

6367254 MOTOROLA SC (XSTRS/R F)

96D 80587

DT-33-13

T-33-23

**MOTOROLA SEMICONDUCTOR TECHNICAL DATA**

**NPN  
BD311  
PNP  
BD312**

**COMPLEMENTARY SILICON HIGH-POWER TRANSISTORS**

... designed for high quality amplifiers operating up to 60 Watts into 4 ohm load.

- High DC Current Gain
- Excellent Safe Operating Area
- High Current Gain – Bandwidth Product – Typical  
 $f_T = 4.0 \text{ MHz} @ I_C = 0.5 \text{ A}$

**10 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS**

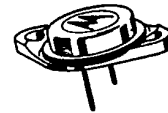
**60 VOLTS  
115 WATTS**

**MAXIMUM RATINGS**

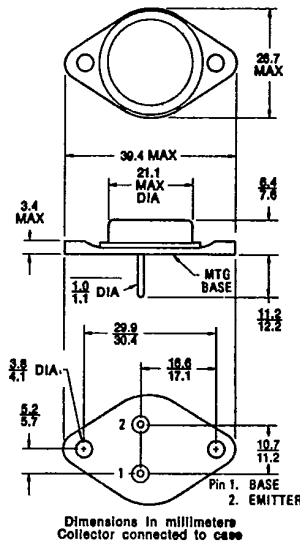
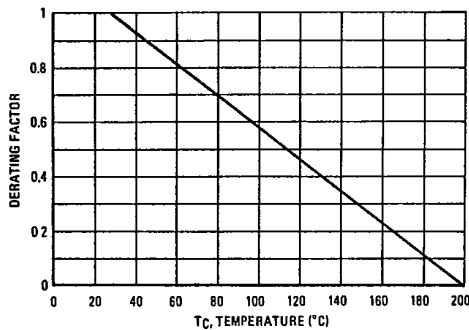
| Rating  | Symbol         | BD311/312   | Unit                |
|---|----------------|-------------|---------------------|
| Collector-Emitter Voltage                           | $V_{CEO}$      | 60          | Vdc                 |
| Collector-Base Voltage                              | $V_{CB}$       | 60          | Vdc                 |
| Emitter-Base Voltage                                | $V_{EB}$       | 5.0         | Vdc                 |
| Collector Current – Continuous                      | $I_C$          | 10          | Adc                 |
| Peak  |                | 20          |                     |
| Base Current  | $I_B$          | 4.0         | Adc                 |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$ | $P_D$          | 115         | Watts               |
| Derate above $25^\circ\text{C}$                     |                | 0.658       | W/ $^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range    | $T_J, T_{stg}$ | -65 to +200 | $^\circ\text{C}$    |

**THERMAL CHARACTERISTICS**

| Characteristic                       | Symbol        | Max. | Unit.              |
|--------------------------------------|---------------|------|--------------------|
| Thermal Resistance, Junction to Case | $\theta_{JC}$ | 1.52 | $^\circ\text{C/W}$ |



**FIGURE 1 – POWER DERATING**



Dimensions in millimeters  
Collector connected to case

CASE 11  
TO-3



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**ELECTIRCAL CHARACTERISTICS\*** (T<sub>C</sub> = 25 °C unless otherwise noted)

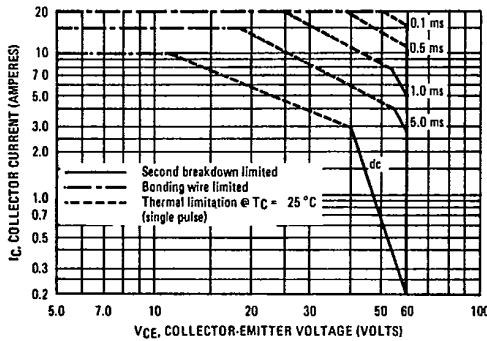
| Characteristic   | Symbol                | Min.         | Max. | Unit. |
|--|-----------------------|--------------|------|-------|
| <b>OFF CHARACTERISTICS</b>   |                       |              |      |       |
| Collector-Emitter Sustaining Voltage <sup>1</sup><br>(I <sub>C</sub> = 200 mA, I <sub>B</sub> = 0)                                 | V <sub>CEO(sus)</sub> | 60           |      | Vdc   |
| Collector-Base Cutoff Current<br>(V <sub>CB</sub> = Rated V <sub>CB</sub> , I <sub>E</sub> = 0)                                    | I <sub>CBO</sub>      |              | 1.0  | mA    |
| Emitter-Base Cutoff Current<br>(V <sub>BE</sub> = 7.0 Vdc, I <sub>C</sub> = 0)   | I <sub>EBO</sub>      |              | 1.0  | mA    |
| <b>ON CHARACTERISTICS<sup>1</sup></b>  |                       |              |      |       |
| DC Current Gain<br>(I <sub>C</sub> = 5.0 Vdc, V <sub>CE</sub> = 4.0 Vdc)<br>(I <sub>C</sub> = 10 Adc, V <sub>CE</sub> = 4.0 Vdc)   | h <sub>FE</sub>       | 25<br>5      |      | -     |
| Collector-Emitter Saturation Voltage<br>(I <sub>C</sub> = 5.0 Adc, I <sub>B</sub> = 0.5 Adc)                                       | V <sub>CE(sat)</sub>  |              | 1.0  | Vdc   |
| Base-Emitter Saturation Voltage<br>(I <sub>C</sub> = 5.0 Adc, I <sub>B</sub> = 0.5 Adc)  | V <sub>BE(sat)</sub>  |              | 1.8  | Vdc   |
| Base-Emitter On Voltage<br>(I <sub>C</sub> = 5.0 Adc, V <sub>CE</sub> = 4.0 Vdc)   | V <sub>BE(on)</sub>   |              | 1.5  | Vdc   |
| <b>DYNAMIC CHARACTERISTICS<sup>1</sup></b>   |                       |              |      |       |
| Current-Gain - Bandwidth Product <sup>2</sup><br>(I <sub>C</sub> = 0.5 Adc, V <sub>CE</sub> = 10 Vdc, f <sub>test</sub> = 1.0 MHz) | f <sub>T</sub>        | 4.0          |      | MHz   |
| <b>SECOND BREAKDOWN</b>  |                       |              |      |       |
| Second Breakdown Collector Current<br>(V <sub>CE</sub> = 39 Vdc, t = 0.5 sec.)<br>(V <sub>CE</sub> = 50 Vdc, t = 0.5 sec.)         | I <sub>S/B</sub>      | 2.95<br>0.60 |      | A     |

<sup>1</sup> Pulse test: Pulse width < 300 μs, Duty Cycle > 2%

<sup>2</sup> f<sub>T</sub> = |h<sub>fe</sub>| · f<sub>test</sub>



**FIGURE 2 - ACTIVE REGION SAFE OPERATING AREA**



There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I<sub>C</sub> - V<sub>CE</sub> 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. Second breakdown pulse limits are valid for duty cycles to 10%.

At high case temperatures, thermal limitation may reduce the power that can be handled to values less than the limitations imposed by second breakdown.

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PNP DEVICE  
 BD312

NPN DEVICE  
 BD311

FIGURE 3 - DC CURRENT GAIN

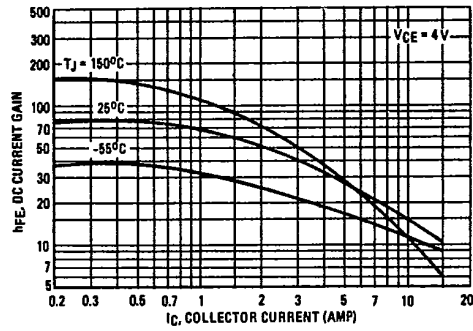
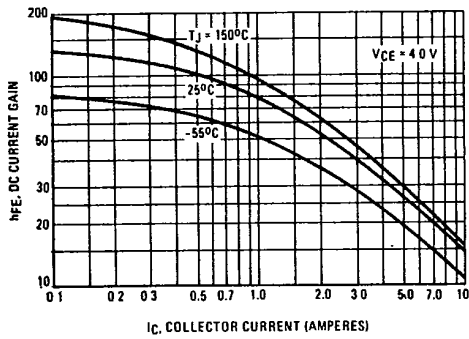
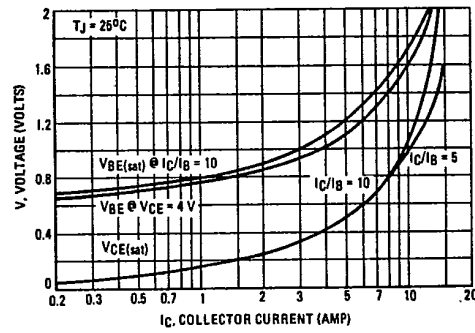
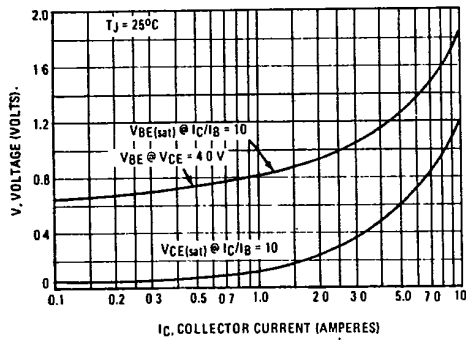


FIGURE 4 - "ON" VOLTAGES





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