

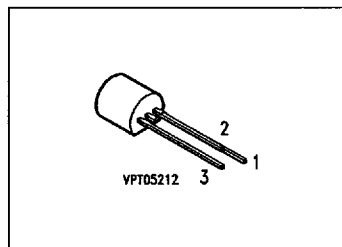
SIEMENS

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T-29-21

PNP Silicon AF Transistors**BC 415****BC 416**

- High current gain
- Low collector-emitter saturation voltage
- Low noise between 30 Hz and 15 kHz
- Complementary types: BC 413, BC 414 (NPN)



Type	Marking	Ordering Code	Pin Configuration			Package ¹⁾
			1	2	3	
BC 415	—	Q62702-C377	C	B	E	TO-92
BC 415 A		Q62702-C377-V1				
BC 415 B		Q62702-C377-V2				
BC 415 C		Q62702-C377-V3				
BC 416		Q62702-C378				
BC 416 A		Q62702-C378-V1				
BC 416 B		Q62702-C378-V2				
BC 416 C		Q62702-C378-V3				

¹⁾ For detailed information see chapter Package Outlines.

Maximum Ratings

Parameter	Symbol	Values		Unit
		BC 415	BC 416	
Collector-emitter voltage	V_{CE0}	35	45	V
Collector-base voltage	V_{CB0}	45	50	
Emitter-base voltage	V_{EB0}	5		
Collector current	I_C	100		mA
Peak collector current	I_{CM}	200		
Peak base current	I_{BM}	200		
Peak emitter current	I_{EM}	200		
Total power dissipation, $T_c = 70\text{ }^{\circ}\text{C}$	P_{tot}	500		mW
Junction temperature	T_j	150		$^{\circ}\text{C}$
Storage temperature range	T_{stg}	− 65 ... + 150		

Thermal Resistance

Junction - ambient	$R_{th JA}$	≤ 250	K/W
Junction - case ¹⁾	$R_{th JC}$	≤ 160	

¹⁾ Mounted on Al heat sink 15 mm × 25 mm × 0.5 mm.

Electrical Characteristics

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

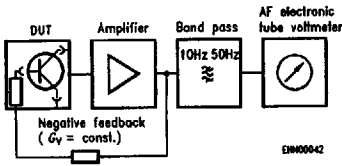
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
DC characteristics					
Collector-emitter breakdown voltage $I_C = 2\text{ mA}$	$V_{(BR)CEO}$				V
BC 415		35	—	—	
BC 416		45	—	—	
Collector-base breakdown voltage $I_C = 10\text{ }\mu\text{A}$	$V_{(BR)CBO}$				
BC 415		45	—	—	
BC 416		50	—	—	
Emitter-base breakdown voltage $I_E = 1\text{ }\mu\text{A}$	$V_{(BR)EBO}$	5	—	—	
Collector cutoff current $V_{CB} = 30\text{ V}$ $V_{CB} = 30\text{ V}$, $T_A = 150\text{ }^\circ\text{C}$	I_{CBO}	— —	— —	15 4	nA μA
DC current gain $I_C = 10\text{ }\mu\text{A}$; $V_{CE} = 5\text{ V}$	h_{FE}				—
BC 415 A, BC 416 A		40	90	—	
BC 415 B, BC 416 B		100	150	—	
BC 415 C, BC 416 C		100	270	—	
$I_C = 2\text{ mA}$; $V_{CE} = 5\text{ V}$					
BC 415 A, BC 416 A		125	180	250	
BC 415 B, BC 416 B		220	290	475	
BC 415 C, BC 416 C		420	520	800	
Collector-emitter saturation voltage ¹⁾ $I_C = 10\text{ mA}$; $I_B = 0.5\text{ mA}$ $I_C = 100\text{ mA}$; $I_B = 5\text{ mA}$	V_{CEsat}	— —	75 250	300 650	mV
Base-emitter saturation voltage ¹⁾ $I_C = 10\text{ mA}$; $I_B = 0.5\text{ mA}$ $I_C = 100\text{ mA}$; $I_B = 5\text{ mA}$	V_{BEsat}	— —	700 930	— —	
Base-emitter voltage $I_C = 2\text{ mA}$; $V_{CE} = 5\text{ V}$ $I_C = 10\text{ mA}$; $V_{CE} = 5\text{ V}$	$V_{BE\text{ (on)}}$	600 —	650 —	750 820	

¹⁾ Pulse test: $t \leq 300\text{ }\mu\text{s}$, $D \leq 2\text{ }\%$.

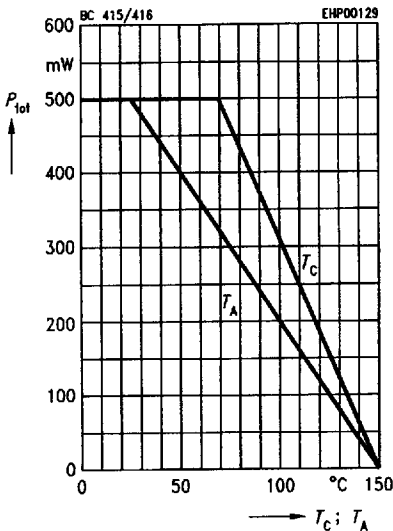
Electrical Characteristicsat $T_A = 25^\circ\text{C}$, unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
AC characteristics					
Transition frequency $I_C = 20\text{ mA}$, $V_{CE} = 5\text{ V}$, $f = 100\text{ MHz}$	f_T	—	250	—	MHz
Output capacitance $V_{CB} = 10\text{ V}$, $f = 1\text{ MHz}$	C_{obo}	—	4	—	pF
Input capacitance $V_{EB} = 0.5\text{ V}$, $f = 1\text{ MHz}$	C_{ibo}	—	8	—	
Short-circuit input impedance $I_C = 2\text{ mA}$, $V_{CE} = 5\text{ V}$, $f = 1\text{ kHz}$ BC 415 A, BC 416 A BC 415 B, BC 416 B BC 415 C, BC 416 C	h_{11e}	— — —	2.7 4.5 8.7	— — —	kΩ
Open-circuit reverse voltage transfer ratio $I_C = 2\text{ mA}$, $V_{CE} = 5\text{ V}$, $f = 1\text{ kHz}$ BC 415 A, BC 416 A BC 415 B, BC 416 B BC 415 C, BC 416 C	h_{12e}	— — —	1.5 2 3	— — —	10 ⁻⁴
Short-circuit forward current transfer ratio $I_C = 2\text{ mA}$, $V_{CE} = 5\text{ V}$, $f = 1\text{ kHz}$ BC 415 A, BC 416 A BC 415 B, BC 416 B BC 415 C, BC 416 C	h_{21e}	— — —	200 330 600	— — —	—
Open-circuit output admittance $I_C = 2\text{ mA}$, $V_{CE} = 5\text{ V}$, $f = 1\text{ kHz}$ BC 415 A, BC 416 A BC 415 B, BC 416 B BC 415 C, BC 416 C	h_{22e}	— — —	18 30 60	— — —	μS
Noise figure $I_C = 0.2\text{ mA}$, $V_{CE} = 5\text{ V}$, $R_S = 2\text{ kΩ}$ $f = 1\text{ kHz}$, $\Delta f = 200\text{ Hz}$	F	—	1	4	dB
Noise figure $I_C = 0.2\text{ mA}$, $V_{CE} = 5\text{ V}$, $R_S = 2\text{ kΩ}$ $f = 10\text{ Hz} \dots 50\text{ Hz}$	E_n	—	—	0.110	mV

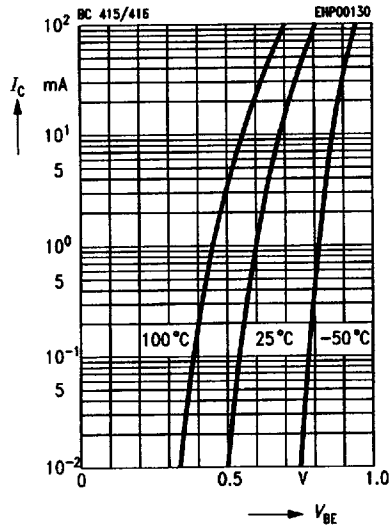
Test circuit for noise voltage measurement



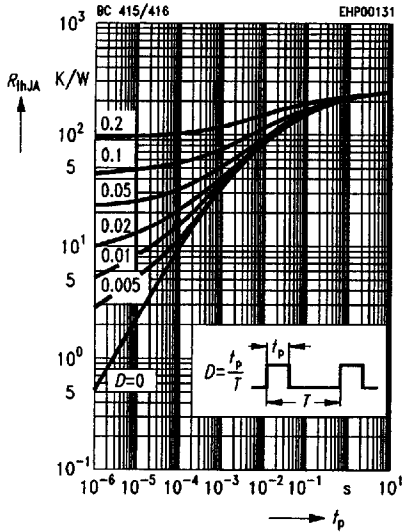
Total power dissipation $P_{tot} = f(T_A; T_C)$



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

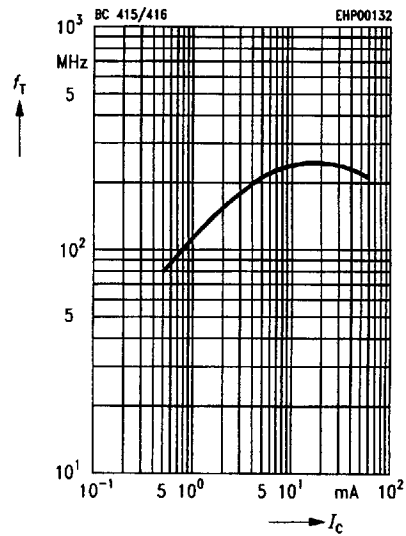
 $V_{CE} = 5 \text{ V}$


Permissible pulse load $R_{thJA} = f(t_p)$



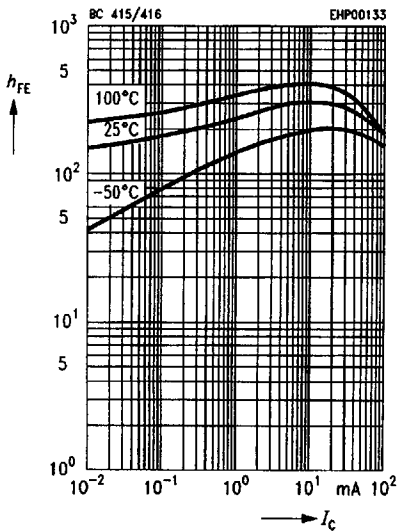
Transition frequency $f_T = f(I_C)$

$V_{CE} = 5 \text{ V}, f = 100 \text{ MHz}$



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

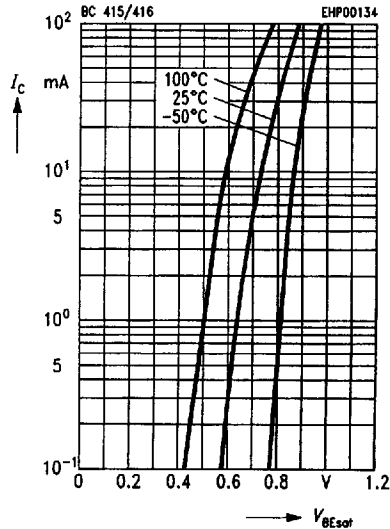
$V_{CE} = 5 \text{ V}$ (common emitter configuration)



Base-emitter saturation voltage

$V_{BEsat} = f(I_C)$

$h_{FE} = 20$

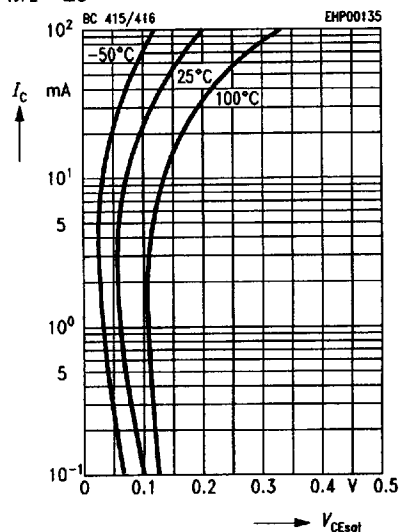


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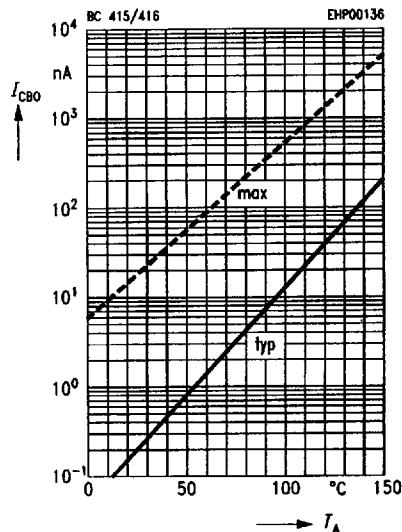
Collector-emitter saturation voltage

$$V_{CEsat} = f(I_C)$$

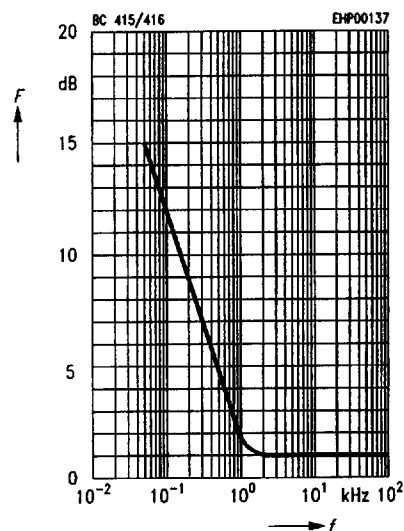
$$h_{FE} = 20$$


Collector cutoff current $I_{CB0} = f(T_A)$

$$V_{CB} = 30 \text{ V}$$

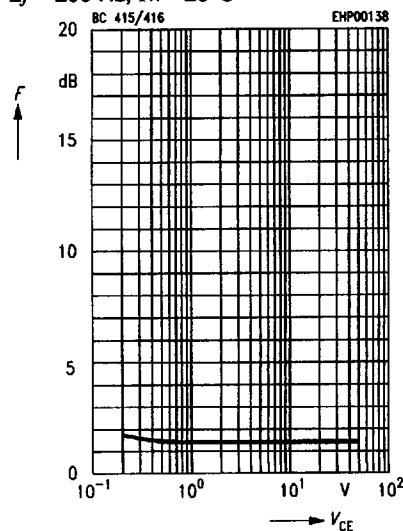

Noise figure $F = f(f)$

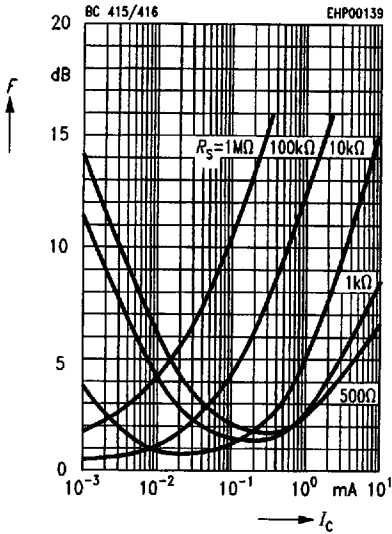
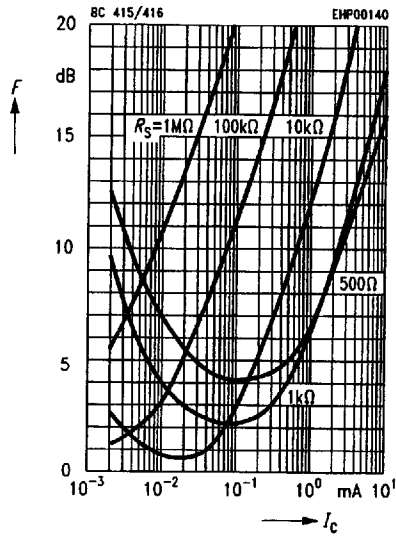
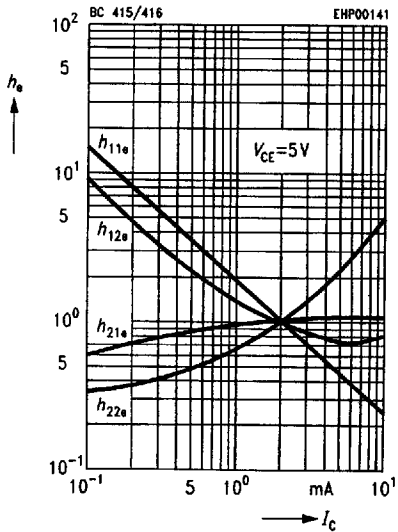
$$I_C = 0.2 \text{ mA}, f = 12 \text{ kHz}, R_s = 2 \text{ k}\Omega$$


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

$$I_C = 0.2 \text{ mA}, R_s = 2 \text{ k}\Omega, f = 1 \text{ kHz}$$

$$\Delta f = 200 \text{ Hz}, T_A = 25^\circ\text{C}$$



Noise figure $F = f(I_C)$
 $V_{CE} = 5 \text{ V}, f = 120 \text{ kHz}$

Noise figure $F = f(I_C)$
 $V_{CE} = 5 \text{ V}, f = 1 \text{ Hz}$

 h parameter $h_o = f(I_C)$

Capacitance $C = f(V_{CB}, V_{EB})$
