

CD74HCT4066-Q1 HIGH-SPEED CMOS LOGIC QUAD BILATERAL SWITCH

SCLS581B – APRIL 2004 – REVISED APRIL 2008

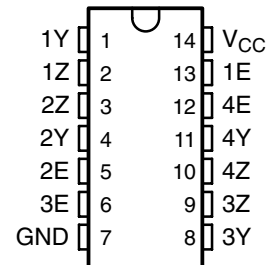
- **Qualified for Automotive Applications**
- **Low ON Resistance**
– 25 Ω Typical ($V_{CC} = 4.5\text{ V}$)
- **Fast Switching and Propagation Speeds**
- **Low OFF Leakage Current**
- **Wide Operating Temperature Range: -40°C to 125°C**
- **Direct LSTTL Input Logic Compatibility:**
 $V_{IL} = 0.8\text{ V Max}$, $V_{IH} = 2\text{ V Min}$
- **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 _A | PACKAGE‡ | | ORDERABLE PART NUMBER§ | TOP-SIDE MARKING |
|----------------|------------|--------------|------------------------|------------------|
| | SOIC – M | Reel of 2500 | | |
| –40°C to 125°C | TSSOP – PW | Reel of 2000 | CD74HCT4066QM96Q1 | HCT4066Q |
| | | | 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



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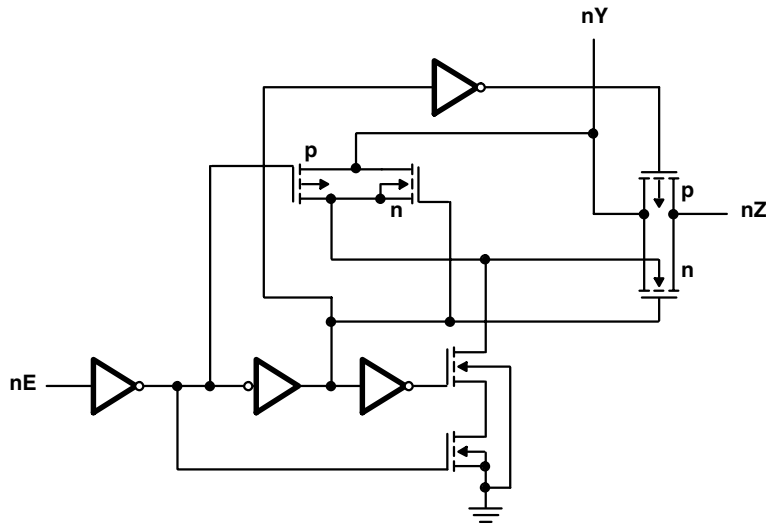
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

| | |
|---|----------------|
| 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) | ± 20 mA |
| Output clamp current, I_{OK} ($V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V) | ± 20 mA |
| Switch current, I_O (see Note 2) ($V_O > -0.5$ V or $V_O < V_{CC} + 0.5$ V) | ± 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) | ± 25 mA |
| Continuous current through V_{CC} or GND | ± 50 mA |
| Package thermal impedance, θ_{JA} (see Note 3): D package | 86°C/W |
| PW package | 113°C/W |
| Storage temperature range, T_{stg} | -65°C to 150°C |

[†] 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 _{CC} | Supply voltage | 4.5 | 5.5 | V |
| V _{IH} | High-level input voltage | 2 | | V |
| V _{IL} | Low-level input voltage | | 0.8 | V |
| V _I | Input voltage | 0 | V _{CC} | V |
| V _O | Output voltage | 0 | V _{CC} | V |
| t _t | Input transition (rise and fall) time | V _{CC} = 4.5 V | | 0 500 ns |
| T _A | Operating free-air temperature | -40 | 125 | °C |

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

NOTE 5: For dual-supply systems, theoretical worst case (V_I = 2.4 V, V_{CC} = 5.5 V) specification is 1.8 mA.

HCT input loading

| INPUT | UNIT LOADS† |
|-------|-------------|
| All | 1 |

† Unit load is ΔI_{CC} limit specified in the electrical characteristics table, e.g., 360 μA max at 25°C.

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HIGH-SPEED CMOS LOGIC
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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 _{CC} | T _A = 25°C | | | T _A = -40°C TO 125°C | | UNIT |
|------------------|--------------|-------------|------------------------|-----------------|-----------------------|-----|-----|---------------------------------|-----|------|
| | | | | | MIN | TYP | MAX | MIN | MAX | |
| t _{pd} | Y or Z | Z or Y | C _L = 15 pF | 5 V | 4 | | | | | ns |
| | | | C _L = 50 pF | 4.5 V | 12 | | | 18 | | |
| t _{en} | E | Y or Z | C _L = 15 pF | 5 V | 9 | | | | | ns |
| | | | C _L = 50 pF | 4.5 V | 24 | | | 36 | | |
| t _{dis} | E | Y or Z | C _L = 15 pF | 5 V | 14 | | | | | ns |
| | | | C _L = 50 pF | 4.5 V | 35 | | | 53 | | |

operating characteristics, V_{CC} = 5 V, T_A = 25°C, input t_r, t_f = 6 ns

| PARAMETER | TYP | UNIT |
|--|-----|------|
| C _{pd} Power dissipation capacitance (see Note 6) | 38 | pF |

NOTE 6: C_{pd} is used to determine the dynamic power consumption (P_D), 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_O = output frequency

f_I = input frequency

C_L = output load capacitance

C_S = switch capacitance

V_{CC} = supply voltage

analog channel characteristics, T_A = 25°C

| PARAMETER | TEST CONDITIONS | V _{CC} | TYP | UNIT |
|---|---|-----------------|-------|------|
| f _{max} 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 _{IS} = 4 V _{P-P} | 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 _S Switch input capacitance | | | 5 | pF |

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

8. V_{IS} is centered at V_{CC}/2.

9. Adjust input for 0 dBm at V_{IS}.



PARAMETER MEASUREMENT INFORMATION

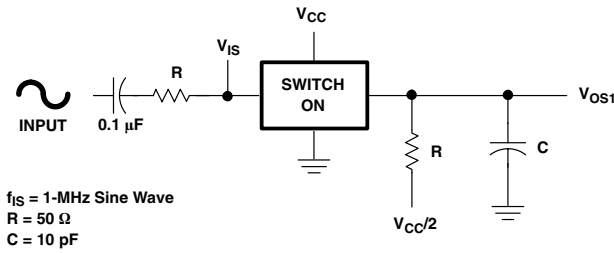


Figure 1. Crosstalk Between Two Switches Test Circuit

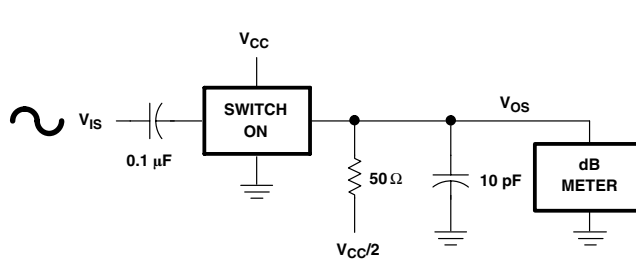
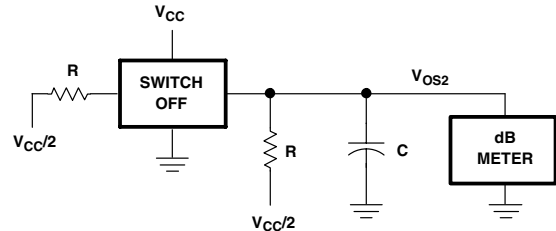


Figure 2. Frequency-Response Test Circuit

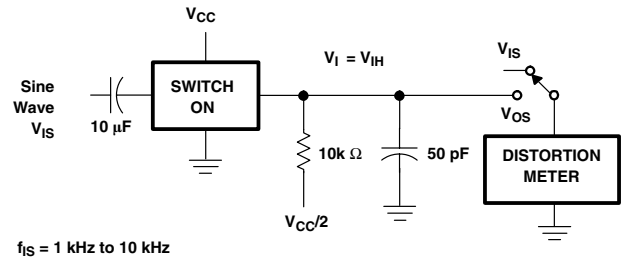


Figure 3. Total Harmonic Distortion Test Circuit

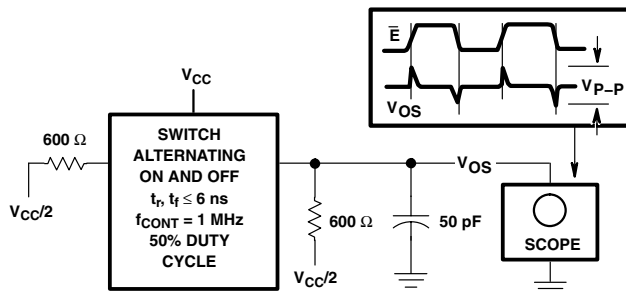


Figure 4. Control-to-Switch Feedthrough Noise Test Circuit

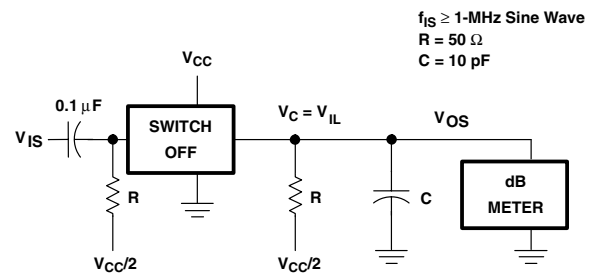
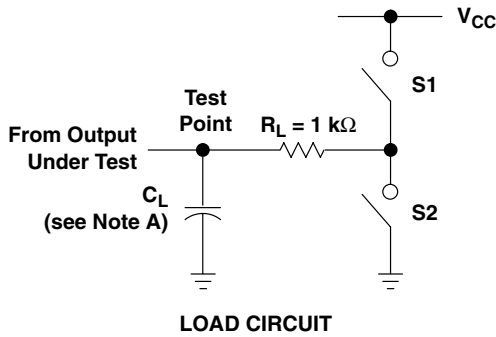
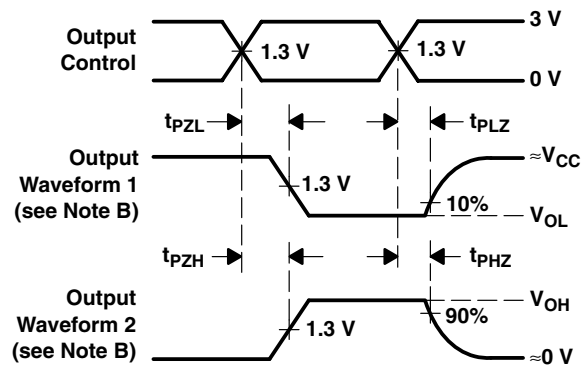
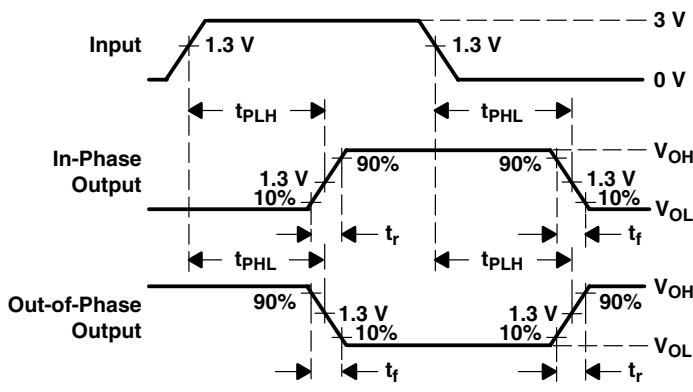


Figure 5. Switch OFF Signal Feedthrough Test Circuit

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

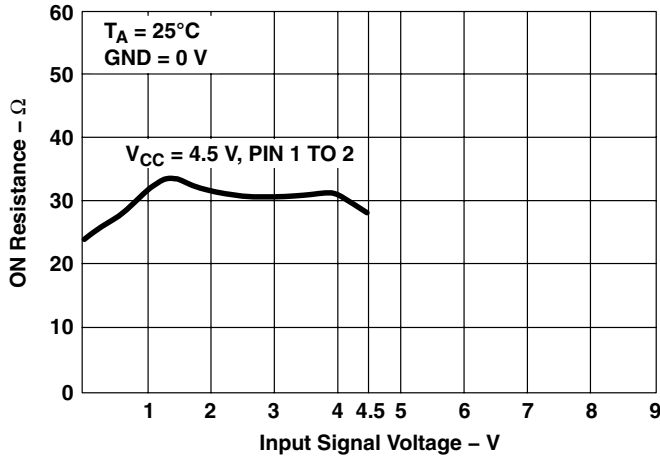


Figure 7. Typical ON Resistance vs Input Signal Voltage

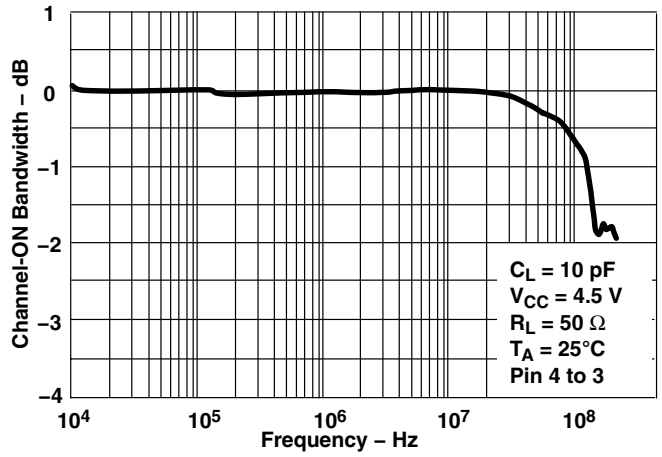


Figure 8. Switch Frequency Response, $V_{CC} = 4.5\text{ V}$

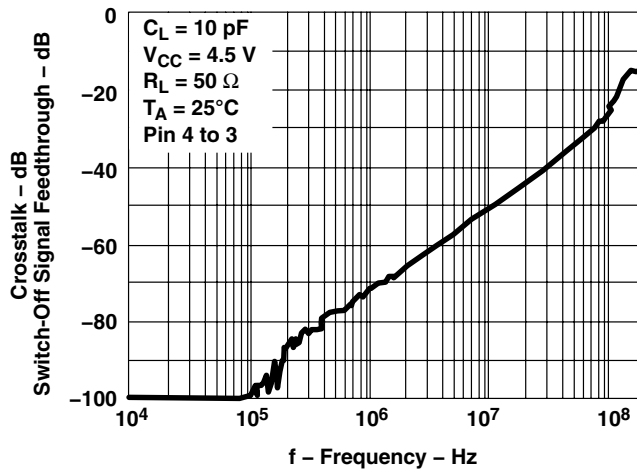


Figure 9. Switch-OFF Signal Feedthrough and Crosstalk vs Frequency, $V_{CC} = 4.5\text{ V}$

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/ Ball Finish | MSL Peak Temp ⁽³⁾ | Samples (Requires Login) |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|----------------------|------------------------------|-----------------------------|
| CD74HCT4066QM96Q1 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| CD74HCT4066QPWRQ1 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| D24066QM96G4Q1 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |
| HCT4066QPWRG4Q1 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | |

⁽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.

OBSELETE: TI has discontinued the production of the device.

⁽²⁾ 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)

⁽³⁾ 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 CD74HCT4066-Q1 :

- Catalog: [CD74HCT4066](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

D (R-PDSO-G14)

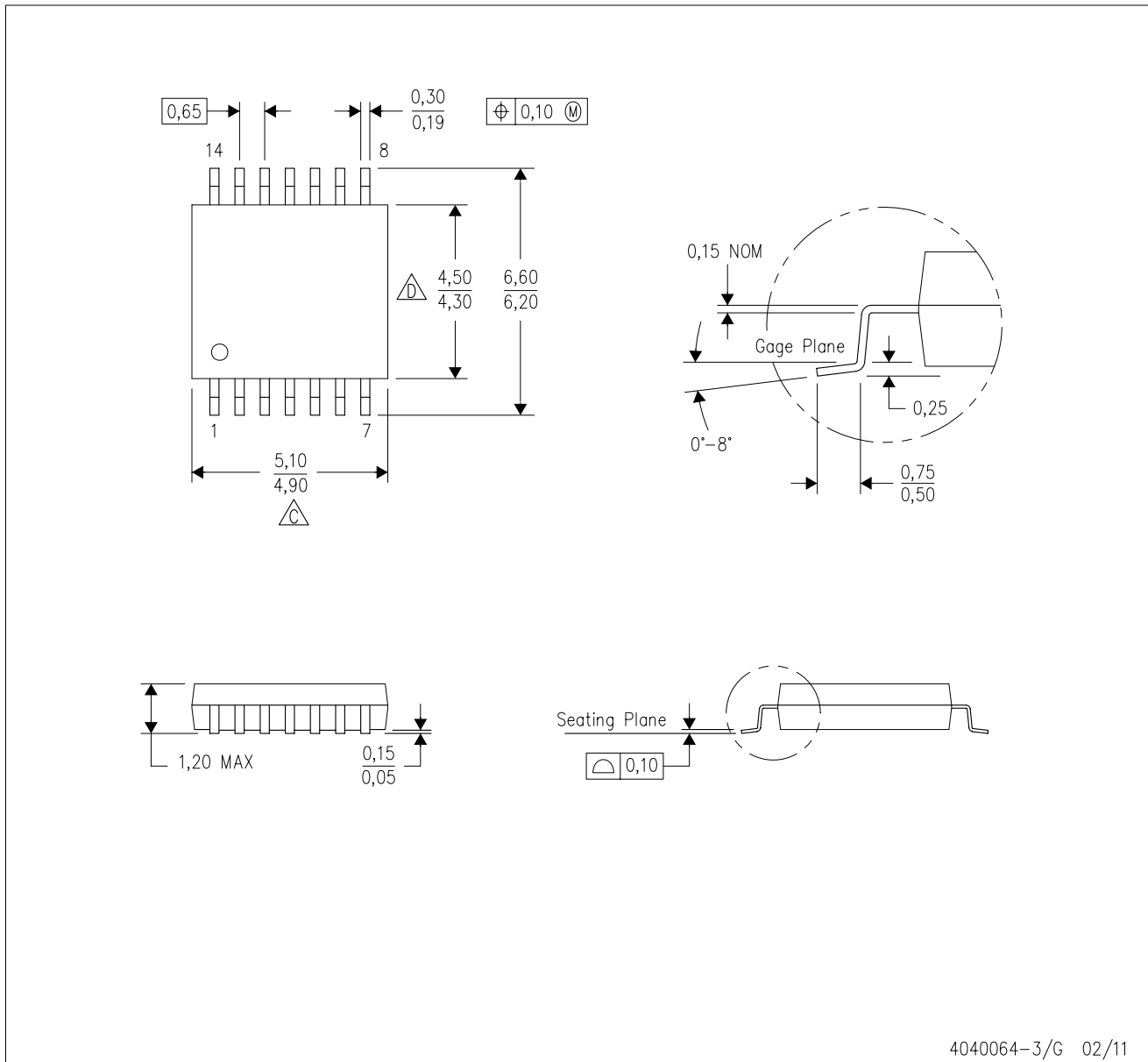
PLASTIC SMALL OUTLINE



- 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.

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE

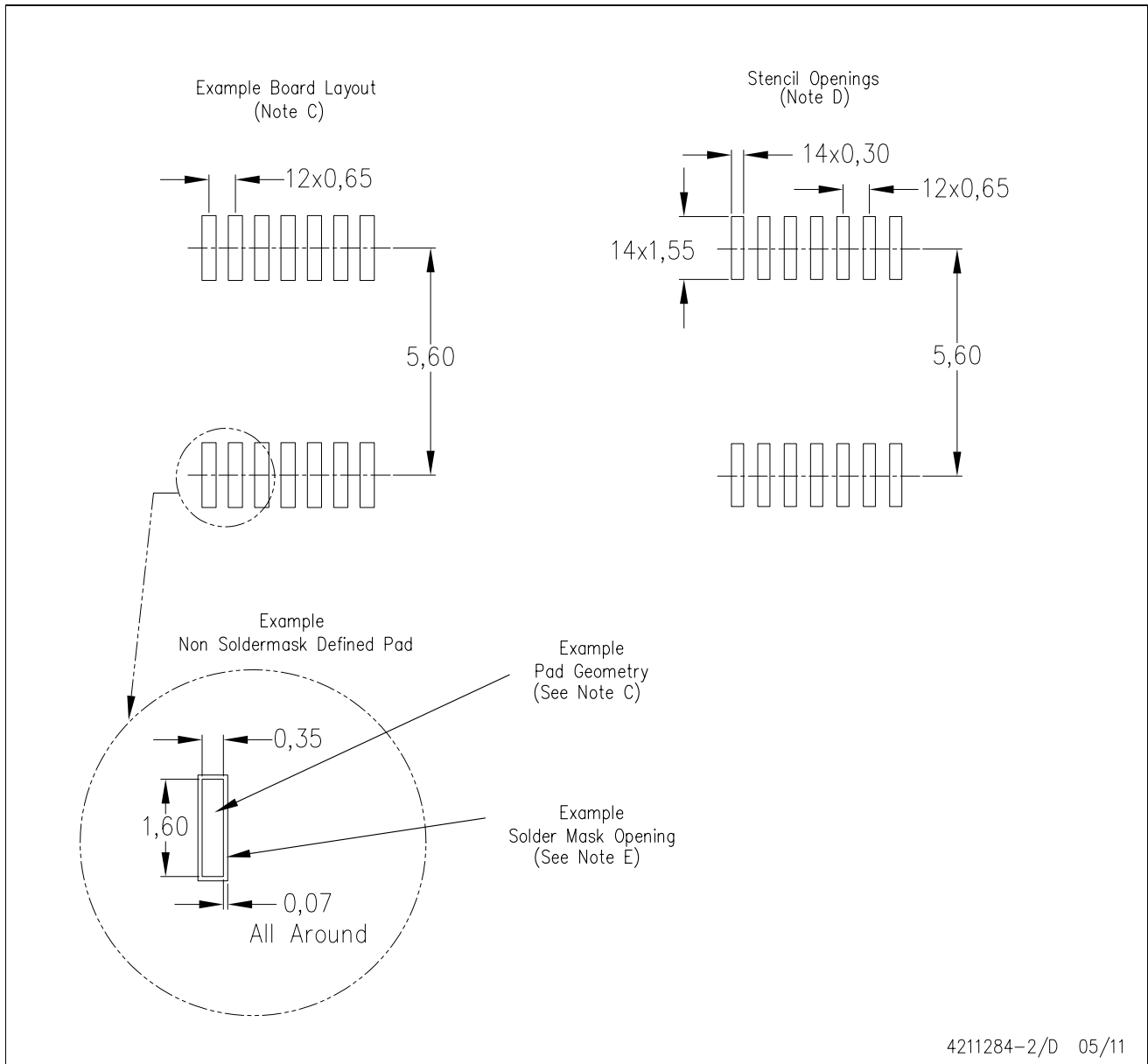


4040064-3/G 02/11

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 -  D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

PW (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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