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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 = 10kHz, V_{DD} = 5V
- Operating Frequency Range up to 1.4MHz (Typ) @ V_{DD} = 10V, RI = 5kΩ
- 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 . . . . . ±10mA
Power Dissipation (T_A = –40° to +60°C), P_D 500mW
T_A = +60° to +85°C . . . . . Derate Linearly at 12mW/°C to 200mW
Device Dissipation Per Output Transistor (T_A = –40° to +85°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° to +85°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°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_{OL}Min	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_{OH}Min	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_{OL}Max	Pin4 driving CMOS e.g. Pin3	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_{OH}Max		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_{IN}Max	–	0V, 18V	18V	–	$\pm10^{-5}$	±0.1	µA
Phase Comparator Section								
Total Device Current Pin14 = Open, Pin5 = V_{DD}	I_{DD}Max	–	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
Pin14 = V_{SS} or V_{DD}, Pin5 = V_{DD}		–	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_{OL}Min	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_{OH}Min	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°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_{IL}Max	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_{IH}Max	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_{IN}Max	–	0V, 18V	18V	–	$\pm10^{-5}$	±0.1	µA
3–State Leakage Current	I_{OUT}Max	0V, 18V	0V, 18V	18V	–	$\pm10^{-5}$	±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	$f_{MIN} \neq 0$			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°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}	RS > 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