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## NTE4093B and NTE4093BT Integrated Circuit CMOS, Quad 2-Input NAND Schmitt Trigger

**Description:**

The NTE4093B (14-Lead DIP) and NTE4093BT (SOIC-14) Schmitt Triggers are constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. These devices find primary use where low power dissipation and/or high noise immunity is desired. The NTE4093B/BT may be used in place of the NTE4011B/BT quad 2-input NAND gate for enhanced noise immunity or to “square up” slowly changing waveforms.

**Features:**

- Quiescent Current = 0.5nA Typ/Pkg at 5 Vdc
- Supply Voltage Range = 3Vdc to 18Vdc
- Capable of Driving Two Low-Power TTL Loads, One Low-Power Schottky TTL Load or Two HTL Loads Over the Rated Temperature Range
- Double Diode Protection on All Inputs

**Absolute Maximum Ratings:** (Voltages Referenced to  $V_{SS}$ , Note 1)

DC Supply Voltage, $V_{DD}$ .....	-0.5 to +18.0V
Input Voltage (All Inputs), $V_{in}$ .....	-0.5 to $V_{DD} + 0.5V$
DC Current Drain (Per Pin), $I$ .....	10mA
Operating Temperature Range, $T_A$ .....	-55 to +125°C
Storage Temperature Range, $T_{stg}$ .....	-65 to +150°C

Note 1. These devices contain circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit. For proper operation it is recommended that  $V_{in}$  and  $V_{out}$  be constrained to the range  $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ .

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either  $V_{SS}$  or  $V_{DD}$ ).

**Electrical Characteristics:** (Voltages referenced to  $V_{SS}$ , Note 2)

Parameter	Symbol	$V_{DD}$ Vdc	-55°C		+25°C			+125°C		Unit	
			Min	Max	Min	Typ	Max	Min	Max		
Output Voltage "0" Level $V_{in} = V_{DD}$ or 0	$V_{OL}$	5.0	-	0.05	-	0	0.05	-	0.05	Vdc	
		10	-	0.05	-	0	0.05	-	0.05	Vdc	
		15	-	0.05	-	0	0.05	-	0.05	Vdc	
	"1" Level $V_{in} = 0$ or $V_{DD}$	$V_{OH}$	5.0	4.95	-	4.95	5.0	-	4.95	-	Vdc
			10	9.95	-	9.95	10	-	9.95	-	Vdc
			15	14.95	-	14.95	15	-	14.95	-	Vdc
Input Voltage "0" Level ( $V_O = 4.5$ or $0.5$ Vdc) ( $V_O = 9.0$ or $1.0$ Vdc) ( $V_O = 13.5$ or $1.5$ Vdc)	$V_{IL}$	5.0	-	1.5	-	-	1.5	-	1.5	Vdc	
		10	-	3.0	-	-	3.0	-	3.0	Vdc	
		15	-	4.0	-	-	4.0	-	4.0	Vdc	
	"1" Level ( $V_O = 0.5$ or $4.5$ Vdc) ( $V_O = 1.0$ or $9.0$ Vdc) ( $V_O = 1.5$ or $13.5$ Vdc)	$V_{IH}$	5.0	3.5	-	3.5	-	-	3.5	-	Vdc
			10	7.0	-	7.0	-	-	7.0	-	Vdc
			15	11.0	-	11.0	-	-	11.0	-	Vdc
Output Drive Current Source ( $V_{OH} = 2.5$ Vdc) ( $V_{OH} = 4.6$ Vdc) ( $V_{OH} = 9.5$ Vdc) ( $V_{OH} = 13.5$ Vdc)	$I_{OH}$	5.0	-3.0	-	-2.4	-4.2	-	-1.7	-	mAdc	
		5.0	-0.64	-	-0.51	-0.88	-	-0.36	-	mAdc	
		10	-1.6	-	-1.3	-2.25	-	-0.9	-	mAdc	
		15	-4.2	-	-3.4	-8.8	-	-2.4	-	mAdc	
	Sink ( $V_{OL} = 0.4$ Vdc) ( $V_{OL} = 0.5$ Vdc) ( $V_{OL} = 1.5$ Vdc)	$I_{OL}$	5.0	0.64	-	0.51	0.88	-	0.36	-	mAdc
			10	1.6	-	1.3	2.25	-	0.9	-	mAdc
15			4.2	-	3.4	8.8	-	2.4	-	mAdc	
Input Current	$I_{in}$	15	-	$\pm 0.1$	-	$\pm 0.00001$	$\pm 0.1$	-	$\pm 0.1$	$\mu$ Adc	
Input Capacitance ( $V_{IN} = 0$ )	$C_{in}$	-	-	-	-	5.0	7.5	-	-	pF	
Quiescent Current (Per Package)	$I_{DD}$	5.0	-	0.25	-	0.0005	0.25	-	7.5	$\mu$ Adc	
		10	-	0.5	-	0.0010	0.5	-	15	$\mu$ Adc	
		15	-	1.0	-	0.0015	1.0	-	30	$\mu$ Adc	
Total Supply Current (Dynamic plus Quiescent, Per Package, $C_L = 50$ pF on all outputs, all buffers switching, Note 3, Note 4)	$I_T$	5.0	$I_T = (1.2\mu A/kHz) f + I_{DD}$							$\mu$ Adc	
		10	$I_T = (2.4\mu A/kHz) f + I_{DD}$							$\mu$ Adc	
		15	$I_T = (3.6\mu A/kHz) f + I_{DD}$							$\mu$ Adc	

Note 2. Data labeled "Typ" is not to be used for design purposes but is intended as an indication of the device's potential performance.

Note 3. The formulas given are for the typical characteristics only at +25°C.

Note 4. To calculate total supply current at loads other than 50pF:

$$I_T(C_L) = I_T(50pF) + 4 \times 10^{-3}(C_L - 50) V_{DD}f$$

where:  $I_T$  is in  $\mu A$  (per package),  $C_L$  in pF,  $V_{DD}$  in volts and  $f$  in kHz is input frequency.

**Electrical Characteristics (Cont'd):** (Voltages referenced to  $V_{SS}$ , Note 2)

Parameter	Symbol	$V_{DD}$ Vdc	-55°C		+25°C			+125°C		Unit
			Min	Max	Min	Typ	Max	Min	Max	
Hysteresis Voltage (Pin2, Pin5, Pin9, Pin12 held high, Note 5)	$V_H$	5.0	0.20	0.42	0.17	0.26	0.39	0.13	0.39	Vdc
		10	-	0.5	-	0.0010	0.5	-	15	Vdc
		15	-	1.0	-	0.0015	1.0	-	30	Vdc
Threshold Voltage Positive-Going (Pin2, Pin5, Pin9, Pin12 held high)  Negative-Going	$V_{IL}$	5.0	1.90	4.15	1.80	2.70	4.05	1.70	4.05	Vdc
		10	3.05	6.75	2.95	4.43	6.65	2.85	6.65	Vdc
		15	4.12	9.15	4.02	6.03	9.05	3.92	9.05	Vdc
	$V_{IH}$	5.0	1.63	3.76	1.63	2.44	3.66	1.53	3.66	Vdc
		10	2.70	6.18	2.70	4.05	6.08	2.60	6.08	Vdc
		15	3.69	8.40	3.69	5.53	8.30	3.70	8.30	Vdc

Note 2. Data labeled "Typ" is not to be used for design purposes but is intended as an indication of the device's potential performance.

Note 3. The formulas given are for the typical characteristics only at +25°C.

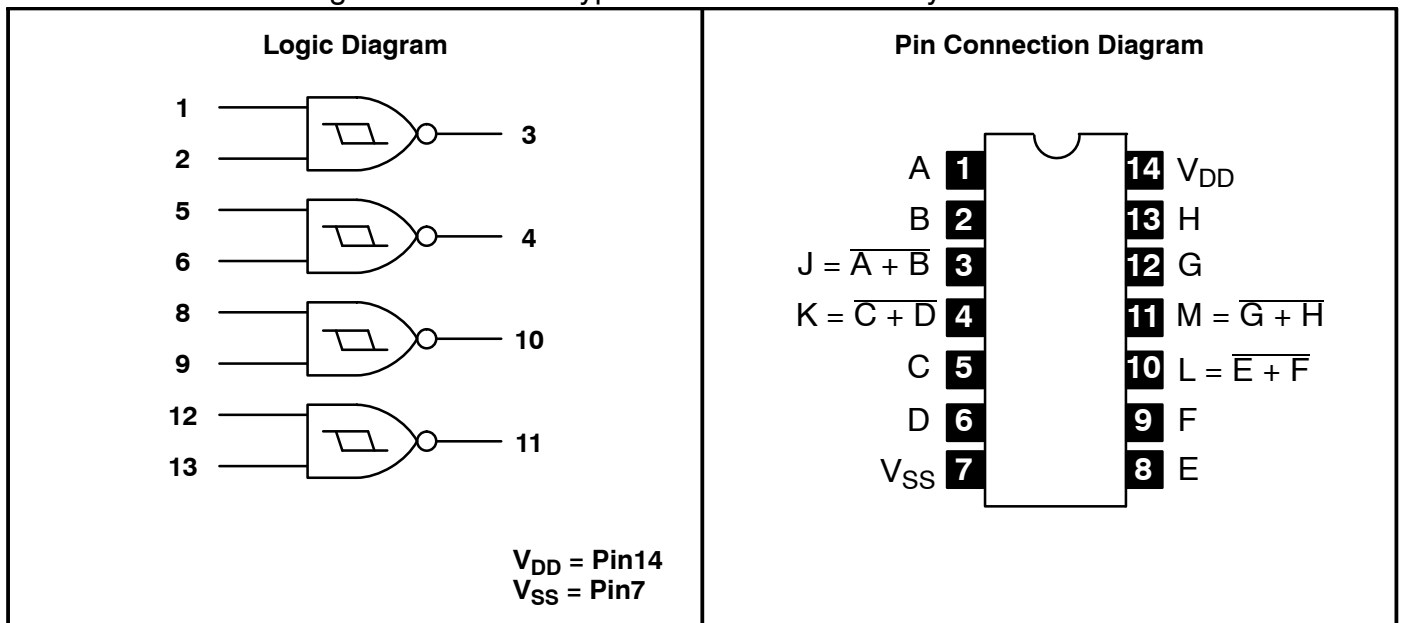
Note 5.  $V_H = V_{T+} - V_{T-}$ . (But maximum variation of  $V_H$  is specified as less than  $V_{T+,max} - V_{T-,min}$ ).

**Switching Characteristics:** ( $C_L = 50pF$ ,  $T_A = +25°C$ , Note 2)

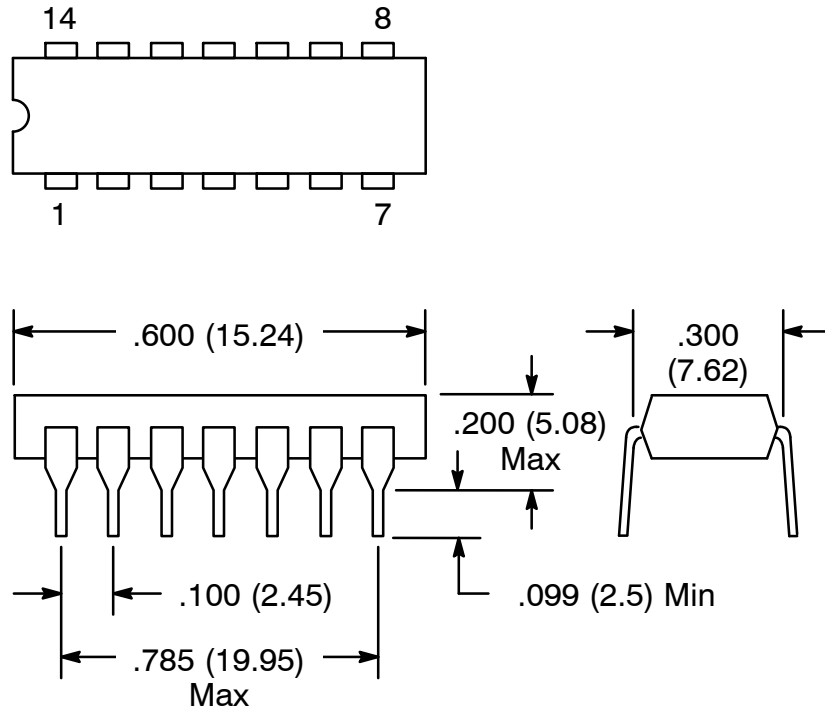
Parameter	Symbol	$V_{DD}$ Vdc	Min	Typ	Max	Unit
Output Rise and Fall Times	$t_{TLH}$ , $t_{THL}$	5.0	-	100	200	ns
		10	-	50	100	ns
		15	-	40	80	ns
Propagation Delay Time	$t_{PLH}$ , $t_{PHL}$	5.0	-	125	250	ns
		10	-	50	100	ns
		15	-	40	80	ns

Note 2. Data labeled "Typ" is not to be used for design purposes but is intended as an indication of the device's potential performance.

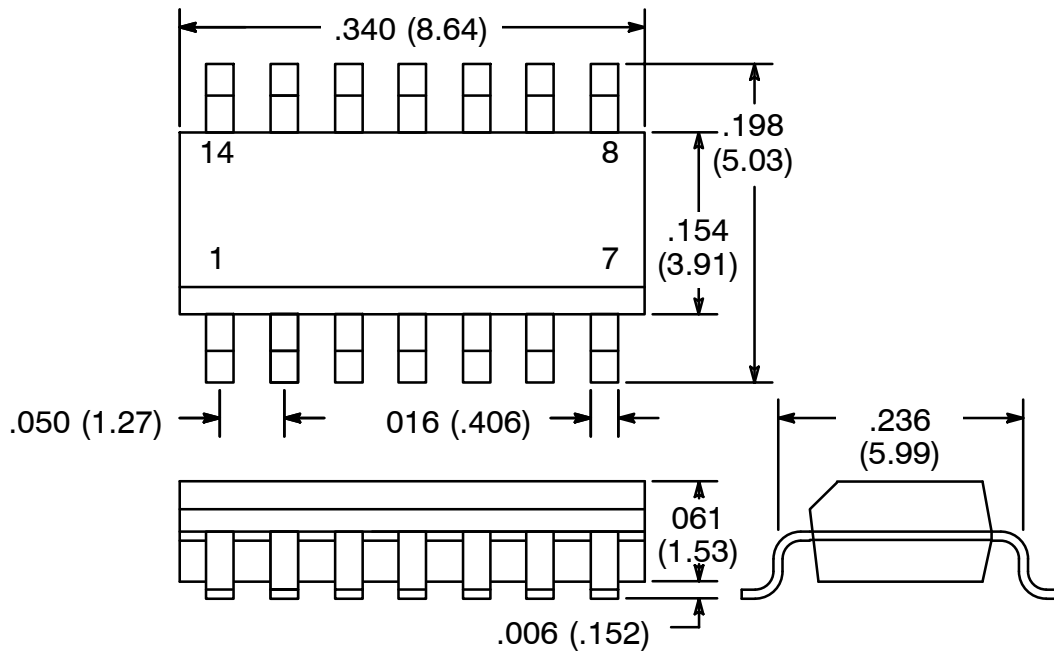
Note 3. The formulas given are for the typical characteristics only at +25°C.



NTE4093B



NTE4093BT



NOTE: Pin1 on Beveled Edge