

# ALPHANUMERIC INDEX — CROSS-REFERENCE (Continued)

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| MJD127                  | MJD127                            |                                    | 3-822          | MJE1092                 | MJE1092                           |                                    | —              |
| MJD127-1                |                                   |                                    | 3-822          | MJE1093                 | MJE1093                           |                                    | —              |
| MJD13003                |                                   |                                    | 3-854          | MJE1100                 | MJE1100                           |                                    | —              |
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| MJD148-1                | MJD148-1                          |                                    | —              | MJE1103                 | MJE1103                           |                                    | —              |
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| MJD29C                  |                                   |                                    | 3-797          | MJE13007                | MJE13007                          |                                    | 3-950          |
| MJD29C1                 | MJD31C1                           |                                    | 3-797          | MJE13008                | MJE13008                          |                                    | 3-958          |
| MJD30                   |                                   |                                    | 3-797          | MJE13009                | MJE13009                          |                                    | 3-958          |
| MJD30-1                 |                                   |                                    | 3-797          | MJE13070                | MJE13070                          |                                    | 3-966          |
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| MJD30C                  | MJD32C                            |                                    | 3-797          | MJE15028                | MJE15028                          |                                    | 3-972          |
| MJD30C1                 |                                   |                                    | 3-797          | MJE15029                | MJE15029                          |                                    | 3-972          |
| MJD31                   |                                   |                                    | 3-797          | MJE15030                | MJE15030                          |                                    | 3-972          |
| MJD31-1                 |                                   |                                    | 3-797          | MJE15031                | MJE15031                          |                                    | 3-972          |
| MJD31C                  |                                   |                                    | 3-797          | MJE16002                | MJE16002                          |                                    | 3-976          |
| MJD31C1                 | MJD32C1                           |                                    | 3-797          | MJE16004                | MJE16004                          |                                    | 3-976          |
| MJD32                   |                                   |                                    | 3-797          | MJE16032                | MJE16032                          |                                    | 3-984          |
| MJD32-1                 |                                   |                                    | 3-797          | MJE16034                | MJE16034                          |                                    | 3-984          |
| MJD32C                  |                                   |                                    | 3-797          | MJE1660                 | MJE1660                           |                                    | 3-898          |
| MJD32C1                 |                                   |                                    | 3-797          | MJE1661                 | MJE1661                           |                                    | 3-898          |
| MJD340                  | MJD340                            |                                    | 3-840          | MJE170                  | MJE170                            |                                    | 3-862          |
| MJD340-1                |                                   |                                    | 3-840          | MJE171                  | MJE171                            |                                    | 3-862          |
| MJD350                  |                                   |                                    | 3-840          | MJE172                  | MJE172                            |                                    | 3-862          |
| MJD350-1                |                                   |                                    | 3-840          | MJE180                  | MJE180                            |                                    | 3-862          |
| MJD41C                  |                                   |                                    | 3-801          | MJE181                  | MJE181                            |                                    | 3-862          |
| MJD41C1                 | MJD41C1                           |                                    | 3-840          | MJE182                  | MJE182                            |                                    | 3-862          |
| MJD42C                  |                                   |                                    | 3-801          | MJE200                  | MJE200                            |                                    | 3-866          |
| MJD42C-1                |                                   |                                    | 3-840          | MJE201                  |                                   |                                    | 3-904          |
| MJD44E3                 |                                   |                                    | 3-805          | MJE2010                 |                                   |                                    | 3-1083         |
| MJD44E3-1               |                                   |                                    | 3-805          | MJE2011                 |                                   |                                    | 3-1083         |

\*Consult Motorola if a direct replacement is necessary.

**TABLE 7 — PLASTIC TO-225 Type (continued)**

| I <sub>C</sub> Cont<br>Amps<br>Max | V <sub>CEO(sus)</sub><br>Volts<br>Min | Device Type                                                                                                        |                                                                                                                    | h <sub>FE</sub><br>Min/Max                                                                                       | @ I <sub>C</sub><br>Amp                                       | Resistive Switching                                                |                                                                                                |                                                          | f <sub>T</sub><br>MHz<br>Min                                 | P <sub>D</sub> (Case)<br>Watts<br>@ 25°C                       |
|------------------------------------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------|
|                                    |                                       | NPN                                                                                                                | PNP                                                                                                                |                                                                                                                  |                                                               | t <sub>s</sub><br>μs<br>Max                                        | t <sub>f</sub><br>μs<br>Max                                                                    | @ I <sub>C</sub><br>Amp                                  |                                                              |                                                                |
| 3                                  | 45                                    |                                                                                                                    | BD176<br>BD176.6<br>BD176.10<br>BD176.16                                                                           | 40/250<br>40/100<br>63/160<br>100/250                                                                            | 0.15<br>0.15<br>0.15<br>0.15                                  |                                                                    |                                                                                                |                                                          | 3<br>3<br>3<br>3                                             | 30<br>30<br>30<br>30                                           |
|                                    |                                       | MJE181                                                                                                             | MJE171                                                                                                             | 50/250                                                                                                           | 0.1                                                           | 0.6 typ                                                            | 0.12 typ                                                                                       | 0.1                                                      | 50                                                           | 12.5                                                           |
|                                    |                                       | BD179<br>BD179.6<br>BD179.10<br>BD179.16<br>MJE182                                                                 | BD180<br>BD180.6<br>BD180.10<br>BD180.16<br>MJE172                                                                 | 40/250<br>40/100<br>63/160<br>100/250<br>50/250                                                                  | 0.15<br>0.15<br>0.15<br>0.15<br>0.1                           |                                                                    |                                                                                                |                                                          | 3<br>3<br>3<br>3<br>50                                       | 30<br>30<br>30<br>30<br>12.5                                   |
|                                    |                                       | BUY49P                                                                                                             |                                                                                                                    | 30 min                                                                                                           | 0.5                                                           |                                                                    |                                                                                                |                                                          | 25                                                           | 20                                                             |
|                                    | 200                                   |                                                                                                                    |                                                                                                                    |                                                                                                                  |                                                               |                                                                    |                                                                                                |                                                          |                                                              |                                                                |
| 4                                  | 30                                    | BD185                                                                                                              |                                                                                                                    | 15 min                                                                                                           | 2                                                             |                                                                    |                                                                                                |                                                          | 20                                                           | 40                                                             |
|                                    | 40                                    | 2N5190<br>MJE521<br>2N6037##                                                                                       | 2N5193<br>MJE371<br>2N6034##                                                                                       | 25/100<br>40 min<br>750/18k                                                                                      | 1.5<br>1<br>2                                                 | 0.4 typ<br>1<br>1.7 typ                                            | 0.4 typ<br>1<br>1.2 typ                                                                        | 1.5<br>1<br>2                                            | 2<br>2<br>25                                                 | 40<br>40<br>40                                                 |
|                                    |                                       | BD437<br>BD675##<br>BD675A##<br>BD785                                                                              | BD438<br>BD676##<br>BD676A##<br>BD786<br>BD776##                                                                   | 40 min<br>750 min<br>750 min<br>20 min<br>750 min                                                                | 2<br>1.5<br>2<br>2<br>2                                       |                                                                    |                                                                                                |                                                          | 3<br>50<br>20                                                | 36<br>40<br>40<br>15<br>15                                     |
|                                    | 60                                    | BD189                                                                                                              |                                                                                                                    | 15 min                                                                                                           | 2                                                             |                                                                    |                                                                                                |                                                          | 20                                                           | 40                                                             |
|                                    |                                       | BD677##<br>BD677A##<br>BD787<br>BD777##<br>2N5191<br>MJE800##<br>MJE801##<br>2N6038##                              | BD440<br>BD678##<br>BD678A##<br>BD788<br>BD778##<br>2N5194<br>MJE700##<br>MJE701##<br>2N6035##                     | 25 min<br>750 min<br>750 min<br>20 min<br>750 min<br>25/100<br>750 min<br>750 min<br>750/18k                     | 2<br>1.5<br>2<br>2<br>2<br>1.5<br>1.5<br>2<br>2               |                                                                    |                                                                                                |                                                          | 3<br>50<br>20<br>2<br>1#<br>1#<br>25                         | 36<br>40<br>40<br>15<br>15<br>40<br>40<br>40                   |
|                                    |                                       |                                                                                                                    |                                                                                                                    |                                                                                                                  |                                                               | 0.4 typ                                                            | 0.4 typ                                                                                        | 1.5                                                      |                                                              |                                                                |
|                                    |                                       |                                                                                                                    |                                                                                                                    |                                                                                                                  |                                                               | 1.7 typ                                                            | 1.2 typ                                                                                        | 2                                                        |                                                              |                                                                |
|                                    |                                       | 2N5192<br>BD441<br>BD679##<br>BD679A##<br>BD789<br>BD779##<br>MJE240<br>MJE241<br>MJE802##<br>MJE803##<br>2N6039## | 2N5195<br>BD442<br>BD680##<br>BD680A##<br>BD790<br>BD780##<br>MJE250<br>MJE251<br>MJE702##<br>MJE703##<br>2N6036## | 25/100<br>15 min<br>750 min<br>750 min<br>10 min<br>750 min<br>40/200<br>40/120<br>750 min<br>750 min<br>750/18k | 1.5<br>2<br>1.5<br>2<br>2<br>2<br>0.2<br>0.2<br>1.5<br>2<br>2 | 0.4 typ<br>1.5<br>1.5<br>1.5<br>1.5<br>0.2<br>0.2<br>1.5<br>2<br>2 | 0.4 typ<br>1.5<br>1.5<br>1.5<br>1.5<br>0.15 typ<br>0.15 typ<br>0.15 typ<br>0.15 typ<br>1.7 typ | 1.5<br>1.5<br>1.5<br>1.5<br>1.5<br>2<br>2<br>2<br>2<br>2 | 2<br>3<br>40<br>40<br>20<br>40<br>40<br>40<br>1#<br>1#<br>25 | 40<br>36<br>40<br>40<br>15<br>15<br>15<br>15<br>40<br>40<br>40 |
|                                    | 80                                    |                                                                                                                    |                                                                                                                    |                                                                                                                  |                                                               |                                                                    |                                                                                                |                                                          |                                                              |                                                                |
|                                    |                                       |                                                                                                                    |                                                                                                                    |                                                                                                                  |                                                               |                                                                    |                                                                                                |                                                          |                                                              |                                                                |
|                                    |                                       |                                                                                                                    |                                                                                                                    |                                                                                                                  |                                                               |                                                                    |                                                                                                |                                                          |                                                              |                                                                |
|                                    | 100                                   | BD681##<br>BD791<br>MJE243<br>MJE244                                                                               | BD682##<br>BD792<br>MJE253<br>MJE254                                                                               | 750 min<br>10 min<br>40/120<br>25 min                                                                            | 1.5<br>2<br>0.2<br>0.2                                        |                                                                    |                                                                                                |                                                          | 40<br>40<br>40<br>40                                         | 40<br>15<br>15<br>15                                           |
|                                    |                                       |                                                                                                                    |                                                                                                                    |                                                                                                                  |                                                               | 0.15 typ<br>0.15 typ                                               | 0.07 typ<br>0.07 typ                                                                           | 2<br>2                                                   |                                                              |                                                                |
|                                    |                                       |                                                                                                                    |                                                                                                                    |                                                                                                                  |                                                               | 1.7 typ                                                            | 1.2 typ                                                                                        | 2                                                        |                                                              |                                                                |
| 5                                  | 25                                    | MJE200                                                                                                             | MJE210                                                                                                             | 45/180                                                                                                           | 2                                                             | 0.13 typ                                                           | 0.035 typ                                                                                      | 2                                                        | 65                                                           | 15                                                             |

● Case 77 (Style 3), # [h<sub>FE</sub>] @ 1 MHz, ## Darlington

**PNP**  
**MJE170 thru MJE172**  
**NPN**  
**MJE180 thru MJE182**

**COMPLEMENTARY PLASTIC SILICON  
POWER TRANSISTORS**

... designed for low power audio amplifier and low current, high speed switching applications.

- Collector-Emitter Sustaining Voltage —  
V<sub>CEO(sus)</sub> = 40 Vdc — MJE170, MJE180  
= 60 Vdc — MJE171, MJE181  
= 80 Vdc — MJE172, MJE182
- DC Current Gain —  
h<sub>FE</sub> = 30 (Min) @ I<sub>C</sub> = 0.5 Adc  
= 12 (Min) @ I<sub>C</sub> = 1.5 Adc
- Current-Gain — Bandwidth Product —  
f<sub>T</sub> = 50 MHz (Min) @ I<sub>C</sub> = 100 mAdc
- Annular Construction for Low Leakages —  
I<sub>CBO</sub> = 100 nA (Max) @ Rated V<sub>CB</sub>

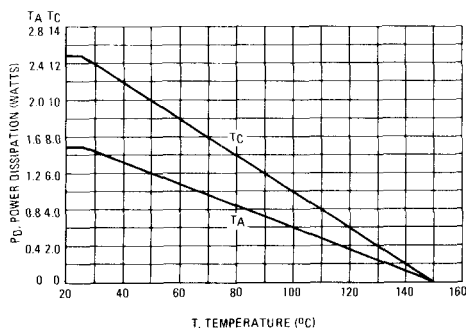
**MAXIMUM RATINGS**

| Rating                                           | Symbol                            | MJE170<br>MJE180 | MJE171<br>MJE181 | MJE172<br>MJE182 | Unit  |
|--------------------------------------------------|-----------------------------------|------------------|------------------|------------------|-------|
| Collector-Base Voltage                           | V <sub>CB</sub>                   | 60               | 80               | 100              | Vdc   |
| Collector-Emitter Voltage                        | V <sub>CEO</sub>                  | 40               | 60               | 80               | Vdc   |
| Emitter-Base Voltage                             | V <sub>EB</sub>                   | 7.0              |                  |                  | Vdc   |
| Collector Current                                | I <sub>C</sub>                    | 3.0              |                  |                  | Adc   |
|                                                  |                                   | 6.0              |                  |                  | Adc   |
| Base Current                                     | I <sub>B</sub>                    | 1.0              |                  |                  | Adc   |
|                                                  |                                   | 0.012            |                  |                  | Watts |
| Total Power Dissipation @ T <sub>A</sub> = 25°C  | P <sub>D</sub>                    | 1.5              |                  |                  | Watts |
|                                                  |                                   | 0.012            |                  |                  | W/°C  |
| Total Power Dissipation @ T <sub>C</sub> = 25°C  | P <sub>D</sub>                    | 12.5             |                  |                  | Watts |
|                                                  |                                   | 0.1              |                  |                  | W/°C  |
| Operating and Storage Junction Temperature Range | T <sub>J</sub> , T <sub>stg</sub> | -65 to +150      |                  |                  | °C    |

**THERMAL CHARACTERISTICS**

| Characteristic                          | Symbol          | Max  | Unit |
|-----------------------------------------|-----------------|------|------|
| Thermal Resistance, Junction to Case    | θ <sub>JC</sub> | 10   | °C/W |
| Thermal Resistance, Junction to Ambient | θ <sub>JA</sub> | 83.4 | °C/W |

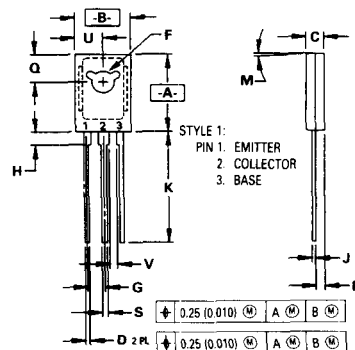
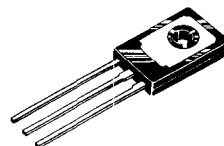
**FIGURE 1 — POWER DERATING**



**3 AMPERE**

**POWER TRANSISTORS  
COMPLEMENTARY SILICON**

**40-60-80 VOLTS  
12.5 WATTS**



NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 10.80       | 11.44 | 0.425     | 0.435 |
| B   | 7.50        | 7.74  | 0.295     | 0.305 |
| C   | 2.42        | 2.66  | 0.095     | 0.105 |
| D   | 0.51        | 0.66  | 0.020     | 0.026 |
| F   | 2.93        | 3.17  | 0.115     | 0.125 |
| G   | 2.39 BSC    |       | 0.094 BSC |       |
| H   | 1.27        | 2.41  | 0.050     | 0.096 |
| J   | 0.39        | 0.63  | 0.015     | 0.025 |
| K   | 14.61       | 16.63 | 0.575     | 0.655 |
| M   | 3" TYP      |       | 3" TYP    |       |
| Q   | 3.76        | 4.01  | 0.148     | 0.158 |
| R   | 1.15        | 1.39  | 0.045     | 0.055 |
| S   | 0.64        | 0.88  | 0.025     | 0.035 |
| U   | 3.69        | 3.93  | 0.145     | 0.155 |
| V   | 1.02        | —     | 0.040     | —     |

**CASE 77-06  
TO-225AA TYPE**

# MJE170, MJ3171, MJE172, PNP, MJE180, MJE181, MJE182, NPN

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

| Characteristic                                                                                                                                                                                                                                                                                                                                                                               | Symbol        | Min                        | Max                                    | Unit                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|----------------------------------------|-----------------------------------------------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                                                                                                   |               |                            |                                        |                                               |
| Collector-Emitter Sustaining Voltage<br>( $I_C = 10 \text{ mA}$ , $I_B = 0$ )                                                                                                                                                                                                                                                                                                                | $V_{CE(sus)}$ | 40<br>60<br>80             | —<br>—<br>—                            | Vdc                                           |
| Collector Cutoff Current<br>( $V_{CB} = 60 \text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 80 \text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 100 \text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 60 \text{ Vdc}$ , $I_E = 0$ , $T_C = 150^\circ\text{C}$ )<br>( $V_{CB} = 80 \text{ Vdc}$ , $I_E = 0$ , $T_C = 150^\circ\text{C}$ )<br>( $V_{CB} = 100 \text{ Vdc}$ , $I_E = 0$ , $T_C = 150^\circ\text{C}$ ) | $I_{CBO}$     | —<br>—<br>—<br>—<br>—<br>— | 0.1<br>0.1<br>0.1<br>0.1<br>0.1<br>0.1 | $\mu\text{Adc}$<br><br><br><br><br><br><br>mA |
| Emitter Cutoff Current<br>( $V_{BE} = 7.0 \text{ Vdc}$ , $I_C = 0$ )                                                                                                                                                                                                                                                                                                                         | $I_{EBO}$     | —                          | 0.1                                    | $\mu\text{Adc}$                               |

## ON CHARACTERISTICS

|                                                                                                                                                                                                        |               |                |                   |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------|-------------------|-----|
| DC Current Gain<br>( $I_C = 100 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ )<br>( $I_C = 500 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ )<br>( $I_C = 1.5 \text{ A}$ , $V_{CE} = 1.0 \text{ Vdc}$ )        | $h_{FE}$      | 50<br>30<br>12 | 250<br>—<br>—     | —   |
| Collector-Emitter Saturation Voltage<br>( $I_C = 500 \text{ mA}$ , $I_B = 50 \text{ mA}$ )<br>( $I_C = 1.5 \text{ A}$ , $I_B = 150 \text{ mA}$ )<br>( $I_C = 3.0 \text{ A}$ , $I_B = 600 \text{ mA}$ ) | $V_{CE(sat)}$ | —<br>—<br>—    | 0.3<br>0.9<br>1.7 | Vdc |
| Base-Emitter Saturation Voltage<br>( $I_C = 1.5 \text{ A}$ , $I_B = 150 \text{ mA}$ )<br>( $I_C = 3.0 \text{ A}$ , $I_B = 600 \text{ mA}$ )                                                            | $V_{BE(sat)}$ | —<br>—         | 1.5<br>2.0        | Vdc |
| Base-Emitter On Voltage<br>( $I_C = 500 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ )                                                                                                                     | $V_{BE(on)}$  | —              | 1.2               | Vdc |

## DYNAMIC CHARACTERISTICS

|                                                                                                                              |          |        |          |     |
|------------------------------------------------------------------------------------------------------------------------------|----------|--------|----------|-----|
| Current-Gain — Bandwidth Product (1)<br>( $I_C = 100 \text{ mA}$ , $V_{CE} = 10 \text{ Vdc}$ , $f_{test} = 10 \text{ MHz}$ ) | $f_T$    | 50     | —        | MHz |
| Output Capacitance<br>( $V_{CB} = 10 \text{ Vdc}$ , $I_E = 0$ , $f = 0.1 \text{ MHz}$ )                                      | $C_{ob}$ | —<br>— | 60<br>40 | pF  |

(1)  $f_T = |h_{fe}| \cdot f_{test}$

FIGURE 2 — SWITCHING TIME TEST CIRCUIT

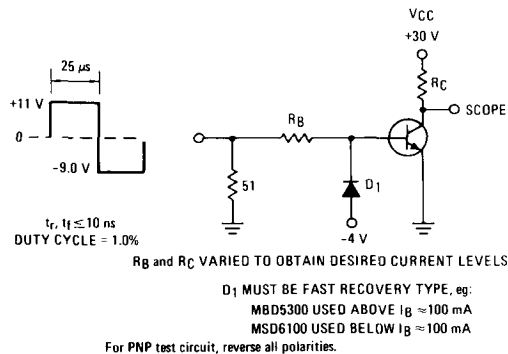
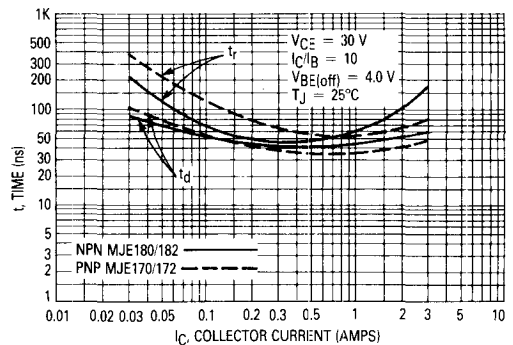
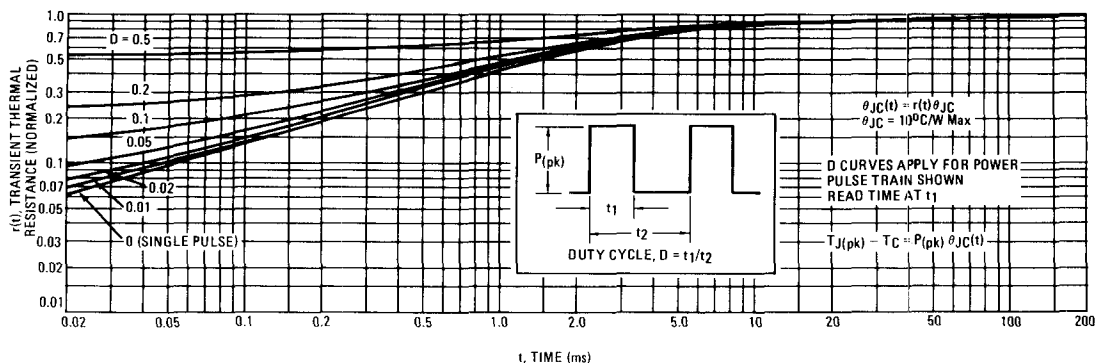


FIGURE 3 — TURN-ON TIME



# MJE170, MJ3171, MJE172, PNP, MJE180, MJE181, MJE182, NPN

FIGURE 4 – THERMAL RESPONSE



## ACTIVE-REGION SAFE OPERATING AREA

FIGURE 5 – MJE170, MJE171, MJE172

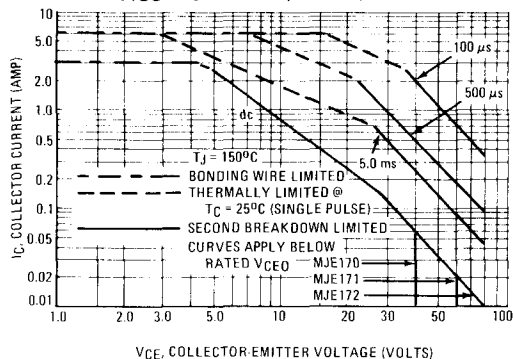
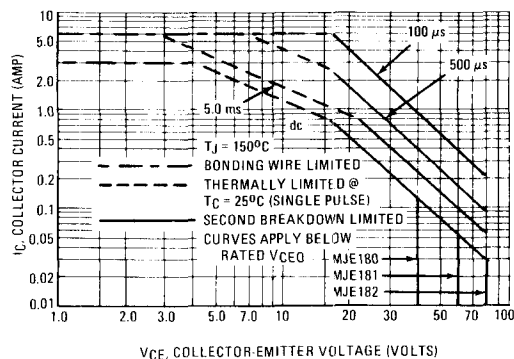


FIGURE 6 – MJE180, MJE181, MJE182



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 Figures 5 and 6 is based on  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  is

variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} < 150^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 4. At high case temperature, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

FIGURE 7 – TURN-OFF TIME

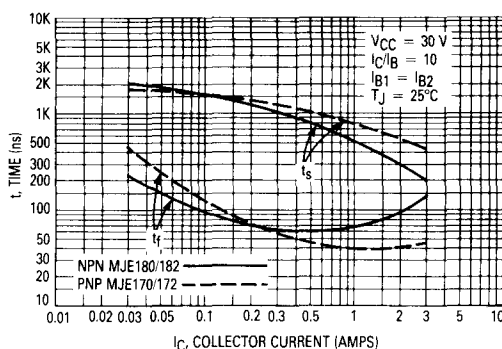
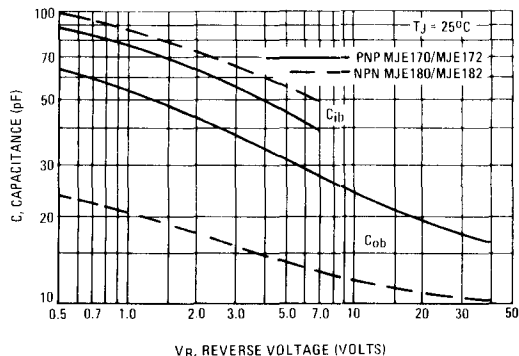


FIGURE 8 – CAPACITANCE



# MJE170, MJ3171, MJE172, PNP, MJE180, MJE181, MJE182, NPN

PNP  
MJE170, MJE171, MJE172

NPN  
MJE180, MJE181, MJE182

FIGURE 9 – DC CURRENT GAIN

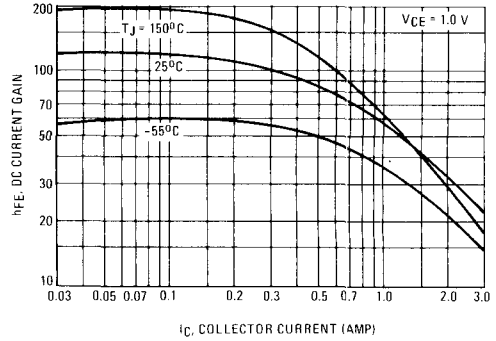
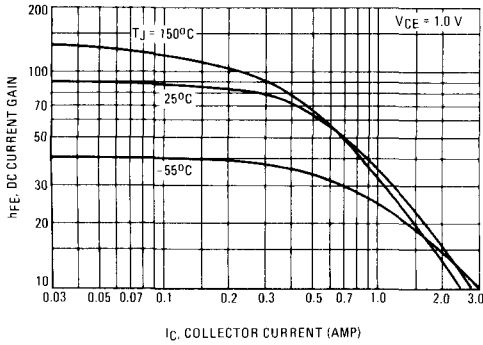


FIGURE 10 – "ON" VOLTAGES

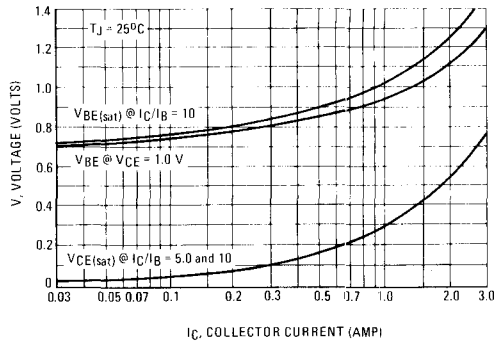
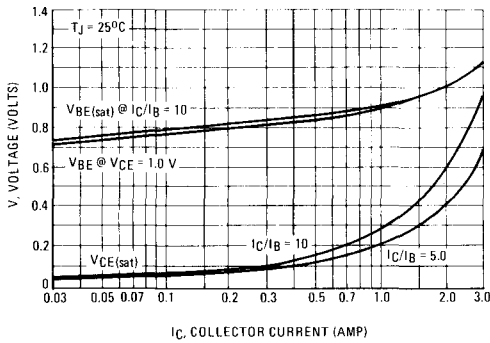


FIGURE 11 – TEMPERATURE COEFFICIENTS

