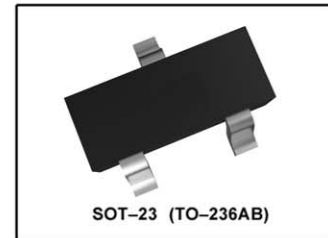
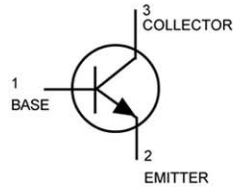


### NPN Silicon



#### ● MAXIMUM RATINGS

| Rating                         | Symbol    | 2222 | 2222A | Unit |
|--------------------------------|-----------|------|-------|------|
| Collector–Emitter Voltage      | $V_{CEO}$ | 30   | 40    | Vdc  |
| Collector–Base Voltage         | $V_{CBO}$ | 60   | 75    | Vdc  |
| Emitter–Base Voltage           | $V_{EBO}$ | 5.0  | 6.0   | Vdc  |
| Collector Current — Continuous | $I_C$     | 600  | 600   | mAdc |

#### ● THERMAL CHARACTERISTICS

| Characteristic  | Symbol          | Max         | Unit                      |
|---|-----------------|-------------|---------------------------|
| Total Device Dissipation FR– 5 Board, (1)<br>$T_A = 25^\circ\text{C}$       | $P_D$           | 225         | mW                        |
| Derate above $25^\circ\text{C}$   |                 | 1.8         | mW/ $^\circ\text{C}$      |
| Thermal Resistance, Junction to Ambient                                     | $R_{\theta JA}$ | 556         | $^\circ\text{C}/\text{W}$ |
| Total Device Dissipation<br>Alumina Substrate, (2) $T_A = 25^\circ\text{C}$ | $P_D$           | 300         | mW                        |
| Derate above $25^\circ\text{C}$   |                 | 2.4         | 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 | $^\circ\text{C}$          |

#### ● DEVICE MARKING

MMBT2222LT1 = M1B; MMBT2222ALT1 = 1P;

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

| Characteristic | Symbol | Min | Max | Unit |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

#### OFF CHARACTERISTICS

|   |                       |               |            |        |                 |
|---|-----------------------|---------------|------------|--------|-----------------|
| Collector–Emitter Breakdown Voltage<br>( $I_C = 10\text{ mAdc}, I_E = 0$ )            | MMBT2222<br>MMBT2222A | $V_{(BR)CEO}$ | 30<br>40   | —<br>— | Vdc             |
| Collector–Base Breakdown Voltage<br>( $I_C = 10\text{ }\mu\text{Adc}, I_E = 0$ )      | MMBT2222<br>MMBT2222A | $V_{(BR)CBO}$ | 60<br>75   | —<br>— | Vdc             |
| Emitter–Base Breakdown Voltage<br>( $I_E = 10\text{ }\mu\text{Adc}, I_C = 0$ )        | MMBT2222<br>MMBT2222A | $V_{(BR)EBO}$ | 5.0<br>6.0 | —<br>— | Vdc             |
| Collector Cutoff Current<br>( $V_{CE} = 60\text{ Vdc}, I_{E(off)} = 3.0\text{ Vdc}$ ) | MMBT2222A             | $I_{CEX}$     | —          | 10     | nAdc            |
| Collector Cutoff Current<br>( $V_{CB} = 50\text{ Vdc}, I_E = 0$ )                     | MMBT2222              | $I_{CBO}$     | —          | 0.01   | $\mu\text{Adc}$ |
| ( $V_{CB} = 60\text{ Vdc}, I_E = 0$ )   | MMBT2222A             |               | —          | 0.01   |                 |
| ( $V_{CB} = 50\text{ Vdc}, I_E = 0, T_A = 125^\circ\text{C}$ )                        | MMBT2222              |               | —          | 10     |                 |
| ( $V_{CB} = 60\text{ Vdc}, I_E = 0, T_A = 125^\circ\text{C}$ )                        | MMBT2222A             |               | —          | 10     |                 |
| Emitter Cutoff Current<br>( $V_{EB} = 3.0\text{ Vdc}, I_C = 0$ )                      | MMBT2222A             | $I_{EBO}$     | —          | 100    | nAdc            |
| Base Cutoff Current<br>( $V_{CE} = 60\text{ Vdc}, V_{E(off)} = 3.0\text{ Vdc}$ )      | MMBT2222A             | $I_{BL}$      | —          | 20     | nAdc            |

1. FR–5 =  $1.0 \times 0.75 \times 0.062\text{ in.}$

2. Alumina =  $0.4 \times 0.3 \times 0.024\text{ in.}$  99.5% alumina.

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● **ELECTRICAL CHARACTERISTICS** (T<sub>A</sub> = 25°C unless otherwise noted) (Continued)

| Characteristic   | Symbol               | Min            | Max | Unit            |   |
|--|----------------------|----------------|-----|-----------------|---|
| <b>DC CHARACTERISTICS</b>  |                      |                |     |                 |   |
| DC Current Gain<br>(I <sub>C</sub> = 0.1 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )                         | h <sub>FE</sub>      | 35             | —   | —               |   |
| (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )  |                      | 50             | —   | —               |   |
| (I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> )   |                      | 75             | —   | —               |   |
| (I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , T <sub>A</sub> = -55°C)                     |                      | MMBT2222A only | 35  | —               | — |
| (I <sub>C</sub> = 150 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> ) (3)  |                      | 100            | 300 | —               |   |
| (I <sub>C</sub> = 150 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> ) (3)                                       |                      | 50             | —   | —               |   |
| (I <sub>C</sub> = 500 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> ) (3)  | MMBT2222             | 30             | —   | —               |   |
|  | MMBT2222A            | 40             | —   | —               |   |
| Collector–Emitter Saturation Voltage(3)<br>(I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B</sub> = 15 mA <sub>dc</sub> ) | V <sub>CE(sat)</sub> | —              | 0.4 | V <sub>dc</sub> |   |
|  |                      | MMBT2222       | —   | 0.3             |   |
| (I <sub>C</sub> = 500mA <sub>dc</sub> , I <sub>B</sub> = 50 mA <sub>dc</sub> )   |                      | MMBT2222       | —   | 1.6             |   |
|  |                      | MMBT2222A      | —   | 1.0             |   |
| Base–Emitter Saturation Voltage<br>(I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B</sub> = 15 mA <sub>dc</sub> )         | V <sub>BE(sat)</sub> | —              | 1.3 | V <sub>dc</sub> |   |
|  |                      | MMBT2222       | 0.6 | 1.2             |   |
| (I <sub>C</sub> = 500 mA <sub>dc</sub> , I <sub>B</sub> = 50 mA <sub>dc</sub> )  |                      | MMBT2222       | —   | 2.6             |   |
|  |                      | MMBT2222A      | —   | 2.0             |   |

**SMALL-SIGNAL CHARACTERISTICS**

|  |           |                                 |      |      |                    |
|--|-----------|---------------------------------|------|------|--------------------|
| Current–Gain — Bandwidth Product(4)<br>(I <sub>C</sub> = 20mA <sub>dc</sub> , V <sub>CE</sub> = 20V <sub>dc</sub> , f = 100MHz)  | MMBT2222  | f <sub>T</sub>                  | 250  | —    | MHz                |
|  | MMBT2222A |                                 | 300  | —    |                    |
| Output Capacitance(V <sub>CB</sub> = 10 V <sub>dc</sub> , I <sub>E</sub> = 0, f = 1.0 MHz)                                       |           | C <sub>obo</sub>                | —    | 8.0  | pF                 |
| Input Capacitance<br>(V <sub>EB</sub> = 0.5 V <sub>dc</sub> , I <sub>C</sub> = 0, f = 1.0 MHz)                                   | MMBT2222  | C <sub>ibo</sub>                | —    | 30   | pF                 |
|  | MMBT2222A |                                 | —    | 25   |                    |
| Input Impedance(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)                      | MMBT2222A | h <sub>ie</sub>                 | 2.0  | 8.0  | kΩ                 |
| (V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 10 mA <sub>dc</sub> , f = 1.0 kHz)                                      | MMBT2222A |                                 | 0.25 | 1.25 |                    |
| Voltage Feedback Ratio(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)               | MMBT2222A | h <sub>re</sub>                 | —    | 8.0  | X 10 <sup>-4</sup> |
| (V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 10 mA <sub>dc</sub> , f = 1.0 kHz)                                      | MMBT2222A |                                 | —    | 4.0  |                    |
| Small–Signal Current Gain(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)            | MMBT2222A | h <sub>fe</sub>                 | 50   | 300  | —                  |
| (V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 10 mA <sub>dc</sub> , f = 1.0 kHz)                                      | MMBT2222A |                                 | 75   | 375  |                    |
| Output Admittance(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 1.0 mA <sub>dc</sub> , f = 1.0 kHz)                    | MMBT2222A | h <sub>oe</sub>                 | 5.0  | 35   | μmhos              |
| (V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 10 mA <sub>dc</sub> , f = 1.0 kHz)                                      | MMBT2222A |                                 | 25   | 200  |                    |
| Current Base Time Constant<br>(V <sub>CB</sub> = 20 V <sub>dc</sub> , I <sub>E</sub> = 20 mA <sub>dc</sub> , f = 31.8 MHz)       | MMBT2222A | r <sub>b</sub> , C <sub>c</sub> | —    | 150  | ps                 |
| Noise Figure(V <sub>CE</sub> = 10 V <sub>dc</sub> , I <sub>C</sub> = 10 mA <sub>dc</sub> , R <sub>S</sub> = 1.0 kΩ, f = 1.0 kHz) | MMBT2222A | NF                              | —    | 4.0  | dB                 |

● **SWITCHING CHARACTERISTICS**

|              |  |                |   |     |    |
|--------------|--|----------------|---|-----|----|
| Delay Time   | (V <sub>CC</sub> = 30 V <sub>dc</sub> , V <sub>EB(off)</sub> = -0.5 V <sub>dc</sub><br>I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B1</sub> = 15 mA <sub>dc</sub> ) | t <sub>d</sub> | — | 10  | ns |
| Rise Time    |  | t <sub>r</sub> | — | 25  |    |
| Storage Time | (V <sub>CC</sub> = 30 V <sub>dc</sub> , I <sub>C</sub> = 150 mA <sub>dc</sub><br>I <sub>B1</sub> = I <sub>B2</sub> = 15 mA <sub>dc</sub> )                             | t <sub>s</sub> | — | 225 | ns |
| Fall Time    |  | t <sub>f</sub> | — | 60  |    |

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

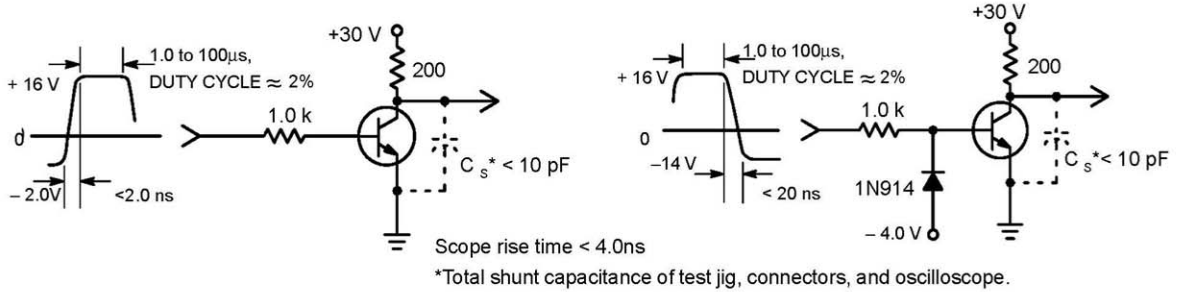
4. f<sub>T</sub> is defined as the frequency at which |h<sub>ie</sub>| extrapolates to unity.

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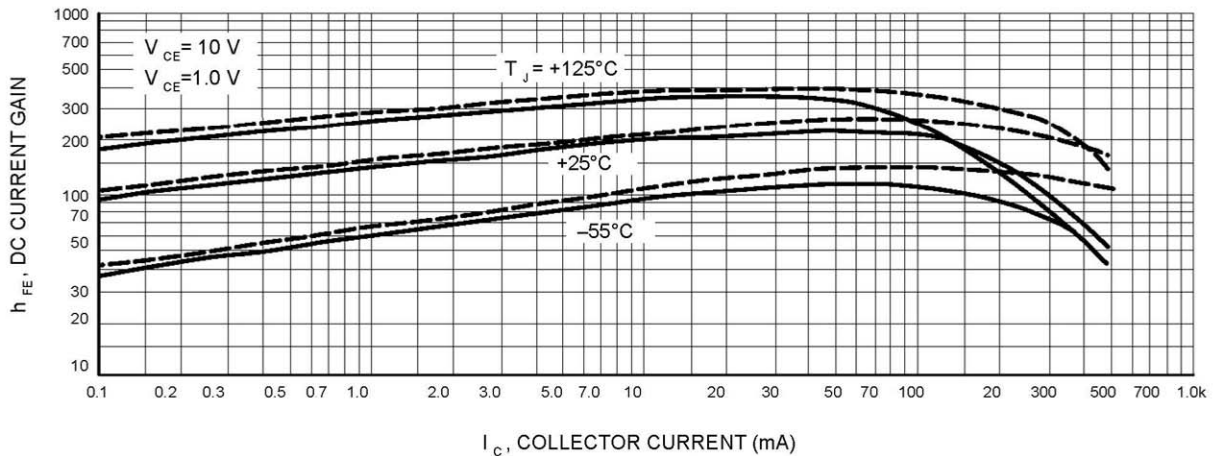


**SWITCHING TIME EQUIVALENT TEST CIRCUITS**

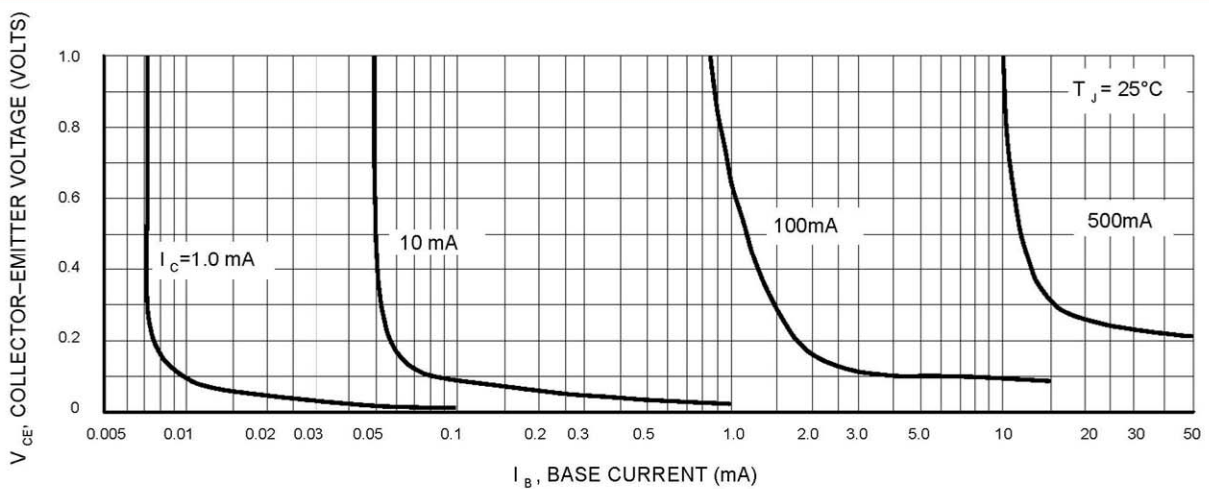


**Figure 1. Turn-On Time**

**Figure 2. Turn-Off Time**



**Figure 3. DC Current Gain**



**Figure 4. Collector Saturation Region**

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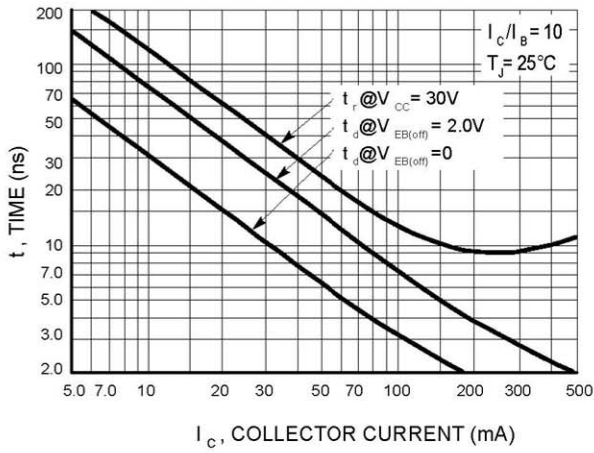


Figure 5. Turn-On Time

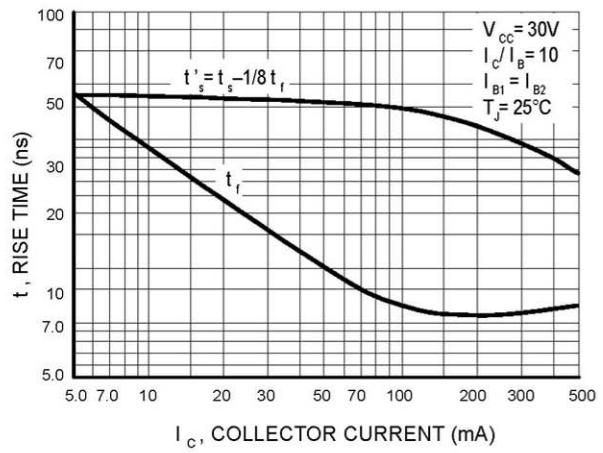


Figure 6. Turn - Off Time

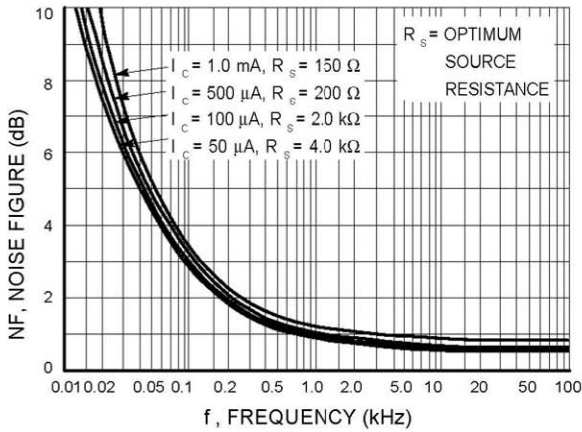


Figure 7. Frequency Effects

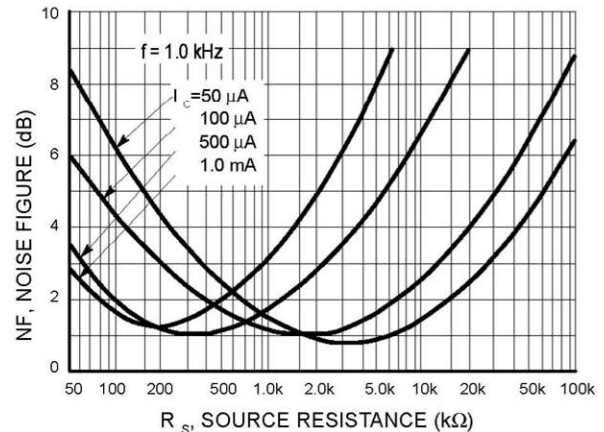


Figure 8. Source Resistance Effects

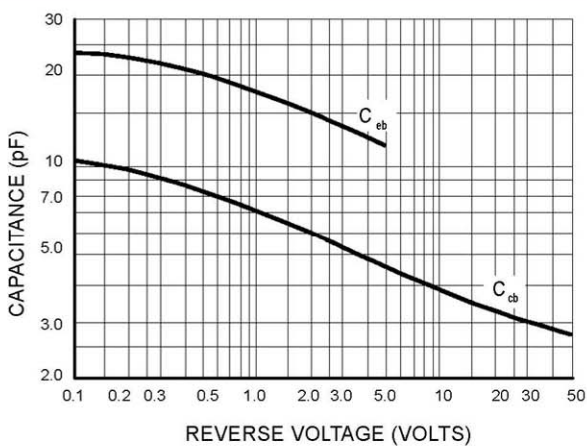


Figure 9. Capacitance

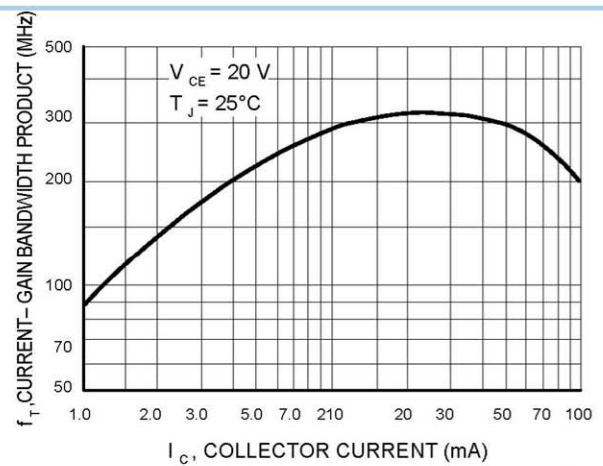


Figure 10. Current-Gain Bandwidth Product



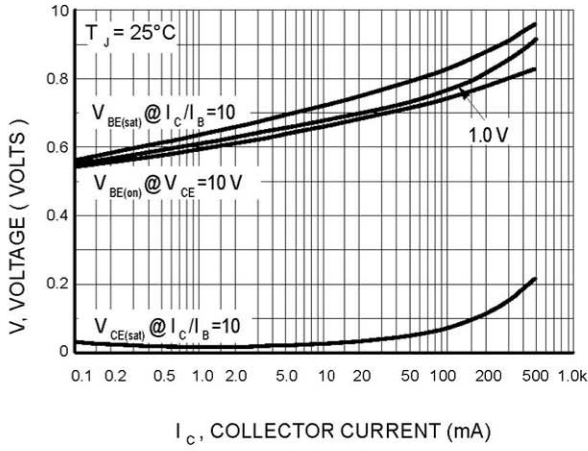


Figure 11. "On" Voltages

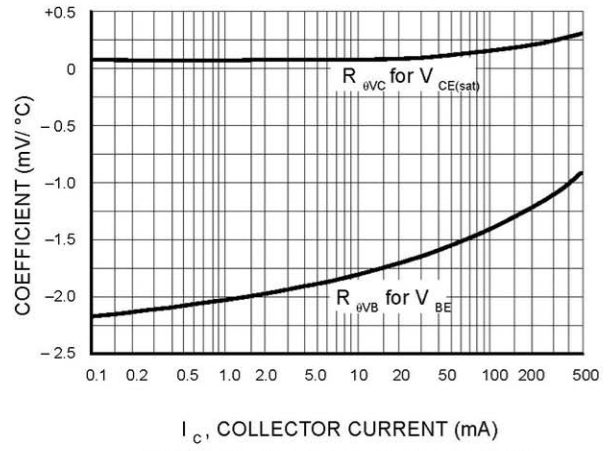


Figure 12. Temperature Coefficients

