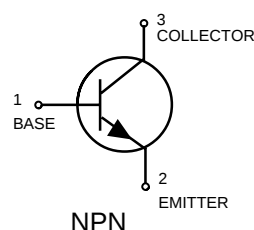
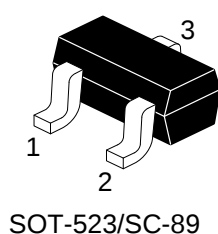


General Purpose Transistors NPN Silicon

FEATURES:

- We declare that the material of product compliance with RoHS requirements.

Circuit Diagram & Pin Configuration:



DEVICE MARKING AND ORDERING INFORMATION

Device	Marking	Shipping
TMBT3904T	MA	3000/Tape&Reel

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	40	Vdc
Collector–Base Voltage	V_{CBO}	60	Vdc
Emitter–Base Voltage	V_{EBO}	6.0	Vdc
Collector Current — Continuous	I_C	200	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR– 4 Board, (1) $T_A = 25^\circ\text{C}$	P_D	200	mW
Derate above 25°C		1.6	mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	600	$^\circ\text{C/W}$
Total Device Dissipation FR-4 Board(2), $T_A = 25^\circ\text{C}$	P_D	300	mW
Derate above 25°C		2.4	mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	400	$^\circ\text{C/W}$
Junction and Storage Temperature	T_J, T_{stg}	–55 to +150	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage(3) (I _C = 1.0 mA)	V _{(BR)CEO}	40	—	Vdc
Collector–Base Breakdown Voltage (I _C = 10 μA)	V _{(BR)CBO}	60	—	Vdc
Emitter–Base Breakdown Voltage (I _E = 10 μA)	V _{(BR)EBO}	6.0	—	Vdc
Base Cutoff Current (V _{CE} = 30 Vdc, V _{EB} = 3.0 Vdc,)	I _{BL}	—	50	nA
Collector Cutoff Current (V _{CE} = 30Vdc, V _{EB} = 3.0Vdc)	I _{CEX}	—	50	nA

1. FR-4 Minimum Pad.
2. FR-4 1.0 x 1.0 Inch Pad.
3. Pulse Test: Pulse Width ≤300 μs, Duty Cycle ≤2.0%.

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Max	Unit
ON CHARACTERISTICS (3)				
DC Current Gain(1) ($I_C = 0.1\text{ mA}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 1.0\text{ mA}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 10\text{ mA}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 50\text{ mA}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 100\text{ mA}$, $V_{CE} = 1.0\text{ Vdc}$)	h_{FE}	40 70 100 60 30	— — 300 — —	—
Collector–Emitter Saturation Voltage ($I_C = 10\text{ mA}$, $I_B = 1.0\text{ mA}$)(3) ($I_C = 50\text{ mA}$, $I_B = 5.0\text{ mA}$)	$V_{CE(sat)}$	— —	0.2 0.3	Vdc
Base–Emitter Saturation Voltage(3) ($I_C = 10\text{ mA}$, $I_B = 1.0\text{ mA}$) ($I_C = 50\text{ mA}$, $I_B = 5.0\text{ mA}$)	$V_{BE(sat)}$	0.65 —	0.85 0.95	Vdc

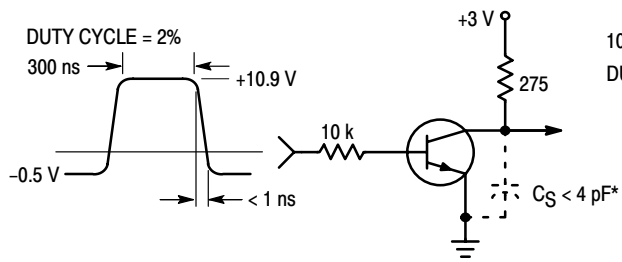
SMALL–SIGNAL CHARACTERISTICS

Current–Gain — Bandwidth Product ($I_C = 10\text{ mA}$, $V_{CE} = 20\text{ Vdc}$, $f = 100\text{ MHz}$)	f_T	200	—	MHz
Output Capacitance ($V_{CB} = 5.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$)	C_{obo}	—	4.0	pF
Input Capacitance ($V_{BE} = 0.5\text{ Vdc}$, $I_C = 0$, $f = 1.0\text{ MHz}$)	C_{ibo}	—	8.0	pF
Input Impedance ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mA}$, $f = 1.0\text{ kHz}$)	h_{ie}	1.0	10	pF
Voltage Feedback Ratio ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mA}$, $f = 1.0\text{ kHz}$)	h_{re}	0.5	8.0	$\times 10^{-4}$
Small–Signal Current Gain ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mA}$, $f = 1.0\text{ kHz}$)	h_{fe}	100	400	—
Output Admittance ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mA}$, $f = 1.0\text{ kHz}$)	h_{oe}	1.0	40	mhos
Noise Figure ($V_{CE} = 5.0\text{ Vdc}$, $I_C = 100\mu\text{A}$, $R_S = 1.0\text{ k}\Omega$, $f = 1.0\text{ kHz}$)	NF	—	5.0	dB

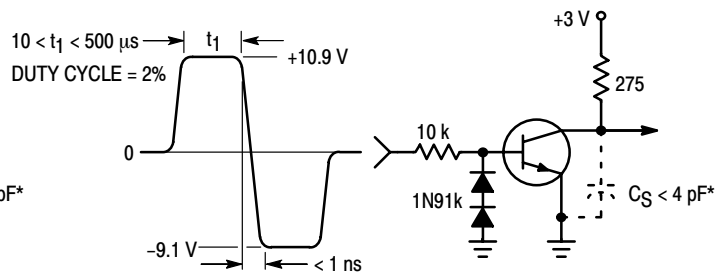
SWITCHING CHARACTERISTICS

Delay Time ($V_{CC} = 3.0\text{ Vdc}$, $V_{BE} = 0.5\text{ Vdc}$)	t_d	—	35	ns
Rise Time ($I_C = 10\text{ mA}$, $I_{B1} = 1.0\text{ mA}$)	t_r	—	35	ns
Storage Time ($V_{CC} = 3.0\text{ Vdc}$, $I_C = 10\text{ mA}$, $I_{B1} = I_{B2} = 1.0\text{ mA}$)	t_s	—	200	ns
Fall Time	t_f	—	50	ns

3. Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2.0\%$.



**Figure 1. Delay and Rise Time
Equivalent Test Circuit**



**Figure 2. Storage and Fall Time
Equivalent Test Circuit**

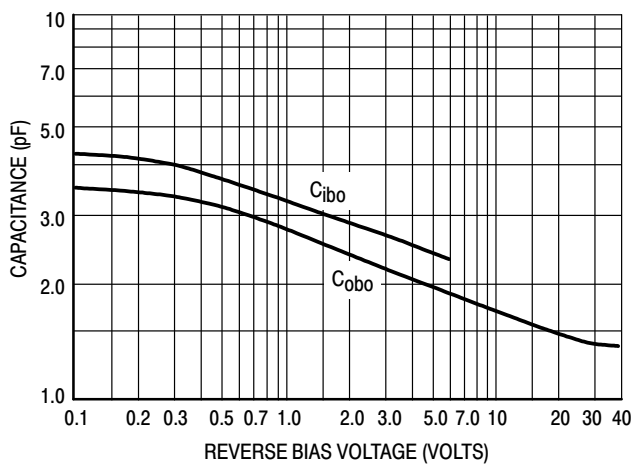


Figure 3. Capacitance

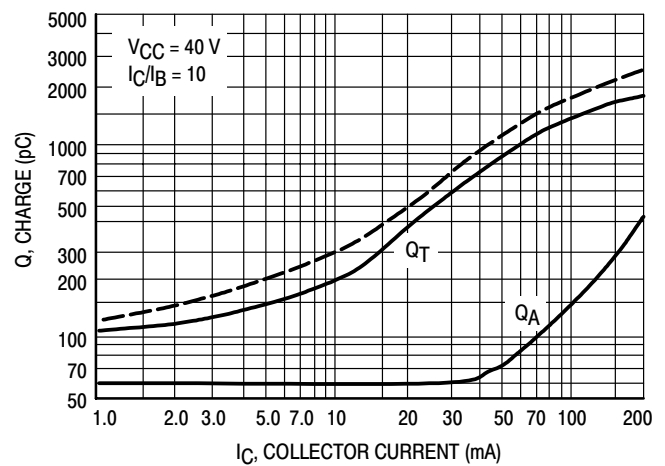


Figure 4. Charge Data

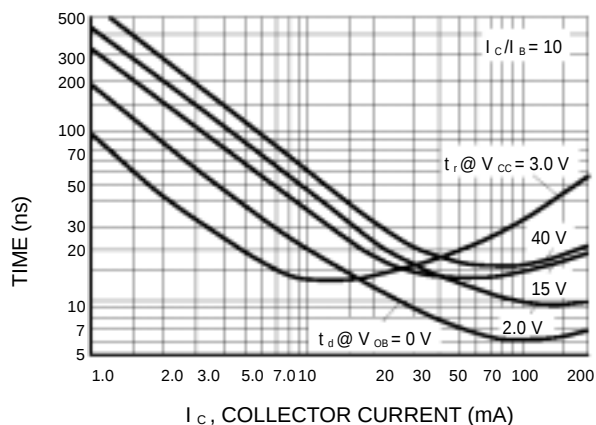


Figure 5. Turn-On Time

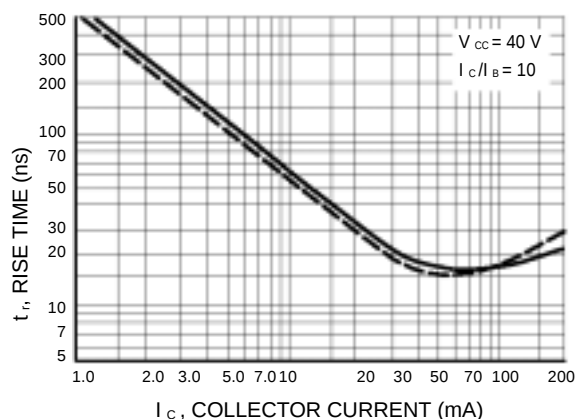


Figure 6. Rise Time

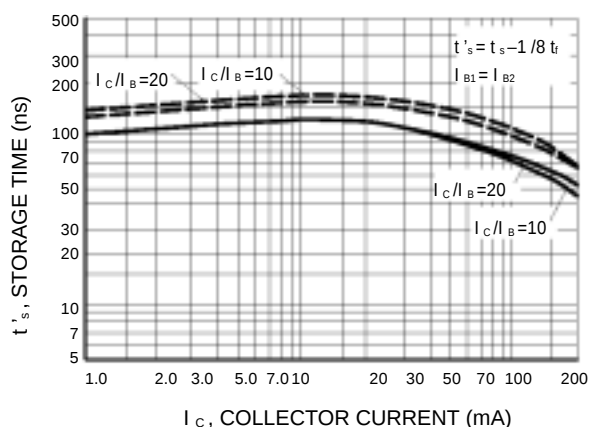


Figure 7. Storage Time

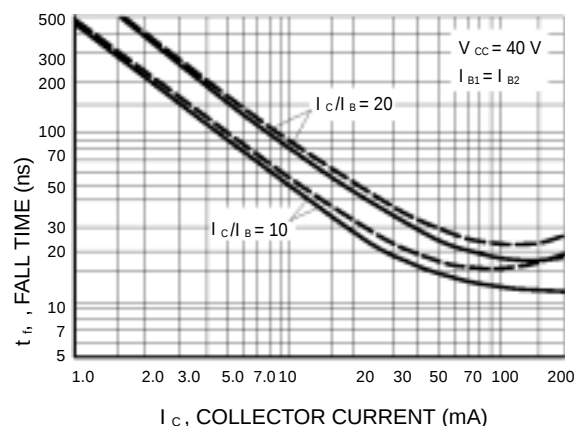


Figure 8. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE VARIATIONS

($V_{CE} = 5.0 \text{ Vdc}$, $T_A = 25^\circ\text{C}$, Bandwidth = 1.0 Hz)

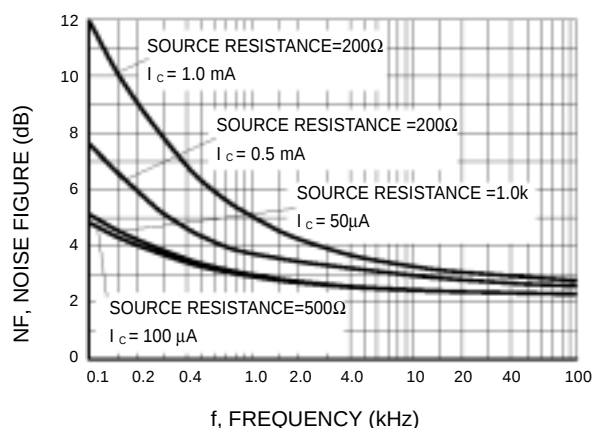


Figure 9.

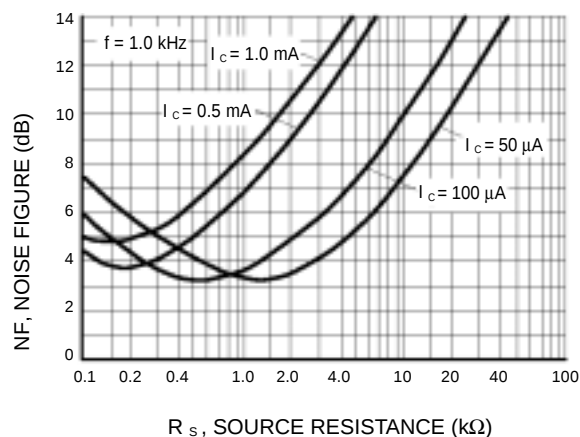


Figure 10.

h PARAMETERS

($V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$, $T_A = 25^\circ\text{C}$)

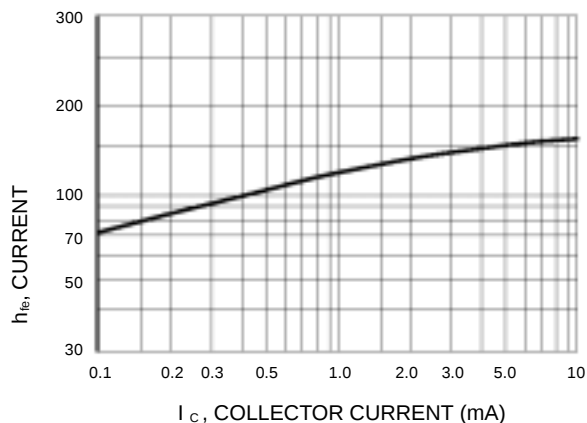


Figure 11. Current Gain

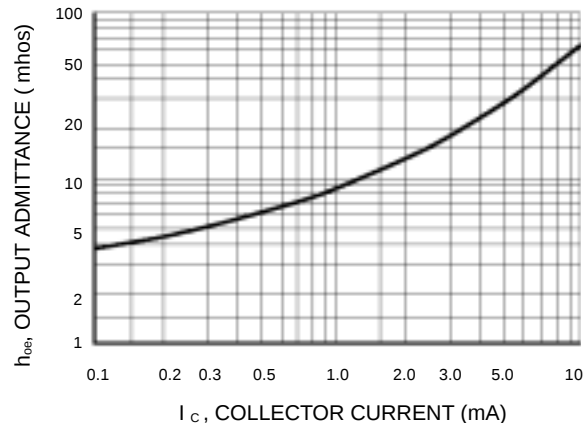


Figure 12. Output Admittance

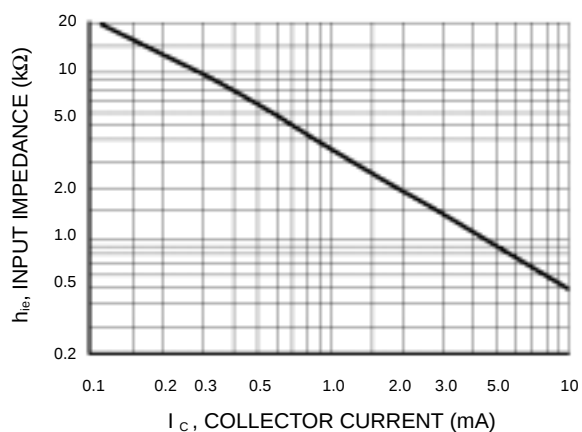


Figure 13. Input Impedance

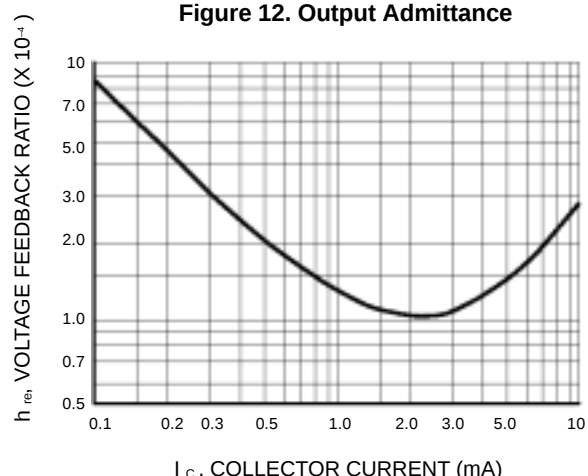


Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

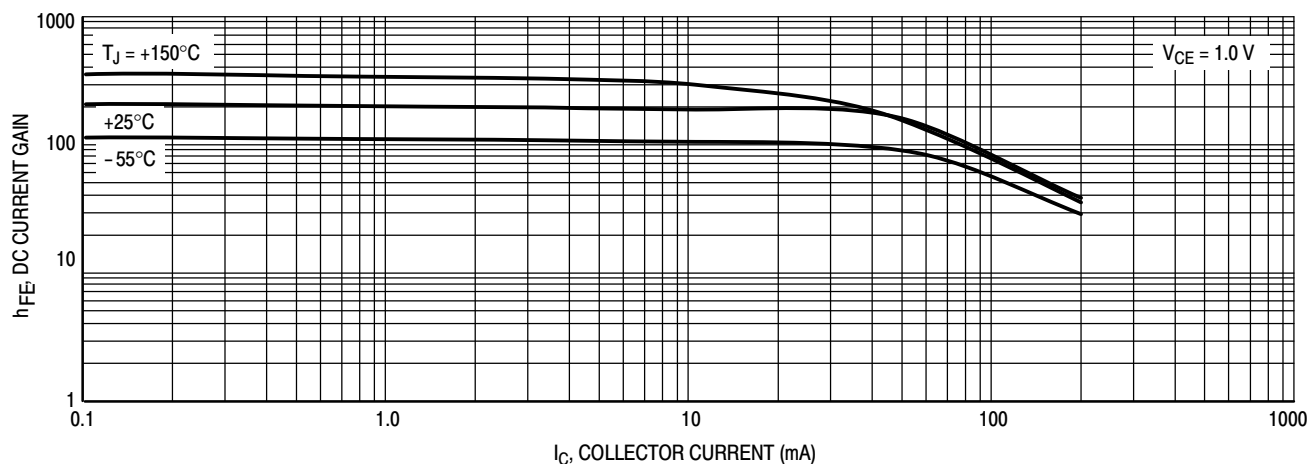


Figure 15. DC Current Gain

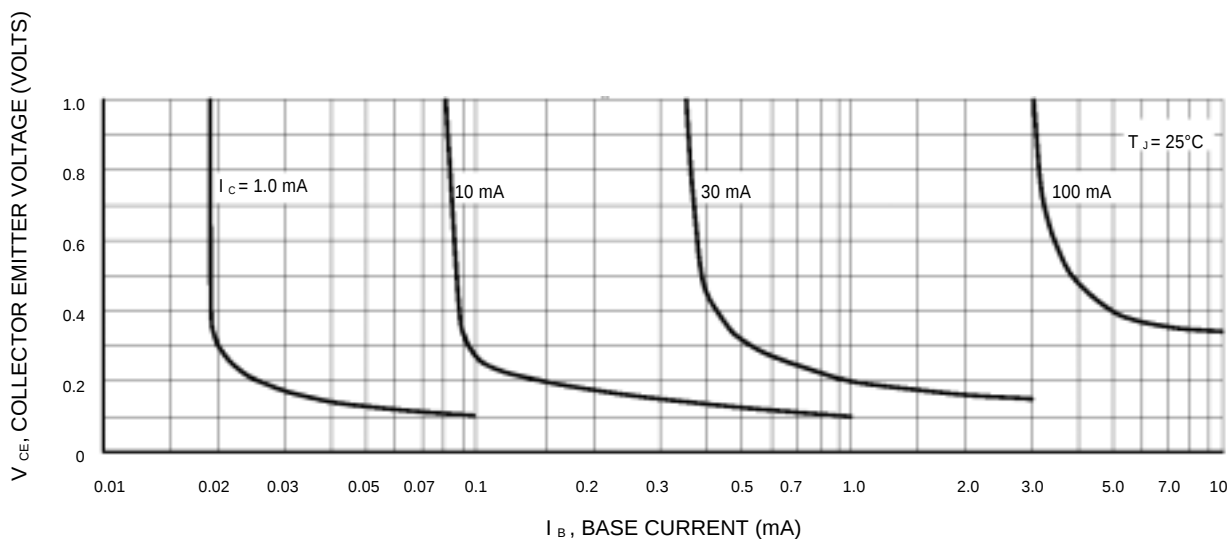


Figure 16. Collector Saturation Region

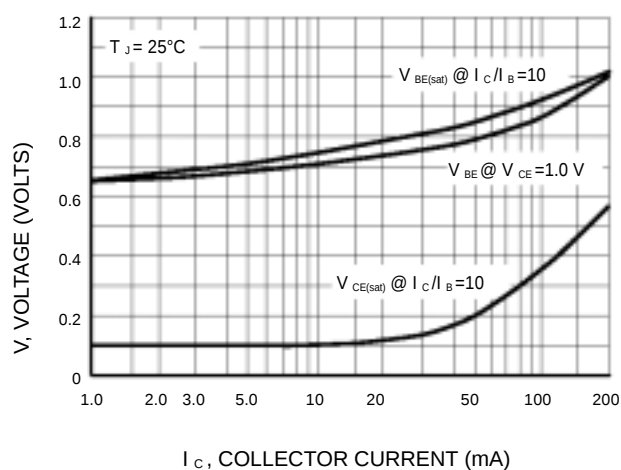


Figure 17. "ON" Voltages

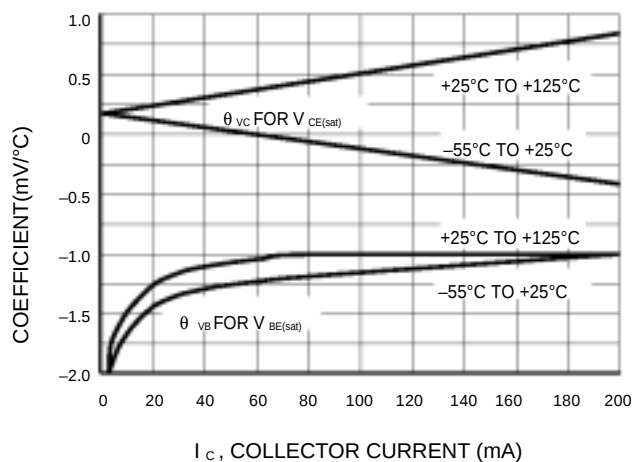
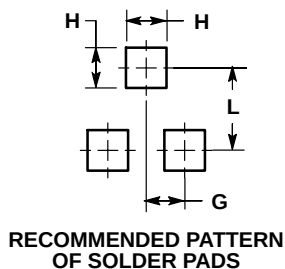
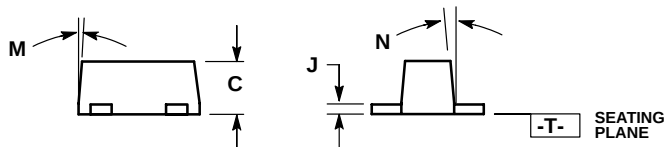
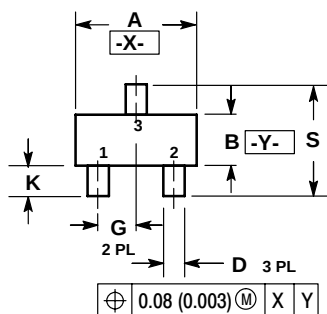


Figure 18. Temperature Coefficients

SC-89



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS, MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 463C-01 OBSOLETE, NEW STANDARD 463C-02.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.50	1.60	1.70	0.059	0.063	0.067
B	0.75	0.85	0.95	0.030	0.034	0.040
C	0.60	0.70	0.80	0.024	0.028	0.031
D	0.23	0.28	0.33	0.009	0.011	0.013
G	0.50 BSC			0.020 BSC		
H	0.53 REF			0.021 REF		
J	0.10	0.15	0.20	0.004	0.006	0.008
K	0.30	0.40	0.50	0.012	0.016	0.020
L	1.10 REF			0.043 REF		
M	---	---	10 °	---	---	10 °
N	---	---	10 °	---	---	10 °
S	1.50	1.60	1.70	0.059	0.063	0.067

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