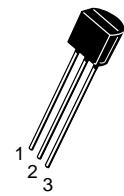
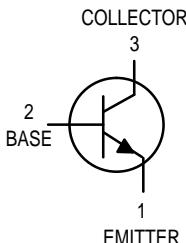


Amplifier Transistors

NPN Silicon

2N2222



TO-92

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--|----------------|-------------|-------------------------------|
| Collector-Emitter Voltage | V_{CEO} | 40 | Vdc |
| Collector-Base Voltage | V_{CBO} | 75 | Vdc |
| Emitter-Base Voltage | V_{EBO} | 6.5 | Vdc |
| Collector Current — Continuous | I_C | 600 | mAdc |
| Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 625 5.0 | mW mW/ $^\circ\text{C}$ |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 1.5 12 | Watts mW/ $^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range | T_J, T_{stg} | -55 to +150 | $^\circ\text{C}$ |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|-----------------|------|--------------------|
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 200 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 83.3 | $^\circ\text{C/W}$ |

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

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

OFF CHARACTERISTICS

| | | | | |
|---|---------------|--------|------------|-----------------|
| Collector-Emitter Breakdown Voltage ($I_C = 10 \text{ mA}, I_B = 0$) | $V_{(BR)CEO}$ | 40 | — | Vdc |
| Collector-Base Breakdown Voltage ($I_C = 10 \mu\text{A}, I_E = 0$) | $V_{(BR)CBO}$ | 75 | — | Vdc |
| Emitter-Base Breakdown Voltage ($I_E = 10 \mu\text{A}, I_C = 0$) | $V_{(BR)EBO}$ | 6.0 | — | Vdc |
| Collector Cutoff Current ($V_{CE} = 60 \text{ Vdc}, V_{EB(\text{off})} = 3.0 \text{ Vdc}$) | I_{CEX} | — | 10 | nAdc |
| Collector Cutoff Current ($V_{CB} = 60 \text{ Vdc}, I_E = 0$) ($V_{CB} = 60 \text{ Vdc}, I_E = 0, T_A = 150^\circ\text{C}$) | I_{CBO} | — — | 0.01 10 | μAdc |
| Emitter Cutoff Current ($V_{EB} = 3.0 \text{ Vdc}, I_C = 0$) | I_{EBO} | — | 10 | nAdc |
| Collector Cutoff Current ($V_{CE} = 10 \text{ V}$) | I_{CEO} | — | 10 | nAdc |
| Base Cutoff Current ($V_{CE} = 60 \text{ Vdc}, V_{EB(\text{off})} = 3.0 \text{ Vdc}$) | I_{BEX} | — | 20 | nAdc |

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

| Characteristic | Symbol | Min | Max | Unit |
|---|---------------|---|-----------------------------------|------|
| ON CHARACTERISTICS | | | | |
| DC Current Gain ($I_C = 0.1 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}$) ($I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}$) ($I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}$) ($I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, T_A = -55^\circ\text{C}$) ($I_C = 150 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}$) ⁽¹⁾ ($I_C = 150 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$) ⁽¹⁾ ($I_C = 500 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}$) ⁽¹⁾ | h_{FE} | 35 50 75 35 100 50 40 | — — — — 300 — — | — |
| Collector-Emitter Saturation Voltage ⁽¹⁾ ($I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc}$) ($I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc}$) | $V_{CE(sat)}$ | — — | 0.3 1.0 | Vdc |
| Base-Emitter Saturation Voltage ⁽¹⁾ ($I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc}$) ($I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc}$) | $V_{BE(sat)}$ | 0.6 — | 1.2 2.0 | Vdc |

SMALL-SIGNAL CHARACTERISTICS

| | | | | |
|--|------------|-------------|-------------|------------------|
| Current-Gain — Bandwidth Product ⁽²⁾ ($I_C = 20 \text{ mAdc}, V_{CE} = 20 \text{ Vdc}, f = 100 \text{ MHz}$) | f_T | 300 | — | MHz |
| Output Capacitance ($V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz}$) | C_{obo} | — | 8.0 | pF |
| Input Capacitance ($V_{EB} = 0.5 \text{ Vdc}, I_C = 0, f = 1.0 \text{ MHz}$) | C_{ibo} | — | 25 | pF |
| Input Impedance ($I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$) | h_{ie} | 2.0 0.25 | 8.0 1.25 | kΩ |
| Voltage Feedback Ratio ($I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$) | h_{re} | — — | 8.0 4.0 | $\times 10^{-4}$ |
| Small-Signal Current Gain ($I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$) | h_{fe} | 50 75 | 300 375 | — |
| Output Admittance ($I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$) | h_{oe} | 5.0 25 | 35 200 | μmhos |
| Collector Base Time Constant ($I_E = 20 \text{ mAdc}, V_{CB} = 20 \text{ Vdc}, f = 31.8 \text{ MHz}$) | $r_b' C_C$ | — | 150 | ps |
| Noise Figure ($I_C = 100 \mu\text{Adc}, V_{CE} = 10 \text{ Vdc}, R_S = 1.0 \text{ k}\Omega, f = 1.0 \text{ kHz}$) | N_F | — | 4.0 | dB |

SWITCHING CHARACTERISTICS

| | | | | | |
|--------------|--|-------|---|-----|----|
| Delay Time | $(V_{CC} = 30 \text{ Vdc}, V_{BE(off)} = -2.0 \text{ Vdc}, I_C = 150 \text{ mAdc}, I_{B1} = 15 \text{ mAdc})$ (Figure 1) | t_d | — | 10 | ns |
| Rise Time | | t_r | — | 25 | ns |
| Storage Time | $(V_{CC} = 30 \text{ Vdc}, I_C = 150 \text{ mAdc}, I_{B1} = I_{B2} = 15 \text{ mAdc})$ (Figure 2) | t_s | — | 225 | ns |
| Fall Time | | t_f | — | 60 | ns |

1. Pulse Test: Pulse Width $\leq 300 \mu\text{s}$, Duty Cycle $\leq 2.0\%$.2. f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

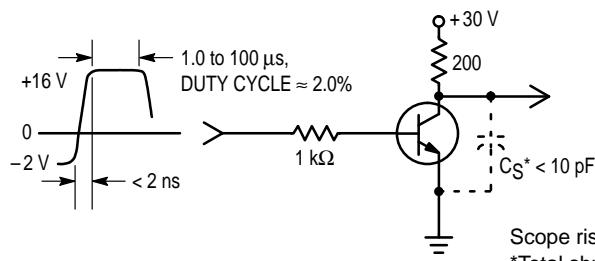


Figure 1. Turn-On Time

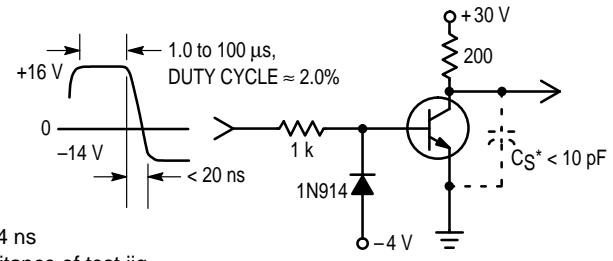


Figure 2. Turn-Off Time

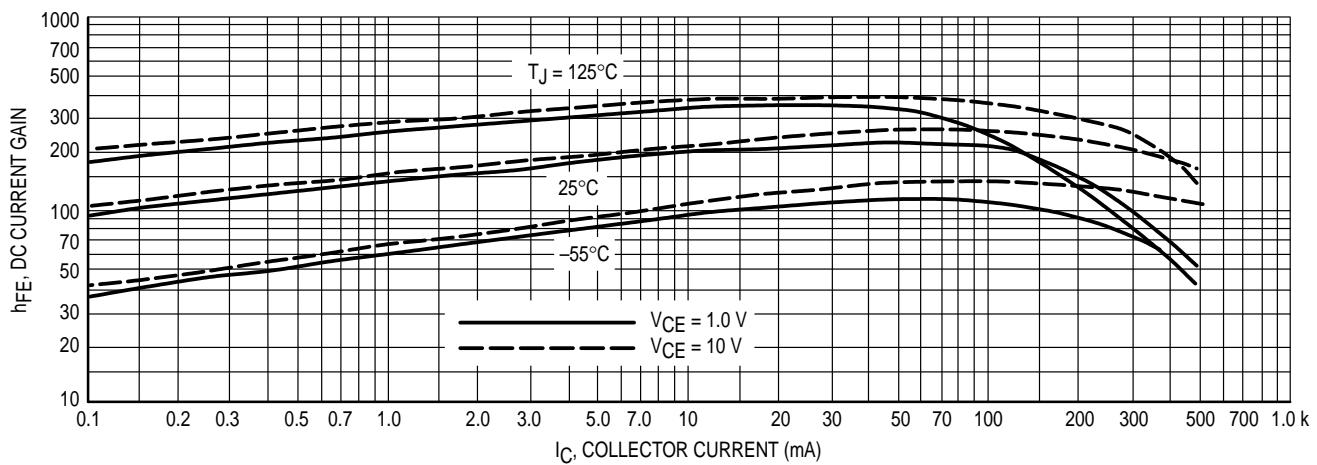


Figure 3. DC Current Gain

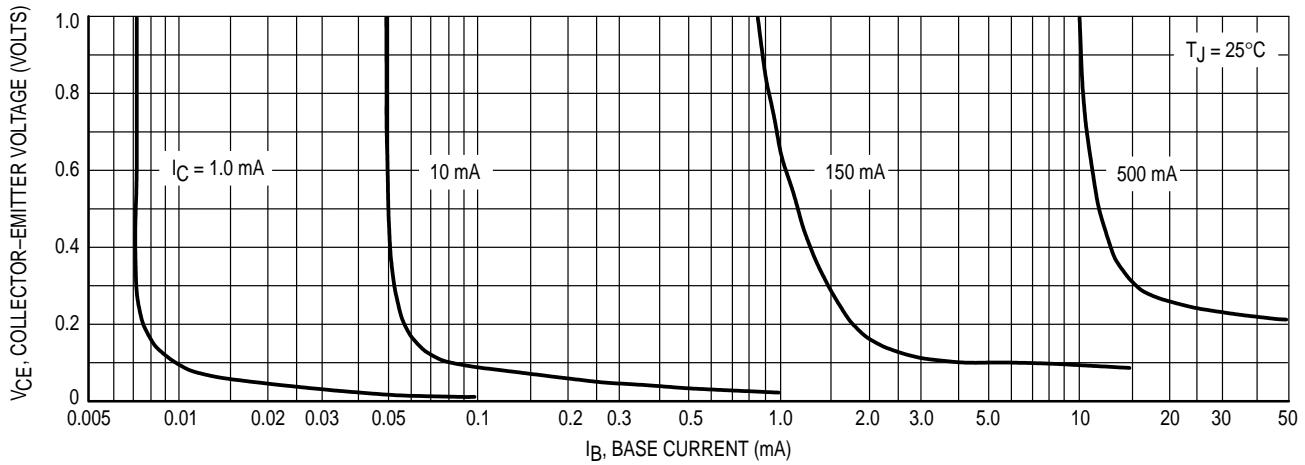


Figure 4. Collector Saturation Region

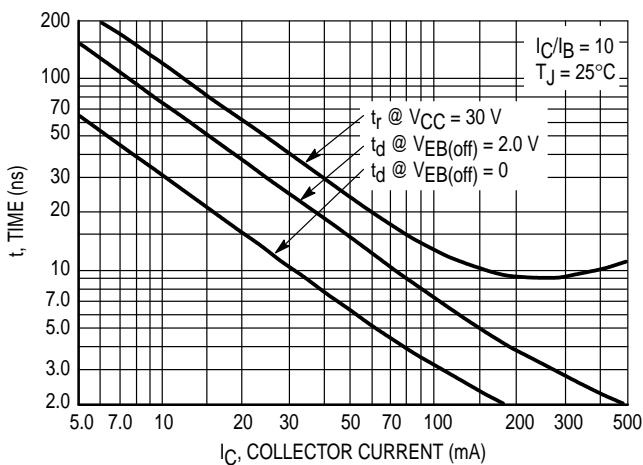


Figure 5. Turn-On Time

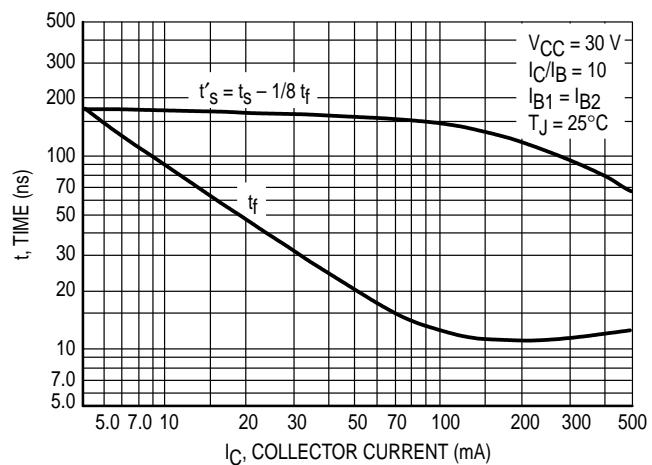


Figure 6. Turn-Off Time

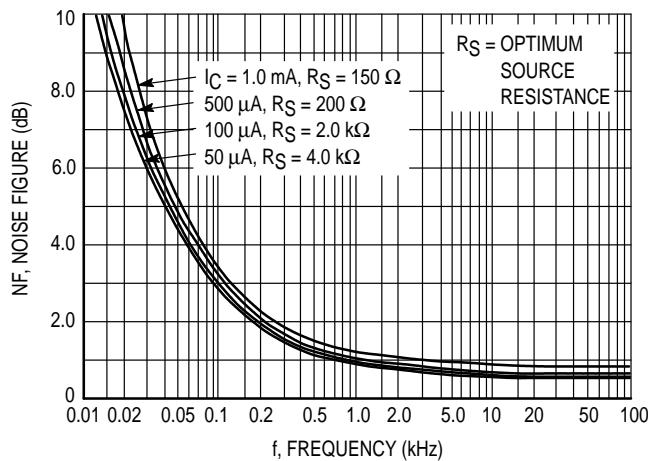


Figure 7. Frequency Effects

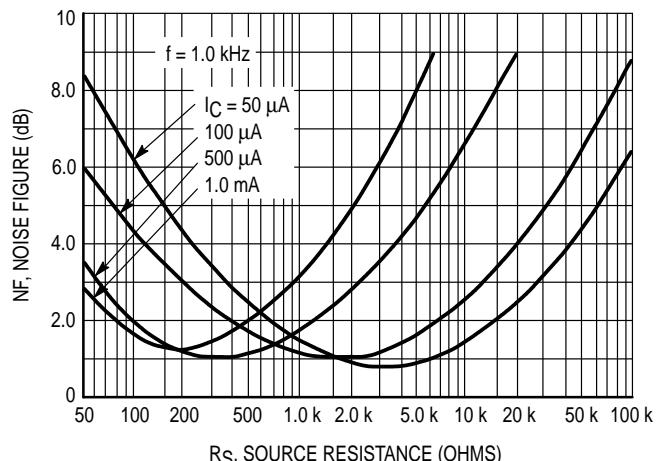


Figure 8. Source Resistance Effects

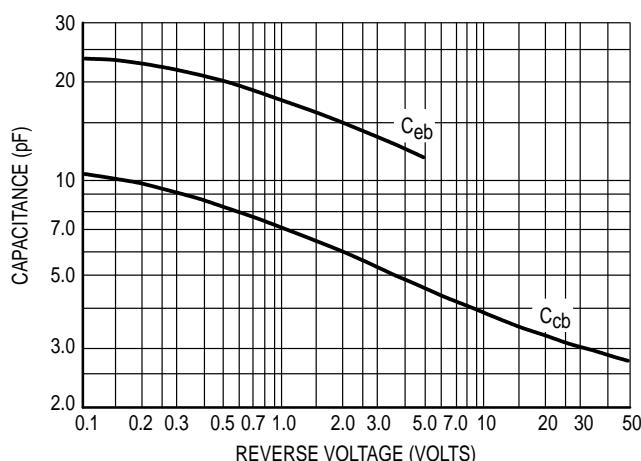


Figure 9. Capacitances

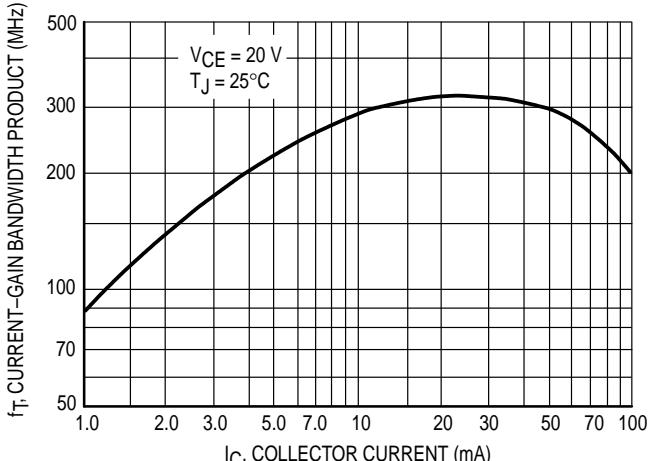


Figure 10. Current-Gain Bandwidth Product

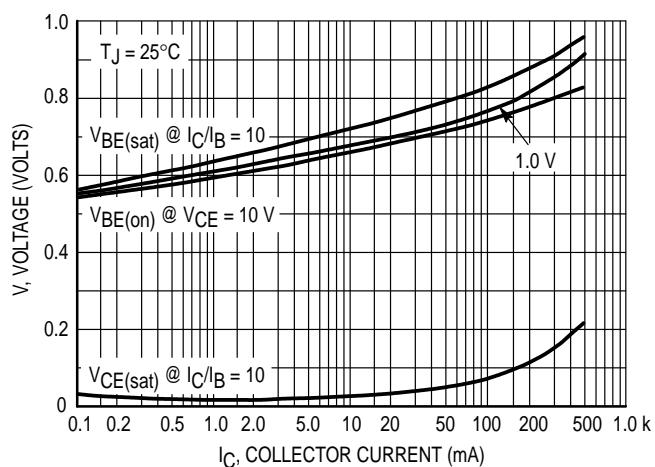


Figure 11. "On" Voltages

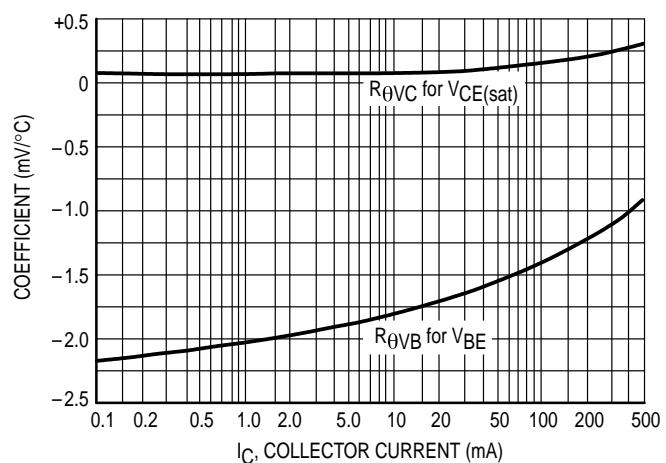


Figure 12. Temperature Coefficients