

## NPN 5 GHz wideband transistor

T-31-23



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## DESCRIPTION

NPN transistor in a plastic SOT37 envelope primarily intended for use in RF wideband amplifiers such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc.

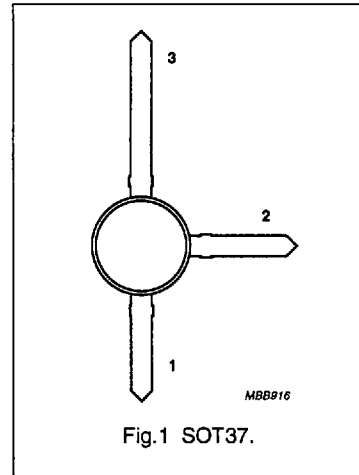
The transistor features very low intermodulation distortion and high power gain; due to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

A SOT54 (TO-92) version (ref: ON4487) is available on request.

PNP complement is BFQ32.

## PINNING

PIN	DESCRIPTION
Code: BFR96/02	
1	base
2	emitter
3	collector



## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$V_{CB0}$	collector-base voltage	open emitter	–	20	V
$V_{CE0}$	collector-emitter voltage	open base	–	15	V
$I_C$	DC collector current		–	75	mA
$P_{tot}$	total power dissipation	up to $T_s = 143\text{ °C}$ (note 1)	–	700	mW
$f_T$	transition frequency	$I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$ ; $T_amb = 25\text{ °C}$	5	–	GHz
$C_{re}$	feedback capacitance	$I_C = 10\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 1\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	–	1.4	pF
$G_{UM}$	maximum unilateral power gain	$I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	15.2	–	dB
F	noise figure	$I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$ ; $T_{amb} = 25\text{ °C}$	3.3	–	dB
$V_O$	output voltage	$d_{im} = -60\text{ dB}$ ; $I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $R_L = 75\text{ }\Omega$ ; $T_{amb} = 25\text{ °C}$ ; $f_{(PQ-I)} = 493.25\text{ MHz}$	500	–	mV

## Note

- $T_s$  is the temperature at the soldering point of the collector lead.

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**LIMITING VALUES**

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CBO}$	collector-base voltage	open emitter	–	20	V
$V_{CEO}$	collector-emitter voltage	open base	–	15	V
$V_{EBO}$	emitter-base voltage	open collector	–	3	V
$I_C$	DC collector current		–	75	mA
$I_{CM}$	peak collector current	$f > 1$ MHz	–	150	mA
$P_{tot}$	total power dissipation	up to $T_s = 143$ °C (note 1)	–	700	mW
$T_{stg}$	storage temperature		–65	150	°C
$T_j$	junction temperature		–	175	°C

**THERMAL RESISTANCE**

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j-s}$	thermal resistance from junction to soldering point	up to $T_s = 143$ °C (note 1)	45 K/W

**Note**

- $T_s$  is the temperature at the soldering point of the collector lead.

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**CHARACTERISTICS** $T_j = 25\text{ °C}$  unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{CBO}$	collector cut-off current	$I_E = 0; V_{CB} = 10\text{ V}$	–	–	100	nA
$h_{FE}$	DC current gain	$I_C = 50\text{ mA}; V_{CE} = 10\text{ V}$	25	80	–	
$f_T$	transition frequency	$I_C = 50\text{ mA}; V_{CE} = 10\text{ V}; f = 500\text{ MHz}$	4	5	–	GHz
$C_c$	collector capacitance	$I_E = I_B = 0; V_{CB} = 10\text{ V}; f = 1\text{ MHz}$	–	1.3	–	pF
$C_e$	emitter capacitance	$I_C = I_C = 0; V_{EB} = 0.5\text{ V}; f = 1\text{ MHz}$	–	6.5	–	pF
$C_{fb}$	feedback capacitance	$I_C = 10\text{ mA}; V_{CE} = 10\text{ V}; f = 1\text{ MHz};$ $T_{amb} = 25\text{ °C}$	–	1	1.4	pF
$G_{UM}$	maximum unilateral power gain (note 1)	$I_C = 50\text{ mA}; V_{CE} = 10\text{ V};$ $f = 500\text{ MHz}; T_{amb} = 25\text{ °C}$	–	15.2	–	dB
F	noise figure	$I_C = 50\text{ mA}; V_{CE} = 10\text{ V};$ $f = 500\text{ MHz}; T_{amb} = 25\text{ °C}$	–	3.3	–	dB
$V_O$	output voltage	see Fig.2 and note 2	–	500	–	mV

**Notes**

- $G_{UM}$  is the maximum unilateral power gain, assuming  $S_{12}$  is zero and  $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$  dB.
- $d_{im} = -60\text{ dB}$  (DIN 45004B);  $I_C = 50\text{ mA}; V_{CE} = 10\text{ V}; R_L = 75\ \Omega; T_{amb} = 25\text{ °C};$   
 $V_p = V_O$  at  $d_{im} = -60\text{ dB}; f_p = 495.25\text{ MHz};$   
 $V_q = V_O - 6\text{ dB}; f_q = 503.25\text{ MHz};$   
 $V_r = V_O - 6\text{ dB}; f_r = 505.25\text{ MHz};$   
 measured at  $f_{(p+q-r)} = 493.25\text{ MHz}.$

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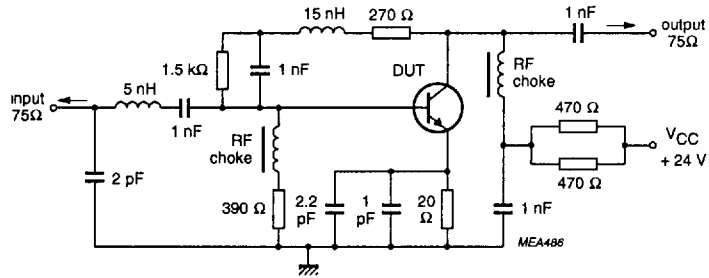


Fig.2 Intermodulation distortion test circuit.

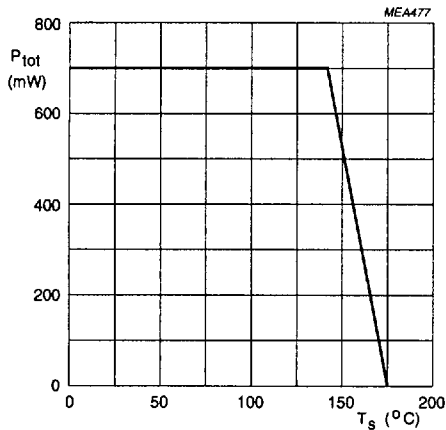
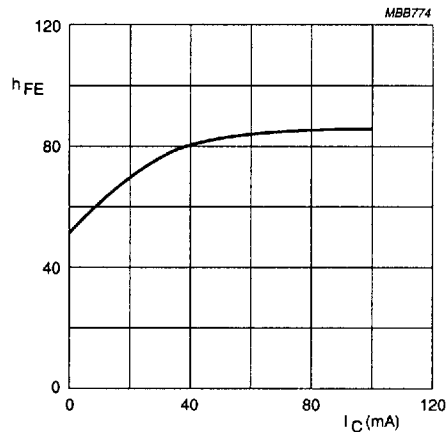


Fig.3 Power derating curve.

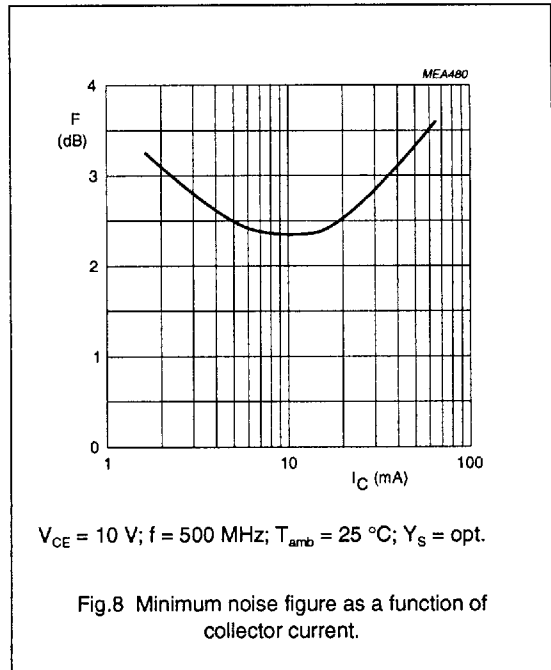
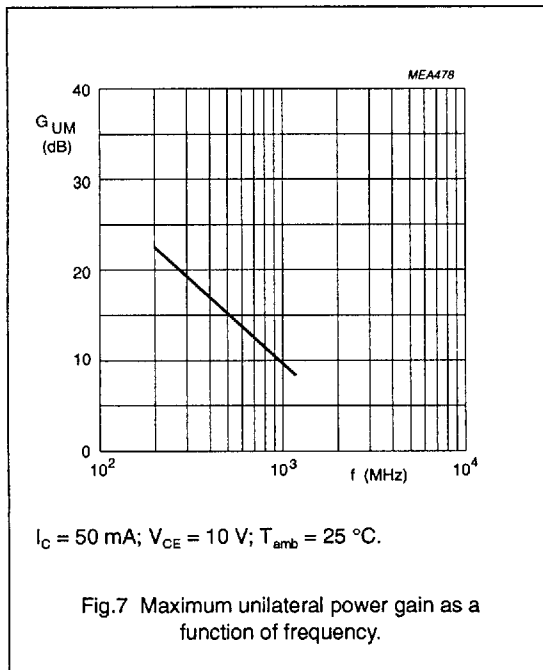
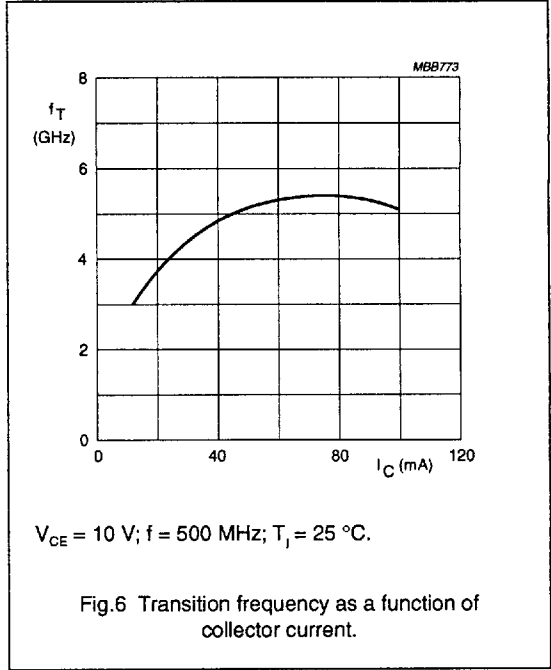
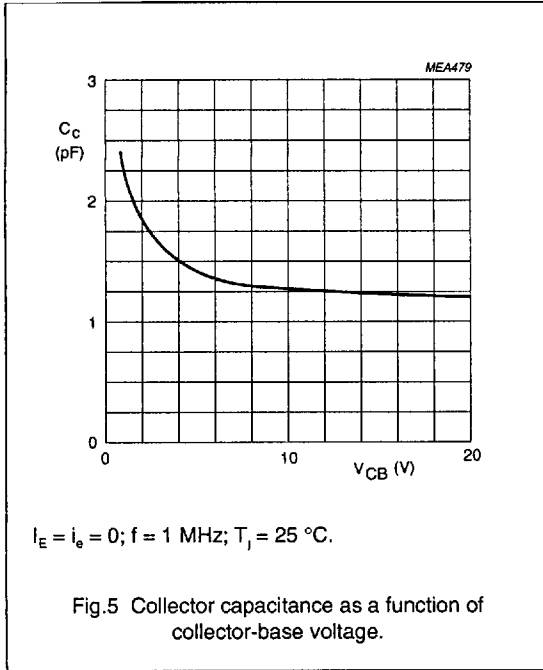


V<sub>CE</sub> = 10 V; T<sub>J</sub> = 25 °C.

Fig.4 DC current gain as a function of collector current.

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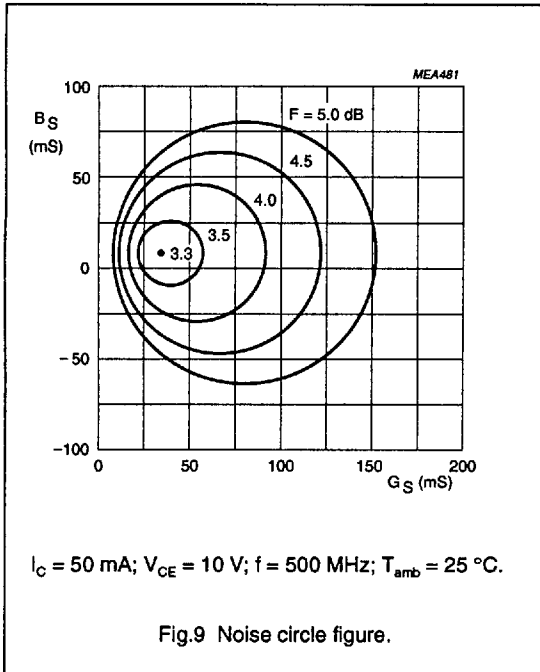


Fig.9 Noise circle figure.

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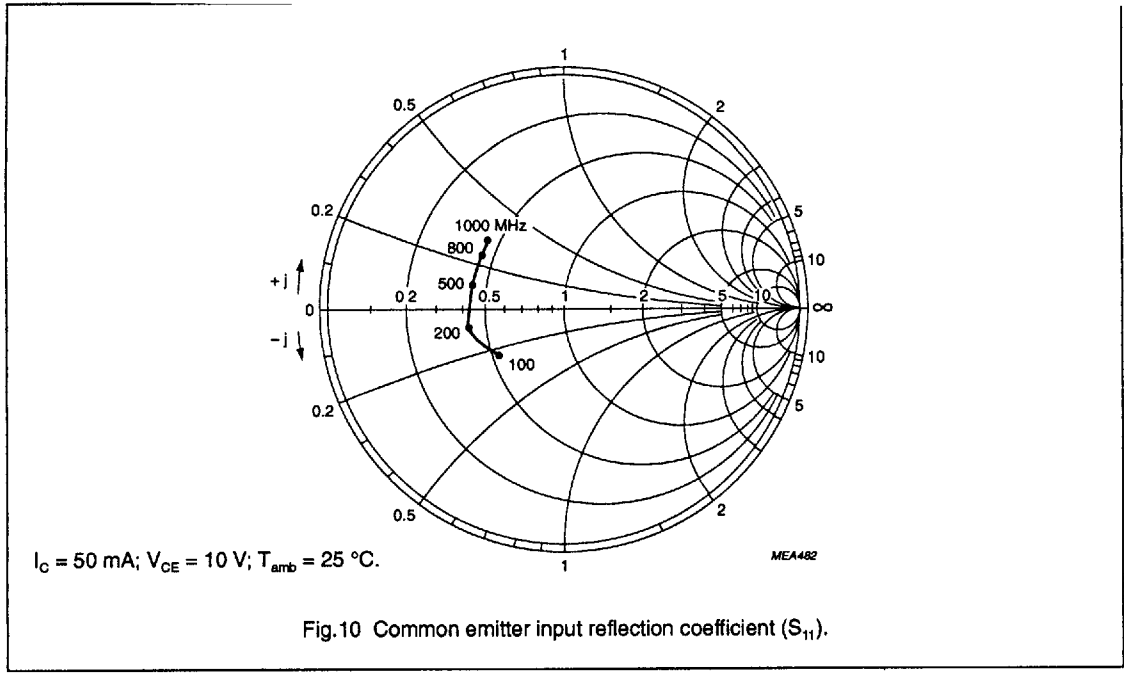


Fig.10 Common emitter input reflection coefficient ( $S_{11}$ ).

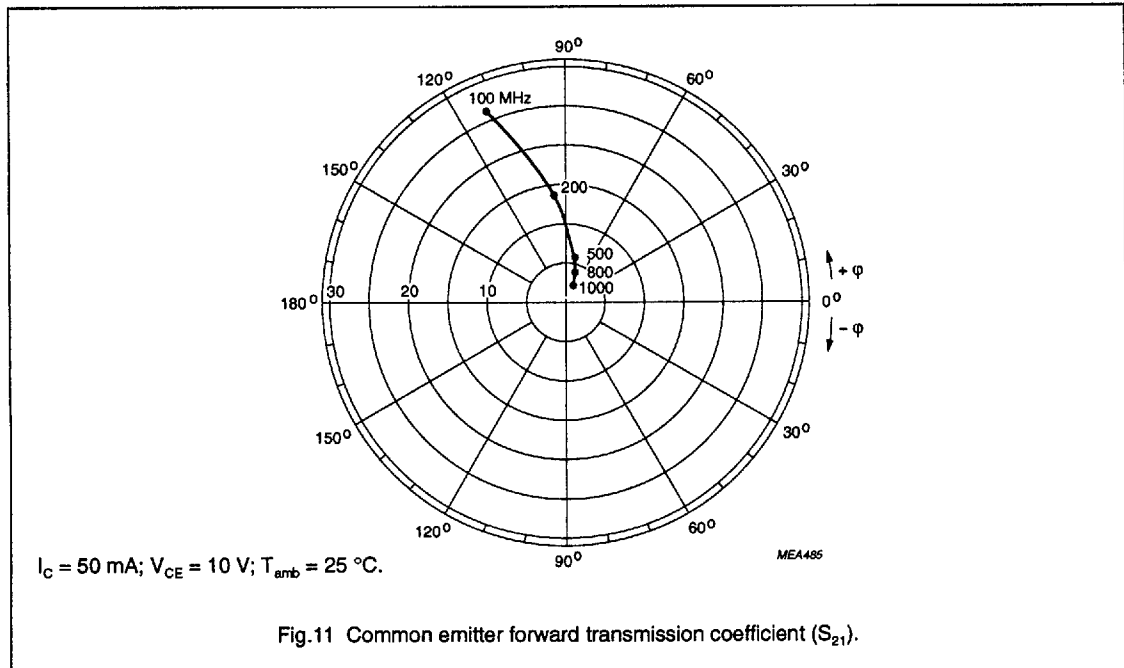


Fig.11 Common emitter forward transmission coefficient ( $S_{21}$ ).

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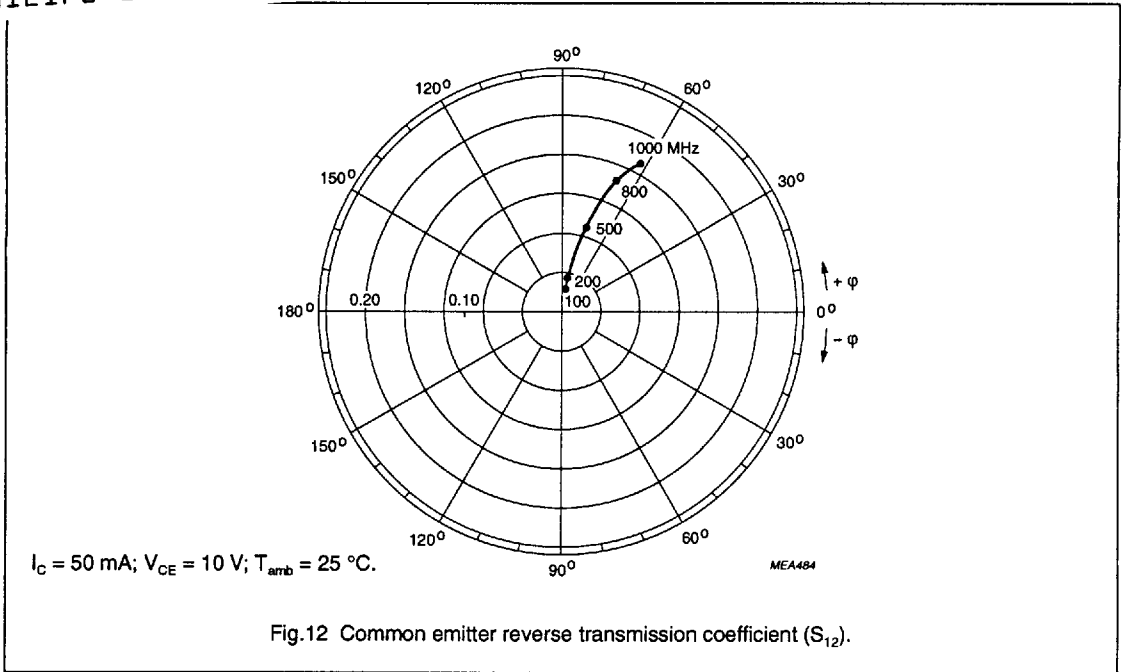


Fig.12 Common emitter reverse transmission coefficient ( $S_{12}$ ).

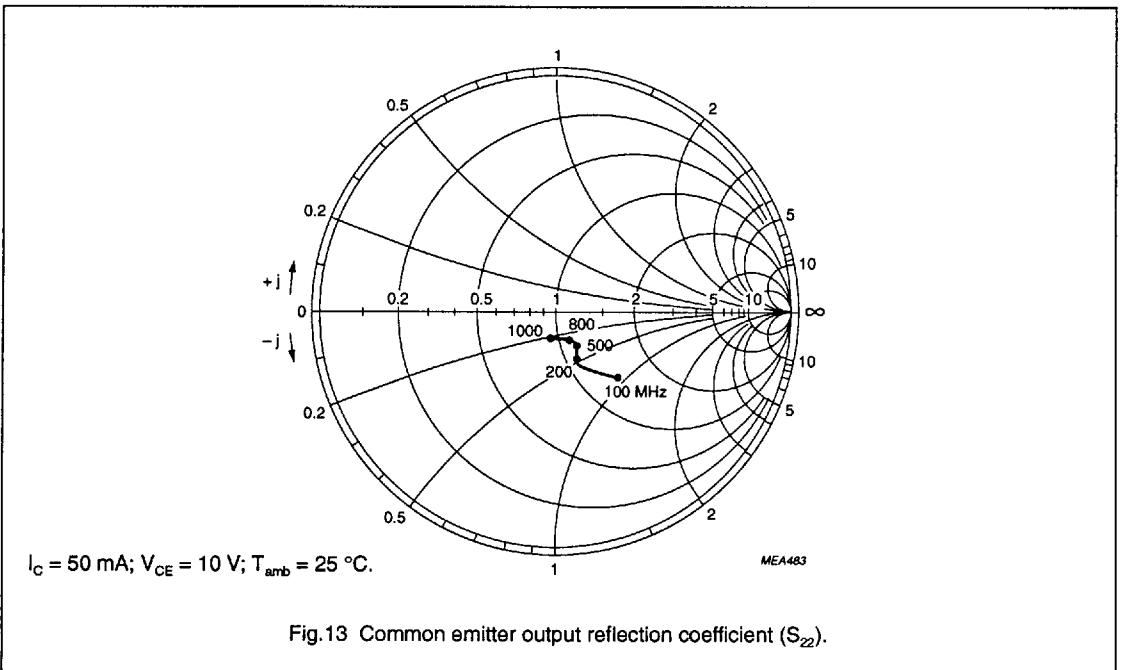


Fig.13 Common emitter output reflection coefficient ( $S_{22}$ ).