BFR843EL3

Low noise broadband pre-matched RF bipolar transistor

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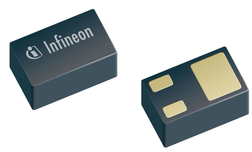
Product description

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***

Table of contents

1 Absolute maximum ratings

Table 2 Absolute maximum ratings at T_A = 25 °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 °C, open base
Collector emitter voltage [1)]	V_{CES}		2.25		E-B short circuited
			2.0		T_A = -55 °C, E-B short circuited
Collector base voltage [2)]	V_{CBO}		2.9		Open emitter
			2.6		T_A = -55 °C, open emitter
Base current	I_B	-1	5	mA	
Collector current	I_C	–	55		
RF input power	P_{RFin}		20	dBm	f = 1.9 GHz, matched to 50 Ω
ESD stress pulse	V_{ESD}	-1	1	kV	HBM, all pins, acc. to JESD22-A114
Total power dissipation [3)]	P_{tot}	–	125	mW	T_S ≤ 103 °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.***

1 V_{CES} is similar to V_{CEO} due to design.
2 V_{CBO} is similar to V_{CEO} due to design.
3 T_S is the soldering point temperature. T_S is measured on the emitter lead at the soldering point of the PCB.

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	

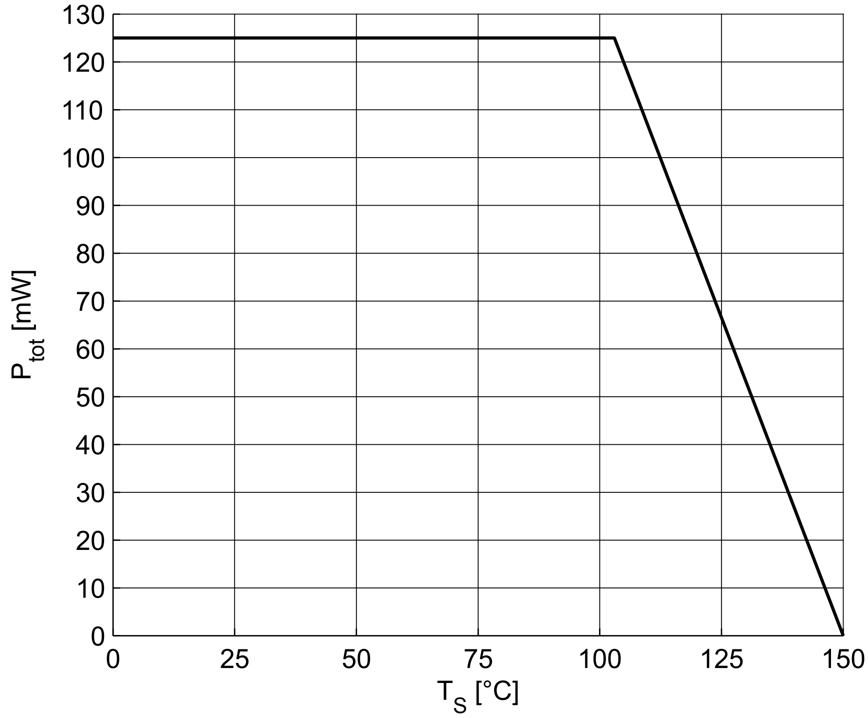


Figure 1 Total power dissipation P_{tot} = f(T_S)

3 Electrical characteristics

3.1 DC characteristics

Table 4 DC characteristics at T_A = 25 °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 mA, I_B = 0, open base
Collector emitter leakage current	I_{CES}	–	–	400 [1]	nA	V_{CE} = 1.5 V, V_{BE} = 0, E-B short circuited
Collector base leakage current	I_{CBO}			400 [1]		V_{CB} = 1.5 V, I_E = 0, open emitter
Emitter base leakage current	I_{EBO}			10 [1]	µA	V_{EB} = 0.5 V, I_C = 0, open collector
DC current gain	h_{FE}	230 –	360 260	580 –		V_{CE} = 1.8 V, I_C = 1 mA V_{CE} = 1.8 V, I_C = 15 mA Pulse measured

3.2 General AC characteristics

Table 5 General AC characteristics at T_A = 25 °C

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

1 Maximum values not limited by the device but by the short cycle time of the 100% test.
2 Including integrated feedback capacitance

3.3 Frequency dependent AC characteristics

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

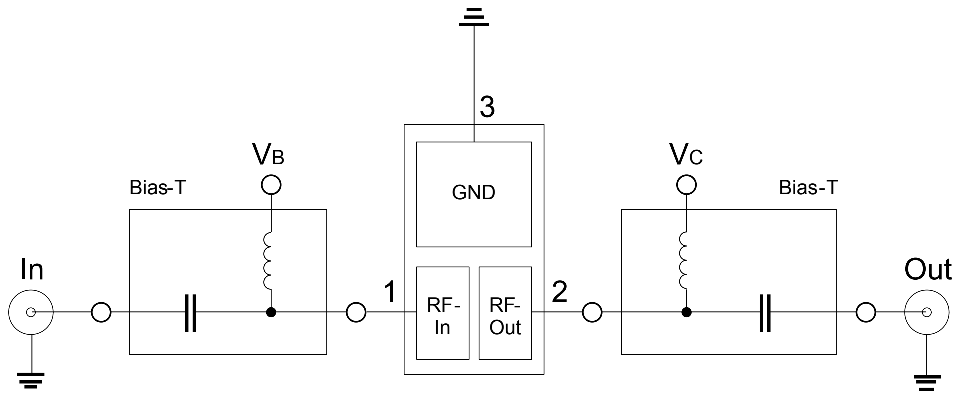


Figure 2 **Testing circuit**

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

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain • Maximum power gain • Transducer gain	 G_{ms} $\|S_{21}\|^2$	–	 25.5 24.5	–	dB	 I_C = 15 mA
Noise figure • Minimum noise figure • Associated gain	 NF_{min} G_{ass}		 0.95 22.5			 I_C = 8 mA
Linearity • 3rd order intercept point at output • 1 dB gain compression point at output	 OIP_3 OP_{1dB}		 23 7.5		dBm	 $Z_S = Z_L$ = 50 Ω, I_C = 15 mA

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

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	
• Maximum power gain	G_{ms}		25			I_C = 15 mA
• Transducer gain	$\|S_{21}\|^2$		24			
Noise figure						
• Minimum noise figure	NF_{min}		0.95			I_C = 8 mA
• Associated gain	G_{ass}		22			
Linearity					dBm	
• 3rd order intercept point at output	OIP_3		21.5			$Z_S = Z_L$ = 50 Ω, I_C = 15 mA
• 1 dB gain compression point at output	OP_{1dB}		7			

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

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	
• Maximum power gain	G_{ms}		24.5			I_C = 15 mA
• Transducer gain	$\|S_{21}\|^2$		23			
Noise figure						
• Minimum noise figure	NF_{min}		0.95			I_C = 8 mA
• Associated gain	G_{ass}		21.5			
Linearity					dBm	
• 3rd order intercept point at output	OIP_3		21.5			$Z_S = Z_L$ = 50 Ω, I_C = 15 mA
• 1 dB gain compression point at output	OP_{1dB}		7			

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

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	
• Maximum power gain	G_{ms}		24.5			I_C = 15 mA
• Transducer gain	$\|S_{21}\|^2$		22.5			
Noise figure						
• Minimum noise figure	NF_{min}		1			I_C = 8 mA
• Associated gain	G_{ass}		21			
Linearity					dBm	
• 3rd order intercept point at output	OIP_3		21			$Z_S = Z_L$ = 50 Ω, I_C = 15 mA
• 1 dB gain compression point at output	OP_{1dB}		7			

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

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	
• Maximum power gain	G_{ms}		24			I_C = 15 mA
• Transducer gain	$\|S_{21}\|^2$		22			
Noise figure						
• Minimum noise figure	NF_{min}		1			I_C = 8 mA
• Associated gain	G_{ass}		20			
Linearity					dBm	
• 3rd order intercept point at output	OIP_3		20.5			$Z_S = Z_L$ = 50 Ω, I_C = 15 mA
• 1 dB gain compression point at output	OP_{1dB}		6			

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

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	
• Maximum power gain	G_{ms}		23			I_C = 15 mA
• Transducer gain	$\|S_{21}\|^2$		19.5			
Noise figure						
• Minimum noise figure	NF_{min}		1.05			I_C = 8 mA
• Associated gain	G_{ass}		18.5			
Linearity					dBm	
• 3rd order intercept point at output	OIP_3		20.5			$Z_S = Z_L$ = 50 Ω, I_C = 15 mA
• 1 dB gain compression point at output	OP_{1dB}		6			

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

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	
• Maximum power gain	G_{ms}		21.5			I_C = 15 mA
• Transducer gain	$\|S_{21}\|^2$		16.5			
Noise figure						
• Minimum noise figure	NF_{min}		1.15			I_C = 8 mA
• Associated gain	G_{ass}		15.5			
Linearity					dBm	
• 3rd order intercept point at output	OIP_3		20.5			$Z_S = Z_L$ = 50 Ω, I_C = 15 mA
• 1 dB gain compression point at output	OP_{1dB}		4.5			

Table 13 AC characteristics, V_{CE} = 1.8 V, f = 10 GHz

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	
• Maximum power gain	G_{ma}		14.5			I_C = 15 mA
• Transducer gain	$\|S_{21}\|^2$		10.5			
Noise figure						
• Minimum noise figure	NF_{min}		1.35			I_C = 8 mA
• Associated gain	G_{ass}		10.5			
Linearity					dBm	
• 3rd order intercept point at output	OIP_3		17			$Z_S = Z_L$ = 50 Ω, I_C = 15 mA
• 1 dB gain compression point at output	OP_{1dB}		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 Ω from 0.2 MHz to 12 GHz.*

3.4 Characteristic DC diagrams

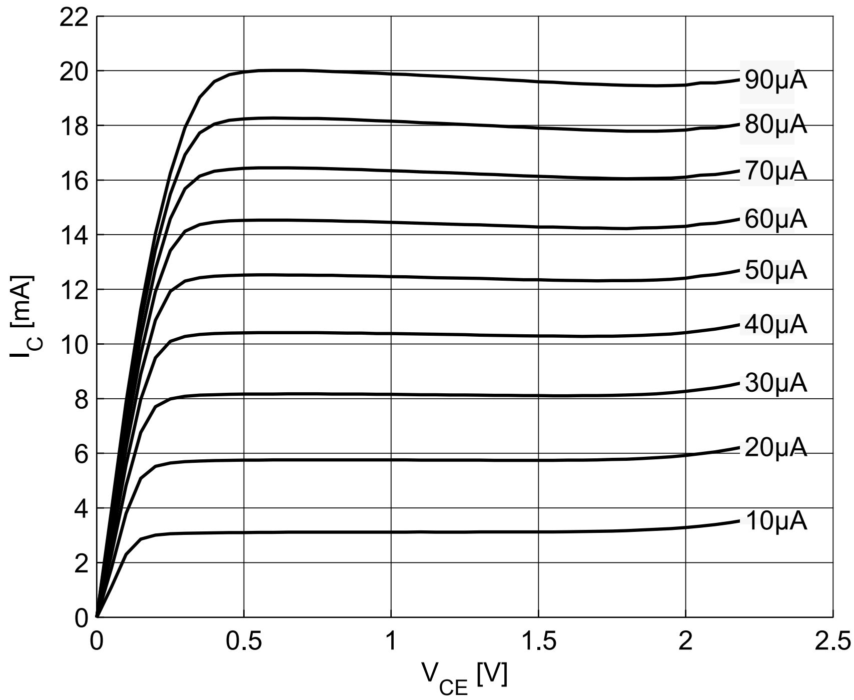


Figure 3 Collector current vs. collector emitter voltage $I_C = f(V_{CE})$, I_B = parameter

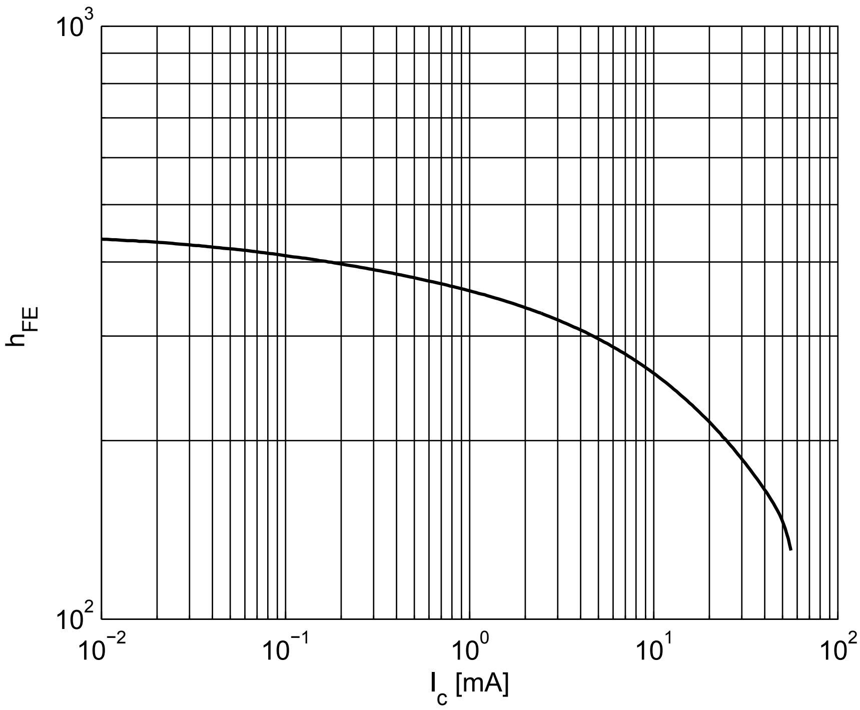


Figure 4 DC current gain $h_{FE} = f(I_C)$, V_{CE} = 1.8 V

Electrical characteristics

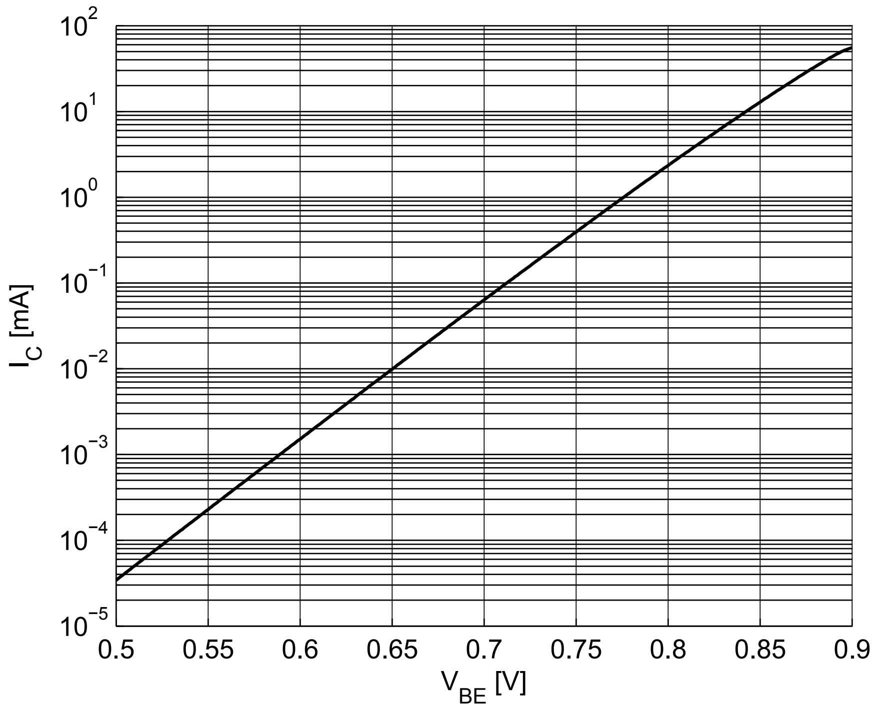


Figure 5 **Collector current vs. base emitter forward voltage $I_C = f(V_{BE})$, $V_{CE} = 1.8$ V**

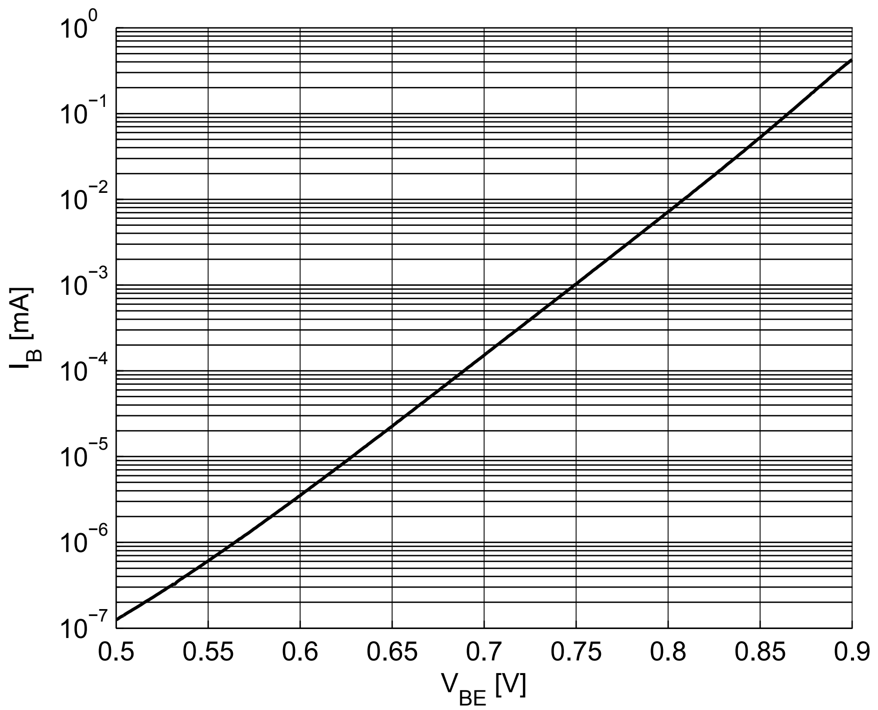


Figure 6 **Base current vs. base emitter forward voltage $I_B = f(V_{BE})$, $V_{CE} = 1.8$ V**

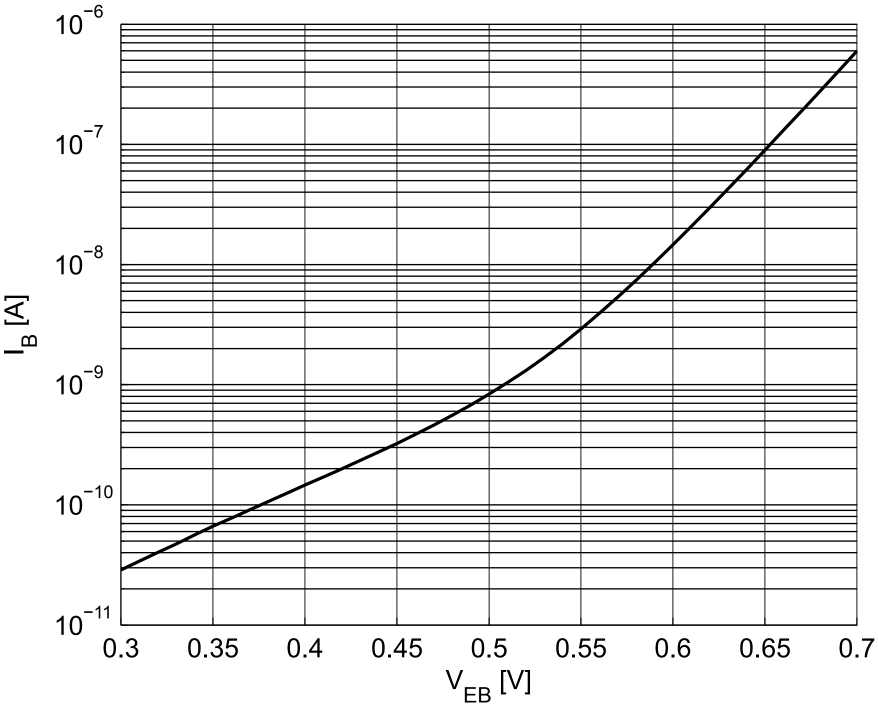


Figure 7 **Base current vs. base emitter reverse voltage $I_B = f(V_{EB})$, $V_{CE} = 1.8$ V**

3.5 Characteristic AC diagrams

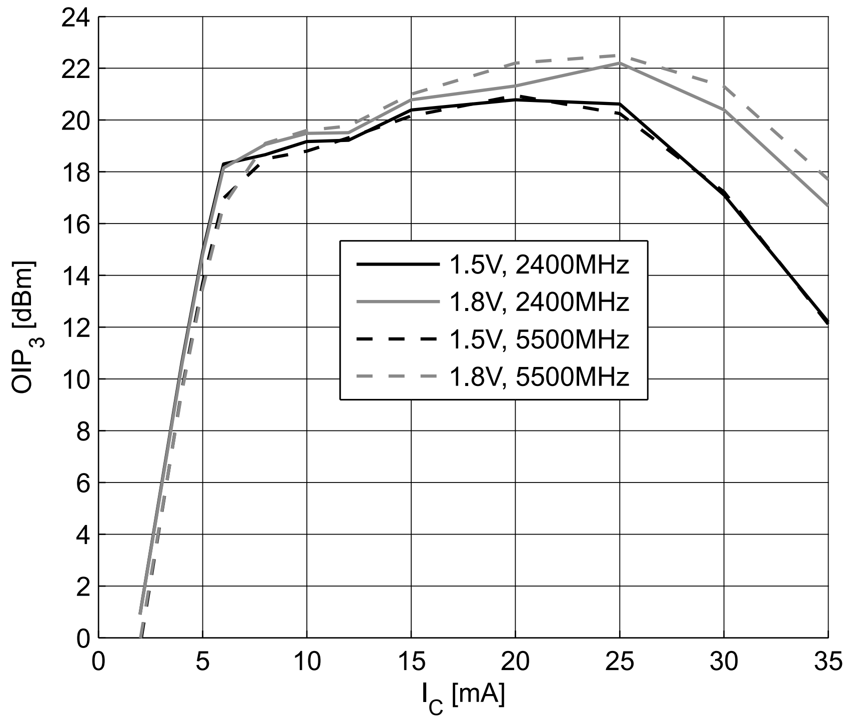


Figure 8 3rd order intercept point $OIP_3 = f(I_C)$, $Z_S = Z_L = 50\ \Omega$, V_{CE}, f = parameter

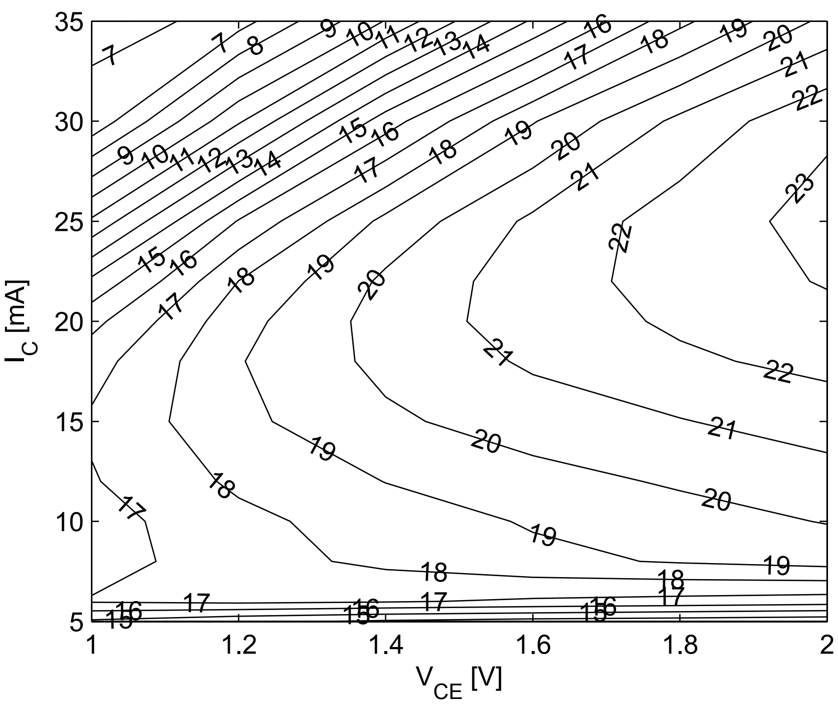


Figure 9 3rd order intercept point at output OIP_3 [dBm] = $f(I_C, V_{CE})$, $Z_S = Z_L = 50\ \Omega$, f = 5.5 GHz

Electrical characteristics

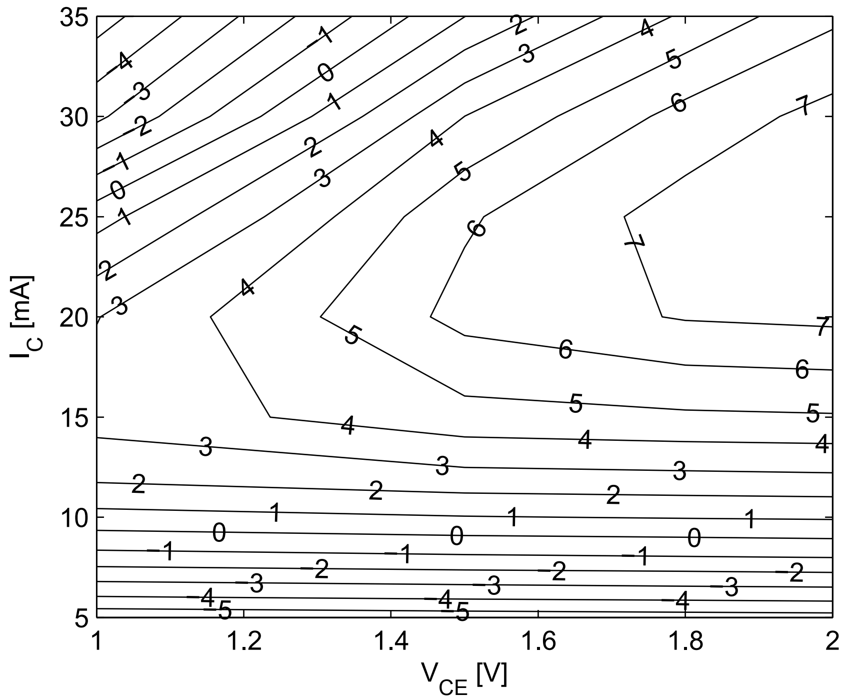


Figure 10 **Compression point at output OP_{1dB} [dBm] = f(I_C, V_{CE}), Z_S = Z_L= 50 Ω, f = 5.5 GHz**

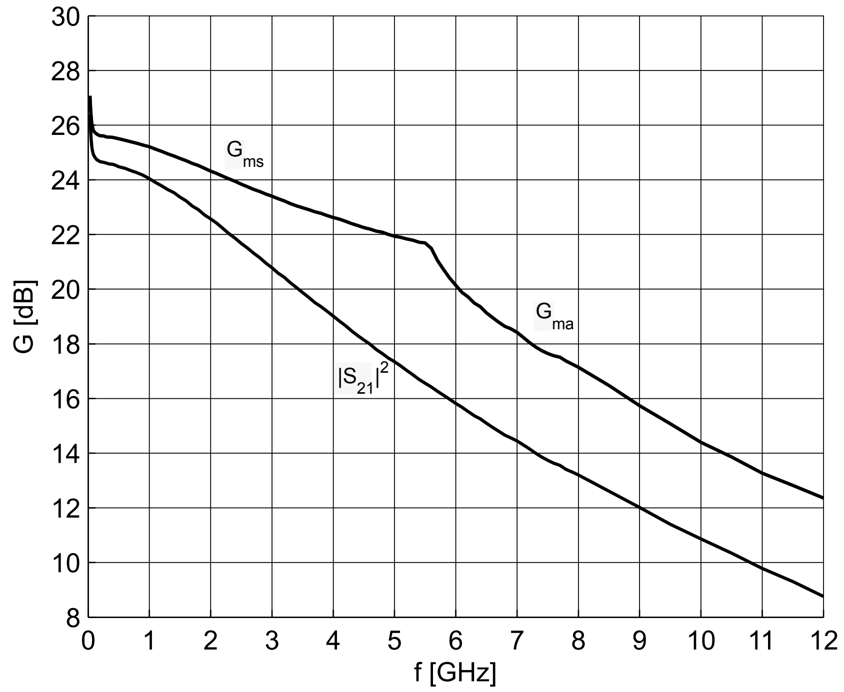


Figure 11 **Gain G_{ma}, G_{ms}, $|S_{21}|^2$ = f(f), V_{CE} = 1.8 V, I_C = 15 mA**

Electrical characteristics

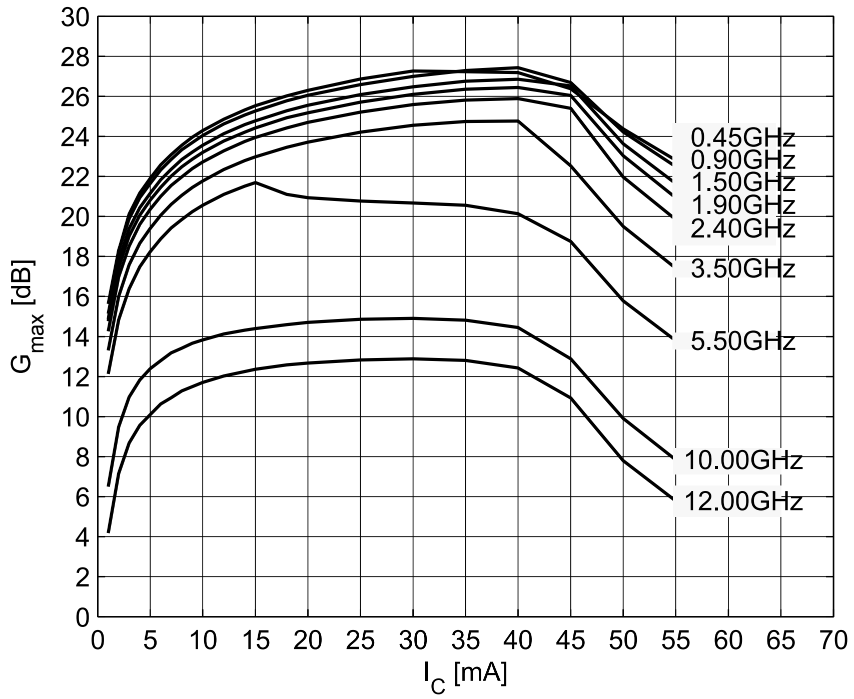


Figure 12 **Maximum power gain G_{max} = f(I_C), V_{CE} = 1.8 V, f = parameter**

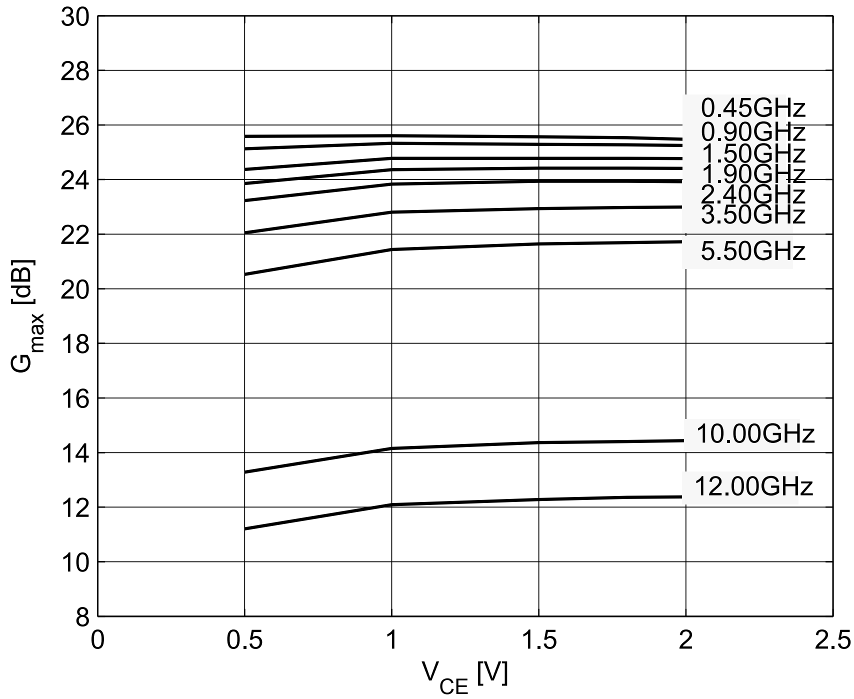


Figure 13 **Maximum power gain G_{max} = f(V_{CE}), I_C = 15 mA, f = parameter**

Electrical characteristics

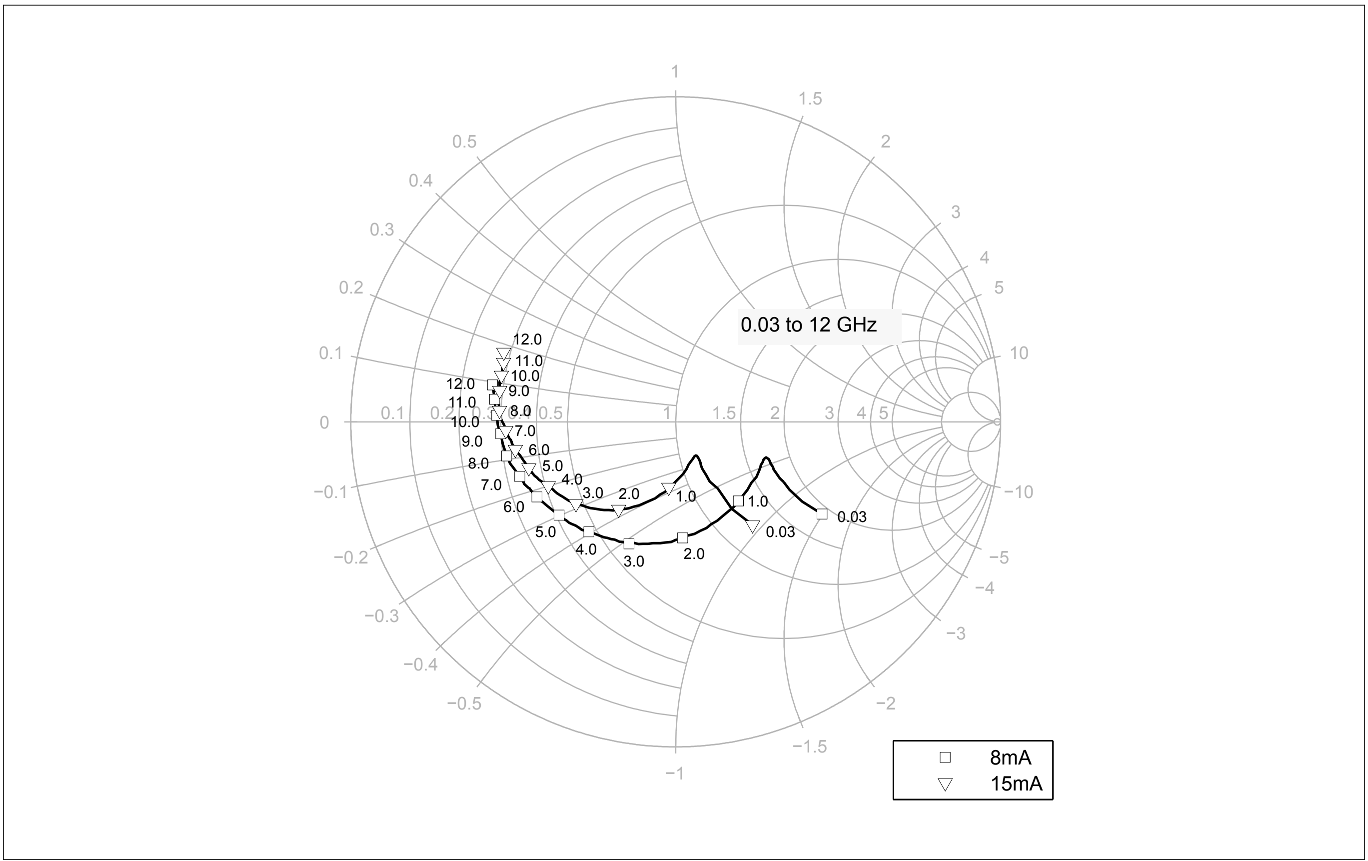


Figure 14 **Input reflection coefficient S_{11} = f(f), V_{CE} =1.8 V, I_C = 8 / 15 mA**

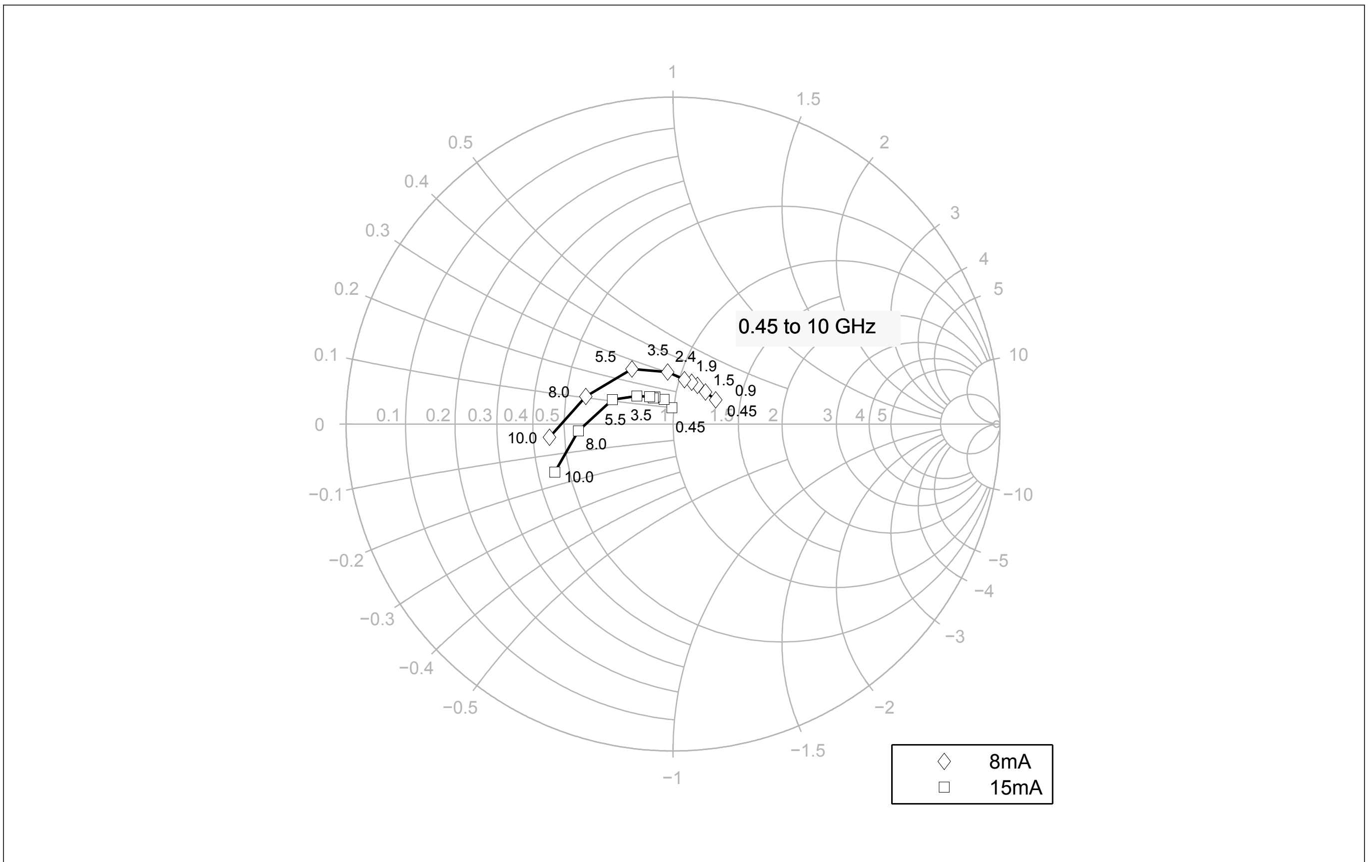


Figure 15 **Source impedance for minimum noise figure $Z_{S,opt}$ = f(f), V_{CE} = 1.8 V, I_C = 8 / 15 mA**

Electrical characteristics

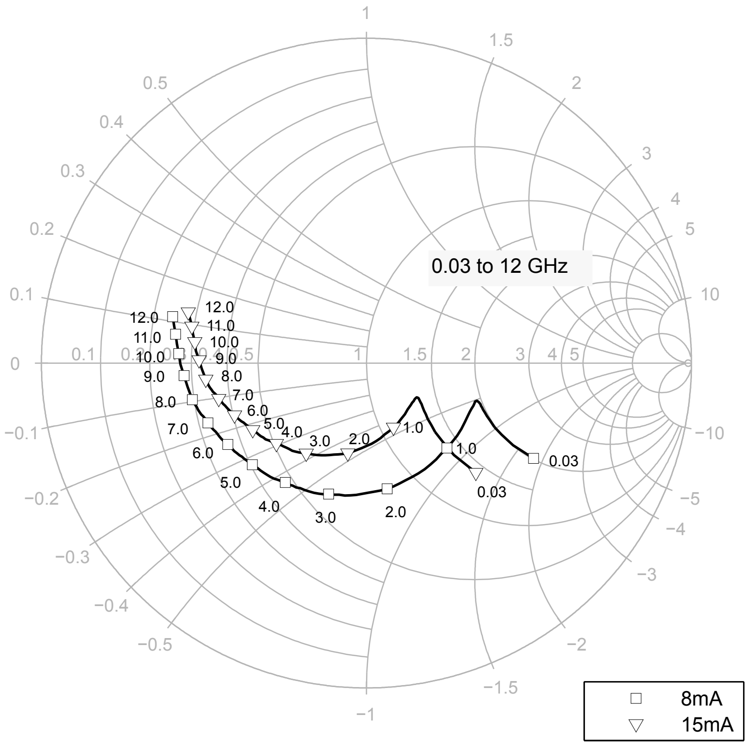


Figure 16 Output reflection coefficient S_{22} = f(f), V_{CE} = 1.8 V, I_C = 8 / 15 mA

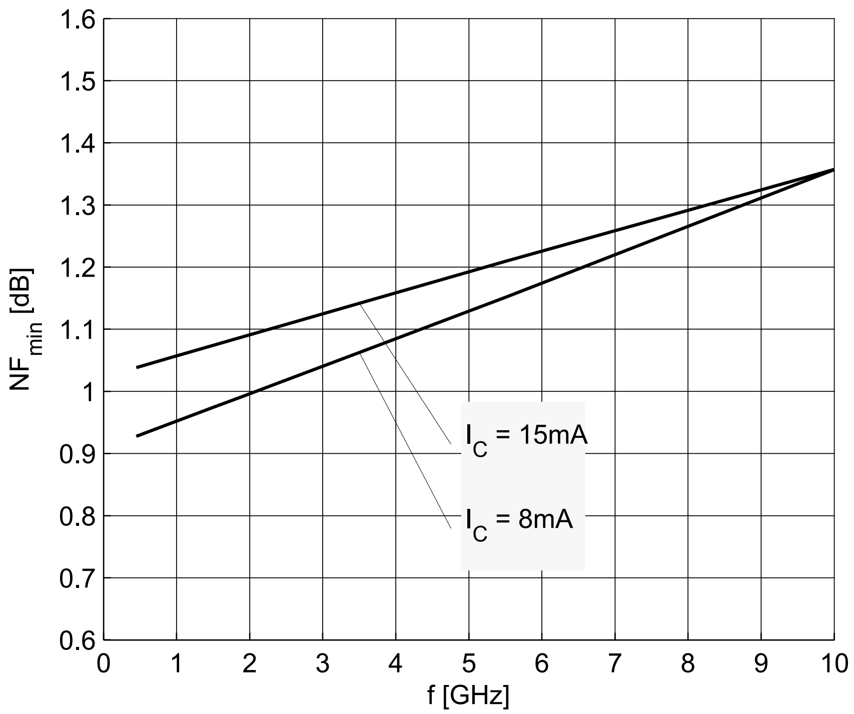


Figure 17 Noise figure NF_{min} = f(f), V_{CE} = 1.8 V, Z_S = $Z_{S,opt}$, I_C = 8 / 15 mA

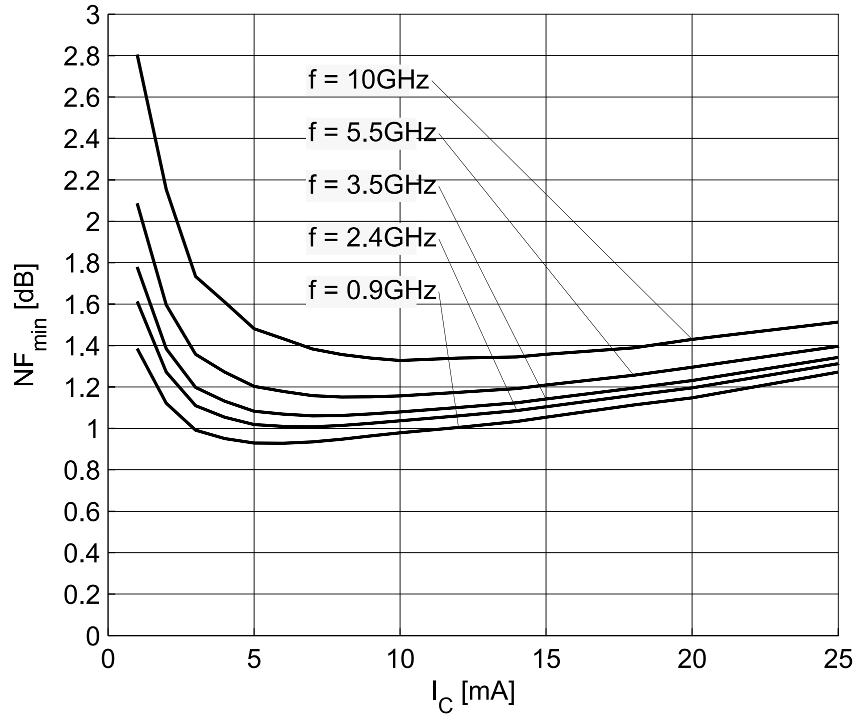


Figure 18 **Noise figure NF_{min} = f(I_C), V_{CE} = 1.8 V, $Z_S = Z_{S,opt}$, f = parameter**

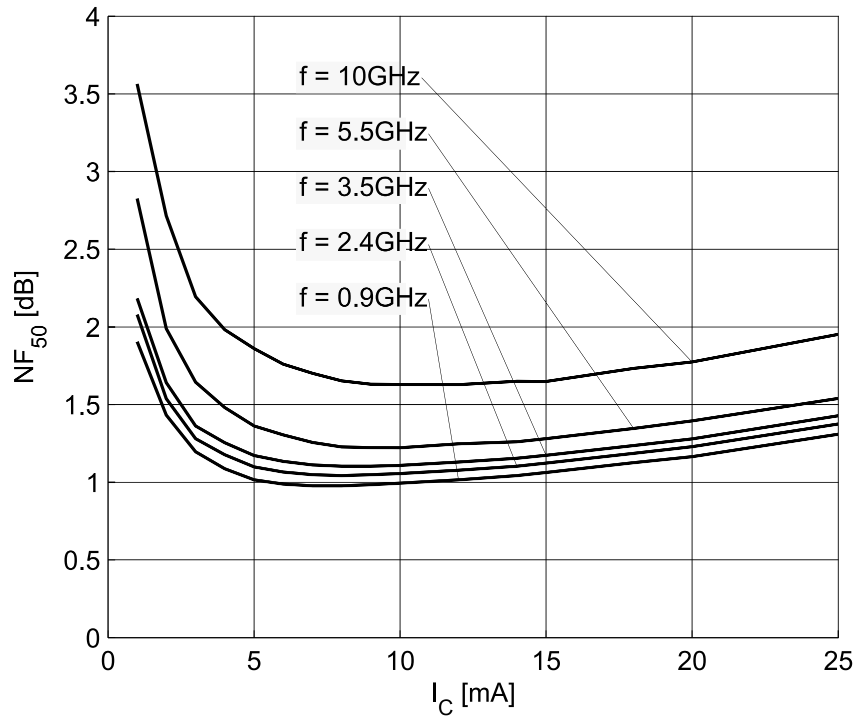


Figure 19 **Noise figure NF_{50} = f(I_C), V_{CE} = 1.8 V, Z_S = 50 Ω, f = parameter**

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 °C.

4 Package information TSLP-3-10

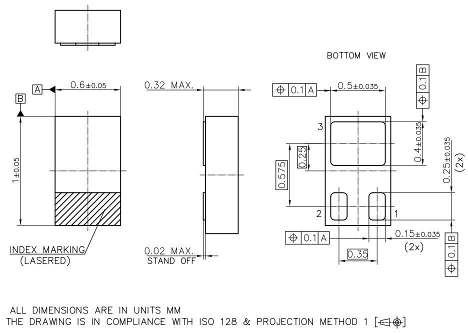


Figure 20 **Package outline**

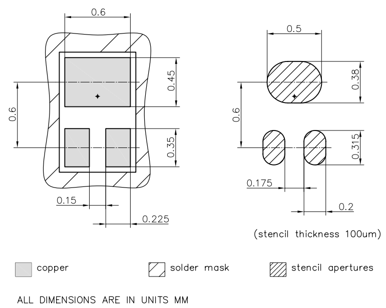


Figure 21 **Foot print**

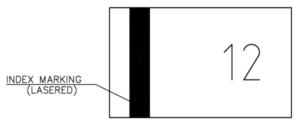


Figure 22 **Marking layout example**

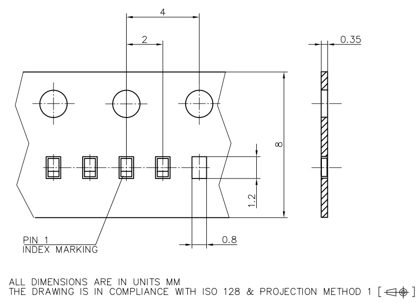


Figure 23 **Tape dimensions**

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.

Revision history

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

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