NTE
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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 = 300MHz (Min) @ I_C 20mA

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°C), P_D 0.4W
    Derate Above +25°C . . . . 2.28mW/°C
Total Device Dissipation (T_C = +25°C), P_D
    NTE123A 1.2W
        Derate Above +25°C . . . . 6.85mW/°C
    NTE159M 1.8W
        Derate Above +25°C . . . . 10.3mW/°C
Operating Temperature Range, T_J . . . . −65° to +200°C
Storage Temperature Range, T_{stg} . . . . −65° to +200°C

Electrical Characteristics: ($T_A = 25°C$ unless otherwise specified)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
OFF Characteristics							
Collector–Emitter Breakdown Voltage NTE123A	$V_{(BR)CEO}$	$I_C = 10mA$, $I_B = 0$		40	–	–	V
NTE159M				60	–	–	V
Collector–Base Breakdown Voltage NTE123A	$V_{(BR)CBO}$	$I_C = 10μA$, $I_E = 0$		75	–	–	V
NTE159M				60	–	–	V
Emitter–Base Breakdown Voltage NTE123A	$V_{(BR)EBO}$	$I_E = 10μA$, $I_C = 0$		6	–	–	V
NTE159M				5	–	–	V
Collector Cutoff Current NTE123A	I_{CEX}	$V_{CE} = 60V$, $V_{EB(off)} = 3V$		–	–	10	nA
NTE159M		$V_{CE} = 30V$, $V_{BE} = 500mV$		–	–	50	nA
Collector Cutoff Current NTE123A	I_{CBO}	$V_{CB} = 60V$, $I_E = 0$		–	–	0.01	μA
		$V_{CB} = 60V$, $I_E = 0$, $T_A = +150°C$		–	–	10	μA
NTE159M		$V_{CB} = 50V$, $I_E = 0$		–	–	0.01	μA
		$V_{CB} = 50V$, $I_E = 0$, $T_A = +150°C$		–	–	10	μA
Emitter Cutoff Current (NTE123A Only)	I_{EBO}	$V_{EB} = 3V$, $I_C = 0$		–	–	10	nA
Base Cutoff Current NTE123A	I_{BL}	$V_{CE} = 60V$, $V_{EB(off)} = 3V$		–	–	20	nA
NTE159M		$V_{CE} = 30V$, $V_{EB(off)} = 500mV$		–	–	50	nA
ON Characteristics							
DC Current Gain NTE123A	h_{FE}	$V_{CE} = 10V$	$I_C = 0.1mA$, Note 1	35	–	–	
			$I_C = 1mA$	50	–	–	
			$I_C = 10mA$, Note 1	75	–	–	
			$I_C = 10mA$, $T_A = –55°C$	35	–	–	
			$I_C = 150mA$, Note 1	100	–	300	
		$V_{CE} = 1V$, $I_C = 150mA$, Note 1		50	–	–	
		$V_{CE} = 10V$	$I_C = 500mA$, Not e 1	40	–	–	
NTE159M			$I_C = 0.1mA$	75	–	–	
			$I_C = 1mA$	100	–	–	
			$I_C = 10mA$	100	–	–	
			$I_C = 150mA$, Note 1	100	–	300	
			$I_C = 500mA$, Note 1	50	–	–	
Collector–Emitter Saturation Voltage NTE123A	$V_{CE(sat)}$	$I_C = 150mA$, $I_B = 15mA$, Note 1		–	–	0.3	V
		$I_C = 500mA$, $I_B = 50mA$, Note 1		–	–	1.0	V
NTE159M		$I_C = 150mA$, $I_B = 15mA$, Note 1		–	–	0.4	V
		$I_C = 500mA$, $I_B = 50mA$, Note 1		–	–	1.6	V

Note 1. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.

Electrical Characteristics (Cont'd): $(T_A = 25°C$ unless otherwise specified)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
ON Characteristics (Cont'd)							
Base–Emitter Saturation Voltage NTE123A	$V_{BE(sat)}$	$I_C = 150mA$, $I_B = 15mA$, Note 1		0.6	–	1.2	V
		$I_C = 500mA$, $I_B = 50mA$, Note 1		–	–	2.0	V
NTE159M		$I_C = 150mA$, $I_B = 15mA$, Note 1		–	–	1.3	V
		$I_C = 500mA$, $I_B = 50mA$		–	–	2.6	V
Small–Signal Characteristics							
Current Gain–Bandwidth Product NTE123A	f_T	$I_C = 20mA$	$V_{CE} = 20V$, $f = 100MHz$, Note 2	300	–	–	MHz
NTE159M		$I_C = 50mA$		200	–	–	MHz
Output Capacitance	C_{obo}	$V_{CB} = 10V$, $I_E = 0$, $f = 100kHz$		–	–	8	pF
Input Capactiance NTE123A	C_{ibo}	$V_{BE} = 0.5V$	$I_C = 0$, $f = 100kHz$	–	–	25	pF
NTE159M		$V_{BE} = 2V$		–	–	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	t_d	$V_{CC} = 30V$, $V_{BE(off)} = 500mV$, $I_C = 150mA$, $I_{B1} = -15mA$		–	–	10	ns
Rise Time	t_r			–	–	25	ns
Storage Time	t_s	$V_{CC} = 30V$, $I_C = 150mA$, $I_{B1} = I_{B2} = 15mA$		–	–	225	ns
Fall Time	t_f			–	–	60	ns
NTE159M Turn–On Time	t_{on}	$V_{CC} = 30V$, $I_C = 150mA$, $I_{B1} = 15mA$		–	26	45	ns
Delay Time	t_d			–	6	10	ns
Rise Time	t_r			–	20	40	ns
Turn–Off Time	t_{off}	$V_{CC} = 6V$, $I_C = 150mA$, $I_{B1} = I_{B2} = 15mA$		–	70	100	ns
Storage Time	t_s			–	50	80	ns
Fall Time	t_f			–	20	30	ns

Note 1. Pulse Test: Pulse Width $\leq 300μs$, Duty Cycle $\leq 2\%$.

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

.230 (5.84) Dia Max

.195 (4.95) Dia Max

.210 (5.33) Max

.030 (.762) Max

.500 (12.7) Min

.018 (0.45)

Base

Emitter

Collector

45°

.041 (1.05)