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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 °C; I_{Dq} = 104 mA (carrier); $V_{GSq(peaking)}$ = $V_{GSq(carrier)}$ − 0.65 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_{DS}	$P_{L(AV)}$	G_p	η_D	$ACPR_{5M}$
	(MHz)	(V)	(W)	(dB)	(%)	(dBc)
single carrier W-CDMA	2167.5	28	5	26.5	37	−34

1.2 Features and benefits

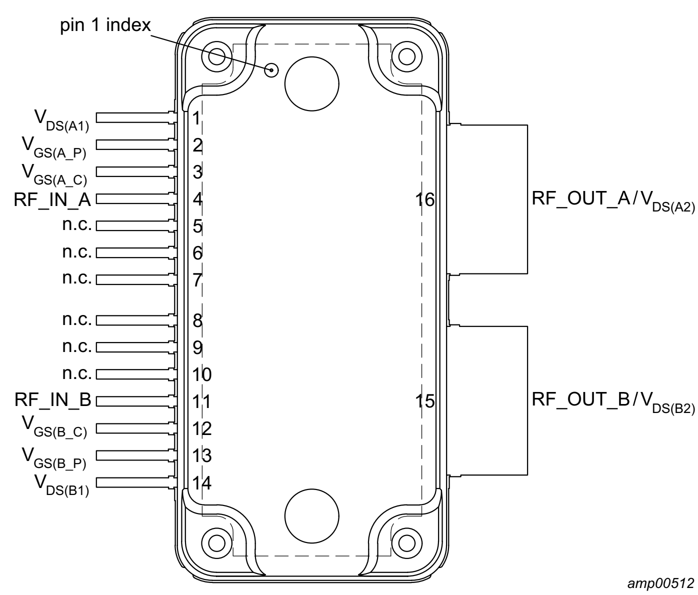
- Integrated input splitter
- Integrated output combiner
- High efficiency
- Designed for broadband operation (frequency 1805 MHz to 2170 MHz)
- High section-to-section isolation enabling multiple combinations
- Integrated temperature compensated bias
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Excellent thermal stability
- Source impedance 50 Ω; 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



Transparent top view

The exposed backside of the package is the ground terminal of the device.

Fig 1. Pin configuration

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		
	Name	Description	Version
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

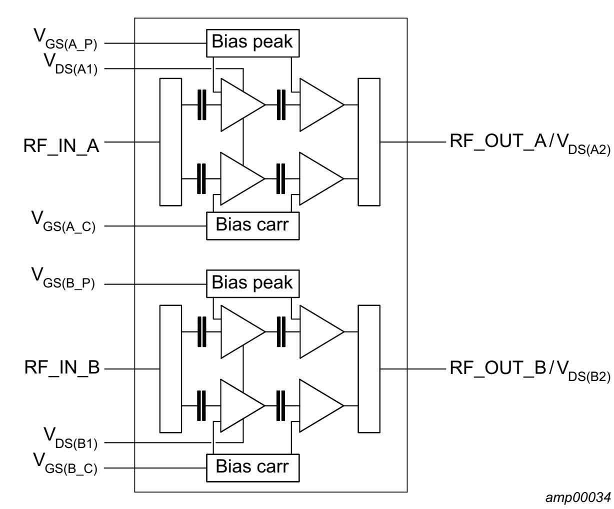


Fig 2. Block diagram

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 °C; P_L = 10 W [1]	1.06	K/W
		T_{case} = 90 °C; P_L = 20 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 °C; per section unless otherwise specified.

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

[1] Final stage.

[2] Driver stage.

Table 7. RF Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Test signal: single carrier W-CDMA [1]						
G_p	power gain	f = 1807.5 MHz	-	26	-	dB
		f = 2167.5 MHz	24.5	26.5	28.5	dB
η_D	drain efficiency	f = 2167.5 MHz	31	37	-	%
RL_{in}	input return loss	f = 2167.5 MHz	-	−19	−10	dB
$ACPR_{5M}$	adjacent channel power ratio (5 MHz)	f = 2167.5 MHz	-	−34	−26	dBc
PAR_O	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

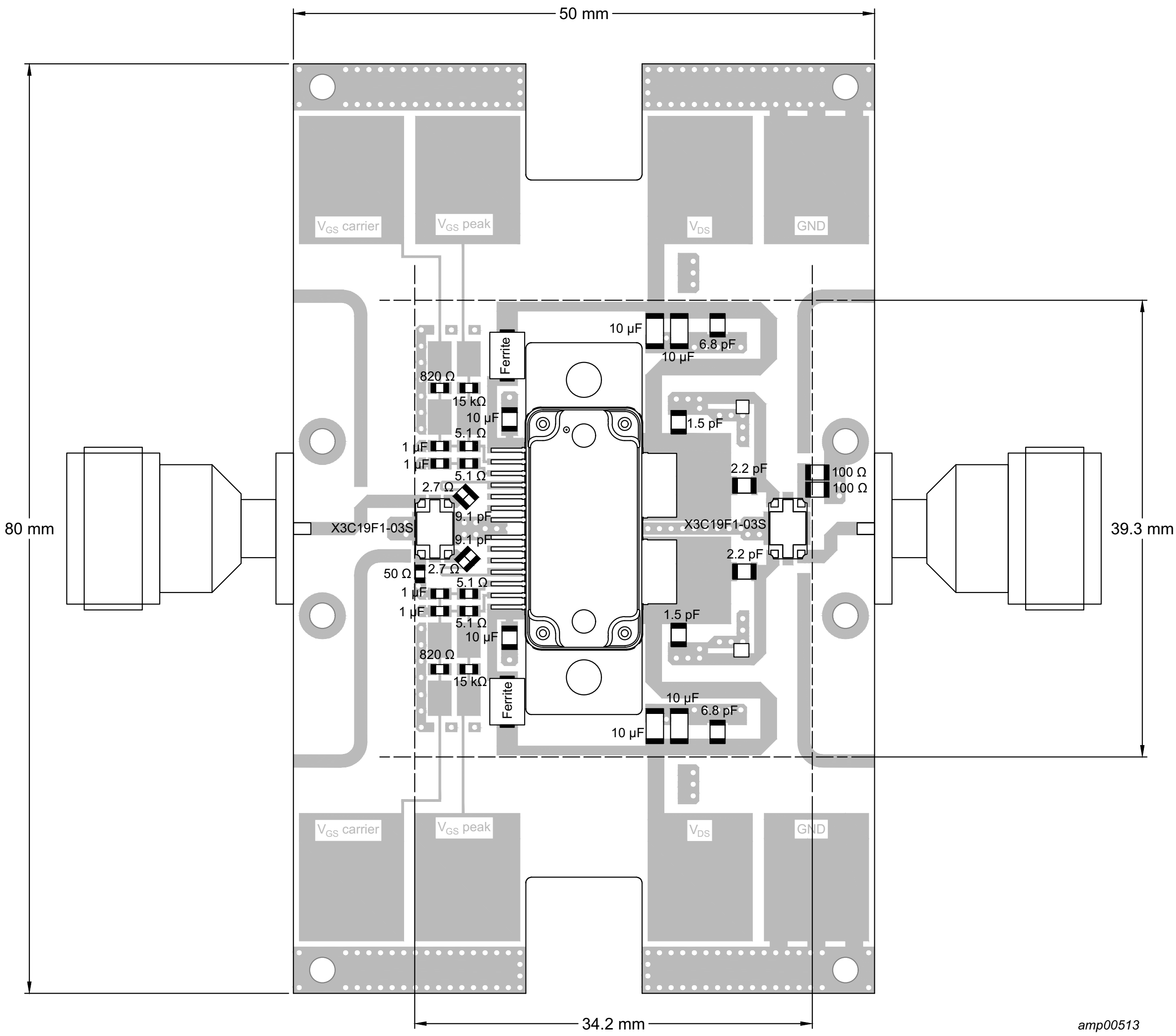
Table 8. Typical performance

T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 190 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
$P_{L(1dB)}$	output power at 1 dB gain compression	f = 1960 MHz [1]	-	48.4	-	dBm
$\varphi_{s21}/\varphi_{s21(norm)}$	normalized phase response	at 3 db compression point; f = 1960 MHz [1]	-	−0.4	-	°
η_D	drain efficiency	8 db OBO (P_L = 40.4 dBm); f = 1960 MHz	-	38.9	-	%
G_p	power gain	$P_{L(AV)}$ = 40.4 dBm; f = 1960 MHz	-	25	-	dB
B_{video}	video bandwidth	$P_{L(AV)}$ set to obtain IMD3 = −30 dBc; 2-tone CW; f = 1960 MHz	-	185	-	MHz
G_{flat}	gain flatness	$P_{L(AV)}$ = 40.4 dBm; f = 1805 MHz to 2170 MHz	-	1	-	dB
$ACPR_{5M}$	adjacent channel power ratio (5M)	$P_{L(AV)}$ = 40.4 dBm; f = 1960 MHz	-	−38.2	-	dB
$\Delta G/\Delta T$	gain variation with temperature	f = 2140 MHz	-	0.04	-	dB/°C
$\lvert s_{12}\rvert^2$	isolation	between sections A and B; $P_{L(AV)}$ = 15.2 dBm; f = 2140 MHz; measured on dual section evaluation board	-	24	-	dB
K	Rollett stability factor	T_{case} = −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).



Printed-Circuit Board (PCB): Rogers 4350; thickness = 0.508 mm.

Fig 3. Component layout

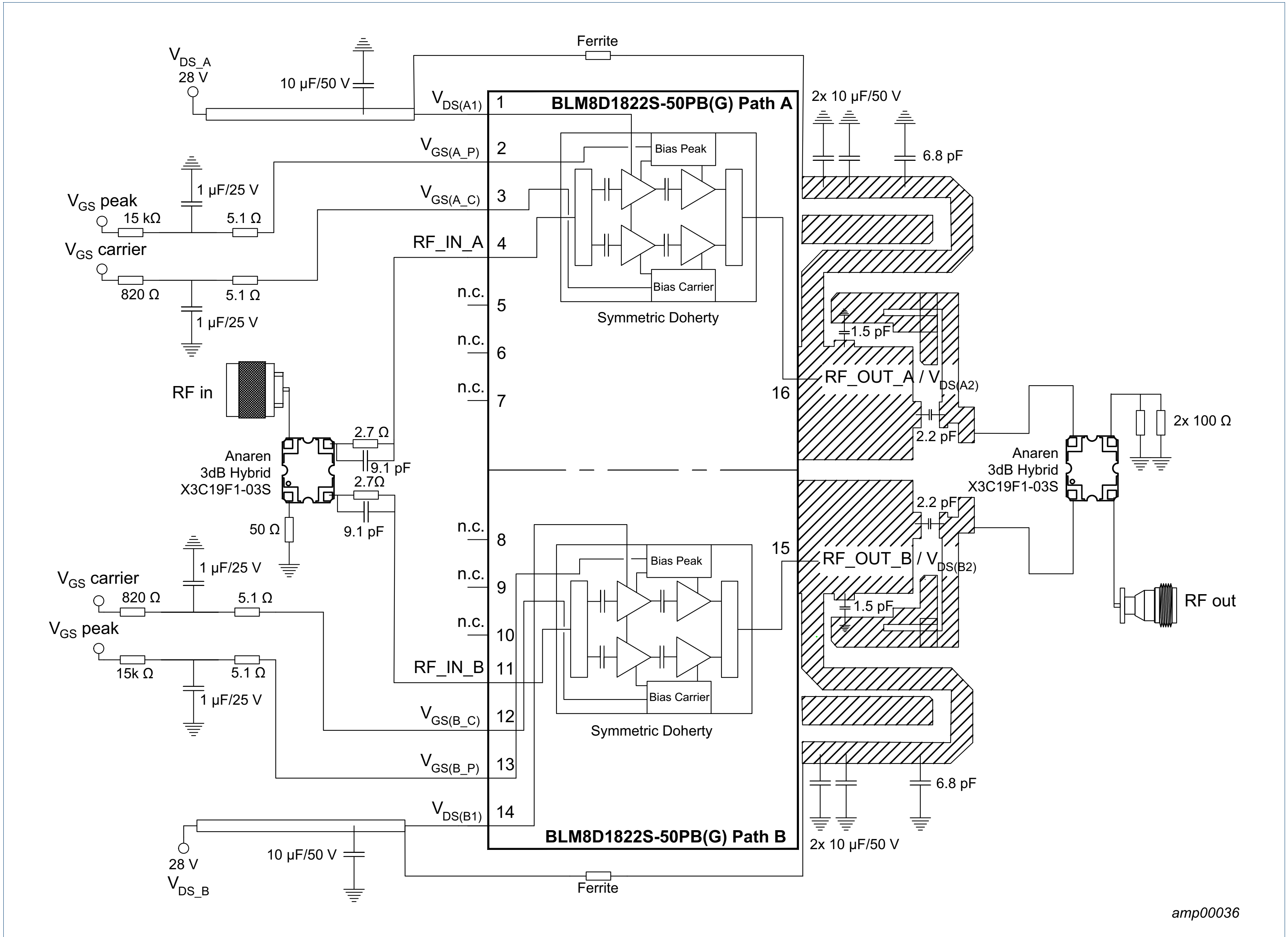


Fig 4. Electrical schematic

8.1 Possible circuit topologies

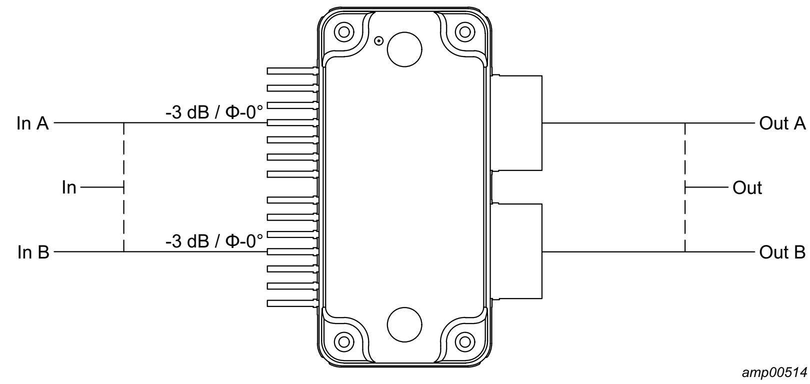


Fig 5. Dual section or single ended

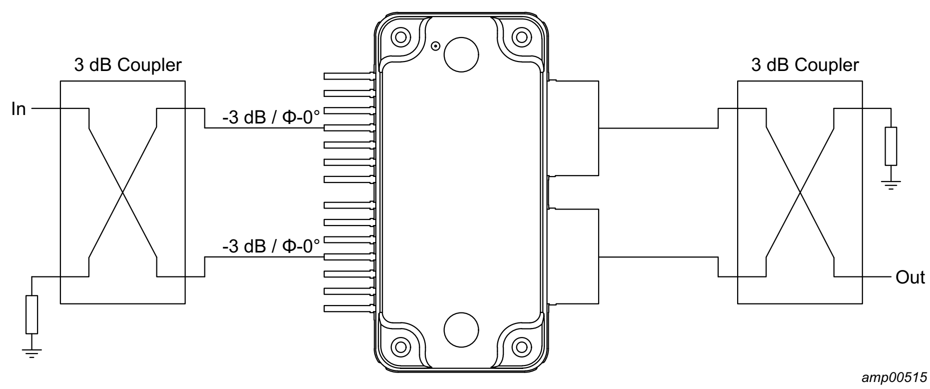


Fig 6. Quadrature combined

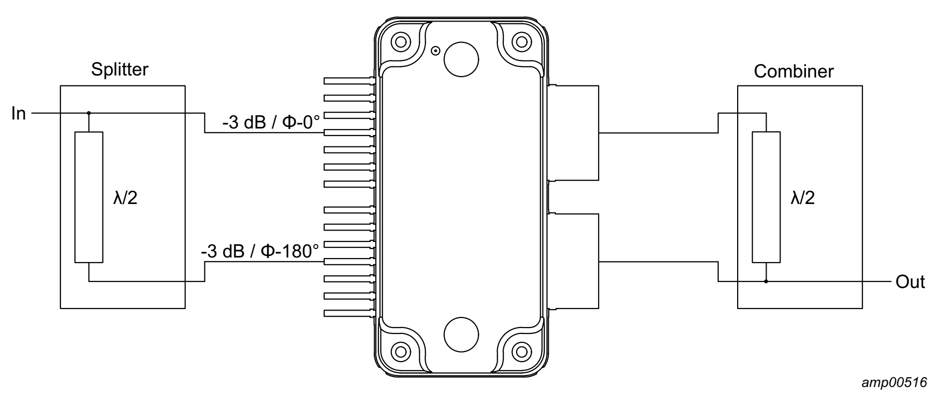


Fig 7. Push-pull

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 V; I_{Dq} = 104 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.65$ V; P_i corresponding to $P_{L(3dB)}$ under Z_S = 50 Ω load; f = 2140 MHz (CW); T_{case} = 25 °C per section unless otherwise specified

8.3 Impedance information

Table 9. Typical impedance for optimum Doherty operation

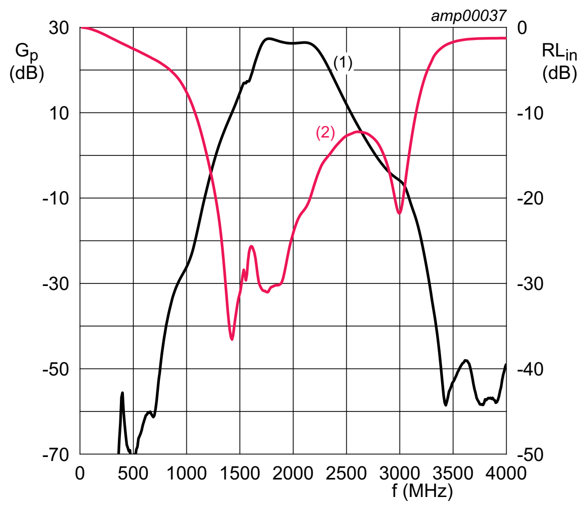
Measured load-pull data per section; test signal: pulsed CW; T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 104 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.65$ V; t_p = 100 μs; δ = 10 %. Typical values per section unless otherwise specified.

f	tuned for optimum Doherty operation				
	Z_L	$G_{p(max)}$	P_L	η_{add} [1]	η_{add} [2]
(MHz)	(Ω)	(dB)	(dBm)	(%)	(%)
BLM8D1822S-50PB					
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
BLM8D1822S-50PBG					
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

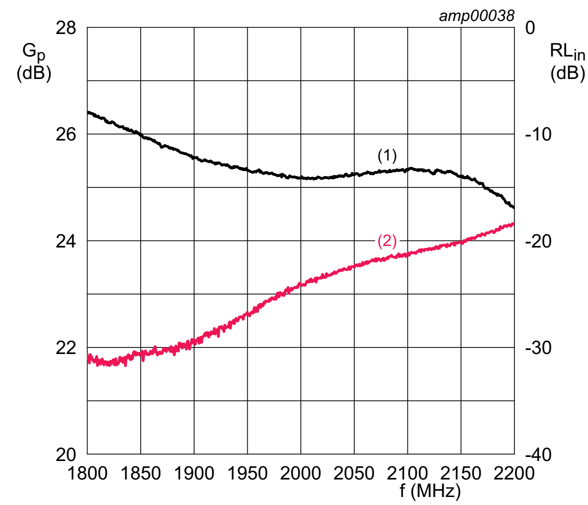


T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)}$ = 190 mA (carrier and peaking);
$V_{GS(A\_C)} = V_{GS(B\_C)}$ = 2.77 V (carrier);
$V_{GS(A\_P)} = V_{GS(B\_P)}$ = 1.65 V (peaking).
Test signal: CW.

(1) magnitude of G_p

(2) magnitude of RL_{in}

Fig 8. Wideband power gain and input return loss as function of frequency; typical values

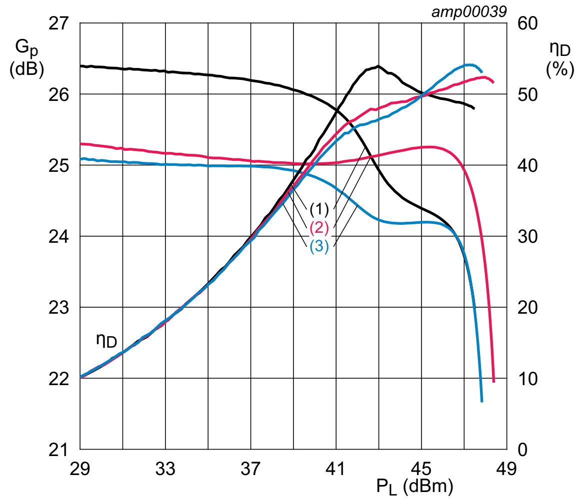


T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)}$ = 190 mA (carrier and peaking);
$V_{GS(A\_C)} = V_{GS(B\_C)}$ = 2.77 V (carrier);
$V_{GS(A\_P)} = V_{GS(B\_P)}$ = 1.65 V (peaking).
Test signal: CW.

(1) magnitude of G_p

(2) magnitude of RL_{in}

Fig 9. In-band power gain and input return loss as function of frequency; typical values



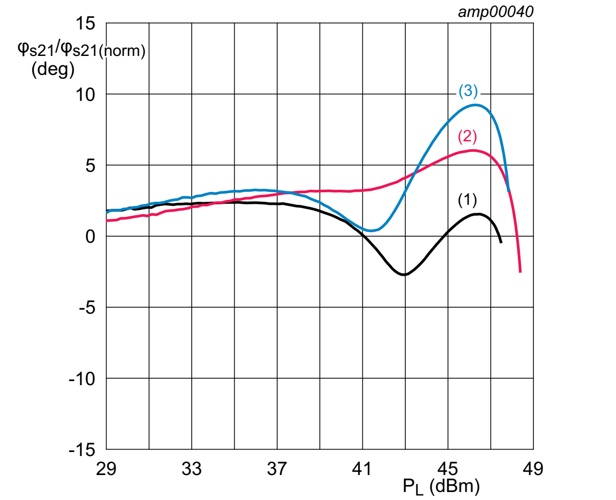
T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)}$ = 190 mA (carrier and peaking);
$V_{GS(A\_C)} = V_{GS(B\_C)}$ = 2.77 V (carrier);
$V_{GS(A\_P)} = V_{GS(B\_P)}$ = 1.65 V (peaking).
Test signal: CW.

(1) f = 1805 MHz

(2) f = 1960 MHz

(3) f = 2170 MHz

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



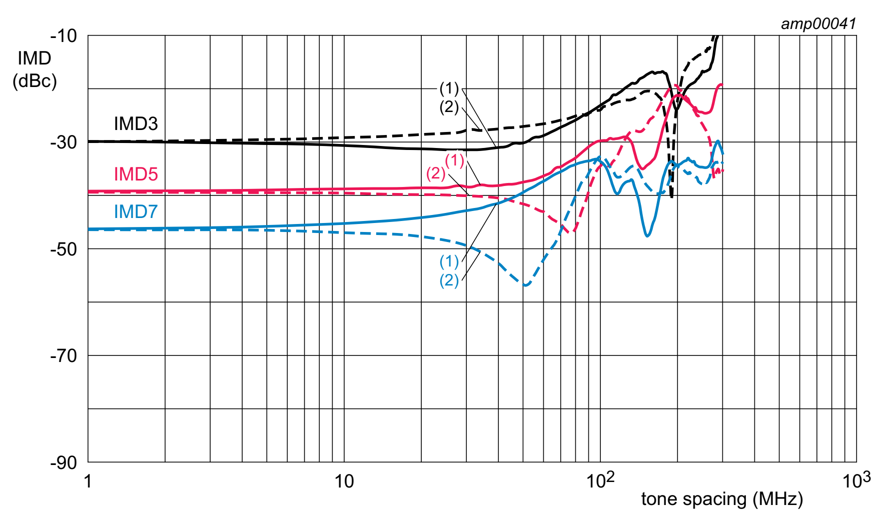
T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)}$ = 190 mA (carrier and peaking);
$V_{GS(A\_C)} = V_{GS(B\_C)}$ = 2.77 V (carrier);
$V_{GS(A\_P)} = V_{GS(B\_P)}$ = 1.65 V (peaking).
Test signal: 25 ms CW power sweep.

(1) f = 1805 MHz

(2) f = 1960 MHz

(3) f = 2170 MHz

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

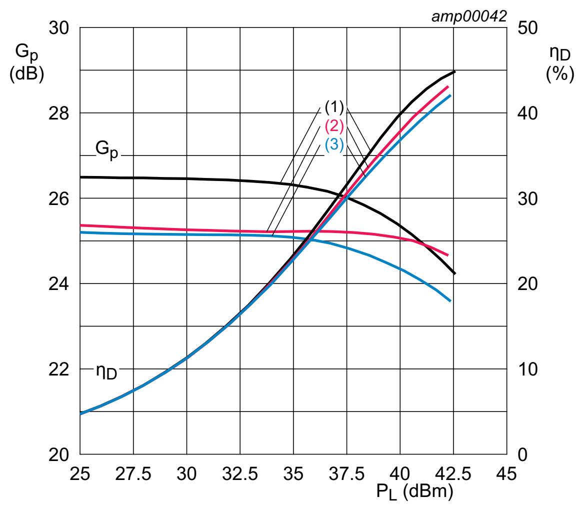


T_{case} = 25 °C; V_{DS} = 28 V; $I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)}$ = 190 mA (carrier and peaking); $V_{GS(A\_C)} = V_{GS(B\_C)}$ = 2.77 V (carrier); $V_{GS(A\_P)} = V_{GS(B\_P)}$ = 1.65 V (peaking). Test signal: 2-tone CW; f_c = 1960 MHz.

(1) IMD low

(2) IMD high

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



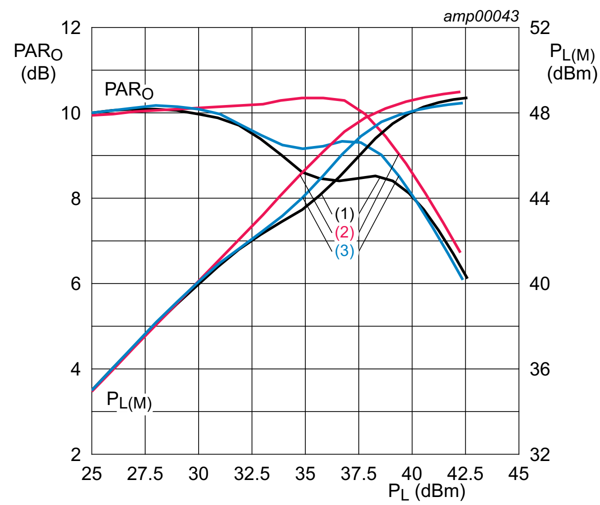
T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)}$ = 190 mA (carrier and peaking);
$V_{GS(A\_C)} = V_{GS(B\_C)}$ = 2.77 V (carrier);
$V_{GS(A\_P)} = V_{GS(B\_P)}$ = 1.65 V (peaking).
Test signal: 1-carrier W-CDMA; test model 1; 64 DCPH; PAR 9.9 dB at 0.01 % probability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

(1) f = 1805 MHz

(2) f = 1960 MHz

(3) f = 2170 MHz

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



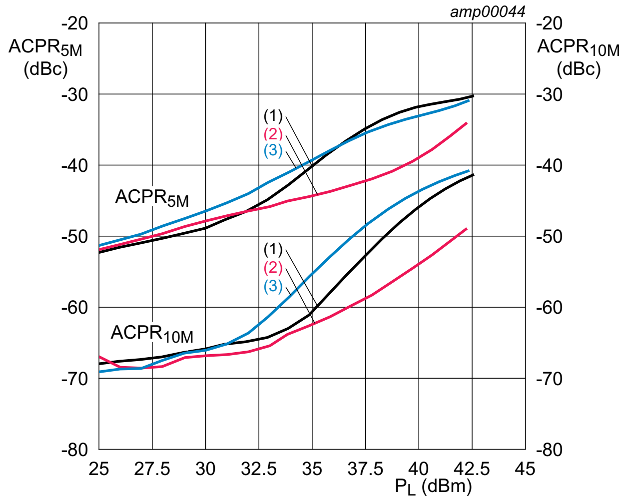
T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)}$ = 190 mA (carrier and peaking);
$V_{GS(A\_C)} = V_{GS(B\_C)}$ = 2.77 V (carrier);
$V_{GS(A\_P)} = V_{GS(B\_P)}$ = 1.65 V (peaking).
Test signal: 1-carrier W-CDMA; test model 1; 64 DCPH; PAR 9.9 dB at 0.01 % probability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

(1) f = 1805 MHz

(2) f = 1960 MHz

(3) f = 2170 MHz

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



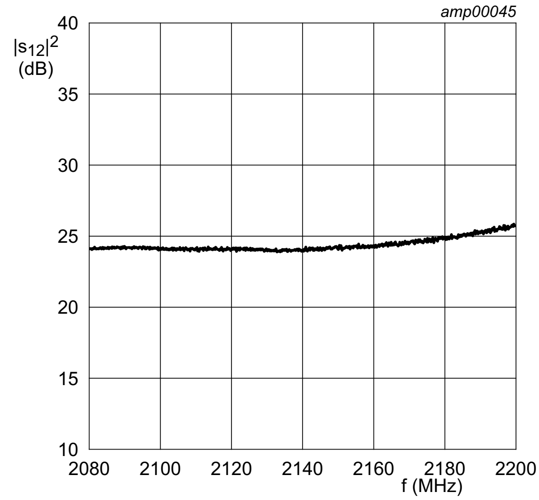
T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq(A\_P)} + I_{Dq(A\_C)} + I_{Dq(B\_P)} + I_{Dq(B\_C)}$ = 190 mA (carrier and peaking);
$V_{GS(A\_C)} = V_{GS(B\_C)}$ = 2.77 V (carrier);
$V_{GS(A\_P)} = V_{GS(B\_P)}$ = 1.65 V (peaking).
Test signal: 1-carrier W-CDMA; test model 1; 64 DCPH; PAR 9.9 dB at 0.01 % probability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

(1) f = 1805 MHz

(2) f = 1960 MHz

(3) f = 2170 MHz

Fig 15. Adjacent channel power ratio as function of output power; typical values

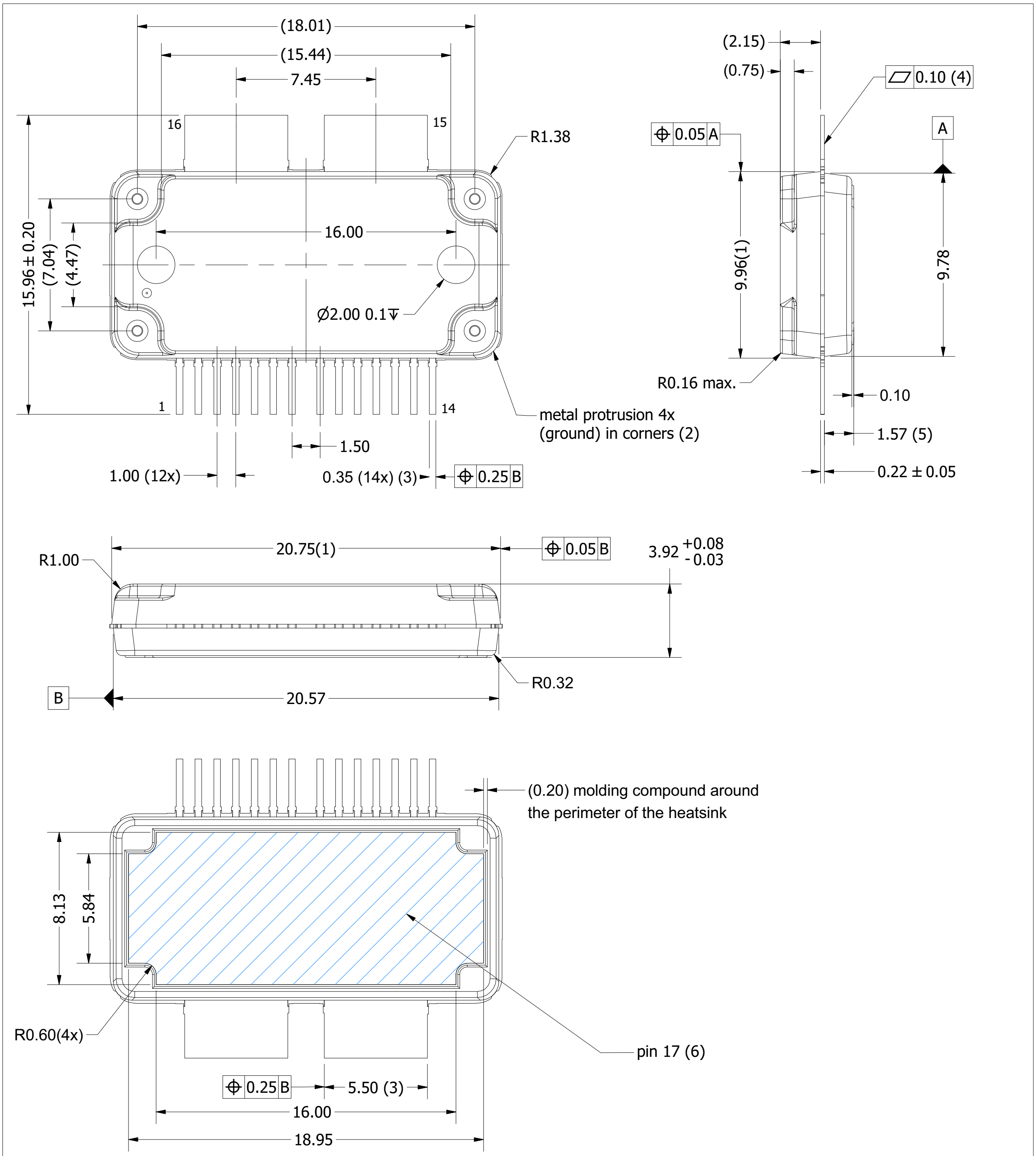


T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 190 mA (carrier and peaking); measured on dual section evaluation board.

Fig 16. Isolation as a function of frequency; typical values

9. Package outline

SOT1211-3

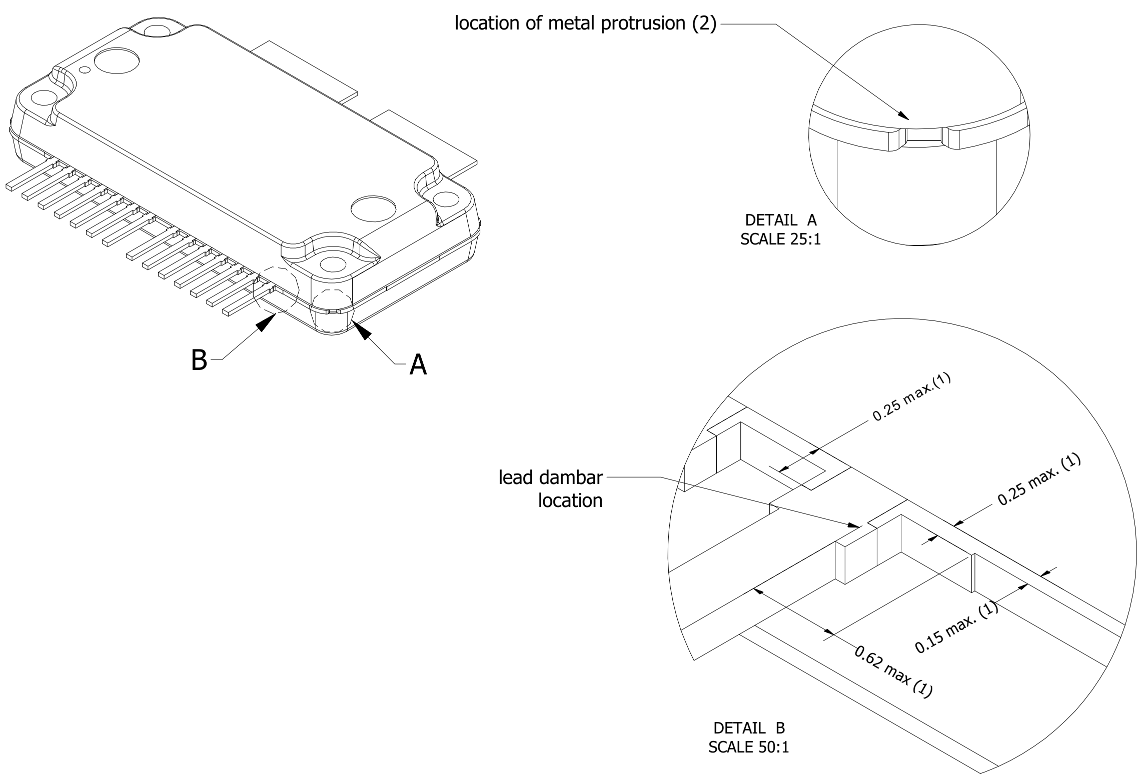


Package outline drawing: SOT1211-3	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.05 Angle: ± 1°	Revision: 0 Revision date: 9/4/2017
		Third angle projection	Sheet 1 of 2

Fig 17. Package outline SOT1211-3 (sheet 1 of 2)

SOT1211-3

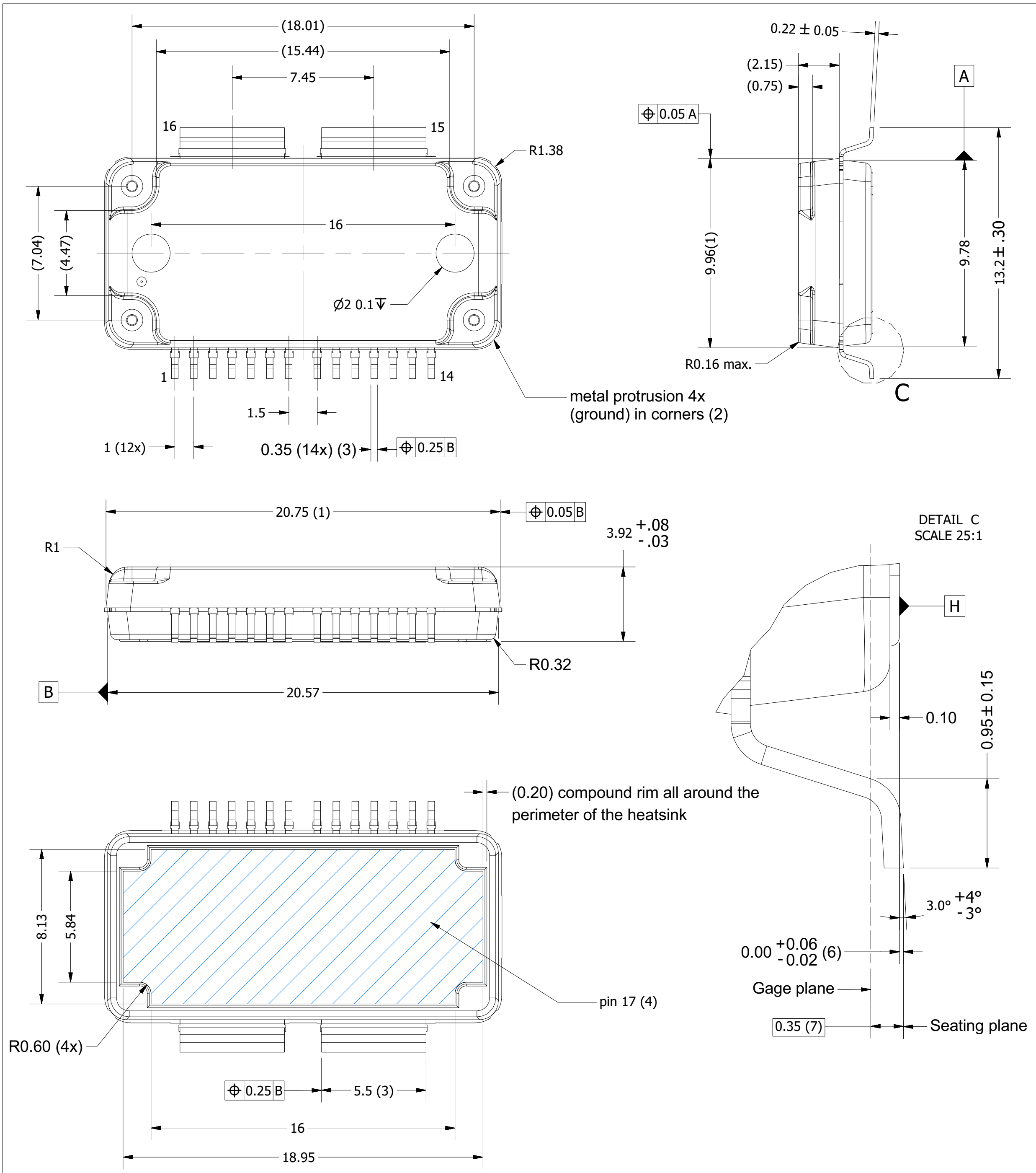
Drawing Notes	
Items	Description
(1)	Dimensions are excluding mold protrusion. Areas located adjacent to the leads have a maximum mold protrusion of 0.25 mm (per side) and 0.62 mm max. in length. In between the 14 leads the protrusion is 0.25 mm. max. At all other areas the mold protrusion is maximum 0.15 mm per side. See also detail B.
(2)	The metal protrusion (tie bars) in the corner will not stick out of the molding compound protrusions (detail A).
(3)	The lead dambar (metal) protrusions are not included. Add 0.14 mm max to the total lead dimension at the dambar location.
(4)	The lead coplanarity over all leads is 0.1 mm maximum.
(5)	Dimension is measured 0.5 mm from the edge of the top package body.
(6)	The hatched area indicates the exposed metal heatsink.
(7)	The leads and exposed heatsink are plated with matte Tin (Sn).



Package outline drawing: SOT1211-3	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.05 Angle: ± 1°	Revision: 0 Revision date: 9/4/2017
		Third angle projection	Sheet 2 of 2

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

SOT1212-3

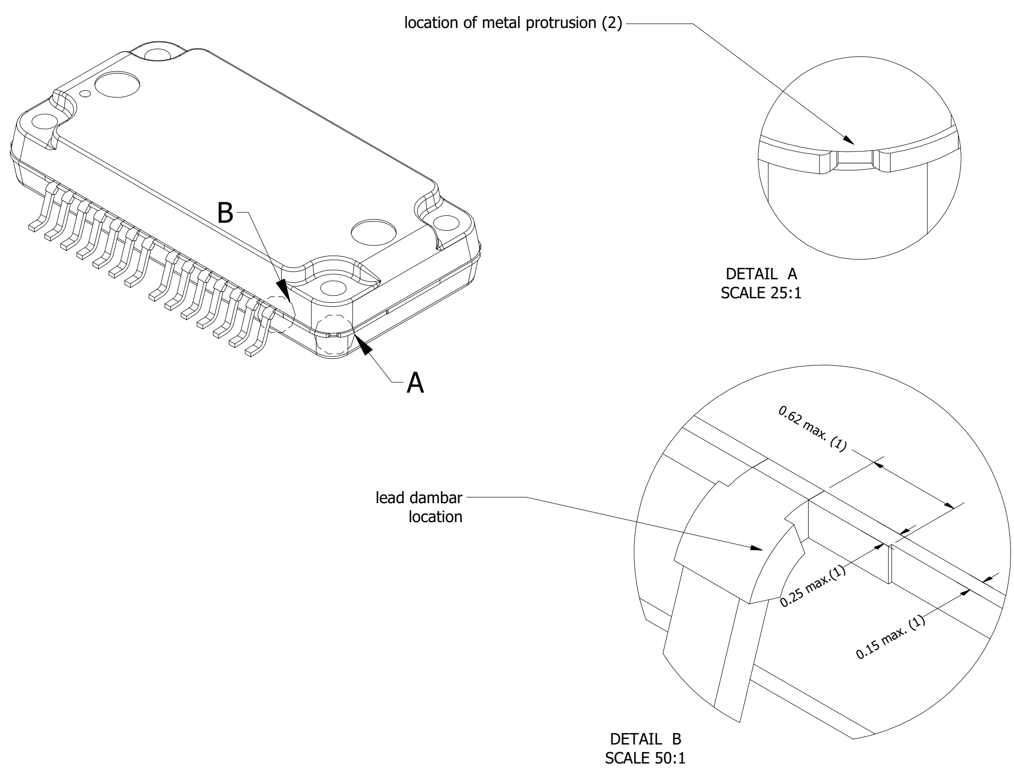


Package outline drawing:	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.05 Angle: ± 1°	Revision: 0 Revision date: 9/4/2017
SOT1212-3		Third angle projection	Sheet 1 of 2

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

SOT1212-3

Drawing Notes	
Items	Description
(1)	Dimensions are excluding mold protrusion. Areas located adjacent to the leads have a maximum mold protrusion of 0.25 mm (per side) and 0.62 mm max. in length. In between the 14 leads the protrusion is 0.25 mm max. At all other areas the mold protrusion is maximum 0.15 mm per side. See also detail B.
(2)	The metal protrusion (tie bars) in the corner will not stick out of the molding compound protrusions (detail A).
(3)	The lead dambar (metal) protrusions are not included. Add 0.14 mm max to the total lead dimension at the dambar location.
(4)	The hatched area indicated the exposed heatsink.
(5)	The leads and exposed heatsink are plated with matte Tin (Sn).
(6)	Dimension is measured with respect to the bottom of the heatsink Datum H. Positive value means that the bottom of the heatsink is higher than the bottom of the lead.
(7)	Gage plane (foot length) to be measured from the seating plane.



Package outline drawing: SOT1212-3	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.05 Angle: ± 1°	Revision: 0 Revision date: 9/4/2017
		Third angle projection	Sheet 2 of 2

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 [1]
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	1C [2]

[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:	• Figure 1 on page 2: pin 1 index position aligned • Figure 3 on page 6: pin 1 index position aligned • Figure 5 on page 8: pin 1 index position aligned • Figure 6 on page 8: pin 1 index position aligned • Figure 7 on page 8: pin 1 index position aligned			
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[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.ampleon.com.

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15. Contents

Date of release: 23 November 2017
Document identifier: BLM8D1822S-50PB_S-50PBG