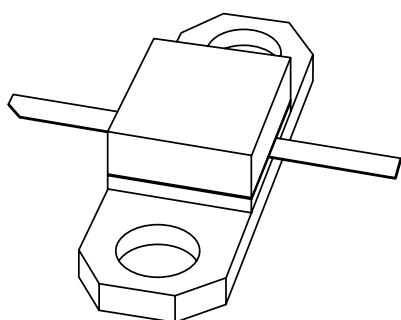


# DATA SHEET



## **LLE18040X** NPN microwave power transistor

Product specification  
Supersedes data of September 1994

1999 Apr 22

NPN microwave power transistor

LLE18040X

FEATURES

- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Interdigitated structure provides high emitter efficiency
  - Gold metallization realizes very good stability of the characteristics and excellent lifetime
  - Multicell geometry gives good balance of dissipated power and low thermal resistance
  - Internal input prematching ensures good stability and allows an easier design of wideband circuits.

APPLICATION

Intended for use in common emitter, class AB amplifiers in CW conditions for professional applications between 1.7 GHz and 2 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a SOT437A glued cap metal ceramic flange package, with emitter connected to flange.

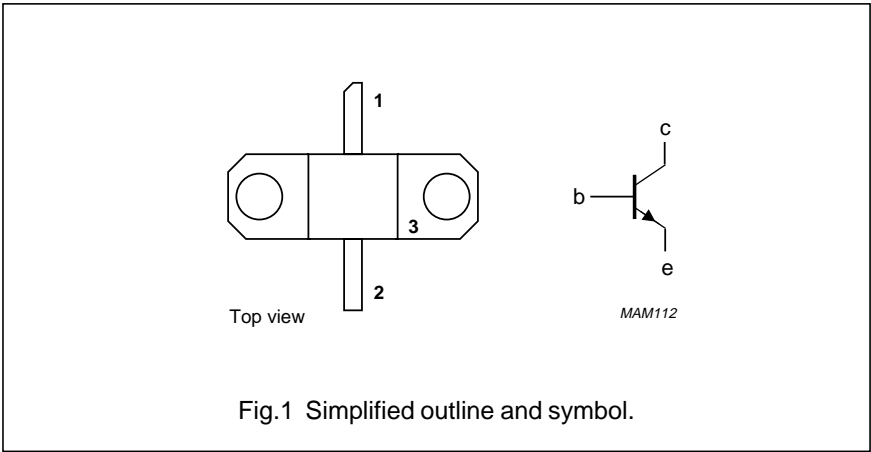
QUICK REFERENCE DATA

Microwave performance up to  $T_{mb} = 25\text{ }^{\circ}\text{C}$  in a common emitter class AB amplifier.

| MODE OF OPERATION | f (GHz) | V <sub>CE</sub> (V) | I <sub>CQ</sub> (A) | P <sub>L1</sub> (W) | G <sub>po</sub> (dB) | η <sub>c</sub> (%) | Z <sub>i</sub> ; Z <sub>L</sub> (Ω) |
|-------------------|---------|---------------------|---------------------|---------------------|----------------------|--------------------|-------------------------------------|
| Class AB (CW)     | 1.85    | 24                  | 0.04                | ≥4                  | ≥8.5                 | typ. 48            | see Figs 8 and 9                    |

PINNING - SOT437A

| PIN | DESCRIPTION                 |
|-----|-----------------------------|
| 1   | collector                   |
| 2   | base                        |
| 3   | emitter connected to flange |



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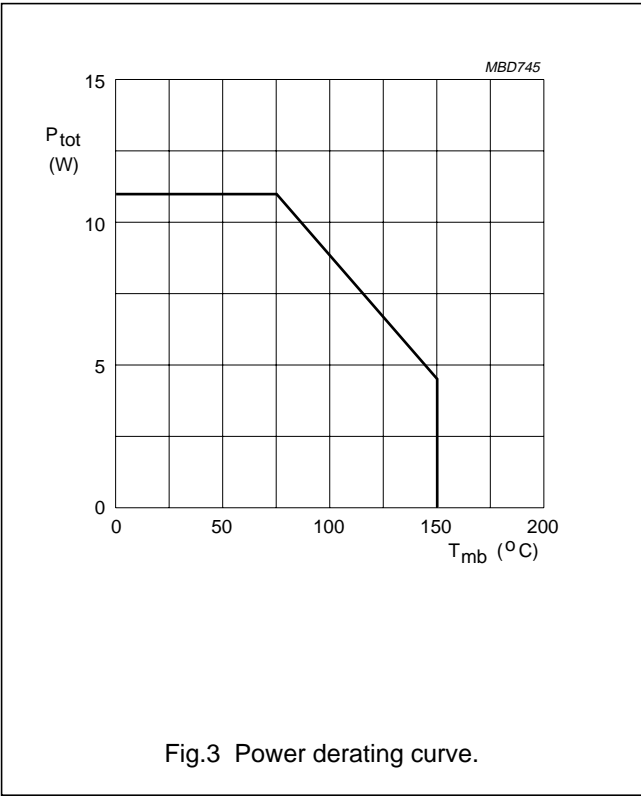
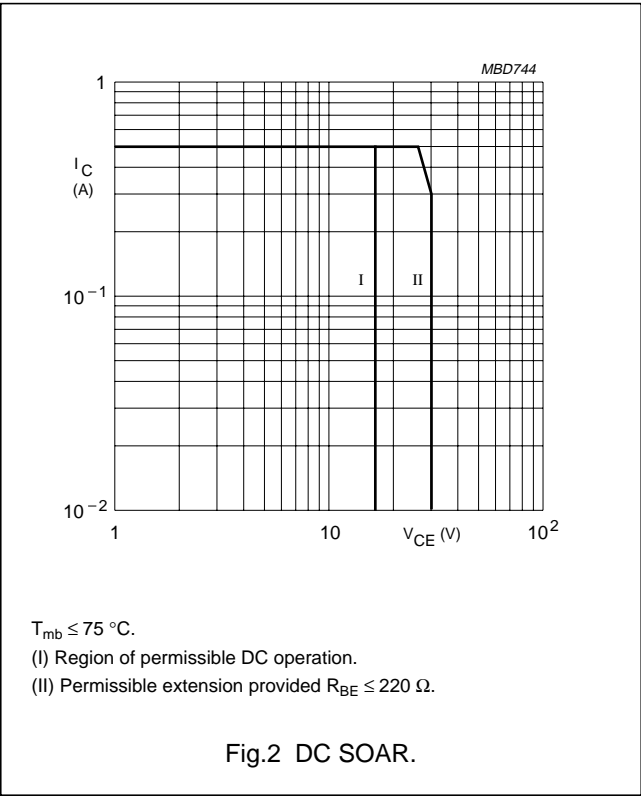
LIMITING VALUES

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

| SYMBOL           | PARAMETER                 | CONDITIONS                                     | MIN. | MAX. | UNIT |
|------------------|---------------------------|--|------|------|------|
| V <sub>CBO</sub> | collector-base voltage    | open emitter                                   | –    | 45   | V    |
| V <sub>CER</sub> | collector-emitter voltage | R <sub>BE</sub> = 220 Ω                        | –    | 30   | V    |
| V <sub>CEO</sub> | collector-emitter voltage | open base                                      | –    | 15   | V    |
| V <sub>EBO</sub> | emitter-base voltage      | open collector                                 | –    | 3    | V    |
| I <sub>C</sub>   | collector current (DC)    |  | –    | 0.5  | A    |
| P <sub>i</sub>   | input power               | f = 1.85 GHz; V <sub>CE</sub> = 24 V; class AB | –    | 1    | W    |
| P <sub>tot</sub> | total power dissipation   | T <sub>mb</sub> = 75 °C                        | –    | 11   | W    |
| T <sub>stg</sub> | storage temperature       |  | –65  | +150 | °C   |
| T <sub>j</sub>   | junction temperature      |  | –    | 200  | °C   |
| T <sub>sld</sub> | soldering temperature     | t ≤ 10 s; 1                                    | –    | 235  | °C   |

Note

- 1. Up to 0.2 mm from ceramic.



## NPN microwave power transistor

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## THERMAL CHARACTERISTICS

| SYMBOL         | PARAMETER   | CONDITIONS                  | MAX. | UNIT |
|----------------|---|-----------------------------|------|------|
| $R_{th\ j-mb}$ | thermal resistance from junction to mounting base | $T_j = 100\ ^\circ\text{C}$ | 8.5  | K/W  |
| $R_{th\ mb-h}$ | thermal resistance from mounting base to heatsink |                             | 0.2  | K/W  |

## CHARACTERISTICS

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

| SYMBOL        | PARAMETER                           | CONDITIONS                                   | MIN. | MAX. | UNIT          |
|---------------|-------------------------------------|--|------|------|---------------|
| $I_{CBO}$     | collector cut-off current           | $I_E = 0; V_{CB} = 20\ \text{V}$             | –    | 75   | $\mu\text{A}$ |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = 1\ \text{mA}; R_{BE} = 220\ \Omega$   | 30   | –    | V             |
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = 1\ \text{mA}$                         | 45   | –    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_E = 1\ \text{mA}$                         | 3    | –    | V             |
| $h_{FE}$      | DC current gain                     | $I_C = 0.25\ \text{A}; V_{CE} = 5\ \text{V}$ | 15   | 100  |               |

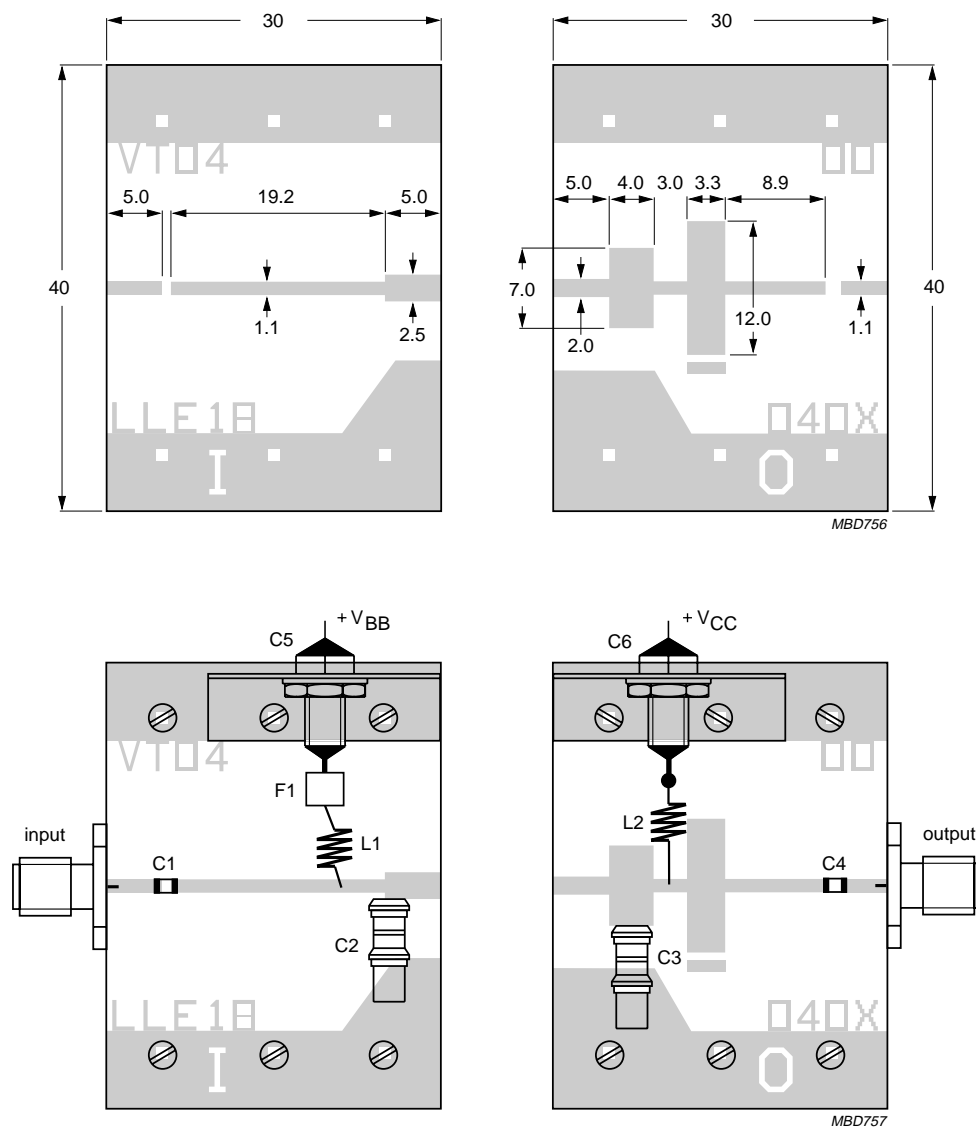
## APPLICATION INFORMATION

Microwave performance up to  $T_{mb} = 25\ ^\circ\text{C}$  in a common emitter class AB amplifier.

| MODE OF OPERATION | f (GHz) | $V_{CE}$ (V) | $I_{CQ}$ (A) | $P_{L1}$ (W)         | $G_{po}$ (dB)          | $\eta_c$ (%) | $Z_i; Z_L$ ( $\Omega$ ) |
|-------------------|---------|--------------|--------------|----------------------|------------------------|--------------|-------------------------|
| Class AB (CW)     | 1.85    | 24           | 0.04         | $\geq 4$<br>typ. 5.5 | $\geq 8.5$<br>typ. 9.5 | typ. 48      | see Figs 8 and 9        |

## NPN microwave power transistor

LLE18040X



The test circuit is split into two independent halves, each being 30 x 40 mm in size.

Dimensions in mm.

Substrate: Teflon fibreglass.

Thickness: 0.4 mm.

Permittivity:  $\epsilon_r = 2.55$ .

Fig.4 Prematching test circuit board.

NPN microwave power transistor

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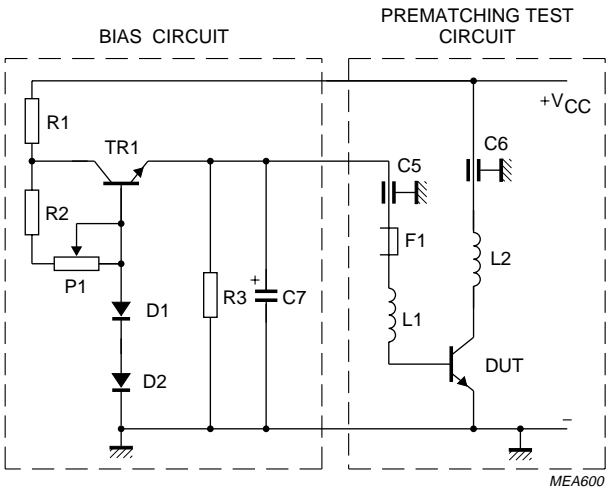


Fig.5 Class AB bias circuit.

List of components (see Figs 4 and 5).

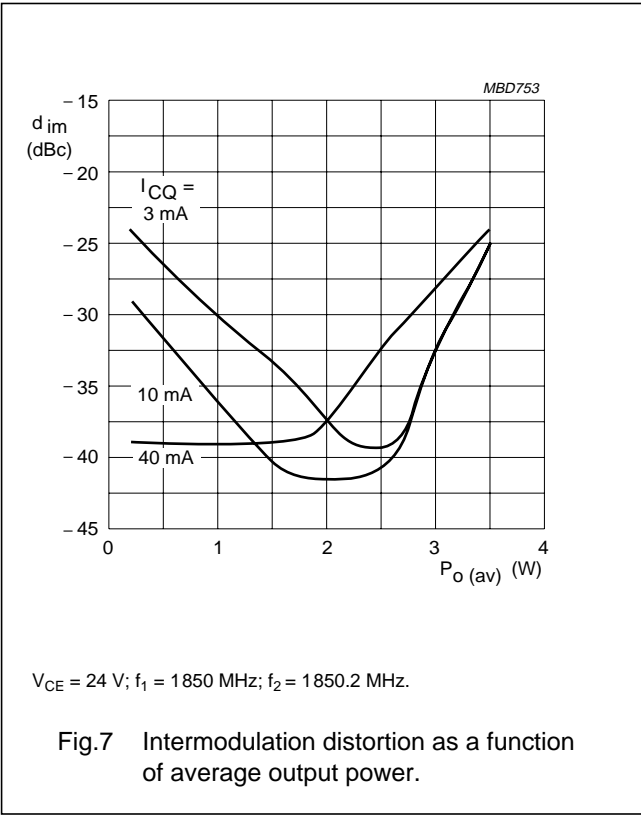
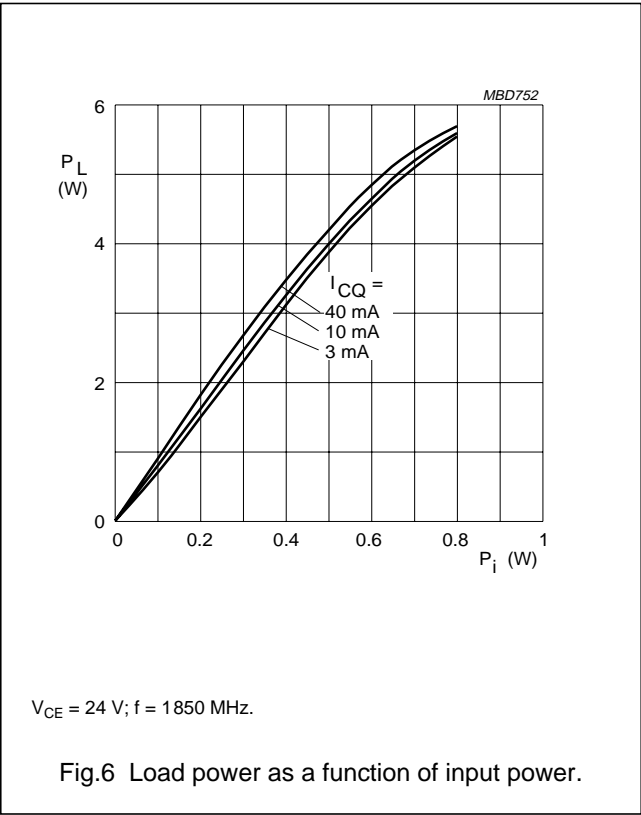
| COMPONENT | DESCRIPTION   | VALUE          | ORDERING INFORMATION  |
|-----------|---|----------------|---|
| TR1       | transistor, BDT239 or equivalent                        |                |   |
| C1, C4    | DC blocking chip capacitor                              | 100 pF         | ATC 100A101kp   |
| C2, C3    | trimmer capacitor                                       | 0.5 to 5.0 pF  | Tekelec 727-1 SL  |
| C5, C6    | feedthrough bypass capacitor                            | 1500 pF        | Erie 1250-003   |
| C7        | electrolytic capacitor                                  | 10 μF, >30 V   |   |
| D1        | diode BY239 or equivalent; 1                            |                |   |
| D2        | diode BY239 or equivalent; 2                            |                |   |
| L1        | 4 turns 0.5 mm copper wire;<br>internal diameter = 2 mm |                |   |
| L2        | 3 turns 0.5 mm copper wire;<br>internal diameter = 2 mm |                |   |
| P1        | linear potentiometer                                    | 4.7 kΩ         |   |
| R1        | resistor  | 100 Ω, 0.25 W  |   |
| R2        | resistor  | 1.5 kΩ, 0.25 W |   |
| R3        | resistor  | 56 Ω, 0.25 W   |   |
| F1        | ferrite bead  |                | Philips tube, 12NC = 4330 030 43081<br>4.2 x 2.2 x 3.2 mm (4B1) |

Notes

- 1. In thermal contact with TR1.
- 2. In thermal contact with DUT.

NPN microwave power transistor

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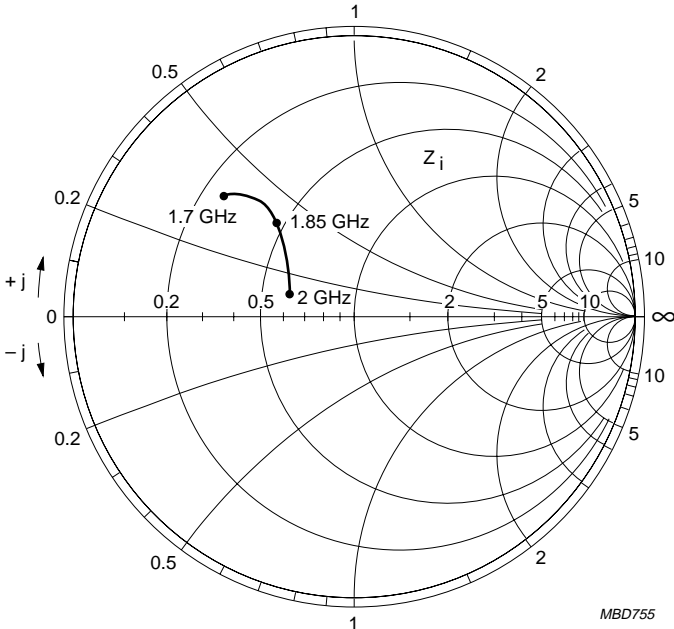
Input and optimum load impedances.

$V_{CE} = 24\text{ V}$ ;  $I_{CQ} = 40\text{ mA}$  (see Figs 8 and 9); typical values at  $P_L = P_{L1}$ .

| $f$<br>(GHz) | $Z_i$<br>( $\Omega$ ) | $Z_L$<br>( $\Omega$ ) |
|--------------|-----------------------|-----------------------|
| 1.70         | $13.0 + j17.5$        | $5.2 + j6.4$          |
| 1.75         | $15.5 + j17.8$        | $5.0 + j6.0$          |
| 1.80         | $18.6 + j17.6$        | $4.8 + j5.5$          |
| 1.85         | $22.1 + j16.5$        | $4.7 + j5.1$          |
| 1.90         | $25.7 + j14.0$        | $4.5 + j4.6$          |
| 1.95         | $28.5 + j10.0$        | $4.4 + j4.2$          |
| 2.00         | $29.8 + j4.9$         | $4.3 + j3.8$          |

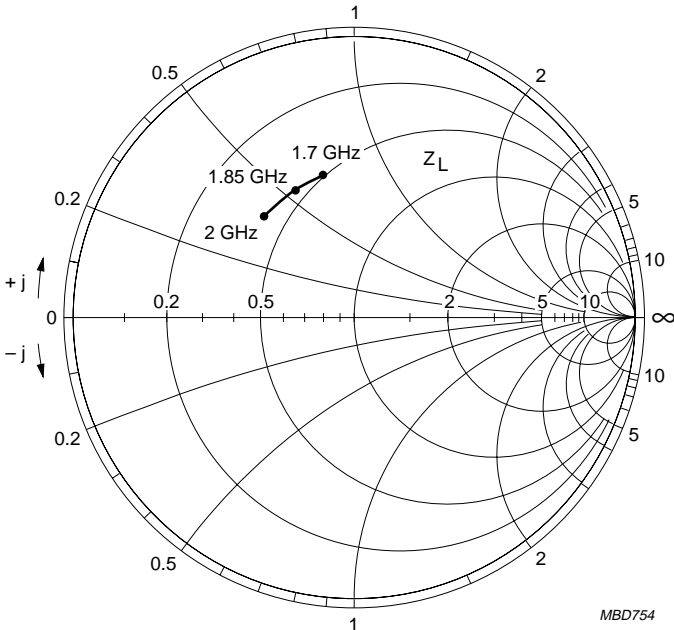
NPN microwave power transistor

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$V_{CE} = 24\text{ V}$ ;  $Z_0 = 50\ \Omega$ ;  $I_{CQ} = 40\text{ mA}$ .

Fig.8 Input impedance as a function of frequency; typical values at  $P_L = P_{L1}$ .



$V_{CE} = 24\text{ V}$ ;  $Z_0 = 10\ \Omega$ ;  $I_{CQ} = 40\text{ mA}$ .

Fig.9 Optimum load impedance as a function of frequency; typical values at  $P_L = P_{L1}$ .



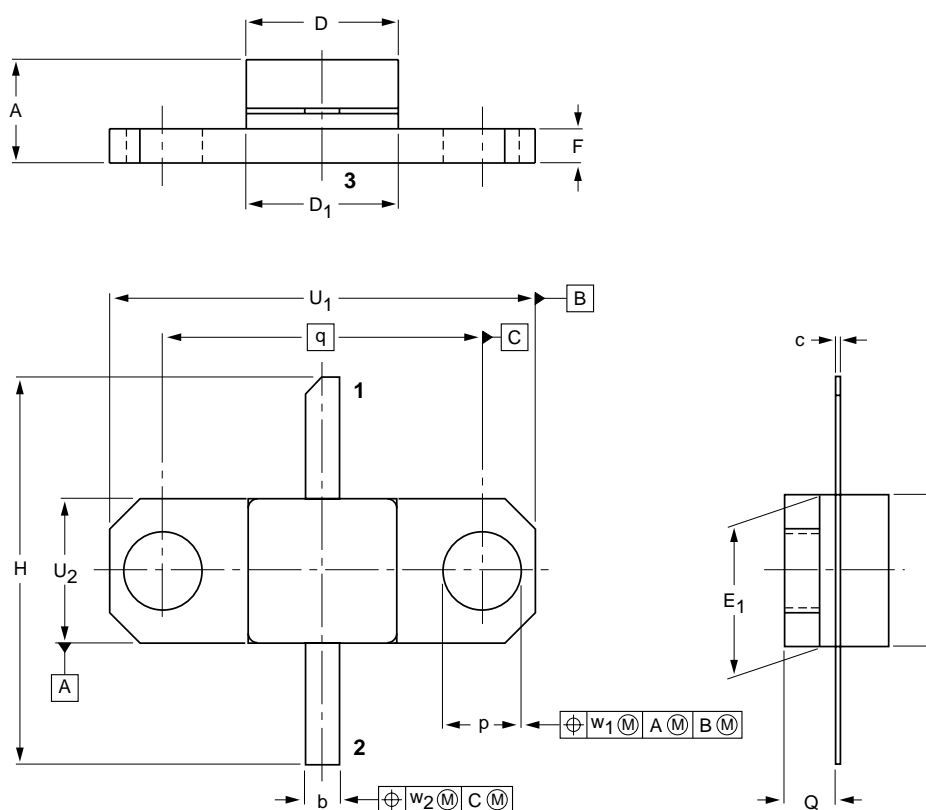
## NPN microwave power transistor

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## PACKAGE OUTLINE

**Flanged ceramic package; 2 mounting holes; 2 leads**


**SOT437A**



A horizontal scale bar with the word "scale" centered below it. The bar has vertical tick marks at 0, 5, and 10 mm, with the unit "mm" at the right end.

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

| UNIT   | A              | b              | c              | D              | D <sub>1</sub> | E              | E <sub>1</sub> | F              | H              | p              | Q            | q     | U <sub>1</sub> | U <sub>2</sub> | w <sub>1</sub> | w <sub>2</sub> |
|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|-------|----------------|----------------|----------------|----------------|
| mm     | 4.98<br>4.32   | 1.66<br>1.40   | 0.13<br>0.08   | 6.48<br>6.22   | 6.48<br>6.22   | 6.48<br>6.22   | 6.48<br>6.22   | 1.65<br>1.40   | 17.02<br>16.00 | 3.43<br>3.18   | 2.29<br>2.03 | 14.22 | 19.02<br>18.77 | 6.48<br>6.22   | 0.25           | 0.51           |
| inches | 0.196<br>0.170 | 0.065<br>0.055 | 0.005<br>0.003 | 0.255<br>0.245 | 0.255<br>0.245 | 0.255<br>0.245 | 0.255<br>0.245 | 0.065<br>0.055 | 0.67<br>0.63   | 0.135<br>0.125 | 0.90<br>0.80 | 0.560 | 0.749<br>0.739 | 0.255<br>0.245 | 0.010          | 0.020          |

| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION  | ISSUE DATE |
|--------------------|------------|-------|------|--|---|------------|
|                    | IEC        | JEDEC | EIAJ |  |   |            |
| SOT437A            |            |       |      |  |  | 99-03-29   |

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**NPN microwave power transistor****LLE18040X**

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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.   |   |

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# Philips Semiconductors – a worldwide company

**Argentina:** see South America

**Australia:** 34 Waterloo Road, NORTH RYDE, NSW 2113,  
Tel. +61 2 9805 4455, Fax. +61 2 9805 4466

**Austria:** Computerstr. 6, A-1101 WIEN, P.O. Box 213,  
Tel. +43 1 60 101 1248, Fax. +43 1 60 101 1210

**Belarus:** Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,  
220050 MINSK, Tel. +375 172 20 0733, Fax. +375 172 20 0773

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51 James Bourchier Blvd., 1407 SOFIA,  
Tel. +359 2 68 9211, Fax. +359 2 68 9102

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Tel. +1 800 234 7381, Fax. +1 800 943 0087

**China/Hong Kong:** 501 Hong Kong Industrial Technology Centre,  
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Tel. +852 2319 7888, Fax. +852 2319 7700

**Colombia:** see South America

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**Denmark:** Sydhavnsgade 23, 1780 COPENHAGEN V,  
Tel. +45 33 29 3333, Fax. +45 33 29 3905

**Finland:** Sinikalliontie 3, FIN-02630 ESPOO,  
Tel. +358 9 615 800, Fax. +358 9 6158 0920

**France:** 51 Rue Carnot, BP317, 92156 SURESNES Cedex,  
Tel. +33 1 4099 6161, Fax. +33 1 4099 6427

**Germany:** Hammerbrookstraße 69, D-20097 HAMBURG,  
Tel. +49 40 2353 60, Fax. +49 40 2353 6300

**Hungary:** see Austria

**India:** Philips INDIA Ltd, Band Box Building, 2nd floor,  
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Tel. +91 22 493 8541, Fax. +91 22 493 0966

**Indonesia:** PT Philips Development Corporation, Semiconductors Division,  
Gedung Philips, Jl. Buncit Raya Kav.99-100, JAKARTA 12510,  
Tel. +62 21 794 0040 ext. 2501, Fax. +62 21 794 0080

**Ireland:** Newstead, Clonskeagh, DUBLIN 14,  
Tel. +353 1 7640 000, Fax. +353 1 7640 200

**Israel:** RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053,  
TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

**Italy:** PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3,  
20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

**Japan:** Philips Bldg 13-37, Kohnan 2-chome, Minato-ku,  
TOKYO 108-8507, Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

**Korea:** Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,  
Tel. +82 2 709 1412, Fax. +82 2 709 1415

**Malaysia:** No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,  
Tel. +60 3 750 5214, Fax. +60 3 757 4880

**Mexico:** 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,  
Tel. +9-5 800 234 7381, Fax +9-5 800 943 0087

**Middle East:** see Italy

**Netherlands:** Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,  
Tel. +31 40 27 82785, Fax. +31 40 27 88399

**New Zealand:** 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,  
Tel. +64 9 849 4160, Fax. +64 9 849 7811

**Norway:** Box 1, Manglerud 0612, OSLO,  
Tel. +47 22 74 8000, Fax. +47 22 74 8341

**Pakistan:** see Singapore

**Philippines:** Philips Semiconductors Philippines Inc.,  
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Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

**Poland:** Ul. Lukiska 10, PL 04-123 WARSZAWA,  
Tel. +48 22 612 2831, Fax. +48 22 612 2327

**Portugal:** see Spain

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**Russia:** Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,  
Tel. +7 095 755 6918, Fax. +7 095 755 6919

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Tel. +65 350 2538, Fax. +65 251 6500

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**South Africa:** S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,  
2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000,  
Tel. +27 11 470 5911, Fax. +27 11 470 5494

**South America:** Al. Vicente Pinzon, 173, 6th floor,  
04547-130 SÃO PAULO, SP, Brazil,  
Tel. +55 11 821 2333, Fax. +55 11 821 2382

**Spain:** Balmes 22, 08007 BARCELONA,  
Tel. +34 93 301 6312, Fax. +34 93 301 4107

**Sweden:** Kottbygatan 7, Akalla, S-16485 STOCKHOLM,  
Tel. +46 8 5985 2000, Fax. +46 8 5985 2745

**Switzerland:** Allmendstrasse 140, CH-8027 ZÜRICH,  
Tel. +41 1 488 2741 Fax. +41 1 488 3263

**Taiwan:** Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1,  
TAIPEI, Taiwan Tel. +886 2 2134 2886, Fax. +886 2 2134 2874

**Thailand:** PHILIPS ELECTRONICS (THAILAND) Ltd.,  
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,  
Tel. +66 2 745 4090, Fax. +66 2 398 0793

**Turkey:** Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,  
Tel. +90 212 279 2770, Fax. +90 212 282 6707

**Ukraine:** PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,  
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

**United Kingdom:** Philips Semiconductors Ltd., 276 Bath Road, Hayes,  
MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

**United States:** 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,  
Tel. +1 800 234 7381, Fax. +1 800 943 0087

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Tel. +381 11 62 5344, Fax. +381 11 63 5777

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