

BFP420F

Low profile silicon NPN RF bipolar transistor



Product description

The BFP420F is a low noise device based on a grounded emitter (SIEGET™) that is part of Infineon's established fourth generation RF bipolar transistor family. Its transition frequency f_T of 25 GHz and low current characteristics make the device suitable for amplifiers up to 4.5 GHz. It remains cost competitive without compromising on ease of use.



Feature list

- Minimum noise figure $NF_{min} = 1.1$ dB at 1.9 GHz, 3 V, 4 mA
- High gain $G_{ma} = 19$ dB at 1.9 GHz, 4 V, 40 mA
- $OIP_3 = 28$ dBm at 1.9 GHz, 4 V, 40 mA

Product validation

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

Potential applications

- Radio-frequency oscillators
- Broadband low noise amplifiers (LNAs) for CATV, DVB-T, DAB/DMB and FM/AM radio
- LNAs for sub-1 GHz ISM band applications

Device information

Table 1 Part information

Product name / Ordering code	Package	Pin configuration				Marking	Pieces / Reel
BFP420F / BFP420FH6327XTSA1	TSFP-4-1	1 = B	2 = E	3 = C	4 = E	AMs	3000

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}	–	4.5	V	Open base
			4.1		$T_A = -55\text{ °C}$, open base
Collector base voltage	V_{CBO}		15		Open emitter
Collector emitter voltage	V_{CES}		15		E-B short circuited
Emitter base voltage	V_{EBO}		1.5		Open collector
Base current	I_B		9	mA	–
Collector current	I_C		60		
Total power dissipation ¹⁾	P_{tot}		210	mW	$T_S \leq 100\text{ °C}$
Junction temperature	T_J	–55	150	°C	–
Storage temperature	T_{Stg}				

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 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}	–	240	–	K/W	–

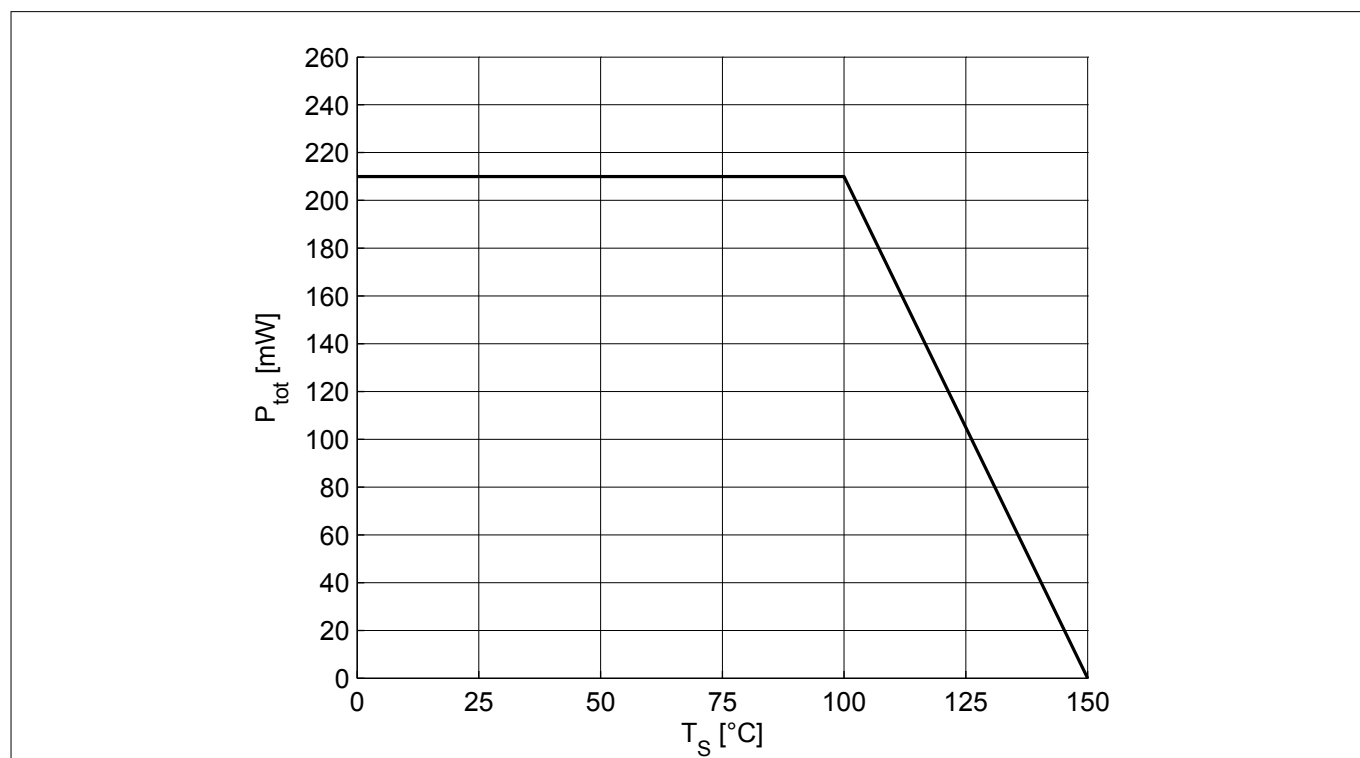


Figure 1 Total power dissipation $P_{tot} = f(T_S)$

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	$V_{(BR)CEO}$	4.5	5.5	–	V	$I_C = 1\text{ mA}$, $I_B = 0$, open base
Collector emitter leakage current	I_{CES}	–	–	10 ²⁾	μA	$V_{CE} = 15\text{ V}$, $V_{BE} = 0$,
			1	30 ²⁾	nA	$V_{CE} = 3\text{ V}$, $V_{BE} = 0$, E-B short circuited
Collector base leakage current	I_{CBO}		1	30 ²⁾		$V_{CB} = 3\text{ V}$, $I_E = 0$, open emitter
Emitter base leakage current	I_{EBO}		10	100 ²⁾		$V_{EB} = 0.5\text{ V}$, $I_C = 0$, open collector
DC current gain	h_{FE}	60	95	130		$V_{CE} = 4\text{ V}$, $I_C = 5\text{ mA}$, 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.		
Transition frequency	f_T	18	25	–	GHz	$V_{CE} = 3\text{ V}$, $I_C = 30\text{ mA}$, $f = 2\text{ GHz}$
Collector base capacitance	C_{CB}	–	0.15	0.3	pF	$V_{CB} = 2\text{ V}$, $V_{BE} = 0$, $f = 1\text{ MHz}$, emitter grounded
Collector emitter capacitance	C_{CE}		0.46	–		$V_{CE} = 2\text{ V}$, $V_{BE} = 0$, $f = 1\text{ MHz}$, base grounded
Emitter base capacitance	C_{EB}		0.55	–		$V_{EB} = 0.5\text{ V}$, $V_{CB} = 0$, $f = 1\text{ MHz}$, collector grounded

²⁾ Maximum values not limited by the device but by the short cycle time of the 100% test.

Electrical characteristics

3.3 Frequency dependent AC characteristics

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

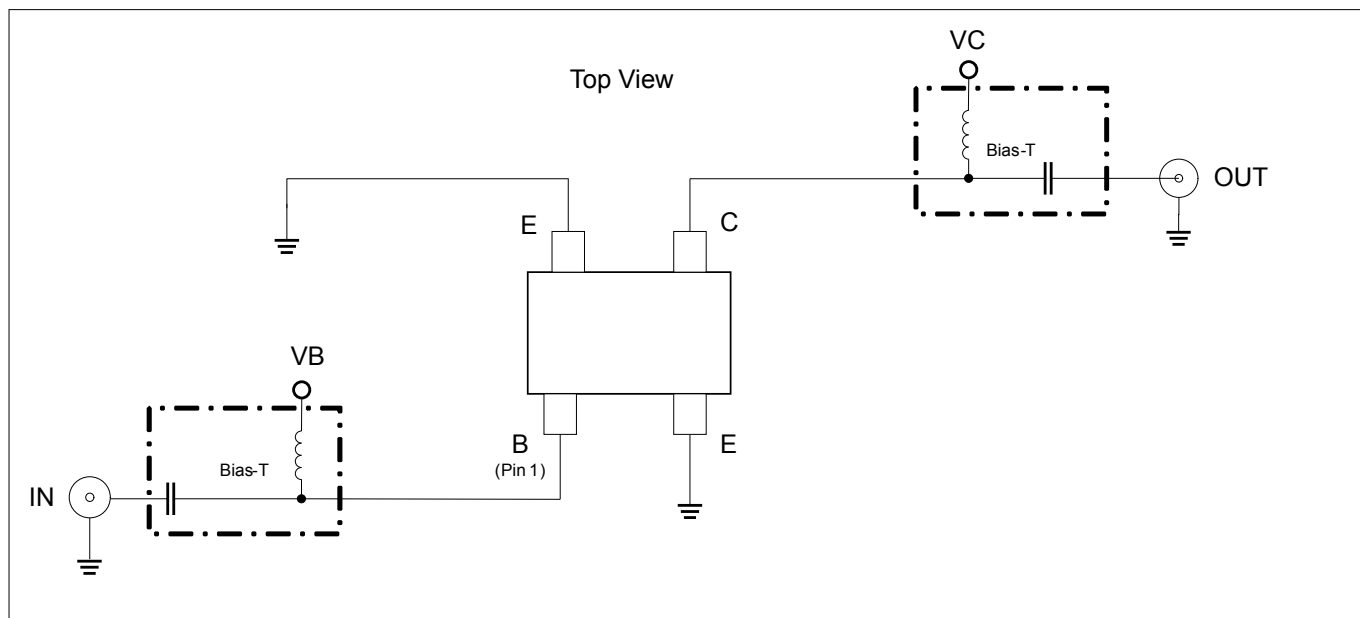


Figure 2 Testing circuit

Table 6 AC characteristics, $V_{CE} = 4\text{ V}$, $f = 150\text{ MHz}$

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	
• Maximum power gain	G_{ms}		37			$I_C = 40\text{ mA}$
• Transducer gain	$ S_{21} ^2$		33			
Noise figure					dB	
• Minimum noise figure	NF_{min}		0.9			$V_{CE} = 3\text{ V}$, $I_C = 4\text{ mA}$
• Associated gain	G_{ass}		24			
Linearity		–		–	dBm	
• 3rd order intercept point at output	OIP_3		25			$I_C = 40\text{ mA}$, $Z_S = Z_L = 50\text{ }\Omega$
• 1 dB gain compression point at output	OP_{1dB}		15.5			

Electrical characteristics

Table 7 AC characteristics, $V_{CE} = 4 \text{ V}$, $f = 450 \text{ MHz}$

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain - Maximum power gain - Transducer gain	G_{ms} $ S_{21} ^2$	–	31 28.5	–	dB	$I_C = 40 \text{ mA}$
Noise figure - Minimum noise figure - Associated gain	NF_{min} G_{ass}		0.9 22.5			$V_{\text{CE}} = 3 \text{ V}, I_C = 4 \text{ mA}$
Linearity 3rd order intercept point at output 1 dB gain compression point at output	OIP_3 $OP_{1\text{dB}}$		26.5 16.5		dBm	$I_C = 40 \text{ mA}, Z_S = Z_L = 50 \Omega$

Table 8 AC characteristics, $V_{CE} = 4 \text{ V}$, $f = 900 \text{ MHz}$

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain - Maximum power gain - Transducer gain	G_{ms} $ S_{21} ^2$	–	26.5 24	–	dB	$I_C = 40\text{ mA}$
Noise figure - Minimum noise figure - Associated gain	NF_{min} G_{ass}		0.95 20			$V_{CE} = 3\text{ V}, I_C = 4\text{ mA}$
Linearity 3rd order intercept point at output 1 dB gain compression point at output	OIP_3 OP_{1dB}		27.5 17		dBm	$I_C = 40\text{ mA}, Z_S = Z_L = 50\text{ }\Omega$

Table 9 AC characteristics, $V_{CE} = 4 \text{ V}$, $f = 1.5 \text{ GHz}$

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain - Maximum power gain - Transducer gain	G_{ma} $ S_{21} ^2$	–	22 19.5	–	dB	$I_C = 40 \text{ mA}$
Noise figure - Minimum noise figure - Associated gain	NF_{min} G_{ass}		1 16.5			$V_{\text{CE}} = 3 \text{ V}, I_C = 4 \text{ mA}$
Linearity 3rd order intercept point at output 1 dB gain compression point at output	OIP_3 $OP_{1\text{dB}}$		27.5 16		dBm	$I_C = 40 \text{ mA}, Z_S = Z_L = 50 \Omega$

Electrical characteristics

Table 10 AC characteristics, $V_{CE} = 4 \text{ V}$, $f = 1.9 \text{ GHz}$

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain - Maximum power gain - Transducer gain	G_{ma} $ S_{21} ^2$	–	19 17	–	dB	$I_C = 40\text{ mA}$
Noise figure - Minimum noise figure - Associated gain	NF_{min} G_{ass}		1.1 15			$V_{CE} = 3\text{ V}, I_C = 4\text{ mA}$
Linearity 3rd order intercept point at output 1 dB gain compression point at output	OIP_3 OP_{1dB}		28 17		dBm	$I_C = 40\text{ mA}, Z_S = Z_L = 50\text{ }\Omega$

Table 11 AC characteristics, $V_{CE} = 4 \text{ V}$, $f = 2.4 \text{ GHz}$

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain - Maximum power gain - Transducer gain	G_{ma} $ S_{21} ^2$	–	16.5 15	–	dB	$I_C = 40\text{ mA}$
Noise figure - Minimum noise figure - Associated gain	NF_{min} G_{ass}		1.2 12.5			$V_{CE} = 3\text{ V}, I_C = 4\text{ mA}$
Linearity 3rd order intercept point at output 1 dB gain compression point at output	OIP_3 OP_{1dB}		28 16.5		dBm	$I_C = 40\text{ mA}, Z_S = Z_L = 50\text{ }\Omega$

Table 12 AC characteristics, $V_{CE} = 4 \text{ V}$, $f = 3.5 \text{ GHz}$

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain - Maximum power gain - Transducer gain	G_{ma} $ S_{21} ^2$	–	13 11.5	–	dB	$I_C = 40\text{ mA}$
Noise figure - Minimum noise figure - Associated gain	NF_{min} G_{ass}		1.6 10			$V_{CE} = 3\text{ V}, I_C = 4\text{ mA}$
Linearity 3rd order intercept point at output 1 dB gain compression point at output	OIP_3 OP_{1dB}		26 17		dBm	$I_C = 40\text{ mA}, Z_S = Z_L = 50\text{ }\Omega$

Electrical characteristics

Table 13 AC characteristics, $V_{CE} = 4 \text{ V}$, $f = 5.5 \text{ GHz}$

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Power gain		–		–	dB	$I_C = 40 \text{ mA}$
• Maximum power gain	G_{ma}		9			
• Transducer gain	$ S_{21} ^2$		8			
Noise figure						
• Minimum noise figure	NF_{min}		2.2			$V_{CE} = 3 \text{ V}$, $I_C = 4 \text{ mA}$
• Associated gain	G_{ass}		5			
Linearity					dBm	$I_C = 40 \text{ mA}$, $Z_S = Z_L = 50 \Omega$
• 3rd order intercept point at output	OIP_3		26			
• 1 dB gain compression point at output	OP_{1dB}		17			

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 50Ω from 0.2 MHz to 12 GHz.

Electrical characteristics

3.4 Characteristic DC diagrams

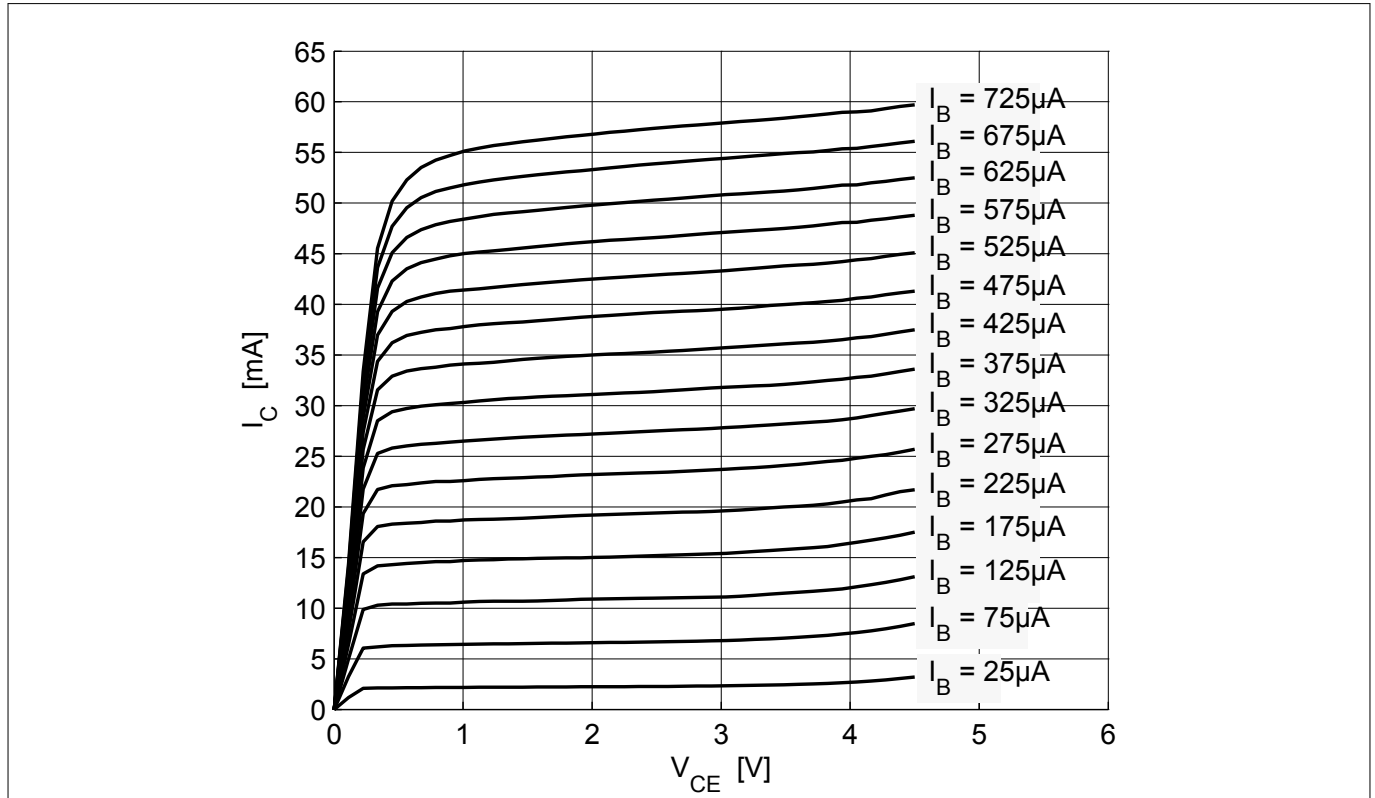


Figure 3 Collector current vs. collector emitter voltage $I_C = f(V_{CE})$, $I_B = \text{parameter}$

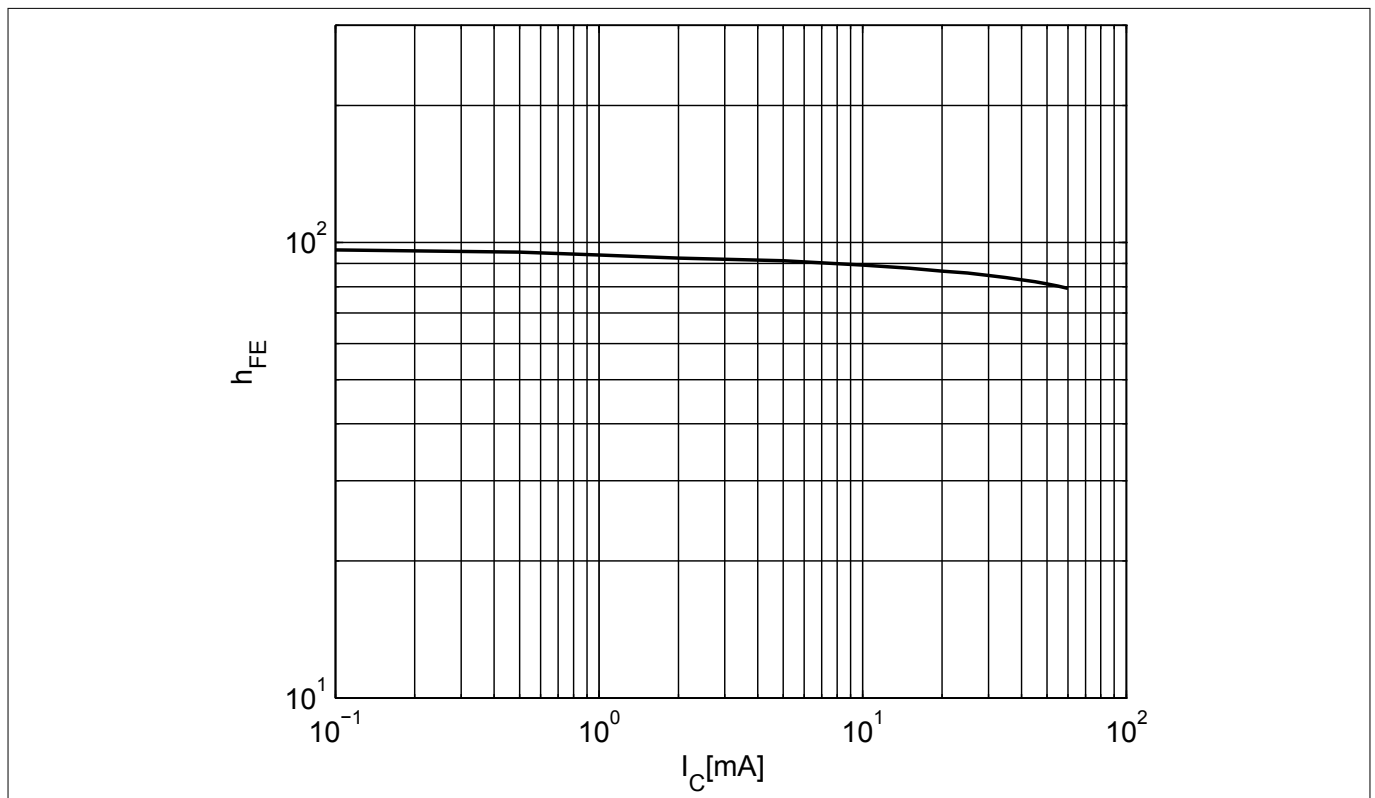


Figure 4 DC current gain $h_{FE} = f(I_C)$, $V_{CE} = 3 V$

Electrical characteristics

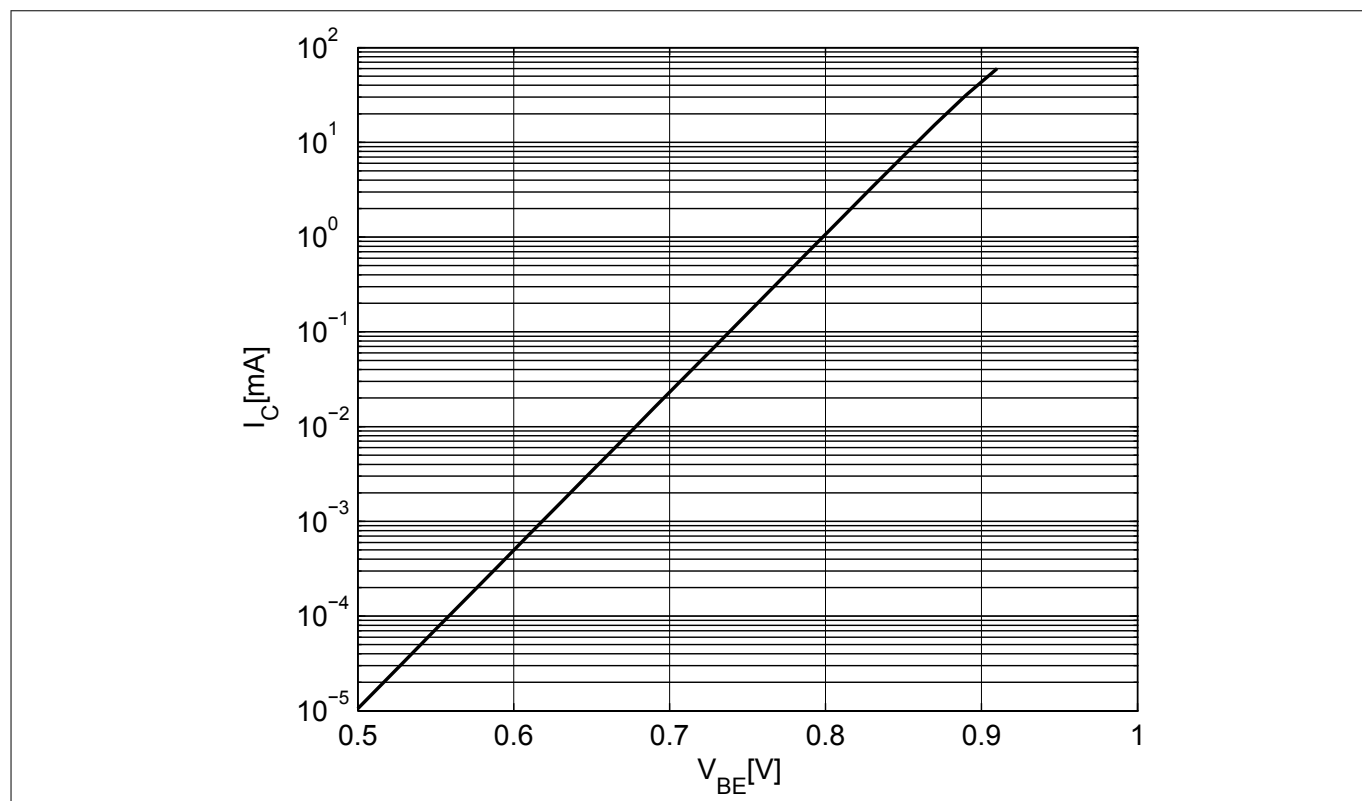


Figure 5 Collector current vs. base emitter forward voltage $I_C = f(V_{BE})$, $V_{CE} = 3\text{ V}$

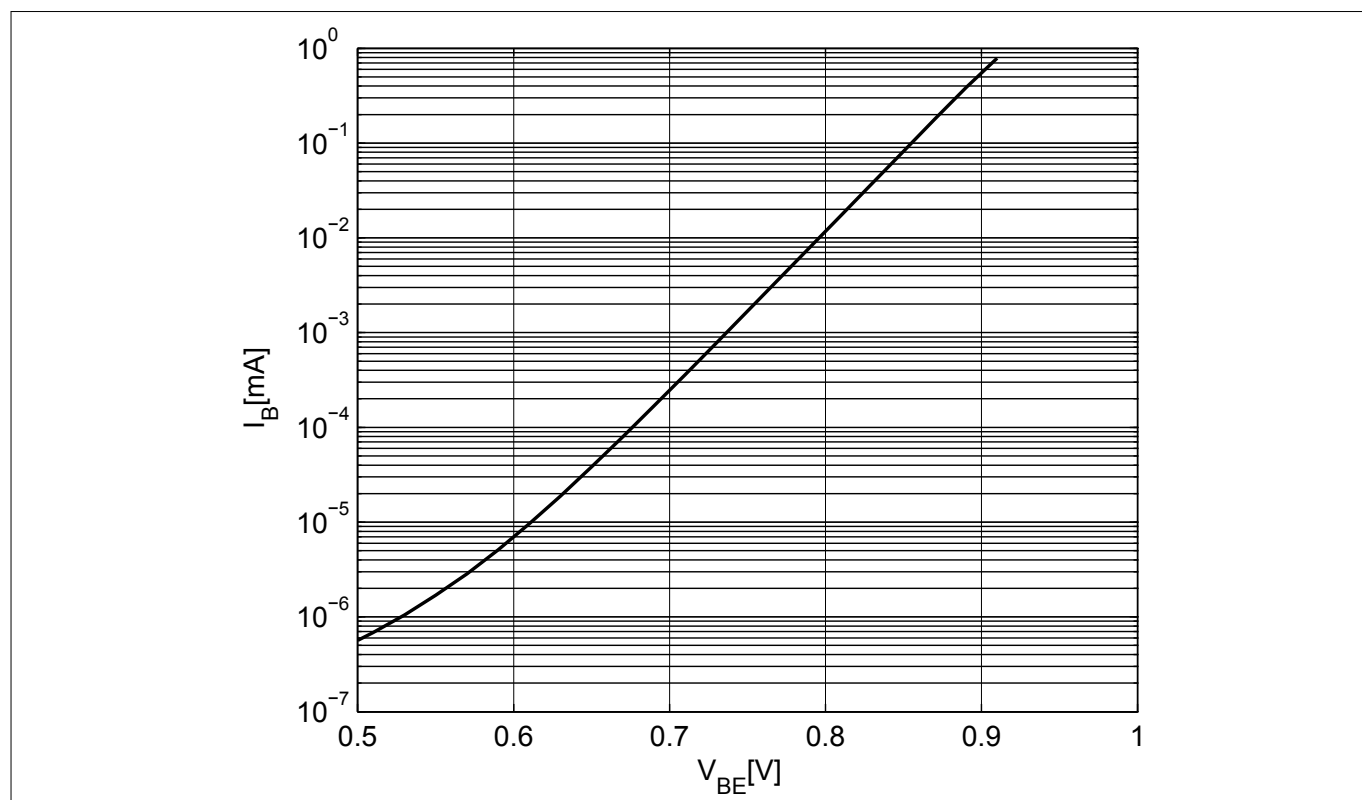


Figure 6 Base current vs. base emitter forward voltage $I_B = f(V_{BE})$, $V_{CE} = 3\text{ V}$

Electrical characteristics

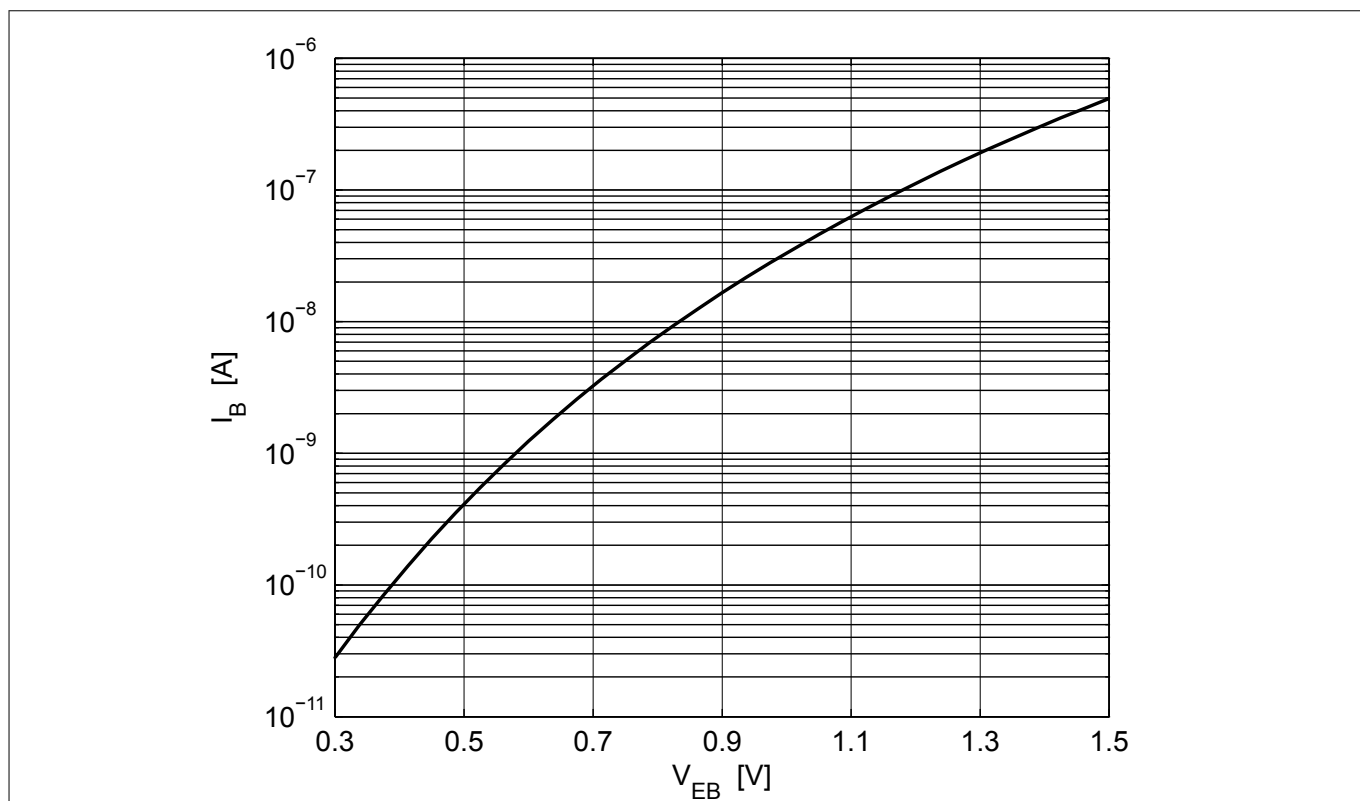


Figure 7 Base current vs. base emitter reverse voltage $I_B = f(V_{EB})$, $V_{CE} = 3\text{ V}$

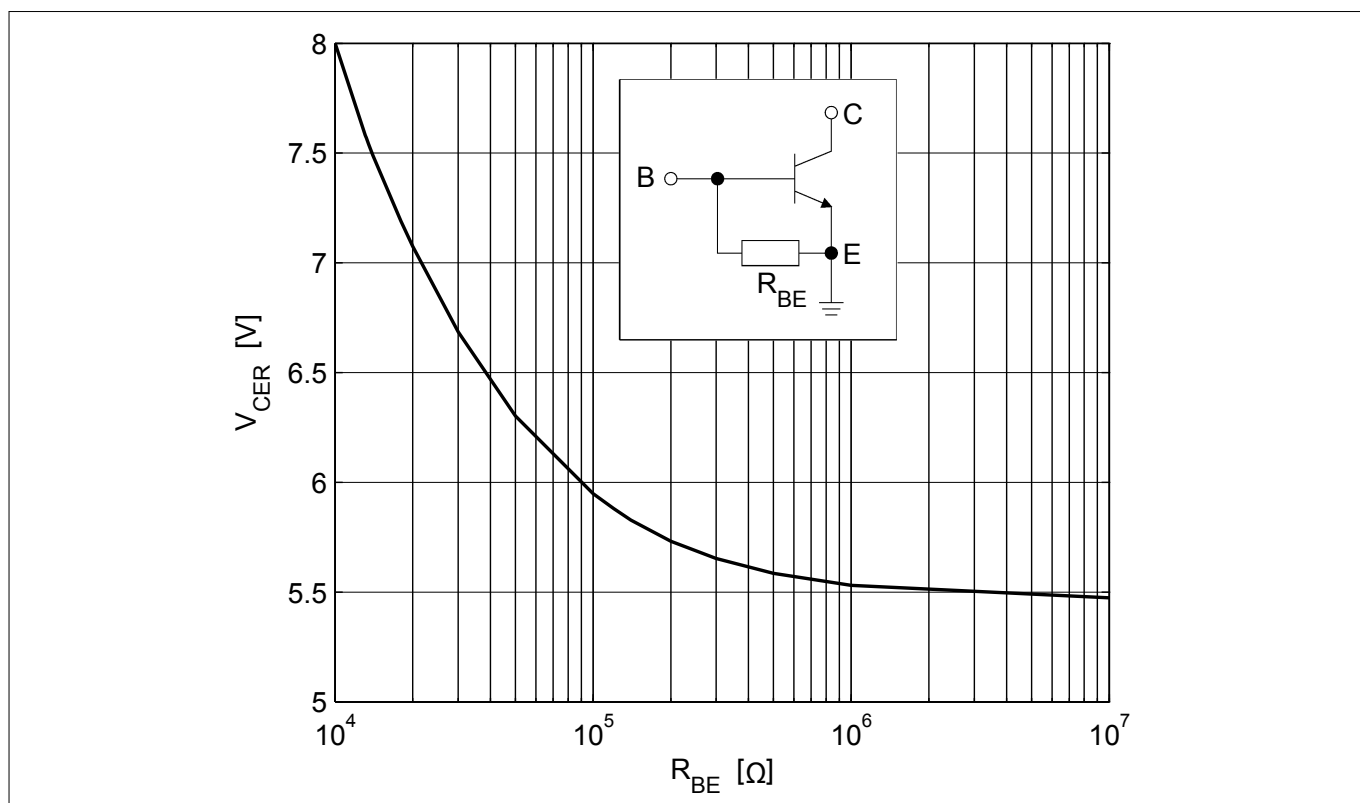


Figure 8 Collector emitter breakdown voltage $V_{CER} = f(R_{BE})$, $I_C = 1\text{ mA}$

Electrical characteristics

3.5 Characteristic AC diagrams

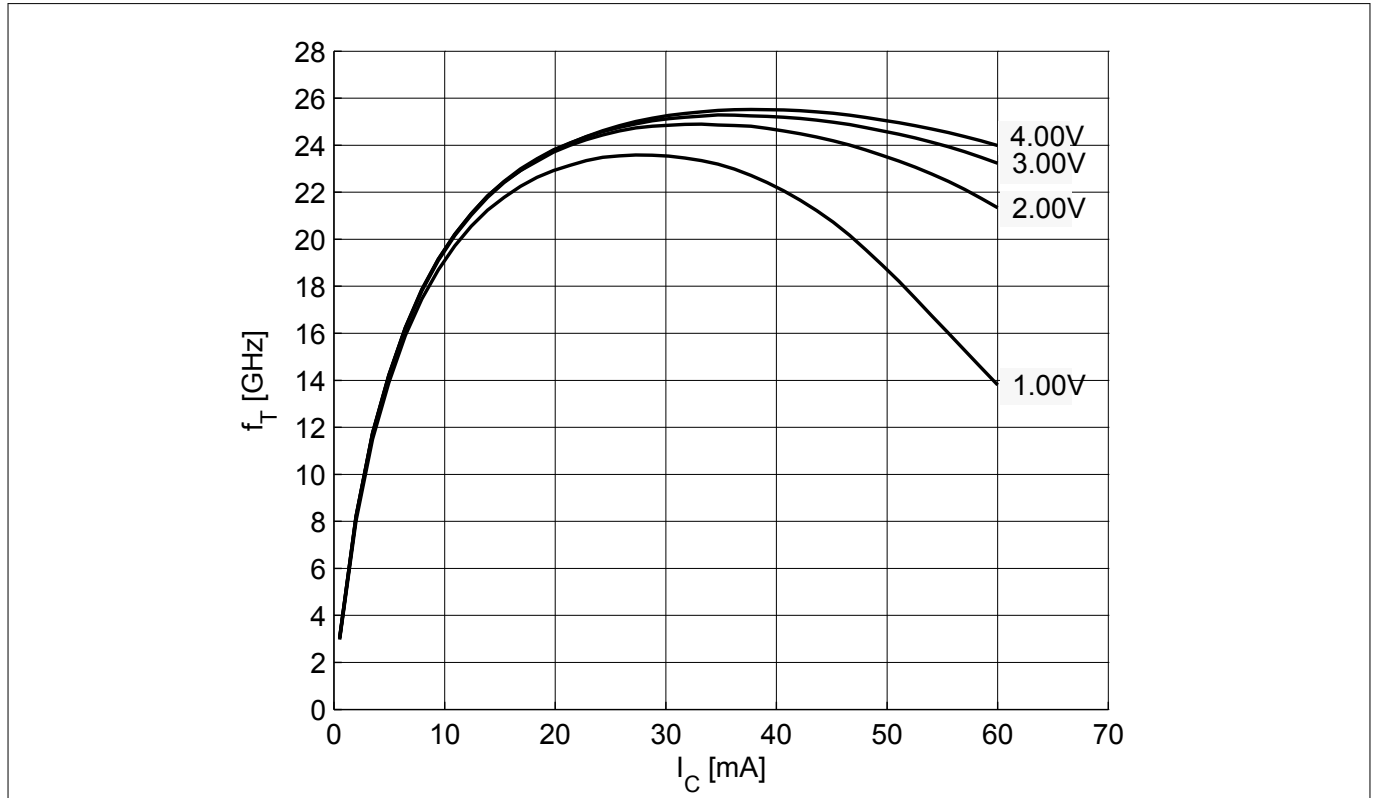


Figure 9 Transition frequency $f_T = f(I_C)$, $f = 2$ GHz, $V_{CE} = \text{parameter}$

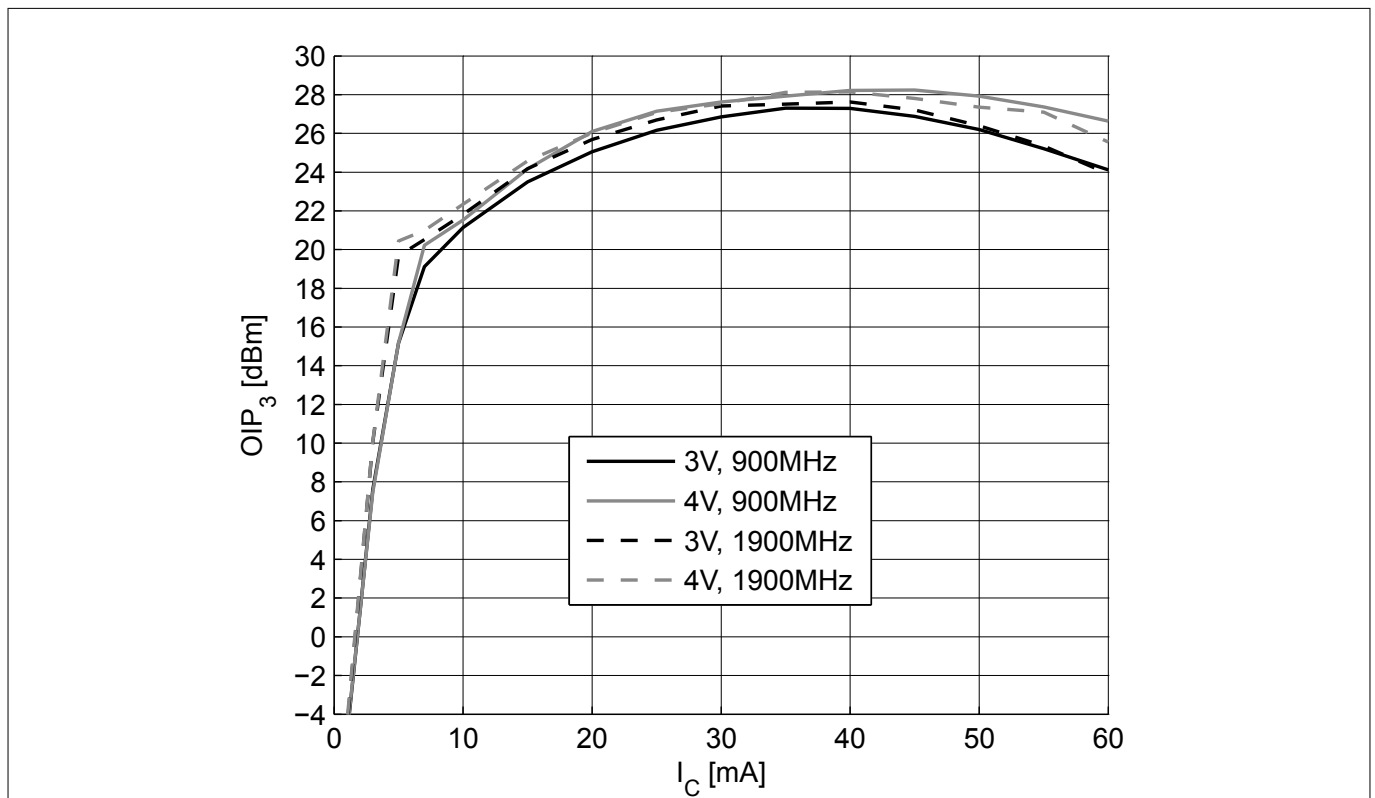


Figure 10 3rd order intercept point $OIP_3 = f(I_C)$, $Z_S = Z_L = 50 \Omega$, V_{CE} , $f = \text{parameters}$

Electrical characteristics

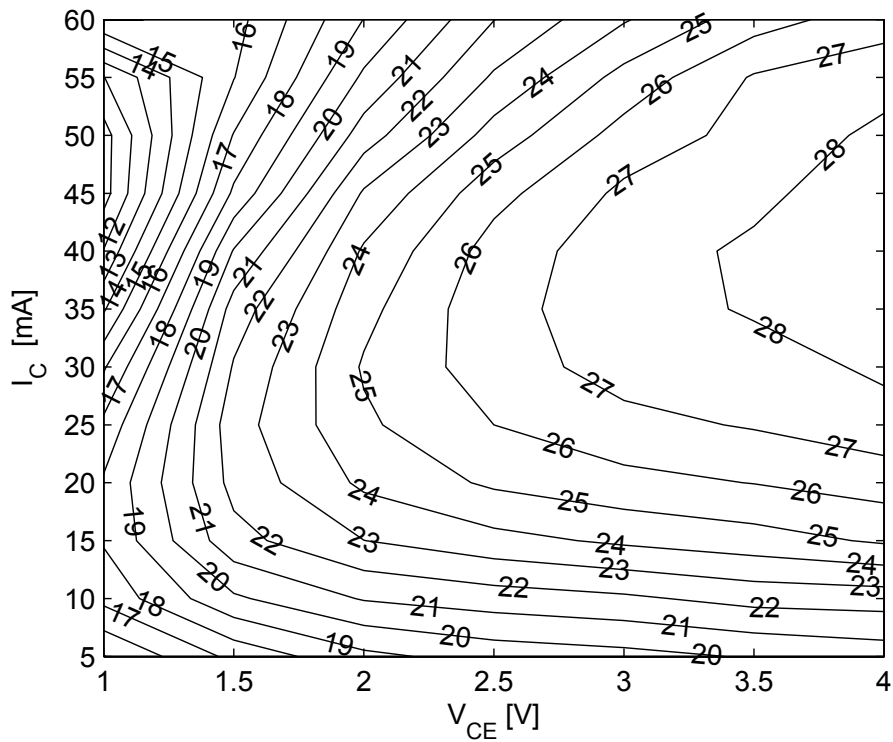


Figure 11 3rd order intercept point at output OIP_3 [dBm] = $f(I_C, V_{CE})$, $Z_S = Z_L = 50 \Omega$, $f = 1.9$ GHz

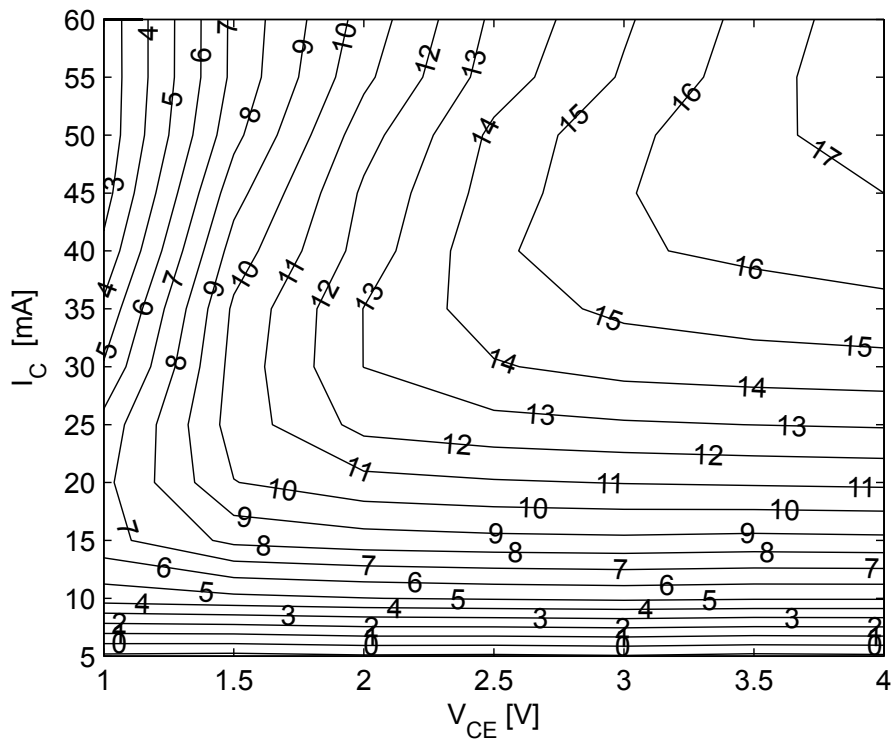


Figure 12 Compression point at output OP_{1dB} [dBm] = $f(I_C, V_{CE})$, $Z_S = Z_L = 50 \Omega$, $f = 1.9$ GHz

Electrical characteristics

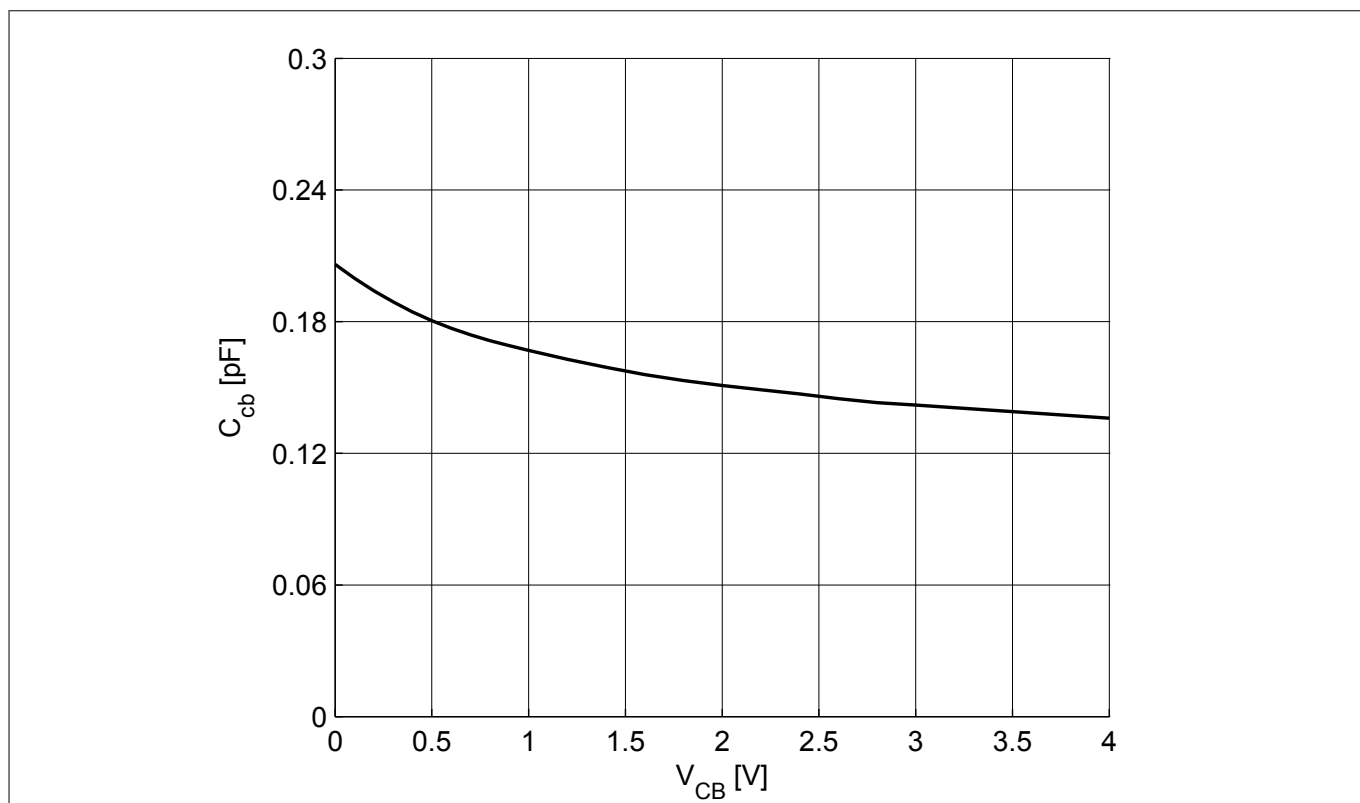


Figure 13 Collector base capacitance $C_{CB} = f(V_{CB})$, $f = 1$ MHz

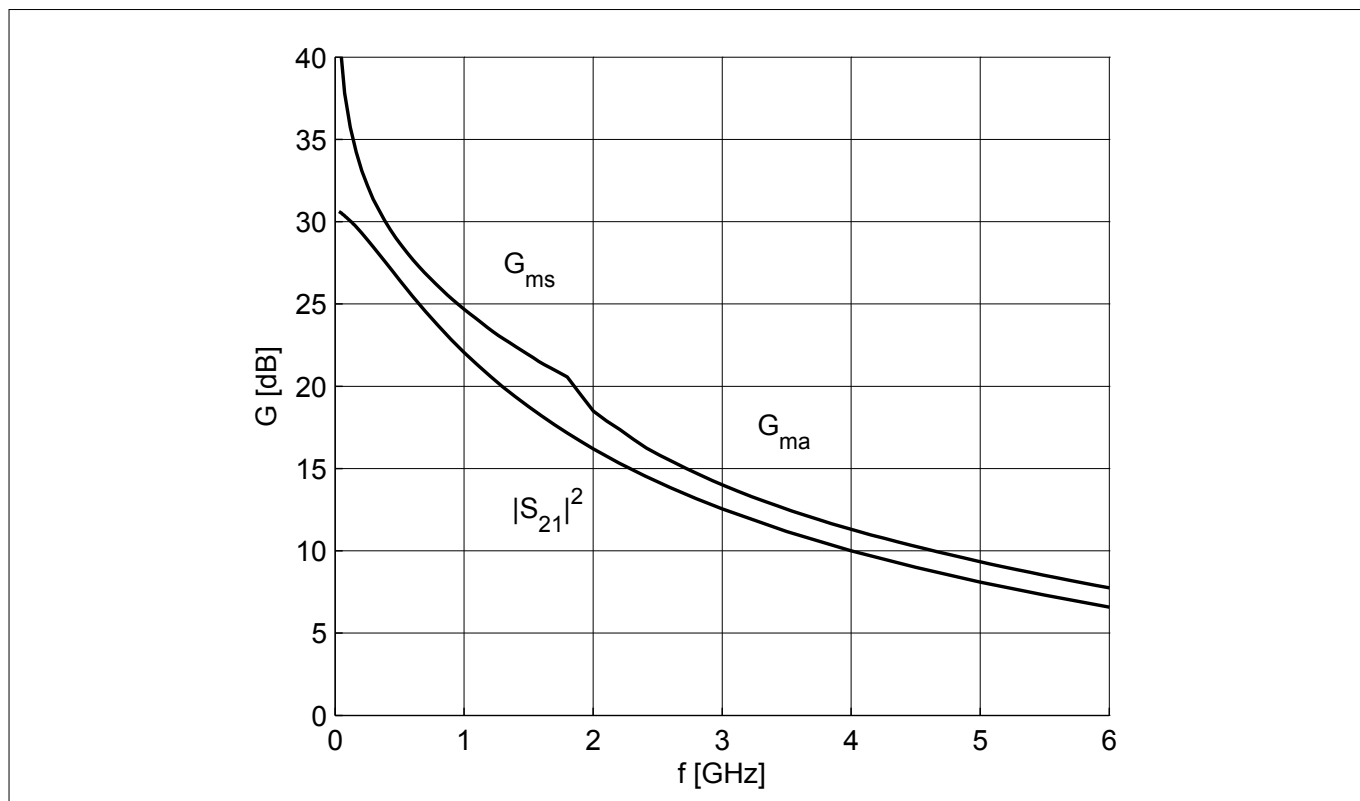


Figure 14 Gain G_{ma} , G_{ms} , $|S_{21}|^2 = f(f)$, $V_{CE} = 3$ V, $I_C = 15$ mA

Electrical characteristics

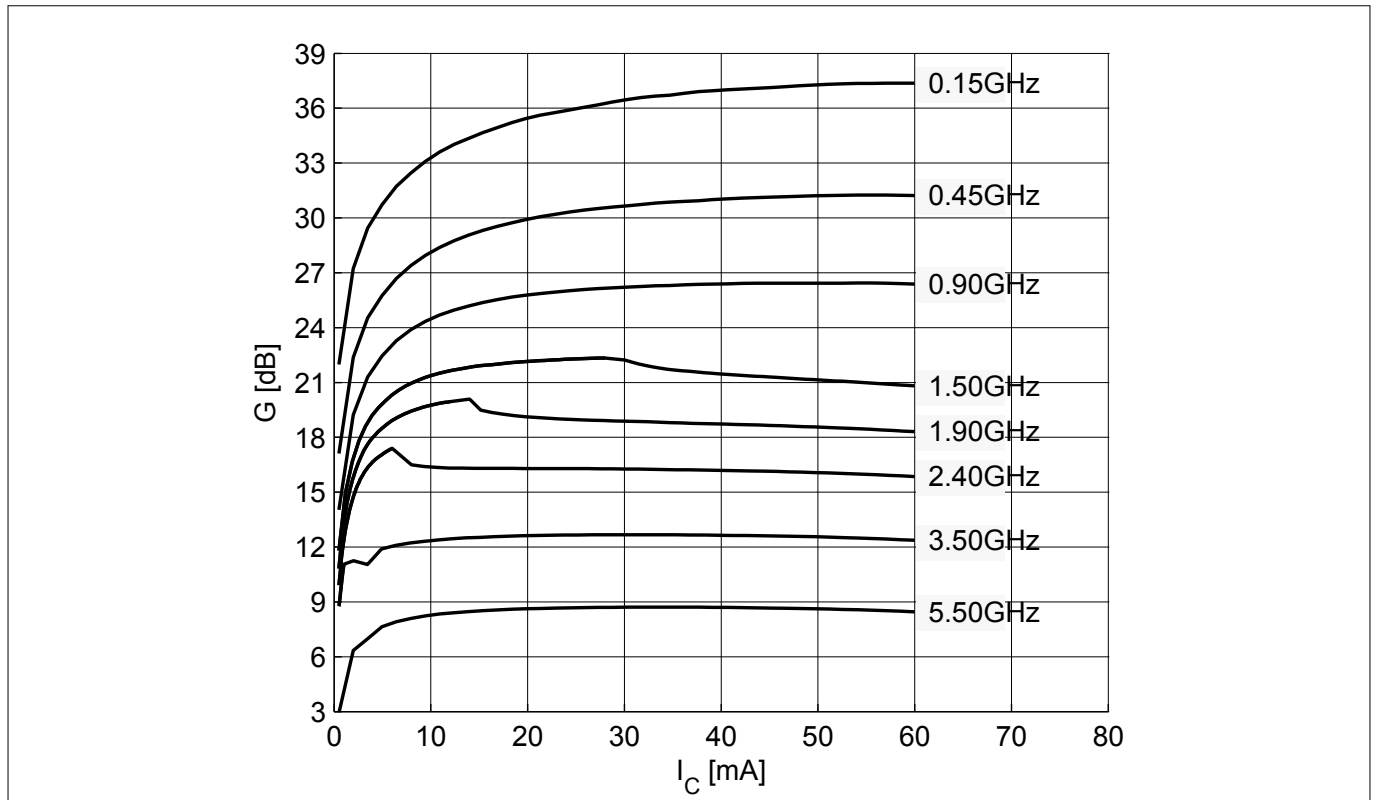


Figure 15 Maximum power gain $G_{\max} = f(I_C)$, $V_{CE} = 3 \text{ V}$, $f = \text{parameter in GHz}$

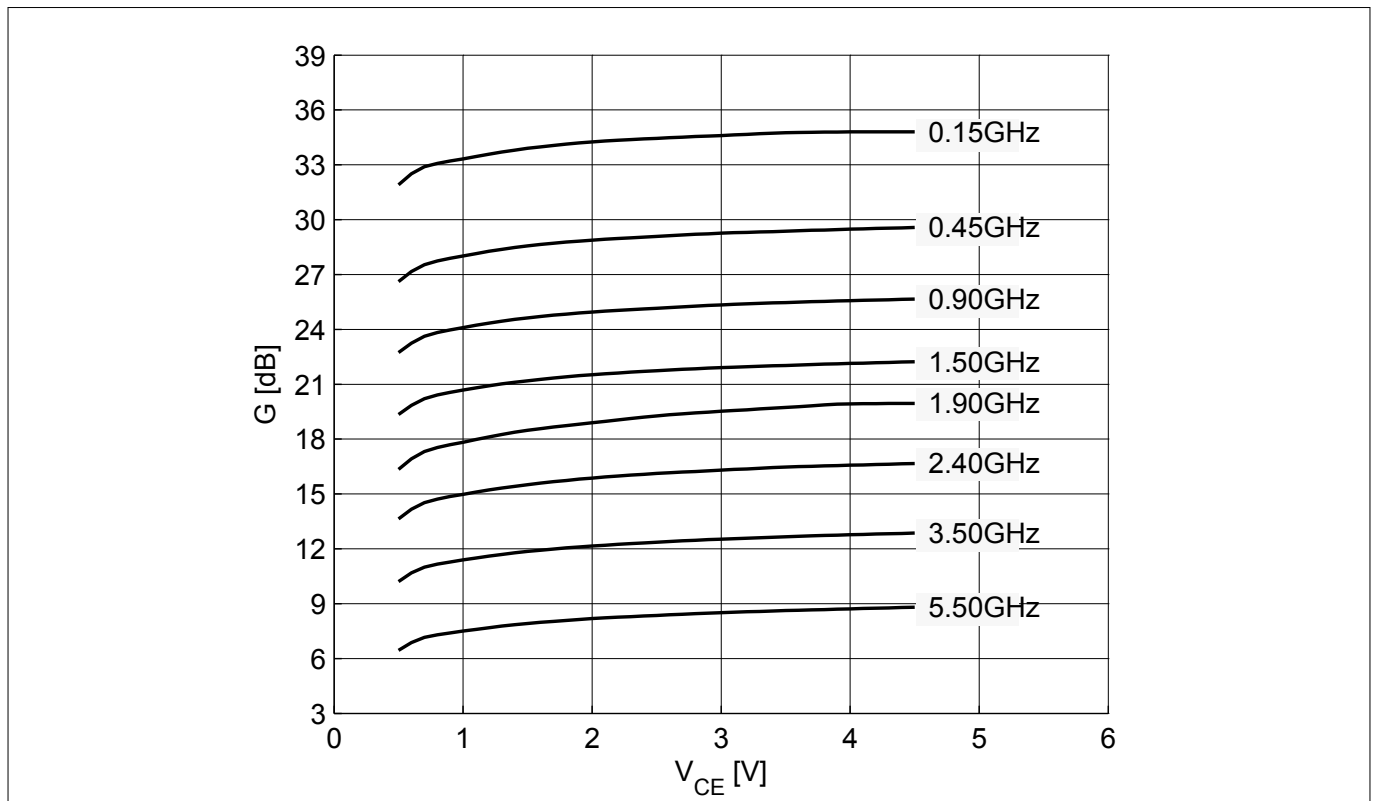


Figure 16 Maximum power gain $G_{\max} = f(V_{CE})$, $I_C = 15 \text{ mA}$, $f = \text{parameter in GHz}$

Electrical characteristics

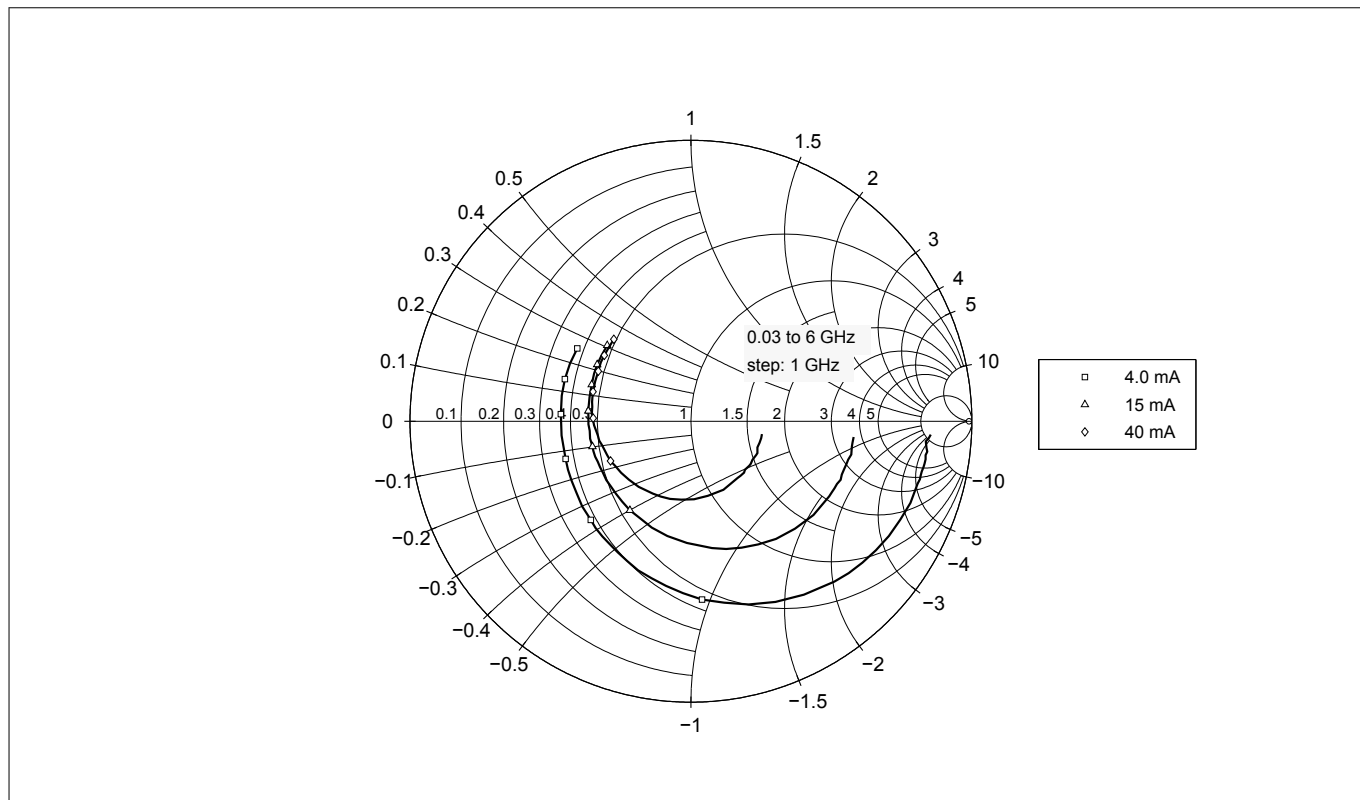


Figure 17 Input reflection coefficient $S_{11} = f(f)$, $V_{CE} = 3 \text{ V}$, $I_C = 4 / 15 / 40 \text{ mA}$

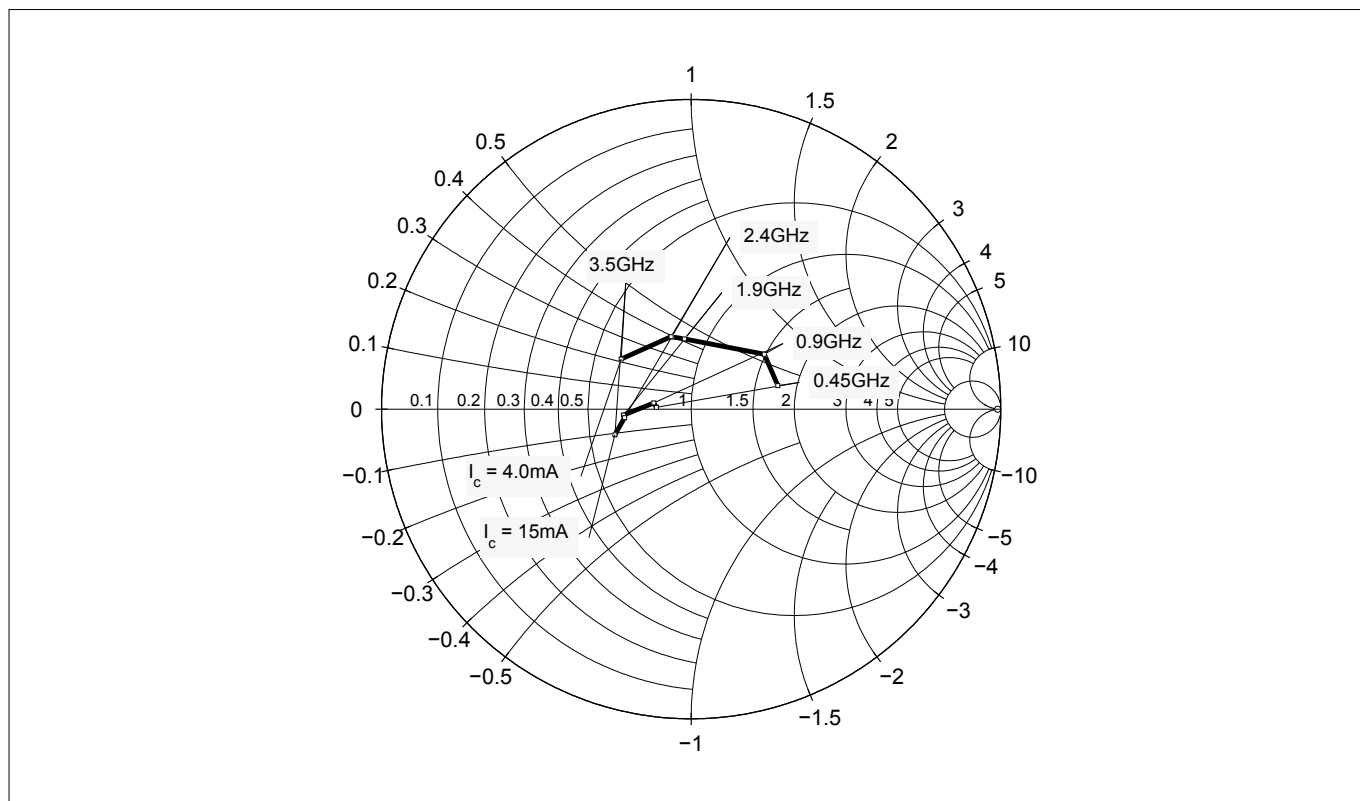


Figure 18 Source impedance for minimum noise figure $Z_{s,opt} = f(f)$, $V_{CE} = 3 \text{ V}$, $I_C = 4 / 15 \text{ mA}$

Electrical characteristics

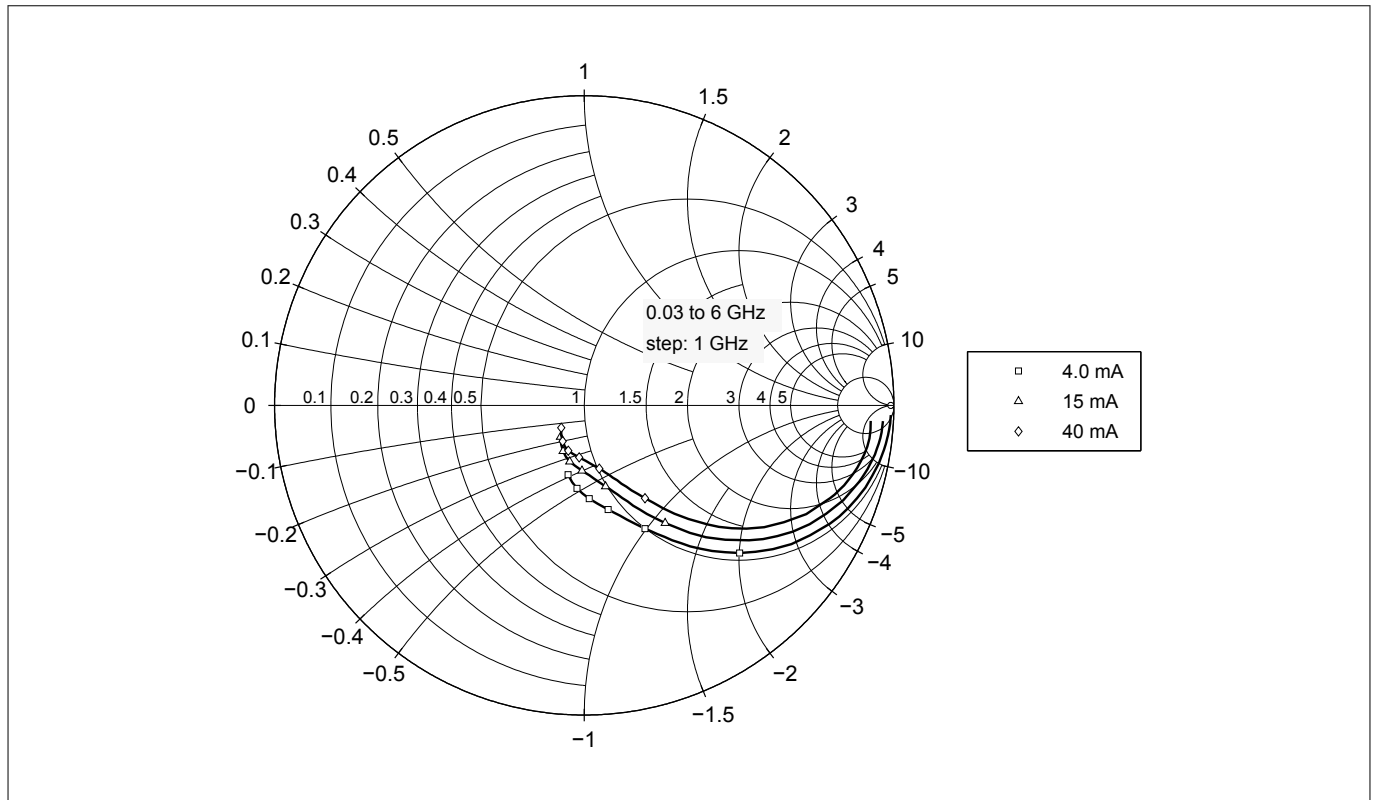


Figure 19 Output reflection coefficient $S_{22} = f(f)$, $V_{CE} = 3 \text{ V}$, $I_C = 4 / 15 / 40 \text{ mA}$

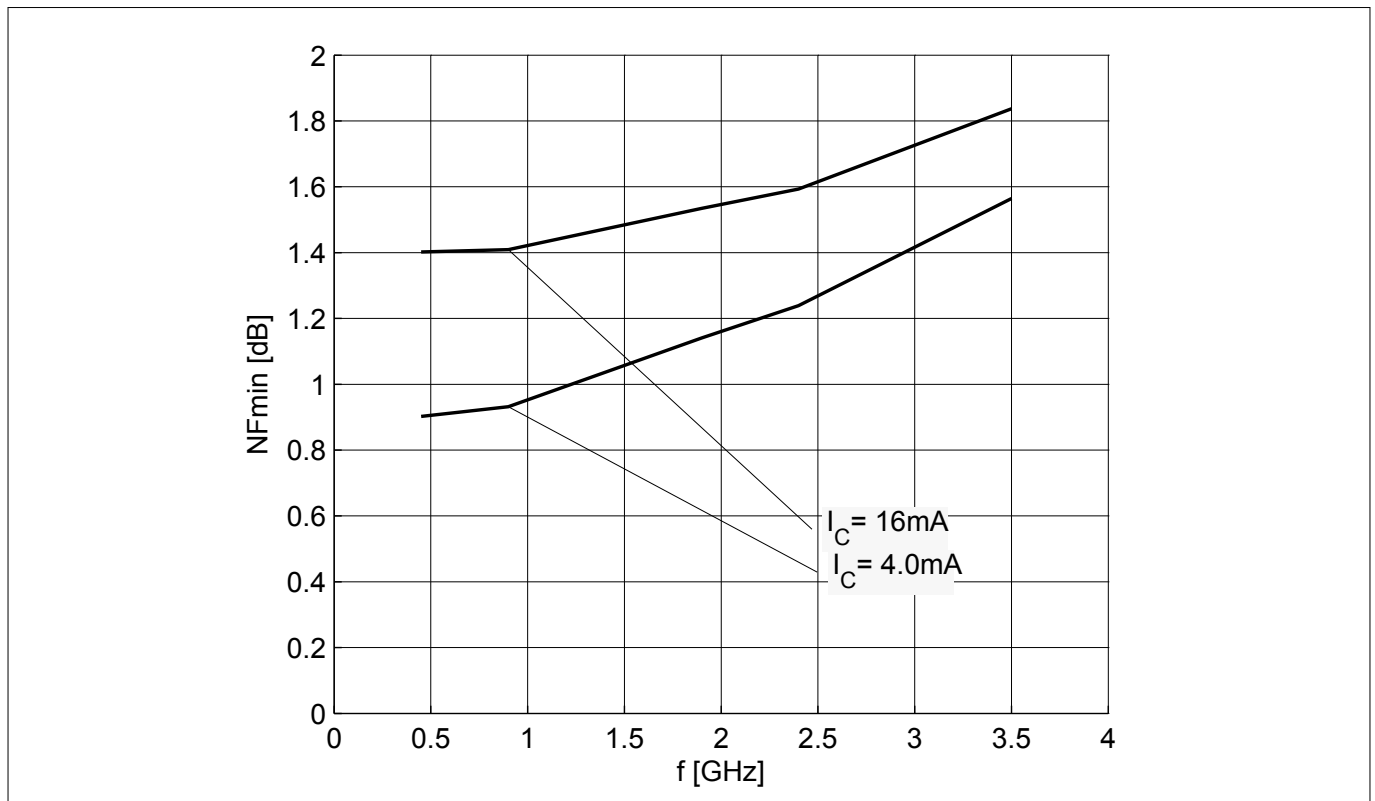


Figure 20 Noise figure $NF_{min} = f(f)$, $V_{CE} = 3 \text{ V}$, $Z_S = Z_{S,opt}$, $I_C = 4 / 16 \text{ mA}$

Electrical characteristics

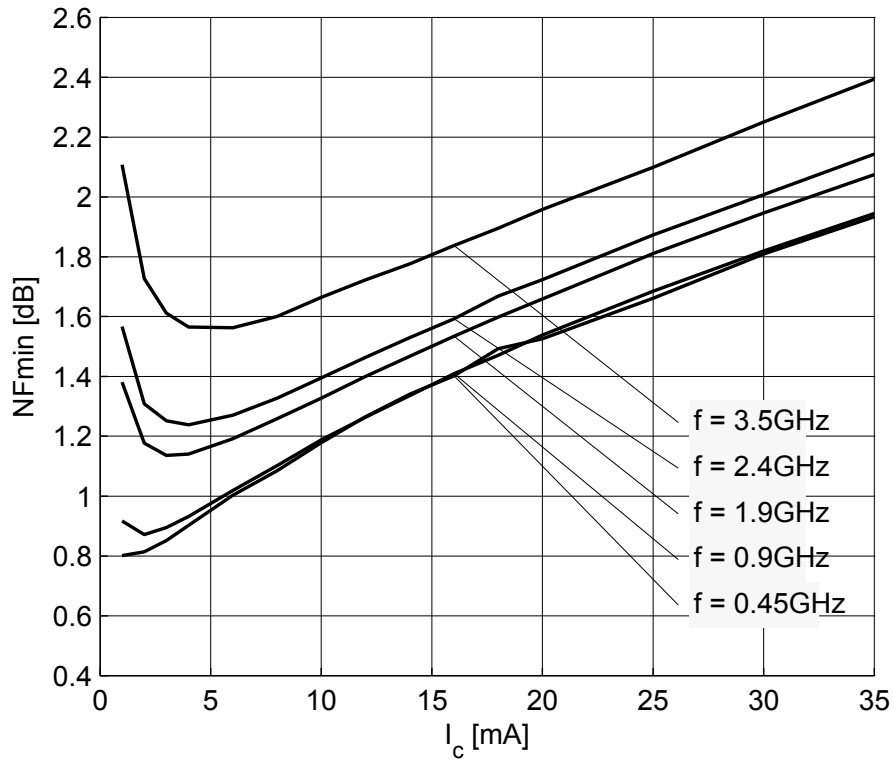


Figure 21 Noise figure $NF_{min} = f(I_c)$, $V_{CE} = 3\text{ V}$, $Z_S = Z_{S,opt}$, f = parameter in GHz

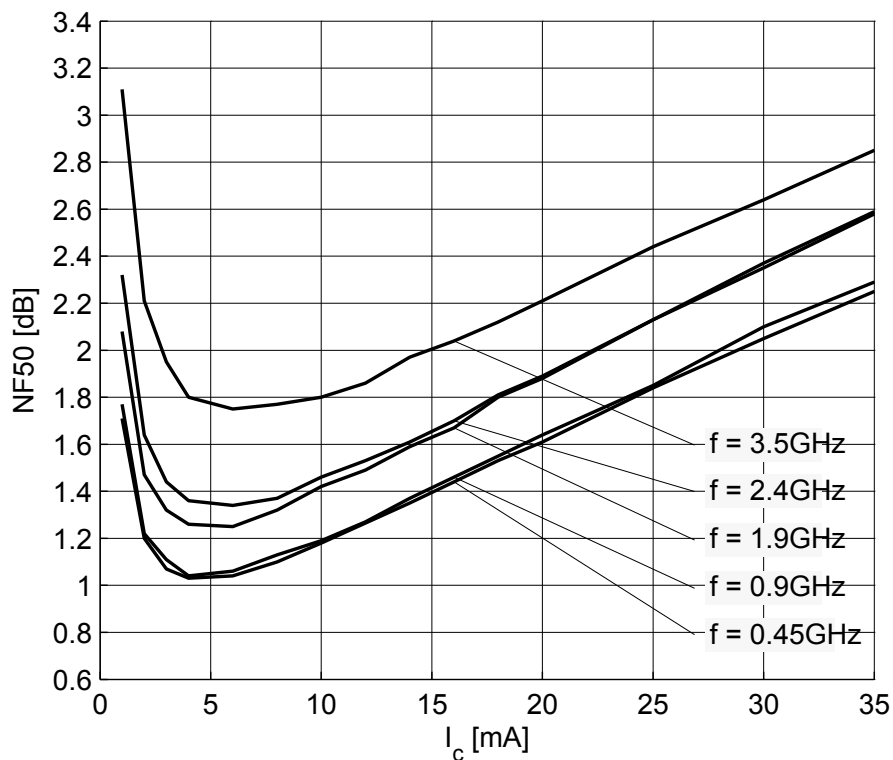


Figure 22 Noise figure $NF_{50} = f(I_c)$, $V_{CE} = 3\text{ V}$, $Z_S = 50\ \Omega$, f = parameter in GHz

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. $T_A = 25\ ^\circ\text{C}$.

Package information TSFP-4-1

4 **Package information TSFP-4-1**

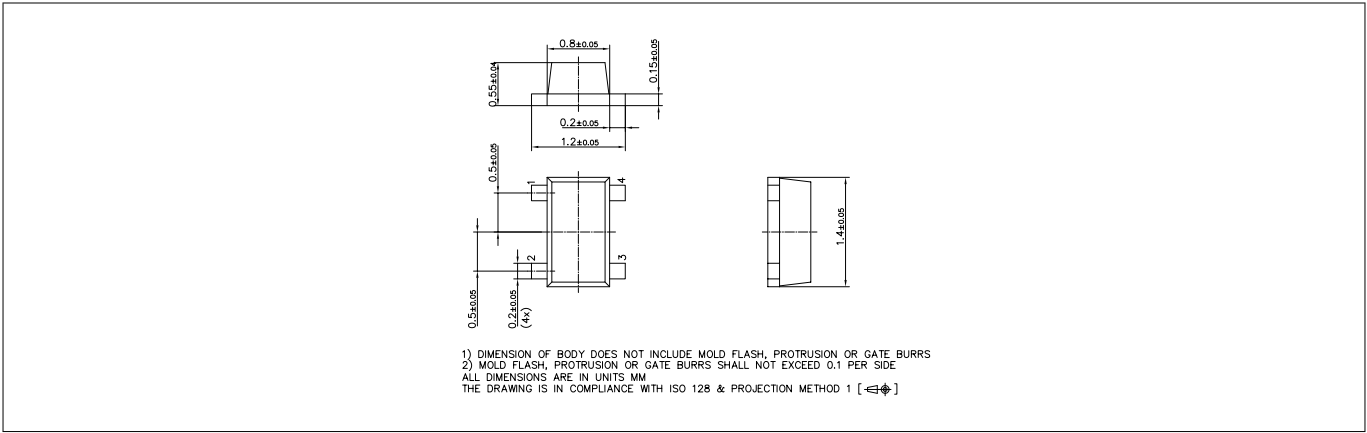


Figure 23 **Package outline**

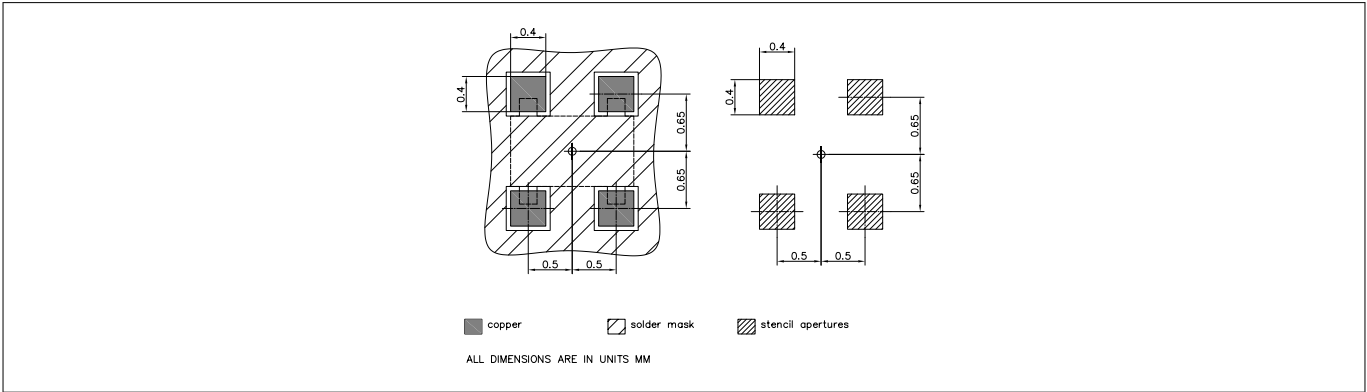


Figure 24 **Foot print**

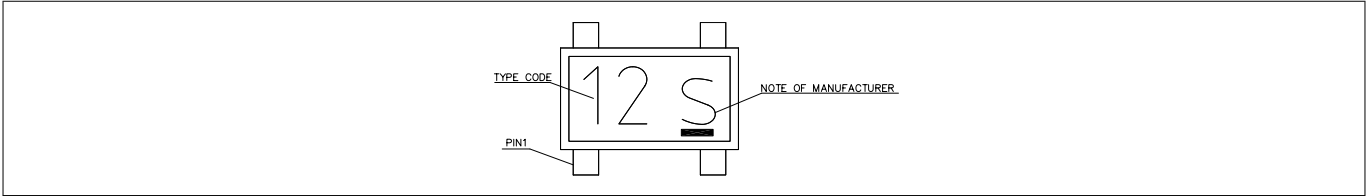


Figure 25 **Marking layout example**

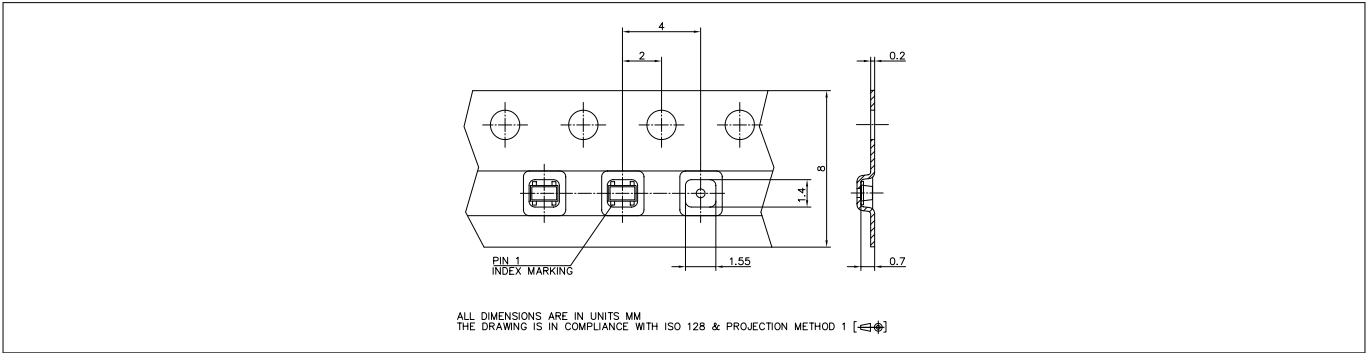


Figure 26 **Tape dimensions**

Revision history

Revision history

Document version	Date of release	Description of changes
Revision 2.0	2019-01-25	New datasheet layout.

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