

# 8-Bit Serial or Parallel-Input/Serial-Output Shift Register with 3-State Output

## High-Performance Silicon-Gate CMOS

### MC74HC589A

The MC74HC589A device consists of an 8-bit storage latch which feeds parallel data to an 8-bit shift register. Data can also be loaded serially (see the Function Table). The shift register output,  $Q_H$ , is a 3-state output, allowing this device to be used in bus-oriented systems.

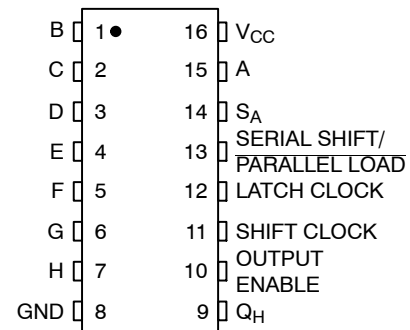
The HC589A directly interfaces with the SPI serial data port on CMOS MPUs and MCUs.

#### Features

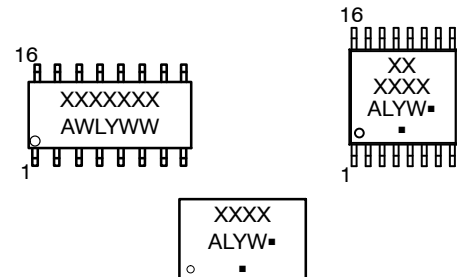
- Output Drive Capability: 15 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2.0 to 6.0 V
- Low Input Current: 1  $\mu$ A
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance with the Requirements Defined by JEDEC Standard No. 7 A
- Chip Complexity: 526 FETs or 131.5 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



#### PIN ASSIGNMENT



#### MARKING DIAGRAMS



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

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

See detailed ordering and shipping information on page 12 of this data sheet.

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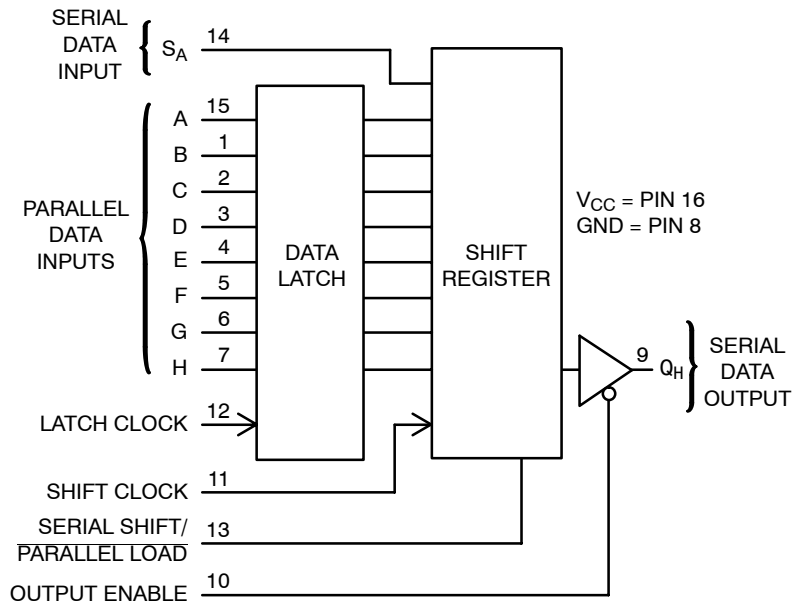


Figure 1. Logic Diagram

## FUNCTION TABLE

| Operation                                                                  | Inputs        |                             |             |             |                 |                     | Resulting Function  |                                       |                         |
|----------------------------------------------------------------------------|---------------|-----------------------------|-------------|-------------|-----------------|---------------------|---------------------|---------------------------------------|-------------------------|
|                                                                            | Output Enable | Serial Shift/ Parallel Load | Latch Clock | Shift Clock | Serial Input SA | Parallel Inputs A-H | Data Latch Contents | Shift Register Contents               | Output QH               |
| Force Output into High Impedance State                                     | H             | X                           |             |             | X               | X                   | X                   | X                                     | Z X                     |
| Load Parallel Data into Data Latch                                         | L             | H                           |             | L, H,       | X               | a-h                 | a-h                 | U                                     | U                       |
| Transfer Latch Contents to Shift Register                                  | L             | L                           | L, H,       | X           | X               | X                   | U                   | $LR_N \rightarrow SR_N$               | $LR_H$                  |
| Contents of Input Latch and Shift Register are Unchanged                   | L             | H                           | L, H,       | L, H,       | X               | X                   | U                   | U                                     | U                       |
| Load Parallel Data into Data Latch and Shift Register                      | L             | L                           |             |             | X               | a-h                 | a-h                 | a-h                                   | h X                     |
| Shift Serial Data into Shift Register                                      | L             | H                           |             |             | D               | X                   | *                   | $SR_A = D, SR_N \rightarrow SR_{N+1}$ | $SR_G \rightarrow SR_H$ |
| Load Parallel Data in Data Latch and Shift Serial Data into Shift Register | L             | H                           |             |             | D               | a-h                 | a-h                 | $SR_A = D, SR_N \rightarrow SR_{N+1}$ | $SR_G \rightarrow SR_H$ |

|     |   |                                     |   |   |                              |
|-----|---|-------------------------------------|---|---|------------------------------|
| LR  | = | latch register contents             | U | = | remains unchanged            |
| SR  | = | shift register contents             | X | = | don't care                   |
| a-h | = | data at parallel data inputs A-H    | Z | = | high impedance               |
| D   | = | data (L, H) at serial data input SA | * | = | depends on Latch Clock input |

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## 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 Diode Current, per Pin                                                    | ±20                                      | mA                   |      |
| I <sub>OUT</sub>     | DC Input Diode Current, Per Pin                                                    | ±35                                      | mA                   |      |
| I <sub>CC</sub>      | DC Supply Current, V <sub>CC</sub> and GND Pins                                    | ±75                                      | 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 Range                                                          | −65 to +150                              | °C                   |      |
| T <sub>L</sub>       | Lead Temperature, 1 mm from Case for 10 secs                                       | 260                                      | °C                   |      |
| T <sub>J</sub>       | Junction Temperature Under Bias                                                    | +150                                     | °C                   |      |
| θ <sub>JA</sub>      | Thermal Resistance (Note 1)                                                        | SOIC−16<br>QFN16<br>TSSOP−16             | 126<br>118<br>159    | °C/W |
| P <sub>D</sub>       | Power Dissipation in Still Air at 25°C                                             | SOIC−16<br>QFN16<br>TSSOP−16             | 995<br>1062<br>787   | mW   |
| MSL                  | Moisture Sensitivity                                                               | Level 1                                  | −                    |      |
| F <sub>R</sub>       | Flammability Rating                                                                | Oxygen Index: 28 to 34                   | UL 94 V−0 @ 0.125 in | −    |
| V <sub>ESD</sub>     | ESD Withstand Voltage (Note 2)                                                     | Human Body Model<br>Charged Device Model | > 4000<br>N/A        | V    |
| I <sub>LATCHUP</sub> | Latchup Performance (Note 3)                                                       |                                          | ±100                 | mA   |

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.
3. Tested to EIA/JESD78 Class II.

## RECOMMENDED OPERATING CONDITIONS

| Symbol                             | Parameter                                                                                                                                          | Min              | Max                       | Unit |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------|------|
| V <sub>CC</sub>                    | DC Supply Voltage (Referenced to GND)                                                                                                              | 2.0              | 6.0                       | V    |
| V <sub>in</sub> , V <sub>out</sub> | DC Input Voltage, Output Voltage (Referenced to GND)                                                                                               | 0                | V <sub>CC</sub>           | V    |
| T <sub>A</sub>                     | Operating Temperature, All Package Types                                                                                                           | −55              | + 125                     | °C   |
| t <sub>r</sub> , t <sub>f</sub>    | Input Rise and Fall Time<br>(Figure 3)<br>V <sub>CC</sub> = 2.0 V<br>V <sub>CC</sub> = 3.0 V<br>V <sub>CC</sub> = 4.5 V<br>V <sub>CC</sub> = 6.0 V | 0<br>0<br>0<br>0 | 1000<br>800<br>500<br>400 | 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.

4. Unused inputs may not be left open. All inputs must be tied to a high-logic voltage level or a low-logic input voltage level.

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## DC ELECTRICAL CHARACTERISTICS

| Symbol          | Parameter                                      | Test Conditions                                                                                                                     | V <sub>CC</sub>          | Guaranteed Limit          |                           |                           | Unit |
|-----------------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------------------|---------------------------|---------------------------|------|
|                 |                                                |                                                                                                                                     | V                        | -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<br> I <sub>out</sub>   ≤ 20 μA                                                  | 2.0<br>3.0<br>4.5<br>6.0 | 1.5<br>2.1<br>3.15<br>4.2 | 1.5<br>2.1<br>3.15<br>4.2 | 1.5<br>2.1<br>3.15<br>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<br> I <sub>out</sub>   ≤ 20 μA                                                  | 2.0<br>3.0<br>4.5<br>6.0 | 0.5<br>0.9<br>1.35<br>1.8 | 0.5<br>0.9<br>1.35<br>1.8 | 0.5<br>0.9<br>1.35<br>1.8 | V    |
| V <sub>OH</sub> | Minimum High-Level Output Voltage              | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>out</sub>   ≤ 20 μA                                                 | 2.0<br>4.5<br>6.0        | 1.9<br>4.4<br>5.9         | 1.9<br>4.4<br>5.9         | 1.9<br>4.4<br>5.9         | V    |
|                 |                                                | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 2.4 mA                                                   | 3.0                      | 2.48                      | 2.34                      | 2.20                      |      |
|                 |                                                | I <sub>out</sub>   ≤ 6.0 mA                                                                                                         | 4.5                      | 3.98                      | 3.84                      | 3.70                      |      |
|                 |                                                | I <sub>out</sub>   ≤ 7.8 mA                                                                                                         | 6.0                      | 5.48                      | 5.34                      | 5.20                      |      |
| V <sub>OL</sub> | Maximum Low-Level Output Voltage               | V <sub>in</sub> = V <sub>IH</sub><br> I <sub>out</sub>   ≤ 20 μA                                                                    | 2.0<br>4.5<br>6.0        | 0.1<br>0.1<br>0.1         | 0.1<br>0.1<br>0.1         | 0.1<br>0.1<br>0.1         | V    |
|                 |                                                | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 2.4 mA                                                   | 3.0                      | 0.26                      | 0.33                      | 0.40                      |      |
|                 |                                                | I <sub>out</sub>   ≤ 6.0 mA                                                                                                         | 4.5                      | 0.26                      | 0.33                      | 0.40                      |      |
|                 |                                                | I <sub>out</sub>   ≤ 7.8 mA                                                                                                         | 6.0                      | 0.26                      | 0.33                      | 0.40                      |      |
| 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>OZ</sub> | Maximum Three-State Leakage Current            | Output in High-Impedance State<br>V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>V <sub>out</sub> = V <sub>CC</sub> or GND | 6.0                      | ±0.5                      | ±5.0                      | ±10                       | μA   |
| I <sub>CC</sub> | Maximum Quiescent Supply Current (per Package) | V <sub>in</sub> = V <sub>CC</sub> or GND<br>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.

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## AC ELECTRICAL CHARACTERISTICS

| Symbol                                 | Parameter                                                                                    | V <sub>CC</sub>          | Guaranteed Limit       |                        |                        | Unit |
|----------------------------------------|----------------------------------------------------------------------------------------------|--------------------------|------------------------|------------------------|------------------------|------|
|                                        |                                                                                              | V                        | –55°C to 25°C          | ≤ 85°C                 | ≤ 125°C                |      |
| f <sub>max</sub>                       | Maximum Clock Frequency (50% Duty Cycle)<br>(Figures 2 and 4)                                | 2.0<br>3.0<br>4.5<br>6.0 | 6.0<br>15<br>30<br>35  | 4.8<br>10<br>24<br>28  | 4.0<br>8.0<br>20<br>24 | MHz  |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, Latch Clock to Q <sub>H</sub><br>(Figures 2 and 3)                | 2.0<br>3.0<br>4.5<br>6.0 | 175<br>100<br>40<br>30 | 225<br>110<br>50<br>40 | 275<br>125<br>60<br>50 | ns   |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, Shift Clock to Q <sub>H</sub><br>(Figures 2 and 4)                | 2.0<br>3.0<br>4.5<br>6.0 | 160<br>90<br>30<br>25  | 200<br>130<br>40<br>30 | 240<br>160<br>48<br>40 | ns   |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, Serial Shift/Parallel Load to Q <sub>H</sub><br>(Figures 2 and 6) | 2.0<br>3.0<br>4.5<br>6.0 | 160<br>90<br>30<br>25  | 200<br>130<br>40<br>30 | 240<br>160<br>48<br>40 | ns   |
| t <sub>PLZ</sub> ,<br>t <sub>PHZ</sub> | Maximum Propagation Delay, Output Enable to Q <sub>H</sub><br>(Figures 2 and 5)              | 2.0<br>3.0<br>4.5<br>6.0 | 150<br>80<br>27<br>23  | 170<br>100<br>30<br>25 | 200<br>130<br>40<br>30 | ns   |
| t <sub>PZL</sub> ,<br>t <sub>PZH</sub> | Maximum Propagation Delay, Output Enable to Q <sub>H</sub><br>(Figures 2 and 5)              | 2.0<br>3.0<br>4.5<br>6.0 | 150<br>80<br>27<br>23  | 170<br>100<br>30<br>25 | 200<br>130<br>40<br>30 | ns   |
| t <sub>TLH</sub> ,<br>t <sub>THL</sub> | Maximum Output Transition Time, Any Output<br>(Figures 2 and 3)                              | 2.0<br>3.0<br>4.5<br>6.0 | 60<br>23<br>12<br>10   | 75<br>27<br>15<br>13   | 90<br>31<br>18<br>15   | ns   |
| C <sub>in</sub>                        | Maximum Input Capacitance                                                                    | –                        | 10                     | 10                     | 10                     | pF   |
| C <sub>out</sub>                       | Maximum Three-State Output Capacitance<br>(Output in High-Impedance State)                   | –                        | 15                     | 15                     | 15                     | pF   |

|                 |                                              |                                         |    |
|-----------------|----------------------------------------------|-----------------------------------------|----|
| C <sub>PD</sub> | Power Dissipation Capacitance (per Package)* | Typical @ 25°C, V <sub>CC</sub> = 5.0 V | pF |
|                 |                                              | 50                                      |    |

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.

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

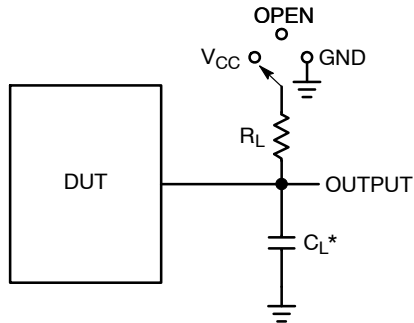
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## TIMING REQUIREMENTS

| Symbol                          | Parameter                                                                         | V <sub>CC</sub><br>V | Guaranteed Limit |       |        | Unit |
|---------------------------------|-----------------------------------------------------------------------------------|----------------------|------------------|-------|--------|------|
|                                 |                                                                                   |                      | -55°C to 25°C    | ≤85°C | ≤125°C |      |
| t <sub>su</sub>                 | Minimum Setup Time, A-H to Latch Clock<br>(Figure 7)                              | 2.0                  | 100              | 125   | 150    | ns   |
|                                 |                                                                                   | 3.0                  | 40               | 50    | 60     |      |
|                                 |                                                                                   | 4.5                  | 20               | 25    | 30     |      |
|                                 |                                                                                   | 6.0                  | 17               | 21    | 26     |      |
| t <sub>su</sub>                 | Minimum Setup Time, Serial Data Input S <sub>A</sub> to Shift Clock<br>(Figure 8) | 2.0                  | 100              | 125   | 150    | ns   |
|                                 |                                                                                   | 3.0                  | 40               | 50    | 60     |      |
|                                 |                                                                                   | 4.5                  | 20               | 25    | 30     |      |
|                                 |                                                                                   | 6.0                  | 17               | 21    | 26     |      |
| t <sub>su</sub>                 | Minimum Setup Time, Serial Shift/Parallel Load to Shift Clock<br>(Figure 9)       | 2.0                  | 100              | 125   | 150    | ns   |
|                                 |                                                                                   | 3.0                  | 40               | 50    | 60     |      |
|                                 |                                                                                   | 4.5                  | 20               | 25    | 30     |      |
|                                 |                                                                                   | 6.0                  | 17               | 21    | 26     |      |
| t <sub>h</sub>                  | Minimum Hold Time, Latch Clock to A-H<br>(Figure 7)                               | 2.0                  | 25               | 30    | 40     | ns   |
|                                 |                                                                                   | 3.0                  | 10               | 12    | 15     |      |
|                                 |                                                                                   | 4.5                  | 5                | 6     | 8      |      |
|                                 |                                                                                   | 6.0                  | 5                | 6     | 7      |      |
| t <sub>h</sub>                  | Minimum Hold Time, Shift Clock to Serial Data Input S <sub>A</sub><br>(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>w</sub>                  | Minimum Pulse Width, Shift Clock<br>(Figure 4)                                    | 2.0                  | 75               | 95    | 110    | ns   |
|                                 |                                                                                   | 3.0                  | 40               | 50    | 60     |      |
|                                 |                                                                                   | 4.5                  | 15               | 19    | 23     |      |
|                                 |                                                                                   | 6.0                  | 13               | 16    | 19     |      |
| t <sub>w</sub>                  | Minimum Pulse Width, Latch Clock<br>(Figure 3)                                    | 2.0                  | 80               | 100   | 120    | ns   |
|                                 |                                                                                   | 3.0                  | 40               | 50    | 60     |      |
|                                 |                                                                                   | 4.5                  | 16               | 20    | 24     |      |
|                                 |                                                                                   | 6.0                  | 14               | 17    | 20     |      |
| t <sub>w</sub>                  | Minimum Pulse Width, Serial Shift/Parallel Load<br>(Figure 6)                     | 2.0                  | 80               | 100   | 120    | ns   |
|                                 |                                                                                   | 3.0                  | 40               | 50    | 60     |      |
|                                 |                                                                                   | 4.5                  | 16               | 20    | 24     |      |
|                                 |                                                                                   | 6.0                  | 14               | 17    | 20     |      |
| t <sub>r</sub> , t <sub>f</sub> | Maximum Input Rise and Fall Times<br>(Figure 3)                                   | 2.0                  | 1000             | 1000  | 1000   | ns   |
|                                 |                                                                                   | 3.0                  | 800              | 800   | 800    |      |
|                                 |                                                                                   | 4.5                  | 500              | 500   | 500    |      |
|                                 |                                                                                   | 6.0                  | 400              | 400   | 400    |      |

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## SWITCHING WAVEFORMS



\*C<sub>L</sub> Includes probe and jig capacitance

| 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 2. Test Circuit

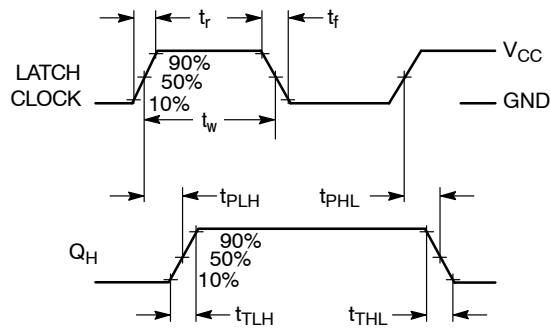


Figure 3. (Serial Shift/Parallel Load = L)

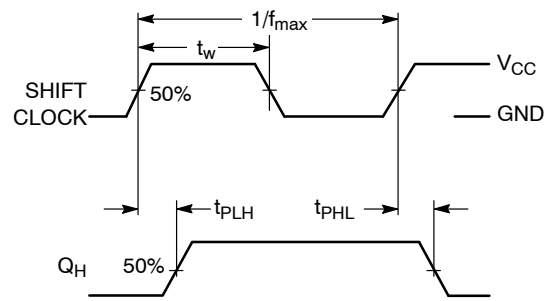


Figure 4. (Serial Shift/Parallel Load = H)

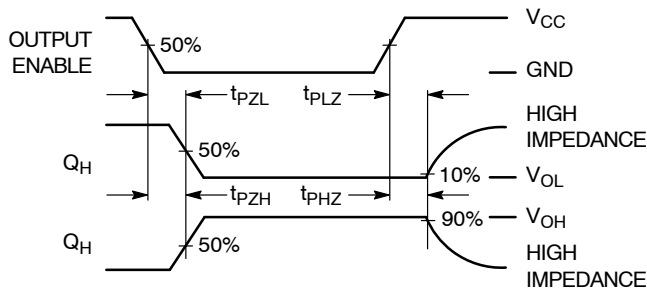


Figure 5.

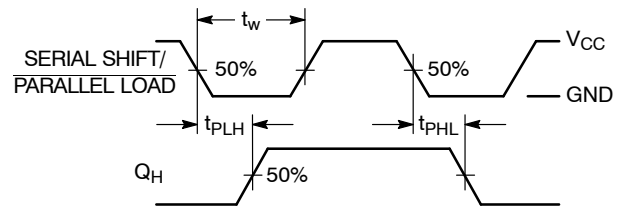


Figure 6.

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## SWITCHING WAVEFORMS

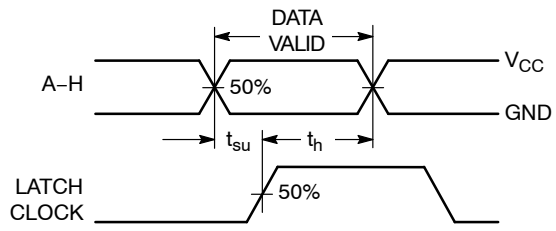


Figure 7.

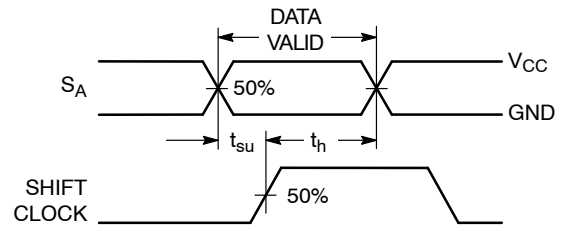


Figure 8.

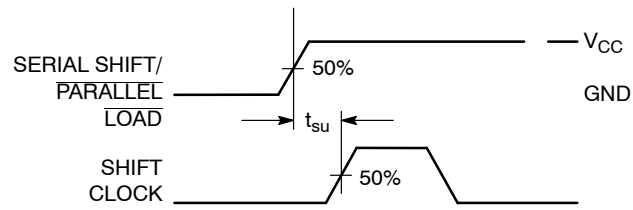


Figure 9.

**PIN DESCRIPTIONS****DATA INPUTS****A, B, C, D, E, F, G, H (Pins 15, 1, 2, 3, 4, 5, 6, 7)**

Parallel data inputs. Data on these inputs are stored in the data latch on the rising edge of the Latch Clock input.

**S<sub>A</sub> (Pin 14)**

Serial data input. Data on this input is shifted into the shift register on the rising edge of the Shift Clock input if Serial Shift/Parallel Load is high. Data on this input is ignored when Serial Shift/Parallel Load is low.

**CONTROL INPUTS****Serial Shift/Parallel Load (Pin 13)**

Shift register mode control. When a high level is applied to this pin, the shift register is allowed to serially shift data. When a low level is applied to this pin, the shift register accepts parallel data from the data latch.

**Shift Clock (Pin 11)**

Serial shift clock. A low-to-high transition on this input shifts data on the serial data input into the shift register and

data in stage H is shifted out Q<sub>H</sub>, being replaced by the data previously stored in stage G.

**Latch Clock (Pin 12)**

Data latch clock. A low-to-high transition on this input loads the parallel data on inputs A–H into the data latch.

**Output Enable (Pin 10)**

Active-low output enable A high level applied to this pin forces the Q<sub>H</sub> output into the high impedance state. A low level enables the output. This control does not affect the state of the input latch or the shift register.

**OUTPUT****Q<sub>H</sub> (Pin 9)**

Serial data output. This pin is the output from the last stage of the shift register. This is a 3-state output.

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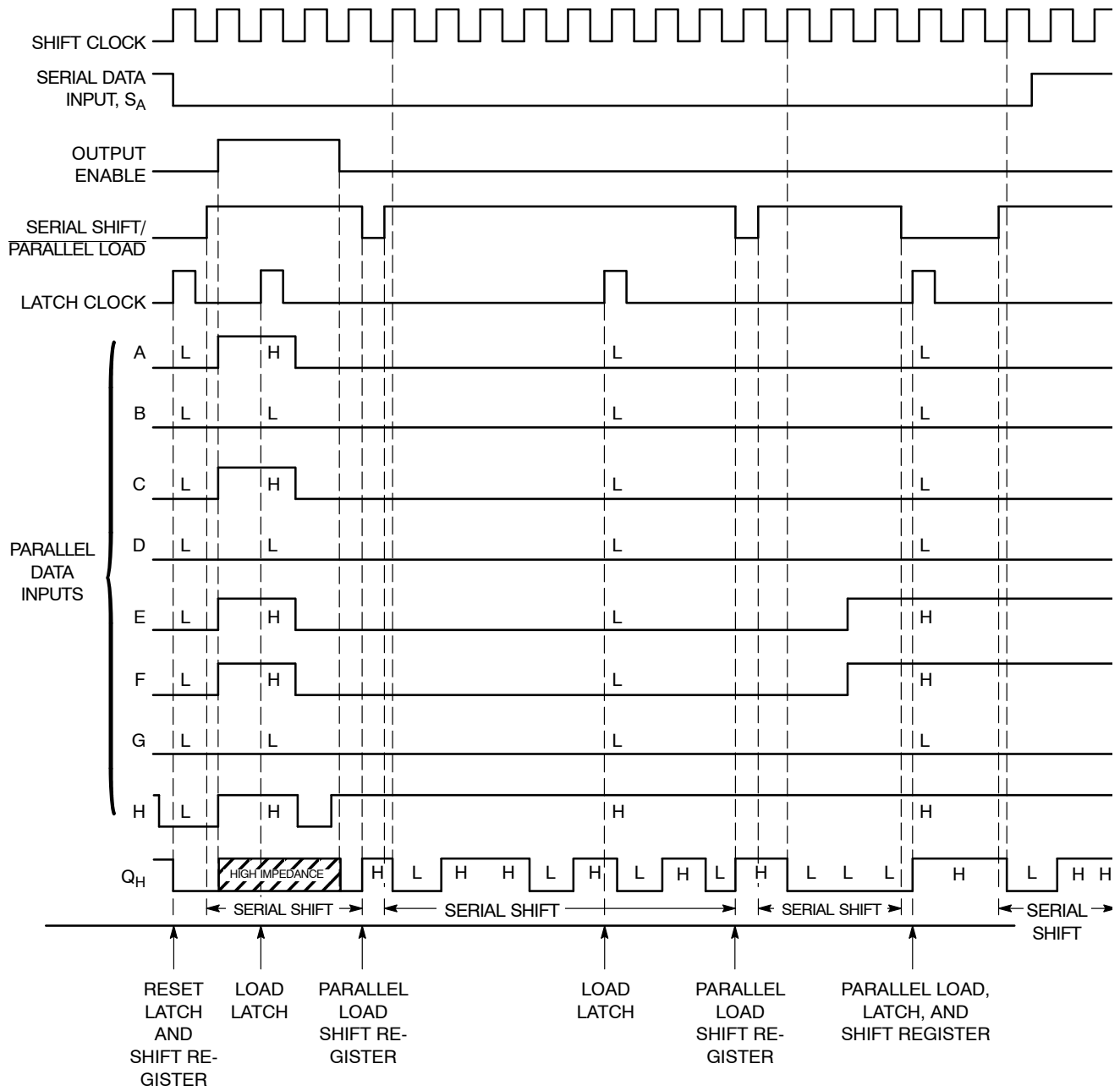
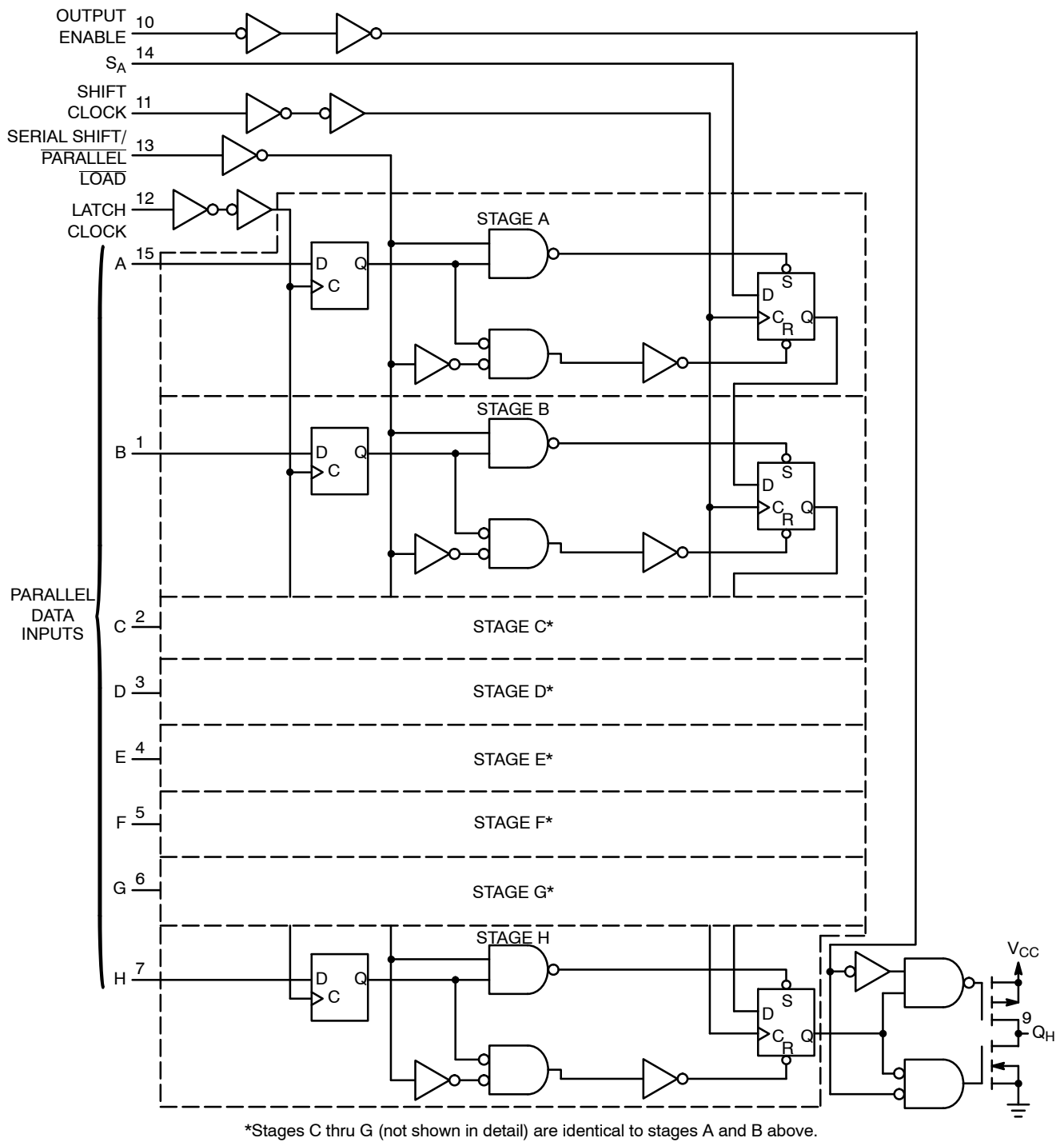


Figure 10. Timing Diagram

# MC74HC589A



**Figure 11. Logic Detail**

## MC74HC589A

### ORDERING INFORMATION

| Device             | Marking    | Package  | Shipping†          |
|--------------------|------------|----------|--------------------|
| MC74HC589ADG       | HC589AG    | SOIC-16  | 48 Units / Rail    |
| MC74HC589ADR2G     | HC589AG    | SOIC-16  | 2500 / Tape & Reel |
| MC74HC589ADR2G-Q*  | HC589AG    | SOIC-16  | 2500 / Tape & Reel |
| MC74HC589ADTR2G    | HC<br>589A | TSSOP-16 | 2500 / Tape & Reel |
| MC74HC589ADTR2G-Q* | HC<br>589A | TSSOP-16 | 2500 / Tape & Reel |

†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.

# MC74HC589A

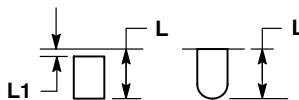
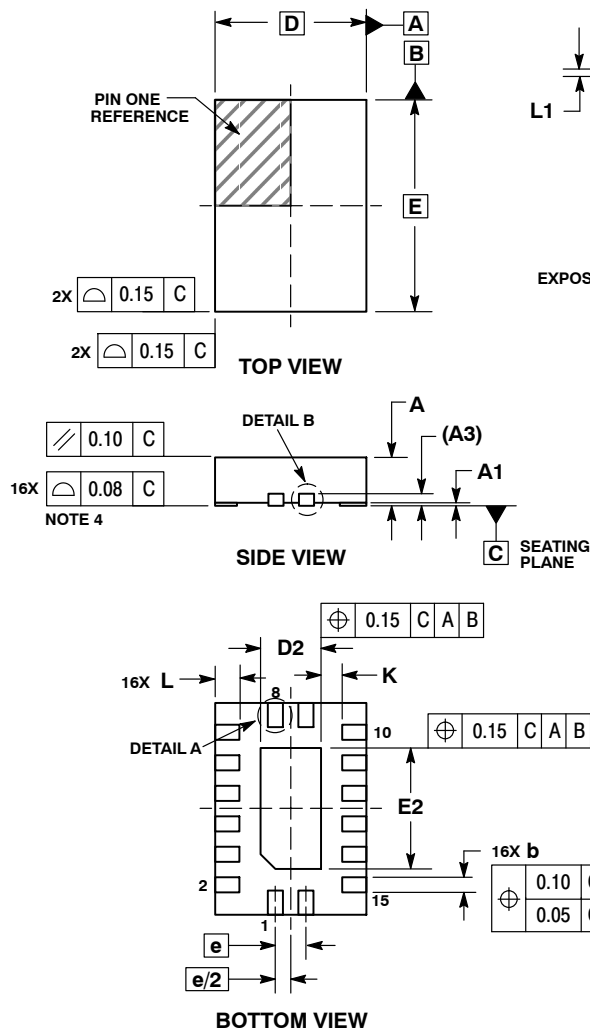
## PACKAGE DIMENSIONS



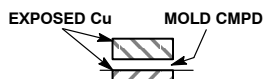
SCALE 2:1

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

DATE 11 DEC 2008



**DETAIL A**  
ALTERNATE TERMINAL  
CONSTRUCTIONS



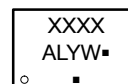
**DETAIL B**  
ALTERNATE  
CONSTRUCTIONS

### NOTES:

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.

| MILLIMETERS |      |      |
|-------------|------|------|
| DIM         | 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  |
| K           | 0.20 | ---  |
| L           | 0.35 | 0.45 |
| L1          | ---  | 0.15 |

### GENERIC MARKING DIAGRAM\*

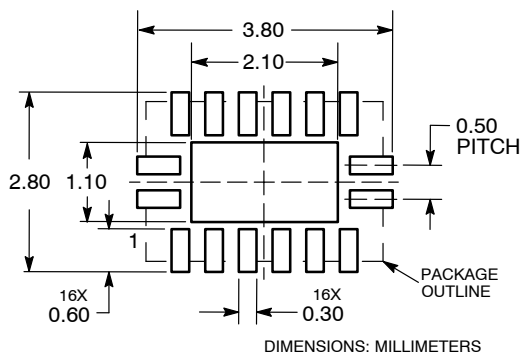


- XXXX = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(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\*



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


**SOIC-16 9.90x3.90x1.37 1.27P**  
**CASE 751B**  
**ISSUE M**

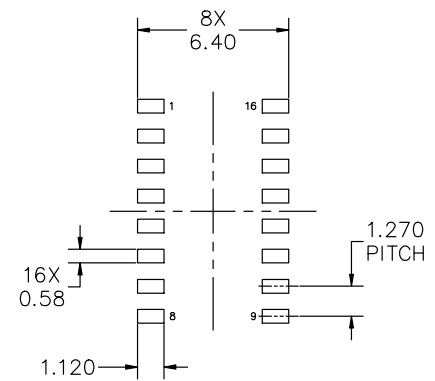
DATE 18 OCT 2024

## 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                             | 0.10     | 0.18 | 0.25 |
| A2                             | 1.25     | 1.37 | 1.50 |
| 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, SOLDERM/D

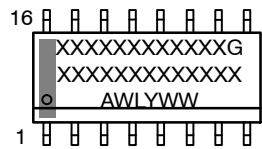
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SOIC-16 9.90x3.90x1.37 1.27P  
CASE 751B  
ISSUE M

DATE 18 OCT 2024

GENERIC  
MARKING DIAGRAM\*

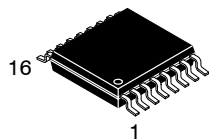


XXXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
WW = Work Week  
G = Pb-Free Package

\*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.

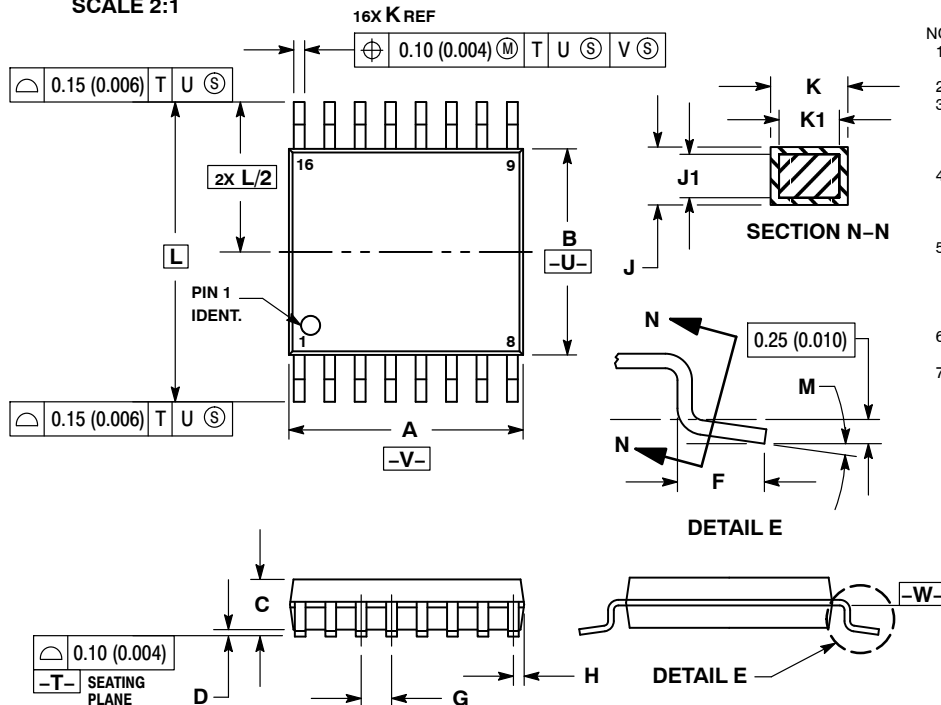
|                                                                                                                                                                                                                                                                                         |                 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

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

DATE 19 OCT 2006

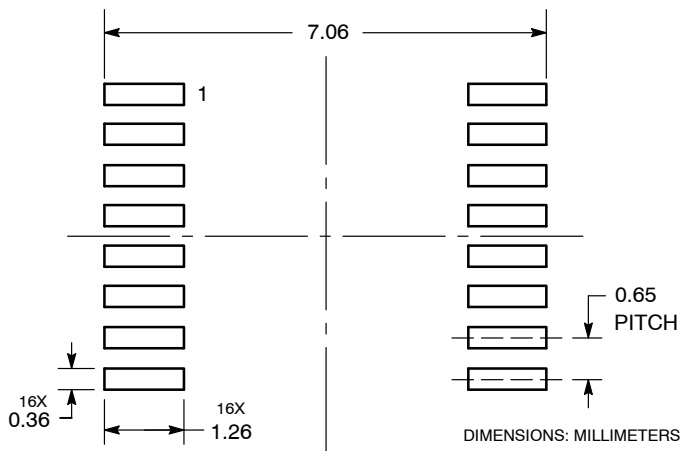


NOTES:

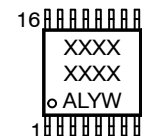
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD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