

CMOS BCD-to-Seven-Segment Latch/Decoder/Driver For Liquid-Crystal Displays

High-Voltage Types (20-Volt Rating)

Features:

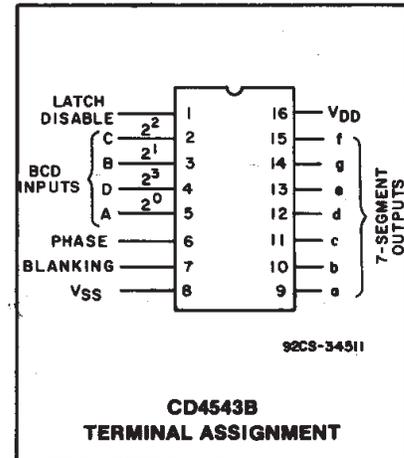
- Display blanking of all illegal input combinations
- Latch storage of code
- Capability of driving two low power TTL loads, two HTL loads, or one low power Schottky load over the full rated-temperature range
- Pin-for-pin replacement for the CD4056B (with pin 7 tied to V_{SS})
- Direct LED driving capability

■ CD4543B is a BCD-to-seven segment latch/decoder/driver designed primarily for liquid-crystal display (LCD) applications. It is also capable of driving light emitting diode (LED), incandescent, gas-discharge, and fluorescent displays. This device is functionally similar to and serves as direct replacement for the CD4056B when pin 7 is connected to V_{SS}. It differs from the CD4056B in that it has a display blanking capability instead of a level-shifting function and requires only one power supply. When the CD4056B is used in the level shifting mode, two power supplies are required. When the CD4543B is used for LCD applications, a square wave must be applied to the PHASE input and the backplane of the LCD device. For LED applications a logic 0 is required at the PHASE input for common-cathode devices; a logic 1 is required for common-anode devices (see truth table).

The CD4543B is supplied in 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (M, M96, MT, and NSR suffixes), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE RANGE, (V _{DD})	-0.5V to +20V
Voltages referenced to V _{SS} Terminal)	
INPUT VOLTAGE RANGE, ALL INPUTS	-0.5V to V _{DD} +0.5V
DC INPUT CURRENT, ANY ONE INPUT	±10mA
POWER DISSIPATION PER PACKAGE (P _D):	
For T _A = -55°C to +100°C	500mW
For T _A = +100°C to +125°C	Derate Linearly at 12mW/°C to 200mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR	
FOR T _A = FULL PACKAGE-TEMPERATURE RANGE (All Package Types)	100mW
OPERATING-TEMPERATURE RANGE (T _A)	-55°C to +125°C
STORAGE TEMPERATURE RANGE (T _{stg})	-65°C to +150°C
LEAD TEMPERATURE (DURING SOLDERING):	
At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10s max	+265°C



- 100% tested for quiescent current at 20 V
- Maximum input current of 1 μA at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- Noise margin (full package-temperature range) = 1 V at V_{DD}=5 V
2 V at V_{DD}=10 V
2.5 V at V_{DD}=15 V
- 5-V, 10-V, and 15-V parametric ratings
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

Applications:

- Instrument display driver
- Dashboard display driver
- Computer/calculator display driver
- Timing device driver (clocks, watches, timers)

3
COMMERCIAL CMOS
HIGH VOLTAGE ICs

CD4543B Types

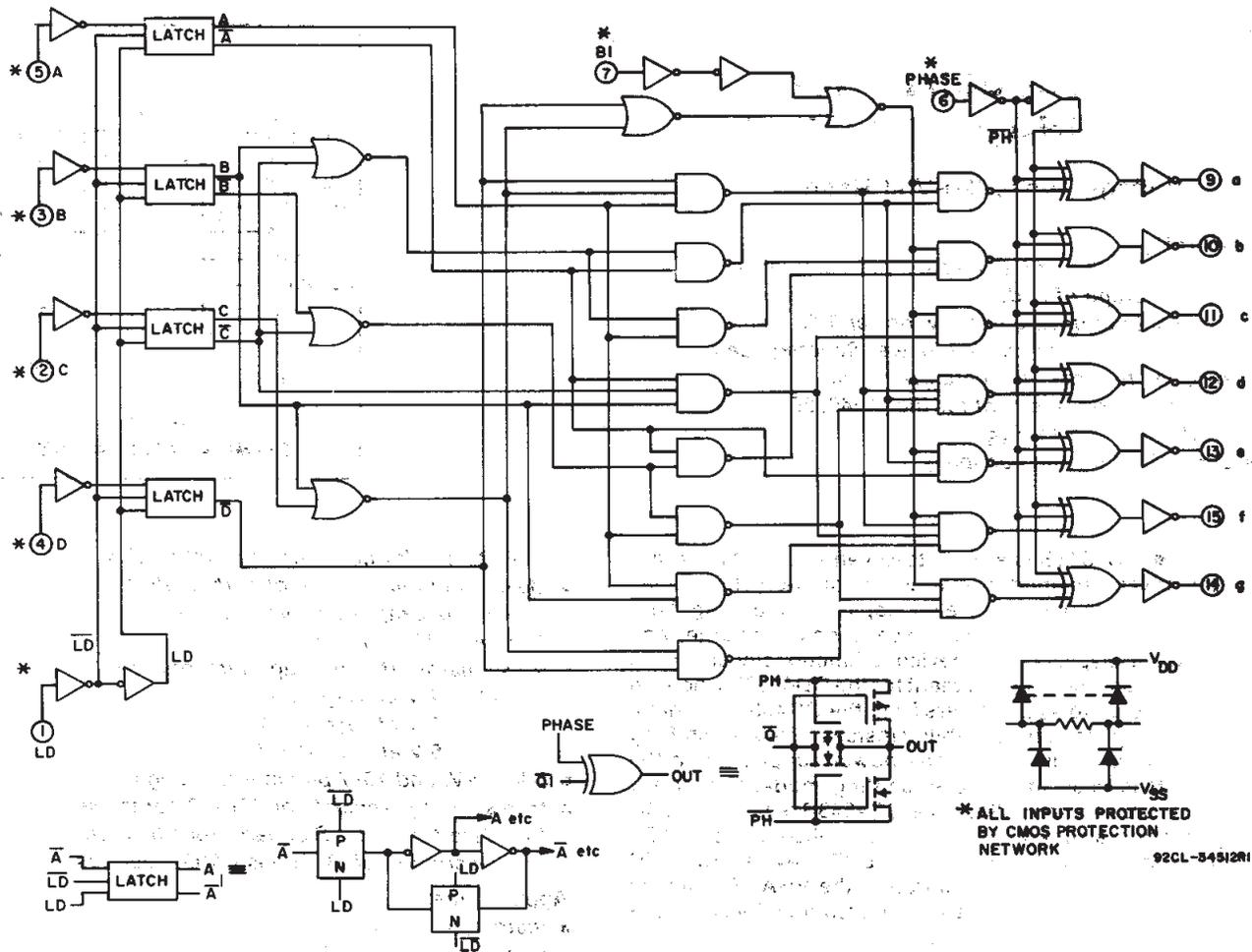


Fig. 1 - BCD-to-seven-segment latch/decoder/driver CD4543B logic circuit diagram.

RECOMMENDED OPERATING CONDITIONS at T_A=25°C, Unless Otherwise Specified

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	V _{DD} (V)	LIMITS		UNITS
		MIN.	TYP.	
Supply-Voltage Range (For T _A =Full Package-Temperature Range)	—	3	18	V
Latch Disable Pulse Width	5	250	125	ns
	10	100	50	
	15	80	40	
Minimum Data Setup Time	5	60	15	ns
	10	20	-5	
	15	10	-5	
Minimum Data Hold Time	5	25	-5	ns
	10	20	10	
	15	20	10	

CD4543B Types

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V _O (V)	V _{IN} (V)	V _{DD} (V)	-55	-40	+85	+125	+25			
								Min.	Typ.	Max.	
Quiescent Device Current Max. I _{DD}	—	0, 5	5	5	5	150	150	—	0.04	5	μA
	—	0,10	10	10	10	300	300	—	0.04	10	
	—	0,15	15	20	20	600	600	—	0.04	20	
	—	0,20	20	100	100	3000	3000	—	0.08	100	
Output Low (Sink) Current Min. I _{OL}	0.4	0, 5	5	0.64	0.61	0.42	0.36	0.51	1	—	mA
	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	—	
	1.5	0,15	15	4.2	4	2.8	2.4	3.4	6.8	—	
Output High (Source) Current Min. I _{OH}	4.6	0, 5	5	-0.46	-0.44	-0.30	-0.26	-0.37	-0.75	—	mA
	2.5	0, 5	5	-1.6	-1.5	-1.1	-0.9	-1.3	-2.6	—	
	9.5	0,10	10	-0.98	-0.92	-0.68	-0.55	-0.8	-1.6	—	
	13.5	0,15	15	-3.33	-3.18	-2.2	-1.9	-2.7	-5.4	—	
Output Voltage: Low-Level Max. V _{OL}	—	0, 5	5	0.05				—	0	0.05	V
	—	0,10	10	0.05				—	0	0.05	
	—	0,15	15	0.05				—	0	0.05	
Output Voltage: High-Level Min. V _{OH}	—	0, 5	5	4.95				4.95	5	—	V
	—	0,10	10	9.95				9.95	10	—	
	—	0,15	15	14.95				14.95	15	—	
Input Low Voltage Max. V _{IL}	0.5,4.5	—	5	1.5				—	—	1.5	V
	1, 9	—	10	3				—	—	3	
	1.5,13.5	—	15	4				—	—	4	
Input High Voltage Min. V _{IH}	0.5,4.5	—	5	3.5				3.5	—	—	V
	1, 9	—	10	7				7	—	—	
	1.5,13.5	—	15	11				11	—	—	
Input Current Max. I _{IN}	—	0,18	18	±0.1	±0.1	±1	±1	—	±10 ⁻⁵	±0.1	μA

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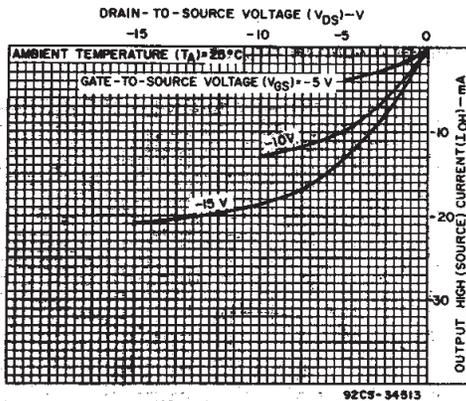


Fig. 2 - Typical output high (source) current characteristics.

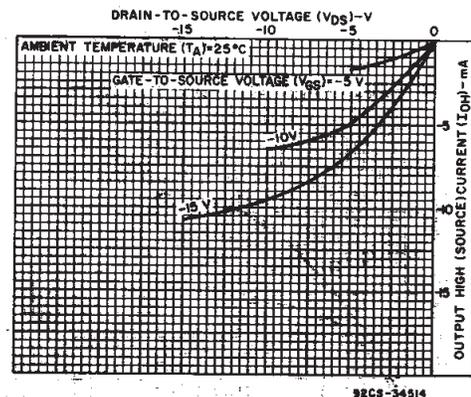


Fig. 3 - Minimum output high (source) current characteristics.

CD4543B Types

DYNAMIC ELECTRICAL CHARACTERISTICS at $T_A=25^\circ\text{C}$; $C_L=50\text{ pF}$, Input $t_r, t_f=20\text{ ns}$, $R_L=200\text{ k}\Omega$

CHARACTERISTIC	TEST CONDITIONS V_{DD} (V)	LIMITS All Packages			UNITS	
		MIN.	TYP.	MAX.		
Propagation Delay Time	t_{PHL}	5	—	600	1200	
		10	—	200	400	
		15	—	150	300	
	t_{PLH}	5	—	500	1000	
		10	—	200	400	
		15	—	150	300	
Transition Time	t_{THL}	5	—	180	360	
		10	—	90	180	
		15	—	65	130	
	t_{TLH}	5	—	180	360	
		10	—	90	180	
		15	—	65	130	
Latch Disable Pulse Width	t_{WH}	5	250	125	—	
		10	100	50	—	
		15	80	40	—	
Address Setup Time	t_{SU}	5	60	15	—	
		10	20	-5	—	
		15	10	-5	—	
Address Hold Time	t_H	5	25	-5	—	
		10	20	10	—	
		15	20	10	—	
Input Capacitance	C_{iN}	Any Input	—	5	7.5	pF

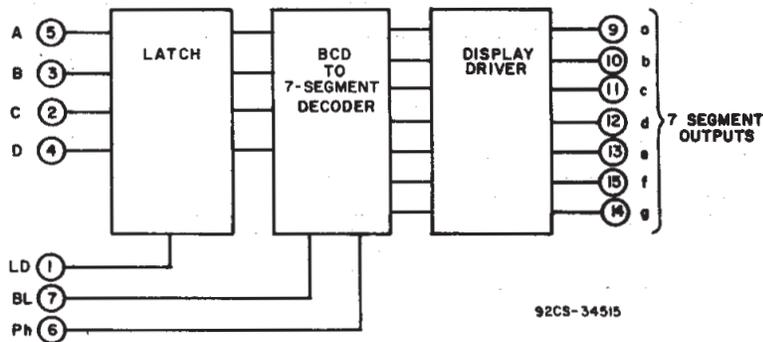


Fig. 4 - BCD-to-seven-segment latch/decoder/driver functional diagram.

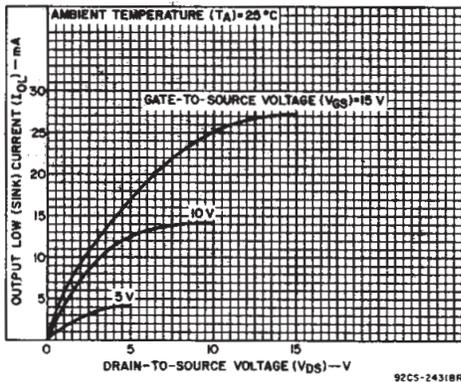


Fig. 5 - Typical output low (sink) current characteristics.

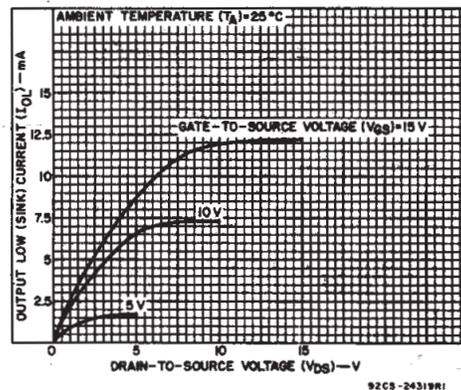


Fig. 6 - Minimum output low (sink) current characteristics.

CD4543B Types

TRUTH TABLE FOR CD4543B

INPUT CODE							OUTPUT STATE							DISPLAY CHARACTER
LD	BI	Ph*	D	C	B	A	a	b	c	d	e	f	g	
X	1	0	X	X	X	X	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	1	1	1	1	1	0	0
1	0	0	0	0	0	1	0	1	1	0	0	0	0	0
1	0	0	0	0	1	0	1	1	0	1	1	0	1	1
1	0	0	0	0	1	1	1	1	1	1	0	0	1	1
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1	0	0	1	1	0	1	0	0	0	0	0	0	0	0
1	0	0	1	1	1	0	0	0	0	0	0	0	0	0
1	0	0	1	1	1	1	0	0	0	0	0	0	0	0
0	0	0	X	X	X	X	**							**
†	†	1	†				Inverse of Output Combinations Above							Display as above

X=Don't care.

†=Above combinations.

*=For liquid-crystal readouts, apply a square wave to Ph.

For common cathode LED readouts, select Ph=0.

For common anode LED readouts, select Ph=1.

**=Depends upon the BCD code previously applied when LD=1.

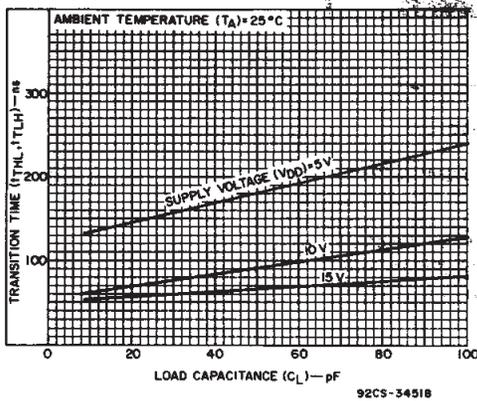


Fig. 7 - Typical transition time as a function of load capacitance.

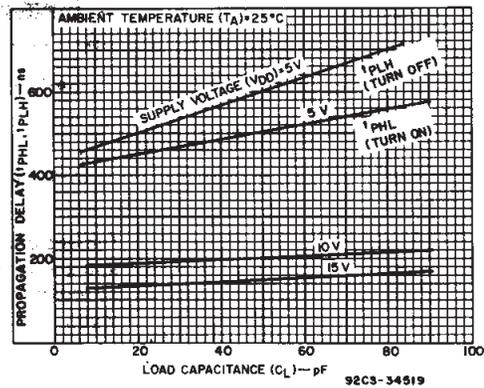


Fig. 8 - Typical propagation delay time as a function of load capacitance.

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CD4543B Types

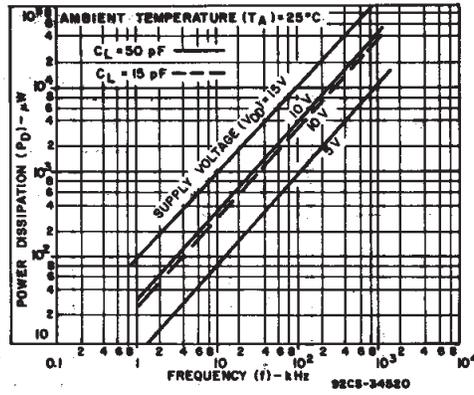


Fig. 9 - Typical dynamic power dissipation as a function of frequency.

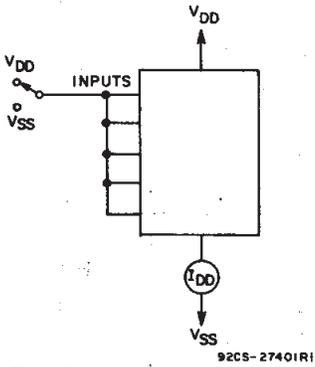


Fig. 10 - Quiescent device current test circuit.

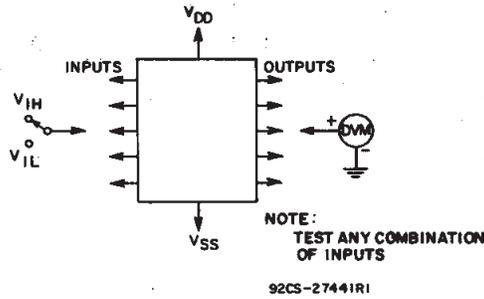


Fig. 11 - Input voltage test circuit.

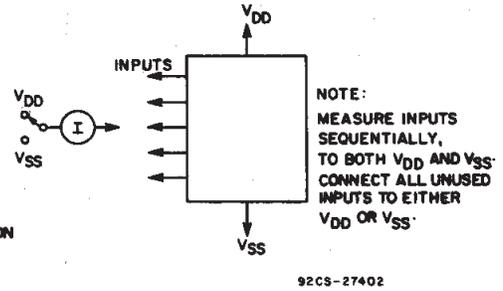
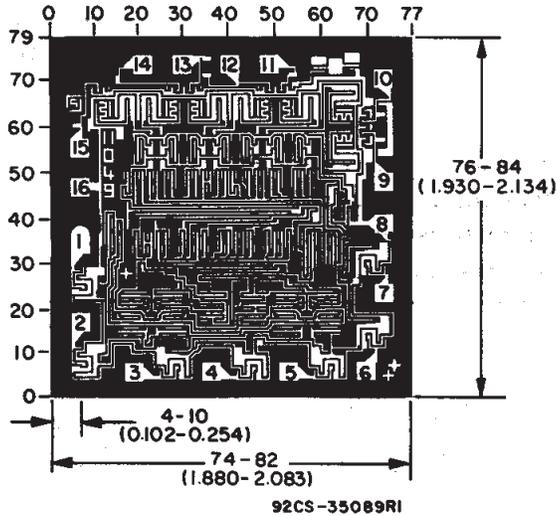


Fig. 12 - Input current test circuit.



Dimensions and pad layout for CD4543BH.

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3} inch).

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)
CD4543BE	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4543BE
CD4543BE.A	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4543BE
CD4543BEE4	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4543BE
CD4543BM	Obsolete	Production	SOIC (D) 16	-	-	Call TI	Call TI	-55 to 125	CD4543BM
CD4543BM96	Active	Production	SOIC (D) 16	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4543BM
CD4543BM96.A	Active	Production	SOIC (D) 16	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4543BM
CD4543BMT	Obsolete	Production	SOIC (D) 16	-	-	Call TI	Call TI	-55 to 125	CD4543BM
CD4543BNSR	Active	Production	SOP (NS) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4543B
CD4543BNSR.A	Active	Production	SOP (NS) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4543B
CD4543BPW	Obsolete	Production	TSSOP (PW) 16	-	-	Call TI	Call TI	-55 to 125	CM543B
CD4543BPWR	Active	Production	TSSOP (PW) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM543B
CD4543BPWR.A	Active	Production	TSSOP (PW) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM543B

(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.

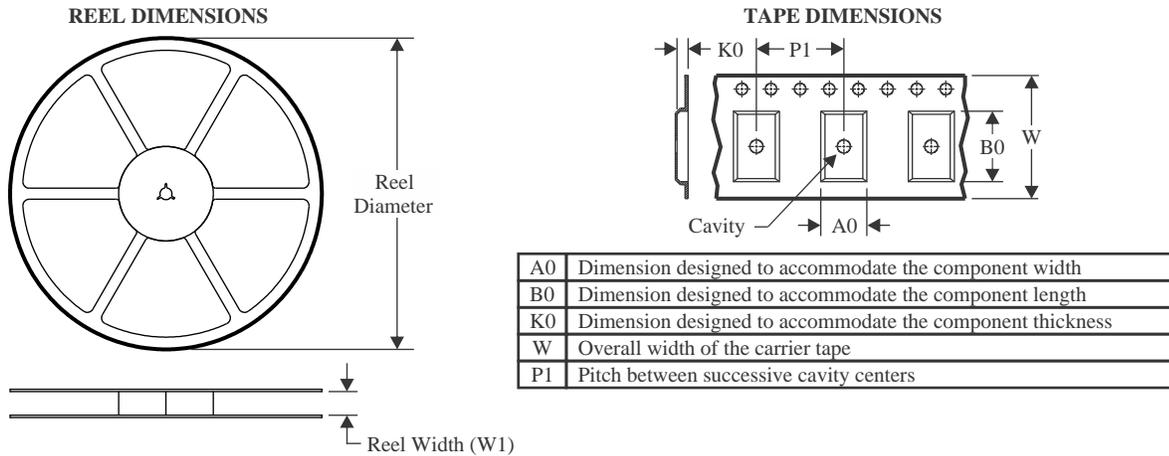
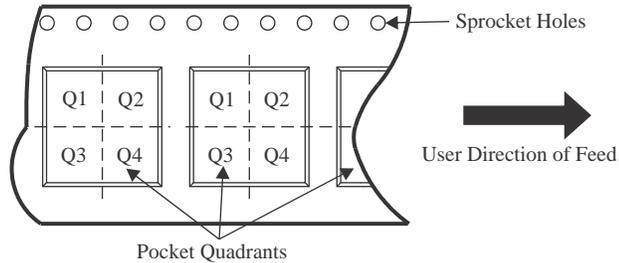
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will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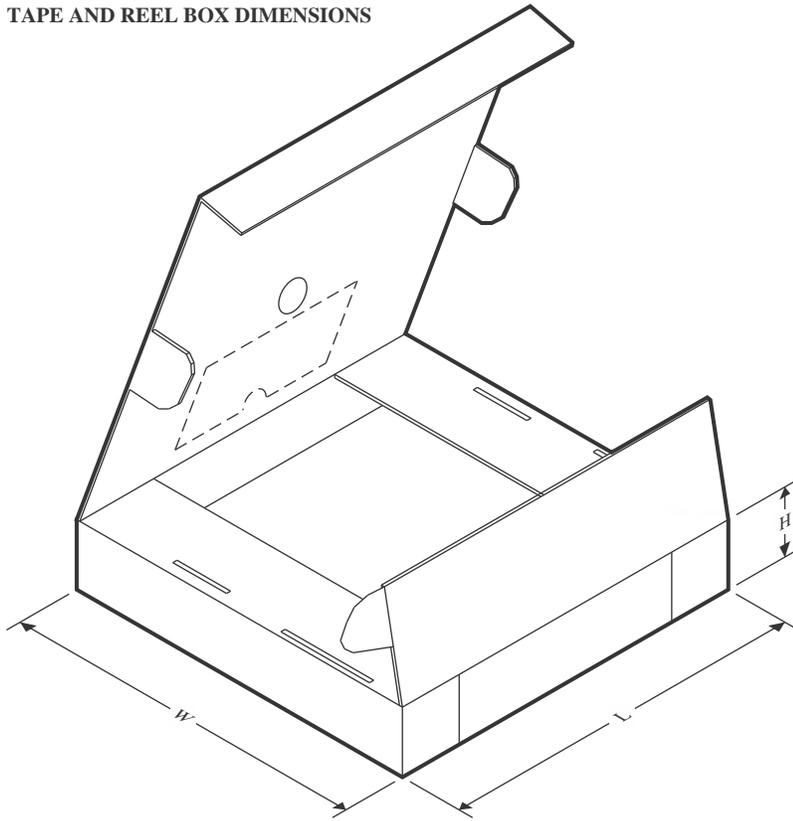
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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

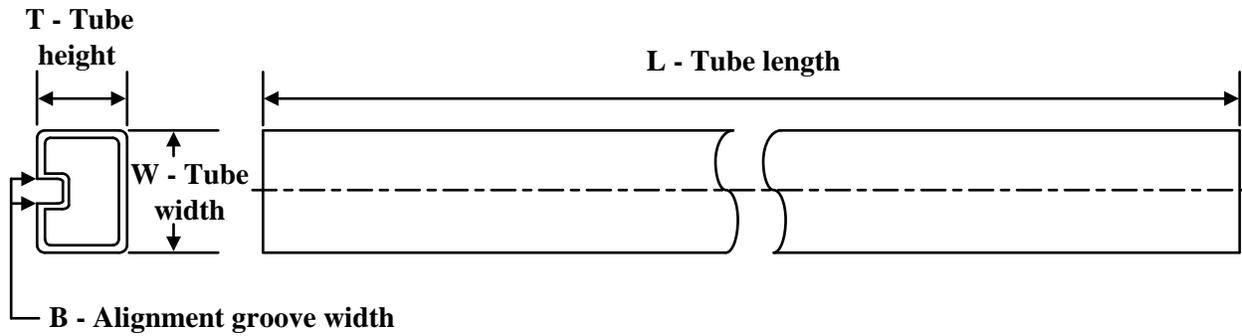
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD4543BM96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD4543BNSR	SOP	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
CD4543BPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



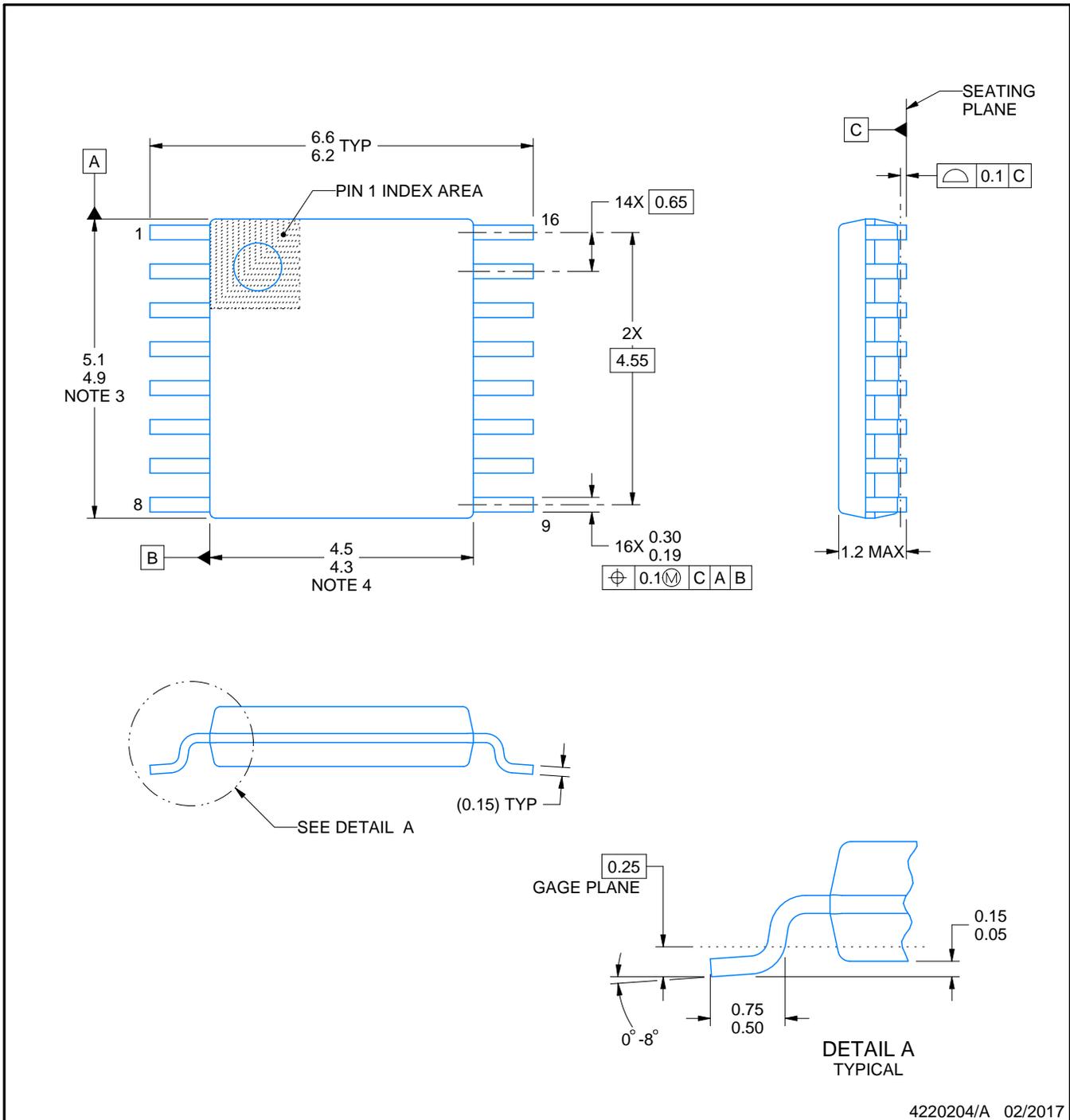
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD4543BM96	SOIC	D	16	2500	353.0	353.0	32.0
CD4543BNSR	SOP	NS	16	2000	356.0	356.0	35.0
CD4543BPWR	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)
CD4543BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4543BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4543BE.A	N	PDIP	16	25	506	13.97	11230	4.32
CD4543BE.A	N	PDIP	16	25	506	13.97	11230	4.32
CD4543BEE4	N	PDIP	16	25	506	13.97	11230	4.32
CD4543BEE4	N	PDIP	16	25	506	13.97	11230	4.32



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NOTES:

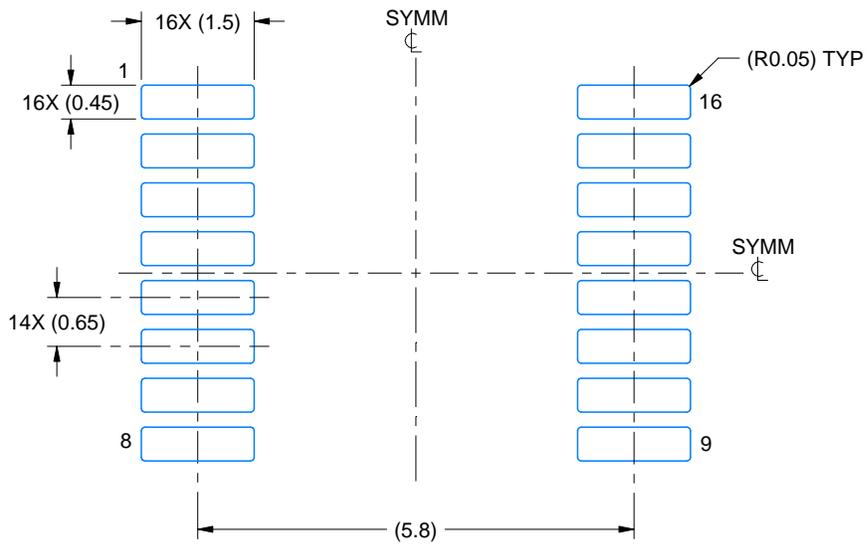
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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

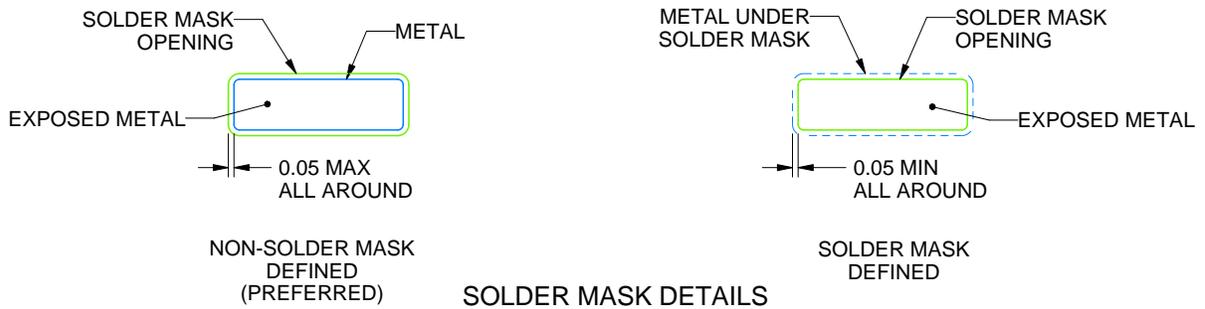
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



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NOTES: (continued)

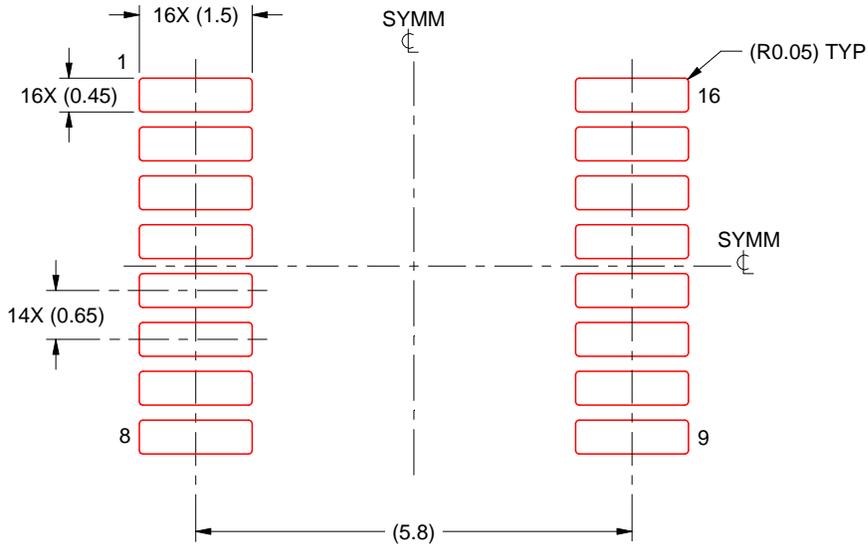
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

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NOTES: (continued)

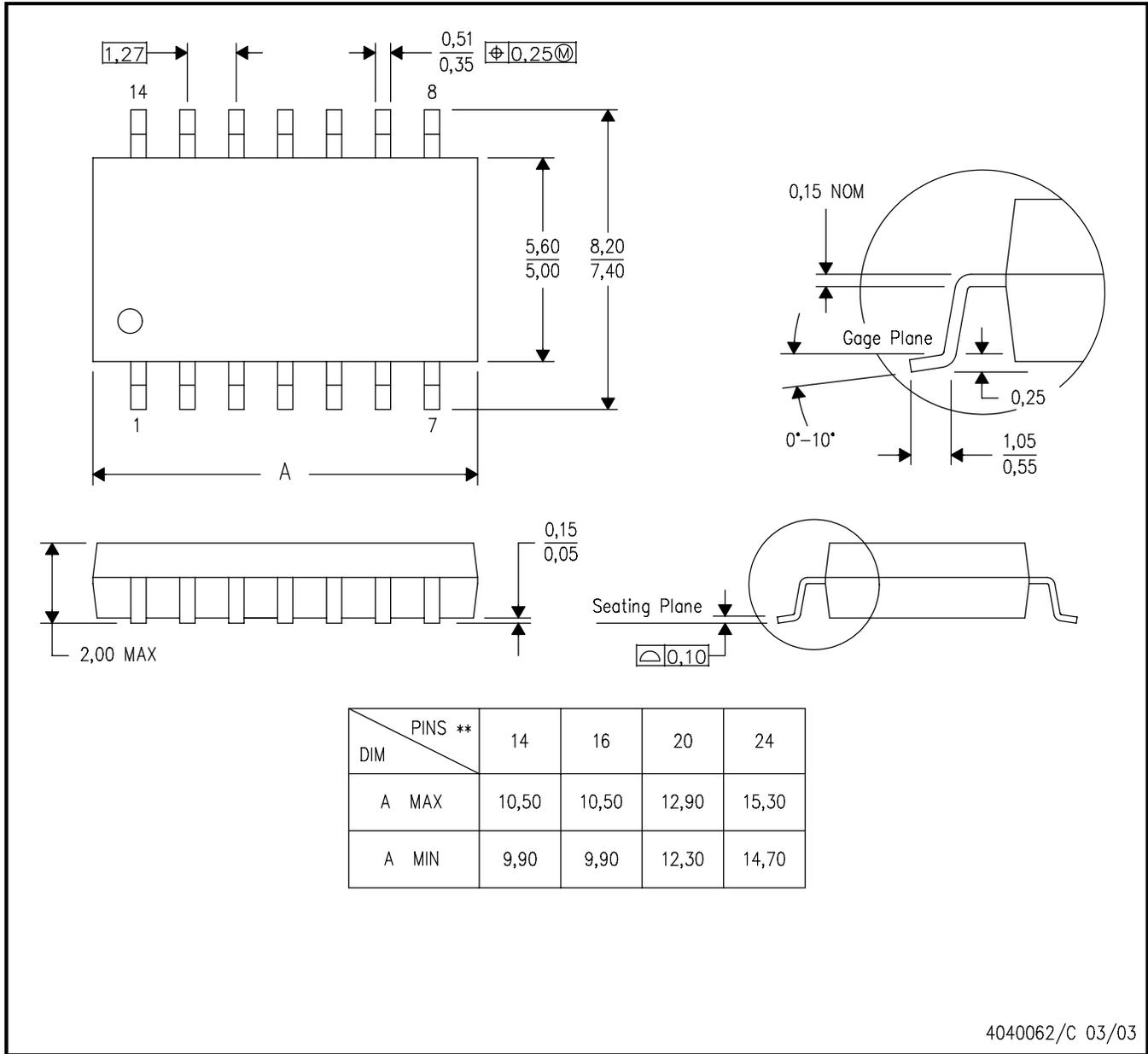
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- 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.

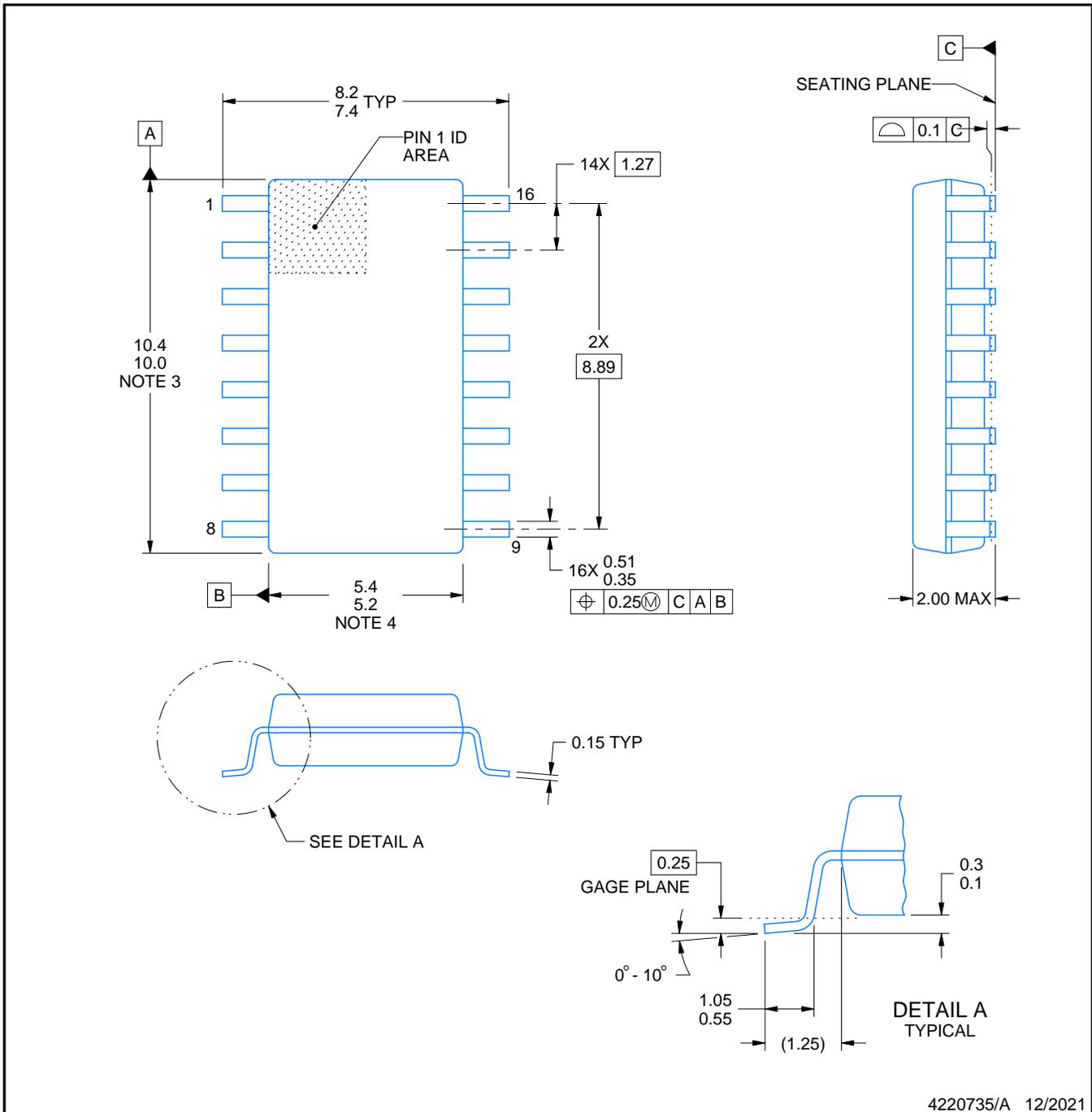


PACKAGE OUTLINE

NS0016A

SOP - 2.00 mm max height

SOP



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NOTES:

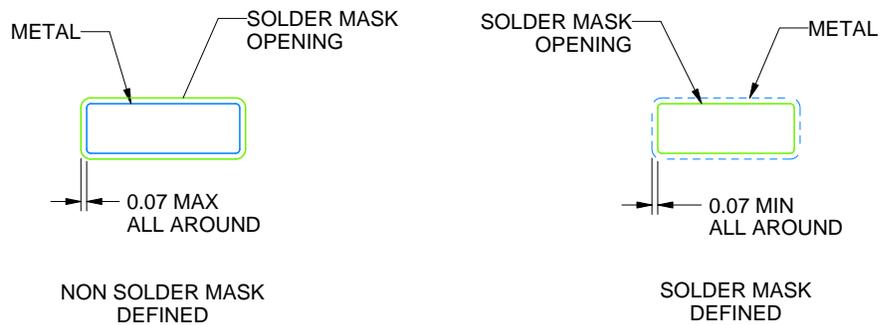
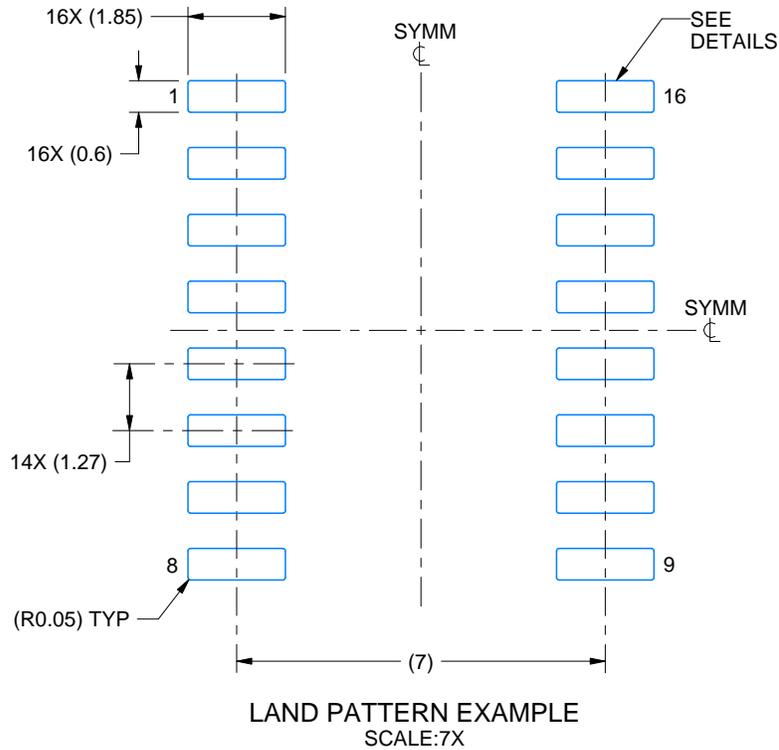
- All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
- This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.

EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER MASK DETAILS

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NOTES: (continued)

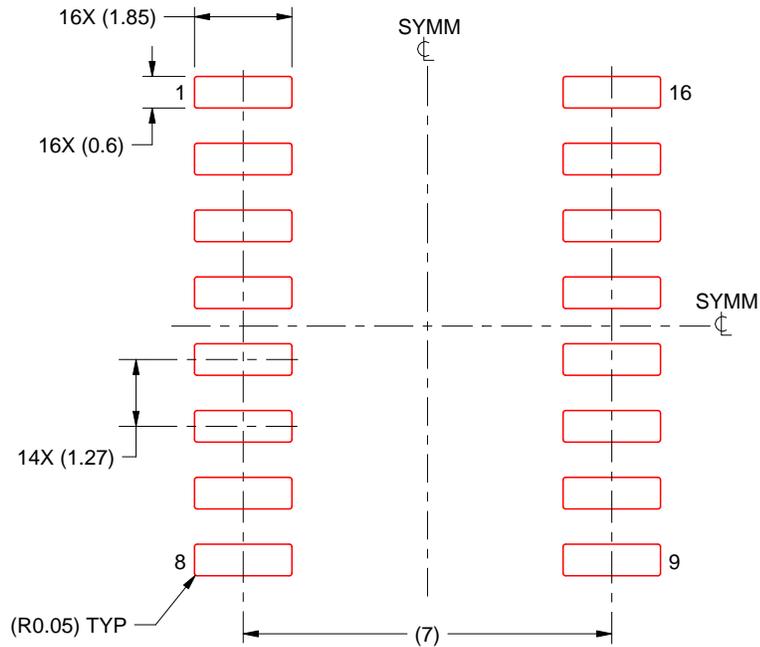
- 5. Publication IPC-7351 may have alternate designs.
- 6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

NS0016A

SOP - 2.00 mm max height

SOP



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

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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.

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