



# BGA2714

## MMIC wideband amplifier

Rev. 01 — 24 May 2007

Product data sheet

## 1. Product profile

### 1.1 General description

Silicon Monolithic Microwave Integrated Circuit (MMIC) wideband amplifier with internal matching circuit in a 6-pin SOT363 plastic SMD package.

**Table 1. Typical performance**

*T<sub>amb</sub> = 25 °C; measured on demo board; typical values.*

f (MHz)	V <sub>SUP</sub> (V)	I <sub>SUP</sub> (mA)	G <sub>p</sub> (dB)	NF (dB)	P <sub>L(1dB)</sub> (dBm)	P <sub>L(sat)</sub> (dBm)	IP3 <sub>O</sub> (dBm)
250	3.0	4.58	20.7	2.4	-7.8	-2.4	4.3
950	3.0	4.58	20.4	2.2	-7.9	-3.4	2.1
2150	3.0	4.58	20.8	3.0	-9.0	-4.7	0.0

#### CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling.

### 1.2 Features

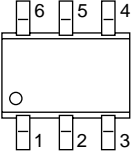
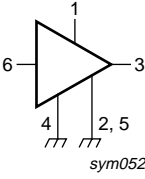
- Internally matched to 50 Ω
- Wide frequency range (2.7 GHz at 3 dB gain bandwidth)
- Flat 21 dB gain ( $\pm 1$  dB from DC up to 2500 MHz)
- Very low current (4.6 mA) at low supply voltage of 3 V
- Very good reverse isolation (> 50 dB up to 2 GHz)
- Good linearity with low second order and third order products
- Low noise (NF = 2.2 dB at 1 GHz)
- Unconditionally stable ( $K > 5$ )

### 1.3 Applications

- LNB IF amplifiers
- General purpose low noise wideband amplifier for frequencies between DC and 2.7 GHz

## 2. Pinning information

**Table 2. Pinning**

Pin	Description	Simplified outline	Symbol
1	V <sub>SUP</sub>		 sym052
2, 5	GND2		
3	RF_OUT		
4	GND1		
6	RF_IN		

## 3. Ordering information

**Table 3. Ordering information**

Type number	Package		
	Name	Description	Version
BGA2714	-	plastic surface-mounted package; 6 leads	SOT363

## 4. Marking

**Table 4. Marking**

Type number	Marking code
BGA2714	BA-

## 5. Limiting values

**Table 5. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>SUP</sub>	supply voltage	RF input AC coupled	-	4	V
I <sub>SUP</sub>	supply current		-	10	mA
P <sub>tot</sub>	total power dissipation	T <sub>sp</sub> = 90 °C	-	200	mW
T <sub>stg</sub>	storage temperature		-65	+150	°C
T <sub>j</sub>	junction temperature		-	150	°C
P <sub>drive</sub>	drive power		-	-20	dBm

## 6. Thermal characteristics

**Table 6. Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	$P_{tot} = 200 \text{ mW}; T_{sp} = 90 \text{ }^\circ\text{C}$	300	K/W

## 7. Characteristics

**Table 7. Characteristics**

$V_{SUP} = 3 \text{ V}; I_{SUP} = 4.58 \text{ mA}; T_{amb} = 25 \text{ }^\circ\text{C};$  measured on demo board; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{SUP}$	supply current		3.7	4.58	5.7	mA
$G_p$	power gain	$f = 100 \text{ MHz}$	20	20.8	21	dB
		$f = 250 \text{ MHz}$	20	20.7	21	dB
		$f = 950 \text{ MHz}$	20	20.4	21	dB
		$f = 2150 \text{ MHz}$	20	20.8	22	dB
		$f = 2500 \text{ MHz}$	19	19.5	21	dB
		$f = 3000 \text{ MHz}$	16	16.8	18	dB
$RL_{in}$	input return loss	$f = 250 \text{ MHz}$	11	13.9	-	dB
		$f = 950 \text{ MHz}$	7	8.9	-	dB
		$f = 2150 \text{ MHz}$	12	15.9	-	dB
$RL_{out}$	output return loss	$f = 250 \text{ MHz}$	10	10.6	-	dB
		$f = 950 \text{ MHz}$	10	10.8	-	dB
		$f = 2150 \text{ MHz}$	8	9.8	-	dB
ISL	isolation	$f = 250 \text{ MHz}$	55	58	-	dB
		$f = 950 \text{ MHz}$	55	59	-	dB
		$f = 2150 \text{ MHz}$	45	49	-	dB
NF	noise figure	$f = 250 \text{ MHz}$	-	2.4	2.5	dB
		$f = 950 \text{ MHz}$	-	2.2	2.3	dB
		$f = 2150 \text{ MHz}$	-	3.0	3.2	dB
$B_{-3dB}$	-3 dB bandwidth	3 dB below gain at 1 GHz	-	2.7	-	GHz
K	Rollet stability factor	$f = 250 \text{ MHz}$	25	30	-	
		$f = 950 \text{ MHz}$	35	47	-	
		$f = 2150 \text{ MHz}$	7	10	-	
$P_{L(sat)}$	saturated output power	$f = 250 \text{ MHz}$	-3	-2.4	-	dBm
		$f = 950 \text{ MHz}$	-4	-3.4	-	dBm
		$f = 2150 \text{ MHz}$	-6	-4.7	-	dBm
$P_{L(1dB)}$	output power at 1 dB gain compression	$f = 250 \text{ MHz}$	-8.5	-7.8	-	dBm
		$f = 950 \text{ MHz}$	-8.7	-7.9	-	dBm
		$f = 2150 \text{ MHz}$	-10	-9	-	dBm

**Table 7. Characteristics ...continued**

$V_{SUP} = 3\text{ V}$ ;  $I_{SUP} = 4.58\text{ mA}$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ ; measured on demo board; unless otherwise specified.

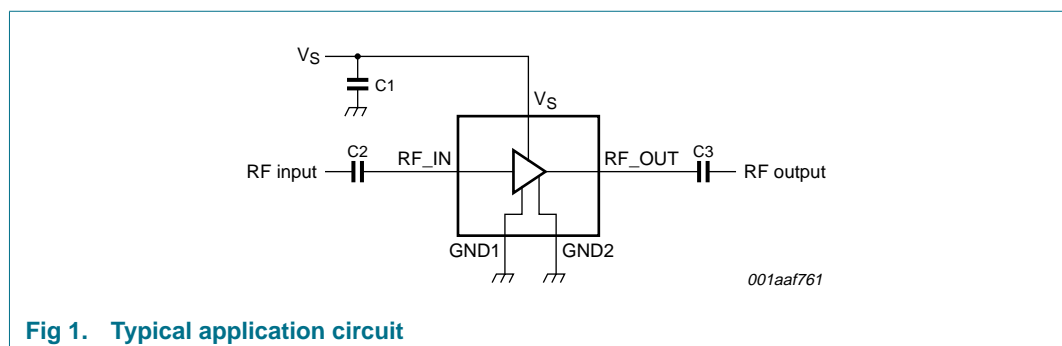
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
IP3 <sub>I</sub>	input third-order intercept point	f = 250 MHz	-17.4	-16.4	-	dBm
		f = 950 MHz	-19.1	-18.3	-	dBm
		f = 2150 MHz	-21.8	-20.8	-	dBm
IP3 <sub>O</sub>	output third-order intercept point	f = 250 MHz	3.3	4.3	-	dBm
		f = 950 MHz	1.3	2.1	-	dBm
		f = 2150 MHz	-1.0	0	-	dBm
P <sub>L(2H)</sub>	second harmonic output power	f <sub>1H</sub> = 250 MHz; f <sub>2H</sub> = 500 MHz; P <sub>drive</sub> = -40 dBm	-62	-64	-	dBm
		f <sub>1H</sub> = 950 MHz; f <sub>2H</sub> = 1900 MHz; P <sub>drive</sub> = -40 dBm	-58	-60	-	dBm
ΔIM2	second-order intermodulation distance	f <sub>1</sub> = 250 MHz; f <sub>2</sub> = 251 MHz; P <sub>drive</sub> = -40 dBm	-36	-38	-	dBc
		f <sub>1</sub> = 950 MHz; f <sub>2</sub> = 951 MHz; P <sub>drive</sub> = -40 dBm	-31	-33	-	dBc

## 8. Application information

Figure 1 shows a typical application circuit for the BGA2714 MMIC. The device is internally matched to 50 Ω, and therefore does not need any external matching. The value of the input and output DC blocking capacitors C2 and C3 should not be more than 100 pF for applications above 100 MHz. However, when the device is operated below 100 MHz, the capacitor value should be increased.

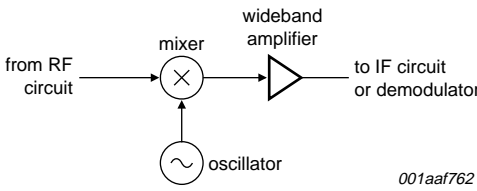
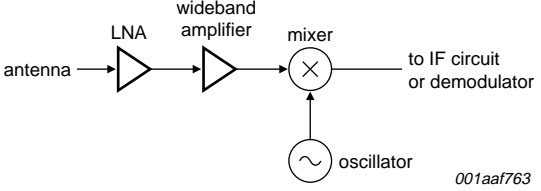
The 22 nF supply decoupling capacitor C1 should be located as close as possible to the MMIC.

The PCB top ground plane, connected to pins 2, 4 and 5 must be as close as possible to the MMIC, preferably also below the MMIC. When using via holes, use multiple via holes as close as possible to the MMIC.

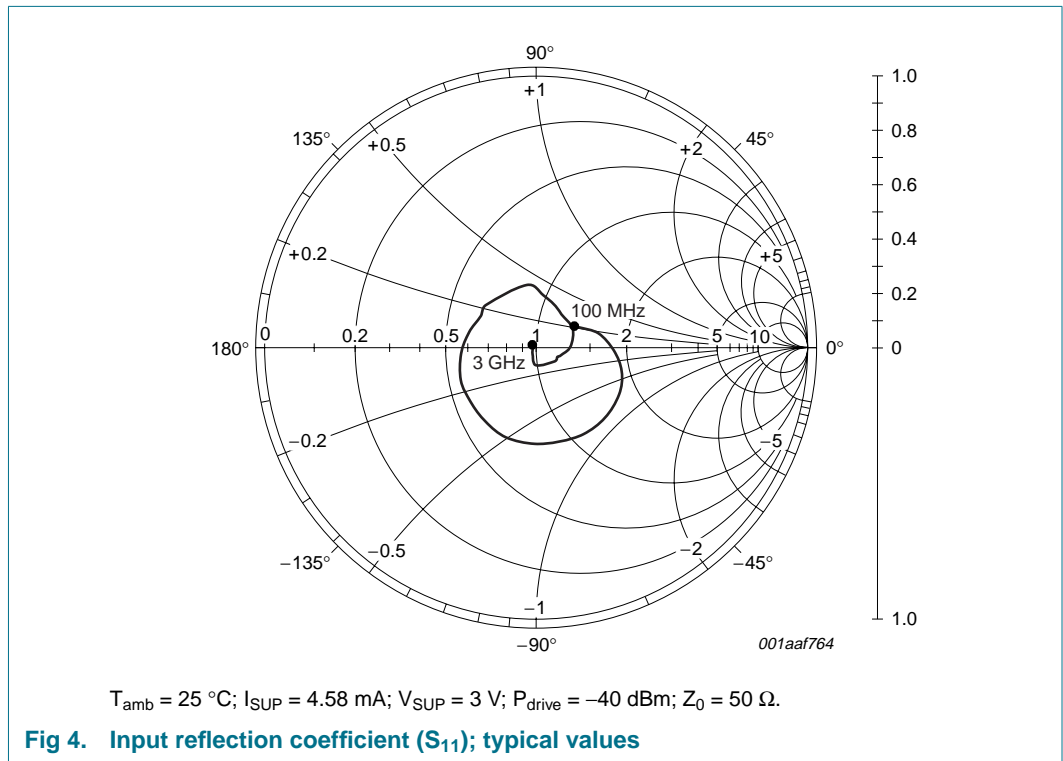


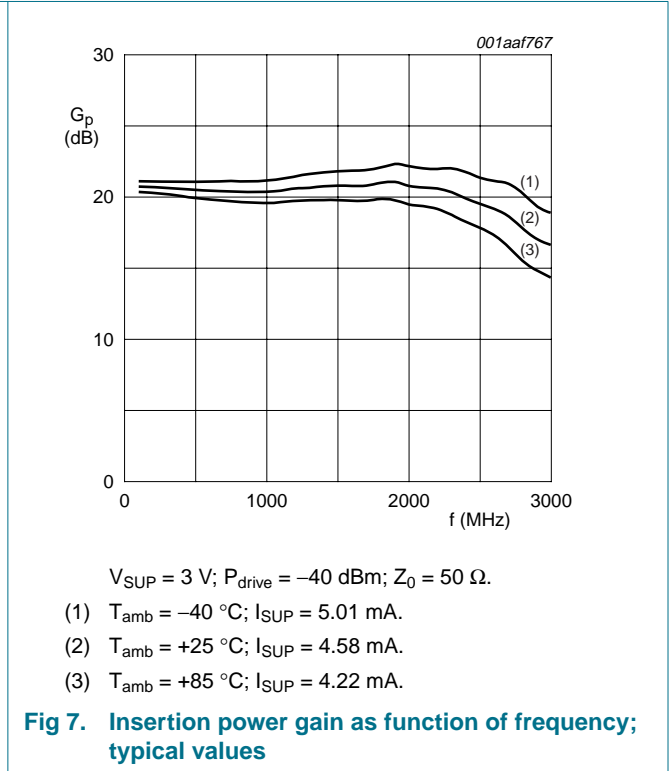
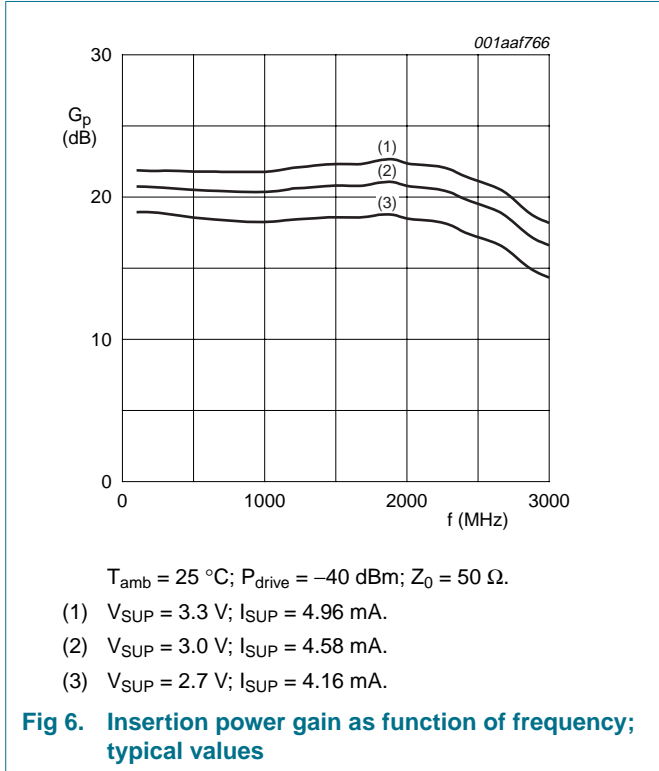
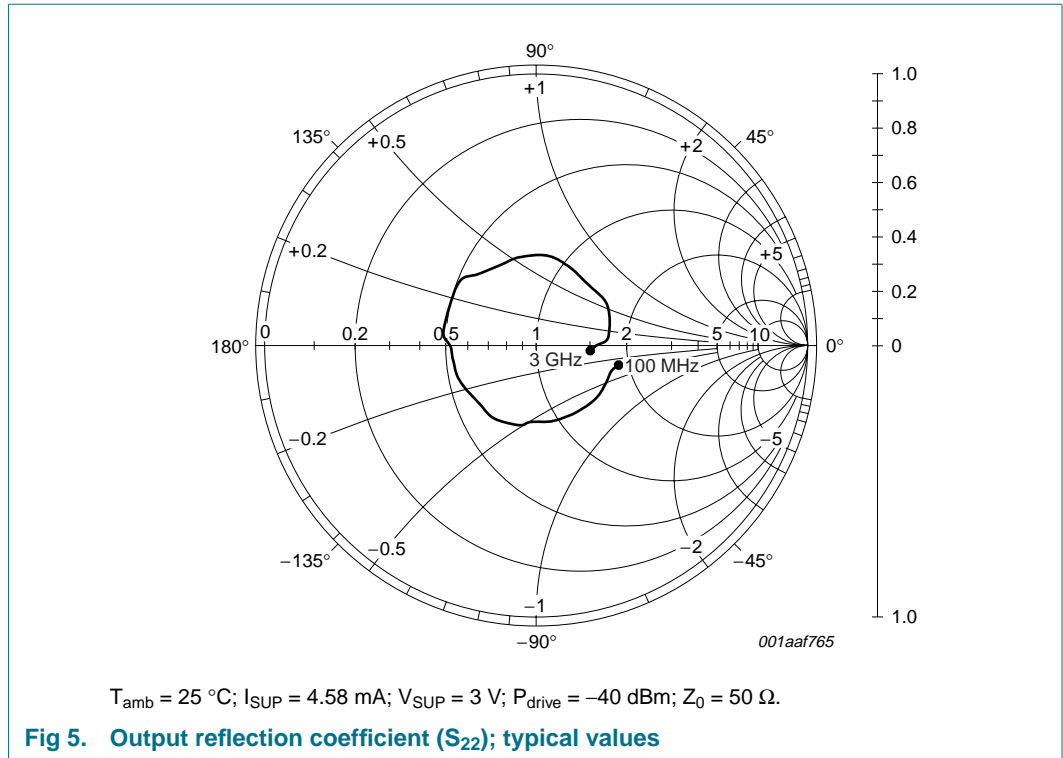
**Fig 1. Typical application circuit**

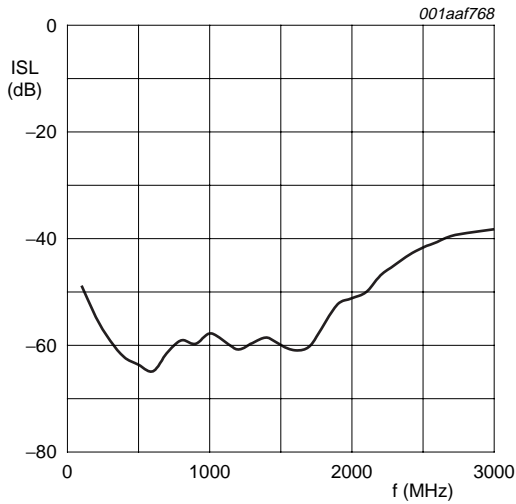
**8.1 Application examples**

 <p>The MMIC is very suitable as IF amplifier in e.g. LNB's. The excellent wideband characteristics make it an easy building block.</p>	 <p>As second amplifier after an LNA, the MMIC offers an easy matching, low noise solution.</p>
<b>Fig 2. Application as IF amplifier</b>	<b>Fig 3. Application as RF amplifier</b>

**8.2 Graphs**

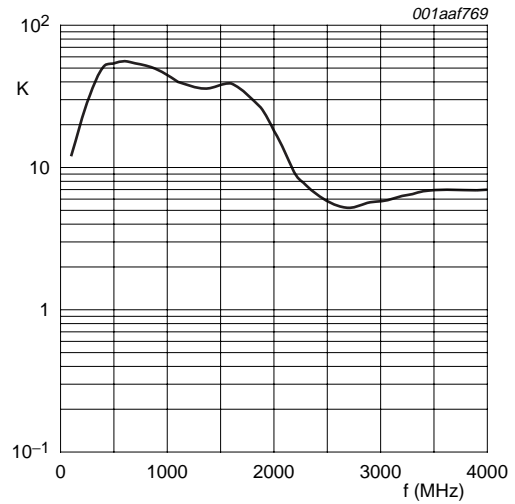






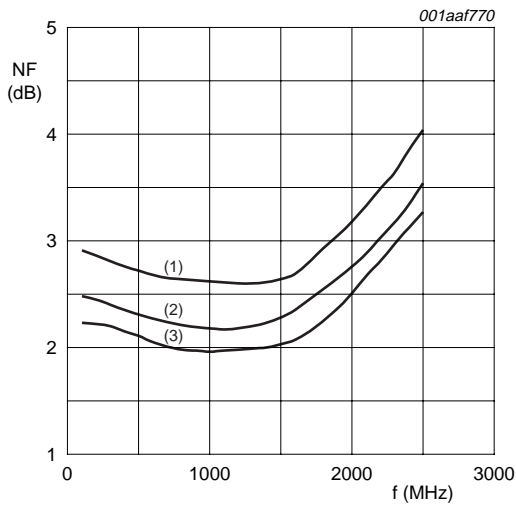
$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $I_{SUP} = 4.58\text{ mA}$ ;  $V_{SUP} = 3\text{ V}$ ;  
 $P_{drive} = -40\text{ dBm}$ ;  $Z_0 = 50\text{ }\Omega$ .

**Fig 8. Isolation as function of frequency; typical values**



$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $I_{SUP} = 4.58\text{ mA}$ ;  $V_{SUP} = 3\text{ V}$ ;  
 $Z_0 = 50\text{ }\Omega$ .

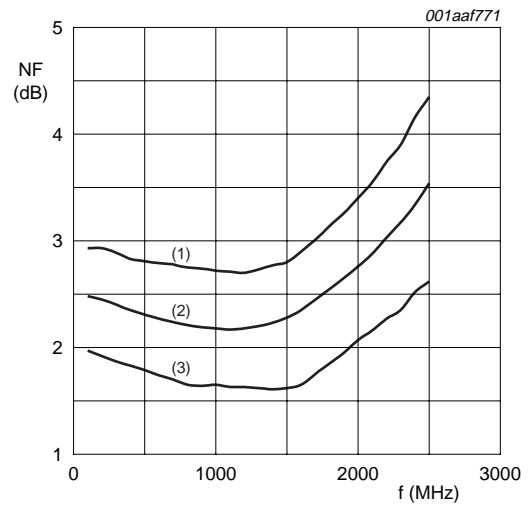
**Fig 9. Rollet stability factor as function of frequency; typical values**



$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $Z_0 = 50\text{ }\Omega$ .

- (1)  $V_{SUP} = 3.3\text{ V}$ ;  $I_{SUP} = 4.96\text{ mA}$ .
- (2)  $V_{SUP} = 3.0\text{ V}$ ;  $I_{SUP} = 4.58\text{ mA}$ .
- (3)  $V_{SUP} = 2.7\text{ V}$ ;  $I_{SUP} = 4.16\text{ mA}$ .

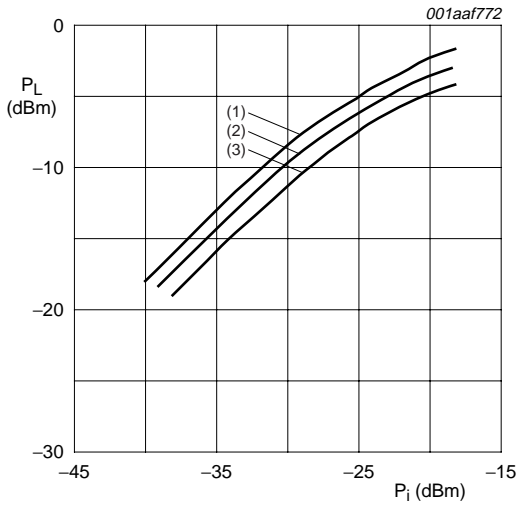
**Fig 10. Noise figure as function of frequency**



$V_{SUP} = 3\text{ V}$ ;  $Z_0 = 50\text{ }\Omega$ .

- (1)  $T_{amb} = -40\text{ }^{\circ}\text{C}$ ;  $I_{SUP} = 5.01\text{ mA}$ .
- (2)  $T_{amb} = +25\text{ }^{\circ}\text{C}$ ;  $I_{SUP} = 4.58\text{ mA}$ .
- (3)  $T_{amb} = +85\text{ }^{\circ}\text{C}$ ;  $I_{SUP} = 4.22\text{ mA}$ .

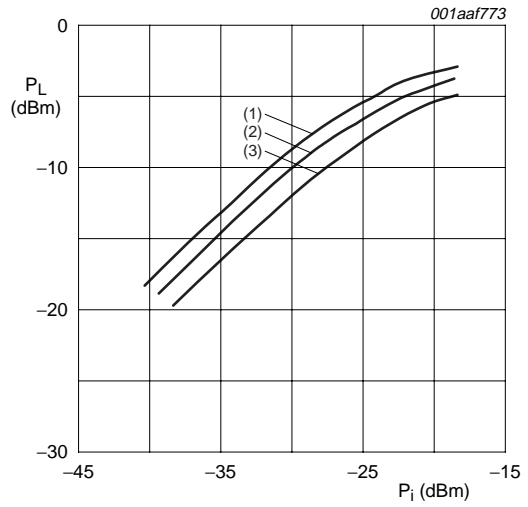
**Fig 11. Noise figure as function of frequency**



$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $f = 250\text{ MHz}$ ;  $Z_0 = 50\text{ }\Omega$ .

- (1)  $V_{SUP} = 3.3\text{ V}$ .
- (2)  $V_{SUP} = 3.0\text{ V}$ .
- (3)  $V_{SUP} = 2.7\text{ V}$ .

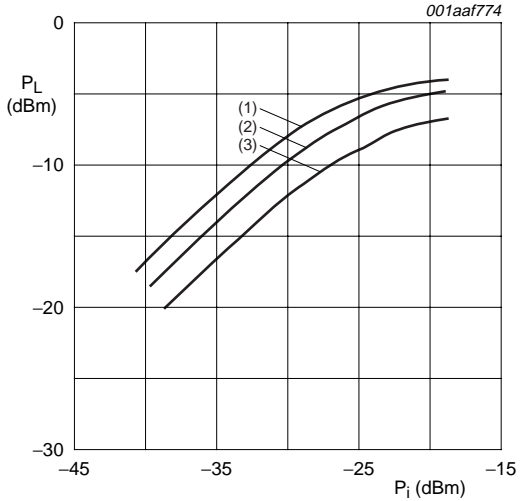
**Fig 12. Output power as function of input power at 250 MHz; typical values**



$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $f = 950\text{ MHz}$ ;  $Z_0 = 50\text{ }\Omega$ .

- (1)  $V_{SUP} = 3.3\text{ V}$ .
- (2)  $V_{SUP} = 3.0\text{ V}$ .
- (3)  $V_{SUP} = 2.7\text{ V}$ .

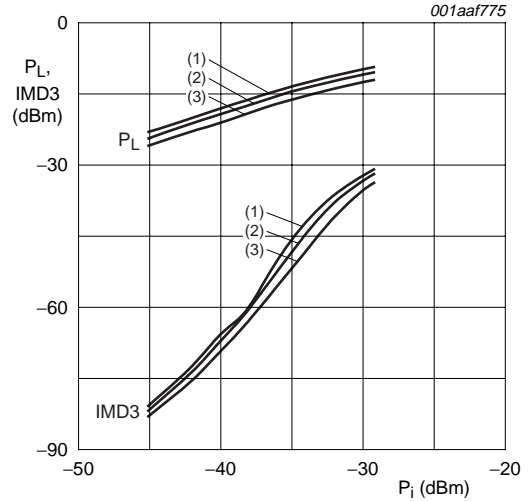
**Fig 13. Output power as function of input power at 950 MHz; typical values**



$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $f = 2150\text{ MHz}$ ;  $Z_0 = 50\text{ }\Omega$ .

- (1)  $V_{SUP} = 3.3\text{ V}$ .
- (2)  $V_{SUP} = 3.0\text{ V}$ .
- (3)  $V_{SUP} = 2.7\text{ V}$ .

**Fig 14. Output power as function of input power at 2150 MHz; typical values**

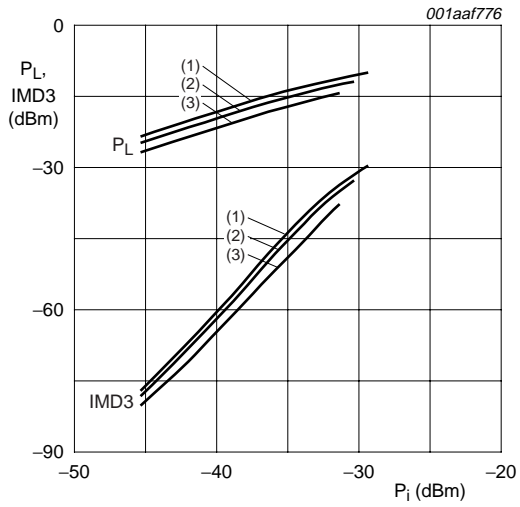


$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $f_1 = 250\text{ MHz}$ ;  $f_2 = 251\text{ MHz}$ ;  $Z_0 = 50\text{ }\Omega$ .

- (1)  $V_{SUP} = 3.3\text{ V}$ .
- (2)  $V_{SUP} = 3.0\text{ V}$ .
- (3)  $V_{SUP} = 2.7\text{ V}$ .

**Fig 15. Output power and third order intermodulation as functions of input power around 250 MHz; typical values**

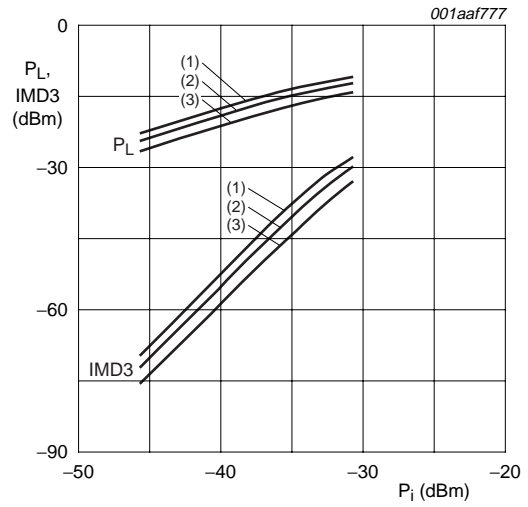




$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $f_1 = 950\text{ MHz}$ ;  $f_2 = 951\text{ MHz}$ ;  
 $Z_0 = 50\text{ }\Omega$ .

- (1)  $V_{SUP} = 3.3\text{ V}$ .
- (2)  $V_{SUP} = 3.0\text{ V}$ .
- (3)  $V_{SUP} = 2.7\text{ V}$ .

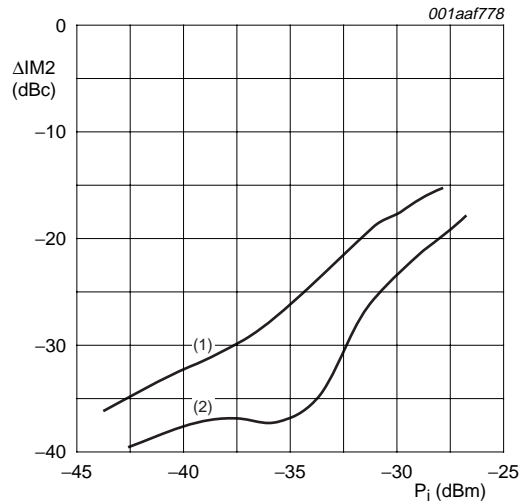
**Fig 16. Output power and third order intermodulation as functions of input power around 950 MHz; typical values**



$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $f_1 = 2150\text{ MHz}$ ;  $f_2 = 2151\text{ MHz}$ ;  
 $Z_0 = 50\text{ }\Omega$ .

- (1)  $V_{SUP} = 3.3\text{ V}$ .
- (2)  $V_{SUP} = 3.0\text{ V}$ .
- (3)  $V_{SUP} = 2.7\text{ V}$ .

**Fig 17. Output power and third order intermodulation as functions of input power around 2150 MHz; typical values**



$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $I_{SUP} = 4.58\text{ mA}$ ;  $V_{SUP} = 3\text{ V}$ ;  $Z_0 = 50\text{ }\Omega$ .

- (1)  $f_1 = 950\text{ MHz}$ ;  $f_2 = 951\text{ MHz}$ .
- (2)  $f_1 = 250\text{ MHz}$ ;  $f_2 = 251\text{ MHz}$ .

**Fig 18. Second-order intermodulation distance as function of input power; typical values**

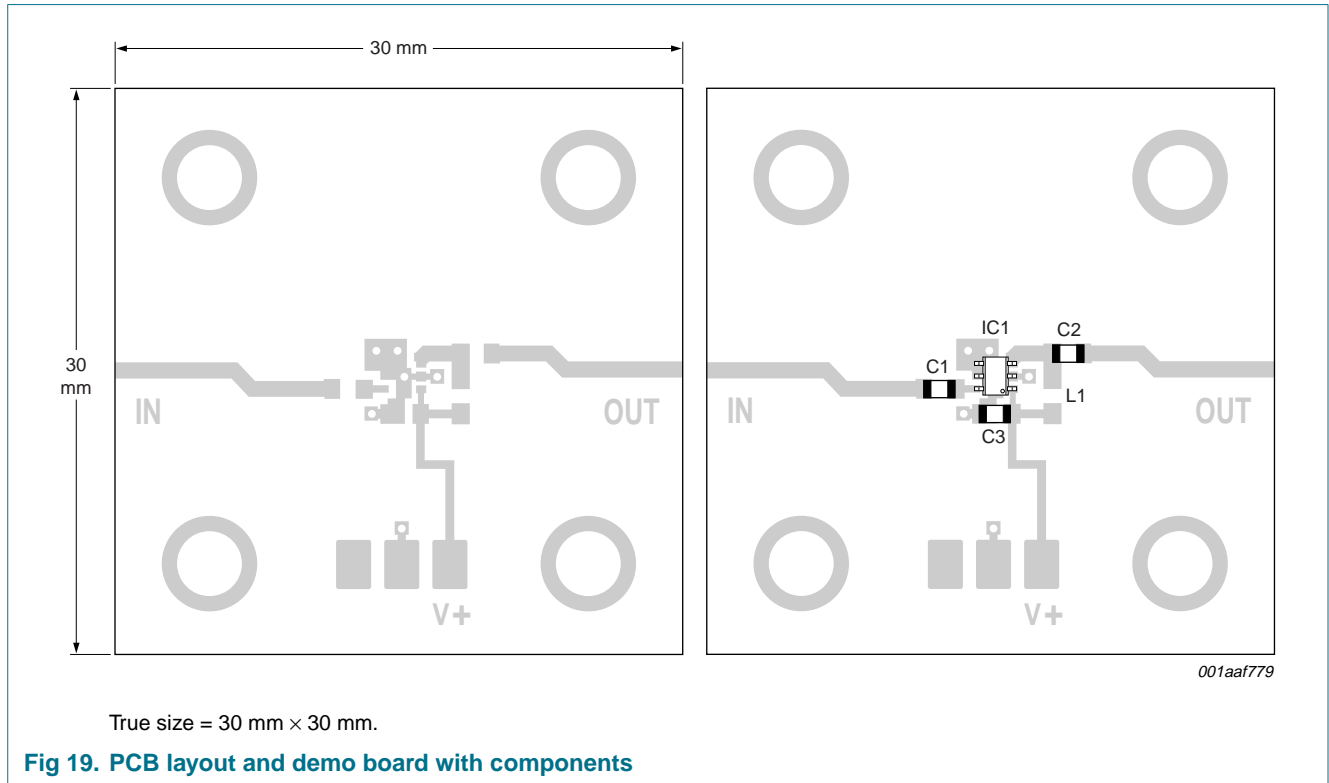
### 8.3 Scattering parameters

**Table 8. Scattering parameters**

$I_{SUP} = 4.58 \text{ mA}$ ;  $V_{SUP} = 3 \text{ V}$ ;  $P_{drive} = -40 \text{ dBm}$ ;  $Z_0 = 50 \Omega$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$ ; measured on demo board.

f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>		K
	Magnitude (ratio)	Angle (deg)	Magnitude (ratio)	Angle (deg)	Magnitude (ratio)	Angle (deg)	Magnitude (ratio)	Angle (deg)	
100	0.155	33.5	10.88	-10.9	0.00364	-155.2	0.313	-14.2	11.2
200	0.170	26.5	10.84	-20.2	0.00183	-21.9	0.294	-19.2	22.3
400	0.280	-2.2	10.69	-43.8	0.00077	-25.5	0.396	-36.4	50.7
600	0.346	-30.4	10.54	-64.1	0.00057	122.0	0.293	-54.9	66.9
800	0.365	-62.7	10.46	-85.9	0.00111	115.1	0.291	-74.4	11.2
1000	0.360	-91.4	10.42	-106.3	0.00129	80.2	0.289	-94.8	29.7
1200	0.335	-124.9	10.72	-127.4	0.00091	-54.8	0.315	-119.5	40.7
1400	0.305	-156.3	10.90	-148.7	0.00118	-55.9	0.304	-140.2	31.9
1600	0.255	167.0	10.94	-172.9	0.00090	157.0	0.310	-167.3	43.0
1800	0.246	139.2	11.22	166.3	0.00155	7.1	0.343	172.3	23.9
2000	0.197	83.5	10.95	140.2	0.00276	133.2	0.335	129.3	14.1
2200	0.153	54.8	10.71	115.3	0.00453	63.4	0.327	101.6	9.0
2400	0.121	1.7	9.87	87.3	0.00700	31.8	0.310	66.2	6.5
2600	0.081	-24.9	9.09	63.3	0.00933	51.9	0.293	45.0	5.4
2800	0.066	-93.6	7.74	36.6	0.01119	24.8	0.266	5.8	5.4
3000	0.019	144.4	6.77	20.5	0.01228	14.1	0.203	-6.6	5.8

**9. Test information**



**Fig 19. PCB layout and demo board with components**

**Table 9. List of components used for the typical application**

Component	Description	Value	Dimensions
C1, C2	multilayer ceramic chip capacitor	100 pF	0603
C3	multilayer ceramic chip capacitor	22 nF	0603
IC1	BGA2714 MMIC		SOT363
L1	not used		

**10. Package outline**

Plastic surface-mounted package; 6 leads

SOT363

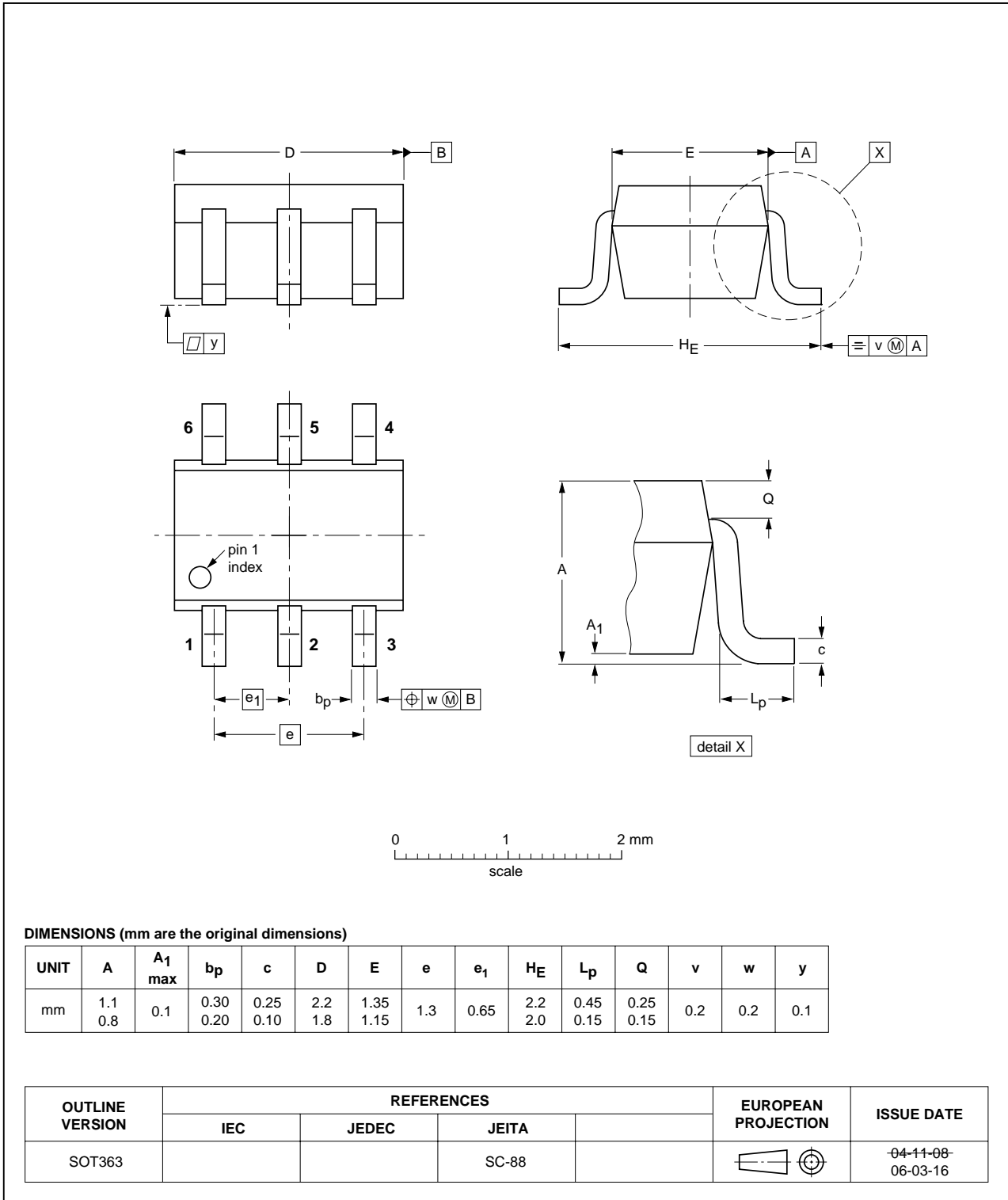


Fig 20. Package outline SOT363

## 11. Abbreviations

Table 10. Abbreviations

Acronym	Description
DC	Direct Current
IF	Intermediate Frequency
LNA	Low-Noise Amplifier
LNB	Low-Noise Block converter
PCB	Printed-Circuit Board
RF	Radio Frequency

## 12. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGA2714_1	20070524	Product data sheet	-	-

## 13. Legal information

### 13.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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