

February 1998 - Revised October 2003

## High-Speed CMOS Logic Quad Analog Switch with Level Translation

### Features

- **Wide Analog-Input-Voltage Range**  
 $V_{CC} - V_{EE}$  ..... 0V to 10V
- **Low "ON" Resistance**
  - 45Ω (Typ) .....  $V_{CC} = 4.5V$
  - 35Ω (Typ) .....  $V_{CC} = 6V$
  - 30Ω (Typ) .....  $V_{CC} - V_{EE} = 9V$
- **Fast Switching and Propagation Delay Times**
- **Low "OFF" Leakage Current**
- **Built-In "Break-Before-Make" Switching**
- **Logic-Level Translation to Enable 5V Logic to Accommodate ±5V Analog Signals**
- **Wide Operating Temperature Range . . . -55°C to 125°C**
- **HC Types**
  - 2V to 10V Operation
  - **High Noise Immunity:  $N_{IL} = 30\%$ ,  $N_{IH} = 30\%$  of  $V_{CC}$  at  $V_{CC} = 5V$**
- **HCT Types**
  - **Direct LSTTL Input Logic Compatibility,  $V_{IL} = 0.8V$  (Max),  $V_{IH} = 2V$  (Min)**
  - **CMOS Input Compatibility,  $I_I \leq 1\mu A$  at  $V_{OL}$ ,  $V_{OH}$**

### Description

The 'HC4316 and CD74HCT4316 contain four independent digitally controlled analog switches that use silicon-gate CMOS technology to achieve operating speeds similar to LSTTL with the low power consumption of standard CMOS integrated circuits.

In addition these devices contain logic-level translation circuits that provide for analog signal switching of voltages between  $\pm 5V$  via 5V logic. Each switch is turned on by a high-level voltage on its select input (S) when the common Enable (E) is Low. A High E disables all switches. The digital inputs can swing between  $V_{CC}$  and GND; the analog inputs/outputs can swing between  $V_{CC}$  as a positive limit and  $V_{EE}$  as a negative limit. Voltage ranges are shown in Figures 2 and 3.

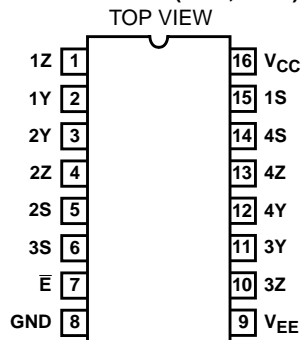
### Ordering Information

| PART NUMBER    | TEMP. RANGE (°C) | PACKAGE      |
|----------------|------------------|--------------|
| CD54HC4316F3A  | -55 to 125       | 16 Ld CERDIP |
| CD74HC4316E    | -55 to 125       | 16 Ld PDIP   |
| CD74HC4316M    | -55 to 125       | 16 Ld SOIC   |
| CD74HC4316MT   | -55 to 125       | 16 Ld SOIC   |
| CD74HC4316M96  | -55 to 125       | 16 Ld SOIC   |
| CD74HC4316NSR  | -55 to 125       | 16 Ld SOP    |
| CD74HC4316PW   | -55 to 125       | 16 Ld TSSOP  |
| CD74HC4316PWR  | -55 to 125       | 16 Ld TSSOP  |
| CD74HC4316PWT  | -55 to 125       | 16 Ld TSSOP  |
| CD74HCT4316E   | -55 to 125       | 16 Ld PDIP   |
| CD74HCT4316M   | -55 to 125       | 16 Ld SOIC   |
| CD74HCT4316MT  | -55 to 125       | 16 Ld SOIC   |
| CD74HCT4316M96 | -55 to 125       | 16 Ld SOIC   |

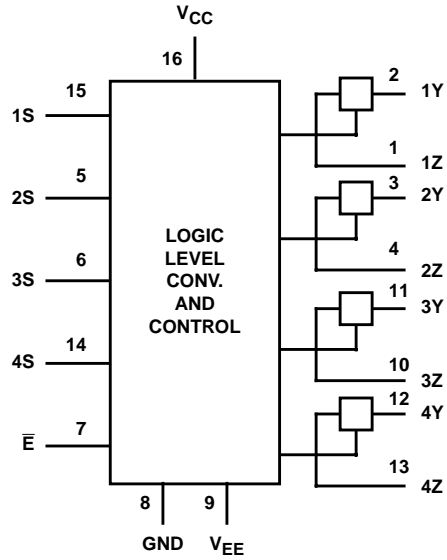
NOTE: When ordering, use the entire part number. The suffixes 96 and R denote tape and reel. The suffix T denotes a small-quantity reel of 250.

### Pinout

CD54HC4316 (CERDIP)  
 CD74HC4316 (PDIP, SOIC, SOP, TSSOP)  
 CD74HCT4316 (PDIP, SOIC)



Functional Diagram



TRUTH TABLE

| INPUTS    |   | SWITCH |
|-----------|---|--------|
| $\bar{E}$ | S |        |
| L         | L | OFF    |
| L         | H | ON     |
| H         | X | OFF    |

H= High Level Voltage  
 L= Low Level Voltage  
 X= Don't Care

Logic Diagram

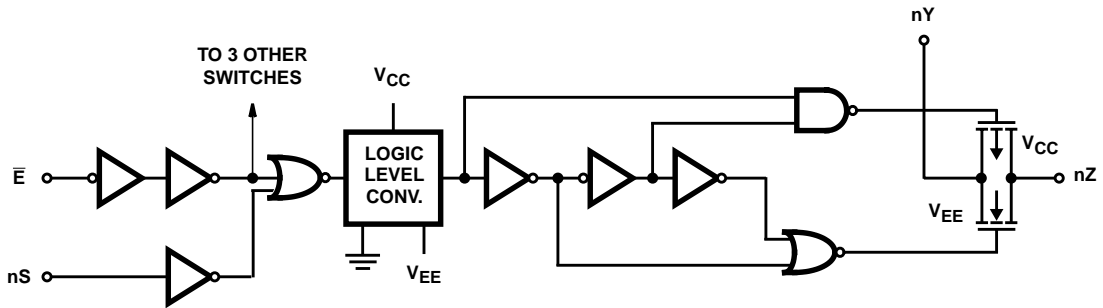


FIGURE 1. ONE SWITCH

# CD54HC4316, CD74HC4316, CD74HCT4316

## Absolute Maximum Ratings

|  |                |
|--|----------------|
| DC Supply Voltage, $V_{CC}$ .....                        | -0.5V to 7V    |
| DC Supply Voltage, $V_{CC} - V_{EE}$ .....               | -0.5V to 10.5V |
| DC Supply Voltage, $V_{EE}$ .....                        | 0.5V to -7V    |
| DC Input Diode Current, $I_{IK}$                         |                |
| For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$ .....         | $\pm 20mA$     |
| DC Switch Diode Current, $I_{OK}$                        |                |
| For $V_I < V_{EE} - 0.5V$ or $V_I < V_{CC} + 0.5V$ ..... | $\pm 25mA$     |
| DC Switch Diode Current                                  |                |
| For $V_I > V_{EE} - 0.5V$ or $V_I < V_{CC} + 0.5V$ ..... | $\pm 25mA$     |
| DC Output Diode Current, $I_{OK}$                        |                |
| For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$ .....         | $\pm 20mA$     |
| DC Output Source or Sink Current per Output Pin, $I_O$   |                |
| For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$ .....         | $\pm 25mA$     |
| DC $V_{CC}$ or Ground Current, $I_{CC}$ .....            | $\pm 50mA$     |

## Operating Conditions

|   |                 |
|---|-----------------|
| Temperature Range, $T_A$ .....            | -55°C to 125°C  |
| Supply Voltage Range, $V_{CC}$            |                 |
| HC Types .....                            | .2V to 6V       |
| HCT Types .....                           | 4.5V to 5.5V    |
| Supply Voltage Range, $V_{CC} - V_{EE}$   |                 |
| HC, HCT Types (Figure 2) .....            | .2V to 10V      |
| Supply Voltage Range, $V_{EE}$            |                 |
| HC, HCT Types (Figure 3) .....            | 0V to -6V       |
| DC Input or Output Voltage, $V_I$ .....   | GND to $V_{CC}$ |
| Analog Switch I/O Voltage, $V_{IS}$ ..... | $V_{EE}$ (Min)  |
| .....                                     | $V_{CC}$ (Max)  |
| Input Rise and Fall Time, $t_r, t_f$      |                 |
| 2V .....                                  | 1000ns (Max)    |
| 4.5V .....                                | 500ns (Max)     |
| 6V .....                                  | 400ns (Max)     |

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

### NOTE:

1. The package thermal impedance is calculated in accordance with JESD 51-7.

## Thermal Information

|  |               |
|--|---------------|
| Package Thermal Impedance, $\theta_{JA}$ (see Note 1): |               |
| E (PDIP) Package .....                                 | 67°C/W        |
| M (SOIC) Package .....                                 | 73°C/W        |
| NS (SOP) Package .....                                 | 64°C/W        |
| PW (TSSOP) Package .....                               | 108°C/W       |
| Maximum Junction Temperature (Plastic Package) .....   | 150°          |
| Maximum Storage Temperature Range .....                | -65°C to 150° |
| Maximum Lead Temperature (Soldering 10s) .....         | 300°          |
| SOIC - Lead Tips Only                                  |               |

## Recommended Operating Area as a Function of Supply Voltage

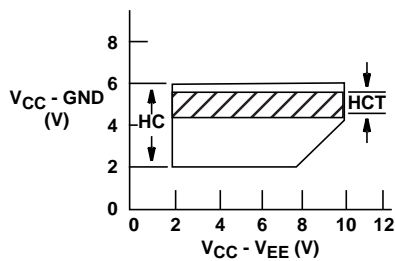


FIGURE 2.

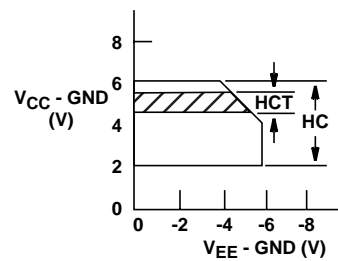


FIGURE 3.

**CD54HC4316, CD74HC4316, CD74HCT4316**

**DC Electrical Specifications**

| PARAMETER  | SYMBOL           | TEST CONDITIONS                       |  |                     |                     | 25°C |     |      | -40°C TO 85°C |      | -55°C TO 125°C |      | UNITS |
|--|------------------|---------------------------------------|--|---------------------|---------------------|------|-----|------|---------------|------|----------------|------|-------|
|  |                  | V <sub>I</sub> (V)                    | V <sub>IS</sub> (V)  | V <sub>EE</sub> (V) | V <sub>CC</sub> (V) | MIN  | TYP | MAX  | MIN           | MAX  | MIN            | MAX  |       |
| <b>HC TYPES</b>  |                  |                                       |  |                     |                     |      |     |      |               |      |                |      |       |
| High Level Input Voltage   | V <sub>IH</sub>  | -                                     | -  | -                   | 2                   | 1.5  | -   | -    | 1.5           | -    | 1.5            | -    | V     |
|  |                  |                                       |  |                     | 4.5                 | 3.15 | -   | -    | 3.15          | -    | 3.15           | -    | V     |
|  |                  |                                       |  |                     | 6                   | 4.2  | -   | -    | 4.2           | -    | 4.2            | -    | V     |
| Low Level Input Voltage  | V <sub>IL</sub>  | -                                     | -  | -                   | 2                   | -    | -   | 0.5  | -             | 0.5  | -              | 0.5  | V     |
|  |                  |                                       |  |                     | 4.5                 | -    | -   | 1.35 | -             | 1.35 | -              | 1.35 | V     |
|  |                  |                                       |  |                     | 6                   | -    | -   | 1.8  | -             | 1.8  | -              | 1.8  | V     |
| “ON” Resistance<br>I <sub>O</sub> = 1mA<br>(Figures 4, 5)                        | R <sub>ON</sub>  | V <sub>IH</sub> or<br>V <sub>IL</sub> | V <sub>CC</sub> or<br>V <sub>EE</sub>  | 0                   | 4.5                 | -    | 45  | 180  | -             | 225  | -              | 270  | Ω     |
|  |                  |                                       |  | 0                   | 6                   | -    | 35  | 160  | -             | 200  | -              | 240  | Ω     |
|  |                  |                                       |  | -4.5                | 4.5                 | -    | 30  | 135  | -             | 170  | -              | 205  | Ω     |
|  |                  |                                       | V <sub>CC</sub> to<br>V <sub>EE</sub>  | 0                   | 4.5                 | -    | 85  | 320  | -             | 400  | -              | 480  | Ω     |
|  |                  |                                       |  | 0                   | 6                   | -    | 55  | 240  | -             | 300  | -              | 360  | Ω     |
|  |                  |                                       |  | -4.5                | 4.5                 | -    | 35  | 170  | -             | 215  | -              | 255  | Ω     |
| Maximum “ON”<br>Resistance Between<br>Any Two Channels                           | ΔR <sub>ON</sub> | -                                     | -  | 0                   | 4.5                 | -    | 10  | -    | -             | -    | -              | -    | Ω     |
|  |                  |                                       |  | 0                   | 6                   | -    | 8.5 | -    | -             | -    | -              | -    | Ω     |
|  |                  |                                       |  | -4.5                | 4.5                 | -    | 5   | -    | -             | -    | -              | -    | Ω     |
| Switch Off Leakage<br>Current  | I <sub>IZ</sub>  | V <sub>IH</sub> or<br>V <sub>IL</sub> | V <sub>CC</sub> -<br>V <sub>EE</sub>   | 0                   | 6                   | -    | -   | ±0.1 | -             | ±1   | -              | ±1   | μA    |
|  |                  |                                       |  | -5                  | 5                   | -    | -   | ±0.1 | -             | ±1   | -              | ±1   | μA    |
| Control Input Leakage<br>Current   | I <sub>IL</sub>  | V <sub>CC</sub> or<br>GND             | -  | 0                   | 6                   | -    | -   | ±0.1 | -             | ±1   | -              | ±1   | μA    |
| Quiescent Device<br>Current<br>I <sub>O</sub> = 0                                | I <sub>CC</sub>  | V <sub>CC</sub> or<br>GND             | When<br>V <sub>IS</sub> = V <sub>EE</sub> ,<br>V <sub>OS</sub> = V <sub>CC</sub> | 0                   | 6                   | -    | -   | 8    | -             | 80   | -              | 160  | μA    |
|  |                  |                                       |  | -5                  | 5                   | -    | -   | 16   | -             | 160  | -              | 320  | μA    |
| When<br>V <sub>IS</sub> = V <sub>CC</sub> ,<br>V <sub>OS</sub> = V <sub>EE</sub> |                  |                                       |  | 0                   | 6                   | -    | -   | 8    | -             | 80   | -              | 160  | μA    |
|  |                  |                                       |  | -5                  | 5                   | -    | -   | 16   | -             | 160  | -              | 320  | μA    |
| <b>HCT TYPES</b>   |                  |                                       |  |                     |                     |      |     |      |               |      |                |      |       |
| High Level Input<br>Voltage  | V <sub>IH</sub>  | -                                     | -  | -                   | 4.5 to<br>5.5       | 2    | -   | -    | 2             | -    | 2              | -    | V     |
| Low Level Input<br>Voltage   | V <sub>IL</sub>  | -                                     | -  | -                   | 4.5 to<br>5.5       | -    | -   | 0.8  | -             | 0.8  | -              | 0.8  | V     |
| “ON” Resistance<br>I <sub>O</sub> = 1mA<br>(Figures 4, 5)                        | R <sub>ON</sub>  | V <sub>IH</sub> or<br>V <sub>IL</sub> | V <sub>CC</sub> or<br>V <sub>EE</sub>  | 0                   | 4.5                 | -    | 45  | 180  | -             | 225  | -              | 270  | Ω     |
|  |                  |                                       |  | -4.5                | 4.5                 | -    | 30  | 135  | -             | 170  | -              | 205  | Ω     |
|  |                  |                                       | V <sub>CC</sub> to<br>V <sub>EE</sub>  | 0                   | 4.5                 | -    | 85  | 320  | -             | 400  | -              | 480  | Ω     |
|  |                  |                                       |  | -4.5                | 4.5                 | -    | 35  | 170  | -             | 215  | -              | 255  | Ω     |
| Maximum “ON”<br>Resistance Between<br>Any Two Channels                           | ΔR <sub>ON</sub> | -                                     | -  | 0                   | 4.5                 | -    | 10  | -    | -             | -    | -              | -    | Ω     |
|  |                  |                                       |  | -4.5                | 4.5                 | -    | 5   | -    | -             | -    | -              | -    | Ω     |
| Switch Off Leakage<br>Current  | I <sub>IZ</sub>  | V <sub>IH</sub> or<br>V <sub>IL</sub> | V <sub>CC</sub> -<br>V <sub>EE</sub>   | 0                   | 6                   | -    | -   | ±0.1 | -             | ±1   | -              | ±1   | μA    |
|  |                  |                                       |  | -5                  | 5                   | -    | -   | ±0.1 | -             | ±1   | -              | ±1   | μA    |

**CD54HC4316, CD74HC4316, CD74HCT4316**

**DC Electrical Specifications (Continued)**

| PARAMETER  | SYMBOL                    | TEST CONDITIONS                             |   |                     |                     | 25°C |     |      | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|--|---------------------------|---|---|---------------------|---------------------|------|-----|------|---------------|-----|----------------|-----|-------|
|  |                           | V <sub>I</sub> (V)                          | V <sub>IS</sub> (V)   | V <sub>EE</sub> (V) | V <sub>CC</sub> (V) | MIN  | TYP | MAX  | MIN           | MAX | MIN            | MAX |       |
| Control Input Leakage Current                                  | I <sub>I</sub>            | V <sub>CC</sub> or GND                      | -   | 0                   | 5.5                 | -    | -   | ±0.1 | -             | ±1  | -              | ±1  | μA    |
| Quiescent Device Current<br>I <sub>O</sub> = 0                 | I <sub>CC</sub>           | Any Voltage Between V <sub>CC</sub> and GND | When V <sub>IS</sub> = V <sub>EE</sub> ,<br>V <sub>OS</sub> = V <sub>CC</sub> | 0                   | 5.5                 | -    | -   | 8    | -             | 80  | -              | 160 | μA    |
|  |                           |   | When V <sub>IS</sub> = V <sub>CC</sub> ,<br>V <sub>OS</sub> = V <sub>EE</sub> | -4.5                | 5.5                 | -    | -   | 16   | -             | 160 | -              | 320 | μA    |
| Additional Quiescent Device Current Per Input Pin: 1 Unit Load | ΔI <sub>CC</sub> (Note 2) | V <sub>CC</sub> -2.1                        | -   | -                   | 4.5 to 5.5          | -    | 100 | 360  | -             | 450 | -              | 490 | μA    |

NOTE:

- For dual-supply systems theoretical worst case (V<sub>I</sub> = 2.4V, V<sub>CC</sub> = 5.5V) specification is 1.8mA.

**HCT Input Loading Table**

| INPUT | UNIT LOADS |
|-------|------------|
| All   | 0.5        |

NOTE: Unit Load is ΔI<sub>CC</sub> limit specified in DC Electrical Table, e.g., 360μA max at 25°C.

**Switching Specifications** Input t<sub>r</sub>, t<sub>f</sub> = 6ns

| PARAMETER                           | SYMBOL                              | TEST CONDITIONS       | V <sub>EE</sub> (V) | V <sub>CC</sub> (V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|-------------------------------------|-------------------------------------|-----------------------|---------------------|---------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|                                     |                                     |                       |                     |                     | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| <b>HC TYPES</b>                     |                                     |                       |                     |                     |      |     |     |               |     |                |     |       |
| Propagation Delay, Switch In to Out | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 0                   | 2                   | -    | -   | 60  | -             | 75  | -              | 90  | ns    |
|                                     |                                     |                       | 0                   | 4.5                 | -    | -   | 12  | -             | 15  | -              | 18  | ns    |
|                                     |                                     |                       | 0                   | 6                   | -    | -   | 10  | -             | 13  | -              | 15  | ns    |
|                                     |                                     |                       | -4.5                | 4.5                 | -    | -   | 8   | -             | 10  | -              | 12  | ns    |
| Turn "ON" Time $\bar{E}$ to Out     | t <sub>PZH</sub> , t <sub>PZL</sub> | C <sub>L</sub> = 50pF | 0                   | 2                   | -    | -   | 205 | -             | 255 | -              | 310 | ns    |
|                                     |                                     |                       | 0                   | 4.5                 | -    | -   | 41  | -             | 51  | -              | 62  | ns    |
|                                     |                                     |                       | 0                   | 6                   | -    | -   | 35  | -             | 43  | -              | 53  | ns    |
|                                     |                                     |                       | -4.5                | 4.5                 | -    | -   | 37  | -             | 47  | -              | 56  | ns    |
|                                     |                                     | C <sub>L</sub> = 15pF | -                   | 5                   | -    | 17  | -   | -             | -   | -              | -   | ns    |
| Turn "ON" Time nS to Out            | t <sub>PZH</sub> , t <sub>PZL</sub> | C <sub>L</sub> = 50pF | 0                   | 2                   | -    | -   | 175 | -             | 220 | -              | 265 | ns    |
|                                     |                                     |                       | 0                   | 4.5                 | -    | -   | 35  | -             | 44  | -              | 53  | ns    |
|                                     |                                     |                       | 0                   | 6                   | -    | -   | 30  | -             | 37  | -              | 45  | ns    |
|                                     |                                     |                       | -4.5                | 4.5                 | -    | -   | 34  | -             | 43  | -              | 51  | ns    |
|                                     |                                     | C <sub>L</sub> = 15pF | -                   | 5                   | -    | 14  | -   | -             | -   | -              | -   | ns    |
| Turn "OFF" Time $\bar{E}$ to Out    | t <sub>PLZ</sub> , t <sub>PHZ</sub> | C <sub>L</sub> = 50pF | 0                   | 2                   | -    | -   | 205 | -             | 255 | -              | 310 | ns    |
|                                     |                                     |                       | 0                   | 4.5                 | -    | -   | 41  | -             | 51  | -              | 62  | ns    |
|                                     |                                     |                       | 0                   | 6                   | -    | -   | 35  | -             | 43  | -              | 53  | ns    |
|                                     |                                     |                       | -4.5                | 4.5                 | -    | -   | 37  | -             | 47  | -              | 56  | ns    |
|                                     |                                     | C <sub>L</sub> = 15pF | -                   | 5                   | -    | 17  | -   | -             | -   | -              | -   | ns    |

**CD54HC4316, CD74HC4316, CD74HCT4316**

**Switching Specifications** Input  $t_r, t_f = 6\text{ns}$  (Continued)

| PARAMETER                                  | SYMBOL                              | TEST CONDITIONS       | V <sub>EE</sub> (V) | V <sub>CC</sub> (V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|--|-------------------------------------|-----------------------|---------------------|---------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|  |                                     |                       |                     |                     | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| Turn "OFF" Time nS to Out                  | t <sub>PLZ</sub> , t <sub>PHZ</sub> | C <sub>L</sub> = 50pF | 0                   | 2                   | -    | -   | 175 | -             | 220 | -              | 265 | ns    |
|  |                                     |                       | 0                   | 4.5                 | -    | -   | 35  | -             | 44  | -              | 53  | ns    |
|  |                                     |                       | 0                   | 6                   | -    | -   | 30  | -             | 37  | -              | 45  | ns    |
|  |                                     |                       | -4.5                | 4.5                 | -    | -   | 34  | -             | 43  | -              | 51  | ns    |
|  |                                     | C <sub>L</sub> = 15pF | -                   | 5                   | -    | 14  | -   | -             | -   | -              | -   | ns    |
| Input (Control) Capacitance                | C <sub>I</sub>                      | -                     | -                   | -                   | -    | 10  | -   | 10            | -   | 10             | pF  |       |
| Power Dissipation Capacitance (Notes 3, 4) | C <sub>PD</sub>                     | -                     | -                   | 5                   | -    | 42  | -   | -             | -   | -              | pF  |       |
| <b>HCT TYPES</b>                           |                                     |                       |                     |                     |      |     |     |               |     |                |     |       |
| Propagation Delay, Switch In to Switch Out | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 0                   | 4.5                 | -    | -   | 12  | -             | 15  | -              | 18  | ns    |
|  |                                     |                       | -4.5                | 4.5                 | -    | -   | 8   | -             | 10  | -              | 12  | ns    |
| Turn "ON" Time $\bar{E}$ to Out            | t <sub>PZH</sub>                    | C <sub>L</sub> = 50pF | 0                   | 4.5                 | -    | -   | 44  | -             | 55  | -              | 66  | ns    |
|  |                                     |                       | -4.5                | 4.5                 | -    | -   | 42  | -             | 53  | -              | 63  | ns    |
|  |                                     | C <sub>L</sub> = 15pF | -                   | 5                   | -    | 18  | -   | -             | -   | -              | -   | ns    |
|  | t <sub>PZL</sub>                    | C <sub>L</sub> = 50pF | 0                   | 4.5                 | -    | -   | 56  | -             | 70  | -              | 85  | ns    |
|  |                                     |                       | -4.5                | 4.5                 | -    | -   | 42  | -             | 53  | -              | 63  | ns    |
|  |                                     | C <sub>L</sub> = 15pF | -                   | 5                   | -    | 24  | -   | -             | -   | -              | -   | ns    |
| Turn "ON" Time nS to Out                   | t <sub>PZH</sub>                    | C <sub>L</sub> = 50pF | 0                   | 4.5                 | -    | -   | 40  | -             | 53  | -              | 60  | ns    |
|  |                                     |                       | -4.5                | 4.5                 | -    | -   | 34  | -             | 43  | -              | 51  | ns    |
|  |                                     | C <sub>L</sub> = 15pF | -                   | 5                   | -    | 17  | -   | -             | -   | -              | -   | ns    |
|  | t <sub>PZL</sub>                    | C <sub>L</sub> = 50pF | 0                   | 4.5                 | -    | -   | 50  | -             | 63  | -              | 75  | ns    |
|  |                                     |                       | -4.5                | 4.5                 | -    | -   | 34  | -             | 43  | -              | 51  | ns    |
|  |                                     | C <sub>L</sub> = 15pF | -                   | 5                   | -    | 18  | -   | -             | -   | -              | -   | ns    |
| Turn "OFF" Time $\bar{E}$ to Out           | t <sub>PLZ</sub>                    | C <sub>L</sub> = 50pF | 0                   | 4.5                 | -    | -   | 50  | -             | 63  | -              | 75  | ns    |
|  |                                     |                       | -4.5                | 4.5                 | -    | -   | 46  | -             | 58  | -              | 69  | ns    |
|  | t <sub>PLZ</sub> , t <sub>PHZ</sub> | C <sub>L</sub> = 15pF | -                   | 5                   | -    | 21  | -   | -             | -   | -              | -   | ns    |
|  |                                     |                       | -                   | 5                   | -    | 21  | -   | -             | -   | -              | -   | ns    |
| Turn "OFF" Time nS to Out                  | t <sub>PHZ</sub>                    | C <sub>L</sub> = 50pF | 0                   | 4.5                 | -    | -   | 44  | -             | 55  | -              | 66  | ns    |
|  |                                     |                       | -4.5                | 4.5                 | -    | -   | 40  | -             | 50  | -              | 60  | ns    |
|  | t <sub>PLZ</sub> , t <sub>PHZ</sub> | C <sub>L</sub> = 15pF | -                   | 5                   | -    | 18  | -   | -             | -   | -              | -   | ns    |
|  |                                     |                       | -                   | 5                   | -    | 18  | -   | -             | -   | -              | -   | ns    |
| Input (Control) Capacitance                | C <sub>I</sub>                      | -                     | -                   | -                   | -    | 10  | -   | 10            | -   | 10             | pF  |       |
| Power Dissipation Capacitance (Notes 3, 4) | C <sub>PD</sub>                     | -                     | -                   | 5                   | -    | 47  | -   | -             | -   | -              | pF  |       |

NOTES:

- C<sub>PD</sub> is used to determine the dynamic power consumption, per package.
- $P_D = C_{PD} V_{CC}^2 f_i + \sum (C_L + C_S) V_{CC}^2 f_o$  where  $f_i$  = input frequency,  $f_o$  = output frequency,  $C_L$  = output load capacitance,  $C_S$  = switch capacitance,  $V_{CC}$  = supply voltage.

**Analog Channel Specifications** T<sub>A</sub> = 25°C

| PARAMETER  | TEST CONDITIONS       | V <sub>CC</sub> (V) | HC4316 | CD74HCT4316 | UNITS |
|--|-----------------------|---------------------|--------|-------------|-------|
| Switch Frequency Response Bandwidth at -3dB (Figure 6) | Figure 9 (Notes 5, 6) | 4.5                 | >200   | >200        | MHz   |
| Crosstalk Between Any Two Switches (Figure 7)          | Figure 8 (Notes 6, 7) | 4.5                 | TBE    | TBE         | dB    |

# CD54HC4316, CD74HC4316, CD74HCT4316

## Analog Channel Specifications $T_A = 25^\circ\text{C}$ (Continued)

| PARAMETER                                  | TEST CONDITIONS                          | $V_{CC}$ (V) | HC4316 | CD74HCT4316 | UNITS |
|--|--|--------------|--------|-------------|-------|
| Total Harmonic Distortion                  | 1kHz, $V_{IS} = 4V_{P-P}$<br>(Figure 10) | 4.5          | 0.078  | 0.078       | %     |
|  | 1kHz, $V_{IS} = 8V_{P-P}$<br>(Figure 10) | 9            | 0.018  | 0.018       | %     |
| Control to Switch Feedthrough Noise        | Figure 11                                | 4.5          | TBE    | TBE         | mV    |
|  |  | 9            | TBE    | TBE         | mV    |
| Switch "OFF" Signal Feedthrough (Figure 7) | Figure 12 (Notes 6, 7)                   | 4.5          | -62    | -62         | dB    |
| Switch Input Capacitance, $C_S$            | -  | -            | 5      | 5           | pF    |

**NOTES:**

5. Adjust input level for 0dBm at output,  $f = 1\text{MHz}$ .
6.  $V_{IS}$  is centered at  $V_{CC}/2$ .
7. Adjust input for 0dBm at  $V_{IS}$ .

## Typical Performance Curves

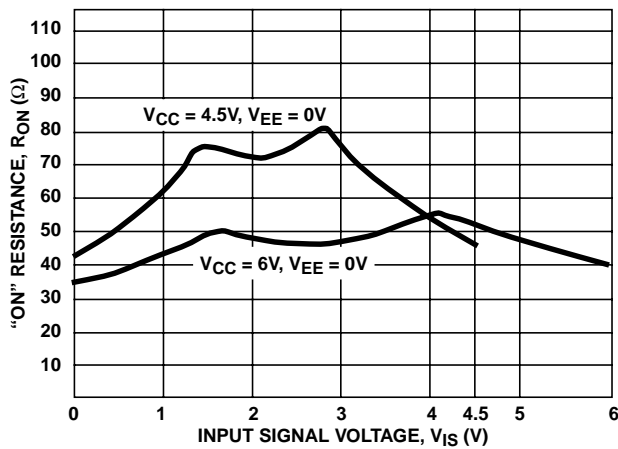


FIGURE 4. TYPICAL "ON" RESISTANCE vs INPUT SIGNAL VOLTAGE

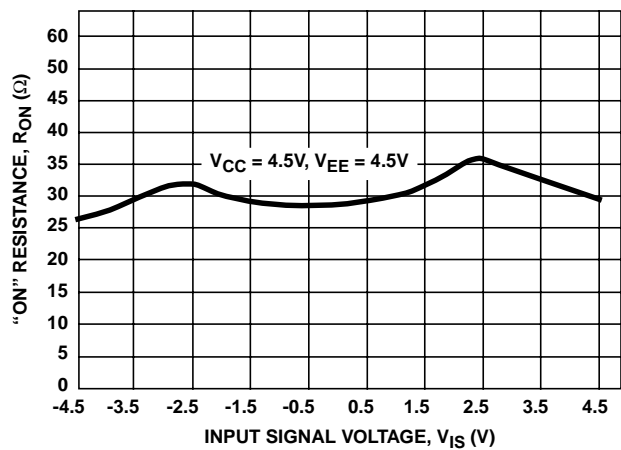


FIGURE 5. TYPICAL "ON" RESISTANCE vs INPUT SIGNAL VOLTAGE

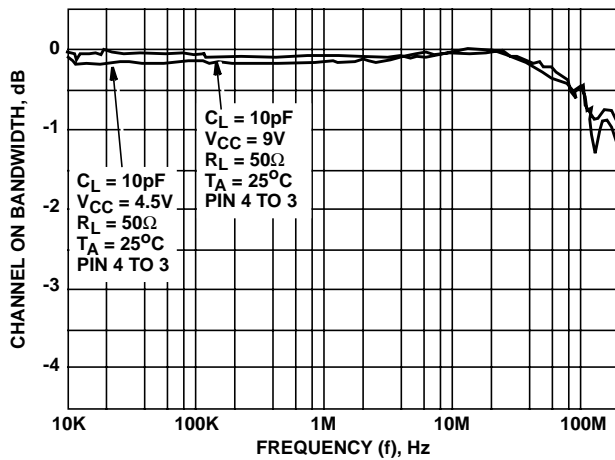


FIGURE 6. SWITCH FREQUENCY RESPONSE

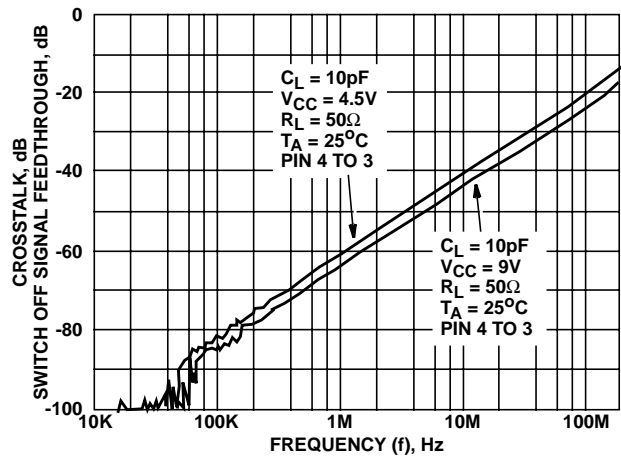


FIGURE 7. SWITCH-OFF SIGNAL FEEDTHROUGH AND CROSSTALK vs FREQUENCY

Analog Test Circuits

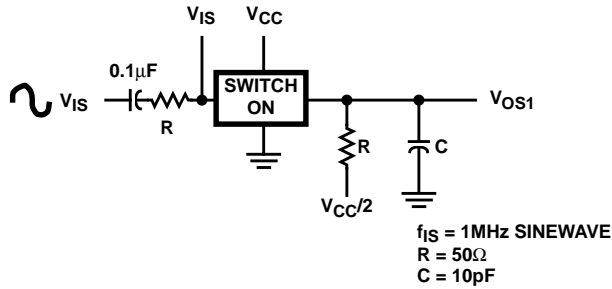


FIGURE 8. CROSTALK BETWEEN TWO SWITCHES TEST CIRCUIT

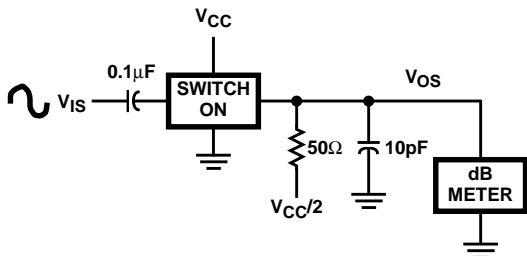
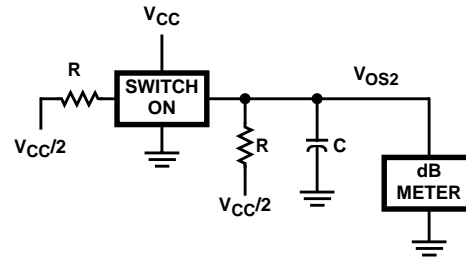


FIGURE 9. FREQUENCY RESPONSE TEST CIRCUIT

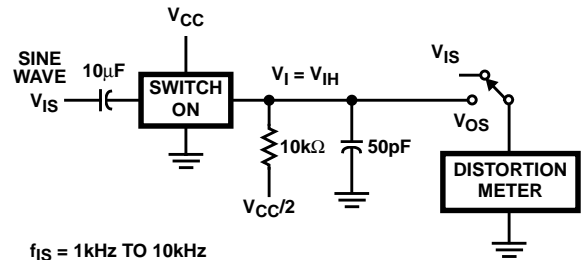


FIGURE 10. TOTAL HARMONIC DISTORTION TEST CIRCUIT

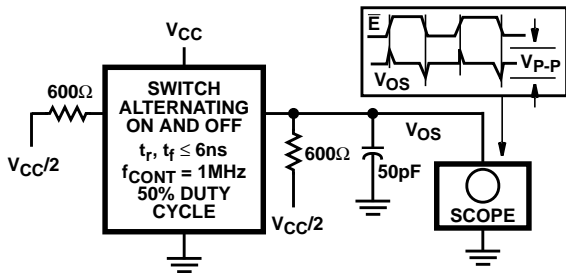


FIGURE 11. CONTROL-TO-SWITCH FEEDTHROUGH NOISE TEST CIRCUIT

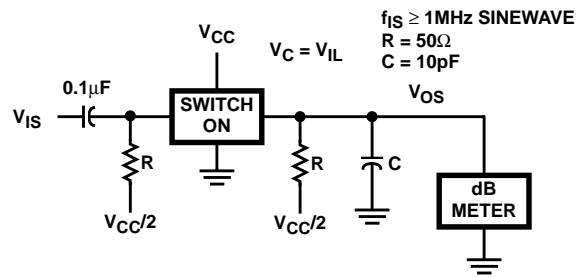


FIGURE 12. SWITCH OFF SIGNAL FEEDTHROUGH

Test Circuits and Waveforms

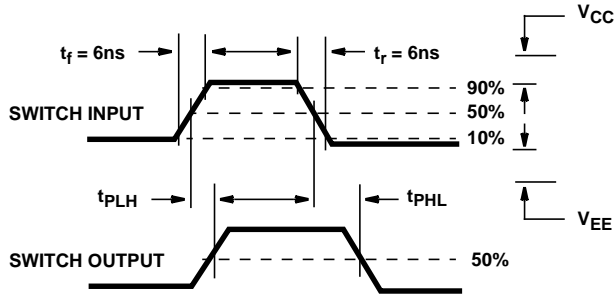


FIGURE 13. SWITCH PROPAGATION DELAY TIMES

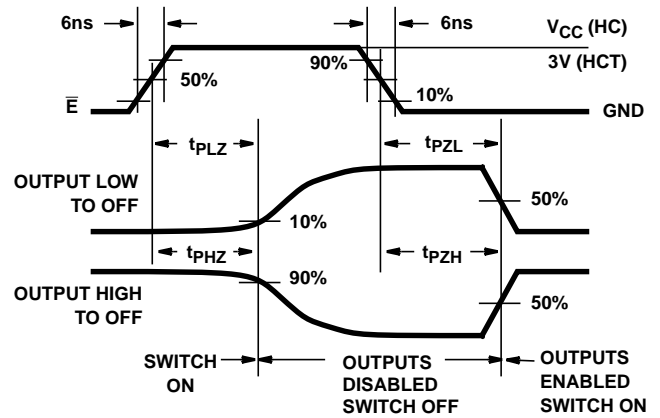
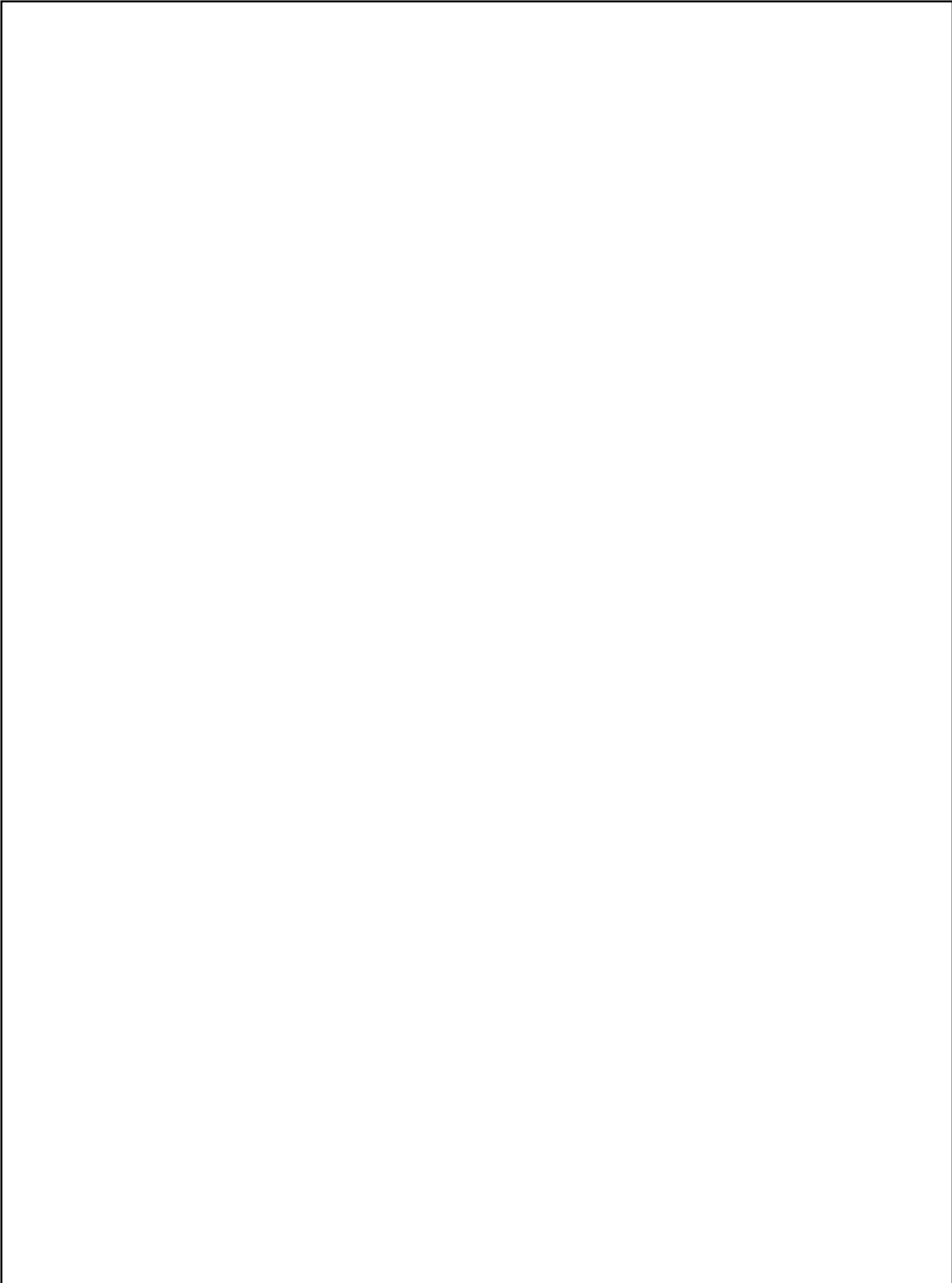


FIGURE 14. SWITCH TURN-ON AND TURN-OFF PROPAGATION DELAY TIMES WAVEFORMS



**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CD54HC4316F3A    | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| CD74HC4316E      | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HC4316EE4    | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HC4316M      | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316M96    | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316M96E4  | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316M96G4  | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316ME4    | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316MG4    | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316MT     | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316MTE4   | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316MTG4   | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316NSR    | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316NSRE4  | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316NSRG4  | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316PW     | ACTIVE                | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316PWE4   | ACTIVE                | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316PWG4   | ACTIVE                | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316PWR    | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316PWRE4  | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316PWRG4  | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316PWT    | ACTIVE                | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316PWTE4  | ACTIVE                | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HC4316PWTG4  | ACTIVE                | TSSOP        | PW              | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT4316E     | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CD74HCT4316EE4   | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| CD74HCT4316M     | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT4316M96   | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT4316M96E4 | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT4316M96G4 | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT4316ME4   | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT4316MG4   | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT4316MT    | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT4316MTE4  | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD74HCT4316MTG4  | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

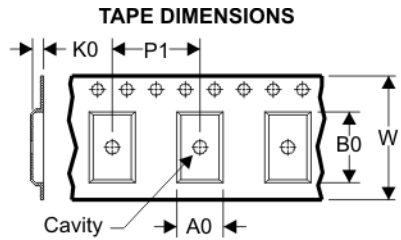
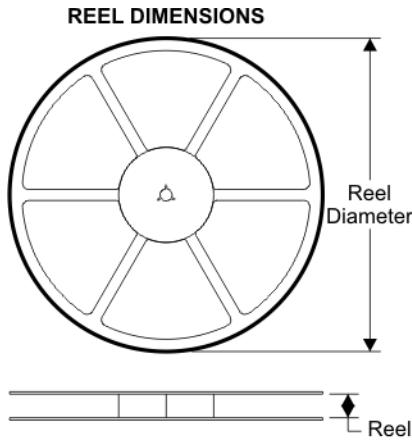
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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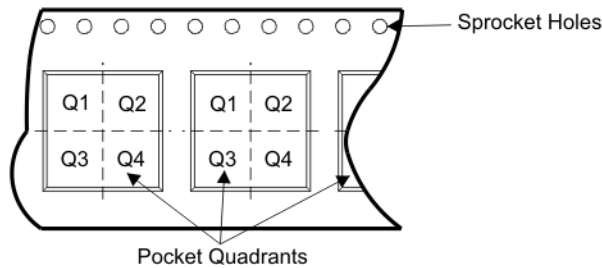
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**TAPE AND REEL BOX INFORMATION**



|    |   |
|----|---|
| A0 | Dimension designed to accommodate the component width     |
| B0 | Dimension designed to accommodate the component length    |
| K0 | Dimension designed to accommodate the component thickness |
| W  | Overall width of the carrier tape                         |
| P1 | Pitch between successive cavity centers                   |

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



| Device         | Package | Pins | Site    | Reel Diameter (mm) | Reel Width (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------|---------|------|---------|--------------------|-----------------|---------|---------|---------|---------|--------|---------------|
| CD74HC4316M96  | D       | 16   | SITE 27 | 330                | 16              | 6.5     | 10.3    | 2.1     | 8       | 16     | Q1            |
| CD74HC4316NSR  | NS      | 16   | SITE 41 | 330                | 16              | 8.2     | 10.5    | 2.5     | 12      | 16     | Q1            |
| CD74HC4316PWR  | PW      | 16   | SITE 41 | 330                | 12              | 7.0     | 5.6     | 1.6     | 8       | 12     | Q1            |
| CD74HCT4316M96 | D       | 16   | SITE 27 | 330                | 16              | 6.5     | 10.3    | 2.1     | 8       | 16     | Q1            |

**TAPE AND REEL BOX DIMENSIONS**



| Device         | Package | Pins | Site    | Length (mm) | Width (mm) | Height (mm) |
|----------------|---------|------|---------|-------------|------------|-------------|
| CD74HC4316M96  | D       | 16   | SITE 27 | 342.9       | 336.6      | 28.58       |
| CD74HC4316NSR  | NS      | 16   | SITE 41 | 346.0       | 346.0      | 33.0        |
| CD74HC4316PWR  | PW      | 16   | SITE 41 | 346.0       | 346.0      | 29.0        |
| CD74HCT4316M96 | D       | 16   | SITE 27 | 342.9       | 336.6      | 28.58       |



N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

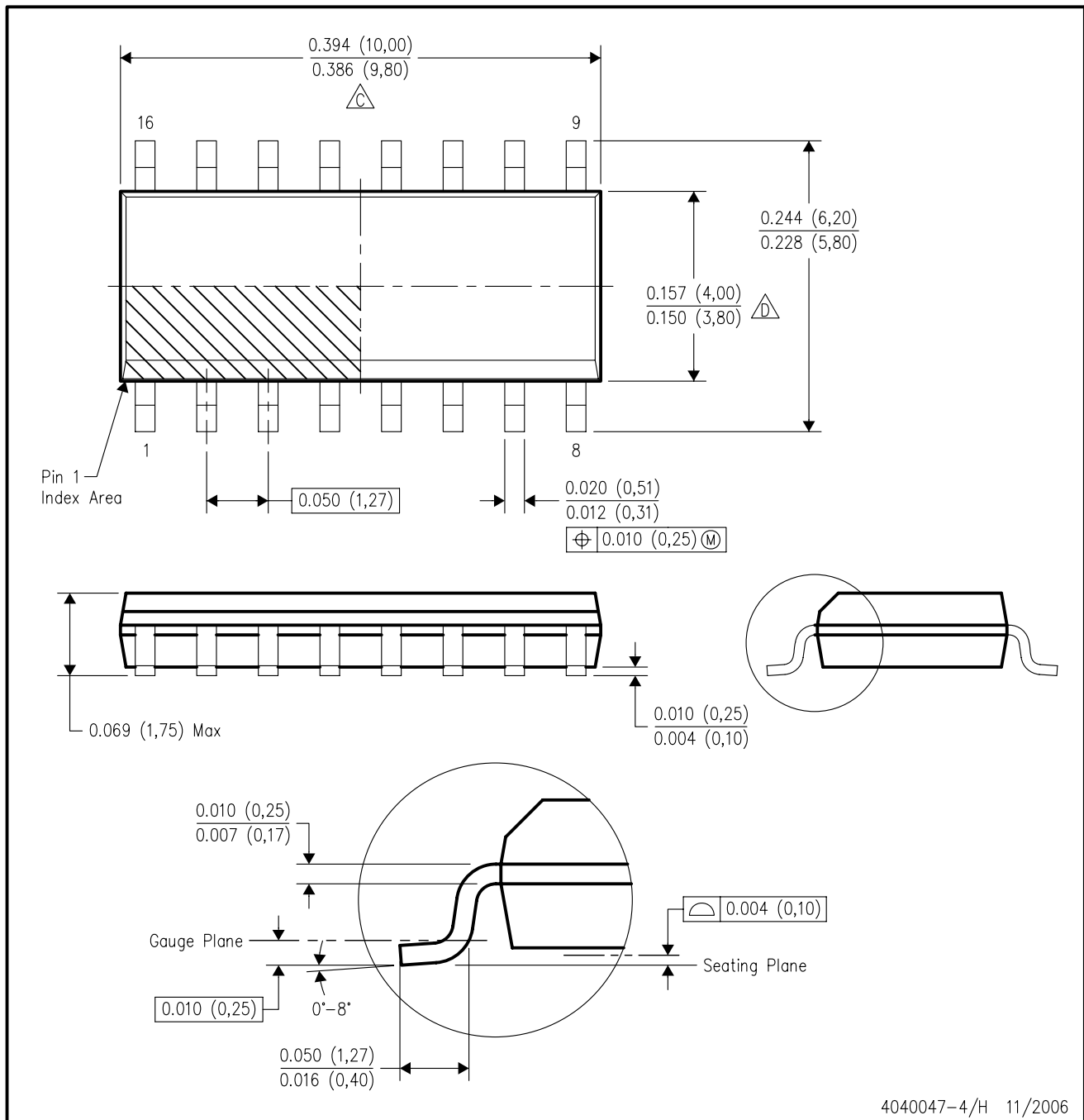
16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference JEDEC MS-012 variation AC.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

PW (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

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