



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

NTE4046B and NTE4046BT **Integrated Circuit** **CMOS, Micropower Phase-Locked Loop (PLL)**

Description:

The NTE4046B (16-Lead DIP) and NTE4046BT (SOIC-16) are CMOS Micropower Phase-Locked Loop (PLL) devices consisting of a low-power, linear voltage-controlled oscillator (VCO) and two different phase comparators having a common signal-input amplifier and a common comparator input. A 5.2V zener diode is provided for supply regulation if necessary.

Features:

- Very Low Power Consumption: 70 μ W (Typ) @ VCO f_o = 10kHz, V_{DD} = 5V
- Operating Frequency Range up to 1.4MHz (Typ) @ V_{DD} = 10V, R_I = 5k Ω
- Low Frequency Drift: 0.04%/°C (Typ) @ V_{DD} = 10V
- Choice of Two Phase Comparators:
 - Exclusive-OR Network (I)
 - Edge-Controlled Memory Network ^w/Phase-Pulse Output for Lock Indication (II)
- High VCO Linearity: < 1% (Typ) @ V_{DD} = 10V
- VCO Inhibit Control for ON-OFF Keying and Ultra-Low Standby Power Consumption
- Source-Follower Output of VCO Control Input (Demod. Output)
- Zener Diode to Assist Supply Regulation
- Standardized, Symmetrical Output Characteristics
- 100% Tested for Quiescent Current at 20V
- 5V, 10V, and 15V Parametric Ratings

Applications:

- FM Demodulator and Modulator
- Frequency Synthesis and Multiplication
- Frequency Discriminator
- Signal Conditioning
- FSK – Modems
- Data Synchronization
- Voltage-to-Frequency Conversion
- Tone Decoding

Absolute Maximum Ratings:

DC Supply Voltage Range (Voltages referenced to V_{SS} terminal), 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 (T_A = -55° to +100°C), P_D 500mW
 T_A = +100° to +125°C Derate Linearly at 12mW/°C to 200mW
Device Dissipation (Per Output Transistor)
For T_A = Full Package Temperature Range 100mW
Operating Temperature Range, T_A -55° to +125°C
Storage Temperature Range, T_{stg} -65° to +150°C
Lead Temperature (During Soldering, 1/16" $\pm$ 1/32" from case, 10sec Max), T_L +265°C

Recommended Operating Conditions: ($T_A = -55^\circ$ to $+125^\circ\text{C}$)

Parameter	Min	Typ	Max	Unit
Supply Voltage Range VCO Section: As Fixed Oscillator	3	–	18	V
Phase-Lock-Loop Operation	5	–	18	V
Supply Voltage Range Phase Comparator Section: Comparators	3	–	18	V
VCO Operation	5	–	18	V

Static Electrical Characteristics:

Characteristic	Conditions			Limits at Indicated Temperature (°C)							Units
	V _O (V)	V _{IN} (V)	V _{DD} (V)	−55°C	−40°C	+85°C	+125°C	+25°C			
								Min.	Typ.	Max.	
VCO Section											
Output Low (Sink) Current I _{OL} Min.	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1.0	–	mA
	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	–	mA
	1.5	0,15	15	4.2	4.0	2.8	2.4	3.4	6.8	–	mA
Output High (Source) Current I _{OH} Min.	4.6	0,5	5	−0.64	−0.61	−0.42	−0.36	−0.51	−1.0	–	mA
	2.5	0.5	5	−2.0	−1.8	−1.3	−1.15	−1.6	−3.2	–	mA
	9.5	0,10	10	−1.6	−1.5	−1.1	−0.9	−1.3	−2.6	–	mA
	13.5	0,15	15	−4.2	−4.0	−2.8	−2.4	−3.4	−6.8	–	mA
Output Voltage Low-Level V _{OL} Max.	–	5	5	0.05				–	0	0.05	V
	–	10	10	0.05				–	0	0.05	V
	–	15	15	0.05				–	0	0.05	V
Output Voltage High-Level V _{OH} Min.	–	5	5	4.95				4.95	5	–	V
	–	10	10	9.95				9.95	10	–	V
	–	15	15	14.95				14.95	15	–	V
Input Current, I _{IN} Max.	–	0,18	18	±0.1	±0.1	±1.0	±1.0	–	±10 ^{−5}	±0.1	µA
Phase Comparator Section											
Total Device Current, I _{DD} Max. (Pin14 Open, Pin5 = V _{DD}) (Pin14 = V _{SS} or V _{DD} , Pin5 = V _{DD})	–	0,5	5	0.2				–	0.1	0.2	mA
	–	0,10	10	1.0				–	0.5	1.0	mA
	–	0,15	15	1.5				–	0.75	1.5	mA
	–	0,20	20	4.0				–	2.0	4.0	mA
	–	0,5	5	20				–	10	20	µA
	–	0,10	10	40				–	20	40	µA
	–	0,15	15	80				–	40	80	µA
	–	0,20	20	160				–	80	160	µA
Output Low (Sink) Current I _{OL} Min.	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1.0	–	mA
	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	–	mA
	1.5	0,15	15	4.2	4.0	2.8	2.4	3.4	6.8	–	mA
Output High (Source) Current I _{OH} Min.	4.6	0,5	5	−0.64	−0.61	−0.42	−0.36	−0.51	−1.0	–	mA
	2.5	0.5	5	−2.0	−1.8	−1.3	−1.15	−1.6	−3.2	–	mA
	9.5	0,10	10	−1.6	−1.5	−1.1	−0.9	−1.3	−2.6	–	mA
	13.5	0,15	15	−4.2	−4.0	−2.8	−2.4	−3.4	−6.8	–	mA

Static Electrical Characteristics (Cont'd):

Characteristic	Conditions			Limits at Indicated Temperature (°C)							Units
	V _O (V)	V _{IN} (V)	V _{DD} (V)	-55°C	-40°C	+85°C	+125°C	+25°C			
								Min.	Typ.	Max.	
Phase Comparator Section (Cont'd)											
DC-Coupled Signal Input and Comparator Input Voltage Sensitivity Low-Level V _{IL} Max. High Level V _{IH} Min.	0.5,4.5	–	5	–	–	1.5	–	–	–	1.5	V
	1,9	–	10	–	–	3.0	–	–	–	3.0	V
	1.5,13.5	–	15	–	–	4.0	–	–	–	4.0	V
	0.5,4.5	–	5	–	–	3.5	–	3.5	–	–	V
	1,9	–	10	–	–	7.0	–	7.0	–	–	V
	1.5,13.5	–	15	–	–	11.0	–	11.0	–	–	V
Input Current, I _{IN} Max. (Except Pin14)	–	0,18	18	±0.1	±0.1	±1.0	±1.0	–	±10 ⁻⁵	±0.1	μA
3-Stage Leakage Current, I _{OUT} Max.	0,18	0,18	18	±0.1	±0.1	±0.2	±0.2	–	±10 ⁻⁵	±0.1	μA

Electrical Characteristics: (T_A = +25°C)

Parameter	Symbol	Test Conditions			Min	Typ	Max	Unit	
		V _{DD}							
VCO Section									
Operating Power Dissipation	P _D	f _o = 10kHz, R ₂ = ∞	R ₁ = 1MΩ, VCO _{IN} = $\frac{V_{DD}}{2}$	5V	–	70	140	μW	
				10V	–	800	1600	μW	
				15V	–	3000	6000	μW	
Maximum Operating Frequency	f _{max}	C ₁ = 50pF, R ₂ = ∞, VCO _{IN} = V _{DD}	R ₁ = 10kΩ	5V	0.3	0.6	–	MHz	
				10V	0.6	1.2	–	MHz	
				15V	0.8	1.6	–	MHz	
			R ₁ = 5kΩ	5V	0.5	0.8	–	MHz	
				10V	1.0	1.4	–	MHz	
				15V	1.4	2.4	–	MHz	
Linearity		VCO _{IN} = 2.5V±0.3V	R ₁ = 10kΩ	5V	–	1.7	–	%	
		VCO _{IN} = 5.0V±1.0V	R ₁ = 100kΩ	10V	–	0.5	–	%	
		VCO _{IN} = 5.0V±2.5V	R ₁ = 400kΩ	10V	–	4.0	–	%	
		VCO _{IN} = 7.5V±0.3V	R ₁ = 100kΩ	15V	–	0.5	–	%	
		VCO _{IN} = 7.5V±5.0V	R ₁ = 1MΩ	15V	–	7.0	–	%	
Temperature–Frequency Stability: No Frequency Offset	f _{MIN} = 0				5V	–	±0.12	–	%/°C
					10V	–	±0.04	–	%/°C
					15V	–	±0.015	–	%/°C
Frequency Offset	f _{MIN} ≠ 0				5V	–	±0.09	–	%/°C
					10V	–	±0.07	–	%/°C
					15V	–	±0.03	–	%/°C
Output Duty Cycle					5, 10, 15V	–	50	–	%
Output Transition Times	t _{THL} , t _{TLH}				5V	–	100	200	ns
					10V	–	50	100	ns
					15V	–	40	80	ns

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

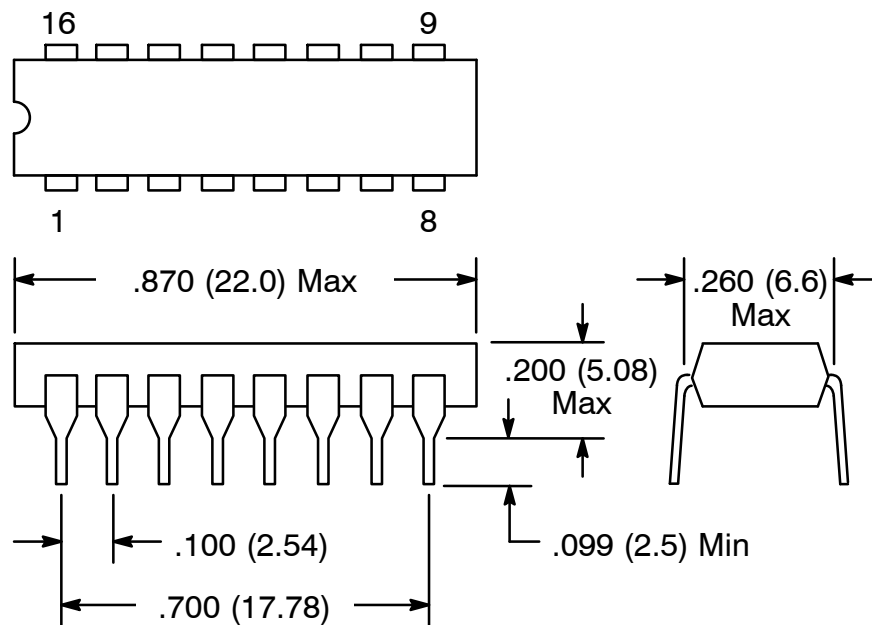
Parameter	Symbol	Test Conditions		V _{DD}	Min	Typ	Max	Unit	
VCO Section (Cont'd)									
Source-Follower Output (Demodulated Output): Offset Voltage	VCO _{IN} -V _{DEM}	R _S > 10kΩ		5V	–	1.8	2.5	V	
				10V	–	1.8	2.5	V	
				15V	–	1.8	2.5	V	
Linearity		VCO _{IN} = 2.5V±0.3V	R _S = 100kΩ	5V	–	0.3	–	%	
		VCO _{IN} = 5.0V±2.5V	R _S = 300kΩ	10V	–	0.7	–	%	
		VCO _{IN} = 7.5V±5.0V	R _S = 500kΩ	15V	–	0.9	–	%	
Zener Diode Voltage	V _Z	I _Z = 50μA		–	4.45	5.50	6.15	V	
Zener Dynamic Resistance	R _Z	I _Z = 1mA		–	–	40	–	Ω	
Phase Comparator Section									
Pin14 (Signal In) Input Resistance	R ₁₄			5V	1.0	2.0	–	MΩ	
				10V	0.2	0.4	–	MΩ	
				15V	0.1	0.2	–	MΩ	
AC Coupled Signal Input Voltage Sensitivity (Peak-to-Peak)		f _{IN} = 100kHz, Sine Wave, Note 1		5V	–	180	360	mV	
				10V	–	330	660	mV	
				15V	–	900	1800	mV	
Propagation Delay Time (Pin14 to Pin13) High to Low Level	t _{PHL}			5V	–	225	450	ns	
				10V	–	100	200	ns	
				15V	–	65	130	ns	
Low to High Level	t _{PLH}			5V	–	350	700	ns	
				10V	–	150	300	ns	
				15V	–	100	200	ns	
3-State Propagation Delay Time (Pin14 to Pin13) High Level to Low Impedance	t _{PHZ}			5V	–	225	450	ns	
				10V	–	100	200	ns	
				15V	–	95	190	ns	
Low Level to High Impedance	t _{PLZ}			5V	–	285	570	ns	
				10V	–	130	260	ns	
				15V	–	95	190	ns	
Input Rise or Fall Times Comparator Input (Pin3)	t _r , t _f			5V	–	–	50.0	μs	
				10V	–	–	1.0	μs	
				15V	–	–	0.3	μs	
		Signal Input (Pin14)			5V	–	–	500.0	μs
					10V	–	–	20.0	μs
					15V	–	–	2.5	μs
Output Transition Times	t _{THL} , t _{TLH}			5V	–	100	200	ns	
				10V	–	50	100	ns	
				15V	–	40	80	ns	

Note 1. For sine wave, the frequency must be greater than 10kHz for Phase Comparator II.

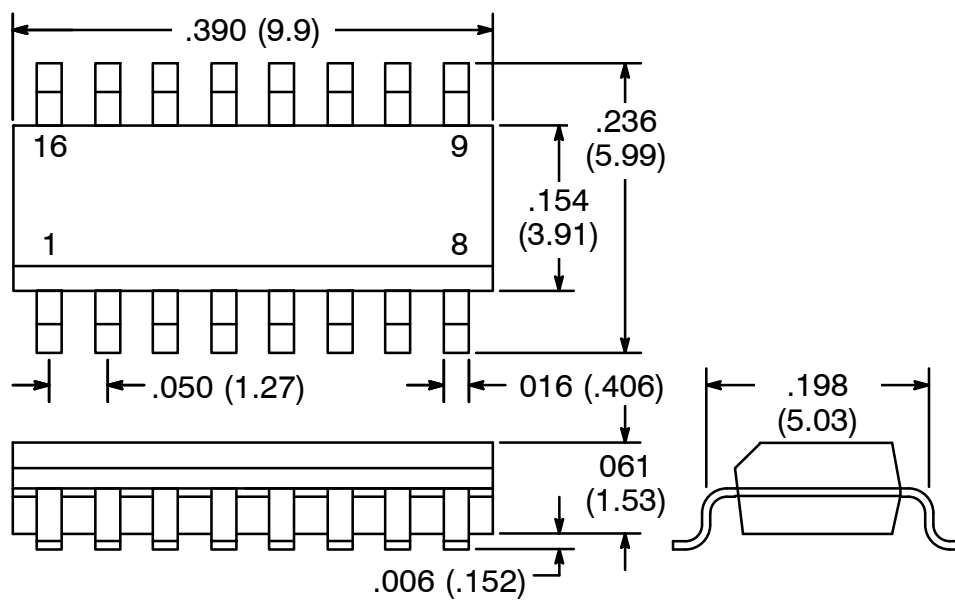
Pin Connection Diagram

Phase Pulses	1	16	V _{DD}
Phase Comp 1 Out	2	15	Zener
Comparator Input	3	14	Signal Input
VCO Output	4	13	Phase Comp 2 Out
Inhibit	5	12	R2 to V _{SS}
C1 (1)	6	11	R1 to V _{SS}
C1 (2)	7	10	Demodulator Output
V _{SS}	8	9	VCO Input

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NOTE: Pin1 on Beveled Edge