

CD4510B, CD4516B Types

CMOS Presettable Up/Down Counters

High-Voltage Types (20-Volt Rating)

CD4510B — — — BCD Type

CD4516B — — — Binary Type

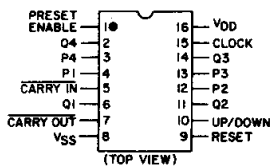
■ CD4510B Presettable BCD Up/Down Counter and the CD4516 Presettable Binary Up/Down Counter consist of four synchronously clocked D-type flip-flops (with a gating structure to provide T-type flip-flop capability) connected as counters. These counters can be cleared by a high level on the RESET line, and can be preset to any binary number present on the jam inputs by a high level on the PRESET ENABLE line. The CD4510B will count out of non-BCD counter states in a maximum of two clock pulses in the up mode, and a maximum of four clock pulses in the down mode.

If the CARRY-IN input is held low, the counter advances up or down on each positive-going clock transition. Synchronous cascading is accomplished by connecting all clock inputs in parallel and connecting the CARRY-OUT of a less significant stage to the CARRY-IN of a more significant stage.

The CD4510B and CD4516B can be cascaded in the ripple mode by connecting the CARRY-OUT to the clock of the next stage. If the UP/DOWN input changes during a terminal count, the CARRY-OUT must be gated with the clock, and the UP/DOWN input must change while the clock is high. This method provides a clean clock signal to the subsequent counting stage. (See Fig. 15).

These devices are similar to types MC14510 and MC14516.

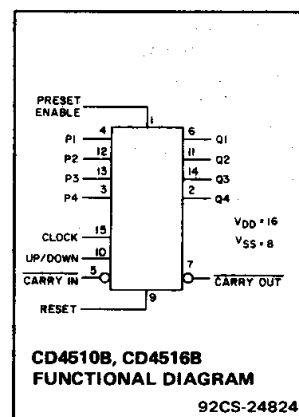
The CD4510B and CD4516B types are supplied in 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (NSR suffix), and 16-lead thin shrink small-outline packages (PW and PWR suffixes). The CD4516B types also are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix).



92CS-27015
CD4510B, CD4516B
TERMINAL ASSIGNMENT

Features:

- Medium-speed operation --
 $f_{CL} = 8 \text{ MHz typ. at } 10 \text{ V}$
- Synchronous internal carry propagation
- Reset and Preset capability
- 100% tested for quiescent current at 20 V
- 5-V, 10-V, and 15-V parametric ratings
- Standardized symmetrical output characteristics
- Maximum input current of $1 \mu\text{A}$ 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 $V_{DD} = 5 \text{ V}$
2 V at $V_{DD} = 10 \text{ V}$
2.5 V at $V_{DD} = 15 \text{ V}$
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"



Applications:

- Up/Down difference counting
- Multistage synchronous counting
- Multistage ripple counting
- Synchronous frequency dividers

OPERATING CONDITIONS AT $T_A = 25^\circ\text{C}$, Unless Otherwise Specified

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

Characteristic	V_{DD}	Min.	Max.	Units
Supply Voltage Range (At $T_A = \text{Full Package-Temperature Range}$)		3	18	V
Clock Pulse Width, t_W	5	150	—	ns
	10	75	—	
	15	60	—	
Clock Input Frequency, f_{CL}	5	—	2	MHz
	10	—	4	
	15	—	5.5	
Preset Enable or Reset Removal Time [●]	5	150	—	ns
	10	80	—	
	15	60	—	
Clock Rise and Fall Time, t_{rCL} , t_{fCL} *	5	—	15	μs
	10	—	5	
	15	—	5	
Carry-In Setup Time, t_S	5	130	—	ns
	10	60	—	
	15	45	—	
Up-Down Setup Time, t_S	5	360	—	ns
	10	160	—	
	15	110	—	
Preset Enable or Reset Pulse Width, t_W	5	220	—	ns
	10	100	—	
	15	75	—	

[●]Time required after the falling edge of the reset or preset enable inputs before the rising edge of the clock will trigger the counter (similar to setup time).

*If more than one unit is cascaded in the parallel clocked application, t_{rCL} should be made less than or equal to the sum of the fixed propagation delay at 15 pF and the transition time of the carry output driving stage for the estimated capacitive load.

CD4510B Types

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 $\pm 10\text{mA}$

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 Linearity at $12\text{mW}/^\circ\text{C}$ 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}) -65°C to $+150^\circ\text{C}$

LEAD TEMPERATURE (DURING SOLDERING):

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

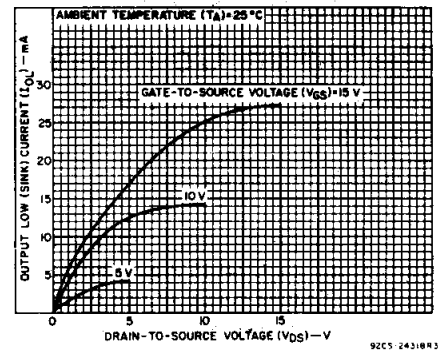


Fig. 1 - Typical output low (sink) current characteristics.

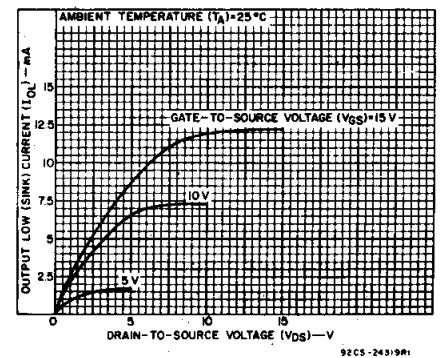


Fig. 2 - Minimum output low (sink) current characteristics.

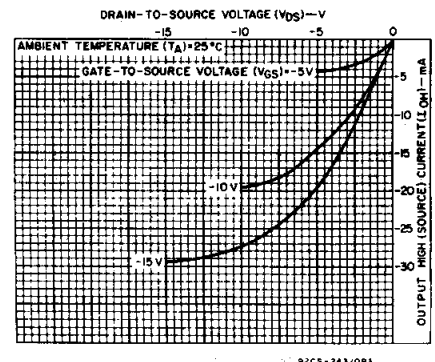


Fig. 4 - Typical output high (source) current characteristics.

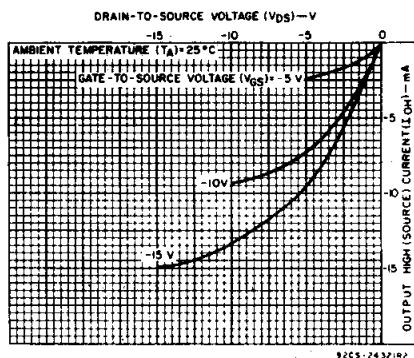


Fig. 5 - Minimum output high (source) current characteristics.

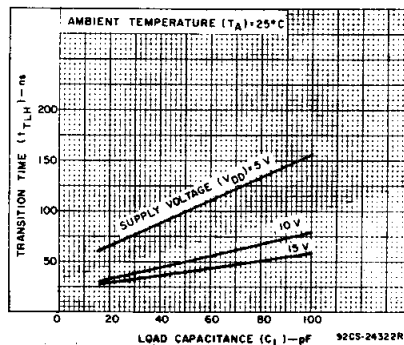


Fig. 6 - Typical transition time vs. load capacitance.

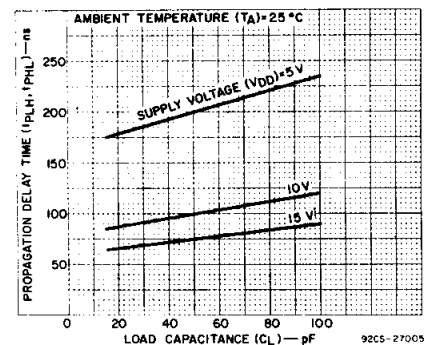


Fig. 7 - Typical propagation delay time vs. load capacitance for clock-to-Q outputs.

CD4510B Types

STATIC ELECTRICAL CHARACTERISTICS

CHARACTER- ISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V _O (V)	V _{IN} (V)	V _{DD} (V)	+25							
				-55	-40	+85	+125	Min.	Typ.	Max.	
Quiescent Device Current, I _{DD} Max.	—	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 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.	4.6	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 _{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	—	V
	—	0,10	10	9.95				9.95	10	—	
	—	0,15	15	14.95				14.95	15	—	
Input Low Voltage, V _{IL} Max.	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, V _{IH} Min.	0.5, 4.5	—	5	3.5				3.5	—	—	V
	1, 9	—	10	7				7	—	—	
	1.5, 13.5	—	15	11				11	—	—	
Input Current I _{IN} Max.	—	0,18	18	±0.1	±0.1	±1	±1	—	±10 ⁻⁵	±0.1	μA

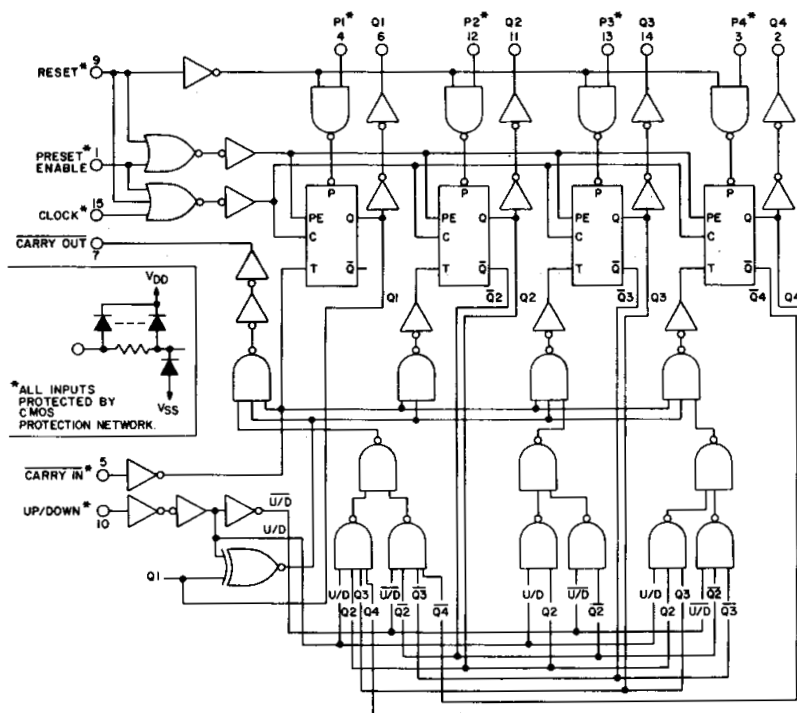


Fig. 10 - Logic Diagram for CD4516B.

92CL-27004R2

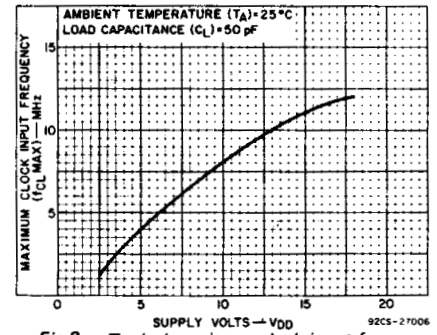


Fig. 8 - Typical maximum clock input frequency vs. supply voltage.

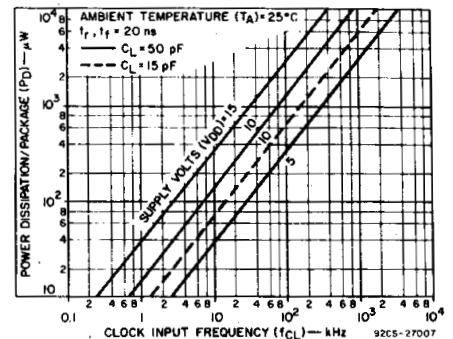


Fig. 9 - Typical dynamic power dissipation vs. frequency.

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COMMERCIAL CMOS
HIGH VOLTAGE ICs

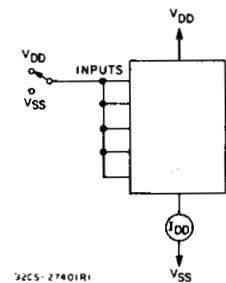


Fig. 11 - Quiescent-device-current test circuit.

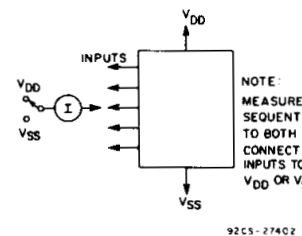


Fig. 12 - Input-current test circuit.

92CS-27402

CD4510B 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	Conditions V_{DD} (V)	Limits All Packages			Units
		Min.	Typ.	Max.	
Propagation Delay Time (t_{PHL}, t_{PLH}):					
Clock-to-Q Output (See Fig. 10)	5 10 15	— — —	200 100 75	400 200 150	ns
Preset or Reset-to-Q Output	5 10 15	— — —	210 105 80	420 210 160	ns
Clock-to-Carry Out	5 10 15	— — —	240 120 90	480 240 180	ns
Carry-In-to-Carry Out	5 10 15	— — —	125 60 50	250 120 100	ns
Preset or Reset-to-Carry Out	5 10 15	— — —	320 160 125	640 320 250	ns
Transition Time (t_{THL}, t_{TLH}) (See Fig. 9)	5 10 15	— — —	100 50 40	200 100 80	ns
Max. Clock Input Frequency (f_{CL})	5 10 15	2 4 5.5	4 8 11	— — —	MHz
Input Capacitance (C_{IN})		—	5	7.5	pF
Set-up Time, t_S Preset Enable to J_n	5 10 15	25 10 10	12 6 5	— — —	ns
Hold times, t_H Clock to Carry-In	5 10 15	60 30 30	30 4 1	— — —	
Clock to Up/Down	5 10 15	30 30 30	10 4 5	— — —	
Preset Enable to J_n	5 10 15	70 40 40	35 20 20	— — —	

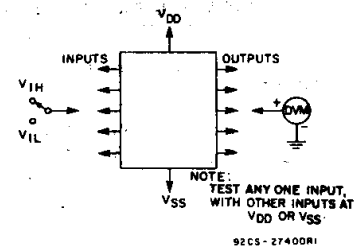


Fig. 13 - Input-voltage test circuit.

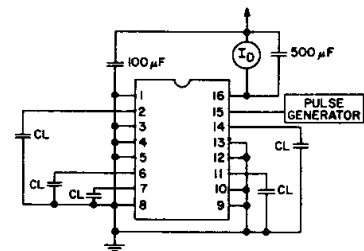


Fig. 14 - Power-dissipation test circuit and input waveform.

CD4510B Types

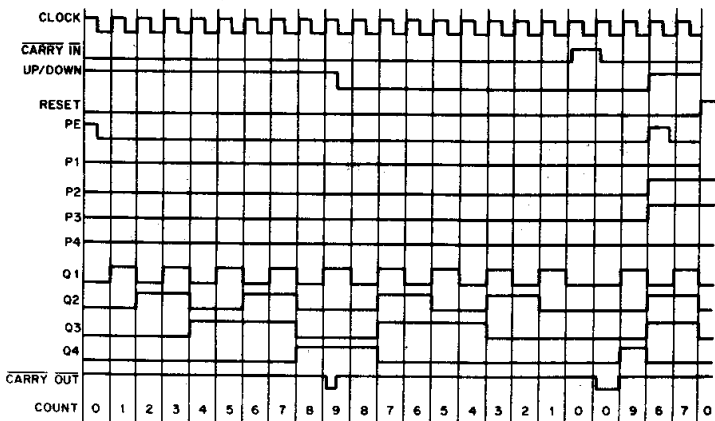


Fig. 15 — Timing Diagram for CD4510B.

92CM-2700B

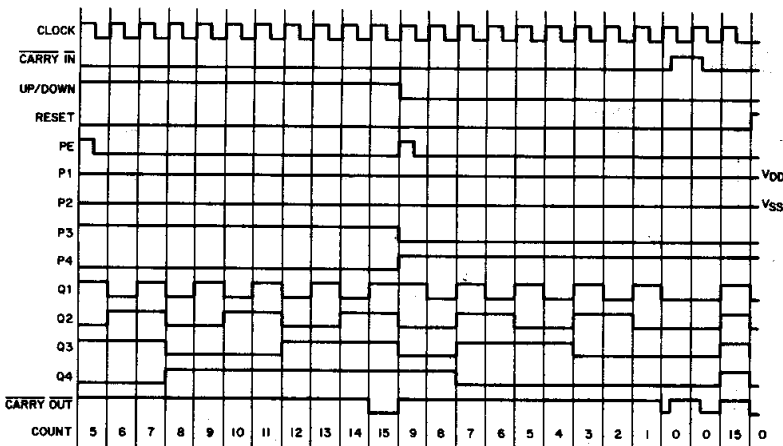
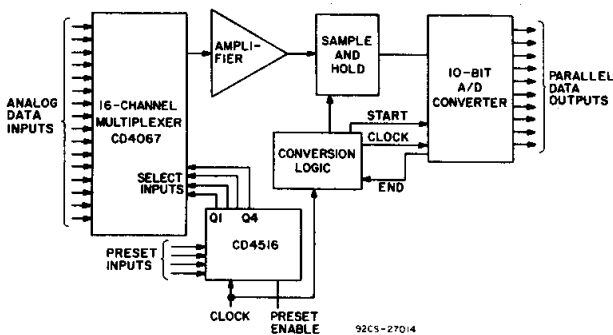


Fig. 16 — Timing diagram for CD4516B.

92CM-27009R1



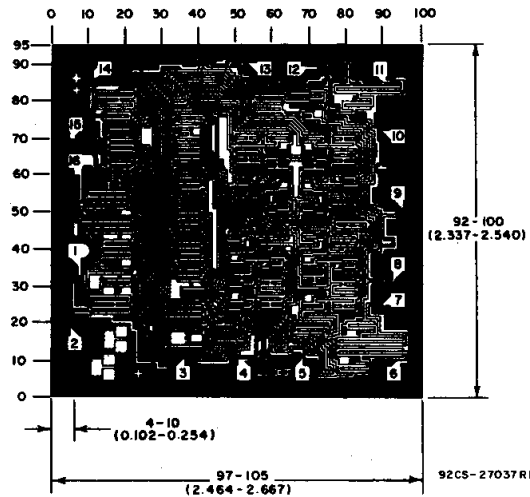
This acquisition system can be operated in the random access mode by jamming in the channel number at the preset inputs, or in the sequential mode by clocking the CD4516B.

Fig. 17 — Typical 16-channel, 10-bit data acquisition system.

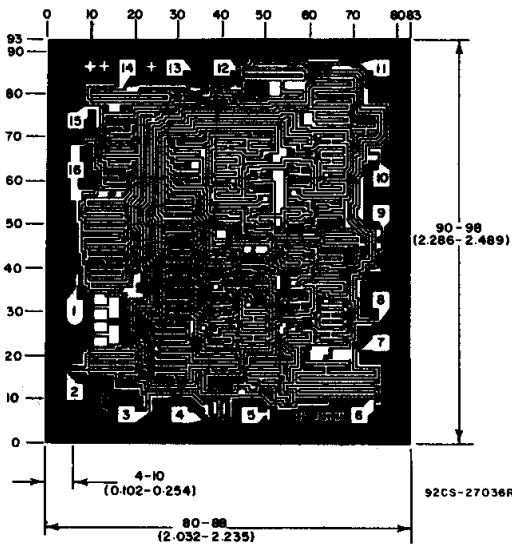
CL	CI	U/D	PE	R	ACTION
X	1	X	0	0	NO COUNT
0	0	1	0	0	COUNT UP
0	0	0	0	0	COUNT DOWN
X	X	X	1	0	PRESET
X	X	X	X	1	RESET

X = DON'T CARE

TRUTH TABLE



Dimensions and Pad Layout for CD4510BH.

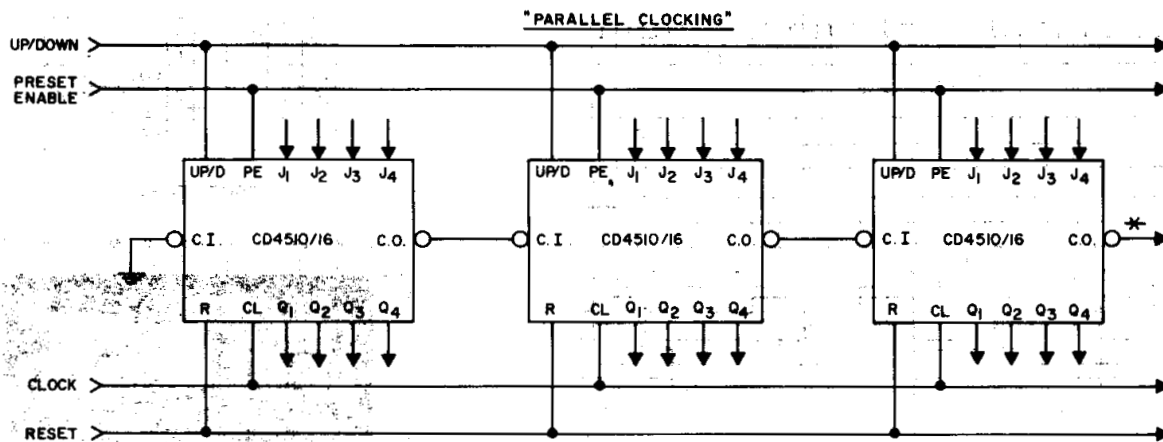


Dimensions and Pad Layout for CD4516BH.

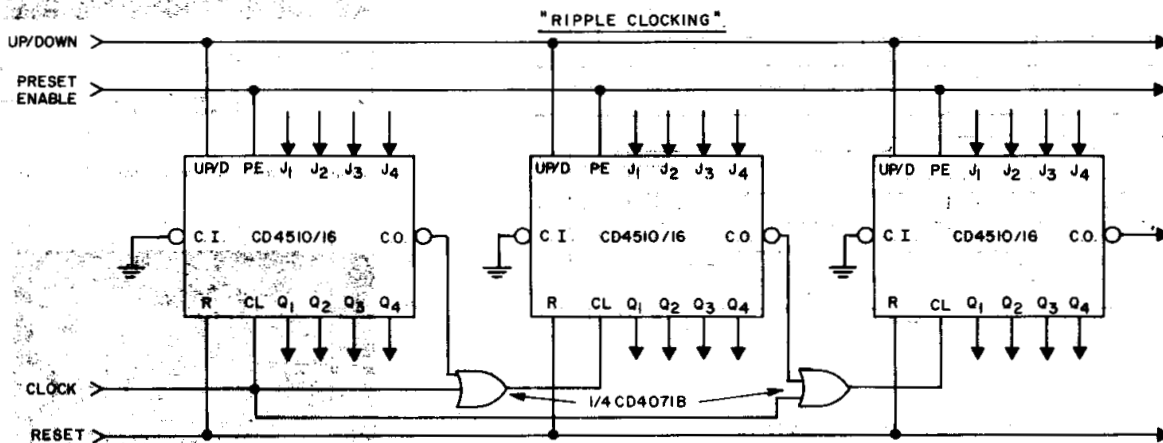
Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3} inch).

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HIGH VOLTAGE ICs

CD4510B Types



* CARRY OUT lines at the 2nd, 3rd, etc., stages may have a negative-going glitch pulse resulting from differential delays of different CD4510/16 IC's. These negative-going glitches do not affect proper CD4510/16 operation. However, if the CARRY OUT signals are used to trigger other edge-sensitive logic devices, such as FF's or counters, the CARRY OUT signals should be gated with the clock signal using a 2-input OR gate such as CD4071B.



RIPPLE CLOCKING MODE:
THE UP/DOWN CONTROL CAN BE CHANGED AT ANY COUNT. THE ONLY RESTRICTION ON CHANGING THE UP/DOWN CONTROL IS THAT THE CLOCK INPUT TO THE FIRST COUNTING STAGE MUST BE "HIGH".

For cascading counters operating in a fixed up-count or down-count mode, the OR gates are not required between stages, and C.O. is connected directly to the CL input of the next stage with C.I. grounded.

92CL-17194R5

Fig. 18 — Cascading counter packages.

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)
CD4510BE	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4510BE
CD4510BE.A	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4510BE
CD4510BNSR	Active	Production	SOP (NS) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4510B
CD4510BNSR.A	Active	Production	SOP (NS) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4510B
CD4510BPWR	Active	Production	TSSOP (PW) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM510B
CD4510BPWR.A	Active	Production	TSSOP (PW) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM510B
CD4516BE	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4516BE
CD4516BE.A	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4516BE
CD4516BEE4	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4516BE
CD4516BF	Active	Production	CDIP (J) 16	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4516BF
CD4516BF.A	Active	Production	CDIP (J) 16	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4516BF
CD4516BF3A	Active	Production	CDIP (J) 16	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4516BF3A
CD4516BF3A.A	Active	Production	CDIP (J) 16	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4516BF3A
CD4516BNSR	Active	Production	SOP (NS) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4516B
CD4516BNSR.A	Active	Production	SOP (NS) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4516B
CD4516BPW	Obsolete	Production	TSSOP (PW) 16	-	-	Call TI	Call TI	-55 to 125	CM516B
CD4516BPWR	Active	Production	TSSOP (PW) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM516B
CD4516BPWR.A	Active	Production	TSSOP (PW) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM516B

⁽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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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF CD4516B, CD4516B-MIL :

- Catalog : [CD4516B](#)
- Military : [CD4516B-MIL](#)

NOTE: Qualified Version Definitions:

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

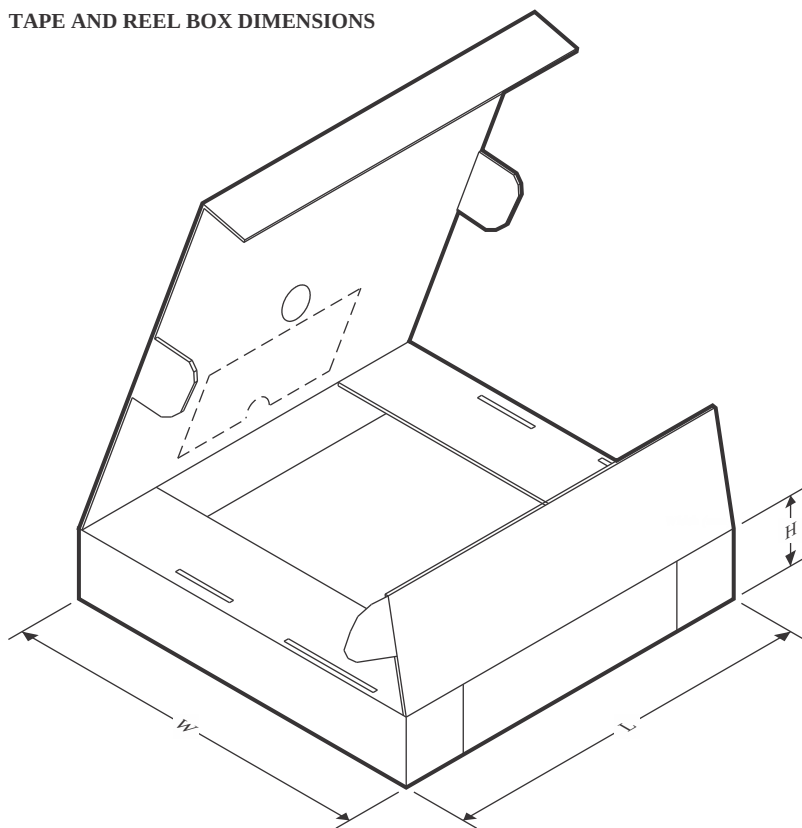
TAPE AND REEL INFORMATION



*All dimensions are nominal

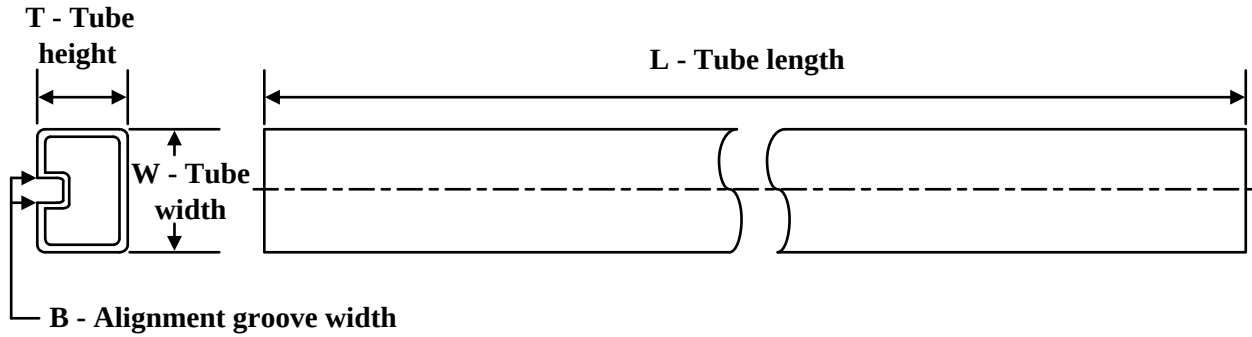
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD4510BNSR	SOP	NS	16	2000	330.0	16.4	8.1	10.4	2.5	12.0	16.0	Q1
CD4510BPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
CD4516BNSR	SOP	NS	16	2000	330.0	16.4	8.1	10.4	2.5	12.0	16.0	Q1
CD4516BPWR	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)
CD4510BNSR	SOP	NS	16	2000	353.0	353.0	32.0
CD4510BPWR	TSSOP	PW	16	2000	353.0	353.0	32.0
CD4516BNSR	SOP	NS	16	2000	353.0	353.0	32.0
CD4516BPWR	TSSOP	PW	16	2000	353.0	353.0	32.0

TUBE


*All dimensions are nominal

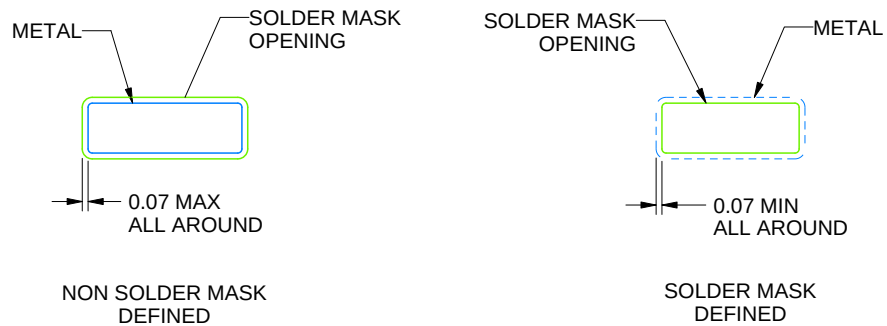
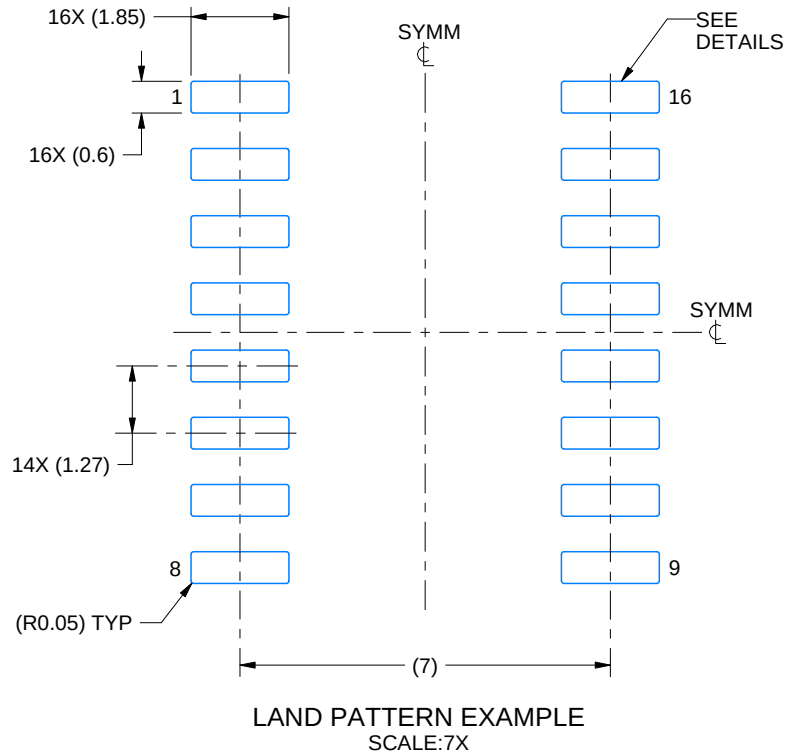
Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
CD4510BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4510BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4510BE.A	N	PDIP	16	25	506	13.97	11230	4.32
CD4510BE.A	N	PDIP	16	25	506	13.97	11230	4.32
CD4516BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4516BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4516BE.A	N	PDIP	16	25	506	13.97	11230	4.32
CD4516BE.A	N	PDIP	16	25	506	13.97	11230	4.32
CD4516BEE4	N	PDIP	16	25	506	13.97	11230	4.32
CD4516BEE4	N	PDIP	16	25	506	13.97	11230	4.32

EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



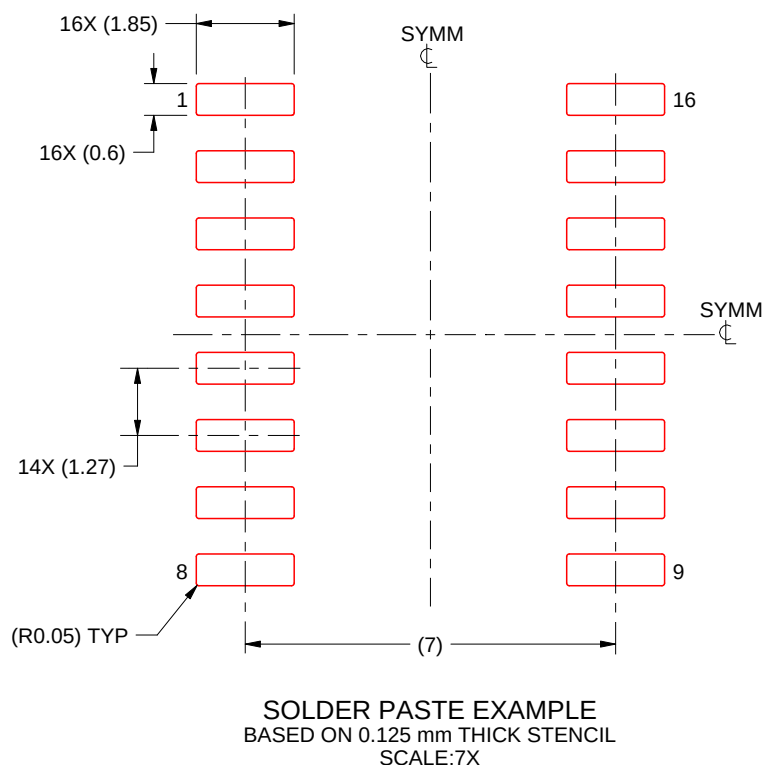
SOLDER MASK DETAILS

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.



4220735/A 12/2021

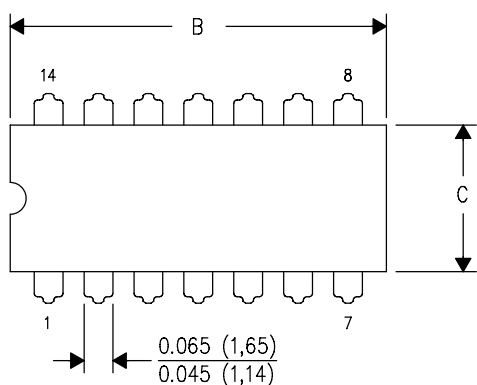
NOTES: (continued)

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.

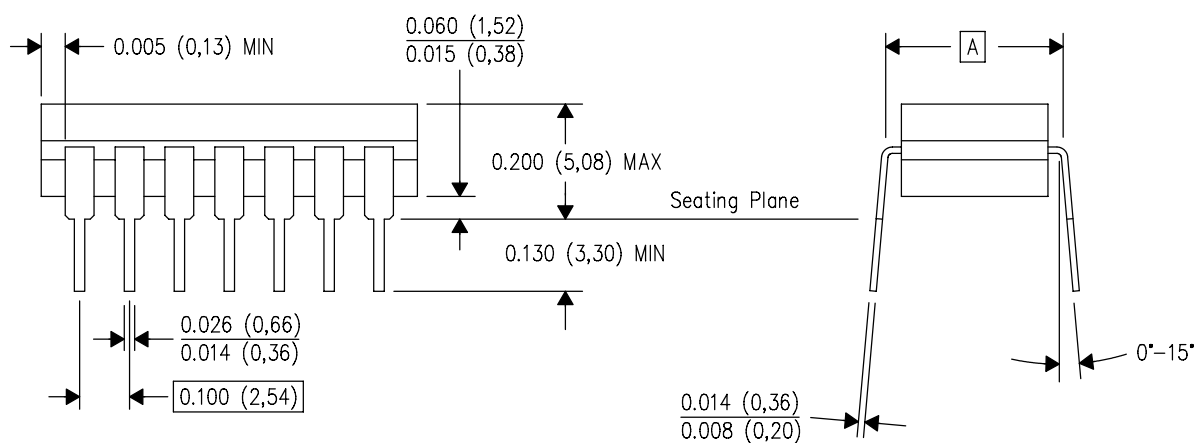
J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE

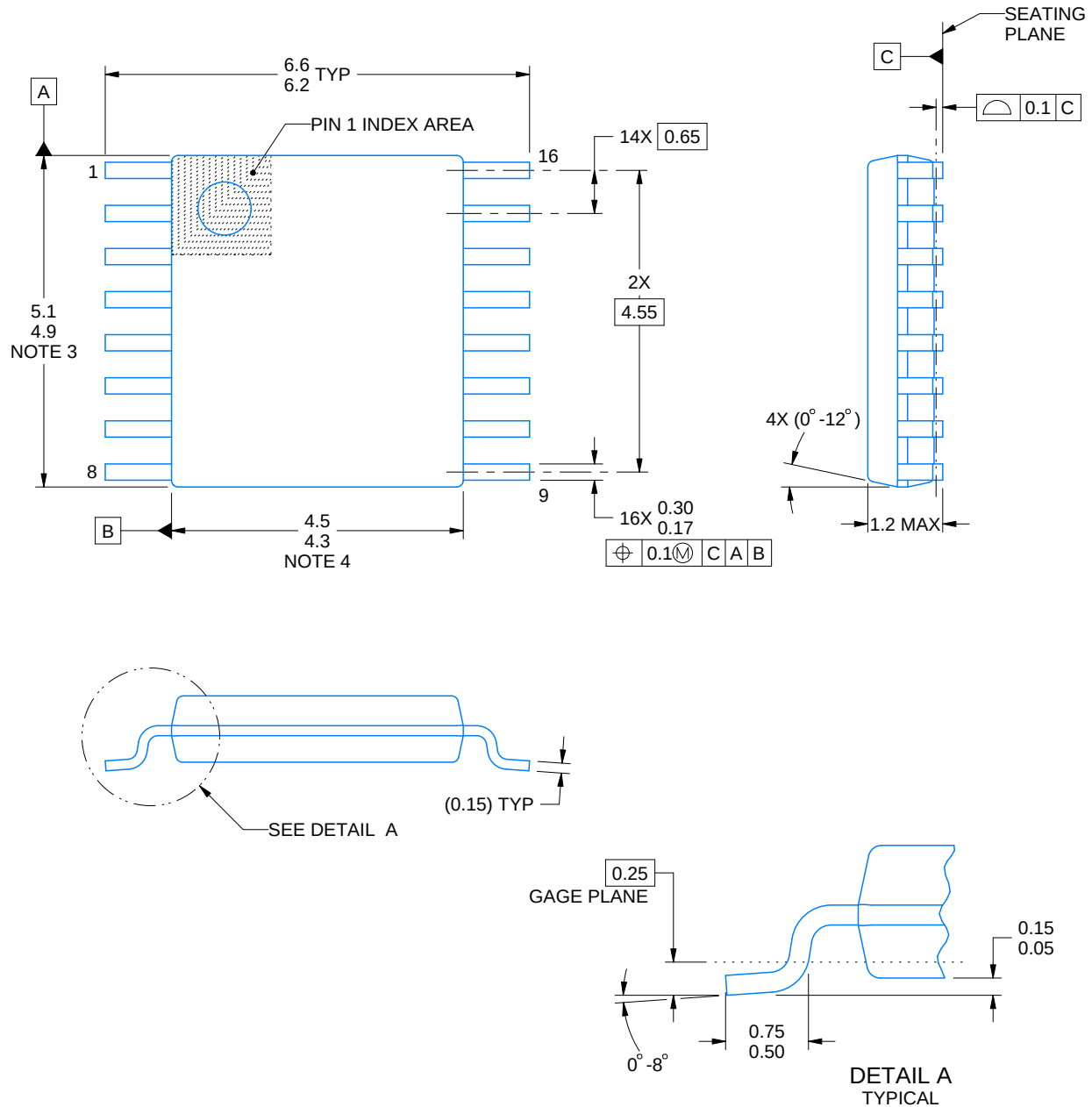
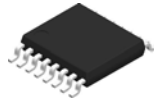


PINS ** DIM	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



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.



4220204/B 12/2023

NOTES:

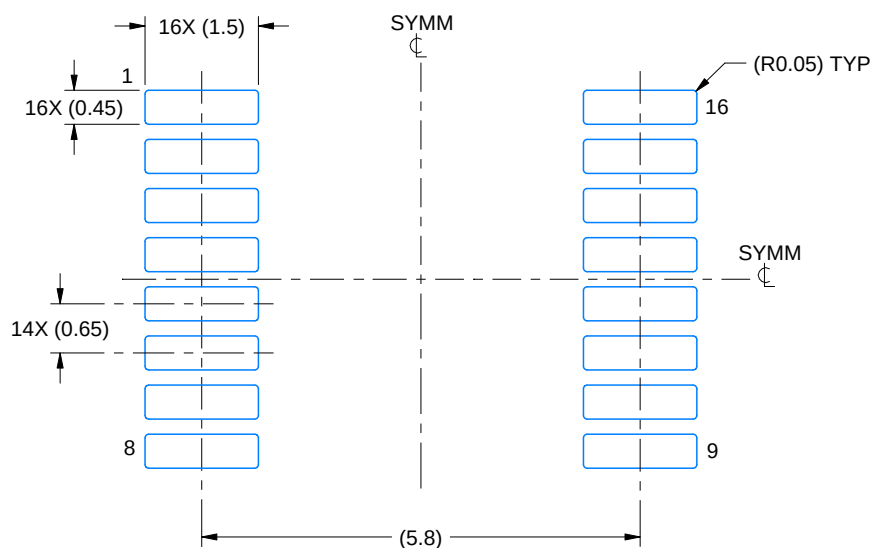
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

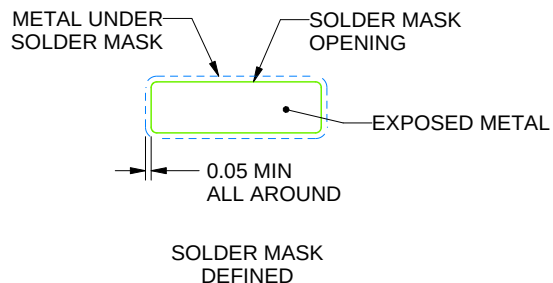
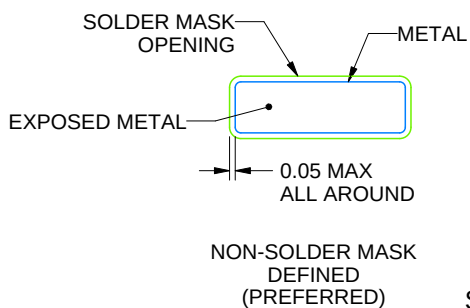
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220204/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

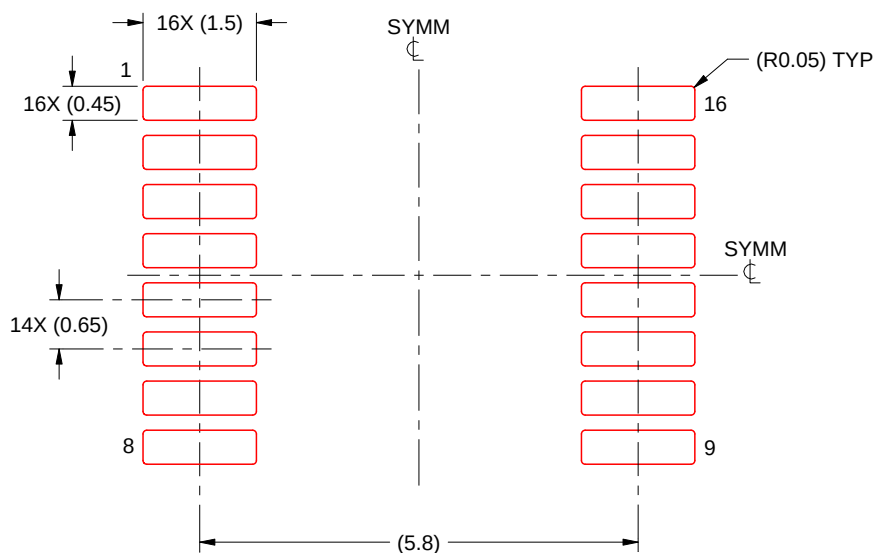
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4220204/B 12/2023

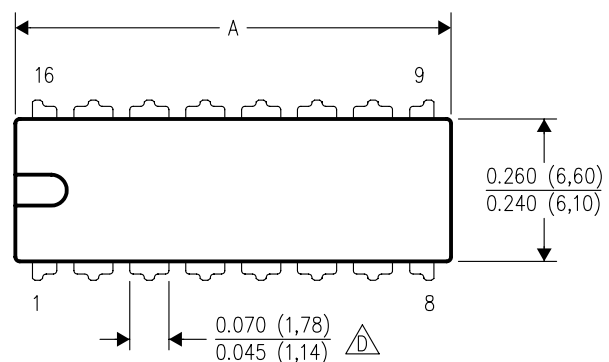
NOTES: (continued)

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.

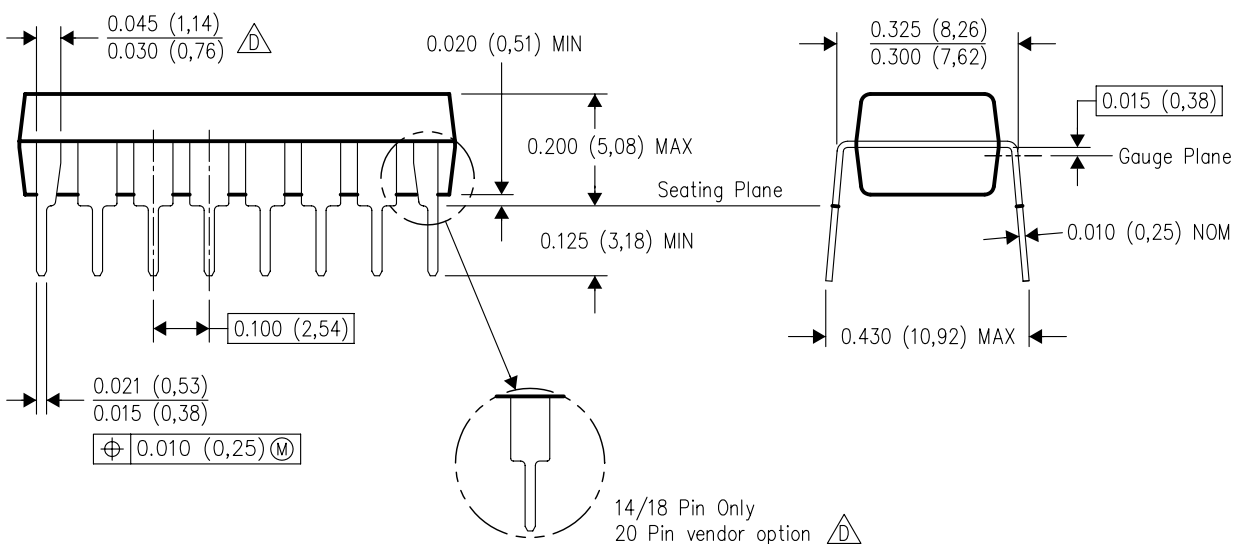
N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



PINS ** DIM	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	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.
-  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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