MC14027B

Dual J-K Flip-Flop

The MC14027B dual J−K flip−flop has independent J, K, Clock (C), Set (S) and Reset (R) inputs for each flip−flop. These devices may be used in control, register, or toggle functions.

- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Logic Swing Independent of Fanout
- Logic Edge−Clocked Flip−Flop Design — Logic state is retained indefinitely with clock level either high or low; information is transferred to the output only on the positive−going edge of the clock pulse
- Capable of Driving Two Low−power TTL Loads or One Low−power Schottky TTL Load Over the Rated Temperature Range
- Pin−for−Pin Replacement for CD4027B

MAXIMUM RATINGS (Voltages Referenced to V_{SS}) (Note 2.)

Symbol	Parameter	Value	Unit
V_{DD}	DC Supply Voltage Range	−0.5 to +18.0	V
V_{in}, V_{out}	Input or Output Voltage Range (DC or Transient)	−0.5 to V_{DD} + 0.5	V
I_{in}, I_{out}	Input or Output Current (DC or Transient) per Pin	±10	mA
P_D	Power Dissipation, per Package (Note 3.)	500	mW
T_A	Ambient Temperature Range	−55 to +125	°C
T_{stg}	Storage Temperature Range	−65 to +150	°C
T_L	Lead Temperature (8−Second Soldering)	260	°C

2. Maximum Ratings are those values beyond which damage to the device may occur.
3. Temperature Derating:
   Plastic “P and D/DW” Packages: – 7.0 mW/°C From 65°C To 125°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high−impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.

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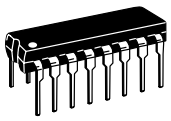
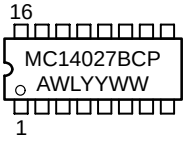
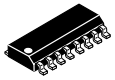
MARKING DIAGRAMS

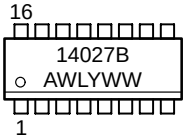


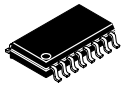
PDIP−16
P SUFFIX
CASE 648



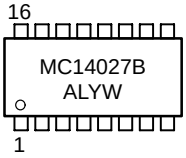


SOIC−16
D SUFFIX
CASE 751B





SOEIAJ−16
F SUFFIX
CASE 966



A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week

ORDERING INFORMATION

Device	Package	Shipping
MC14027BCP	PDIP−16	2000/Box
MC14027BD	SOIC−16	2400/Box
MC14027BDR2	SOIC−16	2500/Tape & Reel
MC14027BF	SOEIAJ−16	See Note 1.
MC14027BFEL	SOEIAJ−16	See Note 1.

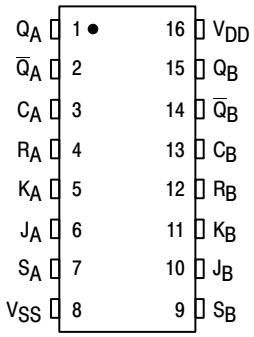
1. For ordering information on the EIAJ version of the SOIC packages, please contact your local ON Semiconductor representative.

TRUTH TABLE

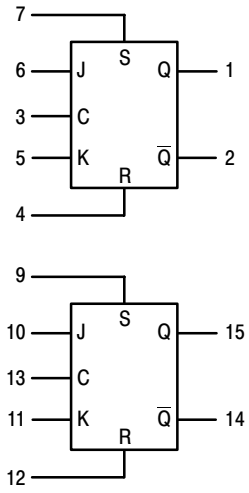
Inputs						Outputs*		
C†	J	K	S	R	Q_n‡	Q_{n+1}	$\overline{Q_{n+1}}$	
↗	1	X	0	0	0	1	0	
↗	X	0	0	0	1	1	0	
↗	0	X	0	0	0	0	1	
↗	X	1	0	0	1	0	1	
↗	1	1	0	0	Qo	$\overline{Qo}$	Qo	
↘	X	X	0	0	X	Q_n	$\overline{Q_n}$	No Change
X	X	X	1	0	X	1	0	
X	X	X	0	1	X	0	1	
X	X	X	1	1	X	1	1	

X = Don't Care
† = Level Change
‡ = Present State
* = Next State

PIN ASSIGNMENT



BLOCK DIAGRAM



V_{DD} = PIN 16
V_{SS} = PIN 8

ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V_{DD} Vdc	− 55°C Min	− 55°C Max	25°C Min	25°C Typ (4.)	25°C Max	125°C Min	125°C Max	Unit
Output Voltage “0” Level V_{in} = V_{DD} or 0	V_{OL}	5.0 10 15	— — —	0.05 0.05 0.05	— — —	0 0 0	0.05 0.05 0.05	— — —	0.05 0.05 0.05	Vdc
V_{in} = 0 or V_{DD} “1” Level	V_{OH}	5.0 10 15	4.95 9.95 14.95	— — —	4.95 9.95 14.95	5.0 10 15	— — —	4.95 9.95 14.95	— — —	Vdc
Input Voltage “0” Level	V_{IL}									Vdc
(V_O = 4.5 or 0.5 Vdc)		5.0	—	1.5	—	2.25	1.5	—	1.5	
(V_O = 9.0 or 1.0 Vdc)		10	—	3.0	—	4.50	3.0	—	3.0	
(V_O = 13.5 or 1.5 Vdc)		15	—	4.0	—	6.75	4.0	—	4.0	
(V_O = 0.5 or 4.5 Vdc) “1” Level	V_{IH}	5.0	3.5	—	3.5	2.75	—	3.5	—	Vdc
(V_O = 1.0 or 9.0 Vdc)		10	7.0	—	7.0	5.50	—	7.0	—	
(V_O = 1.5 or 13.5 Vdc)		15	11	—	11	8.25	—	11	—	
Output Drive Current	I_{OH}									mAdc
(V_{OH} = 2.5 Vdc) Source		5.0	− 3.0	—	− 2.4	− 4.2	—	− 1.7	—	
(V_{OH} = 4.6 Vdc)		5.0	− 0.64	—	− 0.51	− 0.88	—	− 0.36	—	
(V_{OH} = 9.5 Vdc)		10	− 1.6	—	− 1.3	− 2.25	—	− 0.9	—	
(V_{OH} = 13.5 Vdc)		15	− 4.2	—	− 3.4	− 8.8	—	− 2.4	—	
(V_{OL} = 0.4 Vdc) Sink	I_{OL}	5.0	0.64	—	0.51	0.88	—	0.36	—	mAdc
(V_{OL} = 0.5 Vdc)		10	1.6	—	1.3	2.25	—	0.9	—	
(V_{OL} = 1.5 Vdc)		15	4.2	—	3.4	8.8	—	2.4	—	
Input Current	I_{in}	15	—	± 0.1	—	±0.00001	± 0.1	—	± 1.0	µAdc
Input Capacitance (V_{in} = 0)	C_{in}	—	—	—	—	5.0	7.5	—	—	pF
Quiescent Current (Per Package)	I_{DD}	5.0 10 15	— — —	1.0 2.0 4.0	— — —	0.002 0.004 0.006	1.0 2.0 4.0	— — —	30 60 120	µAdc
Total Supply Current (5.) (6.) (Dynamic plus Quiescent, Per Package) (C_L = 50 pF on all outputs, all buffers switching)	I_T	5.0 10 15	I_T = (0.8 µA/kHz) f + I_{DD} I_T = (1.6 µA/kHz) f + I_{DD} I_T = (2.4 µA/kHz) f + I_{DD}							µAdc

4. Data labelled “Typ” is not to be used for design purposes but is intended as an indication of the IC’s potential performance.
5. The formulas given are for the typical characteristics only at 25°C.
6. To calculate total supply current at loads other than 50 pF:

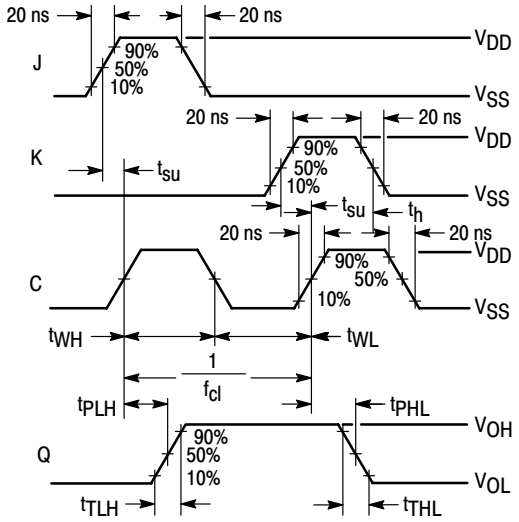
$$I_T(C_L) = I_T(50\ pF) + (C_L - 50)\ Vfk$$

where: I_T is in µA (per package), C_L in pF, V = (V_{DD} − V_{SS}) in volts, f in kHz is input frequency, and k = 0.002.

SWITCHING CHARACTERISTICS (7.) (C_L = 50 pF, T_A = 25°C)

Characteristic	Symbol	V_{DD}	Min	Typ (8.)	Max	Unit
Output Rise and Fall Time	t_{TLH},					ns
t_{TLH}, t_{THL} = (1.5 ns/pF) C_L + 25 ns	t_{THL}	5.0	—	100	200	
t_{TLH}, t_{THL} = (0.75 ns/pF) C_L + 12.5 ns		10	—	50	100	
t_{TLH}, t_{THL} = (0.55 ns/pF) C_L + 12.5 ns		15	—	40	80	
Propagation Delay Times**	t_{PLH},					ns
Clock to Q, Q	t_{PHL}					
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 90 ns		5.0	—	175	350	
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 42 ns		10	—	75	150	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 25 ns		15	—	50	100	
Set to Q, Q						
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 90 ns		5.0	—	175	350	
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 42 ns		10	—	75	150	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 25 ns		15	—	50	100	
Reset to Q, Q						
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 265 ns		5.0	—	350	450	
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 67 ns		10	—	100	200	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 50 ns		15	—	75	150	
Setup Times	t_{su}	5.0	140	70	—	ns
		10	50	25	—	
		15	35	17	—	
Hold Times	t_h	5.0	140	70	—	ns
		10	50	25	—	
		15	35	17	—	
Clock Pulse Width	t_{WH}, t_{WL}	5.0	330	165	—	ns
		10	110	55	—	
		15	75	38	—	
Clock Pulse Frequency	f_{cl}	5.0	—	3.0	1.5	MHz
		10	—	9.0	4.5	
		15	—	13	6.5	
Clock Pulse Rise and Fall Time	t_{TLH}, t_{THL}	5.0	—	—	15	μs
		10	—	—	5.0	
		15	—	—	4.0	
Removal Times	t_{rem}					ns
		5	90	10	—	
Set		10	45	5	—	
		15	35	3	—	
		5	50	– 30	—	
Reset		10	25	– 15	—	
		15	20	– 10	—	
Set and Reset Pulse Width	t_{WH}	5.0	250	125	—	ns
		10	100	50	—	
		15	70	35	—	

7. The formulas given are for the typical characteristics only at 25°C.
8. Data labelled “Typ” is not to be used for design purposes but is intended as an indication of the IC’s potential performance.



Inputs R and S low.
For the measurement of t_{WH}, $1/f_{cl}$, and P_D the Inputs J and K are kept high.

Figure 1. Dynamic Signal Waveforms (J, K, Clock, and Output)

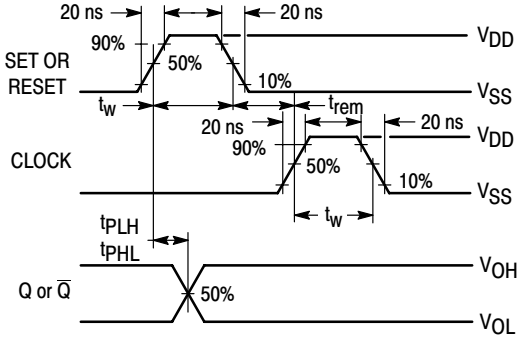


Figure 2. Dynamic Signal Waveforms (Set, Reset, Clock, and Output)

LOGIC DIAGRAM
(1/2 of Device Shown)