ELECTRONICS, INC.
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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

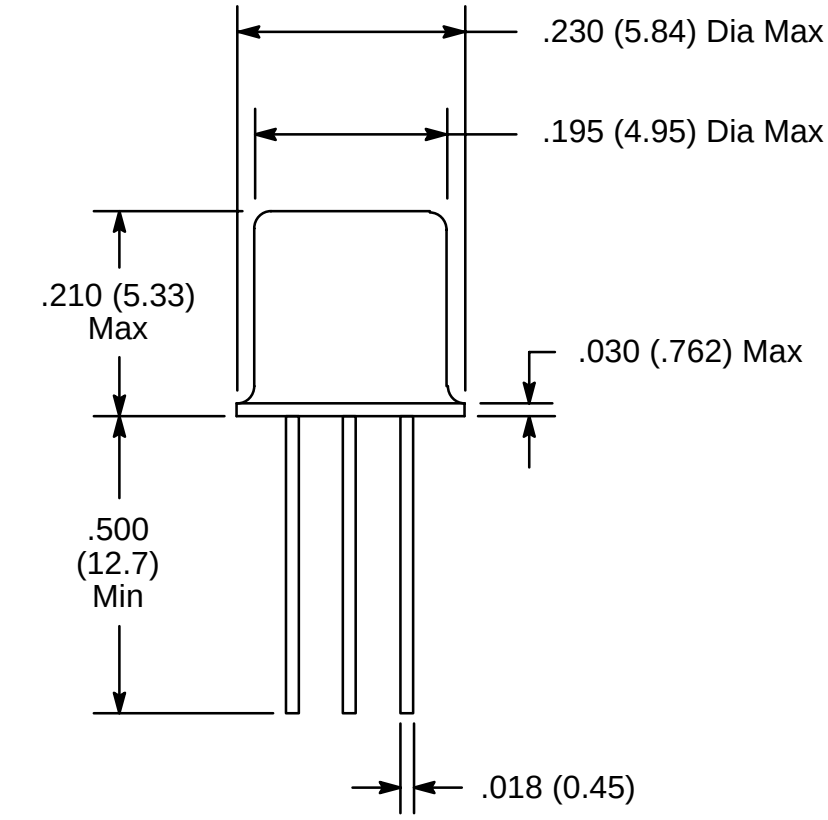
Note 1. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.

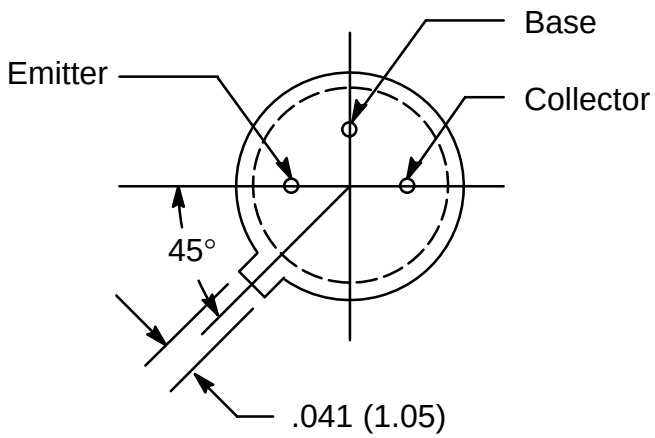
Electrical Characteristics (Cont'd): (T_A = 25°C unless otherwise specified)

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 ≤ 300μs, Duty Cycle ≤ 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)