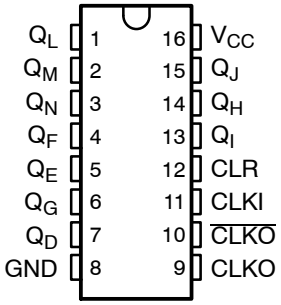
SN74HC4060–Q1
14-STAGE ASYNCHRONOUS BINARY COUNTERS AND OSCILLATORS

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-μA Max I_{CC}**
- **Typical t_{pd} = 14 ns**
- **±4-mA Output Drive at 5 V**
- **Low Input Current of 1 μA 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 ($\overline{CLKO}$ goes high and CLKO goes low) and resets the counter to zero (all Q outputs low).

ORDERING INFORMATION

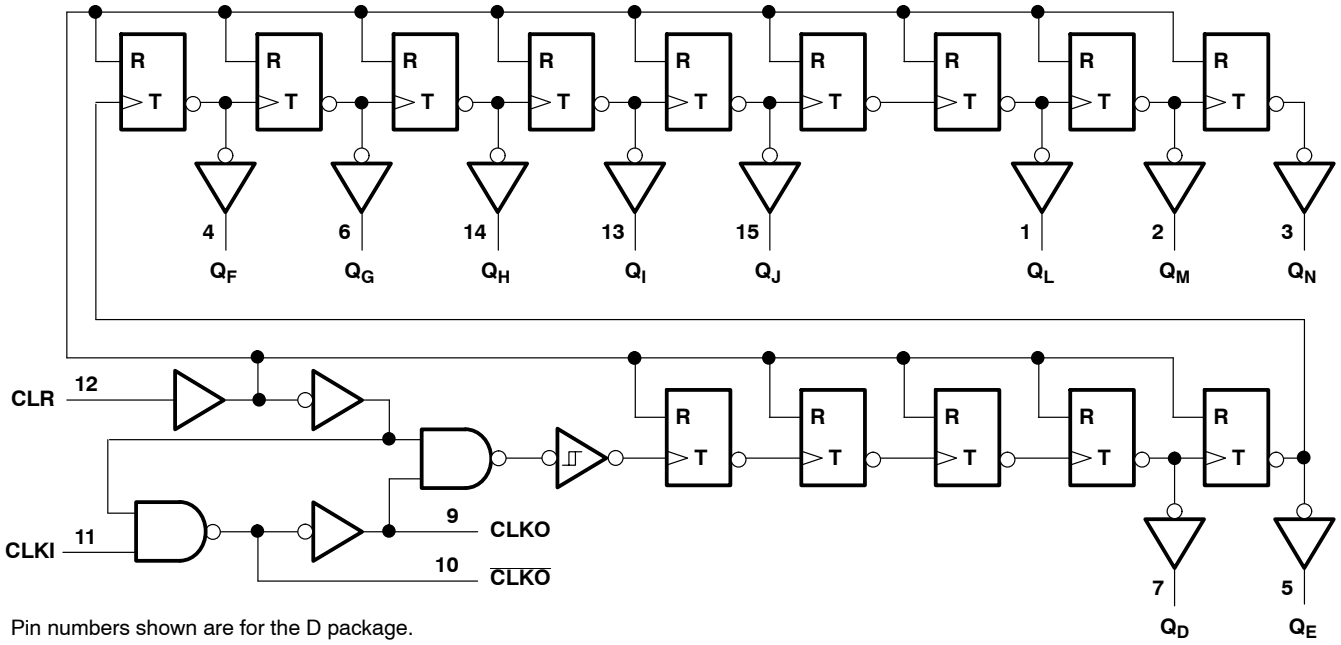
T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	SOIC – D	Reel of 2500	SN74HC4060QDRQ1	HC4060Q

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

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)†

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) . . . . . ±20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) (see Note 1) . . . . . ±20 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC}) . . . . . ±25 mA
Package thermal impedance, θ_{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

† 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.

Recommended operating conditions (see Note 3)

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		2	5	6	V
V_{IH}	High-level input voltage	V_{CC} = 2 V	1.5			V
		V_{CC} = 4.5 V	3.15			
		V_{CC} = 6 V	4.2			
V_{IL}	Low-level input voltage	V_{CC} = 2 V			0.5	V
		V_{CC} = 4.5 V			1.35	
		V_{CC} = 6 V			1.8	
V_I	Input voltage		0		V_{CC}	V
V_O	Output voltage		0		V_{CC}	V
$\Delta t/\Delta v$	Input transition rise/fall time	V_{CC} = 2 V			1000	ns
		V_{CC} = 4.5 V			500	
		V_{CC} = 6 V			400	
T_A	Operating free-air temperature		–40		125	°C

NOTE 3: All unused inputs of the device must be held at V_{CC} 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_{CC}	T_A = 25°C			'HC4060–Q1		UNIT
					MIN	TYP	MAX	MIN	MAX	
V_{OH}	All outputs	V_I = V_{IH} or V_{IL},	I_{OH} = –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_I = V_{IH} or V_{IL}	I_{OH} = –4 mA	4.5 V	3.98	4.3		3.7		
			I_{OH} = –5.2 mA	6 V	5.48	5.8		5.2		
V_{OL}	All outputs	V_I = V_{IH} or V_{IL},	I_{OL} = 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_I = V_{IH} or V_{IL}	I_{OL} = 4 mA	4.5 V		0.17	0.26		0.4	
			I_{OL} = 5.2 mA	6 V		0.15	0.26		0.4	
I_I		V_I = V_{CC} or 0		6 V		±0.1	±100		±1000	nA
I_{CC}		V_I = V_{CC} or 0,	I_O = 0	6 V			8		160	μA
C_i				2 V to 6 V		3	10		10	pF

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

			V_{CC}	T_A = 25°C		’HC4060–Q1		UNIT
				MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		2 V		5.5		3.7	MHz
			4.5 V		28		19	
			6 V		33		22	
t_w	Pulse duration	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_{su}	Setup time, CLR inactive before CLKI↓		2 V	160		240		ns
			4.5 V	32		48		
			6 V	27		41		

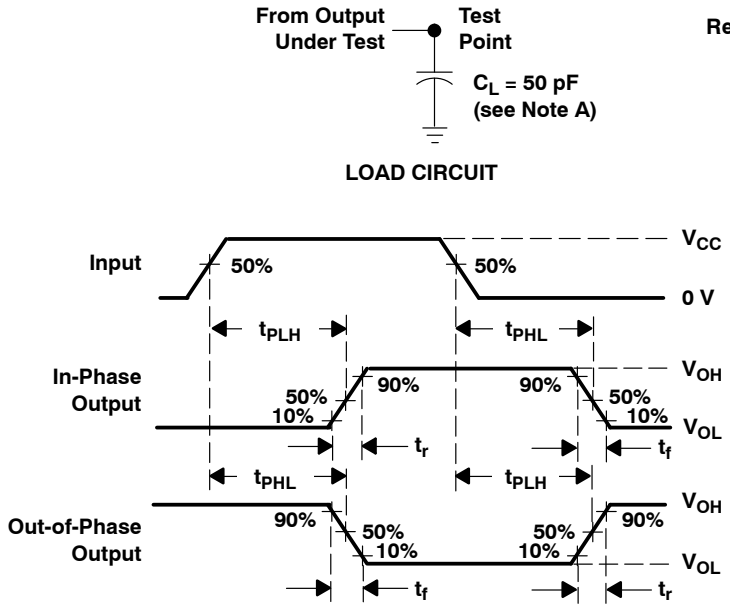
Switching characteristics over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			’HC4060–Q1		UNIT
				MIN	TYP	MAX	MIN	MAX	
f_{max}			2 V	5.5	10		3.7		MHz
			4.5 V	28	45		19		
			6 V	33	53		22		
t_{pd}	CLKI	Q_D	2 V		240	490		735	ns
			4.5 V		58	98		147	
			6 V		42	83		125	
t_{PHL}	CLR	Any Q	2 V		66	140		210	ns
			4.5 V		18	28		42	
			6 V		14	24		36	
t_t		Any	2 V		28	75		110	ns
			4.5 V		8	15		22	
			6 V		6	30		19	

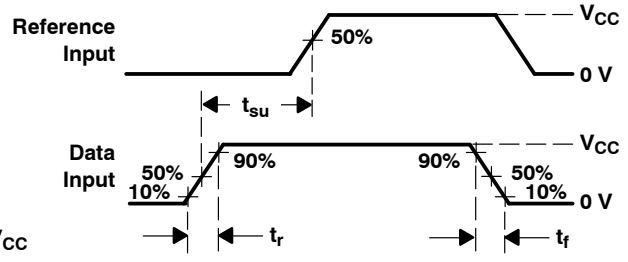
Operating characteristics, T_A = 25°C

PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load	88	pF

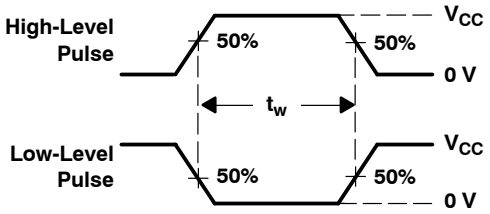
PARAMETER MEASUREMENT INFORMATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES



VOLTAGE WAVEFORMS
SETUP AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS
PULSE DURATIONS

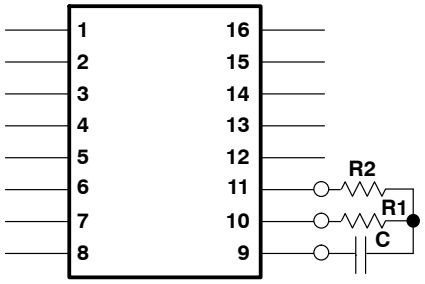
NOTES: A. C_L includes probe and test-fixture capacitance.
B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r = 6 ns, t_f = 6 ns.
C. For clock inputs, f_{max} is measured when 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

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 > > R1 (i.e., R2 = 10R1), the above formula simplifies to:

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

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN74HC4060QDRQ1	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HC4060Q	Samples

(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 <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm 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.

OTHER QUALIFIED VERSIONS OF SN74HC4060-Q1 :

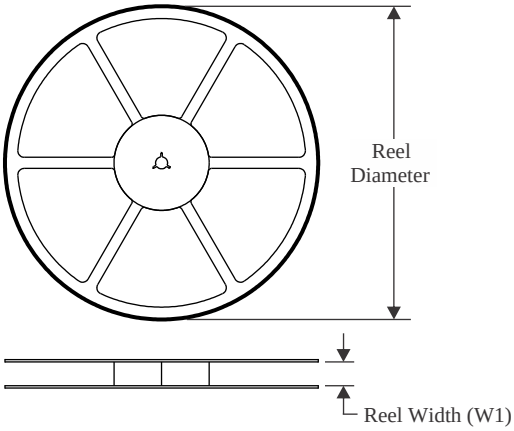
- Catalog: SN74HC4060
- Military: SN54HC4060

NOTE: Qualified Version Definitions:

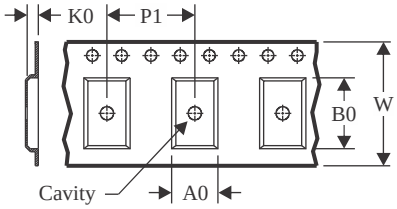
- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS

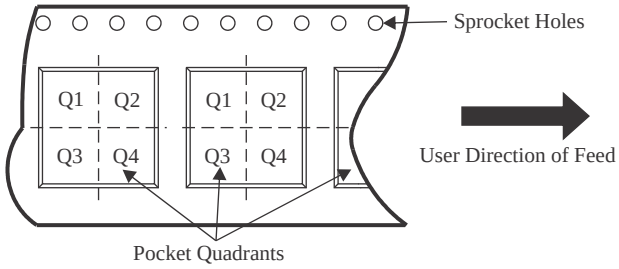


TAPE DIMENSIONS



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

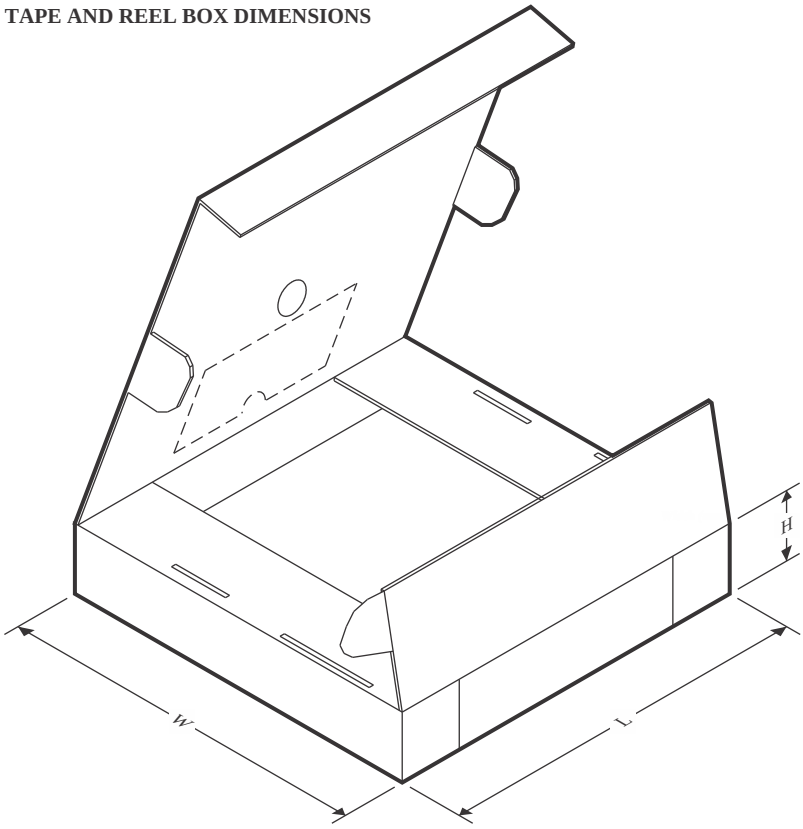
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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

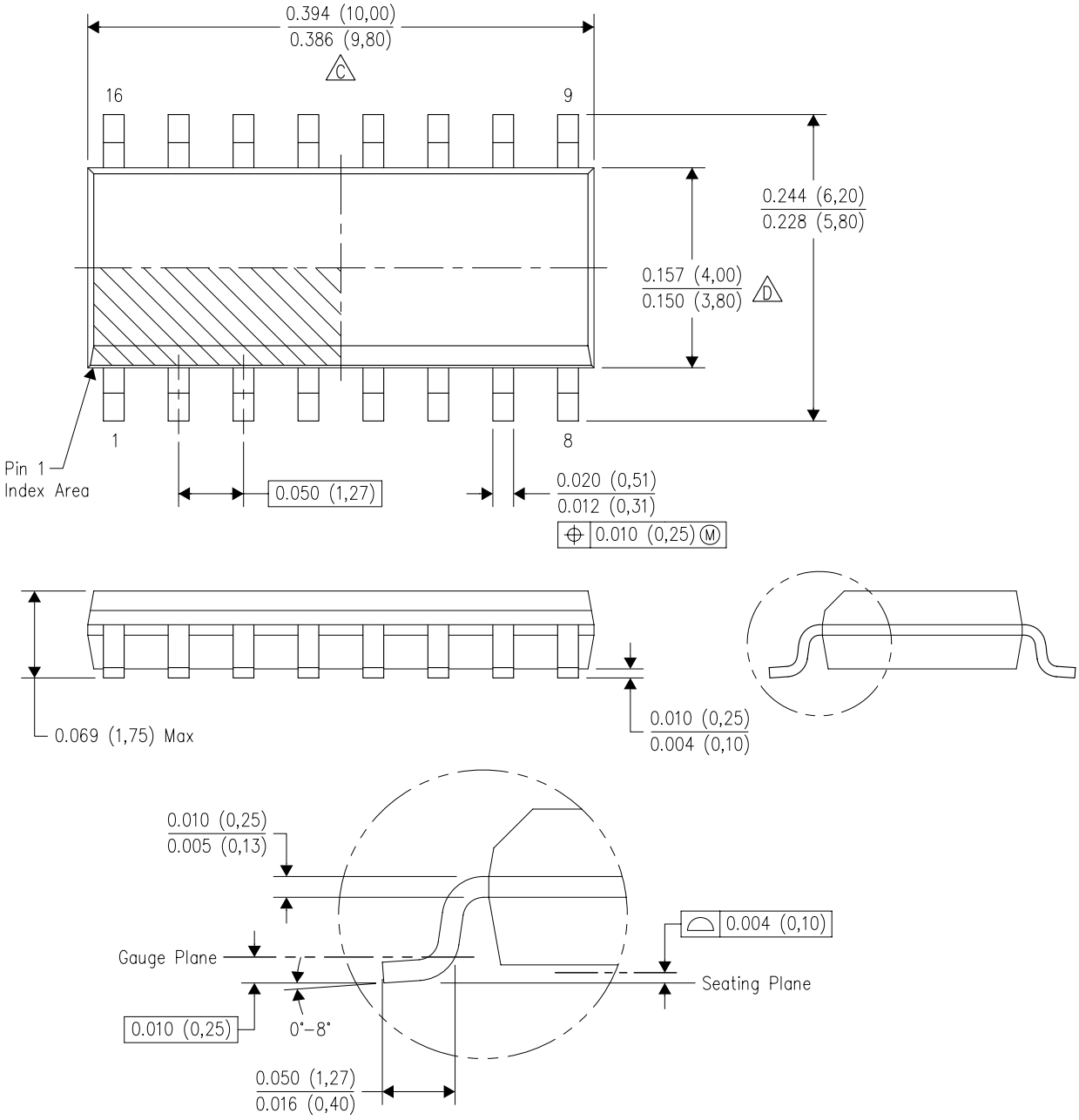
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74HC4060QDRQ1	SOIC	D	16	2500	356.0	356.0	35.0

D (R–PDSO–G16) PLASTIC SMALL OUTLINE



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.

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