CD4049UB and CD4050B CMOS Hex Inverting Buffer and Converter

1 Features

- CD4049UB inverting
- CD4050B noninverting
- High sink current for driving 2 TTL loads
- High-to-low level logic conversion
- 100% tested for quiescent current at 20V
- Maximum input current of 1µA at 18V over full package temperature range; 100nA at 18V and 25°C
- 5V, 10V, and 15V parametric ratings

2 Applications

- CMOS to DTL or TTL hex converters
- CMOS current *sink* or *source* drivers
- CMOS high-to-low logic level converters

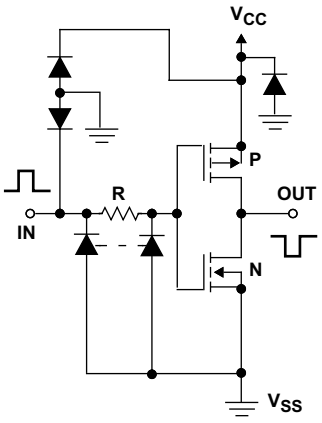
3 Description

The CD4049UB and CD4050B devices are inverting and noninverting hex buffers, and feature logic-level conversion using only one supply voltage (V_{CC}). The input-signal high level (V_{IH}) can exceed the V_{CC} supply voltage when these devices are used for logic-level conversions. These devices are intended for use as CMOS to DTL or TTL converters and can drive directly two DTL or TTL loads. V_{CC} = 5V, V_{OL} ≤ 0.4V, and I_{OL} ≥ 3.3mA.

Package Information

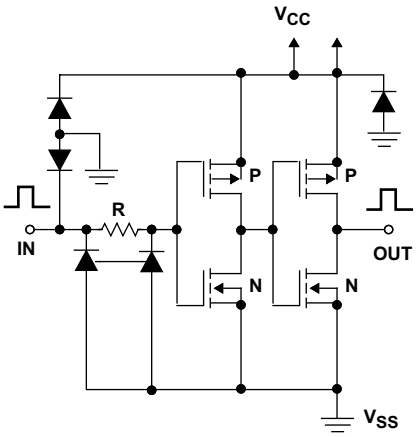
PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
CD4049UBE, CD4050BE	N (PDIP, 16)	6.35mm × 19.30mm
CD4049UBD, CD4050BD	D (SOIC, 16)	9.90mm × 3.91mm
CD4049UBDW, CD4050BDW	DW (SOIC, 16)	10.30mm × 7.50mm
CD4049UBNS, CD4050BNS	SO (16)	10.30mm × 5.30mm
CD4049UBPW, CD4050BPW	PW (TSSOP, 16)	5.00mm × 4.40mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.



1 of 6 Identical Units

Schematic Diagram of CD4049UB



1 of 6 Identical Units

Schematic Diagram of CD4050B

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4 Pin Configuration and Functions

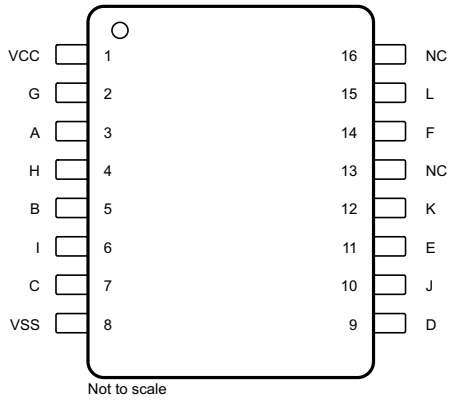


Figure 4-1. CD4049UB D, DW, N, NS, and PW Packages 16-Pin SOIC, PDIP, SO, and TSSOP Top View

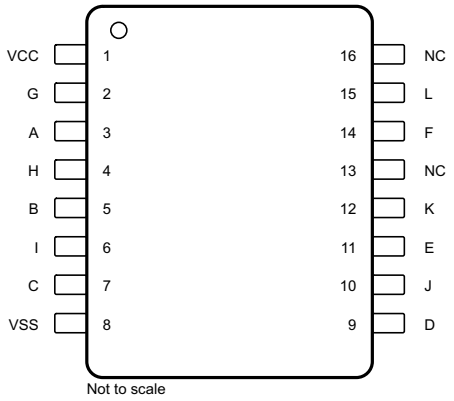


Figure 4-2. CD4050B D, DW, N, NS, and PW Packages 1G6-Pin SOIC, PDIP, SO, and TSSOP Top View

Pin Functions: CD4049UB

PIN		TYPE[1]	DESCRIPTION
NAME	NO.		
A	3	I	Input 1
B	5	I	Input 2
C	7	I	Input 3
D	9	I	Input 4
E	11	I	Input 5
F	14	I	Input 6
G	2	O	Inverting output 1. G = $\overline{A}$
H	4	O	Inverting output 2. H = $\overline{B}$
I	6	O	Inverting output 3. I = $\overline{C}$
J	10	O	Inverting output 4. J = $\overline{D}$
K	12	O	Inverting output 5. K = $\overline{E}$
L	15	O	Inverting output 6. L = $\overline{F}$
NC	13, 16	—	No connection
VCC	1	—	Power pin
VSS	8	—	Negative supply

(1) I = input, O = output

Pin Functions: CD4050B

PIN		TYPE[1]	DESCRIPTION
NAME	NO.		
A	3	I	Input 1
B	5	I	Input 2
C	7	I	Input 3
D	9	I	Input 4
E	11	I	Input 5
F	14	I	Input 6
G	2	O	Inverting output 1. G = A
H	4	O	Inverting output 2. H = B
I	6	O	Inverting output 3. I = C
J	10	O	Inverting output 4. J = D
K	12	O	Inverting output 5. K = E
L	15	O	Inverting output 6. L = F
NC	13, 16	—	No connection
VCC	1	—	Power pin
VSS	8	—	Negative supply

(1) I = input, O = output

5 Specifications

5.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
Supply voltage	VCC to VSS	–0.5	20	V
DC input current, I_{IK}	Any one input		±10	mA
Lead temperature (soldering, 10s)	SOIC, lead tips only		265	°C
Junction temperature	T_J		150	°C
Storage temperature	T_{stg}	–65	150	°C

(1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. *Absolute Maximum Ratings* do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If used outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±1500	V
		Charged-device model (CDM), per JEDEC specification JESD22C101(2)	±1000	

(1) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process.

5.3 Recommended Operating Conditions

PARAMETER				MIN	TYP	MAX	UNIT
V_{CC}				3		18	V
T_A				-55		125	°C
I_{OL}(Min)	Output low (sink) current	V_{OUT} = 0.4V, V_{IN} = 0 or 5V, V_{CC} = 4.5V	T_A = –55°C	3.3			mA
			T_A = –40°C	3.1			
			T_A = 25°C	2.6	5.2		
			T_A = 85°C	2.1			
			T_A = 125°C	1.8			
		V_{OUT} = 0.4V, V_{IN} = 0 or 5V, V_{CC} = 5V	T_A = –55°C	4			
			T_A = –40°C	3.8			
			T_A = 25°C	3.2	6.4		
			T_A = 85°C	2.9			
			T_A = 125°C	2.4			
		V_{OUT} = 0.5V, V_{IN} = 0 or 10V, V_{CC} = 10V	T_A = –55°C	10			
			T_A = –40°C	9.6			
			T_A = 25°C	8	16		
			T_A = 85°C	6.6			
			T_A = 125°C	5.6			
		V_{OUT} = 1.5V, V_{IN} = 0 or 15V, V_{CC} = 15V	T_A = –55°C	26			
			T_A = –40°C	25			
			T_A = 25°C	24	48		
			T_A = 85°C	20			
			T_A = 125°C	18			
I_{OH}(Min)	Output high (source) current	V_{OUT} = 4.6V, V_{IN} = 0 or 5V, V_{CC} = 5V	T_A = –55°C	–0.81			mA
			T_A = –40°C	–0.73			
			T_A = 25°C	–0.65	–1.2		
			T_A = 85°C	–0.58			
			T_A = 125°C	–0.48			
		V_{OUT} = 2.5V, V_{IN} = 0 or 5V, V_{CC} = 5V	T_A = –55°C	–2.6			
			T_A = –40°C	–2.4			
			T_A = 25°C	–2.1	–3.9		
			T_A = 85°C	–1.9			
			T_A = 125°C	–1.55			
		V_{OUT} = 9.5V, V_{IN} = 0 or 10V, V_{CC} = 10V	T_A = –55°C	–2			
			T_A = –40°C	–1.8			
			T_A = 25°C	–1.65	–3		
			T_A = 85°C	–1.35			
			T_A = 125°C	–1.18			
		V_{OUT} = 1.3V, V_{IN} = 0 or 15V, V_{CC} = 15V	T_A = –55°C	–5.2			
			T_A = –40°C	–4.8			
			T_A = 25°C	–4.3	–8		
			T_A = 85°C	–3.5			
			T_A = 125°C	–3.1			

PARAMETER				MIN	TYP	MAX	UNIT
V_{IL}(Max)	Input low voltage (CD4049UB)	V_{OUT} = 4.5V, V_{CC} = 5V, Full temperature range				1	V
		V_{OUT} = 9V, V_{CC} = 10V, Full temperature range				2	
		V_{OUT} = 13.5V, V_{CC} = 15V, Full temperature range				2.5	
	Input low voltage (CD4050B)	V_{OUT} = 0.5V, V_{CC} = 5V, Full temperature range				1.5	
		V_{OUT} = 1V, V_{CC} = 10V, Full temperature range				3	
		V_{OUT} = 1.5V, V_{CC} = 15V, Full temperature range				4	
V_{IH}(Min)	Input high voltage (CD4049UB)	V_{OUT} = 0.5V, V_{CC} = 5V	T_A = –55°C	4			V
			T_A = –40°C	4			
			T_A = 25°C	4			
			T_A = 85°C	4			
			T_A = 125°C	4			
		V_{OUT} = 1V, V_{CC} = 10V	T_A = –55°C	8			
			T_A = –40°C	8			
			T_A = 25°C	8			
			T_A = 85°C	8			
			T_A = 125°C	8			
		V_{OUT} = 1.5V, V_{CC} = 15V	T_A = –55°C	12.5			
			T_A = –40°C	12.5			
			T_A = 25°C	12.5			
			T_A = 85°C	12.5			
			T_A = 125°C	12.5			
V_{IH}	Input high voltage (CD4050B)	V_{OUT} = 4.5V, V_{CC} = 5V	T_A = –55°C	3.5			V
			T_A = –40°C	3.5			
			T_A = 25°C	3.5			
			T_A = 85°C	3.5			
			T_A = 125°C	3.5			
		V_{OUT} = 9V, V_{CC} = 10V	T_A = –55°C	7			
			T_A = –40°C	7			
			T_A = 25°C	7			
			T_A = 85°C	7			
			T_A = 125°C	7			
		V_{OUT} = 13.5V, V_{CC} = 15V	T_A = –55°C	11			
			T_A = –40°C	11			
			T_A = 25°C	11			
			T_A = 85°C	11			
			T_A = 125°C	11			

5.4 Thermal Information

THERMAL METRIC[1]		CD4049UB					CD4050B					UNIT
		D (SOIC)	DW (SOIC)	E (PDIP)	NS (SO)	PW (TSSOP)	D (SOIC)	DW (SOIC)	E (PDIP)	NS (SO)	PW (TSSOP)	
		16 PINS	16 PINS	16 PINS	16 PINS	16 PINS	16 PINS	16 PINS	16 PINS	16 PINS	16 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance[2]	81.6	81.6	49.5	84.3	108.9	81.6	81.2	49.7	83.8	108.4	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	41.5	44.5	36.8	43	43.7	41.5	44.1	37	42.5	43.2	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	39	46.3	29.4	44.6	54	39	45.9	29.6	44.1	53.5	°C/W
ψ_{JT}	Junction-to-top characterization parameter	10.7	16.5	21.7	12.8	4.6	10.7	16.1	21.9	12.5	4.5	°C/W
ψ_{JB}	Junction-to-board characterization parameter	38.7	45.8	29.3	44.3	53.4	38.7	45.4	29.5	43.8	52.9	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application note.
(2) The package thermal impedance is calculated in accordance with JESD 51-7.

5.5 Electrical Characteristics: DC

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_{DD}(Max)	Quiescent device current	V_{IN} = 0 or 5V, V_{CC} = 5V	T_A = –55°C			1	µA
			T_A = –40°C			1	
			T_A = 25°C		0.02	1	
			T_A = 85°C			30	
			T_A = 125°C			30	
		V_{IN} = 0 or 10V, V_{CC} = 10V	T_A = –55°C			2	
			T_A = –40°C			2	
			T_A = 25°C		0.02	2	
			T_A = 85°C			60	
			T_A = 125°C			60	
		V_{IN} = 0 or 15V, V_{CC} = 4V	T_A = –55°C			4	
			T_A = –40°C			4	
			T_A = 25°C		0.02	4	
			T_A = 85°C			120	
			T_A = 125°C			120	
		V_{IN} = 0 or 20V, V_{CC} = 20V	T_A = –55°C			20	
			T_A = –40°C			20	
			T_A = 25°C		0.04	20	
			T_A = 85°C			600	
			T_A = 125°C			600	

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_{OL}(Min)	Output low (sink) current	V_{OUT} = 0.4V, V_{IN} = 0 or 5V, V_{CC} = 4.5V	T_A = –55°C	3.3			mA
			T_A = –40°C	3.1			
			T_A = 25°C	2.6	5.2		
			T_A = 85°C	2.1			
			T_A = 125°C	1.8			
		V_{OUT} = 0.4V, V_{IN} = 0 or 5V, V_{CC} = 5V	T_A = –55°C	4			
			T_A = –40°C	3.8			
			T_A = 25°C	3.2	6.4		
			T_A = 85°C	2.9			
			T_A = 125°C	2.4			
		V_{OUT} = 0.5V, V_{IN} = 0 or 10V, V_{CC} = 10V	T_A = –55°C	10			
			T_A = –40°C	9.6			
			T_A = 25°C	8	16		
			T_A = 85°C	6.6			
			T_A = 125°C	5.6			
		V_{OUT} = 1.5V, V_{IN} = 0 or 15V, V_{CC} = 15V	T_A = –55°C	26			
			T_A = –40°C	25			
			T_A = 25°C	24	48		
			T_A = 85°C	20			
			T_A = 125°C	18			
V_{OL}(Max)	Out voltage low level	V_{IN} = 0 or 5V, V_{CC} = 5V	T_A = –55°C			0.05	V
			T_A = –40°C			0.05	
			T_A = 25°C		0	0.05	
			T_A = 85°C			0.05	
			T_A = 125°C			0.05	
		V_{IN} = 0 or 10V, V_{CC} = 10V	T_A = –55°C			0.05	
			T_A = –40°C			0.05	
			T_A = 25°C		0	0.05	
			T_A = 85°C			0.05	
			T_A = 125°C			0.05	
		V_{IN} = 0 or 15V, V_{CC} = 15V	T_A = –55°C			0.05	
			T_A = –40°C			0.05	
			T_A = 25°C		0	0.05	
			T_A = 85°C			0.05	
			T_A = 125°C			0.05	

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{OH}(Min)	Output voltage high level	V_{IN} = 0 or 5V, V_{CC} = 5V	T_A = –55°C	4.95			V
			T_A = –40°C	4.95			
			T_A = 25°C	4.95	5		
			T_A = 85°C	4.95			
			T_A = 125°C	4.95			
		V_{IN} = 0 or 10V, V_{CC} = 10V	T_A = –55°C	9.95			
			T_A = –40°C	9.95			
			T_A = 25°C	9.95	10		
			T_A = 85°C	9.95			
			T_A = 125°C	9.95			
		V_{IN} = 0 or 15V, V_{CC} = 15V	T_A = –55°C	14.95			
			T_A = –40°C	14.95			
			T_A = 25°C	14.95	15		
			T_A = 85°C	14.95			
			T_A = 125°C	14.95			
I_{IN}(Max)	Input current	V_{IN} = 0 or 18V, V_{CC} = 18V	T_A = –55°C			±0.1	µA
			T_A = –40°C			±0.1	
			T_A = 25°C		$\pm 10^{-5}$	±0.1	
			T_A = 85°C			±1	
			T_A = 125°C			±1	

5.6 Electrical Characteristics: AC

T_A = 25°C, Input t_r and t_f = 20ns, C_L = 50pF, R_L = 200kΩ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	Propagation delay time Low to high (CD4049UB)	V_{IN} = 5V, V_{CC} = 5V		60	120	ns
		V_{IN} = 10V, V_{CC} = 10 V		32	65	
		V_{IN} = 10V, V_{CC} = 5 V		45	90	
		V_{IN} = 15V, V_{CC} = 15 V		25	50	
		V_{IN} = 15V, V_{CC} = 5 V		45	90	
	Propagation delay time Low to high (CD4050B)	V_{IN} = 5V, V_{CC} = 5V		70	140	ns
		V_{IN} = 10V, V_{CC} = 10 V		40	80	
		V_{IN} = 10V, V_{CC} = 5 V		45	90	
		V_{IN} = 15V, V_{CC} = 15 V		30	60	
		V_{IN} = 15V, V_{CC} = 5 V		40	80	
t_{PHL}	Propagation delay time High to low (CD4049UB)	V_{IN} = 5V, V_{CC} = 5V		32	65	ns
		V_{IN} = 10V, V_{CC} = 10 V		20	40	
		V_{IN} = 10V, V_{CC} = 5 V		15	30	
		V_{IN} = 15V, V_{CC} = 15 V		15	30	
		V_{IN} = 15V, V_{CC} = 5 V		10	20	
	Propagation delay time High to low (CD4050B)	V_{IN} = 5V, V_{CC} = 5V		55	110	ns
		V_{IN} = 10V, V_{CC} = 10 V		22	55	
		V_{IN} = 10V, V_{CC} = 5 V		50	100	
		V_{IN} = 15V, V_{CC} = 15 V		15	30	
		V_{IN} = 15V, V_{CC} = 5 V		50	100	
t_{TLH}	Transition time Low to high	V_{IN} = 5V, V_{CC} = 5V		80	160	ns
		V_{IN} = 10V, V_{CC} = 10 V		40	80	
		V_{IN} = 15V, V_{CC} = 15 V		30	60	
t_{THL}	Transition time High to low	V_{IN} = 5V, V_{CC} = 5V		30	60	ns
		V_{IN} = 10V, V_{CC} = 10 V		20	40	
		V_{IN} = 15V, V_{CC} = 15 V		15	30	
C_{IN}	Input capacitance (CD4049UB)			15	22.5	pF
	Input capacitance (CD4050B)			5	7.5	pF

5.7 Typical Characteristics

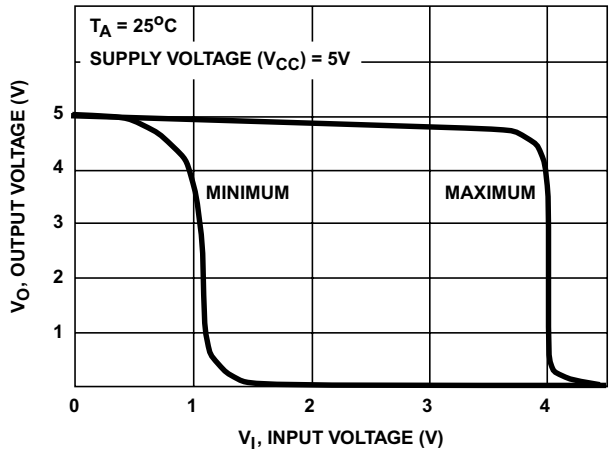


Figure 5-1. Minimum and Maximum Voltage Transfer Characteristics for CD4049UB

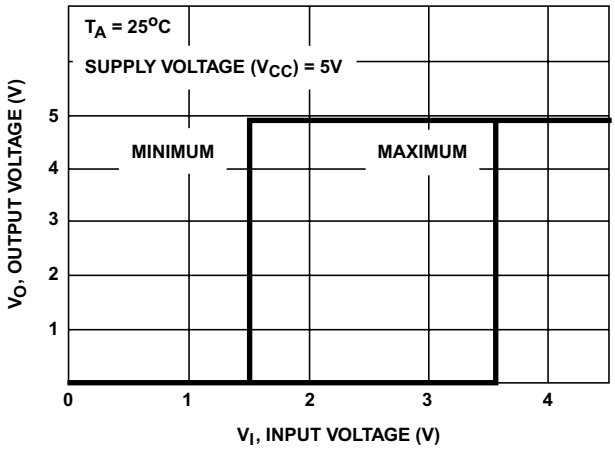


Figure 5-2. Minimum and Maximum Voltage Transfer Characteristics for CD4050B

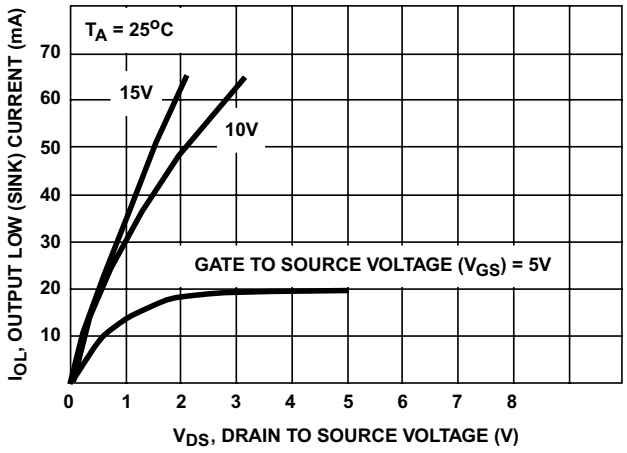


Figure 5-3. Typical Output Low (Sink) Current Characteristics

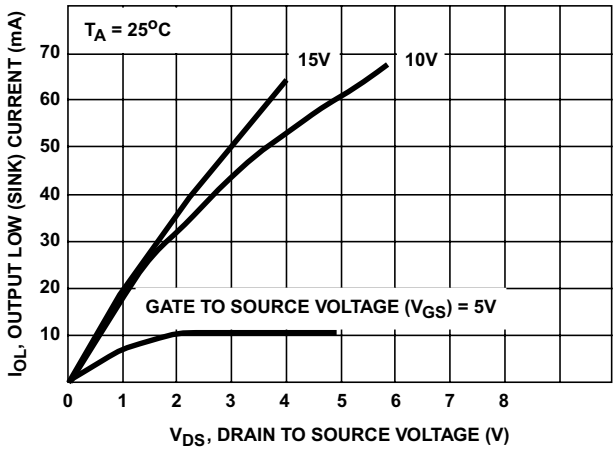


Figure 5-4. Minimum Output Low (Sink) Current Drain Characteristics

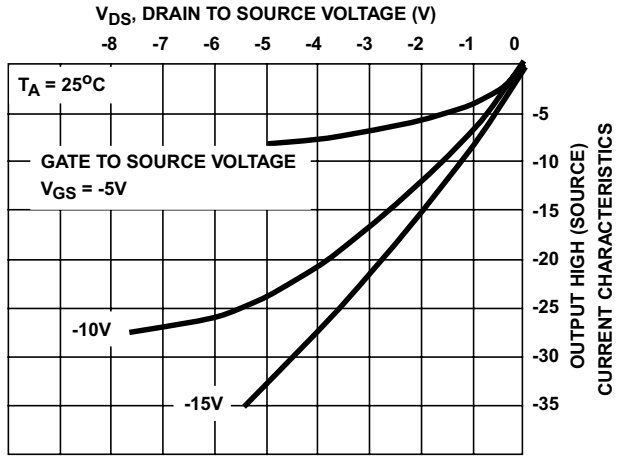


Figure 5-5. Typical Output High (Source) Current Characteristics

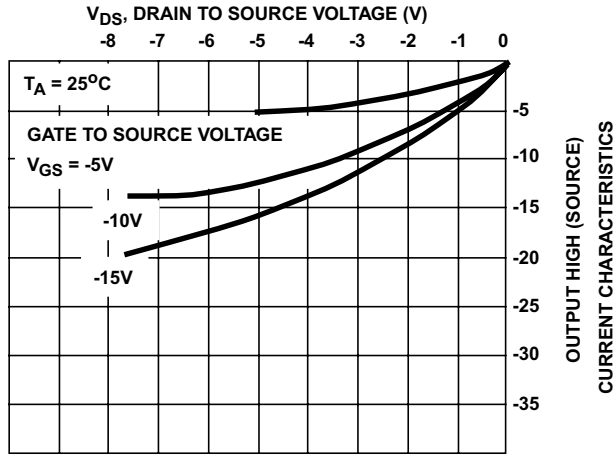


Figure 5-6. Minimum Output High (Source) Current Characteristics

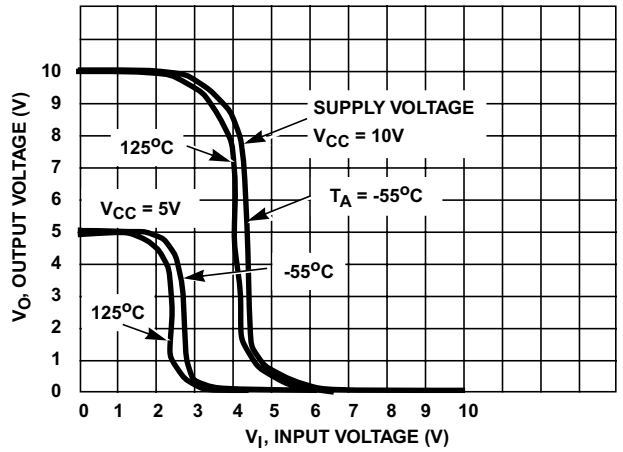


Figure 5-7. Typical Voltage Transfer Characteristics as a Function of Temperature for CD4049UB

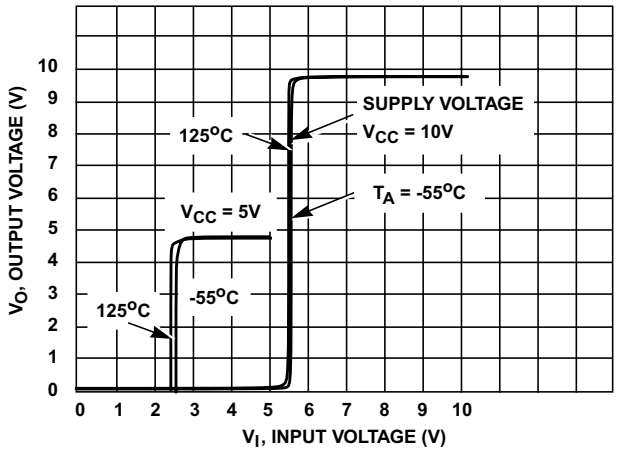


Figure 5-8. Typical Voltage Transfer Characteristics as a Function of Temperature for CD4050B

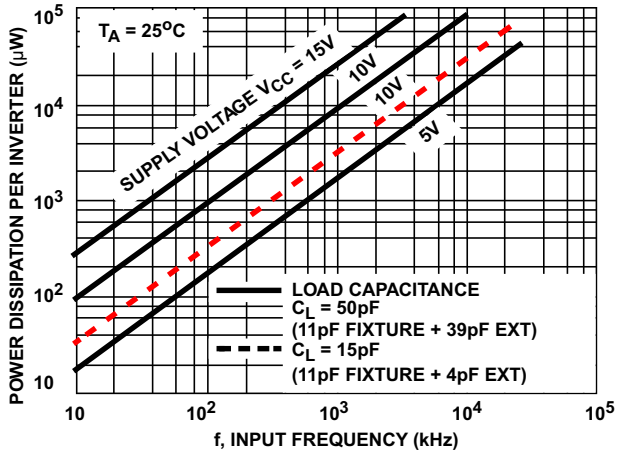


Figure 5-9. Typical Power Dissipation versus Frequency Characteristics

6 Parameter Measurement Information

6.1 Test Circuits

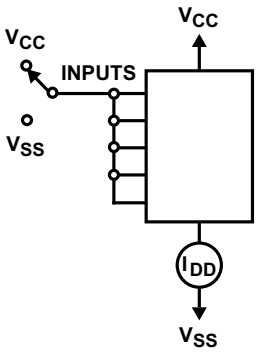
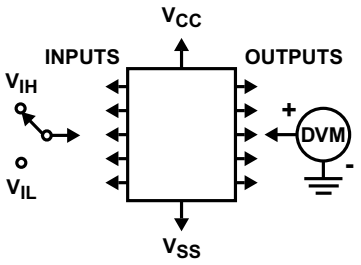
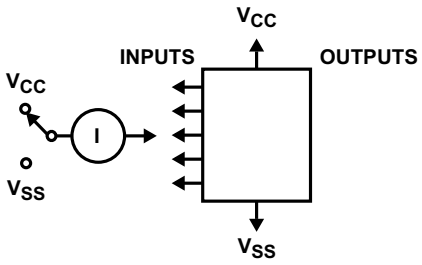


Figure 6-1. Quiescent Device Current Test Circuit



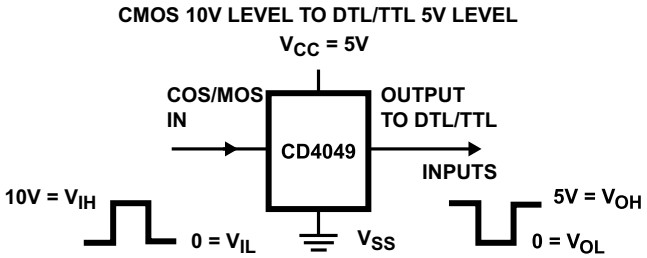
Test any one input with other inputs at VCC or VSS.

Figure 6-2. Input Voltage Test Circuit



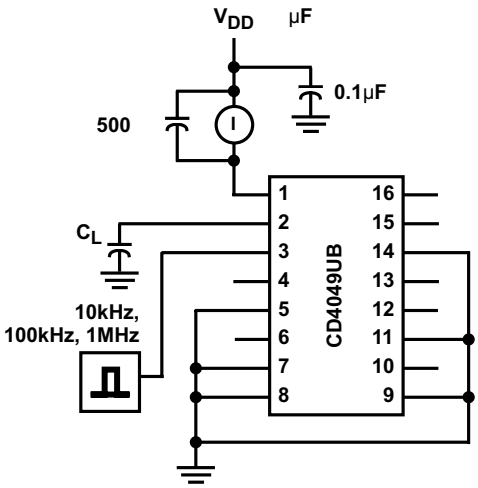
Measure inputs sequentially, to both VCC and VSS connect all unused inputs to either VCC or VSS.

Figure 6-3. Input Current Test Circuit



IN Pin: A, B, C, D, E, or F
OUT Pin: G, H, I, J, K, or L
VCC Pin
VSS Pin

Figure 6-4. Logic Level Conversion Application



C_L includes fixture capacitance.

Figure 6-5. Dynamic Power Dissipation Test Circuits

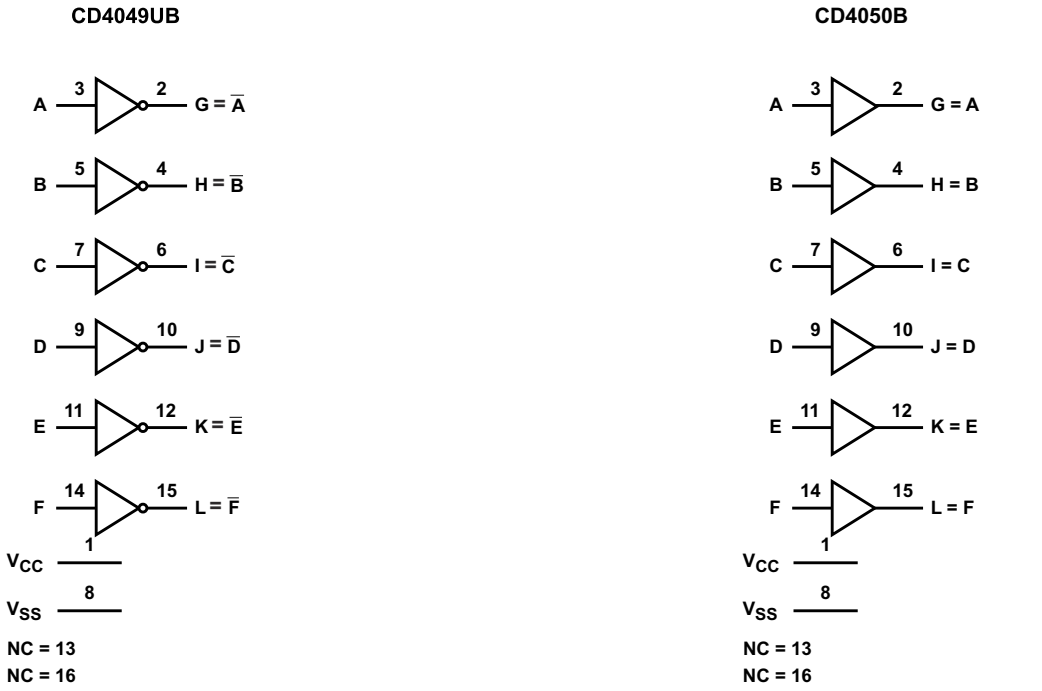
7 Detailed Description

7.1 Overview

The CD4049UB device is an inverting hex buffer; the CD4050B device is a noninverting hex buffer. These devices do logic-level conversions and have a high sink current that can drive two TTL loads. These devices also have low input current of 1µA across the full temperature range at 18V.

The CD4049UB and CD4050B devices are designated as replacements for CD4009UB and CD4010B devices, respectively. Because the CD4049UB and CD4050B require only one power supply, they are preferred over the CD4009UB and CD4010B and should be used in place of the CD4009UB and CD4010B in all inverter, current driver, or logic-level conversion applications. In these applications the CD4049UB and CD4050B are pin compatible with the CD4009UB and CD4010B respectively, and can be substituted for these devices in existing as well as in new designs. Pin 16 (NC) is not connected internally on the CD4049UB or CD4050B, therefore, connection to this terminal is of no consequence to circuit operation. TI recommends the CD4069UB hex inverter is recommended for applications not requiring high sink-current or voltage conversion.

7.2 Functional Block Diagram



7.3 Feature Description

CD4049UB and CD4050B have standardized symmetrical output characteristics and a wide operating voltage from 3V to 18V with quiescent current tested at 20V. These devices have transition times of t_{TLH} = 40ns and t_{THL} = 20ns (typical) at 10V. The operating temperature is from –55°C to 125°C.

7.4 Device Functional Modes

Table 7-1 shows the functional modes for CD4049UB. Table 7-2 shows the functional modes for CD4050B.

Table 7-1. Function Table for CD4049UB

INPUT A, B, C, D, E, F	OUTPUT G, H, I, J, K, L
H	L
L	H

Table 7-2. Function Table for CD4050B

INPUT A, B, C, D, E, F	OUTPUT G, H, I, J, K, L
H	H
L	L

8 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information

The CD4049UB and CD4050B devices have low input currents of 1µA at 18V over full package-temperature range and 100nA at 18V, 25°C. These devices have a wide operating voltage from 3V to 18V and used in high-voltage applications.

8.2 Typical Application

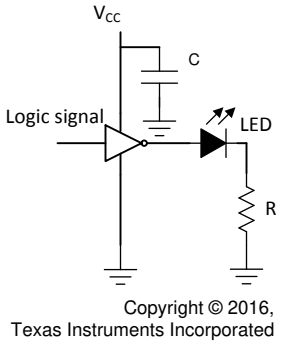


Figure 8-1. CD4049UB Application

8.2.1 Design Requirements

The CD4049UB device is the industry's highest logic inverter operating at 18V under recommended conditions. These devices have high sink current capabilities.

8.2.2 Detailed Design Procedure

The recommended input conditions for Figure 8-1 includes rise time and fall time specifications (see Δt/ΔV in *Recommended Operating Conditions)* and specified high and low levels (see V_{IH} and V_{IL} in *Recommended Operating Conditions).* Inputs are not overvoltage tolerant and must be below V_{CC} level because of the presence of input clamp diodes to VCC.

The recommended output condition for the CD4049UB application includes specific load currents. Load currents must be limited so as to not exceed the total power (continuous current through VCC or GND) for the device. These limits are in the *Absolute Maximum Ratings.* Outputs must not be pulled above V_{CC}.

8.2.3 Application Curves

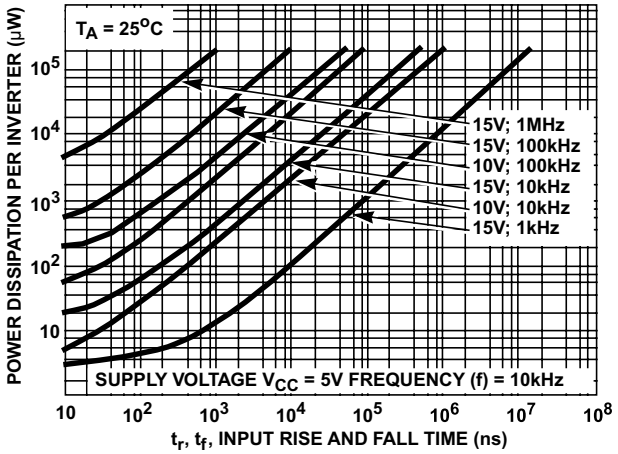


Figure 8-2. Typical Power Dissipation vs Input Rise and Fall Times Per Inverter for CD4049UB

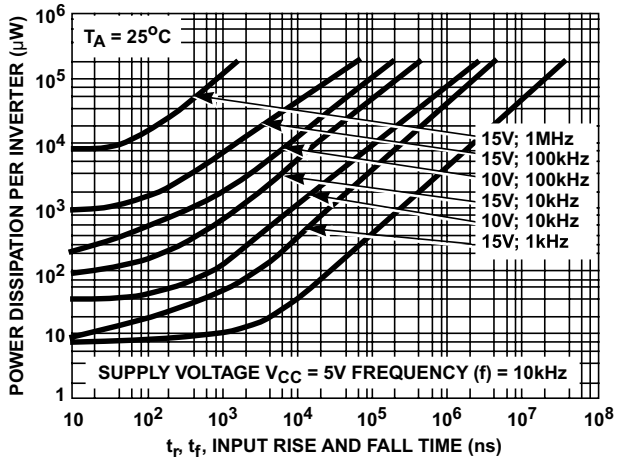


Figure 8-3. Typical Power Dissipation vs Input Rise and Fall Times Per Buffer for CD4050B

8.3 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating in *Recommended Operating Conditions*.

Each VCC pin must have a good bypass capacitor to prevent power disturbance. For devices with a single supply, TI recommends a 0.1µF capacitor. If there are multiple VCC pins, then TI recommends a 0.01µF or 0.022µF capacitor for each power pin. It is acceptable to parallel multiple bypass capacitors to reject different frequencies of noise. 0.1µF and 1µF capacitors are commonly used in parallel. The bypass capacitor must be installed as close to the power pin as possible for best results.

8.4 Layout

8.4.1 Layout Guidelines

When using multiple bit logic devices, inputs must never float.

In many cases, digital logic device functions or parts of these functions are unused (for example, when only two inputs of a triple-input and gate are used, or only 3 of the 4 buffer gates are used). Such input pins must not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. This rule must be observed under all circumstances specified in the next paragraph.

All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. See *Implications of Slow or Floating CMOS Inputs* for more information on the effects of floating inputs. The logic level must apply to any particular unused input depending on the function of the device. Generally, they are tied to GND or VCC (whichever is convenient).

8.4.2 Layout Example

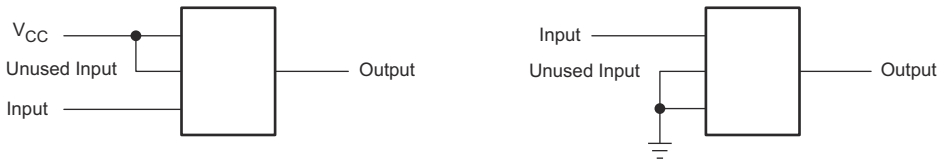


Figure 8-4. Layout Diagram

9 Device and Documentation Support

9.1 Documentation Support

9.1.1 Related Documentation

For related documentation see the following:

- Texas Instruments, *Implications of Slow or Floating CMOS Inputs* application note

9.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* 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.

9.3 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.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

9.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.
All trademarks are the property of their respective owners.

9.5 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.

9.6 Glossary

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

10 Revision History

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

Changes from Revision K (June 2020) to Revision L (February 2026)	Page
• Updated formatting in Recommended Operating Conditions section	6
• Updated formatting in DC Electrical Characteristics to identify maximum and minimum	8
• Moved V_{IH}, V_{IL}, I_{OH}, and I_{OL} to Recommended Operating Conditions section	8

Changes from Revision J (September 2016) to Revision K (June 2020)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document	1
• Updated *Device Information Table* with correct package dimensions	1

11 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.

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)
CD4049UBD	Obsolete	Production	SOIC (D) | 16	-	-	Call TI	Call TI	-55 to 125	CD4049UBM
CD4049UBDR	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4049UBM
CD4049UBDR.A	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4049UBM
CD4049UBDRE4	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4049UBM
CD4049UBDRG4	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4049UBM
CD4049UBDT	Obsolete	Production	SOIC (D) | 16	-	-	Call TI	Call TI	-55 to 125	CD4049UBM
CD4049UBDW	Active	Production	SOIC (DW) | 16	40 | TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4049UBM
CD4049UBDW.A	Active	Production	SOIC (DW) | 16	40 | TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4049UBM
CD4049UBDWG4	Active	Production	SOIC (DW) | 16	40 | TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4049UBM
CD4049UBE	Active	Production	PDIP (N) | 16	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4049UBE
CD4049UBE.A	Active	Production	PDIP (N) | 16	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4049UBE
CD4049UBEE4	Active	Production	PDIP (N) | 16	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4049UBE
CD4049UBF	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4049UBF
CD4049UBF.A	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4049UBF
CD4049UBF3A	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4049UBF3A
CD4049UBF3A.A	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4049UBF3A
CD4049UBNSR	Active	Production	SOP (NS) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4049UB
CD4049UBNSR.A	Active	Production	SOP (NS) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4049UB
CD4049UBPW	Obsolete	Production	TSSOP (PW) | 16	-	-	Call TI	Call TI	-55 to 125	CM049UB
CD4049UBPWR	Active	Production	TSSOP (PW) | 16	2000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-55 to 125	CM049UB
CD4049UBPWR.A	Active	Production	TSSOP (PW) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM049UB
CD4050BD	Obsolete	Production	SOIC (D) | 16	-	-	Call TI	Call TI	-55 to 125	CD4050BM
CD4050BDR	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4050BM
CD4050BDR.A	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4050BM
CD4050BDT	Obsolete	Production	SOIC (D) | 16	-	-	Call TI	Call TI	-55 to 125	CD4050BM
CD4050BDW	Obsolete	Production	SOIC (DW) | 16	-	-	Call TI	Call TI	-55 to 125	CD4050BM
CD4050BDWR	NRND	Production	SOIC (DW) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4050BM
CD4050BDWR.A	NRND	Production	SOIC (DW) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4050BM
CD4050BE	Active	Production	PDIP (N) | 16	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4050BE

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)
CD4050BE.A	Active	Production	PDIP (N) | 16	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4050BE
CD4050BEE4	Active	Production	PDIP (N) | 16	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4050BE
CD4050BF	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4050BF
CD4050BF.A	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4050BF
CD4050BF3A	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4050BF3A
CD4050BF3A.A	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4050BF3A
CD4050BNSR	Active	Production	SOP (NS) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4050B
CD4050BNSR.A	Active	Production	SOP (NS) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4050B
CD4050BPW	Obsolete	Production	TSSOP (PW) | 16	-	-	Call TI	Call TI	-55 to 125	CM050B
CD4050BPWR	Active	Production	TSSOP (PW) | 16	2000 | LARGE T&R	Yes	NIPDAU | SN	Level-1-260C-UNLIM	-55 to 125	CM050B
CD4050BPWR.A	Active	Production	TSSOP (PW) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM050B
CD4050BPWRG4	Active	Production	TSSOP (PW) | 16	2000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM050B
JM38510/05553BEA	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 05553BEA
JM38510/05553BEA.A	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 05553BEA
JM38510/05554BEA	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 05554BEA
JM38510/05554BEA.A	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 05554BEA
M38510/05553BEA	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 05553BEA
M38510/05554BEA	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 05554BEA

(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.

OTHER QUALIFIED VERSIONS OF CD4049UB, CD4049UB-MIL, CD4050B, CD4050B-MIL :

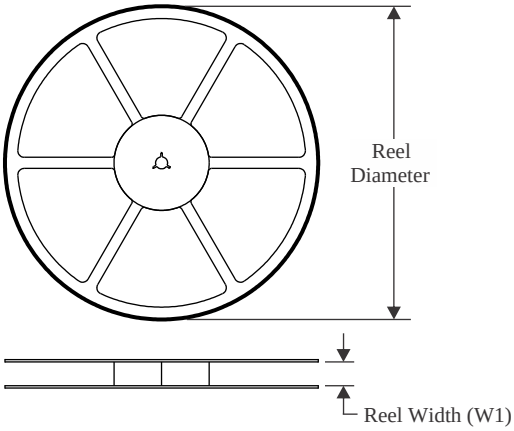
- Catalog : CD4049UB, CD4050B
- Military : CD4049UB-MIL, CD4050B-MIL

NOTE: Qualified Version Definitions:

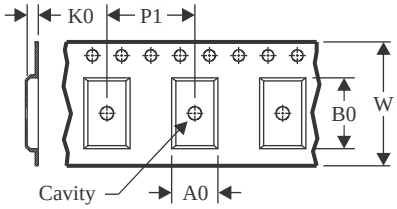
- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS

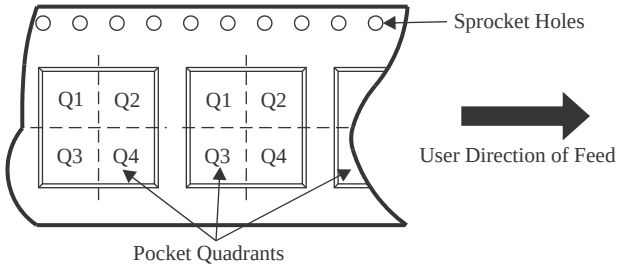


TAPE DIMENSIONS



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

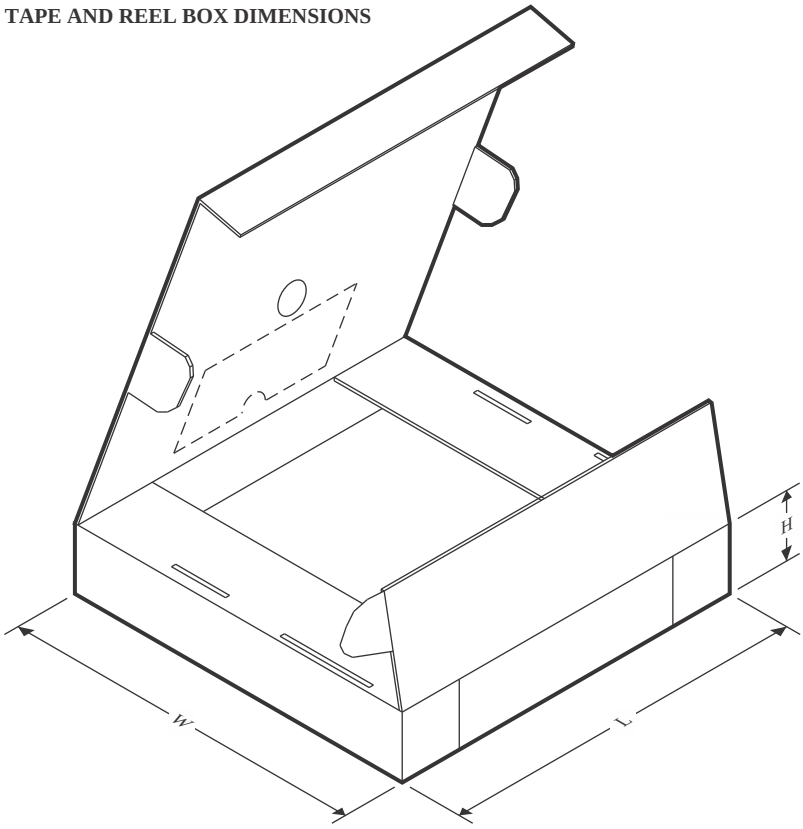
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CD4049UBDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD4049UBNSR	SOP	NS	16	2000	330.0	16.4	8.45	10.55	2.5	12.0	16.2	Q1
CD4049UBPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
CD4050BDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD4050BDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
CD4050BNSR	SOP	NS	16	2000	330.0	16.4	8.45	10.55	2.5	12.0	16.2	Q1
CD4050BPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
CD4050BPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
CD4050BPWRG4	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

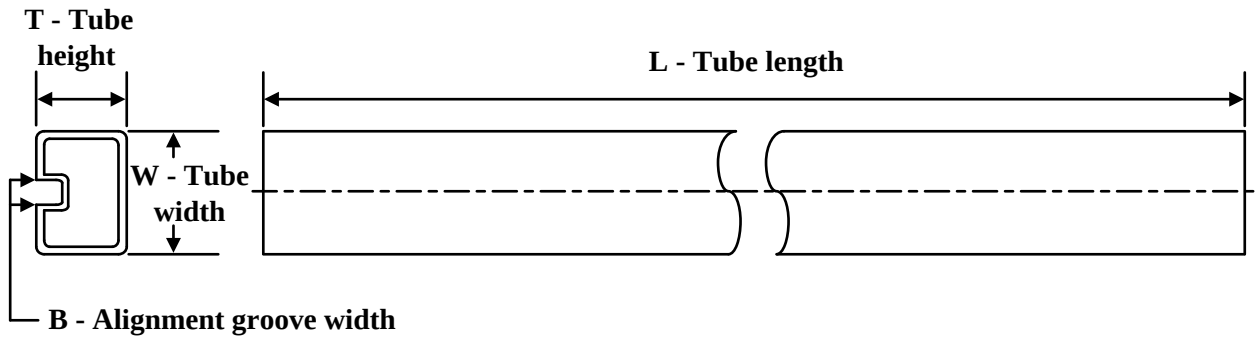
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

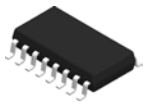
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD4049UBDR	SOIC	D	16	2500	353.0	353.0	32.0
CD4049UBNSR	SOP	NS	16	2000	353.0	353.0	32.0
CD4049UBPWR	TSSOP	PW	16	2000	356.0	356.0	35.0
CD4050BDR	SOIC	D	16	2500	353.0	353.0	32.0
CD4050BDWR	SOIC	DW	16	2000	350.0	350.0	43.0
CD4050BNSR	SOP	NS	16	2000	353.0	353.0	32.0
CD4050BPWR	TSSOP	PW	16	2000	356.0	356.0	35.0
CD4050BPWR	TSSOP	PW	16	2000	353.0	353.0	32.0
CD4050BPWRG4	TSSOP	PW	16	2000	356.0	356.0	35.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
CD4049UBDW	DW	SOIC	16	40	506.98	12.7	4826	6.6
CD4049UBDW.A	DW	SOIC	16	40	506.98	12.7	4826	6.6
CD4049UBDWG4	DW	SOIC	16	40	506.98	12.7	4826	6.6
CD4049UBE	N	PDIP	16	25	506	13.97	11230	4.32
CD4049UBE.A	N	PDIP	16	25	506	13.97	11230	4.32
CD4049UBEE4	N	PDIP	16	25	506	13.97	11230	4.32
CD4050BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4050BE.A	N	PDIP	16	25	506	13.97	11230	4.32
CD4050BEE4	N	PDIP	16	25	506	13.97	11230	4.32

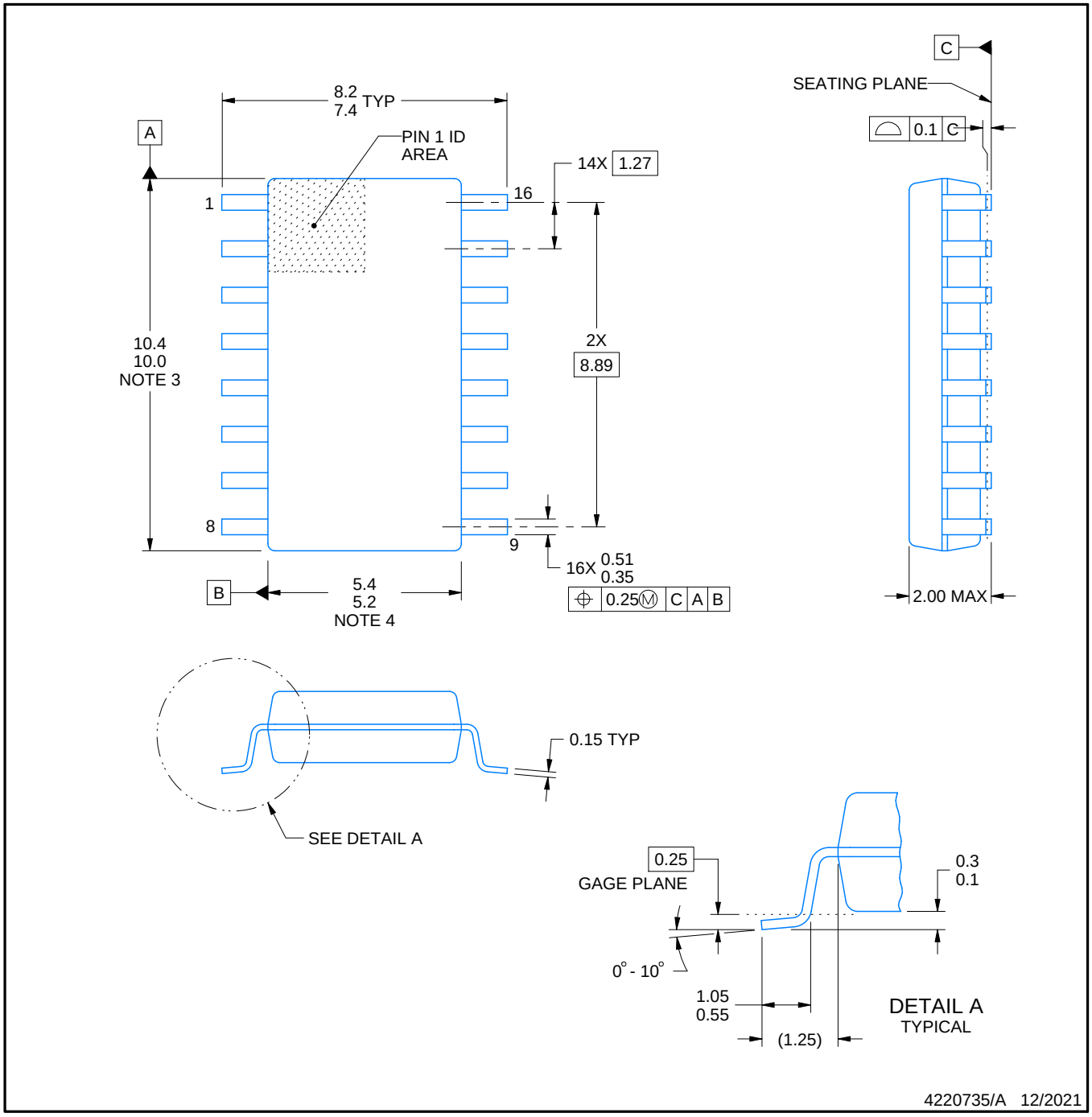


PACKAGE OUTLINE

NS0016A

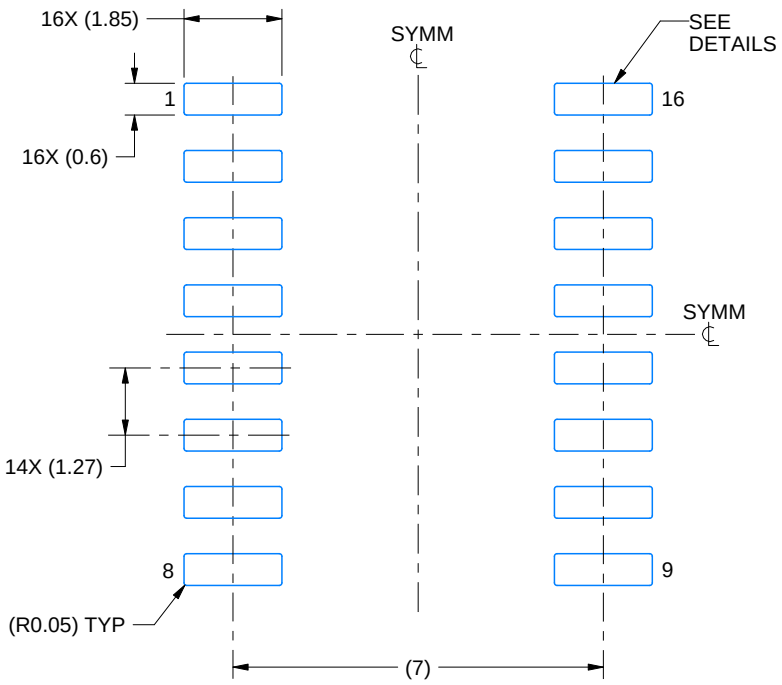
SOP - 2.00 mm max height

SOP

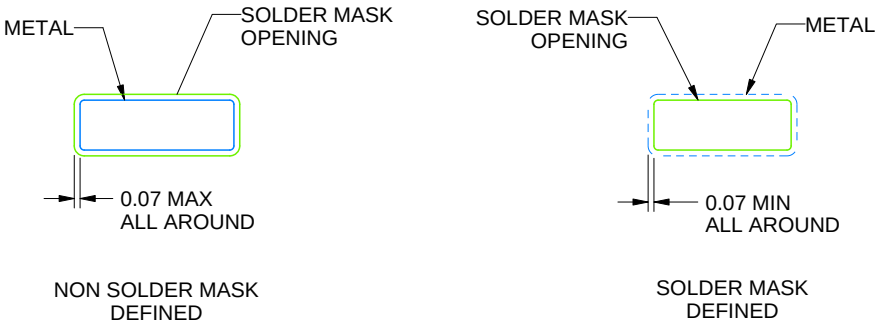


NOTES:

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 0.25 mm, per side.



LAND PATTERN EXAMPLE
SCALE:7X



NON SOLDER MASK
DEFINED

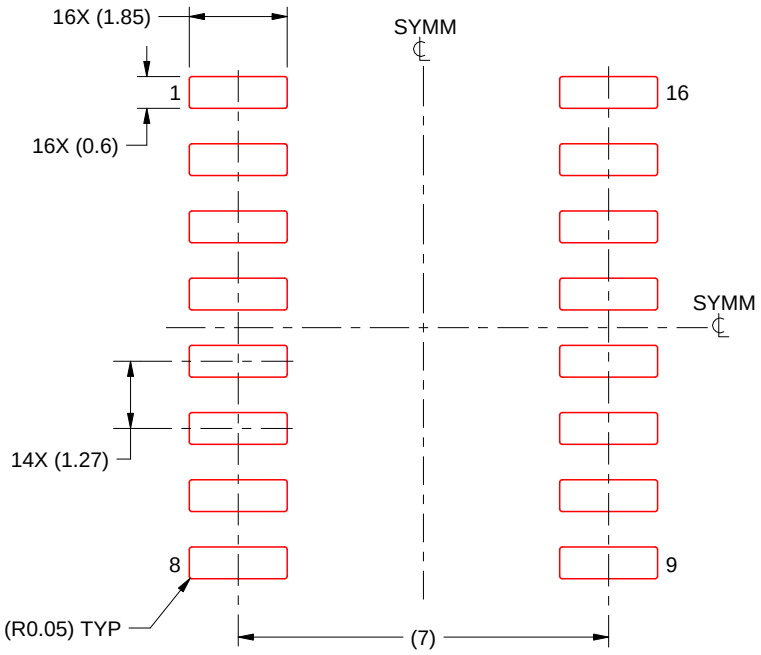
SOLDER MASK
DEFINED

SOLDER MASK DETAILS

4220735/A 12/2021

NOTES: (continued)

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



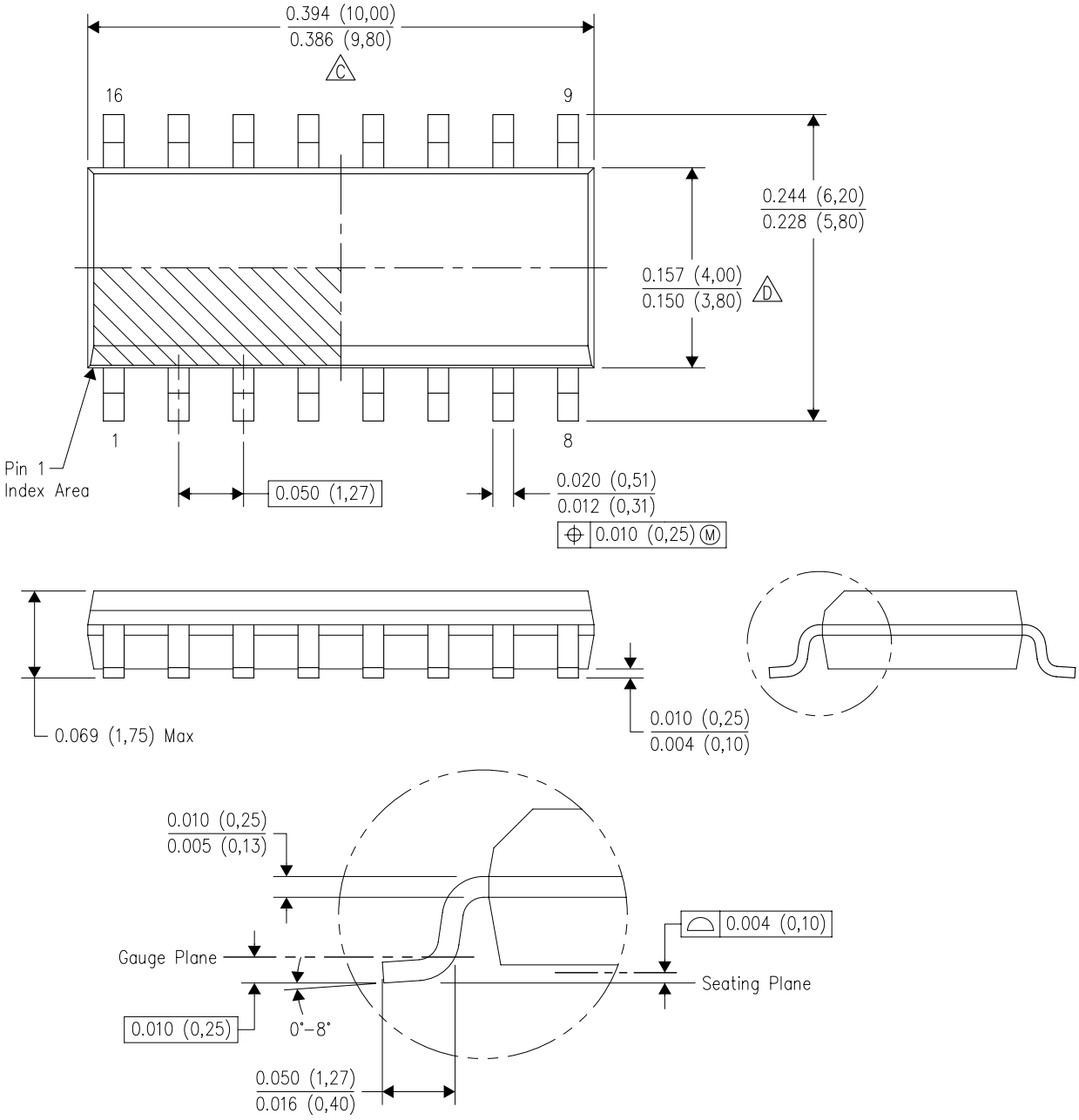
SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:7X

4220735/A 12/2021

NOTES: (continued)

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

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.

GENERIC PACKAGE VIEW

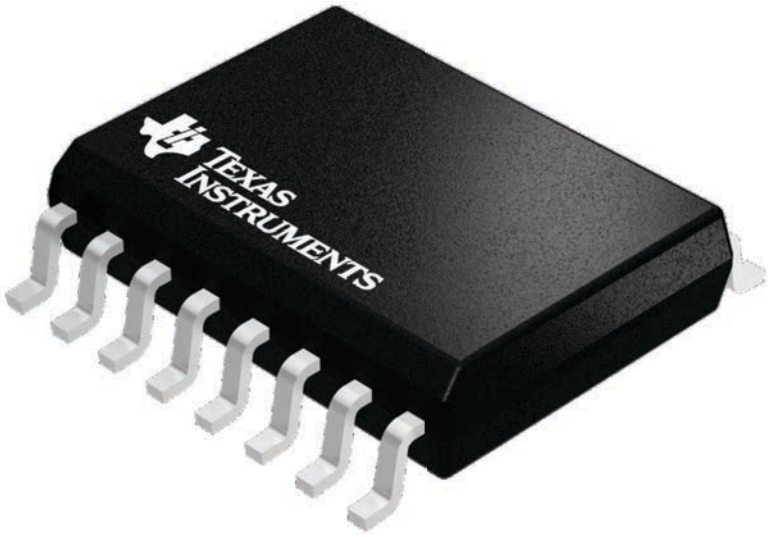
DW 16

SOIC - 2.65 mm max height

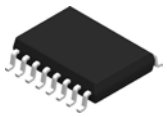
7.5 x 10.3, 1.27 mm pitch

SMALL OUTLINE INTEGRATED CIRCUIT

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



4224780/A

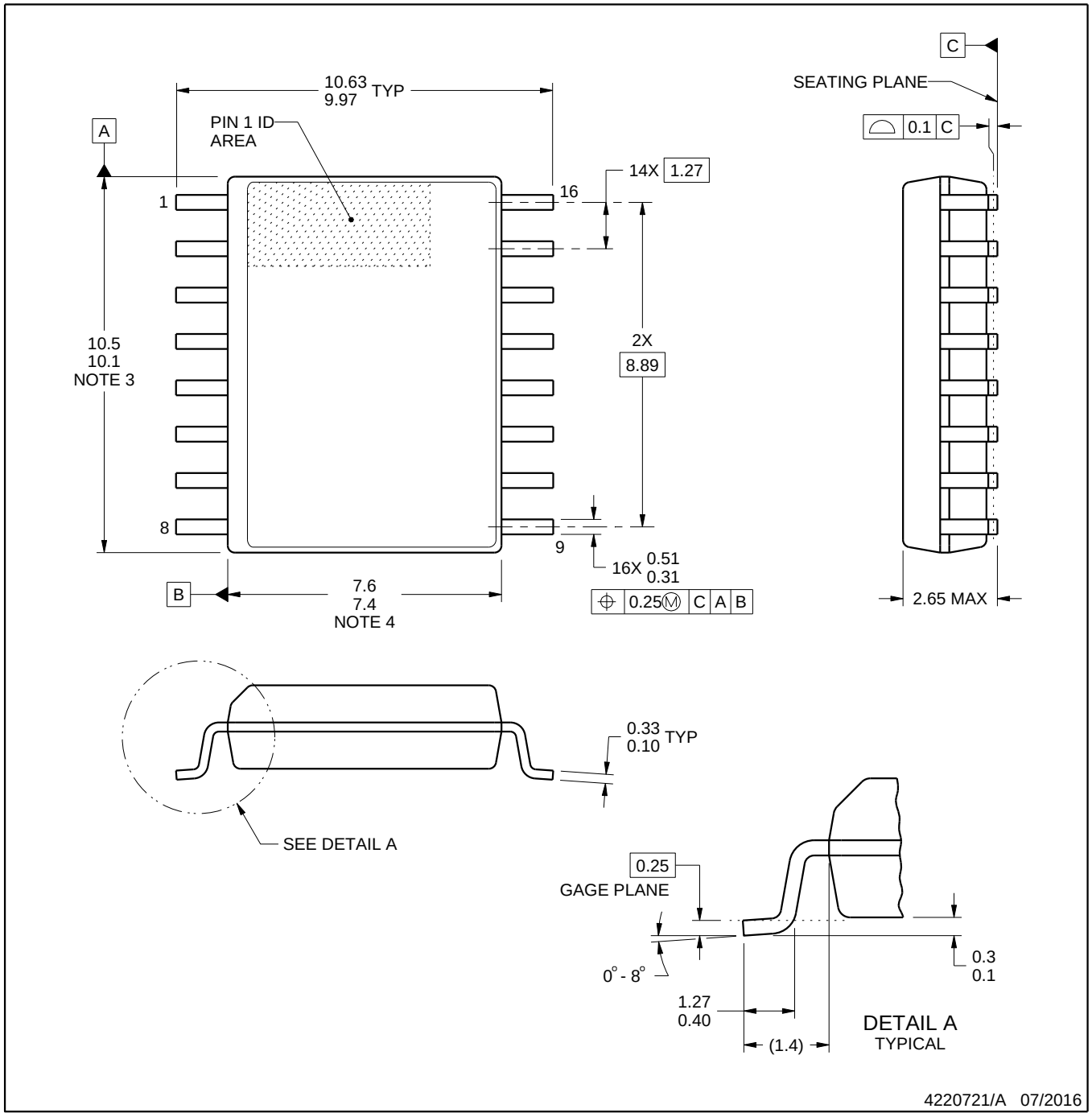


PACKAGE OUTLINE

DW0016A

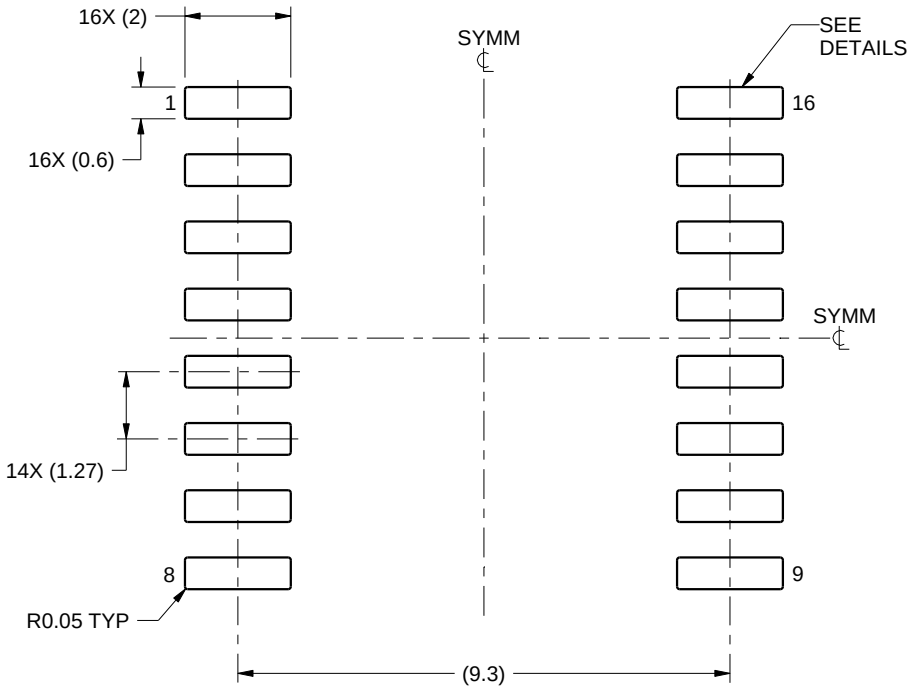
SOIC - 2.65 mm max height

SOIC

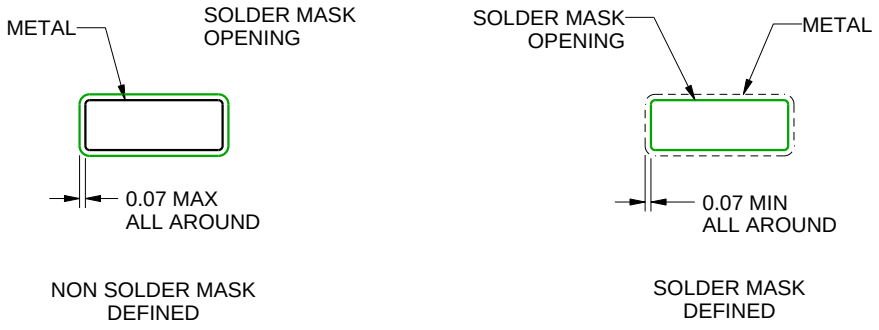


NOTES:

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 0.25 mm, per side.
5. Reference JEDEC registration MS-013.



LAND PATTERN EXAMPLE
SCALE:7X

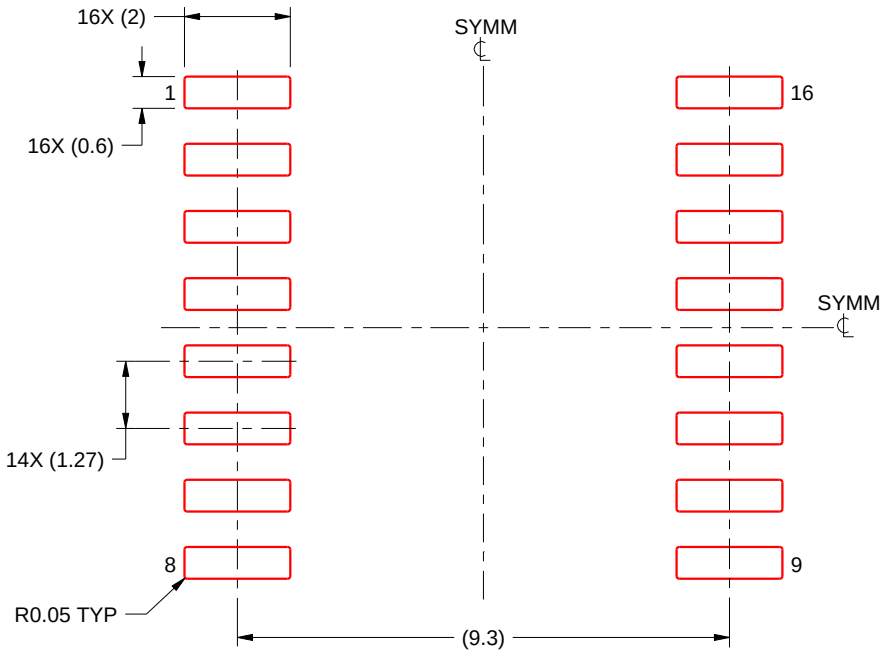


SOLDER MASK DETAILS

4220721/A 07/2016

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:7X

4220721/A 07/2016

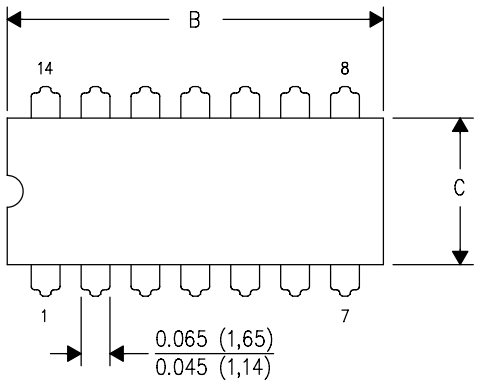
NOTES: (continued)

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.

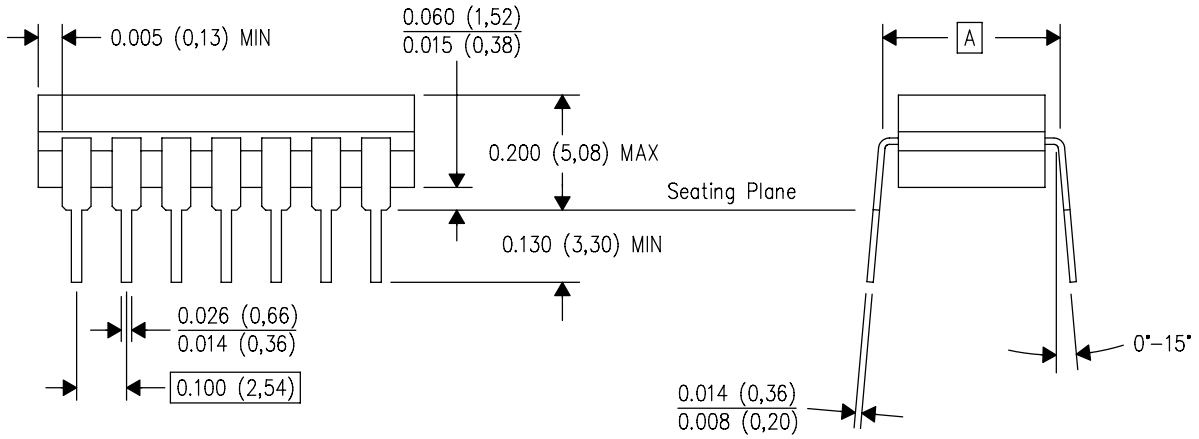
J (R–GDIP–T**)

14 LEADS SHOWN

CERAMIC DUAL IN–LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

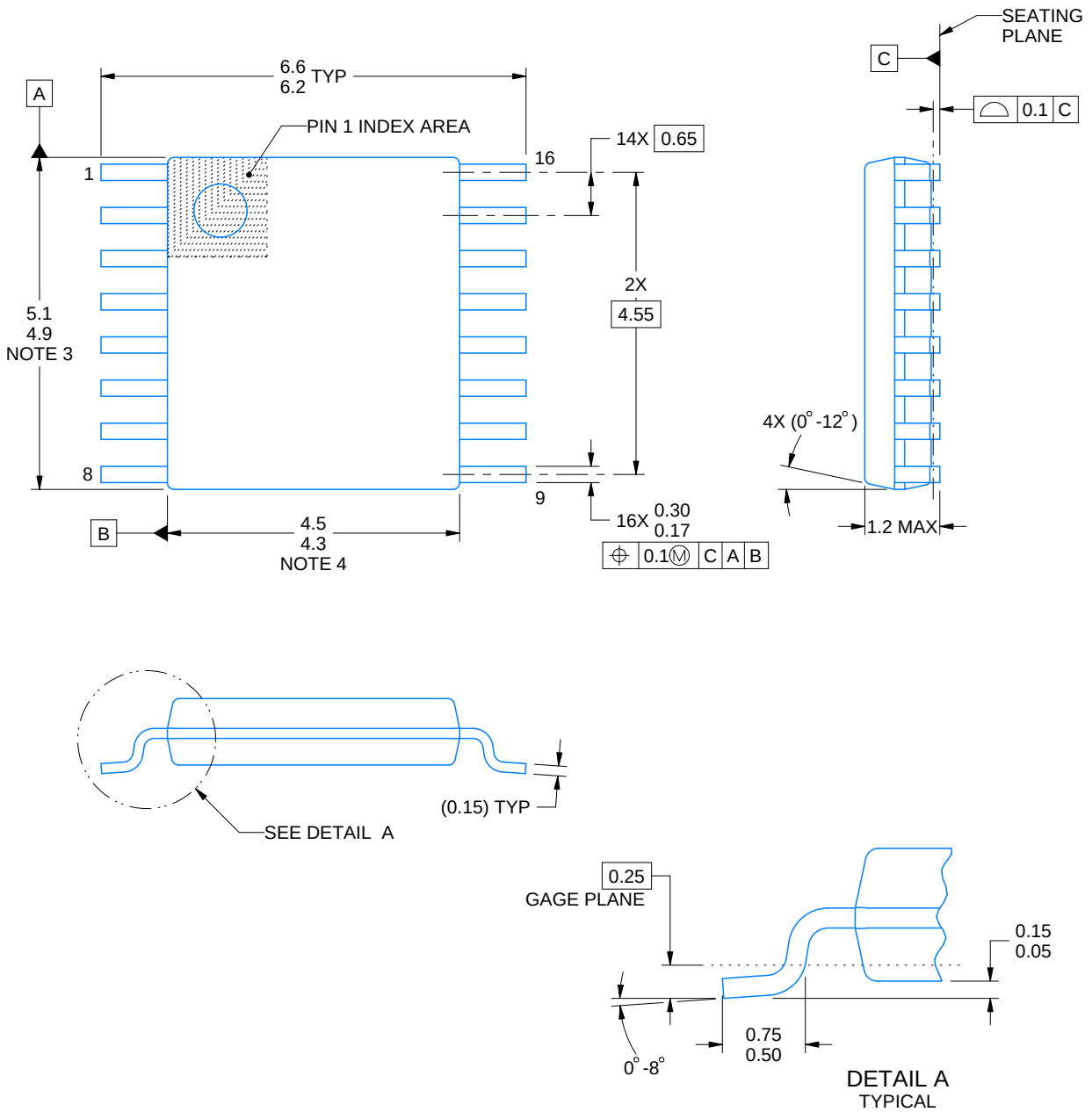
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls within MIL STD 1835 GDIP1–T14, GDIP1–T16, GDIP1–T18 and GDIP1–T20.

PACKAGE OUTLINE

PW0016A

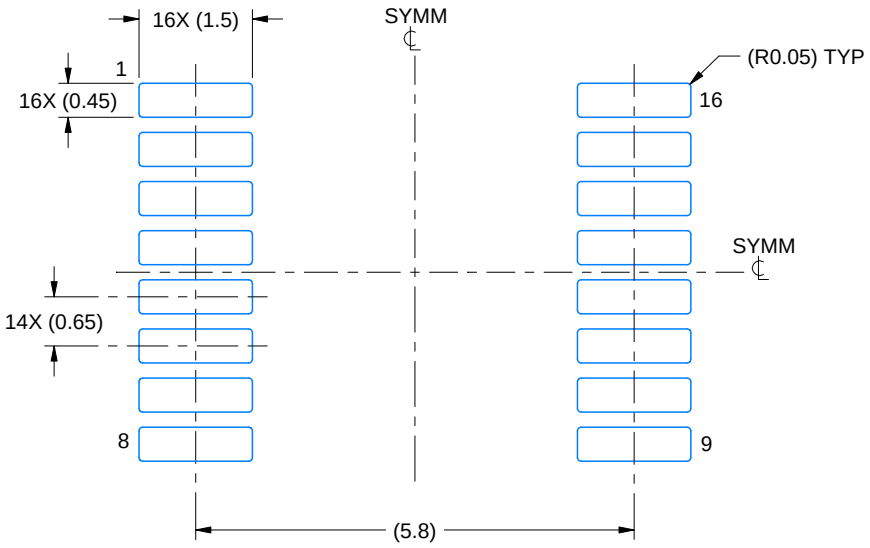
TSSOP - 1.2 mm max height

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.



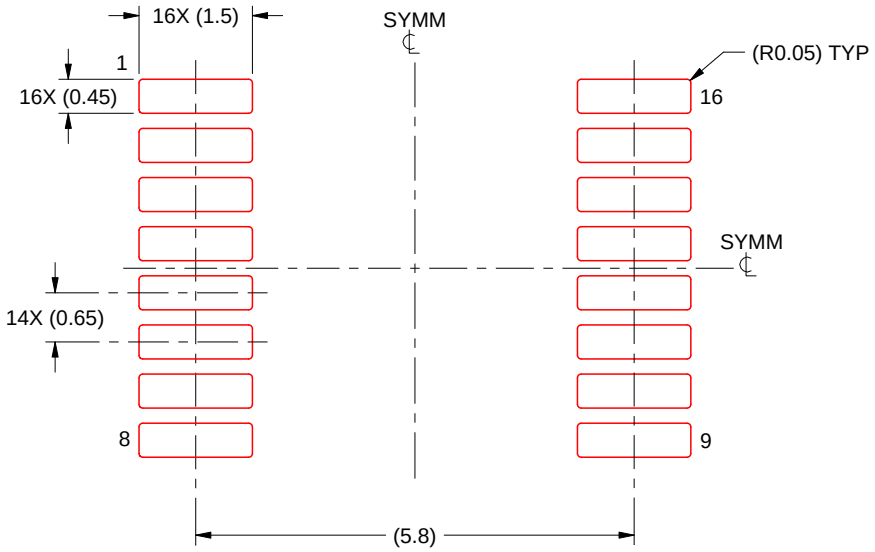
LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X

SOLDER MASK DETAILS

4220204/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

4220204/B 12/2023

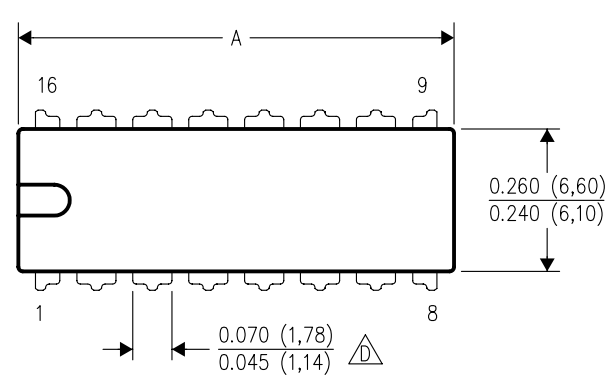
NOTES: (continued)

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.

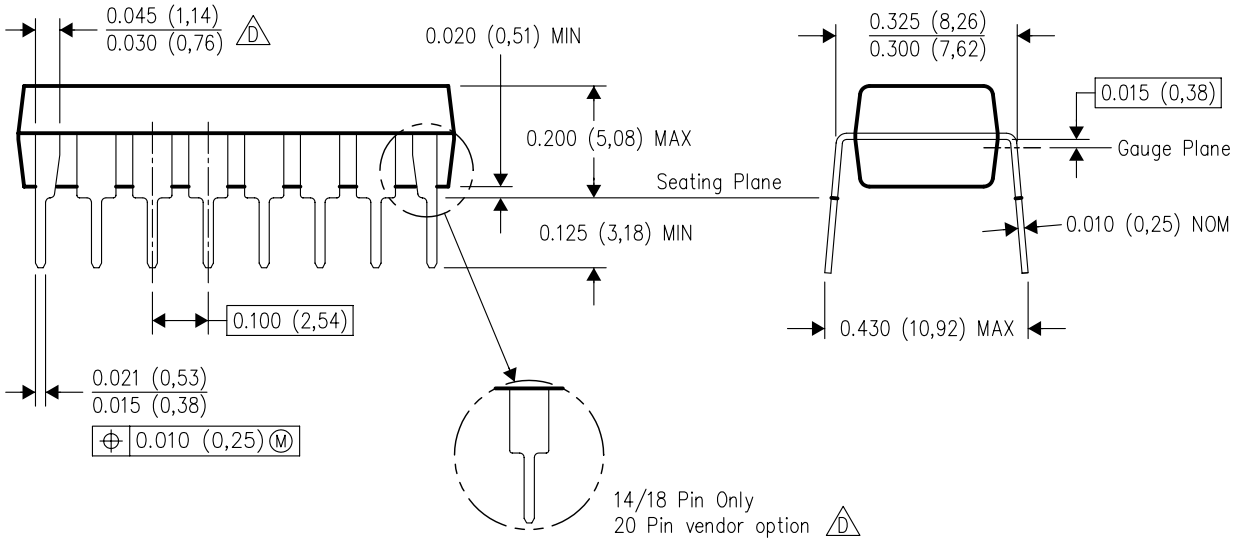
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



DIM \ PINS **	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)
MS–001 VARIATION (C)	AA	BB	AC	AD



4040049/E 12/2002

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.

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