

CD4027B Types

CMOS Dual J-K Master-Slave Flip-Flop

High-Voltage Types (20-Volt Rating)

The RCA-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 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), 16-lead ceramic flat packages (K suffix), and in chip form (H suffix).

MAXIMUM RATINGS, Absolute-Maximum Values:

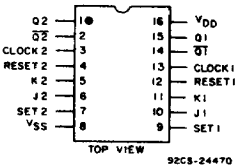
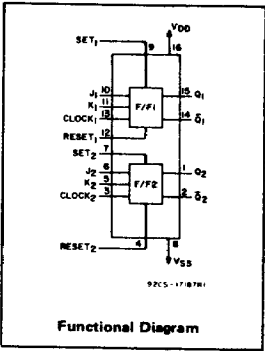
- DC SUPPLY-VOLTAGE RANGE, (VDD) (Voltages referenced to VSS Terminal) -0.5 to +20 V
- INPUT VOLTAGE RANGE, ALL INPUTS -0.5 to VDD +0.5 V
- DC INPUT CURRENT, ANY ONE INPUT ±10 mA
- POWER DISSIPATION PER PACKAGE (PD):
 - For TA = -40 to +60°C (PACKAGE TYPE E) 500 mW
 - For TA = +60 to +85°C (PACKAGE TYPE E) Derate Linearly at 12 mW/°C to 200 mW
 - For TA = -55 to +100°C (PACKAGE TYPES D, F, K) 500 mW
 - For TA = +100 to +125°C (PACKAGE TYPES D, F, K) Derate Linearly at 12 mW/°C to 200 mW
- DEVICE DISSIPATION PER OUTPUT TRANSISTOR:
 - For TA = FULL PACKAGE-TEMPERATURE RANGE (All Package Types) 100 mW
- OPERATING-TEMPERATURE RANGE (TA):
 - PACKAGE TYPES D, F, K, H -55 to +125°C
 - PACKAGE TYPE E -40 to +85°C
- STORAGE TEMPERATURE RANGE (Tstg) -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

Features:

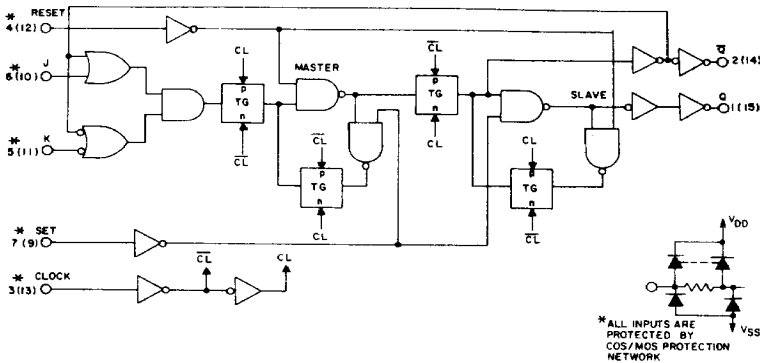
- Set-Reset capability
- Static flip-flop operation — retains state indefinitely with clock level either "high" or "low"
- Medium speed operation — 16 MHz (typ.) clock toggle rate at 10 V
- Standardized symmetrical output characteristics
- 100% tested for quiescent current at 20 V
- Maximum input current of 1 µA 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 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. 13A, "Standard Specifications for Description of 'B' Series CMOS Devices"

Applications:

- Registers, counters, control circuits



TERMINAL ASSIGNMENT



PRESENT STATE					NEXT STATE				
INPUTS					OUTPUTS				
J	K	S	R	Q	Q	Q	Q	Q	Q
1	X	0	0	0	1	0	1	0	0
X	0	0	0	1	0	1	0	1	0
0	X	0	0	0	0	1	0	1	0
X	1	0	0	1	0	1	0	1	0
X	X	0	0	X	X	X	X	X	X
X	X	1	0	X	X	X	X	X	X
X	X	0	1	X	X	X	X	X	X
X	X	1	1	X	X	X	X	X	X

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

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

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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.

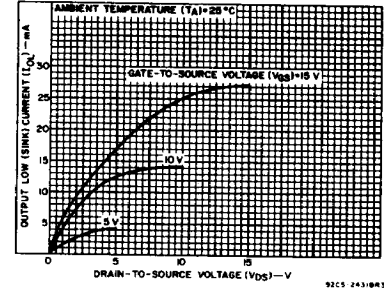


Fig. 2 - Typical output low (sink) current characteristics.

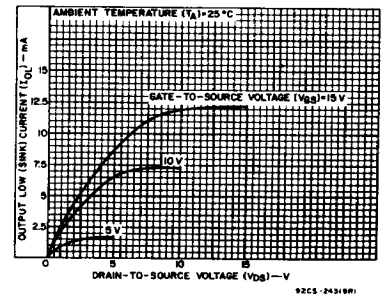


Fig. 3 - Minimum output low (sink) current characteristics.

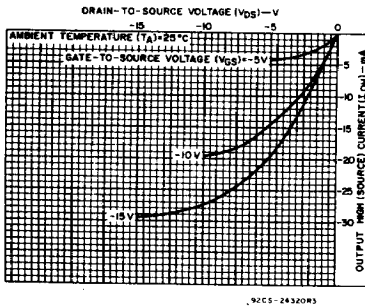


Fig. 4 - Typical output high (source) current characteristics.

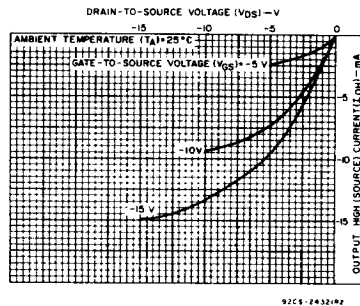


Fig. 5 - Minimum output high (source) current characteristics.

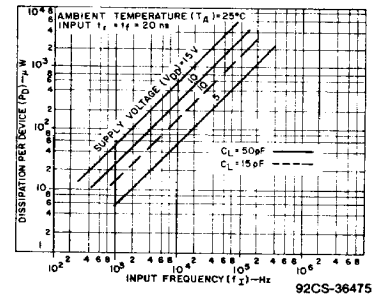


Fig. 6 - Typical power dissipation vs. frequency.

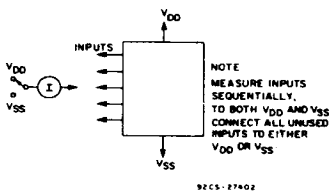


Fig. 7 - Input current test circuit.

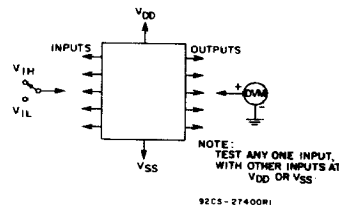


Fig. 8 - Input-voltage test circuit.

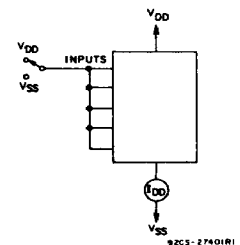
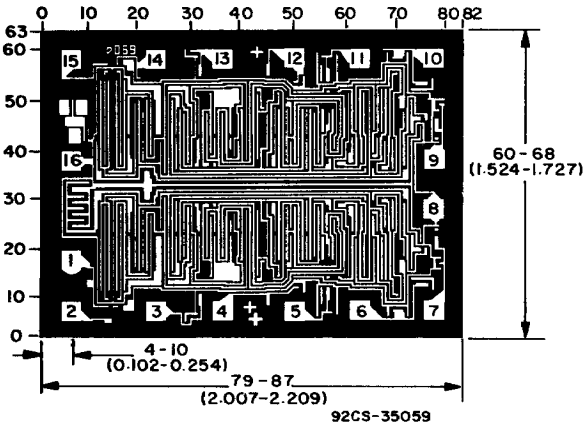


Fig. 9 - Quiescent device current test circuit.

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STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS	
	V _O (V)	V _{IN} (V)	V _{DD} (V)	Values at -55, +25, +125 Apply to D, F, K, H Pkgs. Values at -40, +25, +85 Apply to E Pkgs.								
				-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	—	mA	
	—	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		
	—	0,5	5	4.95				4.95	5	—		
	—	0,10	10	9.95				9.95	10	—		
Output Voltage: High-Level, V _{OH} Min.	—	0,15	15	14.95				14.95	15	—	V	
	0.5,4.5	—	5	1.5				—	—	1.5		V
	1,9	—	10	3				—	—	3		
Input Low Voltage, V _{IL} Max.	1.5,13.5	—	15	4				—	—	4	V	
	0.5,4.5	—	5	3.5				3.5	—	—		
	1,9	—	10	7				7	—	—		
Input High Voltage, V _{IH} Min.	1.5,13.5	—	15	11				11	—	—	V	
	—	0,18	18	±0.1	±0.1	±1	±1	—	±10 ⁻⁵	±0.1		μA
	I _{IN} Max.											



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

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 of -3 mils to +16 mils applicable to the nominal dimensions shown.

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	5	—	150	300	ns
	10	—	65	130	
t_{PHL}, t_{PLH}	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 $t_r, t_f = 5\text{ ns}$.

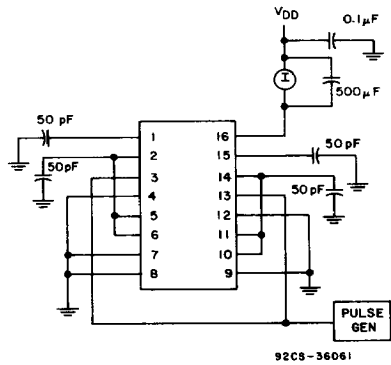


Fig. 13—Dynamic power dissipation test circuit.

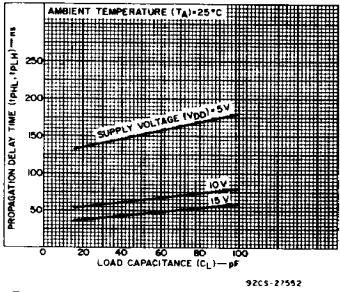


Fig. 10—Typical propagation delay time vs. load capacitance (CLOCK or SET to Q, CLOCK or RESET to $\bar{Q}$).

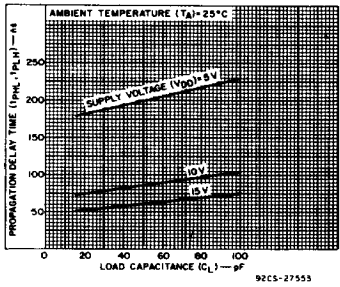


Fig. 11—Typical propagation delay time vs. load capacitance (SET to $\bar{Q}$ or RESET to Q).

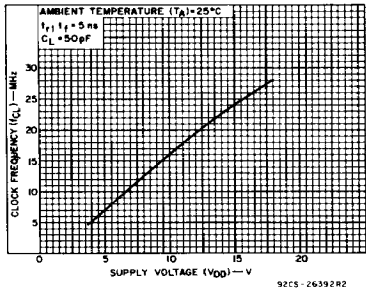


Fig. 12—Typical maximum clock frequency vs. supply voltage (toggle mode).