BGB707L7ESD

SiGe:C Wideband MMIC LNA with Integrated ESD Protection

Data Sheet

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BGB707L7ESD SiGe:C Wideband MMIC LNA with Integrated ESD Protection

Revision History: 2010-06-30, Revision 3.2

Previous Revision: Revision 3.1	
Page	**Subjects (major changes since last revision)**
	New template for data sheet layout.
18 - 26	Linearity description related to the RF output.
13, 14	Typical DC characteristic curves included.
27, 30	Typical AC characteristic curves included.
21, 24	AC performance tables expanded by 2 frequencies.

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1 Features

- High performance general purpose wideband MMIC LNA
- ESD protection integrated for all pins (3 kV for RF input vs. GND, 2 kV for all other pin combinations, HBM)
- Integrated active biasing circuit enables stable operation point against temperature- and processing-variations
- Excellent noise figure from Infineon´s reliable high volume SiGe:C technology
- High gain and linearity at low current consumption
- Operation voltage: 1.8 V to 4.0 V
- Adjustable operation current 2.1 mA to 25 mA by external resistor
- Power-off function
- Very small and leadless package TSLP-7-1, 2.0 x 1.3 x 0.4 mm^3
- Pb-free (RoHS compliant) and halogen-free (WEEE compliant) package

RoHS

Applications

As Low Noise Amplifier (LNA) in

- Mobile, portable and fixed connectivity applications: WLAN 802.11a/b/g/n, WiMax 2.5/3.5/5 GHz, UWB, WiFi, Bluetooth
- Satellite communication systems: Navigation systems (GPS, Glonass), satellite radio (SDARs, DAB) and C-band LNB
- Multimedia applications such as mobile/portable TV, CATV, FM Radio
- 3G/4G UMTS/LTE mobile phone applications
- ISM applications like RKE, AMR and Zigbee, as well as for emerging wireless applications

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

Product Name	Package	Marking
BGB707L7ESD	TSLP-7-1	AZ

2 Product Brief

The BGB707L7ESD is a Silicon Germanium Carbon (SiGe:C) low noise amplifier MMIC with integrated ESD protection and active biasing. The device is as flexible as a discrete transistor and features high gain, reduced power consumption and very low distortion for a very wide range of applications.

The device is based upon Infineon Technologies cost effective SiGe:C technology and comes in a low profile TSLP-7-1 leadless green package

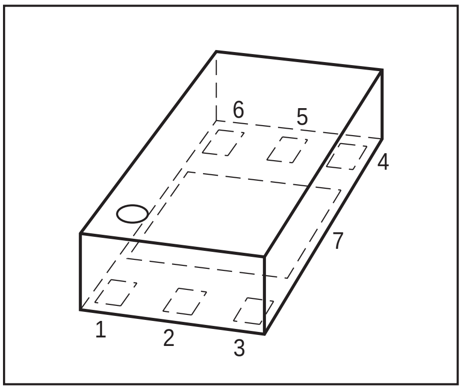

Figure 1 Pinning PG-TSLP-7-1

Table 1 Pinning Table

Pin	Name	Function
1	V_{CC}	Supply voltage
2	V_{Bias}	Bias reference voltage
3	RF_{in}	RF input
4	RF_{out}	RF output
5	V_{Ctrl}	On/Off control voltage
6	Adj	Current adjustment pin
7	GND	DC/RF GND

The following function block in **Figure 2** shows the principal schematic how the BGB707L7ESD is used in a circuit. The 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 (which is adjusted by the integrated biasing when R_{ext} is omitted) can be increased. Base- and collector voltages are applied to the respective pins RF_{in} and RF_{out} by external inductors L_B and L_C.

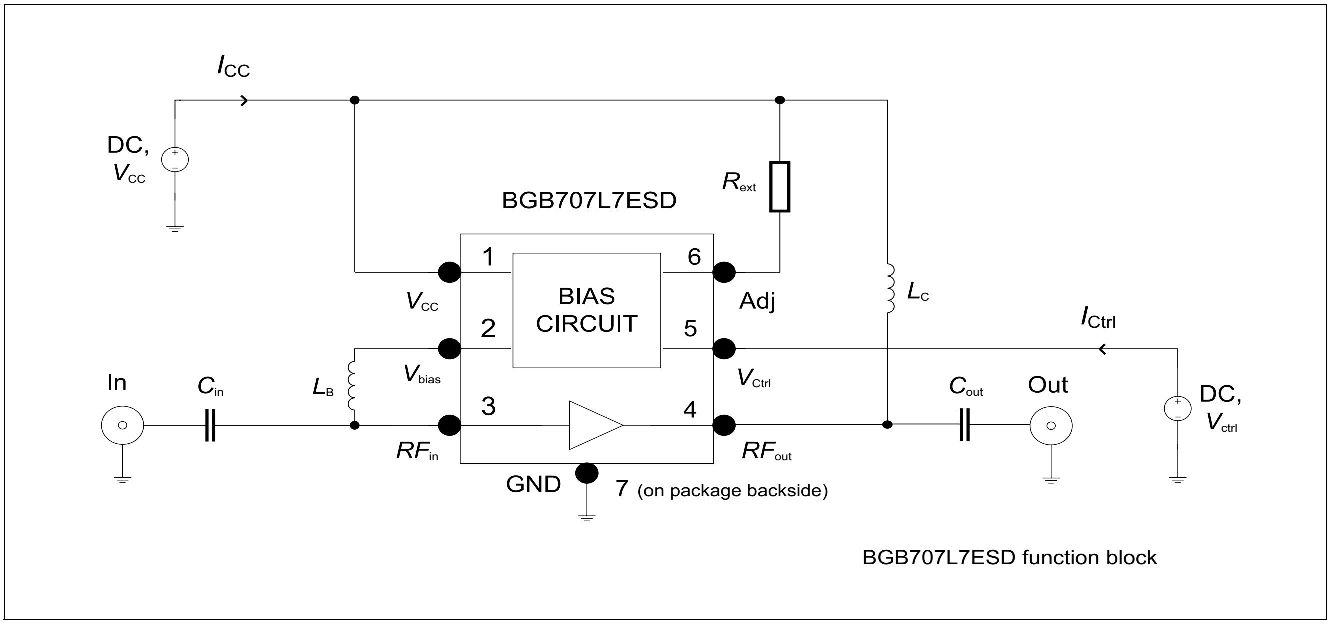

Figure 2 Function Block

3 Maximum Ratings

Table 2 Maximum Ratings at T_A = 25°C (unless otherwise specified)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{CC}	–	–	4.0	V	–
T_A = -55°C		–	–	3.5		–
Supply Current at V_{CC} pin	I_{CC}	–	–	25	mA	–
DC Current at RF In pin	I_B	–	–	2	mA	–
Voltage at Ctrl On/Off pin	V_{ctrl}	–	–	4.0	V	–
Total Power Dissipation T_S<112 °C[1)]	P_{tot}	–	–	100	mW	–
Operation Junction Temperature	T_{JOp}	–	–	150	°C	–
Storage Temperature	T_{Stg}	-55	–	150	°C	–

1) T_S is the soldering point temperature. T_S is measured at the GND pin (7) at the soldering point to the pcb

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. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

4 Thermal Characteristics

Table 3 Thermal Resistance

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Junction - Soldering Point[1)]	R_{thJS}	–	375	–	K/W	–

1) For calculation of R_{thJA} please refer to Application Note Thermal Resistance

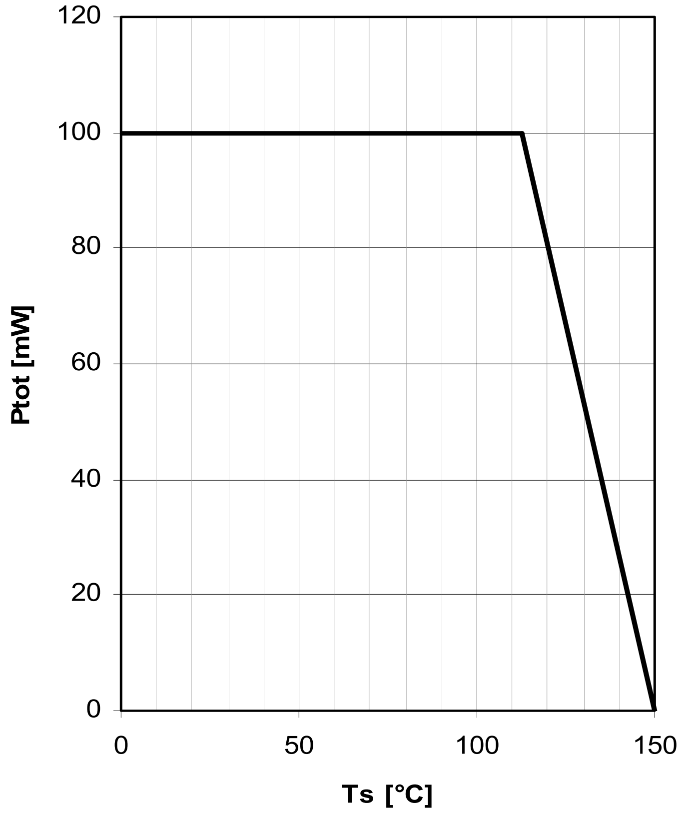

Figure 3 Total Power Dissipation $P_{tot} = f(T_s)$

5 Operation Conditions

Table 4 Operation Conditions

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{CC}	1.8	3.0	4.0	V	–
Voltage Ctrl On/Off pin in On mode	V_{ctrl}	1.2	–	V_{CC}	V	–
Voltage Ctrl On/Off pin in Off mode	V_{ctrl}	-0.3	–	0.3	V	–

6 Electrical Characteristics

6.1 DC Characteristics

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

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Current	I_{CC}	–	–	–	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
Current into V_{Ctrl} pin in On mode	$I_{Ctrl\text{-}on}$	–	14	20	µA	V_{Ctrl} = 3 V
Current into V_{Ctrl} pin in Off mode	$I_{Ctrl\text{-}off}$	–	–	0.1	µA	V_{Ctrl} = 0 V

6.2 Typical DC Characteristic Curves

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

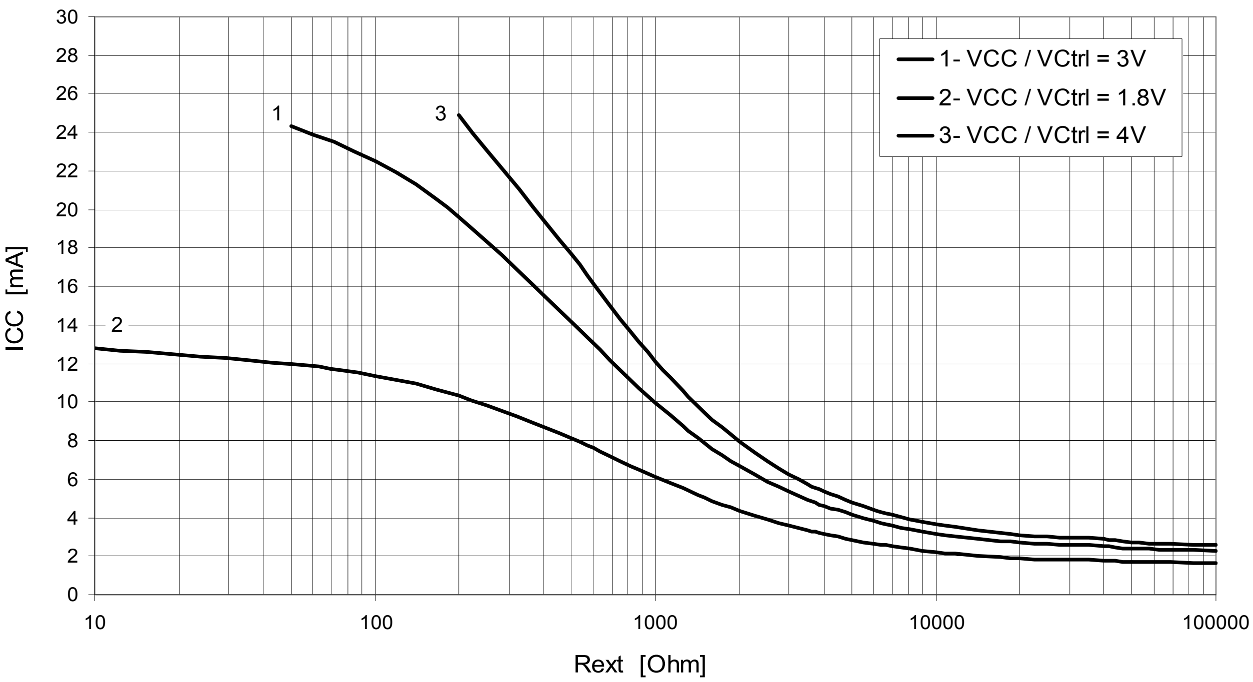

Figure 4 I_{CC} **as a Function of** R_{ext} **,** V_{CC} **as Parameter**

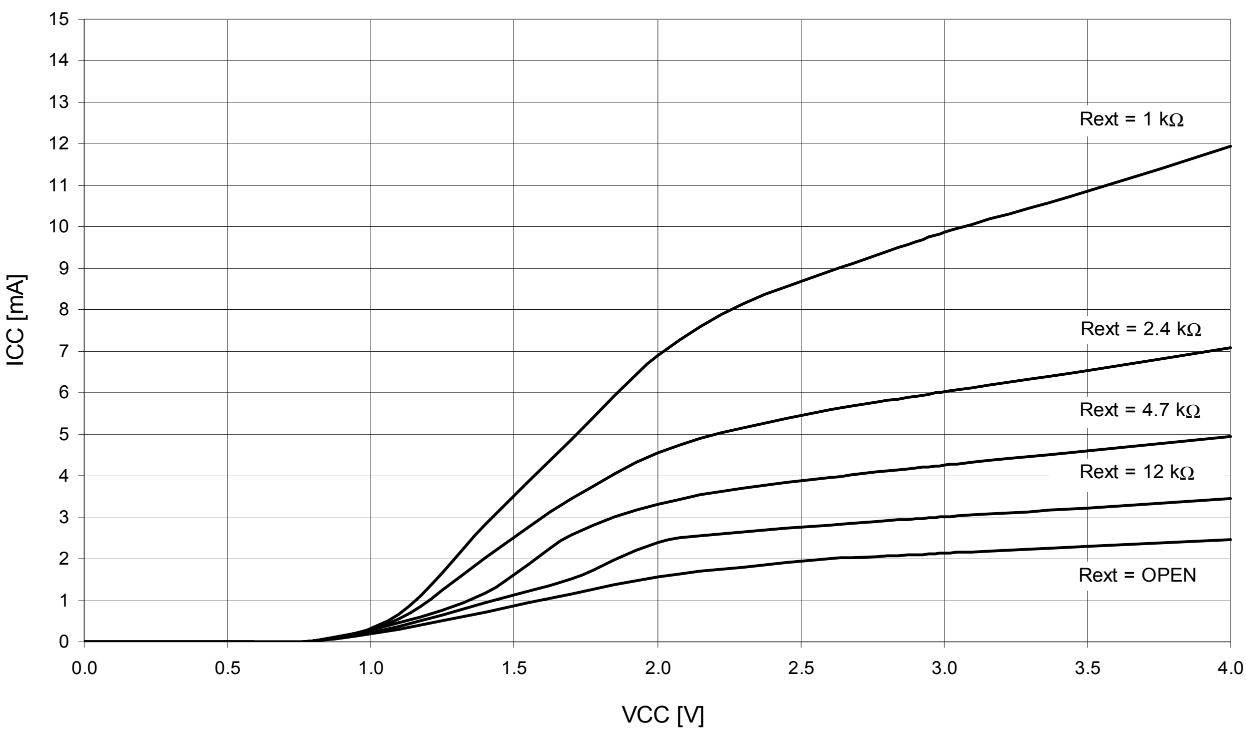

Figure 5 I_{CC} **as a Function of** V_{CC} **,** V_{Ctrl} **= 3 V ,** R_{ext} **as Parameter**

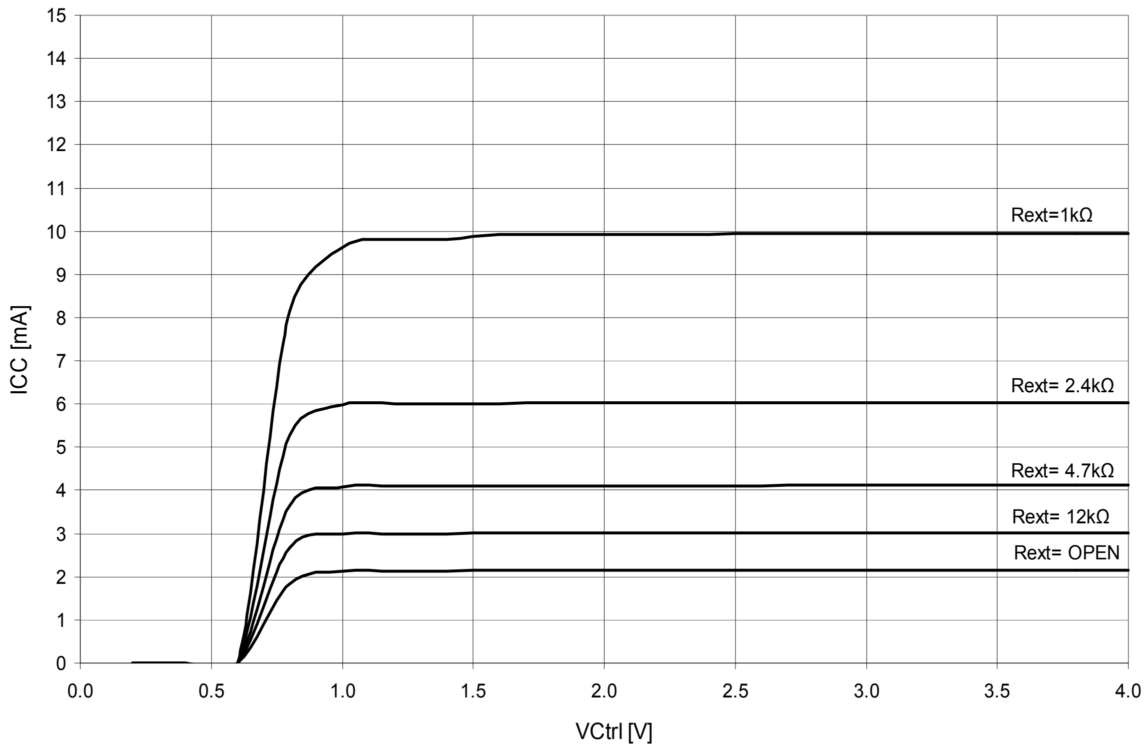

Figure 6 I_{CC} **as a Function of** V_{Ctrl} **,** V_{CC} **= 3 V ,** R_{ext} **as Parameter**

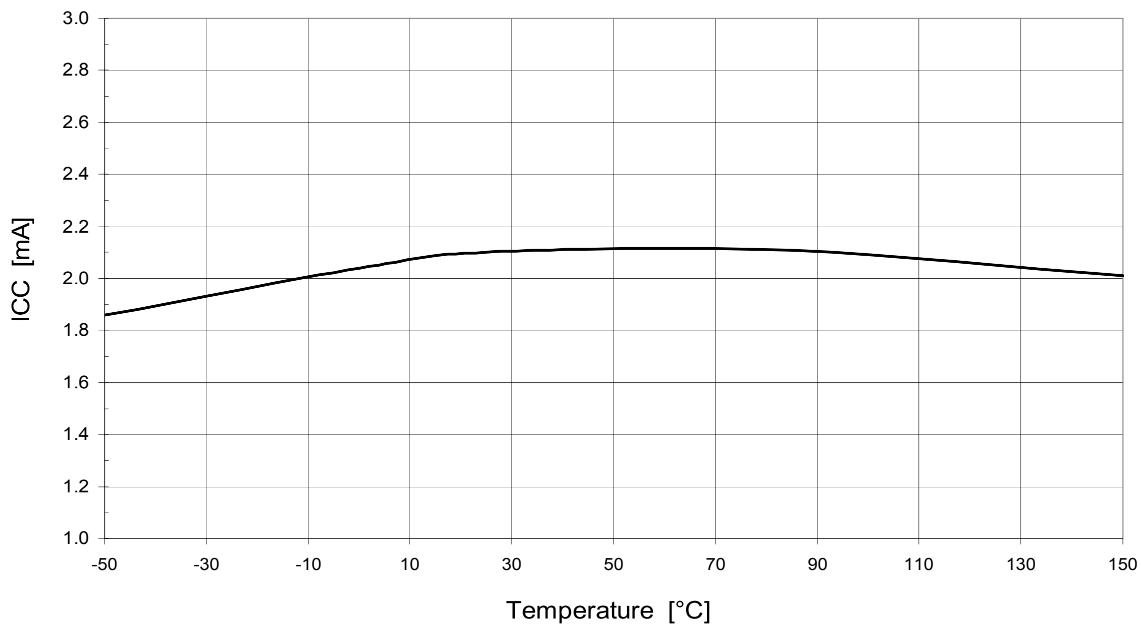

Figure 7 I_{CC} **as a Function of Temperature ,** V_{Ctrl} **=** V_{CC} **= 3 V ,** R_{ext} **= open**

6.3 AC Characteristics

AC characteristics are described in two sub-chapters, first for 100 MHz FM Radio applications, then for higher frequencies in a 50 Ω environment.

6.3.1 AC Characteristics in FM Radio Applications

Two BGB707L7ESD FM radio application notes are available on our website **www.infineon.com/BGB707**. Depending on the impedance of the used antenna, please consult AN177 for high-ohmic antennas and AN181 for 50 Ω antennas. In this chapter you find a summary of the electrical performance as described in these application notes in table form.

6.3.1.1 High-Ohmic FM Radio Antenna

TA = 25°C, V_{CC} = 3.0 V, I_{CC} = 3.0 mA, V_{Ctrl} = 3.0 V, f = 100 MHz, R_{ext} = 12 kΩ

Table 6 AC Characteristics in the FM Radio Application as Described in AN177

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Transducer Gain	$\|S_{21}\|^2$	–	12	–	dB	–
Input Return Loss	RL_{IN}	–	0.5[1)]	–	dB	–
Output Return Loss	RL_{OUT}	–	16	–	dB	–
Noise Figure (Z_s = 50 Ω)	NF	–	1.0	–	dB	–
Input 1 dB Gain Compression Point[2)]	IP_{1dB}	–	-5.5	–	dBm	–
Input 3rd Order Intercept Point[3)]	IIP_3	–	-12.5	–	dBm	–

1) LNA presents a high input impedance match over the 76-108 MHz FM radio band.
2) I_{CC} increases as RF input power level approaches IP_{1dB}.
3) IIP_3 value depends on termination of all intermodulation frequency components. Termination used for the measurement is 50 Ω from 0.1 to 6 GHz.

6.3.1.2 50 Ω FM Radio Antenna

TA = 25°C, V_{CC} = 2.8 V, I_{CC} = 4.2 mA, V_{Ctrl} = 2.8 V, f = 100 MHz, R_{ext} = 4.7 kΩ

Table 7 AC Characteristics in the FM Radio Application as Described in AN181

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Transducer Gain	$\|S_{21}\|^2$	13.5	15	16.5	dB	–
Input Return Loss	RL_{IN}	–	7.5	–	dB	–
Output Return Loss	RL_{OUT}	–	14.5	–	dB	–
Noise figure (Z_s = 50 Ω)	NF	–	1.35	1.9	dB	–
Input 1 dB Gain Compression Point [1) 2)]	IP_{1dB}	–	-10	–	dBm	–
Input 3rd Order Intercept Point [2)3)]	IIP_3	-7.5	-6	–	dBm	–

1) I_{CC} increases as RF input power level approaches IP_{1dB}.
2) Verified by random sampling
3) IIP_3 value depends on termination of all intermodulation frequency components. Termination used for the measurement is 50 Ω from 0.1 to 6 GHz.

6.3.2 AC Characteristics in the SDMB Application

A technical report TR122 for LNA applications in the frequency range 2.3 GHz to 2.7 GHz is available on our web page **www.infineon.com/BGB707**. In this chapter you find a summary of the electrical performance for the SDMB application as described in technical report TR122 in table form.

Table 8 AC Characteristics in the SDMB Application as Described in TR122, T_A = 25°C

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Frequency Range	Freq	–	2.6	–	GHz	–
Supply Voltage	V_{cc}	–	2.8	–	V	–
Bias Current	I_{cc}	4.4	5.6	6.8	mA	–
Transducer Gain	$\|S_{21}\|^2$	13	15	17	dB	Power @ port1 = -30 dBm
Transducer Gain (off mode)	$\|S_{21}\|^2$off	–	-18	–	dB	–
Noise Figure (Z_s = 50 Ω)	NF	–	1.15	1.5	dB	Including 0.1 dB Board losses
Input Return Loss	RL_{IN}	–	13.2	–	dB	–
Output Return Loss	RL_{OUT}	–	12	–	dB	–
Reverse Isolation	I_{REV}	–	27.8	–	dB	Power @ port2 = -10 dBm
Input P1dB	IP_{1dB}	–	-9.6	–	dBm	–
Output P1dB	OP_{1dB}	–	4.4	–	dBm	–
Input IP3	IIP_3	–	-1.4	–	dBm	Input power = -30 dBm
Output IP3	OIP_3	–	13.6	–	dBm	–
On Switching Time	T_{on}	–	1.5	–	µs	Measured with C_2 = 1 nF
Off Switching Time	T_{off}	–	4.2	–	µs	–
Stability	k	–	>1	–		Stability measured up to 10 GHz

6.3.3 AC Characteristics in Test Fixture

For frequencies from 150 MHz to 10 GHz the measurement setup is a test fixture with Bias-T's in a 50 Ω system according to Figure 8 at V_C = 3V, T_A = 25 °C. The collector current I_C is controlled by an external base voltage V_B applied at RF_{in} pin and not by the integrated biasing´s reference voltage V_{Bias}. V_C controls the collector voltage at RF_{out} pin. This allows direct measurement of the amplifier performance as a function of bias conditions without passive components.

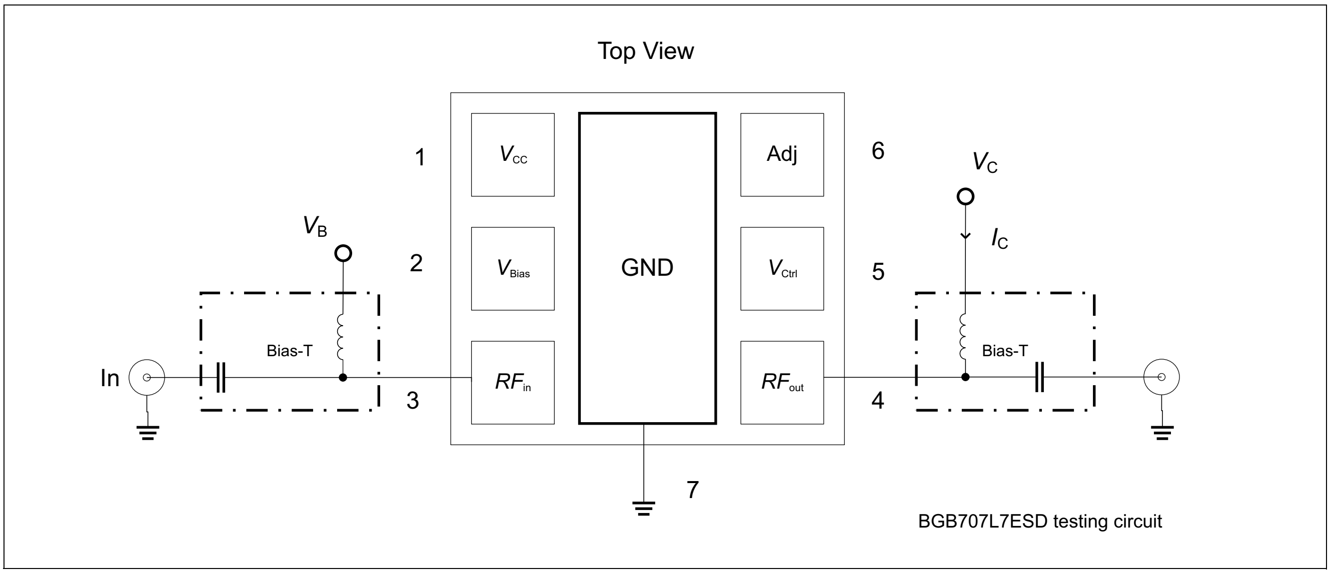

Figure 8 Testing Circuit for Frequencies from 150 MHz to 10 GHz

Table 9 AC Characteristics V_C = 3 V, f = 150 MHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Minimum Noise Figure	NF_{min}				dB	$Z_S = Z_{Sopt}$
		–	0.4	–		I_C = 2.1 mA
		–	0.4	–		I_C = 3 mA
		–	0.5	–		I_C = 6 mA
		–	0.55	–		I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$				dB	$Z_S = Z_L$ = 50 Ω
		–	17	–		I_C = 2.1 mA
		–	19	–		I_C = 3 mA
		–	24	–		I_C = 6 mA
		–	27	–		I_C = 10 mA
Maximum Power Gain	G_{ms}				dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$
		–	31.5	–		I_C = 2.1 mA
		–	33	–		I_C = 3 mA
		–	35	–		I_C = 6 mA
		–	37	–		I_C = 10 mA
Output 1 dB Compression Point[1)]	OP_{1dB}				dBm	
		–	3.5	–		I_{Cq} = 2.1 mA, I_{Ccomp} = 11 mA[2)]
		–	4	–		I_{Cq} = 3 mA, I_{Ccomp} = 11 mA
		–	4.5	–		I_{Cq} = 6 mA, I_{Ccomp} = 11 mA
		–	3	–		I_{Cq} = 10 mA, I_{Ccomp} = 11 mA
Output 3rd Order Intercept Point	OIP_3				dBm	
		–	2	–		I_C = 2.1 mA
		–	6	–		I_C = 3 mA
		–	14.5	–		I_C = 6 mA
		–	19.5	–		I_C = 10 mA

1) OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to **Figure 2** 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 15**.

Table 10 AC Characteristics V_C = 3 V, f = 450 MHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Minimum Noise Figure	NF_{min}				dB	$Z_S = Z_{Sopt}$
		–	0.45	–		I_C = 2.1 mA
		–	0.45	–		I_C = 3 mA
		–	0.5	–		I_C = 6 mA
		–	0.6	–		I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$				dB	$Z_S = Z_L$ = 50 Ω
		–	17	–		I_C = 2.1 mA
		–	19	–		I_C = 3 mA
		–	24	–		I_C = 6 mA
		–	27	–		I_C = 10 mA
Maximum Power Gain	G_{ms}				dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$
		–	27	–		I_C = 2.1 mA
		–	28	–		I_C = 3 mA
		–	30.5	–		I_C = 6 mA
		–	32	–		I_C = 10 mA
Output 1 dB Compression Point[1)]	OP_{1dB}				dBm	
		–	11.5	–		I_{Cq} = 2.1 mA, I_{Ccomp} = 11 mA[2)]
		–	12	–		I_{Cq} = 3 mA, I_{Ccomp} = 14 mA
		–	11.5	–		I_{Cq} = 6 mA, I_{Ccomp} = 16 mA
		–	9.5	–		I_{Cq} = 10 mA, I_{Ccomp} = 15 mA
Output 3rd Order Intercept Point	OIP_3				dBm	
		–	2	–		I_C = 2.1 mA
		–	5.5	–		I_C = 3 mA
		–	14	–		I_C = 6 mA
		–	19.5	–		I_C = 10 mA

1) OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to **Figure 2** 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 15**.

Table 11 AC Characteristics V_C = 3 V, f = 900 MHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Minimum Noise Figure	NF_{min}				dB	$Z_S = Z_{Sopt}$
		–	0.55	–		I_C = 2.1 mA
		–	0.55	–		I_C = 3 mA
		–	0.6	–		I_C = 6 mA
		–	0.7	–		I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$				dB	$Z_S = Z_L$ = 50 Ω
		–	17	–		I_C = 2.1 mA
		–	19	–		I_C = 3 mA
		–	23.5	–		I_C = 6 mA
		–	26	–		I_C = 10 mA
Maximum Power Gain	G_{ms}				dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$
		–	24	–		I_C = 2.1 mA
		–	25	–		I_C = 3 mA
		–	27.5	–		I_C = 6 mA
		–	29	–		I_C = 10 mA
Output 1 dB Compression Point[1)]	OP_{1dB}				dBm	
		–	11	–		I_{Cq} = 2.1 mA, I_{Ccomp} = 13 mA[2)]
		–	11	–		I_{Cq} = 3 mA, I_{Ccomp} = 15 mA
		–	10	–		I_{Cq} = 6 mA, I_{Ccomp} = 14 mA
		–	8.5	–		I_{Cq} = 10 mA, I_{Ccomp} = 14 mA
Output 3rd Order Intercept Point	OIP_3				dBm	
		–	3.5	–		I_C = 2.1 mA
		–	8	–		I_C = 3 mA
		–	17	–		I_C = 6 mA
		–	19.5	–		I_C = 10 mA

1) OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to **Figure 2** 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 15**.

Table 12 AC Characteristics V_C = 3 V, f = 1.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Minimum Noise Figure	NF_{min}				dB	$Z_S = Z_{Sopt}$
		–	0.6	–		I_C = 2.1 mA
		–	0.6	–		I_C = 3 mA
		–	0.6	–		I_C = 6 mA
		–	0.7	–		I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$				dB	$Z_S = Z_L$ = 50 Ω
		–	16	–		I_C = 2.1 mA
		–	18.5	–		I_C = 3 mA
		–	22.5	–		I_C = 6 mA
		–	24.5	–		I_C = 10 mA
Maximum Power Gain	G_{ms}				dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$
		–	21.5	–		I_C = 2.1 mA
		–	23	–		I_C = 3 mA
		–	25.5	–		I_C = 6 mA
		–	27	–		I_C = 10 mA
Output 1 dB Compression Point[1)]	OP_{1dB}				dBm	
		–	10.5	–		I_{Cq} = 2.1 mA, I_{Ccomp} = 14 mA[2)]
		–	10	–		I_{Cq} = 3 mA, I_{Ccomp} = 16 mA
		–	9	–		I_{Cq} = 6 mA, I_{Ccomp} = 15 mA
		–	8	–		I_{Cq} = 10 mA, I_{Ccomp} = 15 mA
Output 3rd Order Intercept Point	OIP_3				dBm	
		–	3.5	–		I_C = 2.1 mA
		–	8	–		I_C = 3 mA
		–	17	–		I_C = 6 mA
		–	19.5	–		I_C = 10 mA

1) OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to **Figure 2** 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 15**.

Table 13 AC Characteristics V_C = 3 V, f = 1.9 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Minimum Noise Figure	NF_{min}				dB	$Z_S = Z_{Sopt}$
		–	0.6	–		I_C = 2.1 mA
		–	0.6	–		I_C = 3 mA
		–	0.6	–		I_C = 6 mA
		–	0.7	–		I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$				dB	$Z_S = Z_L$ = 50 Ω
		–	16	–		I_C = 2.1 mA
		–	18	–		I_C = 3 mA
		–	21.5	–		I_C = 6 mA
		–	23	–		I_C = 10 mA
Maximum Power Gain	G_{ms}				dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$
		–	21	–		I_C = 2.1 mA
		–	22	–		I_C = 3 mA
		–	24	–		I_C = 6 mA
		–	26	–		I_C = 10 mA
Output 1 dB Compression Point[1)]	OP_{1dB}				dBm	
		–	10	–		I_{Cq} = 2.1 mA, I_{Ccomp} = 15 mA[2)]
		–	10	–		I_{Cq} = 3 mA, I_{Ccomp} = 16 mA
		–	8.5	–		I_{Cq} = 6 mA, I_{Ccomp} = 14 mA
		–	8	–		I_{Cq} = 10 mA, I_{Ccomp} = 14 mA
Output 3rd Order Intercept Point	OIP_3				dBm	
		–	3.5	–		I_C = 2.1 mA
		–	7.5	–		I_C = 3 mA
		–	17	–		I_C = 6 mA
		–	19.5	–		I_C = 10 mA

1) OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to **Figure 2** 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 15**.

Table 14 AC Characteristics V_C = 3 V, f = 2.4 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Minimum Noise Figure	NF_{min}				dB	$Z_S = Z_{Sopt}$
		–	0.65	–		I_C = 2.1 mA
		–	0.6	–		I_C = 3 mA
		–	0.6	–		I_C = 6 mA
		–	0.7	–		I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$				dB	$Z_S = Z_L$ = 50 Ω
		–	15.5	–		I_C = 2.1 mA
		–	17	–		I_C = 3 mA
		–	20	–		I_C = 6 mA
		–	21.5	–		I_C = 10 mA
Maximum Power Gain	G_{ms}				dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$
		–	20	–		I_C = 2.1 mA
		–	21	–		I_C = 3 mA
		–	23	–		I_C = 6 mA
		–	25	–		I_C = 10 mA
Output 1 dB Compression Point[1]	OP_{1dB}				dBm	
		–	10	–		I_{Cq} = 2.1 mA, I_{Ccomp} = 15 mA[2]
		–	10	–		I_{Cq} = 3 mA, I_{Ccomp} = 16 mA
		–	9	–		I_{Cq} = 6 mA, I_{Ccomp} = 14 mA
		–	8	–		I_{Cq} = 10 mA, I_{Ccomp} = 14 mA
Output 3rd Order Intercept Point	OIP_3				dBm	
		–	4.5	–		I_C = 2.1 mA
		–	9	–		I_C = 3 mA
		–	17.5	–		I_C = 6 mA
		–	19.5	–		I_C = 10 mA

1) OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to **Figure 2** 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 15**.

Table 15 AC Characteristics V_C = 3 V, f = 3.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Minimum Noise Figure	NF_{min}				dB	$Z_S = Z_{Sopt}$
		–	0.8	–		I_C = 2.1 mA
		–	0.75	–		I_C = 3 mA
		–	0.7	–		I_C = 6 mA
		–	0.75	–		I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$				dB	$Z_S = Z_L$ = 50 Ω
		–	13.5	–		I_C = 2.1 mA
		–	15.5	–		I_C = 3 mA
		–	18	–		I_C = 6 mA
		–	19	–		I_C = 10 mA
Maximum Power Gain	G_{ms}				dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$
		–	18.5	–		I_C = 2.1 mA
		–	20	–		I_C = 3 mA
		–	22	–		I_C = 6 mA
		–	23.5	–		I_C = 10 mA
Output 1 dB Compression Point[1)]	OP_{1dB}				dBm	
		–	10	–		I_{Cq} = 2.1 mA, I_{Ccomp} = 16 mA[2)]
		–	10	–		I_{Cq} = 3 mA, I_{Ccomp} = 16 mA
		–	9	–		I_{Cq} = 6 mA, I_{Ccomp} = 15 mA
		–	8	–		I_{Cq} = 10 mA, I_{Ccomp} = 15 mA
Output 3rd Order Intercept Point	OIP_3				dBm	
		–	5.5	–		I_C = 2.1 mA
		–	12	–		I_C = 3 mA
		–	17.5	–		I_C = 6 mA
		–	19	–		I_C = 10 mA

1) OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to **Figure 2** 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 15**.

Table 16 AC Characteristics V_C = 3 V, f = 5.5 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Minimum Noise Figure	NF_{min}				dB	$Z_S = Z_{Sopt}$
		–	1.05	–		I_C = 2.1 mA
		–	1	–		I_C = 3 mA
		–	0.9	–		I_C = 6 mA
		–	0.95	–		I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$				dB	$Z_S = Z_L$ = 50 Ω
		–	11.5	–		I_C = 2.1 mA
		–	13	–		I_C = 3 mA
		–	15	–		I_C = 6 mA
		–	15.5	–		I_C = 10 mA
Maximum Power Gain	G_{ms}				dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$
		–	17.5	–		I_C = 2.1 mA
		–	18.5	–		I_C = 3 mA
		–	20	–		I_C = 6 mA
		–	19	–		I_C = 10 mA
Output 1 dB Compression Point[1)]	OP_{1dB}				dBm	
		–	10.5	–		I_{Cq} = 2.1 mA, I_{Ccomp} = 17 mA[2)]
		–	10	–		I_{Cq} = 3 mA, I_{Ccomp} = 17 mA
		–	9	–		I_{Cq} = 6 mA, I_{Ccomp} = 15 mA
		–	8	–		I_{Cq} = 10 mA, I_{Ccomp} = 15 mA
Output 3rd Order Intercept Point	OIP_3				dBm	
		–	6.5	–		I_C = 2.1 mA
		–	12	–		I_C = 3 mA
		–	22	–		I_C = 6 mA
		–	21	–		I_C = 10 mA

1) OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to **Figure 2** 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 15**.

Table 17 AC Characteristics V_C = 3 V, f = 10 GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Minimum Noise Figure	NF_{min}				dB	$Z_S = Z_{Sopt}$
		–	2	–		I_C = 2.1 mA
		–	1.8	–		I_C = 3 mA
		–	1.5	–		I_C = 6 mA
		–	1.5	–		I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$				dB	$Z_S = Z_L$ = 50 Ω
		–	5.5	–		I_C = 2.1 mA
		–	7	–		I_C = 3 mA
		–	9	–		I_C = 6 mA
		–	10	–		I_C = 10 mA
Maximum Power Gain	G_{ms}				dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$
		–	14.5	–		I_C = 2.1 mA
		–	15	–		I_C = 3 mA
		–	15.5	–		I_C = 6 mA
		–	15.5	–		I_C = 10 mA
Output 1 dB Compression Point[1)]	OP_{1dB}				dBm	
		–	6	–		I_{Cq} = 2.1 mA, I_{Ccomp} = 16 mA[2)]
		–	6	–		I_{Cq} = 3 mA, I_{Ccomp} = 16 mA
		–	4	–		I_{Cq} = 6 mA, I_{Ccomp} = 15 mA
		–	4	–		I_{Cq} = 10 mA, I_{Ccomp} = 15 mA
Output 3rd Order Intercept Point	OIP_3				dBm	
		–	2.5	–		I_C = 2.1 mA
		–	7	–		I_C = 3 mA
		–	19.5	–		I_C = 6 mA
		–	18	–		I_C = 10 mA

1) OP_{1dB} is the output compression point achieved in a 50 Ω application circuit according to **Figure 2** 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 15**.

6.3.4 Typical AC Characteristic Curves

The measurement setup is the same as described in **Figure 8** except for **Figure 15** where compression is measured in a 50 Ohm application circuit according to **Figure 2** using the integrated biasing; V_C = 3V, T_A = 25 °C.

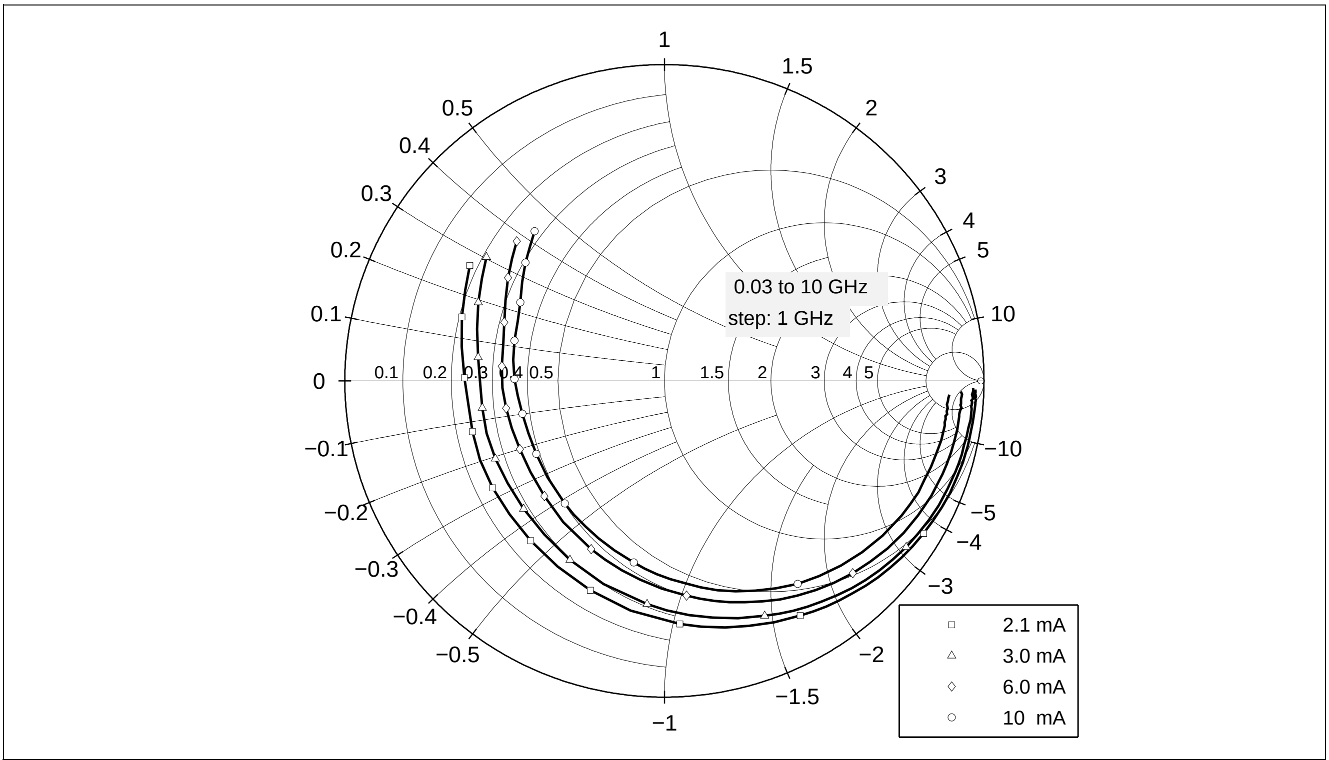

Figure 9 S_{11} **as a Function of Frequency,** I_C **as Parameter**

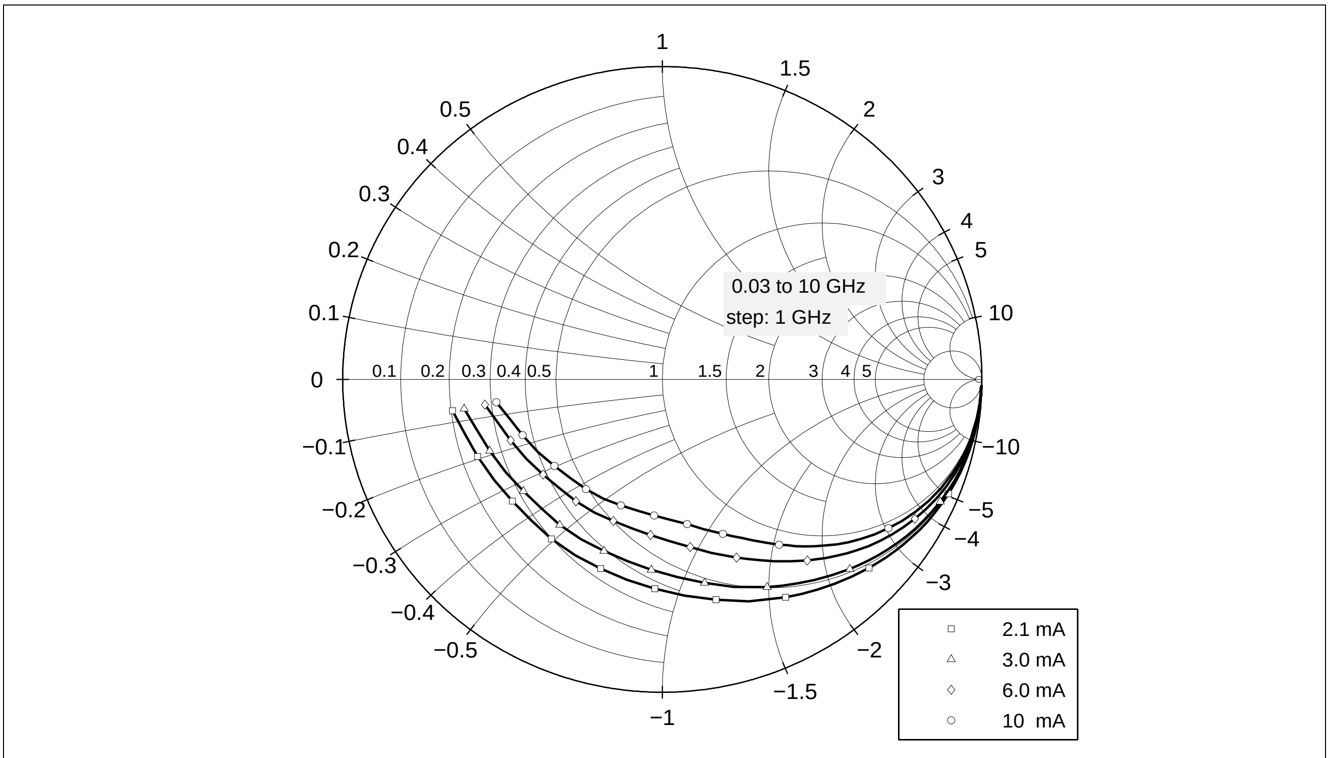

Figure 10 S_{22} **as a Function of Frequency,** I_C **as Parameter**

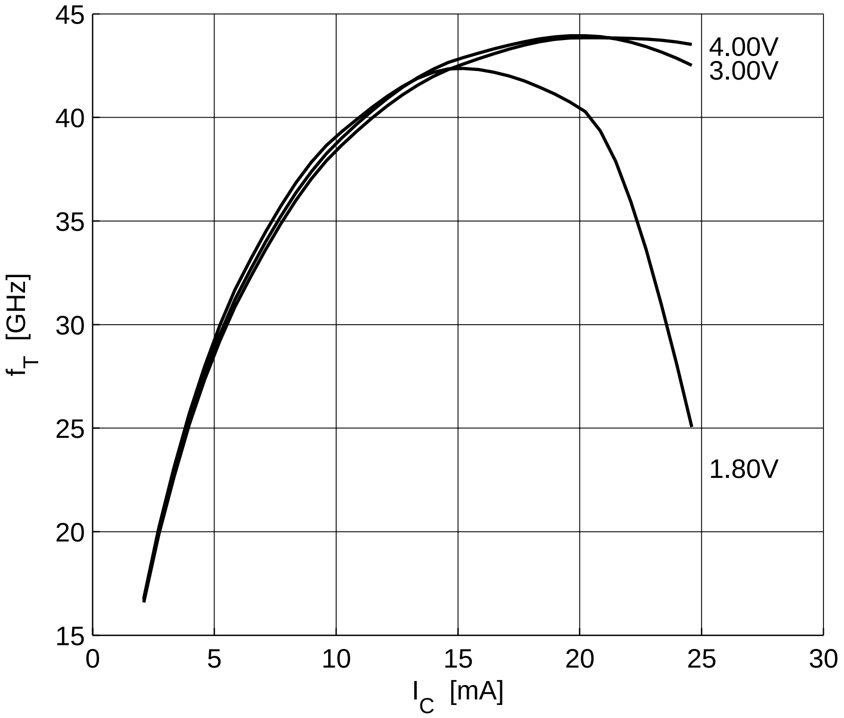

Figure 11 Transition Frequency as a Function of I_C , V_C as Parameter

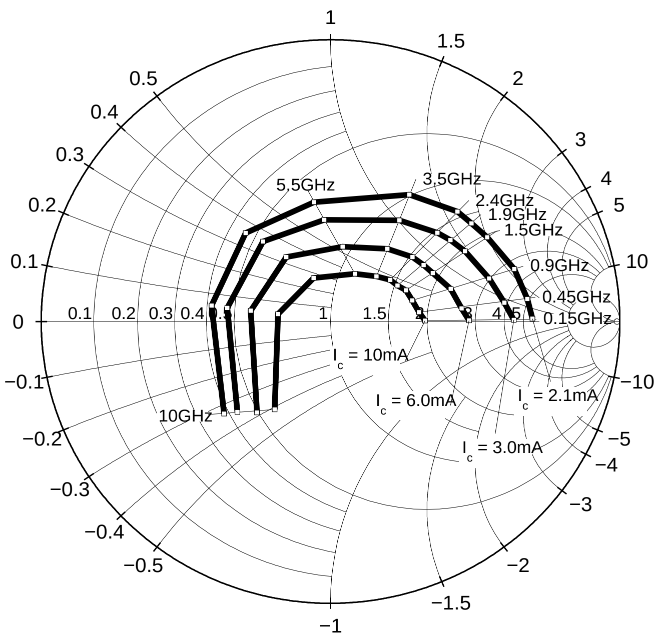

Figure 12 Optimum Source Impedance for Minimum NF as a Function of Frequency, I_C as Parameter

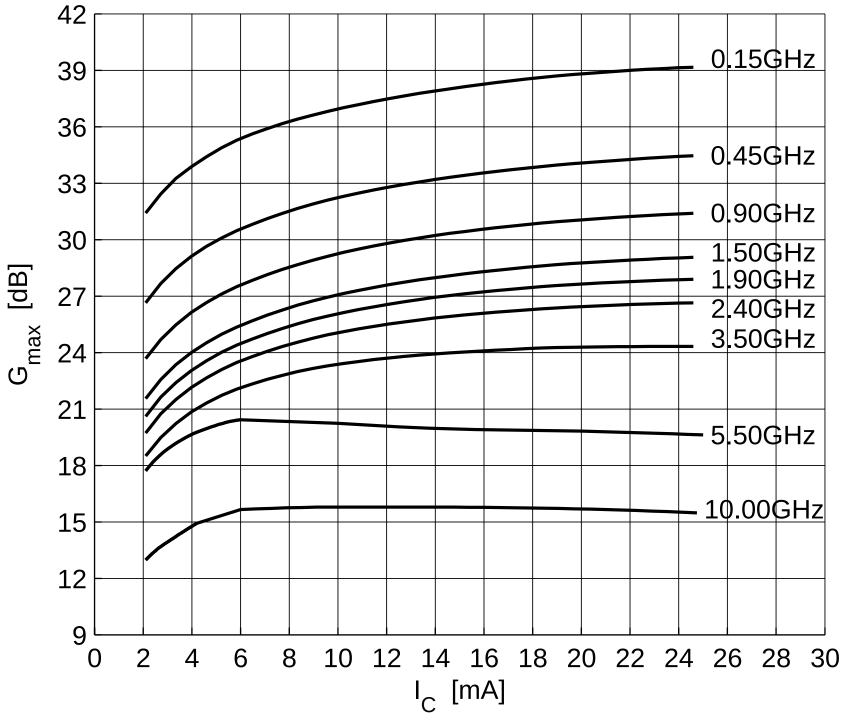

Figure 13 Maximum Power Gain as a Function of I_C , Frequency as Parameter

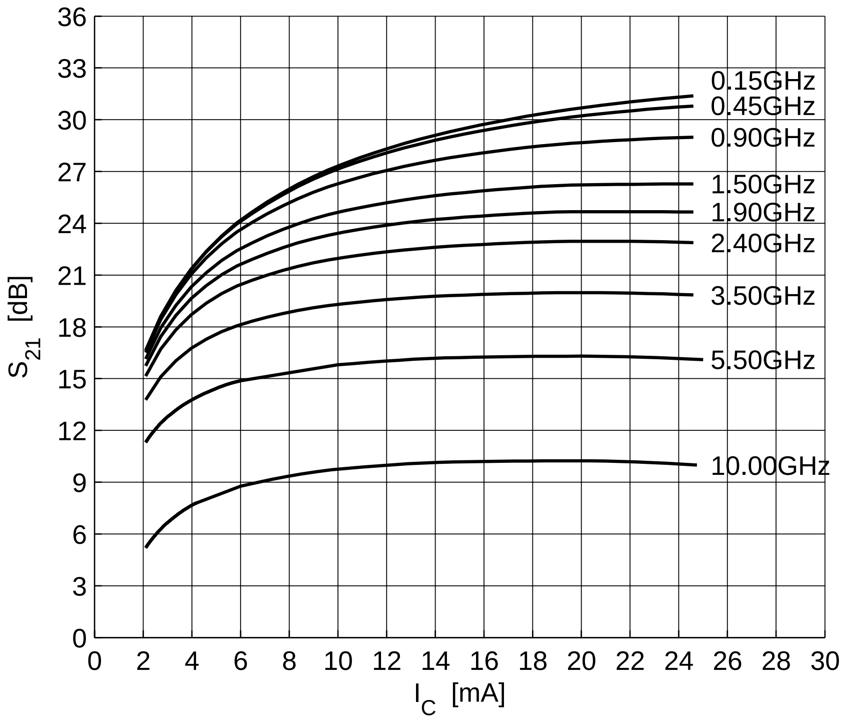

Figure 14 Power Gain as a Function of I_C , Frequency as Parameter

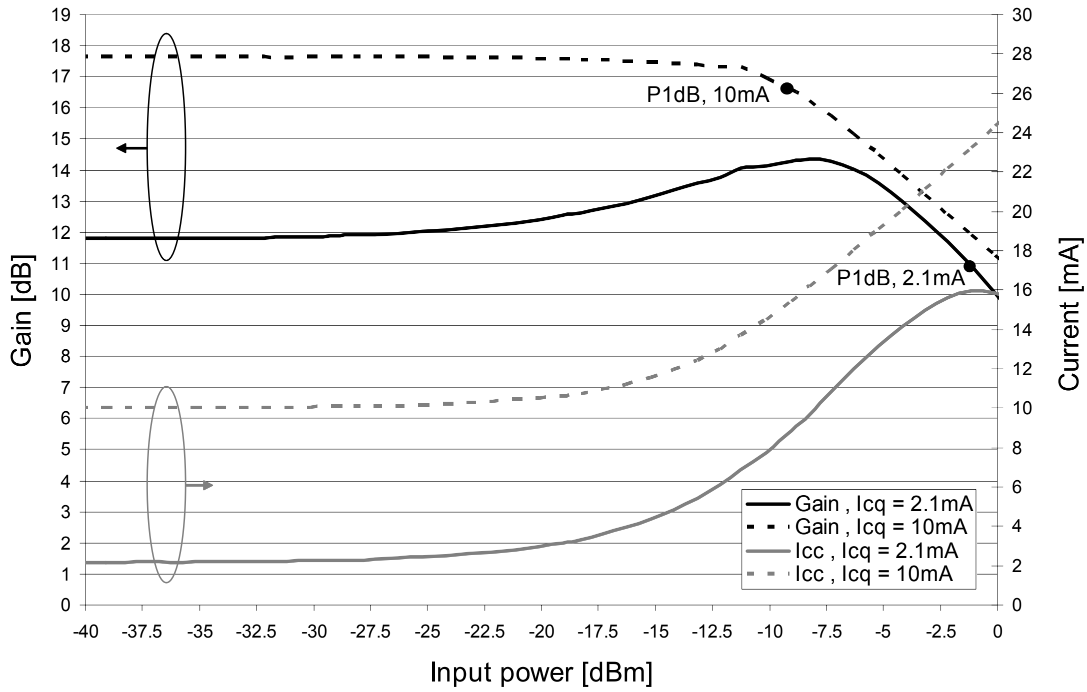

Figure 15 Power Gain and Total Supply Current as a Function of RF Input Power at 3.5 GHz

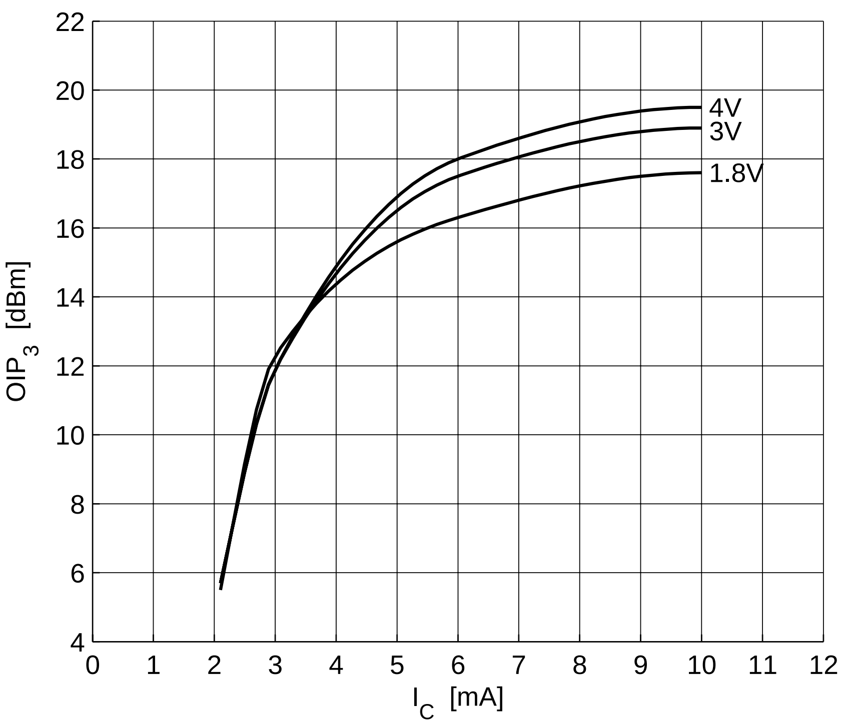

Figure 16 Output 3rd Order Intercept Point as a Function of I_C at 3.5 GHz, V_C as Parameter

7 Package Information

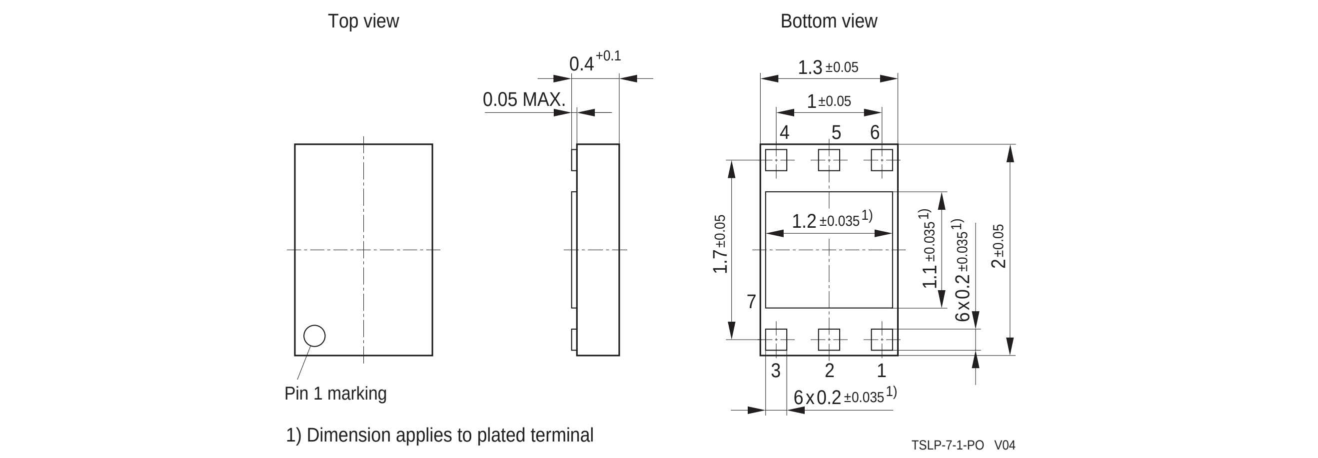

Figure 17 Package Outline TSLP-7-1

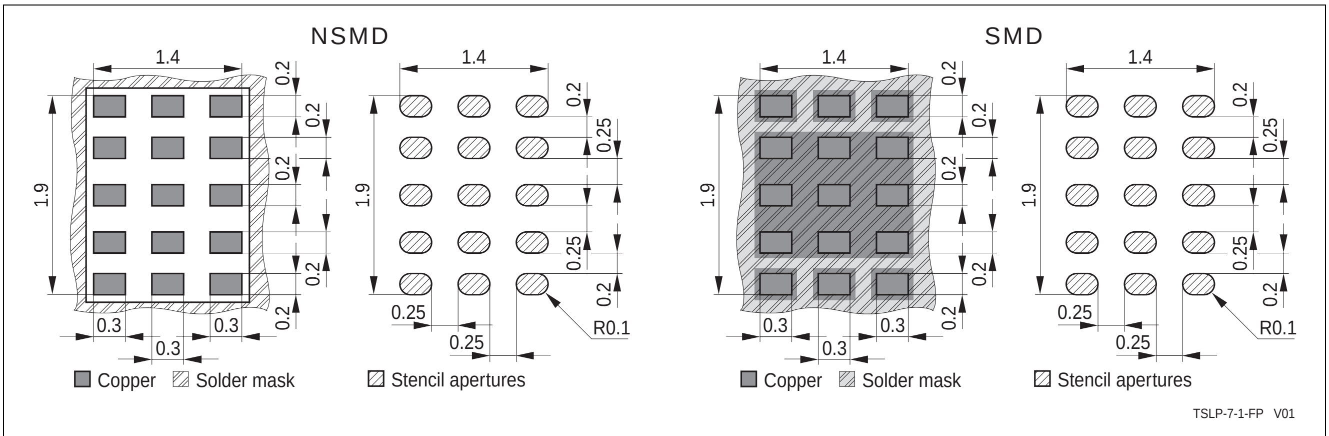

Figure 18 Footprint

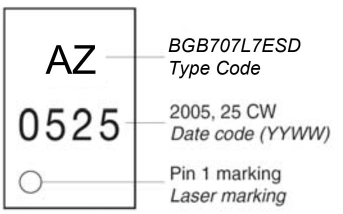

Figure 19 Marking Layout (top view)

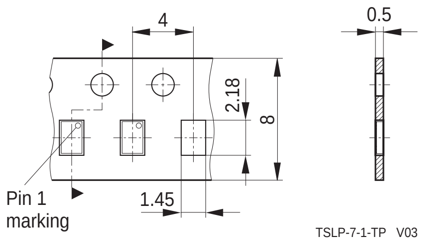

Figure 20 Tape Dimensions

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