

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		Adc
Base Current	I_B	0.5		Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	85		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	$^\circ\text{C/W}$

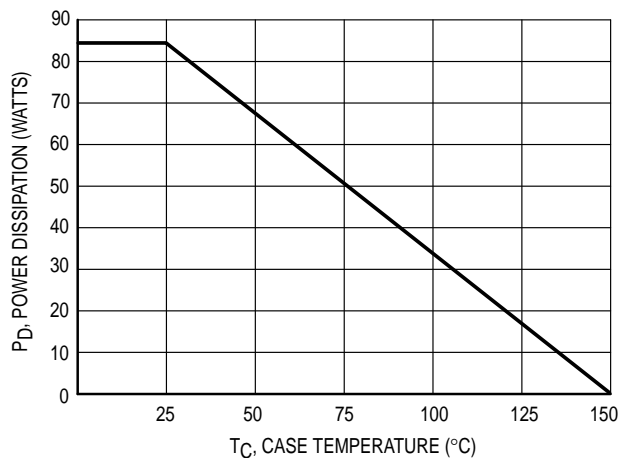
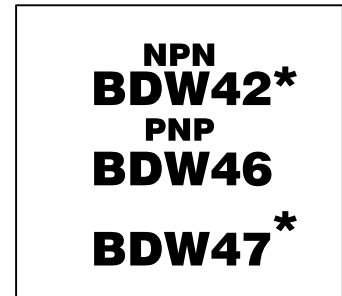


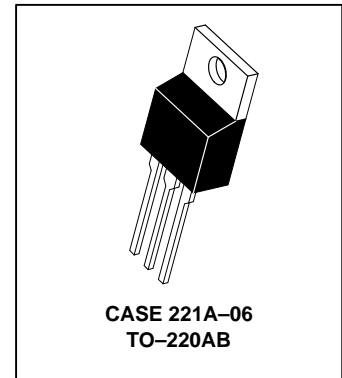
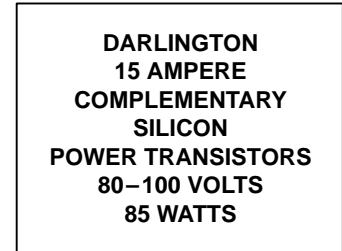
Figure 1. Power Temperature Derating Curve

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

REV 7



*Motorola Preferred Device



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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector Emitter Sustaining Voltage (1) ($I_C = 30\text{ mAdc}$, $I_B = 0$)	$V_{CEO(sus)}$	80 100	— —	Vdc
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 50\text{ Vdc}$, $I_B = 0$)	I_{CEO}	— —	2.0 2.0	mAdc
Collector Cutoff Current ($V_{CB} = 80\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 100\text{ Vdc}$, $I_E = 0$)	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 ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 0.1\text{ MHz}$)	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.

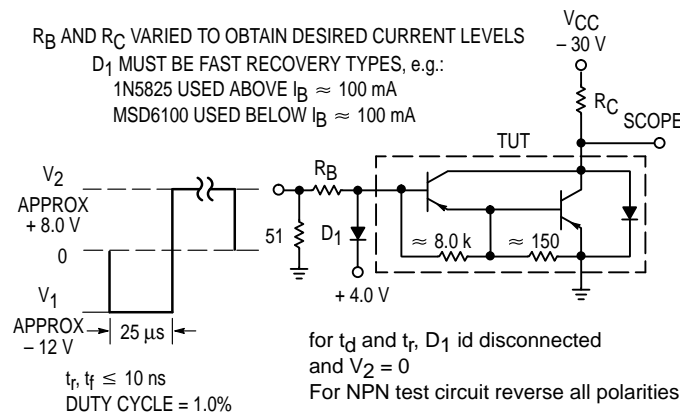


Figure 2. Switching Times Test Circuit

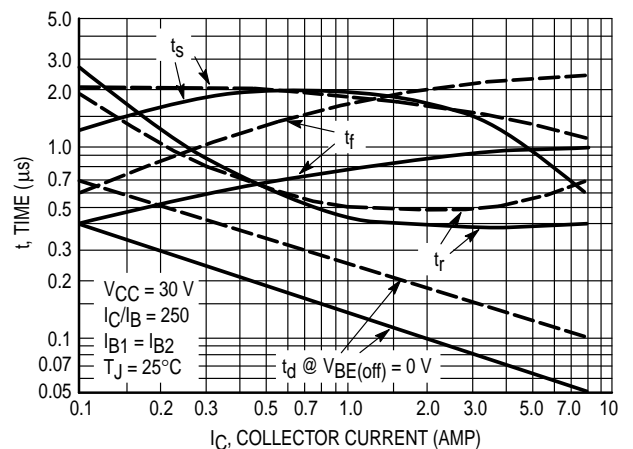


Figure 3. Switching Times

BDW42 BDW46 BDW47

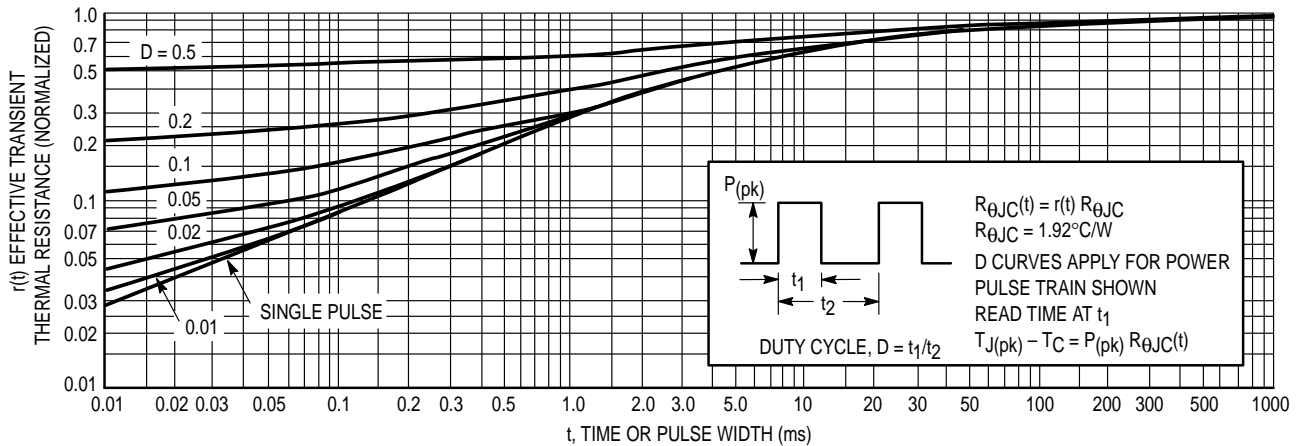


Figure 4. Thermal Response

ACTIVE-REGION SAFE OPERATING AREA

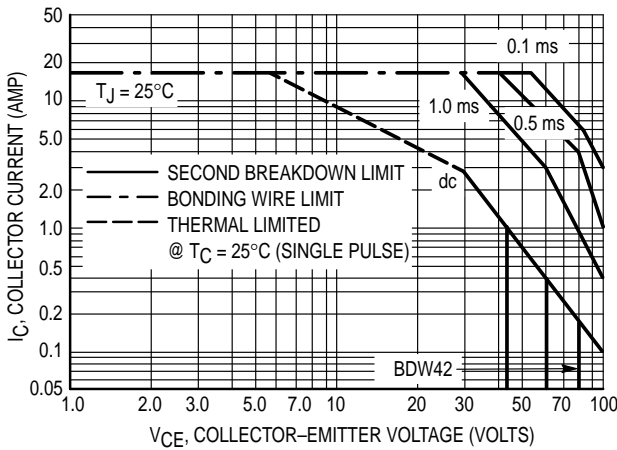


Figure 5. BDW42

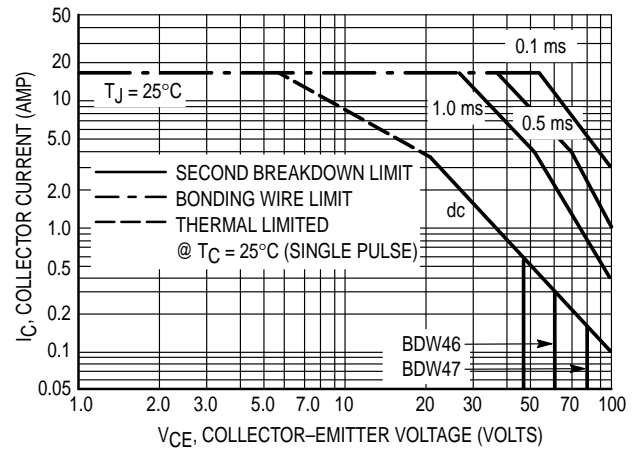


Figure 6. BDW46 and BDW47

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

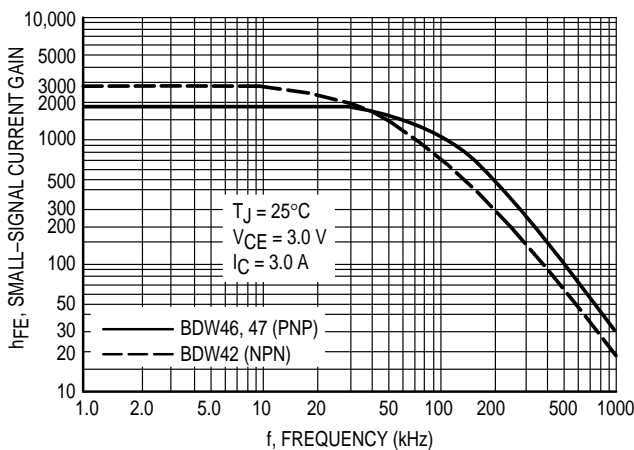


Figure 7. Small-Signal Current Gain

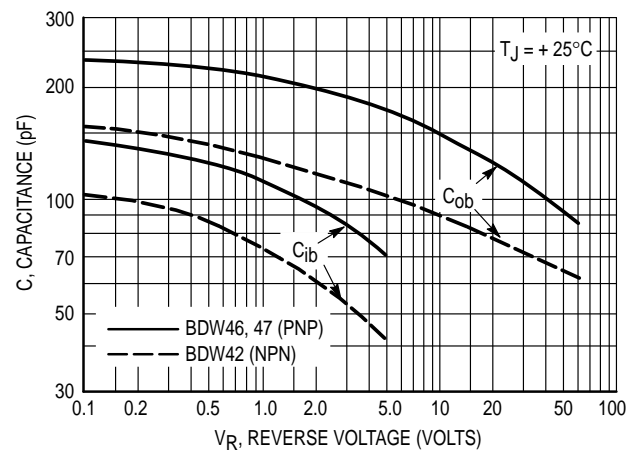
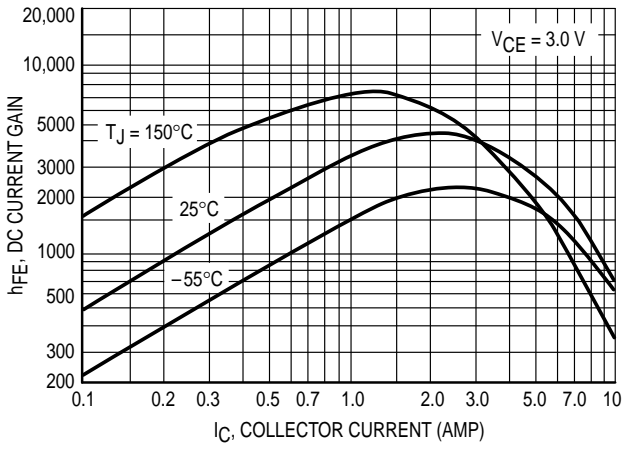


Figure 8. Capacitance

BDW40, 41, 42 (NPN)



BDW45, 46, 47 (PNP)

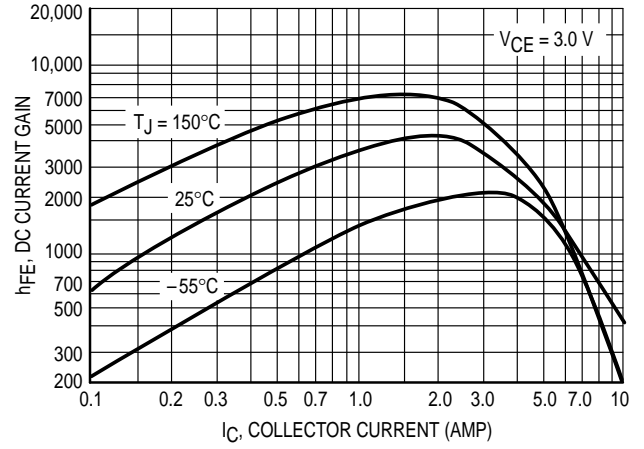


Figure 9. DC Current Gain

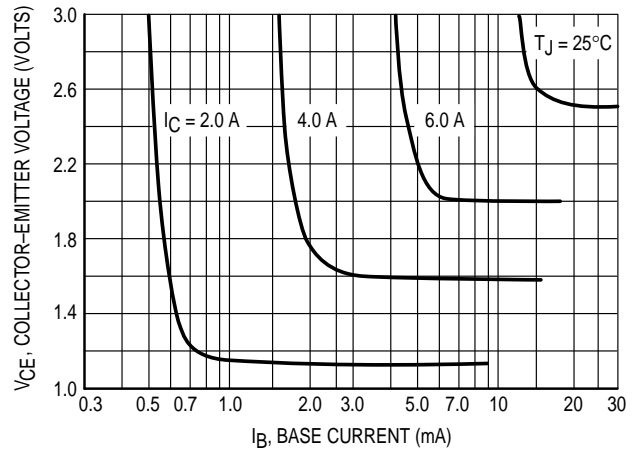
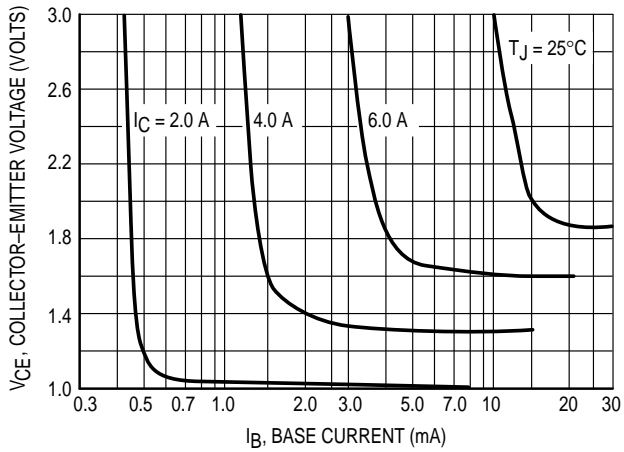
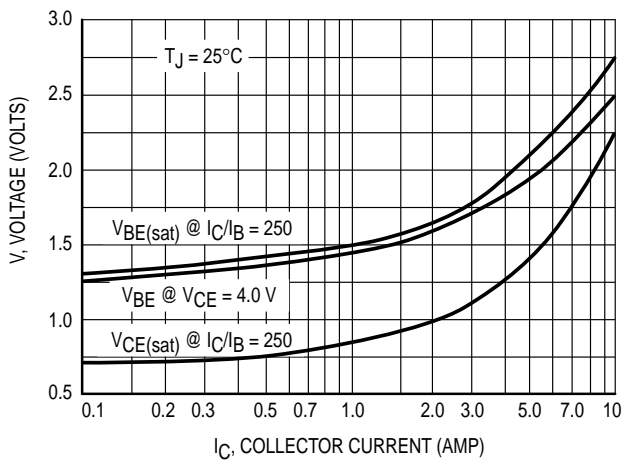


Figure 10. Collector Saturation Region

BDW40, 41, 42 (NPN)



BDW45, 46, 47 (PNP)

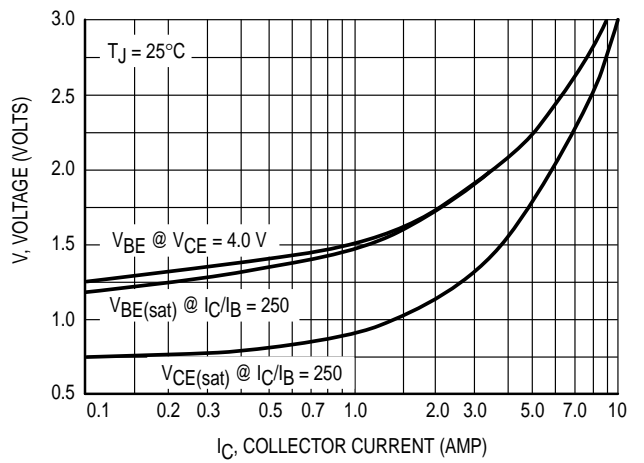


Figure 11. "On" Voltages

BDW42 BDW46 BDW47

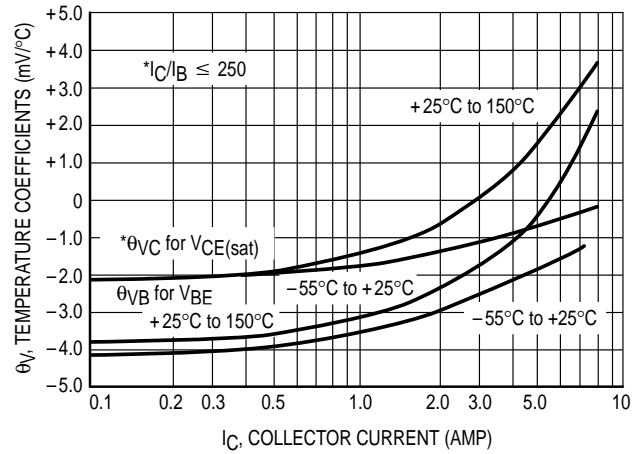
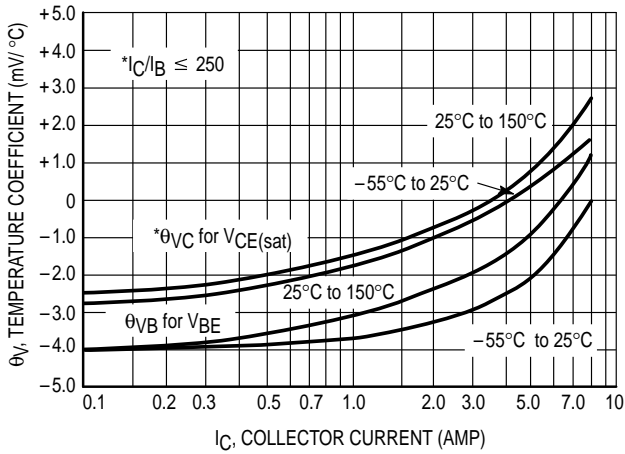


Figure 12. Temperature Coefficients

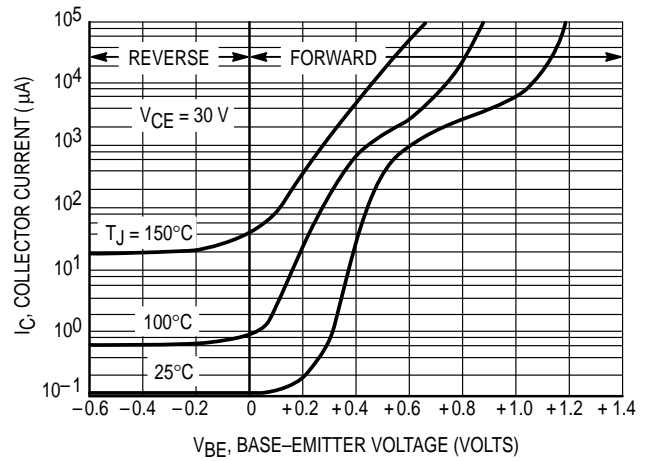
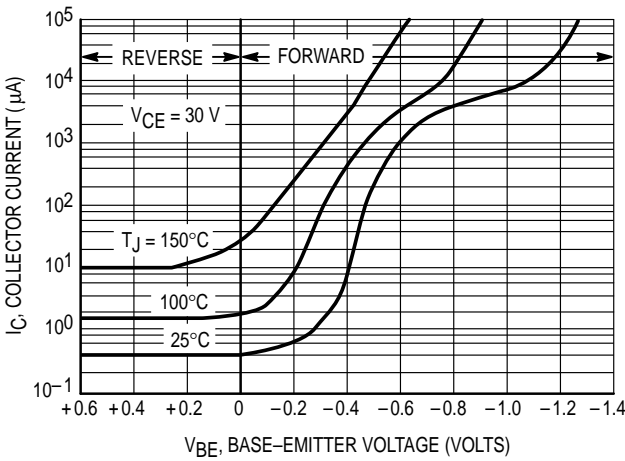


Figure 13. Collector Cut-Off Region

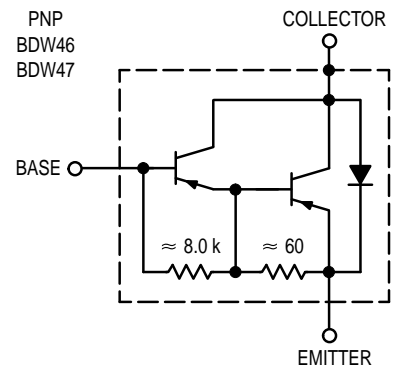
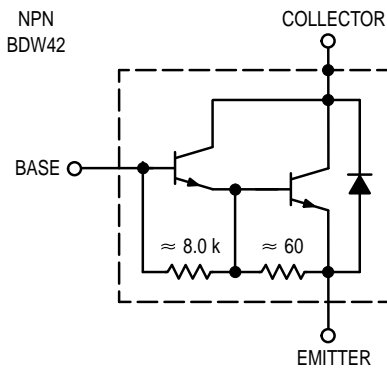
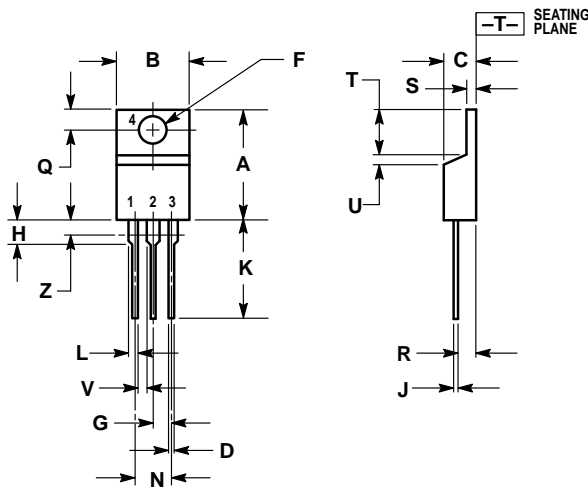


Figure 14. Darlington Schematic

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**

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters can and do vary in different applications. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

How to reach us:

USA / EUROPE: Motorola Literature Distribution;
 P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447

JAPAN: Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, Toshikatsu Otsuki,
 6F Seibu-Butsuryu-Center, 3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-3521-8315

MFAX: RMFAX0@email.sps.mot.com - TOUCHTONE (602) 244-6609
INTERNET: http://Design-NET.com

HONG KONG: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

