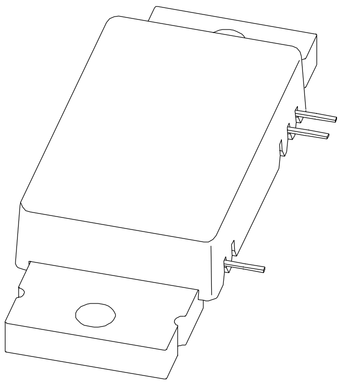
DISCRETE SEMICONDUCTORS

# DATA SHEET



# BGF944
## GSM900 EDGE power module

Preliminary specification 2002 Nov 07

Philips
Semiconductors

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## FEATURES

- Low distortion to a GSM EDGE signal.
- Excellent 2-tone performance
- Low die temperature using copper flange
- Integrated temperature compensated bias
- 50 Ω input/output system
- Flat gain over frequency.

## APPLICATIONS

- Base station RF power amplifiers in the 920 to 960 MHz frequency band.
- GSM, GSM EDGE, multi carier applications
- Macrocell (driver) and microcell (final)

## DESCRIPTION

17 W power amplifier module for base station amplifier applications in 920 to 960 MHz band. Typical GSM EDGE performance at a supply voltage of 26 V:
Output power = 2.5 W
Gain = 29 dB
Efficiency = 15%
ACPR < -65 dBc at 400 kHz
rms EVM < 0.4%
peak EVM < 1.2%.

## PINNING - SOT365C

| PIN | DESCRIPTION |
|---|---|
| 1 | RF input |
| 2 | $V_S$ |
| 3 | RF output |
| Flange | ground |

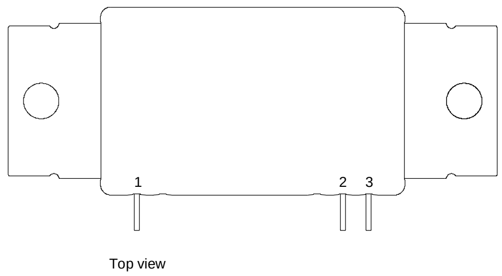



Fig.1 Simplified outline.

## QUICK REFERENCE DATA

Typical RF performance at $T_{mb}$ = 25 °C.

| MODE OF OPERATION | f (MHz) | $V_S$ (V) | $P_L$ (W) | $G_p$ (dB) | η (%) | ACPR (dBc) | rms EVM (%) |
|---|---|---|---|---|---|---|---|
| CW | 920 to 960 | 26 | 17 | 28 | 47 | – | – |
| GSM EDGE | 920 to 960 | 26 | 2.5 | 29 | 15 | –65[1] | 0.4 |

### Note

1. ACPR 400 kHz at 30 kHz resolution bandwidth.

| MODE OF OPERATION | f (MHz) | $V_S$ (V) | $P_L$ (W) | $G_p$ (dB) | IMD3 (dB) | IMD5 (dB) | IMD7 (dB) |
|---|---|---|---|---|---|---|---|
| 2-tone | 920 to 960 | 26 | 2.5 | 29 | –44 | –52 | –60 |

## LIMITING VALUES

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

| SYMBOL | PARAMETER | MIN. | MAX. | UNIT |
|---|---|---|---|---|
| $V_S$ | DC supply voltage | – | 30 | V |
| $P_D$ | input drive power | – | 100 | mW |
| $P_L$ | load power | – | 24 | W |
| $T_{stg}$ | storage temperature range | –30 | +100 | °C |
| $T_{mb}$ | operating mounting base temperature range | 0 | +90 | °C |

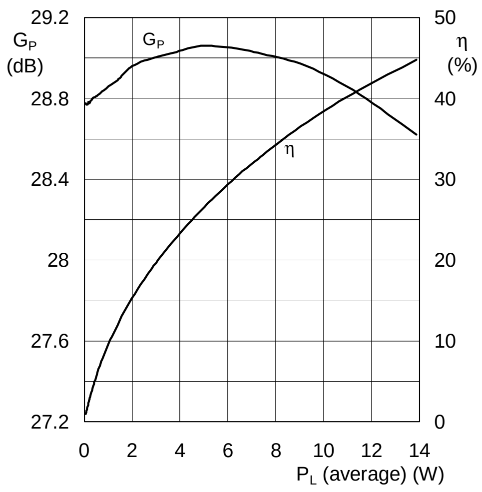
## CHARACTERISTICS

$T_{mb}$ = 25 °C; $V_S$ = 26 V; $P_L$ = 2.5 W; f = 920 – 960 MHz; $Z_S = Z_L$ = 50 Ω; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $I_{DQ}$ | quiescent current (pin 2) | $P_D$ = 0 mW | – | 280 | 320 | mA |
| $P_{1dB}$ | load power | at 1 dB gain compression | 13 | 17 | – | W |
| $G_p$ | power gain | | 27 | 29 | 31 | dB |
| $\Delta G_p$ - freq | gain flatness vs freq. | | – | 0.2 | 1.0 | dB |
| $\Delta G_p$ - pwr | gain flatness vs power | $P_L$ = 25 mW up to 2.5 W | –0.8 | –0.2 | 0.2 | dB |
| $G_{OB}$ | out of band gain | small signal, $P_D$ = 0 dBm; f < 920 MHz, f > 960 MHz | – | – | $G_{Pi\,max}$ + 1 note 1 | dB |
| $VSWR_{in}$ | input VSWR | | – | 1.6 : 1 | 2.0 : 1 | |
| $IMD_r$ | reverse intermodulation | $f_i = f_c$ ±200 kHz; $P_{carrier}$ = 2.5 W; $P_{interference}$ = –40 dBc; | – | –66 | –60 | dBc |
| H2 | 2nd harmonic | | – | –38 | –35 | dBc |
| H3 | 3rd harmonic | | – | –61 | –58 | dBc |
| | stability | VSWR ≤ 3 : 1 through all phases; $V_{S2}$ = 25 to 28 V | all spurious outputs more than 60 dB below desired signal | | | |
| | ruggedness | VSWR = 10 : 1 through all phases; $P_L$ = 5 W | no degradation in output power | | | |
| **EDGE** ($P_L$ = 2.5 W avg) | | | | | | |
| η | efficiency | | 12 | 15 | – | % |
| SR200 | spectral regrowth; EDGE GSM signal | 200 kHz | – | –36 | –35 | dBc |
| SR400 | | 400 kHz | – | –65 | –63 | dBc |
| EVM | rms EDGE signal distortion | | – | 0.4 | 1.2 | % |
| | peak EDGE signal distortion | | – | 1.2 | 4 | % |
| **Intermodulation distortion** | | | | | | |
| $d_3$ | third order intermodulation | $P_L$ = 2.5 W average; carrier spacing = 200 kHz | – | –44 | –40 | dBc |
| $d_5$ | fifth order intermodulation | | – | –52 | – | dBc |
| $d_7$ | seventh order intermodulation | | – | –60 | – | dBc |

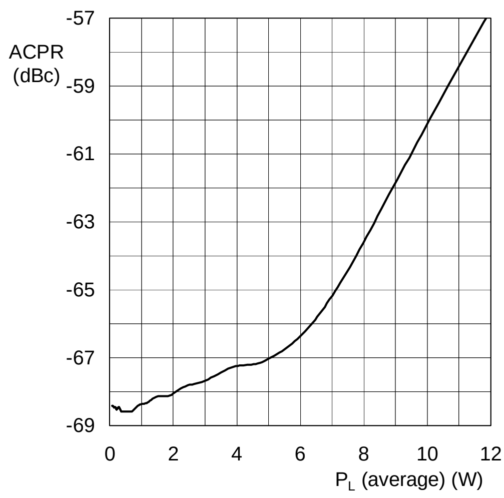
### Notes

1. $G_{Pi}$ is small signal in band gain.



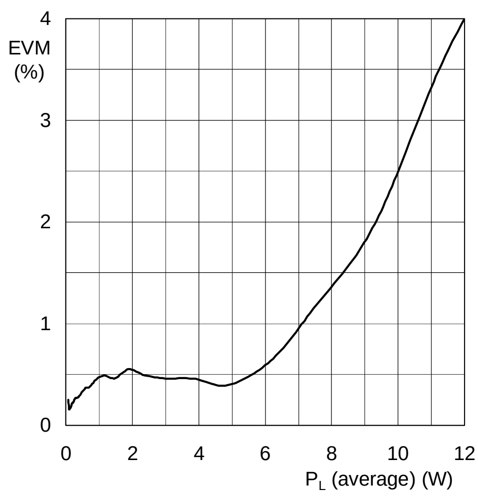

f = 940 MHz

Fig.2 GSM EDGE gain and efficiency as functions of load power; typical values.



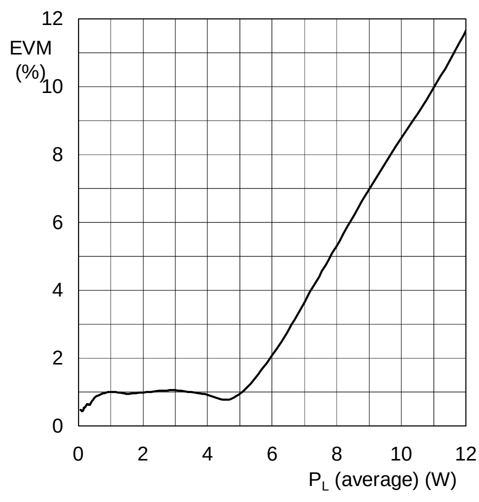

f = 940 MHz

Fig.3 GSM EDGE ACPR at 400 kHz as a function of load power; typical values.



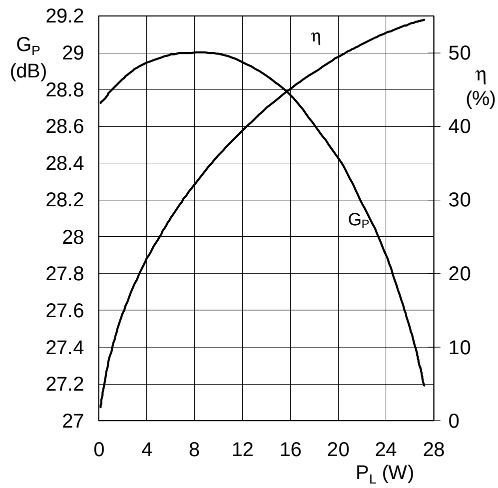

f = 940 MHz.

Fig.4 GSM EDGE rms EVM as a function of load power; typical values.



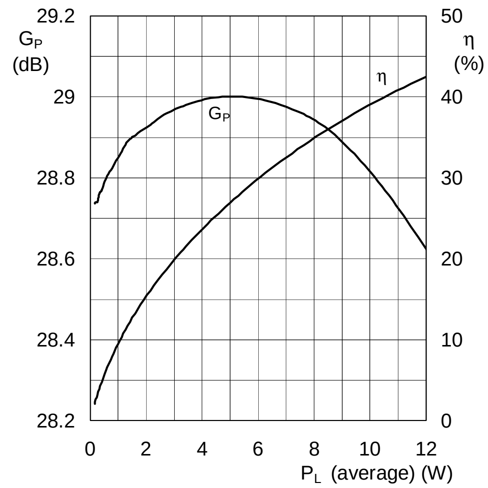

f = 940 MHz.

Fig.5 GSM EDGE peak EVM as function of load power; typical values.



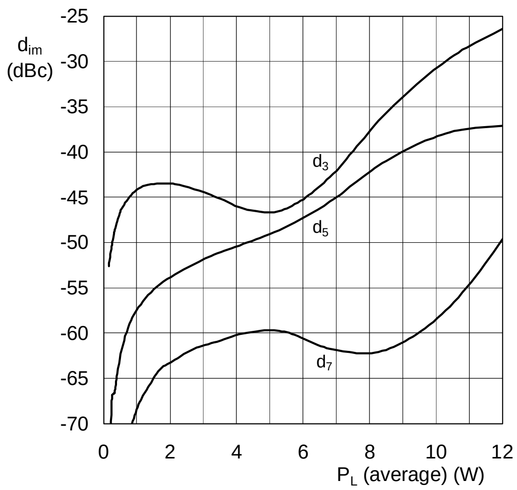

f = 940 MHz.

Fig.6 CW gain and efficiency as functions of load power; typical values.




$f_1$ = 940 MHz; $f_2$ = 941 MHz.

Fig.7 Two tone gain and efficiency as functions of load power; typical values.




$f_1$ = 940 MHz; $f_2$ = 941 MHz.

Fig.8 Two tone intermodulation distortion as function of load power; typical values.

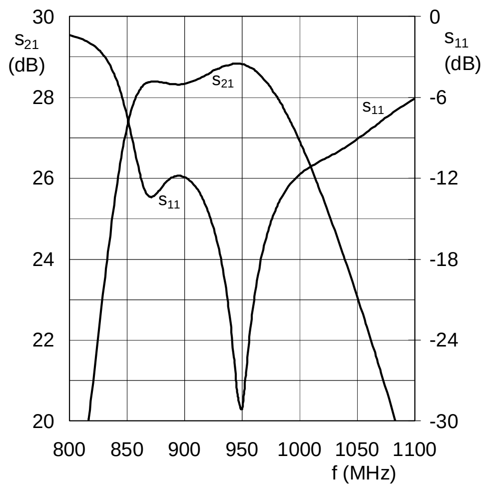



Fig.9 S-parameters as a function of frequency

## MOUNTING RECOMMENDATIONS

### Introduction

LDMOST basestation modules are manufactured with the dies directly mounted on a copper flange. The matching- and bias circuit components are mounted on a printed circuit board (PCB), which is also soldered onto the copper flange. This construction is able to withstand marginal bending, although bending has to be avoided as much as possible. Reason for excessive bending can be mismatch between the flatness of the module flange and the casting (external heatsink) of the amplifier. Mechanical stress can also be caused by thermal mismatch (after soldering the leads). To avoid this, precautgions have to be taken during assembly of the module in the amplifier. Furthermore, a good thermal contact between flange and external heatsink is recommended.

### The external heatsink (amplifier casting)

The module should always be mounted on a heatsink with a low thermal resistance to keep the temperature of the module as low as possible.The mounting area of the heatsink sould be flat and free from burrs and loose particles. We recommend a flatness for the mounting area between 50 µm concave and 50 µm convex. The 50 µm concave limit is to assure an optimal thermal behaviour, while the 50 µm convex limit is intended to prevent the build-up of excessive mechanical stress due to bending.
In order to ensure thermal behaviour it is recommended to apply a thin evenly spread layer of thermal compound between the module and the mounting area.
Recommended thermal compounds have a K>0.5 W/mK, such as:

- WPS II (silicone-free) from Austerlitz-Electronics
- Comp. Trans. from KF
- 340 from Dow Corning
- Trans-Heat from E. Friis-Mikkelsen.

We do not support the use of thermal pads instead of thermal compound because of the risk of unflatness of the thermal pads during use.

### Mounting sequence of the module

1. ESD precautions must be taken to protect the device from electro-static damage.
2. A thin, evenly spread layer of thermal compound shall be used between the module flange and the external heatsink to achieve the best possible thermal contact. Excessive use of thermal compound may result in an increase in thermal resistance and possible bending of the flange. There must always be room for the excessive thermal compound to escape. Too little thermal compound will result in an increase of thermal resistance.
3. Attention must be given to surface finish and cleanliness of the mounting surface.
4. Place the module to the external heatsink, such that there is some free distance between the cap and the printed circuit board.
5. Use 3 mm bolts with flat washers.
6. Both bolts should be tightened at first to “finger tight” (this is approx. 0.05 Nm).
7. Use torque wrench.
8. Tighten in alternating steps to a final torque of 0.4 Nm.
9. After mounting the module on the casting, the module leads can be soldered to the printed circuit board. The leads are intended for making electrical connections to the module and are not intended to support the module at any time in the assembly process.
10. A soldering iron may be used up to a temperature of 250 °C for a maximum of 10 seconds. Avoid contact between the soldering iron and the plastic cap.

**Electrical connections**

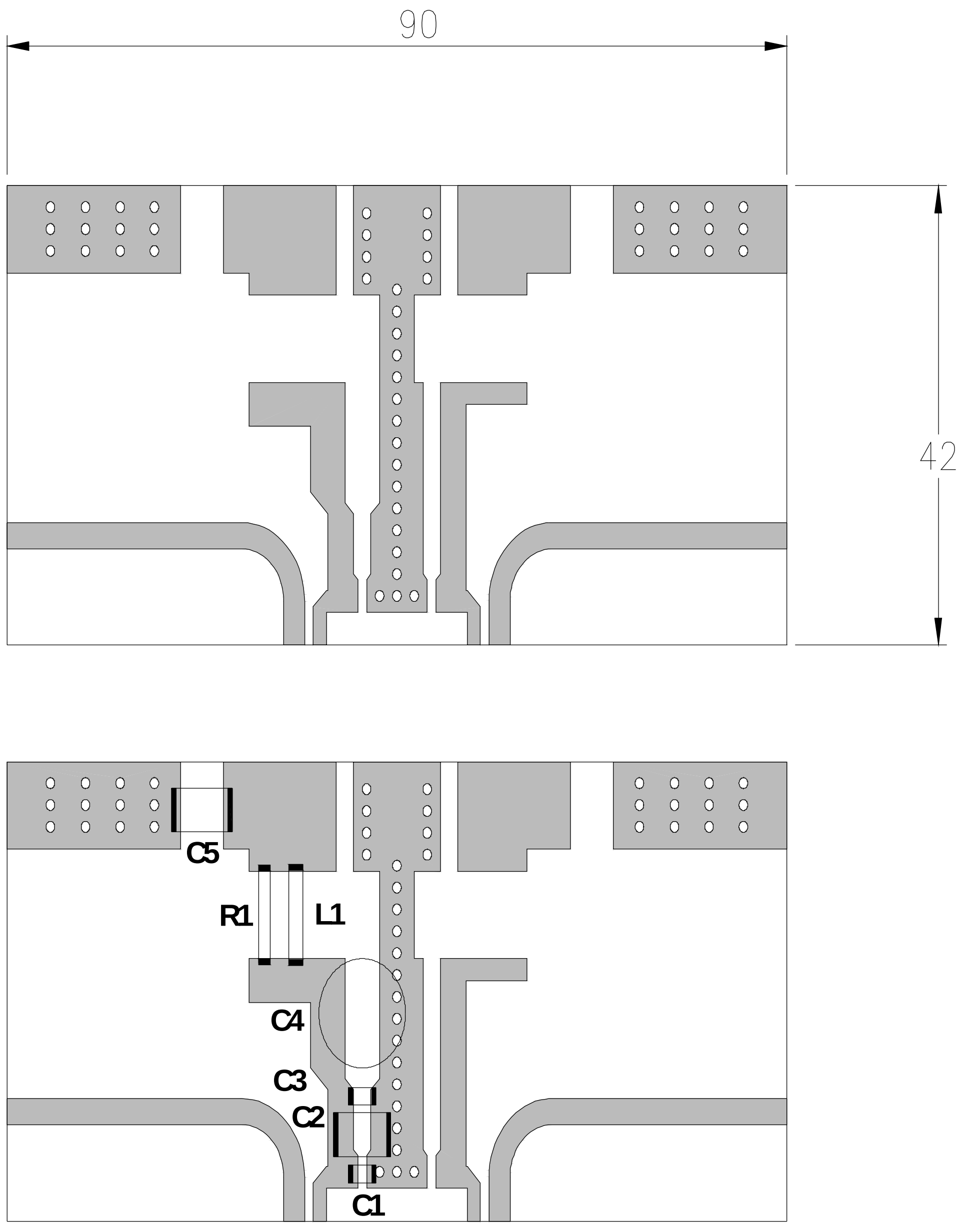
The main ground path of all modules is via the flange. It is therefore important that the flange is well grounded and that return paths are kept as short as possible. A not proper flange grounding can result in a loss of output power or in oscillation.

The RF input and output of the module is designed for 50 Ohm terminations.

**Incomming inspection**

In case an incomming inspection is donbe, use a proper disigned testfixture to avoid excessive mechanical stress and to assure a optimal RF performance. On request Philips can deliver dedicated designed testfixtures.

## APPLICATION INFORMATION




Dimensions in mm

Fig.10 Component layout for test circuit.

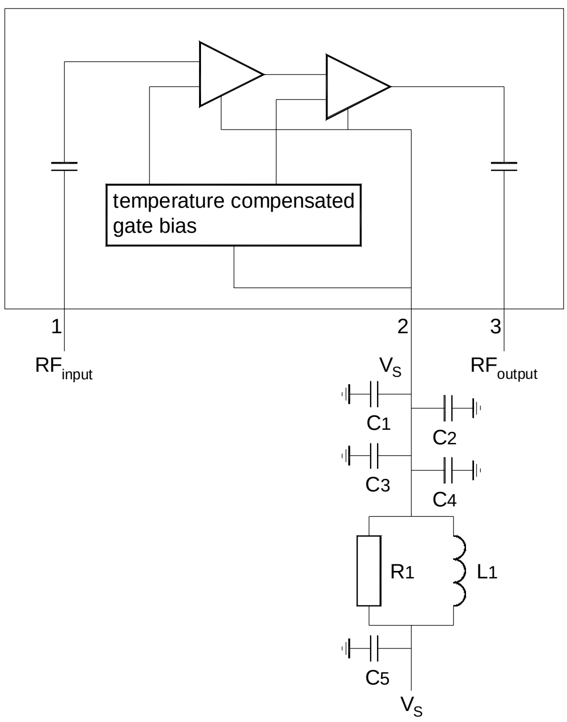


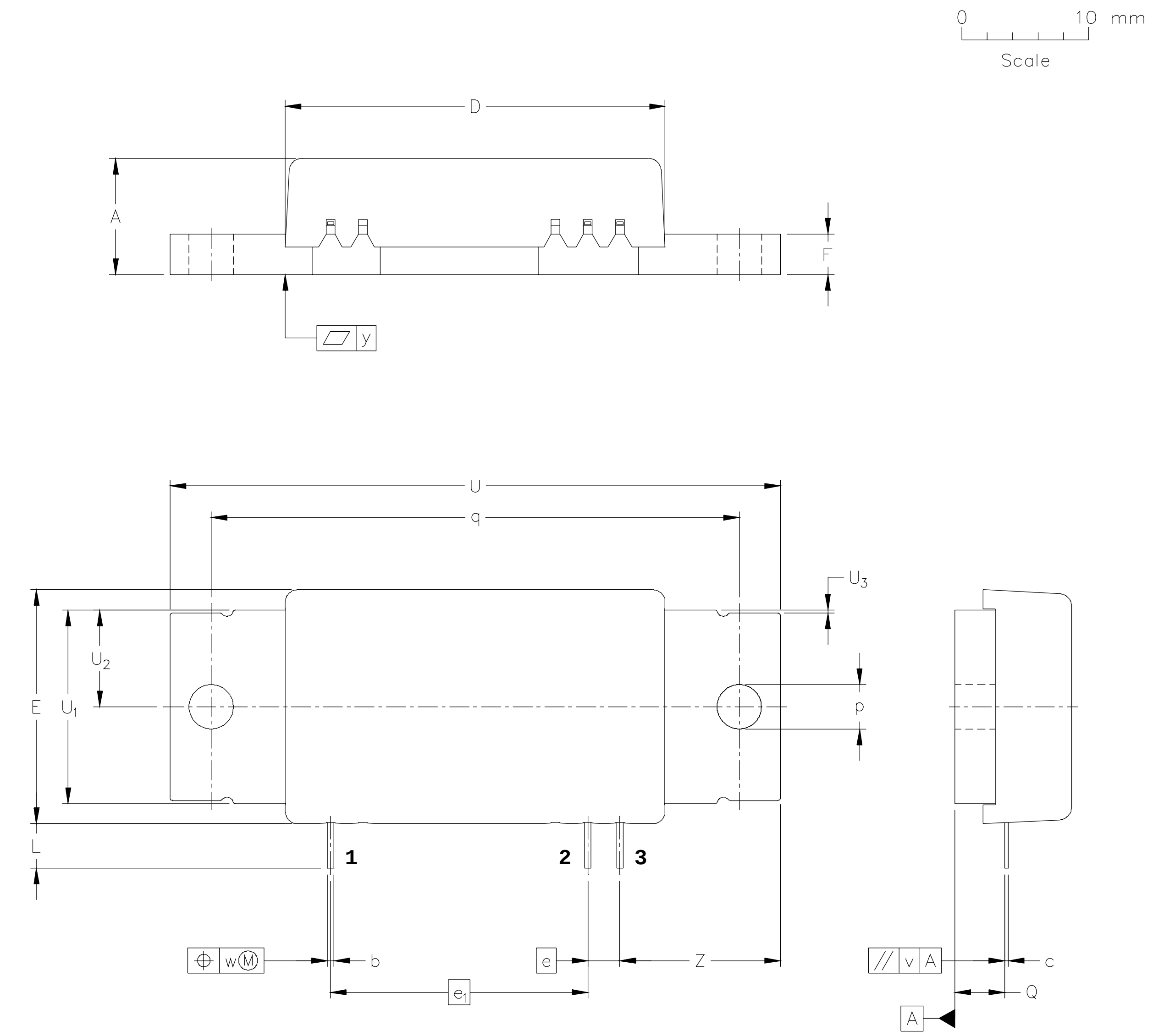

Fig.11 Schematic of test circuit.

**List of components**

| COMPONENT | DESCRIPTION | VALUE | CATALOGUE NUMBER |
|---|---|---|---|
| C1, C3 | multilayer X7R ceramic chip capacitor | 100 nF; 50 V | |
| C2, C5 | tantalium SMD capacitor | 10 μF; 35 V | |
| C4 | electrolitic capacitor | 100 μF; 35 V | |
| L1 | grade 4S2 Ferroxcube bead | | 4330 030 36300 |
| R1 | metal film resistor | | 2322 195 13109 |

## PACKAGE OUTLINE

Plastic rectangular single-ended flat package; flange mounted; 2 mounting holes; 3 in-line leads




| Z |
|---|
| 12.8<br>12.6 |

The mm dimensions are the original dimensions.

| UNIT | A | b | c | D | E | e | $e_1$ | F | L | p | Q | q | U | $U_1$ | $U_2$ | $U_3$ | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 9.5<br>9.0 | 0.56<br>0.46 | 0.30<br>0.20 | 30.1<br>29.9 | 18.6<br>18.4 | 2.54 | 20.32 | 3.3<br>3.1 | 3.7<br>3.3 | 3.55<br>3.45 | 4.0<br>3.8 | 41.75<br>41.65 | 48.4<br>48.0 | 15.4<br>15.2 | 7.75<br>7.55 | 1.1<br>0 | 0.3 | 0.25 | 0.1 |

| PACKAGE OUTLINE VERSION | REFERENCES | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | |
| SOT365C PUBLICATION DRAWING | | | | | 02-02-08 |

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