BGA7027

400 MHz to 2700 MHz 0.5 W high linearity silicon amplifier

Rev. 2 — 26 November 2010   **Product 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: 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	power gain	f = 2140 MHz		9.0	11.0	13.0	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	f = 2140 MHz		26	28	-	dBm
$IP3_O$	output third-order intercept point	f = 2140 MHz	[2]	40.0	42.5	-	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
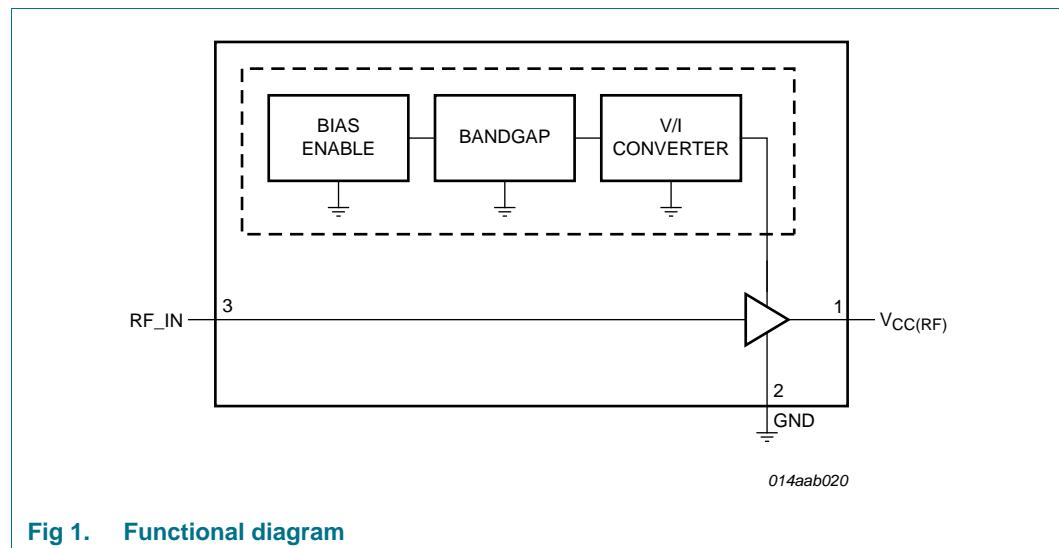
5. Limiting values

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	f = 2140 MHz; switched	[1]	-	28	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

[1]   Withstands switching between zero and maximum $P_{i(RF)}$

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} = 165 mA	38	K/W

7. Static characteristics

Table 6.   Static 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	140	165	190	mA

8. Dynamic characteristics

Table 7.   Dynamic 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	power gain	f = 940 MHz	[2]	-	19.0	-	dB
		f = 1960 MHz	[2]	-	11.5	-	dB
		f = 2140 MHz	[2]	9.0	11.0	13.0	dB

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Table 7. **Dynamic 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
$P_{L(1dB)}$	output power at 1 dB gain compression	f = 940 MHz		-	29.0	-	dBm
		f = 1960 MHz		-	27.5	-	dBm
		f = 2140 MHz		26.0	28.0	-	dBm
$IP3_O$	output third-order intercept point	f = 940 MHz	[3]	-	41.5	-	dBm
		f = 1960 MHz	[3]	-	43.0	-	dBm
		f = 2140 MHz	[3]	40.0	42.5	-	dBm
NF	noise figure	f = 940 MHz		-	2.6	-	dB
		f = 1960 MHz		-	3.8	-	dB
		f = 2140 MHz		-	3.9	-	dB
RL_{in}	input return loss	f = 940 MHz	[2]	-	−16	-	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]	-	−13	-	dB
		f = 2140 MHz	[2]	-	−15	-	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, MMIC only**
V_{CC} = 5 V; I_{CC} = 165 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

Table 8.   Scattering parameters, MMIC only *…continued*

$V_{CC} = 5$ V; $I_{CC} = 165$ 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)
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
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

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12. Application information

12.1 920 MHz to 960 MHz
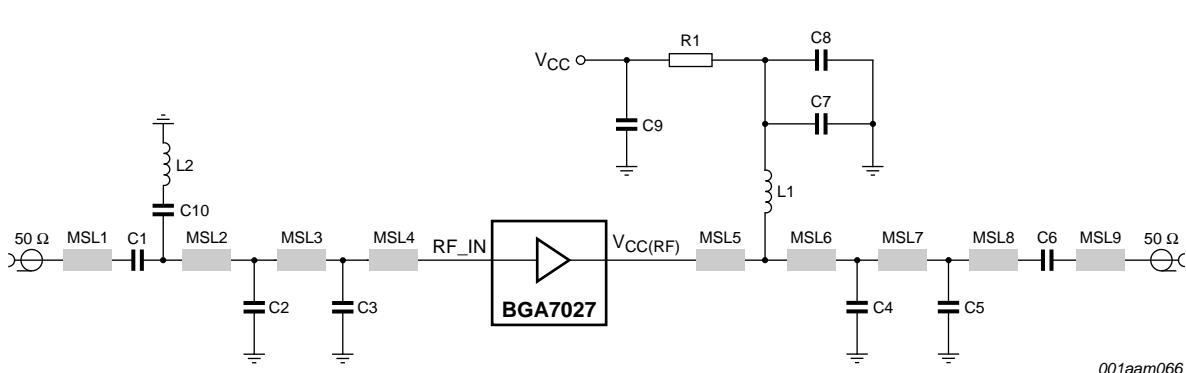
See Table 11 for a list of components.

PCB board specification:

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

Fig 2. 920 MHz to 960 MHz application schematic
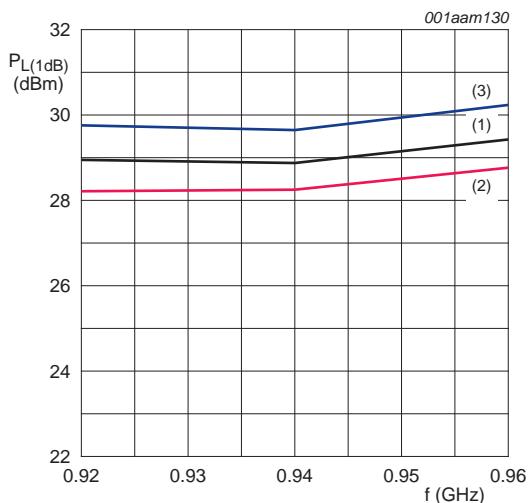
(1) T_{case} = 25 °C.
(2) T_{case} = 85 °C.
(3) T_{case} = −40 °C.

Fig 3. Output power at 1 dB gain compression as a function of frequency
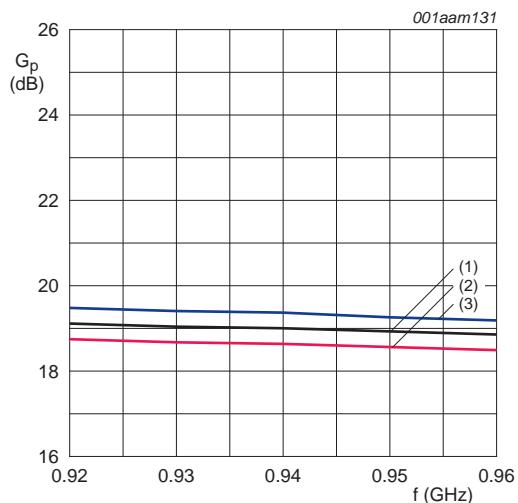
(1) T_{case} = 25 °C.
(2) T_{case} = 85 °C.
(3) T_{case} = −40 °C.

Fig 4. Power gain as a function of frequency
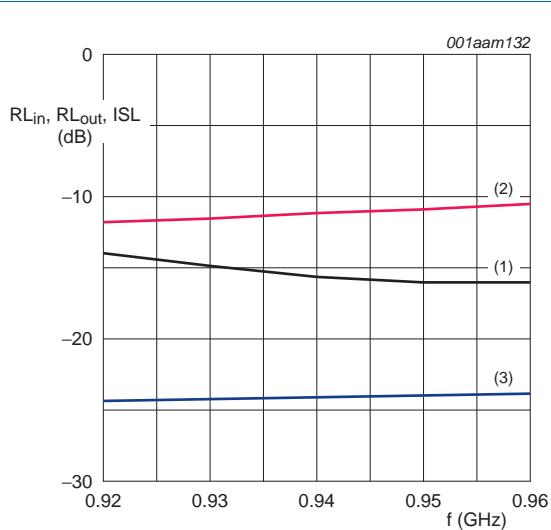
T_{case} = 25 °C.

(1) RL_{in}.

(2) RL_{out}.

(3) ISL.

Fig 5.   Input return loss, output return loss and isolation as a function of frequency
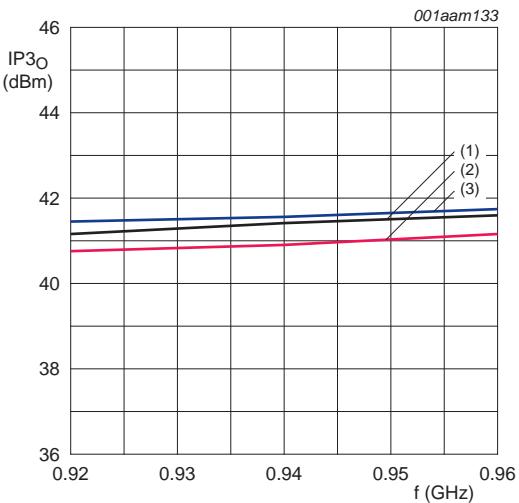
P_L = 17 dBm; tone spacing = 1 MHz

(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
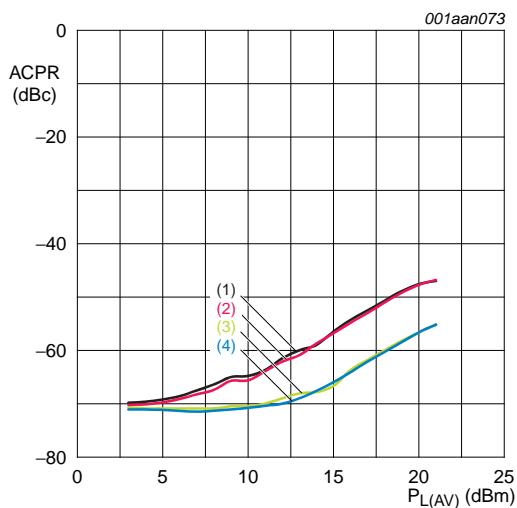
2-carrier W-CDMA; each carrier according to 3GPP test model 1; 64 DPCH; PAR for composite signal = 7.5 dB; 5 MHz carrier spacing.

(1) f = 920 MHz; ACPR measured at f ± 5 MHz

(2) f = 960 MHz; ACPR measured at f ± 5 MHz

(3) f = 920 MHz; ACPR measured at f ± 10 MHz

(4) f = 960 MHz; ACPR measured at f ± 10 MHz

Fig 7.   Adjacent channel power ratio as a function of average output power
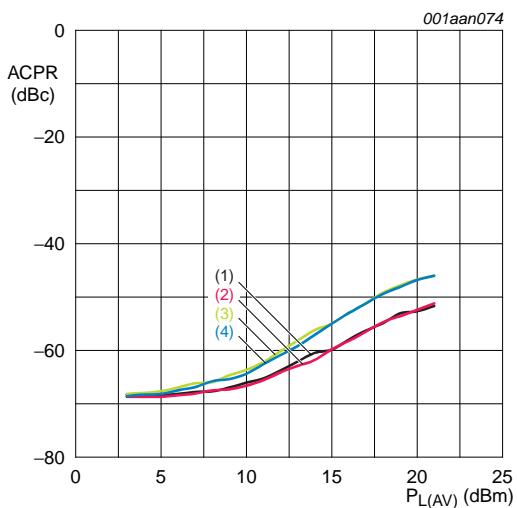
2-carrier W-CDMA; each carrier according to 3GPP test model 1; 64 DPCH; PAR for composite signal = 9 dB; 10 MHz carrier spacing.

(1) f = 920 MHz; ACPR measured at f ± 5 MHz

(2) f = 960 MHz; ACPR measured at f ± 5 MHz

(3) f = 920 MHz; ACPR measured at f ± 10 MHz

(4) f = 960 MHz; ACPR measured at f ± 10 MHz

Fig 8.   Adjacent channel power ratio as a function of average output power

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f = 940 MHz; tone spacing = 1 MHz.

(1) Upper sideband

(2) Lower sideband

Fig 9. Output third-order intercept point as a function of output power per tone

See Table 11 for a list of components.

Fig 10. 920 MHz to 960 MHz application reference board

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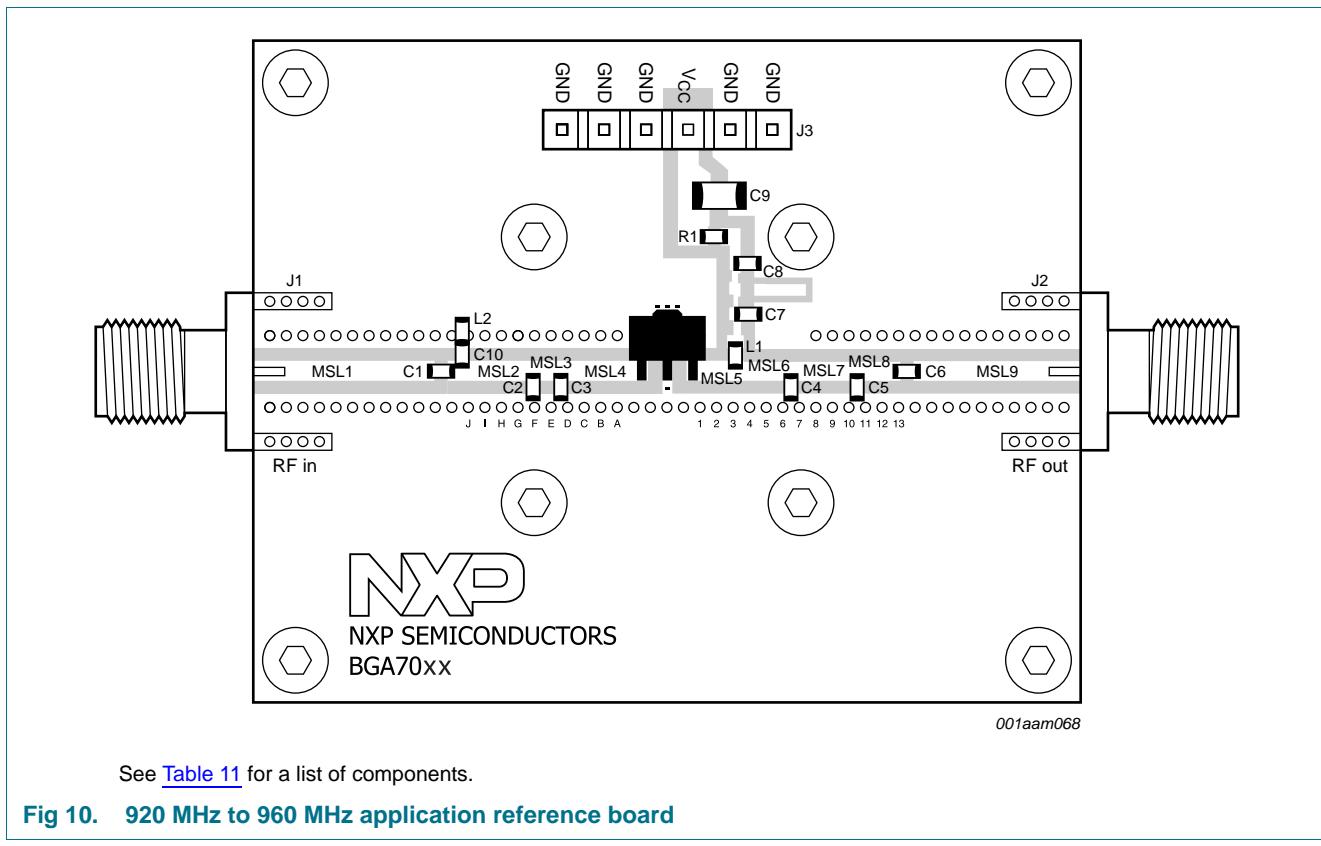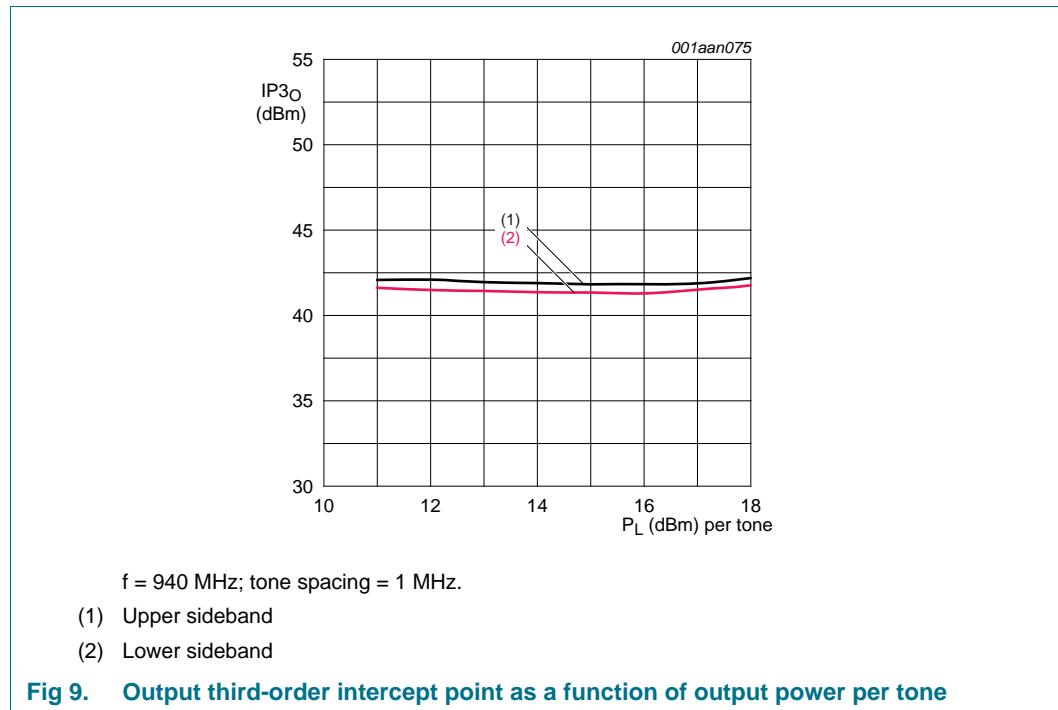
Table 11.   List of components of 920 MHz to 960 MHz
See Figure 2 and Figure 10 for component layout.
Printed-Circuit Board (PCB): Rogers RO4003C stack; height = 0.508 mm; copper plating thickness = 35 μm.

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 × 4.8 mm	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
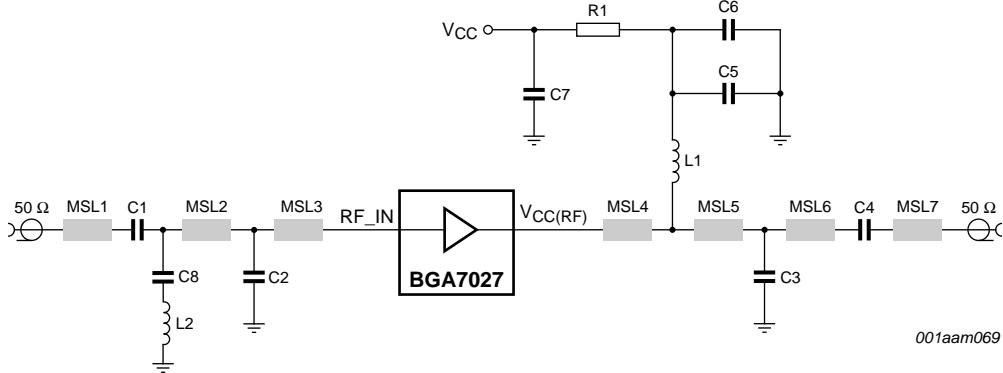
See Table 12 for a list of components.

PCB board specification:

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

Fig 11. 1930 MHz to 1990 MHz application schematic
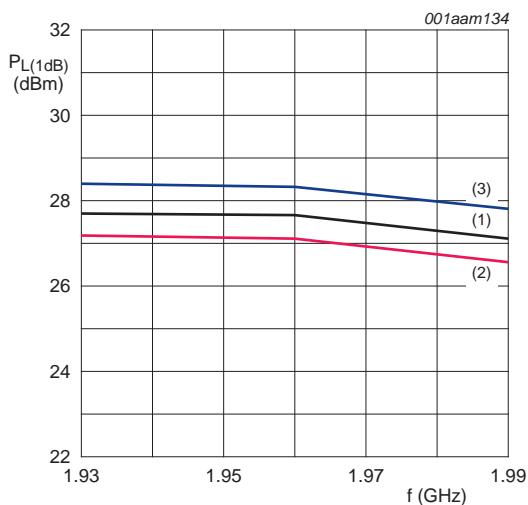
(1) T_{case} = 25 °C.

(2) T_{case} = 85 °C.

(3) T_{case} = −40 °C.

Fig 12. Output power at 1 dB gain compression as a function of frequency
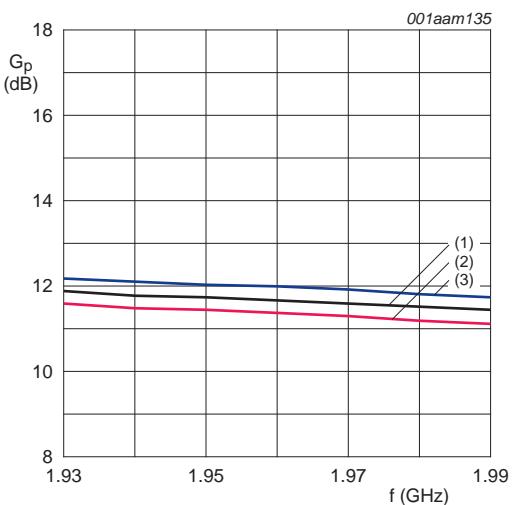
(1) T_{case} = 25 °C.

(2) T_{case} = 85 °C.

(3) T_{case} = −40 °C.

Fig 13. Power gain as a function of frequency
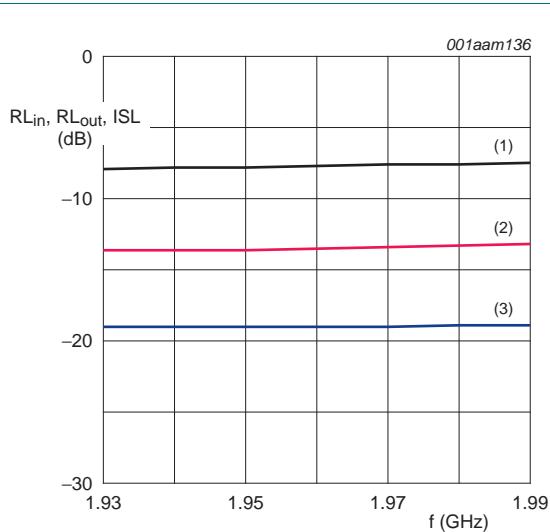
T_{case} = 25 °C.

(1) RL_{in}.

(2) RL_{out}.

(3) ISL.

Fig 14. Input return loss, output return loss and isolation as a function of frequency
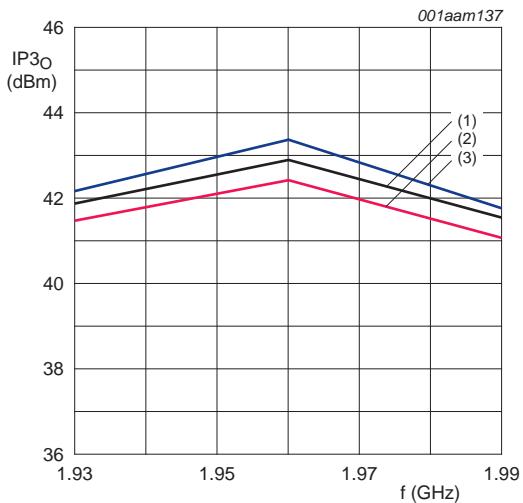
P_L = 17 dBm; tone spacing = 1 MHz

(1) T_{case} = 25 °C.

(2) T_{case} = 85 °C.

(3) T_{case} = −40 °C.

Fig 15. Output third-order intercept point as a function of frequency
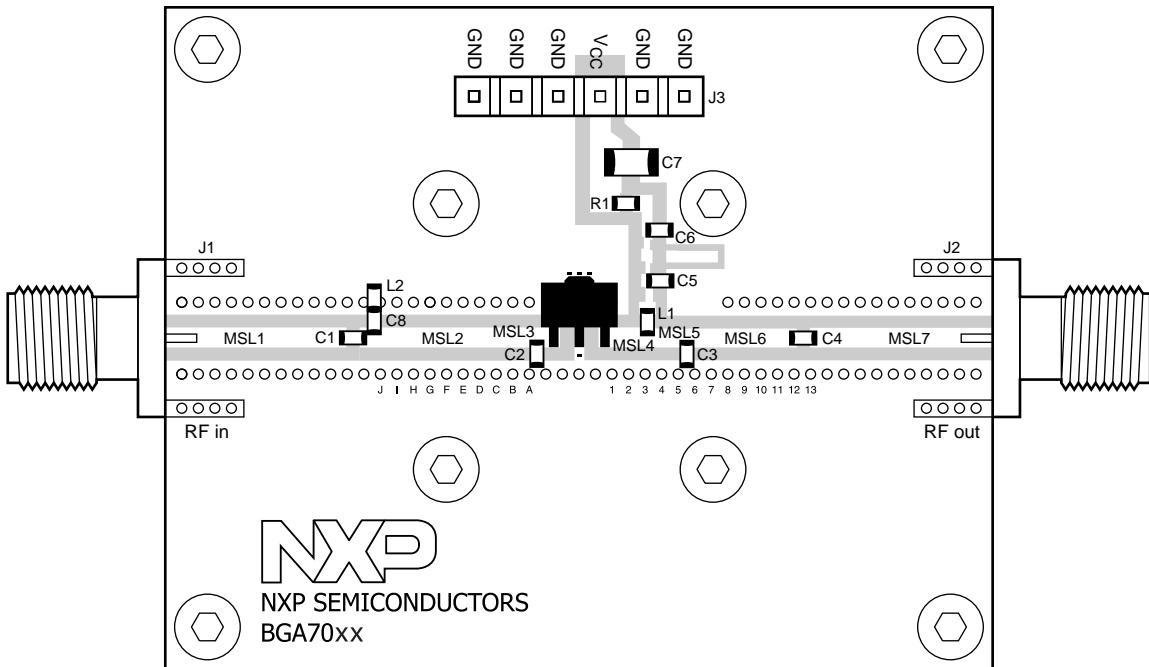
See Table 12 for a list of components.

Fig 16. 1930 MHz to 1990 MHz application reference board

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Table 12. List of components of 1930 MHz to 1990 MHz
See Figure 11 and Figure 16 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
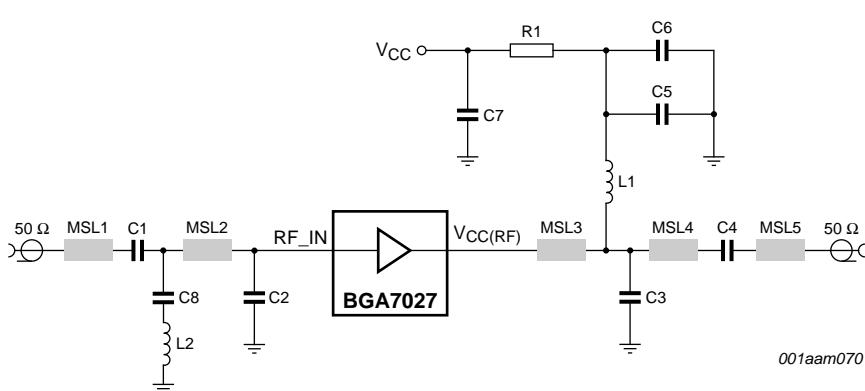
See Table 13 for a list of components.

PCB board specification:

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

Fig 17. 2110 MHz to 2170 MHz application schematic
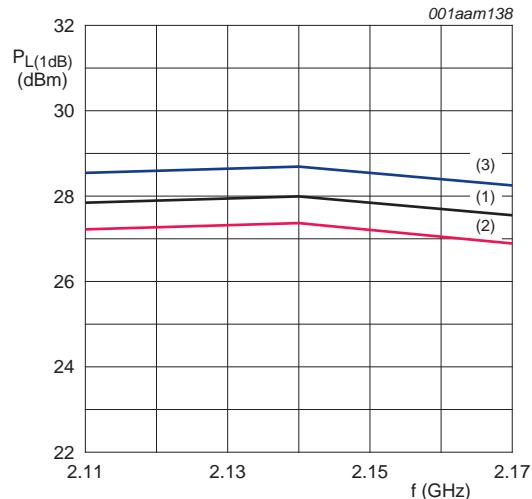
(1) $T_{case} = 25\ °C$.

(2) $T_{case} = 85\ °C$.

(3) $T_{case} = -40\ °C$.

Fig 18. Output power at 1 dB gain compression as a function of frequency
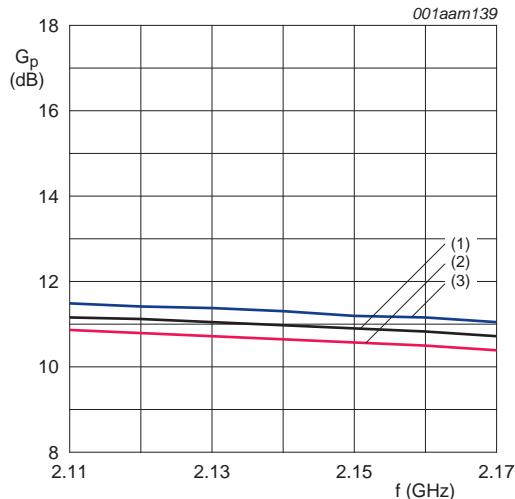
(1) $T_{case} = 25\ °C$.

(2) $T_{case} = 85\ °C$.

(3) $T_{case} = -40\ °C$.

Fig 19. Power gain as a function of frequency
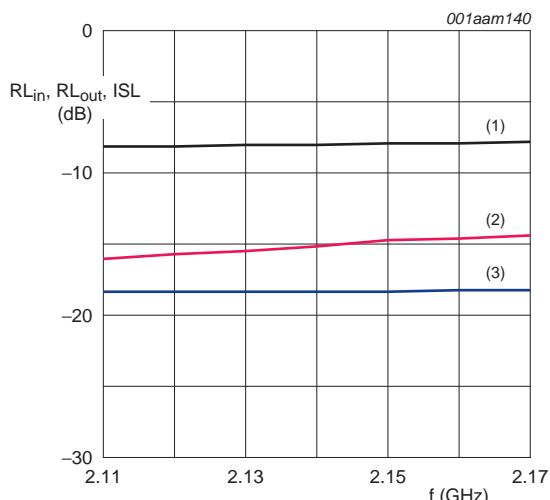
$T_{case} = 25\ °C$.

(1) RL_{in}.

(2) RL_{out}.

(3) ISL.

Fig 20. Input return loss, output return loss and isolation as a function of frequency
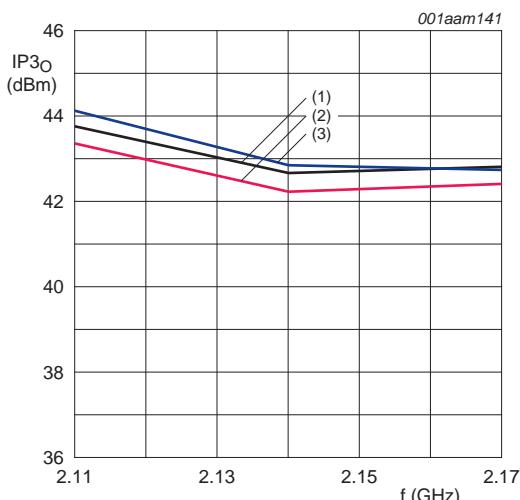
$P_L = 17\ dBm$; tone spacing = 1 MHz

(1) $T_{case} = 25\ °C$.

(2) $T_{case} = 85\ °C$.

(3) $T_{case} = -40\ °C$.

Fig 21. Output third-order intercept point as a function of frequency
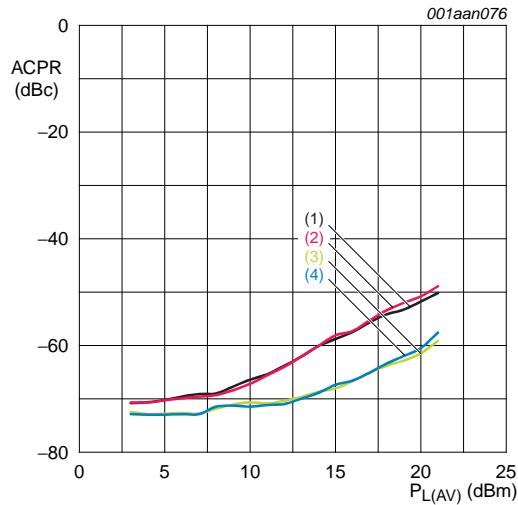
2-carrier W-CDMA; each carrier according to 3GPP test model 1; 64 DPCH; PAR for composite signal = 7.5 dB; 5 MHz carrier spacing.

(1) f = 2110 MHz; ACPR measured at f ± 5 MHz

(2) f = 2170 MHz; ACPR measured at f ± 5 MHz

(3) f = 2110 MHz; ACPR measured at f ± 10 MHz

(4) f = 2170 MHz; ACPR measured at f ± 10 MHz

Fig 22. Adjacent channel power ratio as a function of average output power
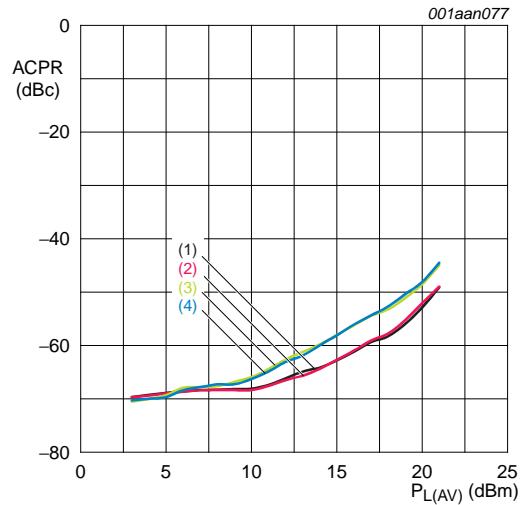
2-carrier W-CDMA; each carrier according to 3GPP test model 1; 64 DPCH; PAR for composite signal = 9 dB; 10 MHz carrier spacing.

(1) f = 2110 MHz; ACPR measured at f ± 5 MHz

(2) f = 2170 MHz; ACPR measured at f ± 5 MHz

(3) f = 2110 MHz; ACPR measured at f ± 10 MHz

(4) f = 2170 MHz; ACPR measured at f ± 10 MHz

Fig 23. Adjacent channel power ratio as a function of average output power
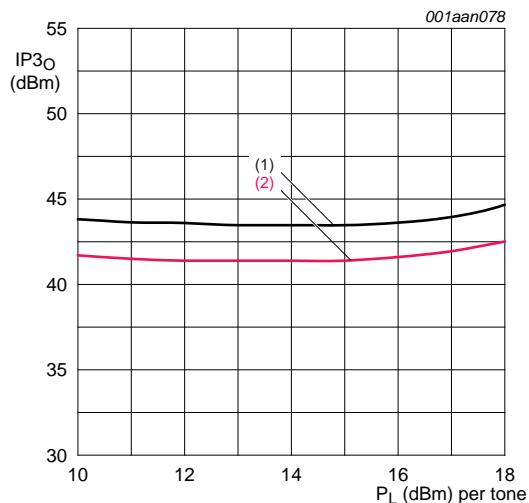
f = 2140 MHz; tone spacing = 1 MHz.

(1) Upper sideband

(2) Lower sideband

**Fig 24. Output third-order intercept point as a function of output power per tone**
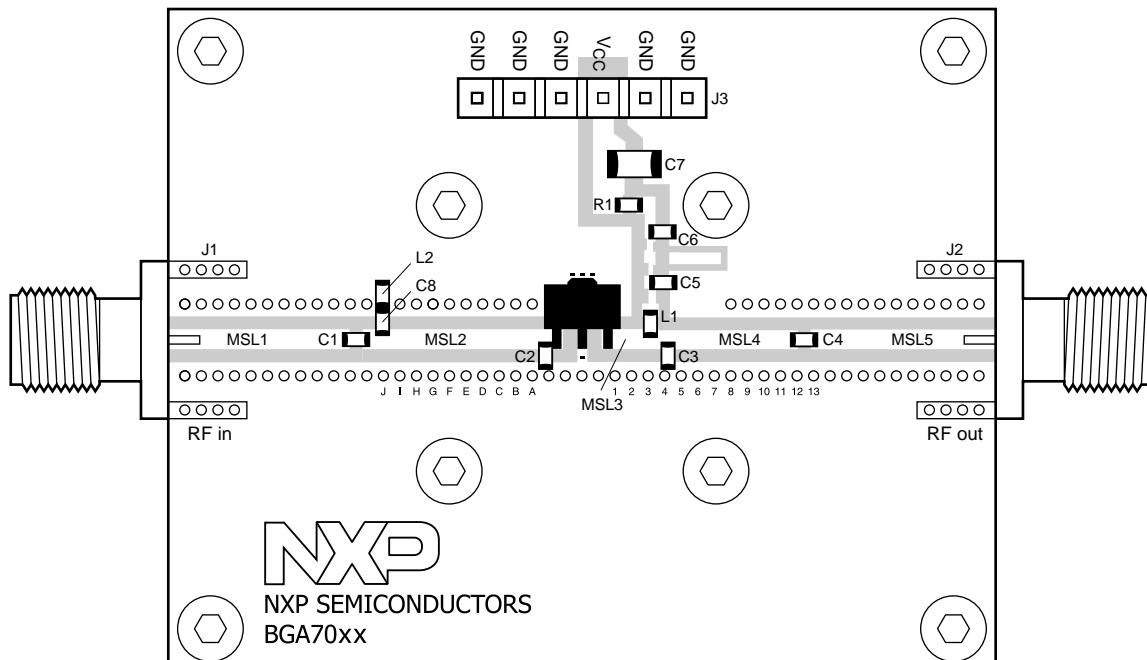
See Table 13 for a list of components.

Fig 25. 2110 MHz to 2170 MHz application reference board

BGA7027

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Table 13.   List of components of 2110 MHz to 2170 MHz
See Figure 17 and Figure 25 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 26.   PCB stack
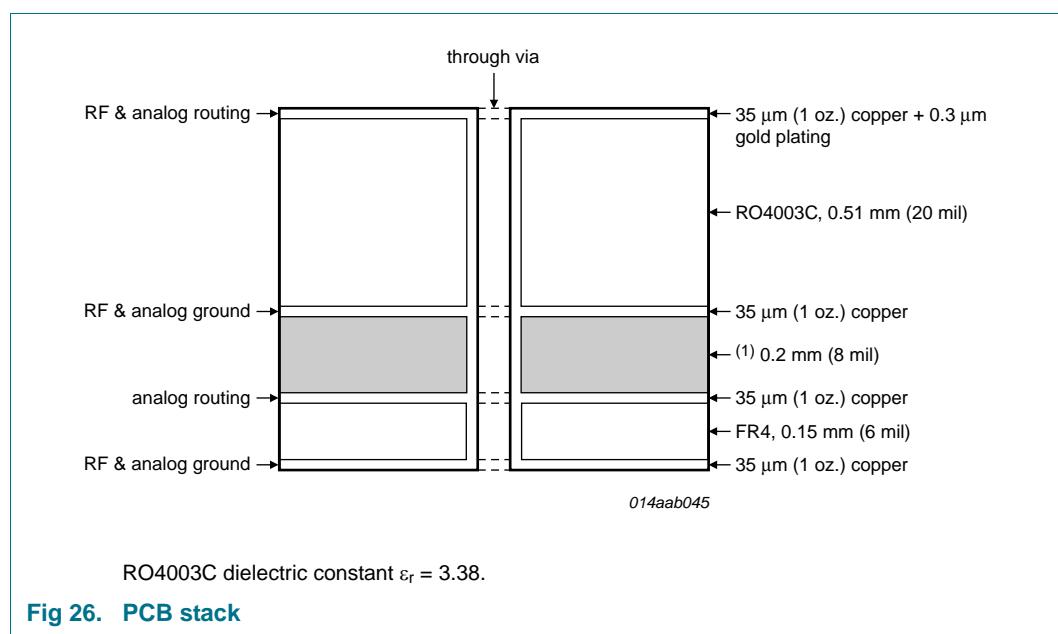
13. Package outline

**Plastic surface-mounted package; exposed die pad for good heat transfer; 3 leads**   **SOT89**
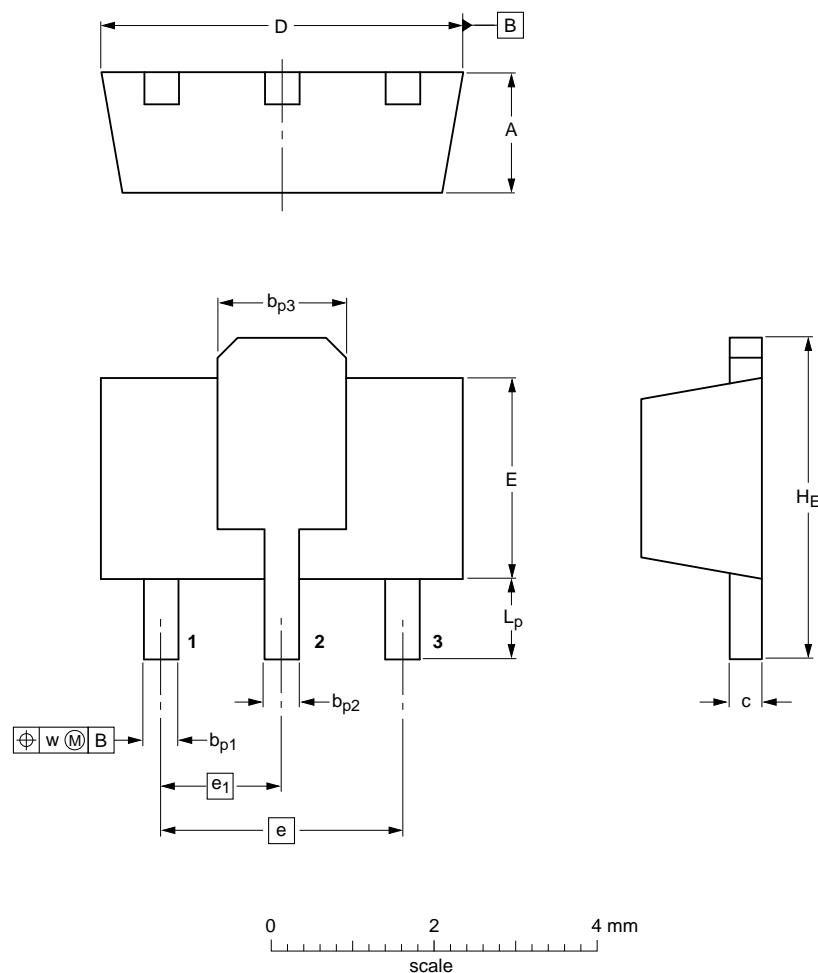
DIMENSIONS (mm are the original dimensions)

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 27. Package outline SOT89

14. Abbreviations

Table 14.   Abbreviations

Acronym	Description
3GPP	3rd Generation Partnership Project
CPE	Customer-Premises Equipment
DPCH	Dedicated Physical CHannel
ESD	ElectroStatic Discharge
HTOL	High Temperature Operating Life
IMD3	3rd-order InterModulation Distortion
ISM	Industrial, Scientific and Medical
MMIC	Monolithic Microwave Integrated Circuit
MoCA	Multimedia over Coax Alliance
RFID	Radio Frequency IDentification
W-CDMA	Wideband Code Division Multiple Access
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.2	20101126	Product data sheet	-	BGA7027 v.1
Modifications:	• The status of this data sheet has been changed to Product data sheet			
	• Table 1 on page 1: some values have been changed			
	• Table 1 on page 1: some values have been added			
	• Table 4 on page 3: data for $P_{i(RF)}$ have been added			
	• Table 5 on page 3: conditions have been changed			
	• Table 7 on page 3: some values have been changed			
	• Table 7 on page 3: some values have been added			
	• Figure 7 on page 7: figure has been added			
	• Figure 8 on page 7: figure has been added			
	• Figure 9 on page 8: figure has been added			
	• Figure 22 on page 14: figure has been added			
	• Figure 23 on page 14: figure has been added			
	• Figure 24 on page 14: figure has been added			
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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