BLM9D2325-20AB

LDMOS 2-stage integrated Doherty MMIC

Rev. 1 — 24 July 2017

AMPLEON

Product data sheet

1. Product profile

1.1 General description

The BLM9D2325-20AB 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 a final device in massive MIMO or small cell applications in the frequency range from 2300 MHz to 2500 MHz. Available in PQFN outline.

Table 1. Application performance

Typical RF performance at T_{case} = 25 °C; I_{Dq} = 39 mA (driver and final stages); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.50$ V. Test signal: 3GPP test model 1; 64 DPCH; PAR = 9.9 dB at 0.01 % probability on CCDF.

Test signal	f	V_{DS}	$P_{L(AV)}$	G_p	η_D	$ACPR_{5M}$
	(MHz)	(V)	(W)	(dB)	(%)	(dBc)
single carrier W-CDMA	2350	28	3.55	27.1	42.1	−36.3

1.2 Features and benefits

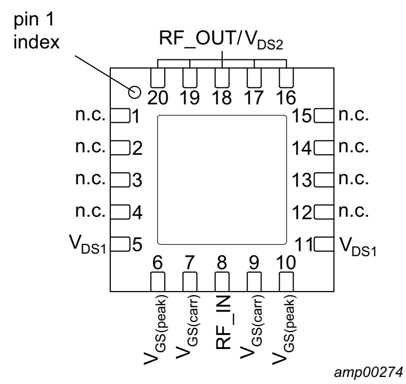
- Integrated input splitter
- Integrated output combiner
- Very high efficiency thanks to asymmetry
- Designed for broadband operation (frequency 2300 MHz to 2500 MHz)
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Excellent thermal stability
- Source impedance 50 Ω; 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 2500 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

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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

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLM9D2325-20AB	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

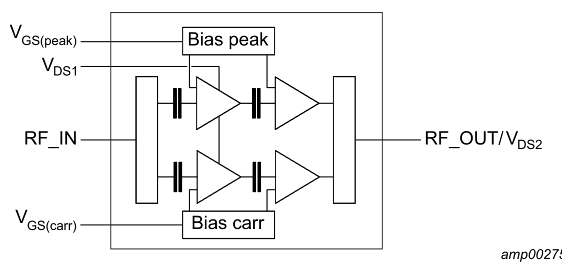

Fig 2. Block diagram

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.

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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; $P_{L(AV)}$ = 3 W	[1]	12	K/W
		T_{case} = 90 °C; $P_{L(AV)}$ = 1.25 W	[1]	17	K/W

[1] When operated with a 1-carrier W-CDMA with PAR = 8 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 = 37 mA	1.65	2.2	2.75	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} = 37 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5$ V; P_L = 2 W; f = 2.5 GHz. Unless otherwise specified, measured in an Ampleon production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Test signal: pulsed CW						
G_p	power gain		26.5	28	29.5	dB
η_D	drain efficiency	P_L = 2 W	35	39	-	%
		$P_L = P_{L(3dB)}$	45	50	-	%
RL_{in}	input return loss		-	−14	−10	dB
$P_{L(3dB)}$	output power at 3 dB gain compression		43	43.4	-	dBm

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8. Application information

Table 8. Typical performance

Test signal: 1-carrier W-CDMA;T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 39 mA (driver and final stages); test model 1; 64 DPCH; PAR = 9.9 dB at 0.01 % probability CCDF; unless otherwise specified, measured in an Ampleon 2300 MHz to 2400 MHz frequency band asymmetrical Doherty application circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_{L(3dB)}$	output power at 3 dB gain compression	f = 2350 MHz [1]	-	43.3	-	dBm
$\varphi_{s21}/\varphi_{s21(norm)}$	normalized phase response	f = 2350 MHz; at 3 dB compression point [2]	-	–14.2	-	°
η_D	drain efficiency	8 dB OBO ($P_{L(AV)}$ = 35.5 dBm); f = 2350 MHz	-	42.1	-	%
G_p	power gain	$P_{L(AV)}$ = 35.5 dBm; f = 2350 MHz	-	27.1	-	dB
B_{video}	video bandwidth	$P_{L(AV)}$ = 38.5 dBm set to obtain IMD3 = –30 dBc; 2-tone CW; f = 2350 MHz	-	216	-	MHz
G_{flat}	gain flatness	$P_{L(AV)}$ = 35.5 dBm; f = 2300 MHz to 2400 MHz	-	0.7	-	dB
$ACPR_{5M}$	adjacent channel power ratio (5M)	$P_{L(AV)}$ = 35.5 dBm; f = 2350 MHz	-	–36.3	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	f = 2350 MHz	-	0.04	-	dB/°C
K	Rollett stability factor	T_{case} = –40 °C; f = 0.15 GHz to 5 GHz [3]	-	>1.7	-	

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

[2] 25 ms CW power sweep measurement.

[3] S-parameters measured with load-pull jig.

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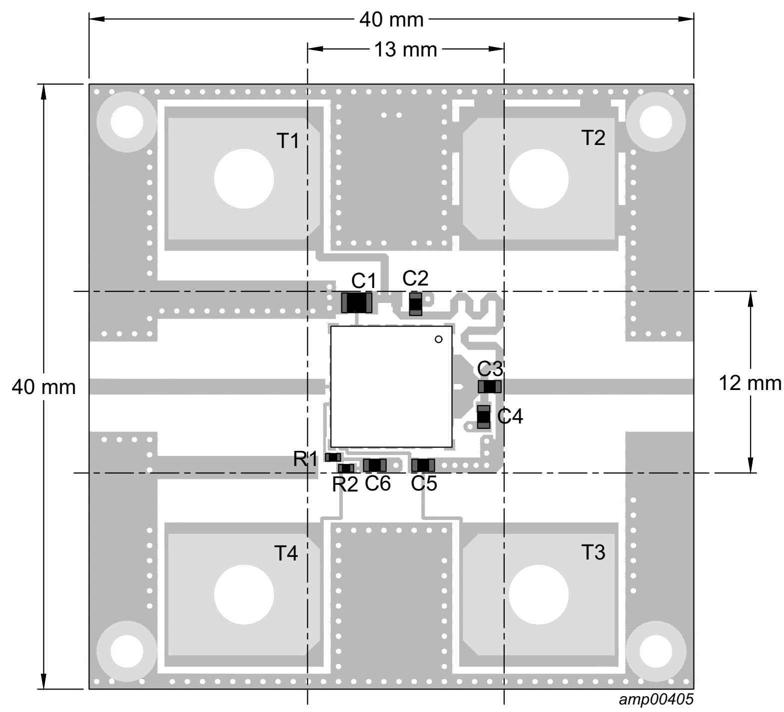

Printed-Circuit Board (PCB): Rogers 4350; thickness = 0.508 mm.

Fig 3. Component layout

Table 9. Demo test circuit list of components

See Figure 3 for component layout.

Component	Description	Value	Remarks
C1	multilayer ceramic chip capacitor	10 μF, 50 V	Murata: GRM31CR61H106KA12L
C2	multilayer ceramic chip capacitor	7.5±0.5 pF	Murata: GQM1875C2E7R5BB12
C3	multilayer ceramic chip capacitor	2.4±0.5 pF	Murata: GQM1875C2E2R4BB12
C4	multilayer ceramic chip capacitor	3.0±0.5 pF	Murata: GQM1875C2E3R0BB12
C5, C6	multilayer ceramic chip capacitor	1 μF, 6.3 V	TDK: C1608X5R0J106K080AB
J1	SMA Coaxial panel connector male		Hubner & Suhner: 13_SMA-50-0-2/111_N
J2	SMA Coaxial panel connector female		Hubner & Suhner: 13_SMA-50-0-2/111_N
R1	SMD resistor	820 Ω, ±1 %	Multicomp: MC805
R2	SMD resistor	5.1 Ω, ±1 %	Multicomp: MC805
T1, T2, T3, T4	PCB Terminal	6.35 mm × 0.81 mm; 4.1 mm	TE connectivity

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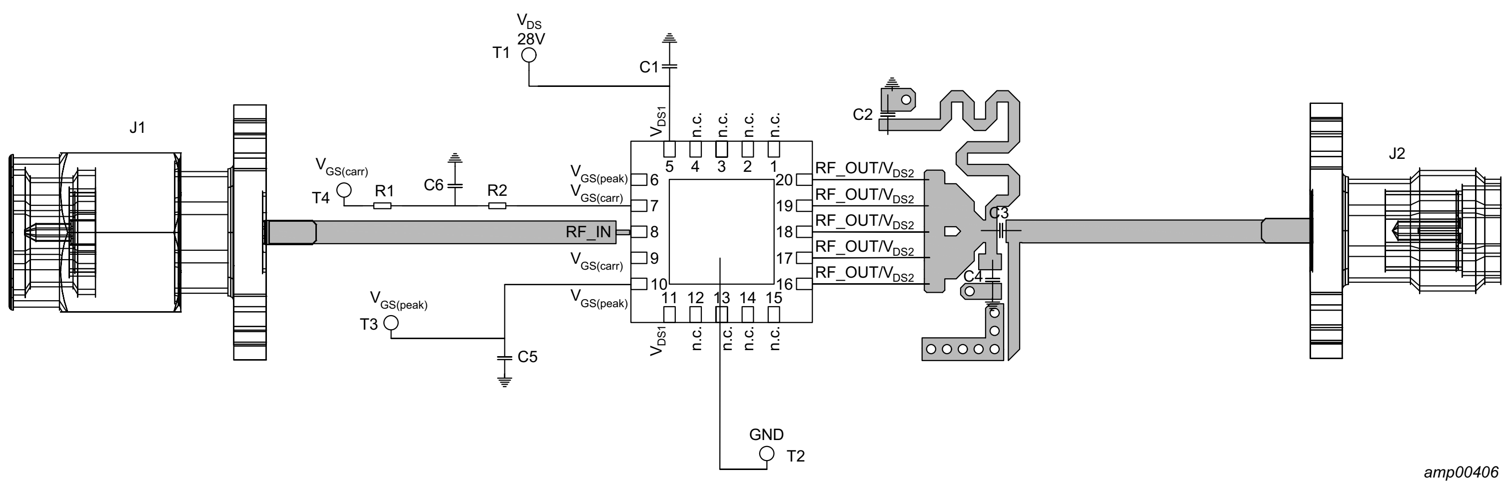

Fig 4. Electrical schematic

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8.1 Ruggedness in a Doherty operation

The BLM9D2325-20AB 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} = 35 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5$ V; P_i corresponding to $P_{L(3dB)}$ under Z_S = 50 Ω load; f = 2500 MHz (CW); T_{case} = 25 °C.

8.2 Impedance information

Table 10. Typical impedance for optimum Doherty operation

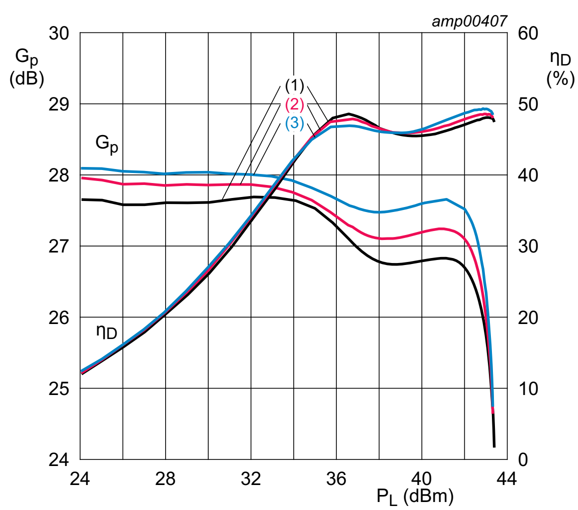
Measured load-pull data per section; test signal: pulsed CW; T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 35 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5$ V; t_p = 100 μs; δ = 10 %. Typical values.

	tuned for optimum Doherty operation				
f	Z_L	$G_{p(max)}$	P_L	η_{add} [1]	η_{add} [2]
(MHz)	(Ω)	(dB)	(dBm)	(%)	(%)
2300	5.30 – j0.46	27.80	43.70	52.10	50.90
2400	5.63 – j1.31	28.40	44.00	55.00	54.00
2500	5.67 – j1.31	28.30	44.10	56.90	54.80

[1] at 43 dBm (nearly 3 dB compression point).

[2] at 35 dBm (nearly 8 dB OBO point).

8.3 Graphs



T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq1} + I_{Dq2}$ = 39 mA (carrier and peaking stages);
V_{GS} = 2.27 V (carrier stage);
V_{GS} = 1.55 V (peaking stage).

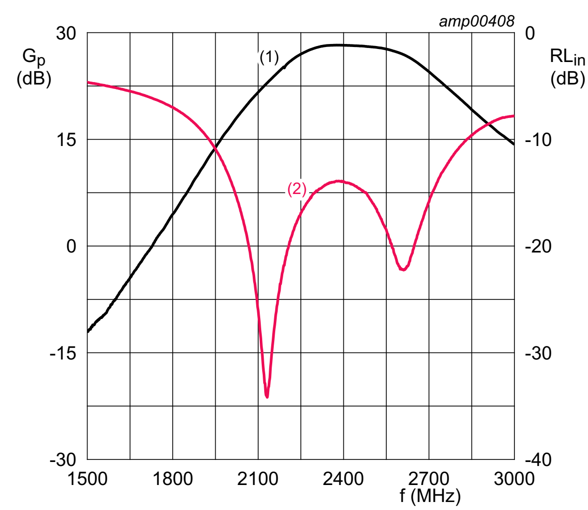
Test signal: pulsed CW; t_p = 100 μs; δ = 10 %.

(1) f = 2300 MHz

(2) f = 2350 MHz

(3) f = 2400 MHz

Fig 5. Power gain and drain efficiency as function of output power; typical values



T_{case} = 25 °C; V_{DS} = 28 V; P_L = 1 W;
$I_{Dq1} + I_{Dq2}$ = 39 mA (carrier and peaking stages);
V_{GS} = 2.27 V (carrier stage);
V_{GS} = 1.55 V (peaking stage).

Test signal: CW.

(1) magnitude of G_p

(2) magnitude of RL_{in}

Fig 6. Wideband power gain and input return loss as function of frequency; typical values

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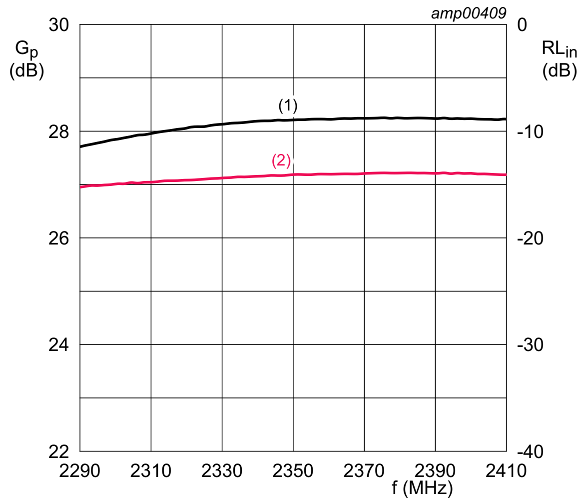


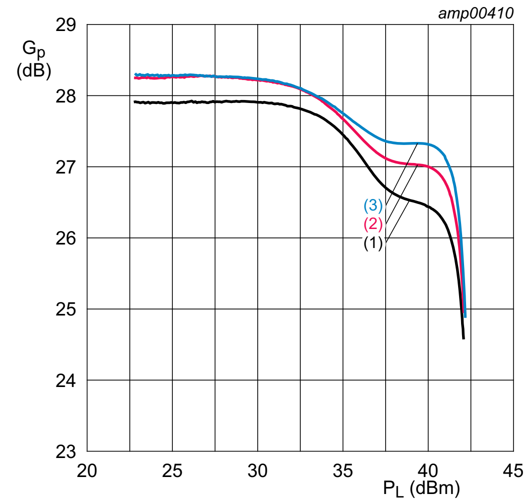
T_{case} = 25 °C; V_{DS} = 28 V; P_L = 1 W;
I_{Dq1} + I_{Dq2} = 39 mA (carrier and peaking stages);
V_{GS} = 2.27 V (carrier stage);
V_{GS} = 1.55 V (peaking stage).

Test signal: CW.

(1) magnitude of G_p

(2) magnitude of RL_{in}

Fig 7. In-band power gain and input return loss as function of frequency; typical values



T_{case} = 25 °C; V_{DS} = 28 V;
I_{Dq1} + I_{Dq2} = 39 mA (carrier and peaking stages);
V_{GS} = 2.27 V (carrier stage);
V_{GS} = 1.55 V (peaking stage).

Test signal: 25 ms CW power sweep.

(1) f = 2300 MHz

(2) f = 2350 MHz

(3) f = 2400 MHz

Fig 8. Power gain as a function of output power; typical values

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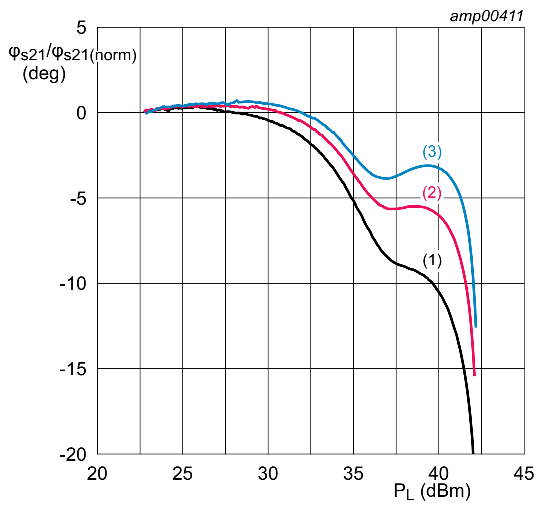


T_{case} = 25 °C; V_{DS} = 28 V; $I_{Dq1} + I_{Dq2}$ = 39 mA (carrier and peaking stages);
V_{GS} = 2.27 V (carrier stage); V_{GS} = 1.55 V (peaking stage).

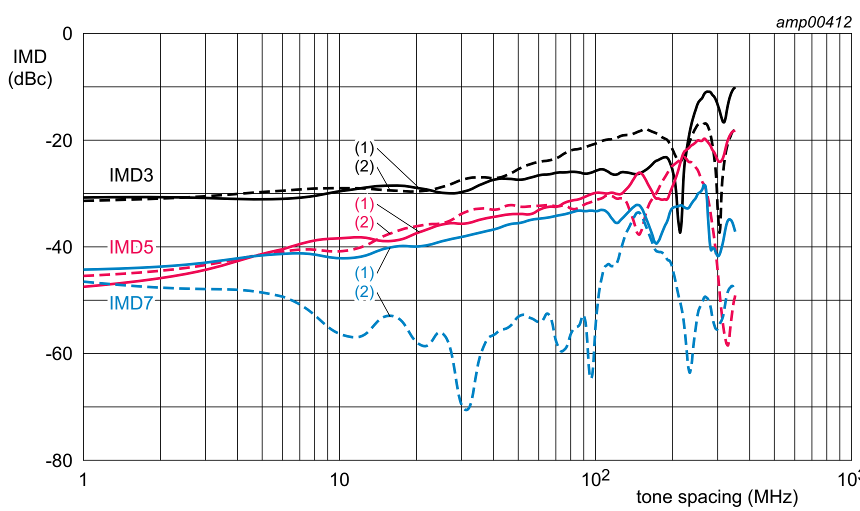
Test signal: 25 ms CW power sweep.

(1) f = 2300 MHz

(2) f = 2350 MHz

(3) f = 2400 MHz

Fig 9. Normalized phase response as a function of output power; typical values



T_{case} = 25 °C; V_{DS} = 28 V; $I_{Dq1} + I_{Dq2}$ = 39 mA (carrier and peaking stages);
V_{GS} = 2.27 V (carrier stage); V_{GS} = 1.55 V (peaking stage).

Test signal: 2-tone CW; f_c = 2350 MHz.

(1) IMD low

(2) IMD high

Fig 10. Intermodulation distortion as a function of tone spacing; typical values

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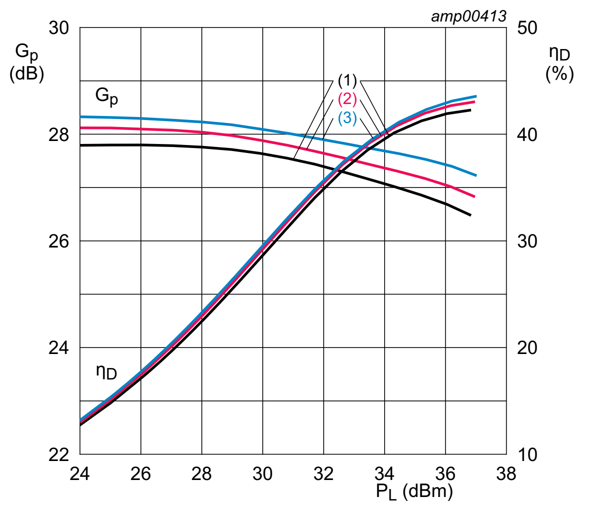


T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq1} + I_{Dq2}$ = 39 mA (carrier and peaking stages);
V_{GS} = 2.27 V (carrier stage);
V_{GS} = 1.55 V (peaking stage).

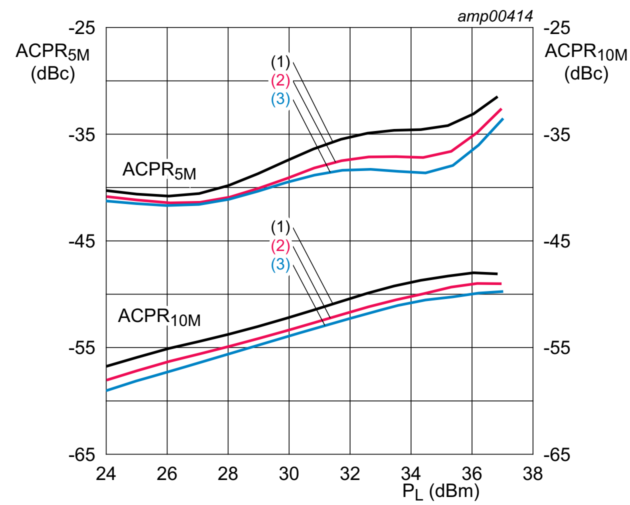
Test signal: 1-carrier W-CDMA; test model 1; 64 DPCH; PAR = 9.9 dB at 0.01 % probability CCDF.

(1) f = 2300 MHz

(2) f = 2350 MHz

(3) f = 2400 MHz

Fig 11. Power gain and drain efficiency as function of output power; typical values



T_{case} = 25 °C; V_{DS} = 28 V;
$I_{Dq1} + I_{Dq2}$ = 39 mA (carrier and peaking stages);
V_{GS} = 2.27 V (carrier stage);
V_{GS} = 1.55 V (peaking stage).

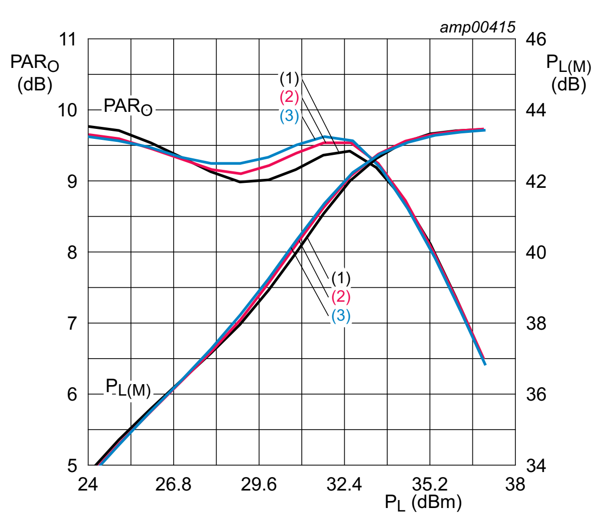
Test signal: 1-carrier W-CDMA; test model 1; 64 DPCH; PAR = 9.9 dB at 0.01 % probability CCDF.

(1) f = 2300 MHz

(2) f = 2350 MHz

(3) f = 2400 MHz

Fig 12. Adjacent channel power ratio as a function of output power; typical values



T_{case} = 25 °C; V_{DS} = 28 V; $I_{Dq1} + I_{Dq2}$ = 39 mA (carrier and peaking stages); V_{GS} = 2.27 V (carrier stage); V_{GS} = 1.55 V (peaking stage).

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

(1) f = 2300 MHz

(2) f = 2350 MHz

(3) f = 2400 MHz

Fig 13. Output peak-to-average ratio and peak output power as function of output power; typical values

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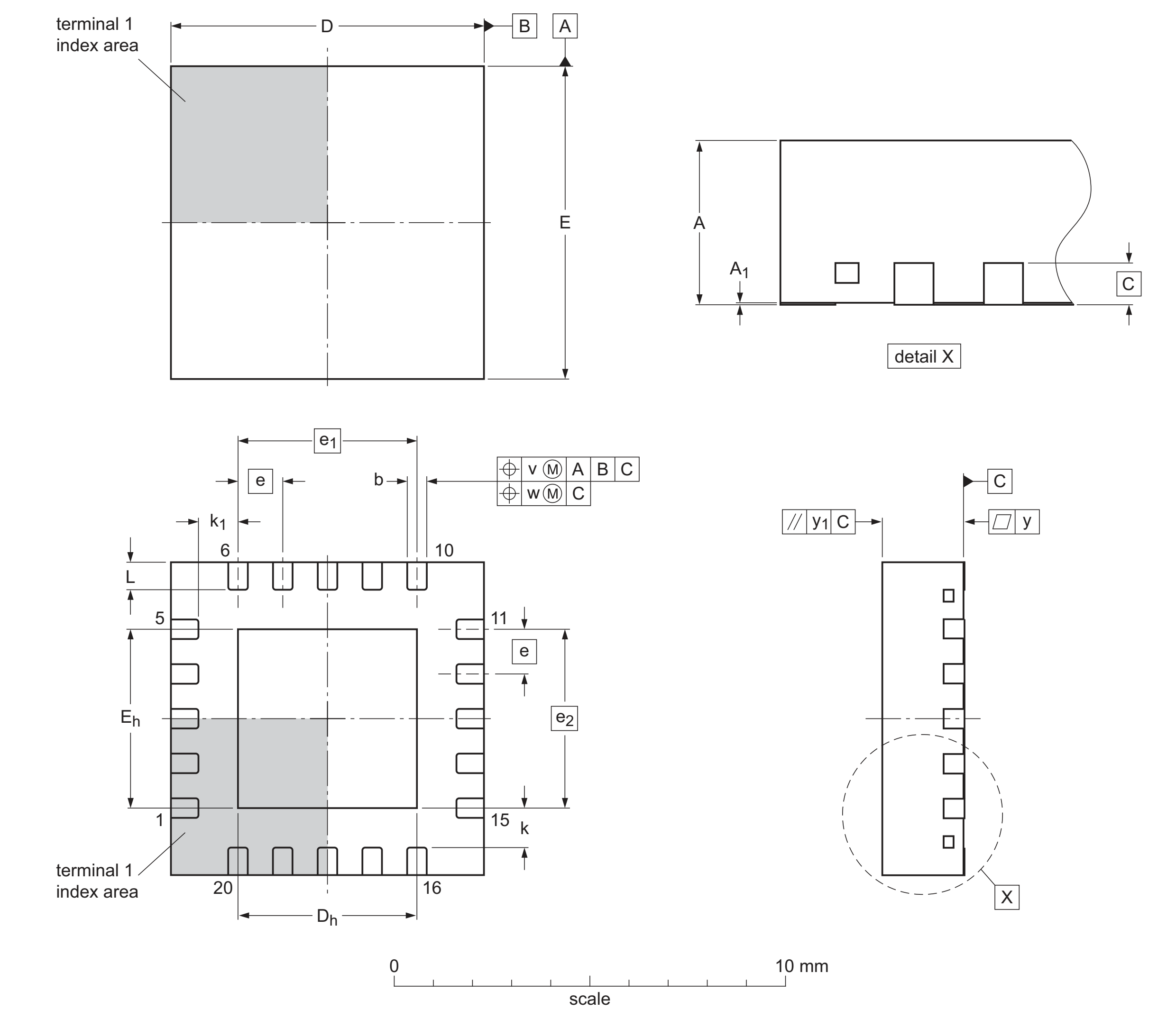
9. Package outline

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
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 14. 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	C2B [1]
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	1B [2]

[1] CDM classification C2B is granted to any part that passes after exposure to an ESD pulse of 750 V, but fails 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, 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
MIMO	Multiple Input Multiple Output
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
BLM9D2325-20AB v.1	20170724	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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Date of release: 24 July 2017
Document identifier: BLM9D2325-20AB