

December 1992

### Features

- High Voltage Type (20V Rating)
- 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 - 5MHz at 10V (typ)
- Standardized Symmetrical Output Characteristics
- 100% Tested for Quiescent Current at 20V
- Maximum Input Current of 1 $\mu$ A at 18V Over Full Package Temperature Range; 100nA at 18V and +25 $^{\circ}$ C
- Noise Margin (Over Full Package/Temperature Range)
  - 1V at VDD = 5V
  - 2V at VDD = 10V
  - 2.5V at VDD = 15V
- 5V, 10V and 15V 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

### Description

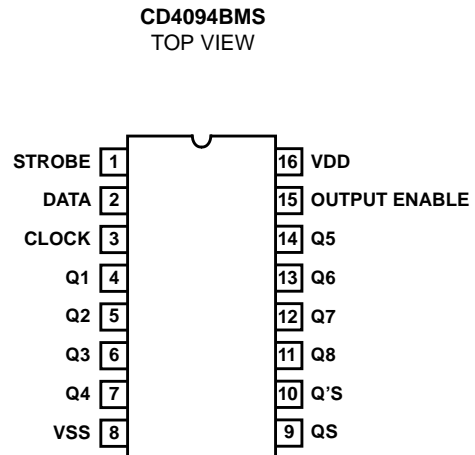
CD4094BMS is a 8-stage serial shift register having a storage latch associated with each stage for strobing data from the serial input to parallel buffered 3-state outputs. The parallel outputs may be connected directly to common bus lines. Data is shifted on positive clock transitions. The data in each 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 CD4094BMS 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 CD4094BMS devices when the clock rise time is slow.

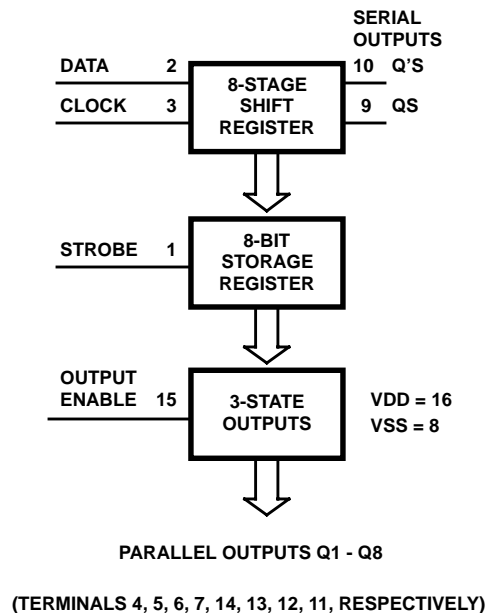
The CD4094BMS is supplied in these 16 lead outline packages:

Braze Seal DIP	H4X
Frit Seal DIP	H1F
Ceramic Flatpack	H6W

### Pinout



### Functional Diagram



# Specifications CD4094BMS

## Absolute Maximum Ratings

DC Supply Voltage Range, (VDD) . . . . .	-0.5V to +20V (Voltage Referenced to VSS Terminals)
Input Voltage Range, All Inputs . . . . .	-0.5V to VDD +0.5V
DC Input Current, Any One Input . . . . .	±10mA
Operating Temperature Range . . . . .	-55°C to +125°C Package Types D, F, K, H
Storage Temperature Range (TSTG) . . . . .	-65°C to +150°C
Lead Temperature (During Soldering) . . . . .	+265°C At Distance 1/16 ± 1/32 Inch (1.59mm ± 0.79mm) from case for 10s Maximum

## Reliability Information

Thermal Resistance . . . . .	$\theta_{ja}$	$\theta_{jc}$
Ceramic DIP and FRIT Package . . . . .	80°C/W	20°C/W
Flatpack Package . . . . .	70°C/W	20°C/W
Maximum Package Power Dissipation (PD) at +125°C		
For TA = -55°C to +100°C (Package Type D, F, K) . . . . .	500mW	
For TA = +100°C to +125°C (Package Type D, F, K) . . . . .	Derate Linearity at 12mW/°C to 200mW	
Device Dissipation per Output Transistor . . . . .	100mW	
For TA = Full Package Temperature Range (All Package Types)		
Junction Temperature . . . . .	+175°C	

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITIONS (NOTE 1)	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS	
					MIN	MAX		
Supply Current	IDD	VDD = 20V, VIN = VDD or GND	1	+25°C	-	10	μA	
			2	+125°C	-	1000	μA	
		VDD = 18V, VIN = VDD or GND	3	-55°C	-	10	μA	
Input Leakage Current	IIL	VIN = VDD or GND	VDD = 20	1	+25°C	-100	-	nA
				2	+125°C	-1000	-	nA
			VDD = 18V	3	-55°C	-100	-	nA
Input Leakage Current	IIH	VIN = VDD or GND	VDD = 20	1	+25°C	-	100	nA
				2	+125°C	-	1000	nA
			VDD = 18V	3	-55°C	-	100	nA
Output Voltage	VOL15	VDD = 15V, No Load	1, 2, 3	+25°C, +125°C, -55°C	-	50	mV	
Output Voltage	VOH15	VDD = 15V, No Load (Note 3)	1, 2, 3	+25°C, +125°C, -55°C	14.95	-	V	
Output Current (Sink)	IOL5	VDD = 5V, VOUT = 0.4V	1	+25°C	0.53	-	mA	
Output Current (Sink)	IOL10	VDD = 10V, VOUT = 0.5V	1	+25°C	1.4	-	mA	
Output Current (Sink)	IOL15	VDD = 15V, VOUT = 1.5V	1	+25°C	3.5	-	mA	
Output Current (Source)	IOH5A	VDD = 5V, VOUT = 4.6V	1	+25°C	-	-0.53	mA	
Output Current (Source)	IOH5B	VDD = 5V, VOUT = 2.5V	1	+25°C	-	-1.8	mA	
Output Current (Source)	IOH10	VDD = 10V, VOUT = 9.5V	1	+25°C	-	-1.4	mA	
Output Current (Source)	IOH15	VDD = 15V, VOUT = 13.5V	1	+25°C	-	-3.5	mA	
N Threshold Voltage	VNTH	VDD = 10V, ISS = -10μA	1	+25°C	-2.8	-0.7	V	
P Threshold Voltage	VPTH	VSS = 0V, IDD = 10μA	1	+25°C	0.7	2.8	V	
Functional	F	VDD = 2.8V, VIN = VDD or GND	7	+25°C	VOH > VDD/2	VOL < VDD/2	V	
		VDD = 20V, VIN = VDD or GND	7	+25°C				
		VDD = 18V, VIN = VDD or GND	8A	+125°C				
		VDD = 3V, VIN = VDD or GND	8B	-55°C				
Input Voltage Low (Note 2)	VIL	VDD = 5V, VOH > 4.5V, VOL < 0.5V	1, 2, 3	+25°C, +125°C, -55°C	-	1.5	V	
Input Voltage High (Note 2)	VIH	VDD = 5V, VOH > 4.5V, VOL < 0.5V	1, 2, 3	+25°C, +125°C, -55°C	3.5	-	V	
Input Voltage Low (Note 2)	VIL	VDD = 15V, VOH > 13.5V, VOL < 1.5V	1, 2, 3	+25°C, +125°C, -55°C	-	4	V	
Input Voltage High (Note 2)	VIH	VDD = 15V, VOH > 13.5V, VOL < 1.5V	1, 2, 3	+25°C, +125°C, -55°C	11	-	V	
Tri-State Output Leakage	IOZL	VIN = VDD or GND VOUT = 0V	VDD = 20V	1	+25°C	-0.4	-	μA
				2	+125°C	-12	-	μA
			VDD = 18V	3	-55°C	-0.4	-	μA
Tri-State Output Leakage	IOZH	VIN = VDD or GND VOUT = VDD	VDD = 20V	1	+25°C	-	0.4	μA
				2	+125°C	-	12	μA
			VDD = 18V	3	-55°C	-	0.4	μA

NOTES: 1. All voltages referenced to device GND, 100% testing being implemented. 2. Go/No Go test with limits applied to inputs. 3. For accuracy, voltage is measured differentially to VDD. Limit is 0.050V max.

## Specifications CD4094BMS

**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Propagation Delay Clock to Serial Output QS	TPHL1 TPLH1	VDD = 5V, VIN = VDD or GND (Note 1, 2)	9	+25°C	-	600	ns
			10, 11	+125°C, -55°C	-	810	ns
Propagation Delay Clock to Serial Output Q'S	TPHL2 TPLH2	VDD = 5V, VIN = VDD or GND (Note 1, 2)	9	+25°C	-	460	ns
			10, 11	+125°C, -55°C	-	621	ns
Propagation Delay Clock to Parallel Output	TPHL3 TPLH3	VDD = 5V, VIN = VDD or GND (Note 1, 2)	9	+25°C	-	840	ns
			10, 11	+125°C, -55°C	-	1134	ns
Propagation Delay Strobe to Parallel Output	TPHL4 TPLH4	VDD = 5V, VIN = VDD or GND (Note 1, 2)	9	+25°C	-	580	ns
			10, 11	+125°C, -55°C	-	783	ns
Propagation Delay Output Enable to Parallel Output	TPHZ TPZH	VDD = 5V, VIN = VDD or GND (Note 2, 3)	9	+25°C	-	280	ns
			10, 11	+125°C, -55°C	-	378	ns
Propagation Delay Output Enable to Parallel Output	TPLZ TPZL	VDD = 5V, VIN = VDD or GND (Note 2, 3)	9	+25°C	-	200	ns
			10, 11	+125°C, -55°C	-	270	ns
Transition Time	TTHL TTLH	VDD = 5V, VIN = VDD or GND (Note 1, 2)	9	+25°C	-	200	ns
			10, 11	+125°C, -55°C	-	270	ns
Maximum Clock Input Frequency	FCL	VDD = 5V, VIN = VDD or GND (Note 1, 2)	9	+25°C	1.25	-	MHz
			10, 11	+125°C, -55°C	.93	-	MHz

**NOTES:**

1. CL = 50pF, RL = 200K, Input TR, TF < 20ns.
2. -55°C and +125°C limits guaranteed, 100% testing being implemented.
3. CL = 50pF, RL = 1K, Input TR, TF < 20ns.

**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Supply Current	IDD	VDD = 5V, VIN = VDD or GND	1, 2	-55°C, +25°C	-	5	μA
				+125°C	-	150	μA
		VDD = 10V, VIN = VDD or GND	1, 2	-55°C, +25°C	-	10	μA
				+125°C	-	300	μA
				VDD = 15V, VIN = VDD or GND	1, 2	-55°C, +25°C	-
+125°C	-	600	μA				
Output Voltage	VOL	VDD = 5V, No Load	1, 2	+25°C, +125°C, -55°C	-	50	mV
Output Voltage	VOL	VDD = 10V, No Load	1, 2	+25°C, +125°C, -55°C	-	50	mV
Output Voltage	VOH	VDD = 5V, No Load	1, 2	+25°C, +125°C, -55°C	4.95	-	V
Output Voltage	VOH	VDD = 10V, No Load	1, 2	+25°C, +125°C, -55°C	9.95	-	V
Output Current (Sink)	IOL5	VDD = 5V, VOUT = 0.4V	1, 2	+125°C	0.36	-	mA
				-55°C	0.64	-	mA
Output Current (Sink)	IOL10	VDD = 10V, VOUT = 0.5V	1, 2	+125°C	0.9	-	mA
				-55°C	1.6	-	mA

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**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)**

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Output Current (Sink)	IOL15	VDD = 15V, VOUT = 1.5V	1, 2	+125°C	2.4	-	mA
				-55°C	4.2	-	mA
Output Current (Source)	IOH5A	VDD = 5V, VOUT = 4.6V	1, 2	+125°C	-	-0.36	mA
				-55°C	-	-0.64	mA
Output Current (Source)	IOH5B	VDD = 5V, VOUT = 2.5V	1, 2	+125°C	-	-1.1	mA
				-55°C	-	-2.0	mA
Output Current (Source)	IOH10	VDD = 10V, VOUT = 9.5V	1, 2	+125°C	-	-0.9	mA
				-55°C	-	-2.6	mA
Output Current (Source)	IOH15	VDD = 15V, VOUT = 13.5V	1, 2	+125°C	-	-2.4	mA
				-55°C	-	-	mA
Input Voltage Low	VIL	VDD = 10V, VOH > 9V, VOL < 1V	1, 2	+25°C, +125°C, -55°C	-	3	V
Input Voltage High	VIH	VDD = 10V, VOH > 9V, VOL < 1V	1, 2	+25°C, +125°C, -55°C	7	-	V
Propagation Delay Clock to Serial Output Qs	TPHL1 TPLH1	VDD = 10V	1, 2, 3	+25°C	-	250	ns
		VDD = 15V	1, 2, 3	+25°C	-	190	ns
Propagation Delay Clock to Serial Output Q's	TPHL2 TPLH2	VDD = 10V	1, 2, 3	+25°C	-	220	ns
		VDD = 15V	1, 2, 3	+25°C	-	150	ns
Propagation Delay Clock to Parallel Output	TPHL3 TPLH3	VDD = 10V	1, 2, 3	+25°C	-	390	ns
		VDD = 15V	1, 2, 3	+25°C	-	270	ns
Propagation Delay Strobe to Parallel Output	TPHL4 TPLH4	VDD = 10V	1, 2, 3	+25°C	-	290	ns
		VDD = 15V	1, 2, 3	+25°C	-	200	ns
Propagation Delay Output Enable to Parallel Output	TPHZ TPZH	VDD = 10V	1, 2, 4	+25°C	-	120	ns
		VDD = 15V	1, 2, 4	+25°C	-	90	ns
Propagation Delay Output Enable to Parallel Output	TPLZ TPZL	VDD = 10V	1, 2, 4	+25°C	-	100	ns
		VDD = 15V	1, 2, 4	+25°C	-	80	ns
Transition Time	TTLH TTHL	VDD = 10V	1, 2, 3	+25°C	-	100	ns
		VDD = 15V	1, 2, 3	+25°C	-	80	ns
Maximum Clock Input Frequency	FCL	VDD = 10V	1, 2, 3	+25°C	2.5	-	MHz
		VDD = 15V	1, 2, 3	+25°C	3	-	MHz
Minimum Data Setup Time	TS	VDD = 5V	1, 2, 3	+25°C	-	125	ns
		VDD = 10V	1, 2, 3	+25°C	-	55	ns
		VDD = 15V	1, 2, 3	+25°C	-	35	ns
Maximum Clock Input Rise and Fall Time	TRCL TFCL	VDD = 5V	1, 2, 3, 5	+25°C	-	15	μs
		VDD = 10V	1, 2, 3, 5	+25°C	-	5	μs
		VDD = 15V	1, 2, 3, 5	+25°C	-	5	μs
Minimum Clock Pulse Width	TW	VDD = 5V	1, 2, 3	+25°C	-	200	ns
		VDD = 10V	1, 2, 3	+25°C	-	100	ns
		VDD = 15V	1, 2, 3	+25°C	-	83	ns

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**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)**

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Minimum Strobe Pulse Width	TW	VDD = 5V	1, 2, 3	+25°C	-	200	ns
		VDD = 10V	1, 2, 3	+25°C	-	80	ns
		VDD = 15V	1, 2, 3	+25°C	-	70	ns
Input Capacitance	CIN	Any Input	1, 2	+25°C	-	7.5	pF

**NOTES:**

1. All voltages referenced to device GND.
2. The parameters listed on Table 3 are controlled via design or process and are not directly tested. These parameters are characterized on initial design release and upon design changes which would affect these characteristics.
3. CL = 50pF, RL = 200K, Input TR, TF < 20ns.
4. CL = 50pF, RL = 1K, Input TR, TF < 20ns.
5. If more than one unit is cascaded, TRCL should be made less than or equal to the sum of the transition time and the fixed propagation delay of the output of the driving stage for the estimated capacitive load.

**TABLE 4. POST IRRADIATION ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Supply Current	IDD	VDD = 20V, VIN = VDD or GND	1, 4	+25°C	-	25	μA
N Threshold Voltage	VNTH	VDD = 10V, ISS = -10μA	1, 4	+25°C	-2.8	-0.2	V
N Threshold Voltage Delta	ΔVTN	VDD = 10V, ISS = -10μA	1, 4	+25°C	-	±1	V
P Threshold Voltage	VTP	VSS = 0V, IDD = 10μA	1, 4	+25°C	0.2	2.8	V
P Threshold Voltage Delta	ΔVTP	VSS = 0V, IDD = 10μA	1, 4	+25°C	-	±1	V
Functional	F	VDD = 18V, VIN = VDD or GND	1	+25°C	VOH > VDD/2	VOL < VDD/2	V
		VDD = 3V, VIN = VDD or GND					
Propagation Delay Time	TPHL TPLH	VDD = 5V	1, 2, 3, 4	+25°C	-	1.35 x +25°C Limit	ns

- NOTES: 1. All voltages referenced to device GND. 2. CL = 50pF, RL = 200K, Input TR, TF < 20ns. 3. See Table 2 for +25°C limit. 4. Read and Record

**TABLE 5. BURN-IN AND LIFE TEST DELTA PARAMETERS +25°C**

PARAMETER	SYMBOL	DELTA LIMIT
Supply Current - MSI-2	IDD	± 1.0μA
Output Current (Sink)	IOL5	± 20% x Pre-Test Reading
Output Current (Source)	IOH5A	± 20% x Pre-Test Reading

**TABLE 6. APPLICABLE SUBGROUPS**

CONFORMANCE GROUP	MIL-STD-883 METHOD	GROUP A SUBGROUPS	READ AND RECORD
Initial Test (Pre Burn-In)	100% 5004	1, 7, 9	IDD, IOL5, IOH5A

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**TABLE 6. APPLICABLE SUBGROUPS**

CONFORMANCE GROUP		MIL-STD-883 METHOD	GROUP A SUBGROUPS	READ AND RECORD
Interim Test 1 (Post Burn-In)		100% 5004	1, 7, 9	IDD, IOL5, IOH5A
Interim Test 2 (Post Burn-In)		100% 5004	1, 7, 9	IDD, IOL5, IOH5A
PDA (Note 1)		100% 5004	1, 7, 9, Deltas	
Interim Test 3 (Post Burn-In)		100% 5004	1, 7, 9	IDD, IOL5, IOH5A
PDA (Note 1)		100% 5004	1, 7, 9, Deltas	
Final Test		100% 5004	2, 3, 8A, 8B, 10, 11	
Group A		Sample 5005	1, 2, 3, 7, 8A, 8B, 9, 10, 11	
Group B	Subgroup B-5	Sample 5005	1, 2, 3, 7, 8A, 8B, 9, 10, 11, Deltas	Subgroups 1, 2, 3, 9, 10, 11
	Subgroup B-6	Sample 5005	1, 7, 9	
Group D		Sample 5005	1, 2, 3, 8A, 8B, 9	Subgroups 1, 2 3

NOTE: 1. 5% Parametric, 3% Functional; Cumulative for Static 1 and 2.

**TABLE 7. TOTAL DOSE IRRADIATION**

CONFORMANCE GROUPS	MIL-STD-883 METHOD	TEST		READ AND RECORD	
		PRE-IRRAD	POST-IRRAD	PRE-IRRAD	POST-IRRAD
Group E Subgroup 2	5005	1, 7, 9	Table 4	1, 9	Table 4

**TABLE 8. BURN-IN AND IRRADIATION TEST CONNECTIONS**

FUNCTION	OPEN	GROUND	VDD	9V ± -0.5V	OSCILLATOR	
					50kHz	25kHz
Static Burn-In 1 (Note 1)	4 - 7, 9 - 14	1 - 3, 8, 15	16			
Static Burn-In 2 (Note 1)	4 - 7, 9 - 14	8	1 - 3, 15, 16			
Dynamic Burn-In (Note 1)	-	8	1, 15, 16	4 - 7, 9 - 14	3	2
Irradiation (Note 2)	4 - 7, 9 - 14	8	1 - 3, 15, 16			

NOTES:

- Each pin except VDD and GND will have a series resistor of  $10K \pm 5\%$ ,  $VDD = 18V \pm 0.5V$
- Each pin except VDD and GND will have a series resistor of  $47K \pm 5\%$ ; Group E, Subgroup 2, sample size is 4 dice/wafer, 0 failures,  $VDD = 10V \pm 0.5V$

# CD4094BMS

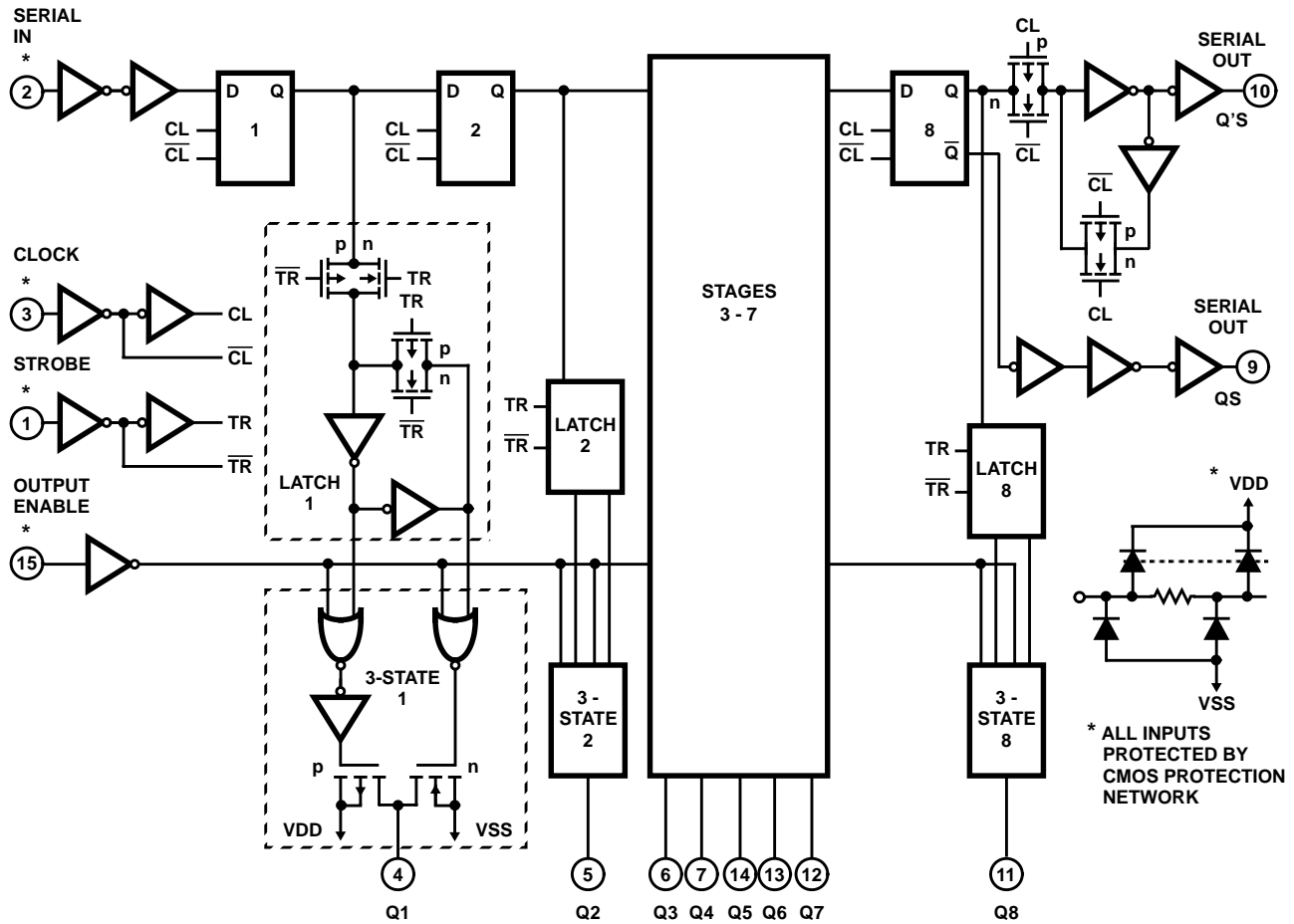


FIGURE 1. LOGIC DIAGRAM

## TRUTH TABLE

CL $\Delta$	OUTPUT ENABLE	STROBE	DATA	PARALLEL OUTPUTS		SERIAL OUTPUTS	
				Q1	QN	QS*	Q'S
	0	X	X	OC	OC	Q7	NC
	0	X	X	OC	OC	NC	Q7
	1	0	X	NC	NC	Q7	NC
	1	1	0	0	QN-1	Q7	NC
	1	1	1	1	QN-1	Q7	NC
	1	1	1	NC	NC	NC	Q7

$\Delta$  = Level Change

X = Don't Care

NC = No Change

OC = Open Circuit

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

Logic 1 = High

Logic 0 = Low

Typical Performance Characteristics

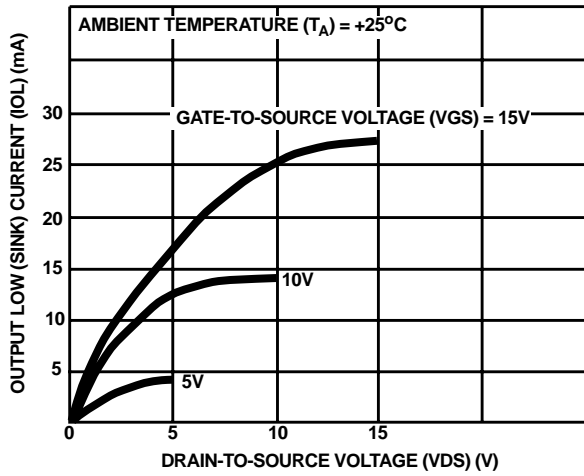


FIGURE 2. TYPICAL OUTPUT LOW (SINK) CURRENT TRANSFER CHARACTERISTICS

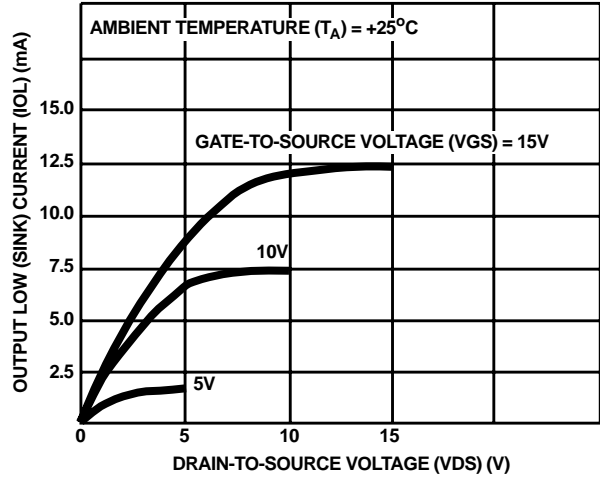


FIGURE 3. MINIMUM OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

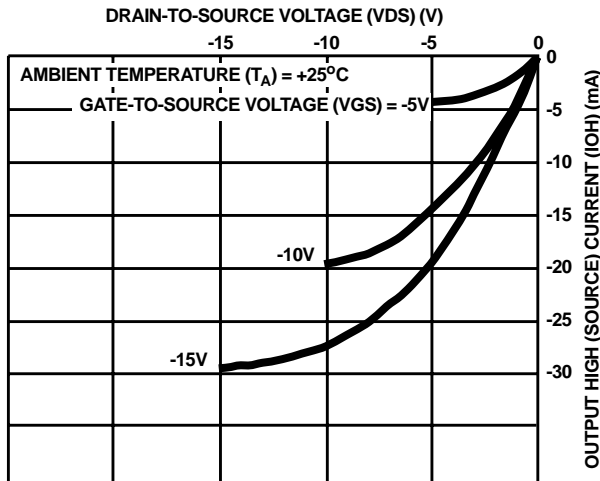


FIGURE 4. TYPICAL OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

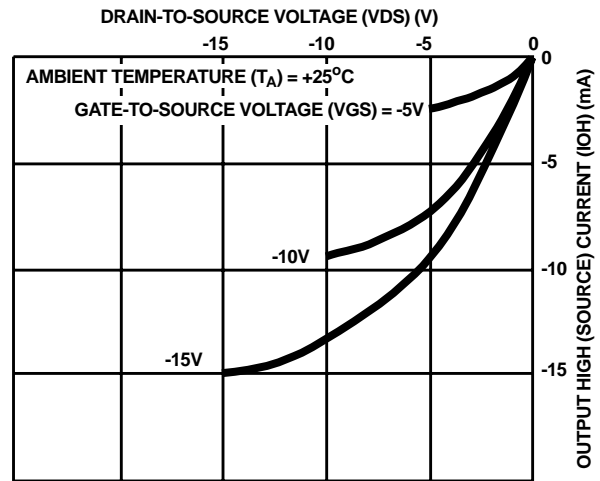


FIGURE 5. MINIMUM OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

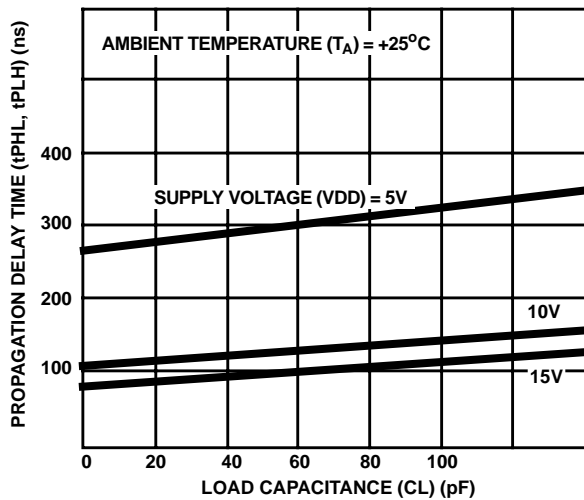


FIGURE 6. CLOCK-TO-SERIAL OUTPUT Q'S PROPAGATION DELAY vs CL

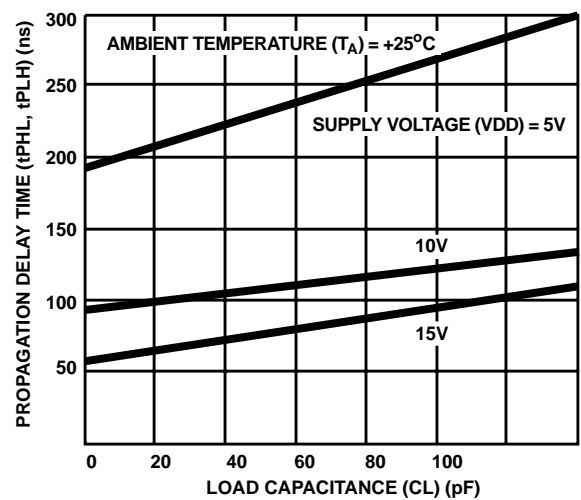


FIGURE 7. CLOCK-TO-SERIAL OUTPUT Q'S PROPAGATION DELAY vs CL



Typical Performance Characteristics (Continued)

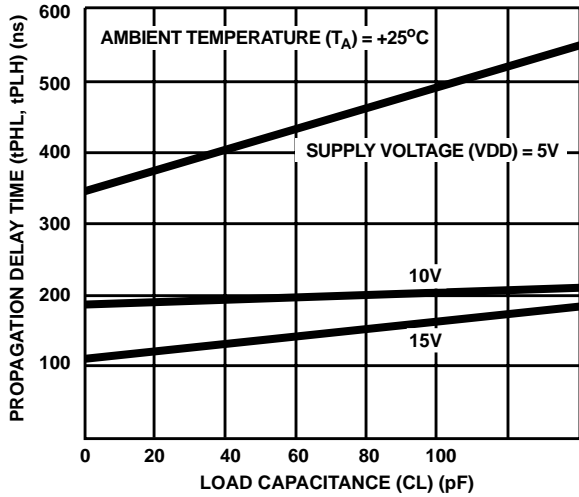


FIGURE 8. CLOCK-TO-PARALLEL OUTPUT PROPAGATION DELAY vs CL

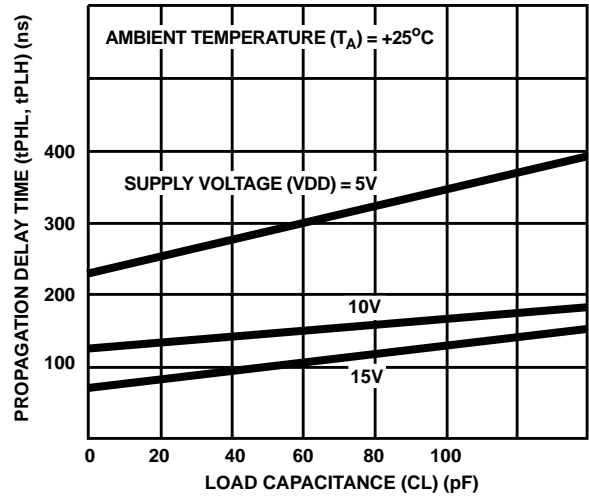


FIGURE 9. STROBE-TO-PARALLEL OUTPUT PROPAGATION DELAY vs CL

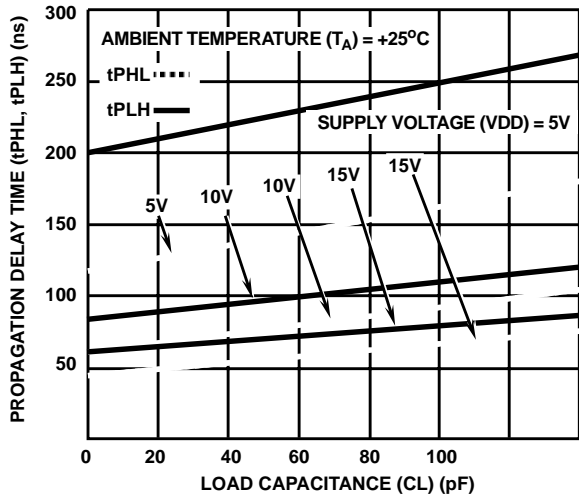


FIGURE 10. OUTPUT ENABLE-TO-PARALLEL OUTPUT PROPAGATION DELAY vs CL

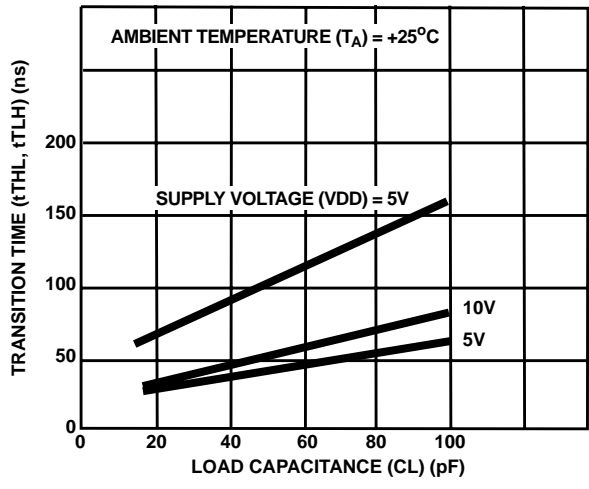


FIGURE 11. TYPICAL TRANSITION TIME vs LOAD CAPACITANCE

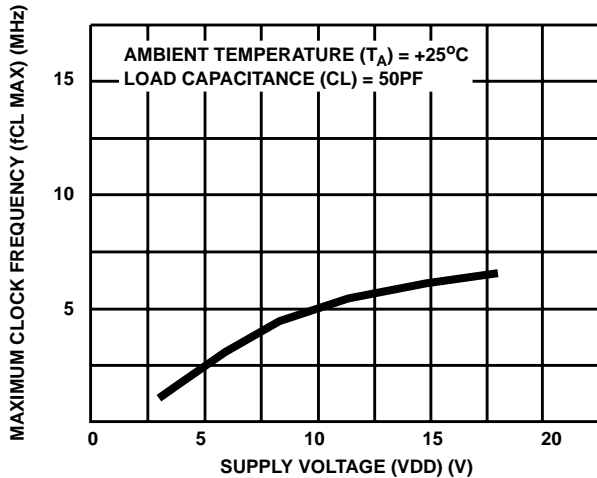


FIGURE 12. TYPICAL MAXIMUM-CLOCK-FREQUENCY vs SUPPLY VOLTAGE

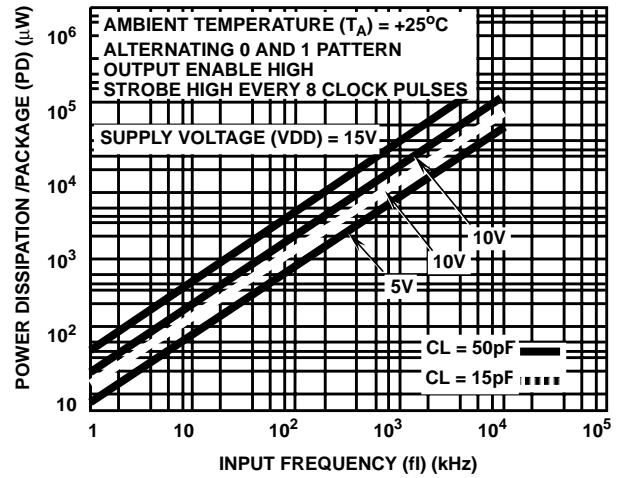


FIGURE 13. DYNAMIC POWER DISSIPATION vs INPUT CLOCK FREQUENCY

# CD4094BMS

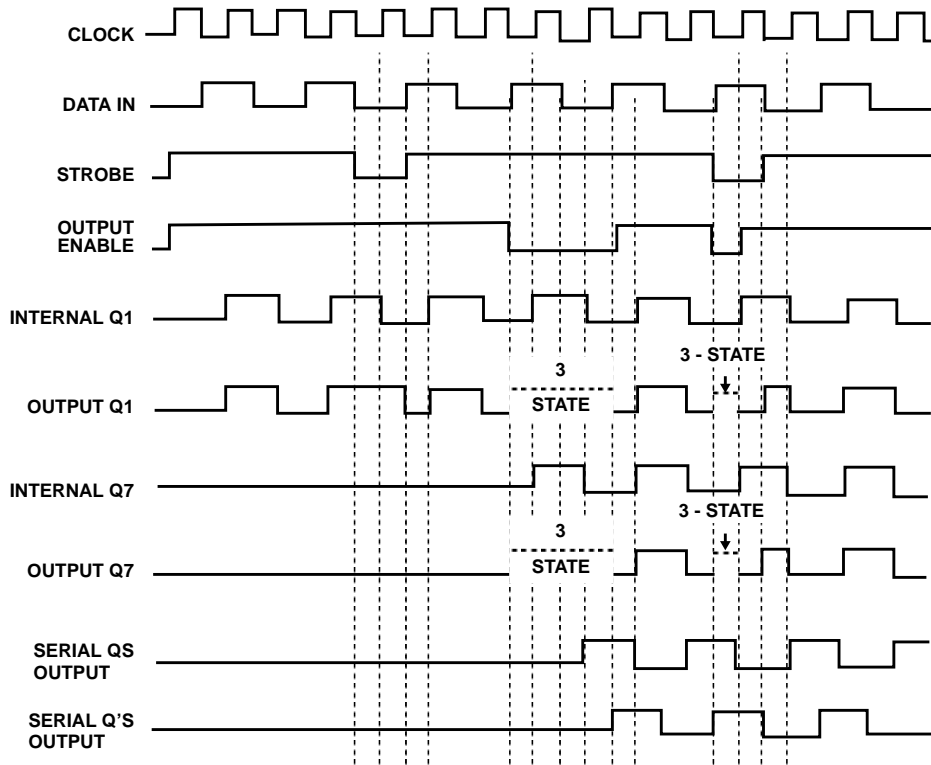


FIGURE 14. TIMING DIAGRAM

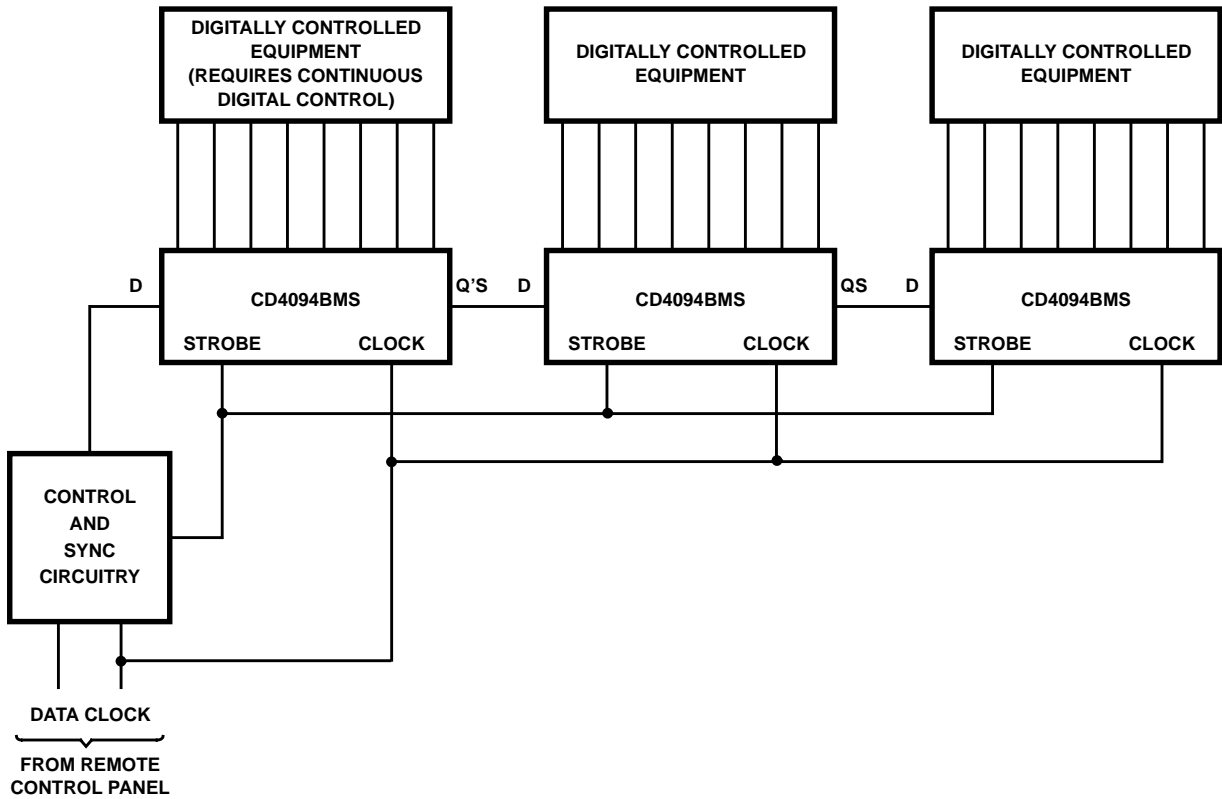
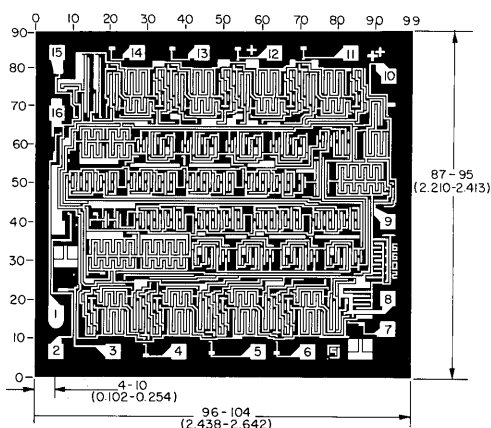


FIGURE 15. REMOTE CONTROL HOLDING REGISTER

**Chip Dimensions and Pad Layout**



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

- METALLIZATION:** Thickness:  $11\text{k}\text{\AA} - 14\text{k}\text{\AA}$ , AL.
- PASSIVATION:**  $10.4\text{k}\text{\AA} - 15.6\text{k}\text{\AA}$ , Silane
- BOND PADS:** 0.004 inches X 0.004 inches MIN
- DIE THICKNESS:** 0.0198 inches - 0.0218 inches

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