

# BGB707L7ESD

SiGe:C Wideband MMIC LNA with Integrated ESD Protection

## Data Sheet

Revision 3.2, 2010-06-30

**Edition 2010-06-30**

**Published by  
Infineon Technologies AG  
81726 Munich, Germany**

**© 2010 Infineon Technologies AG  
All Rights Reserved.**

### **Legal Disclaimer**

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

### **Information**

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office ([www.infineon.com](http://www.infineon.com)).

### **Warnings**

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

**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.
<b>18 - 26</b>	Linearity description related to the RF output.
<b>13, 14</b>	Typical DC characteristic curves included.
<b>27, 30</b>	Typical AC characteristic curves included.
<b>21, 24</b>	AC performance tables expanded by 2 frequencies.

**Trademarks of Infineon Technologies AG**

BlueMoon™, COMNEON™, C166™, CROSSAVE™, CanPAK™, CIPOS™, CoolMOS™, CoolSET™, CORECONTROL™, DAVE™, EasyPIM™, EconoBRIDGE™, EconoDUAL™, EconoPACK™, EconoPIM™, EiceDRIVER™, EUPEC™, FCOS™, HITFET™, HybridPACK™, ISOFACE™, I<sup>2</sup>RF™, IsoPACK™, MIPAQ™, ModSTACK™, my-d™, NovalithIC™, OmniTune™, OptiMOS™, ORIGA™, PROFET™, PRO-SIL™, PRIMARION™, PrimePACK™, RASIC™, ReverSave™, SatRIC™, SensoNor™, SIEGET™, SINDRION™, SMARTi™, SmartLEWIS™, TEMPFET™, thinQ!™, TriCore™, TRENCHSTOP™, X-GOLD™, XMM™, X-PMU™, XPOSYS™.

**Other Trademarks**

Advance Design System™ (ADS) of Agilent Technologies, AMBA™, ARM™, MULTI-ICE™, PRIMECELL™, REALVIEW™, THUMB™ of ARM Limited, UK. AUTOSAR™ is licensed by AUTOSAR development partnership. Bluetooth™ of Bluetooth SIG Inc. CAT-iq™ of DECT Forum. COLOSSUS™, FirstGPS™ of Trimble Navigation Ltd. EMV™ of EMVCo, LLC (Visa Holdings Inc.). EPCOS™ of Epcos AG. FLEXGO™ of Microsoft Corporation. FlexRay™ is licensed by FlexRay Consortium. HYPERTERMINAL™ of Hilgraeve Incorporated. IEC™ of Commission Electrotechnique Internationale. IrDA™ of Infrared Data Association Corporation. ISO™ of INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. MATLAB™ of MathWorks, Inc. MAXIM™ of Maxim Integrated Products, Inc. MICROTEC™, NUCLEUS™ of Mentor Graphics Corporation. Mifare™ of NXP. MIPI™ of MIPI Alliance, Inc. MIPS™ of MIPS Technologies, Inc., USA. muRata™ of MURATA MANUFACTURING CO., MICROWAVE OFFICE™ (MWO) of Applied Wave Research Inc., OmniVision™ of OmniVision Technologies, Inc. Openwave™ Openwave Systems Inc. RED HAT™ Red Hat, Inc. RFMD™ RF Micro Devices, Inc. SIRIUS™ of Sirius Sattelite Radio Inc. SOLARIS™ of Sun Microsystems, Inc. SPANSION™ of Spansion LLC Ltd. Symbian™ of Symbian Software Limited. TAIYO YUDEN™ of Taiyo Yuden Co. TEAKLITE™ of CEVA, Inc. TEKTRONIX™ of Tektronix Inc. TOKO™ of TOKO KABUSHIKI KAISHA TA. UNIX™ of X/Open Company Limited. VERILOG™, PALLADIUM™ of Cadence Design Systems, Inc. VLYNQ™ of Texas Instruments Incorporated. VXWORKS™, WIND RIVER™ of WIND RIVER SYSTEMS, INC. ZETEX™ of Diodes Zetex Limited.

Last Trademarks Update 2010-03-22

## Table of Contents

	<b>Table of Contents</b> .....	4
	<b>List of Figures</b> .....	5
	<b>List of Tables</b> .....	6
<b>1</b>	<b>Features</b> .....	7
<b>2</b>	<b>Product Brief</b> .....	8
<b>3</b>	<b>Maximum Ratings</b> .....	10
<b>4</b>	<b>Thermal Characteristics</b> .....	11
<b>5</b>	<b>Operation Conditions</b> .....	12
<b>6</b>	<b>Electrical Characteristics</b> .....	12
6.1	DC Characteristics .....	12
6.2	Typical DC Characteristic Curves .....	13
6.3	AC Characteristics .....	15
6.3.1	AC Characteristics in FM Radio Applications .....	15
6.3.1.1	High-Ohmic FM Radio Antenna .....	15
6.3.1.2	50 $\Omega$ FM Radio Antenna .....	15
6.3.2	AC Characteristics in the SDMB Application .....	16
6.3.3	AC Characteristics in Test Fixture .....	17
6.3.4	Typical AC Characteristic Curves .....	27
<b>7</b>	<b>Package Information</b> .....	31

## List of Figures

Figure 1	Pinning PG-TSLP-7-1	8
Figure 2	Function Block	9
Figure 3	Total Power Dissipation $P_{tot} = f(T_s)$	11
Figure 4	$I_{CC}$ as a Function of $R_{ext}$ , $V_{CC}$ as Parameter	13
Figure 5	$I_{CC}$ as a Function of $V_{CC}$ , $V_{Ctrl} = 3\text{ V}$ , $R_{ext}$ as Parameter	13
Figure 6	$I_{CC}$ as a Function of $V_{Ctrl}$ , $V_{CC} = 3\text{ V}$ , $R_{ext}$ as Parameter	14
Figure 7	$I_{CC}$ as a Function of Temperature, $V_{Ctrl} = V_{CC} = 3\text{ V}$ , $R_{ext} = \text{open}$	14
Figure 8	Testing Circuit for Frequencies from 150 MHz to 10 GHz	17
Figure 9	$S_{11}$ as a Function of Frequency, $I_C$ as Parameter	27
Figure 10	$S_{22}$ as a Function of Frequency, $I_C$ as Parameter	27
Figure 11	Transition Frequency as a Function of $I_C$ , $V_C$ as Parameter	28
Figure 12	Optimum Source Impedance for Minimum $NF$ as a Function of Frequency, $I_C$ as Parameter	28
Figure 13	Maximum Power Gain as a Function of $I_C$ , Frequency as Parameter	29
Figure 14	Power Gain as a Function of $I_C$ , Frequency as Parameter	29
Figure 15	Power Gain and Total Supply Current as a Function of RF Input Power at 3.5 GHz	30
Figure 16	Output 3 <sup>rd</sup> Order Intercept Point as a Function of $I_C$ at 3.5 GHz, $V_C$ as Parameter	30
Figure 17	Package Outline TSLP-7-1	31
Figure 18	Footprint	31
Figure 19	Marking Layout (top view)	31
Figure 20	Tape Dimensions	31

## List of Tables

Table 1	Pinning Table .....	8
Table 2	Maximum Ratings at $T_A = 25^\circ\text{C}$ (unless otherwise specified) .....	10
Table 3	Thermal Resistance .....	11
Table 4	Operation Conditions .....	12
Table 5	DC Characteristics at $V_{CC} = 3\text{ V}$ , $T_A = 25^\circ\text{C}$ .....	12
Table 6	AC Characteristics in the FM Radio Application as Described in AN177 .....	15
Table 7	AC Characteristics in the FM Radio Application as Described in AN181 .....	15
Table 8	AC Characteristics in the SDMB Application as Described in TR122, $T_A = 25^\circ\text{C}$ .....	16
Table 9	AC Characteristics $V_C = 3\text{ V}$ , $f = 150\text{ MHz}$ .....	18
Table 10	AC Characteristics $V_C = 3\text{ V}$ , $f = 450\text{ MHz}$ .....	19
Table 11	AC Characteristics $V_C = 3\text{ V}$ , $f = 900\text{ MHz}$ .....	20
Table 12	AC Characteristics $V_C = 3\text{ V}$ , $f = 1.5\text{ GHz}$ .....	21
Table 13	AC Characteristics $V_C = 3\text{ V}$ , $f = 1.9\text{ GHz}$ .....	22
Table 14	AC Characteristics $V_C = 3\text{ V}$ , $f = 2.4\text{ GHz}$ .....	23
Table 15	AC Characteristics $V_C = 3\text{ V}$ , $f = 3.5\text{ GHz}$ .....	24
Table 16	AC Characteristics $V_C = 3\text{ V}$ , $f = 5.5\text{ GHz}$ .....	25
Table 17	AC Characteristics $V_C = 3\text{ V}$ , $f = 10\text{ GHz}$ .....	26

## 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<sup>3</sup>
- Pb-free (RoHS compliant) and halogen-free (WEEE compliant) package



### 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

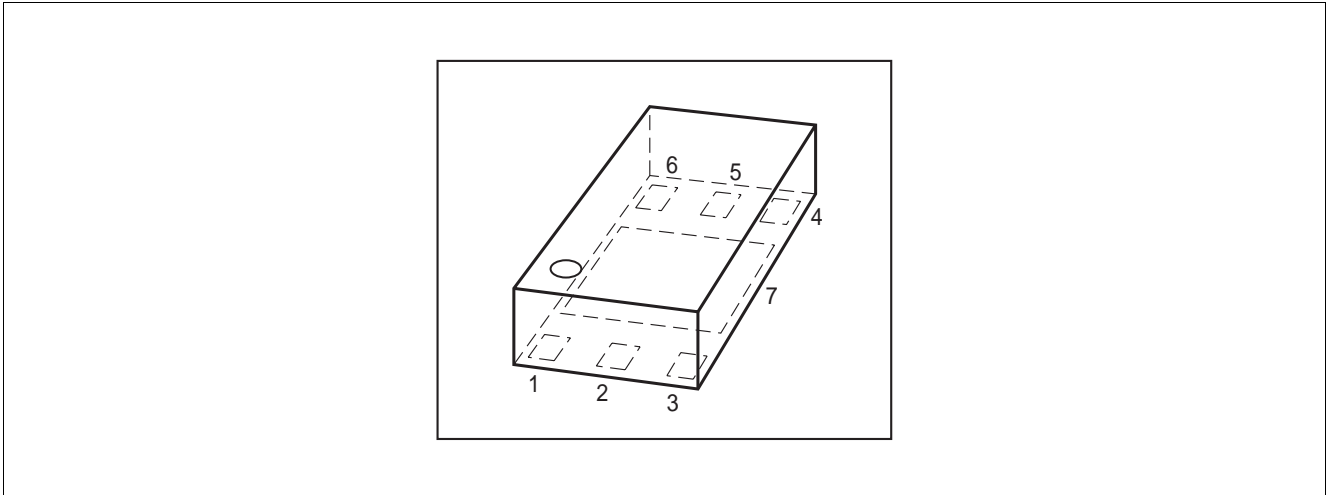
**Attention: ESD (Electrostatic discharge) sensitive device, observe handling precautions**

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  $L_C$ .

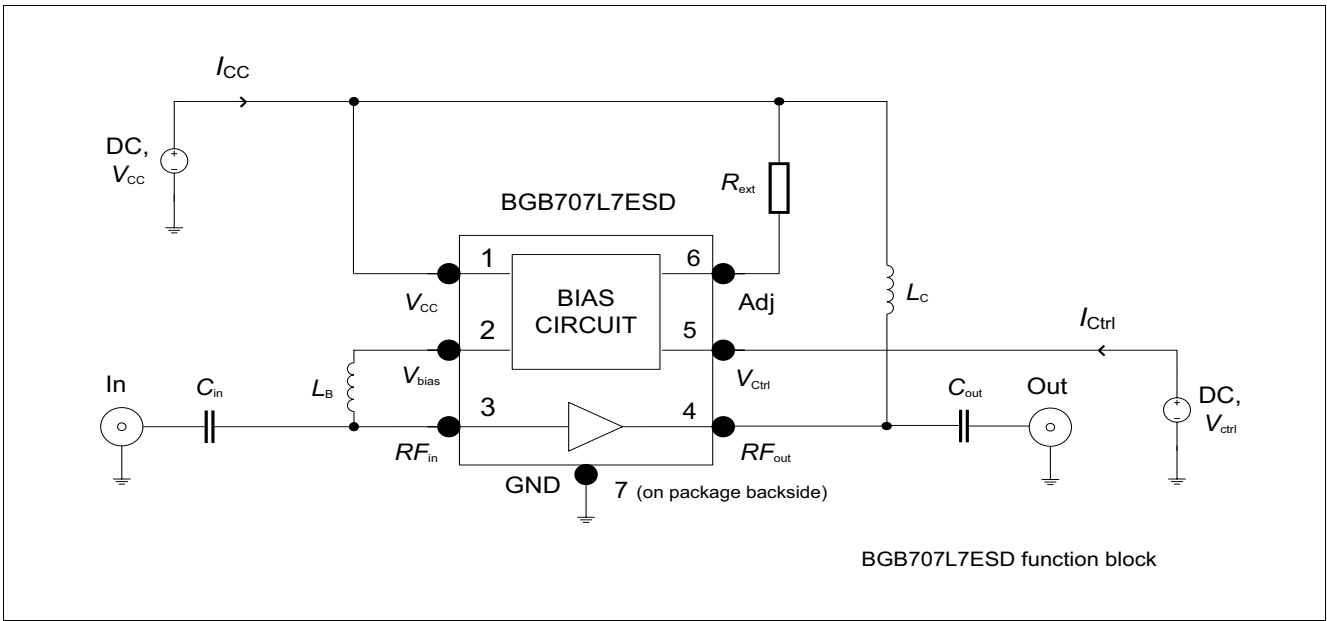


Figure 2 Function Block

### 3 Maximum Ratings

**Table 2** Maximum Ratings at  $T_A = 25^\circ\text{C}$  (unless otherwise specified)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	$V_{CC}$	–	–	4.0	V	–
$T_A = -55^\circ\text{C}$		–	–	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 $T_S < 112^\circ\text{C}^1)$	$P_{tot}$	–	–	100	mW	–
Operation Junction Temperature	$T_{JOp}$	–	–	150	$^\circ\text{C}$	–
Storage Temperature	$T_{Stg}$	-55	–	150	$^\circ\text{C}$	–

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

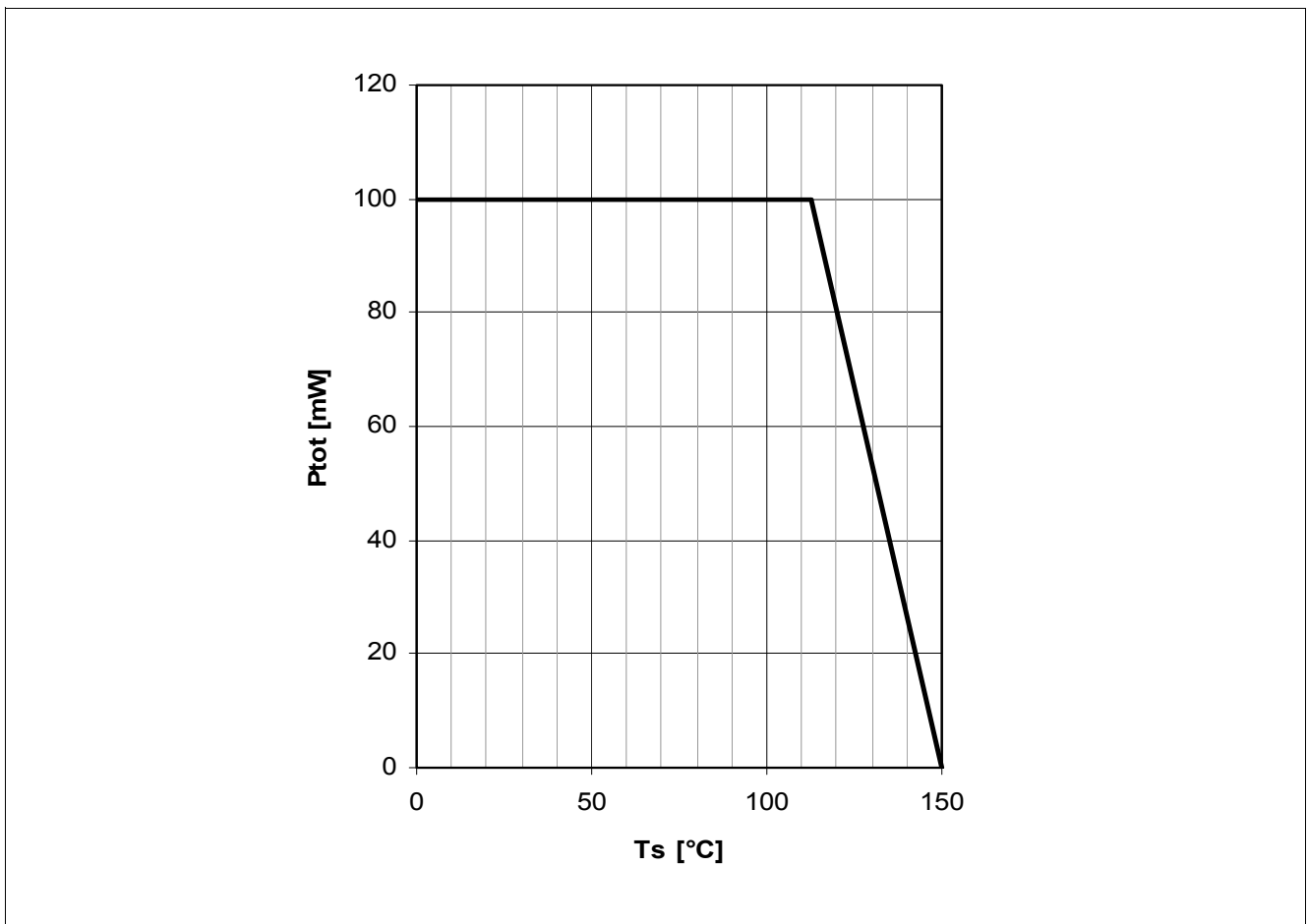
**Attention: Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to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

## 4 Thermal Characteristics

**Table 3 Thermal Resistance**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Junction - Soldering Point <sup>1)</sup>	$R_{thJS}$	–	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

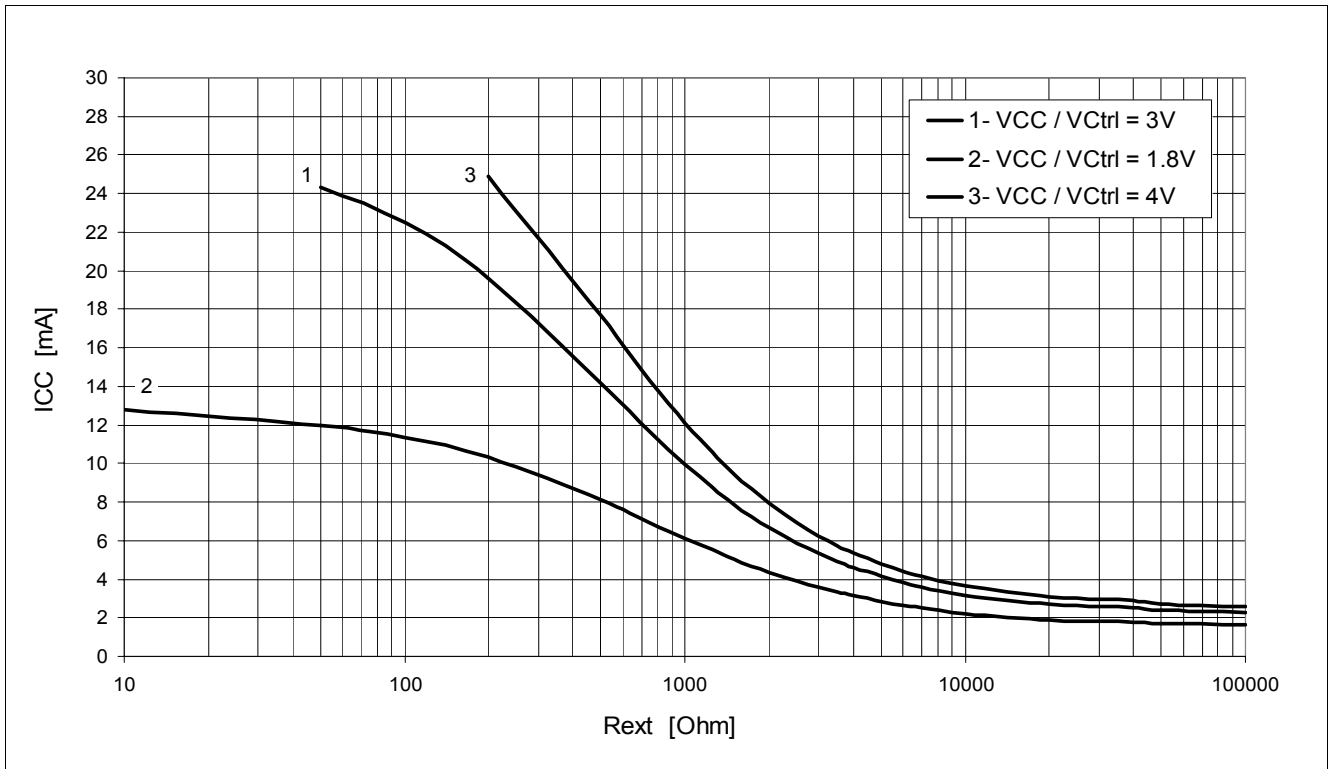
### 6.1 DC Characteristics

**Table 5 DC Characteristics at  $V_{CC} = 3\text{ V}$ ,  $T_A = 25^\circ\text{C}$** 

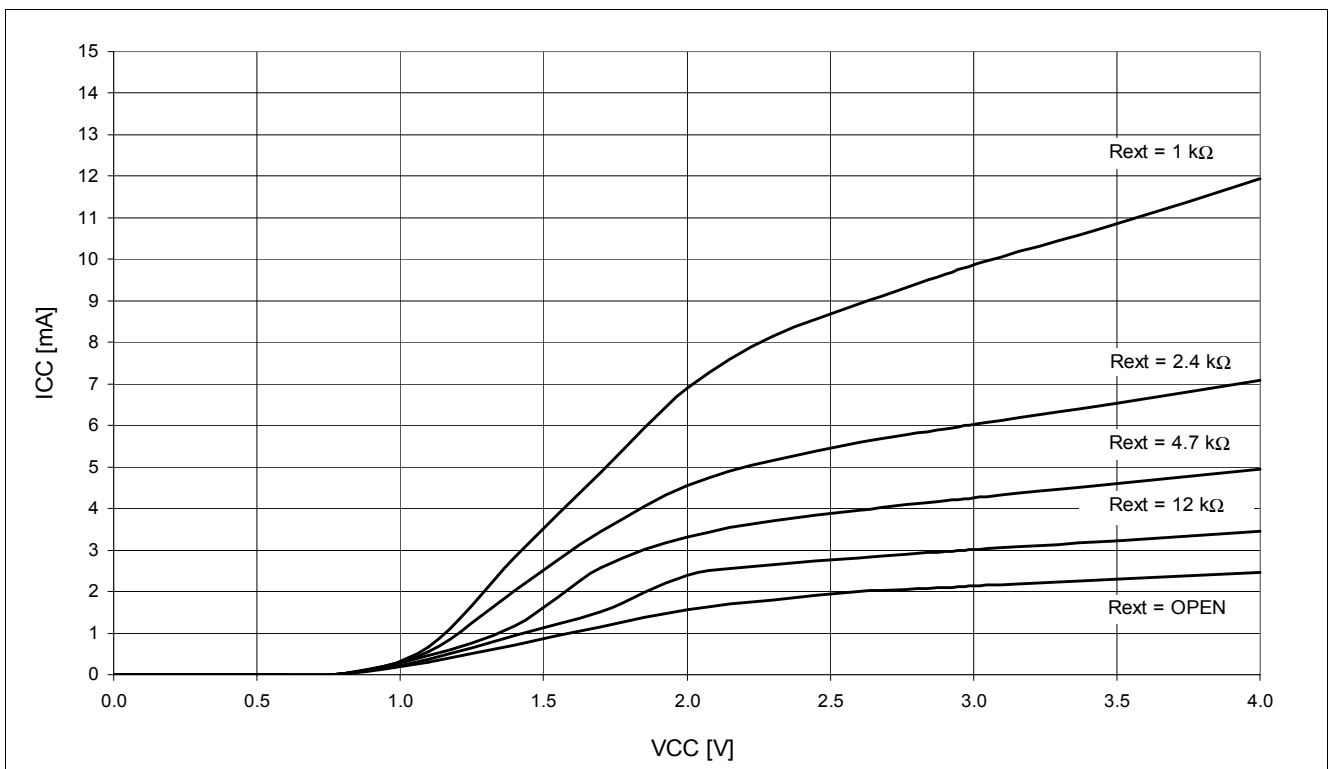
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Current	$I_{CC}$	–	–	–	mA	$V_{Ctrl} = 3\text{ V}$ $R_{ext} = \text{open}$ $R_{ext} = 12\text{ k}\Omega$ $R_{ext} = 4.7\text{ k}\Omega$ $R_{ext} = 2.4\text{ k}\Omega$ $R_{ext} = 1\text{ k}\Omega$
		1.6	2.1	2.6		
		–	3	–		
		–	4.2	–		
		–	6	–		
		–	10	–		
Supply current in Off mode	$I_{CC-off}$	–	–	6	$\mu\text{A}$	$V_{Ctrl} = 0\text{ V}$
Current into $V_{Ctrl}$ pin in On mode	$I_{Ctrl-on}$	–	14	20	$\mu\text{A}$	$V_{Ctrl} = 3\text{ V}$
Current into $V_{Ctrl}$ pin in Off mode	$I_{Ctrl-off}$	–	–	0.1	$\mu\text{A}$	$V_{Ctrl} = 0\text{ V}$

### 6.2 Typical DC Characteristic Curves

The measurement setup is an application circuit according to [Figure 2](#) using the integrated biasing.  
 $T_A = 25\text{ }^\circ\text{C}$  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  $V_{CC}$ ,  $V_{Ctrl} = 3\text{ V}$ ,  $R_{ext}$  as Parameter

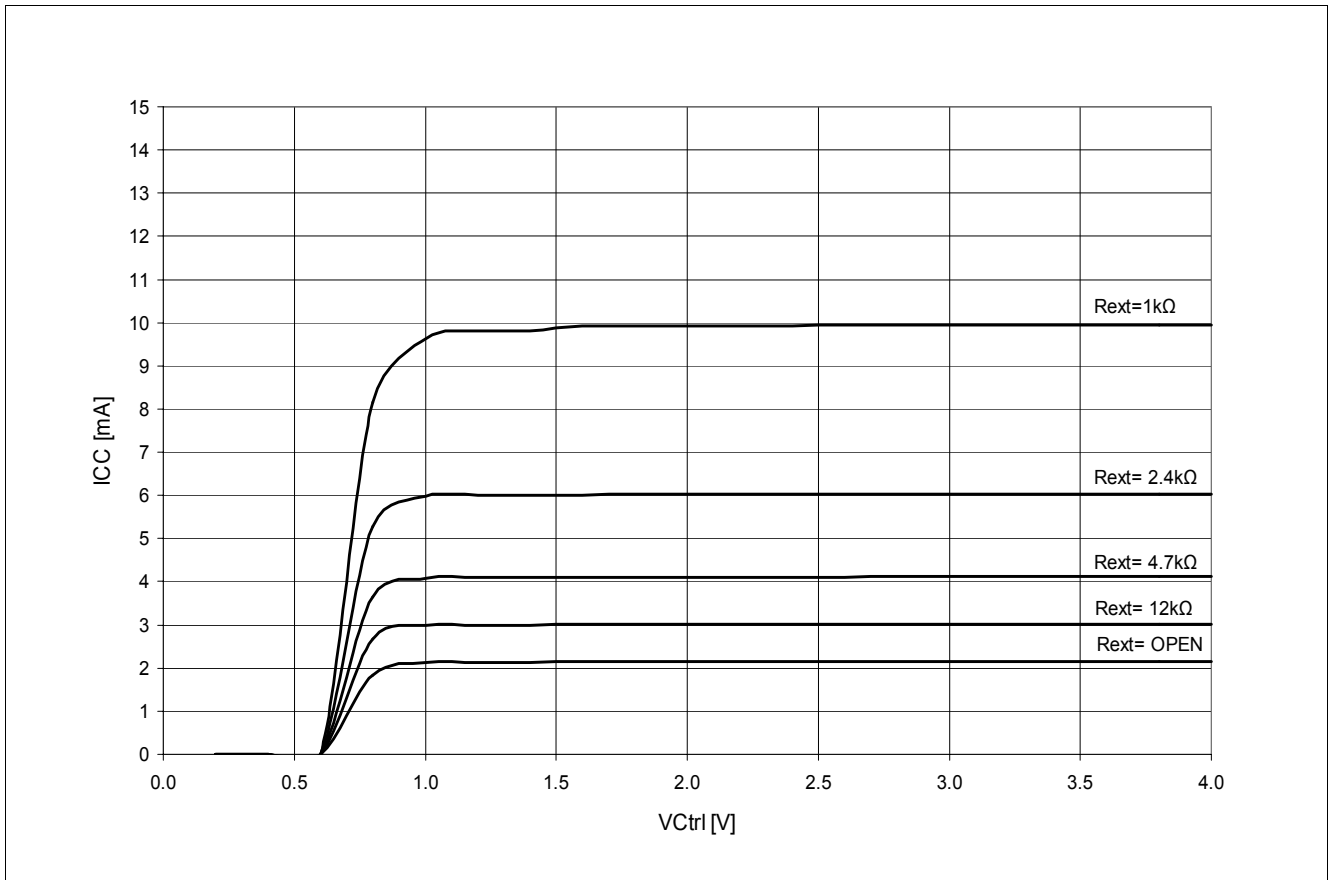


Figure 6  $I_{CC}$  as a Function of  $V_{Ctrl}$ ,  $V_{CC} = 3\text{ V}$ ,  $R_{ext}$  as Parameter

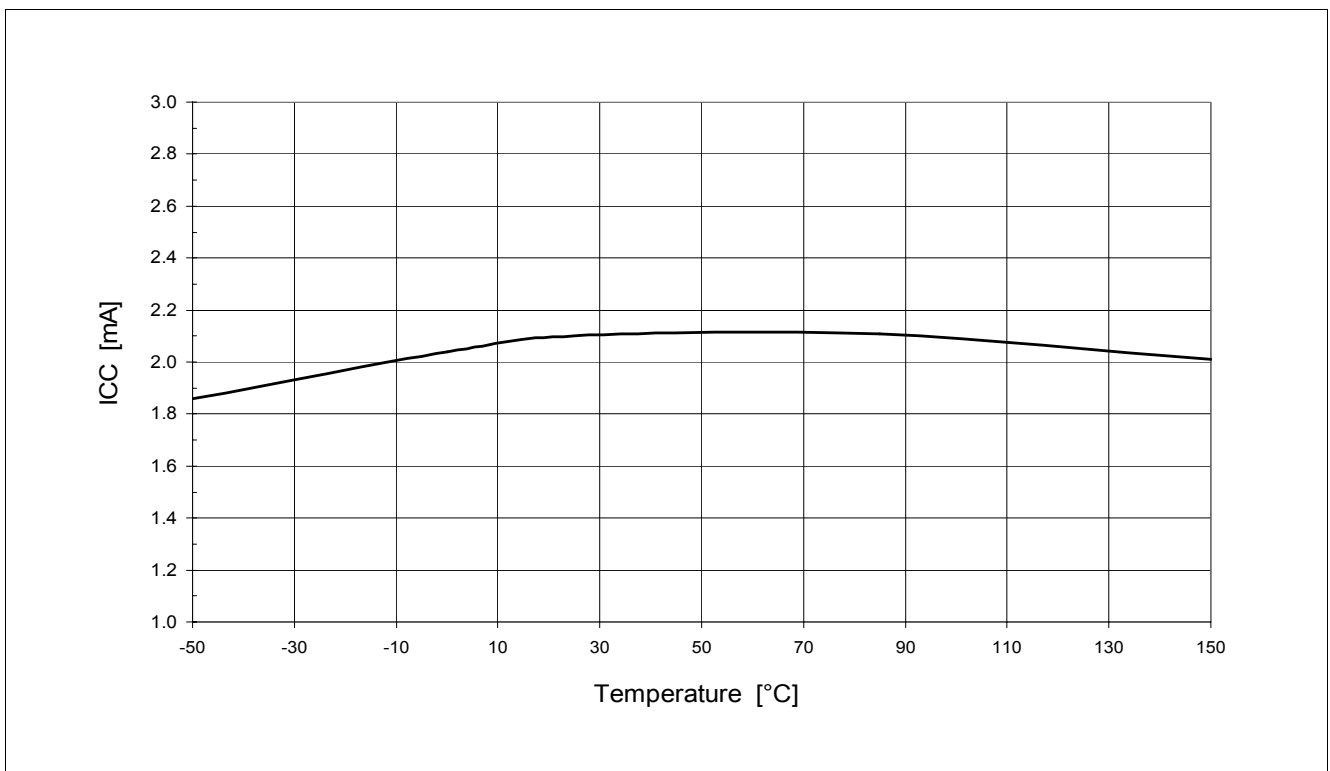


Figure 7  $I_{CC}$  as a Function of Temperature,  $V_{Ctrl} = V_{CC} = 3\text{ V}$ ,  $R_{ext} = \text{open}$

## 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  $\Omega$  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](http://www.infineon.com/BGB707). Depending on the impedance of the used antenna, please consult AN177 for high-ohmic antennas and AN181 for 50  $\Omega$  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

$T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.0\text{ V}$ ,  $I_{CC} = 3.0\text{ mA}$ ,  $V_{Ctrl} = 3.0\text{ V}$ ,  $f = 100\text{ MHz}$ ,  $R_{ext} = 12\text{ k}\Omega$

**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 <sup>1)</sup>	–	dB	–
Output Return Loss	$RL_{OUT}$	–	16	–	dB	–
Noise Figure ( $Z_s = 50\ \Omega$ )	$NF$	–	1.0	–	dB	–
Input 1 dB Gain Compression Point <sup>2)</sup>	$IP_{1dB}$	–	-5.5	–	dBm	–
Input 3 <sup>rd</sup> Order Intercept Point <sup>3)</sup>	$IIP_3$	–	-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  $\Omega$  from 0.1 to 6 GHz.

#### 6.3.1.2 50 $\Omega$ FM Radio Antenna

$T_A = 25^\circ\text{C}$ ,  $V_{CC} = 2.8\text{ V}$ ,  $I_{CC} = 4.2\text{ mA}$ ,  $V_{Ctrl} = 2.8\text{ V}$ ,  $f = 100\text{ MHz}$ ,  $R_{ext} = 4.7\text{ k}\Omega$

**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 ( $Z_s = 50\ \Omega$ )	$NF$	–	1.35	1.9	dB	–
Input 1 dB Gain Compression Point <sup>1) 2)</sup>	$IP_{1dB}$	–	-10	–	dBm	–
Input 3 <sup>rd</sup> Order Intercept Point <sup>2)3)</sup>	$IIP_3$	-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  $\Omega$  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](http://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.

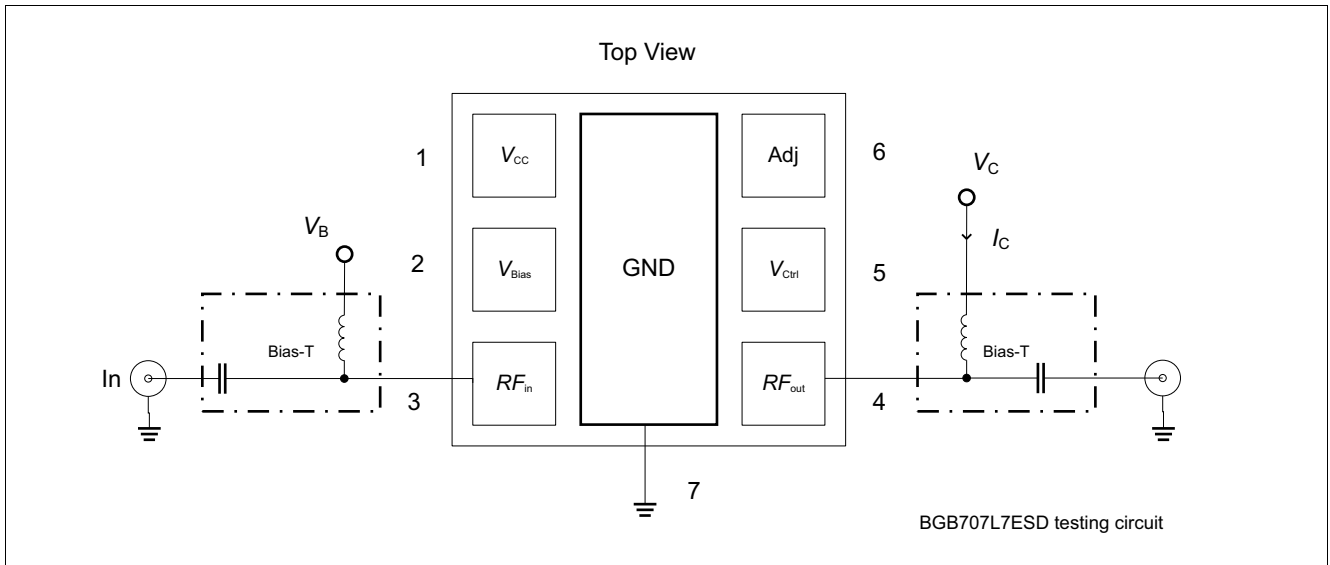
**Table 8 AC Characteristics in the SDMB Application as Described in TR122,  $T_A = 25^\circ\text{C}$**

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_{\text{off}}$	–	-18	–	dB	–
Noise Figure ( $Z_s = 50 \Omega$ )	$NF$	–	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	–	$\mu\text{s}$	Measured with $C_2 = 1 \text{ nF}$
Off Switching Time	$T_{off}$	–	4.2	–	$\mu\text{s}$	–
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  $V_C = 3V$ ,  $T_A = 25\text{ °C}$ . 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

## Electrical Characteristics

 Table 9 AC Characteristics  $V_C = 3\text{ V}$ ,  $f = 150\text{ MHz}$ 

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

1)  $OP_{1\text{dB}}$  is the output compression point achieved in a  $50\ \Omega$  application circuit according to [Figure 2](#) using the integrated biasing.

2)  $I_{\text{Cq}}$  is the quiescent current at small input power levels.  $I_{\text{Cq}}$  increases up to  $I_{\text{Ccomp}}$  as RF input power approaches  $IP_{1\text{dB}}$ , cf. [Figure 15](#).

**Table 10 AC Characteristics  $V_C = 3\text{ V}$ ,  $f = 450\text{ MHz}$** 

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

1)  $OP_{1\text{dB}}$  is the output compression point achieved in a  $50\ \Omega$  application circuit according to [Figure 2](#) using the integrated biasing.

2)  $I_{\text{Cq}}$  is the quiescent current at small input power levels.  $I_{\text{Cq}}$  increases up to  $I_{\text{Ccomp}}$  as RF input power approaches  $IP_{1\text{dB}}$ , cf. [Figure 15](#).

**Table 11 AC Characteristics  $V_C = 3\text{ V}$ ,  $f = 900\text{ MHz}$** 

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

1)  $OP_{1\text{dB}}$  is the output compression point achieved in a  $50\ \Omega$  application circuit according to [Figure 2](#) using the integrated biasing.

2)  $I_{\text{Cq}}$  is the quiescent current at small input power levels.  $I_{\text{Cq}}$  increases up to  $I_{\text{Ccomp}}$  as RF input power approaches  $IP_{1\text{dB}}$ , cf. [Figure 15](#).

**Table 12 AC Characteristics  $V_C = 3\text{ V}$ ,  $f = 1.5\text{ GHz}$** 

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

1)  $OP_{1\text{dB}}$  is the output compression point achieved in a  $50\ \Omega$  application circuit according to [Figure 2](#) using the integrated biasing.

2)  $I_{\text{Cq}}$  is the quiescent current at small input power levels.  $I_{\text{Cq}}$  increases up to  $I_{\text{Ccomp}}$  as RF input power approaches  $IP_{1\text{dB}}$ , cf. [Figure 15](#).

**Table 13 AC Characteristics  $V_C = 3\text{ V}$ ,  $f = 1.9\text{ GHz}$** 

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

1)  $OP_{1\text{dB}}$  is the output compression point achieved in a  $50\ \Omega$  application circuit according to [Figure 2](#) using the integrated biasing.

2)  $I_{\text{Cq}}$  is the quiescent current at small input power levels.  $I_{\text{Cq}}$  increases up to  $I_{\text{Ccomp}}$  as RF input power approaches  $IP_{1\text{dB}}$ , cf. [Figure 15](#).

**Table 14 AC Characteristics  $V_C = 3\text{ V}$ ,  $f = 2.4\text{ GHz}$** 

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

1)  $OP_{1\text{dB}}$  is the output compression point achieved in a  $50\ \Omega$  application circuit according to [Figure 2](#) using the integrated biasing.

2)  $I_{\text{Cq}}$  is the quiescent current at small input power levels.  $I_{\text{Cq}}$  increases up to  $I_{\text{Ccomp}}$  as RF input power approaches  $IP_{1\text{dB}}$ , cf. [Figure 15](#).

**Table 15 AC Characteristics  $V_C = 3\text{ V}$ ,  $f = 3.5\text{ GHz}$** 

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

1)  $OP_{1\text{dB}}$  is the output compression point achieved in a  $50\ \Omega$  application circuit according to [Figure 2](#) using the integrated biasing.

2)  $I_{\text{Cq}}$  is the quiescent current at small input power levels.  $I_{\text{Cq}}$  increases up to  $I_{\text{Ccomp}}$  as RF input power approaches  $IP_{1\text{dB}}$ , cf. [Figure 15](#).



**Table 16 AC Characteristics  $V_C = 3\text{ V}$ ,  $f = 5.5\text{ GHz}$** 

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

1)  $OP_{1\text{dB}}$  is the output compression point achieved in a  $50\ \Omega$  application circuit according to [Figure 2](#) using the integrated biasing.

2)  $I_{\text{Cq}}$  is the quiescent current at small input power levels.  $I_{\text{Cq}}$  increases up to  $I_{\text{Ccomp}}$  as RF input power approaches  $IP_{1\text{dB}}$ , cf. [Figure 15](#).

**Table 17 AC Characteristics  $V_C = 3\text{ V}$ ,  $f = 10\text{ GHz}$** 

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

1)  $OP_{1\text{dB}}$  is the output compression point achieved in a  $50\ \Omega$  application circuit according to [Figure 2](#) using the integrated biasing.

2)  $I_{\text{Cq}}$  is the quiescent current at small input power levels.  $I_{\text{Cq}}$  increases up to  $I_{\text{Ccomp}}$  as RF input power approaches  $IP_{1\text{dB}}$ , 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;  $V_C = 3V$ ,  $T_A = 25^\circ C$ .

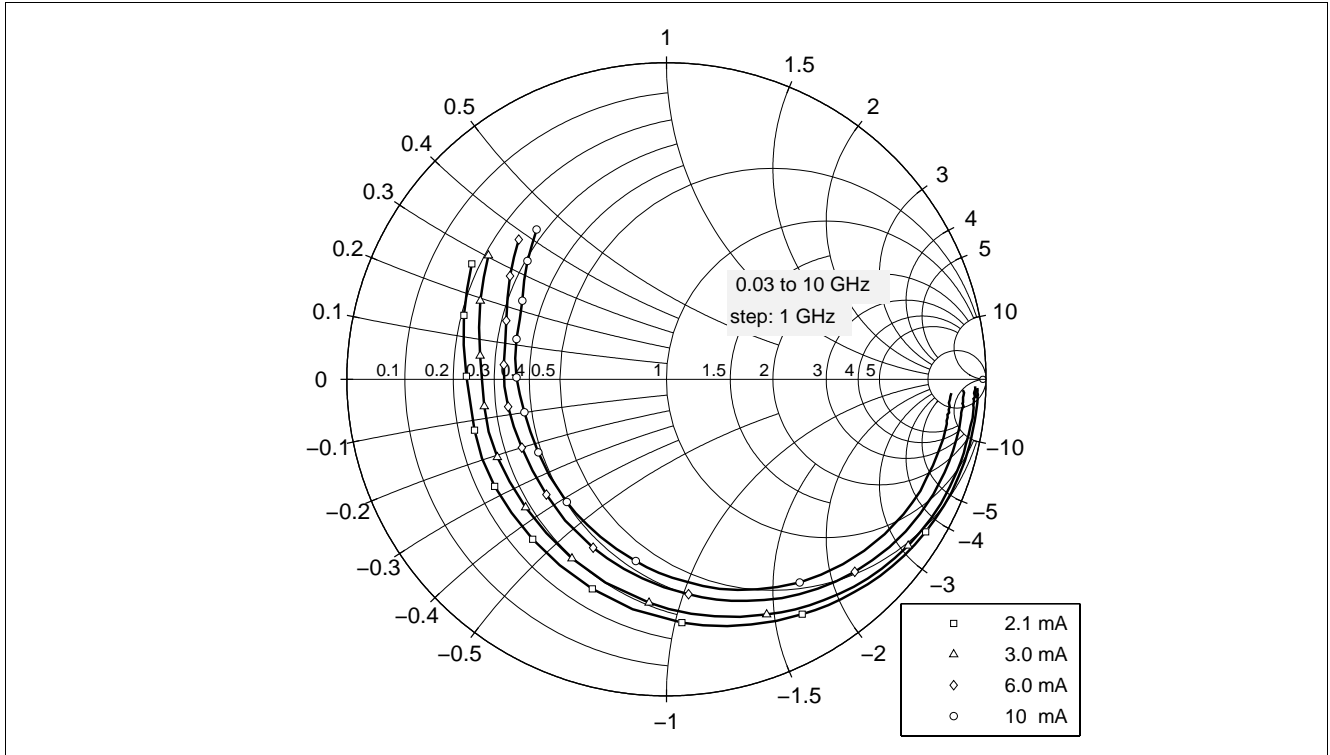


Figure 9  $S_{11}$  as a Function of Frequency,  $I_C$  as Parameter

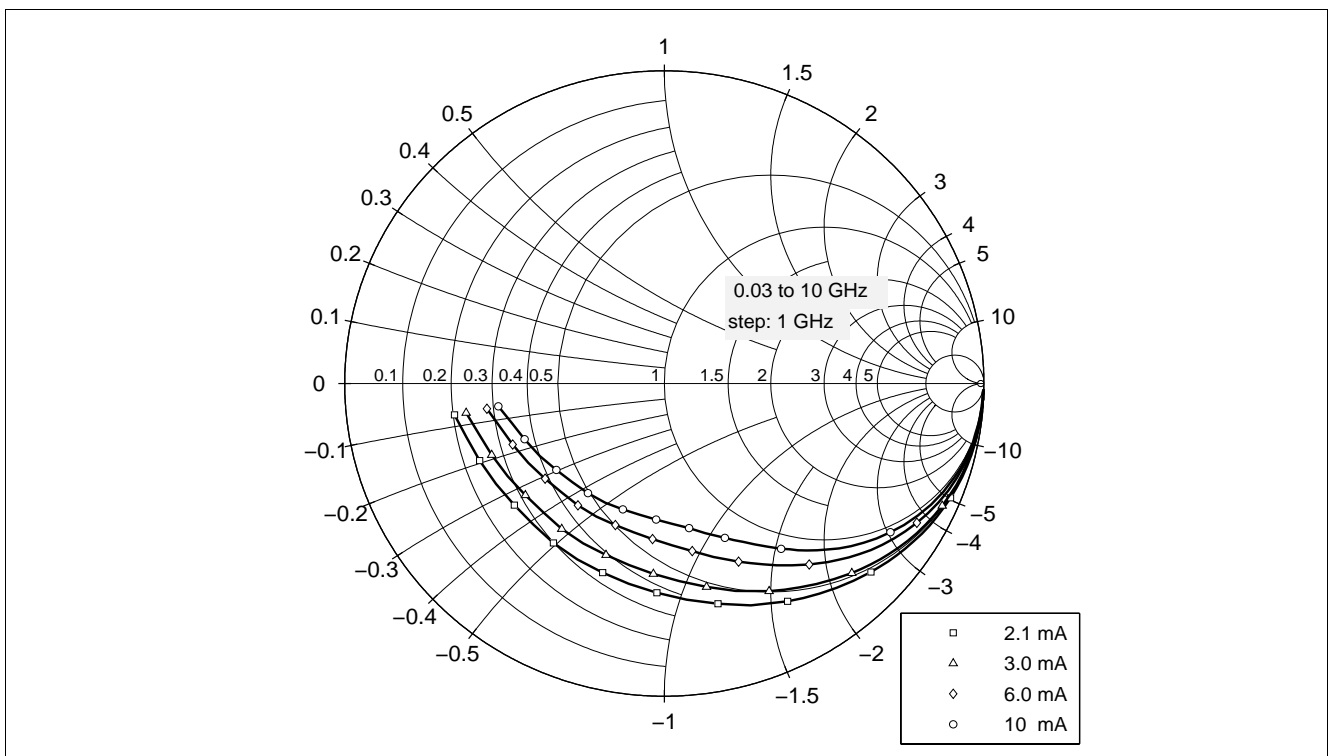


Figure 10  $S_{22}$  as a Function of Frequency,  $I_C$  as Parameter

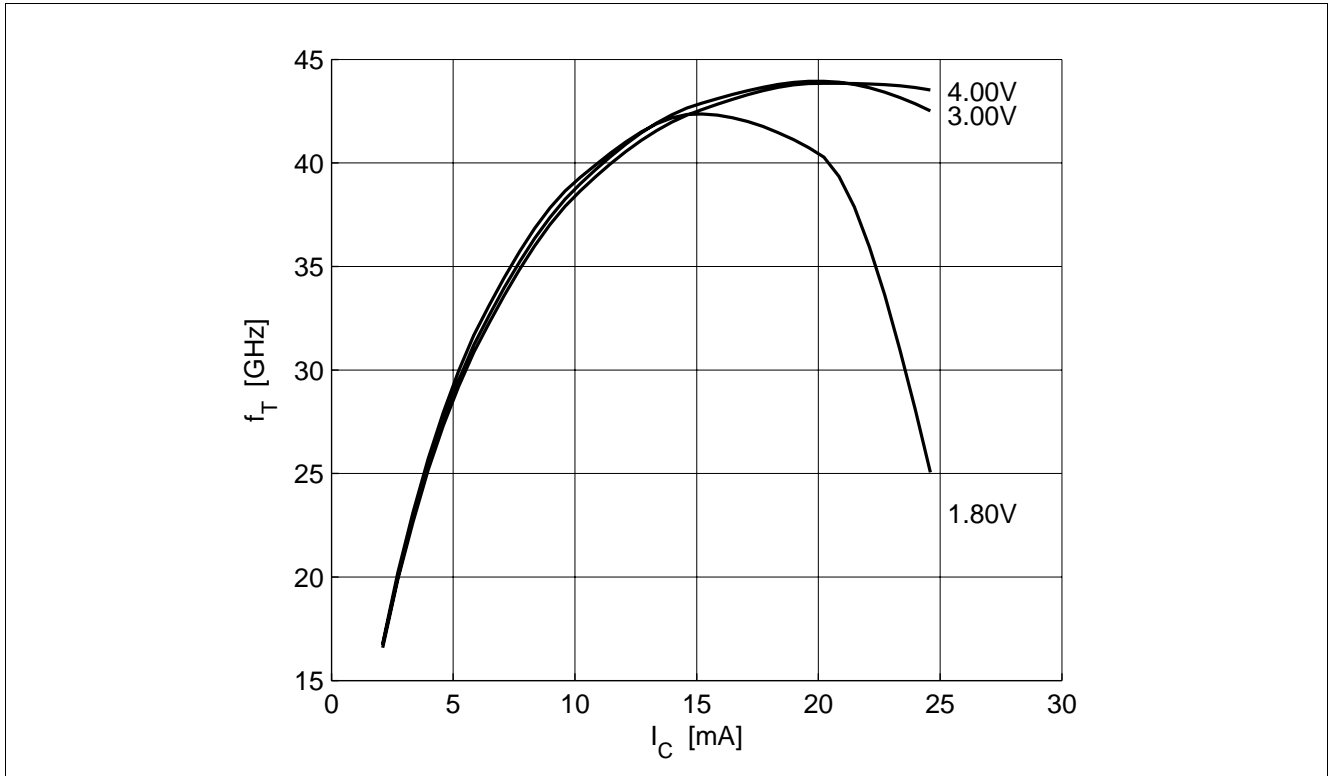


Figure 11 Transition Frequency as a Function of  $I_C$ ,  $V_C$  as Parameter

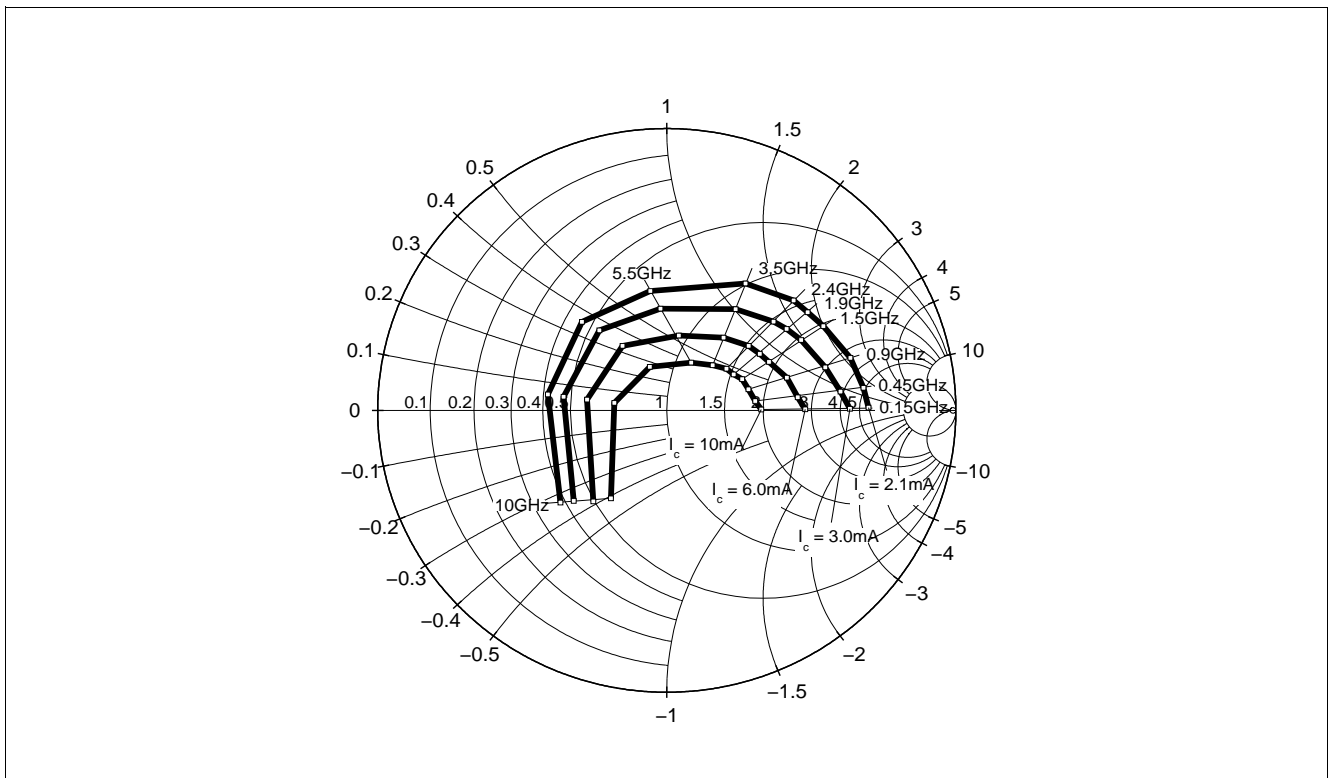


Figure 12 Optimum Source Impedance for Minimum  $NF$  as a Function of Frequency,  $I_C$  as Parameter

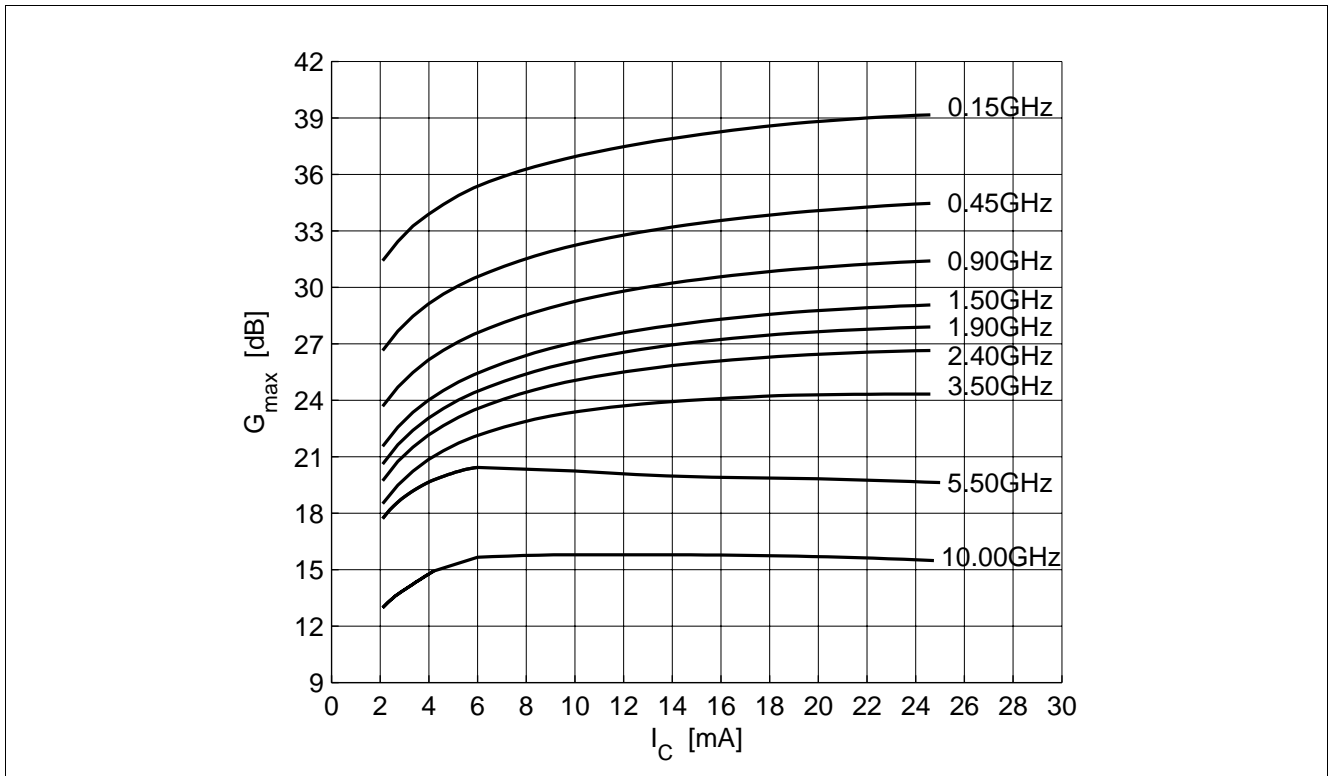


Figure 13 Maximum Power Gain as a Function of  $I_C$ , Frequency as Parameter

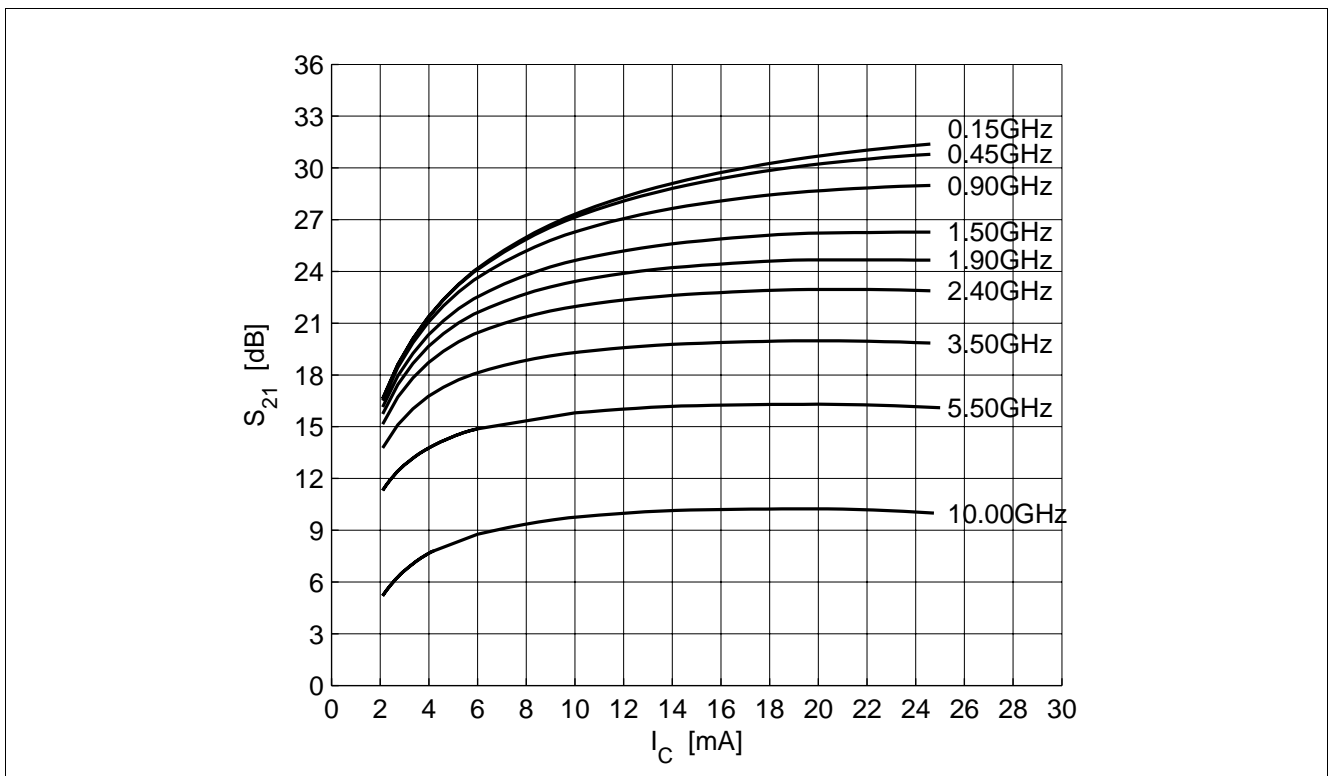


Figure 14 Power Gain as a Function of  $I_C$ , Frequency as Parameter

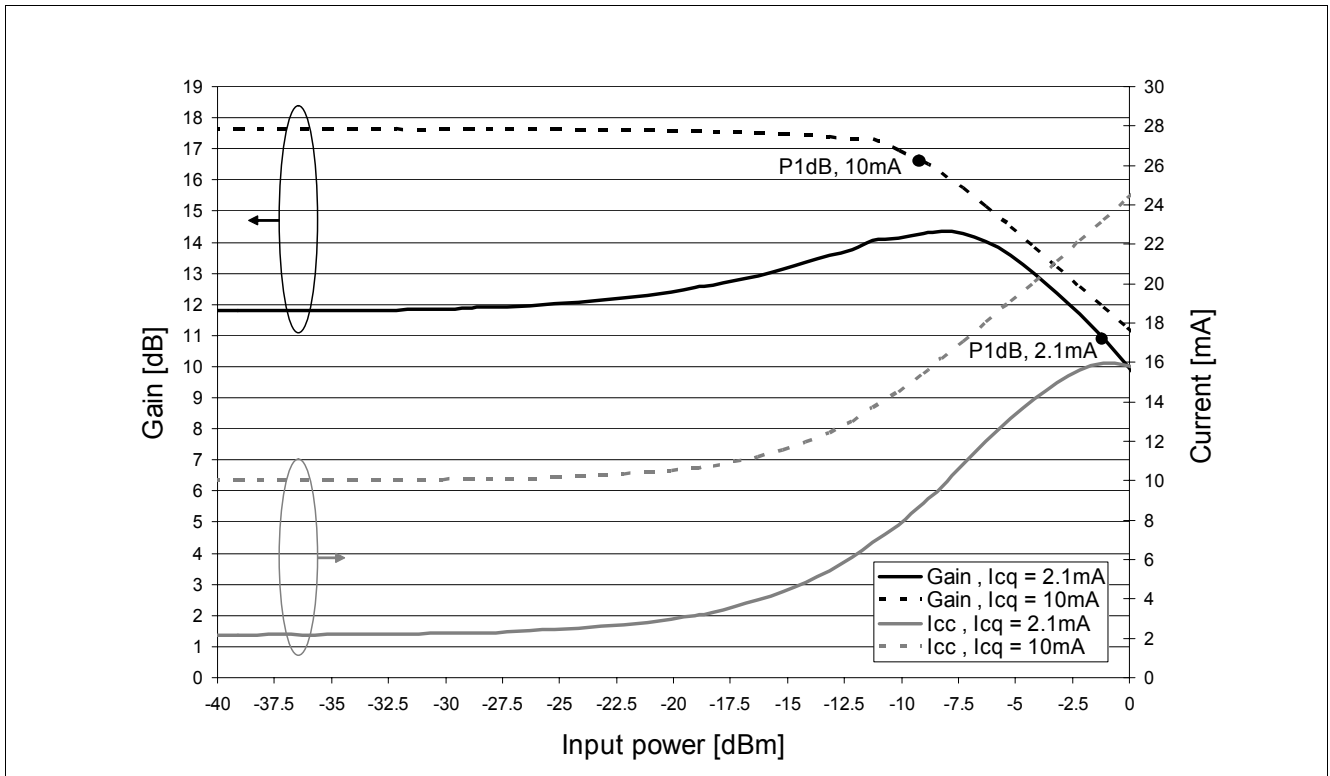


Figure 15 Power Gain and Total Supply Current as a Function of RF Input Power at 3.5 GHz

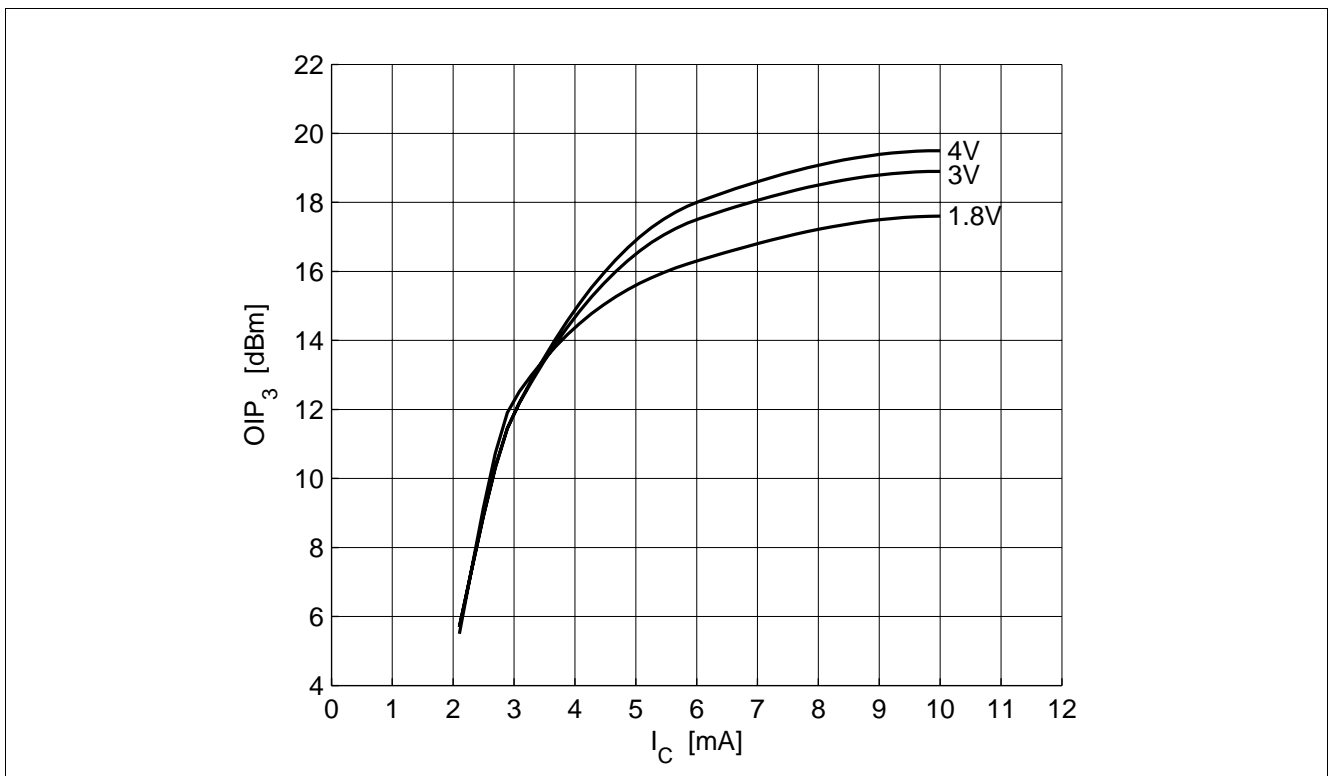


Figure 16 Output 3<sup>rd</sup> Order Intercept Point as a Function of  $I_C$  at 3.5 GHz,  $V_C$  as Parameter



[www.infineon.com](http://www.infineon.com)

Published by Infineon Technologies AG