BGA7017

30 MHz to 6000 MHz broadband gain block

Rev. 4 — 27 March 2013 Objective data sheet

1. Product profile

1.1 General description

The BGA7017 MMIC is a Darlington amplifier, available in a low-cost surface-mount package. It delivers 16.5 dBm output power at 1 dB gain compression and superior performance up to 6000 MHz, with minimal external components.

1.2 Features and benefits

- 30 MHz to 6000 MHz frequency operating range
- 13 dB small signal gain at 2 GHz
- 16.5 dBm output power at 1 dB gain compression at 1000 MHz
- $IP3_O$: 29.3 dBm at 2000 MHz
- Integrated active biasing
- 5 V single supply operation
- Industry standard SOT89 package
- ESD protection at all pins
- Flat (1.5 dB) gain response 100 MHz to 5500 MHz

1.3 Applications

- Wireless infrastructure (base station, repeater, point-to-point backhaul systems)
- Radar
- Instrumentation
- Industrial applications
- E-metering
- Satellite Master Antenna TV (SMATV)

1.4 Quick reference data

Table 1. Quick reference data

Unless otherwise specified input and output impedances terminated to 50 Ω; V_{CC} = 5 V; T_{case} = 25 °C

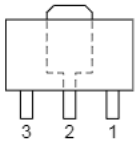
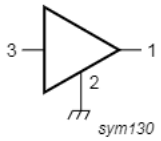
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CC}	supply current			-	87	100	mA
f	frequency		[1]	30	-	6000	MHz
G_p	power gain	f = 2000 MHz		11	13	15	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	f = 2000 MHz		13.5	15.5	-	dBm
$IP3_O$	output third-order intercept point	f = 2000 MHz	[2]	27	29.3	-	dBm

[1] Operation outside this range is possible but not guaranteed.

[2] –13 dBm/tone < 4 GHz; –20 dBm/tone > 4 GHz; 1 MHz tone spacing.

2. Pinning information

Table 2. Pinning

Pin	Description		Simplified outline	Graphic symbol
1	V_{CC}/RF_OUT	[1]		
2	GND	[2]		
3	RF_IN	[1]		

[1] This pin is DC-coupled and requires an external DC-blocking capacitor.

[2] The center metal base of the SOT89 also functions as heatsink for the amplifier.

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BGA7017	-	plastic surface-mounted package; exposed die pad for good heat transfer; 3 leads	SOT89

4. Functional diagram

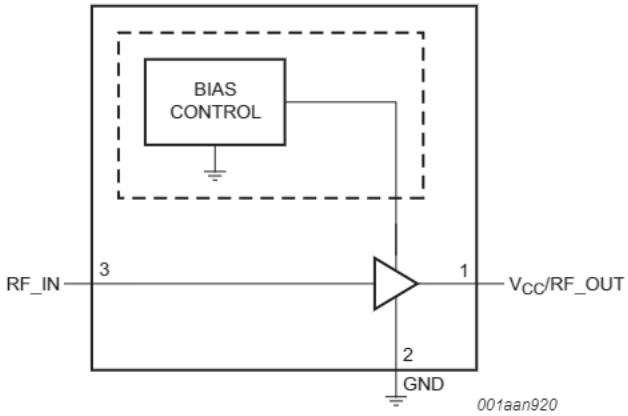


Fig 1. Functional diagram

5. Limiting values

Table 4. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC(RF)}$	RF supply voltage		-	6.0	V
$P_{i(RF)}$	RF input power		-	13	dBm
T_{case}	case temperature		−40	+85	°C
T_j	junction temperature		-	125	°C
V_{ESD}	electrostatic discharge voltage	Human Body Model (HBM); according to JEDEC standard 22-A114E	-	2000	V
		Charged Device Model (CDM); according to JEDEC standard 22-C101B	-	500	V

6. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	T_{case} = 85 °C; V_{CC} = 5 V; I_{CC} = 87 mA	60	K/W

7. Static characteristics

Table 6. Characteristics

Unless otherwise specified input and output impedances terminated to 50 Ω; V_{CC} = 5 V; T_{case} = 25 °C.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		4.75	5.0	5.25	V
I_{CC}	supply current		-	87	100	mA

8. Dynamic characteristics

Table 7. Characteristics

Unless otherwise specified input and output impedances terminated to 50 Ω; V_{CC} = 5 V; T_{case} = 25 °C; see Section 10 "Application information"; unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
f	frequency		[1]	30	-	6000	MHz
ΔG	gain variation	100 MHz to 5500 MHz		-	1.5	-	dB
G_p	power gain	f = 30 MHz		-	11.2	-	dB
		f = 100 MHz		-	13.5	-	dB
		f = 1 GHz		11	13.2	15	dB
		f = 2 GHz		11	13	15	dB
		f = 3 GHz		-	13.8	-	dB
		f = 4 GHz		-	14.5	-	dB
		f = 5 GHz		-	14.5	-	dB
		f = 5.5 GHz		11	13	15	dB
		f = 6 GHz		-	9.8	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	f = 30 MHz		-	18.3	-	dBm
		f = 100 MHz		-	18.5	-	dBm
		f = 1 GHz		-	16.5	-	dBm
		f = 2 GHz		13.5	15.5	-	dBm
		f = 3 GHz		-	14.7	-	dBm
		f = 4 GHz		-	11.7	-	dBm
		f = 5 GHz		-	9	-	dBm
		f = 6 GHz		-	5	-	dBm
$IP3_O$	output third-order intercept point	f = 30 MHz	[2]	-	34.7	-	dBm
		f = 100 MHz	[2]	-	34.6	-	dBm
		f = 1 GHz	[2]	-	30.8	-	dBm
		f = 2 GHz	[2]	27	29.3	-	dBm
		f = 3 GHz	[2]	-	27	-	dBm
		f = 4 GHz	[2]	-	23.5	-	dBm
		f = 6 GHz	[2]	-	15.5	-	dBm
NF	noise figure	f = 100 MHz		-	7.6	-	dB
		f = 2 GHz		-	6	-	dB
RL_{in}	input return loss	f = 30 MHz		-	4.2	-	dB
		f = 100 MHz		-	12.8	-	dB
		f = 1 GHz		-	11.5	-	dB
		f = 2 GHz		-	8	-	dB
		f = 3 GHz		-	7.7	-	dB
		f = 4 GHz		-	6.5	-	dB
		f = 6 GHz		-	2.5	-	dB

Table 7. Characteristics *...continued*

Unless otherwise specified input and output impedances terminated to 50 Ω; V_{CC} = 5 V; T_{case} = 25 °C; see Section 10 "Application information"; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
RL_{out}	output return loss	f = 30 MHz	-	4.5	-	dB
		f = 100 MHz	-	13.5	-	dB
		f = 1 GHz	-	11.5	-	dB
		f = 2 GHz	-	11.2	-	dB
		f = 3 GHz	-	12	-	dB
		f = 4 GHz	-	8.7	-	dB
		f = 6 GHz	-	12.5	-	dB
α_{2H}	second harmonic level	P_i = –5 dBm; F_o = 2 GHz	-	–43	-	dBc
S_{12}	reverse transmission coefficient	10 MHz to 10 GHz	-	<20	-	dB
K	Rollett stability factor	10 MHz to 10 GHz	1	-	-	
$\Delta G/\Delta T$	gain variation with temperature	–40 °C to +85 °C; F_o = 2 GHz	-	–0.006	-	dB/K

[1] Operation outside this range is possible but not guaranteed.

[2] –13 dBm/tone < 4 GHz; –20 dBm/tone > 4 GHz; 1 MHz tone spacing.

9. Moisture sensitivity

Table 8. Moisture sensitivity level

Test methodology	Class
JESD-22-A113	1

10. Application information

10.1 Evaluation board

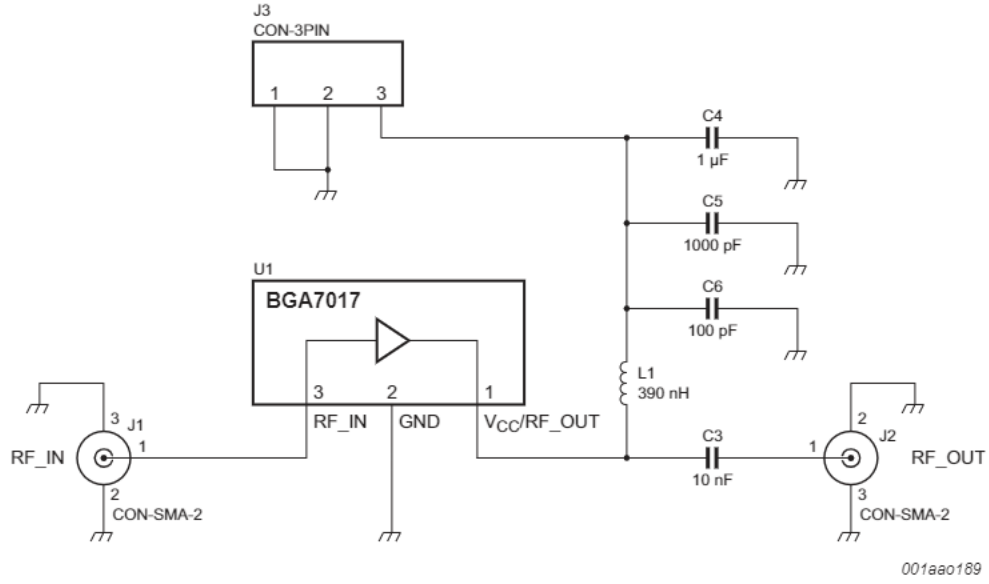
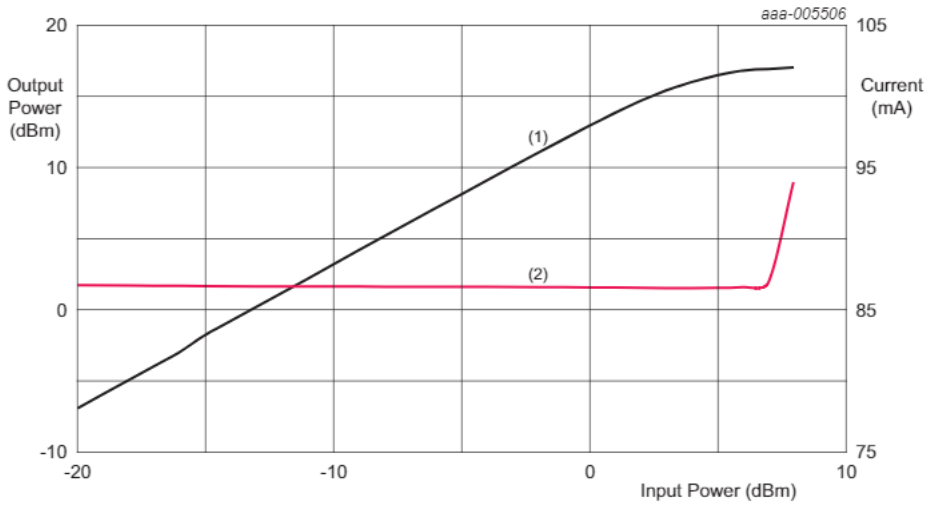


Fig 2. Schematic diagram

10.2 Evaluation board parameters

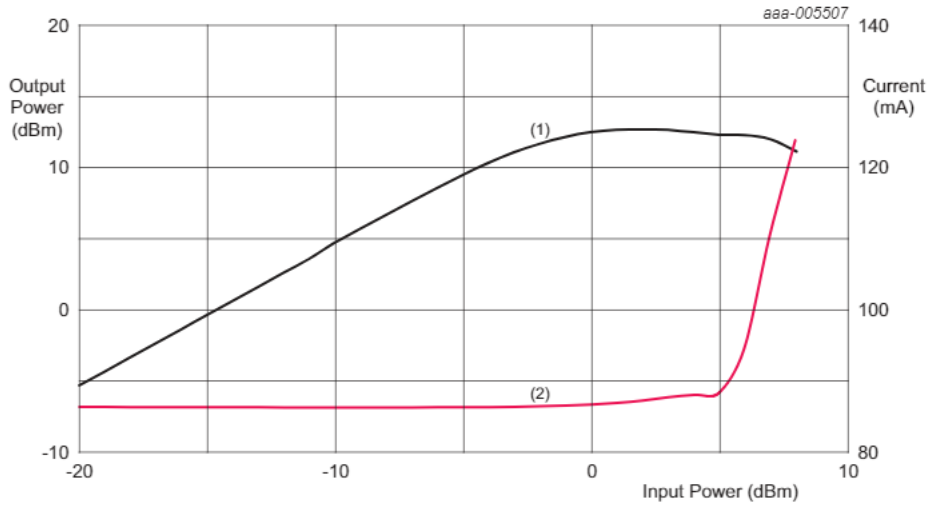
10.2.1 Output power, current as a function of input power



(1) P_{out} at 5 V

(2) I_{CC} at 5 V

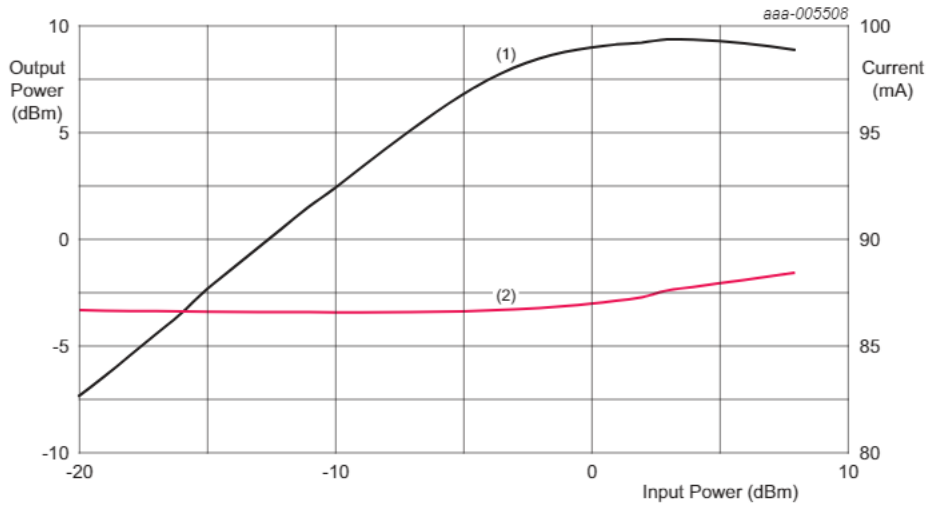
Fig 3. Characteristics for a frequency of 2 GHz



(1) P_{out} at 5 V

(2) I_{CC} at 5 V

Fig 4. Characteristics for a frequency of 4 GHz

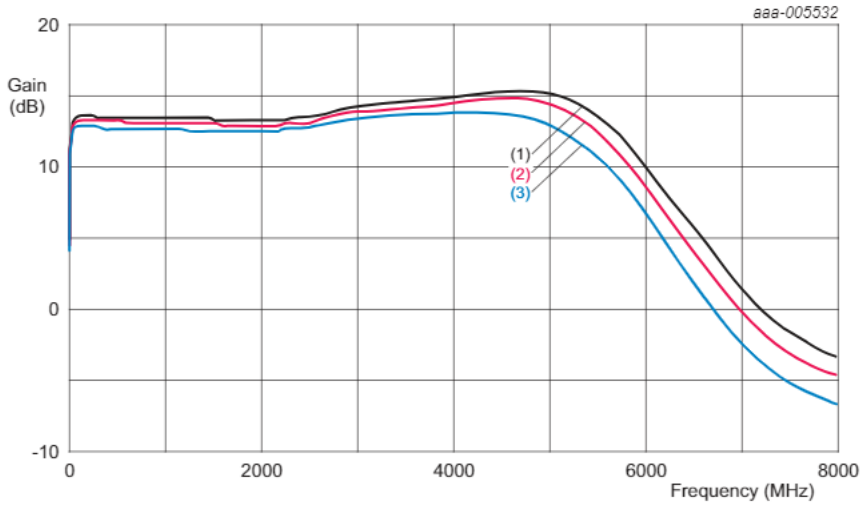


(1) P_{out} at 5 V

(2) I_{CC} at 5 V

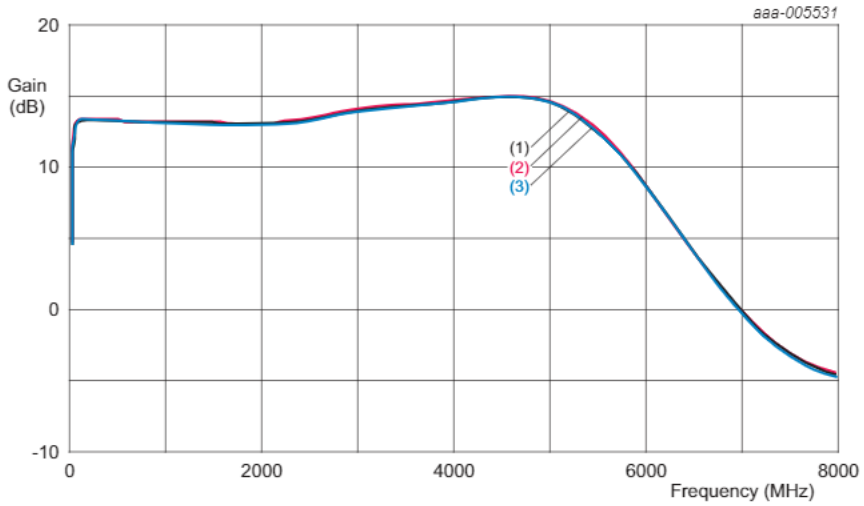
Fig 5. Characteristics for a frequency of 5.5 GHz

10.2.2 Gain characteristics



(1) −40 °C, 5.00 V
(2) 25 °C, 5.00 V
(3) 85 °C, 5.00 V

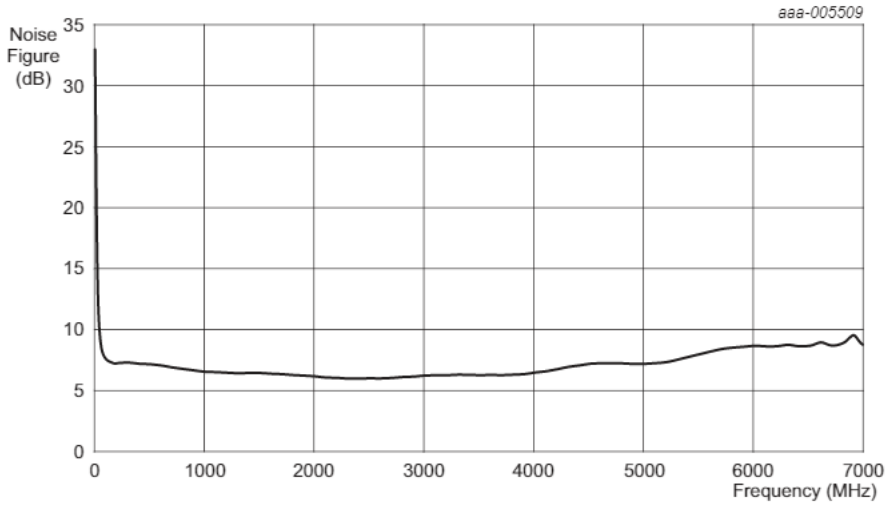
Fig 6. Gain as a function of frequency over temperature



(1) 4.75 V, 25 °C
(2) 5.00 V, 25 °C
(3) 5.25 V, 25 °C

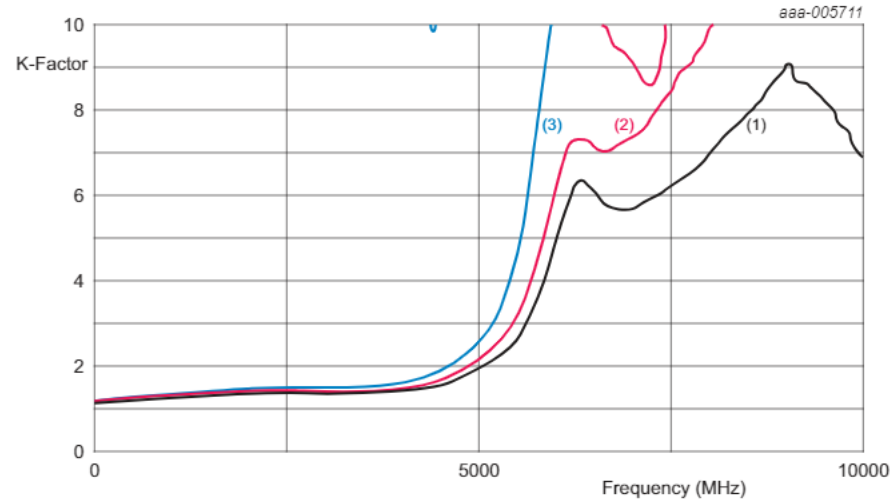
Fig 7. Gain as a function of frequency over voltage

10.2.3 Frequency characteristics



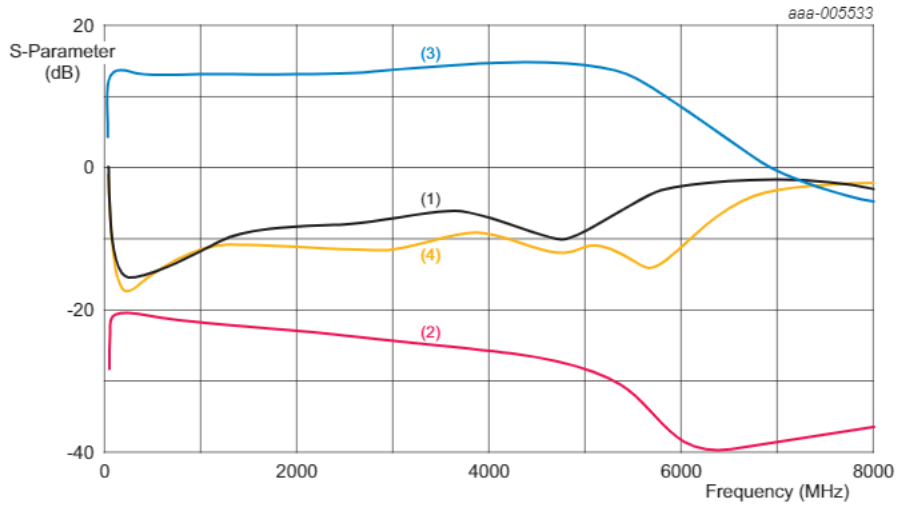
Voltage = 5 V

Fig 8. Noise figure as a function of frequency



(1) −40 °C, 5.00 V
(2) 25 °C, 5.00 V
(3) 85 °C, 5.00 V

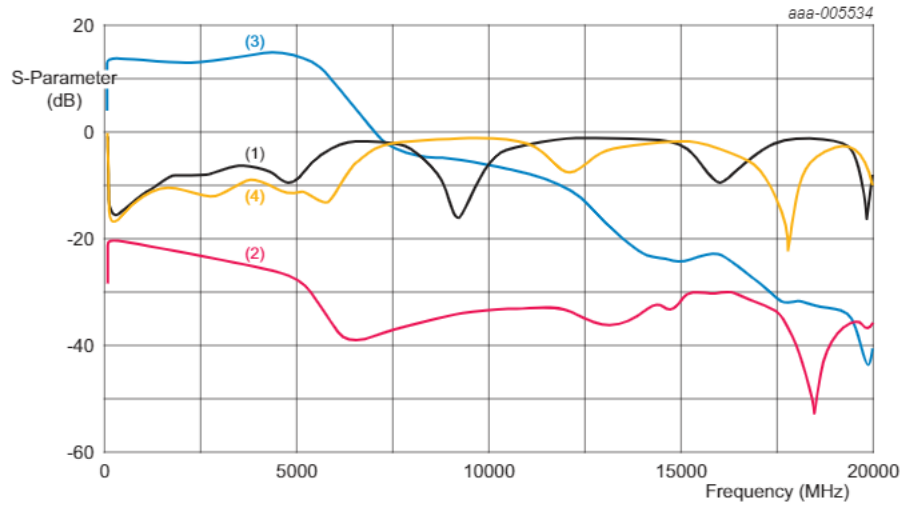
Fig 9. K-factor as a function of frequency over temperature



5 V and 25 °C

(1) S11
(2) S12
(3) S21
(4) S22

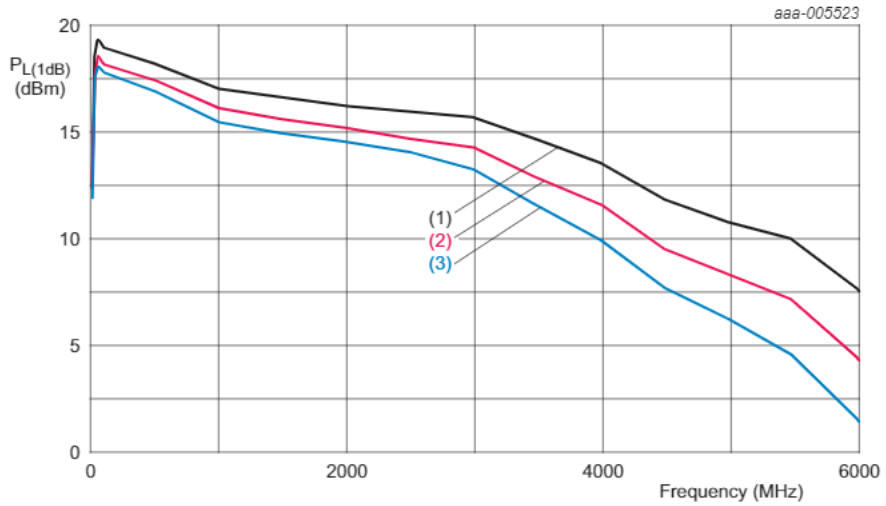
Fig 10. S-parameter as a function of frequency 10 MHZ to 8 GHz



5 V and 25 °C

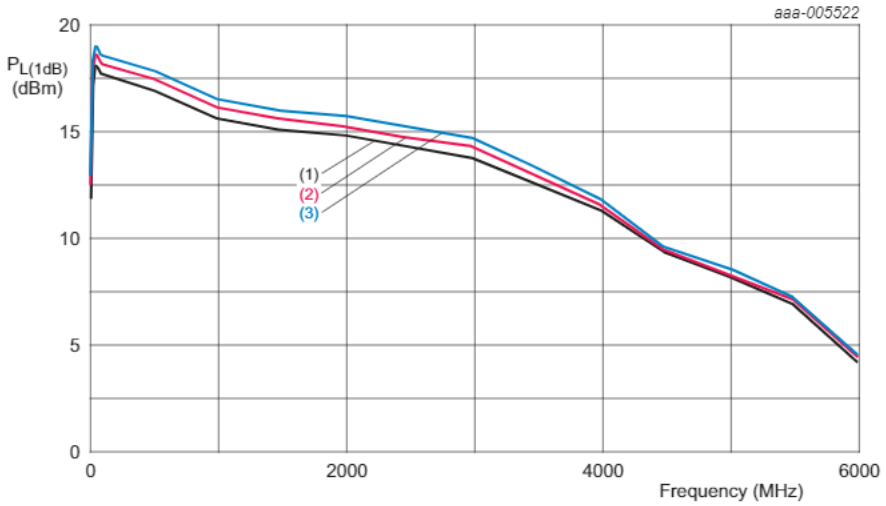
(1) S11
(2) S12
(3) S21
(4) S22

Fig 11. S-parameter as a function of frequency 10 MHZ to 20 GHz



(1) –40 °C, 5.00 V
(2) 25 °C, 5.00 V
(3) 85 °C, 5.00 V

Fig 12. output power at 1 dB gain compression as a function of frequency over temperature



(1) 4.75 V, 25 °C
(2) 5.00 V, 25 °C
(3) 5.25 V, 25 °C

Fig 13. output power at 1 dB gain compression as a function of frequency over voltage

10.3 Evaluation board layout and components

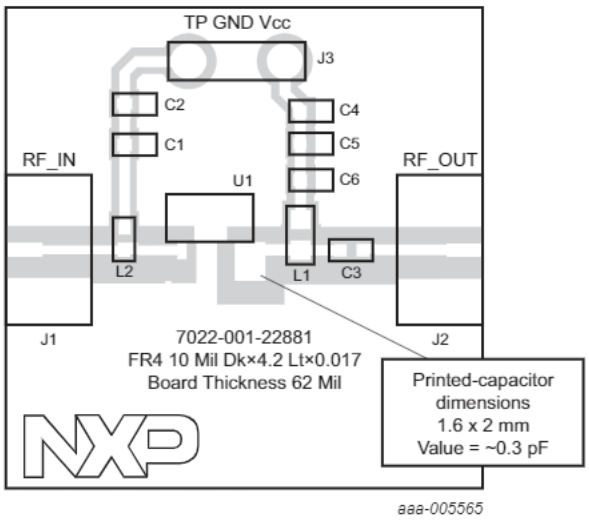


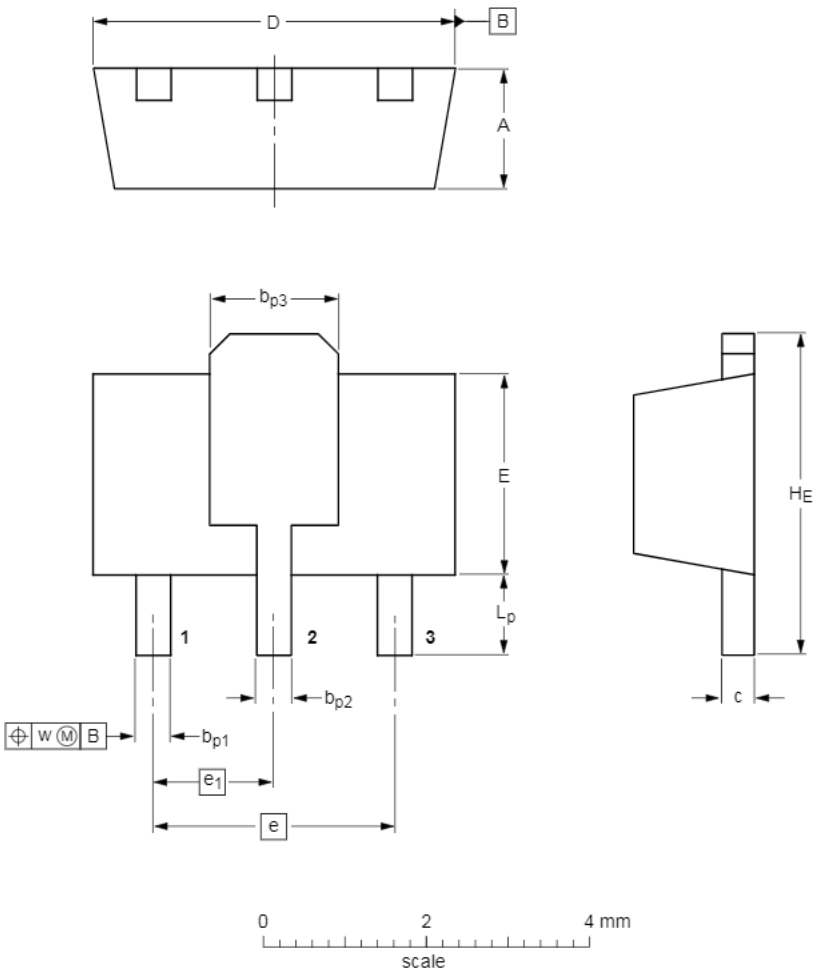
Fig 14. PCB layout

Table 9. Evaluation board components

Designator	Description	Manufacturer Part Number	Manufacturer
C1	Do not populate	-	-
C2	Do not populate	-	-
C3	10 nF	GRM155R71E103KA01D	Murata
C4	1 μF	GRM155R60J105ME19D	Murata
C5	1000 pF	GRM1555C1H102JA01	Murata
C6	100 pF	GRM1555C1H101JA01	Murata
J1	CON-SMA-2	142-0711-821	Johnson
J2	CON-SMA-2	142-0711-821	Johnson
J3	CON-3PIN	PEG3SS-PBQ	Mueller
L1	390 nH	0603CS-R39XJL	COILCRAFT
L2	Do not populate	-	-
U1	BGA7017	BGA7017	NXP

11. Package outline

Plastic surface-mounted package; exposed die pad for good heat transfer; 3 leads **SOT89**



DIMENSIONS (mm are the original dimensions)

UNIT	A	b_{p1}	b_{p2}	b_{p3}	c	D	E	e	e_1	H_E	L_p	w
mm	1.6 1.4	0.48 0.35	0.53 0.40	1.8 1.4	0.44 0.23	4.6 4.4	2.6 2.4	3.0	1.5	4.25 3.75	1.2 0.8	0.13

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT89		TO-243	SC-62			~~06-03-16~~ 06-08-29

Fig 15. Package outline SOT89

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
ESD	ElectroStatic Discharge
HTOL	High Temperature Operating Life
MMIC	Monolithic Microwave Integrated Circuit

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGA7017 v.4	20130327	Objective data sheet	-	BGA7017 v.3
Modifications:	• Updated the “power gain” values and the “output third-order intercept point” values throughout the document.			
BGA7017 v.3	20121030	Objective data sheet	-	BGA7017 v.2
Modifications:	• Section 12 updated to include 11 new figures.			
BGA7017 v.2	20120913	Objective data sheet	-	BGA7017 v.1
BGA7017 v.1	20110505	Objective data sheet	-	-

14. Legal information

14.1 Data sheet status

Document status[1][2]	Product status[3]	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".

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16. Contents

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