

## Description

The 74HC164 is a serial input 8-bit edge-triggered shift register that has outputs from each of eight stages.

### SERIAL DATA INPUT PINS

The serial input data is entered at pin SDA or pin SDB as these are logically ANDED. Either input could be used as an active HIGH enable with data entry on the other pin. If a single input is desired, the pins can be tied together or the unused input can be tied HIGH.

### DATA ENTRY

Data is shifted into Q0 from the serial input pins on each LOW to HIGH transition of the CP pin. Also during the CP edge the data is transferred from each Qn to Qn+1. The serial data on pins DSA and DSB must be stable before and after the CP rising edge to meet the set-up and hold timing requirements.

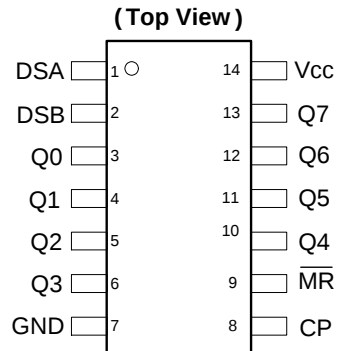
### RESET

When asserted LOW the Master Reset ( $\overline{\text{MR}}$ ) pin sets all Qn to LOW. This action does not depend on the condition of serial input or clock pins. The  $\overline{\text{MR}}$  must be asserted HIGH for a recovery time before the next CP positive edge pulse.

## Features

- Wide Supply Voltage Range from 2.0V to 6.0V
- Sinks or Sources 4mA at  $V_{CC} = 4.5V$
- CMOS Low Power Consumption
- Schmitt Trigger Action at all Inputs
- ESD Protection Exceeds JESD 22
  - 200-V Machine Model (A115)
  - 2000-V Human Body Model (A114)
  - Exceeds 1000-V Charged Device Model (C101)
- Range of Package Options SO-14 and TSSOP-14
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

## Pin Assignments



**SO-14 / TSSOP-14 / PDIP-14**

## Applications

- General Purpose Logic
- Wide Array of Products Such as:
  - PCs, Networking, Notebooks, Netbooks
  - Computer Peripherals, Hard Drives, CD/DVD ROM
  - TV, DVD, DVR, Set-Top Box

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

**Device Ordering Information is on Page 7**

## Pin Descriptions

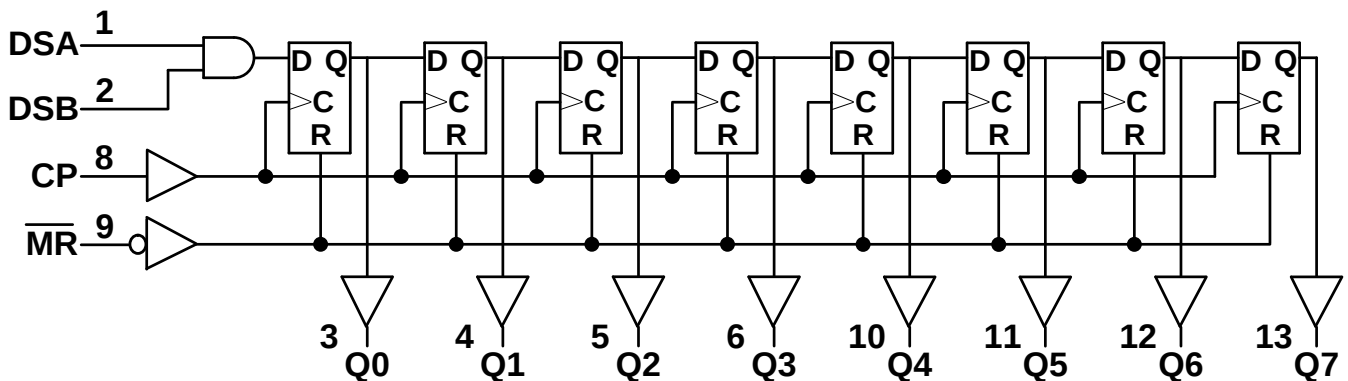
| Pin Number | Pin Name               | Function                             |
|------------|------------------------|--------------------------------------|
| 1          | DSA                    | Serial Data Input                    |
| 2          | DSB                    | Serial Data Input                    |
| 3          | Q0                     | Data Output                          |
| 4          | Q1                     | Data Output                          |
| 5          | Q2                     | Data Output                          |
| 6          | Q3                     | Data Output                          |
| 7          | GND                    | Ground                               |
| 8          | CP                     | Clock Pulse –Positive Edge Triggered |
| 9          | $\overline{\text{MR}}$ | Master Reset - Asynchronous          |
| 10         | Q4                     | Data Output                          |
| 11         | Q5                     | Data Output                          |
| 12         | Q6                     | Data Output                          |
| 13         | Q7                     | Data Output                          |
| 14         | V <sub>CC</sub>        | Supply Voltage                       |

## Function Table (Note 4)

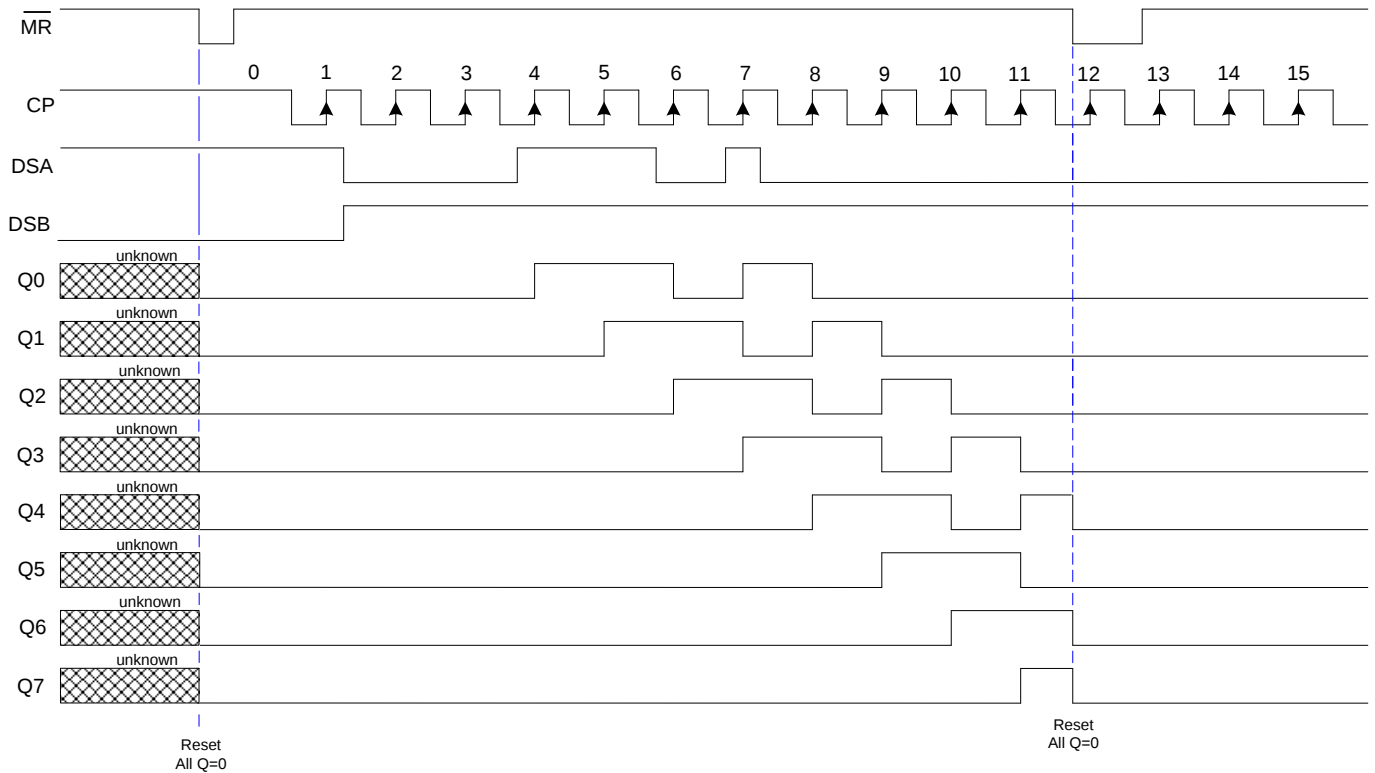
| Mode  | Input                  |            |     |     | Output |                                     |
|-------|------------------------|------------|-----|-----|--------|-------------------------------------|
|       | $\overline{\text{MR}}$ | CP         | DSA | DSB | Q0     | Q1-Q7                               |
| Reset | L                      | X          | X   | X   | L      | L                                   |
| Shift | H                      | $\uparrow$ | L   | X   | L      | $Q_n \leftarrow Q_{n-1}$ (n= 1 to7) |
|       | H                      | $\uparrow$ | X   | L   | L      | $Q_n \leftarrow Q_{n-1}$ (n= 1 to7) |
|       | H                      | $\uparrow$ | H   | H   | H      | $Q_n \leftarrow Q_{n-1}$ (n= 1 to7) |

Note: 4. Signals asserted on DSA and DSB must be in place longer than Tsu (set-up time) before CP occurs and remain in place Thold (hold time) after CP.

## Logic Diagram



## Timing Diagram



- Notes:
5. All  $Q$  values are reset to LOW when  $\overline{MR}$  goes low.  $\overline{MR}$  is asynchronous and overrides all other signals.
  6. Serial data supplied at  $DSA$  and  $DSB$  is ANDED and transferred to  $Q_0$  on positive edge of  $CP$ .

## Absolute Maximum Ratings (Note 7) ( $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

| Symbol    | Description                                                               | Rating       | Unit             |
|-----------|---------------------------------------------------------------------------|--------------|------------------|
| ESD HBM   | Human Body Model ESD Protection                                           | 2            | kV               |
| ESD CDM   | Charged Device Model ESD Protection                                       | 1            | kV               |
| ESD MM    | Machine Model ESD Protection                                              | 200          | V                |
| $V_{CC}$  | Supply Voltage Range                                                      | -0.5 to +7.0 | V                |
| $V_I$     | Input Voltage Range (Note 8)                                              | -0.5 to +7.0 | V                |
| $I_{IK}$  | Input Clamp Current $V_I < -0.5\text{V}$ or $V_I > V_{CC} + 0.5\text{V}$  | $\pm 20$     | mA               |
| $I_{OK}$  | Output Clamp Current $V_O < -0.5\text{V}$ or $V_O > V_{CC} + 0.5\text{V}$ | $\pm 20$     | mA               |
| $I_O$     | Continuous Output Current $-0.5\text{V} < V_O < V_{CC} + 0.5\text{V}$     | +/- 25       | mA               |
| $I_{CC}$  | Continuous Current through $V_{CC}$                                       | 50           | mA               |
| $I_{GND}$ | Continuous Current through GND                                            | -50          | mA               |
| $T_J$     | Operating Junction Temperature                                            | -40 to +150  | $^\circ\text{C}$ |
| $T_{STG}$ | Storage Temperature                                                       | -65 to +150  | $^\circ\text{C}$ |
| $P_{TOT}$ | Total Power Dissipation                                                   | 500          | mW               |

- Notes:
7. Stresses beyond the absolute maximum may result in immediate failure or reduced reliability. These are stress values and device operation should be within recommend values.
  8. Input Voltage cannot exceed  $V_{CC}$  to the extent the maximum clamp current is exceeded.

**Recommended Operating Conditions** (Note 9) ( $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

| Symbol              | Parameter                          | Conditions             | Min | Max      | Unit             |
|---------------------|------------------------------------|------------------------|-----|----------|------------------|
| $V_{CC}$            | Supply Voltage                     | —                      | 2.0 | 6.0      | V                |
| $V_I$               | Input Voltage                      | —                      | 0   | $V_{CC}$ | V                |
| $V_O$               | Output Voltage                     | —                      | 0   | $V_{CC}$ | V                |
| $\Delta t/\Delta V$ | Input Transition Rise or Fall Rate | $V_{CC} = 2.0\text{V}$ | —   | 625      | ns/V             |
|                     |                                    | $V_{CC} = 4.5\text{V}$ | —   | 140      |                  |
|                     |                                    | $V_{CC} = 6.0\text{V}$ | —   | 85       |                  |
| $T_A$               | Operating Free-Air Temperature     | —                      | -40 | +125     | $^\circ\text{C}$ |

 Note: 9. Unused inputs should be held at  $V_{CC}$  or Ground.

**Electrical Characteristics** ( $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

| Symbol   | Parameter                 | Test Conditions                                | $V_{CC}$ | $T_A = +25^\circ\text{C}$ |      |           | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ |         | $T_A = -40^\circ\text{C to } +125^\circ\text{C}$ |         | Unit          |
|----------|---------------------------|------------------------------------------------|----------|---------------------------|------|-----------|-------------------------------------------------|---------|--------------------------------------------------|---------|---------------|
|          |                           |                                                |          | Min.                      | Typ. | Max.      | Min.                                            | Max.    | Min.                                             | Max.    |               |
| $V_{IH}$ | High-level Input Voltage  | —                                              | 2.0V     | 1.5                       | 1.2  | —         | 1.5                                             | —       | 1.5                                              | —       | V             |
|          |                           | —                                              | 4.5V     | 3.15                      | 2.4  | —         | 3.15                                            | —       | 3.15                                             | —       |               |
|          |                           | —                                              | 6.0V     | 4.2                       | 3.2  | —         | 4.2                                             | —       | 4.2                                              | —       |               |
| $V_{IL}$ | Low-level Input Voltage   | —                                              | 2.0V     | —                         | 0.8  | 0.5       | —                                               | 0.5     | —                                                | 0.5     | V             |
|          |                           | —                                              | 4.5V     | —                         | 2.1  | 1.35      | —                                               | 1.35    | —                                                | 1.35    |               |
|          |                           | —                                              | 6.0V     | —                         | 2.8  | 1.8       | —                                               | 1.8     | —                                                | 1.8     |               |
| $V_{OH}$ | High-level Output Voltage | $I_{OH} = -20\mu\text{A}$                      | 2.0V     | 1.9                       | 2.0  | —         | 1.9                                             | —       | 1.9                                              | —       | V             |
|          |                           | $I_{OH} = -20\mu\text{A}$                      | 4.5V     | 4.4                       | 4.5  | —         | 4.4                                             | —       | 4.4                                              | —       |               |
|          |                           | $I_{OH} = -20\mu\text{A}$                      | 6.0V     | 5.9                       | 6.0  | —         | 5.9                                             | —       | 5.9                                              | —       |               |
|          |                           | $I_{OH} = -4.0\text{mA}$                       | 4.5V     | 3.98                      | 4.32 | —         | 3.84                                            | —       | 3.7                                              | —       |               |
|          |                           | $I_{OH} = -5.2\text{mA}$                       | 6.0V     | 5.48                      | 5.81 | —         | 5.34                                            | —       | 5.2                                              | —       |               |
| $V_{OL}$ | Low-level Output Voltage  | $I_{OL} = 20\mu\text{A}$                       | 2.0V     | —                         | 0    | 0.1       | —                                               | 0.1     | —                                                | 0.1     | V             |
|          |                           | $I_{OL} = 20\mu\text{A}$                       | 4.5V     | —                         | 0    | 0.1       | —                                               | 0.1     | —                                                | 0.1     |               |
|          |                           | $I_{OL} = 20\mu\text{A}$                       | 6.0V     | —                         | 0    | 0.1       | —                                               | 0.1     | —                                                | 0.1     |               |
|          |                           | $I_{OL} = 4\text{mA}$                          | 4.5V     | —                         | 0.15 | 0.26      | —                                               | 0.33    | —                                                | 0.4     |               |
|          |                           | $I_{OL} = 5.2\text{mA}$                        | 6.0V     | —                         | 0.15 | 0.26      | —                                               | 0.33    | —                                                | 0.4     |               |
| $I_I$    | Input Current             | $V_I = \text{GND or } V_{CC}$                  | 6.0V     | —                         | —    | $\pm 0.1$ | —                                               | $\pm 1$ | —                                                | $\pm 1$ | $\mu\text{A}$ |
| $I_{CC}$ | Supply Current            | $V_I = \text{GND or } V_{CC}, I_O = 0\text{A}$ | 6.0V     | —                         | —    | 8.0       | —                                               | 80      | —                                                | 160     | $\mu\text{A}$ |

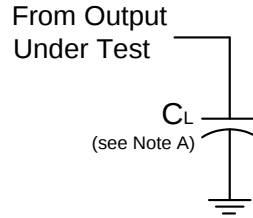
## Switching Characteristics

| Symbol / Parameter                                | Pins             | Test Conditions | V <sub>CC</sub> | T <sub>A</sub> = +25°C |      |     | -40°C to +85°C |     | -40°C to +125°C |     | Unit |
|---------------------------------------------------|------------------|-----------------|-----------------|------------------------|------|-----|----------------|-----|-----------------|-----|------|
|                                                   |                  |                 |                 | Min                    | Typ. | Max | Min            | Max | Min             | Max |      |
| f <sub>MAX</sub><br>Maximum Frequency             | CP               | Figure 1        | 2.0 V           | 6                      | 23   | —   | 5              | —   | 4               | —   | MHz  |
|                                                   |                  |                 | 4.5 V           | 30                     | 71   | —   | 24             | —   | 20              | —   |      |
|                                                   |                  |                 | 5.0 V           | —                      | 78   | —   | —              | —   | —               | —   |      |
|                                                   |                  |                 | 6.0 V           | 35                     | 85   | —   | 28             | —   | 24              | —   |      |
| t <sub>w</sub><br>Pulse Width                     | CP HIGH or LOW   | Figure 1        | 2.0 V           | 80                     | 14   | —   | 100            | —   | 120             | —   | ns   |
|                                                   |                  |                 | 4.5 V           | 16                     | 5    | —   | 20             | —   | 24              | —   |      |
|                                                   |                  |                 | 6.0 V           | 14                     | 4    | —   | 17             | —   | 20              | —   |      |
|                                                   | MR LOW           | Figure 1        | 2.0 V           | 60                     | 17   | —   | 75             | —   | 90              | —   | ns   |
|                                                   |                  |                 | 4.5 V           | 12                     | 6    | —   | 15             | —   | 18              | —   |      |
|                                                   |                  |                 | 6.0 V           | 10                     | 5    | —   | 13             | —   | 15              | —   |      |
| t <sub>SU</sub><br>Set-up Time                    | DSA or DSB to CP | Figure 1        | 2.0 V           | 60                     | 8    | —   | 75             | —   | 90              | —   | ns   |
|                                                   |                  |                 | 4.5 V           | 12                     | 3    | —   | 15             | —   | 18              | —   |      |
|                                                   |                  |                 | 6.0 V           | 10                     | 2    | —   | 13             | —   | 15              | —   |      |
| t <sub>H</sub><br>Hold Time                       | DSA or DSB to CP | Figure 1        | 2.0 V           | 4                      | -6   | —   | 4              | —   | 4               | —   | ns   |
|                                                   |                  |                 | 4.5 V           | 4                      | -2   | —   | 4              | —   | 4               | —   |      |
|                                                   |                  |                 | 6.0 V           | 4                      | -2   | —   | 4              | —   | 4               | —   |      |
| t <sub>PD</sub><br>Propagation Delay              | CP to Qn         | Figure 1        | 2.0 V           | —                      | 41   | 170 | —              | 215 | —               | 255 | ns   |
|                                                   |                  |                 | 4.5 V           | —                      | 15   | 34  | —              | 43  | —               | 51  |      |
|                                                   |                  |                 | 5.0 V           | —                      | 12   | —   | —              | —   | —               | —   |      |
|                                                   |                  |                 | 6.0 V           | —                      | 12   | 29  | —              | 37  | —               | 43  |      |
| t <sub>rec</sub><br>Recovery Time                 | MR to CP         |                 | 2.0 V           | 60                     | 17   | —   | 75             | —   | 90              | —   | ns   |
|                                                   |                  |                 | 4.5 V           | 12                     | 6    | —   | 15             | —   | 18              | —   |      |
|                                                   |                  |                 | 6.0 V           | 10                     | 5    | —   | 13             | —   | 15              | —   |      |
| t <sub>PHL</sub><br>HIGH to LOW Propagation Delay | MR to Qn         | Figure 1        | 2.0 V           | —                      | 39   | 140 | —              | 175 | —               | 210 | ns   |
|                                                   |                  |                 | 4.5 V           | —                      | 14   | 28  | —              | 35  | —               | 42  |      |
|                                                   |                  |                 | 5.0 V           | —                      | 11   | —   | —              | —   | —               | —   |      |
|                                                   |                  |                 | 6.0 V           | —                      | 11   | 24  | —              | 30  | —               | 36  |      |
| t <sub>T</sub><br>Transition Time                 | All signals      | Figure 1        | 2.0 V           | —                      | 19   | 75  | —              | 95  | —               | 110 | ns   |
|                                                   |                  |                 | 4.5 V           | —                      | 7    | 15  | —              | 19  | —               | 22  |      |
|                                                   |                  |                 | 6.0 V           | —                      | 6    | 13  | —              | 16  | —               | 19  |      |

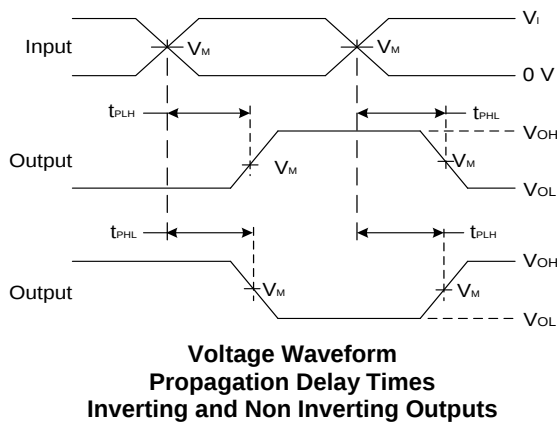
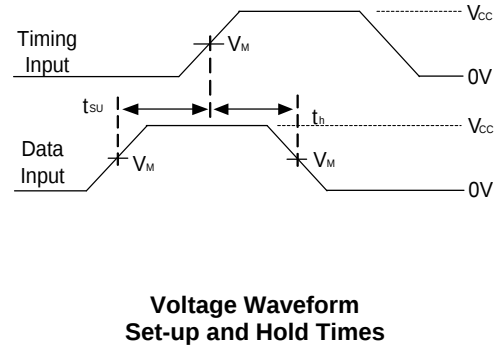
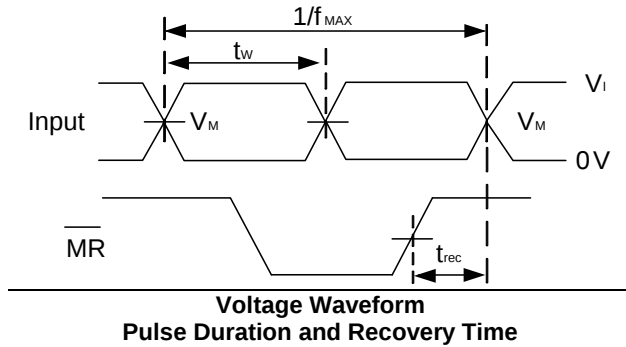
## Operating Characteristics (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Parameter       |                                        | Test Conditions                           | V <sub>CC</sub> = 6V | Unit |
|-----------------|----------------------------------------|-------------------------------------------|----------------------|------|
|                 |                                        |                                           | Typ                  |      |
| C <sub>pd</sub> | Power Dissipation Capacitance per Gate | f = 1 MHz                                 | 40                   | pF   |
| C <sub>I</sub>  | Input Capacitance                      | V <sub>I</sub> = V <sub>CC</sub> – or GND | 3.5                  | pF   |

## Parameter Measurement Information



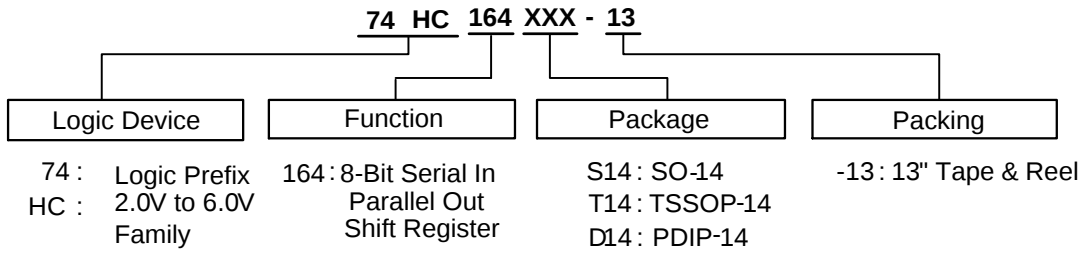
| $V_{CC}$ | Inputs   |           | $V_M$      | $C_L$ |
|----------|----------|-----------|------------|-------|
|          | $V_I$    | $t_r/t_f$ |            |       |
| 2.0V     | $V_{CC}$ | 6ns       | $V_{CC}/2$ | 50pF  |
| 4.5V     | $V_{CC}$ | 6ns       | $V_{CC}/2$ | 50pF  |
| 5.0V     | $V_{CC}$ | 6ns       | $V_{CC}/2$ | 15pF  |
| 6.0V     | $V_{CC}$ | 6ns       | $V_{CC}/2$ | 50pF  |



- Notes:
- A. Includes test lead and test apparatus capacitance.
  - B. All pulses are supplied at pulse repetition rate  $\leq 10$  MHz.
  - C. Inputs are measured separately, one transition per measurement.
  - D.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{PD}$ .
  - E. Transition times  $t_r$ ,  $t_{th}$ ,  $t_{tl}$  are measured from the 10% to 90% or 90% to 10% of the appropriate waveform.

Figure 1 Load Circuit and Voltage Waveforms

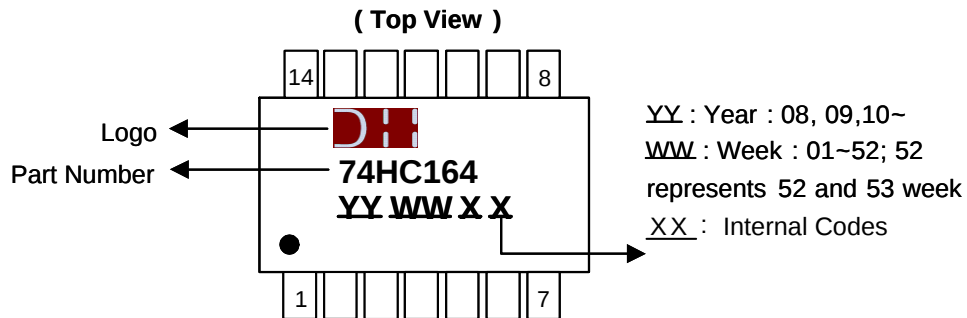
## Ordering Information



| Device        | Package Code | Packaging | Packing           |                    |
|---------------|--------------|-----------|-------------------|--------------------|
|               |              |           | Quantity          | Part Number Suffix |
| 74HC164S14-13 | S14          | SO-14     | 2,500/Tape & Reel | -13                |
| 74HC164T14-13 | T14          | TSSOP-14  | 2,500/Tape & Reel | -13                |
| 74HC164D14    | D14          | PDIP-14   | TUBE              | No Suffix          |

## Marking Information

(1) SO-14, TSSOP-14, PDIP-14

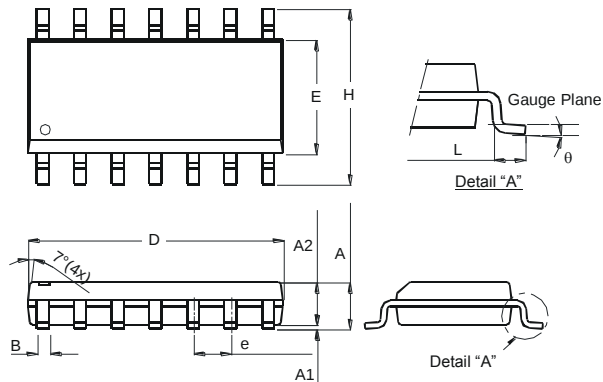


| Part Number   | Package  |
|---------------|----------|
| 74HC164S14-13 | SO-14    |
| 74HC164T14-13 | TSSOP-14 |
| 74HC164D14    | PDIP-14  |

## Package Outline Dimensions (All dimensions in mm.)

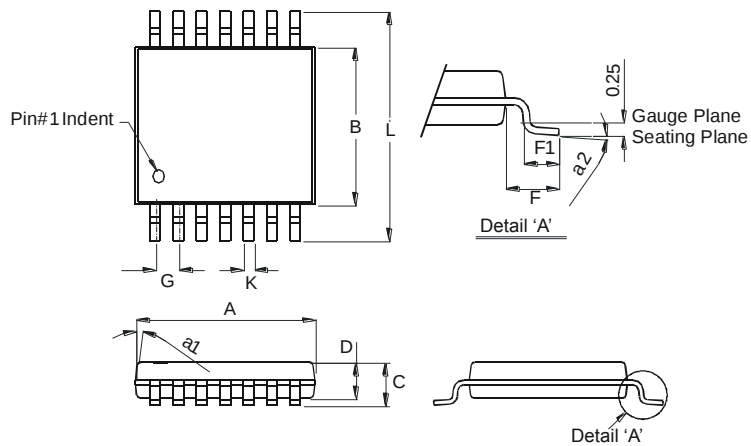
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.

### Package Type: SO-14



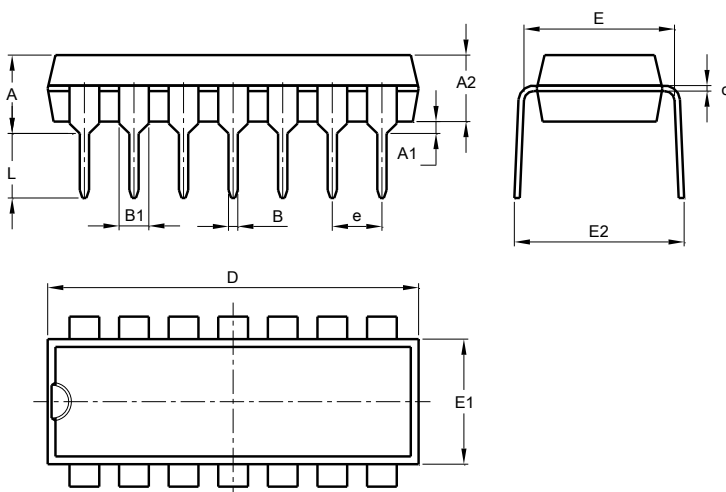
| SO-14                |          |      |
|----------------------|----------|------|
| Dim                  | Min      | Max  |
| A                    | 1.47     | 1.73 |
| A1                   | 0.10     | 0.25 |
| A2                   | 1.45 Typ |      |
| B                    | 0.33     | 0.51 |
| D                    | 8.53     | 8.74 |
| E                    | 3.80     | 3.99 |
| e                    | 1.27 Typ |      |
| H                    | 5.80     | 6.20 |
| L                    | 0.38     | 1.27 |
| θ                    | 0°       | 8°   |
| All Dimensions in mm |          |      |

### Package Type: TSSOP-14



| TSSOP-14             |          |      |
|----------------------|----------|------|
| Dim                  | Min      | Max  |
| a1                   | 7° (4X)  |      |
| a2                   | 0°       | 8°   |
| A                    | 4.9      | 5.10 |
| B                    | 4.30     | 4.50 |
| C                    | —        | 1.2  |
| D                    | 0.8      | 1.05 |
| F                    | 1.00 Typ |      |
| F1                   | 0.45     | 0.75 |
| G                    | 0.65 Typ |      |
| K                    | 0.19     | 0.30 |
| L                    | 6.40 Typ |      |
| All Dimensions in mm |          |      |

### Package Type: PDIP-14

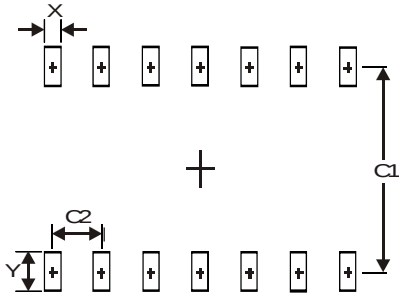


| PDIP-14              |             |        |
|----------------------|-------------|--------|
| Dim                  | Min         | Max    |
| A                    | 3.710       | 4.310  |
| A1                   | 0.510       | -      |
| A2                   | 3.200       | 3.600  |
| B                    | 0.380       | 0.570  |
| B1                   | 1.524 (BSC) |        |
| c                    | 0.204       | 0.360  |
| D                    | 18.800      | 19.200 |
| E                    | 6.200       | 6.600  |
| E1                   | 7.320       | 7.920  |
| E2                   | 8.400       | 9.000  |
| e                    | 2.540 (BSC) |        |
| L                    | 3.000       | 3.600  |
| All Dimensions in mm |             |        |

## Suggested Pad Layout

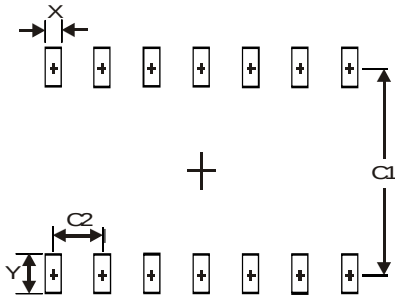
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

Package Type: SO-14



| Dimensions | Value (in mm) |
|------------|---------------|
| X          | 0.60          |
| Y          | 1.50          |
| C1         | 5.4           |
| C2         | 1.27          |

Package Type: TSSOP-14



| Dimensions | Value (in mm) |
|------------|---------------|
| X          | 0.45          |
| Y          | 1.45          |
| C1         | 5.9           |
| C2         | 0.65          |

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