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NTE980 Integrated Circuit CMOS, Micropower Phase-Locked Loop (PLL)

Description:

The NTE980 CMOS Micropower Phase-Locked Loop (PLL) consists 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 in a 16-Lead type package. A 5.2V zener diode is provided for supply regulation if necessary.

Features:

- Very Low Power Consumption: 70μW (Typ) @ VCO $f_o = 10\text{kHz}$, $V_{DD} = 5\text{V}$
- Operating Frequency Range up to 1.4MHz (Typ) @ $V_{DD} = 10\text{V}$, $R_I = 5\text{k}\Omega$
- Low Frequency Drift: 0.04%/°C (Typ) @ $V_{DD} = 10\text{V}$
- 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) @ $V_{DD} = 10\text{V}$
- 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 | ● FSK – Modems |
| ● Frequency Synthesis and Multiplication | ● Data Synchronization |
| ● Frequency Discriminator | ● Voltage-to-Frequency Conversion |
| ● Signal Conditioning | ● 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 $V_{DD}+0.5\text{V}$
DC Input Current, Any One Input	±10mA
Power Dissipation ($T_A = -40^\circ$ to $+60^\circ\text{C}$), P_D	500mW
$T_A = +60^\circ$ to $+85^\circ\text{C}$	Derate Linearly at 12mW/°C to 200mW
Device Dissipation Per Output Transistor ($T_A = -40^\circ$ to $+85^\circ\text{C}$)	100mW
Operating Temperature Range, T_A	-40° to +85°C
Storage Temperature Range, T_{stg}	-65° to +150°C
Lead Temperature (During Soldering, 1/16" ±1/32" from case, 10sec Max), T_L	+265°C

Recommended Operating Conditions: ($T_A = -40^\circ$ to $+85^\circ\text{C}$)

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: ($T_A = +25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Test Conditions			Min	Typ	Max	Unit
		V_O	V_{IN}	V_{DD}				
VCO Section								
Output Low (Sink) Current	I_{OLMin}	400mV	0V, 5V	5V	0.51	1.0	–	mA
		500mV	0V, 10V	10V	1.3	2.6	–	mA
		1.5V	0V, 15V	15V	3.4	6.8	–	mA
Output High (Source) Current	I_{OHMin}	4.6V	0V, 5V	5V	–0.51	–1.0	–	mA
		2.5V	0V, 5V	5V	–1.6	–3.2	–	mA
		9.5V	0V, 10V	10V	–1.3	–2.6	–	mA
		13.5V	0V, 15V	15V	–3.4	–6.8	–	mA
Output Voltage: Low-Level	V_{OLMax}	Pin4 driving CMOS	0V, 5V	5V	–	0	0.05	V
			0V, 10V	10V	–	0	0.05	V
			0V, 15V	15V	–	0	0.05	V
Output Voltage: High-Level	V_{OHMax}	e.g. Pin3	0V, 5V	5V	4.95	5.0	–	V
			0V, 10V	10V	9.95	10.0	–	V
			0V, 15V	15V	14.95	15.0	–	V
Input Current	I_{INMax}	–	0V, 18V	18V	–	$\pm 10^{-5}$	± 0.1	μA
Phase Comparator Section								
Total Device Current Pin14 = Open, Pin5 = V_{DD} Pin14 = V_{SS} or V_{DD} , Pin5 = V_{DD}	I_{DDMax}	–	0V, 5V	5V	–	0.1	0.2	mA
		–	0V, 10V	10V	–	0.5	1.0	mA
		–	0V, 15V	15V	–	0.75	1.5	mA
		–	0V, 20V	20V	–	2.0	4.0	mA
		–	0V, 5V	5V	–	10.0	20.0	μA
		–	0V, 10V	10V	–	20.0	40.0	μA
		–	0V, 15V	15V	–	40.0	80.0	μA
		–	0V, 20V	20V	–	80.0	160.0	μA
Output Low (Sink) Current	I_{OLMin}	400mV	0V, 5V	5V	0.51	1.0	–	mA
		500mV	0V, 10V	10V	1.3	2.6	–	mA
		1.5V	0V, 15V	15V	3.4	6.8	–	mA
Output High (Source) Current	I_{OHMin}	4.6V	0V, 5V	5V	–0.51	–1.0	–	mA
		2.5V	0V, 5V	5V	–1.6	–3.2	–	mA
		9.5V	0V, 10V	10V	–1.3	–2.6	–	mA
		13.5V	0V, 15V	15V	–3.4	–6.8	–	mA

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

Parameter	Symbol	Test Conditions			Min	Typ	Max	Unit
		V_O	V_{IN}	V_{DD}				
Phase Comparator Section (Cont'd)								
DC Coupled Signal Input and Comparator Input Voltage Sensitivity Low Level	V_{ILMax}	0.5V, 4.5V	–	5V	–	–	1.5	V
		1V, 9V	–	10V	–	–	3.0	V
		1.5V, 13.5V	–	15V	–	–	4.0	V
High Level	V_{IHMax}	0.5V, 4.5V	–	5V	3.5	–	–	V
		1V, 9V	–	10V	7.0	–	–	V
		1.5V, 13.5V	–	15V	11.0	–	–	V
Input Current (Except Pin14)	I_{INMax}	–	0V, 18V	18V	–	$\pm 10^{-5}$	± 0.1	μA
3-State Leakage Current	I_{OUTMax}	0V, 18V	0V, 18V	18V	–	$\pm 10^{-5}$	± 0.1	μA

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

Parameter	Symbol	Test Conditions			Min	Typ	Max	Unit
				V_{DD}				
VCO Section								
Operating Power Dissipation	P_D	$f_o = 10\text{kHz}$, $R_2 = \infty$	$R_1 = 1\text{M}\Omega$, $V_{COIN} = \frac{V_{DD}}{2}$	5V	–	70	140	μW
				10V	–	800	1600	μW
				15V	–	3000	6000	μW
Maximum Operating Frequency	f_{max}	$C_1 = 50\text{pF}$, $R_2 = \infty$, $V_{COIN} = V_{DD}$	$R_1 = 10\text{k}\Omega$	5V	0.3	0.6	–	MHz
				10V	0.6	1.2	–	MHz
				15V	0.8	1.6	–	MHz
			$R_1 = 5\text{k}\Omega$	5V	0.5	0.8	–	MHz
				10V	1.0	1.4	–	MHz
				15V	1.4	2.4	–	MHz
Linearity		$V_{COIN} = 2.5\text{V} \pm 0.3\text{V}$	$R_1 = 10\text{k}\Omega$	5V	–	1.7	–	%
			$R_1 = 100\text{k}\Omega$	10V	–	0.5	–	%
			$R_1 = 400\text{k}\Omega$	10V	–	4.0	–	%
			$R_1 = 100\text{k}\Omega$	15V	–	0.5	–	%
			$R_1 = 1\text{M}\Omega$	15V	–	7.0	–	%
Temperature-Frequency Stability: No Frequency Offset	$f_{MIN} = 0$			5V	–	± 0.12	–	$\% / ^\circ\text{C}$
				10V	–	± 0.04	–	$\% / ^\circ\text{C}$
				15V	–	± 0.015	–	$\% / ^\circ\text{C}$
Frequency Offset	$f_{MIN} \neq 0$			5V	–	± 0.09	–	$\% / ^\circ\text{C}$
				10V	–	± 0.07	–	$\% / ^\circ\text{C}$
				15V	–	± 0.03	–	$\% / ^\circ\text{C}$
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

