

# DATA SHEET

## **BLF278** VHF push-pull power MOS transistor

Product Specification  
Supersedes data of October 1992

1996 Oct 21

# VHF push-pull power MOS transistor

# BLF278

### FEATURES

- High power gain
- Easy power control
- Good thermal stability
- Gold metallization ensures excellent reliability.

### APPLICATIONS

- Broadcast transmitters in the VHF frequency range.

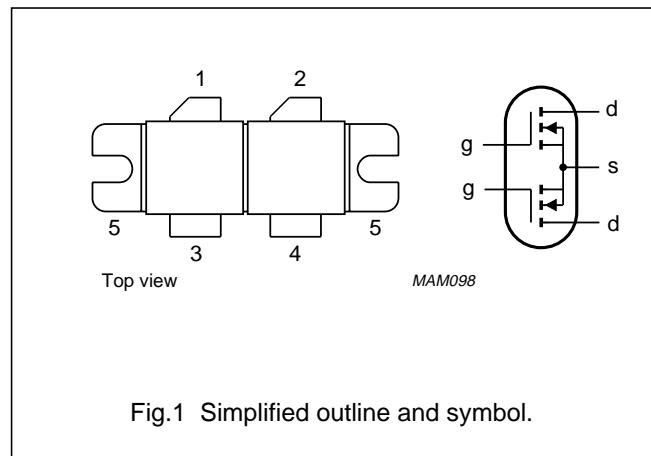
### DESCRIPTION

Dual push-pull silicon N-channel enhancement mode vertical D-MOS transistor encapsulated in a 4-lead, SOT262A1 balanced flange package with two ceramic caps. The mounting flange provides the common source connection for the transistors.

### PINNING - SOT262A1

| PIN | SYMBOL         | DESCRIPTION |
|-----|----------------|-------------|
| 1   | d <sub>1</sub> | drain 1     |
| 2   | d <sub>2</sub> | drain 2     |
| 3   | g <sub>1</sub> | gate 1      |
| 4   | g <sub>2</sub> | gate 2      |
| 5   | s              | source      |

| CAUTION  |
|--|
| The device is supplied in an antistatic package.<br>The gate-source input must be protected against static discharge during transport or handling. |



### QUICK REFERENCE DATA

RF performance at T<sub>h</sub> = 25 °C in a push-pull common source test circuit.

| MODE OF OPERATION | f (MHz) | V <sub>DS</sub> (V) | P <sub>L</sub> (W) | G <sub>p</sub> (dB) | η <sub>D</sub> (%) |
|-------------------|---------|---------------------|--------------------|---------------------|--------------------|
| CW, class-B       | 108     | 50                  | 300                | >20                 | >60                |
| CW, class-C       | 108     | 50                  | 300                | typ. 18             | typ. 80            |
| CW, class-AB      | 225     | 50                  | 250                | >14<br>typ. 16      | >50<br>typ. 55     |

| WARNING  |
|--|
| <b>Product and environmental safety - toxic materials</b>  |
| This product contains beryllium oxide. The product is entirely safe provided that the BeO discs are 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. |

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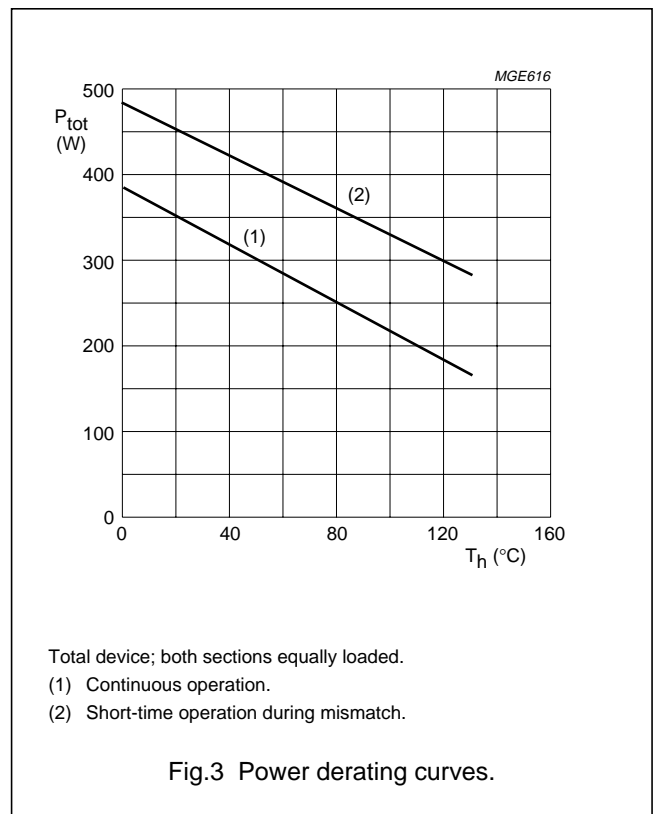
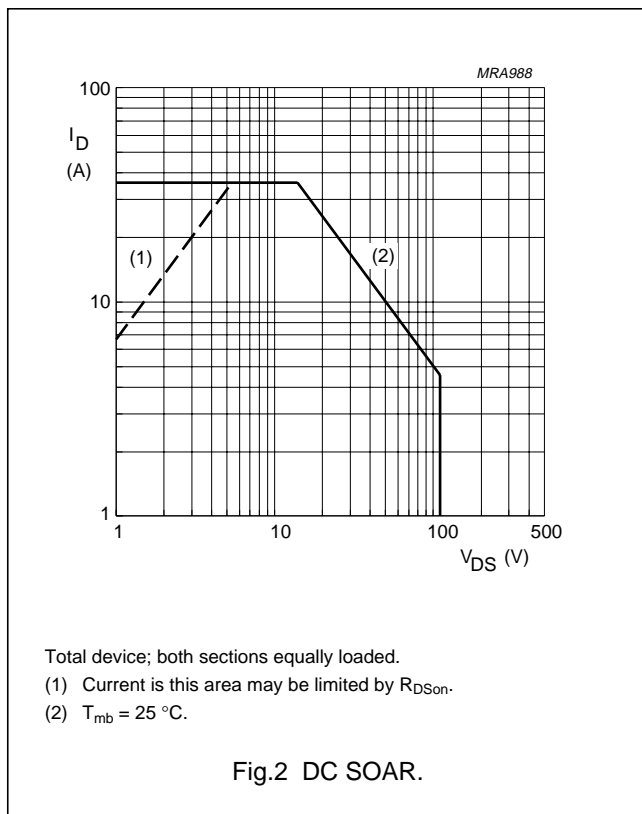
## LIMITING VALUES

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

| SYMBOL                        | PARAMETER               | CONDITIONS  | MIN. | MAX.     | UNIT             |
|-------------------------------|-------------------------|---|------|----------|------------------|
| <b>Per transistor section</b> |                         |   |      |          |                  |
| $V_{DS}$                      | drain-source voltage    |   | –    | 110      | V                |
| $V_{GS}$                      | gate-source voltage     |   | –    | $\pm 20$ | V                |
| $I_D$                         | drain current (DC)      |   | –    | 18       | A                |
| $P_{tot}$                     | total power dissipation | up to $T_{mb} = 25\text{ }^\circ\text{C}$ total device;<br>both sections equally loaded | –    | 500      | 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 | total device; both sections equally loaded. | max. 0.35 | K/W  |
| $R_{th\ mb-h}$ | thermal resistance from mounting base to heatsink | total device; both sections equally loaded. | max. 0.15 | K/W  |



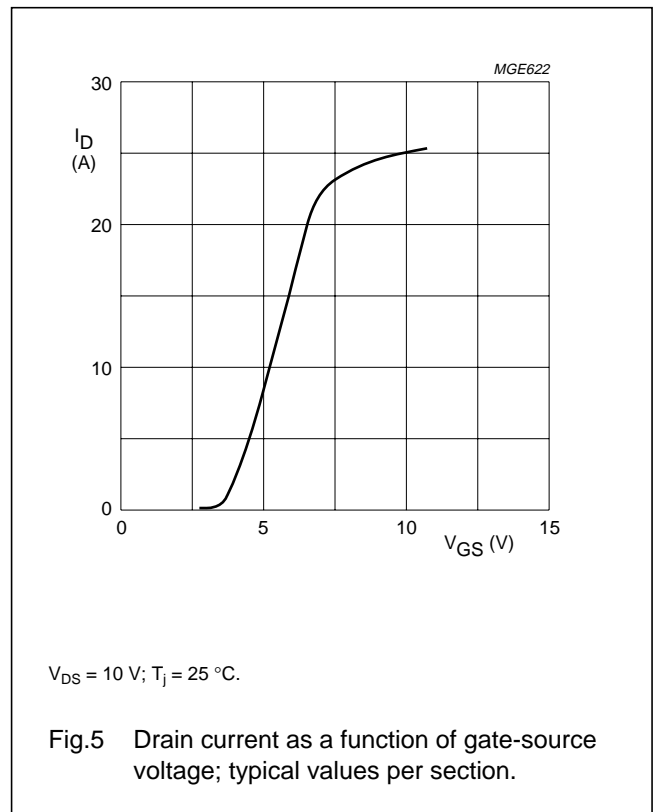
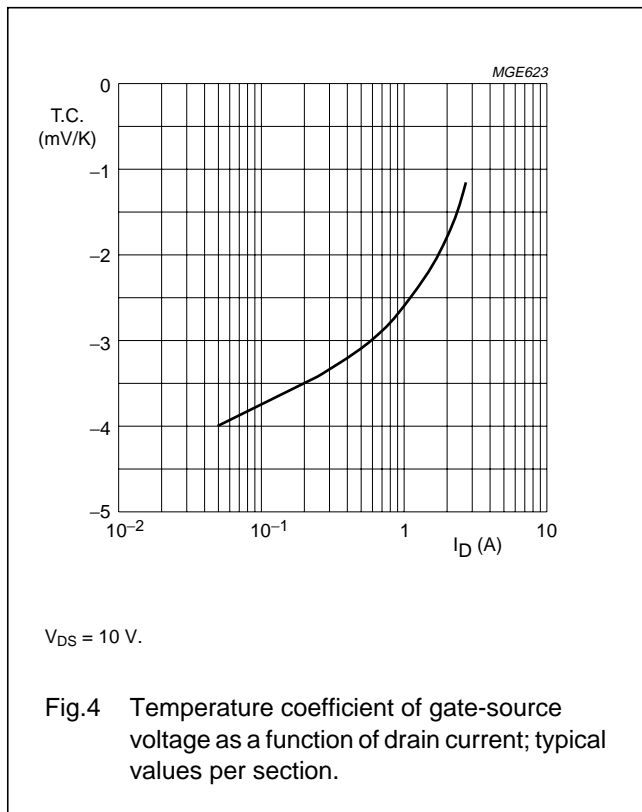
# VHF push-pull power MOS transistor

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## CHARACTERISTICS

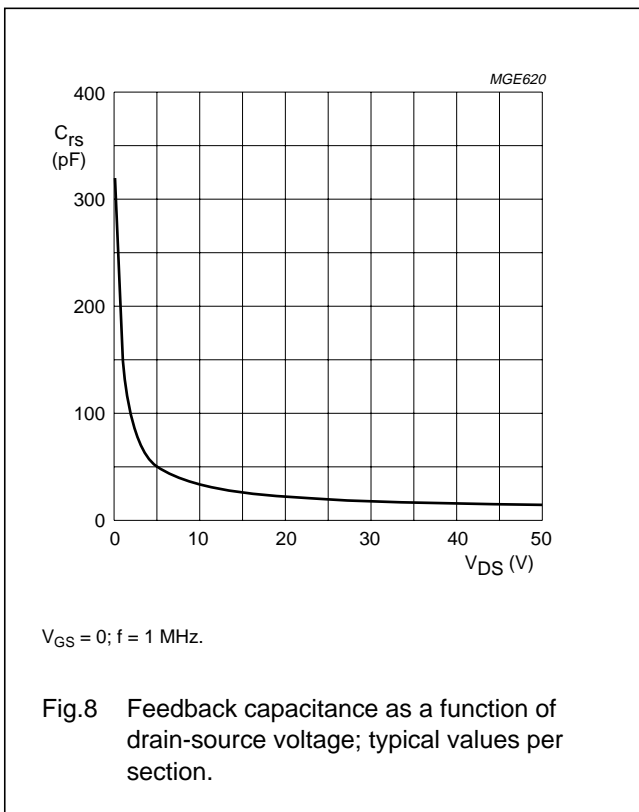
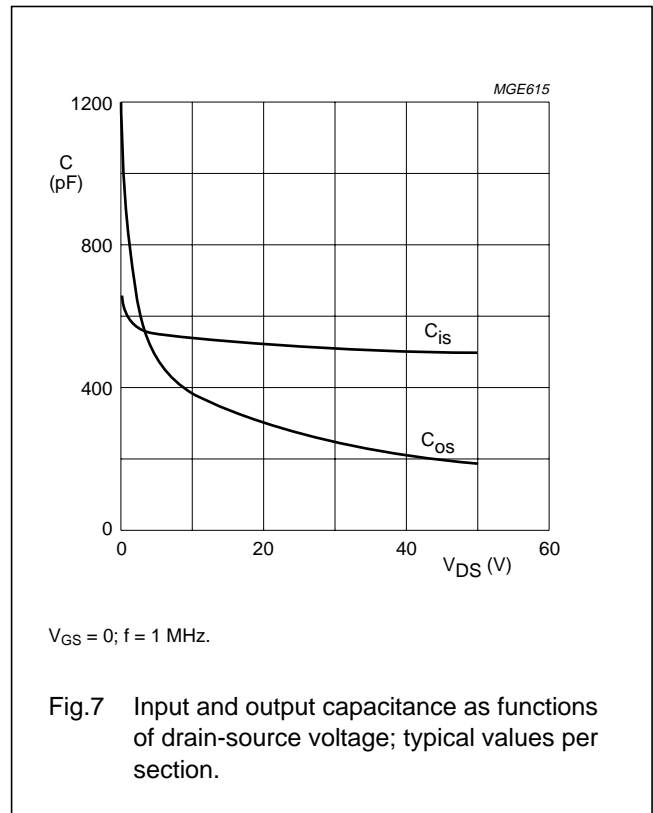
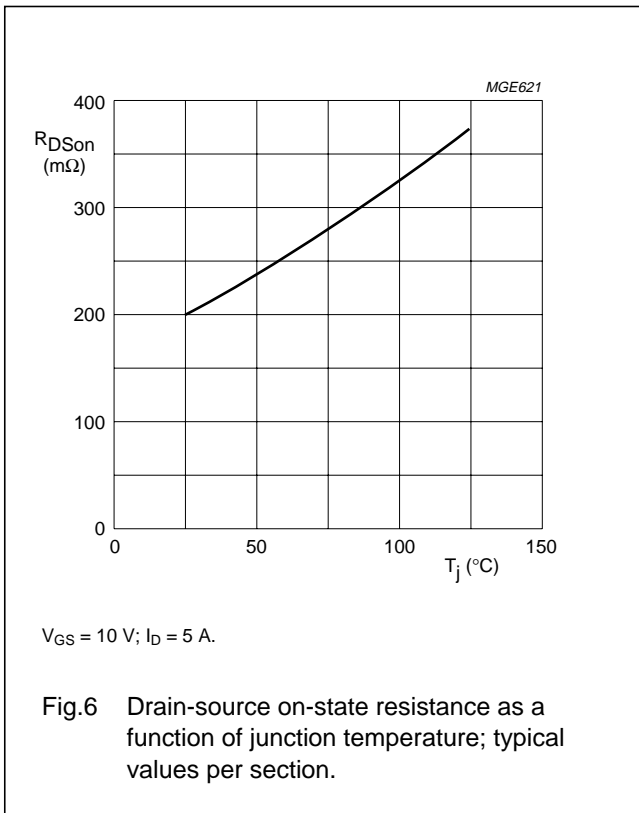
$T_j = 25\text{ }^\circ\text{C}$  unless otherwise specified.

| SYMBOL                        | PARAMETER                                       | CONDITIONS   | MIN. | TYP. | MAX. | UNIT          |
|-------------------------------|---|--|------|------|------|---------------|
| <b>Per transistor section</b> |   |  |      |      |      |               |
| $V_{(BR)DSS}$                 | drain-source breakdown voltage                  | $V_{GS} = 0; I_D = 50\text{ mA}$                     | 110  | –    | –    | V             |
| $I_{DSS}$                     | drain-source leakage current                    | $V_{GS} = 0; V_{DS} = 50\text{ V}$                   | –    | –    | 2.5  | mA            |
| $I_{GSS}$                     | gate-source leakage current                     | $V_{GS} = \pm 20\text{ V}; V_{DS} = 0$               | –    | –    | 1    | $\mu\text{A}$ |
| $V_{GSth}$                    | gate-source threshold voltage                   | $V_{DS} = 10\text{ V}; I_D = 50\text{ mA}$           | 2    | –    | 4.5  | V             |
| $\Delta V_{GS}$               | gate-source voltage difference of both sections | $V_{DS} = 10\text{ V}; I_D = 50\text{ mA}$           | –    | –    | 100  | mV            |
| $g_{fs}$                      | forward transconductance                        | $V_{DS} = 10\text{ V}; I_D = 5\text{ A}$             | 4.5  | 6.2  | –    | S             |
| $g_{fs1}/g_{fs2}$             | forward transconductance ratio of both sections | $V_{DS} = 10\text{ V}; I_D = 5\text{ A}$             | 0.9  | –    | 1.1  |               |
| $R_{DSon}$                    | drain-source on-state resistance                | $V_{GS} = 10\text{ V}; I_D = 5\text{ A}$             | –    | 0.2  | 0.3  | $\Omega$      |
| $I_{DSX}$                     | drain cut-off current                           | $V_{GS} = 10\text{ V}; V_{DS} = 10\text{ V}$         | –    | 25   | –    | A             |
| $C_{is}$                      | input capacitance                               | $V_{GS} = 0; V_{DS} = 50\text{ V}; f = 1\text{ MHz}$ | –    | 480  | –    | pF            |
| $C_{os}$                      | output capacitance                              | $V_{GS} = 0; V_{DS} = 50\text{ V}; f = 1\text{ MHz}$ | –    | 190  | –    | pF            |
| $C_{rs}$                      | feedback capacitance                            | $V_{GS} = 0; V_{DS} = 50\text{ V}; f = 1\text{ MHz}$ | –    | 14   | –    | pF            |
| $C_{d-f}$                     | drain-flange capacitance                        |  | –    | 5.4  | –    | pF            |



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**APPLICATION INFORMATION****Class-B operation**

RF performance in CW operation in a common source push-pull test circuit.  $T_h = 25\text{ }^\circ\text{C}$ ;  $R_{th\text{ mb-h}} = 0.15\text{ K/W}$  unless otherwise specified.  $R_{GS} = 4\text{ }\Omega$  per section; optimum load impedance per section =  $3.2 + j4.3\text{ }\Omega$  ( $V_{DS} = 50\text{ V}$ ).

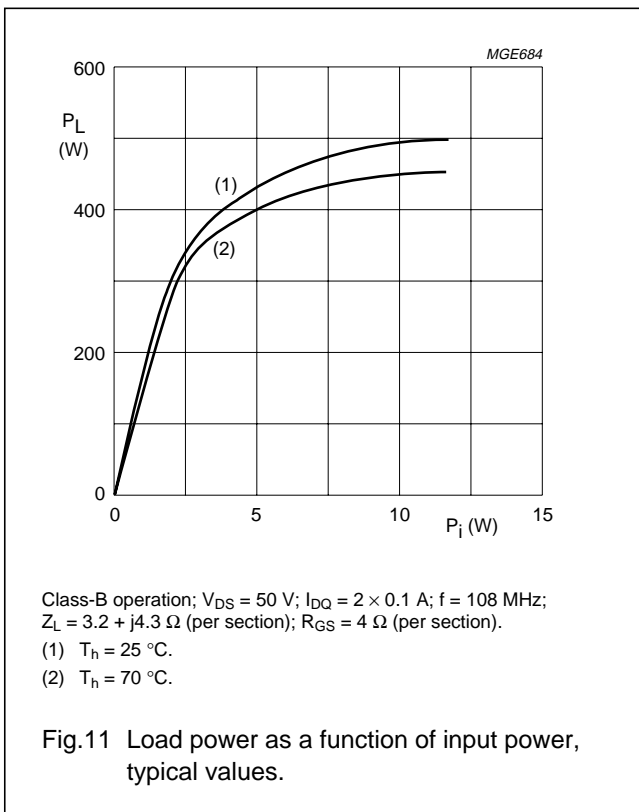
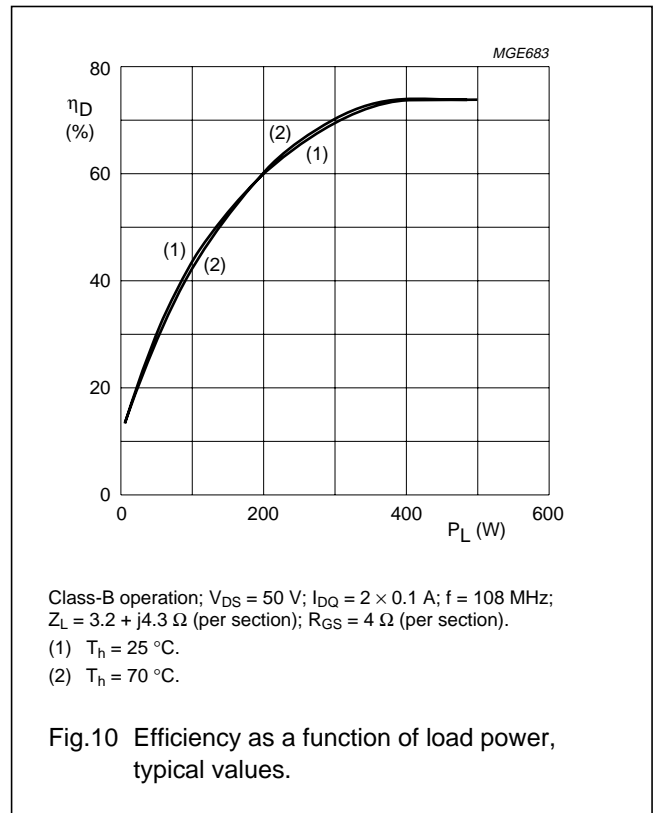
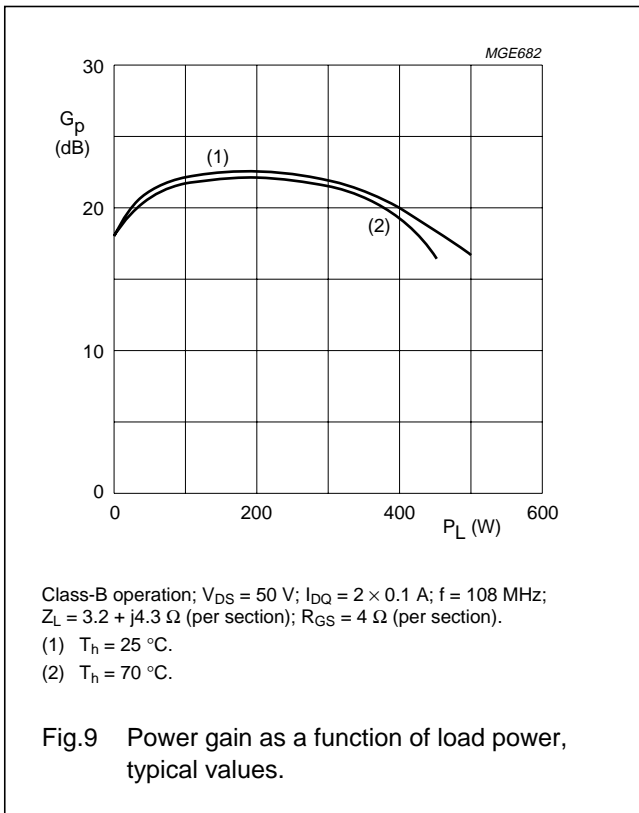
| MODE OF OPERATION | f (MHz) | $V_{DS}$ (V) | $I_{DQ}$ (A)   | $P_L$ (W) | $G_p$ (dB)     | $\eta_D$ (%)   |
|-------------------|---------|--------------|----------------|-----------|----------------|----------------|
| CW, class-B       | 108     | 50           | $2 \times 0.1$ | 300       | >20<br>typ. 22 | >60<br>typ. 70 |
| CW, class-C       | 108     | 50           | $V_{GS} = 0$   | 300       | typ. 18        | typ. 80        |

**Ruggedness in class-B operation**

The BLF278 is capable of withstanding a load mismatch corresponding to  $VSWR = 7 : 1$  through all phases under the conditions:  $V_{DS} = 50\text{ V}$ ;  $f = 108\text{ MHz}$  at rated load power.

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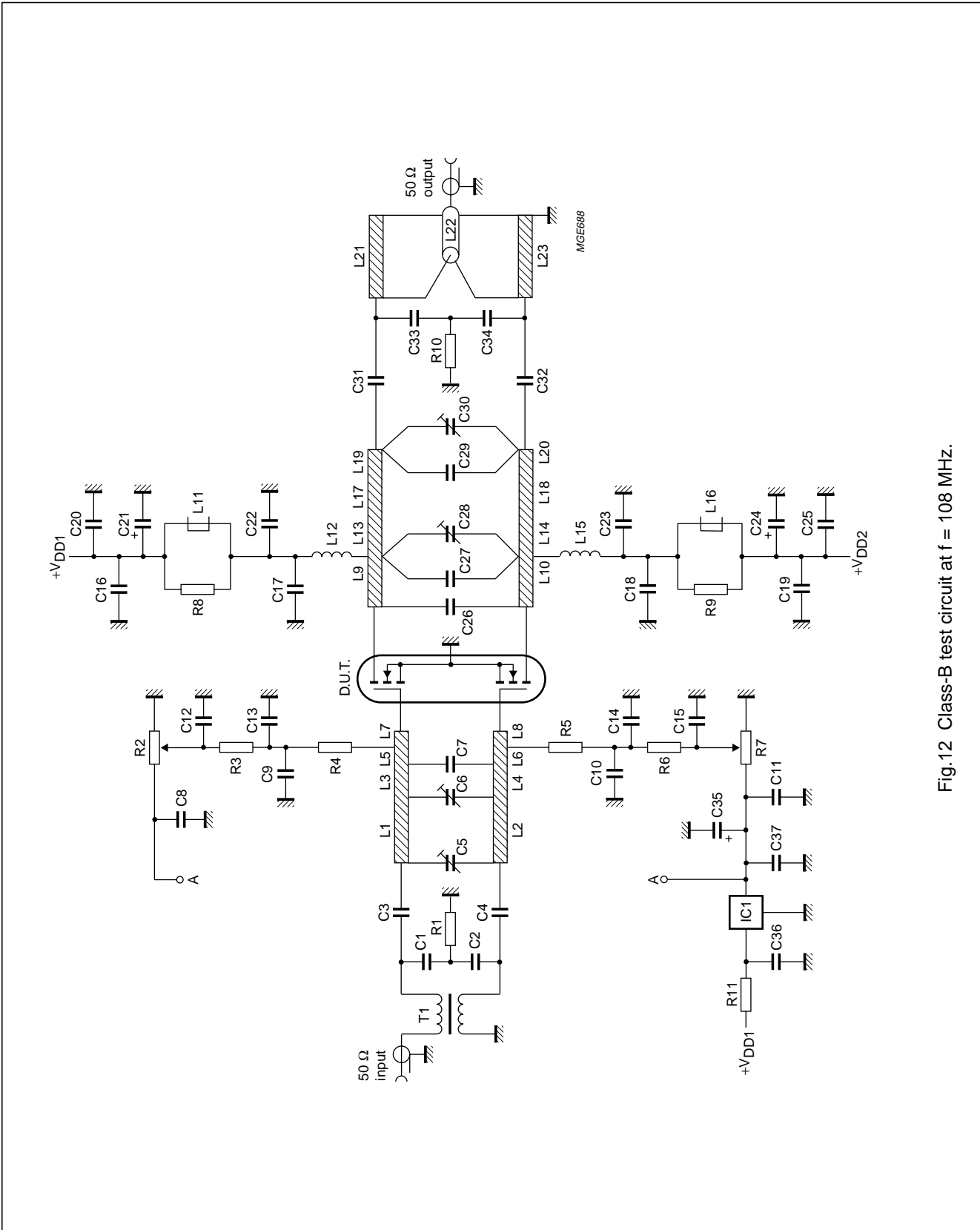


Fig.12 Class-B test circuit at f = 108 MHz.



## VHF push-pull power MOS transistor

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## List of components (see Figs 12 and 13).

| COMPONENT                              | DESCRIPTION   | VALUE  | DIMENSIONS  | CATALOGUE NO.  |
|--|---|--|---|----------------|
| C1, C2, C33, C34                       | multilayer ceramic chip capacitor;<br>note 1              | 22 pF, 500 V                                     |   |                |
| C3, C4                                 | multilayer ceramic chip capacitor;<br>note 1              | 100 pF + 68 pF<br>in parallel, 500 V             |   |                |
| C5, C6, C28                            | film dielectric trimmer                                   | 5 to 60 pF                                       |   | 2222 809 08003 |
| C7                                     | multilayer ceramic chip capacitor;<br>note 1              | 2 × 100 pF +<br>1 × 120 pF in<br>parallel, 500 V |   |                |
| C8, C11, C12,<br>C15, C16, C19,<br>C36 | multilayer ceramic chip capacitor                         | 100 nF, 500 V                                    |   | 2222 852 47104 |
| C9, C10, C13,<br>C14, C20, C25         | multilayer ceramic chip capacitor;<br>note 1              | 1 nF, 500 V                                      |   |                |
| C17, C18, C22,<br>C23                  | multilayer ceramic chip capacitor;<br>note 1              | 470 pF, 500 V                                    |   |                |
| C21, C24, C35                          | electrolytic capacitor                                    | 10 µF, 63 V                                      |   |                |
| C26                                    | multilayer ceramic chip capacitor;<br>note 1              | 2 × 15 pF +<br>1 × 18 pF in<br>parallel, 500 V   |   |                |
| C27                                    | multilayer ceramic chip capacitor;<br>note 1              | 3 × 15 pF in<br>parallel, 500 V                  |   |                |
| C29                                    | multilayer ceramic chip capacitor;<br>note 1              | 2 × 18 pF +<br>1 × 15 pF in<br>parallel, 500 V   |   |                |
| C30                                    | film dielectric trimmer                                   | 2 to 18 pF                                       |   | 2222 809 09006 |
| C31, C32                               | multilayer ceramic chip capacitor;<br>note 1              | 3 × 43 pF in<br>parallel, 500 V                  |   |                |
| L1, L2                                 | stripline; note 2   | 43 Ω   | length 57.5 mm<br>width 6 mm                        |                |
| L3, L4                                 | stripline; note 2   | 43 Ω   | length 29.5 mm<br>width 6 mm                        |                |
| L5, L6                                 | stripline; note 2   | 43 Ω   | length 14 mm<br>width 6 mm                          |                |
| L7, L8                                 | stripline; note 2   | 43 Ω   | length 6 mm<br>width 6 mm                           |                |
| L9, L10                                | stripline; note 2   | 43 Ω   | length 17.5 mm<br>width 6 mm                        |                |
| L11, L16                               | 2 × grade 3B Ferroxcube wideband<br>HF chokes in parallel |  |   | 4312 020 36642 |
| L12, L15                               | 4 turns enamelled 2 mm copper wire                        | 85 nH  | length 13.5 mm<br>int. dia. 10 mm<br>leads 2 × 7 mm |                |
| L13, L14                               | stripline; note 2   | 43 Ω   | length 19.5 mm<br>width 6 mm                        |                |

## VHF push-pull power MOS transistor

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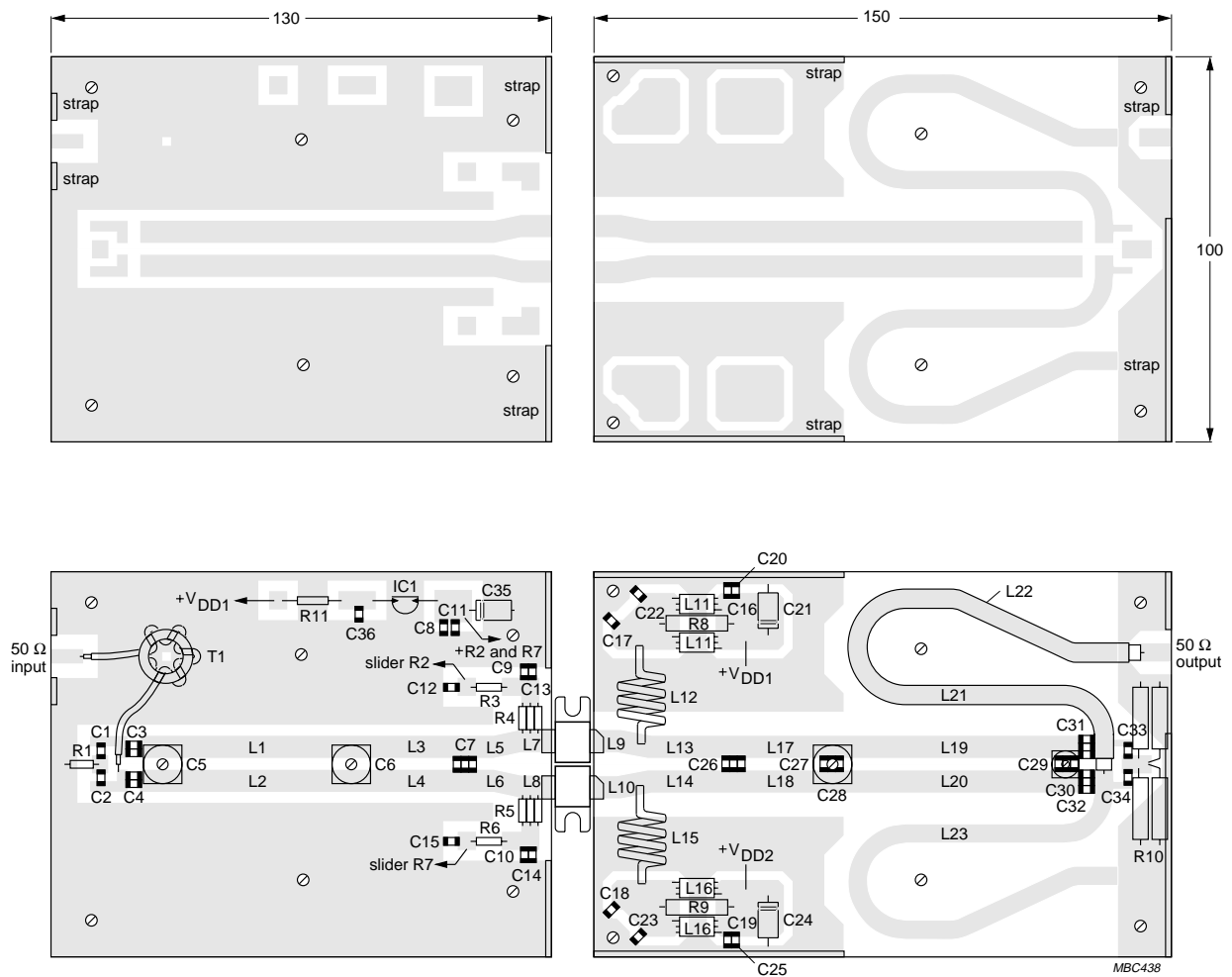
| COMPONENT | DESCRIPTION  | VALUE  | DIMENSIONS   | CATALOGUE NO.  |
|-----------|--|--|--|----------------|
| L17, L18  | stripline; note 2  | 43 $\Omega$                                    | length 24.5 mm<br>width 6 mm                         |                |
| L19, L20  | stripline; note 2  | 43 $\Omega$                                    | length 66 mm<br>width 6 mm                           |                |
| L21, L23  | stripline; note 2  | 50 $\Omega$                                    | length 160 mm<br>width 4.8 mm                        |                |
| L22       | semi-rigid cable; note 3   | 50 $\Omega$                                    | ext. dia. 3.6 mm<br>outer conductor<br>length 160 mm |                |
| R1        | metal film resistor  | 10 $\Omega$ , 0.4 W                            |  |                |
| R2, R7    | 10 turn potentiometer  | 50 k $\Omega$                                  |  |                |
| R3, R6    | metal film resistor  | 3 $\times$ 12.1 $\Omega$ in<br>parallel, 0.4 W |  |                |
| R4, R5    | metal film resistor  | 10 $\Omega$ ; 0.4 W                            |  |                |
| R8, R9    | metal film resistor  | 10 $\Omega$ $\pm$ 5%, 1 W                      |  |                |
| R10       | metal film resistor  | 4 $\times$ 10 $\Omega$ in<br>parallel, 1 W     |  |                |
| R11       | metal film resistor  | 5.11 k $\Omega$ , 1 W                          |  |                |
| IC1       | voltage regulator 78L05  |  |  |                |
| T1        | 1:1 Balun; 7 turns type 4C6 50 $\Omega$<br>coaxial cable wound around toroid |  | 14 $\times$ 9 $\times$ 5 mm                          | 4322 020 90770 |

**Notes**

1. American Technical Ceramics capacitor, type 100B or capacitor of same quality.
2. L1 to L10, L13, L14, L17 to L21 and L23 are striplines on a double copper-clad printed-circuit board, with fibre-glass PTFE dielectric ( $\epsilon_r = 2.2$ ), thickness  $\frac{1}{16}$  inch; thickness of copper sheet  $2 \times 35$   $\mu\text{m}$ .
3. L22 is soldered on to stripline L21.

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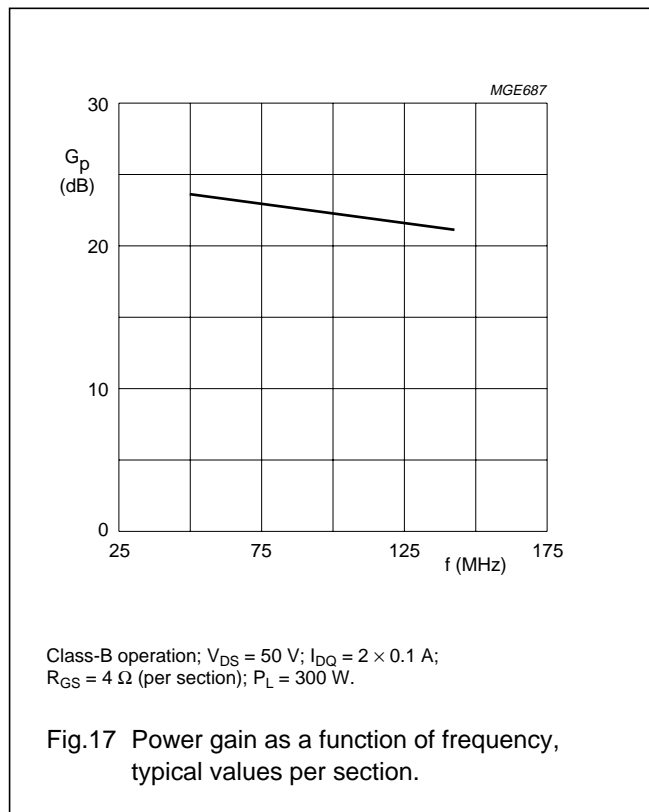
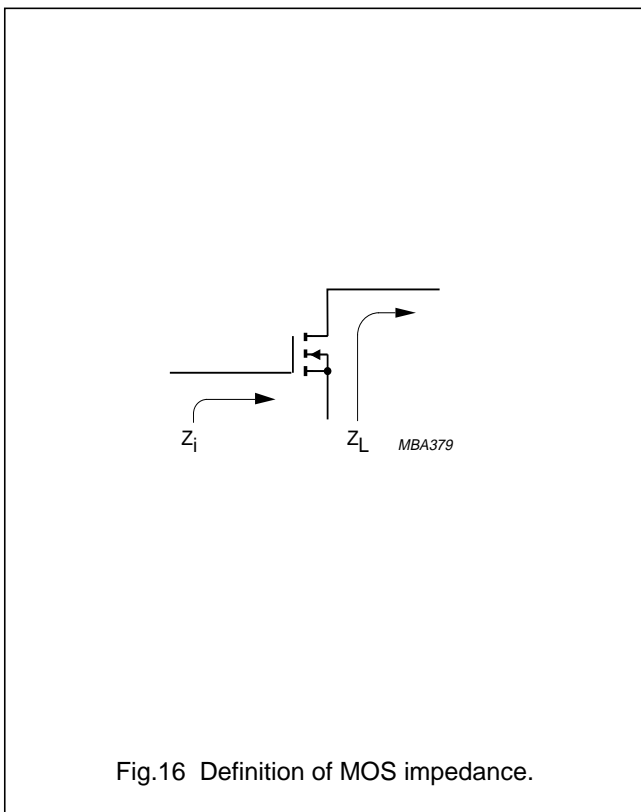
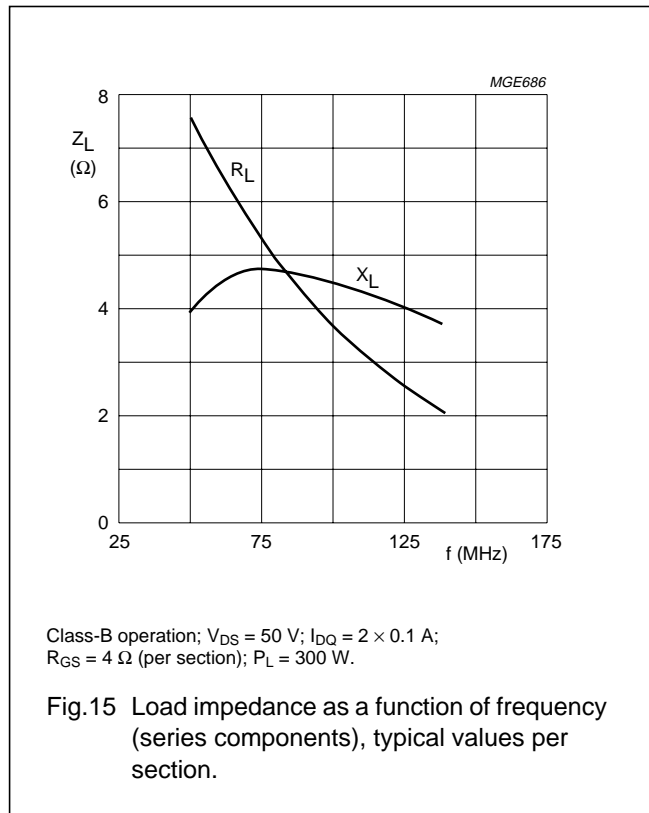
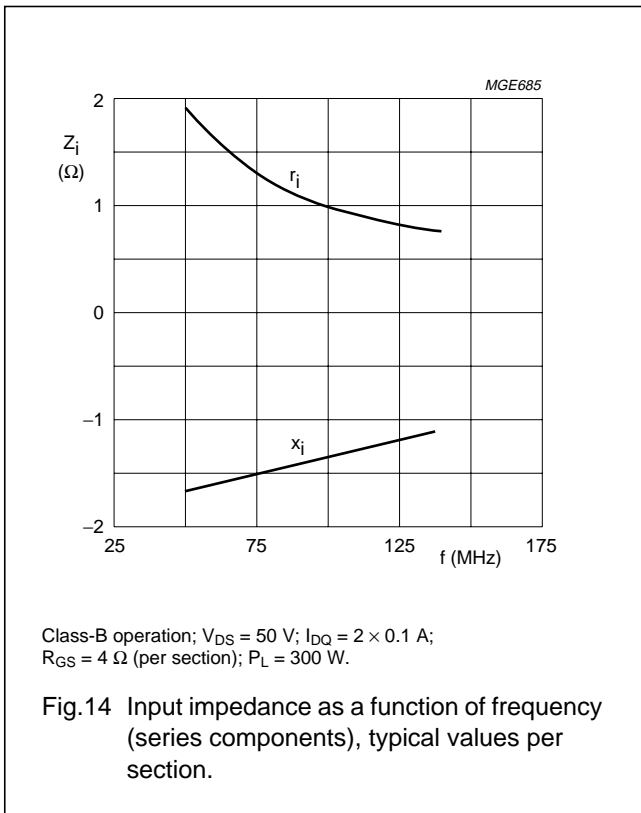
Dimensions in mm.

The circuit and components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as an earth. Earth connections are made by means of copper straps for a direct contact between upper and lower sheets.

Fig.13 Printed-circuit board and component layout for 108 MHz class-B test circuit.

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## VHF push-pull power MOS transistor

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**Class-AB operation**

RF performance in CW operation in a common source push-pull test circuit.  $T_h = 25\text{ }^\circ\text{C}$ ;  $R_{th\text{ mb-h}} = 0.15\text{ K/W}$  unless otherwise specified.  $R_{GS} = 2.8\text{ }\Omega$  per section; optimum load impedance per section =  $0.74 + j2\text{ }\Omega$ ; ( $V_{DS} = 50\text{ V}$ ).

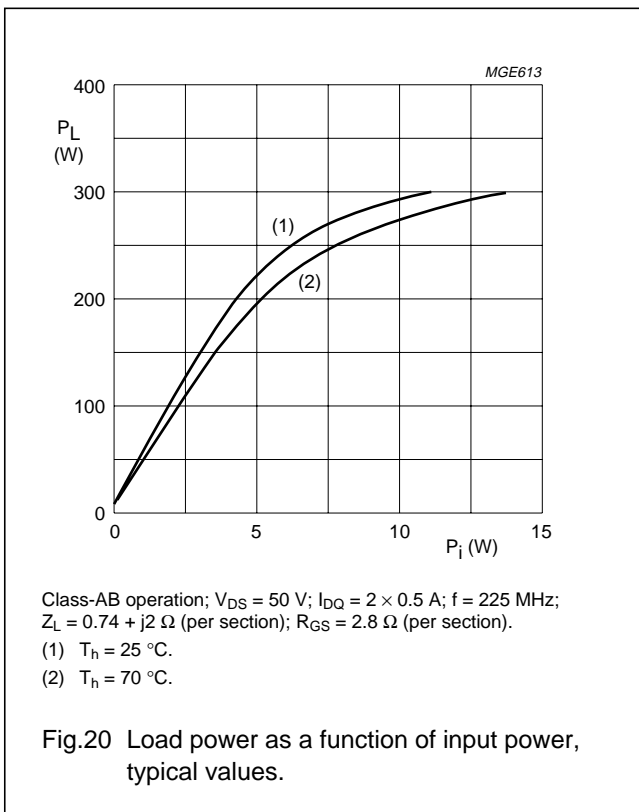
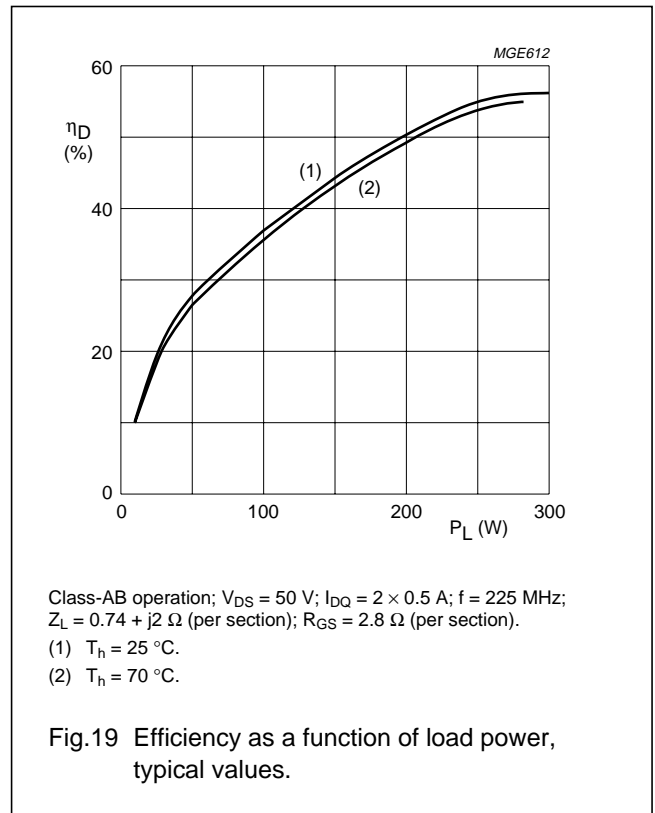
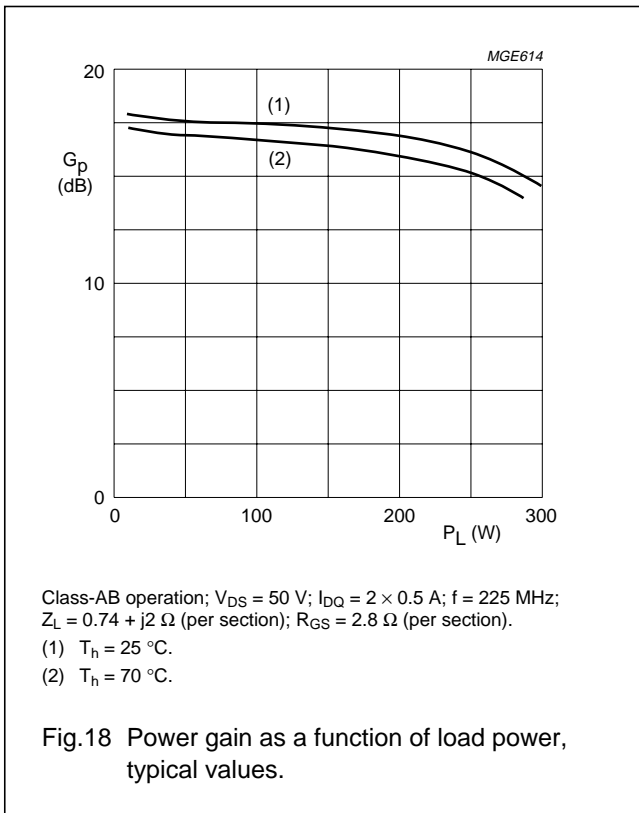
| MODE OF OPERATION | f<br>(MHz) | $V_{DS}$<br>(V) | $I_{DQ}$<br>(A) | $P_L$<br>(W) | $G_p$<br>(dB)  | $\eta_D$<br>(%) |
|-------------------|------------|-----------------|-----------------|--------------|----------------|-----------------|
| CW, class-AB      | 225        | 50              | $2 \times 0.5$  | 250          | >14<br>typ. 16 | >50<br>typ. 55  |

**Ruggedness in class-AB operation**

The BLF278 is capable of withstanding a load mismatch corresponding to  $V_{SWR} = 7 : 1$  through all phases under the conditions:  $V_{DS} = 50\text{ V}$ ;  $f = 225\text{ MHz}$  at rated output power.

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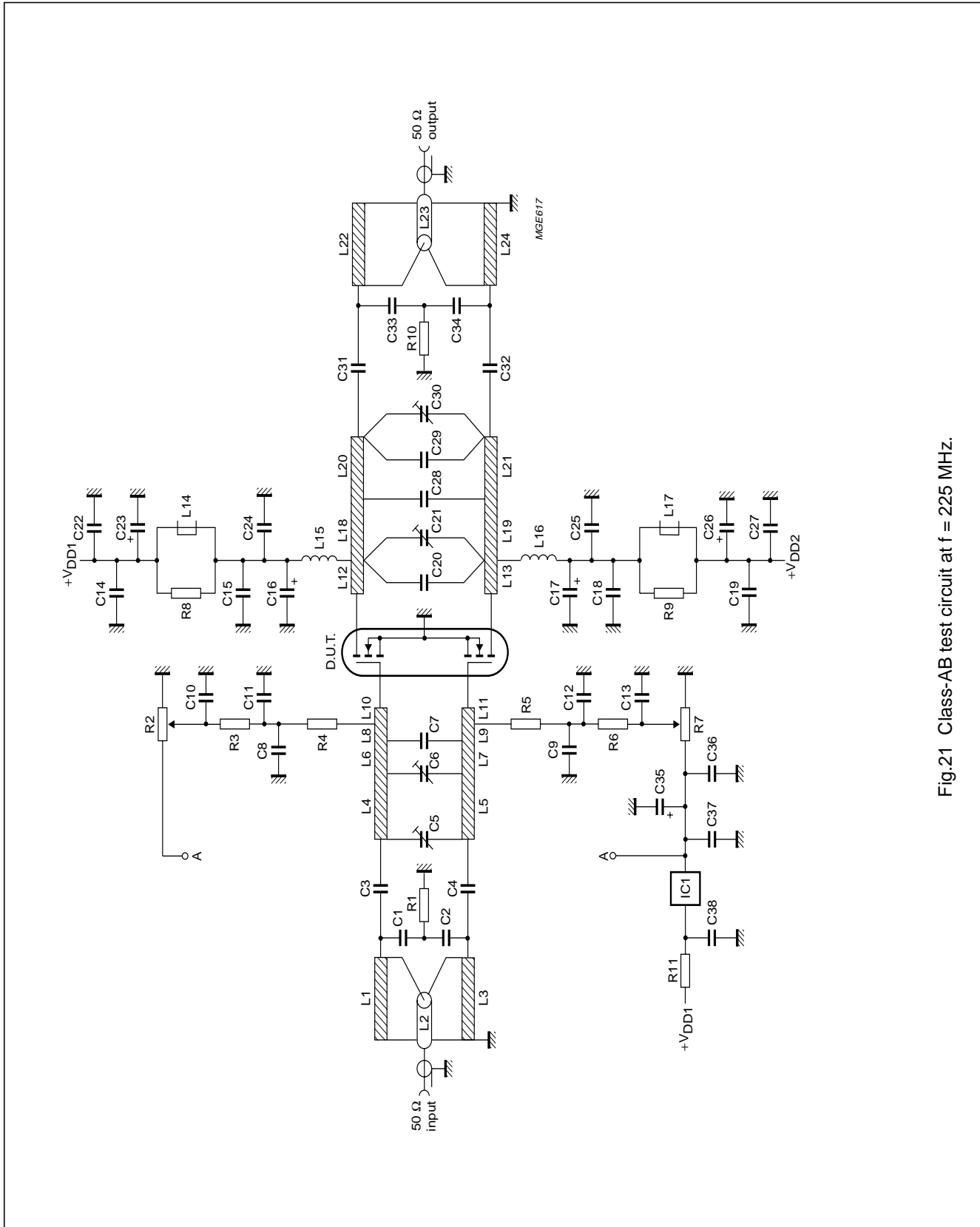


Fig.21 Class-AB test circuit at f = 225 MHz.

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List of components (see Figs 21 and 22).

| COMPONENT                  | DESCRIPTION                                  | VALUE  | DIMENSIONS  | CATALOGUE NO.  |
|----------------------------|--|--|---|----------------|
| C1, C2                     | multilayer ceramic chip capacitor;<br>note 1 | 27 pF, 500 V                                   |   |                |
| C3, C4, C31, C32           | multilayer ceramic chip capacitor;<br>note 1 | 3 × 18 pF<br>in parallel, 500 V                |   |                |
| C5                         | film dielectric trimmer                      | 4 to 40 pF                                     |   | 2222 809 08002 |
| C6, C30                    | film dielectric trimmer                      | 2 to 18 pF                                     |   | 2222 809 09006 |
| C7                         | multilayer ceramic chip capacitor;<br>note 1 | 100 pF, 500 V                                  |   |                |
| C8, C9, C15, C18           | MKT film capacitor                           | 1 μF, 63 V                                     |   | 2222 371 11105 |
| C10, C13, C14,<br>C19, C36 | multilayer ceramic chip capacitor            | 100 nF, 50 V                                   |   | 2222 852 47104 |
| C11, C12                   | multilayer ceramic chip capacitor;<br>note 1 | 2 × 1 nF in parallel,<br>500 V                 |   |                |
| C16, C17                   | electrolytic capacitor                       | 220 μF, 63 V                                   |   |                |
| C20                        | multilayer ceramic chip capacitor;<br>note 1 | 3 × 33 pF in<br>parallel, 500 V                |   |                |
| C21                        | film dielectric trimmer                      | 2 to 9 pF                                      |   | 2222 809 09005 |
| C22, C27, C37,<br>C38      | multilayer ceramic chip capacitor;<br>note 1 | 1 nF, 500 V                                    |   |                |
| C23, C26, C35              | electrolytic capacitor                       | 10 μF, 63 V                                    |   |                |
| C24, C25                   | multilayer ceramic chip capacitor;<br>note 1 | 2 × 470 pF in<br>parallel, 500 V               |   |                |
| C28                        | multilayer ceramic chip capacitor;<br>note 1 | 2 × 10 pF +<br>1 × 18 pF in<br>parallel, 500 V |   |                |
| C29                        | multilayer ceramic chip capacitor;<br>note 1 | 2 × 5.6 pF in<br>parallel, 500 V               |   |                |
| C33, C34                   | multilayer ceramic chip capacitor;<br>note 1 | 5.6 pF, 500 V                                  |   |                |
| L1, L3, L22, L24           | stripline; note 2                            | 50 Ω   | length 80 mm<br>width 4.8 mm                        |                |
| L2, L23                    | semi-rigid cable; note 3                     | 50 Ω   | ext. dia. 3.6 mm<br>outer conductor<br>length 80 mm |                |
| L4, L5                     | stripline; note 2                            | 43 Ω   | length 24 mm<br>width 6 mm                          |                |
| L6, L7                     | stripline; note 2                            | 43 Ω   | length 14.5 mm<br>width 6 mm                        |                |
| L8, L9                     | stripline; note 2                            | 43 Ω   | length 4.4 mm<br>width 6 mm                         |                |
| L10, L11                   | stripline; note 2                            | 43 Ω   | length 3.2 mm<br>width 6 mm                         |                |
| L12, L13                   | stripline; note 2                            | 43 Ω   | length 15 mm<br>width 6 mm                          |                |



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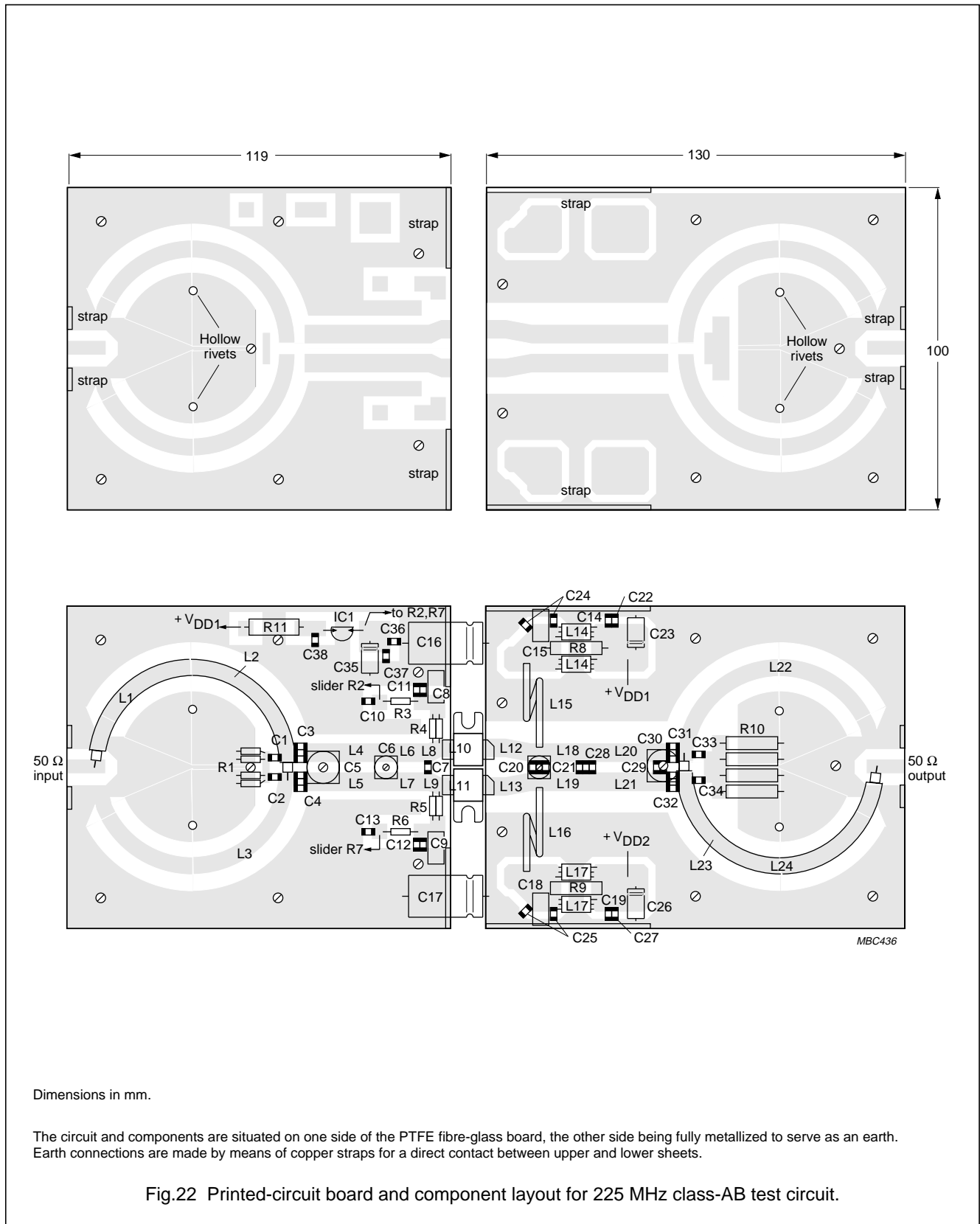
| COMPONENT | DESCRIPTION  | VALUE                          | DIMENSIONS                                      | CATALOGUE NO.  |
|-----------|--|--------------------------------|---|----------------|
| L14, L17  | 2 × grade 3B Ferroxcube wideband HF chokes in parallel |                                |   | 4312 020 36642 |
| L15, L16  | 1 $\frac{3}{4}$ turns enamelled 2 mm copper wire       | 40 nH                          | int. dia. 10 mm<br>leads 2 × 7 mm<br>space 1 mm |                |
| L18, L19  | stripline; note 2                                      | 43 Ω                           | length 13 mm<br>width 6 mm                      |                |
| L20, L21  | stripline; note 2                                      | 43 Ω                           | length 29.5 mm<br>width 6 mm                    |                |
| R1        | metal film resistor                                    | 10 Ω, 0.4 W                    |   |                |
| R2, R7    | 10 turns potentiometer                                 | 50 kΩ                          |   |                |
| R3, R6    | metal film resistor                                    | 1 kΩ, 0.4 W                    |   |                |
| R4, R5    | metal film resistor                                    | 2 × 5.62 Ω, in parallel, 0.4 W |   |                |
| R8, R9    | metal film resistor                                    | 10 Ω ±5%, 1 W                  |   |                |
| R10       | metal film resistor                                    | 4 × 42.2 Ω in parallel, 1 W    |   |                |
| R11       | metal film resistor                                    | 5.11 kΩ, 1 W                   |   |                |
| IC1       | voltage regulator 78L05                                |                                |   |                |

**Notes**

1. American Technical Ceramics capacitor, type 100B or other capacitor of the same quality.
2. L1, L3 to L13, L18 to L22 and L24 are microstriplines on a double copper-clad printed-circuit board, with fibre-glass reinforced PTFE dielectric ( $\epsilon_r = 2.2$ ), thickness  $\frac{1}{16}$  inch; thickness of copper sheet 2 × 35 μm.
3. L2 and L23 are soldered on to striplines L1 and L24 respectively.

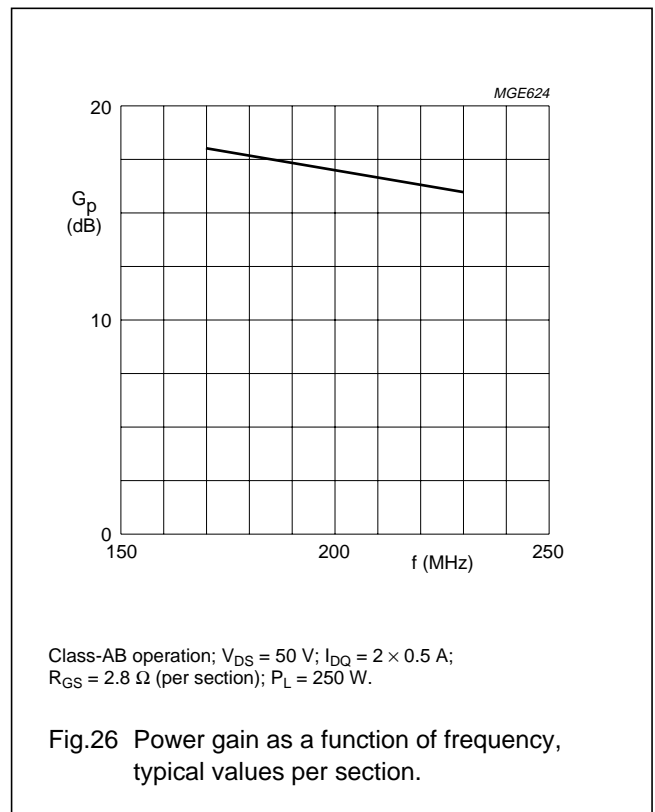
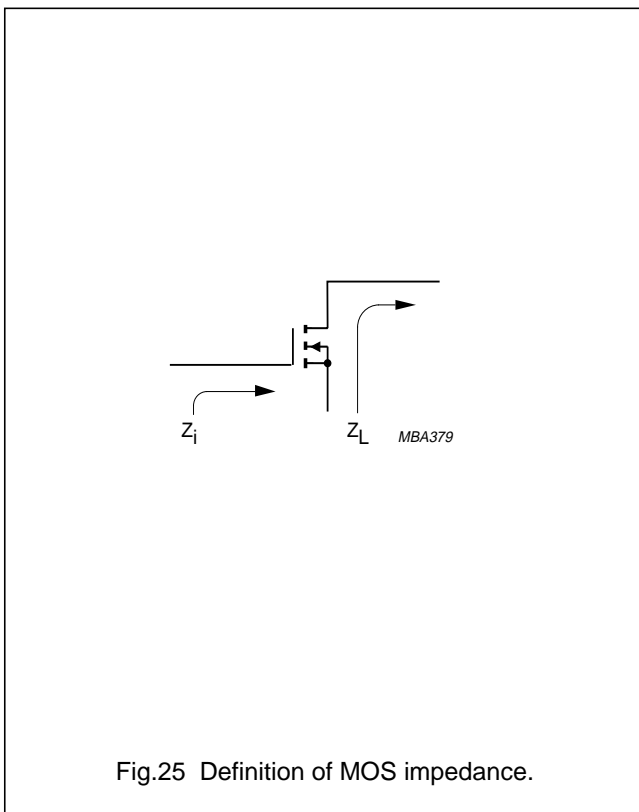
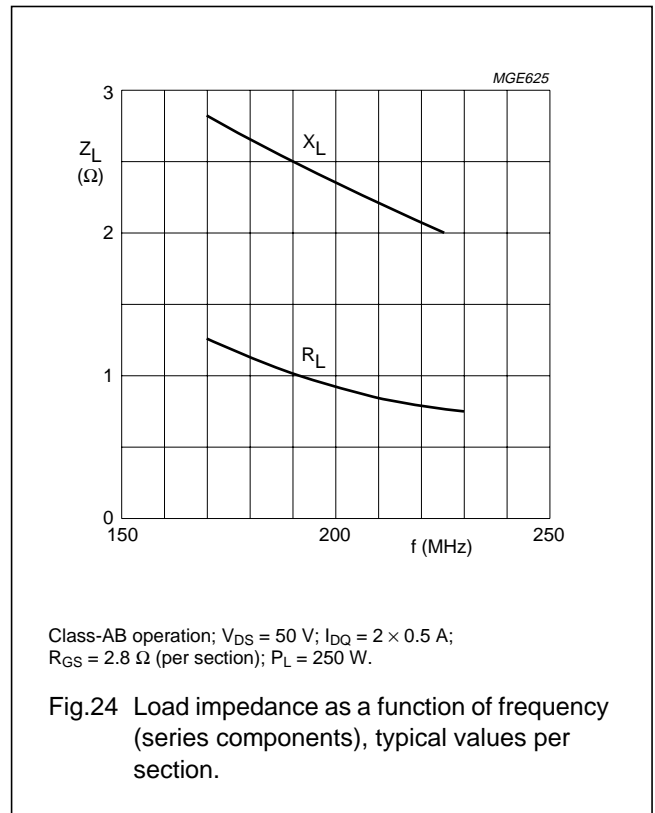
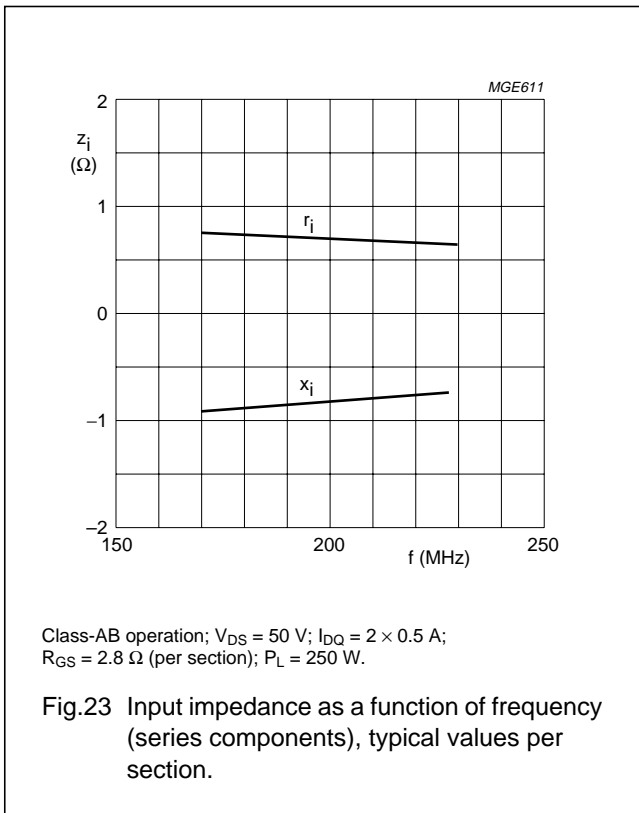
VHF push-pull power MOS transistor

BLF278



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## VHF push-pull power MOS transistor

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**DEFINITIONS**

| <b>Data Sheet Status</b>  |   |
|---|---|
| Objective specification   | This data sheet contains target or goal specifications for product development.       |
| Preliminary specification   | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification   | This data sheet contains final product specifications.                                |
| <b>Limiting values</b>  |   |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). 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. |   |
| <b>Application information</b>  |   |
| Where application information is given, it is advisory and does not form part of the specification.   |   |

**LIFE SUPPORT APPLICATIONS**

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Datasheets for electronics components.