BGB707L7ESD

General purpose LNA MMIC with integrated ESD protection and active biasing

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Product description

The BGB707L7ESD is a high performance low noise amplifier (LNA) MMIC based on Infineon's silicon germanium carbon (SiGe:C) bipolar technology.

Feature list

- Minimum noise figure NF_{min} = 0.6 dB at 2.4 GHz, 3 V, 3 mA
- Supply voltage V_{CC} = 1.8 V to 4.0 V at T_A = 25 °C
- Integrated ESD protection: 2 kV HBM at all pins

Product validation

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

Potential applications

- Satellite navigation systems (e.g. GPS, GLONASS, BeiDou, Galileo)
- Wireless communications: WLAN 2.4 GHz and 5-6 GHz bands, broadband LTE or WiMAX LNA
- ISM applications like RKE and smart meter, as well as for emerging wireless applications such as DVB-Terrestrial

Device information

Table 1 Part information

Product name / Ordering code	Package	Pin configuration				Marking	Pieces / Reel
BGB707L7ESD / BGB707L7ESDE6327XTSA1	TSLP-7-1	1 = V_{CC}	2 = V_{Bias}	3 = RF_{in}	4 = RF_{out}	AZ	7500
		5 = V_{Ctrl}	6 = Current adjust	7 = Ground			

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

Functional block diagram

This functional block diagram explains how the BGB707L7ESD is used. The RF power on/off function is controlled by applying V_{Ctrl}. By using an external resistor R_{ext}, the pre-set current of 2.1 mA (when R_{ext} is omitted) can be increased. Base V_B and collector V_C voltages are applied to the respective pins RF_{in} and RF_{out} by external inductors L_B and L_C.

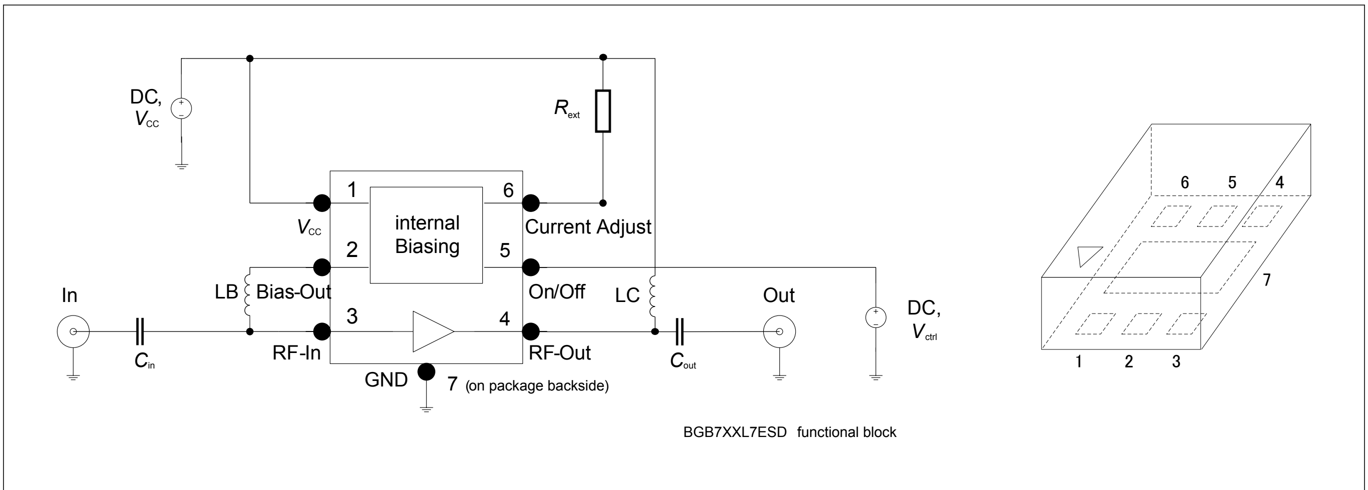

Figure 1 **Functional block diagram**

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1 Operating conditions

Table 2 Operation conditions at $T_A = 25$ °C

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	1.8	3	4	V	–
Control voltage in on-mode	$V_{Ctrl\text{-}on}$	1.2	–	V_{CC}		
Control voltage in off-mode	$V_{Ctrl\text{-}off}$	-0.3		0.3		

2 Absolute maximum ratings

Table 3 Absolute maximum ratings at $T_A = 25$ °C (unless otherwise specified)

Parameter	Symbol	Values		Unit	Note or test condition
		Min.	Max.		
Supply voltage	V_{CC}	–	4 3.5	V	$T_A = 25$ °C $T_A = -55$ °C
Supply current	I_{CC}		25	mA	–
DC current at RF_{in}	I_B		2		
Control voltage	V_{Ctrl}		4	V	
Total power dissipation[1]	P_{tot}		100	mW	$T_S \leq 112$ °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 T_S is the soldering point temperature. T_S is measured on the emitter lead at the soldering point of the PCB.

3 Thermal characteristics

Table 4 Thermal resistance

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

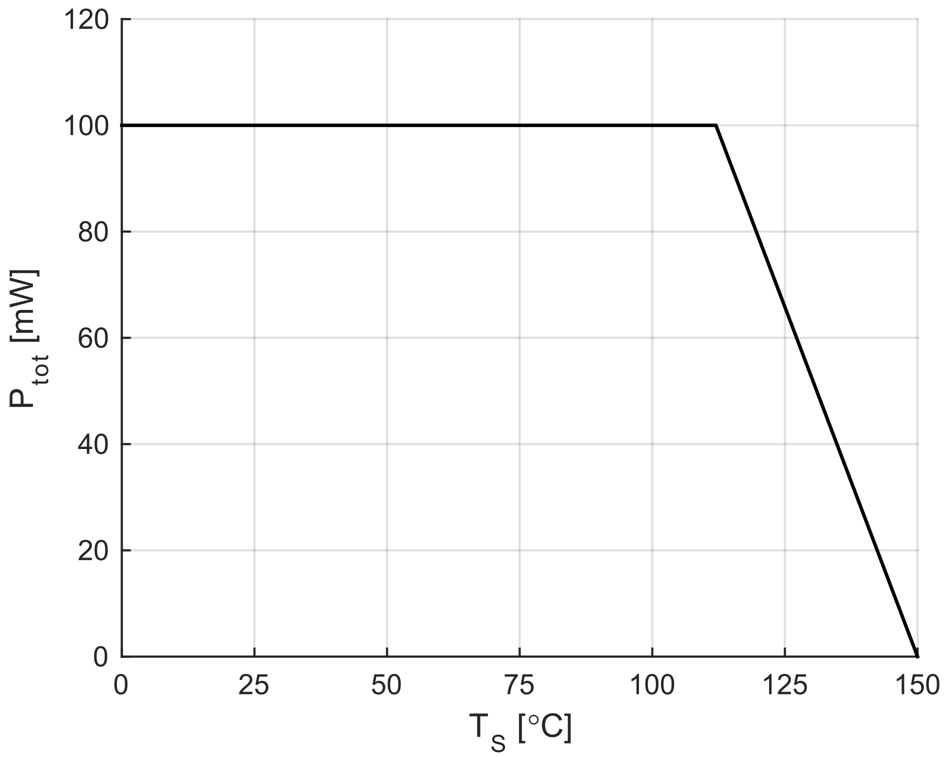

Figure 2 Total power dissipation P_{tot} = f(T_S)

4 Electrical characteristics

4.1 DC characteristics

Table 5 DC characteristics at V_{CC} = 3 V, T_A = 25 °C

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Supply current in on-mode	$I_{CC\text{-}on}$				mA	V_{Ctrl} = 3 V
		1.6	2.1	2.6		R_{ext} = open
		–	3	–		R_{ext} = 12 kΩ
		–	4.2	–		R_{ext} = 4.7 kΩ
		–	6	–		R_{ext} = 2.4 kΩ
		–	10	–		R_{ext} = 1 kΩ
Supply current in off-mode	$I_{CC\text{-}off}$	–	–	6	µA	V_{Ctrl} = 0 V
Control current in on-mode	$I_{Ctrl\text{-}on}$		14	20		V_{Ctrl} = 3 V
Control current in off-mode	$I_{Ctrl\text{-}off}$		–	0.1		V_{Ctrl} = 0 V

4.2 Characteristic DC diagrams

The measurement setup is an application circuit according to ***Figure 1*** on page 2, using the integrated biasing. T_A = 25 °C (unless otherwise specified).

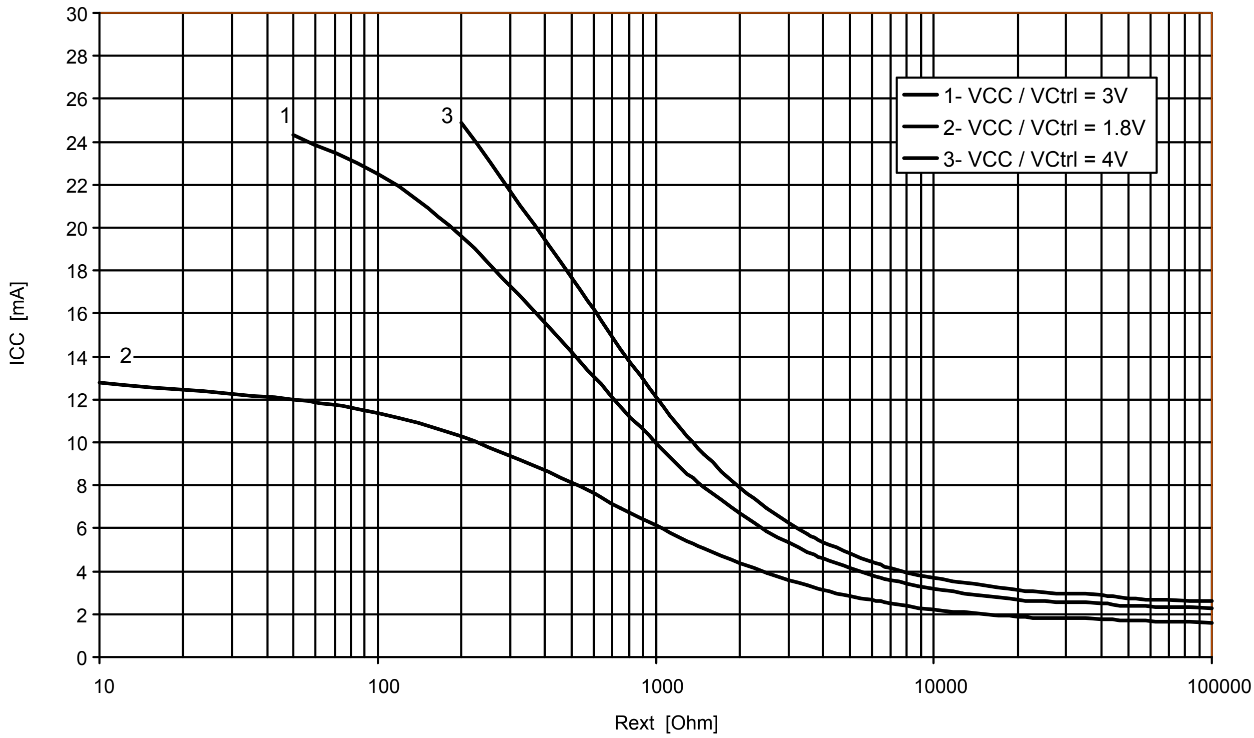

Figure 3 **Supply current vs external resistance $I_{CC} = f(R_{ext})$, V_{CC} / V_{Ctrl} = parameter**

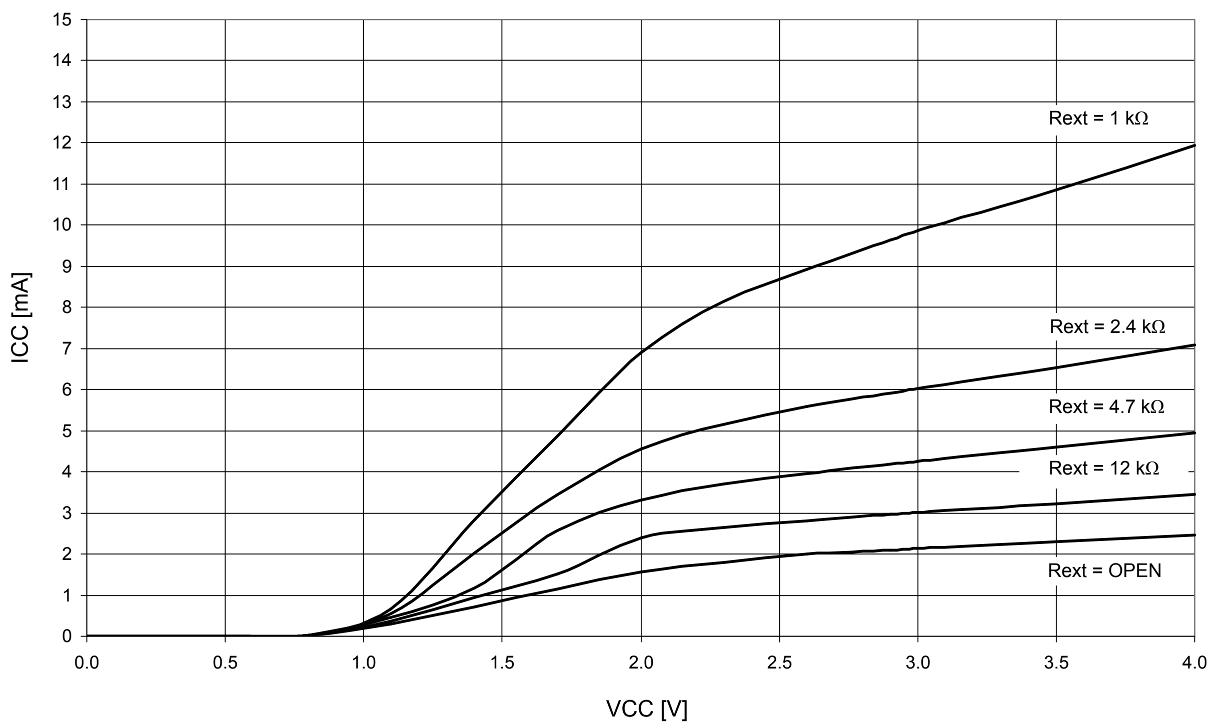

Figure 4 **Supply current vs supply voltage $I_{CC} = f(V_{CC})$, V_{Ctrl} = 3 V, R_{ext} = parameter**

Electrical characteristics

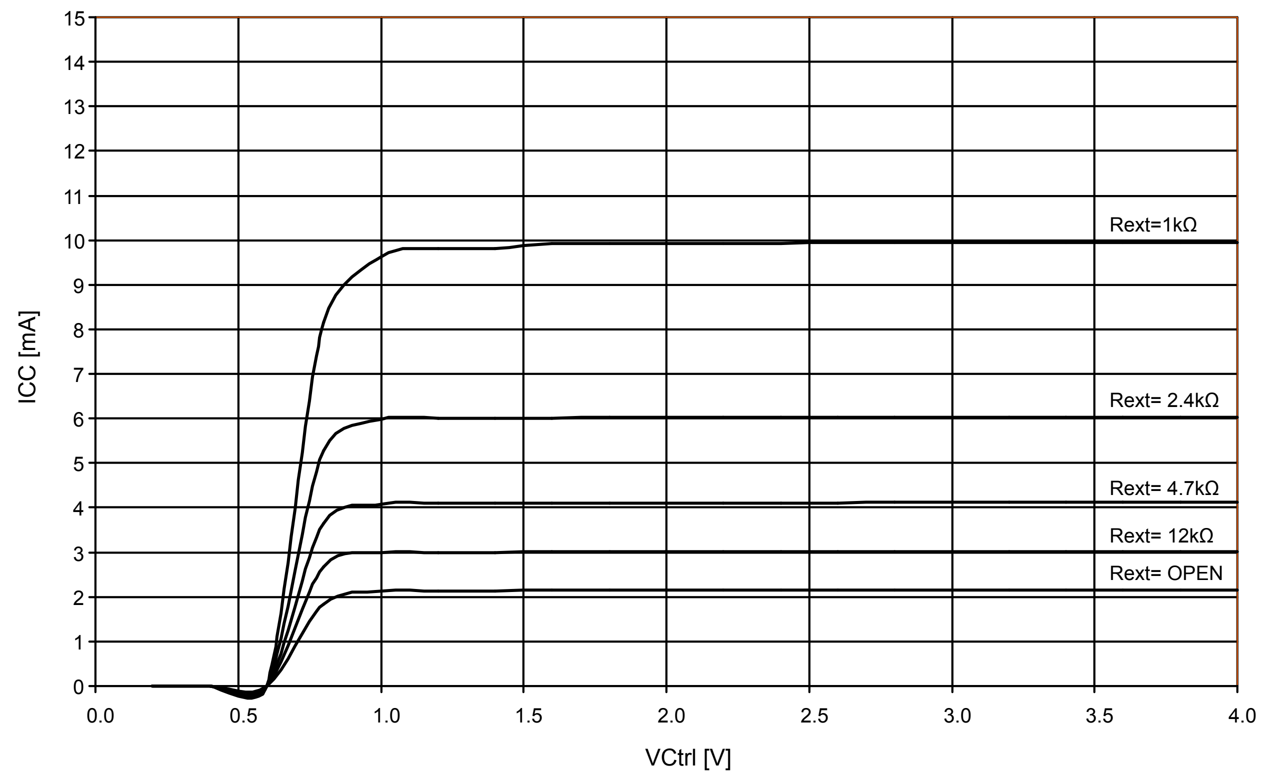

Figure 5 **Supply current vs control voltage I_{CC} = f(V_{Ctrl}), V_{CC} = 3 V, R_{ext} = parameter**

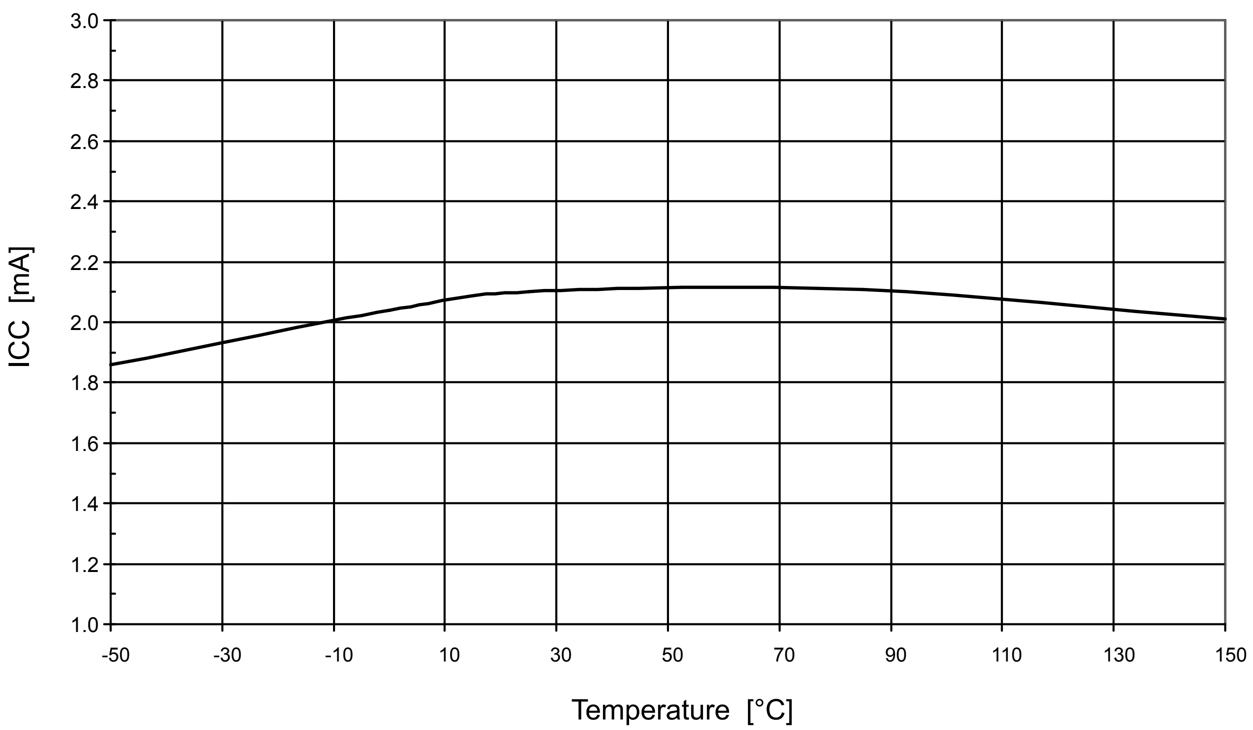

Figure 6 **Supply current vs temperature I_{CC} = f(T_A), V_{Ctrl} = V_{CC} = 3 V, R_{ext} = open**

4.3 AC characteristics

AC characteristics are described for higher frequencies in a 50 Ω environment.

4.3.1 AC characteristics in test fixture

Measurement setup is a test fixture with Bias-T's in a 50 Ω system according to ***Figure 7***, for frequencies *f* from 150 MHz to 10 GHz at V_C = 3 V, T_A = 25 °C. The collector current I_C is controlled by the external base voltage V_B. Which is not dependent of the biasing reference voltage V_{Bias}. The bias voltage V_C at the output RF_{out} allows direct measurement of the amplifier performance, as a function of bias conditions without passive components.

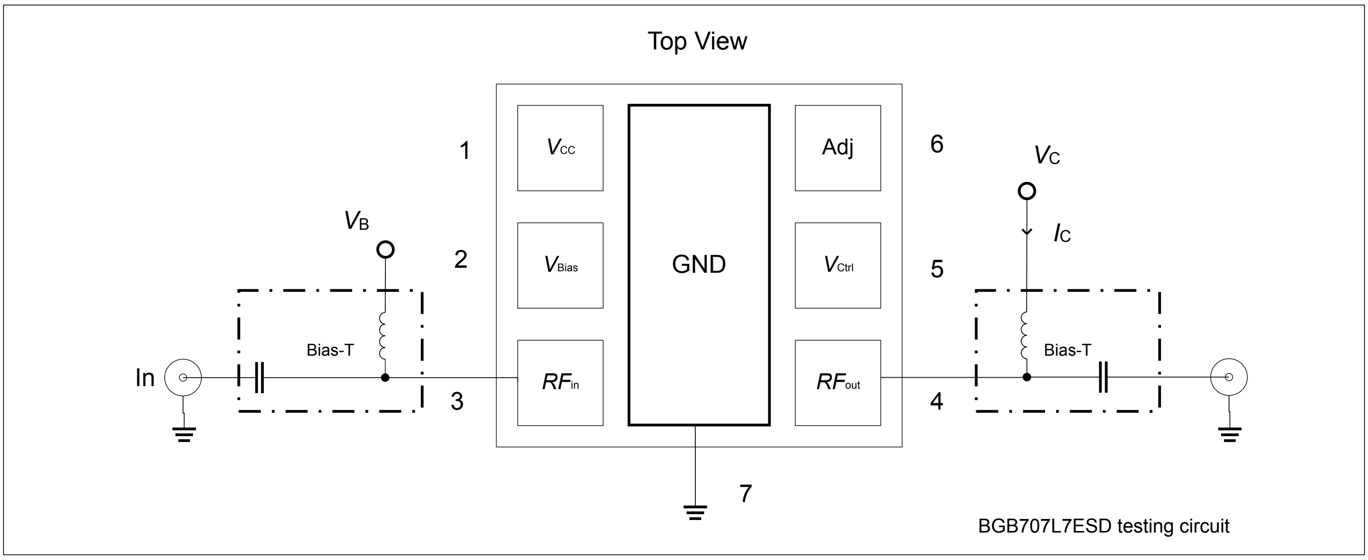

Figure 7 **Testing circuit for frequencies *f* from 150 MHz to 10 GHz**

Table 6 **AC characteristics, V_C = 3 V, f = 150 MHz**

Parameter	Symbol	Values			Unit	Note or test conditions
		Min.	Typ.	Max.		
Minimum noise figure	NF_{min}	–	0.4 0.4 0.5 0.55	–	dB	I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Transducer gain	$\|S_{21}\|^2$		17 19 24 27			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Maximum power gain	G_{ms}		31.5 33 35 37			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Output 1 dB gain compression point [1]	OP_{1dB}		3.5 4 4.5 3		dBm	I_{Cq} = 2.1 mA, I_{Ccomp} = 11 mA [2] I_{Cq} = 3 mA, I_{Ccomp} = 11 mA I_{Cq} = 6 mA, I_{Ccomp} = 11 mA I_{Cq} = 10 mA, I_{Ccomp} = 11 mA
Output 3rd order intercept point	OIP_3		2 6 14.5 19.5			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA

1 OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to ***Figure 1*** using the integrated biasing.

2 I_{Cq} is the quiescent current at small input power levels. I_{Cq} increases up to I_{Ccomp} as RF input power approaches IP_{1dB}, cf. ***Figure 14***.

Table 7 AC characteristics, V_C = 3 V, f = 450 MHz

Parameter	Symbol	Values			Unit	Note or test conditions
		Min.	Typ.	Max.		
Minimum noise figure	NF_{min}	–	0.45 0.45 0.5 0.6	–	dB	I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Transducer gain	$\|S_{21}\|^2$		17 19 24 27			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Maximum power gain	G_{ms}		27 28 30.5 32			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Output 1 dB gain compression point [1]	OP_{1dB}		11.5 12 11.5 9.5		dBm	I_{Cq} = 2.1 mA, I_{Ccomp} = 11 mA [2] I_{Cq} = 3 mA, I_{Ccomp} = 14 mA I_{Cq} = 6 mA, I_{Ccomp} = 16 mA I_{Cq} = 10 mA, I_{Ccomp} = 15 mA
Output 3rd order intercept point	OIP_3		2 5.5 14 19.5			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA

1 OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to ***Figure 1*** using the integrated biasing.

2 I_{Cq} is the quiescent current at small input power levels. I_{Cq} increases up to I_{Ccomp} as RF input power approaches IP_{1dB}, cf. ***Figure 14***.

Table 8 **AC characteristics, V_C = 3 V, f = 900 MHz**

Parameter	Symbol	Values			Unit	Note or test conditions
		Min.	Typ.	Max.		
Minimum noise figure	NF_{min}	–	0.55 0.55 0.6 0.7	–	dB	I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Transducer gain	$\|S_{21}\|^2$		17 19 23.5 26			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Maximum power gain	G_{ms}		24 25 27.5 29			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Output 1 dB gain compression point [1]	OP_{1dB}		11 11 10 8.5		dBm	I_{Cq} = 2.1 mA, I_{Ccomp} = 13 mA [2] I_{Cq} = 3 mA, I_{Ccomp} = 15 mA I_{Cq} = 6 mA, I_{Ccomp} = 14 mA I_{Cq} = 10 mA, I_{Ccomp} = 14 mA
Output 3rd order intercept point	OIP_3		3.5 8 17 19.5			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA

1 OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to ***Figure 1*** using the integrated biasing.

2 I_{Cq} is the quiescent current at small input power levels. I_{Cq} increases up to I_{Ccomp} as RF input power approaches IP_{1dB}, cf. ***Figure 14***.

Table 9 AC characteristics, V_C = 3 V, f = 1.5 GHz

Parameter	Symbol	Values			Unit	Note or test conditions
		Min.	Typ.	Max.		
Minimum noise figure	NF_{min}	–	0.6 0.6 0.6 0.7	–	dB	I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Transducer gain	$\|S_{21}\|^2$		16 18.5 22.5 24.5			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Maximum power gain	G_{ms}		21.5 23 25.5 27			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Output 1 dB gain compression point [1]	OP_{1dB}		10.5 10 9 8		dBm	I_{Cq} = 2.1 mA, I_{Ccomp} = 14 mA [2] I_{Cq} = 3 mA, I_{Ccomp} = 16 mA I_{Cq} = 6 mA, I_{Ccomp} = 15 mA I_{Cq} = 10 mA, I_{Ccomp} = 15 mA
Output 3rd order intercept point	OIP_3		3.5 8 17 19.5			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA

1 OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to ***Figure 1*** using the integrated biasing.

2 I_{Cq} is the quiescent current at small input power levels. I_{Cq} increases up to I_{Ccomp} as RF input power approaches IP_{1dB}, cf. ***Figure 14***.

Table 10 **AC characteristics, V_C = 3 V, f = 1.9 GHz**

Parameter	Symbol	Values			Unit	Note or test conditions
		Min.	Typ.	Max.		
Minimum noise figure	NF_{min}	–	0.6 0.6 0.6 0.7	–	dB	I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Transducer gain	$\|S_{21}\|^2$		16 18 21.5 23			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Maximum power gain	G_{ms}		21 22 24 26			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Output 1 dB gain compression point [1]	OP_{1dB}		10 10 8.5 8		dBm	I_{Cq} = 2.1 mA, I_{Ccomp} = 15 mA [2] I_{Cq} = 3 mA, I_{Ccomp} = 16 mA I_{Cq} = 6 mA, I_{Ccomp} = 14 mA I_{Cq} = 10 mA, I_{Ccomp} = 14 mA
Output 3rd order intercept point	OIP_3		3.5 7.5 17 19.5			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA

1 OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to ***Figure 1*** using the integrated biasing.

2 I_{Cq} is the quiescent current at small input power levels. I_{Cq} increases up to I_{Ccomp} as RF input power approaches IP_{1dB}, cf. ***Figure 14***.

Table 11 AC characteristics, V_C = 3 V, f = 2.4 GHz

Parameter	Symbol	Values			Unit	Note or test conditions
		Min.	Typ.	Max.		
Minimum noise figure	NF_{min}	–	0.65 0.6 0.6 0.7	–	dB	I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Transducer gain	$\|S_{21}\|^2$		15.5 17 20 21.5			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Maximum power gain	G_{ms}		20 21 23 25			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Output 1 dB gain compression point [1]	OP_{1dB}		10 10 9 8		dBm	I_{Cq} = 2.1 mA, I_{Ccomp} = 15 mA [2] I_{Cq} = 3 mA, I_{Ccomp} = 16 mA I_{Cq} = 6 mA, I_{Ccomp} = 14 mA I_{Cq} = 10 mA, I_{Ccomp} = 14 mA
Output 3rd order intercept point	OIP_3		4.5 9 17.5 19.5			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA

1 OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to ***Figure 1*** using the integrated biasing.

2 I_{Cq} is the quiescent current at small input power levels. I_{Cq} increases up to I_{Ccomp} as RF input power approaches IP_{1dB}, cf. ***Figure 14***.

Table 12 AC characteristics, V_C = 3 V, f = 3.5 GHz

Parameter	Symbol	Values			Unit	Note or test conditions
		Min.	Typ.	Max.		
Minimum noise figure	NF_{min}	–	0.8 0.75 0.7 0.75	–	dB	I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Transducer gain	$\|S_{21}\|^2$		13.5 15.5 18 19			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Maximum power gain	G_{ms}		18.5 20 22 23.5			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Output 1 dB gain compression point [1]	OP_{1dB}		10 10 9 8		dBm	I_{Cq} = 2.1 mA, I_{Ccomp} = 16 mA [2] I_{Cq} = 3 mA, I_{Ccomp} = 16 mA I_{Cq} = 6 mA, I_{Ccomp} = 15 mA I_{Cq} = 10 mA, I_{Ccomp} = 15 mA
Output 3rd order intercept point	OIP_3		5.5 12 17.5 19			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA

1 OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to ***Figure 1*** using the integrated biasing.

2 I_{Cq} is the quiescent current at small input power levels. I_{Cq} increases up to I_{Ccomp} as RF input power approaches IP_{1dB}, cf. ***Figure 14***.

Table 13 **AC characteristics, V_C = 3 V, f = 5.5 GHz**

Parameter	Symbol	Values			Unit	Note or test conditions
		Min.	Typ.	Max.		
Minimum noise figure	NF_{min}	–	1.05 1 0.9 0.95	–	dB	I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Transducer gain	$\|S_{21}\|^2$		11.5 13 15 15.5			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Maximum power gain	G_{ms}		17.5 18.5 20 19			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Output 1 dB gain compression point [1]	OP_{1dB}		10.5 10 9 8		dBm	I_{Cq} = 2.1 mA, I_{Ccomp} = 17 mA [2] I_{Cq} = 3 mA, I_{Ccomp} = 17 mA I_{Cq} = 6 mA, I_{Ccomp} = 15 mA I_{Cq} = 10 mA, I_{Ccomp} = 15 mA
Output 3rd order intercept point	OIP_3		6.5 12 22 21			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA

1 OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to ***Figure 1*** using the integrated biasing.

2 I_{Cq} is the quiescent current at small input power levels. I_{Cq} increases up to I_{Ccomp} as RF input power approaches IP_{1dB}, cf. ***Figure 14***.

Table 14 **AC characteristics, V_C = 3 V, f = 10 GHz**

Parameter	Symbol	Values			Unit	Note or test conditions
		Min.	Typ.	Max.		
Minimum noise figure	NF_{min}	–	2 1.8 1.5 1.5	–	dB	I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Transducer gain	$\|S_{21}\|^2$		5.5 7 9 10			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Maximum power gain	G_{ms}		14.5 15 15.5 15.5			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA
Output 1 dB gain compression point [1]	OP_{1dB}		6 6 4 4		dBm	I_{Cq} = 2.1 mA, I_{Ccomp} = 16 mA [2] I_{Cq} = 3 mA, I_{Ccomp} = 16 mA I_{Cq} = 6 mA, I_{Ccomp} = 15 mA I_{Cq} = 10 mA, I_{Ccomp} = 15 mA
Output 3rd order intercept point	OIP_3		2.5 7 19.5 18			I_C = 2.1 mA I_C = 3 mA I_C = 6 mA I_C = 10 mA

1 OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to ***Figure 1*** using the integrated biasing.

2 I_{Cq} is the quiescent current at small input power levels. I_{Cq} increases up to I_{Ccomp} as RF input power approaches IP_{1dB}, cf. ***Figure 14***.

4.3.2 Typical AC characteristic curves

Measurement setup is as described in ***Figure 7*** except for ***Figure 14***, where the compression point is measured in a 50 Ω application circuit according to ***Figure 1*** using the integrated biasing at V_C = 3 V, T_A = 25 °C.

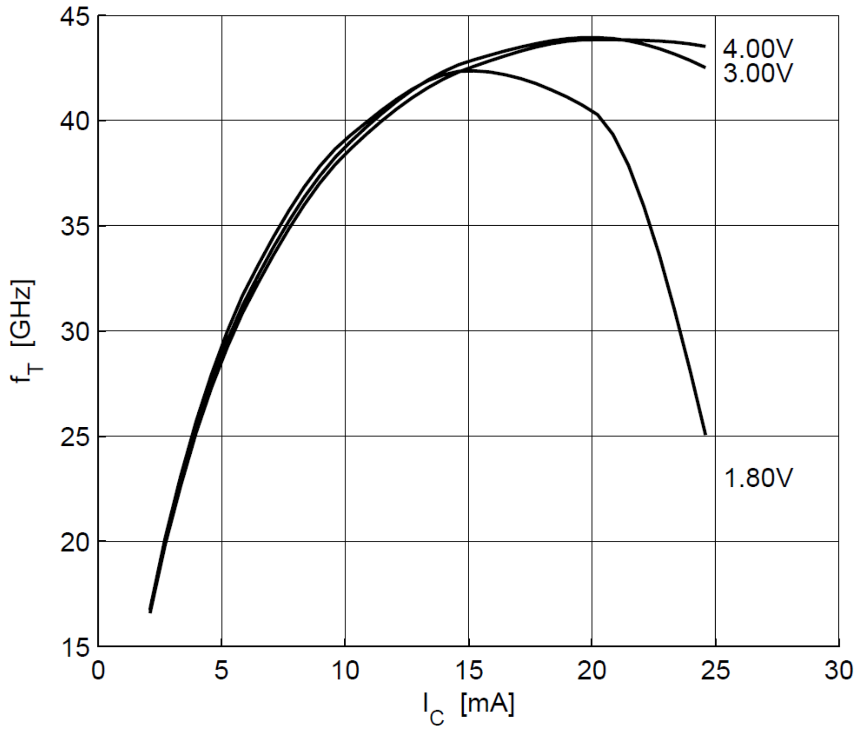

Figure 8 Transition frequency f_T = f(I_C), V_C = parameter

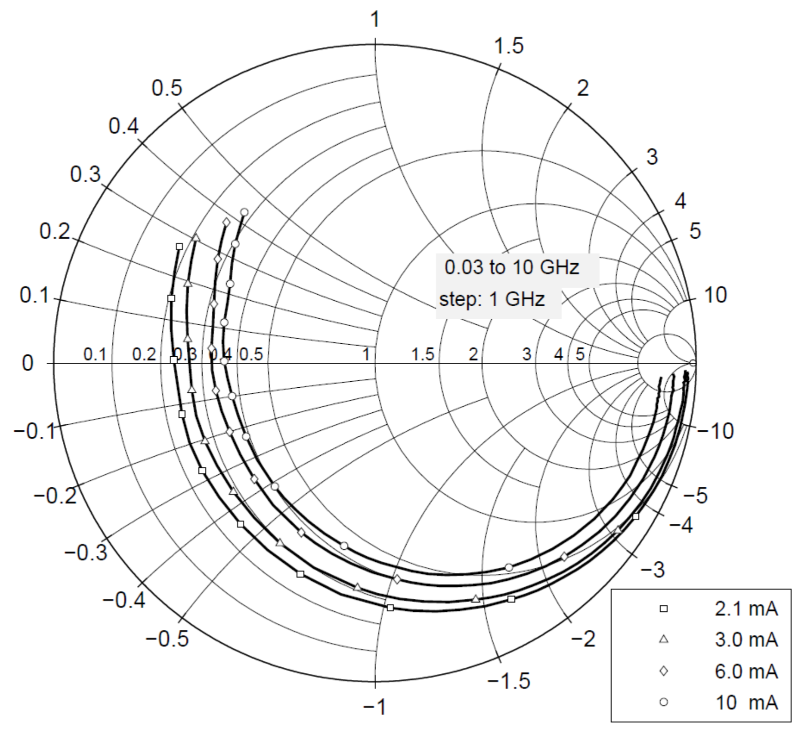

Figure 9 Input reflection coefficient S_{11} = f(f), I_C = parameter

Electrical characteristics

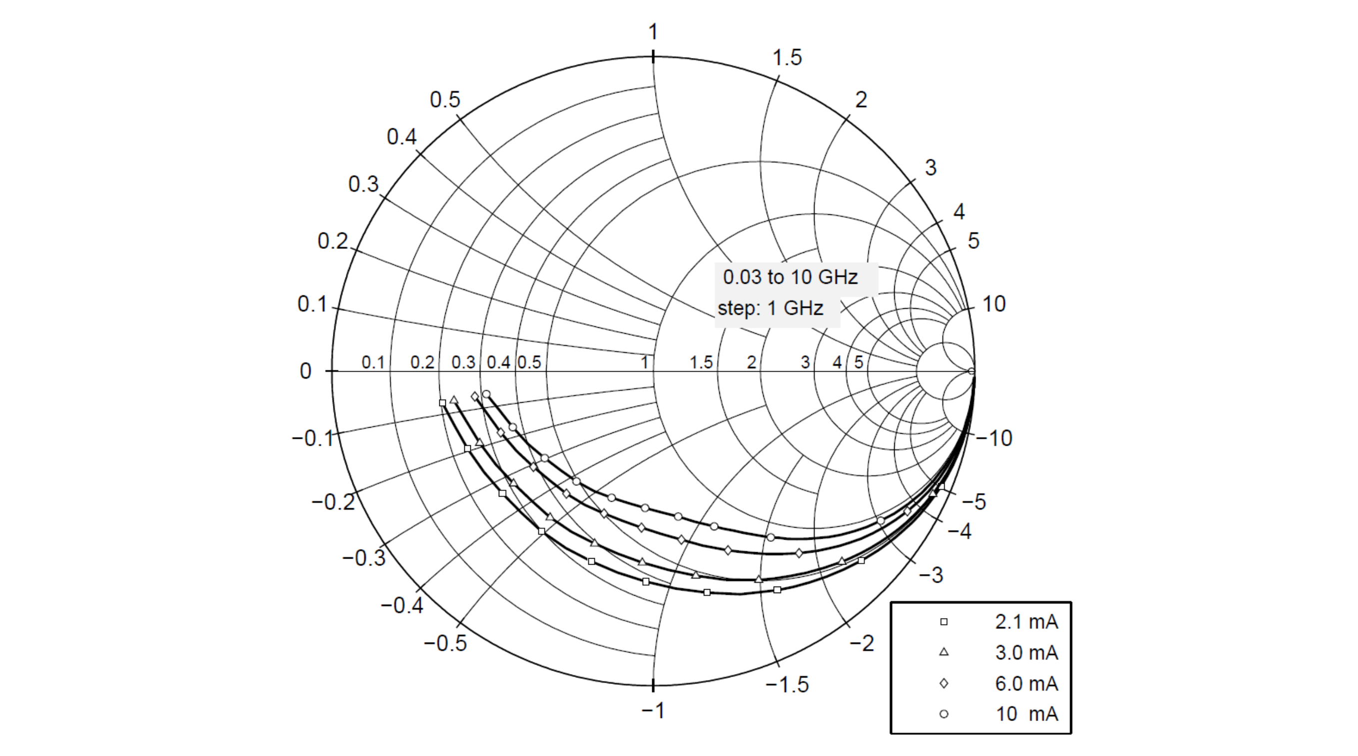

Figure 10 Output reflection coefficient S_{22} = f(f), I_C = parameter

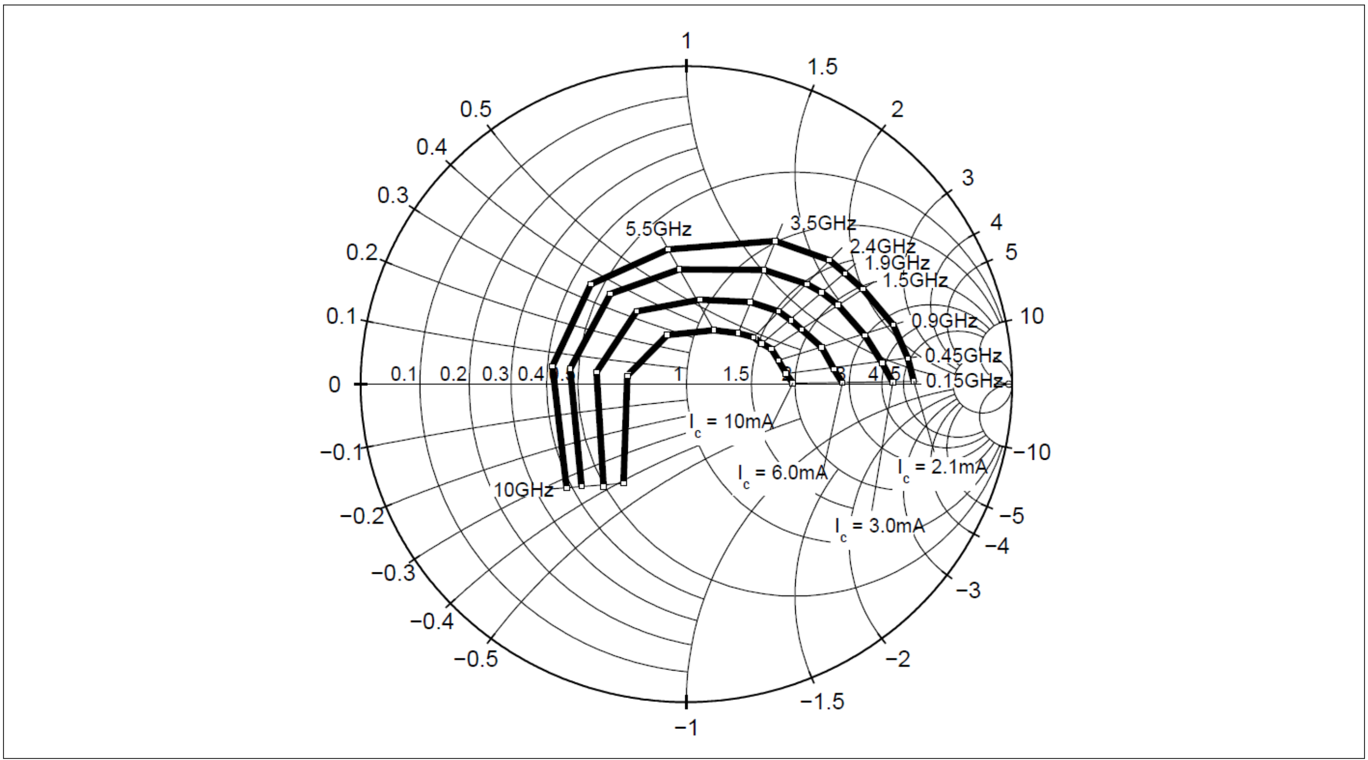

Figure 11 Source impedance for minimum noise figure $Z_{S,opt}$ = f(f), I_C = parameter

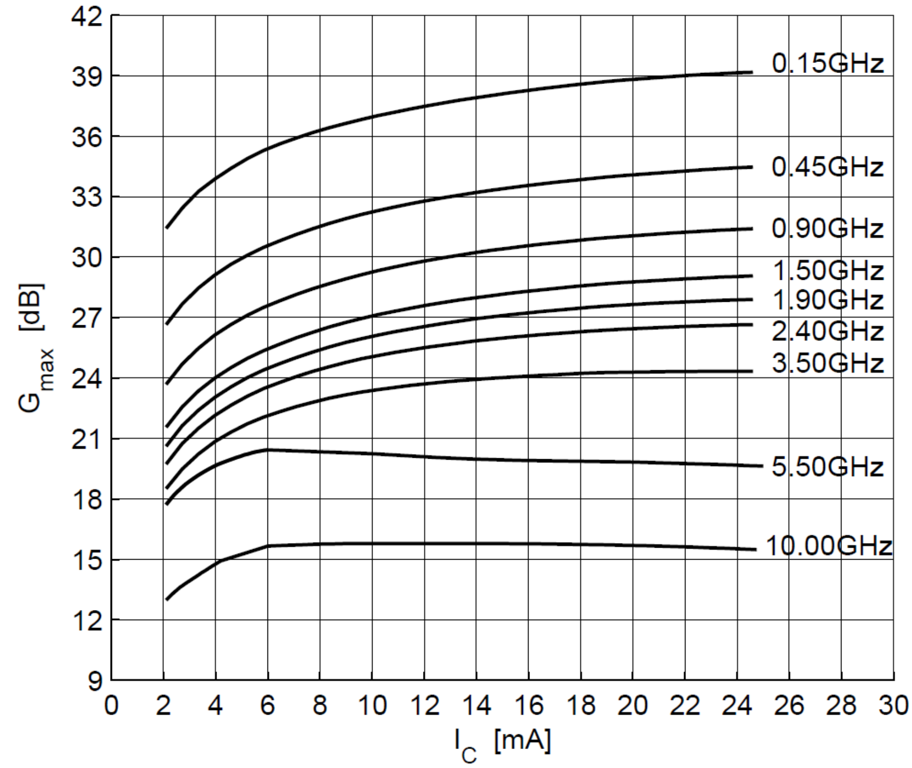

Figure 12 **Maximum power gain $G_{max} = f(I_C)$, f = parameter**

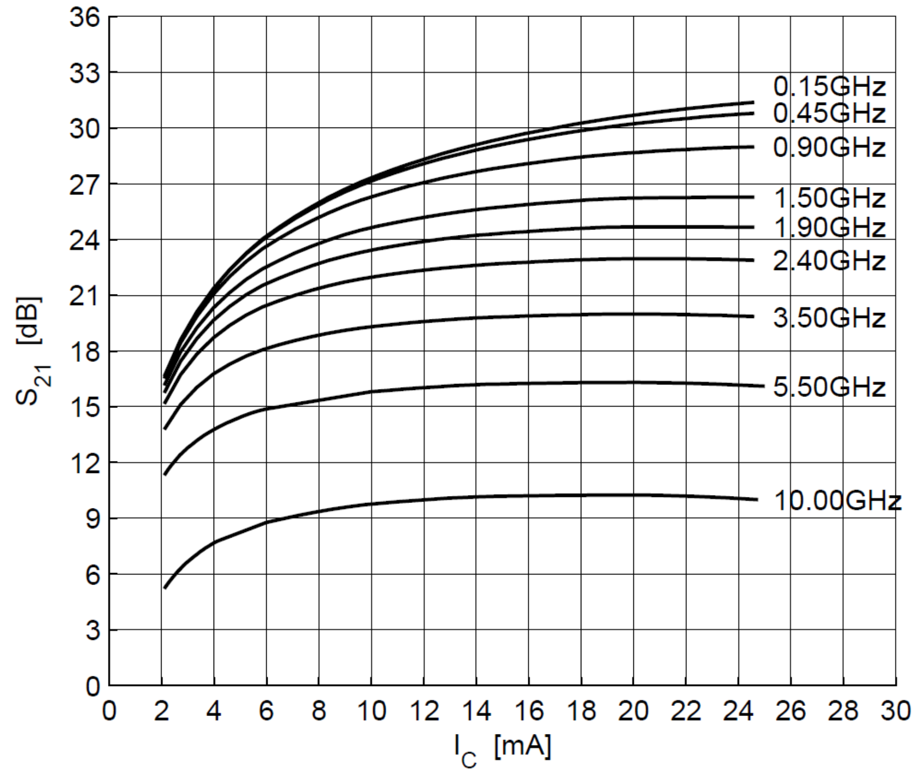

Figure 13 **Transducer gain $|S_{21}|^2 = f(I_C)$, f = parameter**

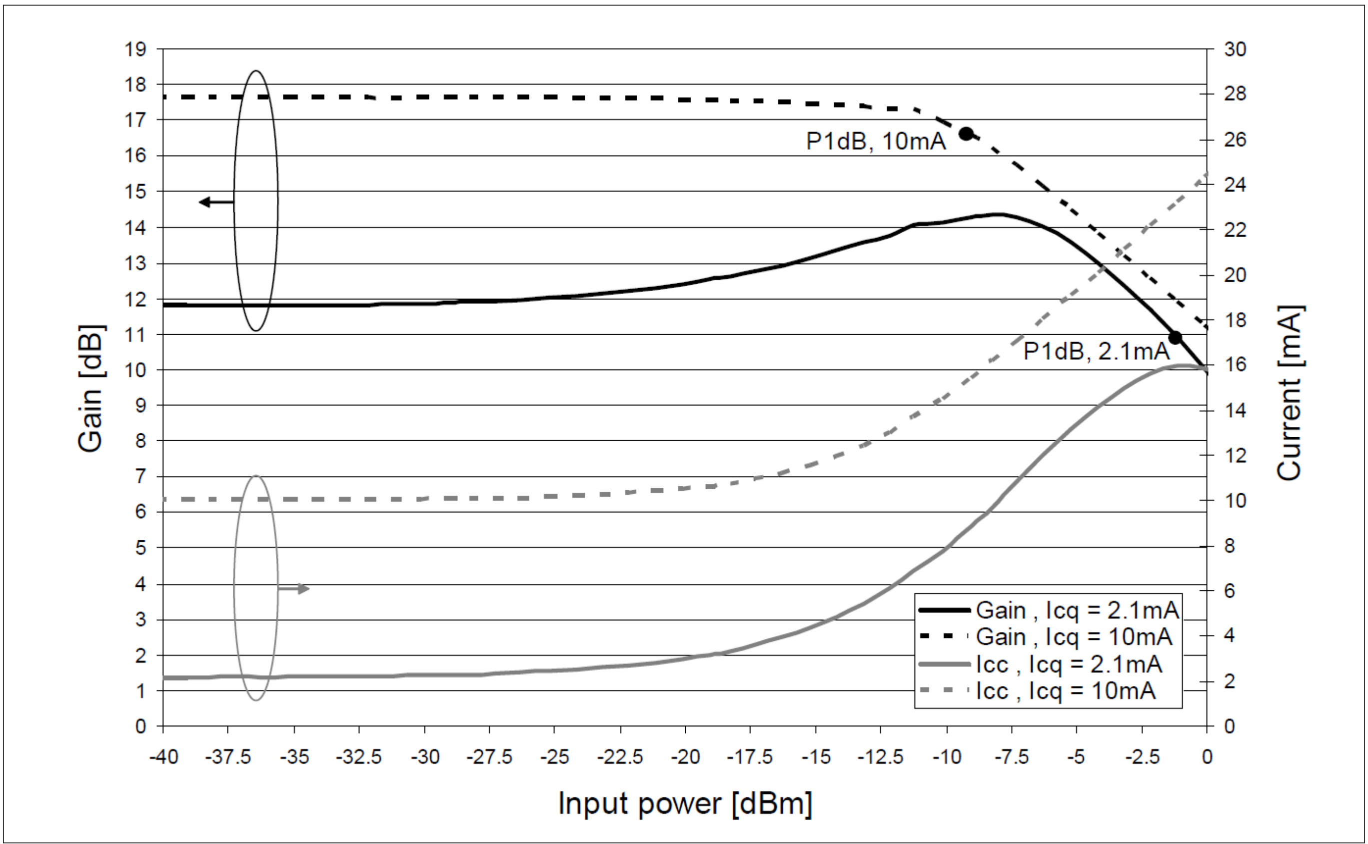

Figure 14 Power gain $G = f(P_{RFin})$ and supply current $I_{cc} = f(P_{RFin})$ at frequency $f = 3.5$ GHz, I_{cq} = parameter

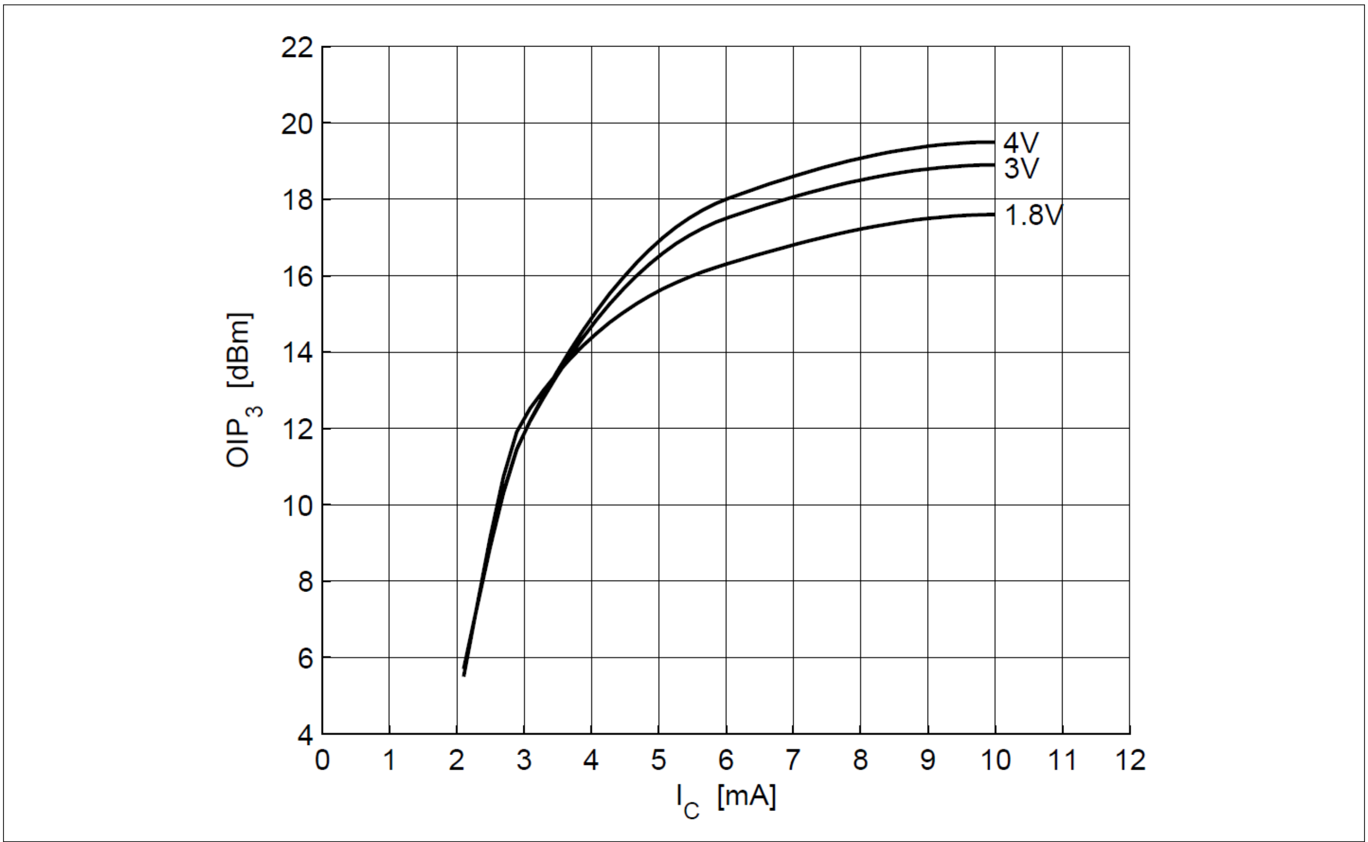

Figure 15 Output 3rd order intercept point $OIP_3 = f(I_C)$ at frequency $f = 3.5$ GHz, V_C = parameter

5 Package information TSLP-7-1

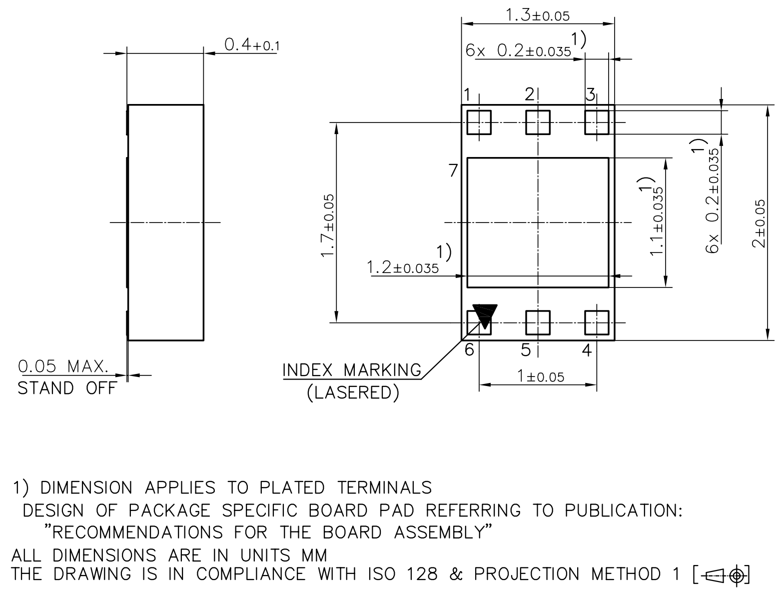

Figure 16 Package outline

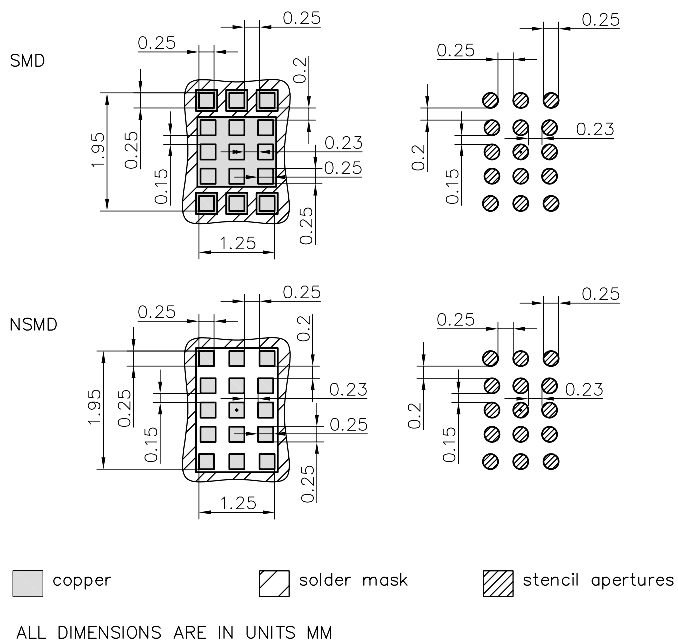

Figure 17 Foot print

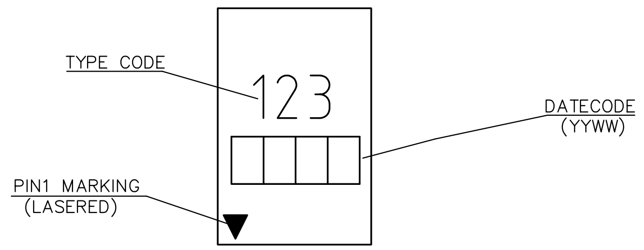

Figure 18 Marking layout example

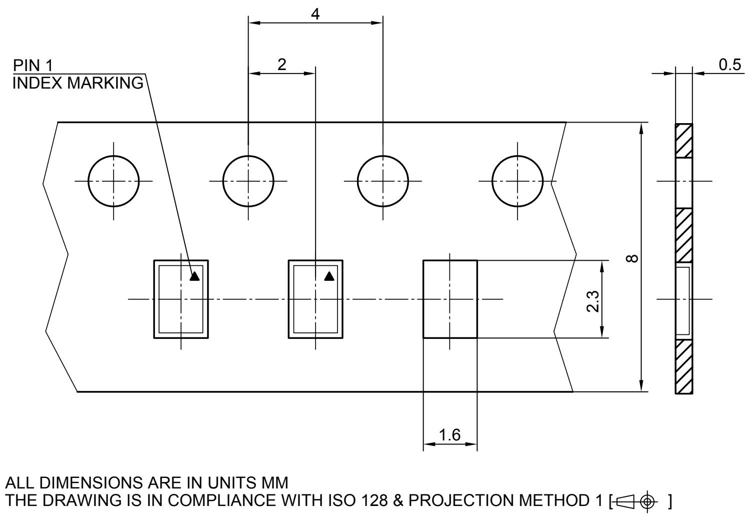

Figure 19 Tape information

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
4.0	2018-09-26	New datasheet layout.

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Email: erratum@infineon.com

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