

# BLM8D1822S-50PB; BLM8D1822S-50PBG

LDMOS 2-stage integrated Doherty MMIC

Rev. 3 — 23 November 2017

AMPLEON

Product data sheet

## 1. Product profile

### 1.1 General description

The BLM8D1822S-50PB(G) is a dual section, 2-stage fully integrated Doherty MMIC solution using Ampleon's state of the art GEN8 LDMOS technology. The carrier and peaking device, input splitter and output combiner are integrated in a single package. This multiband device is perfectly suited as general purpose driver or small cell final in the frequency range from 1805 MHz to 2170 MHz. Available in gull wing or flat lead outline.

**Table 1. Performance**

Typical RF performance at  $T_{case} = 25\text{ }^{\circ}\text{C}$ ;  $I_{Dq} = 104\text{ mA}$  (carrier);  $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.65\text{ V}$ .  
Test signal: 3GPP test model 1; 64 DPCH; PAR = 9.9 dB at 0.01% probability on CCDF; per section.

Test signal	f	V <sub>DS</sub>	P <sub>L(AV)</sub>	G <sub>p</sub>	$\eta_D$	ACPR <sub>5M</sub>
	(MHz)	(V)	(W)	(dB)	(%)	(dBc)
single carrier W-CDMA	2167.5	28	5	26.5	37	-34

### 1.2 Features and benefits

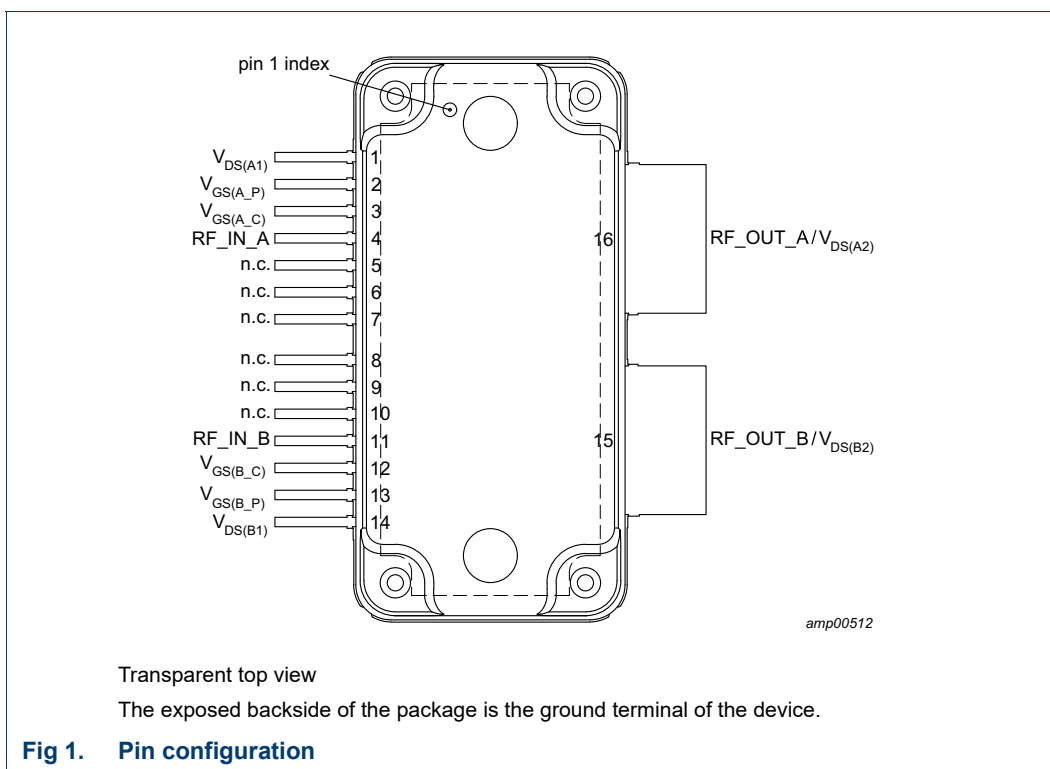
- Integrated input splitter
- Integrated output combiner
- High efficiency
- Designed for broadband operation (frequency 1805 MHz to 2170 MHz)
- High section-to-section isolation enabling multiple combinations
- Integrated temperature compensated bias
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Excellent thermal stability
- Source impedance 50  $\Omega$ ; high power gain
- Compliant to Directive 2002/95/EC, regarding restriction of hazardous substances (RoHS)

### 1.3 Applications

- RF power MMIC for multi-carrier and multi-standard GSM, W-CDMA and LTE base stations in the 1805 MHz to 2170 MHz frequency range. Possible circuit topologies are the following as also depicted in [Section 8.1](#):
  - ◆ Dual section or single ended
  - ◆ Quadrature combined
  - ◆ Push-pull

## 2. Pinning information

### 2.1 Pinning



### 2.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$V_{DS(A1)}$	1	drain-source voltage of driver stages of section A
$V_{GS(A_P)}$	2	gate-source voltage of peaking A_P
$V_{GS(A_C)}$	3	gate-source voltage of carrier A_C
RF_IN_A	4	RF input section A
n.c.	5	not connected
n.c.	6	not connected
n.c.	7	not connected

Table 2. Pin description ...continued

Symbol	Pin	Description
n.c.	8	not connected
n.c.	9	not connected
n.c.	10	not connected
RF_IN_B	11	RF input section B
$V_{GS(B\_C)}$	12	gate-source voltage of carrier B_C
$V_{GS(B\_P)}$	13	gate-source voltage of peaking B_P
$V_{DS(B1)}$	14	drain-source voltage of driver stages of section B
RF_OUT_B/ $V_{DS(B2)}$	15	RF output section B / drain-source voltage of final stages of section B
RF_OUT_A/ $V_{DS(A2)}$	16	RF output section A / drain-source voltage of final stages of section A
GND	flange	RF ground

### 3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
BLM8D1822S-50PB	-	plastic, heatsink small outline package; 16 leads (flat)	SOT1211-3
BLM8D1822S-50PBG	-	plastic, heatsink small outline package; 16 leads	SOT1212-3

### 4. Block diagram

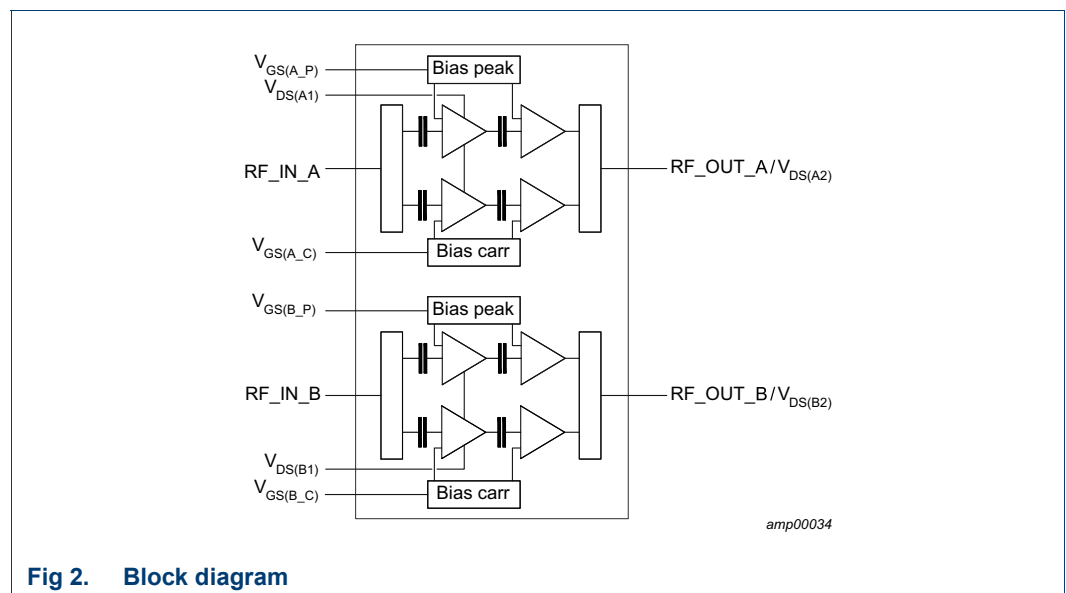


Fig 2. Block diagram

## 5. Limiting values

**Table 4. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage		-	65	V
$V_{GS}$	gate-source voltage		-0.5	+13	V
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature	[1]	-	225	°C
$T_{case}$	case temperature		-	150	°C

[1] Continuous use at maximum temperature will affect the reliability. For details refer to the online MTF calculator.

## 6. Thermal characteristics

**Table 5. Thermal characteristics**

Measured for total device.

Symbol	Parameter	Conditions	Value	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	$T_{case} = 90\text{ °C}; P_L = 10\text{ W}$ [1]	1.06	K/W
		$T_{case} = 90\text{ °C}; P_L = 20\text{ W}$ [1]	0.86	K/W

[1] When operated with a 1-carrier W-CDMA with PAR = 8 dB.

## 7. Characteristics

**Table 6. DC characteristics**

$T_{case} = 25\text{ °C}$ ; per section unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Carrier</b>						
$V_{GSq}$	gate-source quiescent voltage	$V_{DS} = 28\text{ V}; I_D = 104\text{ mA}$	1.6	2.1	2.5	V
$I_{DSX}$	drain cut-off current	$V_{GS} = 5.65\text{ V}; V_{DS} = 10\text{ V}$ [1]	-	2.60	-	A
		$V_{GS} = 5.65\text{ V}; V_{DS} = 10\text{ V}$ [2]	-	0.52	-	A
$I_{GSS}$	gate leakage current	$V_{GS} = 1\text{ V}; V_{DS} = 0\text{ V}$	-	-	140	nA
<b>Peaking</b>						
$I_{DSX}$	drain cut-off current	$V_{GS} = 5.65\text{ V}; V_{DS} = 10\text{ V}$ [1]	-	2.74	-	A
		$V_{GS} = 5.65\text{ V}; V_{DS} = 10\text{ V}$ [2]	-	0.57	-	A
$I_{GSS}$	gate leakage current	$V_{GS} = 1\text{ V}; V_{DS} = 0\text{ V}$	-	-	140	nA
<b>Final stages</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}; I_D = 300\text{ mA}$	65	-	-	V
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}; V_{DS} = 28\text{ V}$	-	-	1.4	μA
<b>Driver stages</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}; I_D = 60\text{ mA}$	65	-	-	V
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}; V_{DS} = 28\text{ V}$	-	-	1.4	μA

[1] Final stage.

[2] Driver stage.

**Table 7. RF Characteristics**

Typical RF performance at  $T_{case} = 25\text{ °C}$ ;  $V_{DS} = 28\text{ V}$ ;  $I_{Dq} = 104\text{ mA}$  (carrier);  
 $V_{GSq(peak)} = V_{GSq(carrier)} - 0.65\text{ V}$ ;  $P_{L(AV)} = 5\text{ W}$ . Unless otherwise specified, measured in an Ampleon straight lead production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Test signal: single carrier W-CDMA [1]</b>						
G <sub>p</sub>	power gain	f = 1807.5 MHz	-	26	-	dB
		f = 2167.5 MHz	24.5	26.5	28.5	dB
η <sub>D</sub>	drain efficiency	f = 2167.5 MHz	31	37	-	%
RL <sub>in</sub>	input return loss	f = 2167.5 MHz	-	-19	-10	dB
ACPR <sub>5M</sub>	adjacent channel power ratio (5 MHz)	f = 2167.5 MHz	-	-34	-26	dBc
PAR <sub>O</sub>	output peak-to-average ratio	f = 2167.5 MHz	6.7	7.8	-	dB

[1] 3GPP test model 1; 64 DPCH; PAR = 9.9 dB at 0.01% probability on CCDF.

## 8. Application information

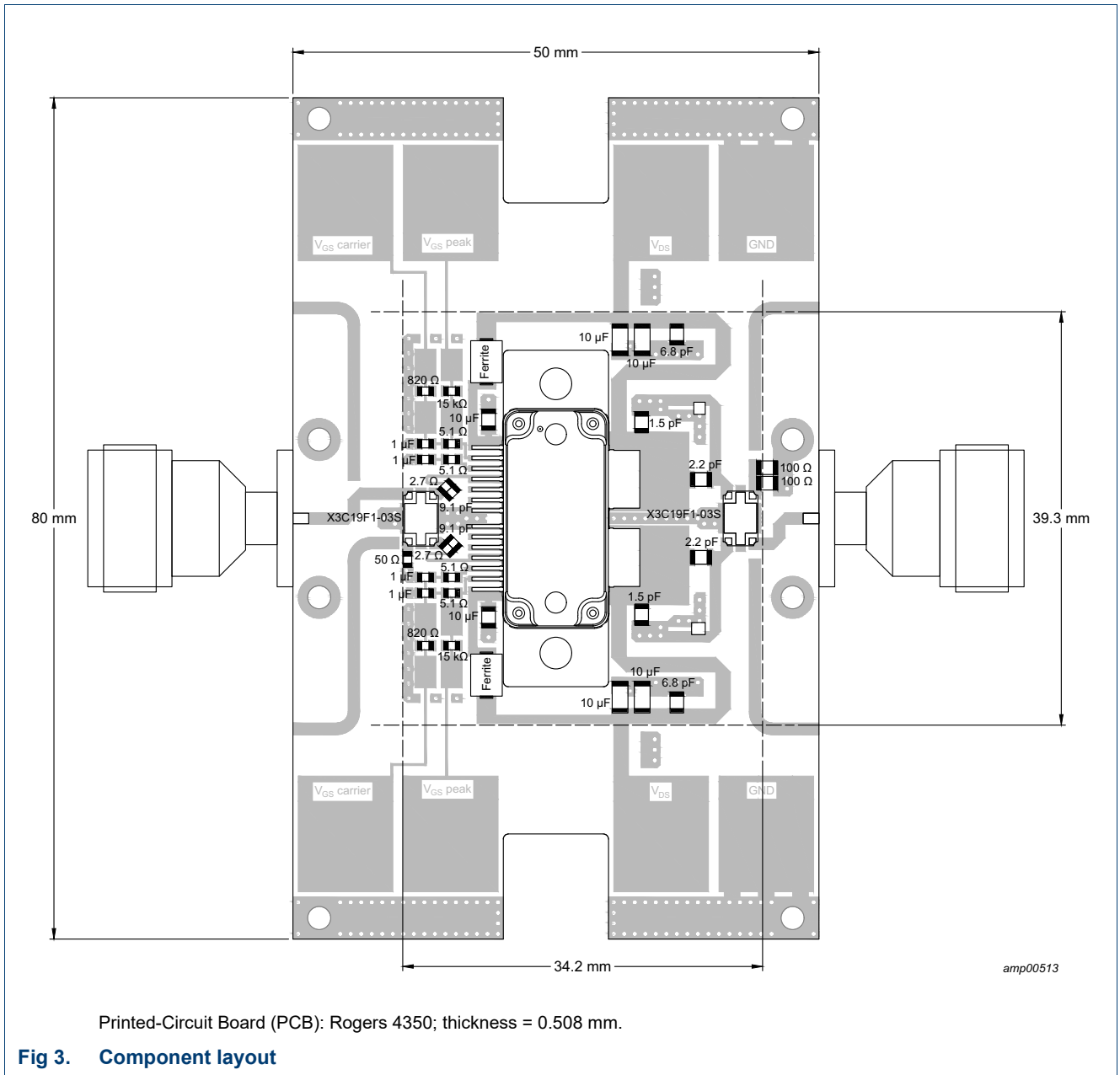
**Table 8. Typical performance**

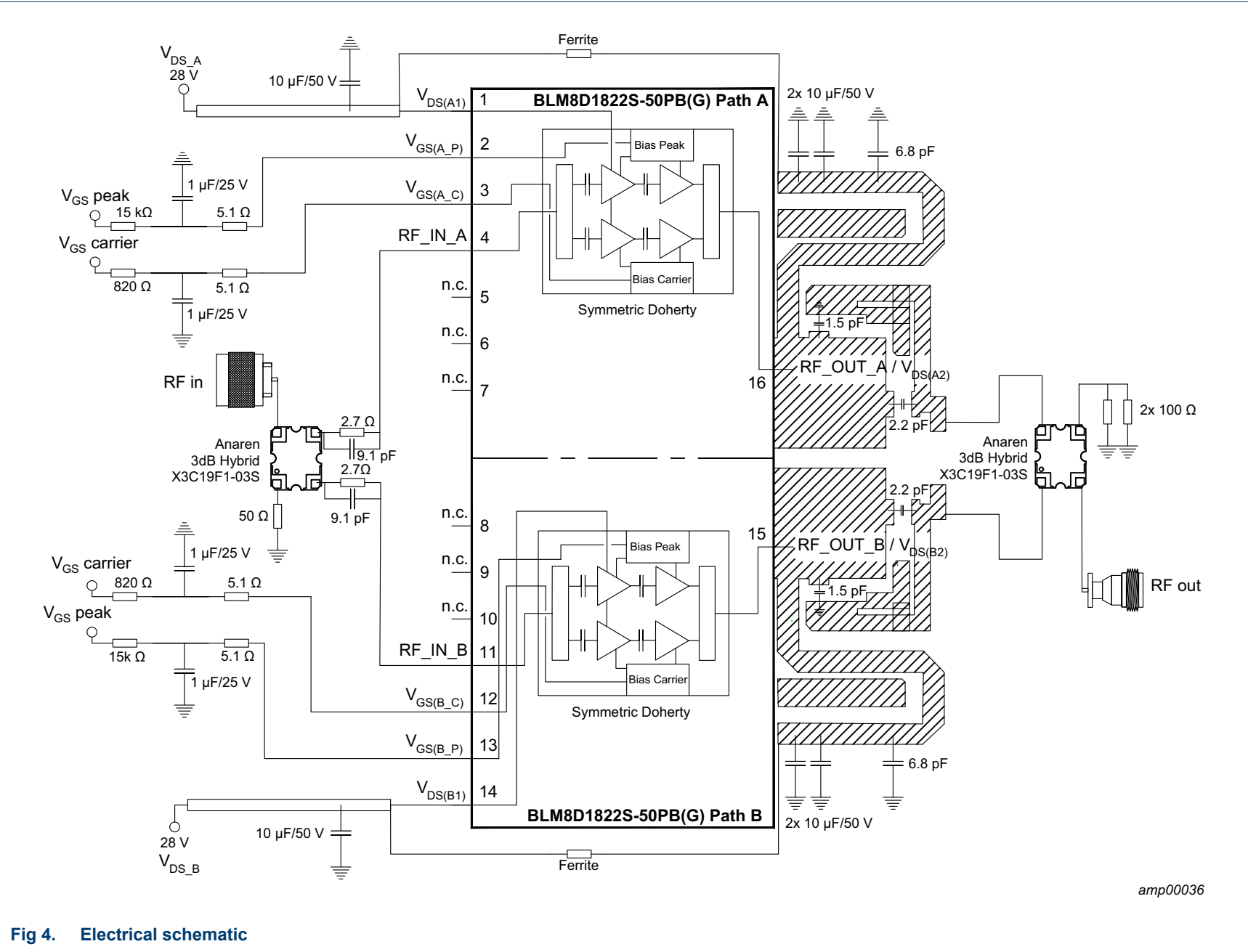
$T_{case} = 25\text{ °C}$ ;  $V_{DS} = 28\text{ V}$ ;  $I_{Dq} = 190\text{ mA}$  (carrier and peaking). Test signal: 1-carrier W-CDMA; test model 1; 64 DPCH; PAR = 9.9 dB at 0.01 % probability CCDF; unless otherwise specified, measured in an Ampleon f = 1805 MHz to 2170 MHz combined integrated Doherty application circuit (see [Figure 3](#) for the component layout and [Figure 4](#) for the electrical schematic).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P <sub>L(1dB)</sub>	output power at 1 dB gain compression	f = 1960 MHz [1]	-	48.4	-	dBm
φ <sub>s21</sub> /φ <sub>s21(norm)</sub>	normalized phase response	at 3 db compression point; f = 1960 MHz [1]	-	-0.4	-	°
η <sub>D</sub>	drain efficiency	8 db OBO (P <sub>L</sub> = 40.4 dBm); f = 1960 MHz	-	38.9	-	%
G <sub>p</sub>	power gain	P <sub>L(AV)</sub> = 40.4 dBm; f = 1960 MHz	-	25	-	dB
B <sub>video</sub>	video bandwidth	P <sub>L(AV)</sub> set to obtain IMD3 = -30 dBc; 2-tone CW; f = 1960 MHz	-	185	-	MHz
G <sub>flat</sub>	gain flatness	P <sub>L(AV)</sub> = 40.4 dBm; f = 1805 MHz to 2170 MHz	-	1	-	dB
ACPR <sub>5M</sub>	adjacent channel power ratio (5M)	P <sub>L(AV)</sub> = 40.4 dBm; f = 1960 MHz	-	-38.2	-	dB
ΔG/ΔT	gain variation with temperature	f = 2140 MHz	-	0.04	-	dB/°C
S <sub>12</sub>   <sup>2</sup>	isolation	between sections A and B; P <sub>L(AV)</sub> = 15.2 dBm; f = 2140 MHz; measured on dual section evaluation board	-	24	-	dB
K	Rollett stability factor	T <sub>case</sub> = -40 °C; f = 0.3 GHz to 3 GHz [2]	-	>3	-	

[1] 25 ms CW power sweep measurement.

[2] For both sections (S-parameters measured with load pull jig).





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Fig 4. Electrical schematic

8.1 Possible circuit topologies

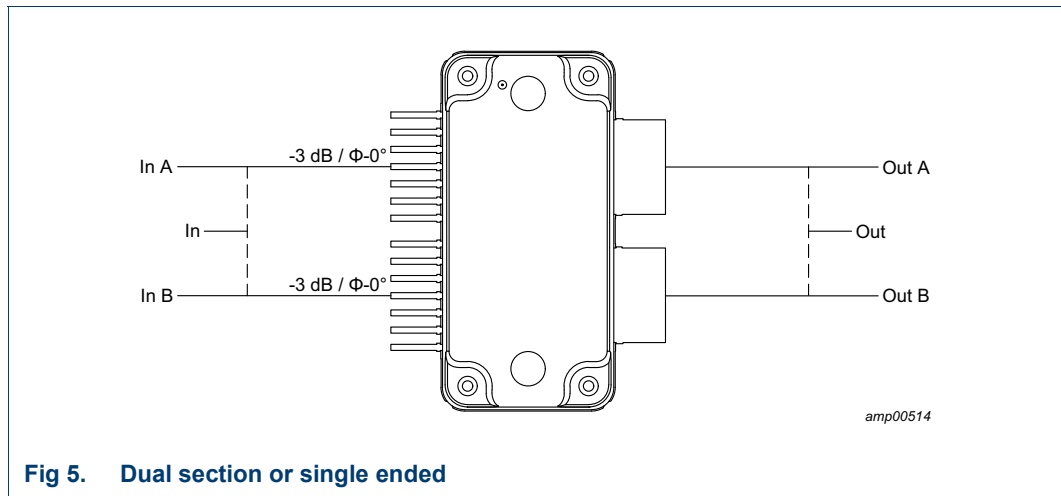


Fig 5. Dual section or single ended

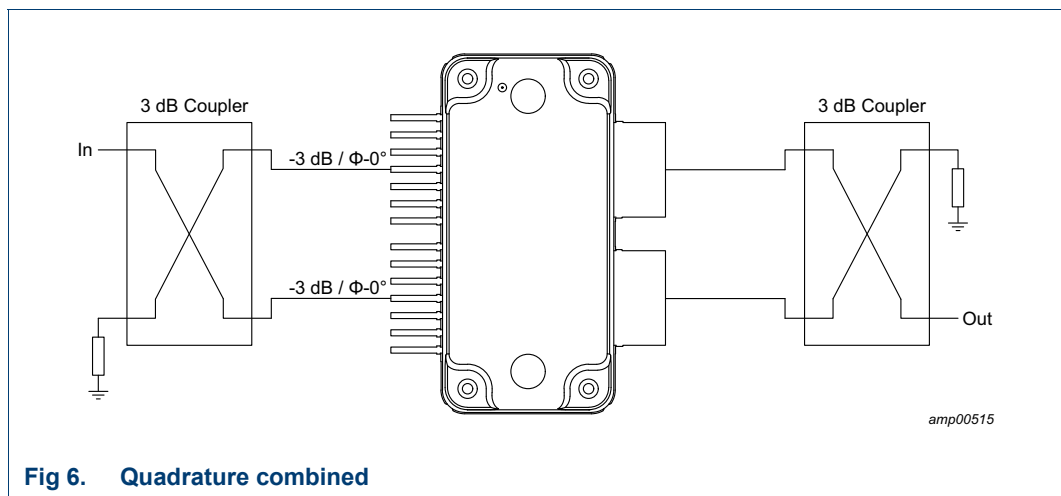


Fig 6. Quadrature combined

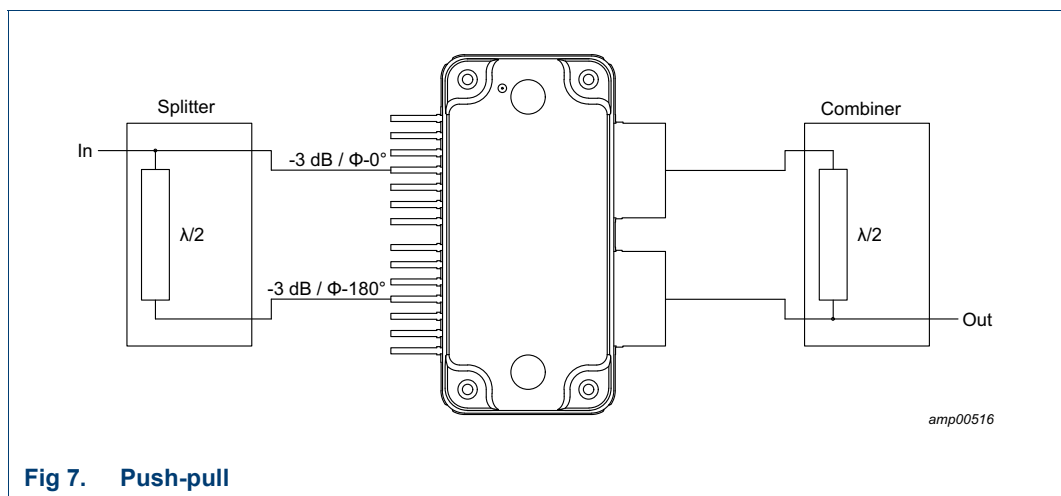


Fig 7. Push-pull



### 8.2 Ruggedness in a Doherty operation

The BLM8D1822S-50PB and BLM8D1822S-50PBG are capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions:  $V_{DS} = 32\text{ V}$ ;  $I_{Dq} = 104\text{ mA}$  (carrier);  $V_{GSq(peak)} = V_{GSq(carrier)} - 0.65\text{ V}$ ;  $P_i$  corresponding to  $P_{L(3dB)}$  under  $Z_S = 50\ \Omega$  load;  $f = 2140\text{ MHz}$  (CW);  $T_{case} = 25\text{ }^\circ\text{C}$  per section unless otherwise specified

### 8.3 Impedance information

**Table 9. Typical impedance for optimum Doherty operation**

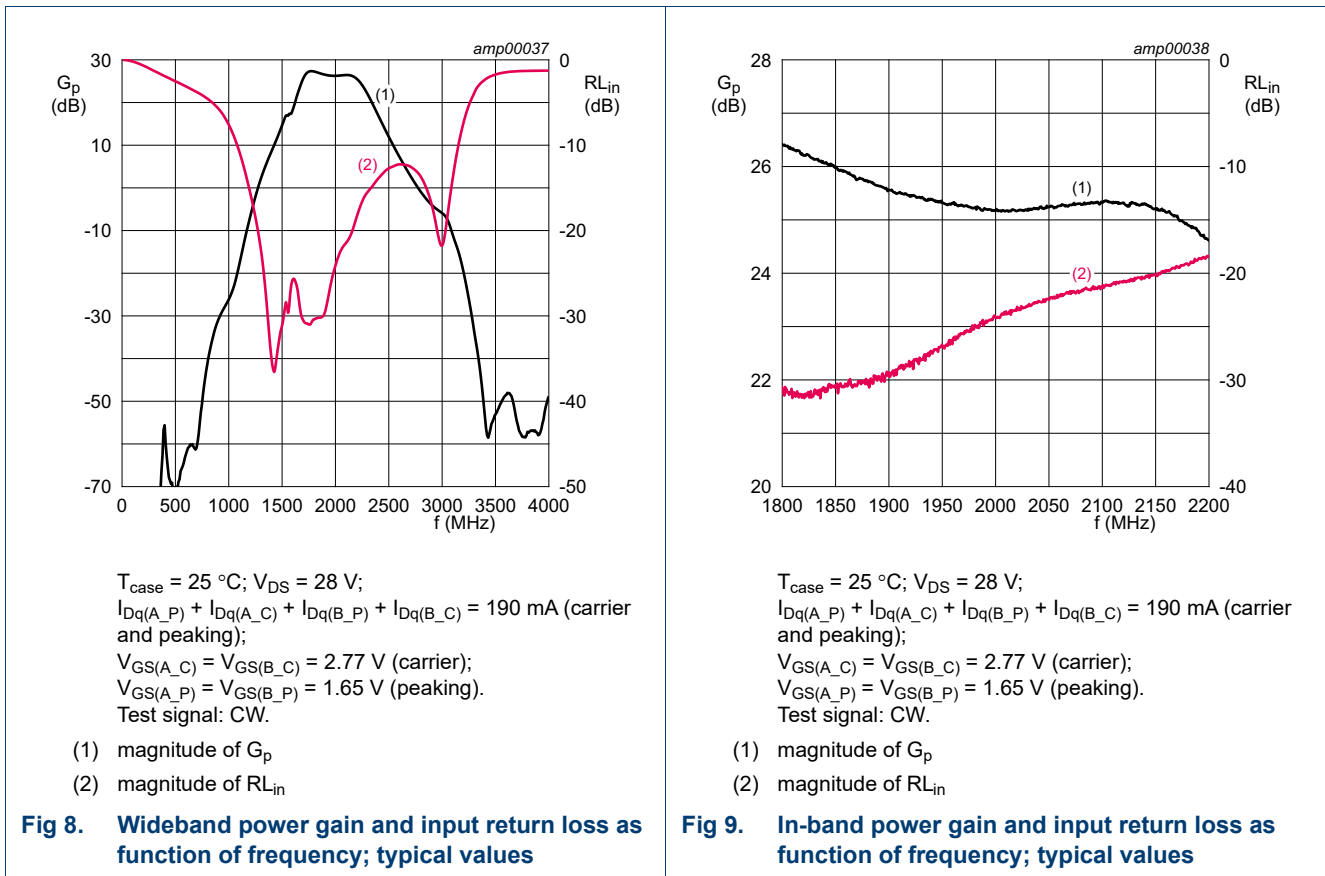
Measured load-pull data per section; test signal: pulsed CW;  $T_{case} = 25\text{ }^\circ\text{C}$ ;  $V_{DS} = 28\text{ V}$ ;  $I_{Dq} = 104\text{ mA}$  (carrier);  $V_{GSq(peak)} = V_{GSq(carrier)} - 0.65\text{ V}$ ;  $t_p = 100\ \mu\text{s}$ ;  $\delta = 10\%$ . Typical values per section unless otherwise specified.

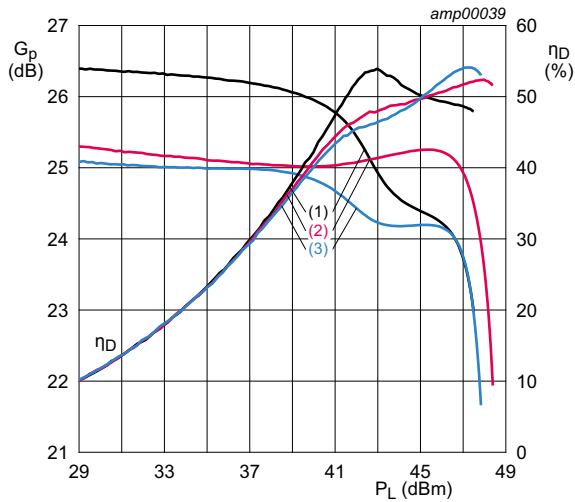
f (MHz)	tuned for optimum Doherty operation				
	$Z_L$ ( $\Omega$ )	$G_{p(max)}$ (dB)	$P_L$ (dBm)	$\eta_{add}$ [1] (%)	$\eta_{add}$ [2] (%)
<b>BLM8D1822S-50PB</b>					
1700	4.20 – j2.10	27.1	45.2	46.1	39.0
1800	4.00 – j2.90	28.6	45.2	48.8	41.4
1900	3.85 – j3.90	27.6	45.2	47.1	42.1
2000	4.90 – j5.50	27.5	45.2	49.4	43.2
2100	5.40 – j5.70	27.5	45.2	53.5	41.9
2200	8.00 – j5.20	27.1	45.2	55.3	40.6
2300	9.10 – j4.70	25.6	45.2	53.8	37.4
<b>BLM8D1822S-50PBG</b>					
1700	4.20 – j3.90	27.8	45.2	43.3	37.8
1800	4.10 – j4.50	28.1	45.2	45.4	39.7
1900	3.90 – j6.00	27.6	45.2	45.4	40.8
2000	4.60 – j7.80	27.3	45.2	45.2	40.1
2100	5.40 – j8.40	27.7	45.3	50.1	52.0
2200	8.20 – j8.50	27.5	45.2	53.0	38.6
2300	9.50 – j7.50	26.2	45.2	54.7	36.2

[1] at 45 dBm (nearly 3 dB compression point).

[2] at 37 dBm (nearly 8 dB OBO point).

8.4 Graphs

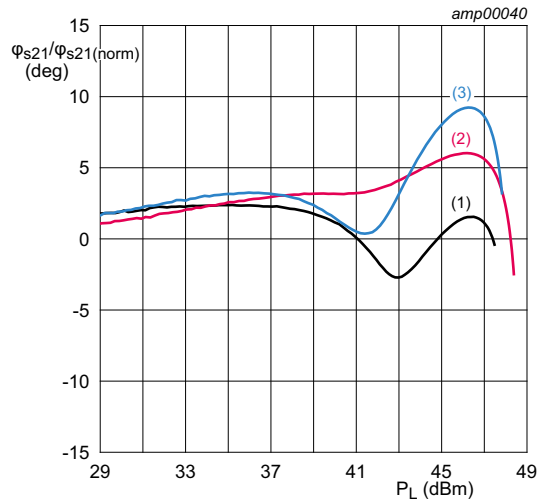




$T_{case} = 25\text{ }^{\circ}\text{C}$ ;  $V_{DS} = 28\text{ V}$ ;  
 $I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)} = 190\text{ mA}$  (carrier and peaking);  
 $V_{GS(A\_C)} = V_{GS(B\_C)} = 2.77\text{ V}$  (carrier);  
 $V_{GS(A\_P)} = V_{GS(B\_P)} = 1.65\text{ V}$  (peaking).  
 Test signal: CW.

- (1)  $f = 1805\text{ MHz}$
- (2)  $f = 1960\text{ MHz}$
- (3)  $f = 2170\text{ MHz}$

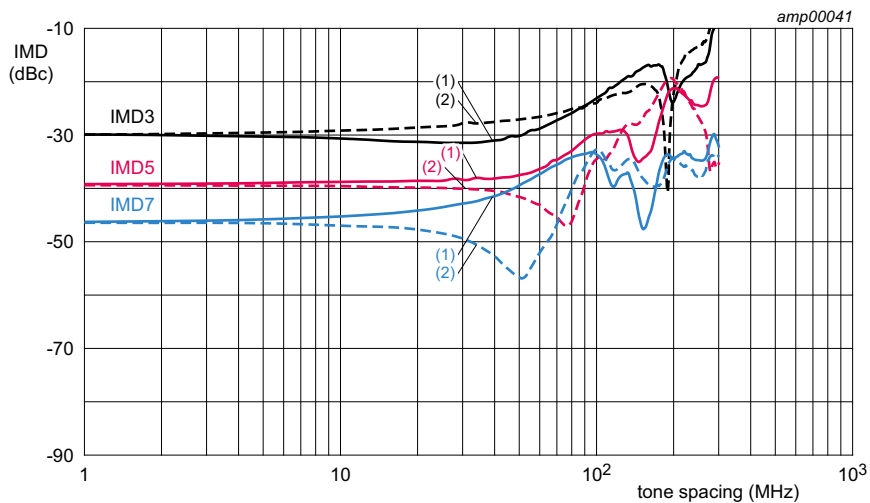
**Fig 10. Power gain and drain efficiency as function of output power; typical values**



$T_{case} = 25\text{ }^{\circ}\text{C}$ ;  $V_{DS} = 28\text{ V}$ ;  
 $I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)} = 190\text{ mA}$  (carrier and peaking);  
 $V_{GS(A\_C)} = V_{GS(B\_C)} = 2.77\text{ V}$  (carrier);  
 $V_{GS(A\_P)} = V_{GS(B\_P)} = 1.65\text{ V}$  (peaking).  
 Test signal: 25 ms CW power sweep.

- (1)  $f = 1805\text{ MHz}$
- (2)  $f = 1960\text{ MHz}$
- (3)  $f = 2170\text{ MHz}$

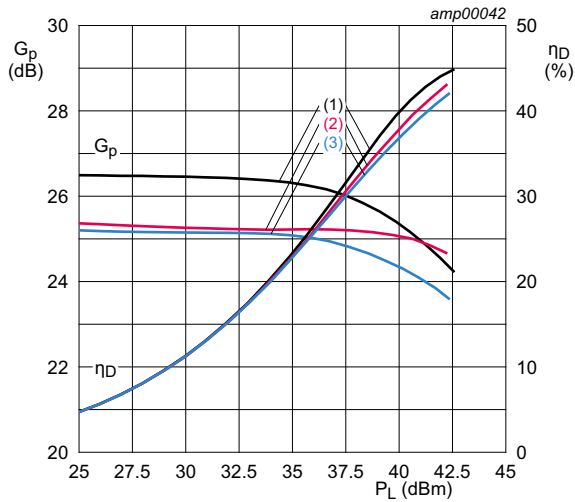
**Fig 11. Normalized phase response as a function of output power; typical values**



$T_{case} = 25\text{ }^{\circ}\text{C}$ ;  $V_{DS} = 28\text{ V}$ ;  $I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)} = 190\text{ mA}$  (carrier and peaking);  $V_{GS(A\_C)} = V_{GS(B\_C)} = 2.77\text{ V}$  (carrier);  $V_{GS(A\_P)} = V_{GS(B\_P)} = 1.65\text{ V}$  (peaking). Test signal: 2-tone CW;  $f_c = 1960\text{ MHz}$ .

- (1) IMD low
- (2) IMD high

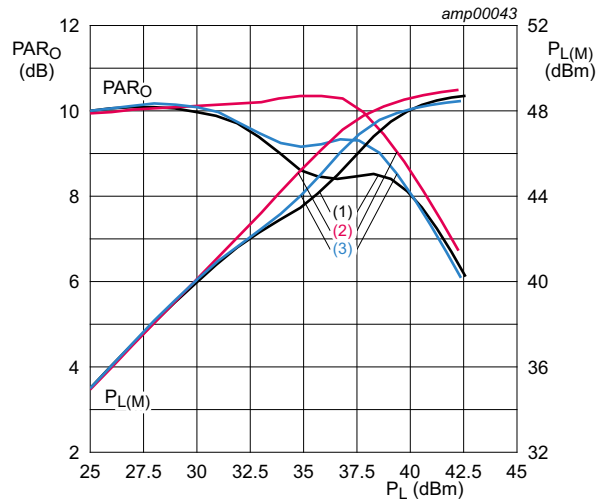
**Fig 12. Intermodulation distortion as a function of tone spacing; typical values**



$T_{case} = 25\text{ }^\circ\text{C}$ ;  $V_{DS} = 28\text{ V}$ ;  
 $I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)} = 190\text{ mA}$  (carrier and peaking);  
 $V_{GS(A\_C)} = V_{GS(B\_C)} = 2.77\text{ V}$  (carrier);  
 $V_{GS(A\_P)} = V_{GS(B\_P)} = 1.65\text{ V}$  (peaking).  
 Test signal: 1-carrier W-CDMA; test model 1; 64 DCPH;  
 PAR 9.9 dB at 0.01 % probability CCDF.

- (1)  $f = 1805\text{ MHz}$
- (2)  $f = 1960\text{ MHz}$
- (3)  $f = 2170\text{ MHz}$

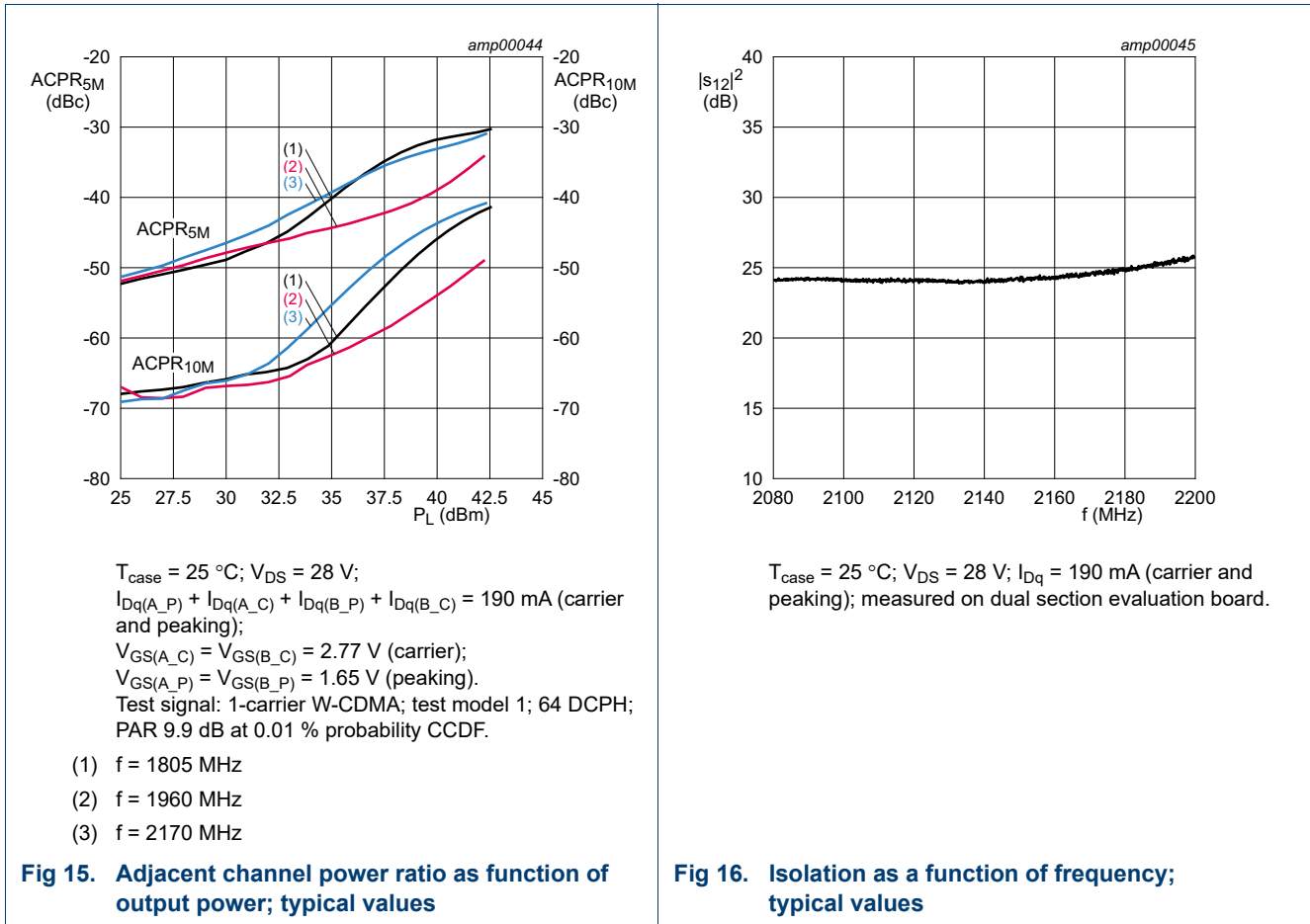
**Fig 13. Power gain and drain efficiency as function of output power; typical values**



$T_{case} = 25\text{ }^\circ\text{C}$ ;  $V_{DS} = 28\text{ V}$ ;  
 $I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)} = 190\text{ mA}$  (carrier and peaking);  
 $V_{GS(A\_C)} = V_{GS(B\_C)} = 2.77\text{ V}$  (carrier);  
 $V_{GS(A\_P)} = V_{GS(B\_P)} = 1.65\text{ V}$  (peaking).  
 Test signal: 1-carrier W-CDMA; test model 1; 64 DCPH;  
 PAR 9.9 dB at 0.01 % probability CCDF.

- (1)  $f = 1805\text{ MHz}$
- (2)  $f = 1960\text{ MHz}$
- (3)  $f = 2170\text{ MHz}$

**Fig 14. Output peak-to-average ratio and peak output power as function of output power; typical values**





SOT1211-3

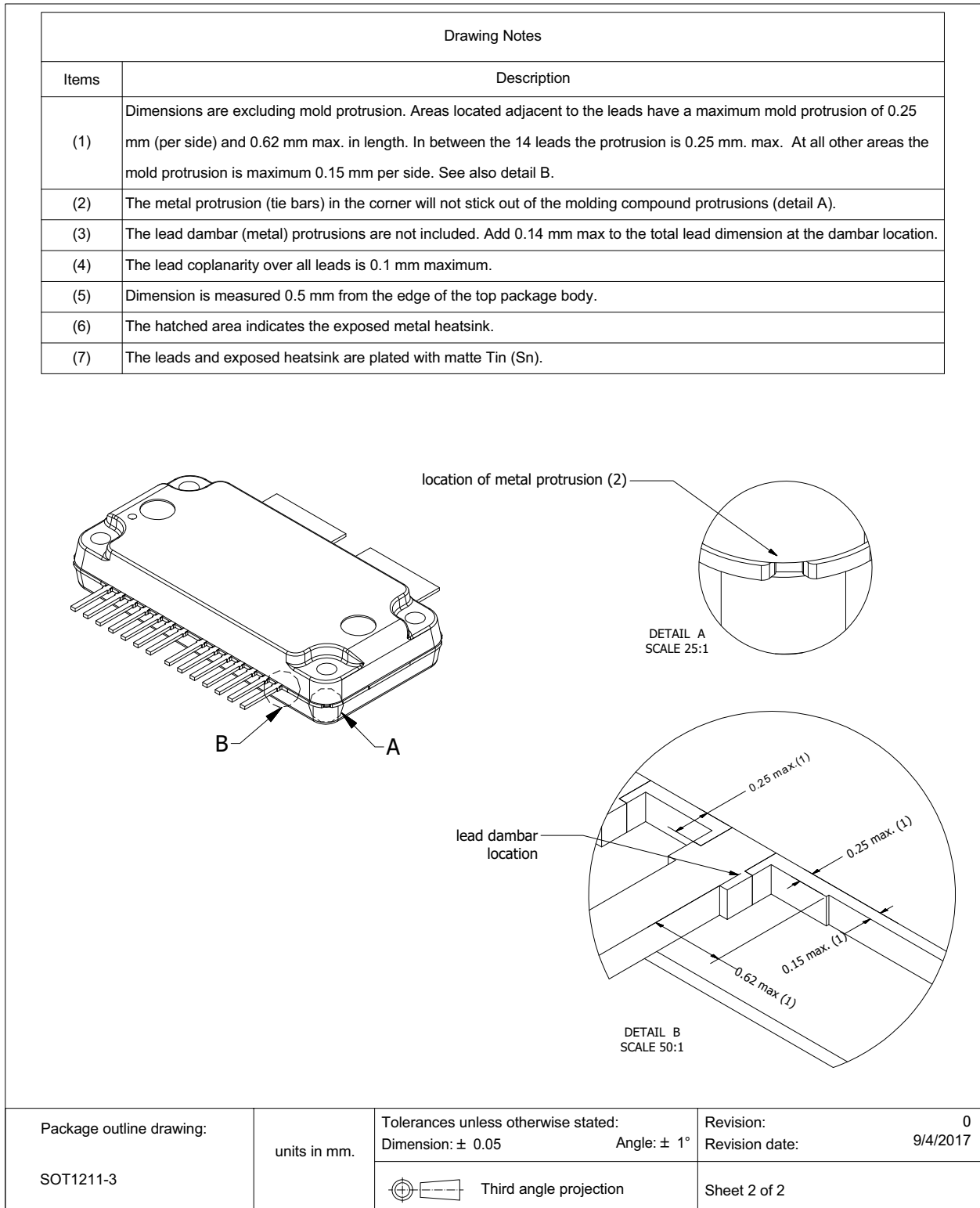


Fig 18. Package outline SOT1211-3 (sheet 2 of 2)

SOT1212-3

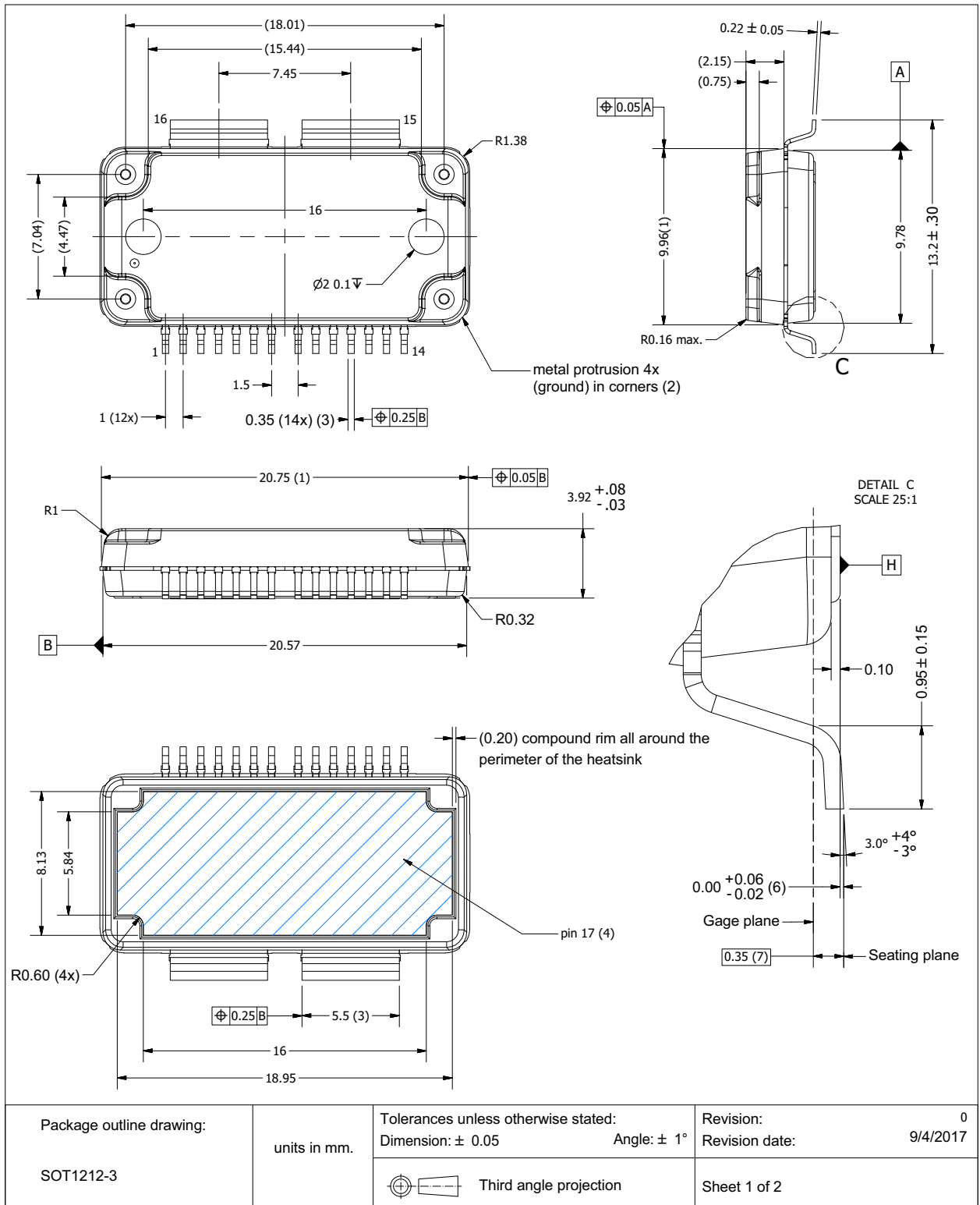


Fig 19. Package outline SOT1212-3 (sheet 1 of 2)



SOT1212-3

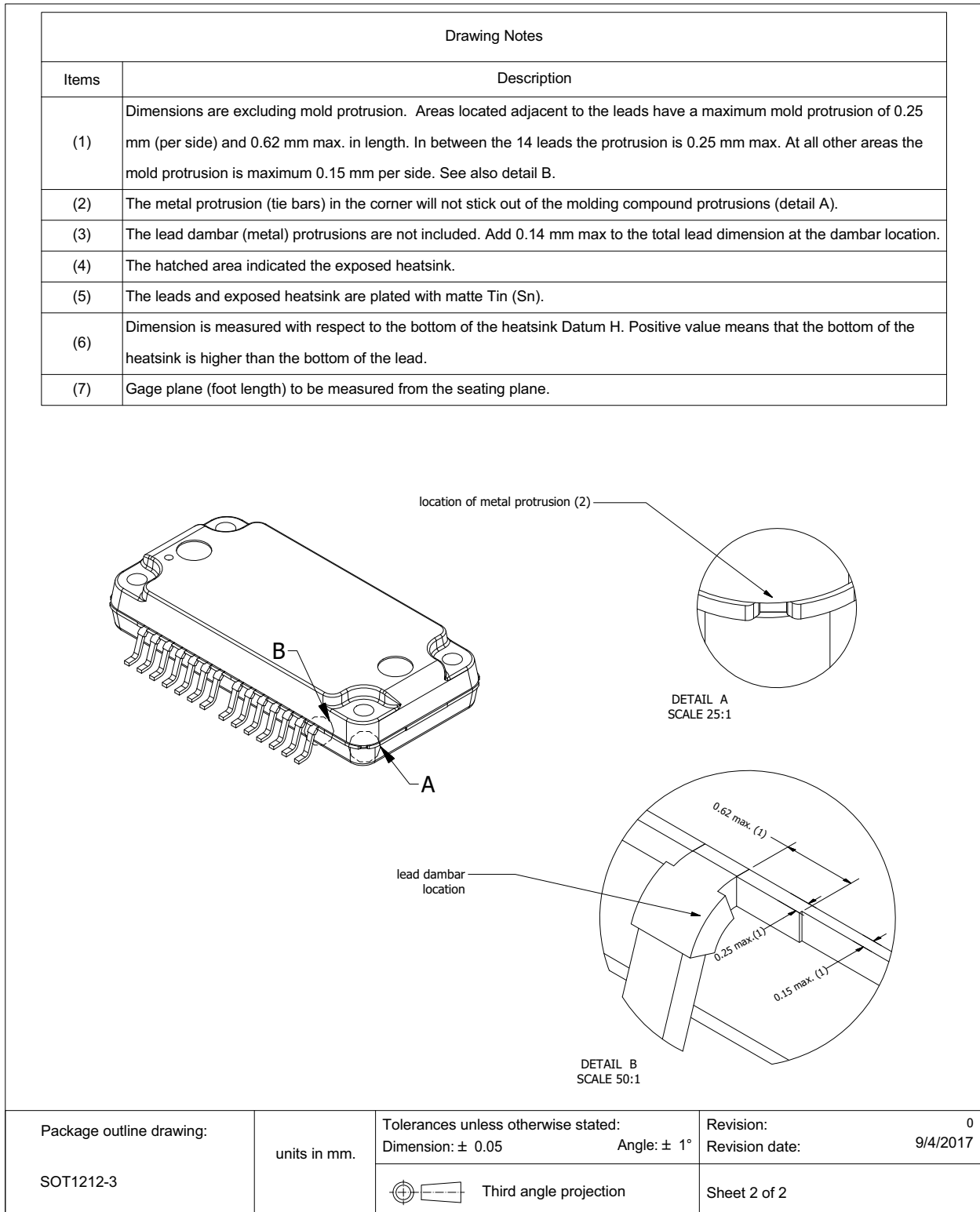


Fig 20. Package outline SOT1212-3 (sheet 2 of 2)

## 10. Handling information

**CAUTION**



This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.

Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A* or equivalent standards.

**Table 10. ESD sensitivity**

ESD model	Class
Charged Device Model (CDM); According to ANSI/ESDA/JEDEC standard JS-002	C2 <a href="#">[1]</a>
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	1C <a href="#">[2]</a>

[1] CDM classification C2 is granted to any part that passes after exposure to an ESD pulse of 500 V, but fails after exposure to an ESD pulse of 1000 V.

[2] HBM classification 1C is granted to any part that passes after exposure to an ESD pulse of 1000 V, but fails after exposure to an ESD pulse of 2000 V.

## 11. Abbreviations

**Table 11. Abbreviations**

Acronym	Description
3GPP	3rd Generation Partnership Project
CCDF	Complementary Cumulative Distribution Function
CW	Continuous Wave
DPCH	Dedicated Physical CHannel
ESD	ElectroStatic Discharge
GEN8	Eighth Generation
GSM	Global System for Mobile Communications
LDMOS	Laterally Diffused Metal Oxide Semiconductor
LTE	Long Term Evolution
MMIC	Monolithic Microwave Integrated Circuit
MTF	Median Time to Failure
OBO	Output Back Off
PAR	Peak-to-Average Ratio
VSWR	Voltage Standing-Wave Ratio
W-CDMA	Wideband Code Division Multiple Access

## 12. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLM8D1822S-50PB_S-50PBG v.3	20171123	Product data sheet	-	BLM8D1822S-50PB_S-50PBG v.2
Modifications:	<ul style="list-style-type: none"> <li>• <a href="#">Figure 1 on page 2</a>: pin 1 index position aligned</li> <li>• <a href="#">Figure 3 on page 6</a>: pin 1 index position aligned</li> <li>• <a href="#">Figure 5 on page 8</a>: pin 1 index position aligned</li> <li>• <a href="#">Figure 6 on page 8</a>: pin 1 index position aligned</li> <li>• <a href="#">Figure 7 on page 8</a>: pin 1 index position aligned</li> </ul>			
BLM8D1822S-50PB_S-50PBG v.2	20171117	Product data sheet	-	BLM8D1822S-50PB_S-50PBG v.1
BLM8D1822S-50PB_S-50PBG v.1	20160322	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.ampleon.com>.

### 13.2 Definitions

**Draft** — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Ampleon does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

**Short data sheet** — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Ampleon sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

**Product specification** — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Ampleon and its customer, unless Ampleon and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Ampleon product is deemed to offer functions and qualities beyond those described in the Product data sheet.

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## 14. Contact information

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