

# CD74HCT4066-Q1 HIGH-SPEED CMOS LOGIC QUAD BILATERAL SWITCH

SCLS581B – APRIL 2004 – REVISED APRIL 2008

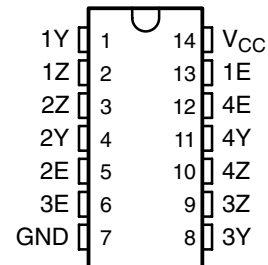
- Qualified for Automotive Applications
- Low ON Resistance  
– 25 Ω Typical ( $V_{CC} = 4.5\text{ V}$ )
- Fast Switching and Propagation Speeds
- Low OFF Leakage Current
- Wide Operating Temperature Range:  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$
- Direct LSTTL Input Logic Compatibility:  
 $V_{IL} = 0.8\text{ V Max}$ ,  $V_{IH} = 2\text{ V Min}$
- CMOS Input Compatibility:  $I_I \leq 1\ \mu\text{A}$  at  $V_{OL}$ ,  $V_{OH}$

## description/ordering information

The CD74HCT4066 contains four independent digitally controlled analog switches that use silicon-gate CMOS technology to achieve operation speeds similar to LSTTL, with the low power consumption of standard CMOS integrated circuits.

These switches feature the characteristic linear ON resistance of the metal-gate CD4066B. Each switch is turned on by a high-level voltage on its control input.

M OR PW PACKAGE  
(TOP VIEW)



## ORDERING INFORMATION†

T <sub>A</sub>	PACKAGE‡		ORDERABLE PART NUMBER§	TOP-SIDE MARKING
	SOIC – M	Reel of 2500		
$-40^{\circ}\text{C}$ to $125^{\circ}\text{C}$	SOIC – M	Reel of 2500	CD74HCT4066QM96Q1	HCT4066Q
	TSSOP – PW	Reel of 2000	CD74HCT4066QPWRQ1	HK4066Q

† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at <http://www.ti.com>.

‡ Package drawings, thermal data, and symbolization are available at <http://www.ti.com/packaging>.

§ The suffix 96 denotes tape and reel.

## FUNCTION TABLE

INPUT nE	SWITCH
L	Off
H	On

H = High level

L = Low level



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

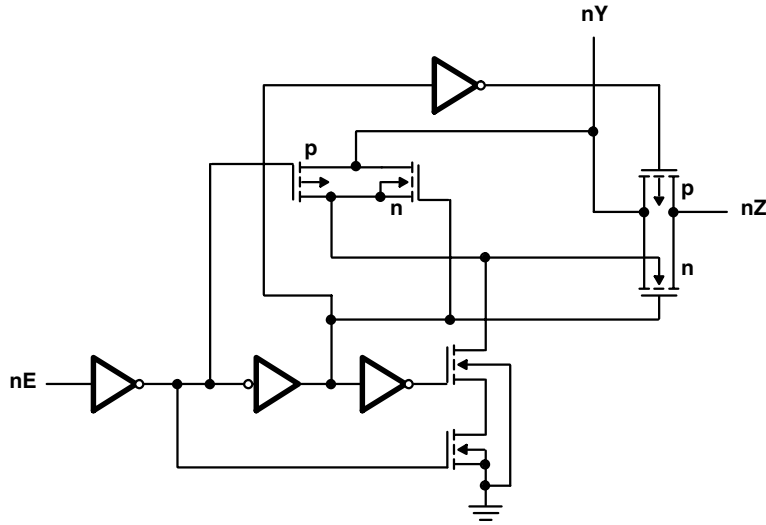
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

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**logic diagram (positive logic)**



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

Supply voltage range, $V_{CC}$ (see Note 1)	-0.5 V to +7 V
Input clamp current, $I_{IK}$ ( $V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V)	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V)	$\pm 20$ mA
Switch current, $I_O$ (see Note 2) ( $V_O > -0.5$ V or $V_O < V_{CC} + 0.5$ V)	$\pm 25$ mA
Output source or sink current per output pin, $I_O$ ( $V_O > -0.5$ V or $V_O < V_{CC} + 0.5$ V)	$\pm 25$ mA
Continuous current through $V_{CC}$ or GND	$\pm 50$ mA
Package thermal impedance, $\theta_{JA}$ (see Note 3): D package	86°C/W
	PW package
	113°C/W
Storage temperature range, $T_{stg}$	-65°C to 150°C

<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. All voltages referenced to GND unless otherwise specified.
  2. In certain applications, the external load-resistor current may include both  $V_{CC}$  and signal-line components. To avoid drawing  $V_{CC}$  current when switch current flows into the transmission gate inputs (terminals 1, 4, 8, and 11), the voltage drop across the bidirectional switch must not exceed 0.6 V (calculated from  $r_{on}$  values shown in the electrical characteristics table). No  $V_{CC}$  current flows through  $R_L$  if the switch current flows into terminals 2, 3, 9, and 10.
  3. The package thermal impedance is calculated in accordance with JESD 51-7.

**recommended operating conditions (see Note 4)**

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage	4.5	5.5	V
V <sub>IH</sub>	High-level input voltage	2		V
V <sub>IL</sub>	Low-level input voltage		0.8	V
V <sub>I</sub>	Input voltage	0	V <sub>CC</sub>	V
V <sub>O</sub>	Output voltage	0	V <sub>CC</sub>	V
t <sub>t</sub>	Input transition (rise and fall) time	V <sub>CC</sub> = 4.5 V		0 500 ns
T <sub>A</sub>	Operating free-air temperature	-40	125	°C

NOTES: 4. 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>I</sub>	V <sub>CC</sub>	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C TO 125°C		UNIT
				MIN	TYP	MAX	MIN	MAX	
I <sub>IL</sub>	Any control	V <sub>CC</sub> or GND	5.5 V			±0.1		±1	μA
I <sub>IZ</sub>	V <sub>IS</sub> = V <sub>CC</sub> or GND	V <sub>IL</sub>	5.5 V			±0.1		±1	μA
r <sub>on</sub>	I <sub>O</sub> = 1 mA, See Figure 7	V <sub>IS</sub> = V <sub>CC</sub> or GND	V <sub>CC</sub>	4.5 V	25	80		128	Ω
		V <sub>IS</sub> = V <sub>CC</sub> to GND	V <sub>CC</sub>	4.5 V		35	95		
Δr <sub>on</sub>	Between any two switches	V <sub>CC</sub>	4.5 V		1				Ω
I <sub>CC</sub>		V <sub>CC</sub> or GND	5.5 V			2		40	μA
ΔI <sub>CC</sub>	Per input pin: 1 unit load, See Note 5	V <sub>CC</sub> - 2.1 V	4.5 V to 5.5 V		100	360		490	μA
C <sub>I</sub>	Control inputs					10		10	pF

NOTE 5: For dual-supply systems, theoretical worst case (V<sub>I</sub> = 2.4 V, V<sub>CC</sub> = 5.5 V) specification is 1.8 mA.

**HCT input loading**

INPUT	UNIT LOADS†
All	1

† Unit load is ΔI<sub>CC</sub> limit specified in the electrical characteristics table, e.g., 360 μA max at 25°C.

**CD74HCT4066-Q1**  
**HIGH-SPEED CMOS LOGIC**  
**QUAD BILATERAL SWITCH**  
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switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 6)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	V <sub>CC</sub>	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C TO 125°C		UNIT
					MIN	TYP	MAX	MIN	MAX	
t <sub>pd</sub>	Y or Z	Z or Y	C <sub>L</sub> = 15 pF	5 V	4					ns
			C <sub>L</sub> = 50 pF	4.5 V	12			18		
t <sub>en</sub>	E	Y or Z	C <sub>L</sub> = 15 pF	5 V	9					ns
			C <sub>L</sub> = 50 pF	4.5 V	24			36		
t <sub>dis</sub>	E	Y or Z	C <sub>L</sub> = 15 pF	5 V	14					ns
			C <sub>L</sub> = 50 pF	4.5 V	35			53		

operating characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C, input t<sub>r</sub>, t<sub>f</sub> = 6 ns

PARAMETER	TYP	UNIT
C <sub>pd</sub> Power dissipation capacitance (see Note 6)	38	pF

NOTE 6: C<sub>pd</sub> is used to determine the dynamic power consumption (P<sub>D</sub>), per package.

$$P_D = (C_{pd} \times V_{CC}^2 \times f_i) + \Sigma (C_L + C_S) \times V_{CC}^2 \times f_O$$

f<sub>O</sub> = output frequency

f<sub>I</sub> = input frequency

C<sub>L</sub> = output load capacitance

C<sub>S</sub> = switch capacitance

V<sub>CC</sub> = supply voltage

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	TYP	UNIT
f <sub>max</sub> Switch frequency response bandwidth at -3 dB	See Figure 2 and Figure 8 and Notes 7 and 8	4.5 V	200	MHz
Crosstalk between any two switches	See Figure 1 and Figure 9 and Notes 8 and 9	4.5 V	-72	dB
Total harmonic distortion	See Figure 3, 1 kHz, V <sub>IS</sub> = 4 V <sub>P-P</sub>	4.5 V	0.023	%
Control to switch feedthrough noise	See Figure 4	4.5 V	130	mV
Switch OFF signal feedthrough	See Figure 5 and Figure 9 and Notes 8 and 9	4.5 V	-72	dB
C <sub>S</sub> Switch input capacitance			5	pF

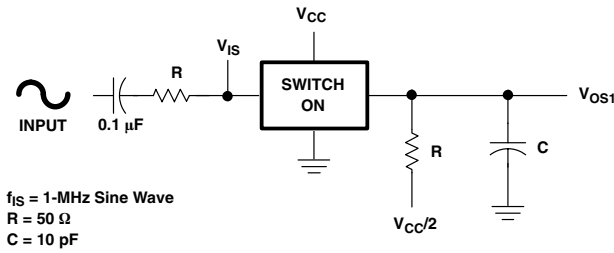
NOTES: 7. Adjust input voltage to obtain 0 dBm at output, f = 1 MHz.

8. V<sub>IS</sub> is centered at V<sub>CC</sub>/2.

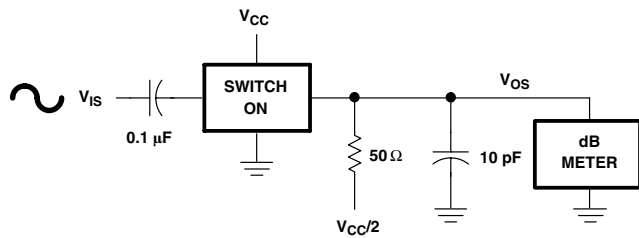
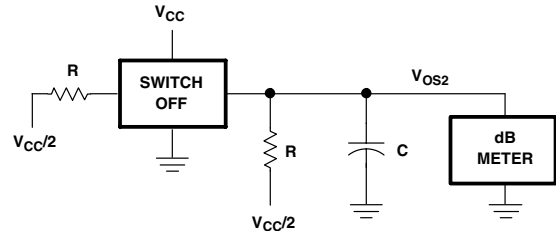
9. Adjust input for 0 dBm at V<sub>IS</sub>.



**PARAMETER MEASUREMENT INFORMATION**

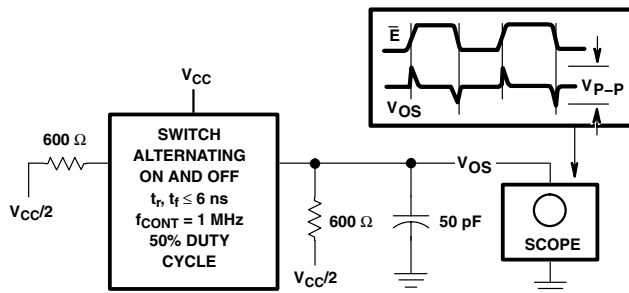


**Figure 1. Crosstalk Between Two Switches Test Circuit**

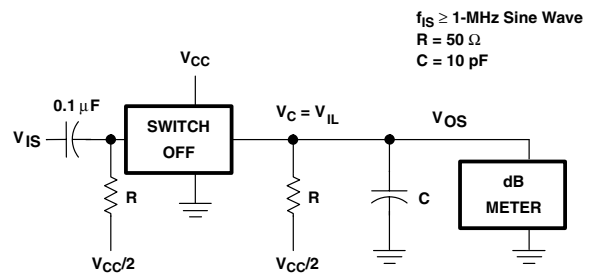


**Figure 2. Frequency-Response Test Circuit**

**Figure 3. Total Harmonic Distortion Test Circuit**

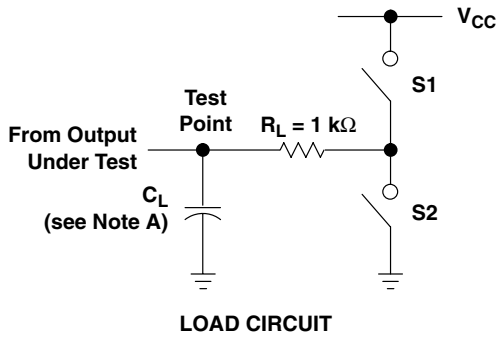


**Figure 4. Control-to-Switch Feedthrough Noise Test Circuit**

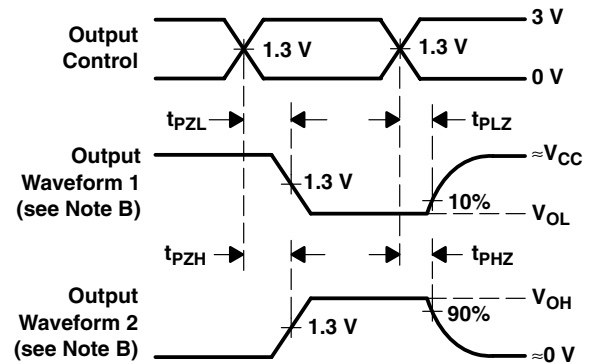
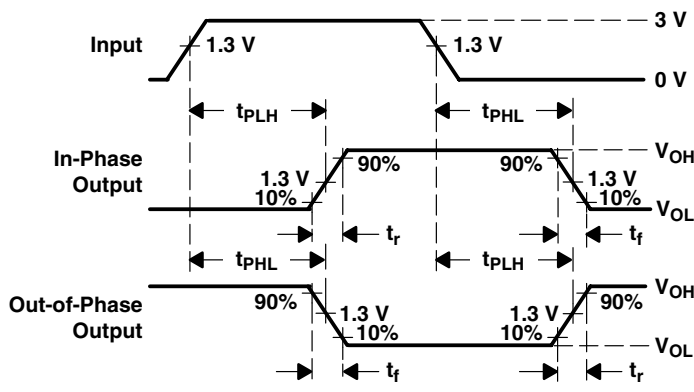


**Figure 5. Switch OFF Signal Feedthrough Test Circuit**

**PARAMETER MEASUREMENT INFORMATION**



PARAMETER		S1	S2
$t_{en}$	$t_{pZH}$	Open	Closed
	$t_{pZL}$	Closed	Open
$t_{dis}$	$t_{pHZ}$	Open	Closed
	$t_{pLZ}$	Closed	Open
$t_{pd}$		Open	Open



- NOTES: A.  $C_L$  includes probe and test-fixture capacitance.  
 B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.  
 C. 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.  
 D. For clock inputs,  $f_{max}$  is measured with the input duty cycle at 50%.  
 E. The outputs are measured one at a time, with one input transition per measurement.  
 F.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .  
 G.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .  
 H.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

**Figure 6. Load Circuit and Voltage Waveforms**

TYPICAL CHARACTERISTICS

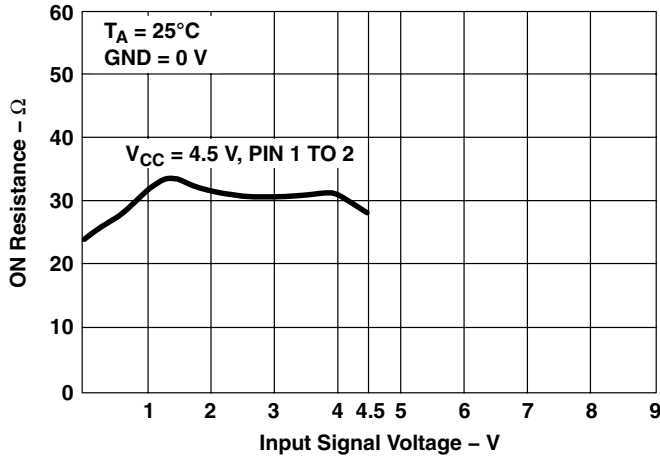


Figure 7. Typical ON Resistance vs Input Signal Voltage

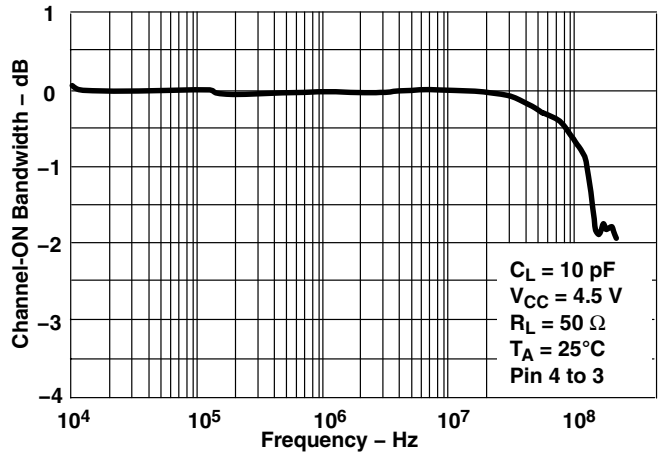


Figure 8. Switch Frequency Response,  $V_{CC} = 4.5 \text{ V}$

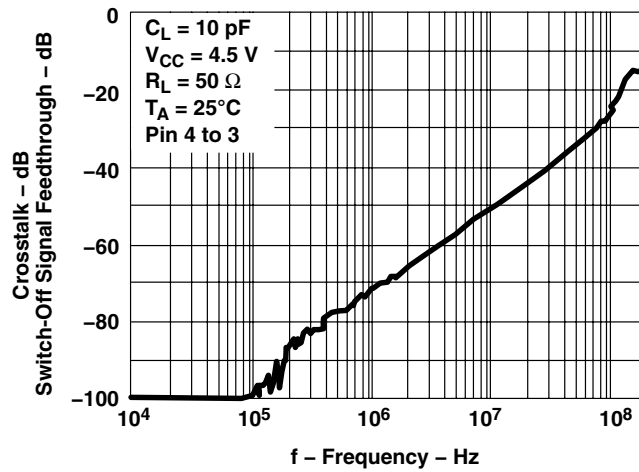


Figure 9. Switch-OFF Signal Feedthrough and Crosstalk vs Frequency,  $V_{CC} = 4.5 \text{ V}$

**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
CD74HCT4066QM96Q1	NRND	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HCT4066Q	
CD74HCT4066QPWRQ1	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HK4066Q	Samples
D24066QM96G4Q1	NRND	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HCT4066Q	

(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.

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**OTHER QUALIFIED VERSIONS OF CD74HCT4066-Q1 :**

- Catalog : [CD74HCT4066](#)

## NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

**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
CD74HCT4066QPWRQ1	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
HCT4066QPWRG4Q1	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

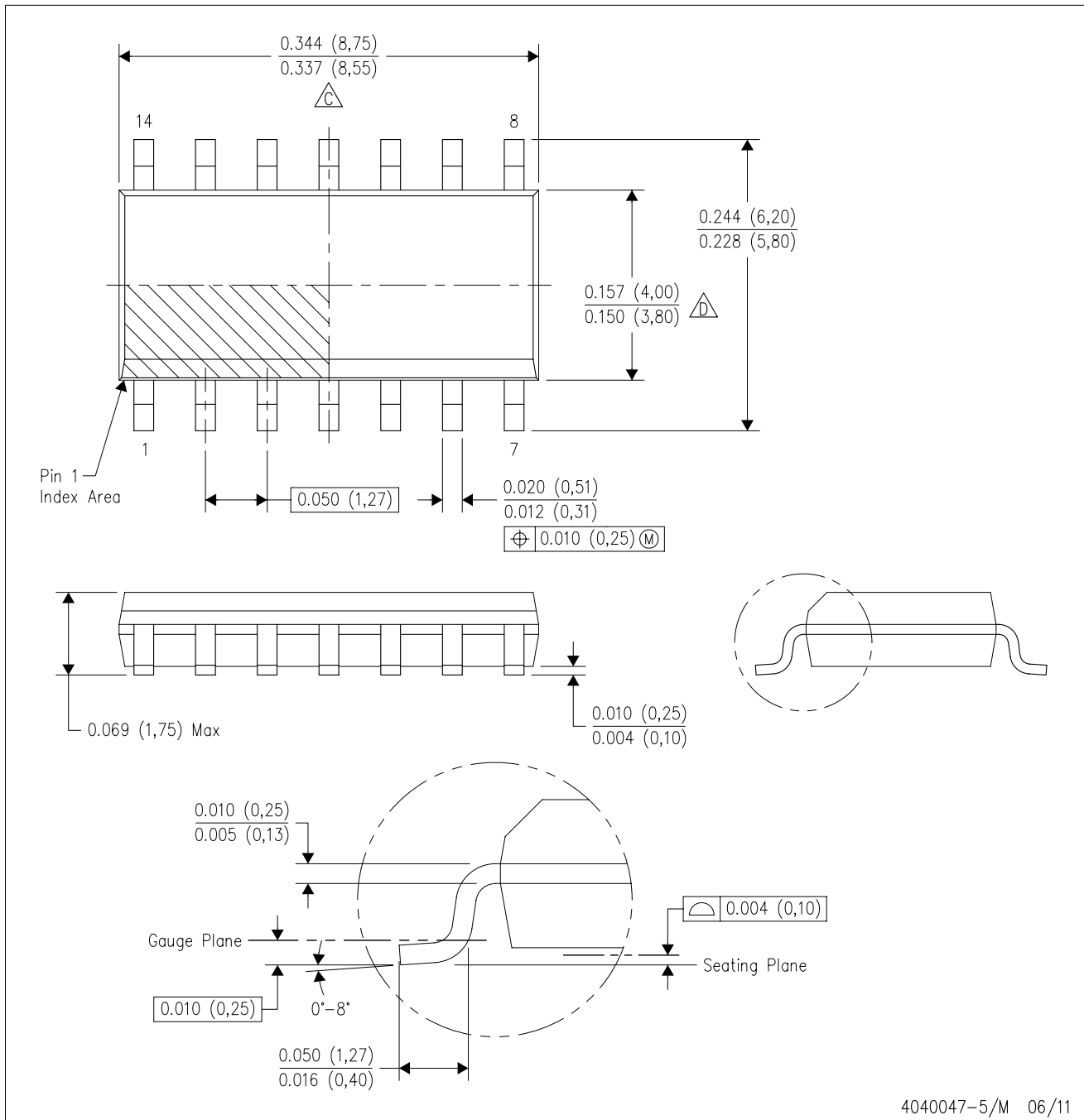
**TAPE AND REEL BOX DIMENSIONS**




\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74HCT4066QPWRQ1	TSSOP	PW	14	2000	367.0	367.0	35.0
HCT4066QPWRG4Q1	TSSOP	PW	14	2000	356.0	356.0	35.0

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  -  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.
  -  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - 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.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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