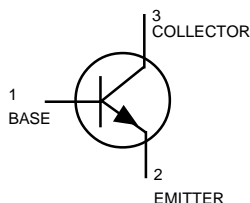
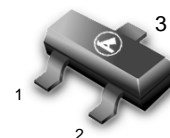


General Purpose Transistors

NPN Silicon


MMBT4401LT1

 CASE 318-08, STYLE 6
SOT-23 (TO-236AB)

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--------------------------------|-----------|-------|------|
| Collector–Emitter Voltage | V_{CE0} | 40 | Vdc |
| Collector–Base Voltage | V_{CBO} | 60 | Vdc |
| Emitter–Base Voltage | V_{EBO} | 6.0 | Vdc |
| Collector Current — Continuous | I_C | 600 | mAdc |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|-----------------|-------------|---------------------------|
| Total Device Dissipation FR–5 Board, (1) $T_A = 25^\circ\text{C}$ | P_D | 225 | mW |
| Derate above 25°C | | 1.8 | mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 556 | $^\circ\text{C}/\text{W}$ |
| Total Device Dissipation Alumina Substrate, (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 | $R_{\theta JA}$ | 417 | $^\circ\text{C}/\text{W}$ |
| Junction and Storage Temperature | T_J, T_{stg} | –55 to +150 | $^\circ\text{C}$ |

DEVICE MARKING

MMBT4401LT1 = 2X

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

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

OFF CHARACTERISTICS

| | | | | |
|---|---------------|-----|-----|-----------------|
| Collector–Emitter Breakdown Voltage (3) ($I_C = 1.0 \text{ mAdc}, I_B = 0$) | $V_{(BR)CEO}$ | 40 | — | Vdc |
| Collector–Base Breakdown Voltage ($I_C = 0.1 \text{ mAdc}, I_E = 0$) | $V_{(BR)CBO}$ | 60 | — | Vdc |
| Emitter–Base Breakdown Voltage ($I_E = 0.1 \text{ mAdc}, I_C = 0$) | $V_{(BR)EBO}$ | 6.0 | — | Vdc |
| Base Cutoff Current ($V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$) | I_{BEV} | — | 0.1 | μAdc |
| Collector Cutoff Current ($V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$) | I_{CEX} | — | 0.1 | μAdc |

- FR–5 = 1.0 x 0.75 x 0.062 in.
- Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.
- Pulse Test: Pulse Width $\leq 300 \mu\text{s}$; Duty Cycle $\leq 2.0\%$.

MMBT4401LT1

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

| Characteristic | Symbol | Min | Max | Unit |
|--|---------------|------|------|------|
| ON CHARACTERISTICS (3) | | | | |
| DC Current Gain ($I_C = 0.1 \text{ mA}$, $V_{CE} = 1.0 \text{ Vdc}$) | h_{FE} | 20 | — | — |
| ($I_C = 1.0 \text{ mA}$, $V_{CE} = 1.0 \text{ Vdc}$) | | 40 | — | |
| ($I_C = 10 \text{ mA}$, $V_{CE} = 1.0 \text{ Vdc}$) | | 80 | — | |
| ($I_C = 150 \text{ mA}$, $V_{CE} = 1.0 \text{ Vdc}$) | | 100 | 300 | |
| ($I_C = 500 \text{ mA}$, $V_{CE} = 2.0 \text{ Vdc}$) | | 40 | — | |
| Collector–Emitter Saturation Voltage ($I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$) | $V_{CE(sat)}$ | — | 0.4 | Vdc |
| ($I_C = 500 \text{ mA}$, $I_B = 50 \text{ mA}$) | | — | 0.75 | |
| Base–Emitter Saturation Voltage ($I_C = 150 \text{ mA}$, $I_B = 15 \text{ mA}$) | $V_{BE(sat)}$ | 0.75 | 0.95 | Vdc |
| ($I_C = 500 \text{ mA}$, $I_B = 50 \text{ mA}$) | | — | 1.2 | |

SMALL–SIGNAL CHARACTERISTICS

| | | | | |
|---|----------|-----|-----|------------------|
| Current–Gain — Bandwidth Product ($I_C = 20 \text{ mA}$, $V_{CE} = 10 \text{ Vdc}$, $f = 100 \text{ MHz}$) | f_T | 250 | — | MHz |
| Collector–Base Capacitance ($V_{CB} = 5.0 \text{ Vdc}$, $I_E = 0$, $f = 1.0 \text{ MHz}$) | C_{cb} | — | 6.5 | pF |
| Emitter–Base Capacitance ($V_{EB} = 0.5 \text{ Vdc}$, $I_C = 0$, $f = 1.0 \text{ MHz}$) | C_{eb} | — | 30 | pF |
| Input Impedance ($V_{CE} = 10 \text{ Vdc}$, $I_C = 1.0 \text{ mA}$, $f = 1.0 \text{ kHz}$) | h_{ie} | 1.0 | 15 | k Ω |
| Voltage Feedback Ratio ($V_{CE} = 10 \text{ Vdc}$, $I_C = 1.0 \text{ mA}$, $f = 1.0 \text{ kHz}$) | h_{re} | 0.1 | 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} | 40 | 500 | — |
| Output Admittance ($V_{CE} = 10 \text{ Vdc}$, $I_C = 1.0 \text{ mA}$, $f = 1.0 \text{ kHz}$) | h_{oe} | 1.0 | 30 | μmhos |

SWITCHING CHARACTERISTICS

| | | | | | |
|--------------|--|-------|---|-----|----|
| Delay Time | ($V_{CC} = 30 \text{ Vdc}$, $V_{EB} = 2.0 \text{ Vdc}$) | t_d | — | 15 | ns |
| Rise Time | ($I_C = 150 \text{ mA}$, $I_{B1} = 15 \text{ mA}$) | t_r | — | 20 | |
| Storage Time | ($V_{CC} = 30 \text{ Vdc}$, $I_C = 150 \text{ mA}$) | t_s | — | 225 | ns |
| Fall Time | ($I_{B1} = I_{B2} = 15 \text{ mA}$) | t_f | — | 30 | |

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

SWITCHING TIME EQUIVALENT TEST CIRCUITS

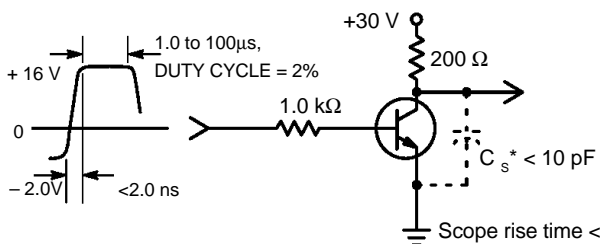


Figure 1. Turn–On Time

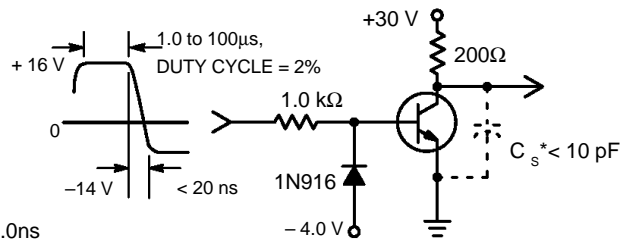


Figure 2. Turn–Off Time

MMBT4401LT1

TRANSIENT CHARACTERISTICS

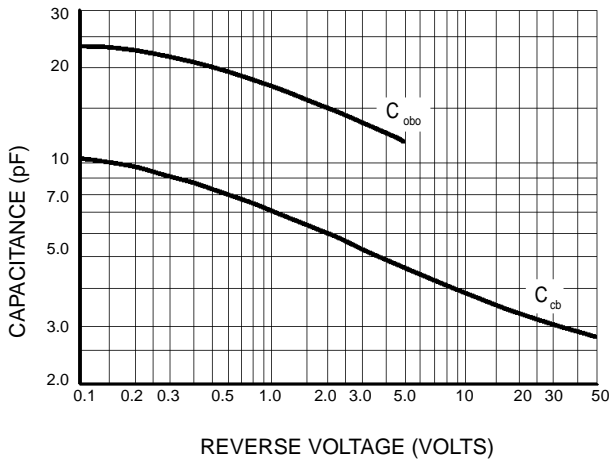


Figure 3. Capacitance

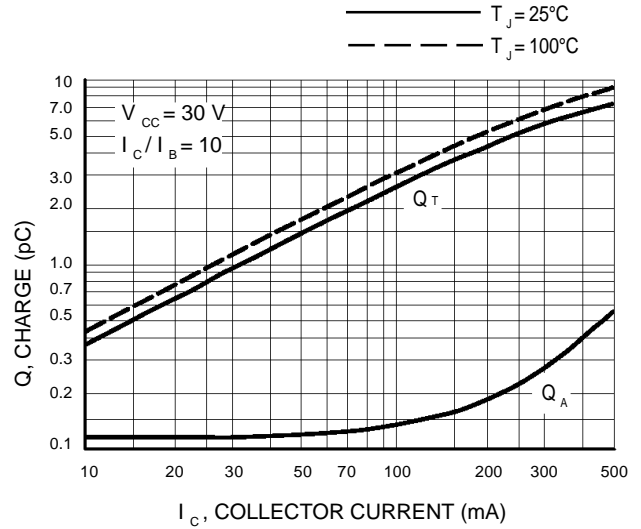


Figure 4. Charge Data

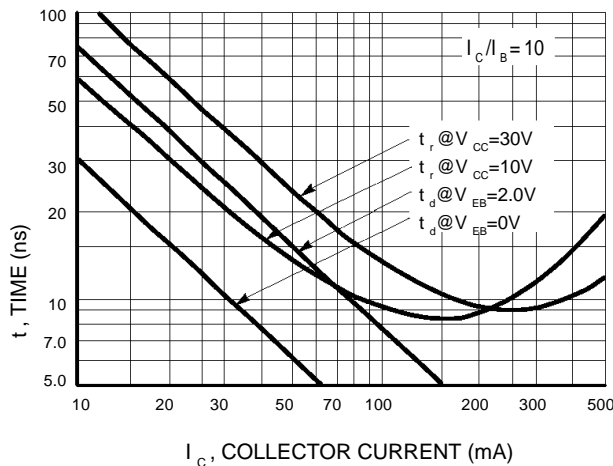


Figure 5. Turn-On Time

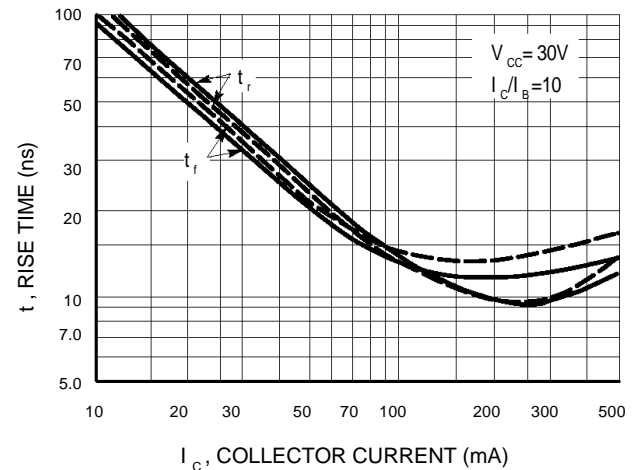


Figure 6. Rise and Fall Time

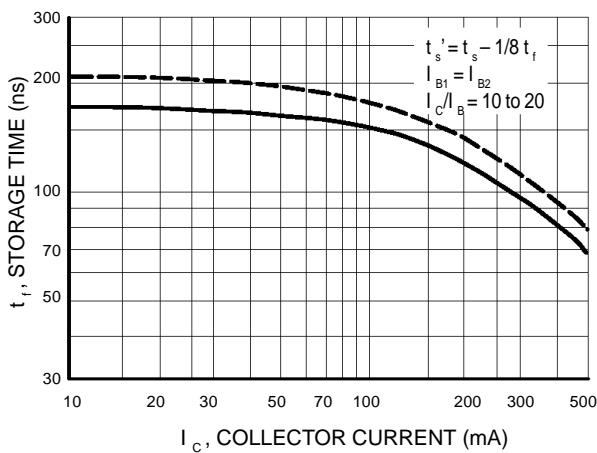


Figure 7. Storage Time

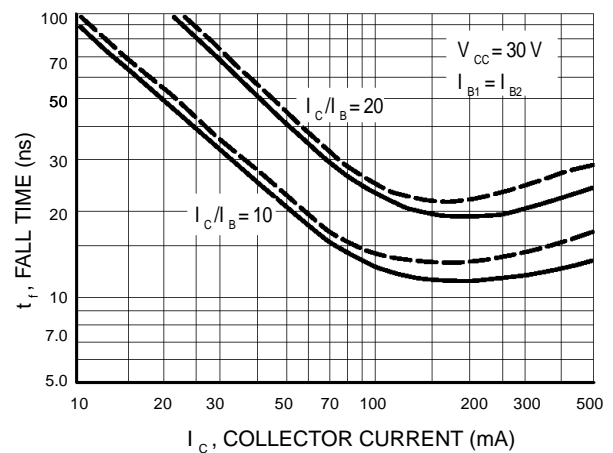


Figure 8. Fall Time

MMBT4401LT1

SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE

$V_{CE} = 10 \text{ Vdc}$, $T_A = 25^\circ\text{C}$
Bandwidth = 1.0 Hz

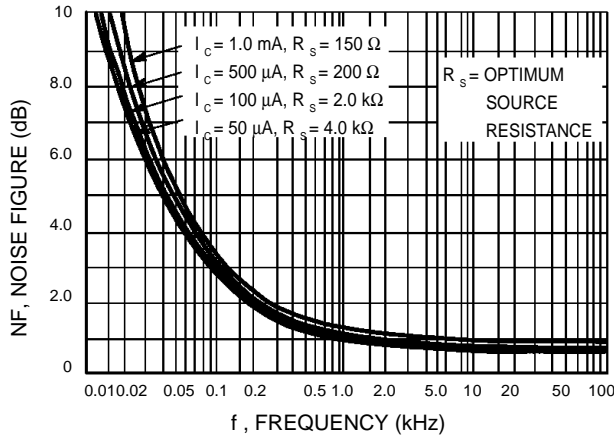


Figure 9. Frequency Effects

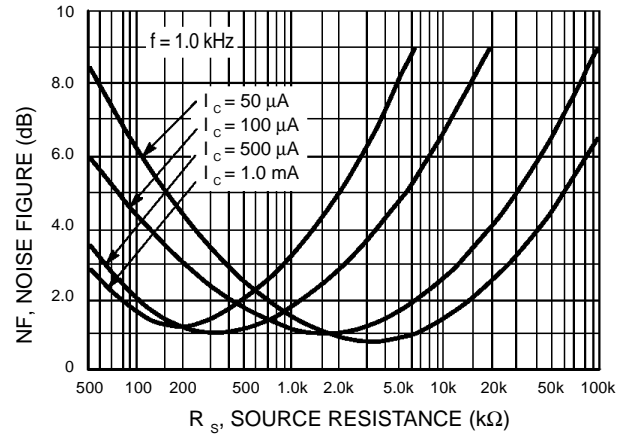


Figure 10. Source Resistance Effects

h PARAMETERS

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

This group of graphs illustrates the relationship between h_{fe} and other “h” parameters for this series of resistors. To obtain these curves, a high-gain and a low-gain unit were selected from the MMBT4401LT1 lines, and the same units were used to develop the correspondingly numbered curves on each graph.

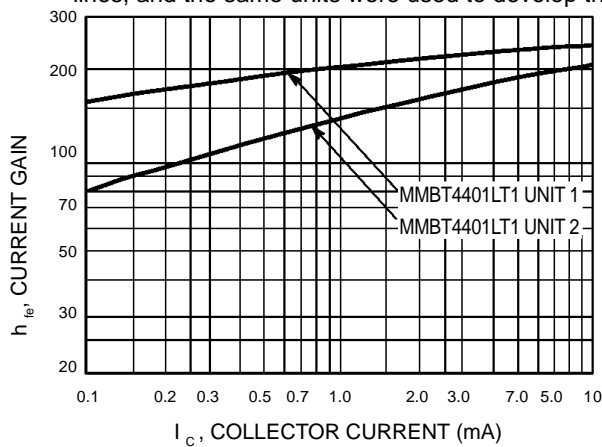


Figure 11. Current Gain

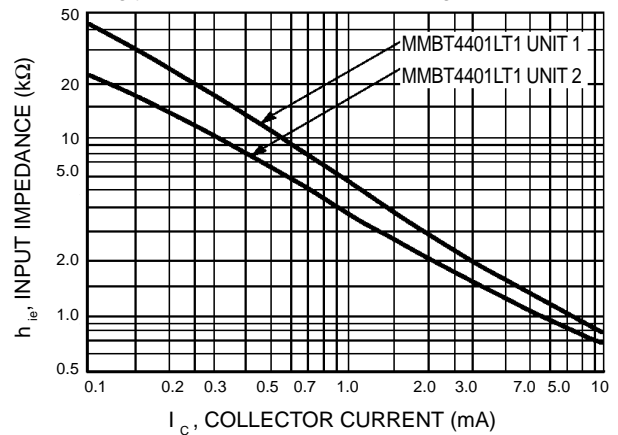


Figure 12. Input Impedance

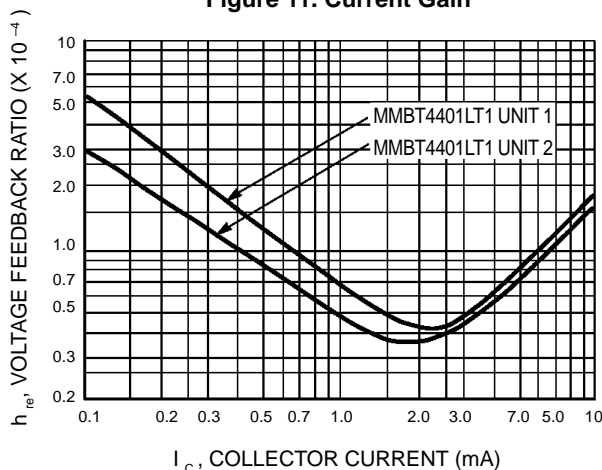


Figure 13. Voltage Feedback Ratio

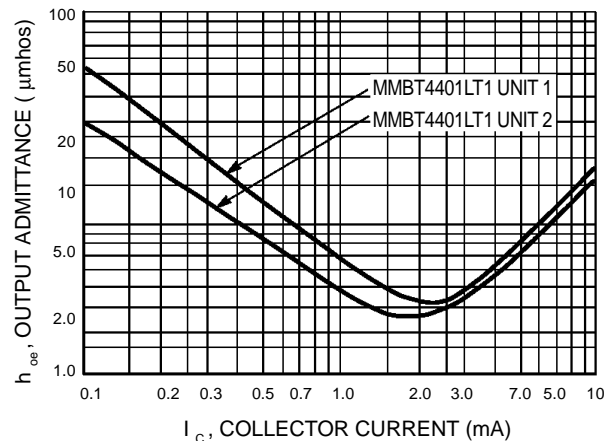


Figure 14. Output Admittance

MMBT4401LT1

STATIC CHARACTERISTICS

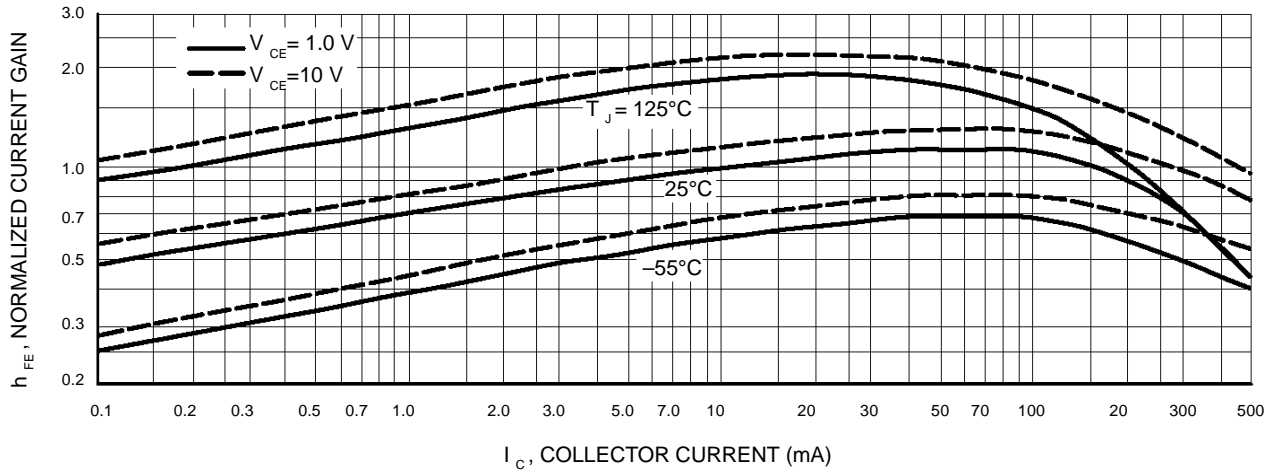


Figure 15. DC Current Gain

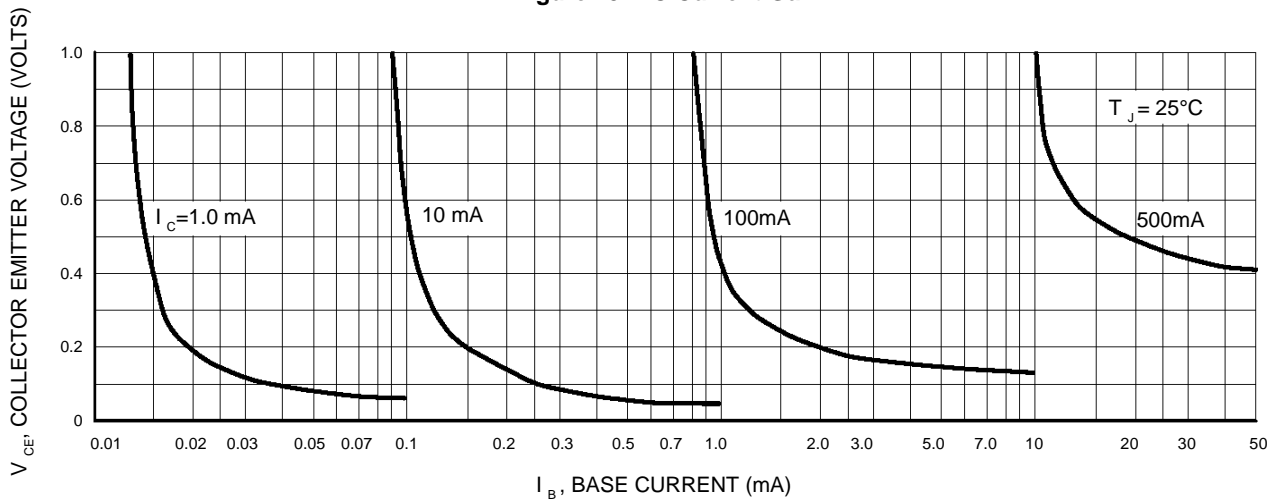


Figure 16. Collector Saturation Region

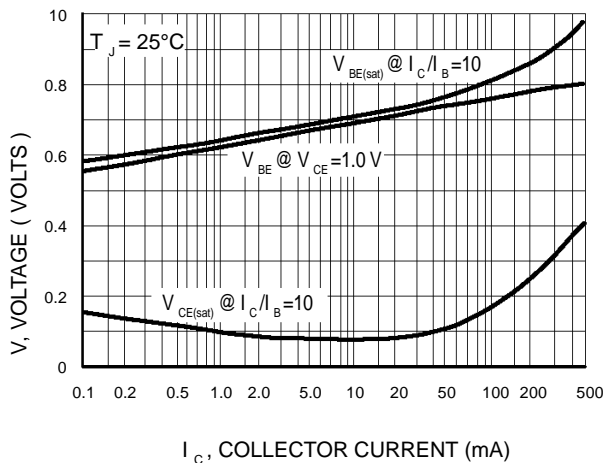


Figure 17. "On" Voltages

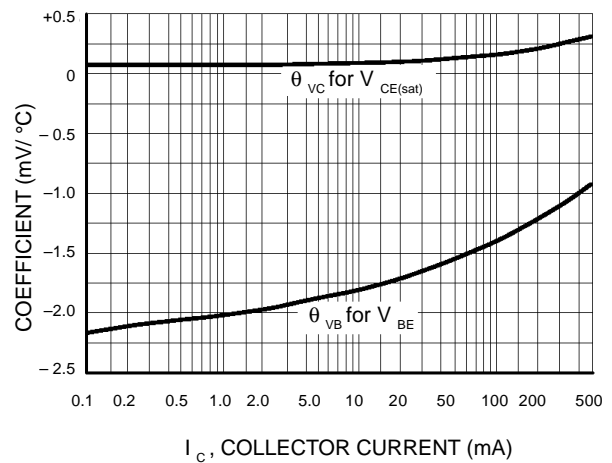


Figure 18. Temperature Coefficients