

ALPHANUMERIC INDEX — CROSS-REFERENCE (Continued)

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*Consult Motorola if a direct replacement is necessary.



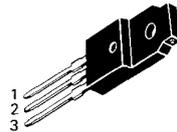
TABLE 5 — PLASTIC TO-220 (continued)

| I _C Cont Amps Max | V _{CEO(sus)} Volts Min | Device Type | | h _{FE} Min/Max | @ I _C Amp | Resistive Switching | | | f _T MHz Min | P _D (Case) Watts @ 25°C | |
|------------------------------------|---------------------------------------|-------------|----------|----------------------------|-------------------------|-----------------------------|-----------------------------|-------------------------|------------------------------|--|-----|
| | | NPN | PNP | | | t _s μs Max | t _f μs Max | @ I _C Amp | | | |
| | | | | | | | | | | | |
| 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 | 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

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



CASE 221C-02

| I _C Cont Amps Max | V _{CEO(sus)} Volts Min | Device Type | | h _{FE} Min/Max | @ I _C Amp | Resistive Switching | | | f _T MHz Min | P _D (Case) Watts @ 25°C |
|------------------------------------|---------------------------------------|-------------|----------|----------------------------|-------------------------|-----------------------------|-----------------------------|-------------------------|------------------------------|--|
| | | NPN | PNP | | | t _s μs Max | t _f μs Max | @ I _C Amp | | |
| | | | | | | | | | | |
| 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

MOTOROLA SEMICONDUCTOR TECHNICAL DATA

NPN
BDW39
thru
BDW43

PNP
BDW44
thru
BDW48

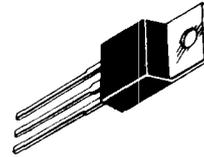
DARLINGTON COMPLEMENTARY SILICON POWER TRANSISTORS

... 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 rAdc:
 $V_{CE(sus)} = 45$ 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



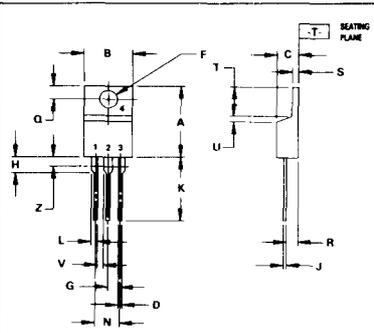
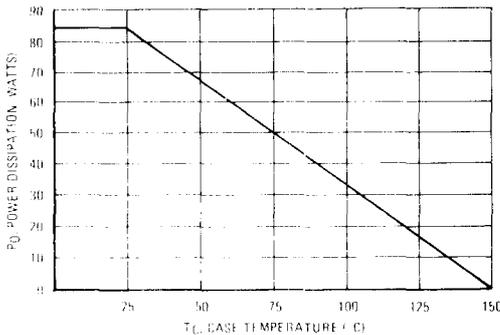
MAXIMUM RATINGS

| Rating | Symbol | BDW39 BDW44 | BDW40 BDW45 | BDW41 BDW46 | BDW42 BDW47 | BDW43 BDW48 | Unit |
|--|-------------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| Collector Emitter Voltage | V_{CE0} | 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 at $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 85 0.68 | | | | | Watts W/C |
| Operating and Storage Junction Temperature Range | T_{JL}, T_{stg} | 55 to -150 | | | | | C |

THERMAL CHARACTERISTICS

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

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 | | INCHES | |
|-----|-------------|-------|--------|-------|
| | MIN | MAX | MIN | 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 | 0.54 | 0.98 | 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 | 1.38 | 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 | 2.78 | 0.080 | 0.110 |
| S | 1.15 | 1.38 | 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**

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

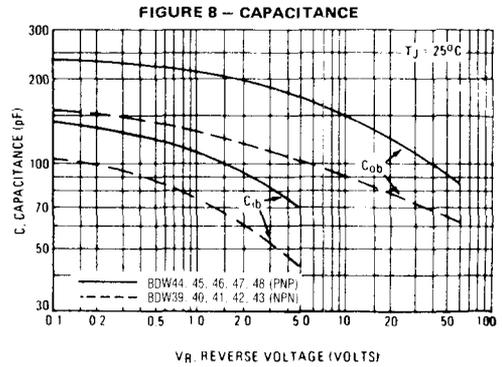
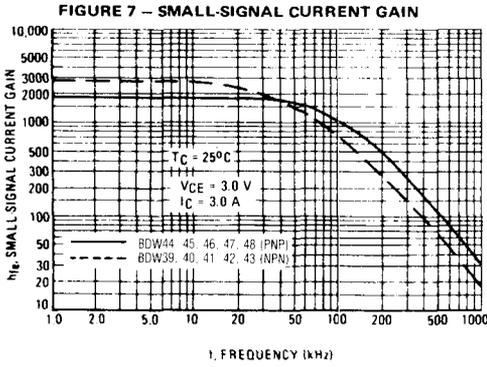
| Characteristic | Symbol | Min | Max | Unit | |
|---|--|---------------|------------------------------|---------------------------------|------|
| OFF CHARACTERISTICS | | | | | |
| Collector Emitter Sustaining Voltage (1) ($I_C = 30 \text{ mAdc}$, $I_B = 0$) | BDW39/BDW44 BDW40/BDW45 BDW41/BDW46 BDW42/BDW47 BDW43/BDW48 | $V_{CE(sus)}$ | 45 60 80 100 120 | — — — — — | Vdc |
| Collector Cutoff Current ($V_{CE} = 22.5 \text{ Vdc}$, $I_B = 0$) ($V_{CE} = 30 \text{ Vdc}$, $I_B = 0$) ($V_{CE} = 40 \text{ Vdc}$, $I_B = 0$) ($V_{CE} = 50 \text{ Vdc}$, $I_B = 0$) ($V_{CE} = 60 \text{ Vdc}$, $I_B = 0$) | BDW39/BDW44 BDW40/BDW45 BDW41/BDW46 BDW42/BDW47 BDW43/BDW48 | I_{CEO} | — — — — — | 2.0 2.0 2.0 2.0 2.0 | mAdc |
| Collector Cutoff Current ($V_{CB} = 45 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 60 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 80 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 100 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 120 \text{ Vdc}$, $I_E = 0$) | BDW39/BDW44 BDW40/BDW45 BDW41/BDW46 BDW42/BDW47 BDW43/BDW48 | I_{CBO} | — — — — — | 1.0 1.0 1.0 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 BDW39/BDW40/BDW41/BDW42/BDW43 BDW44/BDW45/BDW46/BDW47/BDW48 | $V_{CE} = 28.4 \text{ Vdc}$ $V_{CE} = 40 \text{ Vdc}$ $V_{CE} = 22.5 \text{ Vdc}$ $V_{CE} = 36 \text{ Vdc}$ | $I_{S/b}$ | 3.0 1.2 3.8 1.2 | — — — — | Adc |
| 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 ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 0.1 \text{ MHz}$) BDW39/BDW40/BDW41/BDW42/BDW43 BDW44/BDW45/BDW46/BDW47/BDW48 | | 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 | — | |

Indicates JEDEC Registered Data.

(1) Pulse Test: Pulse Width = 300 μs , Duty Cycle = 2.0%.

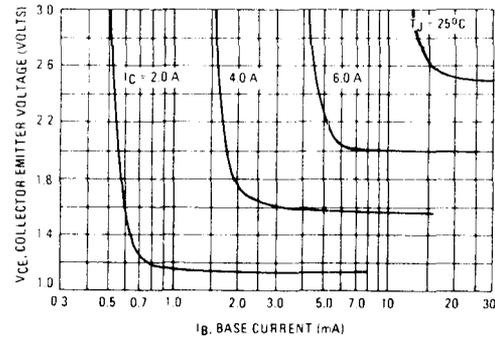
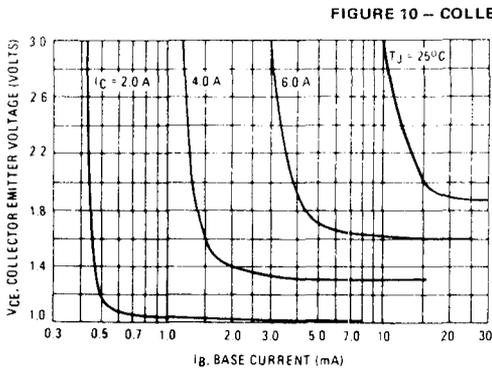
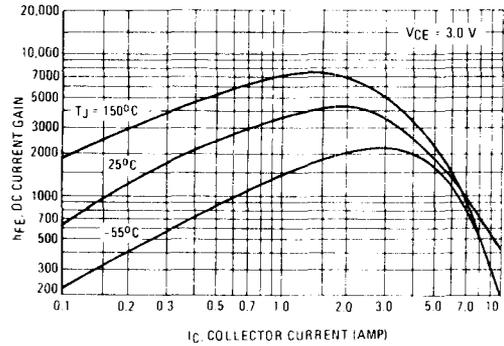
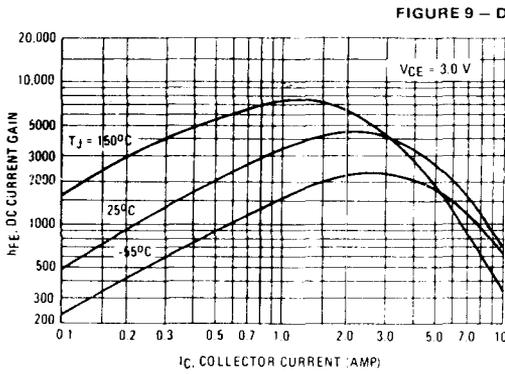
(2) Pulse Test non repetitive: Pulse Width = 250 ms.

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



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

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



**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

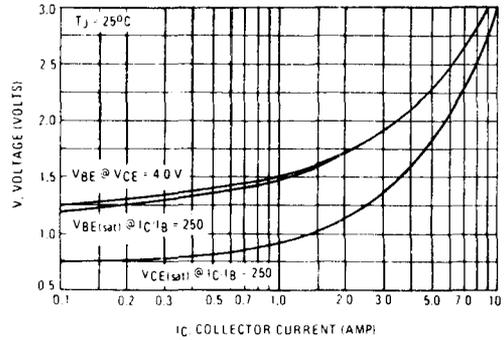
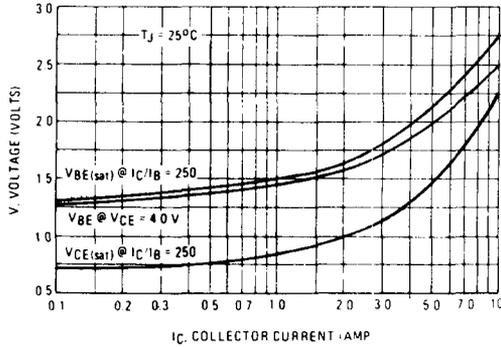


FIGURE 12 – TEMPERATURE COEFFICIENTS

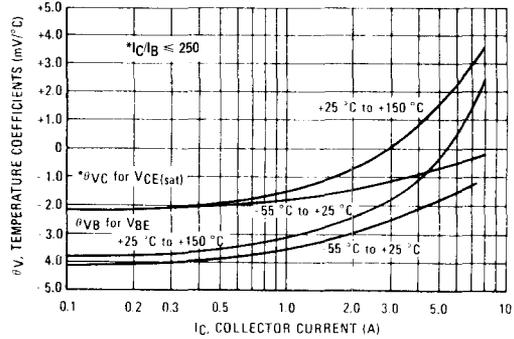
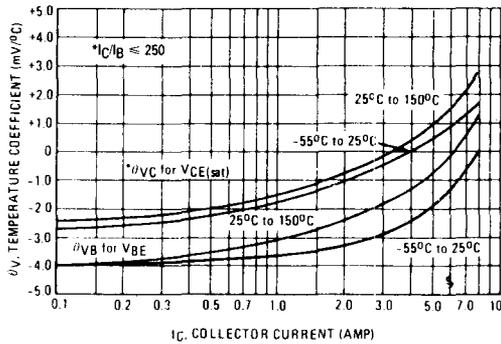
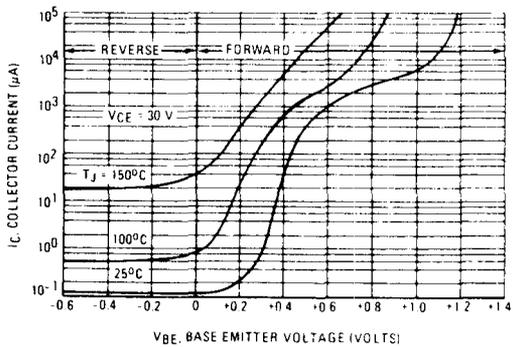
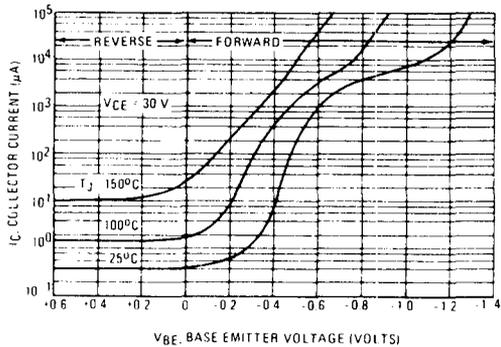


FIGURE 13 – COLLECTOR CUT-OFF REGION



3

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

FIGURE 14 – DARLINGTON SCHEMATIC

