N-P-N SILICON PLANAR TRANSISTOR

BF196

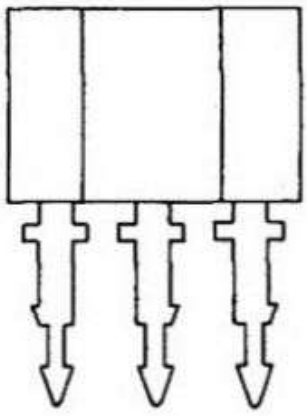
N-P-N silicon planar transistor in plastic encapsulation with three rigid self-locking strips suitable for insertion into printed circuit boards using standard grids. The transistor has a very low feedback capacitance and is intended for use in the forward gain control stage of the television i.f. amplifiers.

QUICK REFERENCE DATA

V_{CBO} max.	40	V
V_{CEO} max.	30	V
I_C max.	25	mA
P_{tot} max. (T_{amb} = 25°C)	250	mW
T_j max.	125	°C
f_T typ. (I_C = 4mA, V_{CE} = 10V, f = 100MHz)	400	MHz
$-C_{re}$ typ. (I_C = 1mA, V_{CE} = 10V, f = 10·7MHz)	0·2	pF
G_{UM} typ. (I_C = 4mA, V_{CE} = 10V)		
f = 35MHz	42	dB
f = 45MHz	39	dB
Gain control range, typ.	60	dB

OUTLINE AND DIMENSIONS

For details see page 4.



Front View
Scale 3:1

N.B. Devices in this Data Sheet should be ordered by the type number followed by Reference 0220.

RATINGS

Limiting values of operation according to the absolute maximum system.

Electrical

V_{CBO} max.	40	V
V_{CEO} 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°C)	250	mW

Temperature

T_{stg}	−65 to + 125	°C
T_j max.	125	°C

THERMAL CHARACTERISTIC

$R_{th(j-amb)}$ in free air	0·4 degC/mW

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C)

		Min.	*Typ.*	*Max.*	
I_B	Base current at about 50 dB gain control				
	I_C = 6·0mA, V_{CE} = 2·0V	—	—	270	μA
	I_C = 15mA, V_{CE} = 5·0V	—	—	1·5	mA
I_B	Base current				
	I_C = 4·0mA, V_{CE} = 10V	—	70	150	μA
V_{BE}	*Base-emitter voltage				
	I_C = 4·0mA, V_{CE} = 10V	—	750	840	mV
$-C_{re}$	Feedback capacitance				
	I_C = 1·0mA, V_{CE} = 10V, f = 10·7MHz	—	—	0·2	pF
f_T	Transition frequency				
	I_C = 4·0mA, V_{CE} = 10V, f = 100MHz	—	400	—	MHz
N	Noise figure				
	I_C = 4·0mA, V_{CE} = 10V,				
	G_S = 10mmho, B_S = 0, f = 35MHz	—	3·0	—	dB

*V_{BE} decreases by about 1·7mV/degC with increasing temperature.

ELECTRICAL CHARACTERISTICS (*continued*)

Typical y-parameters (common emitter)
$I_C = 4{\cdot}0mA$, $V_{CE} = 10V$ (mounted as in the Mounting Details,1.)

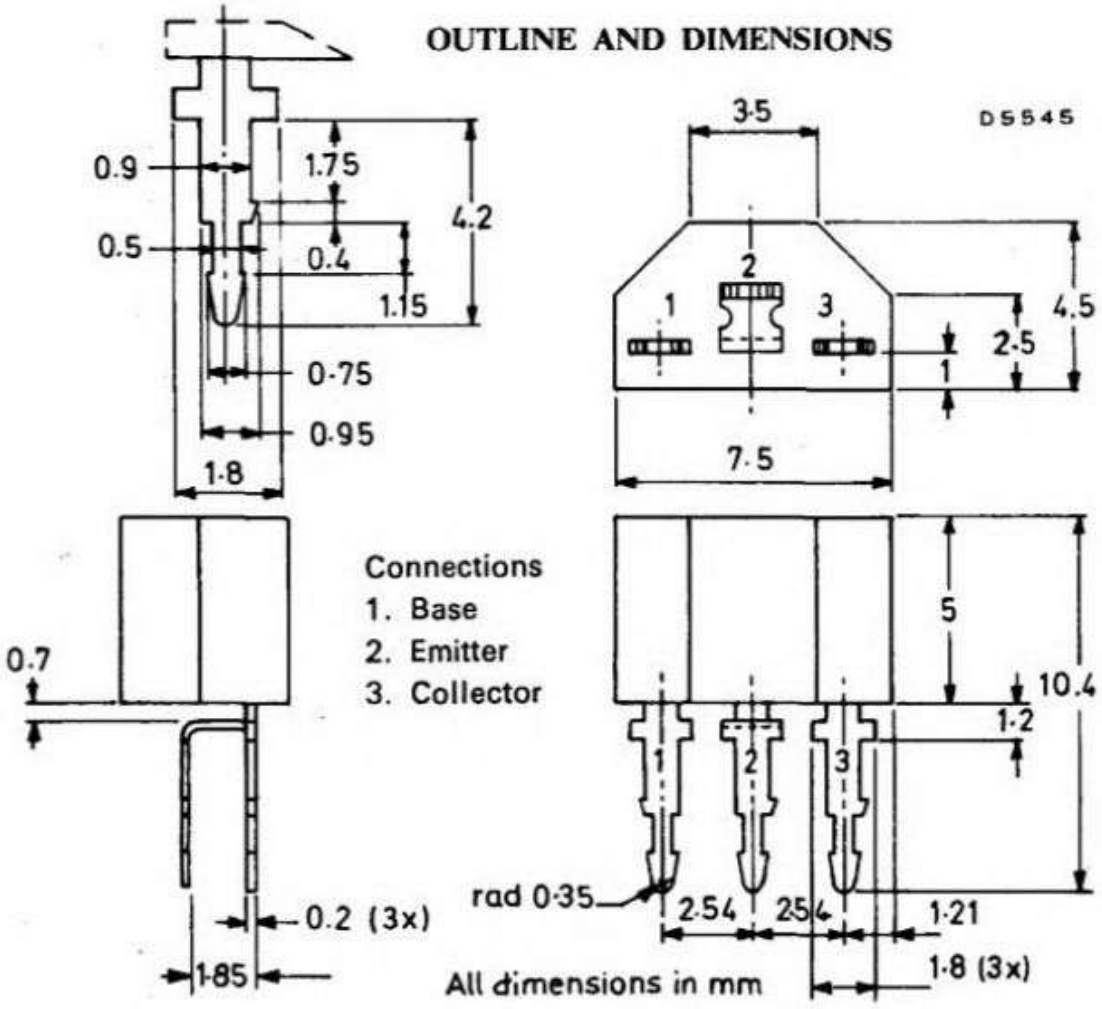
		f = 35	= 45	MHz
g_{ie}	Input conductance	3·2	4·8	mmho
C_{ie}	Input capacitance	37	35	pF
$\|y_{re}\|$	Feedback admittance	47	60	μmho
ϕ_{re}	Phase angle of feedback admittance	268	268	deg
$\|y_{fe}\|$	Transfer admittance	105	100	mmho
ϕ_{fe}	Phase angle of transfer admittance	340	340	deg
g_{oe}	Output conductance	50	60	μmho
C_{oe}	Output capacitance	1·3	1·3	pF

G_{UM} Maximum unilateralised power gain

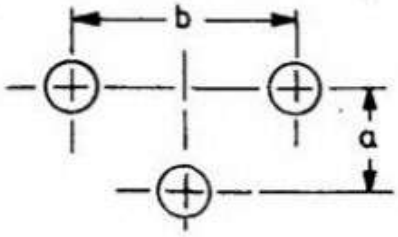
$$G_{UM} \text{ (in dB)} = 10 \log \frac{|y_{fe}|^2}{4 g_{ie} g_{oe}}$$

$I_C = 4{\cdot}0mA$, $V_{CE} = 10V$, 42 39 dB

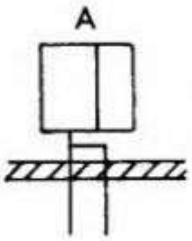
OUTLINE AND DIMENSIONS



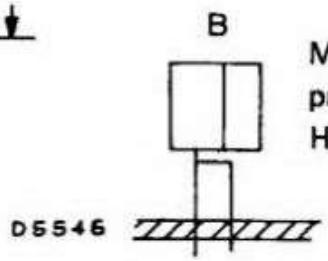
MOUNTING DETAILS



a = 2·49 to 2·59mm
b = 5·03 to 5·13mm

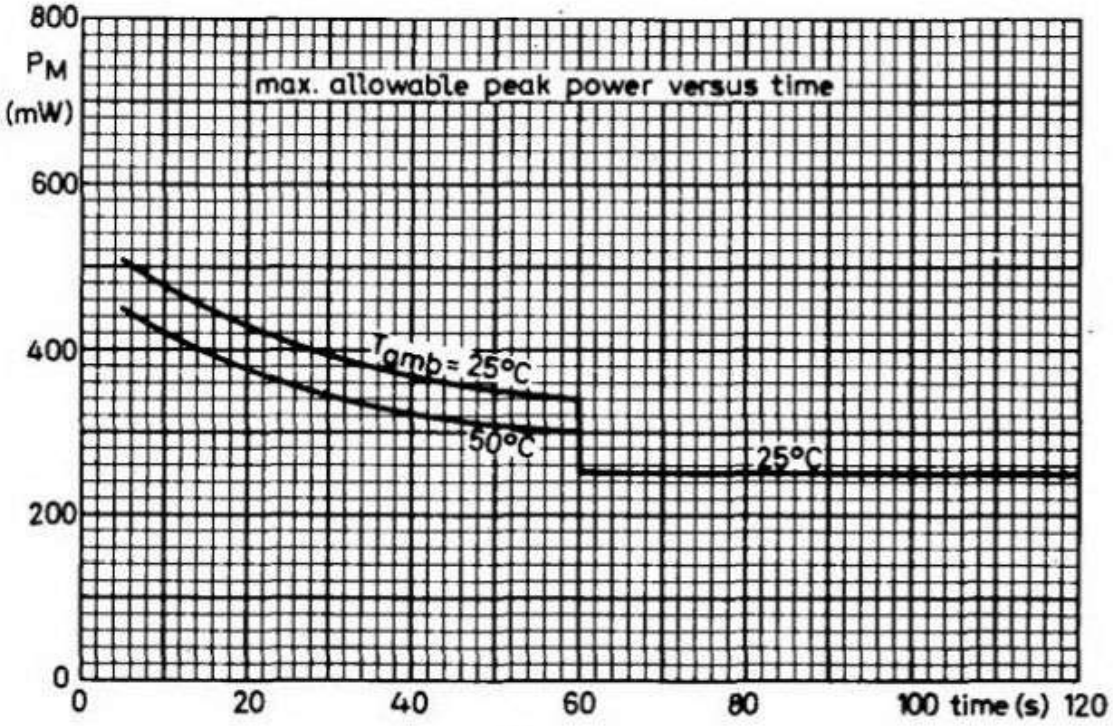


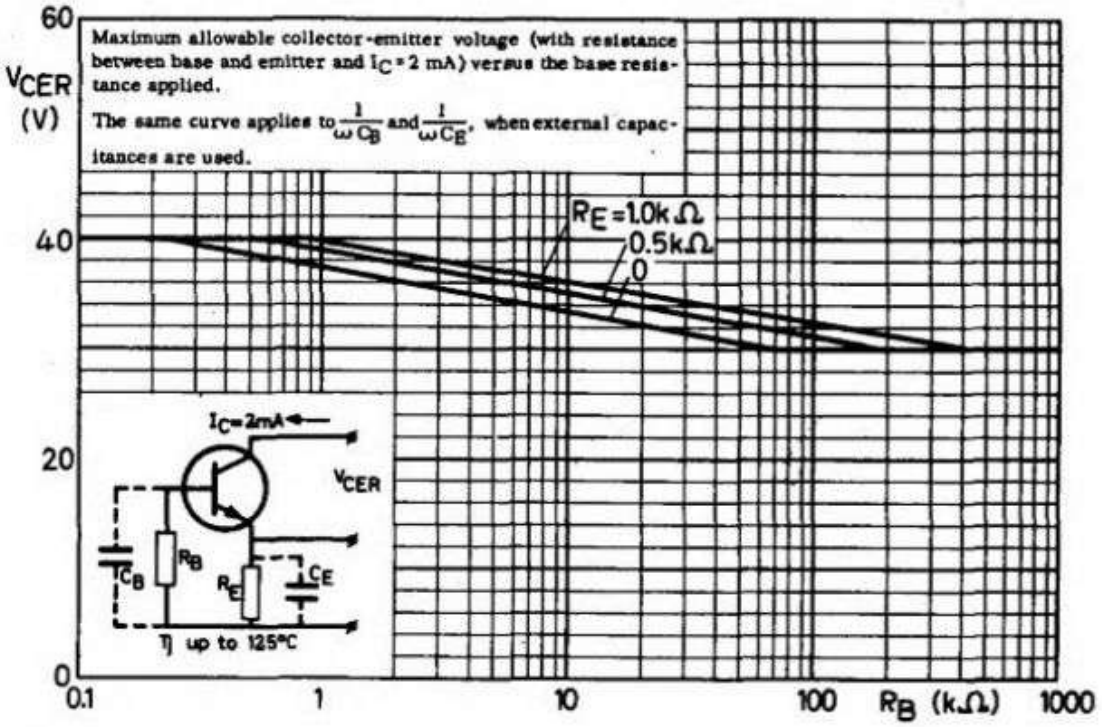
Maximum thickness of printed board = 1·7mm
Recommended hole diameter = 1·0 to 1·1 mm (1·0 to 1·3 mm allowable)

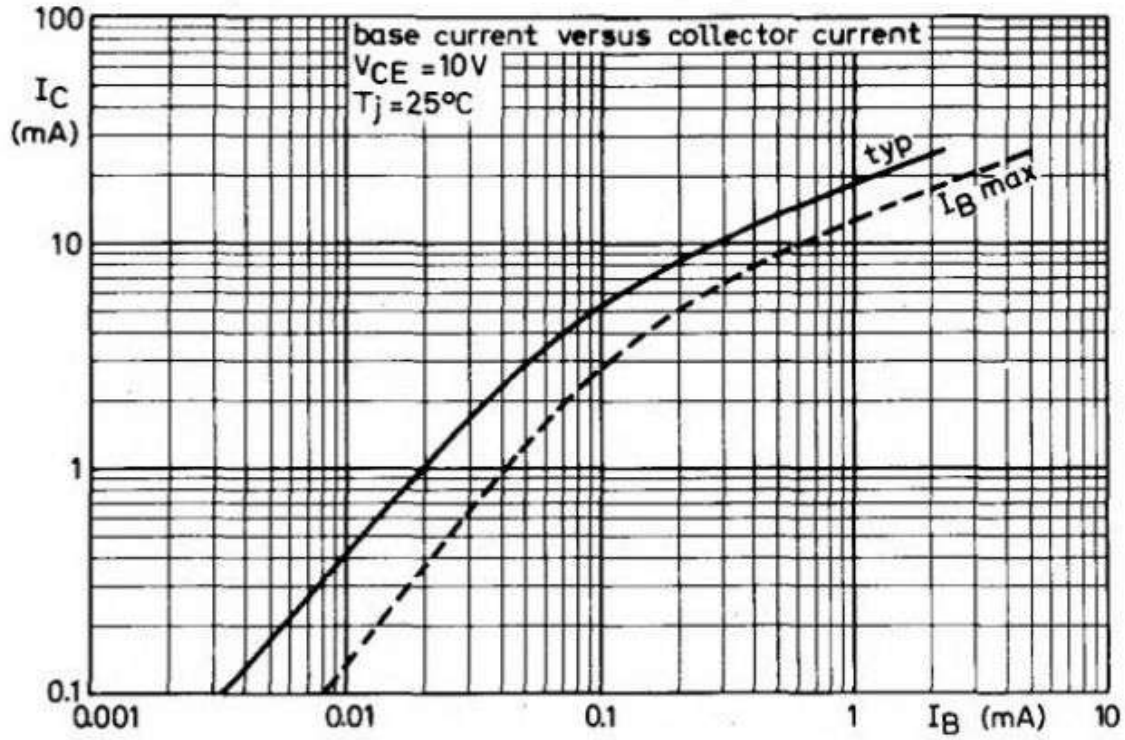


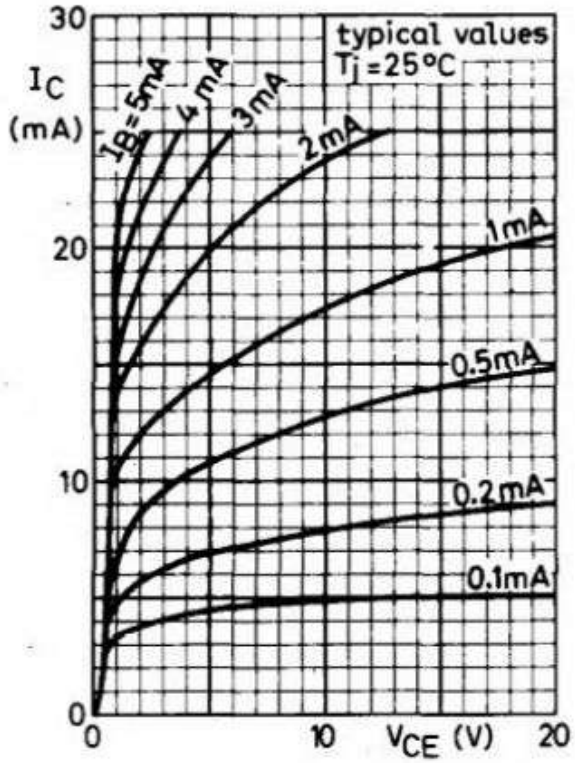
Maximum thickness of printed board = 1·1 mm
Hole diameter = 0·77 to 0·83 mm

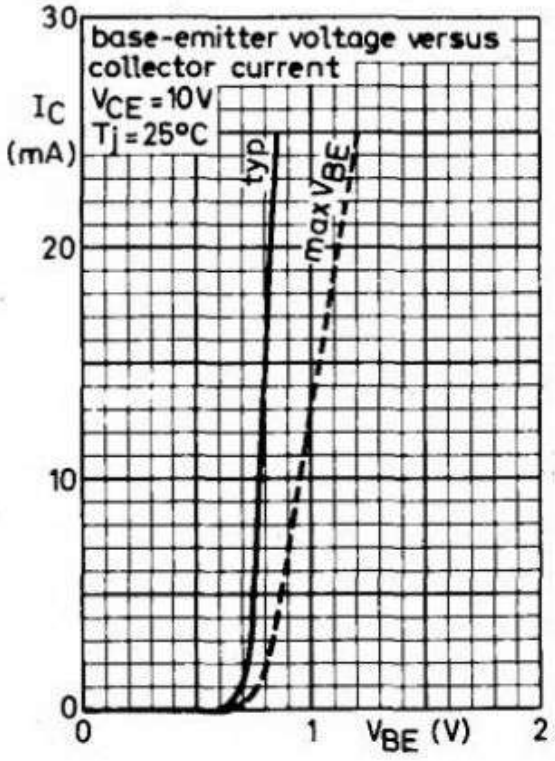
See also General Explanatory Notes, Section IV

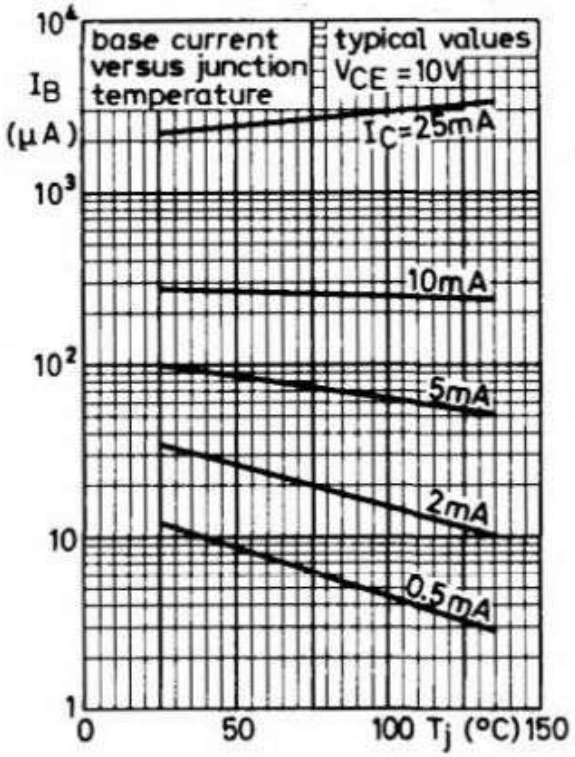

800
P_M
(mW)
600
400
200
0
max. allowable peak power versus time
Tamb = 25°C
50°C
25°C
0
20
40
60
80
100 time (s) 120

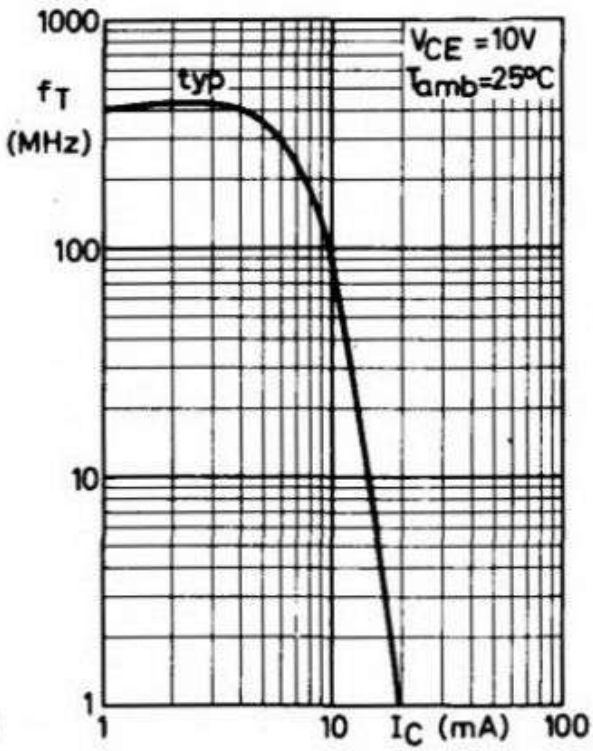

60
V_{CER}
(V)
Maximum allowable collector-emitter voltage (with resistance between base and emitter and I_C = 2 mA) versus the base resistance applied.
The same curve applies to $\frac{1}{\omega C_B}$ and $\frac{1}{\omega C_E}$, when external capacitances are used.
R_E = 1.0kΩ
0.5kΩ
0
40
20
0
I_C = 2mA
V_{CER}
C_B
R_B
R_E
C_E
Tj up to 125°C
0.1
1
10
100
R_B (kΩ)
1000


base current versus collector current
V_{CE} = 10V
T_j = 25°C
I_C (mA)
100
10
1
0.1
typ
I_B max
0.001
0.01
0.1
1
10
I_B (mA)


typical values
T_j = 25°C
I_C (mA)
30
20
10
0
I_B = 5mA
4mA
3mA
2mA
1mA
0.5mA
0.2mA
0.1mA
0
10
20
V_{CE} (V)


base-emitter voltage versus collector current
V_{CE} = 10V
T_j = 25°C
I_C (mA)
30
20
10
0
typ
max V_{BE}
0
1
2
V_{BE} (V)





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 1kΩ (see fig. 1) to minimise the variation of input admittance and output conductance with gain control.

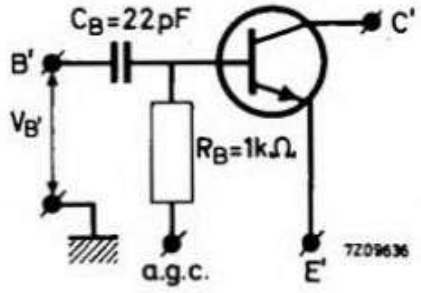
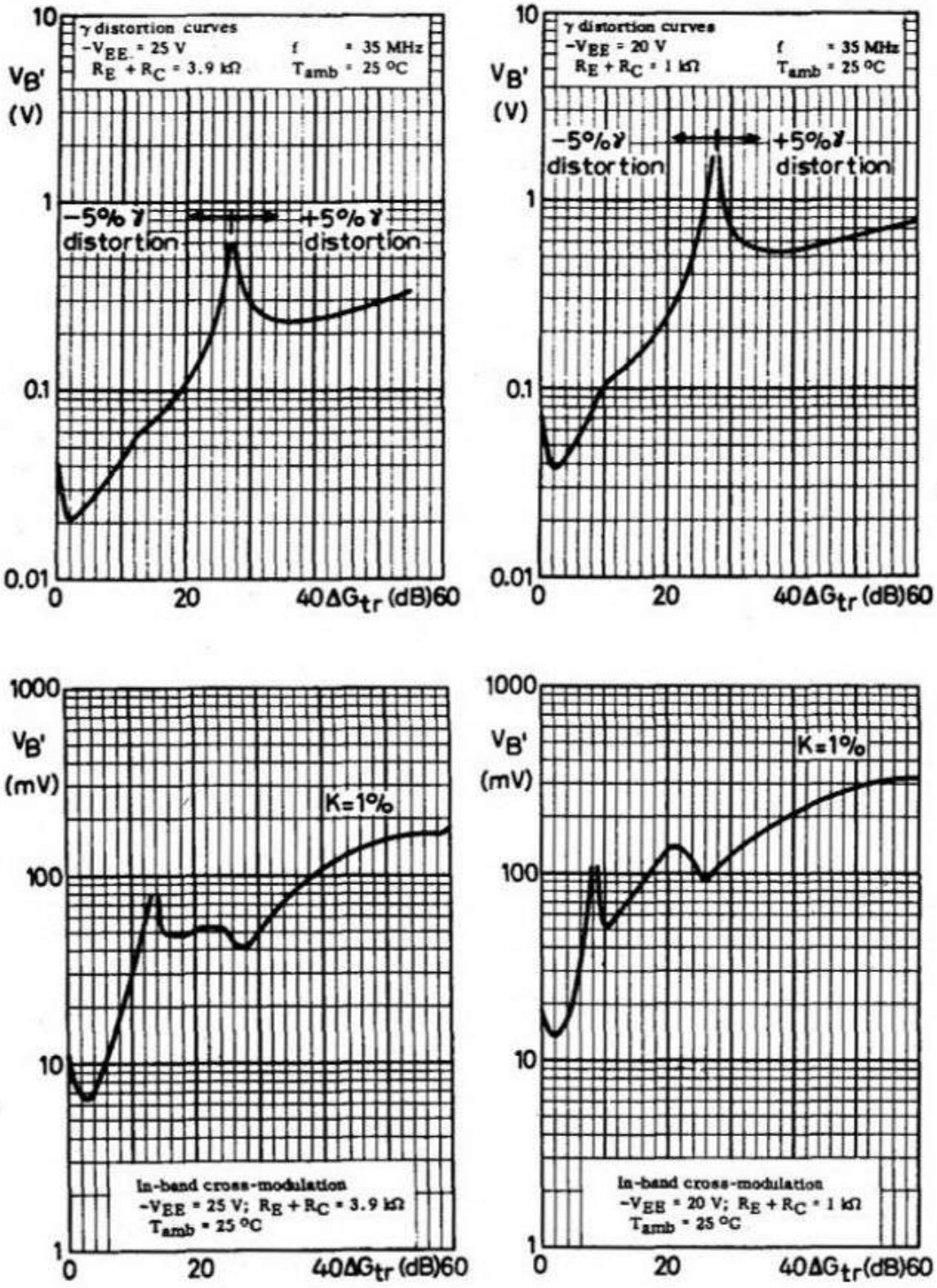


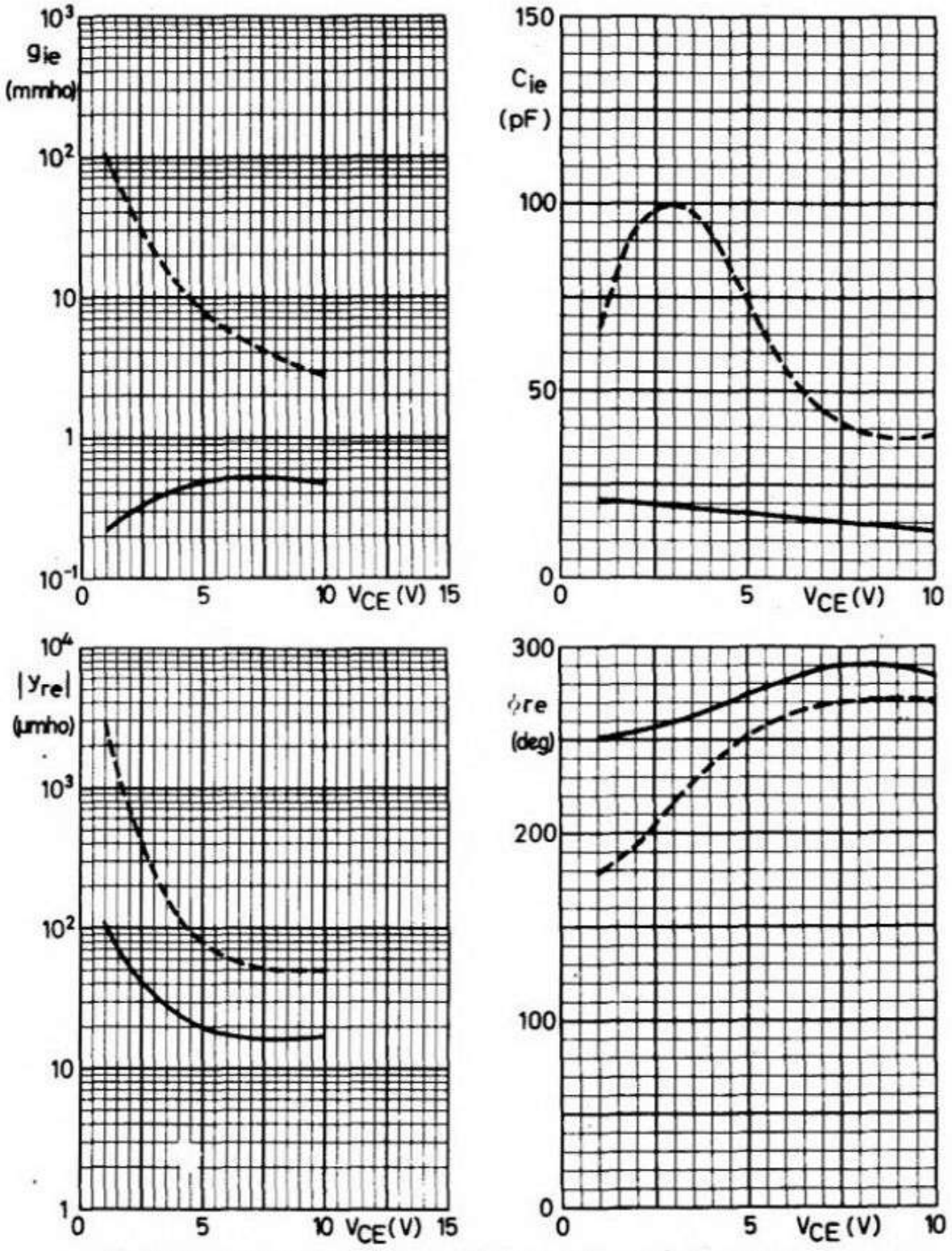
Fig. 1

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)



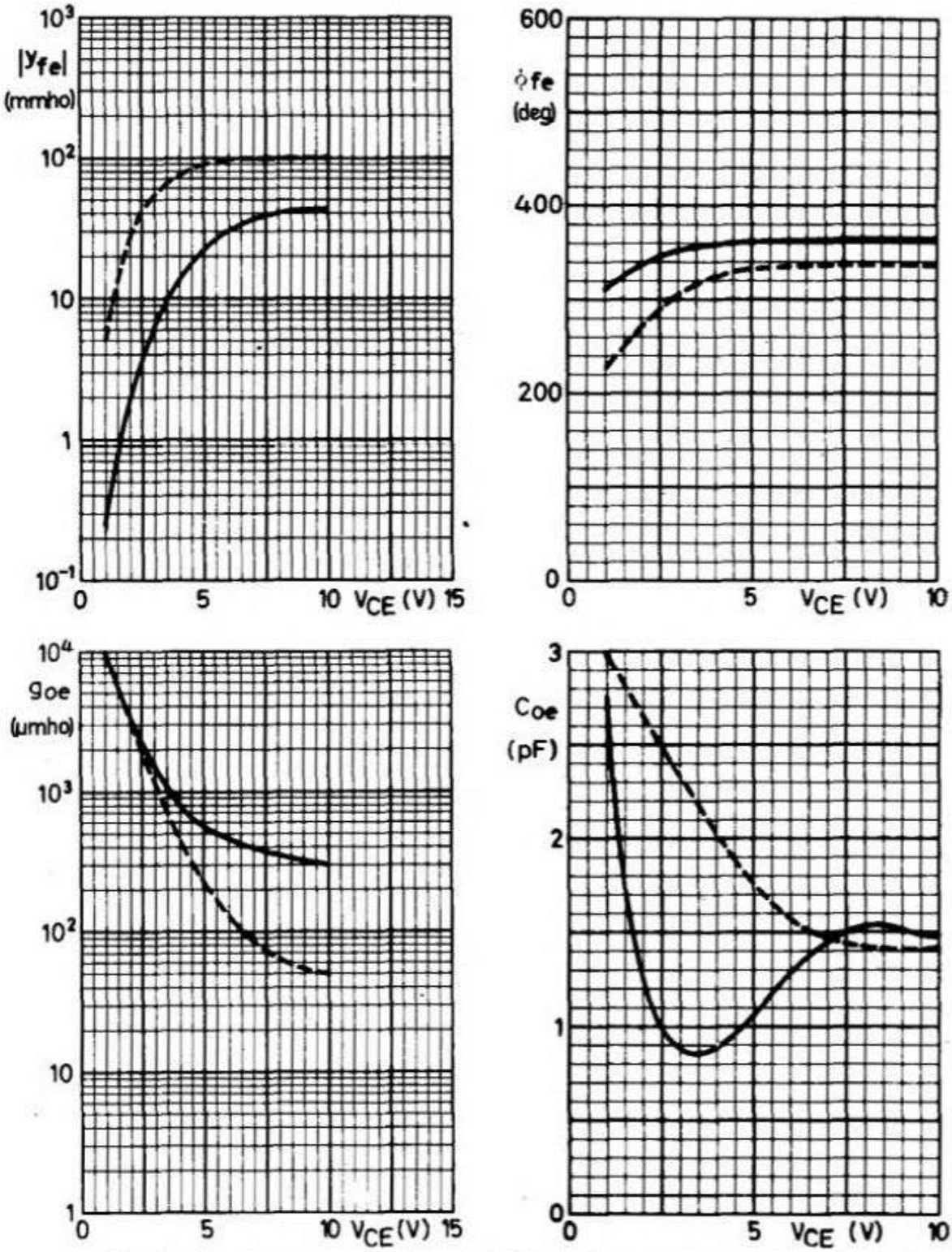
The signal handling capability of the equivalent transistor as a function of gain control.

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



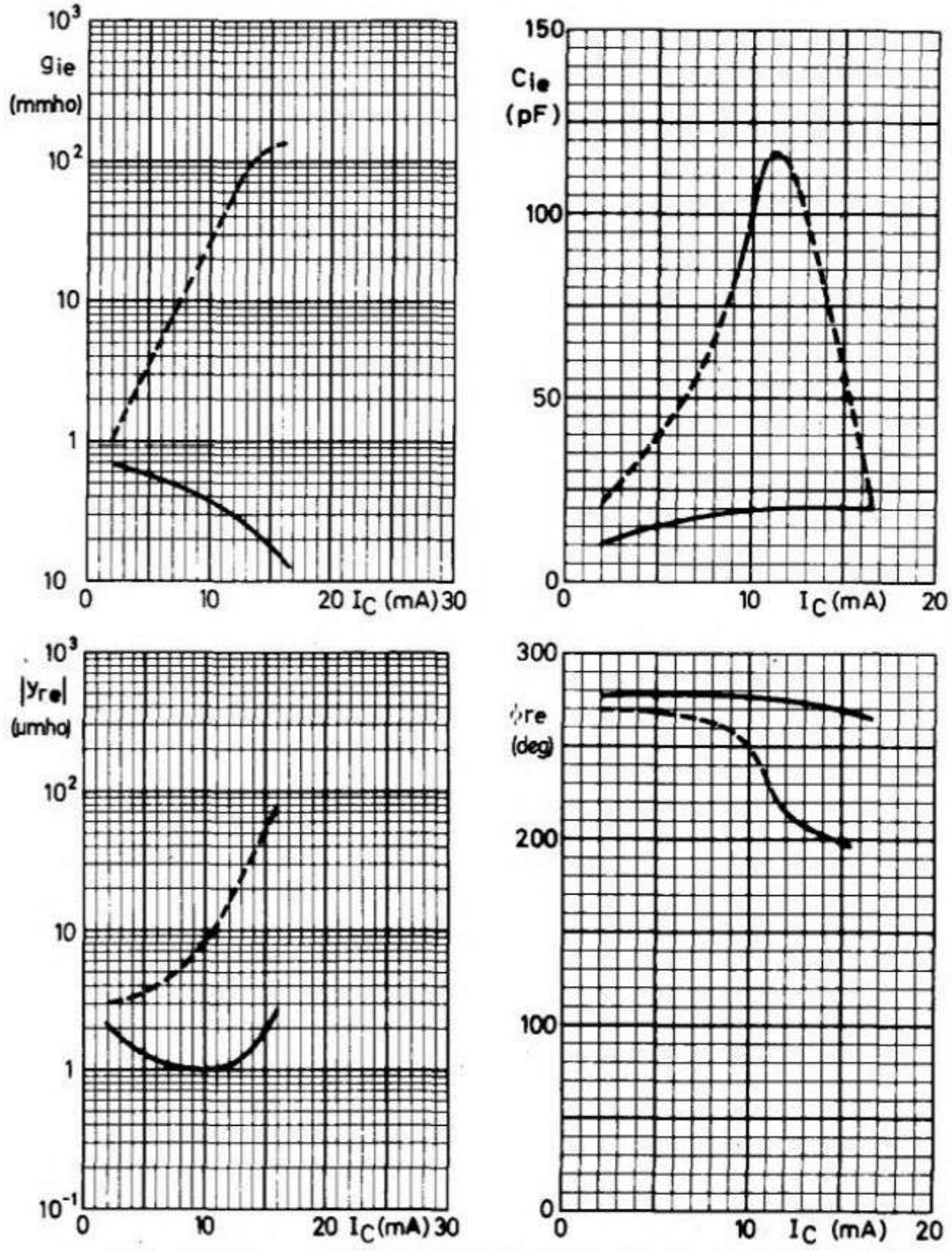
Typical y-parameters of the equivalent gain control transistor, including base capacitor and base resistor as shown on page 7 (dashed curves apply to the transistor only).

Voltage control; $-V_{EE} = 25V$; $R_E + R_C = 3{\cdot}9k\Omega$; $f = 35MHz$



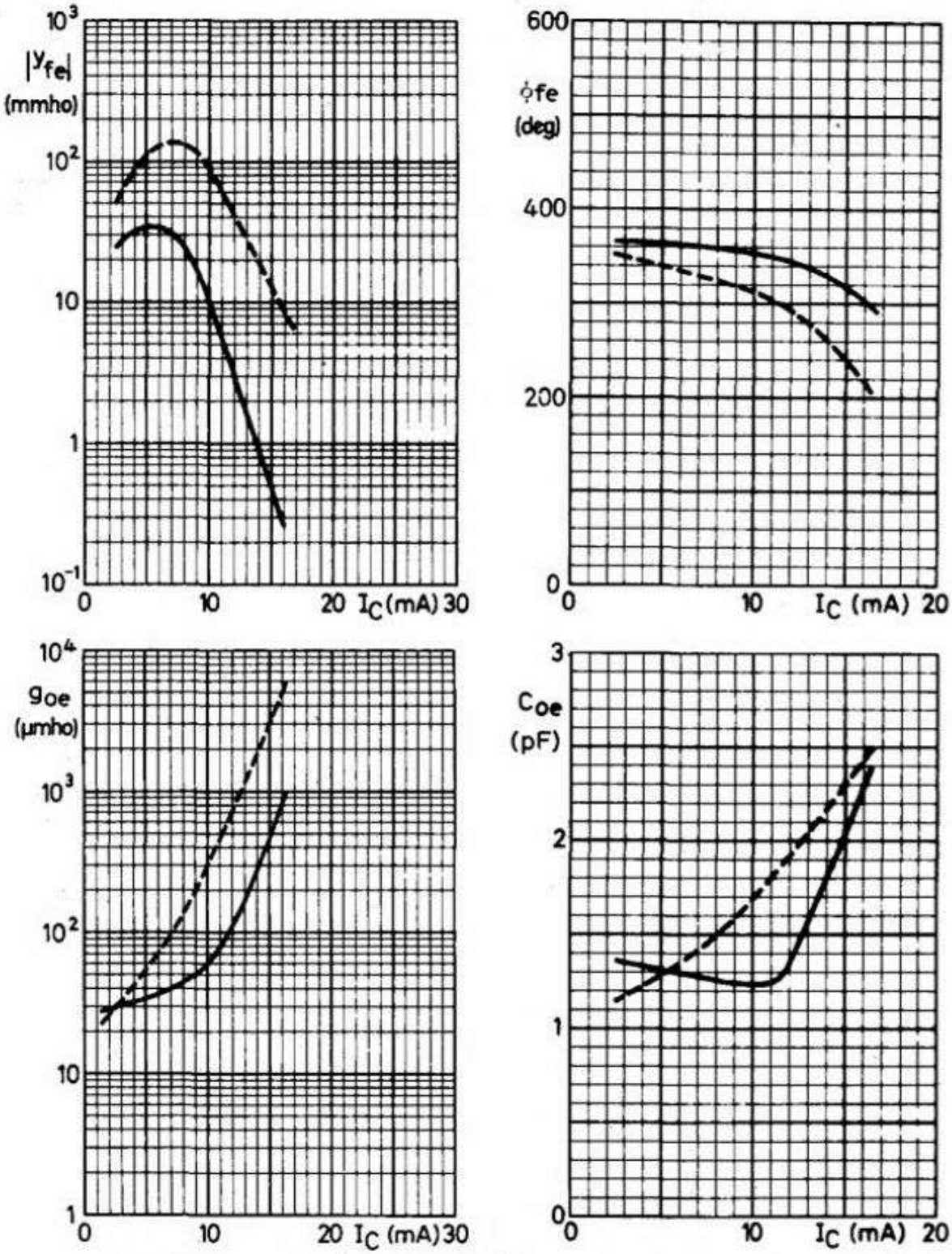
Typical y-parameters of the equivalent gain control transistor, including base capacitor and base resistor as shown on page 7 (dashed curves apply to the transistor only).

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).

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

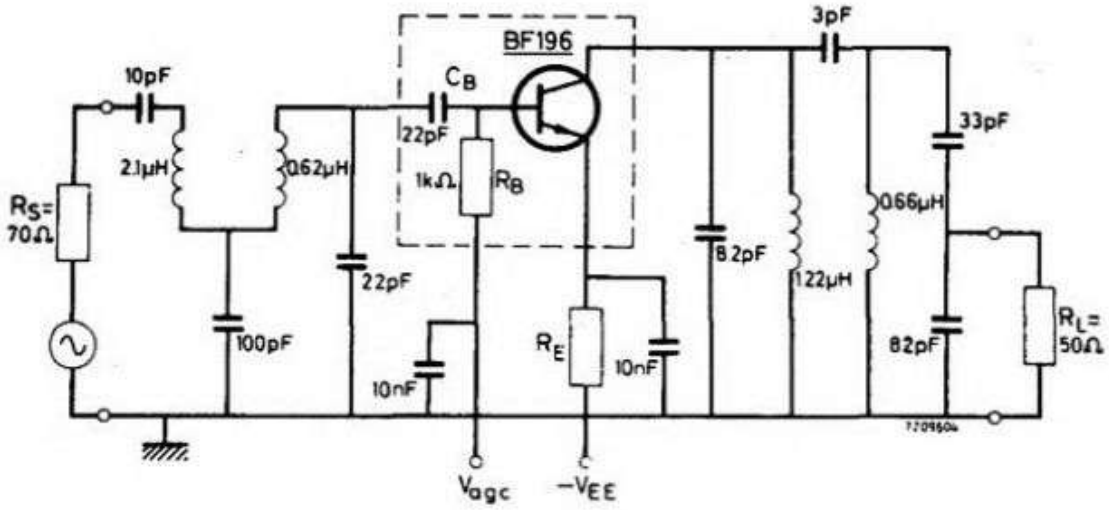


Typical y-parameters of the equivalent gain control transistor, including base capacitor and base resistor as shown on page 7 (dashed curves apply to the transistor only).

APPLICATION INFORMATION

First stage of an i.f. amplifier

Basic circuit with voltage gain control: $R_E + R_C = 3{\cdot}9k\Omega$; $-V_{EE} = 25V$
current gain control: $R_E + R_C = 1k\Omega$; $-V_{EE} = 20V$



G_{tr} Transducer gain — *Typ.*

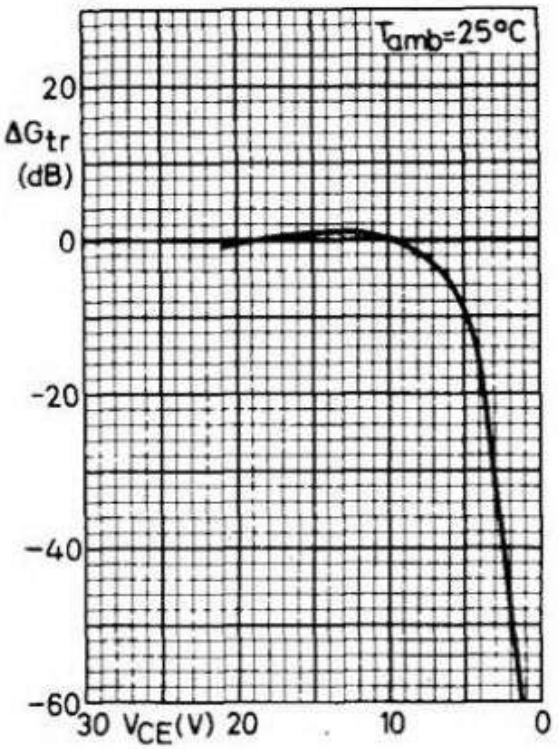
$I_C = 4mA$, $-V_{EE} = 25V$, $R_E + R_C = 3{\cdot}9k\Omega$,
$f = 36{\cdot}4MHz$ — 25·5 dB

$$G_{tr}\,(\text{in dB}) = 10\log \frac{\text{output power in load } R_L}{\text{available power from source } R_S}$$

ΔG_{tr} Gain control range — 60 dB
(see also the upper curves, page 14)

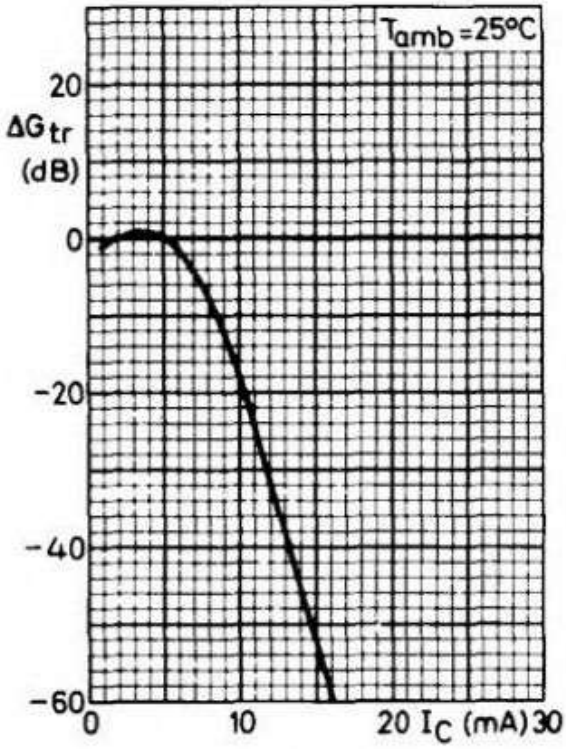
Voltage gain control

(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)