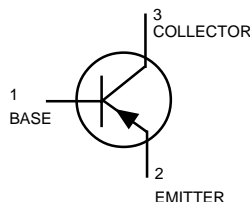
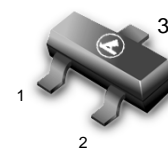


# General Purpose Transistors

## PNP Silicon



**BCW61BLT1**  
**BCW61CLT1**  
**BCW61DLT1**



CASE 318-08, STYLE 6  
 SOT-23 (TO-236AB)

### MAXIMUM RATINGS

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

### THERMAL CHARACTERISTICS

| Characteristic  | Symbol          | Max         | Unit                 |
|---|-----------------|-------------|----------------------|
| Total Device Dissipation FR-5 Board, (1)<br>$T_A = 25^\circ\text{C}$        | $P_D$           | 225         | mW                   |
| Derate above $25^\circ\text{C}$   |                 | 1.8         | mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction to Ambient                                     | $R_{\theta JA}$ | 556         | $^\circ\text{C/W}$   |
| Total Device Dissipation<br>Alumina Substrate, (2) $T_A = 25^\circ\text{C}$ | $P_D$           | 300         | mW                   |
| Derate above $25^\circ\text{C}$   |                 | 2.4         | mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction to Ambient                                     | $R_{\theta JA}$ | 417         | $^\circ\text{C/W}$   |
| Junction and Storage Temperature  | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$     |

### DEVICE MARKING

BCW61BLT1 = BB, BCW61CLT1 = BC, BCW61DLT1 = BD

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

| Characteristic | Symbol | Min | Max | Unit |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

### OFF CHARACTERISTICS

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

1. FR-5 = 1.0 x 0.75 x 0.062 in.

2. Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

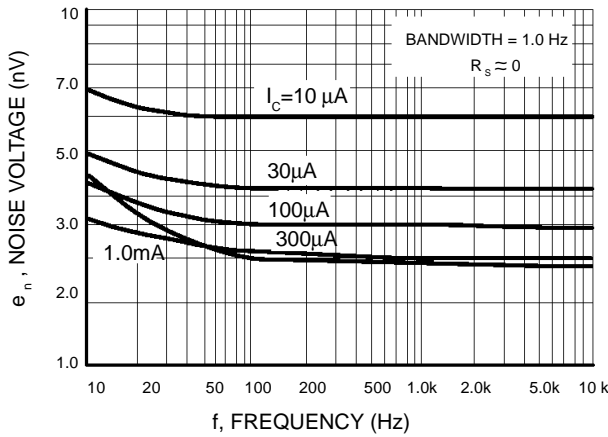
**BCW61BLT1 BCW61CLT1 BCW61DLT1**
**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (Continued)

| Characteristic   | Symbol                                 | Min               | Max               | Unit |
|--|--|-------------------|-------------------|------|
| <b>ON CHARACTERISTICS</b>  |  |                   |                   |      |
| DC Current Gain<br>( $I_C = -10 \mu\text{Adc}$ , $V_{CE} = -5.0 \text{ Vdc}$ )   | $h_{FE}$<br>BCW61B<br>BCW61C<br>BCW61D | 30<br>40<br>100   | —<br>—<br>—       | —    |
| ( $I_C = -2.0 \text{ mAdc}$ , $V_{CE} = -5.0 \text{ Vdc}$ )  | $h_{FE}$<br>BCW61B<br>BCW61C<br>BCW61D | 140<br>250<br>380 | 310<br>460<br>630 | —    |
| ( $I_C = -50 \text{ mAdc}$ , $V_{CE} = -1.0 \text{ Vdc}$ )   | $h_{FE}$<br>BCW61B<br>BCW61C<br>BCW61D | 80<br>100<br>100  | —<br>—<br>—       | —    |
| AC Current Gain<br>( $V_{CE} = -5.0 \text{ Vdc}$ , $I_C = -2.0 \text{ mAdc}$ ,<br>$f = 1.0 \text{ kHz}$ )  | $h_{FE}$<br>BCW61B<br>BCW61C<br>BCW61D | 175<br>250<br>350 | 350<br>500<br>700 | —    |
| Collector–Emitter Saturation Voltage<br>( $I_C = -50 \text{ mAdc}$ , $I_B = -1.25 \text{ mAdc}$ )<br>( $I_C = -10 \text{ mAdc}$ , $I_B = -0.25 \text{ mAdc}$ )   | $V_{CE(\text{sat})}$                   | —<br>—            | -0.55<br>-0.25    | Vdc  |
| Base–Emitter Saturation Voltage<br>( $I_C = -50 \text{ mAdc}$ , $I_B = -1.25 \text{ mAdc}$ )<br>( $I_C = -10 \text{ mAdc}$ , $I_B = -0.25 \text{ mAdc}$ )        | $V_{BE(\text{sat})}$                   | -0.68<br>-0.6     | -1.05<br>-0.85    | Vdc  |
| Base–Emitter On Voltage<br>( $I_C = -2.0 \text{ mAdc}$ , $V_{CE} = -5.0 \text{ Vdc}$ )   | $V_{BE(\text{on})}$                    | -0.6              | -0.75             | Vdc  |
| <b>SMSMAL–SIGNAL CHARACTERISTICS</b>   |  |                   |                   |      |
| Output Capacitance<br>( $V_{CE} = -10 \text{ Vdc}$ , $I_C = 0$ , $f = 1.0 \text{ MHz}$ )   | $C_{obo}$                              | —                 | 6.0               | pF   |
| Noise Figure<br>( $V_{CE} = -5.0 \text{ Vdc}$ , $I_C = -0.2 \text{ mAdc}$ , $R_S = 2.0 \text{ k}\Omega$ , $f = 1.0 \text{ kHz}$ , $\text{BW} = 200 \text{ Hz}$ ) | 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>( $I_{B2} = -1.0 \text{ mAdc}$ , $V_{BB} = -3.6 \text{ Vdc}$ , $R_1 = R_2 = 5.0 \text{ k}\Omega$ , $R_L = 990 \Omega$ )                         | $t_{off}$                              | —                 | 800               | ns   |

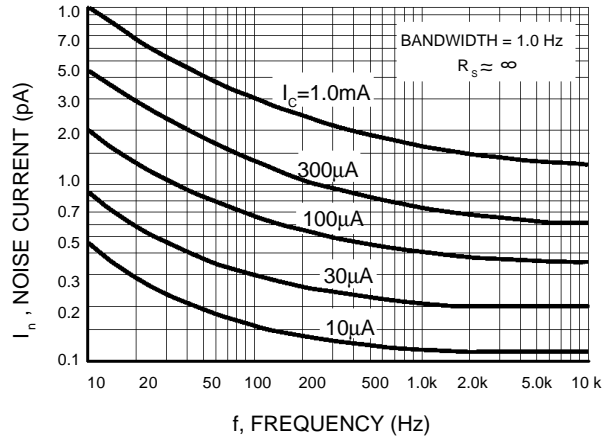
**BCW61BLT1 BCW61CLT1 BCW61DLT1**

**TYPICAL NOISE CHARACTERISTICS**

( $V_{CE} = -5.0$  Vdc,  $T_A = 25^\circ\text{C}$ )



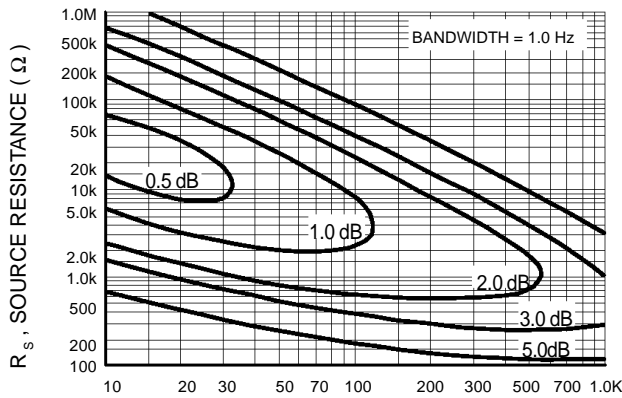
**Figure 1. Noise Voltage**



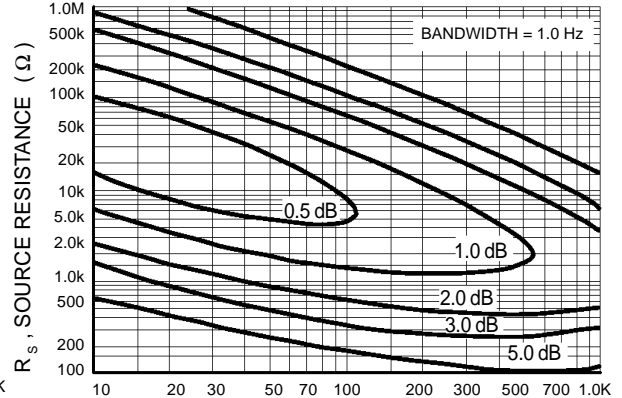
**Figure 2. Noise Current**

**NOISE FIGURE CONTOURS**

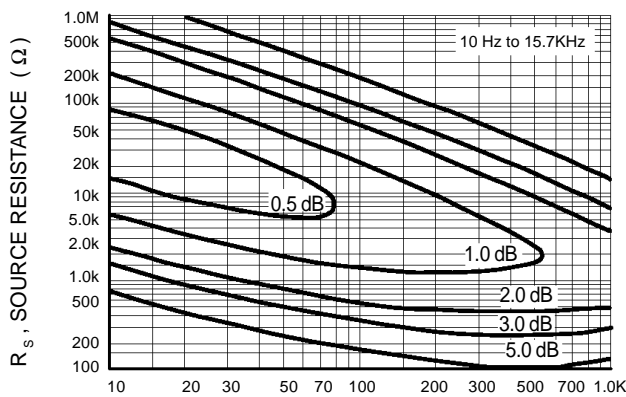
( $V_{CE} = -5.0$  Vdc,  $T_A = 25^\circ\text{C}$ )



**Figure 3. Narrow Band, 100 Hz**



**Figure 4. Narrow Band, 1.0 kHz**



**Figure 5. Wideband**

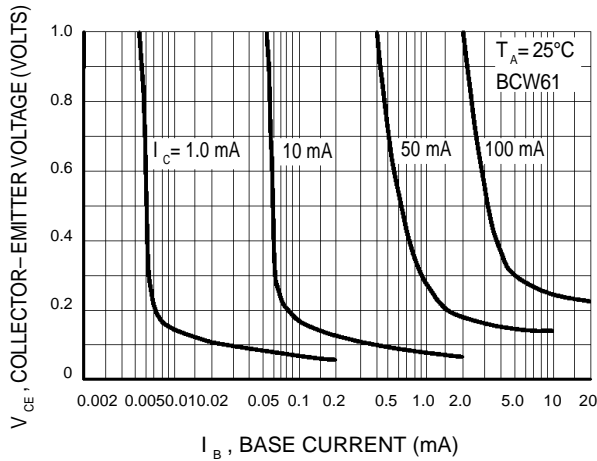
Noise Figure is Defined as:

$$NF = 20 \log_{10} \left( \frac{e_n^2 + 4KTR_s + I_n^2 R_s^2}{4KTR_s} \right)^{1/2}$$

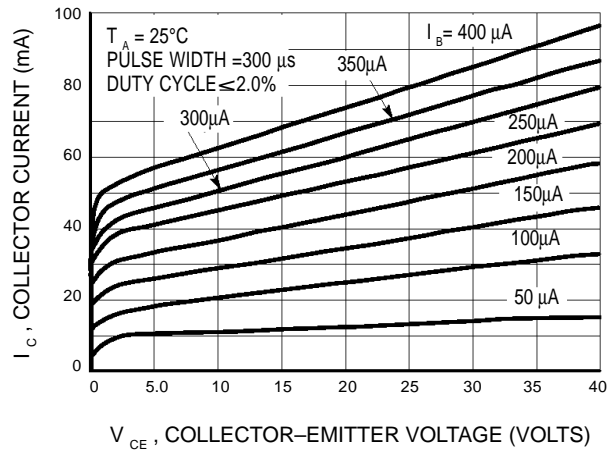
- $e_n$  = Noise Voltage of the Transistor referred to the input. (Figure 3)
- $I_n$  = Noise Current of the Transistor referred to the input. (Figure 4)
- $K$  = Boltzman's Constant ( $1.38 \times 10^{-23}$  j/°K)
- $T$  = Temperature of the Source Resistance (°K)
- $R_s$  = Source Resistance (Ω)

**BCW61BLT1 BCW61CLT1 BCW61DLT1**

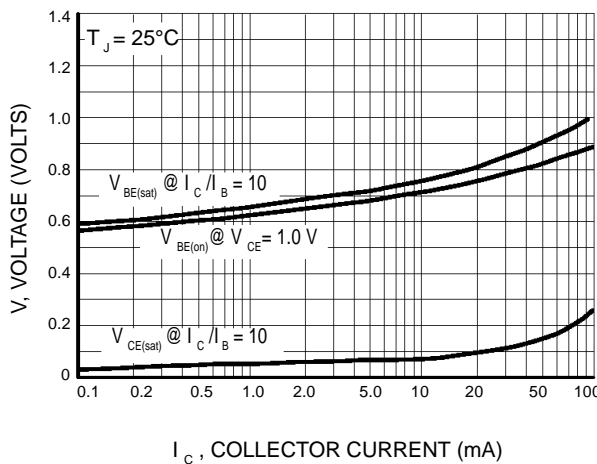
**TYPICAL STATIC CHARACTERISTICS**



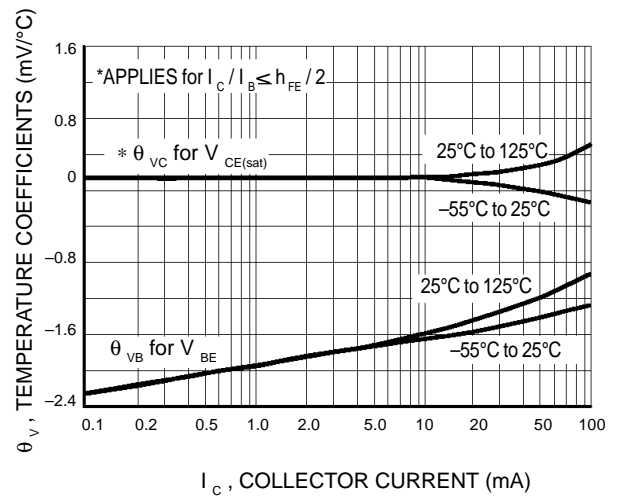
**Figure 6. Collector Saturation Region**



**Figure 7. Collector Characteristics**



**Figure 8. "On" Voltages**



**Figure 9. Temperature Coefficients**

BCW61BLT1 BCW61CLT1 BCW61DLT1

TYPICAL DYNAMIC CHARACTERISTICS

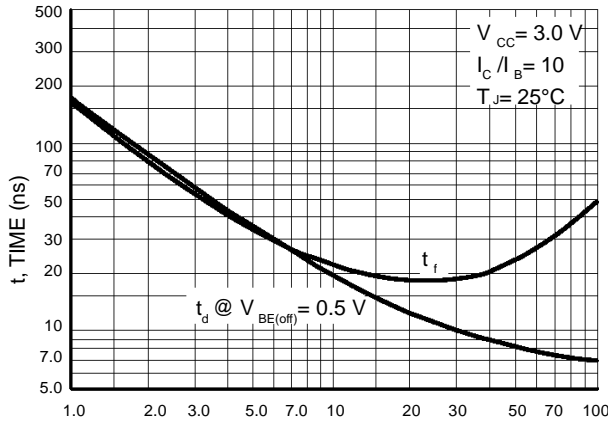


Figure 10. Turn-On Time

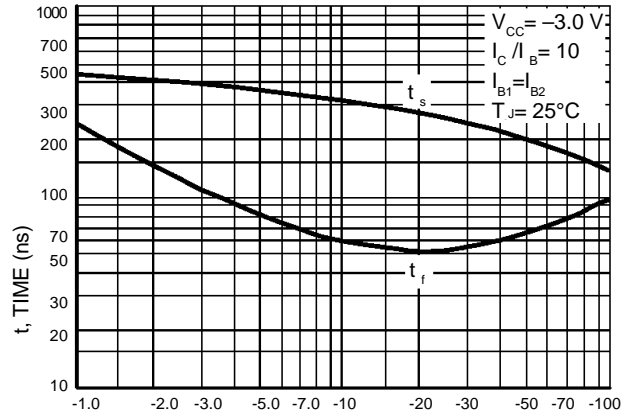


Figure 11. Turn-Off Time

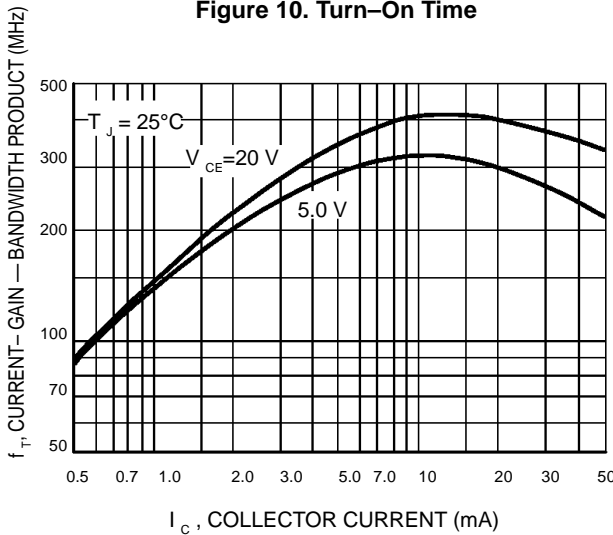


Figure 12. Current-Gain — Bandwidth Product

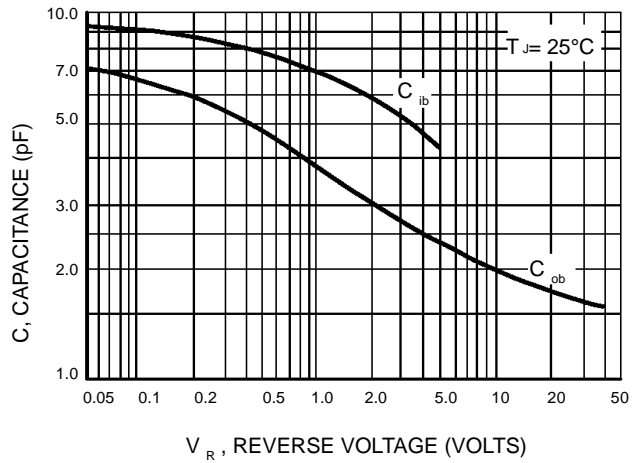


Figure 13. Capacitance

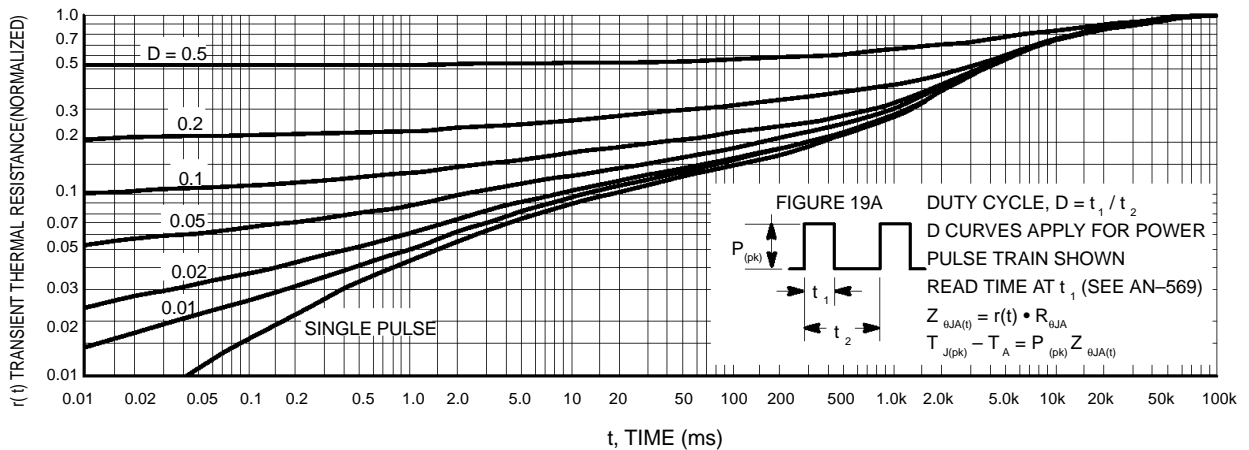
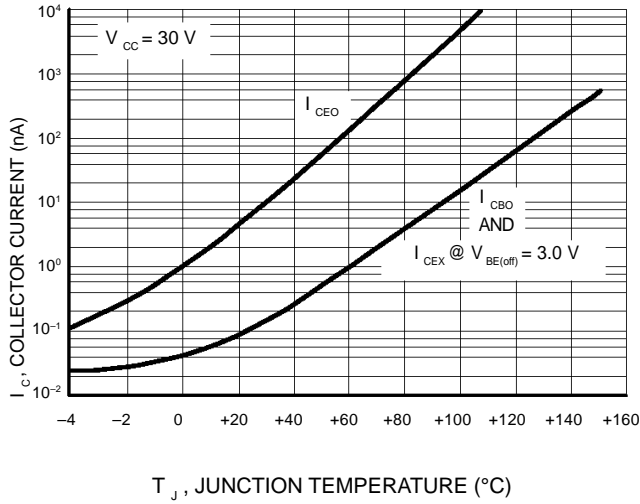


Figure 14. Thermal Response

**BCW61BLT1 BCW61CLT1 BCW61DLT1**



**Figure 15. Typical Collector Leakage Current**

**DESIGN NOTE: USE OF THERMAL RESPONSE DATA**

A train of periodical power pulses can be represented by the model as shown in Figure 15. Using the model and the device thermal response the normalized effective transient thermal resistance of Figure 14 was calculated for various duty cycles.

To find  $Z_{\theta JA(t)}$ , multiply the value obtained from Figure 14 by the steady state value  $R_{\theta JA}$ .

Example:

The MPS3905 is dissipating 2.0 watts peak under the following conditions:

$$t_1 = 1.0\text{ ms}, t_2 = 5.0\text{ ms. (D = 0.2)}$$

Using Figure 14 at a pulse width of 1.0 ms and  $D = 0.2$ , the reading of  $r(t)$  is 0.22.

The peak rise in junction temperature is therefore

$$\Delta T = r(t) \times P_{(pk)} \times R_{\theta JA} = 0.22 \times 2.0 \times 200 = 88^{\circ}\text{C}.$$

For more information, see AN-569.