

CMOS Dual J-K Master-Slave Flip-Flop

High-Voltage Types (20-Volt Rating)

■ CD4027B is a single monolithic chip integrated circuit containing two identical complementary-symmetry J-K master-slave flip-flops. Each flip-flop has provisions for individual J, K, Set, Reset, and Clock input signals. Buffered Q and $\bar{Q}$ signals are provided as outputs. This input-output arrangement provides for compatible operation with the RCA-CD4013B dual D-type flip-flop.

The CD4027B is useful in performing control, register, and toggle functions. Logic levels present at the J and K inputs along with internal self-steering control the state of each flip-flop; changes in the flip-flop state are synchronous with the positive-going transition of the clock pulse. Set and reset functions are independent of the clock and are initiated when a high level signal is present at either the Set or Reset input.

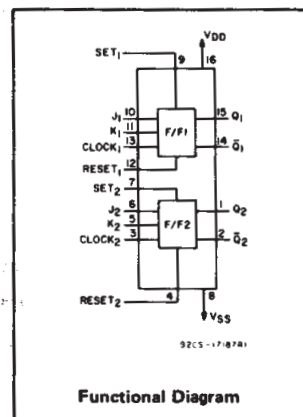
The CD4027B types are supplied in 16-lead hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic packages (E suffix), and in chip form (H suffix).

Features:

- Set-Reset capability
- Static flip-flop operation — retains state indefinitely with clock level either "high" or "low"
- Medium speed operation — 16 MHz (typ.) clock toggle rate at 10 V
- Standardized symmetrical output characteristics
- 100% tested for quiescent current at 20 V
- Maximum input current of 1 μ A at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- Noise margin (over full package-temperature range):
 - 1 V at $V_{DD} = 5$ V
 - 2 V at $V_{DD} = 10$ V
 - 2.5 V at $V_{DD} = 15$ 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:

- Registers, counters, control circuits



MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE RANGE, (V_{DD})

Voltages referenced to V_{SS} Terminal) -0.5V to +20V

INPUT VOLTAGE RANGE, ALL INPUTS -0.5V to $V_{DD} + 0.5$ V

DC INPUT CURRENT, ANY ONE INPUT ± 10 mA

POWER DISSIPATION PER PACKAGE (P_D):

For $T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$ 500mW

For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$ Derate Linearly at 12mW/ $^\circ\text{C}$ to 200mW

DEVICE DISSIPATION PER OUTPUT TRANSISTOR

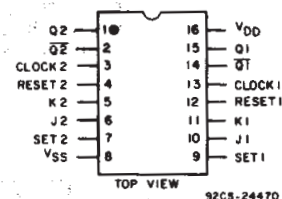
FOR $T_A = \text{FULL PACKAGE-TEMPERATURE RANGE (All Package Types)}$ 100mW

OPERATING-TEMPERATURE RANGE (T_A) -55°C to $+125^\circ\text{C}$

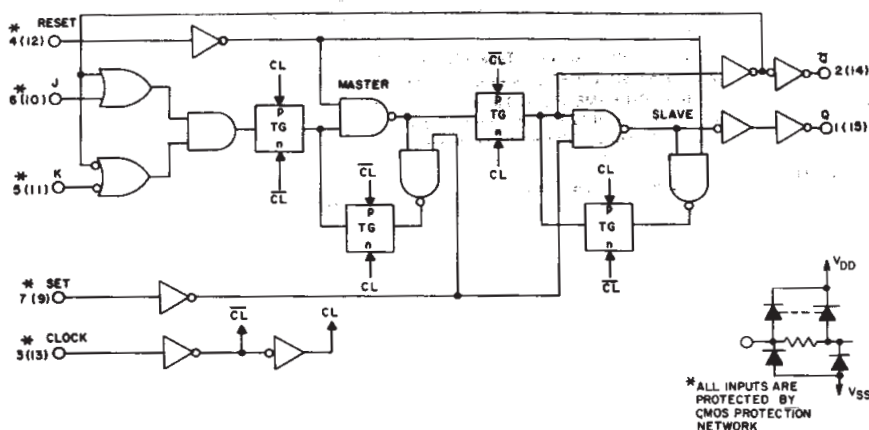
STORAGE TEMPERATURE RANGE (T_{stg}) -65°C to $+150^\circ\text{C}$

LEAD TEMPERATURE (DURING SOLDERING):

At distance $1/16 \pm 1/32$ inch (1.59 ± 0.79 mm) from case for 10s max $+265^\circ\text{C}$



TERMINAL ASSIGNMENT



PRESENT STATE					NEXT STATE	
J	K	S	R	Q	Q	Q-bar
1	x	0	0	0	1	0
x	0	0	0	1	1	0
0	x	0	0	0	0	1
x	1	0	0	1	0	1
x	x	0	0	x	← NO CHANGE	
x	x	1	0	x	1	0
x	x	0	1	x	0	1
x	x	1	1	x	1	1

LOGIC 1 = HIGH LEVEL
LOGIC 0 = LOW LEVEL
A = LEVEL CHANGE
X = DON'T CARE

92CM-27551R1

Fig. 1 — Logic diagram and truth table for CD4027B (one of two identical J-K flip flops).

CD4027B Types

RECOMMENDED OPERATING CONDITIONS at $T_A = 25^\circ\text{C}$, 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
		All Packages		
		Min.	Max.	
Supply-Voltage Range (For T _A = Full Package Temperature Range)	—	3	18	V
Data Setup Time t _S	5 10 15	200 75 50	— — —	ns
Clock Pulse Width t _W	5 10 15	140 60 40	— — —	ns
Clock Input Frequency (Toggle Mode) f _{CL}	5 10 15	dc	3.5 8 12	MHz
Clock Rise or Fall Time t _{rCL} *, t _{fCL}	5 10 15	— — —	45 5 2	μs
Set or Reset Pulse Width t _W	5 10 15	180 80 50	— — —	ns

* If more than one unit is cascaded in a parallel clocked operation, t_{rCL} should be made less than or equal to the sum of the fixed propagation delay time at 15 pF and the transition time of the output driving stage for the estimated capacitive load.

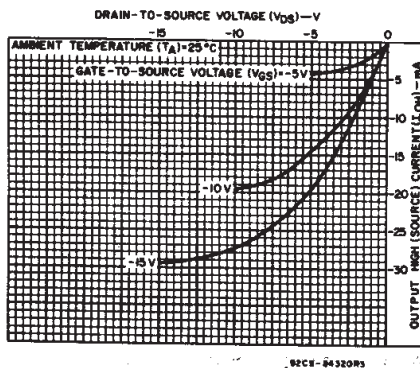


Fig. 4 - Typical output high (source) current characteristics.

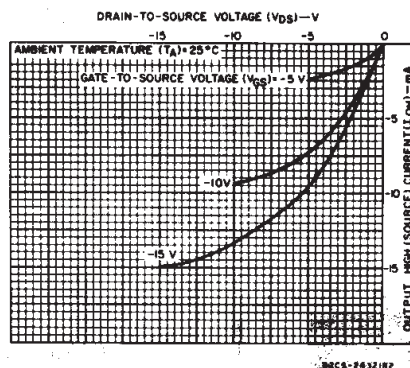


Fig. 5 - Minimum output high (source) current characteristics.

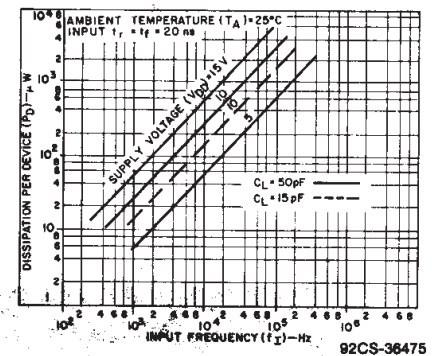


Fig. 6 - Typical power dissipation vs. frequency.

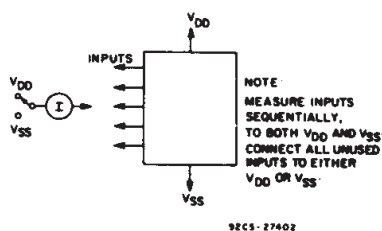


Fig. 7 - Input current test circuit.

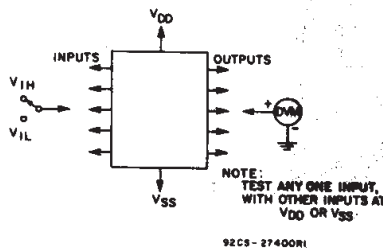


Fig. 8 - Input-voltage test circuit.

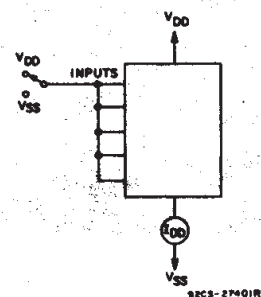


Fig. 9 - Quiescent device current test circuit.

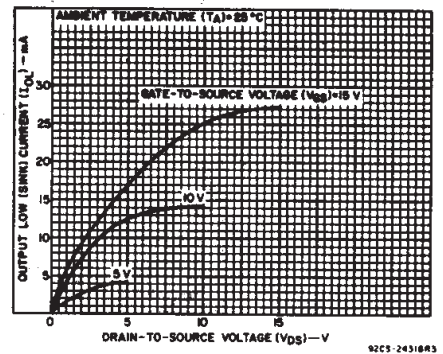


Fig. 2 - Typical output low (sink) current characteristics.

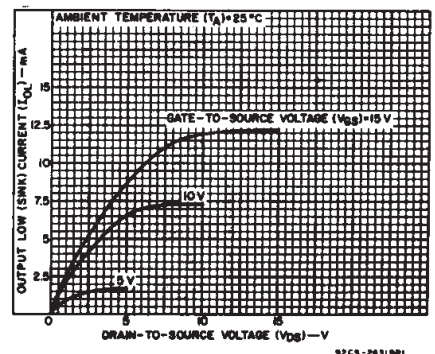
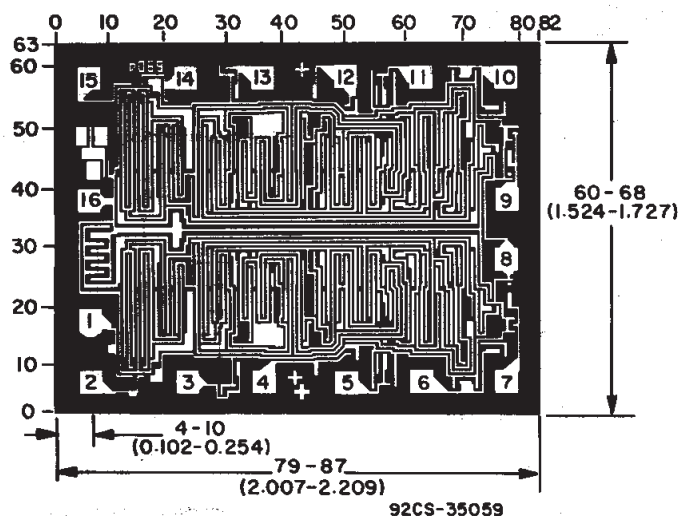


Fig. 3 - Minimum output low (sink) current characteristics.

CD4027B Types

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V _O (V)	V _{IN} (V)	V _{DD} (V)	-55	-40	+85	+125	+25			
								Min.	Typ.	Max.	
Quiescent Device Current, I _{DD} Max.	—	0.5	5	1	1	30	30	—	0.02	1	μA
	—	0.10	10	2	2	60	60	—	0.02	2	
	—	0.15	15	4	4	120	120	—	0.02	4	
	—	0.20	20	20	20	600	600	—	0.04	20	
Output Low (Sink) Current, I _{OL} Min.	0.4	0.5	5	0.64	0.61	0.42	0.36	0.51	1	—	mA
	0.5	0.10	10	1.6	1.5	1.1	0.9	1.3	2.6	—	
	1.5	0.15	15	4.2	4	2.8	2.4	3.4	6.8	—	
	4.6	0.5	5	-0.64	-0.61	-0.42	-0.36	-0.51	-1	—	
	2.5	0.5	5	-2	-1.8	-1.3	-1.15	-1.6	-3.2	—	
	9.5	0.10	10	-1.6	-1.5	-1.1	-0.9	-1.3	-2.6	—	
Output High (Source) Current, I _{OH} Min.	13.5	0.15	15	-4.2	-4	-2.8	-2.4	-3.4	-6.8	—	
Output Voltage: Low-Level, V _{OL} Max.	—	0.5	5	0.05				—	0	0.05	V
	—	0.10	10	0.05				—	0	0.05	
	—	0.15	15	0.05				—	0	0.05	
Output Voltage: High-Level, V _{OH} Min.	—	0.5	5	4.95				4.95	5	—	V
	—	0.10	10	9.95				9.95	10	—	
	—	0.15	15	14.95				14.95	15	—	
Input Low Voltage, V _{IL} Max.	0.5,4.5	—	5	1.5				—	—	1.5	V
	1.9	—	10	3				—	—	3	
	1.5,13.5	—	15	4				—	—	4	
Input High Voltage, V _{IH} Min.	0.5,4.5	—	5	3.5				3.5	—	—	V
	1.9	—	10	7				7	—	—	
	1.5,13.5	—	15	11				11	—	—	
Input Current, I _{IN} Max.	—	0.18	18	±0.1	±0.1	±1	±1	—	±10 ⁻⁵	±0.1	μA



Dimensions in millimeters are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10⁻³).

Dimensions and Pad Layout for CD4027BH

CD4027B Types

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

CHARACTERISTIC	VDD (V)	LIMITS			UNITS
		All Packages			
		Min.	Typ.	Max.	
Propagation Delay Time: Clock to Q or $\bar{Q}$ Outputs t_{PHL}, t_{PLH}	5	—	150	300	ns
	10	—	65	130	
	15	—	45	90	
Set to Q or Reset to $\bar{Q}$ t_{PLH}	5	—	150	300	ns
	10	—	65	130	
	15	—	45	90	
Set to $\bar{Q}$ or Reset to Q t_{PHL}	5	—	200	400	ns
	10	—	85	170	
	15	—	60	120	
Transition Time t_{THL}, t_{TLH}	5	—	100	200	ns
	10	—	50	100	
	15	—	40	80	
Maximum Clock Input Frequency# (Toggle Mode) f_{CL}	5	3.5	7	—	MHz
	10	8	16	—	
	15	12	24	—	
Minimum Clock Pulse Width t_W	5	—	70	140	ns
	10	—	30	60	
	15	—	20	40	
Minimum Set or Reset Pulse Width t_W	5	—	90	180	ns
	10	—	40	80	
	15	—	25	50	
Minimum Data Setup Time t_S	5	—	100	200	ns
	10	—	35	75	
	15	—	25	50	
Clock Input Rise or Fall Time t_{rCL}, t_{fCL}	5	—	—	45	μ s
	10	—	—	5	
	15	—	—	2	
Input Capacitance C_I		—	5	7.5	pF

Input $t_r, t_f = 5\text{ ns}$.

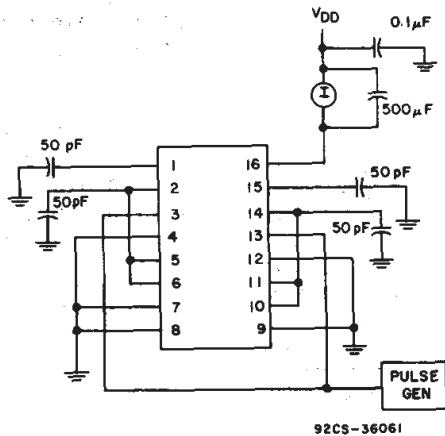


Fig. 13—Dynamic power dissipation test circuit.

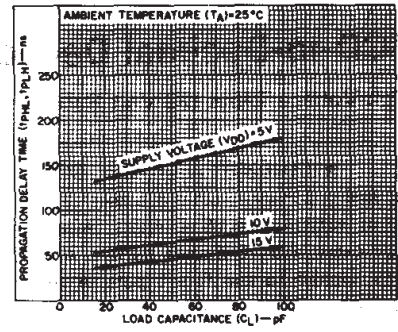


Fig. 10—Typical propagation delay time vs. load capacitance (CLOCK or SET to Q, CLOCK or RESET to $\bar{Q}$).

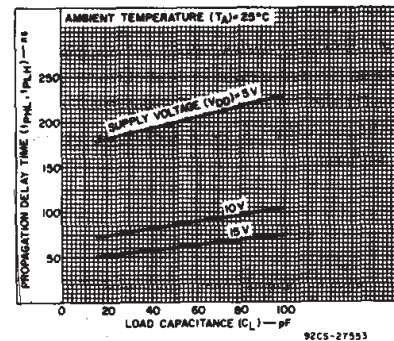


Fig. 11—Typical propagation delay time vs. load capacitance (SET to Q or RESET to Q).

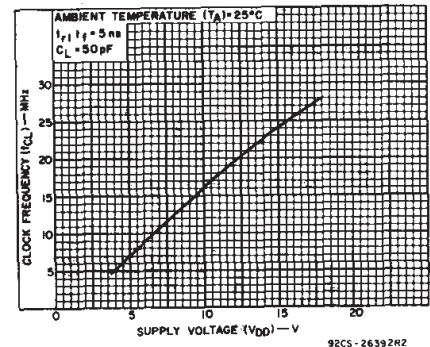


Fig. 12—Typical maximum clock frequency vs. supply voltage (toggle mode).

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COMMERCIAL CMOS
HIGH VOLTAGE ICs

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