

BLD6G21L-50; BLD6G21LS-50

TD-SCDMA 2010 MHz to 2025 MHz fully integrated Doherty transistor

Rev. 2 — 17 August 2010

Product data sheet

1. Product profile

1.1 General description

The BLD6G21L-50 and BLD6G21LS-50 incorporate a fully integrated Doherty solution using NXP's state of the art GEN6 LDMOS technology. This device is perfectly suited for TD-SCDMA base station applications at frequencies from 2010 MHz to 2025 MHz. The main and peak device, input splitter and output combiner are integrated in a single package. This package consists of one gate and drain lead and two extra leads of which one is used for biasing the peak amplifier and the other is not connected. It only requires the proper input/output match and bias setting as with a normal class-AB transistor.

Table 1. Typical performance

RF performance at $T_h = 25$ °C.

Mode of operation	f (MHz)	V_{DS} (V)	$P_{L(AV)}$ (W)	G_p (dB)	η_D (%)	ACPR (dBc)	$P_{L(3dB)}$ (W)
TD-SCDMA [1][2]	2010 to 2025	28	8	14.5	43	-24	53

[1] Test signal: 6-carrier TD-SCDMA; PAR = 10.8 dB at 0.01 % probability on CCDF.

[2] $I_{DQ} = 170$ mA (main); $V_{GS(amp)peak} = 0$ V.

CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling.

1.2 Features and benefits

- Typical TD-SCDMA performance at frequencies from 2010 MHz to 2025 MHz:
 - ◆ Average output power = 8 W
 - ◆ Power gain = 14.5 dB
 - ◆ Efficiency = 43 %
- Fully optimized integrated Doherty concept:
 - ◆ integrated asymmetrical power splitter at input
 - ◆ integrated power combiner
 - ◆ peak biasing down to 0 V
 - ◆ low junction temperature
 - ◆ high efficiency
- 100 % peak power tested for guaranteed output power capability



- Integrated ESD protection
- Good pair match (main and peak on the same chip)
- Independent control of main and peak bias
- Internally matched for ease of use
- Excellent ruggedness
- Compliant to Directive 2002/95/EC, regarding Restriction of Hazardous Substances (RoHS)

1.3 Applications

- High efficiency RF power amplifiers with digital pre-distortion for TD-SCDMA multi carrier applications in the 2010 MHz to 2025 MHz range.

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
BLD6G21L-50 (SOT1130A)			
1	drain		
2	gate + bias main		
3	source [1]		
4	n.c.		
5	bias peak		
BLD6G21LS-50 (SOT1130B)			
1	drain		
2	gate + bias main		
3	source [1]		
4	n.c.		
5	bias peak		

[1] Connected to flange.

3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
BLD6G21L-50	-	flanged ceramic package; 2 mounting holes; 4 leads	SOT1130A
BLD6G21LS-50	-	earless flanged ceramic package; 4 leads	SOT1130B

4. Block diagram

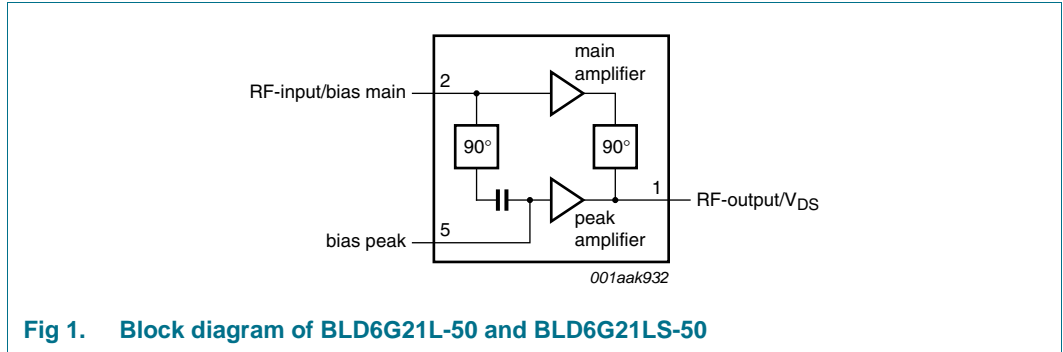


Fig 1. Block diagram of BLD6G21L-50 and BLD6G21LS-50

5. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).
Valid for both main and peak device.

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage		-	65	V
$V_{GS(amp)main}$	main amplifier gate-source voltage		-0.5	+13	V
$V_{GS(amp)peak}$	peak amplifier gate-source voltage		-0.5	+13	V
I_D	drain current		-	10.2	A
T_{stg}	storage temperature		-65	+150	°C
T_j	junction temperature		-	200	°C

6. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-case)}$	thermal resistance from junction to case	$T_{case} = 80\text{ °C}; P_L = 8\text{ W}$	2.1	K/W

[1] When operated with a 6-carrier TD-SCDMA modulated signal with PAR = 10.8 dB at 0.01 % probability on CCDF.

7. Characteristics

Table 6. Characteristics

Valid for both main and peak device.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}; I_D = 0.62\text{ mA}$	65	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10\text{ V}; I_D = 31\text{ mA}$	1.4	1.8	2.4	V
V_{GSq}	gate-source quiescent voltage	$V_{DS} = 28\text{ V}; I_D = 170\text{ mA}$	1.55	2.05	2.55	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	$V_{GS} = V_{GS(th)} + 3.75\text{ V}; V_{DS} = 10\text{ V}$	4.95	5.5	-	A

Table 6. Characteristics ...continued
Valid for both main and peak device.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{GSS}	gate leakage current	$V_{GS} = 11\text{ V}; V_{DS} = 0\text{ V}$	-	-	140	nA
g_{fs}	forward transconductance	$V_{DS} = 10\text{ V}; I_D = 1.55\text{ A}$	1.4	2.2	-	S
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)} + 3.75\text{ V}; I_D = 1.085\text{ A}$	-	0.52	0.736	Ω

8. Application information

Table 7. Application information

Mode of operation: 6-carrier TD-SCDMA; PAR 10.8 dB at 0.01 % probability on CCDF; $f = 2017.5\text{ MHz}$; RF performance at $V_{DS} = 28\text{ V}; I_{Dq} = 170\text{ mA}; V_{GS(amp)peak} = 0\text{ V}; T_{case} = 25\text{ }^\circ\text{C}$; unless otherwise specified; in a production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_{L(AV)}$	average output power		-	8	-	W
G_p	power gain	$P_{L(AV)} = 8\text{ W}$	13	14.5	-	dB
η_D	drain efficiency	$P_{L(AV)} = 8\text{ W}$	39	43	-	%
PAR_O	output peak-to-average ratio	$P_{L(AV)} = 8\text{ W}$	-	9.4	-	dB
RL_{in}	input return loss	$P_{L(AV)} = 8\text{ W}$	8	23	-	dB
ACPR	adjacent channel power ratio	$P_{L(AV)} = 8\text{ W}$	-	-24	-20	dBc

Table 8. Application information

Mode of operation: Pulsed CW; $\delta = 10\text{ }%$; $t_p = 100\text{ }\mu\text{s}$; RF performance at $V_{DS} = 28\text{ V}; I_{Dq} = 170\text{ mA}; V_{GS(amp)peak} = 0\text{ V}; T_{case} = 25\text{ }^\circ\text{C}$; unless otherwise specified; in a production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_{L(3dB)}$	output power at 3 dB gain compression		46	53	-	W

8.1 Ruggedness in Doherty operation

The BLD6G21L-50 and BLD6G21LS-50 are capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions: $V_{DS} = 28\text{ V}; I_{Dq} = 170\text{ mA}; P_L = 8\text{ W}$ (TD-SCDMA); $f = 2017.5\text{ MHz}$.

8.2 Impedance information

Table 9. Typical impedance

Measured Load Pull data; typical values unless otherwise specified.

f	Z_S	Z_L
MHz	Ω	Ω
1995	3.5 – 12.3j	6.7 – 6.1j
2010	3.6 – 12.7j	6.7 – 6.1j
2017.5	3.6 – 12.7j	6.7 – 5.7j
2025	3.7 – 12.7j	6.4 – 5.2j
2040	4.0 – 12.9j	5.7 – 4.8j

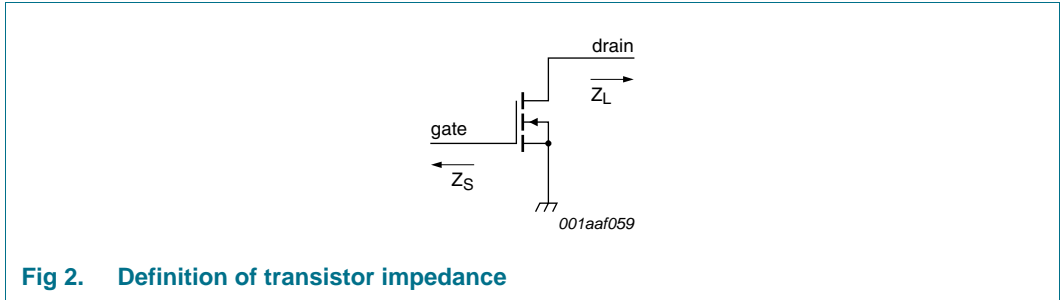


Fig 2. Definition of transistor impedance

8.3 Performance curves

Performance curves are measured in a BLD6G21L-50 application circuit.

8.3.1 CW pulsed

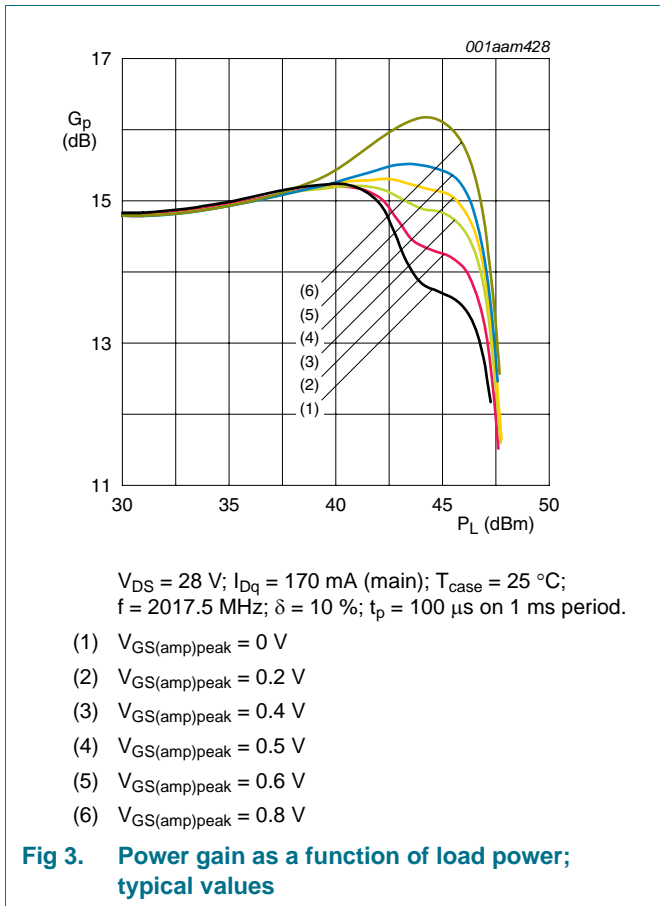


Fig 3. Power gain as a function of load power; typical values

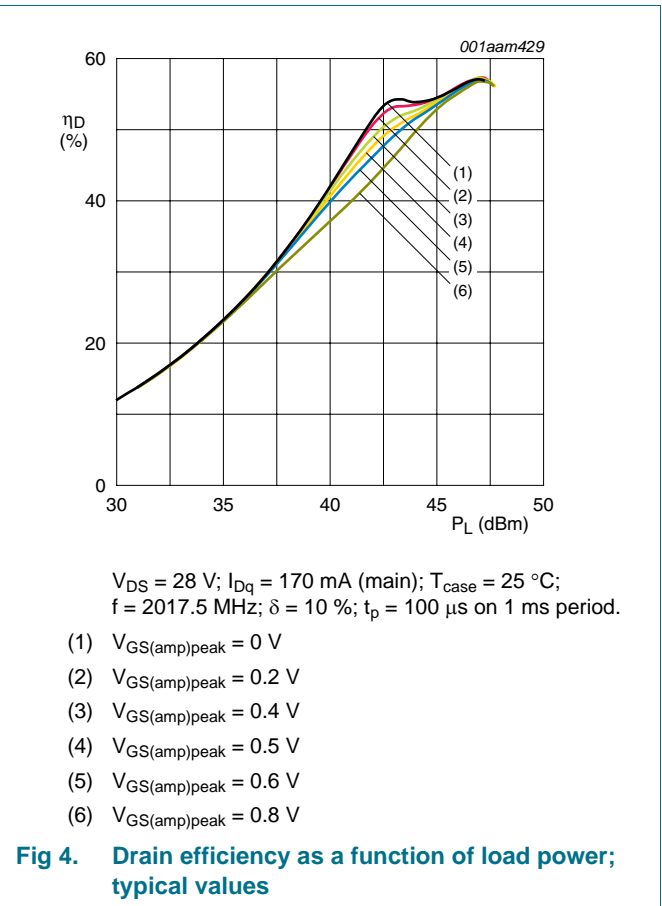
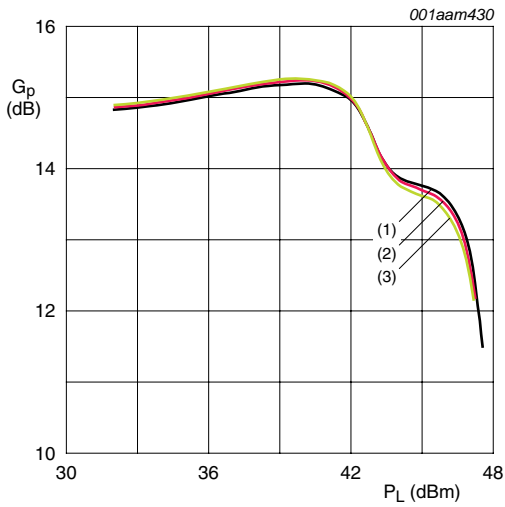


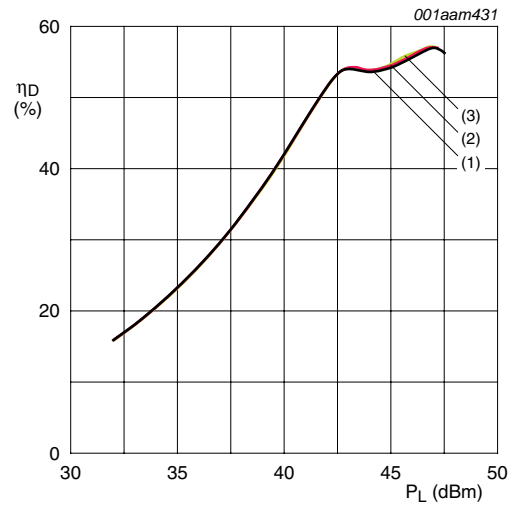
Fig 4. Drain efficiency as a function of load power; typical values



$V_{DS} = 28\text{ V}$; $I_{DQ} = 170\text{ mA}$ (main); $T_{case} = 25\text{ }^{\circ}\text{C}$;
 $V_{GS(amp)peak} = 0\text{ V}$; $\delta = 10\%$; $t_p = 100\text{ }\mu\text{s}$ on 1 ms period.

- (1) $f = 2010\text{ MHz}$
- (2) $f = 2018\text{ MHz}$
- (3) $f = 2025\text{ MHz}$

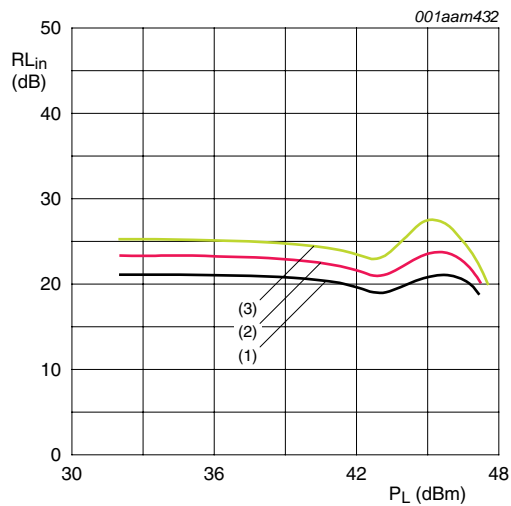
Fig 5. Power gain as a function of load power; typical values



$V_{DS} = 28\text{ V}$; $I_{DQ} = 170\text{ mA}$ (main); $T_{case} = 25\text{ }^{\circ}\text{C}$;
 $V_{GS(amp)peak} = 0\text{ V}$; $\delta = 10\%$; $t_p = 100\text{ }\mu\text{s}$ on 1 ms period.

- (1) $f = 2010\text{ MHz}$
- (2) $f = 2018\text{ MHz}$
- (3) $f = 2025\text{ MHz}$

Fig 6. Drain efficiency as a function of load power; typical values

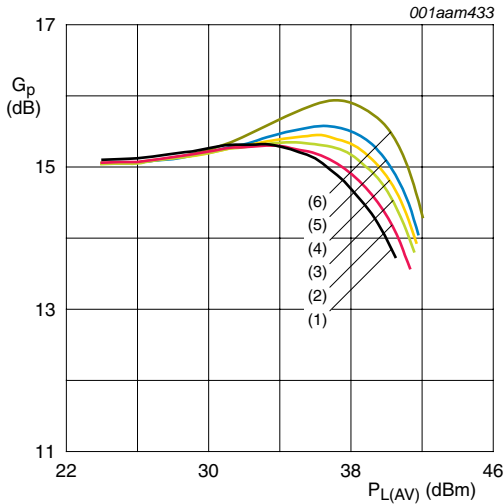


$V_{DS} = 28\text{ V}$; $I_{DQ} = 170\text{ mA}$; $V_{GS(amp)peak} = 0\text{ V}$; $T_{case} = 25\text{ }^{\circ}\text{C}$; $\delta = 10\%$; $t_p = 100\text{ }\mu\text{s}$ on 1 ms period.

- (1) $f = 2010\text{ MHz}$
- (2) $f = 2018\text{ MHz}$
- (3) $f = 2025\text{ MHz}$

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

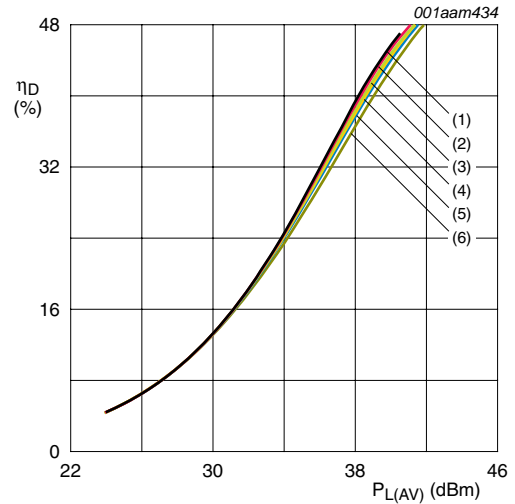
8.3.2 TD-SCDMA



$V_{DS} = 28\text{ V}$; $I_{DQ} = 170\text{ mA}$ (main); $T_{case} = 25\text{ }^\circ\text{C}$;
 $f = 2017.5\text{ MHz}$; 6-carrier TD-SCDMA; PAR = 10.8 dB at 0.01 % probability on CCDF.

- (1) $V_{GS(amp)peak} = 0\text{ V}$
- (2) $V_{GS(amp)peak} = 0.2\text{ V}$
- (3) $V_{GS(amp)peak} = 0.4\text{ V}$
- (4) $V_{GS(amp)peak} = 0.5\text{ V}$
- (5) $V_{GS(amp)peak} = 0.6\text{ V}$
- (6) $V_{GS(amp)peak} = 0.8\text{ V}$

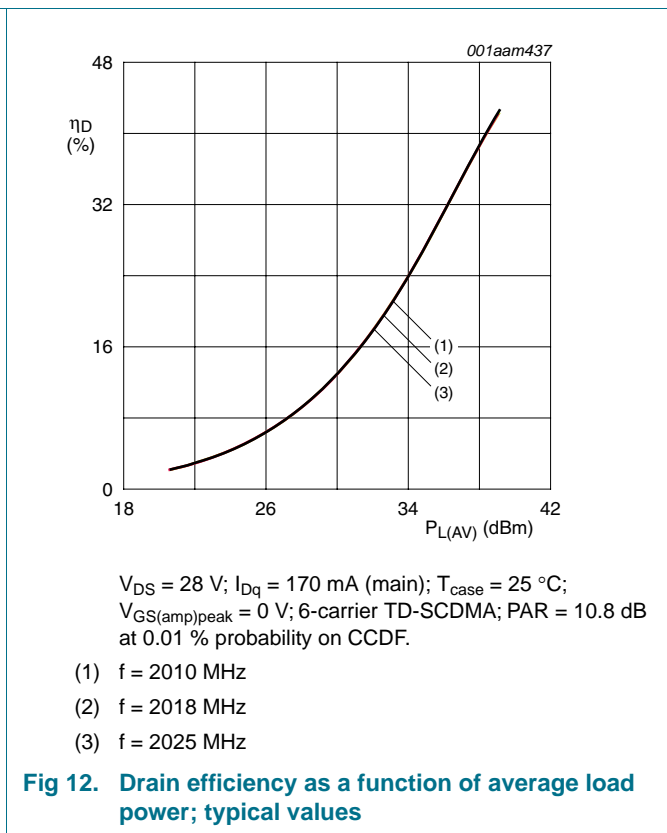
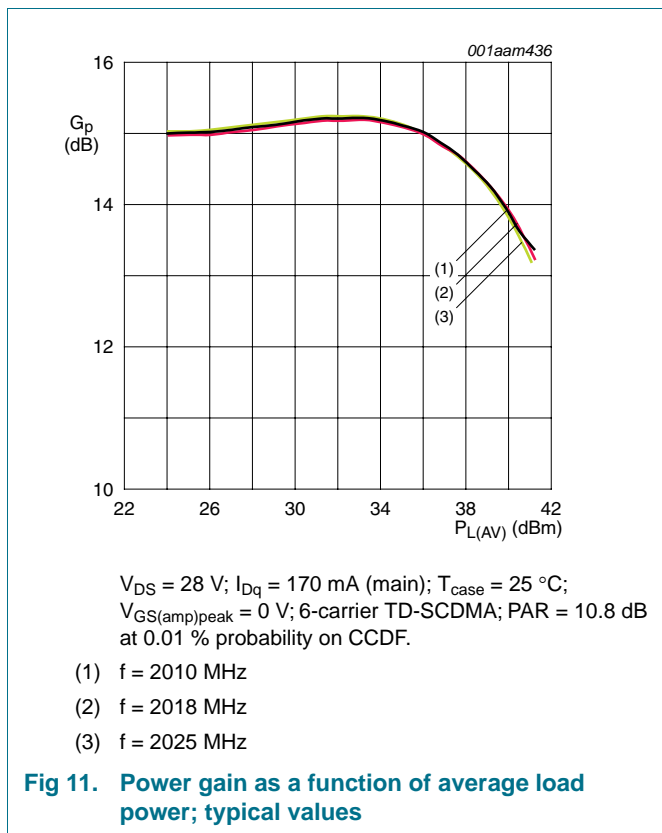
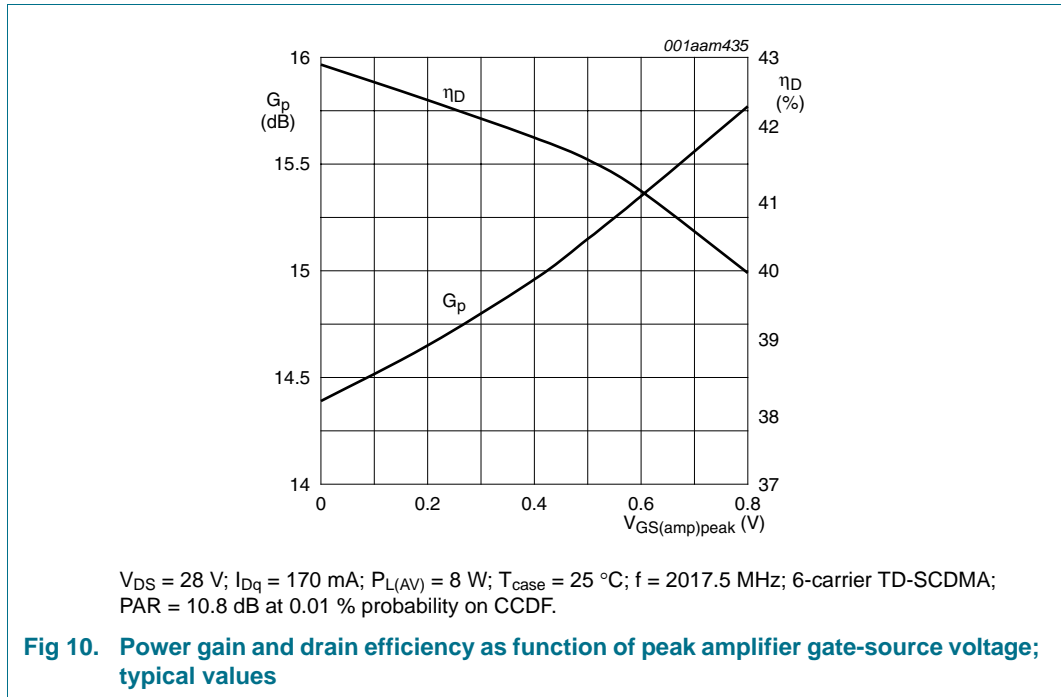
Fig 8. Power gain as a function of average load power; typical values



$V_{DS} = 28\text{ V}$; $I_{DQ} = 170\text{ mA}$ (main); $T_{case} = 25\text{ }^\circ\text{C}$;
 $f = 2017.5\text{ MHz}$; 6-carrier TD-SCDMA; PAR = 10.8 dB at 0.01 % probability on CCDF.

- (1) $V_{GS(amp)peak} = 0\text{ V}$
- (2) $V_{GS(amp)peak} = 0.2\text{ V}$
- (3) $V_{GS(amp)peak} = 0.4\text{ V}$
- (4) $V_{GS(amp)peak} = 0.5\text{ V}$
- (5) $V_{GS(amp)peak} = 0.6\text{ V}$
- (6) $V_{GS(amp)peak} = 0.8\text{ V}$

Fig 9. Drain efficiency as a function of average load power; typical values



9. Test information

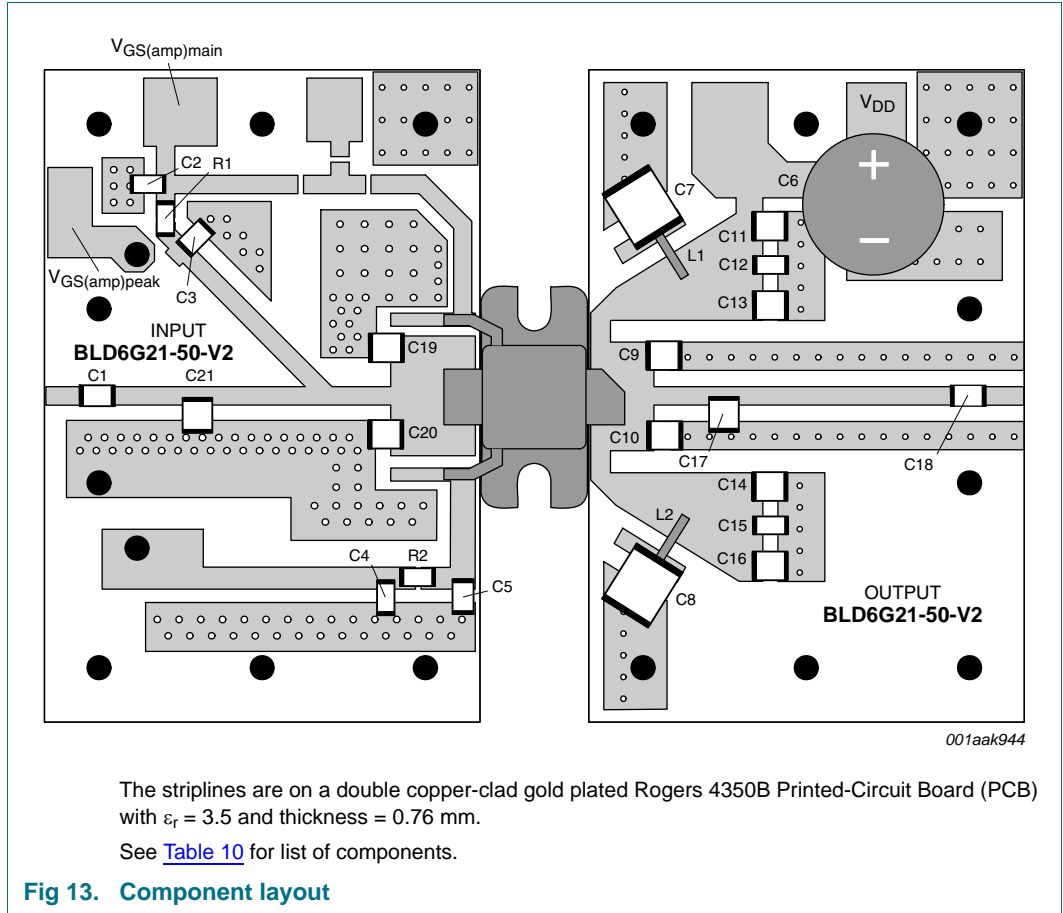


Table 10. List of components

See [Figure 13](#) for component layout.

Component	Description	Value	Dimensions
C1, C3, C5, C18	multilayer ceramic chip capacitor	9.1 pF	[1]
C2, C4, C12, C15	multilayer ceramic chip capacitor	100 nF	
C6	electrolytic capacitor	470 μ F; 63 V	
C7, C8	multilayer ceramic chip capacitor	10 μ F	
C9, C10	multilayer ceramic chip capacitor	1.5 pF	[1]
C11, C13, C14, C16	multilayer ceramic chip capacitor	8.2 pF	[1]
C17	multilayer ceramic chip capacitor	1.2 pF	[1]
C19, C20	multilayer ceramic chip capacitor	0.7 pF	[1]
C21	multilayer ceramic chip capacitor	1.2 pF	[1]
L1, L2	copper wire	-	diameter = 0.8 mm; length = 8 mm
R1	SMD resistor	3.6 Ω	1206
R2	SMD resistor	33 Ω	1206

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

10. Package outline

Flanged ceramic package; 2 mounting holes; 4 leads

SOT1130A

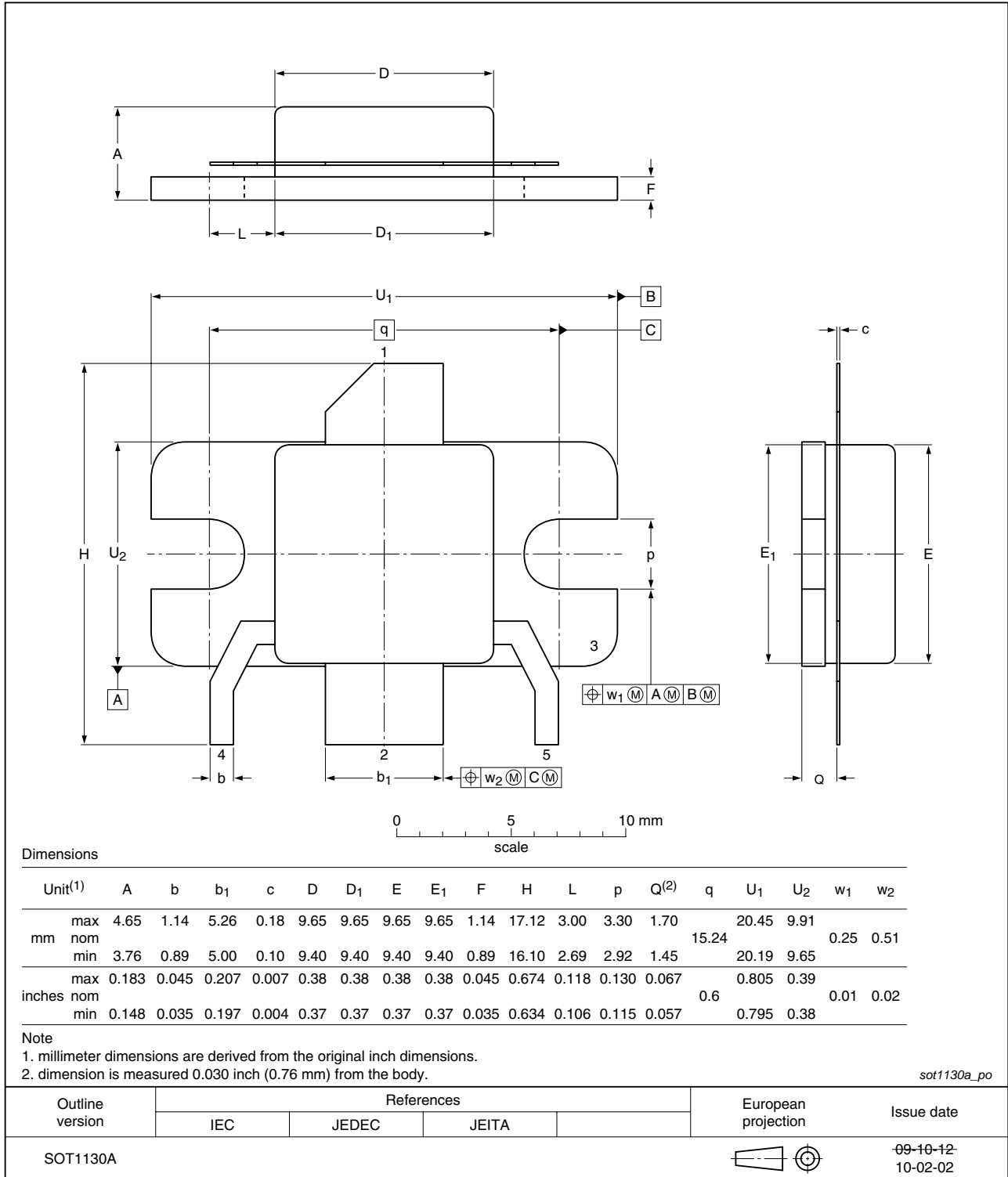


Fig 14. Package outline SOT1130A

Earless flanged ceramic package; 4 leads

SOT1130B

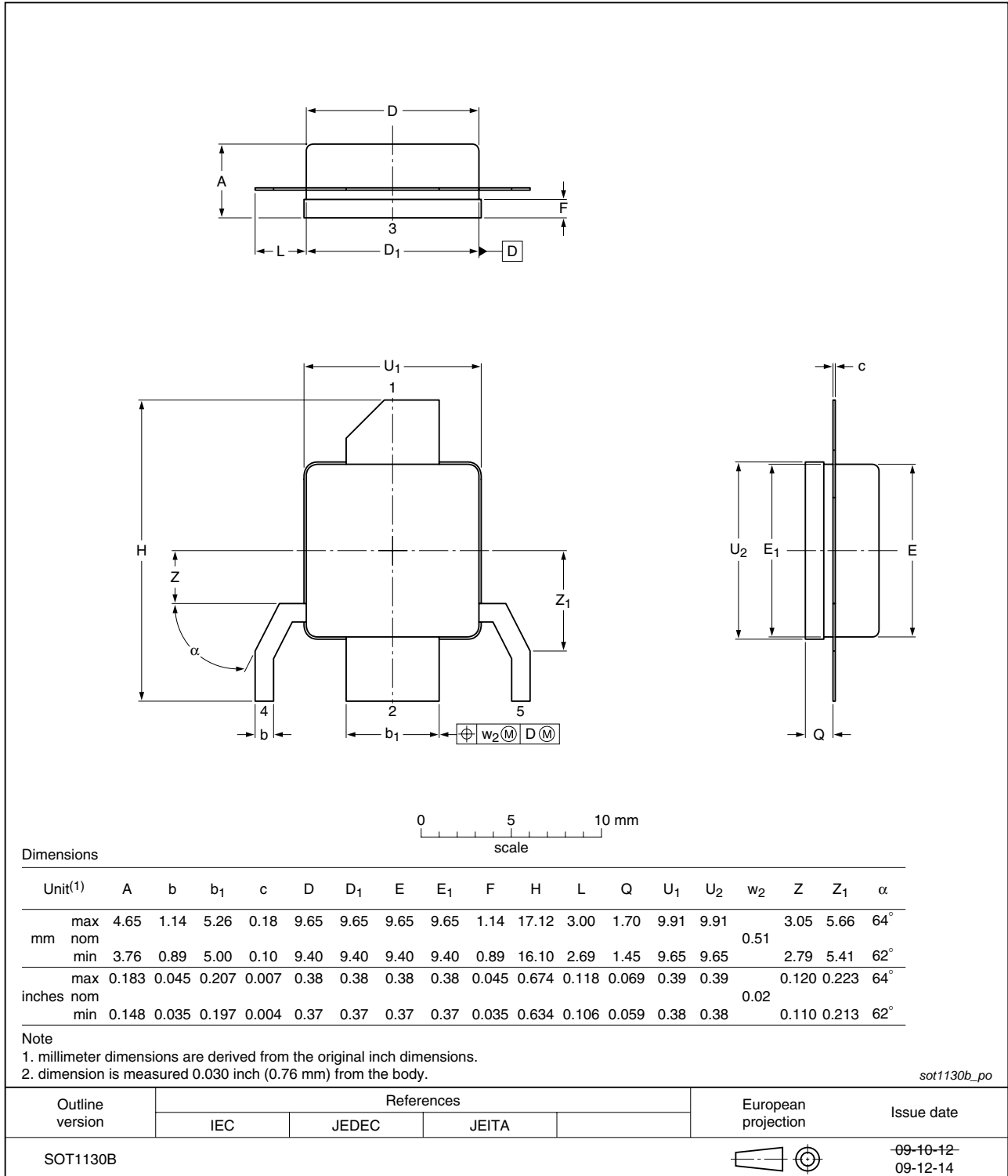


Fig 15. Package outline SOT1130B

11. Abbreviations

Table 11. Abbreviations

Acronym	Description
CCDF	Complementary Cumulative Distribution Function
CW	Continuous Wave
LDMOS	Laterally Diffused Metal-Oxide Semiconductor
PAR	Peak-to-Average power Ratio
RF	Radio Frequency
SMD	Surface Mounted Device
TD-SCDMA	Time Division-Synchronous Code Division Multiple Access
VSWR	Voltage Standing-Wave Ratio

12. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLD6G21L-50_BLD6G21LS-50 v.2	20100817	Product data sheet	-	BLD6G21L-50_ BLD6G21LS-50 v.1
Modifications:				
				<ul style="list-style-type: none"> • Figure 1 on page 3: Some corrections have been made. • Table 5 on page 3: The typical value of $R_{th(j-case)}$ has been changed. • Table 6 on page 3: The values of I_{DSX} have been changed. • Table 7 on page 4: Several values have been changed or added. • Table 8 on page 4: Table has been added. • Section 8.3 on page 5: Figures have been updated.
BLD6G21L-50_BLD6G21LS-50 v.1	20091028	Objective data sheet	-	-

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".

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Date of release: 17 August 2010
 Document identifier: BLD6G21L-50_BLD6G21LS-50