

# CD4013BM

*CD4013BM/CD4013BC Dual D Flip-Flop*



Literature Number: SNOS354A



**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°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°C
CD4013BC	-40°C to +85°C

**DC Electrical Characteristics** CD4013BM (Note 2)

Symbol	Parameter	Conditions	-55°C		+25°C			+125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
$I_{DD}$	Quiescent Device Current	$V_{DD} = 5V, V_{IN} = V_{DD}$ or $V_{SS}$		1.0			1.0		30	$\mu A$
		$V_{DD} = 10V, V_{IN} = V_{DD}$ or $V_{SS}$		2.0			2.0		60	$\mu A$
		$V_{DD} = 15V, V_{IN} = V_{DD}$ or $V_{SS}$		4.0			4.0		120	$\mu A$
$V_{OL}$	Low Level Output Voltage	$ I_O  < 1.0 \mu A$								
		$V_{DD} = 5V$		0.05			0.05		0.05	V
		$V_{DD} = 10V$		0.05			0.05		0.05	V
$V_{OH}$	High Level Output Voltage	$ I_O  < 1.0 \mu A$								
		$V_{DD} = 5V$	4.95		4.95		4.95			V
		$V_{DD} = 10V$	9.95		9.95		9.95			V
$V_{IL}$	Low Level Input Voltage	$ I_O  < 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
$V_{IH}$	High Level Input Voltage	$ I_O  < 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
$I_{OL}$	Low Level Output Current (Note 3)	$V_{DD} = 5V, V_O = 0.4V$	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 (Note 3)	$V_{DD} = 5V, V_O = 4.6V$	-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		$\mu A$
		$V_{DD} = 15V, V_{IN} = 15V$		0.1		$10^{-5}$		0.1		$\mu A$

**DC Electrical Characteristics** CD4013BC (Note 2)

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

## 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 <sub>IH</sub>	High Level Input Voltage	I <sub>OI</sub>   < 1.0 μA								
		V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.5V or 4.5V	3.5		3.5			3.5		V
		V <sub>DD</sub> = 10V, V <sub>O</sub> = 1.0V or 9.0V	7.0		7.0			7.0		V
		V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V or 13.5V	11.0		11.0			11.0		V
I <sub>OL</sub>	Low Level Output Current (Note 3)	V <sub>DD</sub> = 5V, V <sub>O</sub> = 0.4V	0.52		0.44	0.88		0.36		mA
		V <sub>DD</sub> = 10V, V <sub>O</sub> = 0.5V	1.3		1.1	2.25		0.9		mA
		V <sub>DD</sub> = 15V, V <sub>O</sub> = 1.5V	3.6		3.0	8.8		2.4		mA
I <sub>OH</sub>	High Level Output Current (Note 3)	V <sub>DD</sub> = 5V, V <sub>O</sub> = 4.6V	-0.52		-0.44	-0.88		-0.36		mA
		V <sub>DD</sub> = 10V, V <sub>O</sub> = 9.5V	-1.3		-1.1	-2.25		-0.9		mA
		V <sub>DD</sub> = 15V, V <sub>O</sub> = 13.5V	-3.6		-3.0	-8.8		-2.4		mA
I <sub>IN</sub>	Input Current	V <sub>DD</sub> = 15V, V <sub>IN</sub> = 0V		-0.3		-10 <sup>-5</sup>	-0.3		-1.0	μA
		V <sub>DD</sub> = 15V, V <sub>IN</sub> = 15V		0.3		10 <sup>-5</sup>	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<sub>SS</sub> = 0V unless otherwise specified.

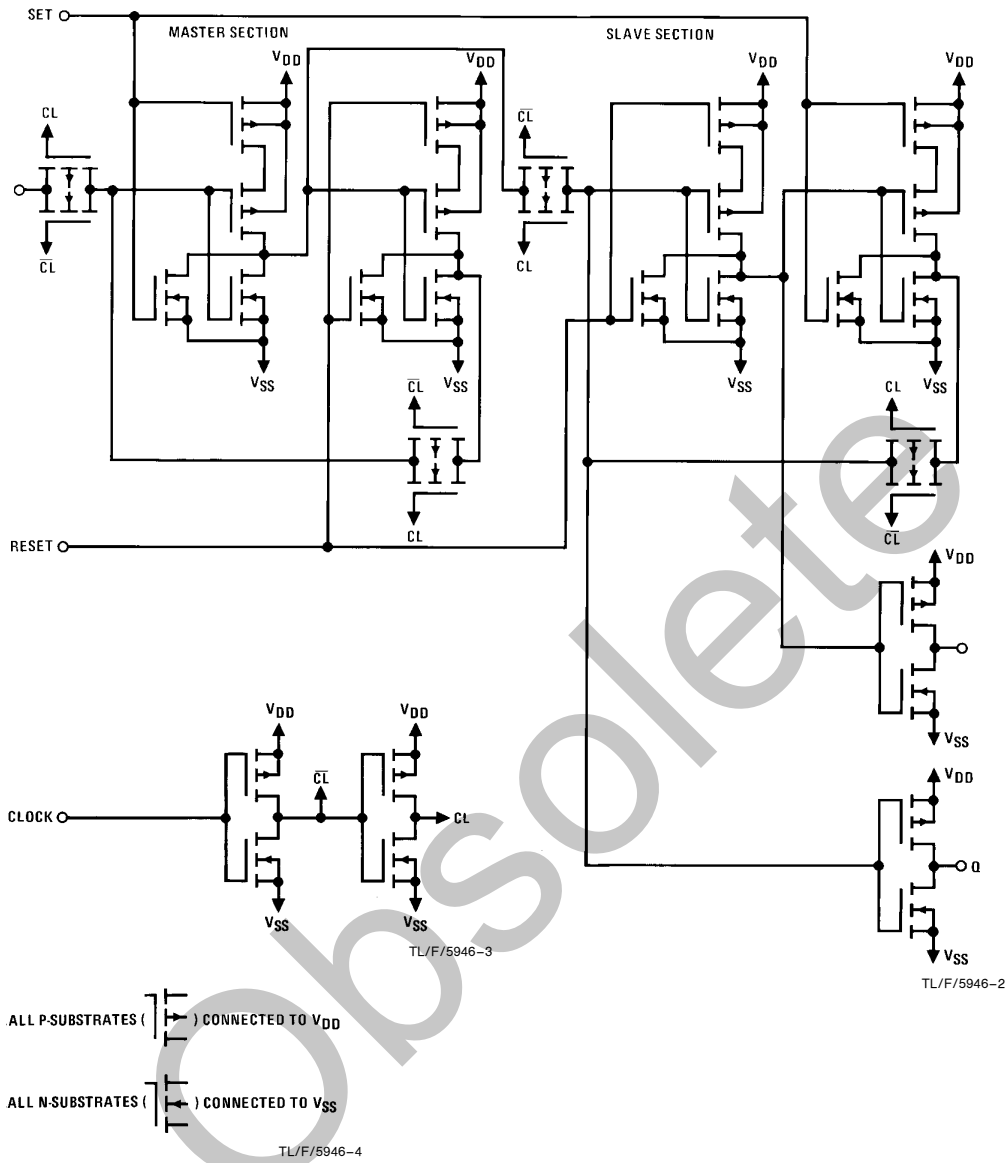
**Note 3:** I<sub>OH</sub> and I<sub>OL</sub> are measured one output at a time.

## AC Electrical Characteristics\* T<sub>A</sub> = 25°C, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 200k, unless otherwise noted

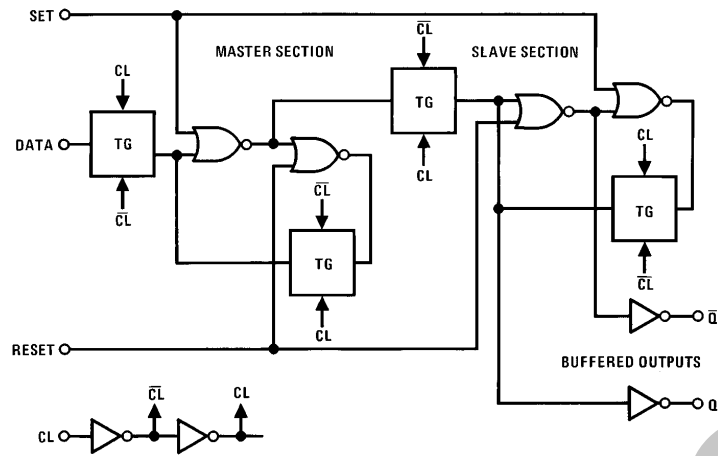
Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>CLOCK OPERATION</b>						
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay Time	V <sub>DD</sub> = 5V V <sub>DD</sub> = 10V V <sub>DD</sub> = 15V		200 80 65	350 160 120	ns ns ns
t <sub>THL</sub> , t <sub>TLH</sub>	Transition Time	V <sub>DD</sub> =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

\*AC Parameters are guaranteed by DC correlated testing.

# Schematic Diagram

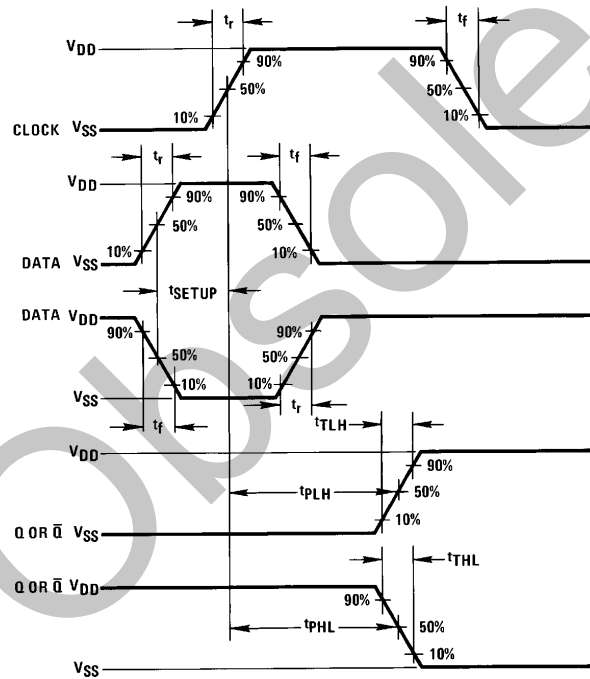


## Logic Diagram



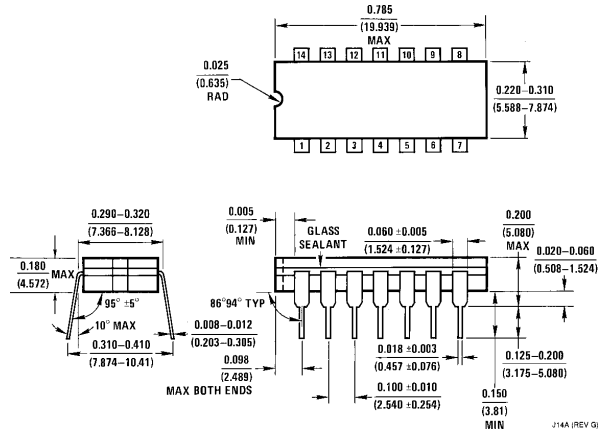
TL/F/5946-5

## Switching Time Waveforms

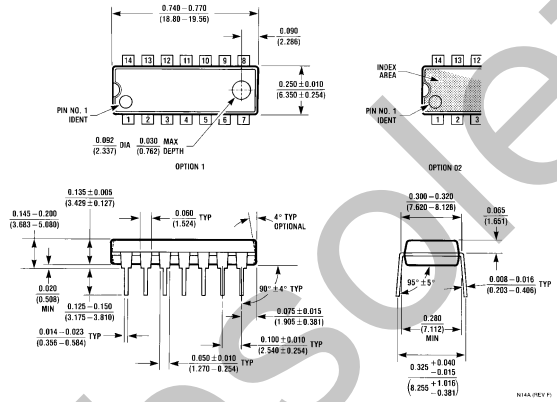


TL/F/5946-6

**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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