

TERMINAL ASSIGNMENT

CMOS Hex Voltage-Level Shifter for TTL-to-CMOS or CMOS-to-CMOS Operation

High-Voltage Types (20-Volt Rating)

Features:

- Independence of power-supply sequence considerations— V_{CC} can exceed V_{DD} ; input signals can exceed both V_{CC} and V_{DD}
- Up and down level-shifting capability
- Shiftable input threshold for either CMOS or TTL compatibility
- Standardized symmetrical output characteristics
- 100% tested for quiescent current @ 20 V
- Maximum input current of 1 μ A at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- 5 V, 10 V, and 15 V parametric ratings
- Meets all requirements of JEDEC Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

■ CD4504B hex voltage level-shifter consists of six circuits which shift input signals from the V_{CC} logic level to the V_{DD} logic level. To shift TTL signals to CMOS logic levels, the SELECT input is at the V_{CC} HIGH logic state. When the SELECT input is at a LOW logic state, each circuit translates signals from one CMOS level to another.

The CD4504B types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (M, M96, and MT suffixes), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

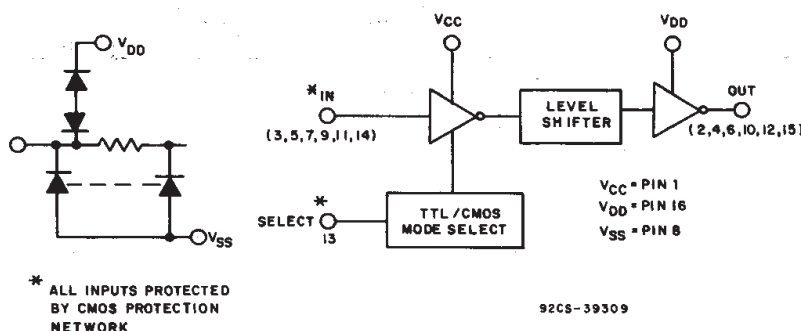


Fig. 1 - Functional diagram for CD4504B.

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_{CC} +0.5V

DC INPUT CURRENT, ANY ONE INPUT ± 10 mA

POWER DISSIPATION PER PACKAGE (P_D):

For $T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$ 500mW

For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$: Derate Linearly at 12mW/ $^\circ\text{C}$ to 200mW

DEVICE DISSIPATION PER OUTPUT TRANSISTOR -

FOR $T_A = \text{FULL PACKAGE-TEMPERATURE RANGE (All Package Types)}$ 100mW

OPERATING-TEMPERATURE RANGE (T_A) -55°C to $+125^\circ\text{C}$

STORAGE TEMPERATURE RANGE (T_{stg}) -85°C to $+150^\circ\text{C}$

LEAD TEMPERATURE (DURING SOLDERING):

At distance 1/16 \pm 1/32 inch (1.59 \pm 0.79mm) from case for 10s max $+265^\circ\text{C}$

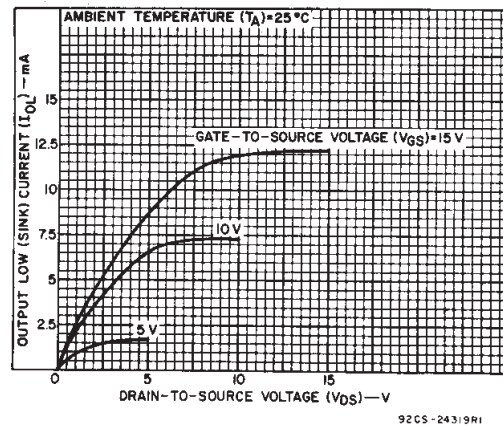
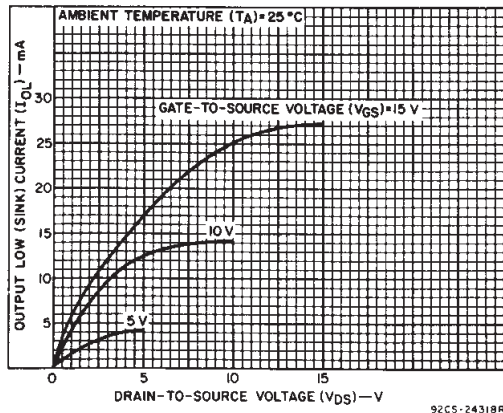
CD4504B Types

V_{GEN}

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC		CONDITIONS				LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
		V _O (V)	V _{IN} (V)	V _{CC} (V)	V _{DD} (V)	-55	-40	+85	+125	+25			
										MIN	TYP	MAX	
Quiescent Device Current, I _{DD} Max and I _{CC} in CMOS-CMOS Mode		—	0, 5	5	5	1.5	1.5	1.5	1.5	—	0.02	1.5	mA
		—	0, 10	5	10	2	2	2	2	—	0.02	2	
		—	0, 15	5	15	4	4	120	120	—	0.02	4	μA
		—	0, 20	5	20	20	20	600	600	—	0.04	20	
Quiescent Device Current, I _{CC} Max TTL-CMOS Mode		—	0, 5	5	5	5	5	6	6	—	2.5	5	mA
		—	0, 10	5	10	5	5	6	6	—	2.5	5	
		—	0, 15	5	15	5	5	6	6	—	2.5	5	
Output Low (Sink) Current, I _{OL} Min		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, I _{OH} Min		4.8	0, 5	—	5	-0.64	-0.61	-0.42	-0.36	-0.51	-1	—	mA
		2.5	0, 5	—	5	-2	-1.8	-1.3	-1.15	-1.6	-3.2	—	
		9.5	0, 10	—	10	-1.6	-1.5	-1.1	-0.9	-1.3	-2.6	—	
		13.5	0, 15	—	15	-4.2	-4	-2.8	-2.4	-3.4	-6.8	—	
Output Voltage: Low-Level, V _{OL} Max		—	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, V _{OH} Min		—	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, V _{IL} Max Note 1	TTL-CMOS	1	—	5	10	0.8				—	—	0.8	V
	TTL-CMOS	1	—	5	15	0.8				—	—	0.8	
	CMOS-CMOS	1	—	5	10	1.5				—	—	1.5	
	CMOS-CMOS	1.5	—	5	15	1.5				—	—	1.5	
	CMOS-CMOS	1.5	—	10	15	3				—	—	3	
Input High Voltage, V _{IH} Min Note 1	TTL-CMOS	9	—	5	10	2				2	—	—	V
	TTL-CMOS	13.5	—	5	15	2				2	—	—	
	CMOS-CMOS	9	—	5	10	3.5				3.5	—	—	
	CMOS-CMOS	13.5	—	5	15	3.5				3.5	—	—	
	CMOS-CMOS	13.5	—	10	15	7				7	—	—	
Input Current, I _{IN} Max		—	0, 18	—	18	±0.1	±0.1	±1	±1	—	±10 ⁻⁵	±0.1	μA

Note 1: Applies to the 6 input signals. For mode control (P13), only the CMOS-CMOS ratings apply.



CD4504B Types

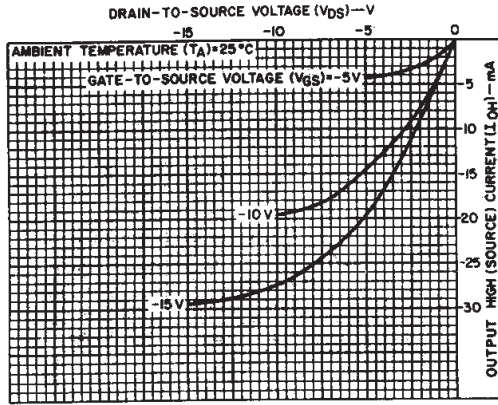


Fig. 4 - Typical output high (source) current characteristics.

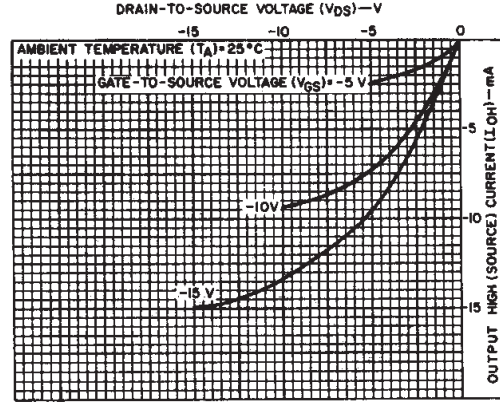


Fig. 5 - Minimum output high (source) current characteristics.

RECOMMENDED OPERATING CONDITIONS

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.	Max.	
Supply-Voltage Range (For T _A = Full Package-Temperature Range)	—	5	18	V

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

CHARACTERISTIC	SHIFTING MODE	VCC (V)	VDD (V)	LIMITS		UNITS
				TYP.	MAX.	
Propagation Delay: High-to-Low, <						

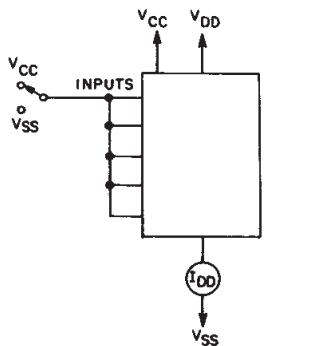


Fig. 6 - Quiescent device current.

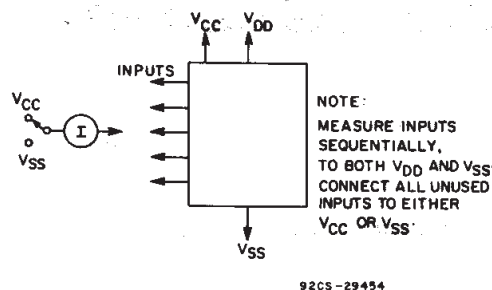


Fig. 7 - Input current.

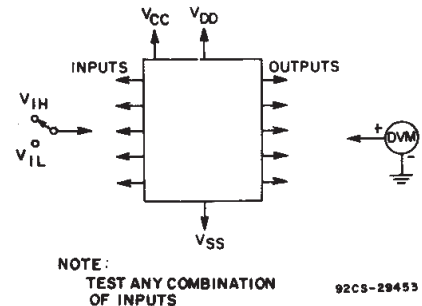


Fig. 8 - Input voltage.

CD4504B Types

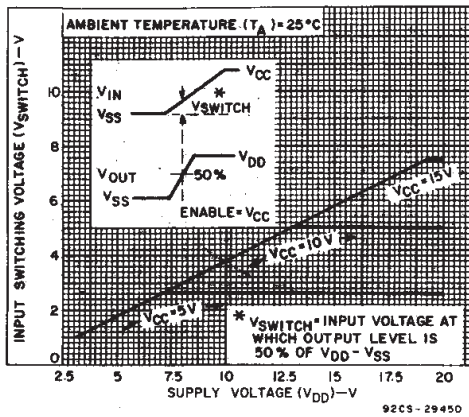


Fig. 9 - Typical input switching as a function of high-level supply voltage. (SELECT at V_{CC} -CMOS mode).

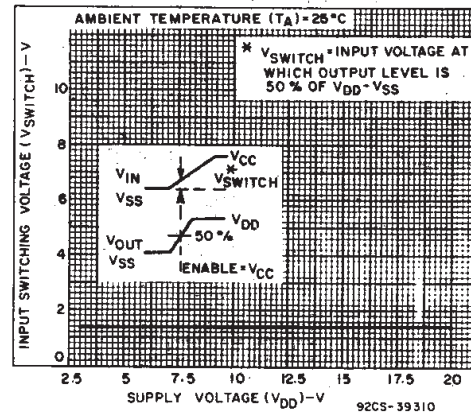


Fig. 10 - Typical input switching as a function of high-level supply voltage (SELECT at V_{SS} -TTL mode).

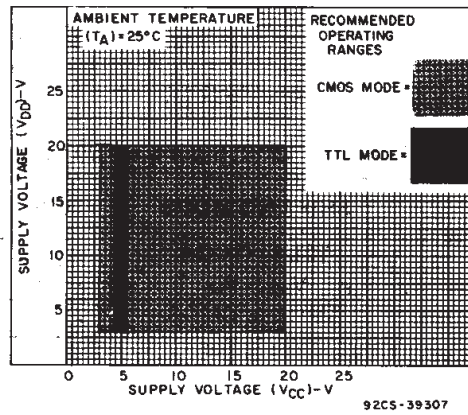
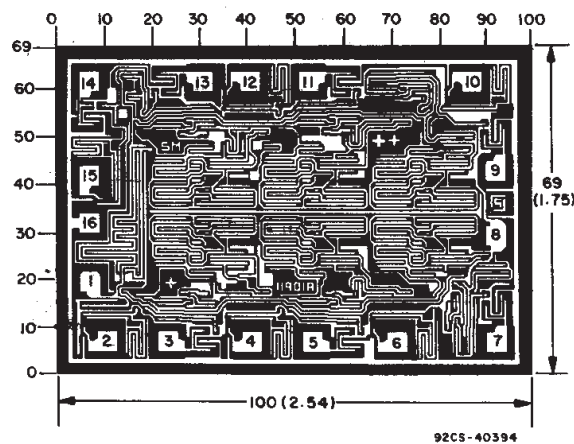


Fig. 11 - High-level supply voltage vs. low-level supply voltage.



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

Dimensions and pad layout for CD4504BH.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CD4504BE	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-55 to 125	CD4504BE	Samples
CD4504BEE4	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-55 to 125	CD4504BE	Samples
CD4504BF3A	ACTIVE	CDIP	J	16	25	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	CD4504BF3A	Samples
CD4504BM	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4504BM	Samples
CD4504BM96	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4504BM	Samples
CD4504BM96E4	ACTIVE	SOIC	D	16	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4504BM	Samples
CD4504BME4	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4504BM	Samples
CD4504BMG4	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4504BM	Samples
CD4504BMT	ACTIVE	SOIC	D	16	250	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4504BM	Samples
CD4504BPW	ACTIVE	TSSOP	PW	16	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM504B	Samples
CD4504BPWE4	ACTIVE	TSSOP	PW	16	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM504B	Samples
CD4504BPWR	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM504B	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBsolete: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

- (3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.
- (5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.
- (6) Lead finish/Ball material - Orderable Devices 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.

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OTHER QUALIFIED VERSIONS OF CD4504B, CD4504B-MIL :

- Catalog : [CD4504B](#)
- Enhanced Product : [CD4504B-EP](#), [CD4504B-EP](#)
- Military : [CD4504B-MIL](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION



*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
CD4504BM96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD4504BPWR	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)
CD4504BM96	SOIC	D	16	2500	340.5	336.1	32.0
CD4504BPWR	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)
CD4504BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4504BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4504BEE4	N	PDIP	16	25	506	13.97	11230	4.32
CD4504BEE4	N	PDIP	16	25	506	13.97	11230	4.32
CD4504BM	D	SOIC	16	40	507	8	3940	4.32
CD4504BME4	D	SOIC	16	40	507	8	3940	4.32
CD4504BMG4	D	SOIC	16	40	507	8	3940	4.32
CD4504BPW	PW	TSSOP	16	90	530	10.2	3600	3.5
CD4504BPWE4	PW	TSSOP	16	90	530	10.2	3600	3.5

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE

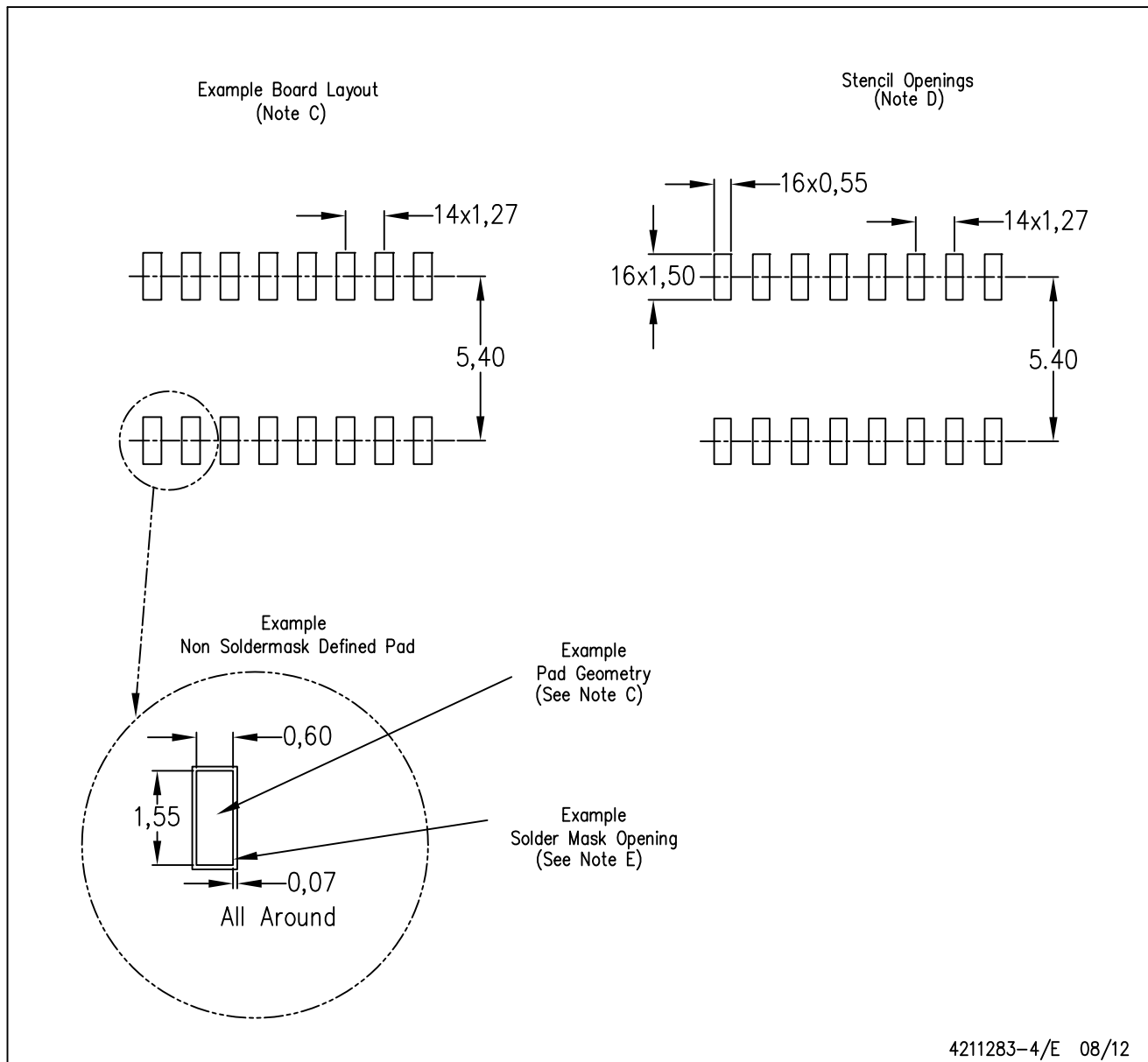


NOTES:

- 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.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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NOTES:

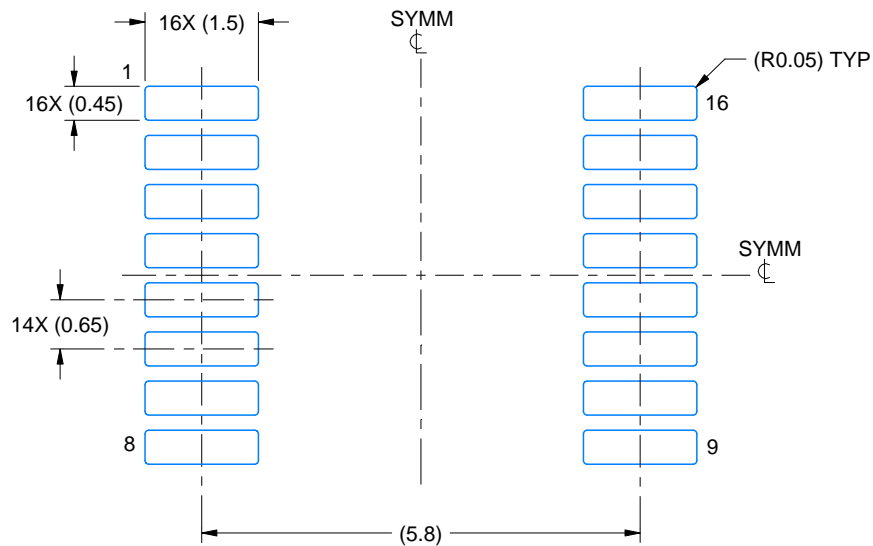
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

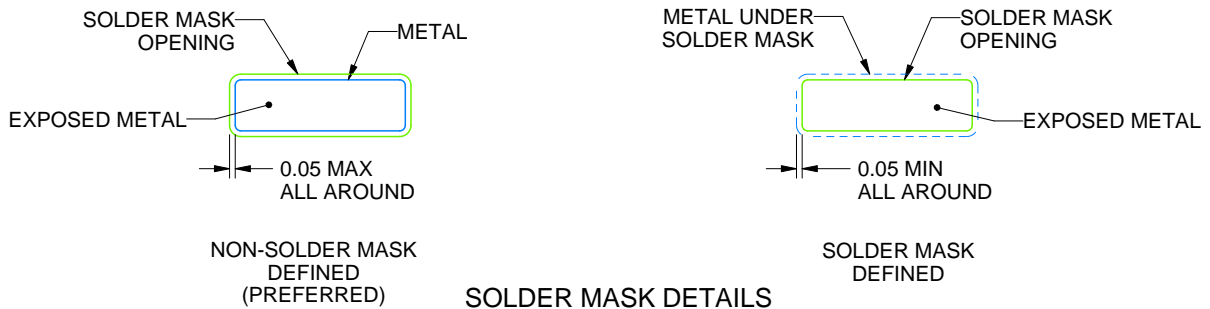
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



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NOTES: (continued)

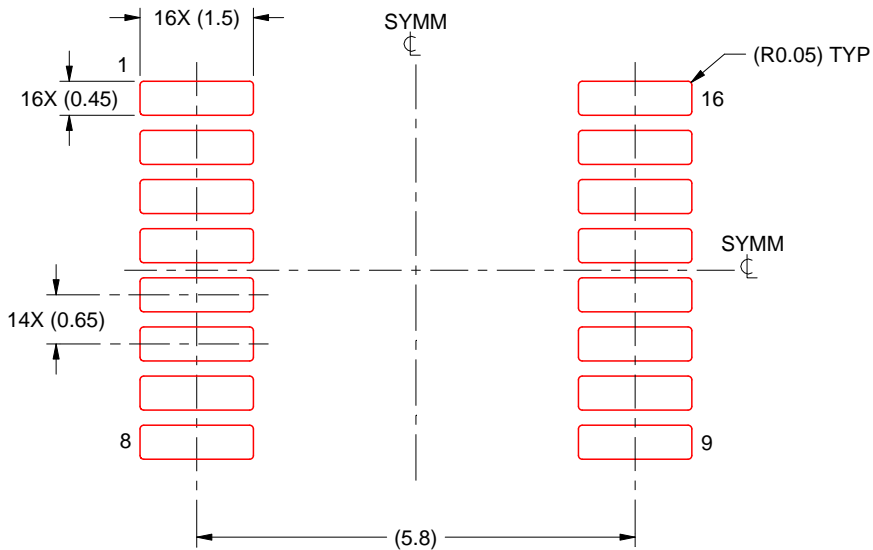
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

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.

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	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.

N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



PINS **	14	16	18	20
DIM				
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	AA	BB	AC	AD



14/18 Pin Only
20 Pin vendor option

4040049/E 12/2002

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

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