

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
- Qualified according AEC Q101



| Type | Marking | Pin Configuration | | | Package |
|---------|---------|-------------------|-----|-----|---------|
| | | 1=B | 2=E | 3=C | |
| 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 |

Maximum Ratings

| Parameter | Symbol | Value | Unit |
|--|-----------|-------------|------|
| Collector-emitter voltage BCW60, ...60FF BCX70 | V_{CEO} | 32 45 | V |
| Collector-base voltage BCW60, ...60FF BCX70 | V_{CBO} | 32 45 | |
| Emitter-base voltage | V_{EBO} | 6 | |
| Collector current | I_C | 100 | mA |
| Peak collector current, $t_p \leq 10$ ms | I_{CM} | 200 | |
| Peak base current | I_{BM} | 200 | |
| Total power dissipation $T_S \leq 71$ °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 AN077 (Thermal Resistance Calculation)

Electrical Characteristics at $T_A = 25^\circ\text{C}$, unless otherwise specified

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

DC Electrical Characteristics

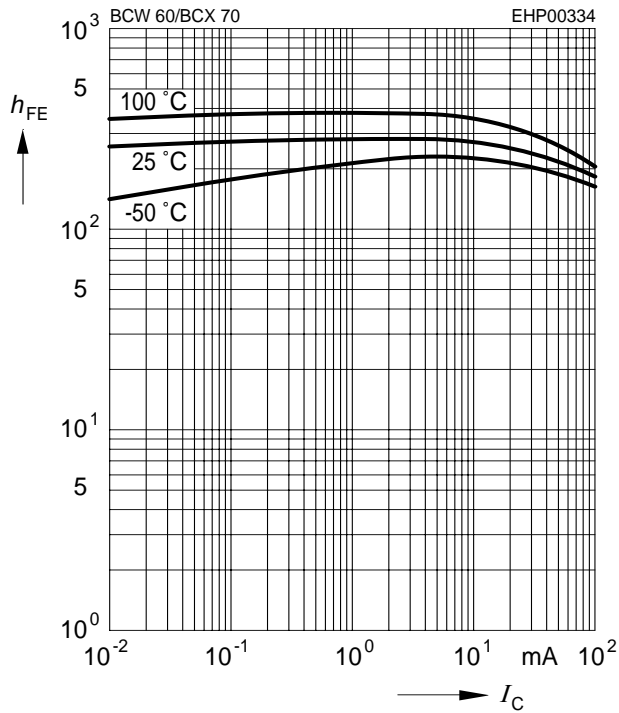
| Parameter | Symbol | Values | | | Unit |
|---|--------------|----------------|----------------------|---------------|------|
| | | min. | typ. | max. | |
| Characteristics | | | | | |
| Collector-emitter saturation voltage ¹⁾ $I_C = 10 \text{ mA}, I_B = 0.25 \text{ mA}$ $I_C = 50 \text{ mA}, I_B =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

¹⁾Pulse test: $t < 300\mu\text{s}$; $D < 2\%$

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

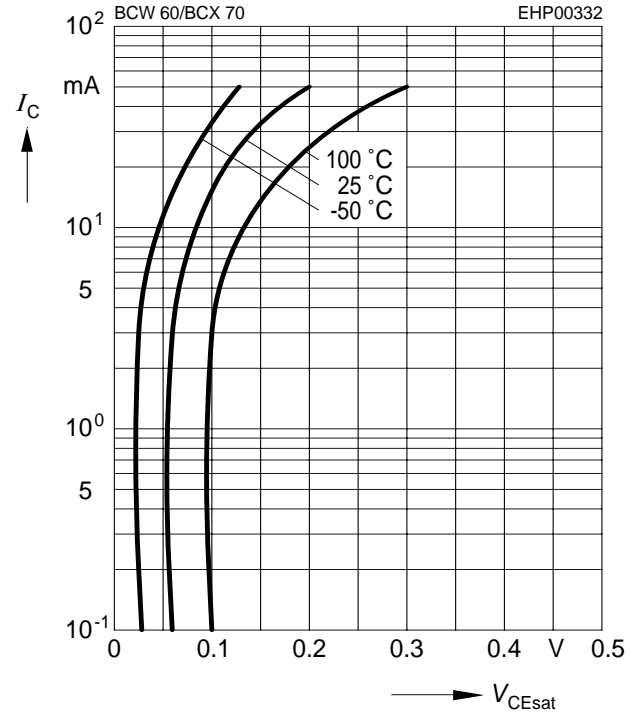
DC current gain $h_{FE} = f(I_C)$

$V_{CE} = 5\text{ V}$



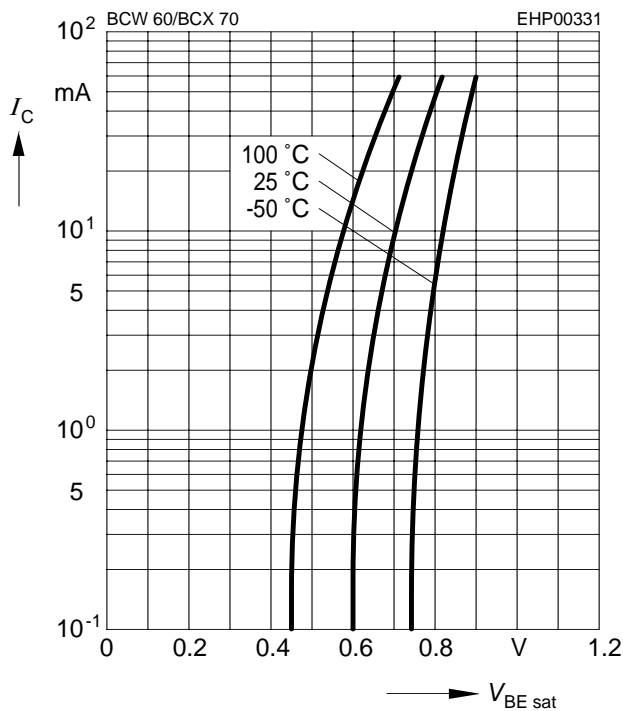
Collector-emitter saturation voltage

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



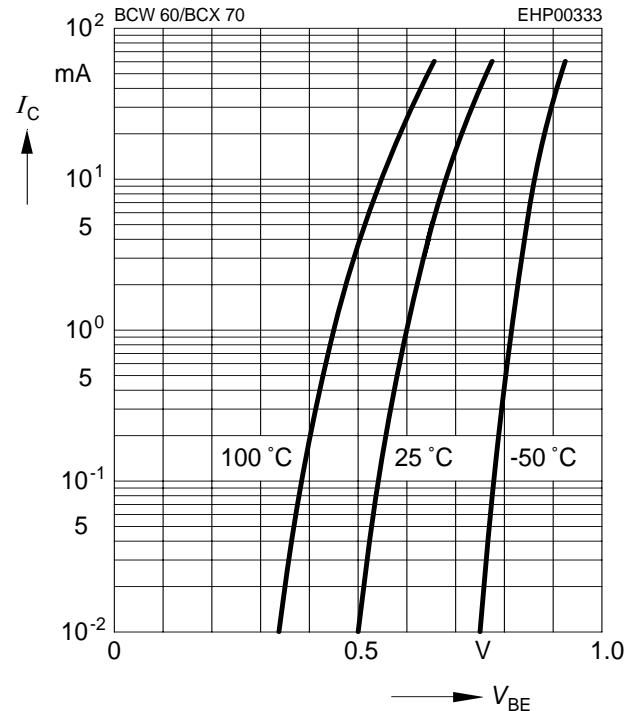
Base-emitter saturation voltage

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



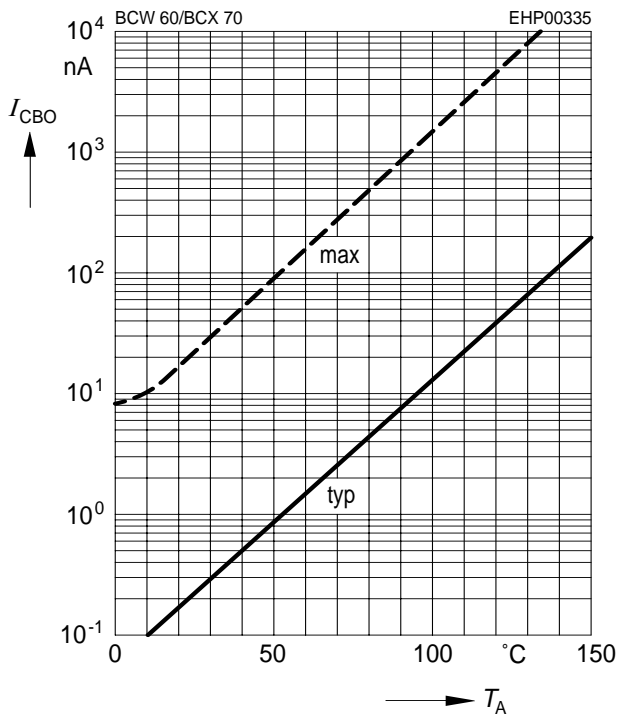
Collector current $I_C = f(V_{BE})$

$V_{CE} = 5\text{ V}$



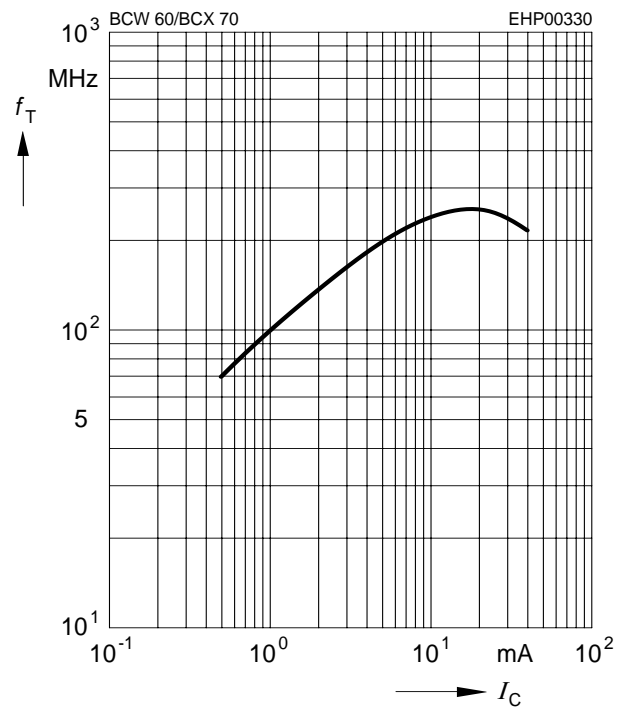
Collector cutoff current $I_{CBO} = f(T_A)$

$V_{CB} = V_{CEmax}$



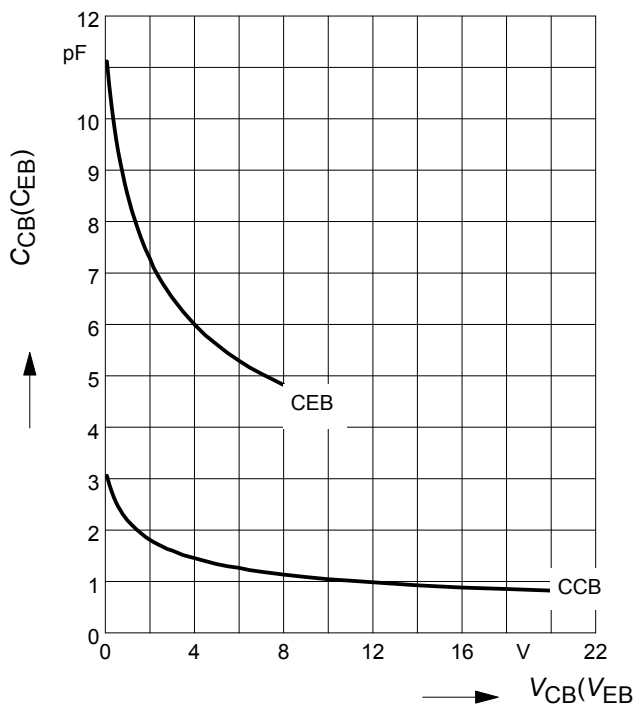
Transition frequency $f_T = f(I_C)$

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

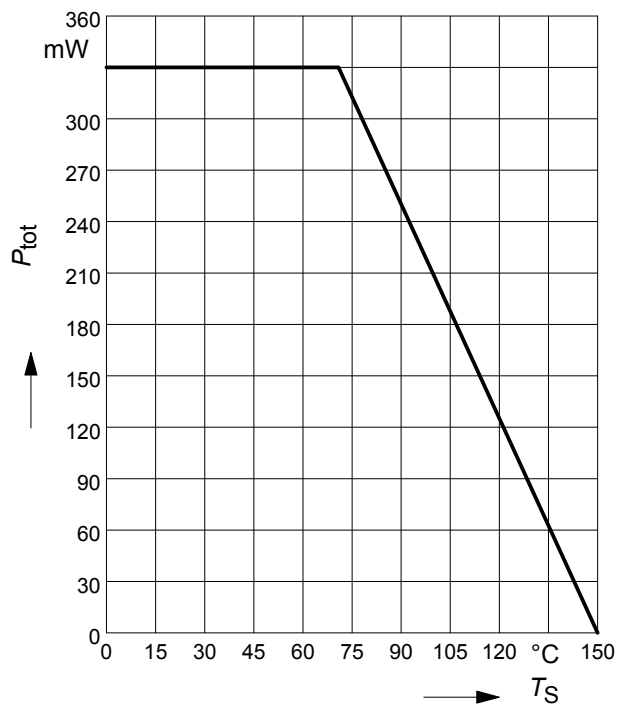


Collector-base capacitance $C_{cb} = f(V_{CB})$

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

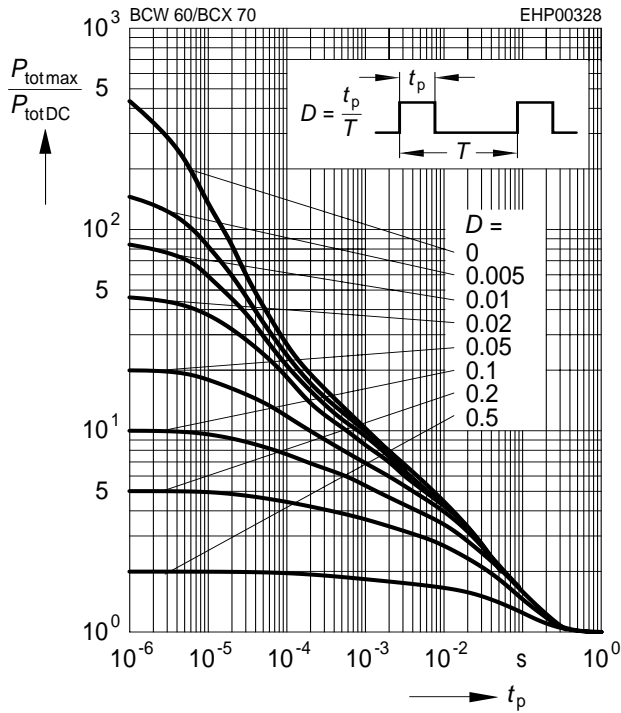


Total power dissipation $P_{tot} = f(T_S)$



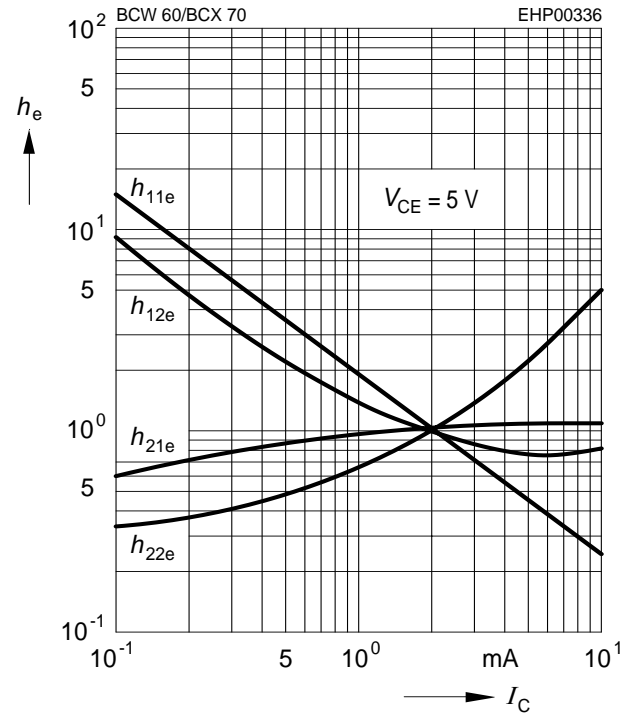
Permissible Pulse Load

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



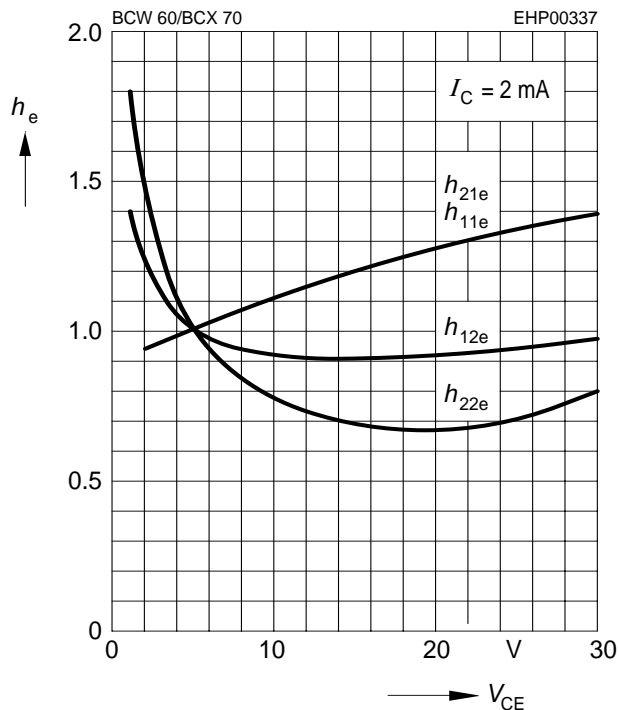
h parameter $h_e = f(I_C)$ normalized

$$V_{CE} = 5V$$



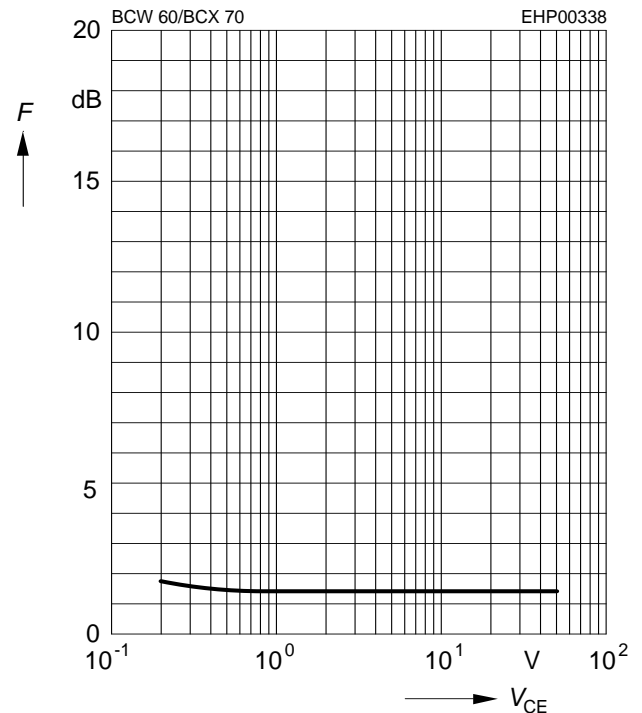
h parameter $h_e = f(V_{CE})$ normalized

$$I_C = 2mA$$



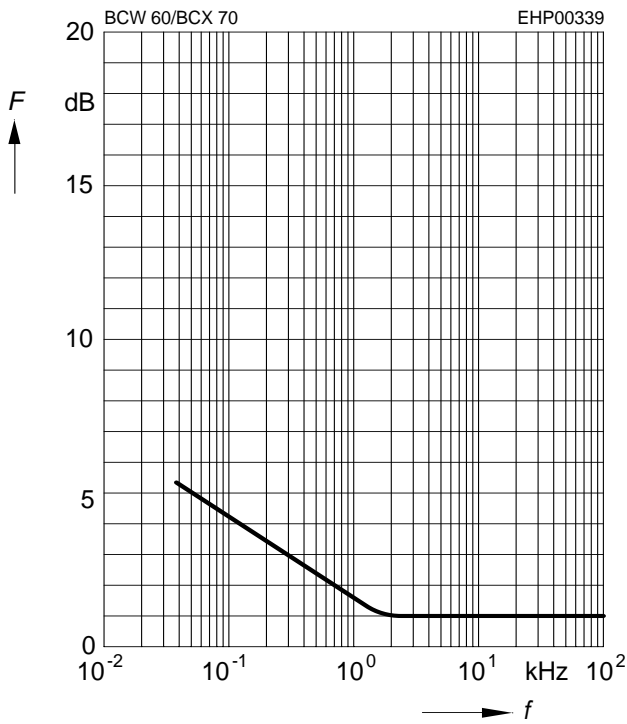
Noise figure $F = f(V_{CE})$

$$I_C = 0.2mA, R_S = 2k\Omega, f = 1kHz$$



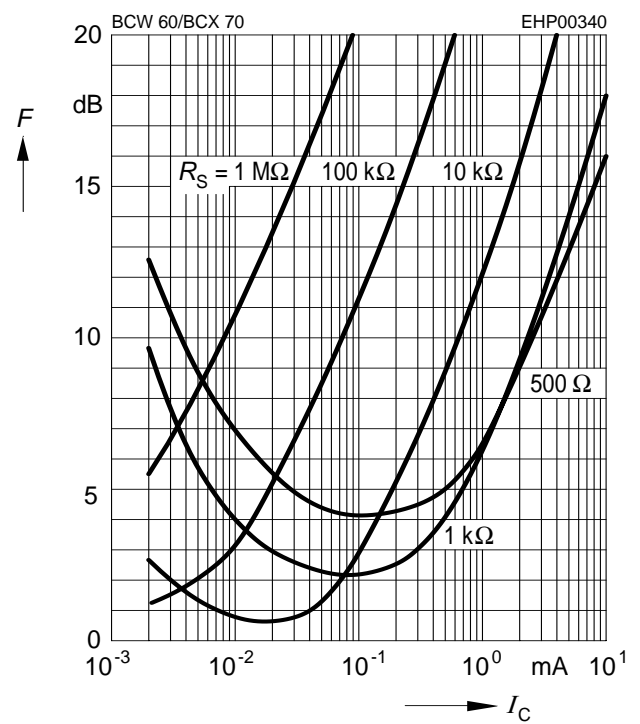
Noise figure $F = f(f)$

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



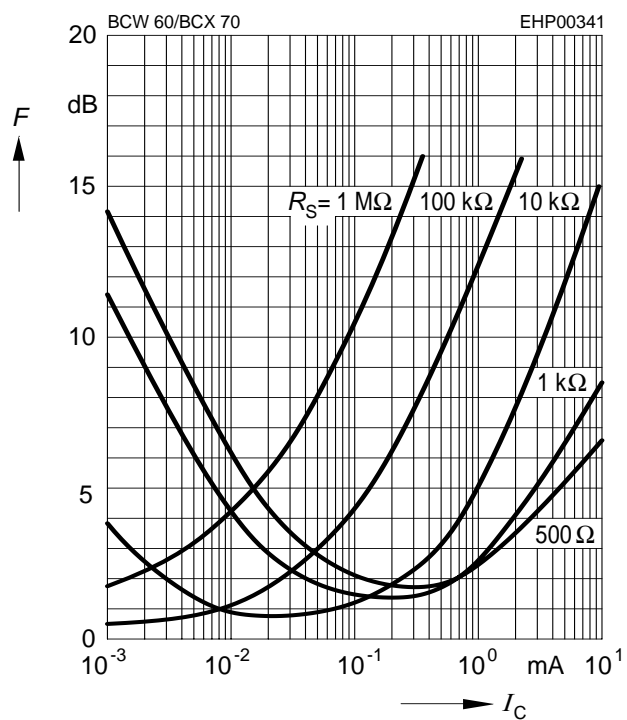
Noise figure $F = f(I_C)$

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



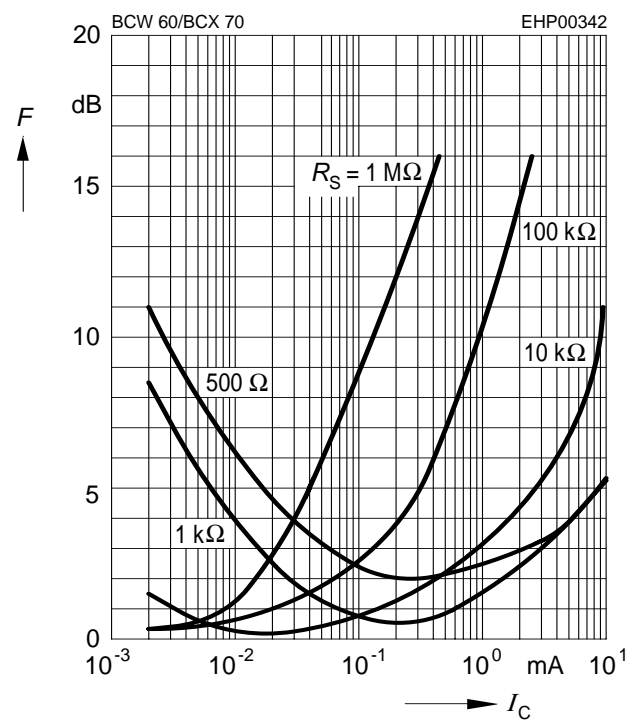
Noise figure $F = f(I_C)$

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

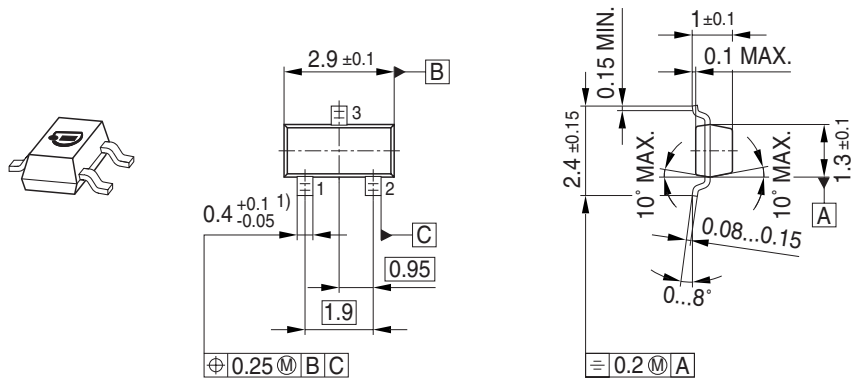


Noise figure $F = f(I_C)$

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

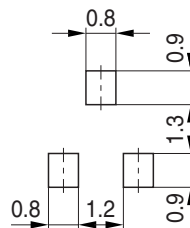


Package Outline

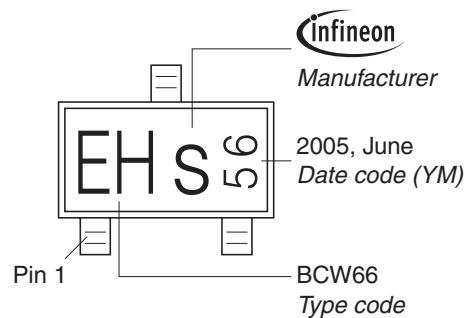


1) Lead width can be 0.6 max. in dambar area

Foot Print

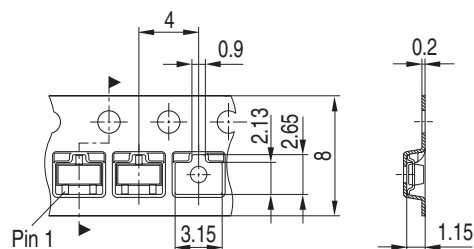


Marking Layout (Example)



Standard Packing

Reel \varnothing 180 mm = 3.000 Pieces/Reel
 Reel \varnothing 330 mm = 10.000 Pieces/Reel



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