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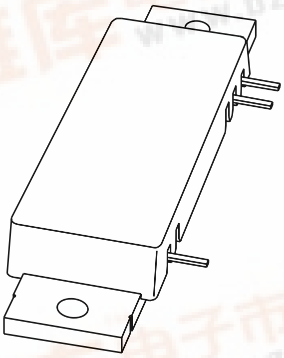
# DATA SHEET



# BGF944
## GSM900 EDGE power module

Product specification
Supersedes data of 2003 Feb 26

2003 Jun 06

Philips
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# GSM900 EDGE power module BGF944

## FEATURES

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

## APPLICATIONS

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

## DESCRIPTION

17 W LDMOS power amplifier module for base station amplifier applications in the 920 to 960 MHz band.

## PINNING - SOT365C

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

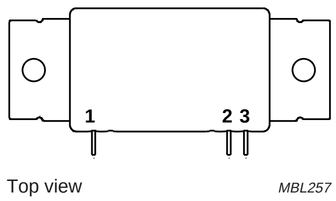



Fig.1 Simplified outline.

## 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) | $d_3$ (dB) | $d_5$ (dB) | $d_7$ (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 | –30 | +100 | °C |
| $T_{mb}$ | operating mounting base temperature | –20 | +90 | °C |

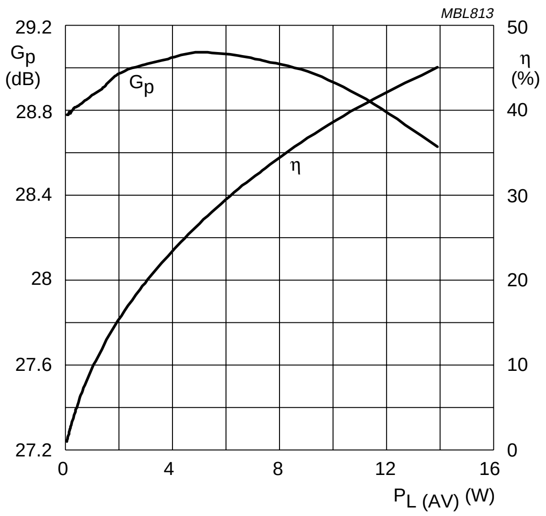
## CHARACTERISTICS

$T_{mb}$ = 25 °C; $V_S$ = 26 V; $P_L$ = 2.5 W; f = 920 to 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 over frequency range | | – | 0.2 | 1 | dB |
| $\Delta G_{p\ pwr}$ | gain flatness over power band | $P_L$ = 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 : 1 | |
| $IMD_r$ | reverse intermodulation | $f_i = f_c$ ±200 kHz; $P_{carrier}$ = 2.5 W; $P_{interference}$ = –40 dBc; | – | –66 | –60 | dBc |
| $H_2$ | second harmonic | | – | –38 | –35 | dBc |
| $H_3$ | third 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 average) | | | | | | |
| η | efficiency | | 12 | 15 | – | % |
| SR200 | spectral regrowth; EDGE GSM signal | 200 kHz | – | –36 | –35 | dBc |
| SR400 | | 400 kHz | – | –65 | –63 | dBc |
| $EVM_{rms}$ | rms EDGE signal distortion | | – | 0.4 | 1.2 | % |
| $EVM_M$ | peak EDGE signal distortion | | – | 1.2 | 4 | % |
| **Intermodulation distortion** ($P_L$ = 2.5 W average) | | | | | | |
| $d_3$ | third order intermodulation | carrier spacing = 200 kHz | – | –45 | –40 | dBc |
| $d_5$ | fifth order intermodulation | | – | –52 | – | dBc |
| $d_7$ | seventh order intermodulation | | – | –60 | – | dBc |

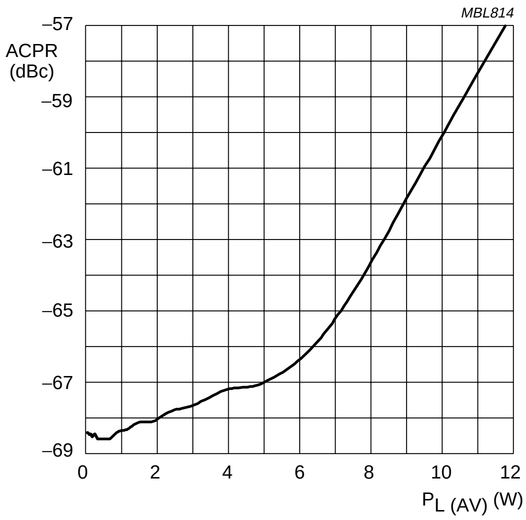
**Note**

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



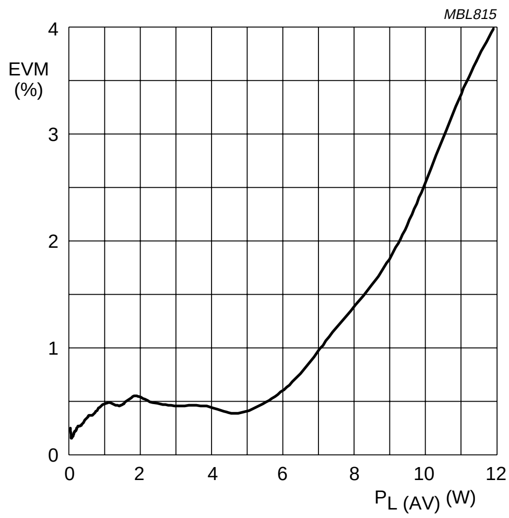

f = 940 MHz.

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



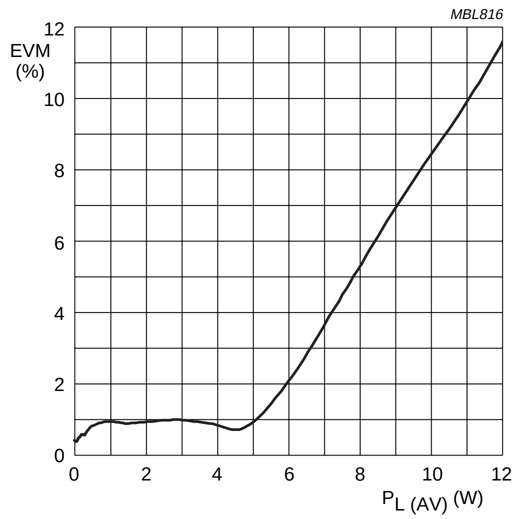

f = 940 MHz.

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



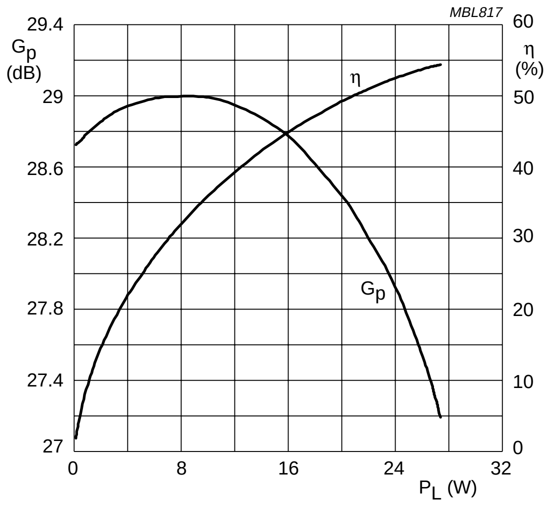

f = 940 MHz.

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



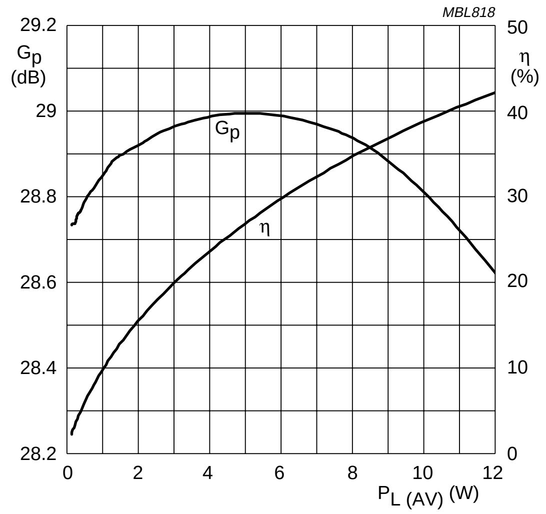

f = 940 MHz.

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



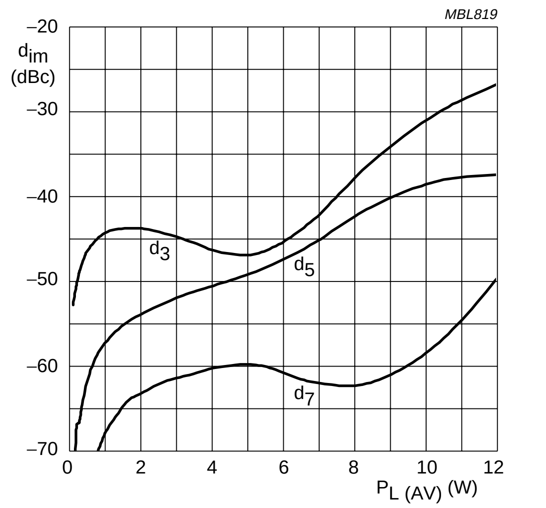

f = 940 MHz.

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




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

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




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

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

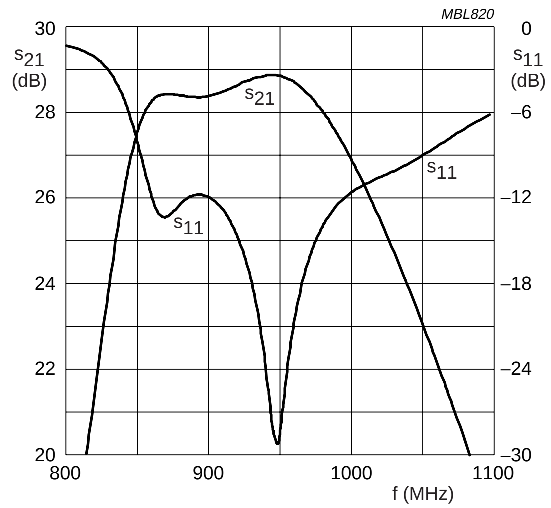



Fig.9 s-parameters as a function of frequency.

## MOUNTING RECOMMENDATIONS

### General

LDMOST base station modules are manufactured with the dies directly mounted onto 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. The dies and the PCB are encapsulated in a plastic cap, and pins extending from the module provide a means of electrical connection. This construction allows the module to withstand a limited amount of flexing, although bending of the module is to be avoided as much as possible. Mechanical stress can occur if the bottom surface of the module and the surface of the amplifier casing (external heatsink) are not mutually flat. This, therefore, should be a consideration when mounting the module in the amplifier. Another cause of mechanical stress can arise from thermal mismatch after soldering of the pins. Precautions should be taken during soldering, and efforts made to ensure a good thermal contact between the flange and the external heatsink.

### External heatsink (amplifier casing)

The module should always be mounted on a heatsink with a low thermal resistance to keep the module temperature as low as possible. The mounting area of the heatsink should be flat and free from burrs and loose particles.
We recommend a flatness for the mounting area of between 50 μm concave and 50 μm convex. The 50 μm concave value is to ensure optimal thermal behaviour, while the 50 μm convex value is intended to limit mechanical stress due to bending.

In order to ensure optimal thermal behaviour, the use of thermal compound is recommended when mounting the module onto the amplifier external heatsink.

The following recommended thermal compounds have a thermal conductivity of >0.5 W/mK:

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

The use of thermal pads instead of thermal compound is not recommended as the pads may not maintain a uniform flatness over a period of time.

### Mounting

PREPARATION

Ensure that the surface finishes are free from burrs, dirt and grease.

CAUTION

During the following procedures ESD precautions should be taken to protect the device from electrostatic damage.

PROCEDURE

1. Apply a thin, evenly spread layer of thermal compound to the module flange bottom surface. Excessive use of thermal compound may result in increased thermal resistance and possible bending of the of the flange. Too little thermal compound will result in an increase in thermal resistance.
2. Take care that there is some space between the cap and the PCB. Bring the module into contact with the external heatsink casing, ensuring that there is sufficient space for excessive thermal compound to escape.
3. Carefully align the module with the heatsink casing mounting holes, and secure with two 3 mm bolts and two flat washers. Initially tighten the bolts to “finger tight” (approximately 0.05 Nm). Using a torque wrench, tighten each bolt in alternating steps to a final torque of 0.4 Nm.
4. After the module is secured to the casing, the module leads may be soldered to the PCB. The leads are for electrical connection only, and should not be used to support the module at any time in the assembly process.

   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.
An incorrectly grounded flange can result in a loss of output power or in oscillation.

The RF input and output of the module are designed for 50 Ω connections.

### Incoming inspection

When incoming inspection is performed, use a properly designed test fixture to avoid excessive mechanical stress and to ensure optimal RF performance. Philips can deliver dedicated test fixtures on request.

## APPLICATION INFORMATION

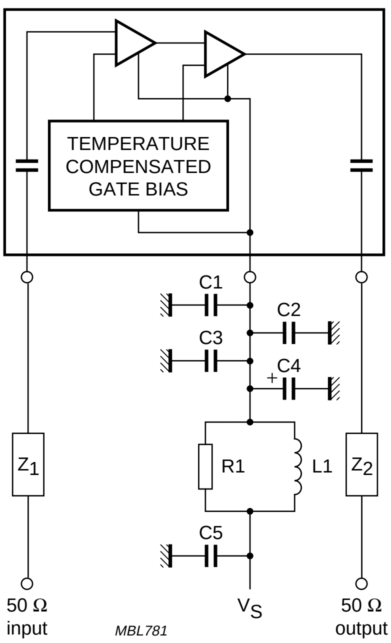


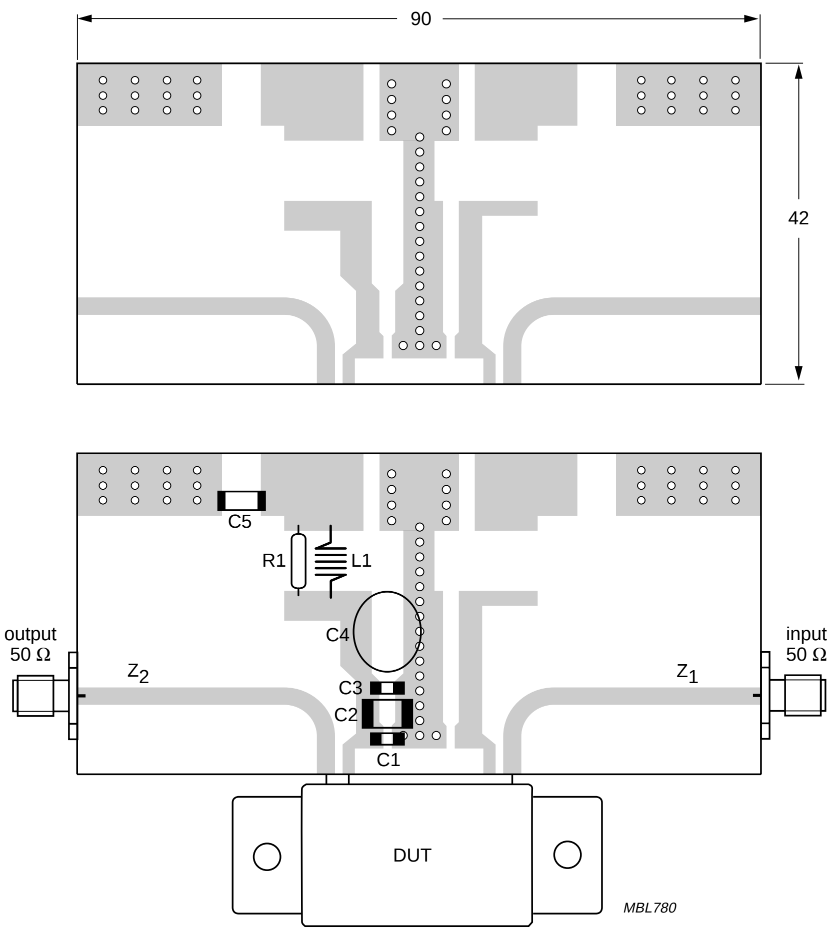

Fig.10 Test circuit.

**List of components (see Figs 10 and 11)**

| COMPONENT | DESCRIPTION | VALUE | CATALOGUE NUMBER |
|---|---|---|---|
| C1, C3 | multilayer X7R ceramic chip capacitor | 100 nF; 50 V | |
| C2, C5 | tantalum SMD capacitor | 10 μF; 35 V | |
| C4 | electrolytic capacitor | 100 μF; 35 V | |
| L1 | grade 4S2 Ferroxcube bead | | 4330 030 36300 |
| R1 | metal film resistor | 10 Ω; 0.4 W | 2322 195 13109 |
| $Z_1$, $Z_2$ | stripline; note 1 | 50 Ω | |

**Note**

1. The striplines are on a double copper-clad printed-circuit board (RO5880) with $\varepsilon_r$ = 2.2 and thickness = 0.79 mm.

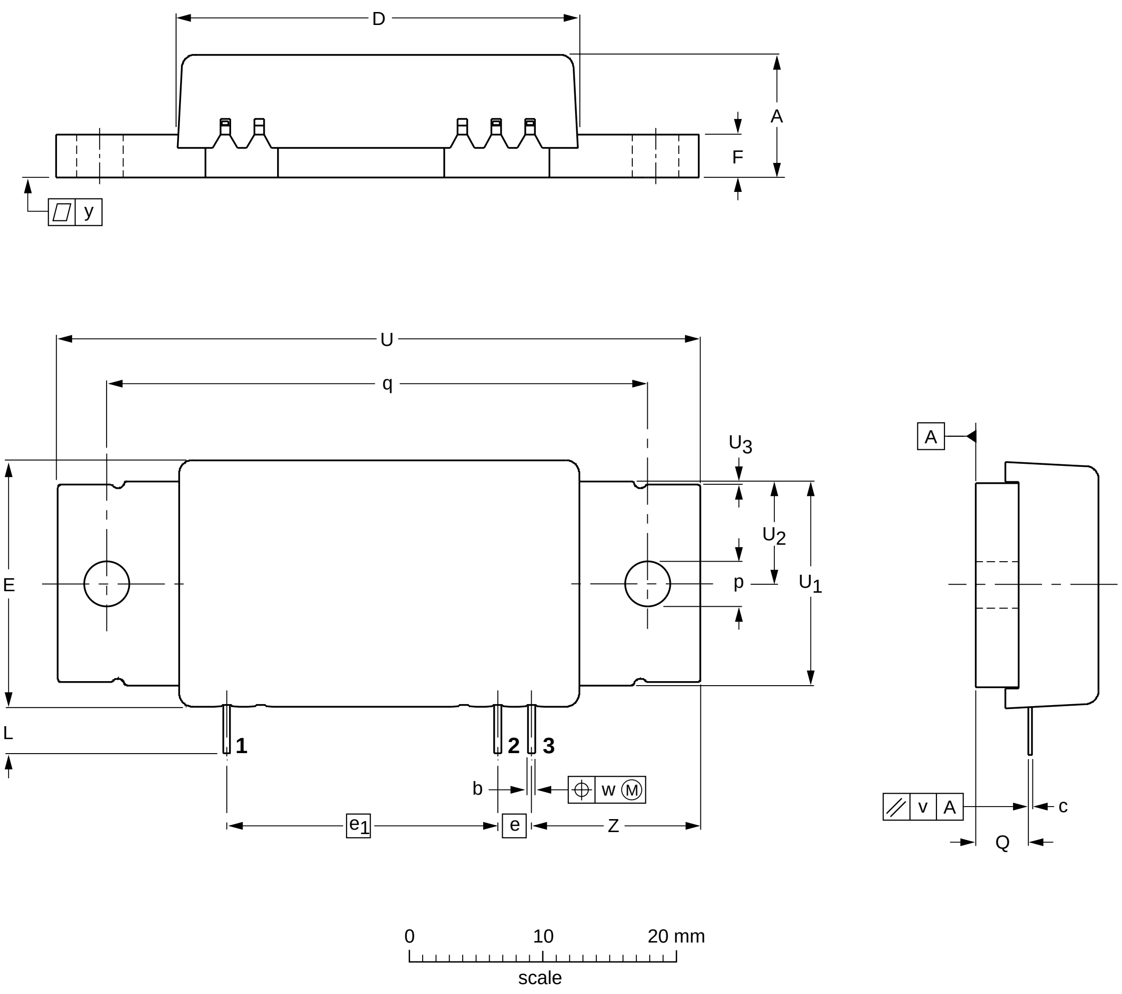



Dimensions in mm.

Fig.11 Printed-circuit board and component layout.

## PACKAGE OUTLINE

**Plastic rectangular single-ended flat package; flange mounted; 2 mounting holes; 3 in-line leads SOT365C**




**DIMENSIONS (mm 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 | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 9.5<br>9.0 | 0.56<br>0.46 | 0.3<br>0.2 | 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 | 0.3 | 0.25 | 0.1 | 12.8<br>12.6 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT365C | | | | | | ~~01-06-06~~<br>02-11-13 |

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|---|---|---|---|
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SCA75

Printed in The Netherlands 613524/07/pp12 Date of release: 2003 Jun 06 Document order number: 9397 750 11508

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