Darlington Complementary Silicon Power Transistors

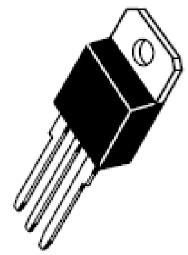
. . . designed for general–purpose amplifier and low frequency switching applications.

- High DC Current Gain — Min h_{FE} = 1000 @ I_C = 5 A, V_{CE} = 4 V
- Collector–Emitter Sustaining Voltage — @ 30 mA
  $V_{CEO(sus)}$ = 60 Vdc (Min) — TIP140, TIP145
  80 Vdc (Min) — TIP141, TIP146
  100 Vdc (Min) — TIP142, TIP147
- Monolithic Construction with Built–In Base–Emitter Shunt Resistor

NPN
TIP140
TIP141*
TIP142*
PNP
TIP145
TIP146*
TIP147*

*Motorola Preferred Device

10 AMPERE DARLINGTON COMPLEMENTARY SILICON POWER TRANSISTORS 60–100 VOLTS 125 WATTS



CASE 340D–01

MAXIMUM RATINGS

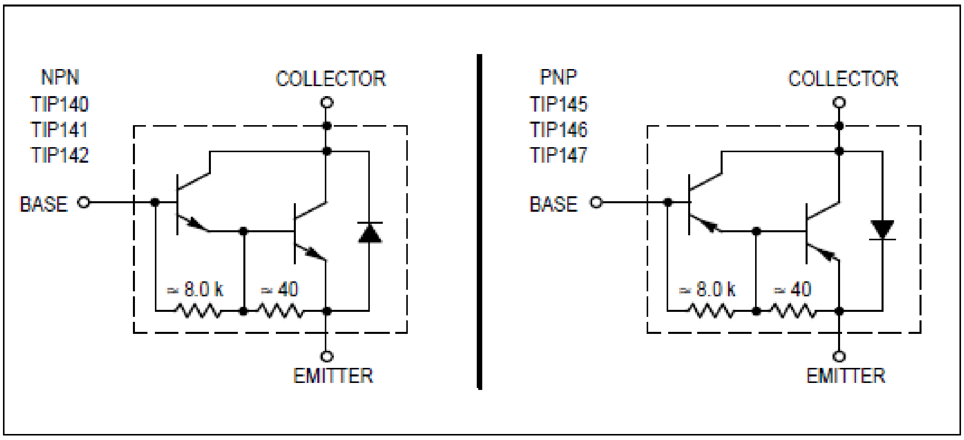
Rating	Symbol	TIP140 TIP145	TIP141 TIP146	TIP142 TIP147	Unit
Collector–Emitter Voltage	V_{CEO}	60	80	100	Vdc
Collector–Base Voltage	V_{CB}	60	80	100	Vdc
Emitter–Base Voltage	V_{EB}	5.0			Vdc
Collector Current — Continuous Peak (1)	I_C	10 15			Adc
Base Current — Continuous	I_B	0.5			Adc
Total Device Dissipation @ T_C = 25°C	P_D	125			Watts
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	$R_{\theta JC}$	1.0	°C/W
Thermal Resistance, Case to Ambient	$R_{\theta JA}$	35.7	°C/W

(1) 5 ms, ≤ 10% Duty Cycle.

DARLINGTON SCHEMATICS

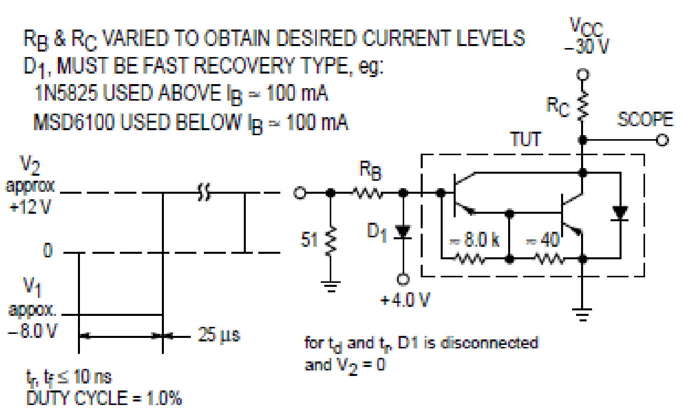


Preferred devices are Motorola recommended choices for future use and best overall value.

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector–Emitter Sustaining Voltage (1) (I_C = 30 mA, I_B = 0) TIP140, TIP145 TIP141, TIP146 TIP142, TIP147	$V_{CEO(sus)}$	60 80 100	— — —	— — —	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc, I_B = 0) TIP140, TIP145 (V_{CE} = 40 Vdc, I_B = 0) TIP141, TIP146 (V_{CE} = 50 Vdc, I_B = 0) TIP142, TIP147	I_{CEO}	— — —	— — —	2.0 2.0 2.0	mA
Collector Cutoff Current (V_{CB} = 60 V, I_E = 0) TIP140, TIP145 (V_{CB} = 80 V, I_E = 0) TIP141, TIP146 (V_{CB} = 100 V, I_E = 0) TIP142, TIP147	I_{CBO}	— — —	— — —	1.0 1.0 1.0	mA
Emitter Cutoff Current (V_{BE} = 5.0 V)	I_{EBO}	—	—	2 0	mA
ON CHARACTERISTICS (1)					
DC Current Gain (I_C = 5.0 A, V_{CE} = 4.0 V) (I_C = 10 A, V_{CE} = 4.0 V)	h_{FE}	1000 500	— —	— —	—
Collector–Emitter Saturation Voltage (I_C = 5.0 A, I_B = 10 mA) (I_C = 10 A, I_B = 40 mA)	$V_{CE(sat)}$	— —	— —	2.0 3.0	Vdc
Base–Emitter Saturation Voltage (I_C = 10 A, I_B = 40 mA)	$V_{BE(sat)}$	—	—	3.5	Vdc
Base–Emitter On Voltage (I_C = 10 A, V_{CE} = 4.0 Vdc)	$V_{BE(on)}$	—	—	3.0	Vdc
SWITCHING CHARACTERISTICS					
Resistive Load (See Figure 1) (V_{CC} = 30 V, I_C = 5.0 A, I_B = 20 mA, Duty Cycle ≤ 2.0%, I_{B1} = I_{B2}, R_C & R_B Varied, T_J = 25°C)					
Delay Time	t_d	—	0.15	—	µs
Rise Time	t_r	—	0.55	—	µs
Storage Time	t_s	—	2.5	—	µs
Fall Time	t_f	—	2.5	—	µs

(1) Pulse Test: Pulse Width = 300 µs, Duty Cycle ≤ 2.0%.



For NPN test circuit reverse diode and voltage polarities.

Figure 1. Switching Times Test Circuit

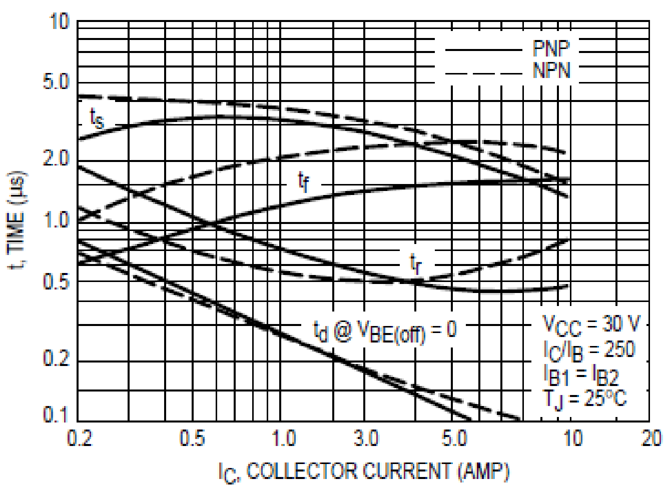


Figure 2. Switching Times

TYPICAL CHARACTERISTICS

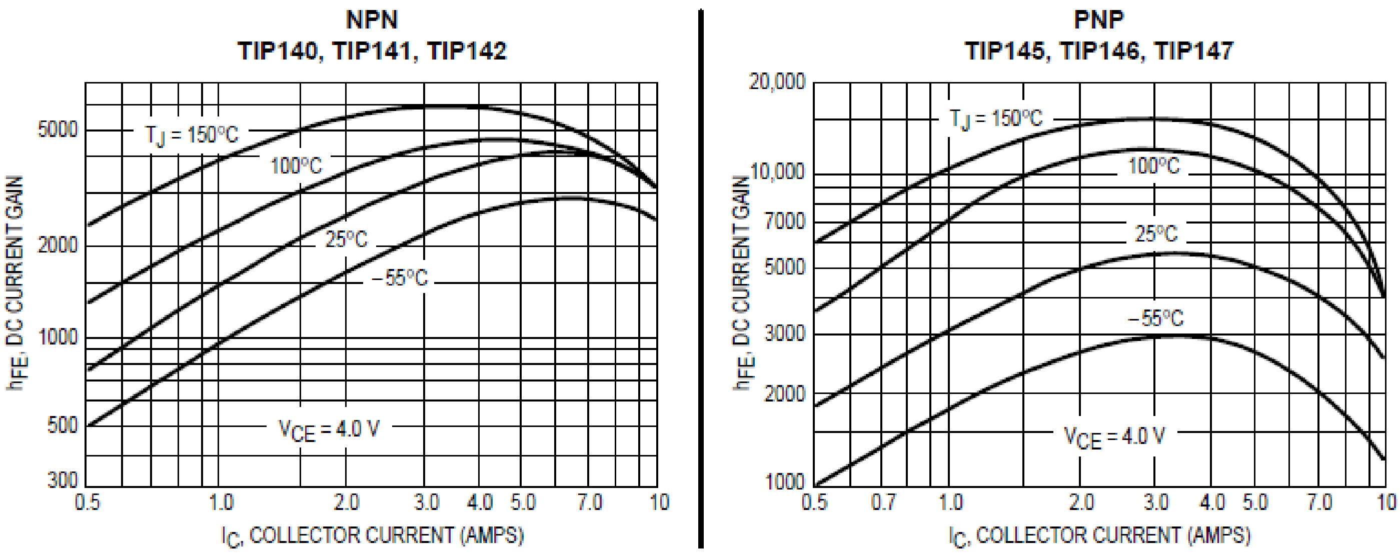


Figure 3. DC Current Gain versus Collector Current

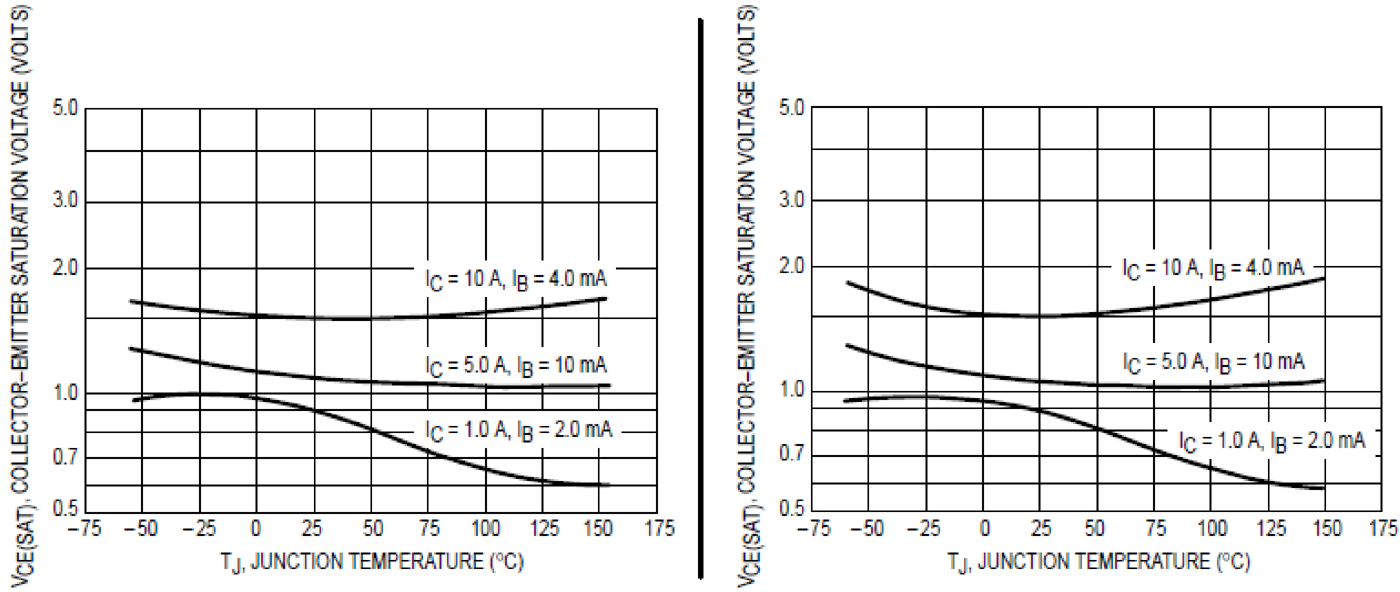


Figure 4. Collector–Emitter Saturation Voltage

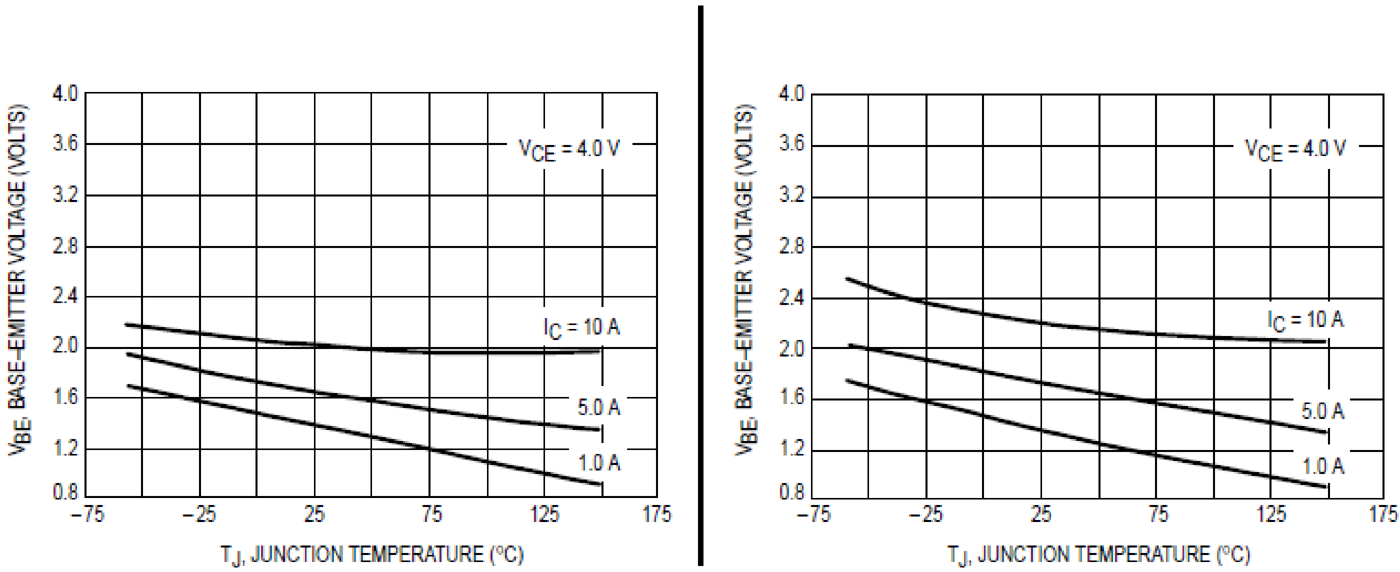


Figure 5. Base–Emitter Voltage

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 6 is based on $T_{J(pk)} = 150°C$; T_C is variable depending on conditions. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

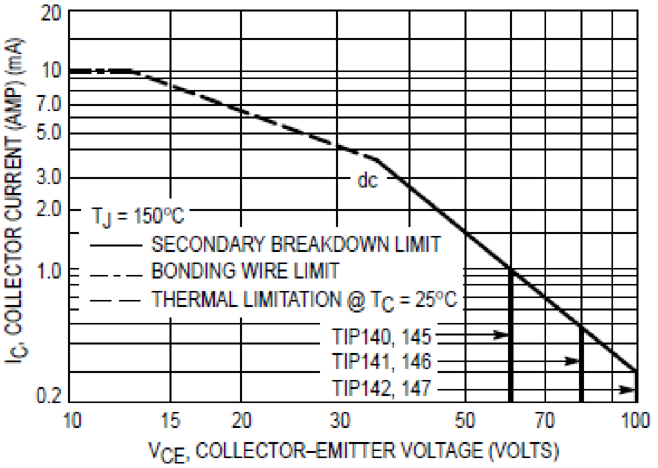


Figure 6. Active–Region Safe Operating Area

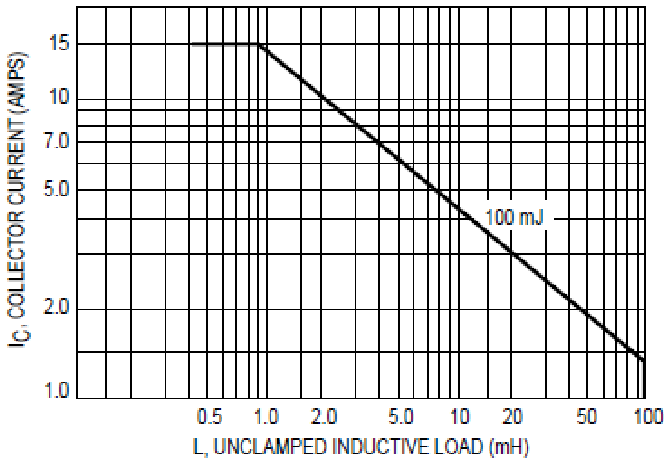
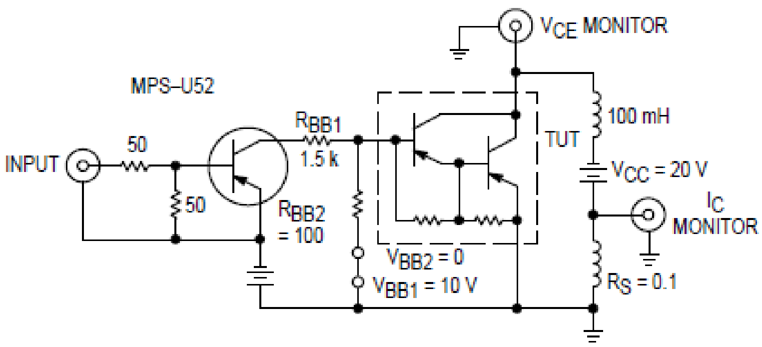
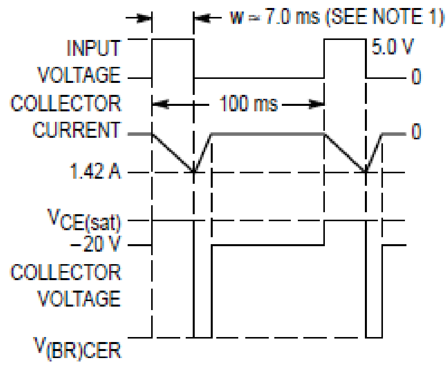


Figure 7. Unclamped Inductive Load



TEST CIRCUIT

NOTE 1: Input pulse width is increased until I_{CM} = 1.42 A.
NOTE 2: For NPN test circuit reverse polarities.



VOLTAGE AND CURRENT WAVEFORMS

Figure 8. Inductive Load

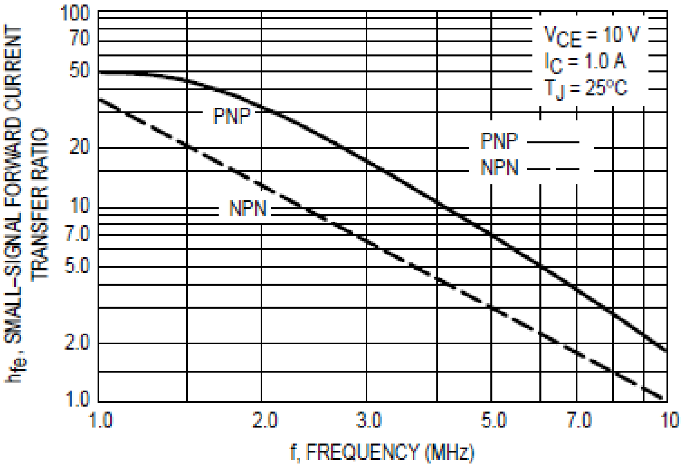


Figure 9. Magnitude of Common Emitter Small–Signal Short–Circuit Forward Current Transfer Ratio

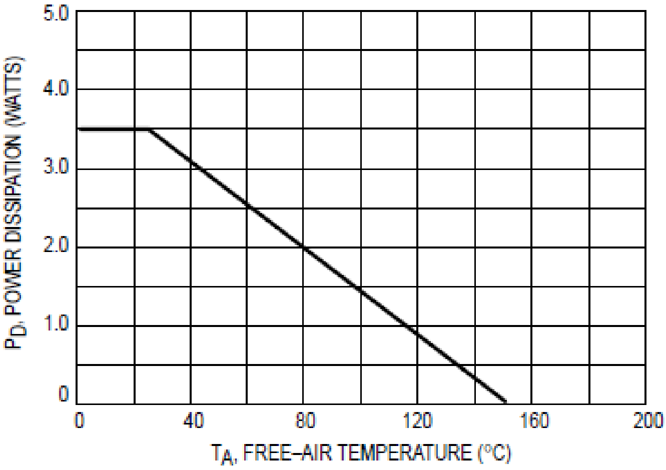


Figure 10. Free–Air Temperature Power Derating