

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, $R_{BE} = 100 \Omega$.

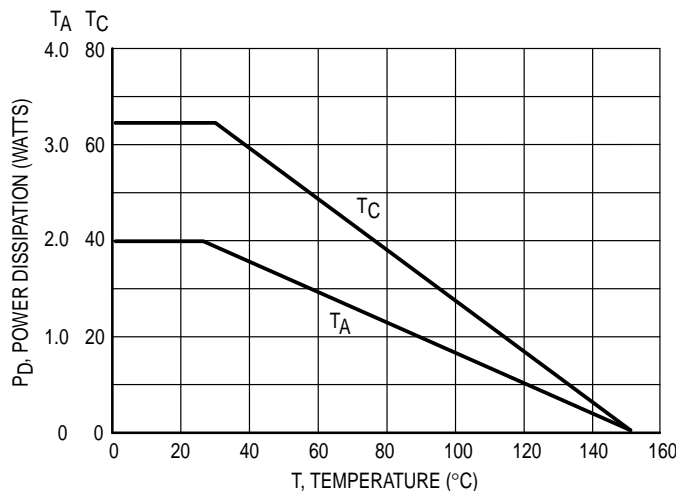


Figure 1. Power Derating

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 $\leq 2\%$.

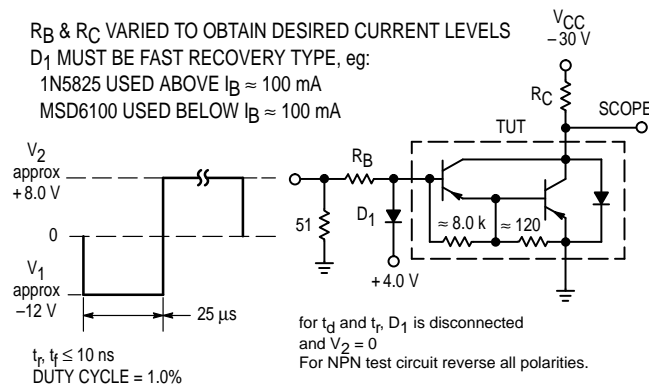


Figure 2. Switching Times Test Circuit

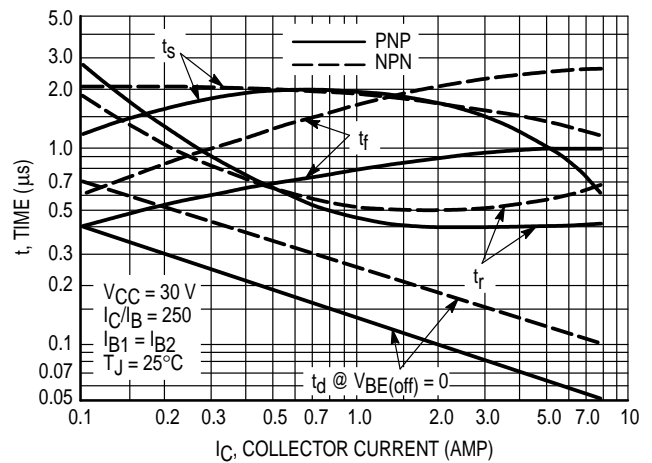


Figure 3. Switching Times

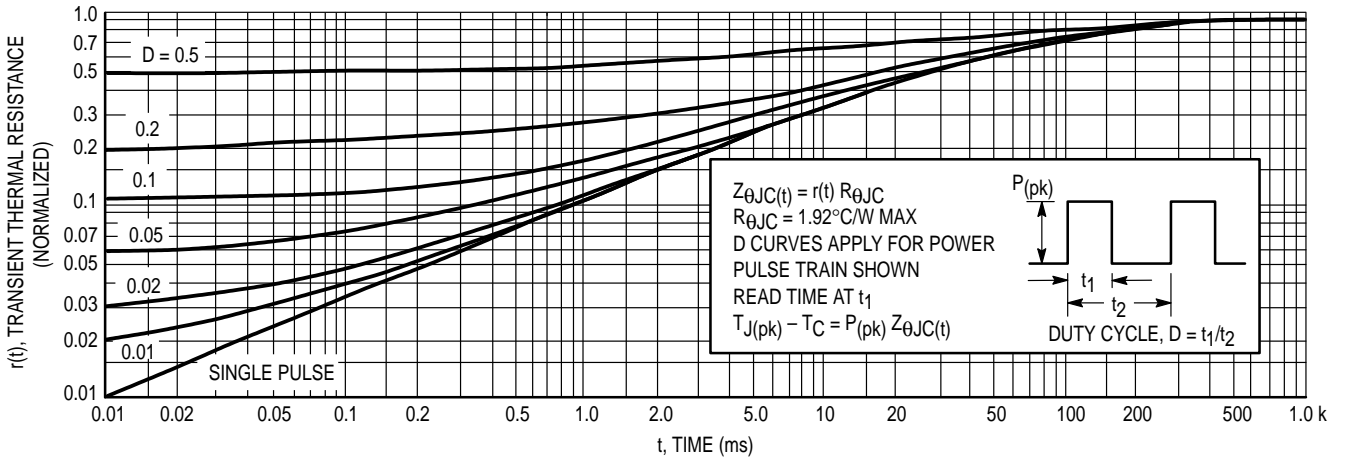


Figure 4. Thermal Response

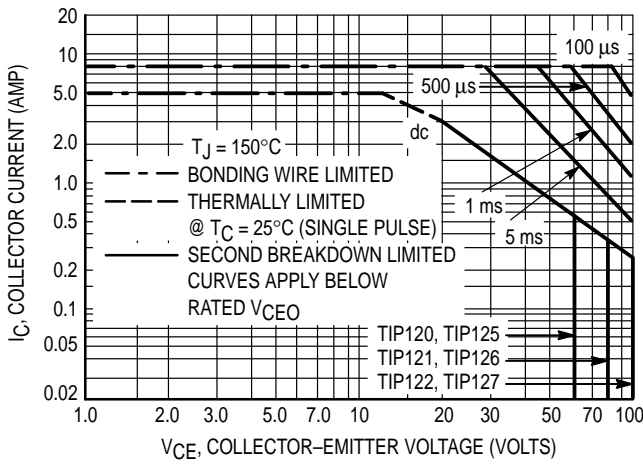


Figure 5. Active-Region Safe Operating Area

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

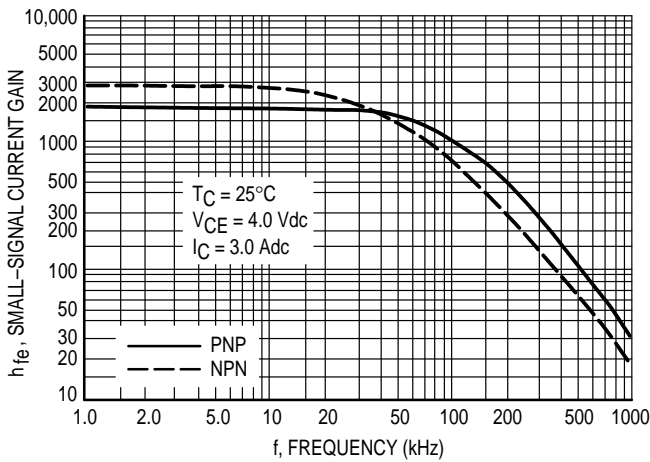


Figure 6. Small-Signal Current Gain

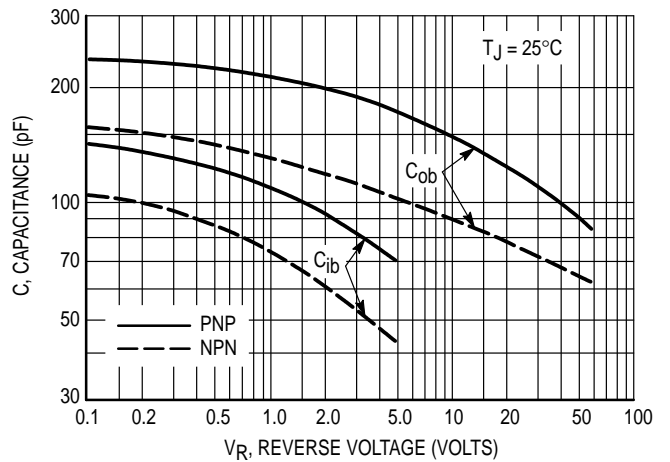


Figure 7. Capacitance

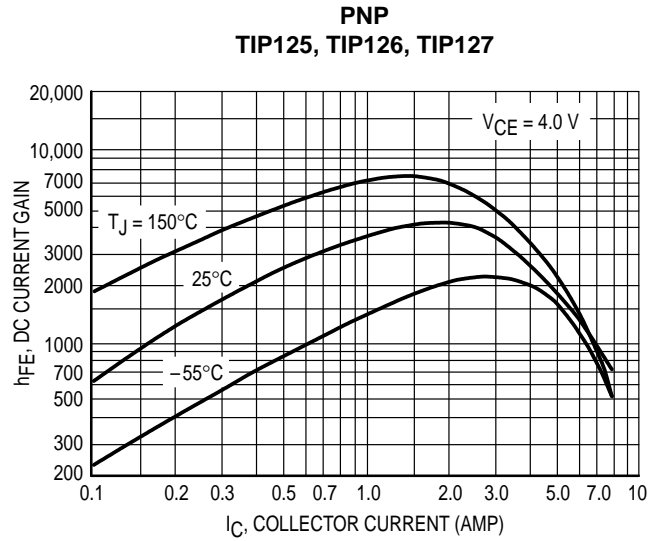
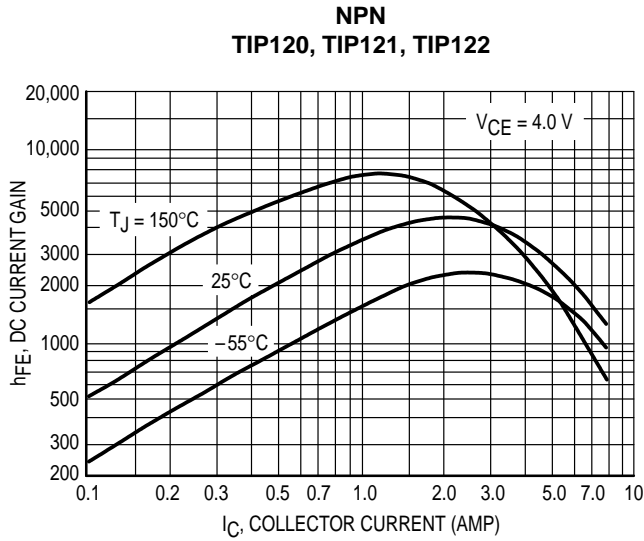


Figure 8. DC Current Gain

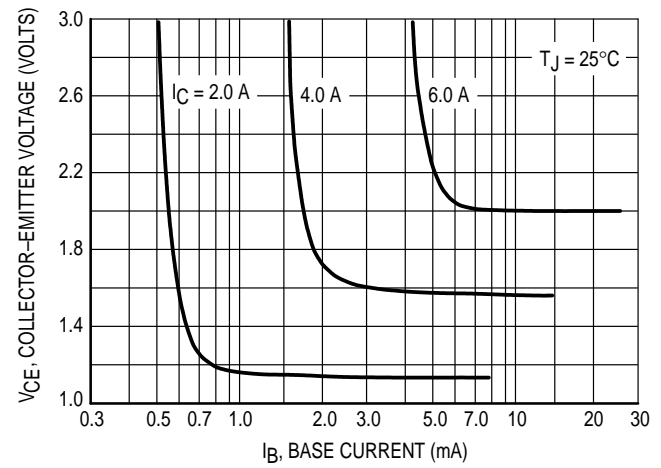
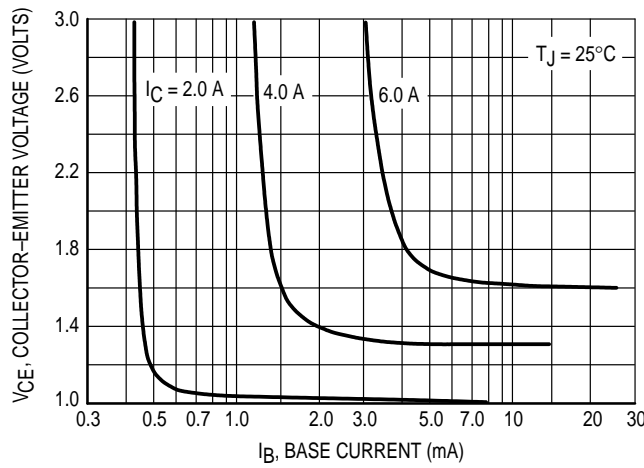


Figure 9. Collector Saturation Region

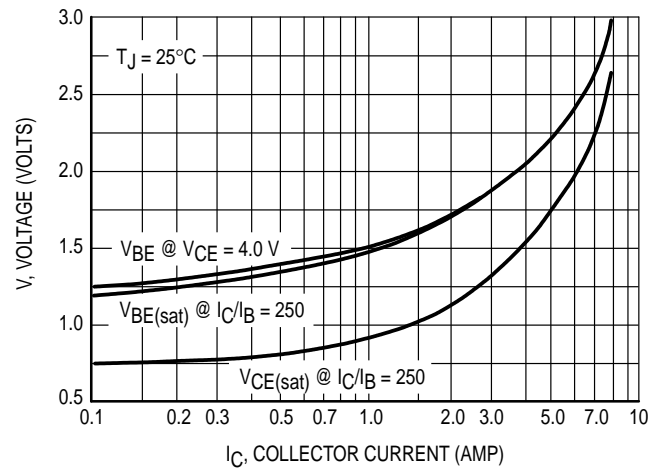
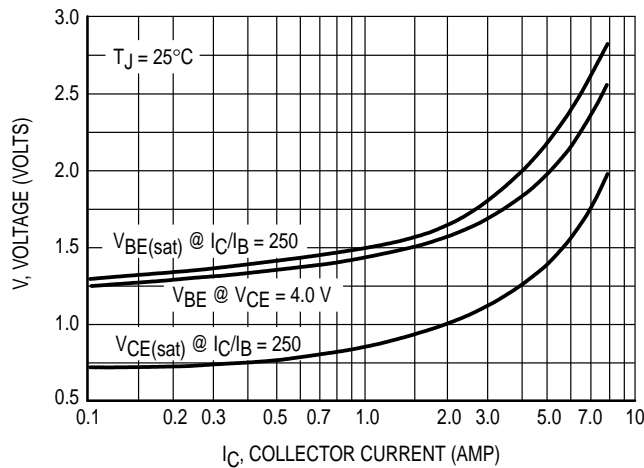
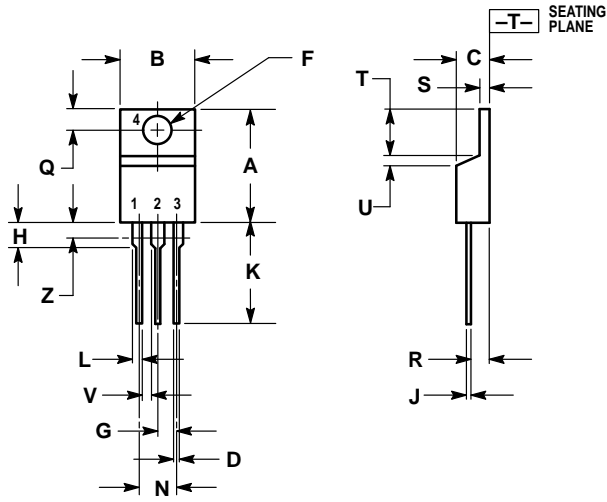


Figure 10. "On" Voltages

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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