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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%/ $^{\circ}$ 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 $^{\circ}$ to +100 $^{\circ}$ C), P_D	500mW
T_A = +100 $^{\circ}$ to +125 $^{\circ}$ C	Derate Linearly at 12mW/ $^{\circ}$ C to 200mW
Device Dissipation (Per Output Transistor)	
For T_A = Full Package Temperature Range	100mW
Operating Temperature Range, T_A	-55 $^{\circ}$ to +125 $^{\circ}$ C
Storage Temperature Range, T_{stg}	-65 $^{\circ}$ to +150 $^{\circ}$ C
Lead Temperature (During Soldering, 1/16" \pm 1/32" from case, 10sec Max), T_L	+265 $^{\circ}$ 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 ($^\circ\text{C}$)							Units
	V_O (V)	V_{IN} (V)	V_{DD} (V)	-55°C	-40°C	$+85^\circ\text{C}$	$+125^\circ\text{C}$	$+25^\circ\text{C}$			
								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	–	$\pm 10^{-5}$	± 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		V _{DD}	Min	Typ	Max	Unit
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	-	%
				10V	-	0.5	-	%
				15V	-	4.0	-	%
				5V	-	0.5	-	%
				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.

