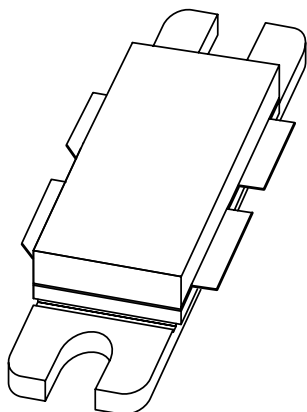


# DATA SHEET



## **BLF647** UHF power LDMOS transistor

Product specification  
Supersedes data of 2001 Aug 02

2001 Nov 27

## UHF power LDMOS transistor

## BLF647

## FEATURES

- High power gain
- Easy power control
- Excellent ruggedness
- Source on underside eliminates DC isolators, reducing common mode inductance
- Designed for broadband operation (HF to 800 MHz)
- Internal input damping for excellent stability over the whole frequency range.

## APPLICATIONS

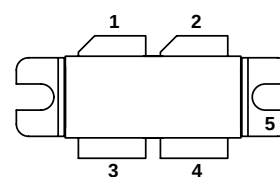
- Communication transmitter applications in the HF to 800 MHz frequency range.

## DESCRIPTION

Silicon N-channel enhancement mode lateral D-MOS push-pull transistor in a SOT540A package with ceramic cap. The common source is connected to the mounting flange.

## PINNING - SOT540A

| PIN | DESCRIPTION                 |
|-----|-----------------------------|
| 1   | drain 1                     |
| 2   | drain 2                     |
| 3   | gate 1                      |
| 4   | gate 2                      |
| 5   | source, connected to flange |



Top view

MBK777

Fig.1 Simplified outline.

## 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) | $P_L$ (W) | $G_p$ (dB) | $\eta_D$ (%) | $d_{im}$ (dBc) |
|-------------------|--------------------------|--------------|-----------|------------|--------------|----------------|
| CW, class-AB      | 600                      | 28           | 120       | >14.5      | >55          | –              |
| 2-tone, class-AB  | $f_1 = 600; f_2 = 600.1$ | 28           | 120 (PEP) | >14.5      | >40          | $\leq -26$     |

## LIMITING VALUES

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

| SYMBOL    | PARAMETER               | CONDITIONS                     | MIN. | MAX.     | UNIT             |
|-----------|-------------------------|--------------------------------|------|----------|------------------|
| $V_{DS}$  | drain-source voltage    |                                | –    | 65       | V                |
| $V_{GS}$  | gate-source voltage     |                                | –    | $\pm 15$ | V                |
| $I_D$     | drain current (DC)      |                                | –    | 18       | A                |
| $P_{tot}$ | total power dissipation | $T_{mb} \leq 25^\circ\text{C}$ | –    | 290      | W                |
| $T_{stg}$ | storage temperature     |                                | –65  | +150     | $^\circ\text{C}$ |
| $T_j$     | junction temperature    |                                | –    | 200      | $^\circ\text{C}$ |

## 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.

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THERMAL CHARACTERISTICS

| SYMBOL         | PARAMETER                                         | CONDITIONS                                      | VALUE | UNIT |
|----------------|---------------------------------------------------|-------------------------------------------------|-------|------|
| $R_{th\ j-mb}$ | thermal resistance from junction to mounting base | $T_{mb} = 25\text{ °C}; P_{tot} = 290\text{ W}$ | 0.6   | K/W  |
| $R_{th\ mb-h}$ | thermal resistance from mounting base to heatsink |                                                 | 0.2   | K/W  |

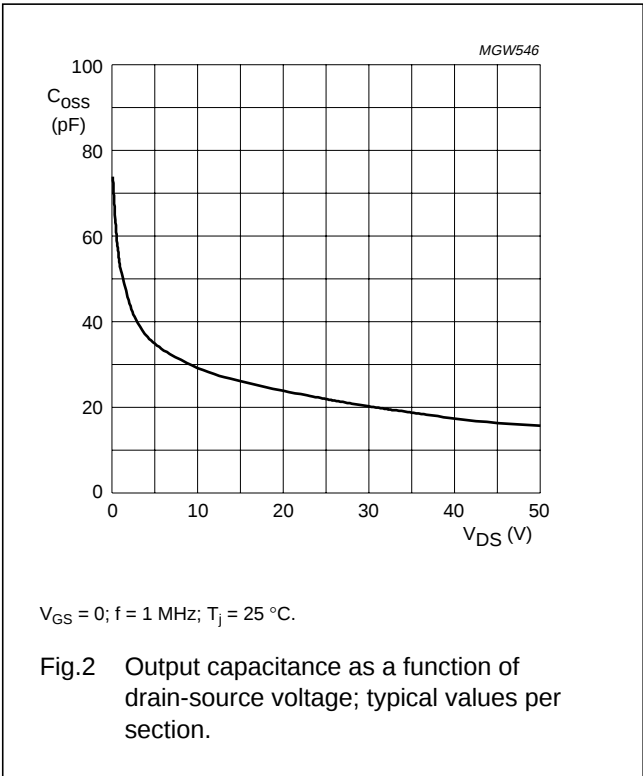
CHARACTERISTICS

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

| SYMBOL        | PARAMETER                        | CONDITIONS                                                      | MIN. | TYP. | MAX. | UNIT          |
|---------------|----------------------------------|-----------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)DSS}$ | drain-source breakdown voltage   | $V_{GS} = 0; I_D = 1.4\text{ mA}$                               | 65   | –    | –    | V             |
| $V_{GSth}$    | gate-source threshold voltage    | $V_{DS} = 20\text{ V}; I_D = 140\text{ mA}$                     | 4    | –    | 5.5  | V             |
| $I_{DSS}$     | drain-source leakage current     | $V_{GS} = 0; V_{DS} = 28\text{ V}$                              | –    | –    | 1.2  | $\mu\text{A}$ |
| $I_{DSX}$     | drain cut-off current            | $V_{GS} = V_{GSth} + 9\text{ V}; V_{DS} = 10\text{ V}$          | 18   | –    | –    | A             |
| $I_{GSS}$     | gate leakage current             | $V_{GS} = \pm 15\text{ V}; V_{DS} = 0$                          | –    | –    | 25   | nA            |
| $g_{fs}$      | forward transconductance         | $V_{DS} = 20\text{ V}; I_D = 4\text{ A}$                        | –    | 4    | –    | S             |
| $R_{DSon}$    | drain-source on-state resistance | $V_{GS} = V_{GSth} + 9\text{ V}; I_D = 4\text{ A}$              | –    | 160  | –    | m $\Omega$    |
| $C_{iss}$     | input capacitance                | $V_{GS} = 0; V_{DS} = 28\text{ V}; f = 1\text{ MHz};$<br>note 1 | –    | 80   | –    | pF            |
| $C_{oss}$     | output capacitance               | $V_{GS} = 0; V_{DS} = 28\text{ V}; f = 1\text{ MHz}$            | –    | 43   | –    | pF            |
| $C_{rss}$     | feedback capacitance             | $V_{GS} = 0; V_{DS} = 28\text{ V}; f = 1\text{ MHz}$            | –    | 6    | –    | pF            |

Note

1. Capacitance values of the die only.



## UHF power LDMOS transistor

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**APPLICATION INFORMATION**

RF performance in a common source class-AB circuit.  $T_h = 25\text{ }^{\circ}\text{C}$ ;  $R_{th\text{ mb-h}} = 0.2\text{ K/W}$ , unless otherwise specified.

| MODE OF OPERATION | f<br>(MHz)                  | $V_{DS}$<br>(V) | $P_L$<br>(W) | $G_p$<br>(dB) | $\eta_D$<br>(%) | $d_{im}$<br>(dBc) |
|-------------------|-----------------------------|-----------------|--------------|---------------|-----------------|-------------------|
| CW, class-AB      | 600                         | 28              | 120          | >14.5         | >55             | –                 |
| 2-tone, class-AB  | $f_1 = 600$ ; $f_2 = 600.1$ | 28              | 120 (PEP)    | >14.5         | >40             | $\leq -26$        |
| CW, class-AB      | 800                         | 32              | 150          | typ. 12.5     | typ. 60         | –                 |
| 2-tone, class-AB  | $f_1 = 800$ ; $f_2 = 800.1$ | 32              | 150 (PEP)    | typ. 13       | typ. 45         | typ. –30          |

**Ruggedness in class-AB operation**

The BLF647 is capable of withstanding a load mismatch corresponding to  $V_{SWR} = 10 : 1$  through all phases under the following conditions:  $V_{DS} = 28\text{ V}$ ;  $f = 100\text{ MHz}$  at rated load power.

The BLF647 is capable of withstanding abrupt source or load mismatch errors under the nominal power conditions.

**Impedances** (per section)

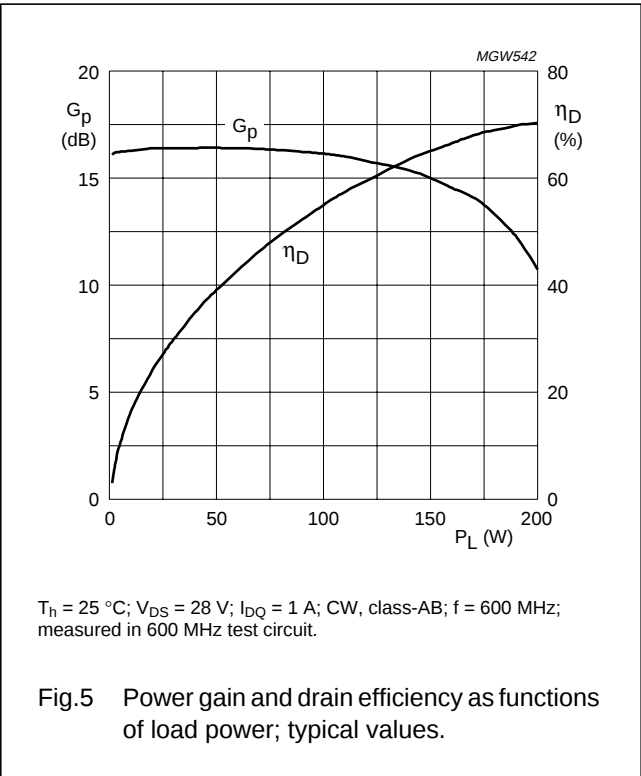
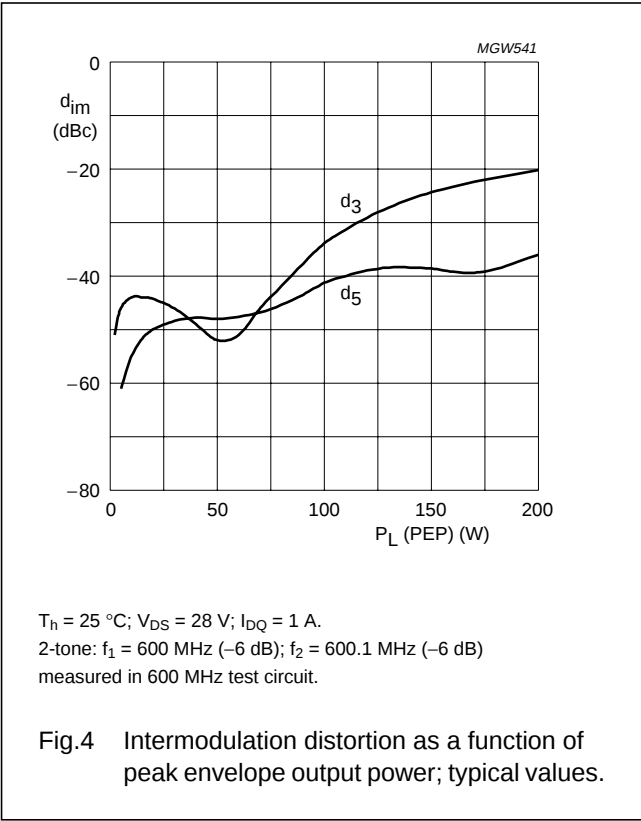
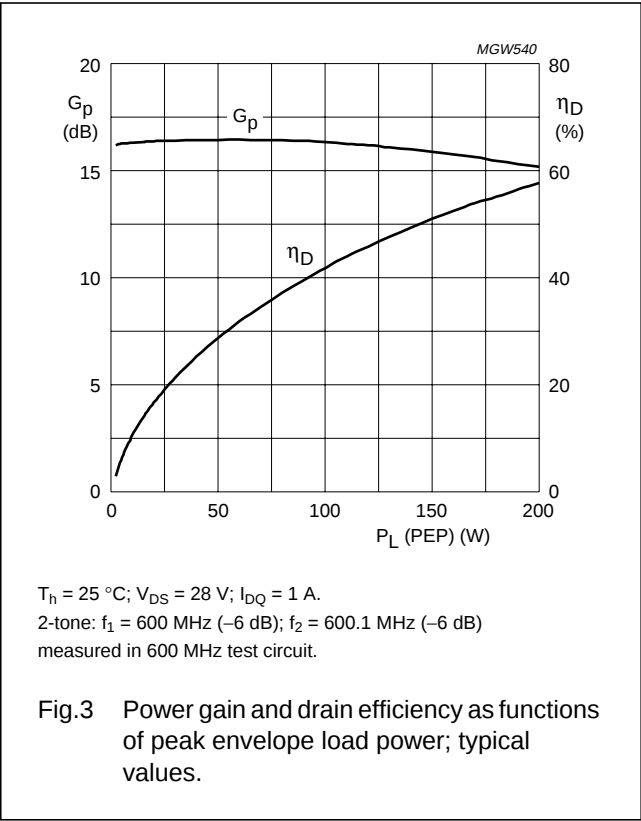
At  $f = 600\text{ MHz}$ ,  $P_L = 120\text{ W}$ ,  $V_{DS} = 28\text{ V}$  and  $I_{DQ} = 1\text{ A}$ :  $Z_{in} = 1.0 + j2.0\text{ }\Omega$  and  $Z_L = 2.7 + j0.7\text{ }\Omega$ .

At  $f = 800\text{ MHz}$ ,  $P_L = 150\text{ W}$ ,  $V_{DS} = 32\text{ V}$  and  $I_{DQ} = 1\text{ A}$ :  $Z_{in} = 1.0 + j3.8\text{ }\Omega$  and  $Z_L = 1.8 + j0.7\text{ }\Omega$ .

UHF power LDMOS transistor

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Application at 600 MHz



UHF power LDMOS transistor

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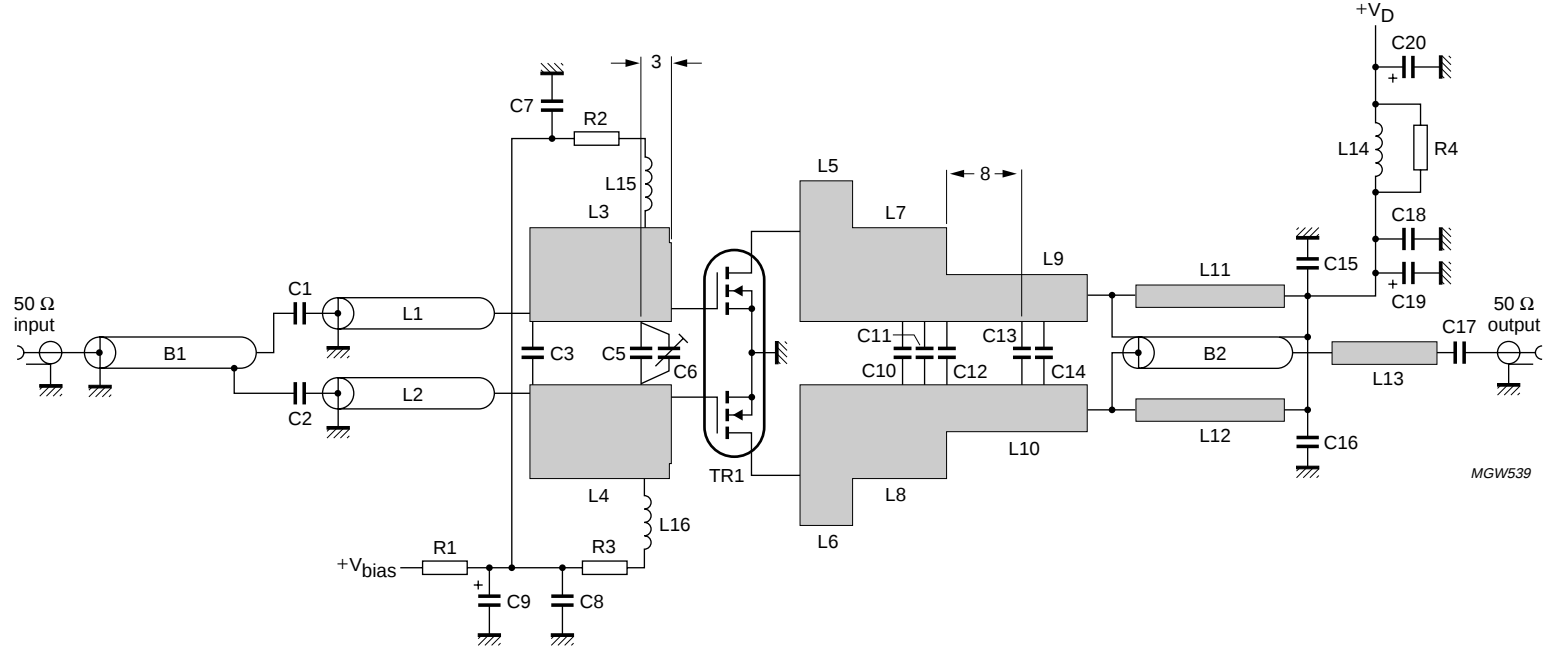


Fig.6 Class-AB common source 600 MHz test circuit.

Dimensions in mm.

## UHF power LDMOS transistor

BLF647

List of components class-AB 600 MHz test circuit (see Figs 6 and 7)

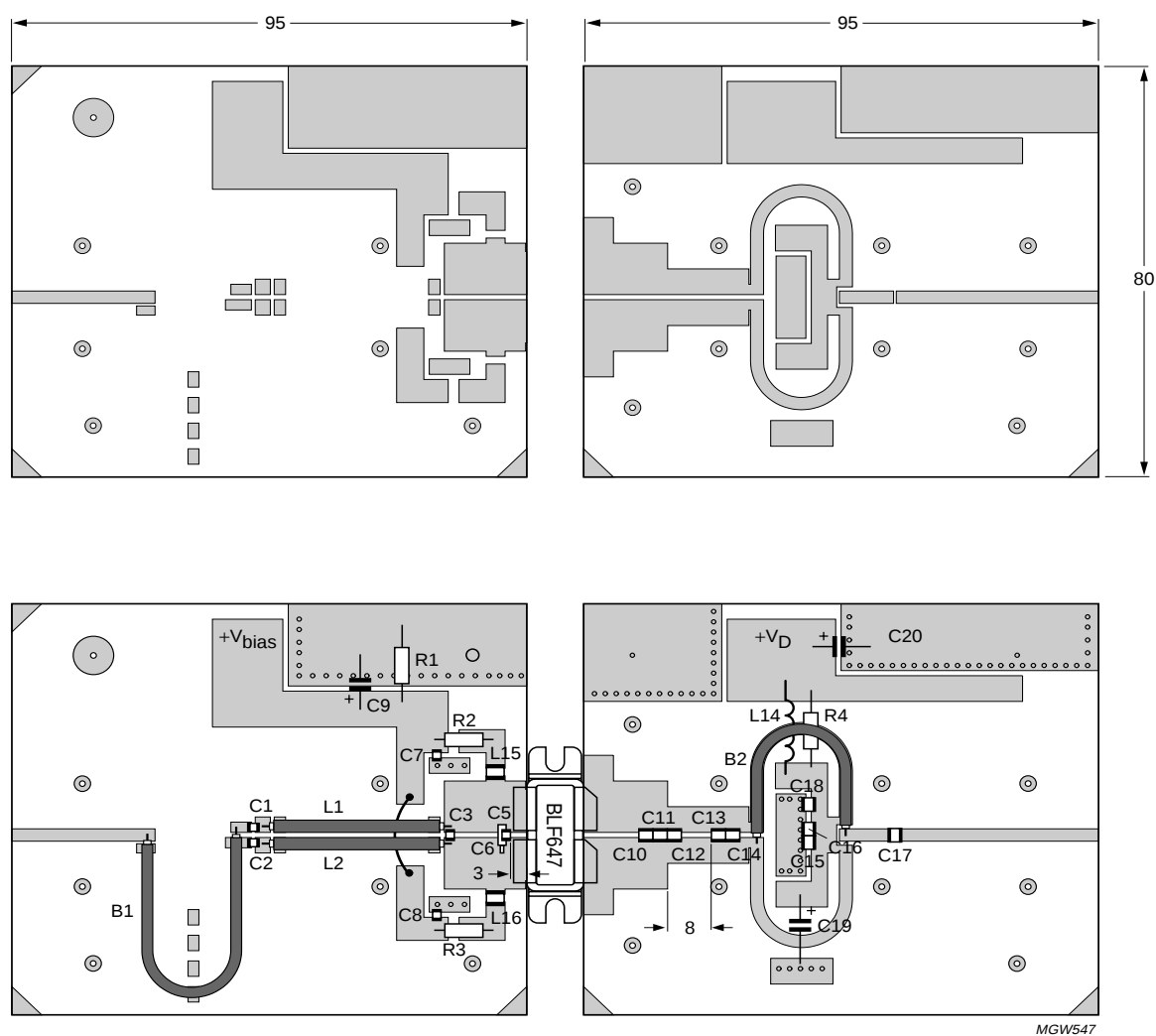
| COMPONENT     | DESCRIPTION                               | VALUE                          | DIMENSIONS           | CATALOGUE No.  |
|---------------|-------------------------------------------|--------------------------------|----------------------|----------------|
| C1, C2        | multilayer ceramic chip capacitor; note 1 | 30 pF                          |                      |                |
| C3            | multilayer ceramic chip capacitor; note 1 | 8.2 pF                         |                      |                |
| C5            | multilayer ceramic chip capacitor; note 1 | 16 pF                          |                      |                |
| C6            | Tekelec trimmer                           | 0.6 to 7.5 pF                  |                      |                |
| C7, C8        | multilayer ceramic chip capacitor; note 1 | 100 pF                         |                      |                |
| C9            | electrolytic capacitor                    | 10 $\mu$ F                     |                      |                |
| C10           | multilayer ceramic chip capacitor; note 2 | 2 pF                           |                      |                |
| C11, C12      | multilayer ceramic chip capacitor; note 2 | 10 pF                          |                      |                |
| C13           | multilayer ceramic chip capacitor; note 2 | 8.2 pF                         |                      |                |
| C14           | multilayer ceramic chip capacitor; note 2 | 1.5 pF                         |                      |                |
| C15, C16, C17 | multilayer ceramic chip capacitor; note 2 | 100 pF                         |                      |                |
| C18           | SMD capacitor                             | 1 $\mu$ F                      |                      | 2222 595 16754 |
| C19           | electrolytic capacitor                    | 470 $\mu$ F                    |                      |                |
| C20           | electrolytic capacitor                    | 100 $\mu$ F                    |                      |                |
| L1, L2        | semi rigid coax UT70-25                   | $Z = 25 \Omega \pm 1.5 \Omega$ | 30.6 mm              |                |
| L3, L4        | stripline; note 3                         |                                | 15 $\times$ 10 mm    |                |
| L5, L6        | stripline; note 3                         |                                | 5.5 $\times$ 15 mm   |                |
| L7, L8        | stripline; note 3                         |                                | 10 $\times$ 10 mm    |                |
| L9, L10       | stripline; note 3                         |                                | 15 $\times$ 5 mm     |                |
| L11, L12      | stripline; note 3                         |                                | 48.5 $\times$ 2.4 mm |                |
| L13           | stripline; note 3                         |                                | 10 $\times$ 2.4 mm   |                |
| L14           | ferrite                                   |                                |                      |                |
| L15, L16      | Coilcraft SMD coil 1008CS-102XKBC         | 1 $\mu$ H                      |                      |                |
| B1            | semi rigid coax ( $\lambda/2$ )           | $Z = 50 \Omega \pm 1.5 \Omega$ | $\lambda/2$          |                |
| B2            | semi rigid coax balun UT70-25             | $Z = 25 \Omega \pm 1.5 \Omega$ | 48.5 mm              |                |
| R1            | resistor                                  | 1 k $\Omega$                   |                      |                |
| R2, R3        | resistor                                  | 100 $\Omega$                   |                      |                |
| R4            | resistor                                  | 3,3 $\Omega$                   |                      |                |

## Notes

1. American Technical Ceramics type 100A or capacitor of same quality.
2. American Technical Ceramics type 180R or capacitor of same quality.
3. The striplines are on a double copper-clad printed-circuit board: Rogers 5880 ( $\epsilon_r = 2.2$ ); thickness 0.79 mm.

## UHF power LDMOS transistor

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Dimensions in mm.

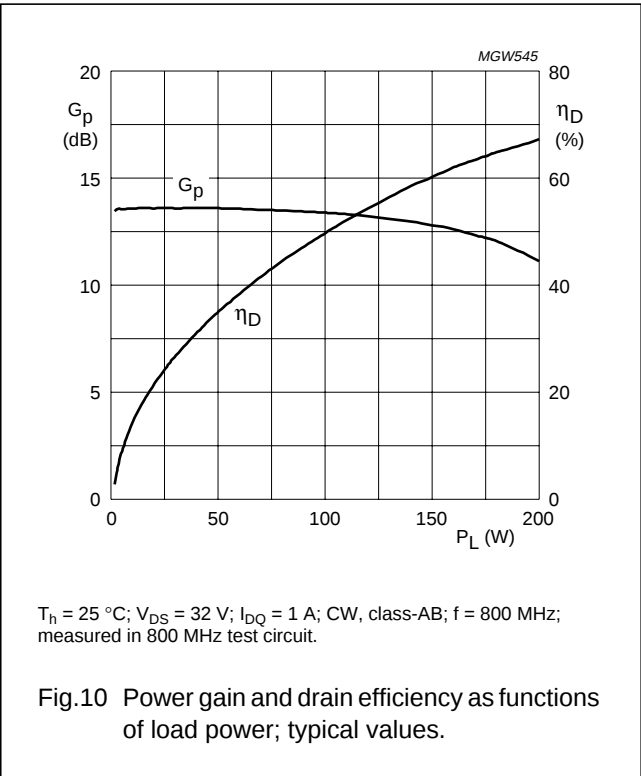
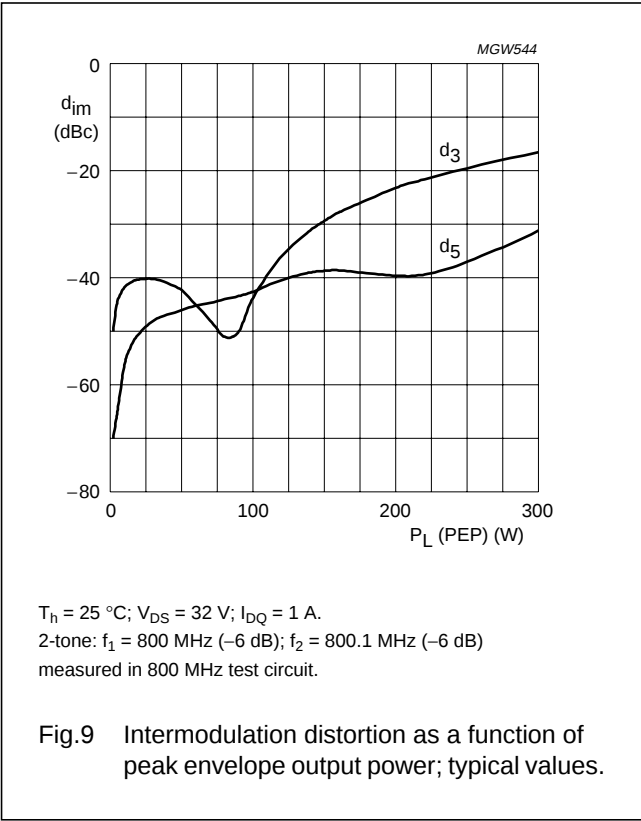
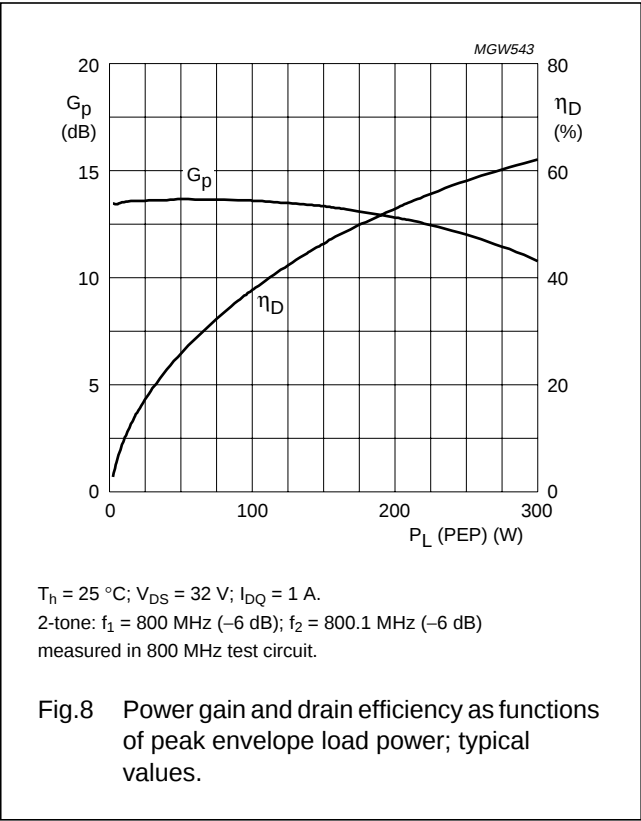
The components are situated on one side of the Rogers 5880 printed-circuit board, the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.7 Printed-circuit board and component layout for class-AB 600 MHz test circuit.

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Application at 800 MHz



UHF power LDMOS transistor

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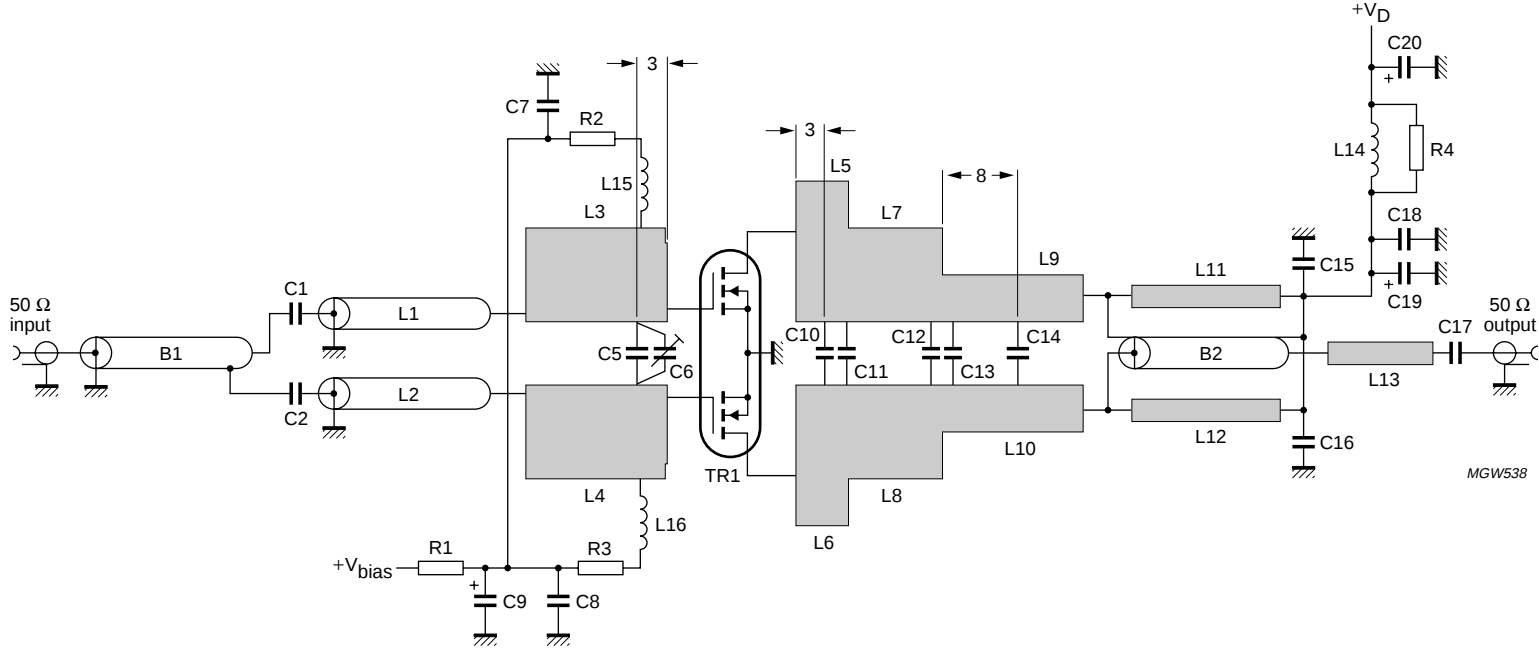


Fig.11 Class-AB common source 800 MHz test circuit.

Dimensions in mm.

## UHF power LDMOS transistor

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## List of components class-AB 800 MHz test circuit (see Figs 11 and 12)

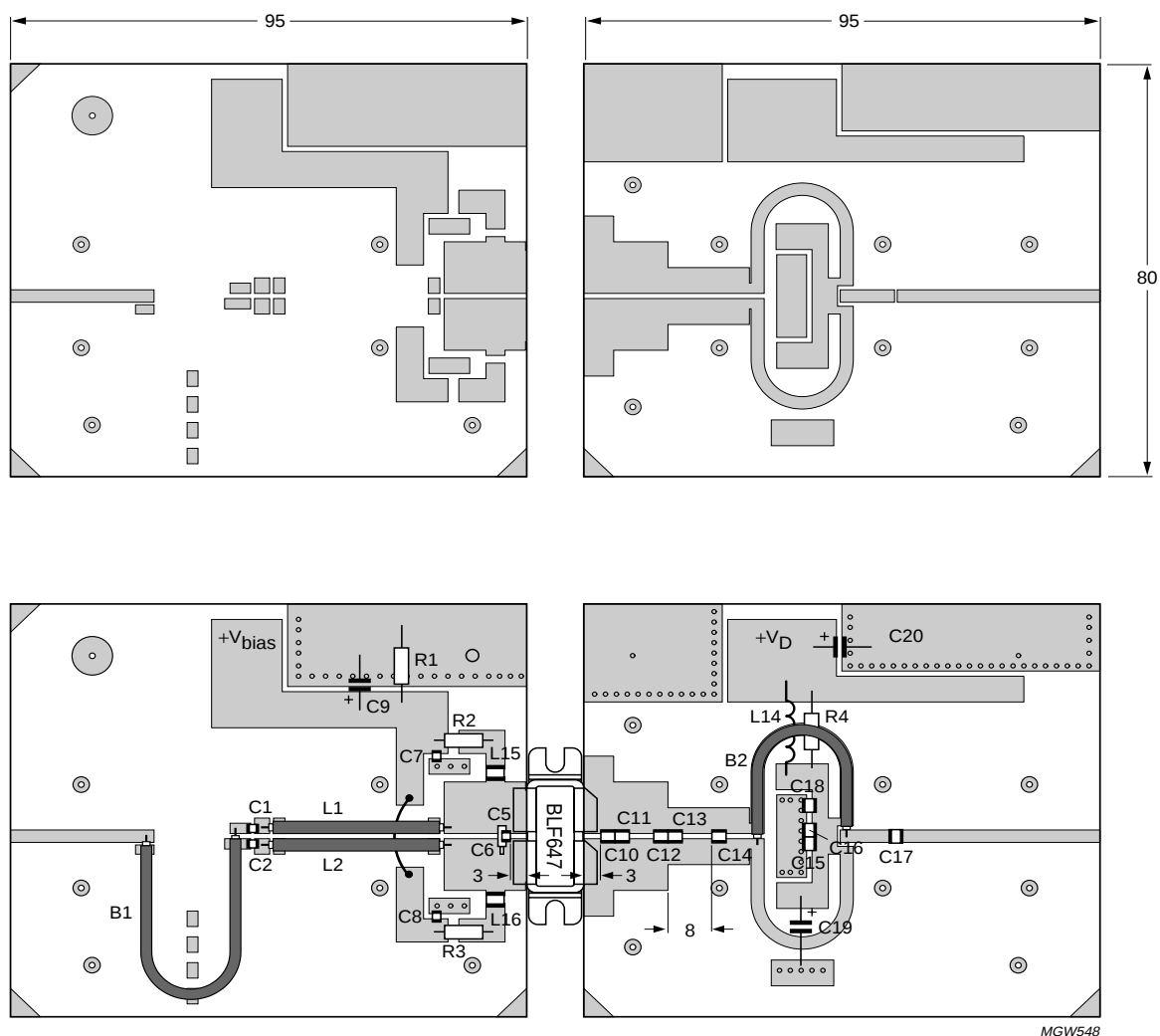
| COMPONENT | DESCRIPTION                               | VALUE                          | DIMENSIONS           | CATALOGUE No.  |
|-----------|-------------------------------------------|--------------------------------|----------------------|----------------|
| C1, C2    | multilayer ceramic chip capacitor; note 1 | 30 pF                          |                      |                |
| C5        | multilayer ceramic chip capacitor; note 1 | 10 pF                          |                      |                |
| C6        | tekelec trimmer                           | 0.6 to 7.5 pF                  |                      |                |
| C7, C8    | multilayer ceramic chip capacitor; note 1 | 100 pF                         |                      |                |
| C9        | electrolytic capacitor                    | 10 $\mu$ F                     |                      |                |
| C10, C11  | multilayer ceramic chip capacitor; note 2 | 8.2 pF                         |                      |                |
| C12, C13  | multilayer ceramic chip capacitor; note 2 | 10 pF                          |                      |                |
| C14       | multilayer ceramic chip capacitor; note 2 | 4.7 pF                         |                      |                |
| C15, C16  | multilayer ceramic chip capacitor; note 2 | 100 pF                         |                      |                |
| C17       | multilayer ceramic chip capacitor; note 2 | 20 pF                          |                      |                |
| C18       | SMD capacitor                             | 1 $\mu$ F                      |                      | 2222 595 16754 |
| C19       | electrolytic capacitor                    | 470 $\mu$ F                    |                      |                |
| C20       | electrolytic capacitor                    | 100 $\mu$ F                    |                      |                |
| L1, L2    | semi rigid coax UT70-25                   | $Z = 25 \Omega \pm 1.5 \Omega$ | 30.6 mm              |                |
| L3, L4    | stripline; note 3                         |                                | 15 $\times$ 10 mm    |                |
| L5, L6    | stripline; note 3                         |                                | 5.5 $\times$ 15 mm   |                |
| L7, L8    | stripline; note 3                         |                                | 10 $\times$ 10 mm    |                |
| L9, L10   | stripline; note 3                         |                                | 15 $\times$ 5 mm     |                |
| L11, L12  | stripline; note 3                         |                                | 48.5 $\times$ 2.4 mm |                |
| L13       | stripline; note 3                         |                                | 10 $\times$ 2.4 mm   |                |
| L14       | ferrite                                   |                                |                      |                |
| L15, L16  | Coilcraft SMD coil 1008CS-102XKBC         | 1 $\mu$ H                      |                      |                |
| B1        | semi rigid coax ( $\lambda/2$ )           | $Z = 50 \Omega \pm 1.5 \Omega$ | $\lambda/2$          |                |
| B2        | semi rigid coax balun UT70-25             | $Z = 25 \Omega \pm 1.5 \Omega$ | 48.5 mm              |                |
| R1        | resistor                                  | 1 k $\Omega$                   |                      |                |
| R2, R3    | resistor                                  | 100 $\Omega$                   |                      |                |
| R4        | resistor                                  | 3,3 $\Omega$                   |                      |                |

## Notes

1. American Technical Ceramics type 100A or capacitor of same quality.
2. American Technical Ceramics type 180R or capacitor of same quality.
3. The striplines are on a double copper-clad printed-circuit board: Rogers 5880 ( $\epsilon_r = 2.2$ ); thickness 0.79 mm.

## UHF power LDMOS transistor

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Dimensions in mm.

The components are situated on one side of the Rogers 5880 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.12 Printed-circuit board and component layout for class-AB 800 MHz test circuit.

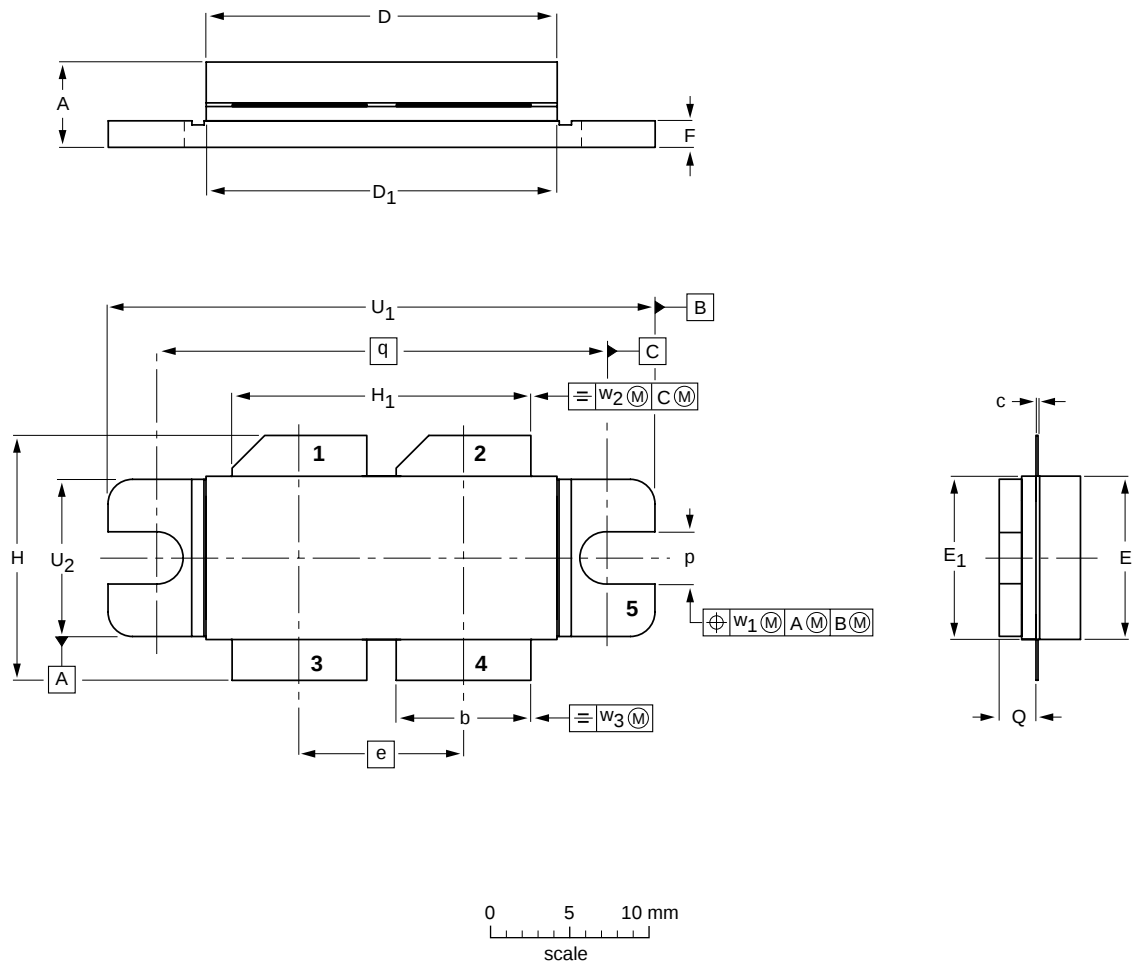
UHF power LDMOS transistor

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PACKAGE OUTLINE

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

SOT540A



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

| UNIT   | A              | b              | c              | D              | D <sub>1</sub> | e     | E              | E <sub>1</sub> | F              | H              | H <sub>1</sub> | p              | Q              | q     | U <sub>1</sub> | U <sub>2</sub> | w <sub>1</sub> | w <sub>2</sub> | w <sub>3</sub> |
|--------|----------------|----------------|----------------|----------------|----------------|-------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------|----------------|----------------|----------------|----------------|----------------|
| mm     | 5.77<br>5.00   | 8.51<br>8.26   | 0.15<br>0.10   | 22.05<br>21.64 | 22.05<br>21.64 | 10.21 | 10.26<br>10.06 | 10.31<br>10.01 | 1.78<br>1.52   | 15.75<br>14.73 | 18.72<br>18.47 | 3.38<br>3.12   | 2.72<br>2.46   | 27.94 | 34.16<br>33.91 | 9.91<br>9.65   | 0.25           | 0.51           | 0.25           |
| inches | 0.227<br>0.197 | 0.335<br>0.325 | 0.006<br>0.004 | 0.868<br>0.852 | 0.868<br>0.852 | 0.402 | 0.404<br>0.396 | 0.406<br>0.394 | 0.070<br>0.060 | 0.620<br>0.580 | 0.737<br>0.727 | 0.133<br>0.123 | 0.107<br>0.097 | 1.100 | 1.345<br>1.335 | 0.390<br>0.380 | 0.010          | 0.020          | 0.010          |

| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION                                                                | ISSUE DATE           |
|--------------------|------------|-------|------|--|---------------------------------------------------------------------------------------|----------------------|
|                    | IEC        | JEDEC | EIAJ |  |                                                                                       |                      |
| SOT540A            |            |       |      |  |  | 99-08-27<br>99-12-28 |

## UHF power LDMOS transistor

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## DATA SHEET STATUS

| DATA SHEET STATUS <sup>(1)</sup> | PRODUCT STATUS <sup>(2)</sup> | DEFINITIONS                                                                                                                                                                                                                                                                                                            |
|----------------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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.                                                                                                                            |
| Preliminary data                 | Qualification                 | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.                                     |
| Product data                     | Production                    | This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Changes will be communicated according to the Customer Product/Process Change Notification (CPCN) procedure SNW-SQ-650A. |

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**UHF power LDMOS transistor****BLF647**

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**NOTES**

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