

BFP780

200 mW High Gain RF Driver Amplifier

Data Sheet

Revision 3.0, 2015-07-08

RF & Protection Devices

Edition 2015-07-08

Published by
Infineon Technologies AG
81726 Munich, Germany

© 2015 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).

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.

BFP780, 200 mW High Gain RF Driver Amplifier**Revision History: 2015-07-08, Revision 3.0**

Page	Subjects (major changes since last revision)
	Final data sheet Rev. 3.0 replaces preliminary data sheet Rev. 2.0

Trademarks of Infineon Technologies AG

AURIX™, C166™, CanPAK™, CIPOS™, CIPURSE™, EconoPACK™, CoolMOS™, CoolSET™, CORECONTROL™, CROSSAVE™, DAVE™, DI-POL™, EasyPIM™, EconoBRIDGE™, EconoDUAL™, EconoPIM™, EconoPACK™, EiceDRIVER™, eupec™, FCOS™, HITFET™, HybridPACK™, I²RF™, ISOFACE™, IsoPACK™, MIPAQ™, ModSTACK™, my-d™, NovalithIC™, OptiMOS™, ORIGA™, POWERCODE™; PRIMARION™, PrimePACK™, PrimeSTACK™, PRO-SIL™, PROFET™, RASIC™, ReverSave™, SatRIC™, SIEGET™, SINDRION™, SIPMOS™, SmartLEWIS™, SOLID FLASH™, TEMPFET™, thinQ!™, TRENCHSTOP™, TriCore™.

Other Trademarks

Advance Design System™ (ADS) of Agilent Technologies, AMBA™, ARM™, MULTI-ICE™, KEIL™, PRIMECELL™, REALVIEW™, THUMB™, µVision™ 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. 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 Satellite 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 2011-11-11

Table of Contents**Table of Contents**

Table of Contents	4
List of Figures	5
List of Tables	6
1 Product Brief	7
2 Features	8
3 Absolute Maximum Ratings	9
4 Recommended Operating Conditions	10
5 Thermal Characteristics	11
6 Electrical Performance in Application	12
7 Electrical Performance in Test Fixture	13
7.1 DC Parameter Table	13
7.2 AC Parameter Tables	14
7.3 Characteristic DC Diagrams	17
7.4 Characteristic AC Diagrams	19
8 Simulation Data	26
9 Package Information SOT343-4-2	27

List of Figures

Figure 5-1	Absolute Maximum Power Dissipation $P_{\text{diss,max}}$ vs. T_s	11
Figure 7-1	BFP780 Testing Circuit.	15
Figure 7-2	Collector Current I_C vs. V_{CE} , I_B = Parameter	17
Figure 7-3	DC Current Gain h_{FE} vs. I_C at $V_{\text{CE}} = 5$ V	17
Figure 7-4	Collector Emitter Breakdown Voltage BV_{CEB} vs. Resistor R_{BE}	18
Figure 7-5	Transition Frequency f_T vs. I_C , V_{CE} = Parameter	19
Figure 7-6	Collector Base Capacitance C_{CB} vs. I_C at $f = 1$ GHz, V_{CE} = Parameter	19
Figure 7-7	Gain G_{ms} , G_{ma} , $IS_{21}I^2$ vs. f at $V_{\text{CE}} = 5$ V, $I_C = 90$ mA	20
Figure 7-8	Maximum Power Gain G_{max} vs. I_C at $V_{\text{CE}} = 5$ V, f = Parameter	20
Figure 7-9	Maximum Power Gain G_{max} vs. V_{CE} at $I_C = 90$ mA, f = Parameter	21
Figure 7-10	Output Reflection Coefficient S_{22} vs. f at $V_{\text{CE}} = 5$ V, I_C = Parameter	21
Figure 7-11	Input Reflection Coefficient S_{11} vs. f at $V_{\text{CE}} = 5$ V, I_C = Parameter	22
Figure 7-12	Source Impedance Z_{Sopt} for Minimum Noise Figure vs. f at $V_{\text{CE}} = 5$ V, I_C = Parameter	22
Figure 7-13	Noise Figure NF_{min} vs. f at $V_{\text{CE}} = 5$ V, $Z_S = Z_{\text{Sopt}}$, I_C = Parameter	23
Figure 7-14	Noise Figure NF_{min} vs. I_C at $V_{\text{CE}} = 5$ V, $Z_S = Z_{\text{Sopt}}$, f = Parameter	23
Figure 7-15	Noise Figure NF_{50} vs. I_C at $V_{\text{CE}} = 5$ V, $Z_S = 50$ Ω , f = Parameter	24
Figure 7-16	Load Pull Contour $OP_{1\text{dB}}$ [dBm] at $V_{\text{CE}} = 5$ V, $I_C = 90$ mA, $f = 0.9$ GHz, $Z_L = Z_{\text{opt}}$	24
Figure 7-17	Load Pull Contour $OIP3$ [dBm] at $V_{\text{CE}} = 5$ V, $I_C = 90$ mA, $f = 0.9$ GHz, $Z_L = Z_{\text{opt}}$	25
Figure 7-18	P_{out} , Gain, I_C , PAE vs. P_{in} at $V_{\text{CE}} = 5$ V, $f = 0.9$ GHz, $Z_L = Z_{\text{opt}}$, $R_1 = 270$ Ω , $R_2 = 8$ k Ω	25
Figure 9-1	Package Outline	27
Figure 9-2	Package Footprint.	27
Figure 9-3	Marking Example (Marking BFP780: R1s)	27
Figure 9-4	Tape Dimensions	27

List of Tables

Table 3-1	Absolute Maximum Ratings at $T_A = 25^\circ\text{C}$ (unless otherwise specified)	9
Table 4-1	Recommended Operating Conditions	10
Table 5-1	Thermal Resistance	11
Table 6-1	Application Notes	12
Table 7-1	DC Characteristics at $T_A = 25^\circ\text{C}$	13
Table 7-2	General AC Characteristics at $T_A = 25^\circ\text{C}$	14
Table 7-3	AC Characteristics, $V_{CE} = 5\text{ V}, f = 0.9\text{ GHz}$	15
Table 7-4	AC Characteristics, $V_{CE} = 5\text{ V}, f = 1.8\text{ GHz}$	15
Table 7-5	AC Characteristics, $V_{CE} = 5\text{ V}, f = 2.6\text{ GHz}$	16
Table 7-6	AC Characteristics, $V_{CE} = 5\text{ V}, f = 3.5\text{ GHz}$	16

1 Product Brief

The BFP780 is a single stage 200 mW high gain driver amplifier. The device is not internally matched and hence provides flexibility to be used for any application where high linearity is key. There are several application notes available, most of them for LTE frequencies. The device is based on Infineon's reliable and cost effective NPN silicon germanium technology running in very high volume. The technology comprises low ohmic substrate contacts so that emitter bond wires can be omitted. Thereby the emitter inductance is minimized and the power gain optimized.

The data sheet describes the device mainly at 90 mA collector current IC, operated in Class A mode. Under these conditions the BFP780 provides 200 mW RF power and highest linearity. If energy efficiency is in the focus it is recommended to operate the device in class AB mode. That means to adjust a quiescent current I_{CQ} lower than 90 mA and use the self biasing effect to get high linearity and efficiency when the input RF power is high. Please refer to figure 7-18, where as an example an I_{CQ} of 70 mA is adjusted.

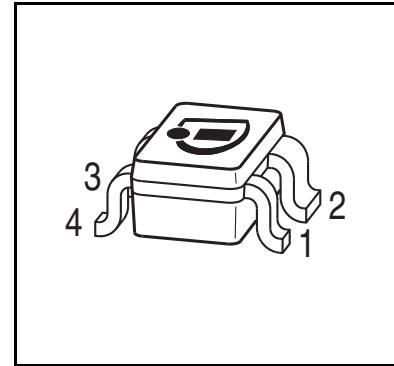
For the BFP780 a large signal compact model in SGP format is available. Further information please find in chapter 8.

The BFP780 is very rugged. The special design of the emitter-base diode makes the input robust and yields a high maximum RF input power. The maximum RF input power is 20 dBm (matched condition). The collector design allows safe operation with a single 5 V supply.

The chip is housed in a halogen free industry standard package SOT343. The high thermal conductivity of the silicon substrate and the low thermal resistance of the package add up to a thermal resistance of only 95 K/W, what leads to moderate junction temperatures even at high dissipated DC power values. Recommended operating conditions can be found in chapter 4. The proper die attach with good thermal contact is tested 100%, so that there is a minimum variation of thermal properties. The devices are 100% DC and RF tested

2 Features

- High 3rd order intercept point OIP3 of 34.5 dBm @ 5 V, 90 mA
- High compression point OP1dB of 23 dBm @ 5 V, 90 mA corresponding to 45 % collector efficiency
- Low minimum noise figure of 1.2 dB @ 900 MHz, 5 V, 30 mA
- Single stage, intended for external matching
- High maximum RF input power PRFinmax of 20 dBm
- Safe operation with single 5 V supply
- 100% test of proper die attach for reproducible thermal contact
- 100% DC and RF tested
- Easy to use large signal compact model available
- Cost effective NPN SiGe technology running in very high volume
- Easy to use Pb-free (RoHS compliant) and halogen-free industry standard package SOT343, low RTHJS of 95 K/W



Applications

As

- High linearity driver or pre-driver in the transmit chain
- 2nd or 3rd stage LNA in the receive chain
- IF or LO buffer amplifier

In

- Commercial / industrial wireless infrastructure / basestations
- Repeaters
- Automated test equipment

For

- Cellular, PCS, DCS, UMTS, LTE, CDMA, WCDMA, GSM, GPRS
- WLAN, WiMAX, WLL and MMDS
- ISM, AMR
- UHF television, CATV, DBS

Attention: ESD-class 1a (Electrostatic discharge) sensitive device, observe handling precautions

Product Name	Package	Pin Configuration				Marking
BFP780	SOT343-4-2	1 = B	2 = E	3 = C	4 = E	R1s

Absolute Maximum Ratings

3 Absolute Maximum Ratings

Table 3-1 Absolute Maximum Ratings at $T_A = 25^\circ\text{C}$ (unless otherwise specified)

Parameter	Symbol	Values		Unit	Note / Test Condition
		Min.	Max.		
Collector emitter voltage	V_{CE}		6.1 5.1	V	$T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C}$
Collector base voltage	V_{CB}		15	V	$T_A = 25^\circ\text{C}$
Instantaneous total collector current	i_C	—	240	mA	DC + RF swing
DC collector current	I_C	—	120	mA	
DC base current	I_B	-1	5	mA	
RF input power	P_{RFin}	—	20	dBm	In- and output matched
Dissipated power	P_{diss}	—	600	mW	$T_S \leq 93^\circ\text{C}$ ¹⁾ , regard derating curve in Figure 5-1
Junction temperature	T_J	—	150	°C	
Operating case temperature	T_A	-40	105 ²⁾	°C	
Storage temperature	T_{Stg}	-55	150	°C	

1) T_S is the soldering point temperature. T_S is measured on the emitter lead at the soldering point of the pcb.

2) At the same time regard $T_{J,max}$.

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 Recommended Operating Conditions

This following table shows examples of recommended operating conditions. As long as maximum ratings are regarded operation outside these conditions is permitted, but increases failure rate and reduces lifetime. For further information refer to the quality report available on the BFP780 internet page.

Table 4-1 Recommended Operating Conditions

Operating Mode	Ambient Temperature ¹⁾	Collector Current	DC Power ²⁾	RF Output Power ³⁾	Efficiency ⁴⁾	Dissipated Power ⁵⁾	Thermal Resistance of pcb ⁶⁾	Junction Temperature ⁷⁾
	T_A [°C]	I_C [mA]	P_{DC} [mW]	P_{RFout} [mW] (dBm)	η [%]	P_{diss} [mW]	R_{THSA} [K/W]	T_J [°C]
Compression	55	90	450	200 (23)	45	250	120	110
Final stage	55	90	450	115 (20.5)	25	340	70	110
High T_A	85	50	250	75 (19)	30	175	35	110
Maximum T_A	105	20	100	45 (16.5)	45	55	35	110
Linear	55	50	250	20 (13)	8	230	120	110
Very Linear	55	90	450	23 (13.5)	5	430	35	110

1) Is the operating case temperature respectively of the heatsink.

2) $P_{DC} = V_{CE} * I_C$ with $V_{CE} = 5$ V.

3) RF power delivered to the load, $P_{RFout} = \eta * P_{DC}$.

4) Efficiency of the conversion from DC power to RF power, $\eta = P_{RFout} / P_{DC}$ (collector efficiency).

5) $P_{diss} = P_{DC} - P_{RFout}$. The RF output power P_{RFout} delivered to the load reduces the power P_{diss} to be dissipated by the device. This means a good output match is recommended.

6) R_{THSA} is the thermal resistance of the pcb including heat sink, that is between the soldering point S and the ambient A. Regard the impact of R_{THSA} on the junction temperature T_J , see below. The thermal design of the pcb, respectively R_{THSA} , has to be adjusted to the intended operating mode.

7) $T_J = T_A + P_{diss} * R_{THJA}$. $R_{THJA} = R_{THJS} + R_{THSA}$.

R_{THJA} is the thermal resistance between the transistor junction J and the ambient A.

R_{THJS} is the combined thermal resistance of die and package, which is 95 K/W for the BFP780, see [Chapter 5](#).

5 Thermal Characteristics

Table 5-1 Thermal Resistance

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Junction - soldering point	R_{THJS}	—	95	—	K/W	—

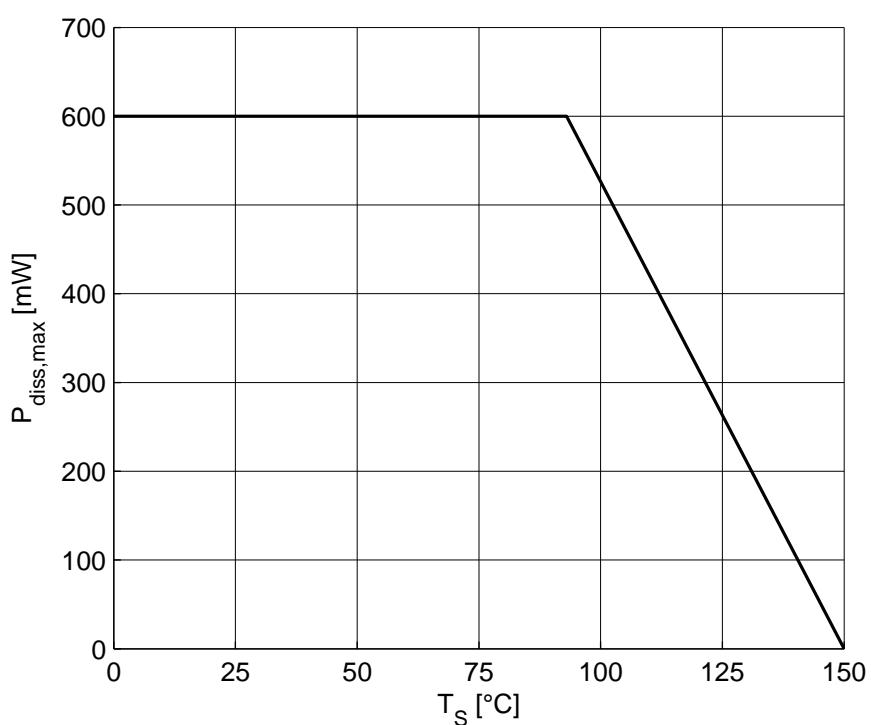


Figure 5-1 Absolute Maximum Power Dissipation $P_{diss,max}$ vs. T_s

Note: In the horizontal part of the derating curve the maximum power dissipation is given by $P_{diss,max} \approx V_{CE,max} * I_{C,max}$.

In this part the junction temperature T_J is lower than $T_{J,max}$. In the declining slope it is $T_J = T_{J,max}$. $P_{diss,max}$ has to be reduced according to the curve in order not to exceed $T_{J,max}$. It is $T_{J,max} = T_s + P_{diss,max} * R_{THJS}$.

6 Electrical Performance in Application

The table shows the most important results of the application notes available for the BFP780. The matching is approximately 10 dB, the isolation is better than 20 dB and the stability factor is above 1 at $V_{CC} = 5$ V. For more detailed informations please refer to the BFP780 internet page. Application notes for Class AB operating mode respectively lower quiescent currents I_{Cq} are in development.

Table 6-1 Application Notes

Application Note	Frequency	OP1dB	OIP3	Gain	Operating Mode	I_{Cq}
#	[MHz]	[dBm]	[dBm]	[dB]		[mA]
AN410	2600	22	34.7	14.4	Class A	80
AN390	1805 - 1880	22	34	18	Class A	90
AN413	900	23	34.7	22	Class A	80

7 Electrical Performance in Test Fixture

7.1 DC Parameter Table

Table 7-1 DC Characteristics at $T_A = 25^\circ\text{C}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Collector emitter breakdown voltage	$V_{(\text{BR})\text{CEO}}$	6.1	6.6	—	V	$I_C = 1 \text{ mA}$, open base
Collector emitter leakage current	I_{CES}	—	1 ¹⁾ 0.1	40 3	nA μA	$V_{\text{CE}} = 8 \text{ V}$, $V_{\text{BE}} = 0$ $V_{\text{CE}} = 18 \text{ V}$, $V_{\text{BE}} = 0$ E-B short circuited
Collector base leakage current	I_{CBO}	—	1 ¹⁾	40	nA	$V_{\text{CB}} = 8 \text{ V}$, $I_E = 0$ Open emitter
Emitter base leakage current	I_{EBO}	—	—	10	μA	$V_{\text{EB}} = 0.5 \text{ V}$, $I_C = 0$ Open collector
DC current gain	h_{FE}	85	160	230		$V_{\text{CE}} = 5 \text{ V}$, $I_C = 90 \text{ mA}$ Pulse measured ²⁾

1) Accuracy of typical value limited by the cycle time of the 100% test.

2) Test duration 14 ms, duty cycle 46%. Regard that the current gain h_{FE} depends on the junction temperature T_J and T_A amongst others from the thermal resistance R_{THSA} of the pcb, see notes on [Table 4-1](#). Hence the h_{FE} specified in this data sheet must not be the same as in the application. It is recommended to apply circuit design techniques to make the collector current I_C independent on the h_{FE} production variation and temperature effects.

7.2 AC Parameter Tables

Table 7-2 General AC Characteristics at $T_A = 25^\circ\text{C}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Transition frequency	f_T	–	20	–	GHz	$V_{CE} = 5\text{ V}$, $I_C = 90\text{ mA}$
Collector base capacitance	C_{CB}	–	0.37	–	pF	$V_{CB} = 5\text{ V}$, $V_{BE} = 0$ $f = 1\text{ MHz}$ Emitter grounded
Collector emitter capacitance	C_{CE}	–	1.4	–	pF	$V_{CE} = 5\text{ V}$, $V_{BE} = 0$ $f = 1\text{ MHz}$ Base grounded
Emitter base capacitance	C_{EB}	–	3.3	–	pF	$V_{EB} = 0.5\text{ V}$, $V_{CB} = 0$ $f = 1\text{ MHz}$ Collector grounded

Measurement setup for the AC characteristics shown in [Table 7-3](#) to [Table 7-6](#) is a test fixture with Bias T's and tuners to adjust the source and load impedances in a $50\ \Omega$ system, $T_A = 25\text{ }^\circ\text{C}$.

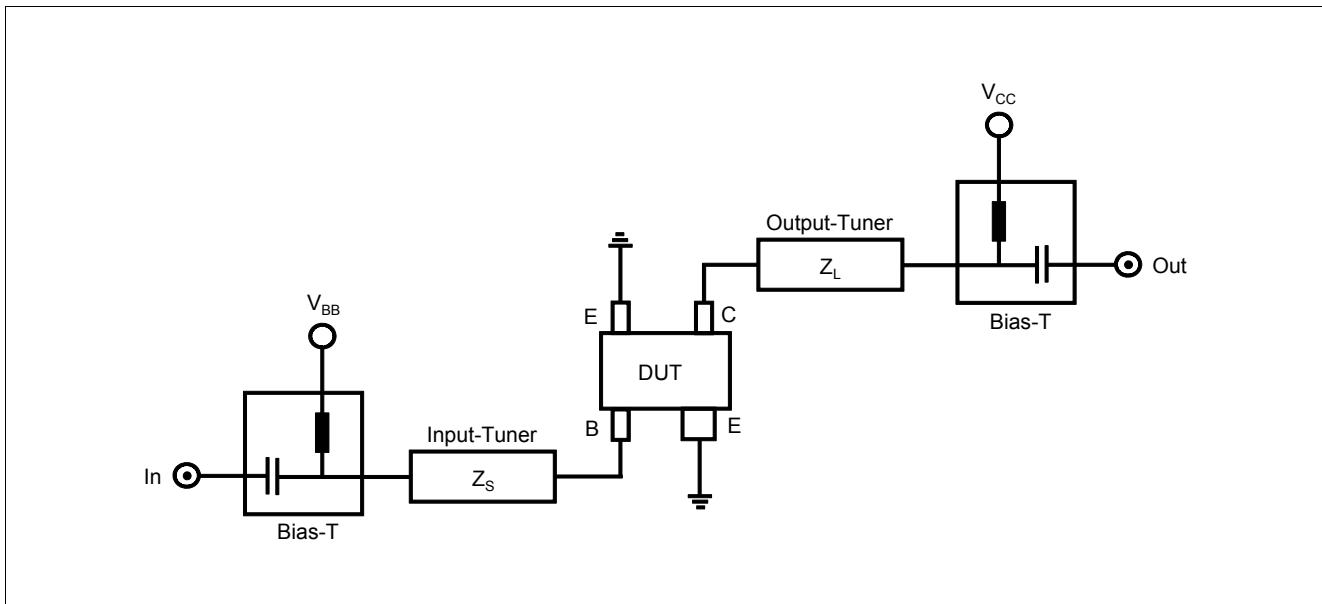


Figure 7-1 BFP780 Testing Circuit

Table 7-3 AC Characteristics, $V_{CE} = 5 \text{ V}$, $f = 0.9 \text{ GHz}$

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power gain						
Maximum power gain	G_{ms}	–	27	–	dB	$I_C = 90$ mA
Transducer gain	$ S_{21} ^2$	–	21.5	–		$I_C = 90$ mA
Minimum Noise Figure						
Minimum noise figure	NF_{min}	–	1.2	–	dB	$Z_S = Z_{Sopt}$ $I_C = 30$ mA
Linearity						
1 dB compression point at output	$OP1dB$	–	23	–	dBm	$Z_L = Z_{Lopt}$ $I_C = 90$ mA
3rd order intercept point at output	$OIP3$	–	34.5	–		$I_C = 90$ mA

Table 7-4 AC Characteristics, $V_{CE} = 5$ V, $f = 1.8$ GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power gain						
Maximum power gain	G_{ma}	–	22	–	dB	$I_C = 90 \text{ mA}$
Transducer gain	$ S_{21} ^2$	–	15	–		$I_C = 90 \text{ mA}$
Minimum Noise Figure						
Minimum noise figure	NF_{min}	–	1.4	–	dB	$Z_S = Z_{\text{opt}}$
						$I_C = 30 \text{ mA}$

Electrical Performance in Test Fixture

Table 7-4 AC Characteristics, $V_{CE} = 5$ V, $f = 1.8$ GHz (cont'd)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Linearity						
1 dB compression point at output	$OP1dB$	–	22	–	dBm	$Z_L = Z_{Lopt}$ $I_C = 90$ mA
3rd order intercept point at output	$OIP3$	–	34	–		$I_C = 90$ mA

Table 7-5 AC Characteristics, $V_{CE} = 5$ V, $f = 2.6$ GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power gain						
Maximum power gain	G_{ma}	–	18	–	dB	$I_C = 90$ mA
Transducer gain	$ S_{21} ^2$	–	12	–		$I_C = 90$ mA
Minimum Noise Figure						
Minimum noise figure	NF_{min}	–	1.7	–	dB	$Z_S = Z_{Sopt}$ $I_C = 30$ mA
Linearity						
1 dB compression point at output	$OP1dB$	–	22	–	dBm	$Z_L = Z_{Lopt}$ $I_C = 90$ mA
3rd order intercept point at output	$OIP3$	–	34	–		$I_C = 90$ mA

Table 7-6 AC Characteristics, $V_{CE} = 5$ V, $f = 3.5$ GHz

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Power gain						
Maximum power gain	G_{ma}	–	15	–	dB	$I_C = 90$ mA
Transducer gain	$ S_{21} ^2$	–	8.5	–		$I_C = 90$ mA
Minimum Noise Figure						
Minimum noise figure	NF_{min}	–	2.4	–	dB	$Z_S = Z_{Sopt}$ $I_C = 30$ mA
Linearity						
1 dB compression point at output	$OP1dB$	–	22	–	dBm	$Z_L = Z_{Lopt}$ $I_C = 90$ mA
3rd order intercept point at output	$OIP3$	–	33.5	–		$I_C = 90$ mA

7.3 Characteristic DC Diagrams

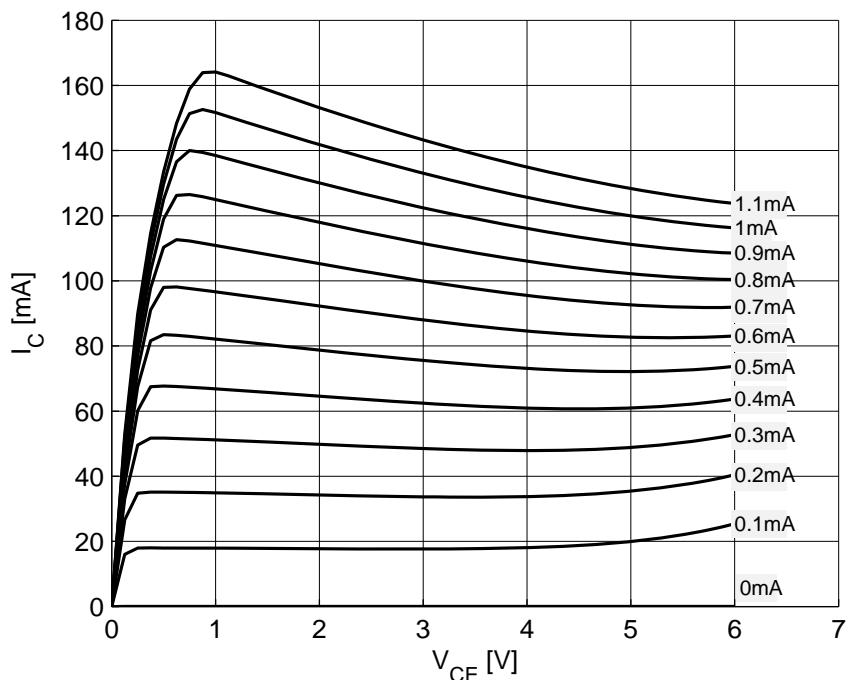


Figure 7-2 Collector Current I_C vs. V_{CE} , I_B = Parameter

Note: Regard absolute maximum ratings for I_C , V_{CE} and P_{diss}

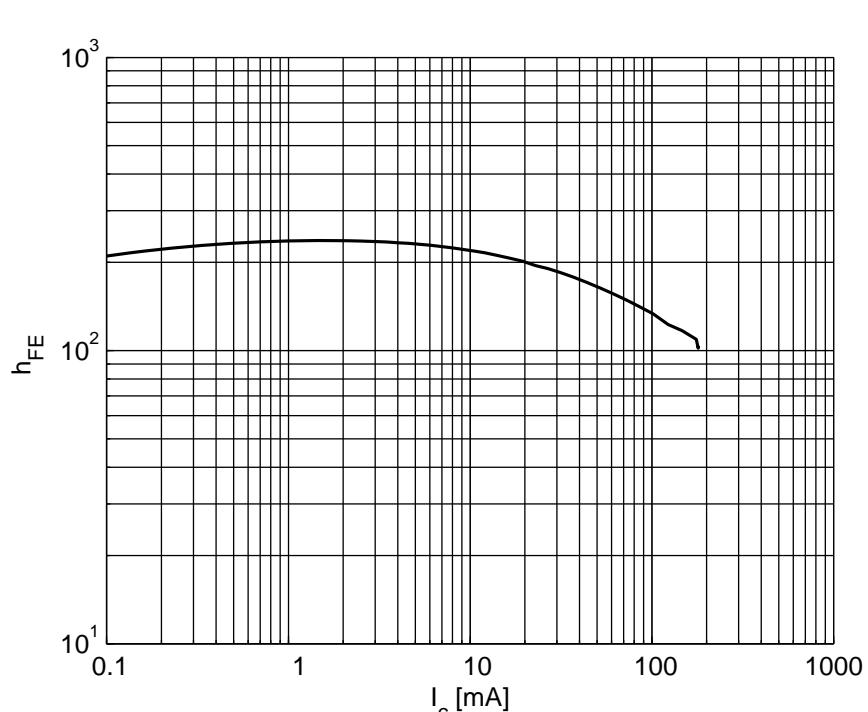


Figure 7-3 DC Current Gain h_{FE} vs. I_C at $V_{CE} = 5$ V

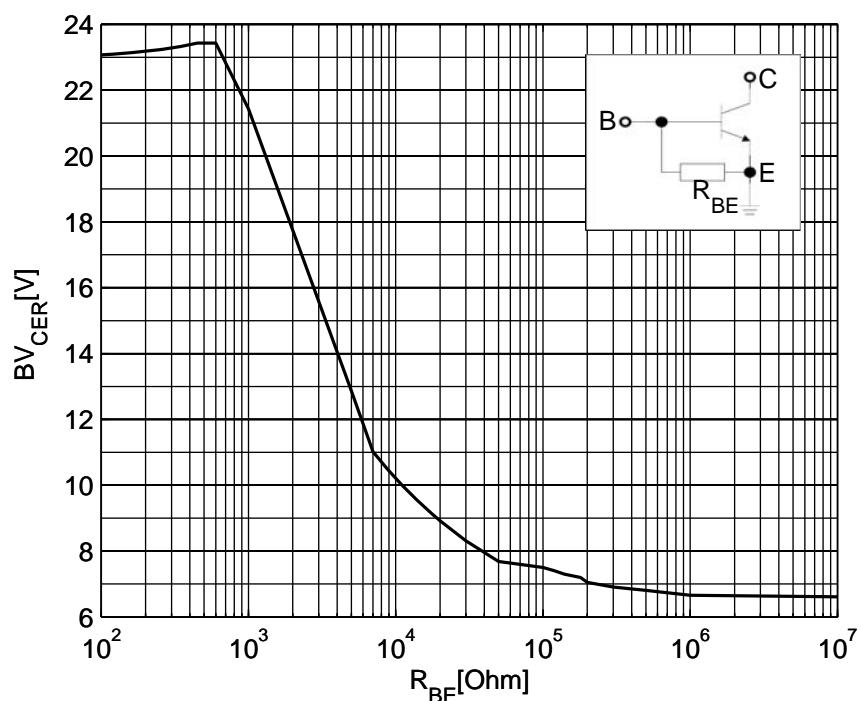


Figure 7-4 Collector Emitter Breakdown Voltage BV_{CER} vs. Resistor R_{BE}

Note: The above figure shows the collector-emitter breakdown voltage BV_{CER} with a resistor R_{BE} between base and emitter. Only for very high R_{BE} values ("open base") the breakdown voltage BV_{CER} is as low as BV_{CEO} (here 6.6 V). With decreasing R_{BE} values BV_{CER} increases, e.g. at $R_{BE} = 10 \text{ kOhm}$ to $BV_{CER} = 10 \text{ V}$. In the application the biasing base resistance together with block capacitors take over the function of R_{BE} and allows the RF voltage amplitude to swing up to voltages much higher than BV_{CEO} , no clipping occurs. Due to this effect the transistor can be biased at $V_{CE} = 5 \text{ V}$ and still high RF output powers achieved, see the OP1dB values reported in [Chapter 7.2](#).

7.4 Characteristic AC Diagrams

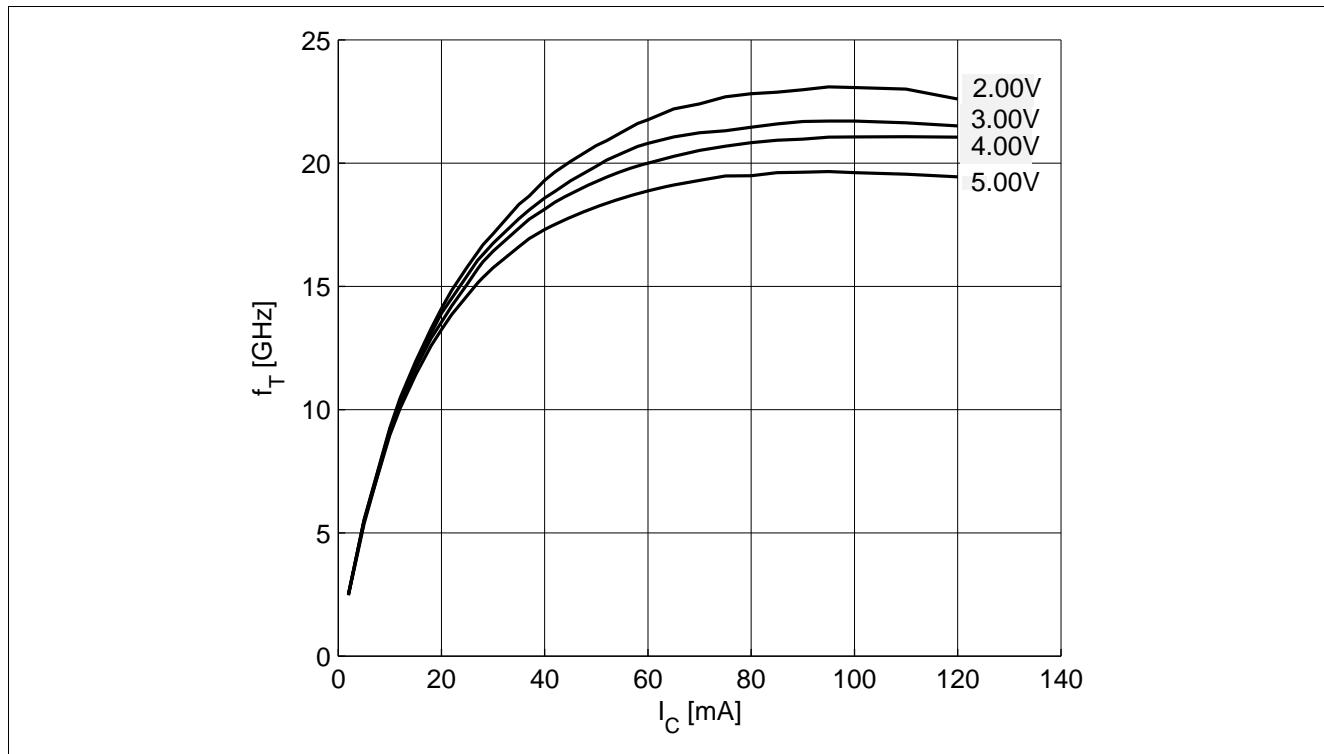


Figure 7-5 Transition Frequency f_T vs. I_C , V_{CE} = Parameter

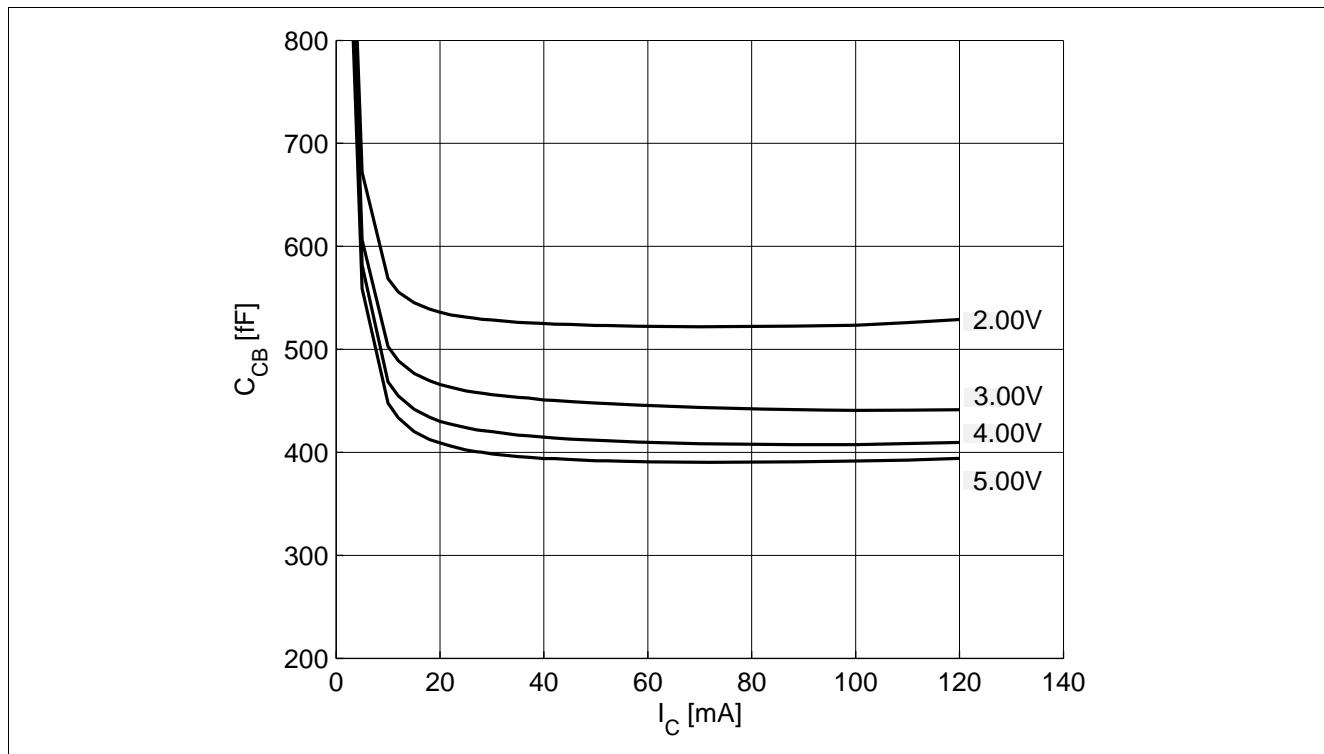


Figure 7-6 Collector Base Capacitance C_{CB} vs. I_C at $f = 1$ GHz, V_{CE} = Parameter

Electrical Performance in Test Fixture

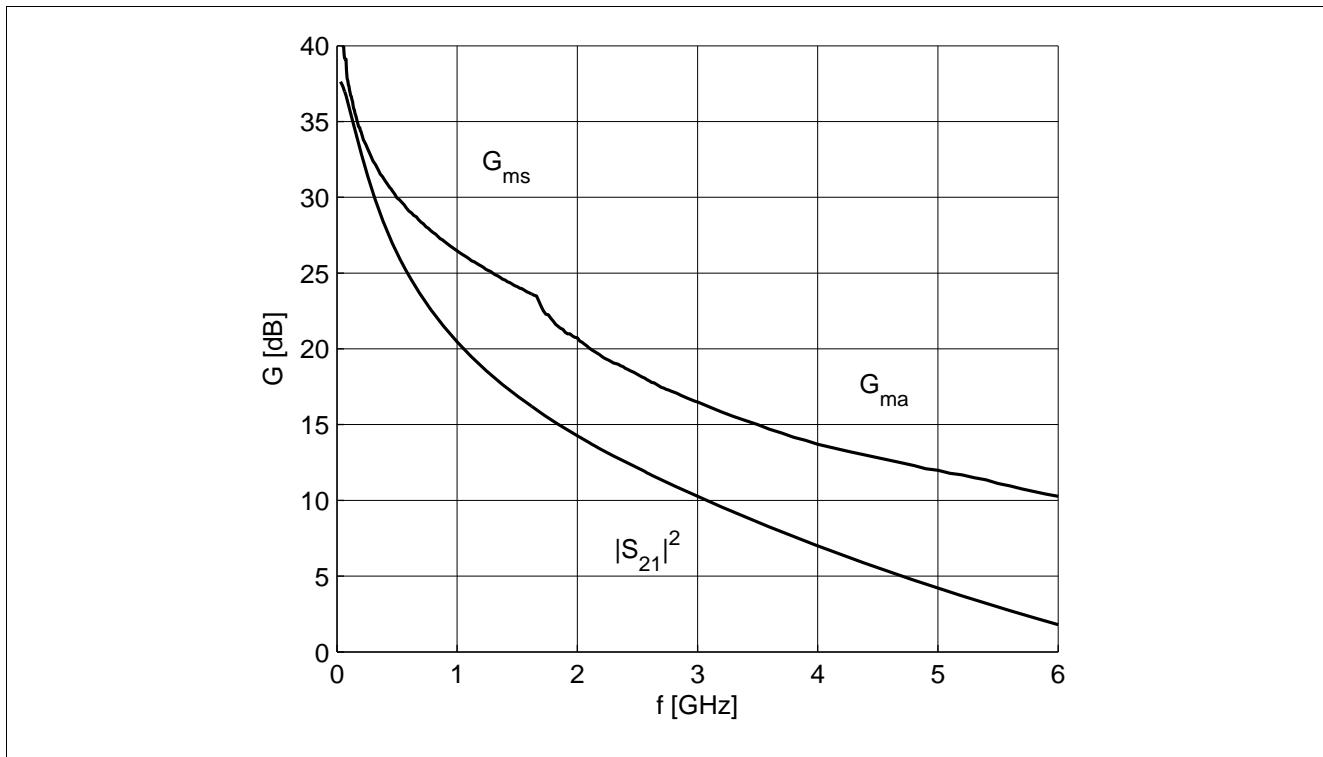


Figure 7-7 Gain G_{ms} , G_{ma} , $|S_{21}|^2$ vs. f at $V_{CE} = 5$ V, $I_C = 90$ mA

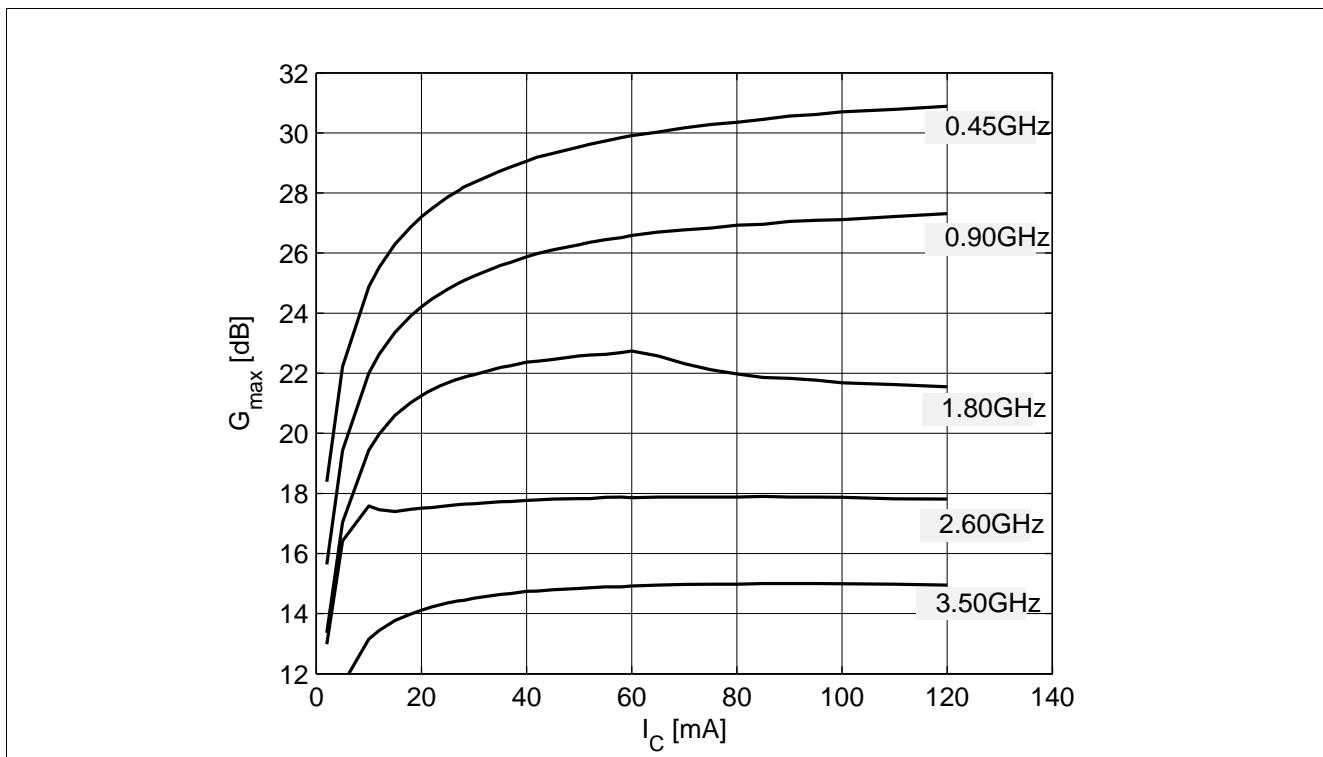
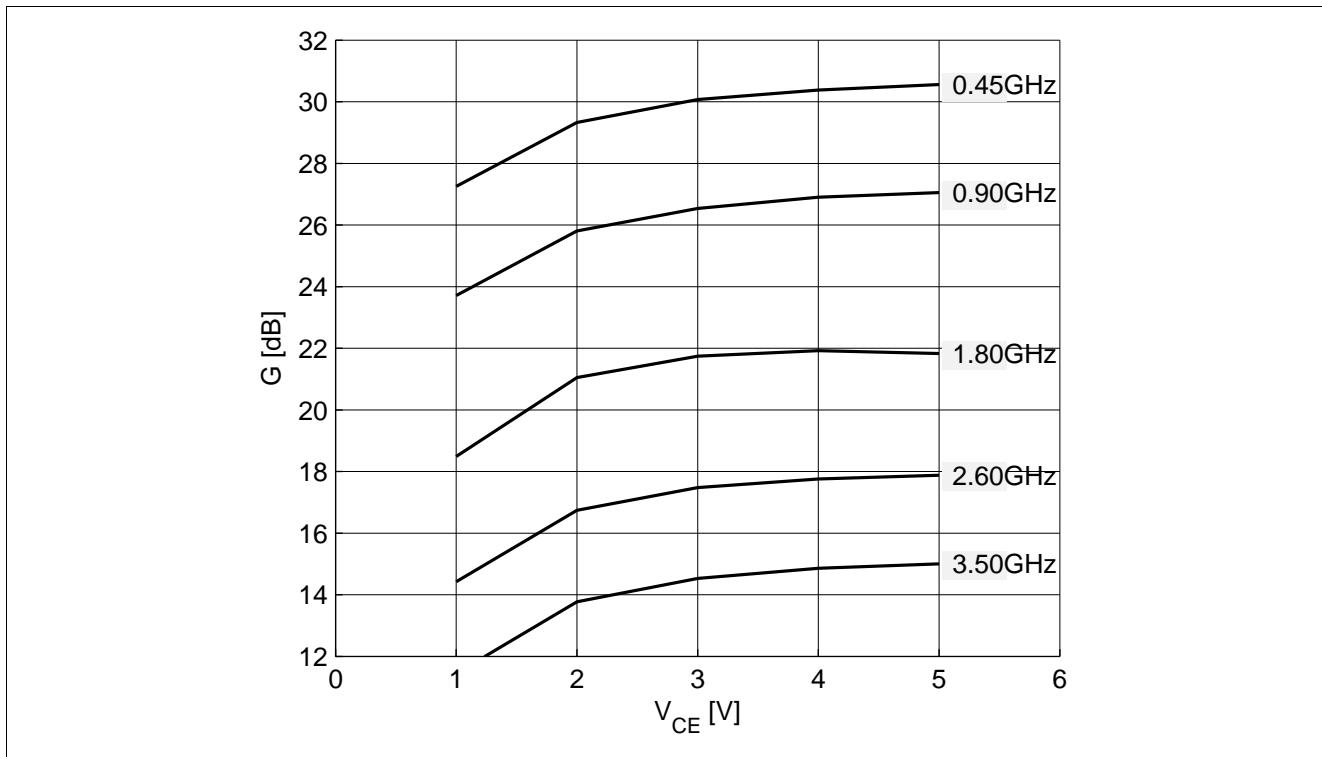
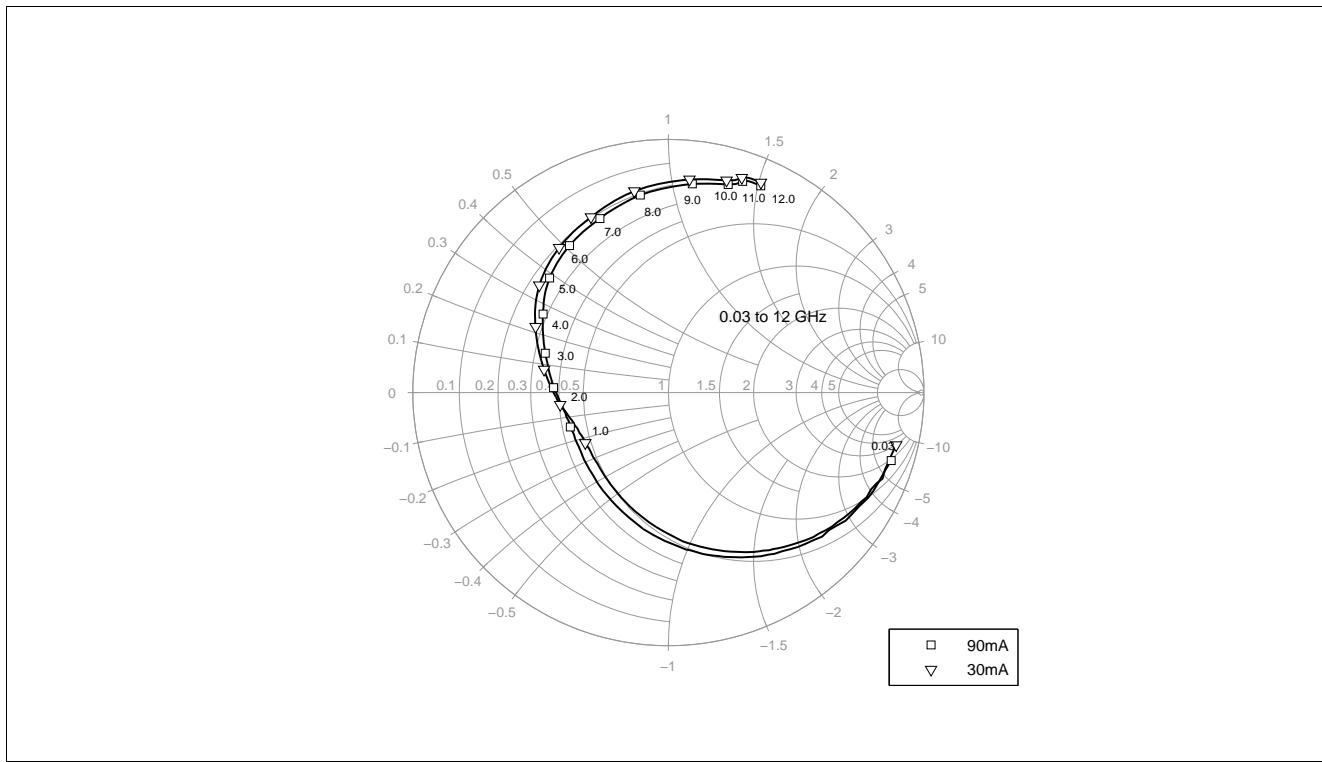


Figure 7-8 Maximum Power Gain G_{max} vs. I_C at $V_{CE} = 5$ V, f = Parameter

Electrical Performance in Test Fixture

Figure 7-9 Maximum Power Gain G_{max} vs. V_{CE} at $I_C = 90$ mA, f = Parameter

Figure 7-10 Output Reflection Coefficient S_{22} vs. f at $V_{CE} = 5$ V, I_C = Parameter

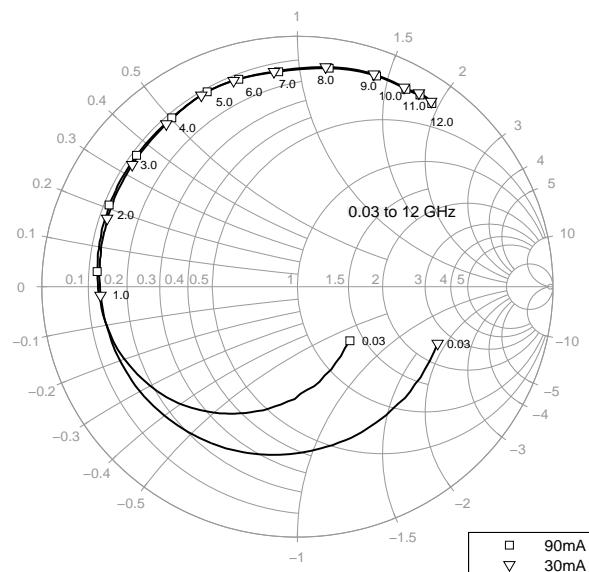
Electrical Performance in Test Fixture


Figure 7-11 Input Reflection Coefficient S_{11} vs. f at $V_{CE} = 5$ V, I_C = Parameter

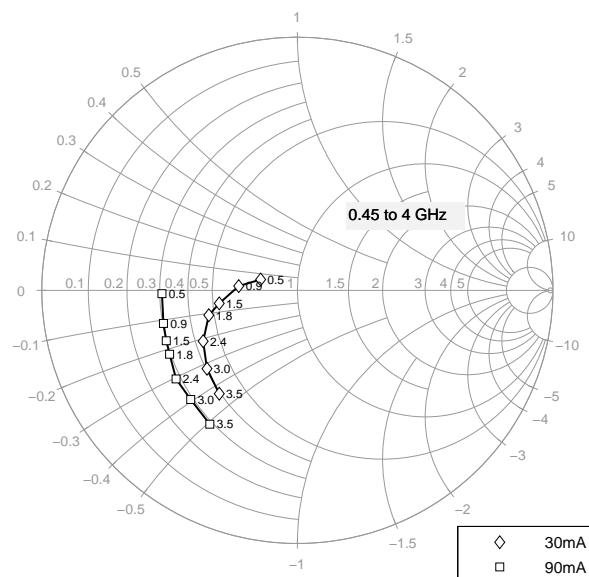


Figure 7-12 Source Impedance $Z_{s\text{opt}}$ for Minimum Noise Figure vs. f at $V_{CE} = 5$ V, I_C = Parameter

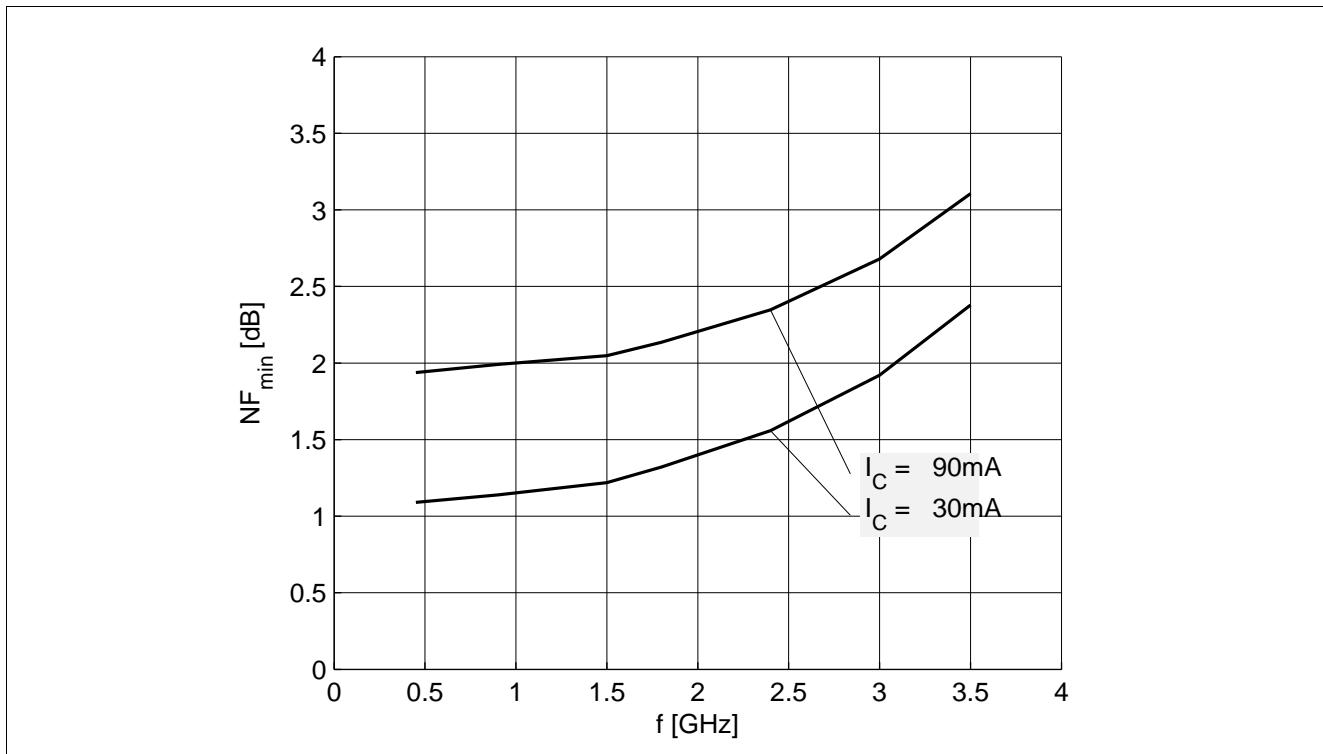
Electrical Performance in Test Fixture


Figure 7-13 Noise Figure NF_{min} vs. f at $V_{CE} = 5\text{ V}$, $Z_S = Z_{Sopt}$, $I_C = \text{Parameter}$

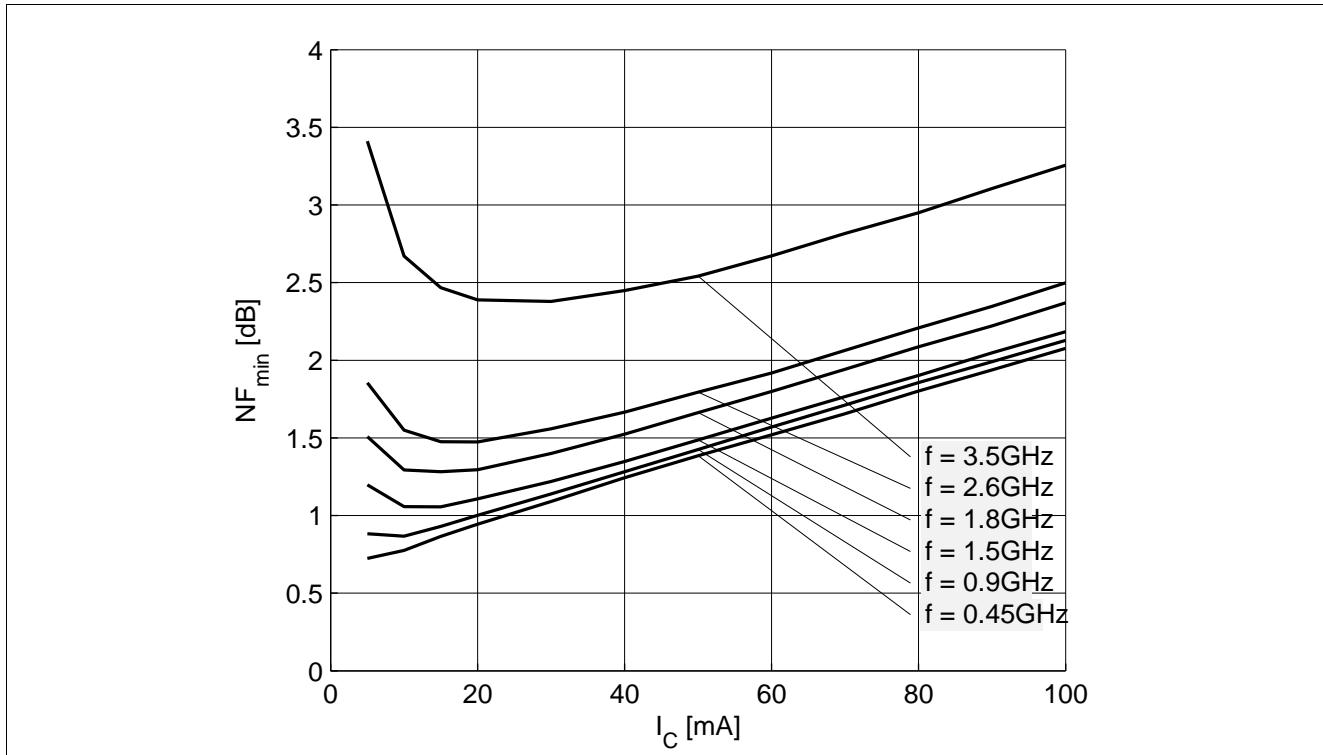


Figure 7-14 Noise Figure NF_{min} vs. I_C at $V_{CE} = 5\text{ V}$, $Z_S = Z_{Sopt}$, $f = \text{Parameter}$

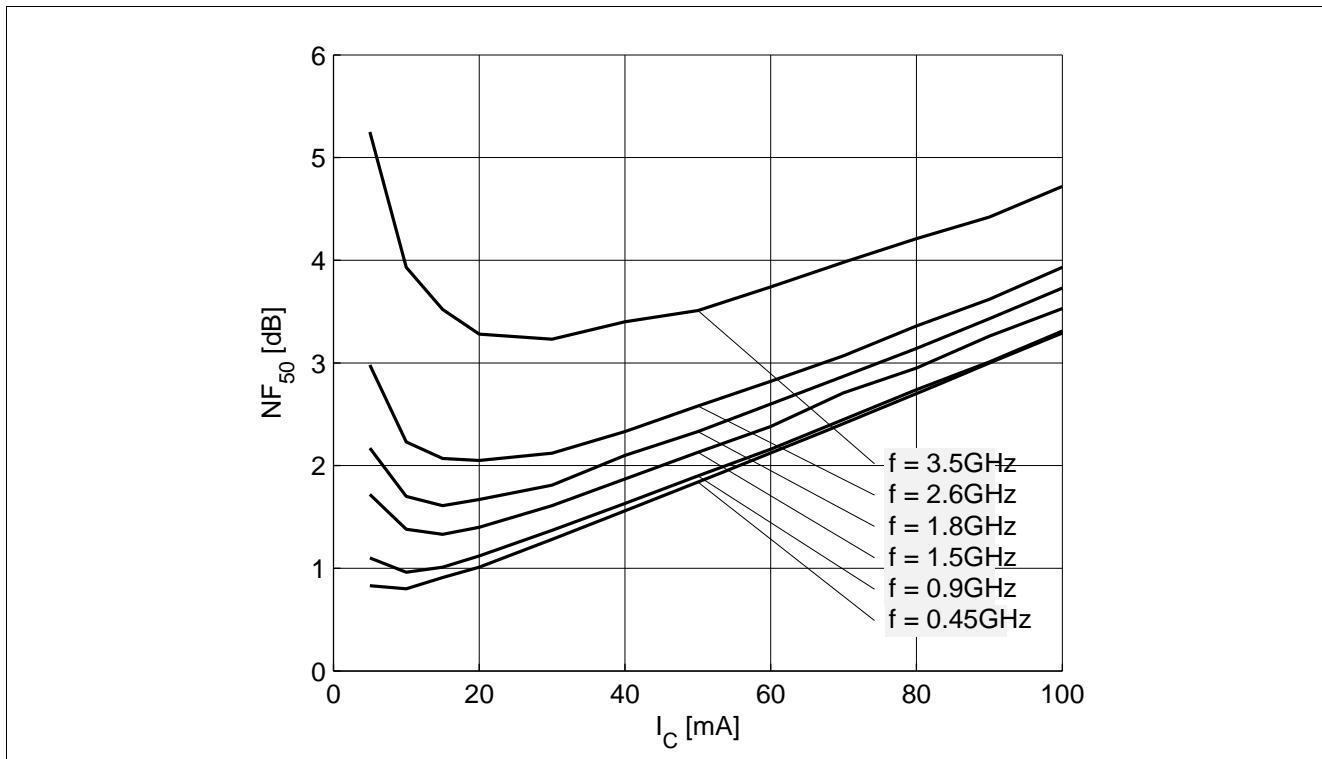
Electrical Performance in Test Fixture


Figure 7-15 Noise Figure NF_{50} vs. I_C at $V_{CE} = 5$ V, $Z_s = 50 \Omega$, $f = \text{Parameter}$

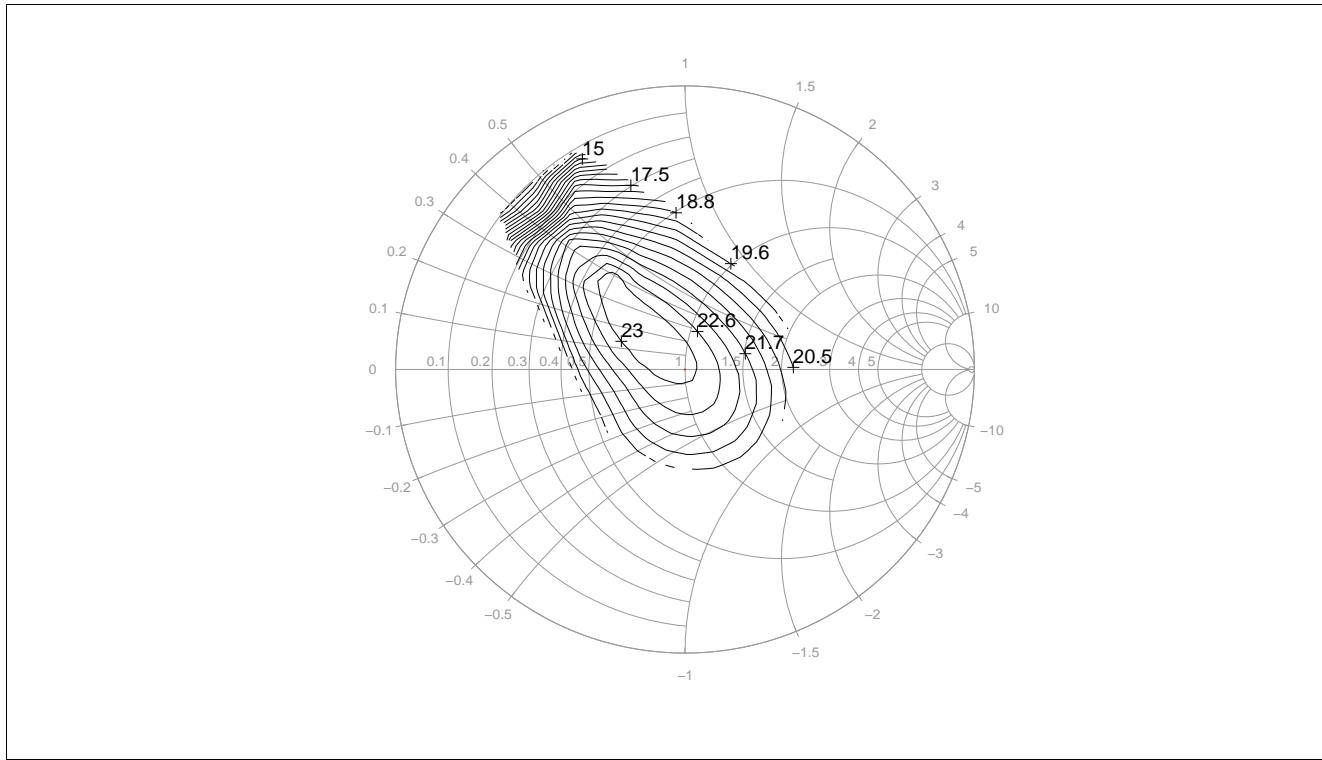


Figure 7-16 Load Pull Contour $OP_{1\text{dB}}$ [dBm] at $V_{CE} = 5$ V, $I_C = 90$ mA, $f = 0.9$ GHz, $Z_l = Z_{\text{opt}}$

Electrical Performance in Test Fixture

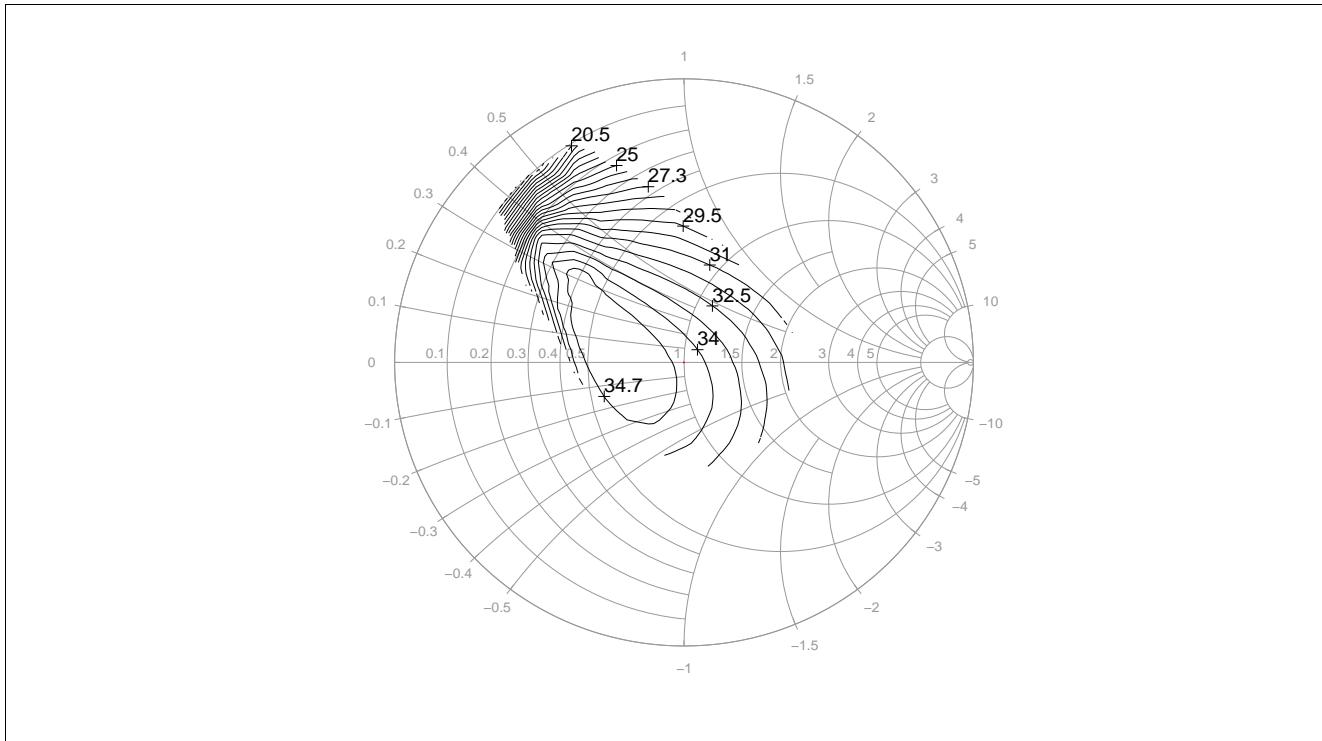


Figure 7-17 Load Pull Contour $OIP3$ [dBm] at $V_{CE} = 5$ V, $I_C = 90$ mA, $f = 0.9$ GHz, $Z_L = Z_{opt}$

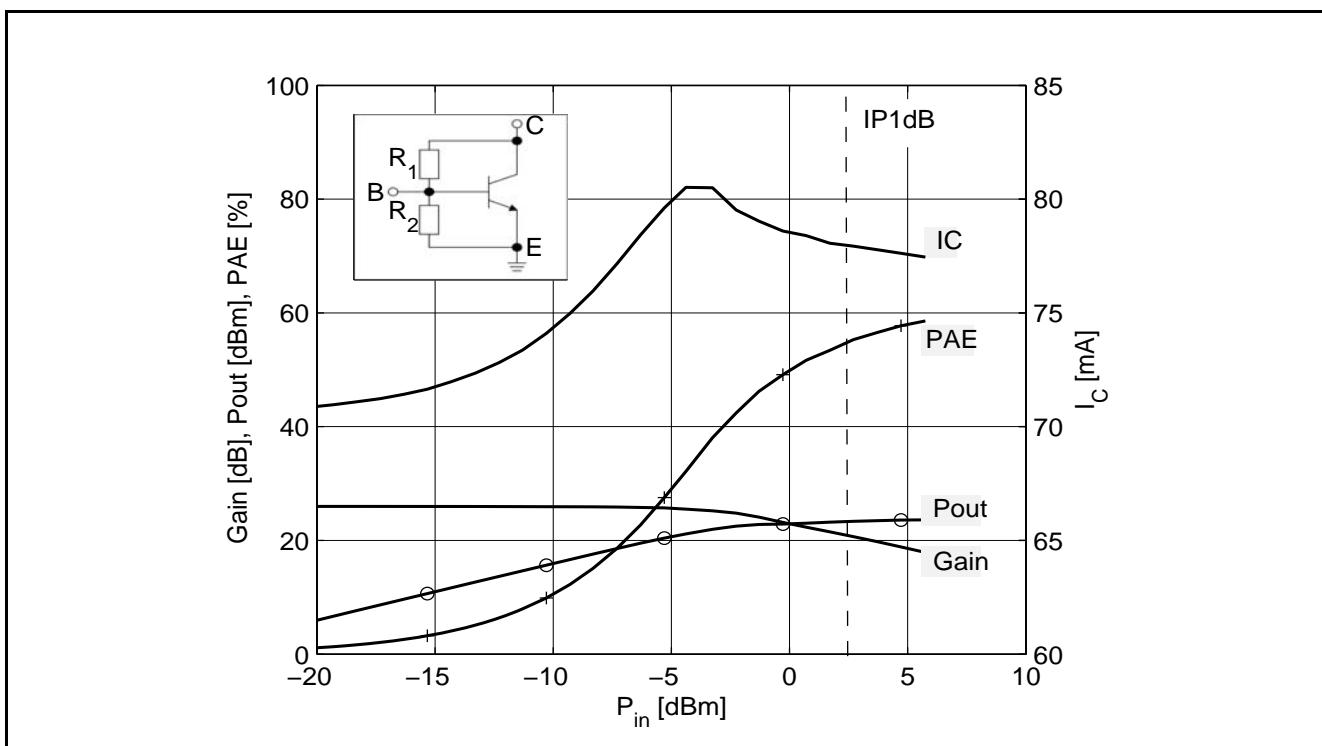


Figure 7-18 P_{out} , Gain, I_C , PAE vs. P_{in} at $V_{CE} = 5$ V, $f = 0.9$ GHz, $Z_L = Z_{opt}$, $R_1 = 270$ Ω , $R_2 = 8$ k Ω

Note: The curves shown in this chapter have been generated using typical devices but shall not be understood as a guarantee that all devices have identical characteristic curves. $T_A = 25$ °C.

8 Simulation Data

For the SPICE Gummel Poon (GP) model as well as for the S-parameters (including noise parameters) please refer to our internet website. Please consult our website and download the latest versions before actually starting your design.

You find the BFP780 SPICE GP model in the internet in the section Development Support / Simulation Data, from where you can download the circuit simulation data very quickly and conveniently. The model already contains the package parasitics and is ready to use for DC and high frequency simulations. The terminals of the model circuit correspond to the pin configuration of the device.

The model parameters have been extracted and verified up to 10 GHz using typical devices. The BFP780 SPICE GP model reflects the typical DC- and RF-performance within the limitations which are given by the SPICE GP model itself. Besides the DC characteristics all S-parameters in magnitude and phase, as well as noise parameters (including NFmin, optimum source impedance and equivalent noise resistance) and intermodulation have been extracted.

9 Package Information SOT343-4-2

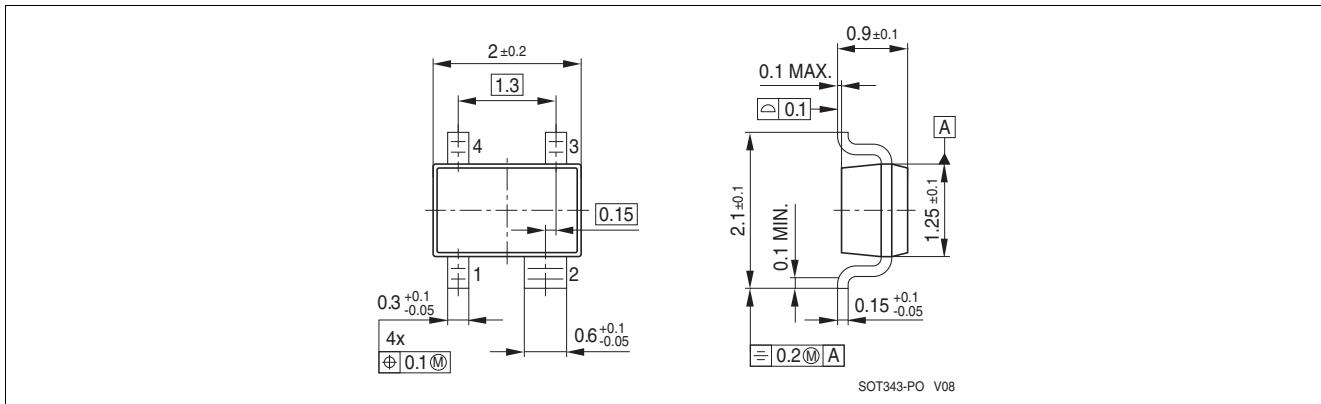


Figure 9-1 Package Outline

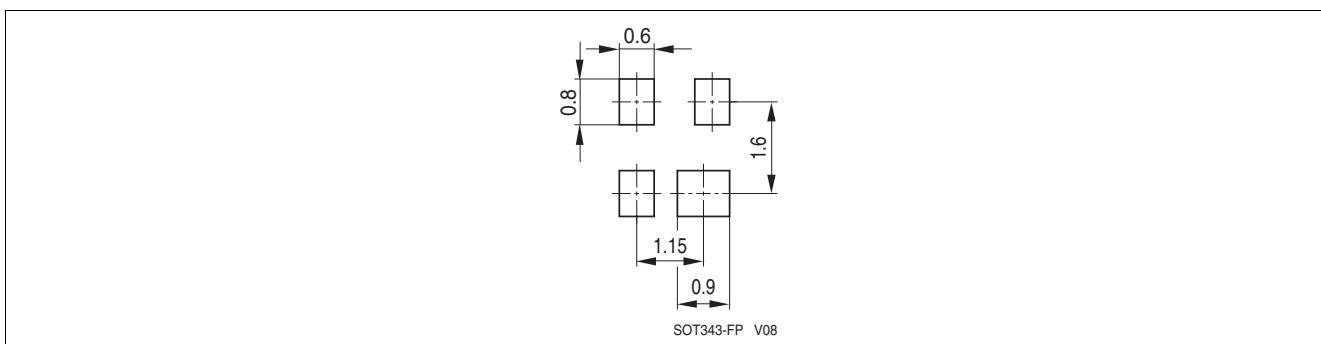


Figure 9-2 Package Footprint

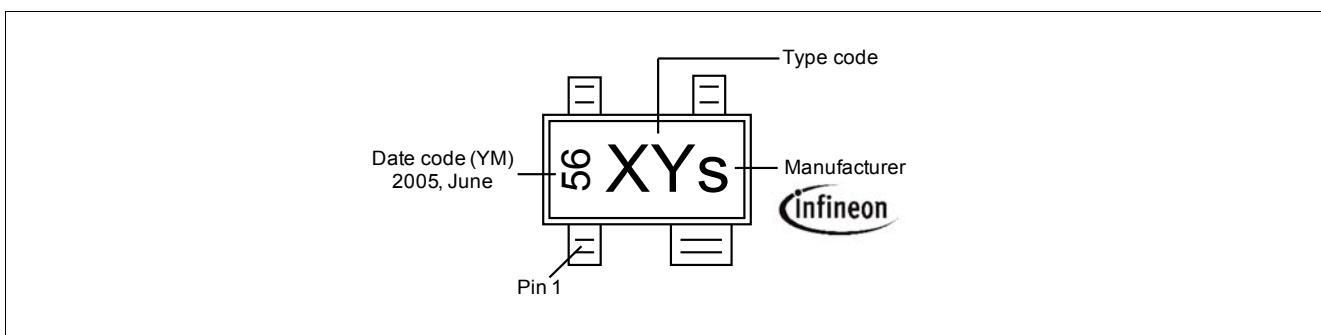


Figure 9-3 Marking Example (Marking BFP780: R1s)

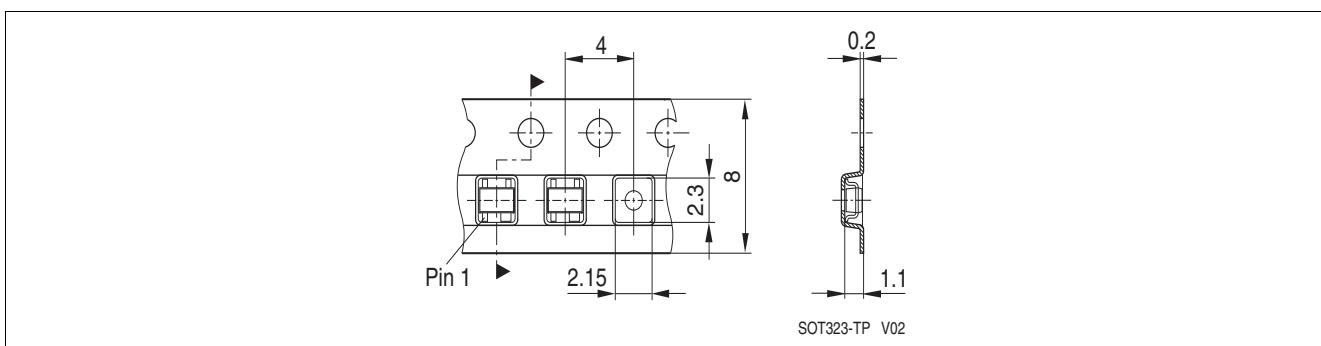


Figure 9-4 Tape Dimensions

www.infineon.com