

# Darlington Complementary Silicon Power Transistors

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

- 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

## MAXIMUM RATINGS

Rating	Symbol	BDW46	BDW42 BDW47	Unit
Collector–Emitter Voltage	$V_{CEO}$	80	100	Vdc
Collector–Base Voltage	$V_{CB}$	80	100	Vdc
Emitter–Base Voltage	$V_{EB}$	5.0		Vdc
Collector Current — Continuous	$I_C$	15		A dc
Base Current	$I_B$	0.5		A dc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	85 0.68		Watts 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	$^\circ\text{C}/\text{W}$

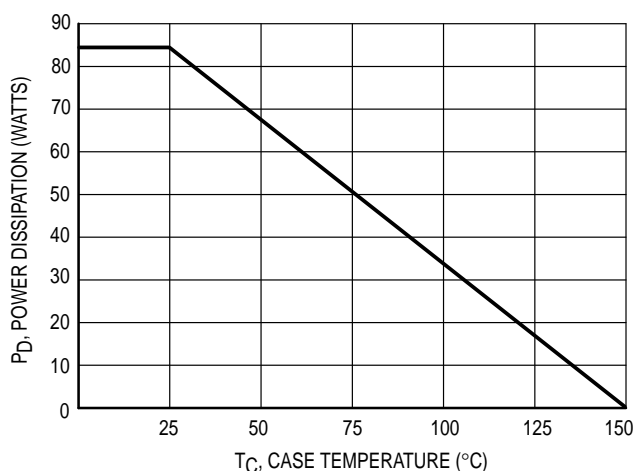


Figure 1. Power Temperature Derating Curve

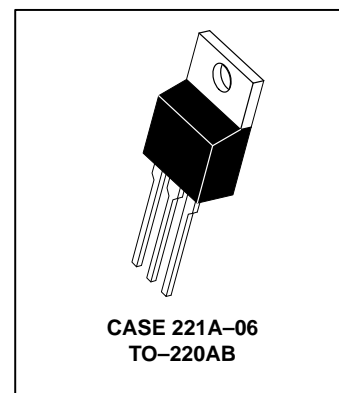
Preferred devices are Motorola recommended choices for future use and best overall value.

REV 7

**NPN**  
**BDW42\***  
**PNP**  
**BDW46**  
  
**BDW47\***

\*Motorola Preferred Device

**DARLINGTON**  
**15 AMPERE**  
**COMPLEMENTARY**  
**SILICON**  
**POWER TRANSISTORS**  
**80–100 VOLTS**  
**85 WATTS**



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

Characteristic	Symbol	Min	Max	Unit	
<b>OFF CHARACTERISTICS</b>					
Collector Emitter Sustaining Voltage (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 ( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 100\text{ Vdc}$ , $I_E = 0$ )	BDW41/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 (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 (2)**

Second Breakdown Collector Current with Base Forward Biased BDW42	$I_{S/b}$	$V_{CE} = 28.4\text{ Vdc}$ $V_{CE} = 40\text{ Vdc}$	3.0 1.2	— —	Adc
BDW46/BDW47		$V_{CE} = 22.5\text{ Vdc}$ $V_{CE} = 36\text{ Vdc}$	3.8 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  $\mu\text{s}$ , Duty Cycle = 2.0%.
- (2) Pulse Test non repetitive: Pulse Width = 250 ms.

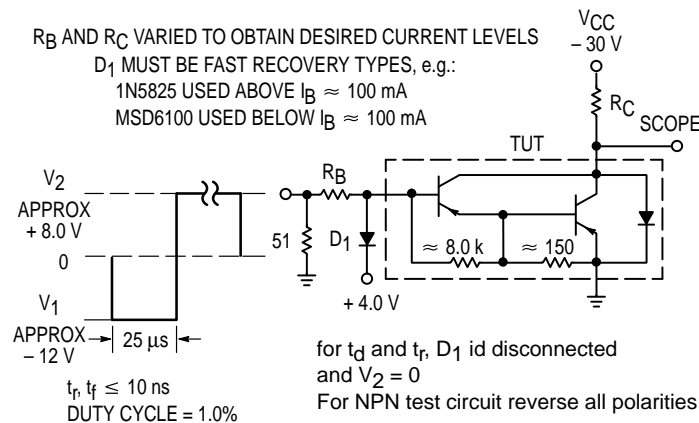


Figure 2. Switching Times Test Circuit

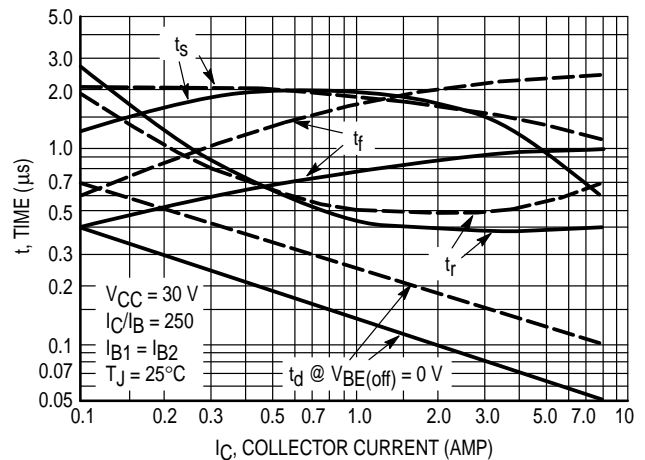


Figure 3. Switching Times

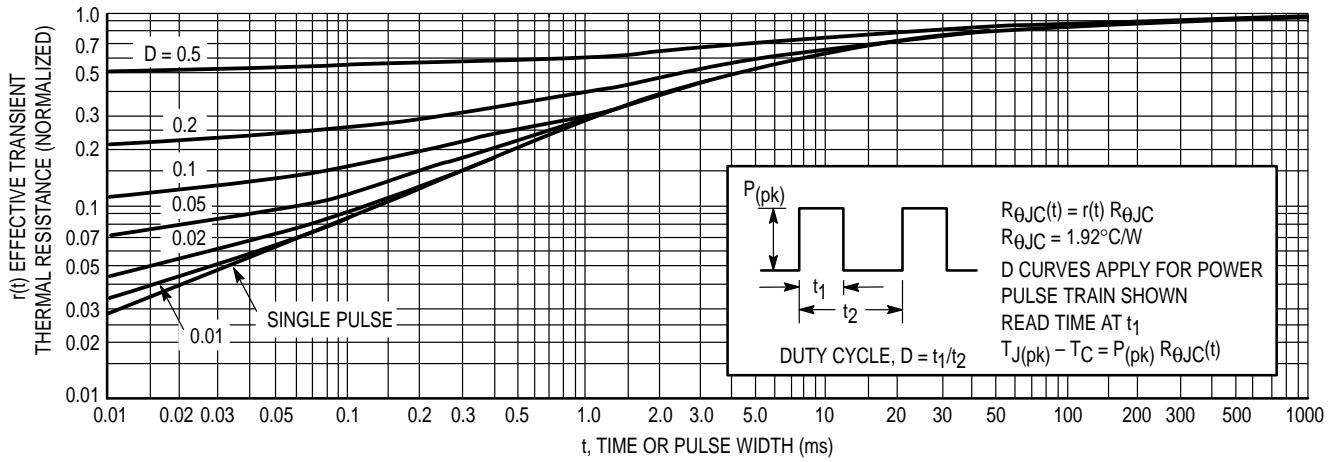


Figure 4. Thermal Response

ACTIVE-REGION SAFE OPERATING AREA

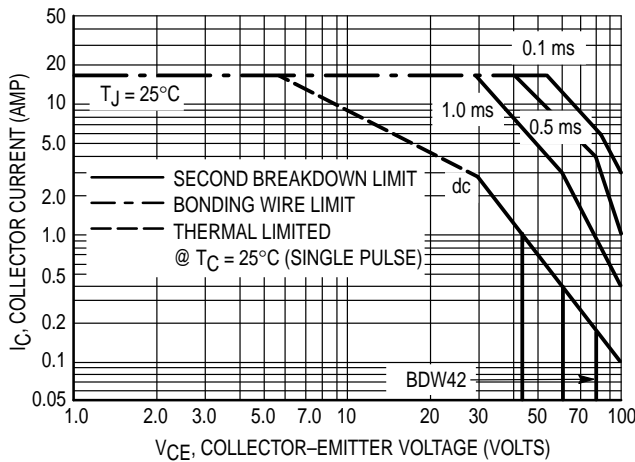


Figure 5. BDW42

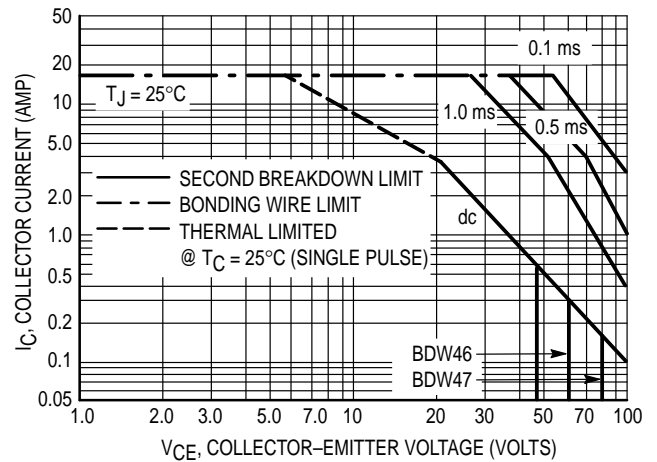


Figure 6. BDW46 and BDW47

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 Fig. 5 and 6 is based on  $T_{J(pk)} = 200^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. Second break-

down 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 Fig. 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

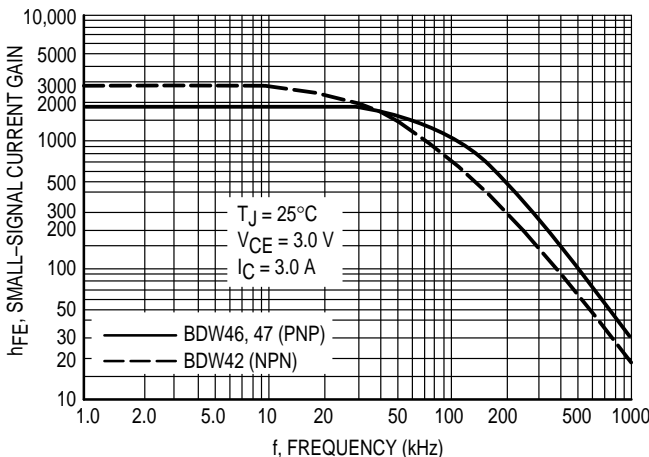


Figure 7. Small-Signal Current Gain

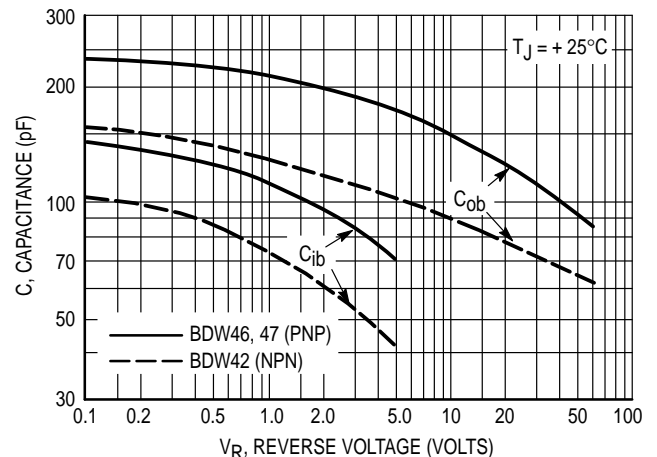


Figure 8. Capacitance

BDW40, 41, 42 (NPN)

BDW45, 46, 47 (PNP)

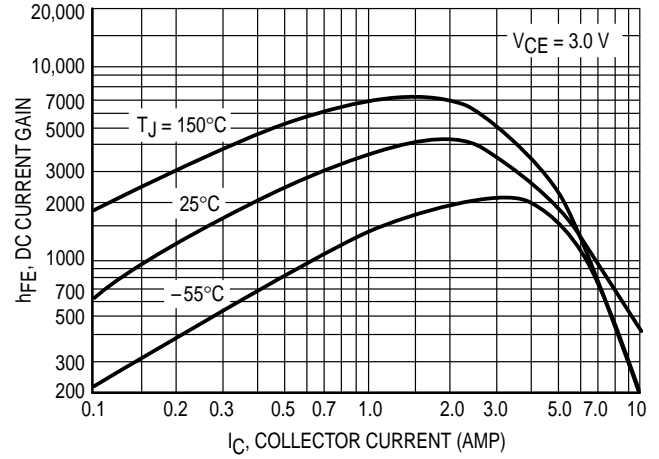
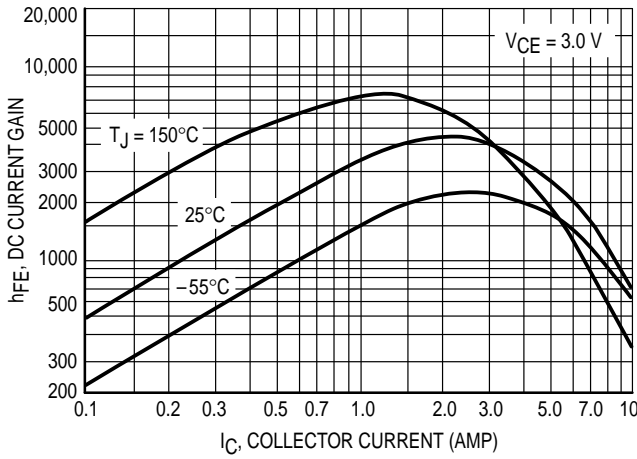


Figure 9. DC Current Gain

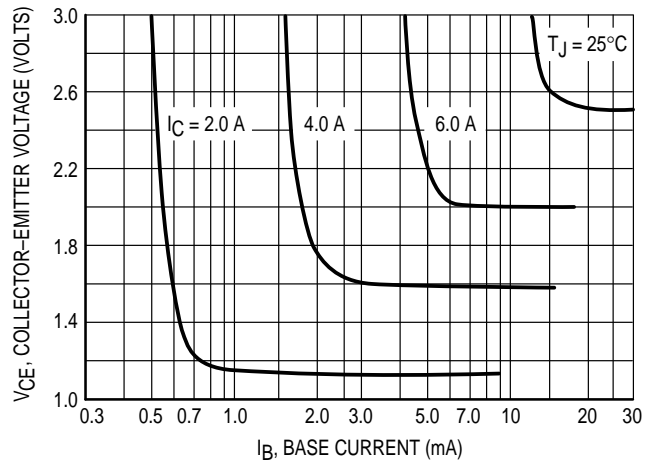
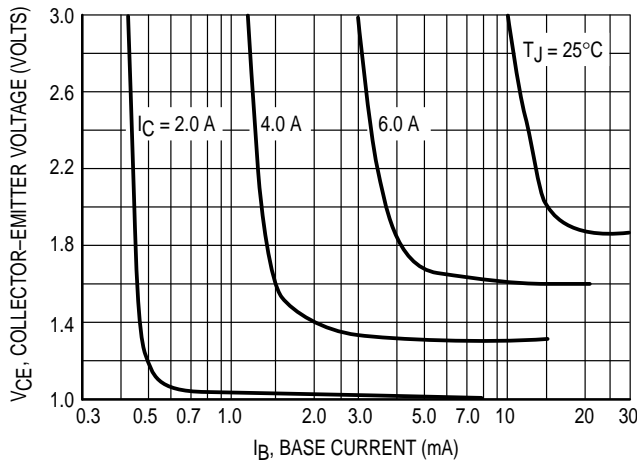


Figure 10. Collector Saturation Region

BDW40, 41, 42 (NPN)

BDW45, 46, 47 (PNP)

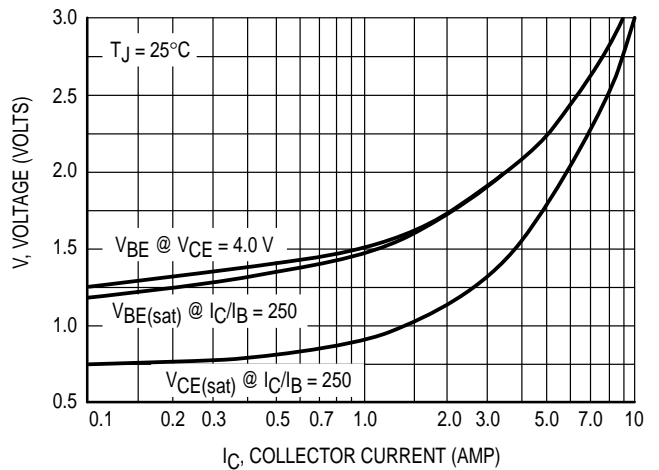
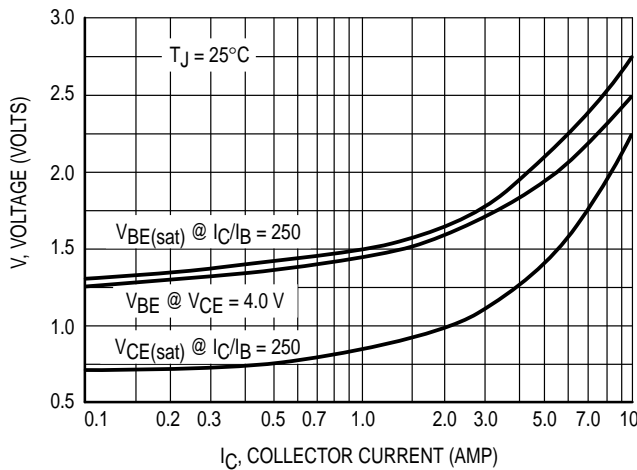
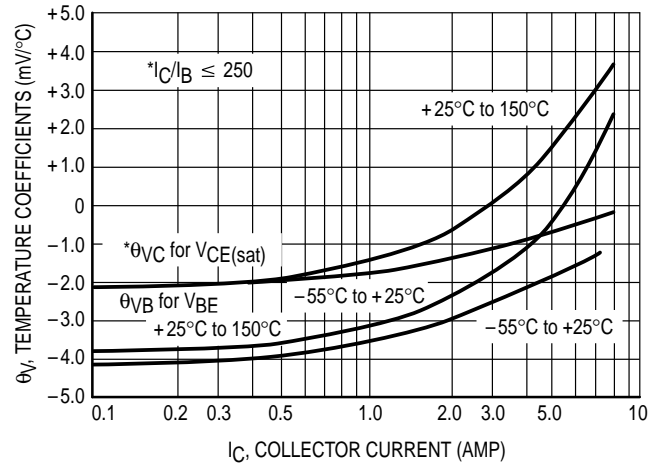
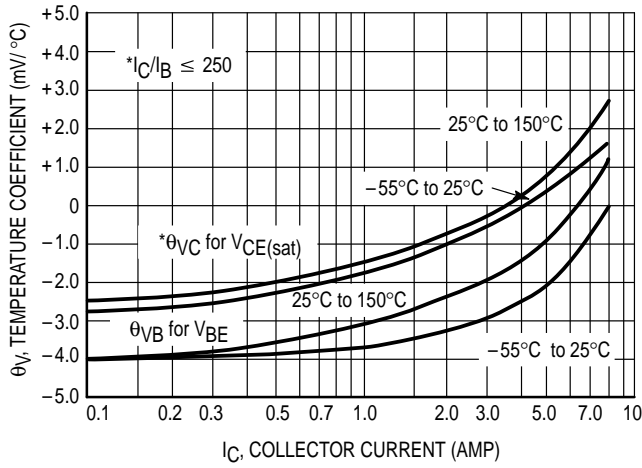
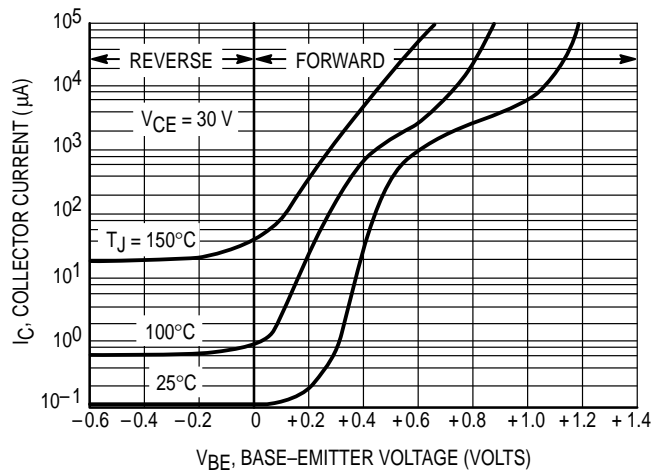
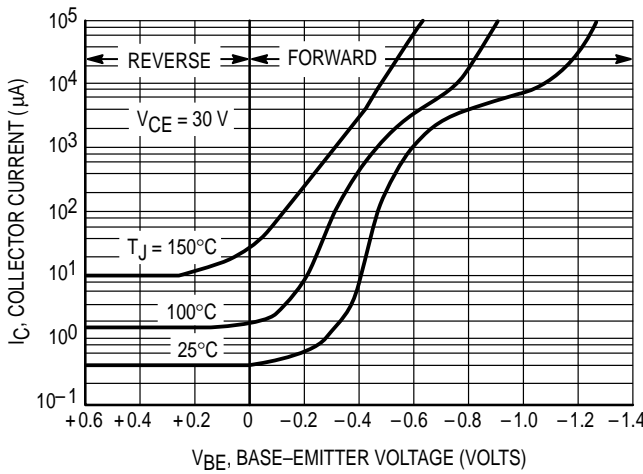


Figure 11. "On" Voltages

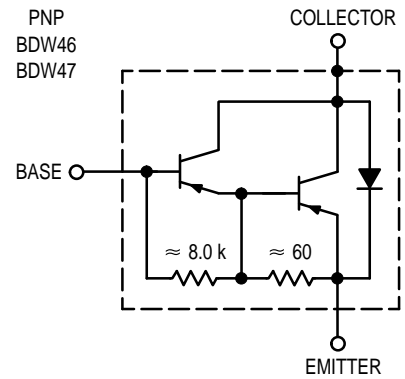
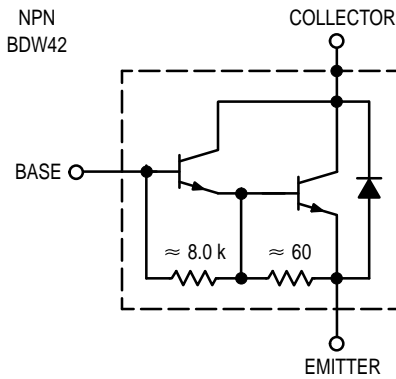
**BDW42 BDW46 BDW47**



**Figure 12. Temperature Coefficients**

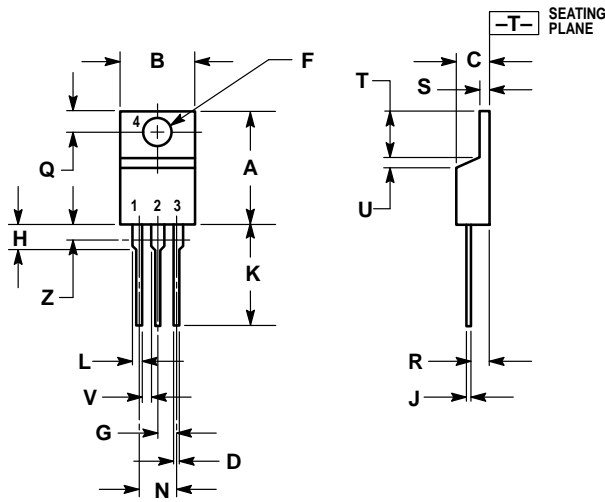


**Figure 13. Collector Cut-Off Region**



**Figure 14. Darlington Schematic**

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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