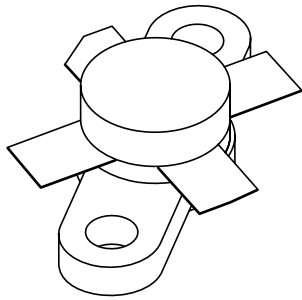


DATA SHEET



BLF175 HF/VHF power MOS transistor

Product specification
Supersedes data of 1997 Dec 15

2003 Jul 22

HF/VHF power MOS transistor

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FEATURES

- High power gain
- Low intermodulation distortion
- Easy power control
- Good thermal stability
- Withstands full load mismatch
- Gold metallization ensures excellent reliability.

DESCRIPTION

Silicon N-channel enhancement mode vertical D-MOS transistor designed for large signal amplifier applications in the HF/VHF frequency range.

The transistor has a 4-lead, SOT123A flange package, with a ceramic cap. All leads are isolated from the flange.

A marking code, showing gate-source voltage (V_{GS}) information is provided for matched pair applications. Refer to the handbook 'General' section for further information.

PIN CONFIGURATION

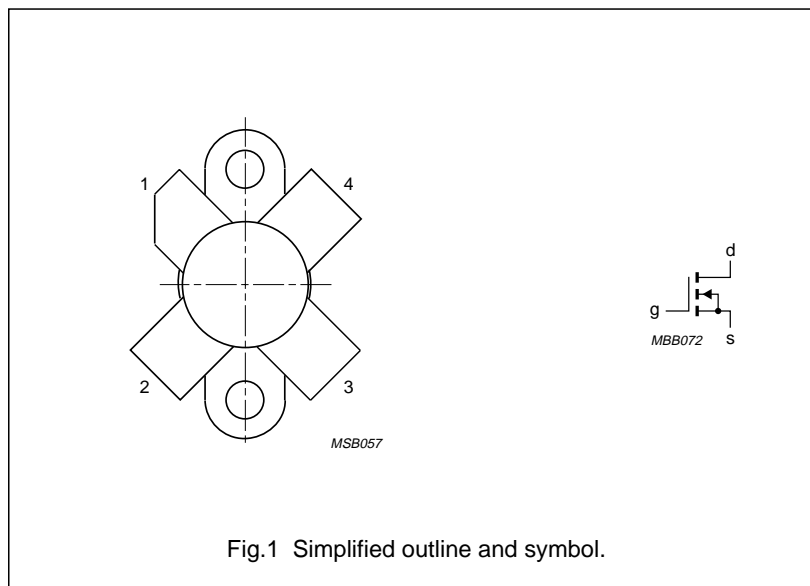


Fig.1 Simplified outline and symbol.

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.

PINNING - SOT123A

PIN	DESCRIPTION
1	drain
2	source
3	gate
4	source

WARNING

Product and environmental safety - toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

QUICK REFERENCE DATA

RF performance at $T_h = 25^\circ\text{C}$ in a common source test circuit.

MODE OF OPERATION	f (MHz)	V_{DS} (V)	I_{DQ} (mA)	P_L (W)	G_p (dB)	η_D (%)	d_3 (dB)
class-A	28	50	800	8 (PEP)	>24	—	<-40
class-AB	28	50	150	30 (PEP)	typ. 24	typ. 40 ⁽¹⁾	typ. -35
CW, class-B	108	50	30	30	typ. 20	typ. 65	—

Note

1. 2-tone efficiency.

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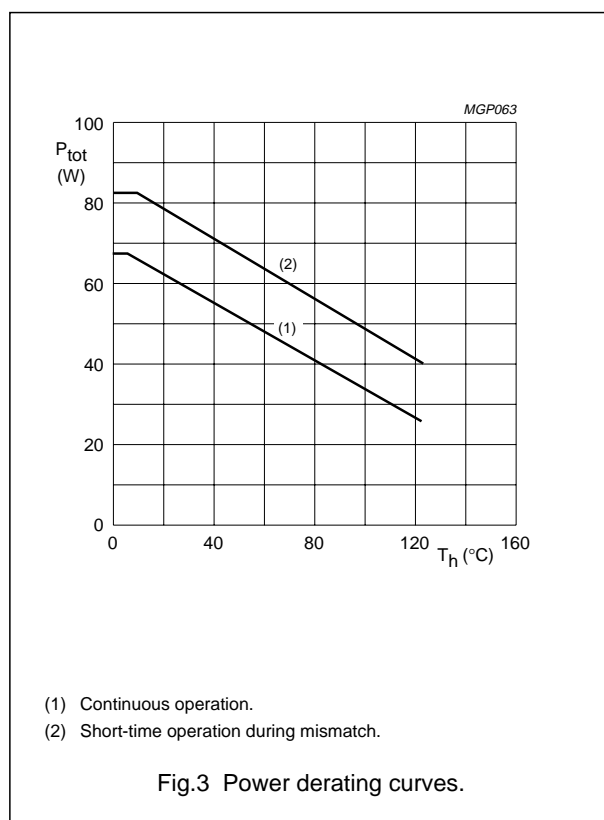
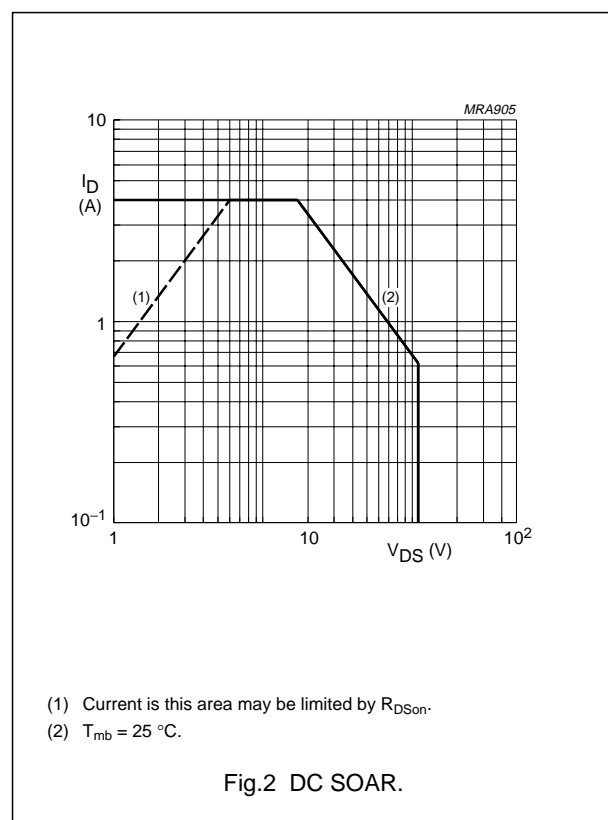
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	125	V
$\pm V_{GS}$	gate-source voltage		–	20	V
I_D	DC drain current		–	4	A
P_{tot}	total power dissipation	$T_{mb} \leq 25\text{ }^{\circ}\text{C}$	–	68	W
T_{stg}	storage temperature		–65	+150	$^{\circ}\text{C}$
T_j	junction temperature		–	200	$^{\circ}\text{C}$

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-mb}$	thermal resistance from junction to mounting base	$T_{mb} = 25\text{ }^{\circ}\text{C}$; $P_{tot} = 68\text{ W}$	2.6	K/W
$R_{th\ mb-h}$	thermal resistance from mounting base to heatsink	$T_{mb} = 25\text{ }^{\circ}\text{C}$; $P_{tot} = 68\text{ W}$	0.3	K/W



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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	$I_D = 100\text{ mA}$; $V_{GS} = 0$	125	–	–	V
I_{DSS}	drain-source leakage current	$V_{GS} = 0$; $V_{DS} = 50\text{ V}$	–	–	100	μA
I_{GSS}	gate-source leakage current	$\pm V_{GS} = 20\text{ V}$; $V_{DS} = 0$	–	–	1	μA
V_{GSth}	gate-source threshold voltage	$I_D = 10\text{ mA}$; $V_{DS} = 10\text{ V}$	2	–	4.5	V
ΔV_{GS}	gate-source voltage difference of matched pairs	$I_D = 10\text{ mA}$; $V_{DS} = 10\text{ V}$	–	–	100	mV
g_{fs}	forward transconductance	$I_D = 1\text{ A}$; $V_{DS} = 10\text{ V}$	1.1	1.6	–	S
R_{DSon}	drain-source on-state resistance	$I_D = 1\text{ A}$; $V_{GS} = 10\text{ V}$	–	0.75	1.5	Ω
I_{DSX}	on-state drain current	$V_{GS} = 10\text{ V}$; $V_{DS} = 10\text{ V}$	–	5.5	–	A
C_{is}	input capacitance	$V_{GS} = 0$; $V_{DS} = 50\text{ V}$; $f = 1\text{ MHz}$	–	130	–	pF
C_{os}	output capacitance	$V_{GS} = 0$; $V_{DS} = 50\text{ V}$; $f = 1\text{ MHz}$	–	36	–	pF
C_{rs}	feedback capacitance	$V_{GS} = 0$; $V_{DS} = 50\text{ V}$; $f = 1\text{ MHz}$	–	3.7	–	pF

 V_{GS} group indication

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			

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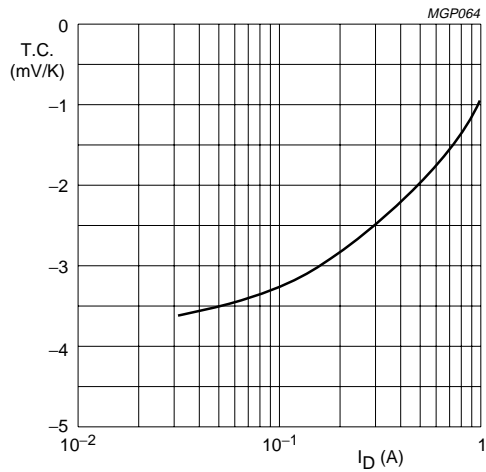
 $V_{DS} = 10 \text{ V.}$

Fig.4 Temperature coefficient of gate-source voltage as a function of drain current; typical values.

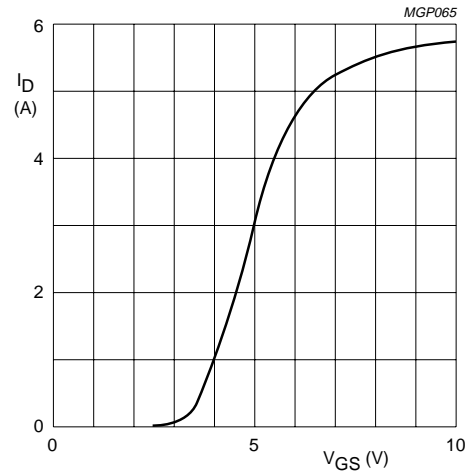
 $V_{DS} = 10 \text{ V; } T_J = 25^\circ\text{C.}$

Fig.5 Drain current as a function of gate-source voltage; typical values.

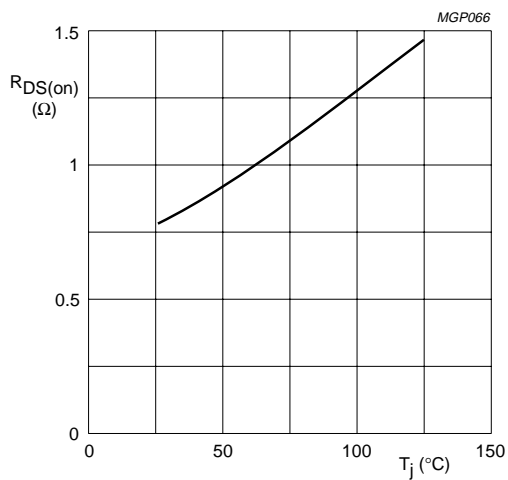
 $I_D = 1 \text{ A; } V_{GS} = 10 \text{ V.}$

Fig.6 Drain-source on-state resistance as a function of junction temperature; typical values.

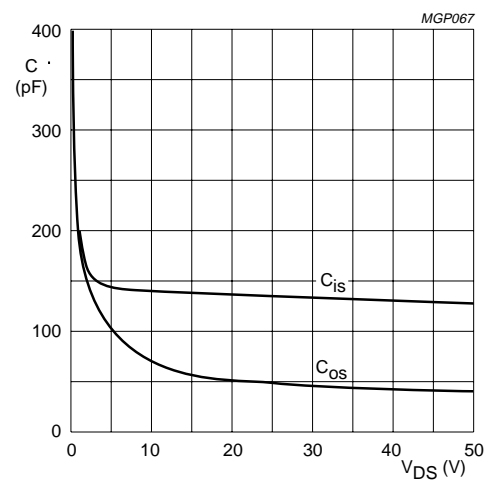
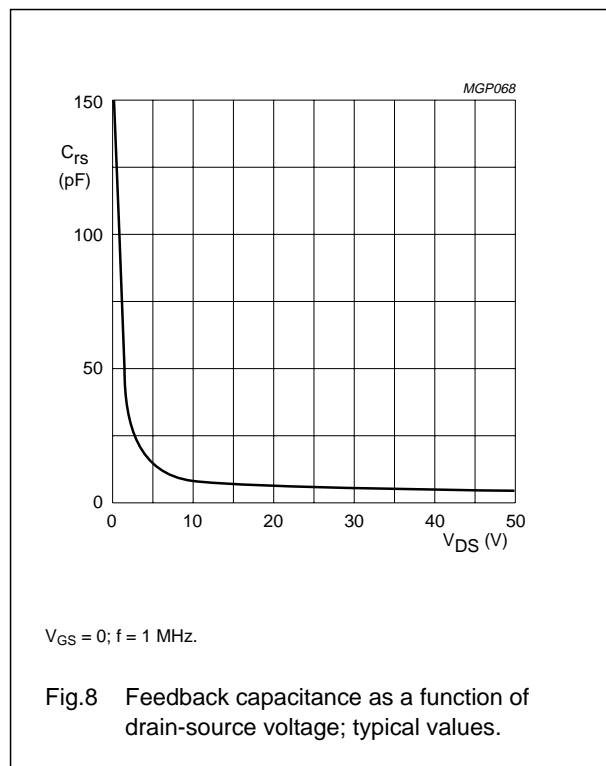
 $V_{GS} = 0; f = 1 \text{ MHz.}$

Fig.7 Input and output capacitance as functions of drain-source voltage; typical values.

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APPLICATION INFORMATION FOR CLASS-A OPERATION

$T_h = 25\text{ }^{\circ}\text{C}$; $R_{th\text{ mb-h}} = 0.3\text{ K/W}$; unless otherwise specified.

RF performance in SSB operation in a common source circuit.

$f_1 = 28.000\text{ MHz}$; $f_2 = 28.001\text{ MHz}$.

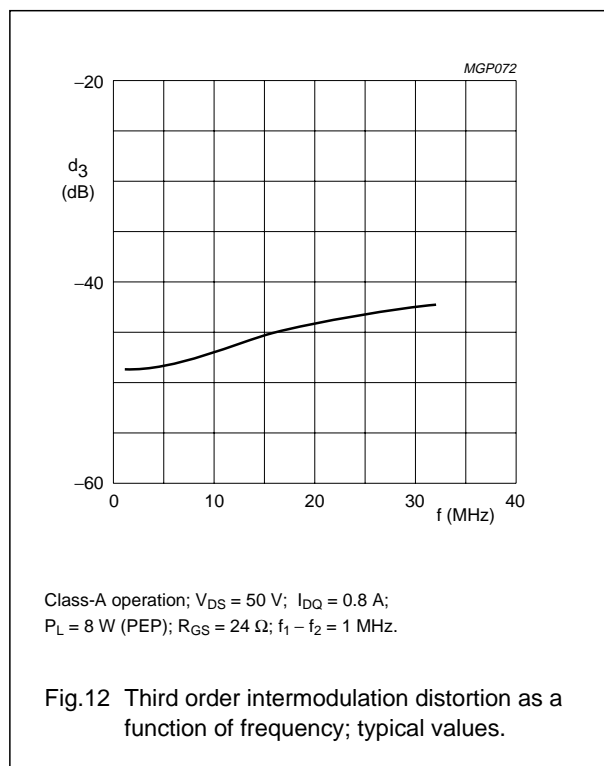
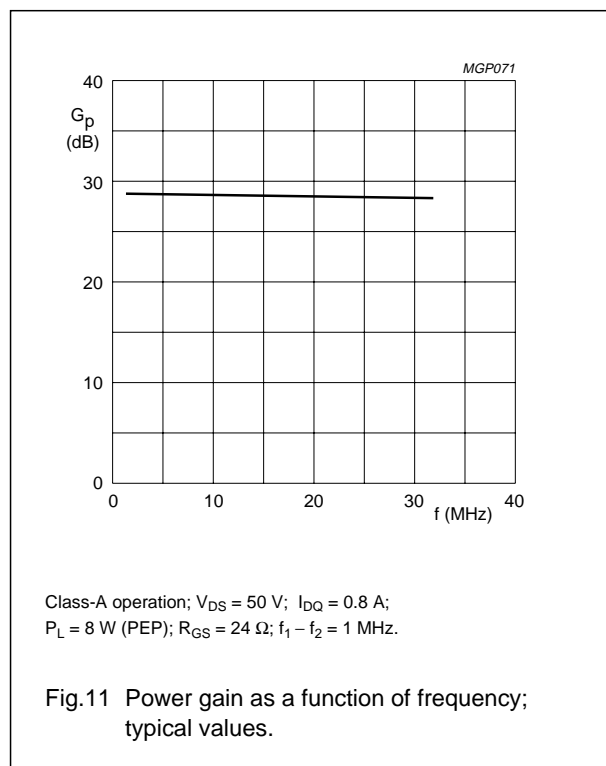
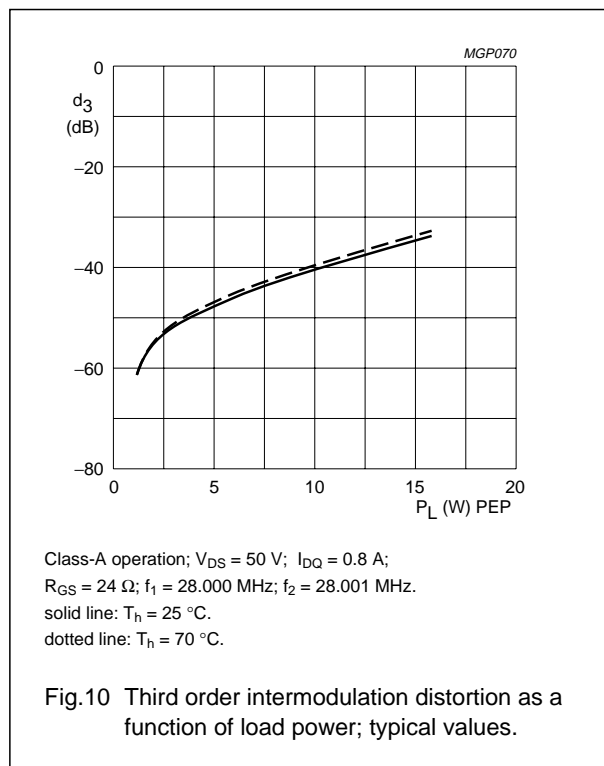
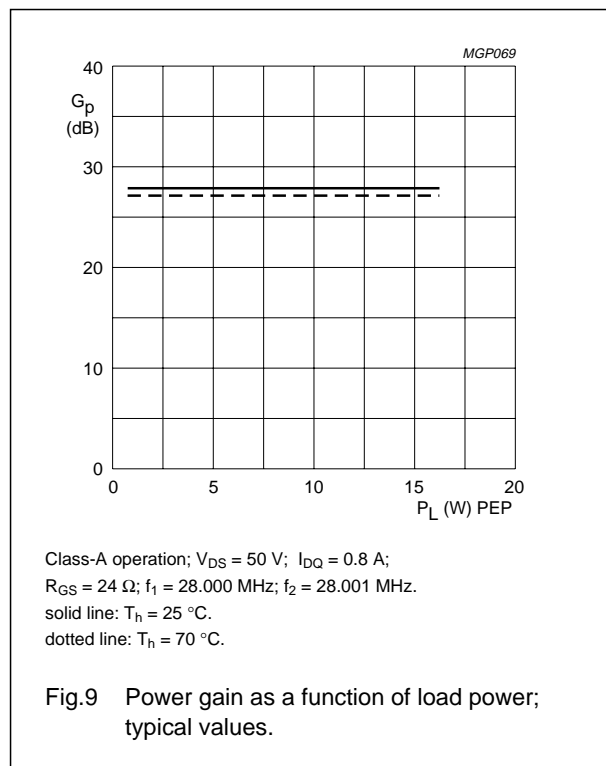
P_L (W)	f (MHz)	V_{DS} (V)	I_{DQ} (mA)	G_p (dB)	d_3 (dB) ⁽¹⁾	d_5 (dB) ⁽¹⁾	R_{GS} (Ω)
0 to 8 (PEP)	28	50	800	> 24 typ. 28	> -40 typ. -44	< -40 typ. -64	24 24

Note

- Maximum values at drive levels within the specified PEP values for either amplified tone. For the peak envelope power the values should be decreased by 6 dB.

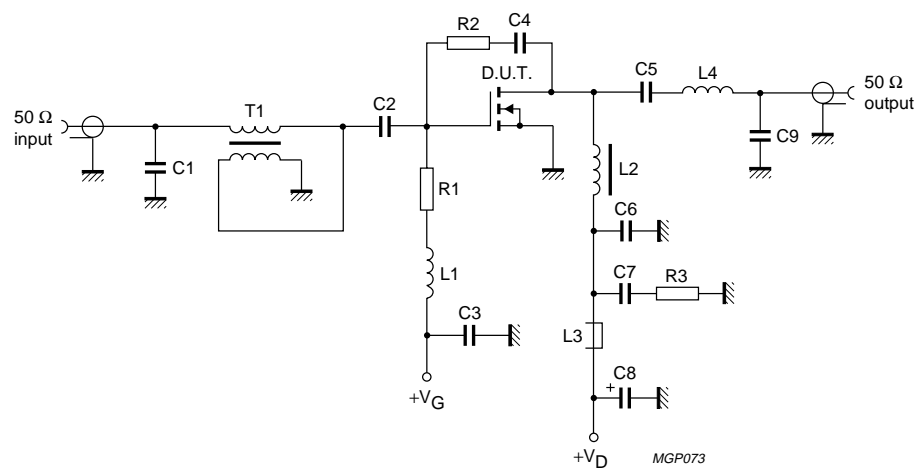
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f = 28 MHz.

Fig.13 Test circuit for class-A operation.

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List of components (class-A test circuit)

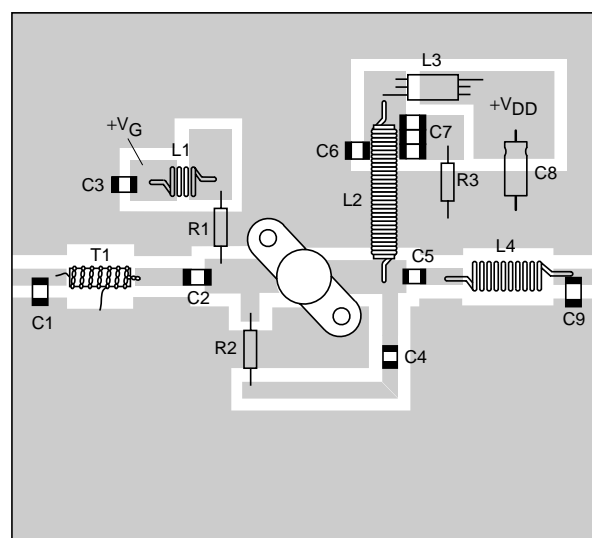
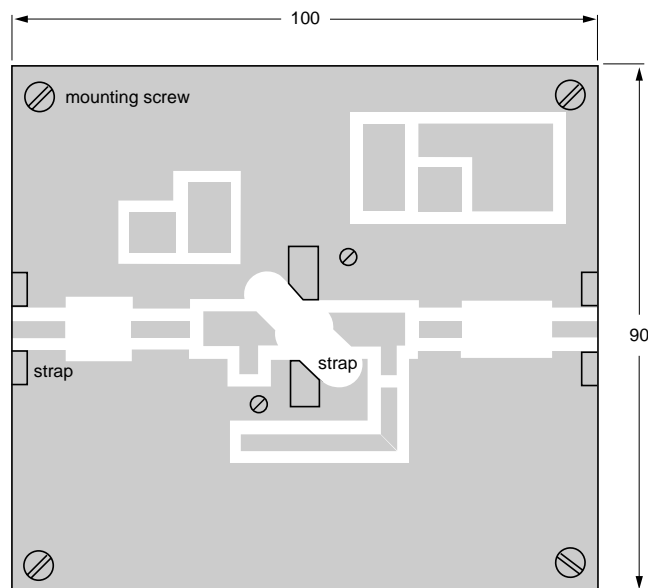
COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1	multilayer ceramic chip capacitor (note 1)	39 pF		
C2	multilayer ceramic chip capacitor	3×10 nF		2222 852 47103
C3, C4, C6	multilayer ceramic chip capacitor	100 nF		2222 852 47104
C5	multilayer ceramic chip capacitor	10 nF		2222 852 47103
C7	multilayer ceramic chip capacitor	3×100 nF		2222 852 47104
C8	aluminium electrolytic capacitor	10 μ F, 63 V		2222 030 28109
C9	multilayer ceramic chip capacitor (note 1)	24 pF		
L1	4 turns enamelled 0.6 mm copper wire	86 nH	length 3.3 mm; int. dia. 5 mm; leads 2×2 mm	
L2	36 turns enamelled 0.7 mm copper wire wound on a rod grade 4B1 Ferroxcube drain choke	20 μ H	length 30 mm; int. dia. 5 mm	4330 030 30031
L3	grade 3B Ferroxcube wideband RF choke			4312 020 36640
L4	8 turns enamelled 1 mm copper wire	189 nH	length 9.5 mm; int. dia. 5 mm; leads 2×3 mm	
R1	0.4 W metal film resistor	24 Ω		
R2	0.4 W metal film resistor	1500 Ω		
R3	0.4 W metal film resistor	10 Ω		
T1	4 : 1 transformer; 18 turns twisted pair of 0.25 mm copper wire with 10 twists per cm, wound on a grade 4C6 toroidal core		dimensions $9 \times 6 \times 3$ mm	4322 020 97171

Note

1. American Technical Ceramics (ATC) capacitor, type 100B or other capacitor of the same quality.

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MGP074

Dimensions in mm.

The circuit and components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets and straps at the two edges and under the source contacts.

Fig.14 Component layout for 28 MHz class-A test circuit.

HF/VHF power MOS transistor

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APPLICATION INFORMATION FOR CLASS-AB OPERATION

$T_h = 25\text{ }^\circ\text{C}$; $R_{th\text{ mb-h}} = 0.3\text{ K/W}$; unless otherwise specified.

RF performance in SSB operation in a common source circuit.

$f_1 = 28.000\text{ MHz}$; $f_2 = 28.001\text{ MHz}$.

P_L (W)	f (MHz)	V_{DS} (V)	I_{DQ} (mA)	G_p (dB)	η_D (%)	d_3 (dB) ⁽¹⁾	d_5 (dB) ⁽¹⁾	R_{GS} (Ω)
30 (PEP)	28	50	150	typ. 24	typ. 40 ⁽²⁾	typ. -35	typ. -40	22

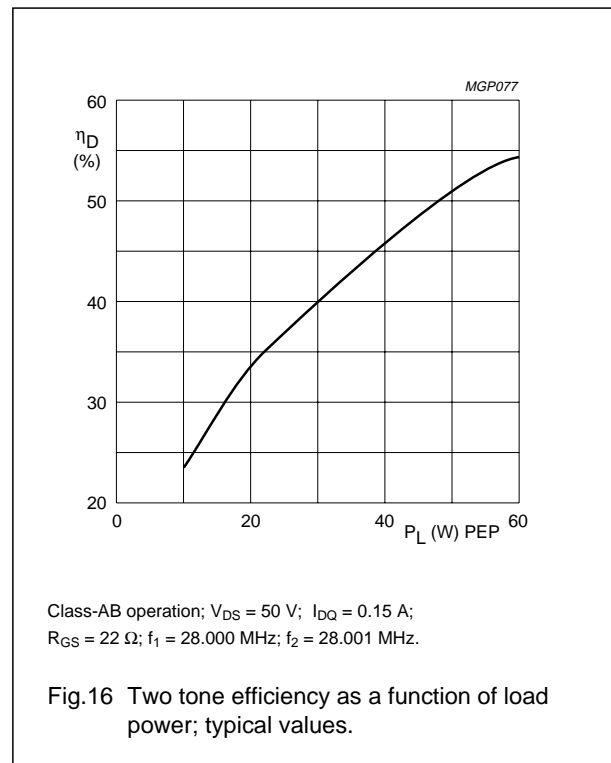
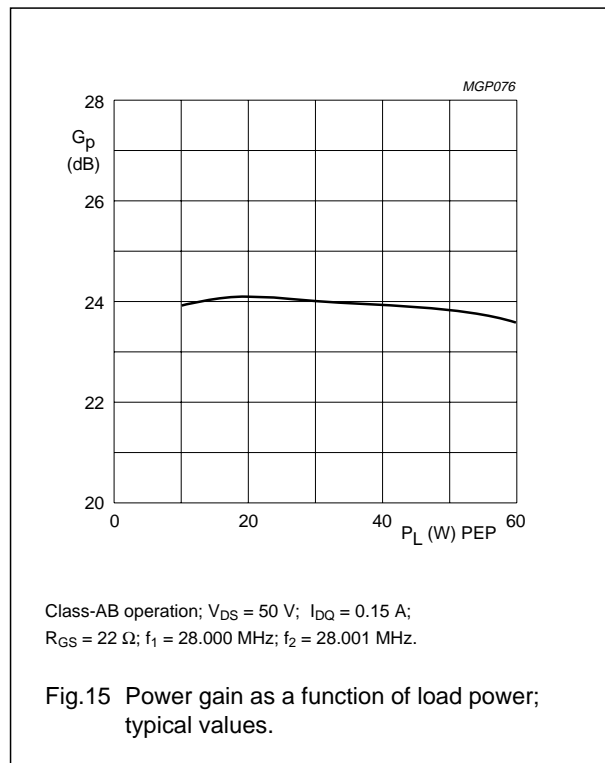
Notes

- Maximum values at drive levels within the specified PEP values for either amplified tone. For the peak envelope power the values should be decreased by 6 dB.
- 2-tone efficiency.

Ruggedness in class-AB operation

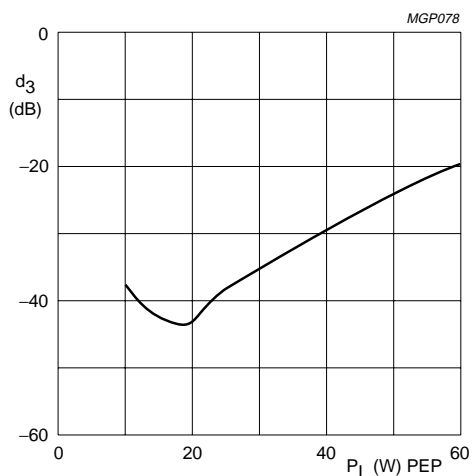
The BLF175 is capable of withstanding a load mismatch corresponding to $V_{SWR} = 50$ through all phases at $P_L = 30\text{ W}$ single tone under the following conditions:

$V_{DS} = 50\text{ V}$; $f = 28\text{ MHz}$.



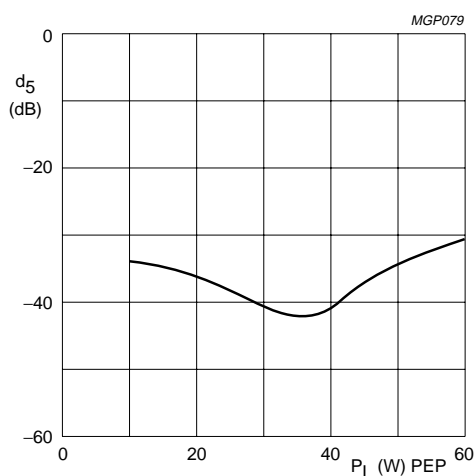
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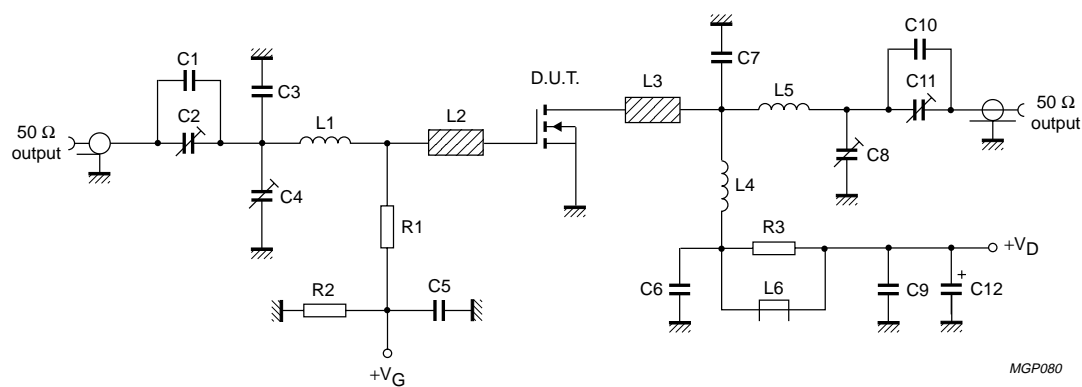
Class-AB operation; $V_{DS} = 50$ V; $I_{DQ} = 0.15$ A;
 $R_{GS} = 22 \Omega$; $f_1 = 28.000$ MHz; $f_2 = 28.001$ MHz.

Fig.17 Third order intermodulation distortion as a function of load power; typical values.



Class-AB operation; $V_{DS} = 50$ V; $I_{DQ} = 0.15$ A;
 $R_{GS} = 22 \Omega$; $f_1 = 28.000$ MHz; $f_2 = 28.001$ MHz.

Fig.18 Fifth order intermodulation distortion as a function of load power; typical values.



$f = 28$ MHz.

Fig.19 Test circuit for class-AB operation.

HF/VHF power MOS transistor

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List of components (class-AB test circuit)

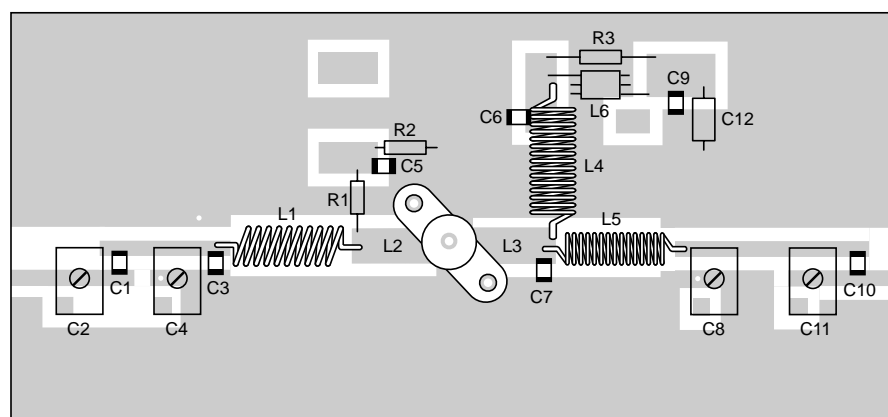
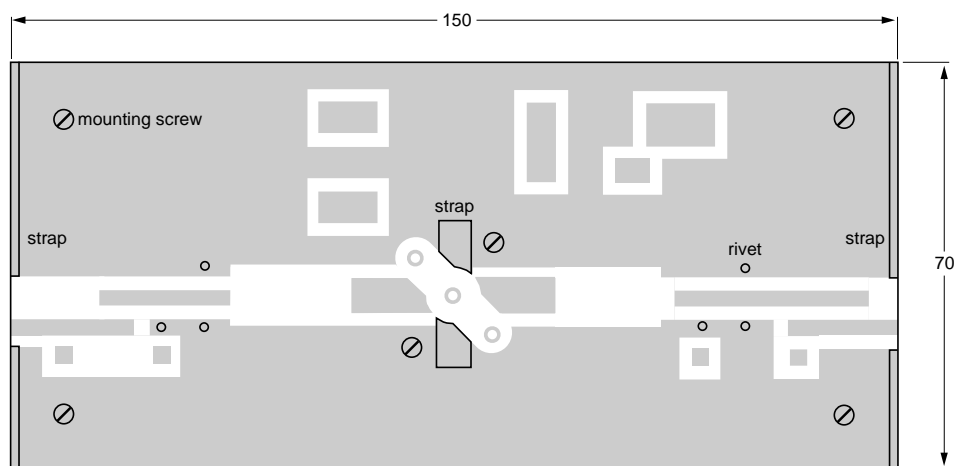
COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1, C10	multilayer ceramic chip capacitor (note 1)	62 pF		
C2, C4, C8, C11	film dielectric trimmer	5 to 60 pF		2222 809 07011
C3	multilayer ceramic chip capacitor (note 1)	51 pF		
C5, C6, C9	multilayer ceramic chip capacitor	100 nF		2222 852 47104
C7	multilayer ceramic chip capacitor (note 1)	10 pF		
C12	aluminium electrolytic capacitor	10 μ F, 63 V		2222 030 28109
L1	9 turns enamelled 1 mm copper wire	280 nH	length 11 mm; int. dia. 6 mm; leads 2 \times 4 mm	
L2, L3	stripline (note 2)	30 Ω	length 10 mm; width 6 mm	
L4	14 turns enamelled 1 mm copper wire	1650 nH	length 20 mm; int. dia. 12 mm; leads 2 \times 2 mm	
L5	10 turns enamelled 1 mm copper wire	380 nH	length 13 mm; int. dia. 7 mm; leads 2 \times 3 mm	
L6	grade 3B Ferroxcube wideband RF choke			4312 020 36640
R1	0.4 W metal film resistor	22 Ω		
R2	0.4 W metal film resistor	1 M Ω		
R3	0.4 W metal film resistor	10 Ω		

Notes

1. American Technical Ceramics (ATC) capacitor, type 100B or other capacitor of the same quality.
2. The striplines are on a double copper-clad printed circuit board, with PTFE fibre-glass dielectric ($\epsilon_r = 4.5$), thickness 1.6 mm.

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MGP081

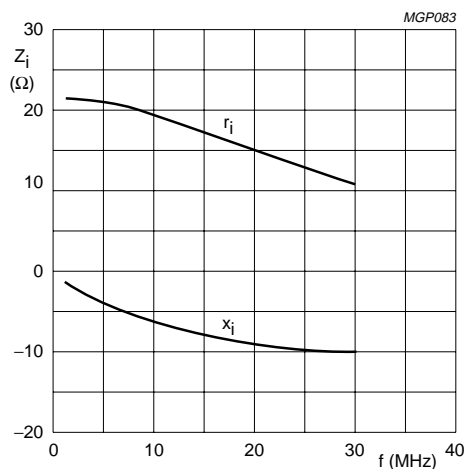
Dimensions in mm.

The circuit and components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets and straps at the two edges and under the source contacts.

Fig.20 Component layout for 28 MHz class-AB test circuit.

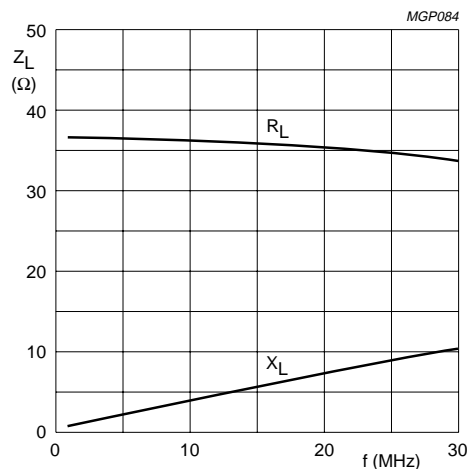
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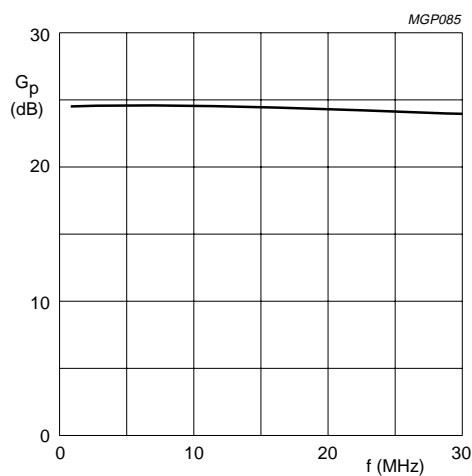
Class-AB operation; $V_{DS} = 50\text{ V}$; $I_{DQ} = 0.15\text{ A}$;
 $P_L = 30\text{ W (PEP)}$; $R_{GS} = 22\ \Omega$.

Fig.21 Input impedance as a function of frequency (series components); typical values.



Class-AB operation; $V_{DS} = 50\text{ V}$; $I_{DQ} = 0.15\text{ A}$;
 $P_L = 30\text{ W (PEP)}$; $R_{GS} = 22\ \Omega$.

Fig.22 Load impedance as a function of frequency (series components); typical values.



Class-AB operation; $V_{DS} = 50\text{ V}$; $I_{DQ} = 0.15\text{ A}$;
 $P_L = 30\text{ W (PEP)}$; $R_{GS} = 22\ \Omega$.

Fig.23 Power gain as a function of frequency; typical values.

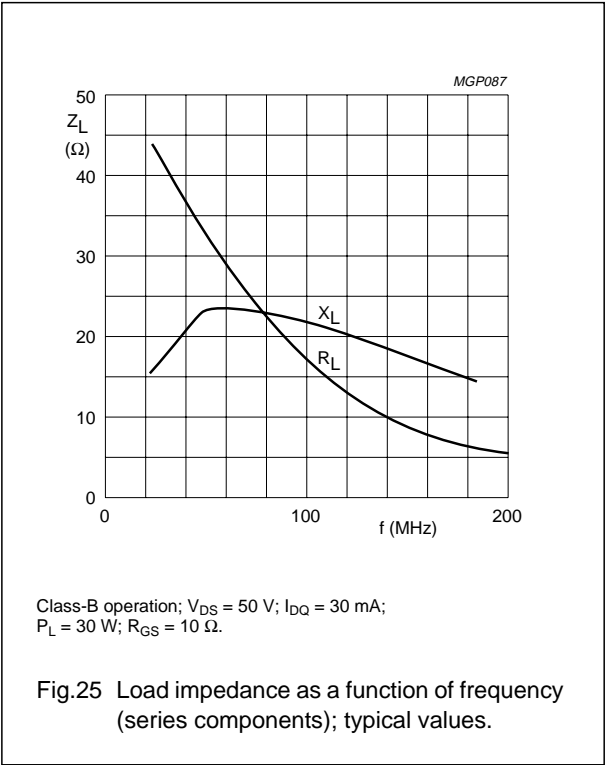
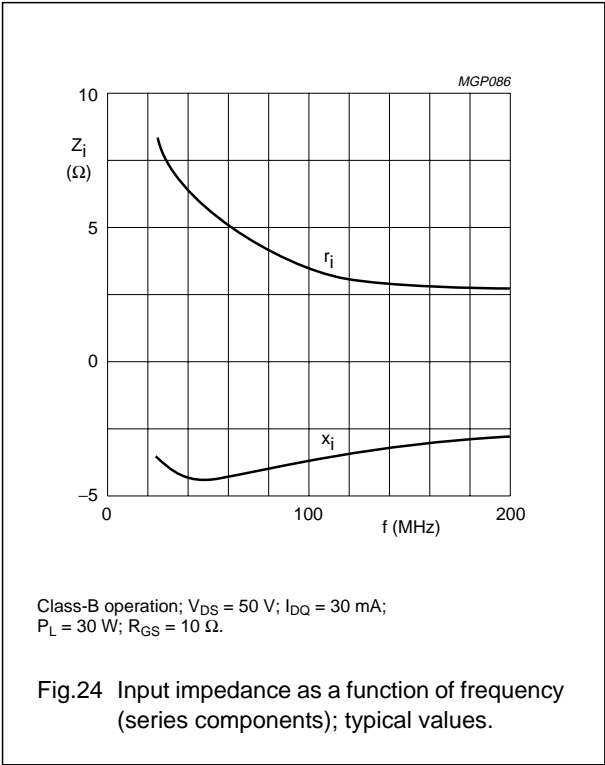
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APPLICATION INFORMATION FOR CLASS-B OPERATION

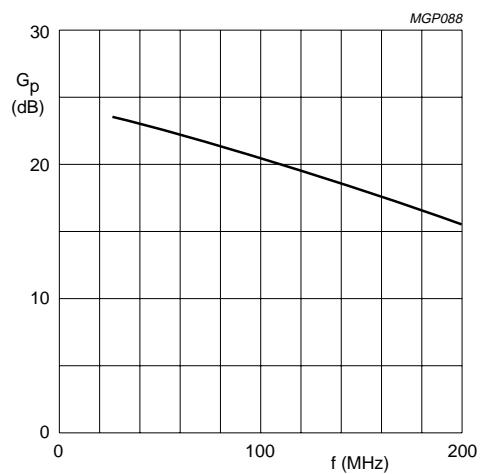
RF performance in SSB operation in a common source circuit.

MODE OF OPERATION	f (MHz)	V _{DS} (V)	I _{DQ} (mA)	P _L (W)	G _p (dB)	η _D (%)	R _{GS} (Ω)
CW, class-B	108	50	30	30	typ. 20	typ. 65	10



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Class-B operation; $V_{DS} = 50$ V; $I_{DQ} = 30$ mA;
 $P_L = 30$ W; $R_{GS} = 10$ Ω .

Fig.26 Power gain as a function of frequency;
typical values.

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BLF175 scattering parameters $V_{DS} = 50\text{ V}$; $I_D = 100\text{ mA}$; note 1.

f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	S ₁₁	∠ Φ	S ₂₁	∠ Φ	S ₁₂	∠ Φ	S ₂₂	∠ Φ
5	0.86	-110.20	36.90	114.20	0.02	25.20	0.64	-84.90
10	0.83	-139.40	20.39	93.30	0.02	5.10	0.55	-112.00
20	0.85	-155.70	9.82	72.60	0.02	-13.40	0.60	-129.30
30	0.88	-161.50	5.96	59.30	0.02	-24.70	0.69	-138.00
40	0.90	-164.90	3.98	49.30	0.02	-31.70	0.76	-144.30
50	0.92	-167.10	2.83	41.90	0.01	-35.80	0.82	-149.30
60	0.94	-169.00	2.11	36.00	0.01	-36.80	0.86	-153.50
70	0.96	-170.70	1.63	31.20	0.01	-33.70	0.89	-157.00
80	0.96	-172.20	1.29	27.40	0.00	-23.00	0.91	-159.90
90	0.97	-173.40	1.04	24.20	0.00	3.30	0.92	-162.40
100	0.97	-174.30	0.86	21.70	0.00	42.50	0.94	-164.50
125	0.99	-176.50	0.57	16.40	0.01	81.60	0.95	-168.80
150	0.99	-178.10	0.40	13.40	0.01	88.70	0.97	-171.90
175	0.99	-179.80	0.30	11.60	0.02	90.70	0.98	-174.50
200	1.00	179.20	0.23	11.00	0.02	90.80	0.98	-176.70
250	1.00	177.00	0.15	11.70	0.03	90.50	0.99	179.80
300	1.00	175.10	0.11	16.70	0.03	89.60	0.99	176.90
350	0.99	173.30	0.08	24.10	0.04	88.30	0.99	174.30
400	1.00	171.80	0.07	33.10	0.05	88.00	0.99	171.90
450	0.99	170.10	0.07	42.70	0.05	87.80	0.99	169.60
500	0.99	168.50	0.07	51.90	0.06	86.50	0.99	167.40
600	0.99	165.40	0.07	64.20	0.07	84.90	0.99	163.10
700	0.99	162.30	0.09	70.60	0.09	83.10	0.98	158.90
800	0.99	158.90	0.10	73.80	0.10	82.20	0.98	154.80
900	0.99	155.30	0.12	74.90	0.12	80.70	0.97	150.60
1000	0.98	151.80	0.14	76.40	0.14	79.80	0.97	146.20

Note

- For more extensive s-parameters see internet website:
<http://www.semiconductors.philips.com/markets/communications/wirelesscommunicationms/broadcast>

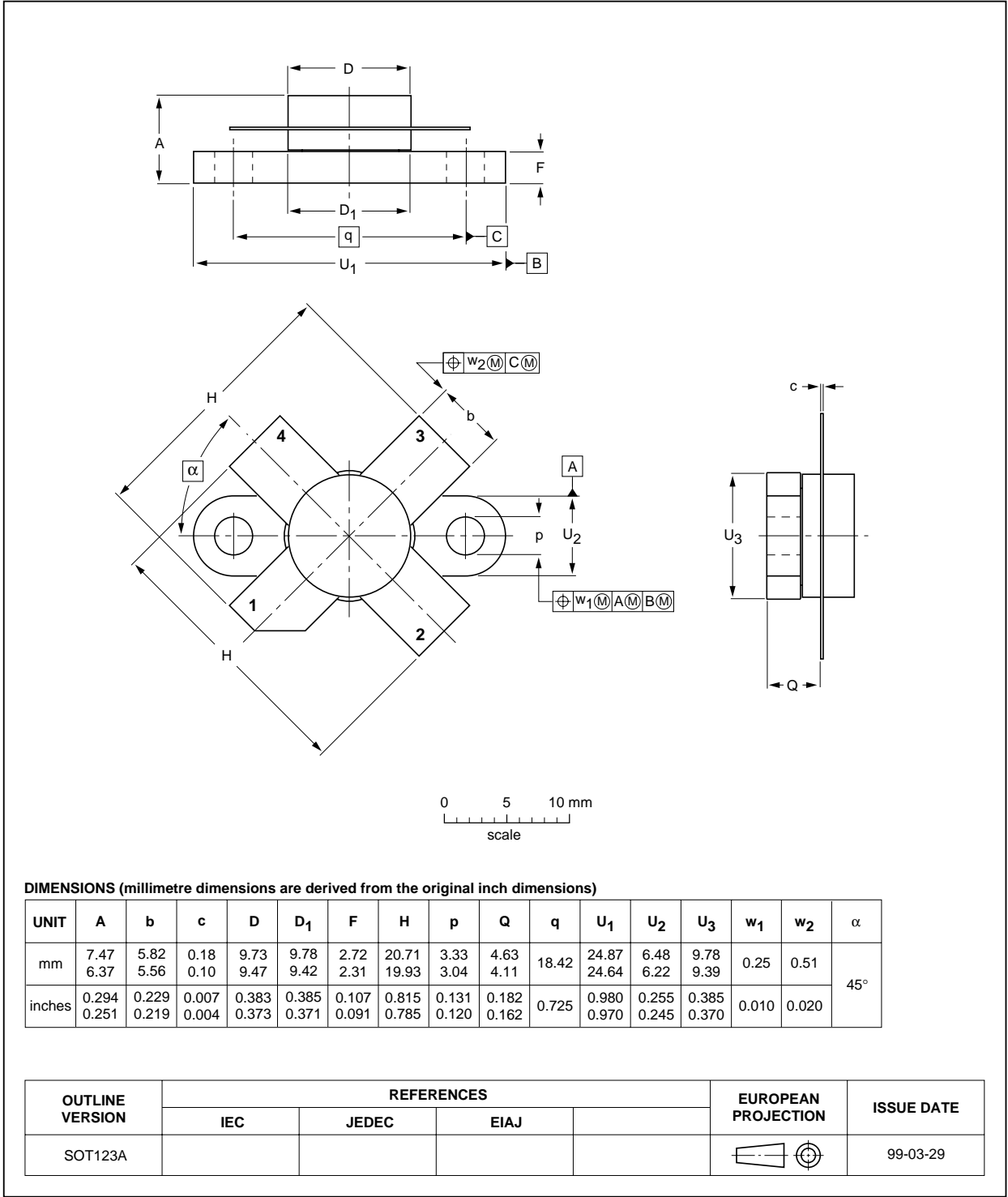
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PACKAGE OUTLINE

Flanged ceramic package; 2 mounting holes; 4 leads

SOT123A



HF/VHF power MOS transistor

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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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Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.
3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

DEFINITIONS

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