

## N-P-N SILICON PLANAR TRANSISTOR

# BF196

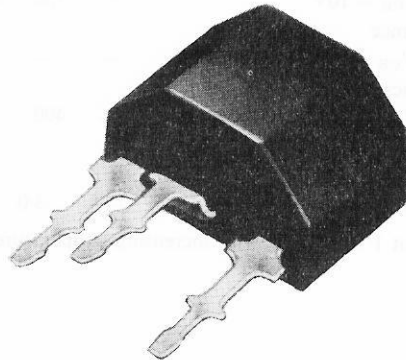
N-P-N silicon planar transistor in plastic encapsulation with three rigid self-locking strips suitable for insertion into printed circuit boards using standard grids. The transistor has a very low feedback capacitance and is intended for use in the forward gain control stage of the television i.f. amplifiers.

### QUICK REFERENCE DATA

$V_{CE0}$ max.	40	V
$V_{CE0}$ max.	30	V
$I_C$ max.	25	mA
$P_{tot}$ max. ( $T_{amb} = 25^\circ\text{C}$ )	250	mW
$T_j$ max.	125	$^\circ\text{C}$
$f_T$ typ. ( $I_C = 4\text{mA}$ , $V_{CE} = 10\text{V}$ , $f = 100\text{MHz}$ )	400	MHz
$-C_{re}$ typ. ( $I_C = 1\text{mA}$ , $V_{CE} = 10\text{V}$ , $f = 10.7\text{MHz}$ )	0.2	pF
$G_{UM}$ typ. ( $I_C = 4\text{mA}$ , $V_{CE} = 10\text{V}$ )		
	$f = 35\text{MHz}$	42 dB
	$f = 45\text{MHz}$	39 dB
Gain control range, typ.	60	dB

### OUTLINE AND DIMENSIONS

For details see page 4.



## RATINGS

Limiting values of operation according to the absolute maximum system.

### Electrical

$V_{CE0}$ max.	40	V
$V_{CE0}$ max. (see also page 5)	30	V
$V_{EBO}$ max.	4.0	V
$I_C$ max.	25	mA
$I_{CM}$ max.	25	mA
$P_{tot}$ max. ( $T_{amb} = 25^\circ\text{C}$ )	250	mW

### Temperature

$T_{stg}$	-65 to +125	$^\circ\text{C}$
$T_j$ max.	125	$^\circ\text{C}$

## THERMAL CHARACTERISTIC

$R_{th(j-amb)}$ in free air	0.4 degC/mW
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## ELECTRICAL CHARACTERISTICS ( $T_{amb} = 25^\circ\text{C}$ )

		<i>Min.</i>	<i>Typ.</i>	<i>Max.</i>	
$I_B$	Base current at about 50 dB gain control				
	$I_C = 6.0\text{mA}, V_{CE} = 2.0\text{V}$	—	—	270	$\mu\text{A}$
	$I_C = 15\text{mA}, V_{CE} = 5.0\text{V}$	—	—	1.5	mA
$I_B$	Base current				
	$I_C = 4.0\text{mA}, V_{CE} = 10\text{V}$	—	70	150	$\mu\text{A}$
$V_{BE}$	*Base-emitter voltage				
	$I_C = 4.0\text{mA}, V_{CE} = 10\text{V}$	—	750	840	mV
$-C_{re}$	Feedback capacitance				
	$I_C = 1.0\text{mA}, V_{CE} = 10\text{V}, f = 10.7\text{MHz}$	—	—	0.2	pF
$f_T$	Transition frequency				
	$I_C = 4.0\text{mA}, V_{CE} = 10\text{V}, f = 100\text{MHz}$	—	400	—	MHz
N	Noise figure				
	$I_C = 4.0\text{mA}, V_{CE} = 10\text{V},$ $G_S = 10\text{mmho}, B_S = 0, f = 35\text{MHz}$	—	3.0	—	dB

\* $V_{BE}$  decreases by about 1.7mV/degC with increasing temperature.



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**ELECTRICAL CHARACTERISTICS (continued)**

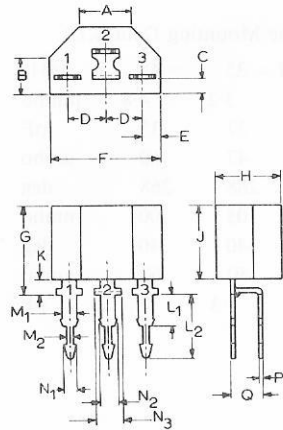
Typical y-parameters (common emitter)

$I_C = 4.0\text{mA}$ ,  $V_{CE} = 10\text{V}$  (mounted as in the Mounting Details, 1.)

		f = 35	= 45	MHz
$g_{ie}$	Input conductance	3.2	4.8	mmho
$C_{ie}$	Input capacitance	37	35	pF
$ y_{re} $	Feedback admittance	47	60	$\mu\text{mho}$
$\phi_{re}$	Phase angle of feedback admittance	268	268	deg
$ y_{fe} $	Transfer admittance	105	100	mmho
$\phi_{fe}$	Phase angle of transfer admittance	340	340	deg
$g_{oe}$	Output conductance	50	60	$\mu\text{mho}$
$C_{oe}$	Output capacitance	1.3	1.3	pF
$G_{UM}$	Maximum unilateralised power gain			
	$G_{UM} \text{ (in dB)} = 10 \log \frac{ y_{fe} ^2}{4g_{ie}g_{oe}}$			
	$I_C = 4.0\text{mA}$ , $V_{CE} = 10\text{V}$	42	39	dB



## OUTLINE AND DIMENSIONS



Millimetres

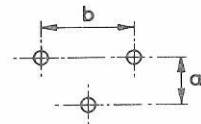
	Min.	Max.
A	3.4	3.6
B	2.4	2.6
C	0.8	1.1
D	2.44	2.64
E	1.1	1.3
F	7.4	7.6
G	6.0	6.4
H	4.4	4.6
J	4.9	5.1
K	1.1	1.3
L1	2.1	2.2
L2	4.0	4.3
M1	0.65	0.80
M2	0.45	0.60
N1	0.70	0.80
N2	1.15	1.25
N3	1.75	2.00
P	0.17	0.25
Q	1.75	2.00

### Connections

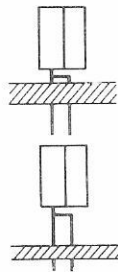
1. Base
2. Emitter
3. Collector

## MOUNTING DETAILS

See also General Explanatory Notes, Section IV



a = 2.49 to 2.59mm  
b = 5.03 to 5.13mm

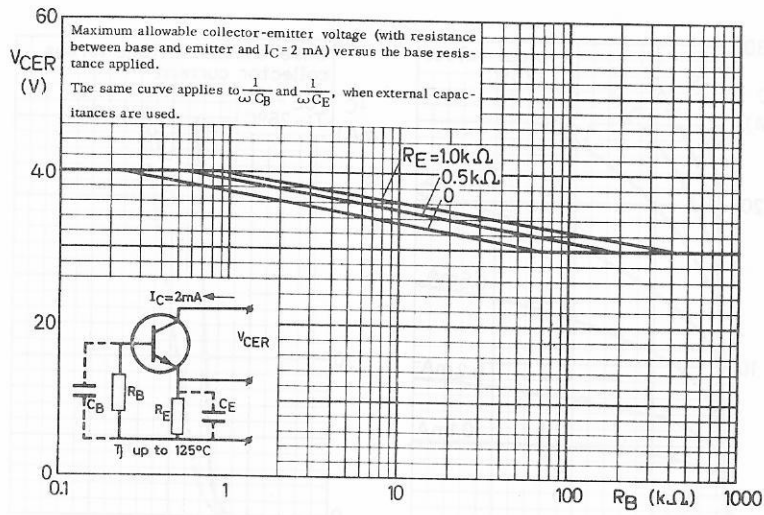
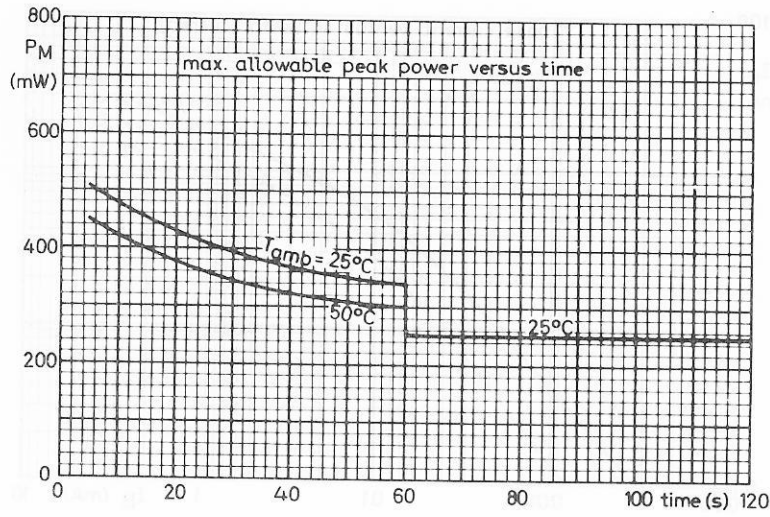


1. Maximum thickness of printed board = 1.7mm  
Hole diameter = 1.25 to 1.35mm
2. Maximum thickness of printed board = 1.1mm  
Hole diameter = 0.77 to 0.83mm

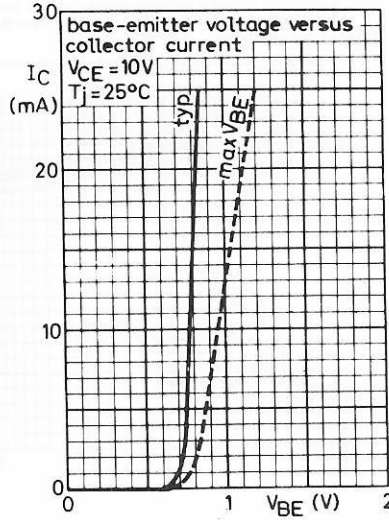
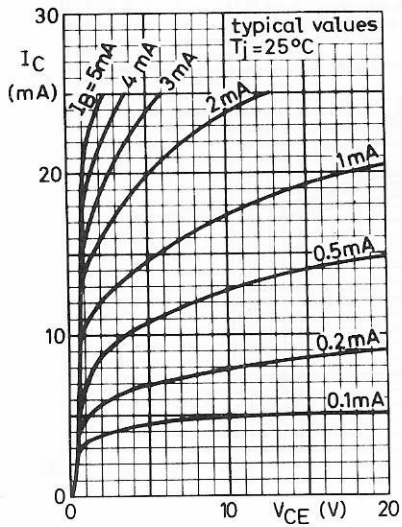
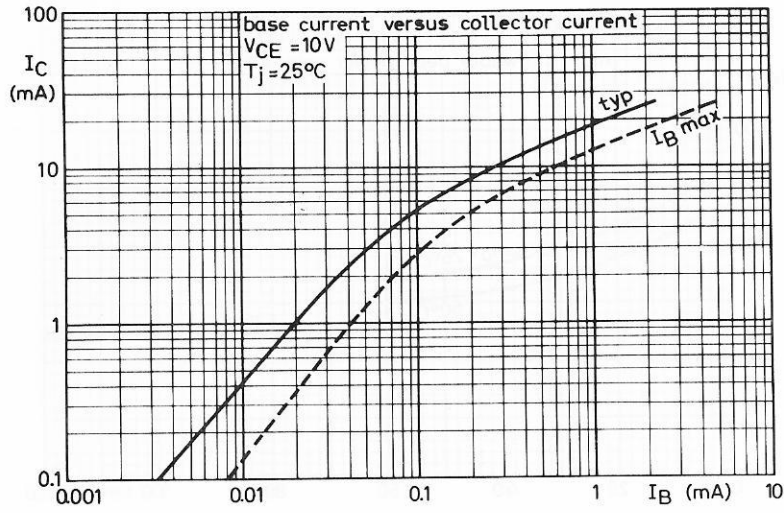


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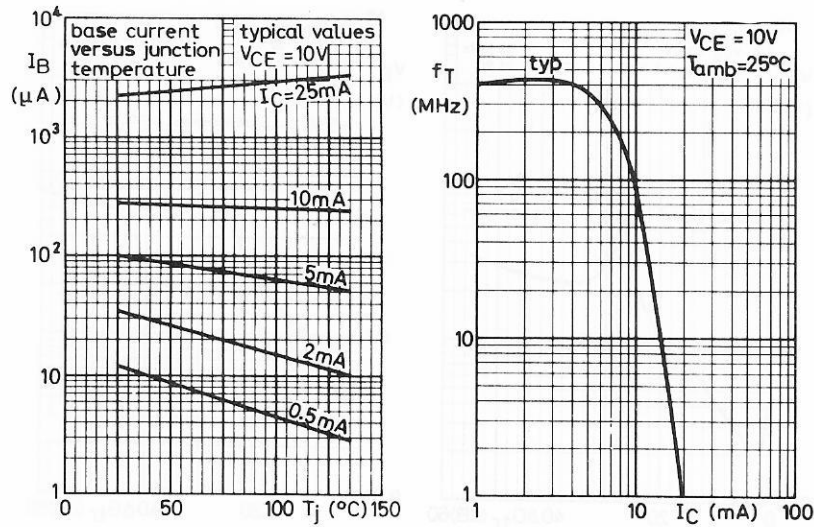


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# N-P-N SILICON PLANAR TRANSISTOR

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### EQUIVALENT GAIN CONTROL TRANSISTOR

When the BF196 is used in a gain controlled i.f. stage it is recommended to connect an optimum series base capacitor of 22pF and a bias resistor of 1k $\Omega$  (see fig. 1) to minimise the variation of input admittance and output conductance with gain control.

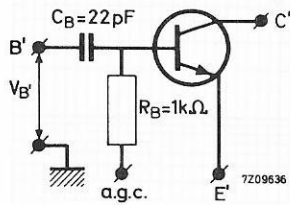
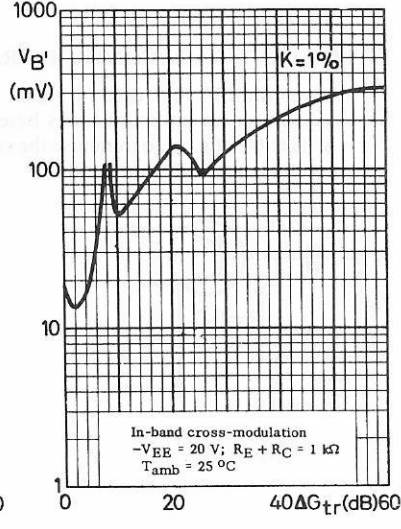
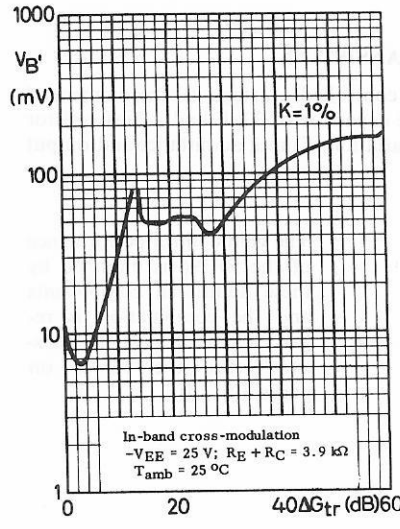
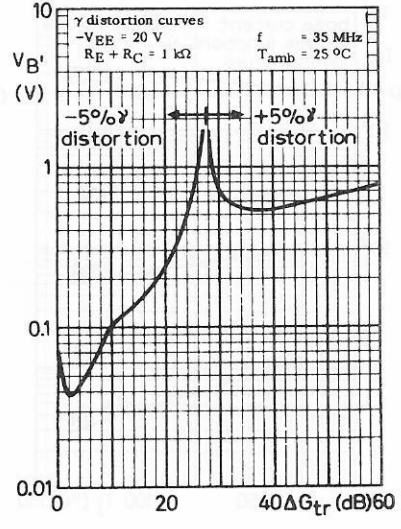
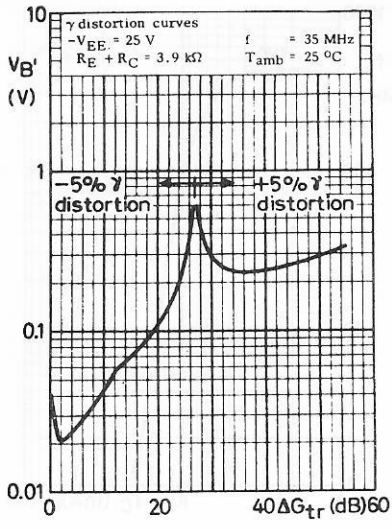


Fig. 1

The gain control performance of the BF196 is modified by these additional components and the combination is regarded as an 'equivalent transistor' (See the curves on pages 8 to 14)





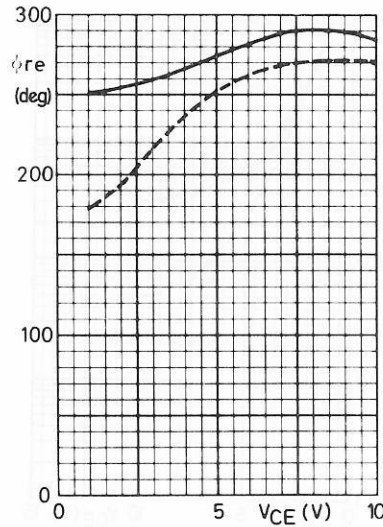
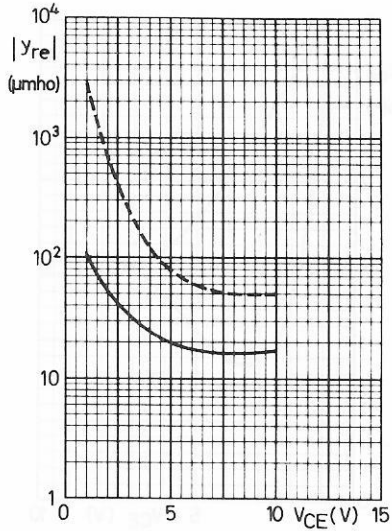
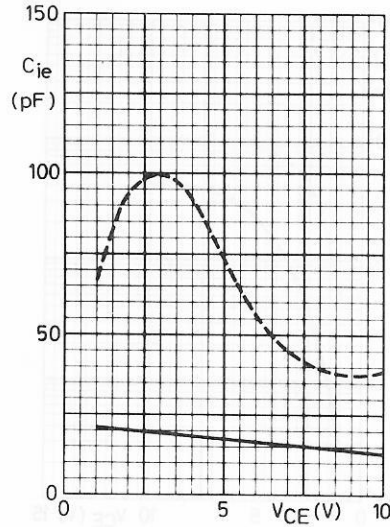
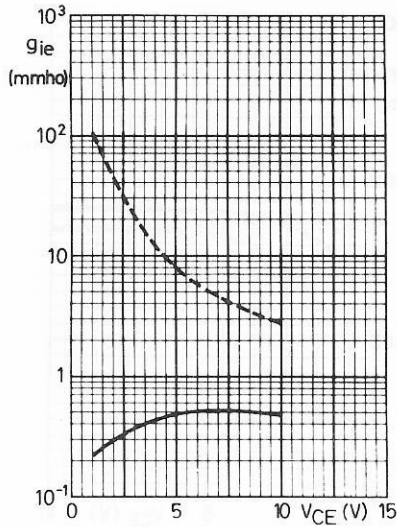
The signal handling capability of the equivalent transistor as a function of gain control.



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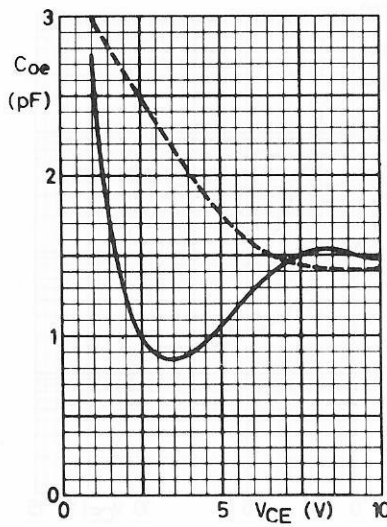
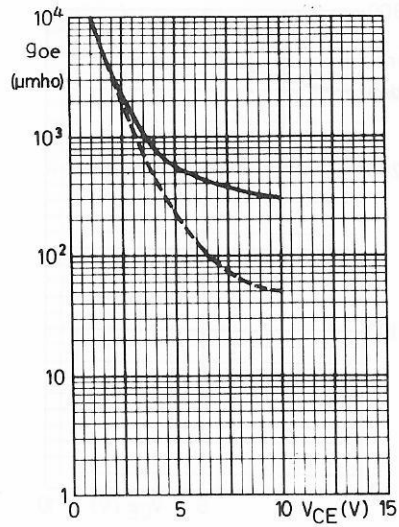
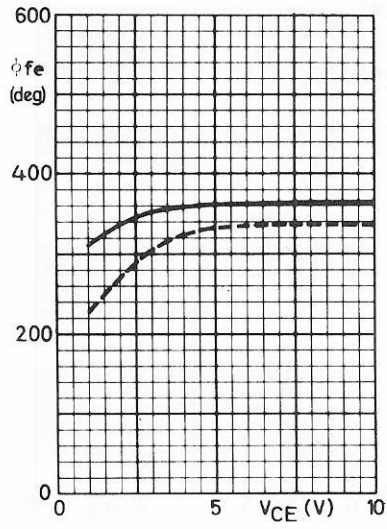
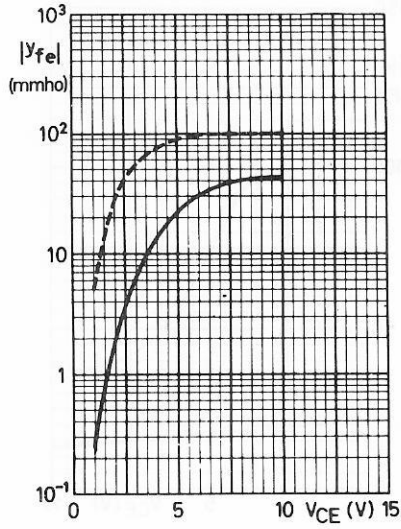
Voltage control;  $-V_{EE} = 25V$ ;  $R_E + R_C = 3.9k\Omega$ ;  $f = 35MHz$



Typical y-parameters of the equivalent gain control transistor, including base capacitor and base resistor as shown on page 7 (dashed curves apply to the transistor only).



Voltage control;  $-V_{EE} = 25V$ ;  $R_E + R_C = 3.9k\Omega$ ;  $f = 35MHz$



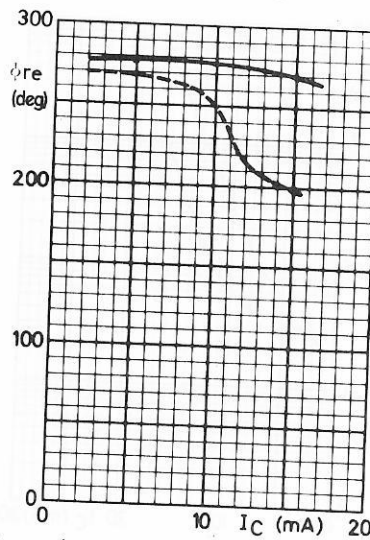
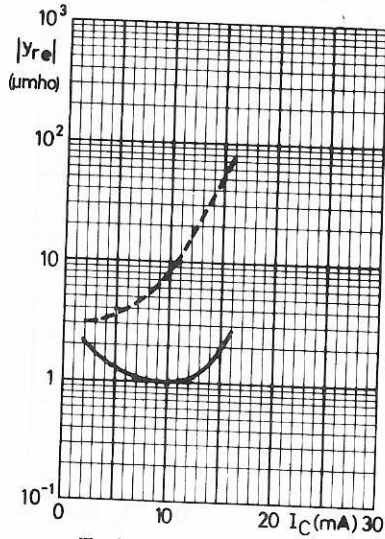
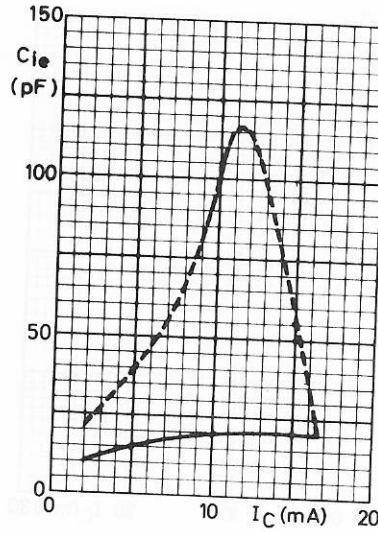
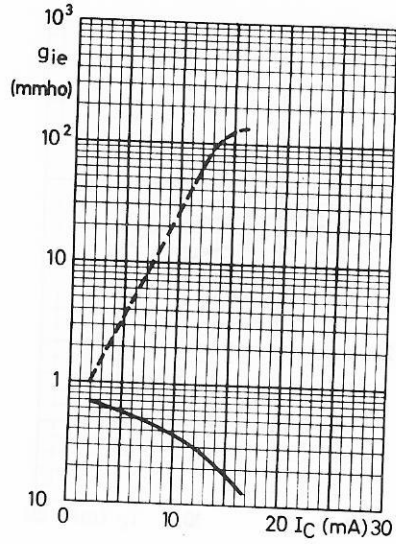
Typical y-parameters of the equivalent gain control transistor, including base capacitor and base resistor as shown on page 7 (dashed curves apply to the transistor only).



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Current control;  $-V_{EE} = 20V$ ;  $R_E + R_C = 1k\Omega$ ;  $f = 35MHz$



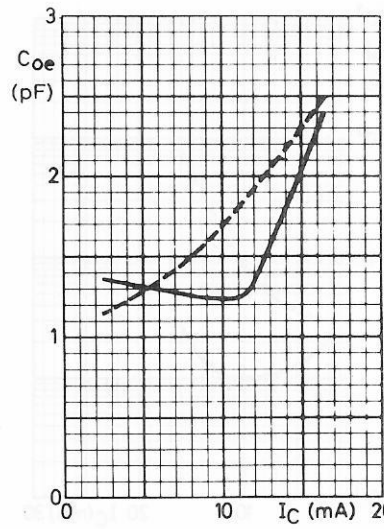
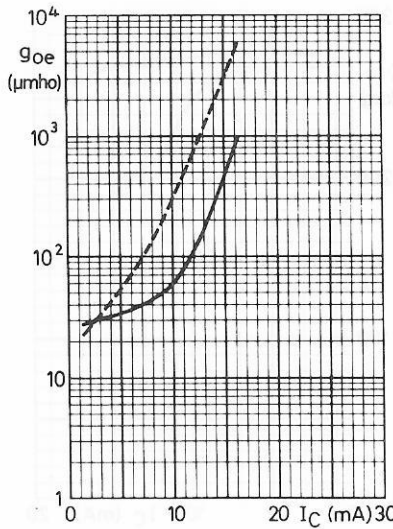
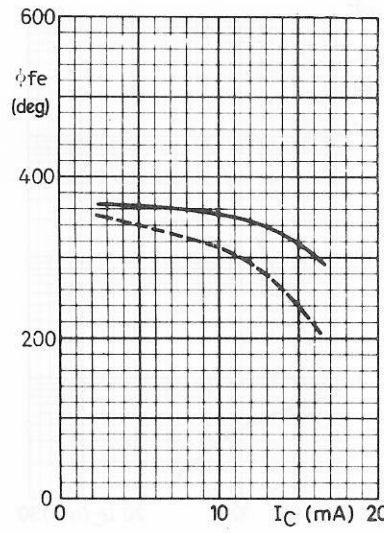
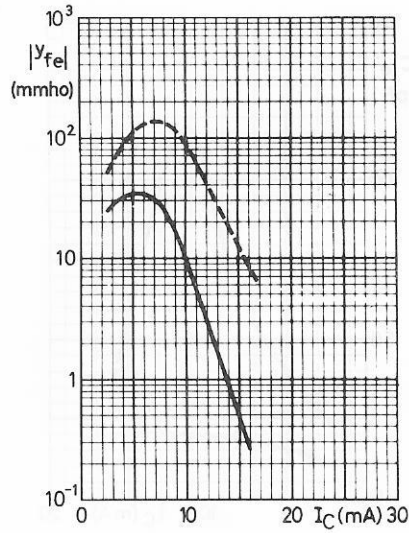
Typical y-parameters of the equivalent gain control transistor, including base capacitor and base resistor as shown on page 7 (dashed curves apply to the transistor only).



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Current control;  $-V_{BE} = 20V$ ;  $R_E + R_C = 1k\Omega$ ;  $f = 35MHz$



Typical y-parameters of the equivalent gain control transistor, including base capacitor and base resistor as shown on page 7 (dashed curves apply to the transistor only).



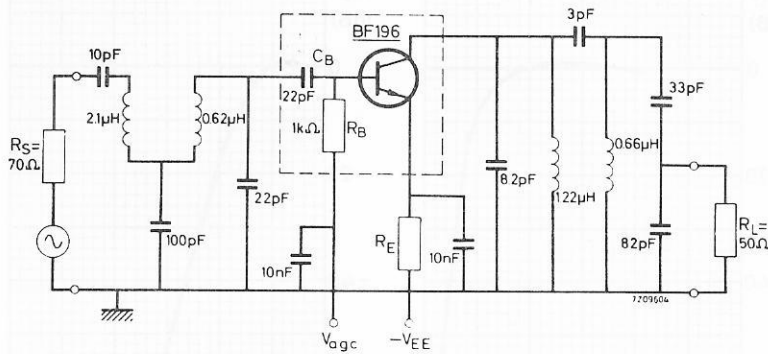
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**APPLICATION INFORMATION**

**First stage of an i.f. amplifier**

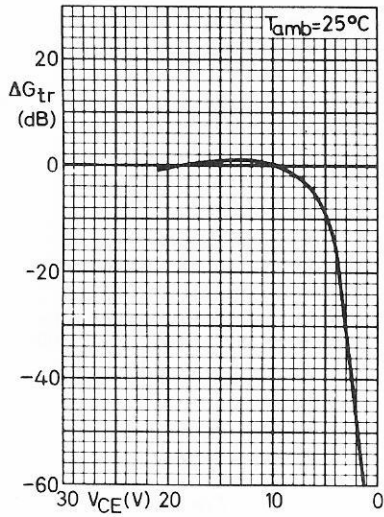
Basic circuit with voltage gain control:  $R_E + R_C = 3.9k\Omega$ ;  $-V_{EE} = 25V$   
 current gain control:  $R_E + R_C = 1k\Omega$ ;  $-V_{EE} = 20V$



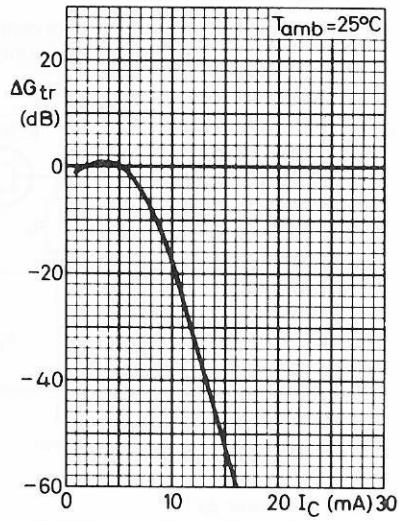
$G_{tr}$  Transducer gain *Typ.*  
 $I_C = 4mA, -V_{EE} = 25V, R_E + R_C = 3.9k\Omega,$   
 $f = 36.4MHz$  25.5 dB  
 $G_{tr} \text{ (in dB)} = 10 \log \frac{\text{output power in load } R_L}{\text{available power from source } R_S}$   
 $\Delta G_{tr}$  Gain control range 60 dB  
 (see also the upper curves, page 14)



Voltage gain control  
(In the circuit given on page 13)



Current gain control  
(In the circuit given on page 13)



Curves of constant gain reduction  
(In the circuit given on page 13)

