

BLF369

Multi-use VHF power LDMOS transistor

Rev. 04 — 19 February 2009

Product data sheet

1. Product profile

1.1 General description

A general purpose 500 W LDMOS RF power transistor for pulsed and continuous wave applications in the HF/VHF band up to 500 MHz.

Table 1. Typical performance

Typical RF performance at $V_{DS} = 32$ V and $T_h = 25$ °C in a common-source 225 MHz test circuit.^[1]

Mode of operation	f (MHz)	P _L (W)	P _{L(PEP)} (W)	G _p (dB)	η _D (%)	IMD3 (dBc)
CW, class AB	225	500	-	18	60	-
2-tone, class AB	f ₁ = 225; f ₂ = 225.1	-	500	19	47	-28
pulsed, class AB ^[2]	225	500	-	19	55	-

[1] T_h is the heatsink temperature.

[2] t_p = 2 ms; δ = 10 %.

CAUTION



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

1.2 Features

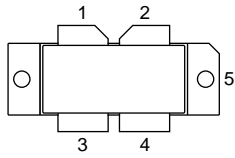
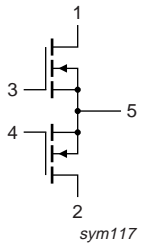
- Typical pulsed performance at 225 MHz, a drain-source voltage V_{DS} of 32 V and a quiescent drain current I_{Dq} = 2 × 1.0 A:
 - ◆ Load power P_L = 500 W
 - ◆ Power gain G_p = 19 dB
 - ◆ Drain efficiency η_D = 55 %
- Advanced flange material for optimum thermal behavior and reliability
- Excellent ruggedness
- High power gain
- Designed for broadband operation (HF/VHF band)
- Source on underside eliminates DC isolators, reducing common-mode inductance
- Easy power control
- Integrated ESD protection
- Compliant to Directive 2002/95/EC, regarding Restriction of Hazardous Substances (RoHS), using exemption No. 7 of the annex

1.3 Applications

- Pulsed applications up to 500 MHz
- Communication transmitter applications in the HF/VHF/UHF band under specific conditions
- Industrial applications up to 500 MHz under special conditions

2. Pinning information

Table 2. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	drain1		 sym117
2	drain2		
3	gate1		
4	gate2		
5	source [1]		

[1] Connected to flange.

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BLF369	-	flanged LDMOST ceramic package; 2 mounting holes; 4 leads	SOT800-2

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		-	200	°C

5. Thermal characteristics

Table 5. Thermal characteristics

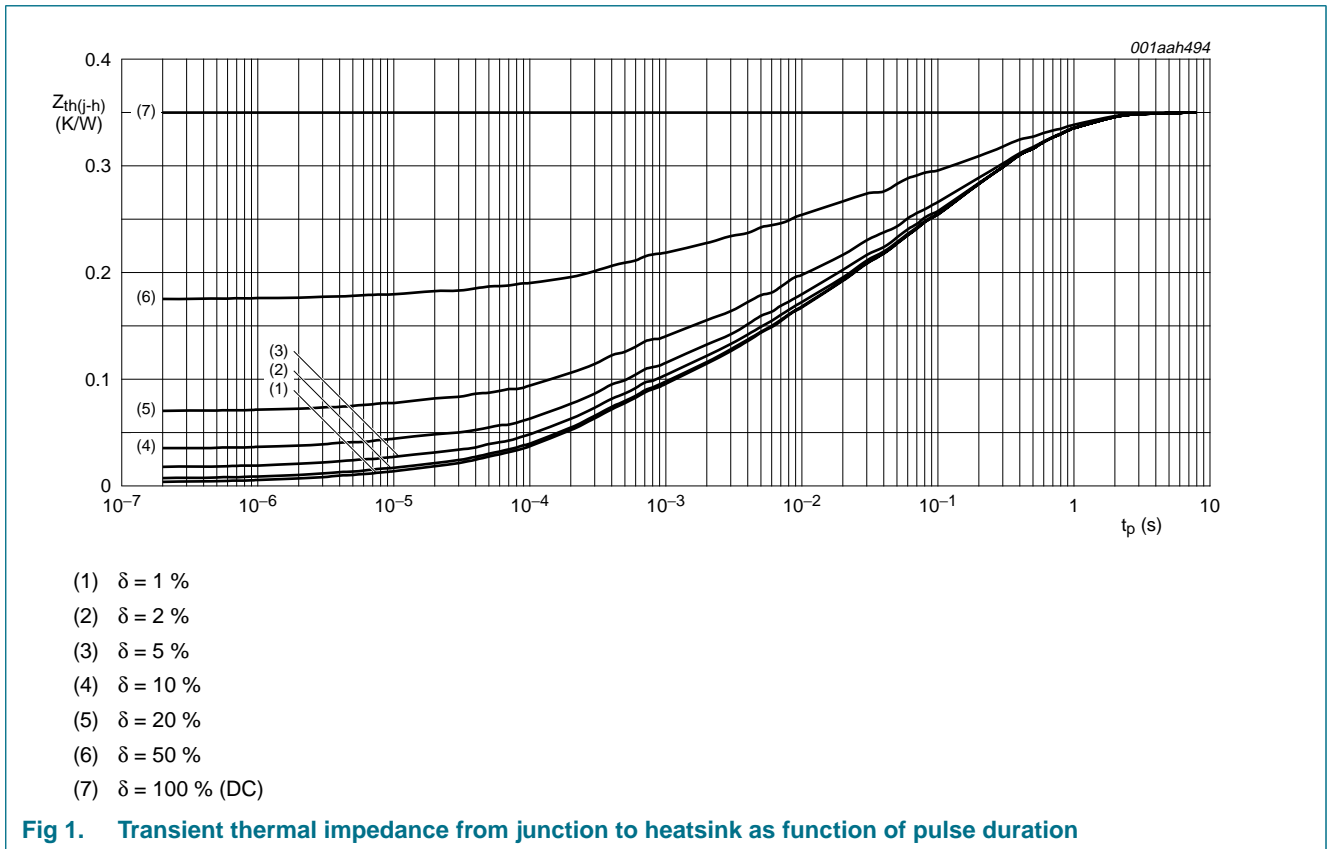
Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-case)}$	thermal resistance from junction to case	$T_j = 200\text{ °C}$	[1][2]	0.26 K/W
$R_{th(j-h)}$	thermal resistance from junction to heatsink	$T_j = 200\text{ °C}$	[1][2][3]	0.35 K/W
$Z_{th(j-h)}$	transient thermal impedance from junction to heatsink	$T_j = 200\text{ °C}$		
		$t_p = 100\text{ }\mu\text{s}; \delta = 10\text{ %}$	[4]	0.063 K/W
		$t_p = 1\text{ ms}; \delta = 10\text{ %}$	[4]	0.117 K/W
		$t_p = 2\text{ ms}; \delta = 10\text{ %}$	[4]	0.133 K/W
		$t_p = 3\text{ ms}; \delta = 10\text{ %}$	[4]	0.142 K/W
		$t_p = 1\text{ ms}; \delta = 20\text{ %}$	[4]	0.140 K/W

[1] T_j is the junction temperature.

[2] $R_{th(j-case)}$ and $R_{th(j-h)}$ are measured under RF conditions.

[3] $R_{th(j-h)}$ is dependent on the applied thermal compound and clamping/mounting of the device.

[4] See [Figure 1](#).



6. Characteristics

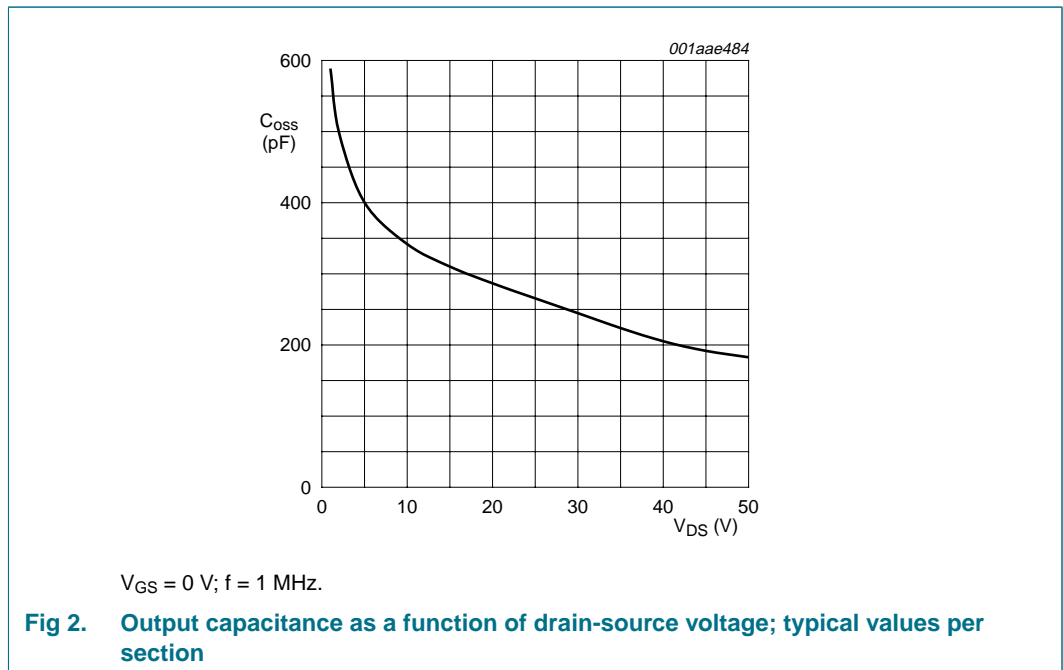
Table 6. Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}; I_D = 6\text{ mA}$	[1]	65	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 20\text{ V}; I_D = 600\text{ mA}$	[1]	4	-	5.5	V
I_{DSS}	drain leakage current	$V_{GS} = 0\text{ V}; V_{DS} = 32\text{ V}$	-	-	4.2	μA	
I_{DSX}	drain cut-off current	$V_{GS} = V_{GS(th)} + 9\text{ V}; V_{DS} = 10\text{ V}$	-	100	-	A	
I_{GSS}	gate leakage current	$V_{GS} = 20\text{ V}; V_{DS} = 0\text{ V}$	-	-	60	nA	
g_{fs}	forward transconductance	$V_{GS} = 20\text{ V}; I_D = 13\text{ A}$	[1]	-	15	-	S
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)} + 9\text{ V}; I_D = 13\text{ A}$	[1]	-	40	-	$\text{m}\Omega$
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 32\text{ V}; f = 1\text{ MHz}$	[2]	-	400	-	pF
C_{oss}	output capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 32\text{ V}; f = 1\text{ MHz}$	[2]	-	230	-	pF
C_{rss}	reverse transfer capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 32\text{ V}; f = 1\text{ MHz}$	-	15	-	pF	

[1] I_D is the drain current.

[2] C_{iss} and C_{oss} include reverse transfer capacitance (C_{rss}).



7. Application information

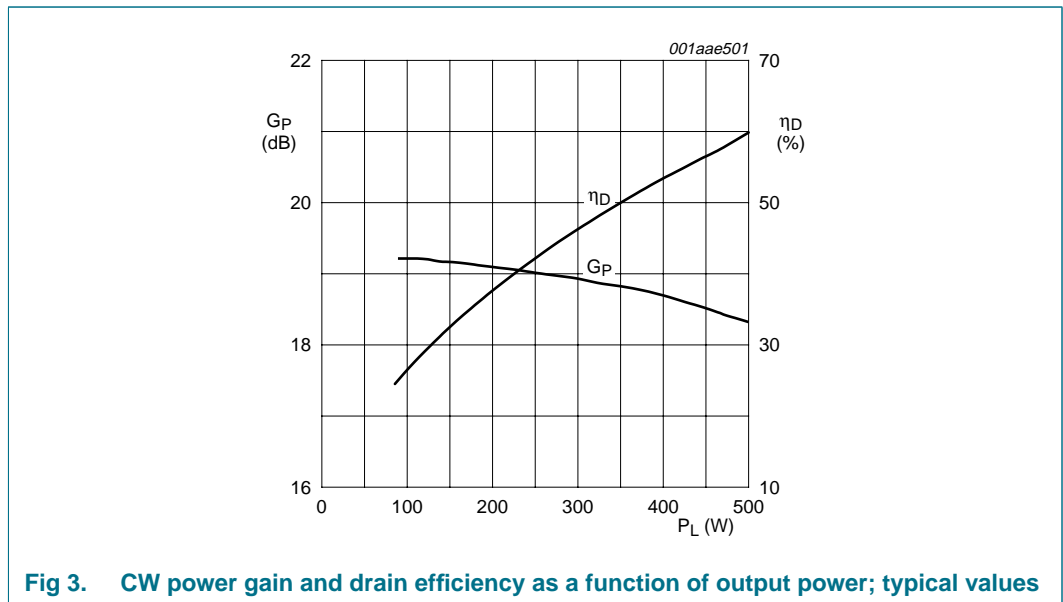
Table 7. RF performance in a common-source 225 MHz test circuit

$T_h = 25^\circ\text{C}$ unless otherwise specified.

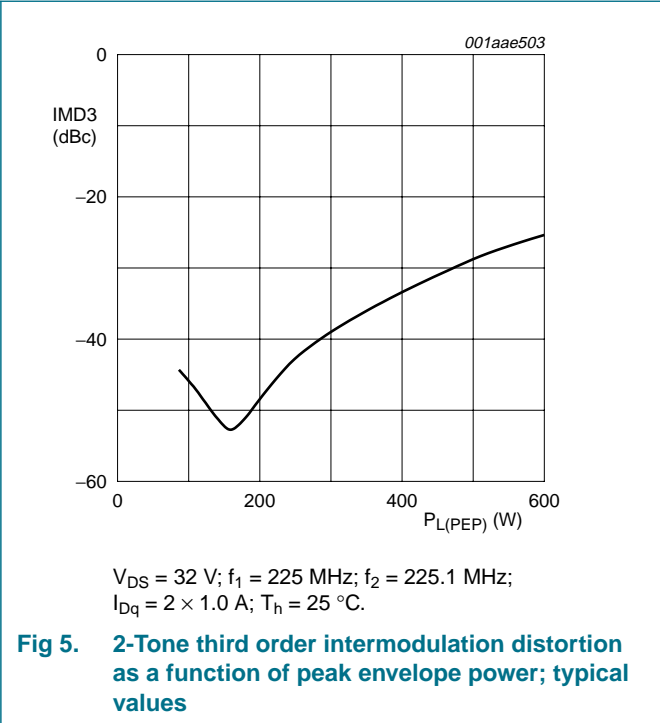
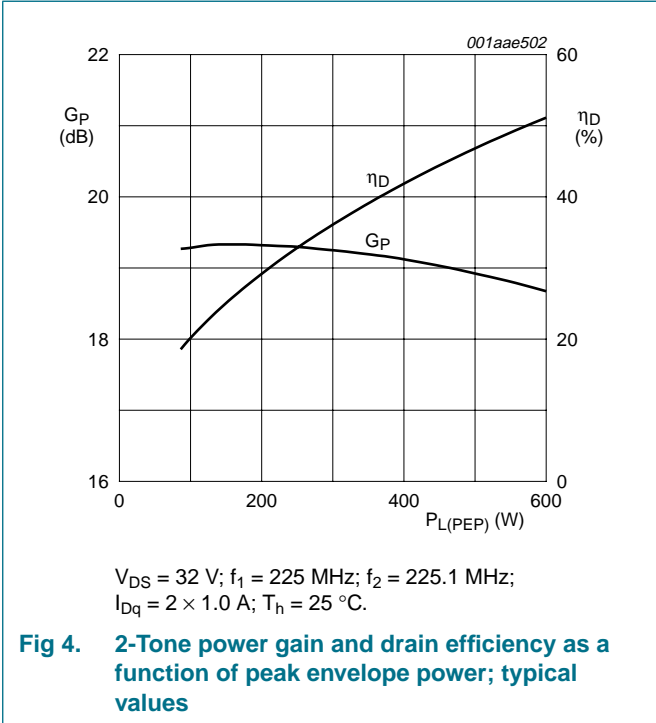
Mode of operation	f (MHz)	V _{DS} (V)	I _{Dq} (A)	P _L (W)	P _{L(PEP)} (W)	G _p (dB)	η _D (%)	IMD3 (dBc)	ΔG _p (dB)
CW, class AB	225	32	2 × 1.0	500	-	> 17	> 55	-	-
2-tone, class AB	f ₁ = 225; f ₂ = 225.1	32	2 × 1.0	-	500	> 18	> 43	< -24	1
pulsed, class AB [1]	225	-	-	500	-	> 18	> 50	-	-

[1] t_p = 2 ms; δ = 10 %.

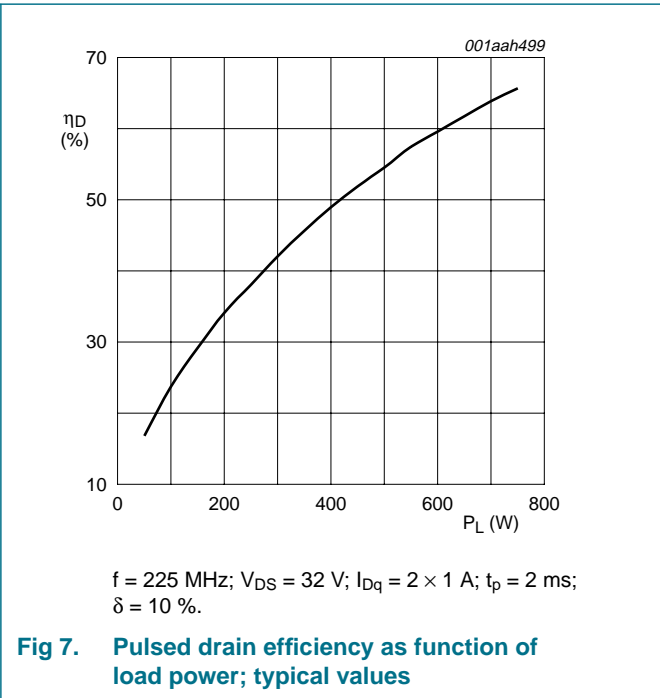
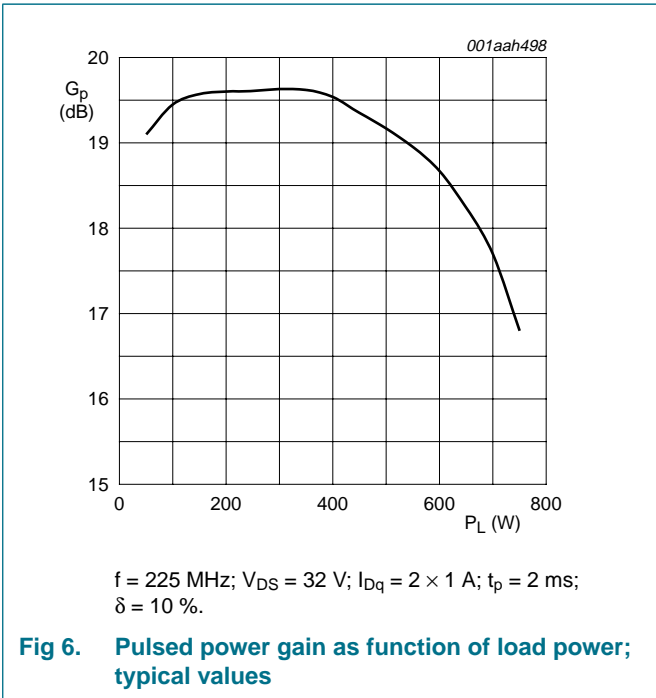
7.1 CW

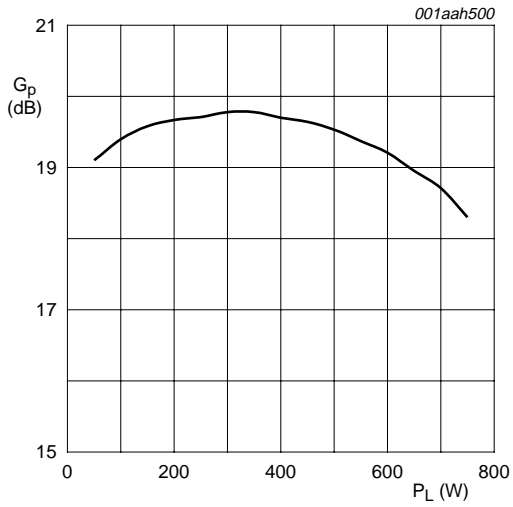


7.2 2-Tone



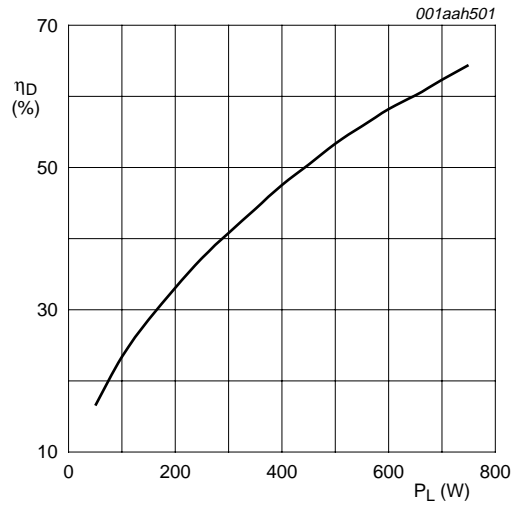
7.3 Pulsed





$f = 225 \text{ MHz}; V_{DS} = 32 \text{ V}; I_{Dq} = 2 \times 1 \text{ A}; t_p = 100 \mu\text{s}; \delta = 10 \%$

Fig 8. Pulsed power gain as function of load power; typical values



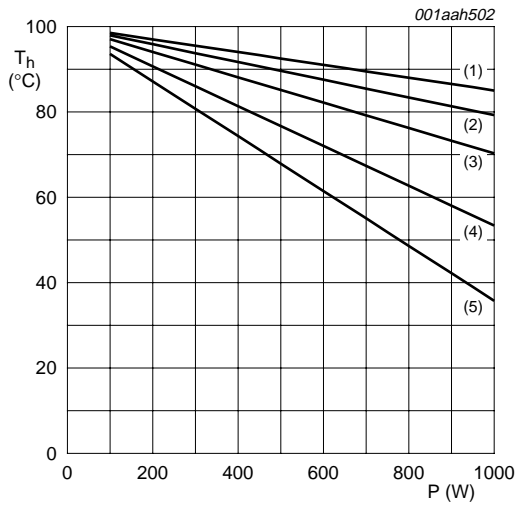
$f = 225 \text{ MHz}; V_{DS} = 32 \text{ V}; I_{Dq} = 2 \times 1 \text{ A}; t_p = 100 \mu\text{s}; \delta = 10 \%$

Fig 9. Pulsed drain efficiency as function of load power; typical values

7.4 Maximum heatsink temperature

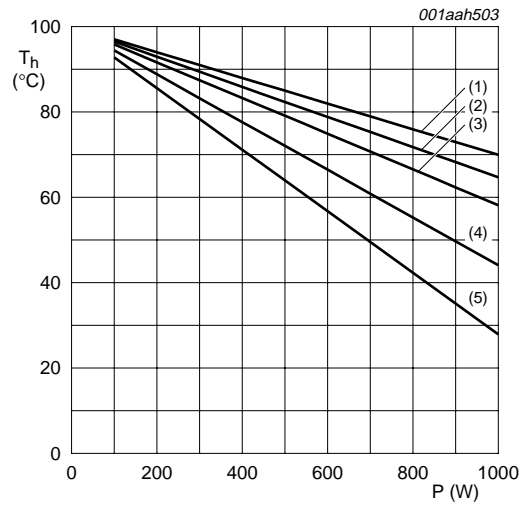
The heatsink temperature is defined 1 mm below the surface of the heatsink at the center of the flange.

The maximum allowable heatsink temperature is given in the following graphs at several pulsed conditions as well as for CW.



- $\delta = 10\%$.
- (1) $t_p \leq 2\text{ ms}$
 - (2) $t_p = 10\text{ ms}$
 - (3) $t_p = 20\text{ ms}$
 - (4) $t_p = 50\text{ ms}$
 - (5) $t_p = 100\text{ ms}$

Fig 10. Heatsink temperature as function of power dissipation at a duty cycle of 10 %



- $\delta = 20\%$.
- (1) $t_p \leq 2\text{ ms}$
 - (2) $t_p = 10\text{ ms}$
 - (3) $t_p = 20\text{ ms}$
 - (4) $t_p = 50\text{ ms}$
 - (5) $t_p = 100\text{ ms}$

Fig 11. Heatsink temperature as function of power dissipation at a duty cycle of 20 %

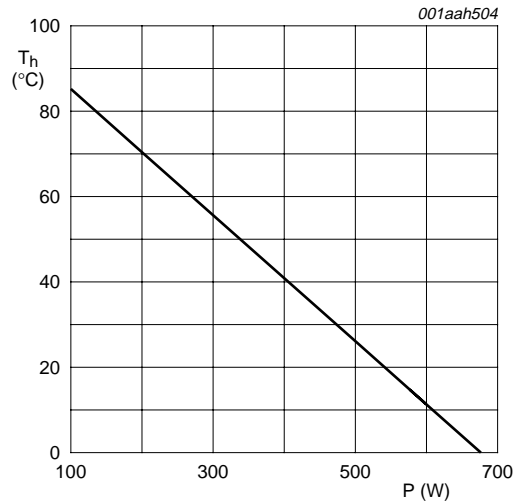
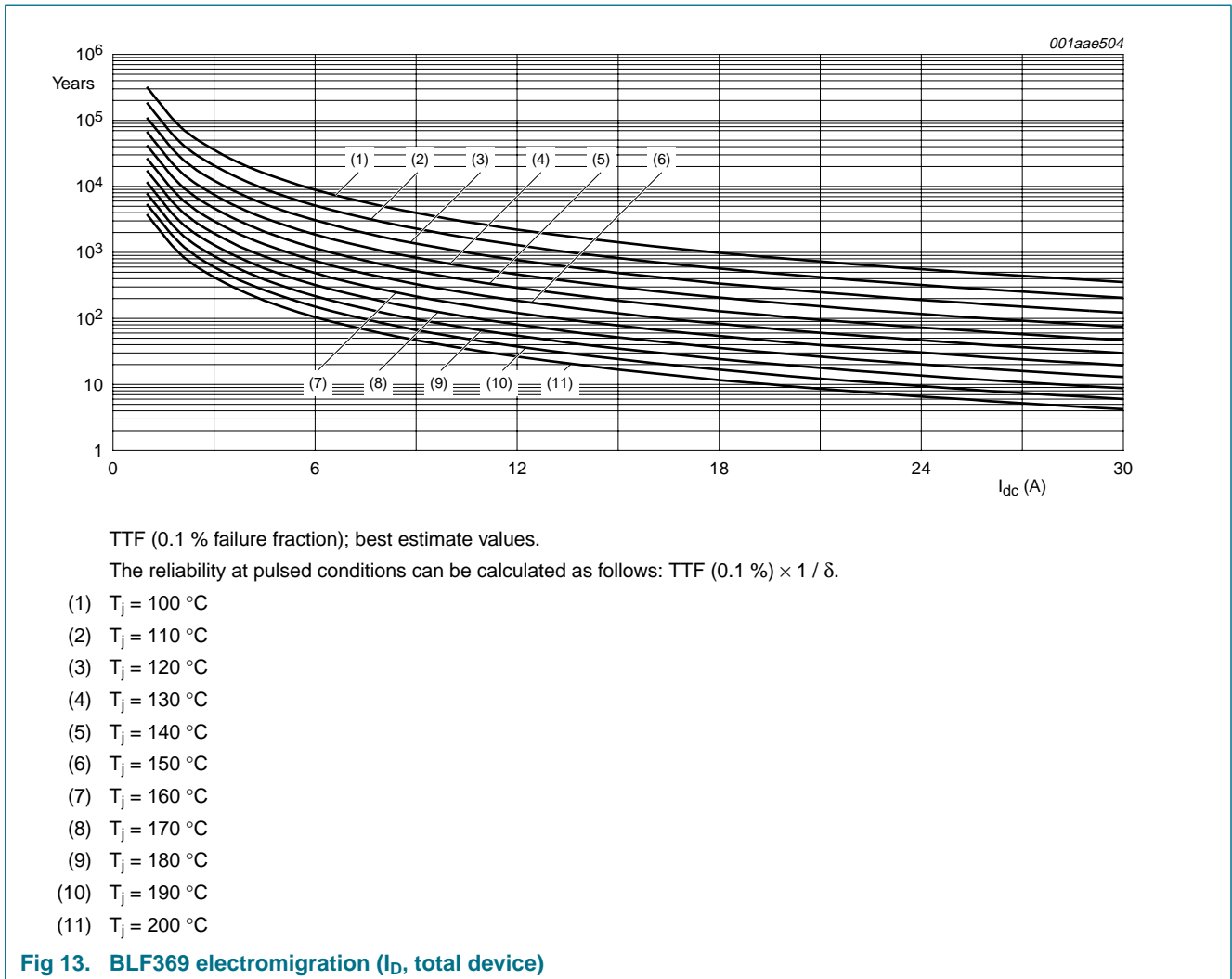


Fig 12. CW heatsink temperature as function of power dissipation

7.5 Ruggedness in class-AB operation

The BLF369 is capable of withstanding a load mismatch corresponding to $V_{SWR} = 10 : 1$ through all phases under the following conditions: 2-tone signal; $V_{DS} = 32\text{ V}$; $f = 225\text{ MHz}$ at rated load power ($P_{L(PEP)} = 500\text{ W}$).

7.6 Reliability



8. Test information

Table 8. List of components

For test circuit, see Figure 14, Figure 15 and Figure 16.

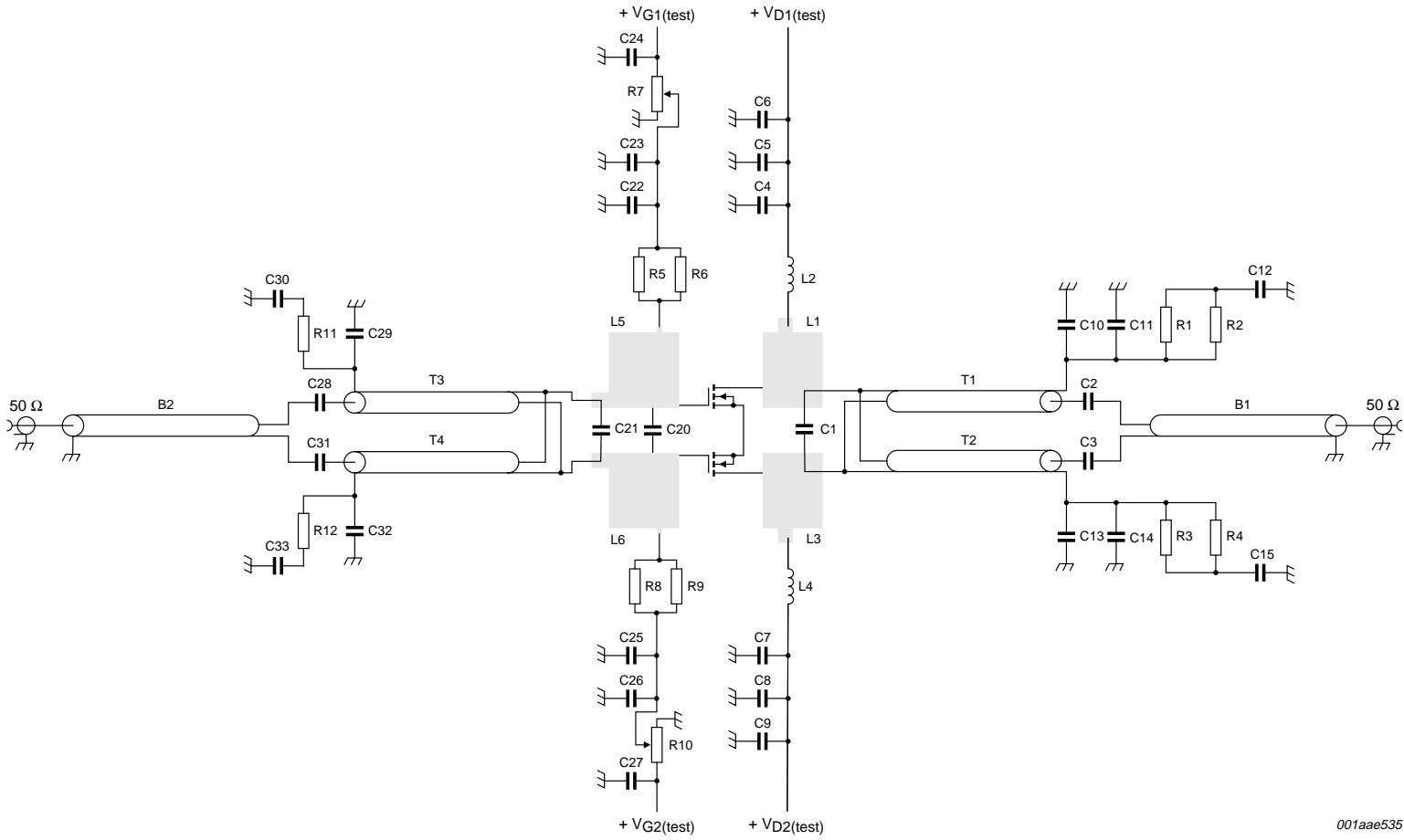
Component	Description	Value	Remarks
B1	semi rigid coax	25 Ω; 120 mm	EZ90-25-TP
B2	semi rigid coax	25 Ω; 56 mm	EZ90-25-TP
C1	multilayer ceramic chip capacitor	91 pF	[1]
C2, C3	multilayer ceramic chip capacitor	56 pF	[1]
C4, C7	multilayer ceramic chip capacitor	100 pF	[1]
C5, C8	ceramic capacitor	15 nF	
C6, C9	electrolytic capacitor	220 μF	
C10, C11, C13, C14	multilayer ceramic chip capacitor	220 pF	[1]
C12, C15	ceramic capacitor	15 nF	[1]

Table 8. List of components ...continued
For test circuit, see [Figure 14](#), [Figure 15](#) and [Figure 16](#).

Component	Description	Value	Remarks
C20	multilayer ceramic chip capacitor	100 pF	[1]
C21	multilayer ceramic chip capacitor	20 pF	[1]
C22, C25	multilayer ceramic chip capacitor	100 pF	[1]
C23, C26	ceramic capacitor	15 nF	
C24, C27	electrolytic capacitor	10 μ F	
C28, C31	multilayer ceramic chip capacitor	100 pF	[1]
C29, C32	multilayer ceramic chip capacitor	220 pF	
C30, C33	ceramic capacitor	15 nF	
L1, L3	stripline	-	[2] (W \times L) 12 mm \times 15 mm
L2, L4	air coil	-	4 windings; D = 8 mm; d = 1 mm
L5, L6	stripline	-	[2] (W \times L) 14 mm \times 15 mm
R1, R2, R3, R4	resistor	0.25 W; 4 Ω	
R5, R6, R8, R9	resistor	0.25 W; 10 Ω	
R7, R10	potentiometer	10 k Ω	
R11, R12	resistor	0.25 W; 1 Ω	
T1, T2	semi rigid coax	25 Ω ; 68 mm	EZ90-25-TP
T3, T4	semi rigid coax	25 Ω ; 60 mm	EZ90-25-TP

[1] American technical ceramics type 100B or capacitor of same quality.

[2] Printed-Circuit Board (PCB): Rogers 5880; $\epsilon_r = 2.2$ F/m; height = 0.79 mm; Cu (top/bottom metallization); thickness copper plating = 35 μ m.



001aae535

Fig 14. Class-AB common-source 225 MHz test circuit; $V_{D1(test)}$, $V_{D2(test)}$, $V_{G1(test)}$ and $V_{G2(test)}$ are drain and gate test voltages

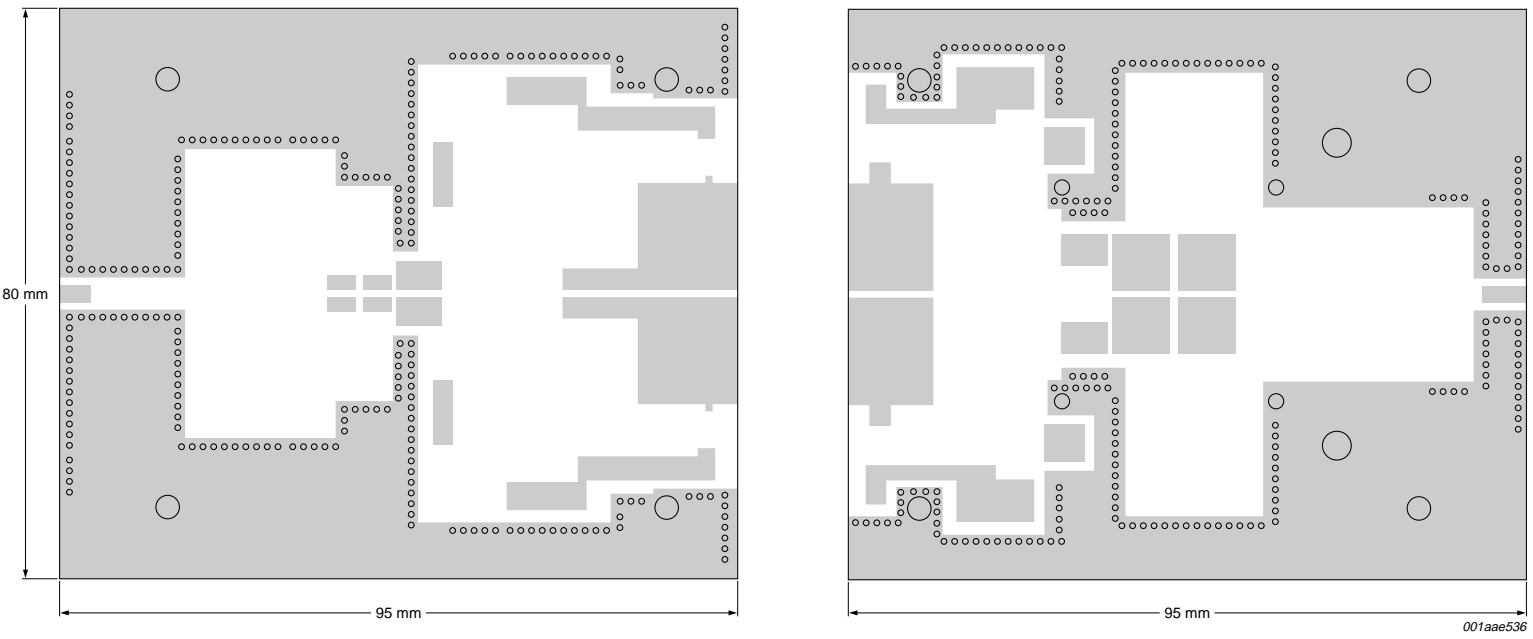
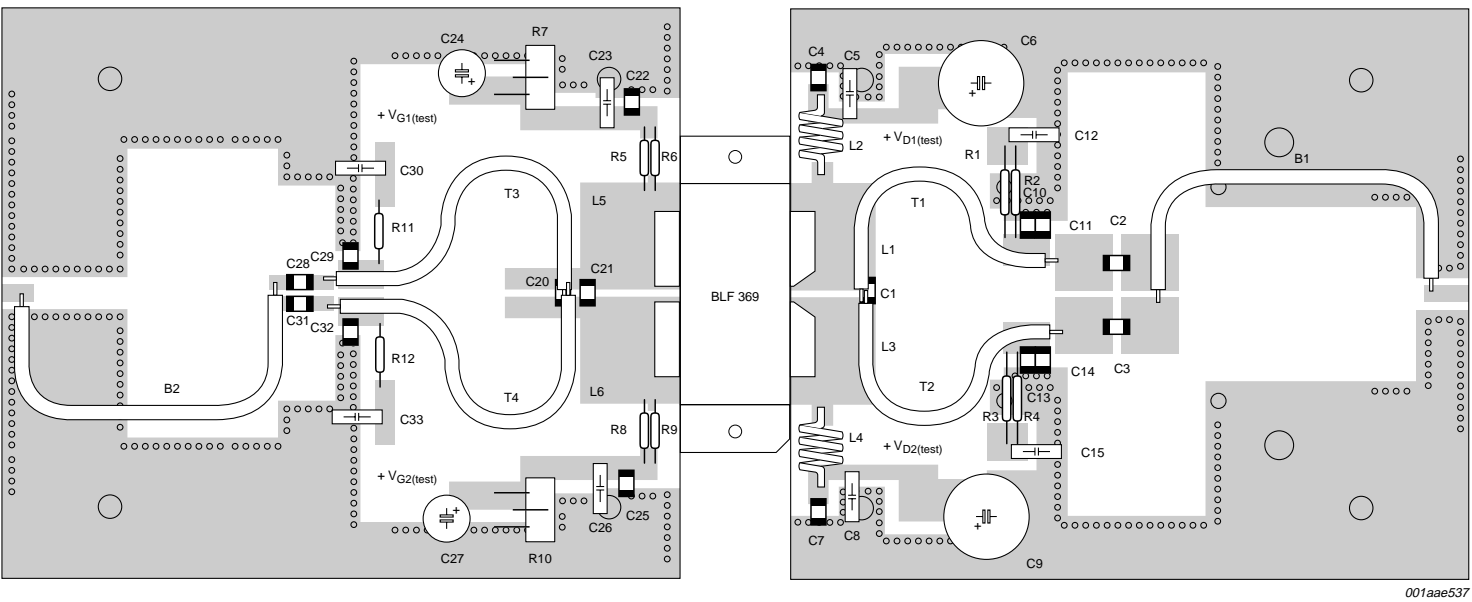


Fig 15. Printed-Circuit Board (PCB) for class-AB 225 MHz test circuit



C1 mounted on top of transformers T1 and T2; C20 mounted on top of transformers T3 and T4.

Fig 16. Component layout for class-AB 225 MHz test circuit

9. Package outline

Flanged LDMOST ceramic package; 2 mounting holes; 4 leads

SOT800-2

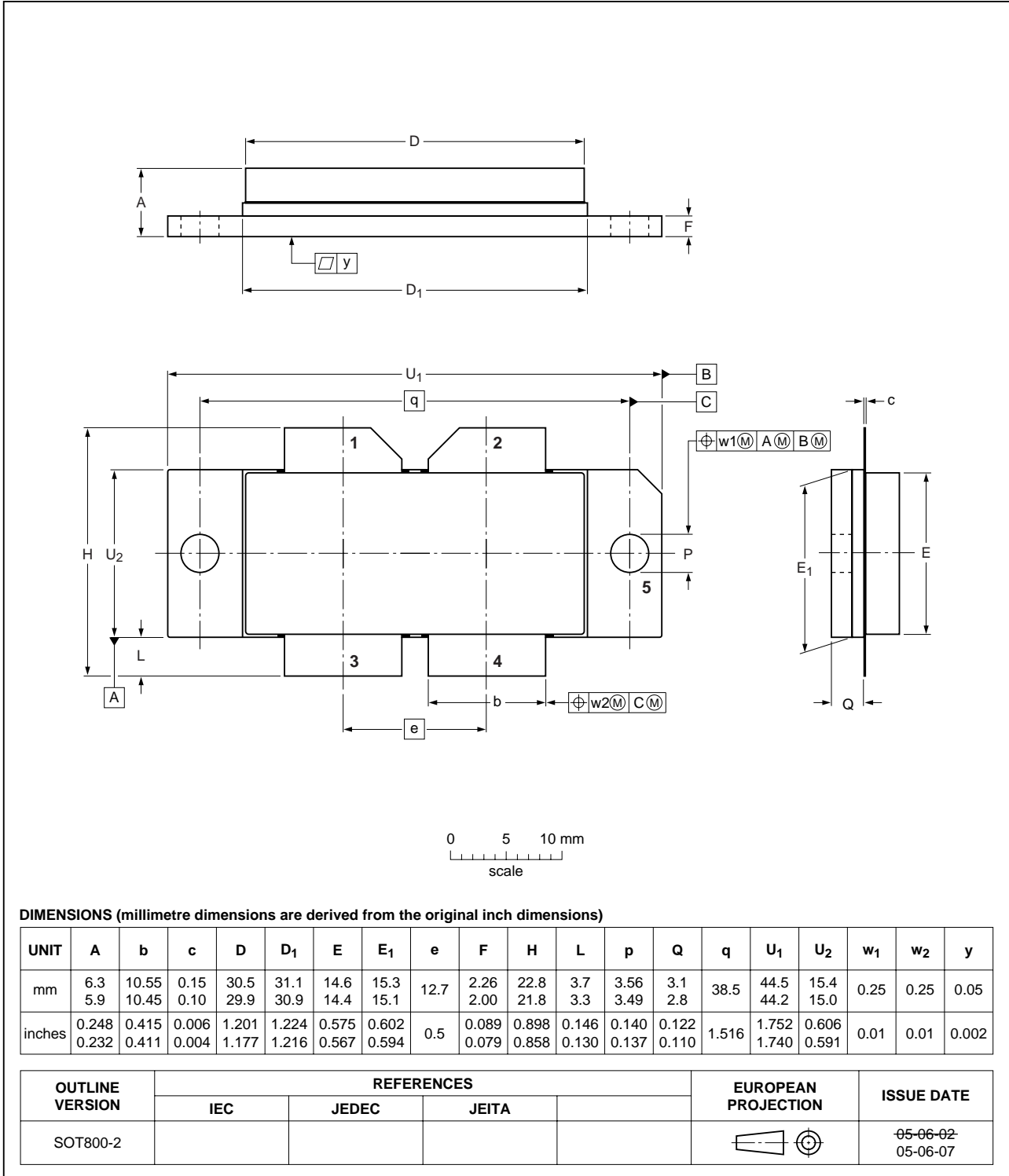


Fig 17. Package outline SOT800-2

10. Abbreviations

Table 9. Abbreviations

Acronym	Description
CW	Continuous Wave
DC	Direct Current
GSM	Global System for Mobile communications
HF	High Frequency
LDMOS	Laterally Diffused Metal-Oxide Semiconductor
LDMOST	Laterally Diffused Metal-Oxide Semiconductor Transistor
PEP	Peak Envelope Power
RF	Radio Frequency
TTF	Time To Failure
UHF	Ultra High Frequency
VHF	Very High Frequency
VSWR	Voltage Standing-Wave Ratio

11. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLF369_4	20090219	Product data sheet	-	BLF369_3
Modifications:	<ul style="list-style-type: none"> Data sheet status updated from 'Preliminary data sheet' to 'Product data sheet' 			
BLF369_3	20080129	Preliminary data sheet	-	BLF369_2
BLF369_2	20061208	Objective data sheet	-	BLF369_1
BLF369_1	20060413	Objective 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.nxp.com>.

12.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

12.3 Disclaimers

General — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or

malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

Terms and conditions of sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nxp.com/profile/terms>, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

12.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

13. Contact information

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: salesaddresses@nxp.com

14. Contents

1	Product profile	1
1.1	General description	1
1.2	Features	1
1.3	Applications	2
2	Pinning information	2
3	Ordering information	2
4	Limiting values	2
5	Thermal characteristics	3
6	Characteristics	4
7	Application information	5
7.1	CW	5
7.2	2-Tone	6
7.3	Pulsed	6
7.4	Maximum heatsink temperature	7
7.5	Ruggedness in class-AB operation	8
7.6	Reliability	9
8	Test information	9
9	Package outline	14
10	Abbreviations	15
11	Revision history	15
12	Legal information	16
12.1	Data sheet status	16
12.2	Definitions	16
12.3	Disclaimers	16
12.4	Trademarks	16
13	Contact information	16
14	Contents	17

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.



© NXP B.V. 2009.

All rights reserved.

For more information, please visit: <http://www.nxp.com>

For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 19 February 2009

Document identifier: BLF369_4