



## DESCRIPTION

The MBT3904T is available in SC-89 package.

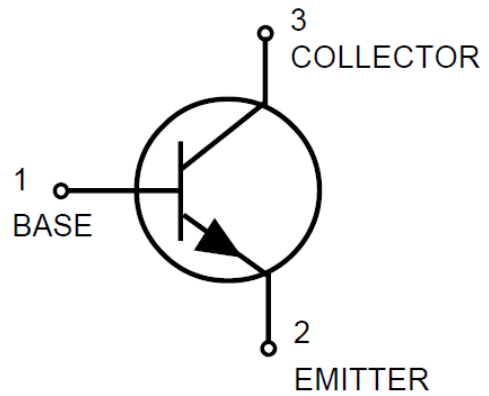
## FEATURES

- Simplifies Circuit Design.
- Available in SC-89 package

## ORDERING INFORMATION

Package Type	Part Number
SC-89	MBT3904T
Package	SPQ: 3,000pcs/Reel
AiT provides all RoHS Compliant Products	

## PIN DESCRIPTION





## ABSOLUTE MAXIMUM RATINGS

$V_{CEO}$ , Collector-Emitter Voltage	40Vdc
$V_{CBO}$ , Collector-Base Voltage	60Vdc
$V_{EBO}$ , Emitter-Base Voltage	6.0Vdc
$I_C$ , Collector Current-Continuous	200mAdc

Stresses above may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## THERMAL CHARACTERISTICS

Parameter	Symbol	Max	Unit
Total Device Dissipation FR-4 Board, <sup>NOTE1</sup> $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	200 1.6	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	600	$^\circ\text{C}/\text{W}$
Total Device Dissipation FR-4 Board, <sup>NOTE2</sup> $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	300 2.4	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	400	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$



## ELECTRICAL CHARACTERISTICS

T<sub>A</sub> = 25°C, unless otherwise noted

Parameter	Symbol	Conditions	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector–Emitter Breakdown Voltage <sup>NOTE3</sup>	V <sub>(BR)CEO</sub>	I <sub>C</sub> = 1.0mA <sub>dc</sub>	40	-	V <sub>dc</sub>
Collector–Base Breakdown Voltage	V <sub>(BR)CBO</sub>	I <sub>C</sub> = 10μA <sub>dc</sub>	60	-	V <sub>dc</sub>
Emitter–Base Breakdown Voltage	V <sub>(BR)EBO</sub>	I <sub>E</sub> = 10μA <sub>dc</sub>	6.0	-	V <sub>dc</sub>
Base Cutoff Current	I <sub>BL</sub>	V <sub>CE</sub> = 30V <sub>dc</sub> , V <sub>EB</sub> = 3.0V <sub>dc</sub>	-	50	nA <sub>dc</sub>
Collector Cutoff Current	I <sub>CEX</sub>	V <sub>CE</sub> = 30V <sub>dc</sub> , V <sub>EB</sub> = 3.0V <sub>dc</sub>	-	50	nA <sub>dc</sub>
<b>ON CHARACTERISTICS<sup>NOTE3</sup></b>					
DC Current Gain <sup>NOTE1</sup>	h <sub>FE</sub>	I <sub>C</sub> = 0.1mA <sub>dc</sub> , V <sub>CE</sub> = 1.0V <sub>dc</sub>	40	-	-
		I <sub>C</sub> = 1.0mA <sub>dc</sub> , V <sub>CE</sub> = 1.0V <sub>dc</sub>	70	-	
		I <sub>C</sub> = 10mA <sub>dc</sub> , V <sub>CE</sub> = 1.0V <sub>dc</sub>	100	300	
		I <sub>C</sub> = 50mA <sub>dc</sub> , V <sub>CE</sub> = 1.0V <sub>dc</sub>	60	-	
		I <sub>C</sub> = 100mA <sub>dc</sub> , V <sub>CE</sub> = 1.0V <sub>dc</sub>	30	-	
Collector–Emitter Saturation Voltage	V <sub>CE(sat)</sub>	I <sub>C</sub> = 10mA <sub>dc</sub> , I <sub>B</sub> = 1.0mA <sub>dc</sub> <sup>NOTE3</sup>	-	0.2	V <sub>dc</sub>
		I <sub>C</sub> = 50mA <sub>dc</sub> , I <sub>B</sub> = 5.0mA <sub>dc</sub>	-	0.3	
Base–Emitter Saturation Voltage <sup>NOTE3</sup>	V <sub>BE(sat)</sub>	I <sub>C</sub> = 10mA <sub>dc</sub> , I <sub>B</sub> = 1.0mA <sub>dc</sub>	0.65	0.85	V <sub>dc</sub>
		I <sub>C</sub> = 50mA <sub>dc</sub> , I <sub>B</sub> = 5.0mA <sub>dc</sub>	-	0.95	



T<sub>A</sub> = 25°C, unless otherwise noted

Parameter	Symbol	Conditions	Min	Max	Unit
<b>SMALL-SIGNAL CHARACTERISTICS</b>					
Current-Gain — Bandwidth Product	f <sub>T</sub>	I <sub>C</sub> = 10mA <sub>dc</sub> , V <sub>CE</sub> = 20V <sub>dc</sub> , f = 100MHz	200	-	MHz
Output Capacitance	C <sub>obo</sub>	V <sub>CB</sub> = 5.0V <sub>dc</sub> , I <sub>E</sub> = 0, f = 1.0MHz	-	4.0	pF
Input Capacitance	C <sub>ibo</sub>	V <sub>BE</sub> = 0.5V <sub>dc</sub> , I <sub>C</sub> = 0, f = 1.0MHz	-	8.0	pF
Input Impedance	h <sub>ie</sub>	V <sub>CE</sub> = 10V <sub>dc</sub> , I <sub>C</sub> = 1.0mA <sub>dc</sub> , f = 1.0kHz	1.0	10	kΩ
Voltage Feedback Ratio	h <sub>re</sub>	V <sub>CE</sub> = 10V <sub>dc</sub> , I <sub>C</sub> = 1.0mA <sub>dc</sub> , f = 1.0kHz	0.5	8.0	X10 <sup>-4</sup>
Small-Signal Current Gain	h <sub>fe</sub>	V <sub>CE</sub> = 10V <sub>dc</sub> , I <sub>C</sub> = 1.0mA <sub>dc</sub> , f = 1.0kHz	100	400	-
Output Admittance	h <sub>oe</sub>	V <sub>CE</sub> = 10V <sub>dc</sub> , I <sub>C</sub> = 1.0mA <sub>dc</sub> , f = 1.0kHz	1.0	40	mhos
Noise Figure	NF	V <sub>CE</sub> = 5.0V <sub>dc</sub> , I <sub>C</sub> = 100μA <sub>dc</sub> , R <sub>S</sub> = 1.0kΩ, f = 1.0kHz	-	5.0	dB
<b>SWITCHING CHARACTERISTICS</b>					
Delay Time	t <sub>d</sub>	V <sub>CC</sub> = 3.0V <sub>dc</sub> , V <sub>BE</sub> = 0.5V <sub>dc</sub>	-	35	ns
Rise Time	t <sub>r</sub>	I <sub>C</sub> = 10mA <sub>dc</sub> , I <sub>B1</sub> = 1.0mA <sub>dc</sub>	-	35	
Storage Time	t <sub>s</sub>	V <sub>CC</sub> = 3.0V <sub>dc</sub> , I <sub>C</sub> = 10mA <sub>dc</sub> ,	-	200	ns
Fall Time	t <sub>f</sub>	I <sub>B1</sub> = I <sub>B2</sub> = 1.0mA <sub>dc</sub>	-	50	

NOTE1: FR-4 Minimum Pad.

NOTE2: FR-4 1.0 x 1.0 Inch Pad.

NOTE3: Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.



**TYPICAL CHARACTERISTICS**

**Equivalent Test Circuit**

Figure 1. Delay and Rise Time

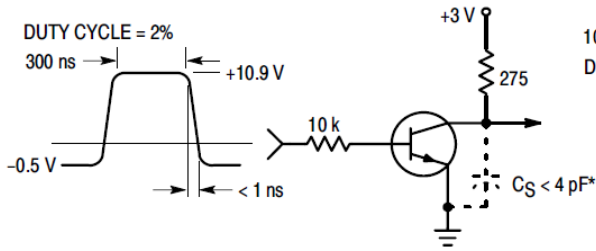
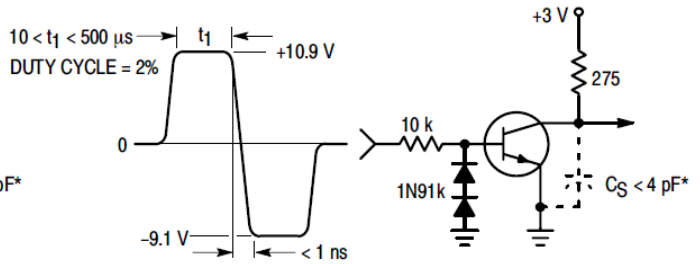


Figure 2. Storage and Fall Time



\* Total shunt capacitance of test jig and connectors

Figure 3. Capacitance

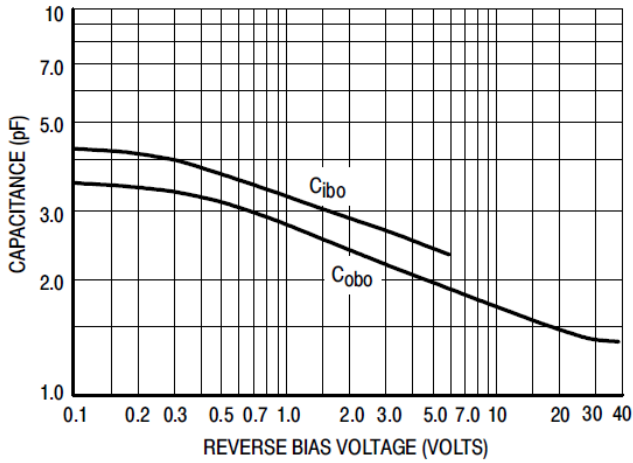


Figure 4. Charge Data

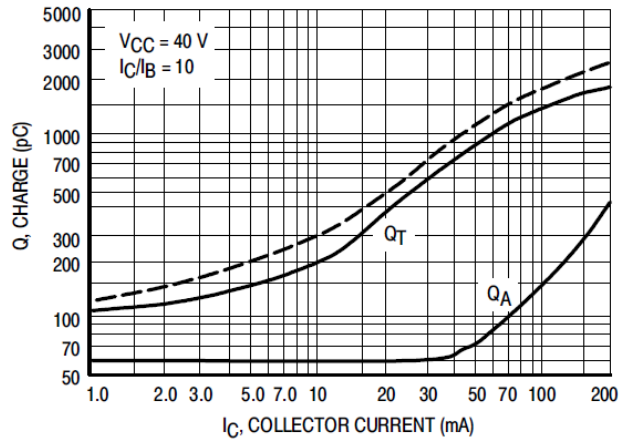


Figure 5. Turn-On Time

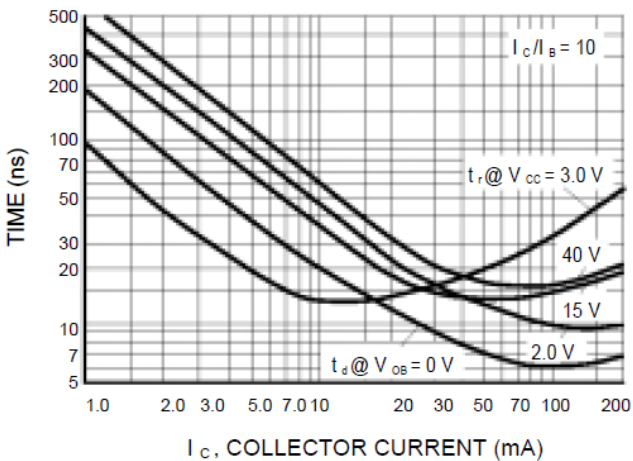


Figure 6. Rise Time

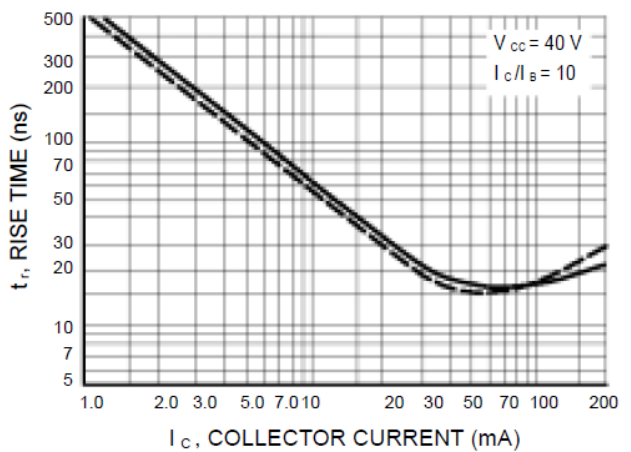




Figure 7. Storage Time

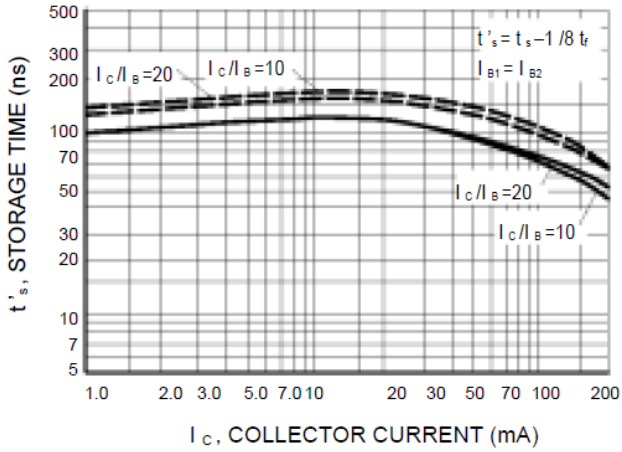
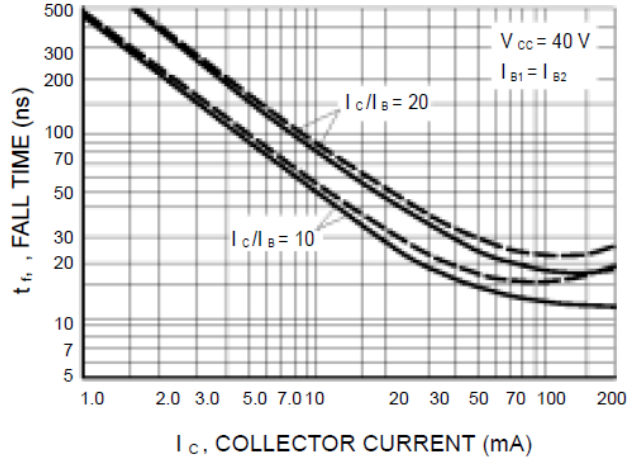


Figure 8. Fall Time



**TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS**

$V_{CE} = 5.0V_{dc}$ ,  $T_A = 25^\circ C$ , Bandwidth = 1.0Hz

Figure 9. Noise Figure

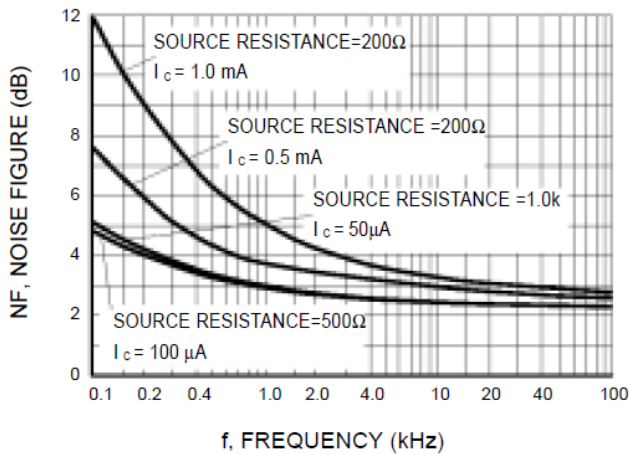
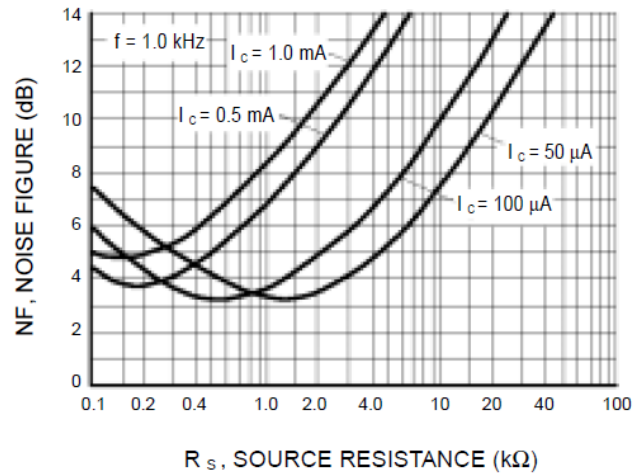


Figure 10. Noise Figure





**h PARAMETERS**  $V_{CE} = 10V_{dc}$ ,  $f = 1.0kHz$ ,  $T_A = 25^\circ C$

Figure 11. Current Gain

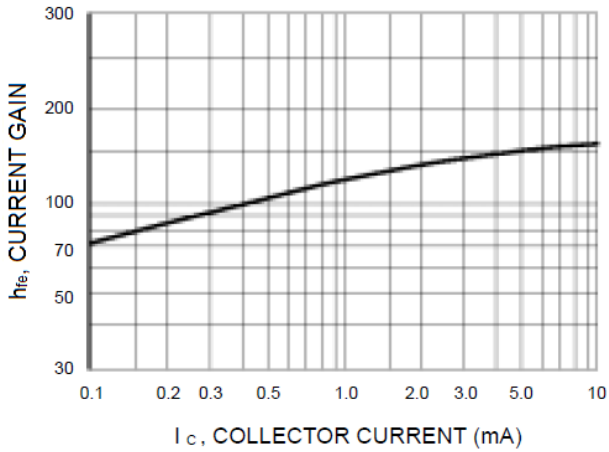


Figure 12. Output Admittance

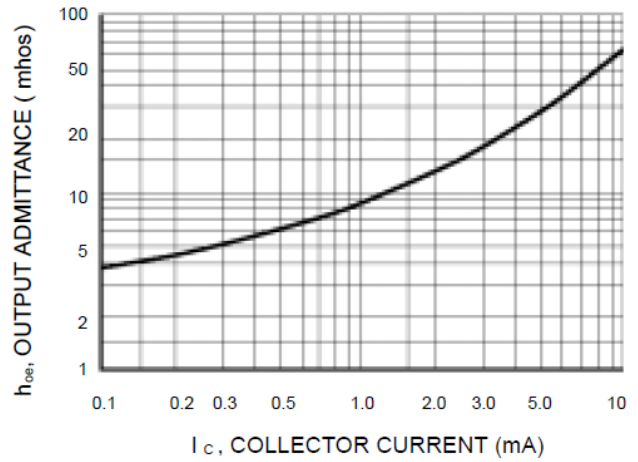


Figure 13. Input Impedance

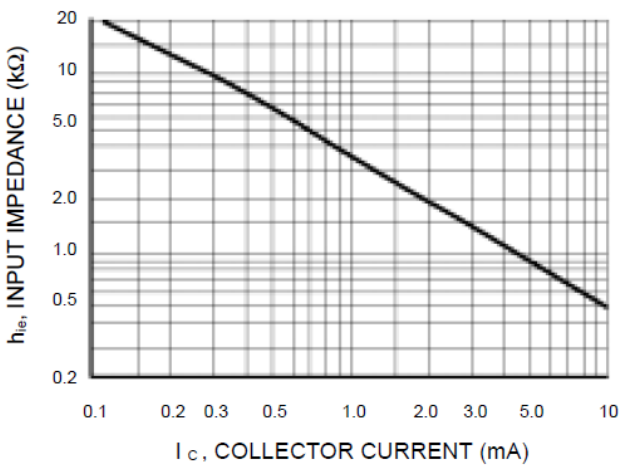
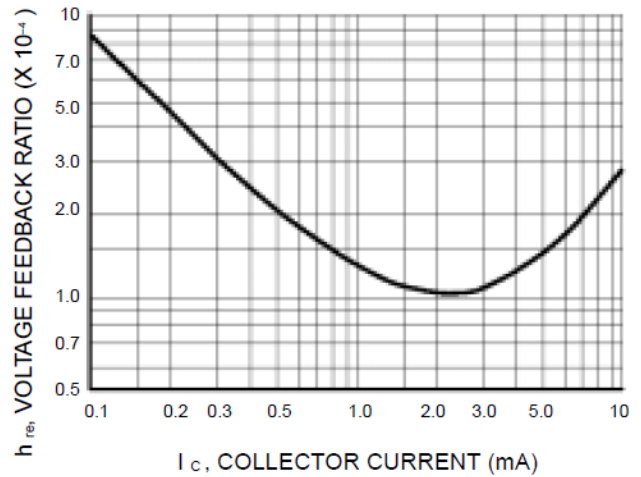


Figure 14. Voltage Feedback Ratio





### TYPICAL STATIC CHARACTERISTICS

Figure 15. DC Current Gain

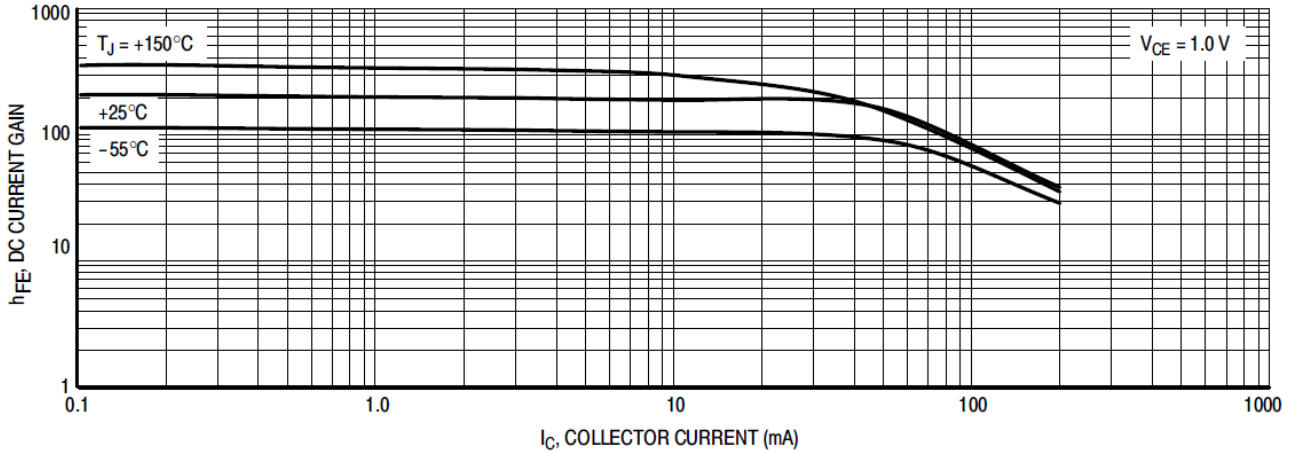


Figure 16. Collector Saturation Region

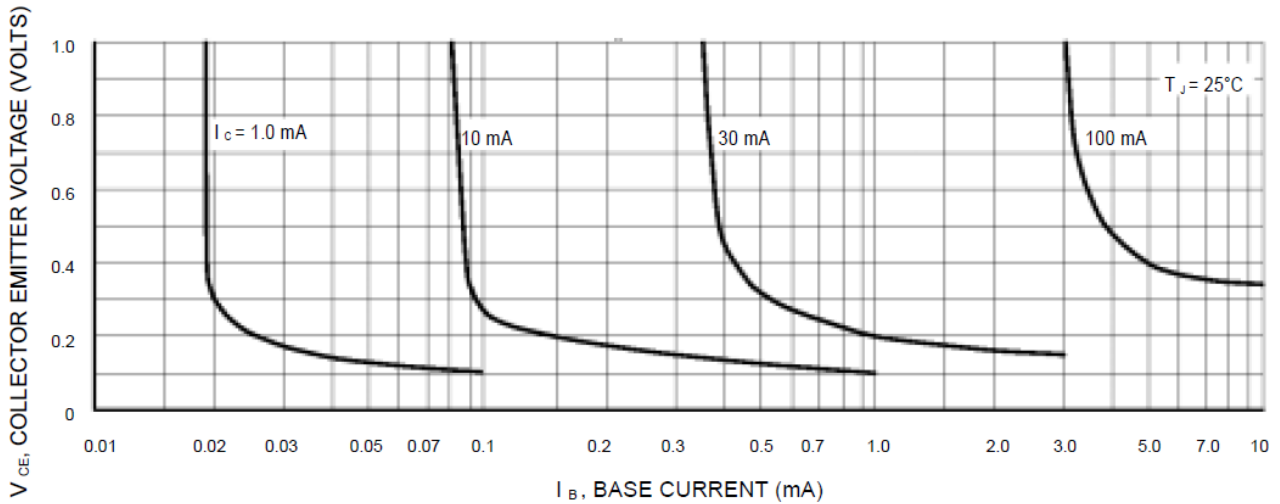


Figure 17. "ON" Voltages

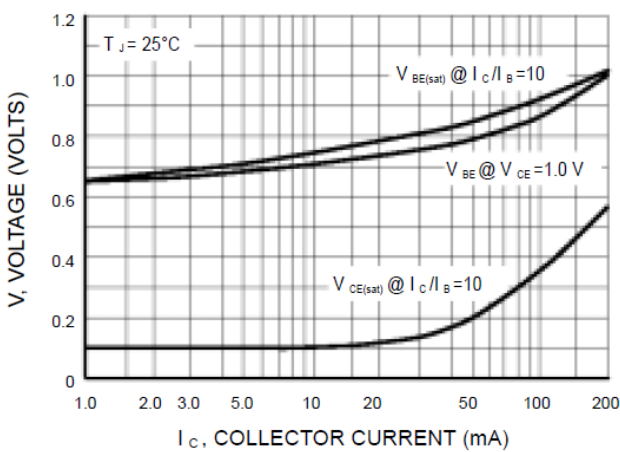
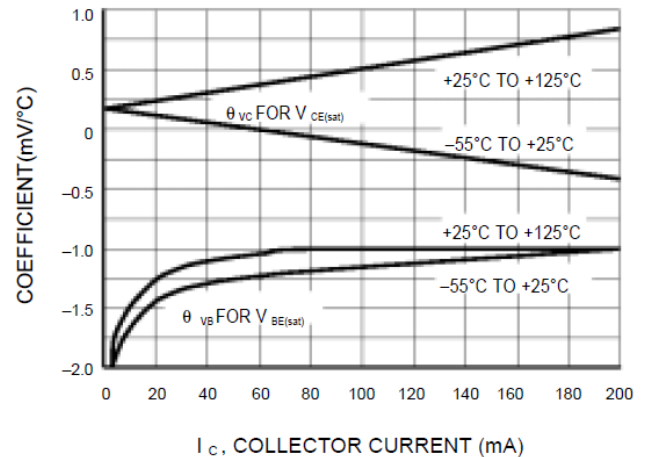


Figure 18. Temperature Coefficients

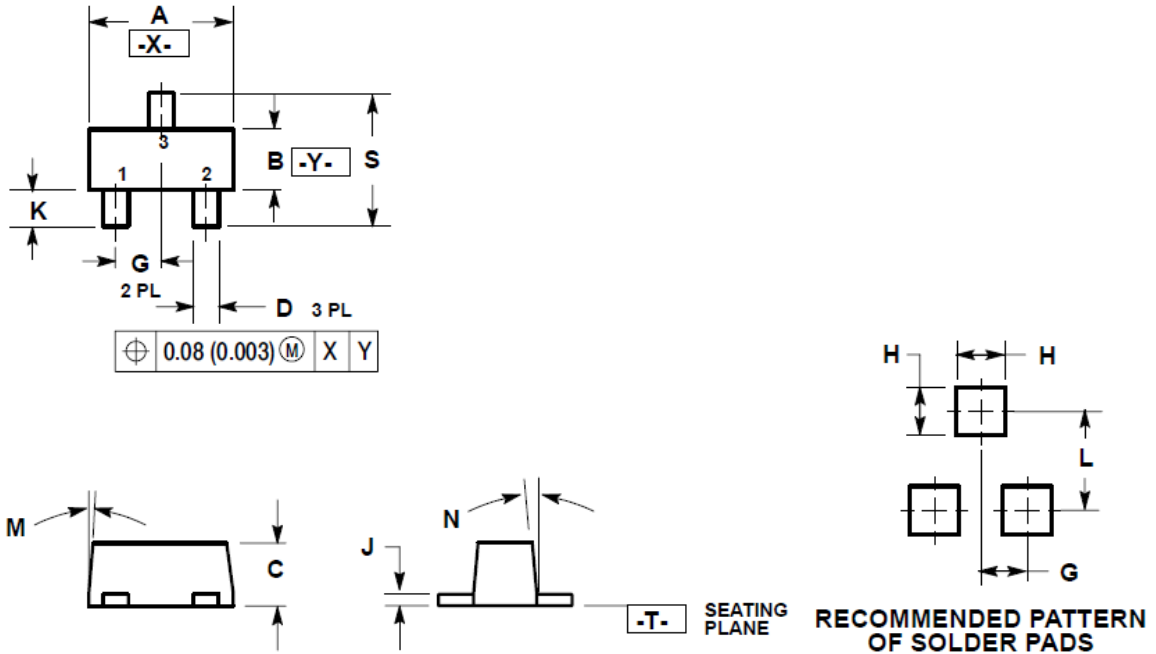






**PACKAGE INFORMATION**

Dimension in SC-89 Package (Unit: mm)



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.50	1.70	0.059	0.067
B	0.75	0.95	0.030	0.040
C	0.60	0.80	0.024	0.031
D	0.23	0.33	0.009	0.013
G	0.50 BSC		0.020 BSC	
H	0.53 REF		0.021 REF	
J	0.10	0.20	0.004	0.008
K	0.30	0.50	0.012	0.020
L	1.10 REF		0.043 REF	
M	-	10°	-	10°
N	-	10°	-	10°
S	1.50	1.70	0.059	0.067



## IMPORTANT NOTICE

AiT Semiconductor Inc. (AiT) reserves the right to make changes to any its product, specifications, to discontinue any integrated circuit product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

AiT Semiconductor Inc.'s integrated circuit products are not designed, intended, authorized, or warranted to be suitable for use in life support applications, devices or systems or other critical applications. Use of AiT products in such applications is understood to be fully at the risk of the customer. As used herein may involve potential risks of death, personal injury, or severe property, or environmental damage. In order to minimize risks associated with the customer's applications, the customer should provide adequate design and operating safeguards.

AiT Semiconductor Inc. assumes to no liability to customer product design or application support. AiT warrants the performance of its products of the specifications applicable at the time of sale.