BGA7027

400 MHz to 2700 MHz 0.5 W high linearity silicon amplifier

Rev. 1 — 11 August 2010 Preliminary data sheet

1. Product profile

1.1 General description

The BGA7027 MMIC is a one-stage amplifier, offered in a low-cost surface-mount package. It delivers 28 dBm output power at 1 dB gain compression and a superior performance up to 2700 MHz.

1.2 Features and benefits

- 400 MHz to 2700 MHz frequency operating range
- 11 dB small signal gain at 2 GHz
- 28 dBm output power at 1 dB gain compression
- Integrated active biasing
- External matching allows broad application optimization of the electrical performance
- 5 V single supply operation
- ESD protection at all pins

1.3 Applications

- Broadband CPE/MoCA
- WLAN/ISM/RFID
- Wireless infrastructure (base station, repeater, backhaul systems)
- Industrial applications
- E-metering
- Satellite Master Antenna TV (SMATV)

1.4 Quick reference data

Table 1. Quick reference data

Input and output impedances matched to 50 Ω. Typical values at: I_{CC} = 170 mA; V_{CC} = 5 V; T_{case} = 25 °C; unless otherwise specified.

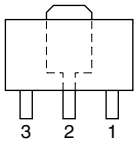
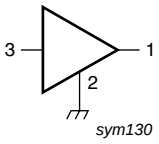
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
f	frequency		[1]	400	-	2700	MHz
G_p	gain power	f = 2140 MHz		-	11	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	f = 2140 MHz		-	28	-	dBm
$IP3_O$	output third-order intercept point	f = 2140 MHz	[2]	-	43	-	dBm

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

[2] P_L = 17 dBm per tone; spacing = 1 MHz.

2. Pinning information

Table 2. Pinning

Pin	Description		Simplified outline	Graphic symbol
1	$V_{CC(RF)}$	[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 power amplifier.

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BGA7027	-	plastic surface-mounted package; exposed die pad for good heat transfer; 3 leads	SOT89

4. Functional diagram

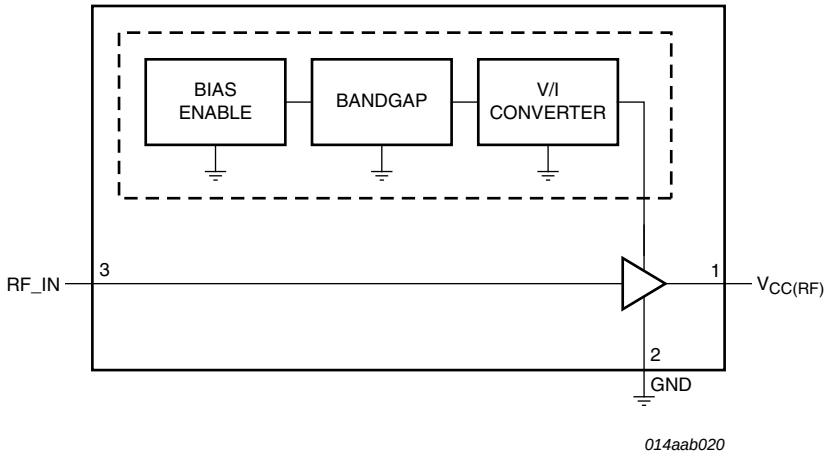


Fig 1. Functional diagram

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}	supply voltage		-	5.7	V
$P_{i(RF)}$	RF input power		-	<tbd>	dBm
T_{case}	case temperature		–40	+85	°C
T_j	junction temperature		-	150	°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} = 170 mA	38	K/W

7. Static characteristics

Table 6. Characteristics

Input and output impedances matched to 50 Ω. Typical values at T_{case} = 25 °C, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		-	5.0	-	V
I_{CC}	supply current	V_{CC} = 5.0 V	145	170	195	mA

8. Dynamic characteristics

Table 7. Characteristics

Input and output impedances matched to 50 Ω. Typical values at V_{CC} = 5 V; T_{case} = 25 °C, NXP application circuit; unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
f	frequency		[1]	400	-	2700	MHz
G_p	gain power	f = 940 MHz	[2]	-	19	-	dB
		f = 1960 MHz	[2]	-	12	-	dB
		f = 2140 MHz	[2]	-	11	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	f = 940 MHz		-	28	-	dBm
		f = 1960 MHz		-	28	-	dBm
		f = 2140 MHz		-	28	-	dBm

Table 7. Characteristics *...continued*

Input and output impedances matched to 50 Ω. Typical values at V_{CC} = 5 V; T_{case} = 25 °C, NXP application circuit; unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$IP3_O$	output third-order intercept point	f = 940 MHz	[3]	-	42	-	dBm
		f = 1960 MHz	[3]	-	43	-	dBm
		f = 2140 MHz	[3]	-	43	-	dBm
NF	noise figure	f = 940 MHz		-	2.5	-	dB
		f = 1960 MHz		-	3.5	-	dB
		f = 2140 MHz		-	3.8	-	dB
RL_{in}	input return loss	f = 940 MHz	[2]	-	−15	-	dB
		f = 1960 MHz	[2]	-	−8	-	dB
		f = 2140 MHz	[2]	-	−8	-	dB
RL_{out}	output return loss	f = 940 MHz	[2]	-	−11	-	dB
		f = 1960 MHz	[2]	-	−19	-	dB
		f = 2140 MHz	[2]	-	−22	-	dB

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

[2] Defined at $P_{i(RF)}$ = −40 dBm; small signal conditions.

[3] P_L= 17 dBm per tone; spacing = 1 MHz.

9. Scattering parameters

Table 8. Scattering parameters at 5 V, MMIC only

V_{CC} = 5 V; I_{CC} = 180 mA; T_{case} = 25 °C.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}	
	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)
400	0.92	178	8.03	93	0.01	49	0.76	−176
500	0.92	176	6.55	89	0.01	53	0.75	−178
600	0.92	173	5.55	85	0.02	55	0.75	179
700	0.92	171	4.80	82	0.02	56	0.75	177
800	0.92	168	4.24	79	0.02	56	0.75	175
900	0.92	165	3.80	76	0.02	56	0.75	173
1000	0.92	162	3.46	72	0.03	55	0.76	170
1100	0.92	160	3.14	69	0.03	54	0.76	167
1200	0.92	157	2.85	66	0.03	53	0.76	165
1300	0.92	154	2.61	63	0.03	52	0.76	163
1400	0.93	152	2.39	61	0.03	50	0.77	161
1500	0.93	150	2.20	58	0.03	49	0.78	160
1600	0.93	149	2.03	56	0.04	48	0.78	159
1700	0.93	148	1.88	54	0.04	47	0.79	157
1800	0.94	147	1.75	63	0.04	47	0.80	157
1900	0.94	146	1.64	51	0.04	46	0.80	157
2000	0.94	146	1.53	50	0.04	46	0.80	157

Table 8. Scattering parameters at 5 V, MMIC only *...continued*

V_{CC} = 5 V; I_{CC} = 180 mA; T_{case} = 25 °C.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}	
	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)	Magnitude (ratio)	Angle (degree)
2100	0.93	146	1.45	49	0.04	46	0.81	157
2200	0.93	147	1.39	49	0.05	46	0.81	157
2300	0.93	147	1.33	48	0.05	45	0.81	158
2400	0.92	147	1.29	48	0.05	45	0.80	159
2500	0.91	147	1.26	47	0.05	45	0.80	160
2600	0.91	148	1.24	46	0.06	45	0.80	160
2700	0.89	147	1.23	45	0.06	44	0.79	161

10. Reliability information

Table 9. Reliability

Life test	Conditions	Intrinsic failure rate
HTOL	according to JESD85; confidence level 60 %; T_j = 55 °C; activation energy = 0.7 eV; acceleration factor determined according to the Arrhenius equation	4

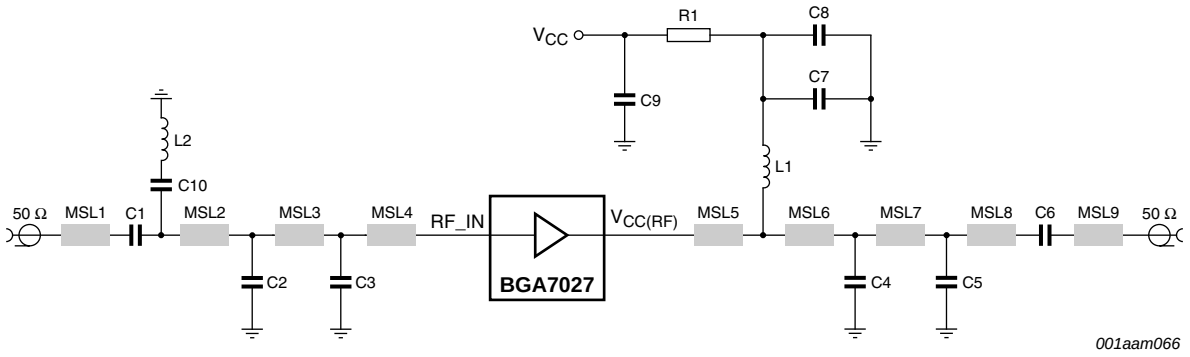
11. Moisture sensitivity

Table 10. Moisture sensitivity level

Test methodology	Class
JESD-22-A113	1

12. Application information

12.1 920 MHz to 960 MHz

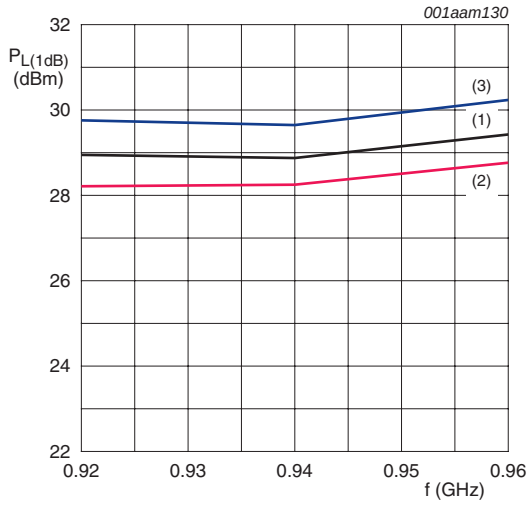


See Table 11 for a list of components.

PCB board specification:

Rogers RO4003C; Height = 0.508 mm; ε_r = 3.38; Copper thickness = 35 μm.

Fig 2. 5 V application schematic; 920 MHz to 960 MHz

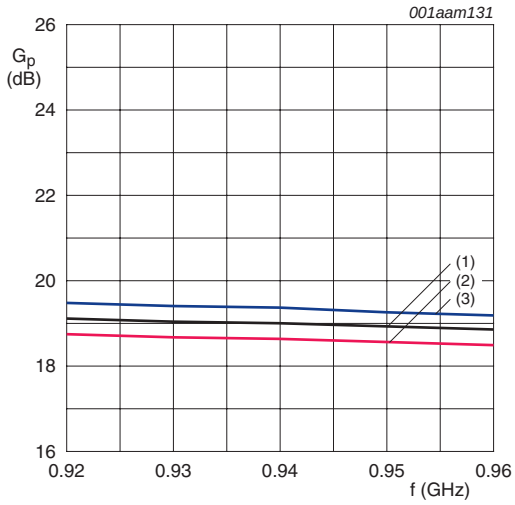


(1) T_{case} = 25 °C.

(2) T_{case} = 85 °C.

(3) T_{case} = −40 °C.

Fig 3. Output power at 1 dB gain compression as a function of frequency

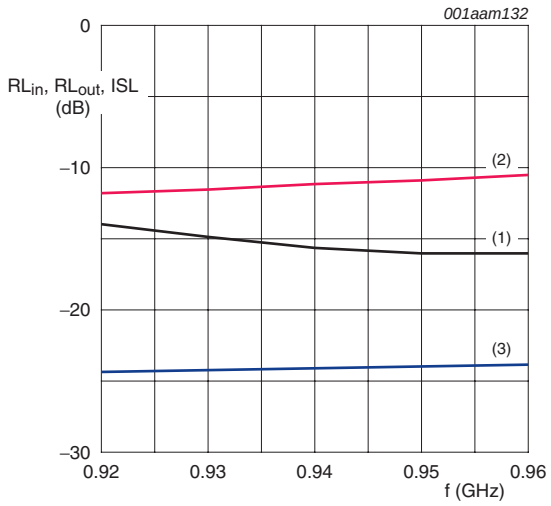


(1) T_{case} = 25 °C.

(2) T_{case} = 85 °C.

(3) T_{case} = −40 °C.

Fig 4. Power gain as a function of frequency



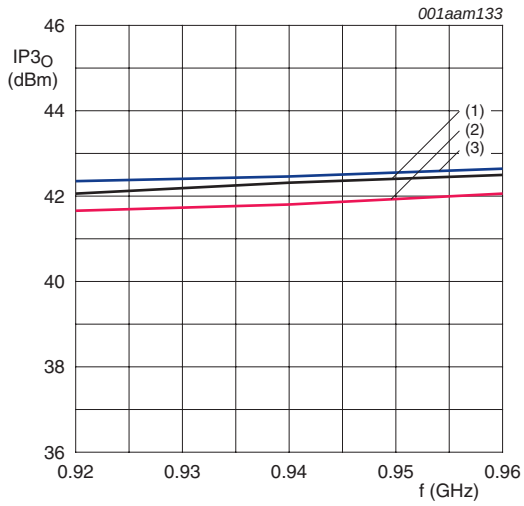
T_{case} = 25 °C.

(1) RL_{in}.

(2) RL_{out}.

(3) ISL.

Fig 5. Input return loss, output return loss and isolation as a function of frequency



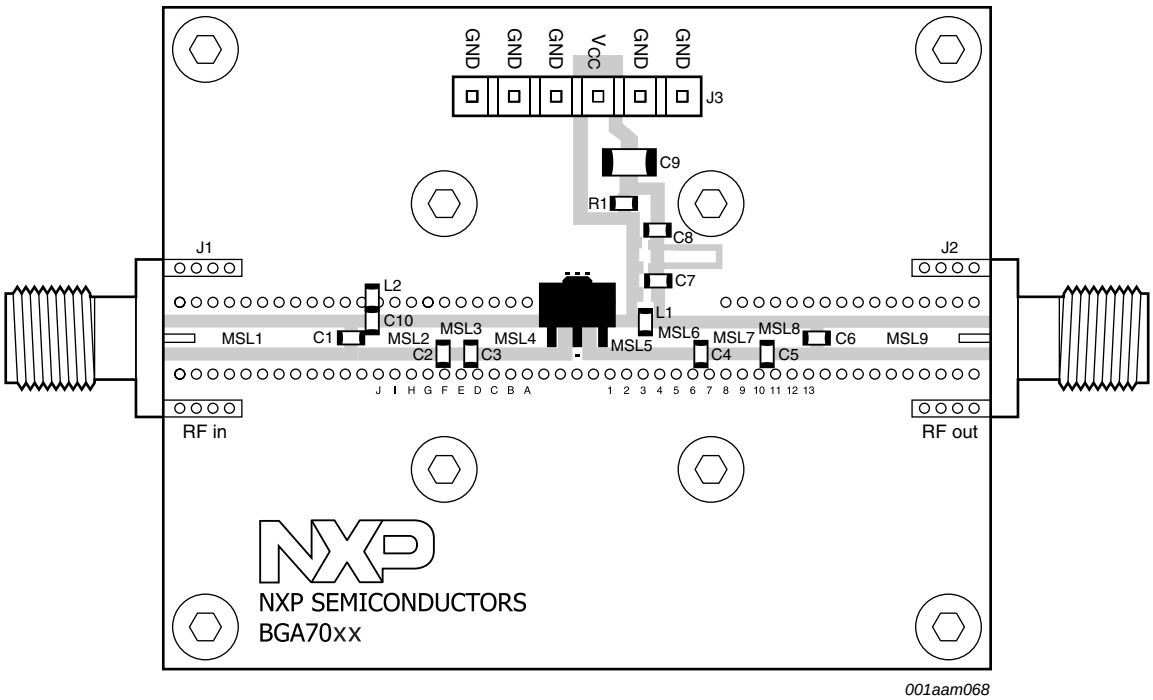
P_L = 17 dBm; tone spacing = 1 MHz

(1) T_{case} = 25 °C.

(2) T_{case} = 85 °C.

(3) T_{case} = −40 °C.

Fig 6. Output third-order intercept point as a function of frequency



See Table 11 for a list of components.

Fig 7. 5 V application reference board; 920 MHz to 960 MHz

Table 11. List of components of 920 MHz to 960 MHz, 5 V application

See Figure 2 and Figure 7 for component layout.

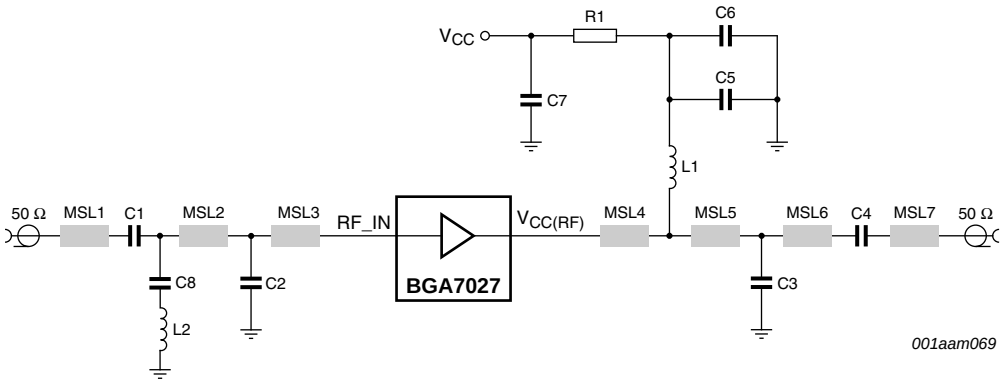
Printed-Circuit Board (PCB): Rogers RO4003C stack; height = 0.508 mm; copper plating thickness = 35 μm.

Component	Description	Value	Function	Remarks
C1, C6	capacitor	68 pF	DC blocking	Murata, GRM1885C1H680JA01D
C2	capacitor	5.6 pF	input match	Murata, GRM1885C1H5R6CZ01D
C3	capacitor	2.7 pF	input match	Murata, GRM1885C1H2R7CZ01D
C4	capacitor	1.0 pF	output match	Murata, GRM1885C1H1R0CZ01D
C5	capacitor	3.9 pF	output match	Murata, GRM1885C1H3R9CZ01D
C7	capacitor	68 pF	RF decoupling	Murata, GRM1885C1H680JA01D
C8	capacitor	100 nF	LF decoupling	AVX, 0603YC104KAT2A
C9	capacitor	10 μF	LF decoupling	AVX, 1206ZG106ZAT2A
C10	capacitor	68 nF	IMD3 suppression	Murata, GRM1888R71H683KA93D
J1, J2	RF connector	SMA		Emerson Network Power, 142-0701-841
J3	DC connector	6 pins		MOLEX
L1	inductor	22 nH	DC Feed	Tyco Electronics, 36501J022JTDG
L2[1]	inductor	33 nH	IMD3 suppression	Tyco Electronics, 36501J033JTDG
MSL1[2]	micro stripline	1.14 mm × 0.8 mm × 10.95 mm	input match	
MSL2[2]	micro stripline	1.14 mm × 0.8 mm × 4.3 mm	input match	
MSL3[2]	micro stripline	1.14 mm × 0.8 mm × 1.7 mm	input match	
MSL4[2]	micro stripline	1.14 mm × 0.8 mm × 4.8mm	input match	
MSL5[2]	micro stripline	1.14 mm × 0.8 mm × 2.7 mm	output match	
MSL6[2]	micro stripline	1.14 mm × 0.8 mm × 3.2 mm	output match	
MSL7[2]	micro stripline	1.14 mm × 0.8 mm × 4.0 mm	output match	
MSL8[2]	micro stripline	1.14 mm × 0.8 mm × 1.6 mm	output match	
MSL9[2]	micro stripline	1.14 mm × 0.8 mm × 10.95 mm	output match	
R1	resistor	0 Ω		Multicomp, MC 0.063W 0603 0R

[1] Low Q inductor.

[2] MSL1 to MSL9 dimensions are specified as Width (W), Spacing (S) and Length (L).

12.2 1930 MHz to 1990 MHz

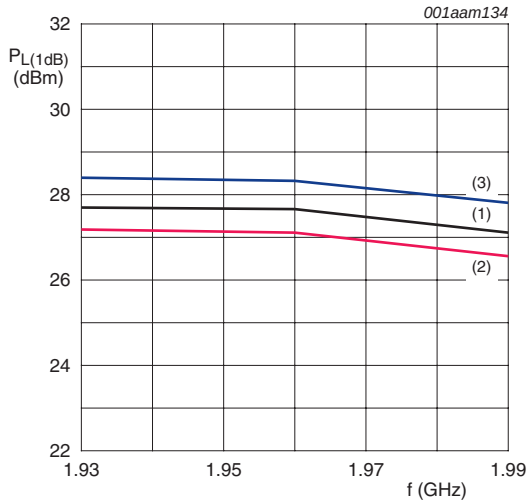


See Table 12 for a list of components.

PCB board specification:

Rogers RO4003C; Height = 0.508 mm; ε_r = 3.38; Copper thickness = 35 μm.

Fig 8. 5 V application schematic; 1930 MHz to 1990 MHz

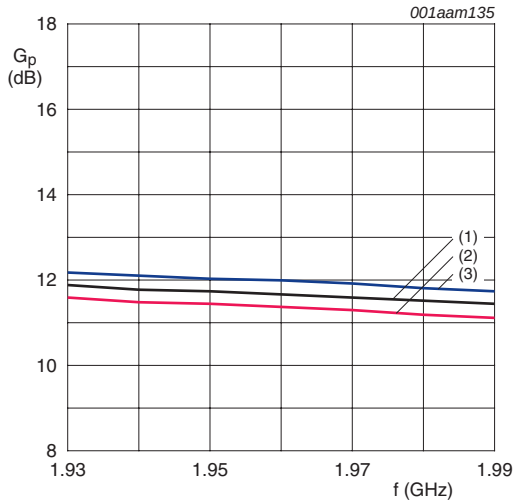


(1) T_{case} = 25 °C.

(2) T_{case} = 85 °C.

(3) T_{case} = −40 °C.

Fig 9. Output power at 1 dB gain compression as a function of frequency

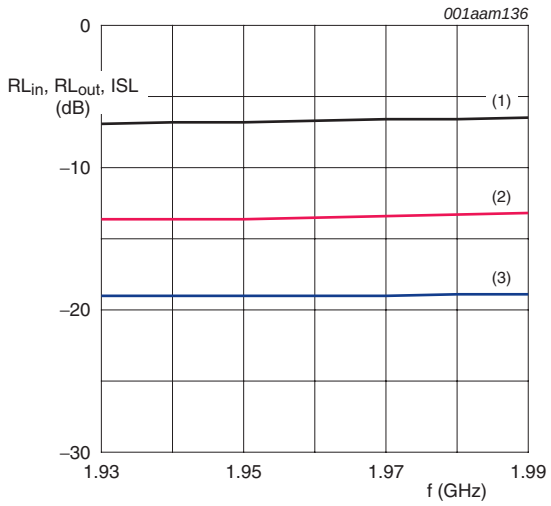


(1) T_{case} = 25 °C.

(2) T_{case} = 85 °C.

(3) T_{case} = −40 °C.

Fig 10. Power gain as a function of frequency



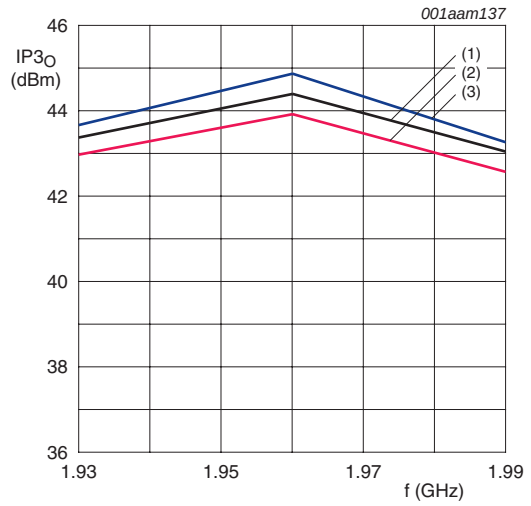
T_{case} = 25 °C.

(1) RL_{in}.

(2) RL_{out}.

(3) ISL.

Fig 11. Input return loss, output return loss and isolation as a function of frequency



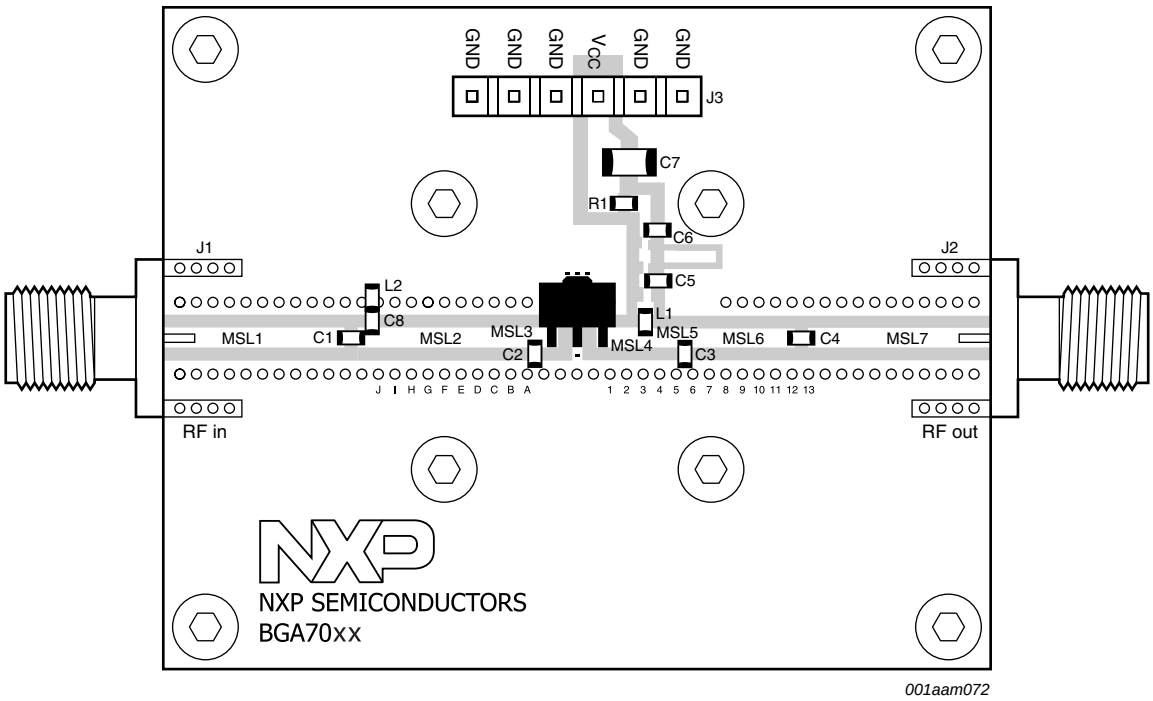
P_L = 17 dBm; tone spacing = 1 MHz

(1) T_{case} = 25 °C.

(2) T_{case} = 85 °C.

(3) T_{case} = −40 °C.

Fig 12. Output third-order intercept point as a function of frequency



See Table 12 for a list of components.

Fig 13. 5 V application reference board; 1930 MHz to 1990 MHz

Table 12. List of components of 1930 MHz to 1990 MHz, 5 V application

See Figure 8 and Figure 13 for component layout.

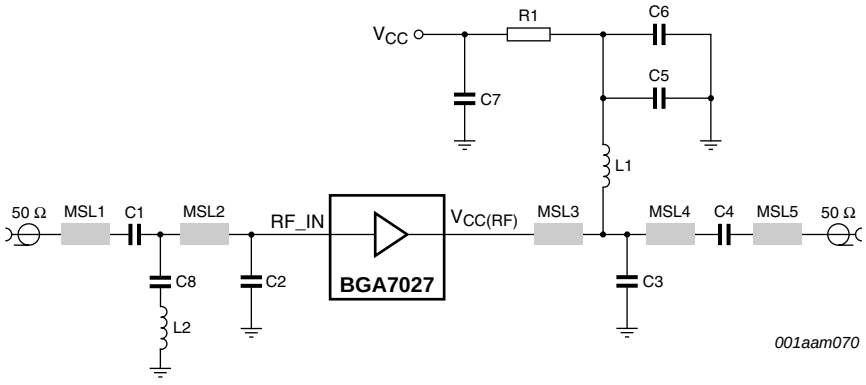
Printed-Circuit Board (PCB): Rogers RO4003C stack; height = 0.508 mm; copper plating thickness = 35 μm.

Component	Description	Value	Function	Remarks
C1, C4	capacitor	15 pF	DC blocking	Murata, GRM1885C1H150JA01D
C2	capacitor	2.4 pF	input match	Murata, GRM1885C1H2R4CZ01D
C3	capacitor	2.0 pF	output match	Murata, GRM1885C1H2R0CZ01D
C5	capacitor	15 pF	RF decoupling	Murata, GRM1885C1H150JA01D
C6	capacitor	100 nF	LF decoupling	AVX, 0603YC104KAT2A
C7	capacitor	10 μF	LF decoupling	AVX, 1206ZG106ZAT2A
C8	capacitor	68 nF	IMD3 suppression	Murata, GRM1888R71H683KA93D
J1, J2	RF connector	SMA		Emerson Network Power, 142-0701-841
J3	DC connector	6 pins		MOLEX
L1	inductor	22 nH	DC Feed	Tyco Electronics, 36501J022JTDG
L2[1]	inductor	33 nH	IMD3 suppression	Tyco Electronics, 36501J033JTDG
MSL1[2]	micro stripline	1.14 mm × 0.8 mm × 10.95 mm	input match	
MSL2[2]	micro stripline	1.14 mm × 0.8 mm × 10.6 mm	input match	
MSL3[2]	micro stripline	1.14 mm × 0.8 mm × 1.0 mm	input match	
MSL4[2]	micro stripline	1.14 mm × 0.8 mm × 2.7 mm	output match	
MSL5[2]	micro stripline	1.14 mm × 0.8 mm × 2.0 mm	output match	
MSL6[2]	micro stripline	1.14 mm × 0.8 mm × 6.8 mm	output match	
MSL7[2]	micro stripline	1.14 mm × 0.8 mm × 10.95 mm	output match	
R1	resistor	0 Ω		Multicomp. MC 0.063W 0603 0R

[1] Low Q inductor.

[2] MSL1 to MSL7 dimensions are specified as Width (W), Spacing (S) and Length (L).

12.3 2110 MHz to 2170 MHz

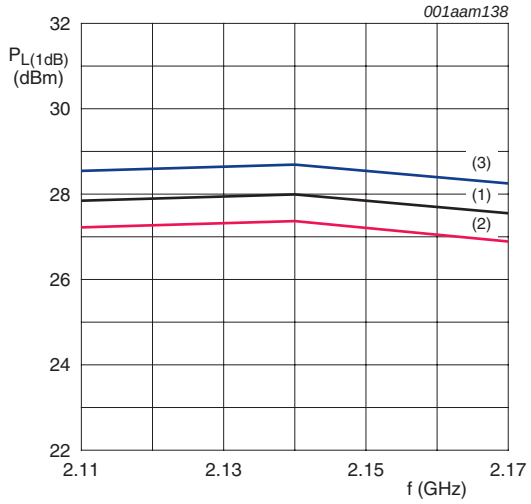


See Table 13 for a list of components.

PCB board specification:

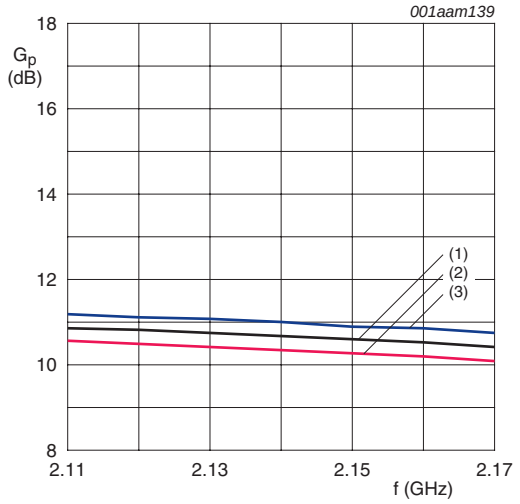
Rogers RO4003C; Height = 0.508 mm; ε_r = 3.38; Copper thickness = 35 μm.

Fig 14. 5 V application schematic; 2110 MHz to 2170 MHz



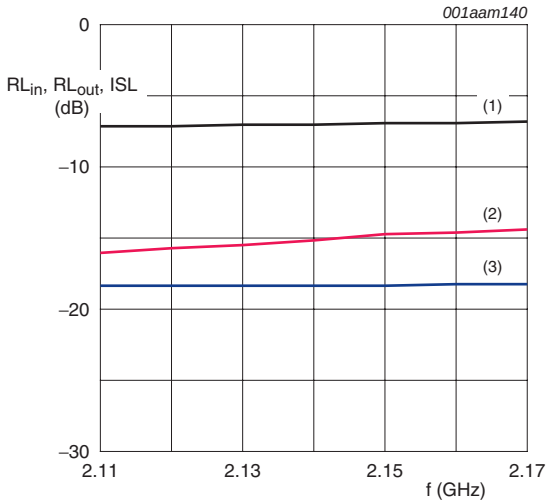
(1) T_{case} = 25 °C.
(2) T_{case} = 85 °C.
(3) T_{case} = −40 °C.

Fig 15. Output power at 1 dB gain compression as a function of frequency



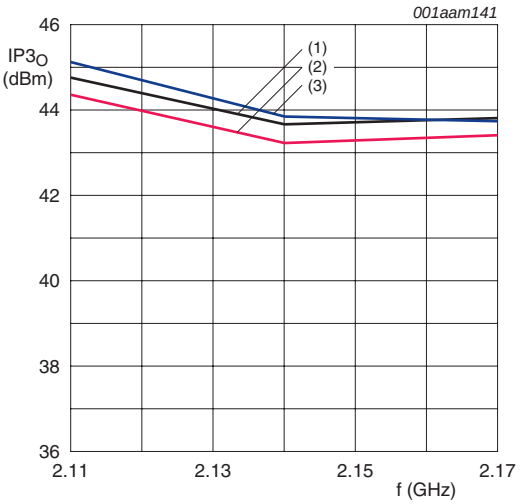
(1) T_{case} = 25 °C.
(2) T_{case} = 85 °C.
(3) T_{case} = −40 °C.

Fig 16. Power gain as a function of frequency



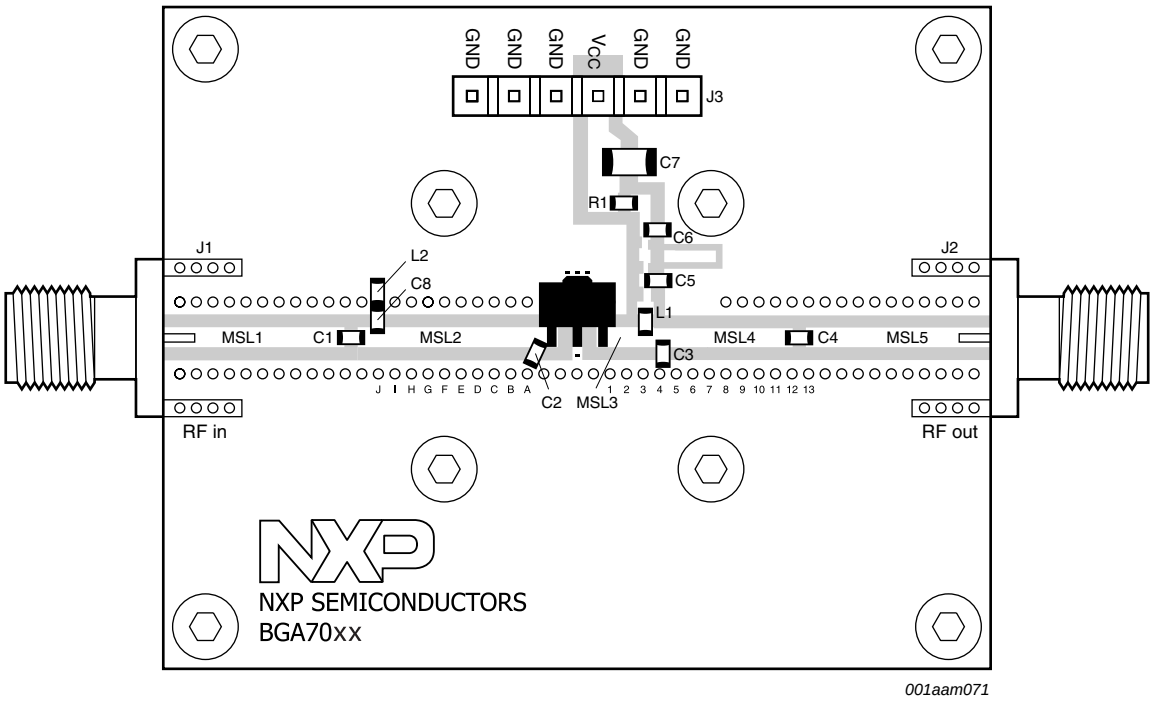
T_{case} = 25 °C.
(1) RL_{in}.
(2) RL_{out}.
(3) ISL.

Fig 17. Input return loss, output return loss and isolation as a function of frequency



P_L = 17 dBm; tone spacing = 1 MHz
(1) T_{case} = 25 °C.
(2) T_{case} = 85 °C.
(3) T_{case} = −40 °C.

Fig 18. Output third-order intercept point as a function of frequency



See Table 13 for a list of components.

Fig 19. 5 V application reference board; 2110 MHz to 2170 MHz

Table 13. List of components of 2110 MHz to 2170 MHz, 5 V application

See Figure 14 and Figure 19 for component layout.

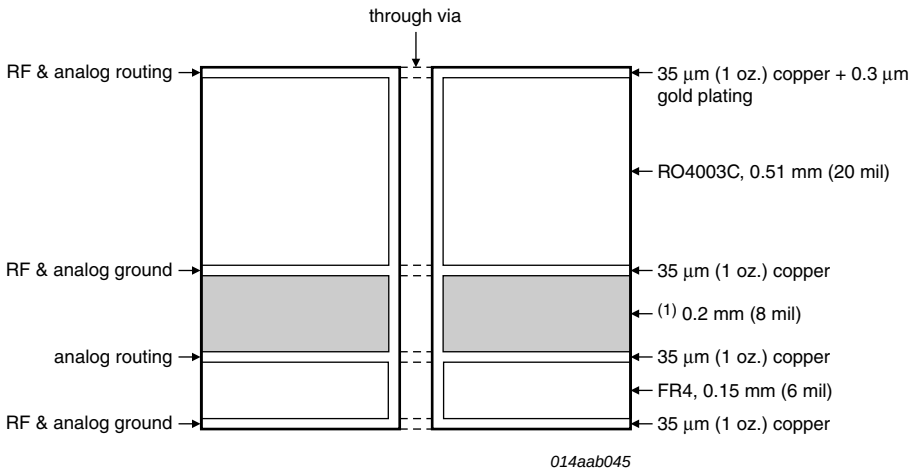
Printed-Circuit Board (PCB): Rogers RO4003C stack; height = 0.508 mm; copper plating thickness = 35 μm.

Component	Description	Value	Function	Remarks
C1, C4	capacitor	15 pF	DC blocking	Murata, GRM1885C1H150JA01D
C2	capacitor	2.2 pF	input match	Murata, GRM1885C1H2R2CZ01D
C3	capacitor	2.0 pF	output match	Murata, GRM1885C1H1R0CZ01D
C5	capacitor	15 pF	RF decoupling	Murata, GRM1885C1H150JA01D
C6	capacitor	100 nF	LF decoupling	AVX, 0603YC104KAT2A
C7	capacitor	10 μF	LF decoupling	AVX, 1206ZG106ZAT2A
C8	capacitor	68 nF	IMD3 suppression	Murata, GRM1888R71H683KA92D
J1, J2	RF connector	SMA		Emerson Network Power, 142-0701-841
J3	DC connector	6 pins		MOLEX
L1	inductor	22 nH	DC Feed	Tyco Electronics, 36501J022JTDG
L2[1]	inductor	33 nH	IMD3 suppression	Tyco Electronics, 36501J033JTDG
MSL1[2]	micro stripline	1.14 mm × 0.8 mm × 10.95 mm	input match	
MSL2[2]	micro stripline	1.14 mm × 0.8 mm × 11.3 mm	input match	
MSL3[2]	micro stripline	1.14 mm × 0.8 mm × 3.2 mm	output match	
MSL4[2]	micro stripline	1.14 mm × 0.8 mm × 8.0 mm	output match	
MSL5[2]	micro stripline	1.14 mm × 0.8 mm × 10.95 mm	output match	
R1	resistor	0 Ω		Multicomp, MC 0.063W 0603 0R

[1] Low Q inductor.

[2] MSL1 to MSL5 dimensions are specified as Width (W), Spacing (S) and Length (L).

12.4 PCB stack

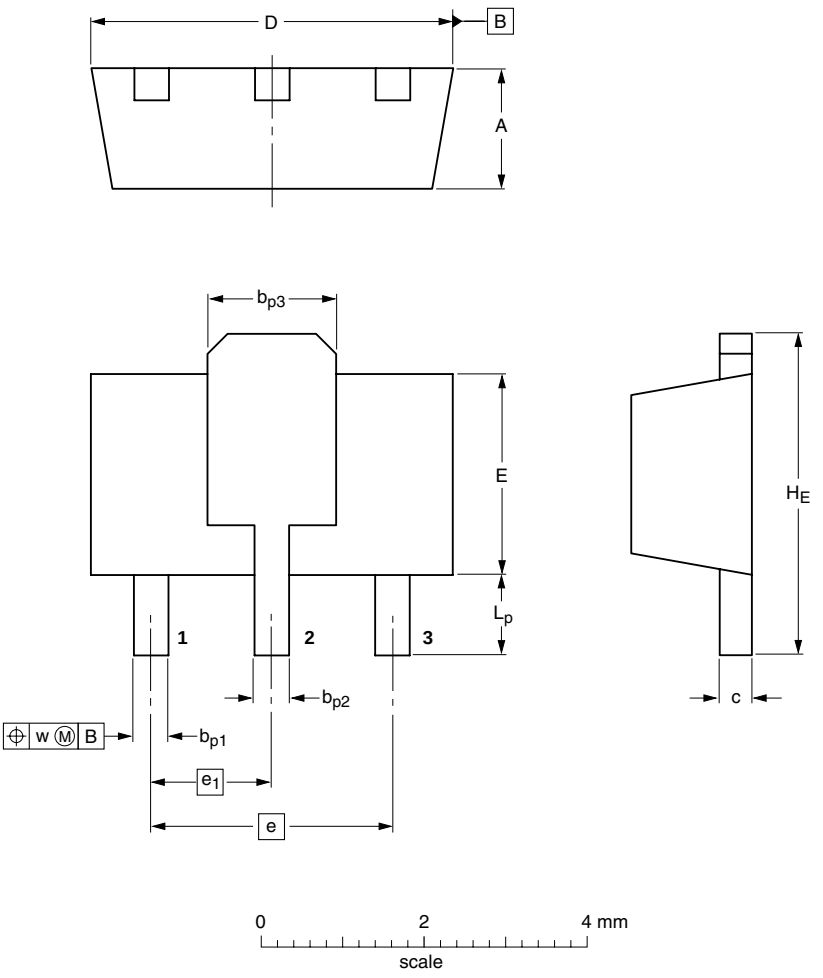


RO4003C dielectric constant ε_r = 3.38.

Fig 20. PCB stack

13. 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 21. Package outline SOT89

14. Abbreviations

Table 14. Abbreviations

Acronym	Description
CPE	Customer-Premises Equipment
ESD	ElectroStatic Discharge
HTOL	High Temperature Operating Life
ISM	Industrial, Scientific and Medical
MMIC	Monolithic Microwave Integrated Circuit
RFID	Radio Frequency IDentification
TX	Transmit
W-LAN	Wireless Local Area Network

15. Revision history

Table 15. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGA7027 v.1	20100811	Preliminary data sheet	-	-

16. Legal information

16.1 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".

[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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