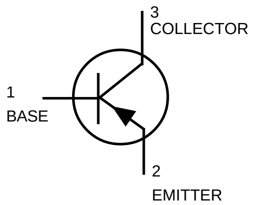
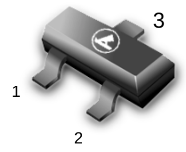
# General Purpose Transistors

## PNP Silicon

**BCW69LT1**
**BCW70LT1**




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

### MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector–Emitter Voltage | $V_{CEO}$ | – 45 | 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) $T_A$ = 25°C | $P_D$ | 225 | mW |
| Derate above 25°C | | 1.8 | mW/°C |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 556 | °C/W |
| Total Device Dissipation Alumina Substrate, (2) $T_A$ = 25°C | $P_D$ | 300 | mW |
| Derate above 25°C | | 2.4 | mW/°C |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 417 | °C/W |
| Junction and Storage Temperature | $T_J$ , $T_{stg}$ | –55 to +150 | °C |

### DEVICE MARKING

BCW69LT1 = H1; BCW70LT1 = H2,

### ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C unless otherwise noted.)

| Characteristic | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | |
| Collector–Emitter Breakdown Voltage ($I_C$ = –2.0 mAdc, $I_B$ = 0 ) | $V_{(BR)CEO}$ | – 45 | — | Vdc |
| Collector–Emitter Breakdown Voltage ($I_C$ = –100 µAdc, $V_{EB}$ = 0 ) | $V_{(BR)CES}$ | – 50 | — | Vdc |
| Emitter–Base Breakdown Voltage ($I_E$ = –10 µAdc, $I_C$ = 0) | $V_{(BR)EBO}$ | – 5.0 | — | Vdc |
| Collector Cutoff Current | $I_{CEO}$ | | | |
| ($V_{CE}$ = –20 Vdc, $I_E$ = 0 ) | | — | – 100 | nAdc |
| ($V_{CE}$ = –20 Vdc, $I_E$ = 0 , $T_A$ = 100°C) | | — | – 10 | µAdc |

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.

# BCW69LT1 BCW70LT1

**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted) (Continued)

| Characteristic | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| **ON CHARACTERISTICS** | | | | |
| DC Current Gain | $h_{FE}$ | | | — |
| ( $I_C$= –2.0 mAdc, $V_{CE}$ = –5.0 Vdc ) BCW69LT1 | | 120 | 260 | |
| BCW70LT1 | | 215 | 500 | |
| Collector–Emitter Saturation Voltage ( $I_C$ = – 10 mAdc, $I_B$ = –0.5 mAdc ) | $V_{CE(sat)}$ | — | – 0.3 | Vdc |
| Base–Emitter On Voltage ( $I_C$ = – 2.0 mAdc, $V_{CE}$ = – 5.0Vdc ) | $V_{BE(on)}$ | – 0.6 | – 0.75 | Vdc |
| **SMALL–SIGNAL CHARACTERISTICS** | | | | |
| Output Capacitance ( $I_E$= 0 $V_{CB}$ = –10Vdc, f = 1.0 MHz) | $C_{obo}$ | — | 7.0 | pF |
| Noise Figure ($V_{CE}$ = – 5.0 Vdc, $I_C$ = – 0.2 mAdc, $R_S$ = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz) | $N_F$ | — | 10 | dB |

## TYPICAL NOISE CHARACTERISTICS

($V_{CE}$ = – 5.0 Vdc, $T_A$ = 25°C)

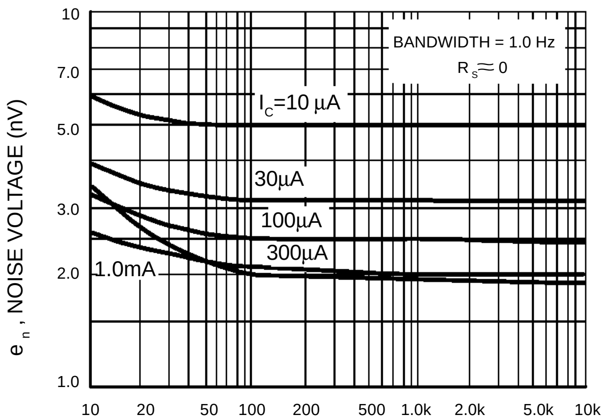



**Figure 1. Noise Voltage**

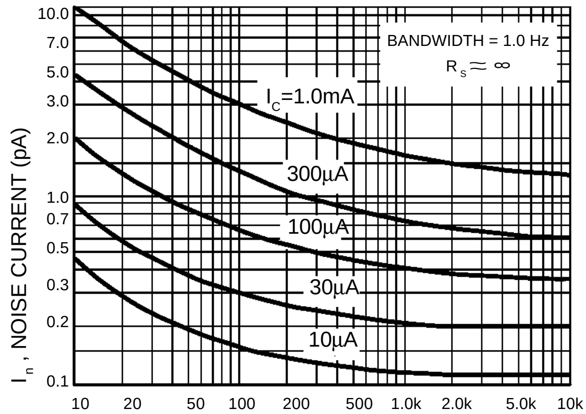



**Figure 2. Noise Current**

## NOISE FIGURE CONTOURS

($V_{CE}$ = – 5.0 Vdc, $T_A$ = 25°C)

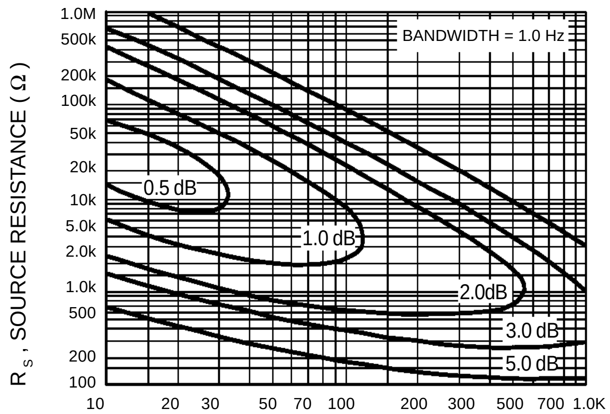



**Figure 3. Narrow Band, 100 Hz**

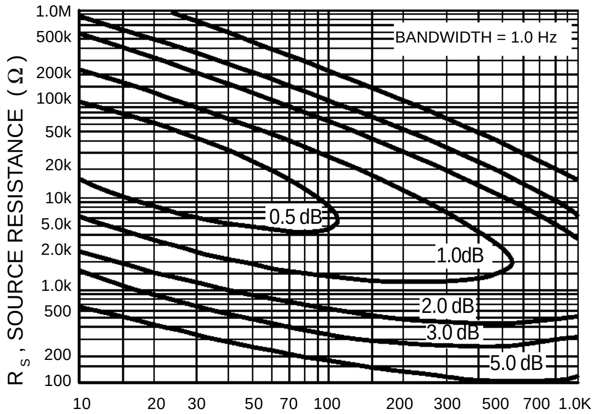



**Figure 4. Narrow Band, 1.0 kHz**

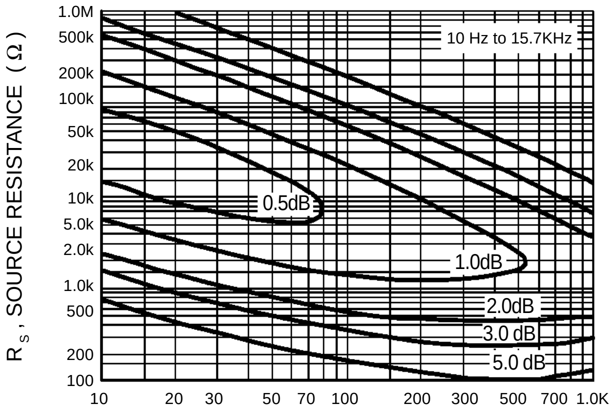



**Figure 5. Wideband**

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 x $10^{-23}$ j/°K)
T = Temperature of the Source Resistance (°K)
$R_s$ = Source Resistance ( Ω )

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### TYPICAL STATIC CHARACTERISTICS

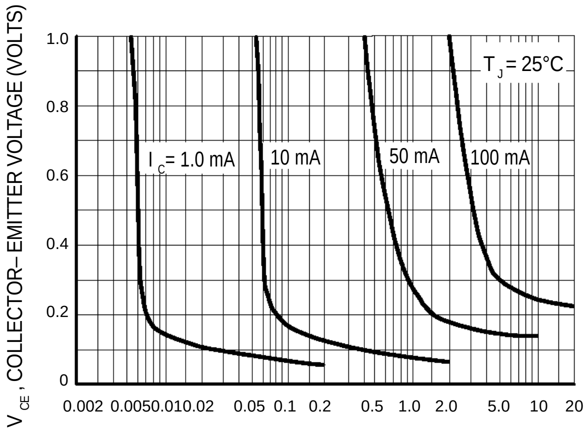


**Figure 6. Collector Saturation Region**

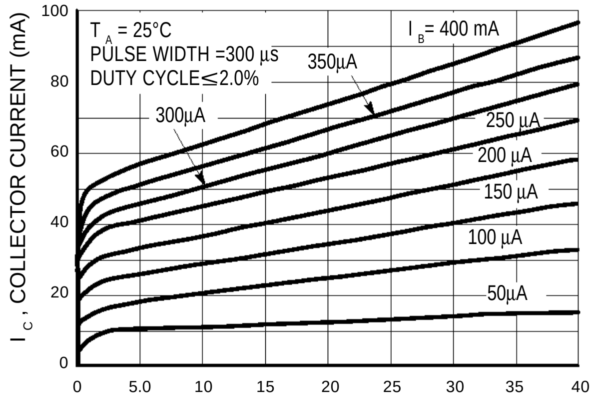


**Figure 7. Collector Characteristics**

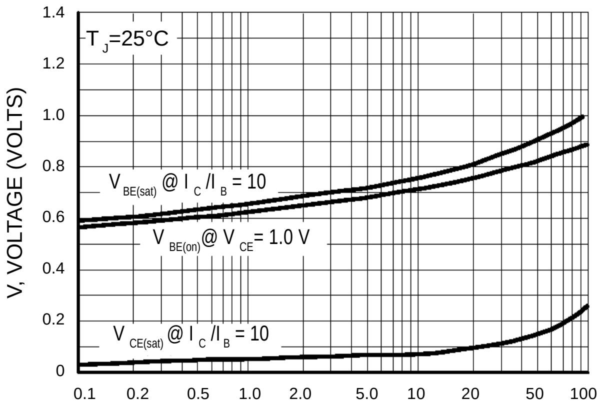


**Figure 10. "On" Voltages**

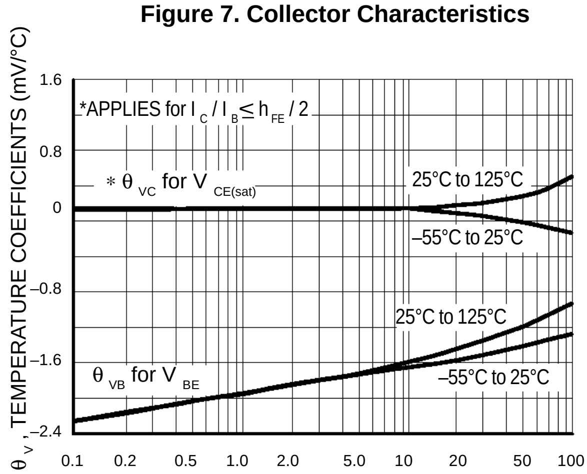


**Figure 11. Temperature Coefficients**

# BCW69LT1 BCW70LT1

## TYPICAL DYNAMIC CHARACTERISTICS

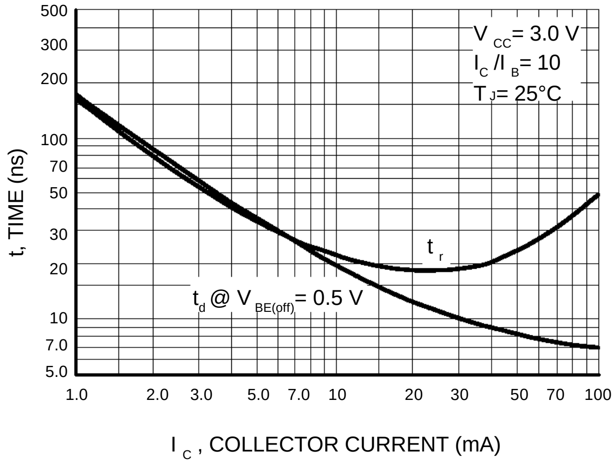


**Figure 10. Turn–On Time**

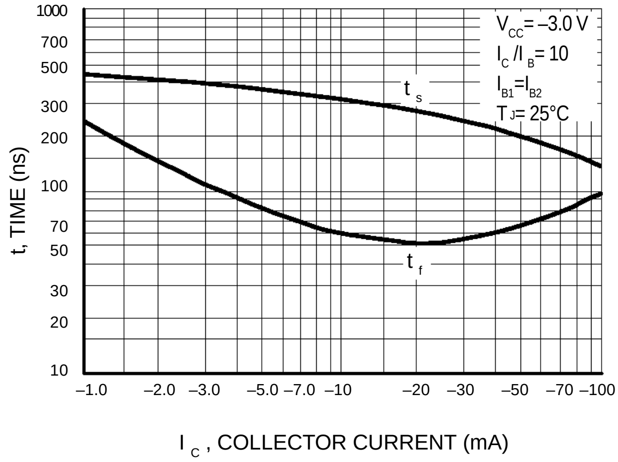


**Figure 11. Turn–Off Time**

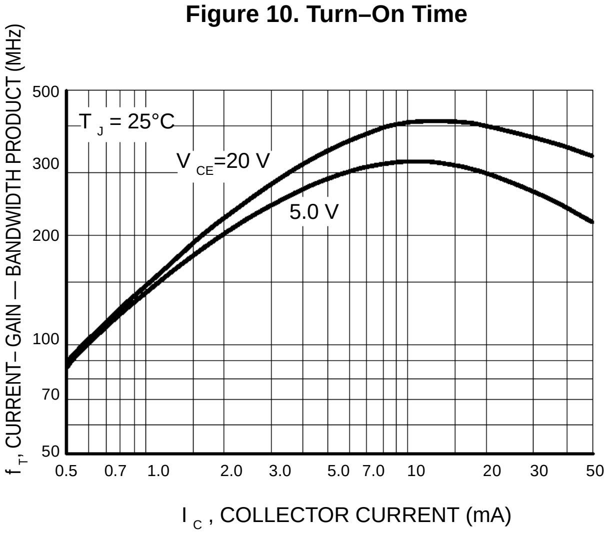


**Figure 12. Current–Gain — Bandwidth Product**

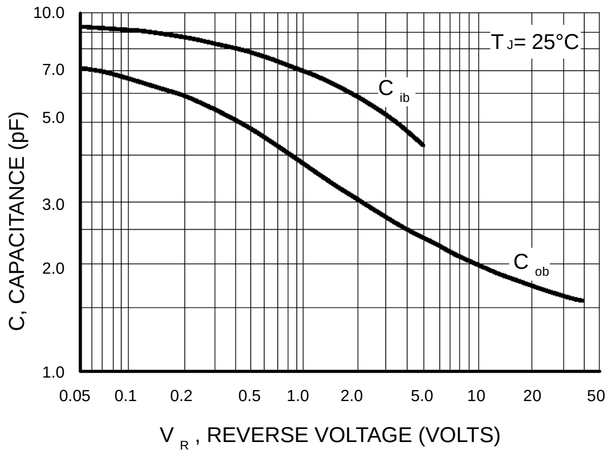


**Figure 13. Capacitance**

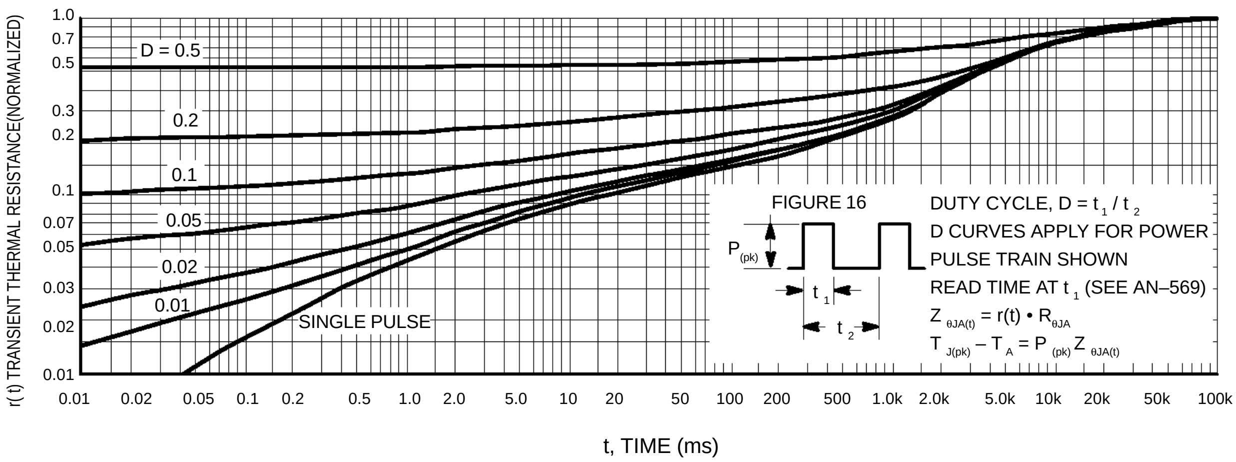


**Figure 14. Thermal Response**

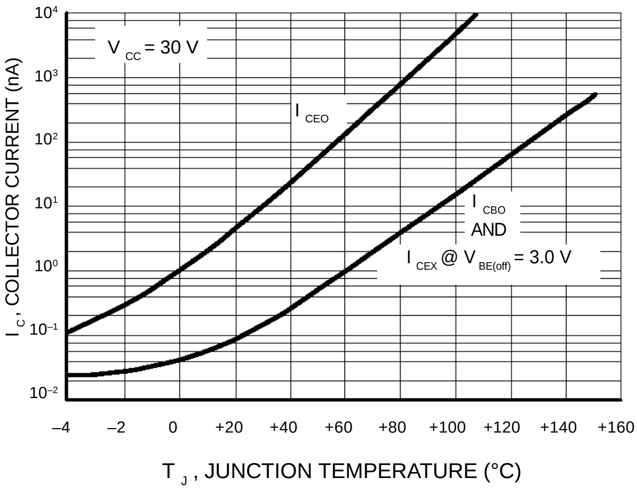


**Figure 15. Typical Collector Leakage Current**

## DESIGN NOTE: USE OF THERMAL RESPONSE DATA

A train of periodical power pulses can be represented by the model as shown in Figure 16. 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:

Dissipating 2.0 watts peak under the following conditions:

$t_1$ = 1.0 ms, $t_2$ = 5.0 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

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

For more information, see AN–569.