FAIRCHILD SEMICONDUCTOR™

October 1987
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CD4013BC
Dual D-Type Flip-Flop

General Description

The CD4013B dual D-type 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 "$\overline{Q}$" outputs. These devices can be used for shift register applications, and by connecting "$\overline{Q}$" 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: 3.0V to 15V
- High noise immunity: 0.45 V_{DD} (typ.)
- Low power TTL: fan out of 2 driving 74L
  compatibility: or 1 driving 74LS

Applications

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

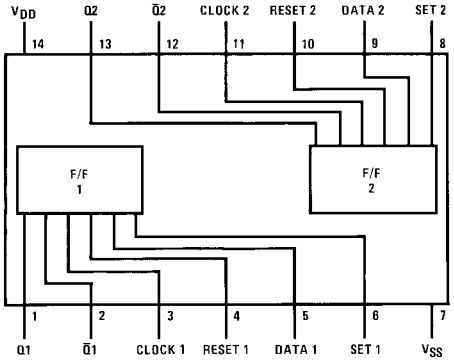
Ordering Code:

Order Number	Package Number	Package Description
CD4013BCM	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow
CD4013BCSJ	M14D	14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
CD4013BCN	N14A	14-Lead Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Connection Diagram

Pin Assignments for DIP, SOIC and SOP



Top View

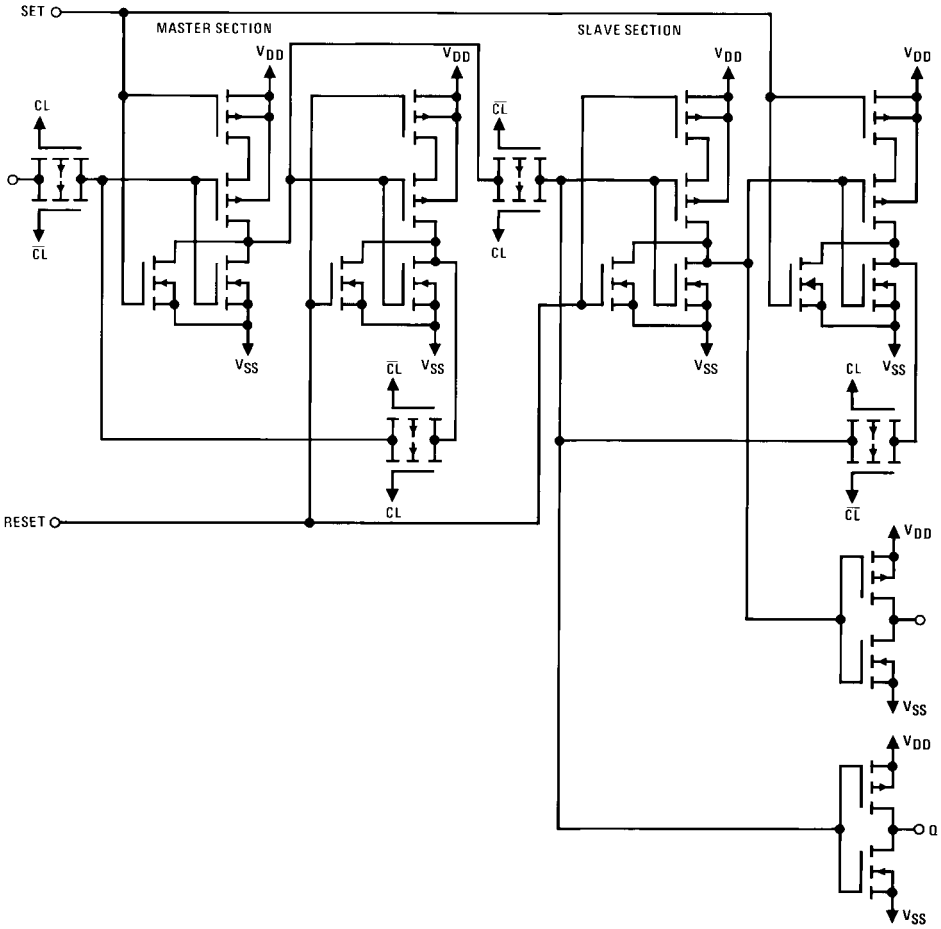
Truth Table

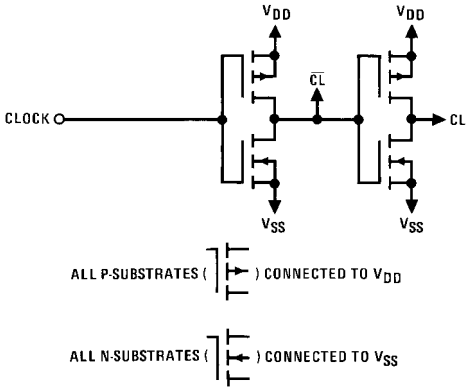
CL (Note 1)	D	R	S	Q	$\overline{Q}$
↗	0	0	0	0	1
↗	1	0	0	1	0
↘	x	0	0	Q	$\overline{Q}$
x	x	1	0	0	1
x	x	0	1	1	0
x	x	1	1	1	1

No Change
x = Don't Care Case

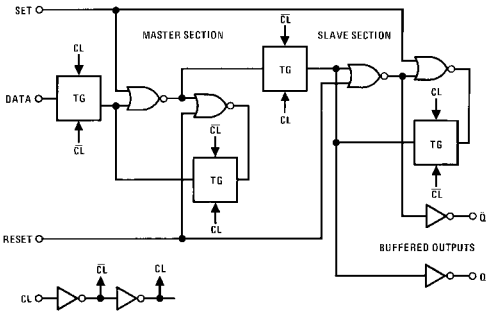
Note 1: Level Change

Schematic Diagrams





Logic Diagram



Absolute Maximum Ratings (Note 2)

(Note 3)

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 Temperature Range (T_S)	−65°C to +150°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 3)

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)	−40°C to +85°C

Note 2: "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 3: V_{SS} = 0V unless otherwise specified.

DC Electrical Characteristics (Note 3)

Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Device	V_{DD} = 5V, V_{IN} = V_{DD} or V_{SS}		4.0			4.0		30	µA
	Current	V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		8.0			8.0		60	µA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		16.0			16.0		120	µA
V_{OL}	LOW Level	$\|I_O\|$ < 1.0 µA								
	Output Voltage	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	$\|I_O\|$ < 1.0 µA								
	Output Voltage	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	$\|I_O\|$ < 1.0 µA								
	Input Voltage	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	$\|I_O\|$ < 1.0 µA								
	Input Voltage	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	V_{DD} = 5V, V_O = 0.4V	0.52		0.44	0.88		0.36		mA
	Current (Note 4)	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	V_{DD} = 5V, V_O = 4.6V	−0.52		−0.44	−0.88		−0.36		mA
	Current (Note 4)	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 4: I_{OH} and I_{OL} are measured one output at a time.

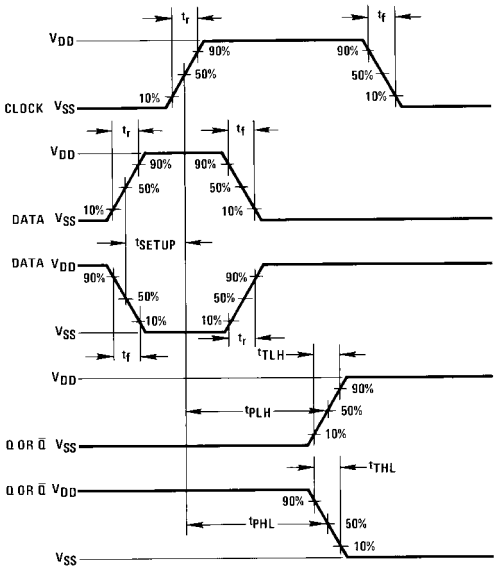
AC Electrical Characteristics (Note 5)

$T_A = 25°C$, $C_L = 50$ pF, $R_L = 200$k, unless otherwise noted

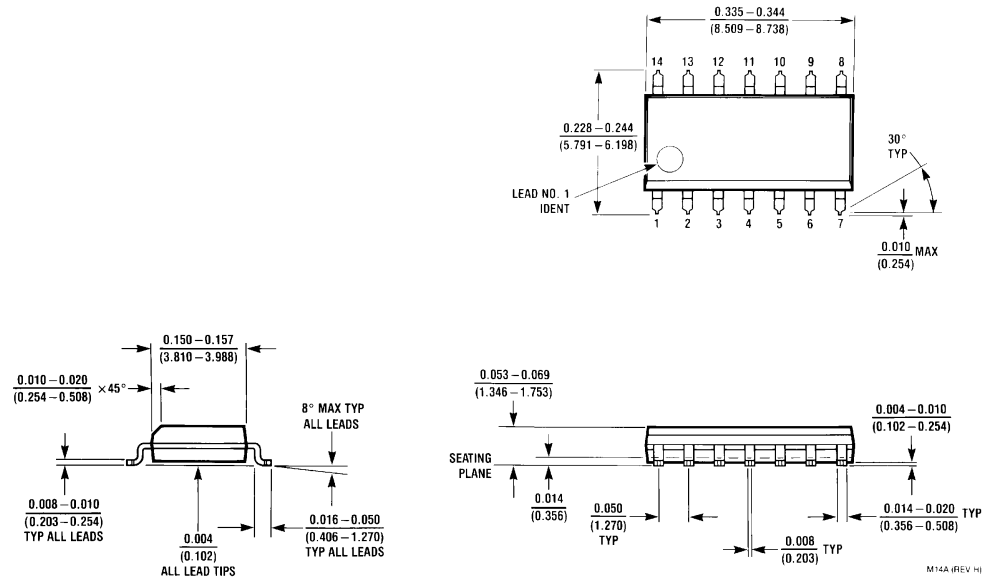
Symbol	Parameter	Conditions	Min	Typ	Max	Units
CLOCK OPERATION						
t_{PHL}, t_{PLH}	Propagation Delay Time	V_{DD} = 5V		200	350	ns
		V_{DD} = 10V		80	160	ns
		V_{DD} = 15V		65	120	ns
t_{THL}, t_{TLH}	Transition Time	V_{DD} = 5V		100	200	ns
		V_{DD} = 10V		50	100	ns
		V_{DD} = 15V		40	80	ns
t_{WL}, t_{WH}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

Note 5: AC Parameters are guaranteed by DC correlated testing.

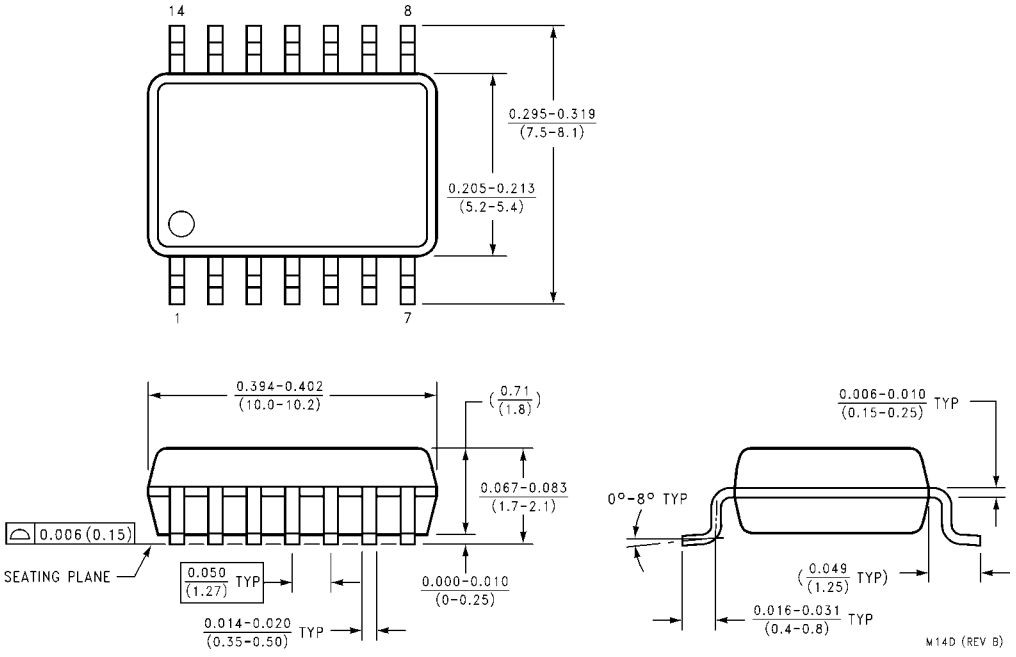
Switching Time Waveforms



Physical Dimensions inches (millimeters) unless otherwise noted

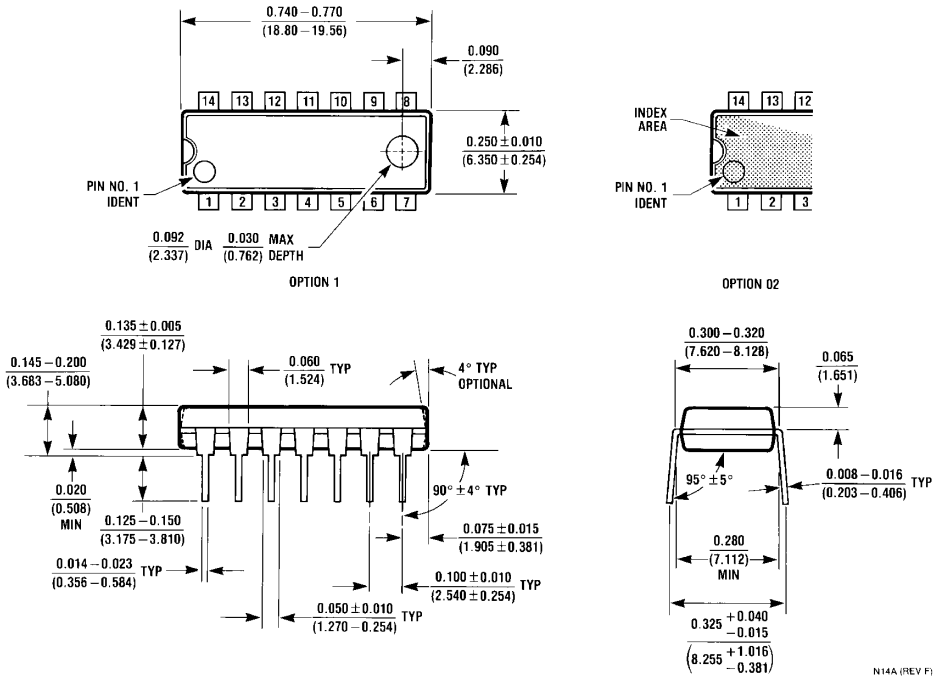


14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow
Package Number M14A



14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
Package Number M14D

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
Package Number N14A

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