

Darlington Complementary Silicon Power Transistors

This series of plastic, medium-power silicon NPN and PNP Darlington transistors are designed for general purpose and low speed switching applications.

Features

- High DC Current Gain – $h_{FE} = 2500$ (typ) @ $I_C = 5.0$ Adc.
- Collector Emitter Sustaining Voltage @ 30 mAdc:
 $V_{CEO(sus)} = 80$ Vdc (min) – BDW46
 100 Vdc (min) – BDW42/BDW47
- Low Collector Emitter Saturation Voltage
 $V_{CE(sat)} = 2.0$ Vdc (max) @ $I_C = 5.0$ Adc
 3.0 Vdc (max) @ $I_C = 10.0$ Adc
- Monolithic Construction with Built-In Base Emitter Shunt resistors
- TO-220AB Compact Package
- Pb-Free Packages Are Available*

MAXIMUM RATINGS

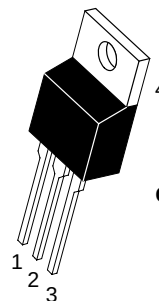
Rating	Symbol	Value	Unit
Collector-Emitter Voltage BDW46 BDW42, BDW47	V_{CEO}	80 100	Vdc
Collector-Base Voltage BDW46 BDW42, BDW47	V_{CB}	80 100	Vdc
Emitter-Base Voltage	V_{EB}	5.0	Vdc
Collector Current	I_C	15	Adc
Base Current	I_B	0.5	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	85 0.68	W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.47	$^\circ\text{C/W}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

**15 AMP DARLINGTON
COMPLEMENTARY SILICON
POWER TRANSISTORS
80-100 VOLT, 85 WATT**



TO-220AB
CASE 221A-09
STYLE 1

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

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Collector Emitter Sustaining Voltage (Note 1) ($I_C = 30\text{ mAdc}$, $I_B = 0$)	BDW46 BDW42/BDW47	$V_{CEO(sus)}$	80 100	– –	Vdc
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 50\text{ Vdc}$, $I_B = 0$)	BDW46 BDW42/BDW47	I_{CEO}	– –	2.0 2.0	mAdc
Collector Cutoff Current ($V_{CB} = 80\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 100\text{ Vdc}$, $I_E = 0$)	BDW46 BDW42/BDW47	I_{CBO}	– –	1.0 1.0	mAdc
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)		I_{EBO}	–	2.0	mAdc

ON CHARACTERISTICS (Note 1)

DC Current Gain ($I_C = 5.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) ($I_C = 10\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)		h_{FE}	1000 250	– –	
Collector–Emitter Saturation Voltage ($I_C = 5.0\text{ Adc}$, $I_B = 10\text{ mAdc}$) ($I_C = 10\text{ Adc}$, $I_B = 50\text{ mAdc}$)		$V_{CE(sat)}$	– –	2.0 3.0	Vdc
Base–Emitter On Voltage ($I_C = 10\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)		$V_{BE(on)}$	–	3.0	Vdc

SECOND BREAKDOWN (Note 2)

Second Breakdown Collector Current with Base Forward Biased BDW42	$V_{CE} = 28.4\text{ Vdc}$	$I_{S/b}$	3.0	–	Adc
	$V_{CE} = 40\text{ Vdc}$		1.2	–	
BDW46/BDW47	$V_{CE} = 22.5\text{ Vdc}$		3.8	–	
	$V_{CE} = 36\text{ Vdc}$		1.2	–	

DYNAMIC CHARACTERISTICS

Magnitude of common emitter small signal short circuit current transfer ratio ($I_C = 3.0\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$, $f = 1.0\text{ MHz}$)		f_T	4.0	–	MHz
Output Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 0.1\text{ MHz}$)	BDW42 BDW46/BDW47	C_{ob}	– –	200 300	pF
Small–Signal Current Gain ($I_C = 3.0\text{ Adc}$, $V_{CE} = 3.0\text{ Vdc}$, $f = 1.0\text{ kHz}$)		h_{fe}	300	–	

1. Pulse Test: Pulse Width = 300 μs , Duty Cycle = 2.0%.
2. Pulse Test non repetitive: Pulse Width = 250 ms.

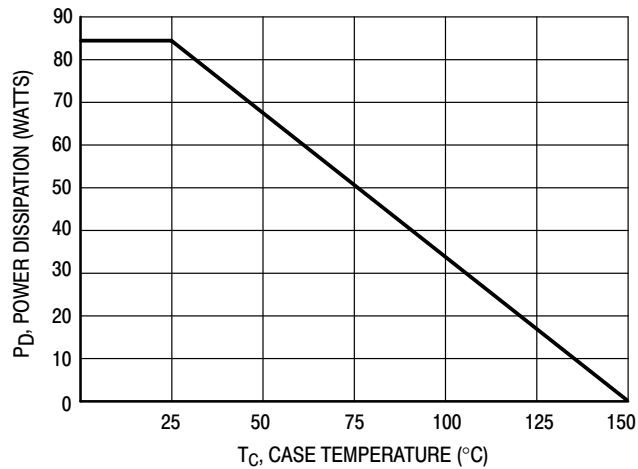


Figure 1. Power Temperature Derating Curve

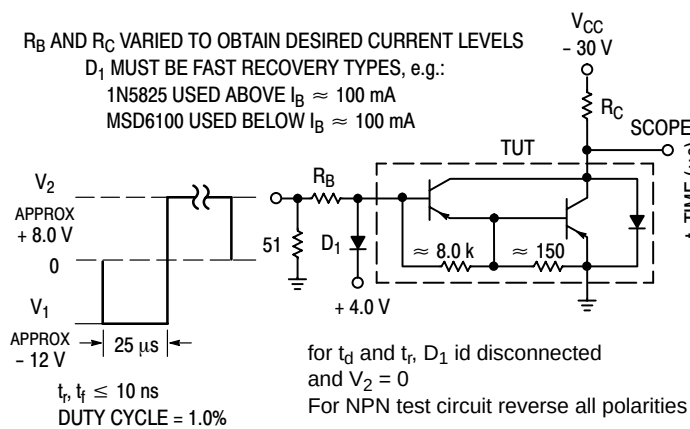


Figure 2. Switching Times Test Circuit

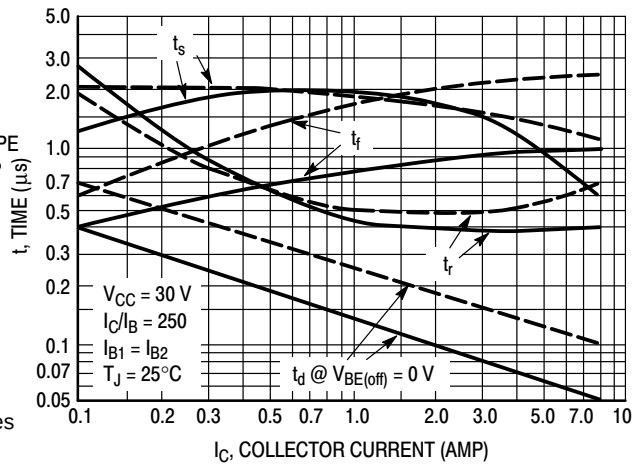


Figure 3. Switching Times

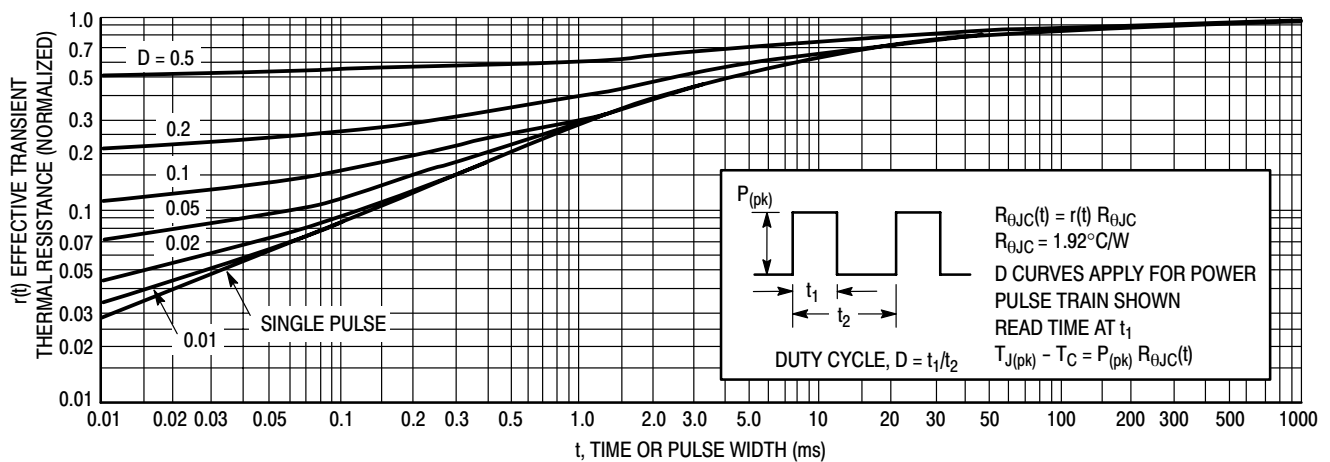


Figure 4. Thermal Response

ACTIVE-REGION SAFE OPERATING AREA

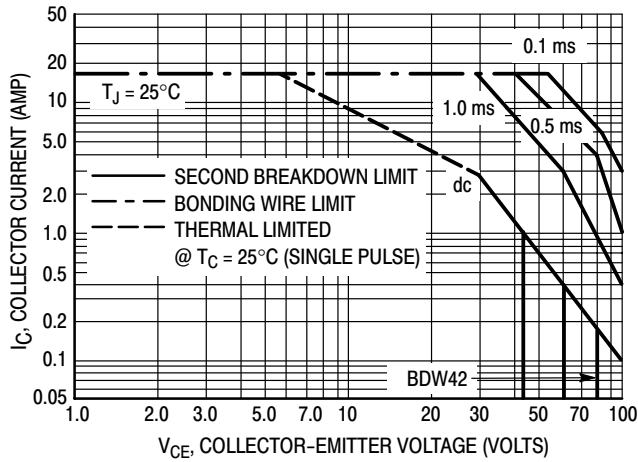


Figure 5. BDW42

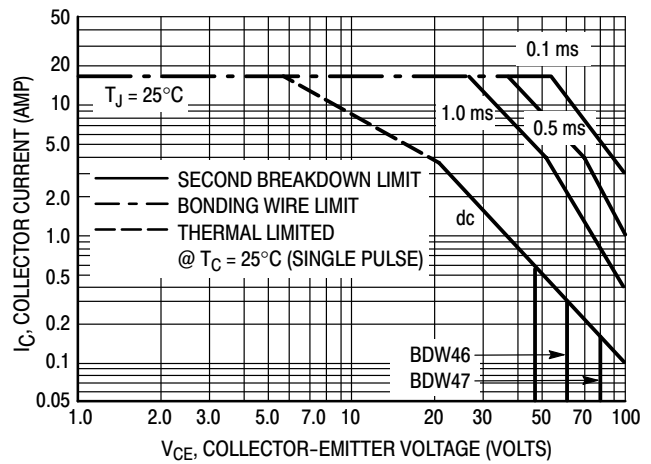


Figure 6. BDW46 and BDW47

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 and 6 is based on $T_{J(pk)} = 200^\circ\text{C}$; T_C is variable depending on conditions.

Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 200^\circ\text{C}$. $T_{J(pk)}$ 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.

*Linear extrapolation

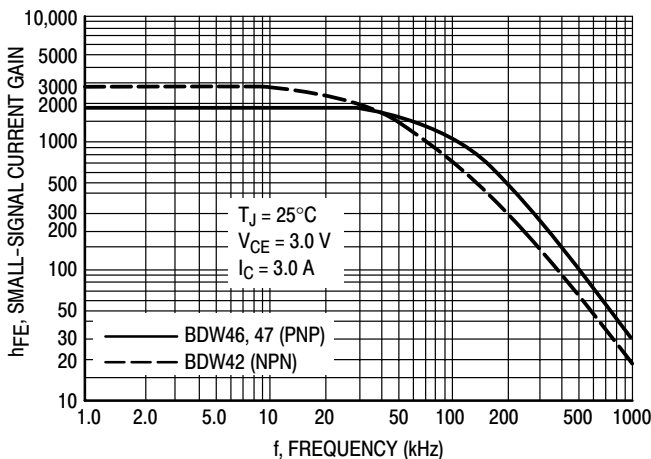


Figure 7. Small-Signal Current Gain

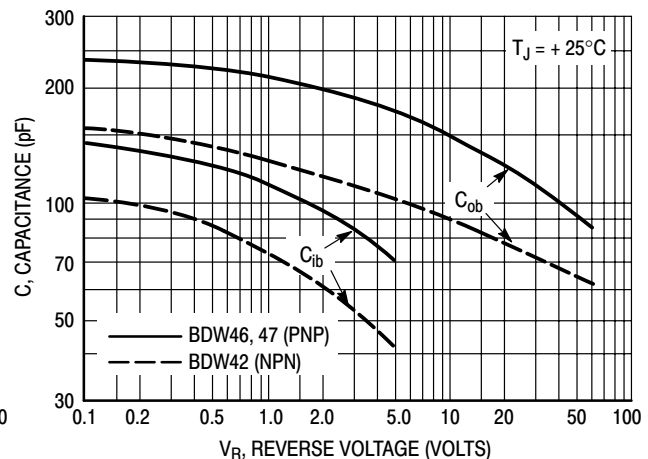
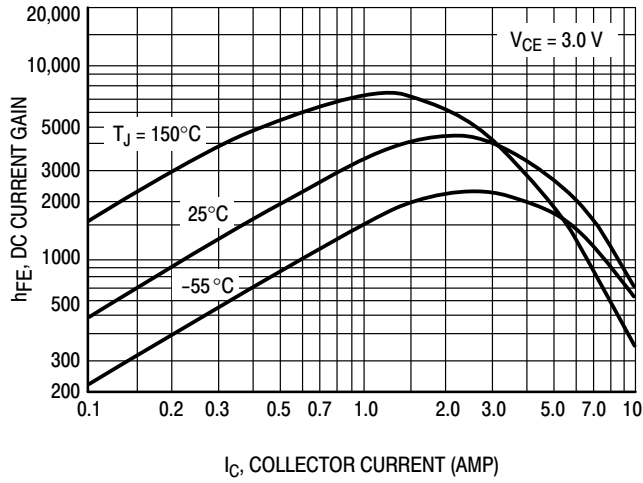


Figure 8. Capacitance

BDW42 (NPN)



BDW46, 47 (PNP)

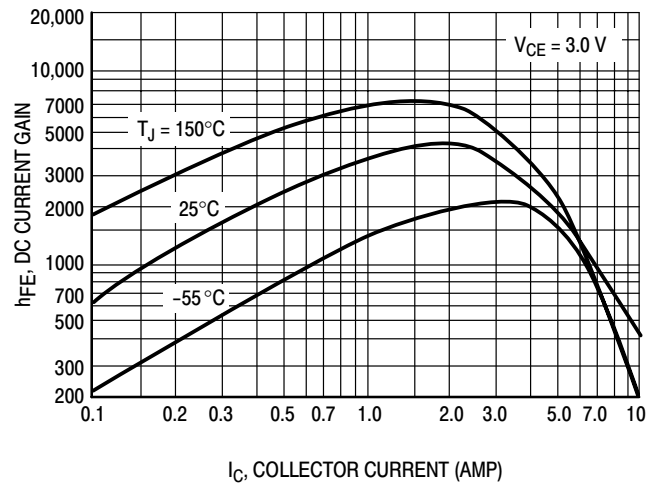


Figure 9. DC Current Gain

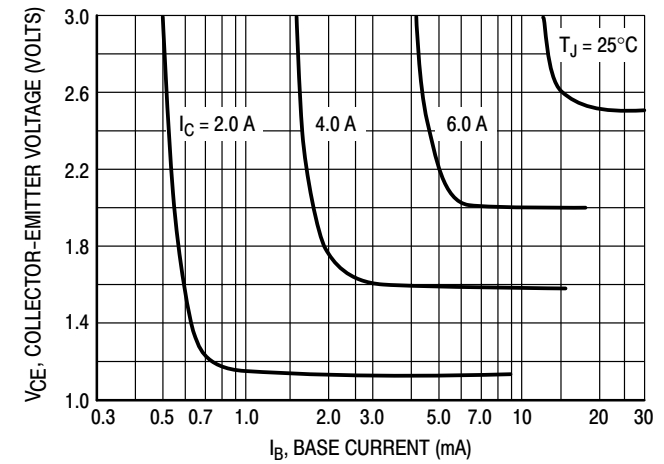
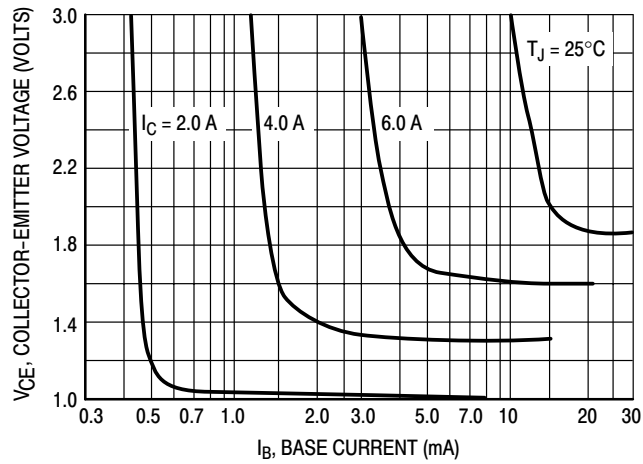


Figure 10. Collector Saturation Region

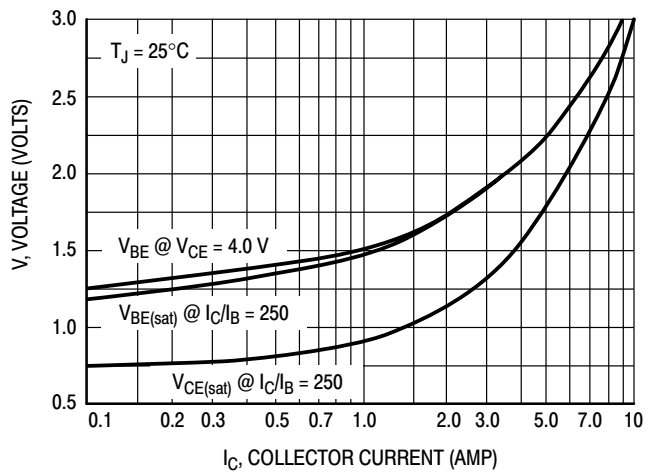
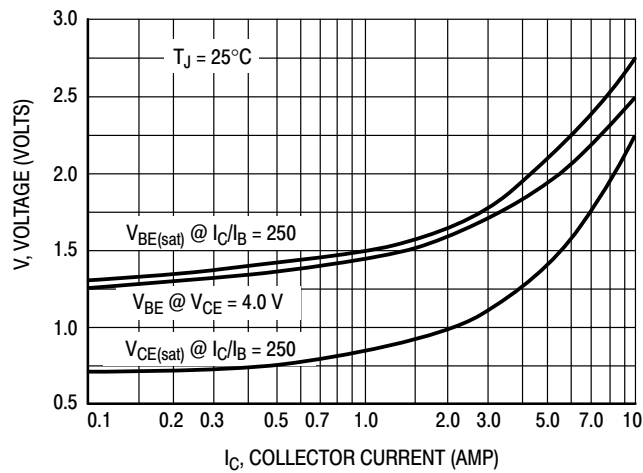
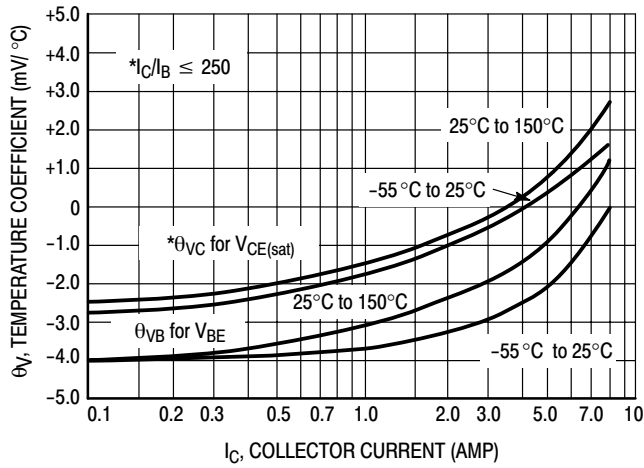


Figure 11. "On" Voltages

BDW42 (NPN)



BDW46, 47 (PNP)

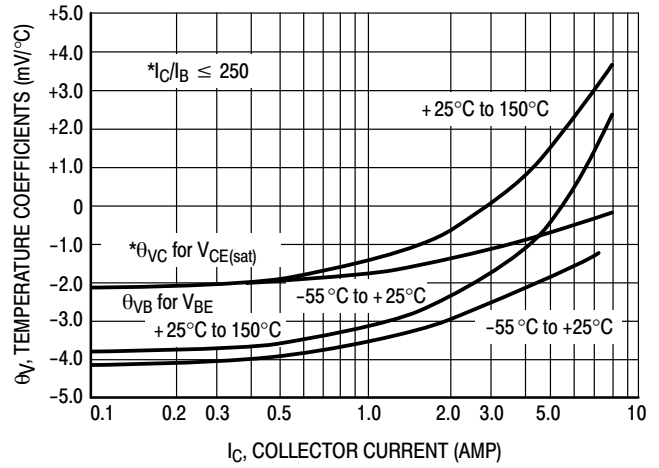


Figure 12. Temperature Coefficients

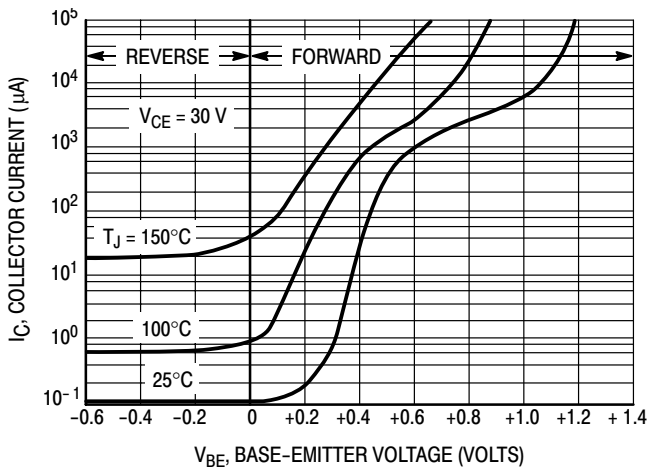
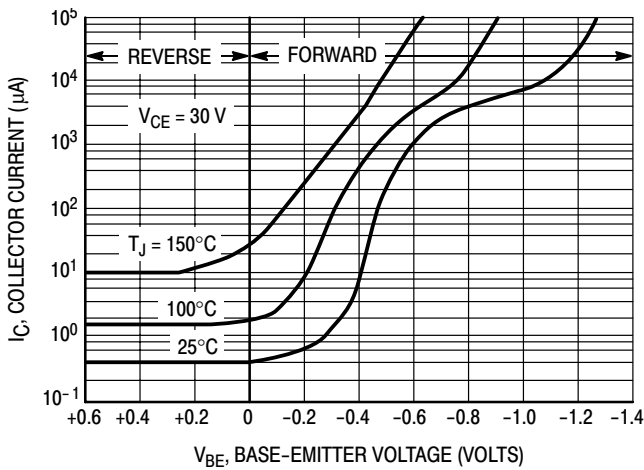


Figure 13. Collector Cut-Off Region

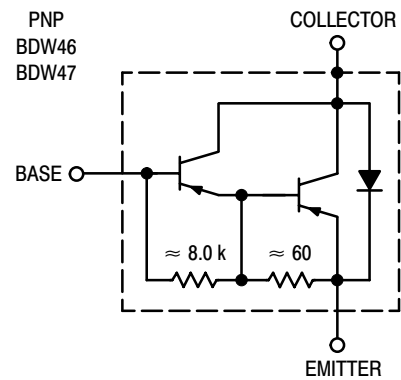
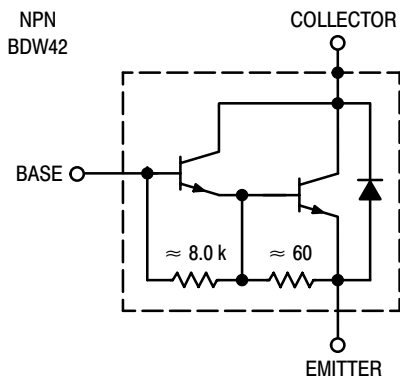


Figure 14. Darlington Schematic