

December 1992

## CMOS Quad 'D' Type Flip-Flop

### Features

- High Voltage Type (20V Rating)
- Output Compatible with Two HTL Loads, Two Low Power TTL Loads, or One Low Power Schottky TTL Load
- Functional Equivalent to TTL74175
- 100% Tested for Quiescent Current at 20V
- 5V, 10V and 15V Parametric Ratings
- Maximum Input Current of 1 $\mu$ A at 18V Over Full Package Temperature Range; 100nA at 18V and +25°C
- Noise Margin (Over Full Package/Temperature Range)
  - 1V at VDD = 5V
  - 2V at VDD = 10V
  - 2.5V at VDD = 15V
- Standardized Symmetrical Output Characteristics
- Meets All Requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

### Applications

- Shift Registers
- Buffer/Storage Registers
- Pattern Generators

### Description

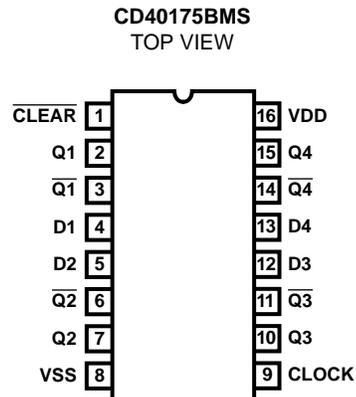
CD40175BMS consists of four identical D-type flip-flops. Each flip-flop has an independent DATA D input and complementary Q and  $\bar{Q}$  outputs. The CLOCK and CLEAR inputs are common to all flip-flops. Data are transferred to the Q outputs on the positive going transition of the clock pulse. All four flip-flops are simultaneously reset by a low level on the CLEAR input.

These devices can function as shift register elements or as T-type flip-flops for toggle and counter applications.

The CD40175BMS is supplied in these 16-lead outline packages:

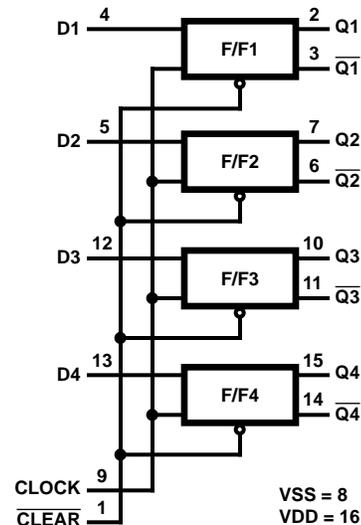
Braze Seal DIP	H4T
Ceramic Flatpack	H6W

### Pinout



VDD = PIN 16  
VSS = PIN 8

### Functional Diagram



## Specifications CD40175BMS

### 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 $+100^\circ\text{C}$ (Package Type D, F, K) . . . . .	500mW	
For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$ (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	-	2	μA	
			2	+125°C	-	200	μA	
		VDD = 18V, VIN = VDD or GND	3	-55°C	-	2	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	

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.

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**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITIONS (NOTES 1, 2)	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Propagation Delay Clock to Q Output	TPHL1 TPLH1	VDD = 5V, VIN = VDD or GND	9	+25°C	-	400	ns
			10, 11	+125°C, -55°C	-	540	ns
Propagation Delay Clear to Q Output	TPHL2	VDD = 5V, VIN = VDD or GND	9	+25°C	-	500	ns
			10, 11	+125°C, -55°C	-	675	ns
Transition Time	TTHL TTLH	VDD = 5V, VIN = VDD or GND	9	+25°C	-	200	ns
			10, 11	+125°C, -55°C	-	270	ns
Maximum Clock Input Frequency	FCL	VDD = 5V, VIN = VDD or GND	9	+25°C	2	-	MHz
			10, 11	+125°C, -55°C	1.48	-	MHz

**NOTES:**

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

**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	-	1	μA
				+125°C	-	30	μA
		VDD = 10V, VIN = VDD or GND	1, 2	-55°C, +25°C	-	2	μA
				+125°C	-	60	μA
		VDD = 15V, VIN = VDD or GND	1, 2	-55°C, +25°C	-	2	μA
+125°C	-			120	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
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

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

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
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 Output	TPHL1 TPLH1	VDD = 10V	1, 2, 3	+25°C	-	160	ns
		VDD = 15V	1, 2, 3	+25°C	-	120	ns
Propagation Delay Clear to Q Output	TPHL2	VDD = 10V	1, 2, 3	+25°C	-	200	ns
		VDD = 15V	1, 2, 3	+25°C	-	150	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	TS	VDD = 5V	1, 2, 3	+25°C	-	120	ns
		VDD = 10V	1, 2, 3	+25°C	-	50	ns
		VDD = 15V	1, 2, 3	+25°C	-	40	ns
Minimum Data Hold Time	TH	VDD = 5V	1, 2, 3	+25°C	-	80	ns
		VDD = 10V	1, 2, 3	+25°C	-	40	ns
		VDD = 15V	1, 2, 3	+25°C	-	30	ns
Minimum Clear 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	-	60	ns
Maximum Clock Rise or Fall Time	TRCL TFCL	VDD = 5V	1, 2, 3, 4	+25°C	15	-	μs
		VDD = 10V	1, 2, 3, 4	+25°C	15	-	μs
		VDD = 15V	1, 2, 3, 4	+25°C	15	-	μs
Minimum Clear Removal Time (Clear to be High before Positive Transition of Clock)	TREM	VDD = 5V	1, 2, 3	+25°C	-	250	ns
		VDD = 10V	1, 2, 3	+25°C	-	100	ns
		VDD = 15V	1, 2, 3	+25°C	-	80	ns
Minimum Clock Pulse Width	TW	VDD = 5V	1, 2, 3	+25°C	-	250	ns
		VDD = 10V	1, 2, 3	+25°C	-	100	ns
		VDD = 15V	1, 2, 3	+25°C	-	75	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. 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.

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**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	-	7.5	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	VDD = 5V	1, 2, 3, 4	+25°C	-	1.35 x +25°C Limit	ns
	TPLH						

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-1	IDD	± 0.2μA
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
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, RONDEL10
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

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

FUNCTION	OPEN	GROUND	VDD	9V ± 0.5V	OSCILLATOR	
					50kHz	25kHz
Static Burn-In 1 (Note 1)	2, 3, 6, 7, 10, 11, 14, 15	1, 4, 5, 8, 9, 12, 13	16			
Static Burn-In 2 (Note 1)	2, 3, 6, 7, 10, 11, 14, 15	8	1, 4, 5, 9, 12, 13, 16			
Dynamic Burn-In (Note 1)	-	8	1, 16	2, 3, 6, 7, 10, 11, 14, 15	9	4, 5, 12, 13
Irradiation (Note 2)	2, 3, 6, 7, 10, 11, 14, 15	8	1, 4, 5, 9, 12, 13, 16			

**NOTES:**

1. Each pin except VDD and GND will have a series resistor of  $10K \pm 5\%$ , VDD =  $18V \pm 0.5V$
2. 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 =  $10V \pm 0.5V$

## Logic Diagram

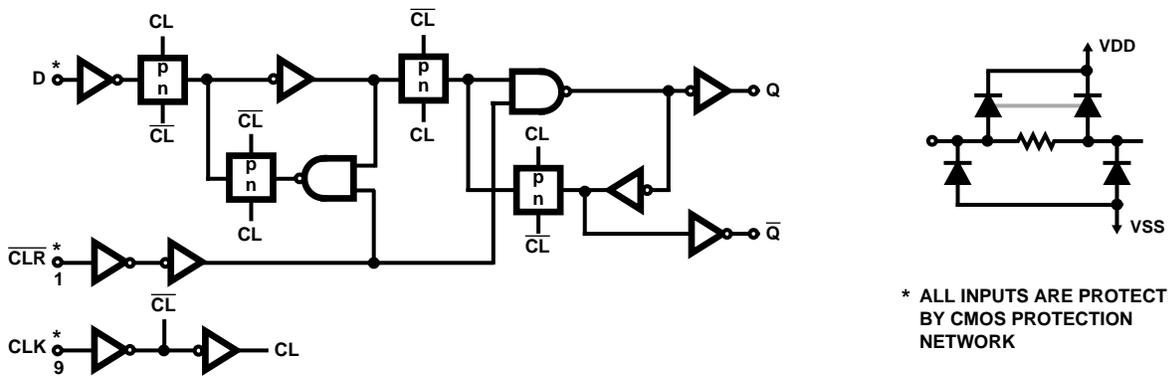


FIGURE 1. 1 OF 4 FLIP-FLOPS

**TRUTH TABLE FOR 1 OF 4 FLIP-FLOPS (Positive Logic)**

INPUTS			OUTPUTS	
CLOCK	DATA	CLEAR	Q	Q̄
	0	1	0	1
	1	1	1	0
	X	1	Q	Q̄
X	X	0	0	1

1 = High level  
X = Don't care  
0 = Low level

**Electrical Performance Characteristics**

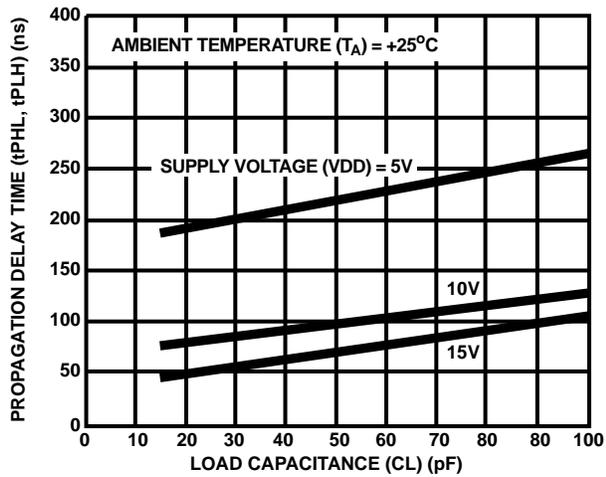


FIGURE 2. TYPICAL PROPAGATION DELAY TIME (CLOCK TO OUTPUT) AS A FUNCTION OF LOAD CAPACITANCE

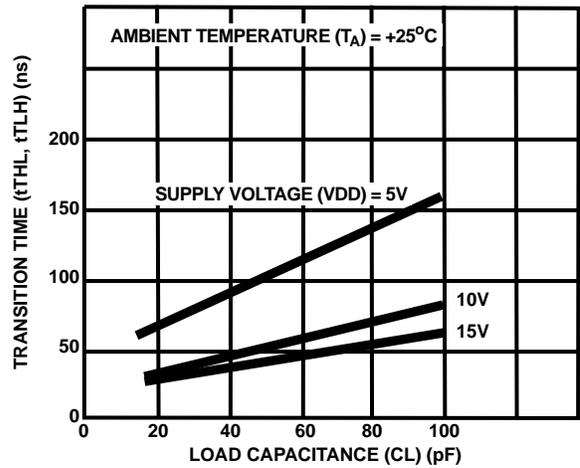


FIGURE 3. TYPICAL TRANSITION TIME AS A FUNCTION OF LOAD CAPACITANCE

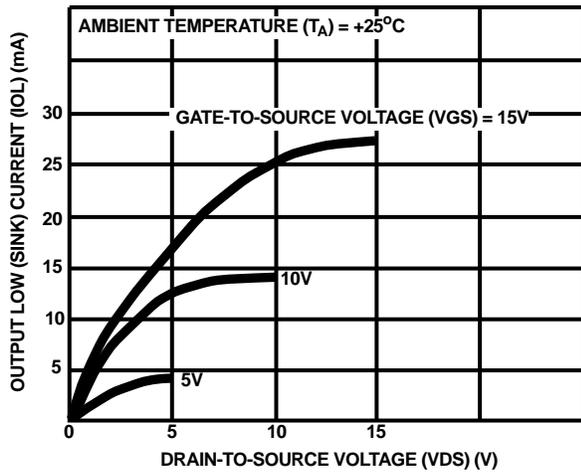


FIGURE 4. TYPICAL OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

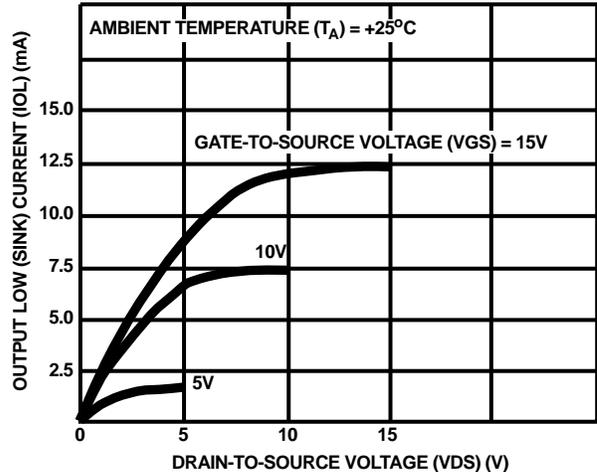


FIGURE 5. MINIMUM OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

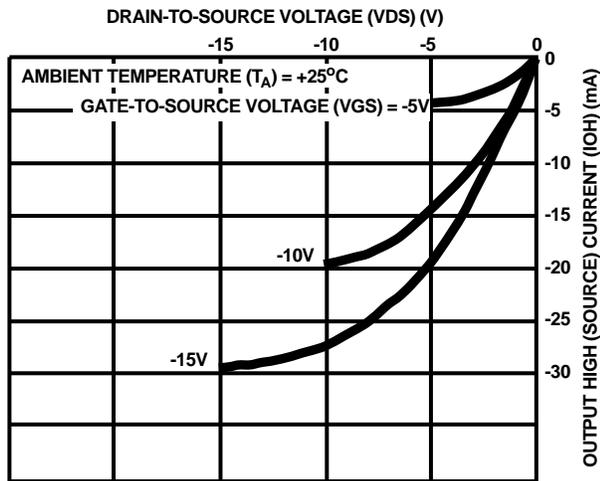


FIGURE 6. TYPICAL OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

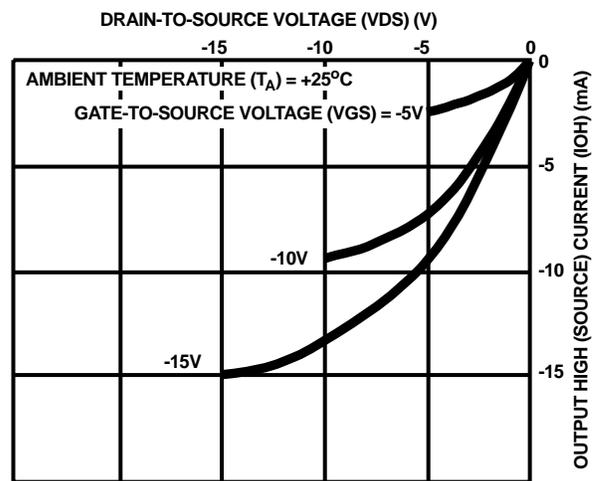


FIGURE 7. MINIMUM OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

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## Electrical Performance Characteristics (Continued)

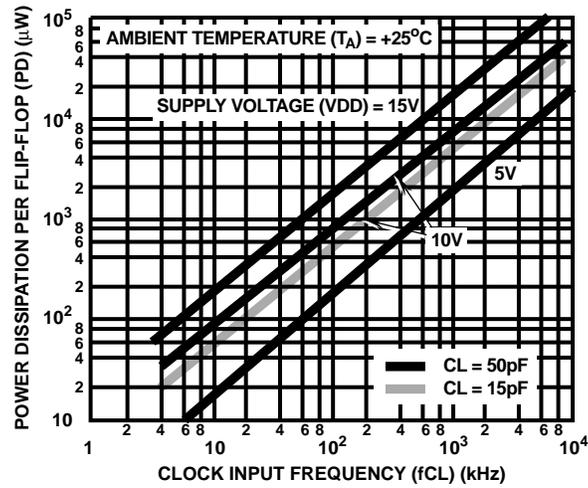
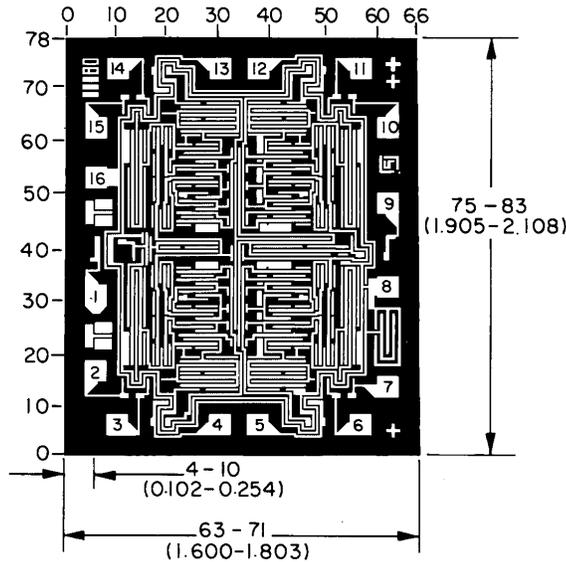


FIGURE 8. TYPICAL DYNAMIC POWER DISSIPATION AS A FUNCTION OF CLOCK FREQUENCY

## 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