



ELECTRONICS, INC.  
44 FARRAND STREET  
BLOOMFIELD, NJ 07003  
(973) 748-5089  
<http://www.nteinc.com>

## **NTE4017B & NTE4022B Integrated Circuit CMOS, Counter/Divider**

### **Description:**

The NTE4017B and NTE4022B are 5-stage and 4-stage Johnson counters in 16-Lead DIP type packages having 10 and 8 decoded outputs, respectively. Inputs include a CLOCK, a RESET, and a CLOCK INHIBIT signal. Schmitt trigger action in the CLOCK input circuit provides pulse shaping that allows unlimited clock input pulse rise and fall times.

These counters are advanced one count at the positive clock signal transition if the CLOCK INHIBIT signal is low. Counter advancement via the clock line is inhibited when the CLOCK INHIBIT signal is high. A high RESET signal clears the counter to its zero count. Use of the Johnson counter configuration permits high-speed operation, 2-input decode-gating, and spike-free decoded outputs. Anti-lock gating is provided, thus assuring proper counting sequence. The decoded outputs are normally low and go high only at their respective decoded time slot. Each decoded output remains high for one full clock cycle. A CARRY-OUT signal completes one cycle every 10 clock input cycles in the NTE4017B or every 8 clock input cycles in the NTE4022B and is used to ripple-clock the succeeding device in a multi-device counting chain.

### **Features:**

- NTE4017B: Decade Counter with 10 Decoded Outputs
- NTE4022B: Octal Counter with 8 Decoded Outputs
- Fully Static Operation
- Medium Speed Operation: 10MHz (Typ) at  $V_{DD} = 10V$
- Standardized, Symmetrical Output Characteristics
- 100% Tested for Quiescent Current at 20V
- 5V, 10V, and 15V Parametric Ratings

### **Applications:**

- Decade Counter/Decimal Decode Display (NTE4017B)
- Binary Counter/Decoder
- Frequency Division
- Counter Control/Timers
- Divide-by-N Counting

**Absolute Maximum Ratings:**

DC Supply–Voltage Range (Voltages referenced to  $V_{SS}$ ),  $V_{DD}$  ..... –0.5 to +20V  
 Input Voltage Range, All Inputs ..... –0.5 to  $V_{DD} + 0.5V$   
 DC Input Current, Any One Input .....  $\pm 10mA$   
 Power Dissipation,  $P_D$   
      $T_A = -40^\circ$  to  $+60^\circ C$  ..... 500mW  
      $T_A = +60^\circ$  to  $+85^\circ C$  ..... Derate Linearly at 12mW/ $^\circ C$  to 200mW  
 Device Dissipation Per Output Transistor ( $T_A = -40^\circ$  to  $+85^\circ C$ ) ..... 100mW  
 Operating Temperature Range,  $T_A$  .....  $-40^\circ$  to  $+85^\circ C$   
 Storage Temperature Range,  $T_{stg}$  .....  $-65^\circ$  to  $+150^\circ C$   
 Lead Temperature,  $T_L$   
     During Soldering,  $1/16'' \pm 1/32''$  ( $1.59 \pm 0.79mm$ ) from case 10s max .....  $+265^\circ C$

**Recommended Operating Conditions:** (Note 1)

Parameter	Symbol	$V_{DD}$	Min	Max	Unit
Supply Voltage Range ( $T_A = -40^\circ$ to $+85^\circ C$ )			3	18	V
Clock Input Frequency	$f_{CL}$	5	–	2.5	MHz
		10	–	5.0	MHz
		15	–	5.5	MHz
Clock Pulse Width	$t_W$	5	200	–	ns
		10	90	–	ns
		15	60	–	ns
Clock Rise & Fall Time	$t_{rCL}, t_{fCL}$	5, 10, 15	Unlimited		
Clock Inhibit Setup Time	$t_s$	5	230	–	ns
		10	100	–	ns
		15	70	–	ns
Reset Pulse Width	$t_{RW}$	5	260	–	ns
		10	110	–	ns
		15	60	–	ns
Reset Removal Time	$t_{rem}$	5	400	–	ns
		10	280	–	ns
		15	150	–	ns

Note 1. For maximum reliability, nominal operating conditions should be selected so that operation is always within the ranges outlined in the Recommended Operating Conditions.

**Static Electrical Characteristics:** ( $T_A = +25^\circ C$  unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Quiescent Device Current	$I_{DDmax}$	$V_{IN} = 0.5V, V_{DD} = 5V$	–	0.04	5.0	$\mu A$
		$V_{IN} = 0.10V, V_{DD} = 10V$	–	0.04	10.0	$\mu A$
		$V_{IN} = 0.15V, V_{DD} = 15V$	–	0.04	20.0	$\mu A$
		$V_{IN} = 0.20V, V_{DD} = 20V$	–	0.08	100.0	$\mu A$

**Static Electrical Characteristics (Cont'd):** ( $T_A = +25^\circ\text{C}$  unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Low (Sink) Current	$I_{OHmin}$	$V_O = 0.4V, V_{IN} = 0.5V, V_{DD} = 5V$	0.51	1.0	-	mA
		$V_O = 0.5V, V_{IN} = 0.10V, V_{DD} = 10V$	1.3	2.6	-	mA
		$V_O = 1.5V, V_{IN} = 0.15V, V_{DD} = 15V$	3.4	6.8	-	mA
Output High (Source) Current	$I_{OHmin}$	$V_O = 4.6V, V_{IN} = 0.5V, V_{DD} = 5V$	-0.51	-1.0	-	mA
		$V_O = 2.5V, V_{IN} = 0.5V, V_{DD} = 5V$	-1.6	-3.2	-	mA
		$V_O = 9.5V, V_{IN} = 0.10V, V_{DD} = 10V$	-1.3	-2.6	-	mA
		$V_O = 13.5V, V_{IN} = 0.15V, V_{DD} = 15V$	-3.4	-6.8	-	mA
Output Voltage Low-Level	$V_{OLmax}$	$V_{IN} = 0.5V, V_{DD} = 5V$	-	0	0.05	V
		$V_{IN} = 0.10V, V_{DD} = 10V$	-	0	0.05	V
		$V_{IN} = 0.15V, V_{DD} = 15V$	-	0	0.05	V
Output Voltage High-Level	$V_{OHmin}$	$V_{IN} = 0.5V, V_{DD} = 5V$	4.95	5.0	-	V
		$V_{IN} = 0.10V, V_{DD} = 10V$	9.95	10.0	-	V
		$V_{IN} = 0.15V, V_{DD} = 15V$	14.95	15.0	-	V
Input Low Voltage	$V_{ILmax}$	$V_O = 0.5V \text{ to } 4.5V, V_{DD} = 5V$	-	-	1.5	V
		$V_O = 1.9V, V_{DD} = 10V$	-	-	3.0	V
		$V_O = 1.5V \text{ to } 13.5V, V_{DD} = 15V$	-	-	4.0	V
Input High Voltage	$V_{IHmin}$	$V_O = 0.5V \text{ to } 4.5V, V_{DD} = 5V$	3.5	-	-	V
		$V_O = 1.9V, V_{DD} = 10V$	7.0	-	-	V
		$V_O = 1.5V \text{ to } 13.5V, V_{DD} = 15V$	11.0	-	-	V
Input Current	$I_{INmax}$	$V_{IN} = 0.18V, V_{DD} = 18V$	-	$\pm 10^{-5}$	$\pm 0.1$	$\mu\text{A}$

**Dynamic Electrical Characteristics:** ( $T_A = +25^\circ\text{C}$ , Input  $t_r, t_f = 20\text{ns}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{k}\Omega$  unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Clocked Operation</b>						
Propagation Delay Time Decode Out  Carry Out	$t_{PHL}, t_{PLH}$	$V_{DD} = 5V$	-	325	650	ns
		$V_{DD} = 10V$	-	135	270	ns
		$V_{DD} = 15V$	-	85	170	ns
		$V_{DD} = 5V$	-	300	600	ns
		$V_{DD} = 10V$	-	125	250	ns
		$V_{DD} = 15V$	-	80	160	ns
Transition Time, Carry Out or Decade Out Line	$t_{THL}, t_{TLH}$	$V_{DD} = 5V$	-	100	200	ns
		$V_{DD} = 10V$	-	50	100	ns
		$V_{DD} = 15V$	-	40	80	ns
Maximum Clock Input Frequency	$f_{CL}$	$V_{DD} = 5V, \text{ Note 2}$	2.5	5.0	-	MHz
		$V_{DD} = 10V, \text{ Note 2}$	5.0	10.0	-	MHz
		$V_{DD} = 15V, \text{ Note 2}$	5.5	11.0	-	MHz

Note 2. Measured with respect to carry output line.

**Dynamic Electrical Characteristics (Cont'd):** ( $T_A = +25^\circ\text{C}$ , Input  $t_r, t_f = 20\text{ns}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{k}\Omega$  unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>Clocked Operation (Cont'd)</b>						
Minimum Clock Pulse Width	$t_W$	$V_{DD} = 5\text{V}$	–	100	200	ns
		$V_{DD} = 10\text{V}$	–	45	90	ns
		$V_{DD} = 15\text{V}$	–	30	60	ns
Clock Rise or Fall Time	$t_{rCL}, t_{fCL}$	$V_{DD} = 5\text{V}, 10\text{V}$ or $15\text{V}$	Unlimited			
Minimum Clock Inhibit to Clock Setup Time	$t_s$	$V_{DD} = 5\text{V}$	–	115	230	ns
		$V_{DD} = 10\text{V}$	–	50	100	ns
		$V_{DD} = 15\text{V}$	–	30	70	ns
Input Capacitance	$C_{IN}$	Any Input	–	5	–	pF
<b>Reset Operation</b>						
Propagation Delay Time, Carry Out or Decode Out Lines	$t_{PHL}, t_{PLH}$	$V_{DD} = 5\text{V}$	–	265	530	ns
		$V_{DD} = 10\text{V}$	–	115	230	ns
		$V_{DD} = 15\text{V}$	–	85	170	ns
Minimum Reset Pulse Width	$t_W$	$V_{DD} = 5\text{V}$	–	130	260	ns
		$V_{DD} = 10\text{V}$	–	55	110	ns
		$V_{DD} = 15\text{V}$	–	30	60	ns
Minimum Reset Removal Time		$V_{DD} = 5\text{V}$	–	200	400	ns
		$V_{DD} = 10\text{V}$	–	140	280	ns
		$V_{DD} = 15\text{V}$	–	75	150	ns

**Application Notes:**

When the  $N^{\text{th}}$  decoded output is reached ( $N^{\text{th}}$  clock pulse) the S–R flip–flop (constructed from two NOR gates of the NTE4001B) generates a reset pulse which clears the NTE4017B or NTE4022B to its zero count. At this time, if the  $N^{\text{th}}$  decoded output is greater than or equal to 6 in the NTE4017B or 5 in the NTE4022B, the  $C_{OUT}$  line goes high to clock the next NTE4017B or NTE4022B counter section. The “0” decoded output also goes high at this time. Coincidence of the clock low and decoded “0” output low resets the S–R flip–flop to enable the NTE4017B or NTE4022B. If the  $N^{\text{th}}$  decoded output is less than 6 (NTE4017B) or 5 (NTE4022B), the  $C_{OUT}$  line will not go high and, therefore, cannot be used. In this case “0” decoded output may be used to perform the clocking function for the next counter.



