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Thank you for your cooperation and understanding,

Ampleon

UHF power MOS transistor BLF404

FEATURES

- High power gain
- Easy power control
- Gold metallization
- Good thermal stability
- Withstands full load mismatch
- Designed for broadband operation.

APPLICATIONS

- Communication transmitters in the VHF/UHF range with a nominal supply voltage of 12.5 V.

DESCRIPTION

Silicon N-channel enhancement mode vertical D-MOS power transistor in an 8-lead SOT409A SMD package with a ceramic cap.

PINNING - SOT409A

PIN	DESCRIPTION
1, 8	source
2, 3	gate
4, 5	source
6, 7	drain

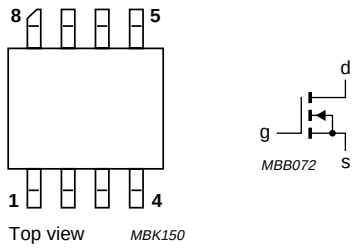


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

RF performance at $T_{mb} \leq 60$ °C in a common source test circuit.

MODE OF OPERATION	f (MHz)	V_{DS} (V)	P_L (W)	G_p (dB)	η_D (%)
CW class-AB	500	12.5	4	≥10	≥50

CAUTION
This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A, and SNW-FQ-302B.

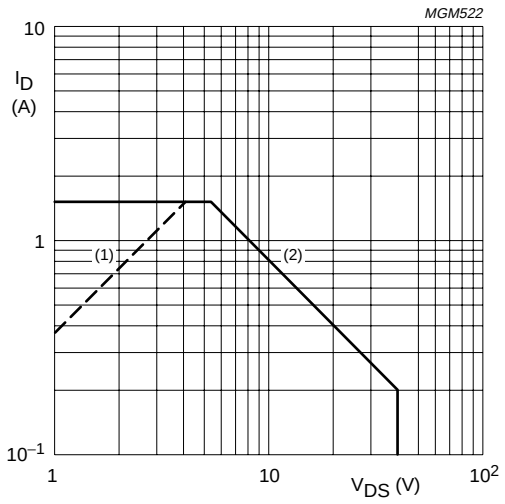
LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	40	V
V_{GS}	gate-source voltage		–	±20	V
I_D	drain current (DC)		–	1.5	A
P_{tot}	total power dissipation	$T_{mb} \leq 85$ °C	–	8.3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_{mb} \leq 85$ °C, P_{tot} = 8.3 W	12.1	K/W



(1) Current in this area may be limited by R_{DSon}.
(2) T_{mb} = 85 °C.

Fig.2 DC SOAR.

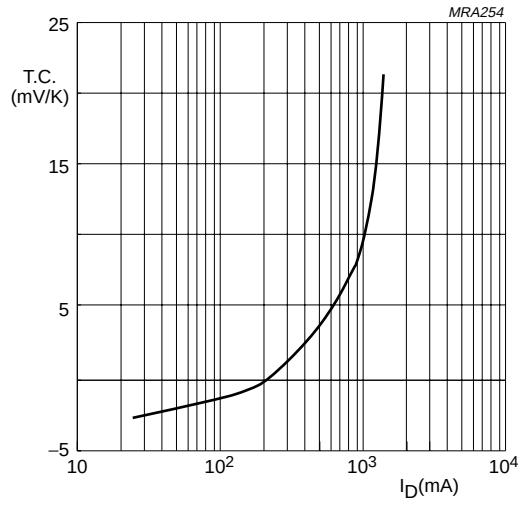
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	V_{GS} = 0; I_D = 5 mA	40	–	–	V
V_{GSth}	gate-source threshold voltage	I_D = 50 mA; V_{DS} = 10 V	2	–	4.5	V
I_{DSS}	drain-source leakage current	V_{GS} = 0; V_{DS} = 12.5 V	–	–	0.5	mA
I_{GSS}	gate-source leakage current	V_{GS} = ±20 V; V_{DS} = 0	–	–	1	μA
I_{DSX}	on-state drain current	V_{GS} = 15 V; V_{DS} = 10 V	–	2.3	–	A
R_{DSon}	drain-source on-state resistance	I_D = 0.7 A; V_{GS} = 15 V	–	1.8	2.7	Ω
g_{fs}	forward transconductance	I_D = 0.7 A; V_{DS} = 10 V	200	270	–	mS
C_{is}	input capacitance	V_{GS} = 0; V_{DS} = 12.5 V; f = 1 MHz	–	14	–	pF
C_{os}	output capacitance	V_{GS} = 0; V_{DS} = 12.5 V; f = 1 MHz	–	17	–	pF
C_{rs}	feedback capacitance	V_{GS} = 0; V_{DS} = 12.5 V; f = 1 MHz	–	3	–	pF

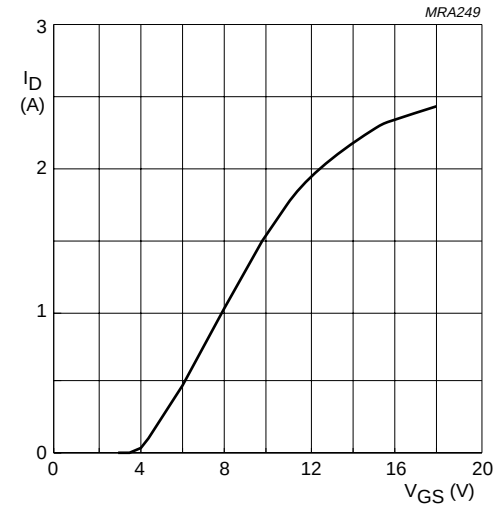
V_{GS} group indicator

GROUP	LIMITS (V)		GROUP	LIMITS (V)	
	MIN.	MAX.		MIN.	MAX.
A	2.0	2.1	O	3.3	3.4
B	2.1	2.2	P	3.4	3.5
C	2.2	2.3	Q	3.5	3.6
D	2.3	2.4	R	3.6	3.7
E	2.4	2.5	S	3.7	3.8
F	2.5	2.6	T	3.8	3.9
G	2.6	2.7	U	3.9	4.0
H	2.7	2.8	V	4.0	4.1
J	2.8	2.9	W	4.1	4.2
K	2.9	3.0	X	4.2	4.3
L	3.0	3.1	Y	4.3	4.4
M	3.1	3.2	Z	4.4	4.5
N	3.2	3.3			



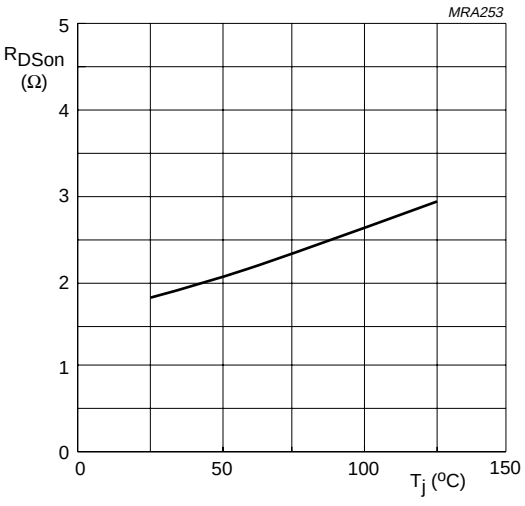
V_{DS} = 10 V.

Fig.3 Temperature coefficient of gate-source voltage as a function of drain current; typical values.



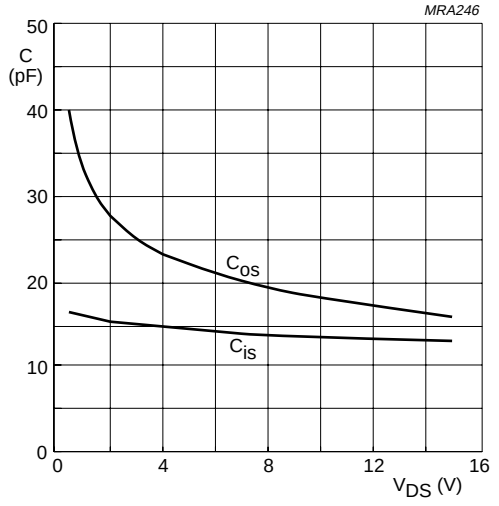
V_{DS} = 10 V; T_j = 25 °C.

Fig.4 Drain current as a function of gate-source voltage; typical values.



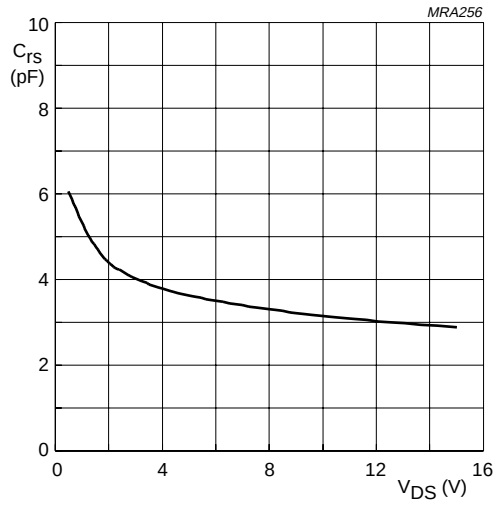
I_D = 0.7 A; V_{GS} = 15 V.

Fig.5 Drain-source on-state resistance as a function of junction temperature; typical values.



V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

Fig.6 Input and output capacitance as functions of drain-source voltage; typical values.



V_{GS} = 0; f = 1 MHz; T_j = 25 °C.

Fig.7 Feedback capacitance as a function of drain-source voltage; typical values.

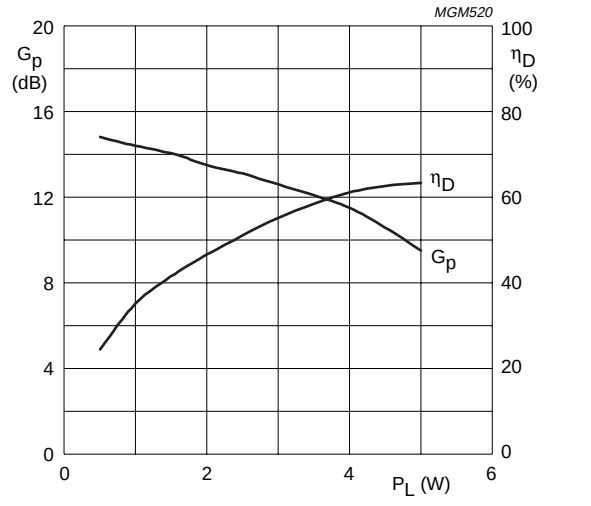
APPLICATION INFORMATION

RF performance at $T_{mb} \leq 60$ °C in a common source test circuit with the device soldered on a printed-circuit board with through metallized holes.

MODE OF OPERATION	f (MHz)	V_{DS} (V)	I_{DQ} (A)	P_L (W)	G_p (dB)	η_D (%)
CW, class-AB	500	12.5	50	4	≥10 typ. 11.5	≥50 typ. 55

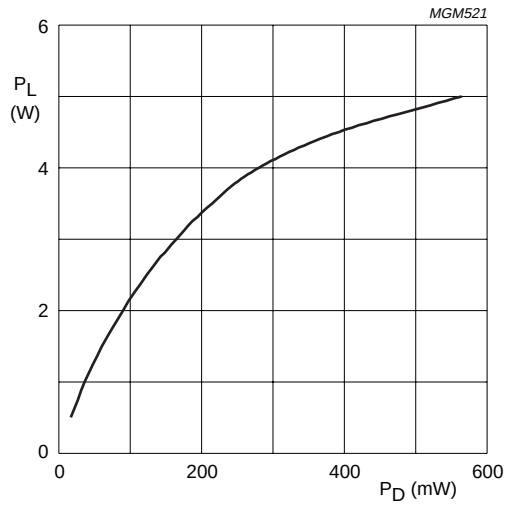
Ruggedness in class-AB operation

The BLF404 is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions: f = 500 MHz; V_{DS} = 12.5 V; P_L = 4 W; $T_{mb} \leq 60$ °C.



CW, class-AB operation; f = 500 MHz; V_{DS} = 12.5 V; I_{DQ} = 50 mA; $T_{mb} \leq 60$ °C.

Fig.8 Power gain and drain efficiency as functions of load power; typical values.



CW, class-AB operation; f = 500 MHz; V_{DS} = 12.5 V; I_{DQ} = 50 mA; $T_{mb} \leq 60$ °C.

Fig.9 Load power as a function of drive power; typical values.

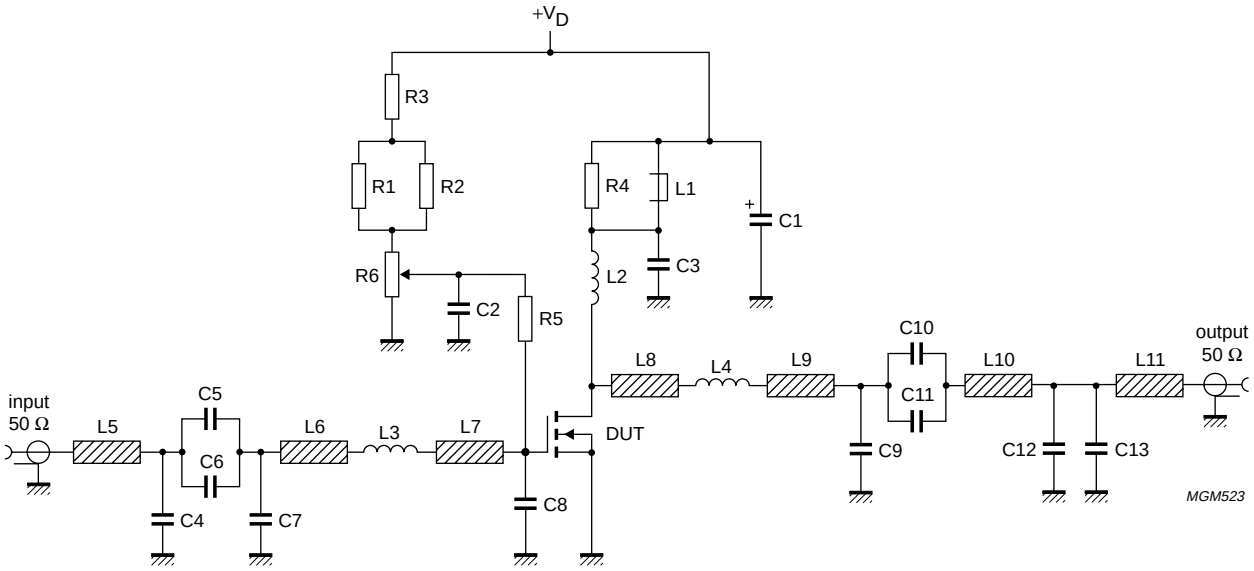


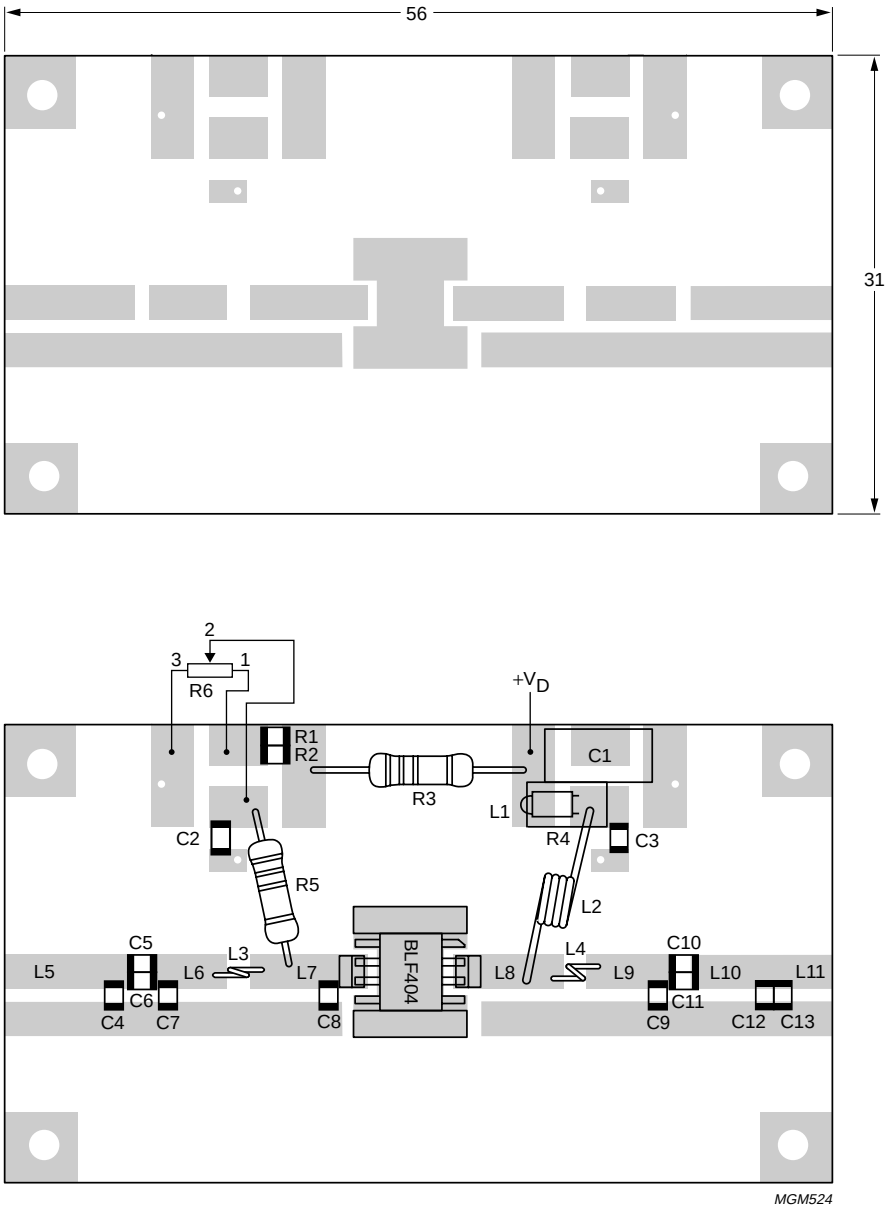
Fig.10 Test circuit for class-AB operation at f = 500 MHz.

List of components; see Figs 10 and 11.

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1	electrolytic capacitor	4.7 μF, 10 V		
C2, C3	multilayer ceramic chip capacitor	47 nF		
C4	multilayer ceramic chip capacitor; note 1	18 pF		
C5, C10	multilayer ceramic chip capacitor; note 1	180 pF		
C6, C11	multilayer ceramic chip capacitor; note 1	270 pF		
C7	multilayer ceramic chip capacitor; note 1	22 pF		
C8	multilayer ceramic chip capacitor; note 1	8.2 pF		
C9	multilayer ceramic chip capacitor; note 1	2.7 pF		
C12	multilayer ceramic chip capacitor; note 1	1.2 pF		
C13	multilayer ceramic chip capacitor; note 1	12 pF		
L1	2 turns 1 mm enamelled copper wire on a grade 4B1 Ferroxcube core		ext. dia. = 4.2 mm int. dia. = 2 mm length = 6 mm	
L2	3 turns 1 mm enamelled copper wire		int. dia. = 4.6 mm leads = 2 x 5 mm	
L3	bifilar coil		lead dia. = 0.8 mm	
L4	bifilar coil		lead dia. = 1 mm	
L5	stripline; note 2	50 Ω	8.8 × 2.38 mm	
L6	stripline; note 2	50 Ω	5.8 × 2.38 mm	
L7	stripline; note 2	50 Ω	6.8 × 2.38 mm	
L8	stripline; note 2	50 Ω	3.76 × 2.38 mm	
L9	stripline; note 2	50 Ω	5.8 × 2.38 mm	
L10	stripline; note 2	50 Ω	4.48 × 2.38 mm	
L11	stripline; note 2	50 Ω	3.13 × 2.38 mm	
R1, R2	SMD resistor	3.9 kΩ		
R3	metal film resistor	1 kΩ, 0.25 W		
R4	metal film resistor	22 Ω, 0.25 W		
R5	metal film resistor	10 kΩ, 0.25 W		
R6	potentiometer	10 kΩ		

Notes

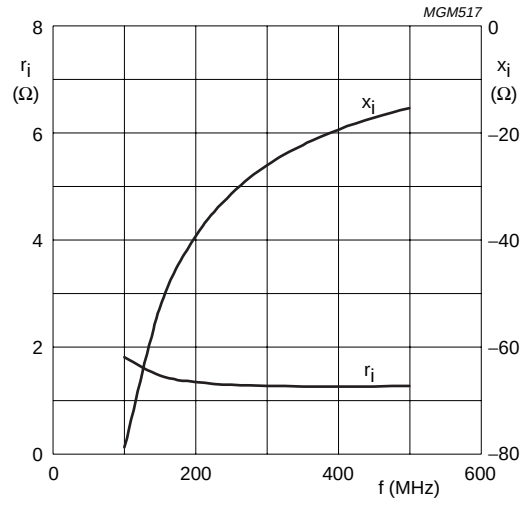
1. American Technical Ceramics type 100A or capacitor of same quality.
2. The striplines are on a double copper-clad printed-circuit board, with DUROID dielectric (ε_r = 2.2); thickness 0.79 mm, thickness of the copper sheet 2 x 35 μm.



Dimensions in mm.

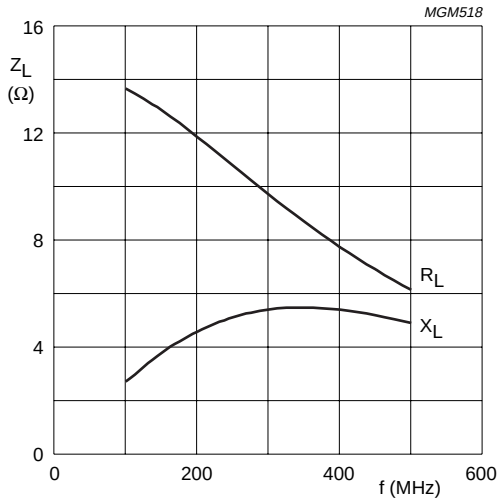
The components are situated on one side of the copper-clad printed-circuit board, the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.11 Component layout for 500 MHz class-AB test circuit.



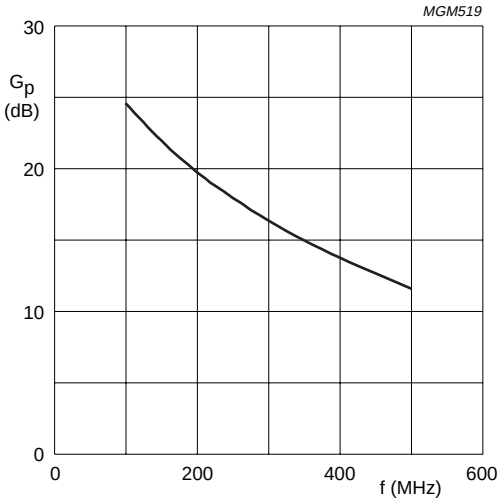
CW, class-AB operation; V_{DS} = 12.5 V; I_D = 50 mA;
P_L = 4 W; $T_{mb} \leq 60$ °C.

Fig.12 Input impedance as a function of frequency (series components); typical values.



CW, class-AB operation; V_{DS} = 12.5 V; I_D = 50 mA;
P_L = 4 W; $T_{mb} \leq 60$ °C.

Fig.13 Load impedance as a function of frequency (series components); typical values.



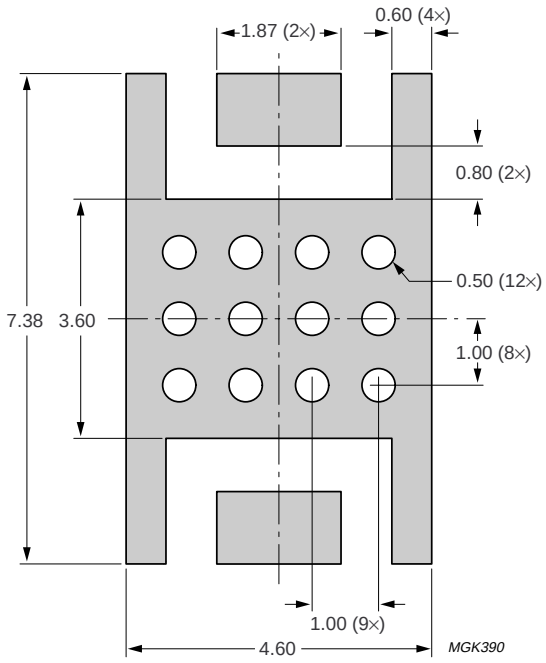
CW, class-AB operation; V_{DS} = 12.5 V; I_{DQ} = 50 mA;
P_L = 4 W; $T_{mb} \leq 60$ °C.

Fig.14 Power gain as a function of frequency (series components); typical values.

MOUNTING RECOMMENDATIONS

Both the metallized ground plate and the device leads contribute to the heat flow. It is recommended that the transistor be mounted on a grounded metallized area of the printed-circuit board. This area should be of maximum 0.8 mm thickness and include at least 12 x 0.5 diameter through metallized holes filled with solder.

A thermal resistance $R_{th(mb-h)}$ of 5 K/W can be achieved if heatsink compound is applied when the transistor is mounted on the printed-circuit board.



Dimensions in mm.

Fig.15 Reflow soldering footprint for SOT409A.

BLF404 scattering parameters

V_{DS} = 12.5 V; I_D = 50 mA; note 1.

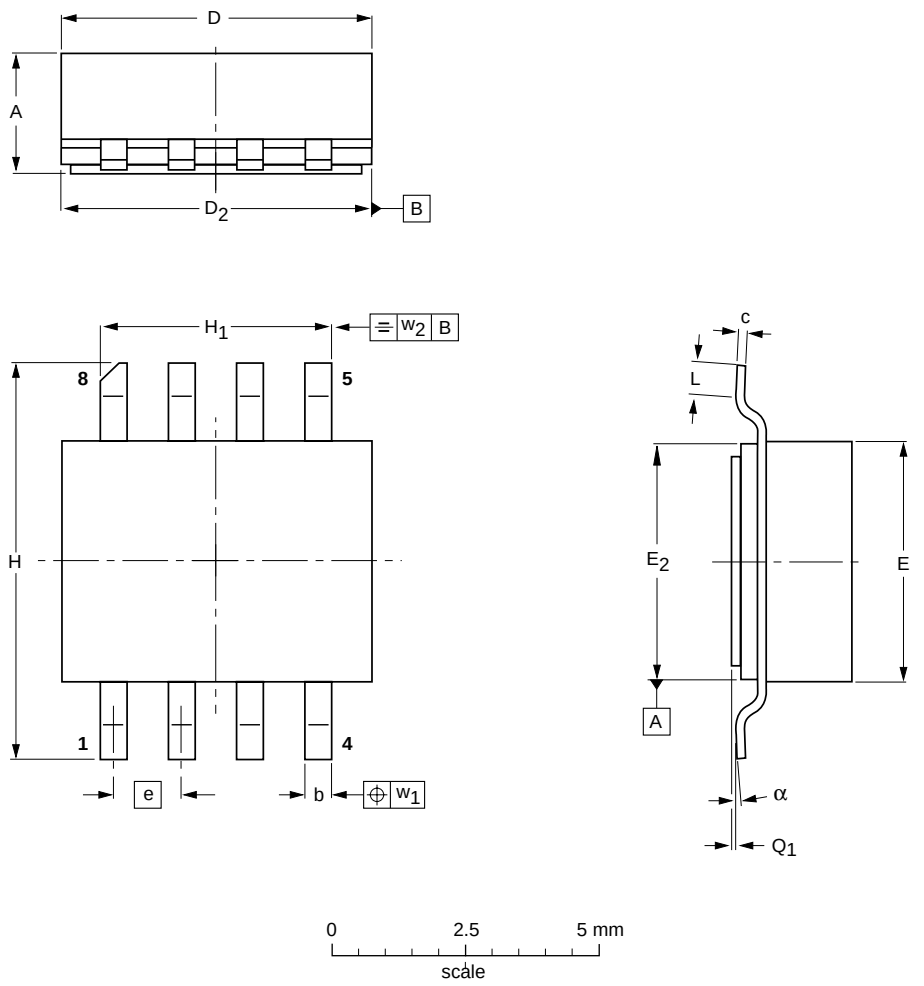
f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}	
	$\|s_{11}\|$	$\angle\Phi$	$\|s_{21}\|$	$\angle\Phi$	$\|s_{12}\|$	$\angle\Phi$	$\|s_{22}\|$	$\angle\Phi$
5	1.00	–5.2	12.97	176.0	0.01	86.0	0.96	–6.0
10	0.99	–10.1	12.89	171.9	0.02	82.2	0.96	–12.0
20	0.98	–20.6	12.61	164.1	0.03	74.8	0.95	–23.5
30	0.96	–30.4	12.18	156.6	0.05	67.6	0.93	–34.7
40	0.93	–39.6	11.62	149.6	0.06	60.9	0.91	–45.1
50	0.89	–48.0	11.00	143.2	0.07	54.8	0.89	–54.7
60	0.86	–55.8	10.37	137.4	0.08	49.4	0.87	–63.5
70	0.83	–62.9	9.74	132.2	0.09	44.4	0.85	–71.4
80	0.80	–69.4	9.15	127.5	0.10	40.1	0.83	–78.5
90	0.78	–75.3	8.60	123.2	0.10	36.2	0.82	–84.8
100	0.75	–80.7	8.08	119.3	0.10	32.7	0.80	–90.5
125	0.71	–92.2	6.96	110.7	0.11	25.1	0.77	–102.6
150	0.68	–101.4	6.03	103.9	0.12	19.1	0.76	–111.9
175	0.66	–108.9	5.30	98.3	0.12	14.4	0.74	–119.2
200	0.64	–115.2	4.73	93.2	0.12	10.2	0.74	–125.1
250	0.63	–124.9	3.81	84.5	0.12	3.5	0.73	–134.1
300	0.64	–132.5	3.19	77.4	0.12	–1.8	0.74	–140.5
350	0.64	–138.6	2.70	71.2	0.11	–6.1	0.74	–145.3
400	0.66	–143.8	2.34	65.7	0.11	–9.7	0.75	–149.1
450	0.67	–148.4	2.03	60.5	0.10	–12.5	0.76	–152.4
500	0.69	–152.6	1.80	56.0	0.09	–15.1	0.78	–155.2
600	0.72	–160.2	1.44	47.7	0.08	–18.2	0.80	–159.9
700	0.75	–167.1	1.18	40.4	0.07	–18.6	0.82	–163.9
800	0.78	–173.6	0.99	34.4	0.05	–15.0	0.84	–167.5
900	0.81	–179.8	0.84	29.2	0.04	-6.0	0.86	–170.7
1000	0.83	174.3	0.73	25.1	0.04	9.9	0.88	–173.6

Note

1. For more extensive s-parameters see internet:
   http://www.semiconductors.philips.com/markets/communications/wirelesscommunications/broadcast

PACKAGE OUTLINE

Ceramic surface mounted package; 8 leads **SOT409A**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	b	c	D	D_2	E	E_2	e	H	H_1	L	Q_1	w_1	w_2	α
mm	2.36 2.06	0.58 0.43	0.23 0.18	5.94 5.03	5.16 5.00	4.93 4.01	4.14 3.99	1.27	7.47 7.26	4.39 4.24	1.02 0.51	0.10 0.00	0.25	0.25	7° 0°
inches	0.093 0.081	0.023 0.017	0.009 0.007	0.234 0.198	0.203 0.197	0.194 0.158	0.163 0.157	0.050	0.294 0.286	0.173 0.167	0.040 0.020	0.004 0.000	0.010	0.010	7° 0°

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT409A						98-01-27

DATA SHEET STATUS

LEVEL	DATA SHEET STATUS(1)	PRODUCT STATUS(2)(3)	DEFINITION
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

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

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