

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

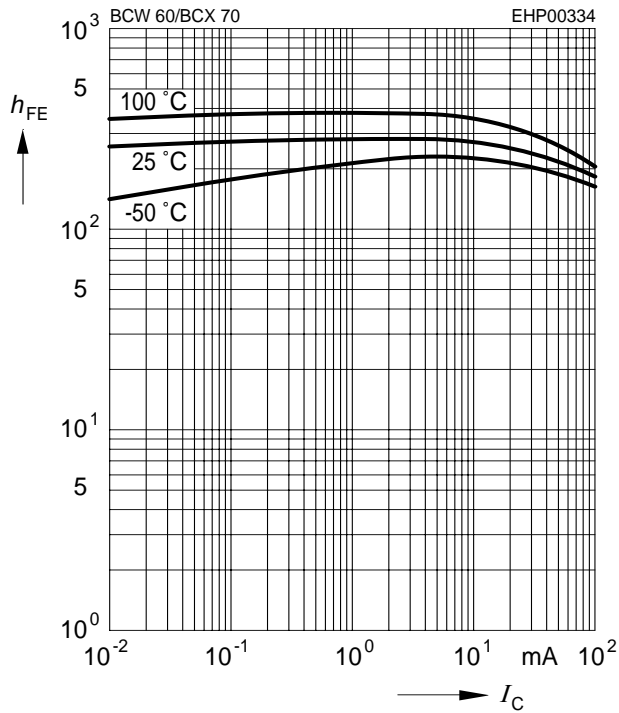
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Collector-emitter saturation voltage ¹⁾ $I_C = 10 \text{ mA}, I_B = 0.25 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 1.25 \text{ mA}$	V_{CEsat}	- -	0.12 0.2	0.25 0.55	V
Base emitter saturation voltage ¹⁾ $I_C = 10 \text{ mA}, I_B = 0.25 \text{ mA}$ $I_C = 50 \text{ mA}, I_B = 1.25 \text{ mA}$	V_{BEsat}	- -	0.7 0.83	0.85 1.05	
Base-emitter voltage ¹⁾ $I_C = 10 \mu\text{A}, V_{CE} = 5 \text{ V}$ $I_C = 2 \text{ mA}, V_{CE} = 5 \text{ V}$ $I_C = 50 \text{ mA}, V_{CE} = 1 \text{ V}$	$V_{BE(ON)}$	- 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 $I_C = 200 \mu\text{A}, V_{CE} = 5 \text{ V}, R_S = 2 \text{ k}\Omega,$ $f = 10\text{...}50 \text{ Hz}, h_{FE}\text{-grp. FF}$	V_n	-	-	0.135	μV

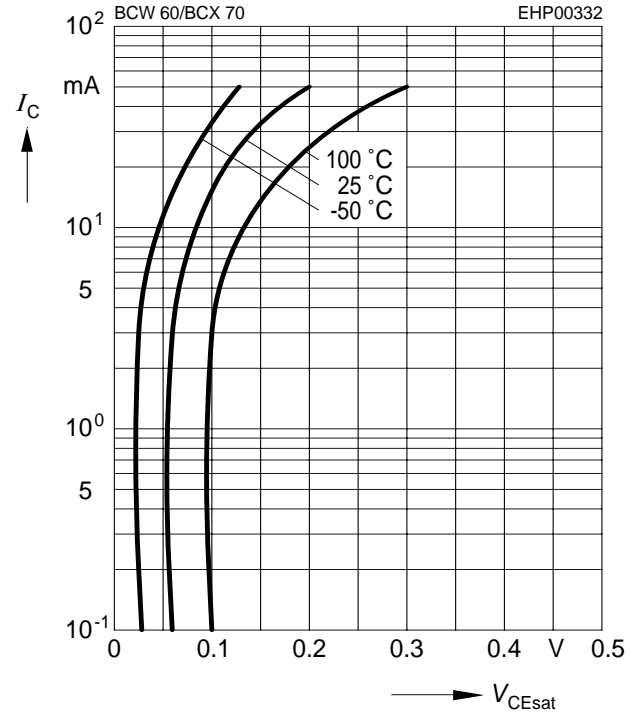
DC current gain $h_{FE} = f(I_C)$

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



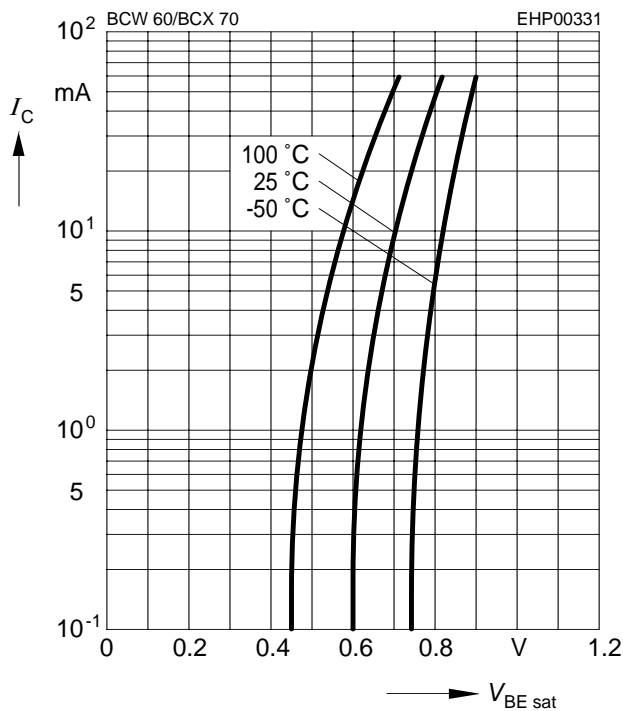
Collector-emitter saturation voltage

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



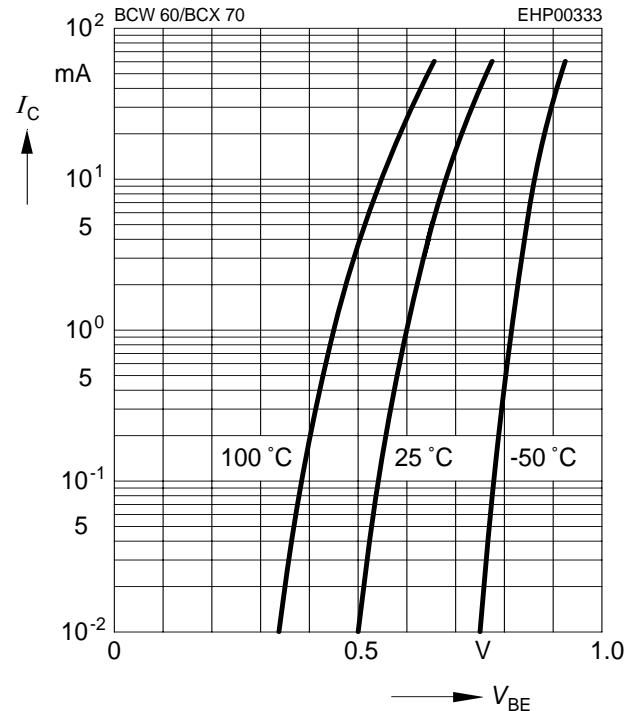
Base-emitter saturation voltage

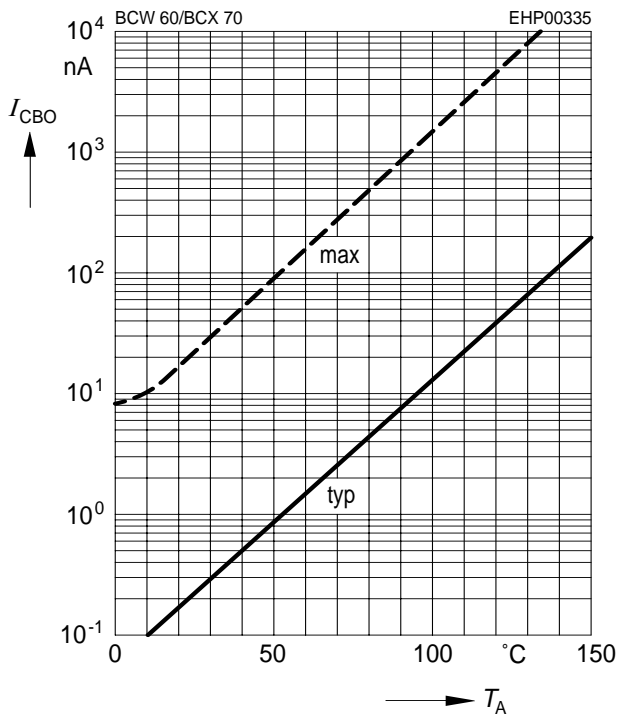
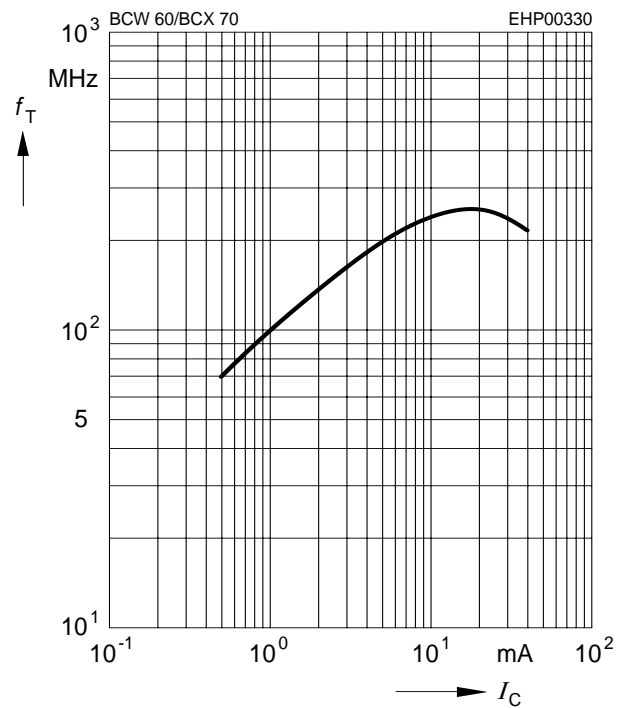
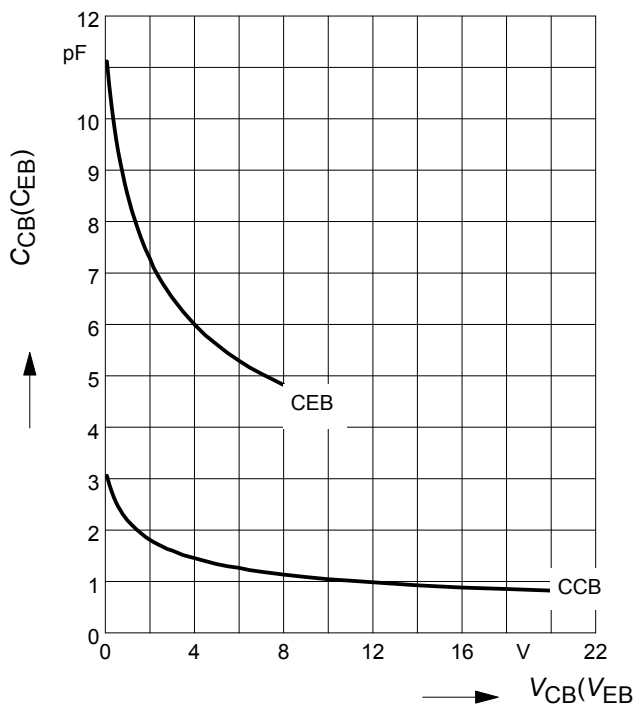
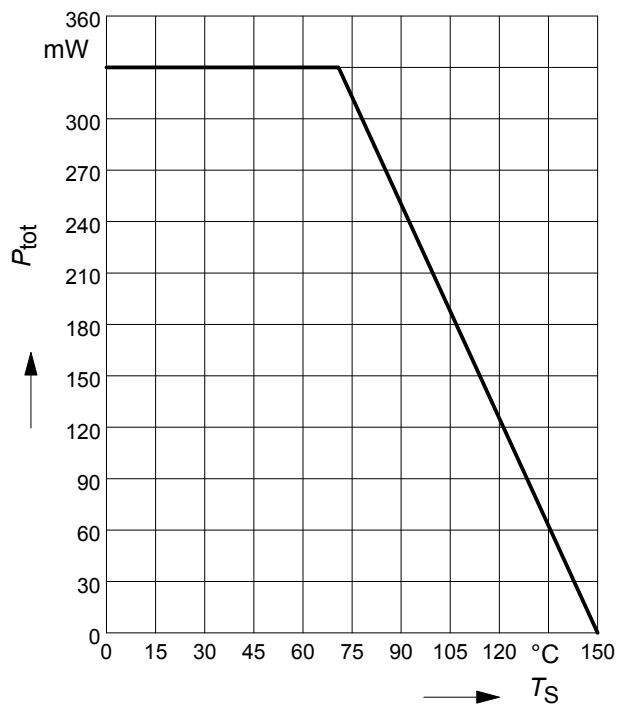
$I_C = f(V_{BEsat}), h_{FE} = 40$



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

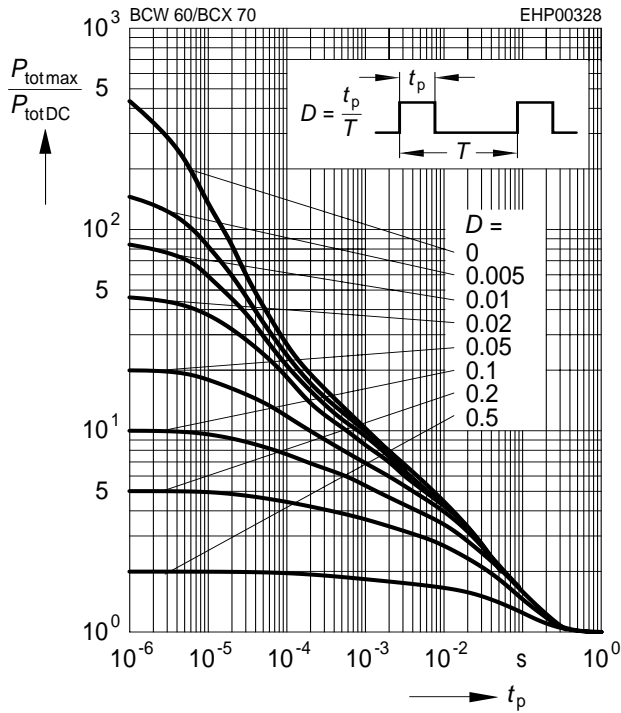
$V_{CE} = 5\text{ V}$



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 $P_{tot} = f(T_S)$


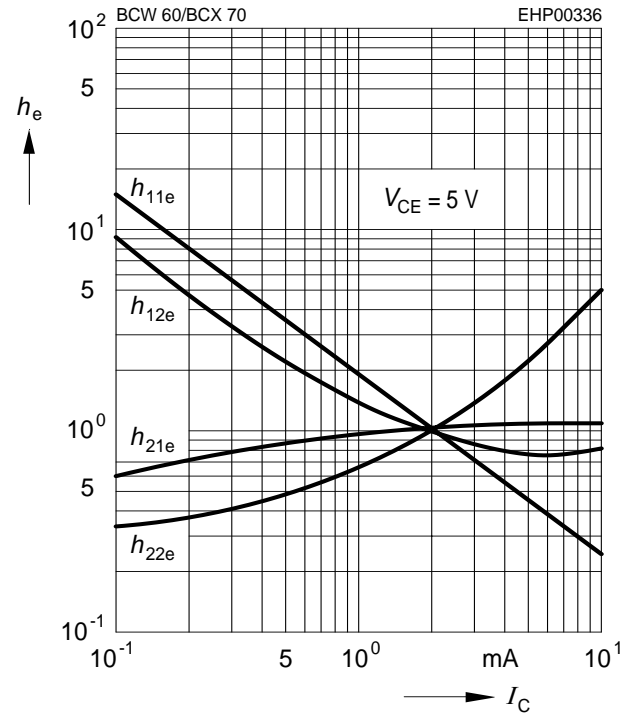
Permissible Pulse Load

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



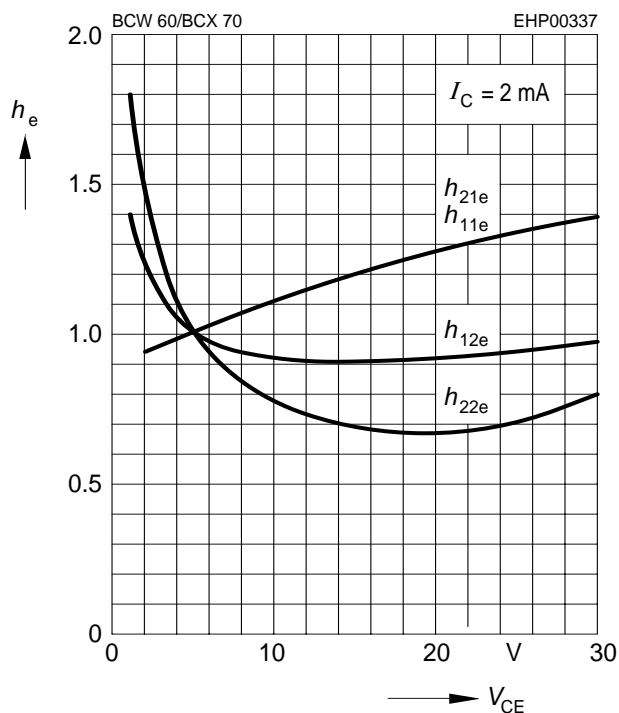
h parameter $h_e = f(I_C)$ normalized

$$V_{CE} = 5V$$



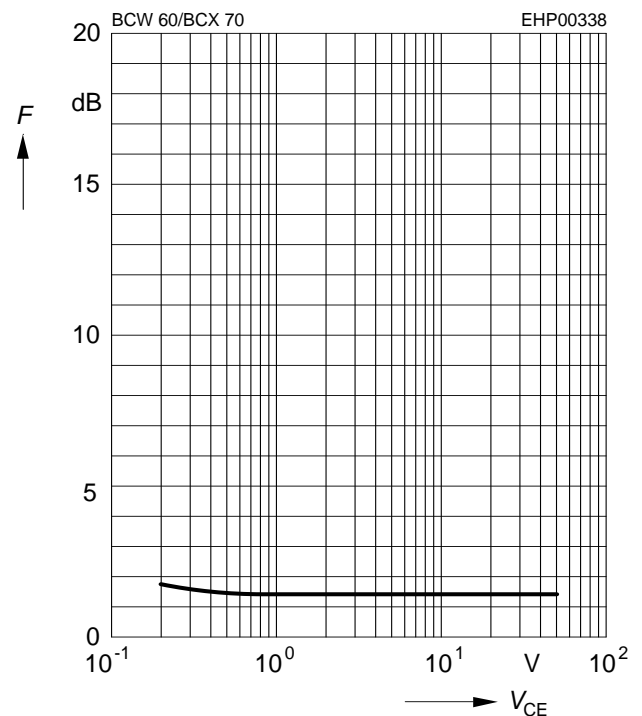
h parameter $h_e = f(V_{CE})$ normalized

$$I_C = 2mA$$



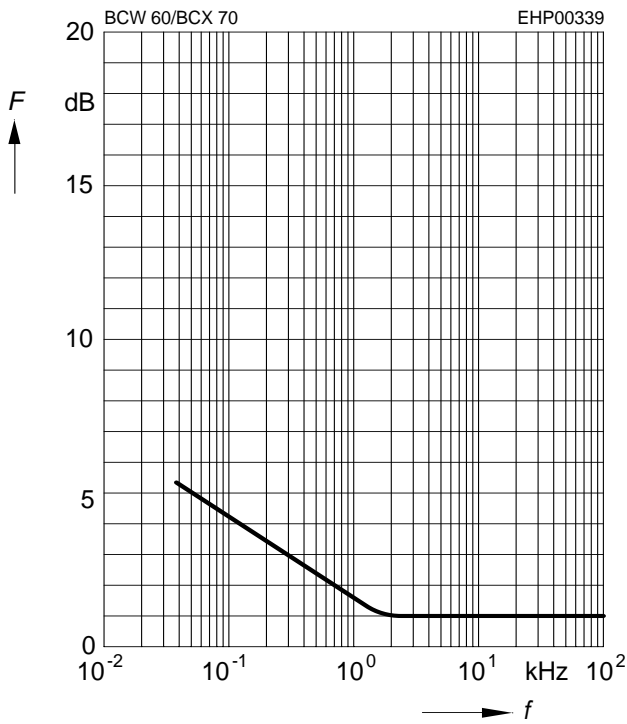
Noise figure $F = f(V_{CE})$

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



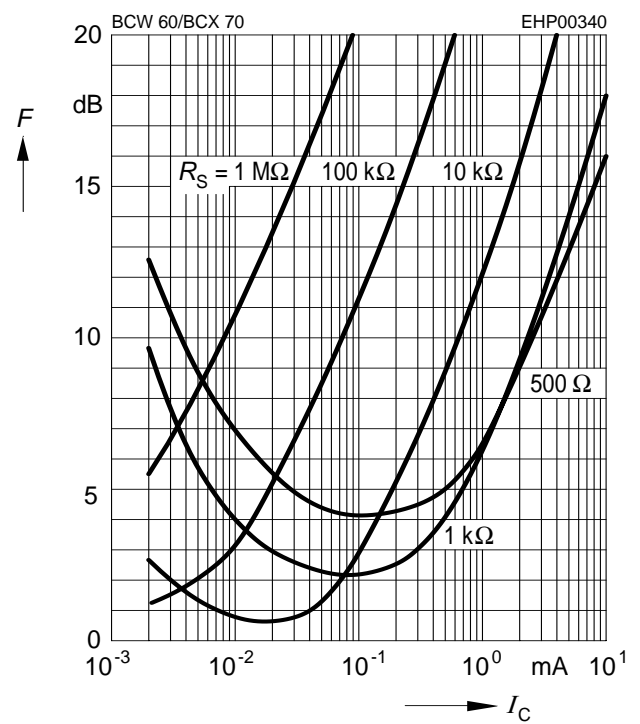
Noise figure $F = f(f)$

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



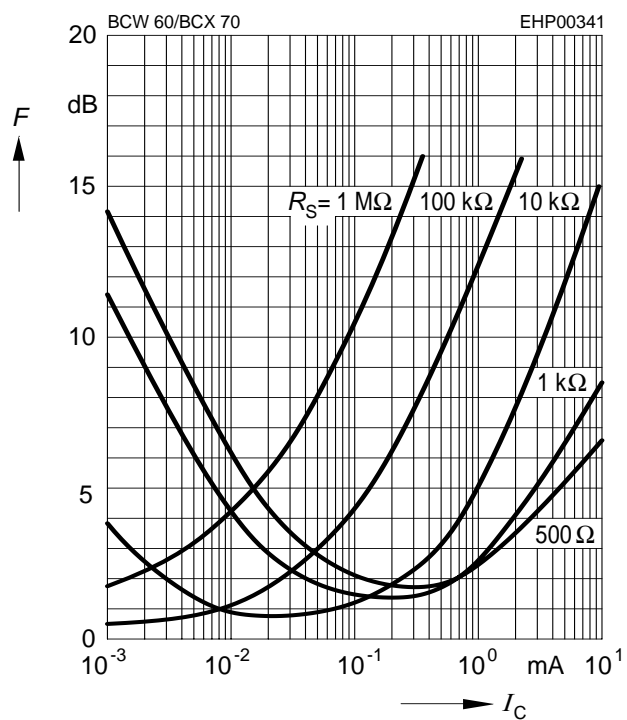
Noise figure $F = f(I_C)$

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



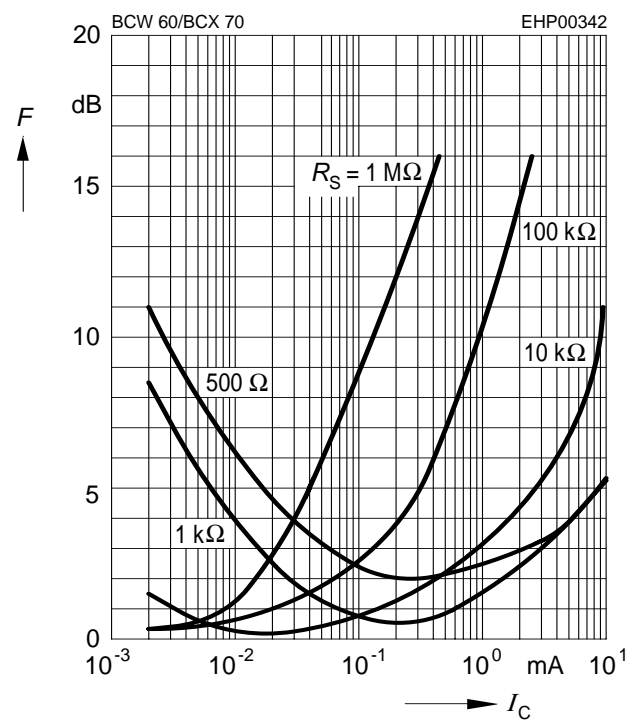
Noise figure $F = f(I_C)$

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

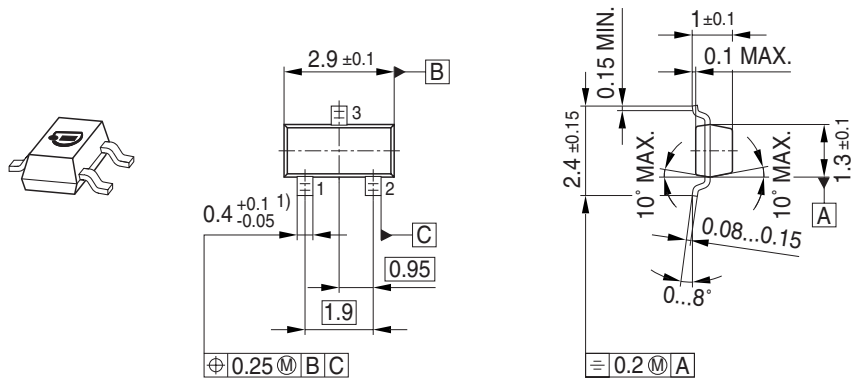


Noise figure $F = f(I_C)$

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

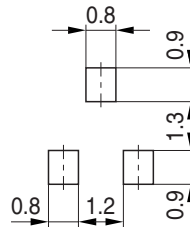


Package Outline

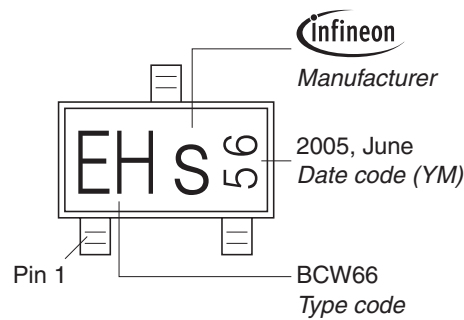


1) Lead width can be 0.6 max. in dambar area

Foot Print

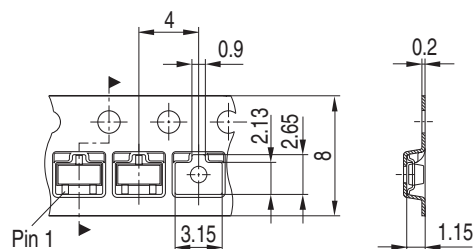


Marking Layout (Example)



Standard Packing

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



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