Microwave Transistors

DATA HANDBOOK

BOOK SC15 1995

ilips
niconductors

PHILIPS

QUALITY ASSURED

Our quality system focuses on the continuing high quality of our components and the best possible service for our customers. We have a three-sided quality strategy: we apply a system of total quality control and assurance; we operate customer-oriented dynamic improvement programmes; and we promote a partnering relationship with our customers and suppliers.

PRODUCT SAFETY

In striving for state-of-the-art perfection, we continuously improve components and processes with respect to environmental demands. Our components offer no hazard to the environment in normal use when operated or stored within the limits specified in the data sheet.

Some components unavoidably contain substances that, if exposed by accident or misuse, are potentially hazardous to health. Users of these components are informed of the danger by warning notices in the data sheets supporting the components. Where necessary the warning notices also indicate safety precautions to be taken and disposal instructions to be followed. Obviously users of these components, in general the set-making industry, assume responsibility towards the consumer with respect to safety matters and environmental demands.

All used or obsolete components should be disposed of according to the regulations applying at the disposal location. Depending on the location, electronic components are considered to be 'chemical', 'special' or sometimes 'industrial' waste. Disposal as domestic waste is usually not permitted.

Microwave Transistors

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DEFINITIONS

Data sheet status	
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.
Limiting values	
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.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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ALPHANUMERIC INDEX

Types added to the range since the last issue of Handbook SC15 (1991 issue) are shown in bold print.

MAINTENANCE TYPES

Maintenance types are no longer recommended for equipment production but available for maintenance of existing equipment. Brief data of maintenance types is included in this handbook; full data, if required can be obtained on request

SELECTION GUIDE

PULSED POWER TRANSISTORS FOR RADAR

L-band

TYPE NUMBER	f (GHz)	V_{CC} (V)	t_p (µS)	at δ (%)	P_L (W)	G_p (dB)	ηc (%)	PAGE
RX1214B80W	1.2 to 1.4	40	500	10	≥80	≥7	≥35	425
RX1214B130Y	1.2 to 1.4	50	150	5	≥130	≥7	≥35	425
RX1214B170W	1.2 to 1.4	42	500	10	≥170	≥6.7	≥40	433
RX1214B300Y	1.2 to 1.4	50	150	5	≥250	≥7	≥35	439
RX1214B350Y	1.2 to 1.4	50	130	6	≥280	≥7	≥40	444
RZ1214B35Y	1.2 to 1.4	50	150	5	≥35	≥7	≥30	453
RZ1214B65Y	1.2 to 1.4	50	150	5	≥70	≥7	≥35	459

S-band

TYPE NUMBER	f (GHz)	V_{CC} (V)	t_p (µS)	at δ (%)	P_L (W)	G_p (dB)	ηc (%)	PAGE
RN2731B110W	2.7 to 3.1	40	100	10	typ. 110	typ. 7.5	typ. 40	410
RN3034B80W	3.0 to 3.4	40	100	10	typ. 80	typ. 6.5	typ. 35	413
RO2731B10W	2.7 to 3.1	40	100	10	typ. 12.5	typ. 7.5	typ. 40	416
RO2731B20W	2.7 to 3.1	40	100	10	typ. 25	typ. 7.5	typ. 40	419
RO2731B50W	2.7 to 3.1	40	100	10	typ. 60	typ. 7.5	typ. 40	422

PULSED POWER TRANSISTORS FOR AVIONICS

TYPE NUMBER	f (GHz)	V_{CC} (V)	t_p (µS)	at δ (%)	P_L (W)	G_p (dB)	ηc (%)	PAGE
MF1011B900Y	1.09	50	10	1	800	≥6.0	≥40	264
MTB10010U	1.03	24	1	1	>9.5	>9.5	>50	273
MX0912B100Y	0.96 to 1.215	50	10	10	>100	>7	>42	279
MX1011B200Y	1.09	50	10	1	200	≥7.5	≥45	302
MX0912B250Y	0.96 to 1.215	50	10	10	>235	>7	>42	287
MX0912B350Y	0.96 to 1.215	50	10	10	>325	>7	>40	295
MX1011B700Y	1.09	50	10	1	650	≥6.0	≥48	312
MZ0912B50Y	0.96 to 1.215	50	10	10	>50	>7	>42	319
MZ0912B100Y	0.96 to 1.215	50	10	10	>100	>7	>42	279

LINEAR POWER TRANSISTORS

Class-A

TYPE NUMBER	f (GHz)	V_{CE} (V)	I_c (mA)	P_{L1} (mW) note 1	G_{po} (dB) note 2	PAGE
LAE4001R	4.0	15	25	>85	>8.5	41
LAE4001RA	4.0	15	25	>85	>8.5	41
LAE4002S	4.0	18	30	>126	>7.5	47
LBE2003S	2.0	18	30	≥200	≥10	53
LBE2009S	2.0	18	110	≥700	≥9	53
LBE2009SA	2.0	18	110	≥700	≥9	53
LCE2009SA	2.0	18	110	≥700	≥9	53
LCE2009S	2.0	18	110	≥700	≥9	53
LEE1015TA	860; note 3	20	140	>1000	>13	61
LTE21015R	2.0	16	250	≥1500	>8.5	161
LTE21009R	2.1	16	150	≥600	≥10	157
LTE21009RA	2.1	16	150	≥600	≥10	157
LTE21025R	2.1	16	400	2800	7.8	167
LTE42005S	4.2	18	110	≥450	≥6.6	171
LTE42008R	4.2	16	250	≥800	>7	177
LTE42012R	4.2	16	400	≥1000	≥6	183
LV1721E50R	1.7 to 2.1	16	1100	≥5	≥7	191
LV2024E45R	2.0 to 2.4	16	1100	≥4	≥6	197
LVE21050R	2.1	16	1100	5500	8	205
LWE2010S	2.3	18	110	≥800	≥8	208
LWE2015R	2.3	16	250	≥1200	≥7.5	215
LZ1418E100R	1.4 to 1.8	16	2000	≥9	≥10	259

Notes

1. Load power for 1 dB compressed power gain.
2. Low level power gain associated with P_{L1}.
3. MHz value.

Class-AB

TYPE NUMBER	f (GHz)	V_{CE} (V)	I_c (mA)	P_{L1} (mW)	G_{po} (dB)	PAGE
LX1214E500X	1.2 to 1.4	24	150	50	11	223
LLE15180X	1.5	24	50	≥15	≥7.8	86
LLE15370X	1.5	24	300	≥33	≥8	93
LXE15450X	1.5	24	150	≥45	≥8	230
LFE15600X	1.5	24	200	≥55	≥8	72
LLE16045X	1.65	24	40	≥4.5	≥8.5	100
LLE16120X	1.65	24	100	≥11	≥8.7	107
LLE16350X	1.65	24	100	≥29	≥8	113
LXE16350X	1.65	24	300	≥32	≥9	237
LFE18500X	1.85	24	200	≥48	≥7	79
LLE18150X	1.85	24	50	≥12	≥7.8	140
LLE18300X	1.85	24	100	≥27	≥7.8	147
LLE18100X	1.85	24	100	≥9	≥8	134
LXE18300X	1.85	24	300	≥27	≥8	244
LXE18400X	1.85	24	150	≥39	≥7	251
LLE18010X	1.85	24	10	≥1	≥8.5	120
LLE18040X	1.85	24	40	≥4	≥8.5	127

CW POWER TRANSISTORS

TYPE NUMBER	CLASS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)	PAGE
PLB16004U	C	1.6	28	4.5	>8.5	>40	326
PLB16012U	C	1.6	28	10	>8	45	331
PLB16030U	B	1.60	28	>30	>7	≥45	336
PTB23001X	B	2	24	≥1	≥7	≥45	345
PTB23003X	B	2	24	≥3	≥8.75	≥45	345
PTB23003XA	B	2	24	≥3	≥8.75	≥45	345
PTB23005X	B	2	24	≥5	≥9.2	≥50	345
PTB23002U	B	2.3	28	>2	>9	>45	350
PTB23006U	C	2	28	>2	>9	>40	355
PTB32001X	B	3	24	≥1.3	≥8	≥35	361
PTB32003X	B	3	24	≥2.5	≥8	≥35	361
PTB32005X	B	3	24	≥4.5	≥8	≥35	361
PVB42004X	B	2	24	10	10	48	375
PXB16050U	C	1.65	28	>45	>8.5	>45	381
PZ1418B15U	B	1.4 to 1.8	28	≥12.5	≥7	≥38	387
PZ1418B30U	B	1.4 to 1.8	28	≥27	≥7.3	≥38	393

TYPE NUMBER	CLASS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)	PAGE
PZ1721B25U	B	1.7 to 2.1	28	≥25	≥7	≥35	393
PZ2024B20U	B	2.0 to 2.4	28	≥20	≥6	≥35	393
PZB16035U	B	1.55	28	≥35	≥8	≥45	405

OSCILLATOR POWER TRANSISTORS

TYPE NUMBER	f (GHz)	V_{CE} (V)	I_c (mA)	P_L (W)	ENVELOPE	PAGE
PTC4001T	2.88 to 3.0	20; note 1	200	≥550	FO-41B	371
PPC5001T	5	20	200	450	FO-102	341

Note

1. V_{CC} value.

MARKING CODES

Microwave Transistors

Marking codes

The range of microwave transistors in this book are normally marked with manufacturer's name or trademark, type designation and lot identification code. If space on the transistor envelope is insufficient for full type designation, the following marking codes may be used for identification.

TYPE NUMBER	MARKING CODE
LAE4001R	R8
LAE4002S	R9
LBE2003S	407
LBE2009S	409
LBE2009SA	445
LCE2003S	406
LCE2009S	408
LCE2009SA	446
LEE1015TA	1015T
LTE21009RA	435
LTE21015R	436
LTE21025R	439
LTE42005S	502
LTE42008R	196
LTE42012R	198
LUE2003S	400
LUE2009S	401
LV1721E50R	1721E50R
LV2024E45R	2024E45R
LV2327E40R	2327E40R

TYPE NUMBER	MARKING CODE
LV2931E50R	430
LWE2015R	411
LWE2025R	413
MRB11175Y	11175Y
MTB10010U	10010U
MX1011B400W	MX1011B400W
MX1011B430W	439
PPC5001T	395
PQC5001T	383
PTB23001X	2301X
PTB23003X	2303X
PTB23005X	2305X
PTB32001X	3201X
PTB32003X	3203X
PTB32005X	3205X
PTB42001X	4201X
PTB42002X	4202X
PTB42003X	4203X
PTC4001T	440
RV3135B5X	3135B5X

GENERAL

TOTAL QUALITY MANAGEMENT

Philips Semiconductors is a Quality Company, renowned for the high quality of our products and service. We keep alive this tradition by constantly aiming towards one ultimate standard, that of zero defects. This aim is guided by our Total Quality Management (TQM) system, the basis of which is described in the following paragraphs.

Quality assurance

Based on ISO 9000 standards, customer standards such as Ford TQE and IBM MDQ, and the CECC system of conformity. Our factories are certified to ISO 9000 and CECC by external inspectorates.

Partnerships with customers

PPM co-operations, design-in agreements, ship-to-stock, just-in-time and self-qualification programmes, and application support.

Partnerships with suppliers

Ship-to-stock, statistical process control and ISO 9000 audits.

Quality improvement programme

Continuous process and system improvement, design improvement, complete use of statistical process control, realization of our final objective of zero defects, and logistics improvement by ship-to-stock and just-in-time agreements.

ADVANCED QUALITY PLANNING

During the design and development of new products and processes, quality is built-in by advanced quality planning. Through failure-mode-and-effect analysis the critical parameters are detected and measures taken to ensure good performance on these parameters. The capability of process steps is also planned in this phase.

PRODUCT CONFORMANCE

The assurance of product conformance is an integral part of our quality assurance (QA) practice. This is achieved by:

- Incoming material management through partnerships with suppliers.
- In-line quality assurance to monitor process reproducibility during manufacture and initiate any necessary corrective action. Critical process steps are 100% under statistical process control.
- Acceptance tests on finished products to verify conformance with the device specification. The test results are used for quality feedback and corrective actions. The inspection and test requirements are detailed in the general quality specifications.
- Periodic inspections to monitor and measure the conformance of products.

PRODUCT RELIABILITY

With the increasing complexity of Original Equipment Manufacturer (OEM) equipment, component reliability must be extremely high. Our research laboratories and development departments study the failure mechanisms of semiconductors. Their studies result in design rules and process optimization for the highest built-in product reliability. Highly accelerated tests are applied to the products reliability evaluation. Rejects from reliability tests and from customer complaints are submitted to failure analysis, to result in corrective action.

CUSTOMER RESPONSES

Our quality improvement depends on joint action with our customer. We need our customer's inputs and we invite constructive comments on all aspects of our performance. Please contact our local sales representative.

RECOGNITION

The high quality of our products and services is demonstrated by many Quality Awards granted by major customers and international organizations.

INTRODUCTION TO THE "5 GHz" TECHNOLOGY

Description of the process

Between the years 1979 to 1981, Philips Semiconductors, supported by various agencies, developed a specific microwave process called "5 GHz "technology. This process is now applied to the complete product range and covers frequencies from 1 GHz to 5 GHz. The main characteristics of this "5 GHz "technology are described as follows:

- Use of ion implantation for all active doping levels (active base, base contacts, emitter). In this way a close control of impurity profiles is obtained, together with submicron junction depths, typically 0.2 µm for emitter-base junction, 0.4 µm for collector-base junction.
- Use of "self-aligned" process. This means that in the interdigited structures, base contacts and emitter fingers are opened in the silicon nitride layer in only one photo-lithographic step. Extremely accurate positioning of elements is thus obtained and emitter paths as small as 4.8 µm are obtained for large active dies with emitter peripheries greater than 40 mm.
- Use of a thick buried silicon oxide layer around active bases of the transistor. A 1.5 µm thick dielectric layer is obtained in this way under the whole of the interconnection part and metallization of the bonding pads is also achieved, thus reducing the parasitic MOS capacitors to very low levels. In addition, the flat surface of the silicon wafer after oxidation is compatible with the accurate photo-lithographic process required.

Other main parts of the process ensure the maximum quality level of the component.
They include:

- Use of TiPtAu emitter-base metallization (Au thickness 0.7 µm delaying electromigration phenomena.
- Use of diffused emitter ballasting resistors improving current sharing and avoiding "hot-spots".
- Silicon nitride emitter-base passivation ensuring very low and stable emitter-base leakage currents.
- Silicon oxide passivation layer acting as mechanical protection of the active area. The schematic cross-section of one active base of a 5 GHz die is shown in Fig.1.

Evaluation programme

OBJECTIVES

We evaluated the capability of the 5 GHz process to fulfil requirements for long lasting satellite applications and defined simplified (less costly and shortened) procedures for delivery in a space programme.

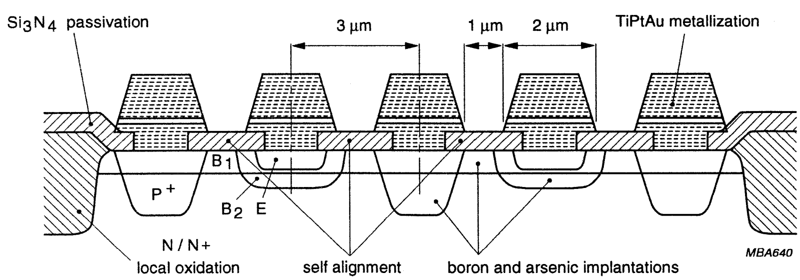


Fig.1 5 GHz die.

PROGRAMME DESCRIPTION

Test vehicles

Two product types were considered representative of the domain of interest (die, assembly technique, package type) and chosen as test vehicles:

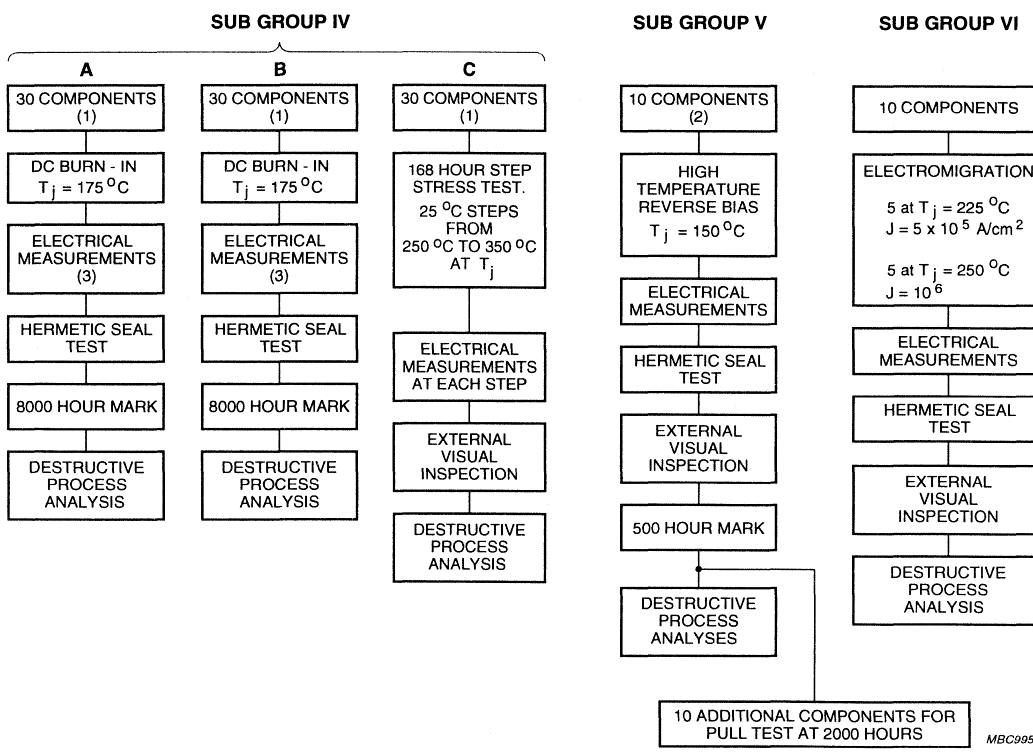
LTE42008R; 2QTN dies; FO-41B package.

PZB16035U; 2QZ dies; FO-57C package.

Emitter periphery is 3 mm for QTN, 30 mm for QZ dies. BeO slab surface is 3 mm^2 for FO-41B; 100 mm^2 for FO-57C.

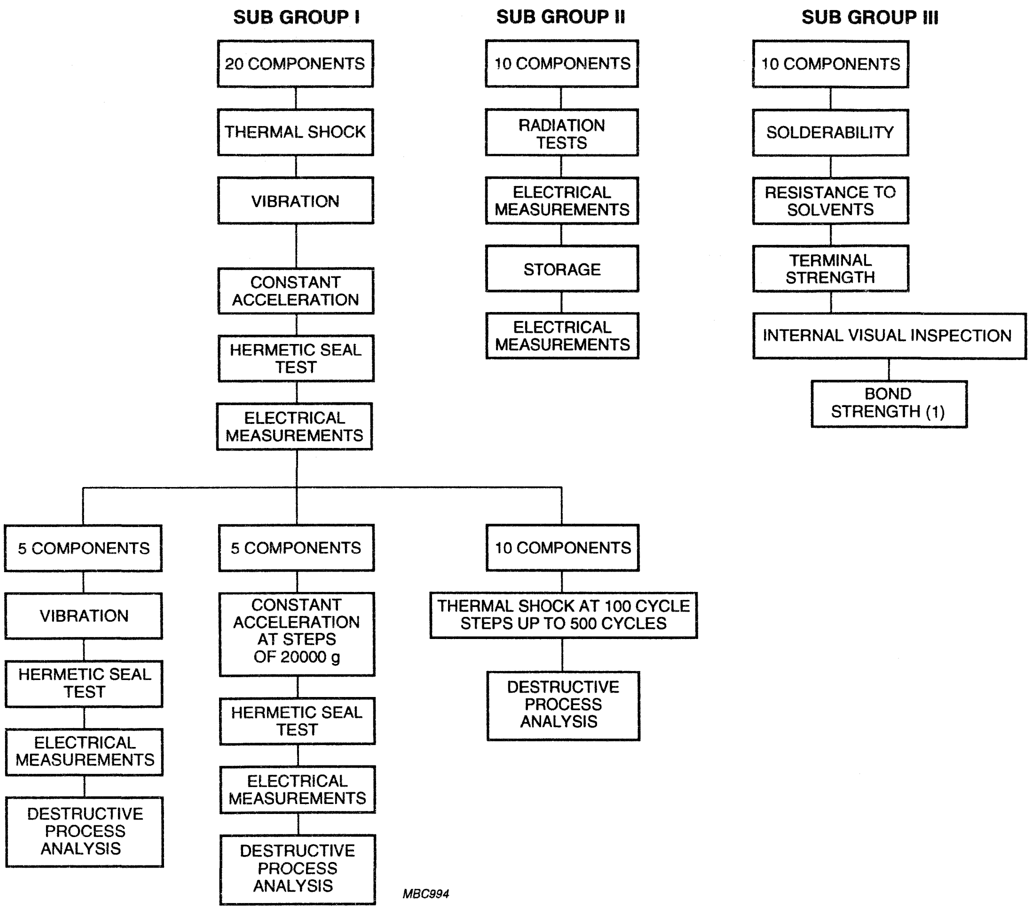
Test programme

A complete technical evaluation programme including mechanical, environmental, radiation and endurance tests was performed on both vehicle types (see Figs 2 and 3 for LTE42008R).
More than 300 transistors were tested, some for 8000 hours (endurance test), and others for more than 20000 hours (electromigration test). This represented more than one million parts hours. A summary of the endurance test results is shown.



(1) Test performed in package type TO-39 plus 5 additional components for pull test at 250, 275 and 300 °C.
(2) Plus 10 additional components in parallel for pull test at 2000 hours.
(3) Electrical measurements at 0, 168, 504, 1000, 2000, 4000, 6000 and 8000 hours.

Fig.2 Endurance test.



(1) Plus the 10 additional components required for pull test.

Fig.3 Mechanical, Climatic and Radiation tests.

ENDURANCE TEST RESULTS

Failures occurred at extreme temperatures well above the maximum specified operating temperature and in line with anticipated mechanical degradation (electromigration and gold diffusion). Results were found satisfactory, and ISO 9001 certification was granted in May 1991.

TEST OPERATION	LTE42008R		PZB16035	
	DEVICES TESTED	FAILURES	DEVICES TESTED	FAILURES
Burn-in; 8000 hours				
T_j = 175 °C	30	0	15	0
T_j = 225 °C	30	0	15	0
T_j = 275 °C	–	–	15	15(1)
168 hours step stress test at 250 to 350 °C (steps of 25 °C)	20	15(2)	–	–
High temperature reverse bias 150 °C				
2000 hours	20	0	–	–
3000 hours	–	–	5	0
Electromigration; 15000 hours				
225 °C; $5 \cdot 10^5$ A/cm^2	5	0	–	–
250 °C; 10^6 A/cm^2	5	0	–	–

Notes

1. Failures that occurred between 4000 and 4500 hours.
2. Failures that occurred at 350 °C.

CERTIFICAT

N° **1991/248a**

L'AFAQ certifie que le système qualité adopté par,
AFAQ certifies that the quality system developed by :

PHILIPS COMPOSANTS

pour les activités suivantes,
for the following activities :

Conception/développement, production et soutien après la vente exercées par le centre de PHILIPS-Composants CAEN dans les domaines suivants : circuits intégrés, transistors micro-ondes

Design/development, production and servicing performed in PHILIPS-Composants CAEN centre in the following fields : integrated circuits, microwave transistors

exercées sur le ou les site(s) suivant(s),
carried out in the following location(s) :

2, rue de la Girafe - F-14043 CAEN

a été évalué et jugé conforme aux exigences de la norme,
has been assessed and found to conform to the requirements of the standard :

ISO 9001 - EN 29001 (1988-12)

Le présent certificat délivré dans les conditions fixées par l'AFAQ, est valable jusqu'au,
This certificate, delivered under AFAQ rules, is valid until :

(année-mois-jour)- **1997-05-15** -(year-month-day)

(sauf suspension notifiée entre temps par l'AFAQ à l'entreprise désignée ci-dessus, qui s'est engagée à observer les règles définies par l'AFAQ)
Le présent document ne peut se substituer en aucune manière au contrat signé entre l'entreprise et l'AFAQ, qui seul fait foi.
(excepting notification by AFAQ of suspension of the above-mentioned company, which has agreed to respect the relevant AFAQ rules)
The present document, shall not replace, in any event, the contract signed by the firm and AFAQ, which remains the only binding document.

Bagneux, **1994-04-21**

LE PRÉSIDENT DU COMITÉ DE CERTIFICATION	LE DIRECTEUR GÉNÉRAL DE L'AFAQ	LE REPRÉSENTANT DE L'ENTREPRISE
THE PRESIDENT OF THE CERTIFICATION COMMITTEE	*THE MANAGING DIRECTOR OF AFAQ*	*ON BEHALF OF THE FIRM*
A. DEJOU	***O. PEYRAT***	J.P. REGNER

TRANSISTORS FOR HIGH POWER LINEAR AMPLIFIERS IN THE 1.5 TO 2.0 GHz RANGE

New applications for emerging technologies in both voice and data communications are appearing throughout the world. Although mass production is still several years away and despite lack of frequency allocations in some countries, engineers are busy with new designs for power amplifiers with power transistor requirements that exhibit the following similarities:

- Frequency of operation in the 1.5 to 2 GHz range
- 24 to 28 V voltage supplies
- Load power up to several hundred watts at the final output stage of the amplifier
- Strict intermodulation distortion requirements for multicarrier digital systems.

A brief overview of some of the major application areas as seen today follows.

Personal Communication System (PCS)

Personal communications encompasses a new generation of wireless telecommunications services, that will enable calls, whether voice or data, to be placed between individuals rather than fixed stations. Frequency allocations will be in the 1.7 to 2 GHz range, with output power from the base stations will be in tens of watts. Important markets will be in Europe (D.E.C.T.), Japan and the U.S.A. Philips now offer complete line-ups in the 1.5 to 1.7 GHz and 1.7 to 2 GHz frequency ranges.

Satellite communications

Mobile satellite links are becoming more popular (Airphone, videolinks). With the advent of Iridium and Inmarsat-like satellite constellations, engineers are busy designing mobile stations with power amplifier requirements in the 1.6 to 2.2 GHz frequency range with output power ranging from 20 to 80 W.

Radio broadcast

A new generation of digital systems such as "Digital Audio Broadcasting" (D.A.B.) is under evaluation today and introduction to the market is planned for 1995 both in Europe and in the U.S.A. Amplifiers will operate in the 1.45 to 1.5 GHz frequency band and the power requirements are in the 200 to 1500 W range.

These requirements have led Philips to develop entire families of power transistors that allow the designer to build a line-up from an input power level of a few milliwatts to an output power level of hundreds of watts. Design choices have been made for a proven reliable die processing technology and sound internal matching arrangement for optimum price/performance effectiveness.

TRANSISTOR DESIGN CONSIDERATIONS

Based on experimental results, it is evident that the most suitable choice of transistor for these applications is the common-emitter class AB type. The variation in linearity with driving current levels of these types is now discussed.

Common emitter

The common-emitter configuration is chosen for the following reasons:

- **Easy driving**

  Common-emitter transistors driven by base currents require lower current levels.

- **Stability**

  It is well known that stability depends mainly on the input impedance a device can present. This impedance is strongly influenced by common lead inductance. In a common emitter configuration, any increase in common inductance can induce an increase in the real part of the input impedance, while in a common-base configuration, this real part is lowered (and can become negative), often leading to oscillation problems.

- **Power gain**

  Power gain in a common emitter configuration remains constant in a lower range of frequency than for the common-base counterparts, but its level in this area is significantly higher (typically +1.5 dB). As far as the frequency range remains below the decreasing point of the power gain as a function of frequency curve, as is the case in the present application, common-emitter configuration offers much higher power gain levels.

Class AB

Class AB operation is chosen as a compromise between high power handling, high collector efficiency and improved linearity.

POWER HANDLING

Increasing power handling allows the reduction of the number of paralleled components at the output stage of the amplifier. Output powers available in the different classes of operation are shown in Table 1. They are expressed in watts by mm of periphery, and measured at

−1 dB of compression gain (related to maximum power gain of the transfer characteristic).

Table 1 Power handling

V_{CE}	CLASS A P_{L1} (W/mm)	CLASS AB P_{L1} (W/mm)	CLASS B P_{L1} (W/mm)
28 V; note 1	0.26	0.38	0.6
16 V; note 2	0.17	−	−
24 V; note 2	−	0.33	−
28 V; note 2	−	−	0.6

Notes

1. Comparison carried out at same voltage supply.
2. Comparison relative to optimized voltages recommended in each case and corresponding to equivalent junction temperatures.

Collector efficiency

High collector efficiency is required in order to minimize junction temperature and to reduce the required power supply. Idealized levels of collector efficiency (expressed as the ratio of load power available on power consumption) can be calculated at 78% in class B and 50% in class A.

In fact, due to parasitic influences, (voltage drop, non resistive and voltage dependant loads) effective values observed in the particular frequency range are approximately 30% in class A, 50% in class B and 40% allowing intermediate values, in class AB.

Linearity

Linearity, commonly expressed in terms of two-tone third-order intermodulation distortion (d_{im}) has to be as high as possible in order to avoid interferences between carriers when used in multichannel amplifiers. Figure 4 shows the intermodulation distortion variations as functions of average power for a common emitter device in the three different modes of operation. Since the average power is normalized to the output power at −1 dB of compression, these curves are in fact independent of the type of component used.

It can be seen that if class A operation offers the lower level in d_{im} at low power, class AB can result in a wider range of acceptable linearity (d_{im} < −1 dB), particularly when delivering higher power levels.

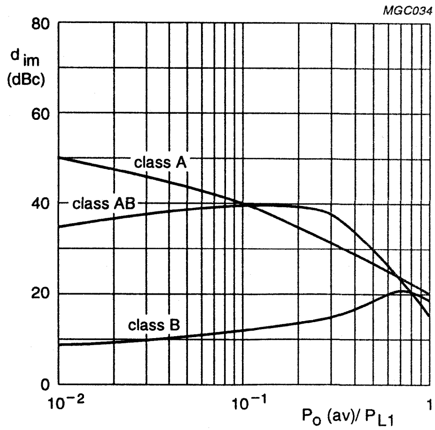
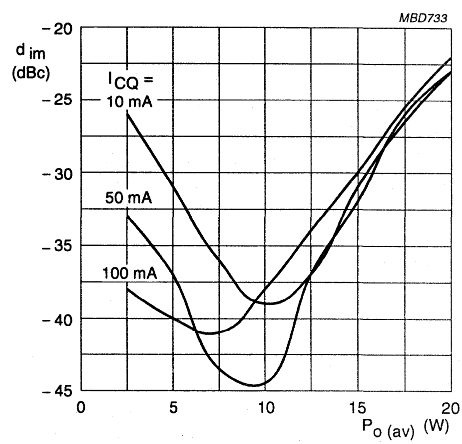


Fig.4 Intermodulation distortion as a function of average output power for Class A, Class AB and Class B operation.

Driving current level

Influence of the driving current level is illustrated in Fig.5. The curve applies to the commercial type LLE16350X which provides 35 W of output power at 1.65 GHz.



V_{CE} = 24 V; f_1 = 1850 MHz; f_2 = 1850.2 MHz.

Fig.5 Intermodulation distortion as a function of average output power.

As the driving current level is increased, the d_{im} response as a function of output power is flattened. A good compromise in this case can be reached for a quiescent current of Icq = 100 mA.

TRANSISTOR DEVELOPMENT

A complete range of power transistors have been developed. Featuring power handling ranging from1 W to 60 W, together with a typical power gain of 9 dB, these new NPN silicon microwave transistors from Philips Semiconductors considerably reduce the number of devices required in common-emitter class AB output stages for transmitters operating in the 1.5 to 2 GHz frequency range. Typical collector efficiency of 42% at junction temperatures up to 100 °C allow these new transistors to run relatively cool, even at high output levels, significantly enhancing long-term reliability. In addition their low levels of intermodulation distortion, typically better than –30 dBc at average output power as high as 50% of PL1, mean fewer transistors are required to achieve higher transmitted power levels.

These transistors have been completely characterized in class AB, both for operation in the 1.5 to 1.7 GHz and 1.7 to 2 GHz frequency ranges, and in class A for increased linearity when used as driver stages with lower output power levels.

Table 2 New transistor types
Class AB; V_{CC} = 24 V; f = 1.85 GHz.

TYPE NUMBER	P_o (W)
LLE18010X	1
LLE18040X	4
LLE18100X	10
LLE18300X	30
LFE18500X	50

All the transistors shown in Table 2 are single-ended devices using flat-pack headers and automatic bonding process for volume production. Internal input and output (for higher power devices) prematching simplifies the process of designing the transistors into wideband circuits.

An example of a line-up suitable for 50 to 60 W operation transmitter is shown in Fig.6.

First low power stage is a general purpose class A transistor. In the near feature, the two paralleled LLE18300X components could be replaced by one LFE18500X stage.

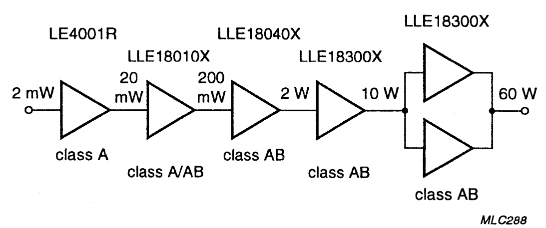


Fig.6 Transistor line-up.

RELIABILITY GRADES

Microwave transistors are available from different quality levels which are listed as follows:

- **Standard grade**

  This applies to devices following the designation rules as listed in the chapter Type Designation.

- **Grad "A"**

  This is designated to batch quantities greater than 400 and suitable for industrial applications. The suffix letter "A" is attached to the standard designation.

- **Grade "X" and "Y"**

  These grades correspond respectively to the equivalent MIL-STD 19500 grades JANTX and JANTXV.

  They have been subject to additional screening tests than those normally applied to the standard grade. The local sales organisation can confirm whether they are available for the type you have selected.

  The majority of the devices included in this book may also be available in accordance with a space screening file similar to JANS or ESA/SCC5010.

Reliability grades (only for brazed cap devices and orders in excess of 50 parts)

OPERATION	MIL STD 750 METHOD	CONDITIONS	REQUIREMENTS (%)			
			GRADE "A"	STD GRADE	GRADE "X"(1)	GRADE "Y"(2)
Assembly			100	100	100	100
Internal visual inspection		note 3	100	100	100	100
Capping			100	100	100	100
Stabilization bake	1032	T = 200 °C; duration 48 hours	100	100	100	100
Temperature cycling	1051	condition C; 20 cycles; no dwell at 25 °C	–	–	100	100
Constant acceleration	2006	20000 g axis Y1; $P_{tot} \leq 5W$	–	–	–	100
		10000 g axis Y1; $P_{tot} > 5W$	–	–	–	100
Hermetic seal (brazed cap)	1071	condition H - FC43				
fine			note 4	100	100	100
gross			note 4	100	100	100
Serialisation			–	–	–	100
Initial electrical parameters		note 5	–	–	100 GO/NOGO	100 GO/NOGO
High temperature reverse bias (HTRB)	1039	T_{amb} = 150 °C; V_{CBmin} = 80% of published V_{CB}; duration 48 hours	–	–	100	100
Interim electrical parameters		note 6	–	–	–	100 read and record
Power burn in	1039	T_{amb} = 150 °C; V_{CB} = 10 V; I_C reached when Tj average = 150 °C; duration 160 hours	–	–	–	100
Delta calculation		note 7	–	–	–	100

OPERATION	MIL STD 750 METHOD	CONDITIONS	REQUIREMENTS (%)			
			GRADE "A"	STD GRADE	GRADE "X"(1)	GRADE "Y"(2)
Other electrical parameters		note 5	note 4	100	100 GO/NOGO	read and record
Marking		as specified	100	100	100	100
External visual inspection	2071		note 4	100	100	100
Packing			100	100	100	100
Check for delivery		note 3				

Notes

1. Grade "X" is equivalent to JANTX.
2. Grade "Y" is equivalent to JANTXV.
3. As per Philips component specification.
4. Level II - AQL = 0.4 for each production batch, except DC parameters 100%.
5. Published DC, R_{th} and RF parameters.
6. Interim electrical parameters are published.
7. Published collector cut off current and forward current ratio. Delta limits are: Delta h_{FE} max = ±20% of initial value; Delta cut off current max = ±100% of initial value or ±10% of published parameter limit (whichever is greater).

BATCH RELEASE TESTS FOR GRADE “X” AND “Y” EQUIVALENTS

Group B; note 1.

INSPECTIONS	MIL STD 750 METHOD	CONDITIONS	SAMPLING PLAN LTPD(2)	SMALL LOT QUALITY CONFORMANCE INSPECTION	
				NO. OF DEVICES	NO. OF DEVICES
Subgroup 1					
Solderability	2026	the sampling plan applies to the number of leads inspected. A minimum of 3 devices shall be tested.	15	4	0
Resistance to solvents	1022				
Subgroup 2					
Temperature cycling (air to air)	1051	no dwell at 25 °C; test condition C, except step 3 at 175 °C; 45 cycles including screening	10	6	0
Thermal shock	1056	10 cycles; condition A			
Hermetic seal	1071				
fine leak		test condition H; max. leak rate = 5 x 10^{-7} atm cc/s			
gross leak		test condition C			
Electrical measurements		DC parameters of the relevant data sheet			
Subgroup 3					
Steady-state operation life	1027	as power burn -in except T_{mb} = 175 °C; T_j average = 200 °C; duration 340 hours	10	12	0
Electrical measurements		DC parameters of the relevant data sheet			
Bond strength	2037	the sample shall include a minimum of 3 devices and shall include all wire sizes	20 (wires)	20 (wires)	0
Subgroup 4					
Decap internal visual (design criteria)	2075	visual criteria in accordance with qualified design		1	0
Subgroup 5 (not applicable)					
Subgroup 6					
High temperature life (non operating)	1032	340 hours at T_{amb} = 200 °C (brazed cap)	10	12	0
Electrical measurements		DC parameters of the relevant data sheet			

Notes

1. Optional for grades “X” and “Y” (minimum order quantity = 50 devices).
2. Sampling according to MIL-STD 19500. Small lot sampling applies for batches up to 500 devices.

TYPE DESIGNATION CODE

Code structure

The standard structures of type designation code for microwave transistors can be shown as follows, where X represents a letter and 0 represents a numeral:

XXX0000X	for transistors without matching cell
XXX00000X	for transistors with input matching cell and specified for narrowband applications
XXX0000X00X or XXX0000X000X	for transistors specified for wideband applications

Letters

FIRST LETTER

The first letter shows the mode of operation:

L linear

M short pulse

P CW class B

R long pulse.

SECOND LETTER

The second letter shows the encapsulation:

A SOT100

B FO-45

C FO-46

E SOT122A

F FO-231

J FO-41A

L FO-229

P FO-102

Q FO-85

R FO-67

T FO-41B

U FO-163

V FO-83 and FO-83B

W FO-93

X FO-91B and FO-125A

Y FO-232

Z FO-57C and FO-57D.

THIRD LETTER

The third letter indicates the common potential:

E common emitter

B common base

C common collector.

FOURTH LETTER (SUFFIX LETTER)

The fourth letter indicates the supply voltage:

Q 10 to 12 V

R 15 to 16 V

S 18 V

T 20 V or 18 to 21 V

U 28 to 30 V

W 40 to 45 V

X 24 V

Y 50 V

Z 48 V.

Numbers

TRANSISTORS WITHOUT MATCHING CELL (XXX0000X)

1st digit indicates frequency of measurement (GHz).

2nd, 3rd and 4th digits indicate power:

in watts for P, M and R modes of operation

in multiples of 100 mW for L mode of operation.

TRANSISTORS SPECIFIED FOR NARROWBAND APPLICATIONS (XXX00000X)

1st and 2nd digits indicate frequency of measurement (× 0.1 GHz).

3rd, 4th and 5th digits give the power:

in watts for P, M and R modes of operation

in multiples of 100 mW for L mode of operation.

TRANSISTORS SPECIFIED FOR WIDEBAND APPLICATIONS

1st and 2nd digits indicate the lower frequency of use (in 0.1 GHz).

3rd and 4th digits indicate the higher frequency of use (in 0.1 GHz).

Last digit indicates the power:

in watts for P, M and R modes of operation

in multiples of 100 mW for L mode of operation.

RATING SYSTEMS

The rating systems described are those recommended by the International Electrotechnical Commission (IEC) in its publication number 134.

Definitions of terms used

ELECTRONIC DEVICE

An electronic tube or valve, transistor or other semiconductor device. This definition excludes inductors, capacitors, resistors and similar components.

CHARACTERISTIC

A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

BOGEY ELECTRONIC DEVICE

An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics that are directly related to the application.

RATING

A value that establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms. Limiting conditions may be either maxima or minima.

RATING SYSTEM

The set of principles upon which ratings are established and which determine their interpretation. The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

Absolute maximum rating system

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type, as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout the life of the device, no absolute maximum value for the intended service is exceeded with any device, under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

Design maximum rating system

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout the life of the device, no design maximum value for the intended service is exceeded with a bogey electronic device, under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

Design centre rating system

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

LETTER SYMBOLS

The letter symbols for transistors and signal diodes detailed in this section are based on IEC publication number 148.

Letter symbols for currents, voltages and powers

BASIC LETTERS

I, i	current
V, v	voltage
P, p	power.

Upper-case letter symbols are used to represent all values except instantaneous values that vary with time, these are represented by lower-case letters.

SUBSCRIPTS

A, a	anode terminal
(AV), (av)	average value
B, b	base terminal (for MOS devices: substrate)
C, c	collector terminal
D, d	drain terminal
E, e	emitter terminal
F, f	forward
G, g	gate terminal
K, k	cathode terminal
M, m	peak value
O, o	as third subscript: the terminal not mentioned is open-circuit
R, r	as first subscript: reverse. As second subscript: repetitive. As third subscript: with a specified resistance between the terminal not mentioned and the reference terminal
(RMS), (rms)	root-mean-square value
S, s	as first or second subscript: source terminal (FETs only). As second subscript: non-repetitive (not FETs). As third subscript: short circuit between the terminal not mentioned and the reference terminal
X, x	specified circuit
Z, z	replaces R to indicate the actual working voltage, current or power of voltage reference and voltage regulator diodes.

No additional subscript is used for DC values.

Upper-case subscripts are used for the indication of:

- continuous (DC) values (without signal), e.g. I_B
- instantaneous total values, e.g. i_B
- average total values, e.g. $I_{B(AV)}$
- peak total values, e.g. I_{BM}
- root-mean-square total values, e.g. $I_{B(RMS)}$.

Lower-case subscripts are used for the indication of values applying to the varying component alone:

- instantaneous values, e.g. i_b
- root-mean-square values, e.g. $I_{b(rms)}$
- peak values, e.g. I_{bm}
- average values, e.g. $I_{b(av)}$.

If more than one subscript is used, the subscript for which both styles exist are either all upper-case or all lower-case.

ADDITIONAL RULES FOR SUBSCRIPTS

Transistor currents

If it is necessary to indicate the terminal carrying the current, this should be done by the first subscript (conventional current flow from the external circuit into the terminal is positive).

Examples: I_B, i_B, i_b, I_{bm}.

Diode currents

To indicate a forward current (conventional current flow into the anode terminal), the subscript F or f should be used. For a reverse current (conventional current flow out of the anode terminal), the subscript R or r should be used.

Examples: I_F, I_R, i_F, $I_{f(rms)}$.

Transistor voltages

If it is necessary to indicate the points between which a voltage is measured, this should be done by the first two subscripts. The first subscript indicates the terminal at which the voltage is measured and the second the reference terminal or the circuit node. Where there is no possibility of confusion, the second subscript may be omitted.

Examples: V_{BE}, v_{BE}, v_{be}, V_{bem}.

Diode voltages

To indicate a forward voltage (anode positive with respect to cathode), the subscript F or f should be used. For a reverse voltage (anode negative with respect to cathode), the subscript R or r should be used.

Examples: V_F, V_R, v_F, V_{rm}.

Supply voltages or currents

Supply voltages or supply currents are indicated by repeating the appropriate terminal subscript.

Examples: V_{CC}, I_{EE}.

If it is necessary to indicate a reference terminal, this should be done by a third subscript.

Example: V_{CCE}.

Subscripts for devices with more than one terminal of the same kind

If a device has more than one terminal of the same kind, the subscript is formed by the appropriate letter for the terminal, followed by a number. In the case of multiple subscripts, hyphens may be necessary to avoid confusion.

Examples:

I_{B2} continuous (DC) current flowing into the second base terminal

V_{B2-E} continuous (DC) voltage between the terminals of second base and emitter.

Subscripts for multiple devices

For multiple unit devices, the subscripts are modified by a number preceding the letter subscript. In the case of multiple subscripts, hyphens may necessary to avoid confusion.

Examples:

I_{2C} continuous (DC) current flowing into the collector terminal of the second unit

V_{1C-2C} continuous (DC) voltage between the collector terminals of the first and second units.

Application of the rules

Figure 4 represents a transistor collector current as a function of time. It comprises a continuous (DC) current and a varying component.

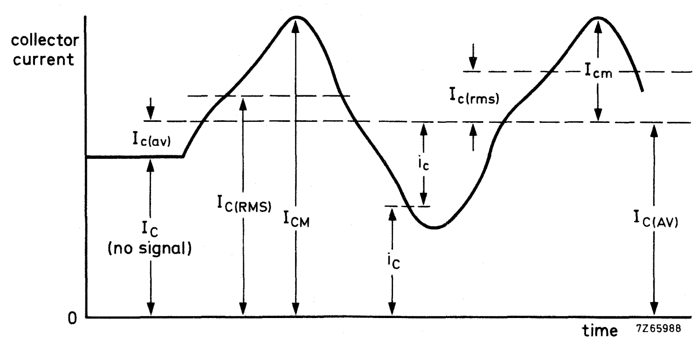


Fig.4 Collector current as a function of time.

Letter symbols for electrical parameters

DEFINITION

For the purpose of this publication, the term 'electrical parameter' applies to four-pole matrix parameters, elements of electrical equivalent circuits, electrical impedances and admittances, inductances and capacitances.

BASIC LETTERS

The following list comprises the most important basic letters used for electrical parameters of semiconductor devices.

B, b	susceptance (imaginary part of an admittance)
C	capacitance
G, g	conductance (real part of an admittance)
H, h	hybrid parameter
L	inductance
R, r	resistance (real part of an impedance)
X, x	reactance (imaginary part of an impedance)
Y, y	admittance
Z, z	impedance.

Upper-case letters are used for the representation of:

- electrical parameters of external circuits and of circuits in which the device forms only a part.
- all inductances and capacitances.

Lower-case letters are used for the representation of electrical parameters inherent in the device, with the exception of inductances and capacitances.

SUBSCRIPTS

General subscripts

The following list comprises the most important general subscripts used for electrical parameters of semiconductor devices.

F, f	forward (forward transfer)
I, i (or 1)	input
L, l	load
O, o (or 2)	output
R, r	reverse (reverse transfer)
S, s	source.

Examples: Z_S, h_f, h_F.

The upper-case variant of a subscript is used for the designation of static (DC) values.

Examples:

h_{FE} static value of forward current transfer ratio in common-emitter configuration (DC current gain)

R_E DC value of the external emitter resistance.

The static value is the slope of the line from the origin to the operating point on the appropriate characteristic curve, i.e. the quotient of the appropriate electrical quantities at the operating point.

The lower-case variant of a subscript is used for the designation of small-signal values.

Examples:

h_{fe}	small-signal value of the short-circuit forward current transfer ratio in common-emitter configuration
$Z_e = R_e + jX_e$	small-signal value of the external impedance.

If more than one subscript is used, subscripts for which both styles exist are either all upper-case or all lower-case.

Example: h_{FE}, y_{RE}, h_{fe}.

Subscripts for four-pole matrix parameters

The first letter subscript (or double numeric subscript) indicates input, output, forward transfer or reverse transfer.

Examples: h_i (or h_{11}), h_o (or h_{22}), h_f (or h_{21}), h_r (or h_{12}).

A further subscript is used for the identification of the circuit configuration. When no confusion is possible, this further subscript may be omitted.

Examples: h_{fe} (or h_{21e}), h_{FE} (or h_{21E}).

DISTINCTION BETWEEN REAL AND IMAGINARY PARTS

If it is necessary to distinguish between real and imaginary parts of electrical parameters, no additional subscripts should be used. If basic symbols for the real and imaginary parts exist, these may be used.

Examples: $Z_i = R_i + jX_i$, $y_{fe} = g_{fe} + jb_{fe}$.

If such symbols do not exist, or if they are not suitable, the following notation is used:

Examples:

Re (h_{ib}) etc. for the real part of h_{ib}

Im (h_{ib}) etc. for the imaginary part of h_{ib}.

Scattering parameters

In distinction to the conventional h-, y- and z-parameters, scattering parameters (s-parameters) relate to travelling wave conditions. Figure 5 shows a two-port network with the incident and reflected waves a_1, b_1, a_2 and b_2.

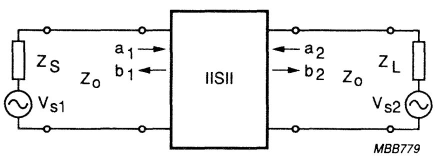


Fig.5 Two-port network.

From Fig.5: $a_1 = \frac{V_{i1}}{\sqrt{Z_o}}$; $a_2 = \frac{V_{i2}}{\sqrt{Z_o}}$; $b_1 = \frac{V_{r1}}{\sqrt{Z_o}}$; $b_2 = \frac{V_{r2}}{\sqrt{Z_o}}$.

The squares of these quantities have the dimension of power.

Z_o = characteristic impedance of the transmission line in which the two-port is connected

V_i = incident voltage

V_r = reflected (generated) voltage.

The four-pole equations for s-parameters are:

$$b_1 = s_{11}a_1 + s_{12}a_2$$
$$b_2 = s_{21}a_1 + s_{22}a_2.$$

Using the subscripts i for 11, r for 12, f for 21 and o for 22, it follows that:

$$s_i = s_{11} = \frac{b_1}{a_1} \mid a_2 = 0$$

$$s_r = s_{12} = \frac{b_1}{a_2} \mid a_1 = 0$$

$$s_f = s_{21} = \frac{b_2}{a_1} \mid a_2 = 0$$

$$s_o = s_{22} = \frac{b_2}{a_2} \mid a_1 = 0.$$

The s-parameters can be named and expressed as follows:

$s_i = s_{11}$ input reflection coefficient: the complex ratio of the reflected wave and the incident wave at the input, under the conditions $Z_l = Z_o = 50\ \Omega$ and $V_{s2} = 0$

$s_r = s_{12}$ reverse transmission coefficient: the complex ratio of the generated wave at the input and the incident wave at the output, under the conditions $Z_s = Z_o = 50\ \Omega$ and $V_{s1} = 0$

$s_f = s_{21}$ forward transmission coefficient: the complex ratio of the generated wave at the output and the incident wave at the input, under the conditions $Z_l = Z_o = 50\ \Omega$ and $V_{s2} = 0$

$s_o = s_{22}$ output reflection coefficient: the complex ratio of the reflected wave and the incident wave at the output, under the conditions $Z_s = Z_o = 50\ \Omega$ and $V_{s1} = 0$.

SUMMARY OF SYMBOLS FOR MICROWAVE TRANSISTORS

C_{cb}	collector-base capacitance
C_{ce}	collector-emitter capacitance
C_{eb}	emitter-base capacitance
d_{im}	intermodulation distortion
δ	duty factor
F_{min}	noise factor
f	signal frequency
G_a	associated gain (for a low-noise transistor)
G_{ma}	maximum available gain
G_{ms}	maximum stable gain
G_p	power gain under specified conditions
G_{po}	low level power gain associated with P_{L1}
h_{FE}	DC current gain
I_C	DC collector current
I_{CBO}	collector cut-off current, open emitter
I_{CER}	collector cut-off current, with specified R_{BE}
I_{CES}	collector cut-off current, base connected to emitter
I_{CQ}	quiescent current
I_{EBO}	emitter cut-off current, open collector
η_C	collector efficiency $P_L / (I_C \times V_{CC})$
η_{add}	power added efficiency $(P_{out} - P_{in}) / (I_C \times V_{CC})$
P_{in}	input power
P_L	load power under specified conditions
P_{L1}	load power for 1 dB compressed power gain
P_{out}	output power
P_{tot}	total power dissipation
$R_{th\ j\text{-}c}$	thermal resistance from junction to case
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base
$R_{th\ mb\text{-}j}$	thermal resistance from mounting base to heatsink
T_j	junction temperature
t_p	pulse width
T_{sld}	lead soldering temperature
T_{stg}	storage temperature
V_{CBO}	collector-base voltage, open emitter
V_{CC}	collector supply voltage
V_{CE}	collector-emitter voltage
V_{CEO}	collector-emitter voltage, open base
V_{CER}	collector-emitter voltage with specified R_{BE}
V_{CES}	collector-emitter voltage, base connected to emitter
V_{EBO}	emitter-base voltage, open collector
VSWR	voltage standing wave ratio
z_i	complex transistor impedance as seen by the generator
Z_L	complex transistor load impedance as seen by the transistor
Z_{th}	thermal impedance from junction to heatsink.

OPERATING RECOMMENDATIONS

These recommendations are included for the avoidance of damage or destruction of silicon bipolar transistors operating at high frequencies and high power during testing, setting-up procedures and final operation.

Polarization

A current-limiting power supply should be used when testing transistors in a new circuit.

Initial testing at reduced supply voltage is discouraged because the resulting change in output impedance could cause oscillation due to mismatch.

The RF blocking choke in the supply line, together with the DC blocking capacitor of the internal output prematching circuit of the transistor, could sometimes cause oscillations at very low frequencies. The oscillations can often be removed by bypassing the choke with a low value resistor.

Operation

INPUT POWER

When the circuit has not been optimized, the average power input should be kept a lower level than specified. Initial testing of CW amplifiers is best performed in pulsed operation at 50% duty factor. For pulsed amplifiers, the duty factor should be reduced.

OUTPUT WAVEFORM

The output waveform should be checked with a spectrum analyser or similar equipment to ensure that no parasitic effects causing unwanted modulation are present.

FREQUENCY

Microwave performance is published in the data sheet at a single frequency or for a range of frequencies. Devices whose data is published for narrow band application can normally be used at frequencies other than that specified. However, for high power types in particular, broadband operation may be difficult to obtain and the gain of transistors with an internal input prematching network may decrease sharply at higher frequencies.

Broadband transistors (generally those with type numbers starting with two letters followed by four digits) also have an output prematching network. This is essentially a high-pass filter with a resonance frequency below the lowest operating frequency. The transistor could be damaged if operated at this resonance frequency, therefore the manufacturer should be consulted if extended frequency operation is required.

Thermal considerations

The junction temperature is of paramount importance in the reliability of transistors and every effort should be made to keep this temperature as low as possible. This is affected by mechanical aspects of the fitting, therefore mounting recommendations given by the manufacturer should be followed.

Values of thermal resistance given in the data sheets are for a specific junction temperature. Note that thermal resistance from junction to mounting base increases with junction temperature at approximately 0.3%/K.

For transistors required for pulsed operation, an equivalent thermal impedance is given for a specified pulse format (pulse width and duty factor). This allows for calculation of peak junction temperature (at the end of a pulse). For widely differing pulse formats the manufacturer should be consulted.

The maximum power dissipation is defined as
$P_{tot} = V_{CE} \times I_C - P_o + P_i$ at $T_j = 200$ °C.

MOUNTING FLANGED MICROWAVE TRANSISTORS

Flanged microwave transistors are easy to mount but for best performance we offer the following recommendations.

Holes or tapped holes in the heatsink should be free from burrs and spaced between centres at:

- 6.7 mm for FO-85
- 14.2 mm for FO-41B, FO-53, FO-67 and FO-83
- 16.5 mm for FO-57
- 19.0 mm for FO-91 and FO-125
- 23.4 mm for FO-96.

Use a washer to spread the joint pressure.

Good thermal and electrical contact between flange and heatsink is essential for efficient operation. The flatness of the heatsink mounting surface must be < 0.02 mm with a surface roughness Ra < 0.5 mm (by grinding or lapping).

Use sparingly-applied heatsink compound evenly distributed on the transistor flange. Alternatively (especially for transistors with a flange distorted by earlier use) the flange can be lapped prior to assembly; surface conditions being as previously described.

The distance from the top of the printed circuit board to the heat sink should be less than the minimum distance from the bottom of the transistor lead to the seating plane of the flange; this is to prevent the leads being subjected to shear forces.

Connections between transistor and amplifier circuits should be as short as possible. Also, the distance between input and output printed circuit board should be the minimum required to accept the maximum specified dimensions of the transistor header. If any tolerance remains, the best performance is usually obtained by pushing the transistor towards the output side.

Before soldering the leads, the mounting screws should be tightened observing the maximum specified torque.

The specified performance will only be obtained if the leads are soldered to the printed circuit board as near as possible to the header. If necessary long leads may be cropped to an appropriate length ($\approx$ 2.5 mm). Solder should completely fill the space between printed circuit board and the bottom side of the lead (avoiding short circuit to the flange by excess solder).

For pre-assembly testing it may be necessary to fill the space below the leads with a gold plated shim placed close to the header. Testing the transistor with high lead inductances will result in reduced performance and may even cause destruction of the transistor.

APPLICATION INFORMATION

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
A	amplifier			1/4 MC 3403 or equivalent
D.U.T	microwave transistor			
TR	transistor			2N2219 or equivalent
D	diode			1N4148 or equivalent
C1, C2	tantalum capacitor	22 µF, 50 V		
R1	resistor	2.2 kΩ ±5 %		
R2, R3, R5, R6	resistor	10 kΩ ±5 %		
R4	resistor	4.7 kΩ ±5 %		
R_p	resistor	10 kΩ ±5 %	10 turns	
R_b, R_c, R_e, R_x	resistor	note 1		

Note

1. Values to be adapted to I_c of the D.U.T.

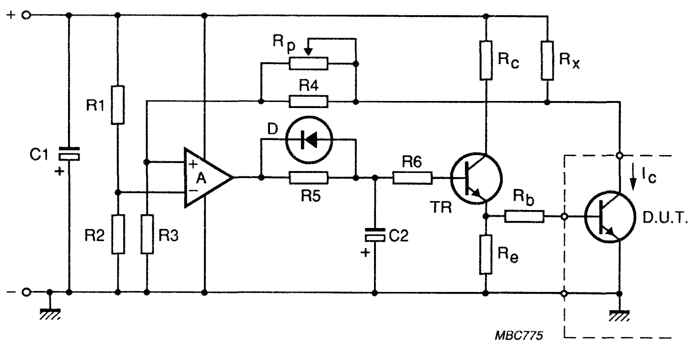


Fig.6 Bias circuit for a class A linear microwave transistor.

DEVICE DATA

MICROWAVE LINEAR POWER TRANSISTOR

NPN transistors for common-emitter class-A linear power amplifiers up to 4 GHz. Self-aligned process entirely ion implanted and gold sandwich metallization ensure an optimum temperature profile, excellent performance and reliability.

A miniature ceramic encapsulation is used for compatibility with stripline microwave circuits.

LAE4001RA is tested on RF parameters by sampling.

QUICK REFERENCE DATA

RF performance up to T_{case} = 25 °C in a common-emitter class-A circuit

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} mW	G_{po} dB	z_i Ω	Z_L Ω
CW; linear amplifier	4	15	25	> 85	> 8.5	typ. 7 + j22	typ. 10 + j38

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT100.

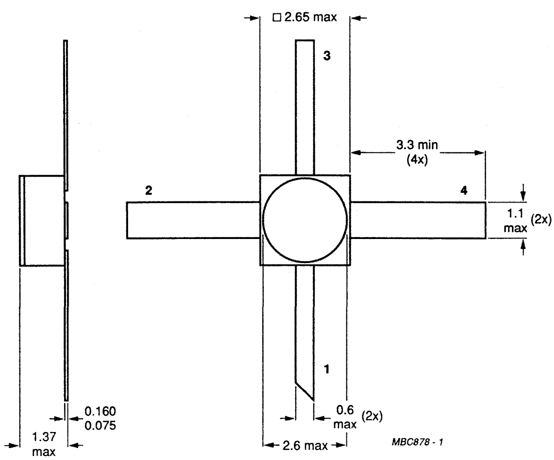
Emitter connected to metallized lid

Marking code

R8 = LAE4001R

Pinning :

1 = collector
2 = emitter
3 = base
4 = emitter



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134).

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage				
(R_{BE} = 220 Ω)	V_{CER}	max.	25	V
(open base)	V_{CEO}	max.	16	V
Emitter-base voltage (open collector)	V_{EBO}	max.	2	V
Collector current (DC)	I_C	max.	80	mA
Total power dissipation up to T_{case} = 100 °C	P_{tot}	max.	480	mW
Storage temperature	T_{stg}	–65 to +200		°C
Junction temperature	T_j	max.	200	°C
Lead soldering temperature at 0.1 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	°C

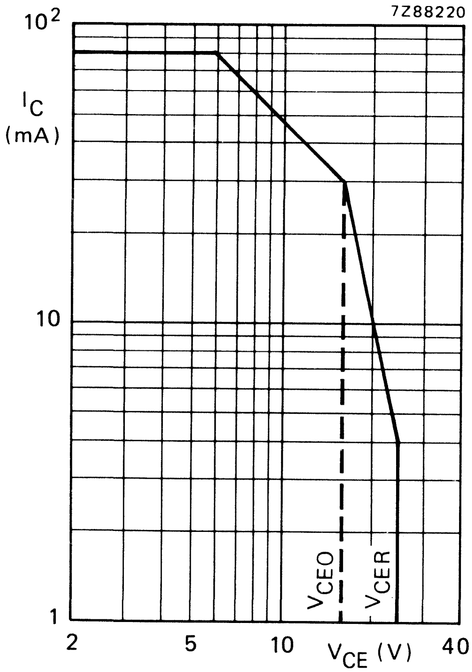


Fig. 2 DC SOAR at $T_{case} \leqslant 100$ °C; $R_{BE} < 220$ Ω.

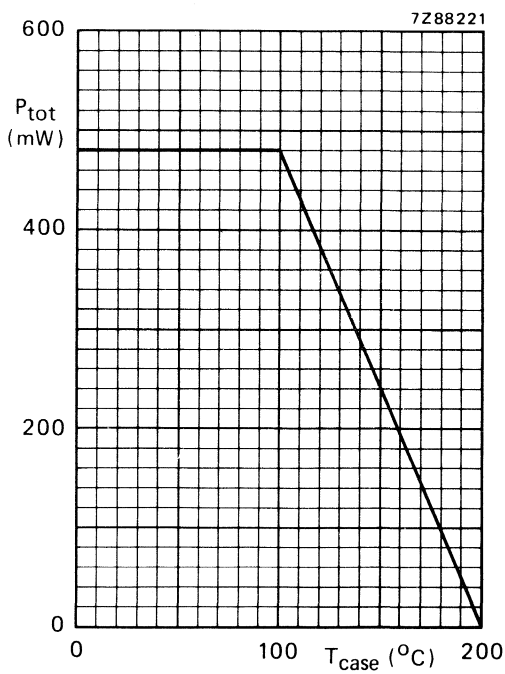


Fig. 3 Power derating curve vs. temperature.

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to case $R_{th\,j\text{-}c}$ max. 210 K/W*

*K/W is SI unit for °C/W.

CHARACTERISTICS

$T_{case} = 25\,^{o}C$

Collector cut-off current				
$I_E = 0$; $V_{CB} = 15$ V	I_{CBO}	<	100	nA
$I_E = 0$; $V_{CB} = 30$ V	I_{CBO}	<	100	μA
$V_{CB} = 25$ V; $R_{BE} = 220\ \Omega$	I_{CER}	<	500	μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 1{,}5$ V	I_{EBO}	<	35	nA
DC current gain				
$I_C = 25$ mA; $V_{CE} = 5$ V	h_{FE}		20 to 220	
Collector-base capacitance at f = 1 MHz				
$I_E = I_C = 0$; $V_{CB} = 15$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	0.25	pF
Collector-emitter capacitance at f = 1 MHz				
$I_E = I_C = 0$; $V_{CE} = 15$; $V_{EB} = 1.5$ V	C_{ce}	typ.	0.5	pF
Emitter-base capacitance at f = 1 MHz				
$I_E = I_C = 0$; $V_{EB} = 1.0$ V; $V_{CB} = 15$ V	C_{eb}	typ.	1.3	pF
Forward power gain				
$I_C = 25$ mA; $V_{CE} = 15$ V; f = 2 GHz	$\lvert s_{fe}\rvert^2$	typ.	9.6	dB
$I_C = 25$ mA; $V_{CE} = 15$ V; f = 4 GHz	$\lvert s_{fe}\rvert^2$	typ.	3.8	dB
Maximum available gain				
$I_C = 25$ mA; $V_{CE} = 15$ V; f = 2 GHz	G_{AM}	typ.	16	dB
$I_C = 25$ mA; $V_{CE} = 15$ V; f = 4 GHz	G_{AM}	typ.	10	dB

s-parameters (common emitter)

Typical values; V_{CE} = 15 V; I_C = 25 mA; T_{case} = 25 °C; Z_o = 50 Ω

f MHz	s_{ie}	s_{re}	s_{fe}	s_{oe}
500	0,63/−165°	0,014(−37,1)/47°	10,7 (20,6)/ 101°	0,59/− 28°
600	0,64/−171°	0,015(−36,2)/47°	9,01(19,1)/ 96°	0,58/− 29°
700	0,65/−177°	0,018(−35,1)/47°	8,03(18,1)/ 89°	0,56/− 30°
800	0,65/ 180°	0,019(−34,5)/47°	7,08(17,0)/ 84°	0,55/− 31°
900	0,65/ 176°	0,021(−33,7)/48°	6,31(16,0)/ 80°	0,54/− 32°
1000	0,66/ 172°	0,023(−32,9)/49°	5,75(15,2)/ 76°	0,53/− 34°
1200	0,67/ 167°	0,026(−31,8)/50°	4,85(13,7)/ 69°	0,53/− 37°
1400	0,67/ 163°	0,030(−30,5)/50°	4,17(12,4)/ 62°	0,52/− 41°
1600	0,67/ 155°	0,034(−29,3)/50°	3,67(11,3)/ 56°	0,52/− 44°
1800	0,67/ 150°	0,038(−28,4)/51°	3,31(10,4)/ 50°	0,52/− 49°
2000	0,68/ 146°	0,043(−27,4)/50°	3,02(9,6)/ 45°	0,52/− 53°
2500	0,70/ 134°	0,053(−25,5)/47°	2,46(7,8)/ 31°	0,52/− 64°
3000	0,72/ 123°	0,064(−23,9)/43°	2,05(6,2)/ 18°	0,51/− 76°
3500	0,74/ 113°	0,075(−22,5)/38°	1,76(4,9)/ 3°	0,50/− 90°
4000	0,76/ 104°	0,085(−21,4)/33°	1,55(3,8)/ −11°	0,50/−105°
4500	0,77/ 95°	0,095(−20,4)/26°	1,37(2,7)/ −23°	0,51/−123°
5000	0,79/ 88°	0,107(−19,4)/19°	1,19(1,5)/ −35°	0,52/−141°
5500	0,80/ 81°	0,120(−18,4)/12°	1,06(0,5)/ −48°	0,57/−158°
6000	0,80/ 75°	0,133(−17,5)/ 6°	0,96(−0,4)/ −60°	0,62/−173°

The figures given between brackets are values in dB.

APPLICATION INFORMATION

RF performance up to T_{case} = 25 °C in a common-emitter class-A circuit*

mode of operation	f GHz	V_{CE}(1) V	I_C(1) mA	P_{L1}(2) mW(dBm)	G_{po}(3) dB	z_i Ω	Z_L Ω
CW; linear amplifier	4	15	25	> 85(19.3) typ. 110(20.4)	> 8.5 typ. 9.5	typ.7+j22	typ.10+j38

Notes

1 I_C and V_{CE} regulated.
2 Load power for 1 dB compressed power gain.
3 Low-level power gain associated with P_{L1}.

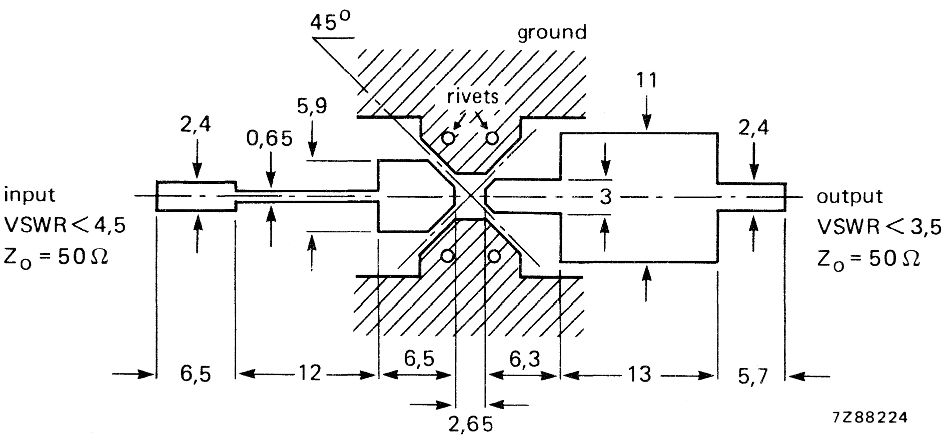


Fig. 4 Prematching test circuit board for 4 GHz. (Dimensions in mm.)

Striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric (ϵ_r = 2.54); thickness 0.8 mm.

* Circuit consists of prematching circuit board in combination with input and output slug tuners.

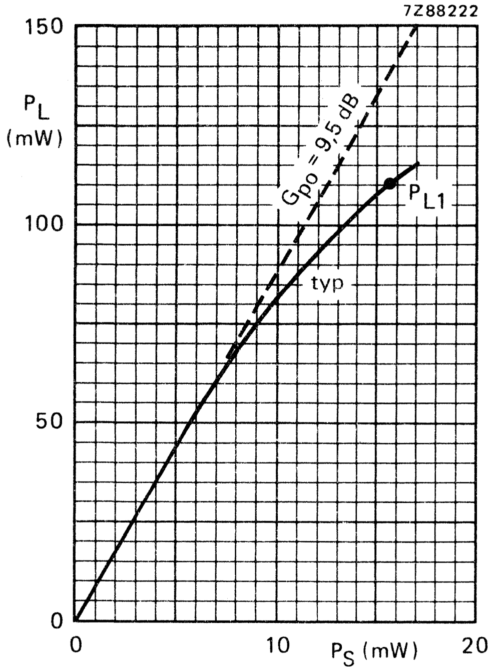


Fig. 5 V_{CE} = 15 V; I_C = 25 mA; f = 4 GHz; T_{case} = 25 °C.

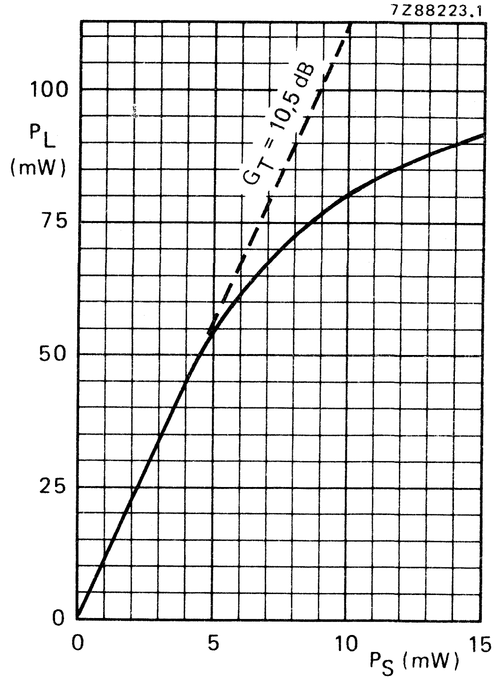


Fig. 6 V_{CE} = 15 V; I_C = 25 mA; f = 4 GHz; maximum low-level linear power gain.

MICROWAVE LINEAR POWER TRANSISTOR

NPN transistor for common-emitter class-A linear power amplifiers up to 4 GHz. Diffused emitter ballasting resistors, self-aligned process entirely ion implanted and gold sandwich metallization ensure an optimum temperature profile, excellent performance and reliability.

A miniature ceramic encapsulation is used for compatibility with stripline microwave circuits.

QUICK REFERENCE DATA

RF performance up to T_{case} = 25 °C in a common-emitter class-A circuit

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} mW	G_{po} dB	z_i Ω	Z_L Ω
CW; linear amplifier	4	18	30	> 126	> 7.5	typ. 4 + j23	typ. 6.5 + j32

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT100.

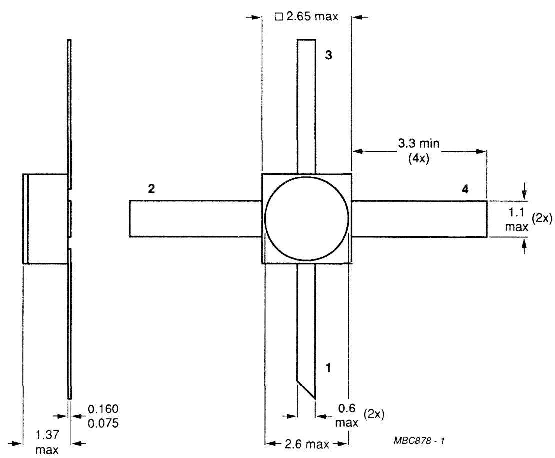
Emitter connected to metallized lid

Marking code:

R9 = LAE4002S

Pinning :

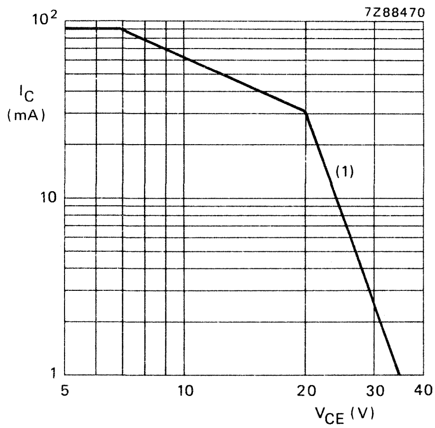
1 = collector
2 = emitter
3 = base
4 = emitter



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage				
(R_{BE} = 220 Ω)	V_{CER}	max.	35	V
(open base)	V_{CEO}	max.	16	V
Emitter-base voltage (open collector)	V_{EBO}	max.	3	V
Collector current (DC)	I_C	max.	90	mA
Total power dissipation up to T_{case} = 75 °C	P_{tot}	max.	625	mW
Storage temperature	T_{stg}	−65 to + 200		°C
Junction temperature	T_j	max.	200	°C
Lead soldering temperature at 0.1 mm from the case; $t_{sld} \leqslant$ 10 s	T_{sld}	max.	235	°C



(1) Second breakdown limit (independent of temperature).

Fig. 2 DC SOAR at $T_{case} \leqslant$ 75 °C; R_{BE} < 220 Ω.

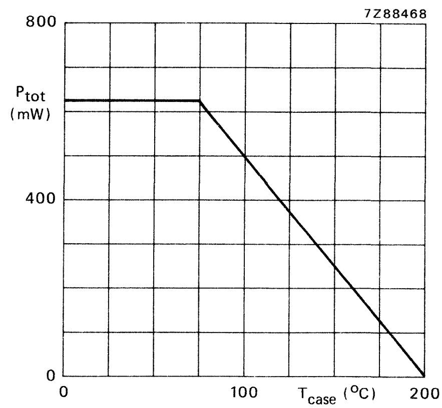


Fig. 3 Power derating curve vs. temperature.

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to case	$R_{th\ j\text{-}c}$	max.	200	K/W*

* K/W is SI unit for °C/W.

CHARACTERISTICS

T_{case} = 25 °C

Collector cut-off current			
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	100 nA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	<	150 μA
$V_{CB} = 35$ V; $R_{BE} = 220\ \Omega$	I_{CER}	<	500 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	<	50 nA
DC current gain			
$I_C = 30$ mA; $V_{CE} = 5$ V	h_{FE}		15 to 150
Collector-base capacitance at f = 1 MHz			
$I_E = I_C = 0$; $V_{CB} = 18$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	0.3 pF
Collector-emitter capacitance at f = 1 MHz			
$I_E = I_C = 0$; $V_{CE} = 18$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	0.55 pF
Emitter-base capacitance at f = 1 MHz			
$I_E = I_C = 0$; $V_{EB} = 1.0$ V; $V_{CB} = 18$ V	C_{eb}	typ.	1.8 pF
Forward power gain			
$I_C = 30$ mA; $V_{CE} = 18$ V; f = 2 GHz	$\lvert s_{fe} \rvert^2$	typ.	8.8 dB
$I_C = 30$ mA; $V_{CE} = 18$ V; f = 4 GHz	$\lvert s_{fe} \rvert^2$	typ.	2.8 dB
Maximum available gain			
$I_C = 30$ mA; $V_{CE} = 18$ V; f = 2 GHz	G_{AM}	typ.	14 dB
$I_C = 30$ mA; $V_{CE} = 18$ V; f = 3 GHz	G_{AM}	typ.	11 dB

s-parameters (common emitter)

Typical values; V_{CE} = 18 V; I_C = 30 mA; T_{case} = 25 ^oC; Z_o = 50 Ω

f MHz	s_{ie}	s_{re}	s_{fe}	s_{oe}
500	0,63/−153°	0,023(−32,7)/38°	9,89(19,9)/ 98°	0,55/ −34°
600	0,63/−161°	0,024(−32,2)/38°	8,22(18,3)/ 94°	0,53/ −35°
700	0,63/−168°	0,026(−31,6)/38°	7,33(17,3)/ 87°	0,51/ −36°
800	0,64/−173°	0,028(−30,9)/38°	6,46(16,2)/ 82°	0,50/ −37°
900	0,64/−177°	0,030(−30,4)/38°	5,82(15,3)/ 78°	0,50/ −38°
1000	0,64/ 179°	0,032(−29,9)/40°	5,25(14,4)/ 74°	0,49/ −40°
1200	0,64/ 172°	0,035(−29,0)/40°	4,47(13,0)/ 66°	0,48/ −44°
1400	0,65/ 165°	0,039(−28,1)/41°	3,80(11,6)/ 59°	0,48/ −49°
1600	0,65/ 159°	0,044(−27,1)/41°	3,35(10,5)/ 52°	0,48/ −53°
1800	0,65/ 154°	0,048(−26,3)/41°	3,02(9,6)/ 46°	0,48/ −59°
2000	0,66/ 147°	0,053(−25,5)/40°	2,75(8,8)/ 40°	0,48/ −64°
2500	0,67/ 134°	0,064(−23,9)/37°	2,24(7,0)/ 25°	0,48/ −77°
3000	0,70/ 122°	0,076(−22,4)/33°	1,84(5,3)/ 11°	0,48/ −91°
3500	0,71/ 111°	0,088(−21,1)/28°	1,58(4,0)/ −4°	0,48/−108°
4000	0,73/ 101°	0,101(−19,9)/22°	1,38(2,8)/−12°	0,50/−125°
4500	0,75/ 92°	0,112(−19,0)/16°	1,21(1,7)/−32°	0,52/−143°
5000	0,76/ 85°	0,125(−18,1)/ 8°	1,05(0,4)/−45°	0,56/−161°
5500	0,77/ 78°	0,138(−17,2)/ 2°	0,92(−0,7)/−58°	0,61/−178°
6000	0,77/ 71°	0,150(−16,5)/−4°	0,81(−1,8)/−69°	0,67/ 168°

Typical values; V_{CE} = 15 V; I_C = 15 mA; T_{case} = 25 ^oC; Z_o = 50 Ω

f MHz	s_{ie}	s_{re}	s_{fe}	s_{oe}
500	0,63/−145°	0,030(−30,5)/36°	9,22(19,3)/103°	0,58/ −38°
600	0,63/−154°	0,031(−30,1)/35°	7,76(17,8)/ 97°	0,56/ −39°
700	0,63/−161°	0,033(−29,6)/33°	6,92(16,8)/ 90°	0,52/ −40°
800	0,64/−167°	0,035(−29,2)/33°	6,16(15,8)/ 85°	0,51/ −41°
900	0,64/−172°	0,036(−28,8)/32°	5,56(14,9)/ 81°	0,50/ −42°
1000	0,64/−177°	0,038(−28,4)/32°	5,01(14,0)/ 76°	0,49/ −44°
1200	0,65/ 176°	0,041(−27,8)/33°	4,26(12,6)/ 68°	0,48/ −48°
1400	0,65/ 170°	0,045(−27,0)/36°	3,67(11,3)/ 61°	0,47/ −53°
1600	0,65/ 162°	0,048(−26,3)/34°	3,23(10,2)/ 55°	0,47/ −57°
1800	0,65/ 157°	0,052(−25,7)/35°	2,92(9,3)/ 48°	0,47/ −63°
2000	0,66/ 149°	0,056(−25,0)/33°	2,66(8,5)/ 42°	0,47/ −67°
2500	0,67/ 136°	0,066(−23,6)/32°	2,14(6,6)/ 26°	0,47/ −80°
3000	0,69/ 124°	0,076(−22,3)/28°	1,78(5,0)/ 12°	0,47/ −95°
3500	0,71/ 112°	0,089(−21,0)/24°	1,53(3,7)/ −2°	0,47/−112°
4000	0,73/ 102°	0,100(−20,0)/20°	1,29(2,2)/−17°	0,49/−130°
4500	0,75/ 93°	0,112(−19,0)/13°	1,16(1,3)/−31°	0,52/−148°
5000	0,76/ 86°	0,125(−18,1)/ 6°	1,01(0,1)/−43°	0,56/−166°
5500	0,77/ 78°	0,136(−17,3)/ 0°	0,88(−1,1)/−56°	0,61/−177°
6000	0,77/ 72°	0,148(−16,6)/−7°	0,79(−2,1)/−67°	0,67/ 168°

The figures given between brackets are values in dB.

s-parameters (common emitter)

Typical values; V_{CE} = 18 V; I_C = 10 mA; T_{case} = 25 °C; Z_o = 50 Ω

f MHz	s_{ie}	s_{re}	s_{fe}	s_{oe}
500	0,65/–135°	0,032(–29,8)/34°	8,41(18,5)/105°	0,64/ –34°
600	0,65/–147°	0,033(–29,5)/33°	7,16(17,1)/100°	0,62/ –36°
700	0,65/–154°	0,036(–28,9)/30°	6,46(16,2)/ 92°	0,59/ –37°
800	0,65/–161°	0,037(–28,6)/29°	5,68(15,1)/ 87°	0,57/ –38°
900	0,65/–166°	0,038(–28,3)/28°	5,13(14,2)/ 82°	0,56/ –40°
1000	0,65/–172°	0,040(–28,0)/28°	4,68(13,4)/ 78°	0,55/ –42°
1200	0,65/ 180°	0,042(–27,5)/29°	3,98(12,0)/ 69°	0,54/ –46°
1400	0,65/ 174°	0,045(–27,0)/29°	3,43(10,7)/ 62°	0,53/ –50°
1600	0,65/ 165°	0,048(–26,4)/29°	3,06(9,7)/ 55°	0,53/ –55°
1800	0,66/ 159°	0,051(–25,9)/30°	2,75(8,8)/ 48°	0,53/ –61°
2000	0,67/ 152°	0,054(–25,4)/30°	2,49(7,9)/ 42°	0,53/ –65°
2500	0,68/ 138°	0,063(–24,1)/29°	2,02(6,1)/ 25°	0,53/ –78°
3000	0,69/ 125°	0,072(–22,8)/27°	1,67(4,5)/ 12°	0,52/ –93°
3500	0,71/ 114°	0,083(–21,6)/24°	1,44(3,2)/ –4°	0,53/–109°
4000	0,74/ 103°	0,095(–20,4)/20°	1,26(2,0)/–19°	0,55/–127°
4500	0,75/ 94°	0,106(–19,5)/14°	1,10(0,8)/–32°	0,57/–145°
5000	0,76/ 86°	0,118(–18,6)/ 7°	0,94(–0,5)/–44°	0,61/–163°
5500	0,77/ 79°	0,132(–17,6)/ 0°	0,83(–1,7)/–57°	0,65/–179°
6000	0,77/ 72°	0,145(–16,8)/–6°	0,72(–2,8)/–68°	0,71/ 168°

The figures given between brackets are values in dB.

APPLICATION INFORMATION

RF performance up to T_{case} = 25 °C in a common-emitter class-A circuit*

mode of operation	f GHz	V_{CE}(1) V	I_C(1) mA	P_{L1}(2) mW(dBm)	G_{po}(3) dB	z_i Ω	Z_L Ω
CW; linear amplifier	4	18	30	> 126(21) typ. 160(22)	> 7.5 typ. 8.0	typ. 4 + j23	typ. 6.5 + j32

Notes

1. I_C and V_{CE} regulated.
2. Load power for 1 dB compressed power gain.
3. Low-level power gain associated with P_{L1}.

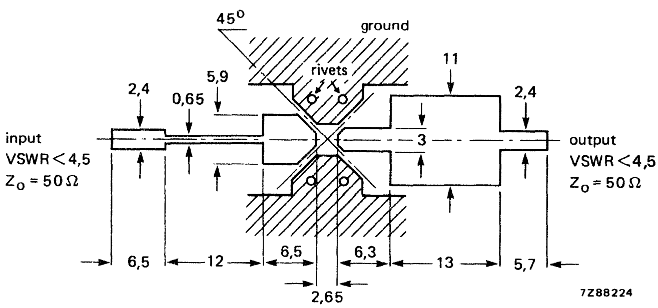


Fig. 4 Prematching test circuit board for 4 GHz. (Dimensions in mm.)

Striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric (ϵ_r = 2.54); thickness 0.8 mm.

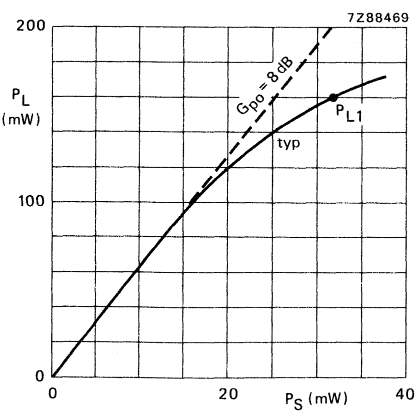


Fig. 5 V_{CE} = 18 V; I_C = 30 mA; f = 4 GHz; T_{case} = 25 °C.

* Circuit consists of prematching circuit board in combination with input and output slug tuners.

MICROWAVE LINEAR POWER TRANSISTORS

NPN transistors for use in a common-emitter class-A linear power amplifier up to 4 GHz.

Diffused emitter ballasting resistors, self-aligned process entirely ion implanted and gold metallization ensure an optimum temperature profile, excellent performance and reliability.

The **LBE2003S** and **LBE2009S** have a metal ceramic studless envelope.
The **LCE2003S** and **LCE2009S** have a metal ceramic capstan envelope.
The **LBE2009SA** and **LCE2009SA** are tested by sampling on RF parameters.

QUICK REFERENCE DATA

RF performance up to T_{mb} = 25 °C in a common-emitter class-A circuit

type number	mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} mW	G_{po} dB	z_i Ω	Z_L Ω
LBE/LCE2003S	CW; linear amplifier	2	18	30	⩾ 200	⩾ 10	6.2 + j30	17.5 + j7
LBE/LCE2009S	CW; linear amplifier	2	18	110	⩾ 700	⩾ 9	7.5 + j15	17.5 + j39

MECHANICAL DATA

Dimensions in mm

Fig.1a **LBE2003S** and **LBE2009S.**

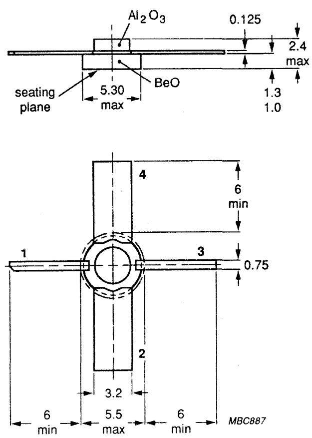
FO-45

Marking code:

407 = LBE2003S
409 = LBE2009S
445 = LBE2009SA

Pinning:

1 = collector
2 = emitter
3 = base
4 = emitter



WARNING

Product and environmental safety — toxic materials
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 general industrial or domestic waste.**

MECHANICAL DATA (continued)

Fig. 1b **LCE2003S** and **LCE2009S.**

FO-46

Dimensions in mm

Marking code:

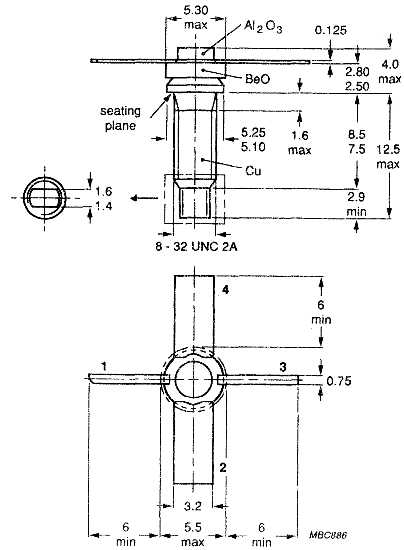
406 = LCE2003S
408 = LCE2009S
446 = LCE2009SA

Torque on nut: min. 0.75 Nm
max. 0.85 Nm

Diameter of clearance hole in heatsink: max. 4.2 mm.

Pinning:

1 = collector
2 = emitter
3 = base
4 = emitter

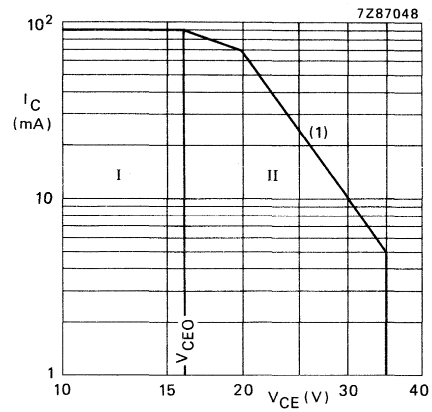


RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			LBE/LCE 2003S	LBE/LCE 2009S	
Collector-base voltage (open emitter)	V_{CBO}	max.	40	40	V
Collector-emitter voltage R_{BE} = 100 Ω	V_{CER}	max.	–	35	V
R_{BE} = 220 Ω	V_{CER}	max.	35	–	V
(open base)	V_{CEO}	max.	16	16	V
Emitter-base voltage (open collector)	V_{EBO}	max.	3	3	V
Collector current (DC)	I_C	max.	90	250	mA
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	1.4	3.5	W
Storage temperature	T_{stg}		−65 to + 150		°C
Operating junction temperature	T_j	max.	200		°C
Lead soldering temperature at 0.3 mm from the case; t_{sld} = 10 s	T_{sld}	max.	235		°C

LBE/LCE2003S



(1) Second breakdown limit
(independent of temperature).

Fig. 2 DC SOAR at $T_{mb} \leqslant 75\ ^{o}C$.

I Region of permissible DC operation.
II Permissible extension provided $R_{BE} \leqslant 220\ \Omega$.

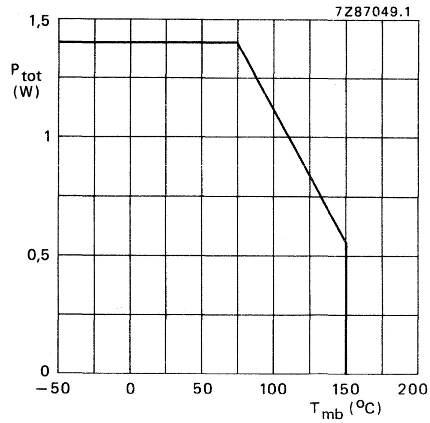
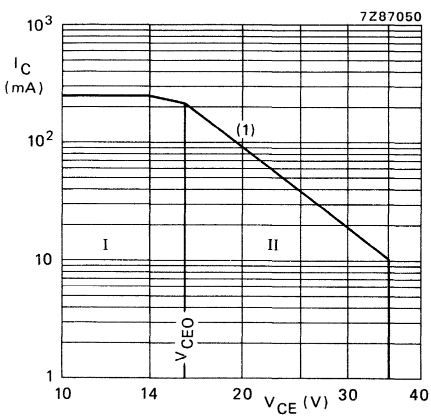


Fig. 3 Power derating curve vs. mounting base temperature.

LBE/LCE2009S



(1) Second breakdown limit
(independent of temperature).

Fig. 4 DC SOAR at $T_{mb} \leqslant 75\ ^{o}C$.

I Region of permissible DC operation.
II Permissible extension provided $R_{BE} \leqslant 100\ \Omega$.

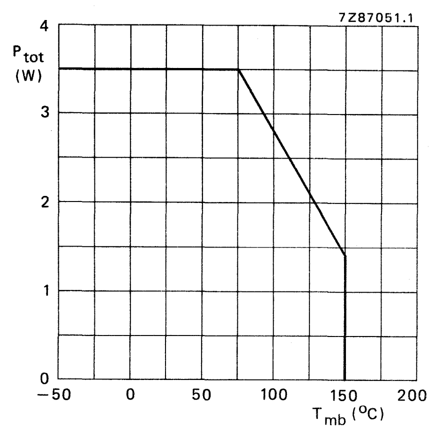


Fig. 5 Power derating curve vs. mounting base temperature.

THERMAL RESISTANCE (at T_j = 75 °C)

			LBE/LCE 2003S	LBE/LCE 2009S	
From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	65	36	K/W*
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	1.5	1.5	K/W*

CHARACTERISTICS

T_{mb} = 25 °C

			LBE/LCE 2003S	LBE/LCE 2009S	
Collector cut-off current					
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	0.1	0.1	μA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	<	150	250	μA
$V_{CB} = 35$ V; $R_{BE} = 220\ \Omega$	I_{CER}	<	500	–	μA
$V_{CB} = 35$ V; $R_{BE} = 100\ \Omega$	I_{CER}	<	–	1000	μA
Emitter cut-off current					
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	<	0.05	0.2	μA
DC current gain					
$I_C = 30$ mA; $V_{CE} = 5$ V	h_{FE}	>	15	–	
		<	150	–	
$I_C = 110$ mA; $V_{CE} = 5$ V	h_{FE}	>	–	15	
		<	–	150	
Collector-base capacitance at f = 1 MHz					
$I_E = I_C = 0$; $V_{CB} = 18$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	0.3	0.6	pF
Collector-emitter capacitance at f = 1 MHz					
$I_E = I_C = 0$; $V_{CE} = 18$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	0.45	0.6	pF
Emitter-base capacitance at f = 1 MHz					
$I_E = I_C = 0$; $V_{EB} = 1$ V; $V_{CB} = 10$ V	C_{eb}	typ.	1.7	3.3	pF

* K/W is SI unit for °C/W.

s-parameters (common emitter)

LBE/LCE2003S: Typical values; V_{CE} = 18 V*; I_C = 30 mA*; T_{mb} = 25 °C; Z_o = 50 Ω

f GHz	s_{ie}	s_{re}	s_{fe}	s_{oe}
0,5	0,56/−143°	0,037(−28,6)/ 41°	9,50(19,6)/101°	0,56/ −34°
0,6	0,55/−154°	0,040(−28,0)/ 39°	8,28(18,4)/ 93°	0,51/ −35°
0,7	0,55/−164°	0,040(−27,9)/ 40°	7,13(17,1)/ 88°	0,50/ −36°
0,8	0,55/−171°	0,041(−27,7)/ 40°	6,35(16,1)/ 82°	0,49/ −37°
0,9	0,55/−178°	0,043(−27,4)/ 41°	5,69(15,1)/ 77°	0,47/ −38°
1,0	0,55/+176°	0,045(−26,9)/ 40°	5,14(14,2)/ 72°	0,46/ −39°
1,1	0,55/+170°	0,048(−26,4)/ 40°	4,72(13,5)/ 68°	0,46/ −39°
1,2	0,55/+165°	0,051(−25,9)/ 41°	4,37(12,8)/ 64°	0,45/ −41°
1,3	0,56/+159°	0,056(−25,1)/ 41°	4,05(12,2)/ 60°	0,44/ −44°
1,4	0,55/+158°	0,060(−24,5)/ 41°	3,76(11,5)/ 57°	0,45/ −46°
1,5	0,55/+149°	0,062(−24,2)/ 40°	3,52(10,9)/ 53°	0,43/ −48°
1,6	0,55/+146°	0,065(−23,8)/ 42°	3,33(10,5)/ 50°	0,43/ −50°
1,7	0,56/+142°	0,068(−23,3)/ 42°	3,15(10,0)/ 46°	0,43/ −53°
1,8	0,57/+137°	0,070(−23,1)/ 41°	2,96(9,4)/ 42°	0,43/ −54°
1,9	0,57/+132°	0,072(−22,9)/ 40°	2,80(8,9)/ 39°	0,43/ −56°
2,0	0,58/+128°	0,074(−22,7)/ 40°	2,66(8,5)/ 36°	0,42/ −57°
2,2	0,60/+121°	0,081(−21,8)/ 39°	2,43(7,7)/ 28°	0,41/ −61°
2,4	0,62/+114°	0,091(−20,8)/ 37°	2,24(7,0)/ 23°	0,40/ −67°
2,6	0,64/+108°	0,099(−20,1)/ 36°	2,08(6,4)/ 16°	0,39/ −75°
2,8	0,66/+102°	0,105(−19,6)/ 33°	1,90(5,6)/ 10°	0,38/ −82°
3,0	0,68/ +96°	0,108(−19,4)/ 31°	1,79(5,1)/ 4°	0,39/ −87°
3,2	0,71/ +92°	0,124(−18,7)/ 29°	1,63(4,3)/ −2°	0,37/ −94°
3,4	0,73/ +89°	0,125(−18,0)/ 27°	1,58(4,0)/ −7°	0,40/−101°
3,6	0,75/ +86°	0,137(−17,3)/ 25°	1,46(3,3)/−13°	0,39/−112°
3,8	0,76/ +82°	0,142(−17,0)/ 23°	1,40(2,9)/−18°	0,38/−120°
4,0	0,77/ +79°	0,149(−16,6)/ 20°	1,31(2,3)/−24°	0,38/−128°
4,2	0,78/ +75°	0,155(−16,2)/ 17°	1,25(1,9)/−28°	0,38/−133°
4,4	0,80/ +73°	0,167(−15,5)/ 15°	1,20(1,6)/−34°	0,39/−142°
4,6	0,81/ +69°	0,177(−15,0)/ 12°	1,14(1,1)/−38°	0,39/−151°
4,8	0,81/ +68°	0,187(−14,6)/ 10°	1,10(0,8)/−43°	0,42/−159°
5,0	0,81/ +65°	0,194(−14,3)/ 6°	1,04(0,4)/−47°	0,44/−165°
5,2	0,80/ +60°	0,203(−13,8)/ 4°	1,03(0,3)/−53°	0,47/−169°
5,4	0,81/ +56°	0,219(−13,2)/ −1°	0,98(−0,2)/−57°	0,48/−175°
5,6	0,81/ +51°	0,229(−12,8)/ −3°	0,97(−0,3)/−62°	0,49/+178°
5,8	0,81/ +48°	0,243(−12,3)/ −8°	0,92(−0,7)/−68°	0,51/+171°
6,0	0,80/ +44°	0,245(−12,2)/−12°	0,90(−0,9)/−72°	0,55/+165°

The figures given between brackets are values in dB.

* V_{CE} and I_C regulated.

s-parameters (common emitter)

LBE/LCE2009S: Typical values; V_{CE} = 18 V*; I_C = 110 mA*; T_{mb} = 25 °C; Z_o = 50 Ω

f GHz	s_{ie}	s_{re}	s_{fe}	s_{oe}
0,5	0,70/177°	0,029(−30,7)/50°	7,55(17,6)/ 83°	0,25/ −48°
0,6	0,70/171°	0,033(−29,6)/51°	6,43(16,2)/ 77°	0,22/ −50°
0,7	0,70/168°	0,036(−29,0)/53°	5,46(14,6)/ 73°	0,23/ −52°
0,8	0,70/163°	0,039(−28,4)/54°	4,80(13,6)/ 68°	0,22/ −54°
0,9	0,71/159°	0,041(−27,8)/54°	4,27(12,6)/ 64°	0,22/ −56°
1,0	0,71/155°	0,045(−27,0)/55°	3,84(11,7)/ 60°	0,21/ −59°
1,1	0,71/151°	0,049(−26,2)/54°	3,53(11,0)/ 56°	0,21/ −62°
1,2	0,71/148°	0,054(−25,4)/54°	3,27/10,3)/ 52°	0,21/ −65°
1,3	0,71/144°	0,060(−24,5)/53°	3,01(9,6)/ 48°	0,20/ −74°
1,4	0,72/143°	0,066(−23,6)/54°	2,80(9,0)/ 45°	0,20/ −79°
1,5	0,72/136°	0,070(−23,1)/52°	2,61(8,3)/ 41°	0,21/ −80°
1,6	0,72/133°	0,075(−22,5)/53°	2,47(7,9)/ 38°	0,21/ −83°
1,7	0,72/130°	0,080(−21,9)/51°	2,33(7,3)/ 34°	0,22/ −87°
1,8	0,73/127°	0,084(−21,5)/49°	2,18(6,8)/ 30°	0,22/ −90°
1,9	0,73/123°	0,087(−21,2)/48°	2,05(6,3)/ 26°	0,22/ −94°
2,0	0,74/120°	0,090(−20,9)/46°	1,97(5,9)/ 23°	0,22/ −97°
2,2	0,75/114°	0,100(−20,0)/43°	1,78(5,0)/ 15°	0,22/−109°
2,4	0,77/108°	0,112(−19,0)/40°	1,63(4,3)/ 10°	0,21/−122°
2,6	0,79/103°	0,123(−18,2)/37°	1;51(3,6)/ 2°	0,24/−133°
2,8	0,80/ 97°	0,129(−17,8)/33°	1,36(2,7)/ −4°	0,25/−143°
3,0	0,81/ 92°	0,134(−17,5)/30°	1,28(2,1)/−11°	0,27/−151°
3,2	0,83/ 88°	0,143(−16,9)/26°	1,15(1,2)/−17°	0,28/−163°
3,4	0,85/ 85°	0,152(−16,4)/24°	1,10(0,9)/−21°	0,30/−173°
3,6	0,86/ 82°	0,163(−15,8)/20°	1,00(0)/−28°	0,34/+178°
3,8	0,87/ 79°	0,168(−15,5)/17°	0,96(−0,4)/−32°	0,37/+173°
4,0	0,88/ 75°	0,175(−15,2)/14°	0,88(−1,1)/−39°	0,41/+168°
4,2	0,88/ 71°	0,180(−14,9)/11°	0,83(−1,6)/−42°	0,42/+162°
4,4	0,89/ 69°	0,193(−14,3)/ 8°	0,79(−2,1)/−48°	0,45/+155°
4,6	0,90/ 66°	0,200(−14,0)/ 5°	0,74(−2,6)/−51°	0,48/+149°
4,8	0,90/ 64°	0,211(−13,5)/ 2°	0,71(−3,0)/−56°	0,52/+145°
5,0	0,90/ 61°	0,214(−13,4)/−2°	0,66(−3,6)/−59°	0,55/+144°

The figures given between brackets are values in dB.

* V_{CE} and I_C regulated.

APPLICATION INFORMATION

Microwave performance in CW operation for the **LBE/LCE2003S** up to T_{mb} = 25 °C in a common-emitter class-A circuit*

f GHz	V_{CE} (1) V	I_C (1) mA	P_{L1} (2) mW(dBm)	G_{po} (3) dB	z_i Ω	Z_L Ω
2	18	30	⩾ 200(23) typ. 250(24)	⩾ 10 typ. 11	6.2 + j30	17.5 + j7

Notes

1. V_{CE} and I_C regulated.
2. Load power for 1 dB compressed power gain.
3. Low-level power gain associated with P_{L1}.

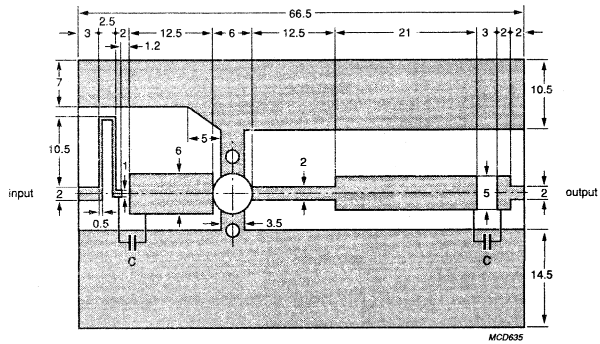


Fig. 6 Prematching test circuit board for 2 GHz. (Dimensions in mm.)

Striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric ($\epsilon_r \approx 2.54$); thickness 0,8 mm.

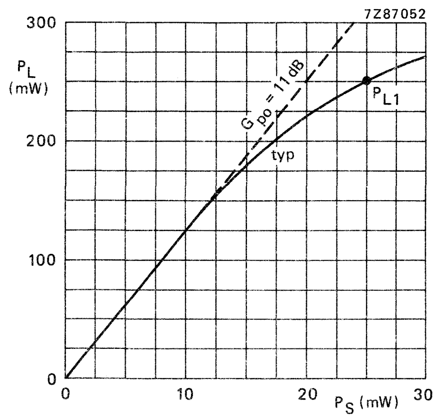


Fig. 7 V_{CE} = 18 V; I_C = 30 mA; f = 2 GHz; T_{mb} = 25 °C.

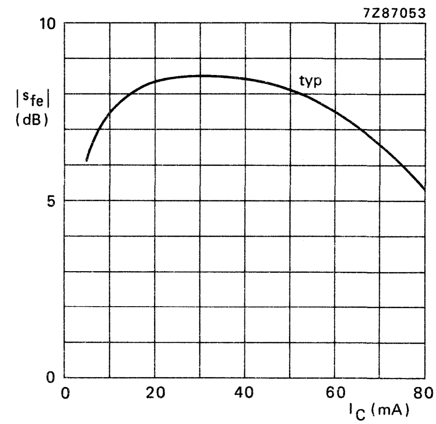


Fig. 8 V_{CE} = 18 V; class-A operation; f = 2 GHz; T_{mb} = 25 °C.

* Circuit consists of prematching circuit board in combination with input and output slug tuners.

APPLICATION INFORMATION

Microwave performance in CW operation for the **LBE/LCE2009S** up to T_{mb} = 75 °C in a common-emitter class-A circuit*

f GHz	V_{CE} (1) V	I_C (1) mA	P_{L1} (2) mW(dBm)	G_{po} (3) dB	z_i Ω	Z_L Ω
2	18	100	⩾ 700(28.5) typ. 900(29.5)	⩾ 9 typ. 9.8	7.5 + j14.5	17.5 + j38.5

Notes

1. V_{CE} and I_C regulated.
2. Load power for 1 dB compressed power gain.
3. Low-level power gain associated with P_{L1}.

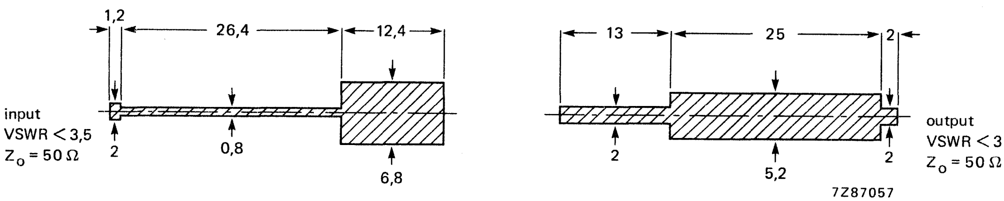


Fig. 9 Prematching test circuit board for 2 GHz. (Dimensions in mm.)

Striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric ($\epsilon_r \approx 2.54$); thickness 0.8 mm.

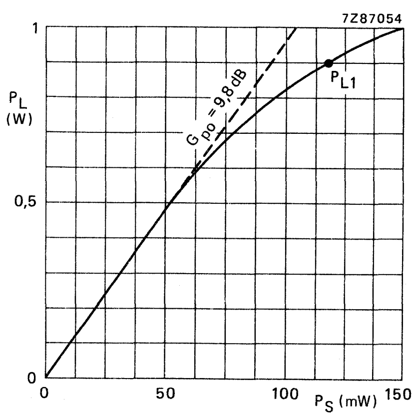


Fig. 10 V_{CE} = 18 V; I_C = 110 mA; f = 2 GHz; T_{mb} = 25 °C.

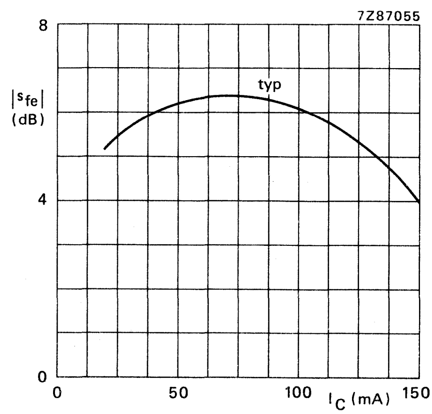


Fig. 11 V_{CE} = 18 V; class-A operation; f = 2 GHz; T_{mb} = 25 °C.

* Circuit consists of prematching circuit board in combination with input and output slug tuners.

NPN silicon planar epitaxial microwave power transistor

LEE1015TA

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.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a SOT122 metal ceramic package.

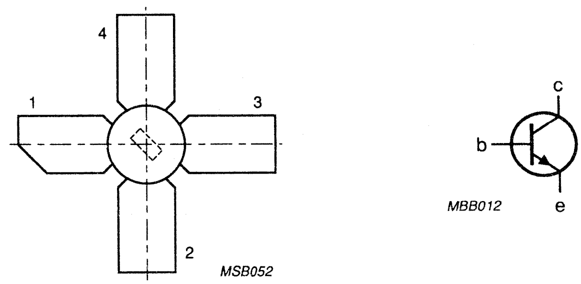
APPLICATIONS

Intended for use in common emitter, class A power amplifiers for applications that require a high level of linearity.

PINNING - SOT122

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

PIN CONFIGURATION



Marking code: 1015T

Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier (guaranteed values).

MODE OF OPERATION	f (MHz)	V_{CE} (V)	I_C (mA)	P_{L1} (W)	G_p (dB)	d_{im} (dB)
class C (CW)	860	20	140	> 1	> 13	<–57 (note 1)

Note

1. The stated intermodulation distortion level is referred to the total output power of 18.25 dB, which corresponds to the sum of the power carried by each of the two equal amplitude tones at f_1 = 859 MHz and f_2 = 861 MHz.

WARNING

Product and environmental safety - toxic materials
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.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CER}	collector-emitter voltage	R_{BE} = 10 Ω	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	22	V
V_{EBO}	emitter-base voltage	open collector	–	3.0	V
I_C	collector current		–	500	mA
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	7.5	W
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.

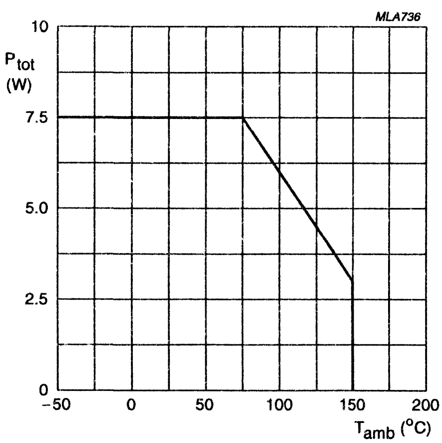
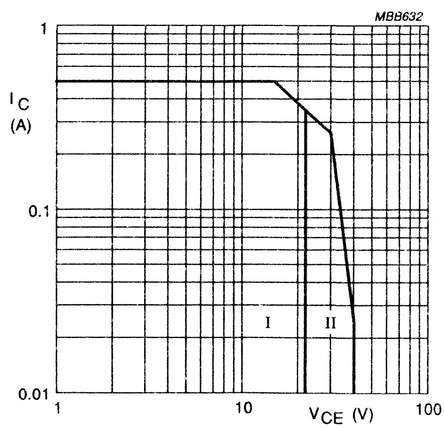


Fig.2 Maximum power dissipation derating as a function of mounting base temperature.



T_{mb} = 75 °C.

I Region of permissible DC operation.

II Possible extension provided R_{BE} = ≤10 Ω.

Fig.3 DC SOAR.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 75 °C	12 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.6 K/W

CHARACTERISTICS

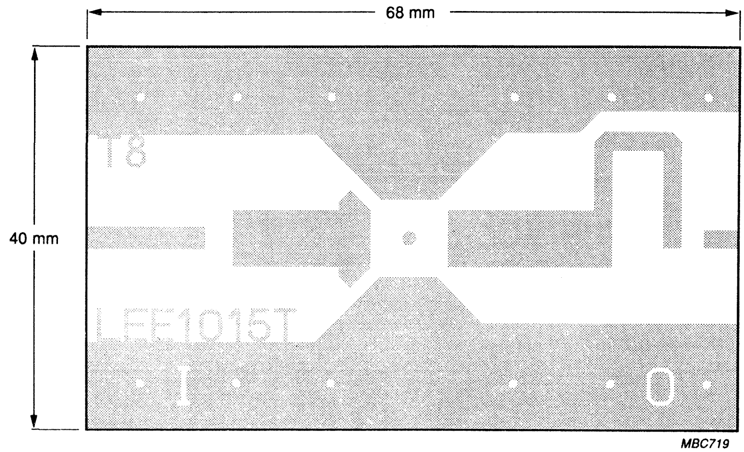
T_{mb} = 25 °C unless otherwise specified

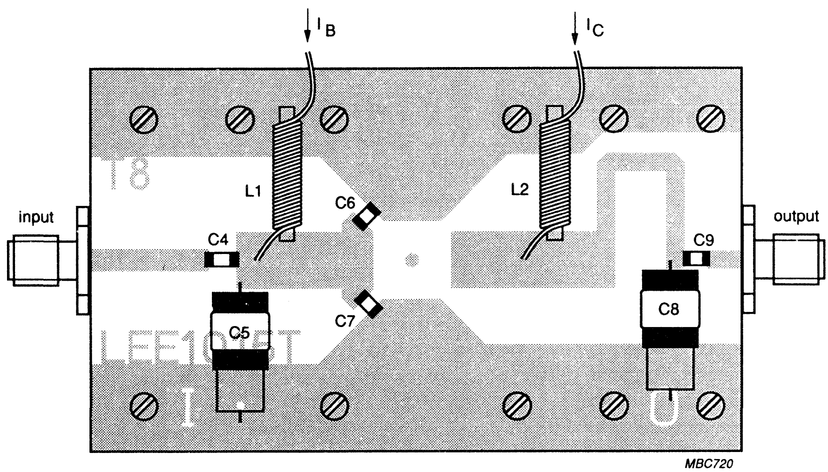
SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 40 V; I_E = 0	400	μA
I_{CER}	collector cut-off current	V_{CE} = 40 V; R_{BE} = 10 Ω	20	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	400	μA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in the test circuit shown in Fig.4

MODE OF OPERATION	f (MHz)	V_{CE} (V)	I_C (mA)	P_{L1} (W)	G_{po} (dB)
class A	860	20	140	> 1.0; typ. 1.3	> 13; typ. 14.5





Dimensions in mm

Fig.4 860 MHz test circuit.

The circuit and the components are situated on the upper side of the PTFE fibreglass board, the other side being fully metallized to serve as ground. Ground connections are made by means of hollow rivets.

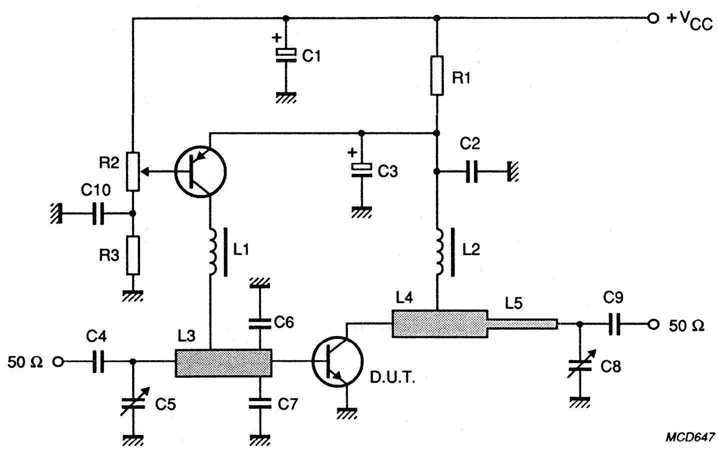


Fig.5 Bias circuit.

List of components (see bias circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1	electrolytic capacitor	10 µF, 63 V		
C2, C10	ceramic capacitor	22 nF		
C3	tantalum capacitor	10 µF, 50 V		AT-3-7-271SL
C4, C9	chip capacitor (note 1)	1000 pF		
C5, C8	tuning capacitor (note 1)	0.8 to 10 pF		
C6, C7	chip capacitor (note 1)	4.7 pF		
L1, L2	Ferroxcube HF choke (note 1)			
L3	micro-stripline (note 2)		6 mm x 15.6 mm	
L4	micro-stripline (note 2)		6 mm x 17 mm	
L5	micro-stripline (note 2)		2.24 mm x 24 mm	
R1	carbon resistor	4.7 Ω, 0.25 W		
R2	carbon potentiometer	10 kΩ	10 turns	
R3	2 x carbon resistors (in parallel)	100 kΩ, 0.25 W		

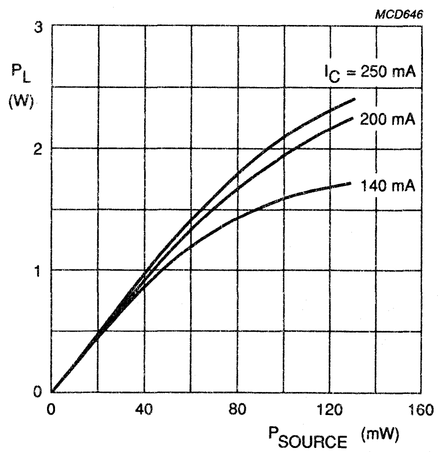
Notes

1. These components are mounted on the 860 MHz test circuit; see Fig.4.
2. L3, L4 and L5 are micro-stripline on a printed circuit board with PTFE fibreglass dielectric.

Common emitter scattering parameters; V_{CE} = 20 V; I_C = 140 mA; T_{case} = 25 °C; Z_O = 50 Ω

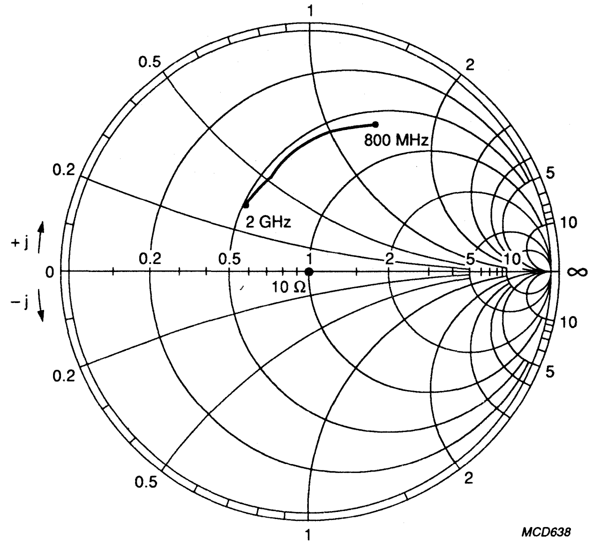
f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	dB	ANG. (DEG)	dB	ANG. (DEG)	dB	ANG. (DEG)	dB	ANG. (DEG)
800	−1.240	167.000	7.900	56.200	−28.200	51.600	−7.200	−155.500
825	−1.252	166.417	7.679	55.283	−28.074	52.058	−7.179	−155.292
850	−1.265	165.833	7.452	54.367	−27.949	52.517	−7.158	−155.083
875	−1.282	165.321	7.213	53.336	−27.739	52.625	−7.117	−154.893
900	−1.301	164.857	6.962	52.229	−27.476	52.500	−7.063	−154.714
925	−1.321	164.393	6.704	51.121	−27.222	52.375	−7.009	−154.536
950	−1.341	163.929	6.438	50.014	−26.975	52.250	−6.956	−154.357
975	−1.360	163.464	6.163	48.907	−26.734	52.125	−6.903	−154.179
1000	−1.380	163.000	5.880	47.800	−26.500	52.000	−6.850	−154.000
1025	−1.395	162.475	5.782	46.818	−26.240	51.698	−6.822	−154.100
1050	−1.409	161.950	5.683	45.835	−25.989	51.395	−6.793	−154.200
1075	−1.424	161.425	5.583	44.853	−25.744	51.093	−6.765	−154.300
1100	−1.438	160.900	5.482	43.870	−25.505	50.790	−6.737	−154.400
1125	−1.453	160.375	5.380	42.888	−25.274	50.488	−6.709	−154.500
1150	−1.467	159.850	5.276	41.905	−25.048	50.185	−6.681	−154.600
1175	−1.482	159.325	5.171	40.923	−24.828	49.883	−6.653	−154.700
1200	−1.497	158.800	5.065	39.940	−24.613	49.580	−6.625	−154.800
1225	−1.511	158.275	4.957	38.958	−24.404	49.278	−6.597	−154.900
1250	−1.526	157.750	4.848	37.975	−24.199	48.975	−6.570	−155.000
1275	−1.541	157.225	4.738	36.993	−23.999	48.673	−6.542	−155.100
1300	−1.556	156.700	4.627	36.010	−23.804	48.370	−6.515	−155.200
1325	−1.570	156.175	4.513	35.028	−23.613	48.068	−6.488	−155.300
1350	−1.585	155.650	4.399	34.045	−23.426	47.765	−6.460	−155.400
1375	−1.600	155.125	4.283	33.063	−23.243	47.463	−6.433	−155.500
1400	−1.615	154.600	4.165	32.080	−23.064	47.160	−6.406	−155.600
1425	−1.630	154.075	4.046	31.098	−22.889	46.858	−6.379	−155.700
1450	−1.645	153.550	3.925	30.115	−22.716	46.555	−6.352	−155.800
1475	−1.660	153.025	3.802	29.133	−22.548	46.253	−6.325	−155.900
1500	−1.675	152.500	3.678	28.150	−22.382	45.950	−6.299	−156.000
1525	−1.690	151.975	3.551	27.168	−22.220	45.648	−6.272	−156.100
1550	−1.705	151.450	3.423	26.185	−22.060	45.345	−6.245	−156.200
1575	−1.720	150.925	3.293	25.203	−21.904	45.043	−6.219	−156.300
1600	−1.735	150.400	3.161	24.220	−21.750	44.740	−6.192	−156.400
1625	−1.750	149.875	3.027	23.238	−21.599	44.438	−6.166	−156.500
1650	−1.765	149.350	2.891	22.255	−21.450	44.135	−6.140	−156.600
1675	−1.780	148.825	2.753	21.273	−21.304	43.833	−6.114	−156.700
1700	−1.796	148.300	2.612	20.290	−21.160	43.530	−6.087	−156.800

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	dB	ANG. (DEG)	dB	ANG. (DEG)	dB	ANG. (DEG)	dB	ANG. (DEG)
1725	−1.811	147.775	2.469	19.307	−21.019	43.228	−6.061	−156.900
1750	−1.826	147.250	2.324	18.325	−20.880	42.925	−6.035	−157.000
1775	−1.841	146.725	2.176	17.343	−20.743	42.623	−6.010	−157.100
1800	−1.857	146.200	2.026	16.360	−20.609	42.320	−5.984	−157.200
1825	−1.872	145.675	1.873	15.378	−20.476	42.018	−5.958	−157.300
1850	−1.887	145.150	1.718	14.395	−20.345	41.715	−5.932	−157.400
1875	−1.903	144.625	1.559	13.412	−20.217	41.413	−5.907	−157.500
1900	−1.918	144.100	1.398	12.430	−20.090	41.110	−5.881	−157.600
1925	−1.934	143.575	1.233	11.448	−19.965	40.808	−5.856	−157.700
1950	−1.949	143.050	1.065	10.465	−19.841	40.505	−5.830	−157.800
1975	−1.964	142.525	0.894	9.483	−19.720	40.203	−5.805	−157.900
2000	−1.980	142.000	0.720	8.500	−19.600	39.900	−5.780	−158.000



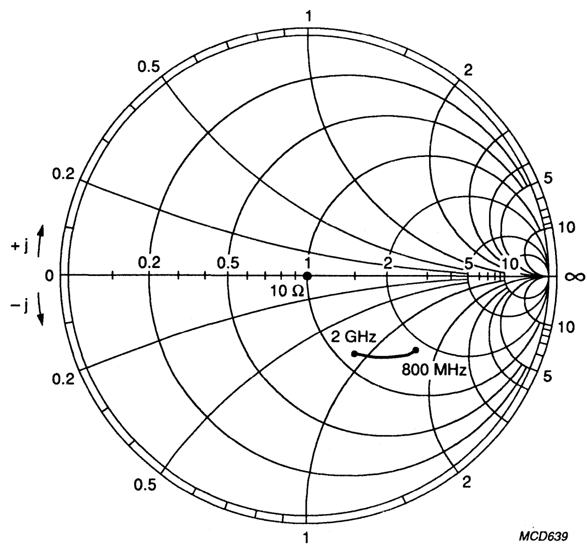
V_{CE} = 20 V; T_{mb} = 25 °C.
In the test circuit as shown in Fig.4.

Fig.6 Load power as a function of source power.



$Z_O = 10\ \Omega$;

Fig.7 Input reflection coefficient (S_{11}).



$Z_O = 10\ \Omega$;

Fig.8 Output reflection coefficient (S_{22}).

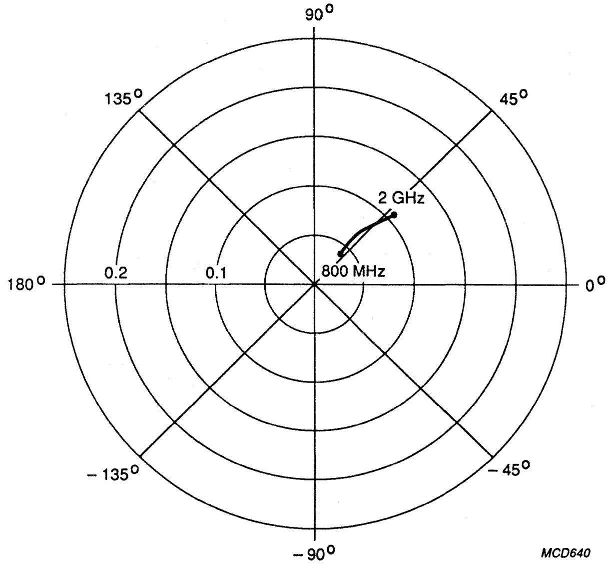


Fig.9 Reverse transmission coefficient (S_{12}).

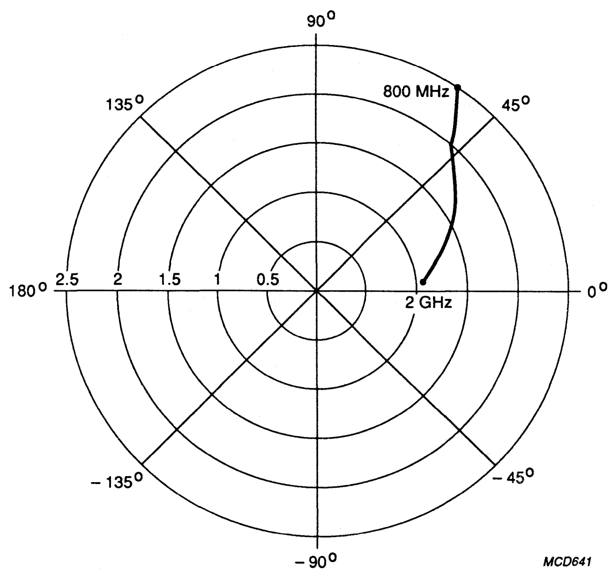


Fig.10 Forward transmission coefficient (S_{21}).

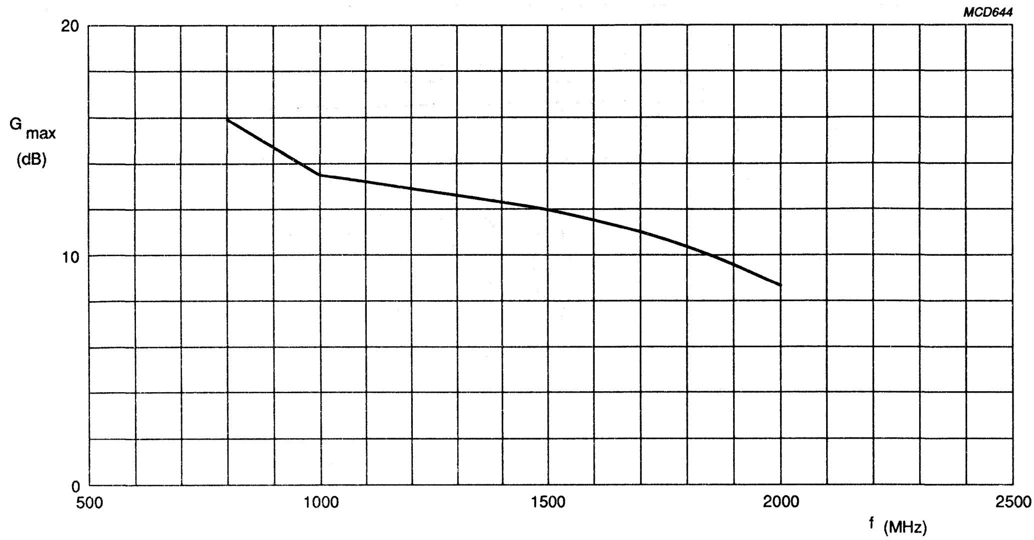
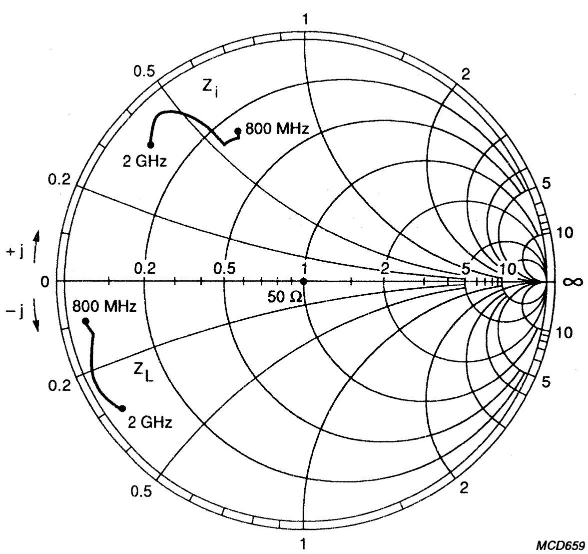


Fig.11 Maximum available gain as a function of frequency.



V_{CE} = 20 V;
I_C = 140 mA;
Z_O = 50 Ω;

Fig.12 Input impedance and optimum output impedance as a function of frequency.

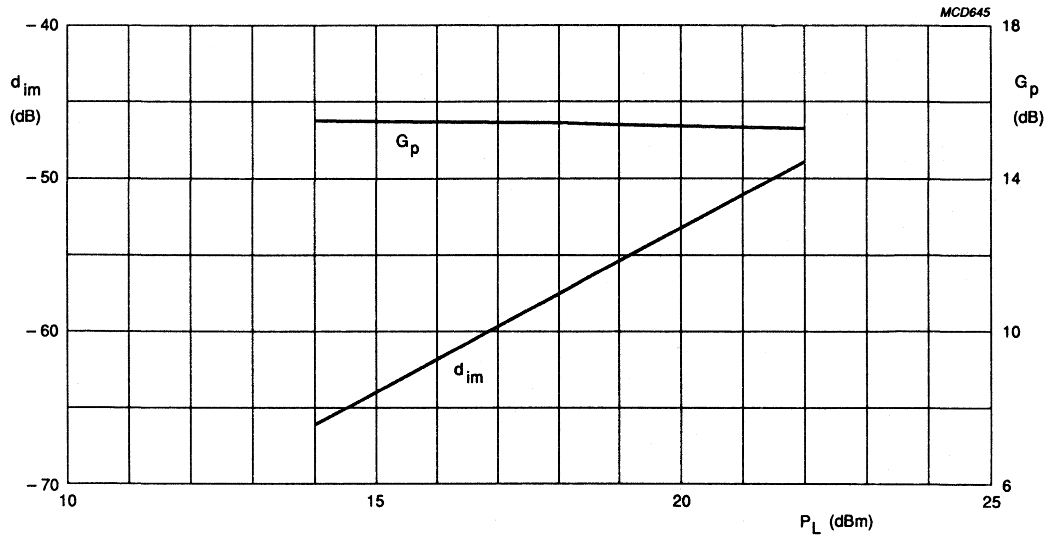


Fig.13 Intermodulation distortion and power gain; typical values.

INTERMODULATION DISTORTION

f (MHz)	V_{CE} (V)	I_C (mA)	P_{OUT} (dBm)	d_{im} (dB)
$f_1 = 859$ $f_2 = 861$	20	140	18.25	<−57 (note 1)

Note

1. The stated intermodulation distortion level is referred to the total output power which corresponds to the sum of the power carried by each of the two equal amplitude tones.

NPN silicon planar epitaxial microwave power transistor

LFE15600X

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 and output prematching ensures good stability and allows an easier design of wideband circuits.

APPLICATIONS

Intended for use in common emitter, class AB amplifiers in CW conditions for professional applications between 1.5 GHz and 1.7 GHz

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-231 glued cap metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i/Z_L (Ω)
class AB (CW)	1.5	24	0.2	≥55	≥8	typ.50	see Figs 7 and 8

PINNING - FO-231

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

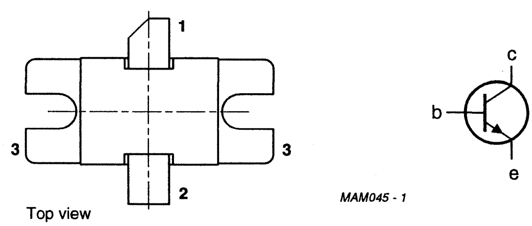


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	$R_{BE} = 56\ \Omega$	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	22	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	12	A
P_i	input power	f = 1.5 GHz; V_{CE} = 24 V; class AB	–	20	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	80	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.

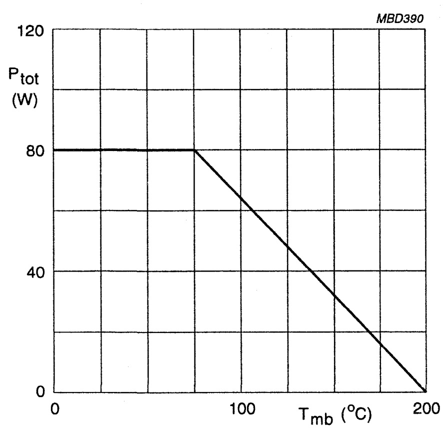


Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	1.2 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2 K/W

CHARACTERISTICS

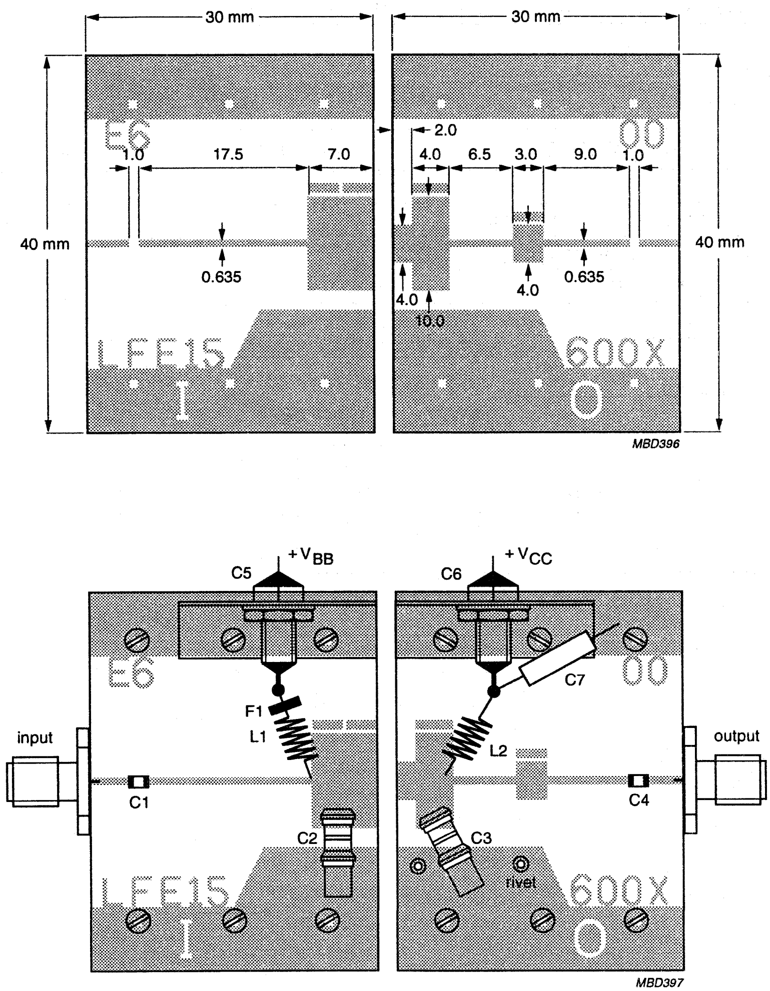
T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB}= 20 V	–	6	mA
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = 30 mA; R_{BE} =56 Ω	30	–	V
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 30 mA	45	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 30 mA	3	–	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	15	100	

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i/Z_L (Ω)
class AB (CW)	1.5	24	0.2	≥ 55 typ. 60	≥ 8 typ. 8.5	typ. 50	see Figs 7 and 8



The test circuit is split into 2 independent halves, each being 30 x 40 mm in size.
Dimensions in mm.
Substrate: Epsilam 10.
Thickness: 0.635 mm.
Permittivity: $\varepsilon_r = 10$.

Fig.3 Prematching test circuit board.

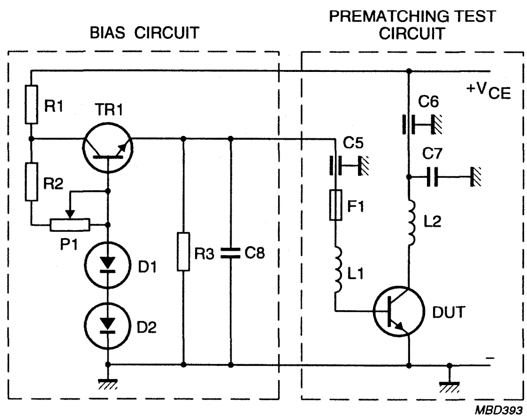


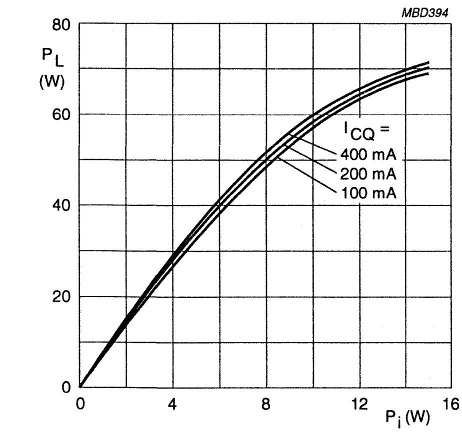
Fig.4 Class AB bias circuit.

List of components (see Figs 3 and 4)

COMPONENT	DESCRIPTION	VALUE	TYPE NUMBERS
TR1	transistor		BDT91 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
C5, C6	feedthrough bypass capacitor	1500 pF	Erie, ref. 1250-003
C7, C8	tantalum capacitor	10 μF, 50 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	3 turns 0.5 mm copper wire; internal diameter = 2 mm		
P1	linear potentiometer	4.7 kΩ	
R1	resistor	100 Ω, 0.25 W	
R2	resistor	10 kΩ, 0.25 W	
R3	resistor	50 Ω, 0.25 W	
F1	ferrite bead		Philips tube 3.7 x 1.2 x 3.5 mm (3B)

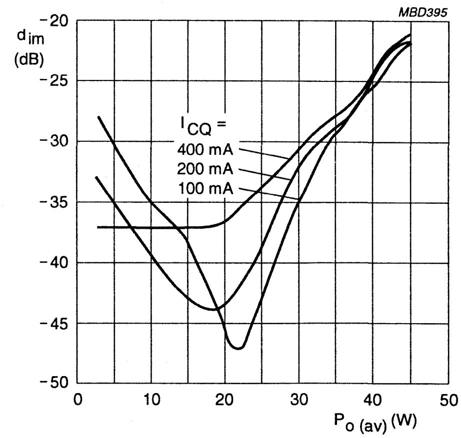
Notes

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



V_{CE} = 24 V; f = 1500 MHz.

Fig.5 Load power as a function of input power.



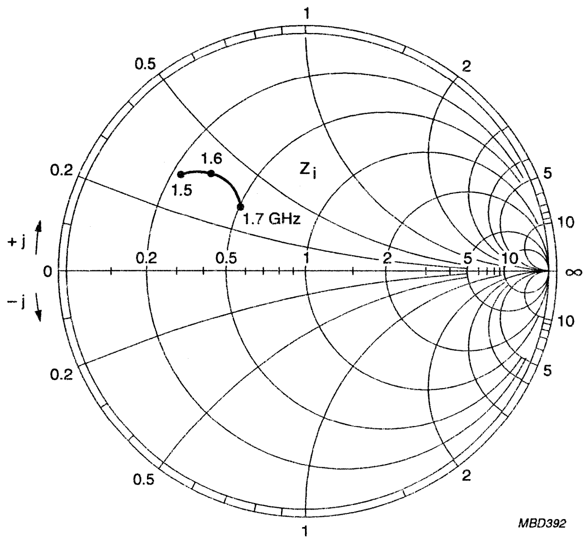
V_{CE} = 24 V; f_1 = 1500 MHz; f_2 = 1500.2 MHz.

Fig.6 Intermodulation distortion as a function of average output power.

Input and optimum load impedances

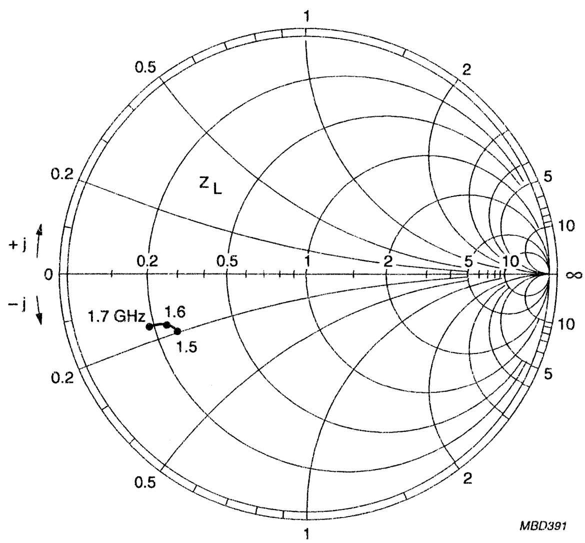
V_{CE} = 24 V; I_{CQ} = 0.2 A.

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.50	2.4 + j3.4	2.4 − j1.8
1.55	3.0 + j3.6	2.3 − j1.7
1.60	3.5 + j3.8	2.2 − j1.6
1.65	4.2 + j3.8	2.1 − j1.5
1.70	4.8 + j2.5	1.8 − j1.5



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.2 A.

Fig.7 Input impedance as a function of frequency; typical values.



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.2 A.

Fig.8 Optimum load impedance as a function of frequency; typical values.

NPN silicon planar epitaxial microwave power transistor

LFE18500X

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 and output 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 1.8 GHz and 1.9 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-231 glued cap metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	0.2	≥48	≥7	typ. 42	see Figs 7 and 8

PINNING - FO-231

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

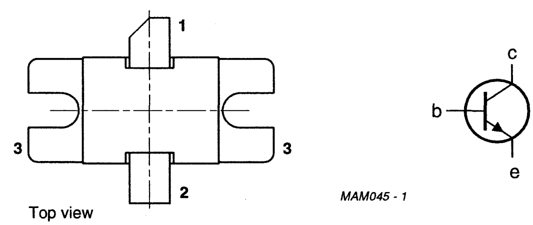


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	$R_{BE} = 220\ \Omega$	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	22	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	12	A
P_i	input power	f = 1.85 GHz; V_{CE} = 24 V; class AB	–	20	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	120	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.

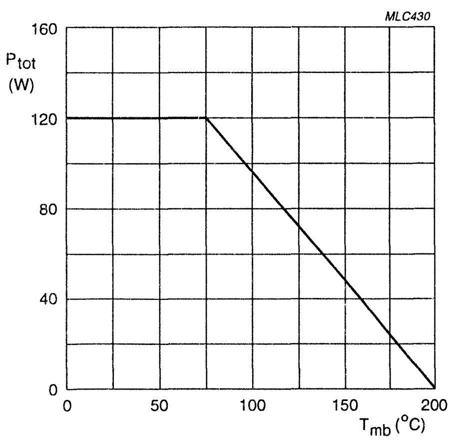


Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	1	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

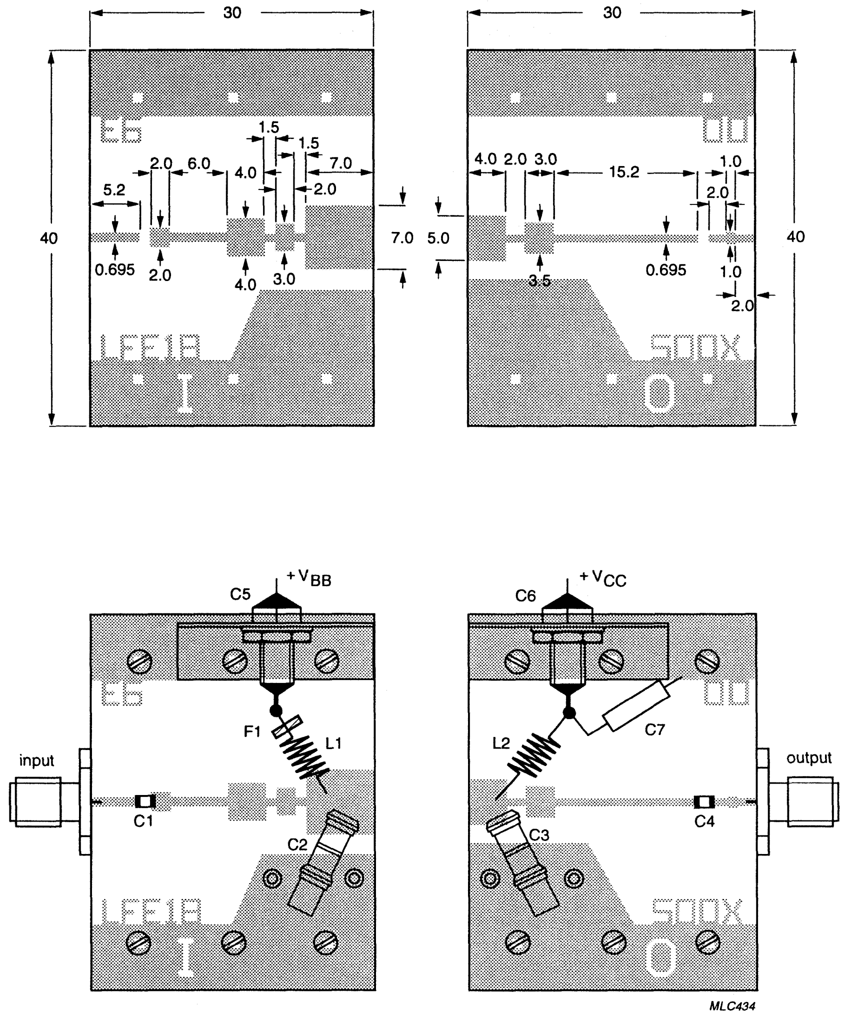
T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 20 V	–	6	mA
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = 30 mA; R_{BE} = 56 Ω	30	–	V
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 30 mA	45	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 30 mA	3	–	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	15	100	

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	0.2	≥48 typ. 53	≥7 typ. 7.5	typ. 42	see Figs 7 and 8



The test circuit is split into two independent halves, each being 30 x 40 mm in size.
Dimensions in mm.
Substrate: Epsilam 10.
Thickness: 0.635 mm.
Permittivity: $\varepsilon_r = 10$.

Fig.3 Prematching test circuit board.

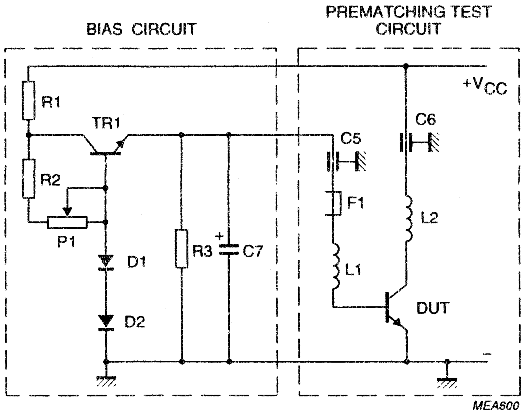


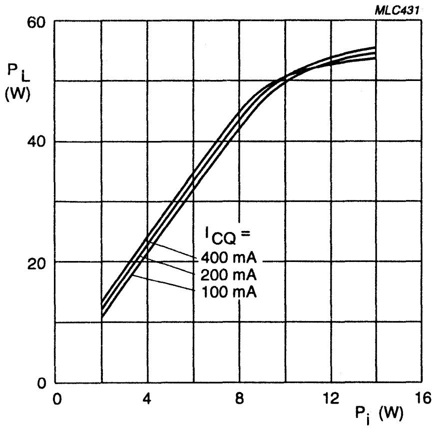
Fig.4 Class AB bias circuit.

List of components (see Figs 3 and 4)

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
TR1	transistor, BDT91 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
C5, C6	feedthrough bypass capacitor	1500 pF	Erie 1250-003
C7	electrolytic capacitor	10 μF, 50 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	3 turns 0.5 mm copper wire; internal diameter = 2 mm		
P1	linear potentiometer	4.7 kΩ	
R1	resistor	100 Ω, 0.25 W	
R2	resistor	10 kΩ, 0.25 W	
R3	resistor	56 Ω, 0.25 W	
F1	ferrite bead		Philips tube, 12NC = 4330 030 43081 4.2 x 2.2 x 3.2 mm (4B1)

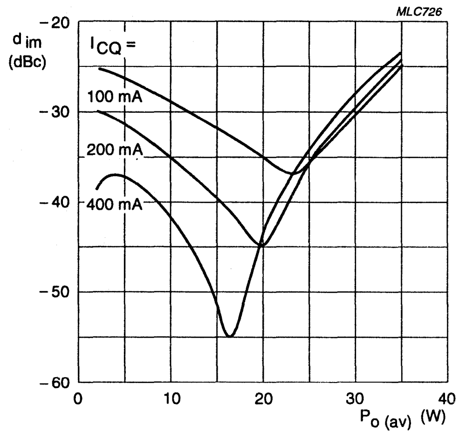
Notes

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



V_{CE} = 24 V; f = 1850 MHz.

Fig.5 Load power as a function of input power.



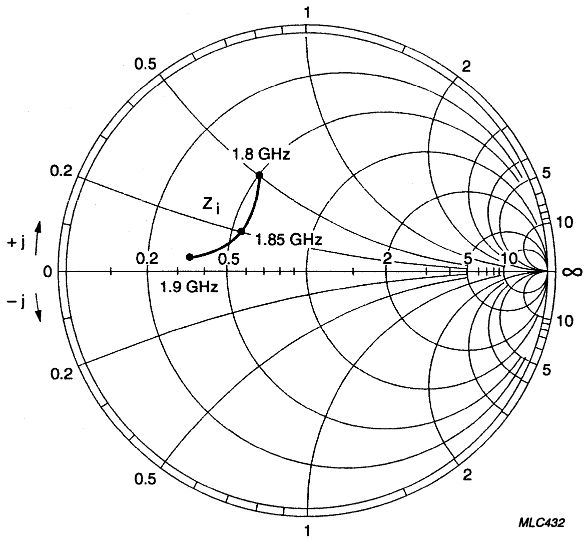
V_{CE} = 24 V; f_1 = 1849.9 MHz; f_2 = 1850.1 MHz.

Fig.6 Intermodulation distortion as a function of average output power.

Input and optimum load impedances

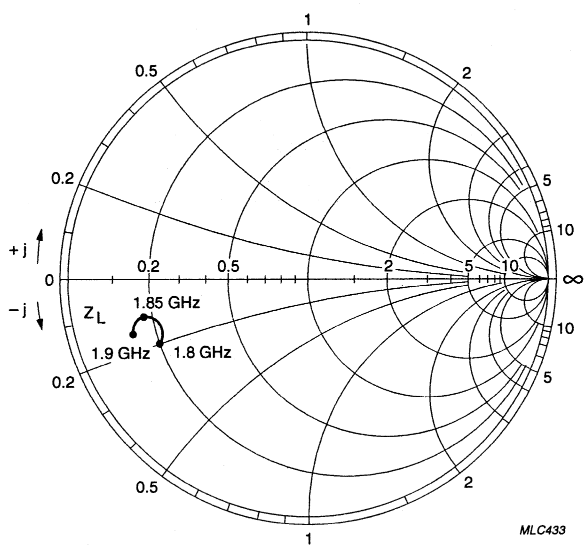
V_{CE} = 24 V; I_{CQ} = 0.2 A; Z_o = 10 Ω; typical values at $P_L = P_{L1}$ (see Figs 7 and 8).

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.80	5.0 + j4.9	2.0 − j2.0
1.85	5.5 + j2.0	1.8 − j1.2
1.90	3.7 + j0.6	1.6 − j1.6



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.2 A.

Fig.7 Input impedance as a function of frequency; typical values at $P_L = P_{L1}$.



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.2 A.

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

NPN silicon planar epitaxial microwave power transistor

LLE15180X

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 and output prematching ensures good stability and allows an easier design of wideband circuits.

APPLICATIONS

Intended for use in common emitter, class AB amplifiers in CW conditions for professional applications between 1.4 GHz and 1.6 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-229 glued cap metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.5	24	0.05	≥15	≥7.8	typ. 50	see Figs 6 and 7

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

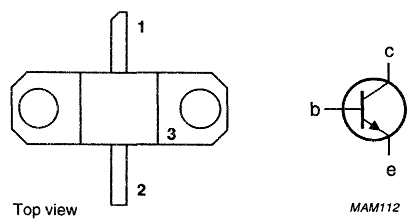


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	$R_{BE} = 220\ \Omega$	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	22	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	3	A
P_i	input power	f = 1.85 GHz; V_{CE} = 24 V; class AB	–	4	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	25	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.

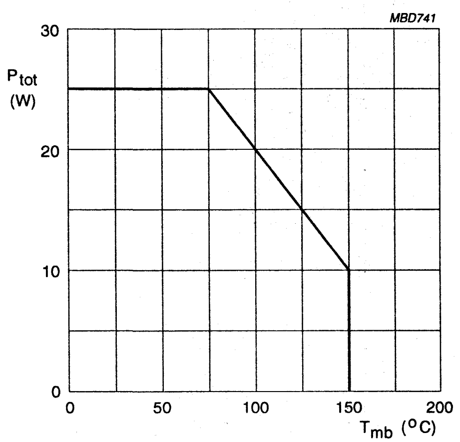


Fig.2 Power derating curve.

NPN silicon planar epitaxial microwave power transistor

LLE15180X

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_j = 100$ °C	3.6 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2 K/W

CHARACTERISTICS

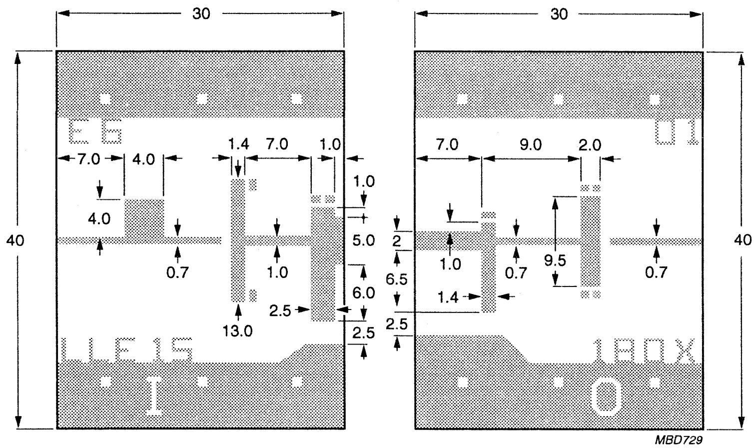
$T_{mb} = 25$ °C unless otherwise specified.

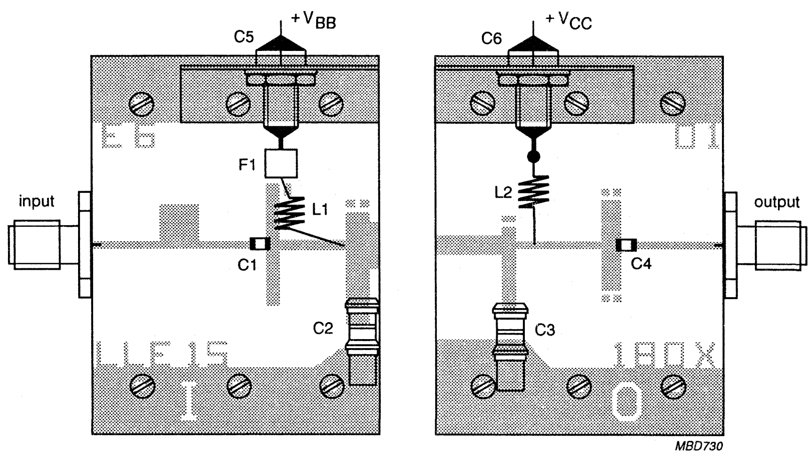
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	1.5	mA
$V_{(BR)CER}$	collector-emitter breakdown voltage	$I_C = 10$ mA; $R_{BE} = 220\ \Omega$	30	–	V
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 10$ mA	45	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 10$ mA	3	–	V
h_{FE}	DC current gain	$I_C = 0.5$ A; $V_{CE} = 3$ V	15	100	

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25$ °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.5	24	0.05	≥15 typ. 18	≥7.8 typ. 8.2	typ. 50	see Figs 6 and 7





The test circuit is split into two independent halves, each being 30 x 40 mm in size.
Dimensions in mm.
Substrate: Epsilam 10.
Thickness: 0.635 mm.
Permittivity: $\varepsilon_r = 10$.

Fig.3 Prematching test circuit board.

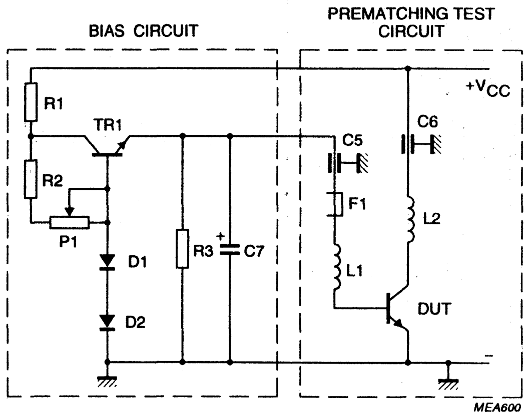


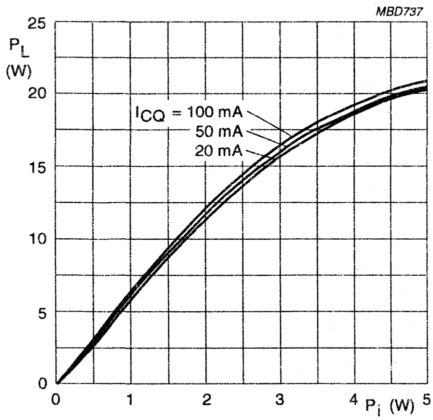
Fig.4 Class AB bias circuit.

List of components (see Figs 3 and 4)

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
TR1	transistor, BDT91 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
C5, C6	feedthrough bypass capacitor	1500 pF	Erie1250-003
C7	electrolytic capacitor	10 µF, >30 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
P1	linear potentiometer	4.7 kΩ	
R1	resistor	100 Ω, 0.25 W	
R2	resistor	10 kΩ, 0.25 W	
R3	resistor	56 Ω, 0.25 W	
F1	ferrite bead		Philips tube, 12NC = 4330 030 43081 4.2 x 2.2 x 3.2 mm (4B1)

Notes

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



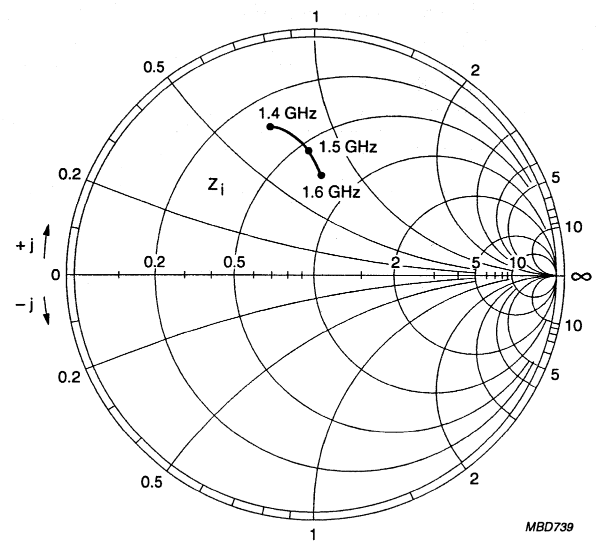
V_{CE} = 24 V; f = 1 850 MHz.

Fig.5 Load power as a function of input power.

Input and optimum load impedances

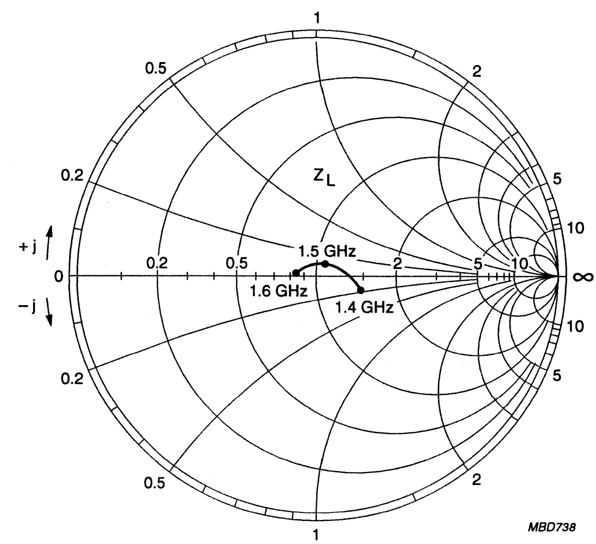
V_{CE} = 24 V; I_{CQ} = 50 mA; Z_o = 10 Ω (see Figs 6 and 7); typical values at $P_L = P_{L1}$.

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.40	3.7 + j6.9	14.0 − j1.8
1.45	4.6 + j7.4	12.5 + j0.5
1.50	5.8 + j7.7	11.0 + j0.1
1.55	7.4 + j7.8	9.7 f+ j0.4
1.60	9.3 + j7.4	8.5 + j0.3



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 50 mA.

Fig.6 Input impedance as a function of frequency; typical values at $P_L = P_{L1}$.



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 50 mA.

Fig.7 Optimum load impedance as a function of frequency; typical values at $P_L = P_{L1}$.

NPN silicon planar epitaxial microwave power transistor

LLE15370X

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 and output 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 1.4 GHz and 1.6 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-229 glued cap metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.5	24	0.3	≥33	≥8	typ. 52	see Figs 8 and 9

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

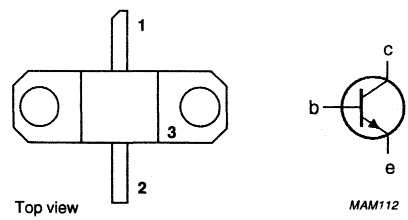


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

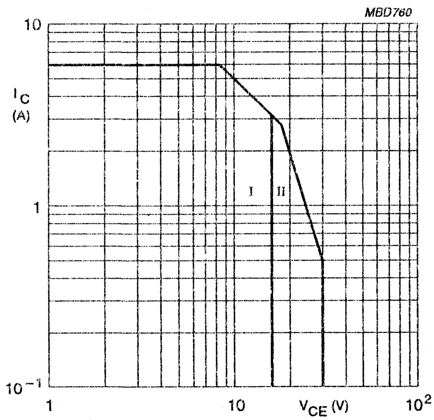
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	6	A
P_i	input power	f = 1.5 GHz; V_{CE} = 24 V; class AB	–	8	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	50	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



T_{mb} ≤ 75 °C.
(I) Region of permissible DC operation.
(II) Permissible extension provided R_{BE} ≤ 220 Ω.

Fig.2 DC SOAR.

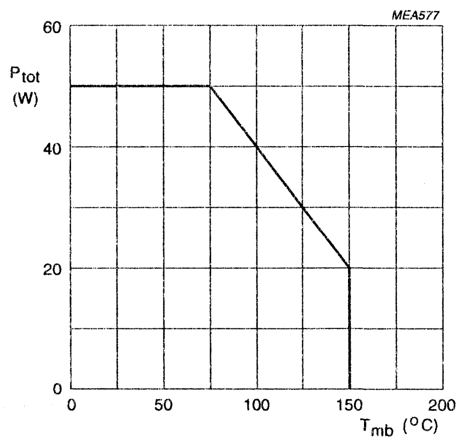


Fig.3 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	2	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

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

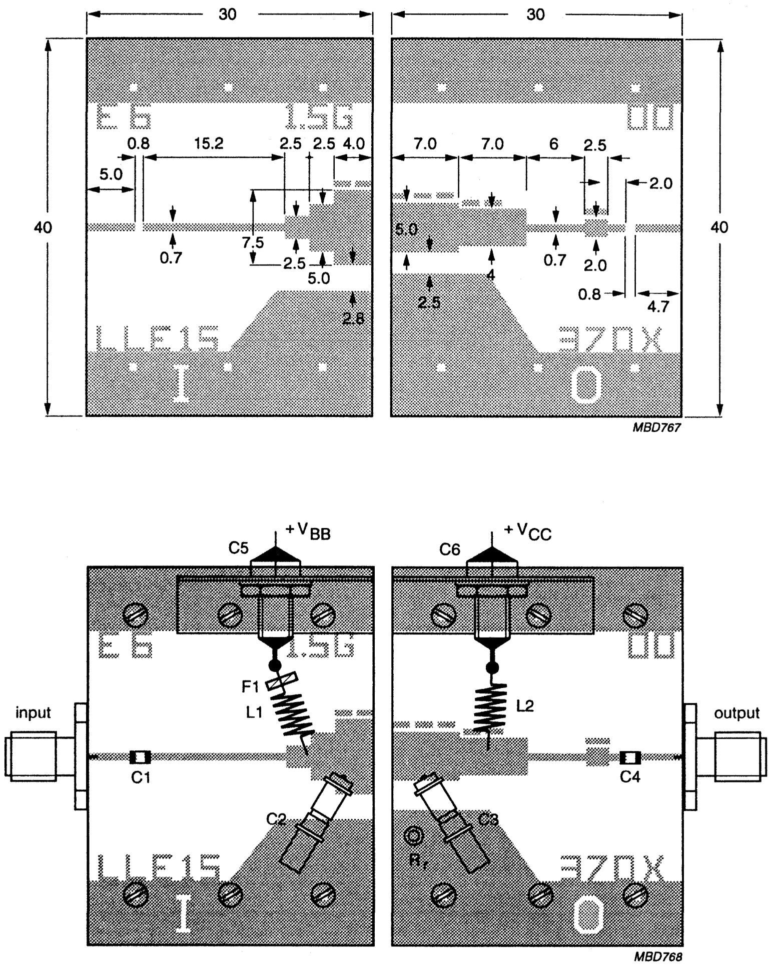
APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW) note 1	1.5	24	0.3	≥33; typ. 37	≥8; typ. 8.7	typ. 43	see Figs 8 and 9

Note

1. d_{im} is less than –30 dBc at P_o = 15 W (av); f = 200 kHz.



The test circuit is split into two independent halves, each being 30 x 30 mm in size.
Dimensions in mm.
Substrate: Epsilam 10.
Thickness: 0.635 mm.
Permittivity: $\varepsilon_r = 10$.

Fig.4 Prematching test circuit board.

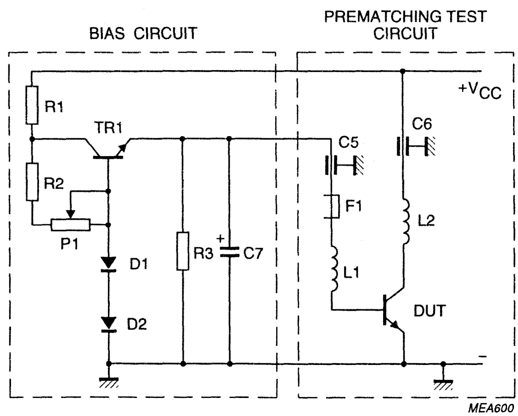


Fig.5 Class AB bias circuit.

List of components (see Figs 4 and 5)

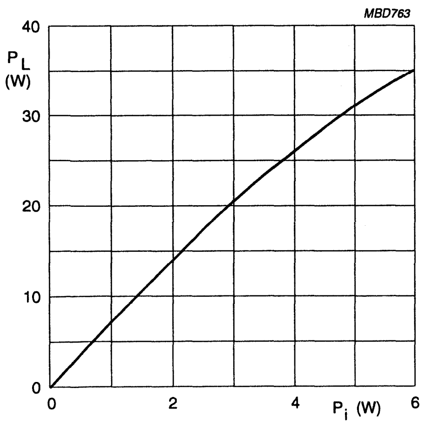
COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
TR1	transistor, BDT91 or equivalent		
C1, C4	DC blocking chip capacitor	100 pF	ATC 100A101kp
C2, C3	trimmer capacitor	0.5 to 5.0 pF	Tekelec 727-1
C5, C6	feedthrough bypass capacitor	1500 pF	Erie 1250-003
C7	electrolytic capacitor	10 μF, >30 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	3 turns 0.5 mm copper wire; internal diameter = 2 mm		
P1	linear potentiometer	4.7 kΩ	
R1	resistor	100 Ω, 0.25 W	
R2	resistor	10 kΩ, 0.25 W	
R3	resistor	56 Ω, 0.25 W	
F1	ferrite bead		Philips tube, 12NC = 4330 030 43081 4.2 x 2.2 x 3.2 mm (4B1)
R_r	copper rivet		

Notes

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

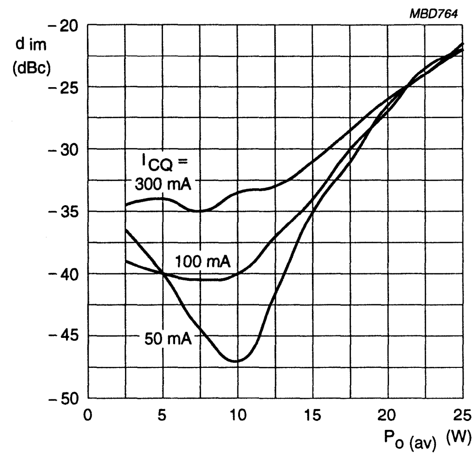
NPN silicon planar epitaxial microwave power transistor

LLE15370X



V_{CE} = 24 V; f = 1500 MHz.

Fig.6 Load power as a function of input power.



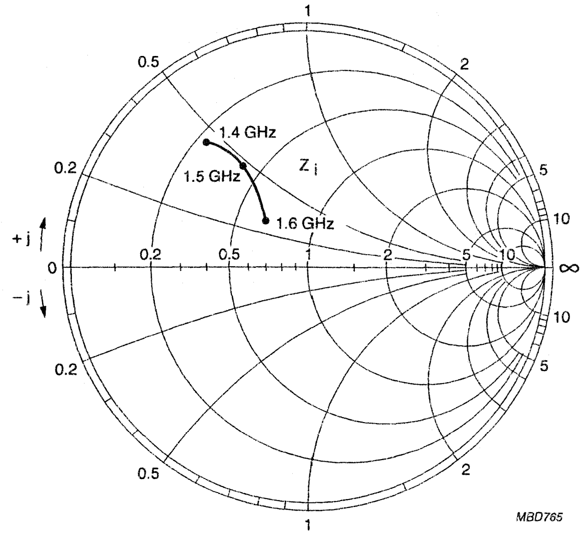
V_{CE} = 24 V; f_1 = 1500 MHz; f_2 = 1500.2 MHz.

Fig.7 Intermodulation distortion as a function of average output power.

Input and optimum load impedances

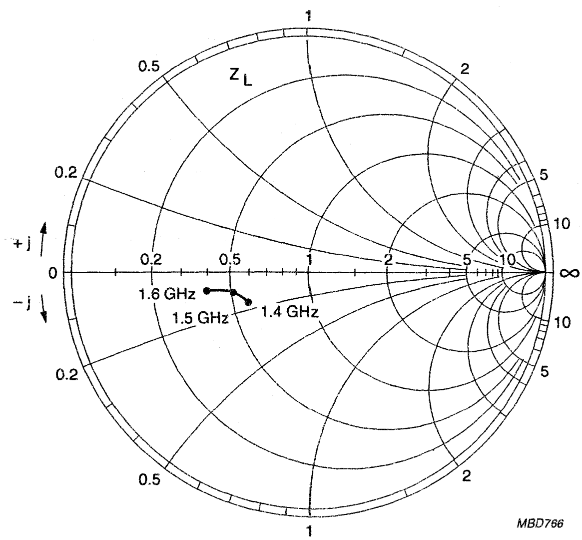
V_{CE} = 24 V; I_{CQ} = 0.3 A (see Figs 8 and 9).

f (GHz)	$\mathbf{Z_i}$ **(Ω)**	$\mathbf{Z_L}$ **(Ω)**
1.40	2.4 + j4.4	5.5 − j1.8
1.45	3.2 + j4.6	5.1 − j1.3
1.50	4.2 + j4.5	4.7 − j1.0
1.55	5.3 + j3.8	4.2 − j0.9
1.60	6.2 + j2.5	3.8 − j0.8



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.3 A.

Fig.8 Input impedance as a function of frequency; typical values.



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.3 A.

Fig.9 Optimum load impedance as a function of frequency; typical values.

NPN silicon planar epitaxial microwave power transistor

LLE16045X

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 1.5 GHz and 1.8 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-229 glued cap metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.65	24	0.04	≥4.5	≥8.5	typ. 50	see Figs 8 and 9

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

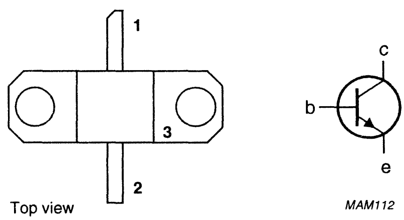


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

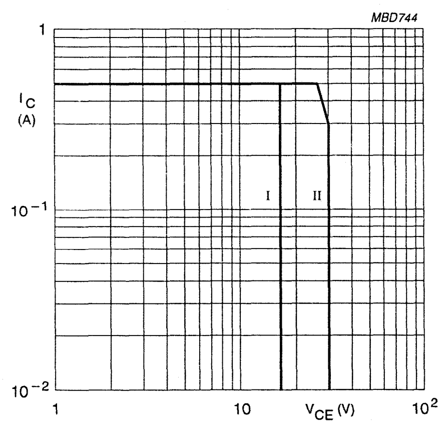
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	0.5	A
P_i	input power	f = 1.65 GHz; V_{CE} = 24 V; class AB	–	1	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	11	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



T_{mb} ≤ 75 °C.
(I) Region of permissible DC operation.
(II) Permissible extension provided R_{BE} ≤ 220 Ω.

Fig.2 DC SOAR.

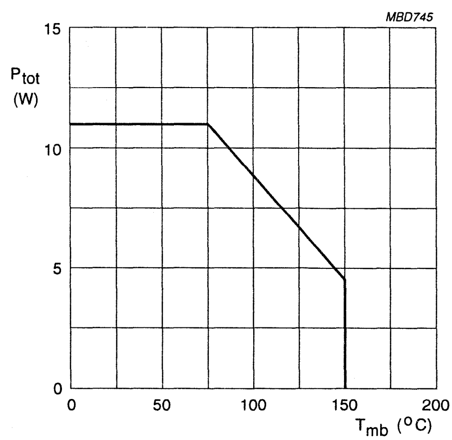


Fig.3 Power derating curve.

THERMAL CHARACTERISTICS

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

CHARACTERISTICS

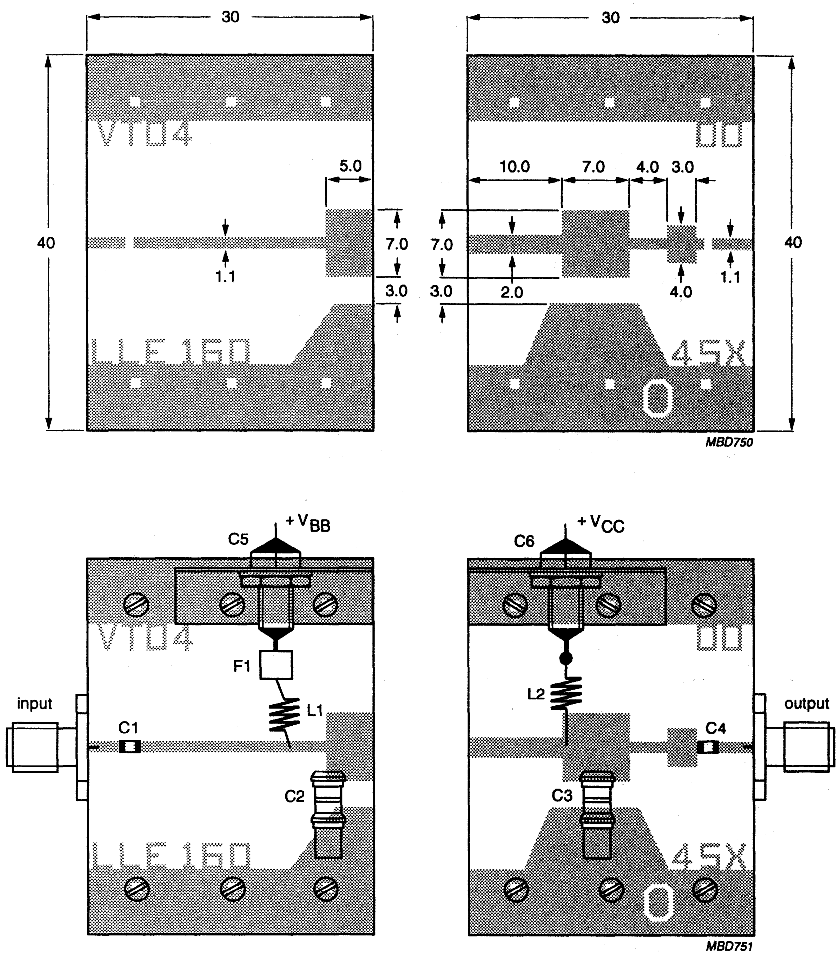
$T_j = 25\ °C$ unless otherwise specified.

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

APPLICATION INFORMATION

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

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (A)	P_{L1} (W)	G_{po} (dB)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.65	24	0.04	≥4.5 typ. 5.5	≥8.5 typ. 9.5	typ. 50	see Figs 8 and 9



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: $\varepsilon_r = 2.55$.

Fig.4 Prematching test circuit board.

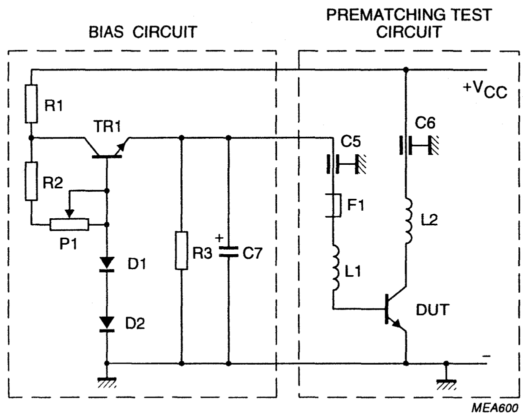


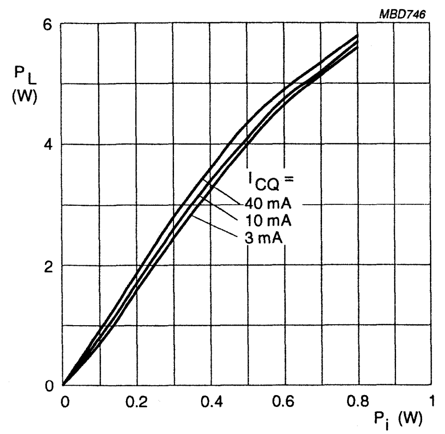
Fig.5 Class AB bias circuit.

List of components (see Figs 4 and 5).

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
TR1	transistor, BD239 or equivalent		
C1, C4	DC blocking chip capacitor	100 pF	ATC 100A101kp
C2, C3	trimmer capacitor	0.5 to 5.0 pF	Tekelec 727-1SL
C5, C6	feedthrough bypass capacitor	1500 pF	Erie 1250-003
C7	electrolytic capacitor	10 μF, >30 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	3 turns 0.5 mm copper wire; 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 4.2 x 2.2 x 3.2 mm (4B1)

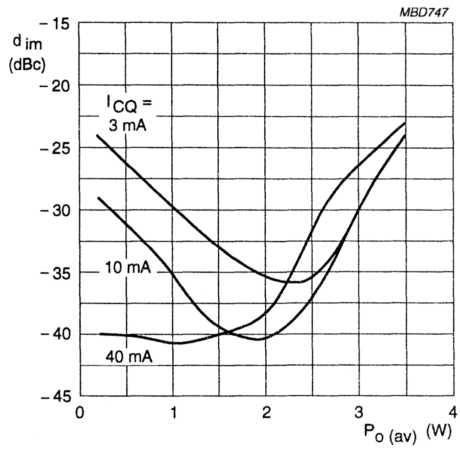
Notes

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



V_{CE} = 24 V; f = 1650 MHz.

Fig.6 Load power as a function of input power.



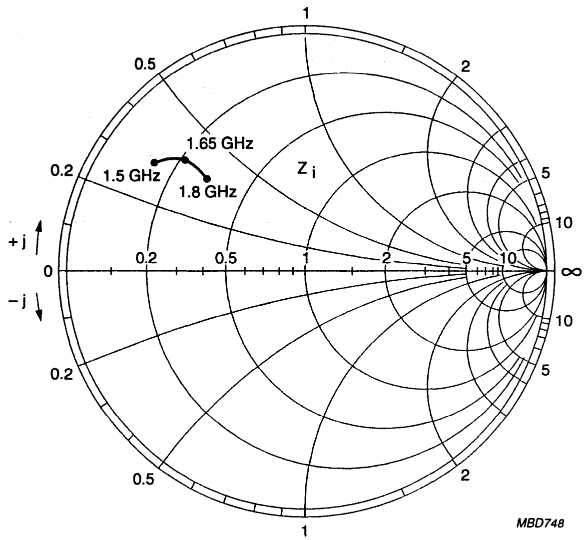
V_{CE} = 24 V; f_1 = 1650 MHz; f_2 = 1650.2 MHz.

Fig.7 Intermodulation distortion as a function of average output power.

Input and optimum load impedances.

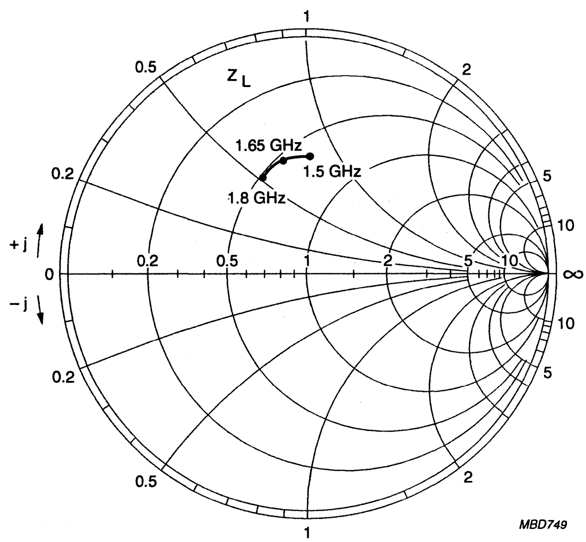
V_{CE} = 24 V; I_{CQ} = 40 mA (see Figs 8 and 9); typical values at $P_L = P_{L1}$.

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.50	6.8 + j14.2	6.1 + j8.3
1.55	7.9 + j15.1	5.8 + j7.8
1.60	9.2 + j16.0	5.6 + j7.3
1.65	10.9 + j16.8	5.4 + j6.9
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



V_{CE} = 24 V; Z_o = 50 Ω; I_{CQ} = 40 mA.

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



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 40 mA.

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

NPN silicon planar epitaxial microwave power transistor

LLE16120X

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.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-229 glued cap metal ceramic flange package, with emitter connected to flange.

APPLICATIONS

Intended for use in common emitter, class AB power amplifiers in CW conditions for professional applications at 1.65 GHz.

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	Z_i/Z_L (Ω)
class AB (CW)	1.65	24	0.1	≥ 11	≥ 8.7	see Figs 8 and 9

PIN CONFIGURATION

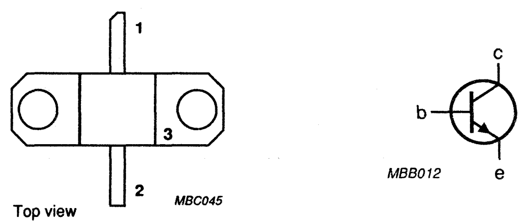


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
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.

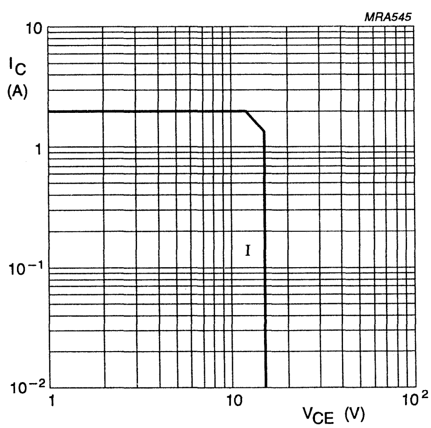
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	2	A
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	23	W
T_{stg}	storage temperature range		−65	150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s note 1	–	235	°C

Note

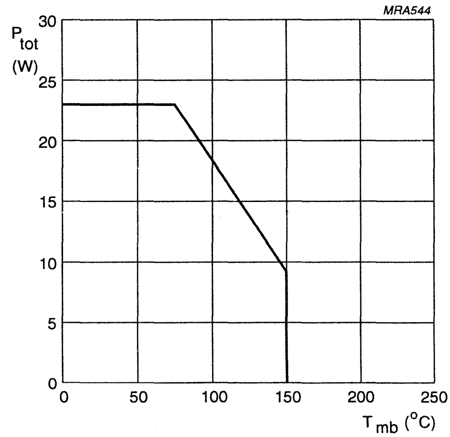
1. Up to 0.2 mm from ceramic.



T_{mb} ≤ 75 °C

(I) Region of permissible DC operation

Fig.2 DC SOAR.



P_{tot} max = 23 W.

Fig.3 Maximum power dissipation derating as a function of mounting base temperature.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	4.2 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

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

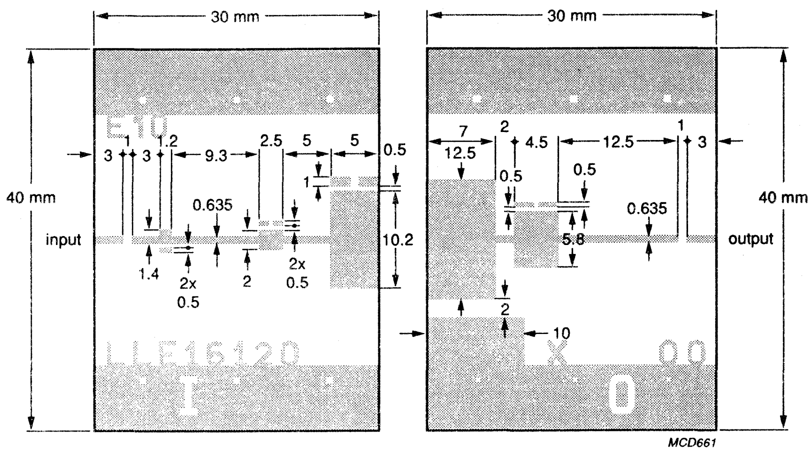
APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common emitter class AB amplifier (note 1).

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (A)	P_{L1} (W)	G_{po} (dB)	η_C (%)	Z_i/Z_L (Ω)
class AB (CW)	1.65	24	0.1	≥ 11; typ.13	≥ 8.7; typ.10.8	typ.45	see Figs 8 and 9

Note

1. The test circuit is split into 2 independant halves each being 30 x 40 mm in size.



Dimensions in mm
Substrate : Epsilam 10
Thickness : 0.635 mm
Permittivity : $\varepsilon_r = 10$

Fig.4 Prematching test circuit board.

List of components (see bias circuit)

COMPONENT	DESCRIPTION	VALUE	CATALOGUE NO.
TR1	transistor, BDT85 (or equivalent)		
D1	diode, BY239800 (or equivalent) note 1		
D2	diode, BY239800 note 2		
R1	resistor	100 Ω	
R2	resistor	3.3 kΩ	
R3	resistor	56 Ω	
P1	potentiometer, 10 turns (sfernice)	4.7 kΩ	
C1	electrolytic capacitor	10 μF, 40 V	
C5, C6	feedthrough bypass capacitor	1500 pF	Erie, ref. 1250-003
L1	5 turns 0.5 mm copper wire with ferrite bead		
L2	5 turns 0.5 mm copper wire		

Notes

1. In thermal contact with TR1.
2. In thermal contact with D.U.T.

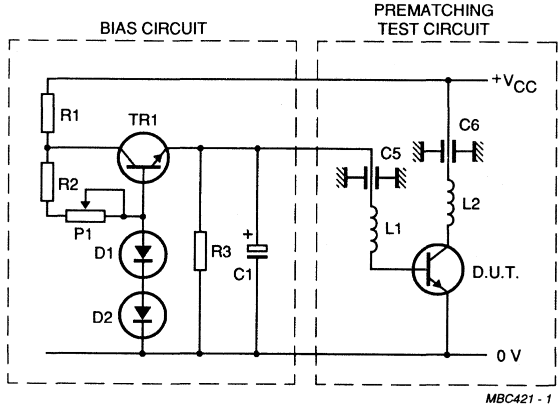
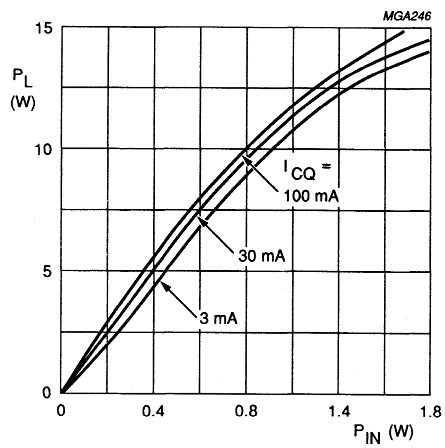
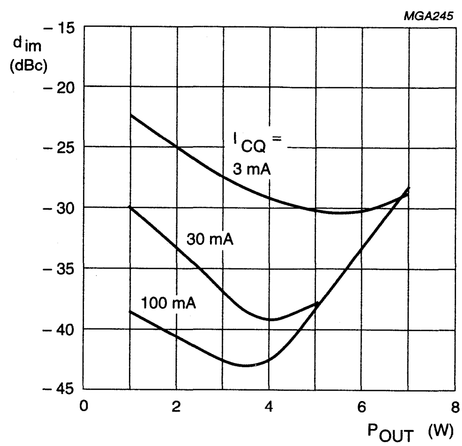


Fig.5 Class AB bias circuit at 1.65 GHz.



V_{CE} = 24 V
f = 1.65 GHz

Fig.6 Load power as a function of input power.



V_{CE} = 24 V
f_1 = 1.65 GHz
f_2 = 1.6502 GHz

Fig.7 Intermodulation distortion as a function of average output power.

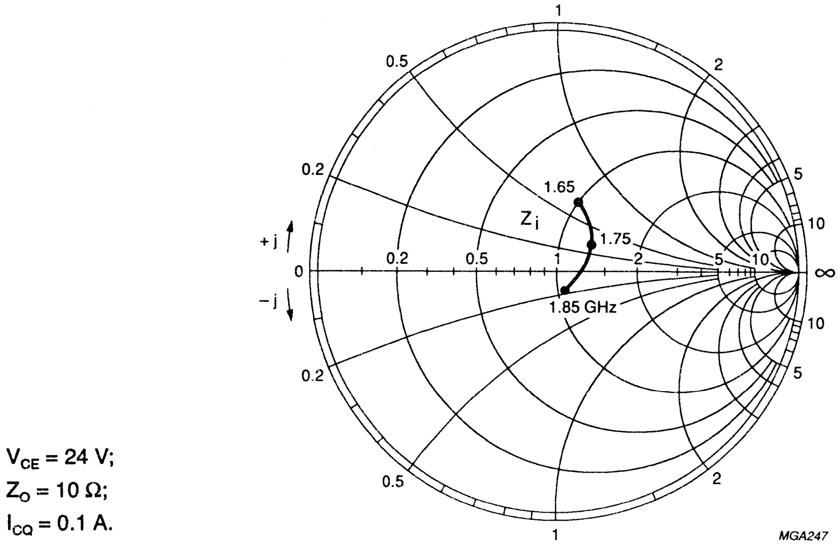


Fig.8 Input impedance as a function of frequency; typical values.

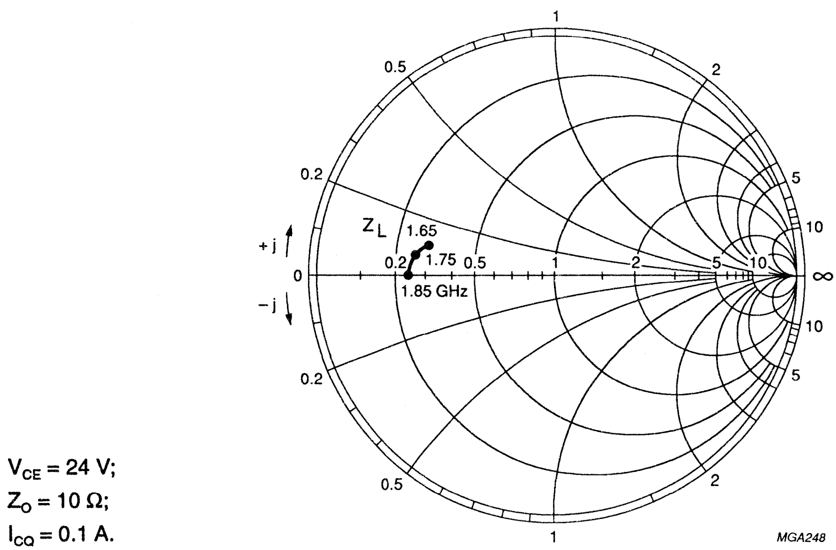


Fig.9 Optimum load impedance as a function of frequency; typical values.

NPN silicon planar epitaxial microwave power transistor

LLE16350X

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 and output 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 1.5 GHz and 1.8 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-229 glued cap metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.65	24	0.1	≥29	≥8	typ. 48	see Figs 8 and 9

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

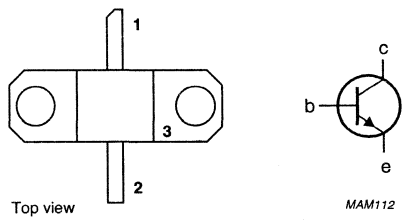


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

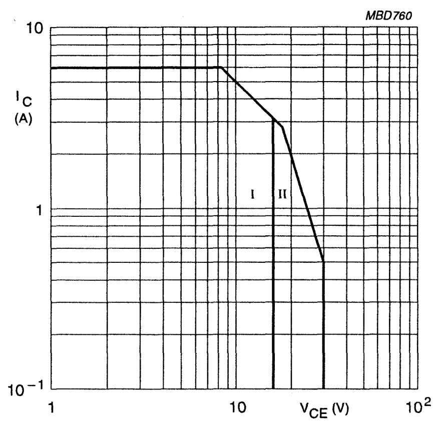
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	6	A
P_i	input power	f = 1.65 GHz; V_{CE} = 24 V; class AB	–	8	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	50	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



T_{mb} ≤ 75 °C.

(I) Region of permissible DC operation.

(II) Permissible extension provided R_{BE} ≤ 220 Ω.

Fig.2 DC SOAR.

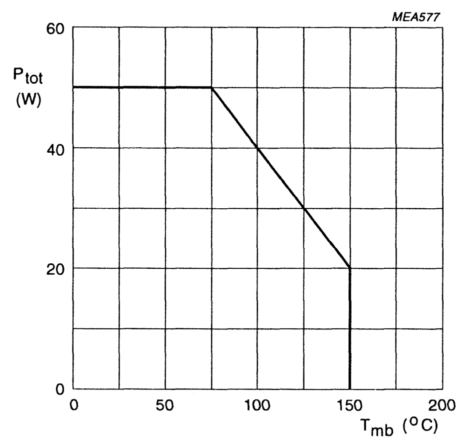


Fig.3 Power derating curve.

NPN silicon planar epitaxial microwave power transistor

LLE16350X

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_j = 100\ °C$	2	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

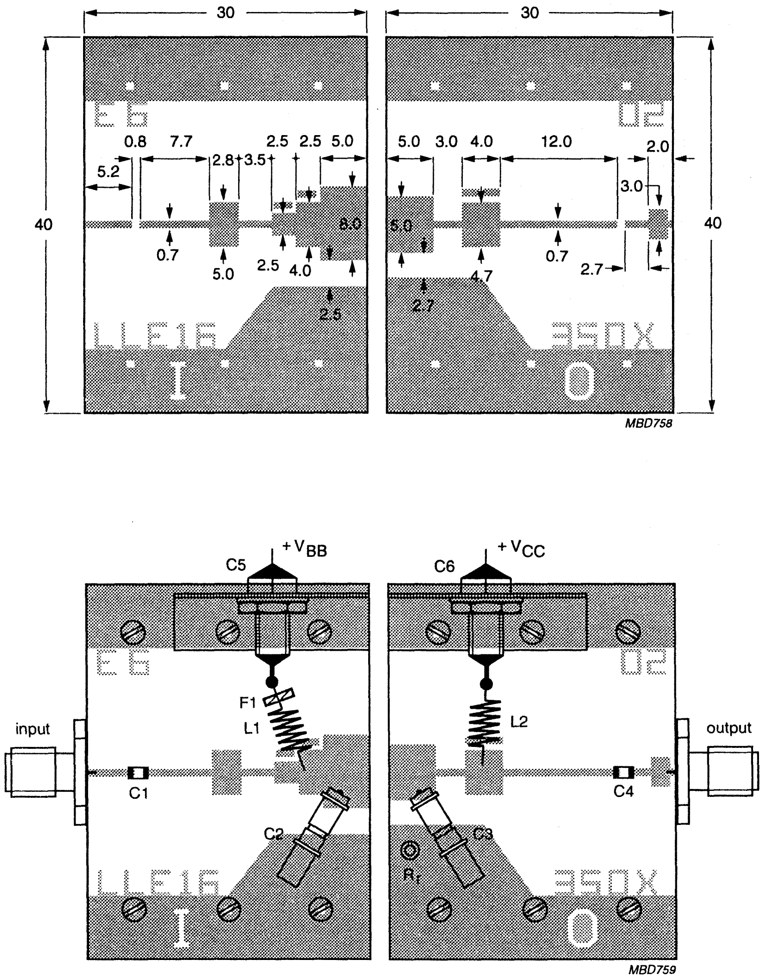
$T_{mb} = 25\ °C$ unless otherwise specified.

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

APPLICATION INFORMATION

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

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (A)	P_{L1} (W)	G_{po} (dB)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.65	24	0.1	≥29 typ. 32	≥8 typ. 9	typ. 48	see Figs 8 and 9



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

Dimensions in mm.

Substrate: Epsilam 10.

Thickness: 0.635 mm.

Permittivity: $\varepsilon_r = 10$.

Fig.4 Prematching test circuit board.

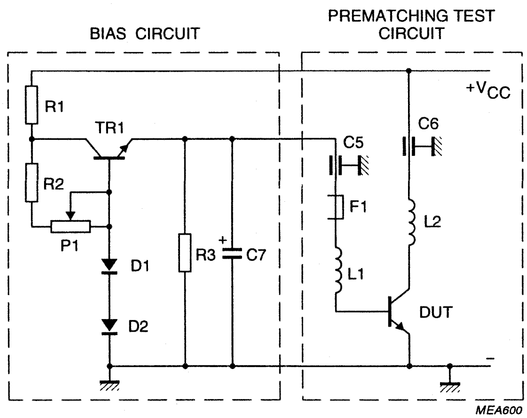


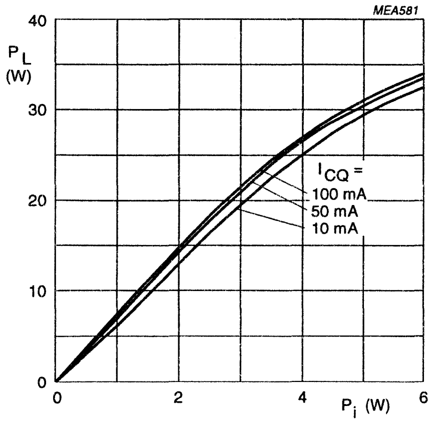
Fig.5 Class AB bias circuit.

List of components (see Figs 4 and 5).

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
TR1	transistor, BDT91 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
C5, C6	feedthrough bypass capacitor	1500 pF	Erie 1250-003
C7	electrolytic capacitor	10 μF, >30 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	3 turns 0.5 mm copper wire; internal diameter = 2 mm		
P1	linear potentiometer	4.7 kΩ	
R1	resistor	100 Ω, 0.25 W	
R2	resistor	10 kΩ, 0.25 W	
R3	resistor	56 Ω, 0.25 W	
F1	ferrite bead		Philips tube, 12NC = 4330 030 43081 4.2 x 2.2 x 3.2 mm (4B1)
R_r	copper rivet		

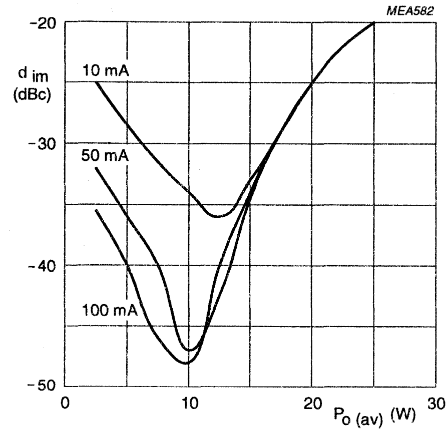
Notes

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



V_{CE} = 24 V; f = 1650 MHz.

Fig.6 Load power as a function of input power.



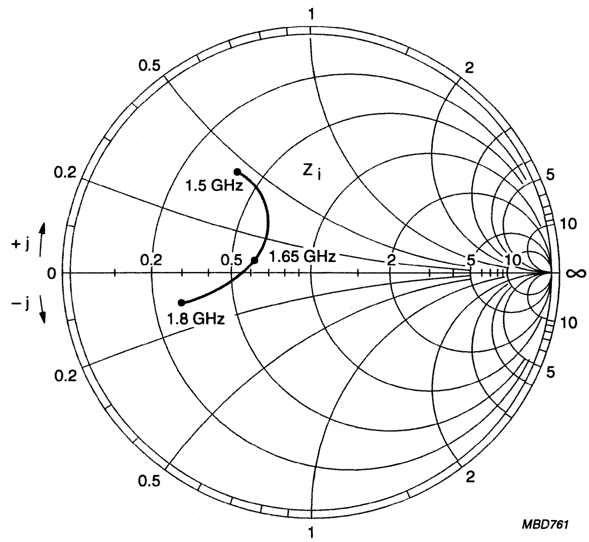
V_{CE} = 24 V; f_1 = 1650 MHz; f_2 = 1650.2 MHz.

Fig.7 Intermodulation distortion as a function of average output power.

Input and optimum load impedances.

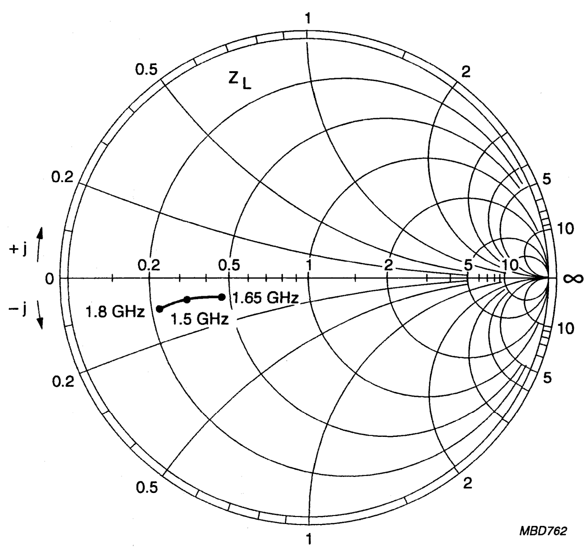
V_{CE} = 24 V; I_{CQ} = 0.1 A (see Figs 8 and 9); typical values at $P_L = P_{L1}$.

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.50	4.15 + j4.45	4.6 − j1.0
1.55	5.3 + j3.8	4.2 − j0.85
1.60	6.2 + j2.45	3.8 − j0.8
1.65	6.1 + j0.7	3.4 − j0.8
1.70	5.1 − j0.6	3.05 − j0.9
1.75	3.9 − j1.1	2.75 − j1.0
1.80	2.9 − j1.1	2.5 − j1.15



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.1 A.

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



V_{CE} = 24 V; Z_o = 100 Ω; I_{CQ} = 0.1 A.

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

NPN silicon planar epitaxial microwave power transistor

LLE18010X

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 up to 2 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-229 glued cap metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common emitter class AB amplifier.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (mA)	P_{L1} (W)	G_{po} (dB)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	10	≥1	≥8.5	see Figs 6 and 7

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

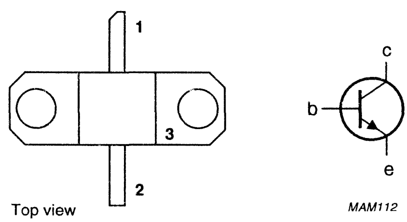


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	250	mA
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	4.5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.

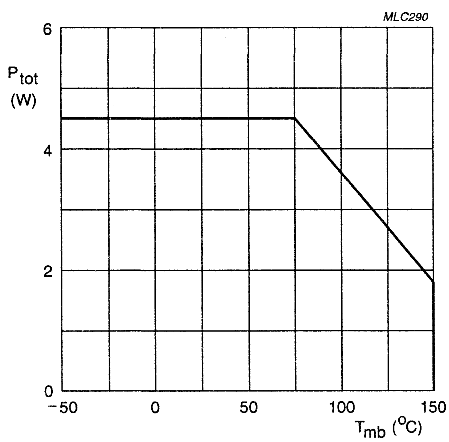


Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_j = 100$ °C	22	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

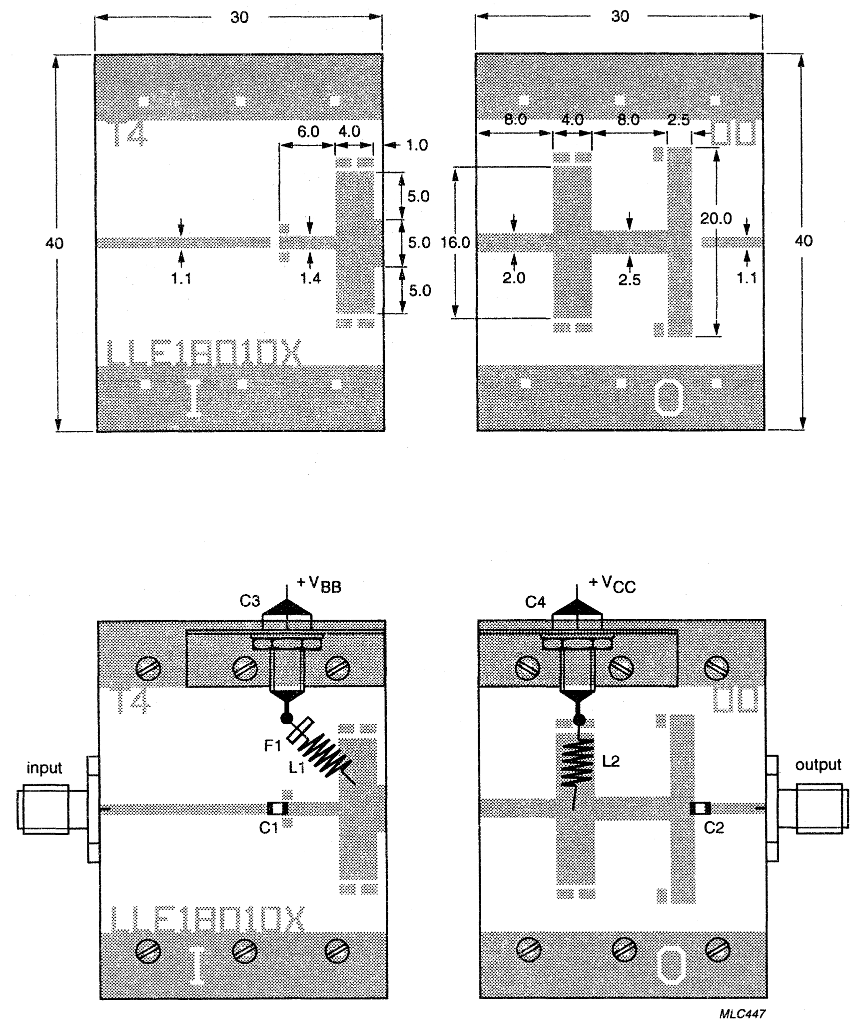
$T_{mb} = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	11	μA
$V_{(BR)CER}$	collector-emitter breakdown voltage	$I_C = 1$ mA; $R_{BE} = 220\ \Omega$	30	–	V
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 1$ mA	40	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 0.5$ mA	3	–	V
h_{FE}	DC current gain	$I_C = 125$ mA; $V_{CE} = 5$ V	15	150	

APPLICATION INFORMATION

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

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (mA)	P_{L1} (W)	G_{po} (dB)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	10	≥1 typ. 1.5	≥8.5 typ. 10	typ. 40	see Figs 6 and 7
	1.65	24	10	typ. 2	typ. 11	typ. 47	see Figs 6 and 7



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: $\varepsilon_r = 2.55$.

Fig.3 Prematching test circuit board.

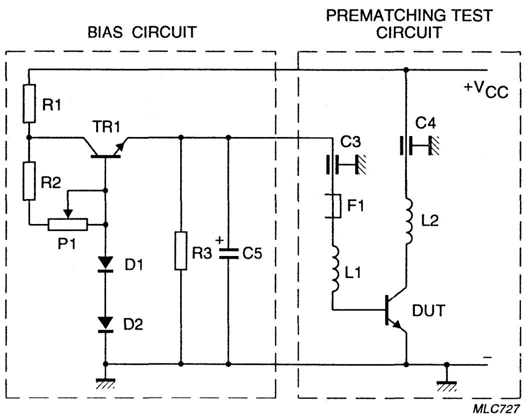


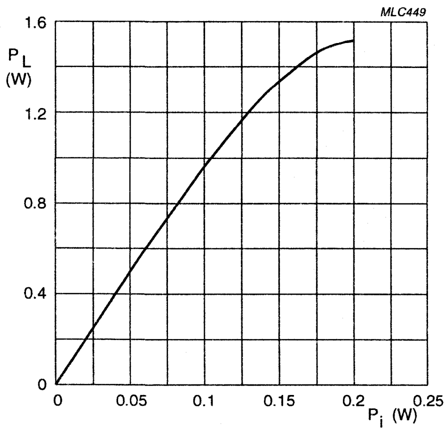
Fig.4 Class AB bias circuit.

List of components (see Figs 3 and 4)

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
TR1	transistor, BDT91 or equivalent		
C1, C2	DC blocking chip capacitor	100 pF	ATC 100A101kp
C3, C4	feedthrough bypass capacitor	1500 pF	Erie 1250-003
C5	electrolytic capacitor	10 μF, >30 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
P1	linear potentiometer	4.7 kΩ	
R1	resistor	100 Ω, 0.25 W	
R2	resistor	10 kΩ, 0.25 W	
R3	resistor	56 Ω, 0.25 W	
F1	ferrite bead		Philips tube, 12NC = 4330 030 43081 4.2 x 2.2 x 3.2 mm (4B1)

Notes

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



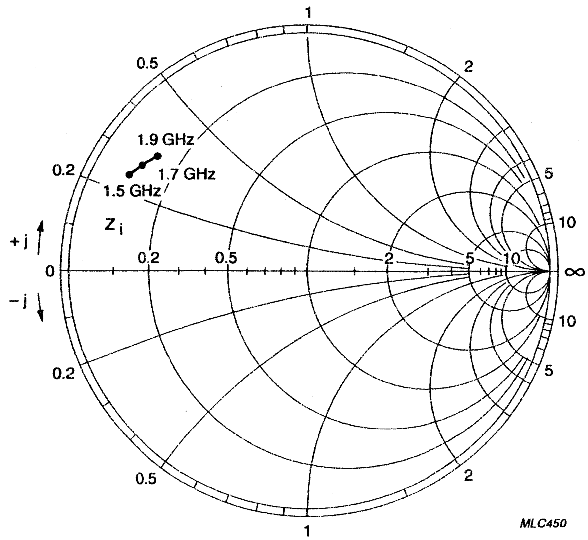
V_{CE} = 24 V; f = 1.85 GHz; I_{CQ} = 10 mA.

Fig.5 Load power as a function of input power.

Input and optimum load impedances

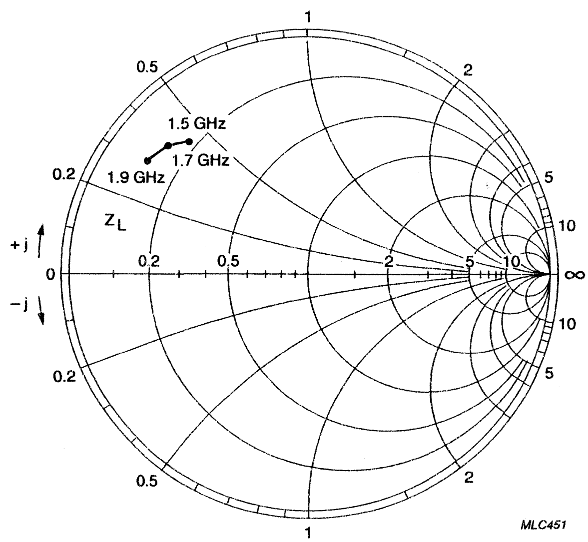
V_{CE} = 24 V; I_{CQ} = 50 mA (see Figs 6 and 7); typical values at $P_L = P_{L1}$.

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.50	4.7 + j12.0	8.2 + j21.7
1.60	5.0 + j13.0	7.3 + j20.5
1.70	5.5 + j14.0	6.5 + j19.0
1.80	6.0 + j15.2	6.2 + j17.5
1.90	6.7 + j16.5	5.9 + j16.0



V_{CE} = 24 V; Z_o = 50 Ω; I_{CQ} = 10 mA.

Fig.6 Input impedance as a function of frequency; typical values at $P_L = P_{L1}$.



V_{CE} = 24 V; Z_o = 50 Ω; I_{CQ} = 10 mA.

Fig.7 Optimum load impedance as a function of frequency; typical values at $P_L = P_{L1}$.

NPN silicon planar epitaxial 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 FO-229 glued cap metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	0.04	≥4	≥8.5	typ. 48	see Figs 8 and 9

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

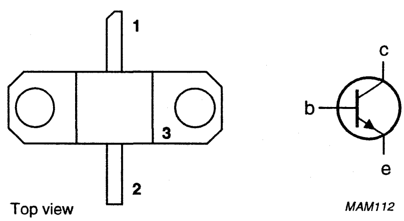


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

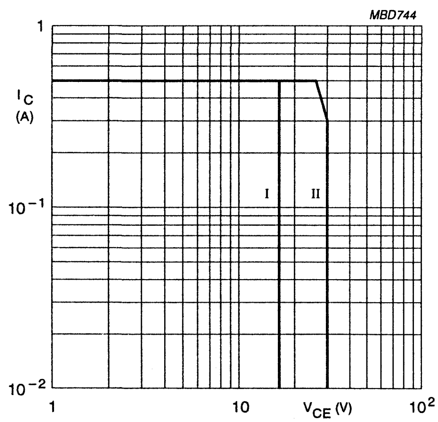
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	0.5	A
P_i	input power	f = 1.85 GHz; V_{CE} = 24 V; class AB	–	1	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	11	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



T_{mb} ≤ 75 °C.

(I) Region of permissible DC operation.

(II) Permissible extension provided R_{BE} ≤ 220 Ω.

Fig.2 DC SOAR.

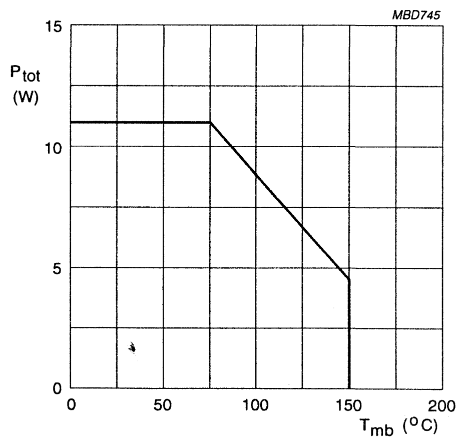


Fig.3 Power derating curve.

THERMAL CHARACTERISTICS

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

CHARACTERISTICS

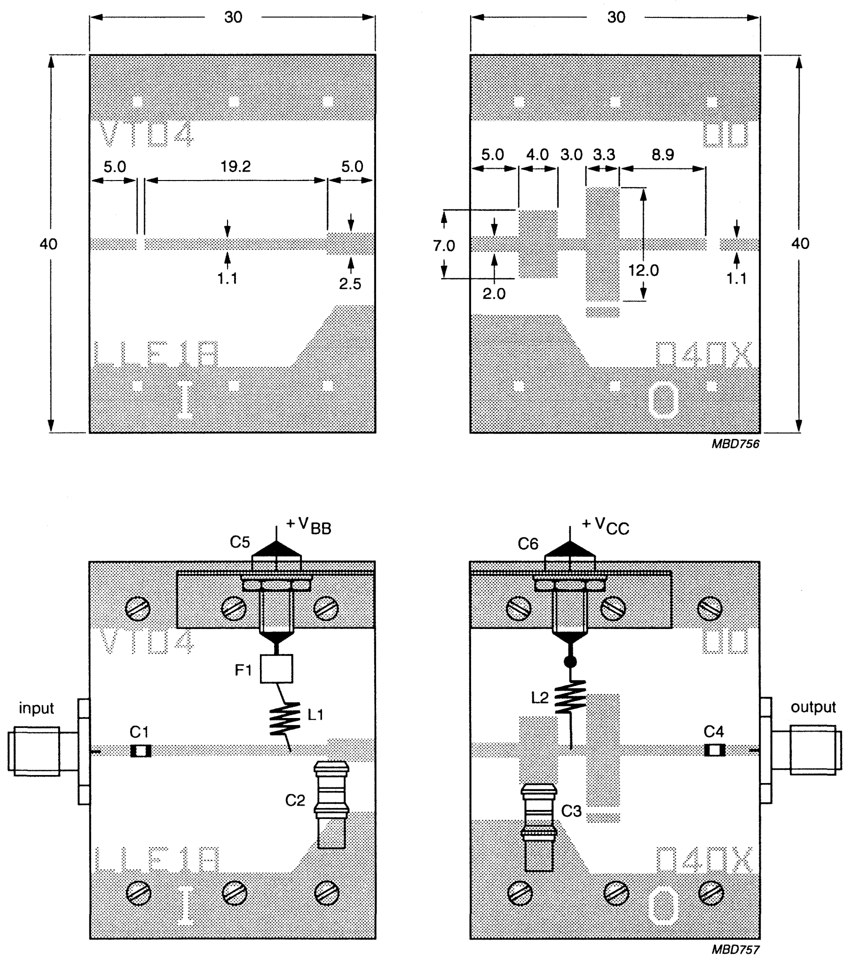
T_{mb} = 25 °C unless otherwise specified.

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

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	0.04	≥4 typ. 5.5	≥8.5 typ. 9.5	typ. 48	see Figs 8 and 9



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: ε_r = 2.55.

Fig.4 Prematching test circuit board.

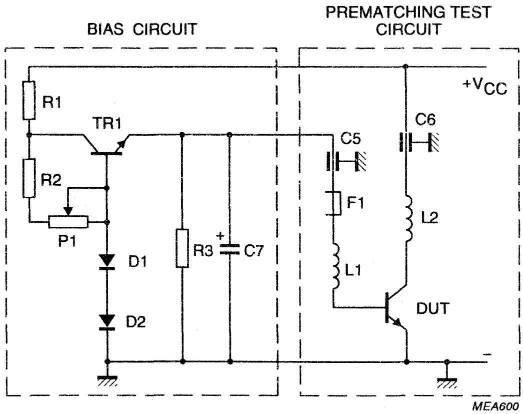


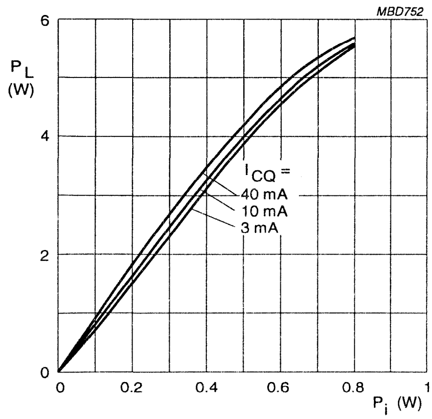
Fig.5 Class AB bias circuit.

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; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	3 turns 0.5 mm copper wire; 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 4.2 x 2.2 x 3.2 mm (4B1)

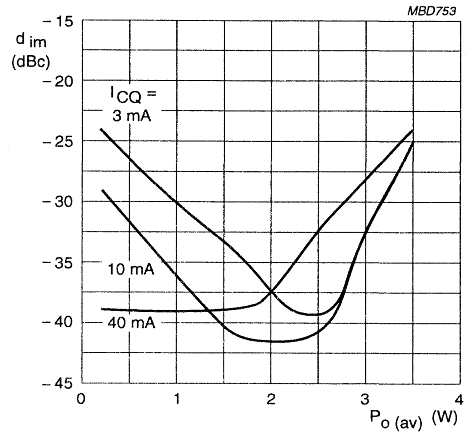
Notes

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



V_{CE} = 24 V; f = 1850 MHz.

Fig.6 Load power as a function of input power.



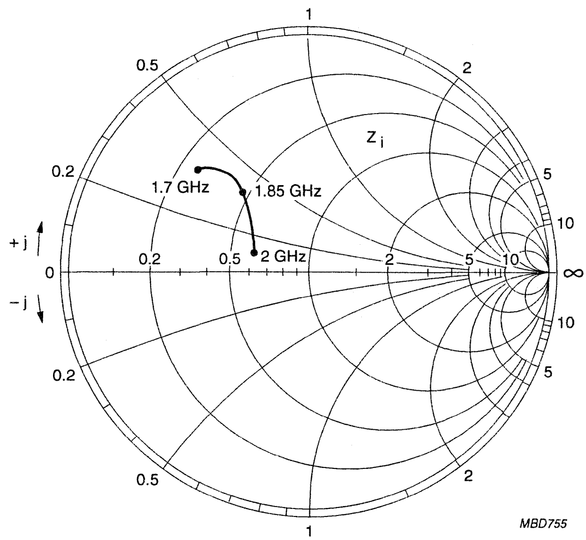
V_{CE} = 24 V; f_1 = 1850 MHz; f_2 = 1850.2 MHz.

Fig.7 Intermodulation distortion as a function of average output power.

Input and optimum load impedances.

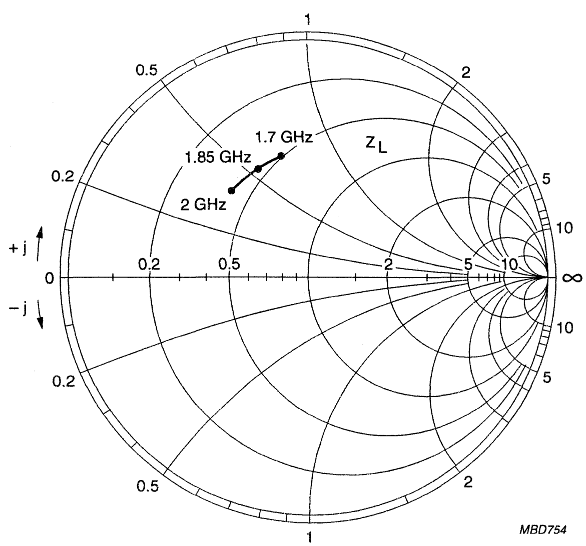
V_{CE} = 24 V; I_{CQ} = 40 mA (see Figs 8 and 9); typical values at $P_L = P_{L1}$.

f (GHz)	**Z_i (Ω)**	**Z_L (Ω)**
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



V_{CE} = 24 V; Z_o = 50 Ω; I_{CQ} = 40 mA.

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



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 40 mA.

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

NPN silicon planar epitaxial microwave power transistor

LLE18100X

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.

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-229 glued cap metal ceramic flange package, with emitter connected to flange.

APPLICATIONS

Intended for use in common emitter, class AB power amplifiers in CW conditions for professional applications at 1.85 GHz.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	Z_i/Z_L (Ω)
class AB (CW)	1.85	24	0.1	≥ 9	≥ 8	see Figs 8 and 9

PIN CONFIGURATION

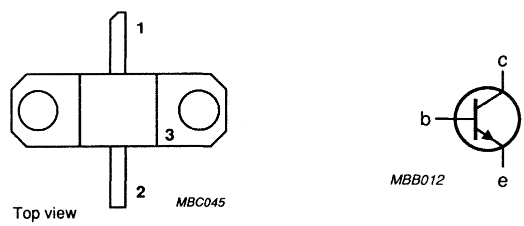


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
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.

NPN silicon planar epitaxial microwave power transistor

LLE18100X

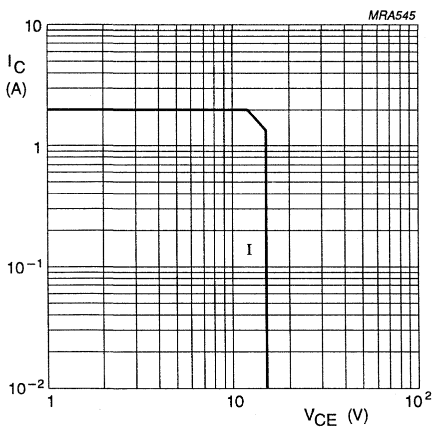
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	2	A
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	23	W
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s note 1	–	235	°C

Note

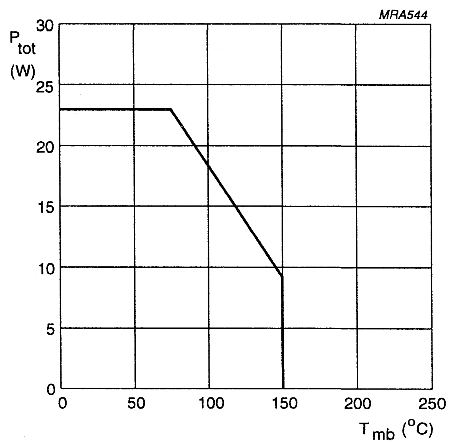
1. Up to 0.2 mm from ceramic.



T_{mb} ≤ 75 °C

(I) Region of permissible DC operation

Fig.2 DC SOAR.



P_{tot} max = 23 W.

Fig.3 Maximum power dissipation derating as a function of mounting base temperature.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_j = 100$ °C	4.2 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2 K/W

CHARACTERISTICS

$T_{mb} = 25$ °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 20$ V; $I_E = 0$	–	1	mA
I_{CER}	collector cut-off current	$V_{CE} = 30$ V; $R_{BE} = 220\ \Omega$	–	10	mA
I_{CEO}	collector cut-off current	$V_{CE} = 20$ V; $I_B = 0$	–	10	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5$ V; $I_C = 0$	–	100	µA
h_{FE}	DC current gain	$V_{CE} = 3$ V; $I_C = 1$ A	15	100	

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common emitter class AB amplifier (note 1).

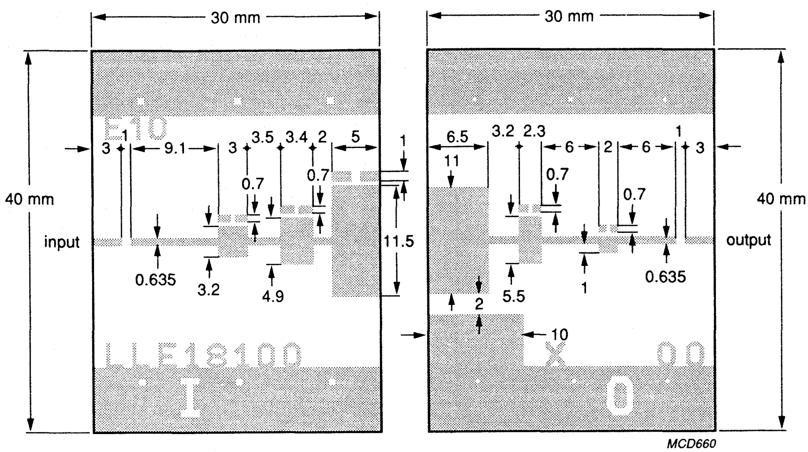
MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (A)	P_{L1} (W)	G_{po} (dB)	Z_i/Z_L (Ω)
class AB (CW)	1.85	24	0.1	≥ 9; typ.11	≥ 8; typ.10	see Figs 8 and 9

Note

1. The test circuit is split into 2 independant halves each being 30 x 40 mm in size.

NPN silicon planar epitaxial microwave power transistor

LLE18100X



Dimensions in mm

Substrate : Epsilam 10

Thickness : 0.635 mm

Permittivity : ε_r = 10

Fig.4 Prematching test circuit board.

List of components (see bias circuit)

COMPONENT	DESCRIPTION	VALUE	CATALOGUE NO.
TR1	transistor, BDT85 (or equivalent)		
D1	diode, BY239800 (or equivalent) note 1		
D2	diode, BY239800 note 2		
R1	resistor	100 Ω	
R2	resistor	3.3 kΩ	
R3	resistor	56 Ω	
P1	potentiometer, 10 turns (sfernice)	4.7 kΩ	
C1	electrolytic capacitor	10 μF, 40 V	
C5, C6	feedthrough bypass capacitor	1500 pF	Erie, ref. 1250-003
L1	5 turns 0.5 mm copper wire with ferrite bead		
L2	5 turns 0.5 mm copper wire		

Notes

1. In thermal contact with TR1.
2. In thermal contact with D.U.T.

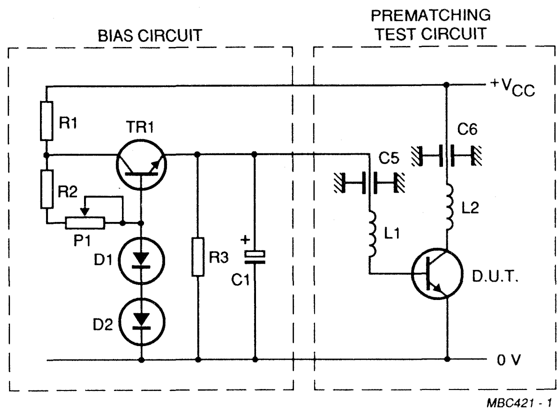
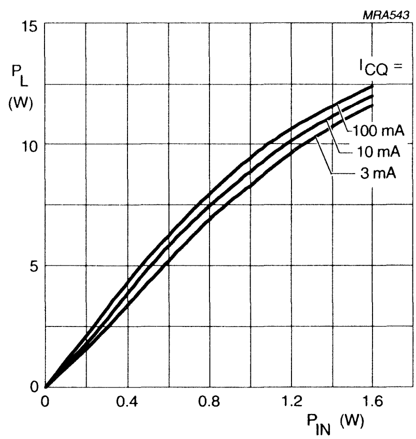
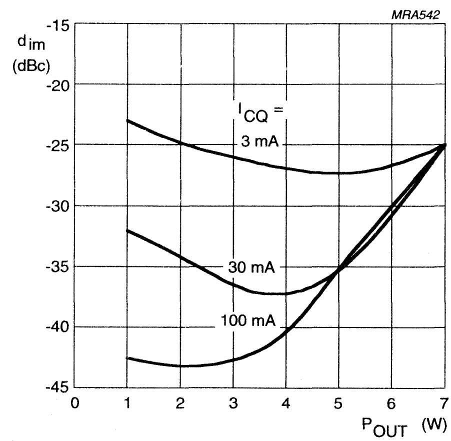


Fig.5 Class AB bias circuit at 1.85 GHz.



$V_{CE} = 24$ V
f = 1.85 GHz

Fig.6 Load power as a function of input power.



$V_{CE} = 24$ V
f = 1.85 GHz

Fig.7 Intermodulation distortion as a function of average output power.

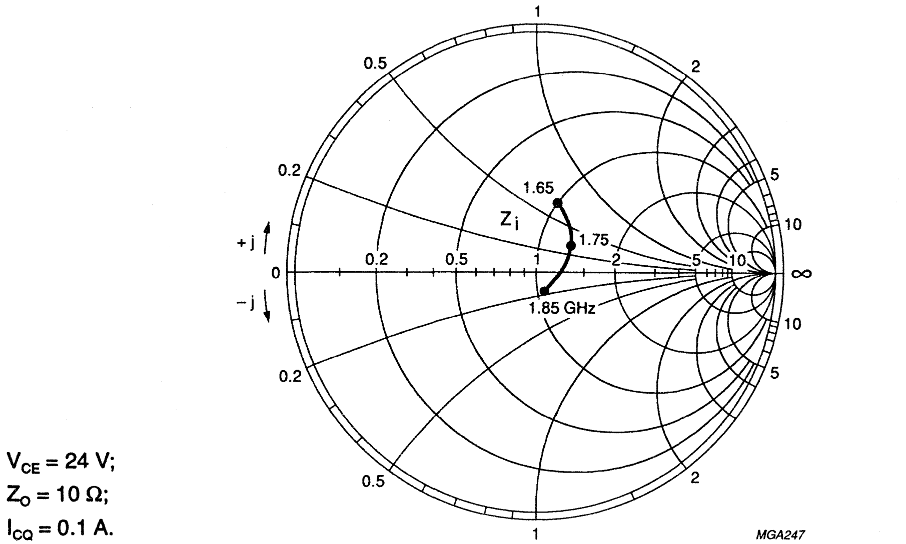


Fig.8 Input impedance as a function of frequency; typical values.

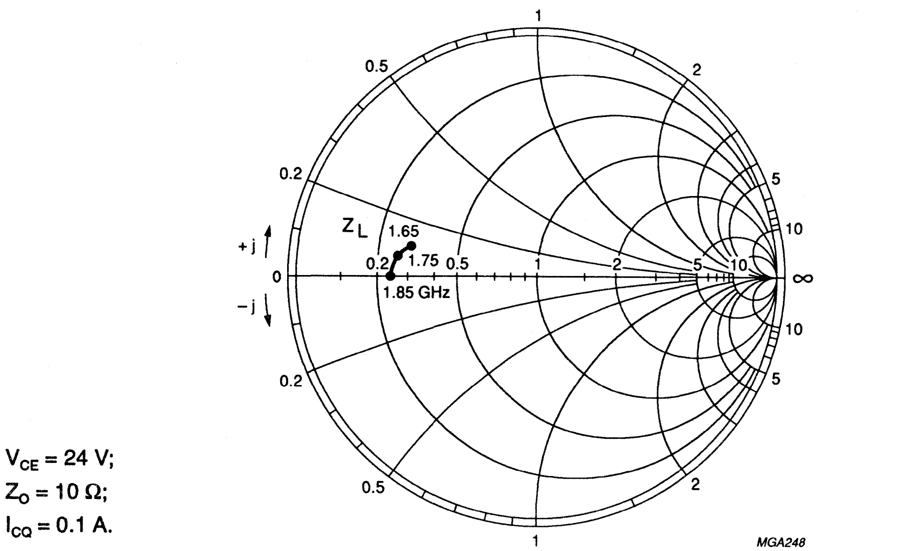


Fig.9 Optimum load impedance as a function of frequency; typical values.

NPN silicon planar epitaxial microwave power transistor

LLE18150X

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 and output 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 2.0 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-229 glued cap metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	0.05	≥12	≥7.8	typ. 43	see Figs 6 and 7

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

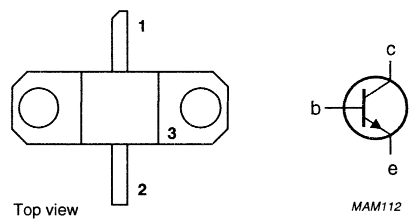


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

NPN silicon planar epitaxial microwave power transistor

LLE18150X

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	22	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	3	A
P_i	input power	f = 1.85 GHz; V_{CE} = 24 V; class AB	–	4	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	25	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.

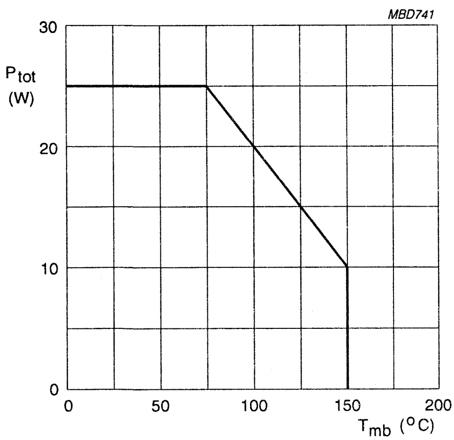


Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	3.6	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; V_{CB} = 20 V	–	1.5	mA
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = 0 mA; R_{BE} = 220 Ω	30	–	V
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 10 mA	45	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 10 mA	3	–	V
h_{FE}	DC current gain	I_C = 0.5 A; V_{CE} = 3 V	15	100	

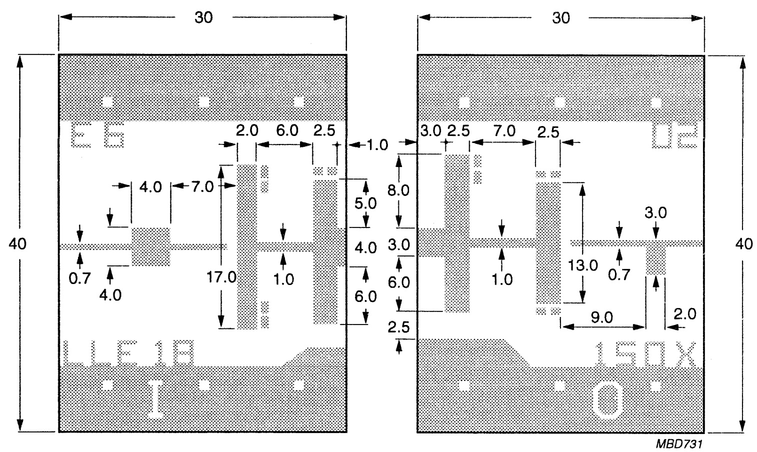
APPLICATION INFORMATION

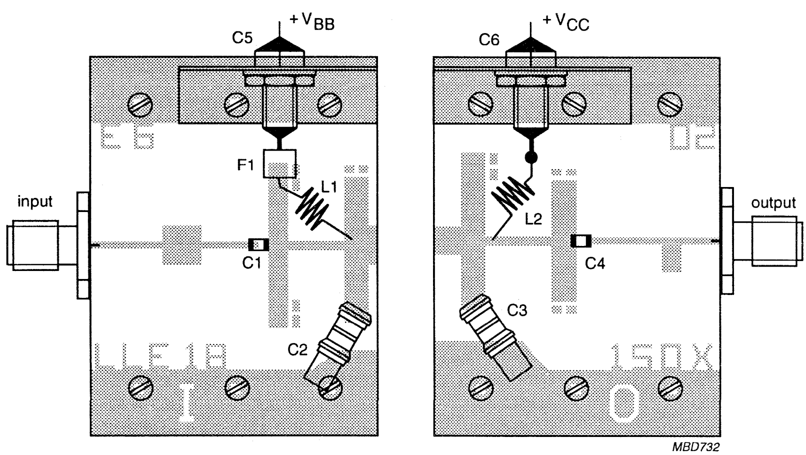
Microwave performance up to T_{mb} = 25 °C in a common emitter class AB amplifier.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (A)	P_{L1} (W)	G_{po} (dB)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	0.05	≥12 typ. 15	≥7.8 typ. 8.5	typ. 43	see Figs 6 and 7

NPN silicon planar epitaxial microwave power transistor

LLE18150X





The test circuit is split into two independent halves, each being 30 x 40 mm in size.
Dimensions in mm.
Substrate: Epsilam 10.
Thickness: 0.635 mm.
Permittivity: $\varepsilon_r = 10$.

Fig.3 Prematching test circuit board.

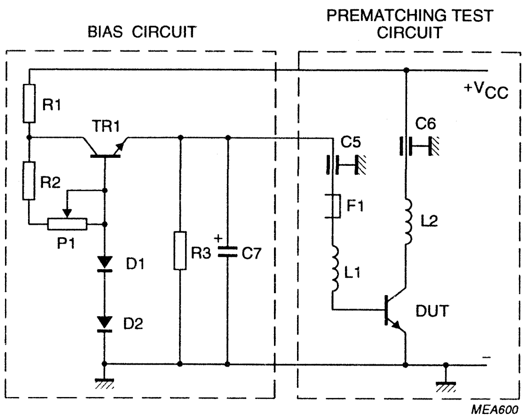


Fig.4 Class AB bias circuit.

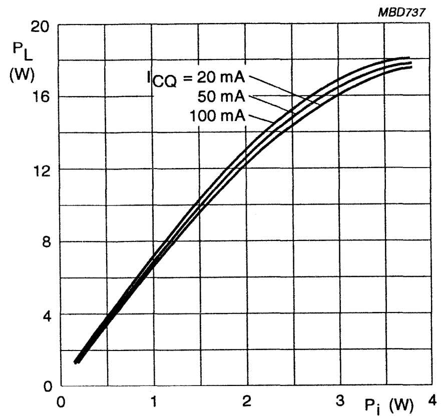
List of components (see Figs 3 and 4).

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
TR1	transistor, BDT91 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
C5, C6	feedthrough bypass capacitor	1500 pF	Erie 1250-003
C7	electrolytic capacitor	10 μF, >30 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
P1	linear potentiometer	4.7 kΩ	
R1	resistor	100 Ω, 0.25 W	
R2	resistor	10 kΩ, 0.25 W	
R3	resistor	56 Ω, 0.25 W	
F1	ferrite bead		Philips tube, 12NC = 4330 030 43081 4.2 x 2.2 x 3.2 mm (4B1)

Notes

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

NPN silicon planar epitaxial microwave power transistor



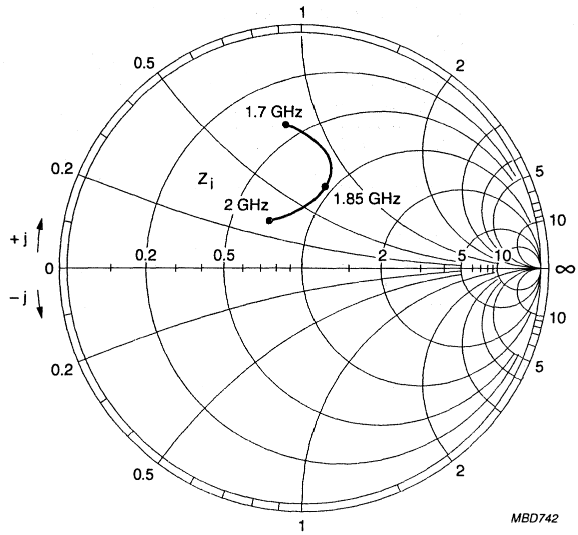
V_{CE} = 24 V; f = 1850 MHz.

Fig.5 Load power as a function of input power.

Input and optimum load impedances.

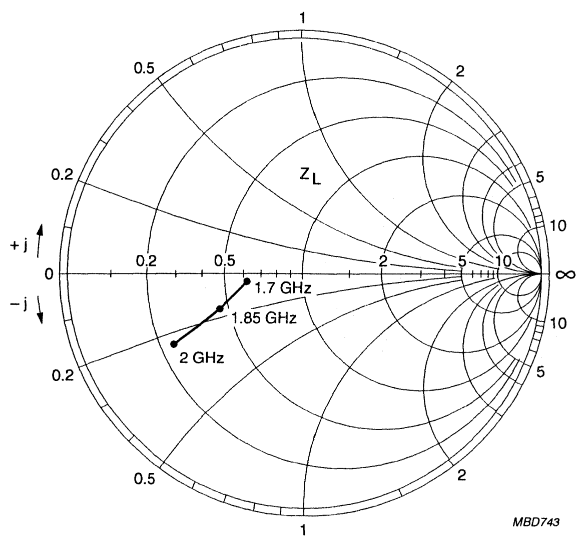
V_{CE} = 24 V; I_{CQ} = 50 mA; Z_o = 10 Ω (see Figs 6 and 7); typical values at $P_L = P_{L1}$.

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.70	4.5 + j8.0	6.2 – j0.5
1.80	7.5 + j9.0	5.7 – j1.0
1.85	9.2 + j8.2	4.7 – j1.7
1.90	9.5 + j6.5	3.9 – j2.2
2.00	7.0 + j3.0	2.7 – j2.4



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 50 mA.

Fig.6 Input impedance as a function of frequency; typical values at $P_L = P_{L1}$



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 50 mA.

Fig.7 Optimum load impedance as a function of frequency; typical values at $P_L = P_{L1}$.

NPN silicon planar epitaxial microwave power transistor

LLE18300X

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 and output 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 FO-229 glued cap metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	0.1	≥27	≥7.8	typ. 40	see Figs 8 and 9

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

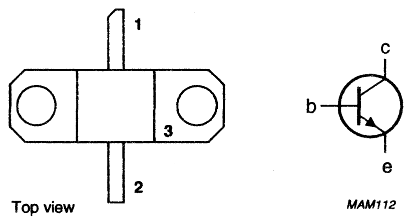


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

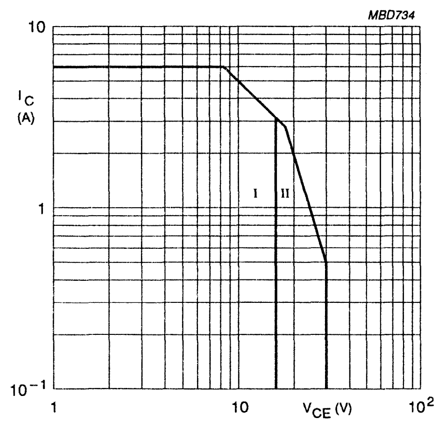
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	6	A
P_i	input power	f = 1.85 GHz; V_{CE} = 24 V; class AB	–	8	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	50	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



T_{mb} ≤ 75 °C.
(I) Region of permissible DC operation.
(II) Permissible extension provided R_{BE} ≤ 220 Ω.

Fig.2 DC SOAR.

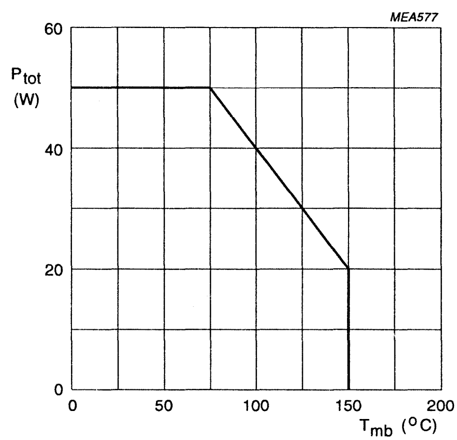


Fig.3 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	2	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

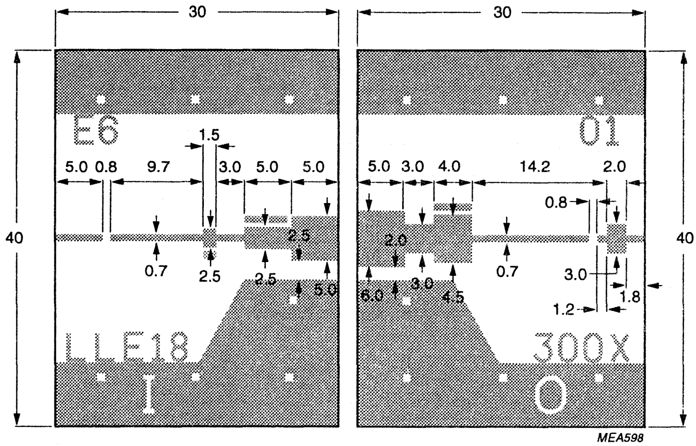
T_{mb} = 25 °C unless otherwise specified.

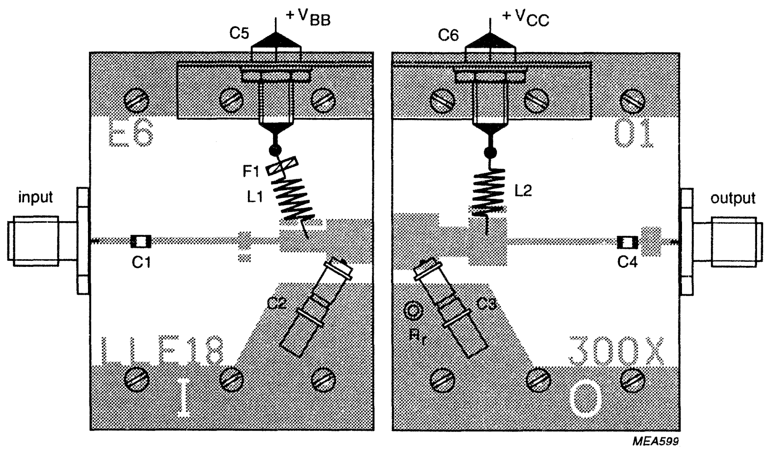
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 20 V	–	3	mA
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = 15 mA; R_{BE} = 220 Ω	30	–	V
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 15 mA	45	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage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

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	0.1	≥27 typ. 30	≥7.8 typ. 8.6	typ. 40	see Figs 8 and 9





The test circuit is split into two independent halves, each being 30 x 40 mm in size.
Dimensions in mm.
Substrate: Epsilam 10.
Thickness: 0.635 mm.
Permittivity: $\varepsilon_r = 10$.

Fig.4 Prematching test circuit board.

NPN silicon planar epitaxial microwave power transistor

LLE18300X

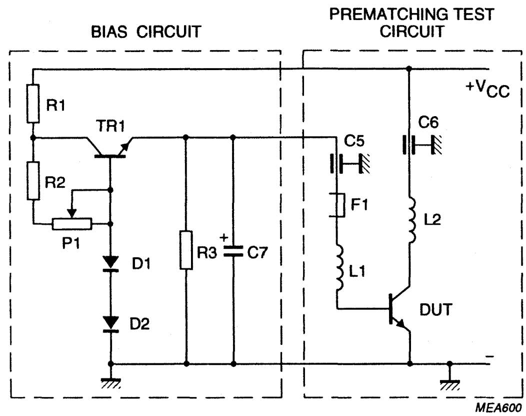


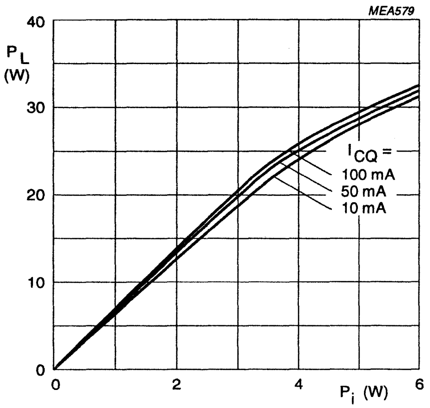
Fig.5 Class AB bias circuit.

List of components (see Figs 4 and 5).

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
TR1	transistor, BDT91 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
C5, C6	feedthrough bypass capacitor	1500 pF	Erie 1250-003
C7	electrolytic capacitor	10 µF, >30 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	3 turns 0.5 mm copper wire; internal diameter = 2 mm		
P1	linear potentiometer	4.7 kΩ	
R1	resistor	100 Ω, 0.25 W	
R2	resistor	10 kΩ, 0.25 W	
R3	resistor	56 Ω, 0.25 W	
F1	ferrite bead		Philips tube, 12NC = 4330 030 43081 4.2 x 2.2 x 3.2 mm (4B1)
R_r	copper rivet		

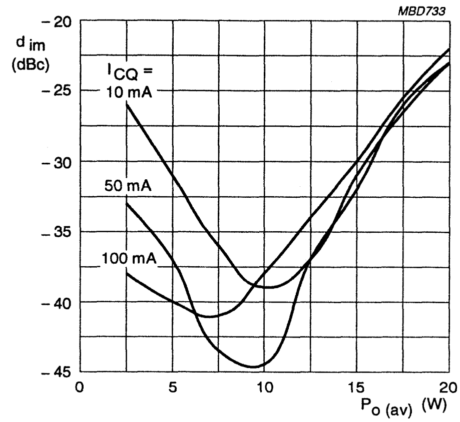
Notes

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



V_{CE} = 24 V; f = 1850 MHz.

Fig.6 Load power as a function of input power.



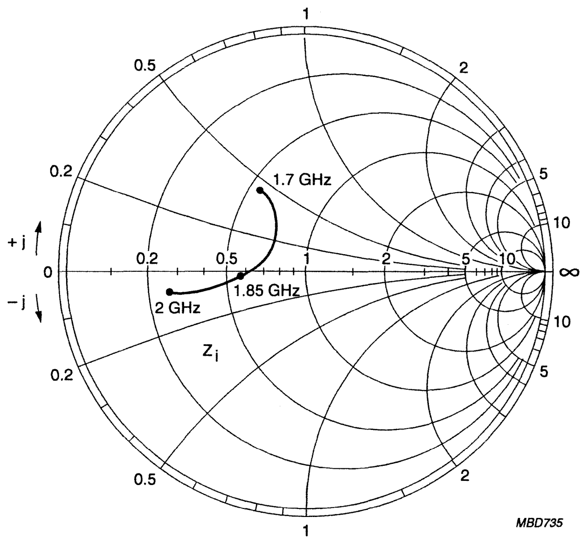
V_{CE} = 24 V; f_1 = 1850 MHz; f_2 = 1850.2 MHz.

Fig.7 Intermodulation distortion as a function of average output power.

Input and optimum load impedances.

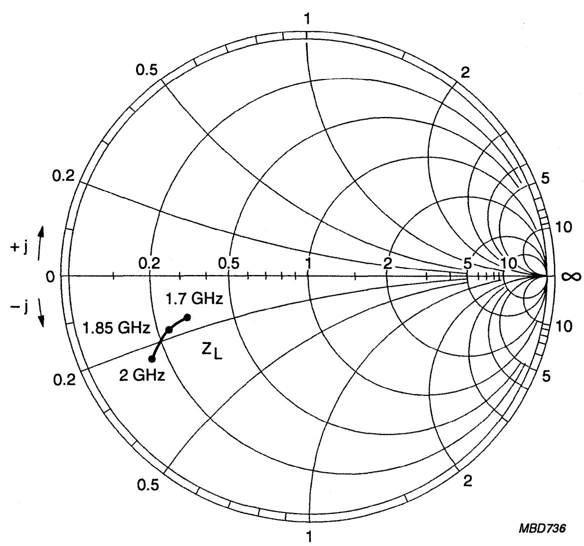
V_{CE} = 24 V; I_{CQ} = 0.1 A; Z_o = 10 Ω (see Figs 8 and 9); typical values at $P_L = P_{L1}$.

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.70	5.6 + j4.0	3.0 − j1.6
1.75	6.4 + j2.7	2.7 − j1.7
1.80	6.3 + j1.1	2.4 − j1.8
1.85	5.5 + j0.2	2.2 − j1.9
1.90	4.4 − j0.8	2.0 − j2.1
1.95	3.4 − j1.0	1.8 − j2.3
2.00	2.6 − j0.8	1.7 − j2.5



$V_{CE} = 24$ V; $Z_o = 10$ Ω; $I_{CQ} = 0.1$ A.

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



$V_{CE} = 24$ V; $Z_o = 10$ Ω; $I_{CQ} = 0.1$ A.

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

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon transistor for use in common-emitter class-A linear amplifiers up to 4 GHz.

Diffused emitter ballasting resistors, self-aligned process entirely ion implanted and gold sandwich metallization ensure an optimum temperature profile with excellent performance and reliability.

QUICK REFERENCE DATA

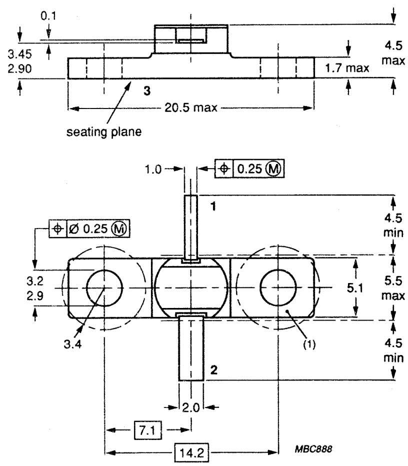
RF performance up to T_{mb} = 25 °C in an unneutralized common-emitter class-A circuit

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} mW	G_{p0} dB
c.w.; linear amplifier	4	18	30	typ. 200	typ. 8

MECHANICAL DATA

Dimensions in mm

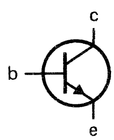
Fig. 1 FO-41B.



Emitter and metallic cap connected to the seating plane.

Pinning:

1 = collector
2 = base
3 = emitter



Torque on screw: max. 0,5 Nm
Recommended screw: M2,5

Marking code: 4002S = LTE4002S

(1) Flatness of this area ensures full thermal contact with bolt head.

WARNING

Product and environmental safety – toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	40 V
Collector-emitter voltage			
open base	V_{CEO}	max.	16 V
$R_{BE} = 220\ \Omega$	V_{CER}	max.	35 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	90 mA
Total power dissipation up to $T_{mb} = 75\ ^oC$	P_{tot}	max.	1 W
Storage temperature range	T_{stg}		−65 to +200 ^oC
Junction temperature	T_j	max.	200 ^oC
Lead soldering temperature at 0.3 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 ^oC

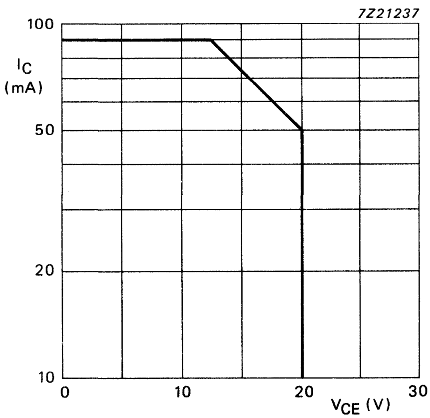


Fig. 2 DC SOAR at $T_{mb} \leqslant 75\ ^oC$; $R_{BE} < 220\ \Omega$.

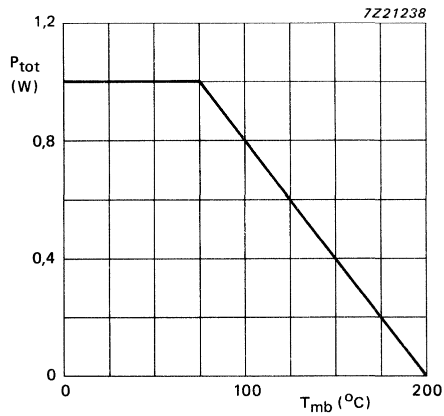


Fig. 3 Power derating curve.

THERMAL RESISTANCE (at Tj=75 ^oC)

From junction to mounting base	$R_{th\ j\text{-}mb}$ =	45 K/W

CHARACTERISTICS

$T_{mb} = 25\ ^oC$; unless otherwise specified

Collector cut-off currents			
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	100 nA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	<	150 μA
$V_{BC} = 35$ V; $R_{BE} = 200\ \Omega$	I_{CER}	<	500 μA
Emitter cut-off currents			
$I_C = 0$; $V_{EB} = 1{,}5$ V	I_{EBO}	<	50 nA
DC current gain			
$I_C = 30$ mA; $V_{CE} = 5$ V	h_{FE}		15 to 150

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon transistor for use in common-emitter class-A linear power amplifiers up to 4.2 GHz.

Diffused emitter ballasting resistors, self-aligned process entirely ion implanted and gold sandwich metallization ensure an optimum temperature profile with excellent performance and reliability.

An input matching cell improves the input impedance and facilitates the design of wideband circuits.

The transistors are housed in a metal-ceramic envelope (FO-41B).

The LTE21009RA is tested by sampling on RF parameters.

QUICK REFERENCE DATA

RF performance up to T_{mb} = 25 °C in a common-emitter class-A circuit

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} W	G_{po} dB
CW; class-A	2.1	16	150	≥ 0.6	≥ 10

MECHANICAL DATA

Dimensions in mm

FO-41B (see Fig.1).

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

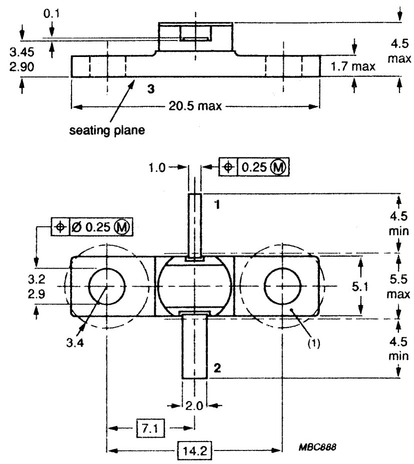
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

MECHANICAL DATA

Dimensions in mm

Fig.1 FO-41B.

Emitter and metallic cap are connected to the seating plane.



Pinning:

1 = collector
2 = base
3 = emitter

Torque on screw : max. 0.4 Nm
Recommended screw: M2.5

Marking code:

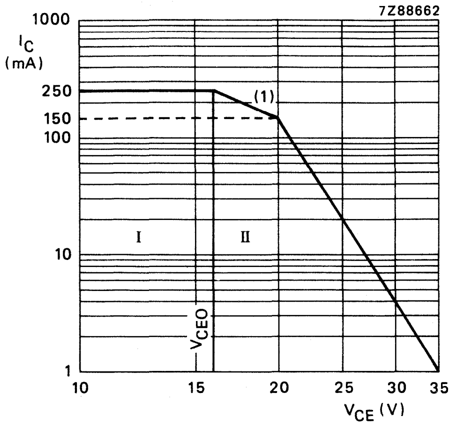
435 = LTE21009R
435A = LTE21009RA

(1) Flatness of this area ensures full thermal contact with bold head.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage			
open emitter	V_{CBO}	max.	40 V
Collector-emitter voltage			
R_{BE} = 100 Ω	V_{CER}	max.	35 V
open base	V_{CEO}	max.	16 V
Emitter-base voltage			
open collector	V_{EBO}	max.	3.0 V
Collector current (DC)	I_C	max.	250 mA
Total power dissipation			
up to T_{mb} = 75 °C	P_{tot}	max.	4.0 W
Storage temperature range	T_{stg}		−65 to + 200 °C
Junction temperature	T_j	max.	200 °C
Lead soldering temperature at			
0.3 mm from case; $t_{std} \leqslant 10$ s	T_{sld}	max.	235 °C



(1) Second breakdown limit
(independent of temperature).

Fig.2 DC SOAR at $T_{mb} \leqslant 75\ ^oC$.

I Region of permissible DC operation.
II Permissible extension provided $R_{BE} \leqslant 100\ \Omega$.

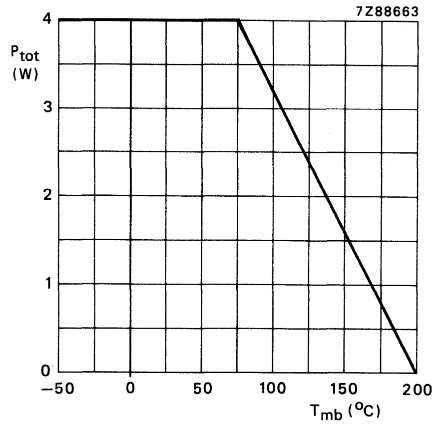


Fig.3 Power derating curve.

THERMAL RESISTANCE (T_{mb} = 25 ^{o}C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	36 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7 K/W

CHARACTERISTICS

T_{mb} = 25 ^{o}C unless otherwise specified

Collector cut-off current			
$I_E = 0$; V_{CB} = 20 V	I_{CBO}	max.	50 μA
$I_E = 0$; V_{CB} = 40 V	I_{CBO}	max.	0.4 mA
Emitter cut-off current			
$I_C = 0$; V_{EB} = 1.5 V	I_{EBO}	max.	200 nA
DC current gain			
I_C = 150 mA; V_{CE} = 5 V	h_{FE}	min.	15
		max.	150

Data sheet	
status	Product specification
date of issue	June 1992

LTE21015R
NPN silicon planar epitaxial microwave power transistor

FEATURES

- Interdigitated structure; high emitter efficiency.
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding at a high VSWR.
- Gold metallization realizes very good stability of the characteristics and excellent life time.
- Multicell geometry gives good balance of dissipated power and low thermal resistance.
- Input matching cell allows an easier design of circuits.

APPLICATION

Intended for use in common-emitter class A linear power amplifier up to 2 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common-emitter class A linear power amplifier up to 2 GHz.
The transistor has a FO-41B metal ceramic flange package, with emitter connected to flange.
It is mounted in common-emitter configuration, and specified in class A.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common emitter class A amplifier.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_C (mA)	P_{L1} (W)	G_{po} (dB)	z_i / Z_L (Ω)
class A	2	16	250	≥ 1.5	> 8.5	see Figs 6 and 7

WARNING

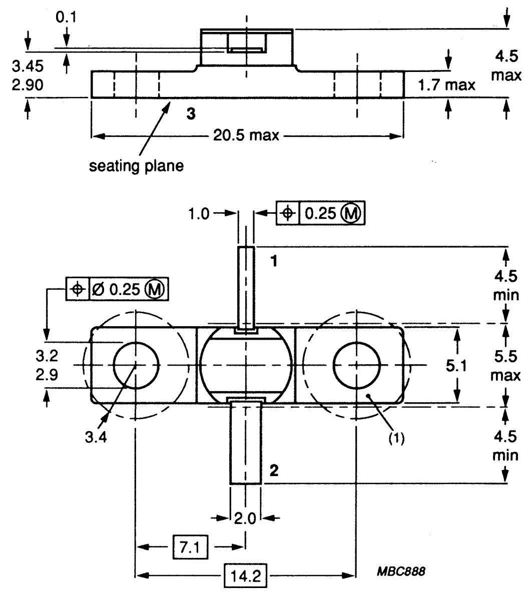
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. **After use, 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.**

NPN silicon planar epitaxial microwave power transistor

LTE21015R

MECHANICAL DATA

Dimensions in mm



Emitter and metallic cap are connected to seating plane.

Torque on screw: max. 0.4 nm
Recommended screw: M 2.5
Marking code: 436 = LTE21015R

Fig.1 FO-41B.

PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

NPN silicon planar epitaxial microwave power transistor

LTE21015R

LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	-	40	V
V_{CER}	collector-emitter voltage	$R_{BE} = 250\ \Omega$	-	20	V
V_{CEO}	collector-emitter voltage	open base	-	16	V
V_{EBO}	emitter-base voltage	open collector	-	3.0	V
I_C	collector current (DC)		-	0.45	A
P_{tot}	total power dissipation	$T_{mb} = 75\ °C$; see Fig.3	-	7.5	W
T_{stg}	storage temperature range		−65	200	°C
T_j	operating junction temperature		-	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; up to 0.2 mm from ceramic	-	235	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	from junction to mounting base	$T_j = 70\ °C$	12	K/W
$R_{th\ mb\text{-}h}$	from mounting base to heatsink		0.7	K/W

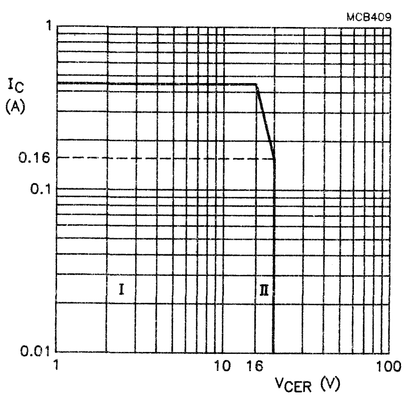


Fig.2 DC SOAR ($T_{mb} = 75\ °C$).
I: Region of permissible DC operation
II: Permissible extension provide $R_{BE} < 250\ \Omega$.

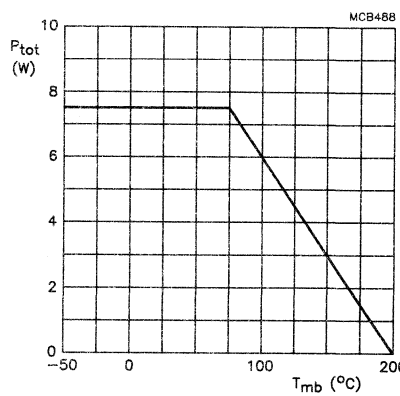


Fig.3 Maximum power dissipation derating as a function of mounting base temperature; P_{tot} max. = 7.5 W.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 20 V; I_E = 0	-	150	µA
I_{CBO}	collector cut-off current	V_{CB} = 40 V; I_E = 0	-	1	mA
I_{CER}	collector cut-off current	V_{CE} = 20 V; R_{BE} = 270 Ω	-	0.5	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	-	1.5	µA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 250 mA	15	150	

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the common emitter test circuit as shown and working in CW class A mode.

MODE OF OPERATION	f (GHz)	V_{CC} (V) note 1	I_C (mA) note 1	P_{L1} (W) note 2	G_{po} (dB) note 3	z_i / Z_L (Ω)
class A	2	16	250	≥ 1.5 typ.1.8	≥ 8.5 typ.9.5	see Figs 6 and 7

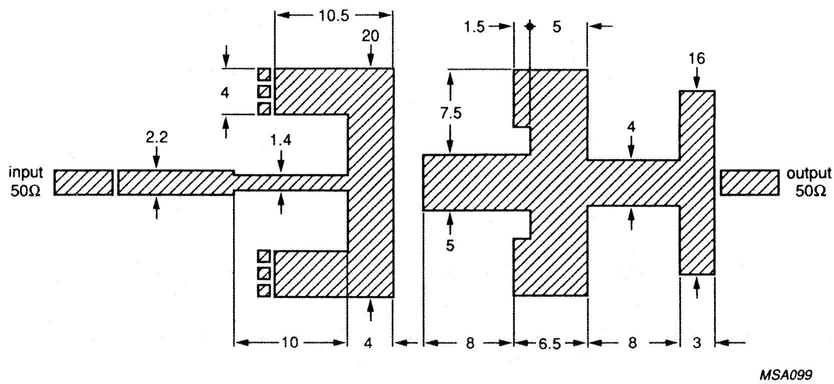
Notes

1. I_C and V_{CE} regulated
2. Load power for 1 dB compression of gain
3. Linear gain

NPN silicon planar epitaxial microwave power transistor

LTE21015R

Dimensions in mm



Substrate: Teflon fibre glass
ε = 2.55
thickness= 0.8 mm

Fig.4 Narrowband test circuit

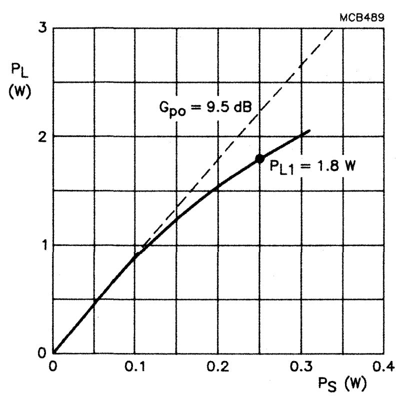


Fig.5 Load power P_L as a function of source power P_S;
V_{CE} = 16 V; I_C = 250 mA (regulated);
(In narrowband test circuit as shown in Fig.4).

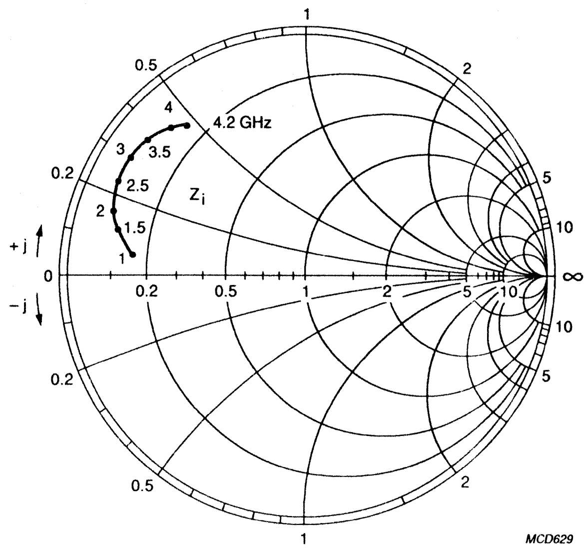


Fig.6 Input impedance as a function of frequency for P_{L1}; associated with optimum load impedance; V_{CE} = 16 V; I_C = 250 mA; Z_o = 50 Ω.

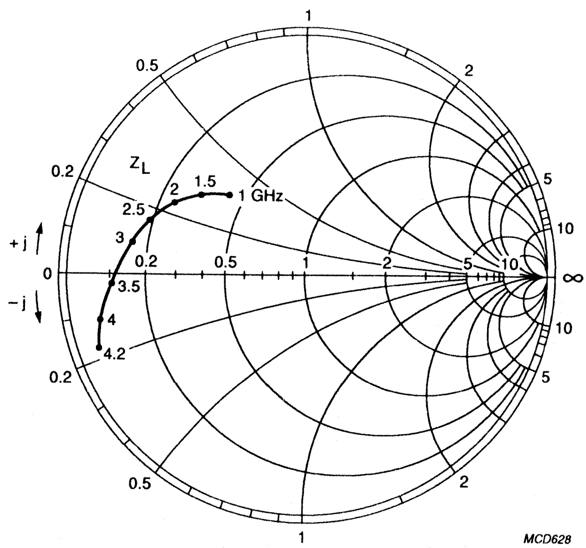


Fig.7 Optimum load impedance as a function of frequency for P_{L1}; associated with input impedance; V_{CE} = 16 V; I_C = 250 mA; Z_o = 50 Ω.

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon transistor for use in common-emitter class-A linear power amplifiers up to 4.2 GHz.

Diffused emitter ballasting resistors, self-aligned process entirely ion implanted and gold sandwich metallization ensure an optimum temperature profile with excellent performance and reliability.

An input matching cell improves the input impedance and facilitates the design of wideband circuits.

The transistor is housed in a metal-ceramic envelope (FO-41B).

QUICK REFERENCE DATA

RF performance up to T_{mb} = 25 °C in a common-emitter class-A circuit

Mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} W	G_{po} dB
CW class-A	2.1	16	400	typ. 2.8	typ. 7.8

MECHANICAL DATA

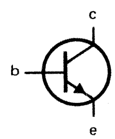
Dimensions in mm

Fig. 1 FO-41B.

Emitter and metallic cap are connected to the seating plane.

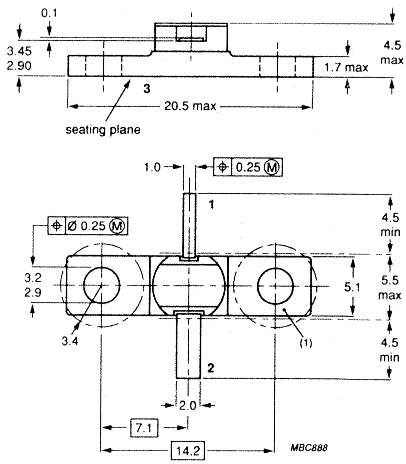
Pinning:

1 = collector
2 = base
3 = emitter



Torque on screw: max. 0.4 Nm
Recommended screw: M2.5

Marking code:
439 = LTE21025R



(1) Flatness of this area ensures full thermal contact with bolt head.

WARNING

Product and environmental safety — toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage open emitter	V_{CBO}	max.	40 V
Collector-emitter voltage $R_{BE} = 70\ \Omega$	V_{CER}	max.	20 V
open base	V_{CEO}	max.	16 V
Emitter-base voltage open collector	V_{EBO}	max.	3.0 V
Collector current (DC)	I_C	max.	800 mA
Total power dissipation up to $T_{mb} = 75\ ^oC$	P_{tot}	max.	8.0 W
Storage temperature range	T_{stg}		−65 to +200 ^oC
Junction temperature	T_j	max.	200 ^oC
Lead soldering temperature at 0.3 mm from case; $t_{std} \leqslant 10$ s	T_{sld}	max.	235 ^oC

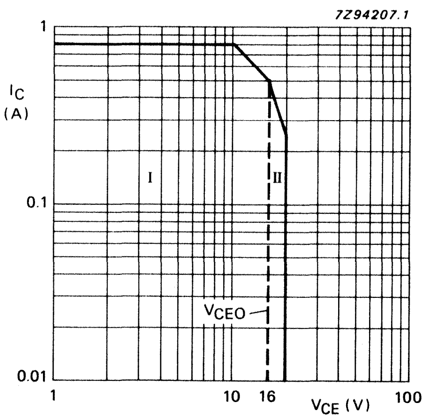


Fig. 2 DC SOAR at $T_{mb} \leqslant 75\ ^oC$.
I Region of permissible DC operation.
II Permissible extention provided $R_{BE} \leqslant 70\ \Omega$.

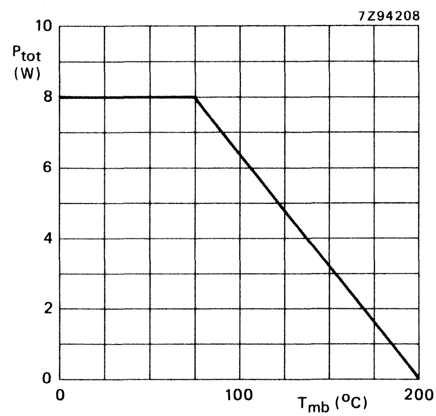


Fig. 3 Power derating curve.

THERMAL RESISTANCE (T_j = 75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	10 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	225 μA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	max.	1.5 mA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	600 nA
DC current gain			
$I_C = 400$ mA; $V_{CE} = 5$ V	h_{FE}	min.	15
		max.	150
Collector-base capacitance at f = 1 MHz			
$I_E = I_C = 0$; $V_{CB} = 16$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	3 pF
Collector-emitter capacitance at f = 1 MHz			
$I_C = I_E = 0$; $V_{CE} = 16$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	1.5 pF
Emitter-base capacitance at f = 1 MHz			
$I_C = I_E = 0$; $V_{EB} = 1$ V; $V_{CB} = 10$ V	C_{eb}	typ.	28 pF

s-parameters (common-emitter)

Typical values; V_{CE} = 16 V; I_C = 400 mA; Z_0 = 50 Ω; T_{mb} = 25 °C.

f GHz	s_{ie}	s_{re}	s_{fe}	s_{oe}
0,5	0,94/176°	0,017(−35,4)/ 43°	2,79(8,9)/ 81°	0,49/−173°
0,6	0,94/174°	0,018(−34,7)/ 46°	2,39(7,6)/ 77°	0,54/−173°
0,7	0,94/173°	0,019(−34,4)/ 47°	2,07(6,3)/ 72°	0,52/−176°
0,8	0,93/172°	0,020(−34,1)/ 49°	1,85(5,3)/ 68°	0,52/−177°
0,9	0,93/170°	0,021(−33,8)/ 49°	1,66(4,4)/ 64°	0,53/−179°
1,0	0,93/168°	0,022(−33,3)/ 50°	1,50(3,5)/ 60°	0,53/ 179°
1,1	0,92/167°	0,023(−32,6)/ 50°	1,39(2,9)/ 57°	0,53/ 179°
1,2	0,93/166°	0,026(−31,6)/ 50°	1,31(2,4)/ 53°	0,54/ 177°
1,3	0,93/164°	0,029(−30,6)/ 49°	1,23(1,8)/ 49°	0,54/ 176°
1,4	0,93/167°	0,032(−29,9)/ 54°	1,16(1,3)/ 48°	0,55/ 179°
1,5	0,93/163°	0,037(−28,7)/ 54°	1,11(0,9)/ 43°	0,54/ 176°
1,6	0,93/162°	0,040(−27,9)/ 53°	1,07(0,6)/ 39°	0,55/ 175°
1,7	0,93/161°	0,042(−27,5)/ 51°	1,03(0,3)/ 35°	0,55/ 176°
1,8	0,92/159°	0,043(−27,3)/ 49°	0,99(−0,1)/ 30°	0,56/ 174°
2,0	0,88/151°	0,046(−26,7)/ 46°	0,99(−0,1)/ 22°	0,56/ 170°
2,2	0,89/148°	0,052(−25,7)/ 43°	0,92(−0,7)/ 14°	0,57/ 168°
2,4	0,90/147°	0,059(−24,6)/ 41°	0,88(−1,1)/ 9°	0,58/ 168°
2,6	0,90/147°	0,069(−23,2)/ 38°	0,90(−0,9)/ 1°	0,59/ 168°
2,8	0,87/142°	0,073(−22,8)/ 32°	0,88(−1,1)/ −8°	0,60/ 169°
3,0	0,83/134°	0,075(−22,5)/ 26°	0,90(−0,9)/ −18°	0,61/ 168°
3,2	0,82/129°	0,077(−22,2)/ 21°	0,87(−1,2)/ −27°	0,63/ 166°
3,4	0,83/130°	0,085(−21,4)/ 18°	0,90(−1,0)/ −37°	0,65/ 165°
3,6	0,80/130°	0,091(−20,8)/ 11°	0,91(−0,8)/ −50°	0,69/ 165°
3,8	0,73/127°	0,091(−20,8)/ 3°	0,94(−0,5)/ −64°	0,74/ 164°
4,0	0,69/122°	0,087(−21,2)/ −7°	0,95(−0,5)/ −82°	0,79/ 162°
4,2	0,67/122°	0,078(−22,2)/−15°	0,89(−1,0)/−100°	0,84/ 157°
4,4	0,69/126°	0,071(−23,0)/−19°	0,83(−1,7)/−121°	0,89/ 150°
4,6	0,72/130°	0,059(−24,6)/−18°	0,70(−3,1)/−141°	0,92/ 143°
4,8	0,76/128°	0,054(−25,4)/−11°	0,60(−4,4)/−160°	0,94/ 136°

The figures between brackets are values in dB.

MICROWAVE LINEAR POWER TRANSISTOR

NPN transistors for use in a common-emitter class-A linear power amplifier up to 4.2 GHz.

Diffused emitter ballasting resistors, self-aligned process entirely ion implanted and gold sandwich metallization ensure an optimum temperature profile and excellent performance and reliability.

An input matching cell improves the input impedance and facilitates the design of wideband circuits.

QUICK REFERENCE DATA

RF performance up to T_{mb} = 25 °C in a common-emitter class-A circuit.

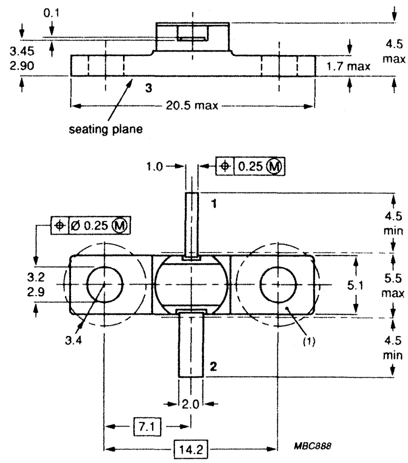
type no.	mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} mW	G_{po} dB	z_i Ω	Z_L Ω
LTE42005S	CW linear ampl.	4.2	18	110	≥ 450	≥ 6.6	100 + j40	4 + j4

MECHANICAL DATA

Dimensions in mm

Fig.1 FO-41B.

Emitter and metallic cap are connected to the seating plane.



Pinning

1 = collector
2 = base
3 = emitter

Torque on nut: max. 0.4 Nm

Recommended screw: M2.5

Marking code

502 = LTE42005S

(1) Flatness of this area ensures full thermal contact with bolt head.

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.

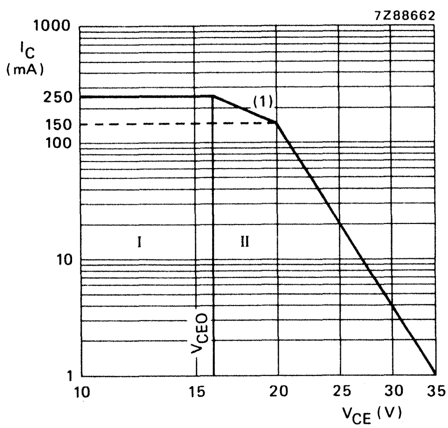
RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	40 V
Collector-emitter voltage R_{BE} = 100 Ω	V_{CER}	max.	35 V
(open base)	V_{CEO}	max.	16 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	250 mA
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	4 W
Storage temperature range	T_{stg}	−65 to + 200 °C	
Junction temperature	T_j	max.	200 °C
Lead soldering temperature at 0.3 mm from the case; t_{sld} = 10 s	T_{sld}	max.	235 °C

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\,j\text{-}mb}$	max.	36 K/W*
From mounting base to heatsink	$R_{th\,mb\text{-}h}$	max.	0.7 K/W*



(1) Second breakdown limit (independent of temperature).

Fig.2 DC SOAR at $T_{mb} \leqslant 75$ °C.

I Region of permissible DC operation.

II Permissible extension provided $R_{BE} \leqslant 100\ \Omega$.

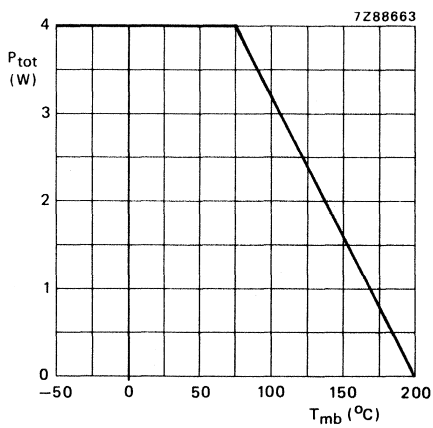


Fig.3 Power derating curve as a function of mounting base temperature.

* K/W is SI unit for °C/W.

CHARACTERISTICS

T_{mb} = 25 °C

Collector cut-off current				
I_E = 0; V_{CB} = 20 V	I_{CBO}	max.	0.1	μA
I_E = 0; V_{CB} = 40 V	I_{CBO}	max.	0.25	mA
V_{CE} = 35 V; R_{BE} = 100 Ω	I_{CER}	max.	1	mA
Emitter cut-off current				
I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	200	nA
DC current gain				
I_C = 110 mA; V_{CE} = 5 V	h_{FE}	min.	15	
		max.	150	
Collector-base capacitance at f = 1 MHz				
I_E = I_C = 0; V_{CB} = 20 V; V_{EB} = 1.5 V	C_{cb}	typ.	0.5	pF
Collector-emitter capacitance at f = 1 MHz				
I_C = I_E = 0; V_{CE} = 20 V; V_{EB} = 1.5 V	C_{ce}	typ.	1.5	pF
Emitter-base capacitance at f = 1 MHz				
I_C = I_E = 0; V_{EB} = 1 V; V_{CB} = 10 V	C_{eb}	typ.	6.5	pF

s-parameters (common-emitter)

V_{CE} = 18 V, I_C = 110 mA } regulated; T_{mb} = 25 °C; Z_o = 50 Ω; typical values.

f GHz	s_{ie}	s_{re}	s_{fe}	s_{oe}
0,5	0,76/−176°	0,022(−33,2)/37°	8,13(18,2)/85°	0,35/−62°
0,6	0,75/+180°	0,023(−32,8)/37°	6,95(16,8)/78°	0,34/−66°
0,7	0,76/+177°	0,023(−32,8)/40°	5,95(15,5)/73°	0,34/−71°
0,8	0,76/+174°	0,024(−32,5)/41°	5,25(14,4)/67°	0,35/−75°
0,9	0,76/+171°	0,024(−32,3)/42°	4,69(13,4)/62°	0,35/−79°
1,0	0,75/+168°	0,026(−31,8)/43°	4,23(12,5)/57°	0,36/−83°
1,1	0,75/+165°	0,028(−31,0)/43°	3,88(11,8)/53°	0,37/−87°
1,2	0,74/+163°	0,031(−30,1)/43°	3,61(11,2)/49°	0,39/−90°
1,3	0,75/+160°	0,035(−29,2)/43°	3,36(10,5)/44°	0,40/−95°
1,4	0,74/+162°	0,037(−28,5)/44°	3,12(9,9)/41°	0,43/−98°
1,5	0,73/+157°	0,041(−27,8)/46°	2,95(9,4)/37°	0,43/−101°
1,6	0,73/+155°	0,045(−27,0)/46°	2,83(9,0)/32°	0,45/−104°
1,7	0,71/+154°	0,047(−26,5)/44°	2,70(8,6)/28°	0,47/−107°
1,8	0,70/+151°	0,049(−26,1)/43°	2,56(8,2)/23°	0,48/−110°
1,9	0,69/+148°	0,050(−25,9)/42°	2,44(7,7)/19°	0,50/−114°
2,0	0,68/+143°	0,051(−25,9)/39°	2,34(7,4)/ 14°	0,51/−116°
2,2	0,67/+138°	0,058(−24,7)/36°	2,16(6,7)/ 4°	0,55/−124°
2,4	0,65/+134°	0,067(−23,5)/34°	2,02(6,1)/ −2°	0,59/−129°
2,6	0,62/+129°	0,077(−22,3)/31°	1,95(5,8)/−12°	0,64/−134°
2,8	0,57/+122°	0,082(−21,7)/25°	1,84(5,3)/−21°	0,68/−138°
3,0	0,52/+113°	0,086(−21,3)/21°	1,78(5,0)/−32°	0,72/−143°
3,2	0,49/+104°	0,093(−20,6)/16°	1,67(4,5)/−42°	0,74/−150°
3,4	0,45/ +99°	0,102(−19,8)/13°	1,62(4,2)/−52°	0,80/−157°
3,6	0,38/ +92°	0,113(−18,9)/ 8°	1,52(3,6)/−64°	0,80/−163°
3,8	0,29/ +83°	0,119(−18,5)/ 6°	1,43(3,1)/−76°	0,82/−170°
4,0	0,24/ +69°	0,137(−17,3)/ 2°	1,27(2,1)/ −88°	0,80/−179°
4,2	0,20/ +54°	0,165(−15,7)/ −5°	1,08(0,7)/ −98°	0,68/+171°
4,4	0,15/ +28°	0,202(−13,9)/−20°	0,92(−0,8)/−100°	0,51/+172°
4,6	0,12/ −36°	0,206(−13,7)/−38°	0,93(−0,6)/−102°	0,52/−174°
4,8	0,17/ −86°	0,195(−14,2)/−52°	0,97(−0,3)/−110°	0,63/−171°
5,0	0,24/−114°	0,177(−15,0)/−65°	0,97(−0,3)/−122°	0,73/−174°
5,2	0,31/−137°	0,164(−15,7)/−73°	0,93(−0,6)/−133°	0,79/−180°
5,4	0,41/−152°	0,154(−16,2)/−83°	0,88(−1,1)/−145°	0,83/+174°
5,6	0,48/−161°	0,134(−17,4)/−90°	0,81(−1,8)/−156°	0,85/+166°
5,8	0,53/−168°	0,122(−18,2)/−97°	0,77(−2,3)/−167°	0,87/+160°
6,0	0,56/−179°	0,105(−19,6)/−104°	0,70(−3,1)/−178°	0,89/+154°

The figures given between brackets are values in dB.

APPLICATION INFORMATION

RF performance in CW operation up to T_{mb} = 25 °C in a common-emitter class-A circuit*

f GHz	V_{CE} (1) V	I_C (1) mA	P_{L1} (2) mW (dBm)	G_{po} (3) dB	z_i Ω	Z_L Ω
4.2	18	110	≥ 450(26.5) typ. 550(27.4)	≥ 6.6 typ. 7.2	100 + j40	4 + j4

Notes

1. V_{CE} and I_C regulated.
2. Load power for 1 dB compressed power gain.
3. Low-level power gain associated with P_{L1}.

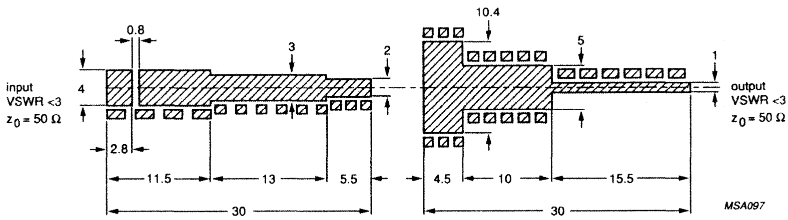


Fig.4 Prematching test circuit board for 4.2 GHz. (Dimensions in mm.)

Input striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric (ϵ_r = 2.54); thickness 1.6 mm.
Output striplines on a double Cu=clad Rexolite printed-circuit board with dielectric (ϵ_r = 2.4); thickness 0.25 mm.

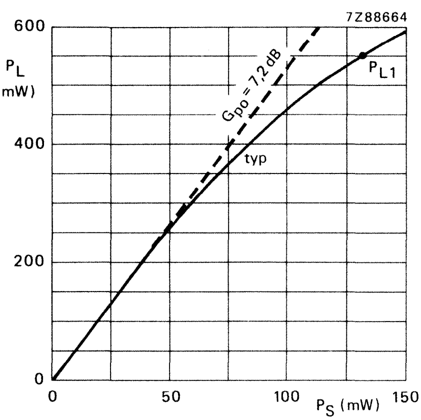


Fig.5 Load power as a function of source power. f = 4.2 GHz; T_{mb} = 25 °C;
V_{CE} = 18 V, I_C = 110 mA } regulated

* Circuit consists of prematching circuit boards in combination with complementary input and output slug tuners.

MICROWAVE LINEAR POWER TRANSISTOR

NPN transistor for use in a common-emitter class-A linear power amplifier up to 4.2 GHz.

Diffused emitter ballasting resistors, self-aligned process entirely ion implanted and gold sandwich metallization ensure an optimum temperature profile and excellent performance and reliability.

An input matching cell improves the input impedance and facilitates the design of wideband circuits.

QUICK REFERENCE DATA

RF performance up to T_{mb} = 25 °C in a common-emitter class-A circuit.

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} mW	G_{po} dB	z_i Ω	Z_L Ω
CW linear ampl.	4.2	16	250	⩾ 800	> 7	7.5 + j23.5	2.5 − j9

MECHANICAL DATA

Dimensions in mm

Fig.1 FO-41B.

Emitter and metallic cap are connected to the seating plane.

Pinning

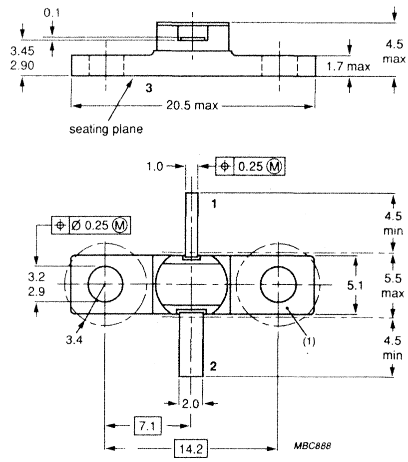
1 = collector
2 = base
3 = emitter

Torque on nut: max. 0.4 Nm

Recommended screw: M2.5

Marking code

196 = LTE42008R



(1) Flatness of this area ensures full thermal contact with bolt head.

WARNING

Product and environmental safety – toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.

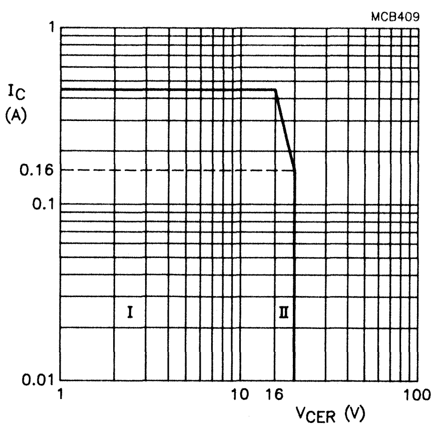
RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	40 V
Collector-emitter voltage R_{BE} = 250 Ω	V_{CER}	max.	20 V
(open base)	V_{CEO}	max.	16 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3.0 V
Collector current (DC)	I_C	max.	450 mA
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	7.5 W
Storage temperature range	T_{stg}		−65 to + 200 °C
Junction temperature	T_j	max.	200 °C
Lead soldering temperature at 0.3 mm from the case; t_{sld} = 10 s	T_{sld}	max.	235 °C

THERMAL RESISTANCE (at T_j = 70 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	12 K/W*
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7 K/W*



(1) Second breakdown limit (independent of temperature).

Fig.2 DC SOAR at $T_{mb} \leqslant$ 75 °C.

I Region of permissible DC operation.

II Permissible extension provided $R_{BE} \leqslant$ 250 Ω.

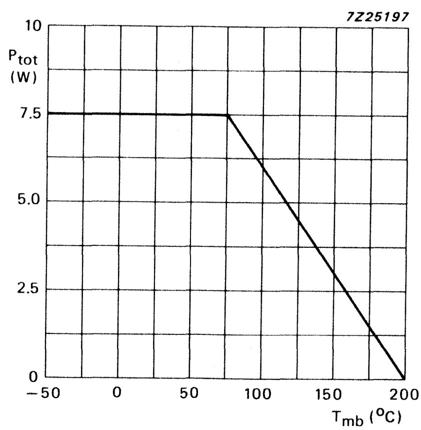


Fig.3 Power derating curve as a function of mounting base temperature.

* K/W is SI unit for °C/W.

CHARACTERISTICS

$T_{mb} = 25\ ^{\circ}C$

Collector cut-off current				
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	150	μA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	max.	1	mA
$V_{CE} = 20$ V; $R_{BE} = 250\ \Omega$	I_{CER}	max.	0.5	mA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	400	nA
DC current gain				
$I_C = 250$ mA; $V_{CE} = 5$ V	h_{FE}	min.	15	
		max.	150	
Collector-base capacitance at f = 1 MHz				
$I_E = I_C = 0$; $V_{CB} = 16$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	2	pF
Collector-emitter capacitance at f = 1 MHz				
$I_C = I_E = 0$; $V_{CE} = 16$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	1.5	pF
Emitter-base capacitance at f = 1 MHz				
$I_C = I_E = 0$; $V_{EB} = 1$ V; $V_{CB} = 10$ V	C_{eb}	typ.	20	pF

s-parameters (common-emitter)

V_{CE} = 16 V; I_C = 250 mA regulated; T_{mb} = 25 °C; Z_o = 50 Ω; typical values.

f GHz	s_{ie}	s_{re}	s_{fe}	s_{oe}
2.0	0.80/160°	0.061/ 61.5°	1.40/ 42.4°	0.45/- 172.7°
2.1	0.79/157°	0.065/ 59.4°	1.37/ 38.0°	0.44/−173.7°
2.2	0.79/155°	0.068/ 56.5°	1.36/ 34.0°	0.44/−175.5°
2.3	0.80/153°	0.071/ 54.3°	1.35/ 29.9°	0.45/−176.5°
2.4	0.79/151°	0.074/ 52.2°	1.35/ 25.3°	0.45/−176.9°
2.5	0.79/150°	0.079/ 50.1°	1.35/ 21.1°	0.45/−177.6°
2.6	0.78/148°	0.085/ 48.4°	1.34/ 16.2°	0.46/−178.0°
2.7	0.77/147°	0.090/ 45.1°	1.34/ 11.8°	0.47/−178.3°
2.8	0.75/146°	0.095/ 41.7°	1.35/ 7.6°	0.48/−178.6°
2.9	0.73/144°	0.099/ 38.3°	1.38/ 2.9°	0.50/−178.9°
3.0	0.71/143°	0.104/ 35.4°	1.40/ −2.6°	0.52/−178.8°
3.1	0.67/143°	0.111/ 31.8°	1.42/ −8.3°	0.55/−179.2°
3.2	0.64/141°	0.116/ 27.4°	1.43/ −14.1°	0.58/−179.9°
3.3	0.60/141°	0.121/ 21.7°	1.44/ −20.4°	0.62/ 178.8°
3.4	0.56/142°	0.124/ 15.7°	1.48/ −28.1°	0.66/ 176.9°
3.5	0.52/143°	0.124/ 11.2°	1.49/ −36.4°	0.70/ 174.4°
3.6	0.49/146°	0.124/ 5.2°	1.48/ −45.1°	0.74/ 171.3°
3.7	0.47/149°	0.122/ −2.2°	1.47/ −53.9°	0.79/ 166.8°
3.8	0.46/154°	0.118/ −9.7°	1.45/ −63.1°	0.84/ 161.9°
3.9	0.48/159°	0.112/−15.7°	1.41/ −72.9°	0.87/ 156.7°
4.0	0.51/161°	0.106/−22.8°	1.34/ −82.5°	0.91/ 150.7°
4.1	0.56/162°	0.096/−29.4°	1.26/ −91.7°	0.94/ 144.8°
4.2	0.61/161°	0.083/−34.5°	1.18/−100.1°	0.96/ 138.6°
4.3	0.67/158°	0.068/−37.4°	1.08/−108.8°	0.97/ 132.5°
4.4	0.71/155°	0.054/−38.7°	0.99/−117.8°	0.98/ 127.3°
4.5	0.76/152°	0.042/−35.4°	0.90/- 126.5°	0.99/ 122.2°
4.6	0.79/147°	0.031/−26.6°	0.81/−134.7°	0.99/ 117.2°
4.7	0.81/143°	0.025/ −5.6°	0.73/−143.0°	0.99/ 113.7°
4.8	0.82/140°	0.026/ 28.8°	0.66/−151.2°	0.99/ 110.0°
4.9	0.82/136°	0.034/ 40.1°	0.59/−158.8°	0.99/ 106.5°
5.0	0.82/132°	0.043/ 52.4°	0.53/−167.3°	0.98/ 103.2°

APPLICATION INFORMATION

RF performance in CW operation up to T_{mb} = 25 °C in a common-emitter class-A circuit*

f GHz	V_{CE} (1) V	I_C (1) mA	P_{L1} (2) mW (dBm)	G_{po} (3) dB	z_i Ω	Z_L Ω
4.2	16	250	≥ 800 (29) typ. 940 (29.7)	≥ 7 typ. 7.5	7.5 + j40	4 + j4

Notes

1. V_{CE} and I_C regulated.
2. Load power for 1 dB compressed power gain.
3. Low-level power gain associated with P_{L1}.

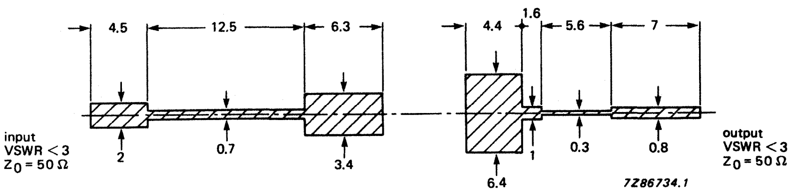


Fig.4 Prematching test circuit board for 4.2 GHz. (Dimensions in mm.)

Input striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric (ϵ_r = 2.54); thickness 1.6 mm.
Output striplines on a double Cu-clad Rexolite printed-circuit board with dielectric (ϵ_r = 2.4); thickness 0.25 mm.

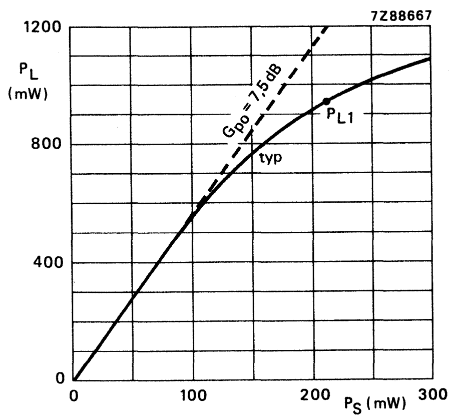


Fig.5 Load power as a function of source power. f = 4.2 GHz; T_{mb} = 25 °C;
V_{CE} = 16 V, I_C = 250 mA } regulated

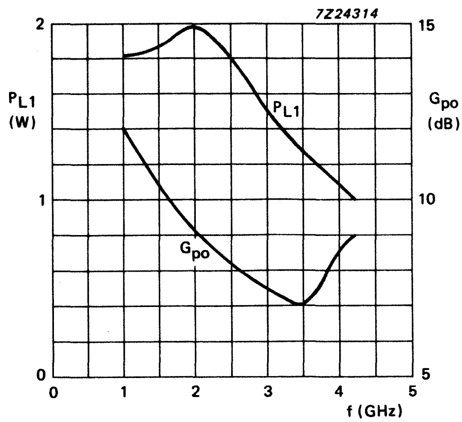


Fig.6 Load power and power gain, associated with 1 dB compressed power gain, as a function of frequency.

* Circuit consists of prematching circuit boards in combination with complementary input and output slug tuners.

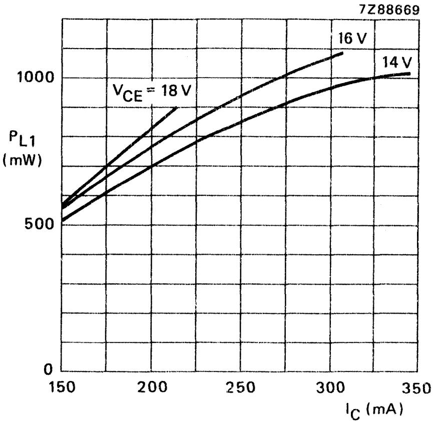


Fig.7 Load power associated with 1 dB compressed power gain, as a function of collector current.

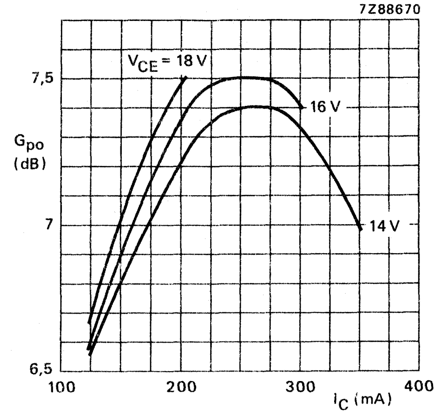


Fig.8 Low-level power gain associated with P_{L1} as a function of collector current.

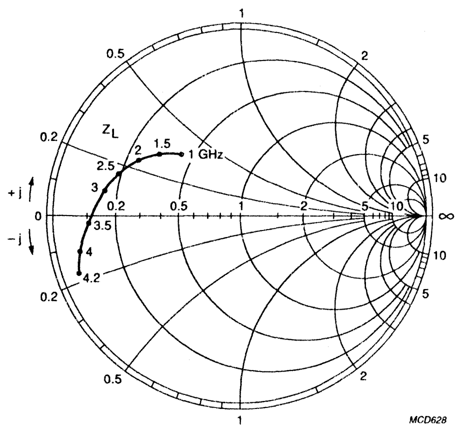


Fig.9 Optimum load impedance as a function of frequency for P_{L1}.

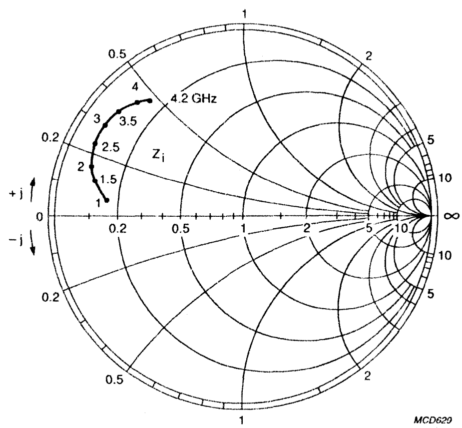


Fig.10 Input impedance as a function of frequency for P_{L1}.

Conditions for Figs 7 and 8:

V_{CE} and I_C regulated; typical values; T_{mb} = 25 °C.

Conditions for Figs 9 and 10:

V_{CE} = 16 V, I_C = 250 mA } regulated; typical values; Z_o = 50 Ω; T_{mb} = 25 °C.

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon power transistor for use in a common-emitter, class-A amplifier up to a frequency of 4.2 GHz in CW conditions in military and professional applications.

Features:

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistor providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- An input matching cell improving the input impedance and allowing an easier design of wideband circuits
- New 5 GHz technology

The transistor is housed in a metal ceramic flange envelope (FO-41B).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-emitter class-A selective amplifier.

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} mW	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	4.2	16	400	⩾ 1000	⩾ 6	7.5+j12	4–j8

MECHANICAL DATA

FO-41B (see Fig.1).

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.

MECHANICAL DATA

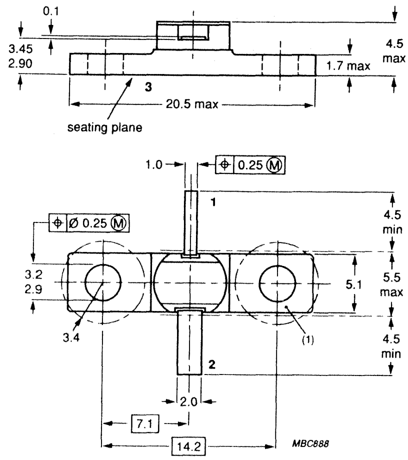
Dimensions in mm

Fig. 1 FO-41B.

Emitter and metallic cap connected to flange.

Pinning:

1 = collector
2 = base
3 = emitter



Torque on screw: max. 0.4 Nm

Recommended screw : M2.5

Marking code 198

(1) Flatness of this area ensures full thermal contact with bolt head.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage, open emitter	V_{CBO}	max.	40	V
Collector-emitter voltage,				
open base	V_{CEO}	max.	16	V
$R_{BE} = 70\ \Omega$	V_{CER}	max.	20	V
Collector current (DC)	I_C	max.	800	mA
Total power dissipation up to $T_{mb} = 75\ ^oC$	P_{tot}	max.	8	W
Storage temperature	T_{stg}		−65 to +200	^oC
Junction temperature	T_j	max.	200	^oC
Soldering temperature				
at 0.1 mm from ceramic; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

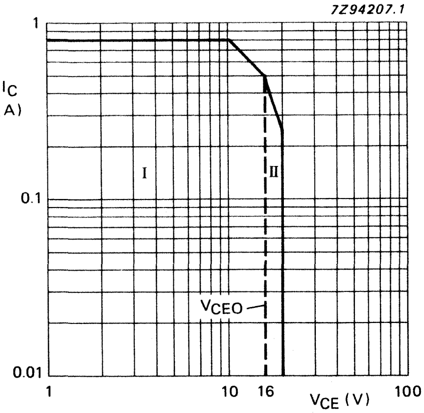


Fig.2 DC SOAR; $T_{mb} \leqslant 75\ ^{o}C$.
I Region of permissible DC operation.
II Permissible extension provided $R_{BE} \leqslant 70\ \Omega$.

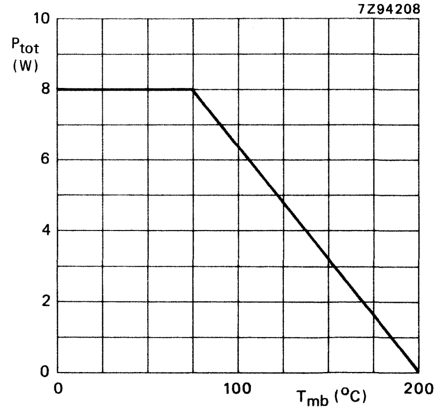


Fig.3 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75\ ^{o}C$

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	10 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7 K/W

CHARACTERISTICS

$T_{mb} = 25\ ^{o}C$ unless otherwise specified

Collector cut-off current $I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	200 μA
Emitter cut-off current $I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	600 nA
DC current gain $I_C = 400$ mA; $V_{CE} = 5$ V	h_{FE}	=	15 to 100
Collector-base capacitance at f = 1 MHz $I_E = I_C = 0$; $V_{CB} = 16$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	3 pF
Collector-emitter capacitance at f = 1 MHz $I_C = I_E = 0$; $V_{CE} = 16$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	1.5 pF
Emitter-base capacitance at f = 1 MHz $I_C = I_E = 0$; $V_{EB} = 1$ V; $V_{CB} = 10$ V	C_{eb}	typ.	28 pF

s-parameters (common-emitter)

Typical values; V_{CE} = 16 V; I_C = 400 mA; Z_O = 50 Ω; T_{mb} = 25 °C.

f GHz	s_{ie}	s_{re}	s_{fe}	s_{oe}
2.0	0.84/163°	0.049/64.0°	0.96/ 47.2°	0.60/179.3°
2.1	0.84/161°	0.051/62.7°	0.94/ 43.3°	0.59/178.0°
2.2	0.84/159°	0.054/60.4°	0.93/ 39.8°	0.59/175.6°
2.3	0.85/158°	0.055/58.8°	0.91/ 36.2°	0.59/174.2°
2.4	0.85/156°	0.057/57.5°	0.91/ 32.2°	0.60/172.6°
2.5	0.85/155°	0.060/56.1°	0.90/ 29.1°	0.60/171.1°
2.6	0.85/154°	0.064/54.9°	0.89/ 24.6°	0.60/169.8°
2.7	0.85/153°	0.067/53.1°	0.89/ 21.2°	0.60/168.6°
2.8	0.85/152°	0.071/51.3°	0.89/ 17.2°	0.61/167.1°
2.9	0.84/150°	0.073/49.5°	0.90/ 13.8°	0.62/165.7°
3.0	0.83/149°	0.076/48.0°	0.90/ 9.3°	0.62/164.7°
3.1	0.82/149°	0.080/46.0°	0.91/ 5.2°	0.63/163.8°
3.2	0.80/147°	0.084/44.1°	0.92/ 0.6°	0.64/163.0°
3.3	0.78/146°	0.088/40.5°	0.93/ −4.3°	0.65/161.5°
3.4	0.76/145°	0.091/36.1°	0.95/ −9.7°	0.67/160.9°
3.5	0.74/144°	0.093/34.4°	0.97/ −16.1°	0.69/159.6°
3.6	0.71/143°	0.095/30.7°	0.98/ −23.2°	0.70/158.3°
3.7	0.70/142°	0.095/26.3°	0.99/ −30.6°	0.73/156.2°
3.8	0.67/142°	0.093/21.6°	0.99/ −37.9°	0.76/153.6°
3.9	0.66/142°	0.091/17.0°	1.00/ −46.6°	0.79/150.7°
4.0	0.64/142°	0.088/13.2°	0.98/ −55.8°	0.82/147.0°
4.1	0.64/142°	0.084/ 9.7°	0.95/ −64.9°	0.85/143.1°
4.2	0.65/143°	0.077/ 7.0°	0.91/ −73.8°	0.88/138.4°
4.3	0.67/143°	0.068/ 5.9°	0.86/ −82.6°	0.90/133.6°
4.4	0.69/143°	0.060/ 8.2°	0.81/ −92.3°	0.93/129.3°
4.5	0.72/141°	0.054/13.8°	0.74/−101.7°	0.94/124.9°
4.6	0.75/139°	0.050/20.5°	0.68/−110.6°	0.95/120.1°
4.7	0.76/137°	0.050/31.2°	0.61/−119.7°	0.96/116.5°
4.8	0.78/135°	0.054/43.5°	0.56/−129.1°	0.97/113.5°
4.9	0.79/133°	0.061/46.6°	0.50/−139.5°	0.97/110.1°
5.0	0.77/130°	0.068/54.3°	0.44/−148.6°	0.97/106.7°

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-emitter class-A selective circuit.

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} mW	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	4.2	16	400	> 1000 typ.1250	> 6 typ. 7	7.5+j12	4–j8

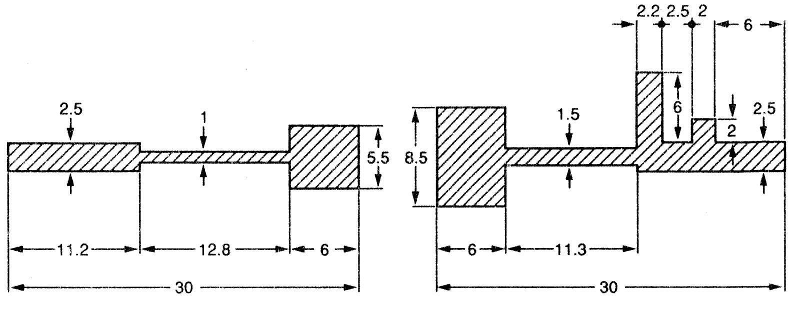


Fig. 4 Prematching test circuit board for CW; class-A application (dimensions in mm).

Striplines on a double Cu-clad printed circuit board with PTFE fibre-glass dielectric (ϵ_r = 2.54); thickness 0.8 mm.

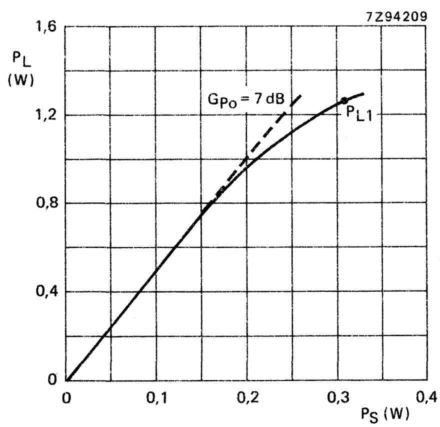


Fig. 5 Load power as a function of input power; f = 4.2 GHz; V_{CE} = 16 V; I_C = 400 mA regulated.

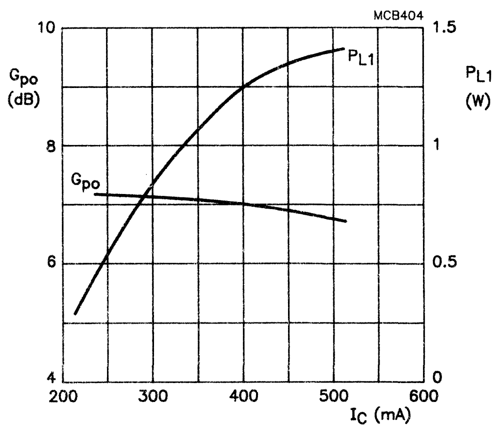


Fig.6 Low level power gain associated with P_{L1} as a function of collector current; f = 4.2 GHZ; V_{CE} = 16 V.

* Circuit consists of prematching boards in combination with complementary input and output slug tuners.

MICROWAVE LINEAR POWER TRANSISTORS

NPN silicon transistors for use in common-emitter class-A linear power amplifiers up to 4 GHz.

Diffused emitter ballasting resistors, a self-aligned process entirely ion implanted and gold sandwich metallization ensure an optimum temperature profile with excellent performance and reliability.

The transistors are housed in a FO-163 metal-ceramic studless envelope.

QUICK REFERENCE DATA

RF performance up to T_{mb} = 25 °C in a common-emitter class-A circuit

type number	mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} mW	G_{po} dB
LUE2003S	CW class-A	2.0	12	30	typ. 100	typ. 10
LUE2009S	CW class-A	2.0	12	50	typ.270; ≥ 250	typ. 9.6; ≥ 8.5

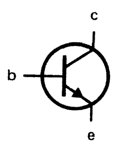
MECHANICAL DATA

Dimensions in mm

Fig.1 FO-163.

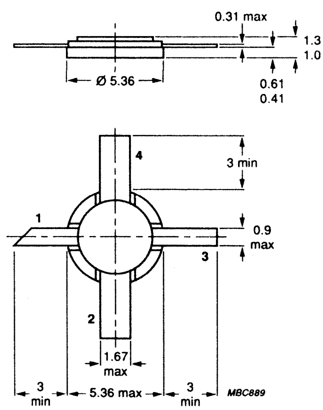
Pinning:

1 = collector
2 = emitter
3 = base
4 = emitter



Marking codes:

400 = LUE2003S
401 = LUE2009S



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			LUE2003S	LUE2009S	
Collector-base voltage open emitter	V_{CBO}	max.	40	40	V
Collector-emitter voltage R_{BE} = 100 Ω	V_{CER}	max.	–	35	V
R_{BE} = 220 Ω	V_{CER}	max.	35	–	V
open base	V_{CEO}	max.	16	16	V
Emitter-base voltage open collector	V_{EBO}	max.	3	3	V
Collector current (DC)	I_C	max.	90	250	mA
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	1.4	1.5	W
Storage temperature range	T_{stg}		−65 to + 200		°C
Junction temperature	T_j	max.	200		°C
Lead soldering temperature at 0.3 mm from case; $t_{std} \leqslant 10$ s	T_{sld}	max.	235		°C

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon power transistor for use in a common-emitter, class-A amplifier from 1.7 GHz to 2.1 GHz in CW conditions in military and professional applications.

Features:

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistor providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- Internal input and output prematching ensuring a good stability and allowing an easier design of wideband circuits
- New 5 GHz technology.

The transistor is housed in a metal ceramic flange envelope (FO-83).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 ^oC in a common-emitter class-A wideband amplifier.

mode of operation	f GHz	V_{CE} V	I_C A	P_{L1} W	G_{po} dB	z_i Ω	Z_l Ω
CW; class-A	1.7 to 2.1	16	1.1	⩾5	⩾7	see Fig. 6	

MECHANICAL DATA

FO-83 (see Fig. 1).

WARNING

Product and environmental safety — toxic materials

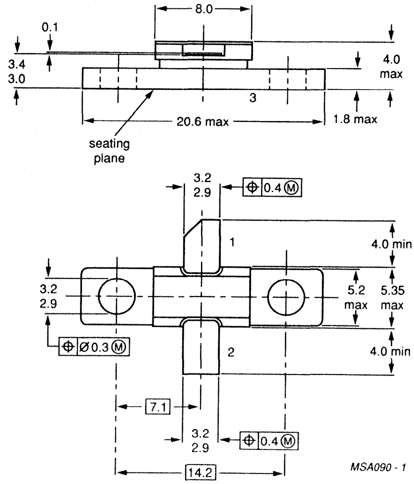
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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 general industrial or domestic waste.

MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-83.



Pinning:

1 = collector
2 = base
3 = emitter

Marking code:

1721E50R = LV1721E50R

Torque on screw: max. 0.4 Nm

Recommended screw: M2.5 or cheesehead 4-40 UNC/2A

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage, open emitter	V_{CBO}	max.	40	V
Collector-emitter voltage				
open base	V_{CEO}	max.	15	V
$R_{BE} = 47\ \Omega$	V_{CER}	max.	20	V
Emitter-base voltage, open collector	V_{EBO}	max.	3.0	V
Collector current (DC)	I_C	max.	2	A
Total power dissipation				
up to $T_{mb} = 75\ ^oC$	P_{tot}	max.	18	W
Storage temperature	T_{stg}	−65 to + 200		^oC
Junction temperature	T_j	max.	200	^oC
Soldering temperature				
at 0.1 mm from case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

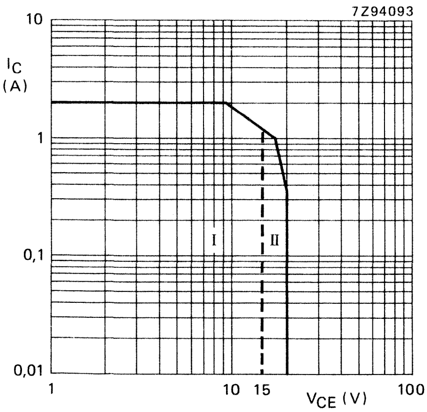


Fig. 2 DC SOAR; $T_{mb} \leqslant 75$ °C.
I Region of permissible DC operation.
II Permissible extension provided $R_{BE} \leqslant 47\ \Omega$.

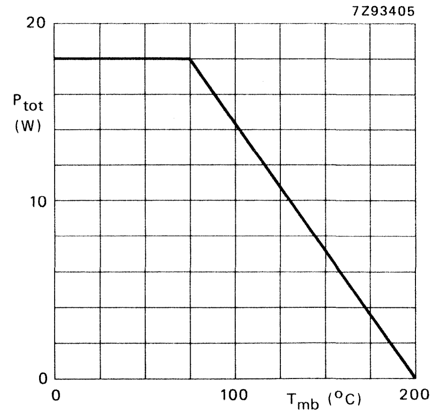


Fig.3 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75$ °C)

From junction to mounting base	$R_{th\,j\text{-}mb}$	typ.	4 K/W
From mounting base to heatsink	$R_{th\,mb\text{-}h}$	max.	0.7 K/W

CHARACTERISTICS

$T_{mb} = 25$ °C unless otherwise specified

Collector cut-off currents			
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	0.5 mA
$I_E = 0$; $V_{CB} = 40$ V		max.	2.5 mA
$V_{CE} = 20$ V; $R_{BE} = 47\ \Omega$	I_{CER}	max.	25 mA
$V_{CE} = 15$ V; $I_B = 0$	I_{CEO}	max.	2 mA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	100 μA
DC current gain			
$I_C = 1$ A; $V_{CE} = 3$ V	h_{FE}		15 to 100

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-emitter class-A wideband amplifier.

mode of operation	f GHz	V_{CE} V	I_C A	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	1.7 to 2.1	16	1.1	≥ 5 typ. 5.5	≥ 7 typ. 8	see Fig. 6	

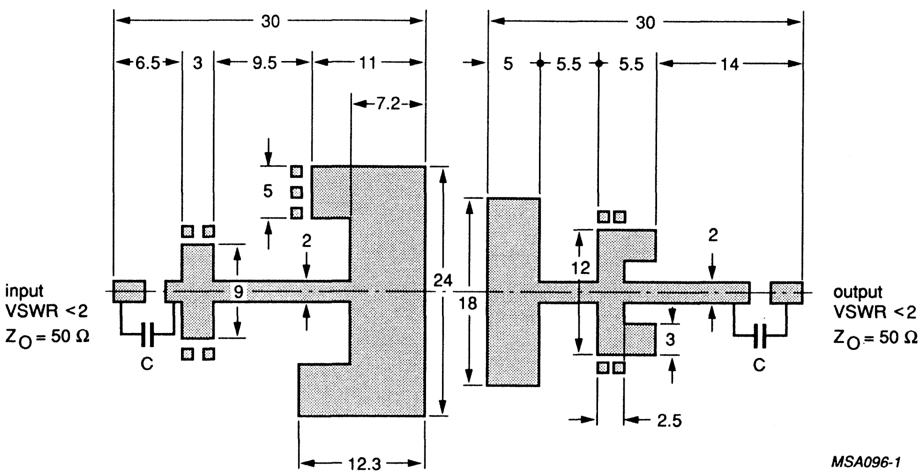


Fig. 4 Wideband test circuit board for 1.7 to 2.1 GHZ, CW, class-A application (Dimensions in mm).

Striplines on a double Cu-clad printed circuit board with Teflon fibre-glass (ϵ_r = 2.5); thickness 0.8 mm. (Dimensions in mm).

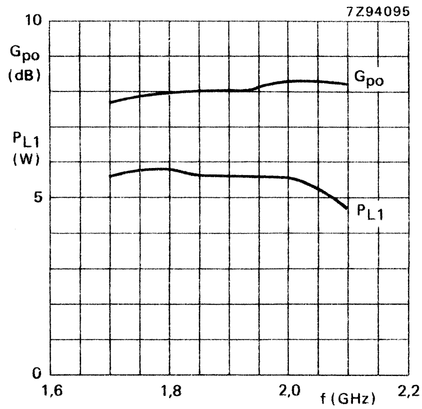


Fig. 5 Load power and power gain as a function of frequency;
V_{CE} = 16 V; I_C = 1.1 A; V_{CE} and I_C regulated.

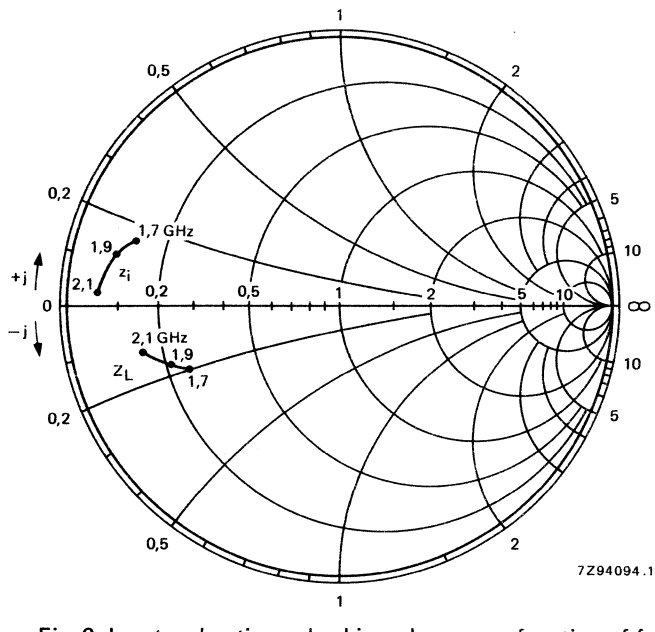


Fig. 6 Input and optimum load impedances as a function of frequency;
P_{L1} = 5.5 W; Z_o = 50 Ω; typical values.

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon power transistor for use in a common-emitter, class-A amplifier from 2.0 GHz to 2.4 GHz in CW conditions in military and professional applications.

Features:

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistor providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- Internal input and output prematching ensuring a good stability and allowing an easier design of wideband circuits
- New 5 GHz technology

The transistor is housed in a metal ceramic flange envelope (FO 83).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-emitter class-A wideband amplifier

mode of operation	f GHz	V_{CE} V	I_C A	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	2.0 to 2.4	16	1.1	≥ 4	≥ 6	see Fig. 6	

MECHANICAL DATA

FO-83 (see Fig. 1).

WARNING

Product and environmental safety — toxic materials

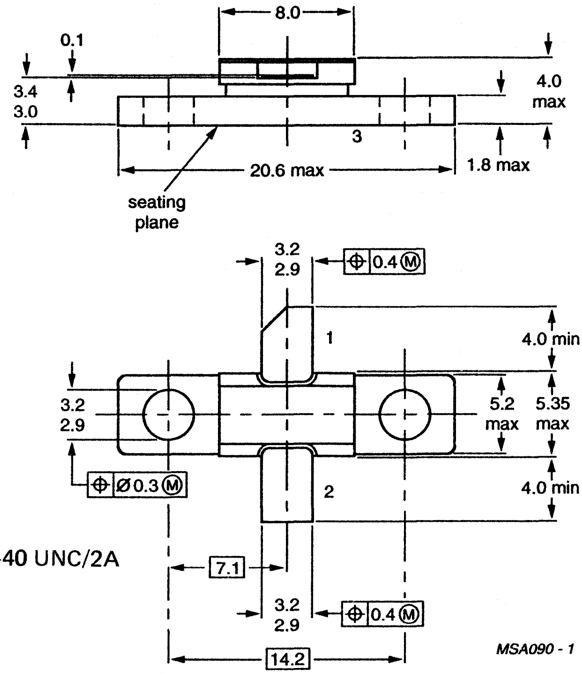
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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 general industrial or domestic waste.

MECHANICAL DATA

Fig. 1 FO-83.

Dimensions in mm



Pinning:

1 = collector
2 = base
3 = emitter

Marking code:

2024E45R = LV2024E45R

Torque on screw: max. 0.4 Nm

Recommended screw: M2.5 or cheesehead 4-40 UNC/2A

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage, open emitter	V_{CBO}	max.	40 V
Collector-emitter voltage, open base			
open base	V_{CEO}	max.	15 V
$R_{BE} = 47\ \Omega$	V_{CER}	max.	20 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.0 V
Collector current (DC)	I_C	max.	2 A
Total power dissipation			
up to $T_{mb} = 75\ ^oC$	P_{tot}	max.	18 W
Storage temperature	T_{stg}	–65 to + 200	^oC
Junction temperature	T_j	max.	200 ^oC
Soldering temperature			
at 0.1 mm from case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 ^oC

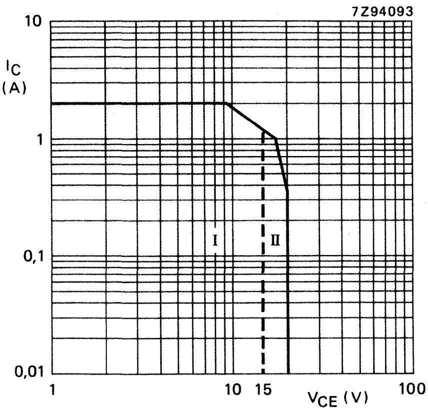


Fig. 2 DC SOAR; $T_{mb} \leqslant 75\ ^oC$.

I Region of permissible DC operation.

II Permissible extension provided $R_{BE} \leqslant 47\ \Omega$.

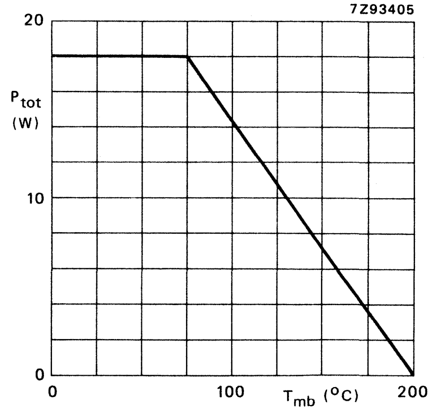


Fig.3 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	typ.	4 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off currents			
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	0.5 mA
$I_E = 0$; $V_{CB} = 40$ V		max.	2.5 mA
$V_{CE} = 20$ V; $R_{BE} = 47\ \Omega$	I_{CER}	max.	25 mA
$V_{CE} = 15$ V; $I_B = 0$	I_{CEO}	max.	2 mA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	100 μA
DC current gain			
$I_C = 1$ A; $V_{CE} = 3$ V	h_{FE}		15 to 100

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-emitter class-A wideband amplifier.

mode of operation	f GHz	V_{CE} V	I_C A	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	2.0 to 2.4	16	1,1	⩾ 4 typ. 5	⩾ 6 typ. 7	see Fig. 6	

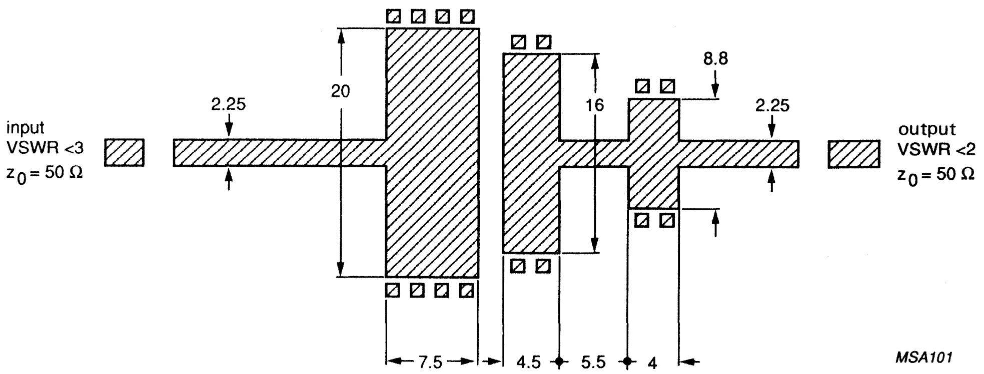


Fig. 4 Wideband test circuit board, class-A application. (Dimensions in mm).

Striplines on a Cu-clad printed circuit board with PTFE fibre-glass dielectric (ϵ_r = 2.55), thickness 0.8 mm.

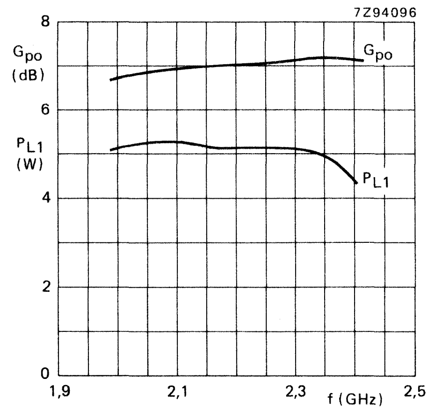


Fig. 5 Load power and power gain as a function of frequency; V_{CE} = 16 V; I_C = 1.1 A; V_{CE} and I_C regulated.

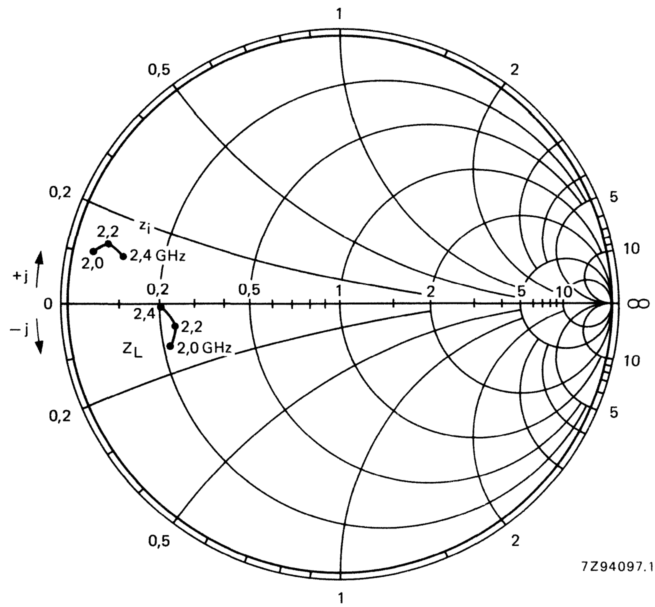


Fig. 6 Input and optimum load impedance as a function of frequency; Z_o = 50 Ω; typical values.

MICROWAVE LINEAR POWER TRANSISTOR

NPN transistor for use in common-emitter class-A linear wideband power amplifier from 2.3 to 2.7 GHz.

Diffused emitter ballasting resistors, interdigitated structure, multicell geometry, localized thick oxide and gold sandwich metallization ensure an optimum temperature profile and excellent performance and reliability.

An input and output matching cell improves the impedances and facilitates the design of wideband circuits.

QUICK REFERENCE DATA

RF performance up to T_{case} = 25 °C in a wideband common-emitter class-A circuit

mode of operation	f GHz	V_{CE} V	I_C A	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; linear amplifier	2.3 to 2.7	16	1	⩾ 4	⩾ 7	11 + j3	7.5–j9

MECHANICAL DATA

FO-83B (see Fig.1).

WARNING

Product and environmental safety — toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.

MECHANICAL DATA

Dimensions in mm

Fig.1 FO-83B.

Metallic cap is connected to the flange

Torque on screw: max. 0.4 Nm

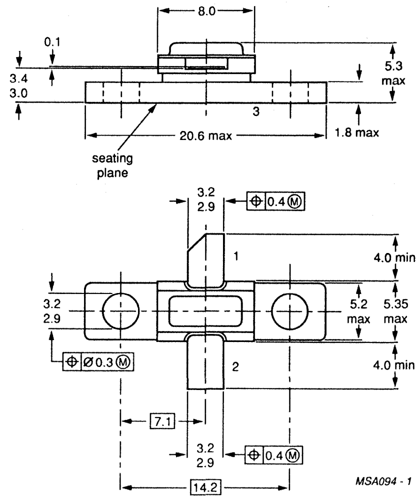
Recommended screw: M2.5

Marking code:

2327E40R = LV2327E40R

Pinning:

1 = collector
2 = base
3 = emitter



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage				
R_{BE} = 47 Ω	V_{CER}	max.	20	V
open base	V_{CEO}	max.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	3.0	V
Collector current (DC)	I_C	max.	2	A
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	18	W
Storage temperature	T_{stg}	−65 to +	200	°C
Junction temperature	T_j	max.	200	°C
Lead soldering temperature at 0.3 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	°C

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon transistor for use in common-emitter class-A linear power amplifiers up to 4.2 GHz.

Diffused emitter ballasting resistors, self-aligned process entirely ion implanted, and gold sandwich metallization ensure an optimum temperature profile with excellent performance and reliability.

An input matching cell improves the input impedance and facilitates the design of wideband circuits.

The transistor is housed in a metal-ceramic envelope (FO-83).

QUICK REFERENCE DATA

RF performance up to T_{mb} = 25 °C in a common-emitter class-A circuit

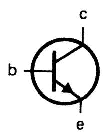
Mode of operation	f GHz	V_{CC} V	I_C A	P_{L1} W	G_{po} dB
CW; class-A	2.1	16	1.1	typ. 5.5	typ. 8.0

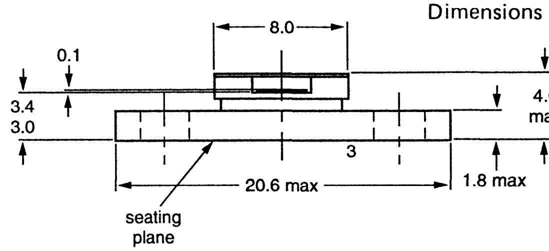
MECHANICAL DATA

Dimensions in mm

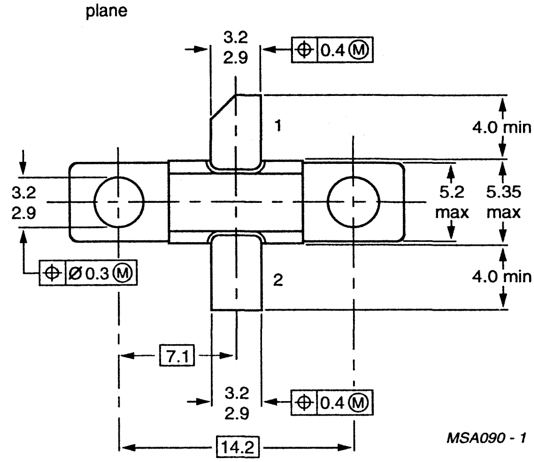
Fig. 1 FO-83.

Pinning
1 = collector
2 = base
3 = emitter





Emitter is connected to the seating plane



Torque on screw: max. 0.4 Nm

Recommended screw: M2.5 or 4-40 UNC/2A

WARNING

Product and environmental safety — toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.**

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage			
open emitter	V_{CBO}	max.	40 V
Collector-emitter voltage			
R_{BE} = 47 Ω	V_{CER}	max.	20 V
open base	V_{CEO}	max.	16 V
Emitter-base voltage			
open collector	V_{EBO}	max.	3.0 V
Collector current (DC)	I_C	max.	2 A
Total power dissipation			
up to T_{mb} = 75 °C	P_{tot}	max.	18 W
Storage temperature range	T_{stg}	−65 to + 200 °C	
Junction temperature	T_j	max.	200 °C
Lead soldering temperature at			
0,3 mm from case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 °C

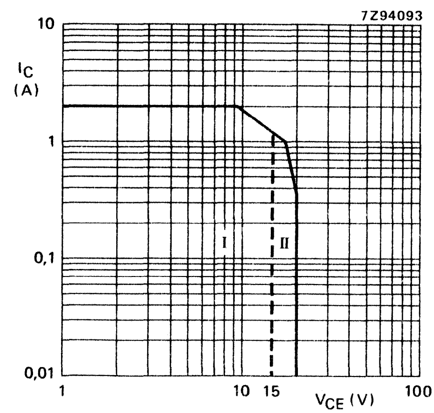


Fig. 2 DC SOAR at $T_{mb} \leqslant 75$ °C.

I Region of permissible DC operation.

II Permissible extention provided $R_{BE} \leqslant 47\ \Omega$.

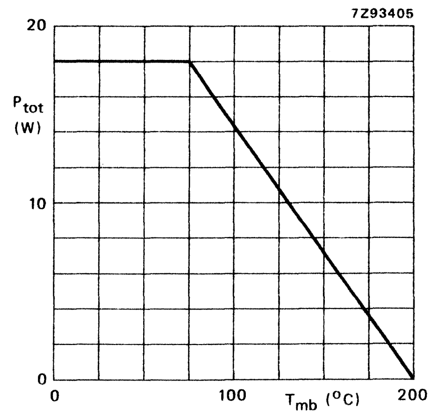


Fig. 3 Power derating curve.

THERMAL RESISTANCE (T_j = 75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	typ.	4 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off currents			
$I_E = 0$; V_{CB} = 20 V	I_{CBO}	max.	0.5 mA
$I_E = 0$; V_{CB} = 40 V	I_{CBO}	max.	2.5 mA
V_{CE} = 20 V; R_{BE} = 47 Ω	I_{CER}	max.	25 mA
V_{CE} = 15 V; $I_B = 0$	I_{CEO}	max.	2 mA
Emitter cut-off current			
$I_C = 0$; V_{EB} = 1.5 V	I_{EBO}	max.	100 μA
DC current gain			
I_C = 1 A; V_{CE} = 3 V	h_{FE}		15 to 100

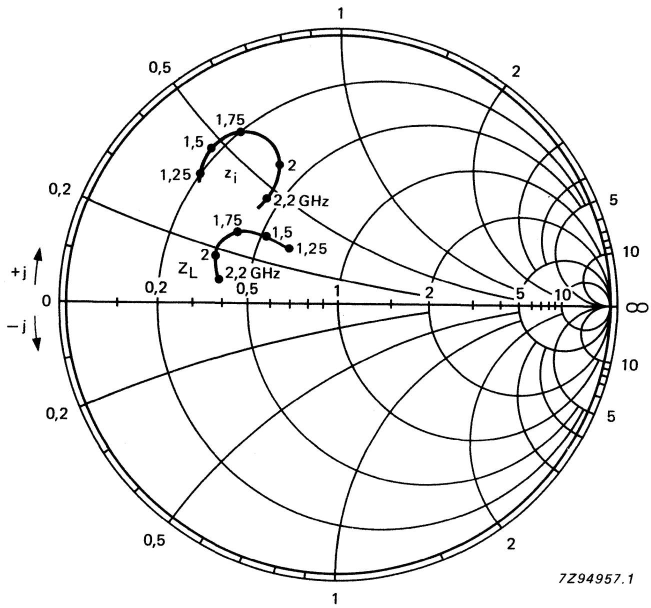


Fig. 4 Input and optimum load impedance as a function of frequency; Z_0 = 10 Ω; typical values.

NPN silicon planar epitaxial microwave power transistor

LWE2010S

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
- 5 GHz technology.

PINNING - FO-93

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-93 metal ceramic flange package, with emitter connected to bottom.

APPLICATIONS

Intended for use in common emitter class A power amplifiers at frequencies up 2.3 GHz.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common emitter class A selective amplifier.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_C (mA)	P_{L1} (W)	G_{po} (dB)	Z_i/Z_L (Ω)
class A (CW)	2.3	18	110	≥ 0.8	≥ 8	see Figs 6 and 7

PIN CONFIGURATION

Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
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.

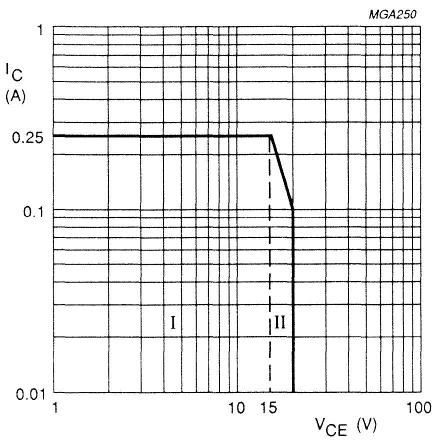
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CER}	collector-emitter voltage	R_{BE} = 250 Ω	–	20	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	250	mA
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	4.8	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s note 1	–	235	°C

Note

1. Up to 0.1 mm from ceramic.

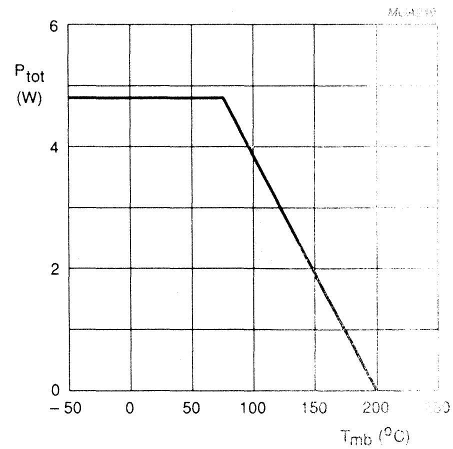


T_{mb} ≤ 75 °C

(I) Region of permissible DC operation

(II) Permissible extension provided R_{BE} ≤ 250 Ω

Fig.2 DC SOAR.



P_{tot} max = 4.8 W.

Fig.3 Maximum power dissipation derating as a function of mounting base temperature.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 75 °C	22 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		2 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 20 V; I_E = 0	–	75	µA
		V_{CB} = 40 V; I_E = 0	–	500	µA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	–	200	nA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 110 mA	15	150	

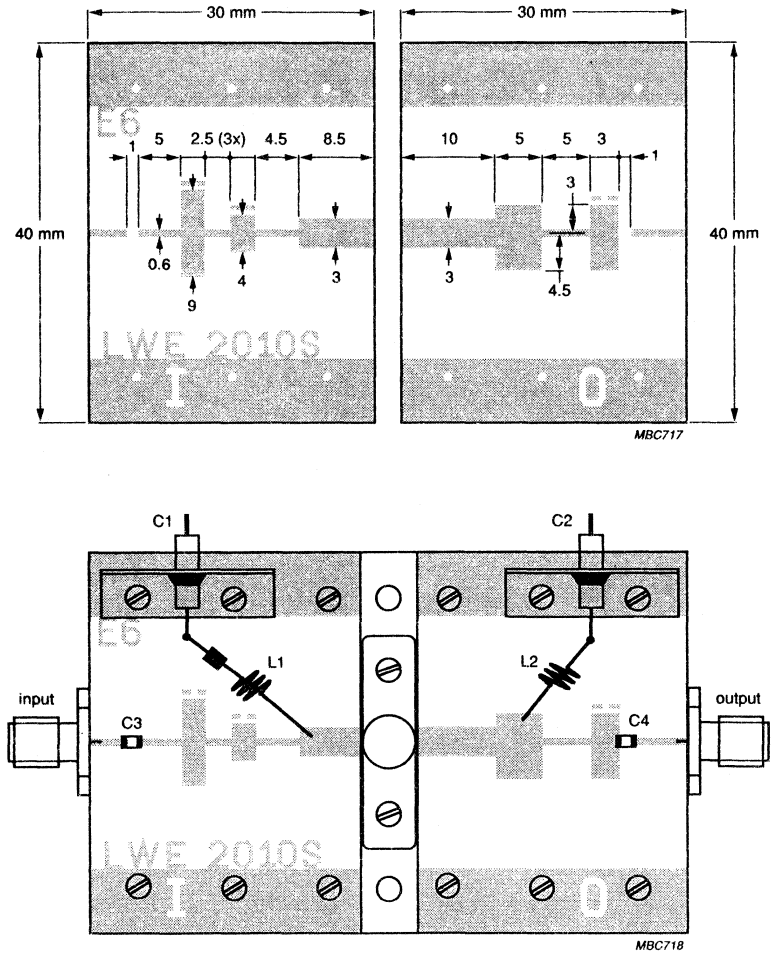
APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common emitter class A selective amplifier.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_C (mA)	P_{L1} (W)	G_{po} (dB)	Z_i (Ω)	Z_L (Ω)
class A (CW) (note 1)	2.3	18	110	≥ 0.8; typ.0.9	≥ 8; typ.9	5.2 + j 16.5	7.5 + j 8.75

Note

1. In narrowband test circuit shown in Fig.4.



Dimensions in mm

Substrate : Epsilam 10

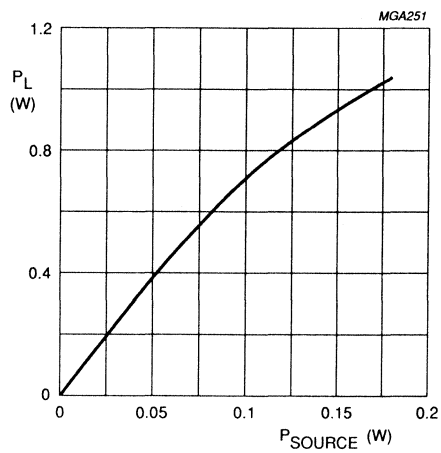
Thickness : 0.635 mm

Permittivity : $\varepsilon_r = 10$

Fig.4 Prematching test circuit board.

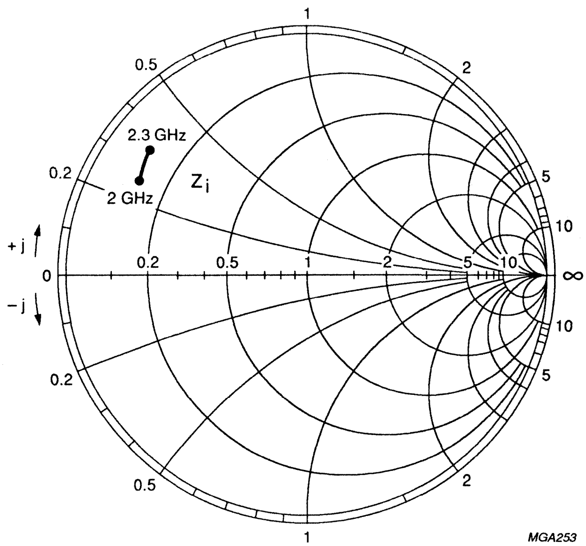
List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
L1	3 turns 0.2 mm copper wire with ferrite bead		int. dia. 2 mm	
L2	5 turns 0.5 mm copper wire		int. dia. 2 mm	
C1, C2	feedthrough bypass capacitor			Erie, ref. 1214-001
C3, C4	DC block capacitor	100 pF		



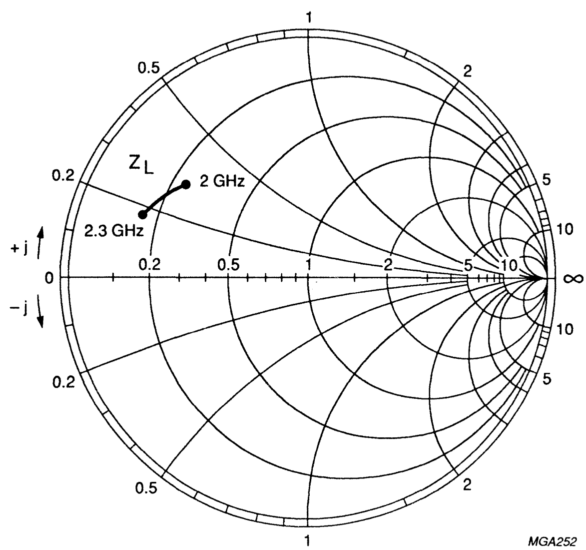
f = 2.3 GHz; V_{CE} = 18 V; I_C = 110 mA (regulated).

Fig.5 Load power as a function of source power.



P_{L1} = 0.8 W;
V_{CE} = 18 V;
Z_O = 50 Ω;
I_C = 110 mA.

Fig.6 Input impedance as a function of frequency associated with optimum load impedances.



P_{L1} = 0.8 W;
V_{CE} = 18 V;
Z_O = 50 Ω;
I_C = 110 mA.

Fig.7 Optimum load impedance as a function of frequency; typical values.

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon power transistor for use in a common-emitter, class-A amplifier up to 2.3 GHz in CW conditions in military and professional applications.

Features:

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistor providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- 5 GHz technology

The transistor is housed in a metal ceramic studless envelope (FO-93).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-emitter class-A selective amplifier

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	2.3	16	250	⩾ 1.2	⩾ 7.5	3.5 + j11	6.4 + j2

MECHANICAL DATA

Dimensions in mm

FO-93 (see Fig. 1)

WARNING

Product and environmental safety — toxic materials

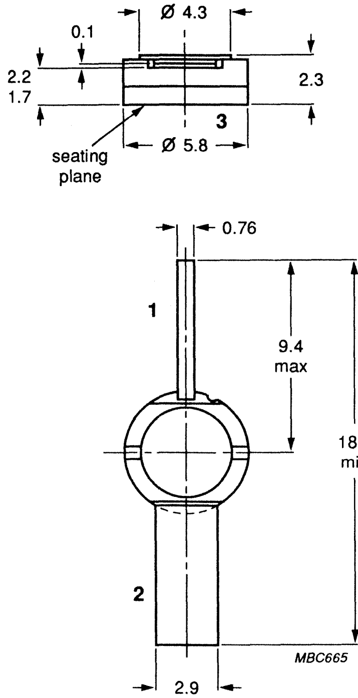
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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 general industrial or domestic waste.

MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-93.



Pinning:

1 = collector
2 = base
3 = emitter

Marking code

411 = LWE2015R

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134).

Collector-base voltage, open emitter	V_{CBO}	max.	35	V
Collector-emitter voltage				
open base	V_{CEO}	max.	16	V
$R_{BE} = 70\ \Omega$	V_{CER}	max.	20	V
Emitter-base voltage, open collector	V_{EBO}	max.	3.0	V
Collector current (DC)	I_C	max.	450	mA
Total power dissipation				
up to $T_{mb} = 75\ ^oC$	P_{tot}	max.	6	W
Storage temperature	T_{stg}	−65 to + 200		^oC
Junction temperature	T_j	max.	200	^oC
Soldering temperature				
at 0.1 mm from case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

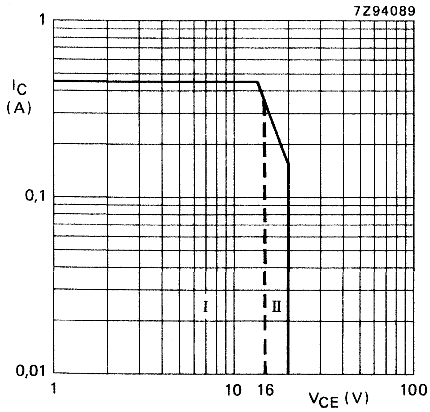


Fig. 2 DC SOAR; $T_{mb} \leqslant 75$ °C.
I Region of permissible DC operation
II Permissible extension at $R_{BE} \leqslant 70\ \Omega$.

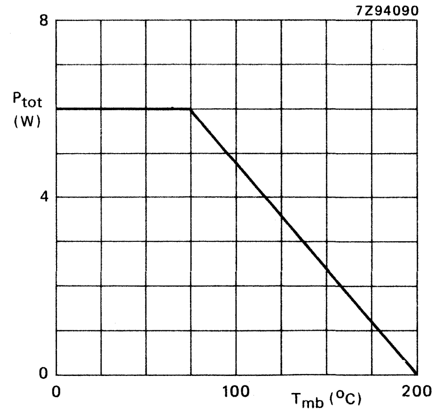


Fig. 3 Power derating curve versus mounting base temperature.

THERMAL RESISTANCE (at Tj=75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max. 12 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; $V_{CB} = 25$ V	I_{EBO}	$\leqslant$	10 μA
Emitter cut-off current $I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	$\leqslant$	10 μA
DC current gain $I_C = 230$ mA; $V_{CE} = 5$ V	h_{FE}	typ.	40
Collector-base capacitance at f = 1 MHz $I_E = I_C = 0$; $V_{CB} = 16$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	2 pF
Collector-emitter capacitance at f = 1 MHz $I_E = I_C = 0$; $V_{CE} = 16$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	2 pF
Emitter-base capacitance at f = 1 MHz $I_E = I_C = 0$; $V_{CB} = 10$ V; $V_{EB} = 1$ V	C_{eb}	typ.	15 pF

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-emitter class-A selective amplifier*

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	2.3	16	250	⩾ 1.2 typ. 1.6	⩾ 7.5 typ. 8.1	3.5 + j11	6.4 + j2

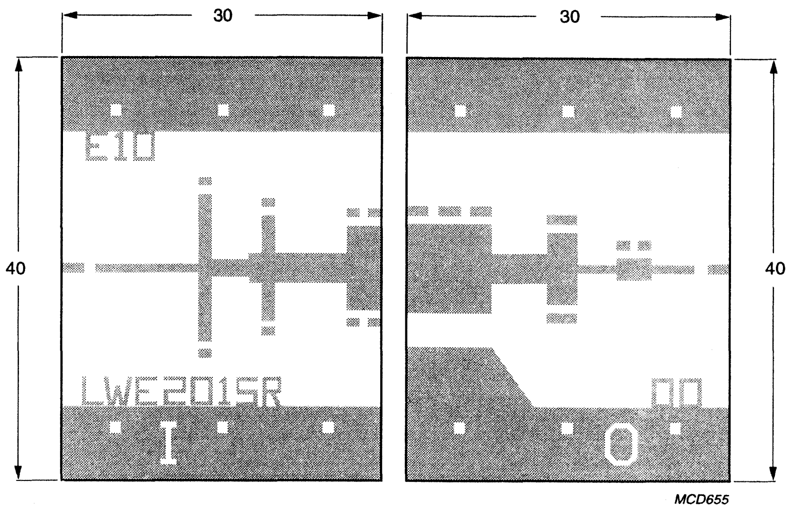


Fig.4 Premat ching test circuit board with PTFE fibre-glass dielectric (ϵ_r = 2.54), thickness 0.8 mm.

* Circuit consists of prematching circuit board in combination with complementary input and output slug tuners.

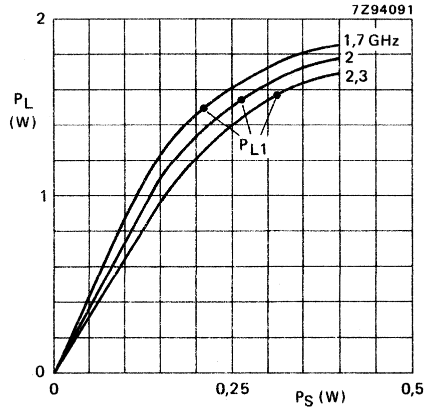


Fig. 5 Output power versus source power.

Conditions for Figs 5 and 6:

V_{CE} = 16 V
I_C = 250 mA
regulated; typical values.

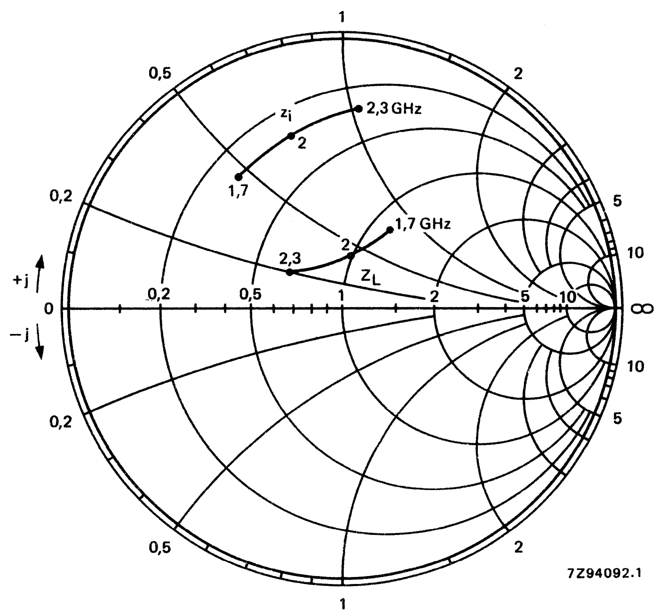


Fig. 6 Input and optimum load impedances versus frequency; Z_o = 10 Ω; P_{L1} = 1.6 W; T_{mb} = 25 °C.

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon power transistor for use in a common-emitter, class-A amplifier up to 2.3 GHz in CW conditions in military and professional applications.

Features:

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistor providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- 5 GHz technology

The transistor is housed in a metal ceramic studless envelope (FO-93).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in an unneutralized common-emitter class-A selective amplifier

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	2.3	16	400	⩾ 2	⩾ 7	2 + j8	5.5 − j1.8

MECHANICAL DATA

Dimensions in mm

FO-93 (see Fig. 1).

WARNING

Product and environmental safety — toxic materials

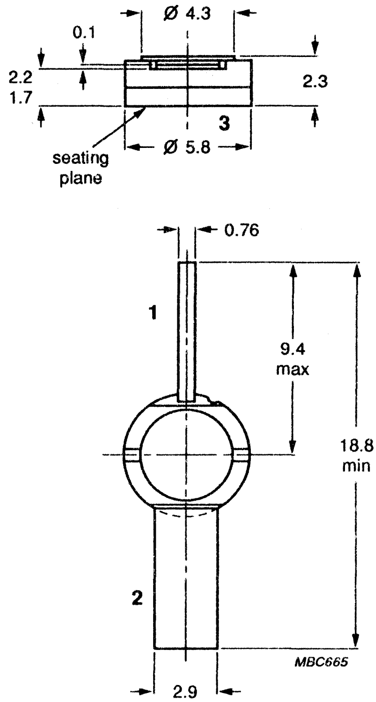
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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 general industrial or domestic waste.

MECHANICAL DATA

Fig. 1 FO-93.

Dimensions in mm



Marking code

413 = LWE2025R

Pinning:

1 = collector
2 = base
3 = emitter

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage, open emitter	V_{CBO}	max.	35 V
Collector-emitter voltage			
open base	V_{CEO}	max.	16 V
R_{BE} = 70 Ω	V_{CER}	max.	20 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.0 V
Collector current (DC)	I_C	max.	800 mA
Total power dissipation			
up to T_{mb} = 75 °C	P_{tot}	max.	8 W
Storage temperature	T_{stg}	−65 to + 200 °C	
Junction temperature	T_j	max.	200 °C
Soldering temperature			
at 0.1 mm from case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 °C

NPN silicon planar epitaxial microwave power transistor

LX1214E500X

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 and output prematching ensures a good stability and allows an easier design of wideband circuits.

APPLICATIONS

Intended for use in common emitter, class AB amplifiers in CW conditions for professional applications between 1.2 GHz and 1.4 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-91B metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common emitter class AB.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (A)	P_{L1} (W)	G_{po} (dB)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.2 to 1.4	24	0.15	typ. 50	typ. 11	typ. 50	see Figs 6 and 7

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

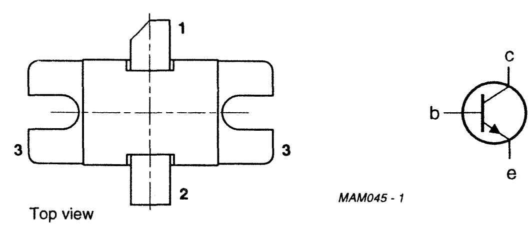


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
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.

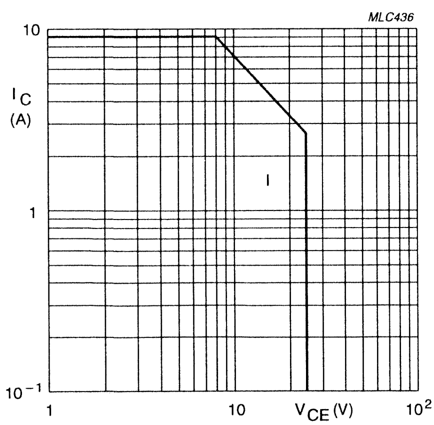
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current (DC)		–	9	A
P_i	input power	f = 1.2 to 1.4 GHz; V_{CC} = 24 V; class AB	–	7	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	70	W
T_{stg}	storage temperature		−65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



T_{mb} ≤ 75 °C.
(I) Region of permissible DC operation.

Fig.2 DC SOAR.

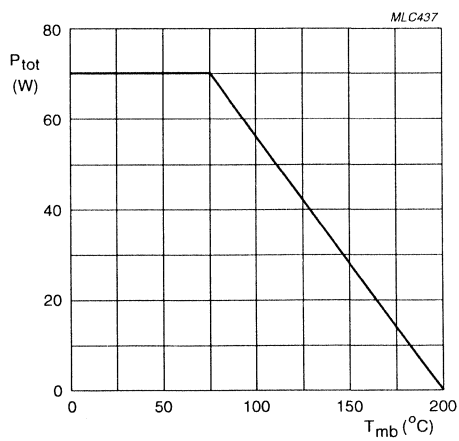


Fig.3 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	1.3	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

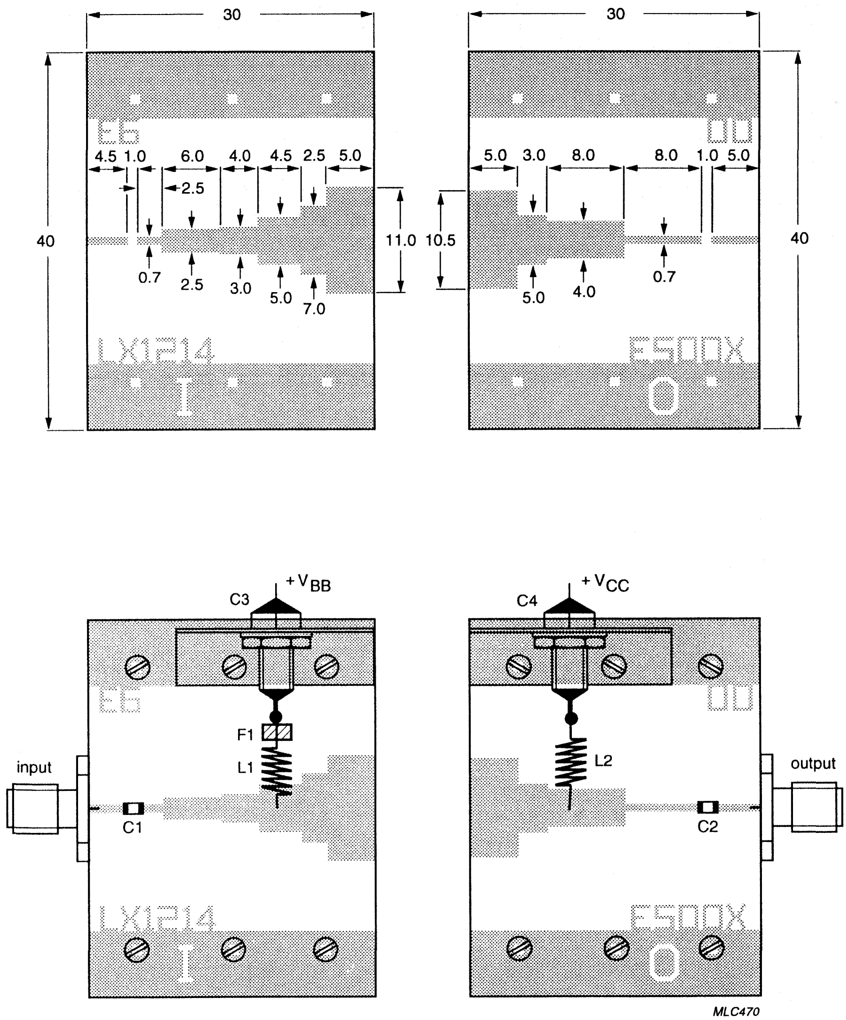
T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 20 V	–	4.5	mA
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 22 mA	45	–	V
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = 150 mA; R_{BE} = 220 Ω	30	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_C = 22 mA	3	–	V
h_{FE}	DC current gain	I_C = 4.5 A; V_{CE} = 3 V	15	100	

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.2 to 1.4	24	0.15	typ. 50	typ. 11	typ. 50	see Figs 6 and 7



The test circuit is split into two independent halves each being 30 × 40 mm in size.
Dimensions in mm.
Substrate: Epsilam 10.
Thickness: 0.635 mm.
Permittivity: $\varepsilon_r = 10$.

Fig.4 Test circuit.

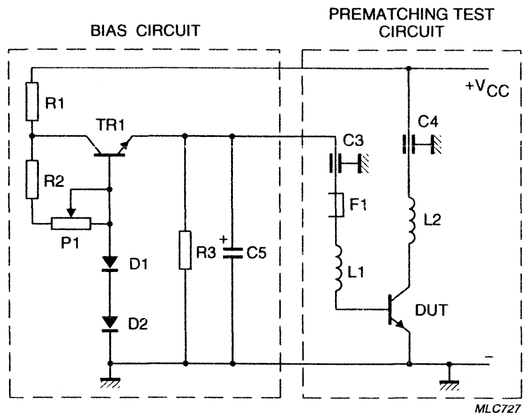


Fig.5 Class AB bias circuit.

List of components (see Figs 4 and 5)

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
TR1	transistor, BD239 or equivalent		
C1, C2	DC blocking chip capacitor	100 pF	ATC 100A1201kp
C3, C4	feedthrough bypass capacitor	1500 pF	Erie1250-003
C5	electrolytic capacitor	10 μF, >30 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	3.5 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	3 turns 0.5 mm copper wire; internal diameter = 2 mm		
P1	linear potentiometer	4.7 kΩ	
R1	resistor	100 Ω, 0.25 W	
R2	resistor	1 kΩ, 0.25 W	
R3	resistor	56 Ω, 0.25 W	
F1	ferrite bead		Philips tube, 12NC = 4330 030 43081 4.2 x 2.2 x 3.2 mm (4B1)

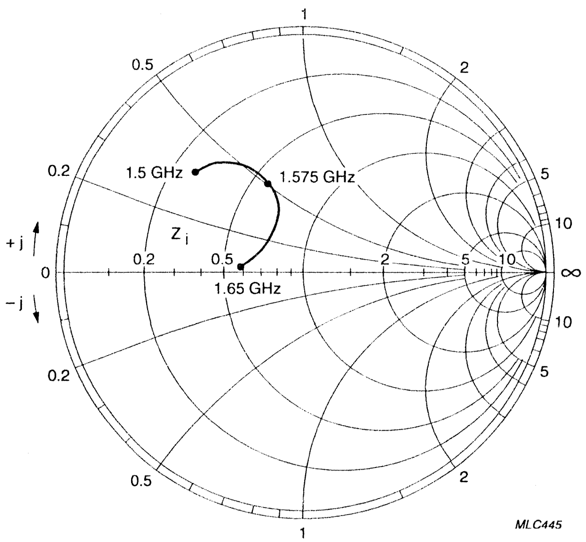
Notes

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

Input and optimum load impedances

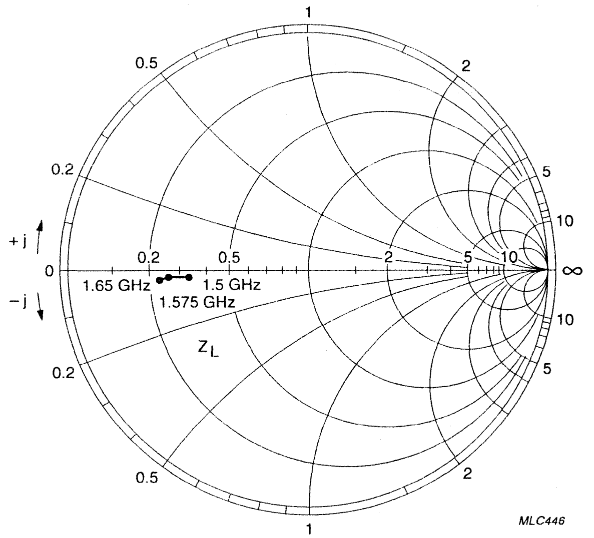
V_{CE} = 24 V; I_{CQ} = 0.15 A; typical values at $P_L = P_{L1}$.

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.2	1.8 + j2.6	4.0 – j2.2
1.3	4.0 + j2.1	3.8 – j0.5
1.4	3.2 + j1.0	3.2 – j0.5



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.15 A.

Fig.6 Input impedance as a function of frequency; typical values at $P_L = P_{L1}$.



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.15 A.

Fig.7 Optimum load impedance as a function of frequency; typical values at $P_L = P_{L1}$.

NPN silicon planar epitaxial microwave power transistor

LXE15450X

FEATURES

- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Interdigitated common-emitter 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 and output prematching ensures a good stability and allows an easier design of circuits.

APPLICATIONS

Intended for use in common-emitter, class AB amplifiers in CW conditions for professional applications between 1.5 GHz and 1.7 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-91B metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.5	24	0.15	≥45	≥8	typ. 48	see Figs 8 and 9

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

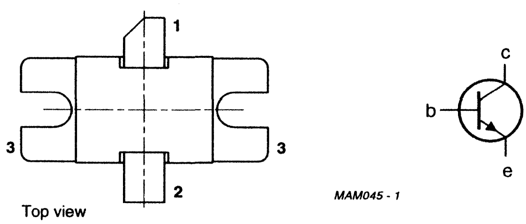


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
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.

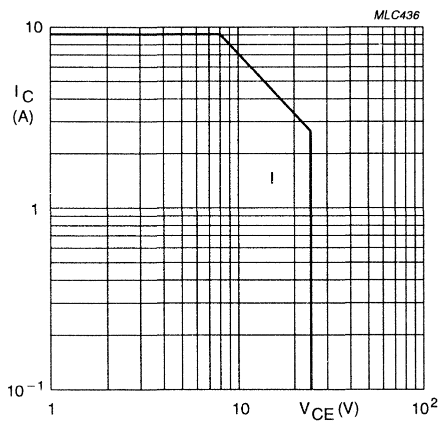
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current (DC)		–	9	A
P_i	input power	f = 1.5 GHz; V_{CE} = 24 V; class AB	–	12	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	70	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



T_{mb} ≤ 75 °C.
(I) Region of permissible DC operation.

Fig.2 DC SOAR.

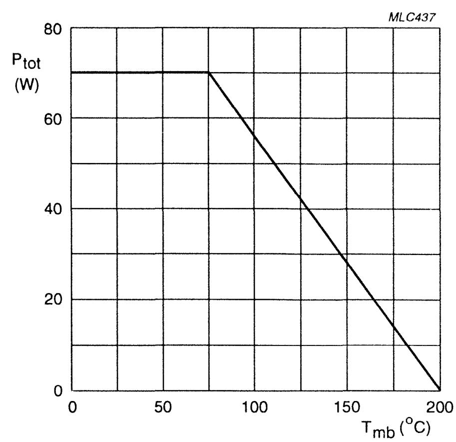


Fig.3 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_j = 100\ °C$	1.3	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

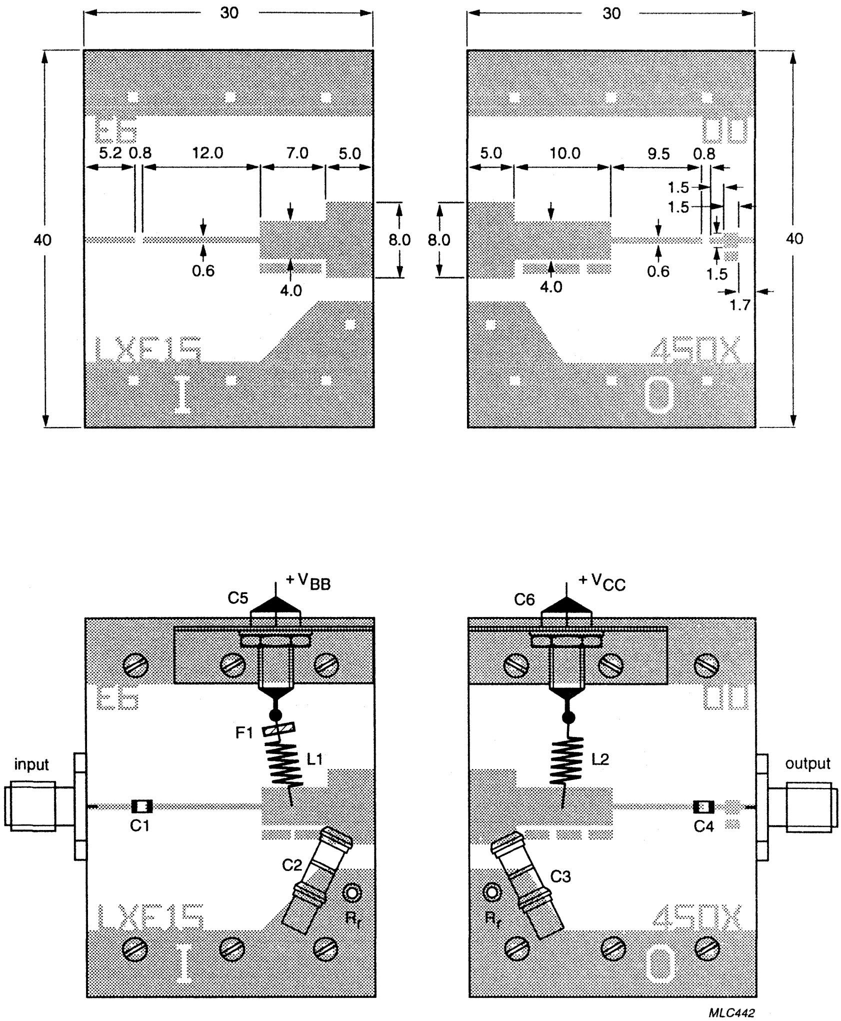
$T_{mb} = 25\ °C$ unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20\ V$	–	4.5	mA
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 22\ mA$	45	–	V
$V_{(BR)CER}$	collector-emitter breakdown voltage	$I_C = 150\ mA$; $R_{BE} = 220\ \Omega$	30	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 22\ mA$	3	–	V
h_{FE}	DC current gain	$I_C = 4.5\ A$; $V_{CE} = 3\ V$	15	100	

APPLICATION INFORMATION

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

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (A)	P_{L1} (W)	G_{po} (dB)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.5	24	0.15	≥45 typ. 50	≥8 typ. 8.8	typ. 48	see Figs 8 and 9



The test circuit is split into two independent halves each being 30 × 40 mm in size.
Dimensions in mm.
Substrate: Epsilam 10.
Thickness: 0.635 mm.
Permittivity: $\varepsilon_r = 10$.

Fig.4 Test circuit.

NPN silicon planar epitaxial microwave power transistor

LXE15450X

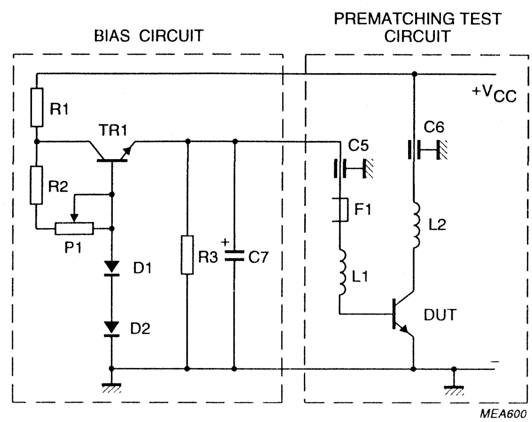


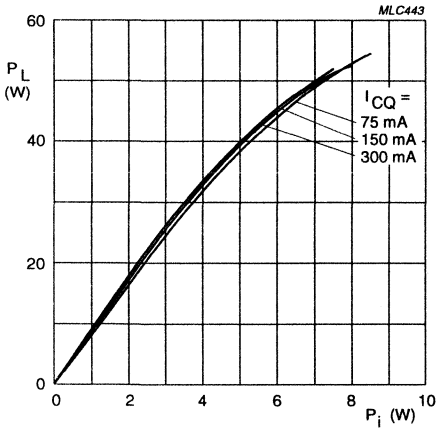
Fig.5 Class AB bias circuit.

List of components (see Figs 4 and 5)

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
TR1	transistor, BD239 or equivalent		
C1, C4	DC blocking chip capacitor	100 pF	ATC 100A1201kp
C2, C3	trimmer capacitor	0.5 to 5 pF	Tekelec 721-1
C5, C6	feedthrough bypass capacitor	1500 pF	Erie1250-003
C7	electrolytic capacitor	10 µF, >30 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	3 turns 0.5 mm copper wire; internal diameter = 2 mm		
P1	linear potentiometer	4.7 kΩ	
R1	resistor	100 Ω, 0.25 W	
R2	resistor	10 kΩ, 0.25 W	
R3	resistor	56 Ω, 0.25 W	
F1	ferrite bead		Philips tube, 12NC = 4330 030 43081 4.2 x 2.2 x 3.2 mm (4B1)
R_r	copper rivet		

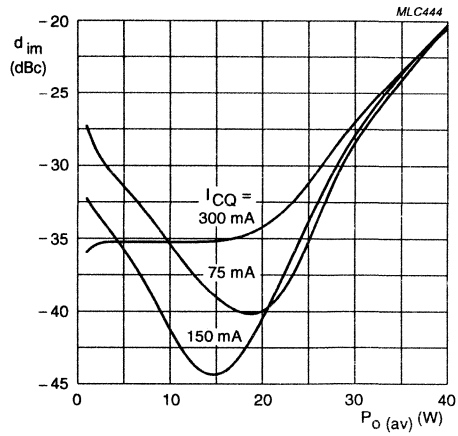
Notes

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



V_{CE} = 24 V.
f = 1500 MHz.

Fig.6 Load power as a function of input power.



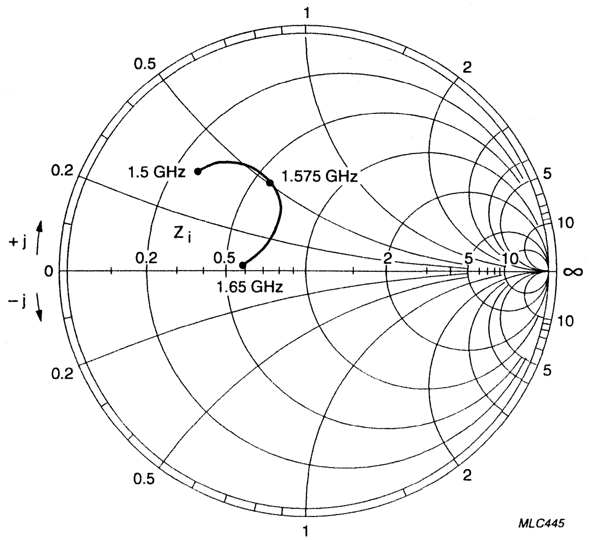
V_{CE} = 24 V.
f_1 = 1500 MHz.
f_2 = 1500.2 MHz.

Fig.7 Intermodulation distortion as a function of average output power.

Input and optimum load impedances

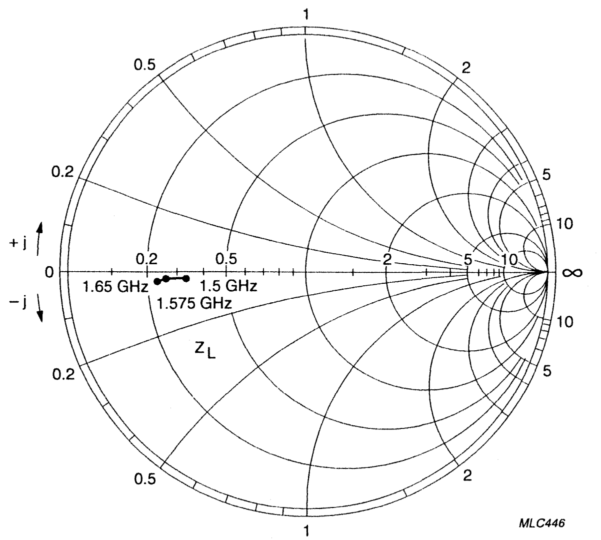
V_{CE} = 24 V; I_{CQ} = 0.15 A; typical values at $P_L = P_{L1}$ (see Figs 8 and 9).

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.500	2.8 + j3.5	3.2 − j0.25
1.575	5.7 + j5.0	2.5 − j0.15
1.650	6.0 + j0.4	2.4 − j0.20



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.15 A.

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



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.15 A.

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

NPN silicon planar epitaxial microwave power transistor

LXE16350X

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 and output prematching ensures good stability and allows an easier design of wideband circuits.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-91B metal ceramic package, with emitter connected to flange.

APPLICATIONS

Intended for use in common emitter class AB power amplifiers for military and professional applications at 1.65 GHz.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	Z_i/Z_L (Ω)
class AB (CW)	1.65	24	0.3	≥ 32	≥ 9	see Figs 8 and 9

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

PIN CONFIGURATION

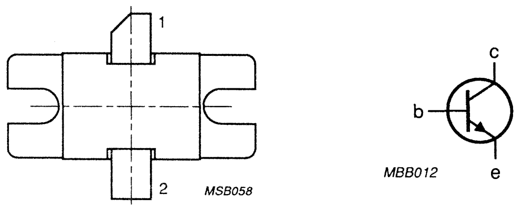


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
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NPN silicon planar epitaxial microwave power transistor

LXE16350X

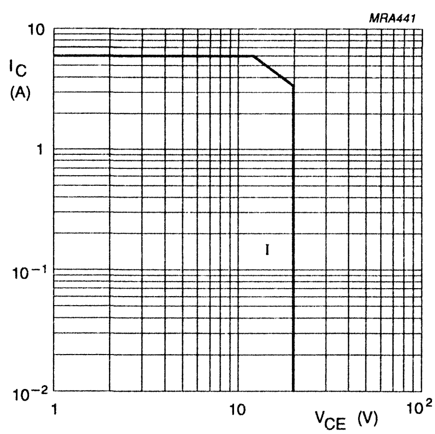
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	$R_{BE} = 220\ \Omega$	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	6	A
P_{tot}	total power dissipation	$T_{mb} = 75$ °C	–	57	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

Note

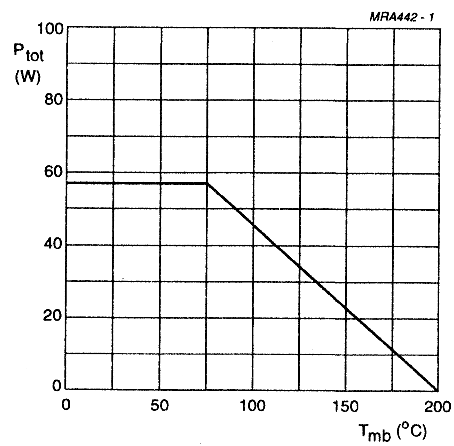
1. Up to 0.2 mm from ceramic.



$T_{mb} \leq 75$ °C

(I) Region of permissible DC operation

Fig.2 DC SOAR.



P_{tot} max = 57 W.

Fig.3 Maximum power dissipation derating as a function of mounting base temperature.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	1.7 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 20 V; I_E = 0	–	3	mA
		V_{CB} = 40 V; I_E = 0	–	30	mA
I_{CER}	collector cut-off current	V_{CE} = 30 V; R_{BE} = 220 Ω	–	30	mA
I_{CEO}	collector cut-off current	V_{CE} = 20 V; I_B = 0	–	30	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	–	300	μA
h_{FE}	DC current gain	V_{CE} = 3 V; I_C = 3 A	15	100	

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common emitter class AB amplifier (note 1).

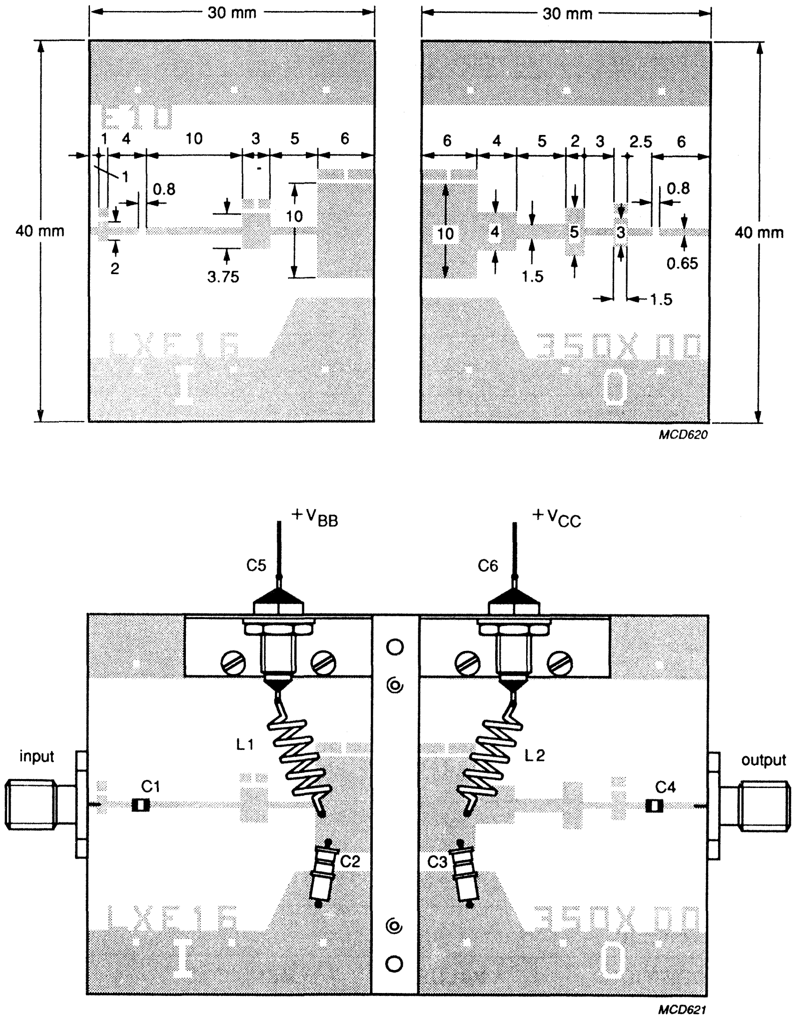
MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (A)	P_{L1} (W)	G_{po} (dB)	Z_i/Z_L (Ω)
class AB (CW)	1.65	24	0.3	≥ 32; typ.35	≥ 9; typ.10	see Figs 8 and 9

Note

1. The test circuit is split into 2 independant halves each being 30 x 40 mm in size.

List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
L1	5 turns 0.5 mm copper wire with ferrite bead		int. dia. 2 mm	
L2	5 turns 0.5 mm copper wire		int. dia. 2 mm	
C1, C4	DC blocking chip capacitor	100 pF		
C2, C3	trimmer capacitor	0.5 to 5 pF		Tekelec
C5, C6	feedthrough bypass capacitor	1500 pF		Erie, ref. 1250-003



Dimensions in mm
Substrate : Epsilam 10
Thickness : 0.635 mm
Permittivity : $\varepsilon_r = 10$

Fig.4 Prematching test circuit board.

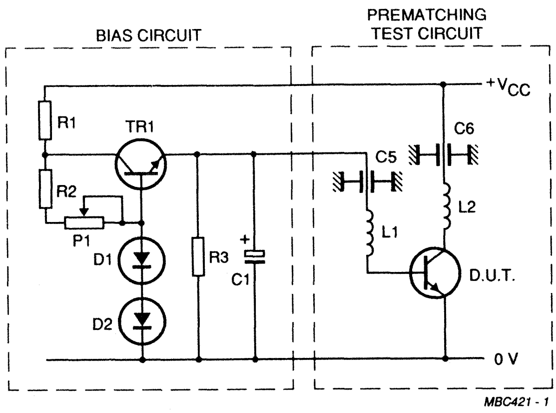


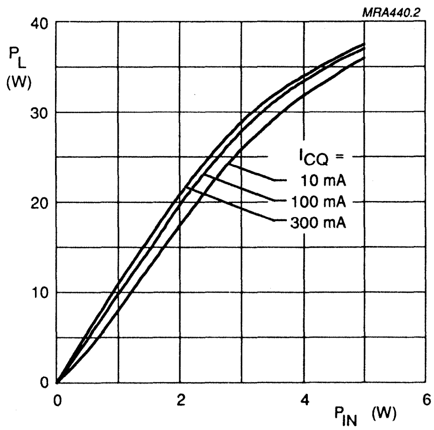
Fig.5 Class AB bias circuit at 1.65 GHz.

List of components (see bias circuit)

COMPONENT	DESCRIPTION	VALUE	CATALOGUE NO.
TR1	transistor, BDT85 (or equivalent)		
D1	diode, IN4148 (or equivalent) note 1		
D2	diode, BY239800 note 2		
R1	resistor	100 Ω	
R2	resistor	10 kΩ	
R3	resistor	56 Ω	
P1	potentiometer, 10 turns (sfernice)	4.7 kΩ	
C1	electrolytic capacitor	10 µF (>30 V)	
C5, C6	feedthrough bypass capacitor	1500 pF	Erie, ref. 1250-003
L1	5 turns 0.5 mm copper wire with ferrite bead		
L2	5 turns 0.5 mm copper wire		

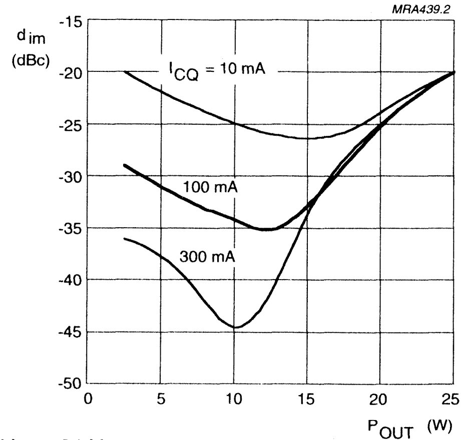
Notes

1. In thermal contact with TR1.
2. In thermal contact with D.U.T.



V_{CE} = 24 V

Fig.6 Load power as a function of input power.

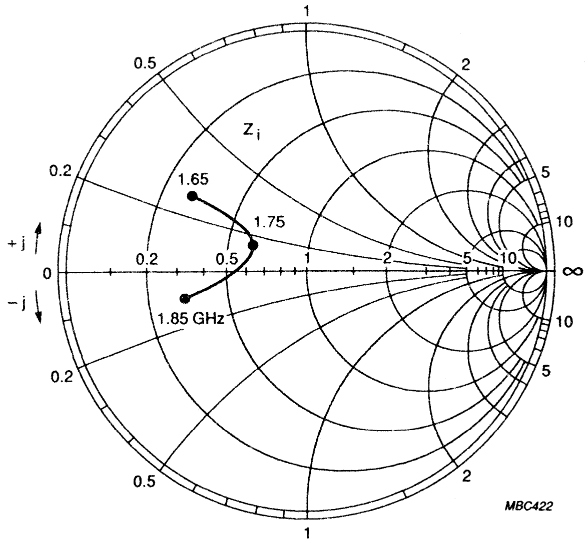


V_{CE} = 24 V

f_1 = 1.65 GHz

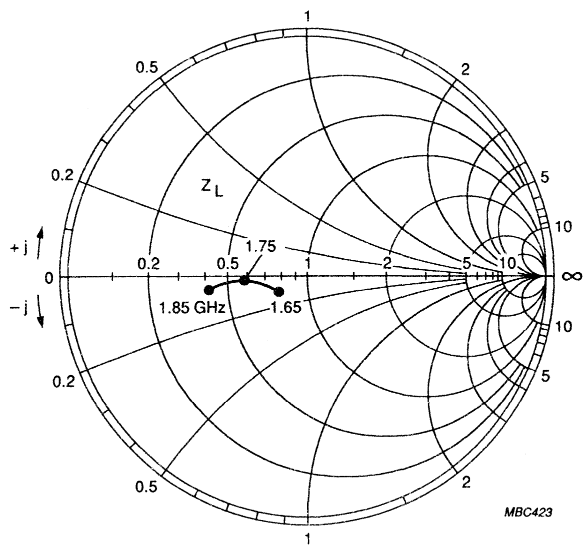
f_2 = 1.6502 GHz

Fig.7 Intermodulation distortion as a function of average output power.



V_{CE} = 24 V;
Z_O = 10 Ω;
I_{CQ} = 0.3 A.

Fig.8 Input impedance as a function of frequency; typical values.



V_{CE} = 24 V;
Z_O = 10 Ω;
I_{CQ} = 0.3 A.

Fig.9 Optimum load impedance as a function of frequency; typical values.

NPN silicon planar epitaxial microwave power transistor

LXE18300X

FEATURES

- Internal input and output prematching ensures a good stability and allows an easier design of wideband circuits
- Diffused emitter ballasting resistors provide excellent current sharing and withstanding at 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.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common emitter class AB amplifiers at frequencies from 1.6 to 1.85 GHz, in CW conditions. The transistor has a FO–91B metal ceramic flange package with emitter connected to flange.

APPLICATIONS

Intended for use in common emitter class AB power amplifiers for military and professional applications.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	Z_i/Z_L (Ω)
class AB (CW)	1.85	24	0.3	≥ 27	≥ 8	see Figs 8 and 9

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

PIN CONFIGURATION

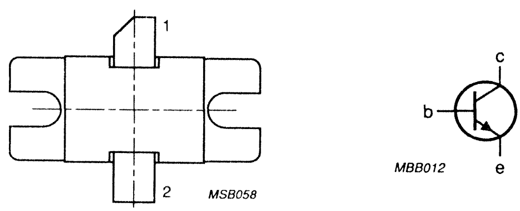


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

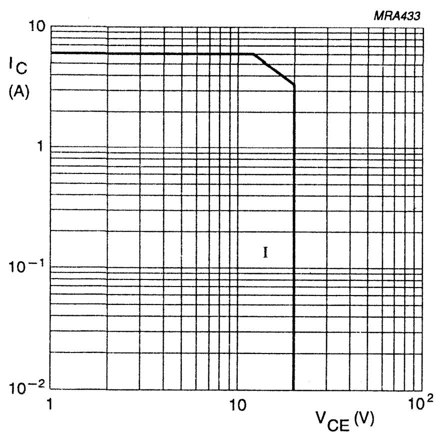
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	6	A
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	57	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s note 1	–	235	°C

Note

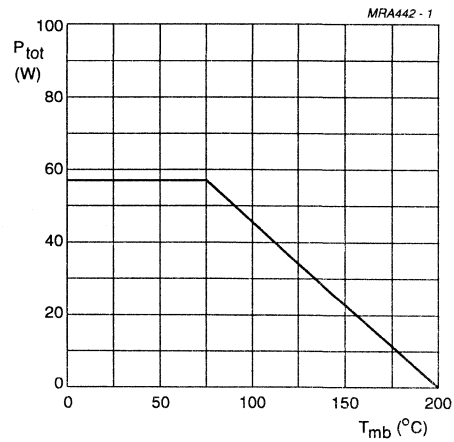
1. Up to 0.2 mm from ceramic.



T_{mb} ≤ 75 °C

(I) Region of permissible DC operation

Fig.2 DC SOAR.



P_{tot} max = 57 W.

Fig.3 Maximum power dissipation derating as a function of mounting base temperature.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE
$R_{th\ j\text{-}mb}$	from junction to mounting base	T_j = 100 °C	1.7 K/W
$R_{th\ mb\text{-}h}$	from mounting base to heatsink		0.2 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 20 V; I_E = 0	–	3	mA
		V_{CB} = 40 V; I_E = 0	–	30	mA
I_{CER}	collector cut-off current	V_{CE} = 30 V; R_{BE} = 220 Ω	–	30	mA
I_{CEO}	collector cut-off current	V_{CE} = 20 V; I_B = 0	–	30	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	–	300	µA
h_{FE}	DC current gain	V_{CE} = 3 V; I_C = 3 A	20	100	

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common emitter class AB amplifier (note 1).

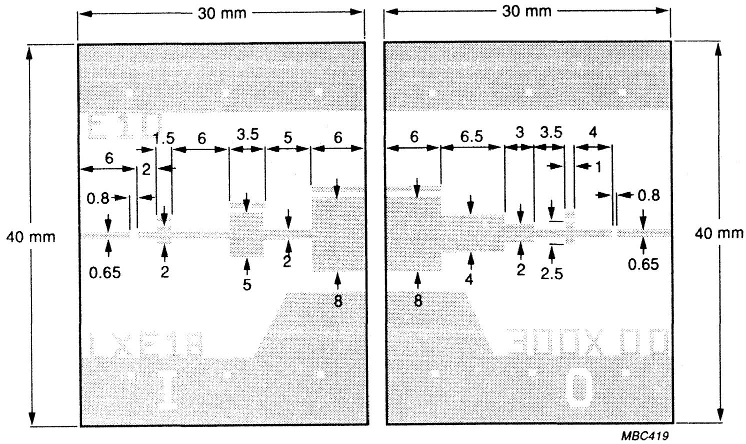
MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_{CQ} (A)	P_{L1} (W)	G_{po} (dB)	Z_i/Z_L (Ω)
class AB (CW)	1.85	24	0.3	≥ 27; typ.30	≥ 8; typ.9	see Figs 8 and 9

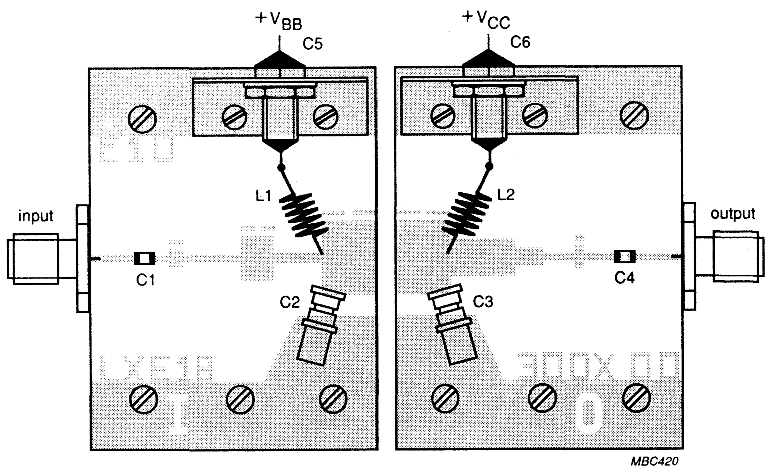
Note

1. The test circuit is split into 2 independant halves each being 30 x 40 mm in size.

List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
L1	5 turns 0.5 mm copper wire with ferrite bead		int. dia. 2 mm	
L2	5 turns 0.5 mm copper wire		int. dia. 2 mm	
C1, C4	DC blocking chip capacitor	100 pF		
C2, C3	trimmer capicitor	0.5 to 5 pF		
C5, C6	feedthrough bypass capacitor	1500 pF		Erie, ref. 1250-003





Dimensions in mm

Substrate : Epsilam 10

Thickness : 0.635 mm

Permittivity : $\varepsilon_r = 10$

Fig.4 Premátching test circuit board.

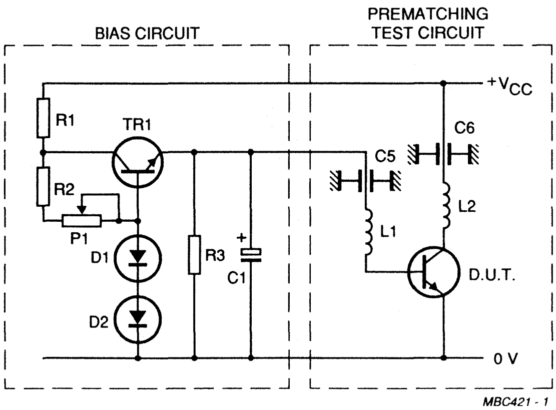


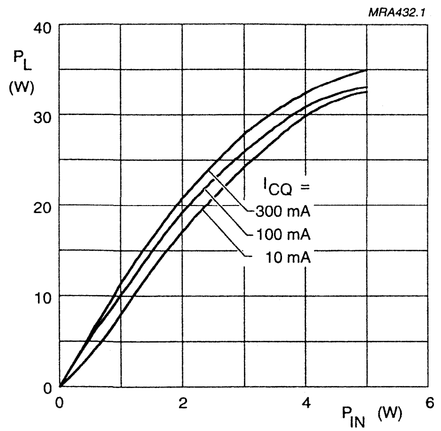
Fig.5 Class AB bias circuit at 1.85 GHz.

List of components (see bias circuit)

COMPONENT	DESCRIPTION	VALUE	CATALOGUE NO.
T1	transistor, BDT85 (or equivalent)		
D1	diode, IN4148 (or equivalent) note 1		
D2	diode, BY239800 note 2		
R1	resistor	100 Ω	
R2	resistor	10 KΩ	
R3	resistor	56 Ω	
P1	potentiometer, 10 turns (sfernice)	4.7 kΩ	
C1	electrolytic capacitor	10 µF (>30 V)	
C5, C6	feedthrough bypass capacitor	1500 pF	Erie, ref. 1250-003
L1	5 turns 0.5 mm copper wire with ferrite bead		
L2	5 turns 0.5 mm copper wire		

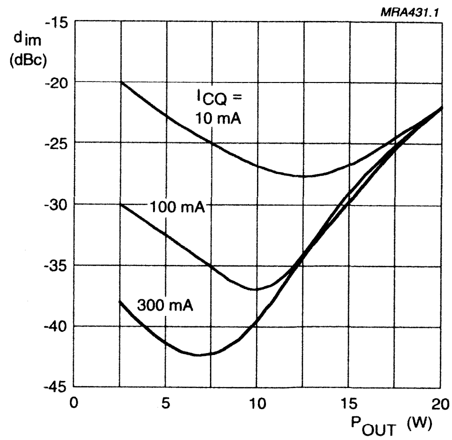
Notes

1. In thermal contact with T1.
2. In thermal contact with D.U.T.



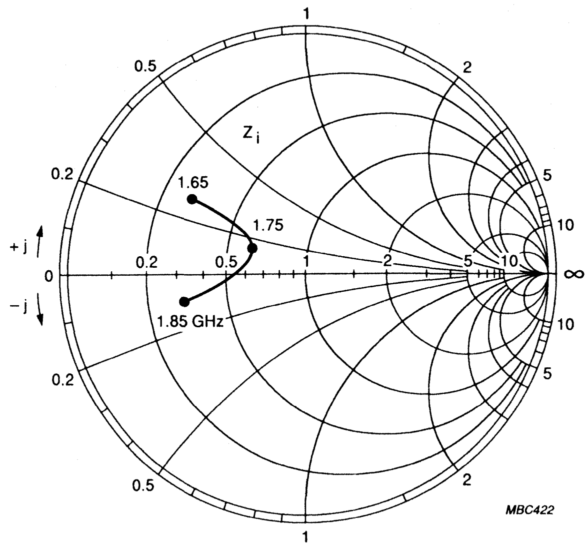
V_{CE} = 24 V

Fig.6 Load power as a function of input power.



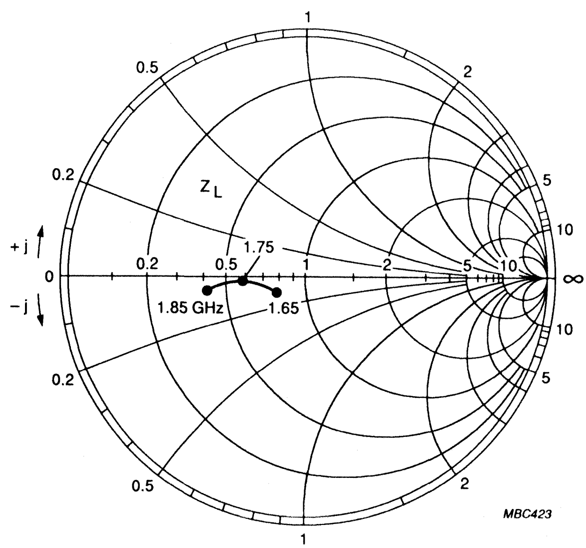
V_{CE} = 24 V
f_1 = 1.85 GHz
f_2 = 1.8502 GHz

Fig.7 Intermodulation distortion as a function of average output power.



V_{CE} = 24 V;
Z_O = 10 Ω;
I_{CQ} = 0.3 A.

Fig.8 Input impedance as a function of frequency; typical values.



V_{CE} = 24 V;
Z_O = 10 Ω;
I_{CQ} = 0.3 A.

Fig.9 Optimum load impedance as a function of frequency; typical values.

NPN silicon planar epitaxial microwave power transistor

LXE18400X

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 and output 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 military and professional applications between 1.7 and 2 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-91B metal ceramic flange package, with emitter connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	0.15	≥39	≥7	typ. 42	see Figs 8 and 9

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	base
3	emitter connected to flange

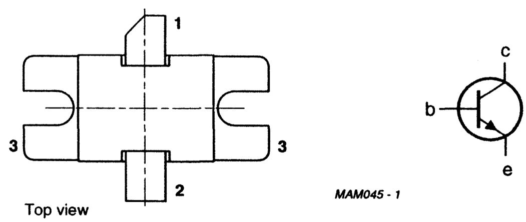


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
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.

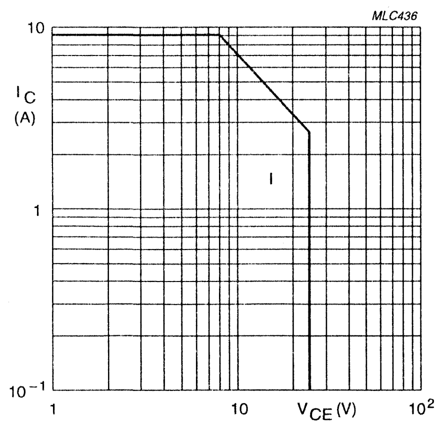
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CER}	collector-emitter voltage	R_{BE} = 220 Ω	–	30	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	9	A
P_i	input power	f = 1.85 GHz; V_{CE} = 24 V; class AB	–	12	W
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	70	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



T_{mb} ≤ 75 °C.
(I) Region of permissible DC operation.

Fig.2 DC SOAR.

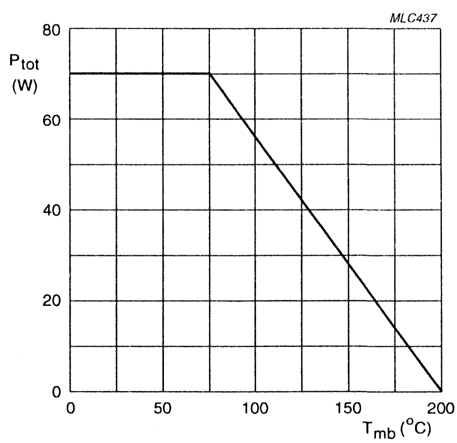


Fig.3 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	1.3	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

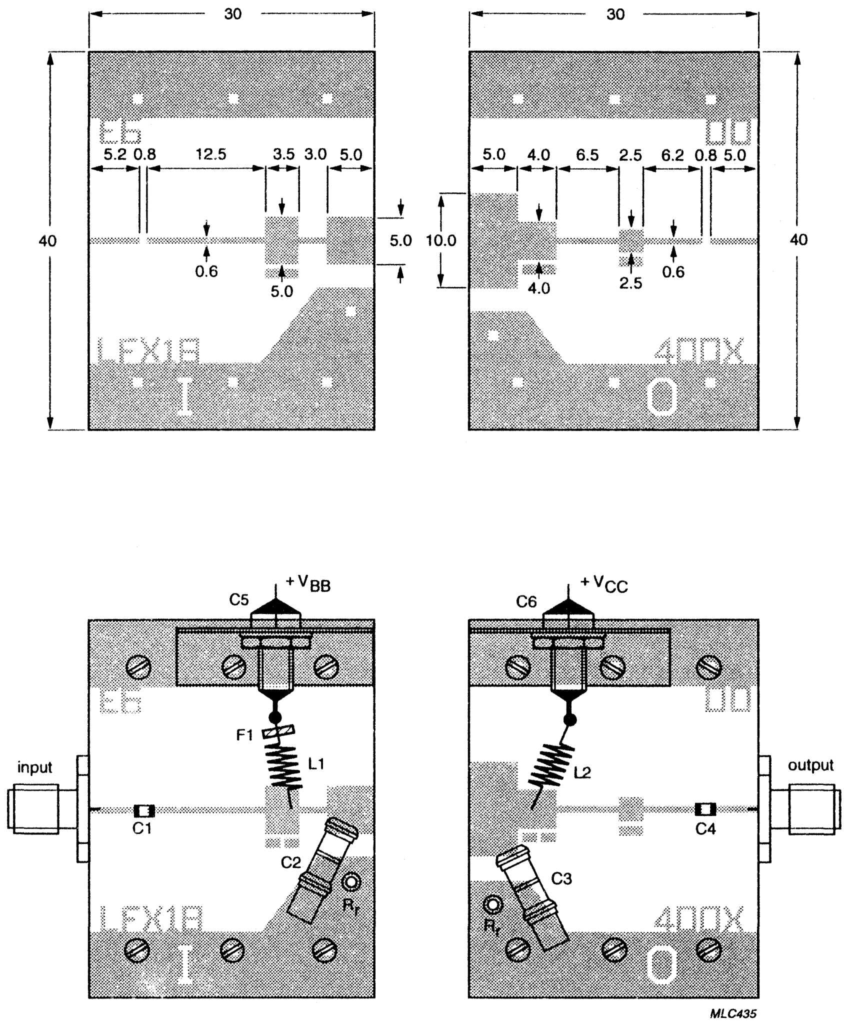
T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; V_{CB} = 20 V	–	4.5	mA
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = 150 mA; R_{BE} = 220 Ω	30	–	V
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 22 mA	45	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 22 mA	3	–	V
h_{FE}	DC current gain	I_C = 4.5 A; V_{CE} = 3 V	15	100	

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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)	η_C (%)	Z_i; Z_L (Ω)
Class AB (CW)	1.85	24	0.15	≥39 typ. 44	≥7 typ. 7.8	typ. 42	see Figs 8 and 9



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

Dimensions in mm.

Substrate: Epsilam 10.

Thickness: 0.635 mm.

Permittivity: $\varepsilon_r = 10$.

Fig.4 Prematching test circuit board.

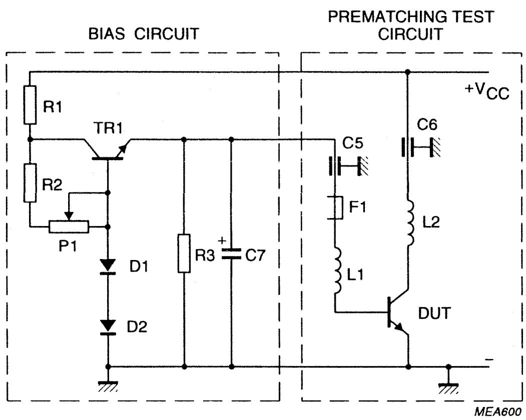


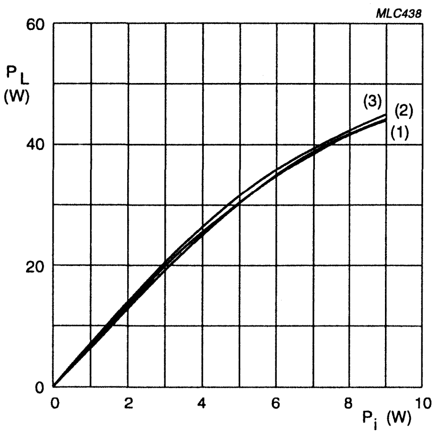
Fig.5 Class AB bias circuit.

List of components (see Figs 4 and 5)

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
TR1	transistor, BD239 or equivalent		
C1, C4	DC blocking chip capacitor	100 pF	ATC 100A1201kp
C2, C3	trimmer capacitor	0.5 to 5.0 pF	Tekelec 727-1
C5, C6	feedthrough bypass capacitor	1500 pF	Erie 1250-003
C7	electrolytic capacitor	10 µF, >30 V	
D1	diode BY239 or equivalent; note 1		
D2	diode BY239 or equivalent; note 2		
L1	4 turns 0.5 mm copper wire; internal diameter = 2 mm		
L2	3 turns 0.5 mm copper wire; internal diameter = 2 mm		
P1	linear potentiometer	4.7 kΩ	
R1	resistor	100 Ω, 0.25 W	
R2	resistor	10 kΩ, 0.25 W	
R3	resistor	56 Ω, 0.25 W	
F1	ferrite bead		Philips tube, 12NC = 4330 030 43081 4.2 x 2.2 x 3.2 mm (4B1)
R_r	copper rivet		

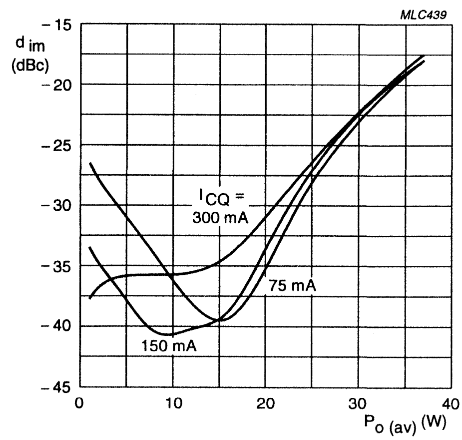
Notes

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



(1) I_{CQ} = 75 mA.
(2) I_{CQ} = 150 mA.
(3) I_{CQ} = 300 mA.
V_{CE} = 24 V; f = 1850 MHz.

Fig.6 Load power as a function of input power.



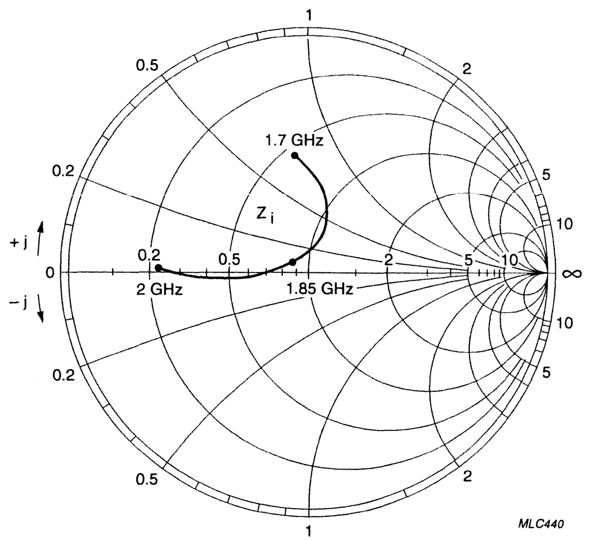
V_{CE} = 24 V; f_1 = 1850 MHz; f_2 = 1850.2 MHz.

Fig.7 Intermodulation distortion as a function of average output power.

Input and optimum load impedances

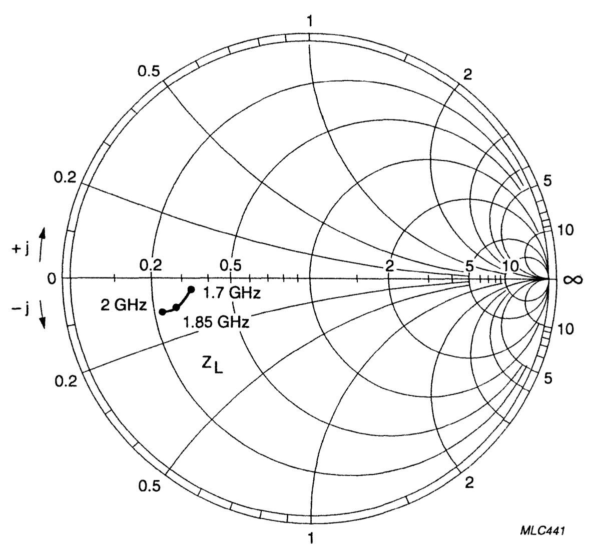
V_{CE} = 24 V; I_{CQ} = 0.15 mA; typical values at $P_L = P_{L1}$ (see Figs 8 and 9).

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.70	5.4 + j7.2	3.3 − j0.3
1.85	8.3 + j0.7	2.4 − j1.0
2.00	2.1 + j0.2	2.2 − j1.0



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.15 mA.

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



V_{CE} = 24 V; Z_o = 10 Ω; I_{CQ} = 0.15 mA.

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

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon power transistor for use in a common-emitter, class-A amplifier from 1.4 GHz to 1.8 GHz in CW conditions in military and professional applications.

Features:

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistor providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- Internal input and output prematching ensuring a good stability and allowing an easier design of wideband circuits

The transistor is housed in a metal ceramic flange envelope (FO-57C).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-emitter class-A wideband amplifier

mode of operation	f GHz	V_{CE} V	I_C A	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	1.4 to 1.8	16	2	⩾ 9	⩾ 10	see Fig. 7	

MECHANICAL DATA

FO-57C (see Fig. 1).

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.

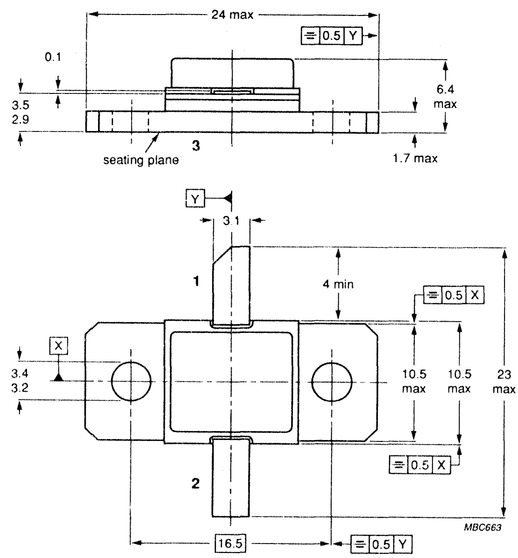
MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-57C.

Pinning:

1 = collector
2 = base
3 = emitter



Torque on screw: max. 0.5 Nm

Recommended screw: M3

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage, open emitter	V_{CBO}	max.	45	V
Collector-emitter voltage				
open base	V_{CEO}	max.	20	V
R_{BE} = 220 Ω	V_{CER}	max.	30	V
Emitter-base voltage, open collector	V_{EBO}	max.	3.0	V
Collector current (DC)	I_C	max.	4	A
Total power dissipation				
up to T_{mb} = 75 °C	P_{tot}	max.	45	W
Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	200	°C
Soldering temperature				
at 0.2 mm from flange; $t_{sld} \leq 10$ s	T_{sld}	max.	235	°C

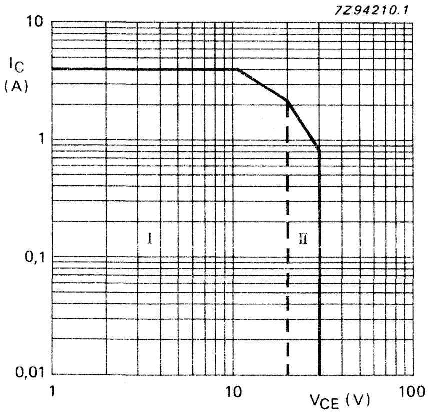


Fig. 2 DC SOAR; $T_{mb} \leqslant 75\ ^oC$.
I Region of permissible DC operation
II Permissible extension provided $R_{BE} \leqslant 220\ \Omega$

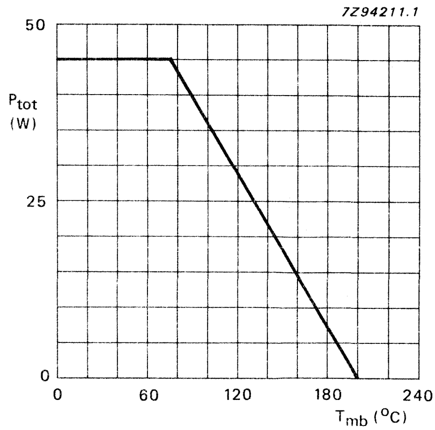


Fig. 3 Power derating curve versus mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	2.2 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2 K/W

CHARACTERISTICS

$T_{mb} = 25\ ^oC$ unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	2 mA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	max.	20 mA
$V_{CE} = 30$ V; $R_{BE} = 220\ \Omega$	I_{CER}	max.	20 mA
$V_{CE} = 20$ V; $I_B = 0$	I_{CEO}	max.	20 mA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	200 μA
DC current gain			
$I_C = 2$ A; $V_{CE} = 3$ V	h_{FE}		15 to 100

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-emitter class-A wideband amplifier*

mode of operation	f GHz	V_{CE} V	I_C A	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	1.4 to 1.8	16	2	⩾ 9 typ. 10	⩾ 10 typ. 11	see Fig. 7	

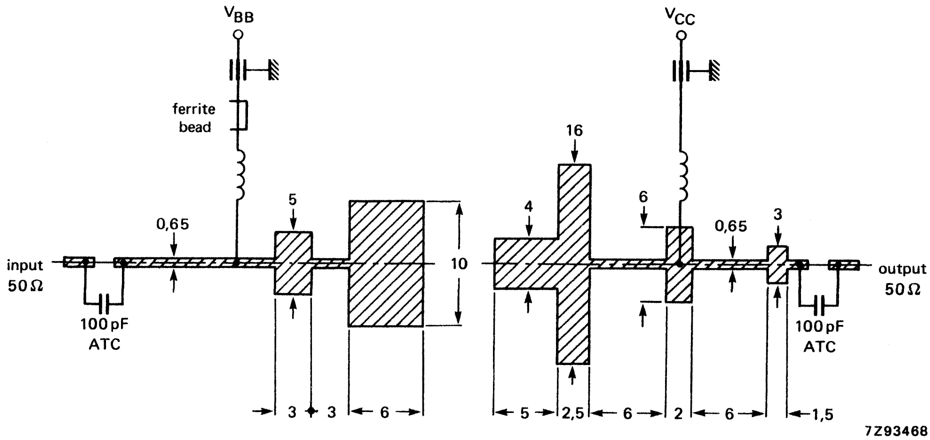


Fig. 4 Wideband test circuit board for 1.4 to 1.8 GHz, CW, class-A application (dimensions in mm). Epsilam p.c. board, thickness 0.635 mm, ϵ_r = 10.

* Amplifier consists of test circuit board without any additional tuning.

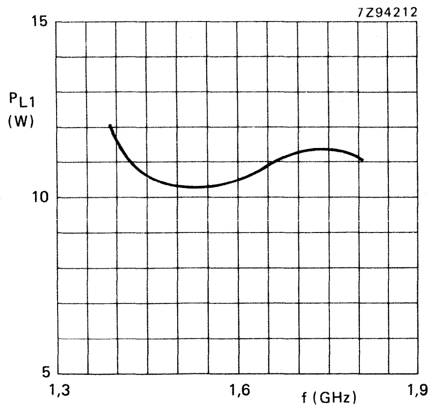


Fig. 5 Load power as a function of frequency.

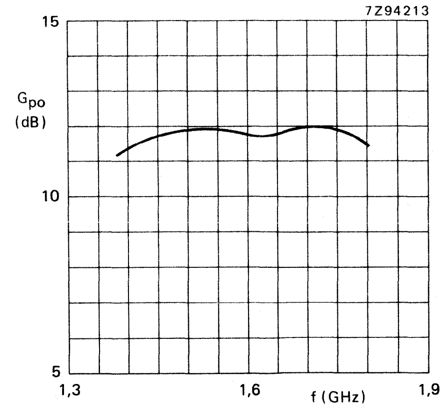


Fig.6 Linear power gain as a function of frequency.

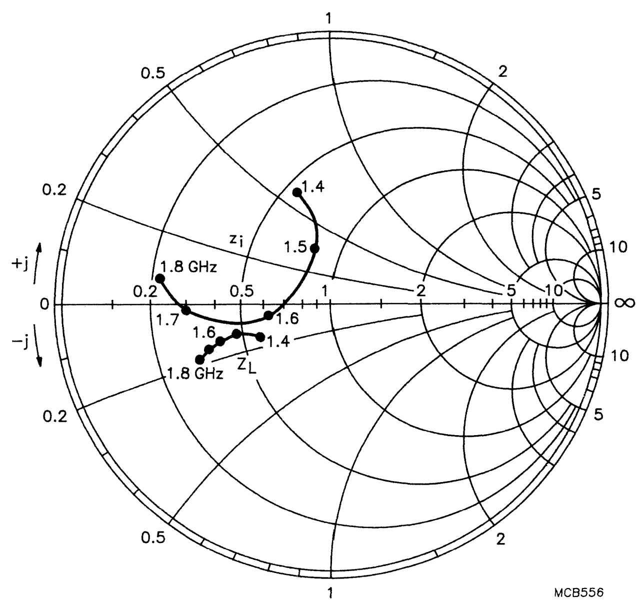


Fig. 7 Input and load impedances as a function of frequency;
Z_O = 10 Ω; typical values.

Conditions for Figs 5 to 7:

V_{CE} = 16 V
I_C = 2 A
regulated; T_{mb} = 25 °C; typical values.

NPN silicon planar epitaxial microwave power transistor

MF1011B900Y

FEATURES

- Suitable for short and medium pulse applications up to 100 μs pulse width, duty factor 10%
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very stable characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance
- Internal input and output prematching networks allow an easier design of circuits.

APPLICATIONS

Intended for use in common base class C broadband pulsed power amplifiers for IFF, TCAS and Mode S applications in the 1 030 MHz to 1 090 MHz band. Also suitable for medium pulse, heavy duty operation within this band.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-231 glued cap metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class C narrowband amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 10 μs; δ = 1%	1.09	50	800	≥6	≥40

PINNING - FO-231

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

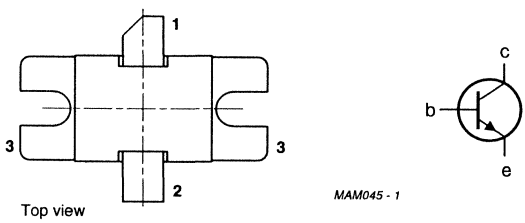


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

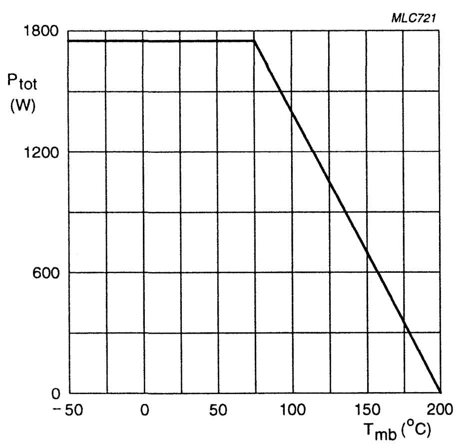
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	65	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_{CM}	peak collector current	$t_p = 10\ \mu s$; $\delta = 1\%$	–	50	A
P_{tot}	total power dissipation	$T_{mb} < 75\ °C$; $t_p \leq 10\ \mu s$; $\delta \leq 1\%$	–	1750	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p = 10\ \mu s$; $\delta = 1\%$.

Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 120 °C	0.84	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	t_p = 10 µs; δ = 1%; note 1	0.01	K/W

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

CHARACTERISTICS

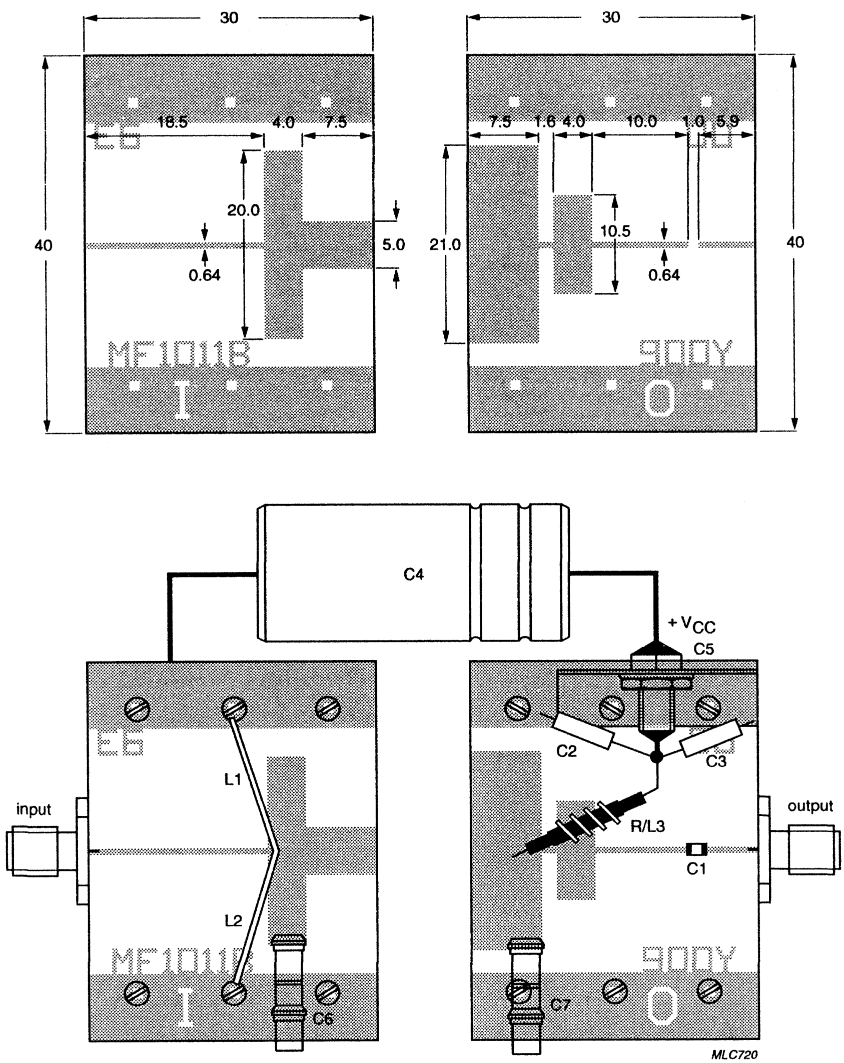
T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 50 V	27	mA
I_{CES}	collector cut-off current	V_{BE} = 0; V_{CE} = 50 V	27	mA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 1.5 V	7	mA
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 180 mA	65	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 180 mA; V_{BE} = 0	65	V

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-base test circuit as shown in Fig.3.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 10 µs; δ = 1%	1.09	50	≥800 typ. 900	≥6 typ. 6.5	≥40 typ. 48
	t_p = 0.5 µs; δ = 50% t_p = 112 µs; δ = 1%	1.03 to 1.09	50	typ. 750	typ. 5.7	typ. 36
	t_p = 32 µs; δ = 1%	1.09	50	typ. 870	typ. 6.3	typ. 46

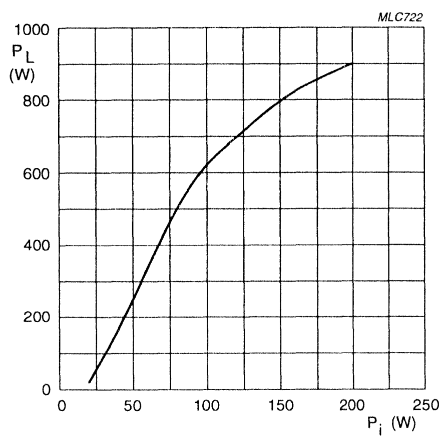


Dimensions in mm.
Substrate: Epsilam 10.
Thickness: 0.635 mm.
Permittivity: ε_r = 10.

Fig.3 Broadband test circuit.

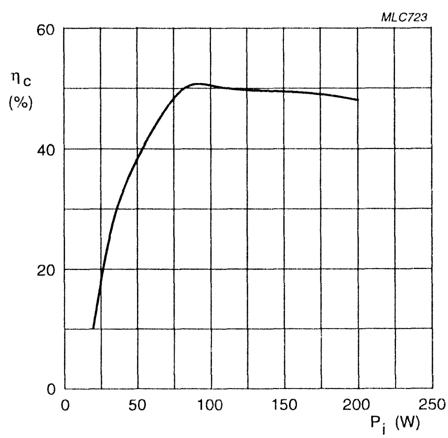
List of components (see Fig.3)

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
C1	capacitor	100 pF	ATC 100A101kp50x
C2,C3	tantalum capacitor	10 μF; 50 V	
C4	electrolytic capacitor	1 mF; 63 V	
C5	feedthrough bypass capacitor		Erie1250-003
C6, C7	variable gigatrim capacitor	0.8 to 8 pF	Tekelec 729-1
L1, L2	0.65 mm copper wire; total length = 26 mm; height of loop = 10 mm		
L3	4 turns 0.65 mm copper wire; total length = 48 mm		
R	resistor	4.7 Ω; 0.5 W	



Class C pulse operation.
t_p = 10 μs; δ = 1%; V_{CC} = 50 V; f = 1.09 GHz.
In broadband test circuit as shown in Fig.3.

Fig.4 Load power as a function of input power.



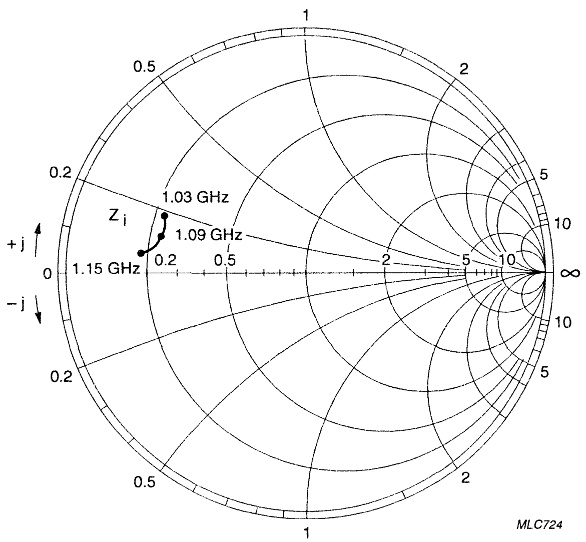
Class C pulse operation.
t_p = 10 μs; δ = 1 %; V_{CC} = 50 V; f = 1.09 GHz.
In broadband test circuit as shown in Fig.3.

Fig.5 Collector efficiency as a function of input power.

Input and optimum load impedances

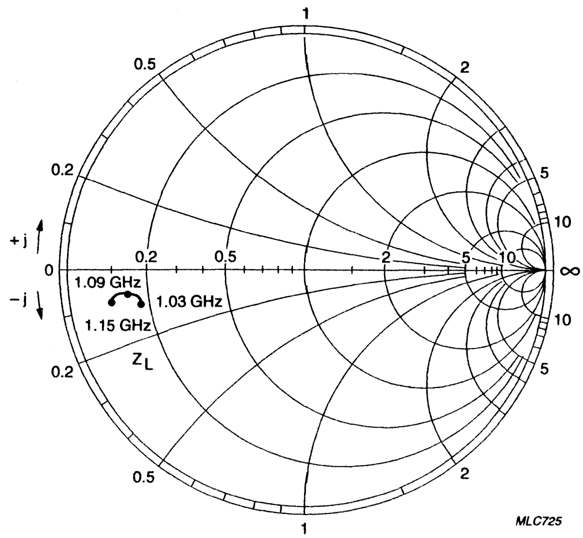
V_{CE} = 50 V; typical values at $P_L = P_{L1}$ (see Figs 6 and 7).

f (GHz)	Z_i (Ω)	Z_L (Ω)
1.03	0.22 + j0.19	0.14 − j0.10
1.09	0.23 + j0.12	0.12 − j0.08
1.15	0.19 + j0.06	0.09 − j0.09



V_{CC} = 50 V; Z_o = 10 Ω; P_o = 240 W.

Fig.6 Input impedance as a function of frequency.



V_{CC} = 50 V; Z_o = 50 Ω; P_o = 240 W.

Fig.7 Optimum load impedance as a function of frequency.

NPN silicon planar epitaxial microwave power transistor

MRB11040W

FEATURES

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

DESCRIPTION

NPN silicon planar epitaxial microwave transistor with internal input prematching cell, in a FO–67 metal ceramic package with base connected to flange.

APPLICATIONS

Intended for use in common base, class C, narrowband pulse power amplifiers at 1030 MHz for IFF applications.

QUICK REFERENCE DATA

Microwave performance for T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	CONDITIONS	f (MHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)	z_i/Z_L (Ω)
class C	t_p = 1 μs; δ = 1%	1030	50	> 60	> 10	> 35	see Figs 5 and 6

PINNING - FO-67

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

PIN CONFIGURATION

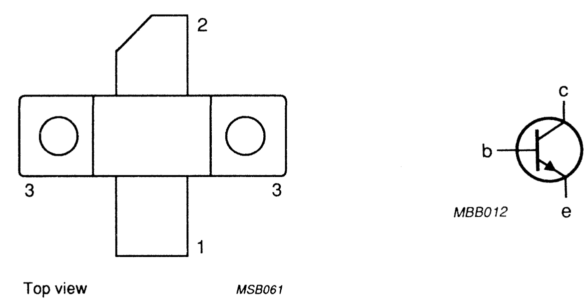


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

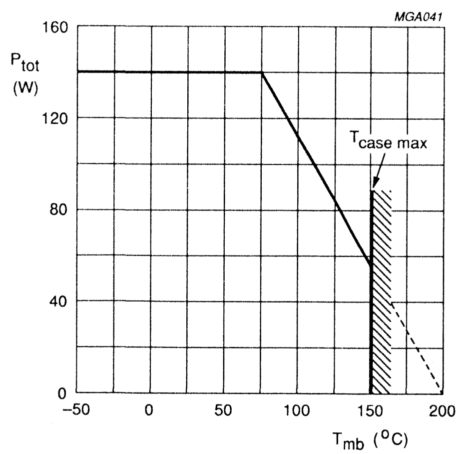
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	60	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	3	A
P_{tot}	total power dissipation	$T_{mb} < 75$ °C; $t_p \leq 1$ µs; $\delta \leq 1\%$	–	140	W
T_{stg}	storage temperature range		–65	150	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

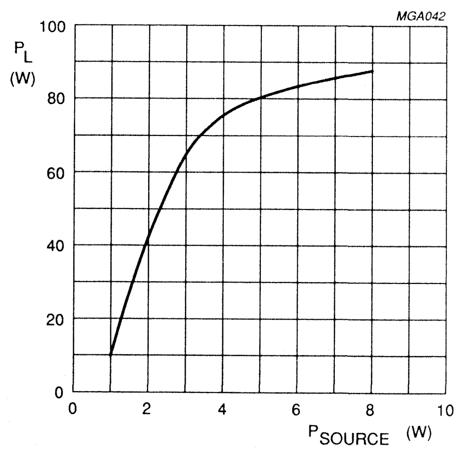
Note

1. Up to 0.2 mm from ceramic.



$t_p = 1$ µs; $\delta = 1$ %; P_{tot} max = 140 W

Fig.2 Maximum power dissipation derating as a function of mounting base temperature.



V_{CC} during pulse = 50 V; $t_p = 1$ µs; $\delta = 1$ %

Fig.3 Load power as a function of source power.

NPN silicon planar epitaxial microwave power transistor

MTB10010U

FEATURES

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

PINNING - FO-41B

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

DESCRIPTION

NPN silicon planar epitaxial microwave transistor with internal input prematching cell, in a FO–41B metal ceramic package with base connected to flange.

APPLICATIONS

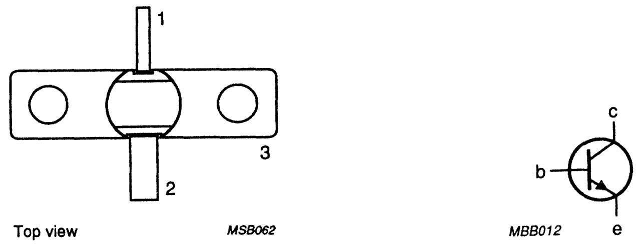
Intended for use in common base class C narrowband pulsed power amplifiers at 1030 MHz for IFF applications.

QUICK REFERENCE DATA

Microwave performance for T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	CONDITIONS	f (MHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)	z_i/Z_L (Ω)
class C	t_p = 1 µs; δ = 1%	1030	24	> 9.5	> 9.5	> 50	see Figs 5 and 6

PIN CONFIGURATION



Marking code : 10010U

Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

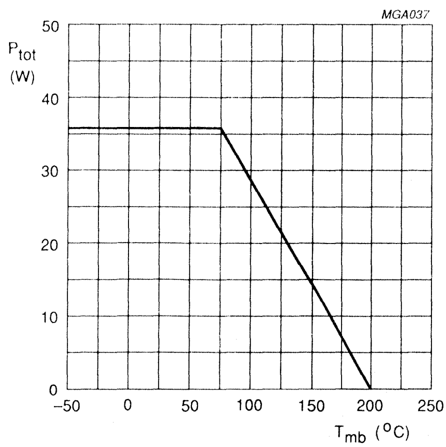
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	average collector current		–	0.75	A
P_{tot}	total power dissipation	$T_{mb} < 75$ °C; $t_p = 1\ \mu$s; $\delta = 1\%$	–	36	W
T_{stg}	storage temperature range		–65	200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

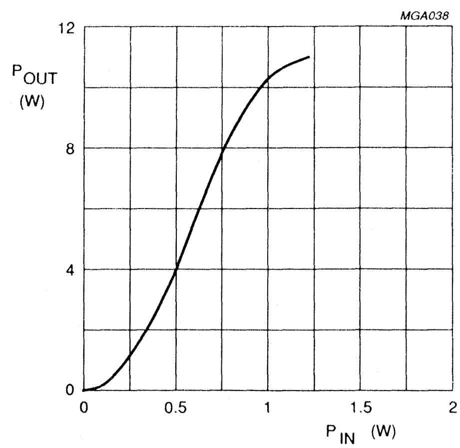
Note

1. Up to 0.3 mm from ceramic.



P_{tot} max = 36 W under the nominal pulse conditions

Fig.2 Maximum power dissipation derating as a function of mounting base temperature.



$V_{CC} = 24$ V; $t_p = 1\ \mu$s; $\delta = 1\%$; f = 1030 MHz.

Fig.3 Load power as a function of source power.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_j = 100$ °C	10.5 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.7 K/W
Z_{th}	thermal impedance from junction to mounting base	$t_p = 1$ µs; $\delta = 1$ %	2.5 K/W

CHARACTERISTICS

$T_{mb} = 25$ °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 30$ V; $I_E = 0$	45	µA
I_{CES}	collector cut-off current	$V_{CE} = 30$ V; $R_{BE} = 0$	300	µA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5$ V; $I_C = 0$	4.5	µA

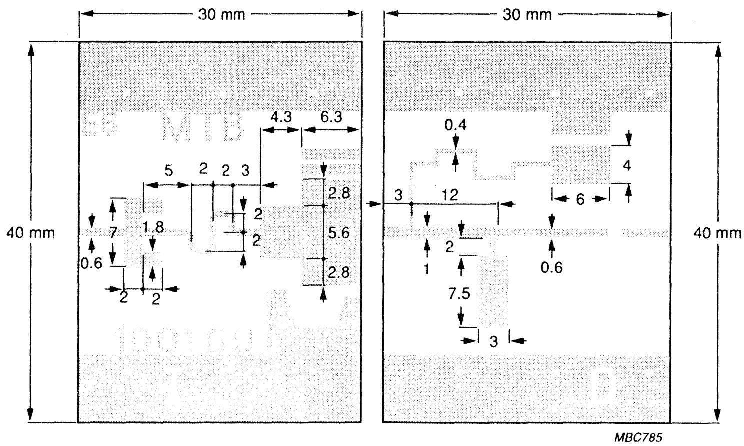
APPLICATION INFORMATION

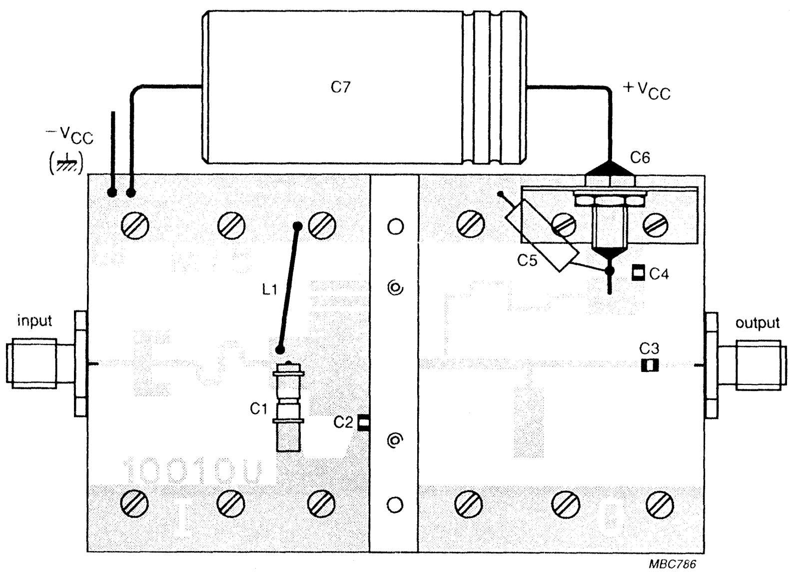
Microwave performance up to $T_{mb} = 25$ °C and working in pulsed conditions in a narrowband test circuit as shown in Fig.4.

MODE OF OPERATION	CONDITIONS	f (MHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)	z_i/Z_L (Ω)
class C	$t_p = 1$ µs; $\delta = 1$ %	1030	24	> 9.5; typ. 11	> 9.5; typ. 10	> 50; typ. 55	see Figs 5 and 6

List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
L1	0.4 mm copper wire		rectangular loop	
C1	tuning capacitor	0.5 - 5 pF		Tekelec 5855
C2	chip capacitor	3 pF		Eurofarad CEC 23
C3	chip capacitor	10 pF		Eurofarad CEC 23
C4	chip capacitor	47 pF		Eurofarad CEC 23
C5	tantalum capacitor	10 µF, 50 V		
C6	feedthrough bypass capacitor			Erie 1250-003
C7	capacitor	220 µF, 63 V		





Dimensions in mm

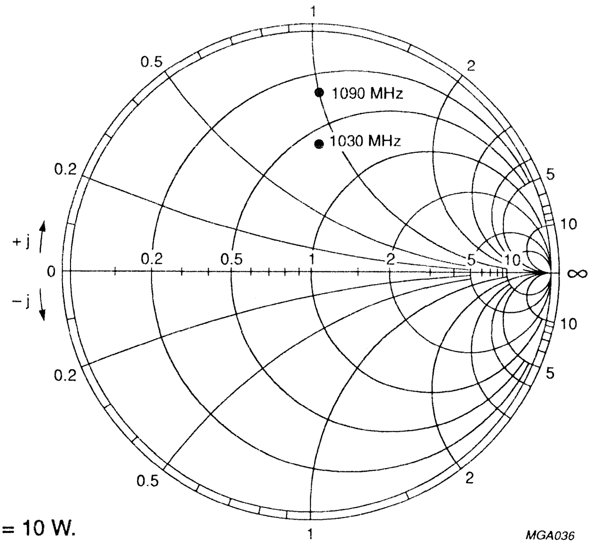
Substrate : Duroid 6010

Permittivity : $\varepsilon_r = 10.2$

Fig.4 Narrowband test circuit.

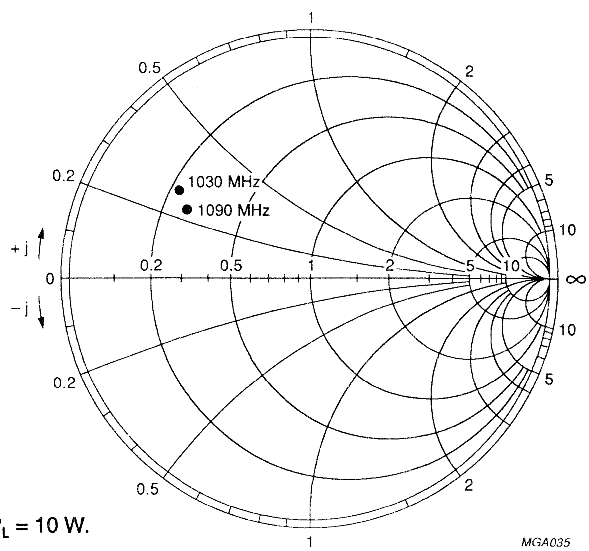
NPN silicon planar epitaxial microwave power transistor

MTB10010U



V_{CC} = 24 V; Z_O = 5 Ω; P_L = 10 W.

Fig.5 Input impedance as a function of frequency, associated with optimum load impedance.



V_{CC} = 24 V; Z_O = 50 Ω; P_L = 10 W.

Fig.6 Optimum load impedance as a function of frequency; associated with input impedance.

Data sheet	
status	Product specification
date of issue	June 1992

MX0912B100Y; MZ0912B100Y

NPN silicon planar epitaxial microwave power transistor

FEATURES

- Interdigitated structure; high emitter efficiency.
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding at a high VSWR.
- Gold metallization realizes very good stability of the characteristics and excellent life time.
- Multicell geometry gives good balance of dissipated power and low thermal resistance.
- Input and output matching cell allows an easier design of circuits.

APPLICATION

Intended for use in common base class C broadband pulse power amplifier from 960 to 1215 MHz for TACAN application.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common base class C broadband pulse power amplifier at 960 to 1215 MHz for TACAN application.

MZ0912B100Y has a FO-57C metal ceramic flange package with base connected to flange.
It is mounted in common base configuration, and specified in class C.
MX0912B100Y has an FO-91B metal ceramic flange package and improved output prematching cells.
It is recommended for new designs.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C broadband amplifier.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η C (%)	z_i/Z_L (Ω)
class C; t_p = 10 μs; δ = 10%	0.960 to 1.215	50	> 100	> 7	> 42	see Figs 7 and 8

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 industrial or domestic waste.**

MECHANICAL DATA

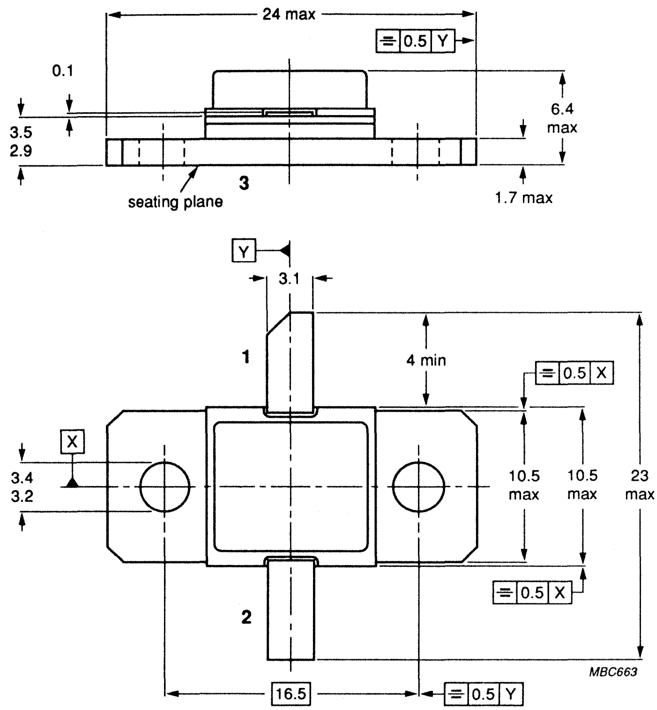


Fig.1 FO-57C.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	-	65	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	-	60	V
V_{CEO}	collector-emitter voltage	open base	-	20	V
V_{EBO}	emitter-base voltage	open collector	-	3	V
I_C	collector current	$t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	6	A
P_{tot}	total power dissipation	peak power; $T_{mb} = 75\ °C$; $t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	290	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		-	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s up to 0.2 mm from ceramic	-	235	°C

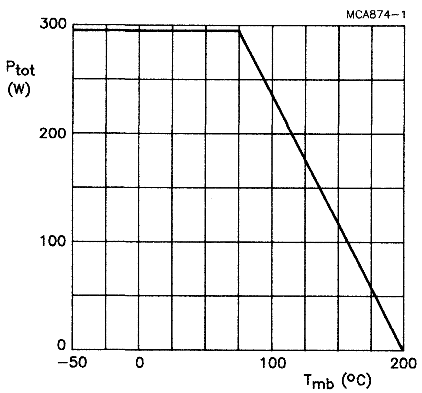


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; $t_p = 10\ \mu s$; $\delta = 10\%$; P_{tot} max = 290 W.

THERMAL CHARACTERISTICS

$T_j = 125\ °C$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	3.2	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink	CW	0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	note 1	0.43	K/W

Notes

1. Equivalent thermal impedance under nominal pulse microwave operating conditions; $t_p = 10\ \mu s$; $\delta = 10\%$.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 65 V; I_E = 0	40	mA
I_{CBO}	collector cut-off current	V_{CB} = 50 V; I_E = 0	4	mA
I_{CES}	collector cut-off current	V_{CE} = 60 V; R_{BE} = 0	40	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	400	μA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the test jig as shown in Fig.4 and working in class C broadband mode in pulse; note 2.

MODE OF OPERATION	f (GHz)	V_{CC} (V) note 1	P_L (W)	G_p (dB)	η C (%)	z_i/Z_L (Ω)
class C t_p = 10 μs; δ = 10%	0.960 to 1.215	50	≥ 100 typ. 115	≥ 7 typ. 7.6	≥ 42 typ. 44	see Figs 7 and 8
t_p = 300 μs; δ = 10% see Fig.3	1.03 to 1.09	50	typ. 125	typ. 8	typ. 50	

Notes

1. V_{CC} during pulse.
2. Operating conditions and performance for other pulse formats can be made available on request.

List of components

L1 = Cu wire ∅ = 0.65 mm ,total length = 12 mm, height of loop = 12 mm
L2 = Cu wire ∅ = 0.65 mm, internal diameter 3 mm, 4 turns, L = 5 mm
C1 = DC block, 100 pF (ATC, ref. 100A101KP50X)
C2 = tantalum capacitor 10 μF/50 V
C3 = electrolytic capacitor 470 μF/63 V
C4 = feedthru bypass capacitor (Erie, ref. 1250-003)
C5 = C6 = Variable gigatrim capacitor 0.6 - 4.5 pF, (Tekelec, ref. 727.1)

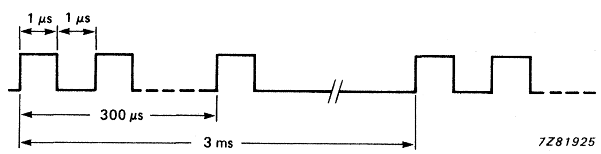
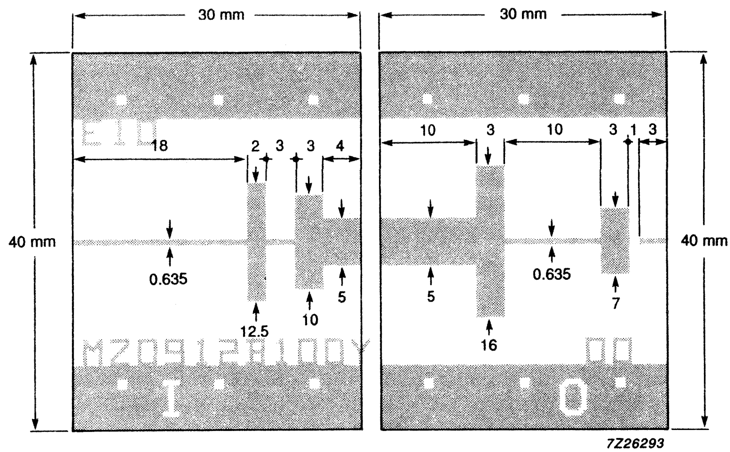
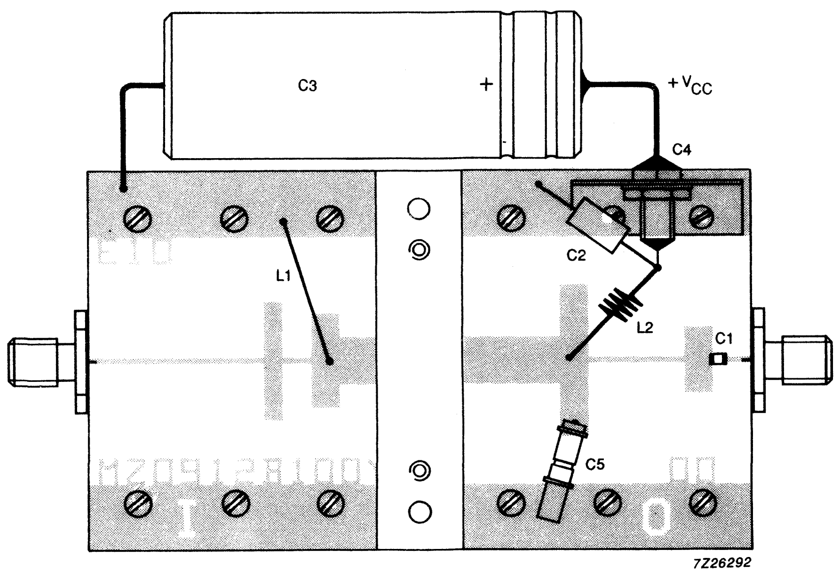


Fig.3 Pulse definition.





Substrate: Epsilam 10
Thickness: 0.635 mm
$\varepsilon_r = 10$
All dimensions in mm.

Fig.4 Broadband test circuit.

NPN silicon planar epitaxial microwave power transistor

MX0912B100Y; MZ0912B100Y

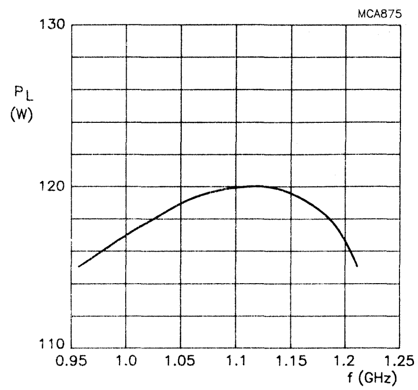


Fig.5 Load power P_L as a function of frequency; V_{CC} = 50 V; t_p = 10 μs; δ = 10%.
(In broadband test circuit as shown in Fig.4).

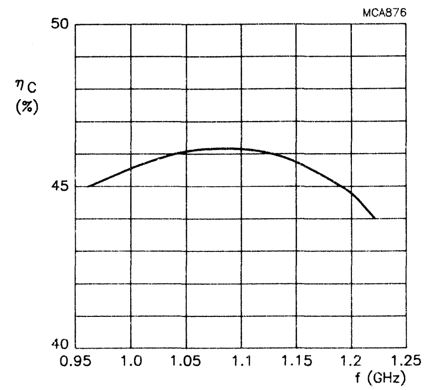


Fig.6 Collector efficiency as a function of frequency.
(In broadband test circuit as shown in Fig.4).

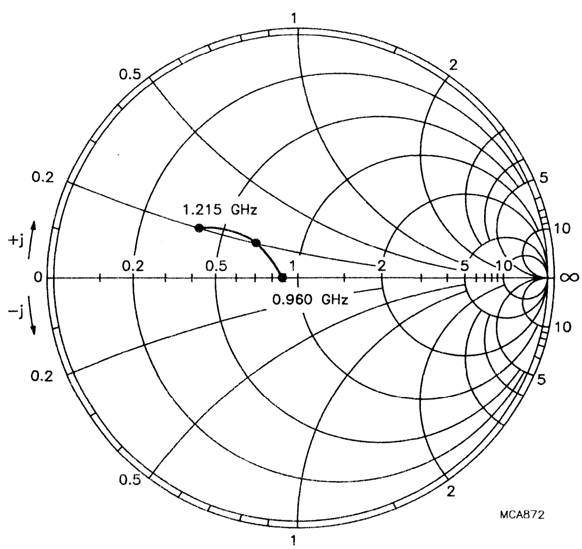


Fig.7 Input impedance as a function of frequency for P_L = 100 W; associated with optimum load impedance; V_{CC} = 50 V; Z_o = 10 Ω.

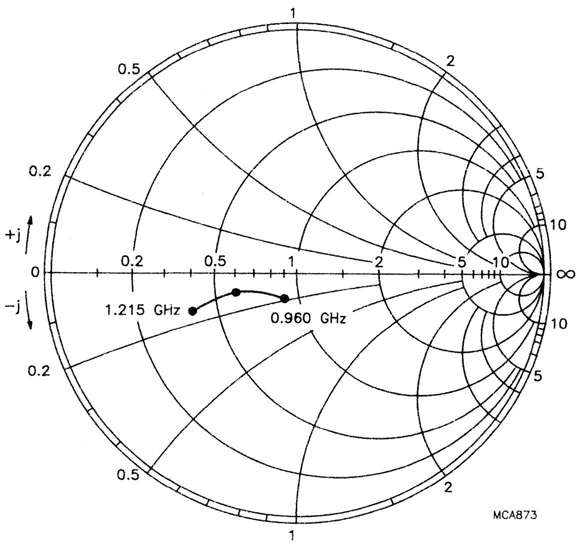


Fig.8 Optimum load impedance as a function of frequency for P_L = 100 W; associated with input impedance; V_{CC} = 50 V; Z_o = 10 Ω.

Data sheet	
status	Product specification
date of issue	November 1994

MX0912B250Y; MX0912B251Y
NPN silicon planar epitaxial microwave power transistor

FEATURES

- Interdigitated structure; high emitter efficiency.
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding at a high VSWR.
- Gold metallization realizes very good stability of the characteristics and excellent life time.
- Multicell geometry gives good balance of dissipated power and low thermal resistance.
- Input and output matching cell allows an easier design of circuits.

APPLICATION

Intended for use in common base class C broadband pulse power amplifier from 960 to 1215 MHz for TACAN application.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common base class C broadband pulse power amplifier at 960 to 1215 MHz for TACAN application.
Transistor has a F0-91B metal ceramic flange package, with base connected to flange.
It is mounted in common base configuration, and specified in class C.
MX0912B251Y is preferred for new designs.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C broadband amplifier.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	ηC (%)	z_i/Z_L (Ω)
class C t_p = 10 µs; δ = 10%	0.960 to 1.215	50	> 235	> 7	> 42	see Figs 6 and 7

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 industrial or domestic waste.

NPN silicon planar epitaxial microwave power transistor

MX0912B250Y; MX0912B251Y

MECHANICAL DATA

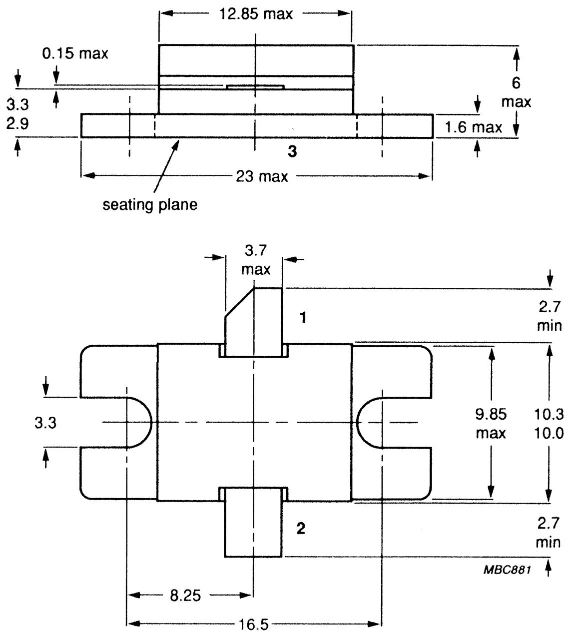


Fig.1 F0-91B.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	-	65	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	-	60	V
V_{CEO}	collector-emitter voltage	open base	-	20	V
V_{EBO}	emitter-base voltage	open collector	-	3	V
I_C	collector current	$t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	15	A
P_{tot}	total power dissipation	peak power $T_{mb} = 75\ °C$; $t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	690	W
T_{stg}	storage temperature range		−65	200	°C
T_j	operating junction temperature		-	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s up to 0.2 mm from ceramic	-	235	°C

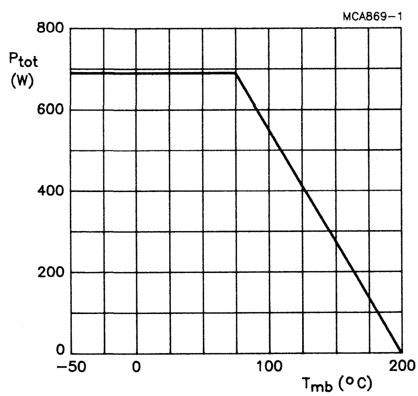


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; $t_p = 10\ \mu s$; $\delta = 10\%$; P_{tot} max = 690 W.

THERMAL CHARACTERISTICS

$T_j = 125\ °C$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	1.9	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink	CW	0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	note 1	0.28	K/W

Note

1. Equivalent thermal impedance under nominal pulse microwave operating conditions ($t_p = 10\ \mu s$; $\delta = 10\%$).

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 65 V; I_E = 0	100	mA
I_{CBO}	collector cut-off current	V_{CB} = 50 V; I_E = 0	10	mA
I_{CES}	collector cut-off current	V_{CE} = 60 V; R_{BE} = 0	100	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	1	mA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the test jig as shown in Fig.4 and working in class C broadband mode in pulse; note 2.

MODE OF OPERATION	f (GHz)	V_{CC} (V) note 1	P_L (W)	G_p (dB)	η C (%)	z_i/Z_L (Ω)
class C t_p = 10 μs; δ = 10%	0.960 to 1.215	50	> 235 typ. 275	> 7 typ. 7.4	> 42 typ. 47	see Figs 6 and 7
t_p = 300 μs; δ = 10% see Fig.3	1.03 to 1.09	50	typ. 280	typ. 8	typ. 48	

Notes

1. V_{CC} during pulse.
2. Operating conditions and performance for other pulse formats can be made available on request.

List of components

L1 = L2 = Cu wire ∅ = 0.65 mm, total length = 12 mm, height of loop = 9 mm
L3 = Cu wire ∅ = 0.65 mm, internal diameter 3 mm, 4 turns, L = 5 mm
C1 = DC block, 100 pF (ATC, ref. 100A101KP50X)
C2 = tantalum capacitor 10 μF/50 V
C3 = electrolytic capacitor 470 μF/63 V
C4 = feedthru bypass capacitor (Erie, ref. 1250-003)
C5 = C6 = Variable gigatrim capacitor 0.8 - 8 pF, (Tekelec, ref. 729.1)

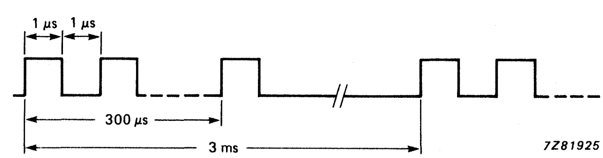
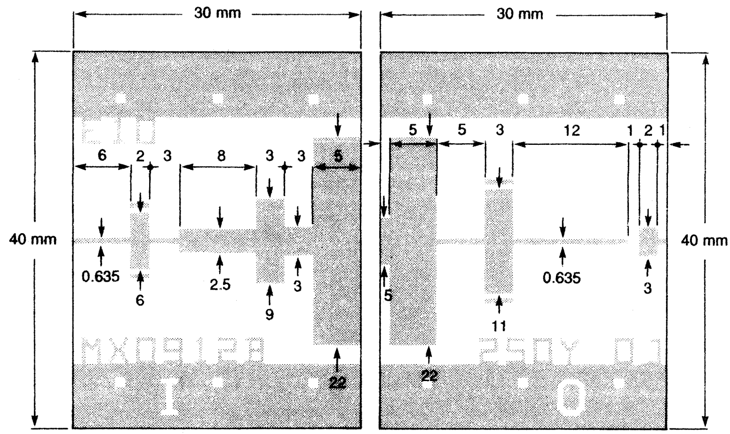


Fig.3 Pulse definition.

NPN silicon planar epitaxial microwave power transistor

MX0912B250Y; MX0912B251Y



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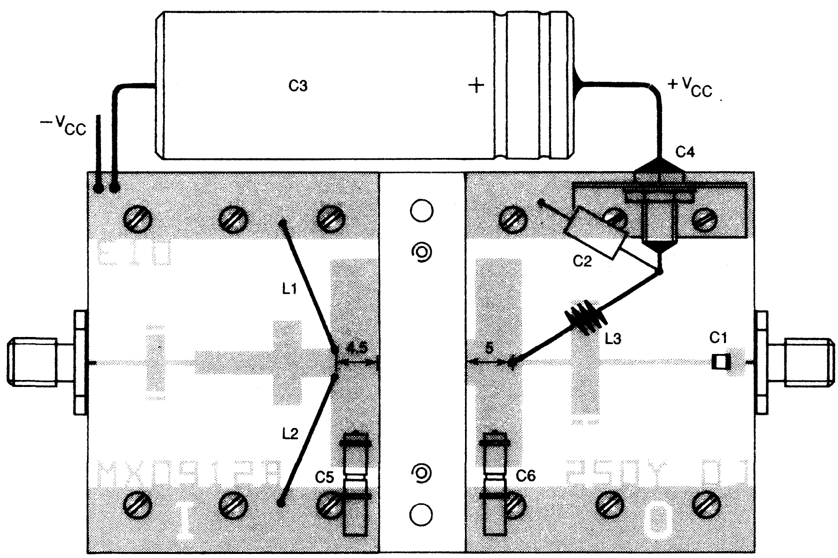


7Z26298

Substrate: Epsilam 10
Thickness: 0.635 mm
$\varepsilon_r = 10$
All dimensions in mm.

Fig.4 Broadband test circuit.

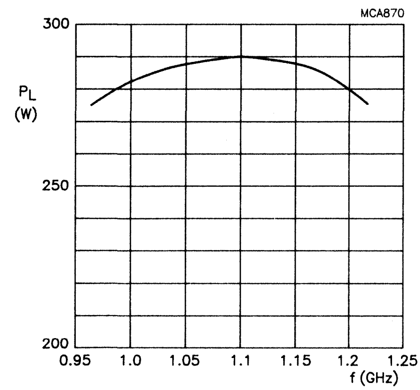


Fig.5 Load power P_L as a function of frequency; V_{CC} = 50 V; t_p = 10 μs; δ = 10%.
(In broadband test circuit as shown in Fig.4).

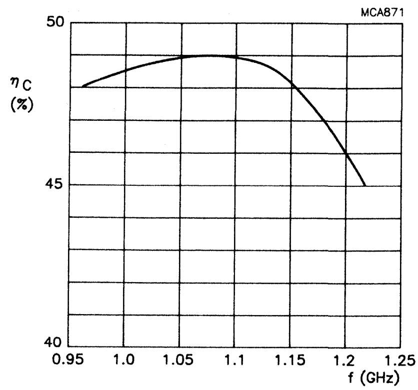


Fig.6 Collector efficiency as a function of frequency. V_{CC} = 50 V; t_p = 10 μs; δ = 10%.
(In broadband test circuit as shown in Fig.4).

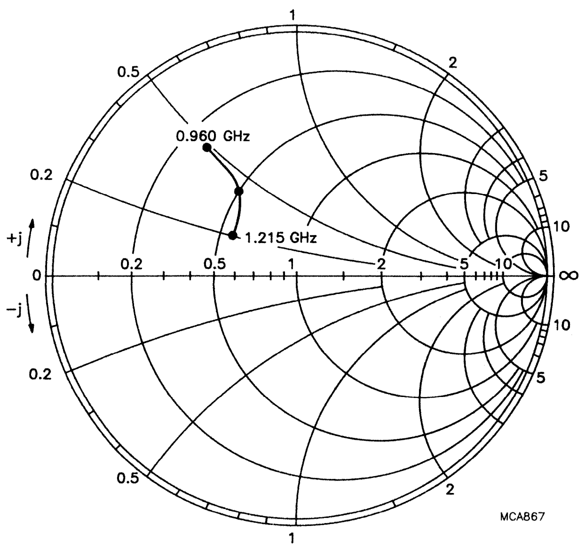


Fig.7 Input impedance as a function of frequency for P_L = 235 W; associated with optimum load impedance; V_{CC} = 50 V; Z_o = 5 Ω.

NPN silicon planar epitaxial microwave power transistor

MX0912B250Y; MX0912B251Y

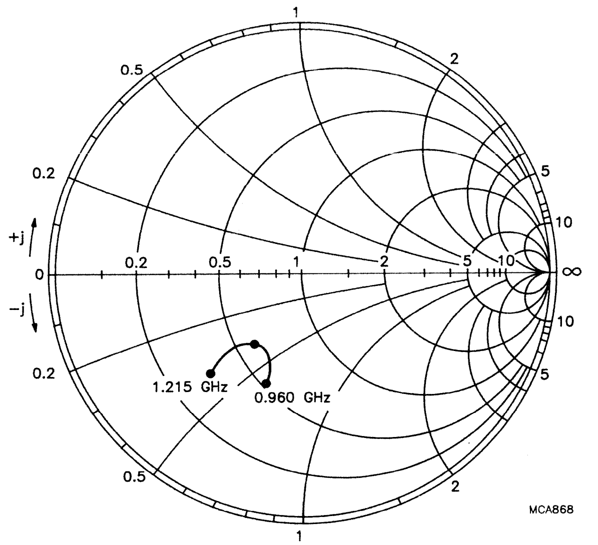


Fig.8 Optimum load impedance as a function of frequency for P_L = 235 W; associated with input impedance; V_{CC} = 50 V; Z_o = 5 Ω.

Data sheet	
status	Product specification
date of issue	November 1994

MX0912B350Y; MX0912B351Y
NPN silicon planar epitaxial microwave power transistor

FEATURES

- Interdigitated structure; high emitter efficiency.
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding at a high VSWR.
- Gold metallization realizes very good stability of the characteristics and excellent life time.
- Multicell geometry gives good balance of dissipated power and low thermal resistance.
- Input and output matching cells allow an easier design of circuits.

APPLICATION

Intended for use in common base class C broadband pulse power amplifier from 960 to 1215 MHz for TACAN application.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common base class C broadband pulse power amplifier at 960 to 1215 MHz for TACAN application.
The transistor has a F0-91B metal ceramic flange package, with base connected to flange.
It is mounted in common base configuration, and specified in class C.
MX0912B351Y is preferred for new designs.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C broadband amplifier.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	ηC (%)	z_i/Z_L (Ω)
class C t_p = 10 μs; δ = 10%	0.960 to 1.215	50	> 325	> 7	> 40	see Figs 7 and 8

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 industrial or domestic waste.**

MECHANICAL DATA

Dimensions in mm.

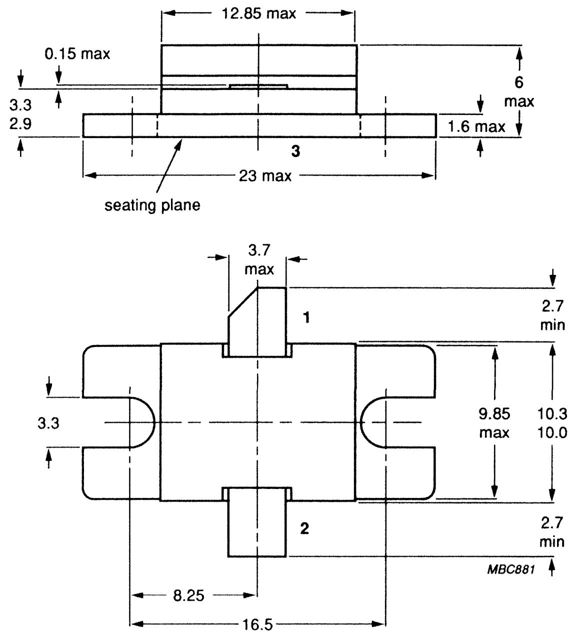


Fig.1 F0-91B.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base

LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	-	65	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	-	60	V
V_{CEO}	collector-emitter voltage	open base	-	20	V
V_{EBO}	emitter-base voltage	open collector	-	3	V
I_C	collector current	$t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	21	A
P_{tot}	total power dissipation	peak power; $T_{mb} = 75\ °C$; $t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	960	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		-	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; up to 0.2 mm from ceramic	-	235	°C

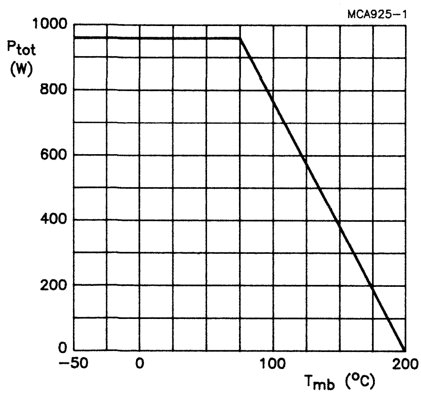


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; $t_p = 10\ \mu s$; $\delta = 10\%$; P_{tot} max = 960 W.

THERMAL CHARACTERISTICS

$T_j = 125\ °C$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	1.7	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink	CW	0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	note 1	0.13	K/W

Note

1. Equivalent thermal impedance under nominal pulse microwave operating conditions ($t_p = 10\ \mu s$; $\delta = 10\%$).

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 65 V; I_E = 0	140	mA
I_{CBO}	collector cut-off current	V_{CB} = 50 V; I_E = 0	14	mA
I_{CES}	collector cut-off current	V_{CE} = 60 V; R_{BE} = 0 Ω	140	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	1.4	mA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the test jig as shown in Fig.4 and working in class C broadband mode in pulse; see also note 2.

MODE OF OPERATION	f (GHz)	V_{CC} (V) note 1	P_L (W)	G_p (dB)	ηC	z_i/Z_L (Ω)
class C t_p = 10 μs = 10%	0.960 to 1.215	50	> 325 typ. 375	> 7 typ. 7.6	> 40 typ. 47	see Figs 7 and 8
t_p = 300 μs; δ = 10% see Fig.3	1.03 to 1.09	50	typ. 350	typ. 8	typ. 48	

Notes

1. V_{CC} during pulse.
2. Operating conditions and performances for other pulse formats can be made available on request.

List of components

L1 = Cu wire ∅ = 0.65 mm, total length = 12 mm, height of loop = 9 mm
L2 = Cu wire ∅ = 0.65 mm, internal diameter 3 mm, 4 turns, L = 5 mm
C1 = DC block, 100 pF (ATC, ref. 100A101KP50X)
C2 = tantalum capacitor 10 μF/50 V
C3 = electrolytic capacitor 470 μF/63 V
C4 = feedthru bypass capacitor (Erie, ref. 1250-003)
C5 = C6 = Variable gigatrim capacitor 0.8 - 8 pF, (Tekelec, ref. 729.1)

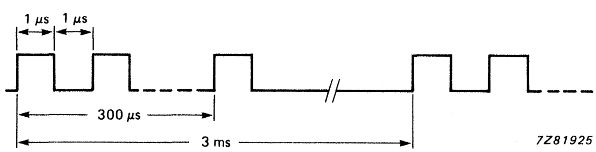
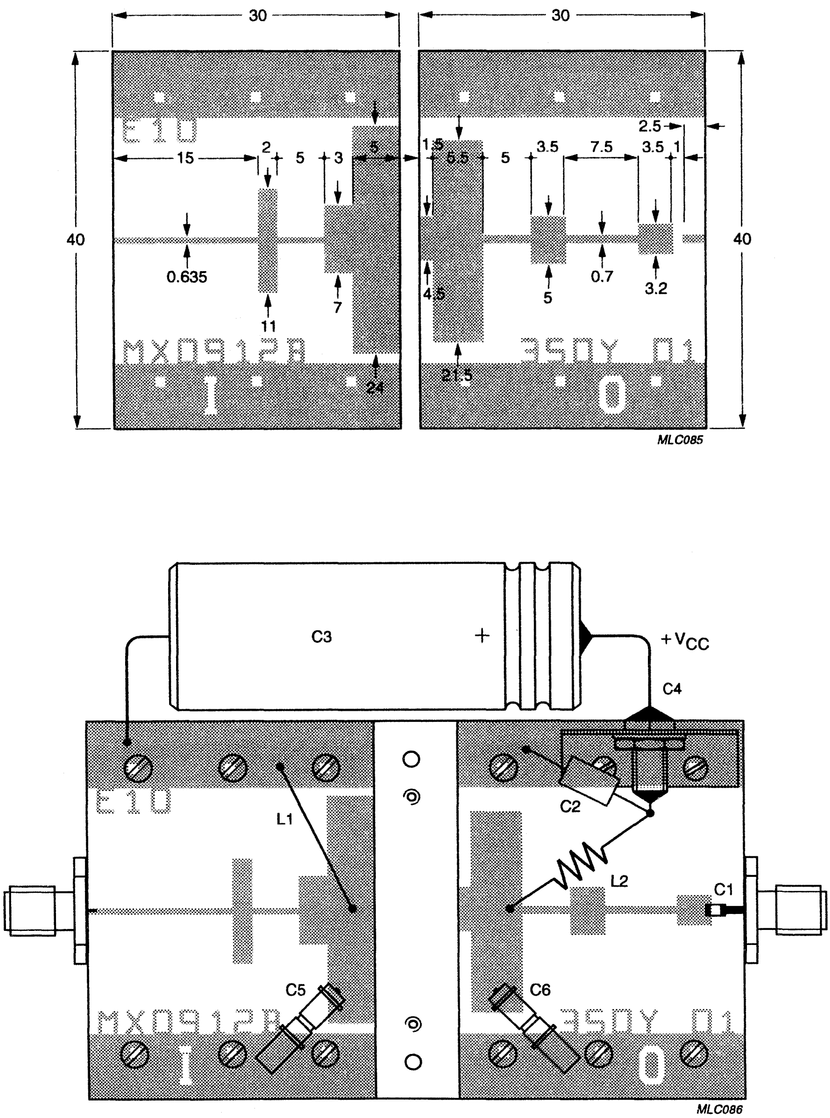


Fig.3 Pulse definition.



Substrate: Epsilam 10
Thickness: 0.635 mm
$\varepsilon_r = 10$
All dimensions in mm.

Fig.4 Broadband test circuit.

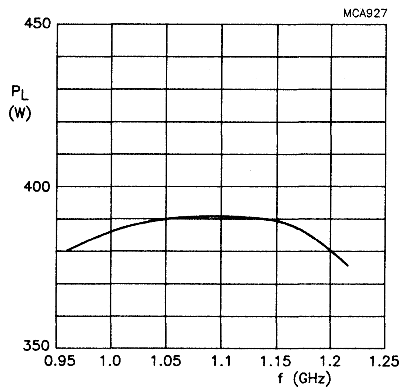


Fig.5 Load power P_L as a function of frequency; V_{CC} = 50 V; t_p = 10 μs; δ = 10%.
(In broadband test circuit as shown in Fig.4).

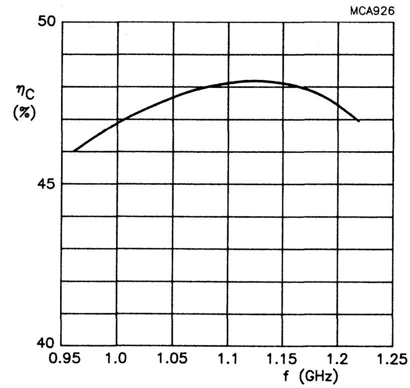


Fig.6 Collector efficiency as a function of frequency; (In broadband test circuit as shown in Fig.4).

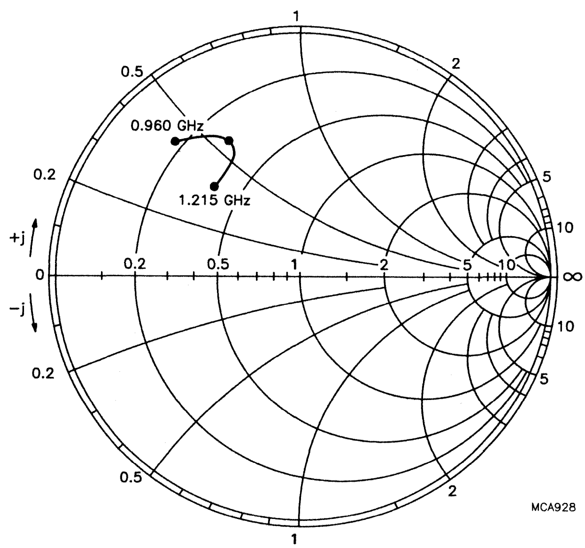


Fig.7 Input impedance as a function of frequency for P_L = 325 W; associated with optimum load impedance; V_{CC} = 50 V; Z_o = 5 Ω.

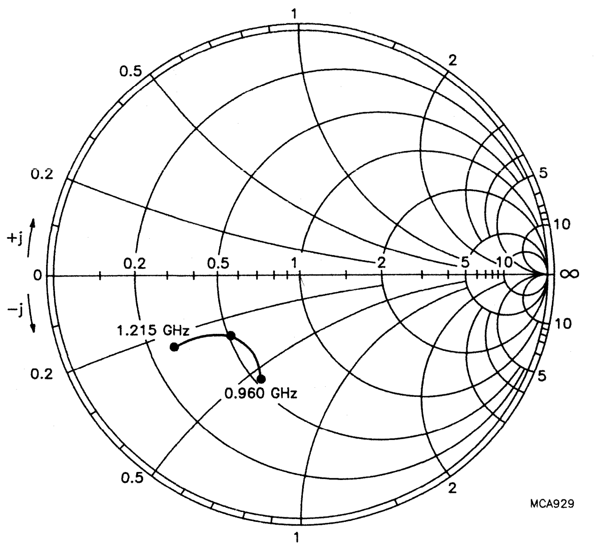


Fig.8 Optimum load impedance as a function of frequency for P_L = 325 W; associated with input impedance; V_{CC} = 50 V; Z_o = 5 Ω.

NPN silicon planar expitaxial microwave power transistor

MX1011B200Y

FEATURES

- Suitable for short and medium pulse applications up to 100 μs pulse width, 10% duty factor
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very stable characteristics and excellent lifetime
- Multicell geometry improves power sharing reduces thermal resistance
- Internal input and output prematching networks allow an easier design of circuits.

APPLICATIONS

Intended for use in common base class C broadband pulsed power amplifiers for IFF, TCAS and Mode S applications in the 1030 MHz to 1090 MHz bandwidth. Also suitable for medium pulse, heavy duty operation within the 1030 MHz to 1150 MHz bandwidth.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-91B metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 10 μs; δ = 1%	1.09	50	200	≥7.5	≥45

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

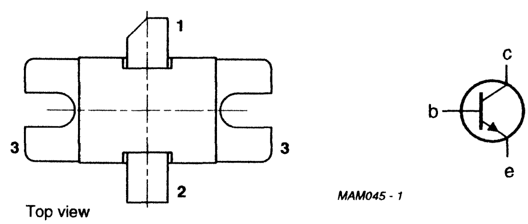


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

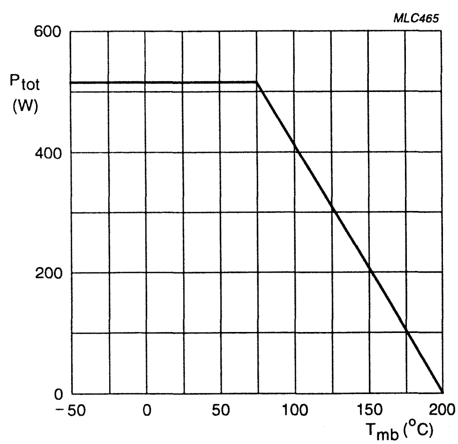
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	65	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_{CM}	peak collector current	$t_p = 10\ \mu s$; $\delta = 1\%$	–	11.5	A
P_{tot}	total power dissipation	$T_{mb} < 75\ °C$; $t_p \leq 10\ \mu s$; $\delta \leq 1\%$	–	515	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p = 10\ \mu s$; $\delta = 1\%$.

Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_j = 120$ °C	2.5	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	$t_p = 10$ µs; $\delta = 1\%$; note 1	0.16	K/W

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

CHARACTERISTICS

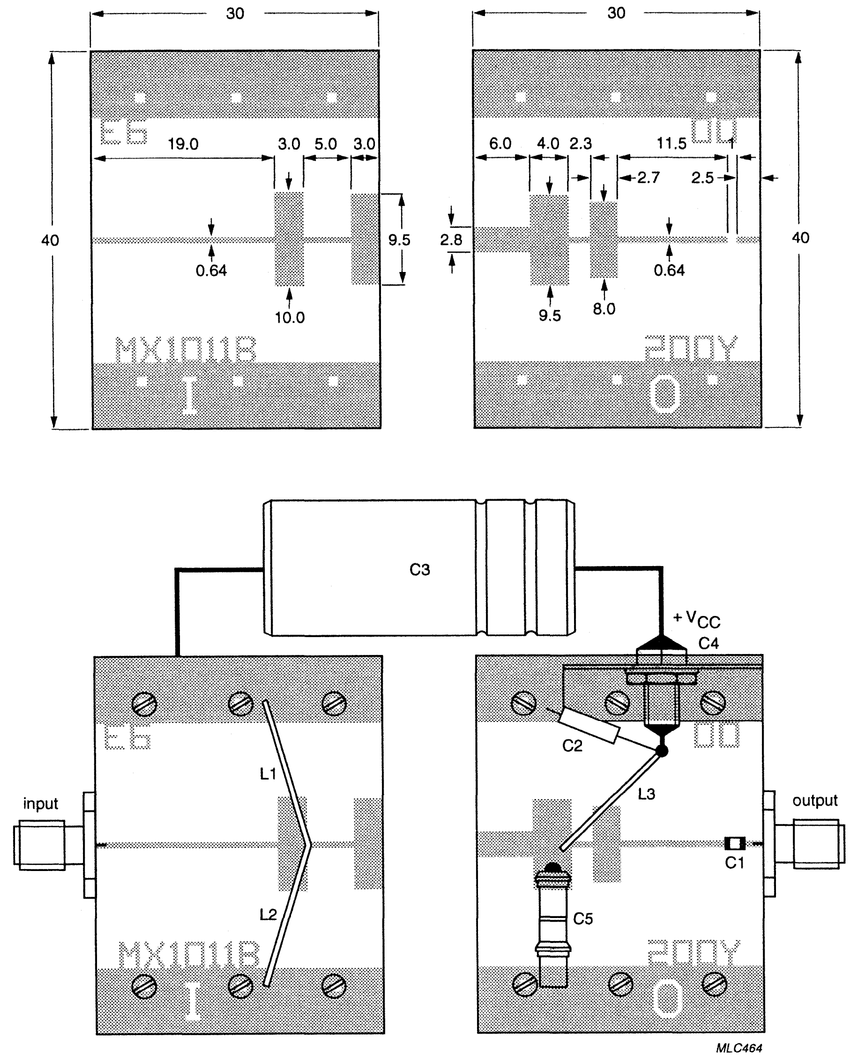
$T_{mb} = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 50$ V	6	mA
I_{CES}	collector cut-off current	$V_{BE} = 0$; $V_{CE} = 50$ V	6	mA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 1.5$ V	1.5	mA
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 40$ mA	65	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	$I_C = 40$ mA; $V_{BE} = 0$	65	V

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25$ °C in a common-base test circuit as shown in Fig.3.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	$t_p = 10$ µs; $\delta = 1\%$	1.09	50	≥200 typ. 220	≥7.5 typ. 8.3	≥45 typ. 52
	$t_p = 0.5$ µs; $\delta = 50\%$ $t_p = 112$ µs; $\delta = 1\%$	1.03 to 1.09	50	typ. 220	typ. 7.5	typ. 50
	$t_p = 6.6$ µs; $\delta = 51\%$ $t_p = 3.3$ µs; $\delta = 43\%$	1.03 to 1.15	50	typ. 100	typ. 6	typ. 35
	$t_p = 32$ µs; $\delta = 1\%$	1.09	50	typ. 210	typ. 7.5	typ. 47



Dimensions in mm.
Substrate: Epsilam 10.
Thickness: 0.635 mm.
Permittivity: $\varepsilon_r = 10$.

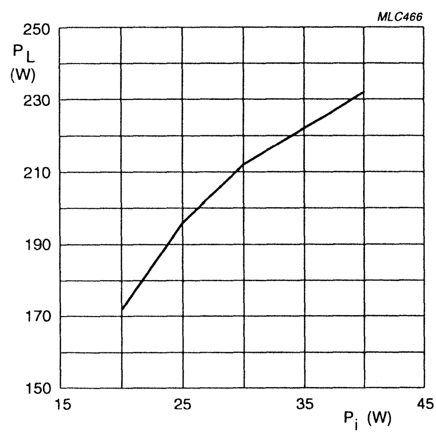
Fig.3 Broadband test circuit.

NPN silicon planar expitaxial microwave power transistor

MX1011B200Y

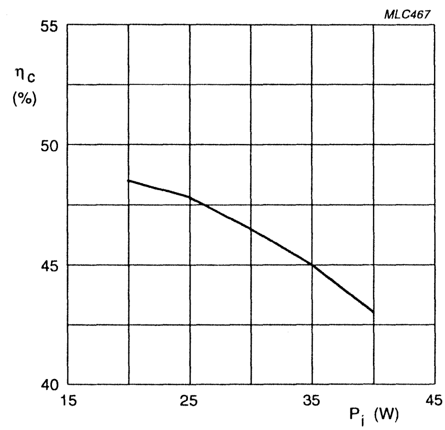
List of components (see Fig.3)

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
C1	capacitor	100 pF	ATC 100A101kp50x
C2	tantalum capacitor	10 µF; 50 V	–
C3	electrolytic capacitor	63 V; 1000 µF	–
C4	feedthrough bypass capacitor	–	Erie1250-003
C5	variable gigatrim capacitor	0.8 to 8 pF	Tekelec 729-1
L1, L2	0.65 mm copper wire; total length = 26 mm; height of loop = 10 mm	–	–
L3	0.85 mm silver wire; total length = 30 mm; height of loop = 15 mm	–	–



Class C pulse operation.
t_p = 10 µs; δ = 1%; V_{CC} = 50 V; f = 1.09 GHz.
In broadband test circuit as shown in Fig.3.

Fig.4 Load power as a function of input power.

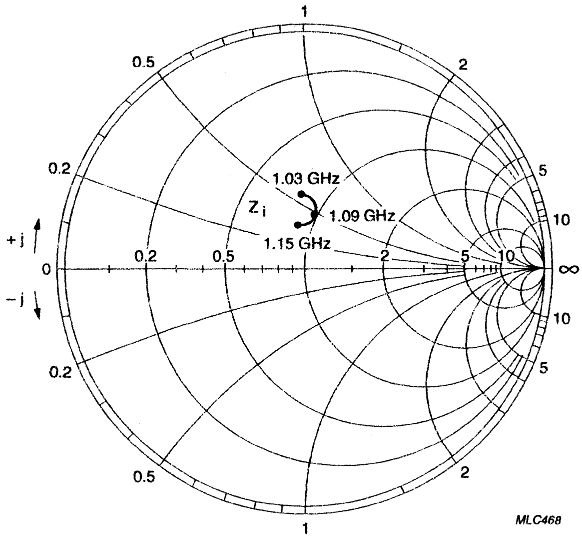


Class C pulse operation.
t_p = 10 µs; δ = 1%; V_{CC} = 50 V; f = 1.09 GHz.
In broadband test circuit as shown in Fig.3.

Fig.5 Collector efficiency as a function of input power.

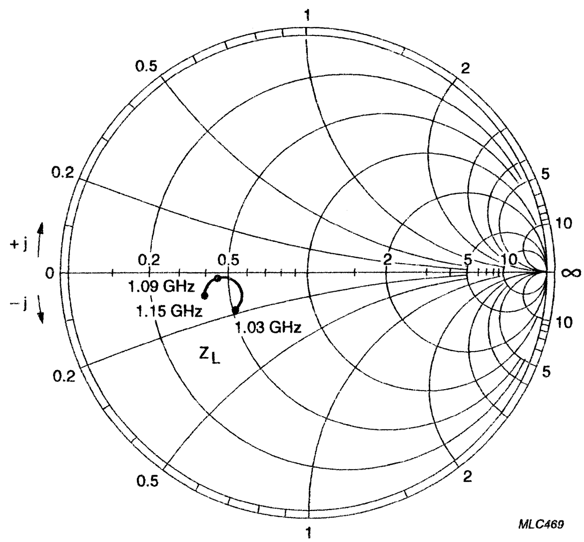
NPN silicon planar expitaxial microwave power transistor

MX1011B200Y



V_{CC} = 50 V; Z_o = 10 Ω; P_o = 240 W.

Fig.6 Input impedance as a function of frequency.



V_{CC} = 50 V; Z_o = 50 Ω; P_o = 240 W.

Fig.7 Optimum load impedance as a function of frequency.

NPN silicon planar epitaxial microwave power transistor

MX1011B400W

FEATURES

- Suitable for short and medium pulse applications up to 500 µs/10%
- Internal input and output prematching networks allow an easier design of circuits
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter–base structure provides high emitter efficiency
- Gold metallization with barrier realizes very good stability of the characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance.

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common base class C pulsed power amplifiers.The transistor has a FO–91B metal ceramic flange package with base connected to flange.

APPLICATIONS

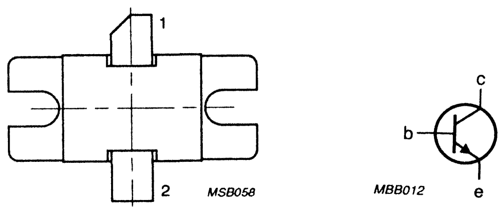
Intended for use in common base class C broadband pulsed power amplifiers for TCAS applications in the 1030 to 1090 MHz band. Also suitable for medium pulse, heavy duty operation within this band.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrow band amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)
class C	t_p = 30 µs; δ = 1%	1.03	45	≥ 450	≥ 6.5	≥ 42

PIN CONFIGURATION



Marking code: MX1011B400W

Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

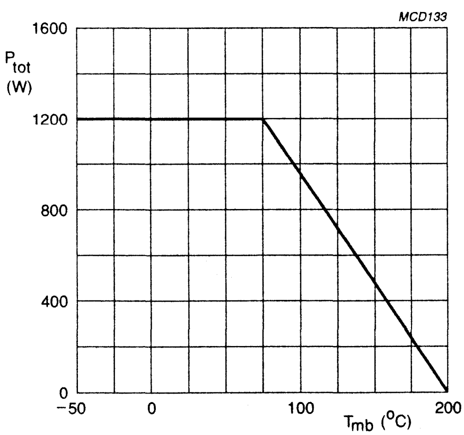
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	65	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	average collector current	$t_p \leq 30\ \mu s$; $\delta \leq 1\%$	–	35	A
P_{tot}	total power dissipation	$T_{mb} < 75$ °C; $t_p \leq 30\ \mu s$; $\delta \leq 1\%$	–	1200	W
T_{stg}	storage temperature range		−65	200	° C
T_j	operating junction temperature		–	200	° C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	° C

Note

1. Up to 0.2 mm from ceramic.



$t_p = 30\ \mu s$; $\delta = 1$ %; P_{tot} max = 1200 W.

Fig.2 Maximum power dissipation derating as a function of mounting base temperature.

NPN silicon planar epitaxial microwave power transistor

MX1011B430W

FEATURES

- Suitable for short and medium pulse applications up to 500 μs/10%
- Internal input and output prematching networks allow an easier design of circuits
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very good stability of the characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance.

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-91B metal ceramic flange package with base connected to flange.

APPLICATIONS

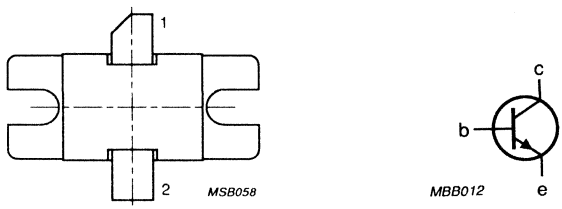
Intended for use in common base, class C, broadband, pulsed power amplifiers for TCAS applications in the 1030 to 1090 MHz band. Also suitable for medium pulse, heavy duty operation within this band.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C broadband amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
class C	t_p = 30 μs; δ = 1%	1.03	45	≥ 480	≥ 6.7	≥ 45

PIN CONFIGURATION



Marking code : MX1011B430W

Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

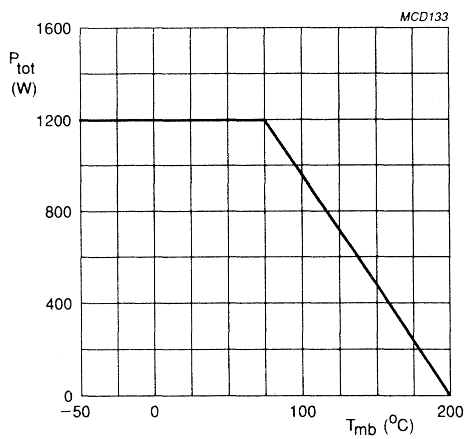
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	65	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current	$t_p \leq 30\ \mu s$; $\delta \leq 1\%$	–	35	A
P_{tot}	total power dissipation	$T_{mb} < 75\ °C$; $t_p \leq 30\ \mu s$; $\delta \leq 1\%$	–	1.2	kW
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p = 30\ \mu s$; $\delta = 1\ \%$; P_{tot} max = 1.2 kW.

Fig.2 Maximum power dissipation derating as a function of mounting base temperature.

NPN silicon planar epitaxial microwave power transistor

MX1011B700Y

FEATURES

- Suitable for short and medium pulse applications up to 100 µs/10%
- Internal input and output prematching networks allow an easier design of circuits
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very good stability of the characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-91B metal ceramic flange package with base connected to flange.

APPLICATIONS

Intended for use in common base, class C, broadband, pulsed power amplifiers for IFF, TCAS and Mode S applications in the 1030 to 1090 MHz band. Also suitable for medium pulse, heavy duty operation within the 1030 to 1150 MHz band.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C broadband amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)
class C	t_p = 10 µs; δ = 1%	1.09	50	650	≥ 6.0	≥ 48

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

PIN CONFIGURATION

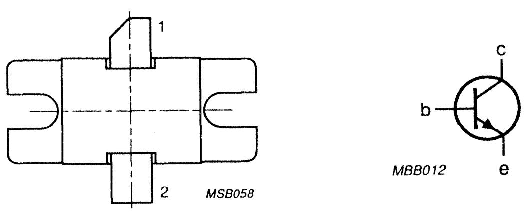


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

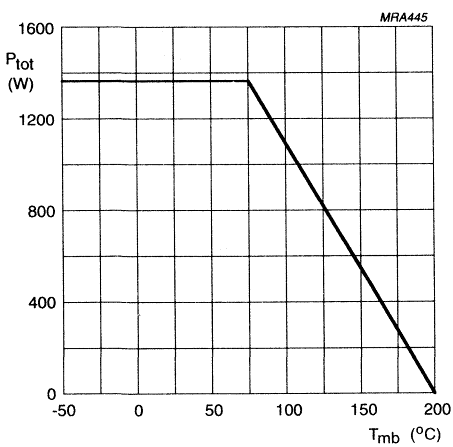
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	65	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_{CM}	peak collector current	$t_p \leq 10\ \mu s$; $\delta \leq 1\%$	–	40	A
P_{tot}	total power dissipation	$T_{mb} < 75\ °C$; $t_p \leq 10\ \mu s$; $\delta \leq 1\%$	–	1365	W
T_{stg}	storage temperature range		–65	200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p = 10\ \mu s$; $\delta = 1\ \%$; P_{tot} max = 1365 W.

Fig.2 Maximum power dissipation derating as a function of mounting base temperature.

NPN silicon planar epitaxial microwave power transistor

MX1011B700Y

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 120 °C	1.12 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2 K/W
Z_{th}	thermal impedance from junction to heatsink	t_p = 10 µs; δ = 1 %; note 1	0.06 K/W

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

CHARACTERISTICS

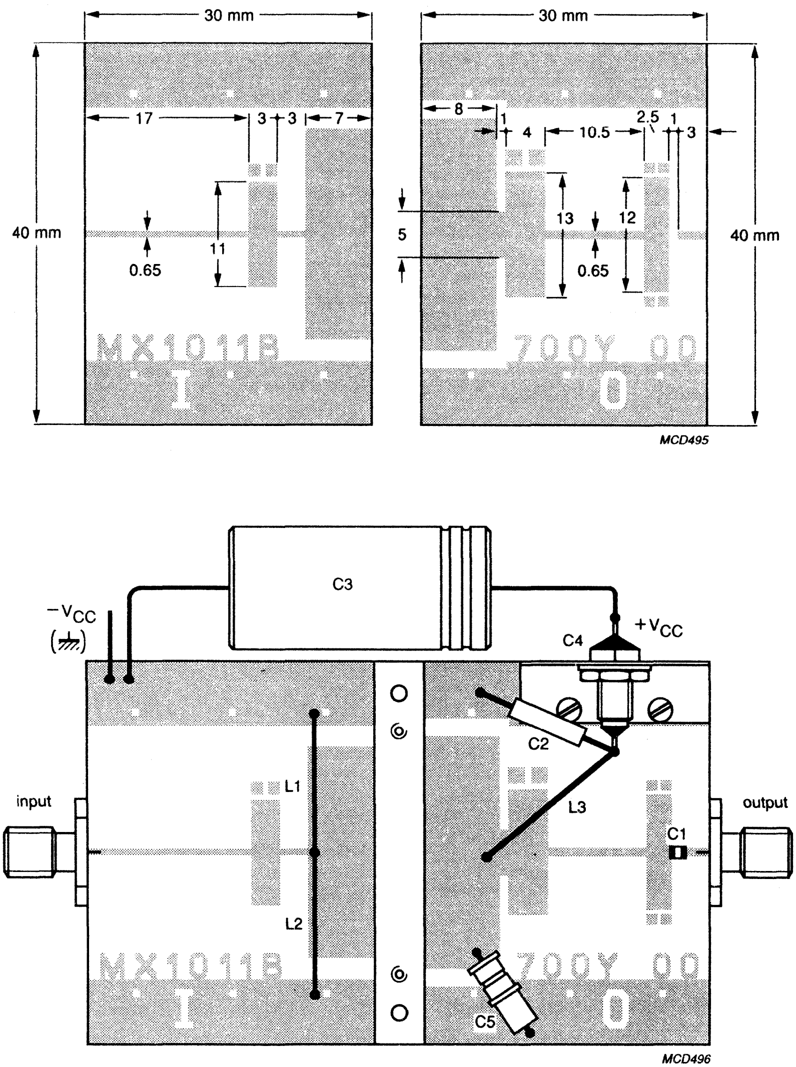
T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 50 V; I_E = 0	20	mA
I_{CES}	collector cut-off current	V_{CE} = 50 V; V_{BE} = 0	20	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	5	mA
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 140 mA V_{BE} = 0	65	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 140 mA V_{BE} = 0	65	V

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common base test circuit as shown in Fig.3.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
class C	t_p = 10 µs; δ = 1 %	1.09	50	650; typ. 740	≥ 6.0; typ. 7	≥ 48; typ. 55
	t_p = 0.5 µs; δ = 50 % t_p = 112 µs; δ = 1 %	1.03 to 1.09	50	typ. 650	typ. 6.4	typ. 45
	t_p = 6.6 µs; δ = 51 % t_p = 3.3 ms; δ = 43 %	1.03 to 1.15	50	typ. 300	typ. 7	typ. 45
	t_p = 32 µs; δ = 1 %	1.09	50	typ. 700	typ. 6.7	typ. 55



Dimensions in mm

Substrate : Epsilam 10

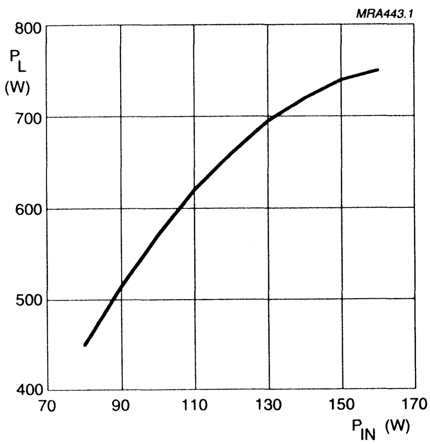
Thickness : 0.635 mm

Permittivity : $\varepsilon_r = 10$

Fig.3 Broadband test circuit.

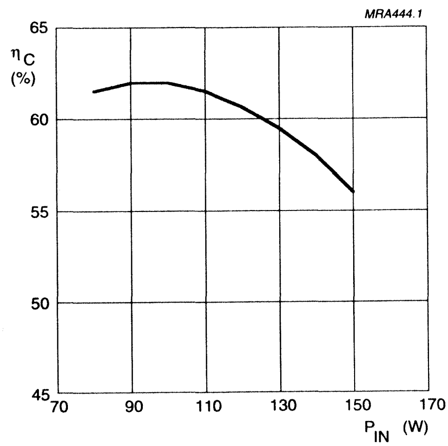
List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
L1, L2	0.65 mm copper wire		total length = 26 mm; height of loop = 10 mm	
L3,	0.85 mm silver wire		total length = 30 mm; height of loop = 15 mm	
C1	capacitor	100 pF		ATC, ref.100A101KP50X
C2	tantalum capicitor	10 µF, 50 V		
C3	electrolytic capacitor	1000 µF, 63 V		
C4	feedthrough bypass capacitor			Erie, ref.1250-003
C5	variable gigatrim capacitor	0.8 - 8 pF		Tekelec, ref.729.1



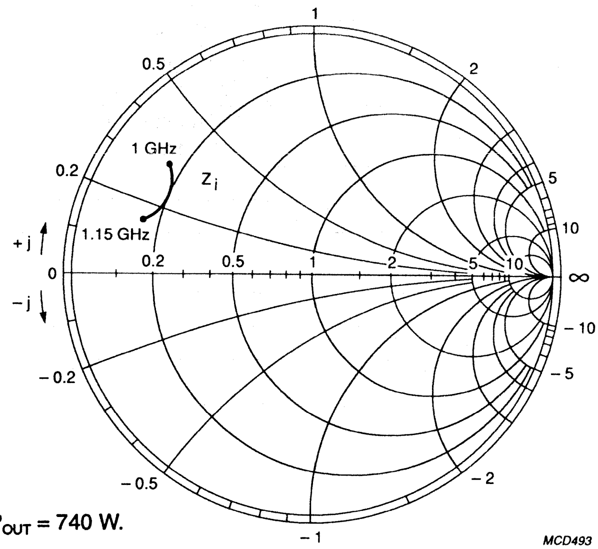
Class C pulse operation; t_p = 10 µs; δ = 1%;
V_{CC} = 50 V; f = 1.09 GHz.
(In broadband test circuit as shown in Fig.3).

Fig.4 Load power as a function of input power.



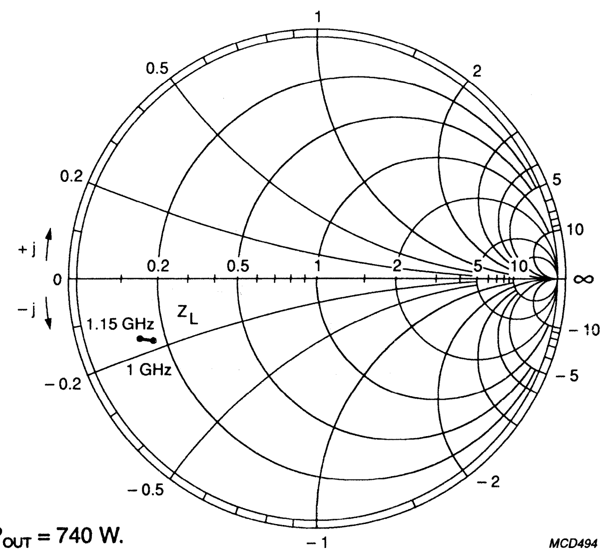
Class C pulse operation; t_p = 10 µs; δ = 1%;
V_{CC} = 50 V; f = 1.09 GHz.
(In broadband test circuit as shown in Fig.3).

Fig.5 Collector efficiency as a function of input power.



V_{CC} = 50 V; Z_O = 10 Ω; P_{OUT} = 740 W.

Fig.6 Input impedance as a function of frequency, associated with optimum load impedance.



V_{CC} = 50 V; Z_O = 10 Ω; P_{OUT} = 740 W.

Fig.7 Optimum load impedance as a function of frequency; associated with input impedance.

Philips Semiconductors

Data sheet	
status	Product specification
date of issue	November 1994

MZ0912B50Y

NPN silicon planar epitaxial microwave power transistor

FEATURES

- Interdigitated structure; high emitter efficiency.
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding at a high VSWR.
- Gold metallization realizes very good stability of the characteristics and excellent life time.
- Multicell geometry gives good balance of dissipated power and low thermal resistance.
- Input and output matching cell allows an easier design of circuits.

APPLICATION

Intended for use in common base class C broadband pulse power amplifier from 960 to 1215 MHz for TACAN application.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common base class C broadband pulse power amplifier at 960 to 1215 MHz for TACAN application.
Transistor has a FO-57C metal ceramic flange package, with base connected to flange.
It is mounted in common base configuration, and specified in class C.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C broadband amplifier.

MODE OF OPERATION	f(GHz)	V_{CC}(V)	P_L(W)	G_p(dB)	ηC(%)	z_i/Z_L(Ω)
class C t_p = 10 μs; δ = 10%	0.960 to 1.215	50	> 50	> 7	> 42	see Figs 6 and 7

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 industrial or domestic waste.**

MECHANICAL DATA

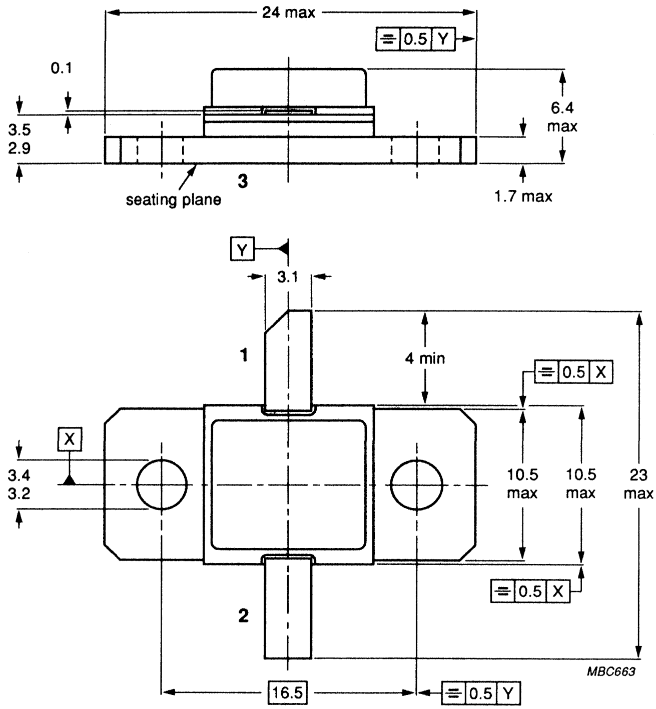


Fig.1 FO-57C.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

NPN silicon planar epitaxial microwave power transistor

MZ0912B50Y

LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	-	65	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	-	60	V
V_{CEO}	collector-emitter voltage	open base	-	20	V
V_{EBO}	emitter-base voltage	open collector	-	3	V
I_C	collector current	$t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	3	A
P_{tot}	total power dissipation	peak power; $T_{mb} = 75\ °C$; $t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	150	W
T_{stg}	storage temperature range		−65	200	°C
T_j	operating junction temperature		-	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s up to 0.2 mm from ceramic	-	235	°C

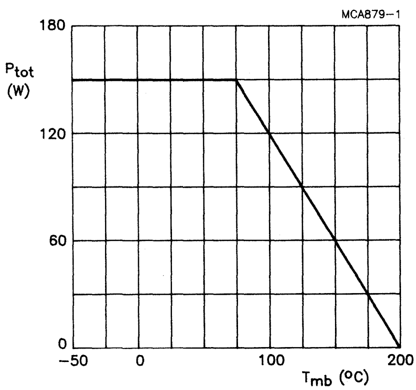


Fig.2 Maximum power dissipation derating as a function of mounting base temperature at $t_p = 10\ \mu s$; $\delta = 10\%$; P_{tot} max = 150 W.

THERMAL CHARACTERISTICS

T_j = 125 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	4.9	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink	CW	0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	note 1	0.85	K/W

Notes

1. Equivalent thermal impedance under nominal pulse microwave operating conditions (t_p = 10 μs and δ = 10%).

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 65 V; I_E = 0	20	mA
I_{CBO}	collector cut-off current	V_{CB} = 50 V; I_E = 0	2	mA
I_{CES}	collector cutt-off current	V_{CE} = 60 V; R_{BE} = 0	20	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	200	μA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the test jig as shown in Fig.3 and working in class C broadband mode in pulse; note 2.

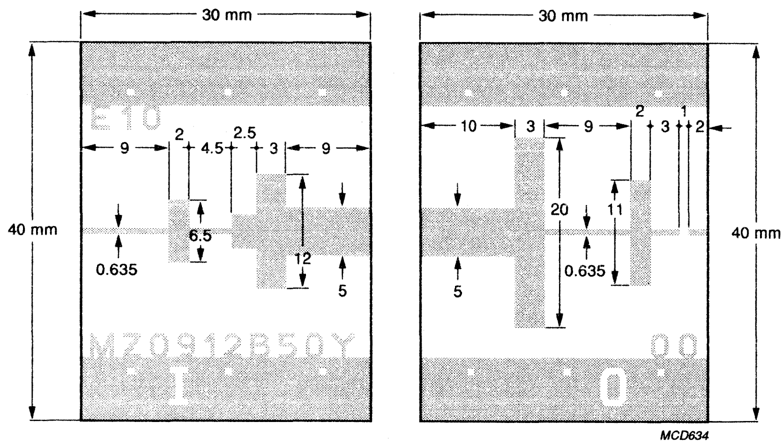
MODE OF OPERATION	f (GHz)	V_{CC} (V) note 1	P_L (W)	G_p (dB)	η C (%)	z_i/Z_L (Ω)
class C t_p = 10 μs; δ = 10%	0.960 to 1.215	50	> 50 typ. 60	> 7 typ. 8	> 42 typ. 44	see Figs 6 and 7

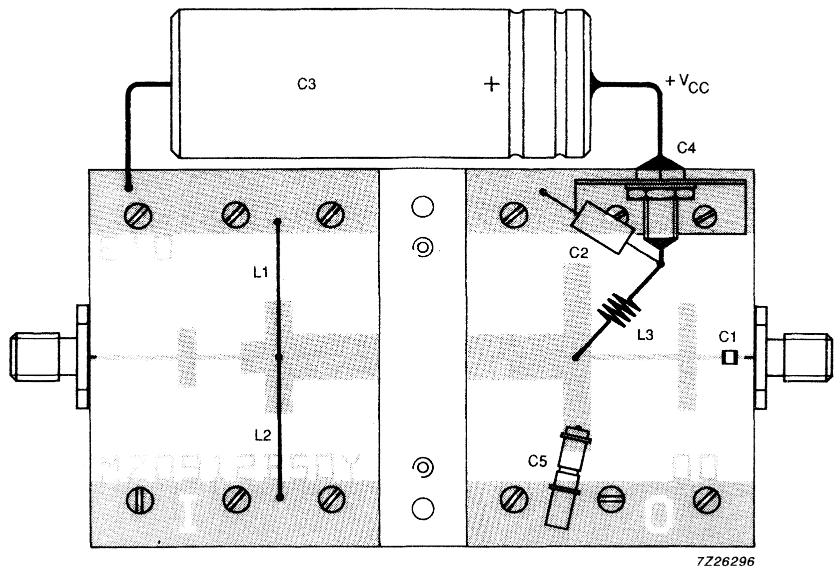
Notes

1. V_{CC} during pulse.
2. Operating conditions and performance for other pulse formats can be made available on request.

List of components

L1 = L2 = Cu wire ∅ = 0.65 mm, total length = 12 mm, height of loop = 9 mm
L3 = Cu wire ∅ = 0.65 mm, internal diameter 3 mm, 4 turns, L = 5 mm
C1 = DC block, 100 pF (ATC, ref. 100A101KP50X)
C2 = tantalum capacitor 10 μF/50 V
C3 = electrolytic capacitor 470 μF/63 V
C4 = feedthru bypass capacitor (Erie, ref. 1250-003)
C5 = C6 = Variable gigatrim capacitor 0.6 - 4.5 pF, (Tekelec, ref. 727.1)





Substrate: Epsilam 10
Thickness: 0.635 mm
$\varepsilon_r = 10$
All dimensions in mm.

Fig.3 Broadband test circuit.

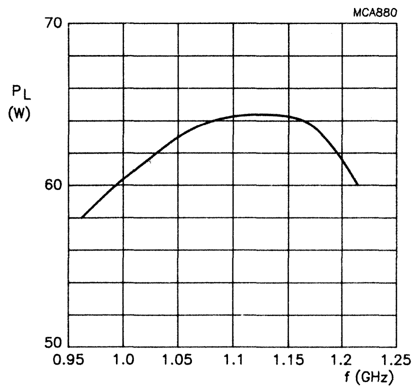


Fig.4 Load power P_L as a function of frequency; V_{CC} = 50 V; t_p = 10 μs; δ = 10%.
(In broadband test circuit as shown in Fig.3).

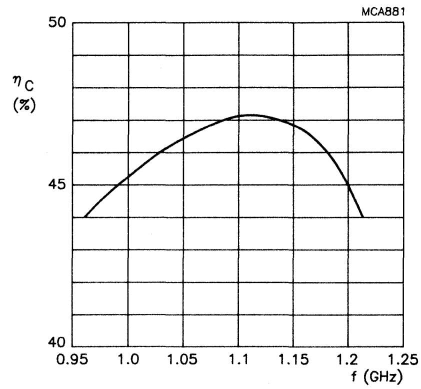


Fig.5 Collector efficiency as a function of frequency.
(In broadband test circuit as shown in Fig.3).

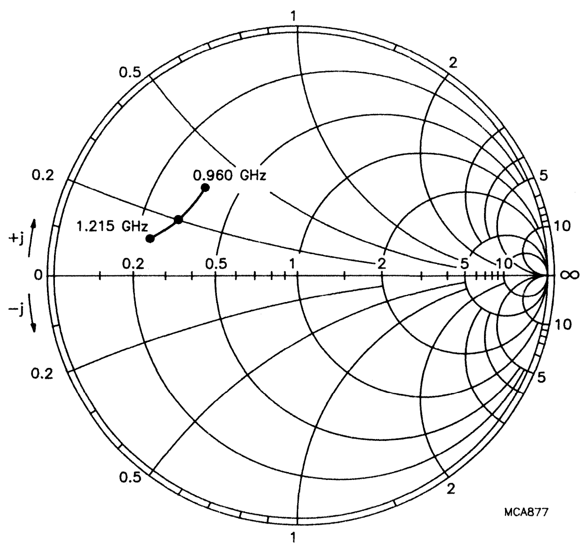


Fig.6 Optimum load impedance as a function of frequency for P_L = 50 W; associated with input impedance; V_{CC} = 50 V; Z_o = 10 Ω.

NPN silicon planar epitaxial microwave power transistor

MZ0912B50Y

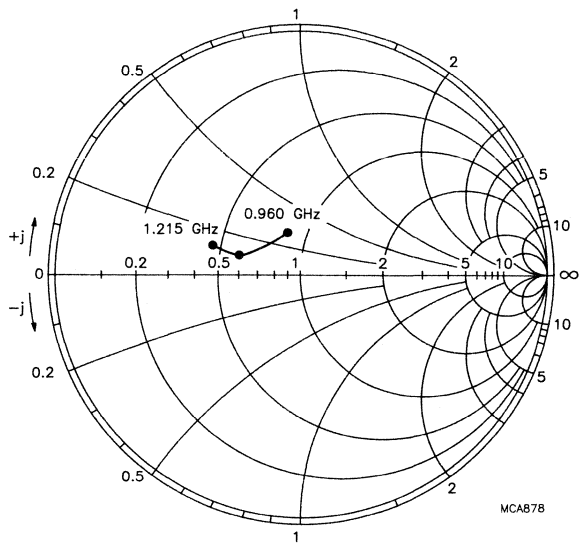


Fig.7 Input impedance as a function of frequency for P_L = 50 W; associated with optimum load impedance, V_{CC} = 50 V; Z_o = 10 Ω.

NPN silicon planar epitaxial microwave power transistor

PLB16004U

FEATURES

- Diffused emitter ballasting resistors improve excellent current sharing and withstanding a high VSWR
- Interdigitated common-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very stable characteristics and excellent lifetime
- Multicell geometry gives good balance of dissipated power and low thermal resistance
- Internal input and output prematching networks allow an easier design of circuits.

APPLICATIONS

Intended for use in common-base class C power amplifiers at 1.6 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-229 glued cap metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)	Z_i; Z_L (Ω)
Class C (CW)	1.6	28	>4.5	>8.5	>40	see Figs 5 and 6

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

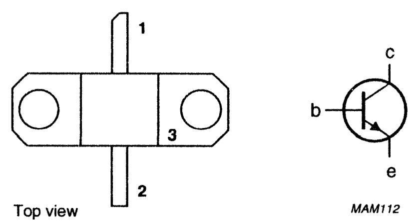


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	DC collector current		–	0.5	A
P_{tot}	total power dissipation	$T_{mb} = 75$ °C	–	9	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; note 1	–	235	°C

Note

1. Up to 0.3 mm from ceramic.

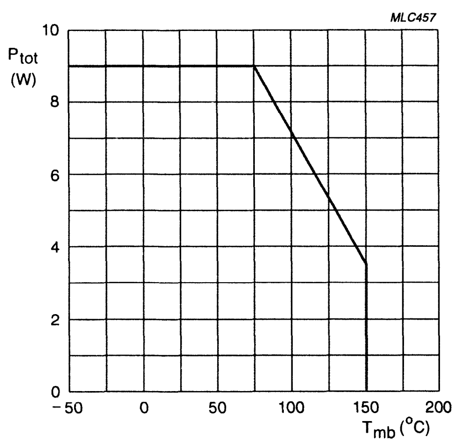


Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	11	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.3	K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CES}	collector cut-off current	R_{BE} = 0; V_{CE} = 30 V	–	200	μA
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 1 mA; I_E = 0	40	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 1 mA; I_E = 0	40	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_C = 1 mA; I_E = 0	3	–	V
h_{FE}	DC current gain	I_C = 300 mA; V_{CE} = 5 V	15	100	

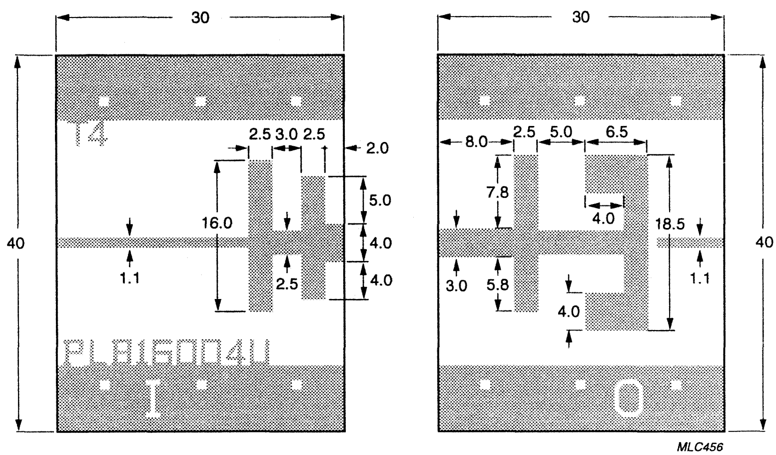
APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-base test circuit as shown in Fig.3.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)	Z_i; Z_L (Ω)
Class C (CW)	1.6	28	typ. 5	typ. 10	typ. 50	see Figs 5 and 6

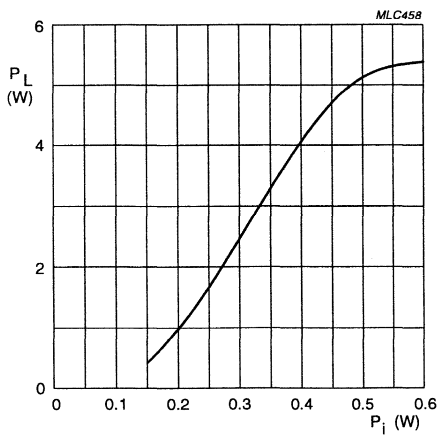
NPN silicon planar epitaxial microwave power transistor

PLB16004U



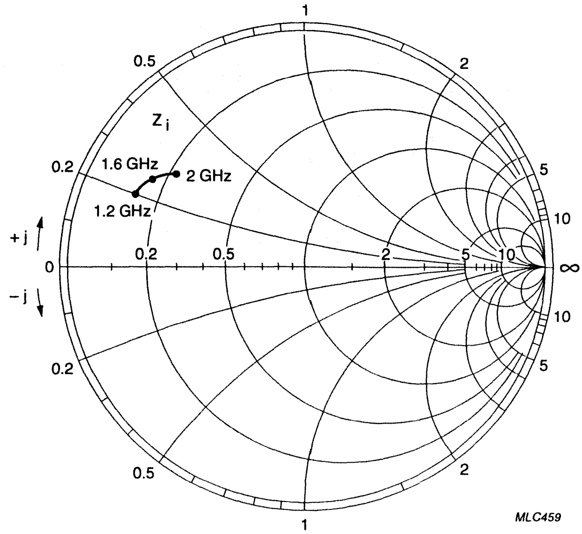
Dimensions in mm.
Substrate: Teflon fibre glass.
Thickness: 0.4 mm.
Permittivity: $\varepsilon_r = 2.55$.

Fig.3 Narrowband test circuit.



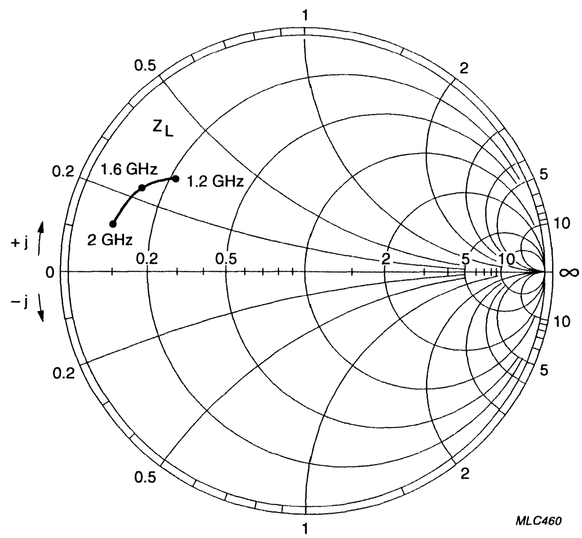
$V_{CC} = 28$ V; f = 1.6 GHz.

Fig.4 Load power as a function of input power.



V_{CC} = 28 V; Z_o = 50 Ω.

Fig.5 Input impedance as a function of frequency; typical values.



V_{CC} = 28 V; Z_o = 50 Ω.

Fig.6 Optimum load impedance as a function of frequency; typical values.

NPN silicon planar epitaxial microwave power transistor

PLB16012U

FEATURES

- Input matching cell allows an easier design of circuits
- 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.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common base, class C, power amplifiers. The transistor has a FO-229 metal ceramic flange package with base connected to flange.

APPLICATIONS

Intended for use in common base, class C, power amplifiers at 1.6 GHz. Also suitable for operation in the 1.4 to 1.8 GHz range.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)	Z_i/Z_L (Ω)
class C (CW)	1.6	28	10	> 8	> 45	see Figs 5 and 6

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

PIN CONFIGURATION

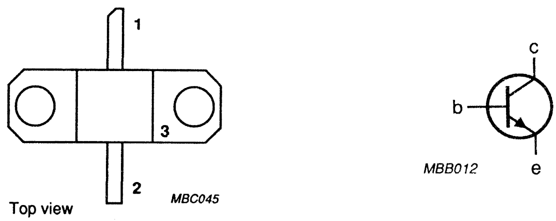


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
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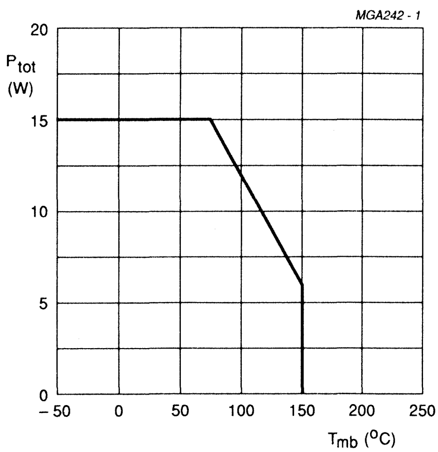
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	0.9	A
P_{tot}	total power dissipation	$T_{mb} = 75$ °C	–	15	W
T_{stg}	storage temperature range		–65	150	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

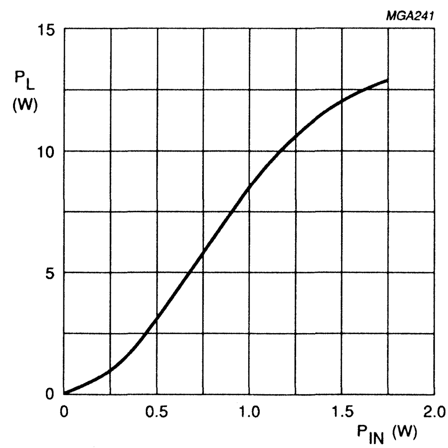
Note

1. Up to 0.3 mm from ceramic.



P_{tot} max = 15 W.

Fig.2 Maximum power dissipation derating as a function of mounting base temperature.



$V_{CC} = 28$ V; f = 1.6 GHz.

Fig.3 Load power as a function of source power.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	6 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.3 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 28 V; I_E = 0	0.3	mA
		V_{CB} = 35 V; I_E = 0	0.6	mA
I_{CES}	collector cut-off current	V_{CE} = 28 V; R_{BE} = 0 Ω	0.6	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	25	µA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common base test circuit as shown in Fig.4 and working in CW class C mode.

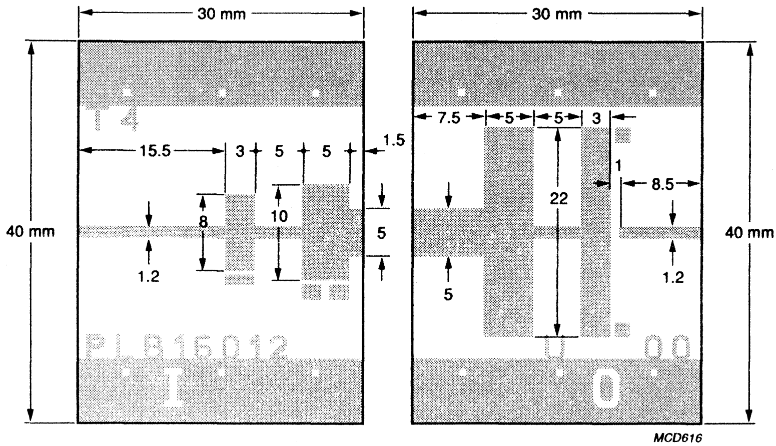
MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)	Z_i/Z_L Ω
class C (CW) note 1	1.6	28	10	≥ 8; typ. 9.4	≥ 45; typ. 60	see Figs 5 and 6
class C - 100 ms 50%	1.6	28	typ. 15	typ. 9.4	typ. 60	

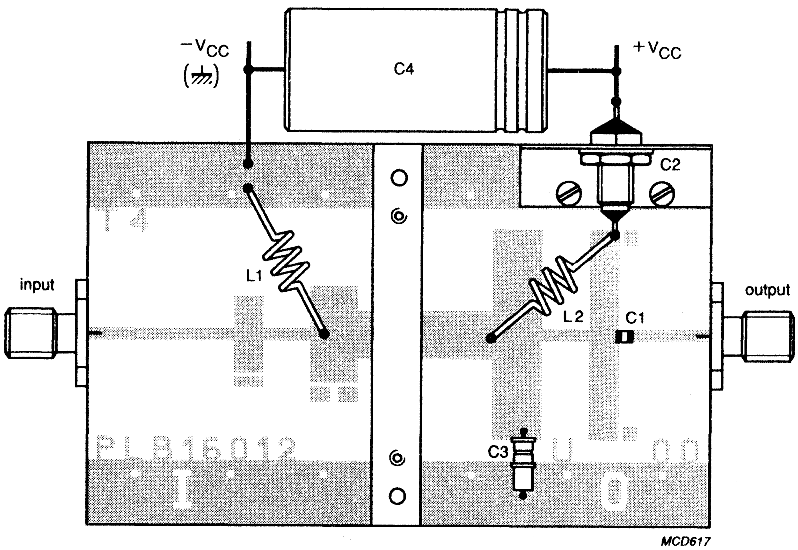
Note

1. May be used for narrowband or broadband amplifiers within the frequency range 1.4 to 1.8 GHz. Operation below 1.4 GHz may damage the transistor due to resonance of the internal output prematching circuit.

List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
L1, L2	5 turns 0.2 mm copper wire		int. dia. = 2 mm	
C1	DC blocking capacitor	100 pF		
C2	feedthrough bypass capacitor			Erie, ref.1250-003
C3	trimmer capacitor	0.6 - 4.5 pF		AT-3-7-271SL
C4	electrolytic capacitor	150 µF, 45 V		





Dimensions in mm

Substrate : Teflon fibre glass

Thickness : 0.4 mm

Permittivity : $\varepsilon_r = 2.55$

Fig.4 Narrowband test circuit.

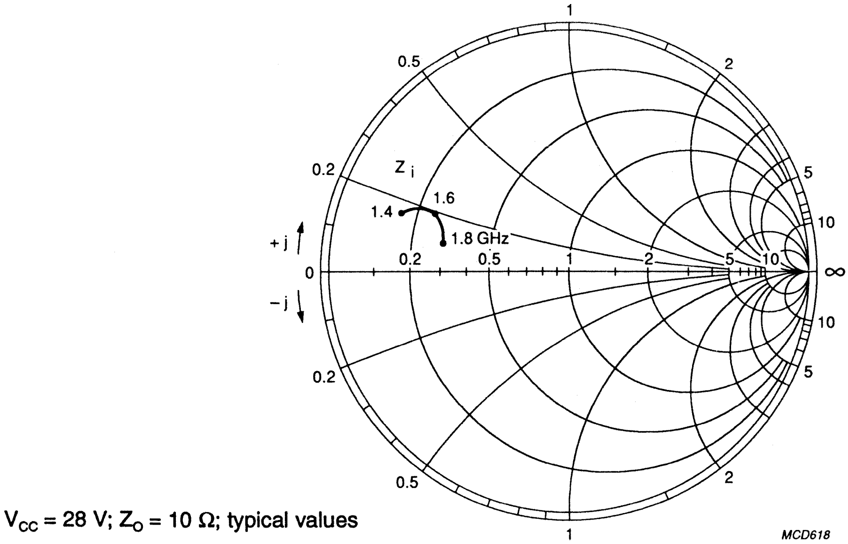


Fig.5 Input impedance as a function of frequency.

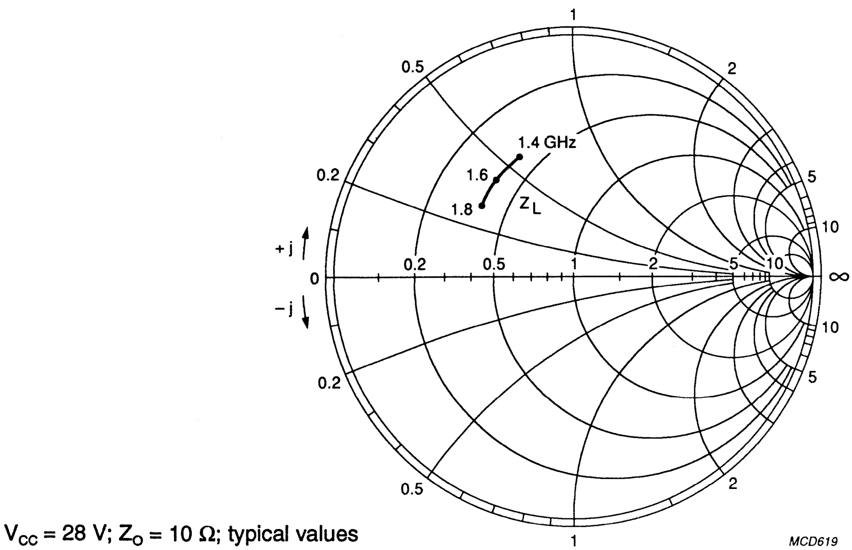


Fig.6 Optimum load impedance as a function of frequency.

NPN silicon planar epitaxial microwave power transistor

PLB16030U

FEATURES

- Input and output matching cell allows an easier design of circuits
- Diffused emitter ballasting resistors provide 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.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common base class B power amplifiers. The transistor has a FO–229 metal ceramic flange package with base connected to flange.

APPLICATIONS

Intended for use in common base class B power amplifiers at 1.6 GHz. Also suitable for operation in the frequency range 1.4 to 1.8 GHz.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class B narrow band amplifier.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)	Z_i/Z_L Ω
class B (CW)	1.6	28	> 30	> 7	> 45	see Figs 5 and 6

PINNING - FO-229

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

PIN CONFIGURATION

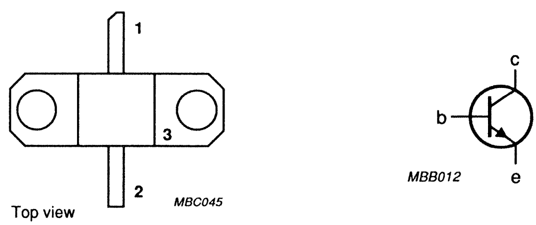


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

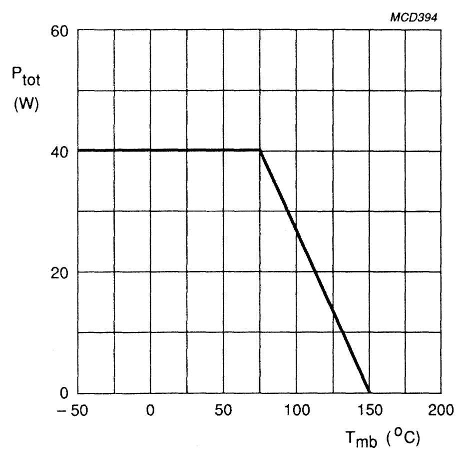
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	2.6	A
P_{tot}	total power dissipation	$T_{mb} = 75$ °C	–	40	W
T_{stg}	storage temperature range		–65	150	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

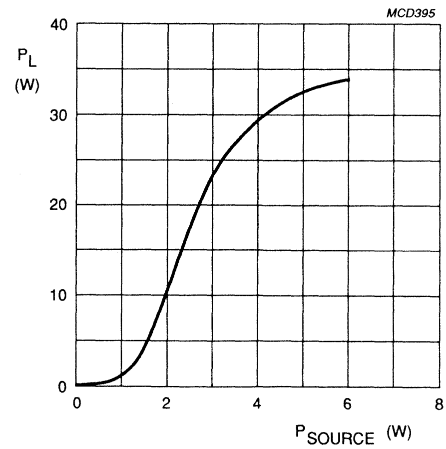
Note

1. Up to 0.3 mm from ceramic.



P_{tot} max = 40 W.

Fig.2 Maximum power dissipation derating as a function of mounting base temperature.



V_{CC} = 28 V; f = 1.6 GHz.

Fig.3 Load power as a function of source power.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 100 °C	2.4 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 28 V; I_E = 0	0.9	mA
		V_{CB} = 35 V; I_E = 0	1.8	mA
I_{CES}	collector cut-off current	V_{CE} = 28 V; R_{BE} = 0 Ω	1.8	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	90	μA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-base test circuit and working in CW class B mode

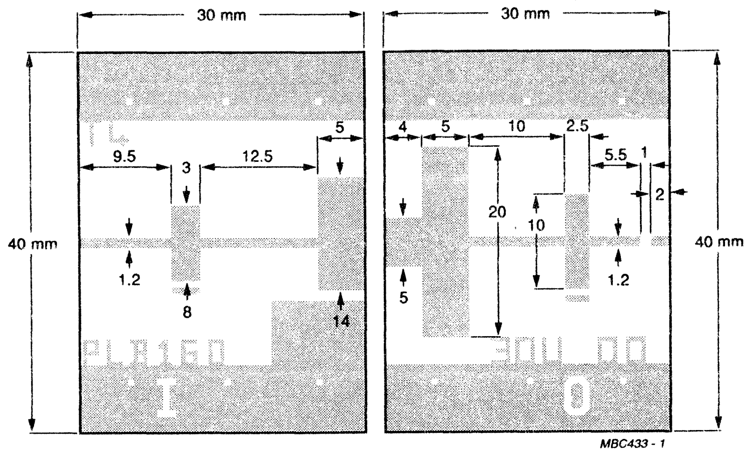
MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)	Z_i/Z_L Ω
class B (CW) note 1	1.6	28	≥ 30	≥ 7; typ. 8.2	≥ 45; typ. 52	see Figs 5 and 6
class B - 100 ms 50%	1.6	28	typ. 38	typ. 8.8	typ. 56	

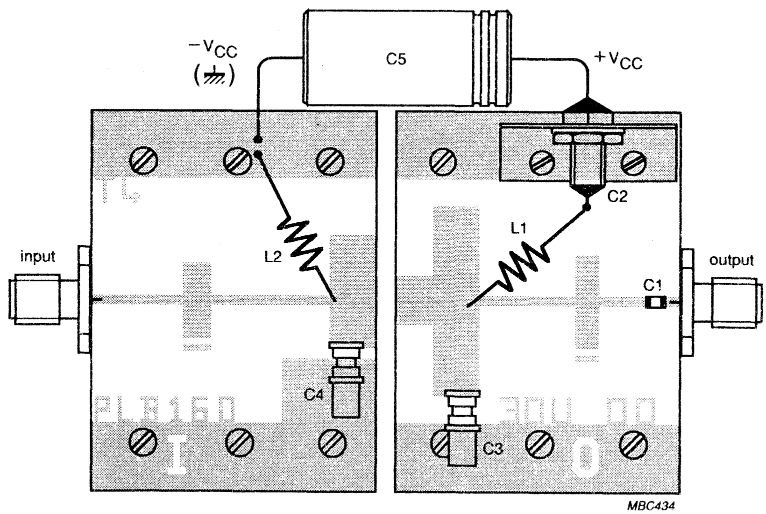
Note

1. May be used for narrow band or broad band amplifiers within the frequency range 1.4 to 1.8 GHz. Operation below 1.4 GHz may damage the transistor due to resonance of the internal output prematching circuit.

List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
L1, L2	5 turns 0.2 mm copper wire		int. dia. 2 mm	
C1	DC blocking capacitor	100 pF		
C2	feedthrough bypass capacitor			Erie, ref.1250-003
C3, C4	trimmer capacitor	0.4 to 2.5 pF		Tekelec AT-3-7281SL
C5	electrolytic capacitor	150 μF		





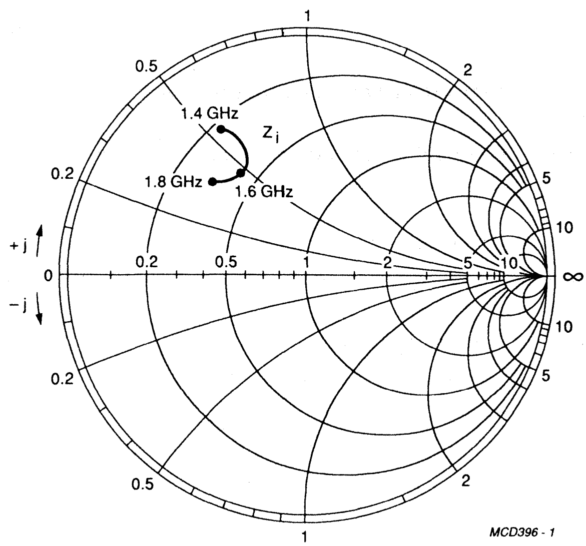
Dimensions in mm

Substrate : Teflon fibre glass

Thickness : 0.4 mm

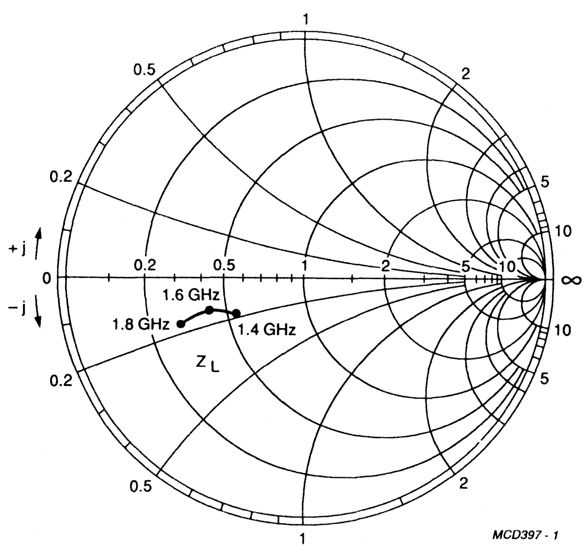
Permittivity : $\varepsilon_r = 2.55$

Fig.4 Narrowband test circuit.



V_{CC} = 28 V; Z_O = 10 Ω;
P_{OUT} = 30 W

Fig.5 Input impedance as a function of frequency; typical values.



V_{CC} = 28 V; Z_O = 10 Ω;
P_{OUT} = 30 W

Fig.6 Optimum load impedance as a function of frequency; typical values.

MICROWAVE POWER TRANSISTORS

NPN silicon power transistor for use in a common-collector oscillator circuits in military and professional applications.

The transistors operate in CW conditions and are recommended for applications up to 5 GHz.

Features:

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- 5 GHz technology

The PPC5001T is housed in a metal ceramic flange envelope (FO-102).
The PQC5001T is housed in a metal ceramic flange envelope (FO-85).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in an oscillator circuit up to 5 GHz; typical values.

mode of operation	f GHz	V_{CE} V	I_C mA	P_L mW
class A; CW	5	20	200	450

MECHANICAL DATA

PPC5001T FO-102 (see Fig. 1a)
PQC5001T FO-85 (see Fig. 1b).

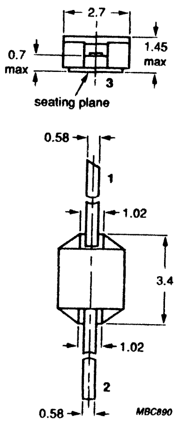
MECHANICAL DATA

Dimensions in mm

Fig. 1a FO-102.

PPC5001T

marking code = 395



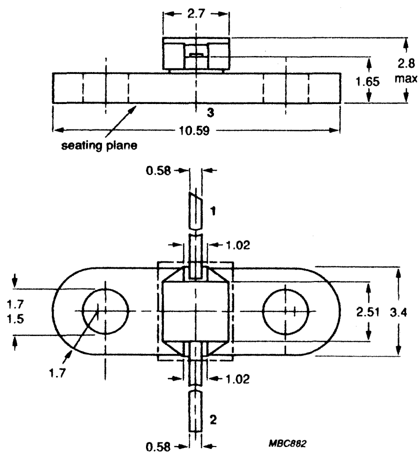
Pinning:

1 = base
2 = emitter
3 = collector

Fig. 1b FO-85.

PQC5001T

marking code = 383



Pinning:

1 = base
2 = emitter
3 = collector

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage, open emitter	V_{CBO}	max.	40 V
Collector-emitter voltage,			
$R_{BE} = 70\ \Omega$	V_{CER}	max.	35 V
open emitter	V_{CEO}	max.	16 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.0 V
Collector current, DC	I_C	max.	0.25 A
Total power dissipation up to $T_{amb} = 75\ ^{o}C$	P_{tot}	max.	4 W
Storage temperature	T_{stg}		−65 to +200 ^{o}C
Junction temperature	T_j	max.	200 ^{o}C
Soldering temperature at 0.1 mm from the case, $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 ^{o}C

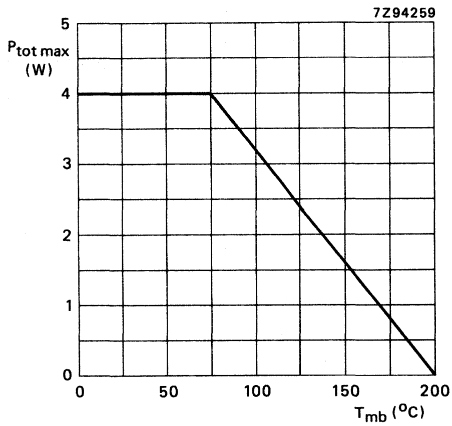


Fig.2 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at Tj=75 ^{o}C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	24 K/W

CHARACTERISTICS

$T_{mb} = 25\ ^{o}C$ unless otherwise specified

Breakdown voltages			
$I_C = 500\ \mu A$; $I_E = 0$	$V_{(BR)CBO}$	min.	40 V
$I_C = 2.5$ mA; $R_{BE} = 70\ \Omega$	$V_{(BR)CER}$	min.	35 V
Collector cut-off current $I_E = 0$; $V_{CB} = 24$ V	I_{CBO}	max.	100 μA
Emitter cut-off current $I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	0.2 μA
Collector-base capacitance at f = 1 MHz $I_E = I_C = 0$; $V_{CB} = 18$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	1.4 pF

Emitter-base capacitance at f = 1 MHz $I_E = I_C = 0$; $V_{EB} = 1$ V; $V_{CB} = 10$ V	C_{eb}	typ.	5.5 pF
Collector-emitter capacitance at f = 1 MHz $I_E = I_C = 0$; $V_{CE} = 18$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	0.9 pF

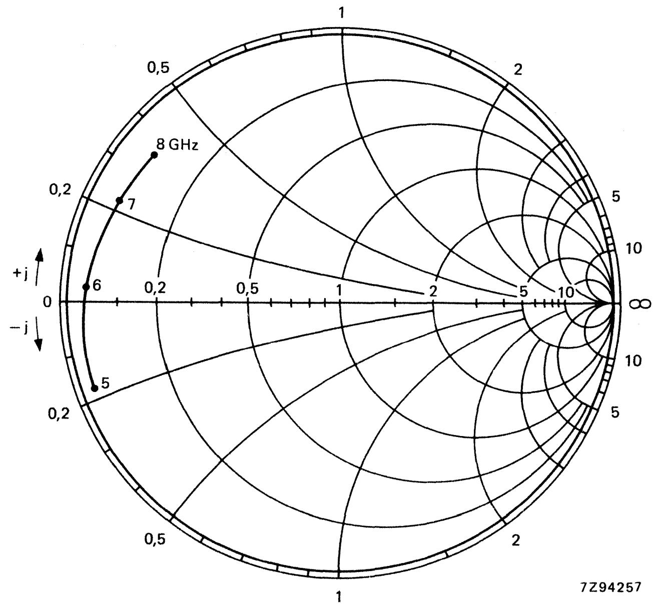


Fig. 3 Emitter reflection coefficient.

Conditions for Figs 3 and 4:

$V_{CE} = 20$ V; $I_C = 200$ mA;
$Z_0 = 50\ \Omega$

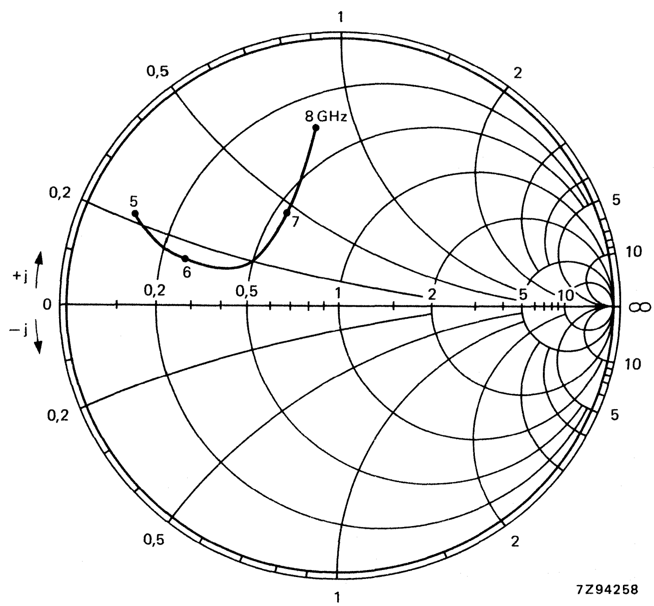


Fig. 4 Base reflection coefficient.

MICROWAVE POWER TRANSISTORS

NPN silicon transistors for use in common-base class-B power amplifiers up to 4.2 GHz.

Diffused emitter ballasting resistors, interdigitated structure, multicell geometry, localized thick oxide auto-alignment process and gold sandwich metallization ensure an optimum temperature profile and excellent performance and reliability.

PTB23003XA is RF tested by sampling, all other parameters being equal to PTB23003X.

QUICK REFERENCE DATA

RF performance up to T_{mb} = 25 °C in a common-base class-B circuit

type number	mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η %	z_i Ω	Z_L Ω
PTB23001X	CW	2	24	⩾ 1	⩾ 7	⩾ 45	8 + j14	8 + j20
PTB23003X	CW	2	24	⩾ 3	⩾ 8.75	⩾ 45	2.5 + j14	8 + j6
PTB23005X	CW	2	24	⩾ 5	⩾ 9.2	⩾ 50	1.9 + j12	7.5 + j3

MECHANICAL DATA

FO-41B (see Fig.1).

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.

MECHANICAL DATA

Fig.1 FO-41B.

Dimensions in mm

Base and metallic cap connected to flange.

Pinning:

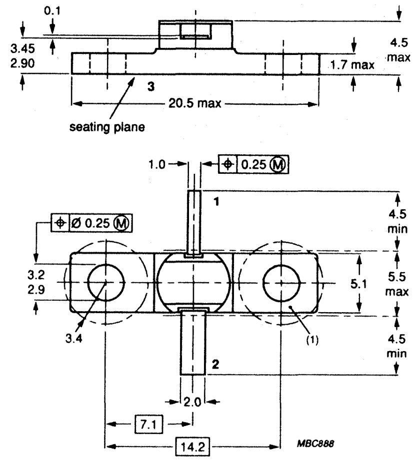
1 = collector
2 = emitter
3 = base

Torque on screw: max. 0.5 Nm

Recommended screw: M2.5

Marking code:

2301X for PTB23001X
2303X for PTB23003X
2305X for PTB23005X



(1) Flatness of this area ensures full thermal contact with bolt head.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PTB23001X	23003X	23005X	
Collector-base voltage open emitter	V_{CBO}	max.	40	40	40	V
Collector-emitter voltage $R_{BE} = 0$	V_{CES}	max.	40	40	40	V
open base	V_{CEO}	max.	15	15	15	V
Collector current (DC)	I_C	max.	0.25	0.5	0.75	A
Total power dissipation (f > 1 MHz) up to T_{mb} = 75 °C	P_{tot}	max.	4.2	7.6	8.7	W
Storage temperature range	T_{stg}		−65 to + 200			
Junction temperature	T_j	max.	200			
Lead soldering temperature at 0.3 mm from ceramic; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235			°C

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

			PTB23001X	23003X	23005X
From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	22	12	10.5 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7	0.7	0.7 K/W

PTB23001X

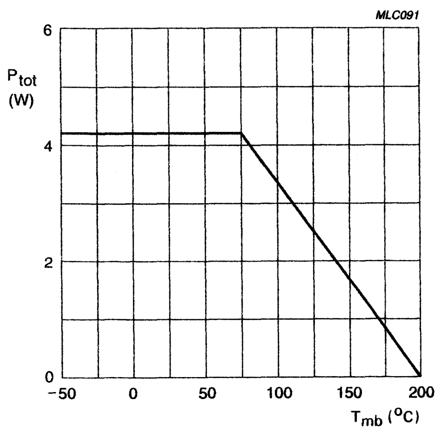


Fig. 2 Maximum permissible RF power dissipation as a function of mounting base temperature; f > 1 MHz.

PTB23003X

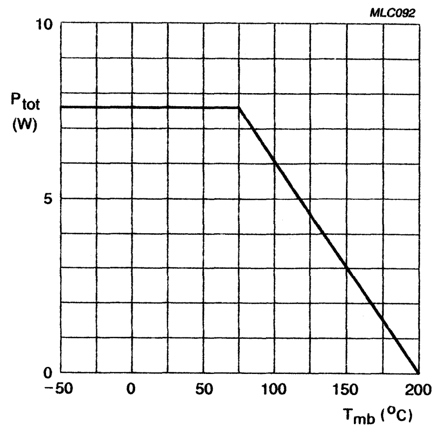
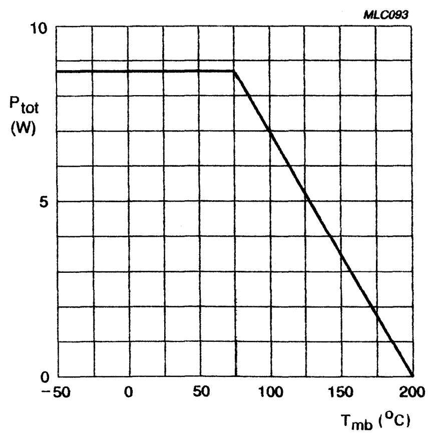


Fig. 3 Maximum permissible RF power dissipation as a function of mounting base temperature; f > 1 MHz.



PTB23005X

Fig. 4 Maximum permissible RF power dissipation as a function of mounting base temperature; f > 1 MHz.

CHARACTERISTICS

			PTB23001X	23003X	23005X	
Collector-base breakdown voltage						
open emitter; I_C = 1 mA		min.	40	—	—	V
open emitter; I_C = 2 mA	$V_{(BR)CBO}$	min.	—	40	—	V
open emitter; I_C = 3 mA		min.	—	—	40	V
Collector-emitter breakdown voltage						
R_{BE} = 0; I_C = 10 mA	$V_{(BR)CES}$	min.	40	40	40	V
Collector cut-off current						
I_E = 0; V_{CB} = 24 V	I_{CBO}	max.	10	20	30	μA
Emitter cut-off current						
I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	0.2	0.4	0.6	μA
Collector-base capacitance at f = 1 MHz						
$I_E = I_C = 0$; V_{CB} = 24 V; V_{EB} = 1.5 V	C_{cb}	typ.	2.2	3	3.8	pF
Collector-emitter capacitance at f = 1 MHz						
$I_E = I_C = 0$; V_{CB} = 24 V; V_{EB} = 1.5 V	C_{ce}	typ.	0.3	0.6	0.9	pF

APPLICATION INFORMATION

Microwave performance in a common-base class-B selective amplifier circuit.*

type number	mode of operation	f GHz	V_{CE} V	P_L W	G_p dB	η_C %
PTB23001X	CW class-B	2	24	> 1 typ. 1.8	> 7 typ. 9	> 45 typ. 50
PTB23003X	CW class-B	2	24	> 3 typ. 4	> 8.75 typ. 10	> 45 typ. 50
PTB23005X	CW class-B	2	24	> 5 typ. 7	> 9.2 typ. 11	> 40 typ. 50

* Circuit consists of prematching circuit board in combination with complementary input and output slug tuners.

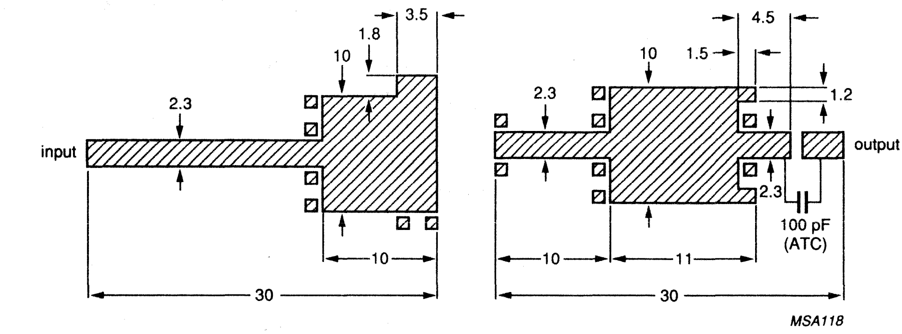


Fig.5 Prematching test circuit board for PTB23001X.

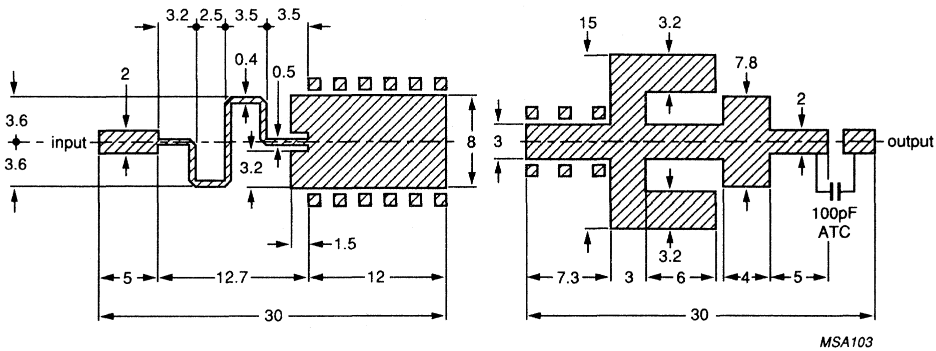


Fig.6 Prematching test circuit board for PTB23003X.

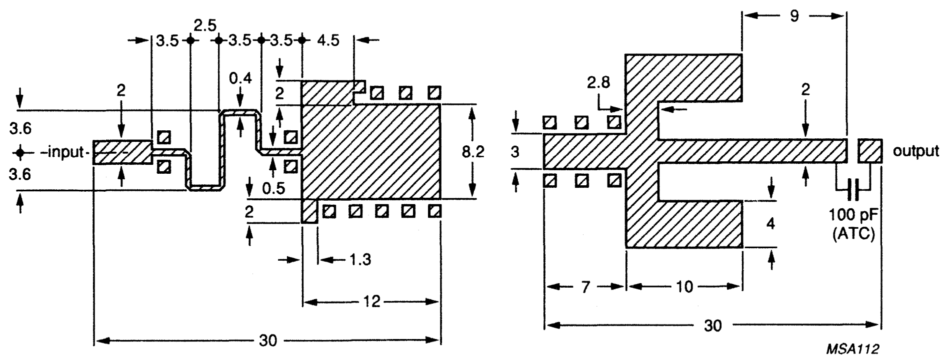


Fig.7 Prematching test circuit board for PTB23005X.

Circuits on a double Cu-clad printed-circuit board Teflon fibre-glass dielectric (ϵ_r = 2.55) thickness 0.8 mm.

NPN silicon planar epitaxial microwave power transistor

PTB23002U

FEATURES

- Very high power gain
- Internal input prematching network
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure
- Gold metallization with barrier layer to prevent electromigration and gold diffusion during life
- Multicell geometry improves power sharing and reduces thermal resistance.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common base, class C, power amplifiers. The transistor has a FO-41B hermetically sealed metal ceramic flange package with base connected to flange.

APPLICATIONS

Intended for use in common base, class C, power amplifiers at frequencies up to 2.3 GHz.

PINNING - FO-41B

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)	Z_i/Z_L (Ω)
class C (CW)	2.3	28	> 2	> 9	> 45	see Figs 5 and 6

PIN CONFIGURATION

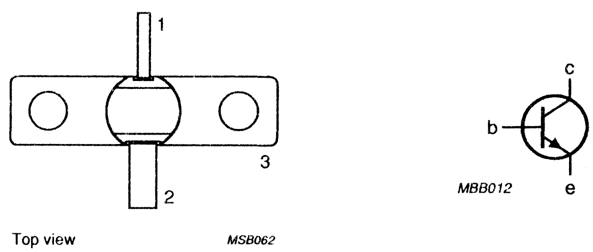


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

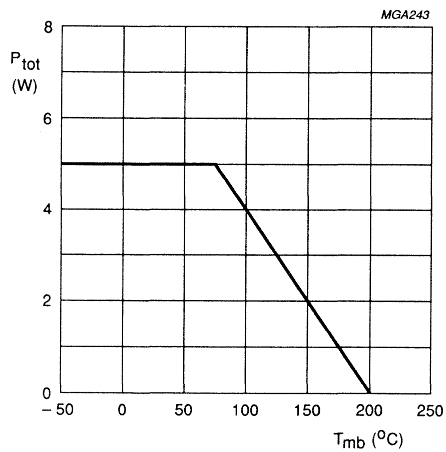
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	40	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	0.25	A
P_{tot}	total power dissipation	$T_{mb} = 75$ °C	–	5	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



P_{tot} max = 5 W.

Fig.2 Maximum power dissipation derating as a function of mounting base temperature.

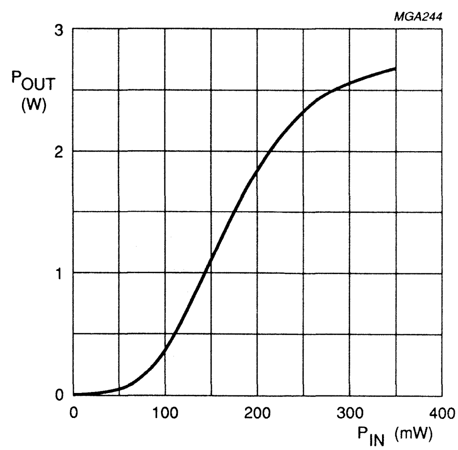


Fig.3 Load power as a function of input power.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 75 °C	22 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.7 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 1 mA; I_E = 0	40	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 1 mA; R_{BE} = 0 Ω	40	–	V
I_{CBO}	collector cut-off current	V_{CE} = 30 V; I_E = 0	–	15	μA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	–	1.5	μA

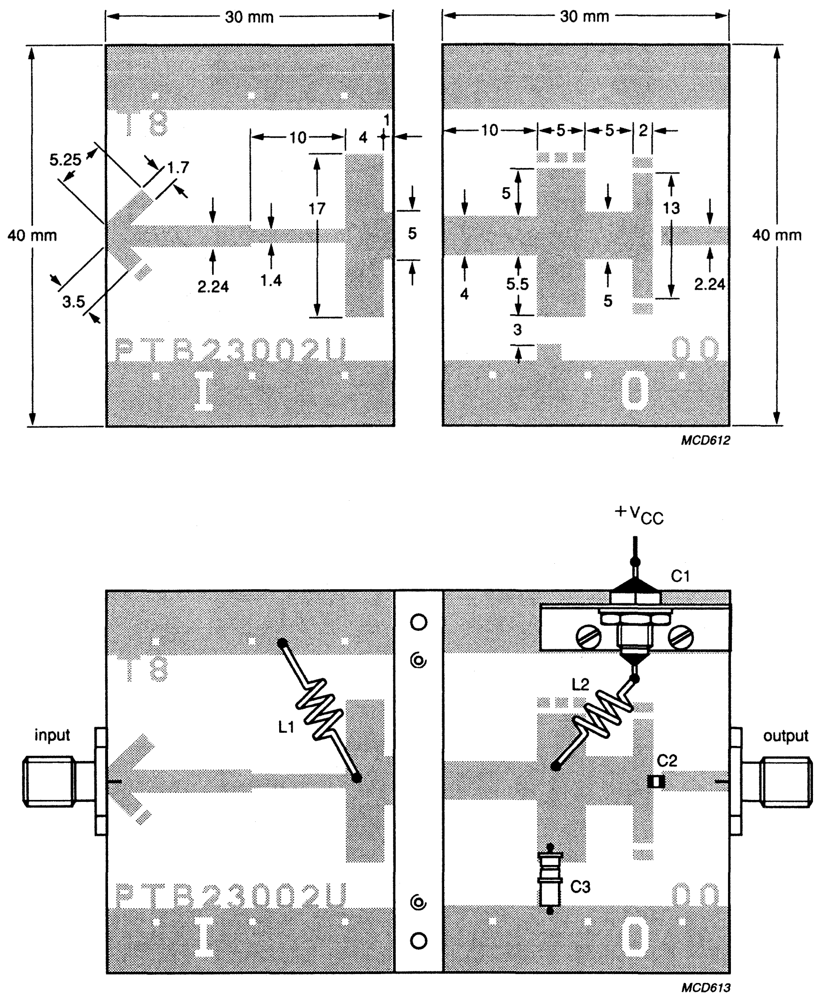
APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-base test circuit as shown in Fig.4 and working in CW class C mode.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)	Z_i/Z_L (Ω)
class C (CW)	2.3	28	≥ 2; typ.2.3	≥ 9; typ.9.6	≥ 45; typ.50	see Figs 5 and 6

List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
L1, L2	3 turns 0.5 mm copper wire		int.dia. = 2 mm	
C1	feedthrough bypass capacitor			Erie, ref.1250-003
C2	DC blocking capacitor	100 pF		
C3	tuning capacitor	0.5 - 5 pF		Tekelec 5855



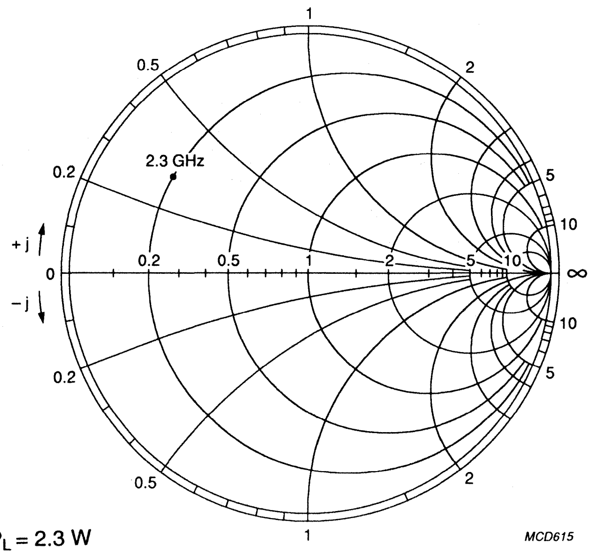
Dimensions in mm

Substrate : PTFE fibre glass

Thickness : 0.8 mm

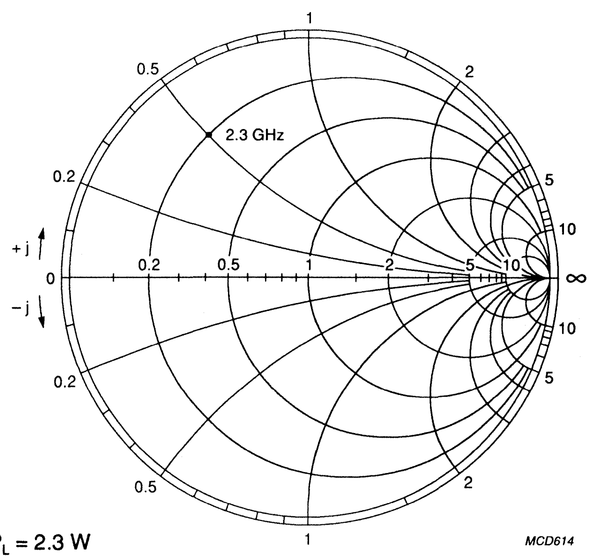
Permittivity : $\varepsilon_r = 2.54$

Fig.4 Prematching test circuit.



V_{CC} = 28 V; Z_o = 50 Ω; P_L = 2.3 W

Fig.5 Input impedance as a function of frequency.



V_{CC} = 28 V; Z_o = 50 Ω; P_L = 2.3 W

Fig.6 Optimum load impedance as a function of frequency.

NPN silicon planar epitaxial microwave power transistor

PTB23006U

FEATURES

- Very high power gain
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure
- Gold metallization with barrier layer to prevent electromigration and gold diffusion during life
- Multicell geometry improves power sharing and reduces thermal resistance
- Internal input prematching network.

APPLICATIONS

Intended for use in common-base, class C power amplifiers at frequencies up to 2.3 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-41B hermetically sealed metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class C narrowband amplifier.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)	Z_i; Z_L (Ω)
Class C (CW)	2	28	>5	>9	>40	see Figs 5 and 6

PINNING - FO-41B

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

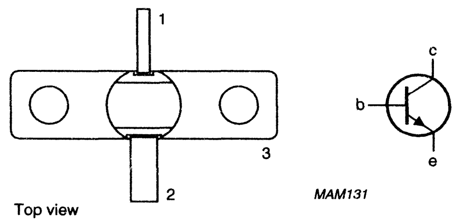


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
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.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current		–	0.75	A
P_{tot}	total power dissipation	$T_{mb} = 75$ °C	–	11	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.

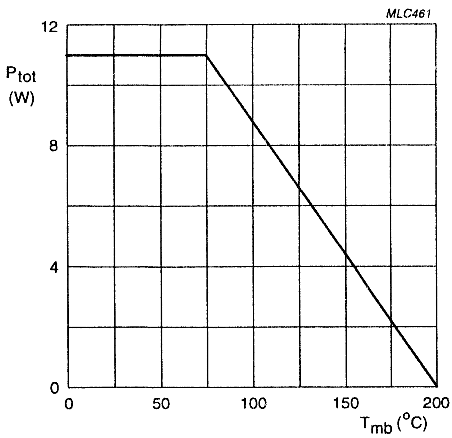


Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_j = 75\ °C$	8.5	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.7	K/W

CHARACTERISTICS

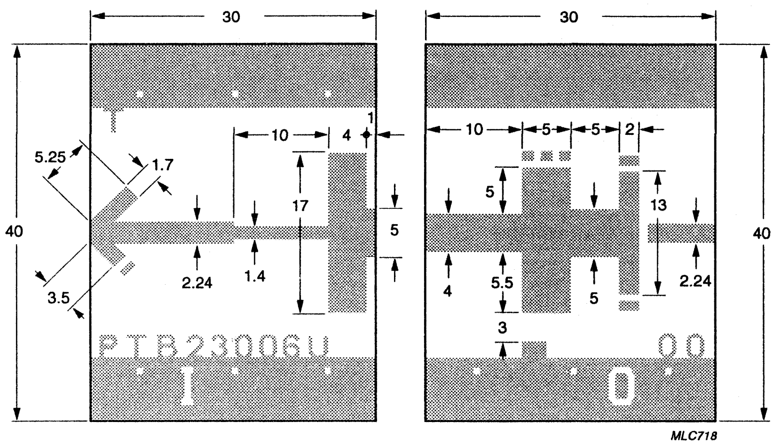
$T_{mb} = 25\ °C$ unless otherwise specified.

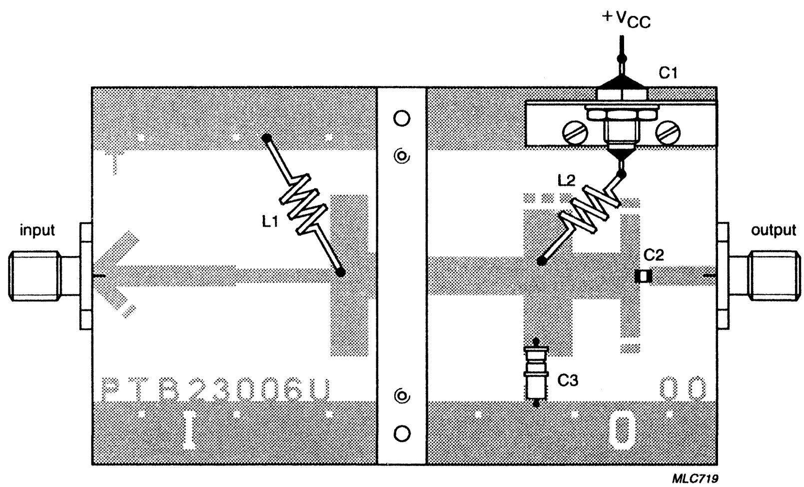
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CES}	collector cut-off current	$I_E = 0$; $V_{CE} = 30\ V$	–	300	μA
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 3\ mA$; $I_E = 0$	40	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	$I_C = 3\ mA$; $R_{BE} = 0$	40	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_C = 1.5\ mA$	3	–	V
h_{FE}	DC current gain	$I_C = 450\ mA$; $V_{CE} = 3\ V$	15	150	

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\ °C$ in a common-base class C test circuit.

MODE OF OPERATION	f (GHz)	V_{CE} (V)	P_L (W)	G_p (dB)	η_C (%)	Z_i; Z_L (Ω)
Class C (CW)	2	28	>5 typ. 5.8	>9 typ. 10.5	>40 typ. 45	see Figs 5 and 6





Dimensions in mm.
Substrate: PTFE fibreglass.
Thickness: 0.8 mm.
Permittivity: $\varepsilon_r = 2.54$.

Fig.3 Prematching test circuit.

List of components (see Fig.3)

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
C1	feedthrough bypass capacitor		Erie1250-003
C2	DC blocking chip capacitor	100 pF	
C3	tuning capacitor	0.5 to 5 pF	Tekelec 5855
L1, L2	3 turns 0.5 mm copper wire; internal diameter = 2 mm		

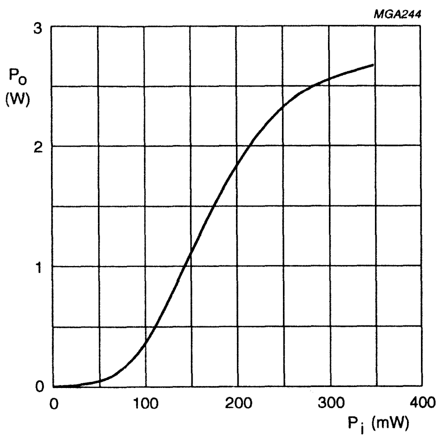
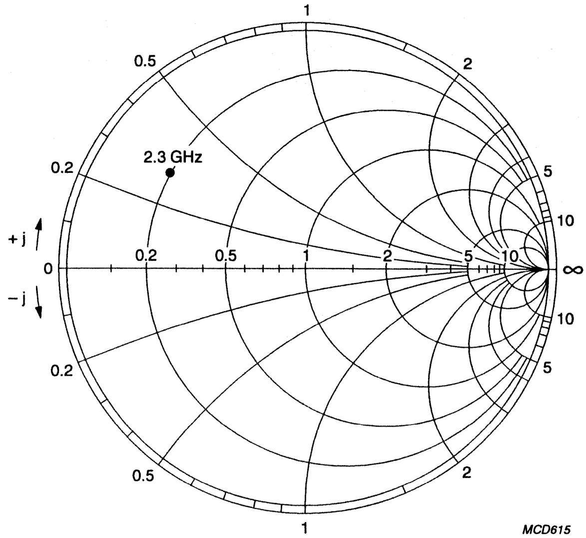
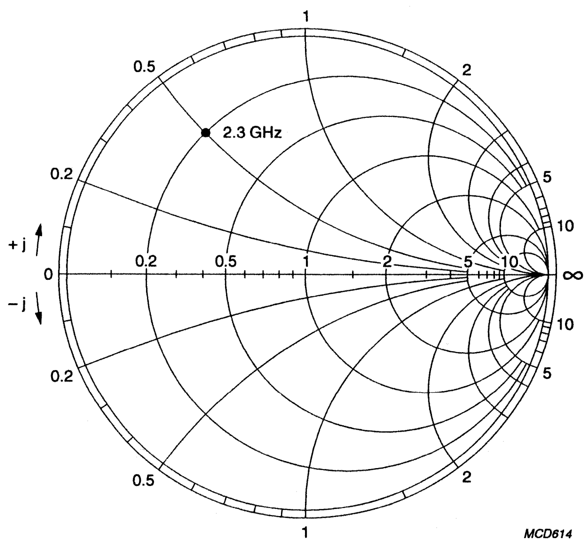


Fig.4 Load power as a function of input power.



V_{CC} = 28 V; Z_o = 50 Ω; P_L = 2.3 W.

Fig.5 Input impedance as a function of frequency.



V_{CC} = 28 V; Z_o = 50 Ω; P_L = 2.3 W.

Fig.6 Optimum load impedance as a function of frequency.

MICROWAVE POWER TRANSISTORS

NPN silicon transistors for use in common-base class-B power amplifiers up to 4.2 GHz.

Diffused emitter ballasting resistors, interdigitated structure, multicell geometry, localized thick oxide auto-alignment process and gold sandwich metallization ensure an optimum temperature profile and excellent performance and reliability.

QUICK REFERENCE DATA

RF performance up to T_{mb} = 25 °C in a common-base class-B circuit

type number	mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η %	z_i Ω	Z_L Ω
PTB32001X	CW	3	24	⩾ 1.3	⩾ 8	⩾ 35	15 + j31	5.5 + j10
PTB32003X	CW	3	24	⩾ 2.5	⩾ 8	⩾ 35	5.5 + j29	5 − j2.2
PTB32005X	CW	3	24	⩾ 4.5	⩾ 8	⩾ 35	2.8 + j20	4 − j7

MECHANICAL DATA

Dimensions in mm

Fig.1 FO-41B.

Base and metallic cap connected to flange.

Pinning:

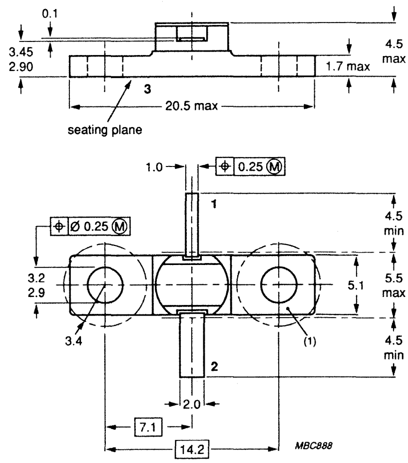
1 = collector
2 = emitter
3 = base

Torque on screw: max. 0.5 Nm

Recommended screw: M2.5

Marking code: 3201X for PTB32001X
3203X for PTB32003X
3205X for PTB32005X

(1) Flatness of this area ensures full thermal contact with bolt head.



WARNING

Product and environmental safety — toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.**

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PTB32001X	32003X	32005X	
Collector-base voltage						
open emitter	V_{CBO}	max.	40	40	40	V
Collector-emitter voltage						
$R_{BE} = 0$	V_{CES}	max.	40	40	40	V
open base	V_{CEO}	max.	15	15	15	V
Emitter-base voltage						
open collector	V_{EBO}	max.	3.0	3.0	3.0	V
Collector current (DC)	I_C	max.	0.25	0.5	0.75	A
Total power dissipation ($f > 1$ MHz)						
up to $T_{mb} = 75$ °C	P_{tot}	max.	4.2	7.6	8.7	W
Storage temperature	T_{stg}		−65 to + 200			
Junction temperature	T_j	max.	200			
Lead soldering temperature						
at 0.3 mm from ceramic; $t_{sld} \leq 10$ s	T_{sld}	max.	235			°C

THERMAL RESISTANCE (at $T_j = 75$ °C)

			PTB32001X	32003X	32005X	
From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	22	12	10.5	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7	0.7	0.7	K/W

PTB32001X

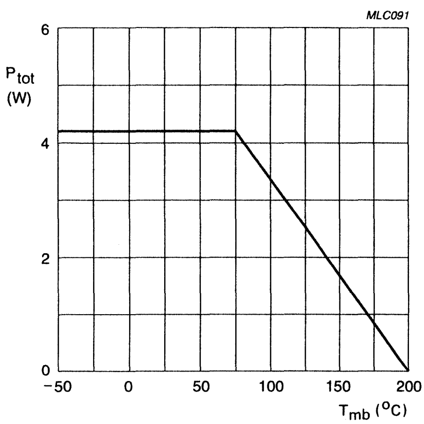


Fig. 2 Maximum permissible RF power dissipation as a function of mounting base temperature. $f > 1$ MHz.

PTB32003X

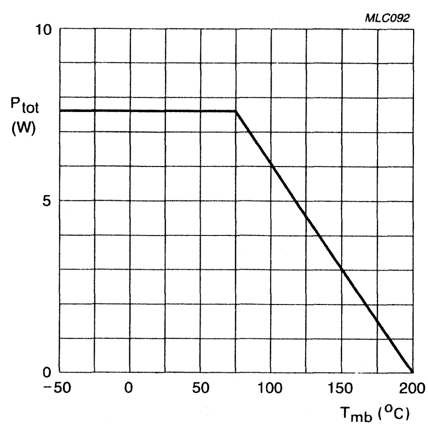
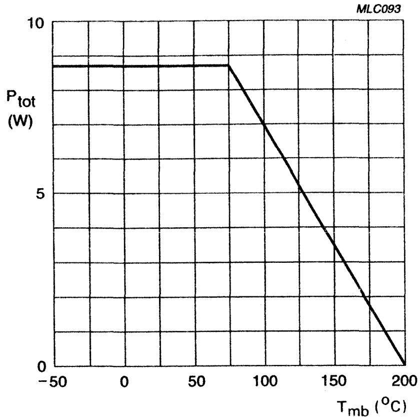


Fig. 3 Maximum permissible RF power dissipation as a function of mounting base temperature. $f > 1$ MHz.



PTB32005X

Fig. 4 Maximum permissible RF power dissipation as a function of mounting base temperature. f > 1 MHz.

CHARACTERISTICS

			PTB32001X	32003X	32005X	
Collector-base breakdown voltage						
open emitter; I_C = 1 mA		min.	40	–	–	V
open emitter; I_C = 2 mA	$V_{(BR)CBO}$	min.	–	40	–	V
open emitter; I_C = 3 mA		min.	–	–	40	V
Collector-emitter breakdown voltage						
R_{BE} = 0; I_C = 10 mA	$V_{(BR)CES}$	min.	40	40	40	V
Collector cut-off current						
I_E = 0; V_{CB} = 24 V	I_{CBO}	max.	10	20	30	μA
Emitter cut-off current						
I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	0.2	0.4	0.6	μA
Collector-base capacitance at f = 1 MHz						
I_E = I_C = 0; V_{CB} = 24 V; V_{EB} = 1.5 V	C_{cb}	typ.	2.2	3	3.8	pF
Collector-emitter capacitance at f = 1 MHz						
I_E = I_C = 0; V_{CB} = 24 V; V_{EB} = 1.5 V	C_{ce}	typ.	0.3	0.6	0.9	pF

APPLICATION INFORMATION

Microwave performance in a common-base class-B selective amplifier circuit*

type number	mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %
PTB32001X	CW class-B	3	24	> 1.3 typ. 1.8	> 8 typ. 9.5	> 35 typ. 45
PTB32003X		3	24	> 2.5 typ. 3.0	> 8 typ. 9.5	> 35 typ. 45
PTB32005X		3	24	> 4.5 typ. 5.5	> 8 typ. 9.5	> 35 typ. 45

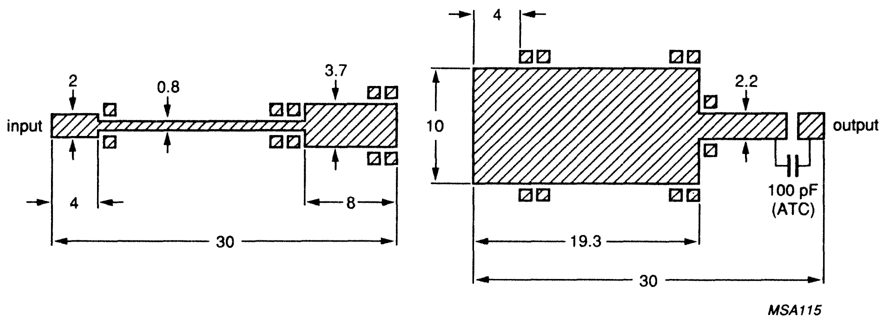


Fig. 5 Prematching test circuit board for PTB32001X.

Circuit on a double Cu-clad printed-circuit board Teflon fibre-glass dielectric (ϵ_r = 2.55); thickness 0.8 mm.

* Circuit consists of prematching circuit board in combination with complementary input and output slug tuners.

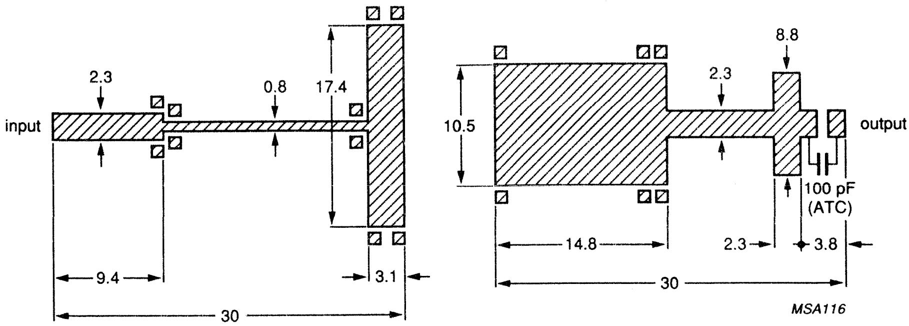


Fig. 6 Prematching test circuit board for PTB32003X.

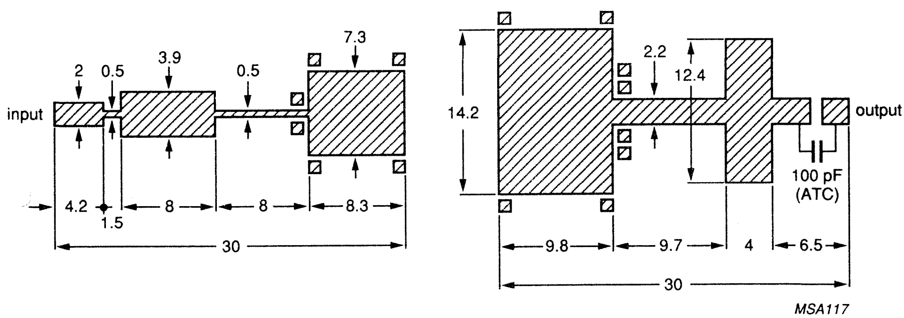


Fig. 7 Prematching test circuit board for PTB32005X.

Circuits on a double Cu-clad printed-circuit board Teflon fibre-glass dielectric (ϵ_r = 2.55); thickness 0.8 mm.

MICROWAVE POWER TRANSISTORS

NPN silicon transistors for use in common-base class-B power amplifiers up to 4.2 GHz.

Diffused emitter ballasting resistors, interdigitated structure, multicell geometry, localized thick oxide auto-alignment process and gold sandwich metallization ensure an optimum temperature profile and excellent performance and reliability.

QUICK REFERENCE DATA

RF performance up to T_{mb} = 25 °C in a common-base class-B circuit

type number	mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η %	z_i Ω	Z_L Ω
PTB42001X	CW	4.2	24	≥ 0.8	> 5	> 28	235 + j0	3.3 − j5.8
PTB42002X	CW	4.2	24	≥ 1.6	> 5	> 28	44.5 + j85	2.4 − j15.5

MECHANICAL DATA

Dimensions in mm

Fig.1 FO-41B.

Base and metallic cap connected to flange.

Pinning

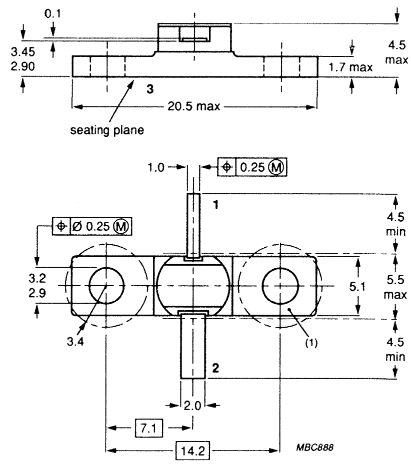
1 = collector
2 = emitter
3 = base

Torque on screw: max. 0.4 Nm

Recommended screw: M2.5

Marking code

4201X = PTB42001X
4202X = PTB42002X



(1) Flatness of this area ensures full thermal contact with bolt head.

WARNING

Product and environmental safety – toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary 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 general industrial or domestic waste.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PTB42001X	42002X	
Collector-base voltage open emitter	V_{CBO}	max.	40	40	V
Collector-emitter voltage $R_{BE} = 0$	V_{CES}	max.	40	40	V
open base	V_{CEO}	max.	15	15	V
Emitter-base voltage open collector	V_{EBO}	max.	3.5	3.5	V
Collector current (DC)	I_C	max.	0.25	0.5	A
RF power dissipation ($f > 1$ MHz) up to $T_{mb} = 75\ ^oC$	P_{tot}	max.	4.2	7.6	W
Storage temperature range	T_{stg}		−65 to + 200		^oC
Junction temperature	T_j	max.	200		^oC
Lead soldering temperature at 0.3 mm from ceramic; $t_{sld} \leq 10$ s	T_{sld}	max.	235		^oC

PTB42001X

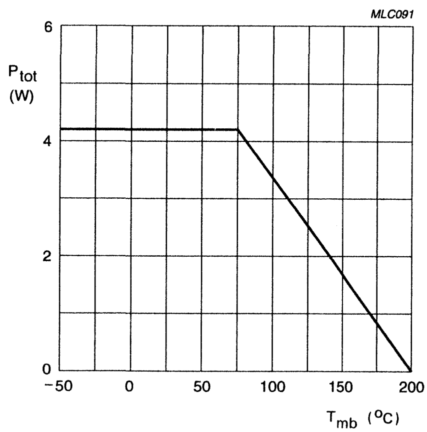


Fig. 2 Maximum permissible RF power dissipation as a function of mounting base temperature; $f > 1$ MHz.

PTB42002X

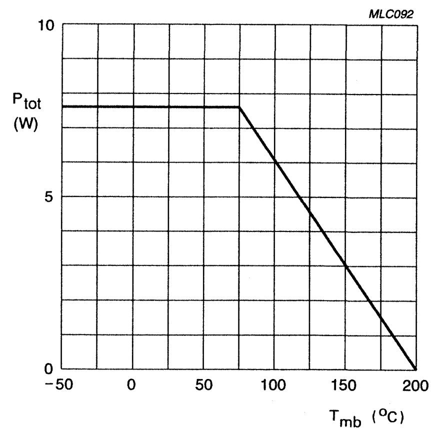


Fig. 3 Maximum permissible RF power dissipation as a function of mounting base temperature; $f > 1$ MHz.

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

			PTB42001X	42002X	
From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	22	12	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7	0.7	K/W

MICROWAVE POWER TRANSISTOR

NPN silicon power transistor for use in a common-base, class-C amplifier up to a frequency of 4.2 GHz in CW conditions in military and professional applications.

Features

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistor providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- An input matching cell improving the input impedance and allowing an easier design of wideband circuits

The transistor is housed in a metal ceramic flange envelope (FO-41B).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class-C selective amplifier

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
CW; class-C	4.2	24	⩾ 2.5	⩾ 5	⩾ 28	12 + j35	2.5 − j10

MECHANICAL DATA

Dimensions in mm

FO-41B (see Fig.1).

WARNING

Product and environmental safety — toxic materials

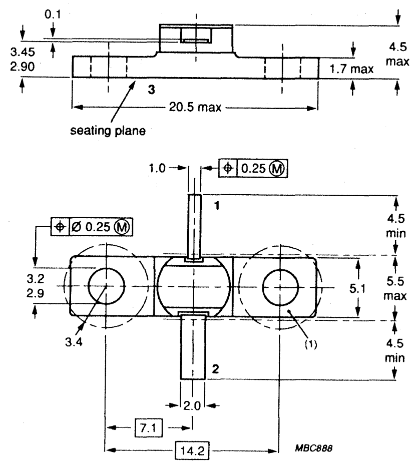
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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 general industrial or domestic waste.

MECHANICAL DATA

Dimensions in mm

Fig.1 FO-41-B.



Base and metallic cap connected to flange

Pinning:

1 = collector
2 = emitter
3 = base

Torque on screw: max. 0.4 Nm

Recommended screw: M2.5 or 4-40 UNC/2A

Marking code: 4203X

(1) Flatness of this area ensures full thermal contact with bolt head.

NPN silicon microwave power transistor

PTC4001T

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 characteristics stability and excellent lifetime
- Multicell geometry gives good balance of dissipated power and low thermal resistance
- 5 GHz technology.

DESCRIPTION

NPN silicon power transistor intended for use in common collector oscillator circuits under CW conditions in military and professional applications up to 5 GHz.The transistor is housed in a FO–41B metal ceramic flange package.

PINNING - FO-41B

PIN	DESCRIPTION
1	base
2	emitter
3	collector connected to flange

QUICK REFERENCE DATA

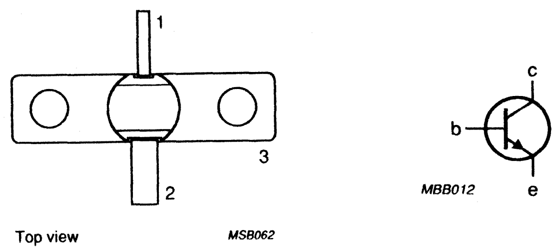
Microwave performance up to T_h = 25 °C in an oscillator circuit up to 3 GHz

MODE OF OPERATION	f (GHz) note 1	V_{CC} (V)	P_L (mW)	I_C (mA)
class A (CW)	2.88 - 3.0	20	≥ 550	200

Note

1. Oscillating frequency should stabilize in this range.

PIN CONFIGURATION



Marking code: 440

Fig.1 Simplified outline and symbol.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	16	V
V_{CER}	collector-emitter voltage	R_{BE} = 70 Ω	–	35	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	average collector current		–	0.25	A
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	4	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	t < 10 s note 1	–	235	°C

Note

1. At 0.1 mm from case.

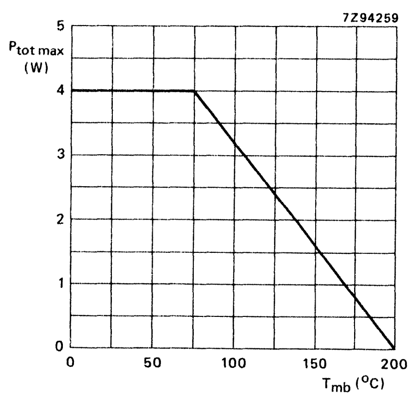
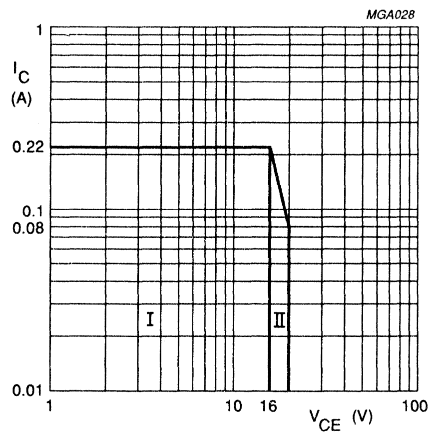


Fig.2 Power derating curve as a function of mounting base temperature.



T_{mb} = 75 °C

(1) Region of permissible DC operation.

(2) Permissible extension provided R_{BE} < 250 Ω.

Fig.3 DC SOAR.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 75 °C	22 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 24 V; I_E = 0	–	100	μA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	–	0.75	μA
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 500 μA; I_E = 0	40	–	V
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = 2.5 mA; R_{BE} = 70 Ω	35	–	V

APPLICATION INFORMATION

Microwave performance up to T_h = 25 °C in a common collector test circuit and working in CW class A.

MODE OF OPERATION	f (GHz) note 1	V_{CC} (V)	P_L (mW)	I_C (mA)
class A (CW)	2.88 - 3.0	20	550 - 750	200

Note

1. Oscillating frequency should stabilize in this frequency range.

MICROWAVE POWER TRANSISTOR

NPN silicon microwave power transistor for use in a common-base, class-B power amplifier up to 4.2 GHz.

Features:

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistor providing excellent current sharing and withstanding a high VSWR
- Local thick oxide and gold sandwich metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance

The transistor is housed in a metal ceramic flange envelope (FO-83).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class-B circuit

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %
class-B; CW	1	24	typ. 13	typ. 11	typ. 60
	2	24	typ. 10	typ. 10	typ. 48
	3	24	typ. 7.5	typ. 8.8	typ. 30
	4	24	typ. 4	typ. 6	typ. 25

MECHANICAL DATA

Dimensions in mm

FO-83 (see Fig. 1).

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.

MECHANICAL DATA

Dimensions in mm

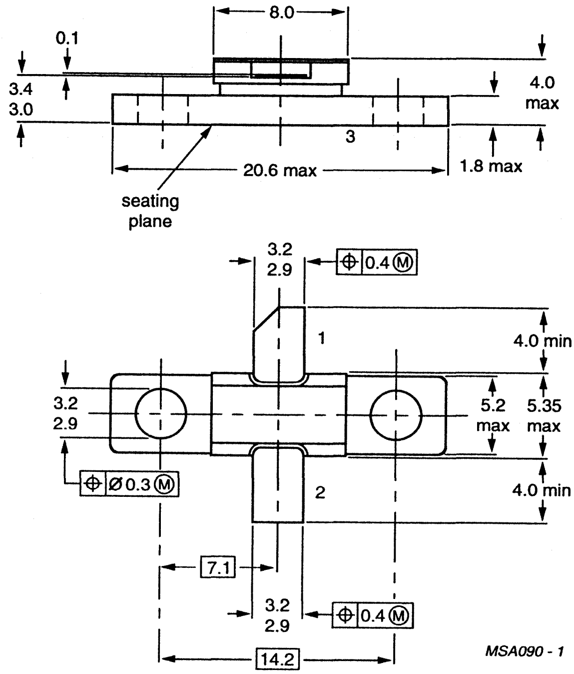
Fig. 1 FO-83.

Base connected to flange.

Pinning:

1 = collector
2 = emitter
3 = base

Torque on nut: 0.4 Nm
Recommended screw: M2.5



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage, open emitter	V_{CBO}	max.	40	V
Collector-emitter voltage				
open base	V_{CEO}	max.	15	V
$R_{BE} = 0$	V_{CES}	max.	40	V
Emitter-base voltage, open collector	V_{EBO}	max.	3.0	V
Collector current (DC)	I_C	max.	1	A
Total power dissipation up to $T_{mb} = 75\ ^oC$	P_{tot}	max.	18	W
Storage temperature	T_{stg}		−65 to 200	^oC
Junction temperature	T_j	max.	200	^oC
Lead soldering temperature at 0.1 mm from the case; $t_{sld} \leq 10$ s	T_{sld}	max.	235	^oC

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	6.5	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7	K/W

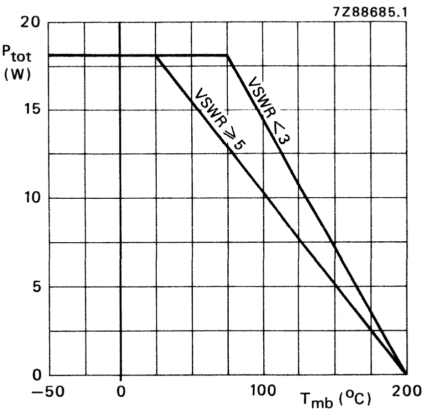


Fig. 2 Power derating curve as a function of mounting base temperature; V_{CE} = 24 V; f > 1 MHz.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage I_C = 30 mA; R_{BE} = 0	$V_{(BR)CES}$	min.	40 V
Collector cut-off current I_E = 0; V_{CB} = 24 V	I_{CBO}	max.	50 mA
Emitter cut-off current I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	1.5 mA
Collector-base capacitance at f = 1 MHz $I_E = I_C$ = 0; V_{CB} = 24 V; V_{EB} = 1.5 V	C_{cb}	typ.	50 pF
Collector-emitter capacitance at f = 1 MHz $I_E = I_C$ = 0; V_{CB} = 24 V; V_{EB} = 1.5 V	C_{ce}	typ.	1.2 pF
Emitter-base capacitance at f = 1 MHz $I_E = I_C$ = 0; V_{CB} = 24 V; V_{EB} = 1 V	C_{eb}	typ.	30 pF

LARGE SIGNAL IMPEDANCES

f GHz	$\overline{z_i}$ Ω	$\overline{Z_L}$ Ω
1	2.3 + j2.8	7.8 + j11.6
2	1.4 + j9.5	3.9 + j2.6
3	4.2 + j21	2.3 − j2.5
4	38 − j32	1.9 − j8.5

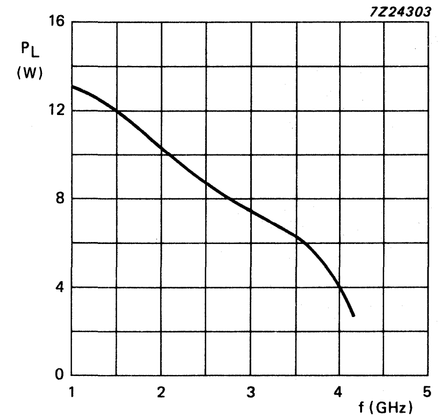


Fig. 3 Load power as a function of frequency.
V_{CC} = 24 V; P_S = 1 W.

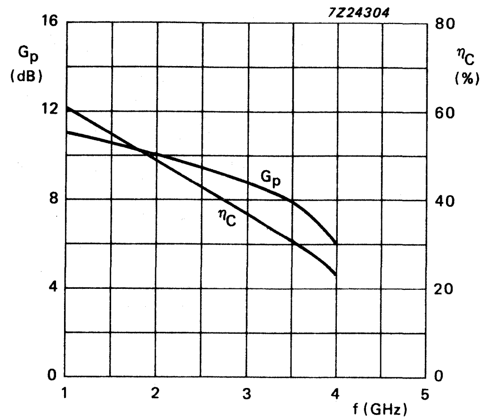


Fig. 4 Power gain and efficiency as a function of frequency. V_{CC} = 24 V; P_S = 1 W.

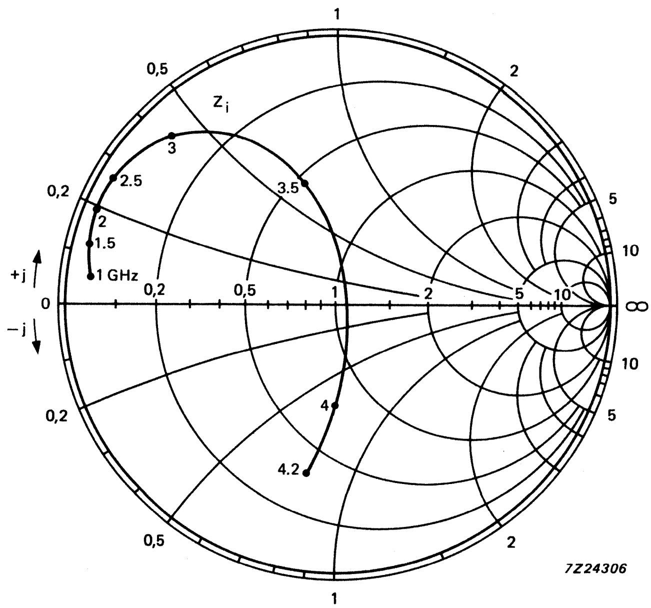


Fig. 5 Input impedance as a function of frequency.
V_{CC} = 24 V; P_S = 1 W; Z_0 = 50 Ω.

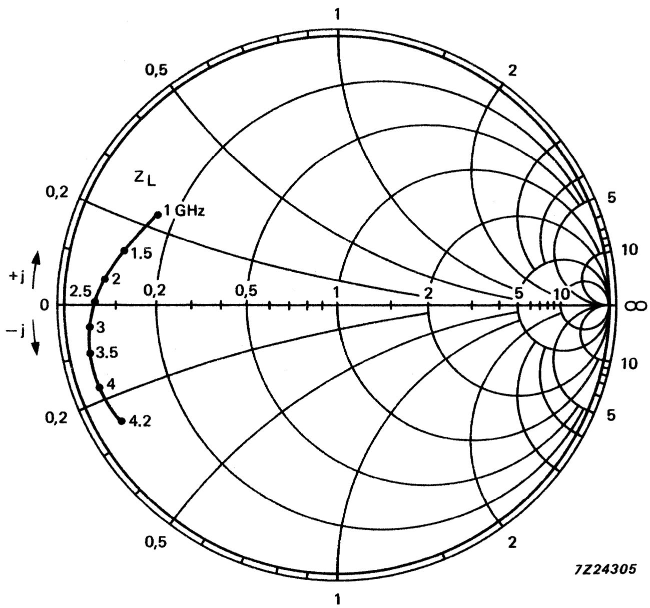


Fig. 6 Output impedance as a function of frequency.
V_{CC} = 24 V; P_S = 1 W; Z_0 = 50 Ω.

Philips Semiconductors

Data sheet	
status	Product specification
date of issue	June 1992

PXB16050U

NPN silicon planar epitaxial microwave power transistor

FEATURES

- Interdigitated structure ; high emitter efficiency
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizes very good stability of the characteristics and excellent life time
- Multicell geometry gives good balance of dissipated power and low thermal resistance
- Input and output matching cells allow an easier design of circuits.

APPLICATION

Intended for use in common-base class C power amplifiers at frequencies from 1.5 to 1.8 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common-base class C power amplifiers at frequencies between 1.5 and 1.8 GHz.

The transistor has a FO-91 metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)	z_i / Z_L (Ω)
class C (CW)	1.65	28	> 45	> 8.5	> 45	see Figs 5 and 6

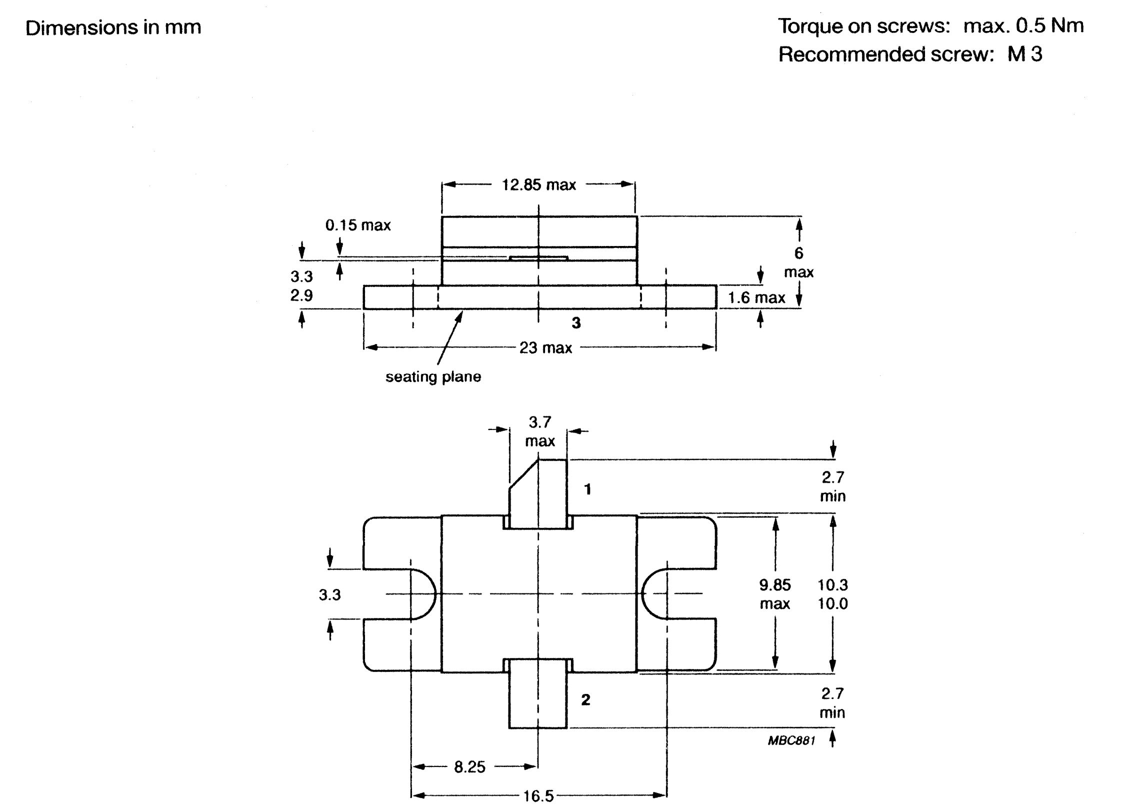
WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.**

NPN silicon planar epitaxial microwave power transistor

PXB16050U

MECHANICAL DATA



Note: Recommended pitch for mounting screws is 19 mm.

Fig.1 FO-91.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base

NPN silicon planar epitaxial microwave power transistor

PXB16050U

LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	45	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current (DC)		–	6	A
P_{tot}	total power dissipation	$T_{mb} = 75$ °C	–	67	W
T_{stg}	storage temperature range		–65	200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s up to 0.2 mm from ceramic	–	235	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	from junction to mounting base	$T_j = 100$ °C	1.5	K/W
$R_{th\ mb\text{-}h}$	from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

$T_{mb} = 25$ °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 40$ V $I_E = 0$	3	mA
I_{CBO}	collector cut-off current	$V_{CB} = 45$ V $I_E = 0$	15	mA
I_{CES}	collector cut-off current	$V_{CE} = 30$ V $R_{BE} = 0\ \Omega$	3	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5$ V $I_C = 0$	300	μA

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25$ °C measured in the common base test circuit as shown in Fig.2 and working in CW class C mode.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)	z_i / Z_L (Ω)
class C (CW) see note 1	1.65	28	≥ 45 typ. 50	≥ 8.5 typ. 9.5	≥ 45 typ. 52	see Figs 5 and 6

Note

Type PXB16050U may be used for narrowband or broadband amplifiers within the frequency range 1.5 to 1.8 GHz. Operation below 1.5 GHz may damage the transistor due to resonance of the internal output prematching circuit.

NPN silicon planar epitaxial microwave power transistor

PXB16050U

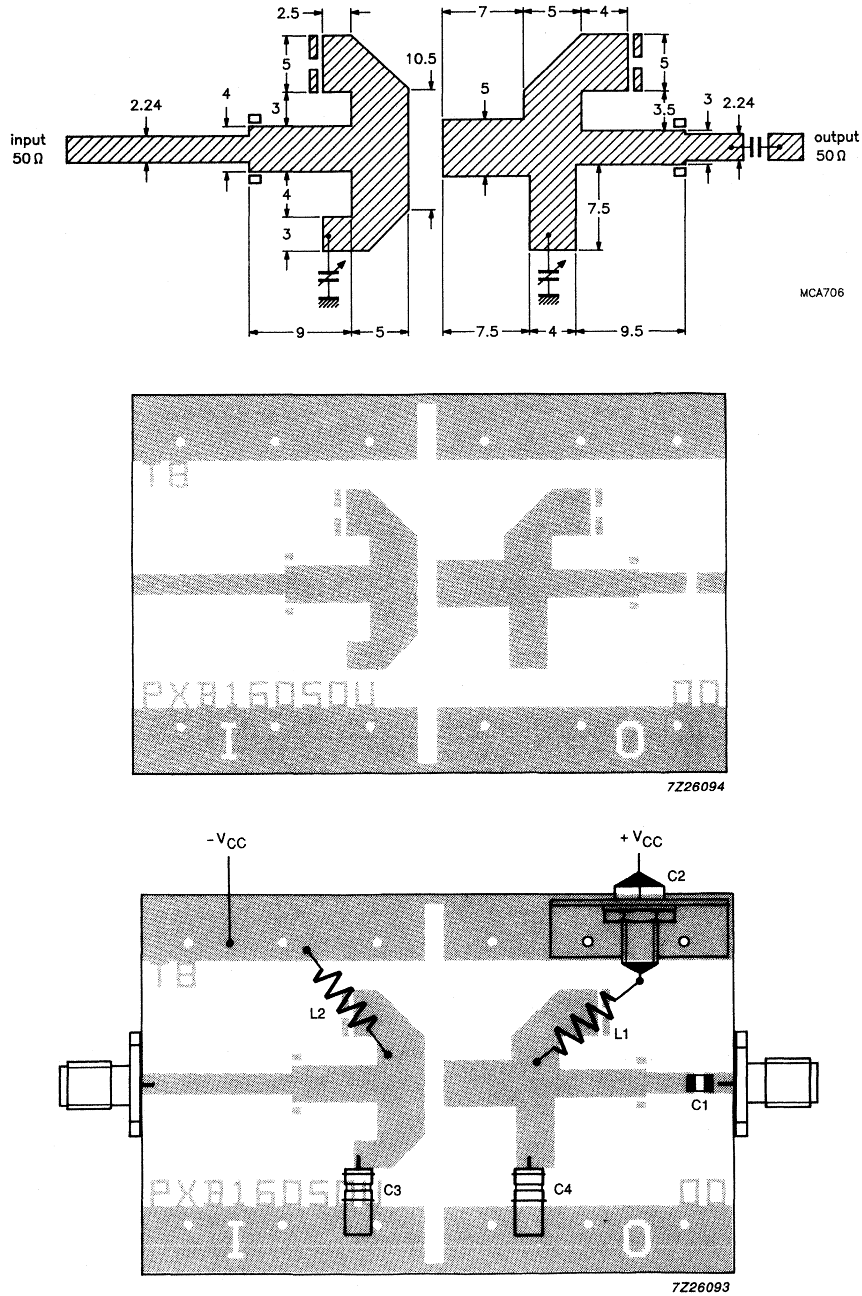


Fig.2 Narrowband test circuit, see note 1.

Note

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

   Substrate : Teflon fibre glass; $\varepsilon = 2.55$; thickness = 0.8 mm.

   C1 DC blocking capacitor: 100 pF (ATC)

   C2 Feedthru bypass capacitor (Erie, 1250-003)

   C3, C4 Trimmer (Tekelec, AT-3-7271SL, 0.6 - 4.5 pF)

   L1 Cu wire ∅ = 0.5 mm; ∅ internal = 2 mm, 4 turns
   L2 Cu wire ∅ = 0.5 mm; ∅ internal = 2 mm, 5 turns

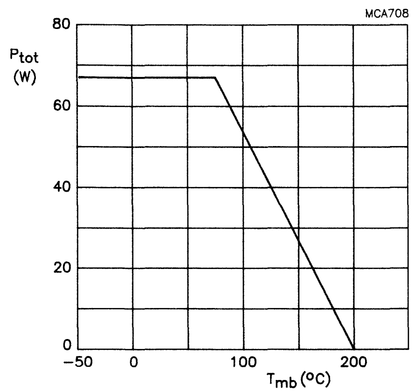


Fig.3 Maximum power dissipation as a function of mounting base temperature; P_{tot} max = 67 W.

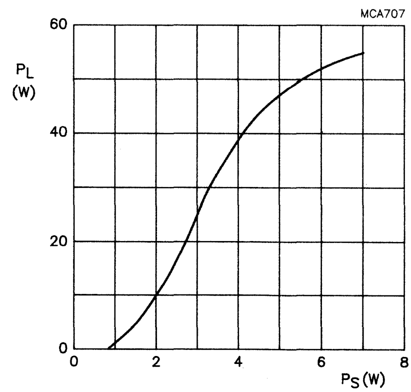


Fig.4 Load power P_L as a function of source power P_S; V_C = 28 V; f = 1.65 GHz.
See narrowband test circuit as shown in Fig.2.

NPN silicon planar epitaxial microwave power transistor

PXB16050U

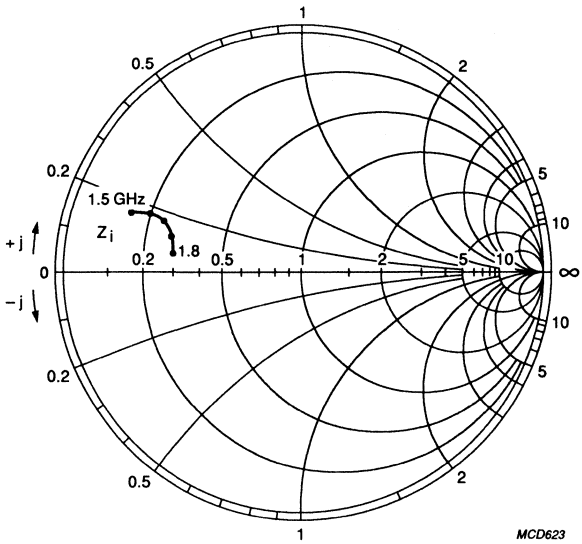


Fig.5 Input impedance as a function of frequency; $Z_o = 10\ \Omega$; $V_{CC} = 28$ V; typical values.

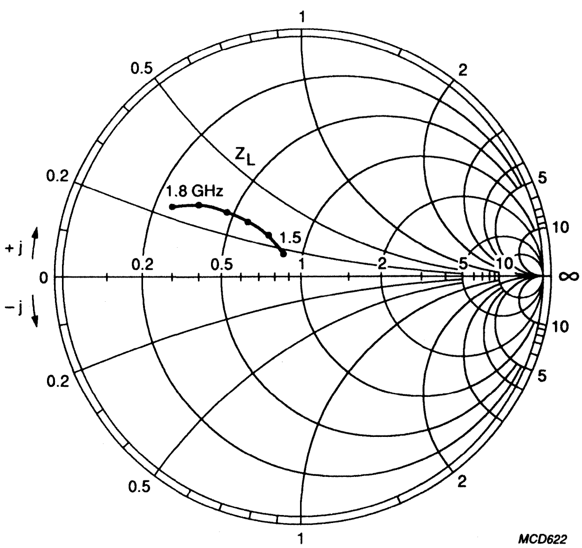


Fig.6 Optimum load impedance as a function of frequency; $Z_o = 10\ \Omega$; $V_{CC} = 28$ V; typical values.

MICROWAVE POWER TRANSISTORS FOR BROADBAND AMPLIFIERS

NPN transistors for use in common-base, class-B, wideband amplifiers under CW conditions in military and professional applications and intended to drive PZ1418B30U/PZ1721B25U/PZ2024B20U family.

Features

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and an excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- 5 GHz technology

The transistors are housed in a ceramic flange envelope (FO-57C).

Internal input and output prematching ensures good stability and easy broadband use.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class-B wideband amplifier

type number	f GHz	V_{CC} V	P_L W	G_P dB	η_C %	z_i Ω	Z_L Ω
PZ1418B15U	1.4 to 1.8	28	≥ 12.5	≥ 7	≥ 38	see Fig. 6	see Fig. 7
PZ1721B12U	1.7 to 2.1	28	≥ 12	≥ 6.8	≥ 35	see Fig. 11	see Fig. 12
PZ2024B10U	2.0 to 2.4	28	≥ 9	≥ 5.6	≥ 30	see Fig. 16	see Fig. 17

MECHANICAL DATA

Dimensions in mm

FO-57C (see Fig. 1)

WARNING

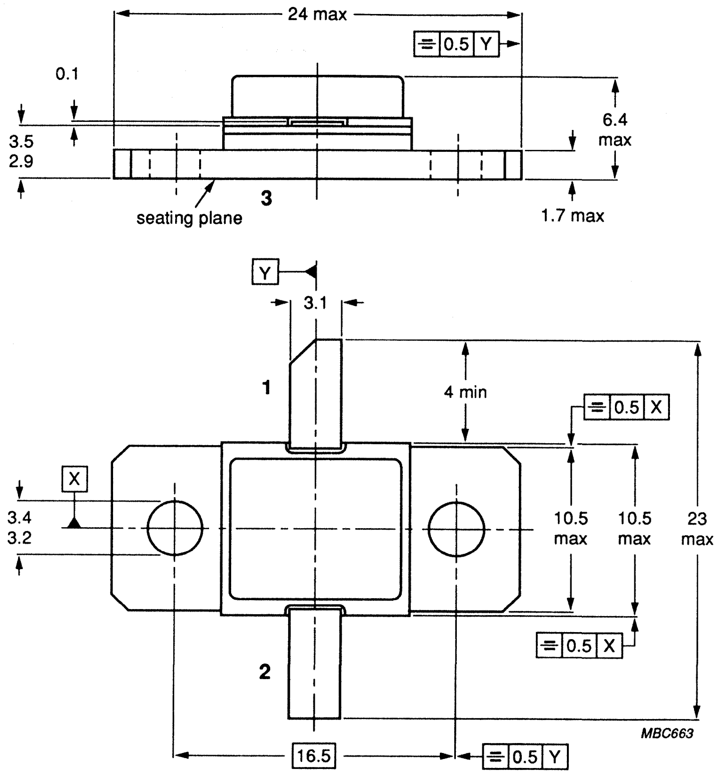
Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.

Fig. 1 FO-57C.

Torque on screw: max. 0,5 Nm
Recommended screw: M3



Pinning

1 = collector
2 = emitter
3 = base

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage			
open emitter	V_{CBO}	max.	40 V
Collector-emitter voltage			
$R_{BE} = 0$	V_{CES}	max.	35 V
open base	V_{CEO}	max.	15 V
Emitter-base voltage			
open collector	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	2 A
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	27 W
Storage temperature	T_{stg}	−65 to	+ 200 °C
Junction temperature	T_j	max.	+ 200 °C
Lead soldering temperature	T_{sld}	max.	+ 235 °C

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\,j\text{-}mb}$	max.	4 K/W
From mounting base to heatsink	$R_{th\,mb\text{-}h}$	max.	0.2 K/W

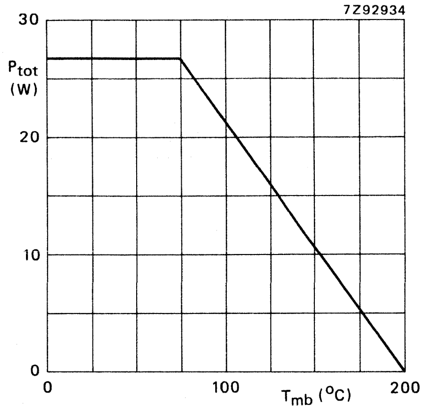


Fig. 2 Power derating curve as a function of mounting base temperature.

CHARACTERISTICS

T_{mb} = 25 °C

Collector cut-off current				
$I_E = 0$; $V_{CB} = 30$ V	I_{CBO}	max.	2.5	mA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	max.	5	mA
$R_{BE} = 0$; $V_{CE} = 35$ V	I_{CES}	max.	25	mA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	100	μA

APPLICATION INFORMATION (type PZ1418B15U)

Microwave performance up to T_{mb} = 25 °C in a common-base class-B wideband amplifier

type number	f GHz	V_{CC} V	P_L W	G_P dB	η_C %	z_i Ω	Z_L Ω
PZ1418B15U	1.4 to 1.8	28	⩾ 12.5 typ. 15	⩾ 7 typ. 7.8	⩾ 38 typ. 45	see Fig.6	see Fig.7

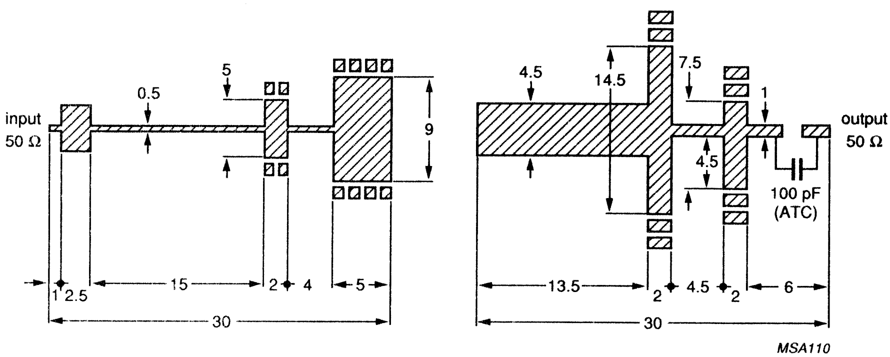


Fig. 3 Wideband test circuit boards for 1.4 to 1.8 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; ϵ_r = 10.

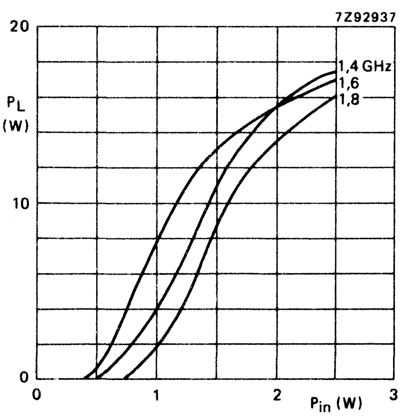


Fig. 4 Load power as a function of input power; typical values.

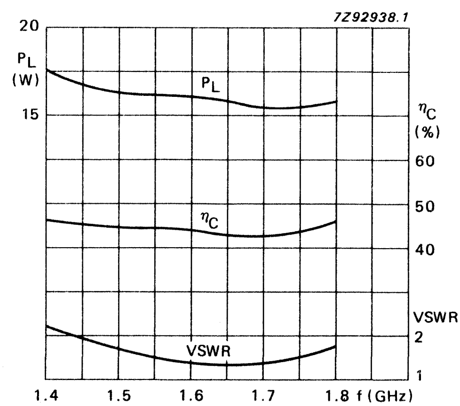


Fig. 5 Load power, efficiency and VSWR as a function of frequency; typical values; P_{in} = 2.5 W.

Conditions for Figs 4 and 5:

V_{CC} = 28 V; class-B operation; T_{mb} = 25 °C.

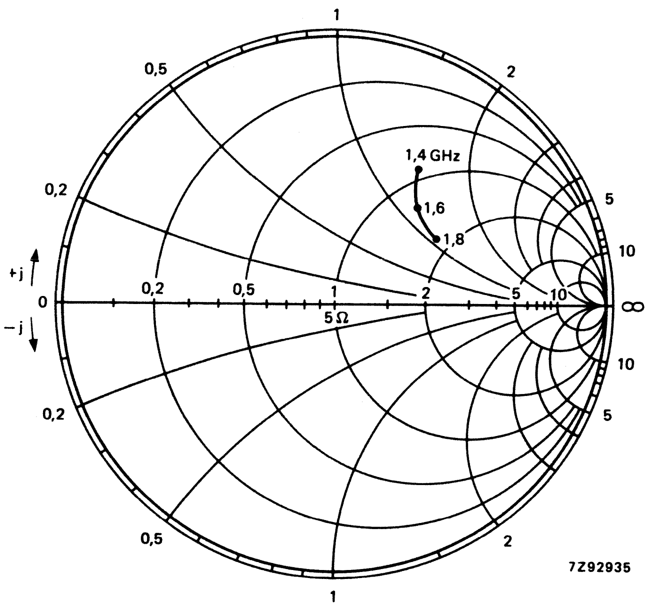


Fig. 6 Input impedance as a function of frequency; typical values; Z_O = 5 Ω.

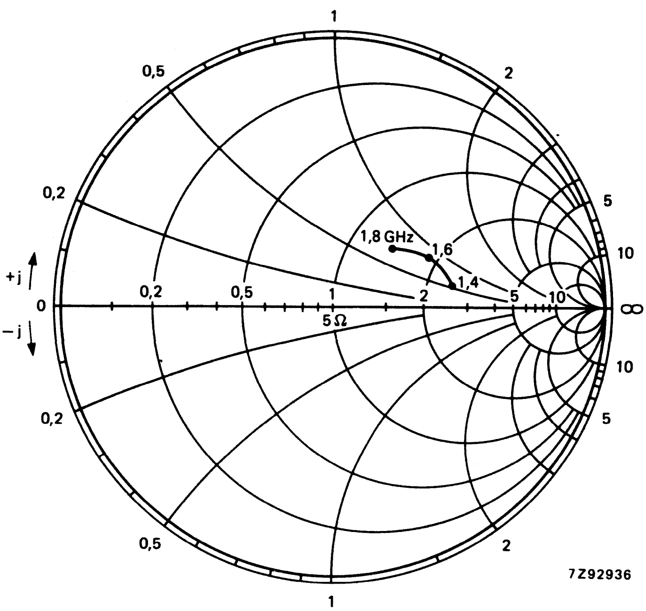


Fig. 7 Optimum load impedance as a function of frequency; typical values; Z_O = 5 Ω.

MICROWAVE POWER TRANSISTORS FOR WIDEBAND AMPLIFIERS

NPN transistors for use in common-base, class-B, broadband amplifiers under CW conditions in military and professional applications.

Features

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Gold metallization realising a very good stability of the characteristics and an excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- 5 GHz technology

The transistors are housed in a ceramic flange envelope.

Internal input and output prematching ensures good stability and easy broadband use.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class-B wideband amplifier

type number	f GHz	V_{CC} V	P_L W	G_P dB	η_C %	z_i Ω	Z_L Ω
PZ1418B30U	1.4 to 1.8	28	$\geqslant 27$	$\geqslant 7.3$	$\geqslant 38$	see Fig. 6	see Fig. 7
PZ1721B25U	1.7 to 2.1	28	$\geqslant 25$	$\geqslant 7$	$\geqslant 35$	see Fig. 11	see Fig. 12
PZ2024B20U	2.0 to 2.4	28	$\geqslant 20$	$\geqslant 6$	$\geqslant 35$	see Fig. 16	see Fig. 17

MECHANICAL DATA

Dimensions in mm

FO-57C (see Fig. 1)

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

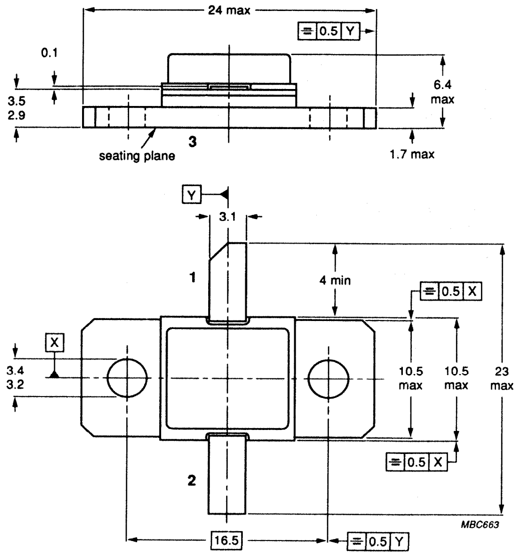
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

Fig. 1 FO-57C.

Torque on screw: max. 0.5 Nm
Recommended screw: M3

Pinning:

1 = collector
2 = emitter
3 = base



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage open emitter	V_{CBO}	max.	40	V
Collector-emitter voltage $R_{BE} = 0$	V_{CES}	max.	35	V
open base	V_{CEO}	max.	15	V
Emitter-base voltage open collector	V_{EBO}	max.	3	V
Collector current (DC)	I_C	max.	4	A
Total power dissipation up to $T_{mb} = 75\ ^oC$	P_{tot}	max.	45	W
Storage temperature	T_{stg}	−65 to	+ 200	^oC
Junction temperature	T_j	max.	+ 200	^oC
Lead soldering temperature	T_{sld}	max.	+ 235	^oC

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	2.2	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2	K/W

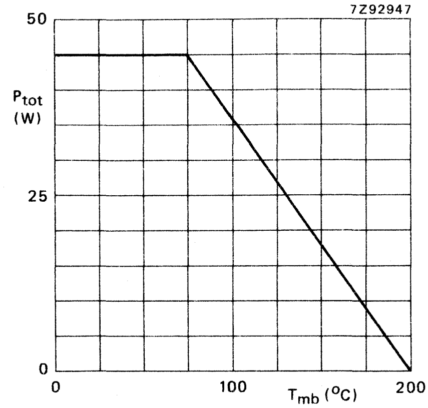


Fig.2 Power derating curve as a function of mounting base temperature.

CHARACTERISTICS

T_{mb} = 25 °C

Collector cut-off current

I_E = 0; V_{CB} = 30 V	I_{CBO}	max.	5	mA
I_E = 0; V_{CB} = 40 V	I_{CBO}	max.	10	mA
R_{BE} = 0; V_{CE} = 35 V	I_{CES}	max.	50	mA

Emitter cut-off current

I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	200	μA

APPLICATION INFORMATION (type PZ1418B30U)

Microwave performance up to T_{mb} = 25 °C in an unneutralized common-base class-B wideband amplifier.

type number	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
PZ1418B30U	1.4 to 1.8	28	≥ 27 typ. 35	≥ 7.3 typ. 8.4	≥ 38 typ. 45	see Fig.6	see Fig.7

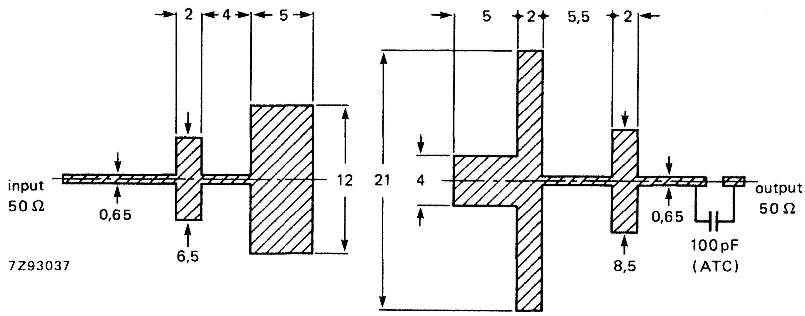


Fig. 3 Wideband test circuit boards for 1.4 to 1.8 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; ϵ_r = 10.

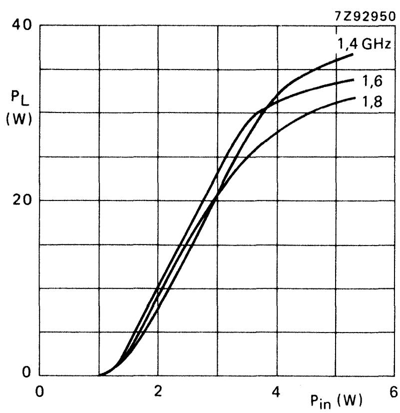


Fig. 4 Load power as a function of input power; typical values.

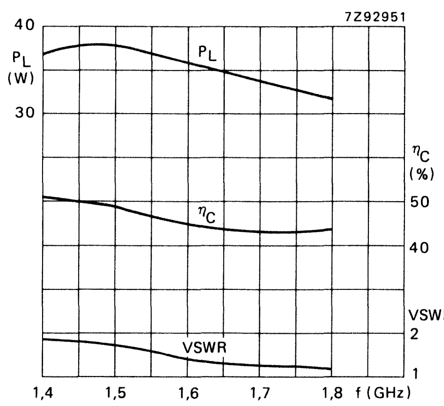


Fig.5 Load power, efficiency and VSWR as a function of frequency; typical values; P_{in} = 5 W.

Conditions for Figs 4 and 5:

V_{CC} = 28 V; class-B operation; T_{mb} = 25 °C.

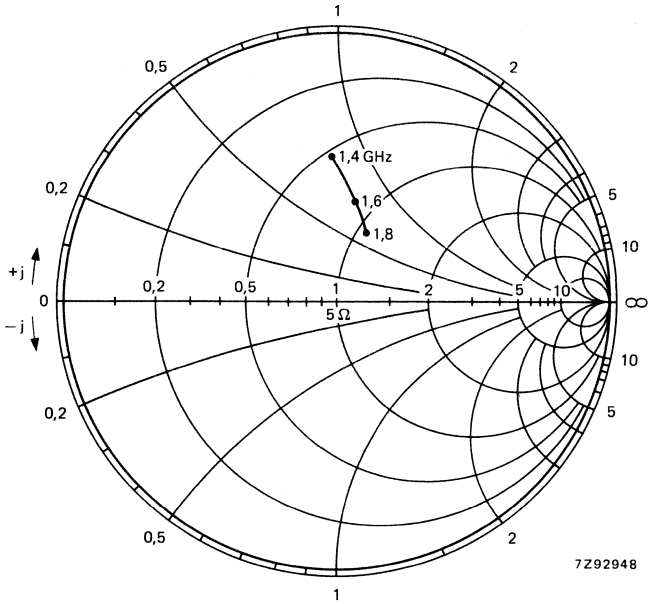


Fig. 6 Input impedance as a function of frequency; typical values; Z_O = 5 Ω.

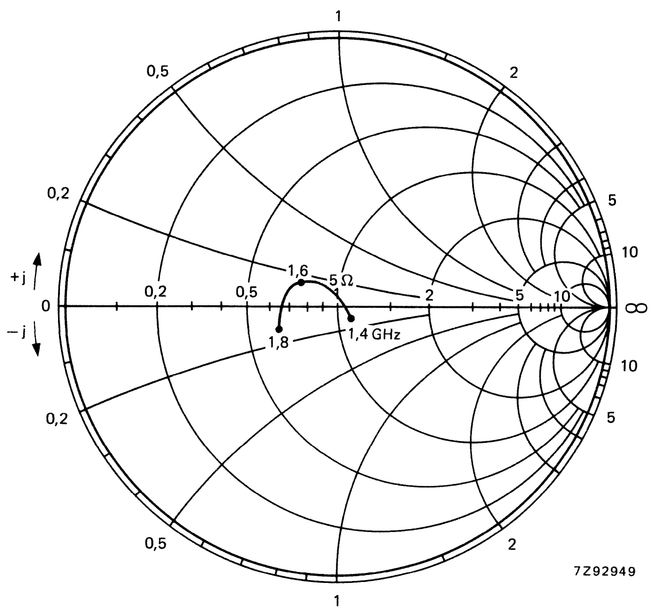


Fig. 7 Optimum load impedance as a function of frequency; typical values; Z_O = 5 Ω.

APPLICATION INFORMATION (type PZ1721B25U)

Microwave performance up to T_{mb} = 25 °C in an unneutralized common-base class-B wideband amplifier.

type number	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
PZ1721B25U	1.7 to 2.1	28	⩾ 25 typ. 30	⩾ 7 typ. 7.8	⩾ 35 typ. 44	see Fig.11	see Fig.12

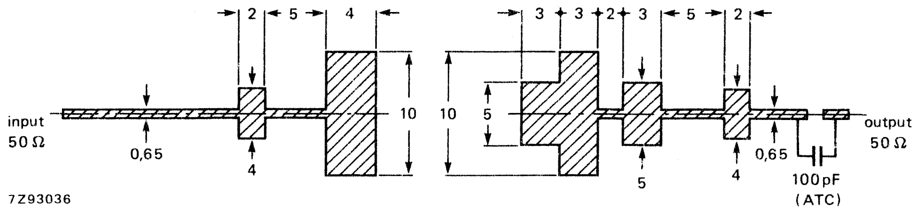


Fig. 8 Wideband test circuit boards for 1.7 to 2.1 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; ϵ_r = 10.

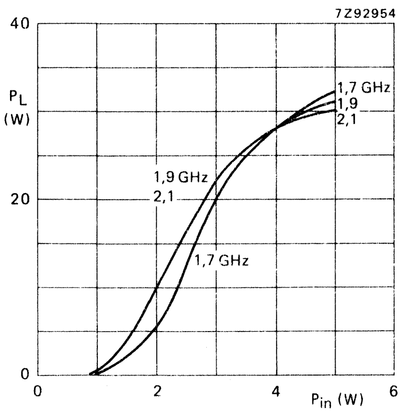


Fig. 9 Load power as a function of input power; typical values.

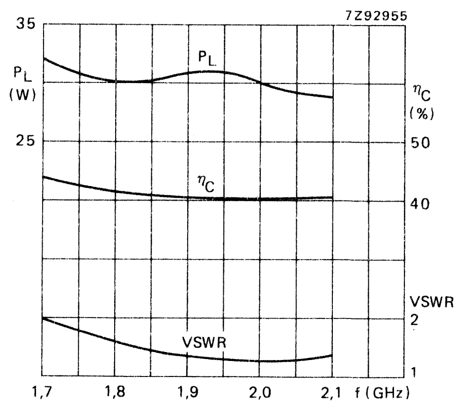


Fig. 10 Load power, efficiency and VSWR as a function of frequency; typical values; P_{in} = 5 W.

Conditions for Figs 9 and 10:

V_{CC} = 28 V; class-B operation; T_{mb} = 25 °C.

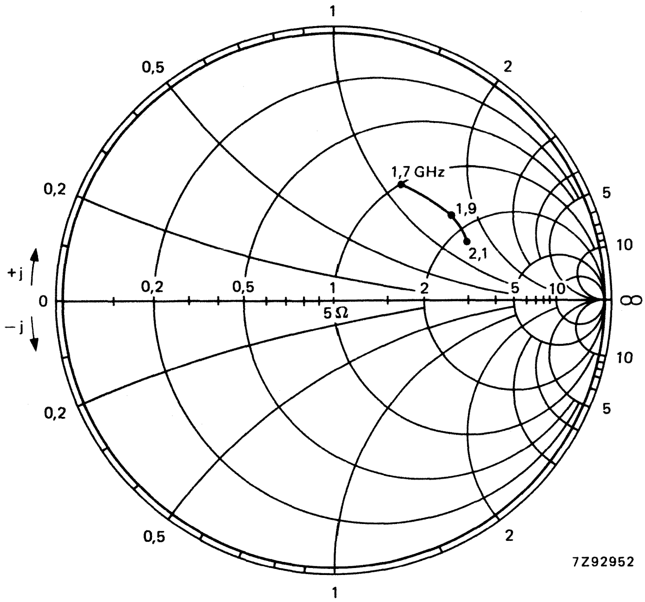


Fig. 11 Input impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

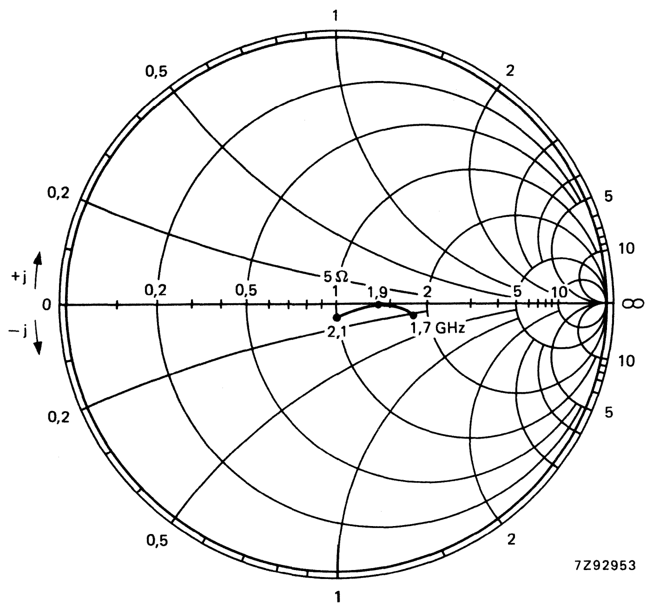


Fig. 12 Optimum load impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

APPLICATION INFORMATION (type PZ2024B20U)

Microwave performance up to T_{mb} = 25 °C in an unneutralized common-base class-B wideband amplifier.

type number	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
PZ2024B20U	2.0 to 2.4	28	⩾ 20 typ. 26	⩾ 6 typ. 7	⩾ 35 typ. 42	see Fig.16	see Fig.17

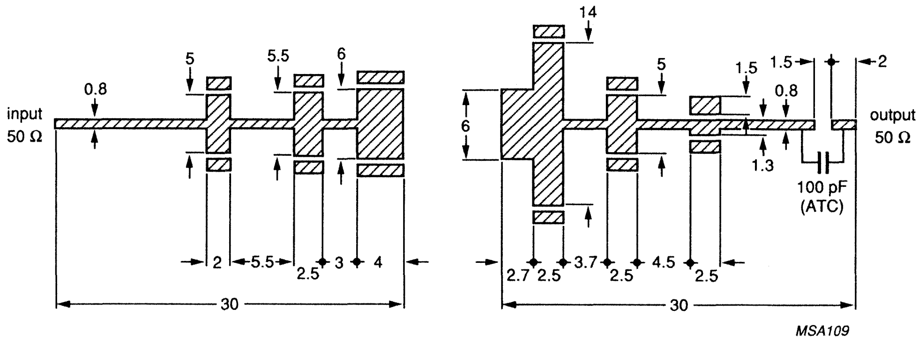


Fig. 13 Wideband test circuit boards for 2.0 to 2.4 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; ϵ_r = 10.

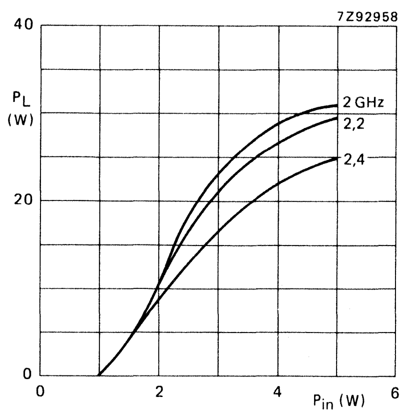


Fig. 14 Load power as a function of input power; typical values.

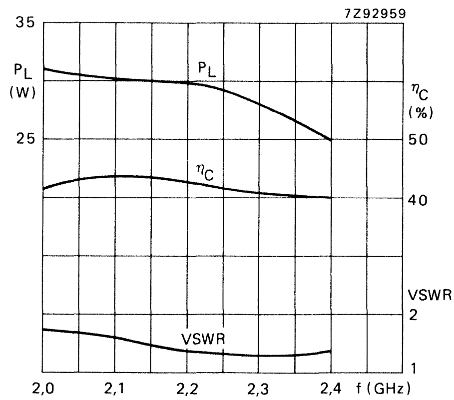


Fig. 15 Load power, efficiency and VSWR as a function of frequency; typical values; P_{in} = 5 W.

Conditions for Figs 14 and 15:

V_{CC} = 28 V; class-B operation; T_{mb} = 25 °C.

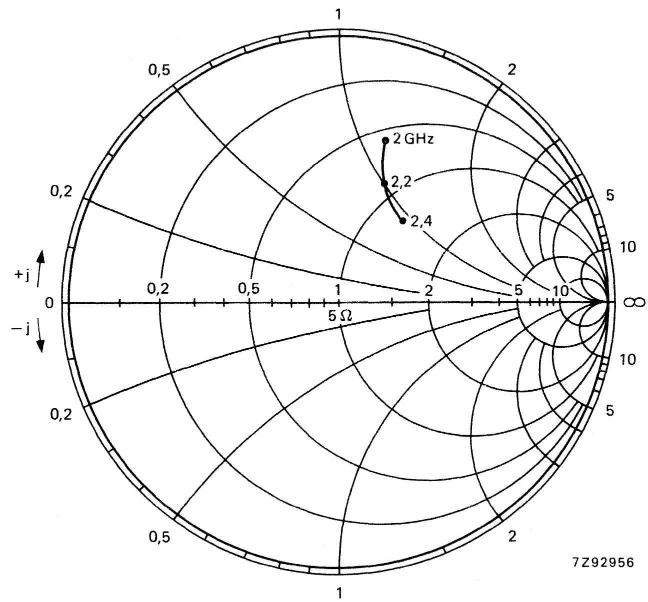


Fig. 16 Input impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

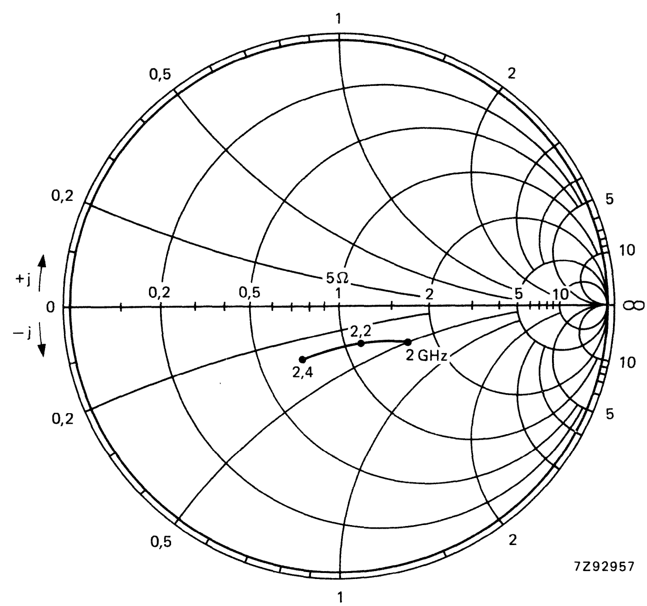


Fig. 17 Optimum load impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

MICROWAVE POWER TRANSISTOR

NPN silicon epitaxial microwave power transistor, intended for use in a common-base, class-C broad-band power amplifier, operating in the 2.3 to 2.7 GHz frequency range.

Features

- Interdigitated structure; giving a high emitter efficiency
- Diffused emitter ballasting resistors; capable of withstanding a high VSWR and providing excellent current sharing
- Gold metallization; ensuring excellent stability of the characteristics and giving a prolonged working life
- Multicell geometry; giving good balance of dissipated power and low thermal resistance
- Internal input and output matching cells; simplifying circuit design

The transistor is housed in a metal-ceramic flange envelope (FO-57D).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class-C broadband amplifier.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i; Z_L Ω
class-C; CW	2.3 to 2.7	28	≥ 15	≥ 7	≥ 40	see Figs 6 and 7

MECHANICAL DATA

FO-57D (see Fig. 1).

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

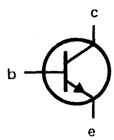
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

MECHANICAL DATA

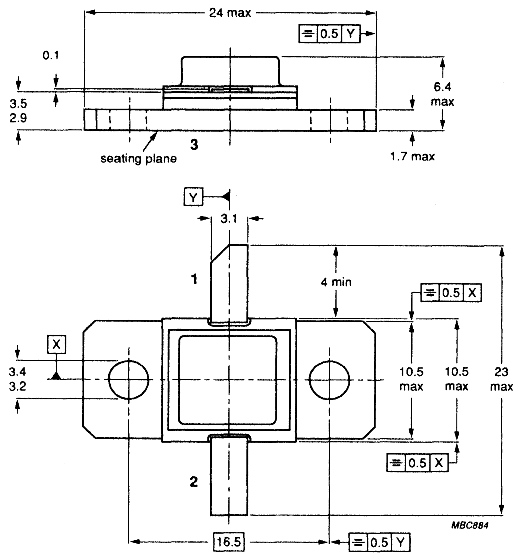
Dimensions in mm

Fig. 1 FO-57D.

Pinning
1 = collector
2 = emitter
3 = base



Base is connected to the seating plane



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage; open emitter	V_{CBO}	max.	40	V
Collector-emitter voltage; $R_{BE} = 0$	V_{CES}	max.	30	V
Collector-emitter voltage; open base	V_{CEO}	max.	15	V
Emitter-base voltage; open collector	V_{EBO}	max.	3.0	V
Collector current (DC)	I_C	max.	2.1	A
Total power dissipation at $T_{mb} \leqslant 75$ °C	P_{tot}	max.	32	W
Storage temperature range	T_{stg}	−65 to + 200		°C
Operating junction temperature	T_j	max.	200	°C
Soldering temperature at 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	°C

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\,j\text{-}mb}$	max.	4	K/W
From mounting base to heatsink	$R_{th\,mb\text{-}h}$	max.	0.2	K/W

MICROWAVE POWER TRANSISTORS

NPN transistor for use in common-base, class-B, amplifier under CW conditions in military and professional applications up to 1.6 GHz.

Features

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and an excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- 5 GHz technology

The transistor is housed in a ceramic flange envelope (FO-57C).

An input matching cell improves the input impedance and allows an easier design of wideband circuits.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class-B selective amplifier.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
CW; class-B	1.55	28	⩾ 35	⩾ 8	⩾ 45	2 + j4.5 typ. value	1.5 + j0 typ. value

MECHANICAL DATA

FO-57C (see Fig.1).

WARNING

Product and environmental safety — toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.**

Fig. 1 FO-57C.

Dimensions in mm

Torque on nut: max. 0.5 Nm

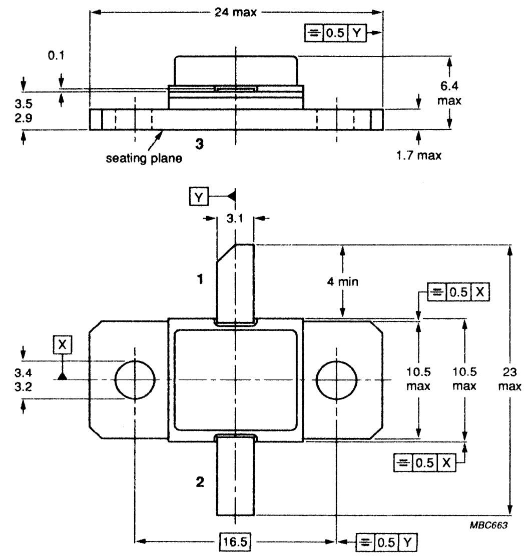
Recommended screw: M3

Pinning:

1 = collector

2 = emitter

3 = base



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage open emitter	V_{CBO}	max.	40 V
Collector-emitter voltage $R_{BE} = 0$	V_{CES}	max.	35 V
open base	V_{CEO}	max.	15 V
Emitter-base voltage open collector	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	4 A
Total power dissipation up to $T_{mb} = 75\ ^oC$	P_{tot}	max.	45 W
Storage temperature	T_{stg}	−65 to	+ 200 ^oC
Junction temperature	T_j	max.	+ 200 ^oC
Lead soldering temperature > 0.2 mm from flange; $t_{sld} < 10$ s	T_{sld}	max.	+ 235 ^oC

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	2.2 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2 K/W

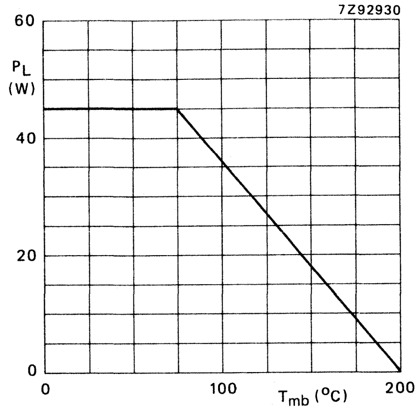


Fig.2 Power derating curve as a function of mounting base temperature.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off currents				
V_{CB} = 40 V; I_E = 0	I_{CBO}	max.	10	mA
V_{CB} = 30 V; I_E = 0	I_{CBO}	max.	5	mA
V_{CER} = 35 V; R_{BE} = 0	I_{CES}	max.	50	mA
Emitter cut-off currents				
V_{EB} = 1.5 V; I_C = 0	I_{EBO}	max.	200	μA
Collector-base capacitance				
I_E = I_C = 0; V_{CB} = 28 V	C_{cb}	typ.	17	pF

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-base class-B selective amplifier.*

mode of operation	f GHz	V_{CC} V	P_L W	G_P dB	η_C %	z_i Ω	Z_L Ω
C.W. class-B	1,55	28	> 35 typ. 38	> 8 typ. 9.8	> 45 typ. 50	2 + j4.5 typ. value	1.5 + j0 typ. value

* Amplifier consists of pre-matching test circuit with complementary input and output slug tuners.

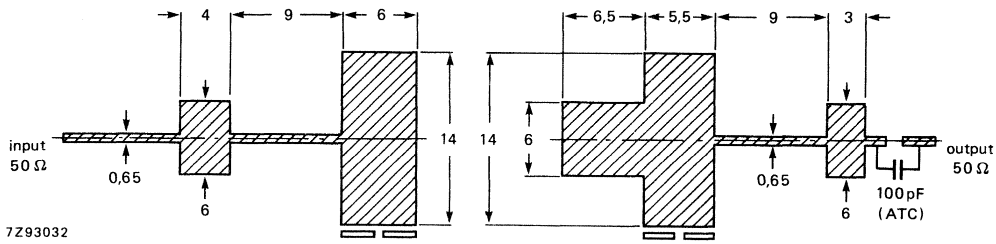


Fig. 3 Prematching test circuit boards, CW, class-B at 1.55 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.65 mm; ϵ_r = 10.

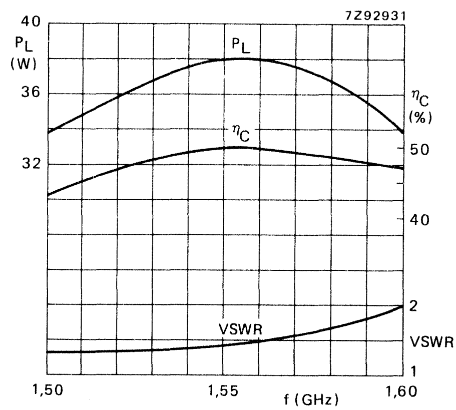


Fig. 4 Load power, efficiency and VSWR as a function of frequency; V_{CE} = 28 V; T_{mb} = 25 °C; class-B operation; typical values.

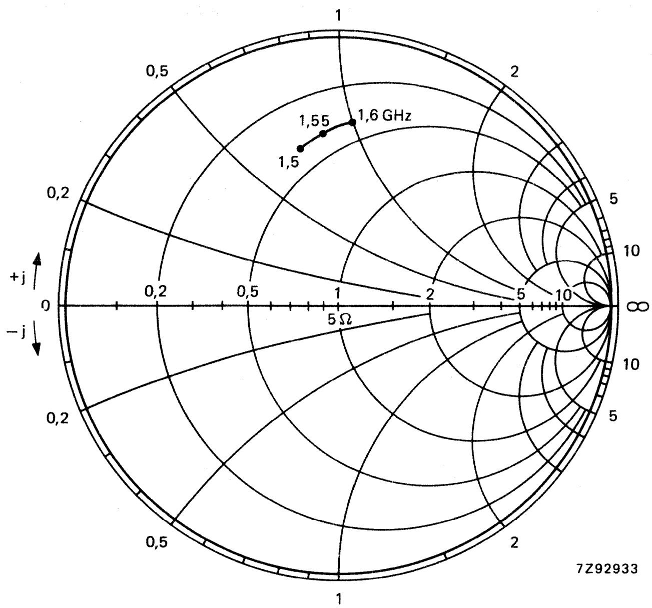


Fig. 5 Input impedance as a function of frequency;
P_L = 38 W; Z_O = 5 Ω; typical values.

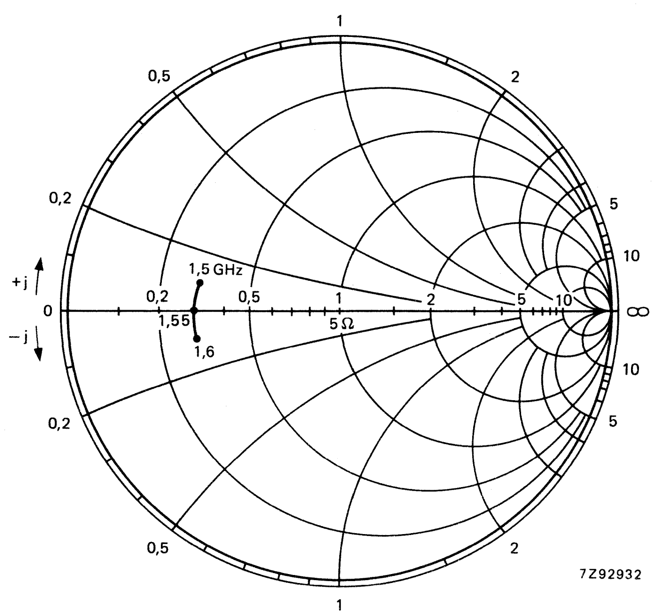


Fig. 6 Optimum load impedance as a function of frequency;
P_L = 38 W; Z_O = 5 Ω; typical values.

NPN silicon planar epitaxial microwave power transistor

RN2731B110W

FEATURES

- Suitable for short and medium pulse applications up to 100 μs pulse width, 10% duty factor
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very stable characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance
- Internal input and output prematching networks allow an easier design of circuits.

APPLICATION

Intended for use in common base, class C, broadband, pulsed power amplifiers in CW conditions for radar applications between 2.7 GHz and 3.1 GHz.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 100μs; δ = 10%	2.7 to 3.1	40	typ. 110	typ. 7.5	typ. 40

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

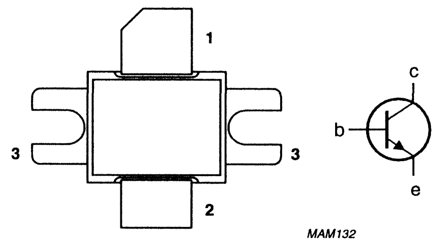


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

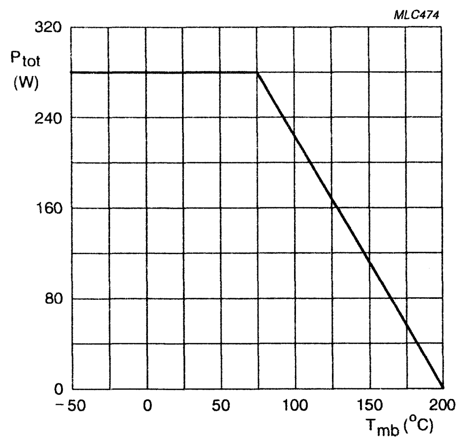
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{CES}	collector-emitter voltage	$R_{BE} = o$	–	50	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_{CM}	peak collector current	$t_p = 100 \mu s$; $\delta = 10\%$	–	12	A
P_{tot}	total power dissipation	$T_{mb} = 75\ °C$; $t_p = 100 \mu s$; $\delta = 10\%$	–	280	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p = 100\ \mu s$; $\delta = 10\%$.

Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	TYP.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_j = 84\ °C$	0.98	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	$t_p = 100 \mu s$; $\delta = 10\%$; note1	0.3	K/W

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

CHARACTERISTICS

$T_{mb} = 25\ °C$ unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 40$ V	–	6	mA
I_{CES}	collector cut-off current	$V_{BE} = 0$; $V_{CE} = 40$ V	–	6	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5$ V; $I_C = 0$	–	0.9	mA
$V_{(BR)CES}$	collector-emitter breakdown voltage	$I_C = 15$ mA; $V_{BE} = 0$	55	–	V
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 15$ mA	55	–	V

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\ °C$ in a common base class C test circuit.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	$t_p = 100 \mu s$; $\delta = 10\%$	2.7 to 3.1	40	typ. 110	typ. 7.5	typ. 40

NPN silicon planar epitaxial microwave power transistor

RN3034B80W

FEATURES

- Suitable for short and medium pulse application up to 100 µs pulse width, 10% duty factor.
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very stable characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance
- Internal input and output prematching networks allow an easier design of circuits.

APPLICATIONS

Intended for use in common base class C broadband pulsed power amplifiers for radar applications in the 3 to 3.4 GHz band.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 100 µs; δ = 10%	3 to 3.4	40	typ. 80	typ. 6.5	typ. 35

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

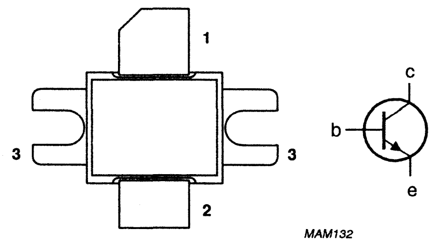


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

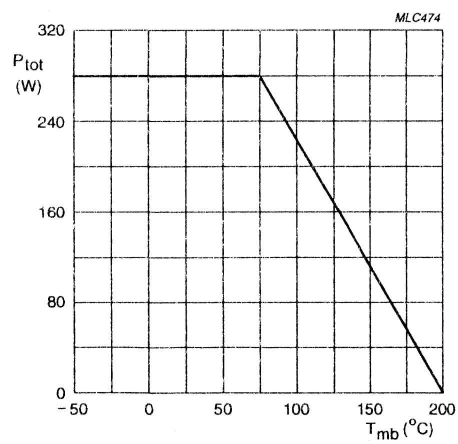
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_{CM}	peak collector current	$t_p = 100\ \mu s$; $\delta = 10\%$	–	10.5	A
P_{tot}	total power dissipation	$T_{mb} < 75\ °C$; $t_p \leq 100\ \mu s$; $\delta \leq 10\%$	–	280	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p = 100\ \mu s$; $\delta = 10\%$.

Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	TYP.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 84 °C	0.98	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W
$Z_{th\ j\text{-}h}$	thermal impedance from junction to heatsink	t_p = 100 µs; δ = 10%; note 1	0.3	K/W

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 40 V	–	6	mA
I_{CES}	collector cut-off current	V_{BE} = 0; V_{CE} = 40 V	–	6	mA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 1.5 V	–	0.9	mA
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 30 mA	55	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 30 mA; V_{BE} = 0	55	–	V

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-base test circuit.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 100 µs; δ = 10%	3 to 3.4	36 to 40	typ. 70	typ. 6.5	typ. 35

NPN silicon planar epitaxial microwave power transistor

RO2731B10W

FEATURES

- Suitable for short and medium pulse application up to 100 µs pulse width, 10% duty factor
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very stable characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance
- Internal input and output prematching networks allow an easier design of circuits.

APPLICATIONS

Intended for use in common-base class C broadband pulsed power amplifiers for radar applications in the 2.7 to 3.1 GHz band.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 100 µs; δ = 10%	2.7 to 3.1	40	typ. 12.5	typ. 7.5	typ. 40

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

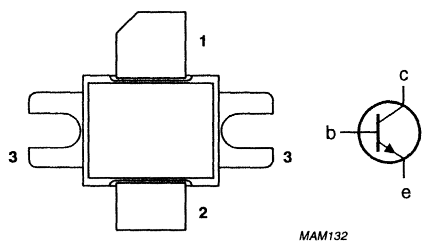


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

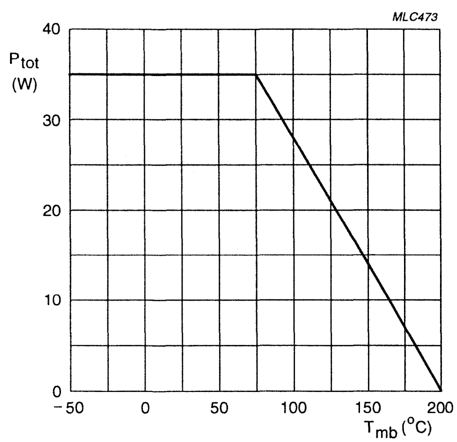
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_{CM}	peak collector current	$t_p = 100\ \mu s$; $\delta = 10\%$	–	1.4	A
P_{tot}	total power dissipation	$T_{mb} < 75$ °C; $t_p \leq 100\ \mu s$; $\delta \leq 10\%$	–	35	W
T_{stg}	storage temperature		−65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p = 100\ \mu s$; $\delta = 10$ %.

Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	TYP.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_j = 93$ °C	6.7	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W
$Z_{th\ j\text{-}h}$	thermal impedance from junction to heatsink	$t_p = 100\ \mu s$; $\delta = 10\%$; note 1	2.46	K/W

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

CHARACTERISTICS

$T_{mb} = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 40$ V	–	0.5	mA
I_{CES}	collector cut-off current	$V_{BE} = 0$; $V_{CE} = 40$ V	–	0.5	mA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 1.5$ V	–	75	μA
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 2.5$ mA	55	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	$I_C = 2.5$ mA; $V_{BE} = 0$	55	–	V

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25$ °C in a common-base test circuit.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	$t_p = 100\ \mu s$; $\delta = 10\%$	2.7 to 3.1	40	typ. 12.5	typ. 7.5	typ. 40

NPN silicon planar epitaxial microwave power transistor

RO2731B20W

FEATURES

- Suitable for short and medium pulse application up to 100 μs pulse width, 10% duty factor
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very stable characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance
- Internal input and output prematching networks allow an easier design of circuits.

APPLICATIONS

Intended for use in common-base class C broadband pulsed power amplifiers for radar applications in the 2.7 to 3.1 GHz band.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 100 μs; δ = 10%	2.7 to 3.1	40	typ. 25	typ. 7.5	typ. 40

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

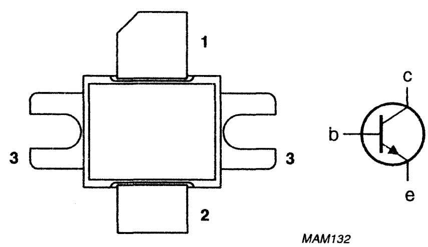


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

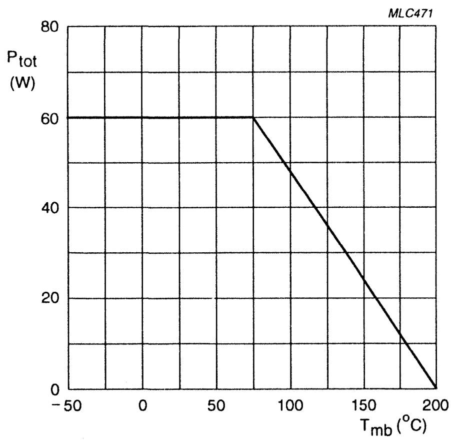
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_{CM}	peak collector current	$t_p = 100\ \mu s$; $\delta = 10\%$	–	2.7	A
P_{tot}	total power dissipation	$T_{mb} < 75\ °C$; $t_p \leq 100\ \mu s$; $\delta \leq 10\%$	–	60	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p = 100\ \mu s$; $\delta = 10\%$.

Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	TYP.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 90 °C	4.16	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W
$Z_{th\ j\text{-}h}$	thermal impedance from junction to heatsink	t_p = 100 µs; δ = 10%; note 1	1.44	K/W

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 40 V	–	1	mA
I_{CES}	collector cut-off current	V_{BE} = 0; V_{CE} = 40 V	–	1	mA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 1.5 V	–	0.15	mA
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 2.5 mA	55	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 2.5 mA; V_{BE} = 0	55	–	V

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-base test circuit.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 100 µs; δ = 10%	2.7 to 3.1	40	typ. 25	typ. 7.5	typ. 40

NPN silicon planar epitaxial microwave power transistor

RO2731B50W

FEATURES

- Suitable for short and medium pulse application up to 100 μs pulse width, 10% duty factor
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very stable characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance
- Internal input and output prematching networks allow an easier design of circuits.

APPLICATIONS

Intended for use in common-base class C broadband pulsed power amplifiers for radar applications in the 2.7 to 3.1 GHz band.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 100 μs; δ = 10%	2.7 to 3.1	40	typ. 60	typ. 7.5	typ. 40

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

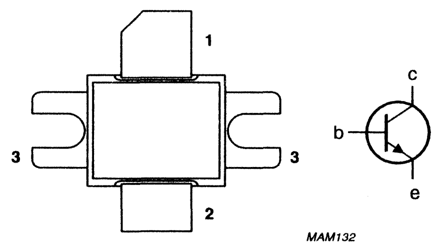


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

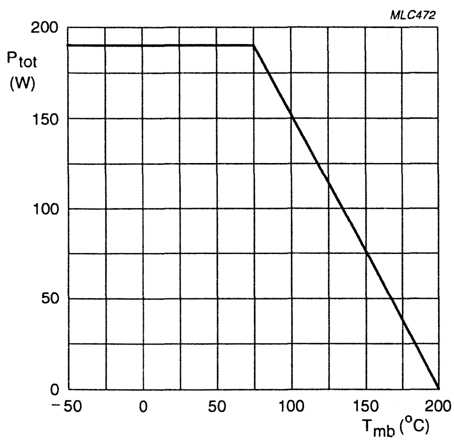
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	50	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	50	V
V_{CEO}	collector-emitter voltage	open base	–	25	V
V_{EBO}	emitter-base voltage	open collector	–	2.5	V
I_{CM}	peak collector current	$t_p = 100\ \mu s$; $\delta = 10\%$	–	6.5	A
P_{tot}	total power dissipation	$T_{mb} < 75\ °C$; $t_p \leq 100\ \mu s$; $\delta \leq 10\%$	–	190	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p = 100\ \mu s$; $\delta = 10\%$.

Fig.2 Power derating curve.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	TYP.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 86 °C	1.69	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W
$Z_{th\ j\text{-}h}$	thermal impedance from junction to heatsink	t_p = 100 μs; δ = 10%; note 1	0.44	K/W

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 40 V	–	3	mA
I_{CES}	collector cut-off current	V_{BE} = 0; V_{CE} = 40 V	–	3	mA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 1.5 V	–	0.45	mA
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 7.5 mA	55	–	V
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 7.5 mA; V_{BE} = 0	55	–	V

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-base test circuit.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 100 μs; δ = 10%	2.7 to 3.1	40	typ. 60	typ. 7.5	typ. 40

NPN silicon planar epitaxial microwave power transistor

RX1214B80W; RX1214B130Y

FEATURES

- Suitable for short and medium pulse application up to 1 ms/10%
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very good stability of the characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance.
- Internal input and output prematching networks allow an easier design of circuits.

APPLICATIONS

Intended for use in common-base class C broadband pulsed power amplifiers for radar applications in the 1.2 to 1.4 GHz band. Also suitable for long pulse, heavy duty operation within this band.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-91B metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C RX1214B80W	t_p = 500 μs; δ = 10%	1.2 to 1.4	40	≥80	≥7	≥35
Class C RX1214B130Y	t_p = 150 μs; δ = 5%	1.2 to 1.4	50	≥130	≥7	≥35

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

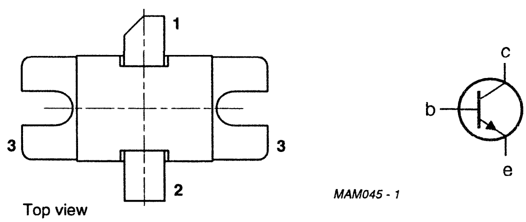


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

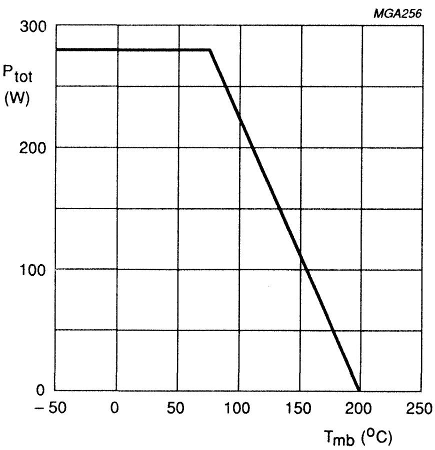
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	60	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current	$t_p \leq 150\ \mu s$; $\delta \leq 5\%$	–	9	A
P_{tot}	total power dissipation	$T_{mb} < 75$ °C; $t_p \leq 150\ \mu s$; $\delta \leq 5\%$	–	280	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p \leq 150\ \mu s$;

$\delta \leq 5\%$;

P_{tot} max = 280 W.

Fig.2 Maximum power dissipation derating as a function of mounting base temperature.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 120 °C	1.75 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2 K/W
Z_{th}	thermal impedance from junction to heatsink	t_p = 150 μs; δ = 5 %; note 1	0.4 K/W

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 50 V; I_E = 0	–	6	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	–	0.6	mA
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 60 mA V_{BE} = 0	60	–	V

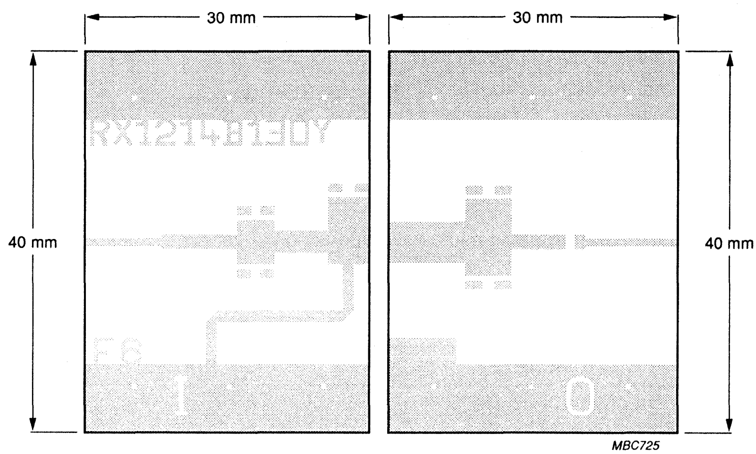
APPLICATION INFORMATION

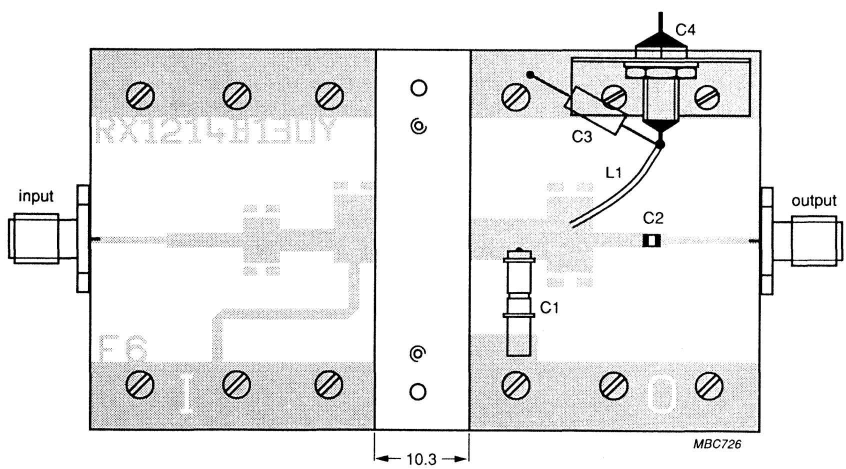
Microwave performance up to T_{mb} = 25 °C in a common base test circuit as shown in Fig.3.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 150 μs; δ = 5 %	1.2 to 1.4	50	≥130; typ.140	≥7; typ. 7.5	≥35; typ. 39
	t_p = 500 μs; δ = 10%	1.2 to 1.4	40	typ. 80	typ. 8.5	typ. 40

List of components (see test circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
L1	0.5 mm copper wire		total length = 15 mm	
C1	trimmer capacitor	0.6 - 5 pF		Tekelec, ref AT3- 7271SL
C2	chip capacitor			
C3	tantalum capacitor	10 μF, 50 V		
C4	feedthrough bypass capacitor			Erie, ref.1250-003





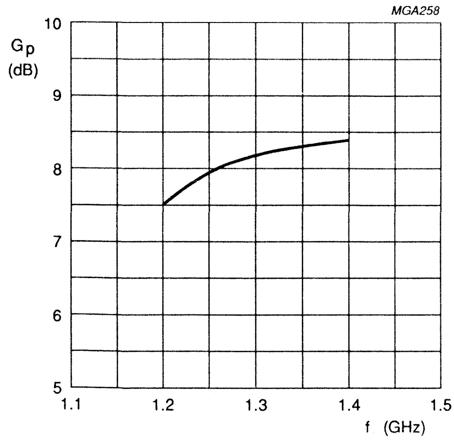
Dimensions in mm

Substrate : Epsilam 10

Thickness : 0.635 mm

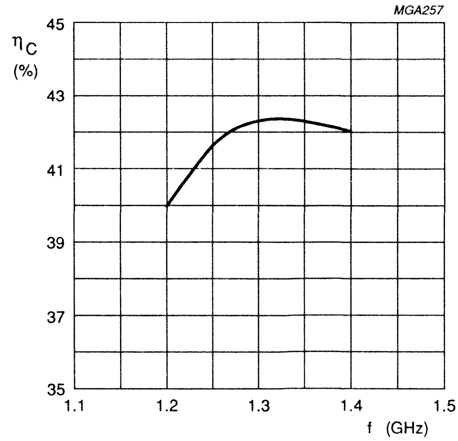
Permittivity : $\varepsilon_r = 10$

Fig.3 Broadband test circuit.



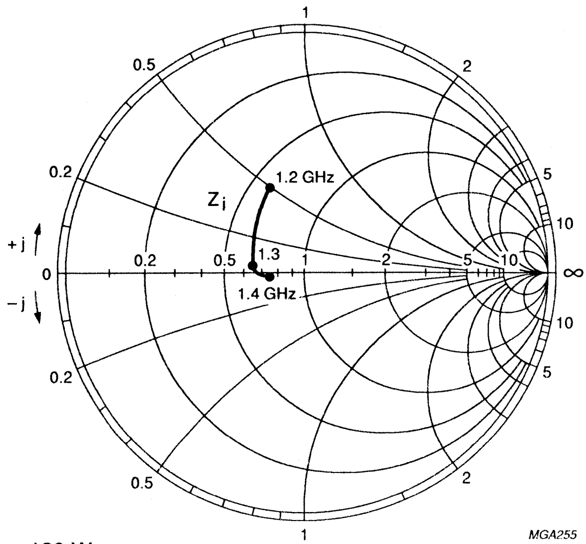
Class C pulse operation; t_p = 150 µs; δ = 5%;
V_{CC} = 50 V; P_{OUT} = 130 W.
(In broadband test circuit as shown in Fig.3).

Fig.4 Power gain as a function of frequency.



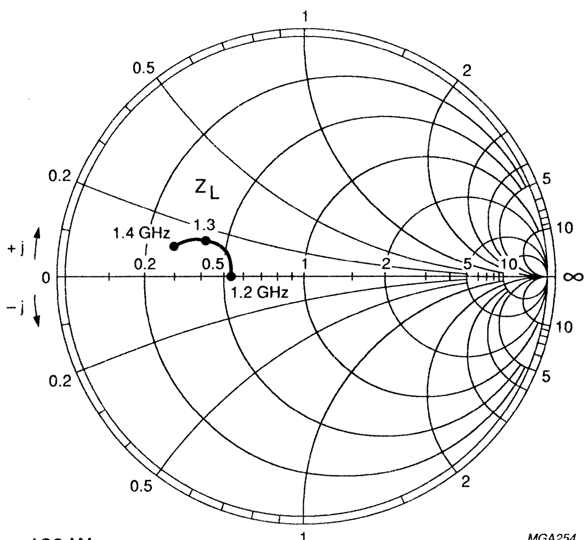
Class C pulse operation; t_p = 150 µs; δ = 5%;
V_{CC} = 50 V; P_{OUT} = 130 W.
(In broadband test circuit as shown in Fig.3).

Fig.5 Collector efficiency as a function of frequency.



V_{CC} = 50 V; Z_O = 10 Ω; P_{OUT} = 130 W.

Fig.6 Input impedance as a function of frequency, associated with optimum load impedance.



V_{CC} = 50 V; Z_O = 10 Ω; P_{OUT} = 130 W.

Fig.7 Load impedance as a function of frequency; associated with optimum input impedance.

MICROWAVE POWER TRANSISTOR

NPN silicon planar epitaxial microwave power transistor, intended for use in a common-base class-C broadband pulse power amplifier, operating in the 1.2 to 1.4 GHz frequency range.

It is recommended for radar applications.

Features

- Interdigitated structure; giving a high emitter efficiency
- Diffused emitter ballasting resistors; capable of withstanding a high VSWR and providing excellent current sharing
- Gold metallization; ensuring excellent stability of the characteristics and giving a prolonged working life
- Multicell geometry; giving good balance of dissipated power and low thermal resistance
- Internal input and output matching cells; simplifying circuit design

The transistor is housed in a metal ceramic flange envelope (FO-91).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class-C broadband amplifier.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i; Z_L Ω
t_p = 1 ms; δ = 10%	1.2 to 1.4	40	⩾ 135	⩾ 6.5	⩾ 35	see Fig. 6

MECHANICAL DATA

Dimensions in mm

FO-91 (see Fig.1).

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

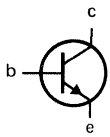
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

MECHANICAL DATA

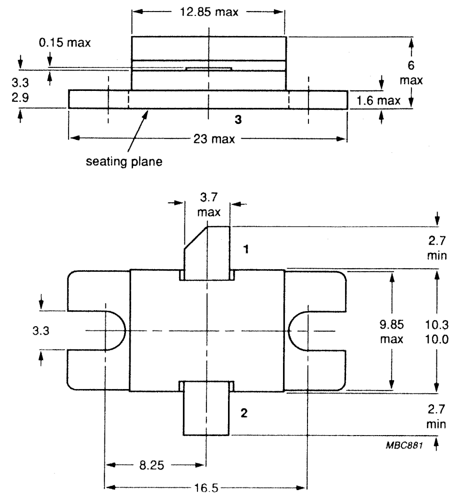
Dimensions in mm

Fig. 1 FO-91.

Pinning:
1 = collector
2 = emitter
3 = base



Base is connected to the seating plane.



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage; open emitter	V_{CBO}	max.	65	V
Collector-emitter voltage; R_{BE} = 0	V_{CES}	max.	60	V
Collector-emitter voltage; open base	V_{CEO}	max.	20	V
Emitter-base voltage; open collector	V_{EBO}	max.	3	V
Collector current (average)*	I_C	max.	15	A
Total power dissipation at $T_{mb} \leqslant 75$ °C*	P_{tot}	max.	355	W
Storage temperature range	T_{stg}	−65 to + 200		°C
Operating junction temperature	T_j	max.	200	°C
Soldering temperature at 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	°C

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base (CW)	$R_{th\ j\text{-}mb}$	max.	1	K/W
From junction to heatsink**	Z_{th}	max.	0.35	K/W
From mounting base to heatsink (CW)	$R_{th\ mb\text{-}h}$	max.	0.2	K/W

* Maximum values under nominal pulsed microwave operating conditions (t_p = 1 ms; δ = 10%).
** Equivalent thermal impedance under nominal pulsed microwave operating conditions (t_p = 1 ms; δ = 10%).

NPN silicon planar epitaxial microwave power transistor

RX1214B170W

FEATURES

- Suitable for short and medium pulse applications up to 1 ms pulse width, 10% duty factor
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very stable characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance
- Internal input and output prematching networks allow an easier design of circuits.

APPLICATIONS

Intended for use in common-base class C broadband pulsed power amplifiers for radar applications in the 1.2 to 1.4 GHz band. Also suitable for long pulse, heavy duty operation within this band.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-91B metal ceramic flange package, with base connected to flange.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 500 μs; δ = 10%	1.2 to 1.4	42	≥170	≥6.7	≥40

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

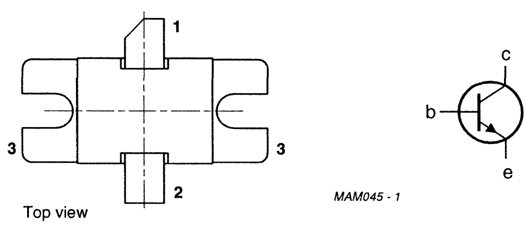


Fig.1 Simplified outline and symbol.

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

NPN silicon planar epitaxial microwave power transistor

RX1214B170W

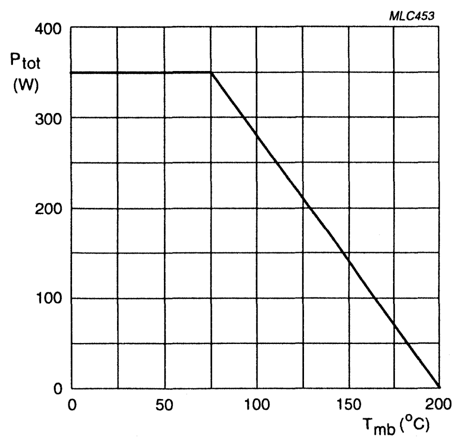
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	65	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0$	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current	$t_p \leq 150\ \mu s$; $\delta \leq 5\%$	–	15	A
P_{tot}	total power dissipation	$T_{mb} \leq 75\ °C$; $t_p \leq 150\ \mu s$; $\delta \leq 5\%$	–	350	W
T_{stg}	storage temperature		–65	+200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p = 150\ \mu s$; $\delta = 5\%$.

Fig.2 Power derating curve.

NPN silicon planar epitaxial microwave power transistor

RX1214B170W

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 120 °C	1.9	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	t_p = 500 µs; δ = 10%; note 1	0.28	K/W

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 50 V	–	20	mA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 1.5 V	–	2	mA
$V_{(BR)CES}$	collector-emitter breakdown voltage	I_C = 60 mA; V_{BE} = 0	65	–	V

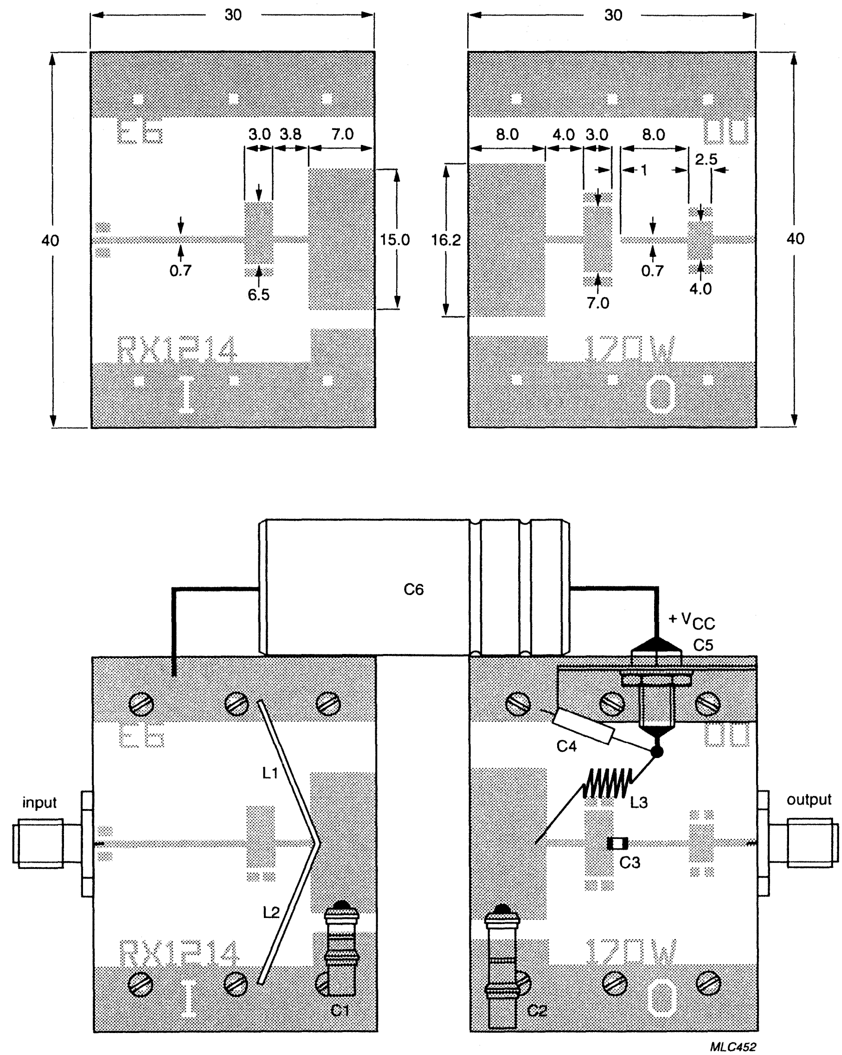
APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-base test circuit as shown in Fig.3; note 1.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
Class C	t_p = 500 µs; δ = 10%	1.2 to 1.4	42	170	≥6.7 typ. 7.2	≥40 typ. 45

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

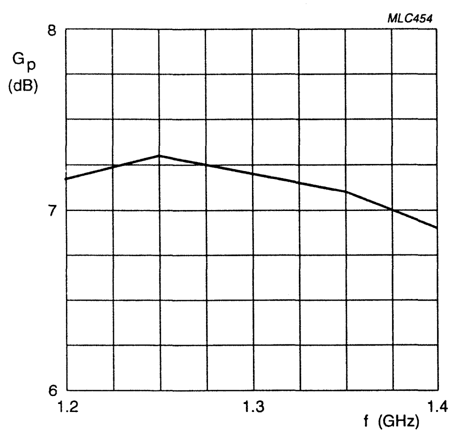


Dimensions in mm.
Substrate: Epsilam 10.
Thickness: 0.635 mm.
Permittivity: $\varepsilon_r = 10$.

Fig.3 Broadband test circuit.

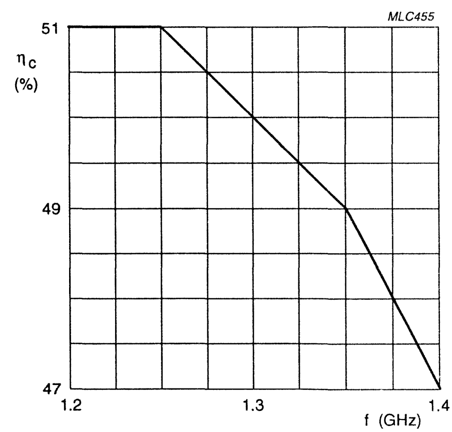
List of components (see Fig.3)

COMPONENT	DESCRIPTION	VALUE	ORDERING INFORMATION
C1	variable gigatrim capacitor	0.6 to 5 pF	Tekelec AT3-7271SL
C2	variable gigatrim capacitor	0.8 to 8 pF	Tekelec 729-1
C3	capacitor	100 pF	ATC 100A101kp50x
C4	tantalum capacitor	10 μF; 50 V	
C5	feedthrough bypass capacitor		Erie 1250-003
L1, L2	0.65 mm copper wire; total length = 24 mm; height of loop = 10 mm		
L3	4 turns 0.65 mm copper wire; total length = 4 mm; internal diameter = 3 mm		



Class C pulse operation.
t_p = 500 μs; δ = 10%; V_{CC} = 42 V; P_o = 170 W.
In broadband test circuit as shown in Fig.3.

Fig.4 Load power as a function of input power.



Class C pulse operation.
t_p = 500 μs; δ = 10%; V_{CC} = 42 V; P_o = 170 W.
In broadband test circuit as shown in Fig.3.

Fig.5 Collector efficiency as a function of frequency.

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon microwave power transistor for use in common-base, class-C wideband amplifiers operating under pulsed conditions.

It is recommended for L-band radar applications.

Features

- Interdigitated structure; giving a high emitter efficiency
- Diffused emitter ballasting resistors; capable of withstanding a high VSWR and providing excellent current sharing
- Gold metallization; ensuring excellent stability of the characteristics and giving a prolonged working life
- Multicell geometry; giving good balance of dissipated power and low thermal resistance
- Internal input and output matching cells; simplifying circuit design

The transistor is housed in a metal-ceramic flange envelope (FO-91).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class-C wideband amplifier.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i; Z_L
class-C; t_p = 150 μs; δ = 5%	1.2 to 1.4	50	$\geqslant$ 250	$\geqslant$ 7	$\geqslant$ 35	see Fig. 6

MECHANICAL DATA

Dimensions in mm

FO-91 (see Fig. 1).

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

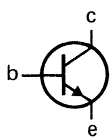
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

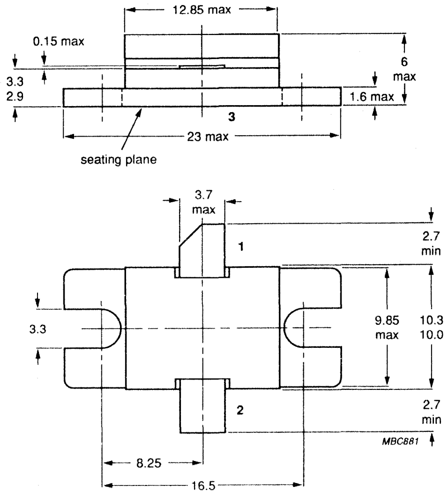
MECHANICAL DATA Dimensions in mm

Fig. 1 FO-91.

Pinning:

1 = collector
2 = emitter
3 = base





RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage, open emitter	V_{CBO}	max.	65	V
Collector-emitter voltage, $R_{BE} = 0$	V_{CES}	max.	60	V
Emitter-base voltage, open collector	V_{EBO}	max.	3	V
Collector current (DC) $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	I_C	max.	21	A
Total power dissipation up to $T_{mb} = 75\ ^oC$ $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	P_{tot}	max.	570	W
Storage temperature range	T_{stg}		−65 to 200	^oC
Junction temperature	T_j	max.	200	^oC
Lead soldering temperature at 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

THERMAL RESISTANCE (at $T_j = 100\ ^oC$)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	0.8	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2	K/W
Equivalent thermal impedance under pulsed microwave conditions; $t_p = 150\ \mu s$; $\delta = 5\%$	Z_{th}	typ.	0.22	K/W

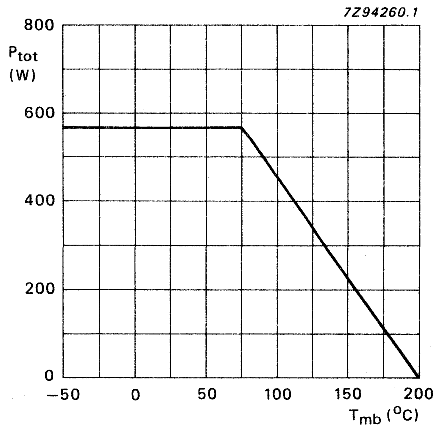


Fig. 2 Power derating curve; pulsed conditions; t_p = 150 μs; δ = 5%.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector-base breakdown voltage I_C = 140 mA; I_E = 0	$V_{(BR)CBO}$	min.	65 V
Collector-emitter breakdown voltage I_C = 140 mA; R_{BE} = 0	$V_{(BR)CES}$	min.	60 V
Emitter-base breakdown voltage I_C = 0; I_E = 20 mA	$V_{(BR)EBO}$	min.	3 V
Collector cut-off current I_E = 0; V_{CB} = 50 V	I_{CBO}	max.	14 mA
Emitter cut-off current I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	1.4 mA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common-base class-C wideband amplifier.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i; Z_L
pulsed; t_p = 150 μs; δ = 5%	1.2 to 1.4	50	⩾ 250 typ. 320	⩾ 7 typ. 8	⩾ 35 typ. 40	see Fig. 6
t_p = 300 μs; δ = 10%	1.2 to 1.4	50	typ. 300	typ. 7.5	typ. 35	see Fig. 6

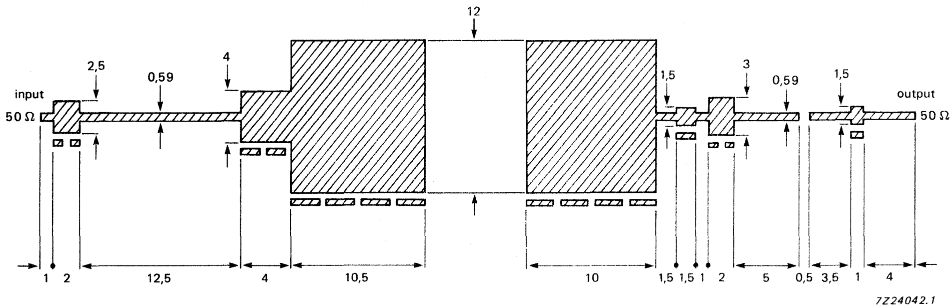


Fig. 3 Wideband test circuit for 1.2 to 1.4 GHz (dimensions in mm).
Epsilam printed circuit board; thickness 0.635 mm; ϵ_r = 10.

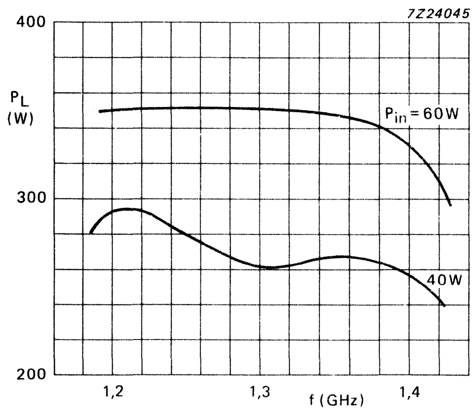


Fig. 4 Load power as a function of frequency; typical values;
t_p = 150 μs; δ = 5%.

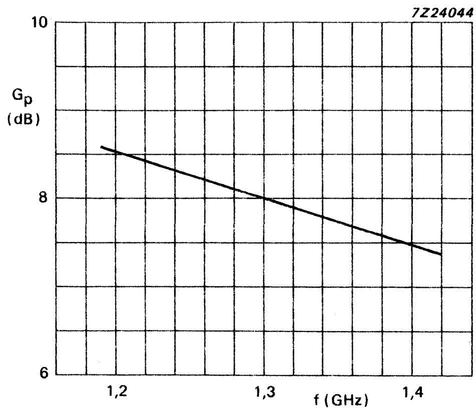


Fig. 5 Power gain as a function of frequency; t_p = 150 μs; δ = 5%.

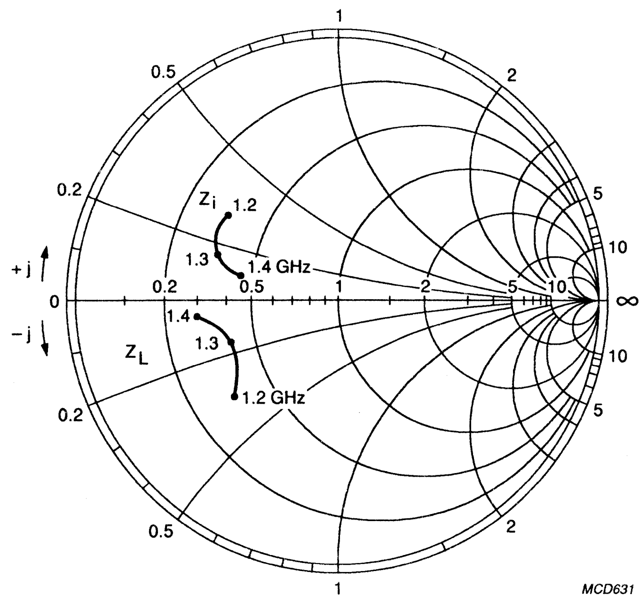


Fig. 6 Input and optimum load impedance as a function of frequency; V_{CC} = 50 V; P_L = 250 W; t_p = 150 μs; δ = 5%; class-C operation; Z_O = 5 Ω; typical values.

NPN silicon planar epitaxial microwave power transistor

RX1214B350Y

FEATURES

- Suitable for short and medium pulse applications up to 1 ms/10%
- Internal input prematching networks allow an easier design of circuits
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very good stability of the characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-91B metal ceramic flange package with base connected to flange.

APPLICATIONS

Intended for use in common base, class C, broadband, pulsed power amplifiers for L-Band radar applications in the 1.2 to 1.4 GHz band. Also suitable for medium pulse, heavy duty operation within this band.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C broadband amplifier.

MODE OF OPERATION	CONDITIONS	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)
class C	t_p = 130 µs; δ = 6%	1.2 to 1.4	50	280	≥ 7.0	≥ 40

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

PIN CONFIGURATION

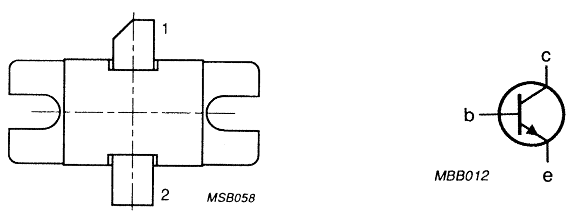


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
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.

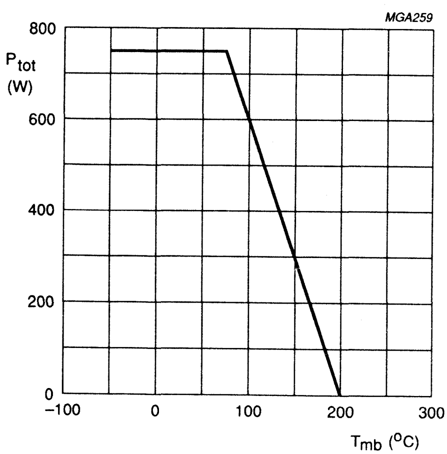
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	20	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	65	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current	$t_p \leq 130\ \mu s$; $\delta \leq 6\%$	–	25	A
P_{tot}	total power dissipation	$T_{mb} < 75\ °C$; $t_p \leq 30\ \mu s$; $\delta \leq 1\%$	–	750	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.



$t_p \leq 30\ \mu s$;
$\delta \leq 1\%$;
P_{tot} max = 750 W

Fig.2 Maximum power dissipation derating as a function of mounting base temperature.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 120 °C	1.2 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2 K/W
Z_{th}	thermal impedance from junction to heatsink	t_p = 130 μs; δ = 6 %; T_j = 110 °C note 1	0.17 K/W

Note

1. Equivalent thermal impedance under pulsed microwave operating conditions.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 50 V; I_E = 0	30	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	3	mA

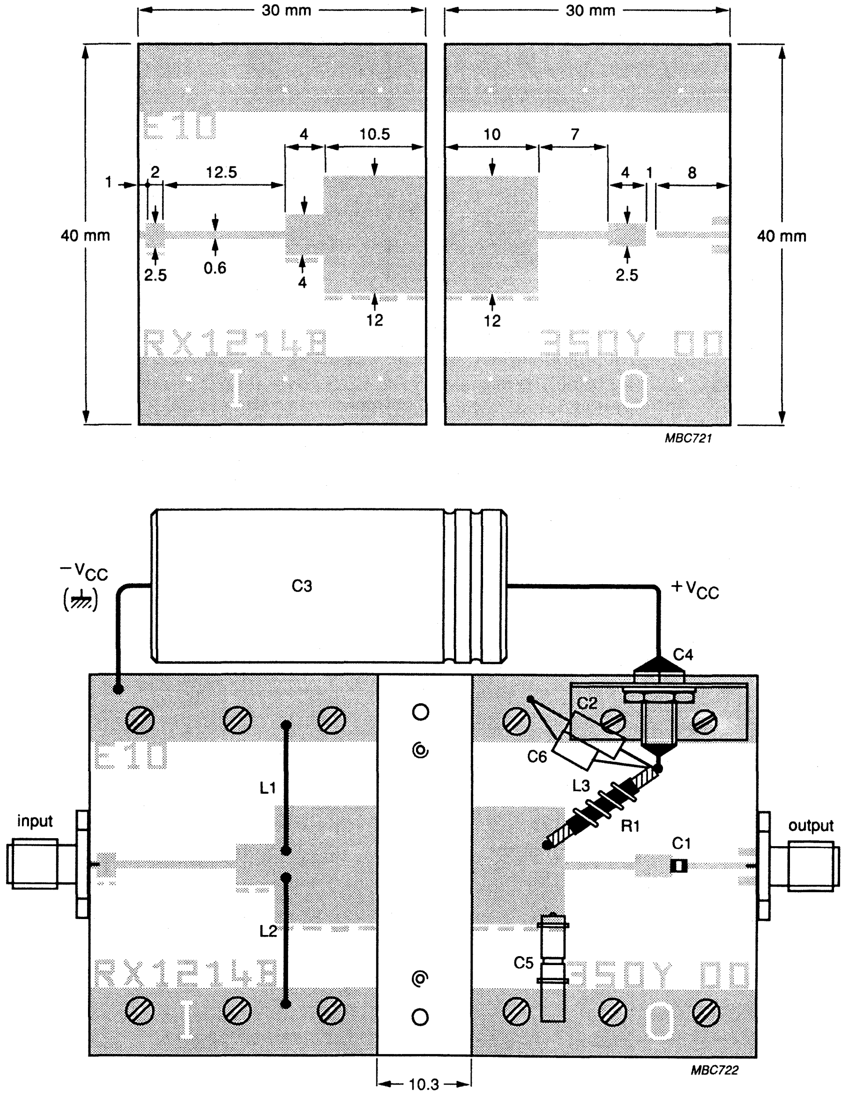
APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in a common base test circuit as shown in Fig.3.

MODE OF OPERATION	CONDITIONS	f (MHz)	V_{CC} (V) note 1	P_L (W)	G_p (dB)	η_C (%)
class C	t_p = 130 μs; δ = 6 %; note 2	1.2 to 1.4	50	280	≥ 7.0; typ. 8	≥ 40; typ. 44

Notes

1. V_{CC} during pulse.
2. Operating conditions and performances for other pulse formats can be made available on request.



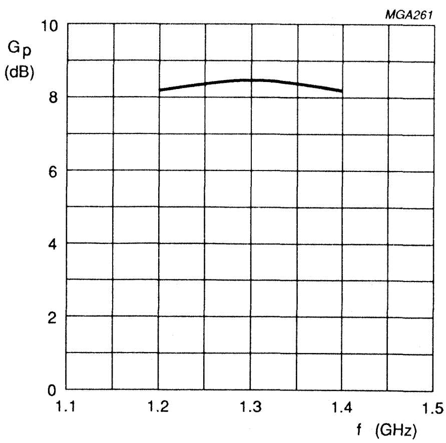
Dimensions in mm

Fig.3 Broadband test circuit.

List of components (see test circuit)

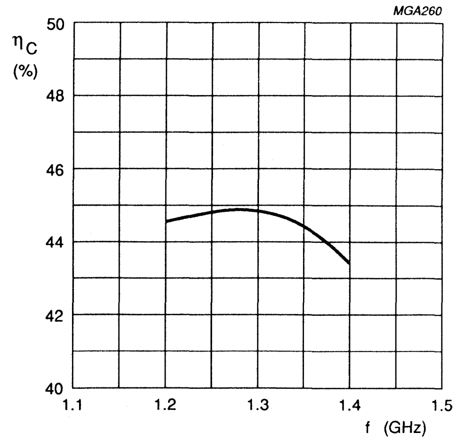
COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
L1, L2, L3	3 turns 0.65 mm copper wire		int dia. = 4 mm; length of turn = 3 mm	
C1	capacitor	100 pF		ATC, ref. 100B101KP50X
C2	tantalum capacitor	10 µF, 50 V		
C3	electrolytic capacitor	470 µF, 63 V		
C4	feedthrough bypass capacitor			Erie, ref.1250-003
C5	variable gigatrim capacitor	0.8 - 8 pF		Tekelec, ref.729.1
C6	capacitor	4.7 nF		
R1	resistor	4.7 Ω		

The test jig consists of two circuits (input and output), each being 30 mm x 40 mm in size. The two circuits are mounted on a 10 mm thick hard aluminium alloy block. A recess should be machined in the aluminium block in which the transistor can be mounted. The mounting surface must be lapped to a surface roughness of Ra < 0.5 µm and the sum of the depth of the recess and the thickness of the circuits should not exceed the specified minimum dimension between mounting face and the leads of the transistor. Tolerances on this dimension may be absorbed by placing a gold plated metal shim under the leads, close to the body of the transistor.



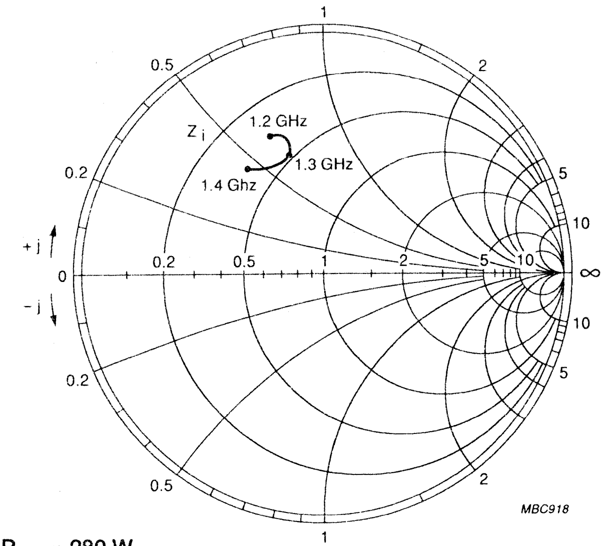
Class C pulse operation; t_p = 130 µs; δ = 6%;
V_{CC} = 50 V; P_{OUT} = 280 W.
(In broadband test circuit as shown in Fig.3).

Fig.4 Power gain as a function of frequency.



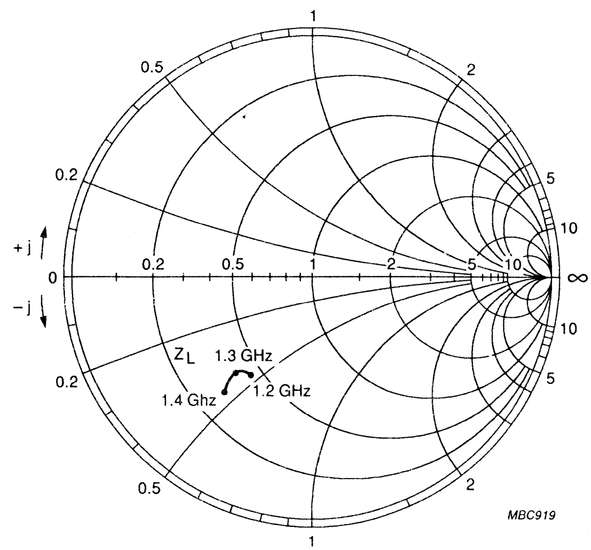
Class C pulse operation; t_p = 130 µs; δ = 6%;
V_{CC} = 50 V; P_{OUT} = 280 W.
(In broadband test circuit as shown in Fig.3).

Fig.5 Collector efficiency as a function of frequency.



V_{CC} = 50 V; Z_O = 5 Ω; P_{OUT} = 280 W.

Fig.6 Input impedance as a function of frequency, associated with optimum load impedance.



V_{CC} = 50 V; Z_O = 5 Ω; P_{OUT} = 280 W.

Fig.7 Optimum load impedance as a function of frequency; associated with input impedance.

NPN silicon planar epitaxial microwave power transistor

RXB06150W

FEATURES

- Suitable for short and medium pulse applications up to 1 ms/15%
- Internal input prematching networks allow an easier design of circuits
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very good stability of the characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-91B metal ceramic flange package with base connected to flange.

APPLICATIONS

Intended for use in common base, class C, broadband, pulsed power amplifiers for radar applications in the 540 to 610 MHz band. Also suitable for medium pulse, heavy duty operation within this band.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C broadband amplifier.

MODE OF OPERATION	CONDITIONS	f (MHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)
class C	t_p = 500 µs; δ = 15%	540 - 610	40	≥ 150	≥ 7.5	≥ 50

PINNING - FO-91B

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

PIN CONFIGURATION

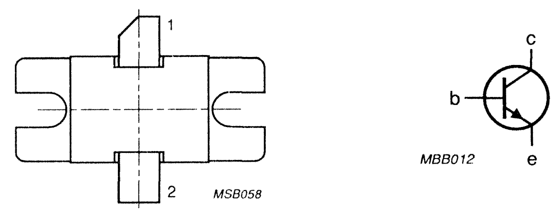


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	60	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
T_{stg}	storage temperature range		–65	200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	MAX.
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink	0.2 K/W

CHARACTERISTICS

$T_{mb} = 25$ °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 50$ V; $I_E = 0$	8	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5$ V; $I_C = 0$	800	µA

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon microwave power transistor for use in a common-base, class-C wideband amplifier and operating under pulsed conditions in L-band radar applications.

Features:

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistor providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- Internal input matching ensuring a good stability and allowing an easier design of wideband circuits.

The transistor is housed in a metal ceramic flange envelope (FO-57C).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class-C wideband amplifier

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
class C t_p = 150 μs δ = 5%	1.2 to 1.4	50	≥ 35	≥ 7	≥ 30	see Fig. 6	

MECHANICAL DATA

FO-57C (see Fig. 1).

WARNING

Product and environmental safety — toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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 general industrial or domestic waste.**

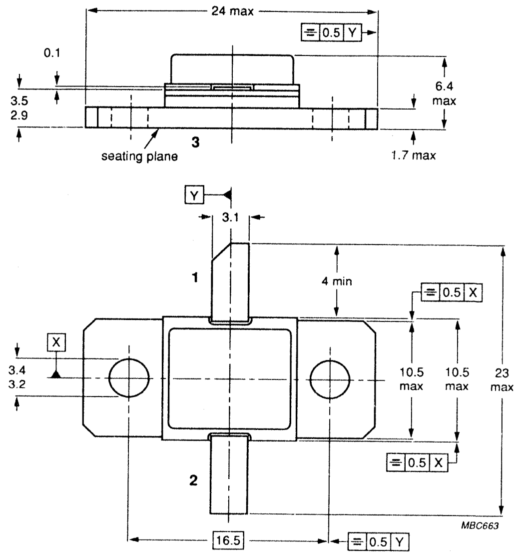
MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-57C.

Pinning:

1 = collector
2 = emitter
3 = base



Torque on screw: max. 0.5 Nm

Recommended screw: M3

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage, open emitter	V_{CBO}	max.	65	V
Collector-emitter voltage, $R_{BE} = 0$	V_{CES}	max.	60	V
Collector-emitter voltage, open base	V_{CEO}	max.	15	V
Emitter-base voltage, open collector	V_{EBO}	max.	3	V
Collector current (DC) $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	I_C	max.	3	A
Total power dissipation up to $T_{mb} = 75\ ^oC$ $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	P_{tot}	max.	125	W
Storage temperature range	T_{stg}		−65 to 200	^oC
Junction temperature	T_j	max.	200	^oC
Lead soldering temperature at 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\,j\text{-}mb}$	max.	5.0 K/W
From mounting base to heatsink	$R_{th\,mb\text{-}h}$	max.	0.2 K/W
Equivalent thermal impedance under pulsed microwave conditions t_p = 100 μs; δ = 10%	Z_{th}	max.	1.0 K/W

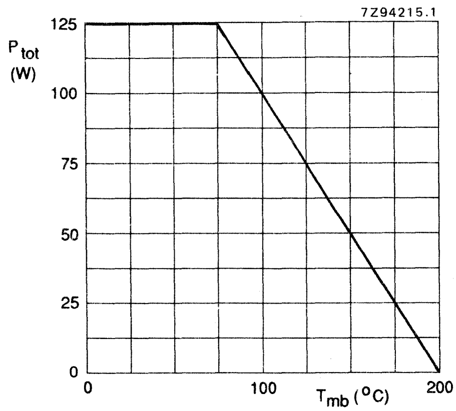


Fig. 2 Power derating curve as a function of mounting base temperature (under pulsed conditions: t_p = 150 μs, δ = 5%).

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector-base breakdown voltage I_C = 20 mA; I_E = 0	$V_{(BR)CBO}$	min.	65 V
Collector-emitter breakdown voltage I_C = 20 mA; R_{BE} = 0	$V_{(BR)CES}$	min.	60 V
Emitter-base breakdown voltage I_C = 0; I_E = 3 mA	$V_{(BR)EBO}$	min.	3 V
Collector cut-off current I_E = 0; V_{CB} = 50 V	I_{CBO}	max.	2 mA
Emitter cut-off current I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	200 μA

PRODUCT TEST

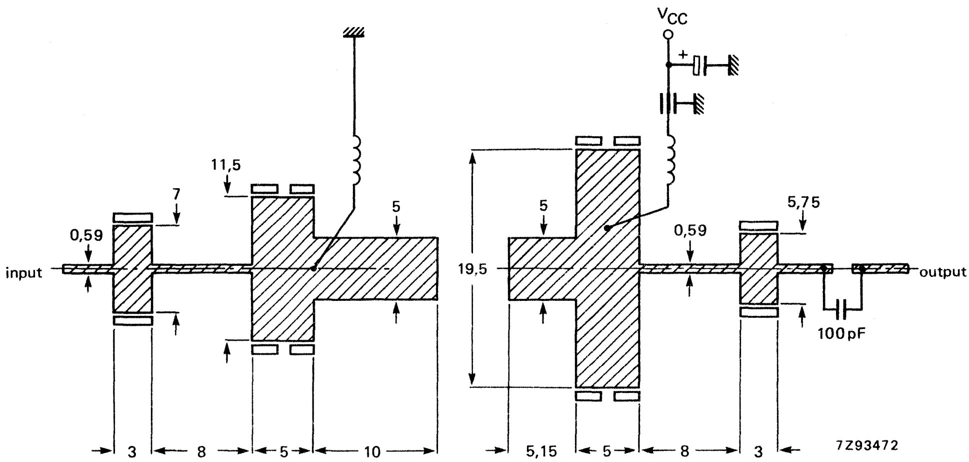


Fig. 3 Wideband test circuit for 1.2 to 1.4 GHz (dimensions in mm).
Epsilam p.c. board, thickness 0.635 mm, ϵ_r = 10.

The transistors are 100% tested on above test circuit and under the following conditions:

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
class-C t_p = 150 μs δ = 5%	1.2 to 1.4	50	typ. 40 > 35	typ. 7.8 > 7	typ. 35 > 35	see Fig. 6	
t_p = 300 μs δ = 10%	1.2 to 1.4	50	typ. 40	typ. 7	typ. 35		

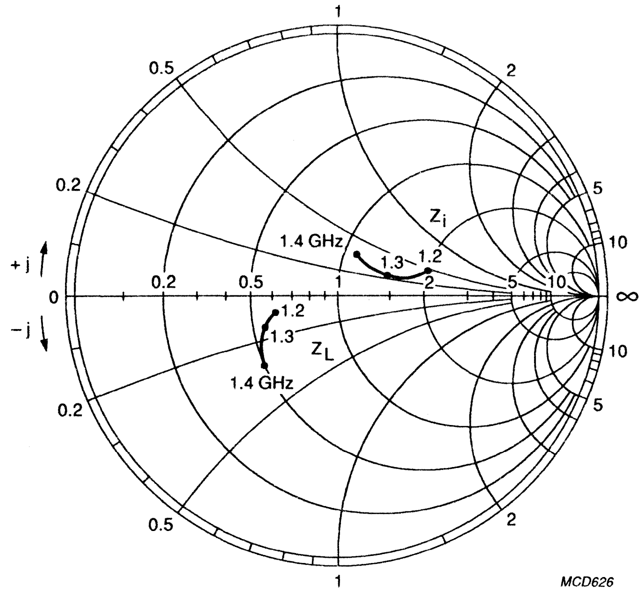


Fig. 4 Input and optimum load impedances as a function of frequency; $Z_O = 5\ \Omega$.

Conditions for Fig. 4:

$V_{CE} = 50$ V; $P_L = 35$ W; $t_p = 150\ \mu s$; $\delta = 5\%$; class-C operation.

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon microwave power transistor for use in a common-base, class-B wideband amplifier and operating under pulsed conditions in L-band radar applications.

Features:

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistor providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- Internal input and output matching ensuring a good stability and allowing an easier design of wideband circuits.

The transistor is housed in a metal ceramic flange envelope (FO-57C).

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common-base class-B wideband amplifier.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
class-B; t_p = 150 μs; δ = 5%	1.2 to 1.4	50	⩾ 70	⩾ 7	⩾ 35	see Fig. 6	

MECHANICAL DATA

FO-57C (see Fig.1).

WARNING

Product and environmental safety — toxic materials

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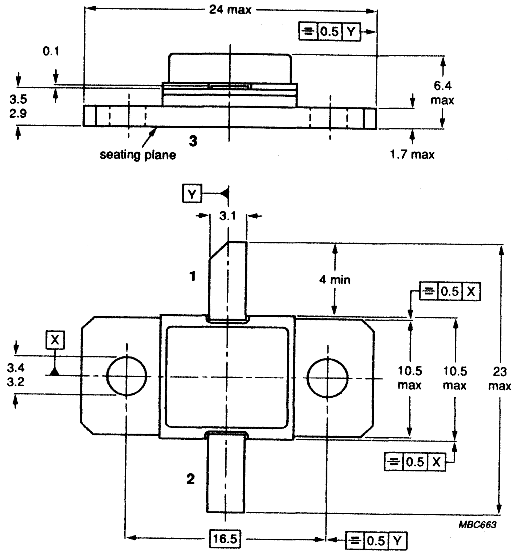
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-57C.



Pinning:

1 = collector
2 = emitter
3 = base

Torque on screw: max. 0.5 Nm

Recommended screw: M3

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage, open emitter	V_{CBO}	max.	65	V
Collector-emitter voltage, $R_{BE} = 0$	V_{CES}	max.	60	V
Collector-emitter voltage, open base	V_{CEO}	max.	15	V
Emitter-base voltage, open collector	V_{EBO}	max.	3	V
Collector current (DC) $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	I_C	max.	6	A
Total power dissipation up to $T_{mb} = 75\ ^oC$ $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	P_{tot}	max.	225	W
Storage temperature range	T_{stg}		−65 to + 200	^oC
Junction temperature	T_j	max.	200	^oC
Lead soldering temperature at 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	2.5	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2	K/W
Equivalent thermal impedance under pulsed microwave conditions; $t_p = 150\ \mu s$; $\delta = 5\%$	Z_{th}	max.	0.55	K/W

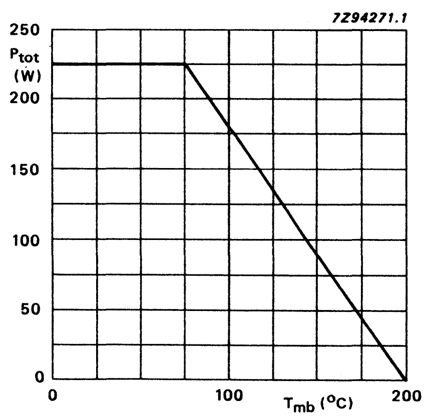


Fig.2 Power derating curve as a function of mounting base temperature (under pulsed conditions: $t_p = 150\ \mu s$, $\delta = 5\%$).

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector-base breakdown voltage I_C = 40 mA; I_E = 0	$V_{(BR)CBO}$	min.	65 V
Collector-emitter breakdown voltage I_C = 40 mA; R_{BE} = 0	$V_{(BR)CES}$	min.	60 V
Collector cut-off current I_E = 0; V_{CB} = 50 V	I_{CBO}	max.	4 mA
Emitter cut-off current I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	400 μA

APPLICATION INFORMATION

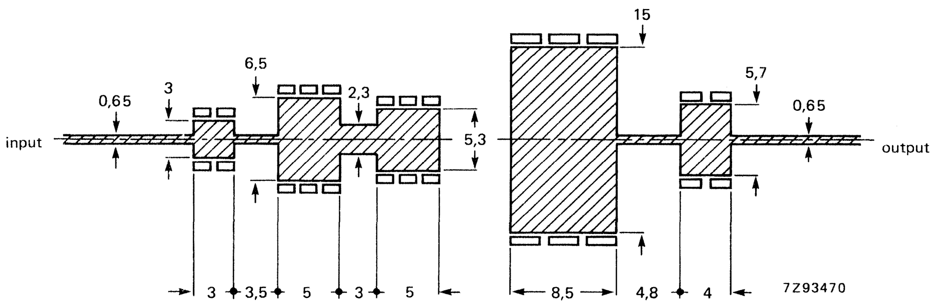


Fig.3 Wideband test circuit for 1.2 to 1.4 GHz (dimensions in mm).
Epsilam p.c. board, thickness 0.635 mm, ϵ_r = 10.

The transistors are 100% tested on above test circuit and under the following conditions:

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
class-C; t_p = 150 μs; δ = 5%	1.2 to 1.4	50	> 70 typ. 80	> 7 typ. 7.8	> 35 typ. 40	see Fig.6	
t_p = 300 μs; δ = 10%	1.2 to 1.4	50	typ. 80	typ. 7	typ. 30		

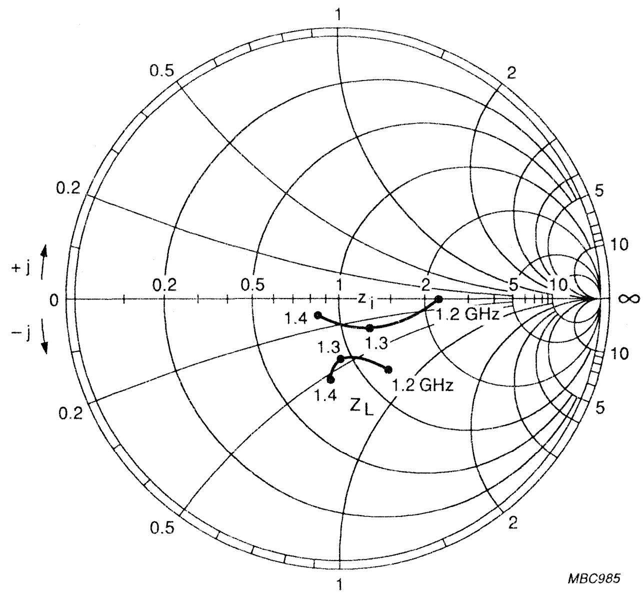


Fig.4 Input and optimum load impedance as a function of frequency; Z_O = 5 Ω.

Conditions for Fig. 4:

V_{CE} = 50 V; P_L = 65 W; t_p = 150 μs; δ = 5%; class-C operation.

NPN silicon planar epitaxial microwave power transistor

RZB06050W

FEATURES

- Suitable for short and medium pulse applications up to 1 ms/10%
- Internal input prematching networks allow an easier design of circuits
- Diffused emitter ballasting resistors improve ruggedness
- Interdigitated emitter-base structure provides high emitter efficiency
- Gold metallization with barrier realizes very good stability of the characteristics and excellent lifetime
- Multicell geometry improves power sharing and reduces thermal resistance.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor in a FO-57C metal ceramic flange package with base connected to flange.

APPLICATIONS

Intended for use in common base, class C, broadband, pulsed power amplifiers for radar applications in the 540 to 610 MHz band. Also suitable for medium pulse, heavy duty operation within this band.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C broadband amplifier.

MODE OF OPERATION	CONDITIONS	f (MHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)
class C	t_p = 500 μs; δ = 15%	540 to 610	40	≥ 30	≥ 7.5	≥ 50

PINNING - FO-57C

PIN	DESCRIPTION
1	collector
2	emitter
3	base connected to flange

PIN CONFIGURATION

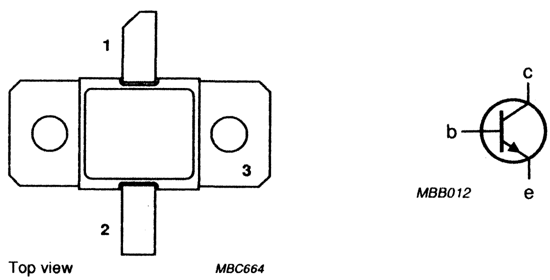


Fig.1 Simplified outline and symbol.

WARNING

Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO slab 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.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	60	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
T_{stg}	storage temperature range		–65	200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.

THERMAL CHARACTERISTICS

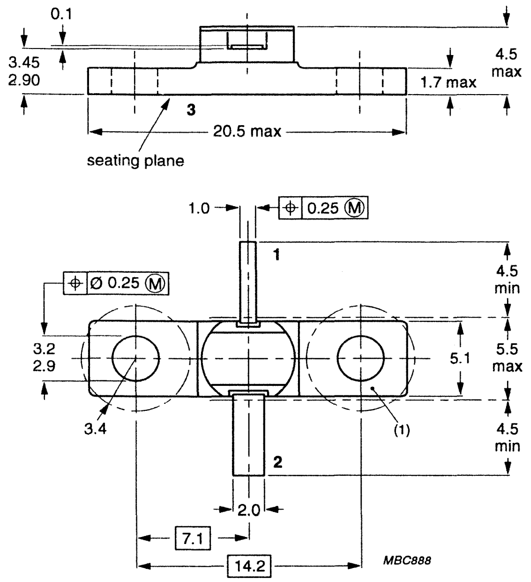
SYMBOL	PARAMETER	CONDITIONS	MAX.
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	$T_j = 120$ °C	5 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.2 K/W

CHARACTERISTICS

$T_{mb} = 25$ °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 50$ V; $I_E = 0$	2	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5$ V; $I_C = 0$	200	μA

ENVELOPES



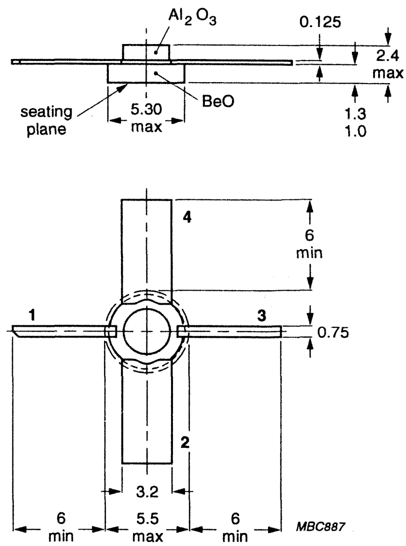
Dimensions in mm.

Torque on nut: max. 0.4 Nm.

Recommended screw: M2.5.

(1) Flatness of this area ensures full thermal contact with bolt head.

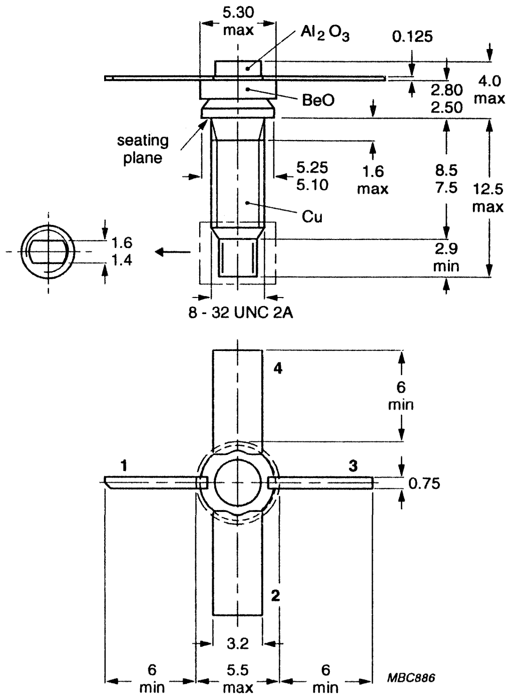
Fig.1 FO-41B.



Dimensions in mm.

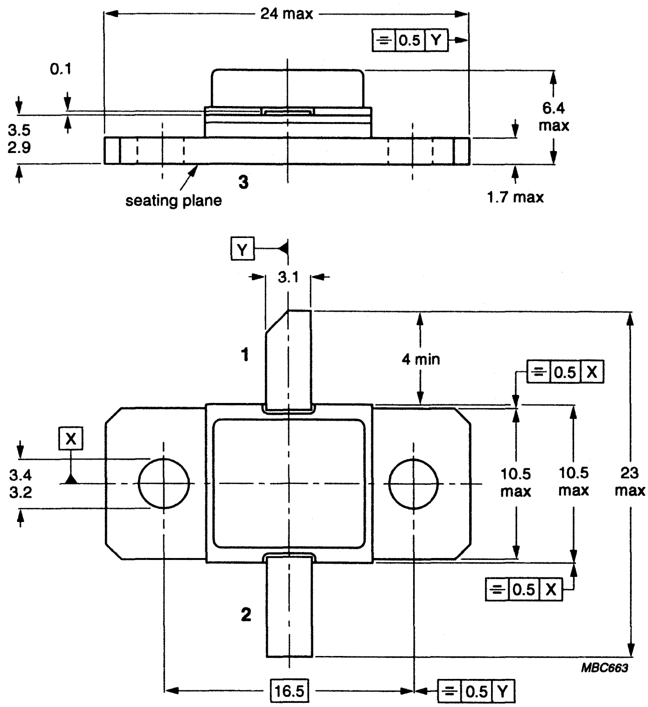
Torque on nut: min. 0.75 Nm; max. 0.4 Nm.

Fig.2 FO-45.



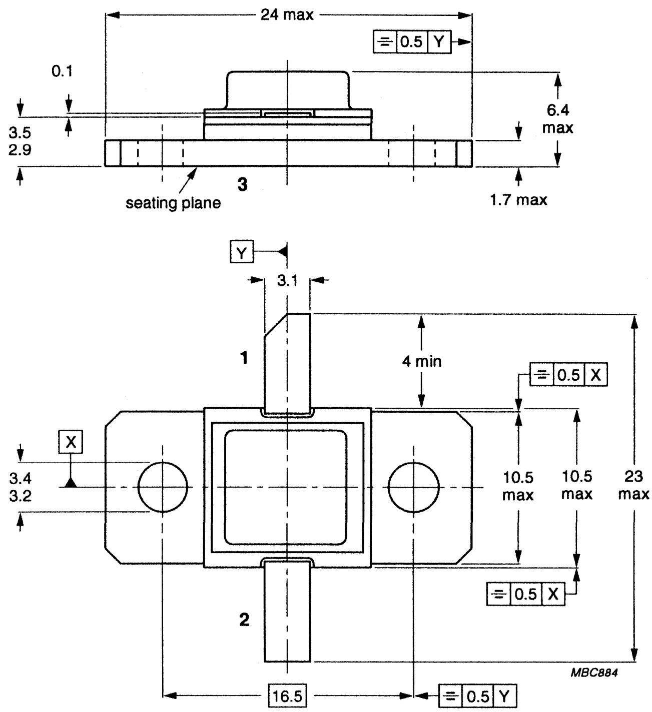
Dimensions in mm.

Fig.3 FO-46.



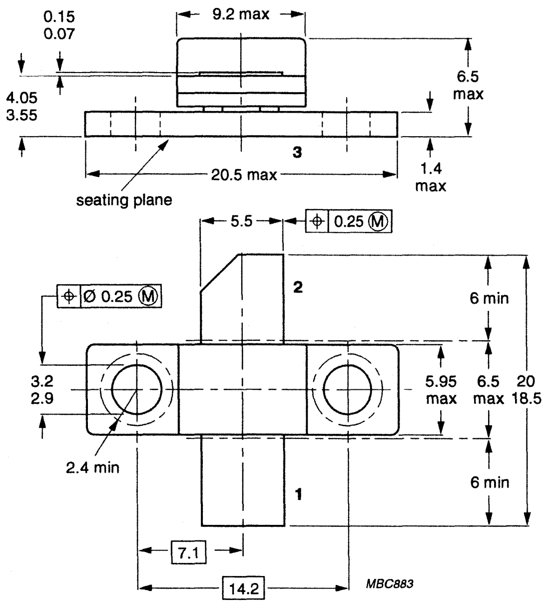
Dimensions in mm.
Torque on nut: max. 0.5 Nm.
Recommended screw: M3.

Fig.4 FO-57C.



Dimensions in mm.
Torque on nut: max. 0.5 Nm.
Recommended screw: M3.

Fig.5 FO-57D.

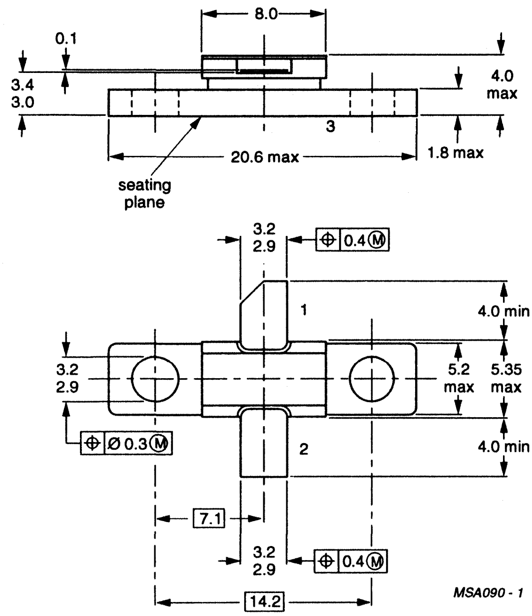


Dimensions in mm.

Torque on nut: max. 0.4 Nm.

Recommended screw: M2.5.

Fig.6 FO-67.

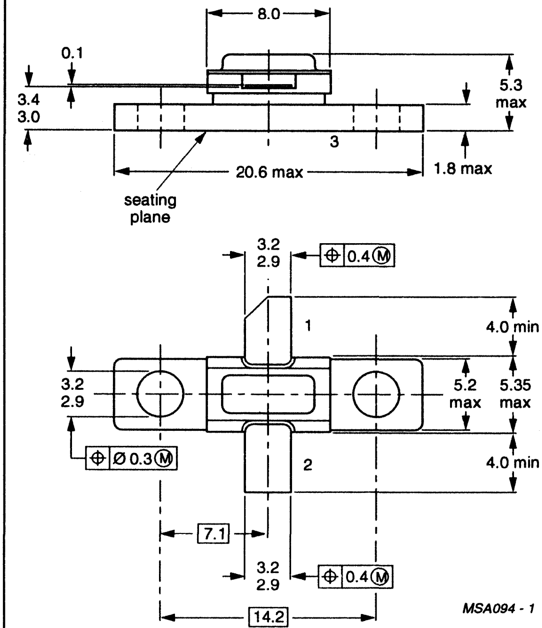


Dimensions in mm.

Torque on nut: max. 0.4 Nm.

Recommended screw: M2.5.

Fig.7 FO-83A.

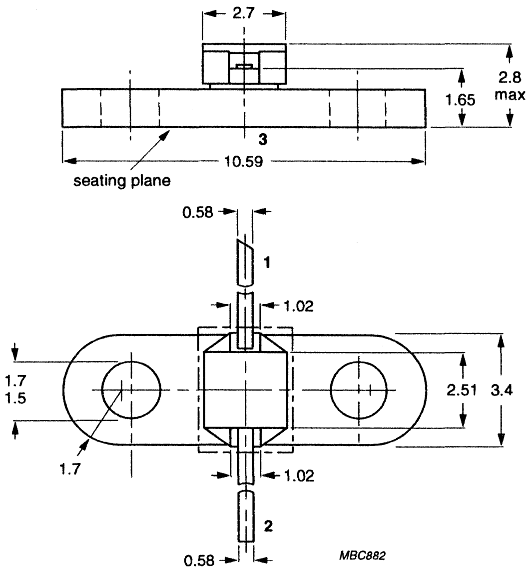


Dimensions in mm.

Torque on nut: max. 0.4 Nm.

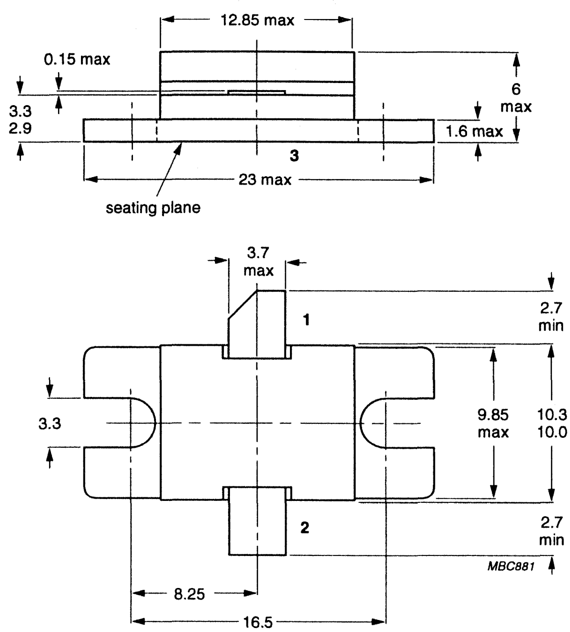
Recommended screw: M2.5.

Fig.8 FO-83B.



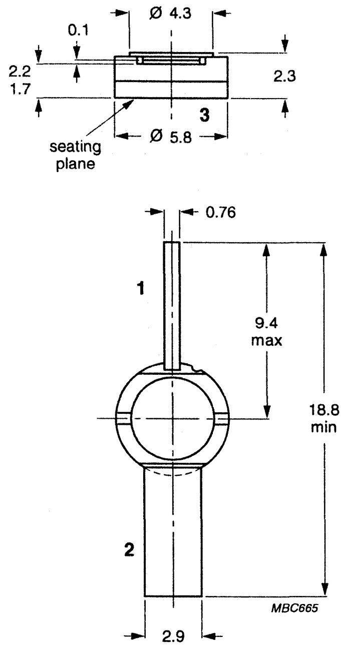
Dimensions in mm.
Recommended screw: M1.5.

Fig.9 FO-85.



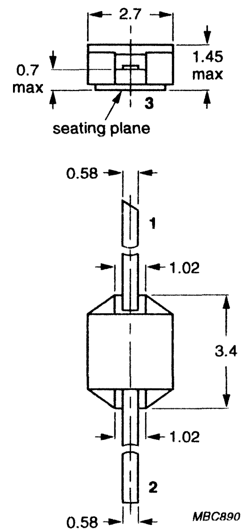
Dimensions in mm.
Torque on nut: max. 0.4 Nm.
Recommended screw: M3.
Recommended pitch for mounting screw: 19 mm.

Fig.10 FO-91.



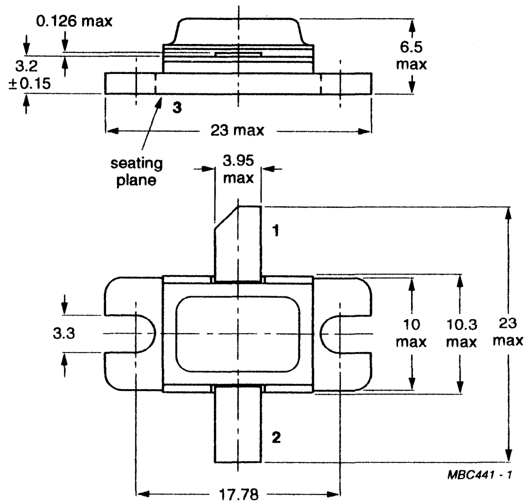
Dimensions in mm.

Fig.11 FO-93.



Dimensions in mm.

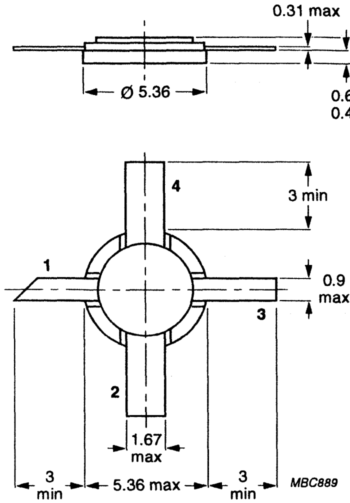
Fig.12 FO-102.



Dimensions in mm.

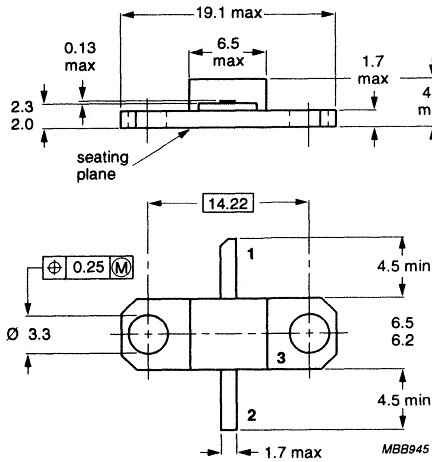
Recommended screw: M3.

Fig.13 FO-125A



Dimensions in mm.

Fig.14 FO-163.



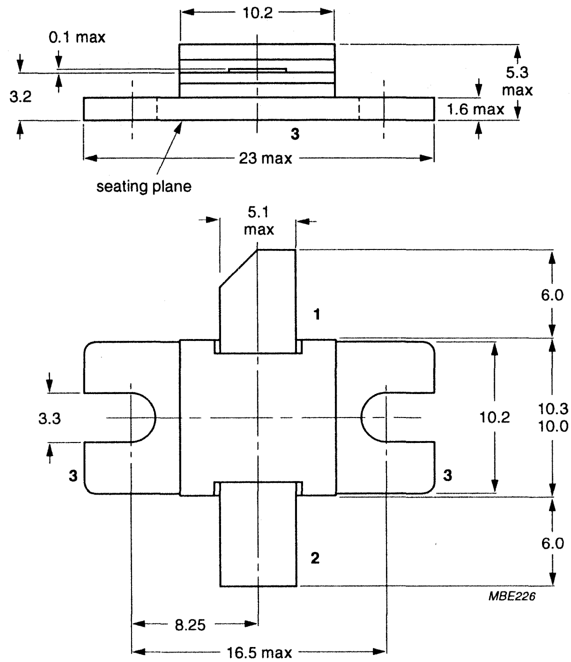
Dimensions in mm.

Torque on nut: max. 0.5 Nm.

Recommended screw: M3.

Recommended pitch for mounting screw: 19 mm.

Fig.15 FO-229.



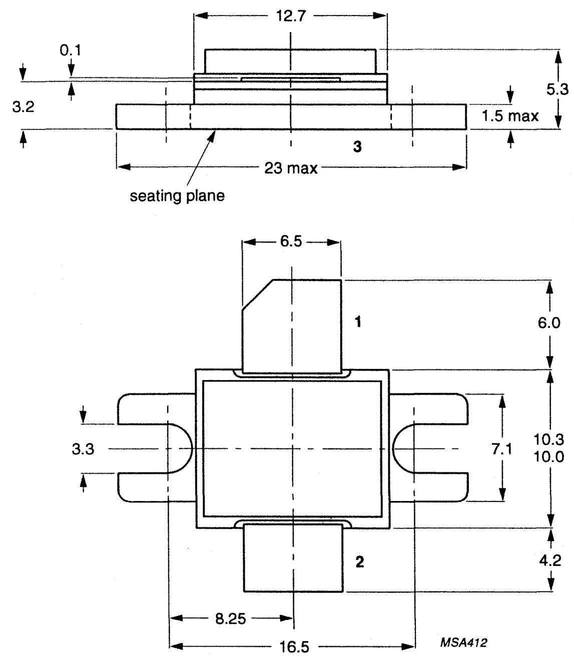
Dimensions in mm.

Torque on screws: max. 0.4 Nm.

Recommended screw: M3.

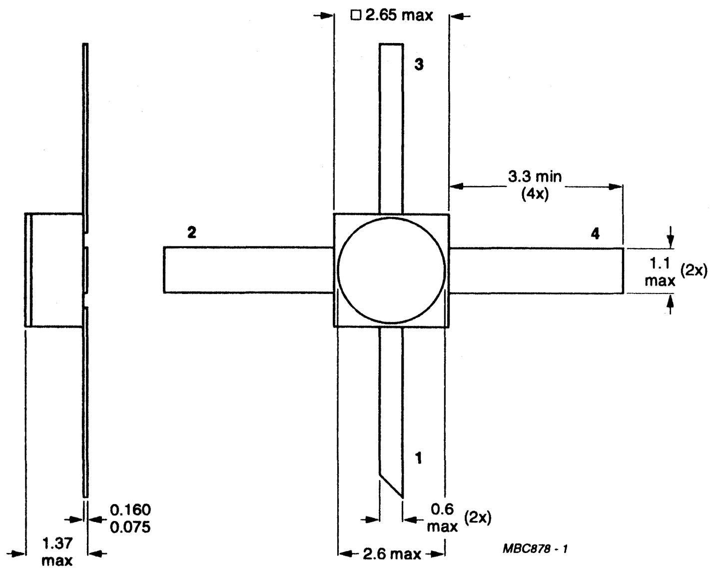
Recommended pitch for mounting screw: 19 mm.

Fig.16 FO-238.



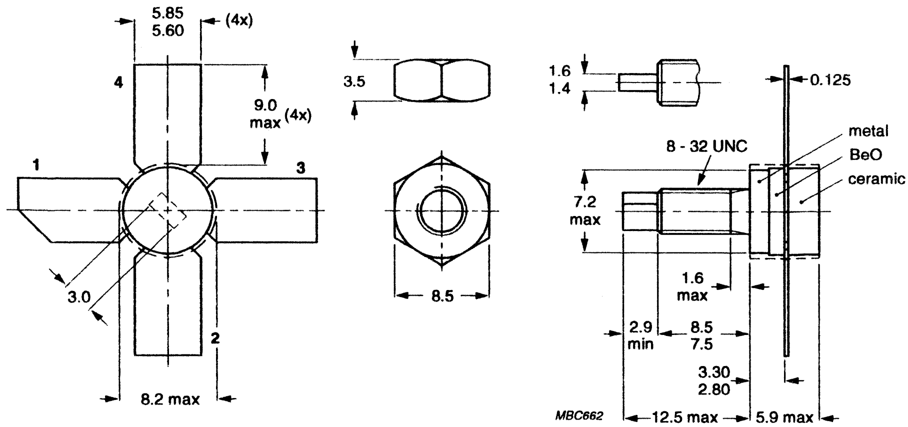
Dimensions in mm.
Torque on screws: max. 0.4 Nm.
Recommended screw: M3.
Recommended pitch for mounting screw: 19 mm.

Fig.17 FO-239.



Dimensions in mm.

Fig.18 SOT100.



Dimensions in mm.

Fig.19 SOT122A.

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DATA HANDBOOK SYSTEM

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IC14	8048-based 8-bit Microcontrollers
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SC05	Low-frequency Power Transistors and Hybrid IC Power Modules
SC06	High-voltage and Switching NPN Power Transistors
SC07	Small-signal Field-effect Transistors
SC08a	RF Power Bipolar Transistors
SC08b	RF Power MOS Transistors
SC09	RF Power Modules
SC10	Surface Mounted Semiconductors
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Data handbook system

OVERVIEW OF PHILIPS COMPONENTS DATA HANDBOOKS

Our sister product division, Philips Components, also has a comprehensive data handbook system to support their products. Their data handbook titles are listed here.

Display components

Book	*Title*
DC01	Colour TV Picture Tubes and Assemblies Colour Monitor Tubes
DC02	Monochrome Monitor Tubes and Deflection Units
DC03	Television Tuners, Coaxial Aerial Input Assemblies
DC05	Flyback Transformers, Mains Transformers and General-purpose FXC Assemblies

Magnetic products

MA01	Soft Ferrites
MA03	Piezoelectric Ceramics Specialty Ferrites
MA04	Dry-reed Switches

Passive components

PA01	Electrolytic Capacitors
PA02	Varistors, Thermistors and Sensors
PA03	Potentiometers
PA04	Variable Capacitors
PA05	Film Capacitors
PA06	Ceramic Capacitors
PA07	Quartz Crystals for Special and Industrial Applications
PA08	Fixed Resistors
PA10	Quartz Crystals for Automotive and Standard Applications
PA11	Quartz Oscillators

Professional components

PC04	Photo Multipliers
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PC07	Vidicon and Newvicon Camera Tubes and Deflection Units
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