

## 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 (D and F suffixes), 16-lead dual-in-line plastic package (E suffix), and in chip form (H suffix).

### 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  $\mu$ 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  $V_{DD} = 5$  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

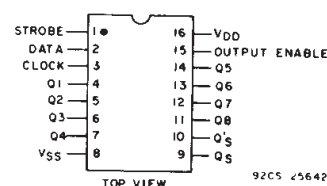
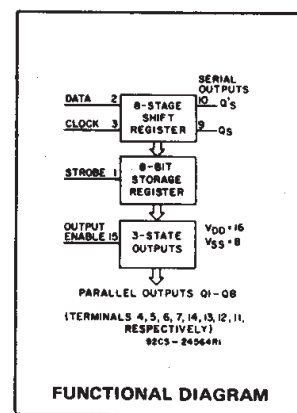


Fig. 1 — Terminal assignment.

### 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  $V_{DD} + 0.5$ V

DC INPUT CURRENT, ANY ONE INPUT .....  $\pm 10$ 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

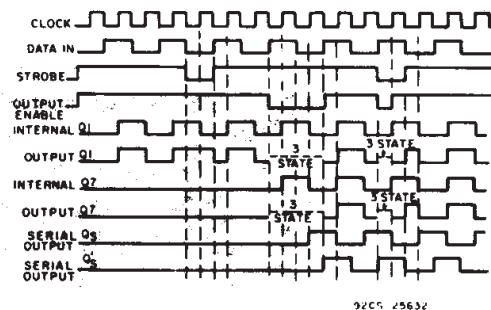
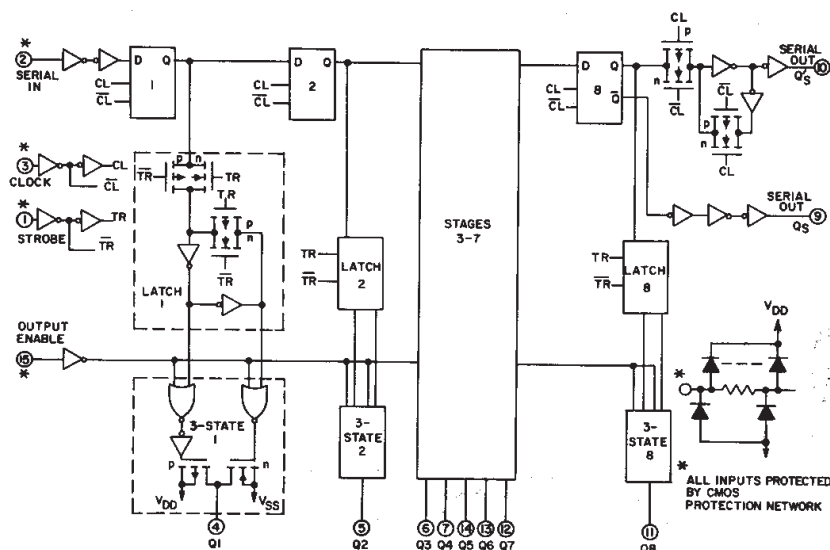
FOR  $T_A = \text{FULL PACKAGE-TEMPERATURE RANGE (All Package Types)}$  ..... 100mW

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

STORAGE TEMPERATURE RANGE ( $T_{stg}$ ) .....  $-65^\circ\text{C}$  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 .....  $+265^\circ\text{C}$



## 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 10 15	125 55 35	— — —	ns
Clock Pulse Width, $t_W$	5 10 15	200 100 83	— — —	ns
Clock Input Frequency, $f_{CL}$	5 10 15	dc	1.25 2.5 3	MHz
Clock Input Rise or Fall time, $t_{rCL}$ , $t_{fCL}$ *	5 10 15	—	15 5 5	$\mu\text{s}$
Strobe Pulse Width, $t_W$	5 10 15	200 80 70	— — —	ns

\*If more than one unit is cascaded  $t_{rCL}$  (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.

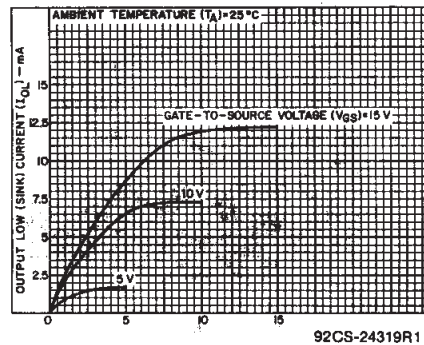


Fig. 5 - Minimum output low (sink) current characteristics.

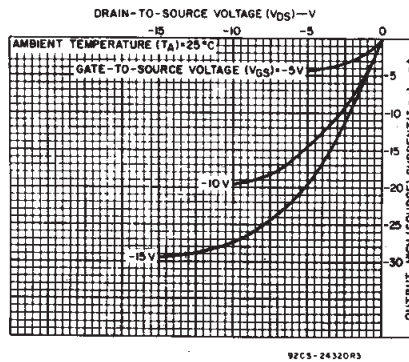


Fig. 6 - Typical output high (source) current characteristics.

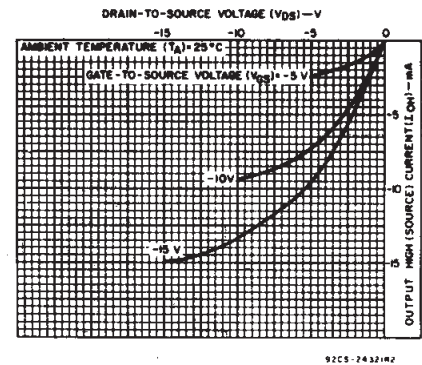


Fig. 7 - Minimum output high (source) current characteristics.

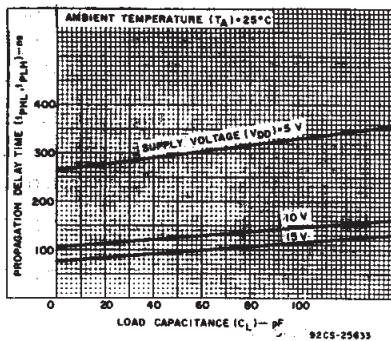


Fig. 8 - Clock-to-serial output  $Q_S$  propagation delay vs  $C_L$ .

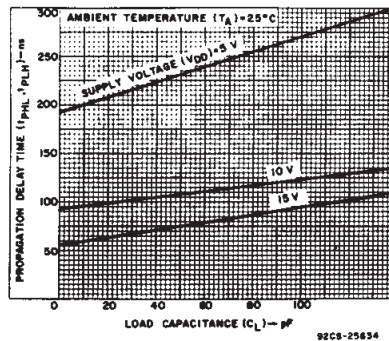


Fig. 9 - Clock-to-parallel output  $Q_S$  propagation delay vs  $C_L$ .

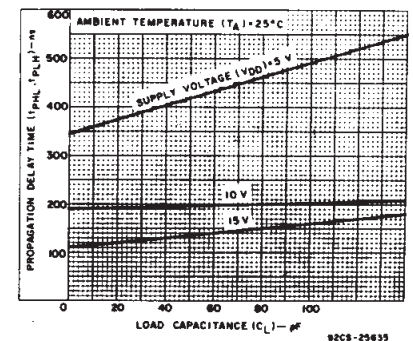


Fig. 10 - Clock-to-parallel output propagation delay vs  $C_L$ .

TRUTH TABLE

CL <sup>Δ</sup>	Output Enable	Strobe	Data	Parallel Outputs		Serial Outputs	
				Q1	Q <sub>N</sub>	Q <sub>S</sub> *	Q <sub>S</sub>
0	0	X	X	OC	OC	Q7	NC
0	0	X	X	OC	OC	NC	Q7
1	0	0	X	NC	NC	Q7	NC
1	1	1	0	0	Q <sub>N</sub> -1	Q7	NC
1	1	1	1	1	Q <sub>N</sub> -1	Q7	NC
1	1	1	1	NC	NC	NC	Q7

<sup>Δ</sup> = Level Change

X = Don't Care

NC = No Change

OC = Open Circuit

Logic 1 = High

Logic 0 = 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.

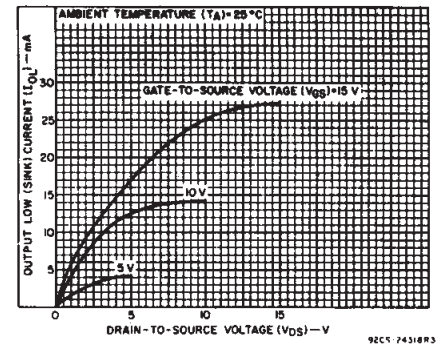


Fig. 4 - Typical output low (sink) current characteristics.

# CD4094B Types

## STATIC ELECTRICAL CHARACTERISTICS

CHARACTER- ISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V <sub>O</sub> (V)	V <sub>IN</sub> (V)	V <sub>DD</sub> (V)					+25			
				-55	-40	+85	+125	Min.	Typ.	Max.	
Quiescent Device Current, I <sub>DD</sub> 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 <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.	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 <sub>IH</sub> 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 <sub>IN</sub> Max.	—	0,18	18	±0.1	±0.1	±1	±1	—	±10 <sup>-5</sup>	±0.1	μA
3-State Output Leakage Current I <sub>OUT</sub> Max.	0,18	0,18	18	±0.4	±0.4	±12	±12	—	±10 <sup>-4</sup>	±0.4	μA

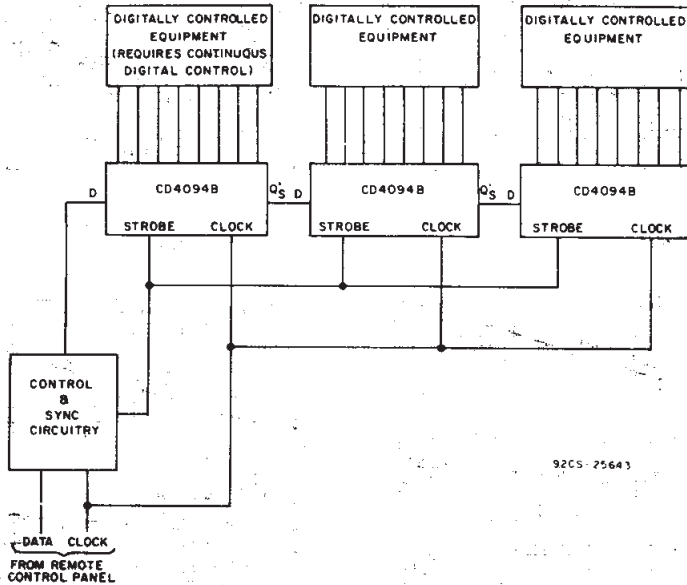


Fig. 14 — Remote control holding register.

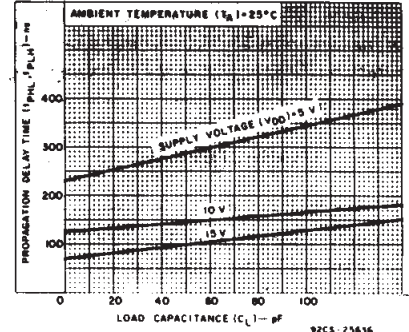


Fig. 11 — Strobe-to-parallel output propagation delay vs.  $C_L$ .

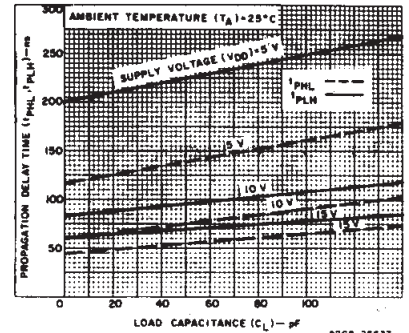


Fig. 12 — Output enable-to-parallel output propagation delay vs.  $C_L$ .

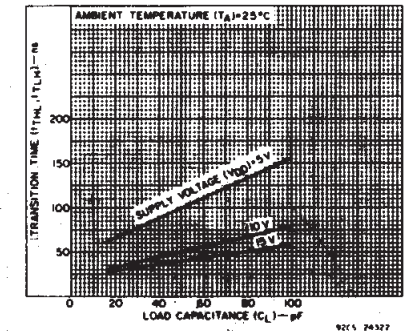


Fig. 13 — Typical transition time vs. load capacitance.

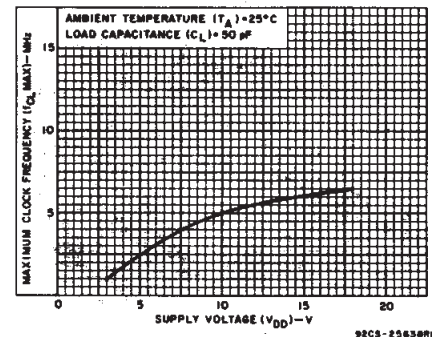


Fig. 15 — Typical maximum-clock-frequency vs. supply voltage.

# 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, $t_{PHL}, t_{PLH}$	5	—	300	600	ns
Clock to Serial Output $Q_S$	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	—	—	$\mu\text{s}$
	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

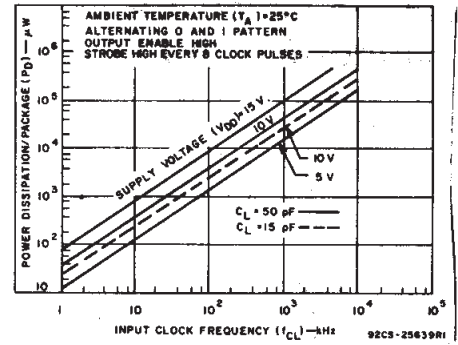


Fig. 16 - Dynamic power dissipation vs input clock frequency.

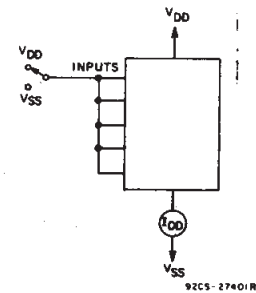


Fig. 17 - Quiescent device current test circuit.

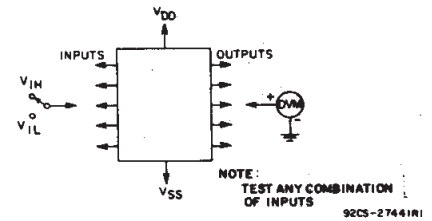


Fig. 18 - Input voltage test circuit.

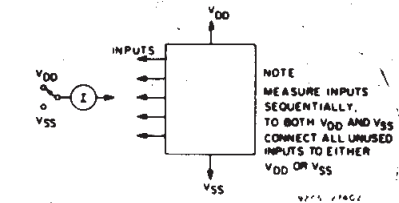
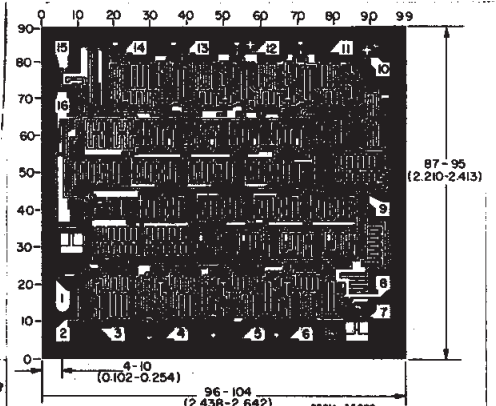


Fig. 19 - Input current test circuit.



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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