MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

Order this document
by TIP120/D

Plastic Medium-Power Complementary Silicon Transistors

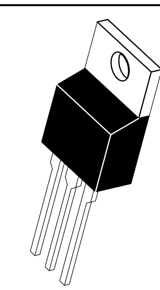
. . . designed for general–purpose amplifier and low–speed switching applications.

- 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

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

*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°C Derate above 25°C	P_D		65 0.52		Watts W/°C
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D		2.0 0.016		Watts W/°C
Unclamped Inductive Load Energy (1)	E		50		mJ
Operating and Storage Junction, Temperature Range	T_J, T_{stg}		–65 to +150		°C

THERMAL CHARACTERISTICS

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

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

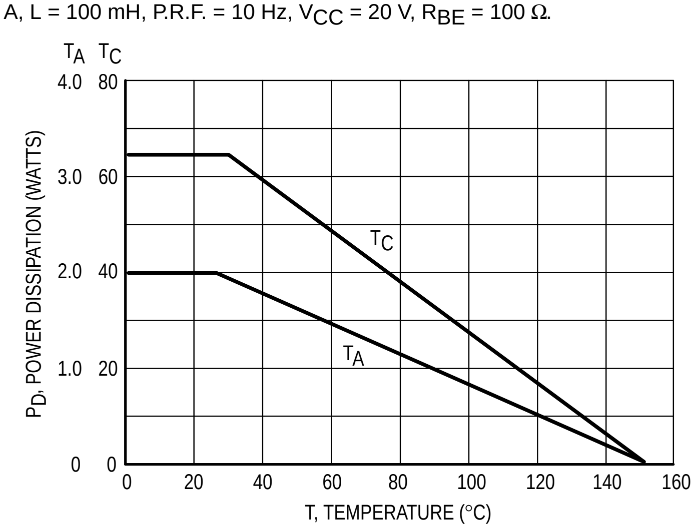


Figure 1. Power Derating

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

REV 2

MOTOROLA

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector–Emitter Sustaining Voltage (1) (I_C = 100 mAdc, I_B = 0)	 TIP120, TIP125 TIP121, TIP126 TIP122, TIP127	$V_{CEO(sus)}$	 60 80 100	 — — —	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc, I_B = 0) (V_{CE} = 40 Vdc, I_B = 0) (V_{CE} = 50 Vdc, I_B = 0)	 TIP120, TIP125 TIP121, TIP126 TIP122, TIP127	I_{CEO}	 — — —	 0.5 0.5 0.5	mAdc
Collector Cutoff Current (V_{CB} = 60 Vdc, I_E = 0) (V_{CB} = 80 Vdc, I_E = 0) (V_{CB} = 100 Vdc, I_E = 0)	 TIP120, TIP125 TIP121, TIP126 TIP122, TIP127	I_{CBO}	 — — —	 0.2 0.2 0.2	mAdc
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)		I_{EBO}	—	2.0	mAdc
ON CHARACTERISTICS (1)					
DC Current Gain (I_C = 0.5 Adc, V_{CE} = 3.0 Vdc) (I_C = 3.0 Adc, V_{CE} = 3.0 Vdc)		h_{FE}	 1000 1000	 — —	—
Collector–Emitter Saturation Voltage (I_C = 3.0 Adc, I_B = 12 mAdc) (I_C = 5.0 Adc, I_B = 20 mAdc)		$V_{CE(sat)}$	 — —	 2.0 4.0	Vdc
Base–Emitter On Voltage (I_C = 3.0 Adc, V_{CE} = 3.0 Vdc)		$V_{BE(on)}$	—	2.5	Vdc
DYNAMIC CHARACTERISTICS					
Small–Signal Current Gain (I_C = 3.0 Adc, V_{CE} = 4.0 Vdc, f = 1.0 MHz)		h_{fe}	4.0	—	—
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 0.1 MHz	 TIP125, TIP126, TIP127 TIP120, TIP121, TIP122	C_{ob}	 — —	 300 200	pF

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

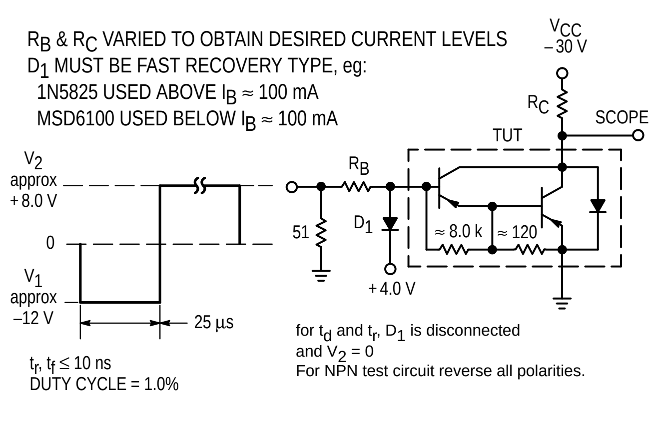


Figure 2. Switching Times Test Circuit

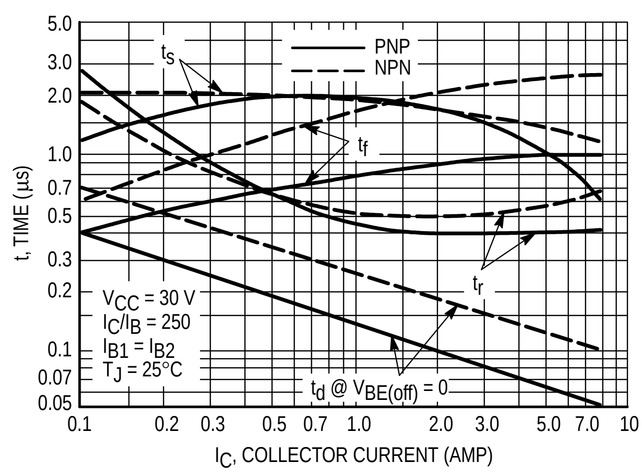


Figure 3. Switching Times

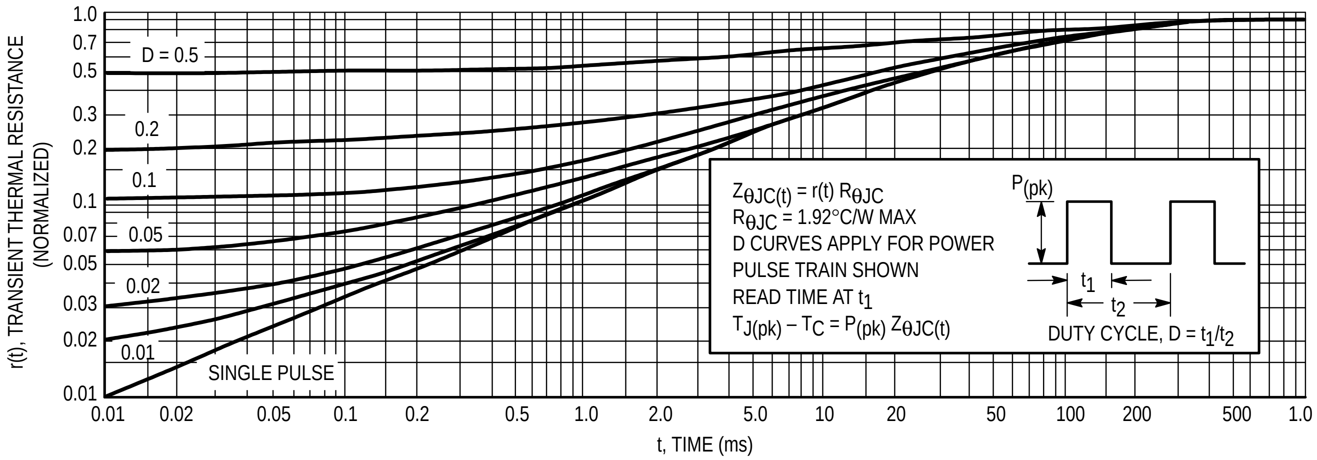


Figure 4. Thermal Response

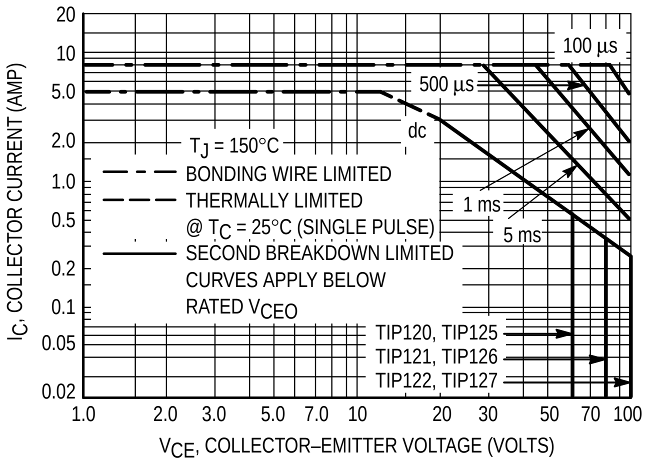


Figure 5. Active–Region Safe Operating Area

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 $T_{J(pk)} = 150°C$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} < 150°C$. $T_{J(pk)}$ 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

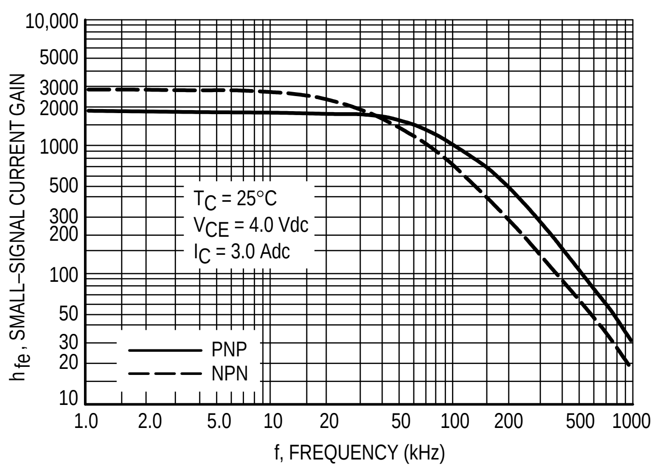


Figure 6. Small–Signal Current Gain

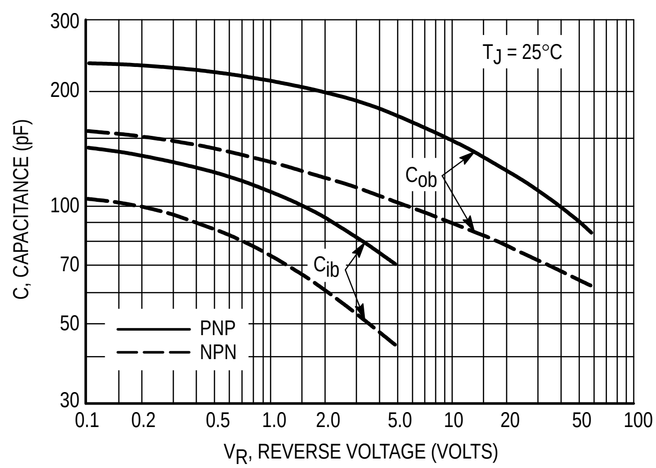


Figure 7. Capacitance

NPN
TIP120, TIP121, TIP122

PNP
TIP125, TIP126, TIP127

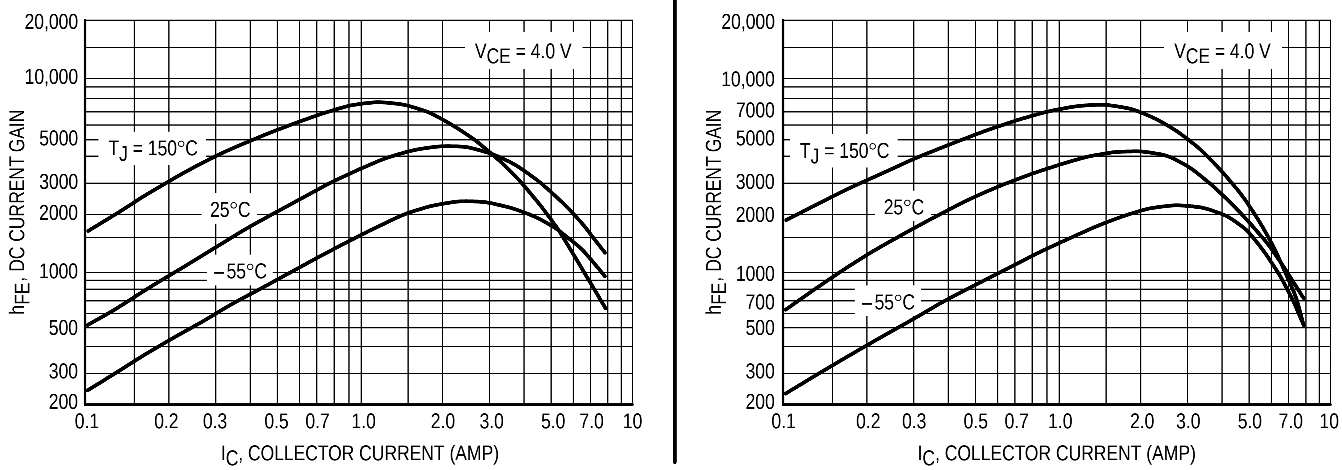


Figure 8. DC Current Gain

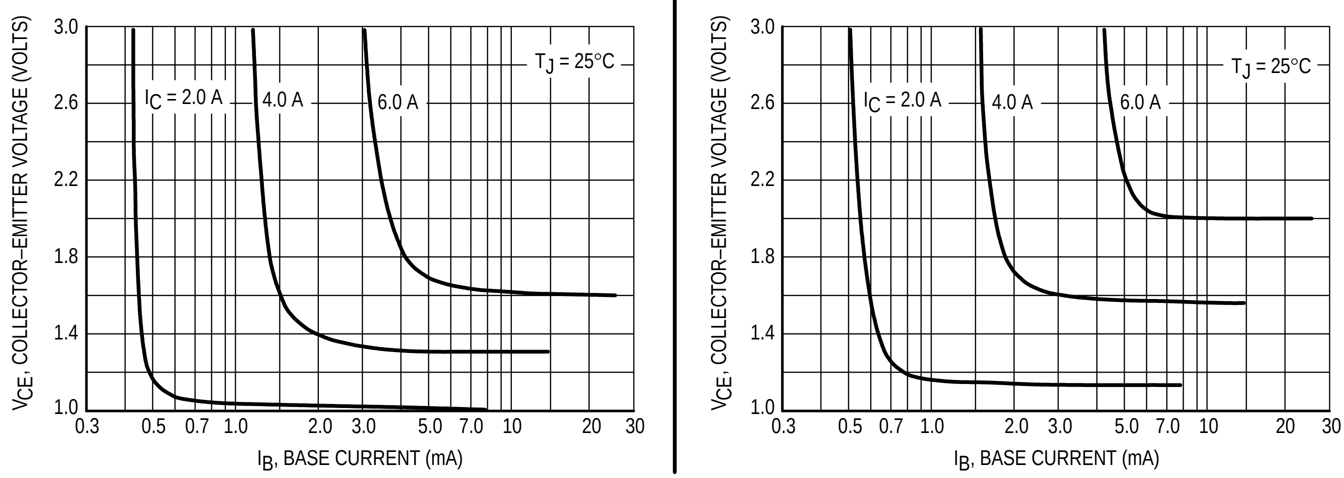


Figure 9. Collector Saturation Region

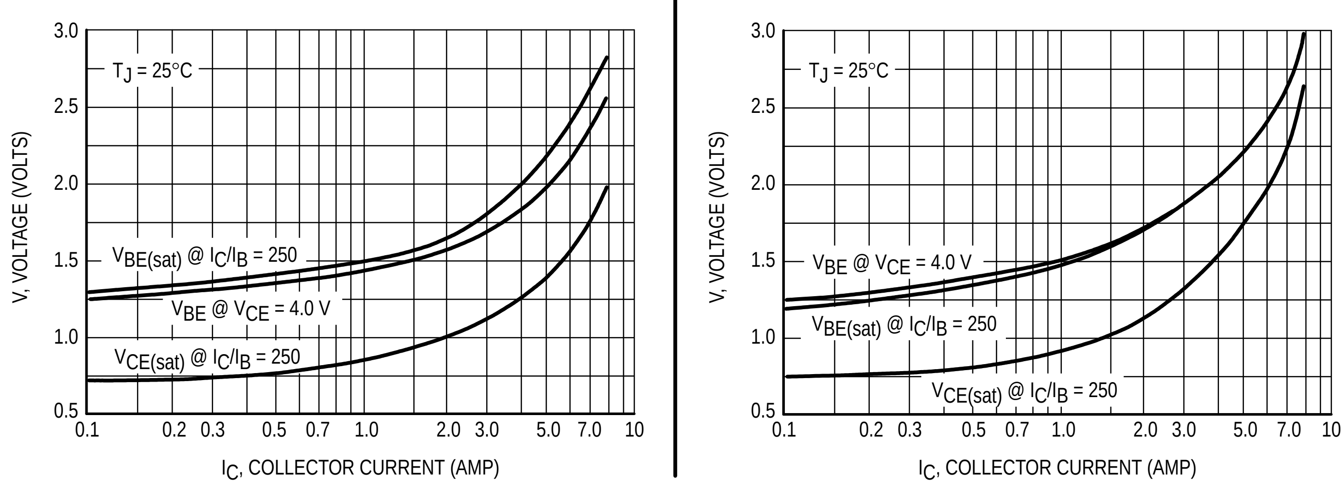
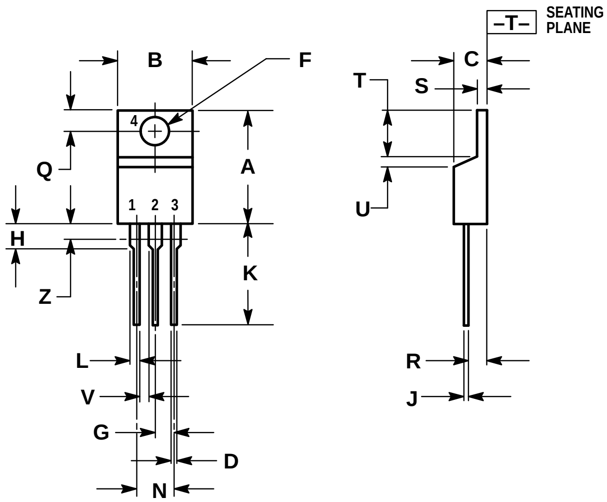


Figure 10. "On" Voltages

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.

	INCHES		MILLIMETERS	
DIM	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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