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## NTE4013B & NTE4013BT Integrated Circuit CMOS, Dual D-Type Flip-Flop

**Description:**

The NTE4013B and NTE4013BT dual D-type flip-flops are constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. Each flip-flop has independent Data (D), Direct Set (S), Direct Reset (R), and Clock (C) inputs and complementary outputs (Q and  $\bar{Q}$ ). These devices may be used as shift register elements or as type T flip-flops for counter and toggle applications.

**Features:**

- Supply Voltage Range: 3V to 15V
- High Noise Immunity:  $0.45V_{DD}$  Typ
- Diode Protection on All Inputs
- Capable of Driving Two Low-Power TTL Loads of One Low-Power Schottky TTL Load Over the Rated Temperature Range
- Available in Two Package Types:  
     NTE4013B (14-Lead DIP)  
     NTE4013BT (SOIC-14 Surface Mount)

**Absolute Maximum Ratings:** ( $V_{SS} = 0V$ , Note 1 unless otherwise specified)

DC Supply Voltage, $V_{DD}$ .....	-0.5 to +18V
Input or Output Voltage (DC or Transient), $V_{in}, V_{out}$ .....	-0.5 to $V_{DD}+0.5V$
Input or Output Current (DC or Transient), Per Pin, $I_{in}, I_{out}$ .....	$\pm 10mA$
Power Dissipation, $P_D$ .....	500mW
Derate Above 65°C .....	7mW/°C
Operating Ambient Temperature Range, $T_A$ .....	-55° to +125°C
Storage Temperature Range, $T_{stg}$ .....	-65° to +150°C
Lead Temperature (During Soldering, 8sec), $T_L$ .....	+260°C

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

**Recommended Operating Conditions:** ( $V_{SS} = 0V$  unless otherwise specified)

DC Supply Voltage, $V_{DD}$ .....	+3 $V_{DC}$ to +15 $V_{DC}$
Input Voltage, $V_{IN}$ .....	0 $V_{DC}$ to $V_{DD}$
Operating Ambient Temperature Range, $T_A$ .....	-40° to +85°C

**Electrical Characteristics:** ( $V_{SS} = 0V$ ,  $T_A = +25^\circ C$  unless otherwise specified)

Parameter	Symbol	$V_{DD}$	Test Conditions	Min	Typ	Max	Unit	
Output Voltage, "0" Level	$V_{OL}$	5	$ I_O  < 1.0\mu A$	-	-	0.05	V	
		10		-	-	0.05	V	
		15		-	-	0.05	V	
Output Voltage, "1" Level	$V_{OH}$	5	$ I_O  < 1.0\mu A$	4.95	-	-	V	
		10		9.95	-	-	V	
		15		14.95	-	-	V	
Input Voltage, "0" Level	$V_{IL}$	5	$ I_O  < 1.0\mu A$	$V_O = 4.5V$ or $0.5V$	-	-	1.5	V
		10		$V_O = 9V$ or $1V$	-	-	3.0	V
		15		$V_O = 13.5V$ or $1.5V$	-	-	4.0	V
Input Voltage, "1" Level	$V_{IH}$	5	$ I_O  < 1.0\mu A$	$V_O = 0.5V$ or $4.5V$	3.5	-	-	V
		10		$V_O = 1V$ or $9V$	7.0	-	-	V
		15		$V_O = 1.5V$ or $13.5V$	11.0	-	-	V
Output Drive Current, Source	$I_{OH}$	5	Note 2	$V_{OH} = 4.6V$	-0.44	-0.88	-	mA
		10		$V_{OH} = 9.5V$	-1.1	-2.25	-	mA
		15		$V_{OH} = 13.5V$	-3.0	-8.8	-	mA
Output Drive Current, Sink	$I_{OL}$	5	Note 2	$V_{OL} = 0.4V$	0.44	0.88	-	mA
		10		$V_{OL} = 0.5V$	1.1	2.25	-	mA
		15		$V_{OL} = 1.5V$	3.0	8.8	-	mA
Input Current	$I_{in}$	15	$V_{IN} = 0V$	-	$-10^{-5}$	-0.3	$\mu A$	
		15	$V_{IN} = 15V$	-	$10^{-5}$	0.3	$\mu A$	
Quiescent Current (Per Package)	$I_{DD}$	5	$V_{IN} = V_{DD}$ or $V_{SS}$	-	-	4.0	$\mu A$	
		10		-	-	8.0	$\mu A$	
		15		-	-	16.0	$\mu A$	

Note 2.  $I_{OH}$  and  $I_{OL}$  are measured one output at a time.

**AC Electrical Characteristics:** ( $C_L = 50pF$ ,  $R_L = 200k$ ,  $T_A = +25^\circ C$ , Note 3 unless otherwise specified)

Parameter	Symbol	$V_{DD}$	Test Conditions	Min	Typ	Max	Unit
<b>Clock Operation</b>							
Propagation Delay Time	$t_{PHL}$ , $t_{PLH}$	5		-	200	350	ns
		10		-	80	160	ns
		15		-	65	120	ns
Transition Time	$t_{THL}$ , $t_{TLH}$	5		-	100	200	ns
		10		-	50	100	ns
		15		-	40	80	ns
Minimum Clock Pulse Width	$t_{WL}$ , $t_{WH}$	5		-	100	200	ns
		10		-	40	80	ns
		15		-	32	65	ns
Maximum Clock Rise and Fall Time	$t_{RCL}$ , $t_{FCL}$	5		-	-	15	$\mu s$
		10		-	-	10	$\mu s$
		15		-	-	5	$\mu s$

Note 3. AC Parameters are guaranteed by DC correlated testing.

**AC Electrical Characteristics (Cont'd):** ( $C_L = 50\text{pF}$ ,  $R_L = 200\text{k}$ ,  $T_A = +25^\circ\text{C}$ , Note 3 unless otherwise specified)

Parameter	Symbol	$V_{DD}$	Test Conditions	Min	Typ	Max	Unit
<b>Clock Operation (Cont'd)</b>							
Minimum Setup Time	$t_{SU}$	5		-	20	40	ns
		10		-	15	30	ns
		15		-	12	25	ns
Maximum Clock Frequency	$f_{CL}$	5		2.5	5.0	-	MHz
		10		6.2	12.5	-	MHz
		15		7.6	15.5	-	MHz
<b>Set and Reset Operation</b>							
Propagation Delay Time	$t_{PHL(R)}$ , $t_{PLH(S)}$	5		-	150	300	ns
		10		-	65	130	ns
		15		-	45	90	ns
Minimum Set and Reset Pulse Width	$t_{WH(R)}$ , $t_{WH(S)}$	5		-	90	180	ns
		10		-	40	80	ns
		15		-	25	50	ns
Averag Input Capacitance	$C_{IN}$	Any		-	5.0	7.5	pF

Note 3. AC Paramters are guaranteed by DC correlated testing.

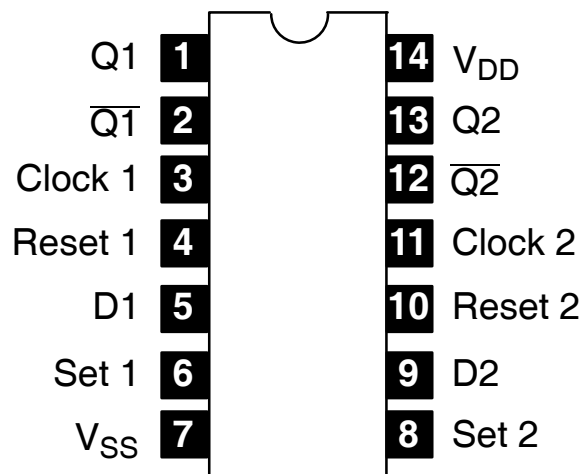
**Truth Table**

INPUTS				OUTPUTS	
CLOCK <sup>†</sup>	DATA	RESET	SET	Q	$\bar{Q}$
	0	0	0	0	1
	1	0	0	1	0
	X	0	0	Q	$\bar{Q}$
X	X	1	0	0	1
X	X	0	1	1	0
X	X	1	1	1	1

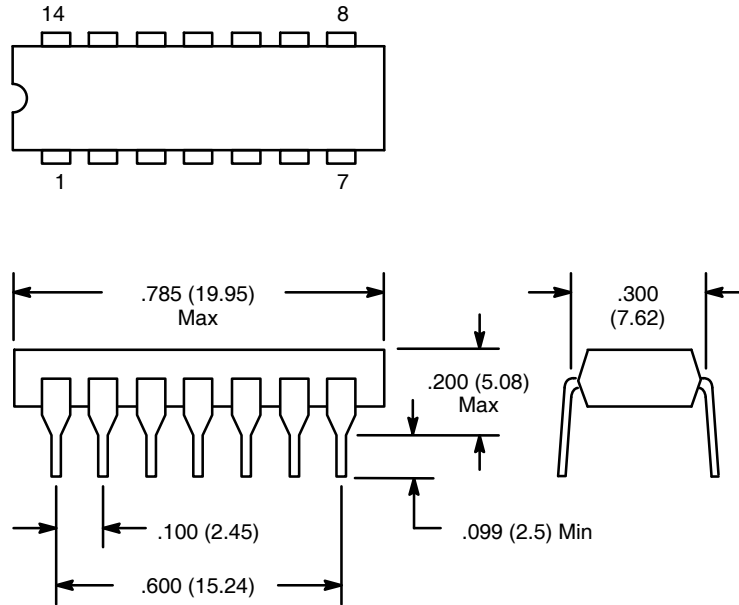
X = Don't Care

† = Level Change

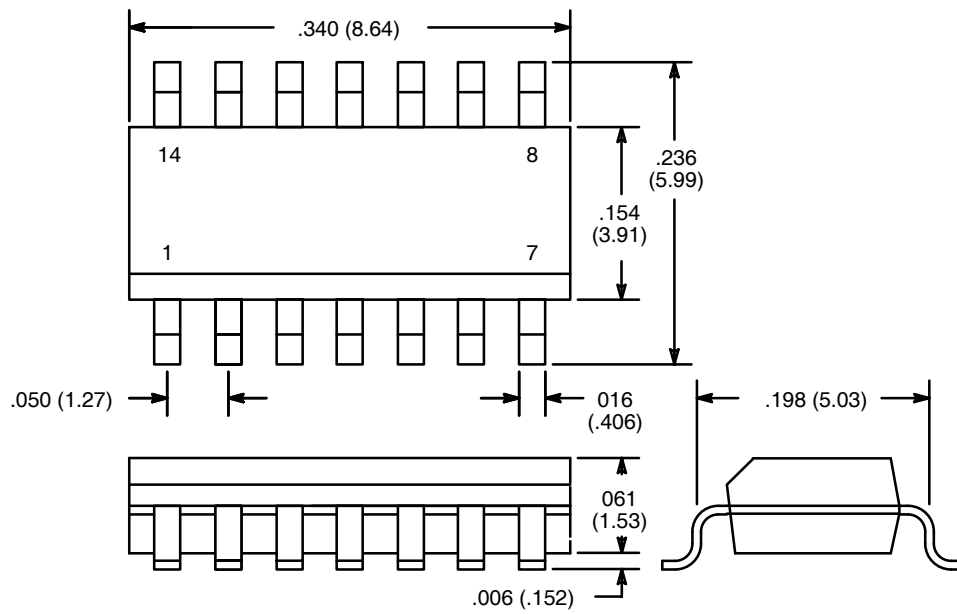
**Pin Connection Diagram**



### NTE4013B (14-Lead DIP)



### NTE4013BT (SOIC-14)



NOTE: Pin1 on Beveled Edge

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