BLC9G21LS-60AV

Power LDMOS transistor

Rev. 1 — 6 July 2017

AMPLEON

Product data sheet

1. Product profile

1.1 General description

60 W LDMOS packaged asymmetric Doherty power transistor for base station applications at frequencies from 1805 MHz to 2200 MHz.

Table 1. Typical performance

Typical RF performance at T_{case} = 25 °C in the Doherty demo board.

Test signal	f	V_{DS}	$P_{L(AV)}$	G_p	η_D	ACPR
	(MHz)	(V)	(W)	(dB)	(%)	(dBc)
1-carrier W-CDMA	1930 to 1990	28	2.5	17.5	30	−39 [1]

[1] Test signal: 3GPP test model 1; 64 DPCH; PAR = 7.2 dB at 0.01% probability on CCDF per carrier.

1.2 Features and benefits

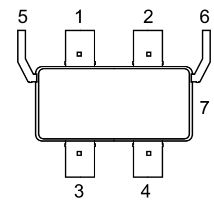
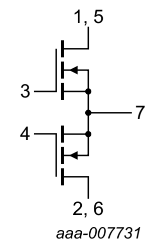
- Excellent ruggedness
- High efficiency
- Low thermal resistance providing excellent thermal stability
- Asymmetric design to achieve optimum efficiency across the band
- Lower output capacitance for improved performance in Doherty applications
- Designed for low memory effects providing excellent digital pre-distortion
- 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 amplifiers for base stations and multi carrier applications in the 1805 MHz to 2200 MHz frequency range

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	drain1 (main)		
2	drain2 (peak)		
3	gate1 (main)		
4	gate2 (peak)		
5	video decoupling (main)		
6	video decoupling (peak)		
7	source [1]		

[1] Connected to flange.

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLC9G21LS-60AV	-	air cavity plastic earless flanged package; 6 leads	SOT1275-1

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		–0.5	+13	V
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature	[1]	-	225	°C

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

5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j\text{-}c)}$	thermal resistance from junction to case	T_{case} = 80 °C		
		P_L = 2.5 W	0.92	K/W
		P_L = 9.5 W	0.97	K/W

6. Characteristics

Table 6. DC characteristics

T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Main device						
$V_{(BR)DSS}$	drain-source breakdown voltage	V_{GS} = 0 V; I_D = 0.2 mA	65	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	V_{DS} = 10 V; I_D = 20 mA	1.5	2	2.5	V
V_{GSq}	gate-source quiescent voltage	V_{DS} = 28 V; I_D = 100 mA	1.7	2.2	2.7	V
I_{DSS}	drain leakage current	V_{GS} = 0 V; V_{DS} = 32 V	-	-	1.4	μA
I_{DSX}	drain cut-off current	V_{GS} = $V_{GS(th)}$ + 3.75 V; V_{DS} = 10 V	-	4	-	A
I_{GSS}	gate leakage current	V_{GS} = 11 V; V_{DS} = 0 V	-	-	140	nA
g_{fs}	forward transconductance	V_{DS} = 10 V; I_D = 1.0 A	-	1.5	-	S
$R_{DS(on)}$	drain-source on-state resistance	V_{GS} = $V_{GS(th)}$ + 3.75 V; I_D = 0.7 A	-	624	1135	mΩ
Peak device						
$V_{(BR)DSS}$	drain-source breakdown voltage	V_{GS} = 0 V; I_D = 0.3 mA	65	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	V_{DS} = 10 V; I_D = 30 mA	1.5	2	2.5	V
V_{GSq}	gate-source quiescent voltage	V_{DS} = 28 V; I_D = 150 mA	1.7	2.2	2.7	V
I_{DSS}	drain leakage current	V_{GS} = 0 V; V_{DS} = 32 V	-	-	1.4	μA
I_{DSX}	drain cut-off current	V_{GS} = $V_{GS(th)}$ + 3.75 V; V_{DS} = 10 V	-	6	-	A
I_{GSS}	gate leakage current	V_{GS} = 11 V; V_{DS} = 0 V	-	-	140	nA
g_{fs}	forward transconductance	V_{DS} = 10 V; I_D = 1.5 A	-	2.2	-	S
$R_{DS(on)}$	drain-source on-state resistance	V_{GS} = $V_{GS(th)}$ + 3.75 V; I_D = 1.05 A	-	420	760	mΩ

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; RF performance at V_{DS} = 28 V; I_{Dq} = 100 mA (main); $V_{GS(amp)peak}$ = 0.8 V; T_{case} = 25 °C; unless otherwise specified; in an asymmetrical Doherty production test circuit at frequencies from 1930 MHz to 1990 MHz.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
G_p	power gain	$P_{L(AV)}$ = 2.5 W	16.3	17.5	-	dB
RL_{in}	input return loss	$P_{L(AV)}$ = 2.5 W	-	−10	−7	dB
η_D	drain efficiency	$P_{L(AV)}$ = 2.5 W	26	30	-	%
ACPR	adjacent channel power ratio	$P_{L(AV)}$ = 2.5 W	-	−39	−34	dBc

Table 8. RF characteristics

Test signal: pulsed CW; t_p = 100 μs; δ = 10 %; RF performance at V_{DS} = 28 V; I_{Dq} = 100 mA (main); $V_{GS(amp)peak}$ = 0.8 V; T_{case} = 25 °C; unless otherwise specified; in an asymmetrical Doherty production test circuit at frequencies from 1930 MHz to 1990 MHz.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_{L(M)}$	peak output power		53	60	-	W

7. Test information

7.1 Ruggedness in Doherty operation

The BLC9G21LS-60AV is capable of withstanding a load mismatch corresponding to a VSWR = 10 : 1 through all phases under the following conditions: V_{DS} = 28 V; I_{Dq} = 100 mA (main); $V_{GS(amp)peak}$ = 0.8 V; P_L = 38 W (CW); f_1 = 1805 MHz; f_2 = 1930 MHz.

7.2 Impedance information

Table 9. Typical impedance of main device

Measured load-pull data of main device; I_{Dq} = 100 mA (main); V_{DS} = 28 V.

f	Z_S [1]	Z_L [1]	P_L [2]	η_D [2]	G_p [2]
(MHz)	(Ω)	(Ω)	(W)	(%)	(dB)
Maximum power load					
1805	2.4 – j6.9	12.0 – j9.4	30.7	63.9	16.4
1842	2.3 – j7.1	12.0 – j9.4	30.2	63.5	16.5
1880	2.6 – j7.9	11.0 – j8.0	29.3	61.2	16.2
1930	2.6 – j9.3	12.0 – j9.4	27.8	60.1	16.6
1960	3.2 – j9.0	12.0 – j9.4	28.4	60.6	16.5
1990	3.4 – j9.6	12.0 – j9.4	27.4	59.1	16.6
2110	4.7 – j15.9	9.7 – j8.8	29.2	60.6	18.0
2140	6.7 – j15.3	9.7 – j8.8	28.1	58.9	18.0
2170	5.3 – j19.6	9.7 – j8.8	29.1	61.7	18.3
Maximum drain efficiency load					
1805	2.4 – j6.9	23.6 – j0.0	20.5	73.3	18.2
1842	2.3 – j7.1	20.0 – j0.0	21.7	73.0	18.0
1880	2.6 – j7.9	19.6 – j3.1	18.9	71.5	18.4
1930	2.6 – j9.3	17.0 – j2.4	18.5	67.9	18.5
1960	3.2 – j9.0	14.8 – j2.0	19.7	69.3	18.3
1990	3.4 – j9.6	15.0 – j0.0	20.0	66.4	18.3
2110	4.7 – j15.9	13.0 – j1.6	17.7	69.4	20.6
2140	6.7 – j15.3	11.2 – j2.7	21.9	66.2	19.5
2170	5.3 – j19.6	11.6 – j1.4	20.7	70.6	20.5

[1] Z_S and Z_L defined in Figure 1.

[2] at 3 dB gain compression.

Table 10. Typical impedance of peak device
Measured load-pull data of peak device; I_{Dq} = 150 mA (peak); V_{DS} = 28 V.

f	Z_S [1]	Z_L [1]	P_L [2]	η_D [2]	G_p [2]
(MHz)	(Ω)	(Ω)	(W)	(%)	(dB)
Maximum power load					
1805	2.2 – j6.6	6.5 – j7.7	46.2	63.4	15.9
1842	1.8 – j6.9	6.5 – j7.7	44.8	63.0	16.4
1880	2.5 – j7.0	6.5 – j7.7	43.0	61.4	16.2
1930	2.5 – j7.9	6.5 – j7.7	41.8	60.9	16.4
1960	2.8 – j8.0	6.9 – j8.6	41.9	60.1	16.3
1990	2.8 – j8.4	6.9 – j8.6	43.8	62.4	16.3
2110	5.1 – j12.6	5.7 – j8.0	43.8	62.5	17.7
2140	4.9 – j12.6	5.9 – j8.9	42.2	59.0	17.6
2170	5.8 – j14.8	5.9 – j8.9	43.1	60.9	17.8
Maximum drain efficiency load					
1805	2.2 – j6.6	10.3 – j1.2	32.0	74.9	17.8
1842	1.8 – j6.9	9.2 – j1.0	31.1	74.5	18.1
1880	2.5 – j7.0	9.0 – j2.0	30.4	69.8	18.2
1930	2.5 – j7.9	7.3 – j1.5	28.6	69.6	18.3
1960	2.8 – j8.0	7.1 – j2.3	29.6	68.5	18.1
1990	2.8 – j8.4	7.3 – j1.5	28.6	72.7	18.8
2110	5.1 – j12.6	7.0 – j4.0	32.0	70.3	19.8
2140	4.9 – j12.6	6.0 – j4.1	30.4	67.8	19.7
2170	5.8 – j14.8	6.0 – j4.1	30.6	70.5	20.2

[1] Z_S and Z_L defined in Figure 1.

[2] at 3 dB gain compression.

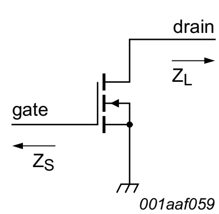


Fig 1. Definition of transistor impedance

7.3 Recommended impedances for Doherty design

Table 11. Typical impedance of main device at 1 : 1 load

Measured load-pull data of main device; I_{Dq} = 100 mA (main); V_{DS} = 28 V.

f	Z_S [1]	Z_L [1]	P_L [2]	η_D [3]	G_p [3]
(MHz)	(Ω)	(Ω)	(W)	(%)	(dB)
1805	2.4 – j6.9	13.6 – j8.2	30.2	67.0	19.7
1842	2.3 – j7.1	13.6 – j8.2	29.4	66.6	19.9
1880	2.6 – j7.9	13.6 – j8.2	28.6	65.6	20.0
1930	2.6 – j9.3	13.6 – j8.2	26.8	62.8	20.1
1960	3.2 – j9.0	13.6 – j8.2	27.5	63.6	20.0
1990	3.4 – j9.6	12.2 – j6.9	26.6	61.9	19.9
2110	4.7 – j15.9	12.2 – j6.9	27.4	66.4	21.9
2140	6.7 – j15.3	10.1 – j6.8	27.5	62.6	21.5
2170	5.3 – j19.6	11.0 – j8.0	28.5	64.9	21.8

[1] Z_S and Z_L defined in Figure 1.

[2] at 3 dB gain compression.

[3] at $P_{L(AV)}$ = 34 dBm.

Table 12. Typical impedance of main device at 1 : 2.7 load

Measured load-pull data of main device; I_{Dq} = 100 mA (main); V_{DS} = 28 V.

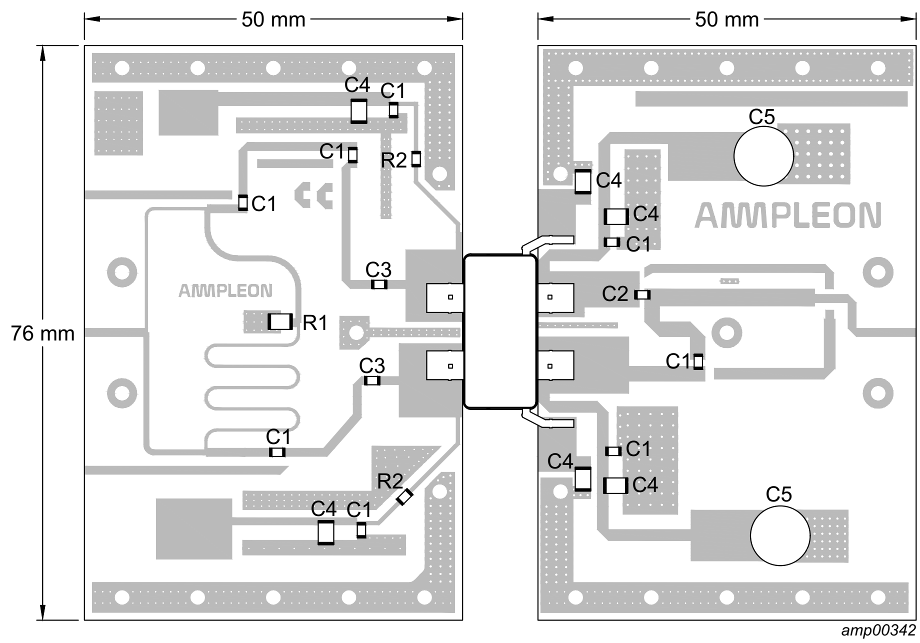
f	Z_S [1]	Z_L [1]	P_L [2]	η_D [3]	G_p [3]
(MHz)	(Ω)	(Ω)	(W)	(%)	(dB)
1805	2.4 – j6.9	23.6 – j0.0	20.5	73.3	21.2
1842	2.3 – j7.1	20.0 – j0.0	21.7	73.0	21.2
1880	2.6 – j7.9	19.6 – j3.1	18.9	71.5	21.4
1930	2.6 – j9.3	17.0 – j2.4	18.5	67.9	21.5
1960	3.2 – j9.0	14.8 – j2.0	19.7	69.3	21.3
1990	3.4 – j9.6	15.0 – j0.0	20.0	66.4	21.3
2110	4.7 – j15.9	13.0 – j1.6	17.7	69.4	23.6
2140	6.7 – j15.3	11.2 – j2.7	21.9	66.2	22.5
2170	5.3 – j19.6	11.6 – j1.4	20.7	70.6	23.5

[1] Z_S and Z_L defined in Figure 1.

[2] at 3 dB gain compression.

[3] at $P_{L(AV)}$ = 34 dBm.

7.4 Test circuit



Printed-Circuit Board (PCB): Rogers RO4350B; thickness = 0.508 mm.

See Table 13 for a list of components.

Fig 2. Component layout

Table 13. List of components

See Figure 2 for component layout.

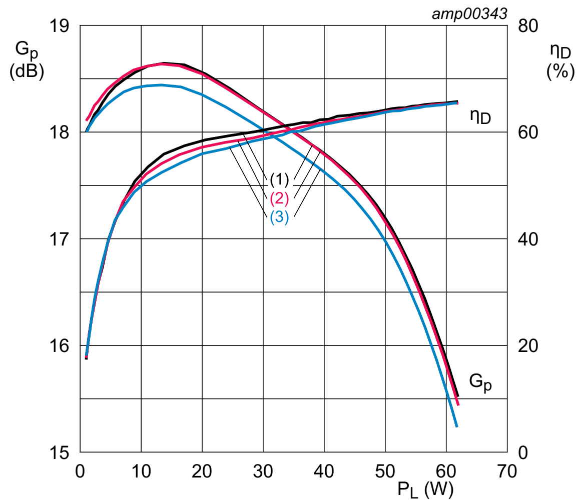
Component	Description	Value	Remarks
C1	multilayer ceramic chip capacitor	30 pF [1]	
C2	multilayer ceramic chip capacitor	20 pF [1]	
C3	multilayer ceramic chip capacitor	3.9 pF [1]	
C4	multilayer ceramic chip capacitor	10 μF, 50 V [2]	
C5	electrolytic capacitor	2200 μF, 63 V	
R1	resistor	50 Ω	SMD 2512
R2	resistor	5.1 Ω	SMD 0805

[1] American Technical Ceramics type 600F or capacitor of same quality.

[2] Murata or capacitor of same quality.

7.5 Graphical data

7.5.1 Pulsed CW



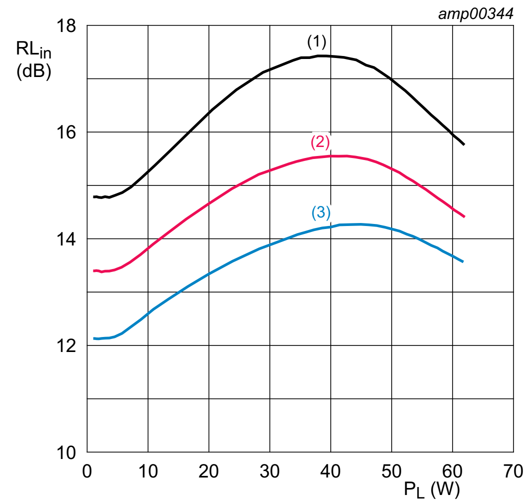
V_{DS} = 28 V; I_{Dq} = 100 mA (main device); $V_{GS(amp)peak}$ = 0.8 V.

(1) f = 1930 MHz

(2) f = 1960 MHz

(3) f = 1990 MHz

Fig 3. Power gain and drain efficiency as function of output power; typical values



V_{DS} = 28 V; I_{Dq} = 100 mA (main device); $V_{GS(amp)peak}$ = 0.8 V.

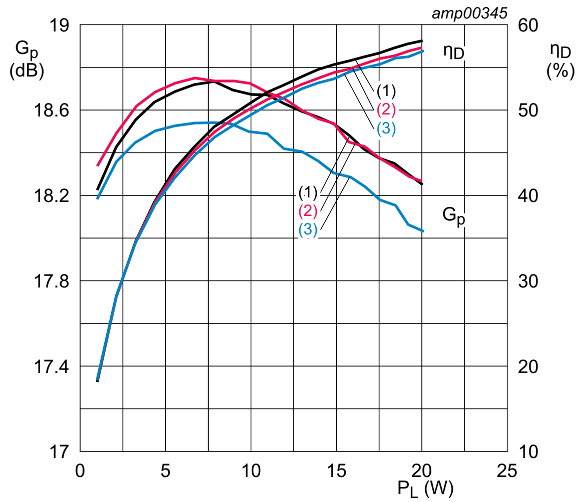
(1) f = 1930 MHz

(2) f = 1960 MHz

(3) f = 1990 MHz

Fig 4. Input return loss as a function of output power; typical values

7.5.2 1-Carrier W-CDMA



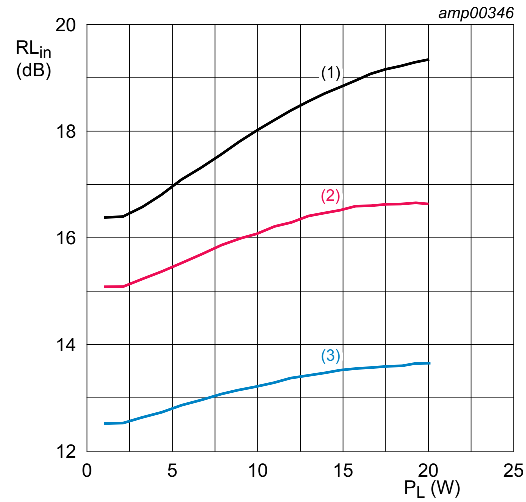
V_{DS} = 28 V; I_{Dq} = 100 mA (main device);
$V_{GS(amp)peak}$ = 0.8 V.

(1) f = 1930 MHz

(2) f = 1960 MHz

(3) f = 1990 MHz

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



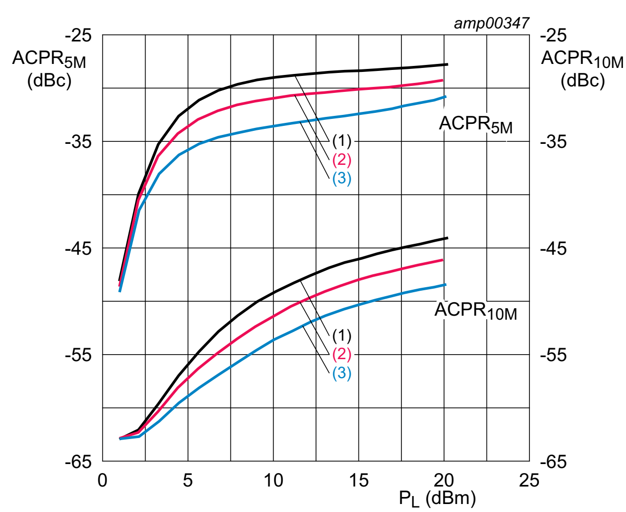
V_{DS} = 28 V; I_{Dq} = 100 mA (main device);
$V_{GS(amp)peak}$ = 0.8 V.

(1) f = 1930 MHz

(2) f = 1960 MHz

(3) f = 1990 MHz

Fig 6. Input return loss as a function of output power; typical values



V_{DS} = 28 V; I_{Dq} = 100 mA (main device); $V_{GS(amp)peak}$ = 0.8 V.

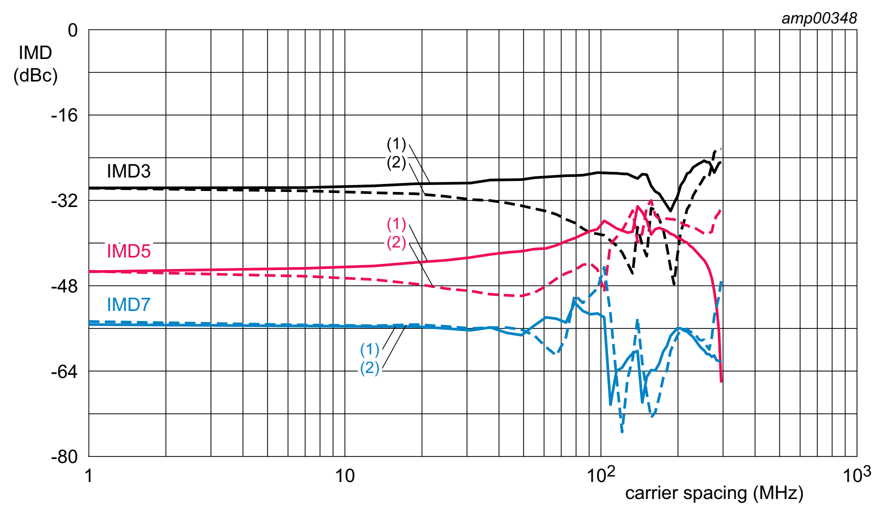
(1) f = 1930 MHz

(2) f = 1960 MHz

(3) f = 1990 MHz

Fig 7. Adjacent channel power ratio (5 MHz) and adjacent channel power ratio (10 MHz) as function of output power; typical values

7.5.3 2-Tone VBW



V_{DS} = 28 V; I_{Dq} = 100 mA (main device); $V_{GS(amp)peak}$ = 0.8 V; f_c = 1960 MHz.

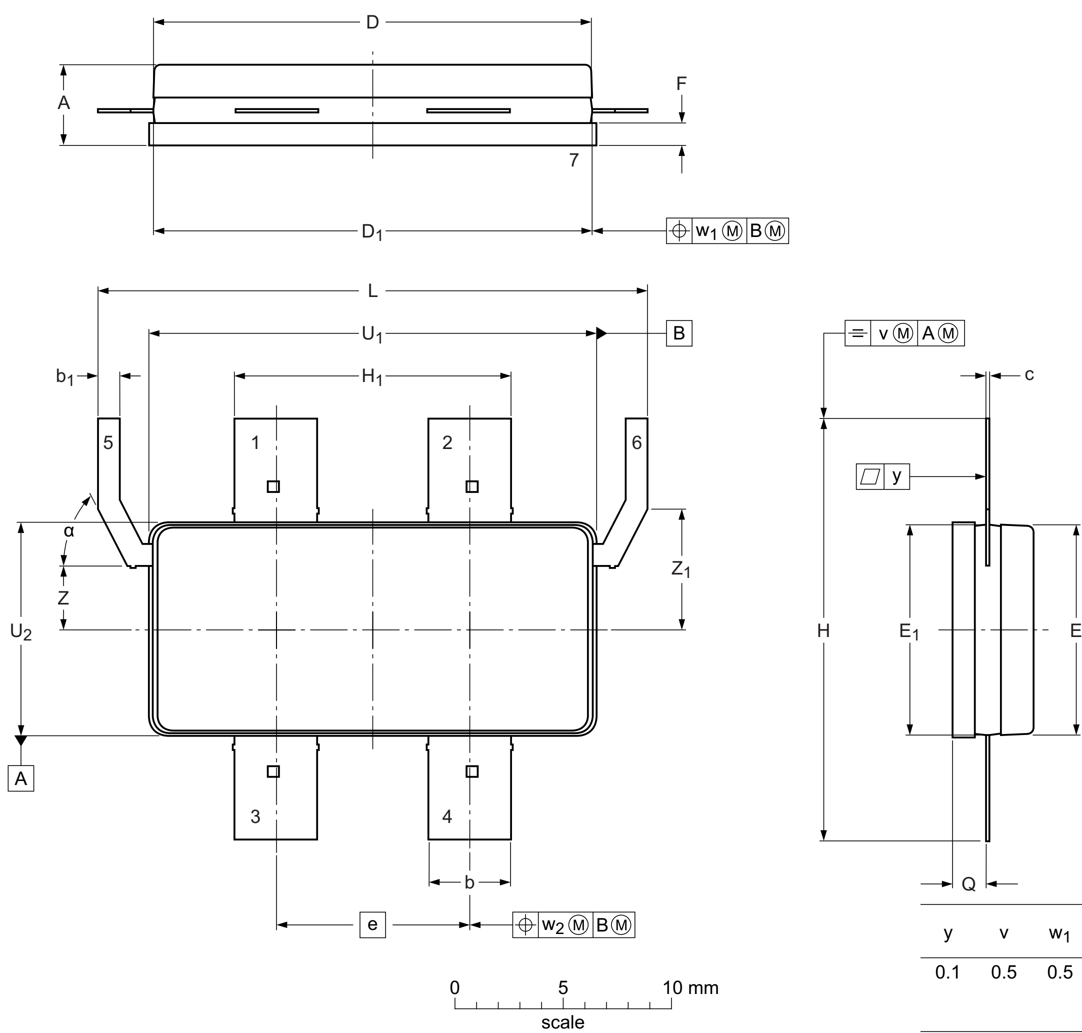
(1) IMD low

(2) IMD high

Fig 8. VBW capability in Doherty demo board

8. Package outline

Air cavity plastic earless flanged package; 6 leads **SOT1275-1**



y	v	w_1	w_2
0.1	0.5	0.5	0.5

Dimensions

Unit		A	b	b_1	c	D	D_1	E	E_1	e	F	H	H_1	L	Q[(1)]	U_1	U_2	Z	Z_1	α
mm	max	4.01	3.94	1.14	0.178	20.42	20.37	9.80	9.75		1.14	19.53	12.80	25.40	1.68	20.70	9.91	3.17	5.79	65°
	nom									8.89										
	min	3.40	3.68	0.89	0.127	20.12	20.17	9.50	9.55		0.94	19.33	12.60	25.20	1.45	20.50	9.70	2.67	5.29	61°

Note
1. Dimension Q is measured 0.1 mm away from the flange.
2. Ringframe and/or ringframe glue shall not overhang at the side of the flange.

sot1275-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1275-1						~~16-11-15~~ 17-04-13

Fig 9. Package outline SOT1275-1

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.

Table 14. 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	2 [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 2 is granted to any part that passes after exposure to an ESD pulse of 2000 V, but fails after exposure to an ESD pulse of 4000 V.

10. Abbreviations

Table 15. Abbreviations

Acronym	Description
3GPP	3rd Generation Partnership Project
CCDF	Complementary Cumulative Distribution Function
CW	Continuous Wave
DPCH	Dedicated Physical CHannel
ESD	ElectroStatic Discharge
LDMOS	Laterally Diffused Metal-Oxide Semiconductor
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 16. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLC9G21LS-60AV v.1	20170706	Product data sheet	-	-

12. Legal information

12.1 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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13. Contact information

For more information, please visit: **http://www.ampleon.com**

For sales office addresses, please visit: **http://www.ampleon.com/sales**

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