HF/VHF power MOS transistor

BLF221B

FEATURES

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

DESCRIPTION

Silicon N-channel enhancement mode vertical D-MOS transistor designed for communications transmitter applications with a nominal supply voltage of 12.5 V, in the HF/VHF frequency range.

The transistor is encapsulated in a 3-lead, SOT5 (TO-39) metal envelope, with the drain connected to the case.

PIN CONFIGURATION

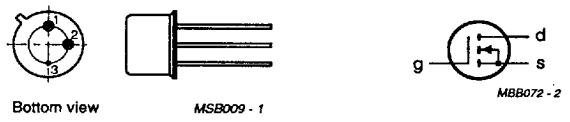


Fig.1 Simplified outline and symbol.

CAUTION

The device is supplied in an antistatic package. The gate-source input must be protected against static charge during transport and handling.

PINNING - SOT5

PIN	DESCRIPTION
1	source
2	gate
3	drain

QUICK REFERENCE DATA

RF performance at T_{mb} = 25 °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-B	175	12.5	2	≥ 9	≥ 50

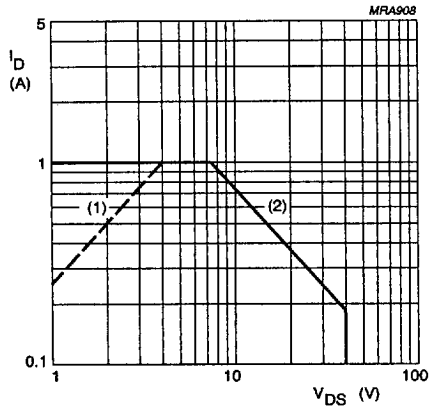
LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	drain-source voltage		–	40	V
$\pm V_{GS}$	gate-source voltage		–	20	V
I_D	DC drain current		–	1	A
P_{tot}	total power dissipation	up to T_{mb} = 25 °C	–	7.4	W
T_{stg}	storage temperature		–65	150	°C
T_j	junction temperature		–	200	°C

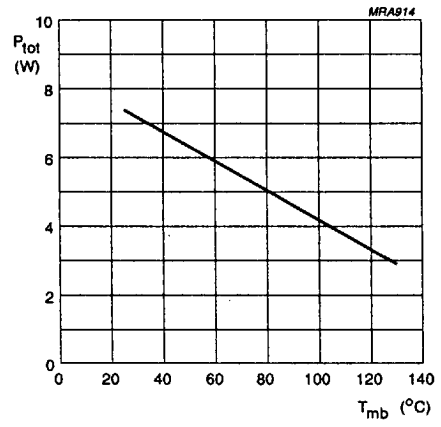
THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_{mb} = 25 °C; P_{tot} = 7.4 W	23.5 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink	T_{mb} = 25 °C; P_{tot} = 7.4 W	3.5 K/W



(1) Current is this area may be limited by $R_{DS(on)}$.
(2) T_{mb} = 25 °C.

Fig.2 DC SOAR.



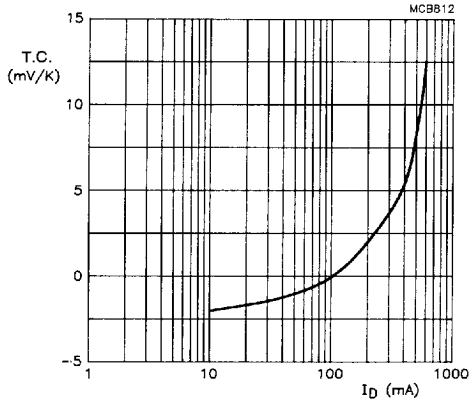
Continuous operation.

Fig.3 Power/temperature derating curve.

CHARACTERISTICS

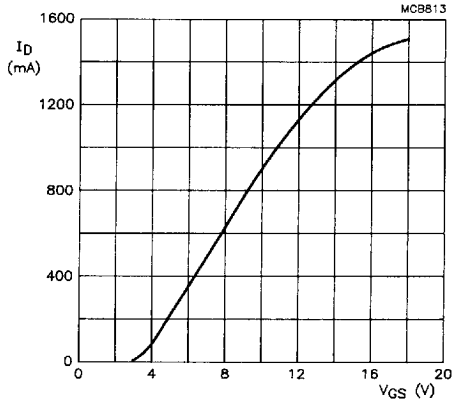
T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 3 mA; V_{GS} = 0	40	–	–	V
I_{DSS}	drain-source leakage current	V_{GS} = 0; V_{DS} = 12.5 V	–	–	10	µA
I_{GSS}	gate-source leakage current	±V_{GS} = 20 V; V_{DS} = 0	–	–	1	µA
$V_{GS(th)}$	gate-source threshold voltage	I_D = 3 mA; V_{DS} = 10 V	2	–	4.5	V
g_{fs}	forward transconductance	I_D = 0.3 A; V_{DS} = 10 V	80	135	–	mS
$R_{DS(on)}$	drain-source on-state resistance	I_D = 0.3 A; V_{GS} = 15 V	–	3.5	4	Ω
I_{DSX}	on-state drain current	V_{GS} = 10 V; V_{DS} = 15 V	–	1.3	–	A
C_{is}	input capacitance	V_{GS} = 0; V_{DS} = 12.5 V; f = 1 MHz	–	5.3	–	pF
C_{os}	output capacitance	V_{GS} = 0; V_{DS} = 12.5 V; f = 1 MHz	–	7.8	–	pF
C_{rs}	feedback capacitance	V_{GS} = 0; V_{DS} = 12.5 V; f = 1 MHz	–	1.8	–	pF



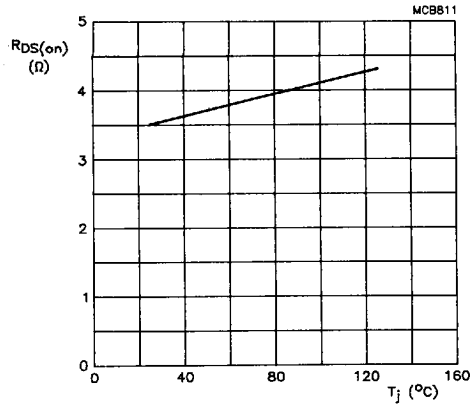
V_{DS} = 10 V.

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



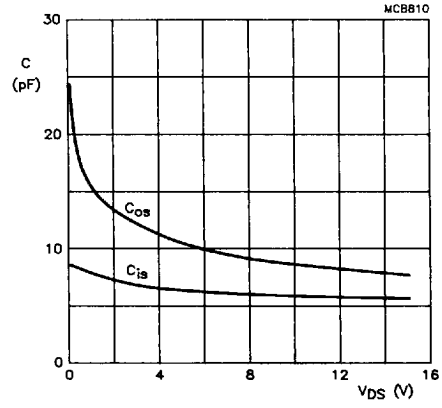
V_{DS} = 10 V; T_j = 25 °C.

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



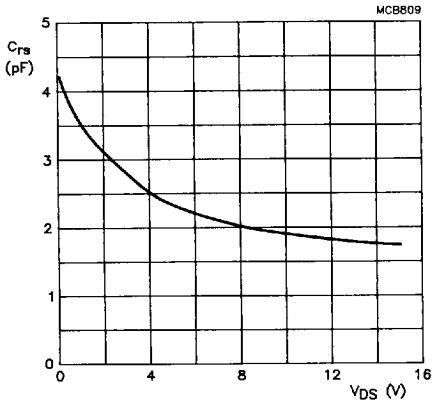
I_D = 0.3 A; V_{GS} = 15 V.

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



V_{GS} = 0; f = 1 MHz.

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



V_{GS} = 0; f = 1 MHz.

Fig.8 Feedback capacitance as a function of drain-source voltage, typical values.

APPLICATION INFORMATION FOR CLASS-B OPERATION

T_{mb} = 25 °C; R_{GS} = 221 Ω; unless otherwise specified.

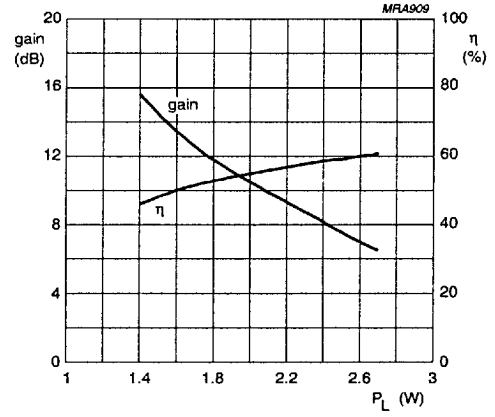
RF performance in CW operation in a common source class-B test circuit.

MODE OF OPERATION	f (MHz)	V_{DS} (V)	I_{DQ} (mA)	P_L (W)	G_p (dB)	η_D (%)
CW class-B	175	12.5	20	2	≥ 9 typ. 11.5	≥ 50 typ. 58

Ruggedness in class-B operation

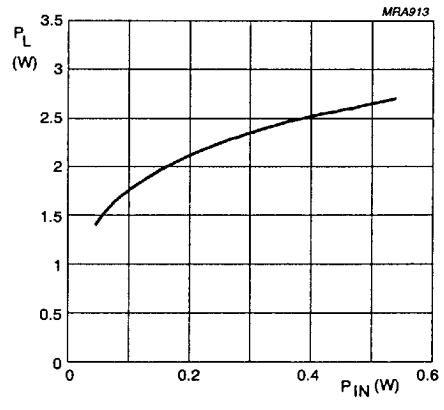
The BLF221B is capable of withstanding a load mismatch corresponding to VSWR = 50 through all phases under the following conditions:

V_{DS} = 15.5 V; f = 175 MHz;
T_{mb} = 25 °C at rated load power.



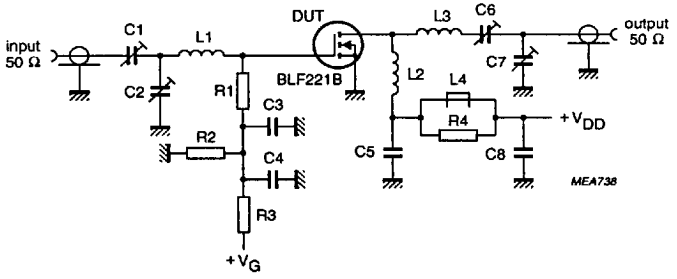
Class-B operation; V_{DS} = 12.5 V; I_{DQ} = 20 mA; f = 175 MHz.

Fig.9 Power gain and efficiency as a functions of load power, typical values.



Class-B operation; V_{DS} = 12.5 V; I_{DQ} = 20 mA; f = 175 MHz.

Fig.10 Load power as a function of input power, typical values.

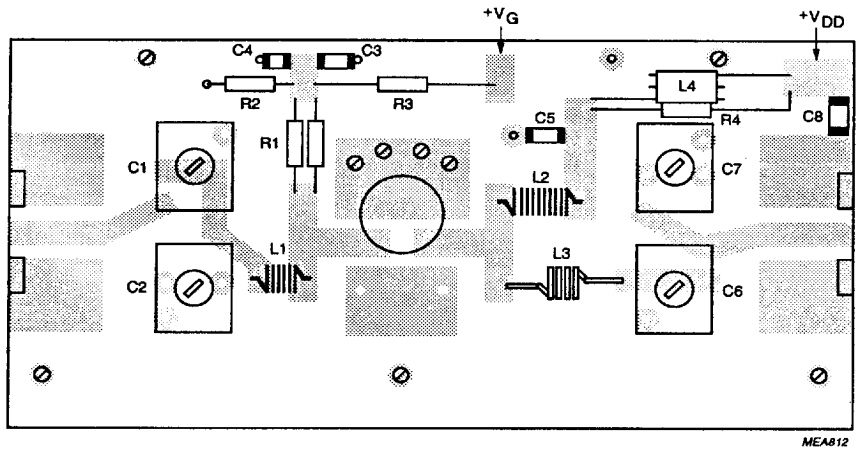


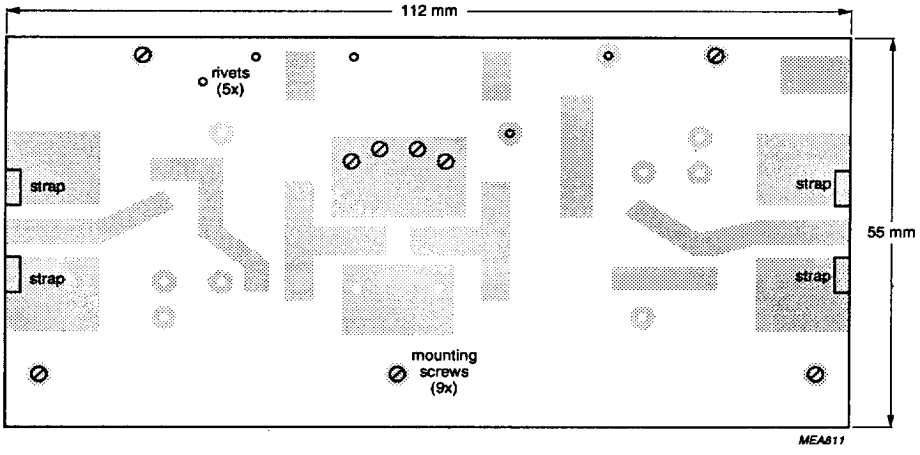
f = 175 MHz.

Fig.11 Test circuit for class-B operation.

List of components (class-B test circuit)

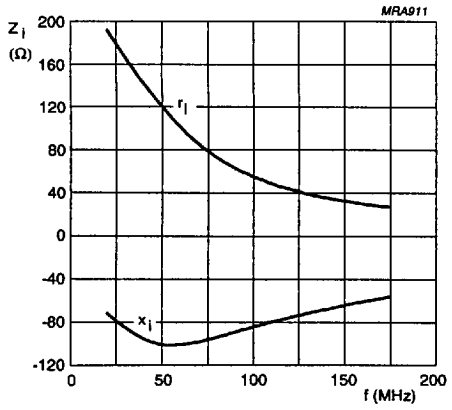
COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1, C6	film dielectric trimmer	4 to 40 pF		2222 809 07008
C2, C7	film dielectric trimmer	2.5 to 20 pF		2222 809 07004
C3, C5	multilayer ceramic chip capacitor	1 nF		2222 581 13102
C4, C8	multilayer ceramic chip capacitor	100 nF		2222 852 47104
L1	6 turns enamelled 0.5 mm copper wire	64.7 nH	length 5.8 mm int. dia. 3 mm leads 2 x 5 mm	
L2	10 turns enamelled 0.5 mm copper wire	178 nH	length 7.4 mm int. dia. 3.5 mm leads 2 x 5 mm	
L3	4 turns enamelled 1 mm copper wire	56.9 nH	length 6.5 mm int. dia. 4.5 mm leads 2 x 5 mm	
L4	grade 3B Ferroxcube RF choke			4312 020 36640
R1	0.4 W metal film resistor	2 x 442 Ω in parallel		2322 151 74421
R2	0.4 W metal film resistor	100 kΩ		2322 151 71004
R3	0.4 W metal film resistor	1 kΩ		2322 151 71002
R4	0.4 W metal film resistor	10 Ω		2322 151 71009





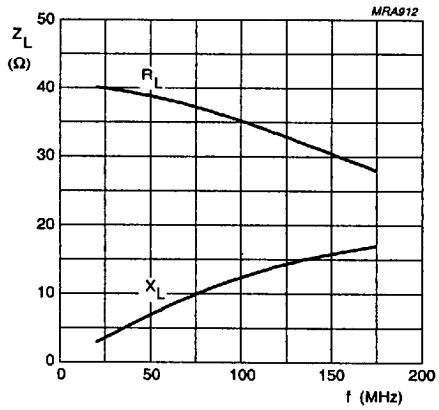
The circuit and components are situated on one side of the printed circuit board, the other side being fully metallized, to serve as a ground plane. Earth connections are made by means of copper straps and hollow rivets for a direct contact between upper and lower sheets. Heatsinking is achieved by pressing the transistor against an insulating thermal conductor (Al_2O_3-disc), which is attached to a track on the printed circuit board. This track is connected to the heatsink by means of four screws.

Fig.12 Component layout for 175 MHz class-B test circuit.



Class-B operation; V_{DS} = 12.5 V; I_{DQ} = 20 mA; R_{GS} = 221 Ω; P_L = 2 W.

Fig.13 Input impedance as a function of frequency (series components), typical values.



Class-B operation; V_{DS} = 12.5 V; I_{DQ} = 20 mA; R_{GS} = 221 Ω; P_L = 2 W.

Fig.14 Load impedance as a function of frequency (series components), typical values.

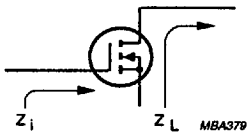
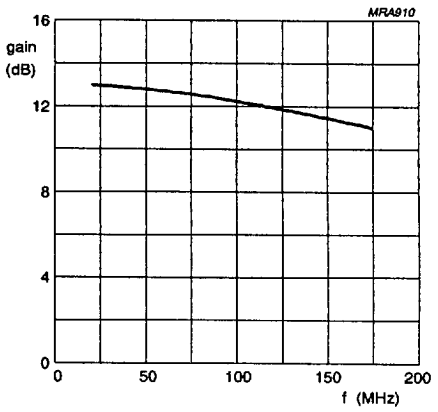


Fig.15 Definition of MOS impedance.



Class-B operation; V_{DS} = 12.5 V; I_{DQ} = 20 mA; R_{GS} = 221 Ω; P_L = 2 W.

Fig.16 Power gain as a function of frequency, typical values.