

# BLL6H1214-500

LDMOS L-band radar power transistor

Rev. 02 — 1 April 2010

Product data sheet

## 1. Product profile

### 1.1 General description

500 W LDMOS power transistor intended for L-band radar applications in the 1.2 GHz to 1.4 GHz range.

**Table 1. Test information**

Typical RF performance at  $T_{case} = 25\text{ °C}$ ;  $t_p = 300\text{ }\mu\text{s}$ ;  $\delta = 10\%$ ;  $I_{DQ} = 150\text{ mA}$ ; in a class-AB production test circuit.

Mode of operation	f (GHz)	V <sub>DS</sub> (V)	P <sub>L</sub> (W)	G <sub>p</sub> (dB)	$\eta_D$ (%)	t <sub>r</sub> (ns)	t <sub>f</sub> (ns)
pulsed RF	1.2 to 1.4	50	500	17	50	20	6

#### CAUTION



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

### 1.2 Features and benefits

- Typical pulsed RF performance at a frequency of 1.2 GHz to 1.4 GHz, a supply voltage of 50 V, an  $I_{DQ}$  of 150 mA, a  $t_p$  of 300  $\mu\text{s}$  with  $\delta$  of 10 %:
  - ◆ Output power = 500 W
  - ◆ Power gain = 17 dB
  - ◆ Efficiency = 50 %
- Easy power control
- Integrated ESD protection
- High flexibility with respect to pulse formats
- Excellent ruggedness
- High efficiency
- Excellent thermal stability
- Designed for broadband operation (1.2 GHz to 1.4 GHz)
- Internally matched for ease of use
- Compliant to Directive 2002/95/EC, regarding restriction of hazardous substances (RoHS)



### 1.3 Applications

- L-band power amplifiers for radar applications in the 1.2 GHz to 1.4 GHz frequency range

## 2. Pinning information

**Table 2. Pinning**

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

[1] Connected to flange.

## 3. Ordering information

**Table 3. Ordering information**

Type number	Package		
	Name	Description	Version
BLL6H1214-500	-	flanged balanced LDMOST ceramic package; 2 mounting holes; 4 leads	SOT539A

## 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		-	100	V
$V_{GS}$	gate-source voltage		-0.5	+13	V
$I_D$	drain current		-	45	A
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature		-	200	°C

## 5. Thermal characteristics

**Table 5. Thermal characteristics**

Symbol	Parameter	Conditions	Typ	Unit
$Z_{th(j-c)}$	transient thermal impedance from junction to case	$T_{case} = 85\text{ °C}; P_L = 500\text{ W}$		
		$t_p = 100\text{ }\mu\text{s}; \delta = 10\text{ }\%$	0.07	K/W
		$t_p = 200\text{ }\mu\text{s}; \delta = 10\text{ }\%$	0.08	K/W
		$t_p = 300\text{ }\mu\text{s}; \delta = 10\text{ }\%$	0.1	K/W
		$t_p = 100\text{ }\mu\text{s}; \delta = 20\text{ }\%$	0.1	K/W

## 6. Characteristics

**Table 6. DC characteristics**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}; I_D = 2.7\text{ mA}$	100	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10\text{ V}; I_D = 270\text{ mA}$	1.3	1.8	2.2	V
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}; V_{DS} = 50\text{ V}$	-	-	1.4	$\mu\text{A}$
$I_{DSX}$	drain cut-off current	$V_{GS} = V_{GS(th)} + 3.75\text{ V}; V_{DS} = 10\text{ V}$	32	42	-	A
$I_{GSS}$	gate leakage current	$V_{GS} = 11\text{ V}; V_{DS} = 0\text{ V}$	-	-	140	nA
$g_{fs}$	forward transconductance	$V_{DS} = 10\text{ V}; I_D = 270\text{ mA}$	1.7	3	-	S
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = V_{GS(th)} + 3.75\text{ V}; I_D = 9.5\text{ A}$	-	100	164	$\text{m}\Omega$

**Table 7. RF characteristics**

Mode of operation: pulsed RF;  $t_p = 300\text{ }\mu\text{s}; \delta = 10\text{ }\%$ ; RF performance at  $V_{DS} = 50\text{ V}; I_{Dq} = 150\text{ mA}$ ;  $T_{case} = 25\text{ °C}$ ; unless otherwise specified, in a class-AB production test circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_L$	output power		500	-	-	W
$V_{DS}$	drain-source voltage	$P_L = 500\text{ W}$	-	-	50	V
$G_p$	power gain	$P_L = 500\text{ W}$	15	17	-	dB
$RL_{in}$	input return loss	$P_L = 500\text{ W}$	-	10	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression		-	600	-	W
$\eta_D$	drain efficiency	$P_L = 500\text{ W}$	45	50	-	%
$P_{droop(pulse)}$	pulse droop power	$P_L = 500\text{ W}$	-	0	0.3	dB
$t_r$	rise time	$P_L = 500\text{ W}$	-	20	50	ns
$t_f$	fall time	$P_L = 500\text{ W}$	-	6	50	ns

### 6.1 Ruggedness in class-AB operation

The BLL6H1214-500 is capable of withstanding a load mismatch corresponding to  $VSWR = 10 : 1$  through all phases under the following conditions:  $V_{DS} = 50\text{ V}$ ;  $I_{Dq} = 150\text{ mA}$ ;  $P_L = 500\text{ W}$ ;  $t_p = 300\text{ }\mu\text{s}$ ;  $\delta = 10\text{ }\%$ .

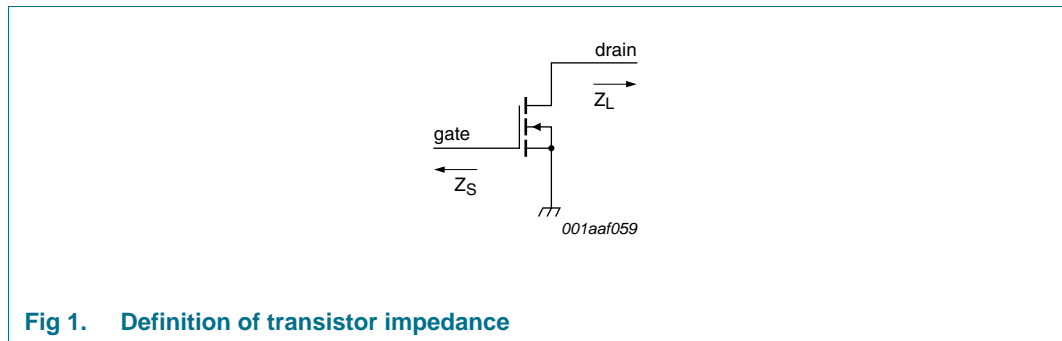
## 7. Application information

### 7.1 Impedance information

**Table 8. Typical impedance**

*Typical values per section unless otherwise specified.*

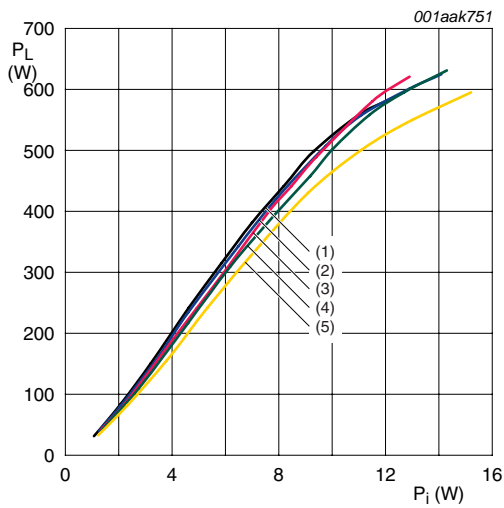
<b>f</b> <b>GHz</b>	<b>Z<sub>S</sub></b> <b>Ω</b>	<b>Z<sub>L</sub></b> <b>Ω</b>
1.2	1.268 – j2.623	2.987 – j1.664
1.3	2.193 – j2.457	2.162 – j1.326
1.4	2.359 – j2.052	1.604 – j1.887



**Fig 1. Definition of transistor impedance**

**7.2 RF performance**

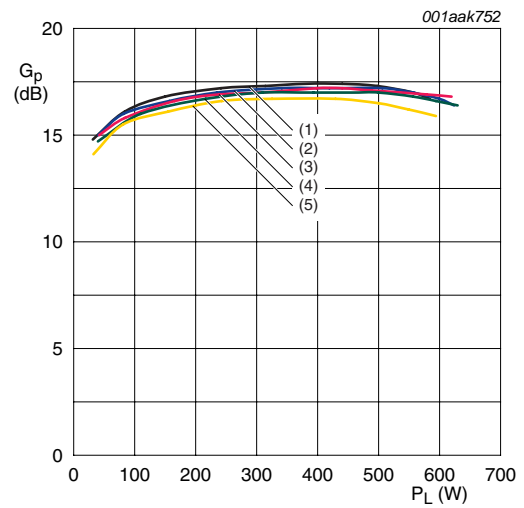
**7.2.1 Performance curves measured with  $\delta = 10\%$ ,  $t_p = 300\ \mu\text{s}$  and  $T_{hs} = 25\ \text{°C}$**



$V_{DS} = 50\ \text{V}$ ;  $t_p = 300\ \mu\text{s}$ ;  $\delta = 10\%$ ;  $I_{Dq} = 150\ \text{mA}$ .

- (1)  $f = 1200\ \text{MHz}$
- (2)  $f = 1250\ \text{MHz}$
- (3)  $f = 1300\ \text{MHz}$
- (4)  $f = 1350\ \text{MHz}$
- (5)  $f = 1400\ \text{MHz}$

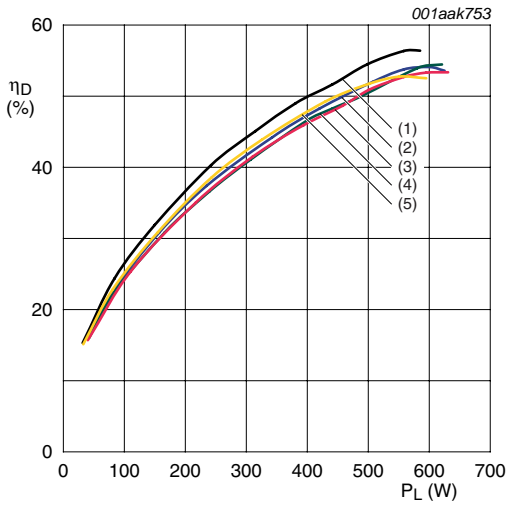
**Fig 2. Output power as a function of input power; typical values**



$V_{DS} = 50\ \text{V}$ ;  $t_p = 300\ \mu\text{s}$ ;  $\delta = 10\%$ ;  $I_{Dq} = 150\ \text{mA}$ .

- (1)  $f = 1200\ \text{MHz}$
- (2)  $f = 1250\ \text{MHz}$
- (3)  $f = 1300\ \text{MHz}$
- (4)  $f = 1350\ \text{MHz}$
- (5)  $f = 1400\ \text{MHz}$

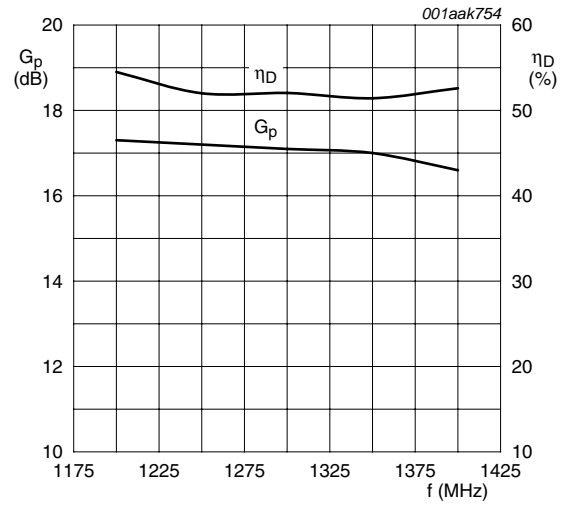
**Fig 3. Power gain as a function of load power; typical values**



$V_{DS} = 50\text{ V}$ ;  $t_p = 300\ \mu\text{s}$ ;  $\delta = 10\%$ ;  $I_{Dq} = 150\text{ mA}$ .

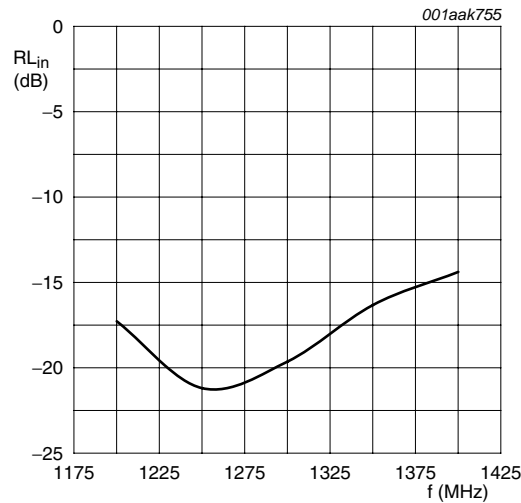
- (1)  $f = 1200\text{ MHz}$
- (2)  $f = 1250\text{ MHz}$
- (3)  $f = 1300\text{ MHz}$
- (4)  $f = 1350\text{ MHz}$
- (5)  $f = 1400\text{ MHz}$

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



$V_{DS} = 50\text{ V}$ ;  $t_p = 300\ \mu\text{s}$ ;  $\delta = 10\%$ ;  $I_{Dq} = 150\text{ mA}$ .

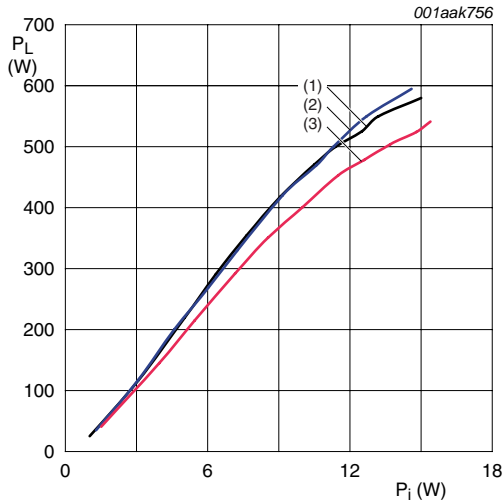
**Fig 5. Power gain and drain efficiency as function of frequency; typical values**



$P_L = 500\text{ W}$ ;  $V_{DS} = 50\text{ V}$ ;  $t_p = 300\ \mu\text{s}$ ;  $\delta = 10\%$ ;  $I_{Dq} = 150\text{ mA}$ .

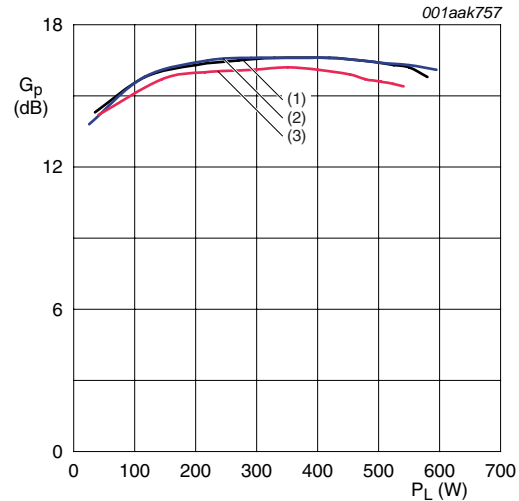
**Fig 6. Input return loss as a function of frequency; typical value**

**7.2.2 Performance curves measured with  $\delta = 10\%$ ,  $t_p = 300 \mu s$  and  $T_{hs} = 65^\circ C$**



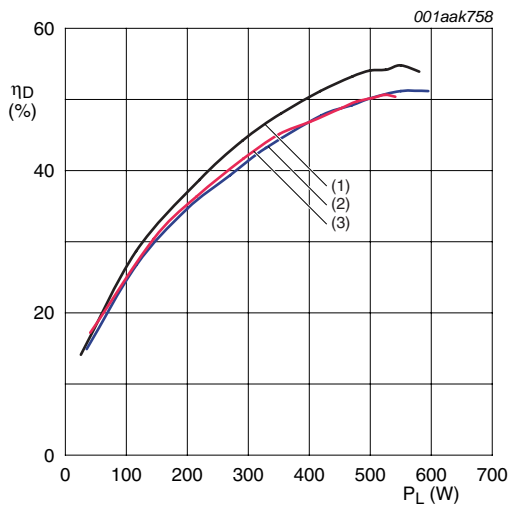
$V_{DS} = 50 V$ ;  $t_p = 300 \mu s$ ;  $\delta = 10\%$ ;  $I_{Dq} = 100 mA$ .  
 (1)  $f = 1200 MHz$   
 (2)  $f = 1300 MHz$   
 (3)  $f = 1400 MHz$

**Fig 7. Output power as a function of input power; typical values**



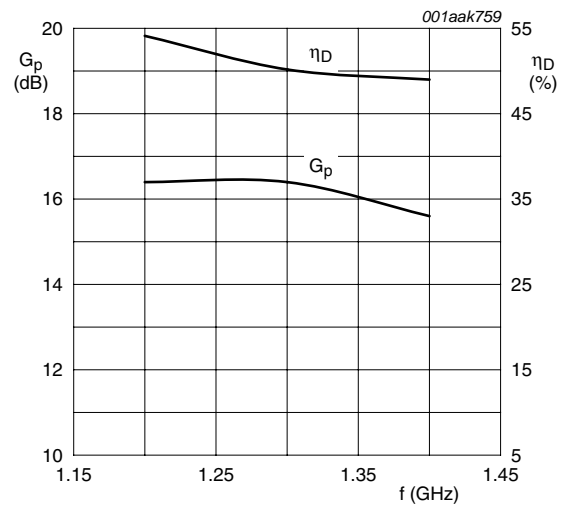
$V_{DS} = 50 V$ ;  $t_p = 300 \mu s$ ;  $\delta = 10\%$ ;  $I_{Dq} = 100 mA$ .  
 (1)  $f = 1200 MHz$   
 (2)  $f = 1300 MHz$   
 (3)  $f = 1400 MHz$

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



$V_{DS} = 50 V$ ;  $t_p = 300 \mu s$ ;  $\delta = 10\%$ ;  $I_{Dq} = 100 mA$ .  
 (1)  $f = 1200 MHz$   
 (2)  $f = 1300 MHz$   
 (3)  $f = 1400 MHz$

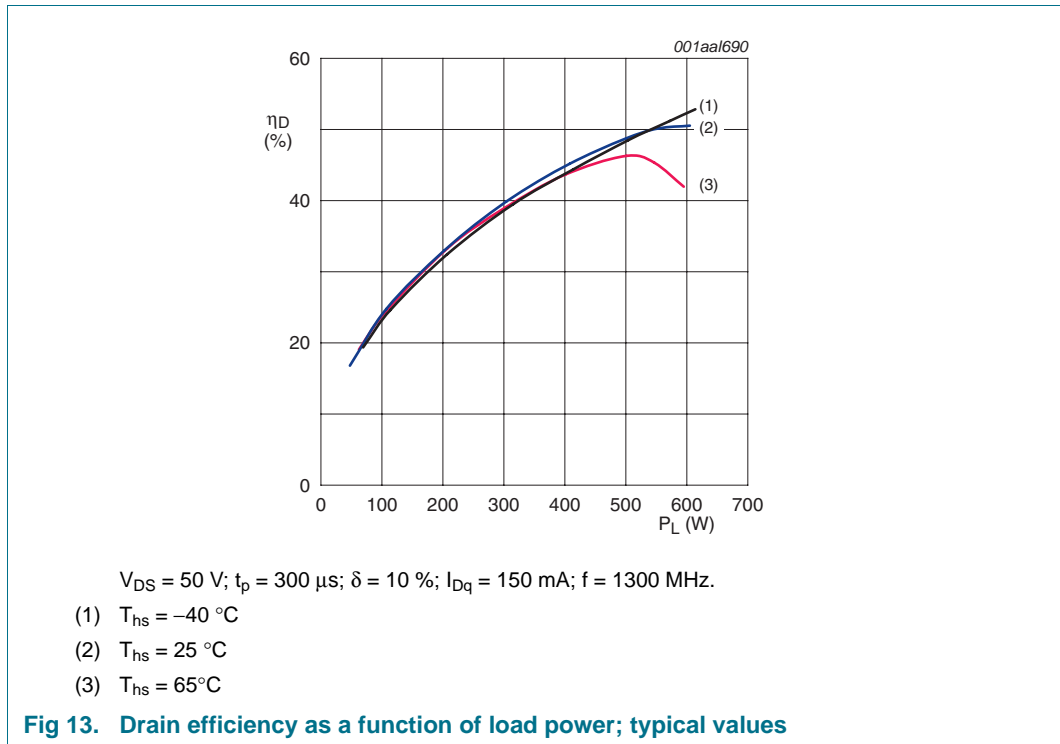
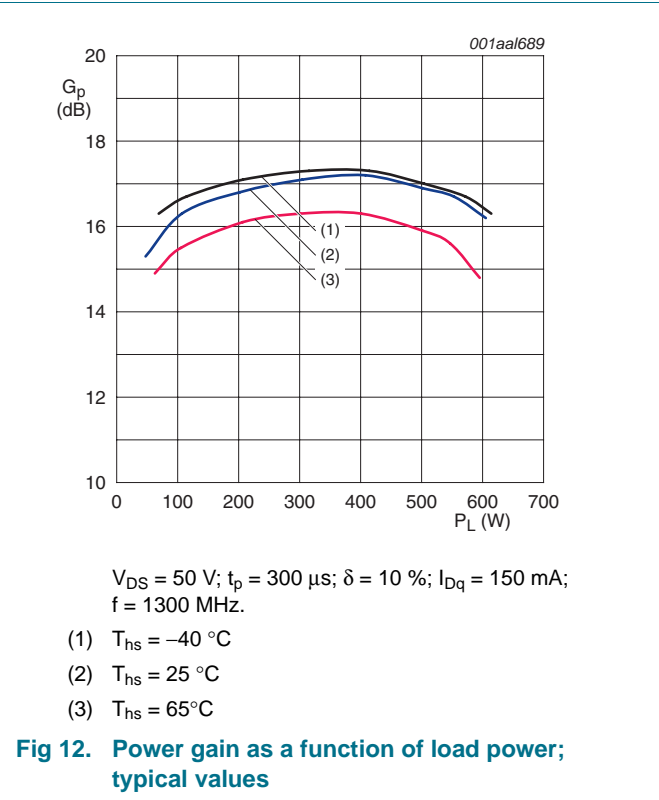
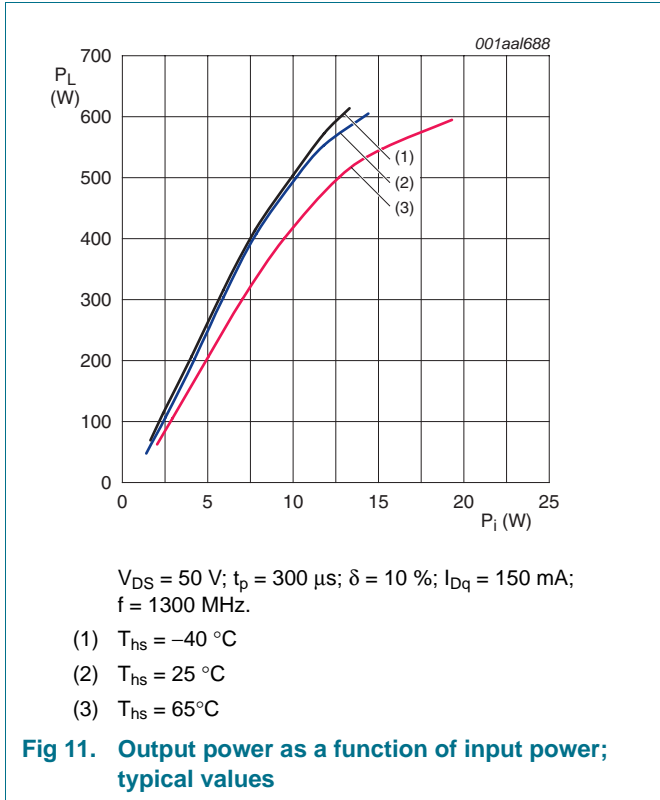
**Fig 9. Drain efficiency as a function of load power; typical values**



$P_L = 250 W$ ;  $V_{DS} = 50 V$ ;  $t_p = 300 \mu s$ ;  $\delta = 10\%$ ;  $I_{Dq} = 100 mA$ .

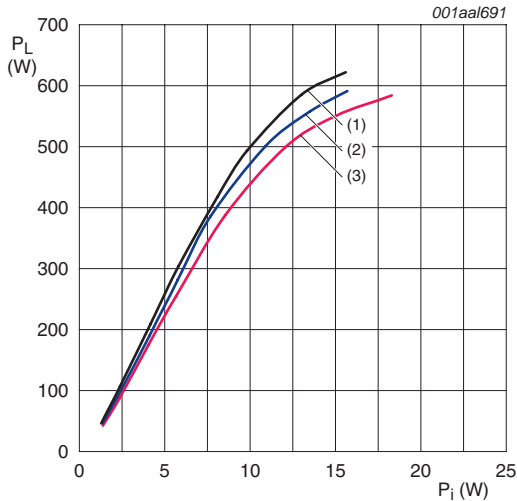
**Fig 10. Power gain and drain efficiency as function of frequency; typical values**

**7.2.3 Performance curves measured with  $\delta = 10\%$ ,  $t_p = 300\ \mu\text{s}$  and  $f = 1300\ \text{MHz}$**



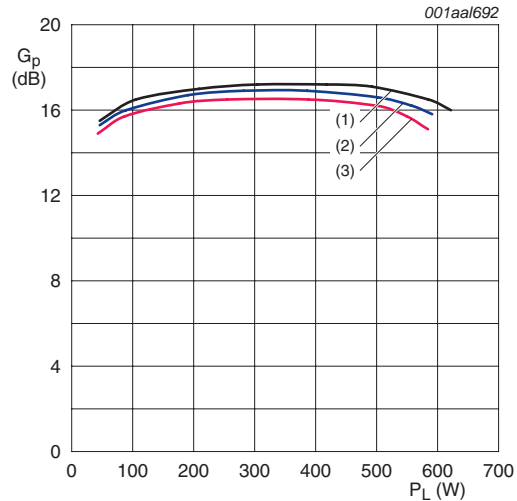


**7.2.4 Performance curves measured with  $\delta = 20\%$ ,  $t_p = 500 \mu s$  and  $T_{hs} = 25^\circ C$**



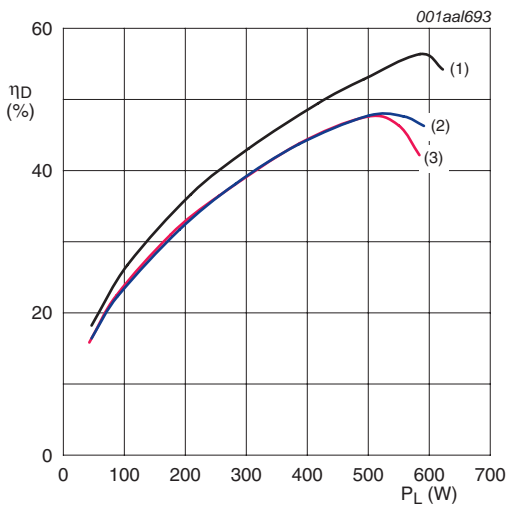
$V_{DS} = 50 V$ ;  $t_p = 500 \mu s$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150 mA$ .  
 (1)  $f = 1200 MHz$   
 (2)  $f = 1300 MHz$   
 (3)  $f = 1400 MHz$

**Fig 14. Output power as a function of input power; typical values**



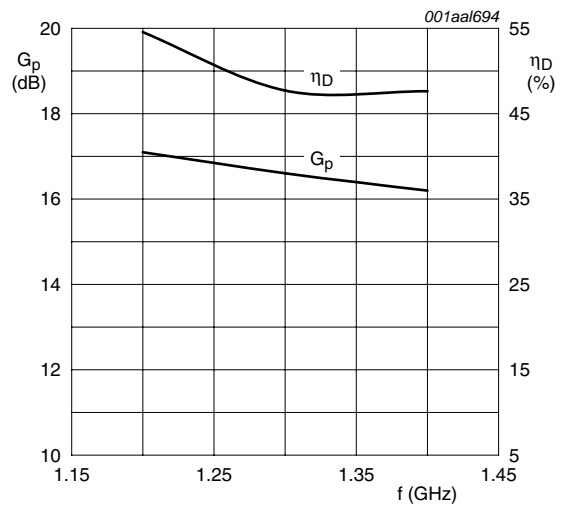
$V_{DS} = 50 V$ ;  $t_p = 500 \mu s$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150 mA$ .  
 (1)  $f = 1200 MHz$   
 (2)  $f = 1300 MHz$   
 (3)  $f = 1400 MHz$

**Fig 15. Power gain as a function of load power; typical values**



$V_{DS} = 50 V$ ;  $t_p = 500 \mu s$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150 mA$ .  
 (1)  $f = 1200 MHz$   
 (2)  $f = 1300 MHz$   
 (3)  $f = 1400 MHz$

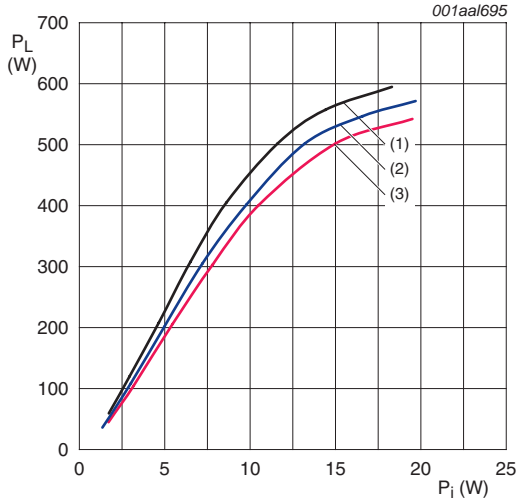
**Fig 16. Drain efficiency as a function of load power; typical values**



$V_{DS} = 50 V$ ;  $t_p = 500 \mu s$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150 mA$ .

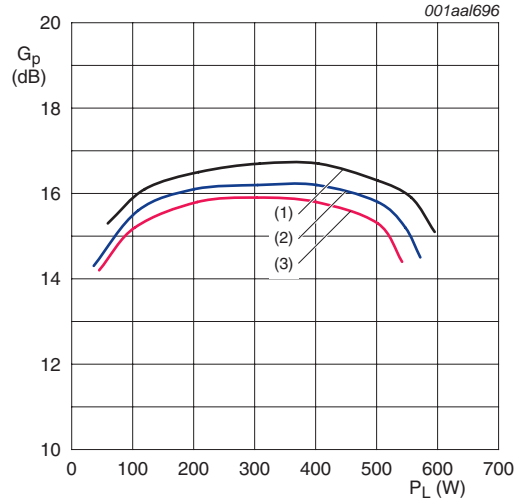
**Fig 17. Power gain and drain efficiency as function of frequency; typical values**

**7.2.5 Performance curves measured with  $\delta = 20\%$ ,  $t_p = 500 \mu s$  and  $T_{hs} = 65^\circ C$**



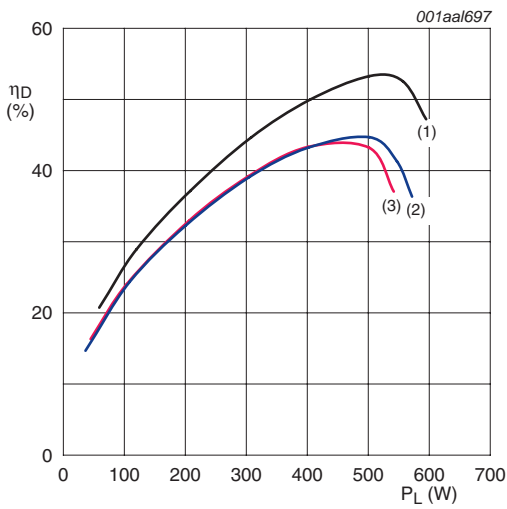
$V_{DS} = 50 V$ ;  $t_p = 500 \mu s$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150 mA$ .  
 (1)  $f = 1200 MHz$   
 (2)  $f = 1300 MHz$   
 (3)  $f = 1400 MHz$

**Fig 18. Output power as a function of input power; typical values**



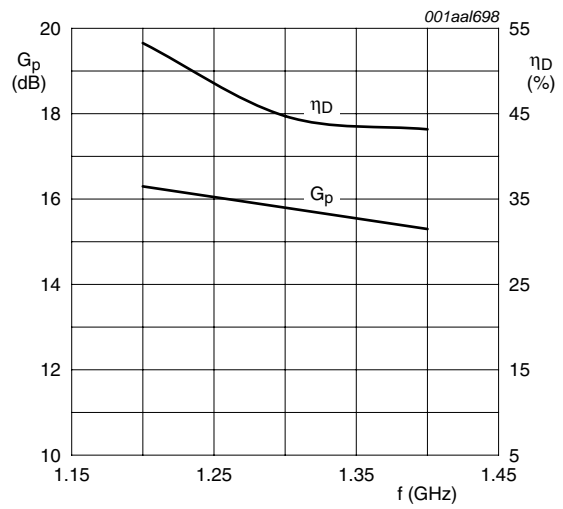
$V_{DS} = 50 V$ ;  $t_p = 500 \mu s$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150 mA$ .  
 (1)  $f = 1200 MHz$   
 (2)  $f = 1300 MHz$   
 (3)  $f = 1400 MHz$

**Fig 19. Power gain as a function of load power; typical values**



$V_{DS} = 50 V$ ;  $t_p = 500 \mu s$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150 mA$ .  
 (1)  $f = 1200 MHz$   
 (2)  $f = 1300 MHz$   
 (3)  $f = 1400 MHz$

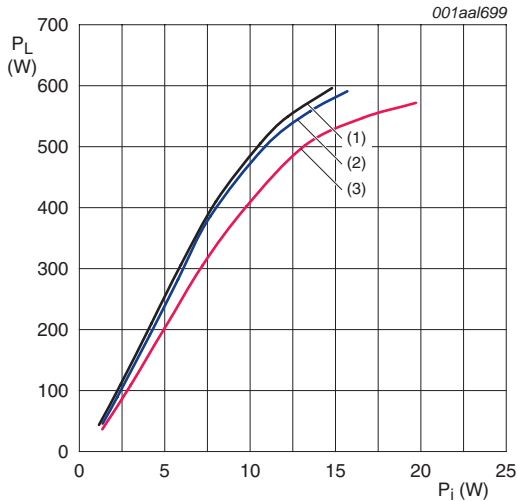
**Fig 20. Drain efficiency as a function of load power; typical values**



$V_{DS} = 50 V$ ;  $t_p = 500 \mu s$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150 mA$ .

**Fig 21. Power gain and drain efficiency as function of frequency; typical values**

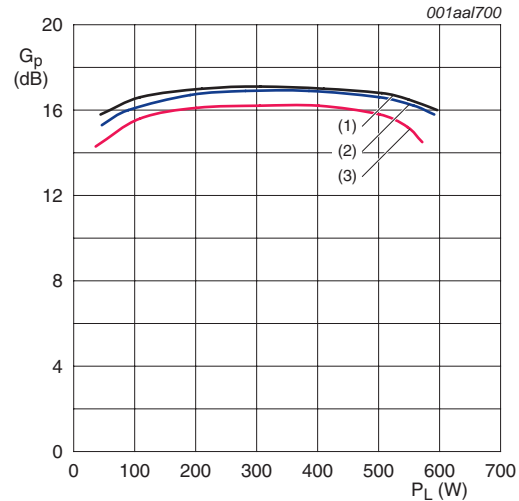
**7.2.6 Performance curves measured with  $\delta = 20\%$ ,  $t_p = 500 \mu s$  and  $f = 1300$  MHz**



$V_{DS} = 50$  V;  $t_p = 500 \mu s$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150$  mA;  $f = 1300$  MHz.

- (1)  $T_{hs} = -40$  °C
- (2)  $T_{hs} = 25$  °C
- (3)  $T_{hs} = 65$  °C

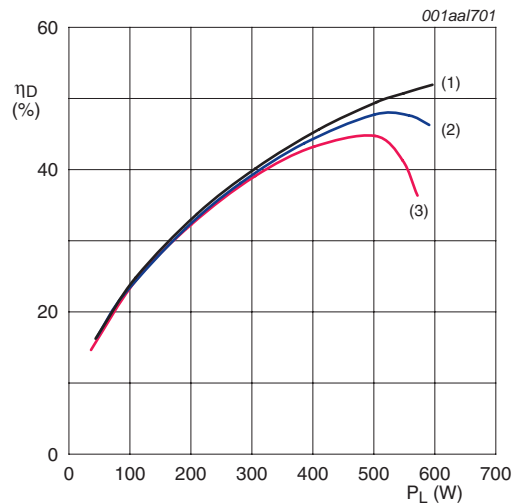
**Fig 22. Output power as a function of input power; typical values**



$V_{DS} = 50$  V;  $t_p = 500 \mu s$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150$  mA;  $f = 1300$  MHz.

- (1)  $T_{hs} = -40$  °C
- (2)  $T_{hs} = 25$  °C
- (3)  $T_{hs} = 65$  °C

**Fig 23. Power gain as a function of load power; typical values**

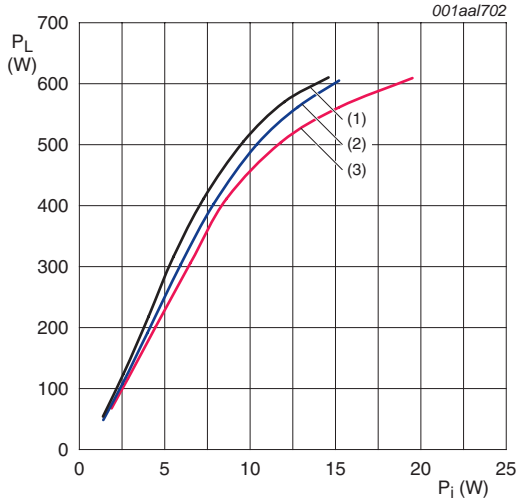


$V_{DS} = 50$  V;  $t_p = 500 \mu s$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150$  mA;  $f = 1300$  MHz.

- (1)  $T_{hs} = -40$  °C
- (2)  $T_{hs} = 25$  °C
- (3)  $T_{hs} = 65$  °C

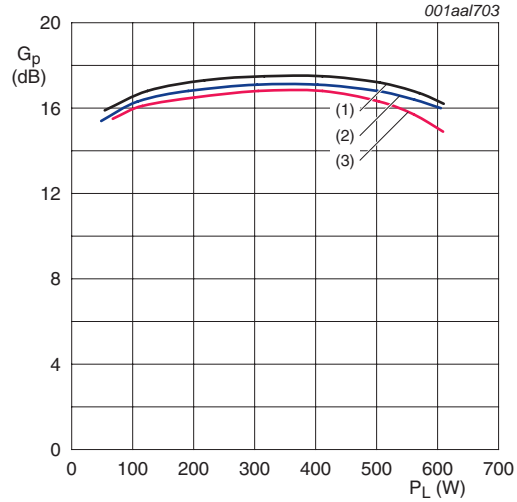
**Fig 24. Drain efficiency as a function of load power; typical values**

**7.2.7 Performance curves measured with  $\delta = 10\%$ ,  $t_p = 1\text{ ms}$  and  $T_{hs} = 25\text{ }^\circ\text{C}$**



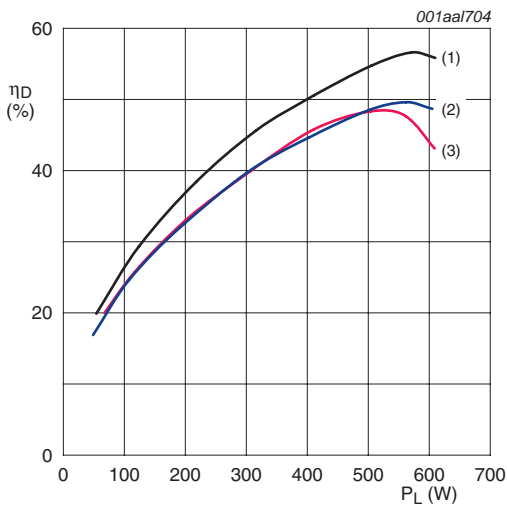
$V_{DS} = 50\text{ V}$ ;  $t_p = 500\text{ }\mu\text{s}$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150\text{ mA}$ .  
 (1)  $f = 1200\text{ MHz}$   
 (2)  $f = 1300\text{ MHz}$   
 (3)  $f = 1400\text{ MHz}$

**Fig 25. Output power as a function of input power; typical values**



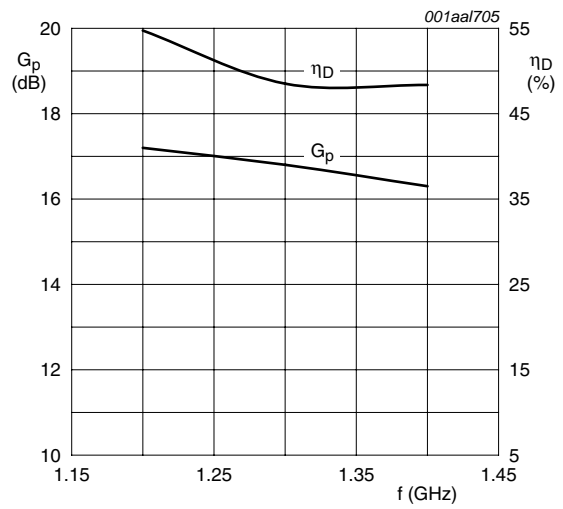
$V_{DS} = 50\text{ V}$ ;  $t_p = 500\text{ }\mu\text{s}$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150\text{ mA}$ .  
 (1)  $f = 1200\text{ MHz}$   
 (2)  $f = 1300\text{ MHz}$   
 (3)  $f = 1400\text{ MHz}$

**Fig 26. Power gain as a function of load power; typical values**



$V_{DS} = 50\text{ V}$ ;  $t_p = 500\text{ }\mu\text{s}$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150\text{ mA}$ .  
 (1)  $f = 1200\text{ MHz}$   
 (2)  $f = 1300\text{ MHz}$   
 (3)  $f = 1400\text{ MHz}$

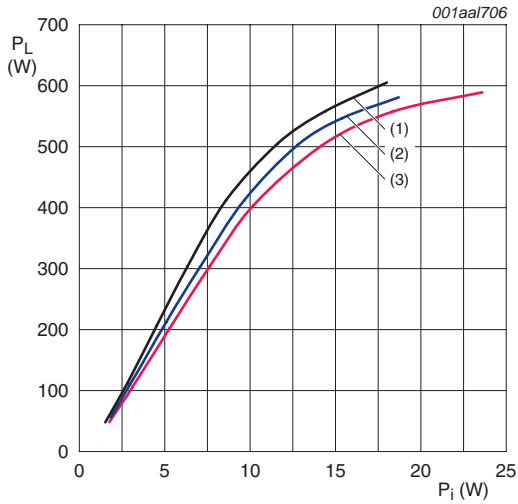
**Fig 27. Drain efficiency as a function of load power; typical values**



$V_{DS} = 50\text{ V}$ ;  $t_p = 500\text{ }\mu\text{s}$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150\text{ mA}$ .

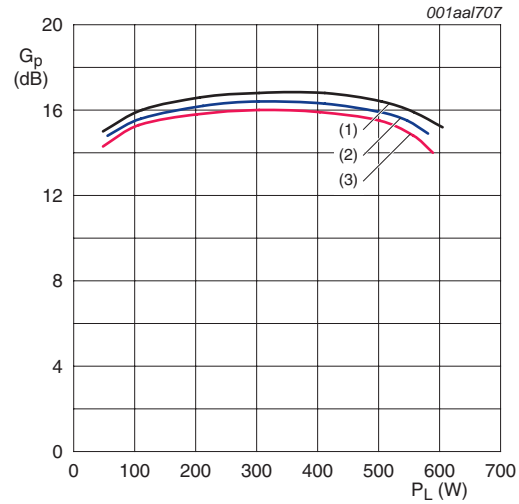
**Fig 28. Power gain and drain efficiency as function of frequency; typical values**

**7.2.8 Performance curves measured with  $\delta = 10\%$ ,  $t_p = 1\text{ ms}$  and  $T_{hs} = 65\text{ }^\circ\text{C}$**



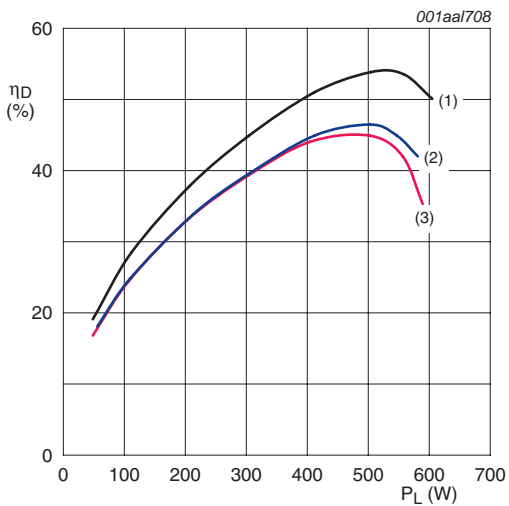
$V_{DS} = 50\text{ V}$ ;  $t_p = 500\text{ }\mu\text{s}$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150\text{ mA}$ .  
 (1)  $f = 1200\text{ MHz}$   
 (2)  $f = 1300\text{ MHz}$   
 (3)  $f = 1400\text{ MHz}$

**Fig 29. Output power as a function of input power; typical values**



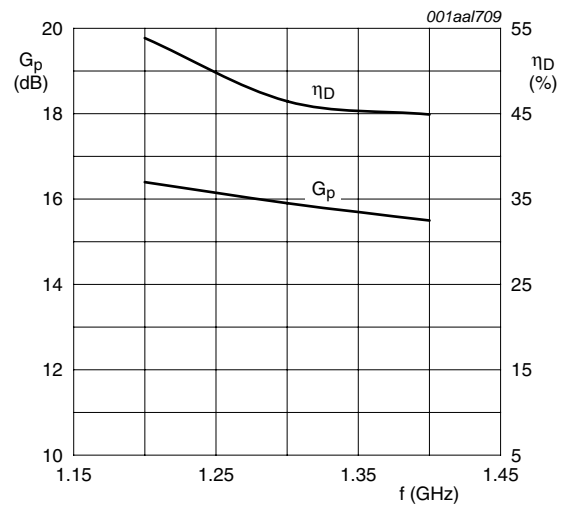
$V_{DS} = 50\text{ V}$ ;  $t_p = 500\text{ }\mu\text{s}$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150\text{ mA}$ .  
 (1)  $f = 1200\text{ MHz}$   
 (2)  $f = 1300\text{ MHz}$   
 (3)  $f = 1400\text{ MHz}$

**Fig 30. Power gain as a function of load power; typical values**



$V_{DS} = 50\text{ V}$ ;  $t_p = 500\text{ }\mu\text{s}$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150\text{ mA}$ .  
 (1)  $f = 1200\text{ MHz}$   
 (2)  $f = 1300\text{ MHz}$   
 (3)  $f = 1400\text{ MHz}$

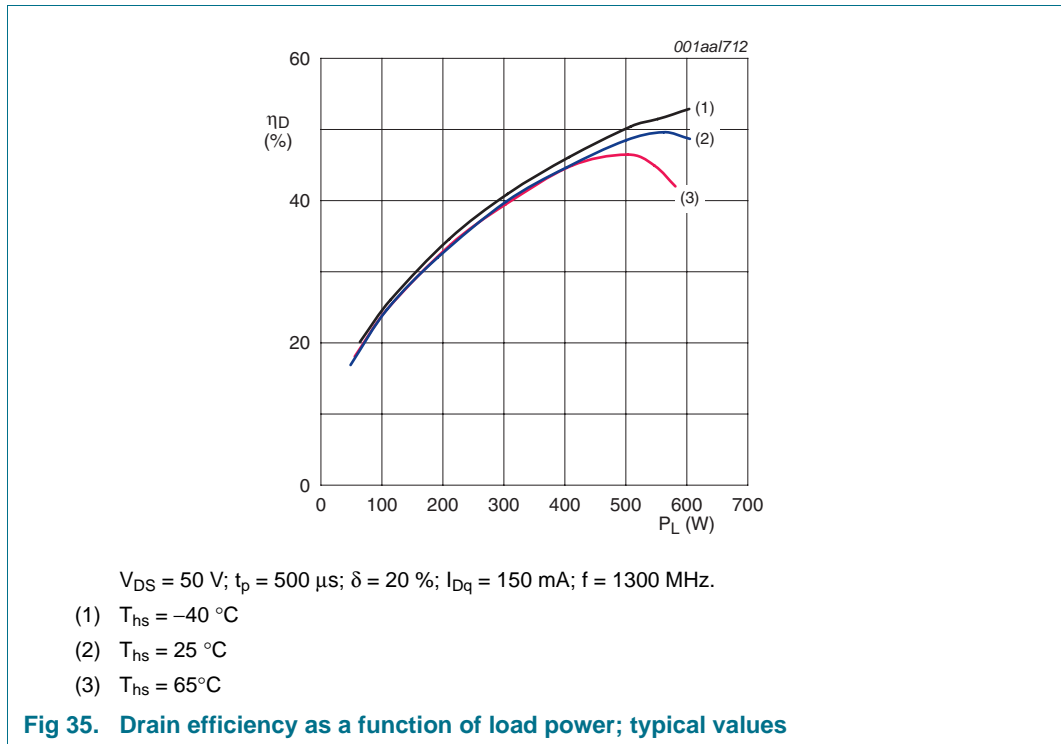
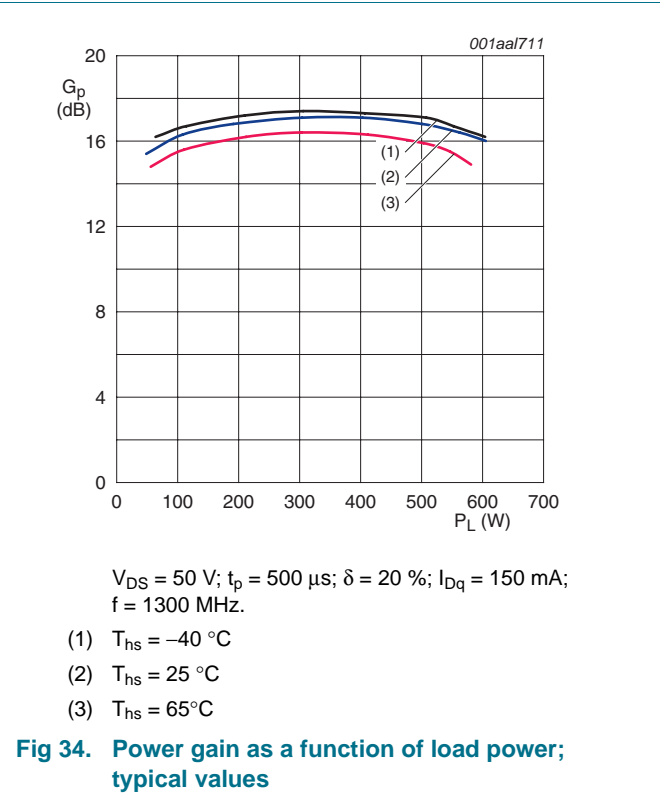
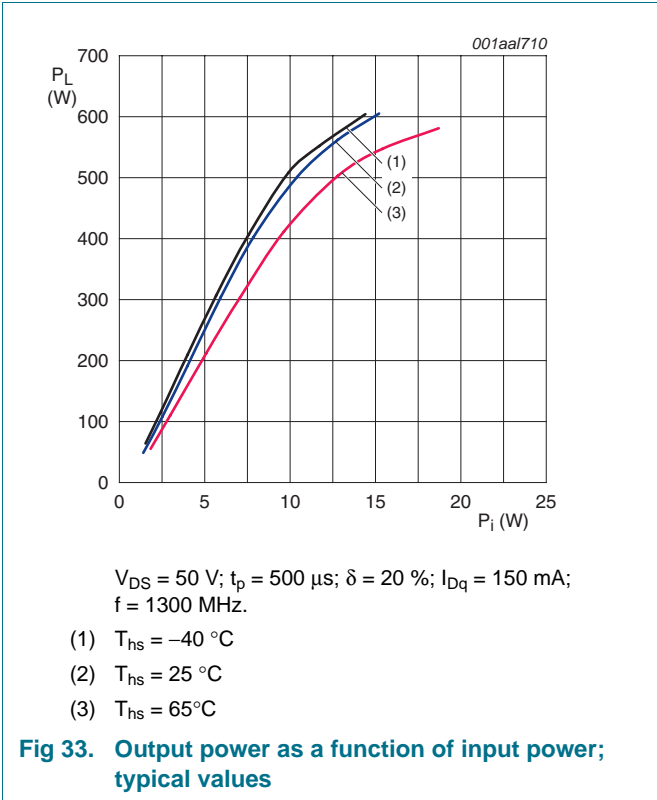
**Fig 31. Drain efficiency as a function of load power; typical values**



$V_{DS} = 50\text{ V}$ ;  $t_p = 500\text{ }\mu\text{s}$ ;  $\delta = 20\%$ ;  $I_{Dq} = 150\text{ mA}$ .

**Fig 32. Power gain and drain efficiency as function of frequency; typical values**

**7.2.9 Performance curves measured with  $\delta = 10\%$ ,  $t_p = 1\text{ ms}$  and  $f = 1300\text{ MHz}$**



## 8. Test information

**Table 9. List of components**

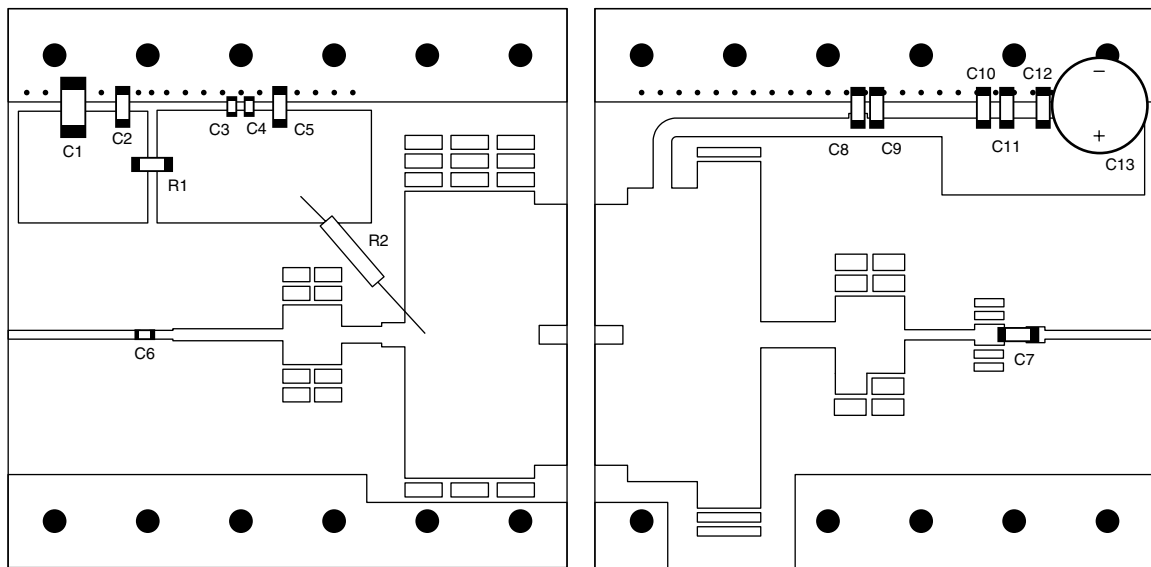
For test circuit see [Figure 36](#).

Component	Description	Value	Remarks
C1	multilayer ceramic chip capacitor	22 $\mu$ F; 35 V	
C2	multilayer ceramic chip capacitor	51 pF	[1]
C3, C4	multilayer ceramic chip capacitor	100 pF	[1]
C5, C11, C12	multilayer ceramic chip capacitor	1 nf	[2]
C6	multilayer ceramic chip capacitor	47 pF	[1]
C7, C8, C10	multilayer ceramic chip capacitor	51 pF	[3]
C9	multilayer ceramic chip capacitor	100 pF	[3]
C13	electrolytic capacitor	10 $\mu$ F; 63 V	
R1	SMD resistor	56 $\Omega$	0603
R2	metal film resistor	51 $\Omega$	

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

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

[3] American Technical Ceramics type 800B or capacitor of same quality.



001aa/490

Printed-Circuit Board (PCB): Duroid 6006;  $\epsilon_r = 6.15$  F/m; thickness = 0.64 mm; thickness copper plating = 35  $\mu$ m.

See [Table 9](#) for a list of components.

**Fig 36. Component layout for class-AB production test circuit**

**9. Package outline**

Flanged balanced LDMOST ceramic package; 2 mounting holes; 4 leads

SOT539A

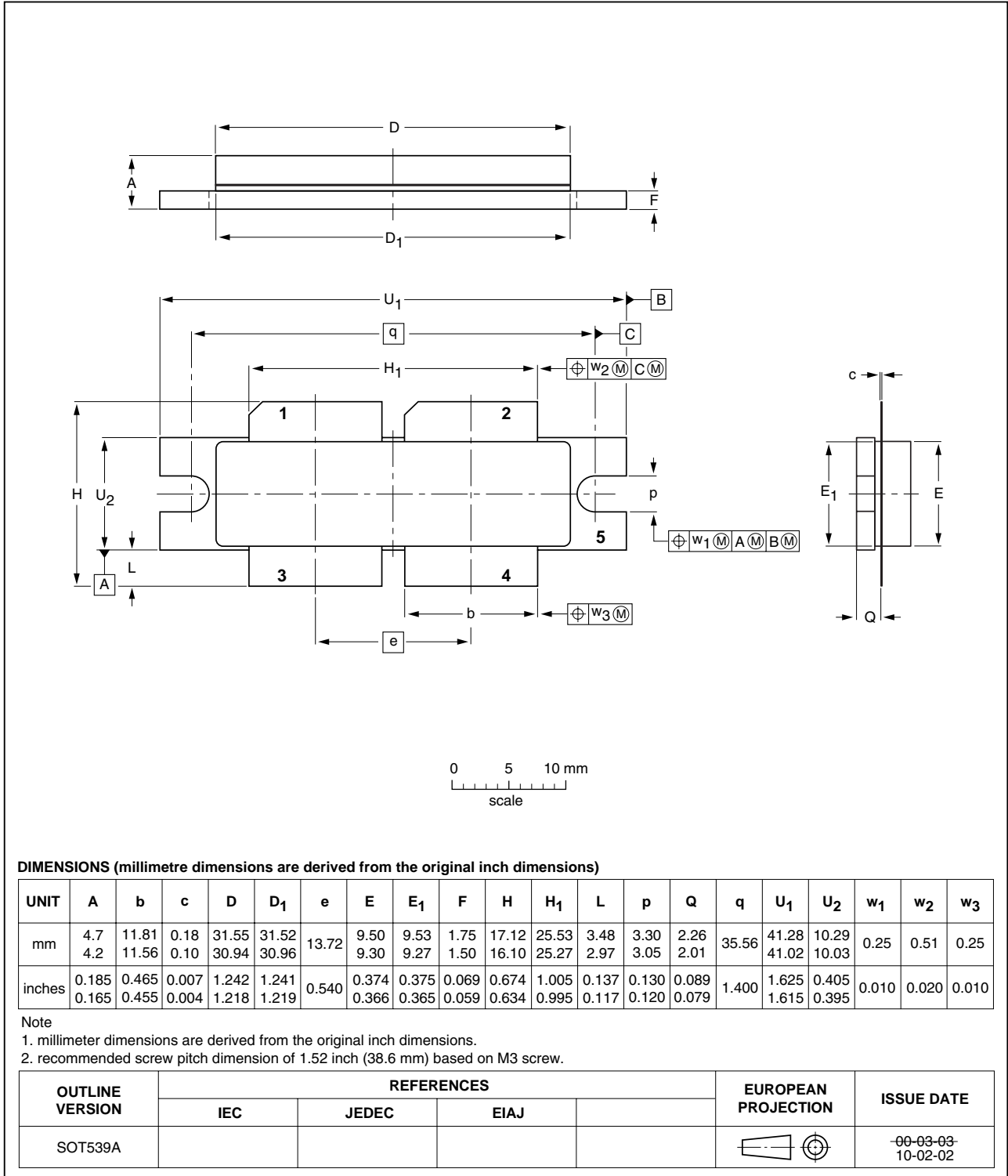


Fig 37. Package outline SOT539A



## 10. Abbreviations

**Table 10. Abbreviations**

Acronym	Description
LDMOS	Laterally Diffused Metal-Oxide Semiconductor
LDMOST	Laterally Diffused Metal-Oxide Semiconductor Transistor
RF	Radio Frequency
SMD	Surface Mounted Device
L-band	Long wave Band
VSWR	Voltage Standing-Wave Ratio

## 11. Revision history

**Table 11. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
BLL6H1214-500_2	20100401	Product data sheet	-	BLL6H1214-500_1
Modifications:	<ul style="list-style-type: none"> <li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>• Legal texts have been adapted to the new company name where appropriate.</li> <li>• The status of this data sheet has been changed to "Product data sheet"</li> <li>• Added <a href="#">Section 7.2.3 on page 8</a>.</li> <li>• Added <a href="#">Section 7.2.4 on page 9</a>.</li> <li>• Added <a href="#">Section 7.2.5 on page 10</a>.</li> <li>• Added <a href="#">Section 7.2.6 on page 11</a>.</li> <li>• Added <a href="#">Section 7.2.7 on page 12</a>.</li> <li>• Added <a href="#">Section 7.2.8 on page 13</a>.</li> <li>• Added <a href="#">Section 7.2.9 on page 14</a>.</li> </ul>			
BLL6H1214-500_1	20090120	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.

[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>.

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