

**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  $\mu$ 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).

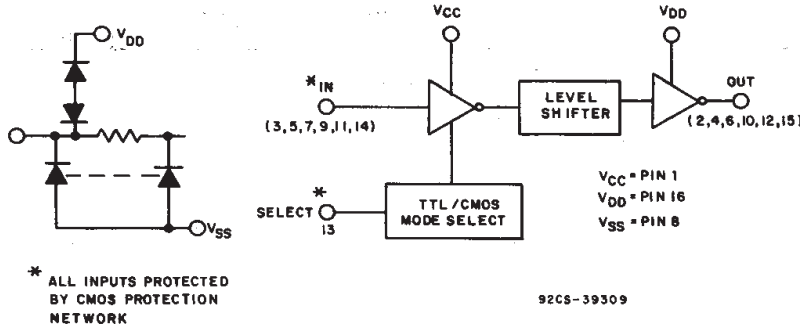


Fig. 1 - Functional diagram for CD4504B.

**MAXIMUM RATINGS, Absolute-Maximum Values:**

<b>DC SUPPLY-VOLTAGE RANGE, (<math>V_{DD}</math>)</b>	
Voltages referenced to $V_{SS}$ Terminal	-0.5V to +20V
<b>INPUT VOLTAGE RANGE, ALL INPUTS</b>	
	-0.5V to $V_{CC} + 0.5V$
<b>DC INPUT CURRENT, ANY ONE INPUT</b>	
	$\pm 10mA$
<b>POWER DISSIPATION PER PACKAGE (<math>P_D</math>):</b>	
For $T_A = -55^\circ C$ to $+100^\circ C$	500mW
For $T_A = +100^\circ C$ to $+125^\circ C$ :	Derate Linearly at 12mW/ $^\circ C$ to 200mW
<b>DEVICE DISSIPATION PER OUTPUT TRANSISTOR -</b>	
FOR $T_A =$ FULL PACKAGE-TEMPERATURE RANGE (All Package Types)	100mW
<b>OPERATING-TEMPERATURE RANGE (<math>T_A</math>)</b>	
	$-55^\circ C$ to $+125^\circ C$
<b>STORAGE TEMPERATURE RANGE (<math>T_{stg}</math>)</b>	
	$-85^\circ C$ to $+150^\circ C$
<b>LEAD TEMPERATURE (DURING SOLDERING):</b>	
At distance 1/16 $\pm$ 1/32 inch (1.59 $\pm$ 0.79mm) from case for 10s max	+265°C

3  
COMMERCIAL CMOS  
HIGH VOLTAGE ICs

# CD4504B Types

V<sub>GEN</sub>

## STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS				LIMITS AT INDICATED TEMPERATURES (°C)							UNITS	
	V <sub>O</sub> (V)	V <sub>IN</sub> (V)	V <sub>CC</sub> (V)	V <sub>DD</sub> (V)	-55	-40	+85	+125	+25				
									MIN	TYP	MAX		
Quiescent Device Current, I <sub>DD</sub> Max and I <sub>CC</sub> 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 <sub>CC</sub> 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 <sub>OL</sub> 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 <sub>OH</sub> Min	4.6	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 <sub>OL</sub> 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 <sub>OH</sub> Min	—	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, V <sub>IL</sub> 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 <sub>IH</sub> 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 <sub>IN</sub> Max	—	0,18	—	18	±0.1	±0.1	±1	±1	—	±10 <sup>-5</sup>	±0.1	μA	

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

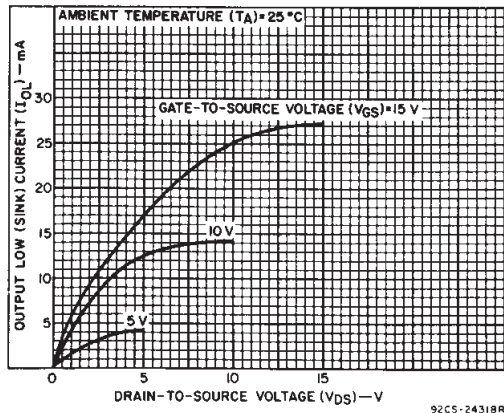


Fig. 2 - Typical output low (sink) current characteristics.

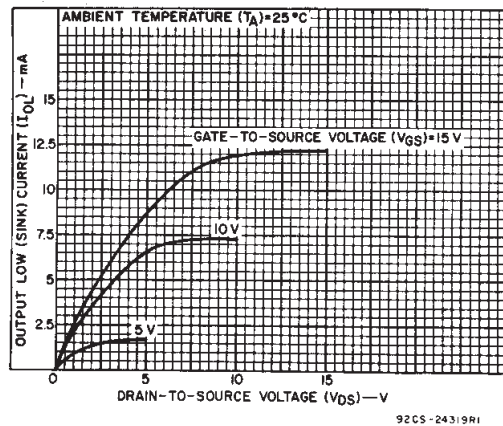
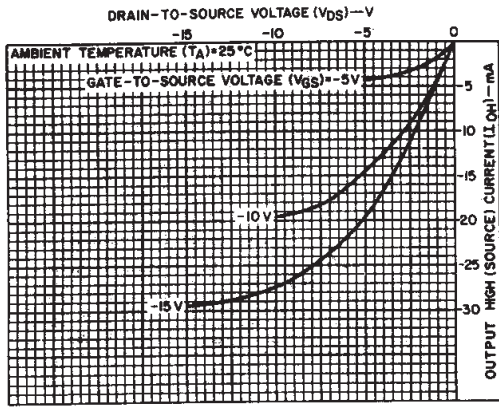


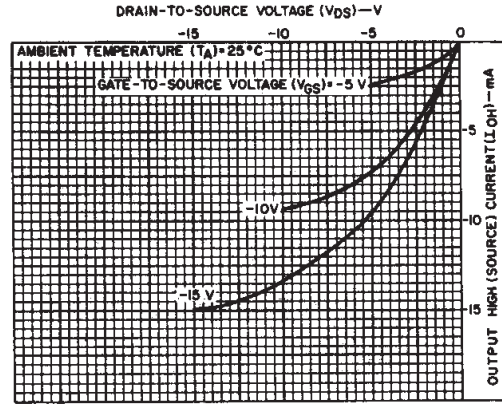
Fig. 3 - Minimum output low (sink) current characteristics.

# CD4504B Types



92CS-24320R3

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



92CS-24321R2

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

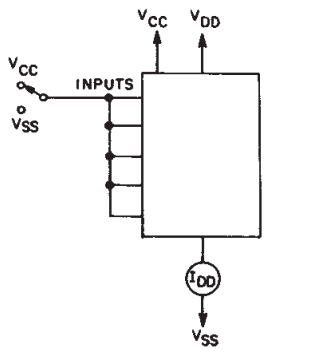
## RECOMMENDED OPERATING CONDITIONS

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

CHARACTERISTIC	V <sub>DD</sub> (V)	LIMITS		UNITS
		Min.	Max.	
Supply-Voltage Range (For T <sub>A</sub> = Full Package-Temperature Range)	—	5	18	V

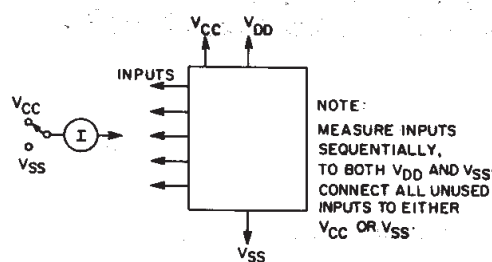
## DYNAMIC ELECTRICAL CHARACTERISTICS, At T<sub>A</sub> = 25°C; Input t<sub>r</sub>, t<sub>f</sub> = 20 ns, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 200 Ω

CHARACTERISTIC	SHIFTING MODE	V <sub>CC</sub> (V)	V <sub>DD</sub> (V)	LIMITS		UNITS
				TYP.	MAX.	
Propagation Delay: High-to-Low, t <sub>PHL</sub>	TTL to CMOS V <sub>DD</sub> > V <sub>CC</sub>	5	10	140	280	ns
	CMOS to CMOS V <sub>DD</sub> > V <sub>CC</sub>	5	15	140	280	
	CMOS to CMOS V <sub>CC</sub> > V <sub>DD</sub>	5	10	120	240	
		5	15	120	240	
		10	15	70	140	
		10	5	275	550	
		15	5	275	550	
		15	10	70	140	
Low-to-High, t <sub>PLH</sub>	TTL to CMOS V <sub>DD</sub> > V <sub>CC</sub>	5	10	140	280	ns
	CMOS to CMOS V <sub>DD</sub> > V <sub>CC</sub>	5	15	140	280	
	CMOS to CMOS V <sub>CC</sub> > V <sub>DD</sub>	5	10	120	240	
		5	15	120	240	
		10	15	70	140	
		10	5	200	400	
		15	5	200	400	
		15	10	60	120	
Transition Time, t <sub>THL</sub> , t <sub>TLH</sub>	All Modes		5	100	200	ns
			10	50	100	
			15	40	80	
Input Capacitance, C <sub>IN</sub>	Any Input			5	7.5	pF



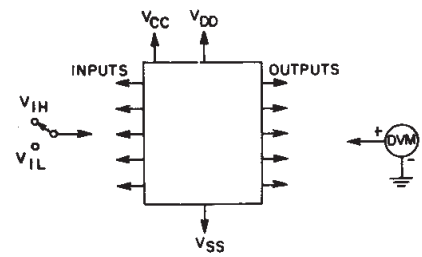
92CS-29452

Fig. 6 - Quiescent device current.



92CS-29454

Fig. 7 - Input current.



NOTE:  
TEST ANY COMBINATION  
OF INPUTS

92CS-29453

Fig. 8 - Input voltage.

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# CD4504B Types

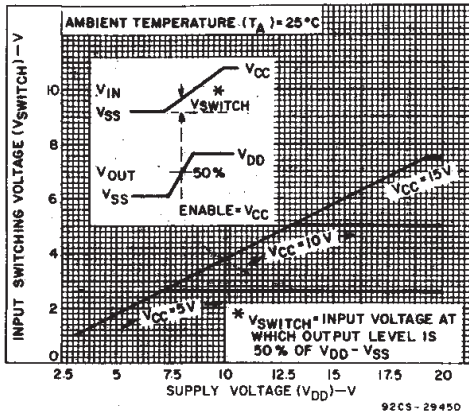


Fig. 9 - Typical input switching as a function of high-level supply voltage. (SELECT at  $V_{CC}$ -CMOS mode).

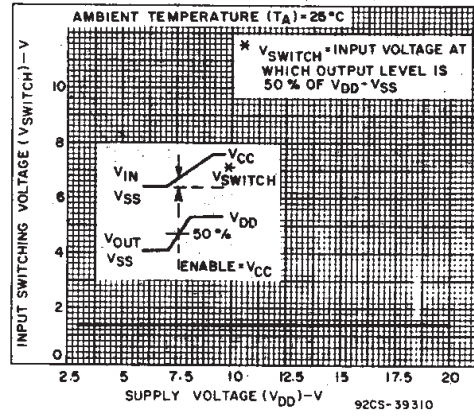


Fig. 10 - Typical input switching as a function of high-level supply voltage (SELECT at  $V_{SS}$ -TTL mode).

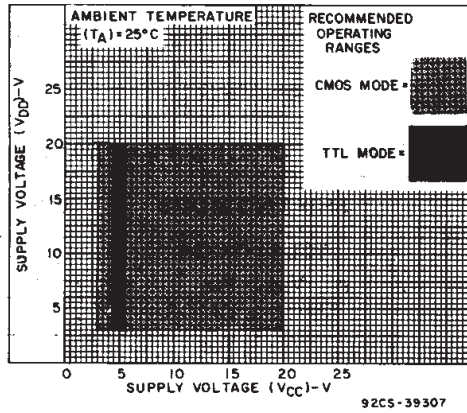
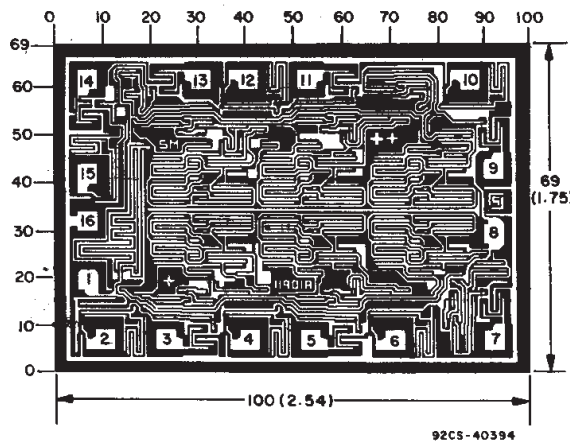


Fig. 11 - High-level supply voltage vs. low-level supply voltage.



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 <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
CD4504BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	
CD4504BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	
CD4504BF3A	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	
CD4504BM	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BM96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BM96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BM96G4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BME4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BMG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BMT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BMTE4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BMTG4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BPWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BPWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BPWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CD4504BPWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	

(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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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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**
**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

**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	333.2	345.9	28.6
CD4504BPWR	TSSOP	PW	16	2000	367.0	367.0	35.0

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

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



4040049/E 12/2002

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

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.

# MECHANICAL DATA

PW (R-PDSO-G16)

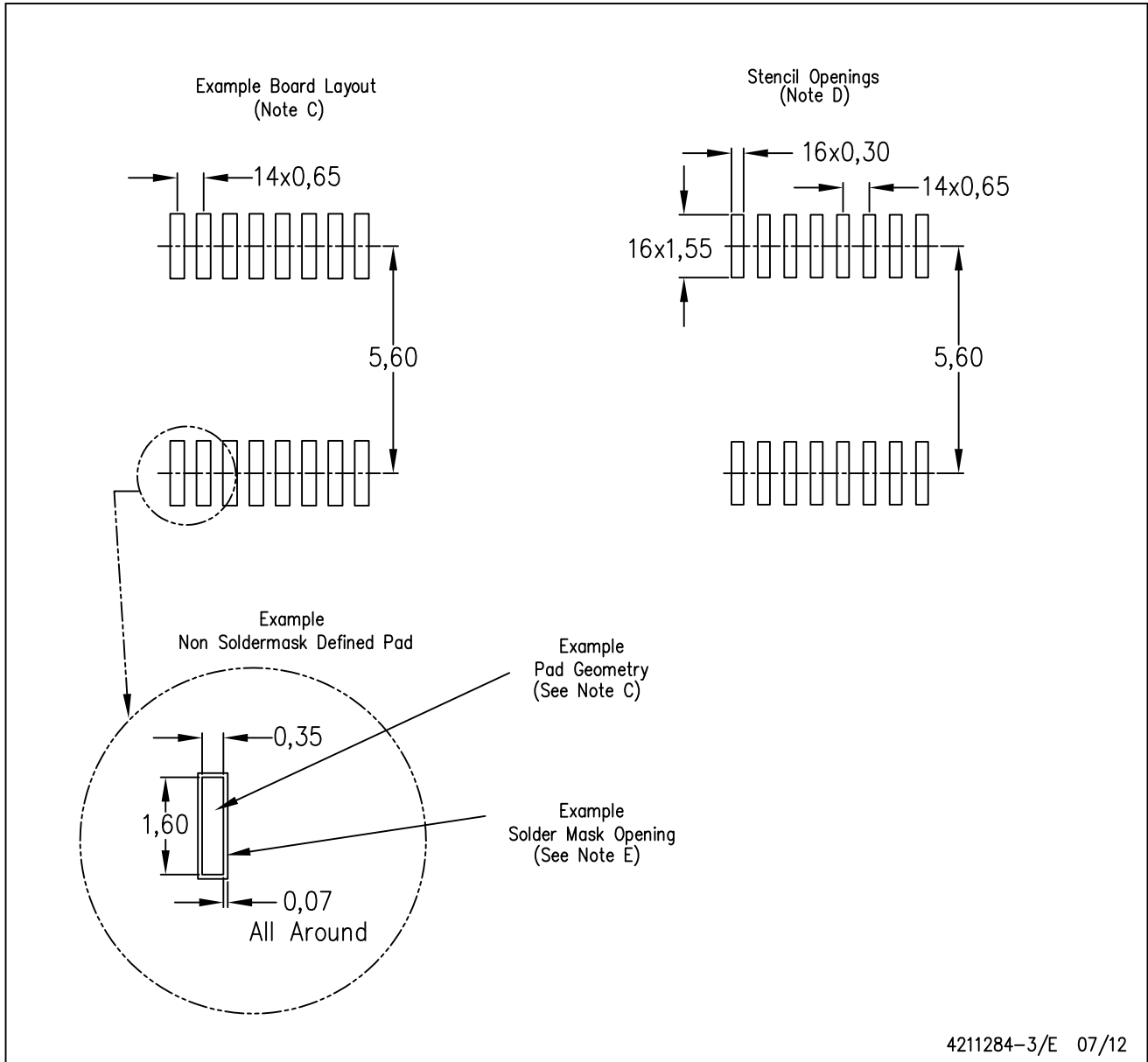
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - 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 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (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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No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

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