FAIRCHILD

SEMICONDUCTOR ™

CD4013BC
Dual D-Type Flip-Flop

General Description

The CD4013B dual D-type flip-flop is a monolithic comple-mentary 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: 3.0V 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-012, 0.150" Narrow
CD4013BCSJ	M14D	14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
CD4013BCN	N14A	14-Lead Plastic 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
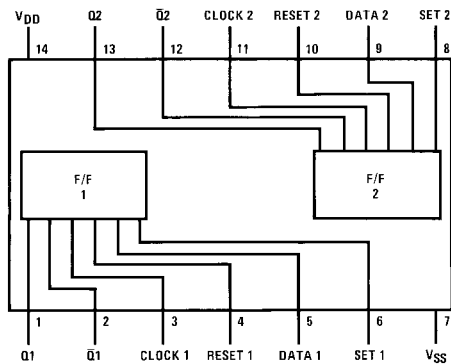
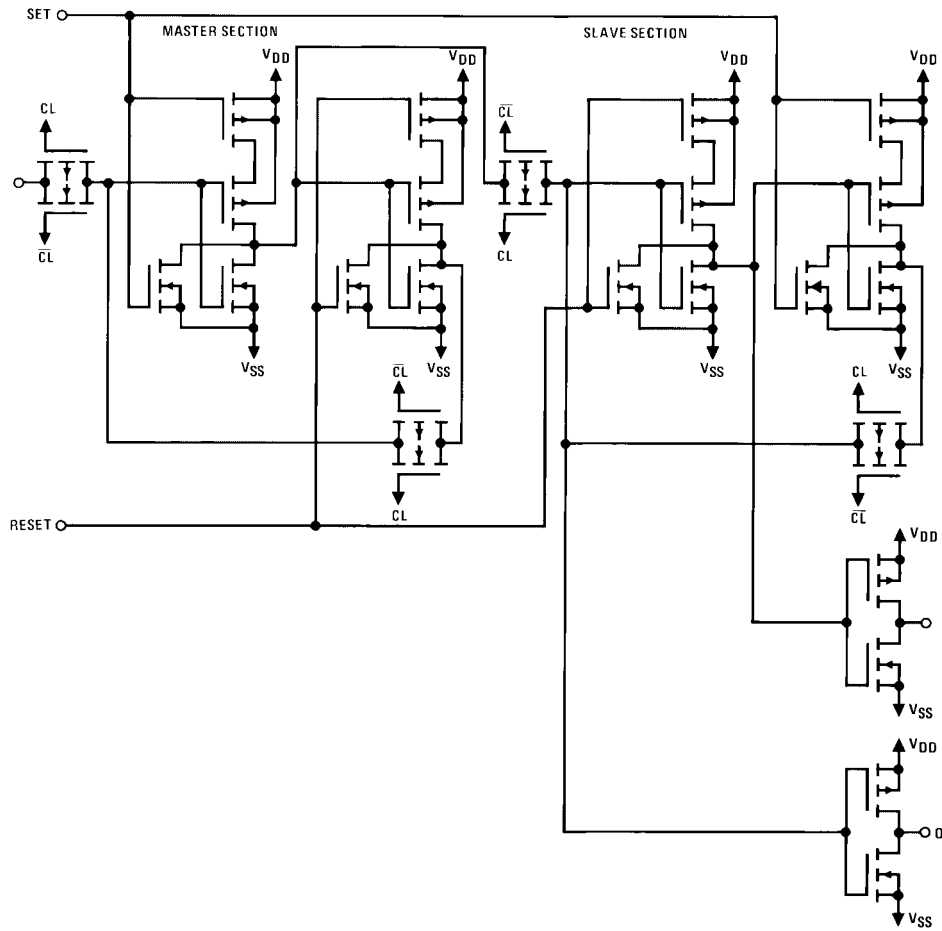
Top View

Truth Table

CL (Note 1)	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
x = Don't Care Case
Note 1: Level Change

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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)   −55°C to +125°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	−55°C Min	−55°C Max	+25°C Min	+25°C Typ	+25°C Max	+125°C Min	+125°C Max	Units
I_{DD}	Quiescent Device Current	V_{DD} = 5V, V_{IN} = V_{DD} or V_{SS}		1.0			1.0		30	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		2.0			2.0		60	
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		4.0			4.0		120	
V_{OL}	LOW Level Output Voltage	$|I_O|$ < 1.0 μA								V
		V_{DD} = 5V		0.05			0.05		0.05	
		V_{DD} = 10V		0.05			0.05		0.05	
		V_{DD} = 15V		0.05			0.05		0.05	
V_{OH}	HIGH Level Output Voltage	$|I_O|$ < 1.0 μA								V
		V_{DD} = 5V	4.95		4.95			4.95		
		V_{DD} = 10V	9.95		9.95			9.95		
		V_{DD} = 15V	14.95		14.95			14.95		
V_{IL}	LOW Level Input Voltage	$|I_O|$ < 1.0 μA								V
		V_{DD} = 5V, V_O = 0.5V or 4.5V		1.5			1.5		1.5	
		V_{DD} = 10V, V_O = 1.0V or 9.0V		3.0			3.0		3.0	
		V_{DD} = 15V, V_O = 1.5V or 13.5V		4.0			4.0		4.0	
V_{IH}	HIGH Level Input Voltage	$|I_O|$ < 1.0 μA								V
		V_{DD} = 5V, V_O = 0.5V or 4.5V	3.5		3.5			3.5		
		V_{DD} = 10V, V_O = 1.0V or 9.0V	7.0		7.0			7.0		
		V_{DD} = 15V, V_O = 1.5V or 13.5V	11.0		11.0			11.0		
I_{OL}	LOW Level Output Current (Note 4)	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		
		V_{DD} = 15V, V_O = 1.5V	4.2		3.4	8.8		2.4		
I_{OH}	HIGH Level Output Current (Note 4)	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		
		V_{DD} = 15V, V_O = 13.5V	−4.2		−3.4	−8.8		−2.4		
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	

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, $R_L = 200k$, unless otherwise noted

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

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

Switching Time Waveforms
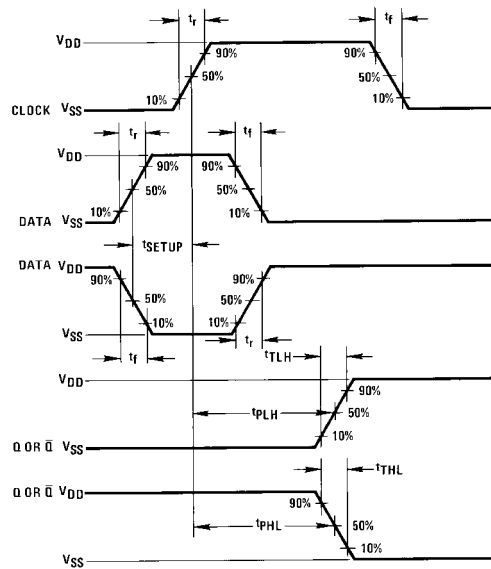
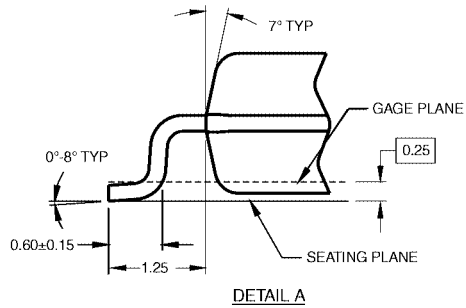## Physical Dimensions inches (millimeters) unless otherwise noted
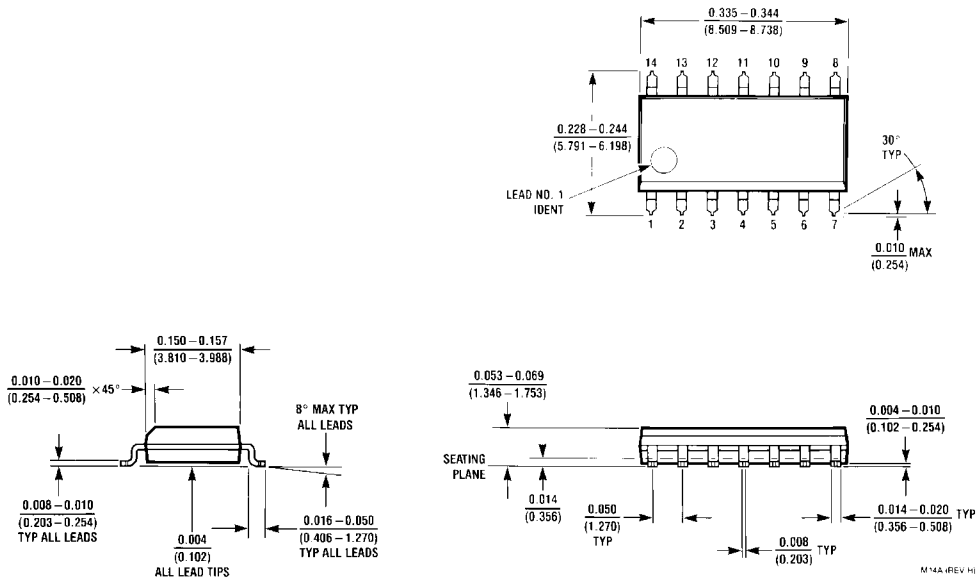
14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
Package Number M14A

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

10.2±0.1

-A-

1.1 TYP

14   8

7.8

5.3±0.1

-B-

3.9

0.2 C B A
ALL LEAD TIPS

PIN #1 IDENT.   1   7

LAND PATTERN RECOMMENDATION

14   13   9   8

5.01 TYP

9.27 TYP

(2.13 TYP)   1   2   6   7

1.27 TYP   0.6 TYP

ALL LEAD TIPS

2.1 MAX.   0.1 C

1.8±0.1

-C-

0.15±0.05

1.27 TYP   0.35-0.51

0.12 M C A

DIMENSIONS ARE IN MILLIMETERS

SEE DETAIL A

0.15-0.25

7° TYP

GAGE PLANE

0°-8° TYP

0.25

0.60±0.15

1.25

SEATING PLANE

DETAIL A

NOTES:
A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M14DRevB1

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

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)
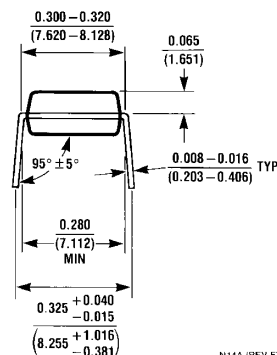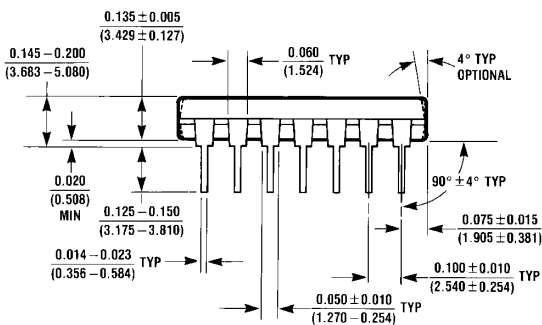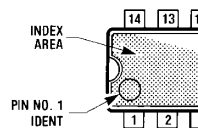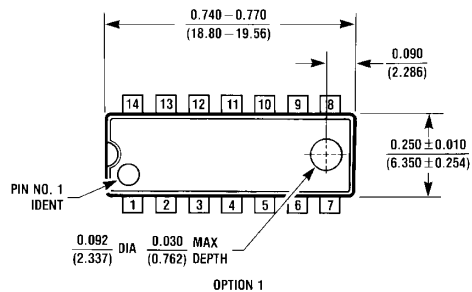
**14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
Package Number N14A**

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