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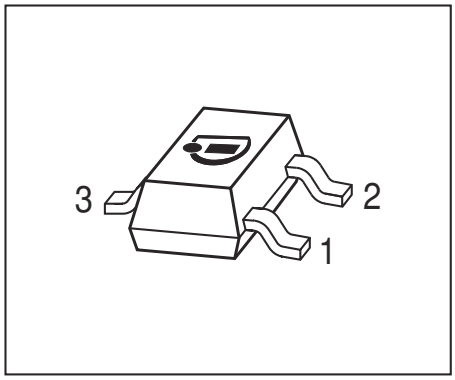
Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

## NPN Silicon AF Transistors




- For AF input stages and driver applications
- High current gain
- Low collector-emitter saturation voltage
- Low noise between 30 Hz and 15 kHz
- Complementary types: BCW61, BCX71 (PNP)
- Pb-free (RoHS compliant) package [1)]
- Qualified according AEC Q101

AEC Qualified RoHS

| Type | Marking | Pin Configuration | | | Package |
|---|---|---|---|---|---|
| BCW60B | ABs | 1=B | 2=E | 3=C | SOT23 |
| BCW60C | ACs | 1=B | 2=E | 3=C | SOT23 |
| BCW60D | ADs | 1=B | 2=E | 3=C | SOT23 |
| BCW60FF | AFs | 1=B | 2=E | 3=C | SOT23 |
| BCX70G | AGs | 1=B | 2=E | 3=C | SOT23 |
| BCX70H | AHs | 1=B | 2=E | 3=C | SOT23 |
| BCX70J | AJs | 1=B | 2=E | 3=C | SOT23 |
| BCX70K | AKs | 1=B | 2=E | 3=C | SOT23 |

[1]Pb-containing package may be available upon special request

## Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Collector-emitter voltage | $V_{CEO}$ | | V |
| BCW60, ...60FF | | 32 | |
| BCX70 | | 45 | |
| Collector-base voltage | $V_{CBO}$ | | |
| BCW60, ...60FF | | 32 | |
| BCX70 | | 45 | |
| Emitter-base voltage | $V_{EBO}$ | 6 | |
| Collector current | $I_C$ | 100 | mA |
| Peak collector current | $I_{CM}$ | 200 | |
| Peak base current | $I_{BM}$ | 200 | |
| Total power dissipation<br>$T_S \leq 71$ °C | $P_{tot}$ | 330 | mW |
| Junction temperature | $T_j$ | 150 | °C |
| Storage temperature | $T_{stg}$ | -65 ... 150 | |

## Thermal Resistance

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Junction - soldering point[1)] | $R_{thJS}$ | ≤ 240 | K/W |

[1]For calculation of $R_{thJA}$ please refer to Application Note Thermal Resistance

**Electrical Characteristics** at $T_A$ = 25°C, unless otherwise specified

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| **DC Characteristics** | | | | | |
| Collector-emitter breakdown voltage | $V_{(BR)CEO}$ | | | | V |
| $I_C$ = 10 mA, $I_B$ = 0 , BCW60, ...60FF | | 32 | - | - | |
| $I_C$ = 10 mA, $I_B$ = 0 , BCX70 | | 45 | - | - | |
| Collector-base breakdown voltage | $V_{(BR)CBO}$ | | | | |
| $I_C$ = 10 µA, $I_E$ = 0 , BCW60, ...60FF | | 32 | - | - | |
| $I_C$ = 10 µA, $I_E$ = 0 , BCX70 | | 45 | - | - | |
| Emitter-base breakdown voltage | $V_{(BR)EBO}$ | 6 | - | - | |
| $I_E$ = 1 µA, $I_C$ = 0 | | | | | |
| Collector-base cutoff current | $I_{CBO}$ | | | | µA |
| $V_{CB}$ = 32 V, $I_E$ = 0 , BCW60, ...60FF | | - | - | 0.02 | |
| $V_{CB}$ = 45 V, $I_E$ = 0 , BCX70 | | - | - | 0.02 | |
| $V_{CB}$ = 32 V, $I_E$ = 0 , $T_A$ = 150 °C, BCW60, ...60FF | | - | - | 20 | |
| $V_{CB}$ = 45 V, $I_E$ = 0 , $T_A$ = 150 °C, BCX70 | | - | - | 20 | |
| Emitter-base cutoff current | $I_{EBO}$ | - | - | 20 | nA |
| $V_{EB}$ = 4 V, $I_C$ = 0 | | | | | |
| DC current gain- | $h_{FE}$ | | | | - |
| $I_C$ = 10 µA, $V_{CE}$ = 5 V, $h_{FE}$-grp. G | | 20 | 140 | - | |
| $I_C$ = 10 µA, $V_{CE}$ = 5 V, $h_{FE}$-grp. B/ H | | 20 | 200 | - | |
| $I_C$ = 10 µA, $V_{CE}$ = 5 V, $h_{FE}$-grp. C/ J/ FF | | 40 | 300 | - | |
| $I_C$ = 10 µA, $V_{CE}$ = 5 V, $h_{FE}$-grp. D/ K | | 100 | 460 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $h_{FE}$-grp. G | | 120 | 170 | 220 | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $h_{FE}$-grp. B/ H | | 180 | 250 | **310** | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $h_{FE}$-grp. C/ J/ FF | | **250** | 350 | 460 | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $h_{FE}$-grp. D/ K | | 380 | 500 | 630 | |
| $I_C$ = 50 mA, $V_{CE}$ = 1 V, $h_{FE}$-grp. G | | 50 | - | - | |
| $I_C$ = 50 mA, $V_{CE}$ = 1 V, $h_{FE}$-grp. B/ H | | **70** | - | - | |
| $I_C$ = 50 mA, $V_{CE}$ = 1 V, $h_{FE}$-grp. C/ J/ FF | | 90 | - | - | |
| $I_C$ = 50 mA, $V_{CE}$ = 1 V, $h_{FE}$-grp. D/ K | | 100 | - | - | |

## DC Electrical Characteristics

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| **Characteristics** | | | | | |
| Collector-emitter saturation voltage[1)] | $V_{CEsat}$ | | | | V |
| $I_C$ = 10 mA, $I_B$ = 0.25 mA | | - | 0.12 | 0.25 | |
| $I_C$ = 50 mA, $I_B$ = 1.25 mA | | - | 0.2 | 0.55 | |
| Base emitter saturation voltage[1)] | $V_{BEsat}$ | | | | |
| $I_C$ = 10 mA, $I_B$ = 0.25 mA | | - | 0.7 | 0.85 | |
| $I_C$ = 50 mA, $I_B$ = 1.25 mA | | - | 0.83 | 1.05 | |
| Base-emitter voltage[1)] | $V_{BE(ON)}$ | | | | |
| $I_C$ = 10 µA, $V_{CE}$ = 5 V | | - | 0.52 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V | | 0.58 | 0.65 | 0.7 | |
| $I_C$ = 50 mA, $V_{CE}$ = 1 V | | - | 0.78 | - | |

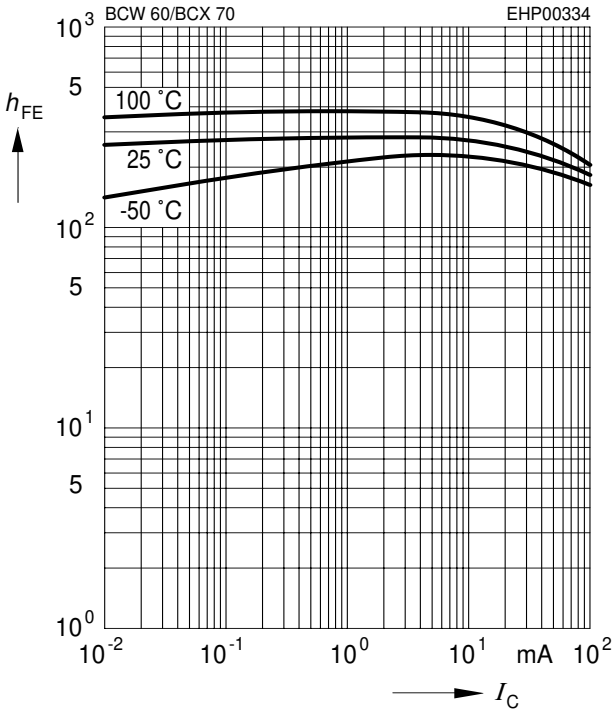
[1]Pulse test: t < 300µs; D < 2%

## AC Characteristics

| | | | | | |
|---|---|---|---|---|---|
| Transition frequency<br>$I_C$ = 20 mA, $V_{CE}$ = 5 V, $f$ = 100 MHz | $f_T$ | - | 250 | - | MHz |
| Collector-base capacitance<br>$V_{CB}$ = 10 V, $f$ = 1 MHz | $C_{cb}$ | - | 0.95 | - | pF |
| Emitter-base capacitance<br>$V_{EB}$ = 0.5 V, $f$ = 1 MHz | $C_{eb}$ | - | 9 | - | |
| Short-circuit input impedance | $h_{11e}$ | | | | kΩ |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. G | | - | 2.7 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. B/ H | | - | 3.6 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. C/ J /FF | | - | 4.5 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. D/ K | | - | 7.5 | - | |
| Open-circuit reverse voltage transf. ratio | $h_{12e}$ | | | | $10^{-4}$ |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. G | | - | 1.5 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. B /H | | - | 2 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. C/ J/ FF | | - | 2 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. D/ K | | - | 3 | - | |
| Short-circuit forward current transf. ratio | $h_{21e}$ | | | | - |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. G | | - | 200 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. B/ H | | - | 260 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. C/ J/ FF | | - | 330 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. D/ K | | - | 520 | - | |
| Open-circuit output admittance | $h_{22e}$ | | | | µS |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. G | | - | 18 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. B/ H | | - | 24 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, $f$ = 1 kHz, $h_{FE}$-grp. C/ J/ FF | | - | 30 | - | |
| $I_C$ = 2 mA, $V_{CE}$ = 5 V, f = 1 kHz, $h_{FE}$-grp. D/ K | | - | 50 | - | |
| Noise figure<br>$I_C$ = 200 µA, $V_{CE}$ = 5 V, f = 1 kHz,<br>D $f$ = 200 Hz, $R_S$ = 2 kΩ, $h_{FE}$-grp. B - K | $F$ | - | 2 | - | dB |
| $I_C$ = 200 µA, $V_{CE}$ = 5 V, $f$ = 1 kHz,<br>Δ $f$ = 200 Hz, $R_S$ = 2 kΩ, $h_{FE}$-grp. FF | | - | 1 | 2 | |
| Equivalent noise voltage<br>$I_C$ = 200 µA, $V_{CE}$ = 5 V, $R_S$ = 2 kΩ,<br>$f$ = 10...50 Hz , $h_{FE}$-grp. FF | $V_n$ | - | - | 0.135 | µV |

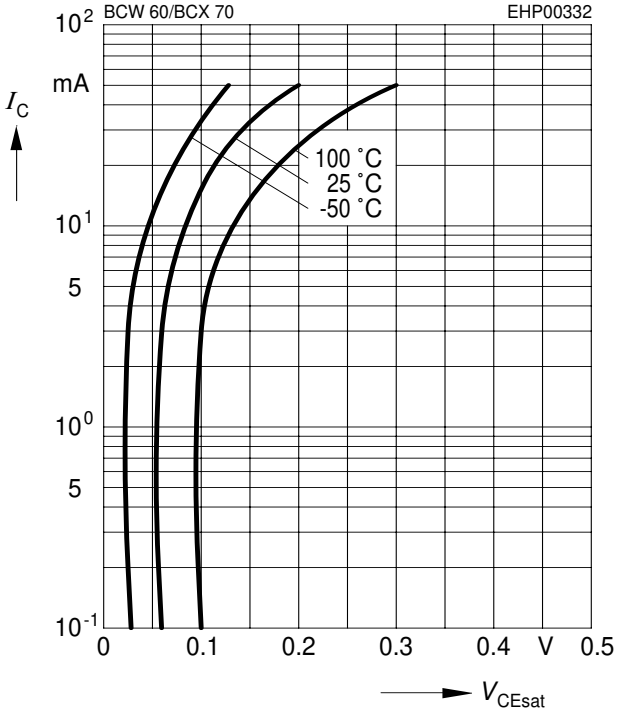
**DC current gain $h_{FE} = f(I_C)$**

$V_{CE}$ = 5 V



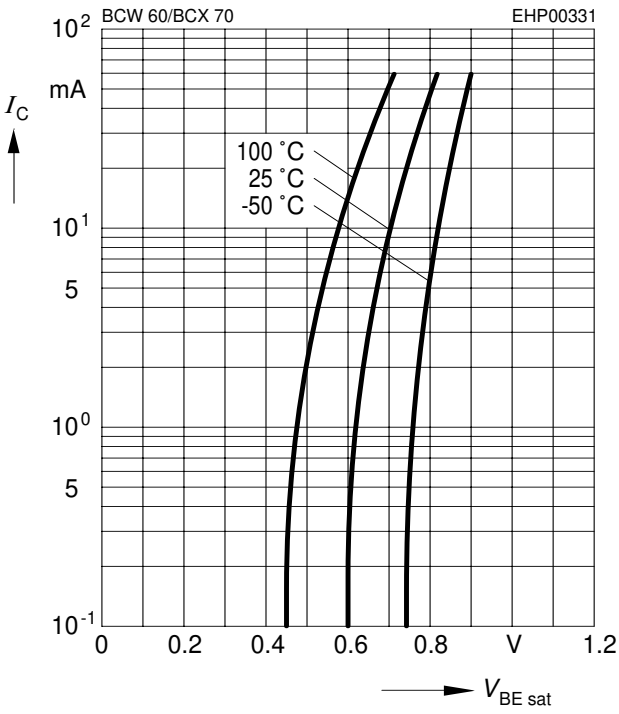

**Collector-emitter saturation voltage**

$I_C = f(V_{CEsat})$, $h_{FE}$ = 10



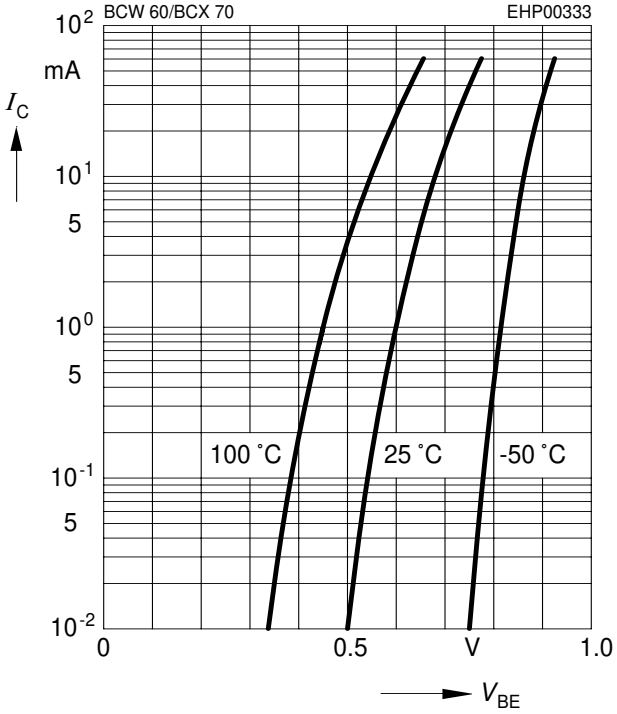

**Base-emitter saturation voltage**

$I_C = f(V_{BEsat})$, $h_{FE}$ = 40



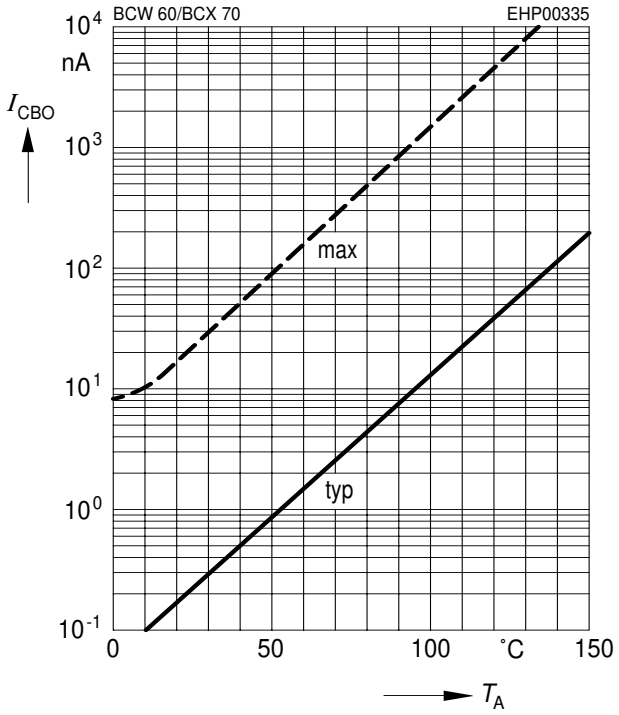

**Collector current $I_C = f(V_{BE})$**

$V_{CE}$ = 5V



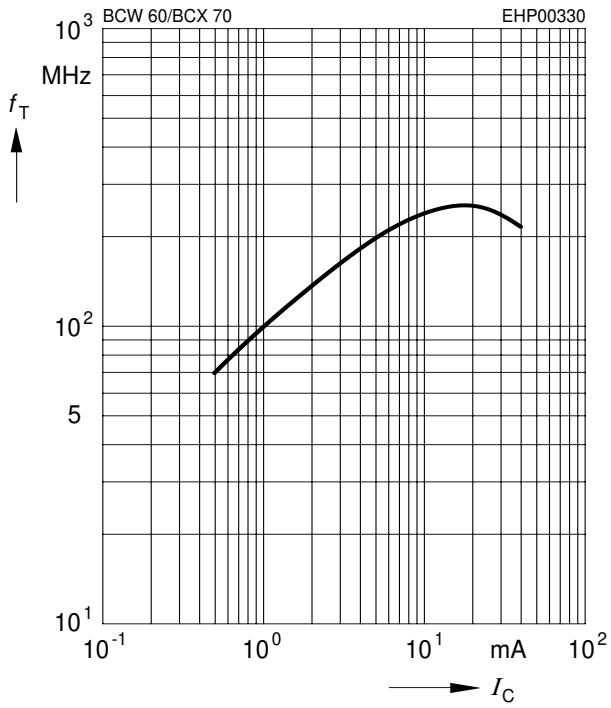
**Collector cutoff current** $I_{CBO} = f(T_A)$

$V_{CB} = V_{CEmax}$



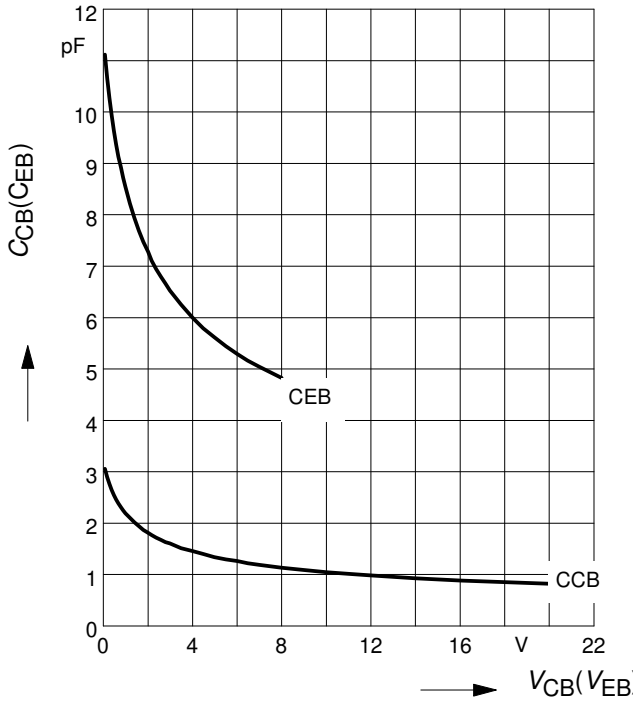

**Transition frequency** $f_T = f(I_C)$

$V_{CE}$ = parameter in V, $f$ = 2 GHz

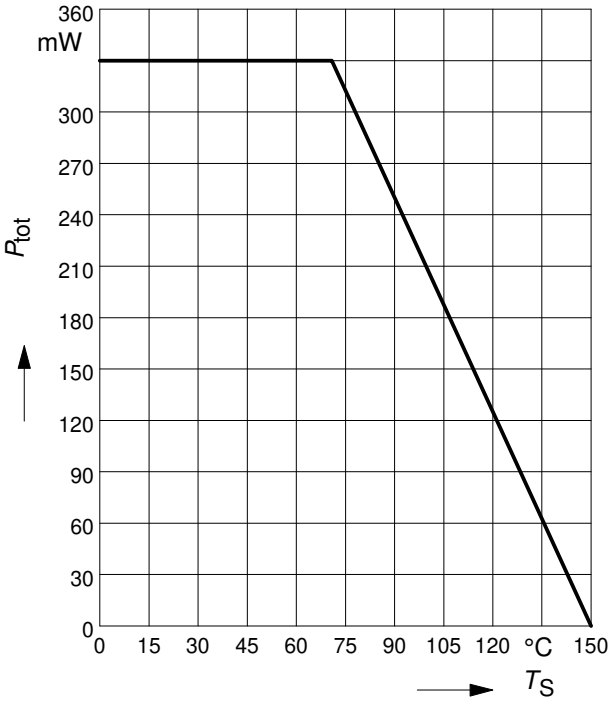



**Collector-base capacitance** $C_{cb} = f(V_{CB})$

**Emitter-base capacitance** $C_{eb} = f(V_{EB})$

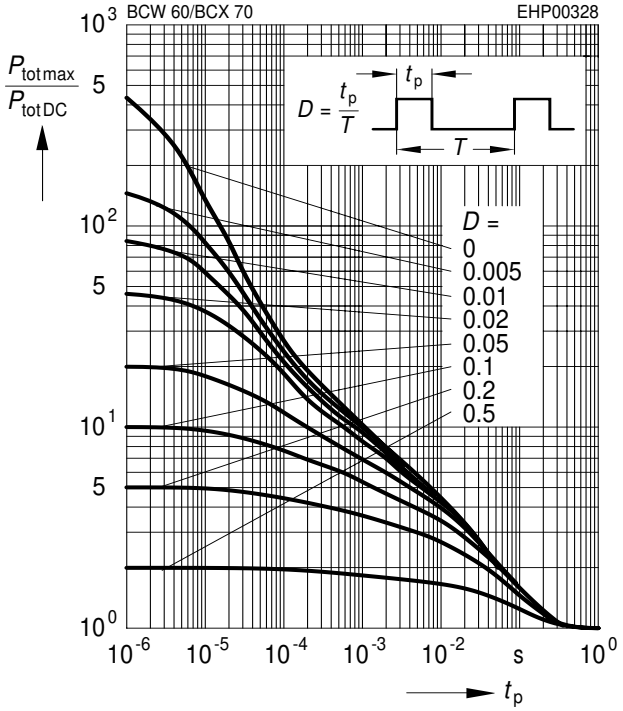



**Total power dissipation** $P_{tot} = f(T_S)$



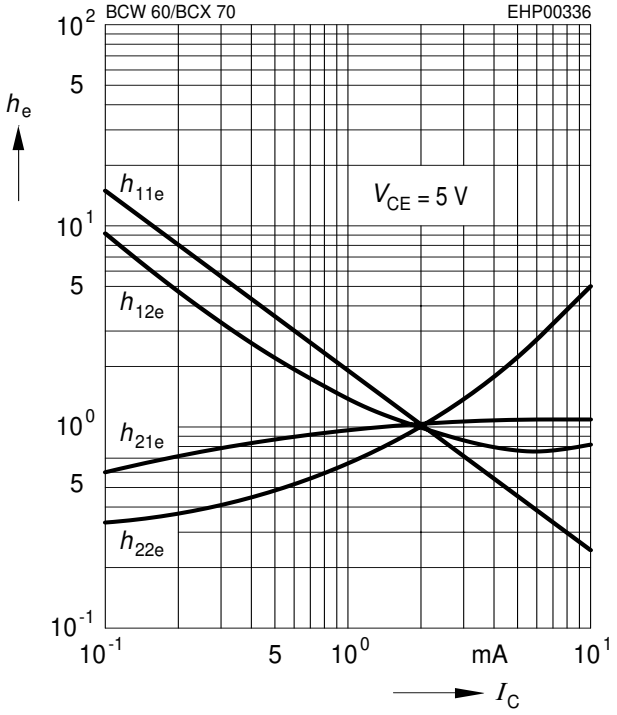
**Permissible Pulse Load**

$P_{totmax}/P_{totDC} = f(t_p)$



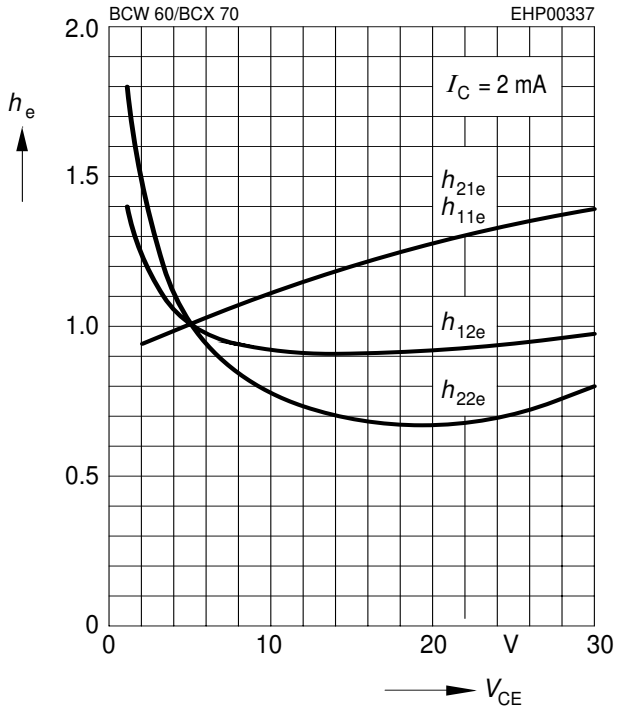

**h parameter $h_e = f(I_C)$ normalized**

$V_{CE}$ = 5V



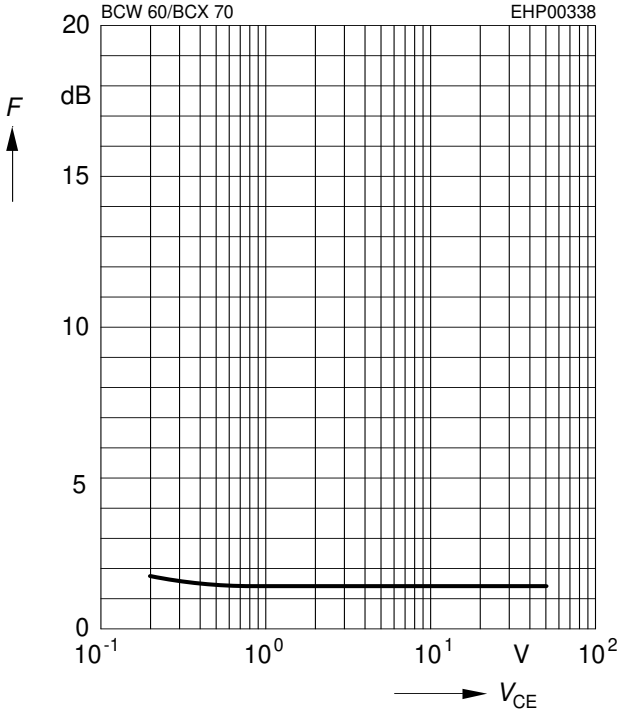

**h parameter $h_e = f(V_{CE})$ normalized**

$I_C$ = 2mA



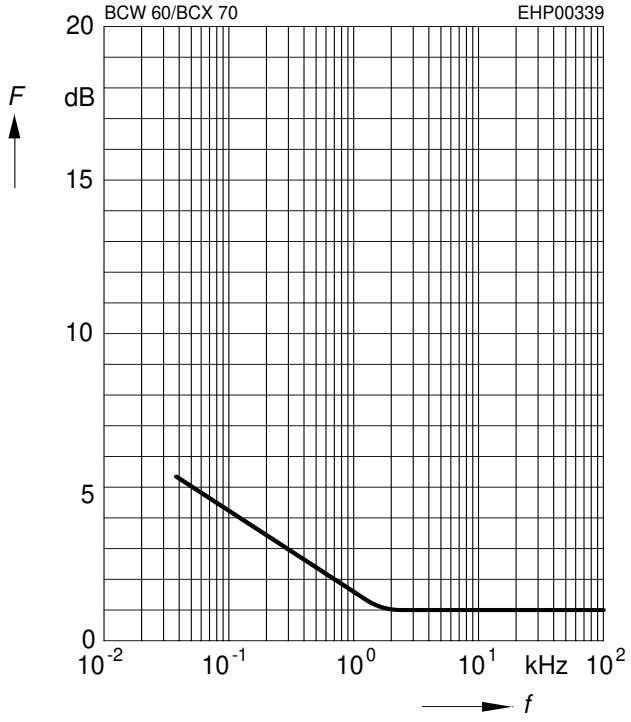

**Noise figure $F = f(V_{CE})$**

$I_C$ = 0.2mA, $R_S$ = 2kΩ , $f$ = 1kHz



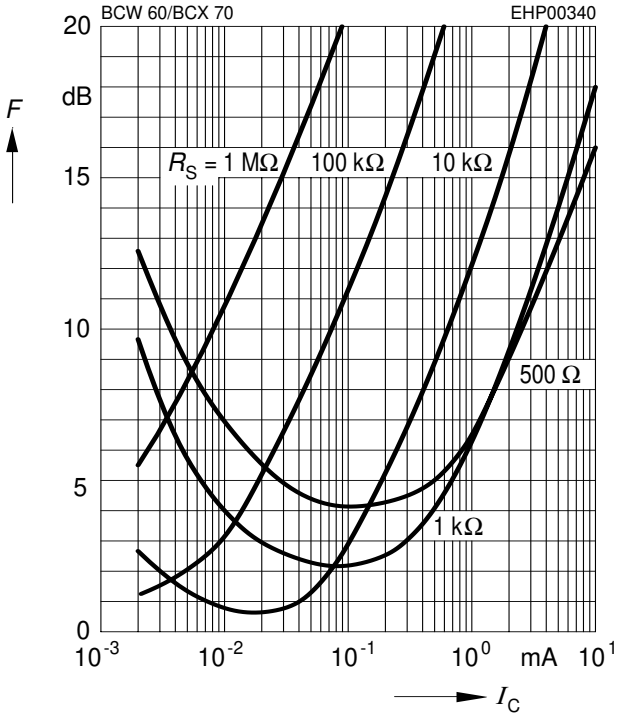
**Noise figure** $F = f(f)$

$V_{CE}$ = 5V, $Z_S = Z_{Sopt}$



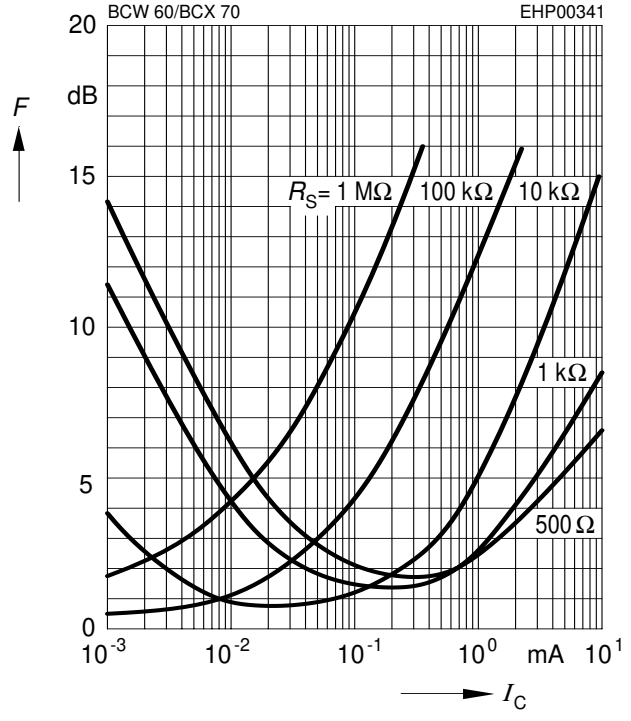

**Noise figure** $F = f(I_C)$

$V_{CE}$ = 5V, $f$ = 120Hz



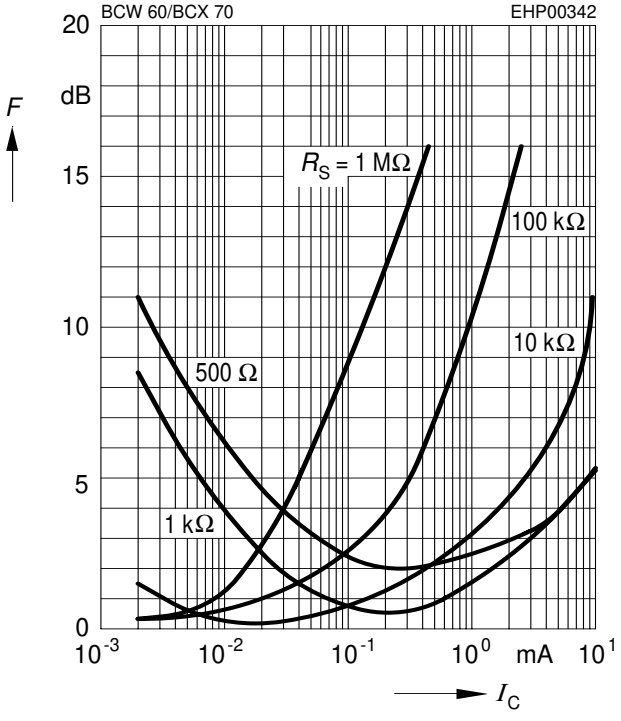

**Noise figure** $F = f(I_C)$

$V_{CE}$ = 5V, $f$ = 1kHz

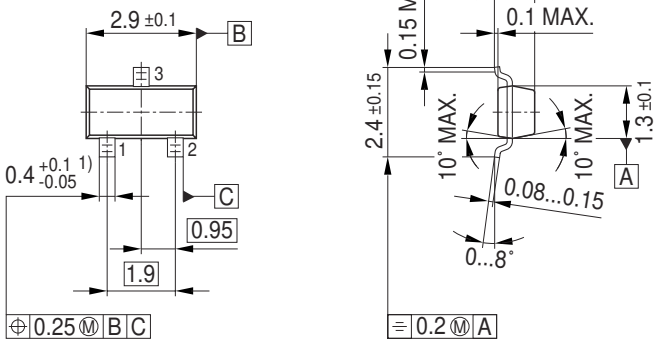



**Noise figure** $F = f(I_C)$

$V_{CE}$ = 5V, $f$ = 10kHz

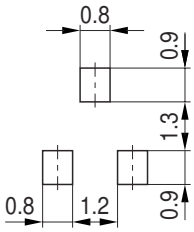


## Package Outline

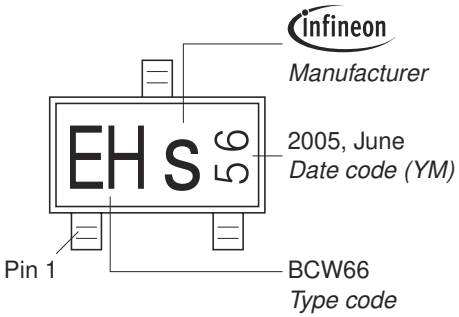



1) Lead width can be 0.6 max. in dambar area

## Foot Print

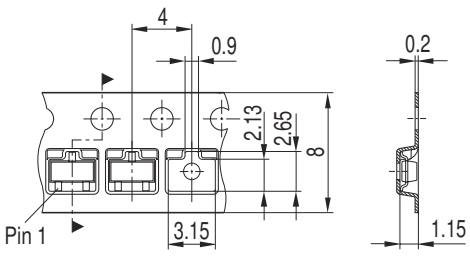



## Marking Layout (Example)




## Standard Packing

Reel ø180 mm = 3.000 Pieces/Reel
Reel ø330 mm = 10.000 Pieces/Reel



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