

# BLM10D3438-35AB

LDMOS 3-stage integrated Doherty MMIC

Rev. 1 — 30 July 2019

AMPLEON

Product data sheet

## 1. Product profile

### 1.1 General description

The BLM10D3438-35AB is a 3-stage fully integrated asymmetrical Doherty MMIC solution using Ampleon's state of the art LDMOS technology. The carrier and peaking device, input splitter, output combiner and pre-match are integrated in a single package. This multiband device is perfectly suited as a final stage for small cells and massive MIMO applications in the frequency range from 3400 MHz to 3800 MHz. Available in PQFN outline.

**Table 1. Application performance**

Typical RF performance at  $T_{case} = 25\text{ }^{\circ}\text{C}$ ;  $I_{DQ} = 41\text{ mA}$  (carrier);  $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5\text{ V}$ .  
Test signal: 1-carrier LTE 20 MHz; PAR = 7.6 dB.

Test signal	f	V <sub>DS</sub>	P <sub>L(AV)</sub>	G <sub>p</sub>	η <sub>D</sub>
	(MHz)	(V)	(W)	(dB)	(%)
single carrier LTE	3600	26	5	33	41

### 1.2 Features and benefits

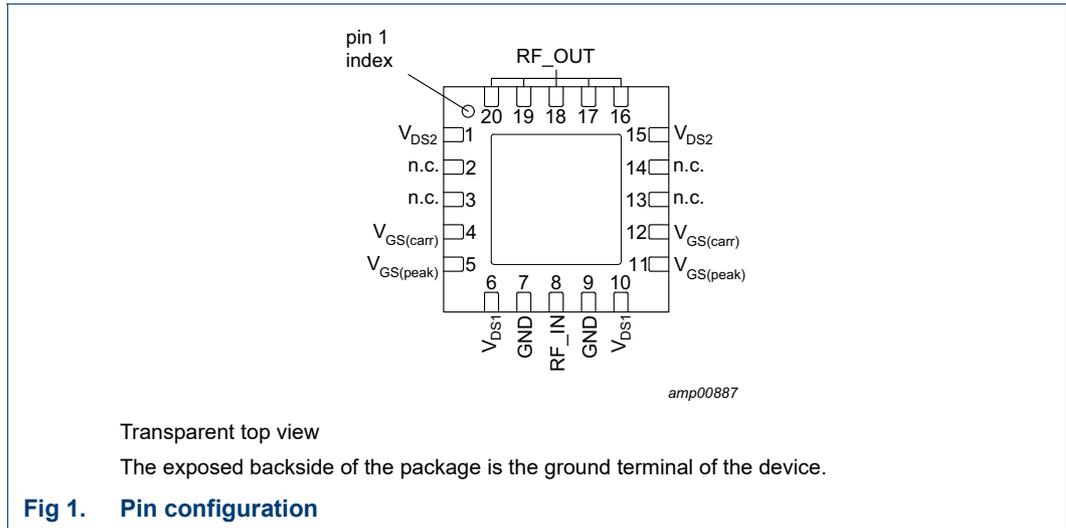
- Integrated input splitter
- Integrated output combiner
- 30 Ω output impedance thanks to integrated pre-match
- Very high efficiency thanks to asymmetry
- Designed for wideband operation (frequency 3400 MHz to 3800 MHz)
- Independent control of carrier and peaking bias
- Integrated ESD protection
- 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 5G base stations in the 3400 MHz to 3800 MHz frequency range

## 2. Pinning information

### 2.1 Pinning



### 2.2 Pin description

Table 2. Pin description

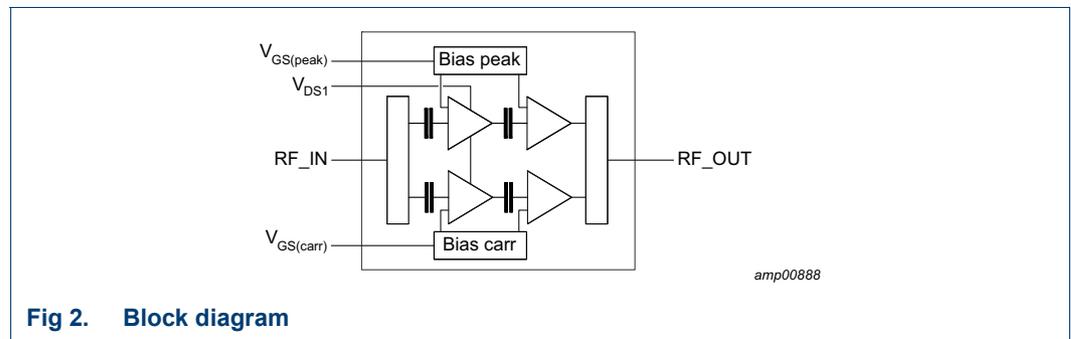
Symbol	Pin	Description
$V_{DS2}$	1	drain-source voltage of final stages
n.c.	2	not connected
n.c.	3	not connected
$V_{GS(carr)}$	4	gate-source voltage of carrier
$V_{GS(peak)}$	5	gate-source voltage of peaking
$V_{DS1}$	6	drain-source voltage of driver stages
GND	7	RF ground
RF_IN	8	RF input
GND	9	RF ground
$V_{DS1}$	10	drain-source voltage of driver stages
$V_{GS(peak)}$	11	gate-source voltage of peaking
$V_{GS(carr)}$	12	gate-source voltage of carrier
n.c.	13	not connected
n.c.	14	not connected
$V_{DS2}$	15	drain-source voltage of final stages
RF_OUT	16	RF output
RF_OUT	17	RF output
RF_OUT	18	RF output
RF_OUT	19	RF output
RF_OUT	20	RF output
GND	flange	RF ground

### 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLM10D3438-35AB	PQFN20	plastic thermal enhanced quad flat package; no leads; 20 terminals; body 8.0 x 8.0 x 2.1 mm	SOT1462-1

### 4. 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]	-	200	°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

Symbol	Parameter	Conditions	Value	Unit	
$R_{th(j-c)}$	thermal resistance from junction to case	$T_{case} = 90\text{ °C}; P_L = 2\text{ W}$	[1]	4	K/W
		$T_{case} = 90\text{ °C}; P_L = 5\text{ W}$	[1]	3.2	K/W

[1] When operated with a 1-carrier W-CDMA with PAR = 7.6 dB.

## 7. Characteristics

**Table 6. DC characteristics**

$T_{case} = 25\text{ }^{\circ}\text{C}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Carrier</b>						
$V_{GSq}$	gate-source quiescent voltage	$V_{DS} = 28\text{ V}; I_D = 42\text{ mA}$	1.65	2.0	2.5	V
$I_{GSS}$	gate leakage current	$V_{GS} = 1\text{ V}; V_{DS} = 0\text{ V}$	-	-	140	nA
<b>Peaking</b>						
$I_{GSS}$	gate leakage current	$V_{GS} = 1\text{ V}; V_{DS} = 0\text{ V}$	-	-	140	nA
<b>Final stages</b>						
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}; V_{DS} = 28\text{ V}$	-	-	1.4	$\mu\text{A}$
<b>Driver stages</b>						
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}; V_{DS} = 28\text{ V}$	-	-	1.4	$\mu\text{A}$

**Table 7. RF Characteristics**

Typical RF performance at  $T_{case} = 25\text{ }^{\circ}\text{C}$ ;  $V_{DS} = 28\text{ V}$ ;  $I_{Dq} = 42\text{ mA}$  (carrier);

$V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5\text{ V}$ ;  $P_{L(AV)} = 5\text{ W}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Test signal: pulsed CW [1]</b>						
$G_p$	power gain	$f = 3600\text{ MHz}$	31.4	33.4	35.4	dB
$\eta_D$	drain efficiency	$P_L = 5\text{ W}$ (37 dBm)	37	42	-	%
		$P_L = P_{L(3dB)}$	41	47	-	%
$RL_{in}$	input return loss		-	-15	-10	dB
$P_{L(3dB)}$	output power at 3 dB gain compression	-	45.0	45.5	-	dBm

[1] Pulsed CW power sweep measurement ( $\delta = 10\text{ }%$ ,  $t_p = 100\text{ }\mu\text{s}$ ).

## 8. Application information

**Table 8. Typical performance**

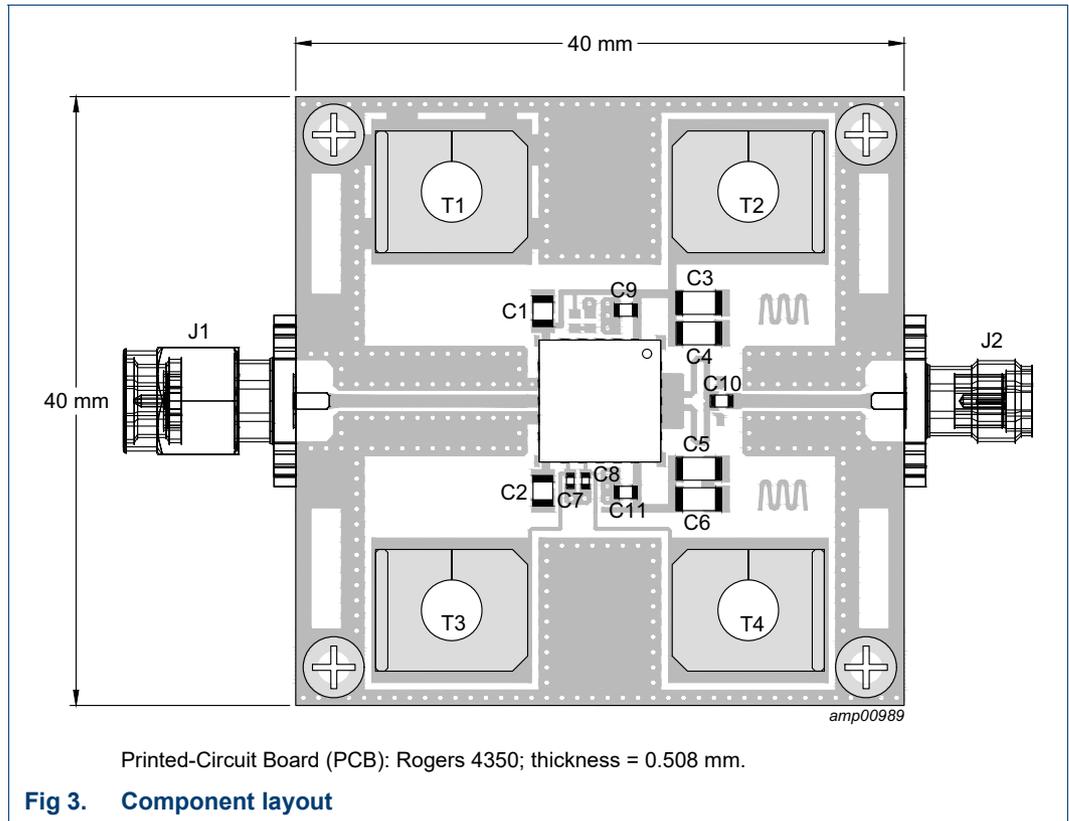
$T_{case} = 25\text{ °C}$ ;  $V_{DS} = 26\text{ V}$ ;  $I_{DQ} = 41\text{ mA}$  (carrier);  $V_{GSQ(peaking)} = V_{GSQ(carrier)} - 0.5\text{ V}$ . Test signal: 1-carrier LTE; PAR = 7.6 dB at 0.01 % probability CCDF; unless otherwise specified, typical performance in an Ampleon  $f = 3400\text{ MHz}$  to  $3800\text{ MHz}$  frequency band application circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_{L(3dB)}$	output power at 3 dB gain compression	$f = 3600\text{ MHz}$ [1]	-	45.4	-	dBm
$\varphi_{s21}/\varphi_{s21(norm)}$	normalized phase response	at 3 dB compression point; $f = 3600\text{ MHz}$ [2]	-	-32	-	°
$\eta_D$	drain efficiency	8.5 dB OBO ( $P_{L(AV)} = 37\text{ dBm}$ ); $f = 3600\text{ MHz}$	-	41	-	%
$G_p$	power gain	$P_{L(AV)} = 37\text{ dBm}$ ; $f = 3600\text{ MHz}$	-	33	-	dB
$B_{video}$	video bandwidth	$P_{L(AV)} = 34.0\text{ dBm}$ set to obtain IMD3 = -25 dBc; 2-tone CW; $f = 3600\text{ MHz}$	-	400	-	MHz
$G_{flat}$	gain flatness	$P_{L(AV)} = 37\text{ dBm}$ ; $f = 3400\text{ MHz}$ to 3800 MHz	-	0.9	-	dB
$ACPR_{20M}$	adjacent channel power ratio (20M)	$P_{L(AV)} = 37\text{ dBm}$ ; $f = 3600\text{ MHz}$	-	30	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	$f = 3600\text{ MHz}$ [3]	-	0.07	-	dB/°C
K	Rollett stability factor	$T_{case} = -40\text{ °C}$ ; $f = 0.1\text{ GHz}$ to 6.1 GHz; VSWR at source > 5 : 1 at 3.2 GHz [3]	-	>1	-	

[1] Pulsed CW power sweep measurement ( $\delta = 10\%$ ,  $t_p = 100\text{ }\mu\text{s}$ ).

[2] 25 ms CW power sweep measurement.

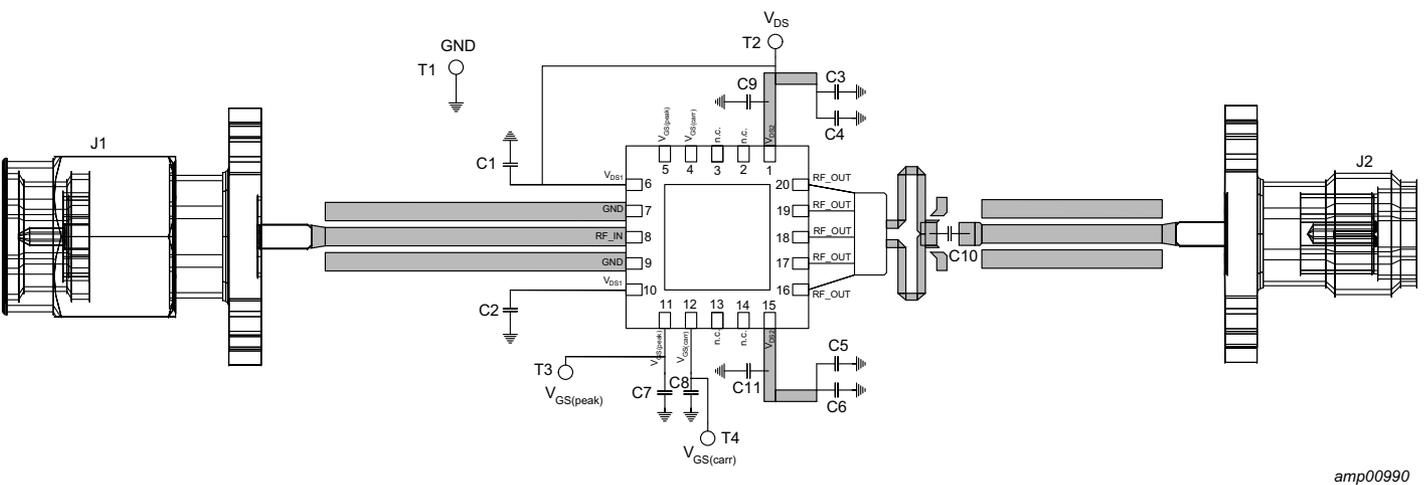
[3] S-parameters measured with broadband demo board.



**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 $\mu$ F, 6.3 V	Murata: GRM21BR60J106KE01L
C3, C4, C5, C6	multilayer ceramic chip capacitor	10 $\mu$ F, 50 V	Murata: GRM31CR61H106KA12L
C7, C8	multilayer ceramic chip capacitor	4.7 $\mu$ F, 6.3 V	Murata: GRM155R60J475ME47D
C9	multilayer ceramic chip capacitor	3.3 pF $\pm$ 0.1 %	Murata: GQM1875C2E3R3BB12
C10	multilayer ceramic chip capacitor	3.6 pF $\pm$ 0.1 %	Murata: GQM1875C2E3R6BB12
C11	multilayer ceramic chip capacitor	3 pF $\pm$ 0.1 %	Murata: GQM1875C2E3R0BB12
J1	SMA Coaxial panel connector male		Huber & Suhner: 13_SMA-50-0-2/111_N
J2	SMA Coaxial panel connector female		Huber & Suhner: 23_SMA-50-0-2/111_N
T1, T2, T3, T4	PCB Terminal	6.35 mm $\times$ 0.81 mm, 4.1 mm	TE connectivity



**Fig 4. Electrical schematic**

### 8.1 Ruggedness in a Doherty operation

The BLM10D3438-35AB is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions:  $V_{DS} = 32\text{ V}$ ;  $I_{Dq} = 45\text{ mA}$  (carrier);  $V_{GSq(peak)} = V_{GSq(carrier)} - 0.5\text{ V}$ ;  $P_1$  corresponding to  $P_{L(3dB)} - 5\text{ dB}$  under  $Z_S = 50\ \Omega$  load;  $f = 3800\text{ MHz}$  (1-carrier W-CDMA; PAR = 9.9 dB);  $T_{case} = 25\text{ }^\circ\text{C}$ .

### 8.2 Impedance information

**Table 10. Typical impedance for optimum Doherty operation**

Measured load-pull data; test signal: pulsed CW;  $T_{case} = 25\text{ }^\circ\text{C}$ ;  $V_{DS} = 28\text{ V}$ ;  $I_{Dq} = 45\text{ mA}$  (carrier);  $V_{GSq(peak)} = V_{GSq(carrier)} - 0.5\text{ V}$ ;  $t_p = 100\ \mu\text{s}$ ;  $\delta = 10\%$ .

f (MHz)	tuned for optimum Doherty operation				
	$Z_L$ ( $\Omega$ )	$P_{L(3dB)}$ (dBm)	$G_{p(max)}$ (dB)	$\eta_{add}$ [1] (%)	$\eta_{add}$ [2] (%)
3400	33.2 – j9.7	45.9	35.2	45.5	49.6
3600	24.5 – j9.1	46.1	35.5	44.4	51.3
3800	27.5 – j11.5	46.0	35.8	43.8	50.8

[1] at 37 dBm.

[2] at 45 dBm.



## 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	C2A <a href="#">[1]</a>
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	1B <a href="#">[2]</a>

[1] CDM classification C2A is granted to any part that passes after exposure to an ESD pulse of 500 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
DPCH	Dedicated Physical CHannel
ESD	ElectroStatic Discharge
LDMOS	Laterally Diffused Metal Oxide Semiconductor
LTE	Long Term Evolution
MMIC	Monolithic Microwave Integrated Circuit
MIMO	Multiple Input Multiple Output
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
BLM10D3438-35AB v.1	20190730	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.
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Product [short] data sheet	Production	This document contains the product specification.

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[2] The term 'short data sheet' is explained in section "Definitions".

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Date of release: 30 July 2019

Document identifier: BLM10D3438-35AB