



## DESCRIPTION

The MMBT3906L is available in SOT-23 package.

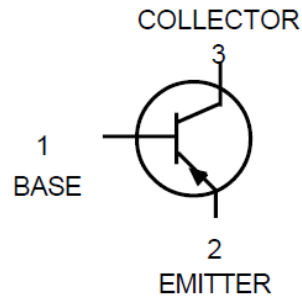
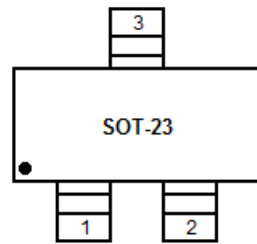
## ORDERING INFORMATION

| Package Type                             | Part Number        |
|--|--------------------|
| SOT-23                                   | MMBT3906L          |
| Note                                     | SPQ: 3,000pcs/Reel |
| AiT provides all RoHS Compliant Products |                    |

## FEATURES

- Available in SOT-23 package

## PIN DESCRIPTION





## ABSOLUTE MAXIMUM RATINGS

|                                       |          |
|---------------------------------------|----------|
| $V_{CEO}$ , Collector-Emitter Voltage | -40Vdc   |
| $V_{CBO}$ , Collector-Base Voltage    | -40Vdc   |
| $V_{EBO}$ , Emitter-Base Voltage      | -5.0Vdc  |
| $I_C$ , 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-5 Board <sup>NOTE1</sup><br>$T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$        | $P_D$           | 225<br>1.8  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction to Ambient  | $R_{\theta JA}$ | 556         | $^\circ\text{C}/\text{W}$  |
| Total Device Dissipation Alumina Substrate <sup>NOTE2</sup><br>$T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$           | 300<br>2.4  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance Junction to Ambient   | $R_{\theta JA}$ | 417         | $^\circ\text{C}/\text{W}$  |
| 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, I <sub>B</sub> = 0         | -40   | -     | Vdc  |
| Collector-Base Breakdown Voltage                     | V <sub>(BR)CBO</sub> | I <sub>C</sub> = -10μA, I <sub>E</sub> = 0          | -40   | -     | Vdc  |
| Emitter-Base Breakdown Voltage                       | V <sub>(BR)EBO</sub> | I <sub>E</sub> = -10μA, I <sub>C</sub> = 0          | -5.0  | -     | Vdc  |
| Base Cutoff Current                                  | I <sub>BL</sub>      | V <sub>CE</sub> = -30Vdc, V <sub>EB</sub> = -3.0Vdc | -     | -50   | nAdc |
| Collector Cutoff Current                             | I <sub>CEX</sub>     | V <sub>CE</sub> = -30Vdc, V <sub>EB</sub> = -3.0Vdc | -     | -50   | nAdc |
| <b>ON CHARACTERISTICS<sup>NOTE3</sup></b>            |                      |   |       |       |      |
| DC Current Gain <sup>NOTE1</sup>                     | h <sub>FE</sub>      | I <sub>C</sub> = -0.1mA, V <sub>CE</sub> = -1.0Vdc  | 60    | -     | -    |
|  |                      | I <sub>C</sub> = -1.0mA, V <sub>CE</sub> = -1.0Vdc  | 80    | -     |      |
|  |                      | I <sub>C</sub> = -10mA, V <sub>CE</sub> = -1.0Vdc   | 100   | 300   |      |
|  |                      | I <sub>C</sub> = -50mA, V <sub>CE</sub> = -1.0Vdc   | 60    | -     |      |
|  |                      | I <sub>C</sub> = -100mA, V <sub>CE</sub> = -1.0Vdc  | 30    | -     |      |
| Collector-Emitter Saturation Voltage                 | V <sub>CE(sat)</sub> | I <sub>C</sub> = -10mA, I <sub>B</sub> = -1.0mA     | -     | -0.25 | Vdc  |
|  |                      | I <sub>C</sub> = -50mA, I <sub>B</sub> = -5.0mA     | -     | -0.4  |      |
| Base-Emitter Saturation Voltage <sup>NOTE3</sup>     | V <sub>BE(sat)</sub> | I <sub>C</sub> = -10mA, I <sub>B</sub> = -1.0mA     | -0.65 | -0.85 | Vdc  |
|  |                      | I <sub>C</sub> = -50mA, I <sub>B</sub> = -5.0mA     | -     | -0.95 |      |



| Parameter                           | Symbol    | Conditions  | Min | Max | Unit             |
|-------------------------------------|-----------|---|-----|-----|------------------|
| <b>SMALL-SIGNAL CHARACTERISTICS</b> |           |   |     |     |                  |
| Current-Gain-Bandwidth Product      | $f_T$     | $I_C = -10\text{mA dc}$ ,<br>$V_{CE} = -20\text{V dc}$ , $f = 100\text{MHz}$                                    | 250 | -   | MHz              |
| Output Capacitance                  | $C_{obo}$ | $V_{CB} = -5.0\text{V dc}$ ,<br>$I_E = 0$ , $f = 1.0\text{MHz}$   | -   | 4.5 | pF               |
| Input Capacitance                   | $C_{ibo}$ | $V_{EB} = -0.5\text{V dc}$ ,<br>$I_C = 0$ , $f = 1.0\text{MHz}$   | -   | 10  | pF               |
| Input Impedance                     | $h_{ie}$  | $V_{CE} = -10\text{V dc}$ ,<br>$I_C = -1.0\text{mA dc}$ , $f = 1.0\text{kHz}$                                   | 2.0 | 12  | k $\Omega$       |
| Voltage Feedback Ratio              | $h_{re}$  | $V_{CE} = -10\text{V dc}$ ,<br>$I_C = -1.0\text{mA dc}$ , $f = 1.0\text{kHz}$                                   | 0.1 | 10  | $\times 10^{-4}$ |
| Small-Signal Current Gain           | $h_{fe}$  | $V_{CE} = -10\text{V dc}$ ,<br>$I_C = -1.0\text{mA dc}$ , $f = 1.0\text{kHz}$                                   | 100 | 400 | -                |
| Output Admittance                   | $h_{oe}$  | $V_{CE} = -10\text{V dc}$ ,<br>$I_C = -1.0\text{mA dc}$ , $f = 1.0\text{kHz}$                                   | 3.0 | 60  | $\mu\text{mhos}$ |
| Noise Figure                        | NF        | $V_{CE} = -5.0\text{V dc}$ ,<br>$I_C = -100\mu\text{A dc}$ , $R_s = 1.0\text{k}\Omega$ ,<br>$f = 1.0\text{kHz}$ | -   | 4.0 | dB               |
| <b>SWITCHING CHARACTERISTICS</b>    |           |   |     |     |                  |
| Delay Time                          | $t_d$     | $V_{CC} = -3.0\text{V dc}$ ,<br>$V_{BE} = 0.5\text{V dc}$   | -   | 35  | ns               |
| Rise Time                           | $t_r$     | $I_C = -10\text{mA dc}$ ,<br>$I_{B1} = -1.0\text{mA dc}$  | -   | 35  |                  |
| Storage Time                        | $t_s$     | $V_{CC} = -3.0\text{V dc}$ ,<br>$I_C = -10\text{mA dc}$   | -   | 225 | ns               |
| Fall Time                           | $t_f$     | $I_{B1} = I_{B2} = -1.0\text{mA dc}$  | -   | 75  |                  |

NOTE1: FR-5 = 1.0 x 0.75 x 0.062 in.

NOTE2: Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

NOTE3: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$



**TYPICAL CHARACTERISTICS**

Figure 1. Delay and Rise Time Equivalent Test Circuit

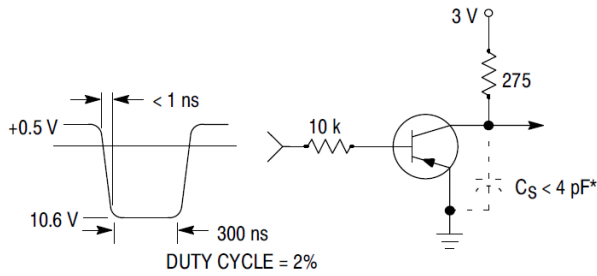
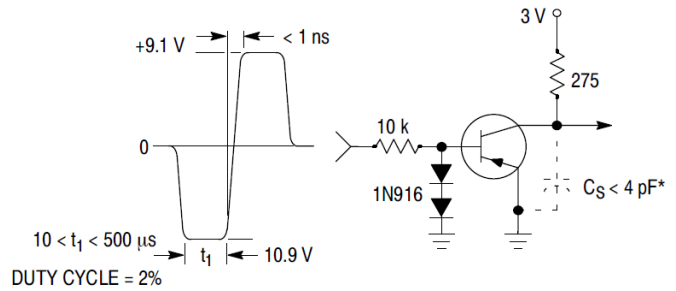


Figure 2. Storage and Fall Time Equivalent Test Circuit



\* Total shunt capacitance of test jig and connectors

**TYPICAL TRANSIENT CHARACTERISTICS**

Figure 3. Capacitance

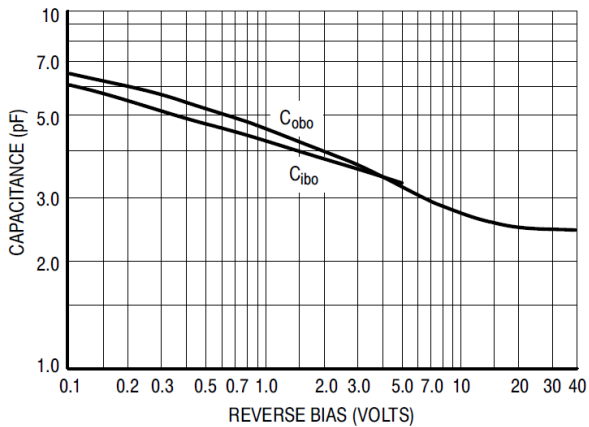


Figure 4. Charge Data

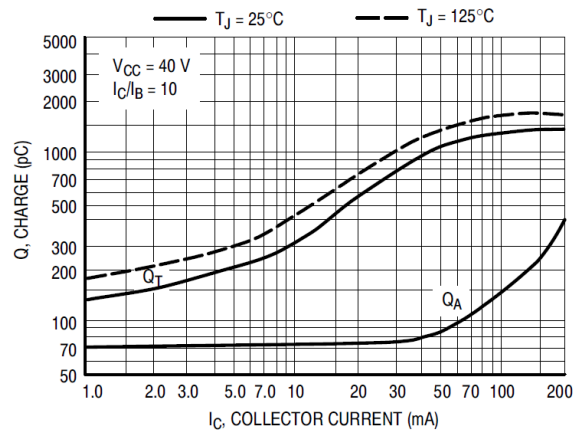


Figure 5. Turn-On Time

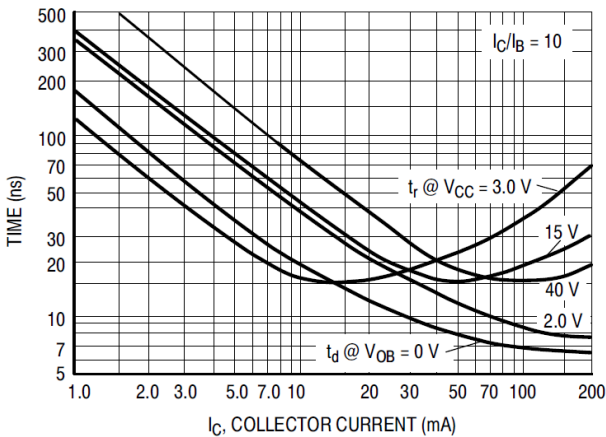
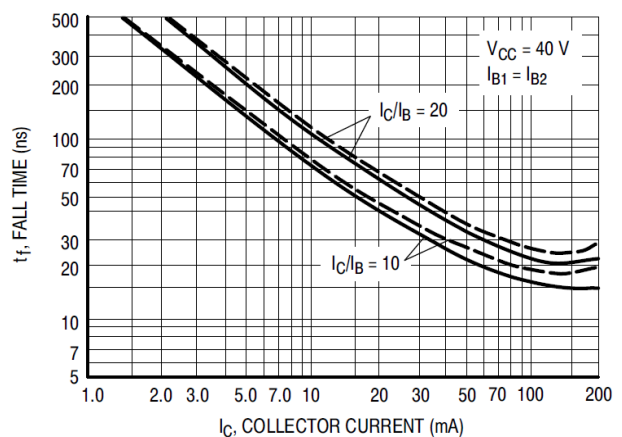


Figure 6. Fall Time





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

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

Figure 7. Noise Figure

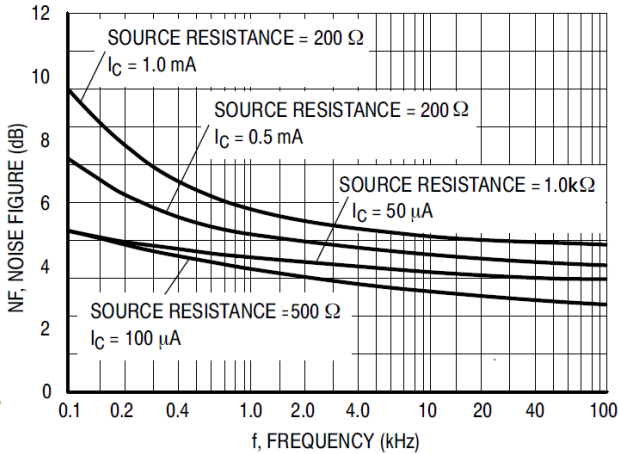
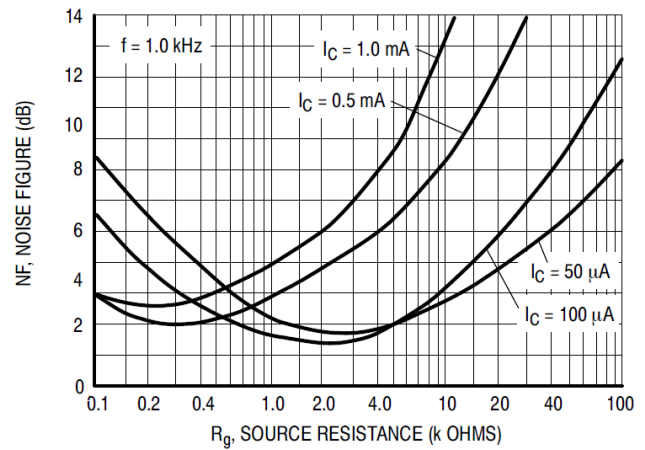


Figure 8. Noise Figure



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

Figure 9. Current Gain

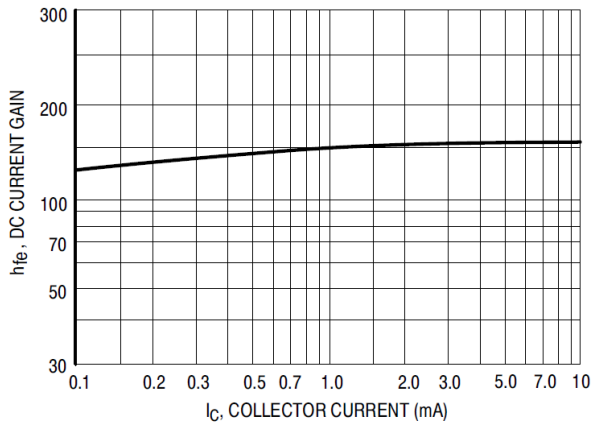


Figure 10. Output Admittance

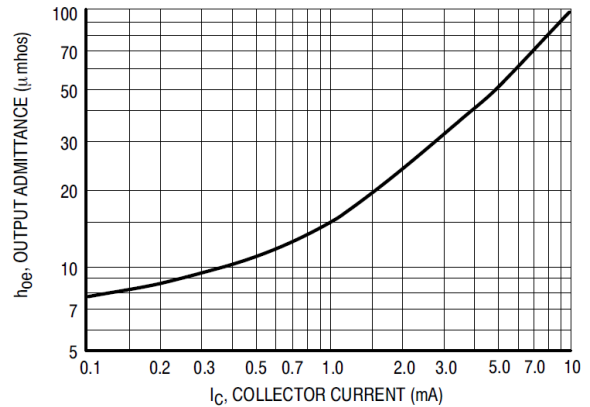


Figure 11. Input Impedance

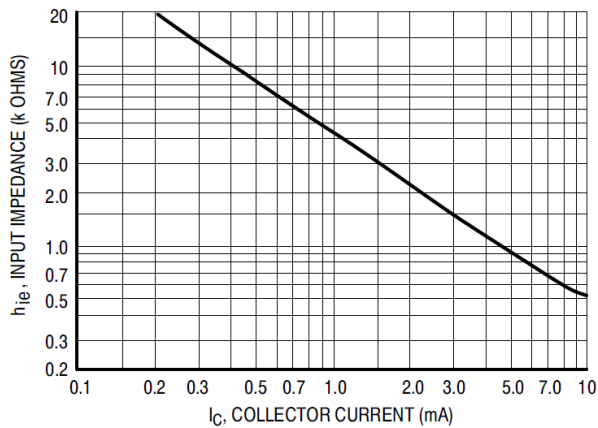
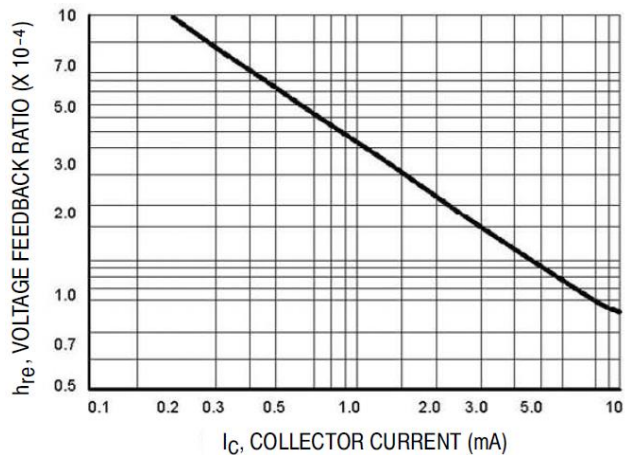


Figure 12. Voltage Feedback Ratio





### TYPICAL STATIC CHARACTERISTICS

Figure 13. DC Current Gain

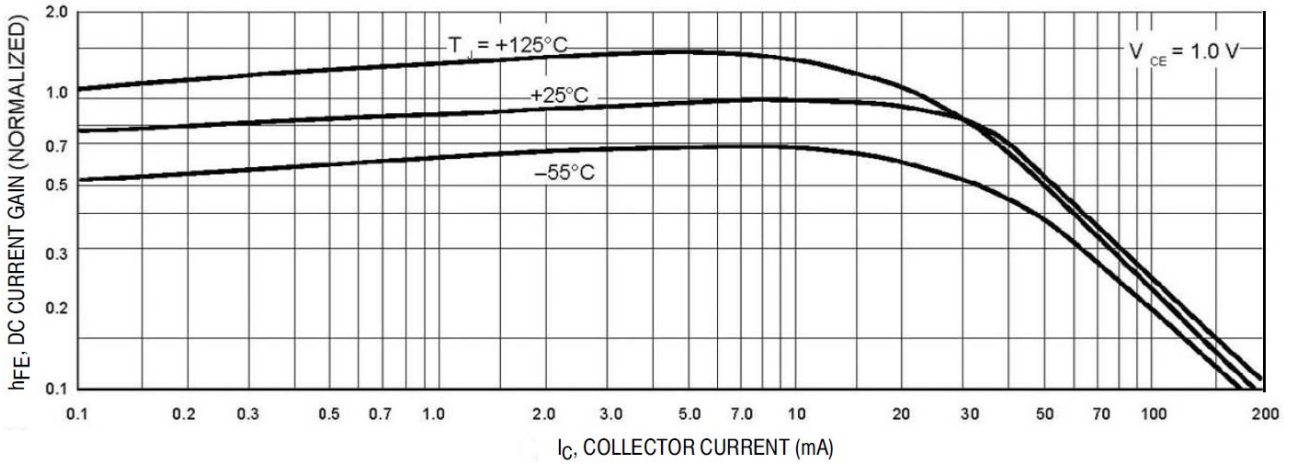


Figure 14. Collector Saturation Region

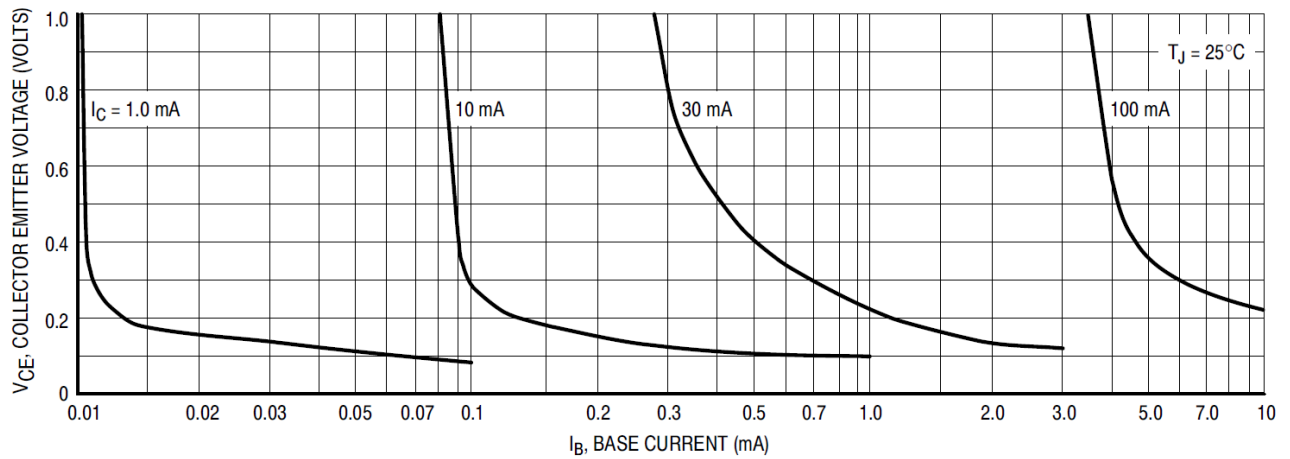


Figure 15. "ON" Voltages

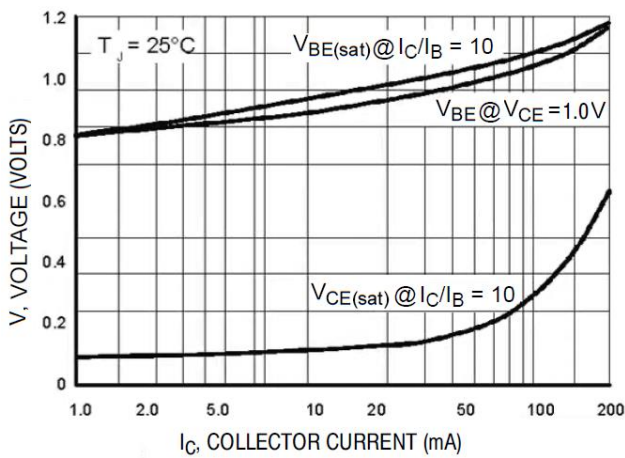
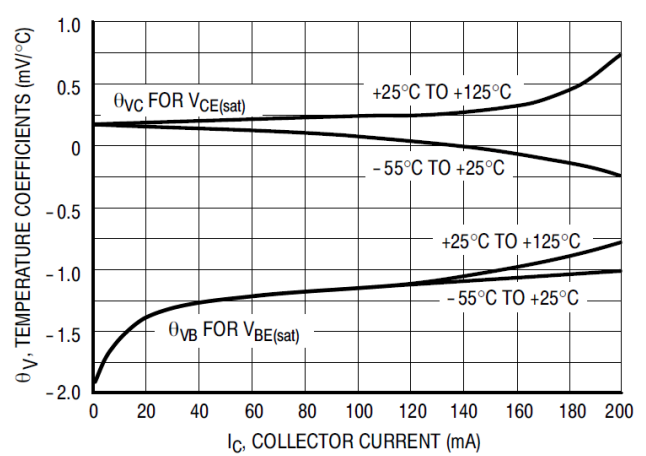


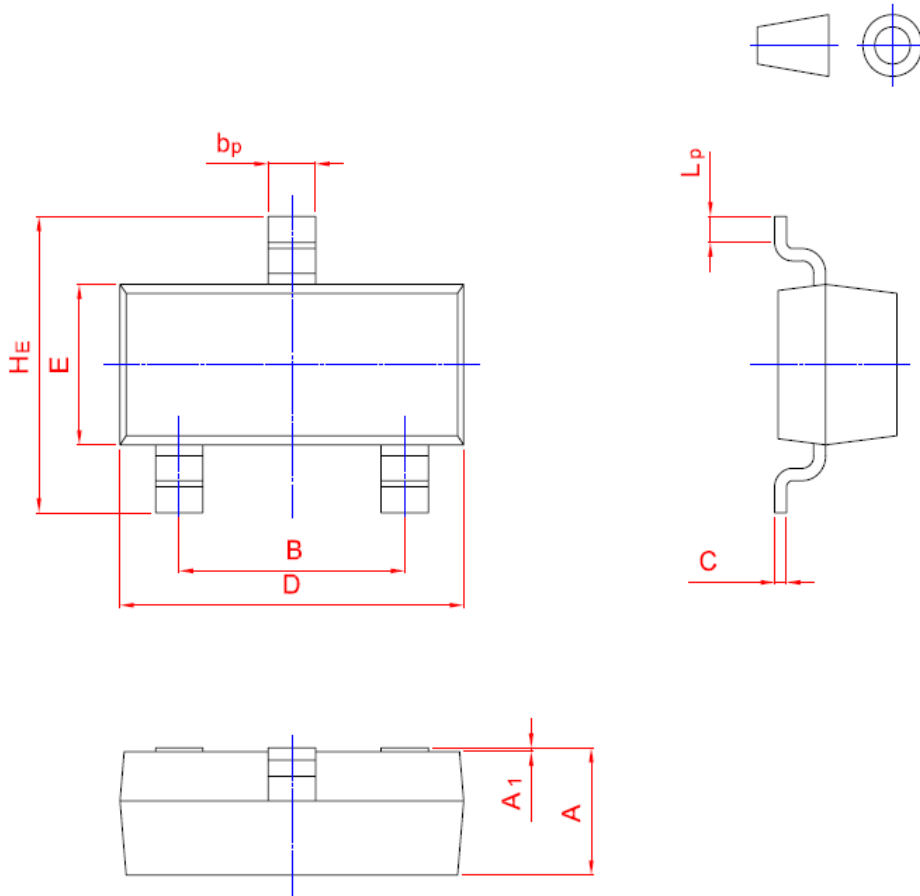
Figure 16. Temperature Coefficients





## PACKAGE INFORMATION

Dimension in SOT-23 Package (Unit: mm)



| Unit | A    | B    | $b_p$ | C    | D    | E    | HE   | A1    | $L_p$ |
|------|------|------|-------|------|------|------|------|-------|-------|
| mm   | 1.40 | 2.04 | 0.50  | 0.19 | 3.10 | 1.65 | 3.00 | 0.100 | 0.50  |
|      | 0.95 | 1.78 | 0.35  | 0.08 | 2.70 | 1.20 | 2.20 | 0.013 | 0.20  |





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