CMOS Quad 'D'-Type Flip-Flop

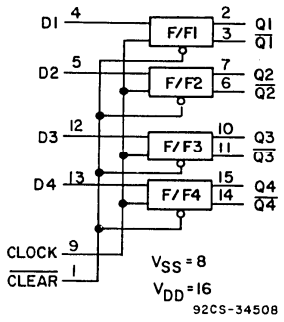
High-Voltage Types (20-Volt Rating)

Features:

- *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 VDD = 5 V
  2 V at VDD = 10 V
  2.5 V at VDD = 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"*
- *Output compatible with two HTL loads, two low power TTL loads, or one low power Schottky TTL load*
- *Functional equivalent to TTL 74175*
- *Standardized symmetrical output characteristics*

Applications:

- *Shift registers*
- *Buffer/storage registers*
- *Pattern generators*

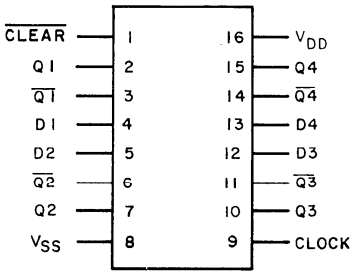


CD40175B FUNCTION DIAGRAM

The RCA CD40175B consists of four identical D-type flip-flops. Each flip-flop has an independent DATA D input and complementary Q and $\overline{Q}$ 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 CD40175B is supplied in hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic packages (E suffix), 16-lead ceramic flat packages (K suffix), and in chip form (H suffix).



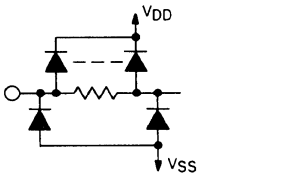
TERMINAL ASSIGNMENT

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC SUPPLY-VOLTAGE RANGE, (V_{DD})
(Voltages referenced to V_{SS} Terminal) ..... -0.5 to V_{DD} +20 V
INPUT VOLTAGE RANGE, ALL INPUTS ..... -0.5 to V_{DD} +0.5 V
DC INPUT CURRENT, ANY ONE INPUT ..... ±10 mA
POWER DISSIPATION PER PACKAGE (P_D):
For T_A = -40 to +60°C (PACKAGE TYPE E) ..... 500 mW
For T_A = +60 to +85°C (PACKAGE TYPE E) ..... Derate Linearly at 12 mW/°C to 200 mW
For T_A = -55 to +100°C (PACKAGE TYPES D, F, K) ..... 500 mW
For T_A = +100 to +125°C (PACKAGE TYPES D, F, K) ..... Derate Linearly at 12 mW/°C to 200 mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR:
For T_A = FULL PACKAGE-TEMPERATURE RANGE (All Package Types) ..... 100 mW
OPERATING-TEMPERATURE RANGE (T_A):
PACKAGE TYPES D, F, K, H ..... -55 to +125°C
PACKAGE TYPE E ..... -40 to +85°C
STORAGE TEMPERATURE RANGE (T_{stg}) ..... -65 to +150°C
LEAD TEMPERATURE (DURING SOLDERING):
At distance 1/16 ± 1/32 inch (1.59 ± 0.79 mm) from case for 10 s max. ..... +265°C

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

CHARACTERISTIC		V_{DD} (V)	LIMITS		UNITS
			MIN.	MAX.	
Supply-Voltage Range (For T_A = Full Package-Temperature Range)		—	3	18	V
Data Setup Time	t_{SU}	5	120	—	ns
		10	50	—	
		15	40	—	
Data Hold Time	t_H	5	80	—	ns
		10	40	—	
		15	30	—	
Clock Input Frequency	f_{CL}	5	—	2	MHz
		10	dc	5	
		15	—	6.5	
Clock Input Rise or Fall Time	t_{rCL}, t_{fCL}	5	—	15	μs
		10	—	15	
		15	—	15	
Clock Input Pulse Width	t_{WL}, t_{WH}	5	250	—	ns
		10	100	—	
		15	75	—	
$\overline{\text{Clear}}$ Pulse Width	t_{WL}	5	200	—	ns
		10	80	—	
		15	60	—	
$\overline{\text{Clear}}$ Removal Time	t_{REM}	5	250	—	ns
		10	100	—	
		15	80	—	



* Inputs Protected by CMOS Protection Network

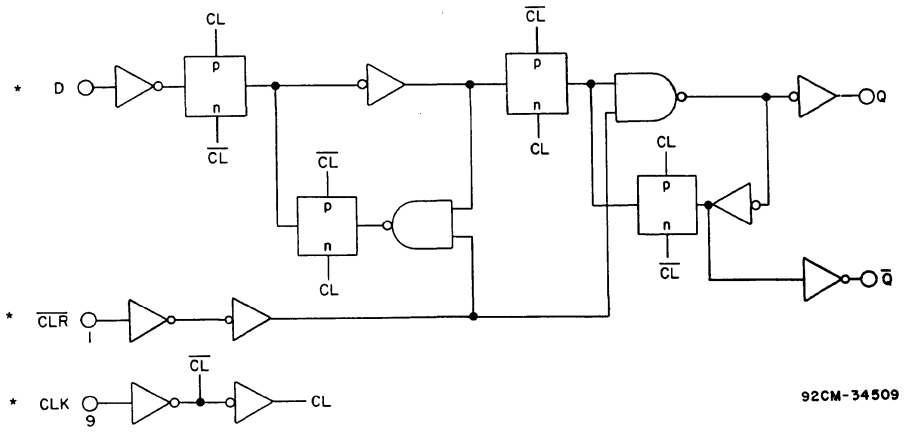


Fig. 1 - Logic diagram (1 of 4 flip-flops).

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C) Values at -55, +25, +125 Apply to D, F, K, H Packages Values at -40, +25, +85 Apply to E Package							UNITS
								+25			
	V_O (V)	V_{IN} (V)	V_{DD} (V)	-55	-40	+85	+125	Min.	Typ.	Max.	
Quiescent	—	0, 5	5	1	1	30	30	—	0.02	1	
Device	—	0, 10	10	2	2	60	60	—	0.02	2	
Current	—	0, 15	15	4	4	120	120	—	0.02	4	μA
Max. I_{DD}	—	0, 20	20	20	20	600	600	—	0.04	20	
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	—	
Min. I_{OL}	1.5	0, 15	15	4.2	4	2.8	2.4	3.4	6.8	—	
Output High	4.6	0, 5	5	-0.64	-0.61	-0.42	-0.36	-0.51	-1	—	mA
(Source)	2.5	0, 5	5	-2	-1.8	-1.3	-1.15	-1.6	-3.2	—	
Current	9.5	0, 10	10	-1.6	-1.5	-1.1	-0.9	-1.3	-2.6	—	
Min. I_{OH}	13.5	0, 15	15	-4.2	-4	-2.8	-2.4	-3.4	-6.8	—	
Output Voltage:	—	0, 5	5	0.05				—	0	0.05	
Low-Level	—	0, 10	10	0.05				—	0	0.05	
Max. V_{OL}	—	0, 15	15	0.05				—	0	0.05	
Output Voltage:	—	0, 5	5	4.95				4.95	5	—	V
High-Level	—	0, 10	10	9.95				9.95	10	—	
Min. V_{OH}	—	0, 15	15	14.95				14.95	15	—	
Input Low	0.5,4.5	—	5	1.5				—	—	1.5	
Voltage	1, 9	—	10	3				—	—	3	
Max. V_{IL}	1.5,13.5	—	15	4				—	—	4	
Input High	0.5,4.5	—	5	3.5				3.5	—	—	V
Voltage	1, 9	—	10	7				7	—	—	
Min. V_{IH}	1.5,13.5	—	15	11				11	—	—	
Input Current Max. I_{IN}	—	0, 18	18	±0.1	±0.1	±1	±1	—	$\pm 10^{-5}$	±0.1	μA

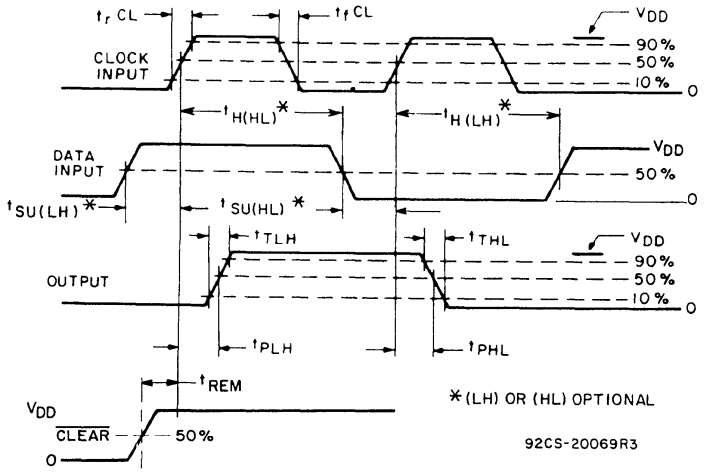


Fig. 2 - Definition of setup, hold, propagation delay, and removal times.

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

INPUTS			OUTPUTS	
CLOCK	DATA	$\overline{\text{CLEAR}}$	Q	$\overline{Q}$
↑	0	1	0	1
↑	1	1	1	0
↓	X	1	Q	$\overline{Q}$
X	X	0	0	1

1=High Level X=Don't Care 0=Low Level

DYNAMIC ELECTRICAL CHARACTERISTICS at T_A = 25° C; Input t_r, t_f = 20 ns, C_L = 50 pF, R_L = 200 kΩ

CHARACTERISTIC		TEST CONDITIONS V_{DD} (V)	LIMITS MIN.	LIMITS TYP.	LIMITS MAX.	UNITS
Transition Time	t_{THL}, t_{TLH}	5	—	100	200	ns
		10	—	50	100	
		15	—	40	80	
Propagation Delay Time Clock to Q Output	t_{PHL}, t_{PLH}	5	—	220	400	
		10	—	90	160	
		15	—	70	120	
Propagation Delay Time $\overline{\text{CLEAR}}$ to Q Output	t_{PHL}	5	—	325	500	
		10	—	130	200	
		15	—	100	150	
Minimum Pulse Width Clock	t_{WH}	5	—	110	250	
		10	—	45	100	
		15	—	35	75	
$\overline{\text{Clear}}$	t_{WL}	5	—	100	200	
		10	—	40	80	
		15	—	30	60	
Maximum Clock Frequency	f_{CL}	5	2	4.5	—	MHz
		10	5	11	—	
		15	6.5	14	—	
Maximum Clock Rise or Fall Time	t_{rCL}, t_{fCL}	5	15	—	—	μs
		10	15	—	—	
		15	15	—	—	
Minimum Data Setup Time	t_{SU}	5	—	60	120	ns
		10	—	25	50	
		15	—	20	40	
Minimum Data Hold Time	t_H	5	—	40	80	
		10	—	20	40	
		15	—	15	30	
Minimum $\overline{\text{Clear}}$ Removal Time ‡	t_{REM}	5	—	125	250	
		10	—	50	100	
		15	—	40	80	
Input Capacitance	C_{IN}	—	—	5	7.5	pF

‡ $\overline{\text{CLEAR}}$ signal must be high prior to positive-going transition of CLOCK pulse.

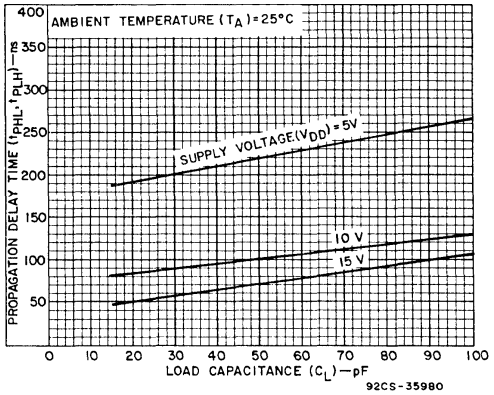


Fig. 3 - Typical propagation delay time (CLOCK to OUTPUT) as a function of load capacitance.

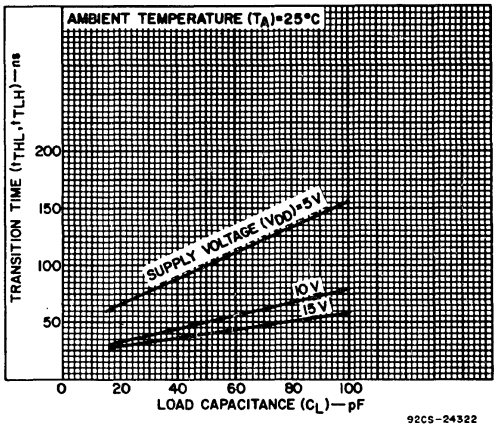


Fig. 4 - Typical transition time as a function of load capacitance.

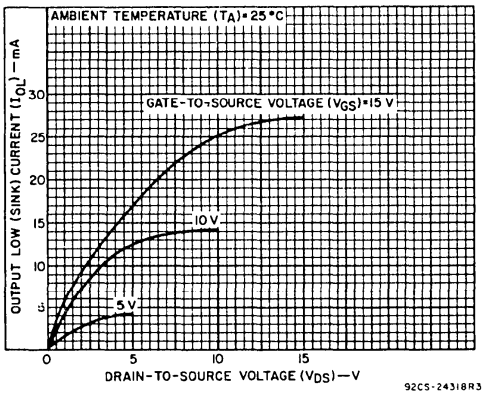


Fig. 5 - Typical output low (sink) current characteristics.

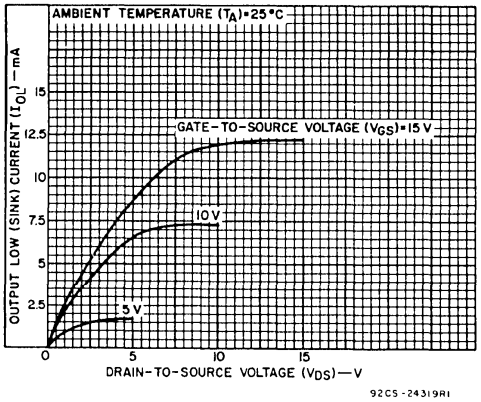


Fig. 6 - Minimum output low (sink) current characteristics.

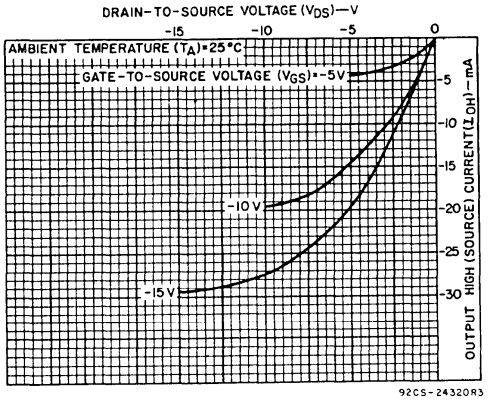


Fig. 7 - Typical output high (source) current characteristics.

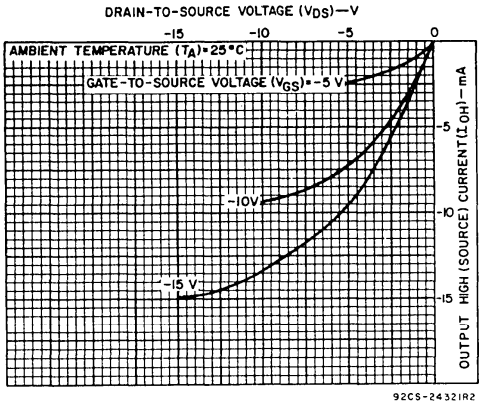


Fig. 8 - Minimum output high (source) current characteristics.

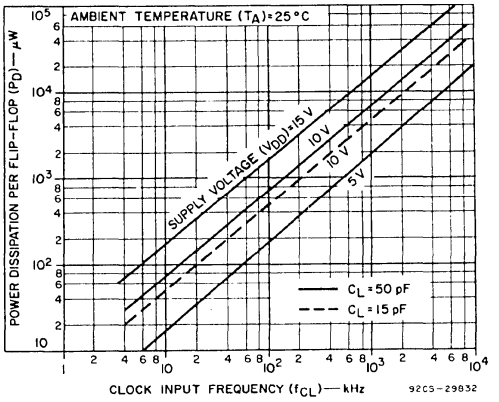


Fig. 9 - Typical dynamic power dissipation as a function of CLOCK frequency.

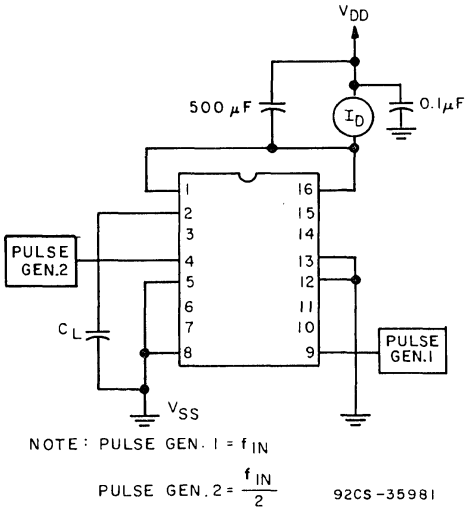


Fig. 10 - Dynamic power dissipation test circuit.

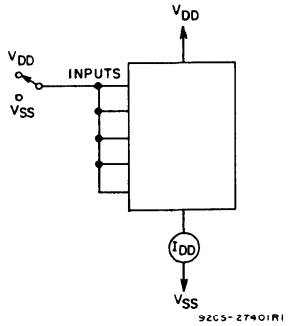


Fig. 11 - Quiescent device current test circuit.

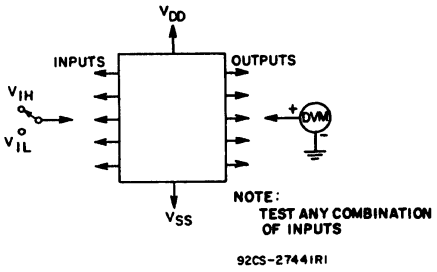


Fig. 12 - Noise immunity test circuit.

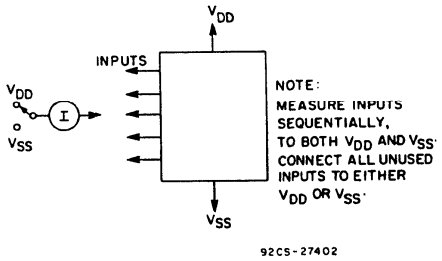
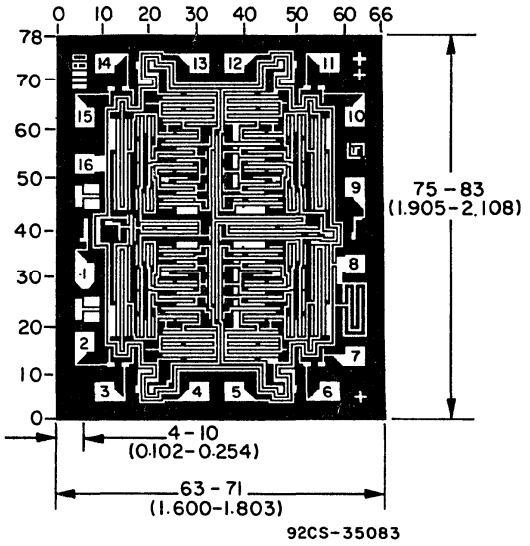


Fig. 13 - Input leakage current test circuit.



Dimensions and pad layout for CD40175BH.

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

The photographs and dimensions of each CMOS chip represent a chip when it is part of the wafer. When the wafer is separated into individual chips, the angle of cleavage may vary with respect to the chip face for different chips. The actual dimensions of the isolated chip, therefore, may differ slightly from the nominal dimensions shown. The user should consider a tolerance −3 mils to +16 mils applicable to the nominal dimensions shown.