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Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

BLM9D2327-25B

LDMOS 2-stage integrated Doherty MMIC

Rev. 1 — 1 September 2017

AMPLEON

Product data sheet

1. Product profile

1.1 General description

The BLM9D2327-25B 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 2300 MHz to 2700 MHz. Available in PQFN outline.

Table 1. Application performance

Typical RF performance tuned in a wideband 2300 MHz to 2700 MHz application board at T_{case} = 25 °C; I_{Dq} = 76 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.81$ V. Test signal: 1-carrier LTE 20 MHz; PAR = 7.2 dB at 0.01% probability on CCDF.*

Test signal	f	V_{DS}	$P_{L(AV)}$	G_p	η_D
	(MHz)	(V)	(W)	(dB)	(%)
single carrier LTE 20 MHz	2500	28	4.9	28.5	40.3

1.2 Features and benefits

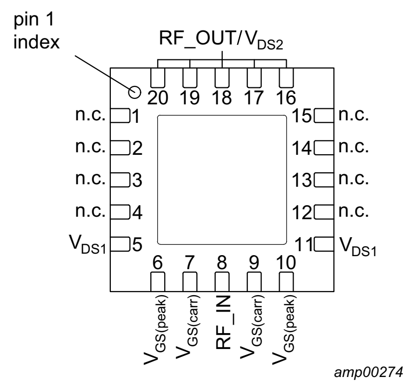
- Integrated input splitter
- Integrated output combiner
- High efficiency
- Designed for broadband operation (frequency 2300 MHz to 2700 MHz)
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Source impedance 50 Ω; high power gain
- Compliant to Directive 2002/95/EC, regarding 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 2300 MHz to 2700 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	gate-source voltage of carrier
RF_IN	8	RF input
$V_{GS(carr)}$	9	gate-source voltage of carrier
$V_{GS(peak)}$	10	gate-source voltage of peaking
V_{DS1}	11	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

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

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLM9D2327-25B	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

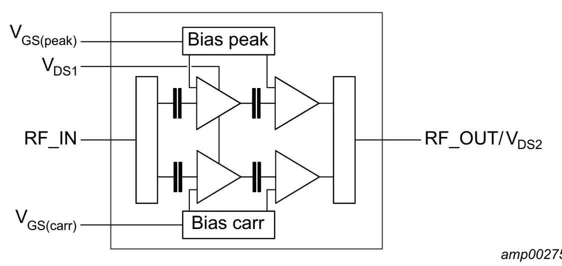


Fig 2. Block diagram

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		–0.5	+13	V
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature	[1]	-	175	°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 °C; P_L = 4 W	[1]	11	K/W
		T_{case} = 90 °C; P_L = 2.5 W	[1]	12	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 = 75 mA	1.7	2.1	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} = 75 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.7$ V; $P_{L(AV)}$ = 5 W.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Test signal: pulsed CW						
G_p	power gain	f = 2700 MHz	25.5	27	28.5	dB
η_D	drain efficiency	P_L = 5 W (37 dBm)	34	38	-	%
		$P_L = P_{L(3dB)}$	50	54.5	-	%
RL_{in}	input return loss		-	−20	−10	dB
$P_{L(3dB)}$	output power at 3 dB gain compression		44	44.6	-	dBm

8. Application information

Table 8. Typical performance

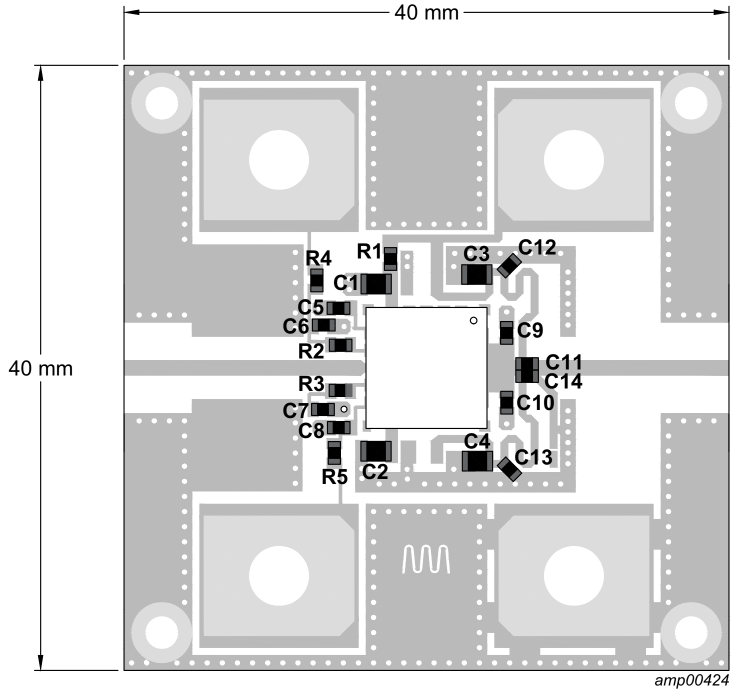
T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 76 mA (carrier and peaking). Test signal: 1-carrier LTE; PAR = 7.2 dB at 0.01 % probability CCDF; unless otherwise specified, typical performance in an Ampleon f = 2300 MHz to 2700 MHz frequency band symmetrical Doherty application circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_{L(3dB)}$	output power at 3 dB gain compression	f = 2500 MHz [1]	-	44.9	-	dBm
$\varphi_{s21}/\varphi_{s21(norm)}$	normalized phase response	at 3 dB compression point; f = 2500 MHz [2]	-	–5.9	-	°
η_D	drain efficiency	8 dB OBO ($P_{L(AV)}$ = 36.9 dBm); f = 2500 MHz	-	40.3	-	%
G_p	power gain	$P_{L(AV)}$ = 36.9 dBm; f = 2500 MHz	-	28.5	-	dB
B_{video}	video bandwidth	$P_{L(AV)}$ = 36 dBm set to obtain IMD3 = –30 dBc; 2-tone CW; f = 2500 MHz	-	420	-	MHz
G_{flat}	gain flatness	$P_{L(AV)}$ = 36.9 dBm; f = 2300 MHz to 2700 MHz	-	0.6	-	dB
$ACPR_{20M}$	adjacent channel power ratio (20M)	$P_{L(AV)}$ = 36.9 dBm; f = 2500 MHz	-	–34.9	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	f = 2500 MHz [3]	-	0.04	-	dB/°C
K	Rollett stability factor	T_{case} = –40 °C; f = 0.2 GHz to 4.5 GHz [3]	-	>2.2	-	

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

[2] 25 ms CW power sweep measurement.

[3] Small signal CW measurements.



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, C3, C4	multilayer ceramic chip capacitor	10 μF, 35 V	TDK: C2012X5R1V106M085ACL
C5, C6, C7, C8	multilayer ceramic chip capacitor	1 μF, 25 V	AVX: 06033D105KAT2A
C9, C10	multilayer ceramic chip capacitor	1.8 pF	Murata: GQM1875C2E1R6BB12
C11	multilayer ceramic chip capacitor	1.6 pF	Murata: GQM1875C2E5R6BB12
C12, C13	multilayer ceramic chip capacitor	9.1 pF	Murata: GQM1875C2E5R6BB12
C14	multilayer ceramic chip capacitor	0.5 pF	Murata: GQM1875C2E5R6BB12
J1	SMA Coaxial panel connector male		Hubner & Suhner: 13_SMA-50-0-2/111_N
J2	SMA Coaxial panel connector female		Hubner & Suhner: 23_SMA-50-0-2/111_N
R1	SMD resistor	0 Ω, ±1 %	Multicomp: MC805
R2, R3	SMD resistor	5.1 Ω, ±1 %	Multicomp: MC805
R4	SMD resistor	820 Ω, ±1 %	Multicomp: MC805
R5	SMD resistor	10 Ω, ±1 %	Multicomp: MC805
T1, T2, T3, T4	PCB Terminal	6.35 mm × 0.81 mm, 4.1 mm	TE connectivity

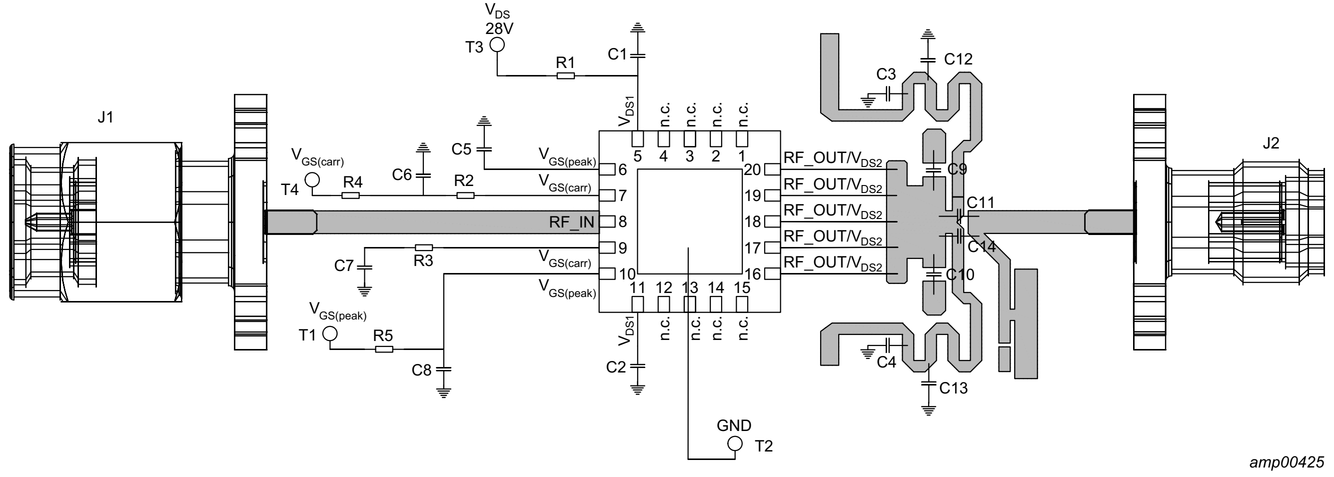


Fig 4. Electrical schematic

8.1 Ruggedness in a Doherty operation

The BLM9D2327-25B 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} = 75 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.7$ V; P_i corresponding to $P_{L(3dB)}$ under Z_S = 50 Ω load; f = 2700 MHz (1-carrier W-CDMA; PAR = 9.9 dB); T_{case} = 25 °C.

8.2 Impedance information

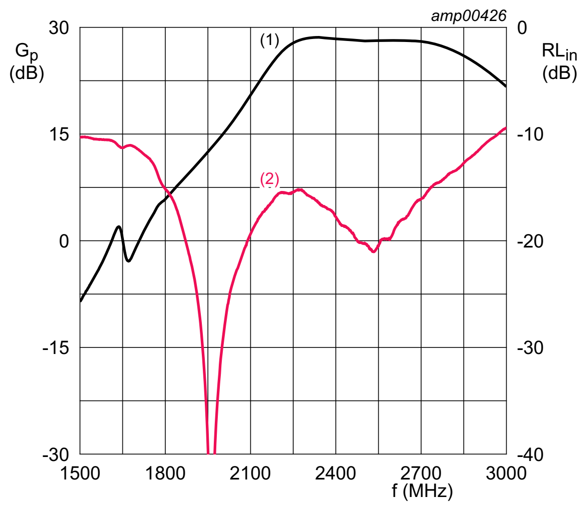
Table 10. Typical impedance for optimum Doherty operation
Measured load-pull data per section; test signal: pulsed CW; T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 70 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.7$ V; t_p = 100 μs; δ = 10 %.

f	tuned for optimum Doherty operation				
	Z_L	$P_{L(3dB)}$	$G_{p(max)}$	η_{add} [1]	η_{add} [2]
(MHz)	(Ω)	(dBm)	(dB)	(%)	(%)
2300	5.30 – j2.38	45.30	28.60	53.10	42.80
2400	5.62 – j3.81	45.30	29.00	55.00	44.10
2500	6.34 – j4.52	45.20	29.40	57.00	45.00
2600	7.67 – j4.10	45.00	29.40	59.10	43.50
2700	7.25 – j2.89	44.90	28.70	58.90	40.70

[1] at 44.5 dBm.

[2] at 36.5 dBm.

8.3 Graphs



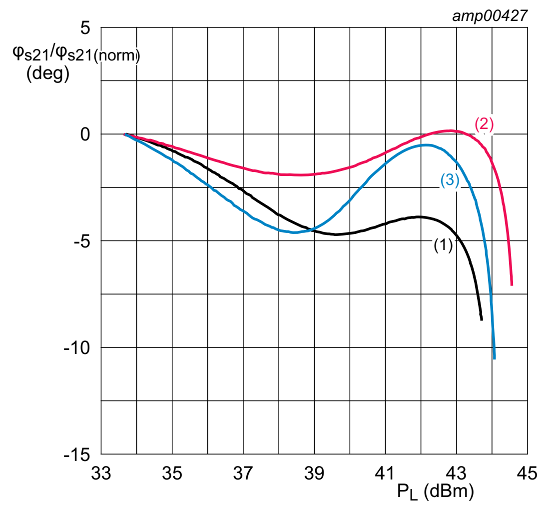
T_{case} = 25 °C; V_{DS} = 28 V;
I_{Dq1} + I_{Dq2} = 76 mA (carrier stages);
V_{GS} = 2.46 V (carrier stage);
V_{GS} = 1.65 V (peaking stage).

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} = 76 mA (carrier stages);
V_{GS} = 2.46 V (carrier stage);
V_{GS} = 1.65 V (peaking stage).

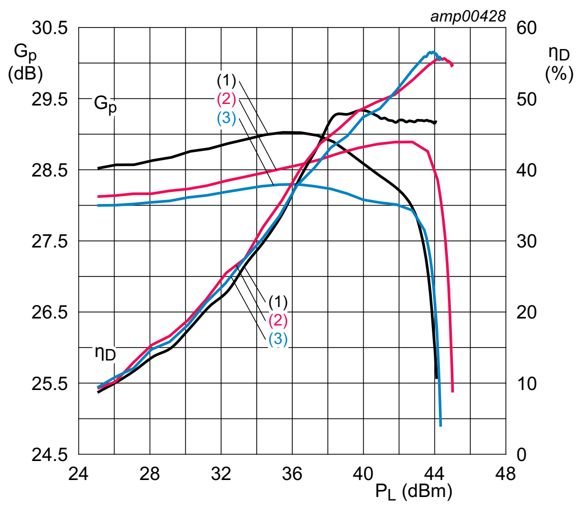
Test signal: 25 ms CW power sweep.

(1) f = 2300 MHz

(2) f = 2500 MHz

(3) f = 2700 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} = 76 mA (carrier stages);
V_{GS} = 2.46 V (carrier stage);
V_{GS} = 1.65 V (peaking stage).

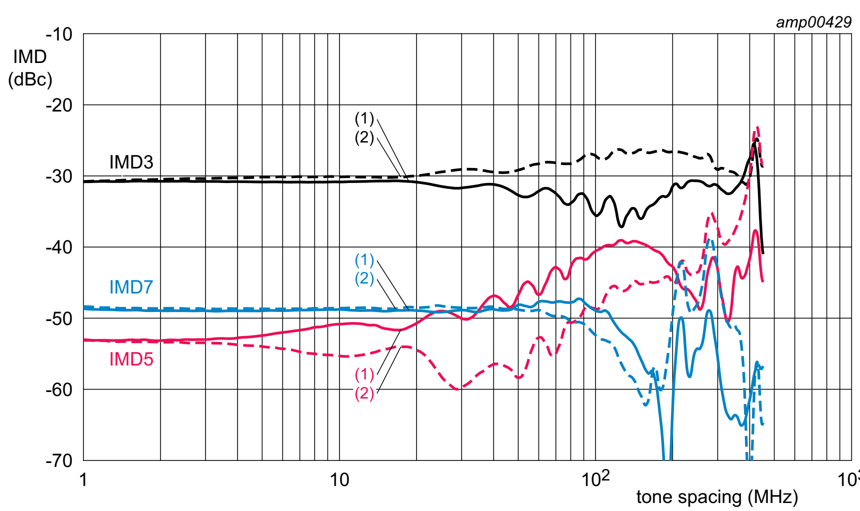
Test signal: pulsed CW power sweep (δ = 10 %; t_p = μs).

(1) f = 2300 MHz

(2) f = 2500 MHz

(3) f = 2700 MHz

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



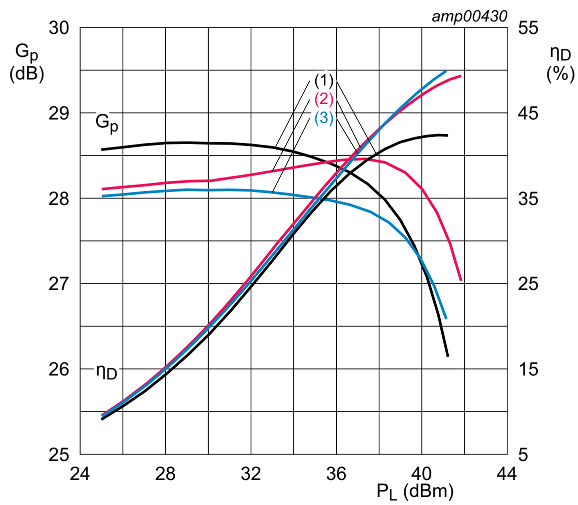
T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq1} + I_{Dq2} = 76 mA (carrier stages);
V_{GS} = 2.46 V (carrier stage); V_{GS} = 1.65 V (peaking stage); $P_{L(AV)}$ = 4 W.

Test signal: 2-tone CW; f_c = 2500 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;
$I_{Dq1} + I_{Dq2}$ = 76 mA (carrier stages);
V_{GS} = 2.46 V (carrier stage);
V_{GS} = 1.65 V (peaking stage).

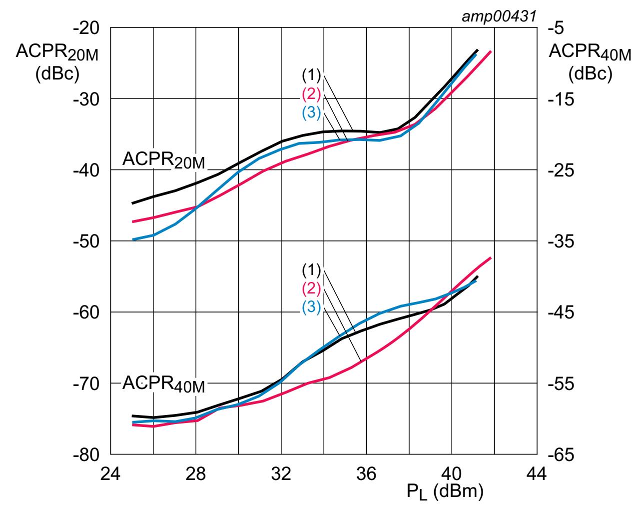
Test signal: 1-carrier LTE; PAR = 7.2 dB at 0.01 % probability CCDF.

(1) f = 2300 MHz

(2) f = 2500 MHz

(3) f = 2700 MHz

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



T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq1} + I_{Dq2}$ = 76 mA (carrier stages);
V_{GS} = 2.46 V (carrier stage);
V_{GS} = 1.65 V (peaking stage).

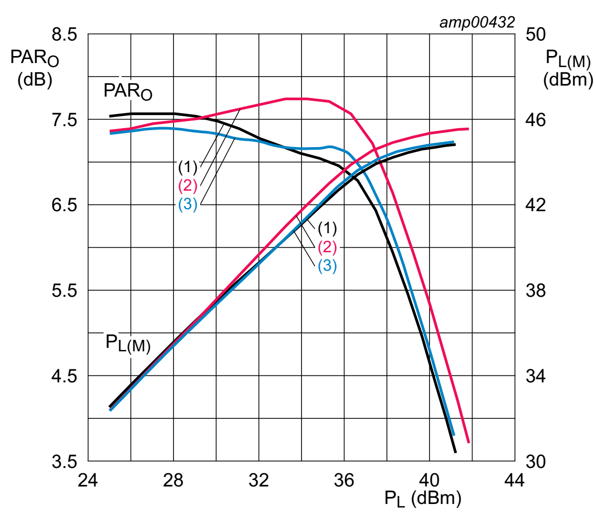
Test signal: 1-carrier LTE; PAR = 7.2 dB at 0.01 % probability CCDF.

(1) f = 2300 MHz

(2) f = 2500 MHz

(3) f = 2700 MHz

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



T_{case} = 25 °C; V_{DS} = 28 V; $I_{Dq1} + I_{Dq2}$ = 76 mA (carrier stages);
V_{GS} = 2.46 V (carrier stage); V_{GS} = 1.65 V (peaking stage).

Test signal: 1-carrier LTE; PAR = 7.2 dB at 0.01 % probability CCDF.

(1) f = 2300 MHz

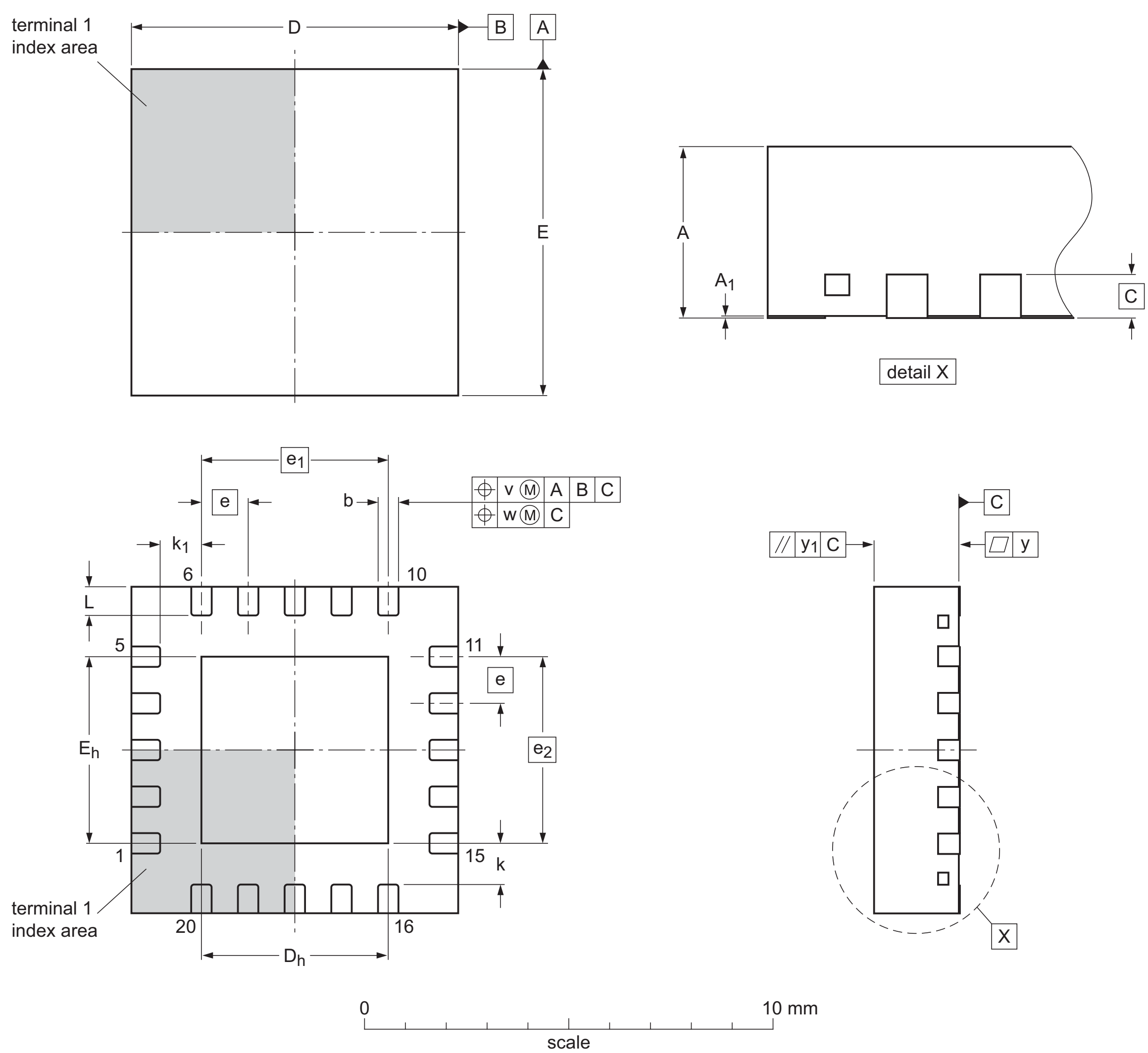
(2) f = 2500 MHz

(3) f = 2700 MHz

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

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
mm	max	2.20	0.05	0.60		8.1	4.72	8.1	4.72						0.8				
	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)

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	1B [2]

[1] CDM classification C2A 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 750 V.

[2] HBM classification 1B 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.

11. Abbreviations

Table 12. Abbreviations

Acronym	Description
3GPP	3rd Generation Partnership Project
CCDF	Complementary Cumulative Distribution Function
CW	Continuous Wave
DPCH	Dedicated Physical CHannel
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
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
BLM9D2327-25B v.1	20170901	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

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