight internal stages.

#### Clock, Clock Inhibit (Pins 2, 15)

Clock inputs. These two clock inputs function identically. Either may be used as an active-high clock inhibit. However, to avoid double clocking, the inhibit input should go high only while the clock input is high.

The shift register is completely static, allowing Clock rates down to DC in a continuous or intermittent mode.

### OUTPUTS

#### $Q_H$ , $\bar{Q}_H$ (Pins 9, 7)

Complementary Shift Register outputs. These pins are the noninverted and inverted outputs of the eighth stage of the shift register.

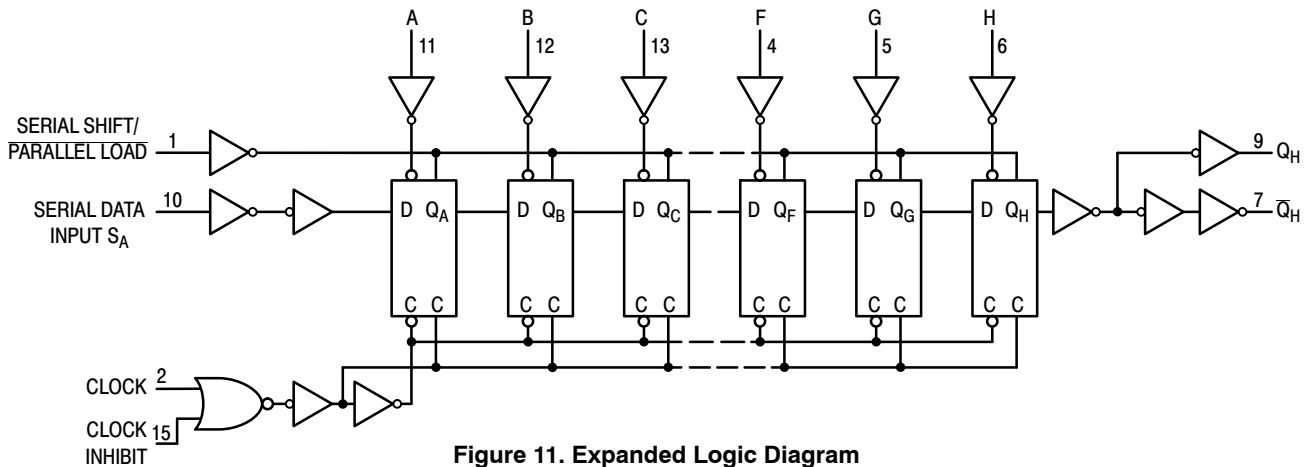


Figure 11. Expanded Logic Diagram

## MC74HC165A, MC74HCT165A

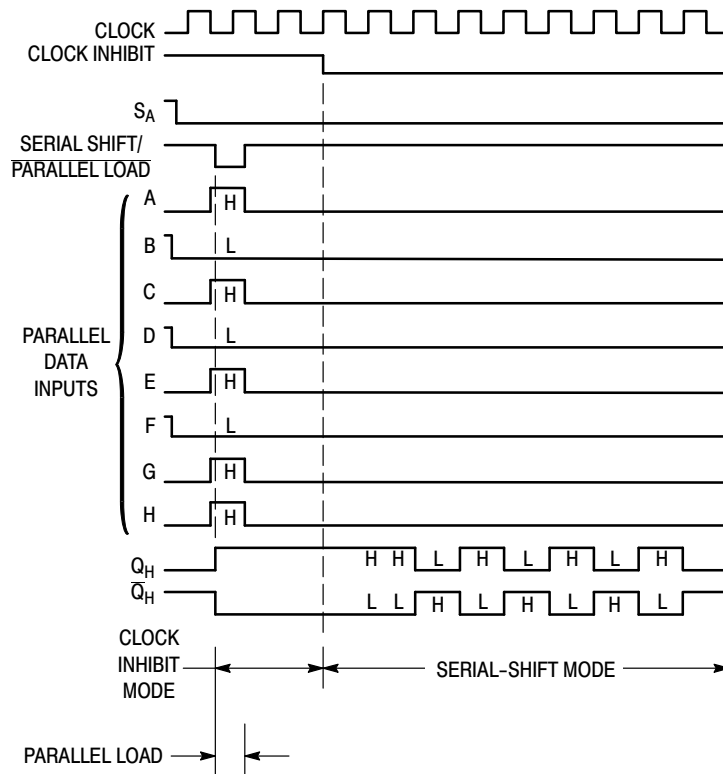


Figure 12. Timing Diagram

### ORDERING INFORMATION

Device	Marking	Package	Shipping <sup>†</sup>
MC74HC165ADG	HC165AG	SOIC-16	48 Units / Rail
MC74HC165ADR2G	HC165AG	SOIC-16	2500 / Tape & Reel
MC74HC165AD2G-Q*	HC165AG	SOIC-16	2500 / Tape & Reel
MC74HC165ADTR2G	HC 165A	TSSOP-16	2500 / Tape & Reel
MC74HC165ADTR2G-Q*	HC 165A	TSSOP-16	2500 / Tape & Reel
MC74HC165AMNTWG	165A	QFN16	3000 / Tape & Reel
MC74HC165AMN2TWG	165A	QFN16	3000 / 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.

\*-Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

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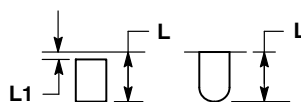
**QFN16, 2.5x3.5, 0.5P**  
CASE 485AW  
ISSUE 0

**Figure 1: Mechanical Drawing of a Rectangular Component**

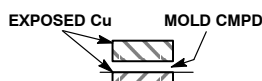
**Top View:** Shows a rectangular component with dimensions  $D$  (width) and  $E$  (height). A shaded area is labeled "PIN ONE REFERENCE". The component is made of material  $2X$  with a thickness of  $0.15$  and a tolerance of  $C$ .

**Side View:** Shows the component's profile with dimensions  $A$  (total height),  $A_1$  (height of the base), and  $A_3$  (height of the top flange). The component is made of material  $16X$  with a thickness of  $0.08$  and a tolerance of  $C$ . A detail callout "DETAIL B" points to a small feature. The base is labeled "SEATING PLANE".

**Bottom View:** Shows the component's base with dimensions  $D_2$  (width),  $K$  (distance from center to side flange),  $E_2$  (height), and  $15$  (distance from center to bottom flange). The component is made of material  $16X$  with a thickness of  $0.10$  and a tolerance of  $C$ . A detail callout "DETAIL A" points to a small feature. The base is labeled "SEATING PLANE".



**DETAIL A**  
**ALTERNATE TERMINAL**  
**CONSTRUCTIONS**

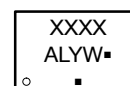


**DETAIL B**  
**ALTERNATE**  
**CONSTRUCTIONS**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

DIM	MILLIMETERS	
	MIN	MAX
A	0.80	1.00
A1	0.00	0.05
A3	0.20 REF	
b	0.20	0.30
D	2.50 BSC	
D2	0.85	1.15
E	3.50 BSC	
E2	1.85	2.15
e	0.50 BSC	
L	0.20	---
L	0.35	0.45
L1	---	0.15

### GENERIC MARKING DIAGRAM\*

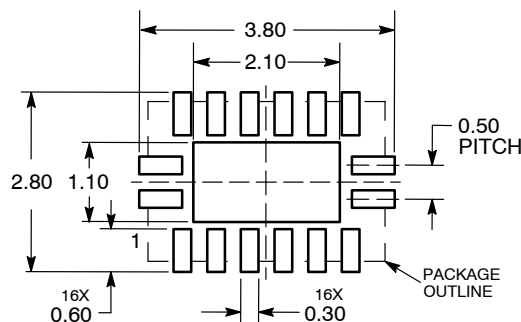


XXXX = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

### RECOMMENDED SOLDERING FOOTPRINT\*



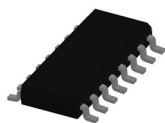
DIMENSIONS: MILLIMETERS

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

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<b>DESCRIPTION:</b>	<b>QFN16, 2.5X3.5, 0.5P</b>	<b>PAGE 1 OF 1</b>

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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

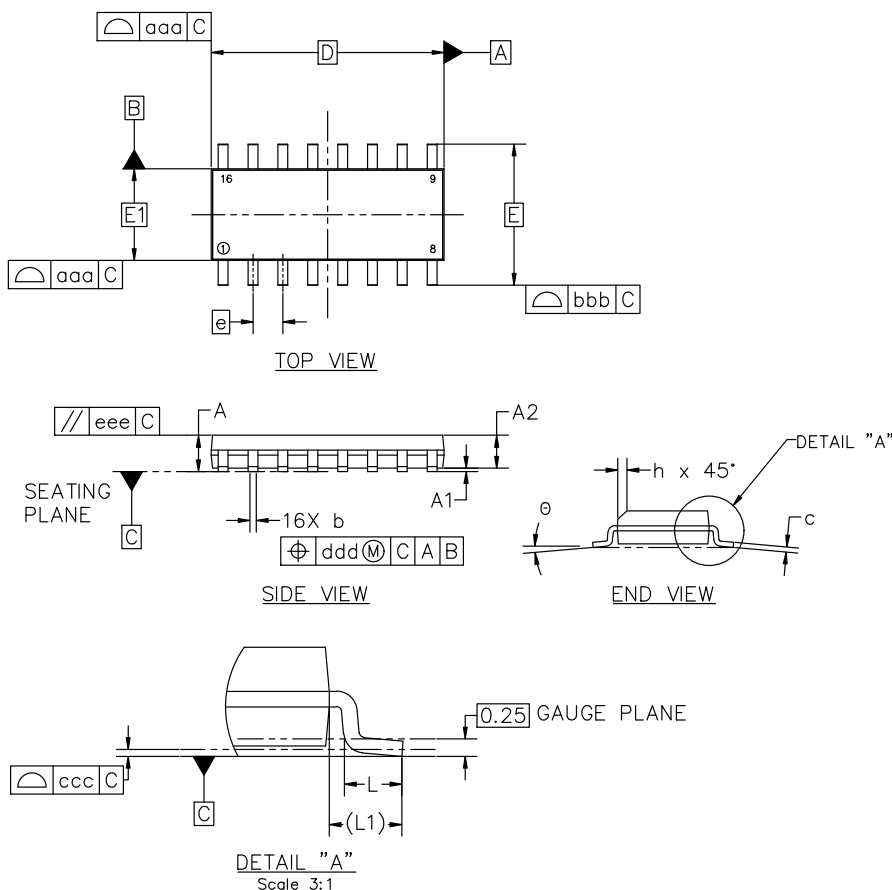


**SOIC-16 9.90x3.90x1.50 1.27P**  
**CASE 751B**  
**ISSUE L**

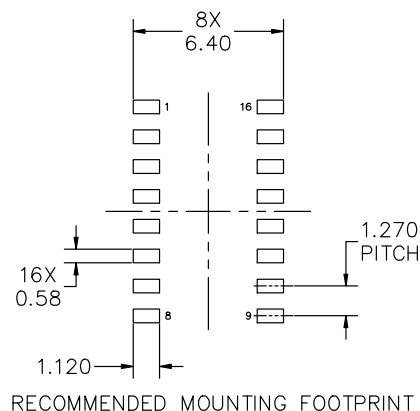
DATE 29 MAY 2024

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. DIMENSION IN MILLIMETERS. ANGLE IN DEGREES.
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15mm PER SIDE.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127mm TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.



MILLIMETERS			
DIM	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.00	0.05	0.10
A2	1.35	1.50	1.65
b	0.35	0.42	0.49
c	0.19	0.22	0.25
D	9.90 BSC		
E	6.00 BSC		
E1	3.90 BSC		
e	1.27 BSC		
h	0.25	---	0.50
L	0.40	0.83	1.25
L1	1.05 REF		
θ	0°	---	7°
TOLERANCE OF FORM AND POSITION			
aaa	0.10		
bbb	0.20		
ccc	0.10		
ddd	0.25		
eee	0.10		



\*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE onsemi SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D

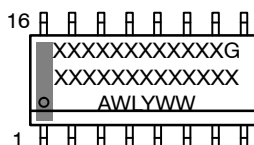
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<b>DESCRIPTION:</b>	<b>SOIC-16 9.90X3.90X1.50 1.27P</b>	<b>PAGE 1 OF 2</b>

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SOIC-16 9.90x3.90x1.50 1.27P  
CASE 751B  
ISSUE L

DATE 29 MAY 2024

GENERIC  
MARKING DIAGRAM\*



XXXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
WW = Work Week  
G = Pb-Free Package

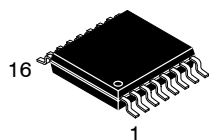
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

<b>STYLE 1:</b> PIN 1. COLLECTOR 2. BASE 3. EMITTER 4. NO CONNECTION 5. EMITTER 6. BASE 7. COLLECTOR 8. COLLECTOR 9. BASE 10. EMITTER 11. NO CONNECTION 12. EMITTER 13. BASE 14. COLLECTOR 15. EMITTER 16. COLLECTOR	<b>STYLE 2:</b> PIN 1. CATHODE 2. ANODE 3. NO CONNECTION 4. CATHODE 5. CATHODE 6. NO CONNECTION 7. ANODE 8. CATHODE 9. CATHODE 10. ANODE 11. NO CONNECTION 12. CATHODE 13. CATHODE 14. NO CONNECTION 15. ANODE 16. CATHODE	<b>STYLE 3:</b> PIN 1. COLLECTOR, DYE #1 2. BASE, #1 3. EMITTER, #1 4. COLLECTOR, #1 5. COLLECTOR, #2 6. BASE, #2 7. EMITTER, #2 8. COLLECTOR, #2 9. COLLECTOR, #3 10. BASE, #3 11. EMITTER, #3 12. COLLECTOR, #3 13. COLLECTOR, #4 14. BASE, #4 15. EMITTER, #4 16. COLLECTOR, #4	<b>STYLE 4:</b> PIN 1. COLLECTOR, DYE #1 2. COLLECTOR, #1 3. COLLECTOR, #2 4. COLLECTOR, #2 5. COLLECTOR, #3 6. COLLECTOR, #3 7. COLLECTOR, #4 8. COLLECTOR, #4 9. BASE, #4 10. EMITTER, #4 11. BASE, #3 12. EMITTER, #3 13. BASE, #2 14. EMITTER, #2 15. BASE, #1 16. EMITTER, #1
<b>STYLE 5:</b> PIN 1. DRAIN, DYE #1 2. DRAIN, #1 3. DRAIN, #2 4. DRAIN, #2 5. DRAIN, #3 6. DRAIN, #3 7. DRAIN, #4 8. DRAIN, #4 9. GATE, #4 10. SOURCE, #4 11. GATE, #3 12. SOURCE, #3 13. GATE, #2 14. SOURCE, #2 15. GATE, #1 16. SOURCE, #1	<b>STYLE 6:</b> PIN 1. CATHODE 2. CATHODE 3. CATHODE 4. CATHODE 5. CATHODE 6. CATHODE 7. CATHODE 8. CATHODE 9. ANODE 10. ANODE 11. ANODE 12. ANODE 13. ANODE 14. ANODE 15. ANODE 16. ANODE	<b>STYLE 7:</b> PIN 1. SOURCE N-CH 2. COMMON DRAIN (OUTPUT) 3. COMMON DRAIN (OUTPUT) 4. GATE P-CH 5. COMMON DRAIN (OUTPUT) 6. COMMON DRAIN (OUTPUT) 7. COMMON DRAIN (OUTPUT) 8. SOURCE P-CH 9. SOURCE P-CH 10. COMMON DRAIN (OUTPUT) 11. COMMON DRAIN (OUTPUT) 12. COMMON DRAIN (OUTPUT) 13. GATE N-CH 14. COMMON DRAIN (OUTPUT) 15. COMMON DRAIN (OUTPUT) 16. SOURCE N-CH	

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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**TSSOP-16 WB**  
**CASE 948F**  
**ISSUE B**

DATE 19 OCT 2006



## NOTES:

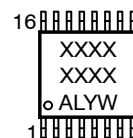
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD 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°

## RECOMMENDED SOLDERING FOOTPRINT\*



## GENERIC MARKING DIAGRAM\*



- XXXX = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
G or ■ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.

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

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