CD74HCT4066-Q1 Automotive High-speed CMOS Logic Quad Bilateral Switch

1 Features

- Qualified for automotive applications
- Low ON resistance:
  - 25Ω typical (V_{CC} = 4.5V)
- 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} = 0.8V maximum, V_{IH} = 2V minimum
- CMOS input compatibility: $I_I \leq 1\mu A$ at V_{OL}, V_{OH}

2 Applications

- Analog signal switching and multiplexing: signal gating, modulators, squelch controls, demodulators, choppers, commutating switches
- Digital signal switching and multiplexing
- Analog-to-digital and digital-to-analog conversions
- Digital control of frequency, impedance, phase, and analog-signal gain
- Building automation

3 Description

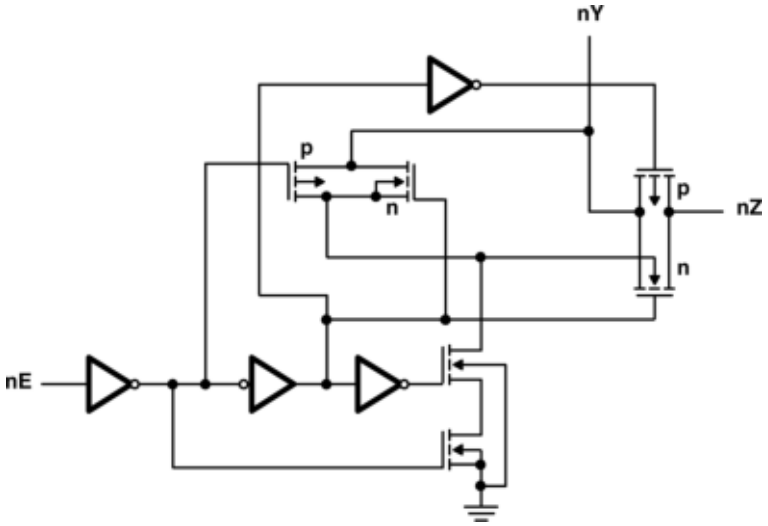
The CD74HCT4066-Q1 contains four independent digitally controlled analog switches that use silicon-gate CMOS technology to achieve operation speeds similar to LSTTL, with the low power consumption of standard CMOS integrated circuits.

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.

Package Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
CD74HCT4066-Q1	PW (TSSOP, 14)	5mm × 6.4mm

(1) For more information, see Section 10
(2) The package size (length × width) is a nominal value and includes pins, where applicable.



Logic Diagram (Positive Logic)

An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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4 Pin Configuration and Functions

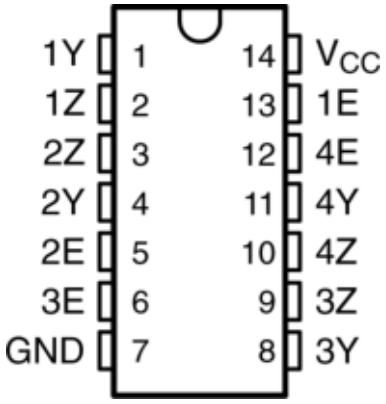


Figure 4-1. DW or PW Package, 14-Pin SOIC or TSSOP (Top View)

Table 4-1. Pin Functions

PIN		TYPE[1]	DESCRIPTION
NAME	NO.		
1Y	1	I/O	Input/Output for Switch 1
1Z	2	I/O	Input/Output for Switch 1
2Z	3	I/O	Input/Output for Switch 2
2Y	4	I/O	Input/Output for Switch 2
2E	5	I	Control pin for Switch 2
3E	6	I	Control pin for Switch 3
GND	7	-	Ground Pin
3Y	8	I/O	Input/Output for Switch 3
3Z	9	I/O	Input/Output for Switch 3
4Z	10	I/O	Input/Output for Switch 4
4Y	11	I/O	Input/Output for Switch 4
4E	12	I	Control pin for Switch 4
1E	13	I	Control pin for Switch 1
V_{CC}	14	-	Power Pin

(1) Signal Types: I = Input, O = Output, I/O = Input or Output.

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5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

			MIN	MAX	UNIT
V_{CC} (see (2))	Supply voltage range		−0.5	+7	V
I_{IK} (V_I < −0.5V or V_I > V_{CC} + 0.5V)	Input clamp current			±20	mA
I_{OK} (V_O < −0.5V or V_O > V_{CC} + 0.5V)	Output clamp current			±20	mA
I_O (see (3)) (V_O > −0.5V or V_O < V_{CC} + 0.5V)	Switch current			±25	mA
I_O (V_O > −0.5V or V_O < V_{CC} + 0.5V)	Output source or sink current per output pin			±25	mA
	Continuous current through V_{CC} or GND			±50	mA
T_{stg}	Storage temperature range		−65	150	°C

(1) 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.
(2) All voltages referenced to GND unless otherwise specified.
(3) 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 0.6V (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.

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5.2 Thermal Information

THERMAL METRIC (1)		CD74HCT4066-Q1 PW (TSSOP) 14 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	133.9	°C/W

(1) For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report.

5.3 Recommended Operating Conditions

(see (1))

			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} = 4.5V	0	500	ns
T_A	Operating free-air temperature		−40	125	°C

(1) 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.

5.4 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 TO 125°C		UNIT
					MIN	TYP	MAX	MIN	MAX	
I_{IL}	Any control		V_{CC} or GND	5.5V			±0.1		±1	µA
I_{IZ}	V_{IS} = V_{CC} or GND		V_{IL}	5.5V			±0.1		±1	µA
r_{on}	I_O = 1mA, See Figure 5-1	V_{IS} = V_{CC} or GND	V_{CC}	4.5V		25	80		128	Ω
		V_{IS} = V_{CC} to GND	V_{CC}	4.5V		35	95		142	
Δr_{on}	Between any two switches		V_{CC}	4.5V		1				Ω
I_{CC}			V_{CC} or GND	5.5V			2		40	µA
ΔI_{CC}	Per input pin: 1 unit load, See (1)		V_{CC} − 2.1V	4.5V to 5.5V		100	360		490	µA
C_I	Control inputs						10		10	pF

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

5.5 HCT Input Loading

INPUT	UNIT LOADS(1)
All	1

(1) Unit load is ΔI_{CC} limit specified in the electrical characteristics table, for example,., 360 µA max at 25°C.

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5.6 Switching Characteristics

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 6-6)

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 = 15pF	5V		1.3				ns
			C_L = 50pF	4.5V			12		18	
t_{en}	E	Y or Z	C_L = 15pF	5V		5				ns
			C_L = 50pF	4.5V			24		36	
t_{dis}	E	Y or Z	C_L = 15pF	5V		5.5				ns
			C_L = 50pF	4.5V			35		53	

5.7 Operating Characteristics

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

PARAMETER		TYP	UNIT
C_{pd}	Power dissipation capacitance (see (1))	38	pF

(1) 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

5.8 Analog Channel Characteristics

T_A = 25°C

PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT
f_{max}	Switch frequency response bandwidth at −3dB	See Figure 6-2 and Figure 5-2 and Notes 7 and 8	4.5V	200	MHz
	Crosstalk between any two switches	See Figure 6-1 and Figure 5-3 and Notes 8 and 9	4.5V	−72	dB
	Total harmonic distortion	See Figure 6-3, 1kHz, $V_{IS} = 4V_{P-P}$	4.5V	0.023	%
	Control to switch feedthrough noise	See Figure 6-4	4.5V	130	mV
	Switch OFF signal feedthrough	See Figure 6-5 and Figure 5-3 and Notes 8 and 9	4.5V	−72	dB
C_S	Switch input capacitance			5	pF

(1) Adjust input voltage to obtain 0dBm at output, f = 1MHz.
(2) V_{IS} is centered at $V_{CC}/2$.
(3) Adjust input for 0dBm at V_{IS}.

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5.9 Typical Characteristics

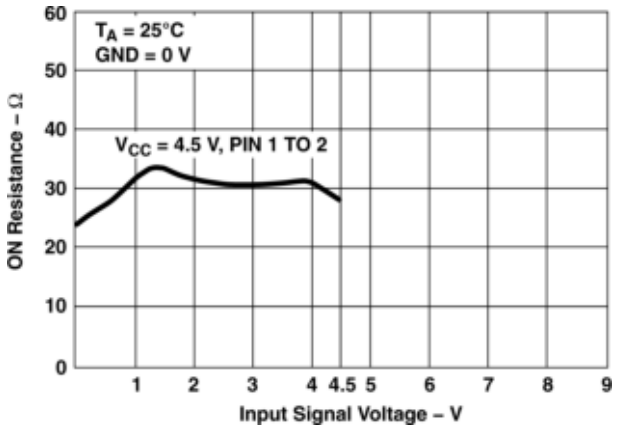


Figure 5-1. Typical on Resistance vs Input Signal Voltage

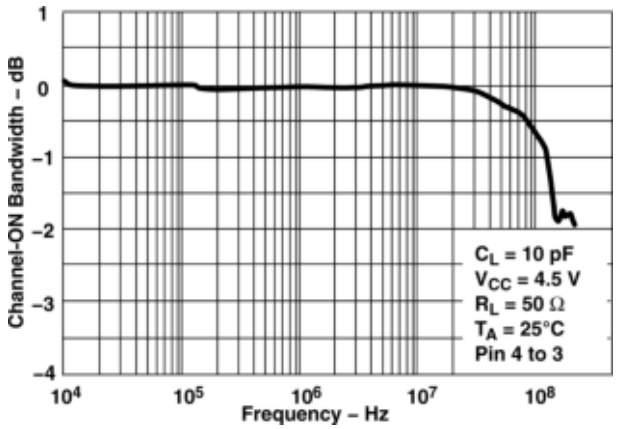


Figure 5-2. Switch Frequency Response, V_{CC} = 4.5V

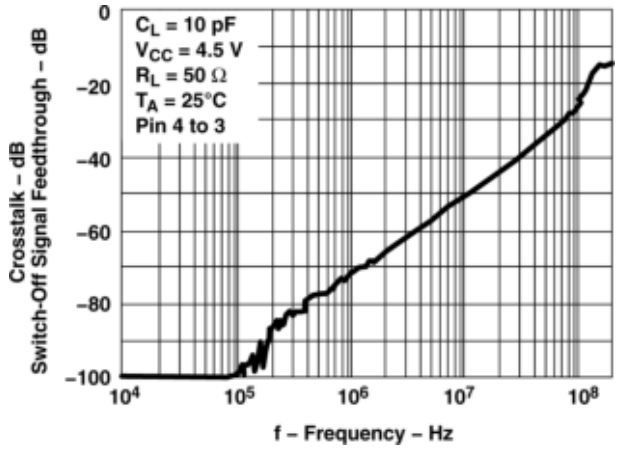


Figure 5-3. Switch-OFF Signal Feedthrough and Crosstalk vs Frequency, V_{CC} = 4.5V

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6 Parameter Measurement Information

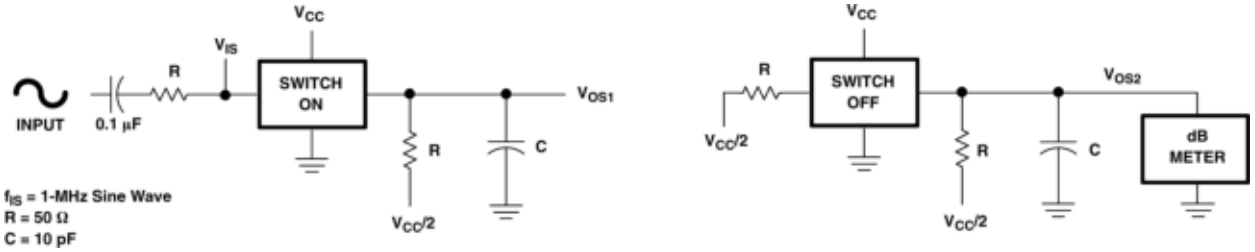


Figure 6-1. Crosstalk between Two Switches Test Circuit

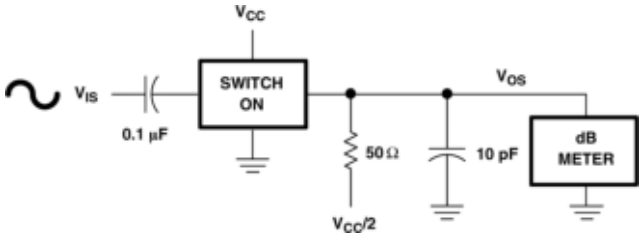


Figure 6-2. Frequency-Response Test Circuit

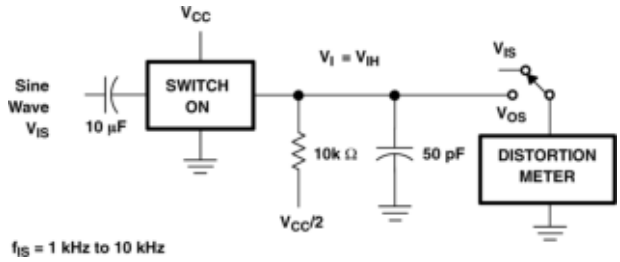


Figure 6-3. Total Harmonic Distortion Test Circuit

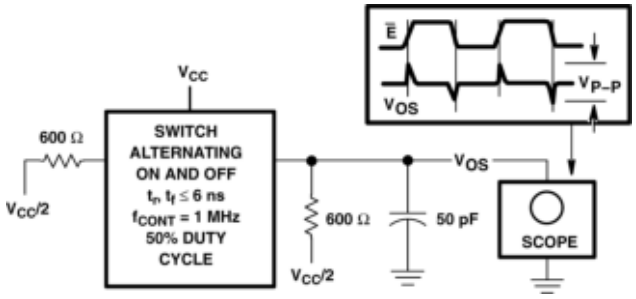


Figure 6-4. Control-to-Switch Feedthrough Noise Test Circuit

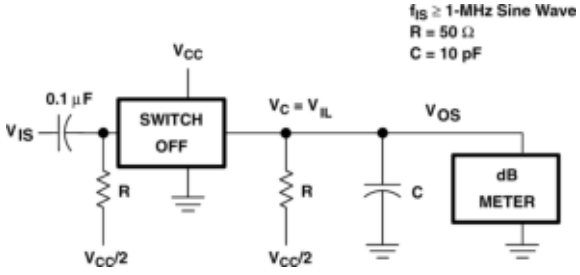
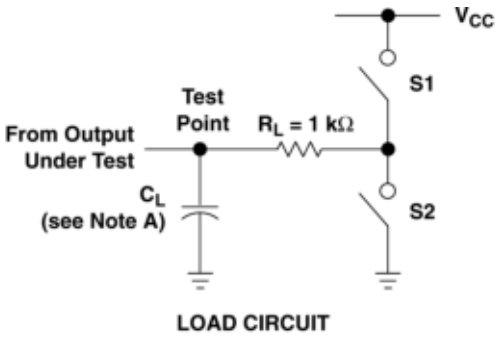
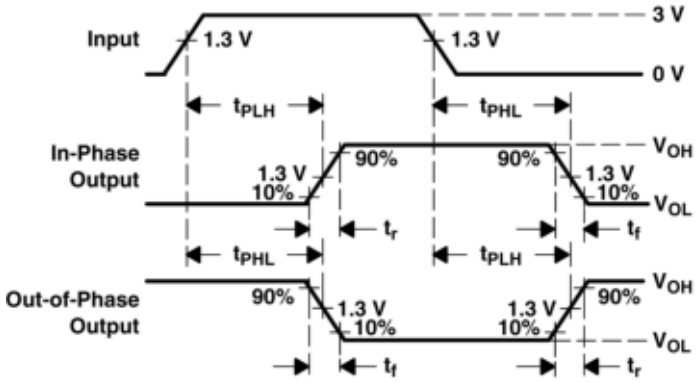


Figure 6-5. Switch off Signal Feedthrough Test Circuit

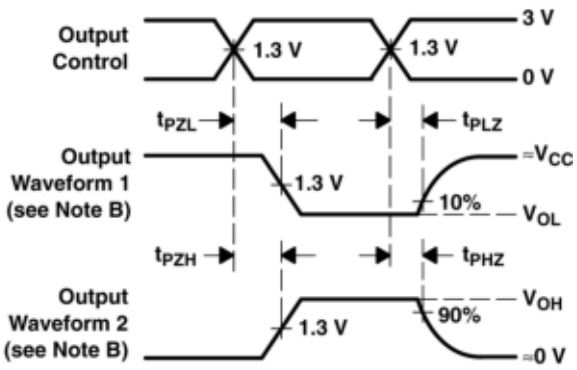
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LOAD CIRCUIT



VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES



VOLTAGE WAVEFORMS
OUTPUT ENABLE AND DISABLE TIMES

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 ≤ 1MHz, Z_O = 50Ω, t_r = 6ns, t_f = 6ns.
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}.

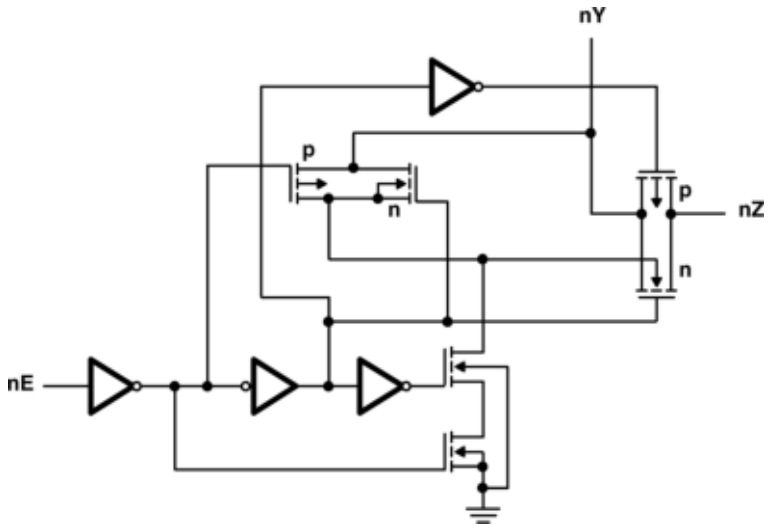
Figure 6-6. Load Circuit and Voltage Waveforms

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

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7 Detailed Description

7.1 Functional Block Diagram



7.2 Device Functional Modes

Table 7-1. Function Table

INPUT	SWITCH
nE	
L(2)	Off
H(1)	On

(1) H = High level
(2) L = Low level

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8 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

8.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

8.2 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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8.3 Trademarks

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8.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

8.5 Glossary

TI Glossary	This glossary lists and explains terms, acronyms, and definitions.

9 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision B (April 2008) to Revision C (July 2024)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document	1
• Updated ordering information	1
• Updated thermal information and added CD74HCT4066-Q1	5
• Updated switching specifications	6

10 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
CD74HCT4066QM96Q1	NRND	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HCT4066Q
CD74HCT4066QM96Q1.A	NRND	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HCT4066Q
CD74HCT4066QPWRQ1	Active	Production	TSSOP (PW) | 14	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HK4066Q
CD74HCT4066QPWRQ1.A	Active	Production	TSSOP (PW) | 14	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HK4066Q
D24066QM96G4Q1	NRND	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HCT4066Q
D24066QM96G4Q1.A	NRND	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HCT4066Q
HCT4066QPWRG4Q1	Obsolete	Production	TSSOP (PW) | 14	-	-	Call TI	Call TI	-40 to 125	HK4066Q

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF CD74HCT4066-Q1 :

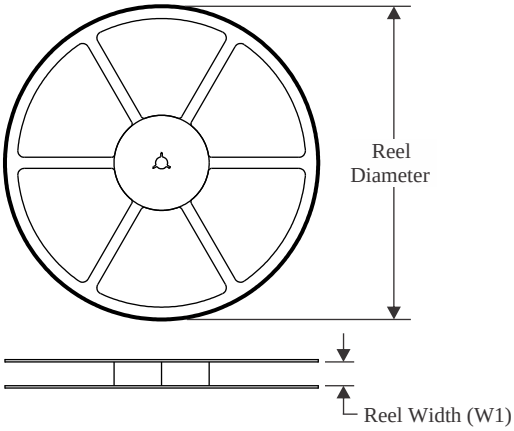
- Catalog : CD74HCT4066

NOTE: Qualified Version Definitions:

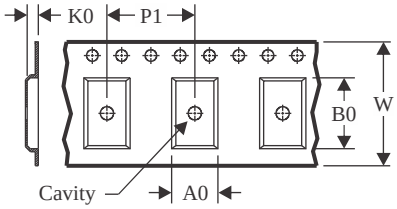
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

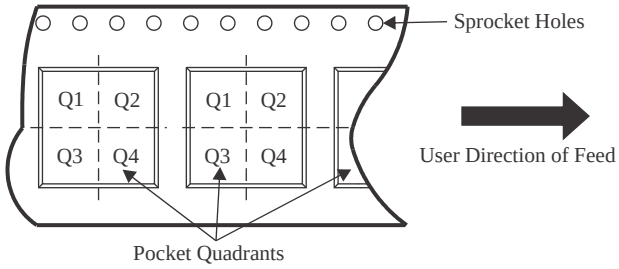


TAPE DIMENSIONS



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

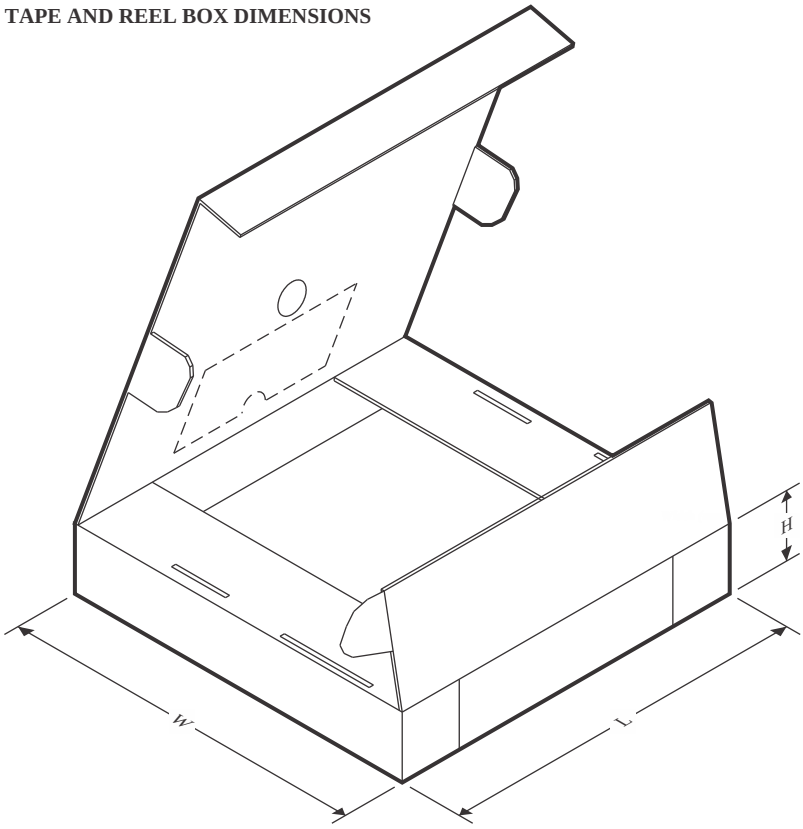
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CD74HCT4066QPWRQ1	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	353.0	353.0	32.0

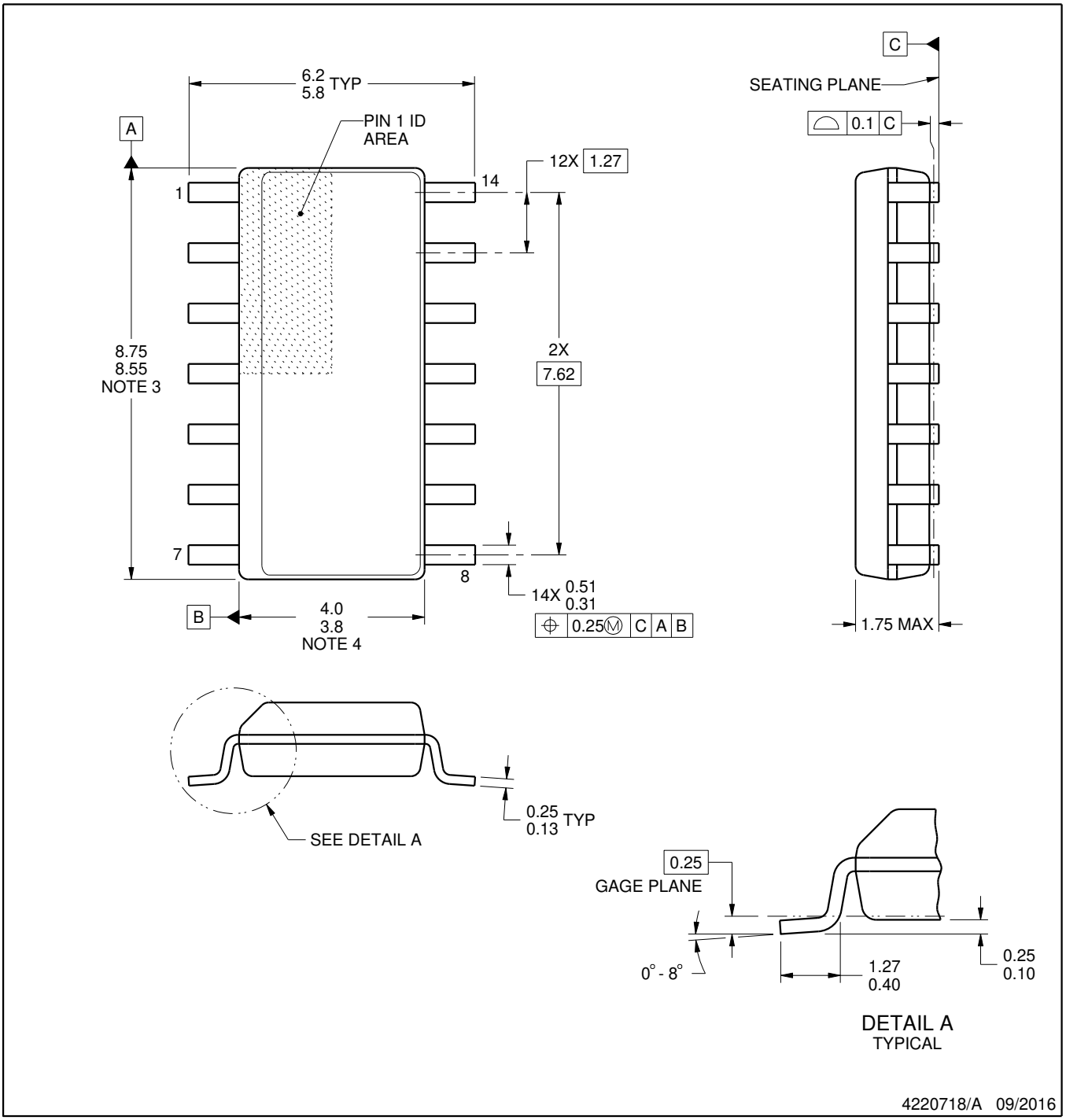


PACKAGE OUTLINE

D0014A

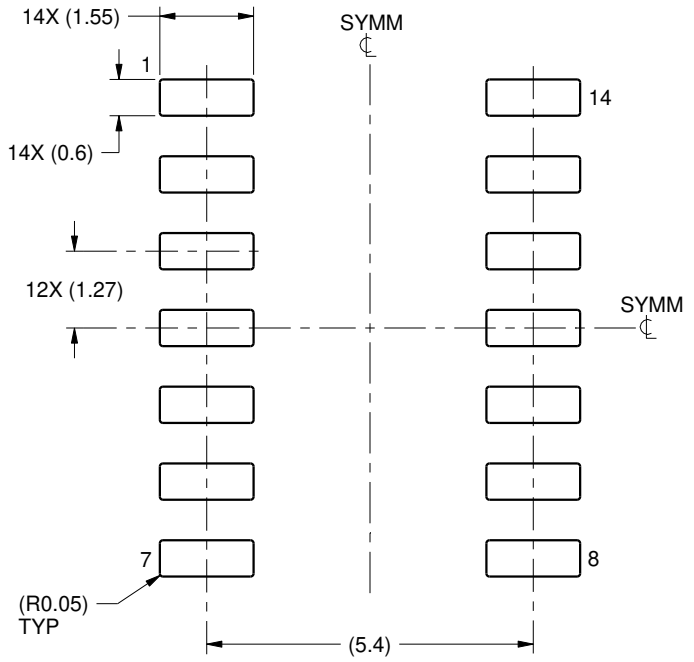
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

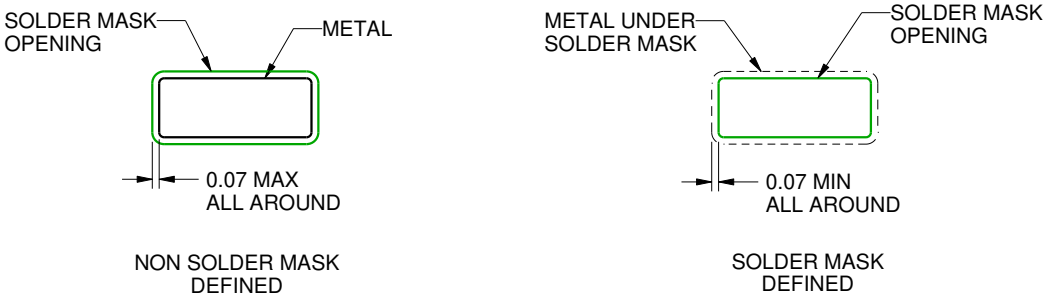


NOTES:

1. All linear dimensions are in millimeters. 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 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.



LAND PATTERN EXAMPLE
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

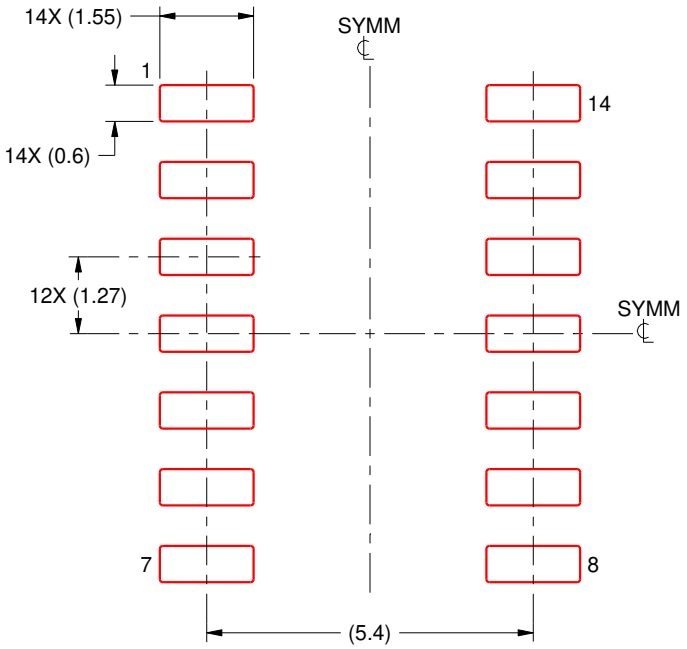
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:8X

4220718/A 09/2016

NOTES: (continued)

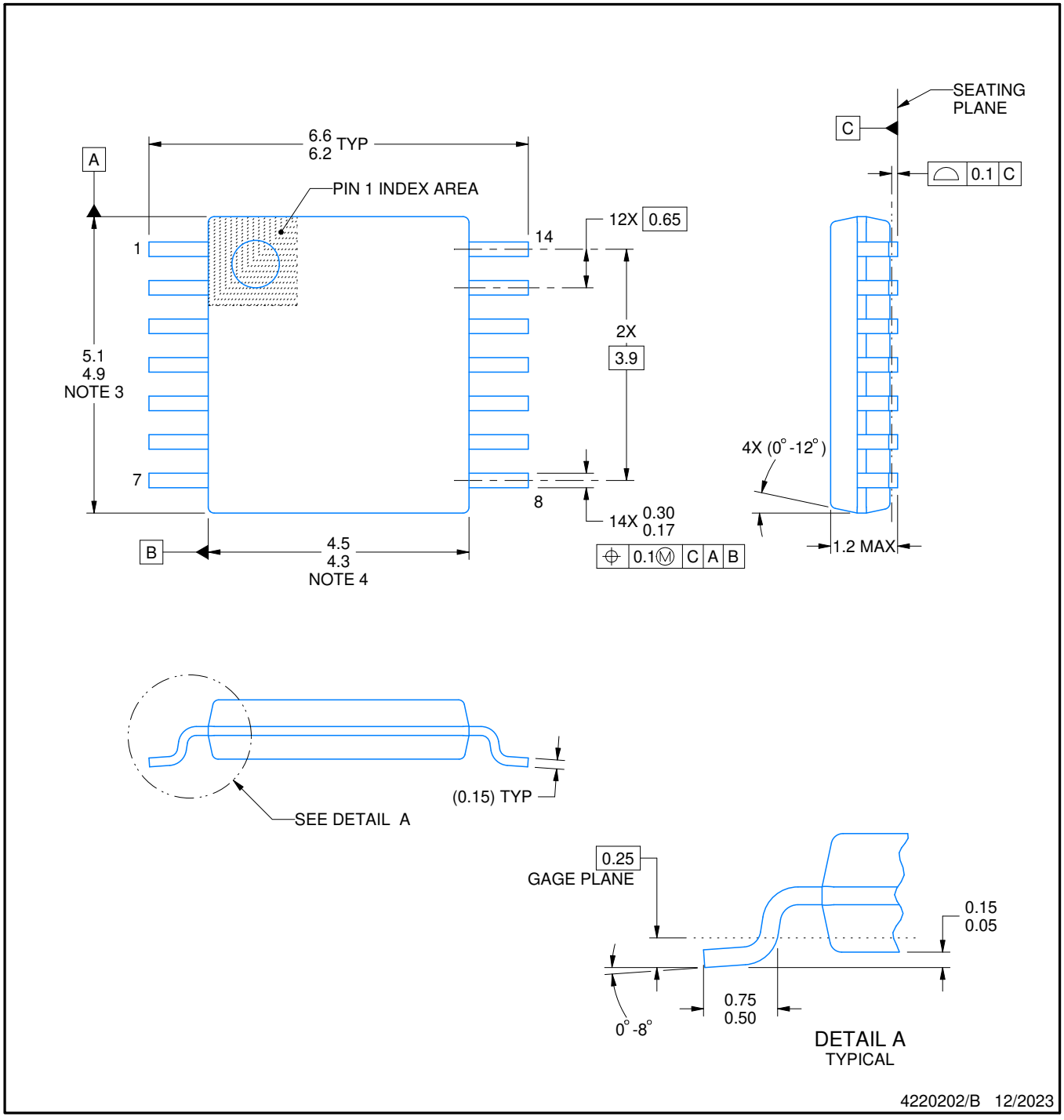
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

PACKAGE OUTLINE

PW0014A

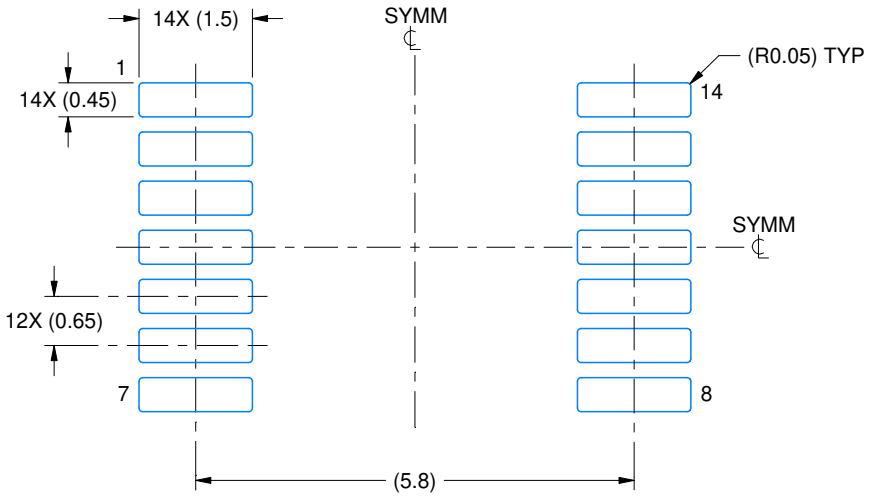
TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



NON-SOLDER MASK DEFINED (PREFERRED)

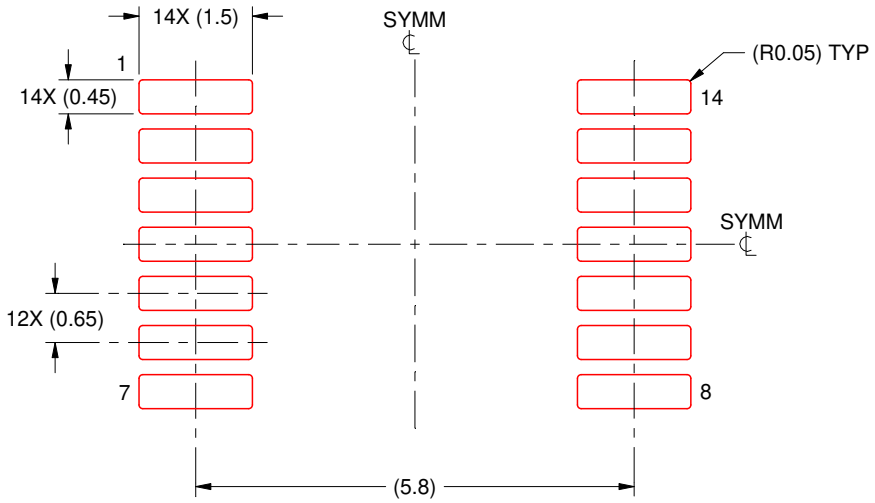
SOLDER MASK DETAILS

SOLDER MASK DEFINED

4220202/B 12/2023

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.



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

4220202/B 12/2023

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.

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Last updated 10/2025