**NPN Silicon Switching Transistor**

- High DC current gain: 0.1mA to 100mA

- Low collector-emitter saturation voltage

- Complementary type: SMBT3906 (PNP)

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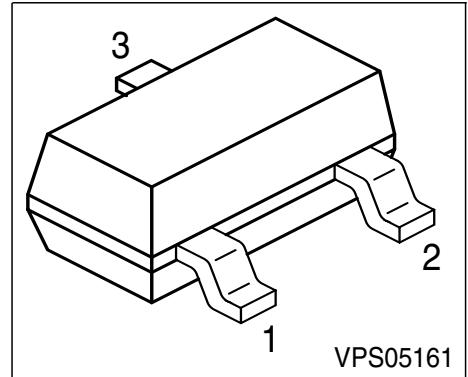
Type	Marking	Pin Configuration			Package
SMBT3904/ MMBT3904	s1A	1 = B	2 = E	3 = C	SOT23

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CEO}	40	V
Collector-base voltage	V_{CBO}	60	
Emitter-base voltage	V_{EBO}	6	
DC collector current	I_C	200	mA
Total power dissipation, T_S = 69 °C	P_{tot}	330	mW
Junction temperature	T_j	150	°C
Storage temperature	T_{stg}	-65 ... 150	

Thermal Resistance

Junction - soldering point[1]	R_{thJS}	$\leq$245	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 I_C = 1 mA, I_B = 0	$V_{(BR)CEO}$	40	-	-	V
Collector-base breakdown voltage I_C = 10 µA, I_E = 0	$V_{(BR)CBO}$	60	-	-	
Emitter-base breakdown voltage I_E = 10 µA, I_C = 0	$V_{(BR)EBO}$	6	-	-	
Collector cutoff current V_{CB} = 30 V, I_E = 0	I_{CBO}	-	-	50	nA
DC current gain 1) I_C = 100 µA, V_{CE} = 1 V I_C = 1 mA, V_{CE} = 1 V I_C = 10 mA, V_{CE} = 1 V I_C = 50 mA, V_{CE} = 1 V I_C = 100 mA, V_{CE} = 1 V	h_{FE}	40 70 100 60 30	- - - - -	- - 300 - -	-
Collector-emitter saturation voltage1) I_C = 10 mA, I_B = 1 mA I_C = 50 mA, I_B = 5 mA	V_{CEsat}	- -	- -	0.2 0.3	V
Base-emitter saturation voltage 1) I_C = 10 mA, I_B = 1 mA I_C = 50 mA, I_B = 5 mA	V_{BEsat}	0.65 -	- -	0.85 0.95	

1) Pulse test: t ≤ 300µs, D = 2%

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

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
AC Characteristics					
Transition frequency I_C = 10 mA, V_{CE} = 20 V, f = 100 MHz	f_T	300	-	-	MHz
Collector-base capacitance V_{CB} = 5 V, f = 1 MHz	C_{cb}	-	-	4	pF
Emitter-base capacitance V_{EB} = 0.5 V, f = 1 MHz	C_{eb}	-	-	8	
Noise figure I_C = 100 µA, V_{CE} = 5 V, R_S = 1 kΩ, f = 1 kHz, Δf = 200 Hz	F	-	-	5	dB
Short-circuit input impedance I_C = 1 mA, V_{CE} = 10 V, f = 1 kHz	h_{11e}	1	-	10	kΩ
Open-circuit reverse voltage transf.ratio I_C = 1 mA, V_{CE} = 10 V, f = 1 kHz	h_{12e}	0.5	-	8	10^{-4}
Short-circuit forward current transf.ratio I_C = 1 mA, V_{CE} = 10 V, f = 1 kHz	h_{21e}	100	400	-	-
Open-circuit output admittance I_C = 1 mA, V_{CE} = 10 V, f = 1 kHz	h_{22e}	1	-	40	µS
Delay time V_{CC} = 3 V, I_C = 10 mA, I_{B1} = 1 mA, $V_{BE(off)}$ = 0.5 V	t_d	-	-	35	ns
Rise time V_{CC} = 3 V, I_C = 10 mA, I_{B1} = 1 mA, $V_{BE(off)}$ = 0.5 V	t_r	-	-	35	
Storage time V_{CC} = 3 V, I_C = 10 mA, I_{B1}=I_{B2} = 1mA	t_{stg}	-	-	200	
Fall time V_{CC} = 3 V, I_C = 10 mA, I_{B1}=I_{B2} = 1mA	t_f	-	-	50	

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Test circuits

Delay and rise time

300 ns

$D = 2\%$

+10.9 V

0

-0.5 V

<1.0 ns

10 kΩ

+3.0 V

275 Ω

C

<4.0 pF

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Storage and fall time

$10 < t_1 < 500\ \mu s$

$D = 2\%$

t_1

+10.9 V

0

-9.1 V

<1.0 ns

10 kΩ

1N916

+3.0 V

275 Ω

C

<4.0 pF

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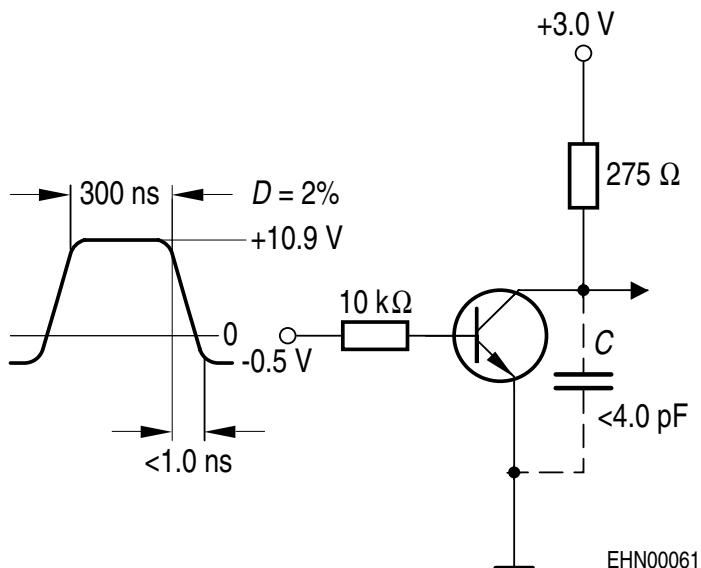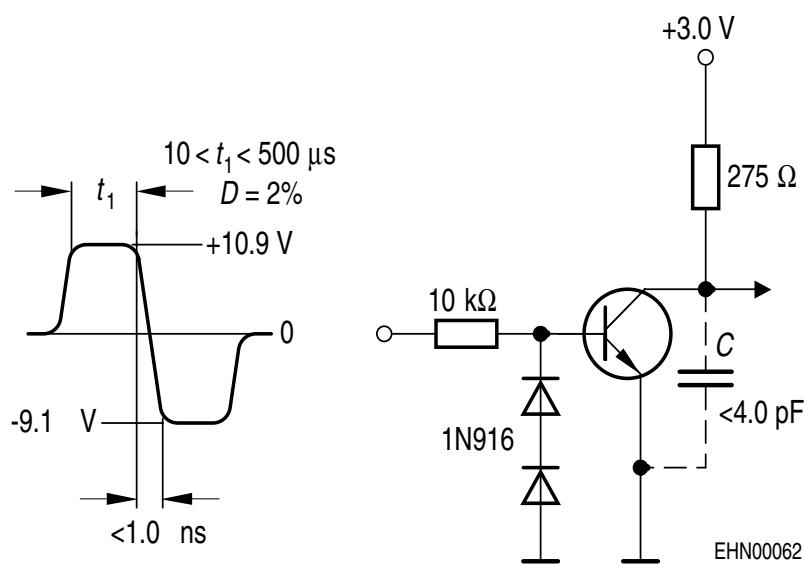
Total power dissipation $P_{tot} = f(T_S)$
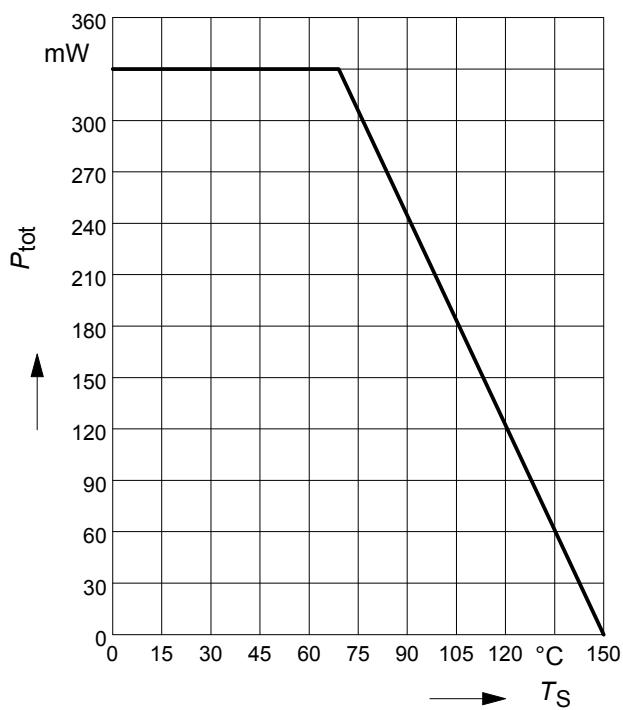
Saturation voltage $I_C = f(V_{BEsat}, V_{CEsat})$
$h_{FE} = 10$
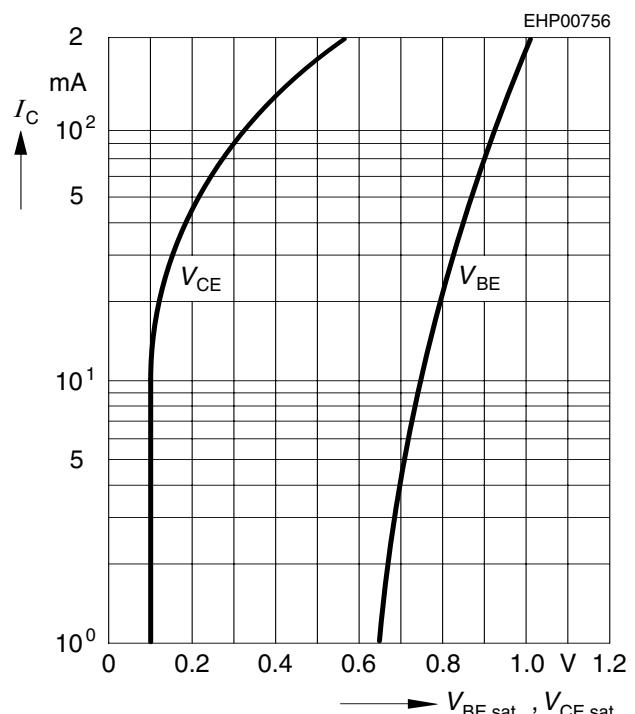
## Permissible pulse load
$P_{totmax} / P_{totDC} = f(t_p)$
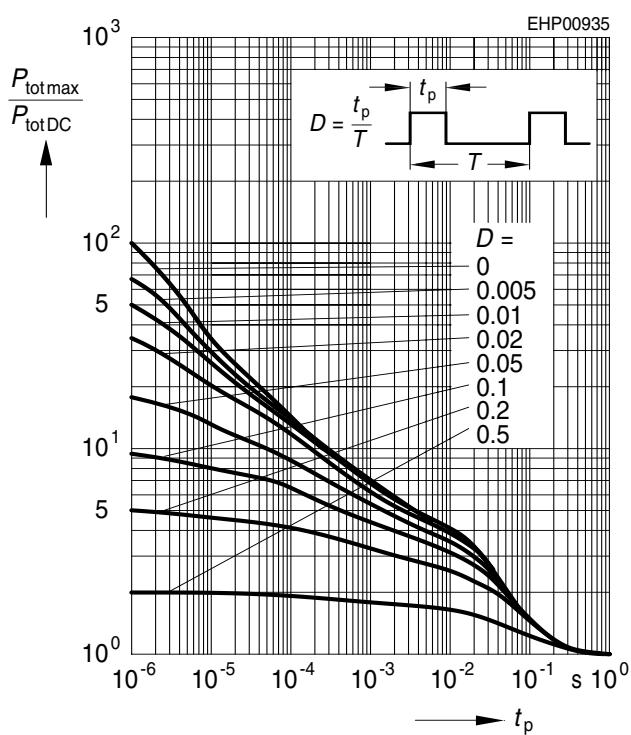
DC current gain $h_{FE} = f(I_C)$
$V_{CE} = 10V$, normalized
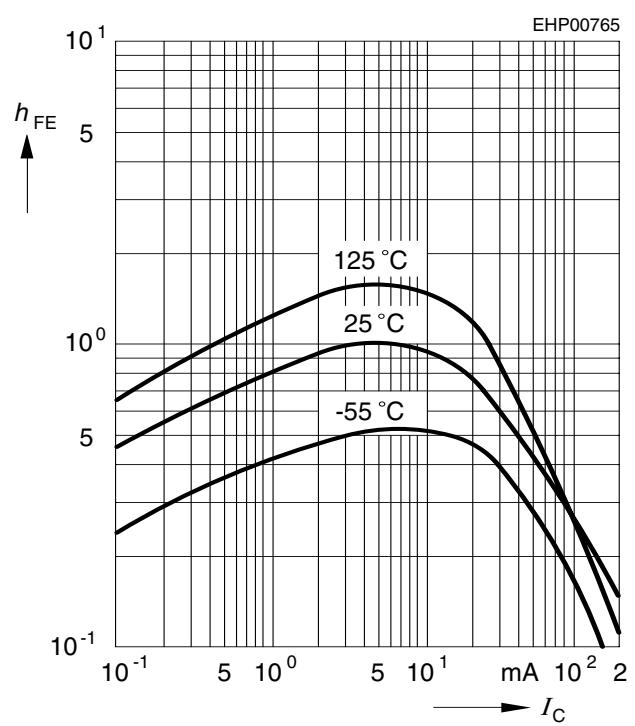
## Short-circuit forward current transfer ratio $h_{21e} = f(I_C)$
V_{CE} = 10V, f = 1MHz
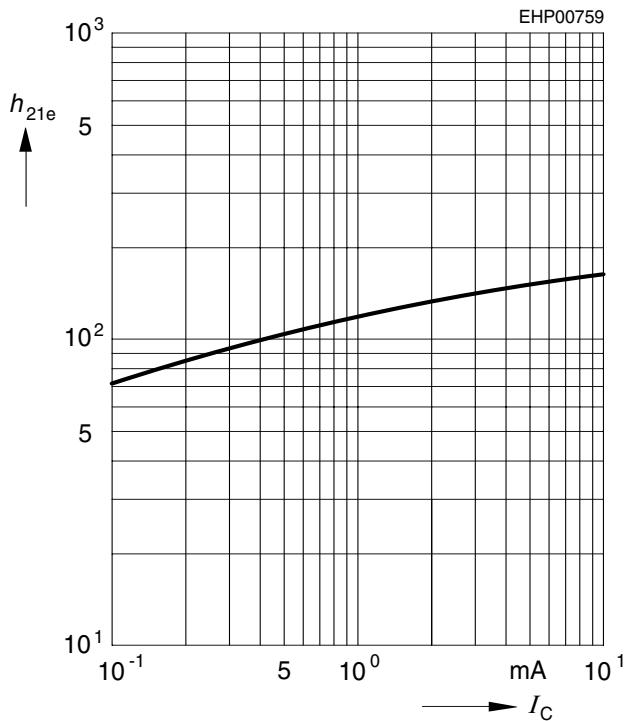
Open-circuit output admittance
$h_{22e} = f(I_C)$
V_{CE} = 10V, f = 1MHz
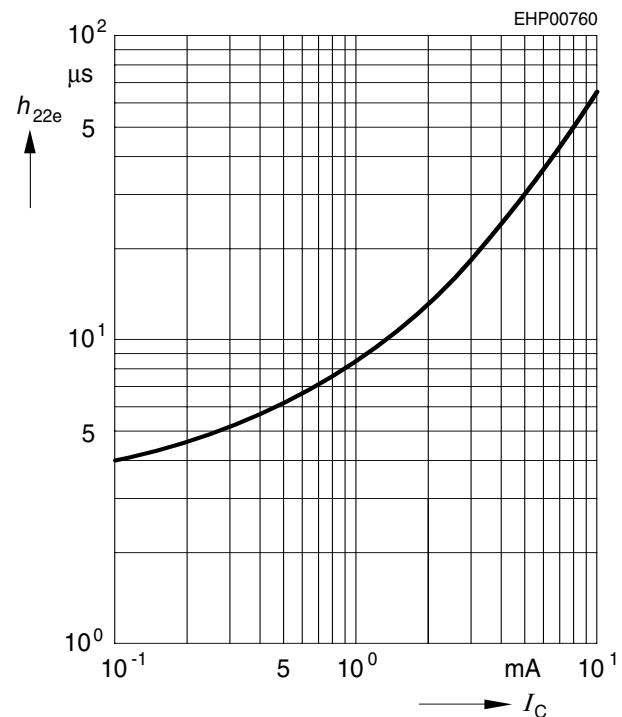
Delay time $t_d = f(I_C)$
Rise time $t_r = f(I_C)$

Storage time $t_{stg} = f(I_C)$

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Fall time $t_f = f(I_C)$

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Rise time $t_r = f(I_C)$

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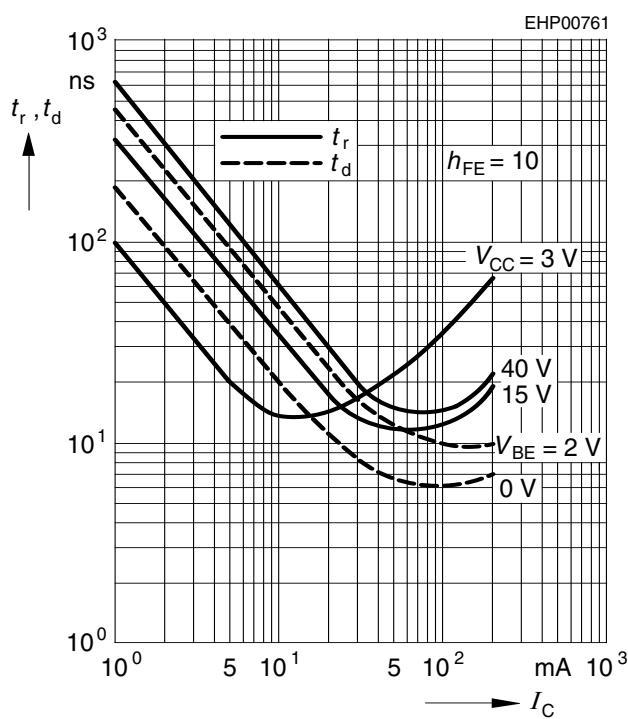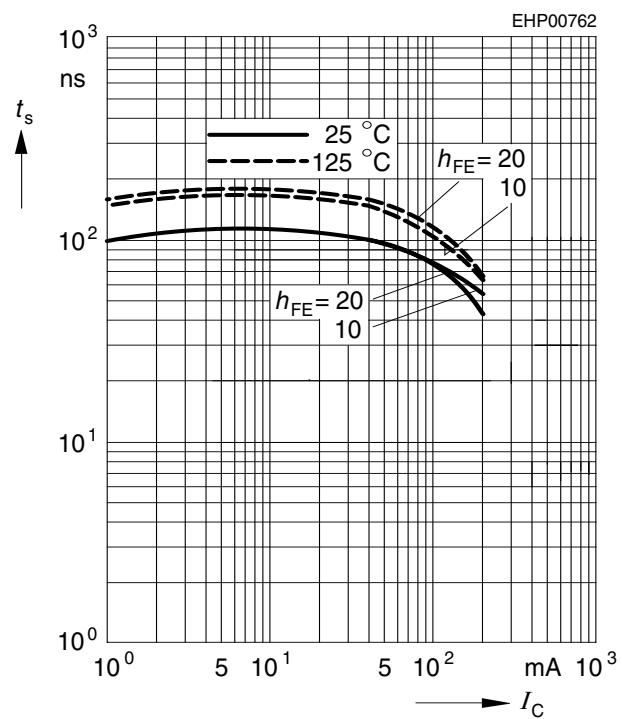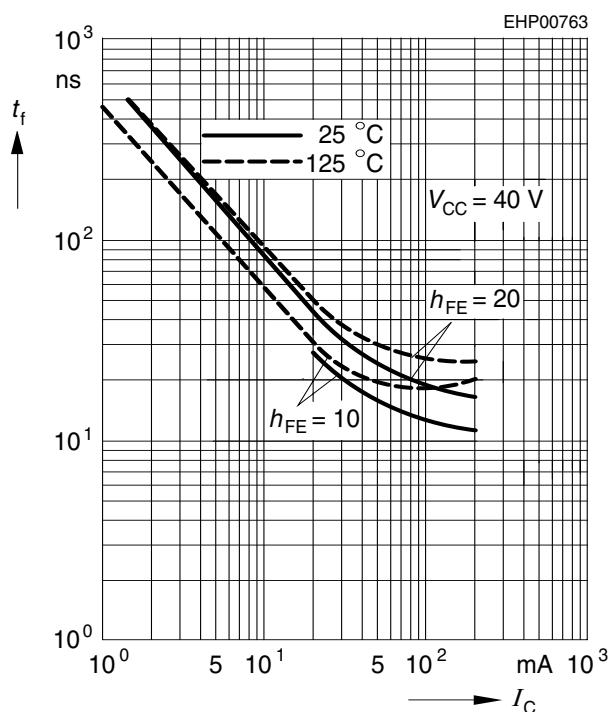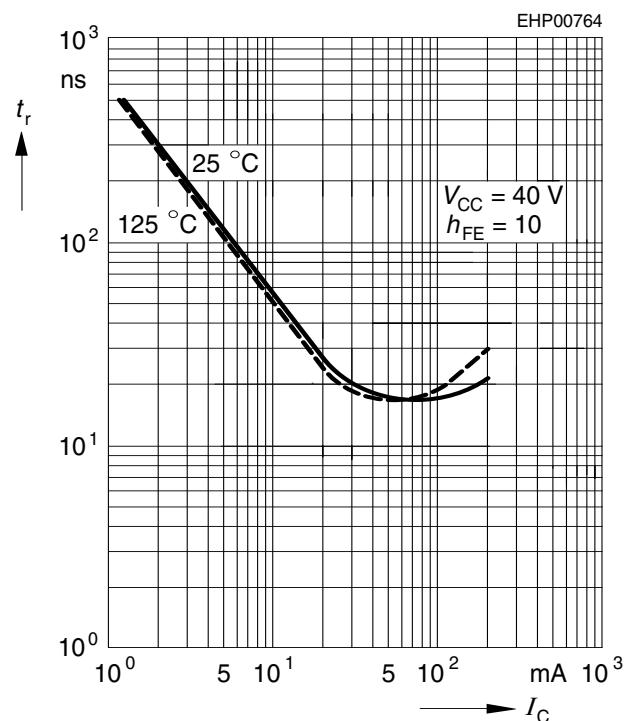
Input impedance

$h_{11e} = f(I_C)$

$V_{CE} = 10V$, $f = 1kHz$

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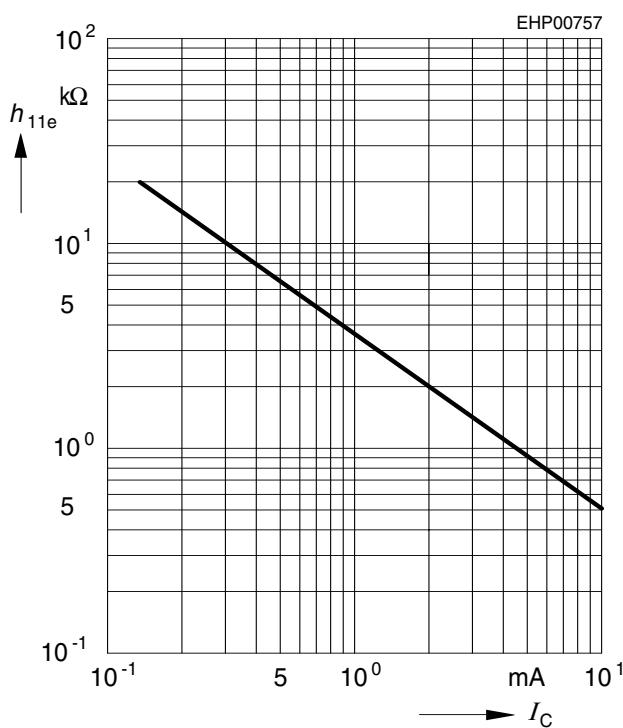
Open-circuit reverse voltage

transfer ratio $h_{12e} = f(I_C)$

$V_{CE} = 10V$, $f = 1kHz$

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