BLM10D1822-60ABG

LDMOS 2-stage integrated Doherty MMIC

AMPLEON

Rev. 2 — 19 December 2019

Product data sheet

1. Product profile

1.1 General description

The BLM10D1822-60ABG is a 2-stage fully integrated Doherty MMIC solution using Ampleon’s state of the art GEN10 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 mMIMO final in the frequency range from 1800 MHz to 2200 MHz. Available in gull wing.

Table 1. Performance

Typical RF performance at T_{case} = 25 °C; Typical RF performance at T_{case} = 25 °C; I_{Dq} = 90 mA (driver and final stages); V_{GS} = 2.11 V (carrier stage); V_{GS} = 1.84 V (peaking stage). Test signal: 1-carrier LTE; carrier spacing = 20 MHz; PAR = 7.6 dB at 0.01 % probability on CCDF.

Test signal	f	V_{DS}	$P_{L(AV)}$	G_p	η_D	$ACPR_{20M}$
	(MHz)	(V)	(W)	(dB)	(%)	(dBc)
1-carrier LTE 20 MHz	2000	28	10	27.5	42	–32

1.2 Features and benefits

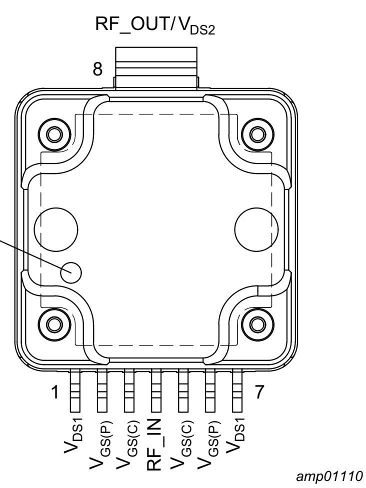
- Integrated input splitter
- Integrated output combiner
- High efficiency
- Designed for broadband operation (frequency 1800 MHz to 2200 MHz)
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Excellent thermal stability
- Source impedance 50 Ω; high power gain
- For RoHS compliance see the product details on the Ampleon website

1.3 Applications

- RF power MMIC for multi-carrier and multi-standard GSM, W-CDMA and LTE base stations in the 1800 MHz to 2200 MHz frequency range

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_{DS1}	1	drain-source voltage of driver stages
$V_{GS(P)}$	2	gate-source voltage of peaking P
$V_{GS(C)}$	3	gate-source voltage of carrier C
RF_IN	4	RF input
$V_{GS(C)}$	5	gate-source voltage of carrier C
$V_{GS(P)}$	6	gate-source voltage of peaking P
V_{DS1}	7	drain-source voltage of driver stages
RF_OUT/V_{DS2}	8	RF output / drain-source voltage of final stages
GND	flange	RF ground

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLM10D1822-60ABG		plastic, heatsink small outline package; 8 leads	OMP-400-8G-1

4. Block diagram

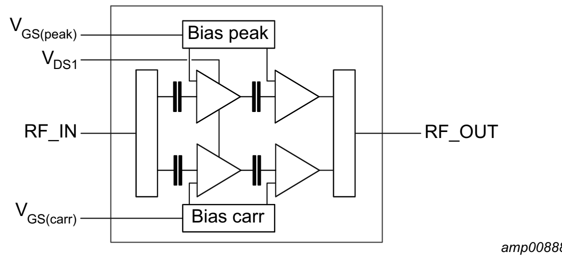


Fig 2. Block diagram

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		–6	+9	V
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature	[1]	-	200	°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]	1.9	K/W
		T_{case} = 90 °C; P_L = 2.5 W [1]	2.7	K/W

[1] When operated with a 1-carrier W-CDMA with PAR = 9.9 dB.

7. Characteristics

Table 6. DC characteristics

T_{case} = 25 °C.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Carrier						
V_{GSq}	gate-source quiescent voltage	V_{DS} = 28 V; I_D = 70 mA	1.6	2.1	2.7	V
I_{GSS}	gate leakage current	V_{GS} = 9 V; V_{DS} = 0 V	-	-	140	nA
Peaking						
I_{GSS}	gate leakage current	V_{GS} = 9 V; V_{DS} = 0 V	-	-	140	nA
Final stages						
I_{DSS}	drain leakage current	V_{GS} = 0 V; V_{DS} = 28 V	-	-	1.4	μA
Driver stages						
I_{DSS}	drain leakage current	V_{GS} = 0 V; V_{DS} = 28 V	-	-	1.4	μA

Table 7. RF Characteristics

Typical RF performance at T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 70 mA (carrier); $V_{GSq(peaking)}$ = $V_{GSq(carrier)}$ − 0.29 V; $P_{L(AV)}$ = 10 W; unless otherwise specified measured in an Ampleon production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Test signal: pulsed CW [1]						
G_p	power gain	f = 2000 MHz	26	27.8	30	dB
η_D	drain efficiency	P_L = 10 W (40 dBm)	39	44	-	%
		P_L = $P_{L(3dB)}$	46	53	-	%
RL_{in}	input return loss		-	−15	−10	dB
$P_{L(3dB)}$	output power at 3 dB gain compression		47.7	48.3	-	dBm

[1] Pulsed CW power sweep measurement (δ = 10 %, t_p = 100 μs).

8. Application information

Table 8. Typical performance

T_{case} = 25 °C; V_{DS} = 30 V; I_{Dq} = 90 mA (driver and final stages). Test signal: 1-carrier LTE 20 MHz; PAR = 7.6 dB at 0.01 % probability CCDF; typical performance in an Ampleon f = 1805 MHz to 2170 MHz frequency band asymmetrical integrated Doherty application circuit.

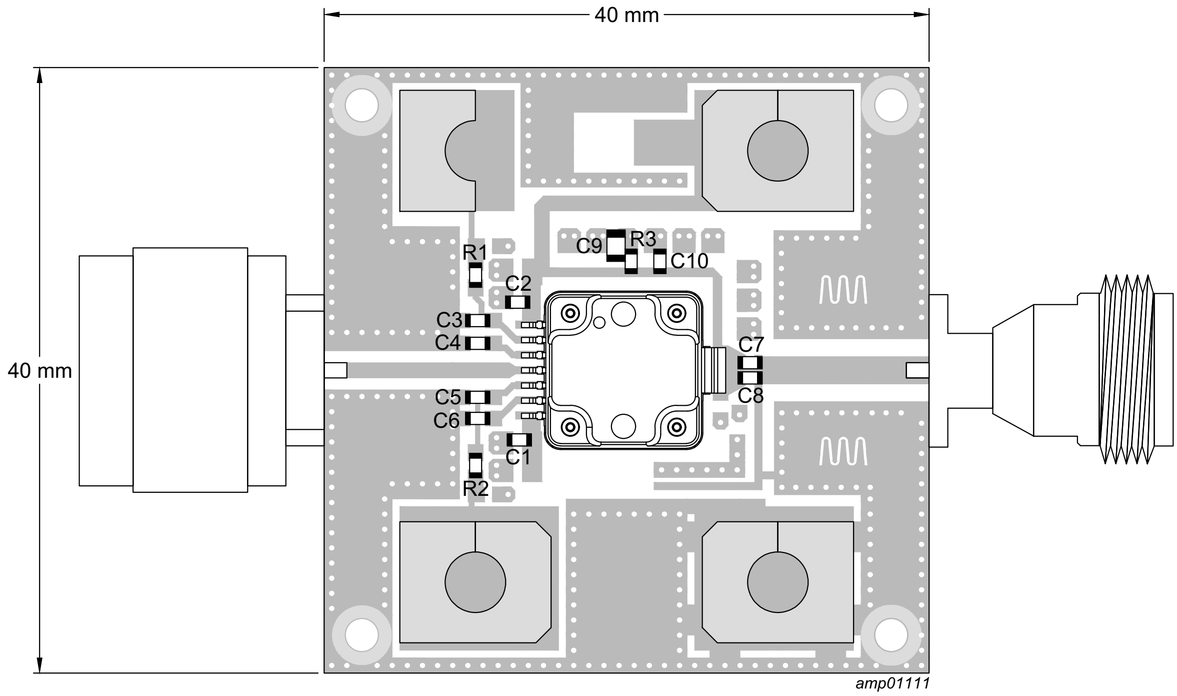
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$P_{L(M)}$	peak output power	f = 1990 MHz	[1]	-	48.4	-	dBm
$\varphi_{s21}/\varphi_{s21(norm)}$	normalized phase response	f = 1990 MHz; at 3 dB compression point;	[2]	-	−17.1	-	°
η_D	drain efficiency	13 dB OBO ($P_{L(AV)}$ = 35 dBm); f = 1990 MHz		-	26.1	-	%
		13 dB OBO ($P_{L(AV)}$ = 35 dBm); f = 1990 MHz	[3]	-	26	-	%
G_p	power gain	$P_{L(AV)}$ = 35 dBm; f = 1990 MHz		-	26.8	-	dB
B_{video}	video bandwidth	$P_{L(AV)}$ = 35 dBm; set to obtain IMD3 = −25 dBc; 2-tone CW; f = 1990 MHz		-	638	-	MHz
G_{flat}	gain flatness	$P_{L(AV)}$ = 35 dBm; f = 1805 MHz to 2170 MHz		-	0.8	-	dB
$ACPR_{20M}$	adjacent channel power ratio (20 MHz)	$P_{L(AV)}$ = 35 dBm; f = 1990 MHz		-	−30.8	-	dB
$\Delta G/\Delta T$	gain variation with temperature	f = 1990 MHz	[4]	-	0.047	-	dB/°C
K	Rollett stability factor	T_{case} = 0 °C; f = 1.4 GHz to 2.6 GHz	[4]	-	>1	-	

[1] Test signal: 1-carrier W-CDMA; test model 1; 64 DPCH; PAR = 9.9 dB at 0.01 % probability CCDF.

[2] 25 ms CW power sweep measurement.

[3] Test signal: 4-carrier LTE 20 MHz, PAR = 8.5 dB at 0.01 % probability CCDF linearized.

[4] S-parameters measured with broadband demo board.



Printed-Circuit Board (PCB): Rogers 4350; thickness = 0.508 mm.
See Table 9 for a list of components.

Fig 3. Component layout

Table 9. Demo test circuit list of components

See Figure 3 for component layout.

Component	Description	Value	Remarks
C1, C2	multilayer ceramic chip capacitor	10 μF, 35 V	TDK: C2012X5R1V106K, SMD 0805
C3, C4, C5,C6	multilayer ceramic chip capacitor	4.7 μF, 6.3 V	AVX: 06036D106MAT2A, SMD 0603
C7	multilayer ceramic chip capacitor	1 pF	Murata: GQM1875C2E1R0WB12D, SMD 0603
C8	multilayer ceramic chip capacitor	0.9 pF	Murata: GQM1875C2ER90BB12D, SMD 0603
C9	multilayer ceramic chip capacitor	10 μF, 50 V	TDK: C2012X5R1V106K, SMD 0805
C10	multilayer ceramic chip capacitor	9.1 pF	Murata: GQM1875C2E9R1CB12D, SMD 0603
R1, R2	resistor	0 Ω	Multicomp: SMD 0603
R3	resistor	3 Ω	Multicomp: SMD 0603

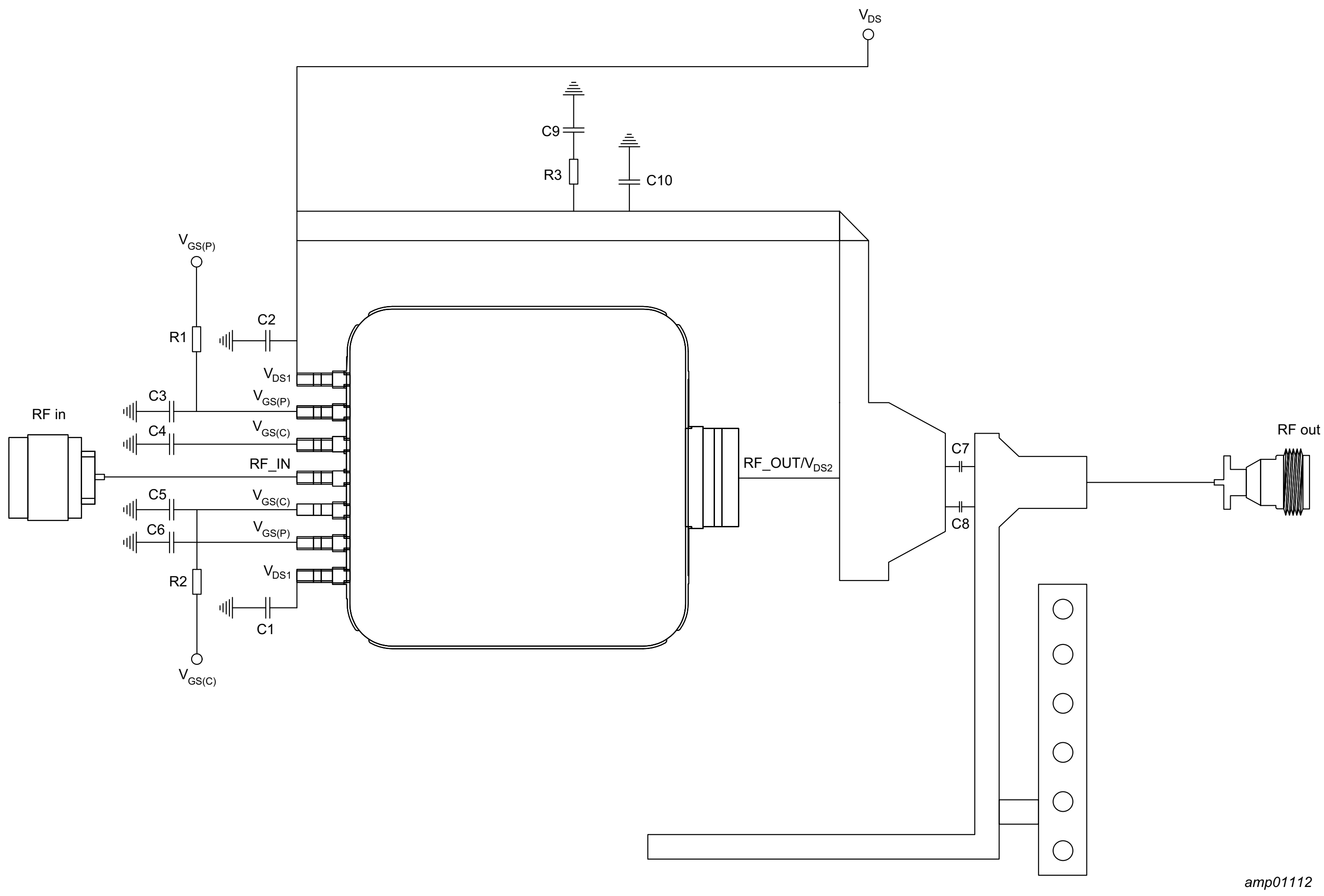


Fig 4. Electrical schematic

8.1 Ruggedness in a Doherty operation

The BLM10D1822-60ABG is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions: V_{DS} = 32 V; I_{Dq} = 70 mA (carrier); $V_{GSq(peaking)} - V_{GSq(carrier)}$ = 0.29 V; P_i corresponding to $P_{L(3dB)}$ – 5 dB under Z_S = 50 Ω load; f = 2170 MHz (1-carrier W-CDMA signal is used during the stress); T_{case} = 25 °C.

8.2 Impedance information

Table 10. Typical impedance for optimum Doherty operation

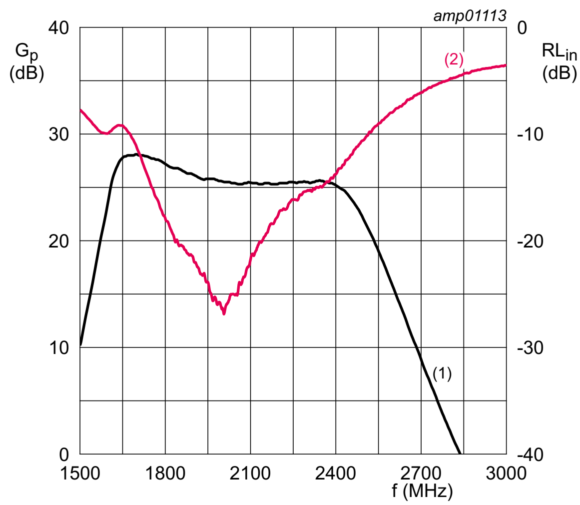
Measured load-pull data per section; test signal: pulsed CW; T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 85 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.3$ V; t_p = 100 μs; δ = 10 %. Typical values.

f	tuned for optimum Doherty operation				
	Z_L	$G_{p(max)}$	P_L	η_{add} [1]	η_{add} [2]
(MHz)	(Ω)	(dB)	(dBm)	(%)	(%)
1800	19.157 – j7.324	29.2	48.1	57.5	50.5
1900	20.372 – j7.684	28.2	48.5	56.1	47.4
2000	19.616 – j6.164	27.5	48.1	53.0	47.5
2100	22.348 – j6.049	27.0	48.1	53.9	46.5
2200	23.431 – j2.632	26.9	47.6	55.2	46.5

[1] At 3 dB gain compression point.

[2] At P_L = 40 dBm (nearly 8 dB OBO point).

8.3 Graphs



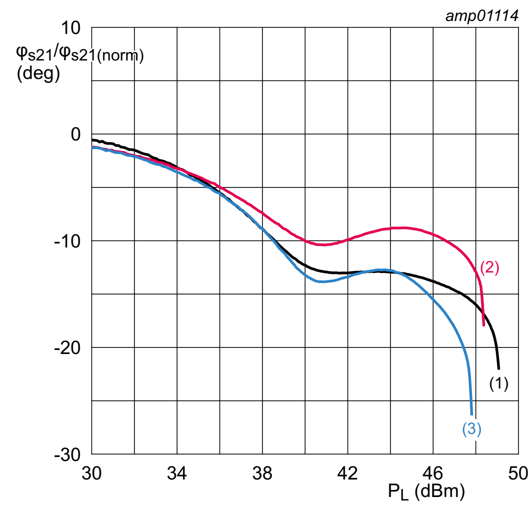
T_{case} = 25 °C; V_{DS} = 30 V;
I_{Dq1} + I_{Dq2} = 91 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage);
V_{GS} = 1.84 V (peaking stage).

Test signal: CW.

(1) magnitude of G_p

(2) magnitude of RL_{in}

Fig 5. Wideband power gain and input return loss as function of frequency; typical values



T_{case} = 25 °C; V_{DS} = 30 V;
I_{Dq1} + I_{Dq2} = 91 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage);
V_{GS} = 1.84 V (peaking stage).

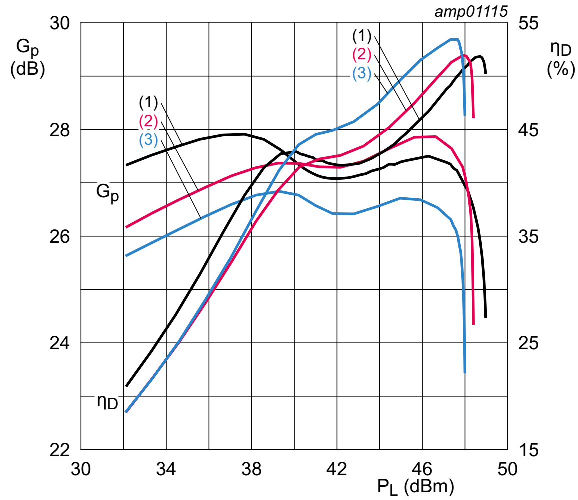
Test signal: 25 ms CW power sweep.

(1) f = 1805 MHz

(2) f = 1990 MHz

(3) f = 2170 MHz

Fig 6. Normalized phase response as a function of output power; typical values



T_{case} = 25 °C; V_{DS} = 30 V; $I_{Dq1} + I_{Dq2}$ = 91 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage); V_{GS} = 1.84 V (peaking stage).

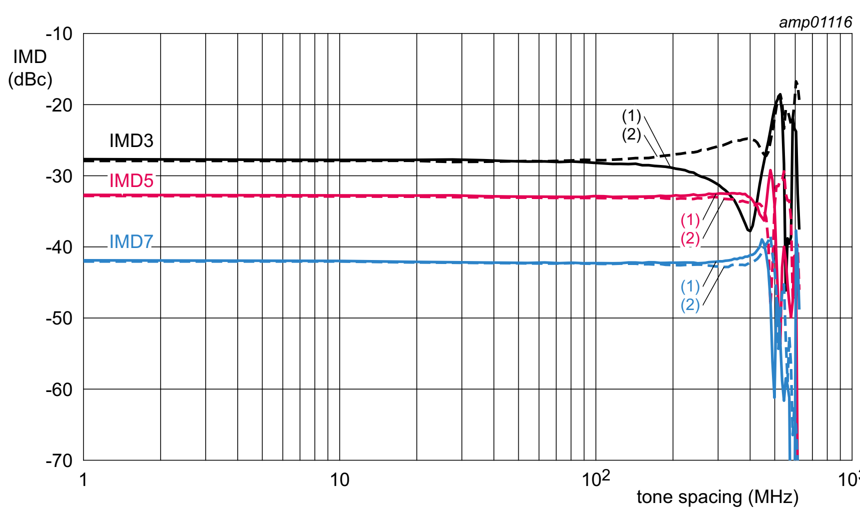
Test signal: pulsed CW power sweep (δ = 10 %; t_p = 100 μs).

(1) f = 1805 MHz

(2) f = 1990 MHz

(3) f = 2170 MHz

Fig 7. Power gain and drain efficiency as function of output power; typical values



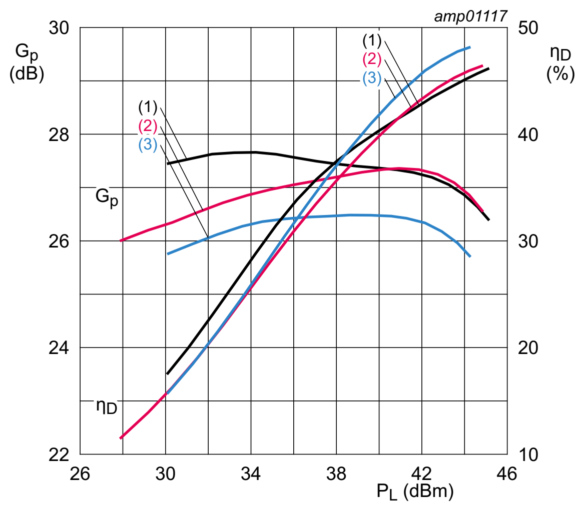
T_{case} = 25 °C; V_{DS} = 30 V; $I_{Dq1} + I_{Dq2}$ = 91 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage); V_{GS} = 1.84 V (peaking stage); $P_{L(AV)}$ = 6.30 W.

Test signal: 2-tone CW; f_c = 1990 MHz.

(1) IMD low

(2) IMD high

Fig 8. Intermodulation distortion as a function of tone spacing; typical values



T_{case} = 25 °C; V_{DS} = 30 V;
I_{Dq1} + I_{Dq2} = 91 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage);
V_{GS} = 1.84 V (peaking stage).

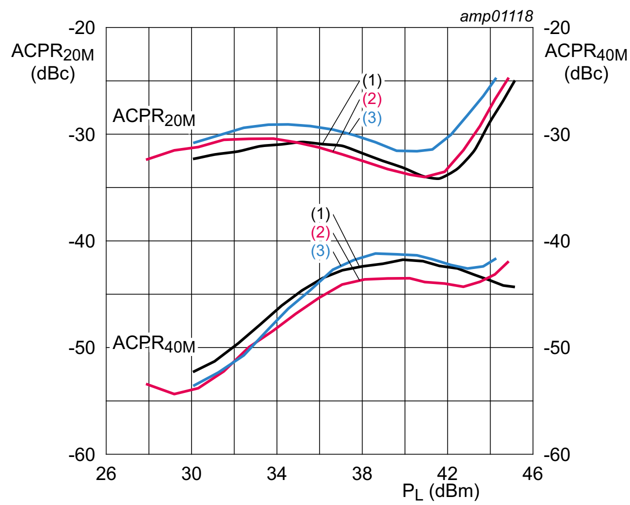
Test signal: 1-carrier LTE; PAR = 7.6 dB at 0.01 % probability CCDF.

(1) f = 1805 MHz

(2) f = 1990 MHz

(3) f = 2170 MHz

Fig 9. Power gain and drain efficiency as function of output power; typical values



T_{case} = 25 °C; V_{DS} = 30 V;
I_{Dq1} + I_{Dq2} = 91 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage);
V_{GS} = 1.84 V (peaking stage).

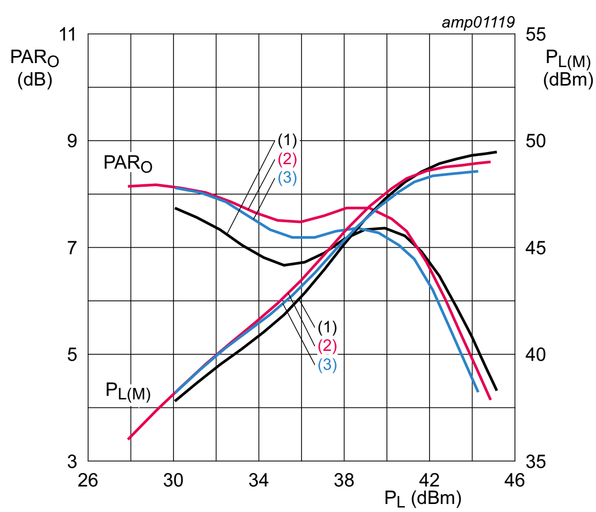
Test signal: 1-carrier LTE; PAR = 7.6 dB at 0.01 % probability CCDF.

(1) f = 1805 MHz

(2) f = 1990 MHz

(3) f = 2170 MHz

Fig 10. Adjacent channel power ratio as a function of output power; typical values



T_{case} = 25 °C; V_{DS} = 30 V; I_{Dq1} + I_{Dq2} = 91 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage); V_{GS} = 1.84 V (peaking stage).

Test signal: 1-carrier LTE; PAR = 7.6 dB at 0.01 % probability CCDF.

(1) f = 1805 MHz

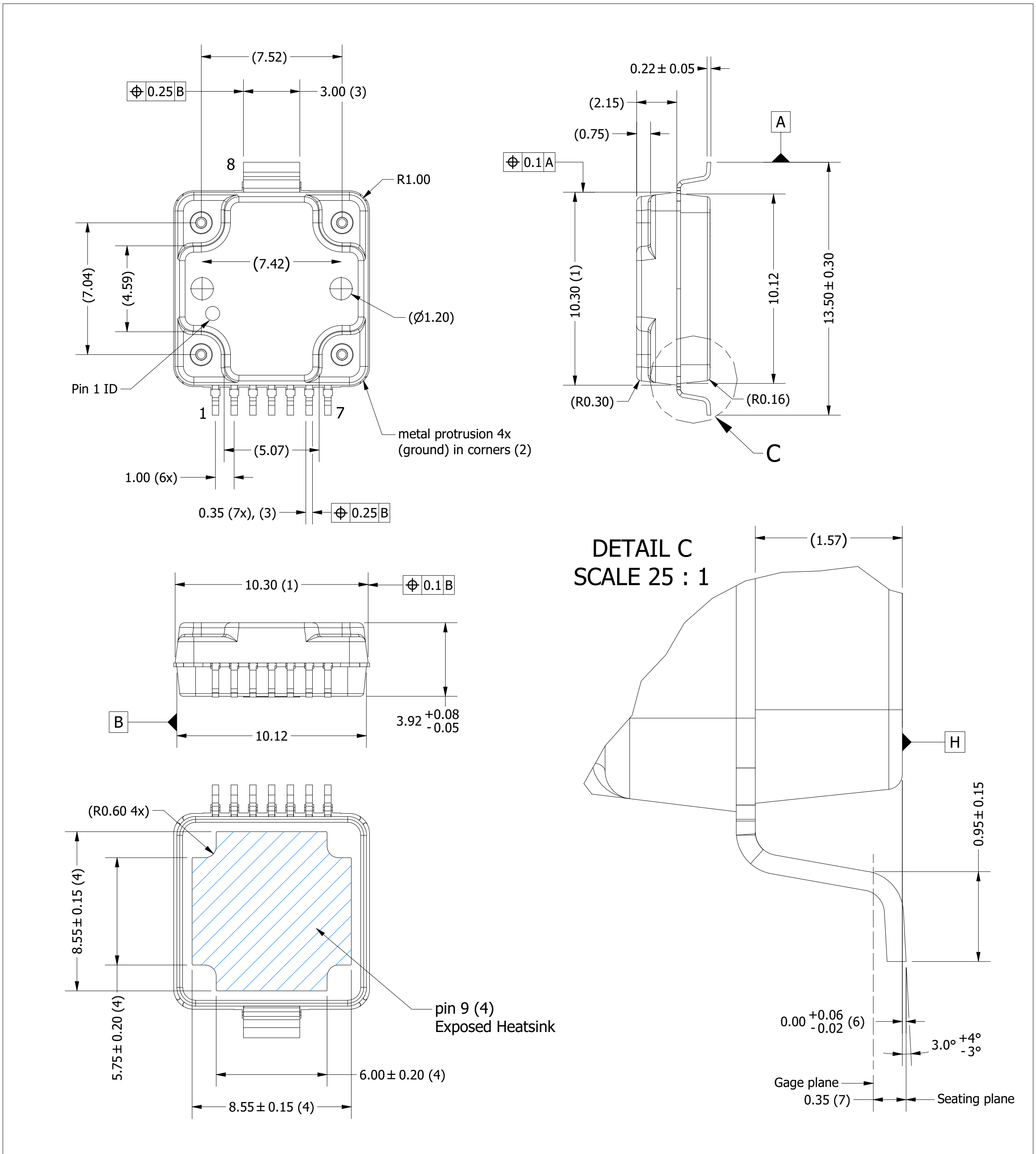
(2) f = 1990 MHz

(3) f = 2170 MHz

Fig 11. Output peak-to-average ratio and peak output power as function of output power; typical values

9. Package outline

OMP-400-8G-1

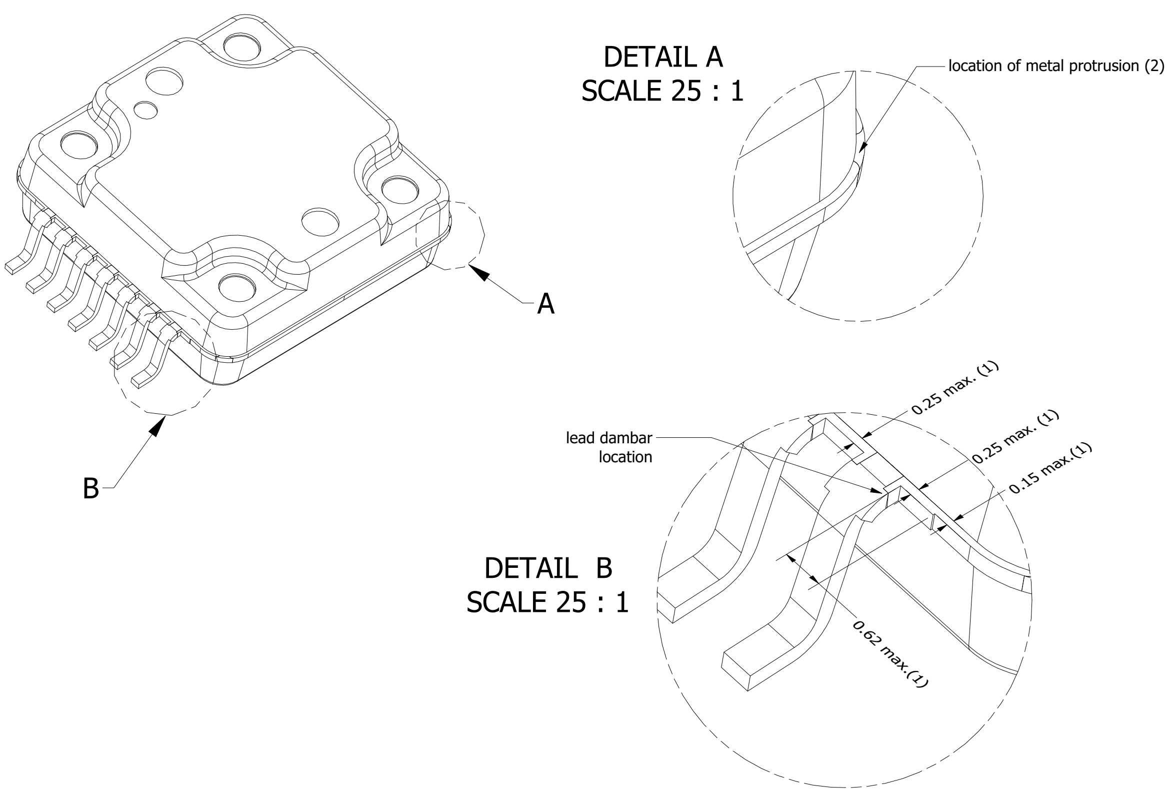


Package outline drawing:	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.05 Angle: ± 1°	Revision: 1 Revision date: 11/26/2019
OMP-400-8G-1		Third angle projection	Sheet 1 of 2

Fig 12. Package outline OMP-400-8G-1 (sheet 1 of 2)

OMP-400-8G-1

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 7 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 indicates the exposed heatsink. The dimensions represent the values between two opposite points along the original heatsink perimeter.
(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: OMP-400-8G-1	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.05 Angle: ± 1°	Revision: 1 Revision date: 11/26/2019
		Third angle projection	Sheet 2 of 2

Fig 13. Package outline OMP-400-8G-1 (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 11. ESD sensitivity

ESD model	Class
Charged Device Model (CDM); According to ANSI/ESDA/JEDEC standard JS-002	C3 [1]
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	1B [2]

[1] CDM classification C3 is granted to any part that passes after exposure to an ESD pulse of 1000 V.

[2] HBM classification 1B is granted to any part that passes after exposure to an ESD pulse of 500 V.

11. Abbreviations

Table 12. Abbreviations

Acronym	Description
CCDF	Complementary Cumulative Distribution Function
CW	Continuous Wave
ESD	ElectroStatic Discharge
GEN10	Tenth Generation
GSM	Global System for Mobile Communications
LDMOS	Laterally Diffused Metal Oxide Semiconductor
LTE	Long Term Evolution
mMIMO	Massive Multiple Input-Multiple Output
MMIC	Monolithic Microwave Integrated Circuit
MTF	Median Time to Failure
OBO	Output Back Off
PAR	Peak-to-Average Ratio
RoHS	Restriction of Hazardous Substances
SMD	Surface Mounted Device
W-CDMA	Wideband Code Division Multiple Access

12. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLM10D1822-60ABG v.2	20191219	Product data sheet	-	BLM10D1822-60ABG v.1
Modifications:	• Section 9 on page 12: package outline drawing updated			
BLM10D1822-60ABG v.1	20191011	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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14. Contact information

For more information, please visit: **http://www.ampleon.com**

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15. Contents

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section ‘Legal information’.

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