

BLM7G22S-60PB; BLM7G22S-60PBG

AMPLEON

LDMOS 2-stage power MMIC

Rev. 5 — 1 September 2015

Product data sheet

1. Product profile

1.1 General description

The BLM7G22S-60PB(G) is a dual path, 2-stage power MMIC using Ampleon's state of the art GEN7 LDMOS technology. This device is perfectly suited as general purpose driver in the frequency range from 2100 MHz to 2400 MHz. Available in gull wing or flat lead outline.

Table 1. Application performance

Typical RF performance at $T_{case} = 25\text{ }^{\circ}\text{C}$; $I_{DQ1} = 75\text{ mA}$; $I_{DQ2} = 233\text{ mA}$.

Test signal: 3GPP test model 1; 64 DPCH; clipping at 46 %; PAR = 8.4 dB at 0.01% probability on CCDF per carrier; carrier spacing = 5 MHz; per section unless otherwise specified in a class-AB production circuit.

Test signal	f	V _{DS}	P _{L(AV)}	G _p	η_D	ACPR
	(MHz)	(V)	(W)	(dB)	(%)	(dBc)
2-carrier W-CDMA	2140	28	1.6	31.5	11.3	-43
2-carrier W-CDMA	2350	28	1.6	29.3	10.7	-42

1.2 Features and benefits

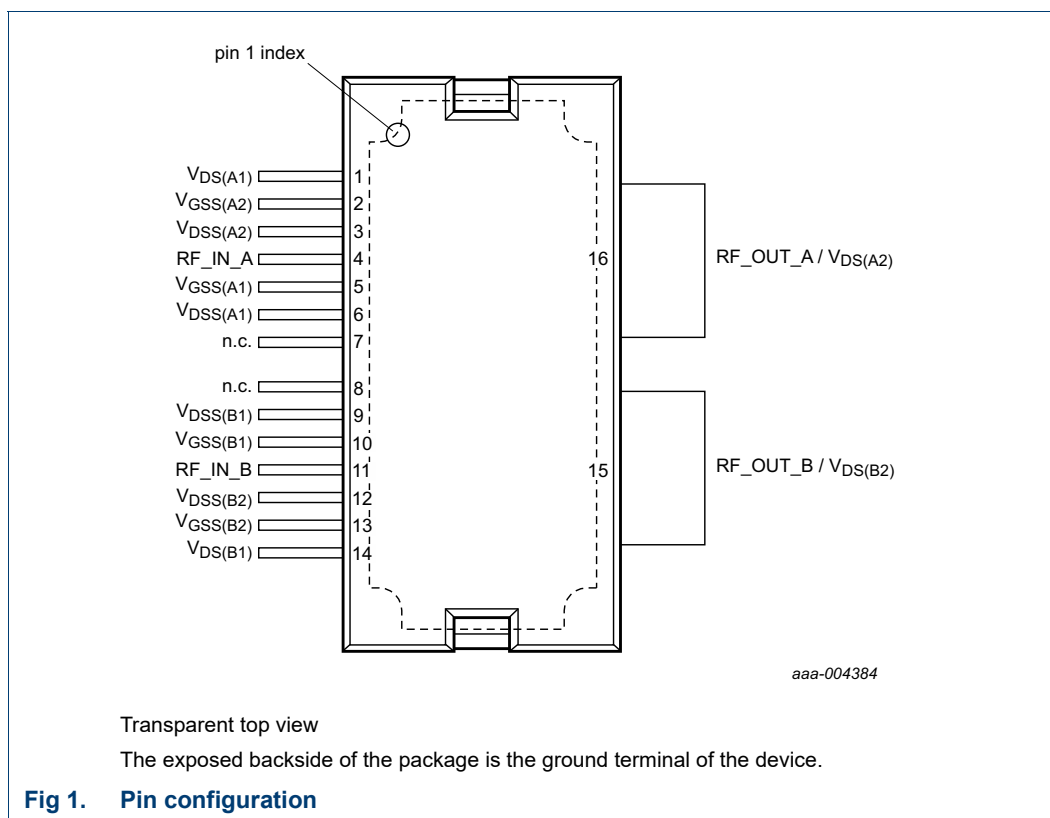
- Integrated temperature compensated bias
- Biasing of individual stages is externally accessible
- Integrated current sense
- Integrated ESD protection
- Excellent thermal stability
- High power gain
- On-chip matching for ease of use (input matched to 50 Ω ; output partially matched)
- Designed for broadband operation (frequency 2100 MHz to 2400 MHz)
- Compliant to Directive 2002/95/EC, regarding restriction of hazardous substances (RoHS)

1.3 Applications

RF power MMIC for W-CDMA base stations in the 2100 MHz to 2400 MHz frequency range.

2. Pinning information

2.1 Pinning



2.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$V_{DS}(A1)$	1	drain-source voltage of stage A1
$V_{GSS}(A2)$	2	gate sense FET and gate source voltage of stage A2
$V_{DSS}(A2)$	3	drain sense FET source voltage of stage A2
RF_IN_A	4	RF input path A
$V_{GSS}(A1)$	5	gate sense FET and gate source voltage of stage A1
$V_{DSS}(A1)$	6	drain sense FET source voltage of stage A1
n.c.	7	not connected
n.c.	8	not connected
$V_{DSS}(B1)$	9	drain sense FET source voltage of stage B1
$V_{GSS}(B1)$	10	gate sense FET and gate source voltage of stage B1
RF_IN_B	11	RF input path of B
$V_{DSS}(B2)$	12	drain sense FET source voltage of stage B2
$V_{GSS}(B2)$	13	gate sense FET and gate source voltage of stage B2
$V_{DS}(B1)$	14	drain-source voltage of stage B1

Table 2. Pin description ...continued

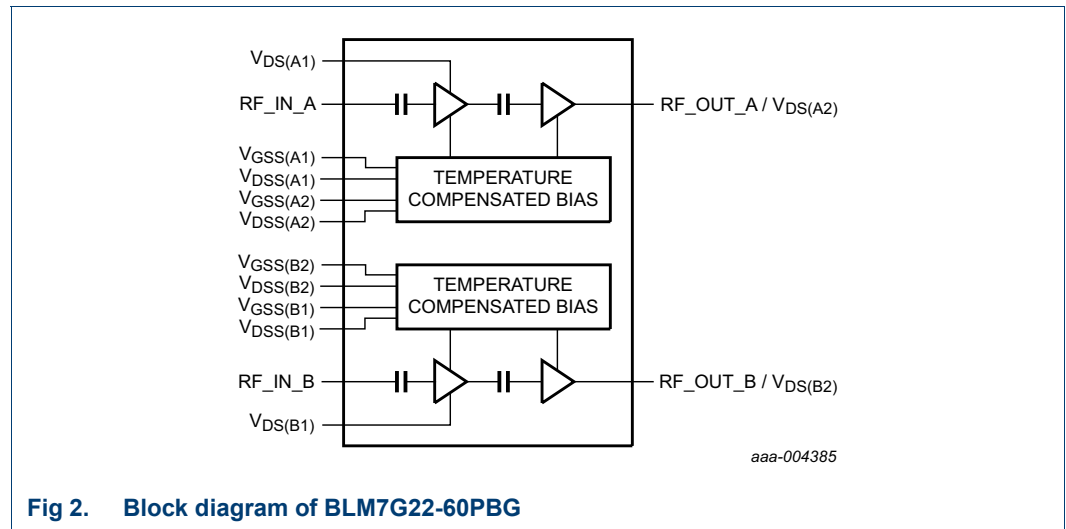
Symbol	Pin	Description
RF_OUT_B/ $V_{DS(B2)}$	15	RF output path B / drain source voltage of stage B2
RF_OUT_A/ $V_{DS(A2)}$	16	RF output path A / drain source voltage of stage A2
GND	flange	RF ground

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLM7G22S-60PB	HSOP16F	plastic, heatsink small outline package; 16 leads (flat)	SOT1211-2
BLM7G22S-60PBG	HSOP16	plastic, heatsink small outline package; 16 leads	SOT1212-2

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
$V_{GS(sense)}$	sense gate-source voltage		-0.5	+9	V
T_{stg}	storage temperature		-65	+150	°C
T_j	junction temperature	[1]	-	225	°C
T_{case}	case temperature		-	150	°C

[1] Continuous use at maximum temperature will affect the reliability, for details refer to the on-line 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	final stage; T _{case} = 90 °C; P _L = 3.2 W	[1]	1.1	K/W
		driver stage; T _{case} = 90 °C; P _L = 3.2 W	[1]	3.2	K/W

[1] When operated with a CW signal.

7. Characteristics

Table 6. DC characteristics

$T_{case} = 25\text{ }^{\circ}\text{C}$; per section unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Final stage						
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}$; $I_D = 0.422\text{ mA}$	65	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10\text{ V}$; $I_D = 42\text{ mA}$	1.4	1.9	2.4	V
V_{GSq}	gate-source quiescent voltage	$V_{DS} = 28\text{ V}$; $I_D = 253\text{ mA}$	1.7	2.1	2.5	V
I_{DSS}	drain leakage current	$V_{GS} = 0\text{ V}$; $V_{DS} = 28\text{ V}$	-	-	1.4	μA
I_{DSX}	drain cut-off current	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$; $V_{DS} = 10\text{ V}$	-	7.8	-	A
I_{GSS}	gate leakage current	$V_{GS} = 11\text{ V}$; $V_{DS} = 0\text{ V}$	-	-	140	nA
g_{fs}	forward transconductance	$V_{DS} = 10\text{ V}$; $I_D = 1478\text{ mA}$	-	2.85	-	S
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$; $I_D = 1.48\text{ A}$	-	350	-	$\text{m}\Omega$
I_{Dq}	quiescent drain current	main transistor: $V_{DS} = 28\text{ V}$ sense transistor: $I_D = 7\text{ mA}$; $V_{DS} = 28\text{ V}$	208	233	257	mA
Driver stage						
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}$; $I_D = 0.116\text{ mA}$	65	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10\text{ V}$; $I_D = 11.6\text{ mA}$	1.4	1.9	2.4	V
V_{GSq}	gate-source quiescent voltage	$V_{DS} = 28\text{ V}$; $I_D = 69.6\text{ mA}$	1.7	2.1	2.5	V
I_{DSS}	drain leakage current	$V_{GS} = 0\text{ V}$; $V_{DS} = 28\text{ V}$	-	-	1.4	μA
I_{DSX}	drain cut-off current	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$; $V_{DS} = 10\text{ V}$	-	2.2	-	A
I_{GSS}	gate leakage current	$V_{GS} = 11\text{ V}$; $V_{DS} = 0\text{ V}$	-	-	140	nA
g_{fs}	forward transconductance	$V_{DS} = 10\text{ V}$; $I_D = 406\text{ mA}$	-	0.8	-	S
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)} + 3.75\text{ V}$; $I_D = 0.4\text{ A}$	-	2350	-	$\text{m}\Omega$
I_{Dq}	quiescent drain current	main transistor: $V_{DS} = 28\text{ V}$ sense transistor: $I_D = 7\text{ mA}$; $V_{DS} = 28\text{ V}$	67	75	83	mA

Table 7. RF Characteristics

Typical RF performance at $T_{case} = 25\text{ }^{\circ}\text{C}$; $V_{DS} = 28\text{ V}$; $I_{DQ1} = 75\text{ mA}$; $I_{DQ2} = 233\text{ mA}$. Test signal: 2-carrier W-CDMA; 3GPP test model 1; 64 DPCH; clipping at 46 %; PAR = 8.4 dB at 0.01% probability on CCDF per carrier; carrier spacing = 5 MHz; $f = 2140\text{ MHz}$; per section unless otherwise specified, measured in a class-AB production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
G_p	power gain	$P_{L(AV)} = 1.6\text{ W}$	29.5	31.5	33.5	dB
η_D	drain efficiency	$P_{L(AV)} = 1.6\text{ W}$	10	11.3	-	%
RL_{in}	input return loss	$P_{L(AV)} = 1.6\text{ W}$	-	-17	-10	dB
ACPR	adjacent channel power ratio	$P_{L(AV)} = 1.6\text{ W}$	-	-43	-40	dBc

8. Application information

8.1 Circuit information for application circuit (2.1 GHz to 2.2 GHz)

Table 8. List of components

For test circuit see [Figure 3](#).

Component	Description	Value	Remarks
C1, C4, C21, C24, C100, C200, C300, C400	capacitor	10 μF	
C2, C5, C6, C22, C25, C26	capacitor	1 μF	
C3, C7, C10, C23, C27, C30	capacitor	8.2 pF [1]	
C8, C28	capacitor	1.6 pF [1]	
C9, C29	capacitor	0.4 pF [1]	
C11, C31	electrolytic capacitor	470 μF	
C101, C201, C301, C401	capacitor	100 nF	
C102, C103, C105, C202, C203, C205, C302, C303, C305, C402, C403, C405	capacitor	12 pF [2]	
C104, C204, C304, C404	capacitor	4.7 μF	
D100, D200, D300, D400	IC: LM4051	-	
P100, P400	potentiometer	-	do not populate
Q100, Q200, Q300, Q400	IC: LM7341	-	
R1, R21	ferrite bead	-	
R100, R200, R300, R400	resistor	4.7 Ω	
R101, R108, R208, R308, R401, R408	resistor	0 Ω	
R102, R402	resistor	360 Ω	1% tolerance
R103, R403	resistor	330 Ω	1% tolerance
R104, R203, R303, R404	resistor	68 k Ω	
R105, R405	resistor	10 k Ω	
R106, R205, R305, R406	resistor	820 Ω	
R107, R206, R306, R407	resistor	47 Ω	
R109, R209, R309, R409	resistor	300 k Ω	
R201, R301	resistor	180 Ω	1% tolerance

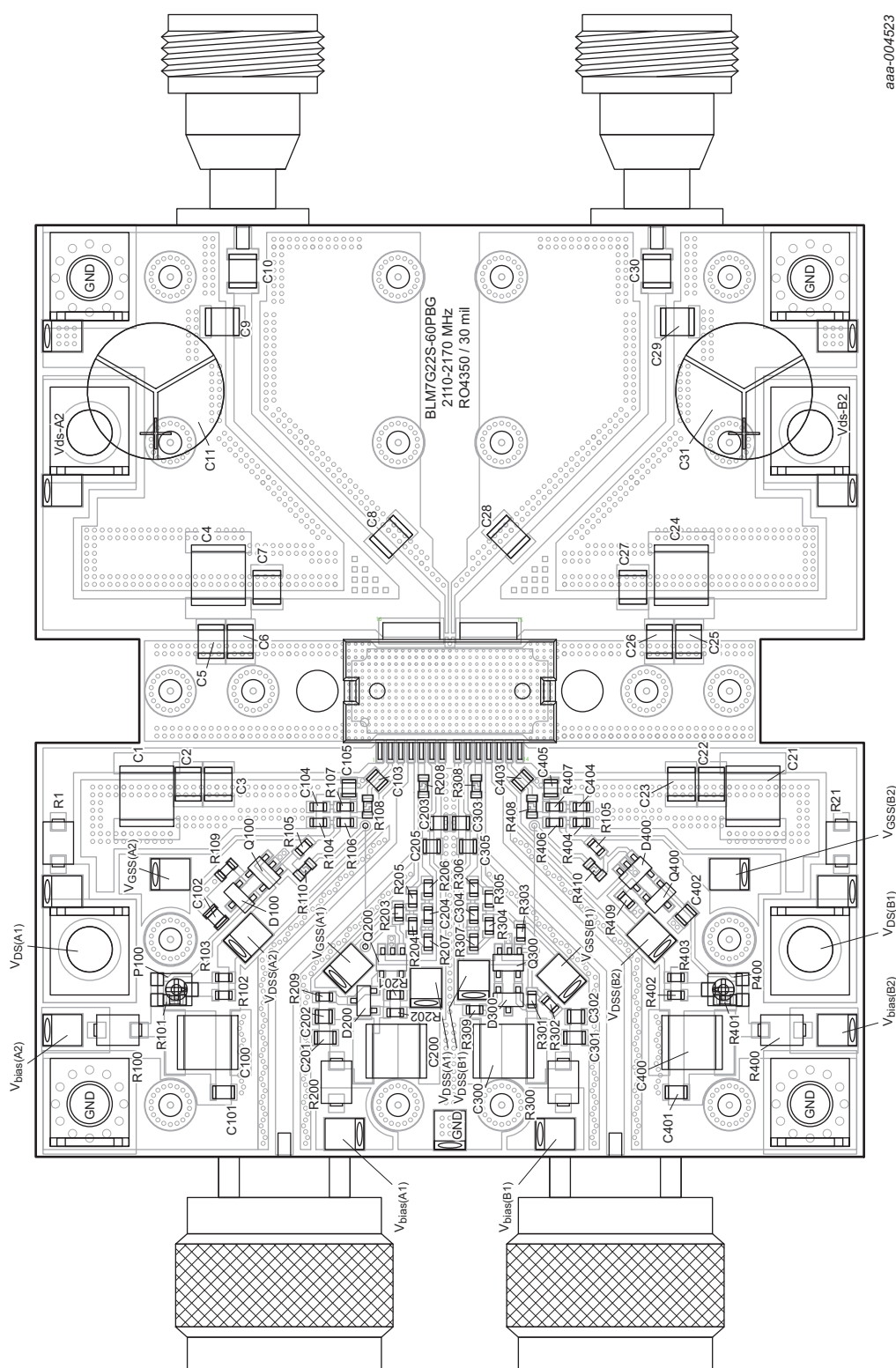
Table 8. List of components ...continued

For test circuit see [Figure 3](#).

Component	Description	Value	Remarks
R202, R302	resistor	3.6 k Ω	1% tolerance
R204, R304	resistor	9.1 k Ω	
R207, R307	resistor	1 k Ω	

[1] American Technical Ceramics type 100B or capacitor of same quality.

[2] American Technical Ceramics type 100A or capacitor of same quality.



Printed-Circuit Board (PCB): Rogers 4350; thickness = 0.762 mm.

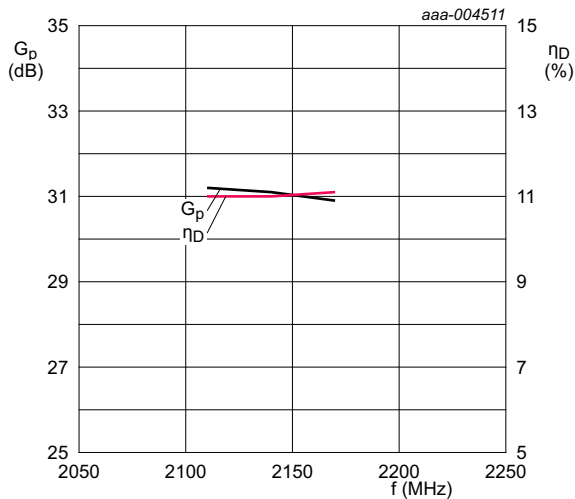
See [Table 8](#) for a list of components.

Fig 3. Component layout for class-AB application circuit with auto-bias

8.2 Performance curves (2.1 GHz to 2.2 GHz)

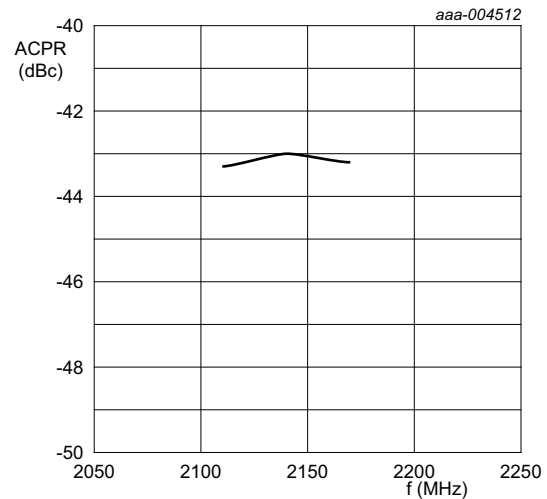
Performance curves are measured in a class-AB dedicated application circuit with auto-bias from 2.1 GHz to 2.2 GHz, see [Table 8](#) and [Figure 3](#).

8.2.1 W-CDMA



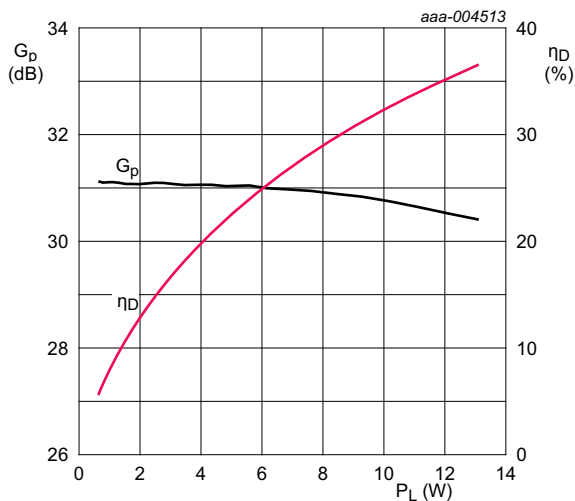
$T_{case} = 25\text{ }^{\circ}\text{C}$; $V_{DS} = 28\text{ V}$; $P_{L(AV)} = 1.6\text{ W}$; $I_{DQ1} = 75\text{ mA}$; $I_{DQ2} = 232\text{ mA}$; carrier spacing = 5 MHz.

Fig 4. Power gain and drain efficiency as function of frequency; typical values



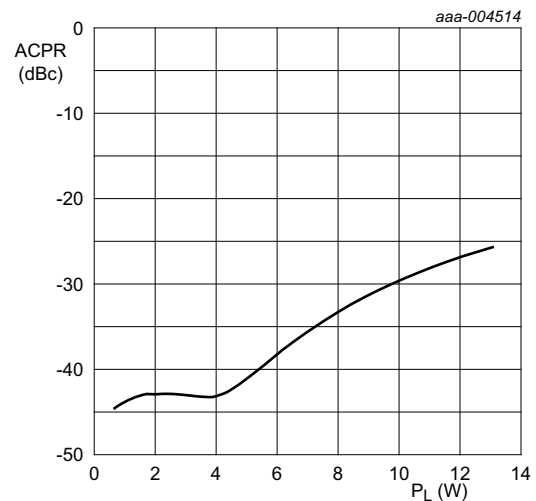
$T_{case} = 25\text{ }^{\circ}\text{C}$; $V_{DS} = 28\text{ V}$; $P_{L(AV)} = 1.6\text{ W}$; $I_{DQ1} = 75\text{ mA}$; $I_{DQ2} = 232\text{ mA}$; carrier spacing = 5 MHz.

Fig 5. Adjacent channel power ratio as a function of frequency; typical values



$T_{case} = 25\text{ }^{\circ}\text{C}$; $V_{DS} = 28\text{ V}$; $f = 2140\text{ MHz}$; $I_{DQ1} = 75\text{ mA}$; $I_{DQ2} = 232\text{ mA}$; carrier spacing = 5 MHz.

Fig 6. Power gain and drain efficiency as function of output power; typical values



$T_{case} = 25\text{ }^{\circ}\text{C}$; $V_{DS} = 28\text{ V}$; $f = 2140\text{ MHz}$; $I_{DQ1} = 75\text{ mA}$; $I_{DQ2} = 232\text{ mA}$; carrier spacing = 5 MHz.

Fig 7. Adjacent channel power ratio as a function of output power; typical values

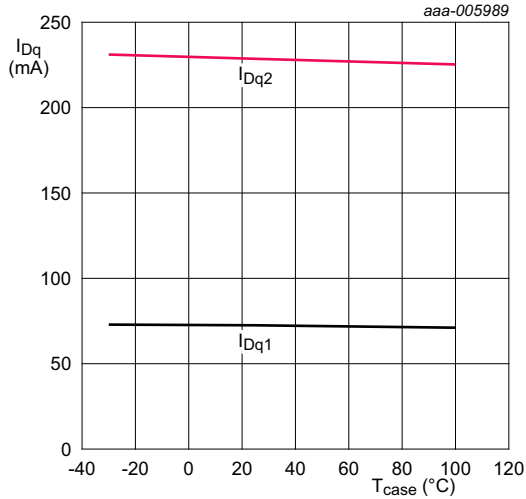
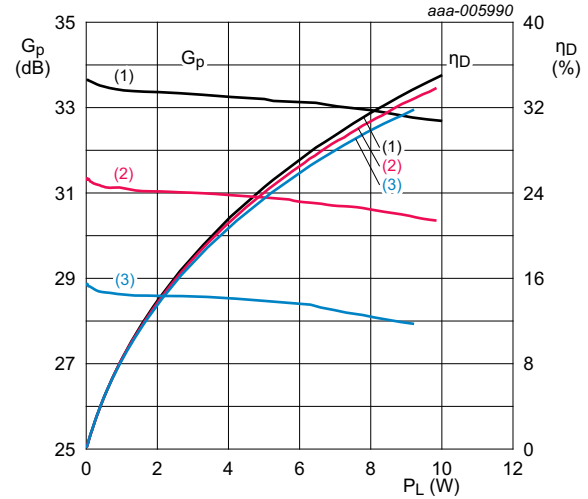


Fig 8. Quiescent drain current as a function of case temperature; typical values

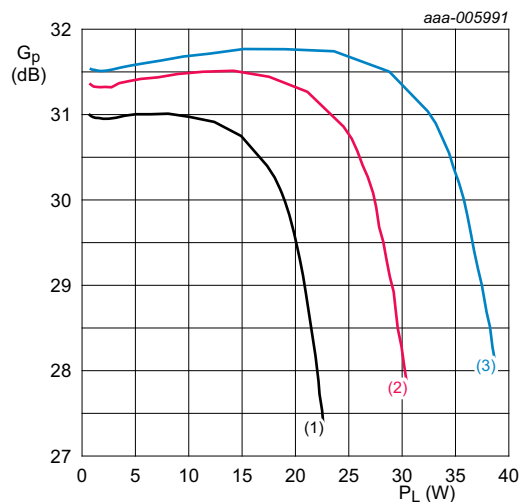


$V_{DS} = 28 \text{ V}$; $f = 2140 \text{ MHz}$; $I_{Dq1} = 75 \text{ mA}$; $I_{Dq2} = 232 \text{ mA}$; carrier spacing = 5 MHz.

- (1) $T_{case} = -30 \text{ °C}$
- (2) $T_{case} = +25 \text{ °C}$
- (3) $T_{case} = +100 \text{ °C}$

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

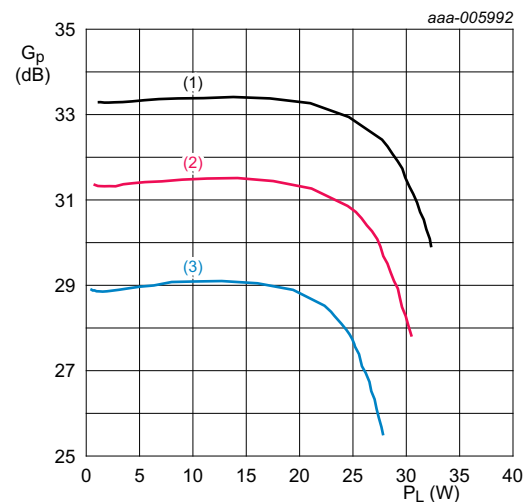
8.2.2 1-Tone pulsed CW



$T_{case} = 25 \text{ °C}$; $V_{DS} = 28 \text{ V}$; $P_{L(AV)} = 1.6 \text{ W}$; $f = 2140 \text{ MHz}$; $I_{Dq1} = 75 \text{ mA}$; $I_{Dq2} = 232 \text{ mA}$; $\delta = 10 \%$; $t_p = 100 \text{ μs}$.

- (1) $V_{DD} = 24 \text{ V}$
- (2) $V_{DD} = 28 \text{ V}$
- (3) $V_{DD} = 32 \text{ V}$

Fig 10. Power gain as a function of output power; typical values

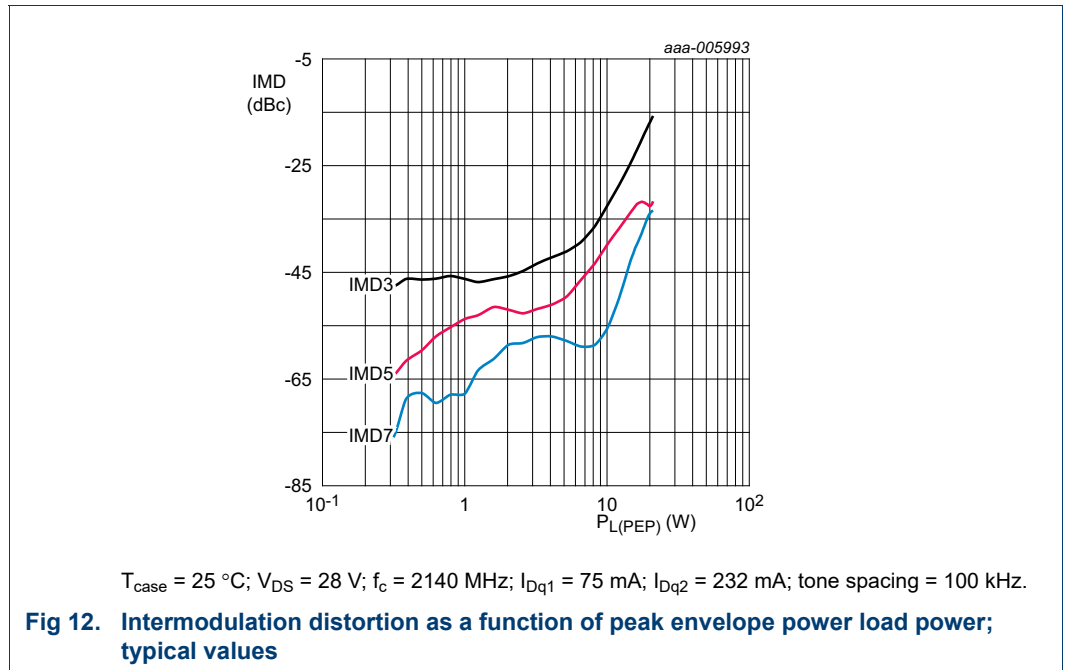


$V_{DS} = 28 \text{ V}$; $P_{L(AV)} = 1.6 \text{ W}$; $f = 2140 \text{ MHz}$; $I_{Dq1} = 75 \text{ mA}$; $I_{Dq2} = 232 \text{ mA}$; $\delta = 10 \%$; $t_p = 100 \text{ μs}$.

- (1) $T_{case} = -30 \text{ °C}$
- (2) $T_{case} = +25 \text{ °C}$
- (3) $T_{case} = +100 \text{ °C}$

Fig 11. Power gain as a function of output power; typical values

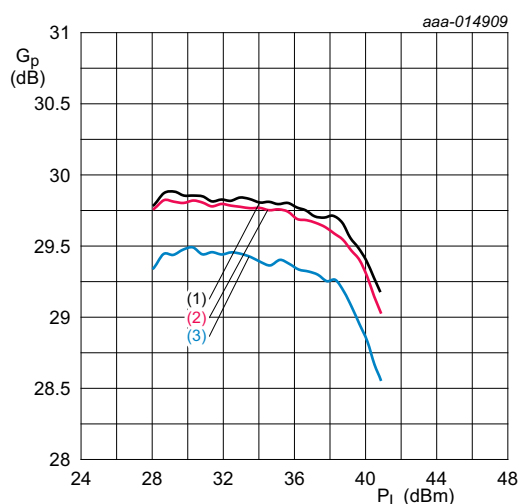
8.2.3 2-Tone CW



8.3 Performance curves (2.3 GHz to 2.4 GHz)

Performance curves are measured in a class-AB dedicated application circuit with auto-bias from 2.3 GHz to 2.4 GHz.

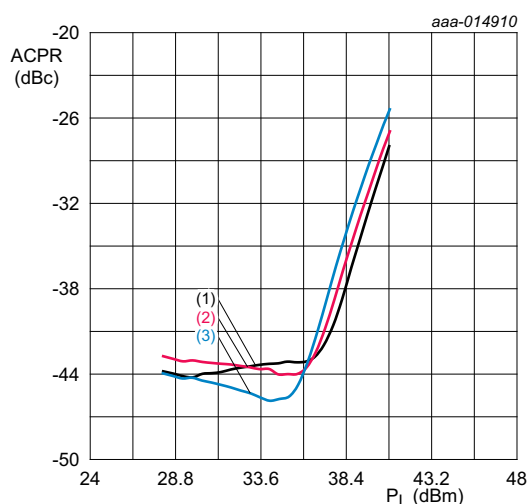
8.3.1 2-Carrier W-CDMA



$V_{DS} = 28\text{ V}$; $I_{DQ1} = 220\text{ mA}$; $I_{DQ2} = 75\text{ mA}$; carrier spacing = 5MHz.

- (1) $f = 2300\text{ MHz}$
- (2) $f = 2350\text{ MHz}$
- (3) $f = 2400\text{ MHz}$

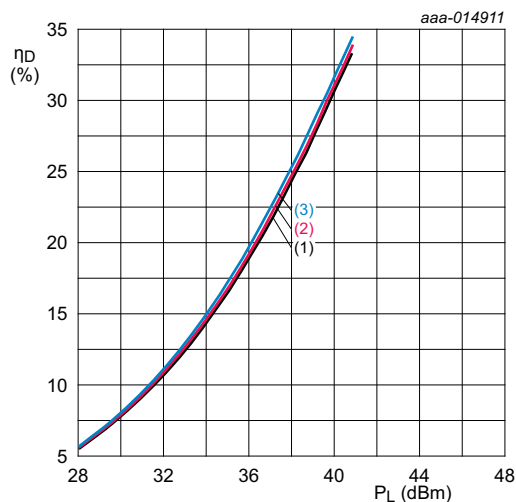
Fig 13. Power gain as a function of output power; typical values



$V_{DS} = 28\text{ V}$; $I_{DQ1} = 220\text{ mA}$; $I_{DQ2} = 75\text{ mA}$; carrier spacing = 5MHz.

- (1) $f = 2300\text{ MHz}$
- (2) $f = 2350\text{ MHz}$
- (3) $f = 2400\text{ MHz}$

Fig 14. Adjacent channel power ratio as a function of output power; typical values

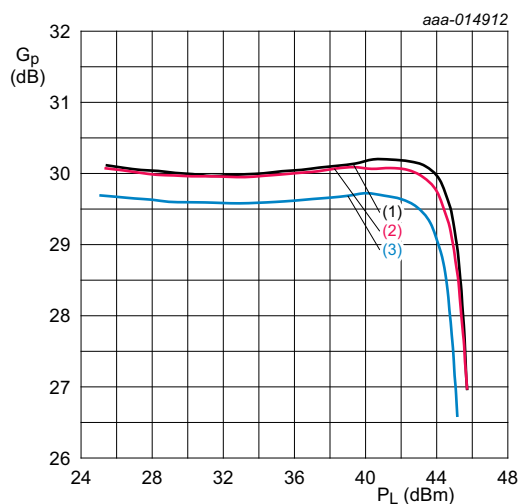


$V_{DS} = 28 \text{ V}$; $I_{DQ1} = 220 \text{ mA}$; $I_{DQ2} = 75 \text{ mA}$; carrier spacing = 5MHz.

- (1) $f = 2300 \text{ MHz}$
- (2) $f = 2350 \text{ MHz}$
- (3) $f = 2400 \text{ MHz}$

Fig 15. Drain efficiency as a function of output power; typical values

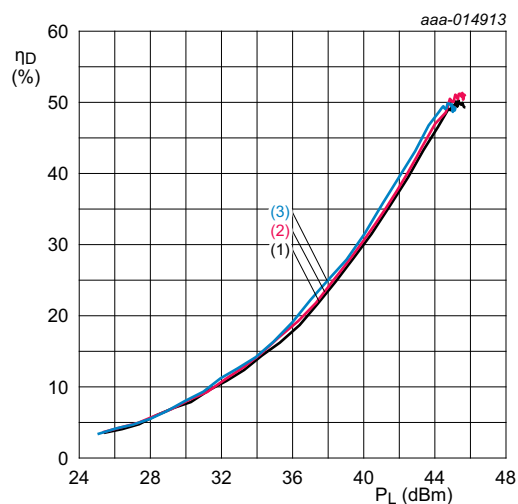
8.3.2 Pulsed CW



$V_{DS} = 28 \text{ V}$; $I_{DQ1} = 220 \text{ mA}$; $I_{DQ2} = 75 \text{ mA}$; $\delta = 10 \%$;
 $t_p = 100 \mu\text{s}$.

- (1) $f = 2300 \text{ MHz}$
- (2) $f = 2350 \text{ MHz}$
- (3) $f = 2400 \text{ MHz}$

Fig 16. Power gain as a function of output power; typical values

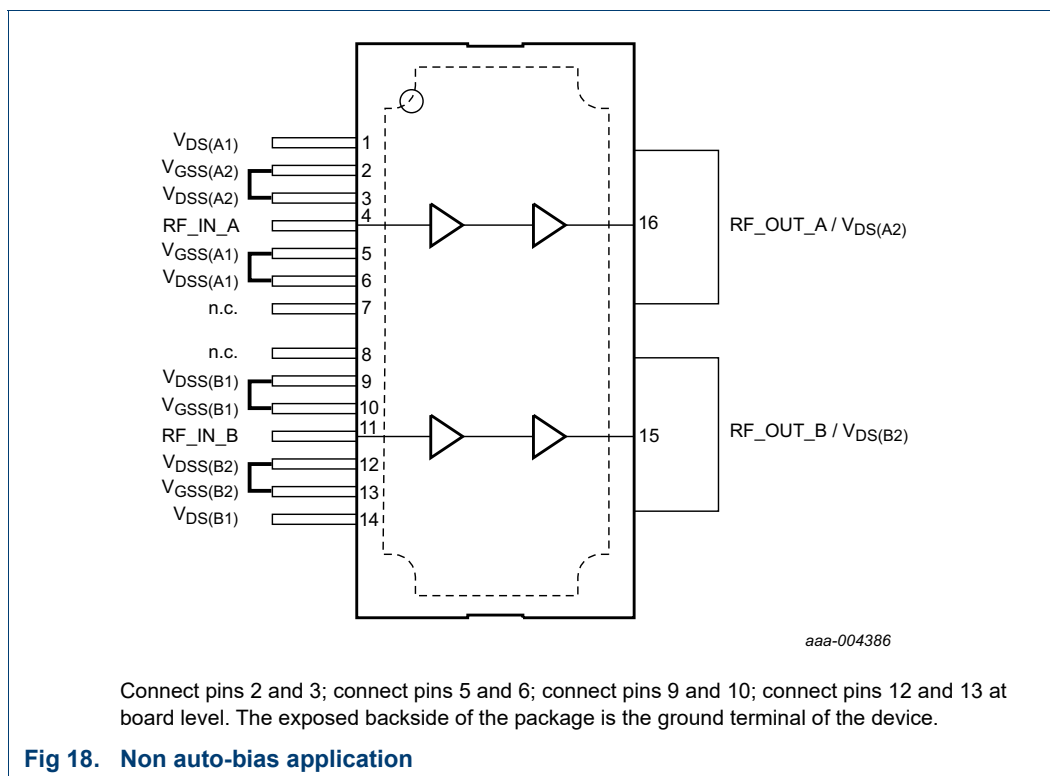


$V_{DS} = 28 \text{ V}$; $I_{DQ1} = 220 \text{ mA}$; $I_{DQ2} = 75 \text{ mA}$; $\delta = 10 \%$;
 $t_p = 100 \mu\text{s}$.

- (1) $f = 2300 \text{ MHz}$
- (2) $f = 2350 \text{ MHz}$
- (3) $f = 2400 \text{ MHz}$

Fig 17. Drain efficiency as a function of output power; typical values

8.4 Application without auto-bias



9. Test information

9.1 Ruggedness

The BLM7G22S-60PB and BLM7G22S-60PBG are capable of withstanding a load mismatch corresponding to $V_{SWR} = 10 : 1$ through all phases under the following conditions: $V_{DS} = 28 \text{ V}$; $I_{Dq1} = 75 \text{ mA}$; $I_{Dq2} = 233 \text{ mA}$; $P_L = 27 \text{ W}$ (W-CDMA); $f = 2140 \text{ MHz}$.

9.2 Impedance information

Table 9. Typical impedance

Measured load-pull data. Typical values per section unless otherwise specified.

f	Z _S [1]	Z _L [1]
(MHz)	(Ω)	(Ω)
BLM7G22S-60PB		
2080	58.86 + j21.82	10.54 – j3.20
2110	58.70 + j29.76	10.23 – j2.72
2140	51.80 + j41.56	9.56 – j2.90
2170	47.31 + j44.60	9.10 – j2.80
2230	38.35 + j46.53	8.41 – j2.05
2300	30.80 + j53.60	6.40 – j2.10
2350	23.80 + j48.20	5.70 – j2.20
2400	19.10 + j43.20	5.30 – j2.40
BLM7G22S-60PBG		
2080	55.62 + j18.89	15.89 – j2.28
2110	55.61 + j19.04	14.74 – j2.59
2140	55.60 + j19.12	13.56 – j2.75
2170	55.57 + j19.25	12.38 – j2.75
2200	55.53 + j19.39	11.20 – j2.61
2230	55.48 + j19.55	10.05 – j2.34
2300	34.51 + j41.45	7.06 – j6.36
2350	29.26 + j36.91	6.35 – j6.24
2400	22.86 + j32.52	5.65 – j6.15

[1] Z_S and Z_L defined in Figure 19.

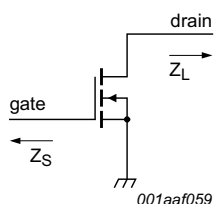
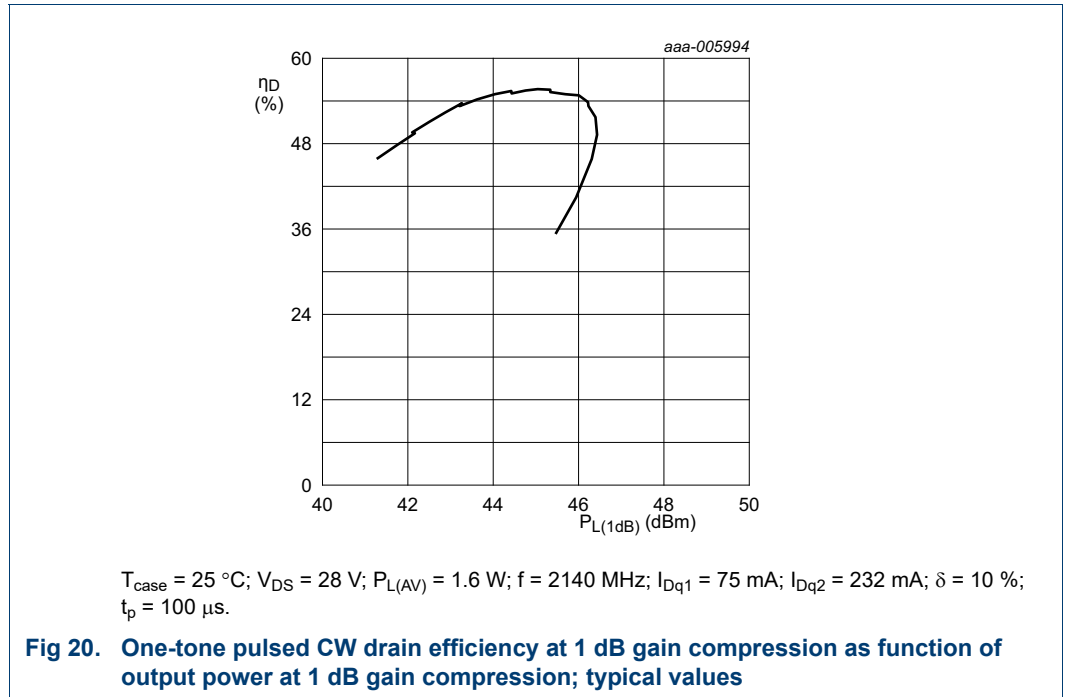


Fig 19. Definition of transistor impedance

9.3 Performance curves

Performance curves are measured per section.



HSOP16: plastic, heatsink small outline package; 16 leads

SOT1212-2

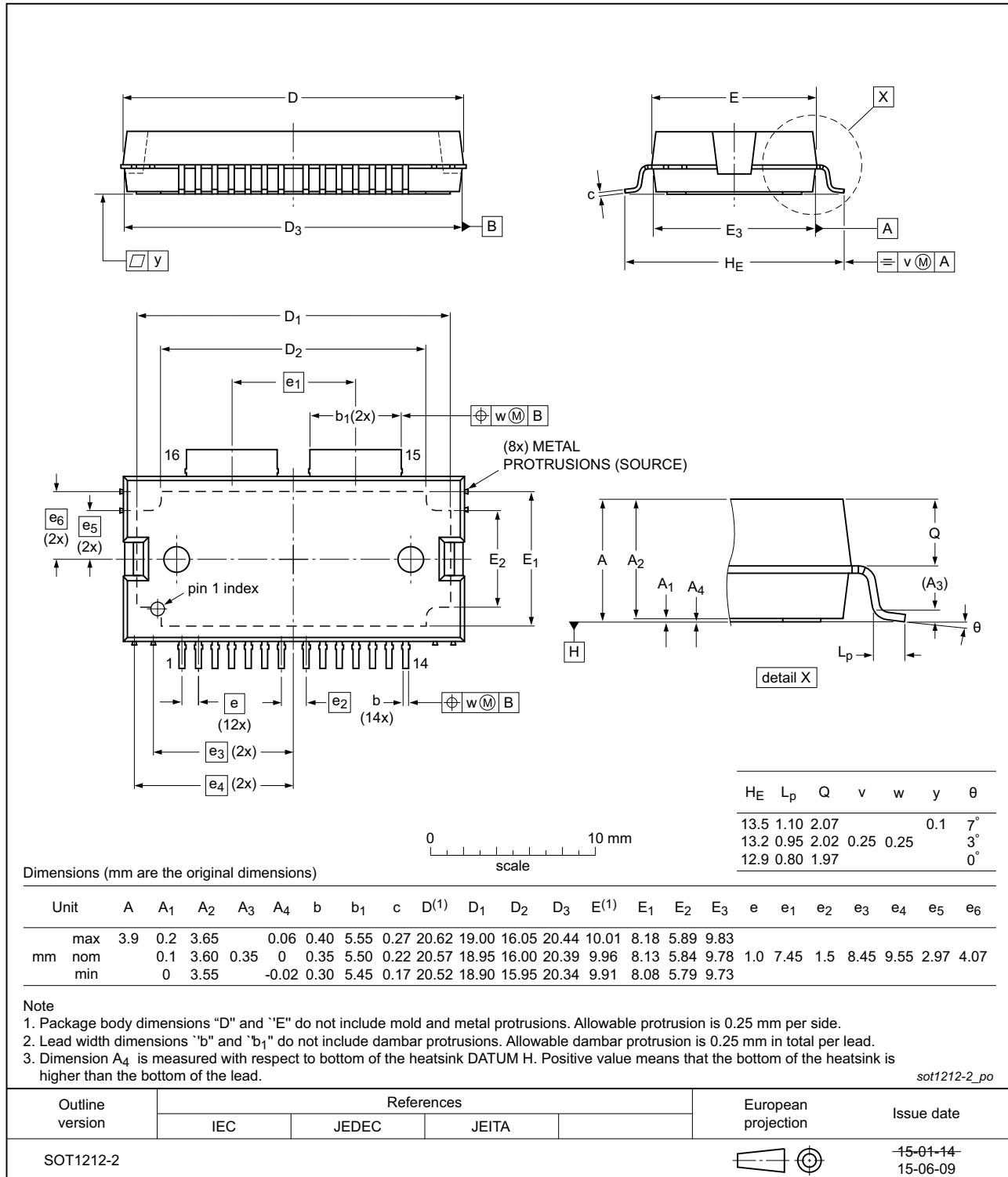


Fig 22. Package outline SOT1212-2 (HSOP16)

11. 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.

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
3GPP	3rd Generation Partnership Project
CCDF	Complementary Cumulative Distribution Function
CW	Continuous Waveform
DPCH	Dedicated Physical CHannel
ESD	ElectroStatic Discharge
FET	Field-Effect Transistor
GEN7	Seventh Generation
LDMOS	Laterally Diffused Metal Oxide Semiconductor
MMIC	Monolithic Microwave Integrated Circuit
MTF	Median Time To Failure
PAR	Peak-to-Average Ratio
VSWR	Voltage Standing Wave Ratio
W-CDMA	Wideband Code Division Multiple Access

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLM7G22S-60PB_7G22S-60PBG#5	20150901	Product data sheet		BLM7G22S-60PB_7G22S-60PBG v.4
Modifications:	- The format of this document has been redesigned to comply with the new identity guidelines of Ampleon. - Legal texts have been adapted to the new company name where appropriate.			
BLM7G22S-60PB_7G22S-60PBG v.4	20150701	Product data sheet	-	BLM7G22S-60PB_7G22S-60PBG v.3
BLM7G22S-60PB_7G22S-60PBG v.3	20141016	Product data sheet	-	BLM7G22S-60PB_7G22S-60PBG v.2
BLM7G22S-60PB_7G22S-60PBG v.2	20140930	Product data sheet	-	BLM7G22S-60PB_7G22S-60PBG v.1
BLM7G22S-60PB_7G22S-60PBG v.1	20121211	Product data sheet	-	-

14. Legal information

14.1 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. Contact information

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Date of release: 1 September 2015

Document identifier: BLM7G22S-60PB_7G22S-60PB#5