

# CD40104BMS, CD40194BMS

## CMOS 4-Bit Bidirectional Universal Shift Register

December 1992

### Features

- High Voltage Type (20V Rating)
- Medium Speed  $f_{CL} = 12\text{MHz}$  (typ.) at  $V_{DD} = 10\text{V}$
- Fully Static Operation
- Synchronous Parallel or Serial Operation
- Three State Outputs (CD40104BMS)
- Asynchronous Master Reset (CD40194BMS)
- 5V, 10V and 15V Parametric Ratings
- Standardized Symmetrical Output Characteristics
- Meets All Requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

### Applications

- Arithmetic Unit Bus Registers
- Serial/Parallel Conversions
- General Purpose Register for Bus Organized Systems
- General Purpose Registers

### Description

The CD40104BMS is a universal shift register featuring parallel inputs, parallel outputs, SHIFT RIGHT and SHIFT LEFT serial inputs, and a high impedance third output state allowing the device to be used in bus organized systems.

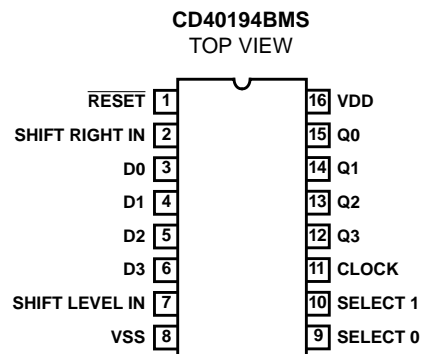
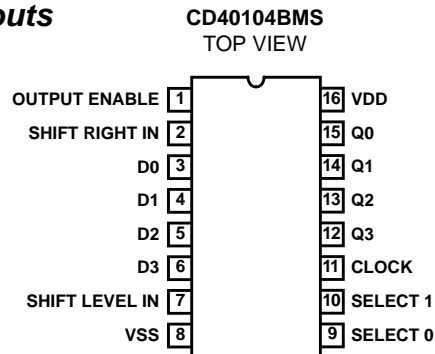
In the parallel load mode ( $S_0$  and  $S_1$  are high), data is loaded into the associated flip-flop and appears at the output after the positive transition of the CLOCK input. During loading, serial data flow is inhibited. Shift right and shift left are accomplished synchronously on the positive clock edge with serial data entered at the SHIFT RIGHT and SHIFT LEFT serial inputs, respectively. Clearing the register is accomplished by setting both mode controls low and clocking the register. When the output enable input is low, all outputs assume the high impedance state.

The CD40194BMS is a universal shift register featuring parallel inputs, parallel outputs SHIFT RIGHT and SHIFT LEFT serial inputs, and a direct overriding clear input. In the parallel load mode ( $S_0$  and  $S_1$  are high), data is loaded into the associated flip-flop and appears at the output after the positive transition of the CLOCK input. During loading, serial data flow is inhibited. Shift right and shift left are accomplished synchronously on the positive clock edge with data entered at the SHIFT RIGHT and SHIFT LEFT serial inputs, respectively. Clocking of the register is inhibited when both mode control inputs are low. When low, the RESET input resets all stages and forces all outputs low. The CD40194BMS is similar to industry types 340194 and MC40194.

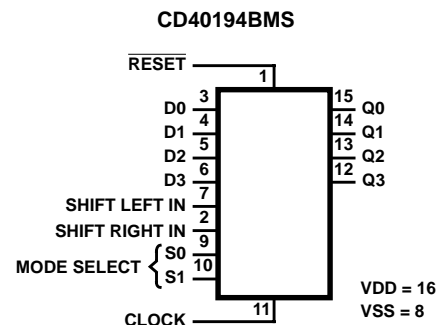
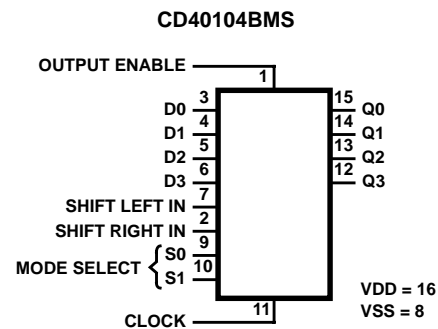
The CD40104BMS and CD40194BMS series types are supplied in these 16 lead outline packages

Braze Seal DIP	*HNX,	†H4W
Frit Seal DIP	*H1L,	†HIF
Ceramic Flatpack	H6W	
* CD40104B Only	†CD40194B Only	

### Pinouts



### Functional Diagrams



# Specifications CD40104BMS, CD40194BMS

## 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  $T_A = -55^\circ\text{C}$  to +100°C (Package Type D, F, K) ..... 500mW  
 For  $T_A = +100^\circ\text{C}$  to +125°C (Package Type D, F, K) ..... Derate  
 Linearity at 12mW/°C to 200mW  
 Device Dissipation per Output Transistor ..... 100mW  
 For  $T_A =$  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 = 20V	1	+25°C	-100	-	nA
			VDD = 18V	3	-55°C	-100	-	nA
		VIN = VDD or GND	VDD = 20V	2	+125°C	-1000	-	nA
Input Leakage Current	IIH	VIN = VDD or GND	VDD = 20V	1	+25°C	-	100	nA
			VDD = 18V	3	-55°C	-	100	nA
		VIN = VDD or GND	VDD = 20V	2	+125°C	-	1000	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
			VDD = 18V	3	-55°C	-0.4	-	μA
		VIN = VDD or GND VOUT = VDD	VDD = 20V	2	+125°C	-12	-	μA
Tri-State Output Leakage	IOZH	VIN = VDD or GND VOUT = VDD	VDD = 20V	1	+25°C	-	0.4	μA
			VDD = 18V	3	-55°C	-	0.4	μA
		VIN = VDD or GND VOUT = VDD	VDD = 20V	2	+125°C	-	12	μA

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

## Specifications CD40104BMS, CD40194BMS

**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITIONS	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Propagation Delay Clock to Q	TPHL TPLH	VDD = 5V, VIN = VDD or GND (Note 1, 2)	9	+25°C	-	440	ns
			10, 11	+125°C, -55°C	-	594	ns
Propagation Delay CD40194BMS Reset to Q	TPHL	VDD = 5V, VIN = VDD or GND (Note 1, 2)	9	+25°C	-	460	ns
			10, 11	+125°C, -55°C	-	621	ns
Propagation Delay CD40104BMS 3-State	TPZH TPZL TPLZ	VDD = 5V, VIN = VDD or GND (Note 2, 3)	9	+25°C	-	160	ns
			10, 11	+125°C, -55°C	-	216	ns
Propagation Delay CD40104BMS 3-State	TPHZ	VDD = 5V, VIN = VDD or GND (Note 2, 3)	9	+25°C	-	90	ns
			10, 11	+125°C, -55°C	-	122	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	3	-	MHz
			10, 11	+125°C, -55°C	2.22	-	MHz

**NOTES:**

1. CL = 50pF, RL = 200K, Input TR, TF < 20ns.
2. -55°C and +125°C limits guaranteed, 100% testing being implemented.
3. VDD = 5V, 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	-	10	μA
				+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
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

## Specifications CD40104BMS, CD40194BMS

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

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Output Current (Source)	IOH5B	VDD = 5V, VOUT = 2.5V	1, 2	+125°C	-	-1.15	mA
				-55°C	-	-2.0	mA
Output Current (Source)	IOH10	VDD = 10V, VOUT = 9.5V	1, 2	+125°C	-	-0.9	mA
				-55°C	-	-1.6	mA
Output Current (Source)	IOH15	VDD = 15V, VOUT = 13.5V	1, 2	+125°C	-	-2.4	mA
				-55°C	-	-4.2	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 Q	TPHL TPLH	VDD = 10V	1, 2, 3	+25°C	-	200	ns
		VDD = 15V	1, 2, 3	+25°C	-	140	ns
Propagation Delay CD40194B Reset to Q	TPLH TPHL	VDD = 10V	1, 2, 3	+25°C	-	180	ns
		VDD = 15V	1, 2, 3	+25°C	-	130	ns
Propagation Delay CD40104BMS 3-State	TPZH TPZL TPLZ	VDD = 10V	1, 2, 3, 4	+25°C	-	70	ns
		VDD = 15V	1, 2, 3, 4	+25°C	-	50	ns
Propagation Delay CD40104BMS 3-State	TPHZ	VDD = 10V	1, 2, 4	+25°C	-	50	ns
		VDD = 15V	1, 2, 4	+25°C	-	40	ns
Transition Time	TTHL TTLH	VDD = 10V	1, 2, 3	+25°C	-	100	ns
		VDD = 15V	1, 2, 3	+25°C	-	80	ns
Minimum Data Setup Time, D0, D3, SRIN, SLIN to Clock	TS	VDD = 5V	1, 2, 3	+25°C	-	100	ns
		VDD = 10V	1, 2, 3	+25°C	-	70	ns
		VDD = 15V	1, 2, 3	+25°C	-	50	ns
Minimum Data Hold Time D0, D3, SRIN, SLIN to Clock	TH	VDD = 5V	1, 2, 3	+25°C	-	0	ns
		VDD = 10V	1, 2, 3	+25°C	-	0	ns
		VDD = 15V	1, 2, 3	+25°C	-	0	ns
Minimum Clock Pulse Width	TW	VDD = 5V	1, 2, 3	+25°C	-	180	ns
		VDD = 10V	1, 2, 3	+25°C	-	80	ns
		VDD = 15V	1, 2, 3	+25°C	-	50	ns
Maximum Clock Rise and Fall Time	TRCL TFCL	VDD = 5V	1, 2, 3, 5	+25°C	3	-	μs
		VDD = 10V	1, 2, 3, 5	+25°C	6	-	μs
		VDD = 15V	1, 2, 3, 5	+25°C	8	-	μs
Minimum Data Setup Time Select 1, Select 0 to Clock	TS	VDD = 5V	1, 2, 3	+25°C	-	400	ns
		VDD = 10V	1, 2, 3	+25°C	-	220	ns
		VDD = 15V	1, 2, 3	+25°C	-	130	ns
Minimum Data Hold Time Select 1, Select 0 to Clock	TH	VDD = 5V	1, 2, 3	+25°C	-	0	ns
		VDD = 10V	1, 2, 3	+25°C	-	0	ns
		VDD = 15V	1, 2, 3	+25°C	-	0	ns

## Specifications CD40104BMS, CD40194BMS

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

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Minimum Reset Pulse Width CD40194BMS	TW	VDD = 5V	1, 2, 3	+25°C	-	300	ns
		VDD = 10V	1, 2, 3	+25°C	-	200	ns
		VDD = 15V	1, 2, 3	+25°C	-	140	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

## Specifications CD40104BMS, CD40194BMS

**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
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
CD40104BMS, CD40194BMS						
Static Burn-In 1 Note 1	12-15	1-11	16			
Static Burn-In 2 Note 1	12-15	8	1-7, 9-11, 16			
Dynamic Burn-In Note 1	-	7, 8, 10	1, 3-6, 9, 16	12-15	11	2
Irradiation Note 2	12-15	8	1-7, 9-11, 16			

NOTES:

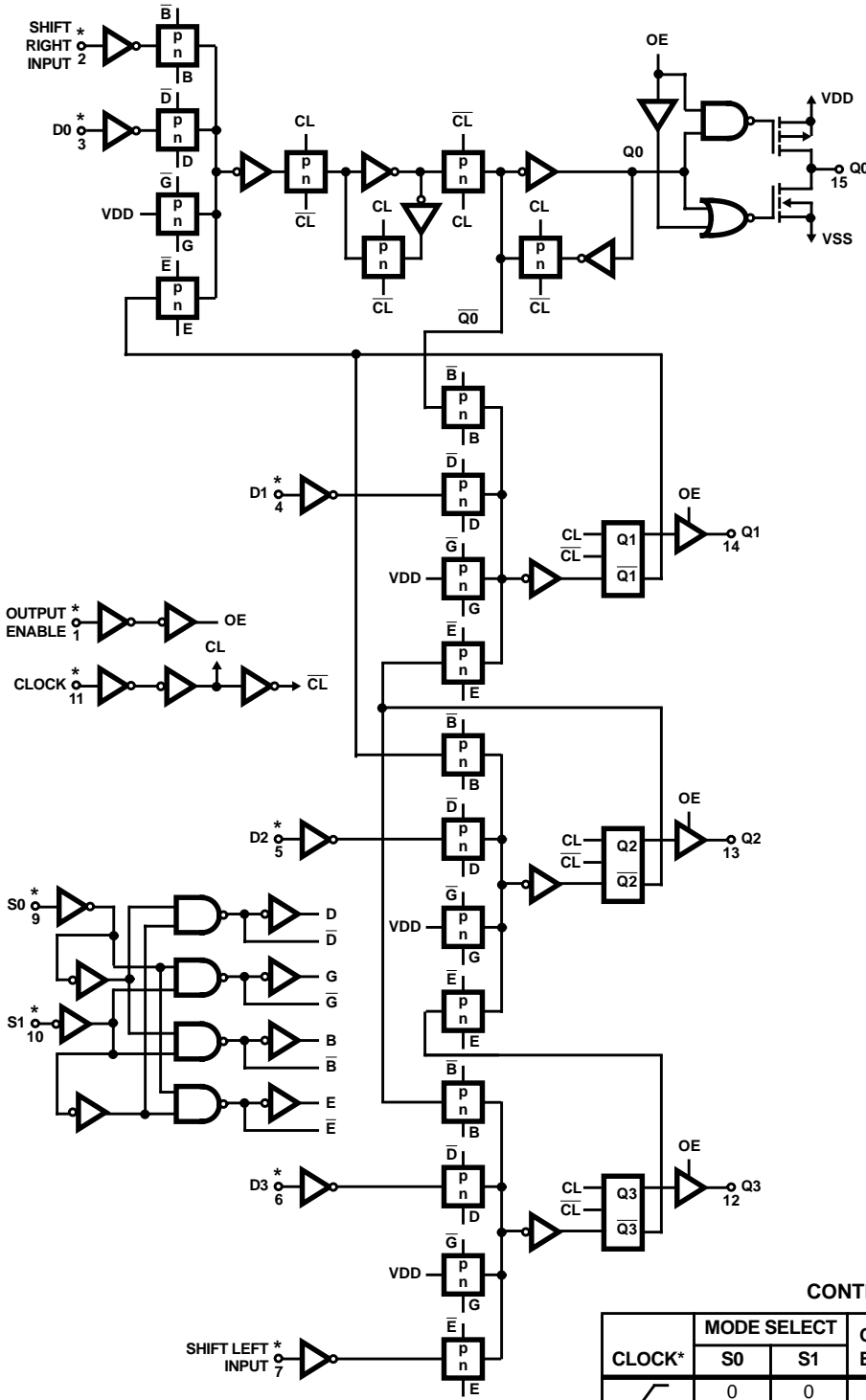
- Each pin except VDD and GND will have a series resistor of  $10K \pm 5\%$ ,  $VDD = 18V \pm 0.5V$
- Each pin except VDD and GND will have a series resistor of  $47K \pm 5\%$ ; Group E, Subgroup 2, sample size is 4 dice/wafer, 0 failures,  $VDD = 10V \pm 0.5V$

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Logic Diagrams



\* ALL INPUTS ARE PROTECTED BY CMOS PROTECTION NETWORK

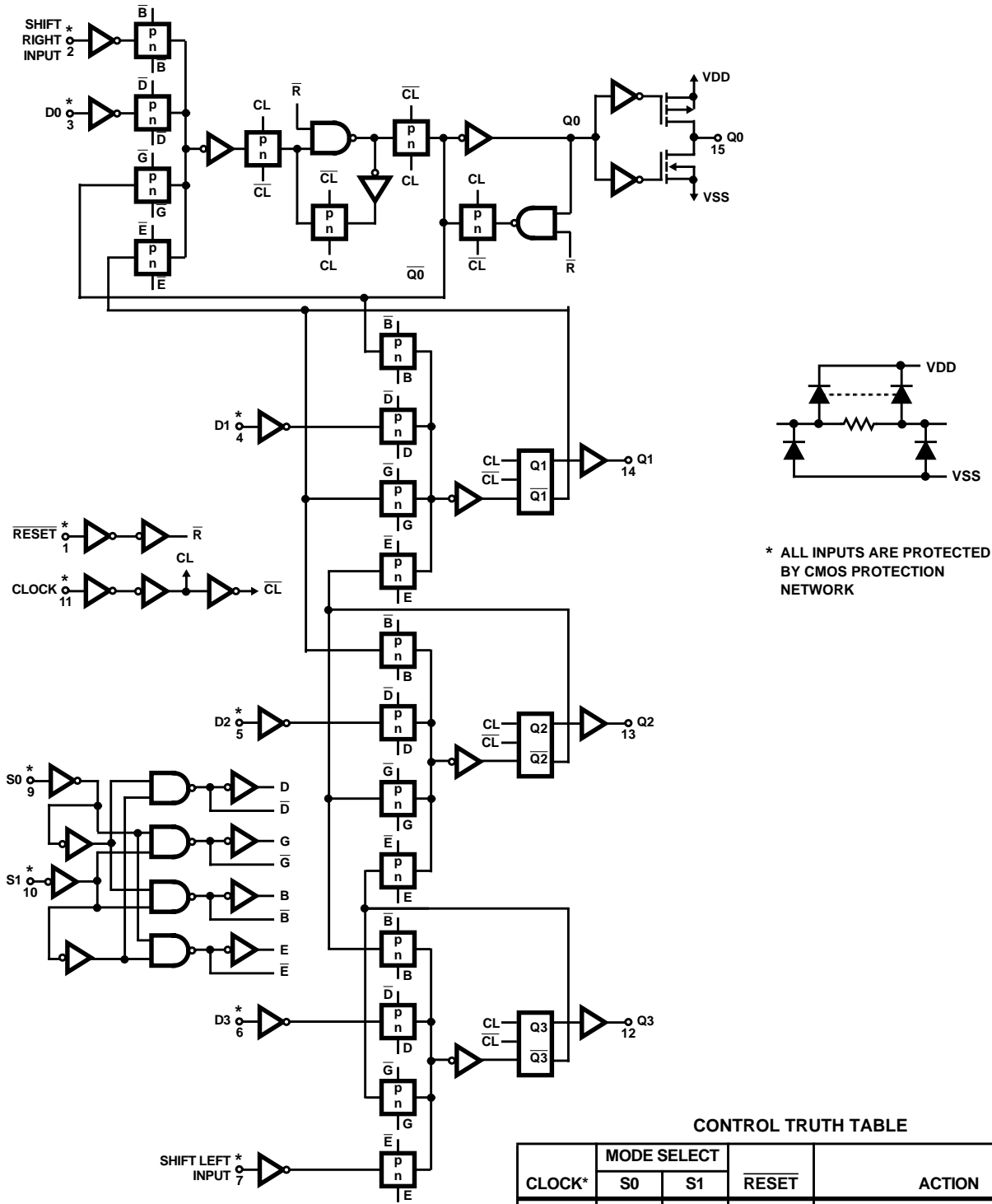
CONTROL TRUTH TABLE

CLOCK*	MODE SELECT		OUTPUT ENABLE	ACTION
	S0	S1		
	0	0	1	Reset
	1	0	1	Shift Right (Q0 toward Q3)
	0	1	1	Shift Left (Q3 toward Q0)
	1	1	1	Parallel Load
X	X	X	0	Operations occur as shown above, but outputs assume high impedance

X = Don't Care 1 = High level 0 = Low level \* Level change

FIGURE 1. CD40104BMS

Logic Diagrams (Continued)



CONTROL TRUTH TABLE

CLOCK*	MODE SELECT		$\overline{\text{RESET}}$	ACTION
	S0	S1		
X	0	0	1	No Change
	1	0	1	Shift Right (Q0 toward Q3)
	0	1	1	Shift Left (Q3 toward Q0)
	1	1	1	Parallel Load
X	X	X	0	Reset

X = Don't Care 1 = High level 0 = Low level \* Level change

FIGURE 2. CD40194BMS



Typical Performance Characteristics

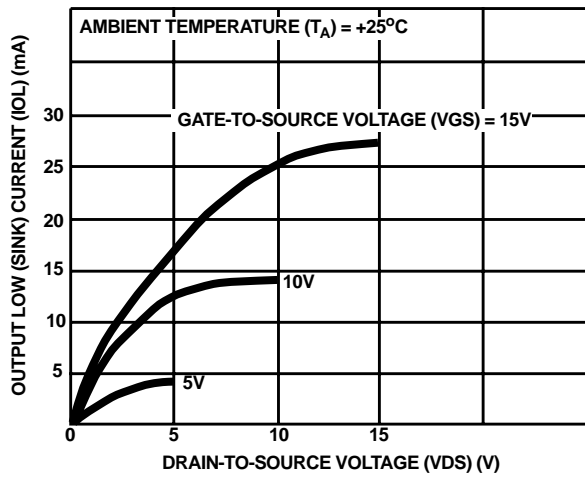


FIGURE 3. TYPICAL N-CHANNEL OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

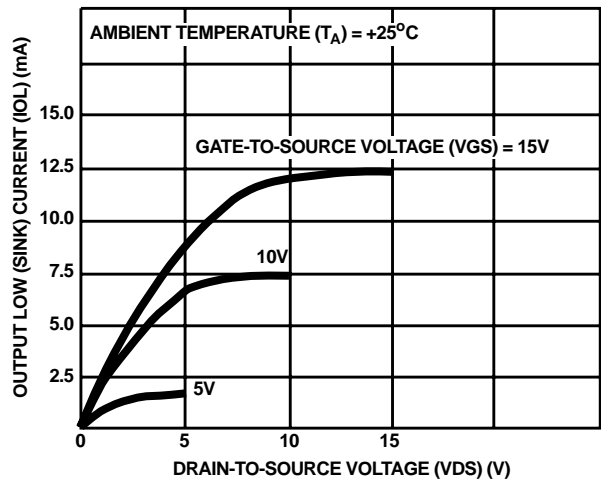


FIGURE 4. MINIMUM N-CHANNEL OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

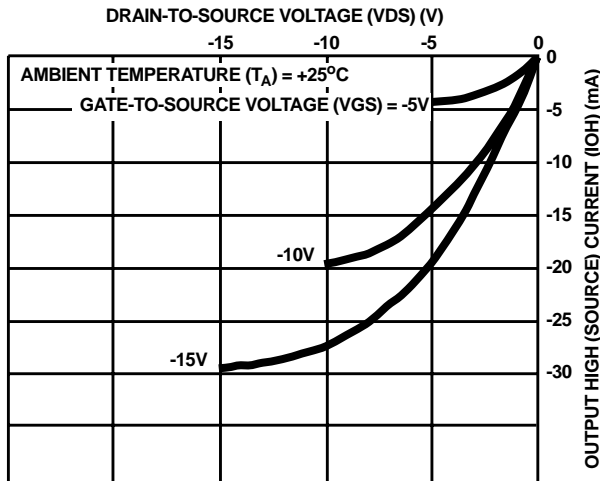


FIGURE 5. TYPICAL P-CHANNEL OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

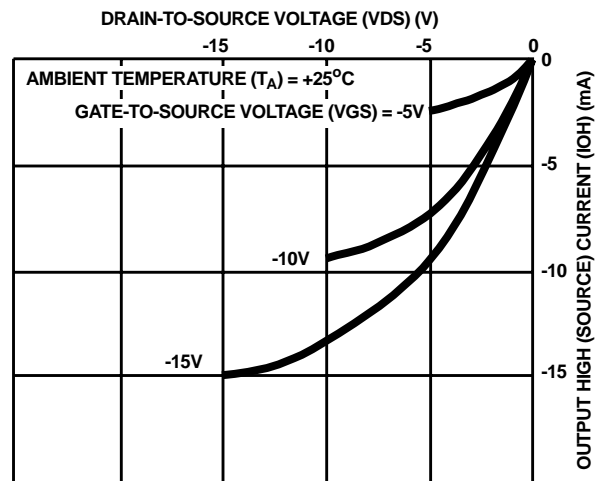


FIGURE 6. MINIMUM P-CHANNEL OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

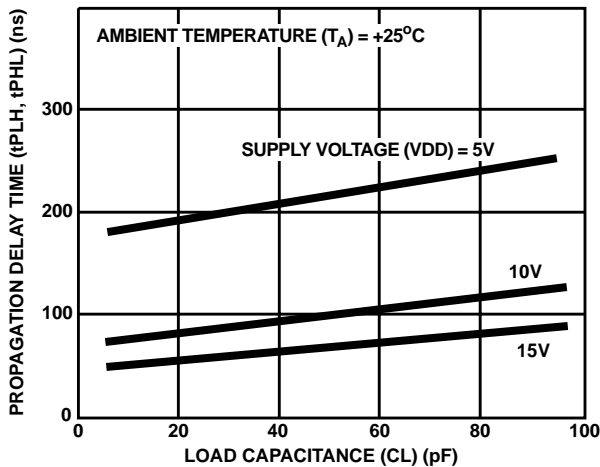


FIGURE 7. TYPICAL PROPAGATION DELAY TIME AS A FUNCTION OF LOAD CAPACITANCE, (CLOCK TO Q)

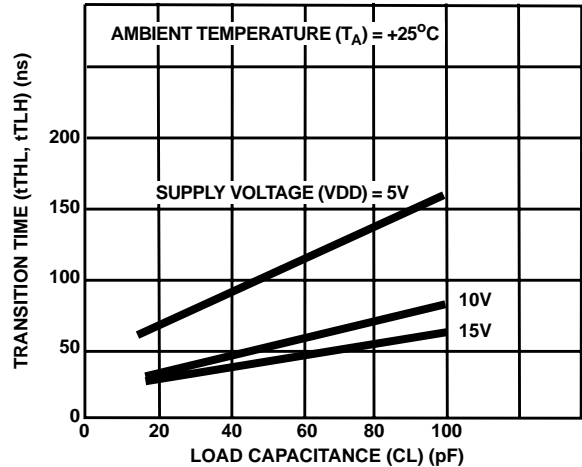


FIGURE 8. TYPICAL TRANSITION TIME AS A FUNCTION OF LOAD CAPACITANCE

Typical Performance Characteristics (Continued)

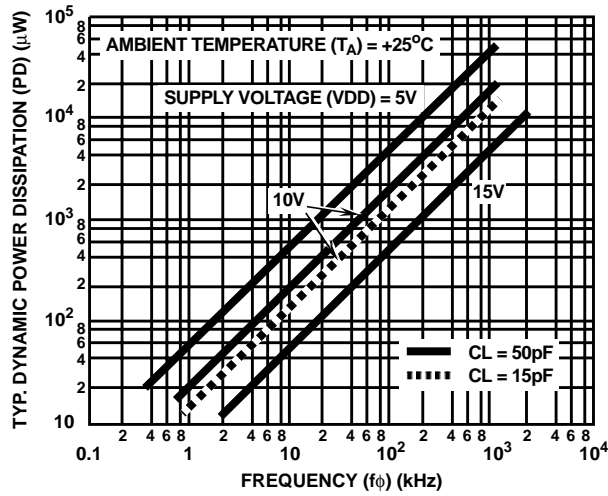
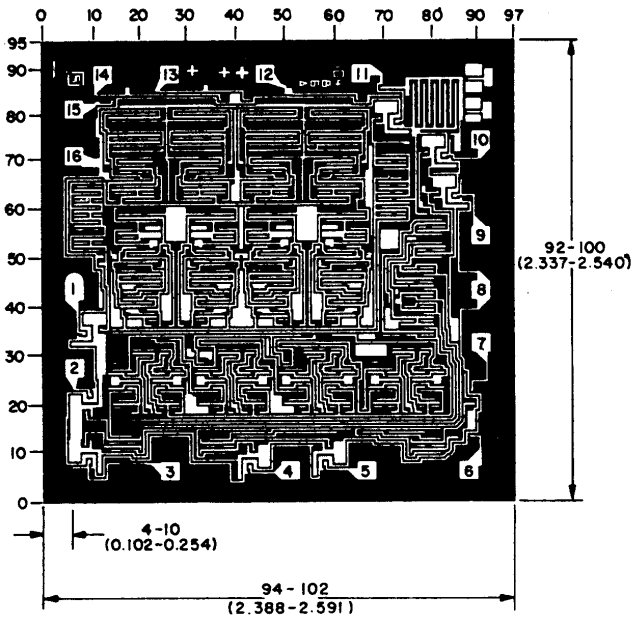
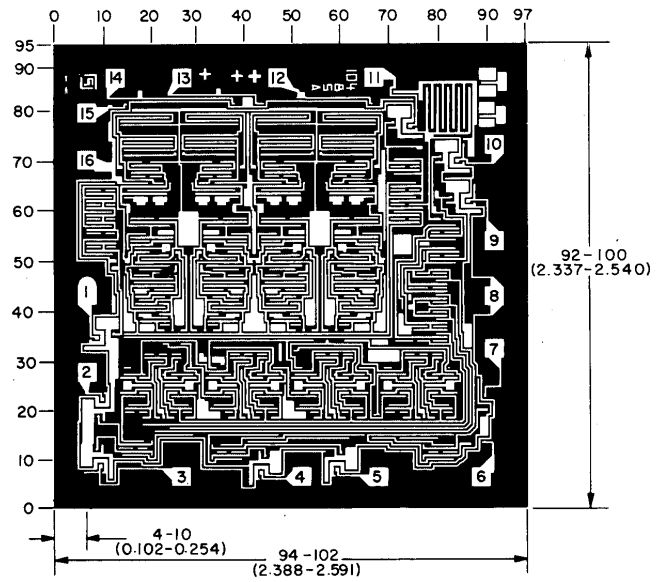


FIGURE 9. TYPICAL POWER DISSIPATION AS A FUNCTION OF FREQUENCY

Chip Dimensions and Pad Layouts



CD40104BMS



CD40194BMS

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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[www.DatasheetCatalog.com](http://www.DatasheetCatalog.com)

Datasheets for electronic components.