BLM10D3438-70ABG

LDMOS 3-stage integrated Doherty MMIC

AMPLEON

Rev. 1 — 18 September 2020 Product data sheet

1. Product profile

1.1 General description

The BLM10D3438-70ABG is a 3-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 3400 MHz to 3800 MHz. Available in gull wing.

Table 1. Performance

Typical RF performance at T_{case} = 25 °C; I_{Dq} = 110 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5$ V.

Test signal	f	V_{DS}	$P_{L(M)}$	G_p	η_D	$ACPR_{20M}$
	(MHz)	(V)	(dBm)	(dB)	(%)	(dBc)
1-carrier LTE 20 MHz	3600	28	40	31.8	37.8	–24

1.2 Features and benefits

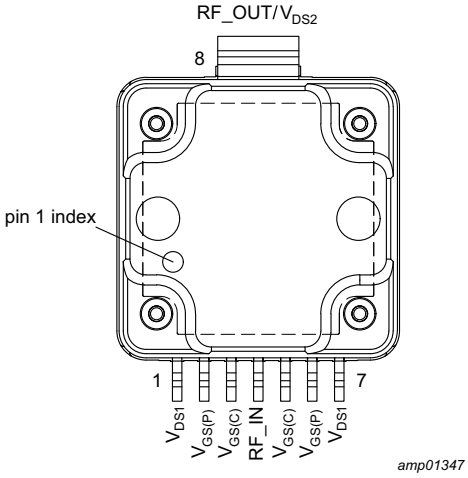
- Integrated input splitter
- Integrated output combiner
- High efficiency
- Designed for broadband operation (frequency 3400 MHz to 3800 MHz)
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Source impedance 50 Ω; high power gain
- For RoHS compliance see the product details 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 3400 MHz to 3800 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
BLM10D3438-70ABG		plastic, heatsink small outline package; 8 leads	OMP-400-8G-1

4. Block diagram

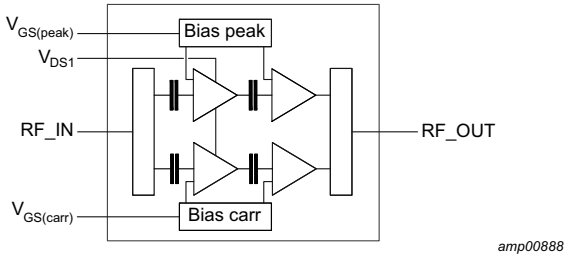


Fig 2. Block diagram

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 = 6.3 W [1]	1.88	K/W
		T_{case} = 90 °C; P_L = 10 W [1]	1.51	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 = 110 mA	1.6	2.2	2.7	V
I_{GSS}	gate leakage current	V_{GS} = 1 V; V_{DS} = 0 V	-	-	140	nA
Peaking						
I_{GSS}	gate leakage current	V_{GS} = 1 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} = 110 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5$ 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 = 3600 MHz	29.5	31.5	33.5	dB
η_D	drain efficiency	P_L = 10 W (40 dBm)	33	42	-	%
		$P_L = P_{L(3dB)}$	34	41	-	%
RL_{in}	input return loss		-	–15	–10	dB
$P_{L(3dB)}$	output power at 3 dB gain compression		47.4	48.2	-	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} = 28 V; I_{Dq} = 110 mA (driver and final stages); test signal: 1-carrier LTE 20 MHz, PAR 7.6 dB at 0.01 % probability CCDF; measured in an Ampleon 3400 MHz to 3800 MHz frequency band asymmetrical integrated Doherty application circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_{L(3dB)}$	output power at 3 dB gain compression	f = 3600 MHz [1]	-	48.6	-	dBm
$\varphi_{s21}/\varphi_{s21(norm)}$	normalized phase response	at 3 dB compression point; f = 3600 MHz [2]	-	–55.4	-	°
η_D	drain efficiency	8.6 dB OBO ($P_{L(AV)}$ = 40 dBm); f = 3600 MHz	-	37.3	-	%
G_p	power gain	$P_{L(AV)}$ = 40 dBm; f = 3600 MHz	-	31.8	-	dB
B_{video}	video bandwidth	$P_{L(AV)}$ = 40 dBm, set to obtain IMD3 = –40 dBc; 2-tone CW; f = 3600 MHz	-	>600	-	MHz
G_{flat}	gain flatness	$P_{L(AV)}$ = 40 dBm; f = 3400 MHz to 3800 MHz	-	0.5	-	dB

Table 8. Typical performance *…continued*

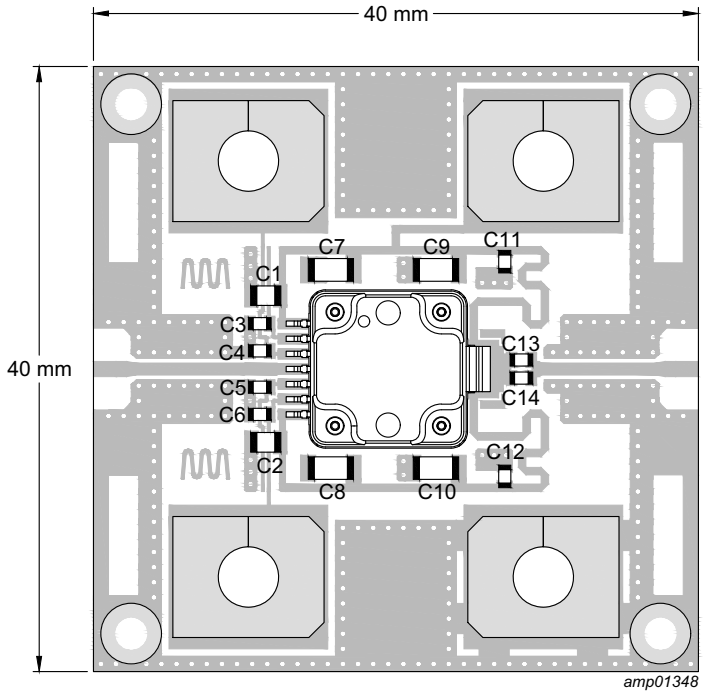
T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 110 mA (driver and final stages); test signal: 1-carrier LTE 20 MHz, PAR 7.6 dB at 0.01 % probability CCDF; measured in an Ampleon 3400 MHz to 3800 MHz frequency band asymmetrical integrated Doherty application circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$ACPR_{20M}$	adjacent channel power ratio (20 MHz)	$P_{L(AV)}$ = 40 dBm; f = 3600 MHz	-	−24.4	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	f = 3600 MHz [3]	-	0.06	-	dB/°C
K	Rollett stability factor	T_{case} = −40 °C; f = 0.2 GHz to 6 GHz [3]	-	>1.5	-	

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

[2] 25 ms CW power sweep measurement.

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



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

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	4.7 μF, 35 V	TDK
C3, C4, C5, C6	multilayer ceramic chip capacitor	1 μF, 6.3 V	Murata
C7, C8, C9, C10	multilayer ceramic chip capacitor	10 μF, 50 V	Murata
C11, C12	multilayer ceramic chip capacitor	3 pF	Murata
C13, C14	multilayer ceramic chip capacitor	4.7 pF	Murata

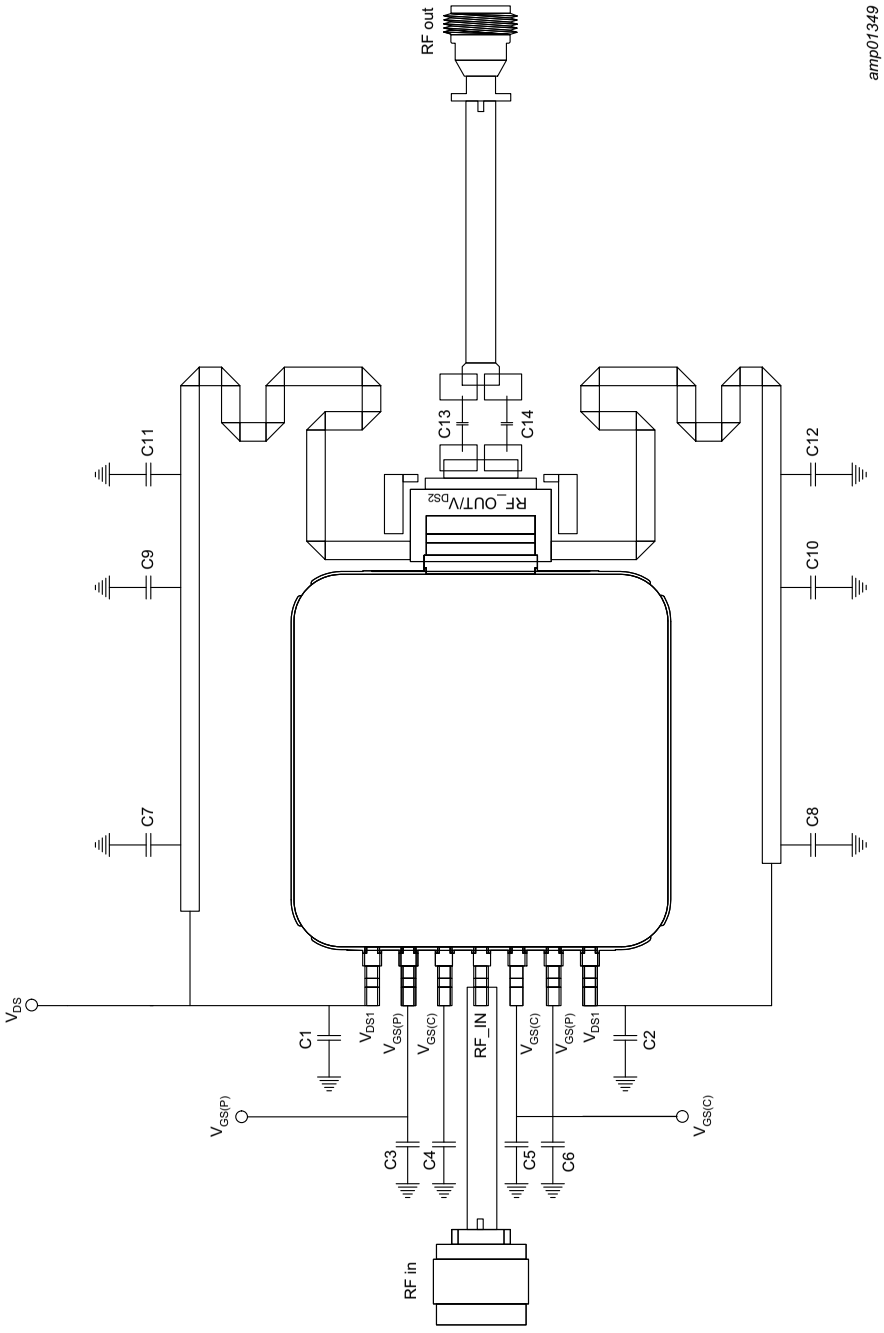


Fig 4. Electrical schematic

8.1 Ruggedness in a Doherty operation

The BLM10D3438-70ABG 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} = 110 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5$ V; P_i corresponding to $P_{L(3dB)} - 5$ dB under Z_S = 50 Ω load; f = 3800 MHz (1-carrier W-CDMA signal with PAR = 9.9 dB); T_{case} = 25 °C unless otherwise specified.

8.2 Impedance information

Table 10. Typical impedance for optimum Doherty operation

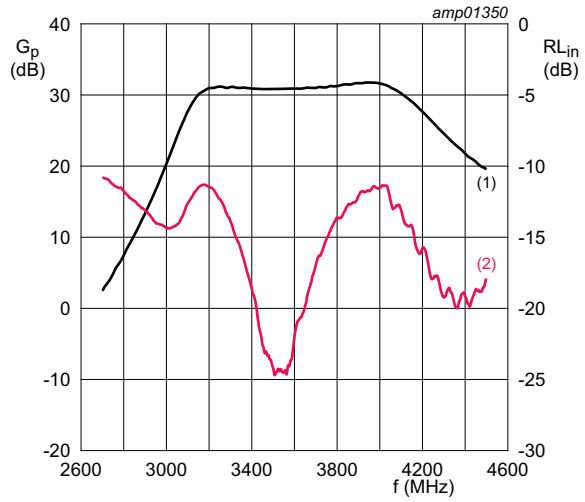
Measured load-pull data per section; test signal: pulsed CW; T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 110 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5$ V; t_p = 100 µs; δ = 10 %. Typical values unless otherwise specified.

	tuned for optimum Doherty operation				
f	Z_L	$G_{p(max)}$	$P_{L(3dB)}$	η_{add} [1]	η_{add} [2]
(MHz)	(Ω)	(dB)	(dBm)	(%)	(%)
3400	19.51 – j22.94	32.4	48.48	43.3	44.0
3500	19.86 – j19.85	32.0	48.59	44.1	45.0
3600	17.03 – j17.98	32.1	48.65	44.9	45.4
3700	15.13 – j18.50	32.2	48.67	45.5	45.1
3800	14.85 – j20.56	32.8	48.68	46.4	44.2

[1] At 3 dB gain compression point.

[2] At P_L = 40 dBm.

8.3 Graphs

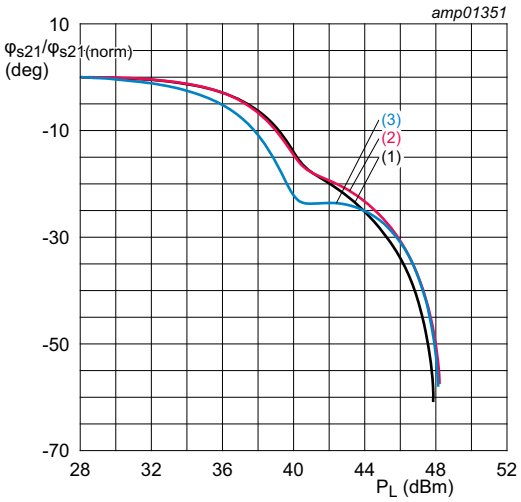


T_{case} = 25 °C; V_{DS} = 28 V;
I_{Dq1} + I_{Dq2} = 110 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage);
V_{GS} = 1.61 V (peaking stage).
Test signal: CW.

(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



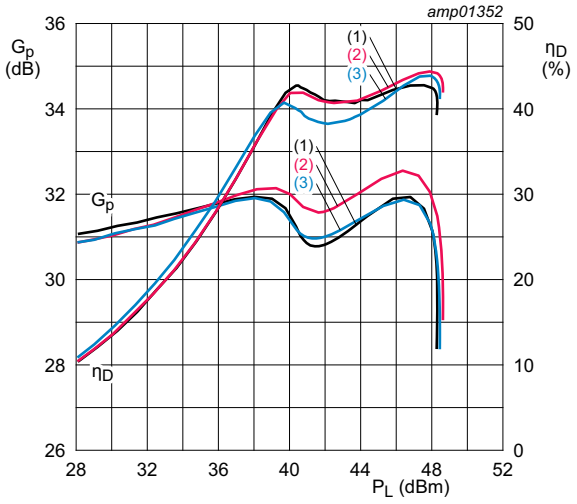
T_{case} = 25 °C; V_{DS} = 28 V;
I_{Dq1} + I_{Dq2} = 110 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage);
V_{GS} = 1.61 V (peaking stage).
Test signal: 25 ms CW power sweep.

(1) f = 3400 MHz

(2) f = 3600 MHz

(3) f = 3800 MHz

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



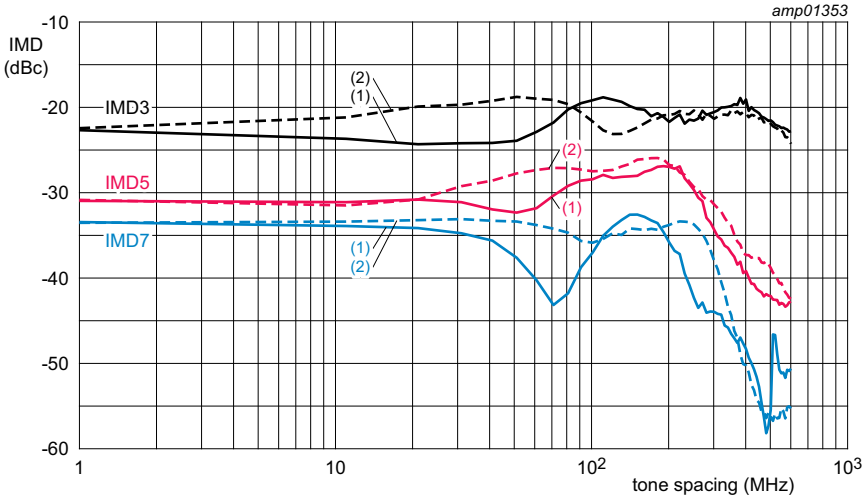
T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq1} + I_{Dq2} = 110 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage); V_{GS} = 1.61 V (peaking stage).
Test signal: pulsed CW power sweep (δ = 10 %; t_p = 100 μs).

(1) f = 3400 MHz

(2) f = 3600 MHz

(3) f = 3800 MHz

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

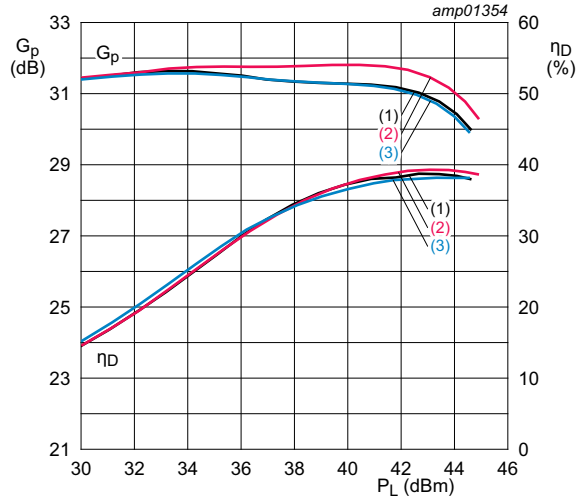


T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq1} + I_{Dq2} = 110 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage); V_{GS} = 1.61 V (peaking stage).
Test signal: 2-tone CW; f_c = 3600 MHz.

(1) IMD low

(2) IMD high

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



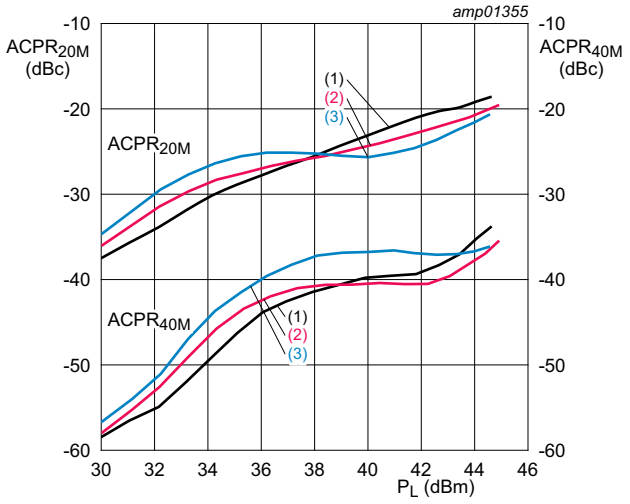
T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq1} + I_{Dq2}$ = 110 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage);
V_{GS} = 1.61 V (peaking stage).
Test signal: 1-carrier LTE; PAR = 7.6 dB at 0.01 % probability CCDF.

(1) f = 3400 MHz

(2) f = 3600 MHz

(3) f = 3800 MHz

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



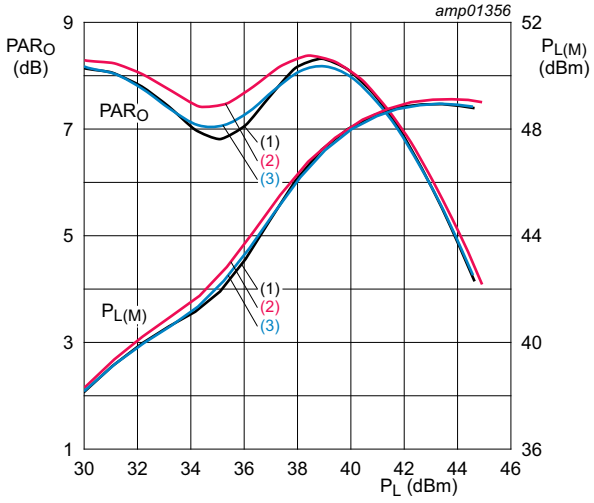
T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq1} + I_{Dq2}$ = 110 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage);
V_{GS} = 1.61 V (peaking stage).
Test signal: 1-carrier LTE; PAR = 7.6 dB at 0.01 % probability CCDF.

(1) f = 3400 MHz

(2) f = 3600 MHz

(3) f = 3800 MHz

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



T_{case} = 25 °C; V_{DS} = 28 V; $I_{Dq1} + I_{Dq2}$ = 110 mA (carrier and peaking stages);
V_{GS} = 2.11 V (carrier stage); V_{GS} = 1.61 V (peaking stage).
Test signal: 1-carrier LTE; PAR = 7.6 dB at 0.01 % probability CCDF.

(1) f = 3400 MHz

(2) f = 3600 MHz

(3) f = 3800 MHz

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

9. Package outline

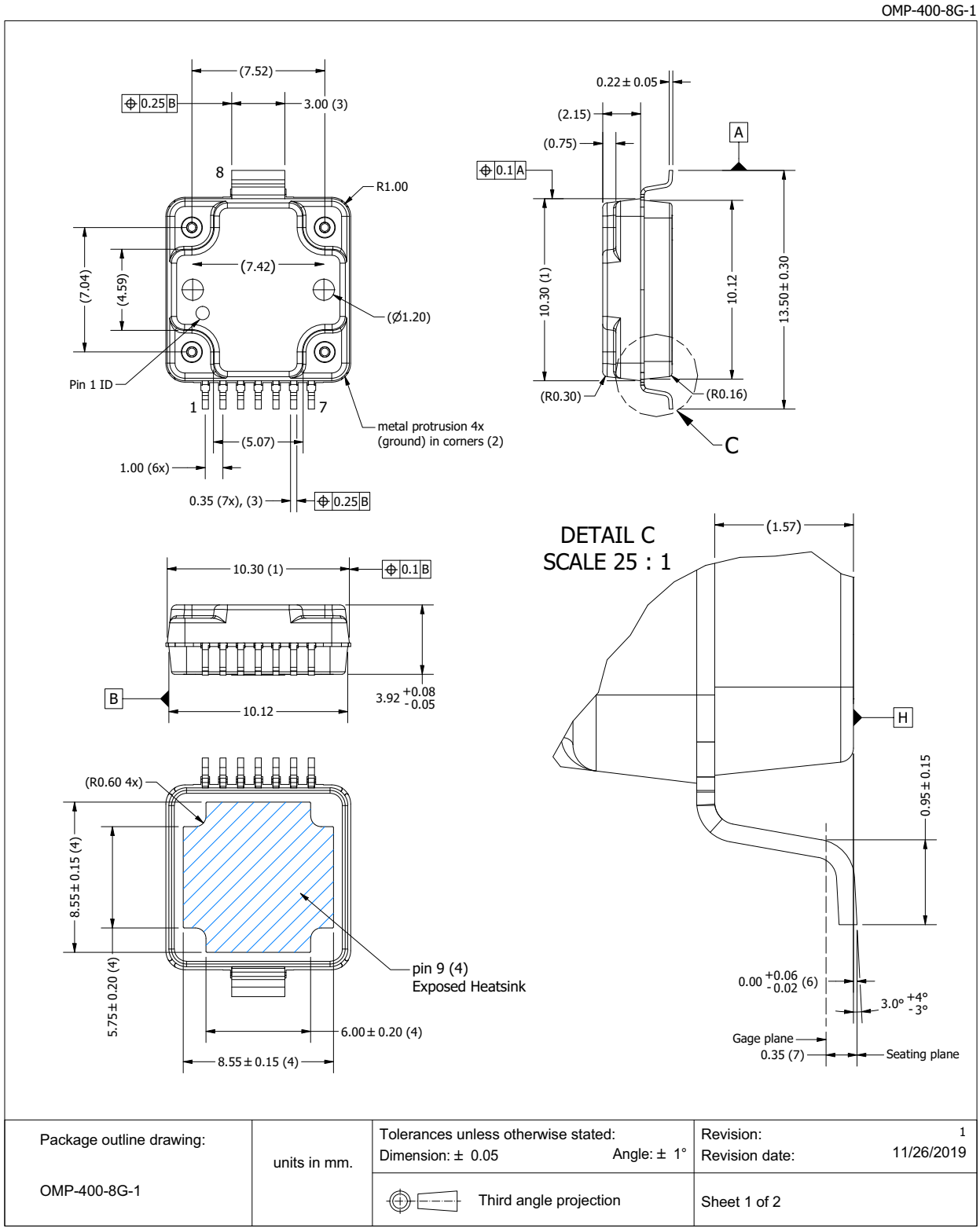
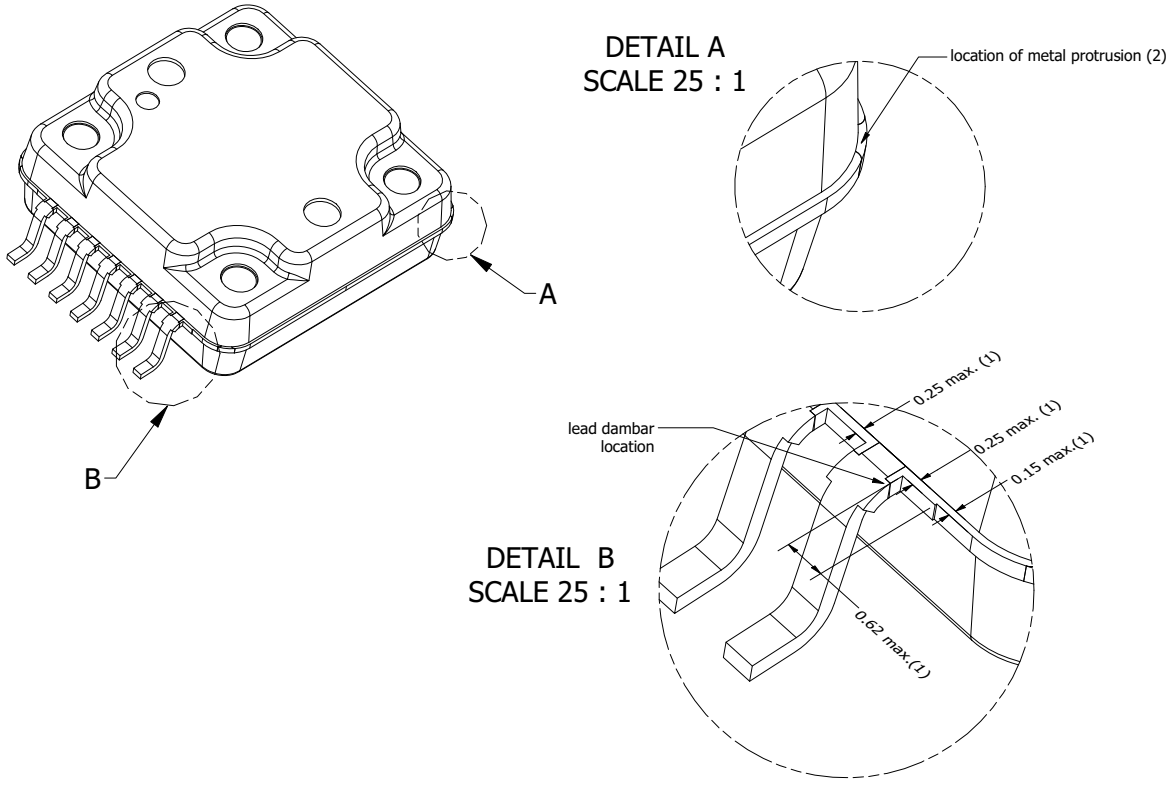


Fig 12. Package outline OMP-400-8G-1 (sheet 1 of 2)

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° Third angle projection	Revision: 1 Revision date: 11/26/2019 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	C1 [1]
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	1B [2]

[1] CDM classification C1 is granted to any part that passes after exposure to an ESD pulse of 250 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
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
VSWR	Voltage Standing Wave Ratio
W-CDMA	Wideband Code Division Multiple Access

12. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLM10D3438-70ABG v.1	20200918	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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Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

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14. Contact information

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For sales office addresses, please visit: **http://www.ampleon.com/sales**

15. Contents

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