

## NTE973D Integrated Circuit Double Balanced Modulator/Demodulator

**Description:**

The NTE973D is a balanced modulator/demodulator in a 14-Lead DIP type package designed for use where the output voltage is a product of an input voltage (signal) and a switching function (carrier). Typical applications include suppressed carrier and amplitude modulation, synchronous detection, FM detection, phase detection, and chopper applications.

**Features:**

- Excellent Carrier Suppression:  
     65dB typ @ 0.5MHz  
     50db typ @ 10MHz
- Adjustable Gain and Signal Handling
- Balanced Inputs and Outputs

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

Applied Voltage, $\Delta V$ ( $V_6-V_7, V_8-V_1, V_9-V_7, V_9-V_8, V_7-V_4, V_7-V_1, V_8-V_4, V_6-V_8, V_2-V_5, V_3-V_5$ ) .....	30V
Differential Input Signal, $V_7-V_8$ .....	+5.0V
Differential Input Signal, $V_4-V_1$ .....	$\pm(5 + I_5 R_e)$ V
Maximum Bias Current, $I_5$ .....	10mA
Operating Temperature Range, $T_A$ .....	$0^\circ$ to $+70^\circ\text{C}$
Storage Temperature Range, $T_{stg}$ .....	$-65^\circ$ to $+150^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient, $R_{thJA}$ .....	$100^\circ\text{C/W}$

**Electrical Characteristics:** ( $V_{CC} = 12\text{V}, V_{EE} = -8\text{V}, I_5 = 1\text{mA}, R_L = 3.9\text{k}\Omega, R_e = 1\text{k}\Omega, T_A = +25^\circ\text{C}$ , Note 1 unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Carrier Feedthrough	$V_{CFT}$	$V_C = 60\text{mV}_{rms}$ sine wave and offset adjusted to zero	$f_C = 1\text{kHz}$	-	40	-	$\mu\text{V}_{rms}$
			$f_C = 10\text{MHz}$	-	140	-	$\mu\text{V}_{rms}$
		$V_C = 300\text{mV}_{P-P}$ square wave, $f_C = 1\text{kHz}$	Offset adjusted to zero	-	0.04	0.4	$\text{mV}_{rms}$
			Offset not adjusted	-	20	200	$\text{mV}_{rms}$
Carrier Suppression	$V_{CS}$	$f_S = 10\text{kHz}, 300\text{mV}_{rms}, 60\text{mV}_{rms}$ sine wave	$f_C = 500\text{kHz}$	40	65	-	dB
			$f_C = 10\text{MHz}$	-	50k	-	dB

Note 1. All input and output characteristics are single-ended unless otherwise specified)

**Electrical Characteristics (Cont'd):** ( $V_{CC} = 12V$ ,  $V_{EE} = -8V$ ,  $I_5 = 1mA$ ,  $R_L = 3.9k\Omega$ ,  $R_e = 1k\Omega$ ,  $T_A = +25^\circ C$ , Note 1 unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Transadmittance Bandwidth (Magnitude)	$BW_{3dB}$	Carrier Input Port, $R_L = 50\Omega$ , $V_C = 60mV_{rms}$ sine wave, $f_S = 1kHz$ , $300mV_{rms}$ sine wave	-	300	-	MHz
		Signal Input Port, $R_L = 50\Omega$ , $V_S = 300mV_{rms}$ sine wave, $ V_C  = 0.5V$	-	80	-	MHz
Signal Gain	$A_{VS}$	$V_S = 100mV_{rms}$ , $f = 1kHz$ , $ V_C  = 0.5V$	2.5	3.5	-	V/V
Single-Ended Input Impedance, Signal Port	$r_{ip}$	Parallel Input Resistance, $f = 5MHz$	-	200	-	$k\Omega$
	$C_{ip}$	Parallel Input Capacitance, $f = 5MHz$	-	2.0	-	pF
Single-Ended Output Impedance, Signal Port	$r_{op}$	Parallel Output Resistance, $f = 10MHz$	-	40	-	$k\Omega$
	$C_{op}$	Parallel Output Capacitance, $f = 10MHz$	-	5.0	-	pF
Input Bias Current	$I_{bS}$	$I_{bS} = (I_1 + I_4) / 2$	-	12	30	$\mu A$
	$I_{bC}$	$I_{bC} = (I_7 + I_8) / 2$	-	12	30	$\mu A$
Input Offset Current	$ I_{ioS} $	$I_{ioS} = I_1 - I_4$	-	0.7	7.0	$\mu A$
	$ I_{ioC} $	$I_{ioC} = I_7 - I_8$	-	0.7	7.0	$\mu A$
Average Temperature Coefficient of Input Offset Current	$ TC_{Iio} $	$T_A = -55^\circ$ to $+125^\circ C$	-	2.0	-	$nA/^\circ C$
Output Offset Current	$ I_{ool} $	$I_6 - I_9$	-	14	80	$\mu A$
Average Temperature Coefficient of Output Offset Current	$ TC_{Iool} $	$T_A = -55^\circ$ to $+125^\circ C$	-	90	-	$nA/^\circ C$
Common-Mode Input Swing	CMV	Signal Port, $f_S = 1kHz$	-	5.0	-	$V_{P-P}$
Common-Mode Gain	ACM	Signal Port, $f_S = 1kHz$ , $ V_C  = 0.5V$	-	-85	-	dB
Common-Mode Quiescent Output Voltage	$V_{out}$	Pin6 or Pin9	-	8.0	-	$V_{P-P}$
Differential Output Voltage Swing Capability	$V_{out}$		-	8.0	-	$V_{P-P}$
Power Supply Current	$I_{CC}$	$I_6 + I_9$	-	2.0	4.0	mA
	$I_{EE}$	$I_{10}$	-	3.0	5.0	mA
DC Power Dissipation	$P_D$		-	33	-	mW

Note 1. All input and output characteristics are single-ended unless otherwise specified)





