SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a subminiature plastic transfer-moulded T-package primarily intended for use in u.h.f. and microwave amplifiers.

Features of this product:

- low noise;
- very low intermodulation distortion;
- high power gain;
- gold metallization.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	15	V
Collector-emitter voltage (open base)	V_{CEO}	max.	12	V
Collector current (d.c.)	I_C	max.	35	mA
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz I_C = 30 mA; V_{CE} = 5 V	f_T	typ.	6	GHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 5 V; T_{amb} = 25 °C	C_{re}	typ.	0,6	pF
Noise figure at optimum source impedance I_C = 4 mA; V_{CE} = 8 V; f = 800 MHz	F	typ.	1,6	dB
Maximum unilateral power gain I_C = 30 mA; V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C	G_{UM}	typ.	14	dB
Output voltage at d_{im} = −60 dB (see Fig. 3) I_C = 30 mA; V_{CE} = 8 V; R_L = 75 Ω; T_{amb} = 25 °C $f_{(p+q-r)}$ = 793,25 MHz	V_o	typ.	425	mV
Output power at 1 dB gain compression	P_{L1}	typ.	+ 17	dBm ←
Third order intercept point	ITO	typ.	+ 36	dBm ←

MECHANICAL DATA

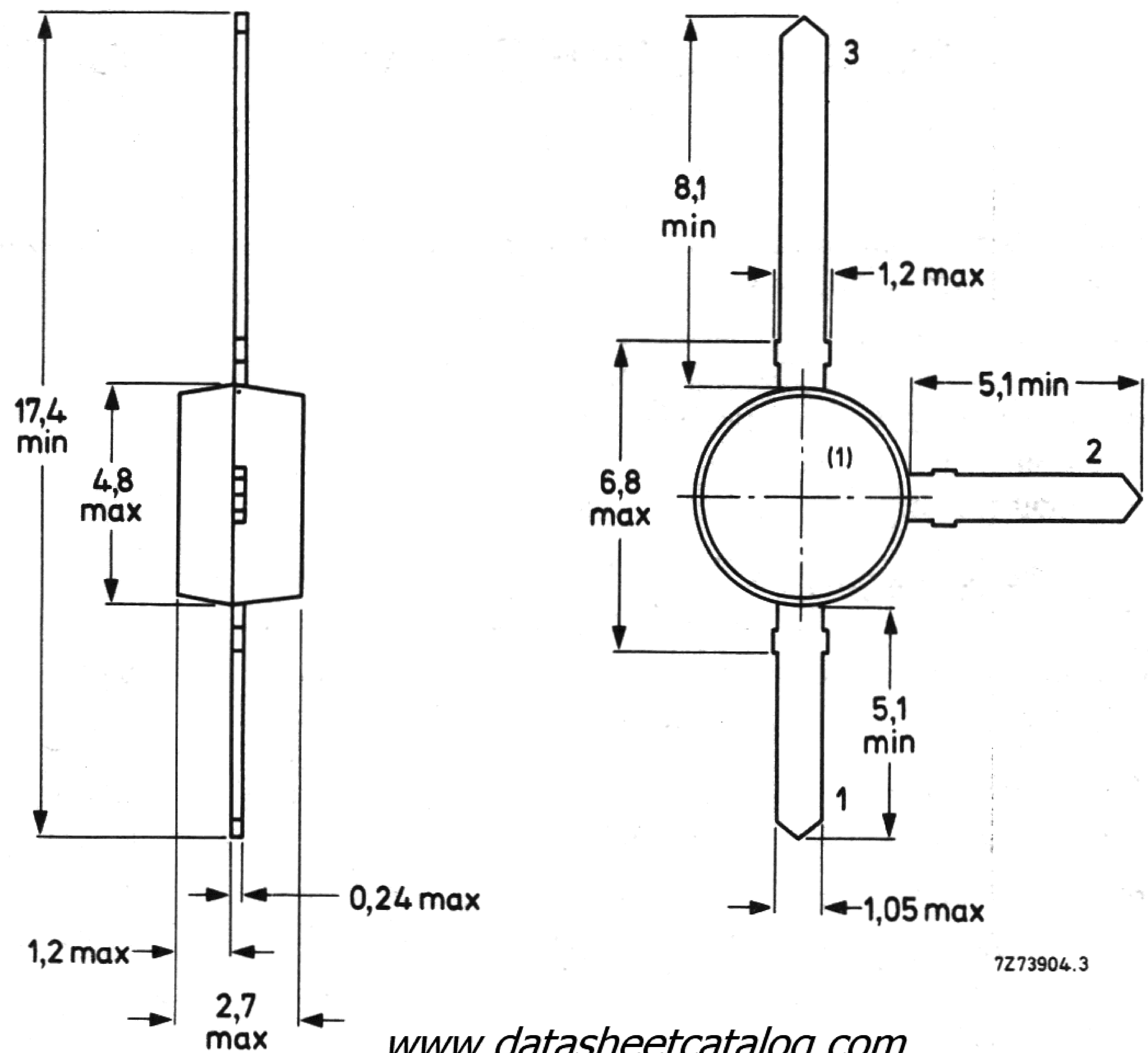
SOT-37 (see Fig. 1).

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-37.

Connections
1. Base
2. Emitter
3. Collector



(1) = type number marking.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	15	V
Collector-emitter voltage (open base)	V_{CEO}	max.	12	V
Emitter-base voltage (open collector)	V_{EBO}	max.	2,0	V
Collector current (d.c.)	I_C	max.	35	mA
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	300	mW
Storage temperature	T_{stg}	−65 to +	150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on a fibre-glass print (see Fig. 2) of 40 mm x 25 mm x 1 mm — $R_{th\ j\text{-}a}$ = 300 K/W

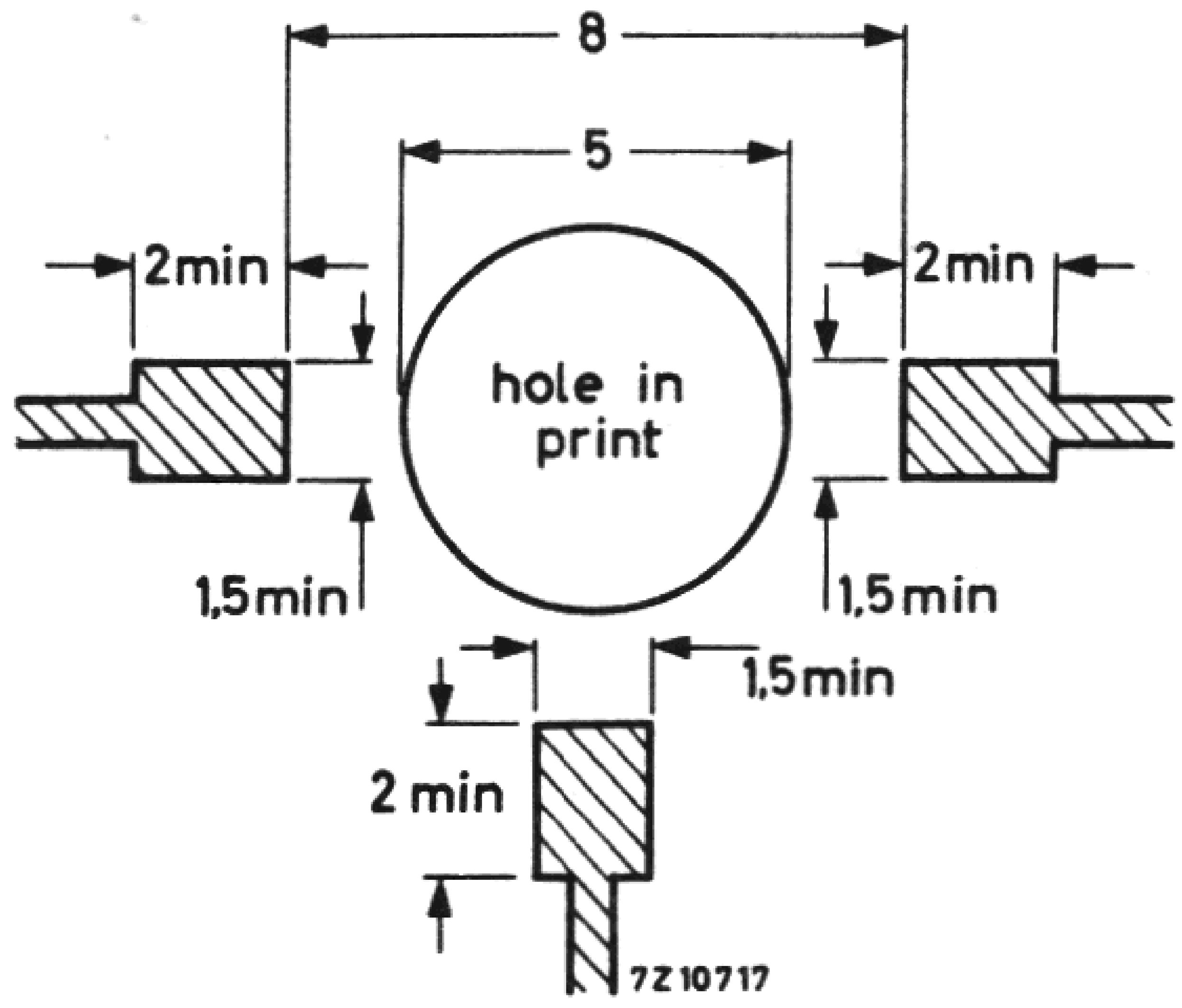


Fig. 2 Requirements for fibre-glass print. (Dimensions in mm.)

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; $V_{CB} = 5$ V	I_{CBO}	<	50 nA
D.C. current gain* $I_C = 30$ mA; $V_{CE} = 5$ V	h_{FE}	> typ.	40 90
Transition frequency at f = 500 MHz* $I_C = 30$ mA; $V_{CE} = 5$ V	f_T	typ.	6 GHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $V_{CB} = 5$ V	C_c	typ.	0,9 pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; $V_{EB} = 0,5$ V	C_e	typ.	2,5 pF
Feedback capacitance at f = 1 MHz $I_C = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C	C_{re}	typ.	0,6 pF
Noise figure at optimum source impedance $I_C = 4$ mA; $V_{CE} = 8$ V; f = 800 MHz $I_C = 30$ mA; $V_{CE} = 8$ V; f = 800 MHz	 F F	 typ. typ.	 1,6 dB 2,3 dB

Maximum unilateral power gain (s_{re} assumed to be zero)

$$G_{UM} \text{ (in dB)} = 10 \log \frac{|s_{fe}|^2}{(1-|s_{ie}|^2)\,(1-|s_{oe}|^2)}$$

$I_C = 30$ mA; $V_{CE} = 8$ V; f = 800 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	14 dB

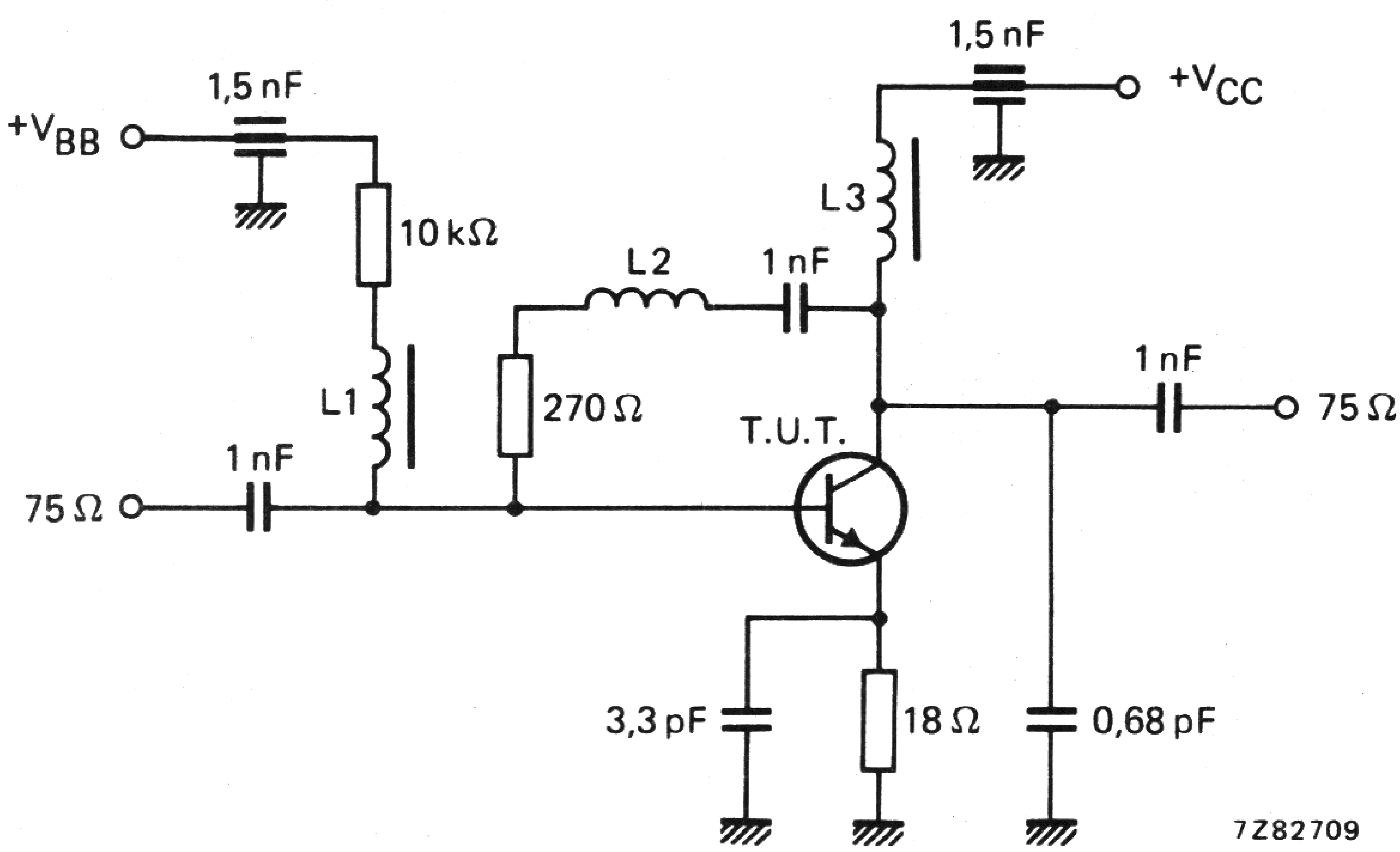
* Measured under pulse conditions.

Output voltage at d_{im} = −60 dB (see Figs 3 and 14)
(DIN 45004B, par. 6.3: 3-tone)
I_C = 30 mA; V_{CE} = 8 V; R_L = 75 Ω; T_{amb} = 25 °C
$V_p = V_o$ at d_{im} = −60 dB; f_p = 795,25 MHz
$V_q = V_o$ −6 dB ; f_q = 803,25 MHz
$V_r = V_o$ −6 dB ; f_r = 805,25 MHz
Measured at $f_{(p+q-r)}$ = 793,25 MHz — V_o typ. 425 mV

Output voltage at d_2 = −50 dB (see Figs 3 and 15)
I_C = 30 mA; V_{CE} = 8 V; R_L = 75 Ω; T_{amb} = 25 °C
$V_p = V_o$ at d_2 = −50 dB; f_p = 250 MHz
$V_q = V_o$ at d_2 = −50 dB; f_q = 560 MHz
measured at $f_{(p+q)}$ = 810 MHz — V_o typ. 200 mV

→ Output power at 1 dB gain compression (see Fig. 3)
I_C = 30 mA; V_{CE} = 8V
R_L = 75 Ω; T_{amb} = 25 °C
measured at f = 800 MHz — P_{L1} typ. + 17 dBm

→ Third order intercept point (see Fig. 3)
I_C = 30 mA; V_{CE} = 8 V
R_L = 75 Ω; T_{amb} = 25 °C
P_p = ITO − 6 dB; f_p = 800 MHz
P_q = ITO − 6 dB; f_q = 801 MHz
measured at $f_{(2q-p)}$ = 802 MHz and
at $f_{(2p-q)}$ = 799 MHz — ITO typ. + 36 dBm



→ Fig. 3 Intermodulation distortion and second harmonic distortion test circuit.

L1 = L3 = 5 μH micro choke
L2 = 3 turns Cu wire (0,4 mm); internal diameter 3 mm; winding pitch 1 mm

s-parameters (common emitter) at V_{CE} = 8 V.

The figures given in the tables below can also be used for operation at V_{CE} = 5 V. Only slight differences for the s-parameters may occur.

I_C mA	f MHz	s_{ie}	s_{re}	s_{fe}	s_{oe}
	40	0,89/ −12,9°	0,01/75°	9,5/166°	0,97/ −6,1°
	100	0,85/ −30,7°	0,03/70,6°	8,7/155°	0,94/−13,5°
	200	0,75/ −57,1°	0,05/61,5°	7,4/138°	0,87/−22,5°
2	500	0,48/−113°	0,08/50,9°	4,4/106°	0,72/−34,2°
	800	0,37/−153°	0,09/51,9°	3,0/ 86,3°	0,64/−40,0°
	1000	0,34/−178°	0,10/55,0°	2,6/ 77,0°	0,61/−47,8°
	1200	0,34/+ 159°	0,11/58,5°	2,2/ 68,0°	0,58/−53,9°
	40	0,79/ −18,4°	0,01/74°	17,8/162°	0,94/ −9,1°
	100	0,71/ −42,1°	0,03/67,1°	15,2/146°	0,87/−19,5°
	200	0,57/ −72,8°	0,04/60,0°	11,5/126°	0,75/−28,7°
5	500	0,31/−127°	0,07/60,1°	5,8/ 98,2°	0,59/−36,1°
	800	0,25/−168°	0,09/63,6°	3,8/ 82,0°	0,54/−41,0°
	1000	0,25/+ 165°	0,11/65,2°	3,2/ 74,4°	0,51/−46,7°
	1200	0,26/+ 141°	0,13/66,1°	2,7/ 66,7°	0,49/−52,2°
	40	0,67/ −25,3°	0,01/71°	27,9/156°	0,90/−12,8°
	100	0,55/ −55,1°	0,02/65,1°	21,8/136°	0,78/−25,6°
	200	0,40/ −88,2°	0,04/62,4°	14,7/116°	0,62/−33,4°
10	500	0,20/−141°	0,06/68,3°	6,7/ 93,0°	0,51/−35,9°
	800	0,16/+ 177°	0,09/70,0°	4,3/ 79,3°	0,48/−40,3°
	1000	0,18/+ 151°	0,12/69,7°	3,5/ 72,5°	0,46/−44,2°
	1200	0,21/+ 130°	0,14/68,9°	3,0/ 65,1°	0,43/−50,7°
	40	0,51/ −34,7°	0,01/69°	39,7/149°	0,84/−17,4°
	100	0,38/ −70,5°	0,02/65,8°	27,7/126°	0,66/−29,5°
20	200	0,26/−104°	0,03/68,0°	16,8/109°	0,51/−32,5°
	500	0,16/−158°	0,06/74,0°	7,3/ 89,3°	0,45/−33,4°
	800	0,14/+ 155°	0,10/73,6°	4,6/ 77,5°	0,42/−39,1°
	1000	0,17/+ 133°	0,12/72,3°	3,8/ 71,2°	0,41/−43,6°
	1200	0,21/+ 115°	0,14/70,5°	3,2/ 64,4°	0,39/−51,0°
	40	0,46/ −36,5°	0,01/73°	43,3/150°	0,87/−16,9°
	100	0,32/ −73,7°	0,02/69,2°	29,1/124°	0,66/−27,2°
	200	0,20/−109°	0,03/72,0°	17,1/106°	0,50/−28,1°
30	500	0,14/−174°	0,06/75,6°	7,4/ 87,2°	0,41/−31,7°
	800	0,15/+ 143°	0,10/74,7°	4,8/ 74,9°	0,39/−41,0°
	1000	0,17/+ 124°	0,12/72,9°	3,9/ 70,5°	0,38/−42,8°
	1200	0,21/+ 111°	0,15/71,0°	3,3/ 63,8°	0,37/−51,0°

Conditions for Figs 4 and 5:
V_{CE} = 8 V; I_C = 30 mA;
T_{amb} = 25 °C.

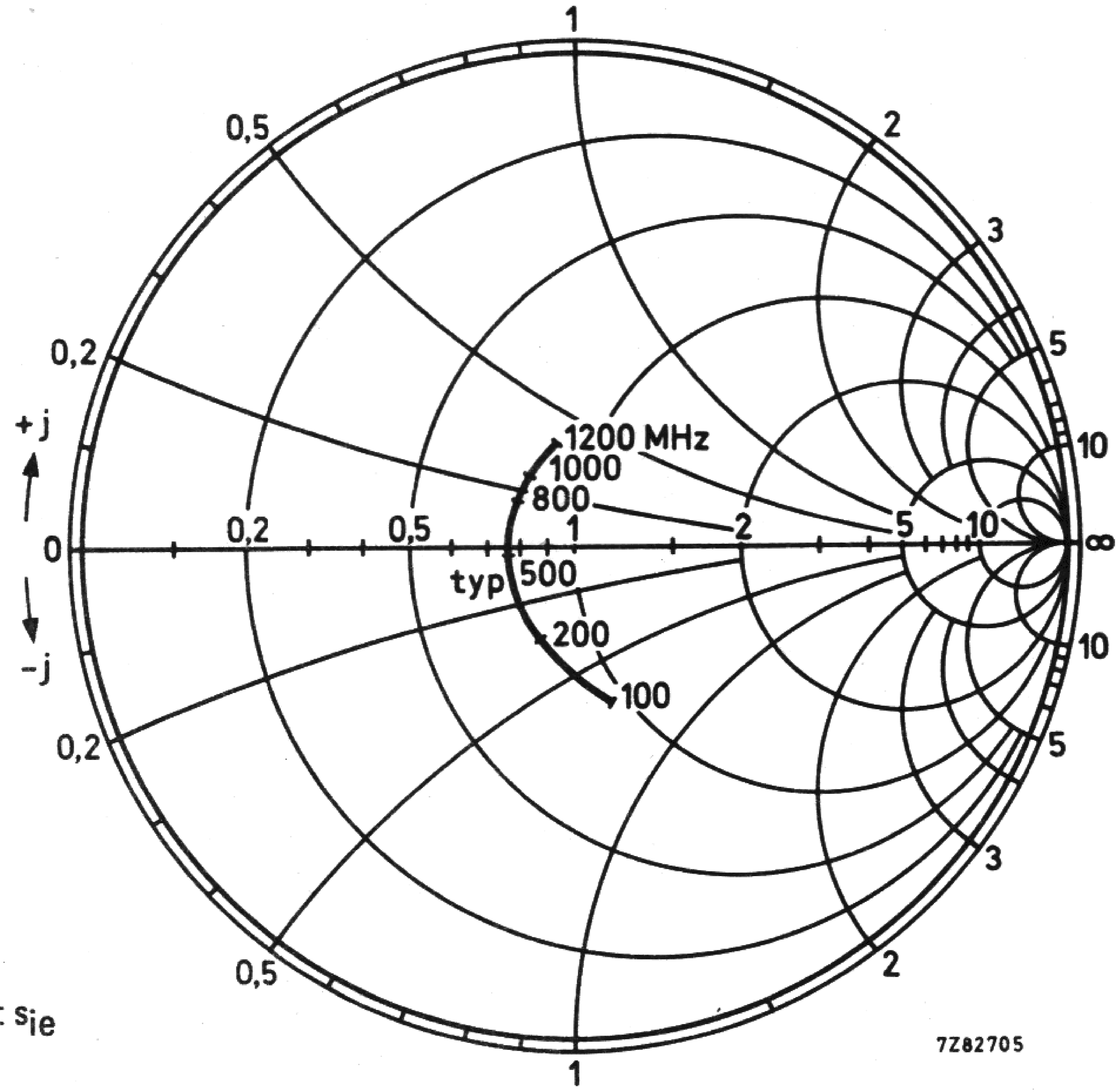


Fig. 4 Input impedance derived from input reflection coefficient s_{ie} co-ordinates in ohm x 50.

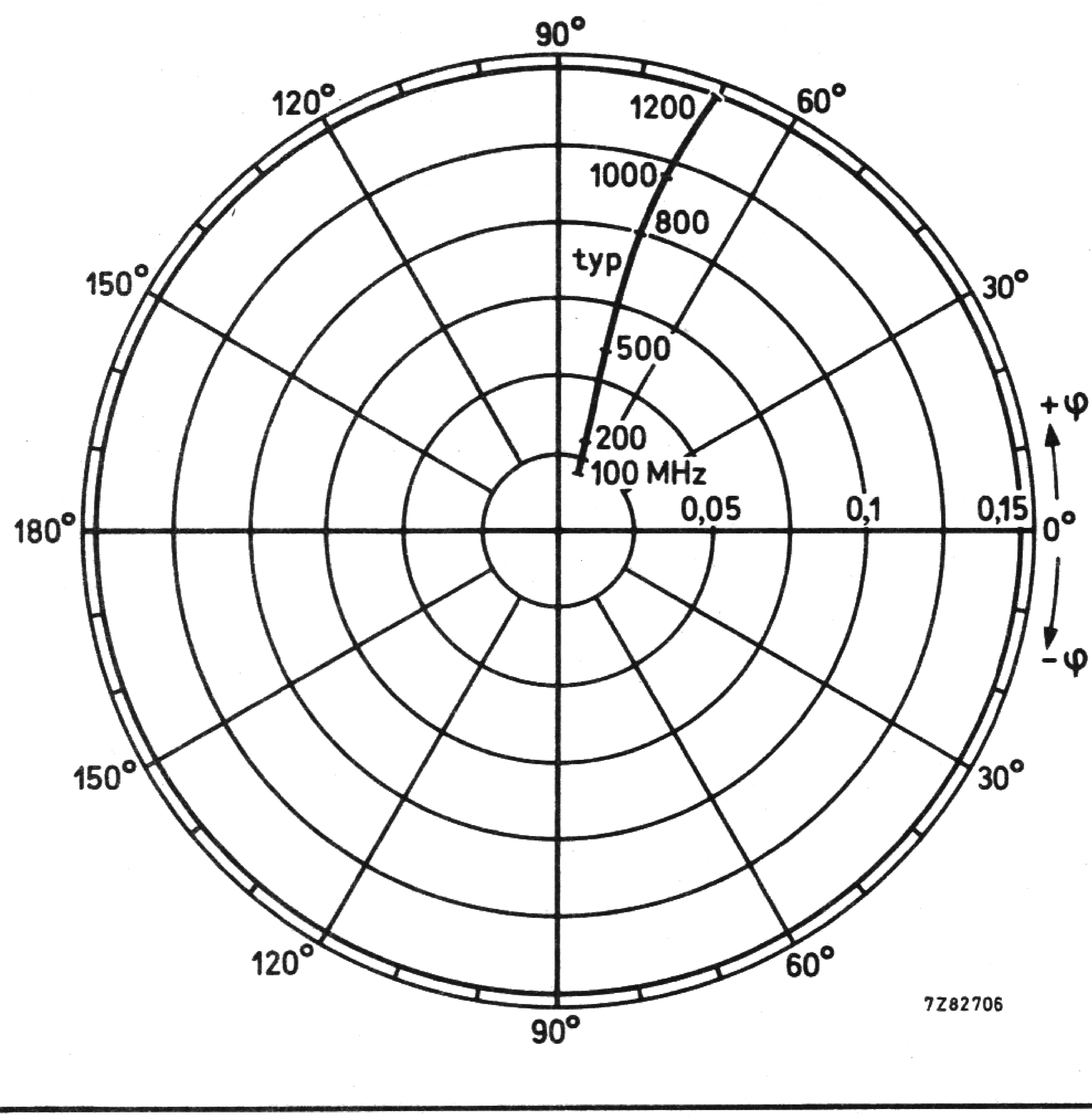


Fig. 5 Reverse transmission coefficient s_{re}.

Conditions for Figs 6 and 7:
V_{CE} = 8 V; I_C = 30 mA;
T_{amb} = 25 °C.

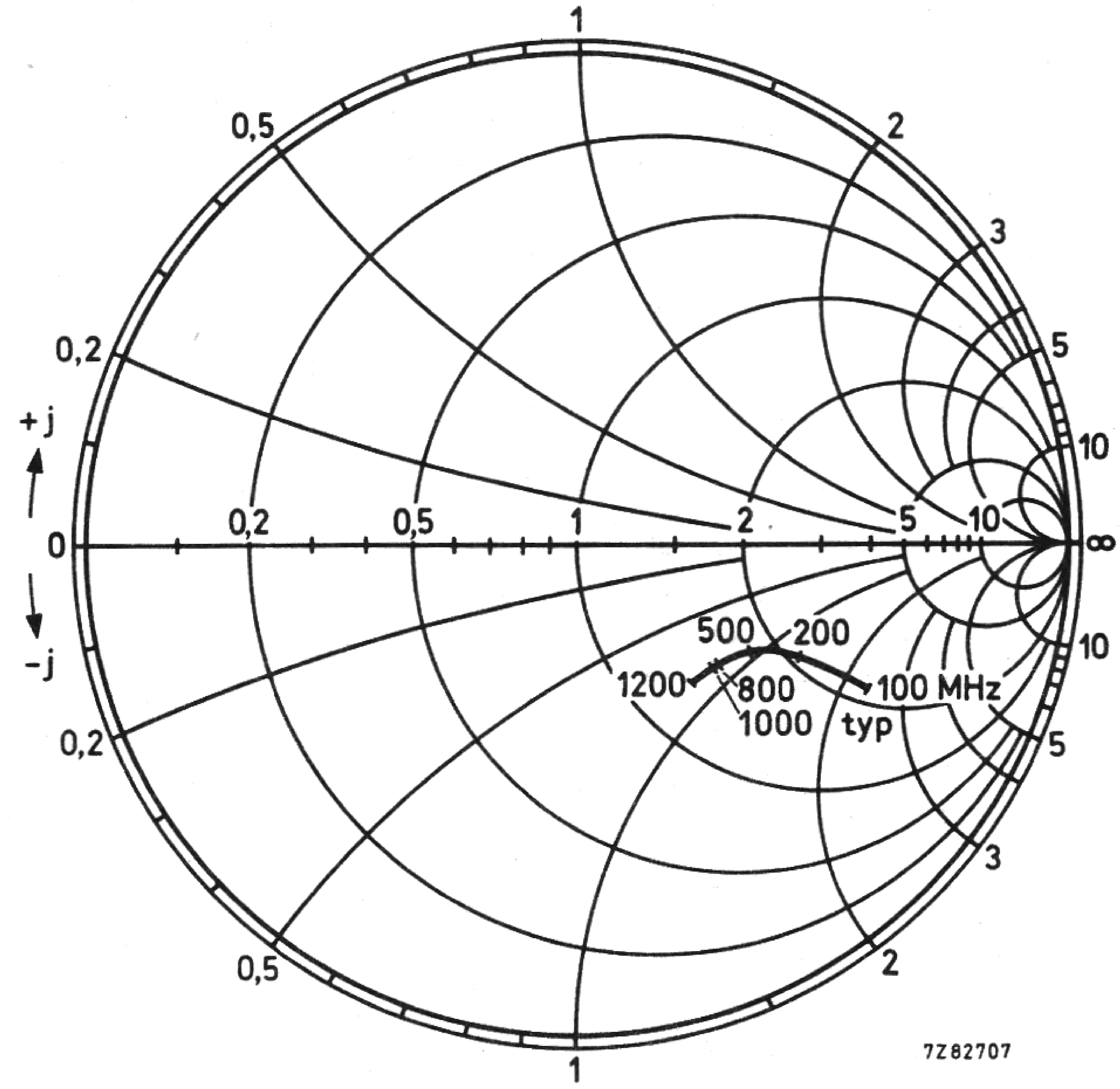


Fig. 6 Output impedance derived from output reflection coefficient s_{oe} co-ordinates in ohm x 50.

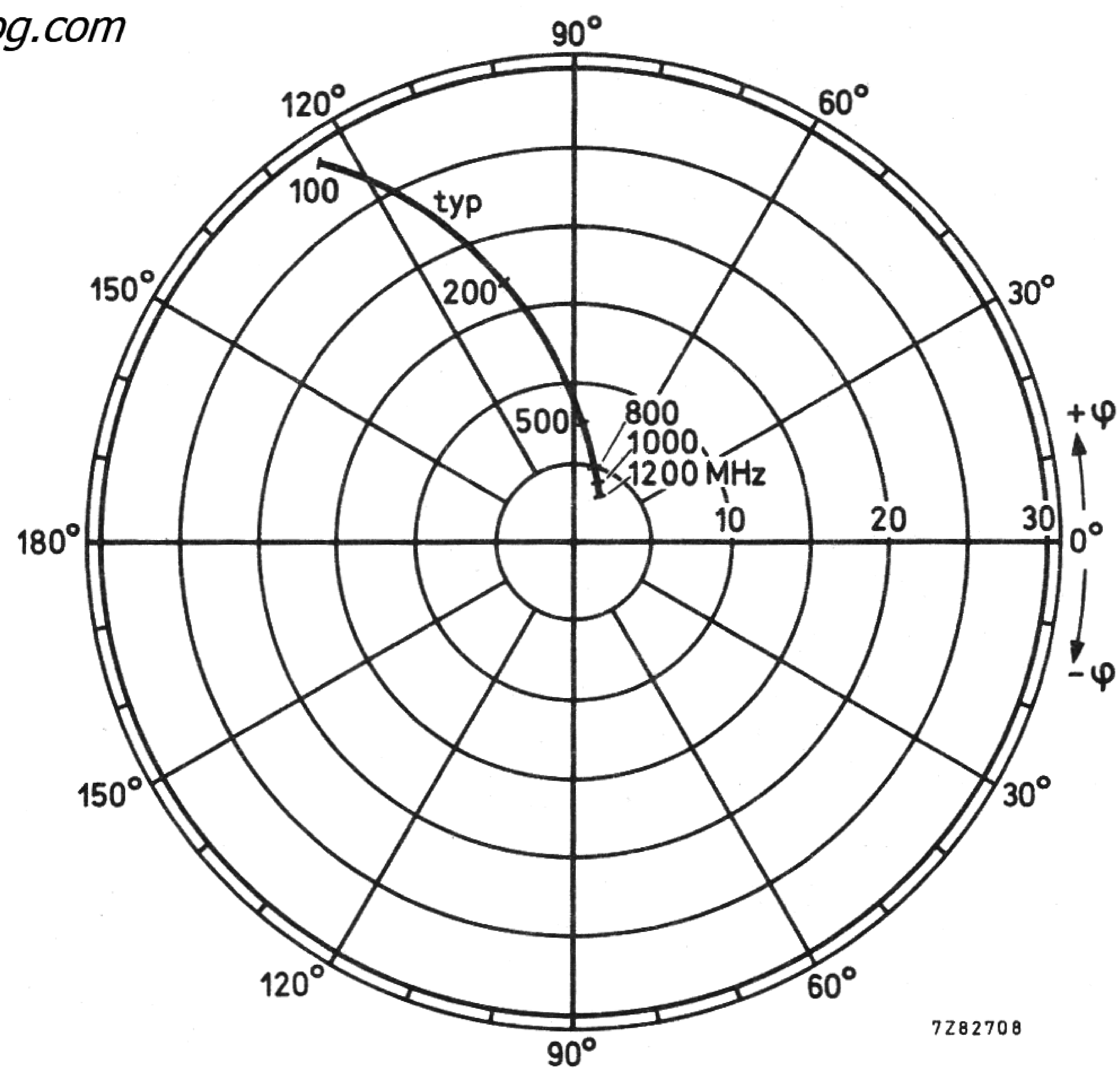


Fig. 7 Forward transmission coefficient s_{fe}.

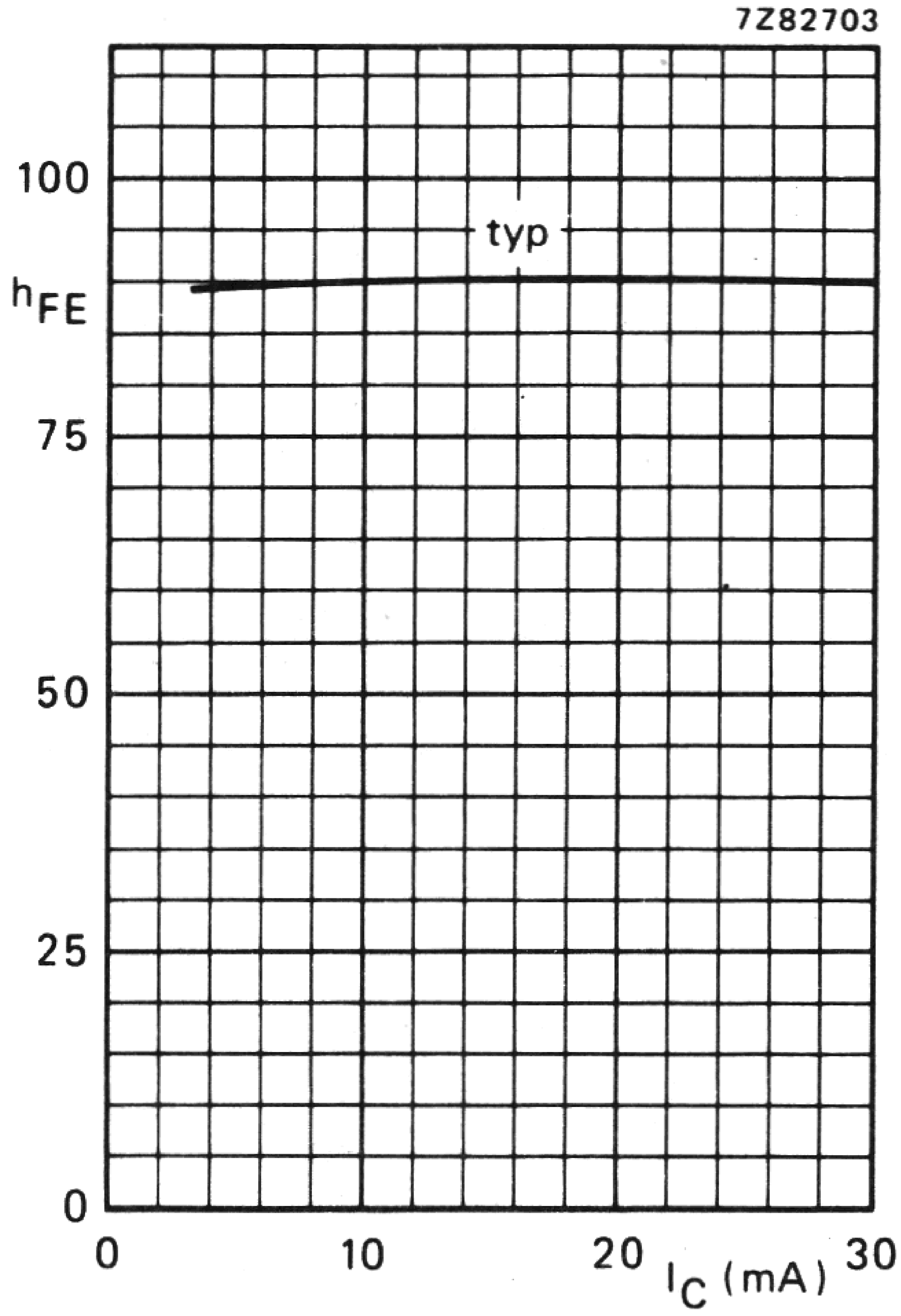


Fig. 8 V_{CE} = 5 V; T_j = 25 °C.

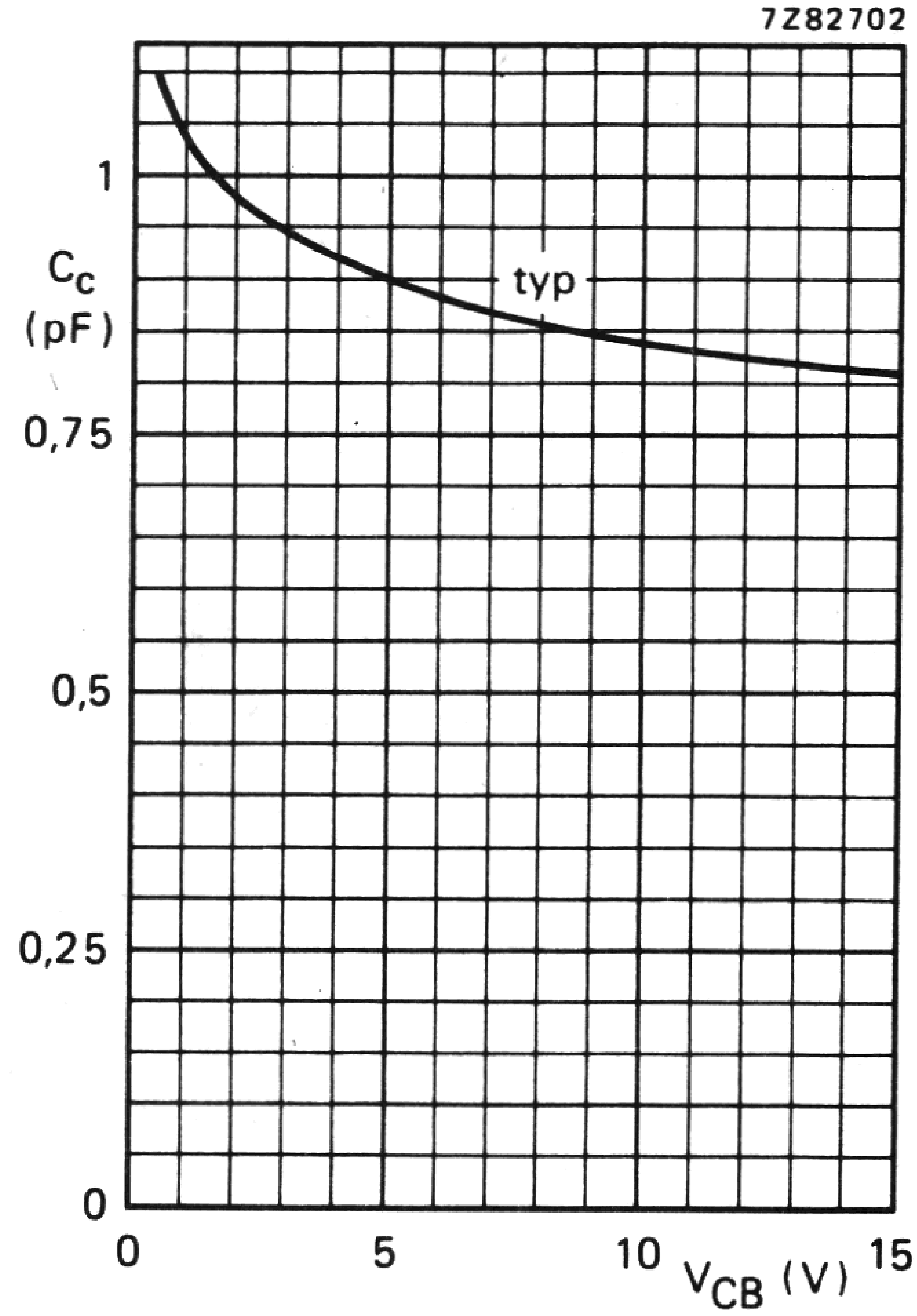


Fig. 9 $I_E = I_e = 0$; f = 1 MHz; T_j = 25 °C.

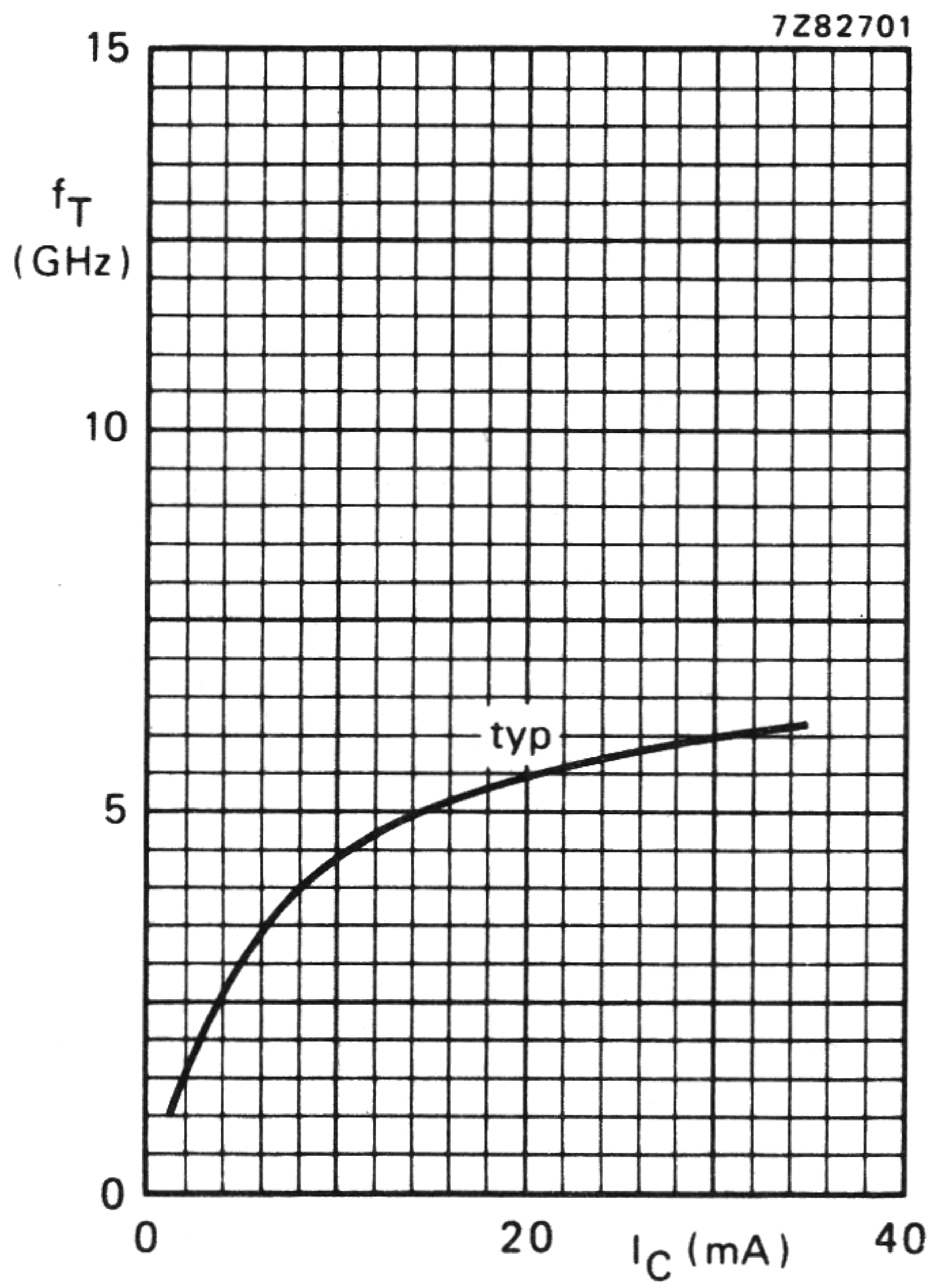


Fig. 10 V_{CE} = 5 V; f = 500 MHz; T_j = 25 °C.

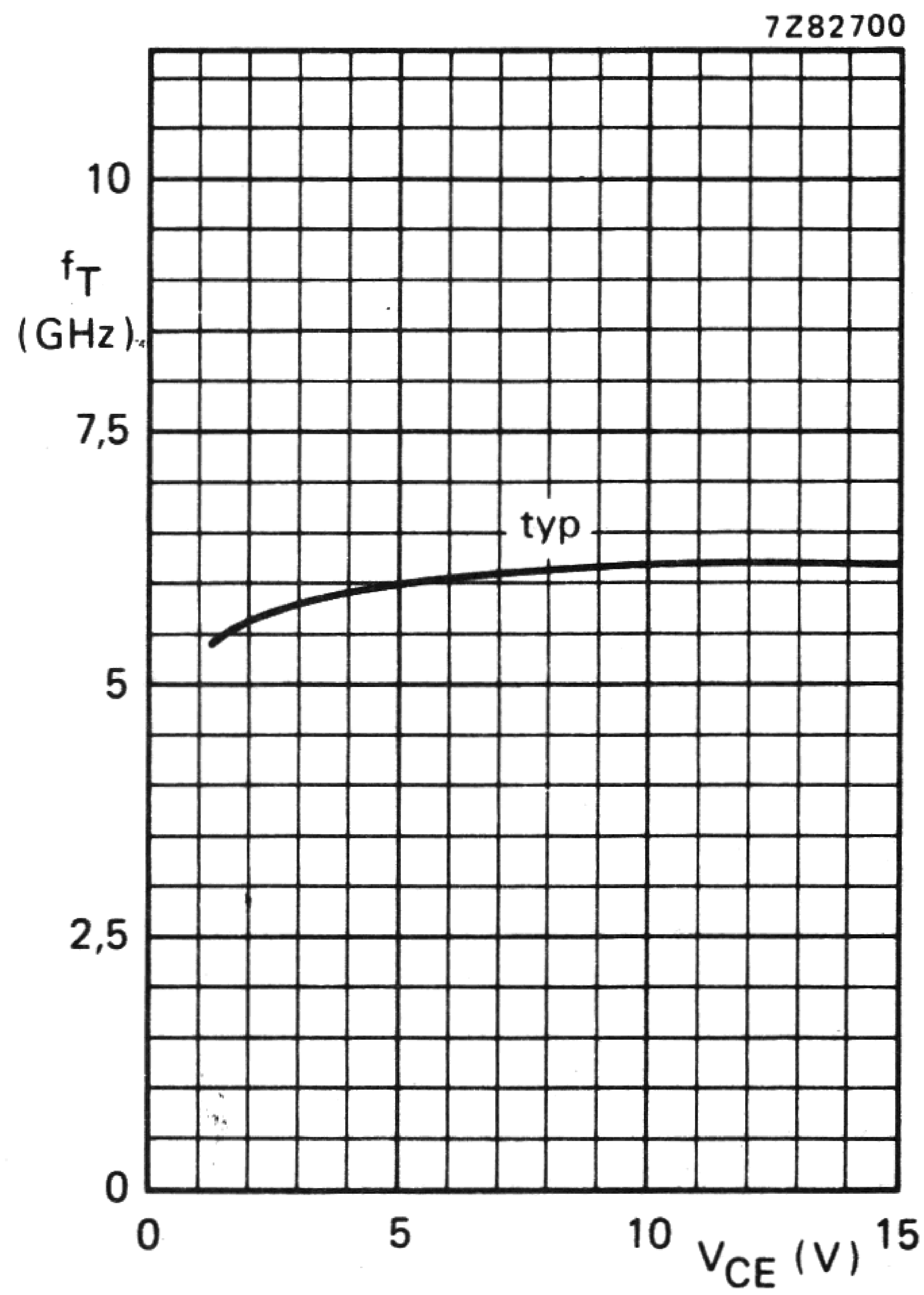


Fig. 11 I_C = 30 mA; f = 500 MHz; T_j = 25 °C.

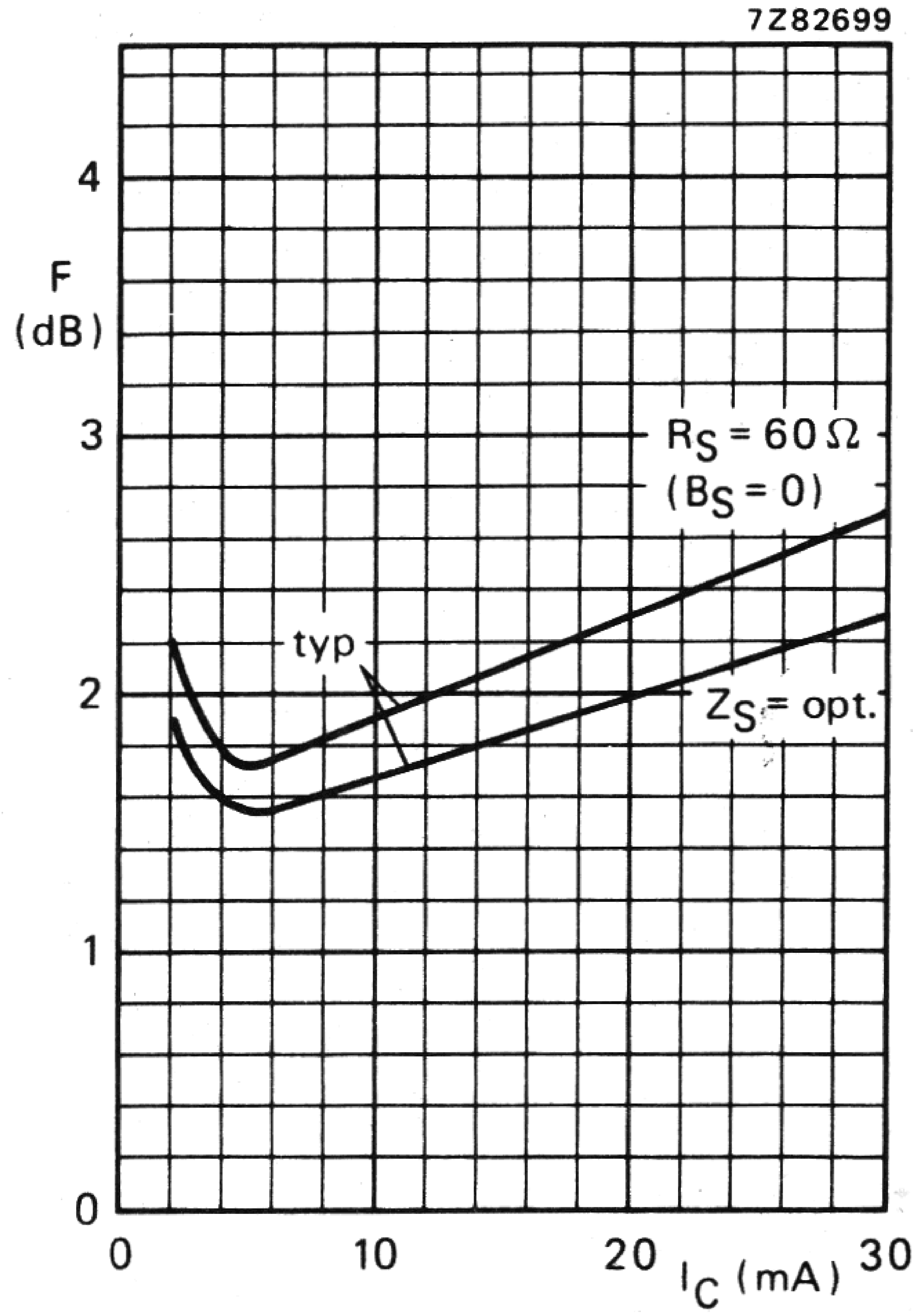


Fig. 12 V_{CE} = 8 V; f = 800 MHz; T_{amb} = 25 °C.

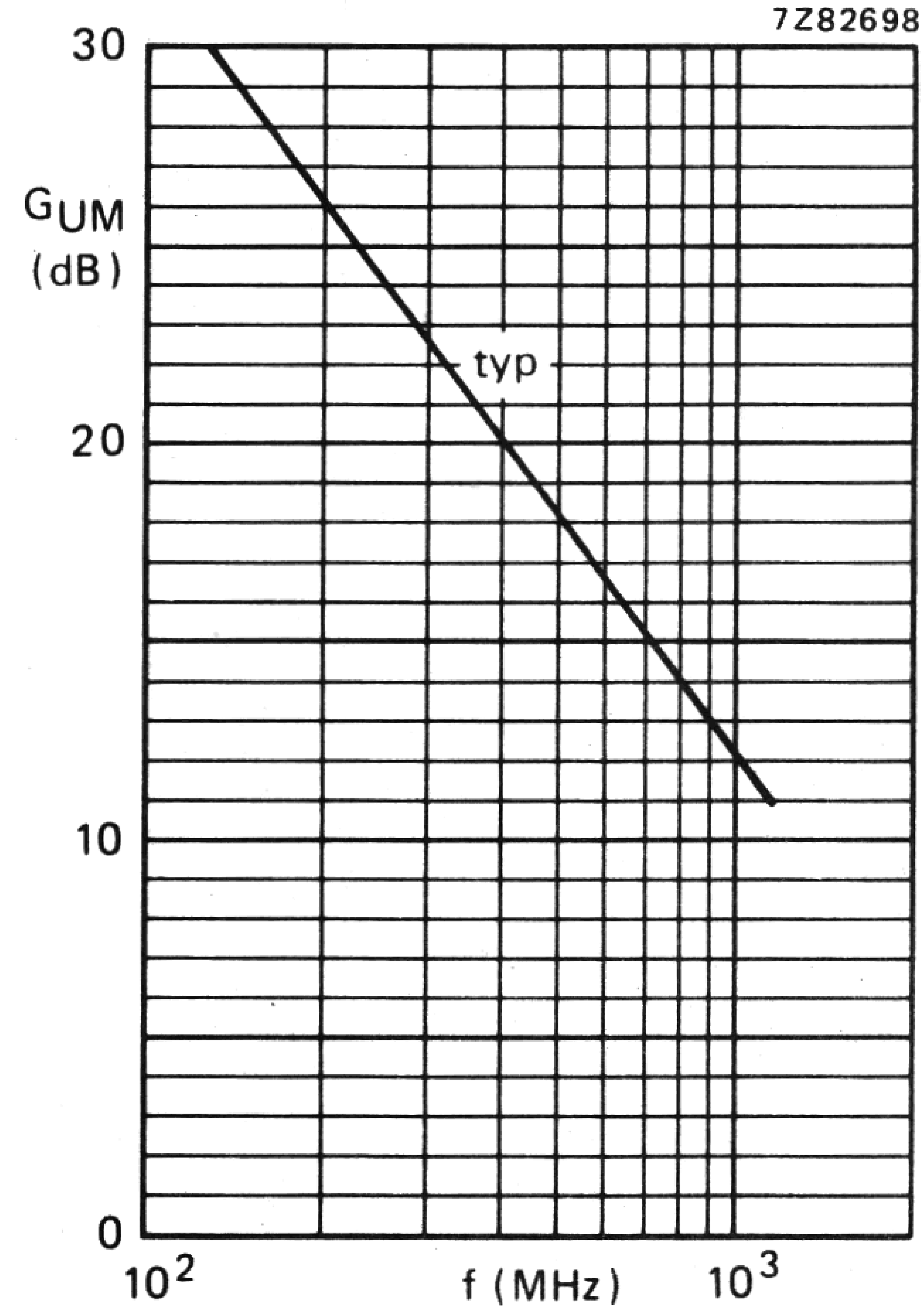


Fig. 13 V_{CE} = 8 V; I_C = 30 mA; T_{amb} = 25 °C.

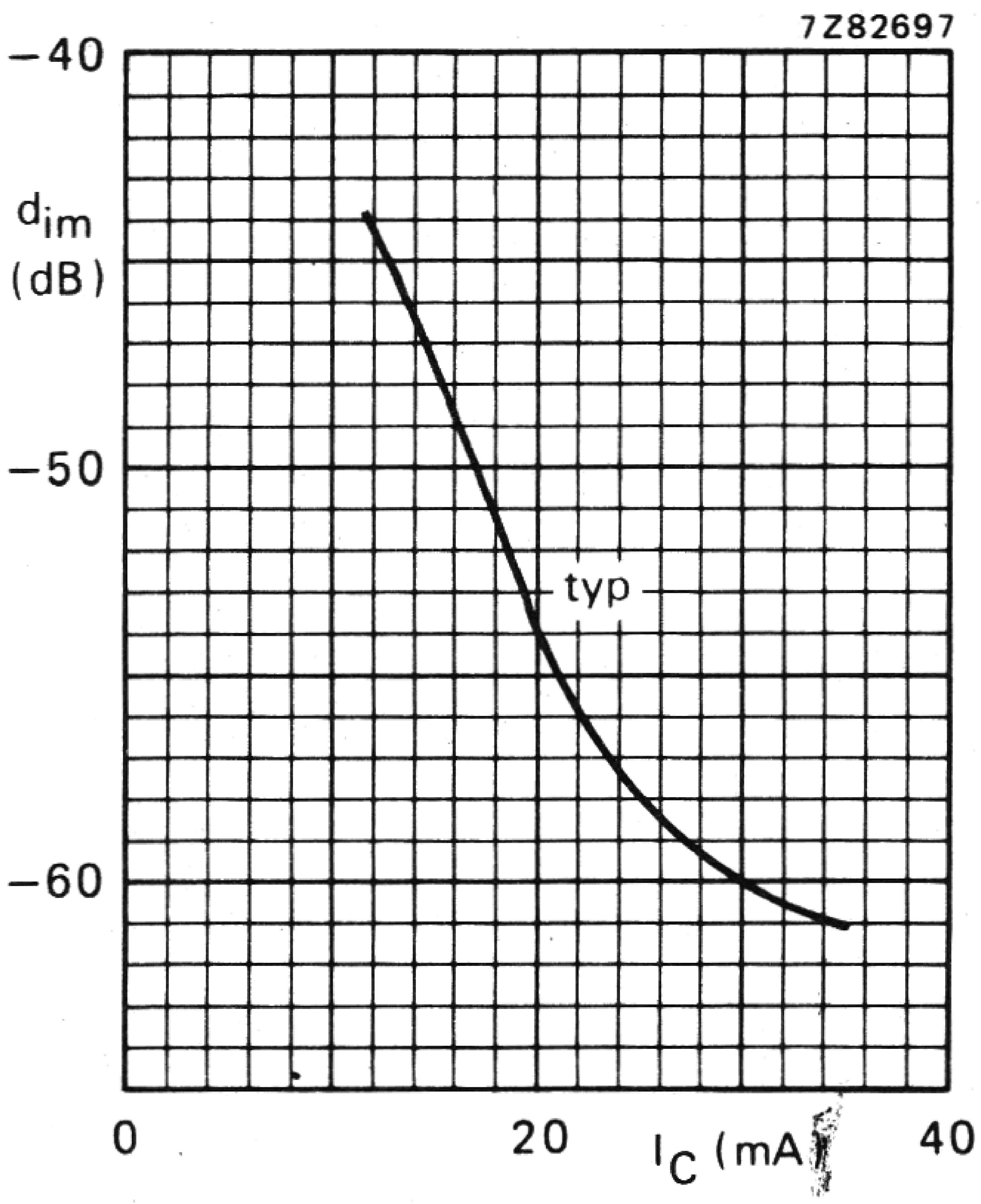


Fig. 14 V_{CE} = 8 V; V_o = 425 mV = 52,6 dBmV; $f_{(p+q-r)}$ = 793,25 MHz; T_{amb} = 25 °C; measured in test circuit (see Fig. 3).

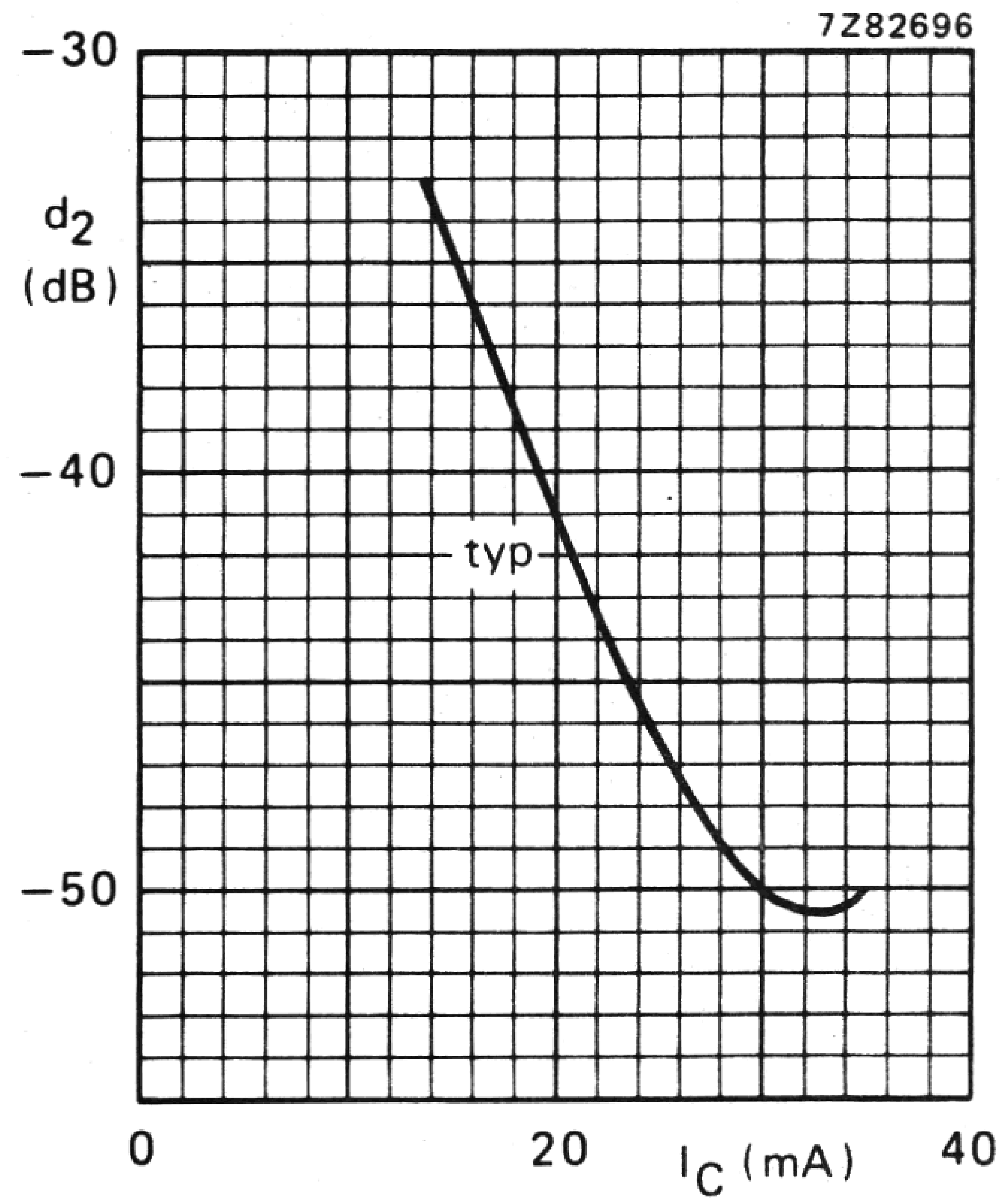


Fig. 15 V_{CE} = 8 V; V_o = 200 mV = 46 dBmV; $f_{(p+q)}$ = 810 MHz; T_{amb} = 25 °C; measured in test circuit (see Fig. 3).

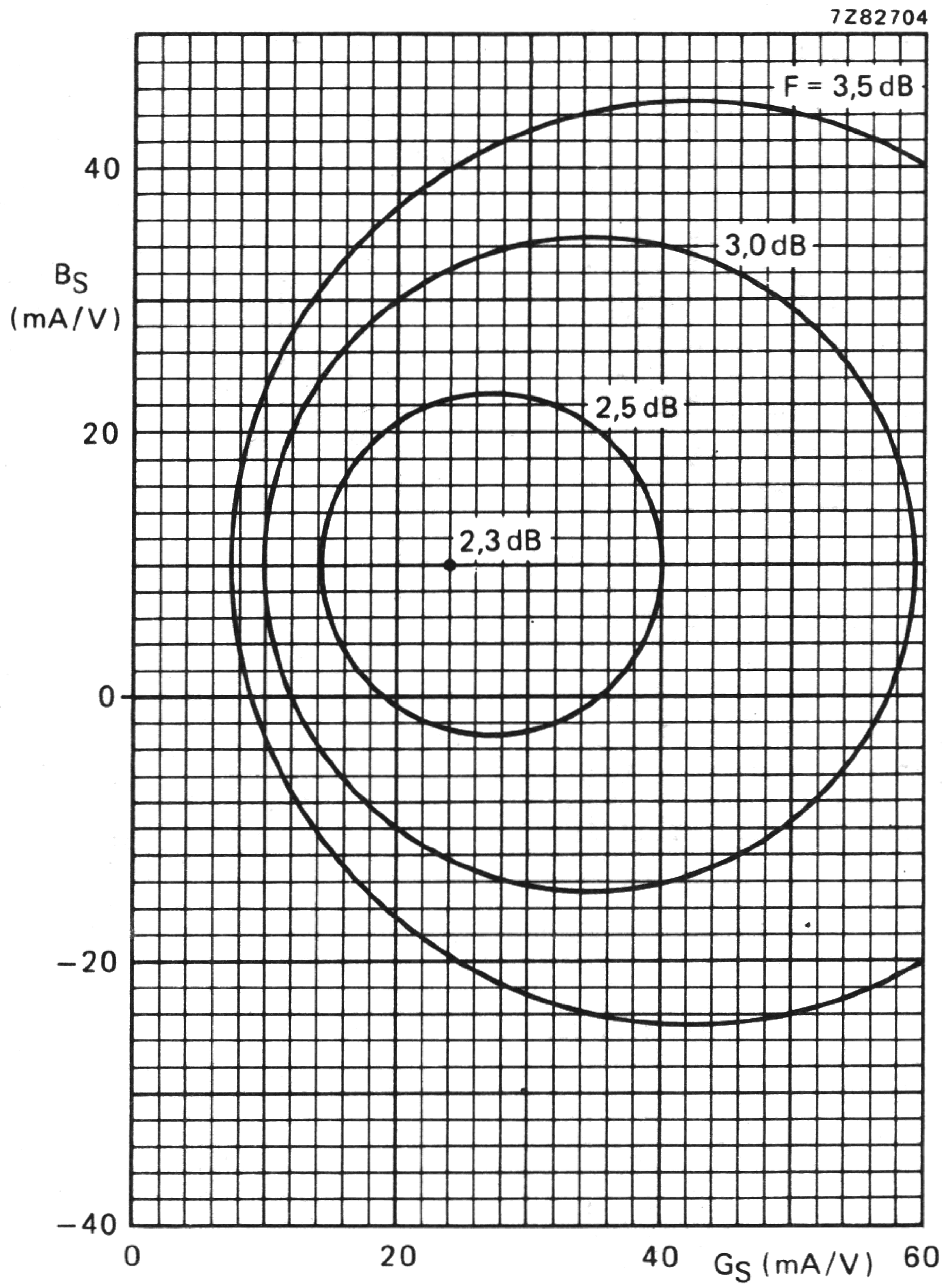


Fig. 16 Circles of constant noise figure.
V_{CE} = 8 V; I_C = 30 mA; f = 800 MHz;
T_{amb} = 25 °C; typical values.

CLASS-B OPERATION

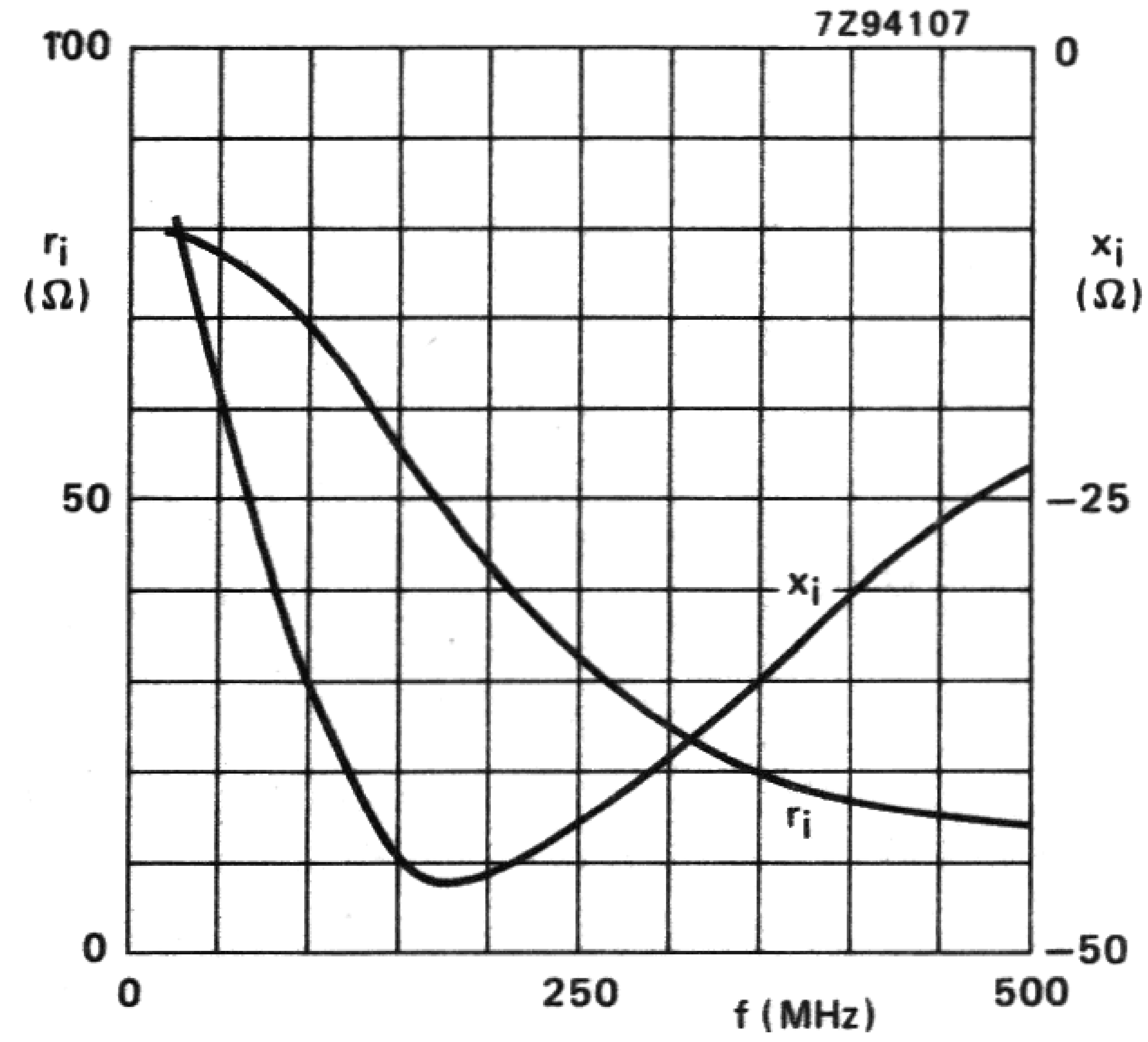


Fig. 17 Input impedance (series components).

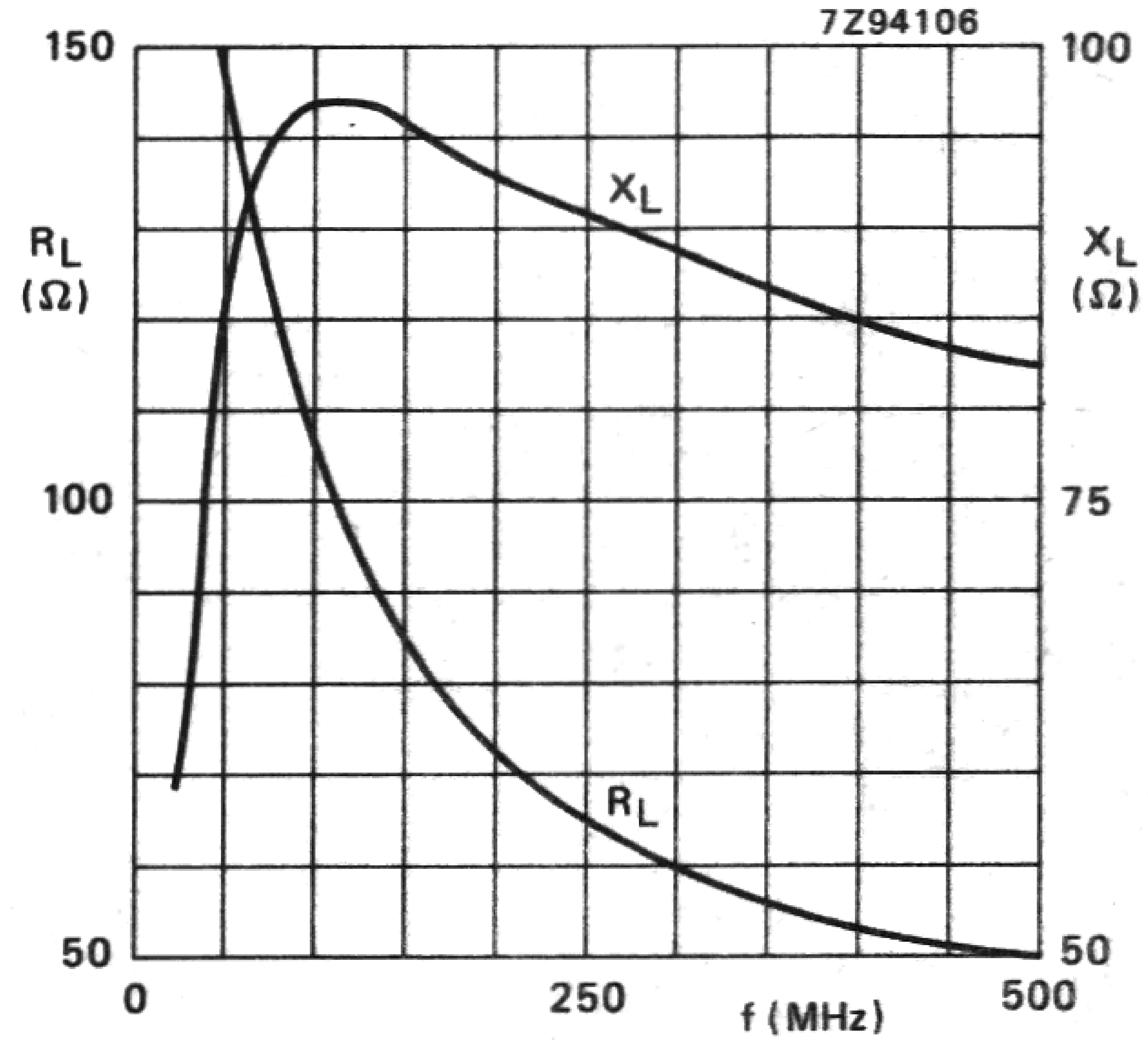


Fig. 18 Load impedance (series components).

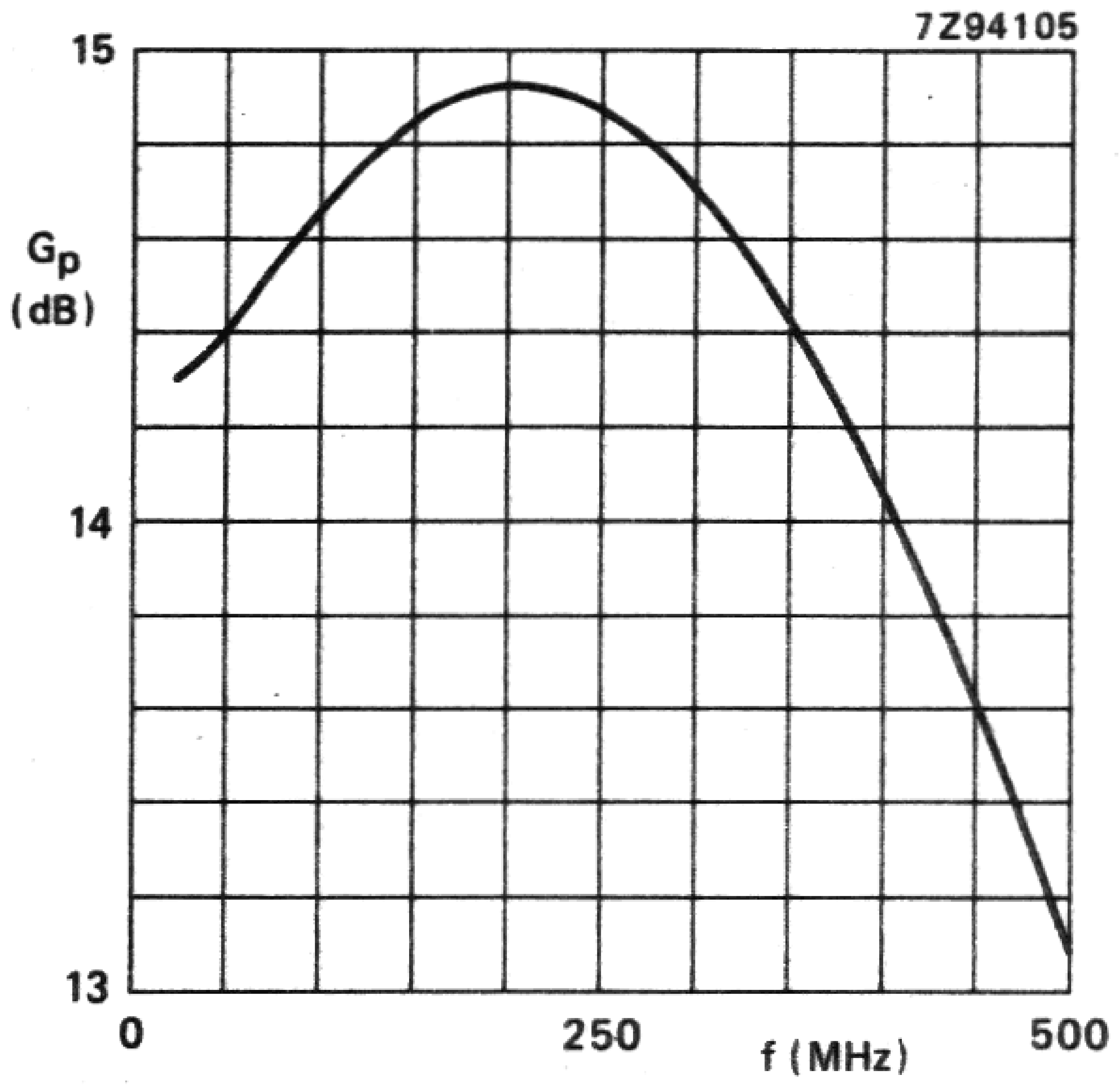


Fig. 19 Power gain versus frequency.

Conditions for Figs 17 to 19:

V_{CE} = 7,5 V; P_L = 160 mW; T_{amb} = 25 °C;

OPERATING NOTE for Figs 17 to 19:

A base-emitter resistor of 82 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.