Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
BDT63A	BDW41		3-328
BDT63B	BDW42		3-328
BDT63C	BDW43		3-328
BDT64	BDW44		3-328
BDT64A	BDW45		3-328
BDT64B	BDW46		3-328
BDT64C	BDW47		3-328
BDT65	BDW40		3-328
BDT65A	BDW41		3-328
BDT65B	BDW42		3-328
BDT65C	BDW43		3-328
BDT91	BD807		3-316
BDT92	BD808		3-318
BDT93	BD809		3-316
BDT94	BD810		3-318
BDV64	BDV64		3-324
BDV64A	BDV64A		3-324
BDV64B	BDV64B		3-324
BDV64C		BDV64B	3-324
BDV65	BDV65		3-324
BDV65A	BDV65A		3-324
BDV65B	BDV65B		3-324
BDV65C		BDV65B	3-324
BDV66C	MJH11018		3-1034
BDV66C	MJH11017		3-1034
BDV66D	MJH11019		3-1034
BDV67D	MJH11020		3-1034
BDV91	MJE3055T		3-904
BDV92	TIP34B		3-1077
BDV93	TIP34C		3-1077
BDV94	TIP2955		3-1108
BDV95	TIP33B		3-1077
BDV96	TIP33C		3-1077
BDW21	2N3714		3-26
BDW21A	2N3714		3-26
BDW21B	2N3714		3-26
BDW21C		2N5882	3-123
BDW22	2N3789		3-56
BDW22A	2N3789		3-56
BDW22B	2N3790		3-56
BDW22C	2N5880		3-123
BDW23	BDX53		3-338
BDW23A	BDX53A		3-338
BDW23B	BDX53B		3-338
BDW23C	BDX53C		3-338
BDW24	BDX54		3-338
BDW24A	BDX54A		3-338
BDW24B	BDX54B		3-338
BDW24C	BDX54C		3-338
BDW39	BDW39		3-328
BDW40	BDW40		3-328
BDW41	BDW41		3-328
BDW42	BDW42		3-328
BDW44	BDW44		3-328
BDW45	BDW45		3-328
BDW46	BDW46		3-328
BDW47	BDW47		3-328
BDW51	2N3715		3-26
BDW51A	2N3715		3-26
BDW51B	2N3716		3-26

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
BDW51C	2N5882		3-123
BDW52	2N3791		3-56
BDW52A	2N3792		3-56
BDW52B	2N3792		3-56
BDW52C	2N5880		3-123
BDW53	TIP120		3-1098
BDW53A	TIP120		3-1098
BDW53B	TIP121		3-1098
BDW53C	BDX53C		3-338
BDW53D	BDX53D		3-338
BDW54	TIP125		3-1098
BDW54A	TIP125		3-1098
BDW54B	TIP126		3-1098
BDW54C	BDX54C		3-338
BDW54D	BDX54D		3-338
BDW55	BD135		3-258
BDW56	BD136		3-260
BDW57	BD137		3-258
BDW58	BD138		3-260
BDW59	BD139		3-258
BDW60	BD140		3-260
BDW63	BDX53		3-338
BDW63A	BDX53A		3-338
BDW63B	BDX53B		3-338
BDW63C	BDX53C		3-338
BDW63D	BDX53D		3-338
BDW64	BDX54		3-338
BDW64A	BDX54A		3-338
BDW64B	BDX54B		3-338
BDW64C	BDX54C		3-338
BDW73	BD895		3-320
BDW73A	BD897		3-320
BDW73B	BD899		3-320
BDW73C	BD901		3-320
BDW73D	BDX33D		3-334
BDW74	BD896		3-322
BDW74A	BD898		3-322
BDW74B	BD900		3-322
BDW74C	BD902		3-322
BDW74D	BDX34D		3-334
BDW83	BDV65		3-324
BDW83A	BDV65		3-324
BDW83B	BDV65A		3-324
BDW83C	BDV65B		3-324
BDW84	BDV64		3-324
BDW84A	BDV64		3-324
BDW84B	BDV64A		3-324
BDW84C	BDV64B		3-324
BDW93	BDW39		3-328
BDW93A	BDW40		3-328
BDW93B	BDW41		3-328
BDW93C	BDW42		3-328
BDW94	BDW44		3-328
BDW94A	BDW45		3-328
BDW94B	BDW46		3-328
BDW94C	BDW47		3-328
BDX10	2N3055A		3-9
BDX10-4	2N3055A		3-9
BDX10-6	2N3055A		3-9
BDX10-7	2N3055A		3-9

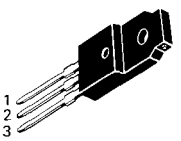
*Consult Motorola if a direct replacement is necessary.

TABLE 5 — PLASTIC TO-220 (continued)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s μs Max	Resistive Switching t_f μs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
10	60	D44H7	D45H7	20 min	4					50
		D44H8	D45H8	40 min	4					50
			D45H9	40 min	4					50
		MJE2801T		25/100	3					75
		MJE3055T	MJE2955T	20/70	4					75
		2N6387##	2N6667##	1k/20k	5				20#	65
		SE9300##	SE9400##	1k min	4				1#	70
	80	BDX33B##	BDX34B##	750 min	3				3	70
		BD809	BD810	15 min	4				1.5	90
		D44E3##		1000 min	5	2 typ	0.5 typ	10		50
			D45H12	40 min	4					50
		2N6388##	2N6668##	1k/20k	5				20#	65
		D44H10	D45H10	20 min	4	0.5 typ	0.14 typ	5	50 typ	50
		D44H11	D45H11	40 min	4	0.5 typ	0.14 typ	5	50 typ	50
		SE9301##	SE9401##	1k min	4				1#	70
	100	BDX33C##	BDX34C##	750 min	3				3	70
		SE9302##	SE9402##	1k min	4				1#	70
12	300	MJE13008		6/30	8	3	0.7	8	4	100
	400	MJE13009		6/30	8	3	0.7	8	4	100
15	30	D44VH1	D45VH1	20 min	4	0.7	0.09	8	50 typ	83
	40	2N6486	2N6489	20/150	5	0.6 typ	0.3 typ	5	5	75
	45	BDW39	BDW44	1 k min	5	1 typ	1.5 typ	5	4	85
		D44VH4	D45VH4	20 min	4	0.5	0.09	8	50 typ	83
	60	2N6487	2N6490	20/150	5	0.6 typ	0.3 typ	5	5	75
		BDW40	BDW45	1 k min	5	1 typ	1.5 typ	5	4	85
		D44VH7		20 min	4	0.5	0.09	8	50 typ	85
	80	2N6488	2N6491	20/150	5	0.6 typ	0.3 typ	5	5	75
		BDW41	BDW46	1 k min	5	1 typ	1.5 typ	5	4	85
		D44VH10	D45VH10	20 min	4	0.5	0.09	8	50 typ	83
	100	BDW42	BDW47	1 k min	5	1 typ	1.5 typ	5	4	85
	120	BDW43	BDW48	1 k min	5	1 typ	1.5 typ	5	4	85

$|h_{fe}|$ @ 1 MHz, ## Darlington

TABLE 6 — PLASTIC Full Pak (TO-220 Type)



CASE 221C-02

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s μs Max	Resistive Switching t_f μs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
1	250	MJF47		30/150	0.3	2 typ	0.17 typ	0.3	10	28
5	100	MJF122##	MJF127##	2000 min	3	1.5 typ	1.5 typ	3	4#	28
8	80		MJF6107	30/90	2	0.5 typ	0.13 typ	2	4	35
	100	MJF102##	MJF107##	3000 min	3	1.5 typ	1.5 typ	3	4#	35
	150	MJF15030	MJF15031	40 min	3	1 typ	0.15 typ	3	30	35
10	60	MJF3055	MJF2955	20/100	4				2	40

$|h_{fe}|$ @ 1 MHz, ## Darlington

NPN BDW39 thru BDW43 — PNP BDW44 thru BDW48

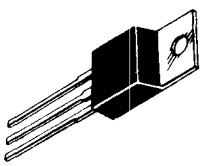
DARLINGTON COMPLEMENTARY SILICON POWER TRANSISTORS

. . . 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

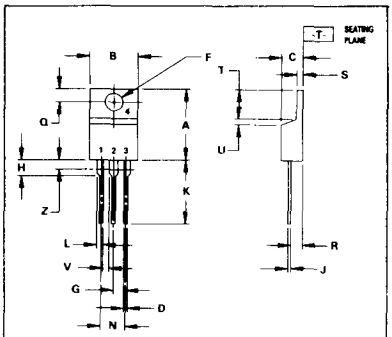


MAXIMUM RATINGS

Rating	Symbol	BDW39 BDW44	BDW40 BDW45	BDW41 BDW46	BDW42 BDW47	BDW43 BDW48	Unit
Collector Emitter Voltage	V_{CEO}	45	60	80	100	120	V_{dc}
Collector Base Voltage	V_{CB}	45	60	80	100	120	V_{dc}
Emitter Base Voltage	V_{EB}	5.0					V_{dc}
Collector Current - Continuous	I_C	15					A_{dc}
Base Current	I_B	0.5					A_{dc}
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



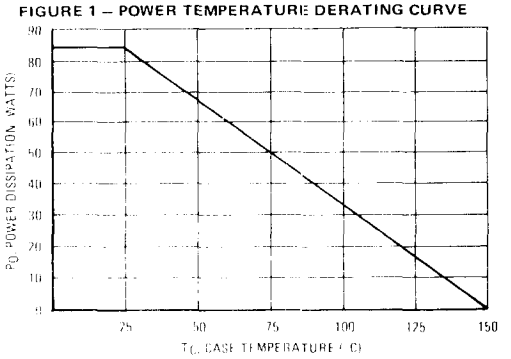
NOTES
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIM Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED

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

FIGURE 1 – POWER TEMPERATURE DERATING CURVE



3

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector Emitter Sustaining Voltage (1)		$V_{CEO(sus)}$			Vdc
(I_C = 30 mAdc, I_B = 0)	BDW39/BDW44		45	—	
	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.

FIGURE 2 – SWITCHING TIMES TEST CIRCUIT

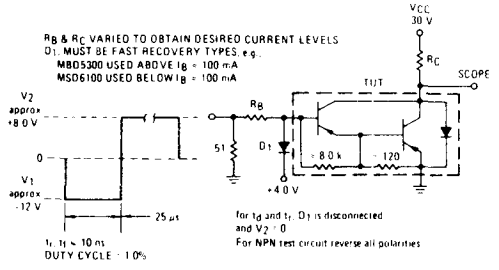


FIGURE 3 – SWITCHING TIMES

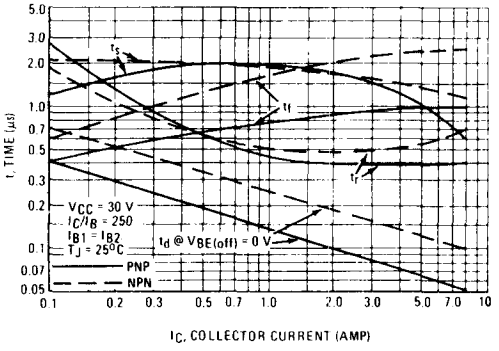
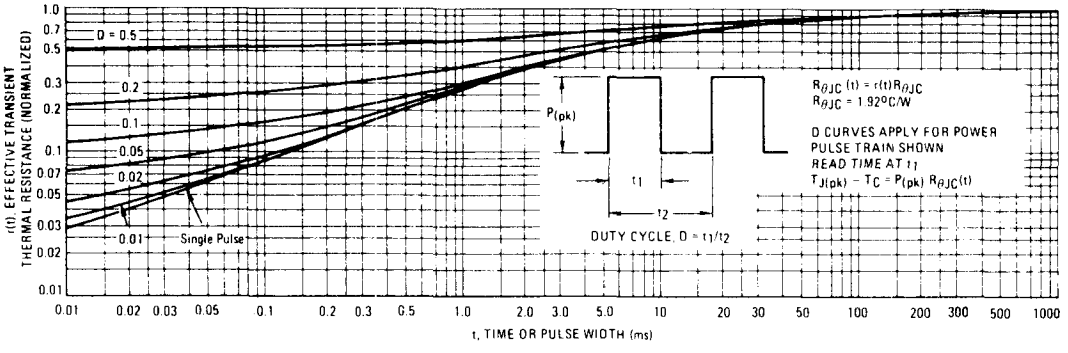


FIGURE 4 – THERMAL RESPONSE



ACTIVE-REGION SAFE OPERATING AREA

FIGURE 5 – BDW39 THRU BDW43

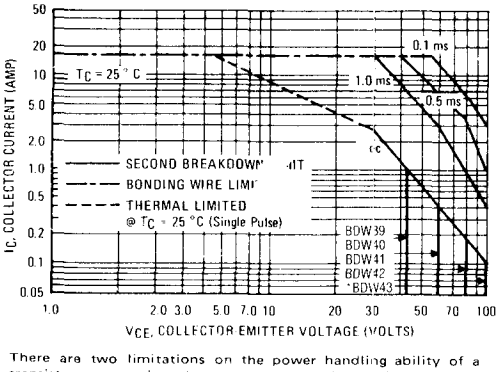
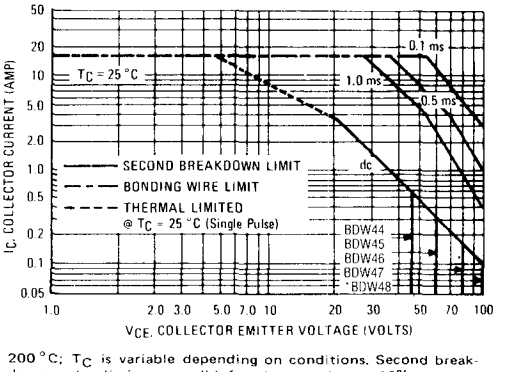


FIGURE 6 – BDW44 THRU BDW48



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

FIGURE 7 – SMALL-SIGNAL CURRENT GAIN

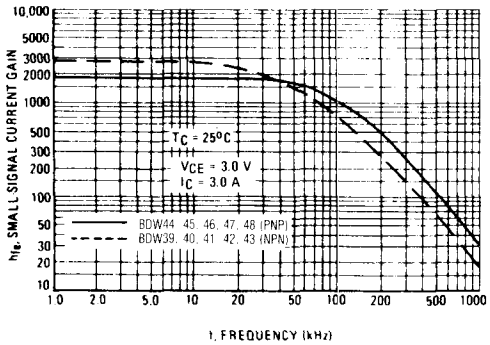
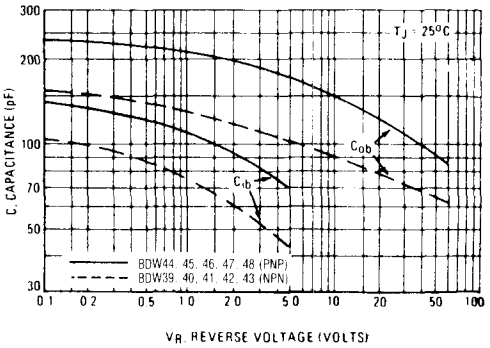


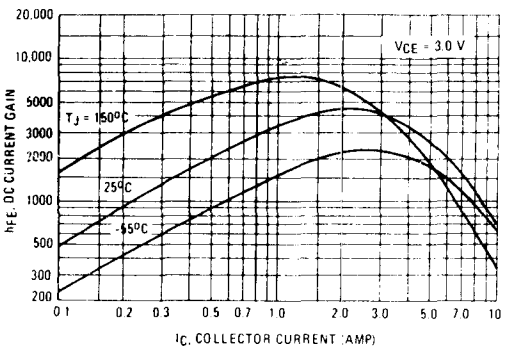
FIGURE 8 – CAPACITANCE



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

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

FIGURE 9 – DC CURRENT GAIN



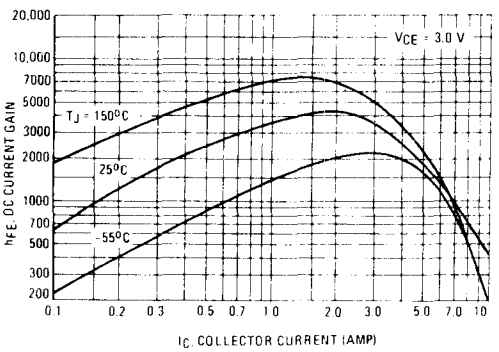
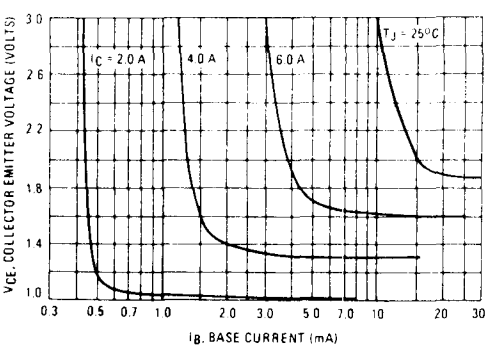
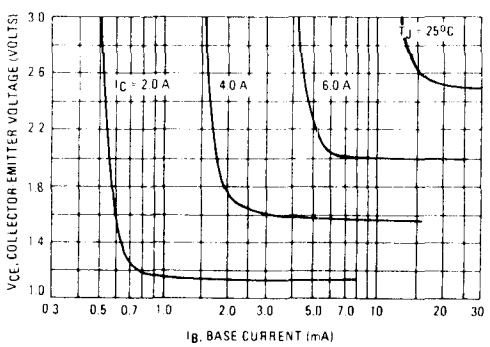


FIGURE 10 – COLLECTOR SATURATION REGION





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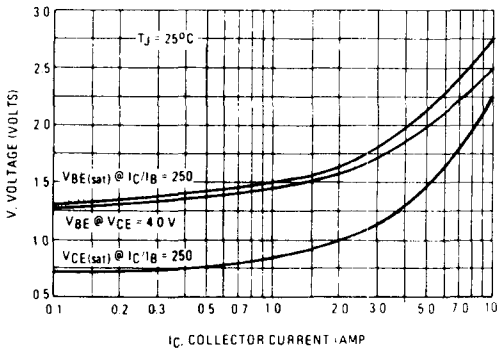
BDW39, 40, 41, 42, 43 (NPN) **BDW44, 45, 46, 47, 48 (PNP)**

FIGURE 11 – "ON" VOLTAGES



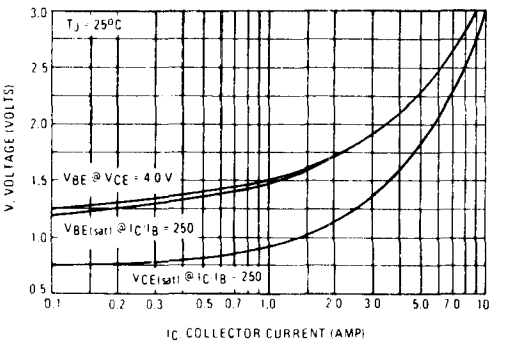
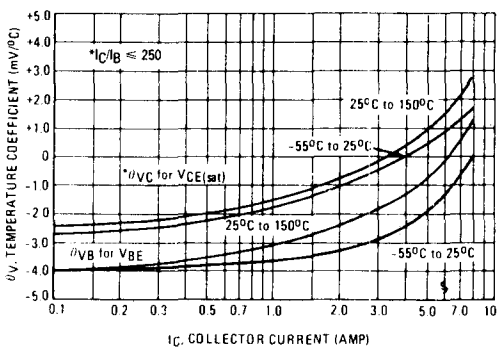


FIGURE 12 – TEMPERATURE COEFFICIENTS



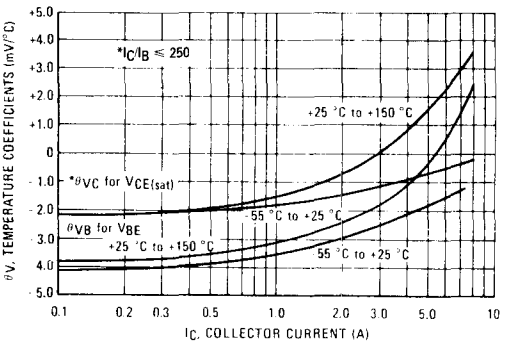
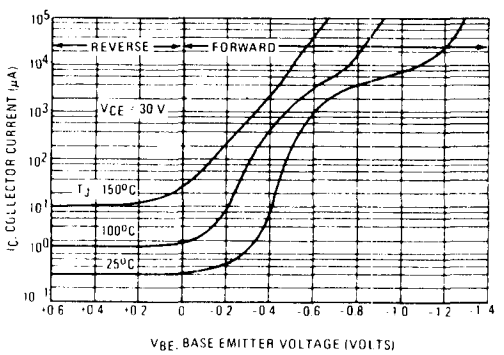


FIGURE 13 – COLLECTOR CUT-OFF REGION



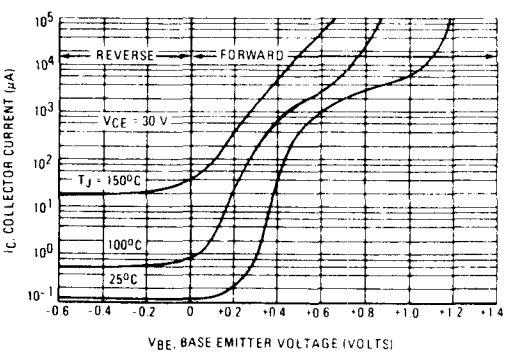


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FIGURE 14 – DARLINGTON SCHEMATIC