

# BFR843EL3

## Low noise broadband pre-matched RF bipolar transistor



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Technical documents



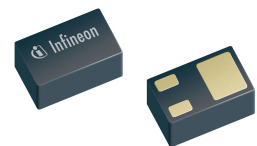
Simulation



Support

## Product description

The BFR843EL3 is a low noise dual band pre-matched transistor in a low profile package for high speed and low power consumption applications.



## Feature list

- Unique combination of high end RF performance and robustness: 20 dBm maximum RF input power and 1 kV HBM ESD hardness
- High transition frequency enables best in class noise performance at high frequencies:  
 $NF_{min} = 1$  dB at 2.4 GHz, 1.8 V, 8 mA and 1.15 dB at 5.5 GHz, 1.8 V, 8 mA
- High gain  $G_{ms} = 24$  dB at 2.4 GHz, 1.8 V, 15 mA and 21.5 dB at 5.5 GHz, 1.8 V, 15 mA
- $OIP_3 = 20.5$  dBm at 2.4 GHz, 1.8 V, 15 mA and 20.5 dBm at 5.5 GHz, 1.8 V, 15 mA
- Suitable for low voltage applications e.g.  $V_{CC} = 1.2$  V and 1.8 V (2.85 V, 3.3 V, 3.6 V require corresponding collector resistor)

## Product validation

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22.

## Potential applications

- Wireless communications: WLAN 2.4 GHz and 5-6 GHz bands, broadband LTE or WiMAX LNA
- Satellite navigation systems (e.g. GPS, GLONASS, BeiDou, Galileo...) and satellite C-band LNB (1st and 2nd stage LNA)

## Device information

**Table 1** Part information

Product name / Ordering code	Package	Pin configuration			Marking	Pieces / Reel
BFR843EL3 / BFR843EL3E6327XTSA1	TSLP-3-10	1 = B	2 = C	3 = E	T2	15000

**Attention:** ESD (Electrostatic discharge) sensitive device, observe handling precautions

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**Absolute maximum ratings**

**1 Absolute maximum ratings**

**Table 2 Absolute maximum ratings at  $T_A = 25\text{ °C}$  (unless otherwise specified)**

Parameter	Symbol	Values		Unit	Note or test condition
		Min.	Max.		
Collector emitter voltage	$V_{CEO}$	-	2.25	V	Open base
			2.0		$T_A = -55\text{ °C}$ , open base
Collector emitter voltage <sup>1)</sup>	$V_{CES}$		2.25		E-B short circuited
			2.0		$T_A = -55\text{ °C}$ , E-B short circuited
Collector base voltage <sup>2)</sup>	$V_{CBO}$		2.9		Open emitter
			2.6		$T_A = -55\text{ °C}$ , open emitter
Base current	$I_B$	-1	5	mA	
Collector current	$I_C$	-	55		
RF input power	$P_{RFIn}$			20	dBm
ESD stress pulse	$V_{ESD}$	-1	1	kV	HBM, all pins, acc. to JESD22-A114
Total power dissipation <sup>3)</sup>	$P_{tot}$	-	125	mW	$T_S \leq 103\text{ °C}$
Junction temperature	$T_J$		150	°C	
Storage temperature	$T_{Stg}$		-55		

**Attention:** *Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Exceeding only one of these values may cause irreversible damage to the integrated circuit.*

<sup>1</sup>  $V_{CES}$  is similar to  $V_{CEO}$  due to design.

<sup>2</sup>  $V_{CBO}$  is similar to  $V_{CEO}$  due to design.

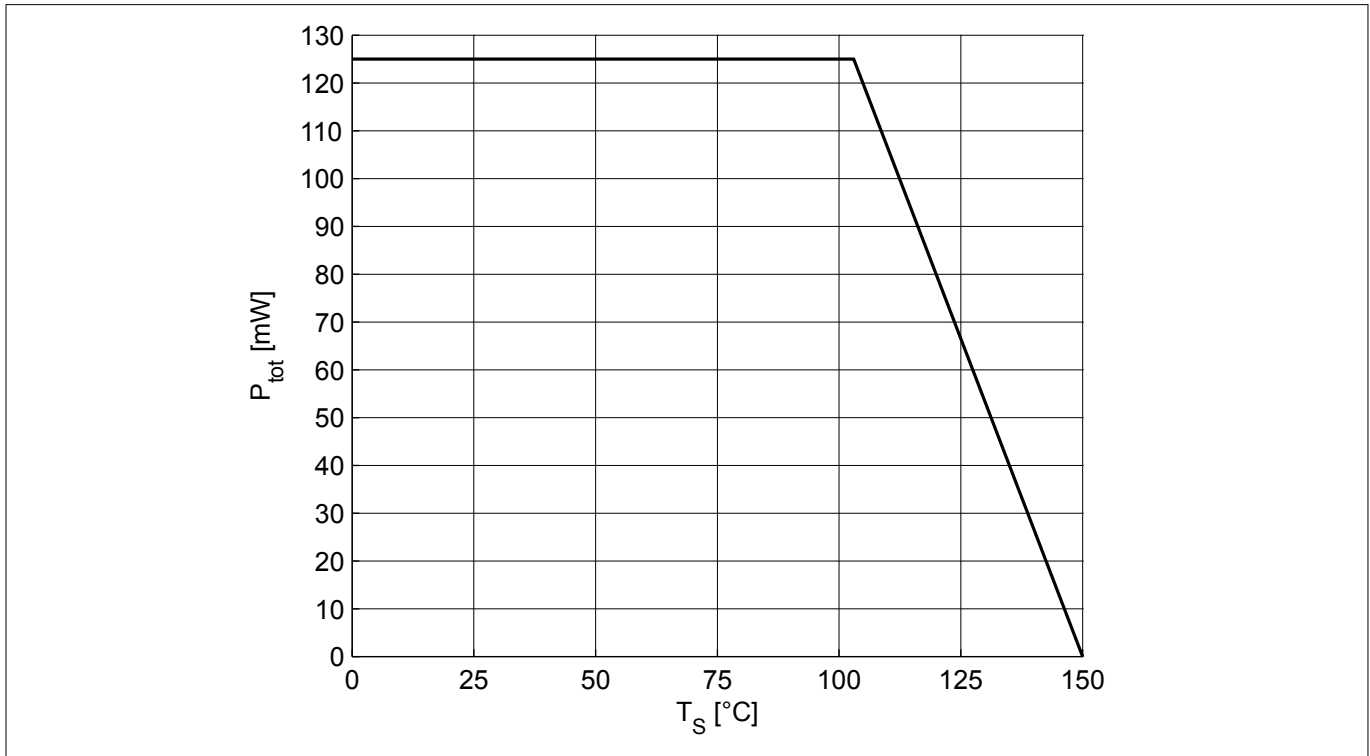
<sup>3</sup>  $T_S$  is the soldering point temperature.  $T_S$  is measured on the emitter lead at the soldering point of the PCB.

Thermal characteristics

## 2 Thermal characteristics

**Table 3 Thermal resistance**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Junction - soldering point	$R_{thJS}$	-	375	-	K/W	



**Figure 1 Total power dissipation  $P_{tot} = f(T_S)$**

**Electrical characteristics**

**3 Electrical characteristics**

**3.1 DC characteristics**

**Table 4 DC characteristics at  $T_A = 25\text{ °C}$**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Collector emitter breakdown voltage	$V_{(BR)CEO}$	2.25	2.6	–	V	$I_C = 1\text{ mA}$ , $I_B = 0$ , open base
Collector emitter leakage current	$I_{CES}$	–	–	400 <sup>1)</sup>	nA	$V_{CE} = 1.5\text{ V}$ , $V_{BE} = 0$ , E-B short circuited
Collector base leakage current	$I_{CBO}$			400 <sup>1)</sup>		$V_{CB} = 1.5\text{ V}$ , $I_E = 0$ , open emitter
Emitter base leakage current	$I_{EBO}$			10 <sup>1)</sup>	$\mu\text{A}$	$V_{EB} = 0.5\text{ V}$ , $I_C = 0$ , open collector
DC current gain	$h_{FE}$	230 –	360 260	580 –		$V_{CE} = 1.8\text{ V}$ , $I_C = 1\text{ mA}$ $V_{CE} = 1.8\text{ V}$ , $I_C = 15\text{ mA}$ Pulse measured

**3.2 General AC characteristics**

**Table 5 General AC characteristics at  $T_A = 25\text{ °C}$**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Collector base capacitance <sup>2)</sup>	$C_{CB}$	–	5.26 0.07	–	pF	$f = 1\text{ MHz}$ $f = 1\text{ GHz}$ $V_{CB} = 1.8\text{ V}$ , $V_{BE} = 0$ , emitter grounded
Collector emitter capacitance	$C_{CE}$		0.42			$f = 1\text{ MHz}$ , $V_{CE} = 1.8\text{ V}$ , $V_{BE} = 0$ , base grounded
Emitter base capacitance	$C_{EB}$		0.66			$f = 1\text{ MHz}$ , $V_{EB} = 0.4\text{ V}$ , $V_{CB} = 0$ , collector grounded

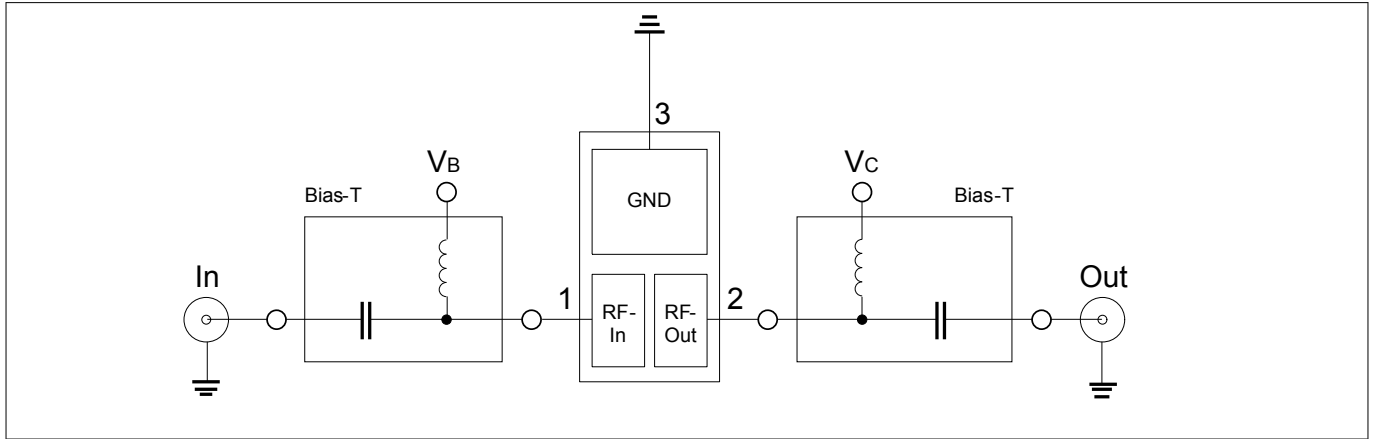
<sup>1</sup> Maximum values not limited by the device but by the short cycle time of the 100% test.

<sup>2</sup> Including integrated feedback capacitance

**Electrical characteristics**

**3.3 Frequency dependent AC characteristics**

Measurement setup is a test fixture with Bias-T's in a 50 Ω system,  $T_A = 25\text{ °C}$ .



**Figure 2 Testing circuit**

**Table 6 AC characteristics,  $V_{CE} = 1.8\text{ V}$ ,  $f = 450\text{ MHz}$**

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	$I_C = 15\text{ mA}$
<ul style="list-style-type: none"> <li>Maximum power gain</li> <li>Transducer gain</li> </ul>	$G_{ms}$ $ S_{21} ^2$		25.5 24.5			
Noise figure					dBm	$I_C = 8\text{ mA}$
<ul style="list-style-type: none"> <li>Minimum noise figure</li> <li>Associated gain</li> </ul>	$NF_{min}$ $G_{ass}$		0.95 22.5			
Linearity					dBm	$Z_S = Z_L = 50\text{ }\Omega$ , $I_C = 15\text{ mA}$
<ul style="list-style-type: none"> <li>3rd order intercept point at output</li> <li>1 dB gain compression point at output</li> </ul>	$OIP_3$ $OP_{1dB}$		23 7.5			

## Electrical characteristics

Table 7 AC characteristics,  $V_{CE} = 1.8 \text{ V}$ ,  $f = 900 \text{ MHz}$ 

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain	$G_{ms}$ $ S_{21} ^2$	–	25	–	dB	$I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>Maximum power gain</li> <li>Transducer gain</li> </ul>						
Noise figure	$NF_{min}$ $G_{ass}$		0.95	22		$I_C = 8 \text{ mA}$
<ul style="list-style-type: none"> <li>Minimum noise figure</li> <li>Associated gain</li> </ul>						
Linearity	$OIP_3$ $OP_{1dB}$		21.5	7	dBm	$Z_S = Z_L = 50 \Omega$ , $I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>3rd order intercept point at output</li> <li>1 dB gain compression point at output</li> </ul>						

Table 8 AC characteristics,  $V_{CE} = 1.8 \text{ V}$ ,  $f = 1.5 \text{ GHz}$ 

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain	$G_{ms}$ $ S_{21} ^2$	–	24.5	–	dB	$I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>Maximum power gain</li> <li>Transducer gain</li> </ul>						
Noise figure	$NF_{min}$ $G_{ass}$		0.95	21.5		$I_C = 8 \text{ mA}$
<ul style="list-style-type: none"> <li>Minimum noise figure</li> <li>Associated gain</li> </ul>						
Linearity	$OIP_3$ $OP_{1dB}$		21.5	7	dBm	$Z_S = Z_L = 50 \Omega$ , $I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>3rd order intercept point at output</li> <li>1 dB gain compression point at output</li> </ul>						

Table 9 AC characteristics,  $V_{CE} = 1.8 \text{ V}$ ,  $f = 1.9 \text{ GHz}$ 

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain	$G_{ms}$ $ S_{21} ^2$	–	24.5	–	dB	$I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>Maximum power gain</li> <li>Transducer gain</li> </ul>						
Noise figure	$NF_{min}$ $G_{ass}$		1	21		$I_C = 8 \text{ mA}$
<ul style="list-style-type: none"> <li>Minimum noise figure</li> <li>Associated gain</li> </ul>						
Linearity	$OIP_3$ $OP_{1dB}$		21	7	dBm	$Z_S = Z_L = 50 \Omega$ , $I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>3rd order intercept point at output</li> <li>1 dB gain compression point at output</li> </ul>						

## Electrical characteristics

Table 10 AC characteristics,  $V_{CE} = 1.8 \text{ V}$ ,  $f = 2.4 \text{ GHz}$ 

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain	$G_{ms}$ $ S_{21} ^2$	–	24	–	dB	$I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>Maximum power gain</li> <li>Transducer gain</li> </ul>						
Noise figure	$NF_{min}$ $G_{ass}$	–	1	20	dB	$I_C = 8 \text{ mA}$
<ul style="list-style-type: none"> <li>Minimum noise figure</li> <li>Associated gain</li> </ul>						
Linearity	$OIP_3$ $OP_{1dB}$	–	20.5	6	dBm	$Z_S = Z_L = 50 \Omega$ , $I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>3rd order intercept point at output</li> <li>1 dB gain compression point at output</li> </ul>						

Table 11 AC characteristics,  $V_{CE} = 1.8 \text{ V}$ ,  $f = 3.5 \text{ GHz}$ 

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain	$G_{ms}$ $ S_{21} ^2$	–	23	–	dB	$I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>Maximum power gain</li> <li>Transducer gain</li> </ul>						
Noise figure	$NF_{min}$ $G_{ass}$	–	1.05	18.5	dB	$I_C = 8 \text{ mA}$
<ul style="list-style-type: none"> <li>Minimum noise figure</li> <li>Associated gain</li> </ul>						
Linearity	$OIP_3$ $OP_{1dB}$	–	20.5	6	dBm	$Z_S = Z_L = 50 \Omega$ , $I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>3rd order intercept point at output</li> <li>1 dB gain compression point at output</li> </ul>						

Table 12 AC characteristics,  $V_{CE} = 1.8 \text{ V}$ ,  $f = 5.5 \text{ GHz}$ 

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain	$G_{ms}$ $ S_{21} ^2$	–	21.5	–	dB	$I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>Maximum power gain</li> <li>Transducer gain</li> </ul>						
Noise figure	$NF_{min}$ $G_{ass}$	–	1.15	15.5	dB	$I_C = 8 \text{ mA}$
<ul style="list-style-type: none"> <li>Minimum noise figure</li> <li>Associated gain</li> </ul>						
Linearity	$OIP_3$ $OP_{1dB}$	–	20.5	4.5	dBm	$Z_S = Z_L = 50 \Omega$ , $I_C = 15 \text{ mA}$
<ul style="list-style-type: none"> <li>3rd order intercept point at output</li> <li>1 dB gain compression point at output</li> </ul>						



**Electrical characteristics**

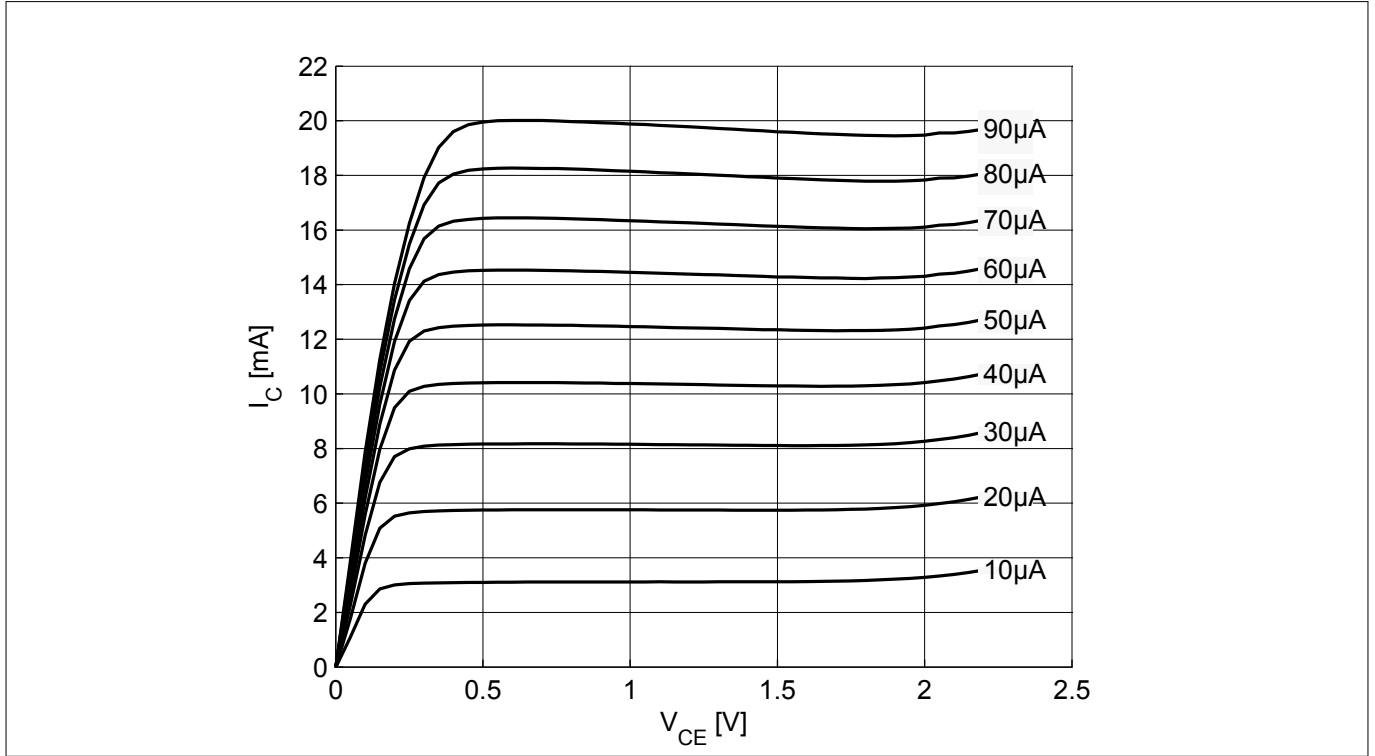
**Table 13 AC characteristics,  $V_{CE} = 1.8 \text{ V}$ ,  $f = 10 \text{ GHz}$**

Parameter	Symbol	Values			Unit	Note or test condition	
		Min.	Typ.	Max.			
Power gain		-		-	dB	$I_C = 15 \text{ mA}$	
<ul style="list-style-type: none"> <li>Maximum power gain</li> <li>Transducer gain</li> </ul>	$G_{ma}$ $ S_{21} ^2$		 14.5 10.5				
Noise figure						dB	$I_C = 8 \text{ mA}$
<ul style="list-style-type: none"> <li>Minimum noise figure</li> <li>Associated gain</li> </ul>	$NF_{min}$ $G_{ass}$		 1.35 10.5				
Linearity				dBm	$Z_S = Z_L = 50 \Omega$ , $I_C = 15 \text{ mA}$		
<ul style="list-style-type: none"> <li>3rd order intercept point at output</li> <li>1 dB gain compression point at output</li> </ul>	$OIP_3$ $OP_{1dB}$	 17 1.5					

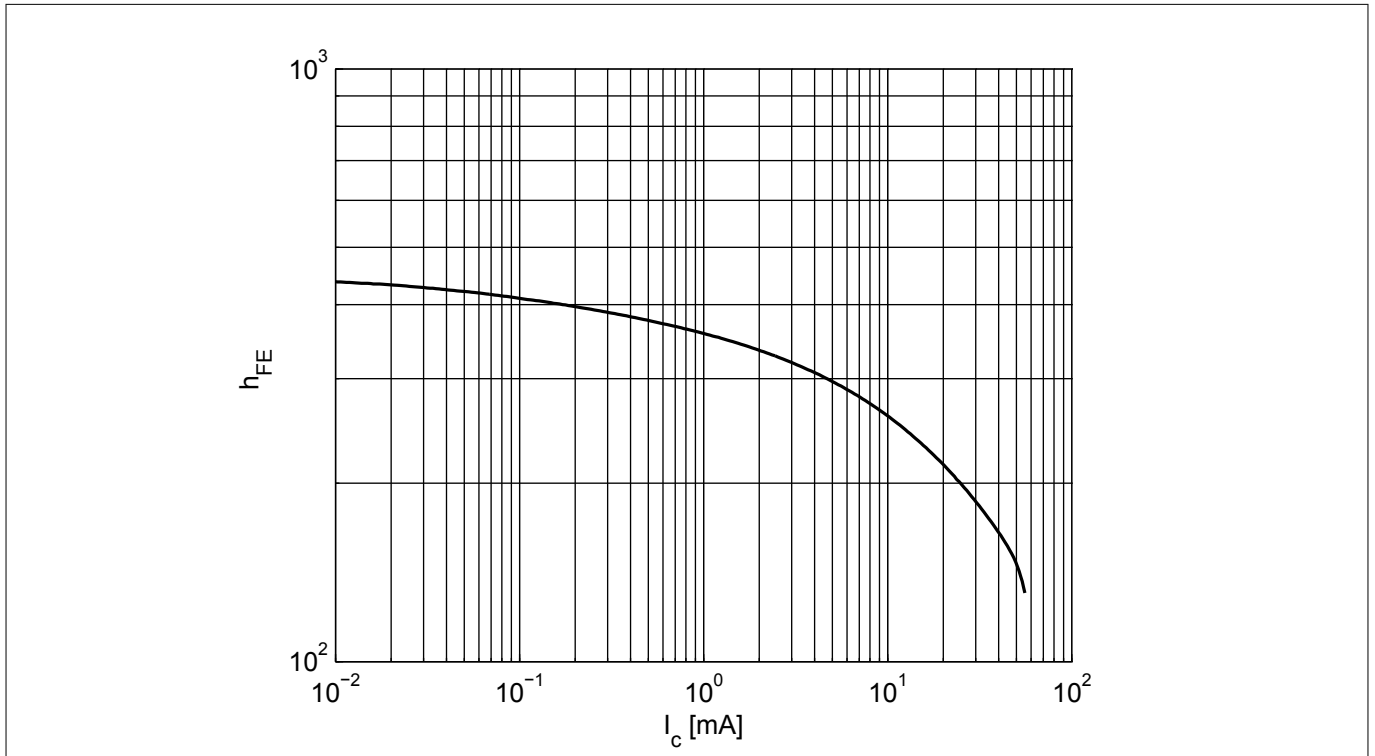
Note:  $G_{ms} = |S_{21}/S_{12}|$  for  $k < 1$ ;  $G_{ma} = |S_{21}/S_{12}|(k-(k^2-1)^{1/2})$  for  $k > 1$ . In order to get the  $NF_{min}$  values stated in this chapter, the test fixture losses have been subtracted from all measured results.  $OIP_3$  value depends on termination of all intermodulation frequency components. Termination used for this measurement is  $50 \Omega$  from 0.2 MHz to 12 GHz.

**Electrical characteristics**

**3.4 Characteristic DC diagrams**

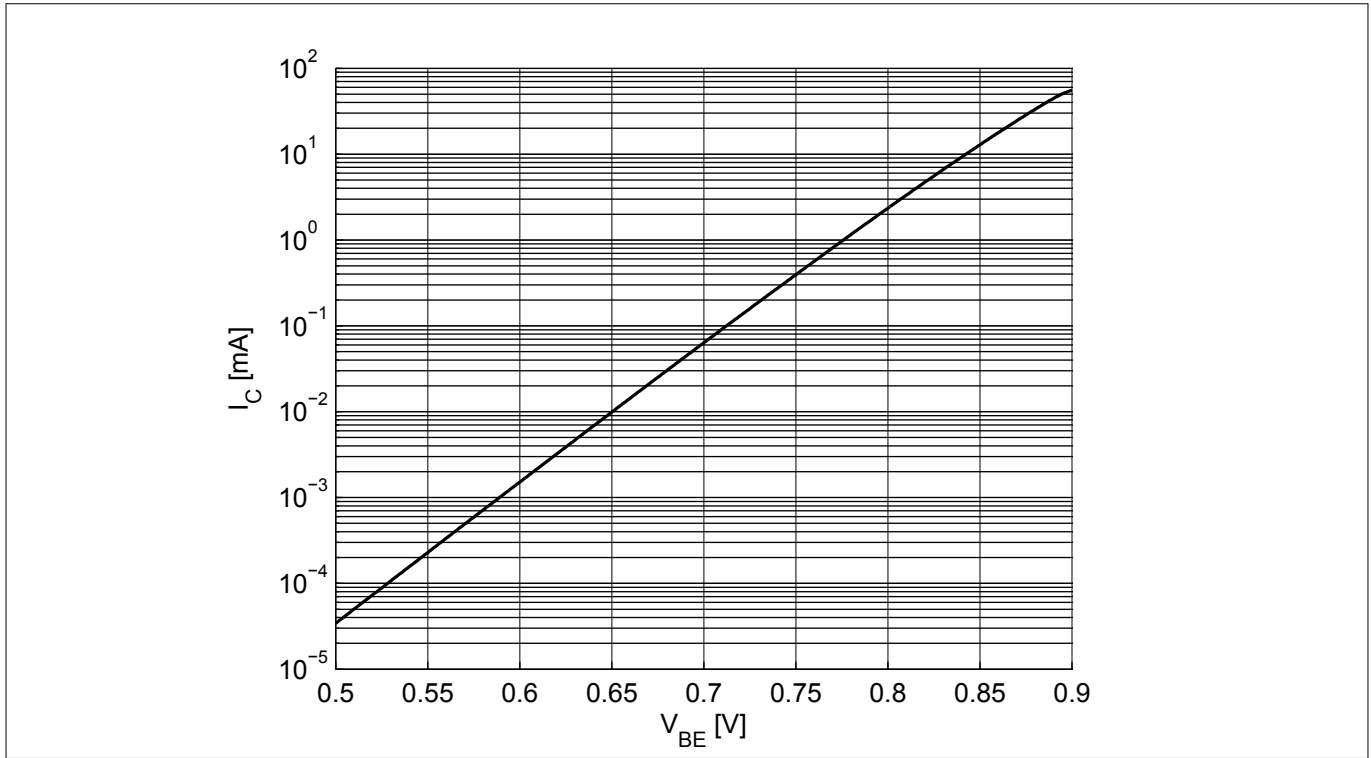


**Figure 3 Collector current vs. collector emitter voltage  $I_C = f(V_{CE}), I_B = \text{parameter}$**

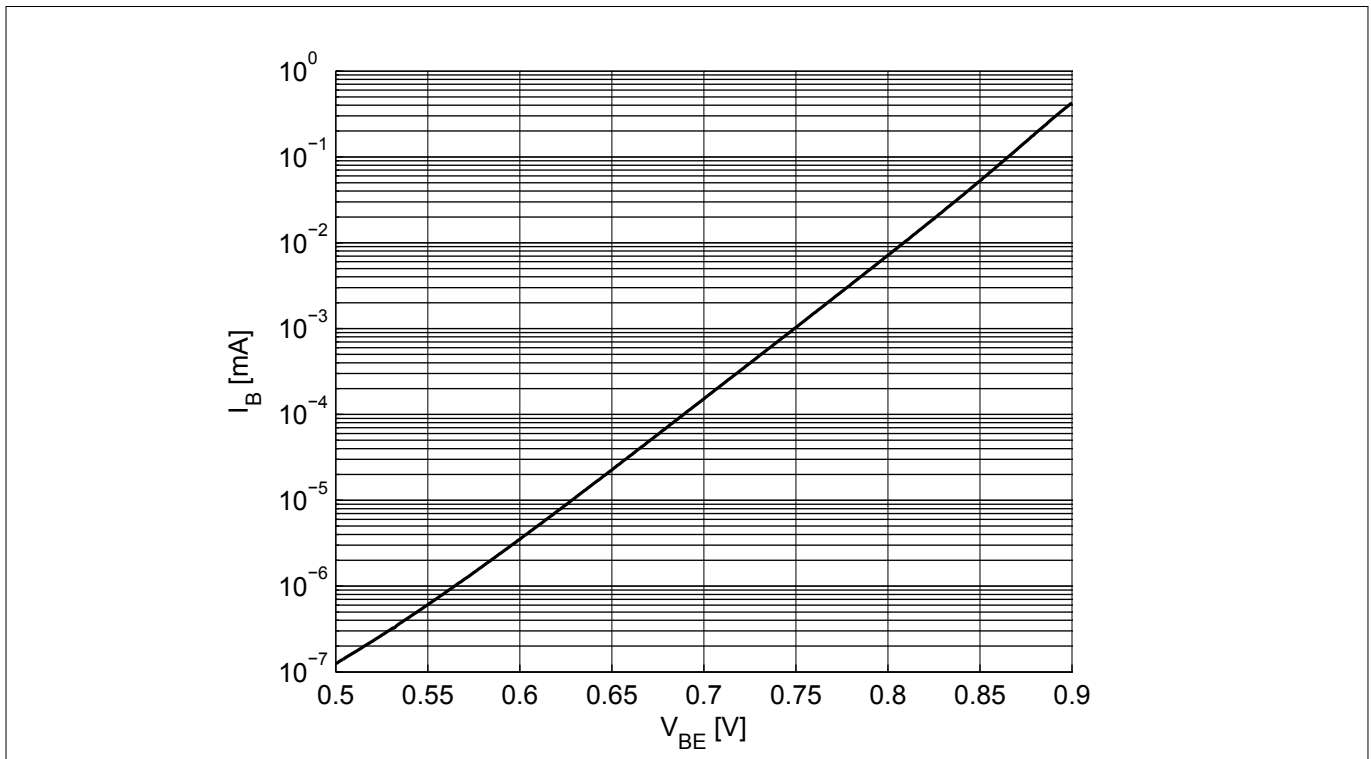


**Figure 4 DC current gain  $h_{FE} = f(I_C), V_{CE} = 1.8 \text{ V}$**

**Electrical characteristics**

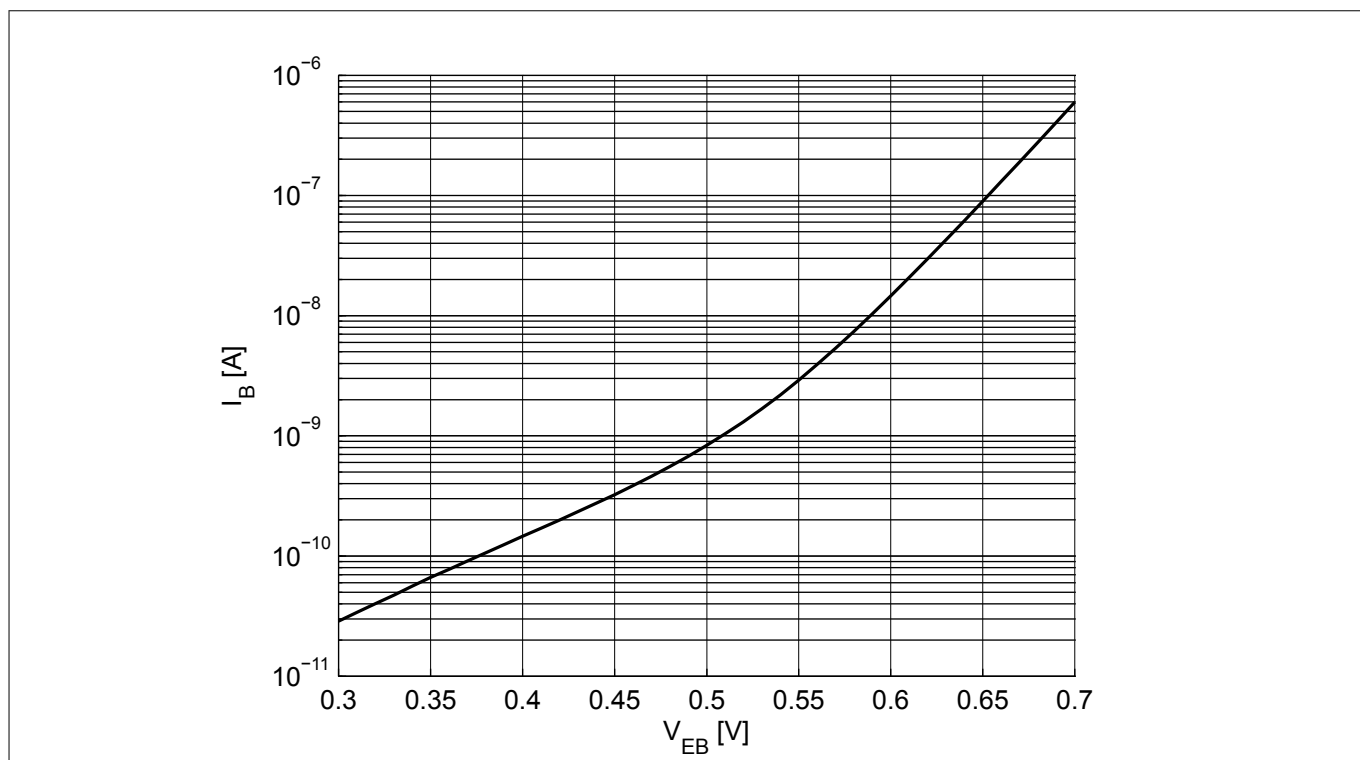


**Figure 5** Collector current vs. base emitter forward voltage  $I_C = f(V_{BE})$ ,  $V_{CE} = 1.8$  V



**Figure 6** Base current vs. base emitter forward voltage  $I_B = f(V_{BE})$ ,  $V_{CE} = 1.8$  V

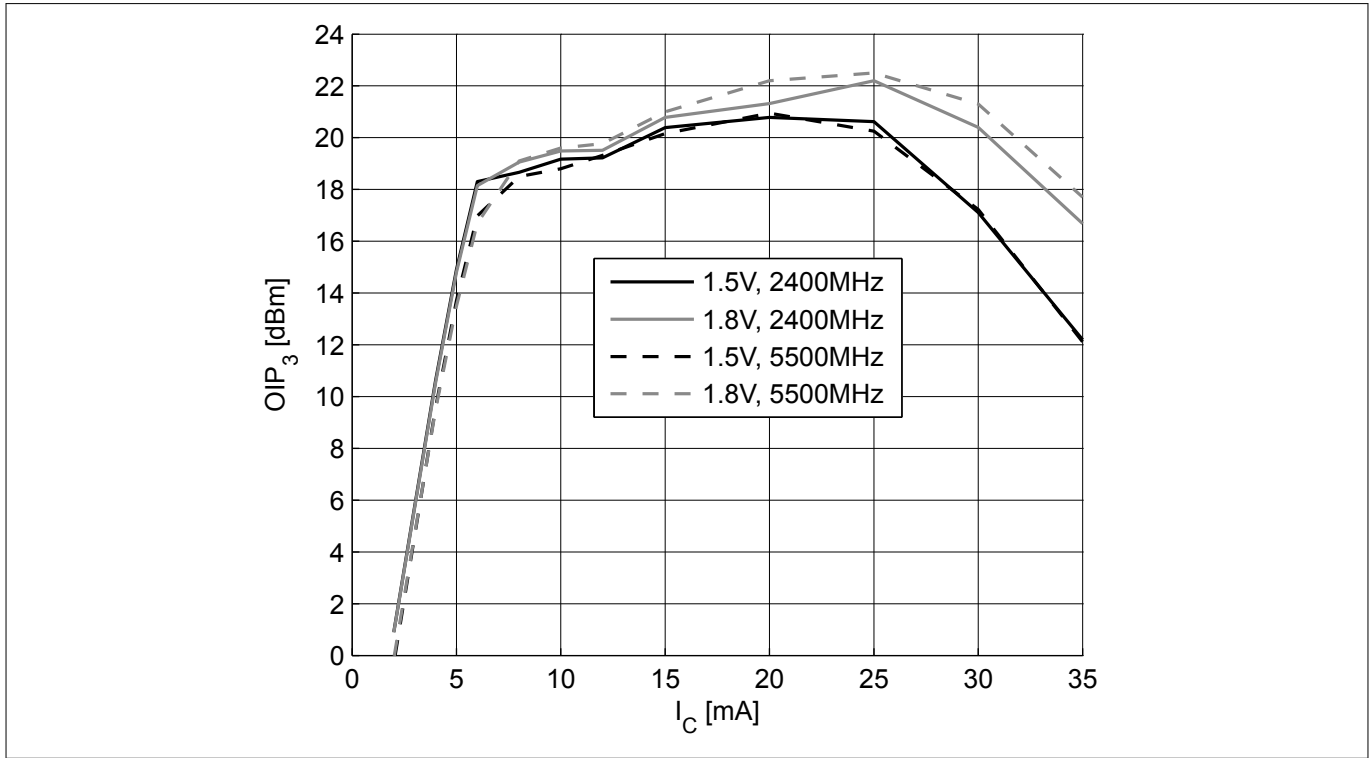
**Electrical characteristics**



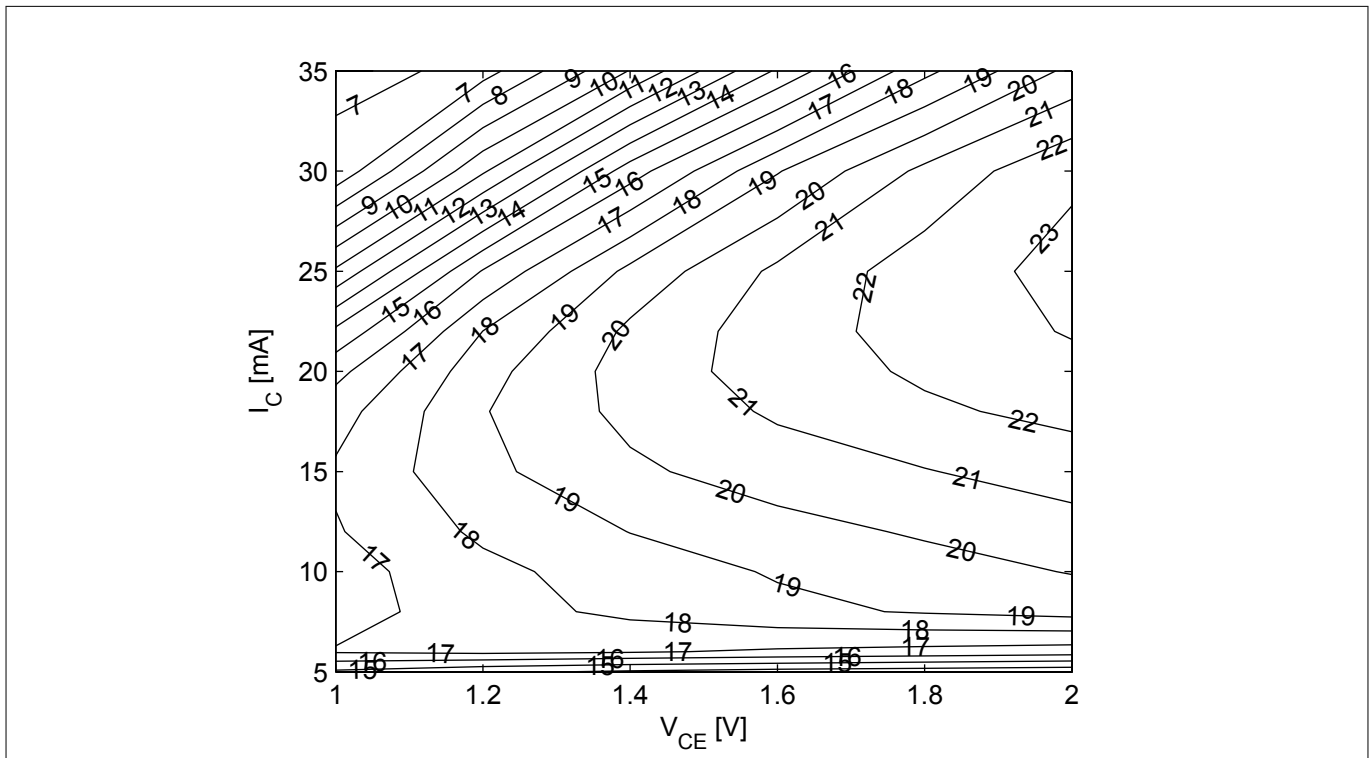
**Figure 7** Base current vs. base emitter reverse voltage  $I_B = f(V_{EB})$ ,  $V_{CE} = 1.8$  V

**Electrical characteristics**

**3.5 Characteristic AC diagrams**

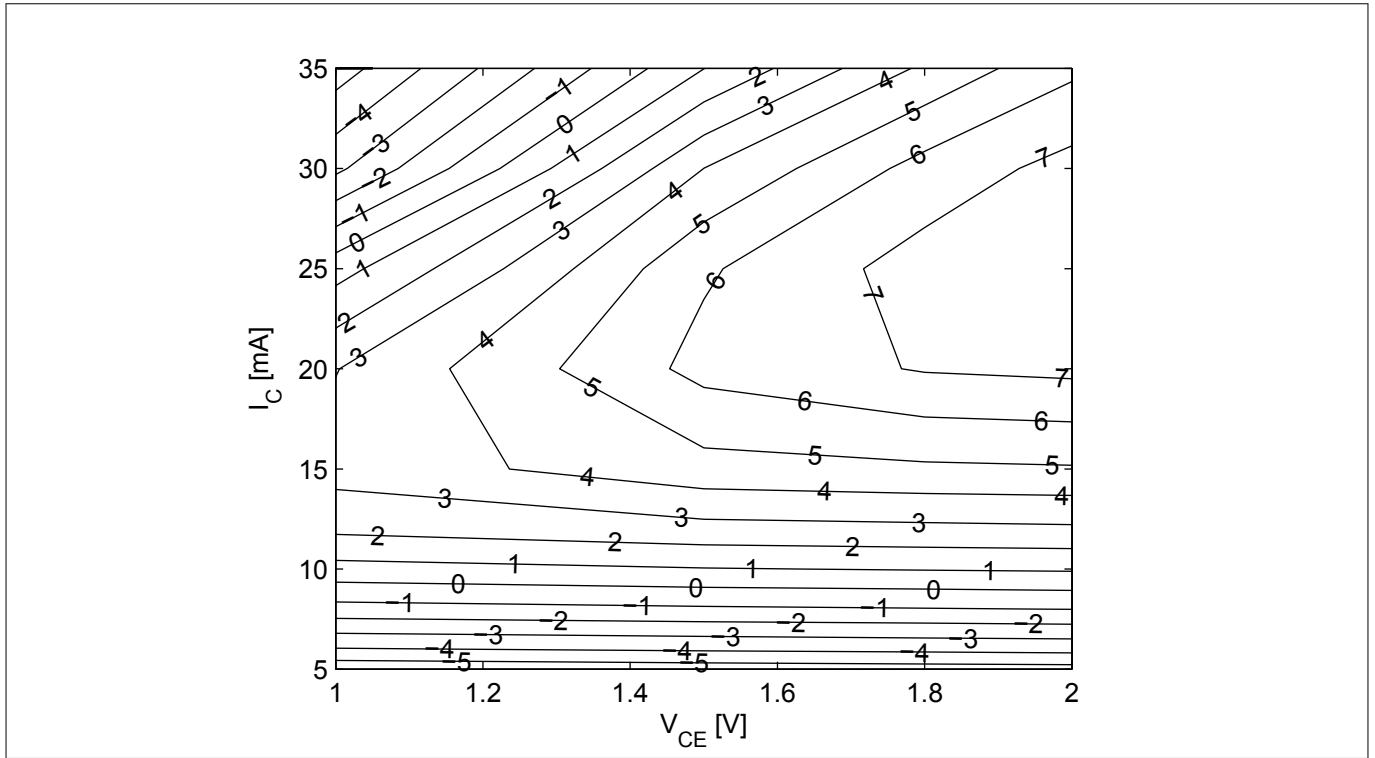


**Figure 8** 3rd order intercept point  $OIP_3 = f(I_C)$ ,  $Z_S = Z_L = 50 \Omega$ ,  $V_{CE}$ ,  $f$  = parameter

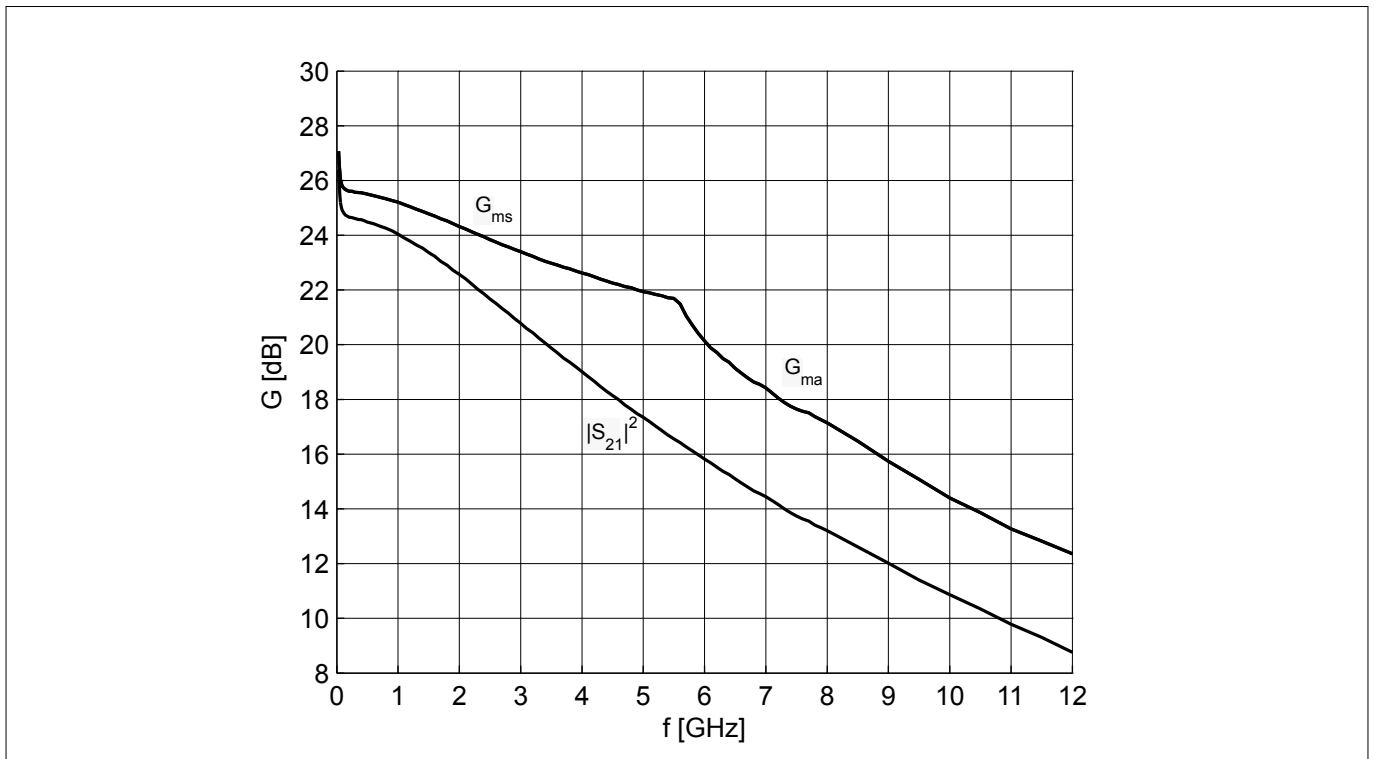


**Figure 9** 3rd order intercept point at output  $OIP_3$  [dBm] =  $f(I_C, V_{CE})$ ,  $Z_S = Z_L = 50 \Omega$ ,  $f = 5.5$  GHz

**Electrical characteristics**

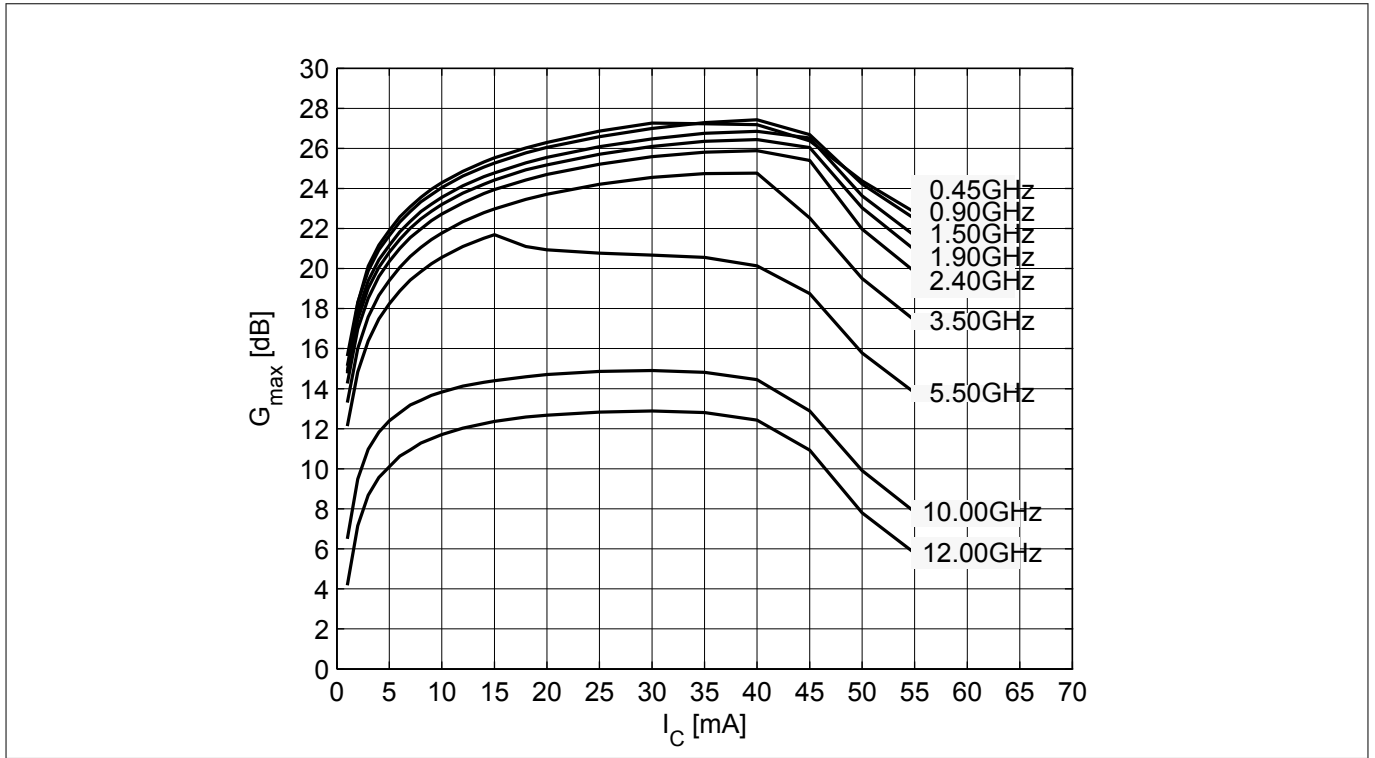


**Figure 10** Compression point at output  $OP_{1dB} [dBm] = f(I_C, V_{CE}), Z_S = Z_L = 50 \Omega, f = 5.5 \text{ GHz}$

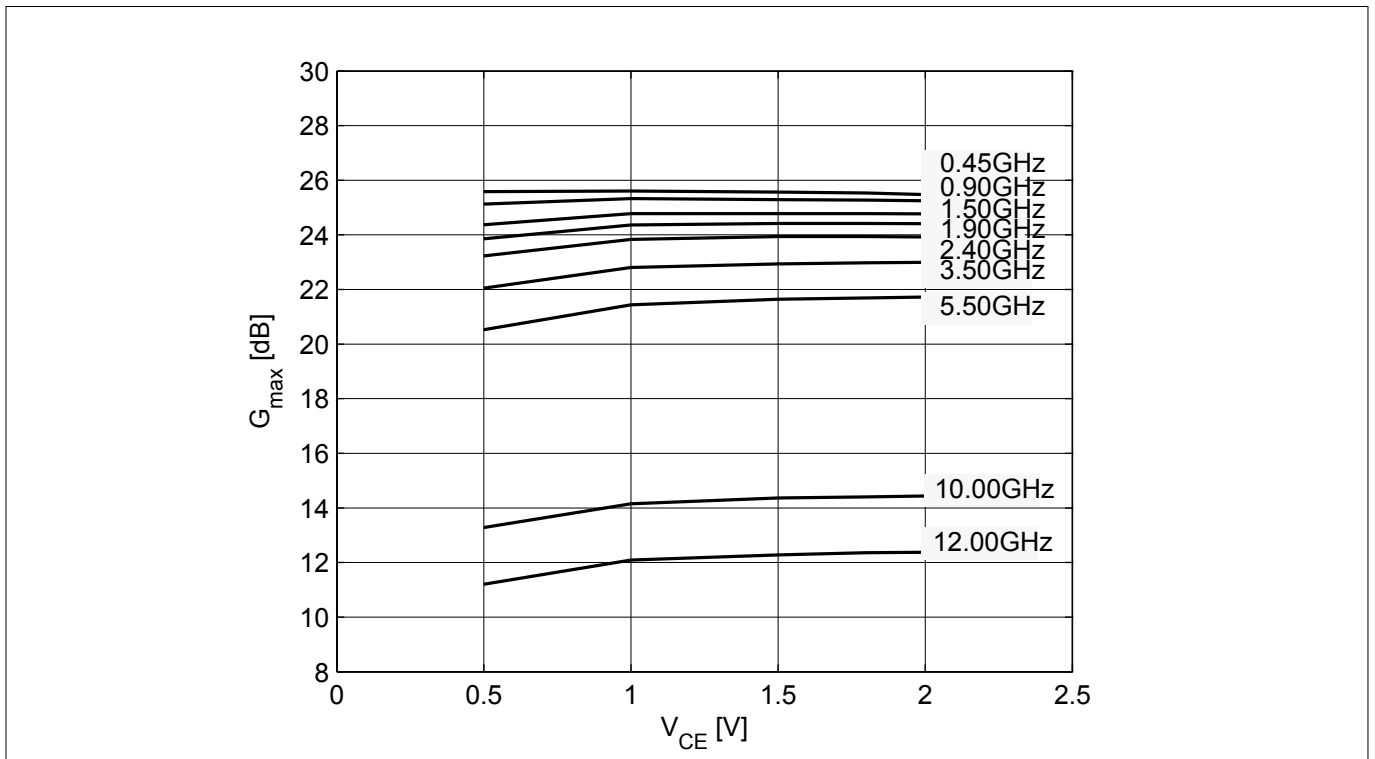


**Figure 11** Gain  $G_{ma}, G_{ms}, |S_{21}|^2 = f(f), V_{CE} = 1.8 \text{ V}, I_C = 15 \text{ mA}$

**Electrical characteristics**

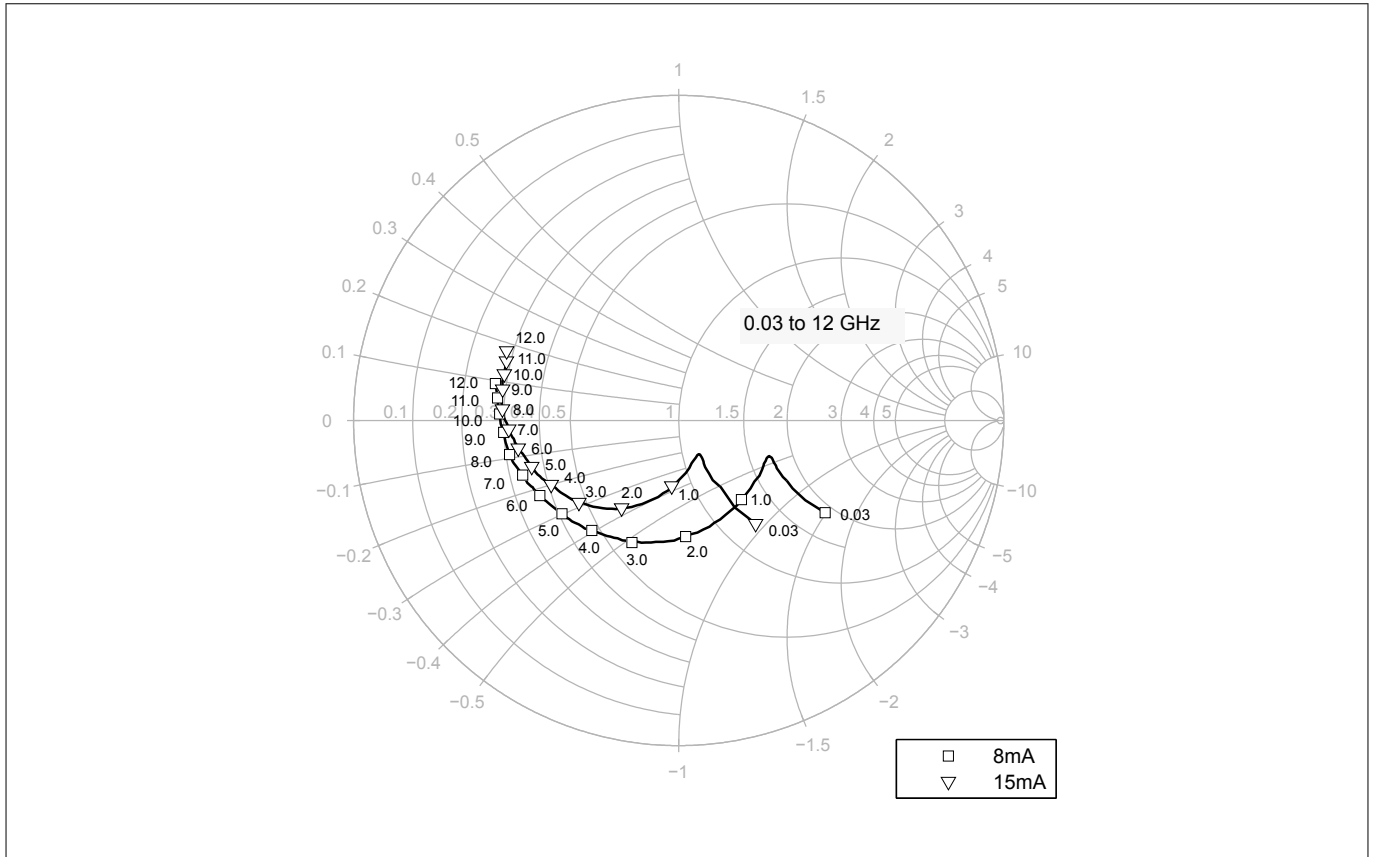


**Figure 12** Maximum power gain  $G_{max} = f(I_C)$ ,  $V_{CE} = 1.8 V$ ,  $f =$  parameter

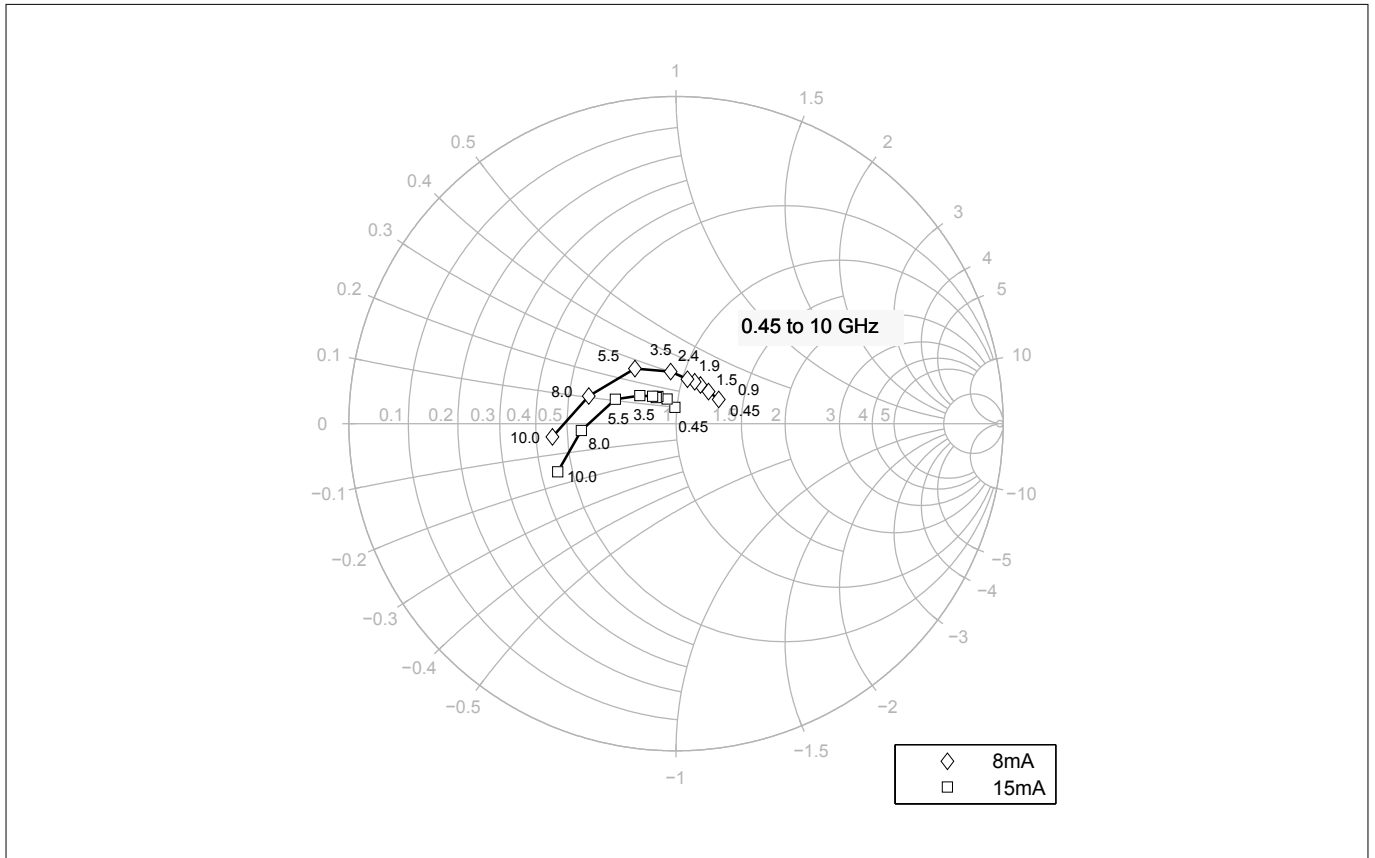


**Figure 13** Maximum power gain  $G_{max} = f(V_{CE})$ ,  $I_C = 15 mA$ ,  $f =$  parameter

**Electrical characteristics**



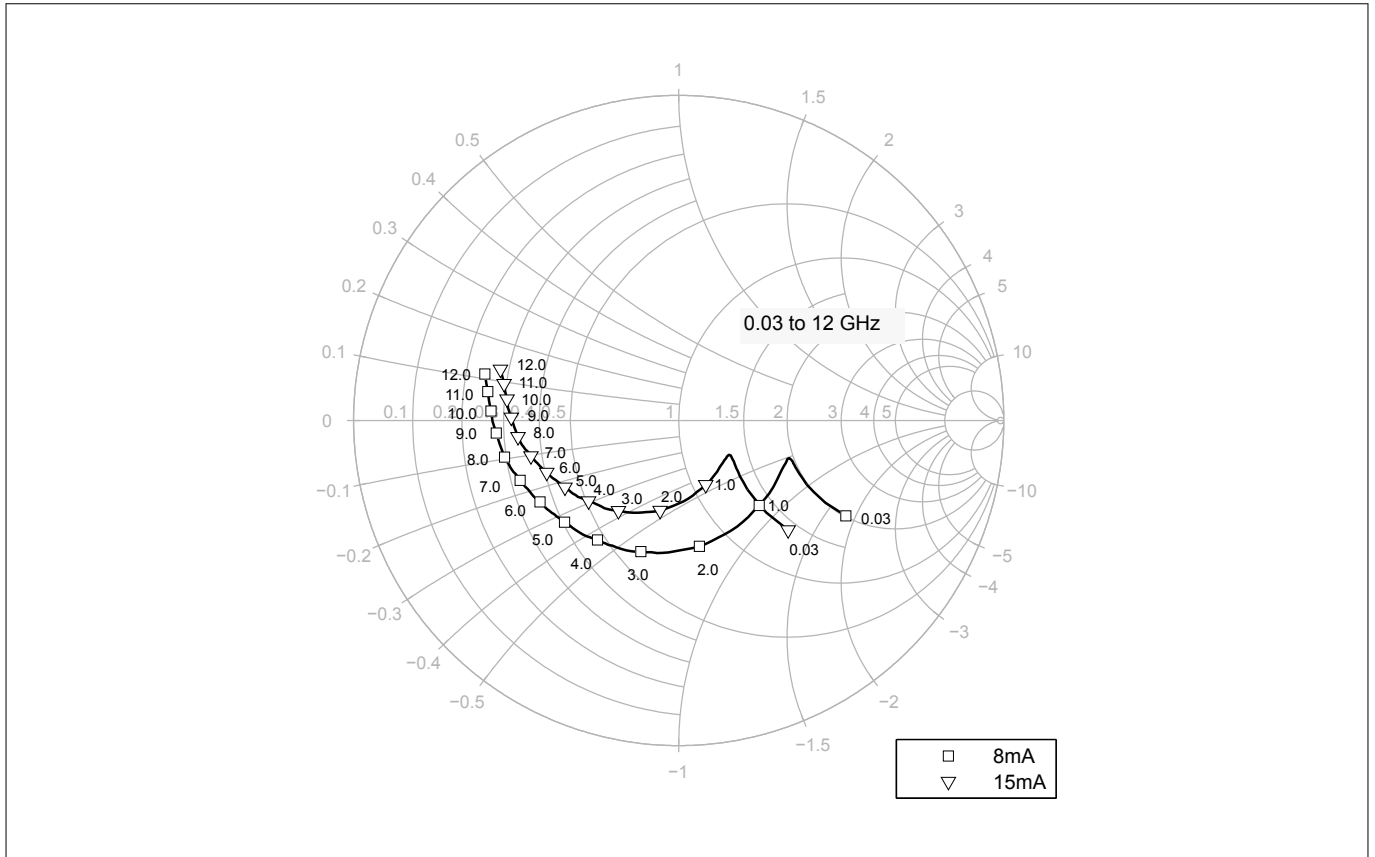
**Figure 14** Input reflection coefficient  $S_{11} = f(f)$ ,  $V_{CE} = 1.8 \text{ V}$ ,  $I_C = 8 / 15 \text{ mA}$



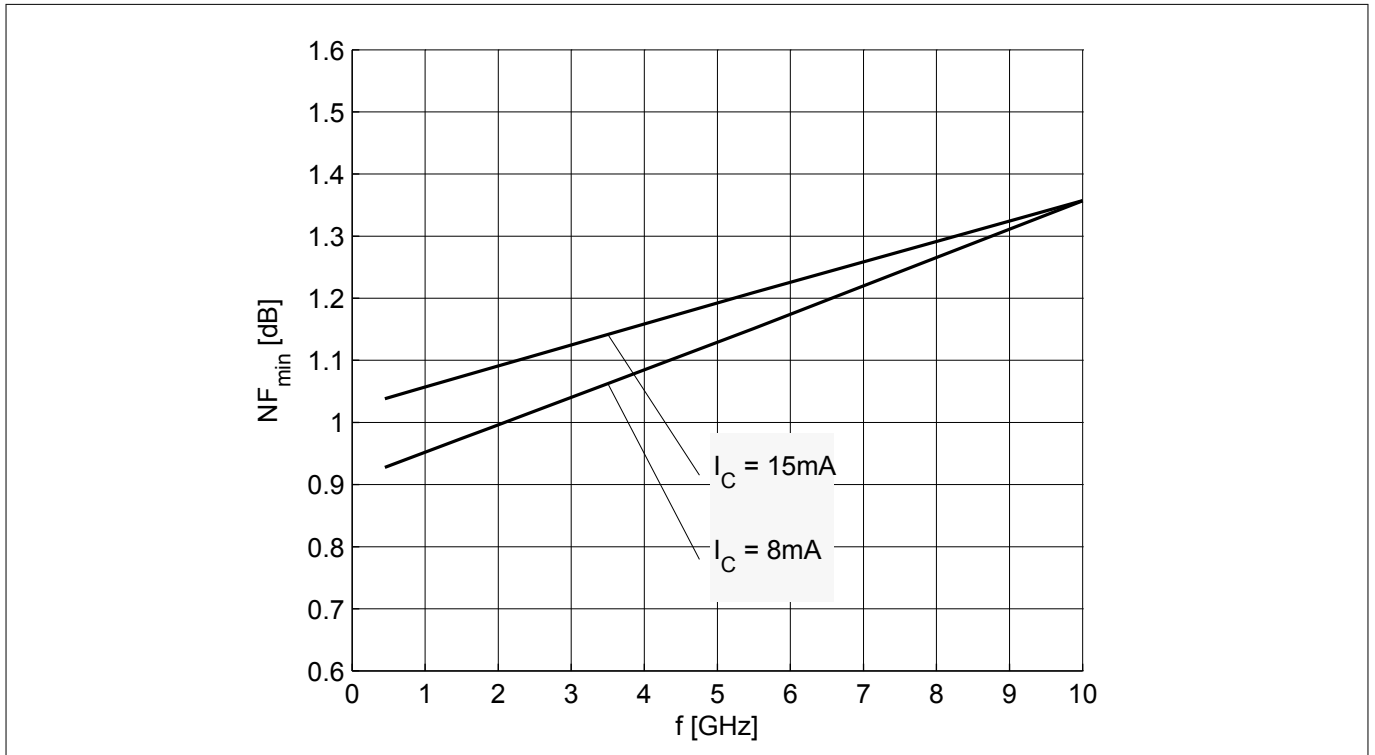
**Figure 15** Source impedance for minimum noise figure  $Z_{S,opt} = f(f)$ ,  $V_{CE} = 1.8 \text{ V}$ ,  $I_C = 8 / 15 \text{ mA}$



**Electrical characteristics**

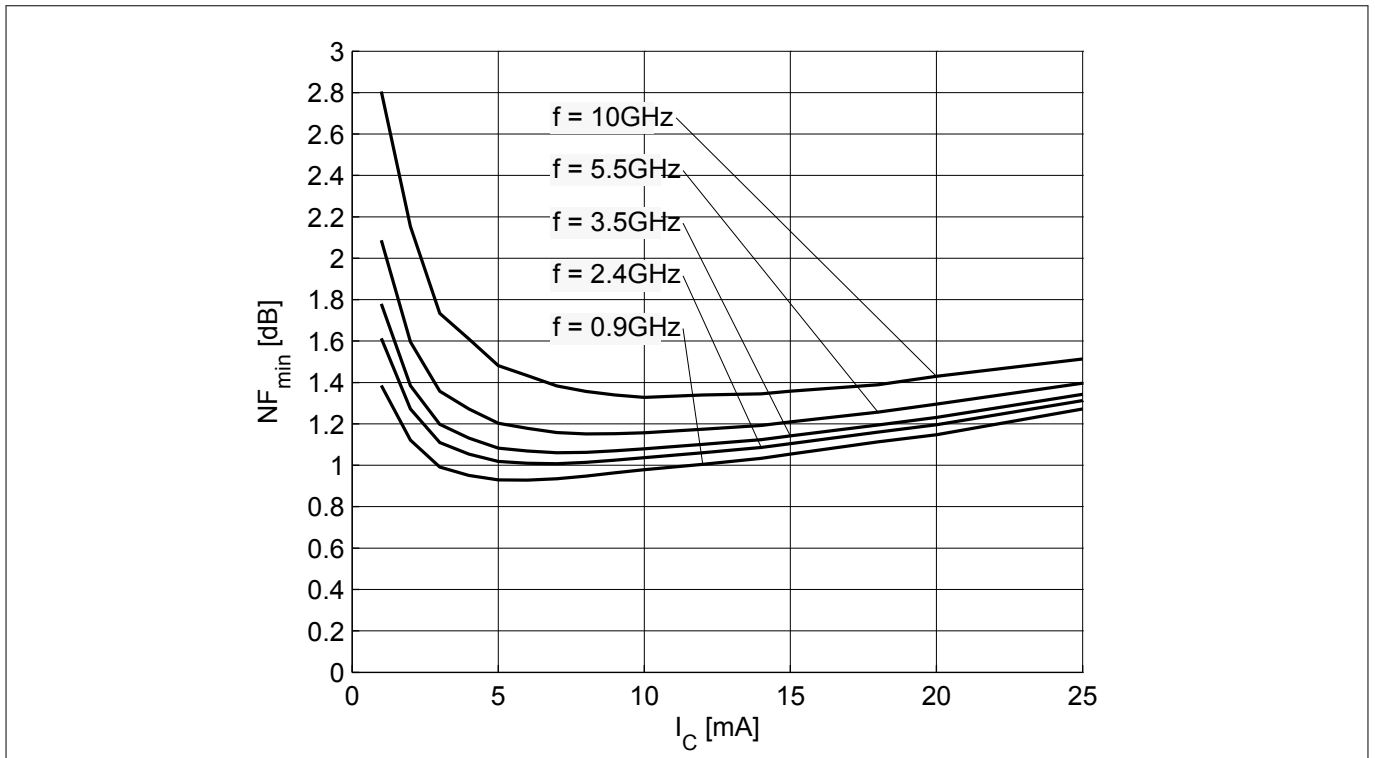


**Figure 16** Output reflection coefficient  $S_{22} = f(f)$ ,  $V_{CE} = 1.8\text{ V}$ ,  $I_C = 8 / 15\text{ mA}$

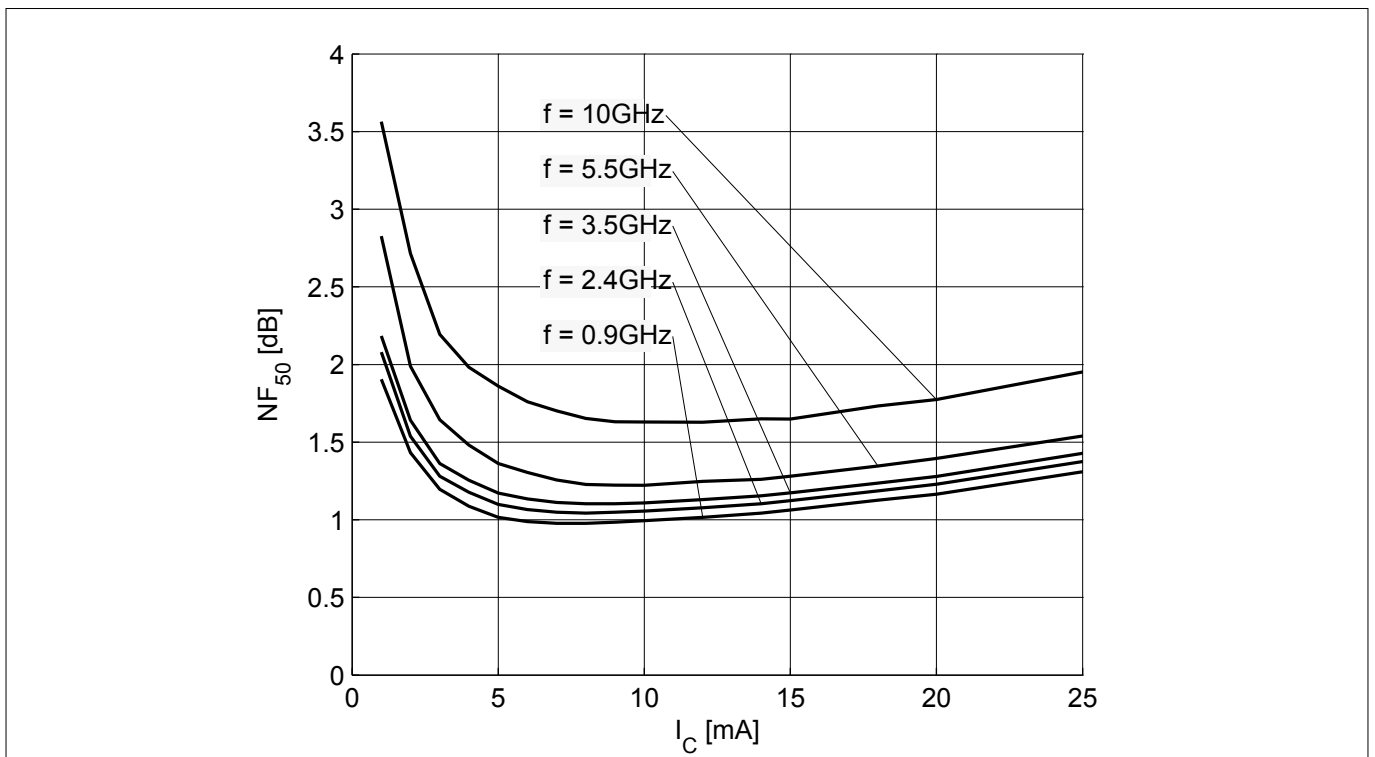


**Figure 17** Noise figure  $NF_{min} = f(f)$ ,  $V_{CE} = 1.8\text{ V}$ ,  $Z_S = Z_{S,opt}$ ,  $I_C = 8 / 15\text{ mA}$

**Electrical characteristics**



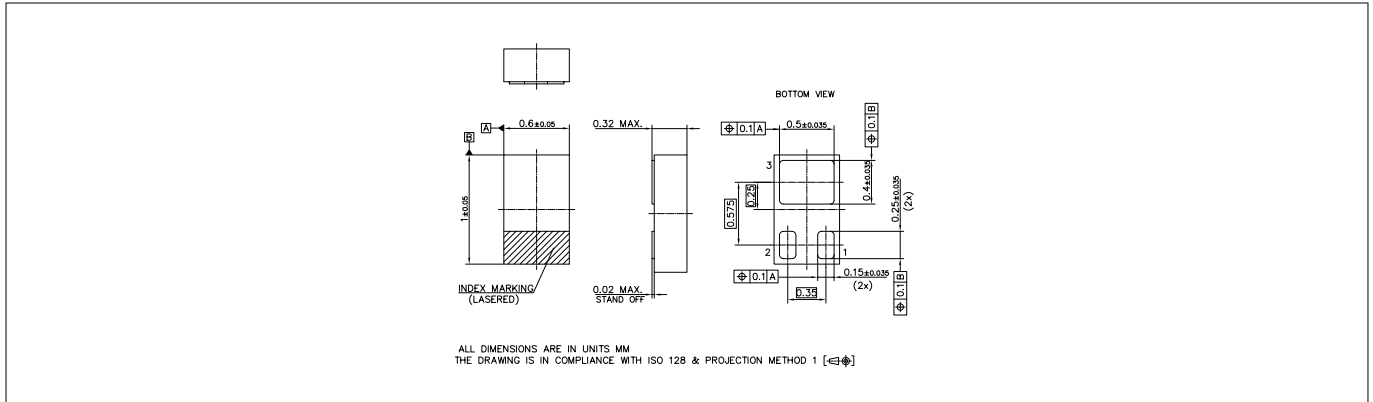
**Figure 18** Noise figure  $NF_{min} = f(I_C)$ ,  $V_{CE} = 1.8\text{ V}$ ,  $Z_S = Z_{S,opt}$ ,  $f = \text{parameter}$



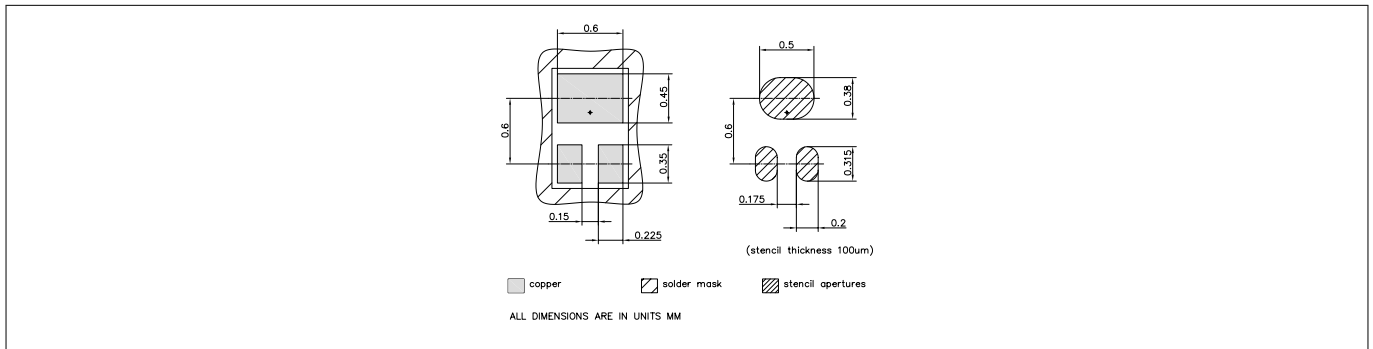
**Figure 19** Noise figure  $NF_{50} = f(I_C)$ ,  $V_{CE} = 1.8\text{ V}$ ,  $Z_S = 50\ \Omega$ ,  $f = \text{parameter}$

*Note:* The curves shown in this chapter have been generated using typical devices but shall not be considered as a guarantee that all devices have identical characteristic curves.  $T_A = 25\text{ }^\circ\text{C}$ .

## 4 Package information TSLP-3-10



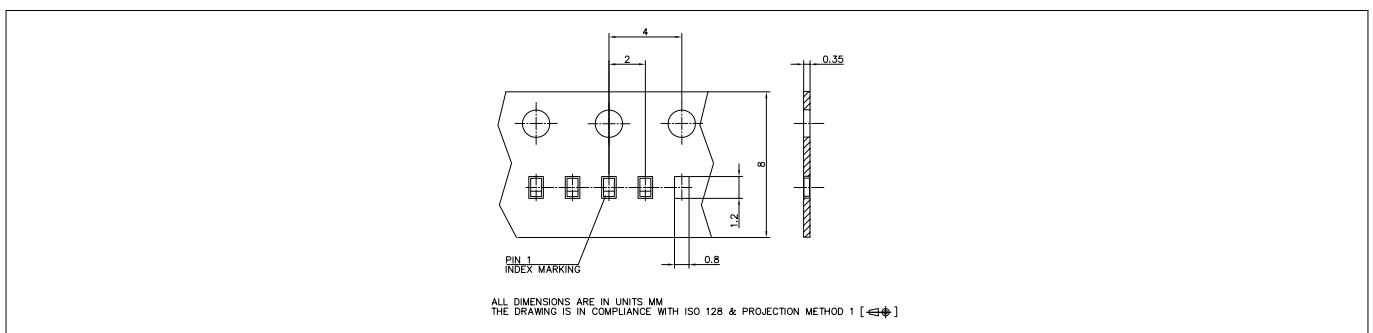
**Figure 20** Package outline



**Figure 21** Foot print



**Figure 22** Marking layout example



**Figure 23** Tape dimensions

Note: See our [Recommendations for Printed Circuit Board Assembly of TSLP/TSSLP/TSNP Packages](#). The marking layout is an example. For the real marking code refer to the device information on the first page. The number of characters shown in the layout example is not necessarily the real one. The marking layout can consist of less characters.

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Revision history

## Revision history

Document version	Date of release	Description of changes
2.0	2018-09-26	New datasheet layout.

## Trademarks

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