BLC10G19XS-601AVT

Power LDMOS transistor

AMPLEON

Rev. 1 — 7 October 2021

Product data sheet

1. Product profile

1.1 General description

600 W LDMOS packaged asymmetric Doherty power transistor for base station applications at frequencies from 1930 MHz to 1995 MHz.

Table 1. Typical performance

Typical RF performance at T_{case} = 25 °C in an asymmetrical Doherty production test circuit. V_{DS} = 30 V; I_{Dq} = 1060 mA (main); $V_{GS(amp)peak}$ = 1.0 V, unless otherwise specified.

Test signal	f	V_{DS}	$P_{L(AV)}$	G_p	η_D	ACPR
	(MHz)	(V)	(W)	(dB)	(%)	(dBc)
1-carrier W-CDMA	1930 to 1995	30	112	15.5	48.5	–34 [1]

[1] Test signal: 1-carrier W-CDMA; 3GPP test model 1; 64 DPCH; PAR = 9.9 dB at 0.01 % probability on CCDF.

1.2 Features and benefits

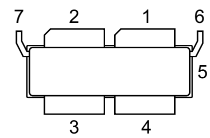
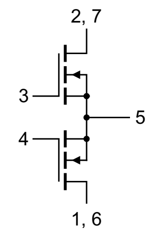
- Excellent ruggedness
- High efficiency
- Low thermal resistance providing excellent thermal stability
- Lower output capacitance for improved performance in Doherty applications
- Designed for low memory effects and minimum I_{Dq} drift providing excellent digital pre-distortion capability
- Internally matched for ease of use
- Integrated ESD protection
- For RoHS compliance see the product details on the Ampleon website

1.3 Applications

- RF power amplifiers for base stations and multi carrier applications in the 1930 MHz to 1995 MHz frequency range

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	drain (peak)		 aaa-014884
2	drain (main)		
3	gate (main)		
4	gate (peak)		
5	source [1]		
6	video decoupling (peak)		
7	video decoupling (main)		

[1] Connected to flange.

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLC10G19XS-601AVT	-	air cavity plastic earless flanged package; 6 leads	SOT1258-4

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
$V_{GS(amp)main}$	main amplifier gate-source voltage		–6	+9	V
$V_{GS(amp)peak}$	peak amplifier gate-source voltage		–6	+9	V
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature	[1]	-	225	°C
T_{case}	case temperature	operating [1]	–40	+125	°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
$R_{th(j-c)}$	thermal resistance from junction to case	V_{DS} = 30 V; I_{Dq} = 1060 mA (main); $V_{GS(amp)peak}$ = 1.2 V; T_{case} = 80 °C		
		P_L = 112 W	0.18	K/W
		P_L = 141 W	0.16	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 = 2.1 mA	65	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	V_{DS} = 10 V; I_D = 208 mA	1.6	2.0	2.4	V
V_{GSq}	gate-source quiescent voltage	V_{DS} = 30 V; I_D = 1060 mA	-	2.2	-	V
I_{DSS}	drain leakage current	V_{GS} = 0 V; V_{DS} = 32 V	-	-	2.8	μA
I_{DSX}	drain cut-off current	$V_{GS} = V_{GS(th)}$ + 2.37 V	-	37	-	A
I_{GSS}	gate leakage current	V_{GS} = 9 V; V_{DS} = 0 V	-	-	280	nA
g_{fs}	forward transconductance	V_{DS} = 10 V; I_D = 10.4 A	-	20.5	-	S
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)}$ + 2.37 V; I_D = 7.28 A	-	67.1	111	mΩ
Peak device						
$V_{(BR)DSS}$	drain-source breakdown voltage	V_{GS} = 0 V; I_D = 4.3 mA	65	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	V_{DS} = 10 V; I_D = 434 mA	1.6	2.0	2.4	V
V_{GSq}	gate-source quiescent voltage	V_{DS} = 30 V; I_D = 2400 mA	-	2.2	-	V
I_{DSS}	drain leakage current	V_{GS} = 0 V; V_{DS} = 32 V	-	-	2.8	μA
I_{DSX}	drain cut-off current	$V_{GS} = V_{GS(th)}$ + 2.37 V	-	68	-	A
I_{GSS}	gate leakage current	V_{GS} = 9 V; V_{DS} = 0 V	-	-	280	nA
g_{fs}	forward transconductance	V_{DS} = 10 V; I_D = 21.7 A	-	39.0	-	S
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)}$ + 2.37 V; I_D = 15.2 A	-	36.3	58.4	mΩ

Table 7. RF characteristics

Test signal: 1-carrier W-CDMA; PAR = 9.6 dB at 0.01 % probability on the CCDF; 3GPP test model 1; 1 to 64 DPCH; f_1 = 1932.5 MHz; f_2 = 1987.5 MHz; RF performance at V_{DS} = 30 V; I_{Dq} = 1060 mA (main); $V_{GS(amp)peak}$ = 1 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	$P_{L(AV)}$ = 112 W	14	15	-	dB
RL_{in}	input return loss	$P_{L(AV)}$ = 112 W	-	−15	−10	dB
η_D	drain efficiency	$P_{L(AV)}$ = 112 W	45	49	-	%
ACPR	adjacent channel power ratio	$P_{L(AV)}$ = 112 W	-	−32	−28	dBc

Table 8. RF characteristics

Test signal: 1-carrier W-CDMA; PAR = 9.6 dB at 0.01 % probability on the CCDF; 3GPP test model 1; 1 to 64 DPCH; f_1 = 1932.5 MHz; f_2 = 1987.5 MHz; RF performance at V_{DS} = 30 V; I_{Dq} = 1060 mA (main); $V_{GS(amp)peak}$ = 1 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
PAR_O	output peak-to-average ratio	$P_{L(AV)}$ = 150 W	6.4	7.2	-	dB
$P_{L(M)}$	peak output power	$P_{L(AV)}$ = 150 W	642	750	-	W

7. Test information

7.1 Ruggedness in Doherty operation

The BLC10G19XS-601AVT 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} = 1060 mA; $V_{GS(amp)peak}$ = 1 V; f = 1932.5 MHz; P_L = 250 W (5 dB OBO); 100 % clipping.

7.2 Impedance information

Table 9. Typical impedance of main device

Measured load-pull data of main device; I_{Dq} = 1500 mA (main); V_{DS} = 30 V; pulsed CW (t_p = 100 μs; δ = 10 %).

f (MHz)	Z_S [1] (Ω)	Z_L [1] (Ω)	P_L [2] (W)	η_D [2] (%)	G_p [2] (dB)
Maximum power load					
1930	2.1 – j5.5	1.4 – j3.3	335	61.2	16.0
1960	2.6 – j5.8	1.4 – j3.3	335	61.2	16.0
1990	3.4 – j6.1	1.4 – j3.4	335	60.0	16.0
Maximum drain efficiency load					
1930	2.4 – j5.7	2.9 – j2.9	255	70.1	17.9
1960	3.3 – j6.2	3.4 – j2.0	200	69.7	18.5
1990	4.0 – j6.4	2.8 – j2.0	225	69.7	18.3

[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} = 2800 mA (peak); V_{DS} = 30 V; pulsed CW (t_p = 100 μs; δ = 10 %).

f (MHz)	Z_S [1] (Ω)	Z_L [1] (Ω)	P_L [2] (W)	η_D [2] (%)	G_p [2] (dB)
Maximum power load					
1930	1.2 – j5.2	2.1 – j3.0	635	59.4	16.4
1960	1.4 – j5.6	1.9 – j2.9	630	59.9	16.6
1990	1.8 – j5.9	2.0 – j3.1	630	57.7	16.8
Maximum drain efficiency load					
1930	1.2 – j5.2	5.1 – j3.4	535	66.1	16.3
1960	1.4 – j5.6	4.8 – j3.4	505	66.0	16.5
1990	1.7 – j6.0	4.4 – j3.8	485	65.9	16.8

[1] Z_S and Z_L defined in Figure 1.

[2] At 3 dB gain compression.

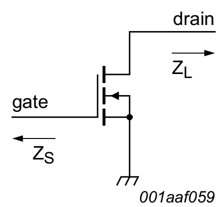


Fig 1. Definition of transistor impedance

7.3 Recommended impedances for Doherty design

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

Measured load-pull data of main device; I_{Dq} = 1500 mA (main); V_{DS} = 30 V; pulsed CW (t_p = 100 μs; δ = 10 %).

f	Z_S [1]	Z_L [1]	$P_{L(3dB)}$ [2]	η_D [2]	G_p [2]
(MHz)	(Ω)	(Ω)	(W)	(%)	(dB)
1930	2.5 – j5.2	1.8 – j3.4	315	41.3	19.3
1960	2.9 – j5.5	1.8 – j3.2	315	41.3	19.5
1990	3.6 – j5.8	1.8 – j2.9	310	41.6	19.7

[1] Z_S and Z_L defined in Figure 1.

[2] At $P_{L(AV)}$ = 112 W.

Table 12. Typical impedance of main device at 1 : 2.5 load

Measured load-pull data of main device; I_{Dq} = 1500 mA (main); V_{DS} = 30 V; pulsed CW (t_p = 100 μs; δ = 10 %).

f	Z_S [1]	Z_L [1]	$P_{L(3dB)}$ [2]	η_D [2]	G_p [2]
(MHz)	(Ω)	(Ω)	(W)	(%)	(dB)
1930	2.5 – j5.2	4.6 – j1.9	155	60.5	21.5
1960	2.9 – j5.5	4.6 – j1.8	150	60.5	21.5
1990	3.6 – j5.8	4.7 – j1.7	140	60.0	21.5

[1] Z_S and Z_L defined in Figure 1.

[2] At $P_{L(AV)}$ = 112 W.

Table 13. Typical impedance of peak device at 1 : 1 load

Measured load-pull data of peak device; I_{Dq} = 2800 mA (peak); V_{DS} = 30 V; pulsed CW.

f	Z_S [1]	Z_L [1]	$P_{L(3dB)}$ [2]	η_D [2]	G_p [2]
(MHz)	(Ω)	(Ω)	(W)	(%)	(dB)
1930	1.3 – j5.0	2.7 – j3.5	580	26.5	17.7
1960	1.5 – j5.2	2.6 – j3.2	580	27.0	17.9
1990	1.7 – j5.5	2.6 – j3.0	580	27.5	18.0

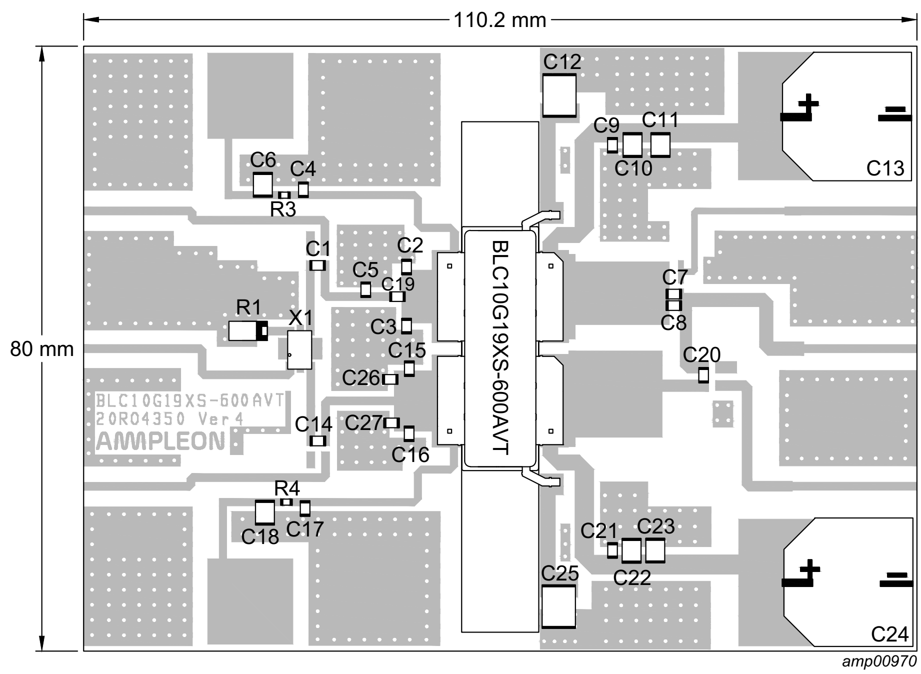
[1] Z_S and Z_L defined in Figure 1.

[2] At $P_{L(AV)}$ = 112 W.

Table 14. Off-state impedances of peak device

f	Z_{off}
(MHz)	(Ω)
1930	0.5 – j1.6
1960	0.4 – j1.0
1990	0.3 – j0.6

7.4 Test circuit



Printed-Circuit Board (PCB): Rogers RO4350B; ε_r = 3.5; thickness = 0.508 mm; thickness copper plating =35 μm.

See Table 15 for a list of components.

Fig 2. Component layout

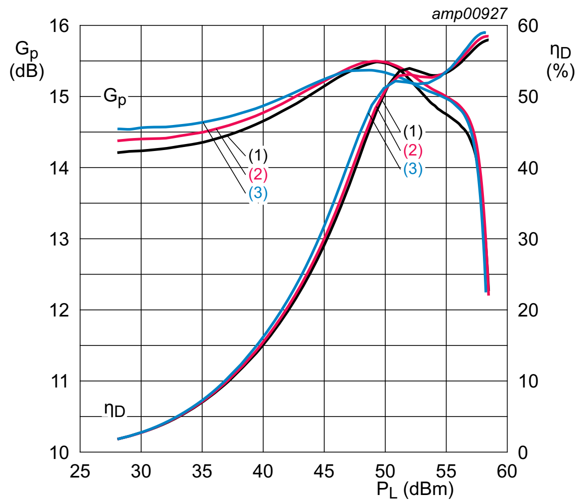
Table 15. List of components

See Figure 2 for component layout.

Component	Description	Value	Remarks
C1, C4, C9, C14, C17, C19, C20, C21	multilayer ceramic chip capacitor	15 pF	Murata: Hi-Q, GQM21 series, SMD 0805
C2, C3	multilayer ceramic chip capacitor	1.6 pF	Murata: Hi-Q, GQM21 series, SMD 0805
C6, C10, C11, C12, C18, C22, C23, C25	multilayer ceramic chip capacitor	4.7 μF, 50 V	Murata: GRM32ER71H475KA88L, SMD 1210
C7,C8	multilayer ceramic chip capacitor	4.3 pF	Murata: Hi-Q, GQM21 series, SMD 0805
C13, C24	electrolytic capacitor	470 μF, 63 V	
C15	multilayer ceramic chip capacitor	1.0 pF	Murata: Hi-Q, GQM21 series, SMD 0805
C16	multilayer ceramic chip capacitor	0.8 pF	Murata: Hi-Q, GQM21 series, SMD 0805
C26, C27	multilayer ceramic chip capacitor	1.1 pF	Murata: Hi-Q, GQM21 series, SMD 0805
R1	resistor	50 Ω., 16 W	Anaren: C16A50Z4
R2, R3	resistor	5.1 Ω., ±1 %	SMD 0805
X1	hybrid coupler	2 dB, 90°	Anaren: X3C20F1-02S

7.5 Graphical data

7.5.1 Pulsed CW and CW (VNA sweep)



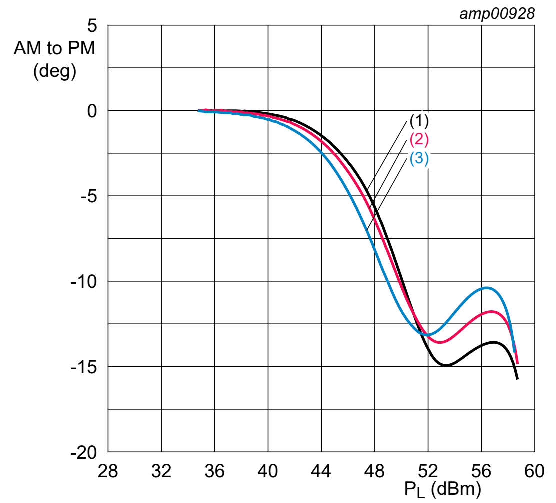
V_{DS} = 30 V; I_{Dq} = 1060 mA; $V_{GS(amp)peak}$ = 1.0 V.

(1) f = 1930 MHz

(2) f = 1960 MHz

(3) f = 1995 MHz

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



V_{DS} = 30 V; I_{Dq} = 1060 mA; $V_{GS(amp)peak}$ = 1.0 V.

(1) f = 1930 MHz

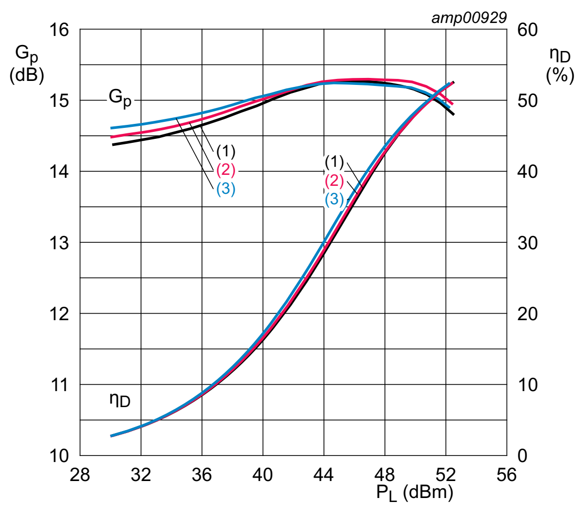
(2) f = 1960 MHz

(3) f = 1995 MHz

Fig 4. Normalized AM to PM as a function of output power; typical values

7.5.2 1-Carrier W-CDMA

Test signal: 3GPP test model 1; 64 DPCH (100 % clipping); PAR = 9.9 dB at 0.01 % probability on CCDF.



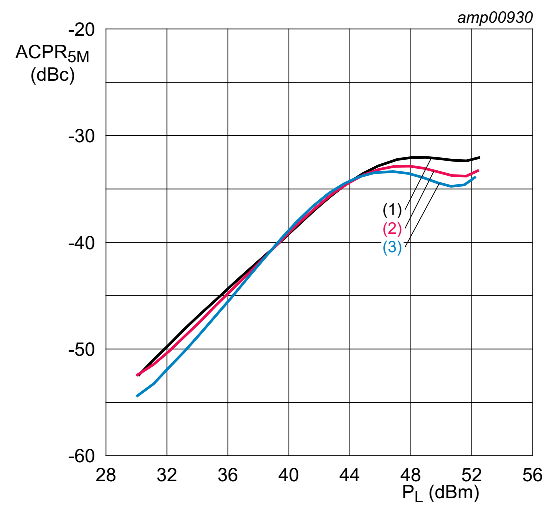
V_{DS} = 30 V; I_{Dq} = 1060 mA; $V_{GS(amp)peak}$ = 1.0 V.

(1) f = 1930 MHz

(2) f = 1960 MHz

(3) f = 1995 MHz

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



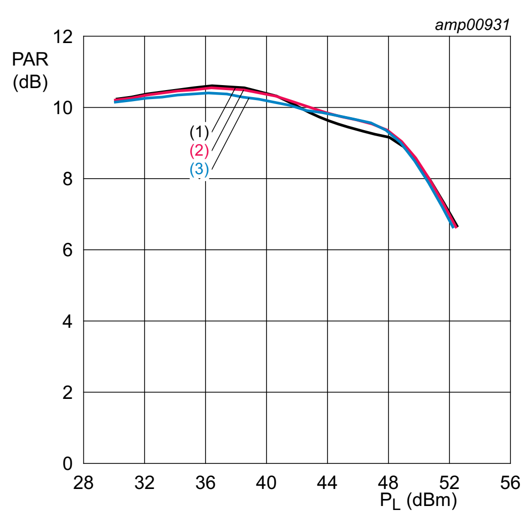
V_{DS} = 30 V; I_{Dq} = 1060 mA; $V_{GS(amp)peak}$ = 1.0 V.

(1) f = 1930 MHz

(2) f = 1960 MHz

(3) f = 1995 MHz

Fig 6. Adjacent channel power ratio (5 MHz) as a function of output power; typical values



V_{DS} = 30 V; I_{Dq} = 1060 mA; $V_{GS(amp)peak}$ = 1.0 V.

(1) f = 1930 MHz

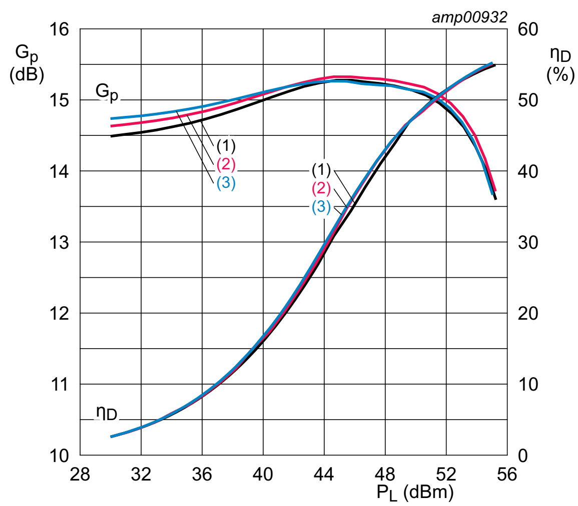
(2) f = 1960 MHz

(3) f = 1995 MHz

Fig 7. Peak-to-average power ratio as a function of output power; typical values

7.5.3 1-Carrier LTE

Test signal: 1-carrier LTE 10 MHz; PAR = 6.8 dB at 0.01 % probability on CCDF.



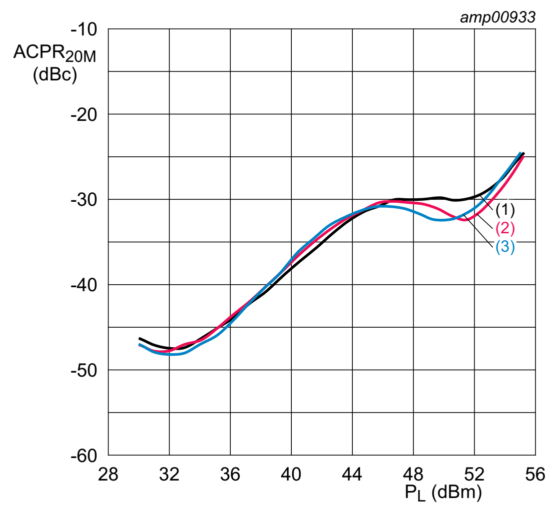
V_{DS} = 30 V; I_{Dq} = 1060 mA; $V_{GS(amp)peak}$ = 1.0 V.

(1) f = 1930 MHz

(2) f = 1960 MHz

(3) f = 1995 MHz

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



V_{DS} = 30 V; I_{Dq} = 1060 mA; $V_{GS(amp)peak}$ = 1.0 V.

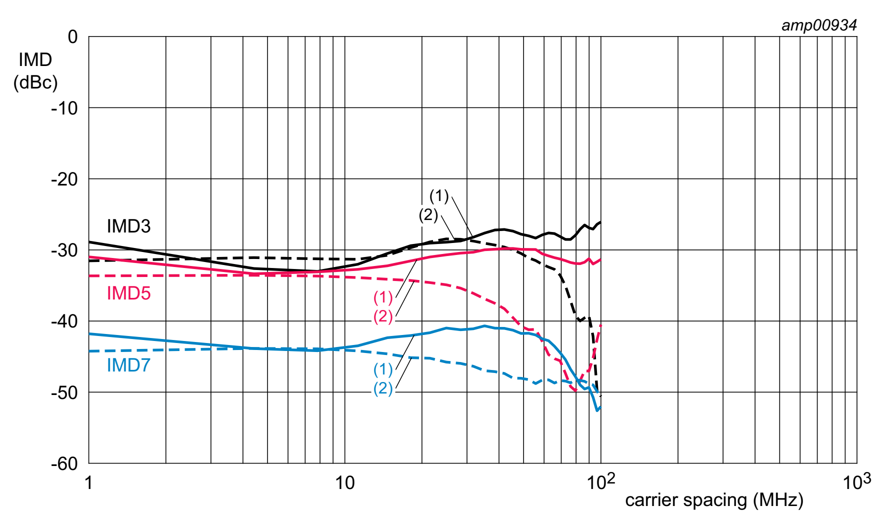
(1) f = 1930 MHz

(2) f = 1960 MHz

(3) f = 1995 MHz

Fig 9. Adjacent channel power ratio (20 MHz) as a function of output power; typical values

7.5.4 2-Tone VBW



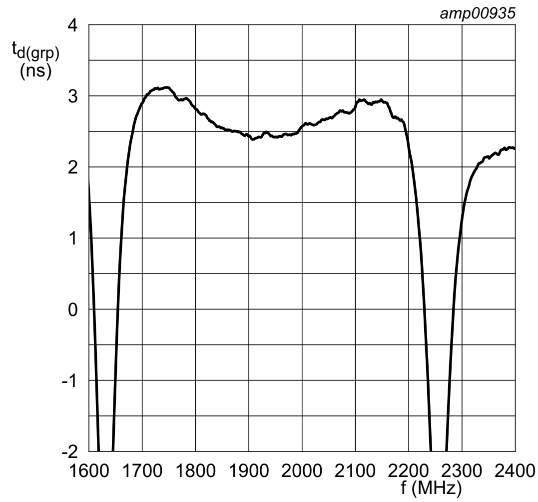
V_{DS} = 30 V; I_{Dq} = 1060 mA; $V_{GS(amp)peak}$ = 1.0 V; PL = 50.5 dBm; f = 1960 MHz

(1) IMD low

(2) IMD high

Fig 10. VBW capability

7.5.5 Group delay

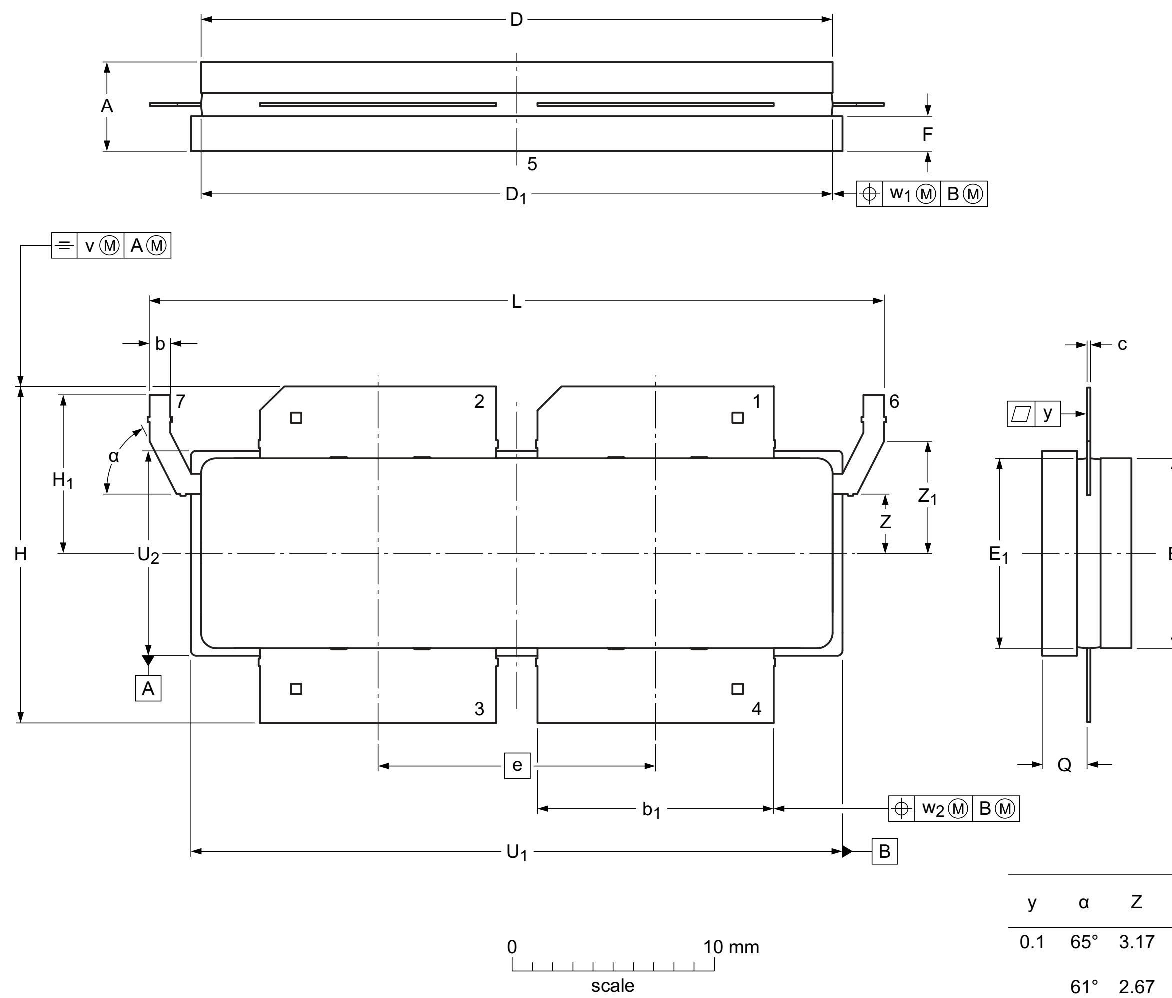


V_{DS} = 30 V; I_{Dq} = 1060 mA; $V_{GS(amp)peak}$ = 1.0 V.

Fig 11. Group delay time as a function of frequency; typical values

8. Package outline

Air cavity plastic earless flanged package; 6 leads — **SOT1258-4**



y	α	Z	Z_1
0.1	65°	3.17	5.79
	61°	2.67	5.29

Dimensions

Unit		A	b	b_1	c	D	D_1	E	E_1	e	L	F	H	H_1	Q(1)	U_1	U_2	v	w_1	w_2
mm	max	4.52	1.12	11.78	0.18	31.44	31.34	9.60	9.50		36.42	1.73	16.71	8.12	2.25	32.33	10.23	0.5	0.5	0.5
	nom									13.72										
	min	4.12	0.91	11.58	0.13	31.04	31.14	9.20	9.30		36.22	1.53	16.51	7.62	2.03	32.13	10.03			

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.

sot1258-4_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1258-4						17-08-31

Fig 12. Package outline SOT1258-4

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 16. ESD sensitivity

ESD model	Class
Charged Device Model (CDM); According to ANSI/ESDA/JEDEC standard JS-002	C3 [1]
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	2 [2]

[1] CDM classification C3 is granted to any part that passes after exposure to an ESD pulse of 1000 V.

[2] HBM classification 2 is granted to any part that passes after exposure to an ESD pulse of 2000 V.

10. Abbreviations

Table 17. Abbreviations

Acronym	Description
3GPP	3rd Generation Partnership Project
AM	Amplitude Modulation
CCDF	Complementary Cumulative Distribution Function
CW	Continuous Wave
DPCH	Dedicated Physical CHannel
ESD	ElectroStatic Discharge
LDMOS	Laterally Diffused Metal-Oxide Semiconductor
LTE	Long Term Evolution
MTF	Median Time to Failure
OBO	Output Back Off
PAR	Peak-to-Average Ratio
PM	Phase Modulation
RoHS	Restriction of Hazardous Substances
SMD	Surface Mounted Device
VNA	Vector Analyzer Network
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio
W-CDMA	Wideband Code Division Multiple Access

11. Revision history

Table 18. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLC10G19XS-601AVT v.1	20211007	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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