

Data sheet acquired from Harris Semiconductor SCHS063B – Revised July 2003

# 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 QS 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.

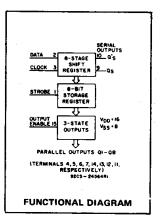
The CD4094B types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (NSR suffix), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

#### 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<sub>DD</sub> = 5 V
   2 V at V<sub>DD</sub> = 10 V
   2.5 V at V<sub>DD</sub> = 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



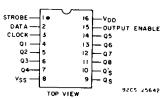
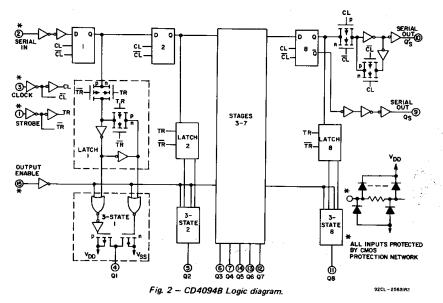


Fig. 1 - Terminal assignment.

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

	DC SUPPLY-VOLTAGE RANGE, (V <sub>DD</sub> )
0.5V to +20V	Voltages referenced to VSS Terminal)
0.5V to Vnn +0.5V	INPUT VOLTAGE RANGE, ALL INPUTS
±10mA	DC INPUT CURRENT, ANY ONE INPUT
	POWER DISSIPATION PER PACKAGE (PD):
500mW	For T <sub>A</sub> = -55°C to +100°C
rate Linearity at 12mW/OC to 200mW	For T <sub>A</sub> = +100°C to +125°C
•	DEVICE DISSIPATION PER OUTPUT TRANSISTOR
100mW	FOR TA = FULL PACKAGE-TEMPERATURE RANGE (All Package Ty
55°C to +125°C	OPERATING-TEMPERATURE RANGE (TA)
65°C to +150°C	STORAGE TEMPERATURE RANGE (Tstg)
	LEAD TEMPERATURE (DURING SOLDERING):
1.20500	At distance 1/16 + 1/32 inch (1.59 + 0.79mm) from case for 10e may



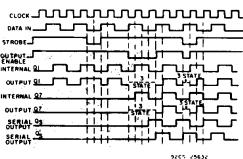


Fig. 3 — Timing diagram.

### CD4094B Types

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

OUADA OTERICTIO	VDD	LIR			
CHARACTERISTIC	(V)	MIN.	MAX.	UNITS	
Supply-Voltage Range (For TA=Full Package-Temperature Range)		3	18	V	
	5	125	_		
Data Setup Time, ts	10	55		ns	
	15	35	-	1	
	5	200	_		
Clock Pulse Width, tw	10	100	-	ns	
	15	83			
	5		1.25		
Clock Input Frequency, fCL	10	dc		MHz	
	5 125 - 10 55 - 15 35 -  5 200 - 10 100 - 15 83 -  5 4c 2.5 15 3  5 10 - 15 5				
Clock Input Rise or Fall time,	5	1	15		
t <sub>r</sub> CL, t <sub>f</sub> CL:*	15	_	5	μς	
, , , , , , , , , , , , , , , , , , , ,	5	200	-		
Strobe Pulse Width, tw	10	80	-	ns	
	15	70	- :		

<sup>\*</sup>If more than one unit is cascaded trCL (for QS 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.

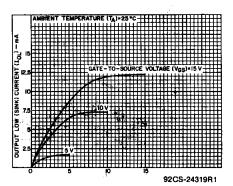


Fig. 5 - Minimum output low (sink) current characteristics.

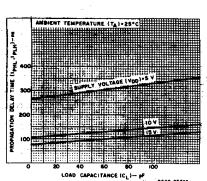


Fig. 8 - Clock-to-serial output Q<sub>S</sub> propagation delay vs C delay vs C<sub>L</sub>.

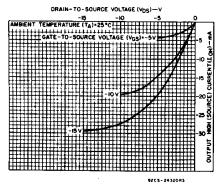


Fig. 6 - Typical output high (source) current characteristics.

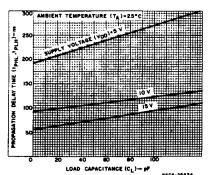


Fig. 9 — Clock-to-serial output  $Q'_{S}$  propagation delay vs CL.

TRUTH TABLE

CL▲	Output	Strobe	Data		railei tputs	Se Out	rial puts
	Enable	311000	Date	Q1	QN	œ.	0.2
7	0	х	х	ос	ос	Q7	NC
🥄	0	×	x	ос	ос	NC	Q7
<u> </u>	- 1	0	x	NC.	NC	Q7	NC
<b>-</b>	1	1 1	Ö	0	QN-1	<b>Q</b> 7	NC
[	1	1	1	1	QN-1	Q7	NC
	1	۱ ،	1	NC	NC	NC	Q7

- 4 = Level Change X = Don't Care NC = No Change
- Logic 1 ≡ High Logic 0 ≡ Low
- OC = Open Circuit
- At the positive clock edge information in the 7th shift register stage is transferred to the 8th register stage and the OS output.

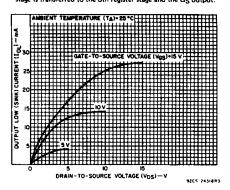


Fig. 4 - Typical output low (sink) current characteristics.

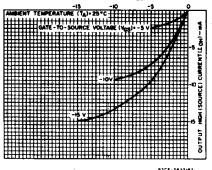


Fig. 7 - Minimum output high (source) current characteristics.

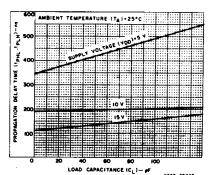


Fig. 10 — Clock-to-parallel output propagation delay vs  $C_L$ .

### CD4094B Types

#### STATIC ELECTRICAL CHARACTERISTICS

CHARACTER-	COND	OITIO	ıs	LIMI	LIMITS AT INDICATED TEMPERATURES (°C)						
ISTIC	Vo	VIN	VDD			<del></del>			+25	T	UNITS
	(V)	(V)	(V)	-55	-40	+85	+125	Min.	Тур.	Max.	L
Quiescent Device	-	0,5	5	5	5	150	150	-	0.04	5	
Current,	_	0,10	10	10	10	300	300		0.04	-10	μΑ
IDD Max.		0,15	15	20	20	600	600	- ,	0.04	20	1 1 1
	_	0,20	20	100	100	3000	3000	- ;	0.08	100	:
Output Low	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1	-	
(Sink) Current	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	-	
Output High (Source) Current, IOH Min.	1.5	0,15	15	4.2	4	2.8	2.4	34	6.8		
	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	1,0	-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:	1 =	0,5	5	2	0	.05			0	0.05	
Low Level, VOL Max.	-	0,10	10		0	.05			0	0.05	
VOL Wax.	_	0,15	15		ō	.05		- :	0	0.05	l v
Output Voltage:	-	0,5	5		4	.95		4.95	5	-	`
High-Level,	-	0,10	.10		9	.95		9.95	10	-	
VOH Min.	_	0,15	15		14	1.95		14.95	15	-	
Input Low	0.5, 4.5	-	5		1	1.5		_	_	1.5	
Voltage,	1, 9	_	10			3		_	_	3	}
VIL Max.	1.5,13.5	_	15			4				4	
Input High	0.5, 4.5	-	5			3.5		3.5	_		٧
Voltage,	1, 9	_	10			7		7			
VIH Min.	1.5,13.5	-	15			11		11	-		· ·
Input Current IJN Max.		0,18	18	±0.1	±0.1	±1	±1	-	±10-5	±0.1	μА
3 State Output Leakage Current IOUT Max.	0,18	0,18	18	±0.4	±0.4	±12	±12		±10 <sup>4</sup>	±0.4	μА

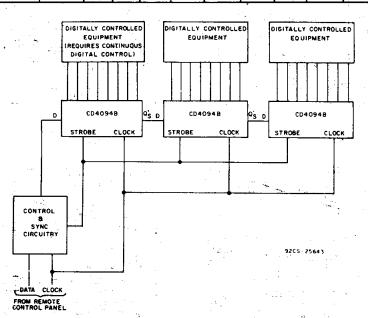


Fig. 14 - Remote control holding register.

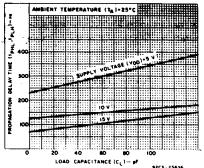


Fig. 11 – Strobe-to-parallel output propagation delay vs C<sub>L</sub>.

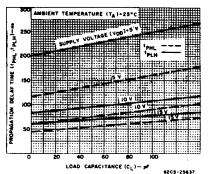


Fig. 12 — Output enable-to-parallel output propagation delay vs  $C_L$ .

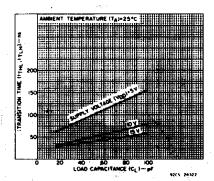


Fig. 13 - Typical transition time vs. load capacitance.

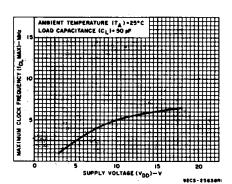
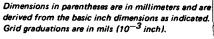


Fig. 15 — Typical maximum-clock-frequency vs. supply voltage.

#### **DYNAMIC ELECTRICAL CHARACTERISTICS**

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

CHARACTERISTIC	Van		LIMITS			
on and teniorio	VDD (V)	MIN.	TYP.	MAX.	UNITS	
Propagation Delay Time,			1			
tPHL, tPLH	_		200	000		
Clock to Serial Output Q <sub>S</sub>	10	_	300 125	600 250		
clock to Serial Output QS	15	_	95	190	ns	
	5	<del> </del>	230	460		
Clock to Serial Output Q'S	10	_	110	220	l ns	
3	15	_	75	150		
	5	_	420	840		
Clock to Parallel Output	10	-	195	390	ns	
	15	-	135	270		
	- 5	_	290	580		
Strobe to Parallel Output	10	-	145	290	ns	
	15		100	200		
Output Enable to Parallel	5	-	140	280		
Output:	10	-	60	120	ns	
tPHZ <sup>, t</sup> PZH	15	_	45	90	, ,	
<b>4</b>	5	-	100	200		
<sup>t</sup> PLZ <sup>, t</sup> PZL	10	-	50	100	пs	
	15	-	40	80		
Minimum Strobe Pulse	5	-	100	200		
Width, tw	10	-	. 40	80	ns	
	15		35	70		
Minimum Clock Pulse	5	-	100	200		
Width, tw	10	_	50	100	ns	
	15		40	83		
Minimum Data Setup	5	_	60	125		
Time, t <sub>S</sub>	10	-	30	55	ns	
	15		20	35		
Transition Time;	5	-	100	200		
THL, TLH	10	-	50	100	ns	
	15		40	80		
Maximum Clock Input Rise	5 10	15 5	_	_	μs	
or Fall Time, t <sub>F</sub> CL, t <sub>f</sub> CL	15	5			μs 	
Maximum Clock Input	5	1.25	2.5			
Frequency, fCL	10	2.5	5	-	MHz	
	15	3	6		<del></del>	
Input Capacitance C <sub>IN</sub>	_	_	5	7.5	pF	
(Any Input)		1	1		Α.	



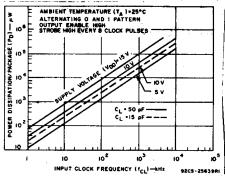


Fig. 16 – Dynamic power dissipation vs input clock frequency.

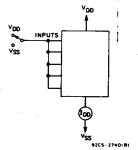


Fig. 17 — Quiescent device current test circuit.

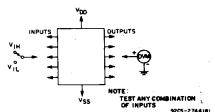


Fig. 18 - Input voltage test circuit.

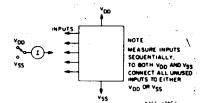
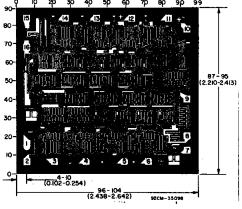


Fig. 19 - Input current test circuit.



Dimensions and Pad Layout for CD4094B Chip.





25-Sep-2013

#### **PACKAGING INFORMATION**

Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
7702501EA	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	7702501EA CD4094BF3A	Samples
CD4094BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-55 to 125	CD4094BE	Samples
CD4094BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-55 to 125	CD4094BE	Samples
CD4094BF	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	CD4094BF	Samples
CD4094BF3A	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	7702501EA CD4094BF3A	Samples
CD4094BNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4094B	Samples
CD4094BNSRE4	ACTIVE	so	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4094B	Samples
CD4094BNSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4094B	Samples
CD4094BPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM094B	Samples
CD4094BPWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM094B	Samples
CD4094BPWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM094B	Samples
CD4094BPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM094B	Samples
CD4094BPWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM094B	Samples
CD4094BPWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CM094B	Samples

<sup>(1)</sup> 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.

### PACKAGE OPTION ADDENDUM



25-Sep-2013

(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.
- (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.

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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

### PACKAGE MATERIALS INFORMATION

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### TAPE AND REEL INFORMATION





A0	<u> </u>
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

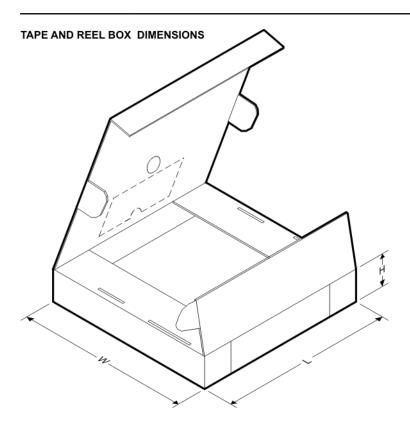
### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



#### \*All dimensions are nominal

Device	Package Type	Package Drawing			Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD4094BPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

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#### \*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)	
CD4094BPWR	TSSOP	PW	16	2000	367.0	367.0	35.0	

### 14 LEADS SHOWN



- 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\*\*)

### PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- 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.



PW (R-PDSO-G16)

### PLASTIC SMALL OUTLINE



- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M—1994.
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
- 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



- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. 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.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



### **MECHANICAL DATA**

### NS (R-PDSO-G\*\*)

# 14-PINS SHOWN

### PLASTIC SMALL-OUTLINE PACKAGE



- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.



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