

NTE123A (NPN) & NTE159M (PNP) Silicon Complementary Transistors General Purpose

Description:

The NTE123A (NPN) and NTE159M (PNP) are widely used "Industry Standard" complementary transistors in a TO18 type case designed for applications such as medium-speed switching and amplifiers from audio to VHF frequencies.

Features:

- Low Collector Saturation Voltage: 1V (Max)
- High Current Gain-Bandwidth Product: $f_T = 300\text{MHz}$ (Min) @ $I_C 20\text{mA}$

Absolute Maximum Ratings:

Collector-Emitter Voltage, V_{CEO}	
NTE123A	40V
NTE159M	60V
Collector-Base Voltage, V_{CBO}	
NTE123A	75V
NTE159M	60V
Emitter-Base Voltage, V_{EBO}	
NTE123A	6V
NTE159M	5V
Continuous Collector Current, I_C	
NTE123A	800mA
NTE159M	600mA
Total Device Dissipation ($T_A = +25^\circ\text{C}$), P_D	
Derate Above $+25^\circ\text{C}$	2.28mW/ $^\circ\text{C}$
Total Device Dissipation ($T_C = +25^\circ\text{C}$), P_D	
NTE123A	1.2W
Derate Above $+25^\circ\text{C}$	6.85mW/ $^\circ\text{C}$
NTE159M	1.8W
Derate Above $+25^\circ\text{C}$	10.3mW/ $^\circ\text{C}$
Operating Temperature Range, T_J	
Storage Temperature Range, T_{stg}	

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
OFF Characteristics							
Collector–Emitter Breakdown Voltage NTE123A	$V_{(BR)CEO}$	$I_C = 10\text{mA}, I_B = 0$	40	–	–	V	
NTE159M			60	–	–	V	
Collector–Base Breakdown Voltage NTE123A	$V_{(BR)CBO}$	$I_C = 10\mu\text{A}, I_E = 0$	75	–	–	V	
NTE159M			60	–	–	V	
Emitter–Base Breakdown Voltage NTE123A	$V_{(BR)EBO}$	$I_E = 10\mu\text{A}, I_C = 0$	6	–	–	V	
NTE159M			5	–	–	V	
Collector Cutoff Current NTE123A	I_{CEX}	$V_{CE} = 60\text{V}, V_{EB(\text{off})} = 3\text{V}$	–	–	10	nA	
NTE159M		$V_{CE} = 30\text{V}, V_{BE} = 500\text{mV}$	–	–	50	nA	
Collector Cutoff Current NTE123A	I_{CBO}	$V_{CB} = 60\text{V}, I_E = 0$	–	–	0.01	μA	
		$V_{CB} = 60\text{V}, I_E = 0, T_A = +150^\circ\text{C}$	–	–	10	μA	
NTE159M		$V_{CB} = 50\text{V}, I_E = 0$	–	–	0.01	μA	
		$V_{CB} = 50\text{V}, I_E = 0, T_A = +150^\circ\text{C}$	–	–	10	μA	
Emitter Cutoff Current (NTE123A Only)	I_{EBO}	$V_{EB} = 3\text{V}, I_C = 0$	–	–	10	nA	
Base Cutoff Current NTE123A	I_{BL}	$V_{CE} = 60\text{V}, V_{EB(\text{off})} = 3\text{V}$	–	–	20	nA	
NTE159M		$V_{CE} = 30\text{V}, V_{EB(\text{off})} = 500\text{mV}$	–	–	50	nA	
ON Characteristics							
DC Current Gain NTE123A	h_{FE}	$V_{CE} = 10\text{V}$	$I_C = 0.1\text{mA}$, Note 1	35	–	–	
			$I_C = 1\text{mA}$	50	–	–	
			$I_C = 10\text{mA}$, Note 1	75	–	–	
			$I_C = 10\text{mA}, T_A = -55^\circ\text{C}$	35	–	–	
			$I_C = 150\text{mA}$, Note 1	100	–	300	
		$V_{CE} = 1\text{V}, I_C = 150\text{mA}$, Note 1		50	–	–	
		$V_{CE} = 10\text{V}$	$I_C = 500\text{mA}$, Note 1	40	–	–	
			$I_C = 0.1\text{mA}$	75	–	–	
			$I_C = 1\text{mA}$	100	–	–	
			$I_C = 10\text{mA}$	100	–	–	
			$I_C = 150\text{mA}$, Note 1	100	–	300	
			$I_C = 500\text{mA}$, Note 1	50	–	–	
Collector–Emitter Saturation Voltage NTE123A	$V_{CE(\text{sat})}$	$I_C = 150\text{mA}, I_B = 15\text{mA}$, Note 1	–	–	0.3	V	
		$I_C = 500\text{mA}, I_B = 50\text{mA}$, Note 1	–	–	1.0	V	
NTE159M		$I_C = 150\text{mA}, I_B = 15\text{mA}$, Note 1	–	–	0.4	V	
		$I_C = 500\text{mA}, I_B = 50\text{mA}$, Note 1	–	–	1.6	V	

Note 1. Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$.

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

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
ON Characteristics (Cont'd)							
Base–Emitter Saturation Voltage NTE123A NTE159M	V _{BE(sat)}	I _C = 150mA, I _B = 15mA, Note 1		0.6	–	1.2	V
		I _C = 500mA, I _B = 50mA, Note 1		–	–	2.0	V
		I _C = 150mA, I _B = 15mA, Note 1		–	–	1.3	V
		I _C = 500mA, I _B = 50mA		–	–	2.6	V
Small–Signal Characteristics							
Current Gain–Bandwidth Product NTE123A NTE159M	f _T	I _C = 20mA	V _{CE} = 20V, f = 100MHz, Note 2	300	–	–	MHz
		I _C = 50mA		200	–	–	MHz
Output Capacitance	C _{obo}	V _{CB} = 10V, I _E = 0, f = 100kHz		–	–	8	pF
Input Capacitance NTE123A NTE159M	C _{ibo}	V _{BE} = 0.5V	I _C = 0, f = 100kHz	–	–	25	pF
		V _{BE} = 2V		–	–	30	pF
Input Impedance (NTE123A Only)	h _{ie}	I _C = 1mA	V _{CE} = 10V, f = 1kHz	2.0	–	8.0	kΩ
		I _C = 10mA		0.25	–	1.25	kΩ
Voltage Feedback Ratio (NTE123A Only)	h _{re}	I _C = 1mA	V _{CE} = 10V, f = 1kHz	–	–	8	x 10 ^{–4}
		I _C = 10mA		–	–	4	x 10 ^{–4}
Small–Signal Current Gain (NTE123A Only)	h _{fe}	I _C = 1mA	V _{CE} = 10V, f = 1kHz	50	–	300	
		I _C = 10mA		75	–	375	
Output Admittance (NTE123A Only)	h _{oe}	I _C = 1mA	V _{CE} = 10V, f = 1kHz	5	–	35	μmhos
		I _C = 10mA		25	–	200	μmhos
Collector–Base Time Constant (NTE123A Only)	rb'C _C	I _E = 20mA, V _{CB} = 20V, f = 31.8MHz		–	–	150	ps
Noise Figure (NTE123A Only)	NF	I _C = 100μA, V _{CE} = 10V, R _S = 1kΩ, f = 1kHz		–	–	4	dB
Real Part of Common–Emitter High Frequency Input Impedance (NTE123A Only)	Re(h _{ie})	I _C = 20mA, V _{CE} = 20V, f = 300MHz		–	–	60	Ω
Switching Characteristics							
NTE123A Delay Time Rise Time Storage Time Fall Time	t _d	V _{CC} = 30V, V _{BE(off)} = 500mV, I _C = 150mA, I _{B1} = –15mA		–	–	10	ns
	t _r			–	–	25	ns
	t _s	V _{CC} = 30V, I _C = 150mA, I _{B1} = I _{B2} = 15mA		–	–	225	ns
	t _f			–	–	60	ns
NTE159M Turn–On Time Delay Time Rise Time Turn–Off Time Storage Time Fall Time	t _{on}	V _{CC} = 30V, I _C = 150mA, I _{B1} = 15mA		–	26	45	ns
	t _d			–	6	10	ns
	t _r			–	20	40	ns
	t _{off}	V _{CC} = 6V, I _C = 150mA, I _{B1} = I _{B2} = 15mA		–	70	100	ns
	t _s			–	50	80	ns
	t _f			–	20	30	ns

Note 1. Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$.

Note 2. f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

