BLM9D1822-30B

LDMOS 2-stage integrated Doherty MMIC

AMPLEON

Rev. 2 — 13 December 2019 **Product data sheet**

1. Product profile

1.1 General description

The BLM9D1822-30B is a 2-stage fully integrated Doherty MMIC solution using Ampleon's state of the art GEN9 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 1800 MHz to 2200 MHz. Available in PQFN outline.

Table 1. Application performance

Typical RF performance at T_{case} = 25 °C; I_{Dq} = 107 mA (carrier and peaking). Test signal: 1-carrier LTE 20 MHz; PAR = 7.6 dB; measured in an Ampleon f = 1990 MHz integrated Doherty application circuit.

Test signal	f	V_{DS}	$P_{L(AV)}$	G_p	η_D	$ACPR_{5M}$
	(MHz)	(V)	(W)	(dB)	(%)	(dBc)
1-carrier LTE 20 MHz	2000	28	2	28.5	28	–45.7

1.2 Features and benefits

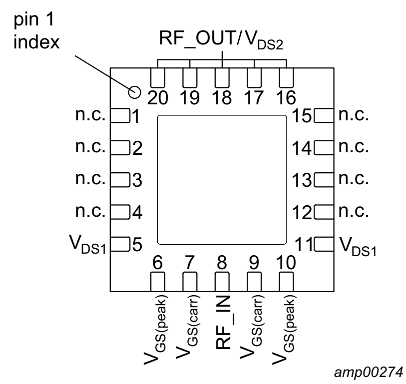
- Integrated input splitter
- Integrated output combiner
- high efficiency
- Designed for broadband operation (frequency 1800 MHz to 2200 MHz)
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Excellent thermal stability
- Source impedance 50 Ω; high power gain
- For RoHS 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
n.c.	1	not connected
n.c.	2	not connected
n.c.	3	not connected
n.c.	4	not connected
V_{DS1}	5	drain-source voltage of driver stages
$V_{GS(peak)}$	6	gate-source voltage of peaking
$V_{GS(carr)}$	7 [1]	gate-source voltage of carrier
RF_IN	8	RF input
$V_{GS(carr)}$	9	gate-source voltage of carrier
$V_{GS(peak)}$	10 [1]	gate-source voltage of peaking
V_{DS1}	11 [1]	drain-source voltage of driver stages
n.c.	12	not connected
n.c.	13	not connected
n.c.	14	not connected
n.c.	15	not connected
RF_OUT/V_{DS2}	16	RF output / drain-source voltage of final stages
RF_OUT/V_{DS2}	17	RF output / drain-source voltage of final stages
RF_OUT/V_{DS2}	18	RF output / drain-source voltage of final stages

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Table 2. Pin description *...continued*

Symbol	Pin	Description
RF_OUT/V_{DS2}	19	RF output / drain-source voltage of final stages
RF_OUT/V_{DS2}	20	RF output / drain-source voltage of final stages
GND	flange	RF ground

[1] Not used.

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLM9D1822-30B	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

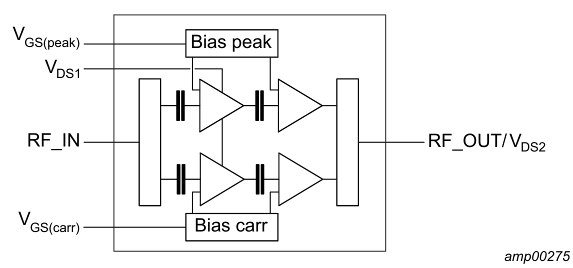

Fig 2. Block diagram

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	+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.

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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 = 4 W	[1]	2.08	K/W
		T_{case} = 90 °C; P_L = 8 W	[1]	1.89	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; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Carrier						
V_{GSq}	gate-source quiescent voltage	V_{DS} = 28 V; I_D = 110 mA	1.7	2.1	2.5	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); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.4$ V; $P_{L(AV)}$ = 2.51 W (34 dBm); f = 2200 MHz.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Test signal: pulsed CW (t_p = 100 μs, δ = 10 %)						
G_p	power gain	P_L = 2.51 W (34 dBm)	27.1	29.3	31.3	dB
η_D	drain efficiency	P_L = 2.51 W (34 dBm)	24	27	-	%
		$P_L = P_{L(3dB)}$	52	55.5	-	%
RL_{in}	input return loss		-	-	−10	dB
$P_{L(3dB)}$	output power at 3 dB gain compression		45.0	45.9	-	dBm

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8. Application information

Table 8. Typical performance

T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 107 mA (carrier and peaking). Test signal: 1-carrier LTE 20 MHz; PAR = 7.6 dB; unless otherwise specified, measured in an Ampleon 1800 MHz to 2200 MHz frequency band symmetrical integrated Doherty application circuit.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$P_{L(1dB)}$	output power at 1 dB gain compression	f = 2000 MHz	[1]	-	45.1	-	dBm
$P_{L(3dB)}$	output power at 3 dB gain compression	f = 2000 MHz	[1]	-	45.7	-	dBm
$\varphi_{s21}/\varphi_{s21(norm)}$	normalized phase response	f = 2000 MH; at 3 dB compression point;	[2]	-	–3.4	-	°
η_D	drain efficiency	12.7 dB OBO ($P_{L(AV)}$ = 33 dBm); f = 2000 MHz		-	28	-	%
G_p	power gain	$P_{L(AV)}$ = 33 dBm; f = 2000 MHz		-	28.5	-	dB
B_{video}	video bandwidth	$P_{L(AV)}$ = 33 dBm set to obtain IMD3 = –40 dBc; 2-tone CW; f = 2000 MHz		-	231	-	MHz
G_{flat}	gain flatness	$P_{L(AV)}$ = 33 dBm; f = 1800 MHz to 2200 MHz		-	1.5	-	dB
$ACPR_{20M}$	adjacent channel power ratio (20M)	$P_{L(AV)}$ = 33 dBm; f = 2000 MHz		-	–45.7	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	f = 2000 MHz	[3]	-	0.044	-	dB/°C
K	Rollett stability factor	T_{case} = –40 °C; f = 0.2 GHz to 5 GHz	[3]	-	>3	-	

[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.

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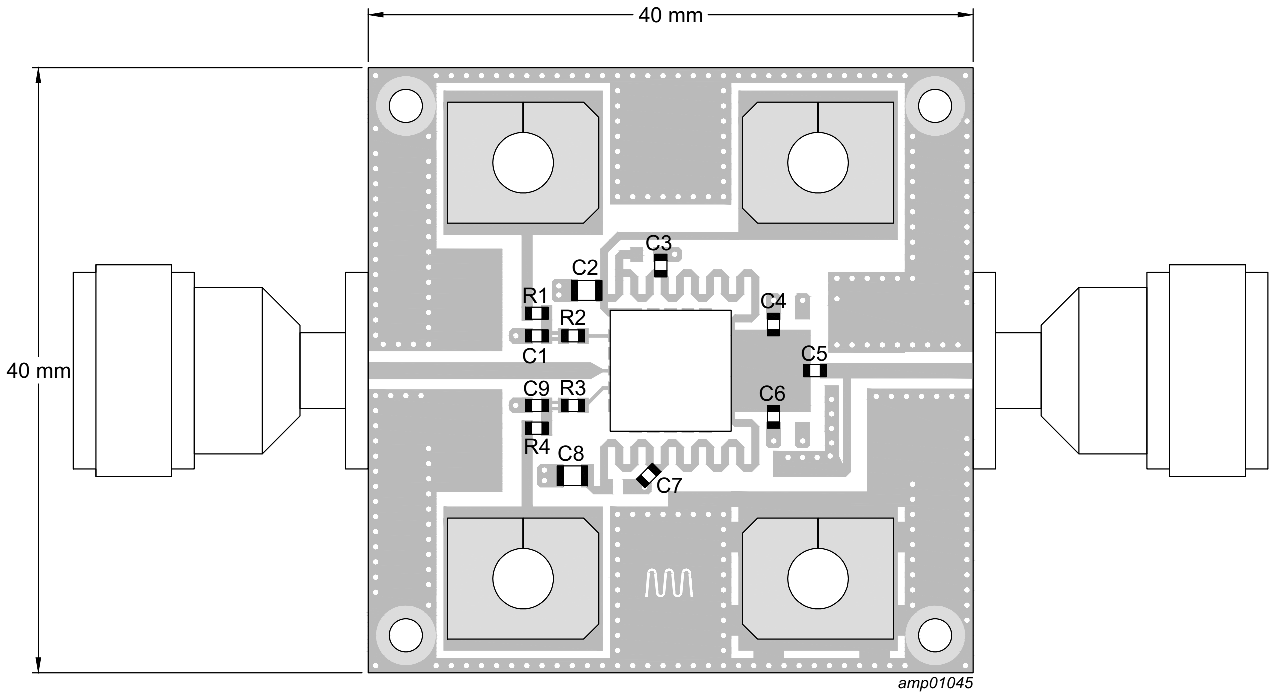

Printed-Circuit Board (PCB): Rogers 4350; thickness = 0.508 mm.

Fig 3. Component layout

Table 9. Demo test circuit list of components

See Figure 3 for component layout.

Component	Description	Value	Remarks
C1, C9	multilayer ceramic chip capacitor	10 μF, 50 V	Murata: SMD 0603
C2, C8	multilayer ceramic chip capacitor	10 μF, 50 V	TDK: SMD 0805
C3, C7	multilayer ceramic chip capacitor	9.1 pF	Murata: SMD 0603
C4, C6	multilayer ceramic chip capacitor	0.4 pF	Murata: SMD 0603
C5	multilayer ceramic chip capacitor	1.8 pF	Murata: SMD 0603
R1, R2, R3, R4	resistor	0 Ω	Multicomp: SMD 0603

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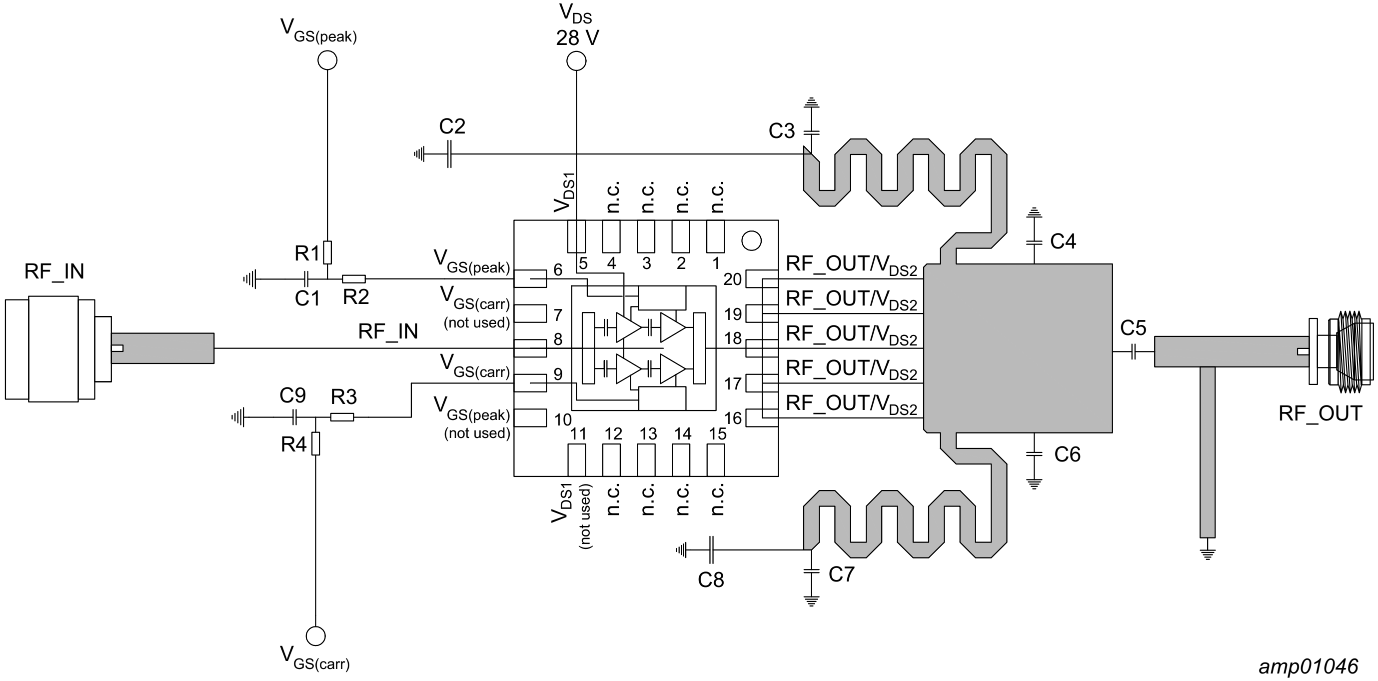

Fig 4. Electrical schematic

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8.1 Ruggedness in a Doherty operation

The BLM9D1822-30B 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) and $V_{GSq(peaking)}$ - $V_{GSq(carrier)}$ = 0.43 V; corresponding to $P_{L(3dB)}$ under Z_S = 50 Ω load; f = 2000 MHz (60 s 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; test signal: pulsed CW; T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 110 mA (carrier); $V_{GSq(peaking)}$ = $V_{GSq(carrier)}$ − 0.3 V; t_p = 100 μs; δ = 10 %. Typical values 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)	(%)	(%)
1700	5.6 – j7.8	30.4	45.3	46.1	25.0
1800	6.1 – j9.3	30.0	45.7	50.1	25.8
1900	7.4 – j10.6	29.9	46.1	54.6	28.5
2000	9.1 – j10.2	30.8	46.1	57.3	28.6
2100	13.6 – j9.3	32.4	45.5	57.2	28.9
2200	13.8 – j6.0	31.7	45.6	56.7	26.4

[1] At 3 dB compression point.

[2] At 34 dBm.

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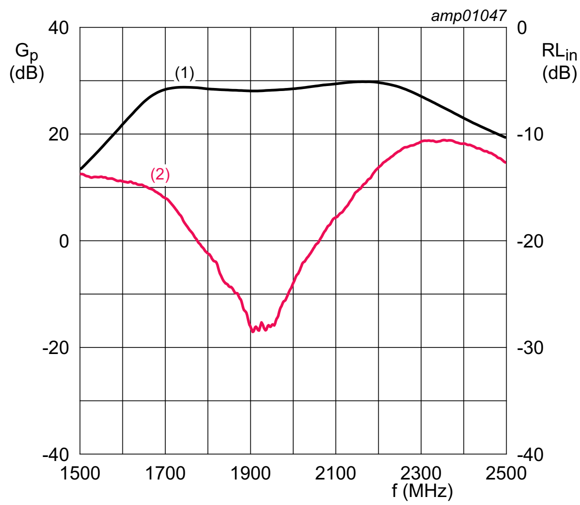
8.3 Graphs



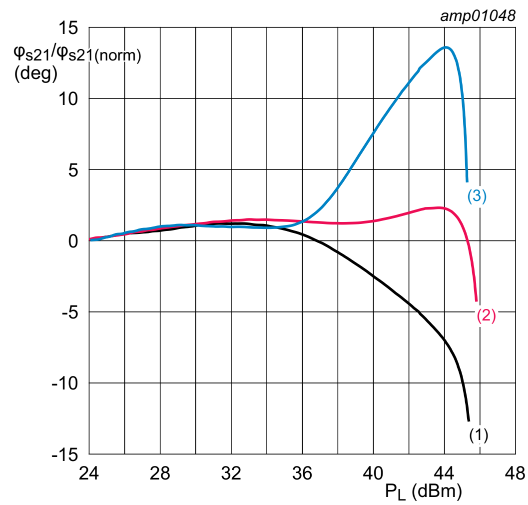
T_{case} = 25 °C; V_{DS} = 28 V;
I_{Dq1} + I_{Dq2} = 107 mA (carrier and peaking stages);
V_{GS} = 2.13 V (carrier stage);
V_{GS} = 1.71 V (peaking stage).

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} = 107 mA (carrier and peaking stages);
V_{GS} = 2.13 V (carrier stage);
V_{GS} = 1.71 V (peaking stage).

Test signal: 25 ms CW power sweep.

(1) f = 1800 MHz

(2) f = 2000 MHz

(3) f = 2200 MHz

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

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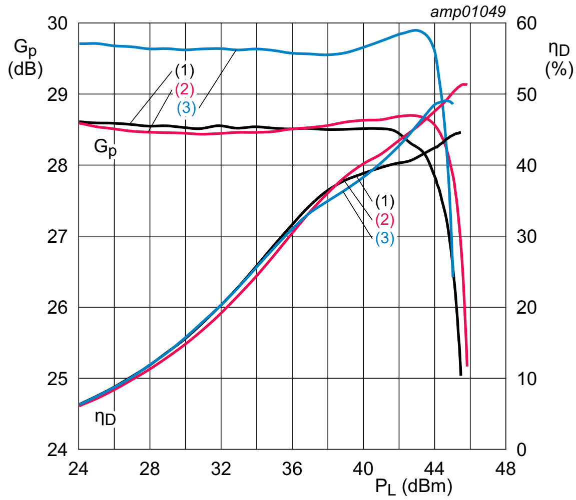


T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq1} + I_{Dq2} = 107 mA (carrier and peaking stages); V_{GS} = 2.13 V (carrier stage); V_{GS} = 1.71 V (peaking stage).

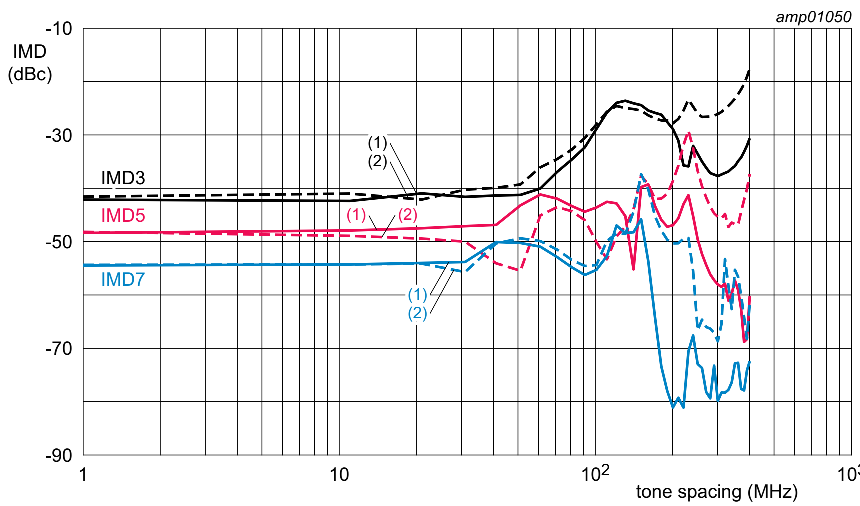
Test signal: pulsed CW power sweep (δ = 10 5; t_p = 100 μs).

(1) f = 1800 MHz

(2) f = 2000 MHz

(3) f = 2200 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} = 107 mA (carrier and peaking stages); V_{GS} = 2.13 V (carrier stage); V_{GS} = 1.71 V (peaking stage); $P_{L(AV)}$ = 2 W.

Test signal: 2-tone CW; f_c = 2000 MHz.

(1) IMD low

(2) IMD high

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

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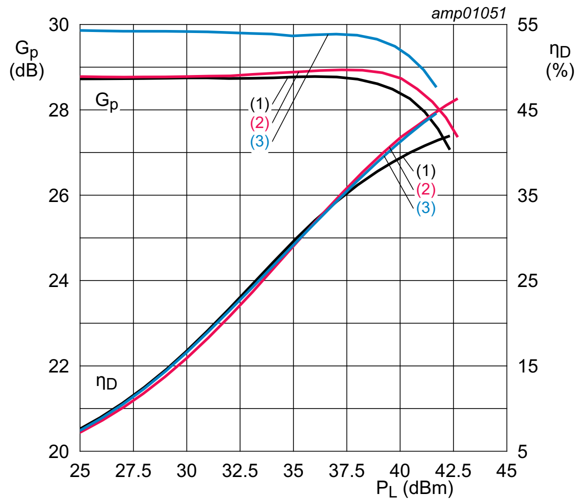


T_{case} = 25 °C; V_{DS} = 28 V;
I_{Dq1} + I_{Dq2} = 107 mA (carrier and peaking stages);
V_{GS} = 2.13 V (carrier stage);
V_{GS} = 1.71 V (peaking stage).

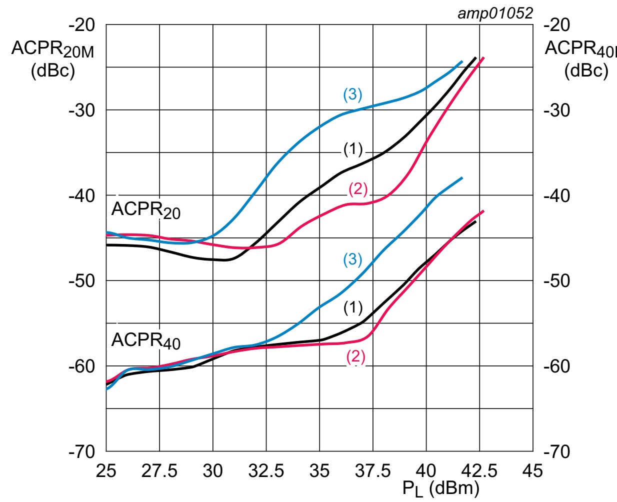
Test signal: 1-carrier LTE; PAR = 7.6 dB at 0.01 % probability CCDF.

(1) f = 1800 MHz

(2) f = 2000 MHz

(3) f = 2200 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} = 107 mA (carrier and peaking stages);
V_{GS} = 2.13 V (carrier stage);
V_{GS} = 1.71 V (peaking stage).

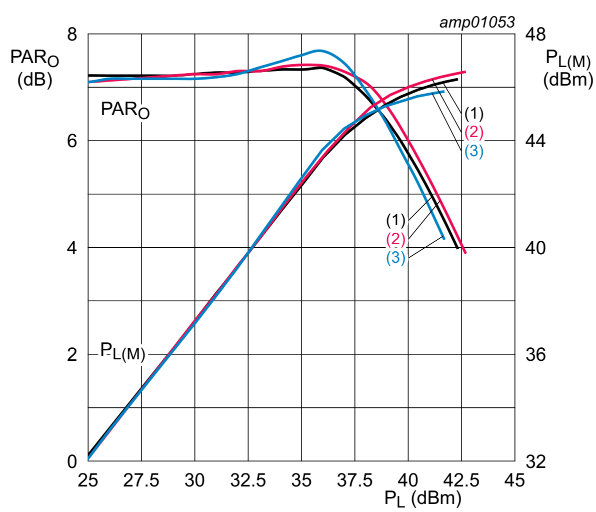
Test signal: 1-carrier LTE; PAR = 7.6 dB at 0.01 % probability CCDF.

(1) f = 1800 MHz

(2) f = 2000 MHz

(3) f = 2200 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} = 107 mA (carrier and peaking stages); V_{GS} = 2.13 V (carrier stage); V_{GS} = 1.71 V (peaking stage).

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

(1) f = 1800 MHz

(2) f = 2000 MHz

(3) f = 2200 MHz

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

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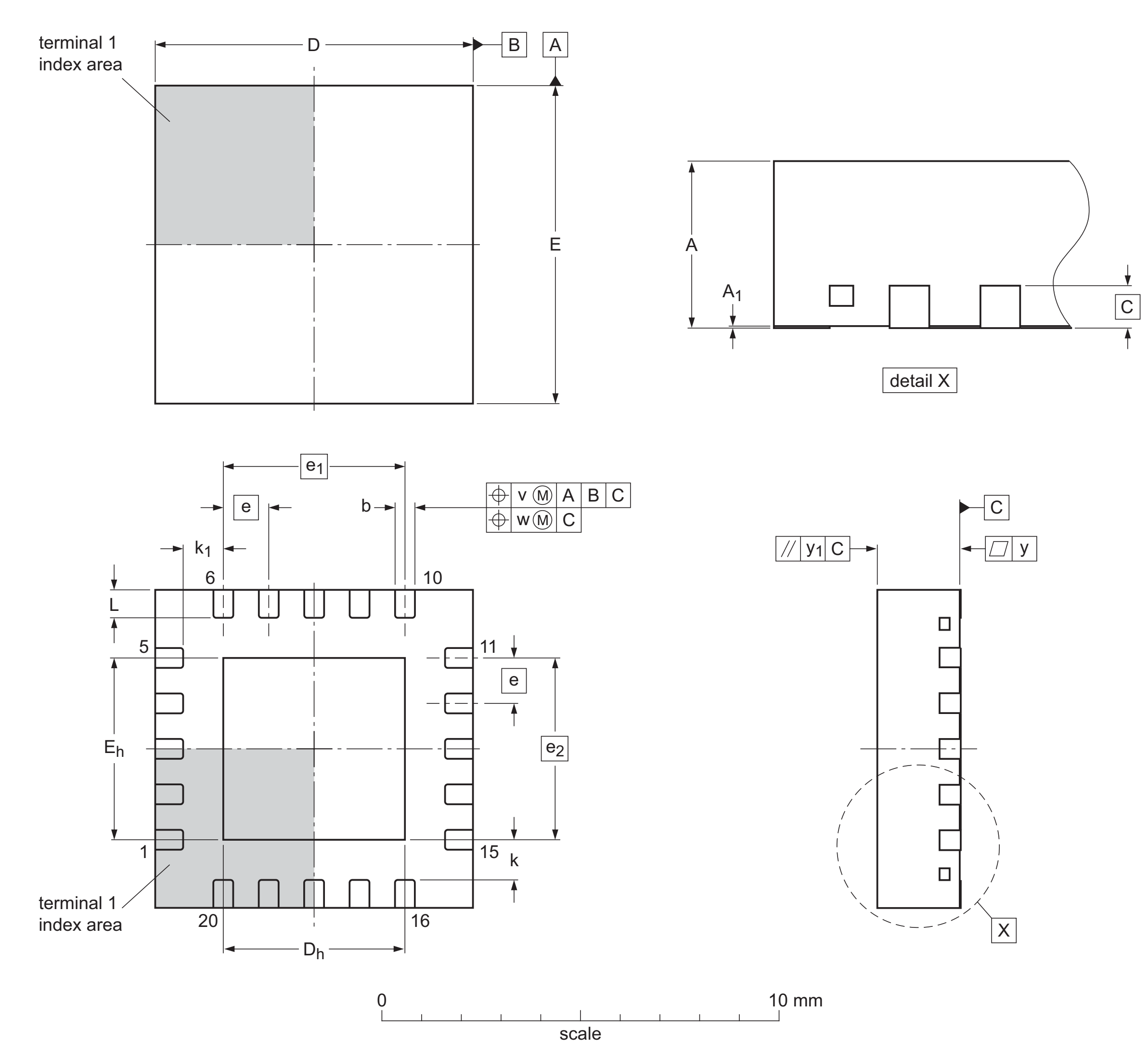
9. Package outline

PQFN20: plastic thermal enhanced quad flat package; no leads; 20 terminals; body 8.0 x 8.0 x 2.1 mm **SOT1462-1**



Dimensions

Unit		A(1)	A_1	b	C	D(1)	D_h	E(1)	E_h	e	e_1	e_2	k	k_1	L	v	w	y	y_1
	max	2.20	0.05	0.60		8.1	4.72	8.1	4.72						0.8				
mm	nom	2.10		0.50	0.508	8.0	4.62	8.0	4.62	1.15	4.6	4.6			0.7	0.1	0.05	0.1	0.1
	min	2.00	0.00	0.40		7.9	4.52	7.9	4.52				0.99	0.99	0.6				

Note
1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

sot1462-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1462-1						~~15-10-12~~ 17-06-23

Fig 12. Package outline SOT1462-1 (PQFN20)

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

[1] CDM classification C2A is granted to any part that passes after exposure to an ESD pulse of 500 V.

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

11. Abbreviations

Table 12. Abbreviations

Acronym	Description
CCDF	Complementary Cumulative Distribution Function
CW	Continuous Wave
ESD	ElectroStatic Discharge
GEN9	Ninth 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
RoHS	Restriction of Hazardous Substances
SMD	Surface Mounted Device
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
BLM9D1822-30B v.2	20191213	Product data sheet	-	BLM9D1822-30B v.1
Modifications:	• Official product release, restrictions removed			
BLM9D1822-30B v.1	20191025	Product data sheet	-	-

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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

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