

CD4094B Types

CMOS 8-Stage Shift-and-Store Bus Register

High-Voltage Types (20-Volt Rating)

■ CD4094B is an 8-stage serial shift register having a storage latch associated with each stage for strobing data from the serial input to parallel buffered 3-state outputs. The parallel outputs may be connected directly to common bus lines. Data is shifted on positive clock transitions. The data in each shift register stage is transferred to the storage register when the STROBE input is high. Data in the storage register appears at the outputs whenever the OUTPUT-ENABLE signal is high.

Two serial outputs are available for cascading a number of CD4094B devices. Data is available at the Q_S serial output terminal on positive clock edges to allow for high-speed operation in cascaded systems in which the clock rise time is fast. The same serial information, available at the Q_S terminal on the next negative clock edge, provides a means for cascading CD4094B devices when the clock rise time is slow.

The CD4094B 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 (NSR suffix), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

Features:

- 3-state parallel outputs for connection to common bus
- Separate serial outputs synchronous to both positive and negative clock edges for cascading
- Medium speed operation - 5 MHz at 10 V (typ.)
- Standardized, symmetrical output characteristics
- 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:

- Serial-to-parallel data conversion
- Remote control holding register
- Dual-rank shift, hold, and bus applications

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

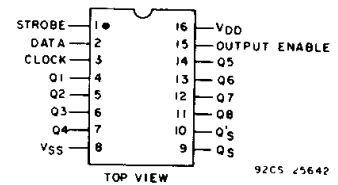
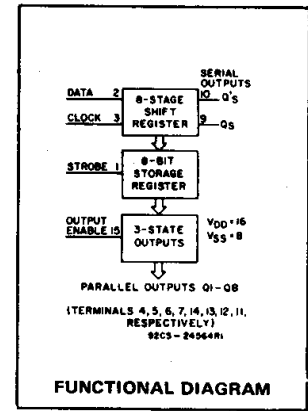


Fig. 1 - Terminal assignment.

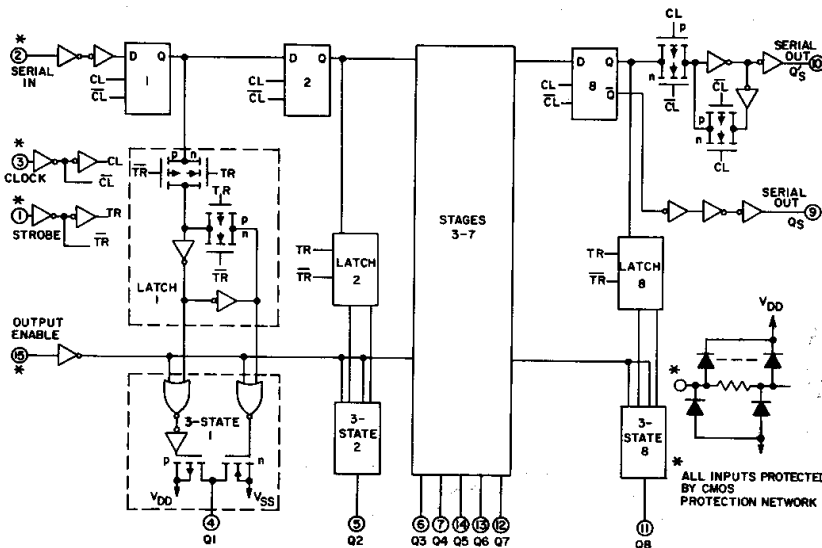


Fig. 2 - CD4094B Logic diagram.

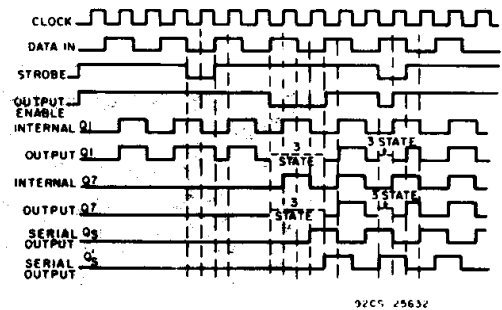


Fig. 3 - Timing diagram.

CD4094B Types

RECOMMENDED OPERATING CONDITIONS at $T_A = 25^\circ\text{C}$, Except as Noted.
 For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	VDD (V)	LIMITS		UNITS
		MIN.	MAX.	
Supply-Voltage Range (For T_A =Full Package-Temperature Range)		3	18	V
Data Setup Time, t_S	5	125	—	ns
	10	55	—	
	15	35	—	
Clock Pulse Width, t_W	5	200	—	ns
	10	100	—	
	15	83	—	
Clock Input Frequency, f_{CL}	5		1.25	MHz
	10	dc	2.5	
	15		3	
Clock Input Rise or Fall time, t_{rCL}, t_{fCL} *	5		15	μs
	10	—	5	
	15		5	
Strobe Pulse Width, t_W	5	200	—	ns
	10	80	—	
	15	70	—	

*If more than one unit is cascaded t_{fCL} (for Q_S only) should be made less than or equal to the sum of the fixed propagation delay at 50 pF and the transition time of the output driving stage for the estimated capacitive load.

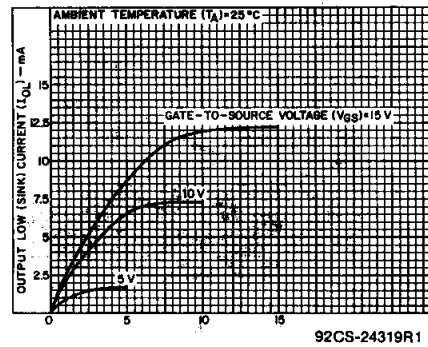


Fig. 5 - Minimum output low (sink) current characteristics.

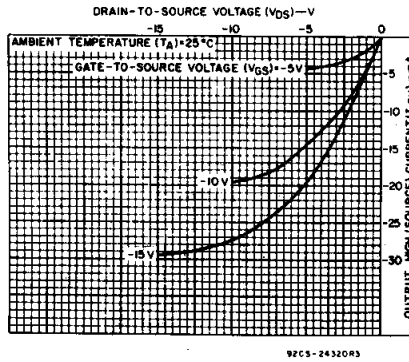


Fig. 6 - Typical output high (source) current characteristics.

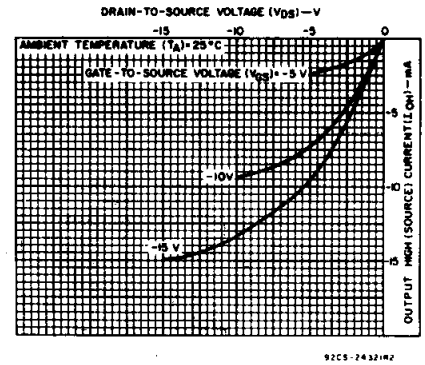


Fig. 7 - Minimum output high (source) current characteristics.

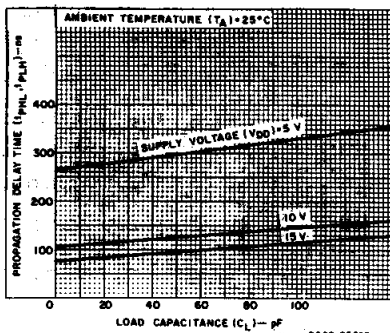


Fig. 8 - Clock-to-serial output Q_S propagation delay vs C_L .

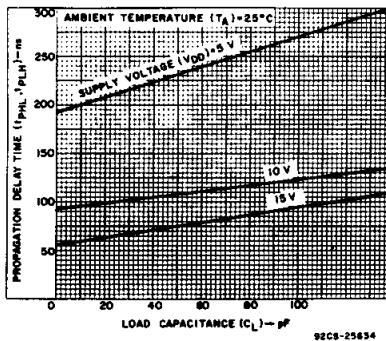


Fig. 9 - Clock-to-serial output Q_S propagation delay vs C_L .

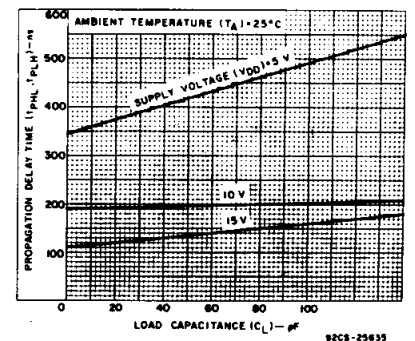


Fig. 10 - Clock-to-parallel output propagation delay vs C_L .

TRUTH TABLE							
CL [▲]	Output Enable	Strobe	Data	Parallel Outputs		Serial Outputs	
				Q1	Q2	Q3*	Q4
[Symbol]	0	X	X	OC	OC	Q7	NC
	0	X	X	OC	OC	NC	Q7
[Symbol]	1	0	X	NC	NC	Q7	NC
	1	1	0	0	QN-1	Q7	NC
[Symbol]	1	1	1	1	1	QN-1	Q7
	1	1	1	1	1	NC	Q7

▲ = Level Change
 X = Don't Care
 NC = No Change
 OC = Open Circuit
 Logic 1 \equiv High
 Logic 0 \equiv Low

* At the positive clock edge information in the 7th shift register stage is transferred to the 8th register stage and the Q_S output.

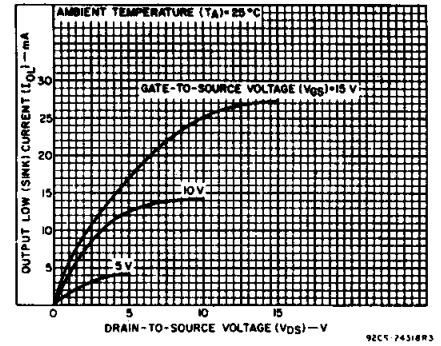


Fig. 4 - Typical output low (sink) current characteristics.

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STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V _O (V)	V _{IN} (V)	V _{DD} (V)	-55			+25				
				Min.	Typ.	Max.	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
3-State Output Leakage Current I _{OUT} Max.	0.18	0.18	18	±0.4	±0.4	±12	±12	-	±10 ⁻⁴	±0.4	μA

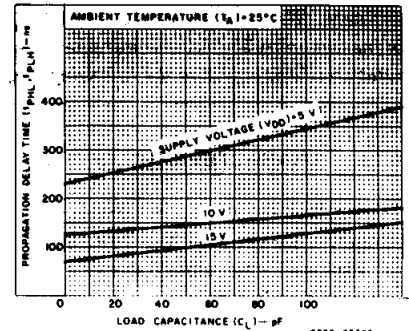


Fig. 11 - Strobe-to-parallel output propagation delay vs C_L.

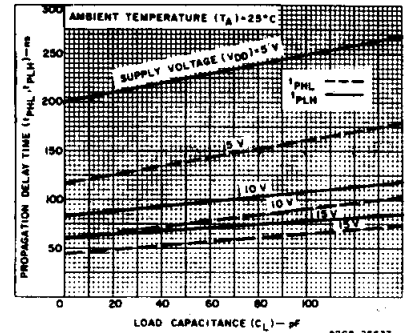


Fig. 12 - Output enable-to-parallel output propagation delay vs C_L.

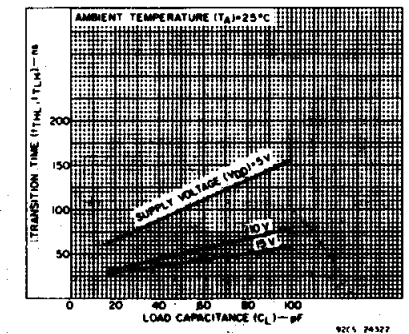


Fig. 13 - Typical transition time vs. load capacitance.

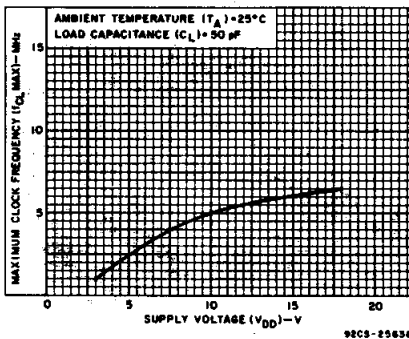


Fig. 15 - Typical maximum-clock-frequency vs. supply voltage.

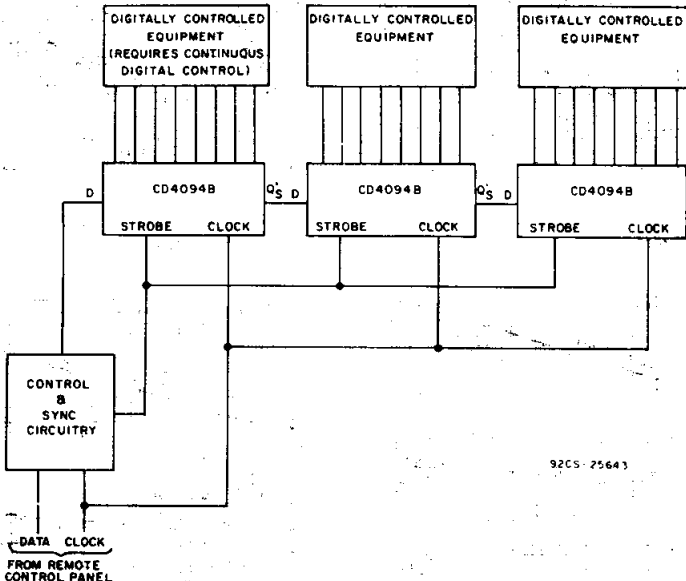


Fig. 14 - Remote control holding register.

CD4094B Types

DYNAMIC ELECTRICAL CHARACTERISTICS

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

CHARACTERISTIC	VDD (V)	LIMITS			UNITS
		MIN.	TYP.	MAX.	
Propagation Delay Time, t_{PHL}, t_{PLH} Clock to Serial Output Q_S	5	—	300	600	ns
	10	—	125	250	
	15	—	95	190	
Clock to Serial Output Q'_S	5	—	230	460	ns
	10	—	110	220	
	15	—	75	150	
Clock to Parallel Output	5	—	420	840	ns
	10	—	195	390	
	15	—	135	270	
Strobe to Parallel Output	5	—	290	580	ns
	10	—	145	290	
	15	—	100	200	
Output Enable to Parallel Output: t_{PHZ}, t_{PZH}	5	—	140	280	ns
	10	—	60	120	
	15	—	45	90	
t_{PLZ}, t_{PZL}	5	—	100	200	ns
	10	—	50	100	
	15	—	40	80	
Minimum Strobe Pulse Width, t_W	5	—	100	200	ns
	10	—	40	80	
	15	—	35	70	
Minimum Clock Pulse Width, t_W	5	—	100	200	ns
	10	—	50	100	
	15	—	40	83	
Minimum Data Setup Time, t_S	5	—	60	125	ns
	10	—	30	55	
	15	—	20	35	
Transition Time; t_{THL}, t_{TLH}	5	—	100	200	ns
	10	—	50	100	
	15	—	40	80	
Maximum Clock Input Rise or Fall Time, t_{rCL}, t_{fCL}	5	15	—	—	μs
	10	5	—	—	
	15	5	—	—	
Maximum Clock Input Frequency, f_{CL}	5	1.25	2.5	—	MHz
	10	2.5	5	—	
	15	3	6	—	
Input Capacitance C_{iN} (Any Input)	—	—	5	7.5	pF

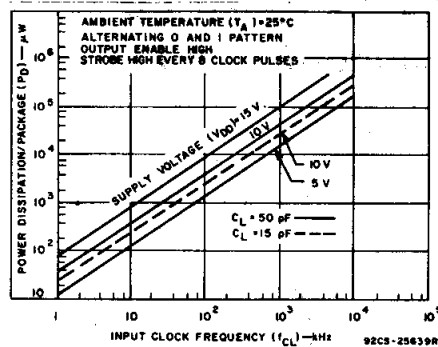


Fig. 16 — Dynamic power dissipation vs input clock frequency.

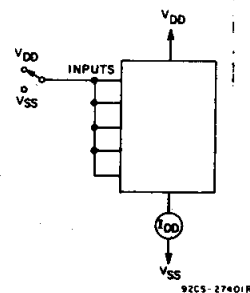


Fig. 17 — Quiescent device current test circuit.

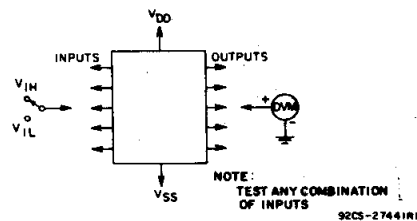


Fig. 18 — Input voltage test circuit.

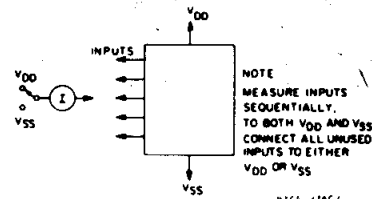
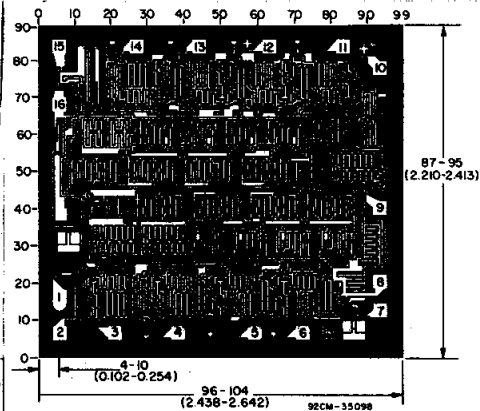


Fig. 19 — Input current test circuit.



Dimensions and Pad Layout for CD4094B Chip.

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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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)
7702501EA	Active	Production	CDIP (J) 16	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	7702501EA CD4094BF3A
CD4094BE	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4094BE
CD4094BE.A	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4094BE
CD4094BEE4	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD4094BE
CD4094BF	Active	Production	CDIP (J) 16	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4094BF
CD4094BF.A	Active	Production	CDIP (J) 16	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD4094BF
CD4094BF3A	Active	Production	CDIP (J) 16	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	7702501EA CD4094BF3A
CD4094BF3A.A	Active	Production	CDIP (J) 16	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	7702501EA CD4094BF3A
CD4094BNSR	Active	Production	SOP (NS) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4094B
CD4094BNSR.A	Active	Production	SOP (NS) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4094B
CD4094BPW	Obsolete	Production	TSSOP (PW) 16	-	-	Call TI	Call TI	-55 to 125	CM094B
CD4094BPWR	Active	Production	TSSOP (PW) 16	2000 LARGE T&R	Yes	NIPDAU SN	Level-1-260C-UNLIM	-55 to 125	CM094B
CD4094BPWR.A	Active	Production	TSSOP (PW) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM094B
CD4094BPWRG4	Active	Production	TSSOP (PW) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM094B

(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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OTHER QUALIFIED VERSIONS OF CD4094B, CD4094B-MIL :

- Catalog : [CD4094B](#)
- Military : [CD4094B-MIL](#)

NOTE: Qualified Version Definitions:

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

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
CD4094BNSR	SOP	NS	16	2000	330.0	16.4	8.1	10.4	2.5	12.0	16.0	Q1
CD4094BPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
CD4094BPWRG4	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)
CD4094BNSR	SOP	NS	16	2000	353.0	353.0	32.0
CD4094BPWR	TSSOP	PW	16	2000	356.0	356.0	35.0
CD4094BPWRG4	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)
CD4094BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4094BE.A	N	PDIP	16	25	506	13.97	11230	4.32
CD4094BEE4	N	PDIP	16	25	506	13.97	11230	4.32

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE

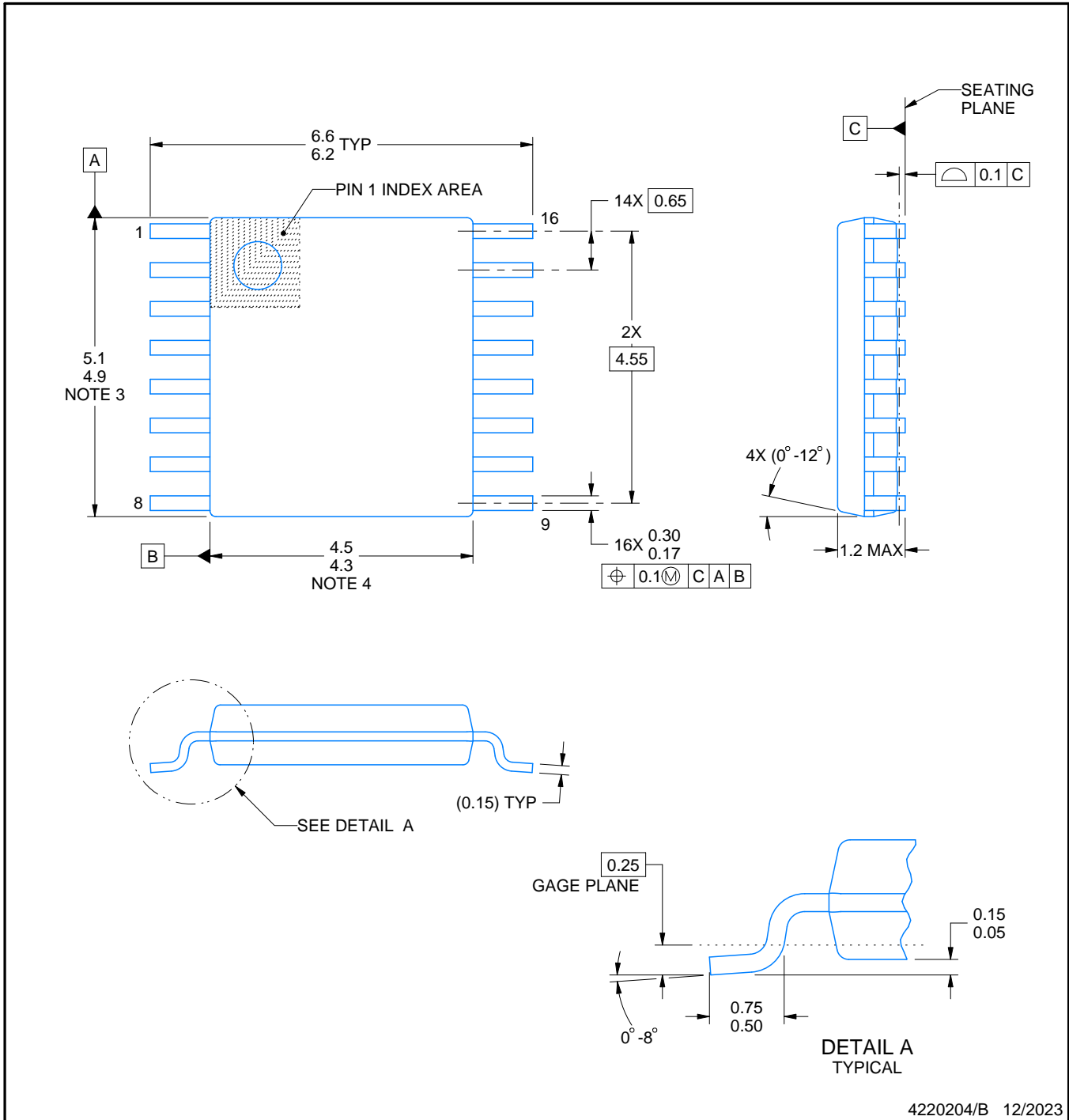
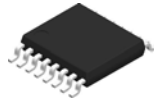


DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



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.



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NOTES:

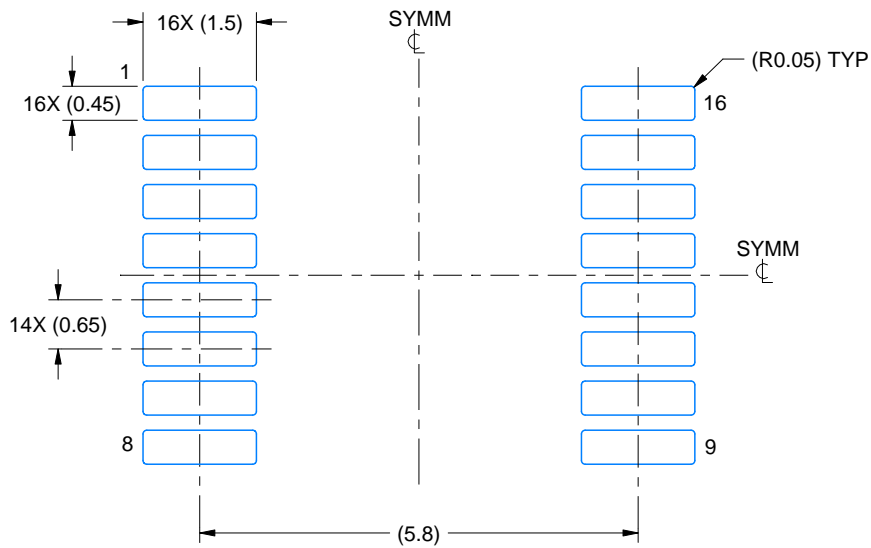
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

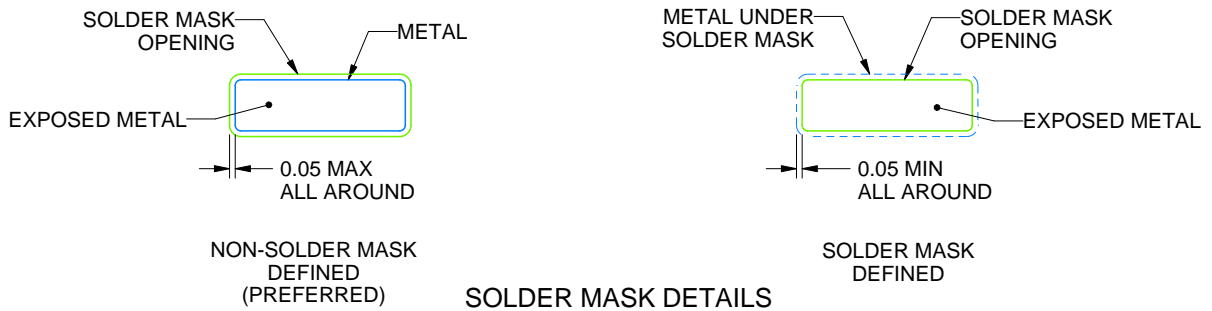
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

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NOTES: (continued)

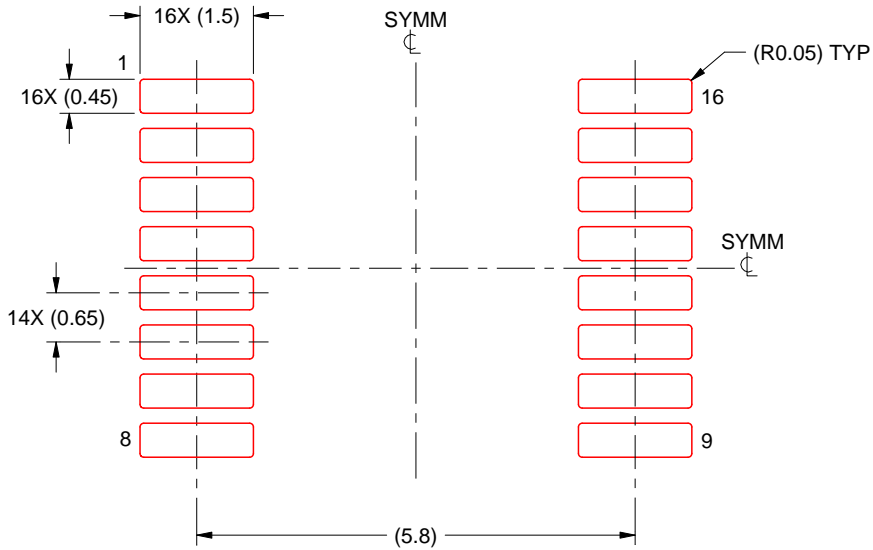
- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

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.



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.

EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



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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.

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Last updated 10/2025