

CD4013BM/CD4013BC Dual D Flip-Flop

General Description

The CD4013B dual D flip-flop is a monolithic complementary MOS (CMOS) integrated circuit constructed with N- and P-channel enhancement mode transistors. Each flip-flop has independent data, set, reset, and clock inputs and "Q" and "Q̄" outputs. These devices can be used for shift register applications, and by connecting "Q̄" output to the data input, for counter and toggle applications. The logic level present at the "D" input is transferred to the Q output during the positive-going transition of the clock pulse. Setting or resetting is independent of the clock and is accomplished by a high level on the set or reset line respectively.

Features

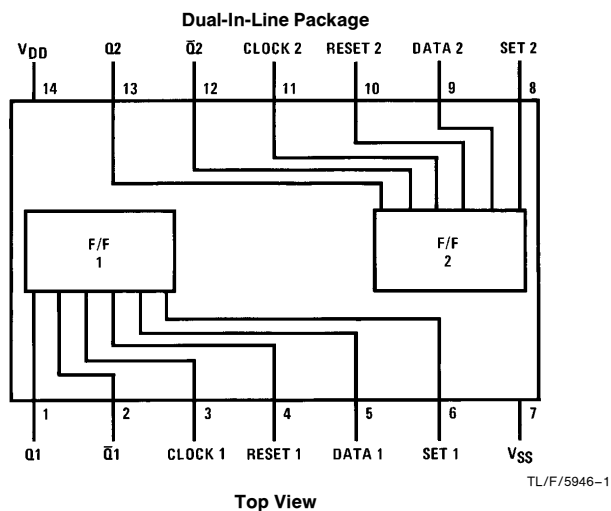
- Wide supply voltage range
- High noise immunity
- Low power TTL compatibility

3.0V to 15V
0.45 V_{DD} (typ.)
fan out of 2 driving 74L
or 1 driving 74LS

Applications

- Automotive
- Data terminals
- Instrumentation
- Medical electronics
- Alarm system
- Industrial electronics
- Remote metering
- Computers

Connection Diagram



Order Number CD4013B

Truth Table

CL [†]	D	R	S	Q	Q̄
	0	0	0	0	1
	1	0	0	1	0
	x	0	0	Q	Q̄
x	x	1	0	0	1
x	x	0	1	1	0
x	x	1	1	1	1

No change

[†] = Level change

x = Don't care case

Absolute Maximum Ratings (Notes 1 & 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

DC Supply Voltage (V_{DD})	$-0.5 V_{DC}$ to $+18 V_{DC}$
Input Voltage (V_{IN})	$-0.5 V_{DC}$ to $V_{DD} + 0.5 V_{DC}$
Storage Temp. Range (T_S)	-65°C to $+150^{\circ}\text{C}$
Power Dissipation (P_D)	
Dual-In-Line	700 mW
Small Outline	500 mW
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260°C

Recommended Operating Conditions (Note 2)

DC Supply Voltage (V_{DD})	$+3 V_{DC}$ to $+15 V_{DC}$
Input Voltage (V_{IN})	$0 V_{DC}$ to $V_{DD} V_{DC}$
Operating Temperature Range (T_A)	
CD4013BM	-55°C to $+125^{\circ}\text{C}$
CD4013BC	-40°C to $+85^{\circ}\text{C}$

DC Electrical Characteristics CD4013BM (Note 2)

Symbol	Parameter	Conditions	-55°C		$+25^{\circ}\text{C}$			$+125^{\circ}\text{C}$		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	$V_{DD} = 5V, V_{IN} = V_{DD}$ or V_{SS} $V_{DD} = 10V, V_{IN} = V_{DD}$ or V_{SS} $V_{DD} = 15V, V_{IN} = V_{DD}$ or V_{SS}		1.0 2.0 4.0			1.0 2.0 4.0		30 60 120	μA μA μA
V_{OL}	Low Level Output Voltage	$ I_O < 1.0 \mu\text{A}$ $V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		0.05 0.05 0.05			0.05 0.05 0.05		0.05 0.05 0.05	V V V
V_{OH}	High Level Output Voltage	$ I_O < 1.0 \mu\text{A}$ $V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$	4.95 9.95 14.95		4.95 9.95 14.95			4.95 9.95 14.95		V V V
V_{IL}	Low Level Input Voltage	$ I_O < 1.0 \mu\text{A}$ $V_{DD} = 5V, V_O = 0.5V$ or $4.5V$ $V_{DD} = 10V, V_O = 1.0V$ or $9.0V$ $V_{DD} = 15V, V_O = 1.5V$ or $13.5V$		1.5 3.0 4.0			1.5 3.0 4.0		1.5 3.0 4.0	V V V
V_{IH}	High Level Input Voltage	$ I_O < 1.0 \mu\text{A}$ $V_{DD} = 5V, V_O = 0.5V$ or $4.5V$ $V_{DD} = 10V, V_O = 1.0V$ or $9.0V$ $V_{DD} = 15V, V_O = 1.5V$ or $13.5V$	3.5 7.0 11.0		3.5 7.0 11.0			3.5 7.0 11.0		V V V
I_{OL}	Low Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 0.4V$ $V_{DD} = 10V, V_O = 0.5V$ $V_{DD} = 15V, V_O = 1.5V$	0.64 1.6 4.2		0.51 1.3 3.4	0.88 2.25 8.8		0.36 0.9 2.4		mA mA mA
I_{OH}	High Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 4.6V$ $V_{DD} = 10V, V_O = 9.5V$ $V_{DD} = 15V, V_O = 13.5V$	-0.64 -1.6 -4.2		-0.51 -1.3 -3.4	-0.88 -2.25 -8.8		-0.36 -0.9 -2.4		mA mA mA
I_{IN}	Input Current	$V_{DD} = 15V, V_{IN} = 0V$ $V_{DD} = 15V, V_{IN} = 15V$		-0.1 0.1		-10^{-5} 10^{-5}	-0.1 0.1		-1.0 1.0	μA μA

DC Electrical Characteristics CD4013BC (Note 2)

Symbol	Parameter	Conditions	-40°C		$+25^{\circ}\text{C}$			$+85^{\circ}\text{C}$		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device Current	$V_{DD} = 5V, V_{IN} = V_{DD}$ or V_{SS} $V_{DD} = 10V, V_{IN} = V_{DD}$ or V_{SS} $V_{DD} = 15V, V_{IN} = V_{DD}$ or V_{SS}		4.0 8.0 16.0			4.0 8.0 16.0		30 60 120	μA μA μA
V_{OL}	Low Level Output Voltage	$ I_O < 1.0 \mu\text{A}$ $V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		0.05 0.05 0.05			0.05 0.05 0.05		0.05 0.05 0.05	V V V
V_{OH}	High Level Output Voltage	$ I_O < 1.0 \mu\text{A}$ $V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$	4.95 9.95 14.95		4.95 9.95 14.95			4.95 9.95 14.95		V V V
V_{IL}	Low Level Input Voltage	$ I_O < 1.0 \mu\text{A}$ $V_{DD} = 5V, V_O = 0.5V$ or $4.5V$ $V_{DD} = 10V, V_O = 1.0V$ or $9.0V$ $V_{DD} = 15V, V_O = 1.5V$ or $13.5V$		1.5 3.0 4.0			1.5 3.0 4.0		1.5 3.0 4.0	V V V

DC Electrical Characteristics CD4013BC (Note 2) (Continued)

Symbol	Parameter	Conditions	− 40°C		+ 25°C			+ 85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
V_{IH}	High Level Input Voltage	$ I_O < 1.0 \mu A$								
		$V_{DD} = 5V, V_O = 0.5V \text{ or } 4.5V$	3.5		3.5			3.5		V
		$V_{DD} = 10V, V_O = 1.0V \text{ or } 9.0V$	7.0		7.0			7.0		V
		$V_{DD} = 15V, V_O = 1.5V \text{ or } 13.5V$	11.0		11.0			11.0		V
I_{OL}	Low Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 0.4V$	0.52		0.44	0.88		0.36		mA
		$V_{DD} = 10V, V_O = 0.5V$	1.3		1.1	2.25		0.9		mA
		$V_{DD} = 15V, V_O = 1.5V$	3.6		3.0	8.8		2.4		mA
I_{OH}	High Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 4.6V$	−0.52		−0.44	−0.88		−0.36		mA
		$V_{DD} = 10V, V_O = 9.5V$	−1.3		−1.1	−2.25		−0.9		mA
		$V_{DD} = 15V, V_O = 13.5V$	−3.6		−3.0	−8.8		−2.4		mA
I_{IN}	Input Current	$V_{DD} = 15V, V_{IN} = 0V$		−0.3		-10^{-5}	−0.3		−1.0	μA
		$V_{DD} = 15V, V_{IN} = 15V$		0.3		10^{-5}	0.3		1.0	μA

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed, they are not meant to imply that the devices should be operated at these limits. The tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual device operation.

Note 2: $V_{SS} = 0V$ unless otherwise specified.

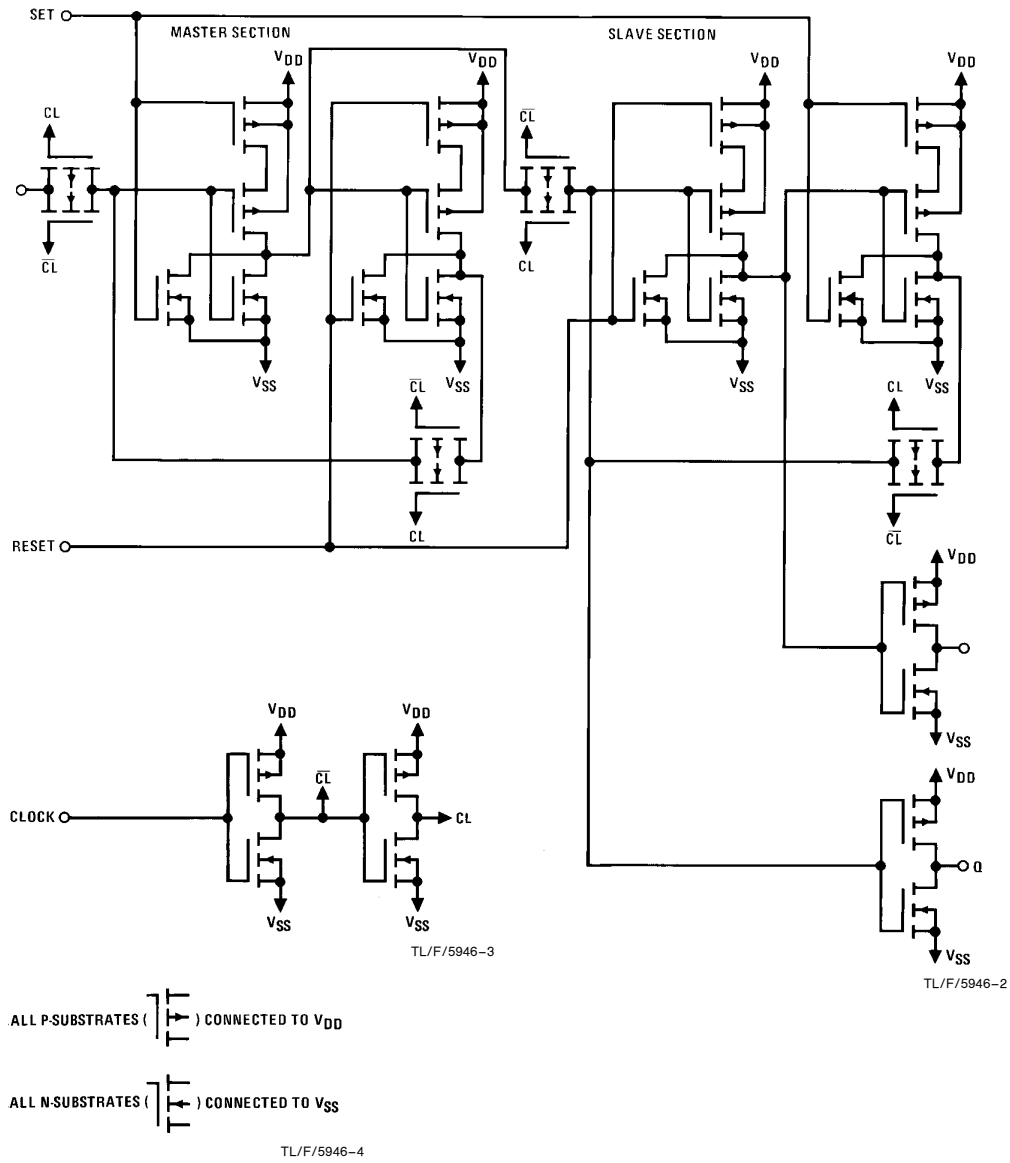
Note 3: I_{OH} and I_{OL} are measured one output at a time.

AC Electrical Characteristics* $T_A = 25^\circ C, C_L = 50 \text{ pF}, R_L = 200k$, unless otherwise noted

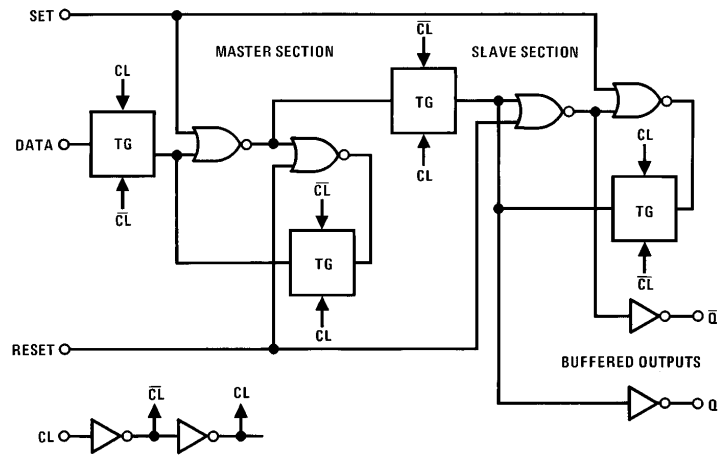
Symbol	Parameter	Conditions	Min	Typ	Max	Units
CLOCK OPERATION						
t_{PHL}, t_{PLH}	Propagation Delay Time	$V_{DD} = 5V$		200	350	ns
		$V_{DD} = 10V$		80	160	ns
		$V_{DD} = 15V$		65	120	ns
t_{THL}, t_{TLH}	Transition Time	$V_{DD} = 5V$		100	200	ns
		$V_{DD} = 10V$		50	100	ns
		$V_{DD} = 15V$		40	80	ns
t_{WL}, t_{WH}	Minimum Clock Pulse Width	$V_{DD} = 5V$		100	200	ns
		$V_{DD} = 10V$		40	80	ns
		$V_{DD} = 15V$		32	65	ns
t_{RCL}, t_{FCL}	Maximum Clock Rise and Fall Time	$V_{DD} = 5V$			15	μs
		$V_{DD} = 10V$			10	μs
		$V_{DD} = 15V$			5	μs
t_{SU}	Minimum Set-Up Time	$V_{DD} = 5V$		20	40	ns
		$V_{DD} = 10V$		15	30	ns
		$V_{DD} = 15V$		12	25	ns
f_{CL}	Maximum Clock Frequency	$V_{DD} = 5V$	2.5	5		MHz
		$V_{DD} = 10V$	6.2	12.5		MHz
		$V_{DD} = 15V$	7.6	15.5		MHz
SET AND RESET OPERATION						
$t_{PHL(R)}, t_{PLH(S)}$	Propagation Delay Time	$V_{DD} = 5V$		150	300	ns
		$V_{DD} = 10V$		65	130	ns
		$V_{DD} = 15V$		45	90	ns
$t_{WH(R)}, t_{WH(S)}$	Minimum Set and Reset Pulse Width	$V_{DD} = 5V$		90	180	ns
		$V_{DD} = 10V$		40	80	ns
		$V_{DD} = 15V$		25	50	ns
C_{IN}	Average Input Capacitance	Any Input		5	7.5	pF

*AC Parameters are guaranteed by DC correlated testing.

Schematic Diagram

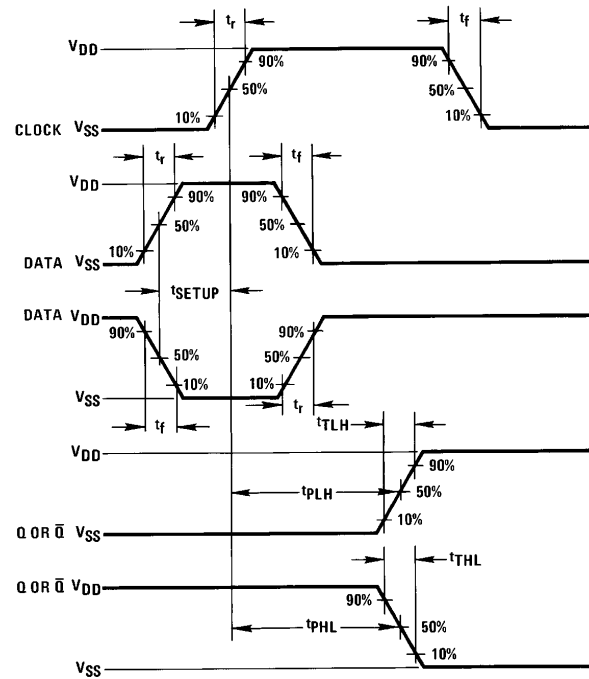


Logic Diagram



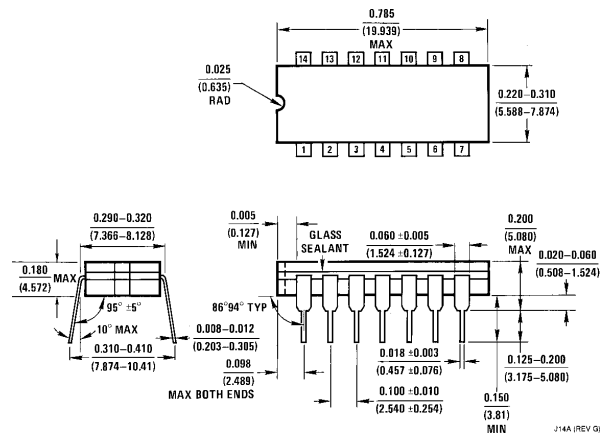
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Switching Time Waveforms

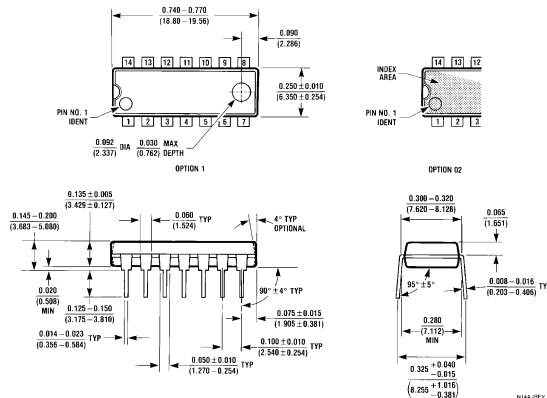


TL/F/5946-6

Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number CD4013BMJ or CD4013BCJ
NS Package Number J14A



Molded Dual-In-Line Package (N)
Order Number CD4013BMN or CD4013BCN
NS Package Number N14A

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National Semiconductor Corporation
 1111 West Bardin Road
 Arlington, TX 76017
 Tel: 1(800) 272-9959
 Fax: 1(800) 737-7018

National Semiconductor Europe
 Fax: (+49) 0-180-530 85 86
 Email: cnjwge@tevm2.nsc.com
 Deutsch Tel: (+49) 0-180-530 85 85
 English Tel: (+49) 0-180-532 78 32
 Français Tel: (+49) 0-180-532 93 58
 Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
 19th Floor, Straight Block,
 Ocean Centre, 5 Canton Rd.
 Tsimshatsui, Kowloon
 Hong Kong
 Tel: (852) 2737-1600
 Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
 Tel: 81-043-299-2309
 Fax: 81-043-299-2408