

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.

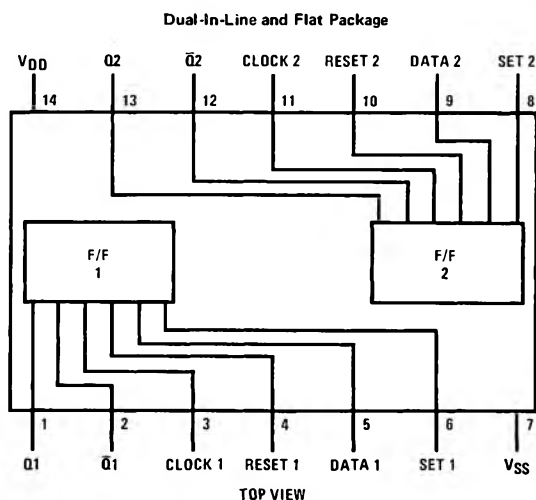
Features

- Wide supply voltage range 3.0 V to 15 V
- High noise immunity 0.45 V_{DD} (typ.)
- Low power TTL compatibility 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



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 and 2)

V_{DD} dc Supply Voltage	-0.5 to +18 V_{DC}
V_{IN} Input Voltage	-0.5 to V_{DD} +0.5 V_{DC}
T_S Storage Temperature Range	-65°C to +150°C
P_D Package Dissipation	500 mW
T_L Lead Temperature (Soldering, 10 seconds)	300°C

Recommended Operating Conditions

(Note 2)

V_{DD} dc Supply Voltage	+3 to +15 V_{DC}
V_{IN} Input Voltage	0 to V_{DD} V_{DC}
T_A Operating Temperature Range	-55°C to +125°C
CD4013BM	-40°C to +85°C
CD4013BC	

DC Electrical Characteristics 4013BM (Note 2)

PARAMETER	CONDITIONS	-55°C		25°C			125°C		UNITS
		MIN	MAX	MIN	TYP	MAX	MIN	MAX	
I_{DD} Quiescent Device Current	$V_{DD} = 5V$		1.0			1.0		30	μA
	$V_{DD} = 10V$		2.0			2.0		60	μA
	$V_{DD} = 15V$		4.0			4.0		120	μA
V_{OL} Low Level Output Voltage	$I_{O1} < 1.0\mu A$								
	$V_{DD} = 5V$		0.05			0.05		0.05	V
	$V_{DD} = 10V$		0.05			0.05		0.05	V
	$V_{DD} = 15V$		0.05			0.05		0.05	V
V_{OH} High Level Output Voltage	$I_{O1} < 1.0\mu A$								
	$V_{DD} = 5V$	4.95		4.95			4.95		V
	$V_{DD} = 10V$	9.95		9.95			9.95		V
	$V_{DD} = 15V$	14.95		14.95			14.95		V
V_{IL} Low Level Input Voltage	$I_{O1} < 1.0\mu A$								
	$V_{DD} = 5V, V_O = 0.5V$ or 4.5V		1.5			1.5		1.5	V
	$V_{DD} = 10V, V_O = 1.0V$ or 9.0V		3.0			3.0		3.0	V
	$V_{DD} = 15V, V_O = 1.5V$ or 13.5V		4.0			4.0		4.0	V
V_{IH} High Level Input Voltage	$I_{O1} < 1.0\mu A$								
	$V_{DD} = 5V, V_O = 0.5V$ or 4.5V	3.5		3.5			3.5		V
	$V_{DD} = 10V, V_O = 1.0V$ or 9.0V	7.0		7.0			7.0		V
	$V_{DD} = 15V, V_O = 1.5V$ or 13.5V	11.0		11.0			11.0		V
I_{OL} Low Level Output Current	$V_{DD} = 5V, V_O = 0.4V$	0.64		0.51	0.88		0.36		mA
	$V_{DD} = 10V, V_O = 0.5V$	1.6		1.3	2.25		0.9		mA
	$V_{DD} = 15V, V_O = 1.5V$	4.2		3.4	8.8		2.4		mA
I_{OH} High Level Output Current	$V_{DD} = 5V, V_O = 4.6V$	-0.64		-0.51	-0.88		-0.36		mA
	$V_{DD} = 10V, V_O = 9.5V$	-1.6		-1.3	-2.25		-0.9		mA
	$V_{DD} = 15V, V_O = 13.5V$	-4.2		-3.4	-8.8		-2.4		mA
I_{IN} Input Current	$V_{DD} = 15V, V_{IN} = 0V$		-0.1		-10^{-5}	-0.1		-1.0	μA
	$V_{DD} = 15V, V_{IN} = 15V$		0.1		10^{-5}	0.1		1.0	μA

DC Electrical Characteristics 4013BC (Note 2)

PARAMETER	CONDITIONS	-40°C		25°C			85°C		UNITS
		MIN	MAX	MIN	TYP	MAX	MIN	MAX	
I_{DD} Quiescent Device Current	$V_{DD} = 5V$		4.0			4.0		30	μA
	$V_{DD} = 10V$		8.0			8.0		60	μA
	$V_{DD} = 15V$		16.0			16.0		120	μA
V_{OL} Low Level Output Voltage	$I_{O1} < 1.0\mu A$								
	$V_{DD} = 5V$		0.05			0.05		0.05	V
	$V_{DD} = 10V$		0.05			0.05		0.05	V
	$V_{DD} = 15V$		0.05			0.05		0.05	V
V_{OH} High Level Output Voltage	$I_{O1} < 1.0\mu A$								
	$V_{DD} = 5V$	4.95		4.95			4.95		V
	$V_{DD} = 10V$	9.95		9.95			9.95		V
	$V_{DD} = 15V$	14.95		14.95			14.95		V
V_{IL} Low Level Input Voltage	$I_{O1} < 1.0\mu A$								
	$V_{DD} = 5V, V_O = 0.5V$ or 4.5V		1.5			1.5		1.5	V
	$V_{DD} = 10V, V_O = 1.0V$ or 9.0V		3.0			3.0		3.0	V
	$V_{DD} = 15V, V_O = 1.5V$ or 13.5V		4.0			4.0		4.0	V

DC Electrical Characteristics (Cont'd.) CD4013BC (Note 2)

PARAMETER	CONDITIONS	-40°C		25°C			85°C		UNITS
		MIN	MAX	MIN	TYP	MAX	MIN	MAX	
V_{IH} High Level Input Voltage	$ I_{OI} < 1.0\mu A$ $V_{DD} = 5V, V_O = 0.5V \text{ or } 4.5V$ $V_{DD} = 10V, V_O = 1.0V \text{ or } 9.0V$ $V_{DD} = 15V, V_O = 1.5V \text{ or } 13.5V$	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	$V_{DD} = 5V, V_O = 0.4V$ $V_{DD} = 10V, V_O = 0.5V$ $V_{DD} = 15V, V_O = 1.5V$	0.52 1.3 3.6		0.44 1.1 3.0	0.88 2.25 8.8		0.36 0.9 2.4		mA mA mA
I_{OH} High Level Output Current	$V_{DD} = 5V, V_O = 4.6V$ $V_{DD} = 10V, V_O = 9.5V$ $V_{DD} = 15V, V_O = 13.5V$	-0.52 -1.3 -3.6		-0.44 -1.1 -3.0	-0.88 -2.25 -8.8		-0.36 -0.9 -2.4		mA mA mA
I_{IN} Input Current	$V_{DD} = 15V, V_{IN} = 0V$ $V_{DD} = 15V, V_{IN} = 15V$		-0.3 0.3		-10^{-5} 10^{-5}	-0.3 0.3		-1.0 1.0	μA μA

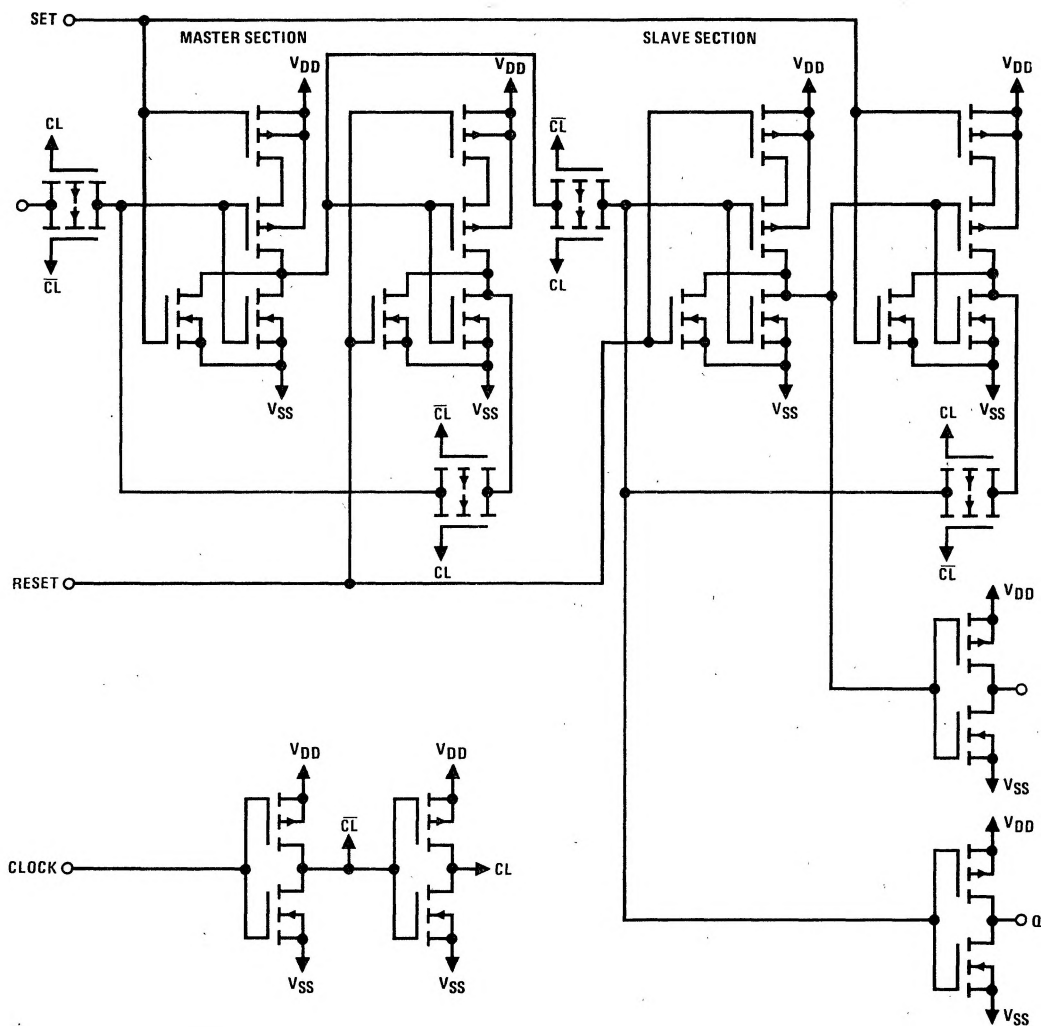
Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed, they are not meant to imply that the devices should be operated at these limits. The table of "Recommended Operating Conditions" and "Electrical Characteristics" provides conditions for actual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

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

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

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

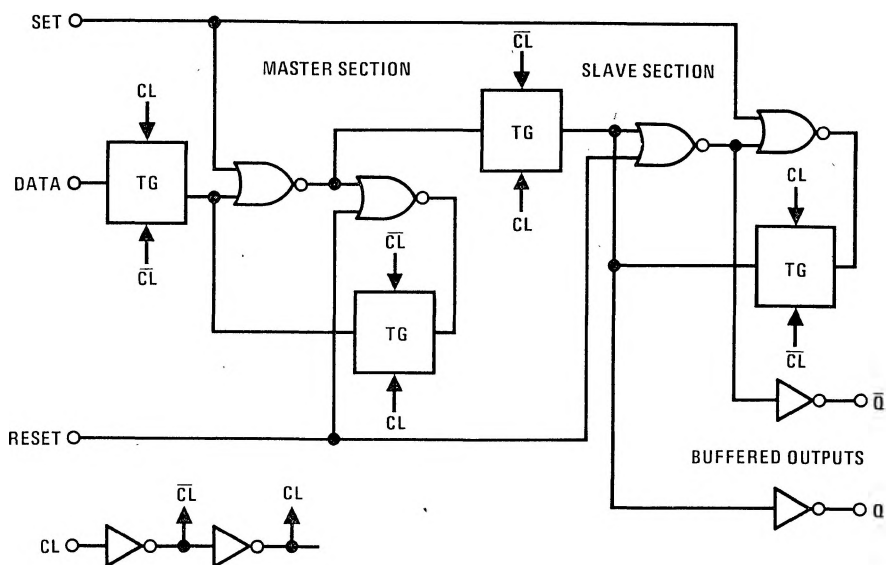
Schematic Diagram



ALL P-SUBSTRATES () CONNECTED TO **V_{DD}**

ALL N-SUBSTRATES () CONNECTED TO **V_{SS}**

Logic Diagram



Switching Time Waveforms

