

Plastic Medium-Power Complementary Silicon Transistors

... designed for general-purpose amplifier and low-speed switching applications.

- High DC Current Gain —
 $h_{FE} = 2500$ (Typ) @ $I_C = 4.0$ Adc
- Collector-Emitter Sustaining Voltage — @ 100 mAdc
 $V_{CEO(sus)} = 60$ Vdc (Min) — TIP120, TIP125
 $= 80$ Vdc (Min) — TIP121, TIP126
 $= 100$ Vdc (Min) — TIP122, TIP127
- Low Collector-Emitter Saturation Voltage —
 $V_{CE(sat)} = 2.0$ Vdc (Max) @ $I_C = 3.0$ Adc
 $= 4.0$ Vdc (Max) @ $I_C = 5.0$ Adc
- Monolithic Construction with Built-In Base-Emitter Shunt Resistors
- TO-220AB Compact Package

***MAXIMUM RATINGS**

| Rating | Symbol | TIP120, TIP125 | TIP121, TIP126 | TIP122, TIP127 | Unit |
|---|----------------|-------------------|-------------------|-------------------|------------------------------|
| Collector-Emitter Voltage | V_{CEO} | 60 | 80 | 100 | Vdc |
| Collector-Base Voltage | V_{CB} | 60 | 80 | 100 | Vdc |
| Emitter-Base Voltage | V_{EB} | 5.0 | | | Vdc |
| Collector Current — Continuous Peak | I_C | 5.0 8.0 | | | Adc |
| Base Current | I_B | 120 | | | mAdc |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 65 0.52 | | | Watts W/ $^\circ\text{C}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 2.0 0.016 | | | Watts W/ $^\circ\text{C}$ |
| Unclamped Inductive Load Energy (1) | E | 50 | | | mJ |
| Operating and Storage Junction, Temperature Range | T_J, T_{stg} | -65 to +150 | | | $^\circ\text{C}$ |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|-----------------|------|--------------------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 1.92 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 62.5 | $^\circ\text{C/W}$ |

(1) $I_C = 1$ A, $L = 100$ mH, P.R.F. = 10 Hz, $V_{CC} = 20$ V, $R_{BE} = 100 \Omega$.

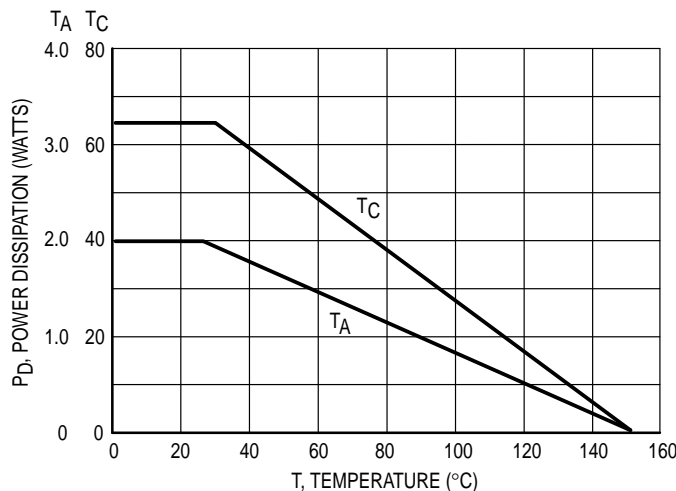


Figure 1. Power Derating

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

REV 2

NPN
TIP120*
TIP121*
TIP122*
PNP
TIP125*
TIP126*
TIP127*

*Motorola Preferred Device

DARLINGTON
5 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
60-80-100 VOLTS
65 WATTS

CASE 221A-06
TO-220AB

TIP120 TIP121 TIP122 TIP125 TIP126 TIP127

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

| Characteristic | Symbol | Min | Max | Unit |
|---|----------------|-----------------|-------------------|------|
| OFF CHARACTERISTICS | | | | |
| Collector–Emitter Sustaining Voltage (1) ($I_C = 100\text{ mAdc}$, $I_B = 0$) | $V_{CEO(sus)}$ | 60 80 100 | — | Vdc |
| Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 40\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 50\text{ Vdc}$, $I_B = 0$) | I_{CEO} | — — — | 0.5 0.5 0.5 | mAdc |
| Collector Cutoff Current ($V_{CB} = 60\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 80\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 100\text{ Vdc}$, $I_E = 0$) | I_{CBO} | — — — | 0.2 0.2 0.2 | mAdc |
| Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$) | I_{EBO} | — | 2.0 | mAdc |

ON CHARACTERISTICS (1)

| | | | | |
|--|---------------|--------------|------------|-----|
| DC Current Gain ($I_C = 0.5\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$) ($I_C = 3.0\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$) | h_{FE} | 1000 1000 | — — | — |
| Collector–Emitter Saturation Voltage ($I_C = 3.0\text{ Adc}$, $I_B = 12\text{ mAdc}$) ($I_C = 5.0\text{ Adc}$, $I_B = 20\text{ mAdc}$) | $V_{CE(sat)}$ | — — | 2.0 4.0 | Vdc |
| Base–Emitter On Voltage ($I_C = 3.0\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$) | $V_{BE(on)}$ | — | 2.5 | Vdc |

DYNAMIC CHARACTERISTICS

| | | | | |
|--|----------|--------|------------|----|
| Small–Signal Current Gain ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$, $f = 1.0\text{ MHz}$) | h_{fe} | 4.0 | — | — |
| Output Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 0.1\text{ MHz}$) | C_{ob} | — — | 300 200 | pF |

(1) Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2\%$.

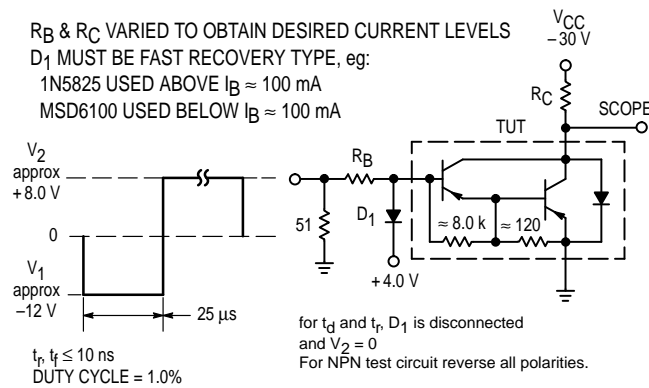


Figure 2. Switching Times Test Circuit

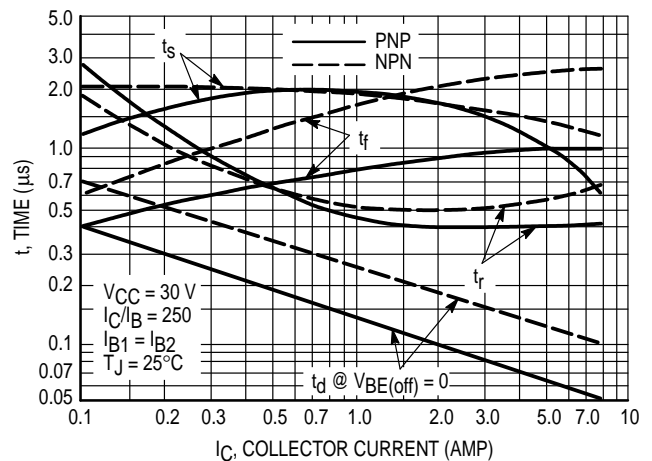


Figure 3. Switching Times

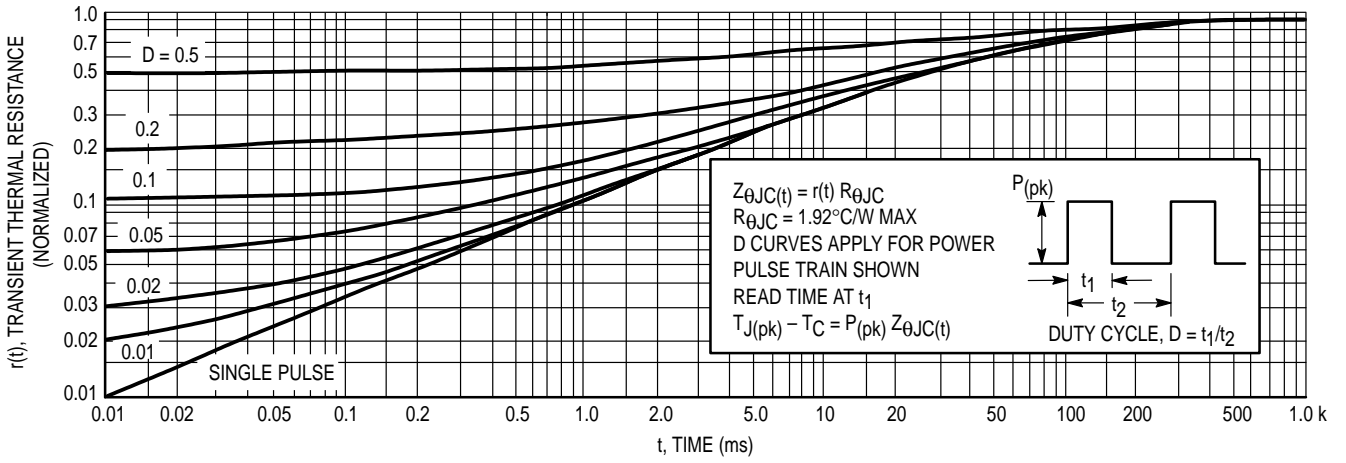


Figure 4. Thermal Response

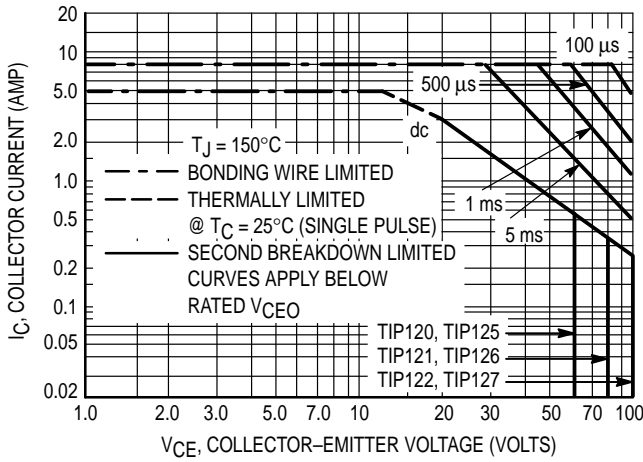


Figure 5. Active-Region Safe Operating Area

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation, i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 5 is based on $T_{J(pk)} = 150^{\circ}\text{C}$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} < 150^{\circ}\text{C}$. $T_{J(pk)}$ may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown

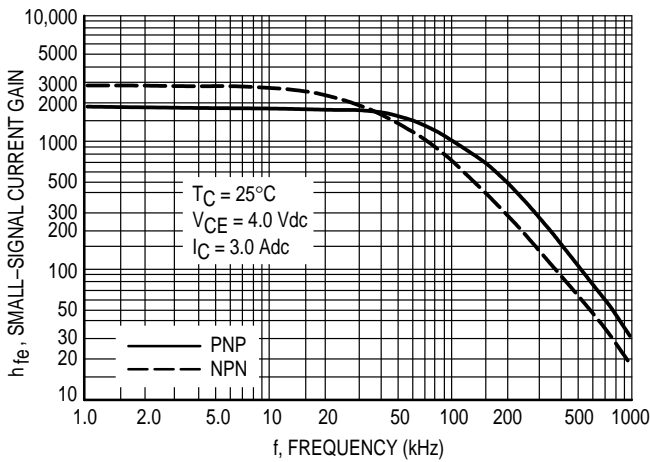


Figure 6. Small-Signal Current Gain

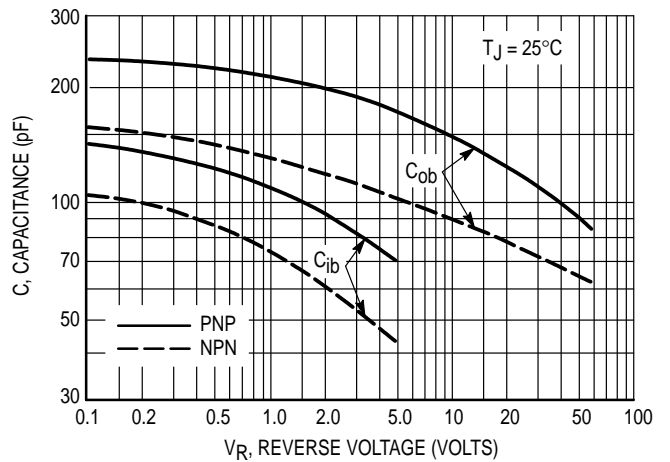


Figure 7. Capacitance

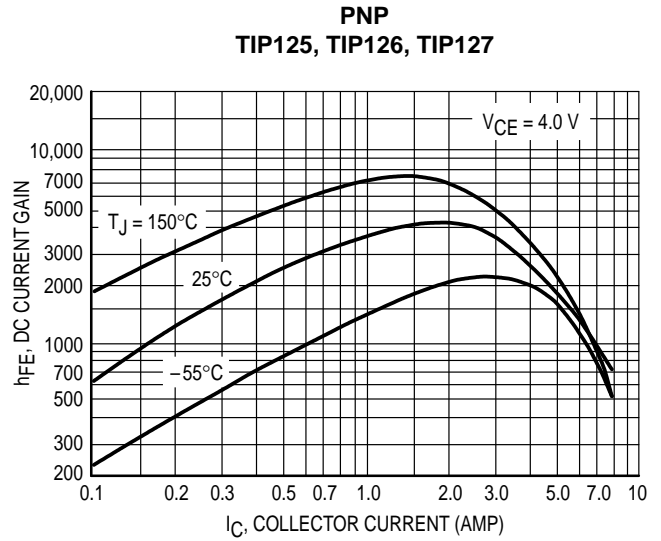
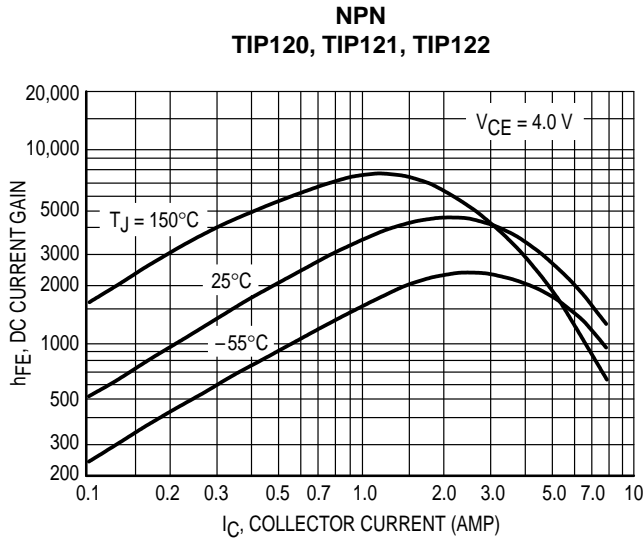


Figure 8. DC Current Gain

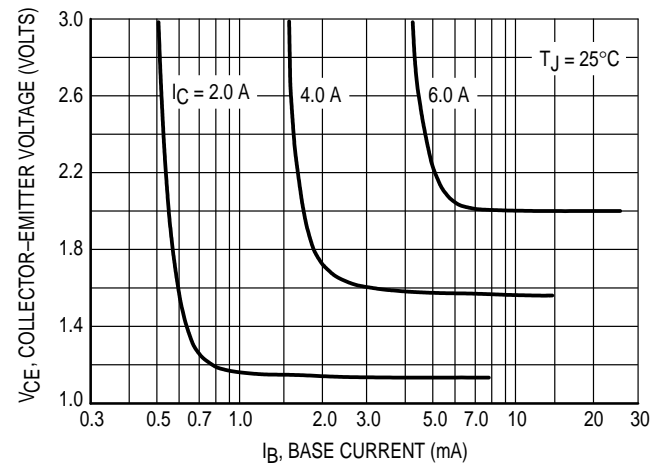
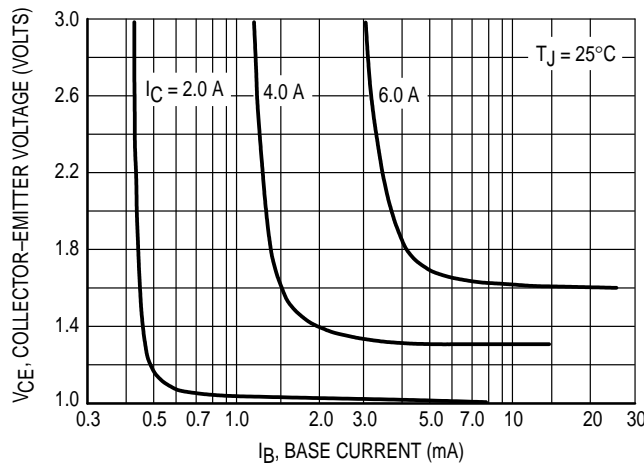


Figure 9. Collector Saturation Region

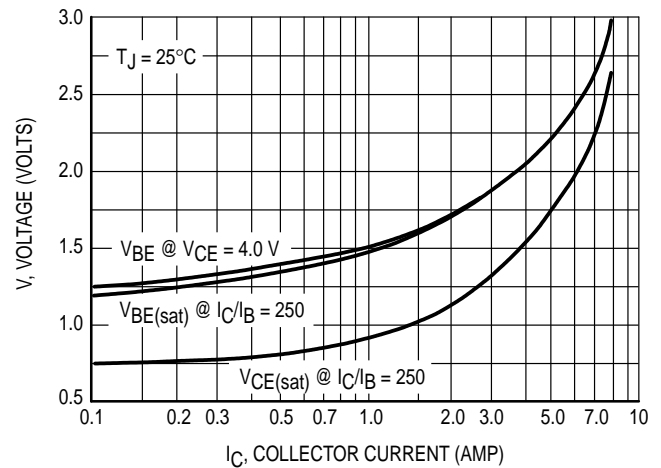
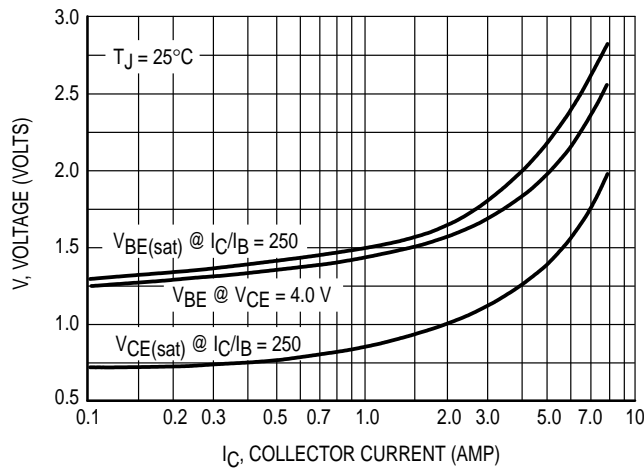
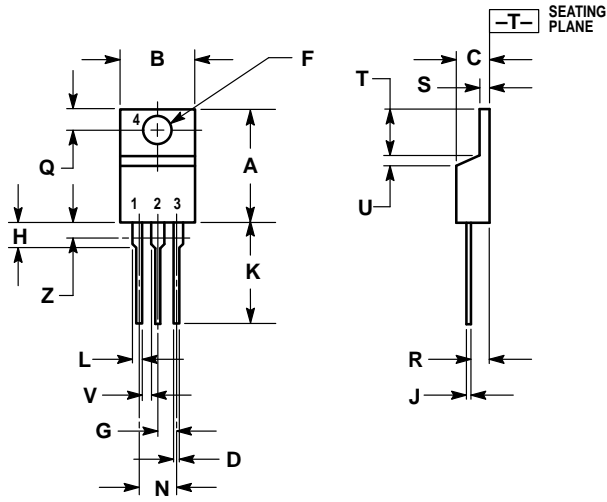


Figure 10. "On" Voltages

TIP120 TIP121 TIP122 TIP125 TIP126 TIP127
PACKAGE DIMENSIONS




- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

| DIM | INCHES | | MILLIMETERS | |
|-----|--------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.570 | 0.620 | 14.48 | 15.75 |
| B | 0.380 | 0.405 | 9.66 | 10.28 |
| C | 0.160 | 0.190 | 4.07 | 4.82 |
| D | 0.025 | 0.035 | 0.64 | 0.88 |
| F | 0.142 | 0.147 | 3.61 | 3.73 |
| G | 0.095 | 0.105 | 2.42 | 2.66 |
| H | 0.110 | 0.155 | 2.80 | 3.93 |
| J | 0.018 | 0.025 | 0.46 | 0.64 |
| K | 0.500 | 0.562 | 12.70 | 14.27 |
| L | 0.045 | 0.060 | 1.15 | 1.52 |
| N | 0.190 | 0.210 | 4.83 | 5.33 |
| Q | 0.100 | 0.120 | 2.54 | 3.04 |
| R | 0.080 | 0.110 | 2.04 | 2.79 |
| S | 0.045 | 0.055 | 1.15 | 1.39 |
| T | 0.235 | 0.255 | 5.97 | 6.47 |
| U | 0.000 | 0.050 | 0.00 | 1.27 |
| V | 0.045 | — | 1.15 | — |
| Z | — | 0.080 | — | 2.04 |

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

CASE 221A-06
TO-220AB
ISSUE Y

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