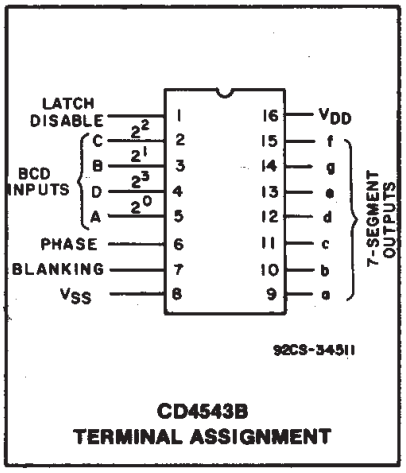
TEXAS INSTRUMENTS
Data sheet acquired from Harris Semiconductor
SCHS086D – Revised April 2004

CD4543B Types

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 TERMINAL ASSIGNMENT

■ 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).

- *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

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC SUPPLY-VOLTAGE RANGE, (V_{DD})
(Voltages referenced to V_{SS} Terminal) ..... -0.5V to +20V
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 Linearity 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

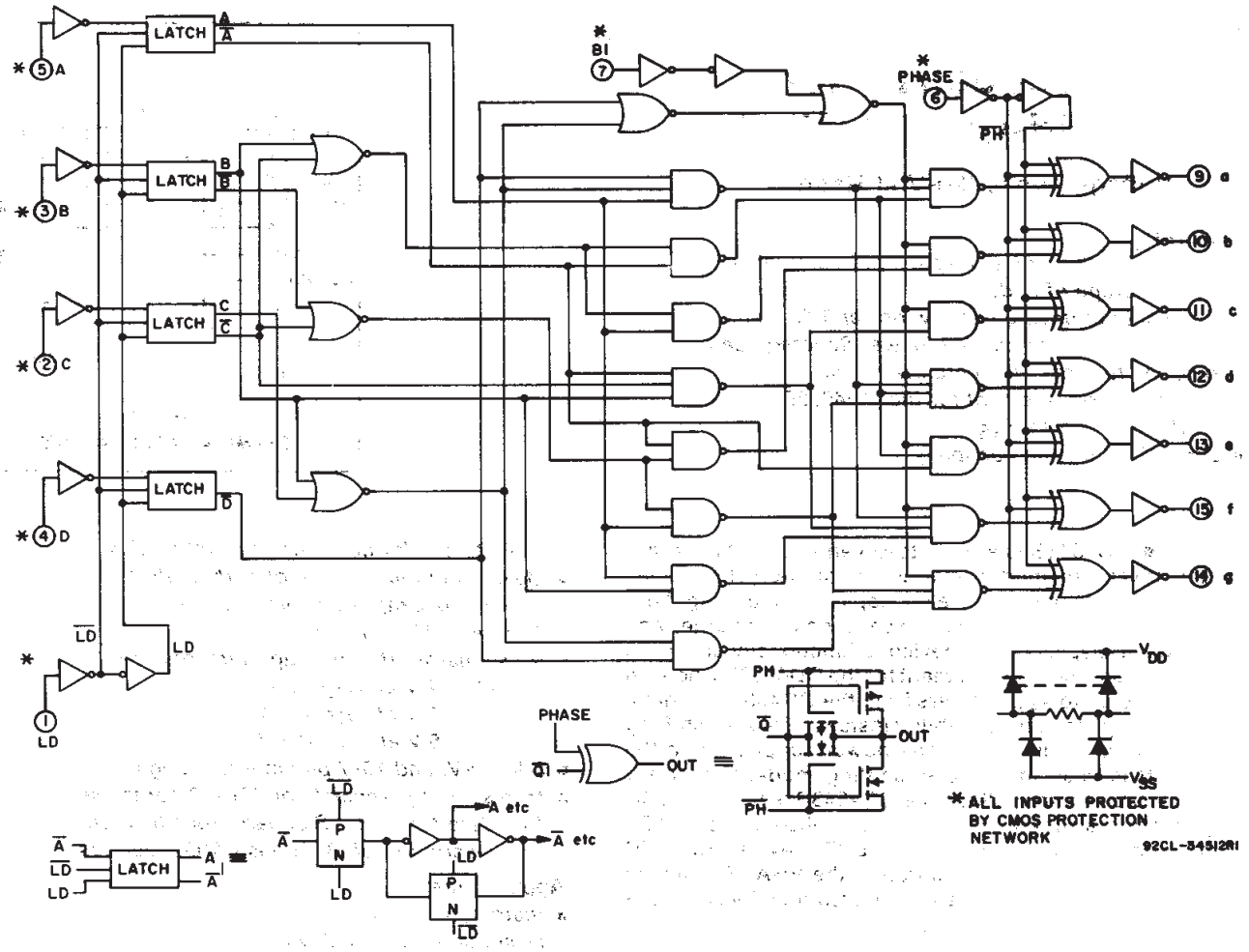


Fig. 1 - BCD-to-seven-segment latch/decoder/driver CD4543B logic circuit diagram.

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

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.	+25 Typ.	+25 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	—	
		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	—	
		—	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	—	—	
		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

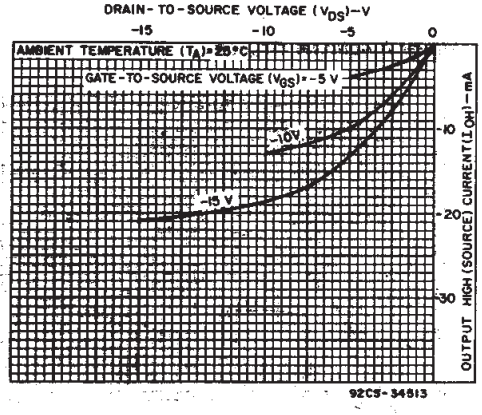


Fig. 2 – Typical output high (source) current characteristics.

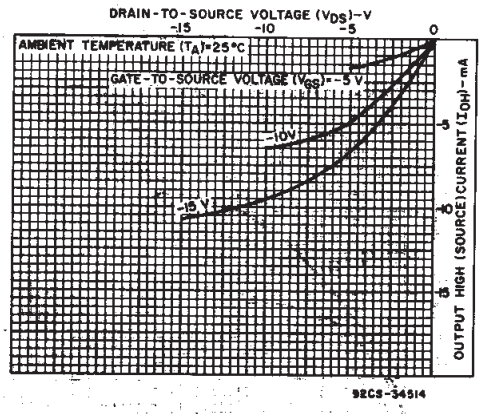


Fig. 3 – Minimum output high (source) current characteristics.

DYNAMIC ELECTRICAL CHARACTERISTICS at T_A=25° C; C_L=50 pF, Input t_r,t_f=20 ns, R_L=200 kΩ

CHARACTERISTIC		TEST CONDITIONS V_{DD} (V)	LIMITS All Packages MIN.	TYP.	MAX.	UNITS
Propagation Delay Time	t_{PHL}	5	—	600	1200	ns
		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

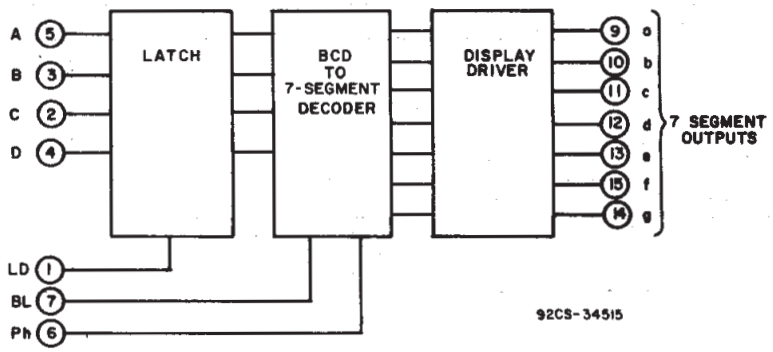


Fig. 4 - BCD-to-seven-segment latch/decoder/driver functional diagram.

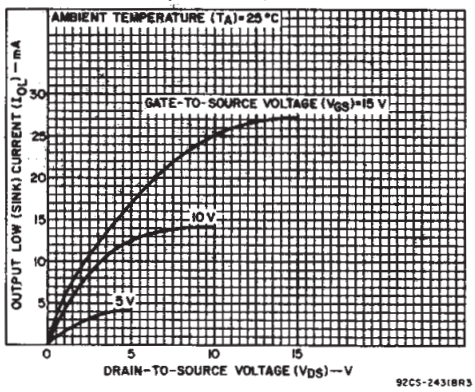


Fig. 5 - Typical output low (sink) current characteristics.

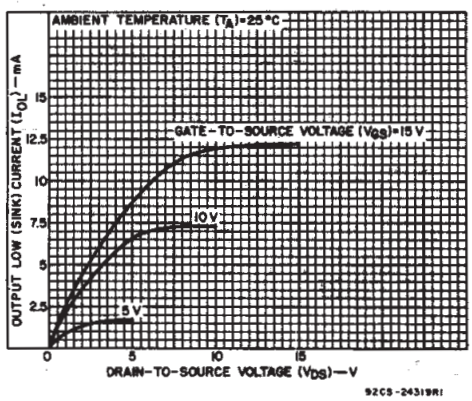


Fig. 6 - Minimum output low (sink) current characteristics.

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	
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	1
1	0	0	0	0	1	0	1	1	0	1	1	0	1	2
1	0	0	0	0	1	1	1	1	1	1	0	0	1	3
1	0	0	0	1	0	0	0	1	1	0	0	1	1	4
1	0	0	0	1	0	1	1	0	1	1	0	1	1	5
1	0	0	0	1	1	0	1	0	1	1	1	1	1	6
1	0	0	0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	0	0	1	1	1	1	1	0	1	1	9
1	0	0	1	0	1	0	0	0	0	0	0	0	0	Blank
1	0	0	1	0	1	1	0	0	0	0	0	0	0	Blank
1	0	0	1	1	0	0	0	0	0	0	0	0	0	Blank
1	0	0	1	1	0	1	0	0	0	0	0	0	0	Blank
1	0	0	1	1	1	0	0	0	0	0	0	0	0	Blank
1	0	0	1	1	1	1	0	0	0	0	0	0	0	Blank
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.

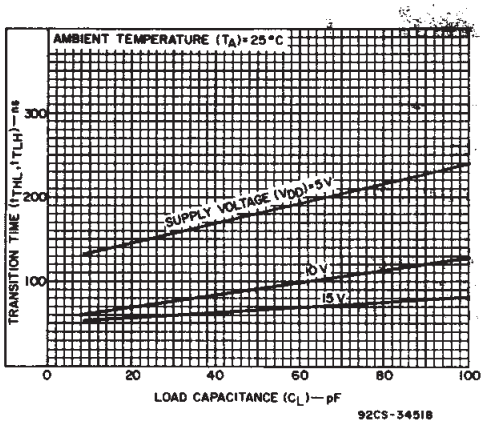


Fig. 7 - Typical transition time as a function of load capacitance.

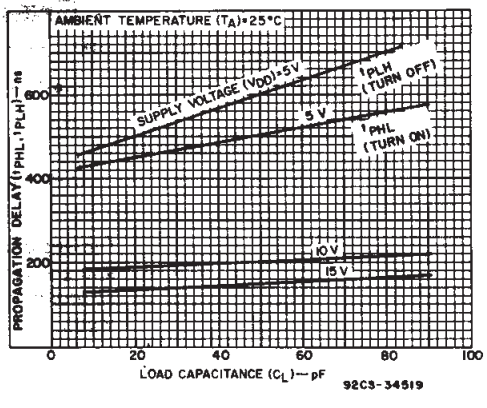


Fig. 8 - Typical propagation delay time as a function of load capacitance.

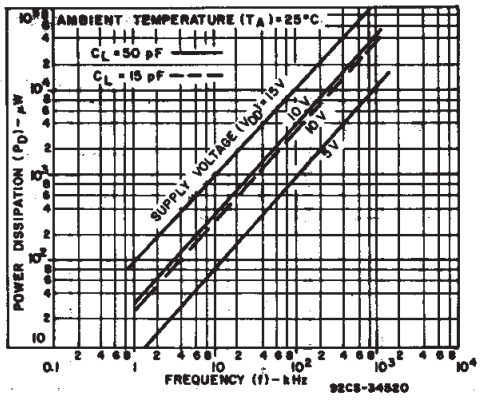


Fig. 9 – Typical dynamic power dissipation as a function of frequency.

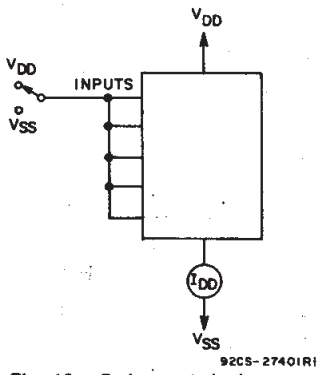


Fig. 10 – Quiescent device current test circuit.

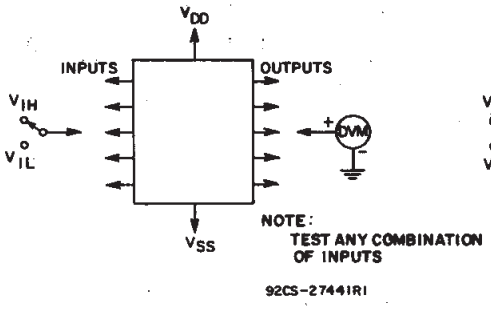


Fig. 11 – Input voltage test circuit.

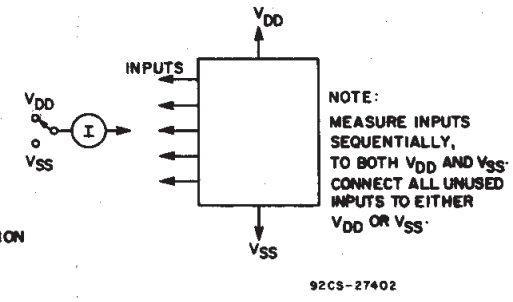
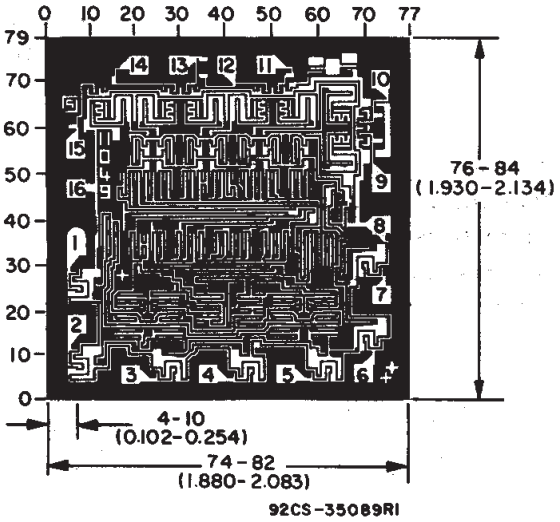


Fig. 12 – Input current test circuit.



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.

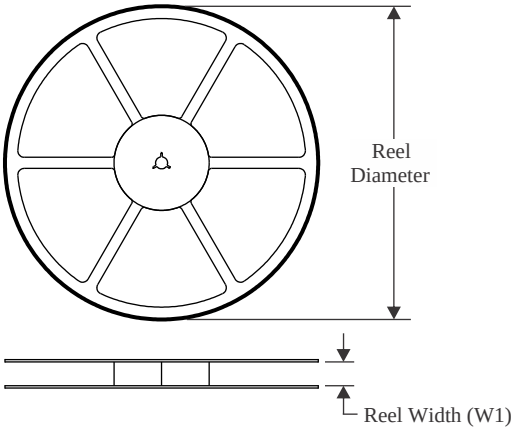
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will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

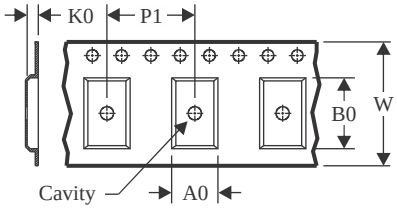
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

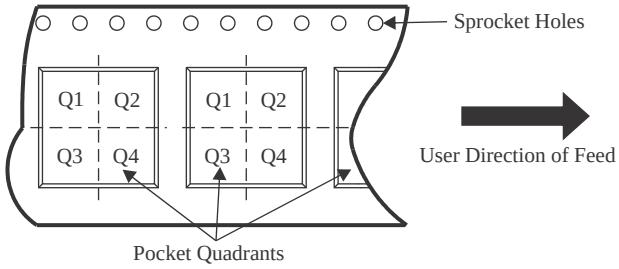


TAPE DIMENSIONS



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

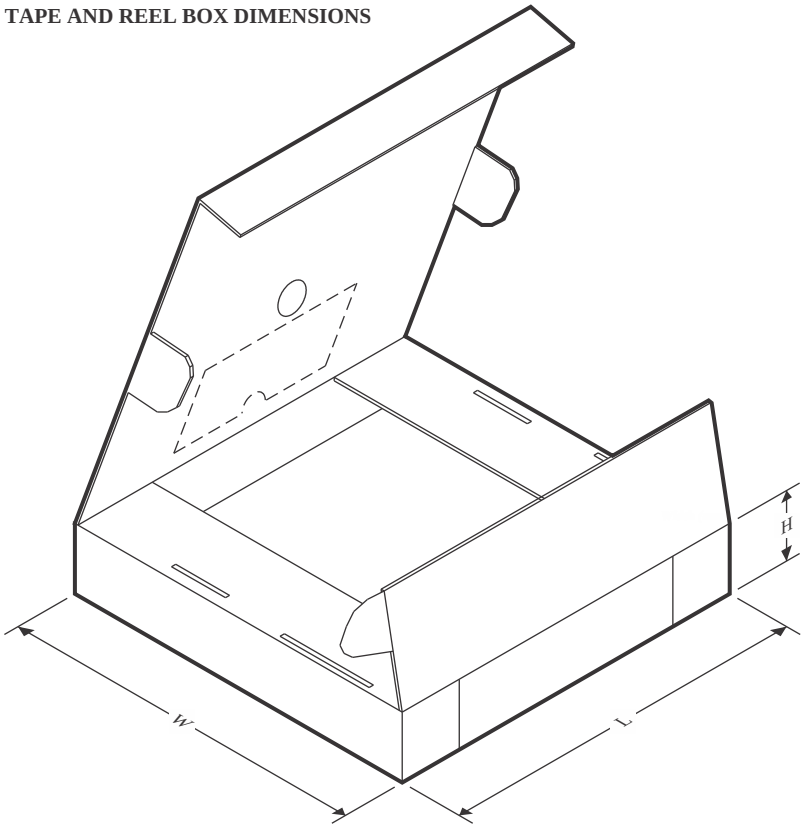
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
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	8.1	10.4	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

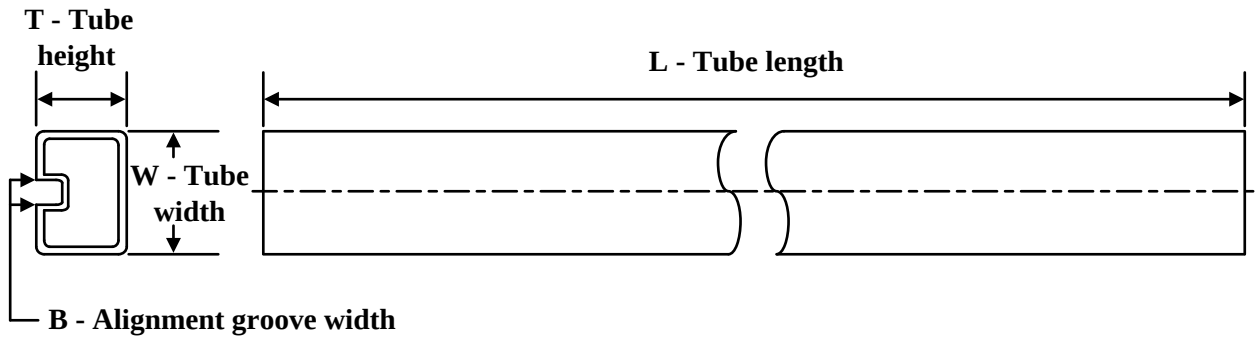
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

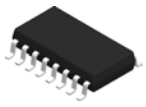
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD4543BM96	SOIC	D	16	2500	353.0	353.0	32.0
CD4543BNSR	SOP	NS	16	2000	353.0	353.0	32.0
CD4543BPWR	TSSOP	PW	16	2000	353.0	353.0	32.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
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

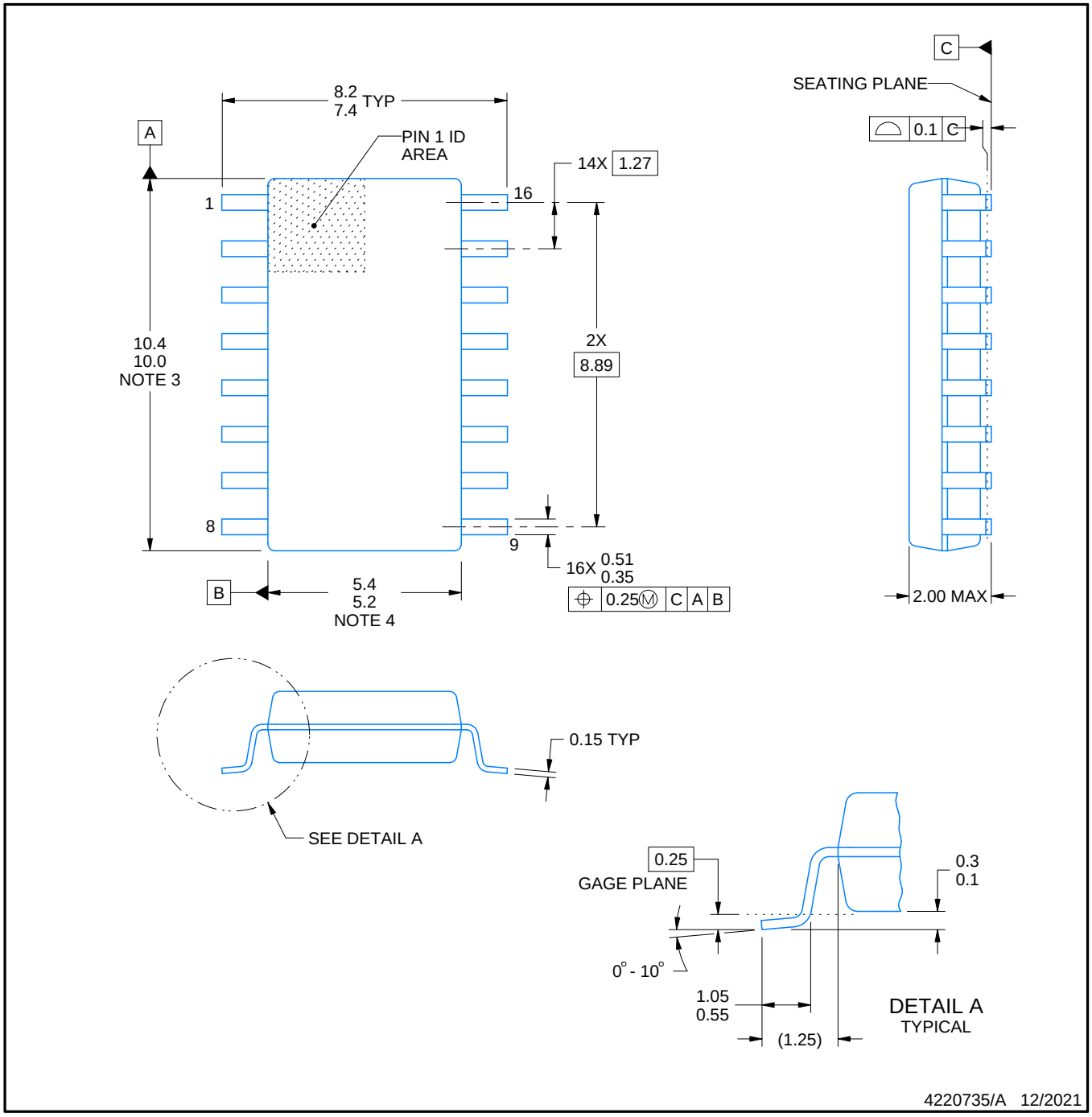


PACKAGE OUTLINE

NS0016A

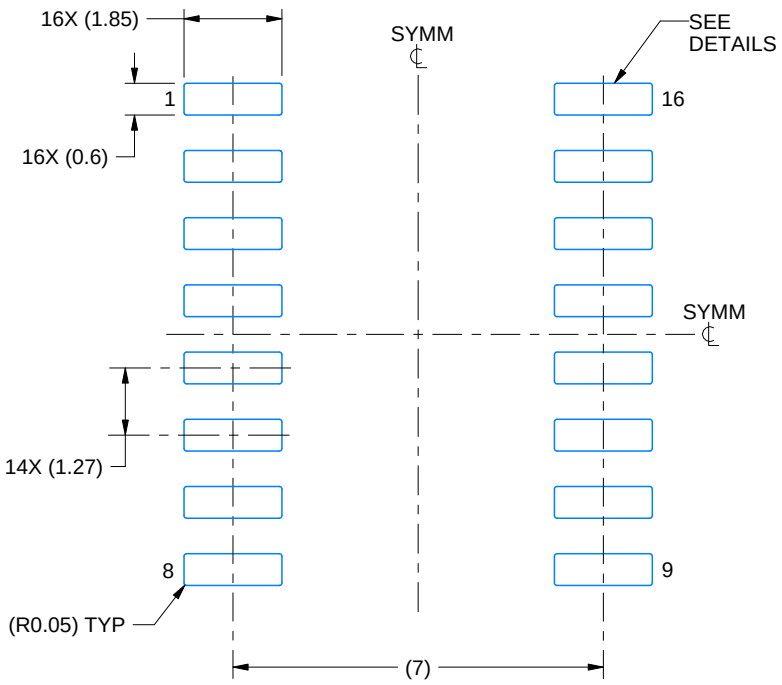
SOP - 2.00 mm max height

SOP

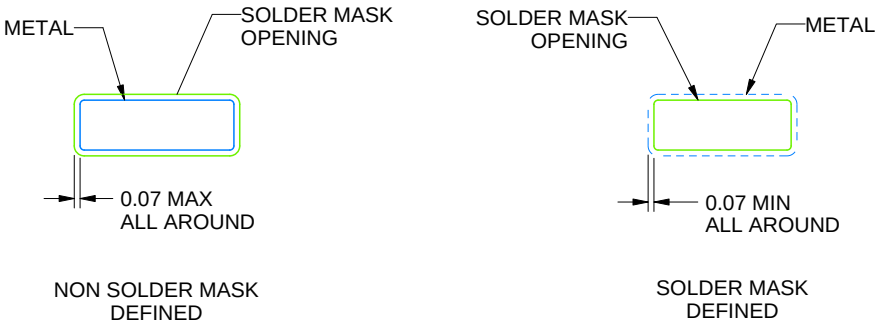


NOTES:

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

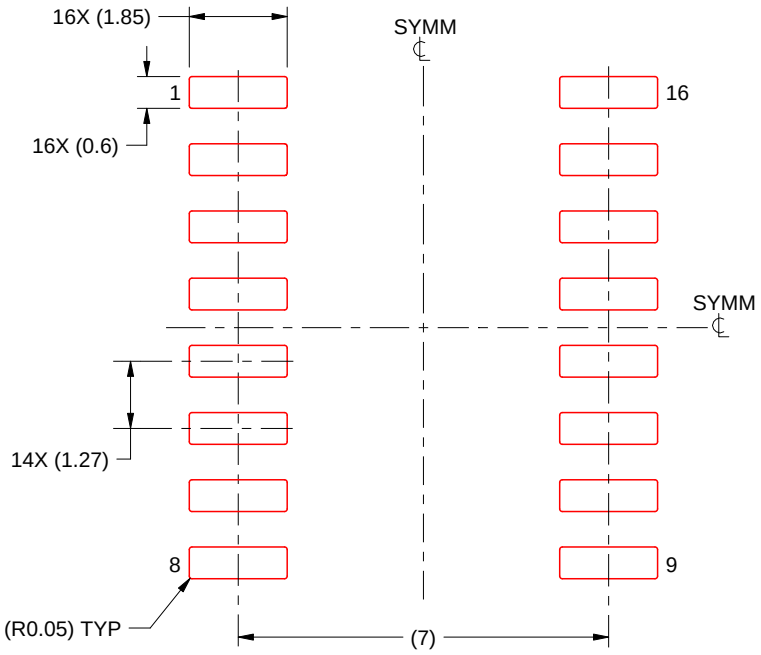
SOLDER MASK
DEFINED

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.



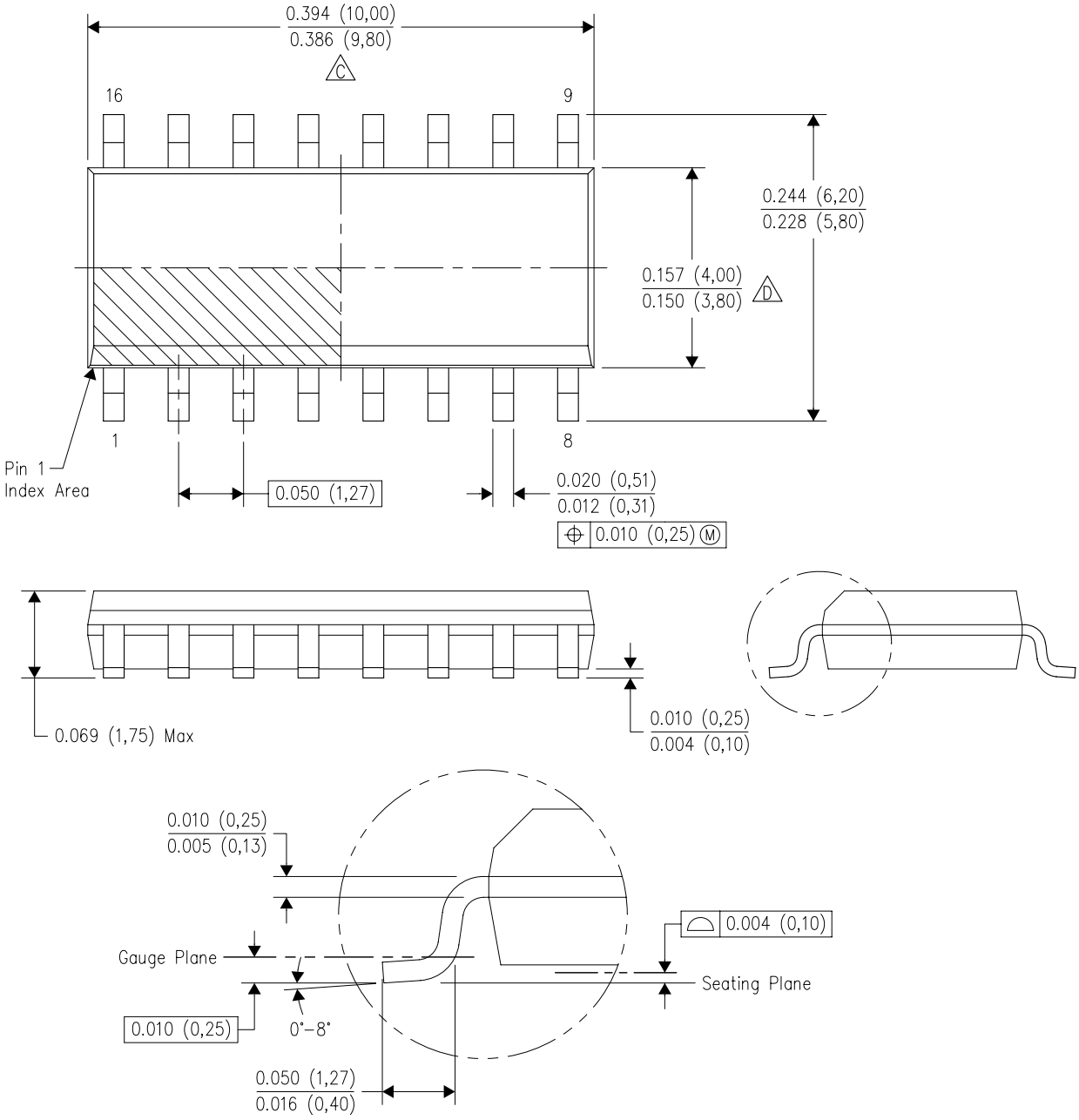
SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:7X

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



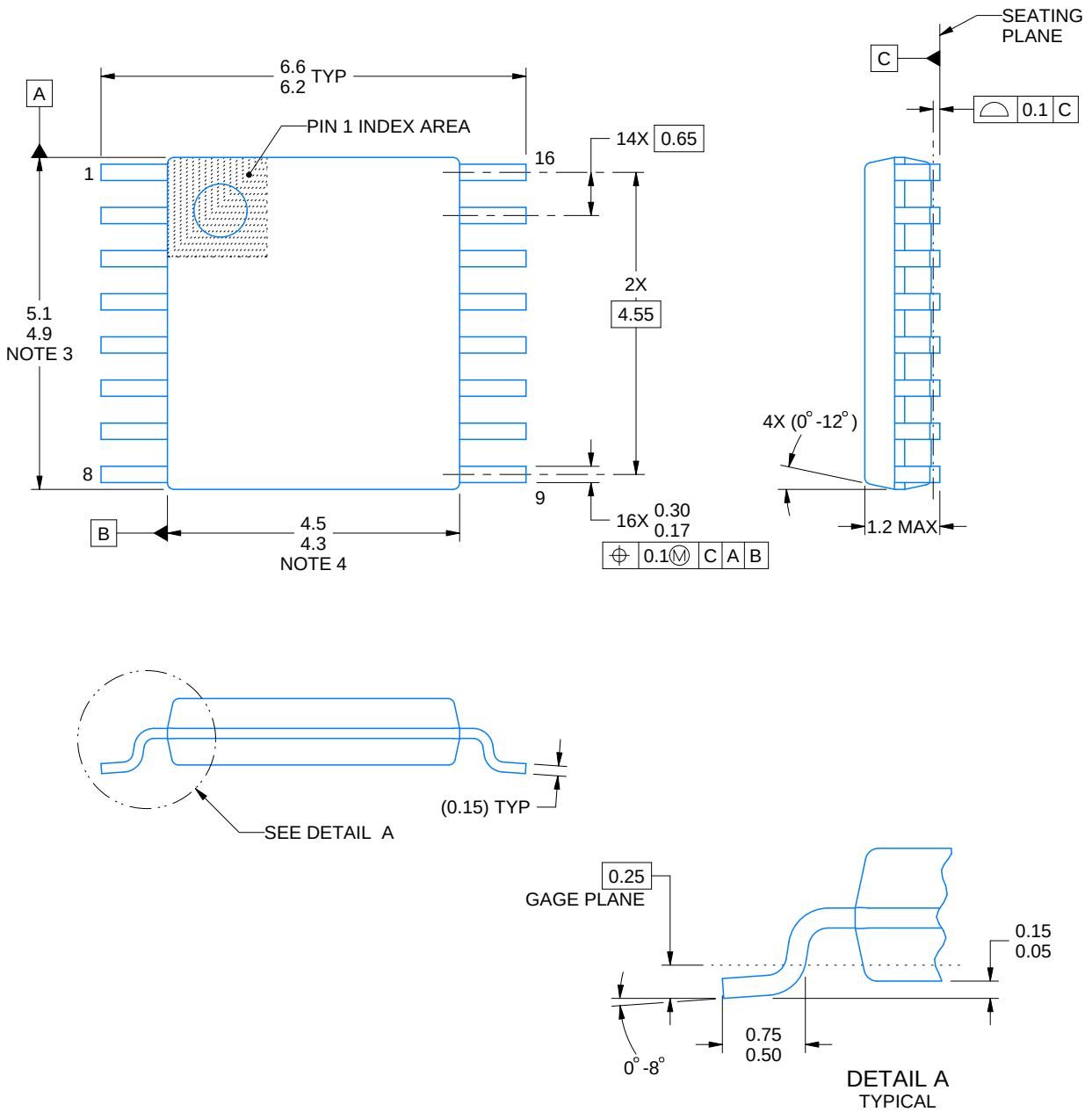
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AC.

PACKAGE OUTLINE

PW0016A

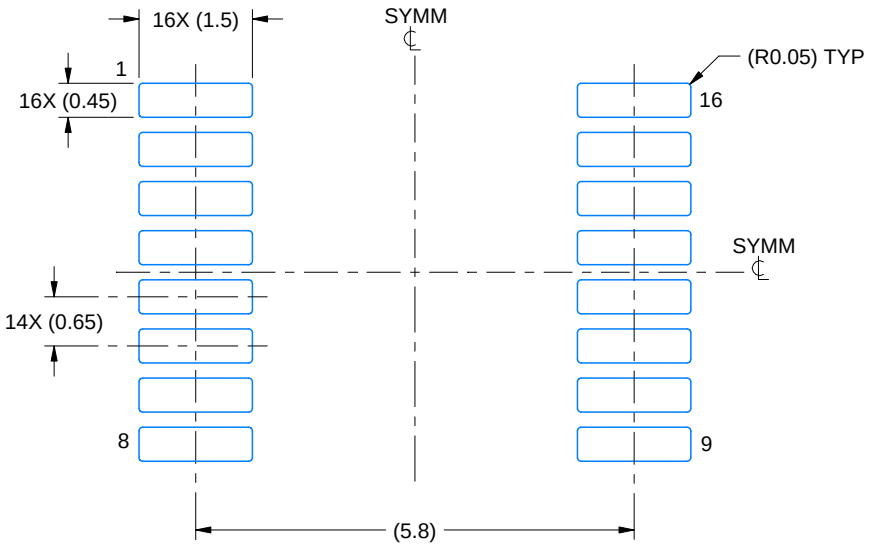
TSSOP - 1.2 mm max height

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.



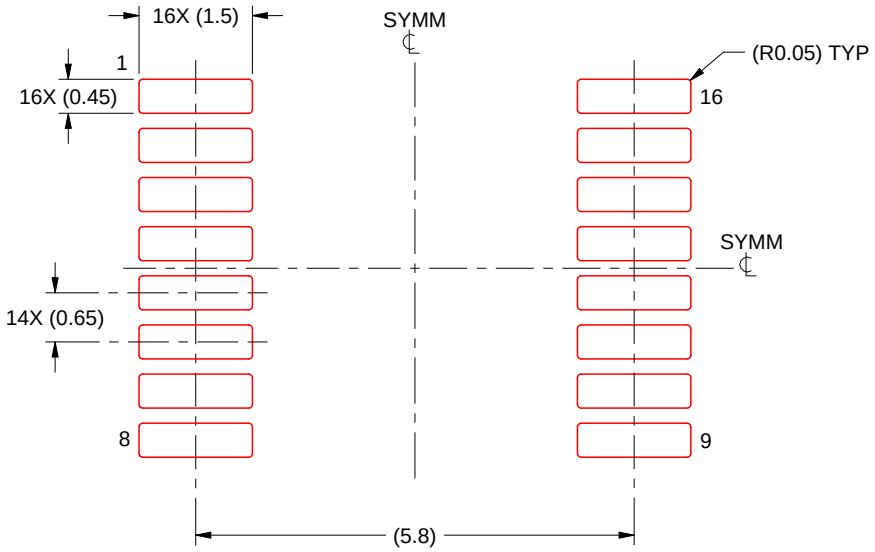
LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X

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

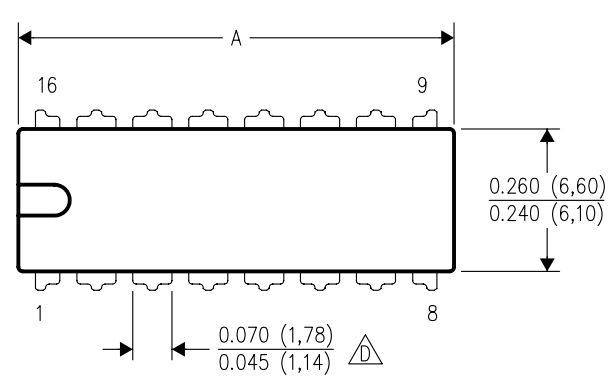
NOTES: (continued)

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.

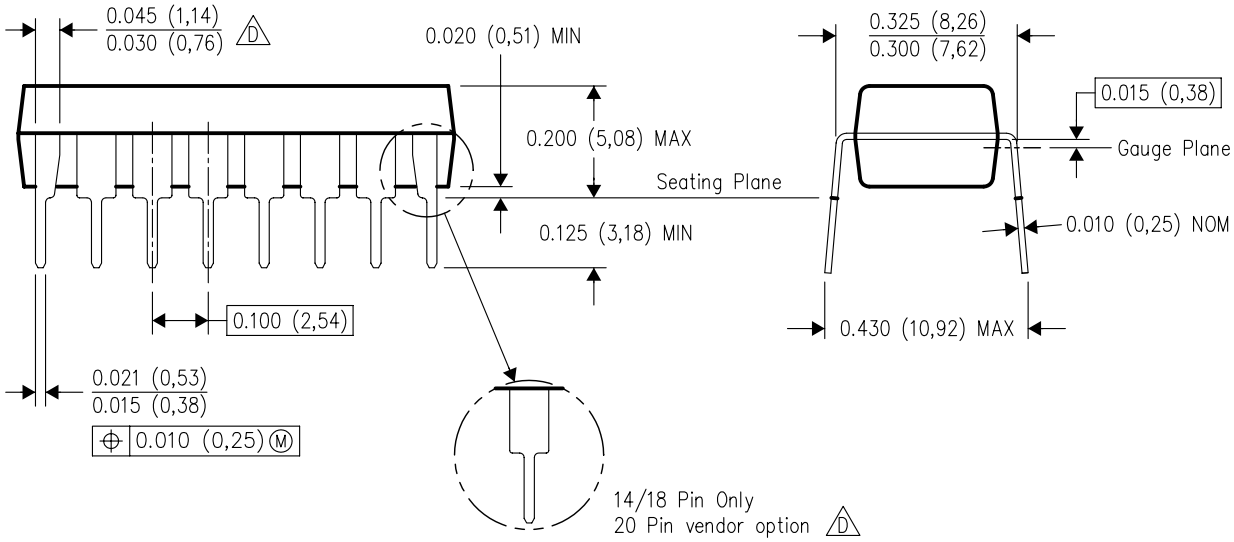
N (R–PDIP–T**)

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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