MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

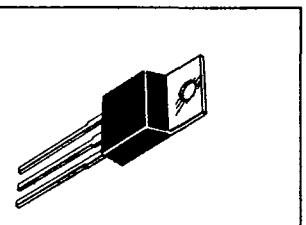
NPN BDW39 thru BDW43 — PNP BDW44 thru BDW48

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:
  $V_{CEO(sus)}$ = 45 Vdc (min.) – BDW39/BDW44
  60 Vdc (min.) – BDW40/BDW45
  80 Vdc (min.) – BDW41/BDW46
  100 Vdc (min.) – BDW42/BDW47
  120 Vdc (min.) – BDW43/BDW48
- 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
- TO-66 Lead form also available ordered with "-66" suffix.

DARLINGTON
15 AMPERE
COMPLEMENTARY SILICON POWER TRANSISTORS
45-60-80-100-120 VOLTS
85 WATTS



MAXIMUM RATINGS

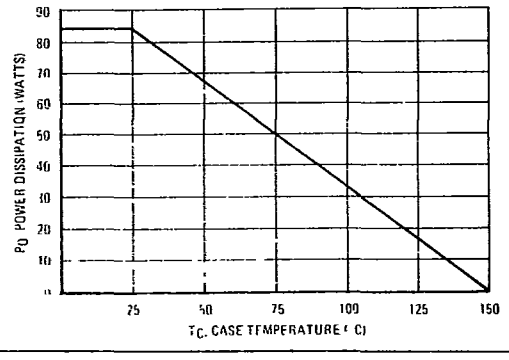
Rating	Symbol	BDW39 BDW44	BDW40 BDW45	BDW41 BDW46	BDW42 BDW47	BDW43 BDW48	Unit
Collector-Emitter Voltage	V_{CEO}	45	60	80	100	120	Vdc
Collector-Base Voltage	V_{CB}	45	60	80	100	120	Vdc
Emitter-Base Voltage	V_{EB}	5.0					Vdc
Collector Current – Continuous	I_C	15					Adc
Base Current	I_B	0.5					Adc
Total Device Dissipation @ T_C = 25 C Derate above 25 C	P_D	85 0.68					Watts W/ C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150					C

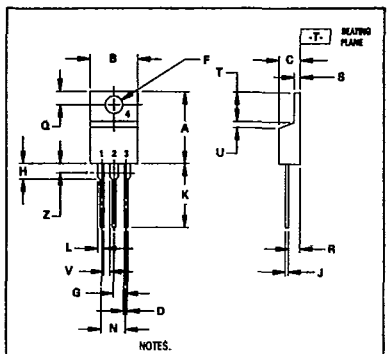
THERMAL CHARACTERISTICS

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

3

FIGURE 1 – POWER TEMPERATURE DERATING CURVE





NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIM Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	14.48	15.75	0.570	0.620
B	9.66	10.28	0.380	0.405
C	4.07	4.82	0.160	0.190
D	0.64	0.88	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.42	2.66	0.095	0.105
H	2.80	3.93	0.110	0.155
J	0.46	0.71	0.018	0.028
K	12.70	14.27	0.500	0.562
L	1.15	1.39	0.045	0.055
N	4.83	5.33	0.190	0.210
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.15	1.39	0.045	0.055
T	5.97	6.47	0.235	0.255
U	0.00	1.27	0.000	0.050
V	1.15	—	0.045	—
Z	—	2.04	—	0.080

STYLE 1
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

CASE 221A-04
TO-220AB

BDW39, BDW40, BDW41, BDW42, BDW43 NPN
BDW44, BDW45, BDW46, BDW47, BDW48 PNP

T-33-31

T-33-29

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector Emitter Sustaining Voltage (1) (I_C = 30 mAdc, I_B = 0)	BDW39/BDW44	$V_{CEO(sus)}$	45	—	Vdc
	BDW40/BDW45		60	—	
	BDW41/BDW46		80	—	
	BDW42/BDW47		100	—	
	BDW43/BDW48		120	—	
Collector Cutoff Current		I_{CEO}			mAdc
(V_{CE} = 22.5 Vdc, I_B = 0)	BDW39/BDW44		—	2.0	
(V_{CE} = 30 Vdc, I_B = 0)	BDW40/BDW45		—	2.0	
(V_{CE} = 40 Vdc, I_B = 0)	BDW41/BDW46		—	2.0	
(V_{CE} = 50 Vdc, I_B = 0)	BDW42/BDW47		—	2.0	
(V_{CE} = 60 Vdc, I_B = 0)	BDW43/BDW48		—	2.0	
Collector Cutoff Current		I_{CBO}			mAdc
(V_{CB} = 45 Vdc, I_E = 0)	BDW39/BDW44		—	1.0	
(V_{CB} = 60 Vdc, I_E = 0)	BDW40/BDW45		—	1.0	
(V_{CB} = 80 Vdc, I_E = 0)	BDW41/BDW46		—	1.0	
(V_{CB} = 100 Vdc, I_E = 0)	BDW42/BDW47		—	1.0	
(V_{CB} = 120 Vdc, I_E = 0)	BDW43/BDW48		—	1.0	
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)		I_{EBO}	—	2.0	mAdc
ON CHARACTERISTICS (1)					
DC Current Gain		h_{FE}			
(I_C = 5.0 Adc, V_{CE} = 4.0 Vdc)			1000	—	
(I_C = 10 Adc, V_{CE} = 4.0 Vdc)			250	—	
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$			Vdc
(I_C = 5.0 Adc, I_B = 10 mAdc)			—	2.0	
(I_C = 10 Adc, I_B = 50 mAdc)			—	3.0	
Base-Emitter On Voltage (I_C = 10 Adc, V_{CE} = 4.0 Vdc)		$V_{BE(on)}$	—	3.0	Vdc
SECOND BREAKDOWN (2)					
Second Breakdown Collector Current with Base Forward Biased		$I_{S/b}$			Adc
BDW39/BDW40/BDW41/BDW42/BDW43	V_{CE} = 28.4 Vdc		3.0	—	
	V_{CE} = 40 Vdc		1.2	—	
BDW44/BDW45/BDW46/BDW47/BDW48	V_{CE} = 22.5 Vdc		3.8	—	
	V_{CE} = 36 Vdc		1.2	—	
DYNAMIC CHARACTERISTICS					
Magnitude of common emitter small signal short circuit current transfer ratio (I_C = 3.0 Adc, V_{CE} = 3.0 Vdc, f = 1.0 MHz)		f_T	4.0	—	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 0.1 MHz)		C_{ob}			pF
	BDW39/BDW40/BDW41/BDW42/BDW43		—	200	
	BDW44/BDW45/BDW46/BDW47/BDW48		—	300	
Small-Signal Current Gain (I_C = 3.0 Adc, V_{CE} = 3.0 Vdc, f = 1.0 kHz)		h_{fe}	300	—	

Indicates JEDEC Registered Data.
(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2.0%.
(2) Pulse Test non repetitive: Pulse Width = 250 ms.

3

BDW39, BDW40, BDW41, BDW42, BDW43 NPN
BDW44, BDW45, BDW46, BDW47, BDW48 PNP

T-33-31
T-33-29

FIGURE 2 – SWITCHING TIMES TEST CIRCUIT

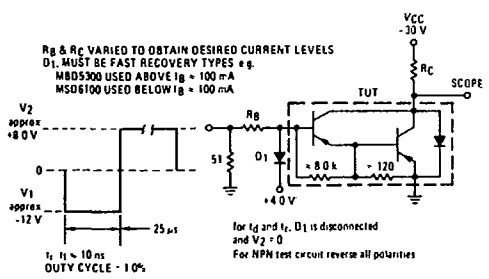


FIGURE 3 – SWITCHING TIMES

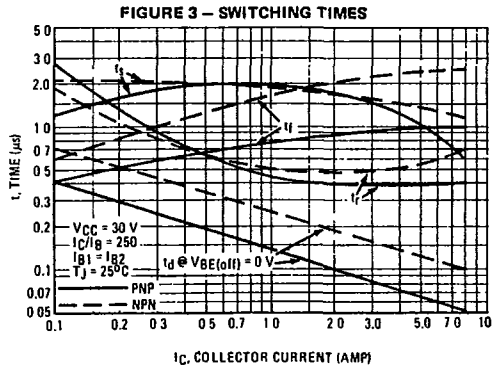
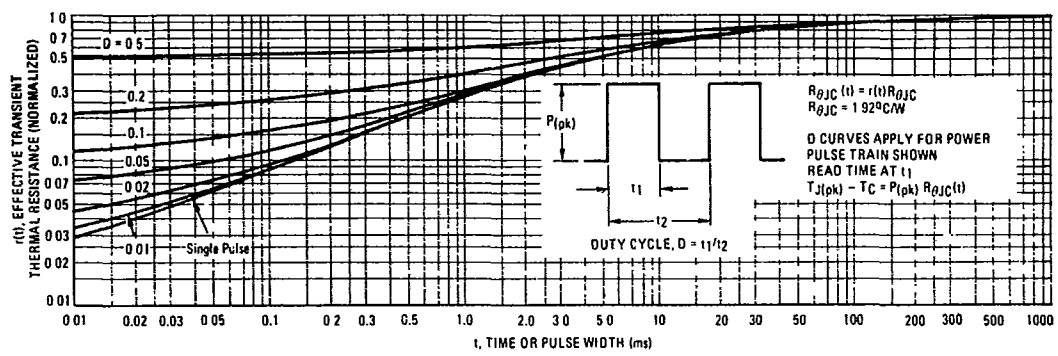


FIGURE 4 – THERMAL RESPONSE



ACTIVE-REGION SAFE OPERATING AREA

3

FIGURE 5 – BDW39 THRU BDW43

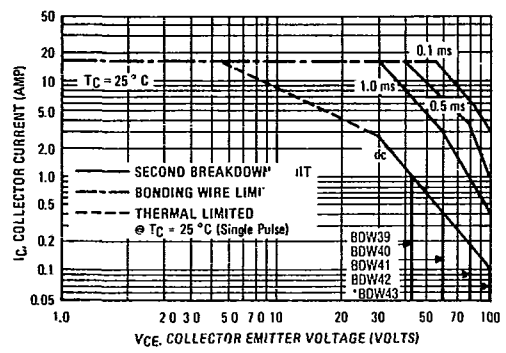
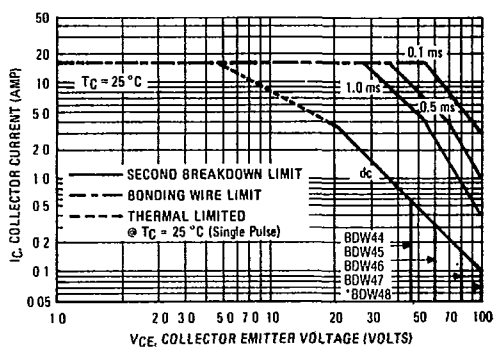


FIGURE 6 – BDW44 THRU BDW48



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°C; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 200°C$. $T_{J(pk)}$ 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. (See an-415).

*Linear extrapolation

BDW39, BDW40, BDW41, BDW42, BDW43 NPN
BDW44, BDW45, BDW46, BDW47, BDW48 PNP

FIGURE 7 – SMALL-SIGNAL CURRENT GAIN

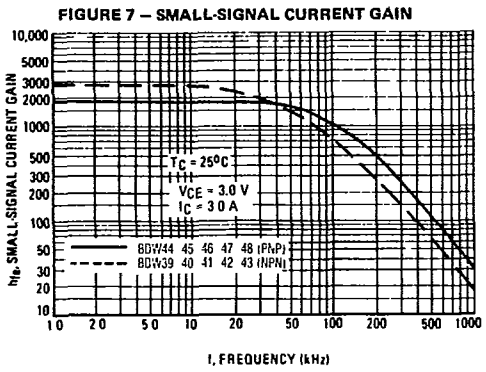
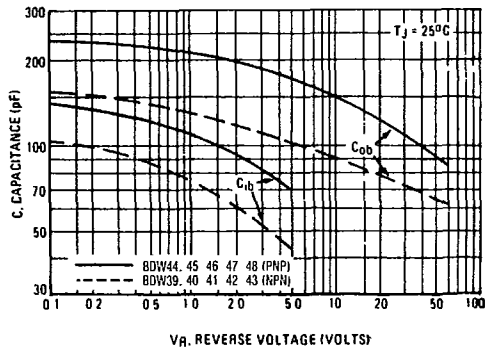


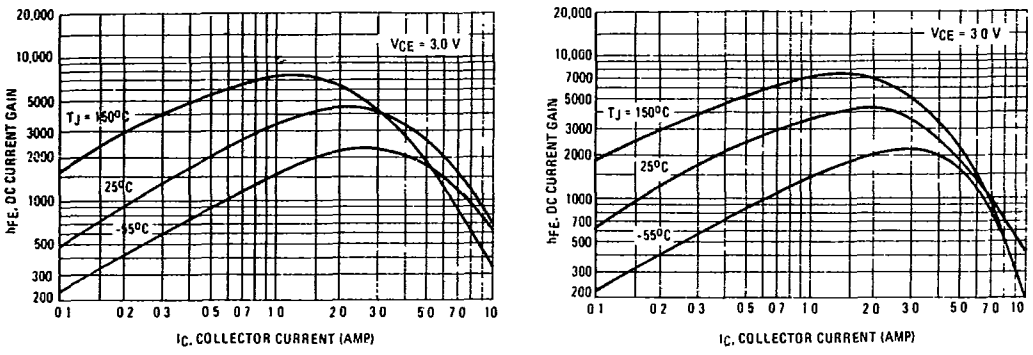
FIGURE 8 – CAPACITANCE



BDW39, 40, 41, 42, 43 (NPN)

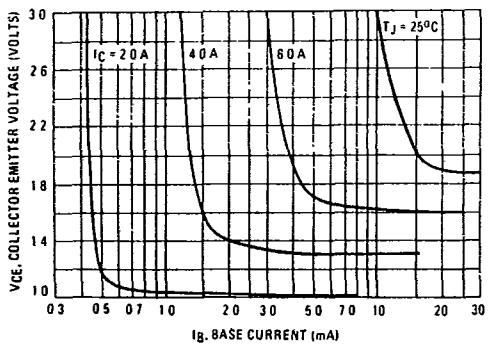
BDW44, 45, 46, 47, 48 (PNP)

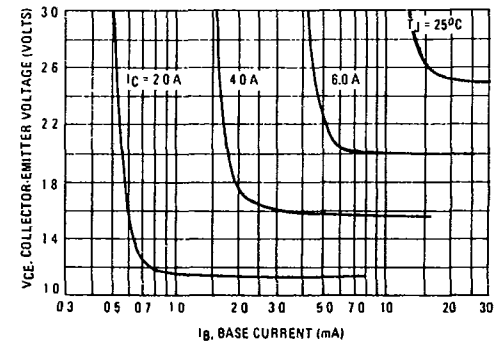
FIGURE 9 – DC CURRENT GAIN



3

FIGURE 10 – COLLECTOR SATURATION REGION





BDW39, BDW40, BDW41, BDW42, BDW43 NPN
BDW44, BDW45, BDW46, BDW47, BDW48 PNP

BDW39, 40, 41, 42, 43 (NPN) **BDW44, 45, 46, 47, 48 (PNP)**

FIGURE 11 – "ON" VOLTAGES

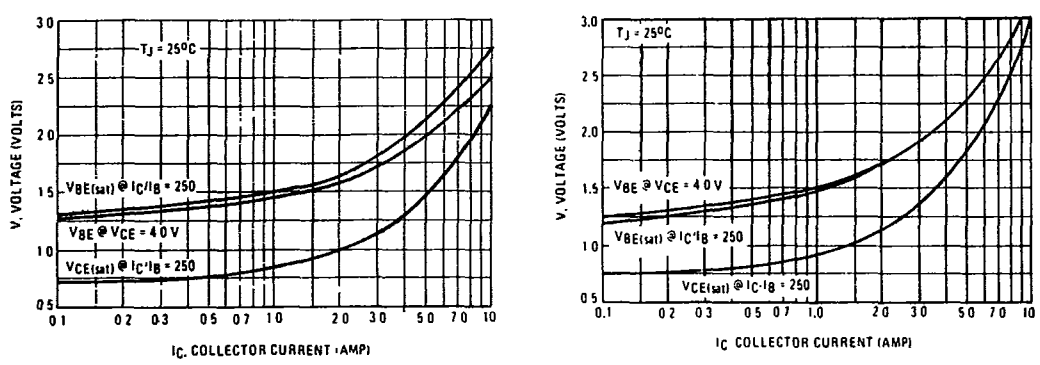


FIGURE 12 – TEMPERATURE COEFFICIENTS

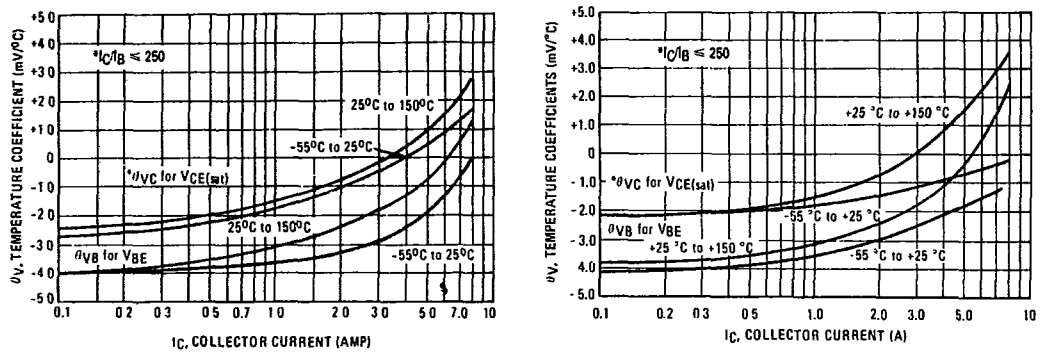
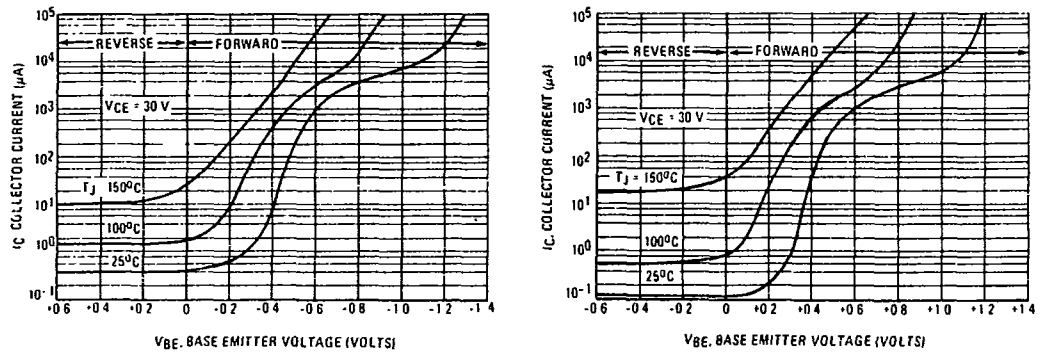


FIGURE 13 – COLLECTOR CUT-OFF REGION

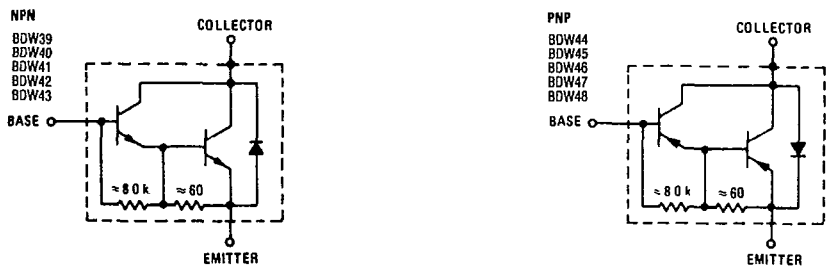


BDW39, BDW40, BDW41, BDW42, BDW43 NPN
BDW44, BDW45, BDW46, BDW47, BDW48 PNP

T-33-31

T-33-29

FIGURE 14 – DARLINGTON SCHEMATIC



3