

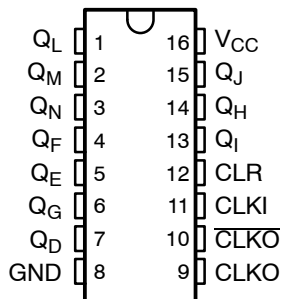
# SN74HC4060-Q1

## 14-STAGE ASYNCHRONOUS BINARY COUNTERS AND OSCILLATORS

SCLS726 – DECEMBER 2011

- Qualified for Automotive Applications
- Wide Operating Voltage Range of 2 V to 6 V
- Outputs Can Drive Up To 10 LSTTL Loads
- Low Power Consumption, 80- $\mu$ A Max  $I_{CC}$
- Typical  $t_{pd} = 14$  ns
- $\pm 4$ -mA Output Drive at 5 V
- Low Input Current of 1  $\mu$ A Max
- Allow Design of Either RC- or Crystal-Oscillator Circuits

SN74HC4060-Q1 . . . D PACKAGE  
(TOP VIEW)



### description/ordering information

The 'HC4060-Q1 devices consist of an oscillator section and 14 ripple-carry binary counter stages. The oscillator configuration allows design of either RC- or crystal-oscillator circuits. A high-to-low transition on the clock (CLKI) input increments the counter. A high level at the clear (CLR) input disables the oscillator ( $\overline{\text{CLKO}}$  goes high and CLKO goes low) and resets the counter to zero (all Q outputs low).

### ORDERING INFORMATION

| T <sub>A</sub> | PACKAGE <sup>†</sup>     | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|--------------------------|-----------------------|------------------|
| -40°C to 125°C | SOIC - D    Reel of 2500 | SN74HC4060QDRQ1       | HC4060Q          |

<sup>†</sup> Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

# SN74HC4060-Q1

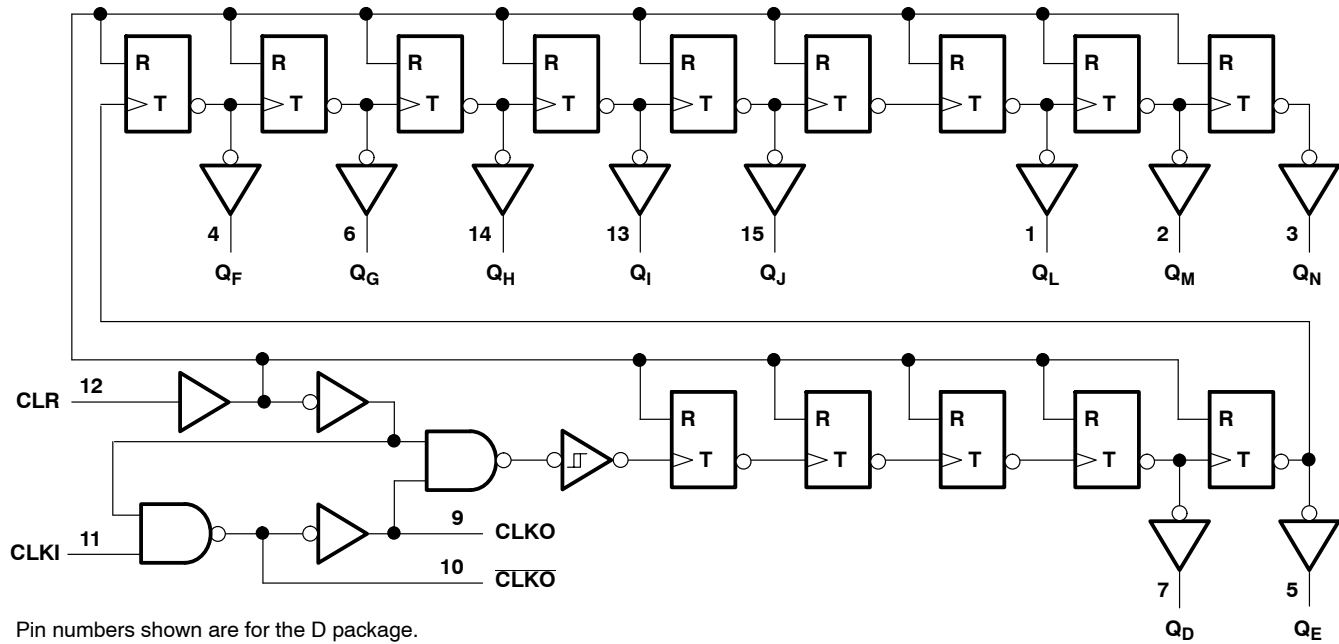
## 14-STAGE ASYNCHRONOUS BINARY COUNTERS AND OSCILLATORS

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**FUNCTION TABLE**  
(each buffer)

| INPUTS |     | FUNCTION              |
|--------|-----|-----------------------|
| CLK    | CLR |                       |
| ↑      | L   | No change             |
| ↓      | L   | Advance to next stage |
| X      | H   | All outputs L         |

### Logic diagram (positive logic)



Pin numbers shown are for the D package.

### Absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|                                                                             |                |
|-----------------------------------------------------------------------------|----------------|
| Supply voltage range, $V_{CC}$                                              | -0.5 V to 7 V  |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1)  | $\pm 20$ mA    |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1) | $\pm 20$ mA    |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )                  | $\pm 25$ mA    |
| Package thermal impedance, $\theta_{JA}$ (see Note 2): D package            | 73°C/W         |
| Storage temperature range, $T_{stg}$                                        | -65°C to 150°C |
| ESD rating: Human Body Model (HBM)                                          | 2000 V         |
| Charged Device Model (CDM)                                                  | 1000 V         |
| Machine Model (MM)                                                          | 200 V          |

<sup>†</sup> Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51-7.

# SN74HC4060-Q1

## 14-STAGE ASYNCHRONOUS BINARY COUNTERS AND OSCILLATORS

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### Recommended operating conditions (see Note 3)

|                 |                                 | MIN                     | NOM             | MAX | UNIT |
|-----------------|---------------------------------|-------------------------|-----------------|-----|------|
| V <sub>CC</sub> | Supply voltage                  | 2                       | 5               | 6   | V    |
| V <sub>IH</sub> | High-level input voltage        | V <sub>CC</sub> = 2 V   | 1.5             |     | V    |
|                 |                                 | V <sub>CC</sub> = 4.5 V | 3.15            |     |      |
|                 |                                 | V <sub>CC</sub> = 6 V   | 4.2             |     |      |
| V <sub>IL</sub> | Low-level input voltage         | V <sub>CC</sub> = 2 V   | 0.5             |     | V    |
|                 |                                 | V <sub>CC</sub> = 4.5 V | 1.35            |     |      |
|                 |                                 | V <sub>CC</sub> = 6 V   | 1.8             |     |      |
| V <sub>I</sub>  | Input voltage                   | 0                       | V <sub>CC</sub> |     | V    |
| V <sub>O</sub>  | Output voltage                  | 0                       | V <sub>CC</sub> |     | V    |
| Δt/Δv           | Input transition rise/fall time | V <sub>CC</sub> = 2 V   | 1000            |     | ns   |
|                 |                                 | V <sub>CC</sub> = 4.5 V | 500             |     |      |
|                 |                                 | V <sub>CC</sub> = 6 V   | 400             |     |      |
| T <sub>A</sub>  | Operating free-air temperature  | -40                     | 125             |     | °C   |

NOTE 3: All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

### Electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER                 |                                        | TEST CONDITIONS                                       |                          | V <sub>CC</sub> | T <sub>A</sub> = 25°C |       |       | 'HC4060-Q1 |     | UNIT |
|---------------------------|----------------------------------------|-------------------------------------------------------|--------------------------|-----------------|-----------------------|-------|-------|------------|-----|------|
|                           |                                        |                                                       |                          |                 | MIN                   | TYP   | MAX   | MIN        | MAX |      |
| V <sub>OH</sub>           | All outputs                            | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> , | I <sub>OH</sub> = -20 μA | 2 V             | 1.9                   | 1.998 | 1.9   |            | V   |      |
|                           |                                        |                                                       |                          | 4.5 V           | 4.4                   | 4.499 | 4.4   |            |     |      |
|                           |                                        |                                                       |                          | 6 V             | 5.9                   | 5.999 | 5.9   |            |     |      |
|                           | Q outputs                              | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>   | I <sub>OH</sub> = -4 mA  | 4.5 V           | 3.98                  | 4.3   | 3.7   |            |     |      |
| I <sub>OH</sub> = -5.2 mA |                                        |                                                       | 6 V                      | 5.48            | 5.8                   | 5.2   |       |            |     |      |
| V <sub>OL</sub>           | All outputs                            | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> , | I <sub>OL</sub> = 20 μA  | 2 V             | 0.002                 |       | 0.1   | 0.1        | V   |      |
|                           |                                        |                                                       |                          | 4.5 V           | 0.001                 |       | 0.1   | 0.1        |     |      |
|                           |                                        |                                                       |                          | 6 V             | 0.001                 |       | 0.1   | 0.1        |     |      |
|                           | Q outputs                              | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>   | I <sub>OL</sub> = 4 mA   | 4.5 V           | 0.17                  | 0.26  | 0.4   |            |     |      |
| I <sub>OL</sub> = 5.2 mA  |                                        |                                                       | 6 V                      | 0.15            | 0.26                  | 0.4   |       |            |     |      |
| I <sub>I</sub>            | V <sub>I</sub> = V <sub>CC</sub> or 0  |                                                       |                          | 6 V             | ±0.1                  | ±100  | ±1000 |            | nA  |      |
| I <sub>CC</sub>           | V <sub>I</sub> = V <sub>CC</sub> or 0, |                                                       | I <sub>O</sub> = 0       | 6 V             | 8                     |       | 160   |            | μA  |      |
| C <sub>i</sub>            |                                        |                                                       |                          | 2 V to 6 V      | 3                     | 10    | 10    |            | pF  |      |



# SN74HC4060-Q1

## 14-STAGE ASYNCHRONOUS BINARY COUNTERS AND OSCILLATORS

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Timing requirements over recommended operating free-air temperature range (unless otherwise noted)

|                    |                                       | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     | 'HC4060-Q1 |     | UNIT |
|--------------------|---------------------------------------|-----------------|-----------------------|-----|------------|-----|------|
|                    |                                       |                 | MIN                   | MAX | MIN        | MAX |      |
| f <sub>clock</sub> | Clock frequency                       | 2 V             | 5.5                   |     | 3.7        |     | MHz  |
|                    |                                       | 4.5 V           | 28                    |     | 19         |     |      |
|                    |                                       | 6 V             | 33                    |     | 22         |     |      |
| t <sub>w</sub>     | CLKI high or low                      | 2 V             | 90                    |     | 135        |     | ns   |
|                    |                                       | 4.5 V           | 18                    |     | 27         |     |      |
|                    |                                       | 6 V             | 15                    |     | 23         |     |      |
|                    | CLR high                              | 2 V             | 90                    |     | 135        |     |      |
|                    |                                       | 4.5 V           | 18                    |     | 27         |     |      |
|                    |                                       | 6 V             | 15                    |     | 23         |     |      |
| t <sub>su</sub>    | Setup time, CLR inactive before CLKI↓ | 2 V             | 160                   |     | 240        |     | ns   |
|                    |                                       | 4.5 V           | 32                    |     | 48         |     |      |
|                    |                                       | 6 V             | 27                    |     | 41         |     |      |

Switching characteristics over recommended operating free-air temperature range, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

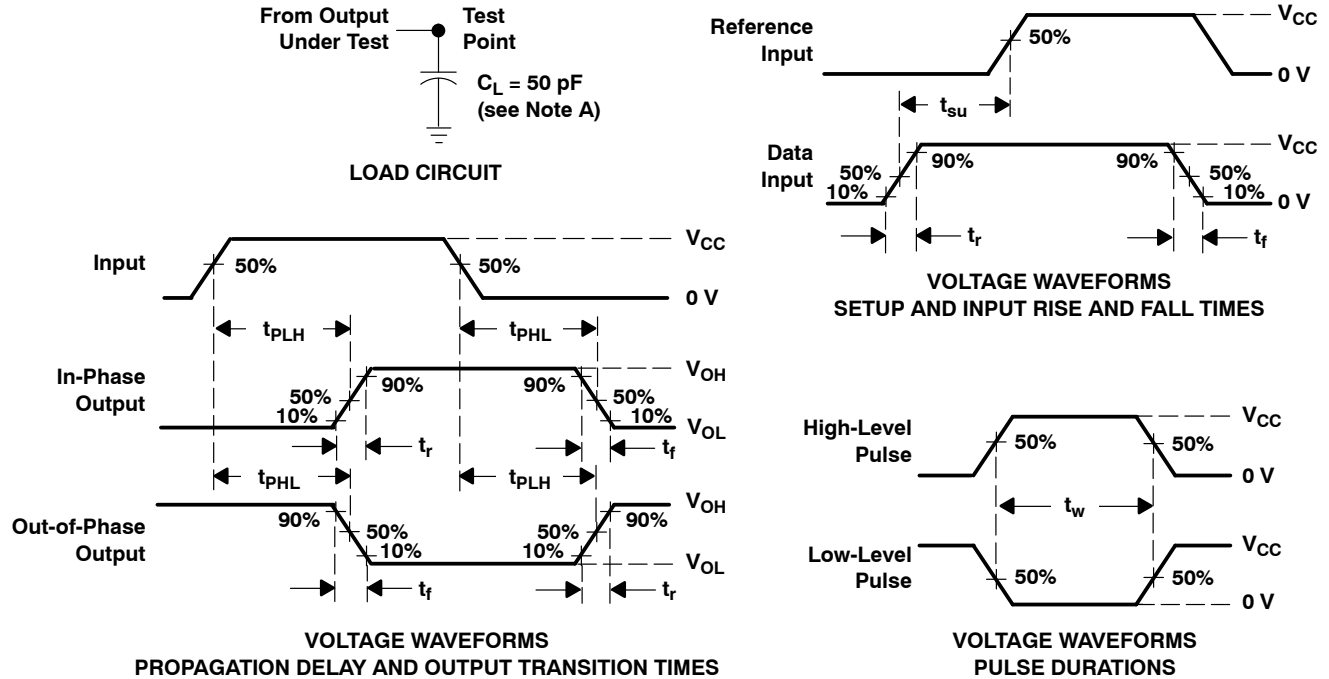
| PARAMETER        | FROM (INPUT) | TO (OUTPUT)    | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |     | 'HC4060-Q1 |     | UNIT |
|------------------|--------------|----------------|-----------------|-----------------------|-----|-----|------------|-----|------|
|                  |              |                |                 | MIN                   | TYP | MAX | MIN        | MAX |      |
| f <sub>max</sub> |              |                | 2 V             | 5.5                   | 10  |     | 3.7        |     | MHz  |
|                  |              |                | 4.5 V           | 28                    | 45  |     | 19         |     |      |
|                  |              |                | 6 V             | 33                    | 53  |     | 22         |     |      |
| t <sub>pd</sub>  | CLKI         | Q <sub>D</sub> | 2 V             |                       | 240 | 490 | 735        |     | ns   |
|                  |              |                | 4.5 V           |                       | 58  | 98  | 147        |     |      |
|                  |              |                | 6 V             |                       | 42  | 83  | 125        |     |      |
| t <sub>PHL</sub> | CLR          | Any Q          | 2 V             |                       | 66  | 140 | 210        |     | ns   |
|                  |              |                | 4.5 V           |                       | 18  | 28  | 42         |     |      |
|                  |              |                | 6 V             |                       | 14  | 24  | 36         |     |      |
| t <sub>t</sub>   |              | Any            | 2 V             |                       | 28  | 75  | 110        |     | ns   |
|                  |              |                | 4.5 V           |                       | 8   | 15  | 22         |     |      |
|                  |              |                | 6 V             |                       | 6   | 30  | 19         |     |      |

Operating characteristics, T<sub>A</sub> = 25°C

| PARAMETER                                     | TEST CONDITIONS | TYP | UNIT |
|-----------------------------------------------|-----------------|-----|------|
| C <sub>pd</sub> Power dissipation capacitance | No load         | 88  | pF   |



### PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A.  $C_L$  includes probe and test-fixture capacitance.
  - B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 6$  ns,  $t_f = 6$  ns.
  - C. For clock inputs,  $f_{max}$  is measured when the input duty cycle is 50%.
  - D. The outputs are measured one at a time with one input transition per measurement.
  - E.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

**Figure 1. Load Circuit and Voltage Waveforms**

# SN74HC4060-Q1

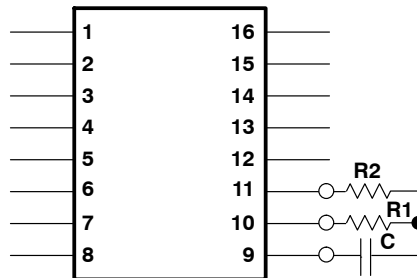
## 14-STAGE ASYNCHRONOUS BINARY COUNTERS AND OSCILLATORS

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### CONNECTING AN RC-OSCILLATOR CIRCUIT TO THE 'HC4060-Q1 DEVICE

The 'HC4060-Q1 devices consist of an oscillator section and 14 ripple-carry binary counter stages. The oscillator configuration allows design of either RC- or crystal-oscillator circuits.

When an RC-oscillator circuit is implemented, two resistors and a capacitor are required. The components are attached to the terminals as shown:



To determine the values of capacitance and resistance necessary to obtain a specific oscillator frequency (f), use this formula:

$$f = \frac{1}{2(R1)(C)\left(\frac{0.405 R2}{R1 + R2} + 0.693\right)}$$

If  $R2 \gg R1$  (i.e.,  $R2 = 10R1$ ), the above formula simplifies to:

$$f = \frac{0.455}{RC}$$

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>    | Lead/<br>Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| SN74HC4060QDRQ1  | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS<br>& 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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**OTHER QUALIFIED VERSIONS OF SN74HC4060-Q1 :**

● Catalog: [SN74HC4060](#)

● Military: [SN54HC4060](#)

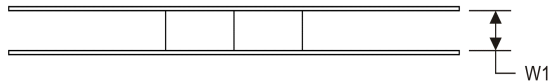
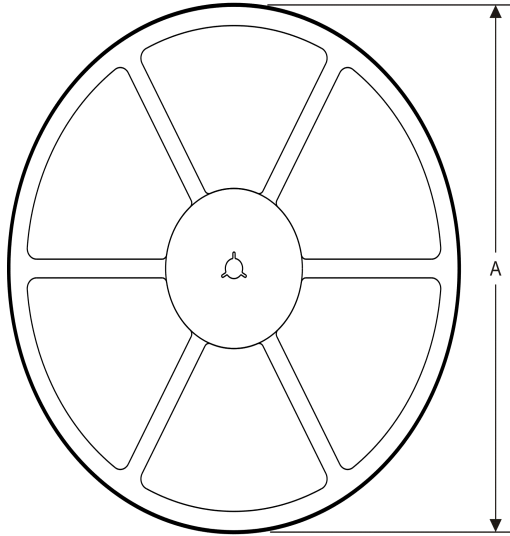
NOTE: Qualified Version Definitions:

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



**TAPE AND REEL INFORMATION**

**REEL DIMENSIONS**



**TAPE DIMENSIONS**



|    |                                                           |
|----|-----------------------------------------------------------|
| 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                   |

**TAPE AND REEL INFORMATION**

\*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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74HC4060QDRQ1 | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |

TAPE AND REEL BOX DIMENSIONS

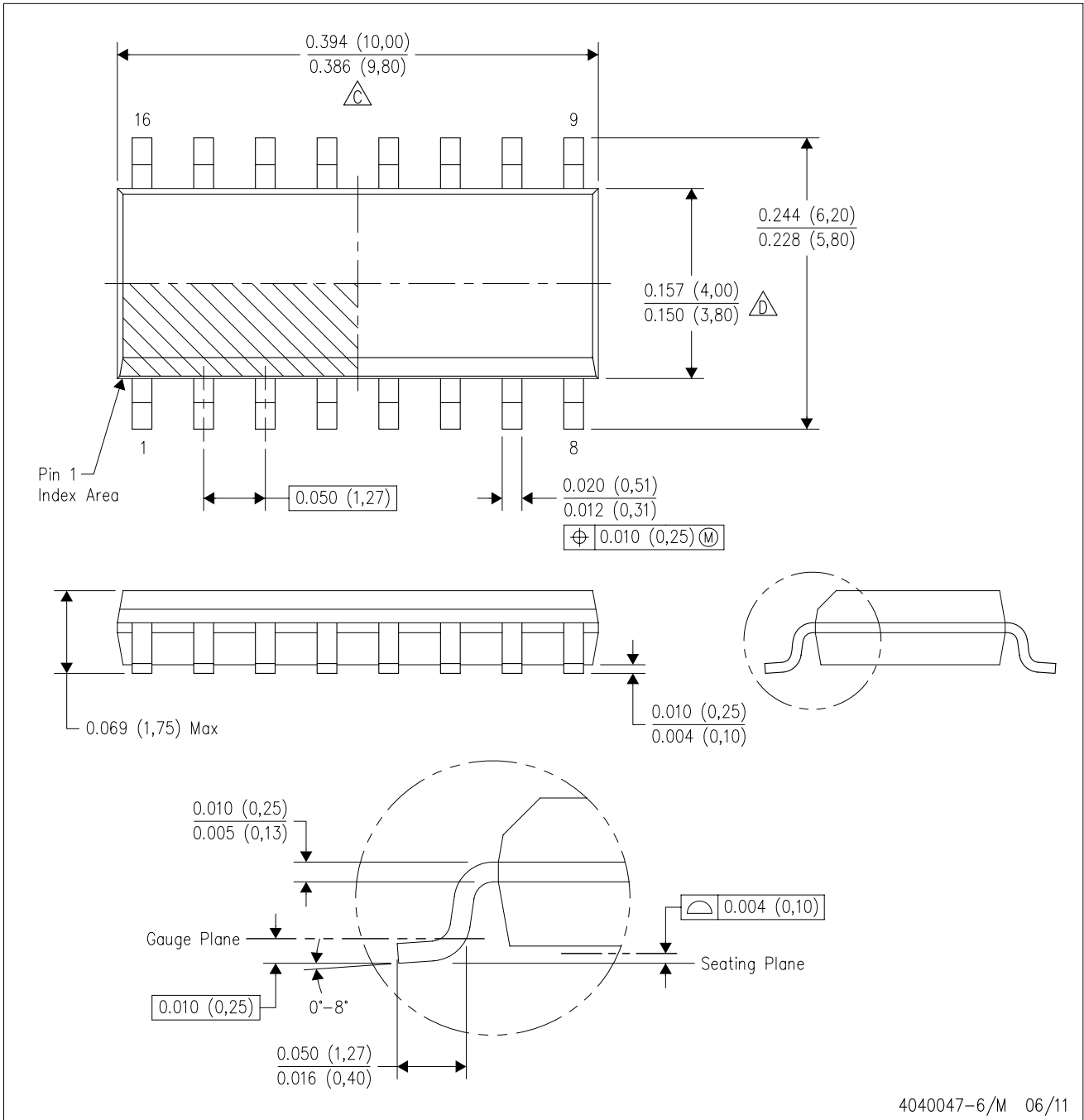


\*All dimensions are nominal



| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74HC4060QDRQ1 | SOIC         | D               | 16   | 2500 | 367.0       | 367.0      | 38.0        |

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.

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### Applications

|                               |                                                                                          |
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### TI E2E Community

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## Стандарт Электрон Связь

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

### Наши контакты:

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331