BGA2815

MMIC wideband amplifier

Rev. 2 — 19 October 2010 **Product data sheet**

1. Product profile

1.1 General description

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

1.2 Features and benefits

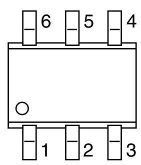
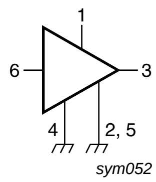
- Input internally matched to 50 Ω
- A gain of 25.8 dB at 250 MHz decreasing to 25.2 dB at 2150 MHz
- Output power at 1 dB gain compression = 6 dBm
- Supply current = 18.2 mA at a supply voltage of 3.3 V
- Reverse isolation > 36 dB up to 2 GHz
- Good linearity with low second order and third order products
- Noise figure = 3.8 dB at 950 MHz
- Unconditionally stable (K > 1)
- No output inductor required

1.3 Applications

- LNB IF amplifiers
- General purpose low noise wideband amplifier for frequencies between DC and 2.2 GHz

2. Pinning information

Table 1. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	V_{CC}		
2, 5	GND2		
3	RF_OUT		
4	GND1		
6	RF_IN		

3. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
BGA2815	-	plastic surface-mounted package; 6 leads	SOT363

4. Marking

Table 3. Marking

Type number	Marking code	Description
BGA2815	*E9	* = - : made in Hong Kong
		* = p : made in Hong Kong
		* = W : made in China
		* = t : made in Malaysia

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	RF input AC coupled	–0.5	3.6	V
I_{CC}	supply current		-	55	mA
P_{tot}	total power dissipation	T_{sp} = 90 °C	-	200	mW
T_{stg}	storage temperature		–40	+125	°C
T_j	junction temperature		-	125	°C
P_{drive}	drive power		-	–14	dBm

6. Thermal characteristics

Table 5. Thermal characteristics

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

7. Characteristics

Table 6. Characteristics

V_{CC} = 3.3 V; Z_S = Z_L = 50 Ω; P_i = –40 dBm; T_{amb} = 25 °C; measured on demo board; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		3.0	3.3	3.6	V
I_{CC}	supply current		15.7	18.2	21.1	mA

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Table 6. Characteristics *...continued*

V_{CC} = 3.3 V; $Z_S = Z_L$ = 50 Ω; P_i = –40 dBm; T_{amb} = 25 °C; measured on demo board; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
G_p	power gain	f = 250 MHz	25.2	25.8	26.4	dB
		f = 950 MHz	24.6	25.3	26.0	dB
		f = 2150 MHz	23.7	25.2	26.7	dB
RL_{in}	input return loss	f = 250 MHz	11	13	15	dB
		f = 950 MHz	11	13	15	dB
		f = 2150 MHz	14	21	28	dB
RL_{out}	output return loss	f = 250 MHz	16	20	25	dB
		f = 950 MHz	15	16	17	dB
		f = 2150 MHz	11	13	16	dB
ISL	isolation	f = 250 MHz	56	76	97	dB
		f = 950 MHz	46	48	49	dB
		f = 2150 MHz	33	36	38	dB
NF	noise figure	f = 250 MHz	3.2	3.7	4.2	dB
		f = 950 MHz	3.4	3.8	4.3	dB
		f = 2150 MHz	3.2	3.7	4.1	dB
B_{-3dB}	–3 dB bandwidth	3 dB below gain at 1 GHz	2.9	3.1	3.2	GHz
K	Rollett stability factor	f = 250 MHz	101	157	213	
		f = 950 MHz	5	6	8	
		f = 2150 MHz	1.1	1.8	2.4	
$P_{L(sat)}$	saturated output power	f = 250 MHz	7	8	8	dBm
		f = 950 MHz	3	5	6	dBm
		f = 2150 MHz	–1	1	2	dBm
$P_{L(1dB)}$	output power at 1 dB gain compression	f = 250 MHz	6	6	7	dBm
		f = 950 MHz	3	5	6	dBm
		f = 2150 MHz	–1	1	2	dBm
$IP3_I$	input third-order intercept point	P_{drive} = –38 dBm (for each tone)				
		f_1 = 250 MHz; f_2 = 251 MHz	–8	–6	–4	dBm
		f_1 = 950 MHz; f_2 = 951 MHz	–11	–8	–6	dBm
		f_1 = 2150 MHz; f_2 = 2151 MHz	–18	–15	–12	dBm
$IP3_O$	output third-order intercept point	P_{drive} = –38 dBm (for each tone)				
		f_1 = 250 MHz; f_2 = 251 MHz	18	20	22	dBm
		f_1 = 950 MHz; f_2 = 951 MHz	15	17	19	dBm
		f_1 = 2150 MHz; f_2 = 2151 MHz	7	10	13	dBm
$P_{L(2H)}$	second harmonic output power	P_{drive} = –35 dBm				
		f_{1H} = 250 MHz; f_{2H} = 500 MHz	–54	–52	–50	dBm
		f_{1H} = 950 MHz; f_{2H} = 1900 MHz	–46	–44	–43	dBm
$\Delta IM2$	second-order intermodulation distance	P_{drive} = –38 dBm (for each tone)				
		f_1 = 250 MHz; f_2 = 251 MHz	42	53	64	dBc
		f_1 = 950 MHz; f_2 = 951 MHz	39	51	62	dBc

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8. Application information

Figure 1 shows a typical application circuit for the BGA2815 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.

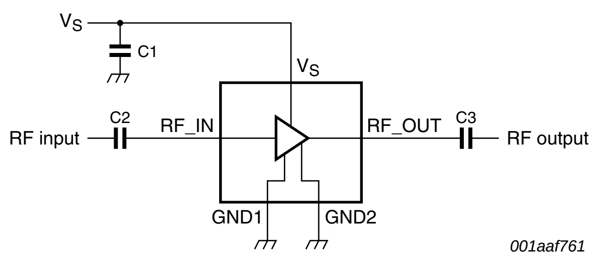
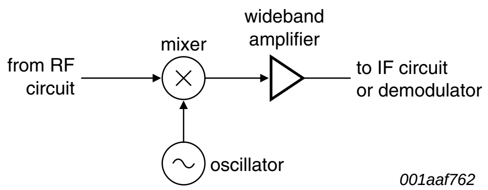


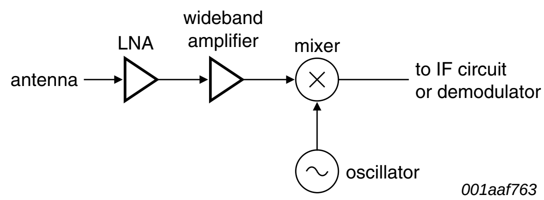
Fig 1. Typical application circuit

8.1 Application examples



The MMIC is very suitable as IF amplifier in e.g. LNB's. The excellent wideband characteristics make it an easy building block.

Fig 2. Application as IF amplifier



As second amplifier after an LNA, the MMIC offers an easy matching, low noise solution.

Fig 3. Application as RF amplifier

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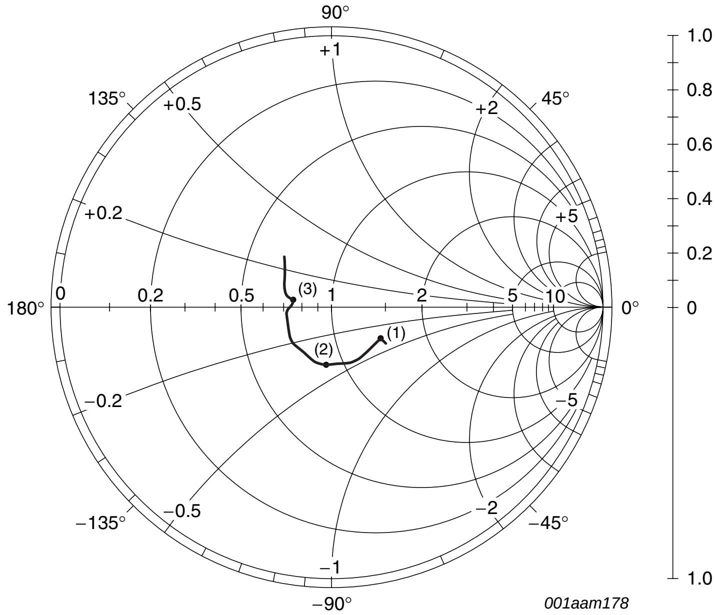
8.2 Graphs



T_{amb} = 25 °C; I_{CC} = 18.4 mA; V_{CC} = 3.3 V; Z_0 = 50 Ω.

(1) f = 250 MHz

(2) f = 950 MHz

(3) f = 2150 MHz

Fig 4. Input reflection coefficient (S_{11}); typical values

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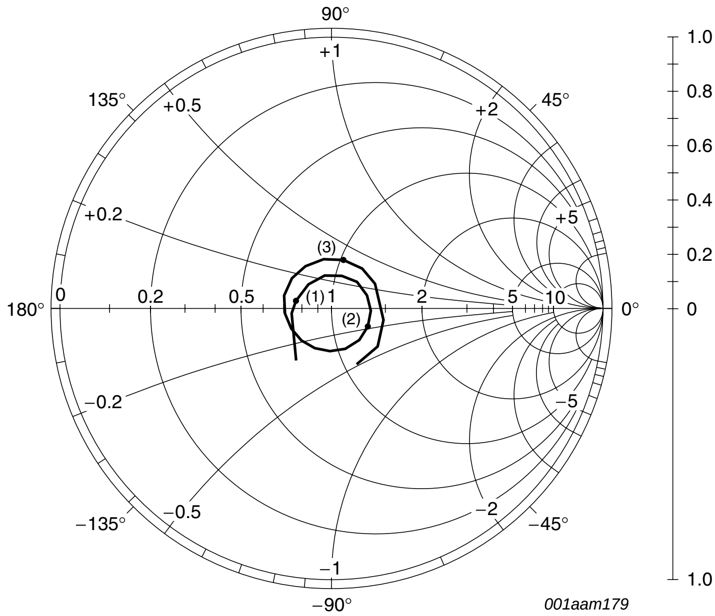

T_{amb} = 25 °C; I_{CC} = 18.4 mA; V_{CC} = 3.3 V; Z_0 = 50 Ω.

(1) f = 250 MHz

(2) f = 950 MHz

(3) f = 2150 MHz

Fig 5. Output reflection coefficient (S_{22}); typical values

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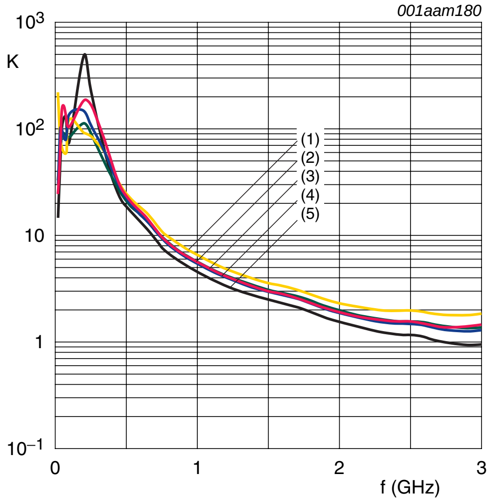


$P_{drive} = -40$ dBm; $Z_0 = 50\ \Omega$.

(1) $V_{CC} = 3.0$ V; $T_{amb} = 85$ °C; $I_{CC} = 15.93$ mA.

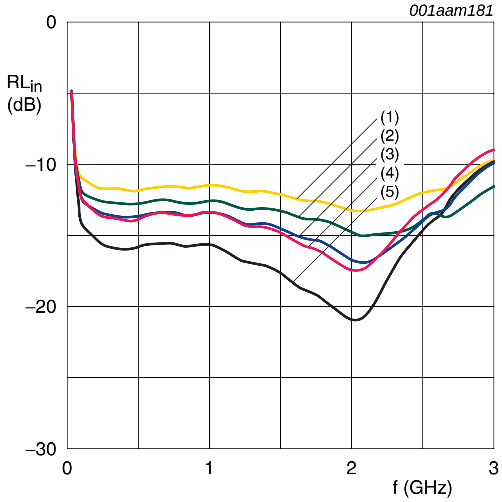
(2) $V_{CC} = 3.0$ V; $T_{amb} = -40$ °C; $I_{CC} = 16.12$ mA.

(3) $V_{CC} = 3.3$ V; $T_{amb} = 25$ °C; $I_{CC} = 18.41$ mA.

(4) $V_{CC} = 3.6$ V; $T_{amb} = 85$ °C; $I_{CC} = 20.11$ mA.

(5) $V_{CC} = 3.6$ V; $T_{amb} = -40$ °C; $I_{CC} = 20.23$ mA.

Fig 6. Rollett stability factor as function of frequency; typical values



$P_{drive} = -40$ dBm; $Z_0 = 50\ \Omega$.

(1) $V_{CC} = 3.0$ V; $T_{amb} = 85$ °C; $I_{CC} = 15.93$ mA.

(2) $V_{CC} = 3.0$ V; $T_{amb} = -40$ °C; $I_{CC} = 16.12$ mA.

(3) $V_{CC} = 3.3$ V; $T_{amb} = 25$ °C; $I_{CC} = 18.41$ mA.

(4) $V_{CC} = 3.6$ V; $T_{amb} = 85$ °C; $I_{CC} = 20.11$ mA.

(5) $V_{CC} = 3.6$ V; $T_{amb} = -40$ °C; $I_{CC} = 20.23$ mA.

Fig 7. Input return loss as function of frequency; typical values

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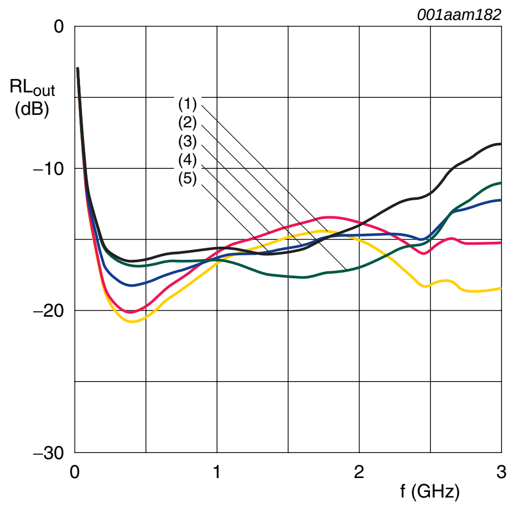


P_{drive} = −40 dBm; Z_0 = 50 Ω.

(1) V_{CC} = 3.0 V; T_{amb} = 85 °C; I_{CC} = 15.93 mA.

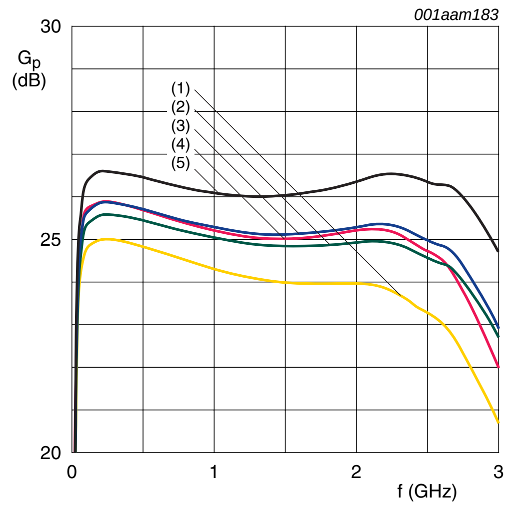
(2) V_{CC} = 3.0 V; T_{amb} = −40 °C; I_{CC} = 16.12 mA.

(3) V_{CC} = 3.3 V; T_{amb} = 25 °C; I_{CC} = 18.41 mA.

(4) V_{CC} = 3.6 V; T_{amb} = 85 °C; I_{CC} = 20.11 mA.

(5) V_{CC} = 3.6 V; T_{amb} = −40 °C; I_{CC} = 20.23 mA.

Fig 8. Output return loss as function of frequency; typical values



P_{drive} = −40 dBm; Z_0 = 50 Ω.

(1) V_{CC} = 3.0 V; T_{amb} = 85 °C; I_{CC} = 15.93 mA.

(2) V_{CC} = 3.0 V; T_{amb} = −40 °C; I_{CC} = 16.12 mA.

(3) V_{CC} = 3.3 V; T_{amb} = 25 °C; I_{CC} = 18.41 mA.

(4) V_{CC} = 3.6 V; T_{amb} = 85 °C; I_{CC} = 20.11 mA.

(5) V_{CC} = 3.6 V; T_{amb} = −40 °C; I_{CC} = 20.23 mA.

Fig 9. Insertion power gain as function of frequency; typical values

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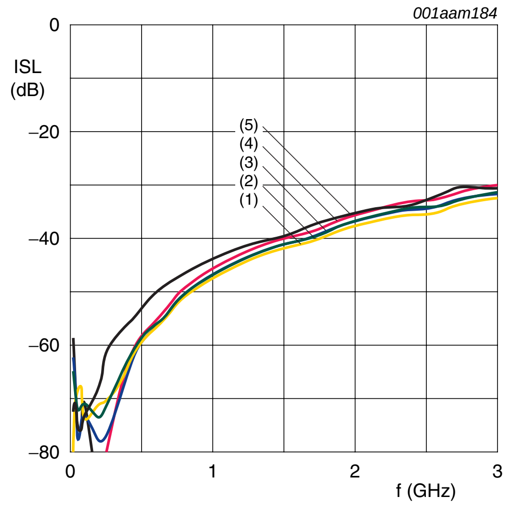
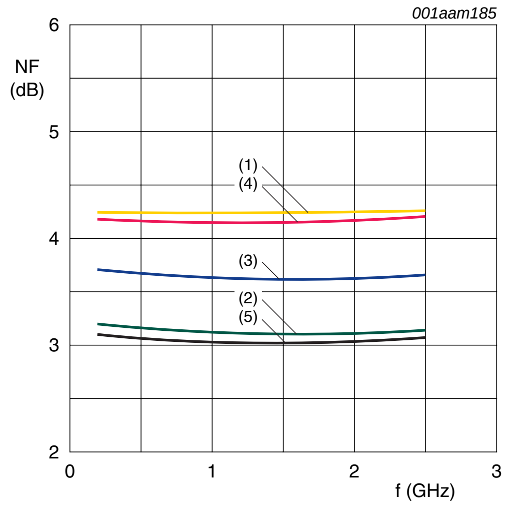


P_{drive} = −40 dBm; Z_0 = 50 Ω.

(1) V_{CC} = 3.0 V; T_{amb} = 85 °C; I_{CC} = 15.93 mA.
(2) V_{CC} = 3.0 V; T_{amb} = −40 °C; I_{CC} = 16.12 mA.
(3) V_{CC} = 3.3 V; T_{amb} = 25 °C; I_{CC} = 18.41 mA.
(4) V_{CC} = 3.6 V; T_{amb} = 85 °C; I_{CC} = 20.11 mA.
(5) V_{CC} = 3.6 V; T_{amb} = −40 °C; I_{CC} = 20.23 mA.

Fig 10. Isolation as function of frequency; typical values



Z_0 = 50 Ω.

(1) V_{CC} = 3.0 V; T_{amb} = 85 °C; I_{CC} = 15.93 mA.
(2) V_{CC} = 3.0 V; T_{amb} = −40 °C; I_{CC} = 16.12 mA.
(3) V_{CC} = 3.3 V; T_{amb} = 25 °C; I_{CC} = 18.41 mA.
(4) V_{CC} = 3.6 V; T_{amb} = 85 °C; I_{CC} = 20.11 mA.
(5) V_{CC} = 3.6 V; T_{amb} = −40 °C; I_{CC} = 20.23 mA.

Fig 11. Noise figure as function of frequency; typical values

8.3 Tables

Table 7. Supply current over temperature and supply voltages

Typical values.

Symbol	Parameter	Conditions	T_{amb} (°C)			Unit
			-40	**25**	**85**	
I_{CC}	supply current	V_{CC} = 3.0 V	16.12	16.34	15.93	mA
		V_{CC} = 3.3 V	18.76	18.41	17.95	mA
		V_{CC} = 3.6 V	20.23	19.91	20.11	mA

Table 8. Second harmonic output power over temperature and supply voltages

Typical values.

Symbol	Parameter	Conditions	T_{amb} (°C)			Unit
			-40	**25**	**85**	
$P_{L(2H)}$	second harmonic output power	f = 250 MHz; P_{drive} = −35 dBm				
		V_{CC} = 3.0 V	−49	−51	−53	dBm
		V_{CC} = 3.3 V	−51	−53	−54	dBm
		V_{CC} = 3.6 V	−52	−54	−55	dBm
		f = 950 MHz; P_{drive} = −35 dBm				
		V_{CC} = 3.0 V	−43	−44	−45	dBm
		V_{CC} = 3.3 V	−43	−44	−45	dBm
		V_{CC} = 3.6 V	−43	−44	−45	dBm

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Table 9. Input power at 1 dB gain compression over temperature and supply voltages

Typical values.

Symbol	Parameter	Conditions	T_{amb} (°C)			Unit
			-40	25	85	
$P_{i(1dB)}$	input power at 1 dB gain compression	f = 250 MHz				
		V_{CC} = 3.0 V	–19	–19	–19	dBm
		V_{CC} = 3.3 V	–18	–18	–19	dBm
		V_{CC} = 3.6 V	–18	–18	–18	dBm
		f = 950 MHz				
		V_{CC} = 3.0 V	–19	–20	–20	dBm
		V_{CC} = 3.3 V	–19	–19	–20	dBm
		V_{CC} = 3.6 V	–19	–19	–20	dBm
		f = 2150 MHz				
		V_{CC} = 3.0 V	–22	–23	–24	dBm
		V_{CC} = 3.3 V	–23	–23	–24	dBm
		V_{CC} = 3.6 V	–23	–23	–24	dBm

Table 10. Output power at 1 dB gain compression over temperature and supply voltages

Typical values.

Symbol	Parameter	Conditions	T_{amb} (°C)			Unit
			-40	25	85	
$P_{L(1dB)}$	output power at 1 dB gain compression	f = 250 MHz				
		V_{CC} = 3.0 V	6	6	5	dBm
		V_{CC} = 3.3 V	7	7	6	dBm
		V_{CC} = 3.6 V	8	7	6	dBm
		f = 950 MHz				
		V_{CC} = 3.0 V	5	4	3	dBm
		V_{CC} = 3.3 V	5	5	4	dBm
		V_{CC} = 3.6 V	6	5	4	dBm
		f = 2150 MHz				
		V_{CC} = 3.0 V	2	0	–2	dBm
		V_{CC} = 3.3 V	2	1	–1	dBm
		V_{CC} = 3.6 V	3	1	0	dBm

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Table 11. Saturated output power over temperature and supply voltages
Typical values.

Symbol	Parameter	Conditions	T_{amb} (°C)			Unit
			-40	25	85	
$P_{L(sat)}$	saturated output power	f = 250 MHz				
		V_{CC} = 3.0 V	7	7	7	dBm
		V_{CC} = 3.3 V	8	8	7	dBm
		V_{CC} = 3.6 V	9	9	8	dBm
		f = 950 MHz				
		V_{CC} = 3.0 V	5	4	3	dBm
		V_{CC} = 3.3 V	5	5	4	dBm
		V_{CC} = 3.6 V	6	5	4	dBm
		f = 2150 MHz				
		V_{CC} = 3.0 V	2	1	–1	dBm
		V_{CC} = 3.3 V	3	1	–1	dBm
		V_{CC} = 3.6 V	3	2	0	dBm

Table 12. Second-order intermodulation distance over temperature and supply voltages
Typical values.

Symbol	Parameter	Conditions	T_{amb} (°C)			Unit
			-40	25	85	
ΔIM2	second-order intermodulation distance	f_1 = 250 MHz; f_2 = 251 MHz; P_{drive} = –38 dBm				
		V_{CC} = 3.0 V	43	47	51	dBc
		V_{CC} = 3.3 V	50	55	58	dBc
		V_{CC} = 3.6 V	58	62	57	dBc
		f_1 = 950 MHz; f_2 = 951 MHz; P_{drive} = –38 dBm				
		V_{CC} = 3.0 V	41	44	49	dBc
		V_{CC} = 3.3 V	49	53	60	dBc
		V_{CC} = 3.6 V	58	64	56	dBc

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Table 13. Output third-order intercept point over temperature and supply voltages

Typical values.

Symbol	Parameter	Conditions	T_{amb} (°C)			Unit
			-40	25	85	
$IP3_O$	output third-order intercept point	f_1 = 250 MHz; f_2 = 251 MHz; P_{drive} = −38 dBm				
		V_{CC} = 3.0 V	18	20	18	dBm
		V_{CC} = 3.3 V	20	20	19	dBm
		V_{CC} = 3.6 V	23	21	20	dBm
		f_1 = 950 MHz; f_2 = 951 MHz; P_{drive} = −38 dBm				
		V_{CC} = 3.0 V	18	16	14	dBm
		V_{CC} = 3.3 V	19	18	16	dBm
		V_{CC} = 3.6 V	20	19	17	dBm
		f_1 = 2150 MHz; f_2 = 2151 MHz; P_{drive} = −38 dBm				
		V_{CC} = 3.0 V	12	10	8	dBm
		V_{CC} = 3.3 V	12	11	8	dBm
		V_{CC} = 3.6 V	13	11	8	dBm

Table 14. −3 dB bandwidth over temperature and supply voltages

Typical values.

Symbol	Parameter	Conditions	T_{amb} (°C)			Unit
			-40	25	85	
B_{-3dB}	−3 dB bandwidth	V_{CC} = 3.0 V	3.085	3.017	2.912	GHz
		V_{CC} = 3.3 V	3.162	3.065	2.957	GHz
		V_{CC} = 3.6 V	3.219	3.094	2.975	GHz

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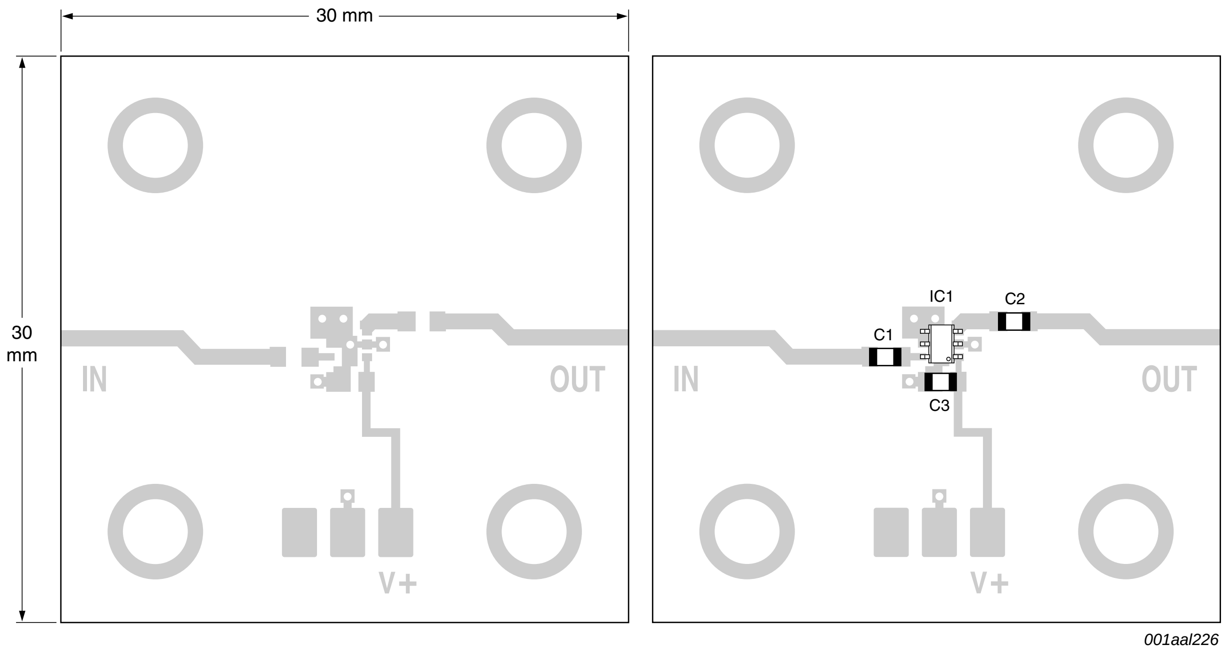
9. Test information



True size = 30 mm × 30 mm.

Fig 12. PCB layout and demo board with components

Table 15. 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	BGA2815 MMIC		SOT363

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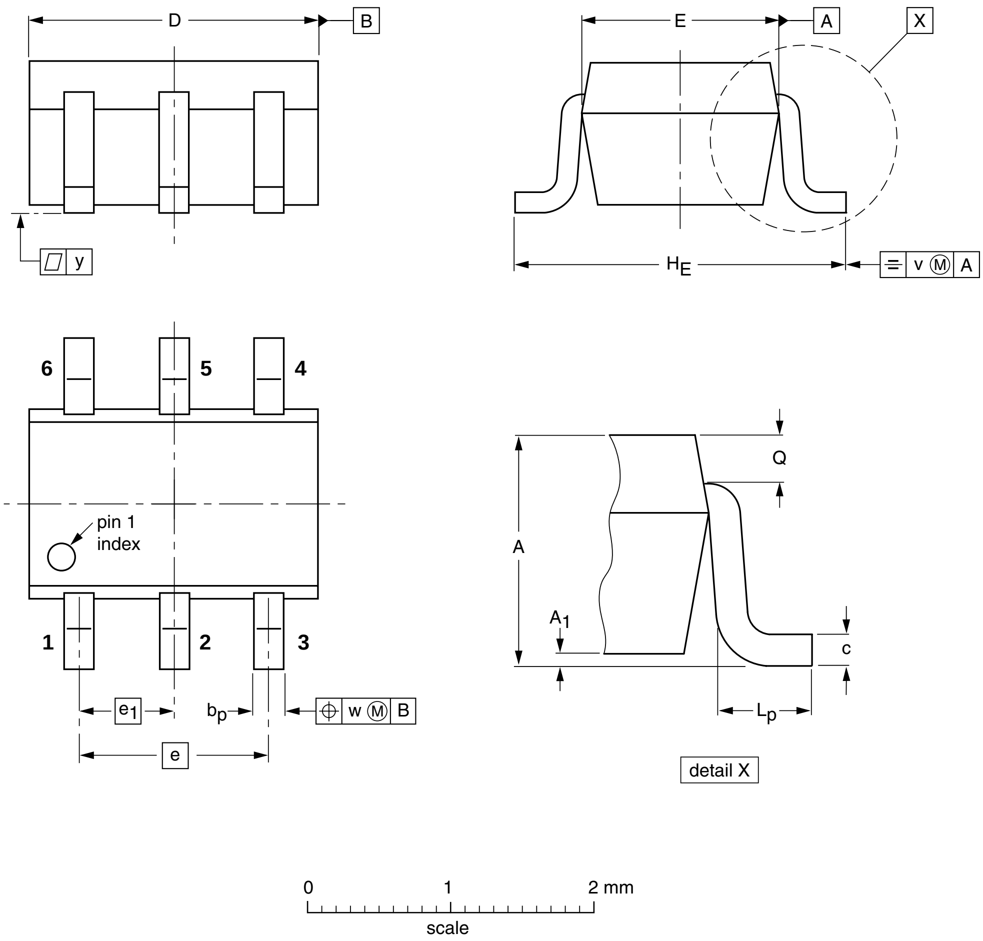
10. Package outline

Plastic surface-mounted package; 6 leads **SOT363**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT363			SC-88			~~04-11-08~~ 06-03-16

Fig 13. Package outline SOT363

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11. Abbreviations

Table 16. 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 17. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGA2815 v.2	20101019	Product data sheet	-	BGA2815 v.1
Modifications	• Table 4 on page 2: The minimum value for V_{CC} has been changed to −0.5 V			
BGA2815 v.1	20100625	Product data sheet	-	-

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13. Legal information

13.1 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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15. Contents

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