

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.

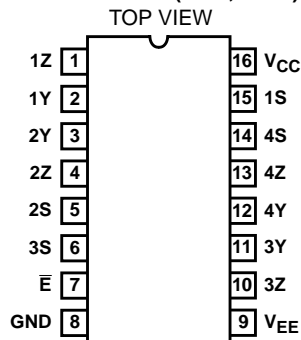
### Ordering Information

| 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   |

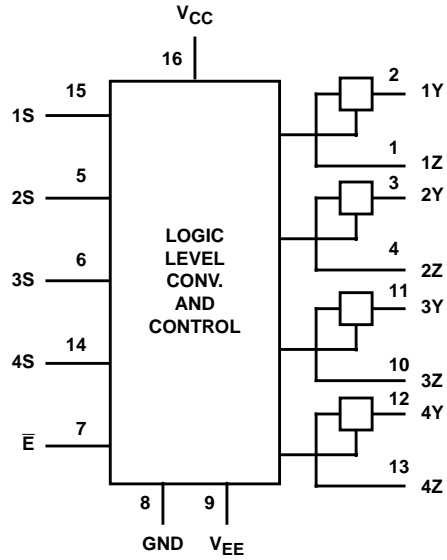
NOTE: When ordering, use the entire part number. The suffixes 96 and R denote tape and reel. The suffix T denotes a small-quantity reel of 250.

### 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**

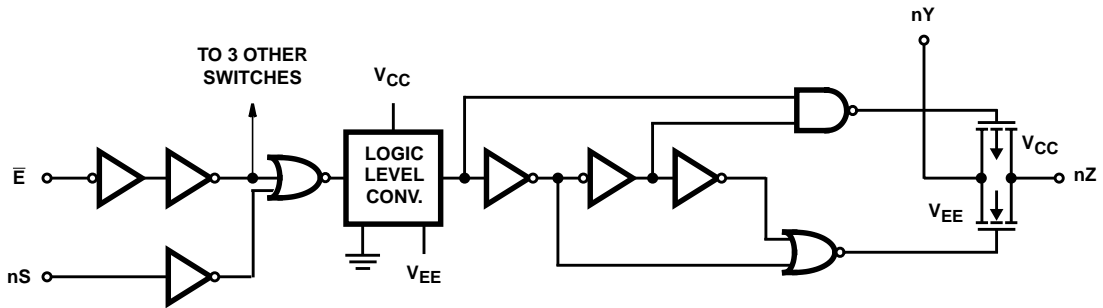


FIGURE 1. ONE SWITCH

# 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

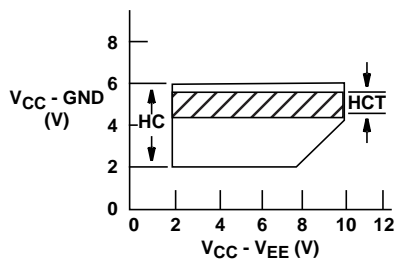


FIGURE 2.

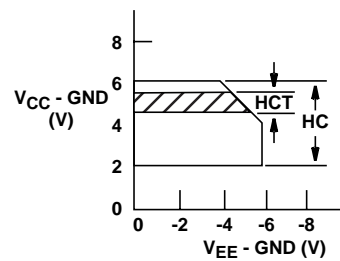


FIGURE 3.

**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><br>(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     | $V_{EE}$ (V) | $V_{CC}$ (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                  | $t_{PLZ}, t_{PHZ}$ | $C_L = 50\text{pF}$ | 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    |
|  |                    | $C_L = 15\text{pF}$ | -            | 5            | -    | 14  | -   | -             | -   | -              | -   | ns    |
| Input (Control) Capacitance                | $C_I$              | -                   | -            | -            | -    | 10  | -   | 10            | -   | 10             | pF  |       |
| Power Dissipation Capacitance (Notes 3, 4) | $C_{PD}$           | -                   | -            | 5            | -    | 42  | -   | -             | -   | -              | pF  |       |
| <b>HCT TYPES</b>                           |                    |                     |              |              |      |     |     |               |     |                |     |       |
| Propagation Delay, Switch In to Switch Out | $t_{PLH}, t_{PHL}$ | $C_L = 50\text{pF}$ | 0            | 4.5          | -    | -   | 12  | -             | 15  | -              | 18  | ns    |
|  |                    |                     | -4.5         | 4.5          | -    | -   | 8   | -             | 10  | -              | 12  | ns    |
| Turn "ON" Time $\bar{E}$ to Out            | $t_{PZH}$          | $C_L = 50\text{pF}$ | 0            | 4.5          | -    | -   | 44  | -             | 55  | -              | 66  | ns    |
|  |                    |                     | -4.5         | 4.5          | -    | -   | 42  | -             | 53  | -              | 63  | ns    |
|  |                    | $C_L = 15\text{pF}$ | -            | 5            | -    | 18  | -   | -             | -   | -              | -   | ns    |
|  | $t_{PZL}$          | $C_L = 50\text{pF}$ | 0            | 4.5          | -    | -   | 56  | -             | 70  | -              | 85  | ns    |
|  |                    |                     | -4.5         | 4.5          | -    | -   | 42  | -             | 53  | -              | 63  | ns    |
|  |                    | $C_L = 15\text{pF}$ | -            | 5            | -    | 24  | -   | -             | -   | -              | -   | ns    |
| Turn "ON" Time nS to Out                   | $t_{PZH}$          | $C_L = 50\text{pF}$ | 0            | 4.5          | -    | -   | 40  | -             | 53  | -              | 60  | ns    |
|  |                    |                     | -4.5         | 4.5          | -    | -   | 34  | -             | 43  | -              | 51  | ns    |
|  |                    | $C_L = 15\text{pF}$ | -            | 5            | -    | 17  | -   | -             | -   | -              | -   | ns    |
|  | $t_{PZL}$          | $C_L = 50\text{pF}$ | 0            | 4.5          | -    | -   | 50  | -             | 63  | -              | 75  | ns    |
|  |                    |                     | -4.5         | 4.5          | -    | -   | 34  | -             | 43  | -              | 51  | ns    |
|  |                    | $C_L = 15\text{pF}$ | -            | 5            | -    | 18  | -   | -             | -   | -              | -   | ns    |
| Turn "OFF" Time $\bar{E}$ to Out           | $t_{PLZ}$          | $C_L = 50\text{pF}$ | 0            | 4.5          | -    | -   | 50  | -             | 63  | -              | 75  | ns    |
|  |                    |                     | -4.5         | 4.5          | -    | -   | 46  | -             | 58  | -              | 69  | ns    |
|  | $t_{PLZ}, t_{PHZ}$ | $C_L = 15\text{pF}$ | -            | 5            | -    | 21  | -   | -             | -   | -              | -   | ns    |
|  |                    |                     | -            | 5            | -    | 21  | -   | -             | -   | -              | -   | ns    |
| Turn "OFF" Time nS to Out                  | $t_{PHZ}$          | $C_L = 50\text{pF}$ | 0            | 4.5          | -    | -   | 44  | -             | 55  | -              | 66  | ns    |
|  |                    |                     | -4.5         | 4.5          | -    | -   | 40  | -             | 50  | -              | 60  | ns    |
|  | $t_{PLZ}, t_{PHZ}$ | $C_L = 15\text{pF}$ | -            | 5            | -    | 18  | -   | -             | -   | -              | -   | ns    |
|  |                    |                     | -            | 5            | -    | 18  | -   | -             | -   | -              | -   | ns    |
| Input (Control) Capacitance                | $C_I$              | -                   | -            | -            | -    | 10  | -   | 10            | -   | 10             | pF  |       |
| Power Dissipation Capacitance (Notes 3, 4) | $C_{PD}$           | -                   | -            | 5            | -    | 47  | -   | -             | -   | -              | pF  |       |

**NOTES:**

- $C_{PD}$  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 $T_A = 25^\circ\text{C}$

| PARAMETER  | TEST CONDITIONS       | $V_{CC}$ (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

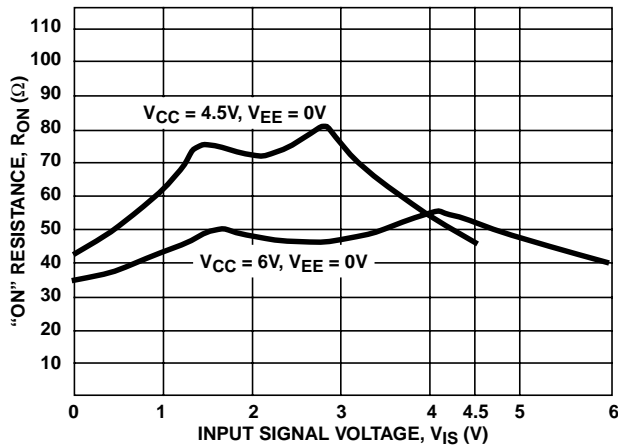


FIGURE 4. TYPICAL "ON" RESISTANCE vs INPUT SIGNAL VOLTAGE

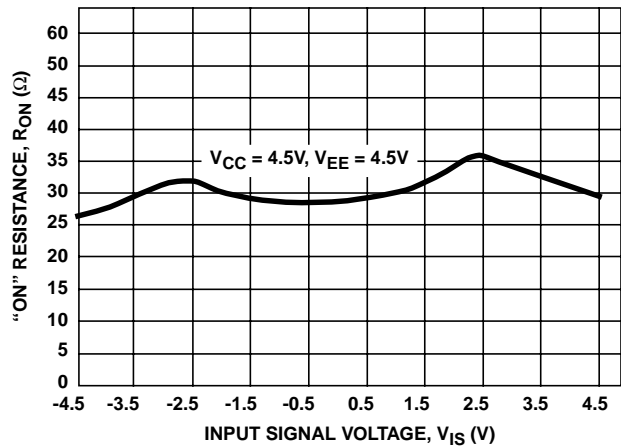


FIGURE 5. TYPICAL "ON" RESISTANCE vs INPUT SIGNAL VOLTAGE

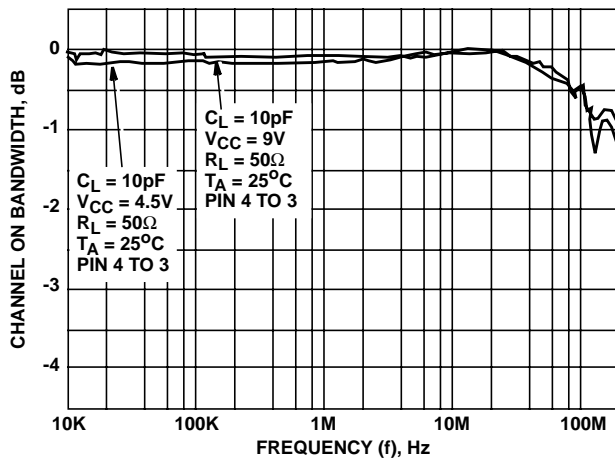


FIGURE 6. SWITCH FREQUENCY RESPONSE

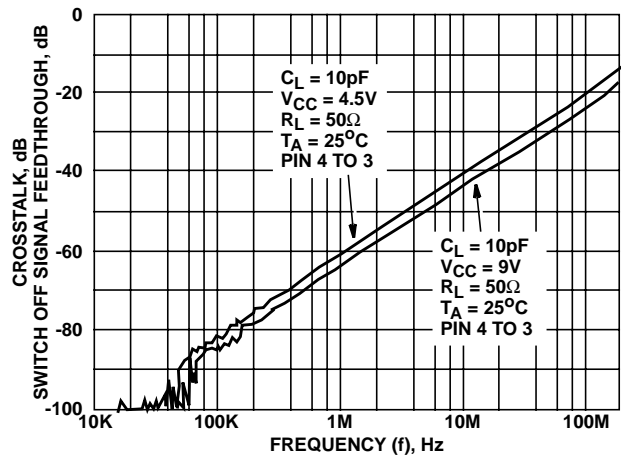


FIGURE 7. SWITCH-OFF SIGNAL FEEDTHROUGH AND CROSSTALK vs FREQUENCY

Analog Test Circuits

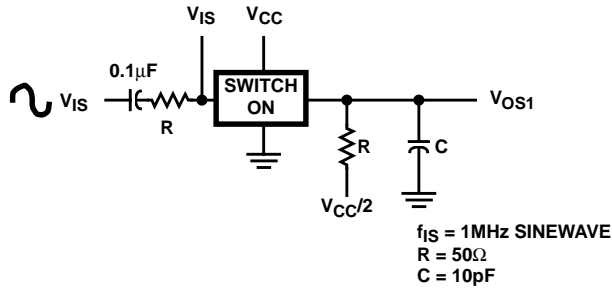


FIGURE 8. CROSTALK BETWEEN TWO SWITCHES TEST CIRCUIT

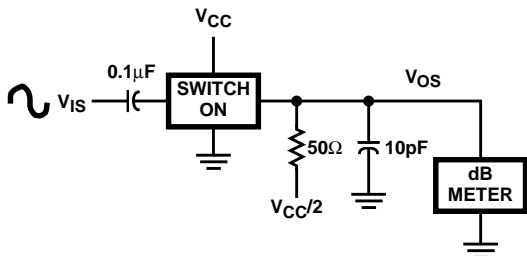
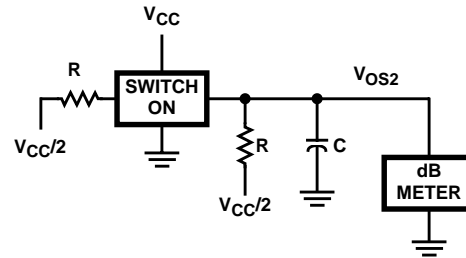


FIGURE 9. FREQUENCY RESPONSE TEST CIRCUIT

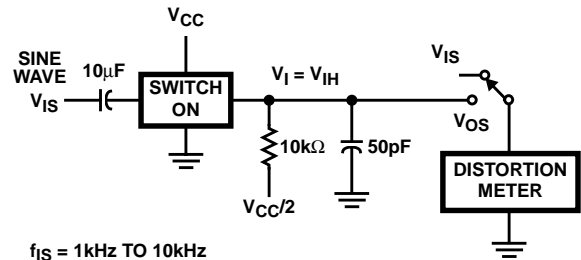


FIGURE 10. TOTAL HARMONIC DISTORTION TEST CIRCUIT

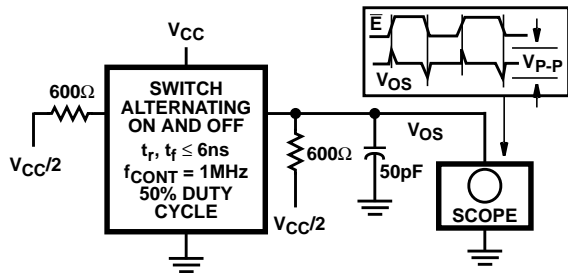


FIGURE 11. CONTROL-TO-SWITCH FEEDTHROUGH NOISE TEST CIRCUIT

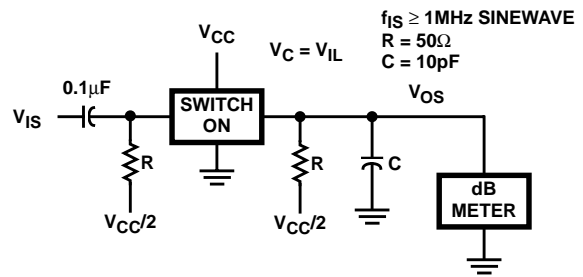


FIGURE 12. SWITCH OFF SIGNAL FEEDTHROUGH



Test Circuits and Waveforms

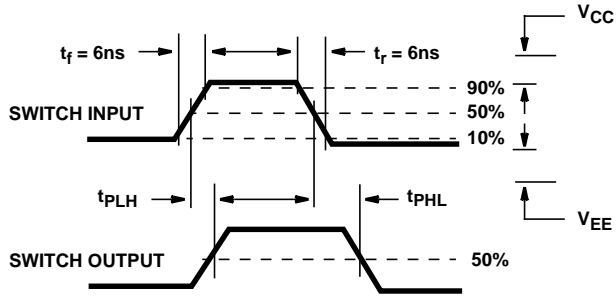


FIGURE 13. SWITCH PROPAGATION DELAY TIMES

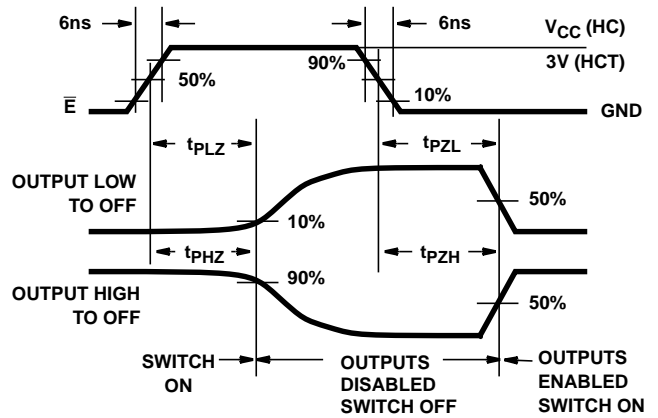
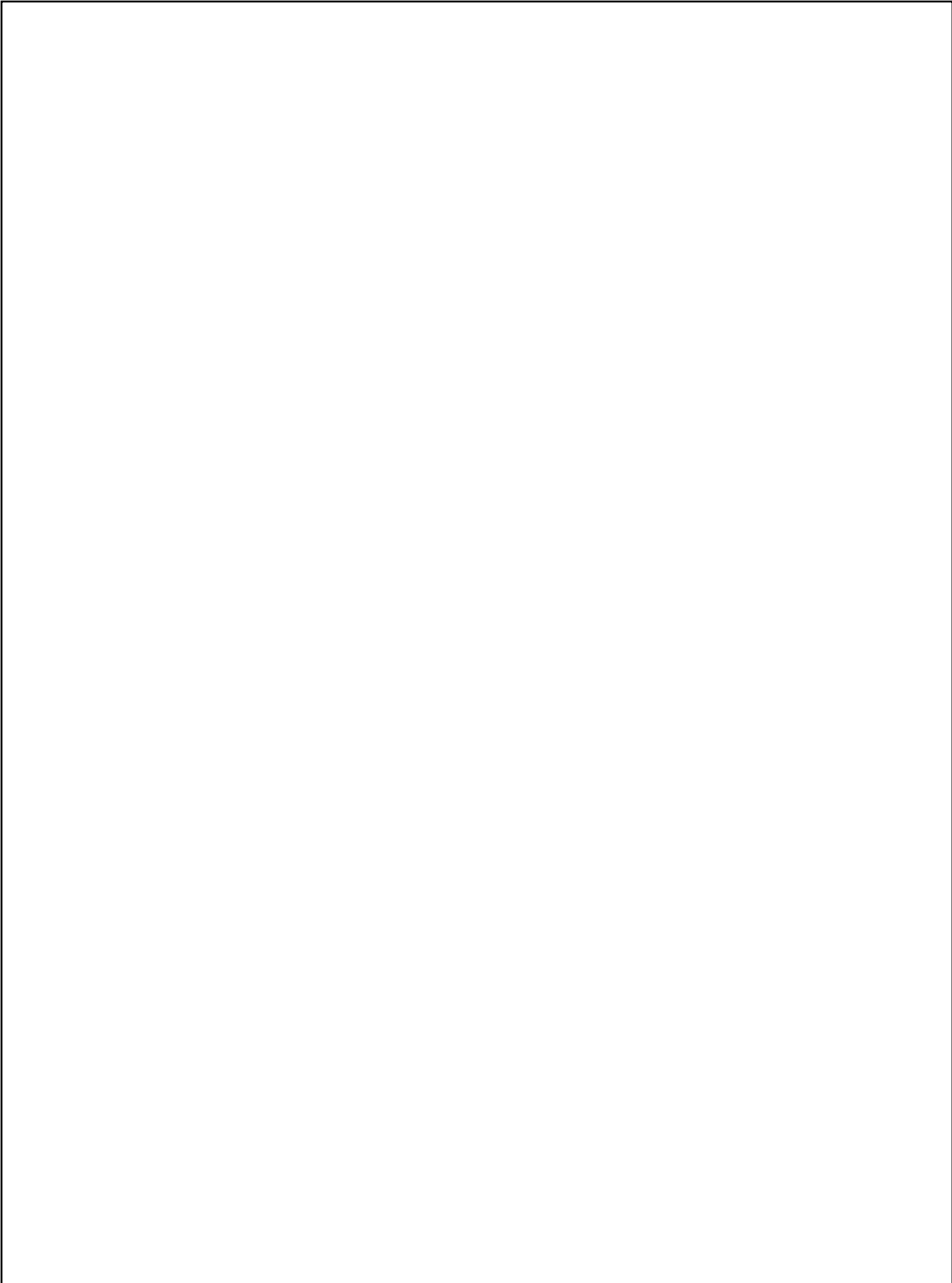


FIGURE 14. SWITCH TURN-ON AND TURN-OFF PROPAGATION DELAY TIMES WAVEFORMS



**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)         | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| CD54HC4316F3A    | ACTIVE        | CDIP         | J               | 16   | 1           | TBD                     | SNPB                                 | N / A for Pkg Type   | -55 to 125   | CD54HC4316F3A           | <a href="#">Samples</a> |
| CD74HC4316E      | ACTIVE        | PDIP         | N               | 16   | 25          | Green (RoHS & no Sb/Br) | NIPDAU                               | N / A for Pkg Type   | -55 to 125   | CD74HC4316E             | <a href="#">Samples</a> |
| CD74HC4316EE4    | ACTIVE        | PDIP         | N               | 16   | 25          | Green (RoHS & no Sb/Br) | NIPDAU                               | N / A for Pkg Type   | -55 to 125   | CD74HC4316E             | <a href="#">Samples</a> |
| CD74HC4316M      | ACTIVE        | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HC4316M                 | <a href="#">Samples</a> |
| CD74HC4316M96    | ACTIVE        | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HC4316M                 | <a href="#">Samples</a> |
| CD74HC4316M96G4  | ACTIVE        | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HC4316M                 | <a href="#">Samples</a> |
| CD74HC4316ME4    | ACTIVE        | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HC4316M                 | <a href="#">Samples</a> |
| CD74HC4316MG4    | ACTIVE        | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HC4316M                 | <a href="#">Samples</a> |
| CD74HC4316NSR    | ACTIVE        | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HC4316M                 | <a href="#">Samples</a> |
| CD74HC4316PW     | ACTIVE        | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HJ4316                  | <a href="#">Samples</a> |
| CD74HC4316PWR    | ACTIVE        | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HJ4316                  | <a href="#">Samples</a> |
| CD74HC4316PWRE4  | ACTIVE        | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HJ4316                  | <a href="#">Samples</a> |
| CD74HC4316PWRG4  | ACTIVE        | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HJ4316                  | <a href="#">Samples</a> |
| CD74HCT4316E     | ACTIVE        | PDIP         | N               | 16   | 25          | Green (RoHS & no Sb/Br) | NIPDAU                               | N / A for Pkg Type   | -55 to 125   | CD74HCT4316E            | <a href="#">Samples</a> |
| CD74HCT4316M     | ACTIVE        | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HCT4316M                | <a href="#">Samples</a> |
| CD74HCT4316M96   | ACTIVE        | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HCT4316M                | <a href="#">Samples</a> |
| CD74HCT4316M96G4 | ACTIVE        | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | NIPDAU                               | Level-1-260C-UNLIM   | -55 to 125   | HCT4316M                | <a href="#">Samples</a> |

(1) 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.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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**OTHER QUALIFIED VERSIONS OF CD54HC4316, CD74HC4316 :**

● Catalog: [CD74HC4316](#)

● Military: [CD54HC4316](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

**TAPE AND REEL INFORMATION**

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


\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD74HC4316M96  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| CD74HC4316NSR  | SO           | NS              | 16   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| CD74HC4316PWR  | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| CD74HCT4316M96 | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD74HC4316M96  | SOIC         | D               | 16   | 2500 | 333.2       | 345.9      | 28.6        |
| CD74HC4316NSR  | SO           | NS              | 16   | 2000 | 367.0       | 367.0      | 38.0        |
| CD74HC4316PWR  | TSSOP        | PW              | 16   | 2000 | 367.0       | 367.0      | 35.0        |
| CD74HCT4316M96 | SOIC         | D               | 16   | 2500 | 333.2       | 345.9      | 28.6        |

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- 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 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.



D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



4220204/A 02/2017

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220204/A 02/2017

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220204/A 02/2017

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

# 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.

# J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



| DIM   | PINS **                |                        |                        |                        |
|-------|------------------------|------------------------|------------------------|------------------------|
|       | 14                     | 16                     | 18                     | 20                     |
| A     | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC |
| B MAX | 0.785<br>(19,94)       | .840<br>(21,34)        | 0.960<br>(24,38)       | 1.060<br>(26,92)       |
| B MIN | —                      | —                      | —                      | —                      |
| C MAX | 0.300<br>(7,62)        | 0.300<br>(7,62)        | 0.310<br>(7,87)        | 0.300<br>(7,62)        |
| C MIN | 0.245<br>(6,22)        | 0.245<br>(6,22)        | 0.220<br>(5,59)        | 0.245<br>(6,22)        |



4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package is hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

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.
  - $\triangle C$  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - $\triangle D$  The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002

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