Data sheet acquired from Harris Semiconductor
SCHS127D

February 1998 - Revised May 2004

CD74HCU04

High-Speed CMOS Logic Hex Inverter

Features

- **Typical Propagation Delay: 6ns at V_{CC} = 5V, C_L = 15pF, T_A = 25°C, Fastest Part in QMOS Line**
- **Wide Operating Temperature Range . . . -55°C to 125°C**
- **Balanced Propagation Delay and Transition Times**
- **Significant Power Reduction Compared to LSTTL Logic ICs**
- **HCU Types**
  - **2-V to 6-V Operation**
  - **High Noise Immunity: N_{IL} = 20%, N_{IH} = 30% of V_{CC} at V_{CC} = 5V**
- **CMOS Input Compatibility, $I_I \leq 1\mu A$ at V_{OL}, V_{OH}**

Description

The CD74HCU04 unbuffered hex inverter utilizes silicon-gate CMOS technology to achieve operation speeds similar to LSTTL gates, with the low power consumption of standard CMOS integrated circuits. These devices especially are useful in crystal oscillator and analog applications.

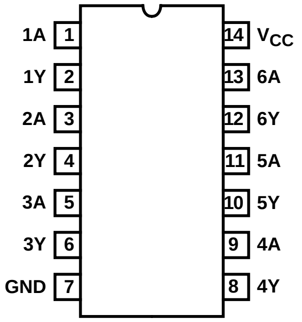
Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE
CD74HCU04E	-55 to 125	14 Ld PDIP
CD74HCU04M	-55 to 125	14 Ld SOIC
CD74HCU04MT	-55 to 125	14 Ld SOIC
CD74HCU04M96	-55 to 125	14 Ld SOIC
CD74HCU04PWR	-55 to 125	14 Ld TSSOP

NOTE: When ordering, use the entire part number. The suffixes 96 and R denote tape and reel. The suffix T denotes a small-quantity reel of 250.

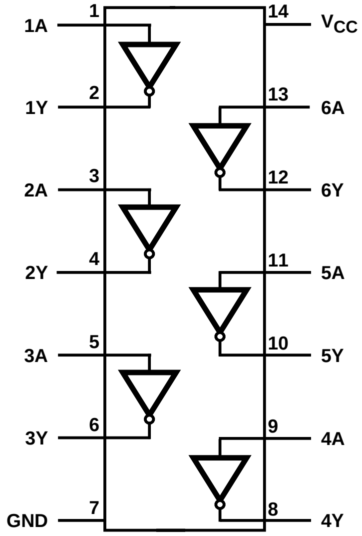
Pinout

CD74HCU04
(PDIP, SOIC, TSSOP)
TOP VIEW

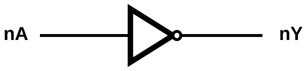


CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper IC Handling Procedures.

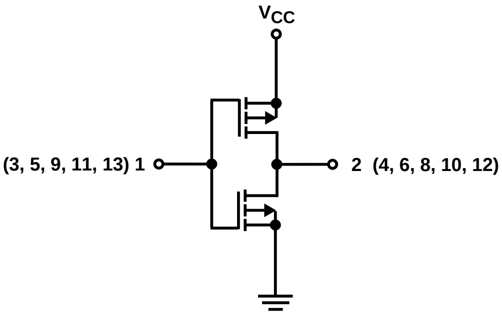
Functional Diagram



Logic Symbol



Schematic Diagram



Absolute Maximum Ratings

DC Supply Voltage, V_{CC}
Voltages Referenced to Ground . . . . -0.5V to +7V
DC Input Diode Current, I_{IK}
For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$ . . . . ±20mA
DC Output Diode Current, I_{OK}
For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$ . . . . ±20mA
DC Drain Current, per Output, I_O
For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$ . . . . ±25mA
DC V_{CC} or Ground Current, I_{CC} . . . . ±50mA

Operating Conditions

Temperature Range T_A . . . . -55°C to 125°C
Supply Voltage Range, V_{CC} . . . . 2V to 6V
DC Input or Output Voltage, V_I, V_O . . . . 0V to V_{CC}

Thermal Information

Thermal Resistance (Typical, Note 1) θ_{JA} (°C/W)
E (PDIP) Package 80
M (SOIC) Package 86
PW (TSSOP) Package 113
Maximum Junction Temperature (Hermetic Package or Die) . . . 175°C
Maximum Junction Temperature (Plastic Package) . . . . 150°C
Maximum Storage Temperature Range . . . . -65°C to 150°C
Maximum Lead Temperature (Soldering 10s) . . . . 300°C
(SOIC - Lead Tips Only)

CAUTION: Stresses above those listed in “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress only rating, and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

1. The package thermal impedance is calculated in accordance with JESD 51-7.

DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		V_{CC} (V)	25°C		-40°C TO +85°C		-55°C TO 125°C		UNITS
		V_I (V)	I_O (mA)		MIN	MAX	MIN	MAX	MIN	MAX	
High Level Input Voltage	V_{IH}	-	-	2	1.7	-	1.7	-	1.7	-	V
				4.5	3.6	-	3.6	-	3.6	-	V
				6	4.8	-	4.8	-	4.8	-	V
Low Level Input Voltage	V_{IL}	-	-	2	-	0.3	-	0.3	-	0.3	V
				4.5	-	0.8	-	0.8	-	0.8	V
				6	-	1.1	-	1.1	-	1.1	V
High Level Output Voltage CMOS Loads	V_{OH}	V_{IH} or V_{IL}	-0.02	2	1.8	-	1.8	-	1.8	-	V
			-0.02	4.5	4	-	4	-	4	-	V
			-0.02	6	5.5	-	5.5	-	5.5	-	V
High Level Output Voltage TTL Loads		V_{CC} or GND	-4	4.5	3.98	-	3.84	-	3.7	-	V
			-5.2	6	5.48	-	5.34	-	5.2	-	V
Low Level Output Voltage CMOS Loads	V_{OL}	V_{IH} or V_{IL}	0.02	2	-	0.2	-	0.2	-	0.2	V
			0.02	4.5	-	0.5	-	0.5	-	0.5	V
			0.02	6	-	0.5	-	0.5	-	0.5	V
Low Level Output Voltage TTL Loads			4	4.5	-	0.26	-	0.33	-	0.4	V
		V_{CC} or GND	5.2	6	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	I_I	V_{CC} or GND	-	6	-	±0.1	-	±1	-	±1	µA
Quiescent Device Current	I_{CC}	V_{CC} or GND	0	6	-	2	-	20	-	40	µA

Switching Specifications Input t_r, t_f = 6ns

PARAMETER	SYMBOL	TEST CONDITIONS	V_{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Propagation Delay, Input to Output Y (Figure 1)	t_{PLH}, t_{PHL}	C_L = 50pF	2	-	-	70	-	90	-	105	ns
		C_L = 50pF	4.5	-	-	14	-	18	-	21	ns
		C_L = 15pF	5	-	5	-	-	-	-	-	ns
		C_L = 50pF	6	-	-	12	-	15	-	18	ns
Transition Times (Figure 1)	t_{TLH}, t_{THL}	C_L = 50pF	2	-	-	75	-	95	18	110	ns
			4.5	-	-	15	-	19	-	22	ns
			6	-	-	13	-	16	-	19	ns
Input Capacitance	C_I	-	See Figure 3								pF
Power Dissipation Capacitance (Notes 2, 3)	C_{PD}	-	5	-	14	-	-	-	-	-	pF

NOTES:

2. C_{PD} is used to determine the dynamic power consumption, per inverter.
3. $P_D = V_{CC}^2 f_i (C_{PD} + C_L)$ where f_i = input frequency, C_L = output load capacitance, V_{CC} = supply voltage.

Test Circuits and Waveforms

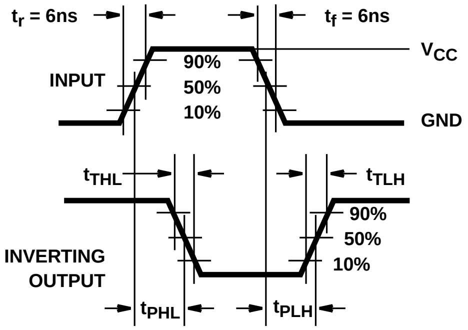


FIGURE 1. HC AND HCU TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

Typical Performance Curves

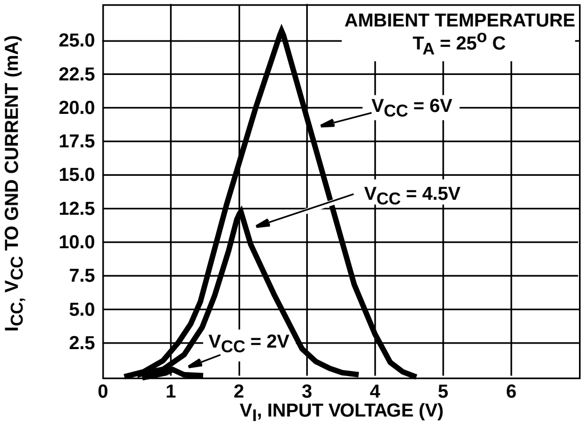


FIGURE 2. TYPICAL INVERTER SUPPLY CURRENT AS FUNCTION OF INPUT VOLTAGE

Typical Performance Curves (Continued)

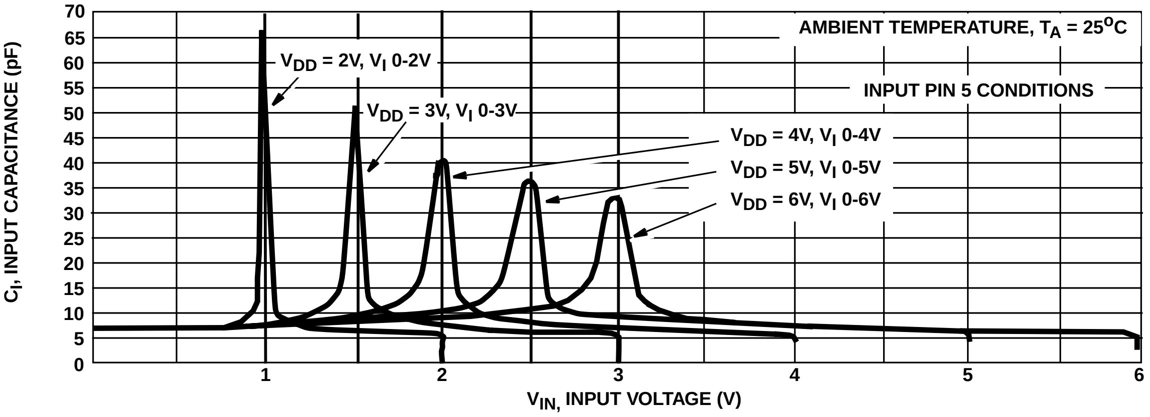


FIGURE 3. INPUT CAPACITANCE AS A FUNCTION OF INPUT VOLTAGE

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)
CD74HCU04E	Active	Production	PDIP (N) | 14	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HCU04E
CD74HCU04E.A	Active	Production	PDIP (N) | 14	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HCU04E
CD74HCU04M	Obsolete	Production	SOIC (D) | 14	-	-	Call TI	Call TI	-55 to 125	HCU04M
CD74HCU04M96	Active	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCU04M
CD74HCU04M96.A	Active	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCU04M
CD74HCU04M96E4	Active	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCU04M
CD74HCU04M96G4	Active	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCU04M
CD74HCU04PWR	Active	Production	TSSOP (PW) | 14	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HJU04
CD74HCU04PWR.A	Active	Production	TSSOP (PW) | 14	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HJU04

(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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OTHER QUALIFIED VERSIONS OF CD74HCU04 :

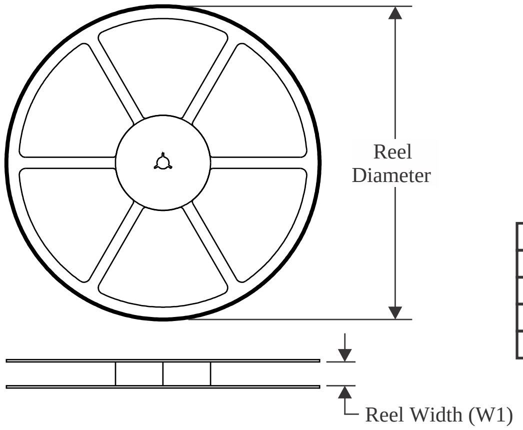
- Automotive : CD74HCU04-Q1

NOTE: Qualified Version Definitions:

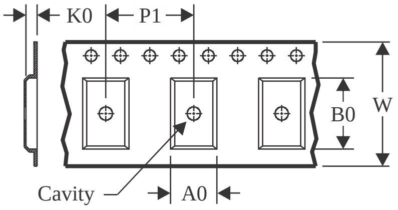
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

REEL DIMENSIONS

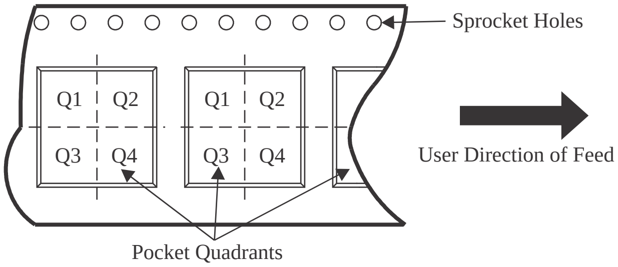


TAPE DIMENSIONS



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

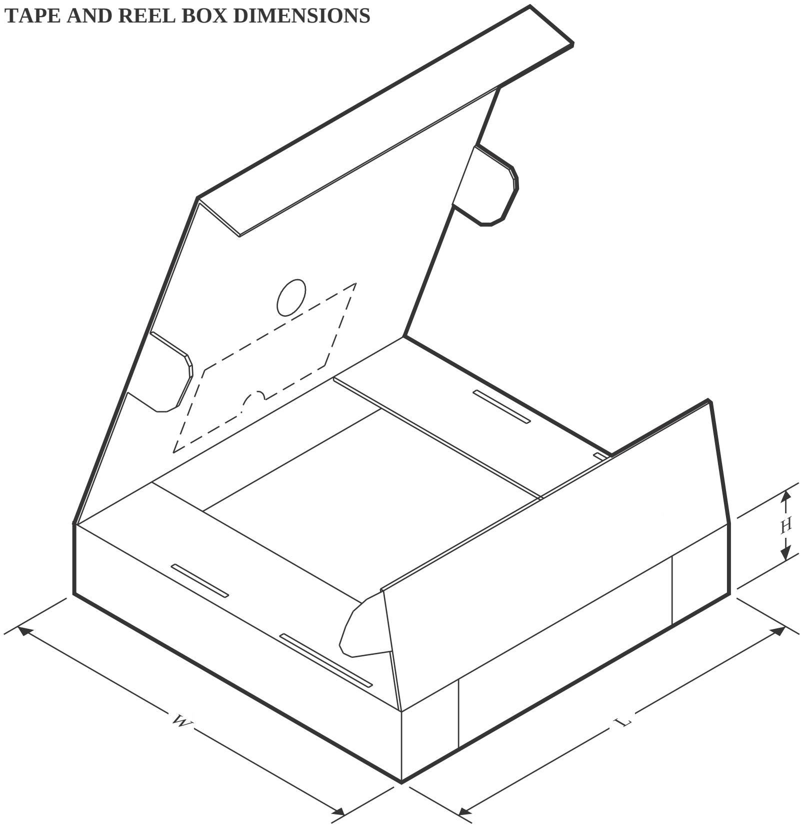
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CD74HCU04M96	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
CD74HCU04PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

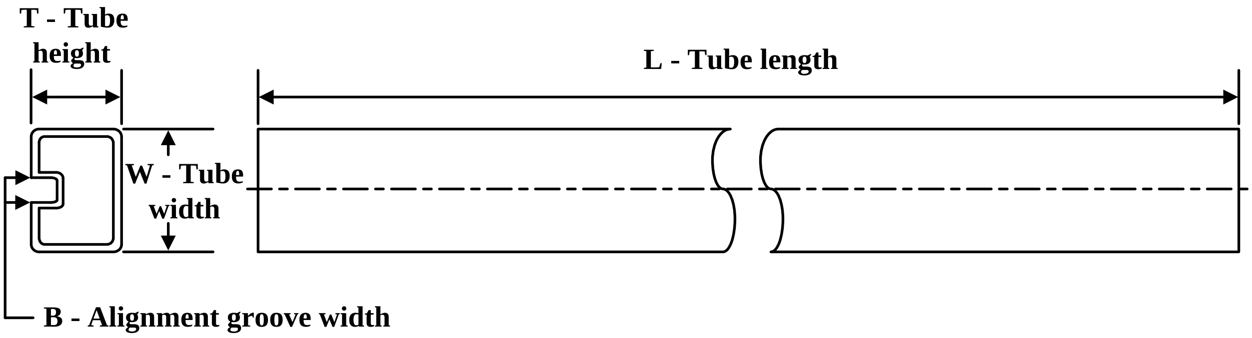
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74HCU04M96	SOIC	D	14	2500	353.0	353.0	32.0
CD74HCU04PWR	TSSOP	PW	14	2000	353.0	353.0	32.0

TUBE

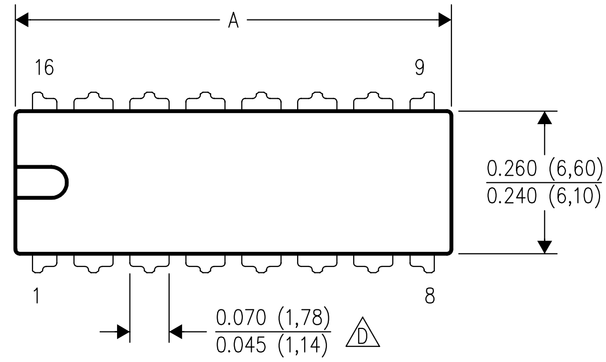


*All dimensions are nominal

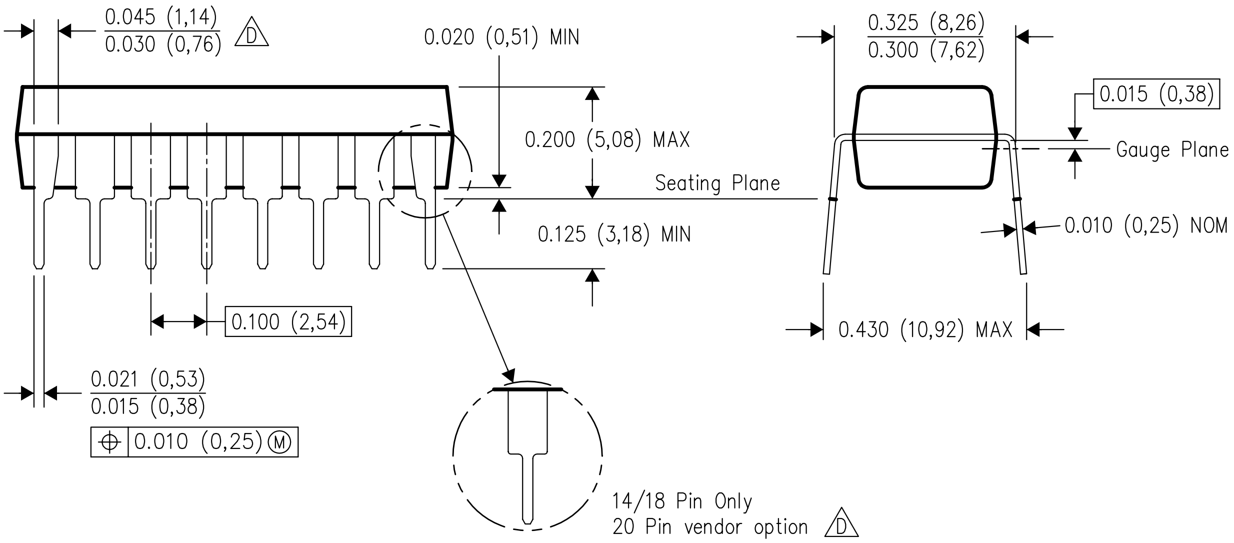
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
CD74HCU04E	N	PDIP	14	25	506	13.97	11230	4.32
CD74HCU04E	N	PDIP	14	25	506	13.97	11230	4.32
CD74HCU04E.A	N	PDIP	14	25	506	13.97	11230	4.32
CD74HCU04E.A	N	PDIP	14	25	506	13.97	11230	4.32

N (R–PDIP–T**) PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



PINS ** / DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
C MS–001 VARIATION	AA	BB	AC	AD



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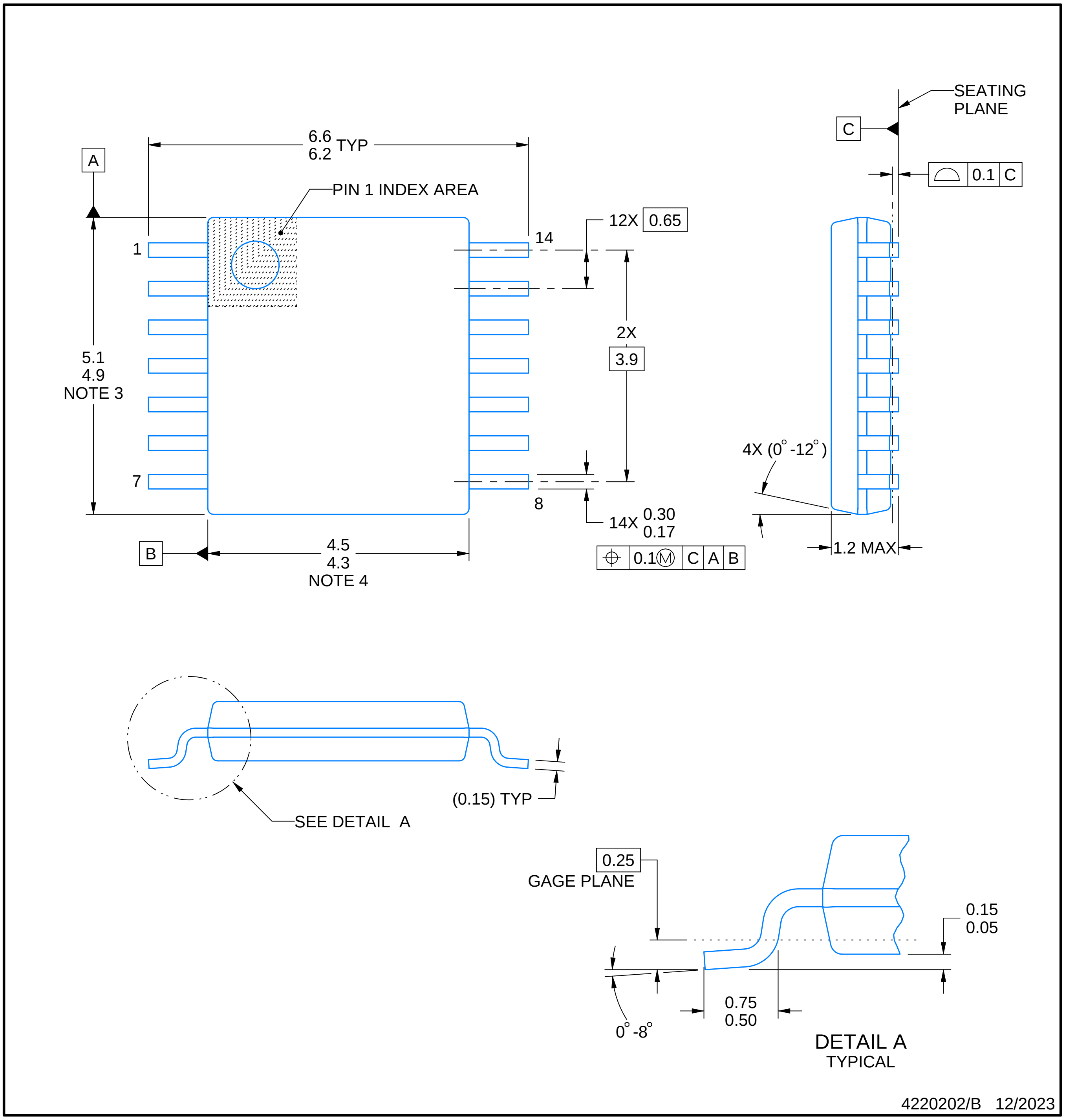
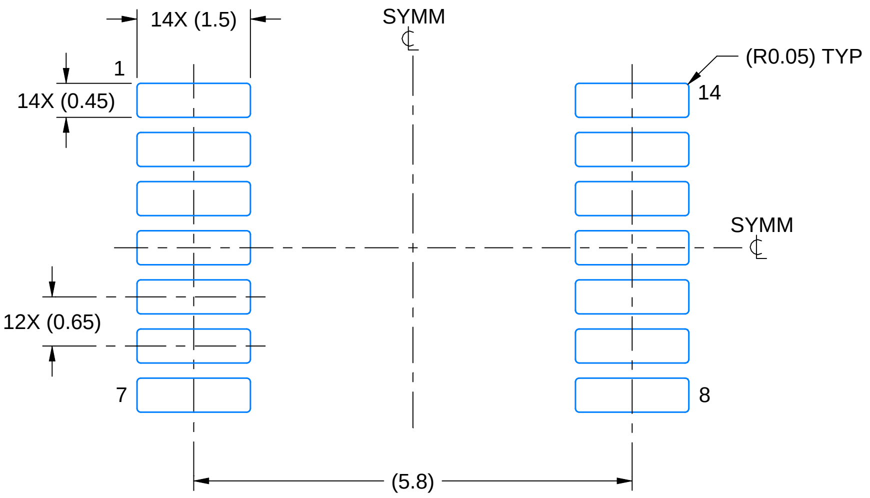
NOTES:
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
- D. The 20 pin end lead shoulder width is a vendor option, either half or full width.



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.

EXAMPLE BOARD LAYOUT



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X

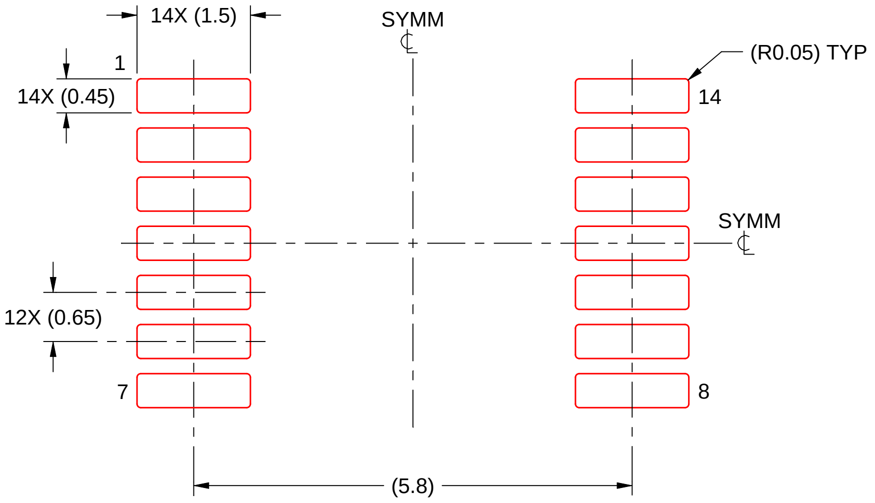
NON-SOLDER MASK
DEFINED
(PREFERRED)

SOLDER MASK
DEFINED

SOLDER MASK DETAILS

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

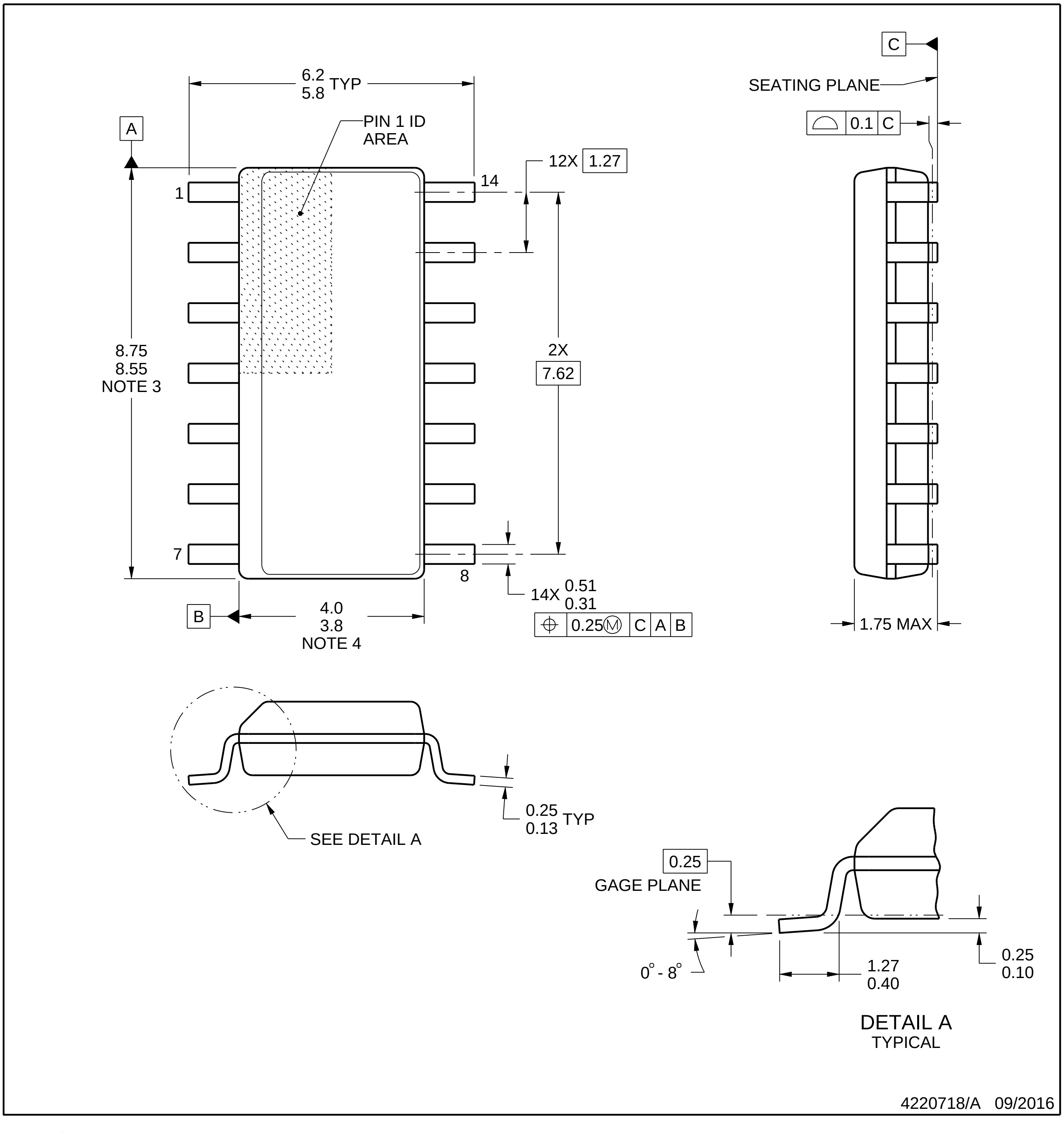
NOTES: (continued)

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.

D0014A

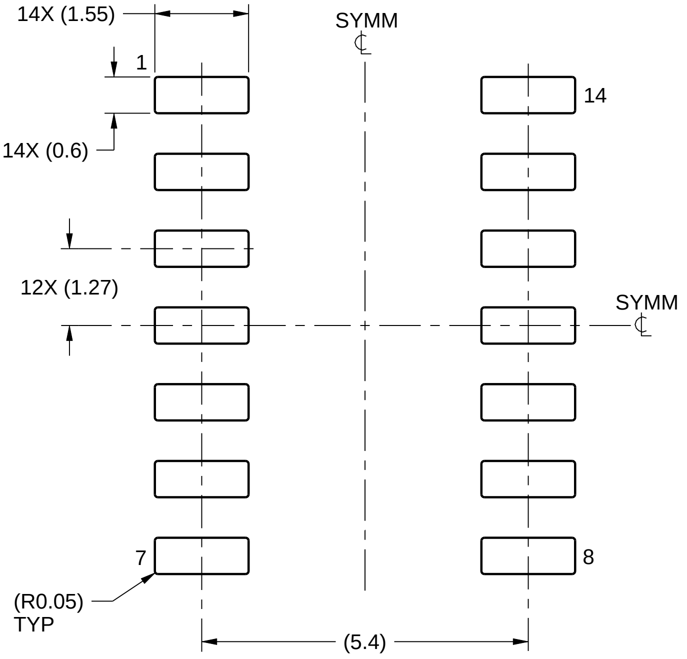
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

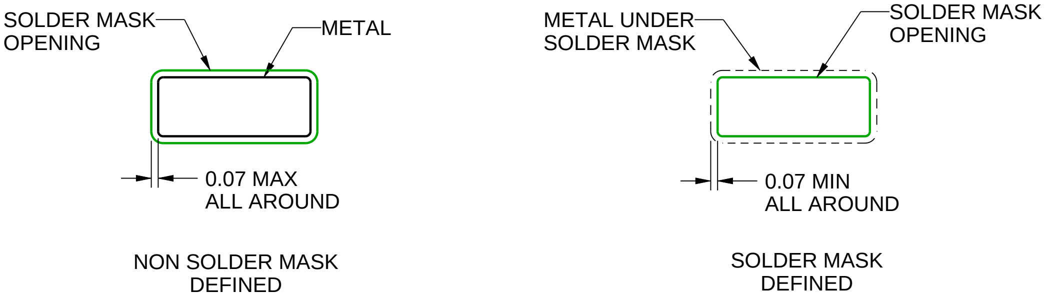


NOTES:

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

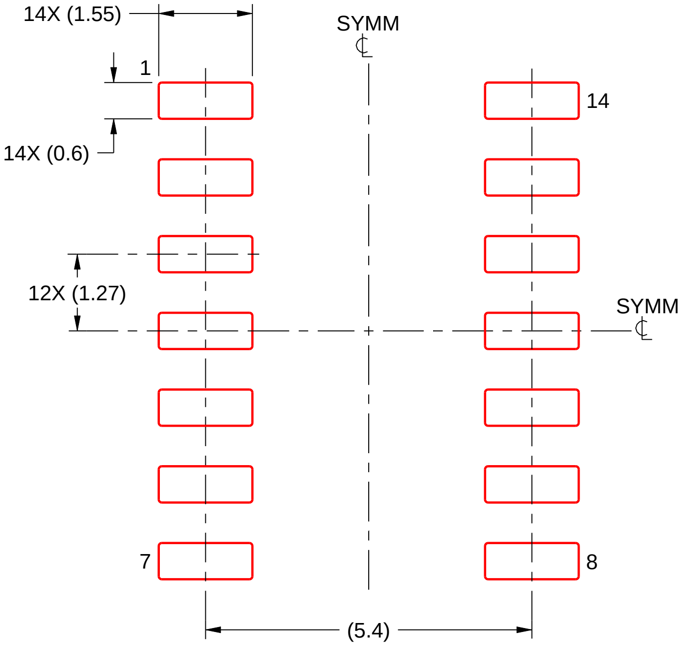


SOLDER MASK DETAILS

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.



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.

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