

## MAXIMUM RATINGS

| Rating                         | Symbol    | Value | Unit |
|--------------------------------|-----------|-------|------|
| Collector-Emitter Voltage      | $V_{CE0}$ | 32    | V    |
| Collector-Base Voltage         | $V_{CBO}$ | 32    | V    |
| Emitter-Base Voltage           | $V_{EBO}$ | 5.0   | V    |
| Collector Current — Continuous | $I_C$     | 100   | mAdc |

## THERMAL CHARACTERISTICS

| Characteristic                                                                                               | Symbol          | Max         | Unit               |
|--------------------------------------------------------------------------------------------------------------|-----------------|-------------|--------------------|
| Total Device Dissipation FR-5 Board,*<br>$T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$         | $P_D$           | 225         | mW                 |
| Thermal Resistance Junction to Ambient                                                                       | $R_{\theta JA}$ | 556         | $^\circ\text{C/W}$ |
| Total Device Dissipation<br>Alumina Substrate,** $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$           | 300         | mW                 |
| Thermal Resistance Junction to Ambient                                                                       | $R_{\theta JA}$ | 417         | $^\circ\text{C/W}$ |
| Junction and Storage Temperature                                                                             | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$   |

\*FR-5 = 1.0 x 0.75 x 0.062 in.

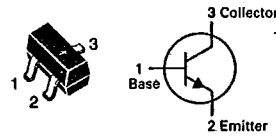
\*\*Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

## DEVICE MARKING

BCW60AL = AA; BCW60BL = AB; BCW60CL = AC; BCW60DL = AD

MOTOROLA SC XSTRS/R F

BCW60AL, BL, CL, DL T-27-09

CASE 318-03, STYLE 6  
SOT-23 (TO-236AB)GENERAL PURPOSE  
TRANSISTORS  
NPN SILICON

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Refer to MPS3904 for graphs.

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

| Characteristic                                                                                                         | Symbol        | Min | Max | Unit                    |
|------------------------------------------------------------------------------------------------------------------------|---------------|-----|-----|-------------------------|
| OFF CHARACTERISTICS                                                                                                    |               |     |     |                         |
| Collector-Emitter Breakdown Voltage<br>( $I_C = 2.0 \text{ mAdc}$ , $I_E = 0$ )                                        | $V_{(BR)CEO}$ | 32  | —   | Vdc                     |
| Emitter-Base Breakdown Voltage<br>( $I_E = 1.0 \mu\text{Adc}$ , $I_C = 0$ )                                            | $V_{(BR)EBO}$ | 5.0 | —   | Vdc                     |
| Collector Cutoff Current<br>( $V_{CE} = 32 \text{ Vdc}$ )<br>( $V_{CE} = 32 \text{ Vdc}$ , $T_A = 150^\circ\text{C}$ ) | $I_{CES}$     | —   | 20  | nAdc<br>$\mu\text{Adc}$ |
| Emitter Cutoff Current<br>( $V_{EB} = 4.0 \text{ Vdc}$ , $I_C = 0$ )                                                   | $I_{EBO}$     | —   | 20  | nAdc                    |

## ON CHARACTERISTICS

|                                                                                                                                                                                                                       |               |          |      |          |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------|------|----------|---|
| DC Current Gain<br>( $I_C = 10 \mu\text{Adc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )<br><br><br>( $I_C = 2.0 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )<br><br><br>( $I_C = 50 \text{ mAdc}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) | BCW60AL       | $h_{FE}$ | 20   | —        | — |
|                                                                                                                                                                                                                       | BCW60BL       |          | 30   | —        |   |
|                                                                                                                                                                                                                       | BCW60CL       |          | 40   | —        |   |
|                                                                                                                                                                                                                       | BCW60DL       |          | 100  | —        |   |
|                                                                                                                                                                                                                       | BCW60AL       |          | 120  | 220      |   |
|                                                                                                                                                                                                                       | BCW60BL       |          | 175  | 310      |   |
|                                                                                                                                                                                                                       | BCW60CL       |          | 250  | 460      |   |
|                                                                                                                                                                                                                       | BCW60DL       |          | 380  | 630      |   |
|                                                                                                                                                                                                                       | BCW60AL       |          | 60   | —        |   |
|                                                                                                                                                                                                                       | BCW60BL       |          | 70   | —        |   |
|                                                                                                                                                                                                                       | BCW60CL       |          | 90   | —        |   |
|                                                                                                                                                                                                                       | BCW60DL       |          | 100  | —        |   |
| AC Current Gain<br>( $I_C = 2.0 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )                                                                                                                  | BCW60AL       | $h_{fe}$ | 125  | 250      | — |
|                                                                                                                                                                                                                       | BCW60BL       |          | 175  | 350      |   |
|                                                                                                                                                                                                                       | BCW60CL       |          | 250  | 500      |   |
|                                                                                                                                                                                                                       | BCW60DL       |          | 350  | 700      |   |
| Collector-Emitter Saturation Voltage<br>( $I_C = 50 \text{ mAdc}$ , $I_B = 1.25 \text{ mAdc}$ )<br>( $I_C = 10 \text{ mAdc}$ , $I_B = 0.25 \text{ mAdc}$ )                                                            | $V_{CE(sat)}$ | —        | 0.55 | $V_{dc}$ |   |
|                                                                                                                                                                                                                       |               | —        | 0.35 |          |   |
| Base-Emitter Saturation Voltage<br>( $I_C = 50 \text{ mAdc}$ , $I_B = 1.25 \text{ mAdc}$ )<br>( $I_C = 50 \text{ mAdc}$ , $I_B = 0.25 \text{ mAdc}$ )                                                                 | $V_{BE(sat)}$ | 0.7      | 1.05 | $V_{dc}$ |   |
|                                                                                                                                                                                                                       |               | 0.6      | 0.85 |          |   |
| Base-Emitter On Voltage<br>( $I_C = 2.0 \text{ mAdc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )                                                                                                                                  | $V_{BE(on)}$  | 0.6      | 0.75 | $V_{dc}$ |   |

MOTOROLA SMALL-SIGNAL TRANSISTORS, FETs AND DIODES

**ELECTRICAL CHARACTERISTICS** (continued) ( $T_A = 25^\circ\text{C}$  unless otherwise noted.)

| Characteristic                                                                                                                                        | Symbol    | Min | Max | Unit |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----|-----|------|
| <b>SMALL-SIGNAL CHARACTERISTICS</b>                                                                                                                   |           |     |     |      |
| Current-Gain — Bandwidth Product<br>( $I_C = 10\text{ mAdc}$ , $V_{CE} = 5.0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )                                     | $f_T$     | 125 | —   | MHz  |
| Output Capacitance<br>( $V_{CE} = 10\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )                                                                 | $C_{obo}$ | —   | 4.5 | pF   |
| Noise Figure<br>( $I_C = 0.2\text{ mAdc}$ , $V_{CE} = 5.0\text{ Vdc}$ , $R_S = 2.0\text{ k}\Omega$ ,<br>$f = 1.0\text{ kHz}$ , $BW = 200\text{ Hz}$ ) | NF        | —   | 6.0 | dB   |
| <b>SWITCHING CHARACTERISTICS</b>                                                                                                                      |           |     |     |      |
| Turn-On Time<br>( $I_C = 10\text{ mAdc}$ , $I_{B1} = 1.0\text{ mAdc}$ )                                                                               | $t_{on}$  | —   | 150 | ns   |
| Turn-Off Time<br>( $I_{B2} = 1.0\text{ mAdc}$ , $V_{BB} = 3.6\text{ Vdc}$ , $R_1 = R_2 = 5.0\text{ k}\Omega$ ,<br>$R_L = 990\text{ }\Omega$ )         | $t_{off}$ | —   | 800 | ns   |