

# BLF9G38LS-90P

Power LDMOS transistor

Rev. 3 — 1 September 2015

AMPLEON

Product data sheet

## 1. Product profile

### 1.1 General description

90 W LDMOS power transistor for base station applications at frequencies from 3400 MHz to 3600 MHz.

**Table 1. Typical performance**

*Typical RF performance at  $T_{case} = 25\text{ °C}$  in the Doherty application demo circuit.*

Test signal	f	V <sub>DS</sub>	P <sub>L(AV)</sub>	G <sub>p</sub>	η <sub>D</sub>	ACPR
	(MHz)	(V)	(W)	(dB)	(%)	(dBc)
IS-95	3400 to 3600	28	15.1	12.7	37.0	-37 [1]

[1] Test signal: IS-95; pilot, paging, sync, 6 traffic channels with Walsh codes 8 – 13; PAR = 9.7 dB at 0.01 % probability.

### 1.2 Features and benefits

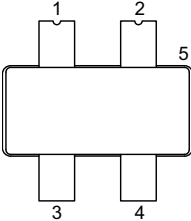
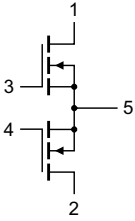
- Excellent ruggedness
- High efficiency
- Low thermal resistance providing excellent thermal stability
- Lower output capacitance for improved performance in Doherty applications
- Designed for low memory effects providing excellent pre-distortability
- Internally matched for ease of use
- Integrated ESD protection
- Compliant to Directive 2002/95/EC, regarding Restriction of Hazardous Substances (RoHS)

### 1.3 Applications

- RF power amplifier for LTE base stations and multi carrier applications in the 3400 MHz to 3600 MHz frequency range

## 2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	drain1		
2	drain2		
3	gate1		
4	gate2		
5	source <sup>[1]</sup>		

[1] Connected to flange.

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLF9G38LS-90P	-	earless flanged ceramic package; 4 leads	SOT1121B

## 4. 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		-5	+13	V
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature	<sup>[1]</sup>	-	225	°C

[1] Continuous use at maximum temperature will affect the reliability, for details refer to the on-line MTF calculator.

## 5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-case)}$	thermal resistance from junction to case	$T_{case} = 80\text{ °C}; V_{DS} = 28\text{ V}; I_{DQ} = 300\text{ mA}; V_{GS(amp)peak} = 1.0\text{ V}$ <sup>[1]</sup>		
		$P_L = 18\text{ W (CW)}$	0.37	K/W
		$P_L = 56\text{ W (CW)}$	0.22	K/W

[1] Measured in Doherty development circuit for thermal measurement

## 6. Characteristics

**Table 6. DC characteristics**

$T_j = 25\text{ °C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}; I_D = 0.513\text{ mA}$	65	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10\text{ V}; I_D = 51.3\text{ mA}$	1.5	2.1	3.1	V
$V_{GSq}$	gate-source quiescent voltage	$V_{DS} = 28\text{ V}; I_D = 307.8\text{ mA}$	1.7	2.3	3.3	V
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}; V_{DS} = 32\text{ V}$	-	-	1.4	$\mu\text{A}$
$I_{DSX}$	drain cut-off current	$V_{GS} = V_{GS(th)} + 3.75\text{ V};$ $V_{DS} = 10\text{ V}$	-	11	-	A
$I_{GSS}$	gate leakage current	$V_{GS} = 11\text{ V}; V_{DS} = 0\text{ V}$	-	-	140	nA
$g_{fs}$	forward transconductance	$V_{DS} = 10\text{ V}; I_D = 51.3\text{ mA}$	-	0.45	-	S
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)} + 3.75\text{ V};$ $I_D = 1.8\text{ A}$	-	236	449	$\text{m}\Omega$

**Table 7. RF characteristics**

Test signal: 1-carrier W-CDMA; PAR = 7.2 dB at 0.01 % probability on the CCDF; 3GPP test model 1; 1 to 64 DPCH;  $f_1 = 3400\text{ MHz}; f_2 = 3500\text{ MHz}; f_3 = 3600\text{ MHz}$ ; RF performance at  $V_{DS} = 28\text{ V}; I_{Dq} = 600\text{ mA}; T_{case} = 25\text{ °C}$ ; unless otherwise specified; in a class-AB production test circuit at frequencies from 3400 MHz to 3600 MHz.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$G_p$	power gain	$P_{L(AV)} = 20\text{ W}$	13.8	15.0	-	dB
$RL_{in}$	input return loss	$P_{L(AV)} = 20\text{ W}$	-	-10	-6	dB
$\eta_D$	drain efficiency	$P_{L(AV)} = 20\text{ W}$	23	28	-	%
ACPR	adjacent channel power ratio	$P_{L(AV)} = 20\text{ W}$	-	-26	-21	dBc

## 7. Test information

### 7.1 Ruggedness in Doherty operation

The BLF9G38LS-90P is capable of withstanding a load mismatch corresponding to a VSWR = 10 : 1 through all phases under the following conditions:  $V_{DS} = 28\text{ V}; I_{Dq} = 300\text{ mA}; V_{GS(amp)peak} = 0.7\text{ V}; P_L = 56\text{ W (CW)}; f = 3400\text{ MHz}$ ; tested on the Doherty development test circuit.

## 7.2 Impedance information

**Table 8. Typical impedance of maximum power and drain efficiency**

Measured load-pull data (half device);  $I_{DQ} = 300 \text{ mA}$ ;  $V_{DS} = 28 \text{ V}$ ; typical values unless otherwise specified.

f	$Z_S$ [1]	$Z_L$ [1]	$P_L$ [2]	$\eta_D$ [2]	$G_p$ [2]
(MHz)	( $\Omega$ )	( $\Omega$ )	(W)	(%)	(dB)
<b>Maximum power load</b>					
3400	7.0 – j20.0	6.5 – j14.1	64	52.8	12.2
3600	18.1 – j29.7	7.9 – j15.2	61	50.9	12.5
3800	47.2 – j5.9	6.7 – j16.7	60	47.4	11.7
<b>Maximum drain efficiency load</b>					
3400	7.0 – j20.0	9.3 – j9.1	50	58.8	14.1
3600	18.1 – j29.7	7.5 – j10.3	50	55.6	14.1
3800	47.2 – j5.9	7.0 – j11.7	49	53.4	14.1

[1]  $Z_S$  and  $Z_L$  defined in [Figure 1](#).

[2] at 3 dB gain compression.

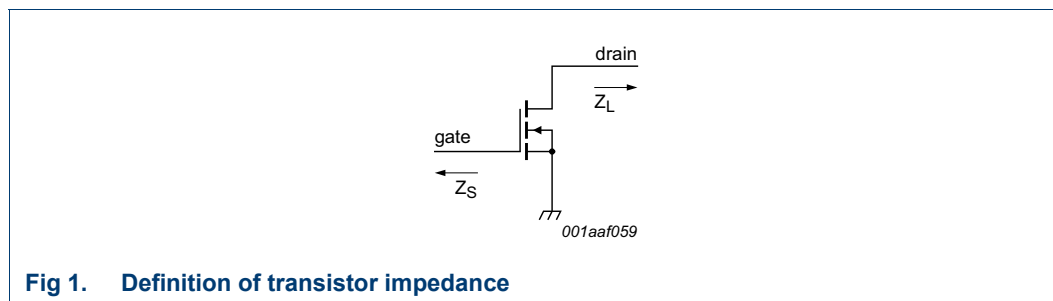
**Table 9. Typical trade off impedance at 1 : 1 load**

Measured load-pull data (half device);  $I_{DQ} = 300 \text{ mA}$ ;  $V_{DS} = 28 \text{ V}$ ; typical values unless otherwise specified.

f	$Z_S$ [1]	$Z_L$ [1]	$P_L$ [2]	$\eta_D$ [2]	$G_p$ [2]
(MHz)	( $\Omega$ )	( $\Omega$ )	(dBm)	(%)	(dB)
3400	7.0 – j20.0	8.5 – j12.3	60	57.9	13.3
3600	18.1 – j29.7	7.3 – j12.7	59	54.7	13.2
3800	47.2 – j5.9	7.7 – j13.9	56	52.3	13.1

[1]  $Z_S$  and  $Z_L$  defined in [Figure 1](#).

[2] at 3 dB gain compression.

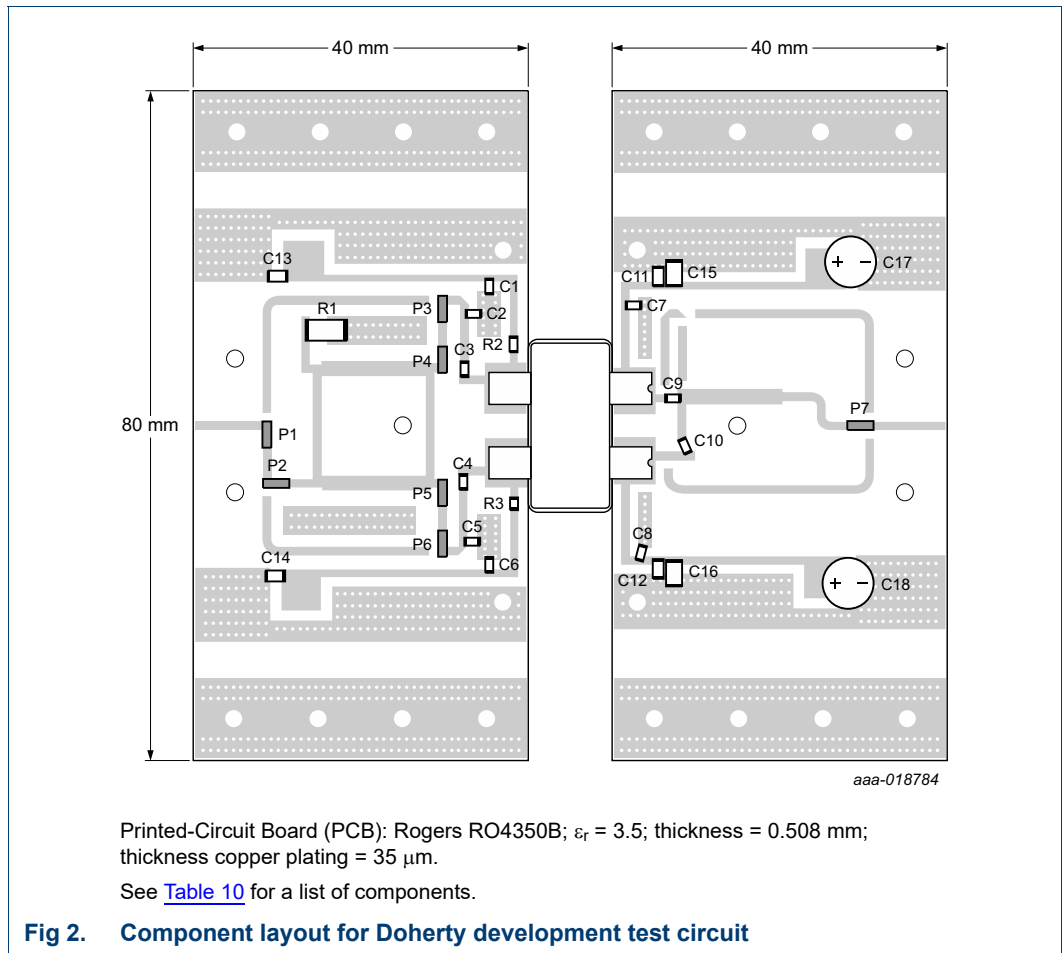


**Fig 1. Definition of transistor impedance**

## 7.3 VBW in Doherty operation

The BLF9G38LS-90P shows 100 MHz (typical) video bandwidth in Doherty development test circuit in 3500 MHz at  $V_{DS} = 28 \text{ V}$ ;  $I_{DQ} = 300 \text{ mA}$  and  $V_{GS(amp)peak} = 0.6 \text{ V}$ .

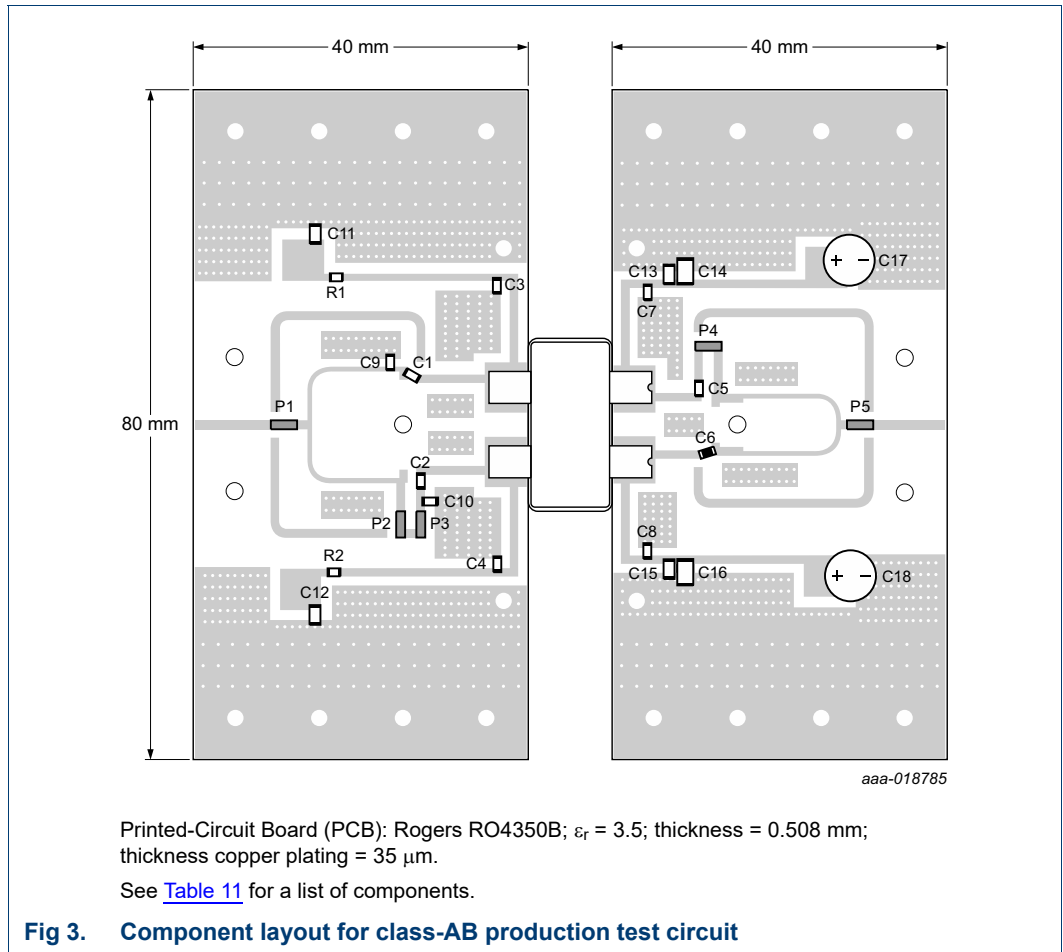
7.4 Test circuit



**Table 10. List of components**

See [Figure 3](#) for component layout.

Component	Description	Value	Remarks
C1, C3, C4, C6, C7, C8, C10	multilayer ceramic chip capacitor	9.1 pF	ATC 600F
C2, C5	multilayer ceramic chip capacitor	0.9 pF	ATC 600F
C9	multilayer ceramic chip capacitor	1.3 pF	ATC 600F
C11, C12, C13, C14	multilayer ceramic chip capacitor	1 $\mu\text{F}$ , 50 V	Murata
C15, C16	multilayer ceramic chip capacitor	10 $\mu\text{F}$ , 50 V	Murata
C17, C18	electrolytic capacitor	2200 $\mu\text{F}$ , 63 V	
P1, P2, P3, P4, P5, P6, P7	copper foil strip	-	needed for tuning
R1	SMD resistor	50 $\Omega$	SMD 2512
R2, R3	SMD resistor	5.1 $\Omega$	SMD 0805



**Table 11. List of components**

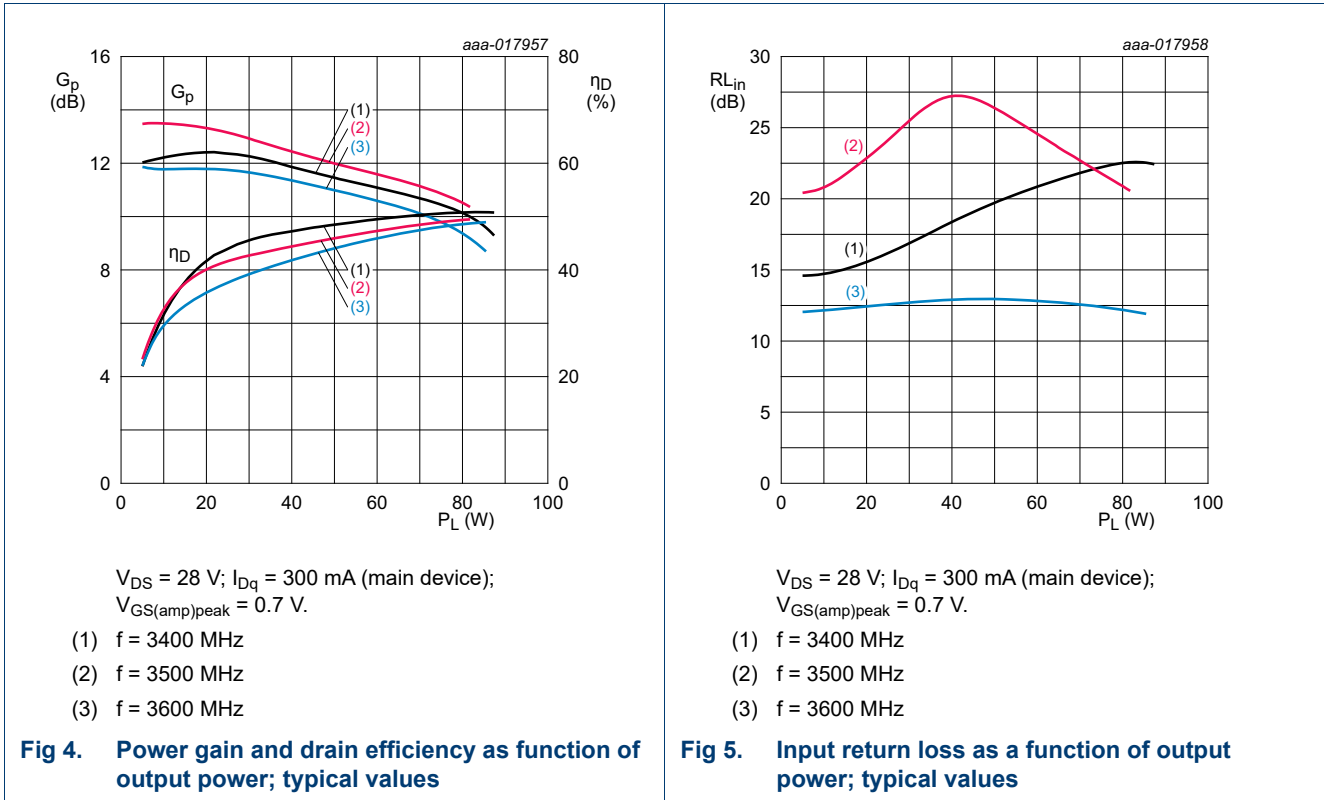
See [Figure 3](#) for component layout.

Component	Description	Value	Remarks
C1, C2, C3, C4, C5, C6, C7, C8	multilayer ceramic chip capacitor	9.1 pF	ATC 600F
C9, C10	multilayer ceramic chip capacitor	0.6 pF	ATC 600F
C11, C12, C13, C15	multilayer ceramic chip capacitor	1 $\mu\text{F}$ , 50 V	Murata
C14, C16	multilayer ceramic chip capacitor	10 $\mu\text{F}$ , 50 V	Murata
C17, C18	electrolytic capacitor	1000 $\mu\text{F}$ , 63 V	
P1, P2, P3, P4, P5	copper foil strip	-	needed for tuning
R1, R2	SMD resistor	5.1 $\Omega$	SMD 0805

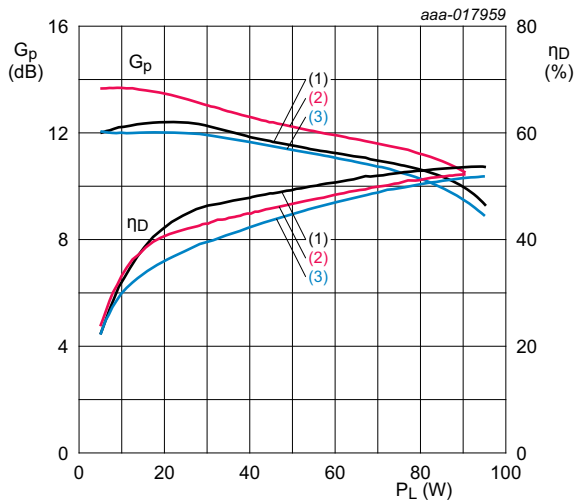
7.5 Graphical data

All data are measured on the Doherty development test circuit.

7.5.1 CW



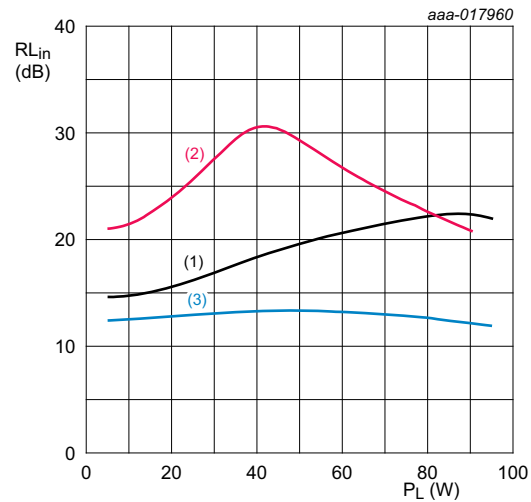
7.5.2 Pulsed CW



$V_{DS} = 28 \text{ V}; I_{Dq} = 300 \text{ mA}$  (main device);  
 $V_{GS(amp)peak} = 0.7 \text{ V}; t_p = 100 \mu\text{s}; \delta = 10 \%$ .

- (1)  $f = 3400 \text{ MHz}$
- (2)  $f = 3500 \text{ MHz}$
- (3)  $f = 3600 \text{ MHz}$

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



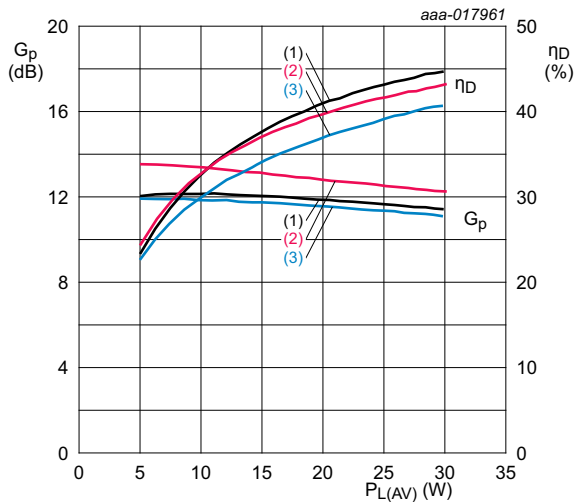
$V_{DS} = 28 \text{ V}; I_{Dq} = 300 \text{ mA}$  (main device);  
 $V_{GS(amp)peak} = 0.7 \text{ V}; t_p = 100 \mu\text{s}; \delta = 10 \%$ .

- (1)  $f = 3400 \text{ MHz}$
- (2)  $f = 3500 \text{ MHz}$
- (3)  $f = 3600 \text{ MHz}$

**Fig 7. Input return loss as a function of output power; typical values**

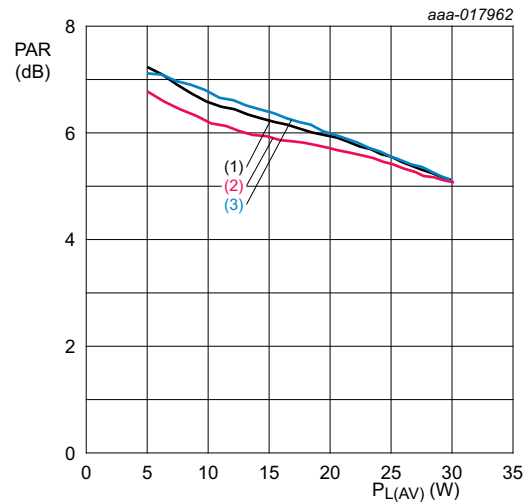


7.5.3 1-Carrier W-CDMA



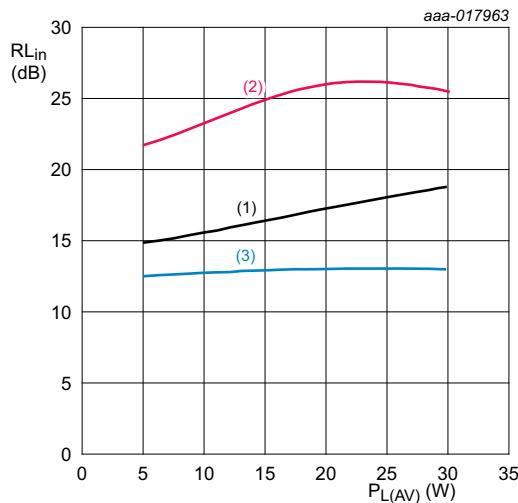
$V_{DS} = 28\text{ V}$ ;  $I_{Dq} = 300\text{ mA}$  (main device);  
 $V_{GS(amp)peak} = 0.7\text{ V}$ .  
 (1)  $f = 3400\text{ MHz}$   
 (2)  $f = 3500\text{ MHz}$   
 (3)  $f = 3600\text{ MHz}$

**Fig 8. Power gain and drain efficiency as function of average output power; typical values**



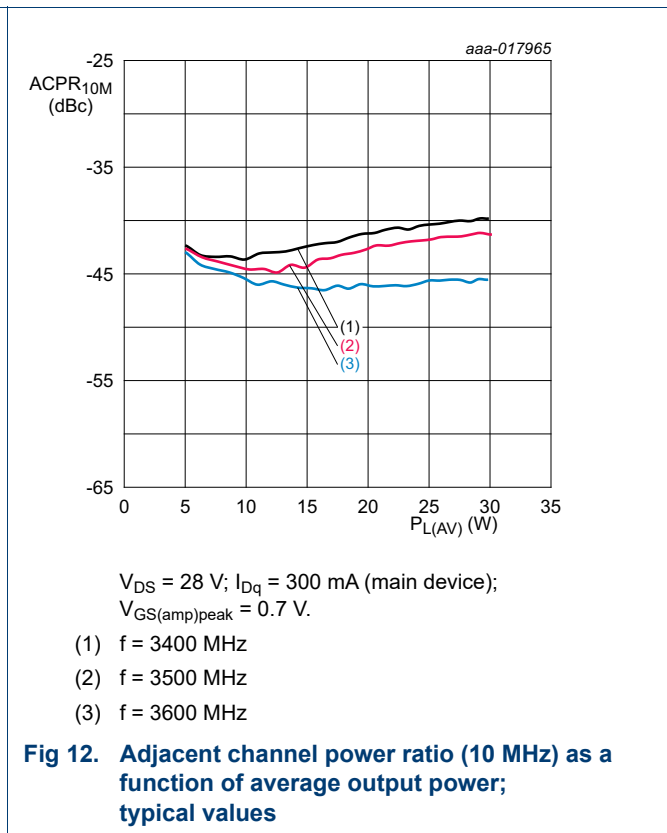
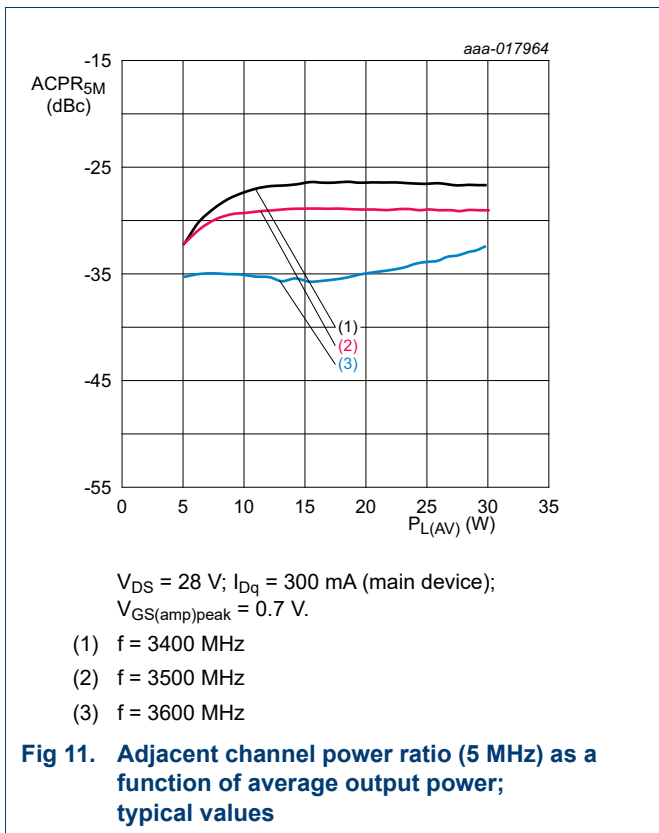
$V_{DS} = 28\text{ V}$ ;  $I_{Dq} = 300\text{ mA}$  (main device);  
 $V_{GS(amp)peak} = 0.7\text{ V}$ .  
 (1)  $f = 3400\text{ MHz}$   
 (2)  $f = 3500\text{ MHz}$   
 (3)  $f = 3600\text{ MHz}$

**Fig 9. Peak-to-average power ratio as a function of average output power; typical values**

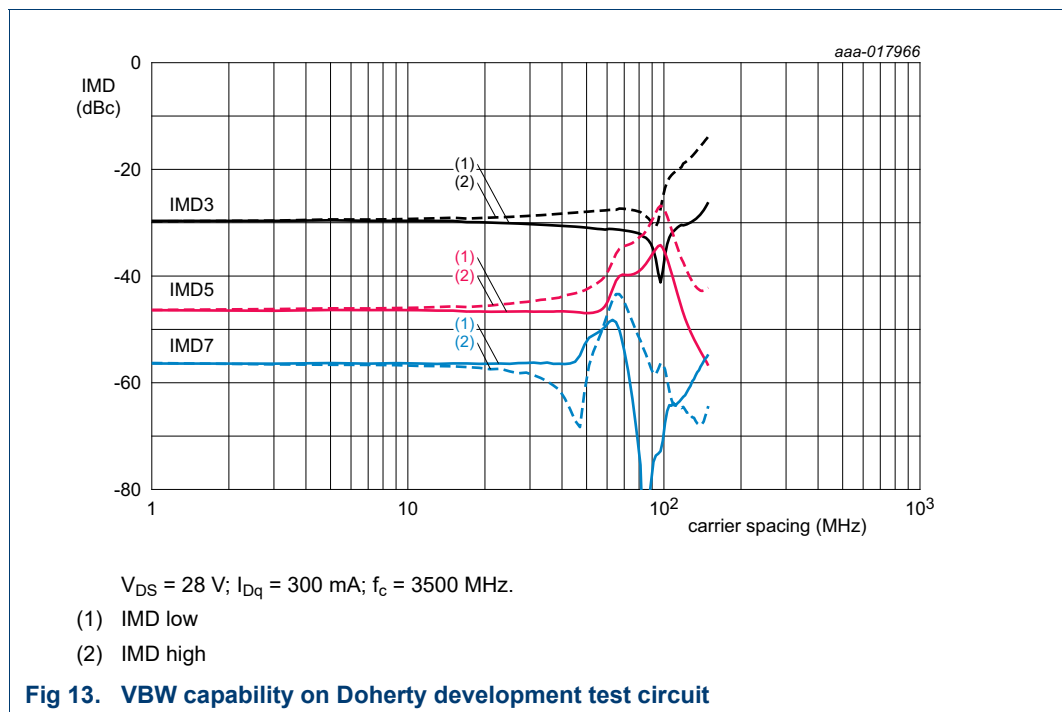


$V_{DS} = 28\text{ V}$ ;  $I_{Dq} = 300\text{ mA}$  (main device);  $V_{GS(amp)peak} = 0.7\text{ V}$ .  
 (1)  $f = 3400\text{ MHz}$   
 (2)  $f = 3500\text{ MHz}$   
 (3)  $f = 3600\text{ MHz}$

**Fig 10. Input return loss as a function of average output power; typical values**



7.5.4 2-Tone VBW



### 8. Package outline

Earless flanged ceramic package; 4 leads

SOT1121B

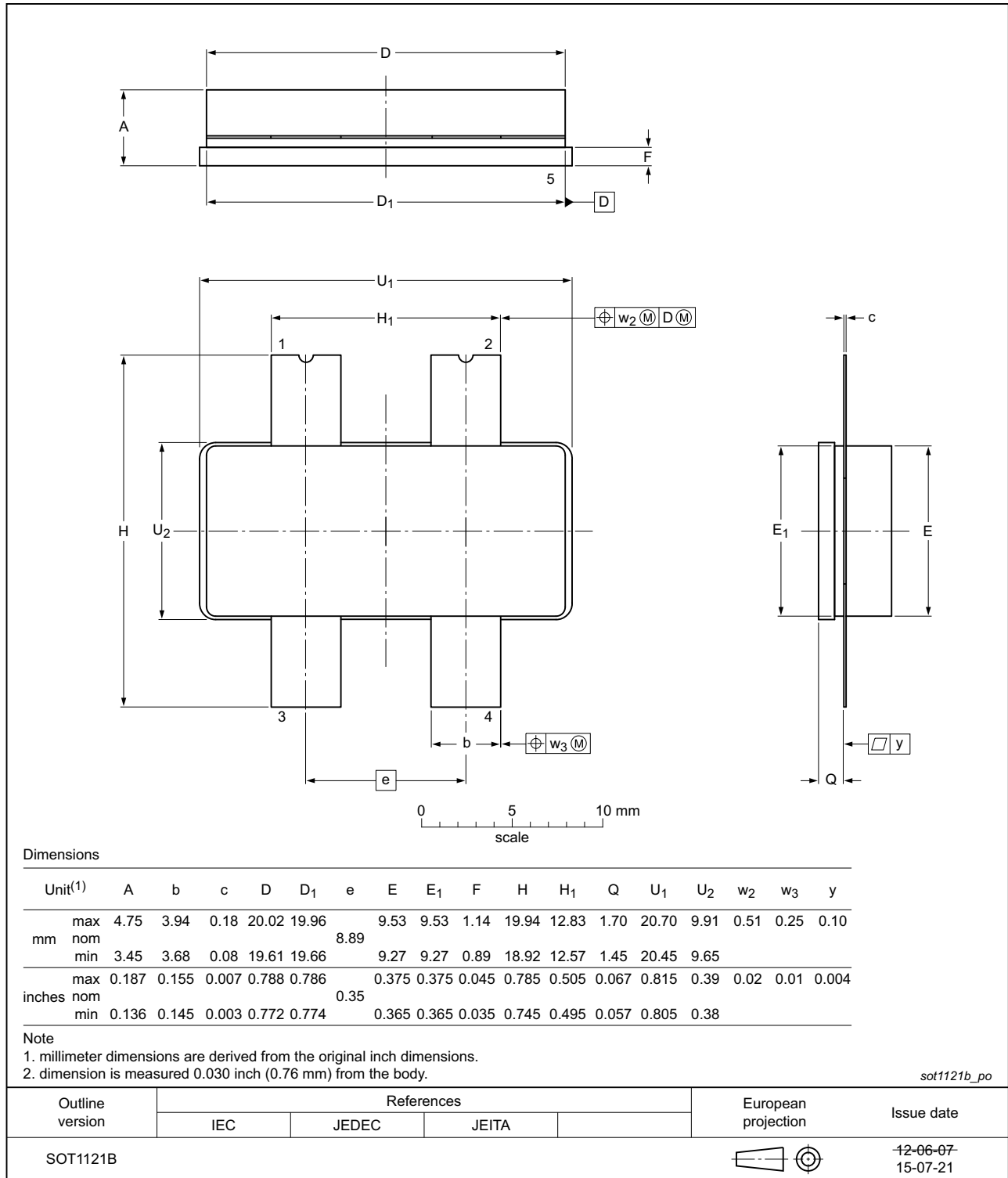


Fig 14. Package outline SOT1121B

## 9. 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.

## 10. 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
IS-95	Interim Standard 95
LDMOS	Laterally Diffused Metal-Oxide Semiconductor
LTE	Long Term Evolution
MTF	Median Time to Failure
PAR	Peak-to-Average Ratio
SMD	Surface Mounted Device
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio
W-CDMA	Wideband Code Division Multiple Access

## 11. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLF9G38LS-90P#3	20150901	Product data sheet		BLF9G38LS-90P v.2
Modifications:	<ul style="list-style-type: none"> <li>The format of this document has been redesigned to comply with the new identity guidelines of Ampleon.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>			
BLF9G38LS-90P v.2	20150703	Product data sheet	-	BLF9G38LS-90P v.1
BLF9G38LS-90P v.1	20141215	Objective data sheet	-	-

## 12. Legal information

### 12.1 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.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
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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