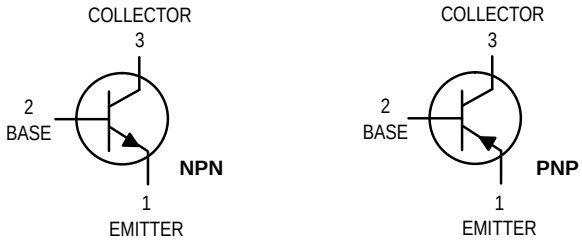
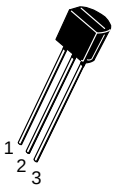
# Amplifier Transistors




**NPN**
**MPS6601**
**MPS6602***
**PNP**
**MPS6651**
**MPS6652***

**Voltage and current are negative for PNP transistors**

***Motorola Preferred Device**




**CASE 29–04, STYLE 1**
**TO–92 (TO–226AA)**

**MAXIMUM RATINGS**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector–Emitter Voltage<br>MPS6601/6651<br>MPS6602/6652 | $V_{CEO}$ | <br>25<br>40 | Vdc |
| Collector–Base Voltage<br>MPS6601/6651<br>MPS6602/6652 | $V_{CBO}$ | <br>25<br>30 | Vdc |
| Emitter–Base Voltage | $V_{EBO}$ | 4.0 | Vdc |
| Collector Current — Continuous | $I_C$ | 1000 | mAdc |
| Total Device Dissipation @ $T_A$ = 25°C<br>Derate above 25°C | $P_D$ | 625<br>5.0 | mW<br>mW/°C |
| Total Device Dissipation @ $T_C$ = 25°C<br>Derate above 25°C | $P_D$ | 1.5<br>12 | Watts<br>mW/°C |
| Operating and Storage Junction Temperature Range | $T_J$, $T_{stg}$ | –55 to +150 | °C |

**THERMAL CHARACTERISTICS**

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$(1) | 200 | °C/W |
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 83.3 | °C/W |

**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted)

| Characteristic | | Symbol | Min | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector–Emitter Breakdown Voltage<br>($I_C$ = 1.0 mAdc, $I_B$ = 0) | <br>MPS6601/6651<br>MPS6602/6652 | $V_{(BR)CEO}$ | <br>25<br>40 | <br>—<br>— | Vdc |
| Collector–Base Breakdown Voltage<br>($I_C$ = 100 μAdc, $I_E$ = 0) | <br>MPS6601/6651<br>MPS6602/6652 | $V_{(BR)CBO}$ | <br>25<br>40 | <br>—<br>— | Vdc |
| Emitter–Base Breakdown Voltage<br>($I_E$ = 10 μAdc, $I_C$ = 0) | | $V_{(BR)EBO}$ | 4.0 | — | Vdc |
| Collector Cutoff Current<br>($V_{CE}$ = 25 Vdc, $I_B$ = 0)<br>($V_{CE}$ = 30 Vdc, $I_B$ = 0) | <br>MPS6601/6651<br>MPS6602/6652 | $I_{CES}$ | <br>—<br>— | <br>0.1<br>0.1 | μAdc |
| Collector Cutoff Current<br>($V_{CB}$ = 25 Vdc, $I_E$ = 0)<br>($V_{CB}$ = 30 Vdc, $I_E$ = 0) | <br>MPS6601/6651<br>MPS6602/6652 | $I_{CBO}$ | <br>—<br>— | <br>0.1<br>0.1 | μAdc |

1. $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.

**Preferred** devices are Motorola recommended choices for future use and best overall value.

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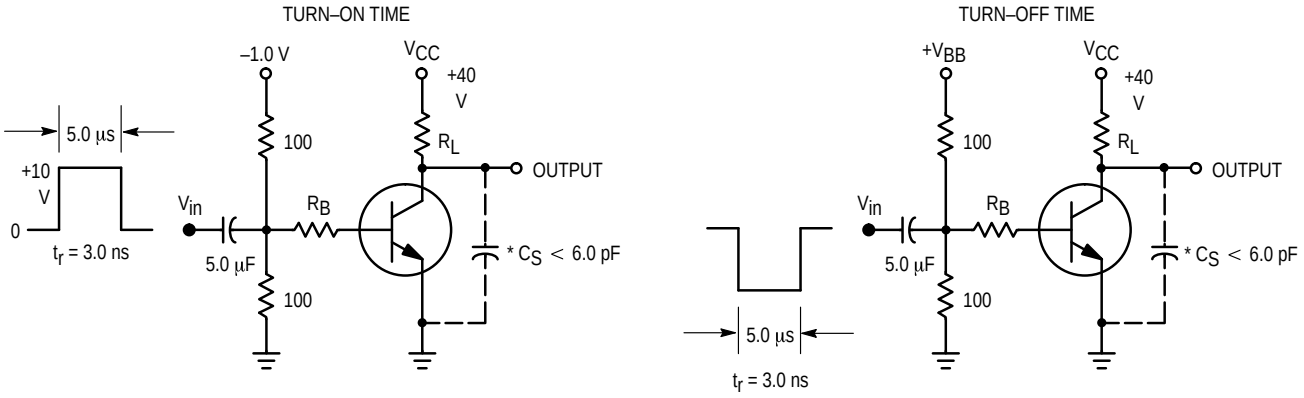
**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted) (Continued)

| Characteristic | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| **ON CHARACTERISTICS** | | | | |
| DC Current Gain<br>($I_C$ = 100 mAdc, $V_{CE}$ = 1.0 Vdc)<br>($I_C$ = 500 mAdc, $V_{CE}$ = 1.0 Vdc)<br>($I_C$ = 1000 mAdc, $V_{CE}$ = 1.0 Vdc) | $h_{FE}$ | <br>50<br>50<br>30 | <br>—<br>—<br>— | — |
| Collector–Emitter Saturation Voltage<br>($I_C$ = 1000 mAdc, $I_B$ = 100 mAdc) | $V_{CE(sat)}$ | — | 0.6 | Vdc |
| Base–Emitter On Voltage<br>($I_C$ = 500 mAdc, $V_{CE}$ = 1.0 Vdc) | $V_{BE(on)}$ | — | 1.2 | Vdc |
| **SMALL–SIGNAL CHARACTERISTICS** | | | | |
| Current–Gain — Bandwidth Product<br>($I_C$ = 50 mAdc, $V_{CE}$ = 10 Vdc, f = 100 MHz) | $f_T$ | 100 | — | MHz |
| Output Capacitance<br>($V_{CB}$ = 10 Vdc, $I_E$ = 0, f = 1.0 MHz) | $C_{obo}$ | — | 30 | pF |
| **SWITCHING CHARACTERISTICS** | | | | |
| Delay Time | ($V_{CC}$ = 40 Vdc, $I_C$ = 500 mAdc, $I_{B1}$ = 50 mAdc, $t_p \geq$ 300 ns Duty Cycle) | $t_d$ | — | 25 | ns |
| Rise Time | | $t_r$ | — | 30 | ns |
| Storage Time | | $t_s$ | — | 250 | ns |
| Fall Time | | $t_f$ | — | 50 | ns |




* Total Shunt Capacitance of Test Jig and Connectors
For PNP Test Circuits, Reverse All Voltage Polarities

**Figure 1. Switching Time Test Circuits**

**NPN**

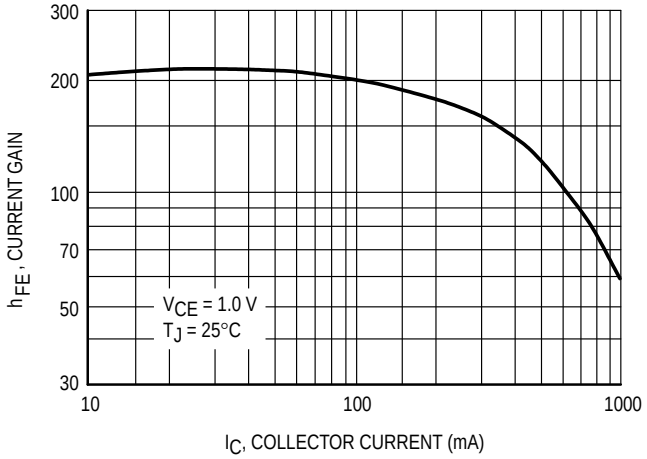



**Figure 2. MPS6601/6602 DC Current Gain**

**PNP**

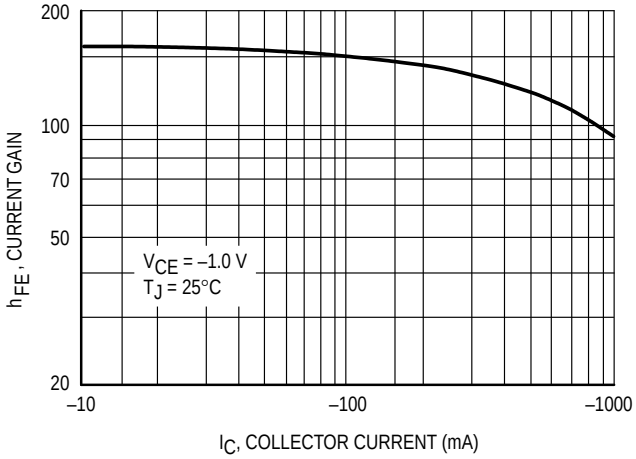



**Figure 3. MPS6651/6652 DC Current Gain**

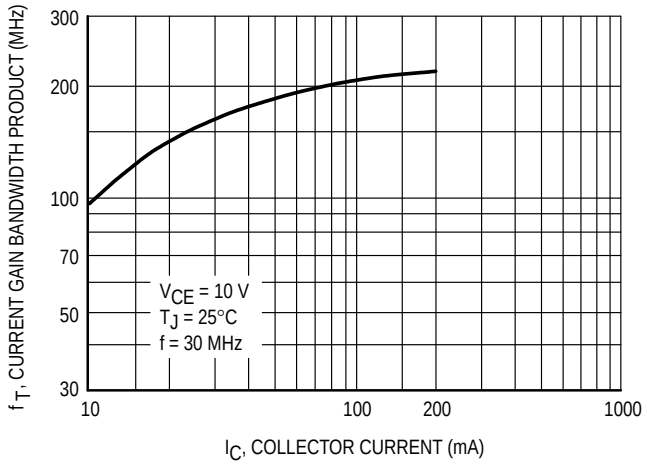



**Figure 4. Current Gain Bandwidth Product**

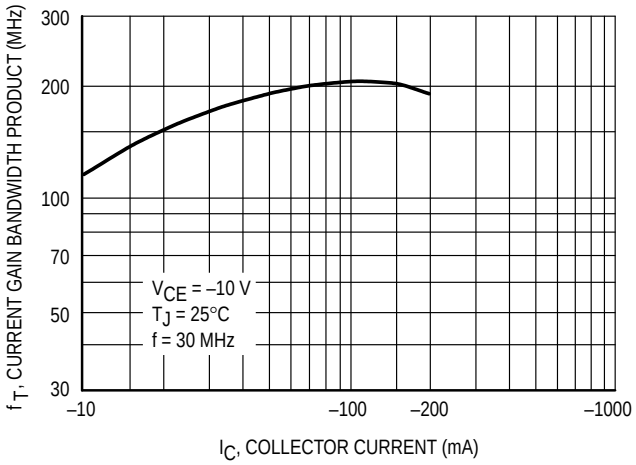



**Figure 5. Current Gain Bandwidth Product**

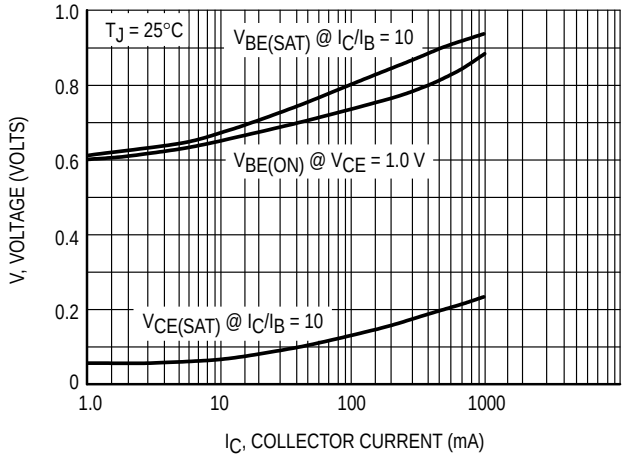



**Figure 6. On Voltages**

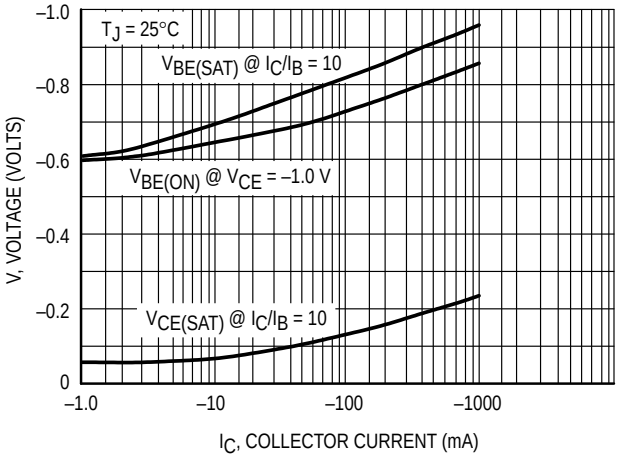



**Figure 7. On Voltages**

**NPN**

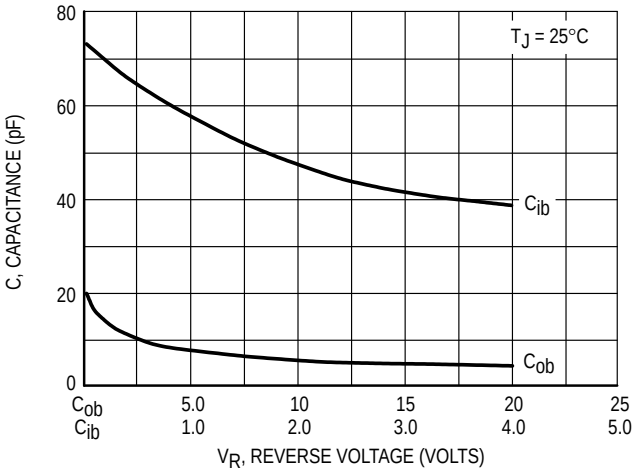



**Figure 8. Capacitance**

**PNP**

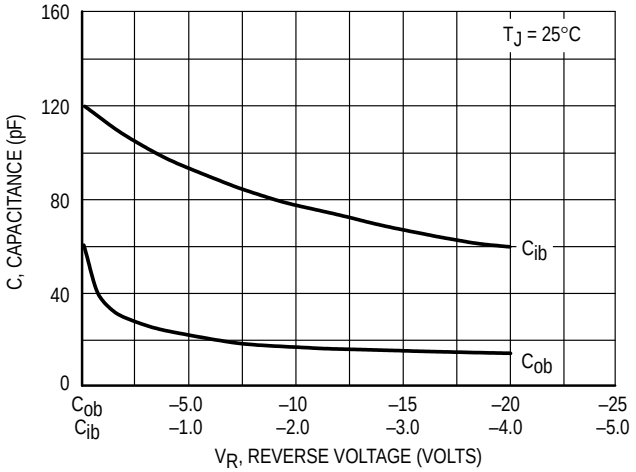



**Figure 9. Capacitance**

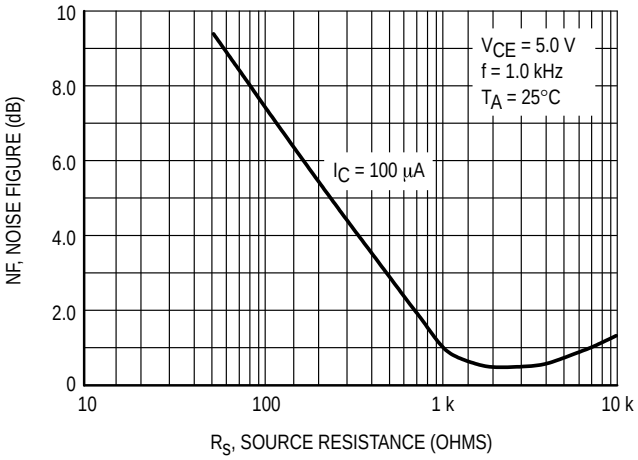



**Figure 10. MPS6601/6602 Noise Figure**

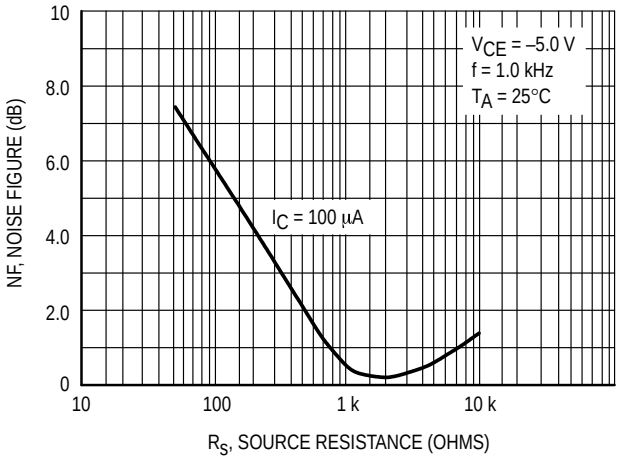



**Figure 11. MPS6651/6652 Noise Figure**

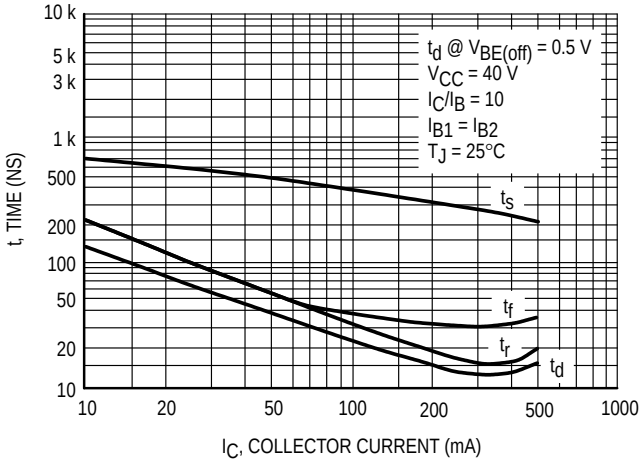



**Figure 12. MPS6601/6602 Switching Times**

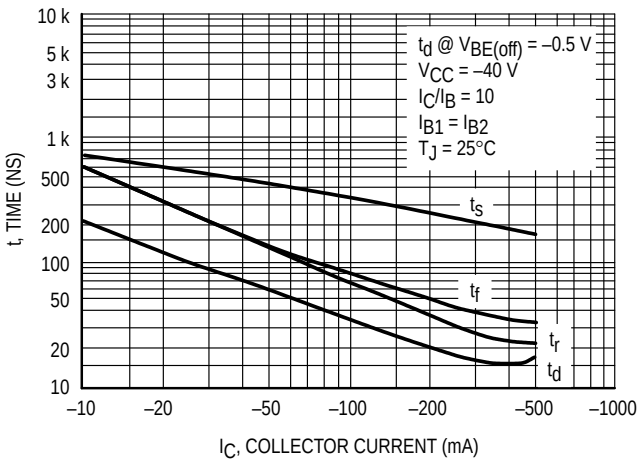



**Figure 13. MPS6651/6652 Switching Times**

**NPN**

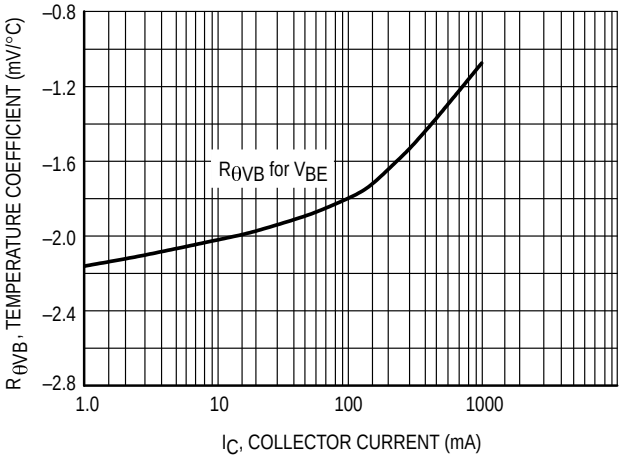



**Figure 14. Base–Emitter Temperature Coefficient**

**PNP**

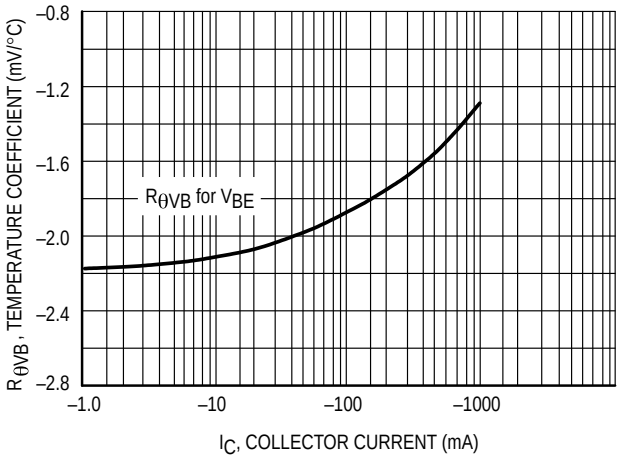



**Figure 15. Base–Emitter Temperature Coefficient**

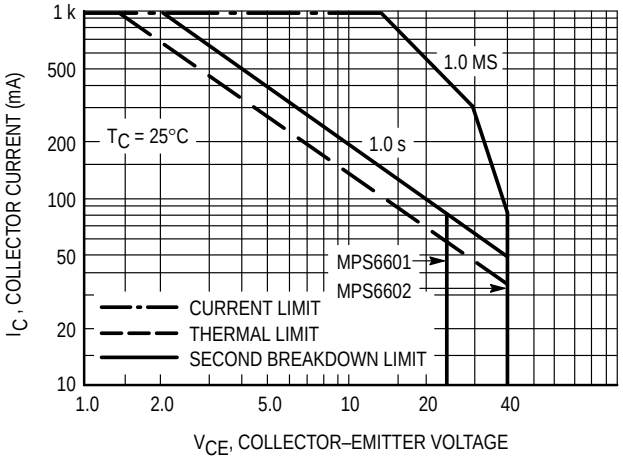



**Figure 16. Safe Operating Area**

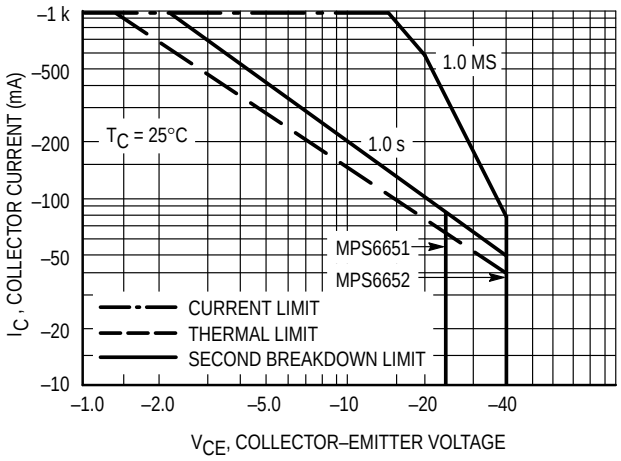



**Figure 17. Safe Operating Area**

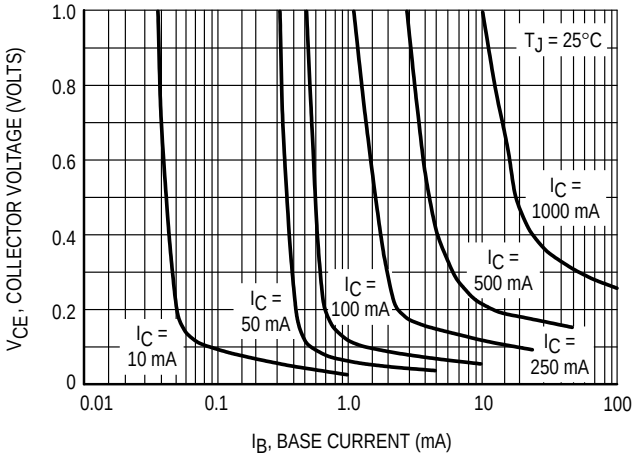



**Figure 18. MPS6601/6602 Saturation Region**

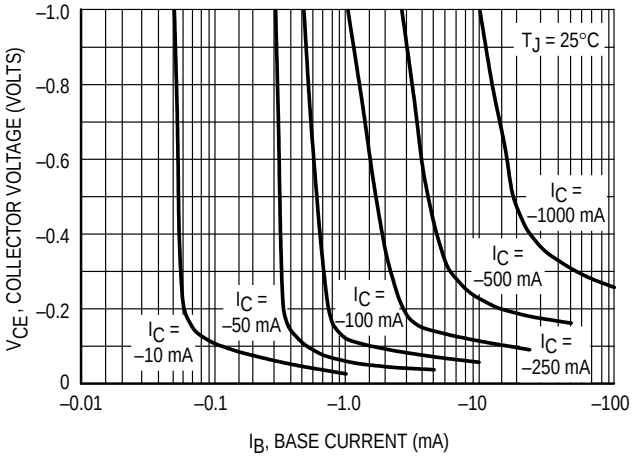



**Figure 19. MPS6651/6652 Saturation Region**

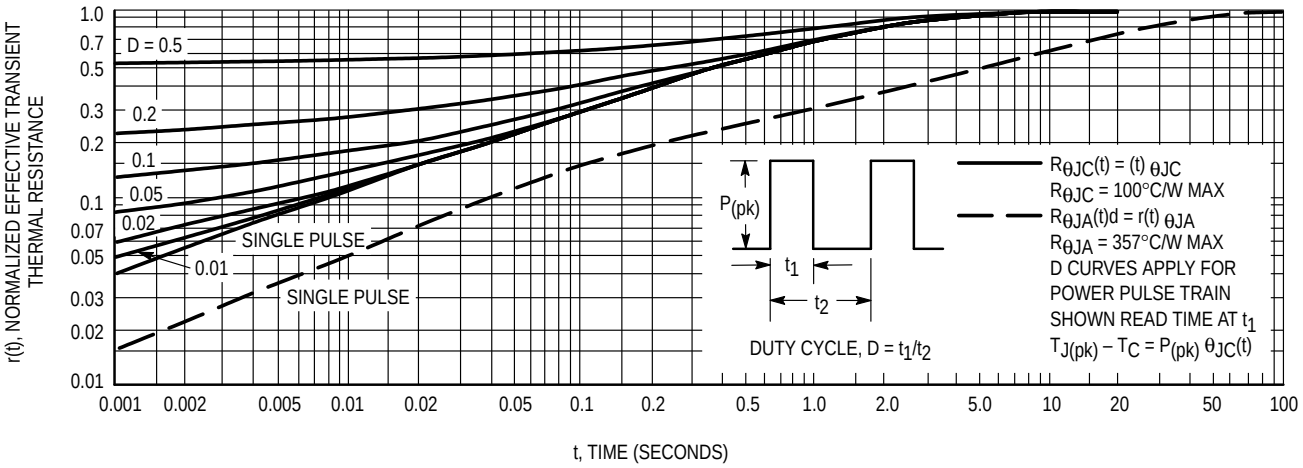
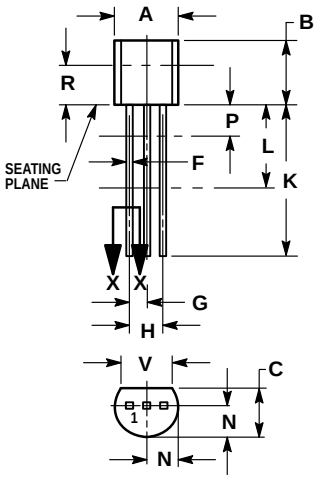
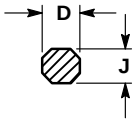



**Figure 20. Thermal Response**

## PACKAGE DIMENSIONS




SECTION X–X

**CASE 029–04**
**(TO–226AA)**
**ISSUE AD**

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSION D AND J APPLY BETWEEN L AND K MINIMUM. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.175 | 0.205 | 4.45 | 5.20 |
| B | 0.170 | 0.210 | 4.32 | 5.33 |
| C | 0.125 | 0.165 | 3.18 | 4.19 |
| D | 0.016 | 0.022 | 0.41 | 0.55 |
| F | 0.016 | 0.019 | 0.41 | 0.48 |
| G | 0.045 | 0.055 | 1.15 | 1.39 |
| H | 0.095 | 0.105 | 2.42 | 2.66 |
| J | 0.015 | 0.020 | 0.39 | 0.50 |
| K | 0.500 | — | 12.70 | — |
| L | 0.250 | — | 6.35 | — |
| N | 0.080 | 0.105 | 2.04 | 2.66 |
| P | — | 0.100 | — | 2.54 |
| R | 0.115 | — | 2.93 | — |
| V | 0.135 | — | 3.43 | — |

STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR

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