

Microwave transistors

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Philips Components



PHILIPS

MICROWAVE TRANSISTORS

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SELECTION GUIDE

(Maintenance types not included)

1. Radar pulsed power transistors

1.1 L-band

type	f GHz	V _{CC} V	t _p at δ μs %		P _L W	G _p dB	η _C %	page
RZ1214B35Y	1.2 - 1.4	50	150	5	≥ 35	≥ 7	≥ 30	317
RZ1214B65Y	1.2 - 1.4	50	150	5	≥ 70	≥ 7	≥ 35	323
RX1214B150W	1.2 - 1.4	40	1000	10	≥ 135	≥ 6.5	≥ 35	289
RX1214B300Y	1.2 - 1.4	50	150	5	≥ 250	≥ 7	≥ 35	295

1.2 S-band

type	f GHz	V _{CC} V	t _p at δ μs %		P _L W	G _p dB	η _C %	page
RZ2731B16W	2.7 - 3.1	40	100	10	≥ 15	≥ 6	≥ 32	329
RZ2731B32W	2.7 - 3.1	40	100	10	≥ 30	≥ 6	≥ 32	335
RZ2731B48W	2.7 - 3.1	40	100	10	≥ 45	≥ 6	≥ 32	341
RZ2731B60W	2.7 - 3.1	40	100	10	≥ 60	≥ 6	≥ 35	347
RX2731B90W ▲	2.7 - 3.1	40	100	10	≥ 90	≥ 6	≥ 35	301
RV3135B5X	3.1 - 3.5	24	100	10	≥ 4	≥ 4.3	≥ 30	281
RZ3135B14W	3.1 - 3.5	40	100	10	≥ 13	≥ 5.5	≥ 30	353
RZ3135B28W	3.1 - 3.5	40	100	10	≥ 27	≥ 5.5	≥ 30	359
RZ3135B42W	3.1 - 3.5	40	100	10	≥ 40	≥ 5.5	≥ 30	365
RZ3135B50W	3.1 - 3.5	40	100	10	≥ 50	≥ 5.2	≥ 30	371
RX3034B70W ▲	3.0 - 3.4	40	100	10	≥ 70	≥ 5.4	≥ 30	307

▲ Development Data.

2. Avionics pulsed power transistors

type	f GHz	V _{CC} V	t _p at δ μs %		P _L W	G _p dB	η _C %	page
MRB11175Y	1.09	50	10	1	≥ 175	≥ 7.5	> 35	161
MRB11350Y	1.09	50	10	1	≥ 350	≥ 7	≥ 30	165
MSB11900Y	1.09	50	10	1	≥ 800	≥ 7	≥ 30	169
MZ0912B50Y	0.960 - 1.215	50	10	10	≥ 50	≥ 7	≥ 42	173
MZ0912B100Y	0.960 - 1.215	50	10	10	≥ 100	≥ 7	≥ 42	181
MX0912B250Y	0.960 - 1.215	50	10	10	≥ 235	≥ 7	≥ 42	189
MX0912B350Y	0.960 - 1.215	50	10	10	≥ 325	≥ 7	≥ 40	197
RZB12050Y	1.09	50	100	10	≥ 35	≥ 7	≥ 30	377
RZB12100Y	1.09	50	100	10	≥ 80	≥ 7	≥ 30	381
RZB12250Y	1.09	50	100	10	≥ 200	≥ 7	≥ 30	385
RXB12350Y	1.09	50	100	10	≥ 300	≥ 7	≥ 30	313
RX1011B350Y	1.03 - 1.09	50	300	10	≥ 300	≥ 7	≥ 38	285

3. Linear power transistors

3.1 Class-A medium power

type	f GHz	V _{CE} V	I _C mA	P _{L1} (1) mW	G _{po} (2) dB	page
LBE2003S	2.0	18	30	≥ 200	≥ 10	53
LCE2003S	2.0	18	30	≥ 200	≥ 10	53
LUE2003S	2.0	18	30	250	11	105
LBE2009S	2.0	18	110	≥ 700	≥ 9	53
LCE2009S	2.0	18	110	≥ 700	≥ 9	53
LUE2009S	2.0	18	110	900	9.8	105
LTE21009R	2.1	16	150	1000	8.5	73
LTE21015R	2.0	16	250	≥ 1500	> 8.5	77
LTE21025R	2.1	16	400	2800	7.8	83
LVE21050R	2.1	16	1100	5500	8	135
LWE2015R	2.3	16	250	≥ 1200	≥ 7.5	139
LWE2025R	2.3	16	400	≥ 2000	≥ 7	145
LAE4001R	4.0	15	25	≥ 85	≥ 8.5	39
LAE4002S	4.0	18	30	≥ 126	≥ 7.5	45
LTE4002S [▲]	4.0	18	30	200	8	69
LTE42005S	4.2	18	110	≥ 450	≥ 6.6	87
LTE42008R	4.2	16	250	≥ 800	≥ 7	93
LTE42012R	4.2	16	400	≥ 1000	≥ 6	99

3.2 Class-A high power (wideband)

type	f GHz	V _{CE} V	I _C A	P _{L1} (1) W	G _{po} (2) dB	page
LZ1418E100R	1.4 - 1.8	16	2	≥ 9	≥ 10	151
LZE18100R	1.4 - 1.8	16	2	≥ 9	≥ 10	157
LV1721E50R	1.7 - 2.1	16	1.1	≥ 5	≥ 7	111
LV2024E45R	2.0 - 2.4	16	1.1	≥ 4	≥ 6	117
LV2327E40R	2.3 - 2.7	16	1	≥ 4	≥ 7	123
LV2931E50S	2.9 - 3.1	18	1	≥ 4.5	≥ 6	129

(1) Load power for 1 dB compressed power gain.

(2) Low-level power gain associated with P_{L1}.

[▲] Development Data.

4. CW power transistors

4.1 Class-C medium power

type	f GHz	V _{CE} V	P _L W	G _p dB	η _C %	page
PTB23001X	2	24	≥ 1	≥ 7	≥ 45	213
PTB23003X	2	24	≥ 3	≥ 8.75	≥ 45	213
PTB23005X	2	24	≥ 5	≥ 9.2	≥ 50	213
PTB32001X	3	24	≥ 1.3	≥ 8	≥ 35	219
PTB32003X	3	24	≥ 2.5	≥ 8	≥ 35	219
PTB32005X	3	24	≥ 4.5	≥ 8	≥ 35	219
PTB42001X	4.2	24	≥ 0.8	≥ 5	≥ 28	225
PTB42002X	4.2	24	≥ 1.6	≥ 5	≥ 28	225
PTB42003X	4.2	24	≥ 2.5	≥ 5	≥ 28	229
PVB42004X	1	24	13	11	60	233
	2	24	10	10	48	233
	3	24	7.5	8.8	30	233
	4	24	4	6	25	233

4.2 Class-C high power

type	f GHz	V _{CE} V	P _L W	G _p dB	η _C %	page
PZ1418B15U	1.4 - 1.8	28	≥ 12.5	≥ 7	≥ 38	245
PZ1418B30U	1.4 - 1.8	28	≥ 27	≥ 7.3	≥ 38	255
PZB16035U	1.55	28	≥ 35	≥ 8	≥ 45	271
PXB16050U	1.65	28	≥ 45	≥ 8.5	≥ 45	239
PZ1721B12U	1.7 - 2.1	28	≥ 12	≥ 6.8	≥ 35	245
PZ1721B25U	1.7 - 2.1	28	≥ 25	≥ 7	≥ 35	255
PZ2024B10U	2.0 - 2.4	28	≥ 9	≥ 5.6	≥ 30	245
PZ2024B20U	2.0 - 2.4	28	≥ 20	≥ 6	≥ 35	255
PZ2327B15U▲	2.3 - 2.7	28	≥ 15	≥ 7	≥ 40	265

5. Oscillator power transistors

type	f GHz	V _{CE} V	I _C mA	P _L mW	envelope	page
PPC5001T	5	20	200	450	FO-102	209
PQC5001T	5	20	200	450	FO-85	209

▲ Development Data.

TYPE NUMBER SURVEY

Class-A bipolar transistors

type number	f GHz	V _{CC} V	I _C mA	P _{L1} (1) W	G _{po} (2) dB	page
LAE4001R	4	15	25	≥ 0.085	≥ 8.5	39
LAE4002S	4	18	30	≥ 0.126	≥ 7.5	45
LAE6000Q (3)	2	10	4	—	—	51
LBE2003S	2	18	30	≥ 0.2	≥ 10	53
LBE2009S	2	18	110	≥ 0.7	≥ 9	53
LCE2003S	2	18	30	≥ 0.2	≥ 10	53
LCE2009S	2	18	110	≥ 0.7	≥ 9	53
LJE42002T	4	20	65	0.2	7	61
LKE21004R	2.1	15	140	0.6	10	63
LKE21015T	2.1	20	300	1.75	10	65
LKE21050T	2.1	20	1200	5.5	9	67
LTE4002S	4.0	18	30	0.2	8	69
LTE21009R	2.1	16	150	1.0	8.5	73
LTE21015R	2.1	16	250	1.5	8.5	77
LTE21025R	2.1	16	400	2.8	7.8	83
LTE42005S	4.2	18	110	≥ 0.45	≥ 6.6	87
LTE42008R	4.2	16	250	≥ 0.80	≥ 7	93
LTE42012R	4.2	16	400	≥ 1.0	≥ 6	99
LUE2003S	2.0	18	30	0.25	11	105
LUE2009S	2.0	18	110	0.90	9.8	105

Class-A bipolar transistors

type number	f GHz	V _{CC} V	I _C A	P _{L1} (1) W	G _{po} (2) dB	page
LV1721E50R	1.7 - 2.1	16	1.1	≥ 5	≥ 7	111
LV2024E45R	2.0 - 2.4	16	1.1	≥ 4	≥ 6	117
LV2327E40R	2.3 - 2.7	16	1.0	≥ 4	≥ 7	123
LV2931E50S	2.9 - 3.1	18	1.0	≥ 4.5	≥ 6	129
LVE21050R	2.1	16	1.1	5.5	8.0	135
LWE2015R	2.3	16	0.25	≥ 1.2	≥ 7.5	139
LWE2025R	2.3	16	0.4	≥ 2	≥ 7	145
LZ1418E100R	1.4 - 1.8	16	2.0	≥ 9	≥ 10	151
LZE18100R	1.8	16	2.0	10	11	157

Notes

- (1) Load power for 1 dB compressed power gain.
- (2) Low-level power gain associated with P_{L1}.
- (3) Low-noise type: F = 3 dB; G_a = 12 dB.

TYPE NUMBER SURVEY

CW class-B and pulsed power bipolar transistors

type number	f GHz	V _{CC} V	P _L W	G _p dB	η _c %	page
MRB11175Y	1.09	50	≥ 175 (1)	≥ 7.5 (1)	≥ 35	161
MRB11350Y	1.09	50	≥ 350 (1)	≥ 7 (1)	≥ 30	165
MSB11900Y	1.09	50	≥ 800 (1)	≥ 7 (1)	≥ 30	169
MZ0912B50Y	0.960 - 1.215	50	≥ 50 (2)	≥ 7 (2)	≥ 42	173
MZ0912B100Y	0.960 - 1.215	50	≥ 100 (2)	≥ 7 (2)	≥ 42	181
MX0912B250Y	0.960 - 1.215	50	≥ 235 (2)	≥ 7 (2)	≥ 42	189
MX0912B350Y	0.960 - 1.215	50	≥ 325 (2)	≥ 7 (2)	≥ 40	197
PKB12005U	1.2	28	6.5	10.5	45	205
	0.960 - 1.215	28	5 (2)	9 (2)	45	205
PKB20010U	1	28	25	11	58	207
	2	28	10	6	42	207
PPC5001T	5	20	0.45	in oscillator	—	209
PQC5001T	5	20	0.45	circuits	—	209
PTB23001X	2	24	≥ 1	≥ 7	≥ 45	213
PTB23003X	2	24	≥ 3	≥ 8.75	≥ 45	213
PTB23005X	2	24	≥ 5	≥ 9.2	≥ 50	213
PTB32001X	3	24	≥ 1.3	≥ 8	≥ 35	219
PTB32003X	3	24	≥ 2.5	≥ 8	≥ 35	219
PTB32005X	3	24	≥ 4.5	≥ 8	≥ 35	219
PTB42001X	4.2	24	≥ 0.8	≥ 5	≥ 28	225
PTB42002X	4.2	24	≥ 1.6	≥ 5	≥ 28	225
PTB42003X	4.2	24	≥ 2.5	≥ 5	≥ 28	229
PVB42004X	1	24	13	11	60	233
	2	24	10	10	48	233
	3	24	7.5	8.8	30	233
	4	24	4	6	25	233
PXB16050U	1.65	28	≥ 45	≥ 8.5	≥ 45	239
PZ1418B15U	1.4 - 1.8	28	≥ 12.5	≥ 7	≥ 38	245
PZ1418B30U	1.4 - 1.8	28	≥ 27	≥ 7.3	≥ 38	255
PZ1721B12U	1.7 - 2.1	28	≥ 12	≥ 6.8	≥ 35	245
PZ1721B25U	1.7 - 2.1	28	≥ 25	≥ 7	≥ 35	255
PZ2024B10U	2.0 - 2.4	28	≥ 9	≥ 5.6	≥ 30	245
PZ2024B20U	2.0 - 2.4	28	≥ 20	≥ 6	≥ 35	255
PZ2327B15U	2.3 - 2.7	28	≥ 15	≥ 7	≥ 40	265
PZB16035U	1.55	28	≥ 35	≥ 8	≥ 45	271
PZB16040U	1.64	28	45	9	45	277
PZB27020U	1	28	70	10	62	279
	2	28	40	7.8	48	279
	3	28	22	5	25	279

Notes

- (1) Measured under pulsed condition $t_p = 10 \mu s$; $\delta = 1\%$.
- (2) Measured under pulsed condition $t_p = 10 \mu s$; $\delta = 10\%$.

Pulsed power bipolar transistors

type number	f GHz	V _{CC} V	P _L W	G _p dB	η _c %	page
RV3135B5X	3.1 - 3.5	24	≥ 4 (1)	≥ 4.3 (1)	≥ 30	281
RX1011B350Y	1.03 - 1.09	50	≥ 300 (2)	≥ 7 (2)	≥ 38	285
RX1214B150W	1.2 - 1.4	40	≥ 135 (4)	≥ 6.5 (4)	≥ 35	289
RX1214B300Y	1.2 - 1.4	50	≥ 250 (3)	≥ 7 (3)	≥ 35	295
RX2731B90W	2.7 - 3.1	40	≥ 90 (1)	≥ 6 (1)	≥ 35	301
RX3034B70W	3.0 - 3.4	40	≥ 70 (1)	≥ 5.4 (1)	≥ 30	307
RXB12350Y	1.09	50	≥ 300 (1)	≥ 7 (1)	≥ 30	313
RZ1214B35Y	1.2 - 1.4	50	≥ 35 (3)	≥ 7 (3)	≥ 30	317
RZ1214B65Y	1.2 - 1.4	50	≥ 70 (3)	≥ 7 (3)	≥ 35	323
RZ2731B16W	2.7 - 3.1	40	≥ 15 (1)	≥ 6 (1)	≥ 32	329
RZ2731B32W	2.7 - 3.1	40	≥ 30 (1)	≥ 6 (1)	≥ 32	335
RZ2731B48W	2.7 - 3.1	40	≥ 45 (1)	≥ 6 (1)	≥ 32	341
RZ2731B60W	2.7 - 3.1	40	≥ 60 (1)	≥ 6 (1)	≥ 35	347
RZ3135B14W	3.1 - 3.5	40	≥ 13 (1)	≥ 5.5 (1)	≥ 30	353
RZ3135B28W	3.1 - 3.5	40	≥ 27 (1)	≥ 5.5 (1)	≥ 30	359
RZ3135B42W	3.1 - 3.5	40	≥ 40 (1)	≥ 5.5 (1)	≥ 30	365
RZ3135B50W	3.1 - 3.5	40	≥ 50 (1)	≥ 5.2 (1)	≥ 30	371
RZB12050Y	1.09	50	≥ 35 (1)	≥ 7 (1)	≥ 30	377
RZB12100Y	1.09	50	≥ 80 (1)	≥ 7 (1)	≥ 30	381
RZB12250Y	1.09	50	≥ 200 (1)	≥ 7 (1)	≥ 30	385

Notes

- (1) Measured under pulsed condition $t_p = 100 \mu\text{s}$; $\delta = 10\%$.
- (2) Measured under pulsed condition $t_p = 300 \mu\text{s}$; $\delta = 10\%$.
- (3) Measured under pulsed condition $t_p = 150 \mu\text{s}$; $\delta = 5\%$.
- (4) Measured under pulsed condition $t_p = 1 \text{ ms}$; $\delta = 10\%$.

MARKING CODES
LETTER SYMBOLS FOR 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.

Marking code	Type number	Marking code	Type number
R7	LAE6000Q	1005M	PKB12005U
R8	LAE4001R	2301X	PTB23001X
R9	LAE4002S	2303X	PTB23003X
104	LJE42002T	2305X	PTB23005X
146	LKE21004R	3201X	PTB32001X
190	LKE21050T	3203X	PTB32003X
196	LTE42008R	3205X	PTB32005X
198	LTE42012R	4002S	LTE4002S
383	PQC5001T	4201X	PTB42001X
395	PPC5001T	4202X	PTB42002X
400	LUE2003S	4203X	PTB42003X
401	LUE2009S	11175Y	MRB11175Y
407	LBE2003S	11350Y	MRB11350Y
408	LCE2009S	3135B5X	RV3135B5X
409	LBE2009S	42004X	PVB42004X
411	LWE2015R	1721E50R	LV1721E50R
413	LWE2025R	2024E45R	LV2024E45R
430	LV2931E50S	2327E40R	LV2327E40R
435	LTE21009R		
436	LTE210015R		
439	LTE21025R		
502	LTE42005S		

LETTER SYMBOLS FOR MICROWAVE TRANSISTORS

C_{cb}	= collector-base capacitance
C_{ce}	= collector-emitter capacitance
C_{eb}	= emitter-base capacitance
δ	= duty factor
f	= signal frequency
h_{FE}	= DC current gain
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}
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_{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
$R_{th\ j-c}$	= thermal resistance from junction to case
$R_{th\ j-mb}$	= thermal resistance from junction to mounting base
$R_{th\ mb-h}$	= 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
V_{SWR}	= voltage standing wave ratio
z_i	= complex transistor input 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

GENERAL

Type designation code

General recommendations

**Mounting recommendations
for flange envelopes**

Rating systems

Letter symbols

s-parameters

TYPE DESIGNATION CODE
FOR SILICON POWER BIPOLAR TRANSISTORS

X : Letter

∅ : Number

- a) XXX ∅ ∅ ∅ ∅ X : transistors without matching cell
- b) XXX ∅ ∅ ∅ ∅ ∅ X : transistors with input matching cell only (exception type PXB16050U)
- c) XX ∅ ∅ ∅ ∅ X ∅ ∅ X } transistors with input and output matching cell
 ∅ ∅ ∅ X } (exception type RZ1214B35Y)

X LETTERS

- First letter: mode of operation

L : Linear
M : Short pulse
P : CW class B
R : Long pulse

- Second letter: encapsulation

A : SOT100	K : FO-53	U : FO-163	←
B : FO-45	P : FO-102	V : FO-83 and FO-83B	←
C : FO-46	Q : FO-85	W : FO-93	
D : FO-58	R : FO-67	X : FO-91, FO-91B and FO-125A	←
E : FO-38	S : FO-96	Z : FO-57C and FO-57D	←
J : FO-41A	T : FO-41B		

- Third letter: common potential

E : Common emitter
B : Common base
C : Common collector

- Fourth letter: supply voltage
(suffix)

Q : 10 - 12 V	W : 40 - 45 V
R : 15 - 16 V	X : 24 V
S : 18 V	Y : 50 V
T : 20 (18 - 21 V)	Z : 48 V
U : 28 - 30 V	

∅ NUMBERS

a) Transistors without matching cell

- first digit: frequency of measurement (GHz)
- 2nd, 3rd, 4th digits: power
 - in watts (W) for P - M and R mode of operation
 - in 100 mW for L mode of operation

b) Transistors with input matching cell

- first and second digits: frequency of measurement (x 0.1 GHz)
- 3rd, 4th, 5th digits: power
 - in watts (W) for P - M and R mode of operation
 - in 100 mW for L mode of operation

c) Transistors with input and output matching cell

- first and second digits: lower frequency of use (in 0.1 GHz)
- third and fourth digits: higher frequency of use (in 0.1 GHz)
- last digit: power
 - in watt (W) for P - M and R mode of operation
 - in 100 mW for L mode operation

SILICON BIPOLAR TRANSISTORS

GENERAL OPERATIONAL RECOMMENDATIONS

INTRODUCTION

These devices operate at high frequencies and high power. To avoid damage or destruction, it is advisable to follow the advice given below during testing, setting-up procedures and final operation.

POLARIZATION

1. When testing transistors in a new circuit, the use of a current limiting power supply is recommended.
2. Initial testing at reduced supply voltage is discouraged as the resultant change of output impedance may cause oscillations due to mismatch conditions.
3. The RF blocking choke in the supply line, together with the DC blocking capacitor of the internal output prematching circuit of the transistor, may sometimes cause oscillations at very low frequencies. These can often be removed by bypassing the choke with a low value resistor.

OPERATION

1. Input power

While the circuit is not optimized, it is recommended that the average power input should be at a lower level than that specified. Initial testing of CW amplifiers is best performed in pulse operation at 50% duty factor. For pulsed amplifiers a reduction in duty factor is recommended.

2. Output waveform

It is advisable to check the output waveform with a spectrum analyzer or similar equipment to ensure that no parasitic effects causing unwanted modulation are present.

3. Frequency

Microwave performance is published in the datasheet at a single frequency or for a frequency range. Devices published for narrowband application can normally be used at frequencies other than that specified. However, especially for high power types, 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 the type numbers starting with two letters followed by four digits, e.g. LZ1418E100R) also have an output prematching network. This is essentially a high-pass filter with a resonance frequency below the lowest frequency of operation. Operation at this resonance frequency may damage the transistor, therefore it is recommended to consult the manufacturer if extended frequency operation is required.

THERMAL

Because the junction temperature is of paramount importance for the reliability of the transistors, all possible efforts should be made to keep it as low as possible.

1. Mechanical

The mounting recommendations given by the manufacturer should be followed.

THERMAL (continued)

2. Thermal resistance

Values are given in the datasheets for a specified junction temperature. Thermal resistance from junction to mounting base increases with junction temperature at approximately 0.3%/°C.

3. Thermal impedance

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

MOUNTING RECOMMENDATIONS
FOR FLANGE MICROWAVE TRANSISTORS

Flange microwave transistors are easy to mount but for optimum 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, FO-83
 - 16.5 mm for FO-57
 - 19 mm for FO-91, FO-125
 - 23.4 mm for FO-96They must have a depth of at least 6 mm.
Recommended screw:
 - M1.5 for FO-85
 - M2.5 for FO-41B, FO-53, FO-67, FO-83 and FO-96
 - M3 for FO-57, FO-91 and FO-125A washer to spread the joint pressure is recommended.
- 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 $R_a < 0.5$ mm (by grinding or lapping). The sparing use of evenly distributed heatsink compound on the transistor flange is recommended. Alternatively (especially for transistors of which the flange may have been distorted by earlier assembly) it may be recommended to lapp the flange prior to assembly to the above mentioned surface conditions.
- To prevent shear forces from being applied to the leads, it must be assured that the distance from the top of the printed-circuit board to the heatsink mounting surface is less than the minimum distance from the bottom of the transistor lead to the seating plane of the flange.
- Connections between transistor and amplifier circuits should be as short as possible. Therefore 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 is left, generally the best performance is obtained by pushing the transistor towards the output (collector) side.
- Before soldering the leads the mounting screws should be tightened observing the maximum specified torque.
- 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 (≈ 2.5 mm). Solder should completely fill the space between printed wiring 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 device.

RATING SYSTEMS

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

DEFINITIONS OF TERMS USED

Electronic device. An electronic tube or valve, transistor or other semiconductor device.

Note

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 which are directly related to the application.

Rating. A value which 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.

Note

Limiting conditions may be either maxima or minima.

Rating system. The set of principles upon which ratings are established and which determine their interpretation.

Note

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 life, 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 life, no design maximum value for the intended service is exceeded with a bogey 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 FOR TRANSISTORS AND SIGNAL DIODES

based on IEC Publication 148

LETTER SYMBOLS FOR CURRENTS, VOLTAGES AND POWERS

Basic letters

The basic letters to be used are:

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

Lower-case basic letters shall be used for the representation of instantaneous values which vary with time.

In all other instances upper-case basic letters shall be used.

Subscripts

A, a	Anode terminal
(AV), (av)	Average value
B, b	Base terminal, for MOS devices: Substrate
(BR)	Breakdown
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 circuited
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 (for FETS only) As second subscript: Non-repetitive (not for 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.

Note: No additional subscript is used for DC values.

Upper-case subscripts shall be used for the indication of:

- a) continuous (DC) values (without signal)
Example I_B
- b) instantaneous total values
Example i_B
- c) average total values
Example $I_{B(AV)}$
- d) peak total values
Example I_{BM}
- e) root-mean-square total values
Example $I_{B(RMS)}$

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

- a) instantaneous values
Example i_b
- b) root-mean-square values
Example $I_{b(rms)}$
- c) peak values
Example I_{bm}
- d) average values
Example $I_{b(av)}$

Note: If more than one subscript is used, subscript for which both styles exist shall either be all upper-case or all lower-case.

Additional rules for subscripts

Subscripts for currents

Transistors: 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}

Diodes: 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 , $I_{f(rms)}$

Subscripts for voltages

Transistors: 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}

Diodes: 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}

Subscripts for supply voltages or supply currents

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

Examples: V_{CC} , I_{EE}

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

Example: V_{CCE}

Subscripts for devices having 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 misunderstanding.

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

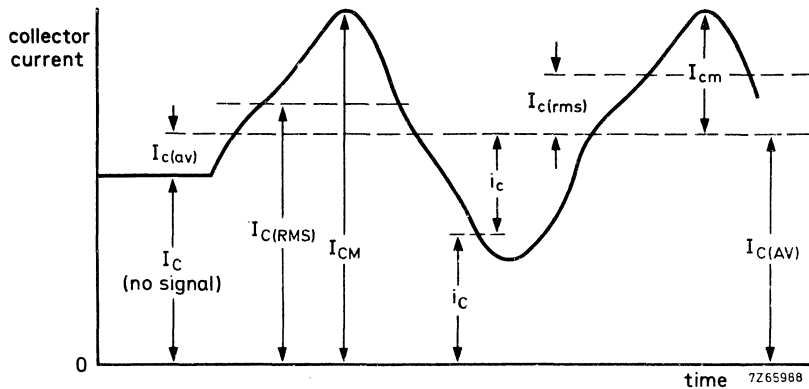
For multiple unit devices, the subscripts are modified by a number preceding the letter subscript; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

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 the second unit.

Application of the rules

The figure below represents a transistor collector current as a function of time. It consists of a continuous (DC) current and a varying component.



LETTER SYMBOLS FOR ELECTRICAL PARAMETERS

Defenition

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 is a list of 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 shall be used for the representation of:

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

Lower-case letters shall be used for the representation of electrical parameters inherent in the device (with the exception of inductances and capacitances).

Subscripts

General subscripts

The following is a list of 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_I , h_F

The upper-case variant of a subscript shall be used for the designation of static (d.c.) 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

Note: 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 shall be 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

Note: If more than one subscript is used, subscripts for which both styles exist shall either be all upper-case or all lower-case

Examples: 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.

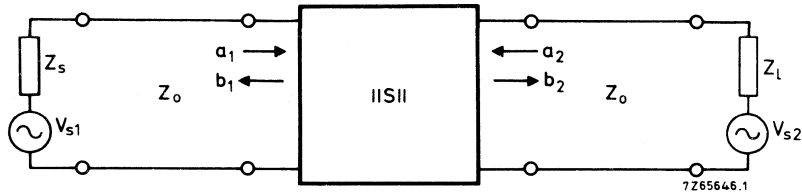
Examples: $Z_i = R_i + jX_i$
 $y_{fe} = g_{fe} + jb_{fe}$

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

Examples: $\text{Re}(h_{ib})$ etc. for the real part of h_{ib}
 $\text{Im}(h_{ib})$ etc. for the imaginary part of h_{ib}

SCATTERING PARAMETERS

In distinction to the conventional h, y and z-parameters, s-parameters relate to traveling wave conditions. The figure below shows a two-port network with the incident and reflected waves a_1 , b_1 , a_2 and b_2 .



$$a_1 = \frac{V_{i1}}{\sqrt{Z_0}}$$

$$a_2 = \frac{V_{i2}}{\sqrt{Z_0}}$$

$$b_1 = \frac{V_{r1}}{\sqrt{Z_0}}$$

$$b_2 = \frac{V_{r2}}{\sqrt{Z_0}}$$

1)

Z_0 = 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:

$$s_i = s_{11} = \left. \frac{b_1}{a_1} \right|_{a_2 = 0}$$

$$s_r = s_{12} = \left. \frac{b_1}{a_2} \right|_{a_1 = 0}$$

$$s_f = s_{21} = \left. \frac{b_2}{a_1} \right|_{a_2 = 0}$$

$$s_o = s_{22} = \left. \frac{b_2}{a_2} \right|_{a_1 = 0}$$

1) The squares of these quantities have the dimension of power.

S-PARAMETERS

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 $Z_1 = Z_0 = 50 \Omega$ 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 $Z_s = Z_0 = 50 \Omega$ 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 $Z_1 = Z_0 = 50 \Omega$ 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 $Z_s = Z_0 = 50 \Omega$ and $V_{s1} = 0$.

DEVICE DATA

MICROWAVE LINEAR POWER TRANSISTOR

NPN transistor 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.

QUICK REFERENCE DATA

RF performance up to $T_{\text{case}} = 25\text{ }^{\circ}\text{C}$ 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

Fig. 1 SOT100.

Emitter connected to metallized lid

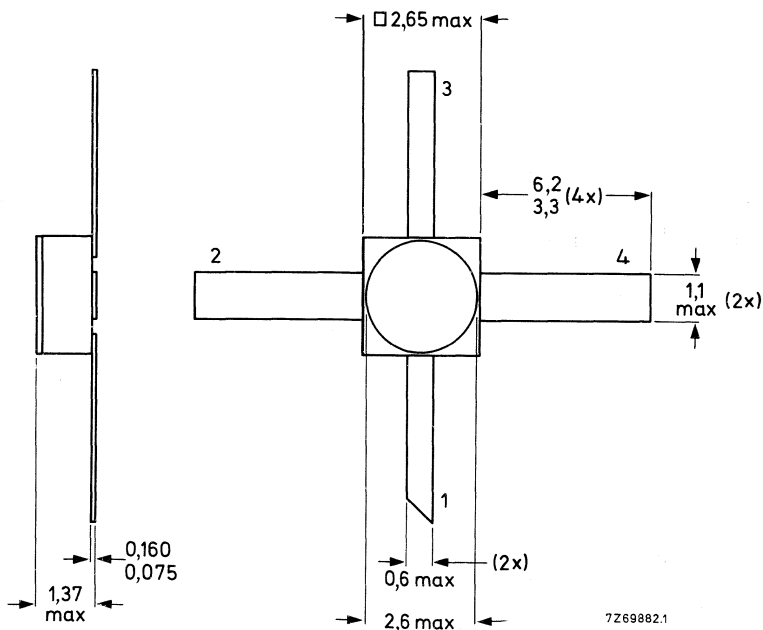
Dimensions in mm

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 ($R_{BE} = 220 \Omega$) (open base)	V_{CER}	max.	25 V
	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 $T_{case} = 100 \text{ }^\circ\text{C}$	P_{tot}	max.	480 mW
Storage temperature	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.1 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

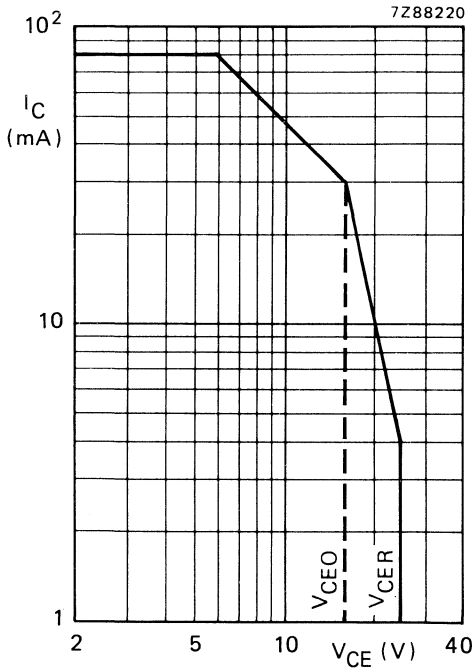


Fig. 2 DC SOAR at $T_{case} \leq 100 \text{ }^\circ\text{C}$;
 $R_{BE} < 220 \Omega$.

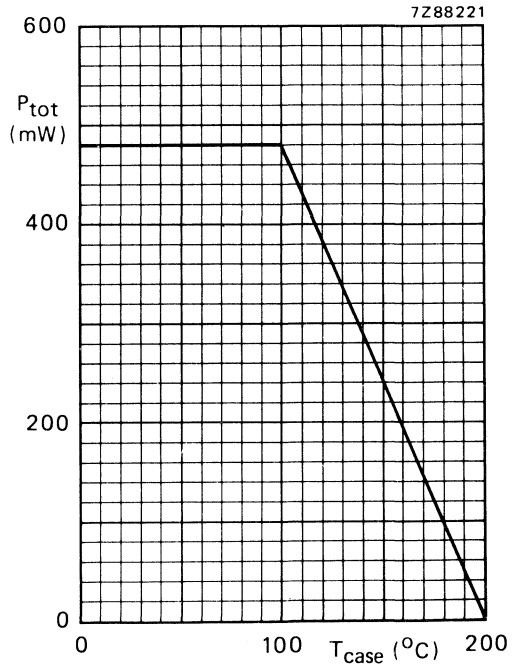


Fig. 3 Power derating curve vs. temperature.

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

→ From junction to case

R_{thj-c} max. 210 K/W*

*K/W is SI unit for $^\circ\text{C}/\text{W}$.

CHARACTERISTICS

 $T_{\text{case}} = 25\text{ }^{\circ}\text{C}$

Collector cut-off current

 $I_E = 0; V_{CB} = 15\text{ V}$ $I_{CBO} < 100\text{ nA}$ $I_E = 0; V_{CB} = 30\text{ V}$ $I_{CBO} < 100\text{ }\mu\text{A}$ $V_{CB} = 25\text{ V}; R_{BE} = 220\text{ }\Omega$ $I_{CER} < 500\text{ }\mu\text{A}$

Emitter cut-off current

 $I_C = 0; V_{EB} = 1,5\text{ V}$ $I_{EBO} < 35\text{ nA}$ $I_C = 0; V_{EB} = 2,0\text{ V}$ $I_{EBO} < 0.15\text{ }\mu\text{A}$

DC current gain

 $I_C = 25\text{ mA}; V_{CE} = 5\text{ V}$ $h_{FE} \quad 20\text{ to }220$ Collector-base capacitance at $f = 1\text{ MHz}$ $I_E = I_C = 0; V_{CB} = 15\text{ V}; V_{EB} = 1.5\text{ V}$ $C_{cb} \quad \text{typ.} \quad 0.25\text{ pF}$ Collector-emitter capacitance at $f = 1\text{ MHz}$ $I_E = I_C = 0; V_{CE} = 15; V_{EB} = 1.5\text{ V}$ $C_{ce} \quad \text{typ.} \quad 0.5\text{ pF}$ Emitter-base capacitance at $f = 1\text{ MHz}$ $I_E = I_C = 0; V_{EB} = 1.0\text{ V}; V_{CB} = 15\text{ V}$ $C_{eb} \quad \text{typ.} \quad 1.3\text{ pF}$

Forward power gain

 $I_C = 25\text{ mA}; V_{CE} = 15\text{ V}; f = 2\text{ GHz}$ $|s_{fe}|^2 \quad \text{typ.} \quad 9.6\text{ dB}$ $I_C = 25\text{ mA}; V_{CE} = 15\text{ V}; f = 4\text{ GHz}$ $|s_{fe}|^2 \quad \text{typ.} \quad 3.8\text{ dB}$

Maximum available gain

 $I_C = 25\text{ mA}; V_{CE} = 15\text{ V}; f = 2\text{ GHz}$ $G_{AM} \quad \text{typ.} \quad 16\text{ dB}$ $I_C = 25\text{ mA}; V_{CE} = 15\text{ V}; f = 4\text{ GHz}$ $G_{AM} \quad \text{typ.} \quad 10\text{ dB}$

s-parameters (common emitter)

Typical values; $V_{CE} = 15 \text{ V}$; $I_C = 25 \text{ mA}$; $T_{case} = 25 \text{ }^\circ\text{C}$; $Z_o = 50 \text{ } \Omega$

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 $T_{\text{case}} = 25\text{ }^{\circ}\text{C}$ in a common-emitter class-A circuit*

mode of operation	f GHz	$V_{\text{CE}}^{(1)}$ V	$I_{\text{C}}^{(1)}$ mA	$P_{\text{L1}}^{(2)}$ mW(dBm)	$G_{\text{po}}^{(3)}$ 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

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

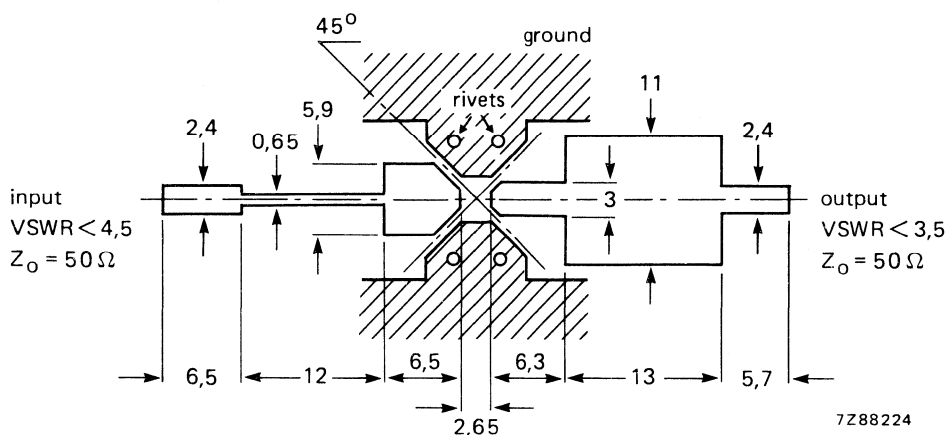


Fig. 4 Prematching test circuit board for 4 GHz. (Dimensions in mm.)

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

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

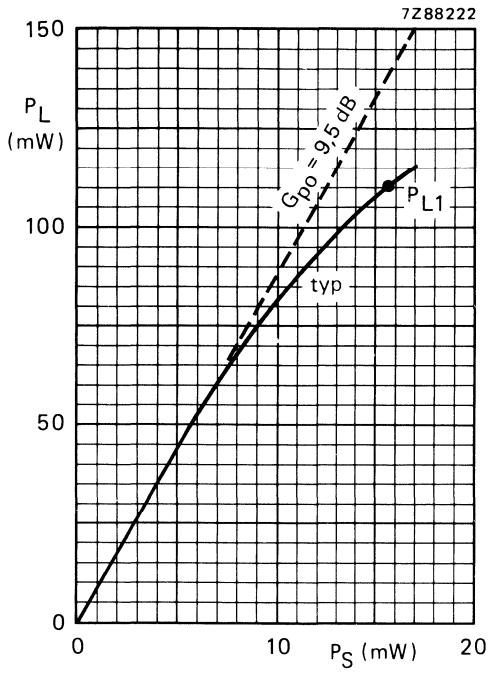


Fig. 5 $V_{CE} = 15 \text{ V}$; $I_C = 25 \text{ mA}$; $f = 4 \text{ GHz}$;
 $T_{case} = 25^\circ\text{C}$.

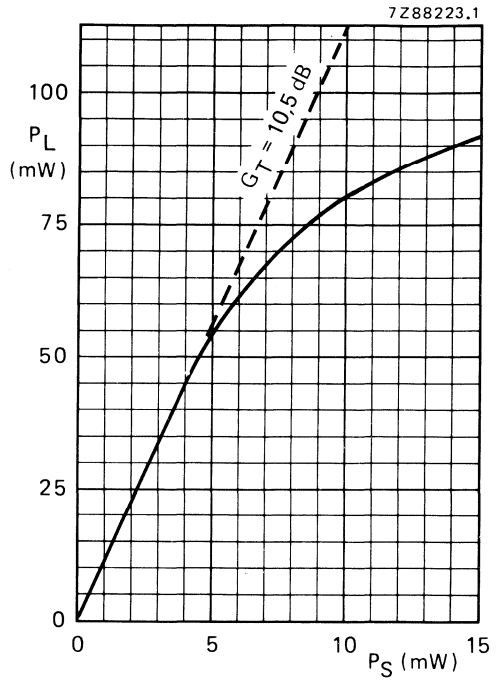


Fig. 6 $V_{CE} = 15 \text{ V}$; $I_C = 25 \text{ mA}$; $f = 4 \text{ GHz}$;
 maximum low-level linear power gain.

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 $T_{\text{case}} = 25\text{ }^{\circ}\text{C}$ 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

Fig. 1 SOT100.

Emitter connected to metallized lid

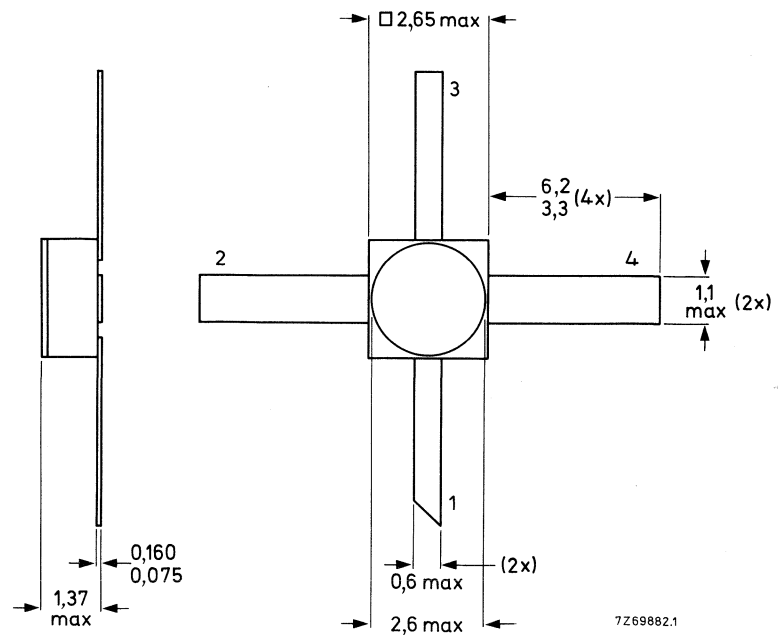
Dimensions in mm

Marking code:

R9 = LAE4002S

Pinning :

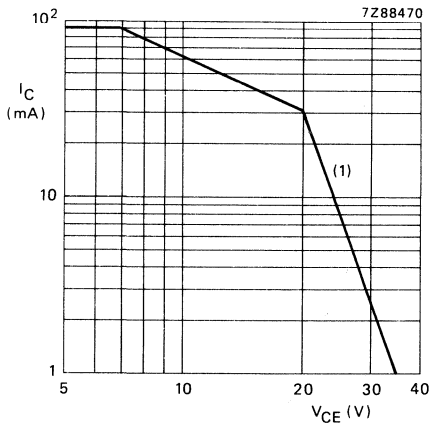
- 1 = collector
- 2 = emitter
- 3 = base
- 4 = emitter



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 ($R_{BE} = 220 \Omega$) (open base)	V_{CER} V_{CEO}	max.	35 V 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 $T_{case} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	625 mW
Storage temperature	T_{stg}		-65 to + 200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.1 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$



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

Fig. 2 DC SOAR at $T_{case} \leq 75 \text{ }^\circ\text{C}$;
 $R_{BE} < 220 \Omega$.

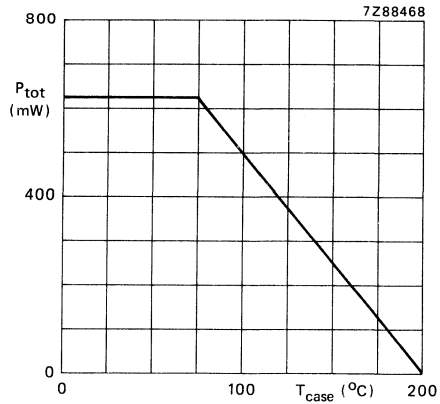


Fig. 3 Power derating curve vs. temperature.

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

➔ From junction to case

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

* K/W is SI unit for $^\circ\text{C}/\text{W}$.

CHARACTERISTICS

 $T_{\text{case}} = 25\text{ }^{\circ}\text{C}$

Collector cut-off current

 $I_E = 0; V_{CB} = 20\text{ V}$ $I_{CBO} < 100\text{ nA}$ $I_E = 0; V_{CB} = 40\text{ V}$ $I_{CBO} < 150\text{ }\mu\text{A}$ $V_{CB} = 35\text{ V}; R_{BE} = 220\text{ }\Omega$ $I_{CER} < 500\text{ }\mu\text{A}$

Emitter cut-off current

 $I_C = 0; V_{EB} = 1.5\text{ V}$ $I_{EBO} < 50\text{ nA}$ $I_C = 0; V_{EB} = 3.0\text{ V}$ $I_{EBO} < 25\text{ }\mu\text{A}$

DC current gain

 $I_C = 30\text{ mA}; V_{CE} = 5\text{ V}$ $h_{FE} \quad 15\text{ to }150$ Collector-base capacitance at $f = 1\text{ MHz}$ $I_E = I_C = 0; V_{CB} = 18\text{ V}; V_{EB} = 1.5\text{ V}$ $C_{cb} \quad \text{typ.} \quad 0.3\text{ pF}$ Collector-emitter capacitance at $f = 1\text{ MHz}$ $I_E = I_C = 0; V_{CE} = 18\text{ V}; V_{EB} = 1.5\text{ V}$ $C_{ce} \quad \text{typ.} \quad 0.55\text{ pF}$ Emitter-base capacitance at $f = 1\text{ MHz}$ $I_E = I_C = 0; V_{EB} = 1.0\text{ V}; V_{CB} = 18\text{ V}$ $C_{eb} \quad \text{typ.} \quad 1.8\text{ pF}$

Forward power gain

 $I_C = 30\text{ mA}; V_{CE} = 18\text{ V}; f = 2\text{ GHz}$ $|s_{fe}|^2 \quad \text{typ.} \quad 8.8\text{ dB}$ $I_C = 30\text{ mA}; V_{CE} = 18\text{ V}; f = 4\text{ GHz}$ $|s_{fe}|^2 \quad \text{typ.} \quad 2.8\text{ dB}$

Maximum available gain

 $I_C = 30\text{ mA}; V_{CE} = 18\text{ V}; f = 2\text{ GHz}$ $G_{AM} \quad \text{typ.} \quad 14\text{ dB}$ $I_C = 30\text{ mA}; V_{CE} = 18\text{ V}; f = 3\text{ GHz}$ $G_{AM} \quad \text{typ.} \quad 11\text{ dB}$

s-parameters (common emitter)

Typical values; $V_{CE} = 18\text{ V}$; $I_C = 30\text{ mA}$; $T_{case} = 25\text{ }^\circ\text{C}$; $Z_0 = 50\ \Omega$

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; $V_{CE} = 15\text{ V}$; $I_C = 15\text{ mA}$; $T_{case} = 25\text{ }^\circ\text{C}$; $Z_0 = 50\ \Omega$

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; $V_{CE} = 18 \text{ V}$; $I_C = 10 \text{ mA}$; $T_{\text{case}} = 25 \text{ }^\circ\text{C}$; $Z_0 = 50 \text{ } \Omega$

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 $T_{case} = 25\text{ }^{\circ}\text{C}$ 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)	$G_{pp}^{(3)}$ 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} .

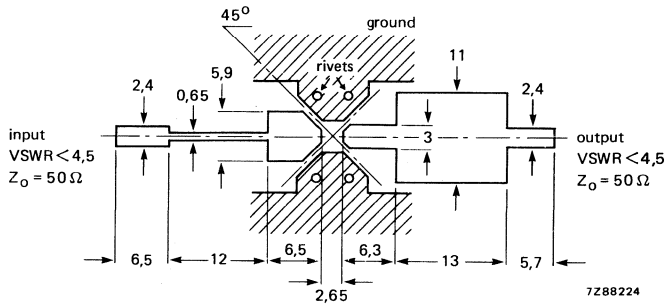


Fig. 4 Prematching test circuit board for 4 GHz. (Dimensions in mm.)

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

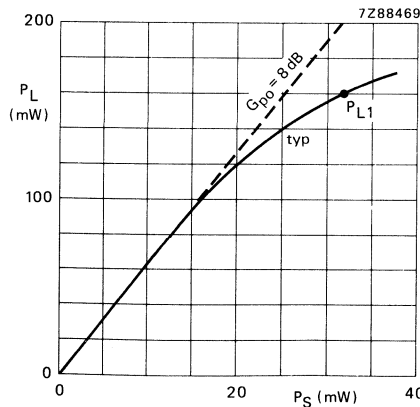


Fig. 5 $V_{CE} = 18\text{ V}$; $I_C = 30\text{ mA}$;
 $f = 4\text{ GHz}$; $T_{case} = 25\text{ }^{\circ}\text{C}$.

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

LOW-NOISE MICROWAVE TRANSISTOR

NPN transistor for common-emitter class-A low-noise 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 and microwave circuits.

QUICK REFERENCE DATA

RF performance up to $T_{case} = 25\text{ }^{\circ}\text{C}$ in an unneutralized common-emitter class-A circuit

mode of operation	f GHz	V_{CE} V	I_C mA	F_{min} dB	G_a dB
CW; linear amplifier	2	10	4	typ. 3	typ. 12

MECHANICAL DATA

Fig. 1 SOT100.

Emitter connected to metallized lid

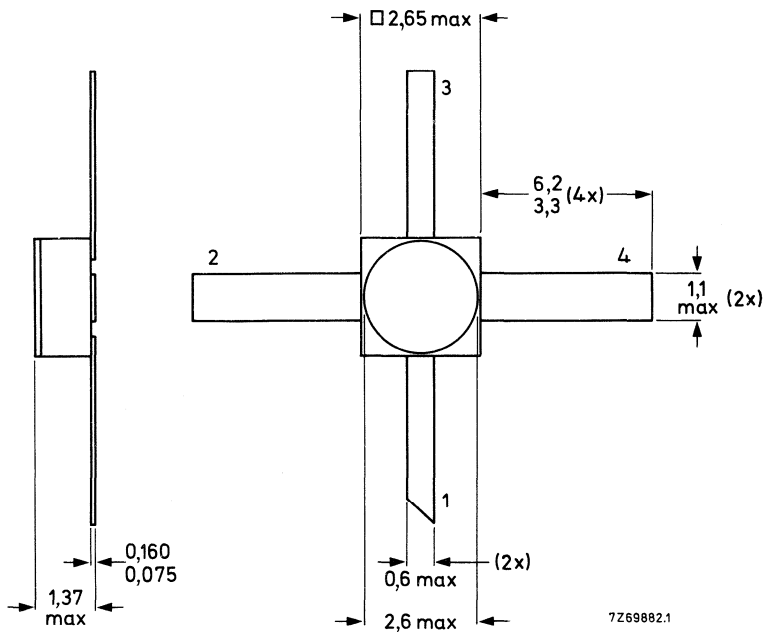
Dimensions in mm

Marking code:

R7 = LAE6000Q

Pinning :

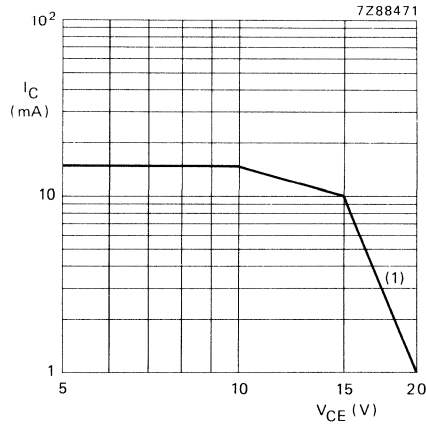
- 1 = collector
- 2 = emitter
- 3 = base
- 4 = emitter



RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	25 V
Collector-emitter voltage ($R_{BE} = 150 \Omega$) (open base)	V_{CER} V_{CEO}	max.	20 V 12 V
Emitter-base voltage (open collector)	V_{EBO}	max.	2 V
Collector current (DC)	I_C	max.	15 mA
Total power dissipation up to $T_{case} = 150 \text{ }^\circ\text{C}$	P_{tot}	max.	150 mW
Storage temperature	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.1 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$



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

Fig. 2 DC SOAR at $T_{case} \leq 150 \text{ }^\circ\text{C}$; $R_{BE} \leq 150 \Omega$.

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to case

$$R_{th \text{ j-c}} = 300 \text{ K/W}^*$$

* K/W is SI unit for $^\circ\text{C/W}$.

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.

QUICK REFERENCE DATA

RF performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

Fig.1a LBE2003S and LBE2009S.

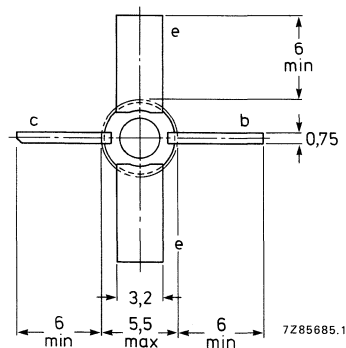
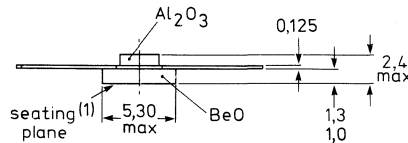
FO-45

Dimensions in mm

Marking code:

407 = LBE2003S

409 = LBE2009S



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

Marking code:

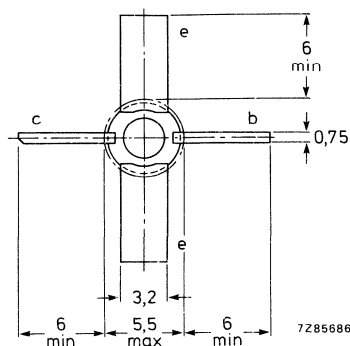
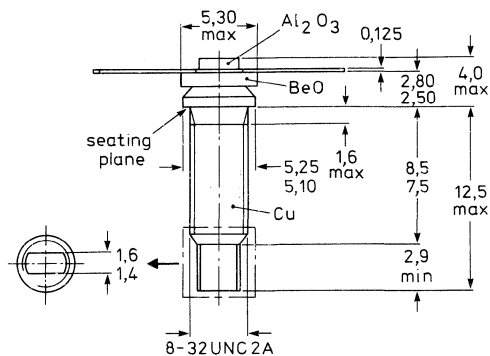
→ 406 = LCE2003S

→ 408 = LCE2009S

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

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

Dimensions in mm

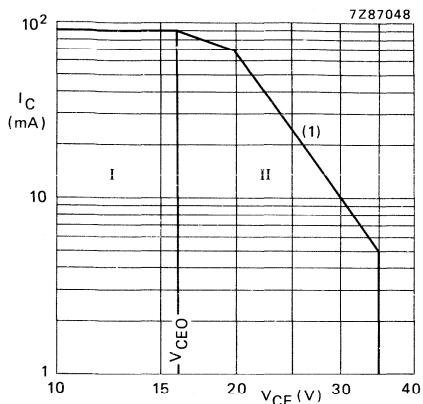


RATINGS

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 $R_{BE} = 100 \Omega$	V_{CER}	max.	—	35	V
	V_{CER}	max.	35	—	V
Collector-emitter voltage $R_{BE} = 220 \Omega$ (open base)	V_{CEO}	max.	16	16	V
	V_{EBO}	max.	3	3	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 $T_{mb} = 75^\circ\text{C}$	P_{tot}	max.	1.4	3.5	W
Storage temperature	T_{stg}		-65 to +150		$^\circ\text{C}$
Operating junction temperature	T_j	max.	200		$^\circ\text{C}$
Lead soldering temperature at 0.3 mm from the case; $t_{sld} = 10 \text{ s}$	T_{sld}	max.	235		$^\circ\text{C}$

LBE/LCE2003S



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

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

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

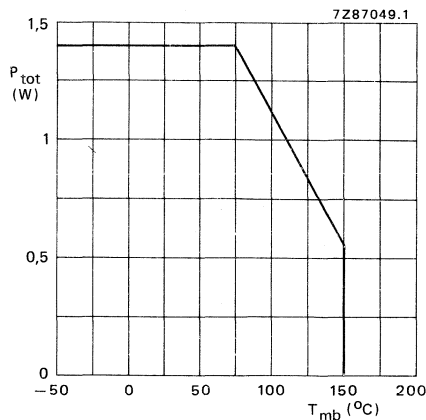
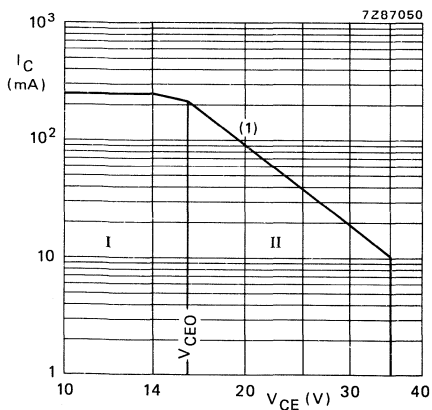


Fig. 3 Power derating curve vs. mounting base temperature.

LBE/LCE2009S



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

Fig. 4 DC SOAR at $T_{mb} \leq 75$ °C.

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

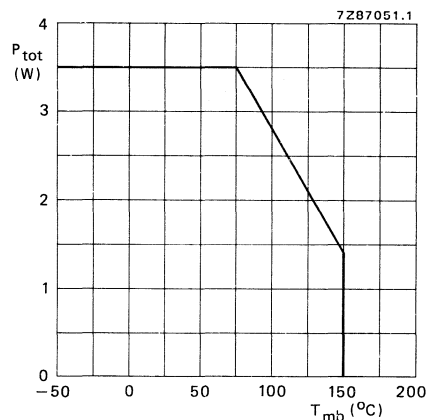


Fig. 5 Power derating curve vs. mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75\text{ }^\circ\text{C}$)

- From junction to mounting base
- From mounting base to heatsink

		LBE/LCE 2003S	LBE/LCE 2009S	
$R_{th\ j-mb}$	max.	65	36	K/W*
$R_{th\ mb-h}$	max.	1.5	1.5	K/W*

CHARACTERISTICS

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

Collector cut-off current

$I_E = 0; V_{CB} = 20\text{ V}$

$I_{CBO} < 0.1\text{ }\mu\text{A}$

$I_E = 0; V_{CB} = 40\text{ V}$

$I_{CBO} < 150\text{ }\mu\text{A}$

$V_{CB} = 35\text{ V}; R_{BE} = 220\ \Omega$

$I_{CER} < 500\text{ }\mu\text{A}$

$V_{CB} = 35\text{ V}; R_{BE} = 100\ \Omega$

$I_{CER} < 1000\text{ }\mu\text{A}$

Emitter cut-off current

$I_C = 0; V_{EB} = 1.5\text{ V}$

$I_{EBO} < 0.05\text{ }\mu\text{A}$

$I_C = 0; V_{EB} = 3.0\text{ V}$

$I_{EBO} < 50\text{ }\mu\text{A}$

DC current gain

$I_C = 30\text{ mA}; V_{CE} = 5\text{ V}$

$h_{FE} > 15$
 $h_{FE} < 150$

$I_C = 110\text{ mA}; V_{CE} = 5\text{ V}$

$h_{FE} > 15$
 $h_{FE} < 150$

Collector-base capacitance at $f = 1\text{ MHz}$

$I_E = I_C = 0; V_{CB} = 18\text{ V}; V_{EB} = 1.5\text{ V}$

C_{cb} typ. 0.3 pF

Collector-emitter capacitance at $f = 1\text{ MHz}$

$I_E = I_C = 0; V_{CE} = 18\text{ V}; V_{EB} = 1.5\text{ V}$

C_{ce} typ. 0.45 pF

Emitter-base capacitance at $f = 1\text{ MHz}$

$I_E = I_C = 0; V_{EB} = 1\text{ V}; V_{CB} = 10\text{ V}$

C_{eb} typ. 1.7 pF

* K/W is SI unit for $^\circ\text{C/W}$.

s-parameters (common emitter)

LBE/LCE2003S: Typical values; $V_{CE} = 18 \text{ V}^*$; $I_C = 30 \text{ mA}^*$; $T_{mb} = 25 \text{ }^\circ\text{C}$; $Z_o = 50 \text{ } \Omega$

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

The figures given between brackets are values in dB.

* V_{CE} and I_C regulated.

s-parameters (common emitter)

LBE/LCE2009S: Typical values; $V_{CE} = 18\text{ V}^*$; $I_C = 110\text{ mA}^*$; $T_{mb} = 25\text{ }^\circ\text{C}$; $Z_o = 50\ \Omega$

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

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

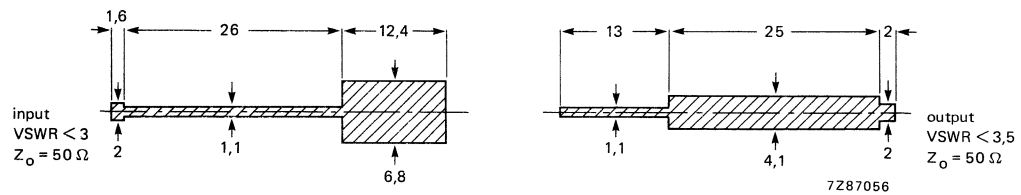


Fig. 6 Prematching test circuit board for 2 GHz. (Dimensions in mm.)

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

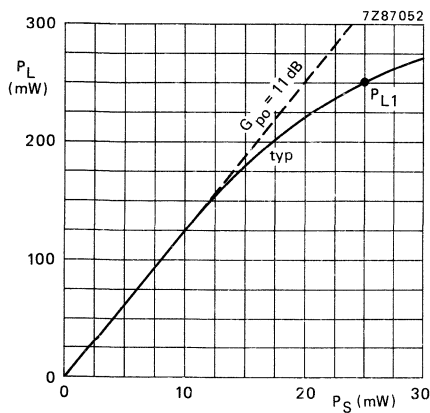


Fig. 7 $V_{CE} = 18\text{ V}$; $I_C = 30\text{ mA}$;
 $f = 2\text{ GHz}$; $T_{mb} = 25\text{ }^{\circ}\text{C}$.

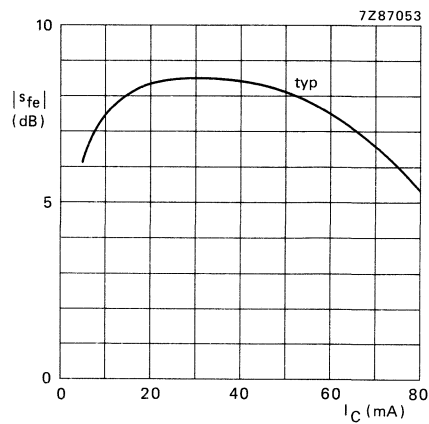


Fig. 8 $V_{CE} = 18\text{ V}$; class-A
operation; $f = 2\text{ GHz}$; $T_{mb} = 25\text{ }^{\circ}\text{C}$.

* 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 $T_{mb} = 75\text{ }^\circ\text{C}$ in a common-emitter class-A circuit*

f GHz	V_{CE} (1) V	I_C (1) mA	P_{L1} (2) mW(dBm)	G_{ppo} (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

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

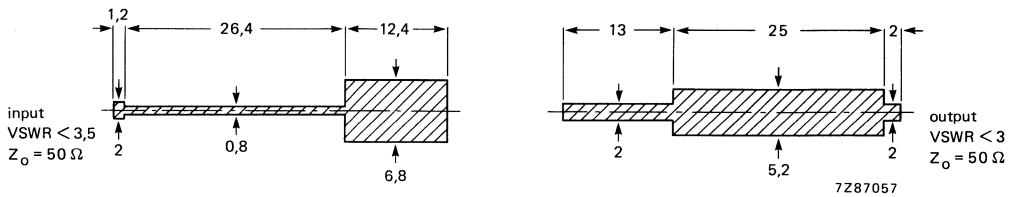


Fig. 9 Prematching test circuit board for 2 GHz. (Dimensions in mm.)

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

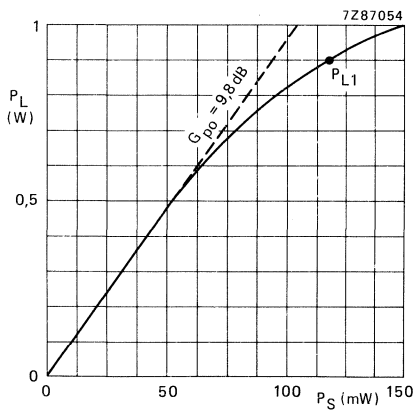


Fig. 10 $V_{CE} = 18\text{ V}$; $I_C = 110\text{ mA}$;
 $f = 2\text{ GHz}$; $T_{mb} = 25\text{ }^\circ\text{C}$.

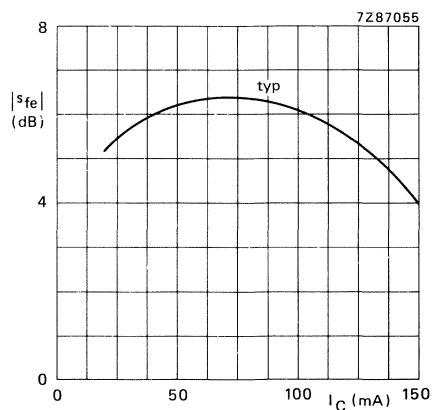


Fig. 11 $V_{CE} = 18\text{ V}$; class-A
operation; $f = 2\text{ GHz}$; $T_{mb} = 25\text{ }^\circ\text{C}$.

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

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon transistor intended for use in military and professional applications. It operates in c.w. conditions and is recommended in common-emitter class-A amplifiers up to 4 GHz.

It offers the following technological advantages:

- Interdigitated structure: high emitter efficiency
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high V.S.W.R.
- 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

The transistor has an FO-41A metal ceramic flange package.

It is mounted in a common-emitter configuration, specified in class-A and operates in c.w. conditions.

An input matching cell improves the input impedance and allows an easier design of broadband circuits.

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in an unneutralized common-emitter class-A selective amplifier.

Typical values

mode of operation	f GHz	V _{CE} V	I _C mA	P _{L1} mW	G _{po} dB	\bar{z}_i Ω	\bar{z}_L Ω
c.w.; class-A	4	20	65	200	7	50 + j65	2,5 + j6

MECHANICAL DATA

FO-41A (see Fig. 1).

WARNING

Product and environmental safety – toxic materials

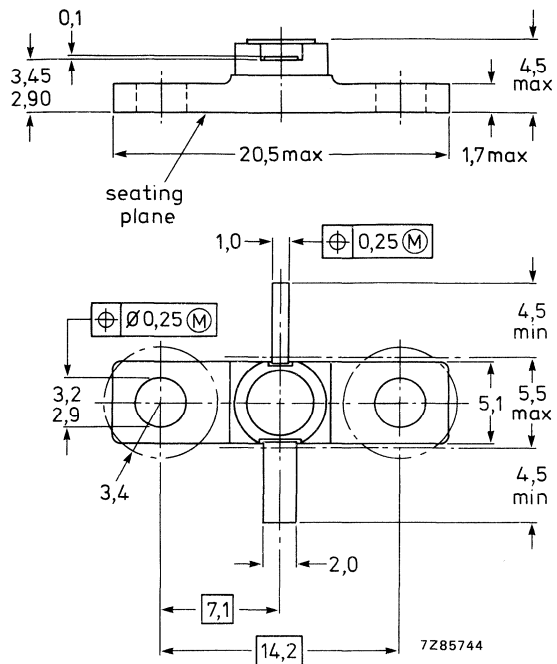
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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-41A.

Dimensions in mm



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 ($R_{BE} = 220 \Omega$) (open base)	V_{CER}	max.	25 V
	V_{CEO}	max.	20 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3,5 V
Collector current	I_C	max.	400 mA
Total power dissipation ($T_{mb} \leq 75 \text{ }^\circ\text{C}$)	P_{tot}	max.	1,5 W
Storage temperature	T_{stg}		-65 to 200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature at 0,1 mm from case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to mounting base	$R_{th \text{ j-mb}}$	41 K/W
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MICROWAVE LINEAR POWER TRANSISTOR

NPN transistor for use in a common-emitter class-A linear power amplifier up to 2.1 GHz.

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

QUICK REFERENCE DATA

RF performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in an unneutralized common-emitter class-A circuit

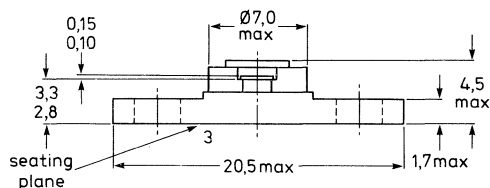
mode of operation	f GHz	V _{CE} V	I _C mA	P _{L1} mW	G _{po} dB	z _i Ω	Z _L Ω
CW; linear amplifier	2.1	15	140	typ. 600	typ. 10	6 + j8	4 + j8

MECHANICAL DATA

Dimensions in mm

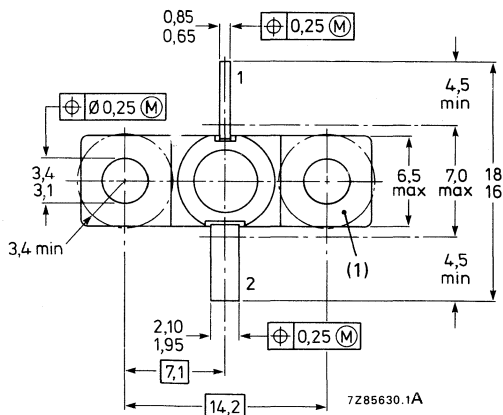
Fig. 1 FO-53.

Emitter connected to flange



Torque on nut: max. 0.5 Nm

Recommended screw: M3



Marking code

RTC146 = LKE21004R

(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 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.

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	30 V
Collector-emitter voltage $R_{be} = 500 \Omega$ open base	V_{CER}	max.	20 V
	V_{CEO}	max.	14 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	600 mA
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	2.8 W
Storage temperature	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.3 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to mounting base	$R_{th \text{ j-mb}}$	=	22 K/W
From mounting base to heatsink	$R_{th \text{ mb-h}}$	=	0.7 K/W

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon transistor intended for use in military and professional applications. It operates in c.w. conditions and is recommended in common-emitter class-A amplifiers up to 2,1 GHz.

It offers the following technological advantages:

- Interdigitated structure: high emitter efficiency
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high V.S.W.R.
- 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

The transistor has an FO-53 metal ceramic flange package.

It is mounted in a common-emitter configuration, specified in class-A and operates in c.w. conditions.

An input matching cell improves the input impedance and allows an easier design of broadband circuits.

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in an unneutralized common-emitter class-A selective amplifier.

Typical values

mode of operation	f GHz	V _{CE} V	I _C mA	PL ₁ mW	G _{po} dB	\bar{z}_i Ω	\bar{Z}_L Ω
c.w. class-A	2,1	20	300	1750	10	5 + j15	3 - j1

MECHANICAL DATA

FO-53 (see Fig. 1)

WARNING

Product and environmental safety – toxic materials

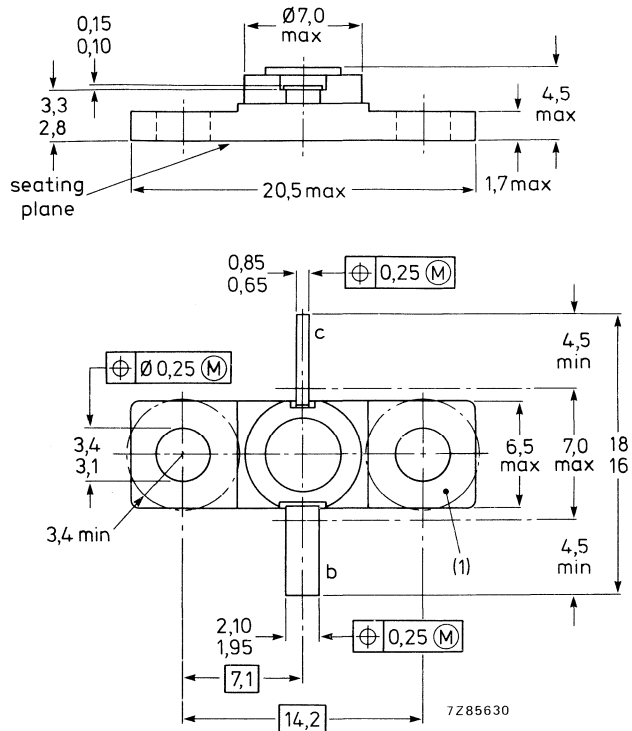
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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-53.



RATINGS

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

Collector-base voltage (open emitter)	V_{CB0}	max.	45 V
Collector-emitter voltage ($R_{BE} = 10 \Omega$) (open base)	V_{CEr}	max.	40 V
	V_{CE0}	max.	22 V
Emitter-base voltage (open collector)	V_{EB0}	max.	3.5 V
Collector current	I_C	max.	800 mA
Total power dissipation ($T_{mb} \leq 75 \text{ }^\circ\text{C}$)	P_{tot}	max.	8 W
Storage temperature	T_{stg}		-65 to 200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature at 0.1 mm from case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to mounting base	$R_{th \text{ j-mb}}$	11 K/W
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MICROWAVE LINEAR POWER TRANSISTOR

NPN transistor for use in a common-emitter class-A linear power amplifier up to 2.1 GHz.

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

An internal input matching network facilitates wideband operation.

QUICK REFERENCE DATA

RF performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in an unneutralized common-emitter class-A circuit

mode of operation	f GHz	V_{CE} V	I_C A	P_{L1} W	G_{p0} dB	z_i Ω	Z_L Ω
CW; linear amplifier	2.1	20	1.2	typ. 5.5	typ. 9	$2.5 + j8$	$2.5 - j7$

MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-53.

Emitter connected to flange.

Pinning:

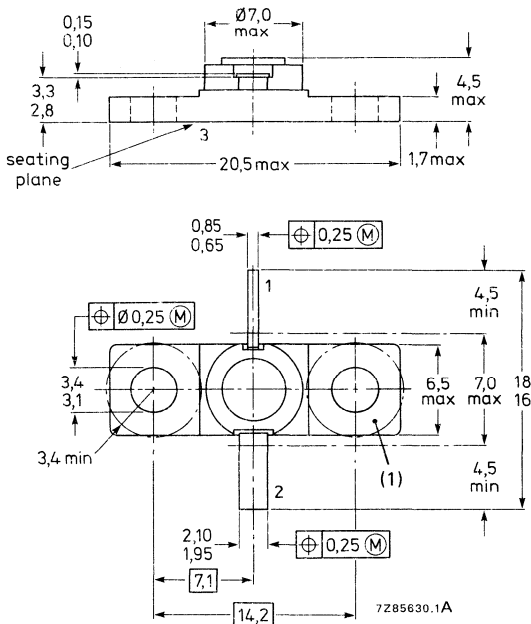
- 1 = collector
- 2 = base
- 3 = emitter

Torque on nut: max. 0.5 Nm

Recommended screw: M3

Marking code

RTC190 = LKE21050T



(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 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.

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	V_{CER}	max.	40 V
$R_{be} = 47 \Omega$	V_{CEO}	max.	22 V
open base	V_{EBO}	max.	3.5 V
Emitter-base voltage (open collector)	I_C	max.	3 A
Collector current (DC)	P_{tot}	max.	30 W
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	T_{stg}	-65 to +200	$^\circ\text{C}$
Storage temperature	T_j	max.	200 $^\circ\text{C}$
Junction temperature	T_{sld}	max.	235 $^\circ\text{C}$
Lead soldering temperature at 0.3 mm from the case; $t_{sld} \leq 10 \text{ s}$			

THERMAL RESISTANCE (at $T_j = 75^\circ\text{C}$)

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

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

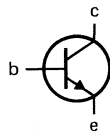
Dimensions in mm

Fig. 1 FO-41B.

Emitter and metallic cap connected to the seating plane.

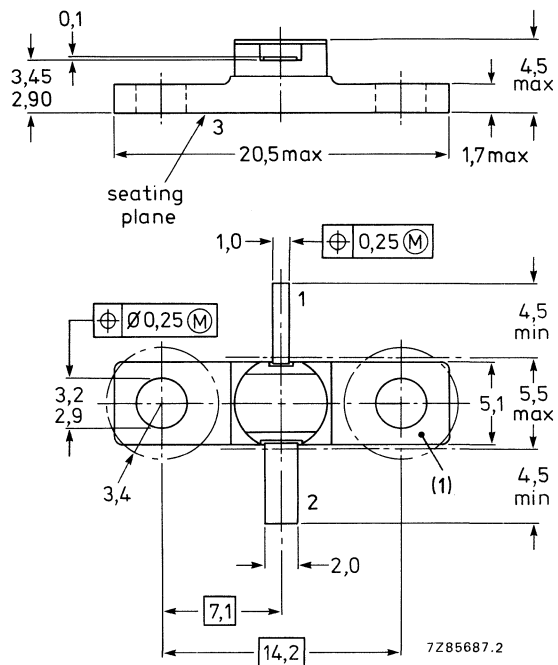
Pinning:

- 1 = collector
- 2 = base
- 3 = emitter



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

Marking code: RTC4002S = 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 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.

RATINGS

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

Collector-base voltage (open emitter)	V_{CB0}	max.	40 V
Collector-emitter voltage	V_{CEO}	max.	16 V
open base	V_{CER}	max.	35 V
$R_{BE} = 220 \Omega$	V_{EBO}	max.	3 V
Emitter-base voltage (open collector)	I_C	max.	90 mA
Collector current (DC)	P_{tot}	max.	1 W
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	T_{stg}	-65 to +200	$^\circ\text{C}$
Storage temperature range	T_j	max.	200 $^\circ\text{C}$
Junction temperature	T_{sld}	max.	235 $^\circ\text{C}$
Lead soldering temperature			
at 0.3 mm from the case; $t_{sld} \leq 10 \text{ s}$			

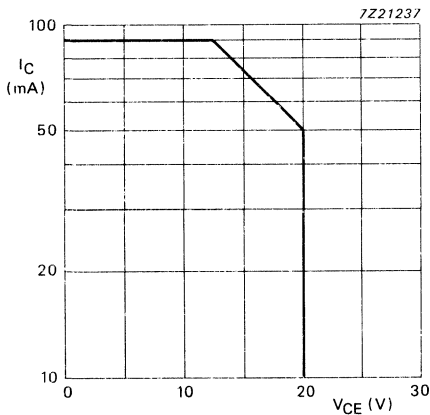


Fig. 2 DC SOAR at $T_{mb} \leq 75 \text{ }^\circ\text{C}$; $R_{BE} < 220 \Omega$.

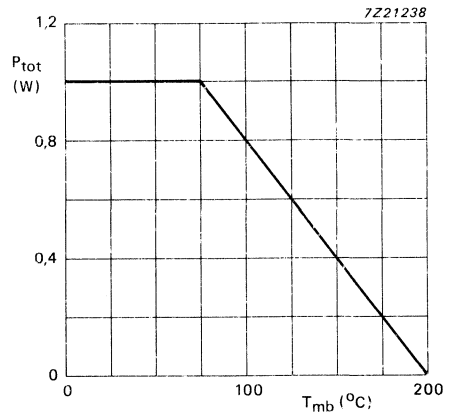


Fig. 3 Power derating curve.

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base

$$R_{th \text{ j-mb}} = 65 \text{ K/W}$$

CHARACTERISTICS

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

Collector cut-off currents

$$I_E = 0; V_{CB} = 20 \text{ V}$$

$$I_E = 0; V_{CB} = 40 \text{ V}$$

$$V_{BC} = 35 \text{ V}; R_{BE} = 200 \Omega$$

$$I_{CB0} < 100 \text{ nA}$$

$$I_{CB0} < 150 \mu\text{A}$$

$$I_{CER} < 500 \mu\text{A}$$

Emitter cut-off currents

$$I_C = 0; V_{EB} = 1,5 \text{ V}$$

$$I_C = 0; V_{EB} = 3,0 \text{ V}$$

$$I_{EBO} < 50 \text{ nA}$$

$$I_{EBO} < 25 \mu\text{A}$$

DC current gain

$$I_C = 30 \text{ mA}; V_{CE} = 5 \text{ V}$$

$$h_{FE} \quad 15 \text{ to } 150$$

s-parameters (common-emitter)

 $V_{CE} = 18 \text{ V}$; $I_C = 30 \text{ mA}$; $T_{mb} = 25 \text{ }^\circ\text{C}$; $Z_O = 50 \text{ } \Omega$; typical values

f GHz	S_{ie}	S_{re}	S_{fe}	S_{oe}
0.25	0.63/ -111 $^\circ$	0.022/ 41.4 $^\circ$	15.60/ 120.2 $^\circ$	0.74/ -30.2 $^\circ$
0.50	0.66/ -149 $^\circ$	0.027/ 29.8 $^\circ$	9.38/ 93.4 $^\circ$	0.61/ -40.3 $^\circ$
0.75	0.66/ -167 $^\circ$	0.030/ 26.8 $^\circ$	6.51/ 76.9 $^\circ$	0.58/ -49.0 $^\circ$
1.00	0.66/ -180 $^\circ$	0.031/ 26.9 $^\circ$	4.94/ 63.7 $^\circ$	0.58/ -57.8 $^\circ$
1.25	0.65/ 171 $^\circ$	0.033/ 26.9 $^\circ$	3.96/ 52.1 $^\circ$	0.58/ -57.2 $^\circ$
1.50	0.65/ 164 $^\circ$	0.035/ 29.1 $^\circ$	3.29/ 41.7 $^\circ$	0.60/ -75.9 $^\circ$
1.75	0.63/ 156 $^\circ$	0.039/ 30.0 $^\circ$	2.84/ 31.3 $^\circ$	0.63/ -84.8 $^\circ$
2.00	0.61/ 148 $^\circ$	0.042/ 29.0 $^\circ$	2.47/ 21.3 $^\circ$	0.65/ -93.2 $^\circ$
2.25	0.60/ 141 $^\circ$	0.046/ 28.5 $^\circ$	2.19/ 11.2 $^\circ$	0.67/ -102.3 $^\circ$
2.50	0.58/ 135 $^\circ$	0.051/ 27.0 $^\circ$	1.96/ 1.8 $^\circ$	0.71/ -109.4 $^\circ$
2.75	0.55/ 128 $^\circ$	0.058/ 24.2 $^\circ$	1.78/ -7.3 $^\circ$	0.74/ -115.7 $^\circ$
3.00	0.50/ 118 $^\circ$	0.063/ 19.4 $^\circ$	1.66/ -17.2 $^\circ$	0.76/ -121.4 $^\circ$
3.25	0.47/ 105 $^\circ$	0.067/ 14.3 $^\circ$	1.53/ -27.7 $^\circ$	0.78/ -127.8 $^\circ$
3.50	0.43/ 94 $^\circ$	0.070/ 7.2 $^\circ$	1.41/ -38.2 $^\circ$	0.81/ -134.5 $^\circ$
3.75	0.37/ 80 $^\circ$	0.073/ 0.2 $^\circ$	1.30/ -48.7 $^\circ$	0.83/ -139.8 $^\circ$
4.00	0.31/ 58 $^\circ$	0.074/ -8.0 $^\circ$	1.21/ -59.7 $^\circ$	0.83/ -144.0 $^\circ$
4.25	0.29/ 30 $^\circ$	0.073/ -17.9 $^\circ$	1.23/ -72.0 $^\circ$	0.84/ -149.6 $^\circ$
4.50	0.29/ 7 $^\circ$	0.069/ -28.7 $^\circ$	1.03/ -84.3 $^\circ$	0.86/ -157.0 $^\circ$
4.75	0.28/ -19 $^\circ$	0.060/ -42.0 $^\circ$	0.93/ -97.3 $^\circ$	0.86/ -164.2 $^\circ$
5.00	0.30/ -48 $^\circ$	0.047/ -56.3 $^\circ$	0.83/ -110.5 $^\circ$	0.85/ -169.9 $^\circ$
5.25	0.35/ -71 $^\circ$	0.032/ -76.3 $^\circ$	0.73/ -124.2 $^\circ$	0.84/ -175.9 $^\circ$
5.50	0.38/ -88 $^\circ$	0.015/ -124.9 $^\circ$	0.64/ -138.4 $^\circ$	0.84/ 176.2 $^\circ$
5.75	0.39/ -106 $^\circ$	0.023/ 141.5 $^\circ$	0.56/ -154.4 $^\circ$	0.83/ 167.2 $^\circ$
6.00	0.42/ -128 $^\circ$	0.051/ 108.0 $^\circ$	0.47/ -172.3 $^\circ$	0.81/ 159.8 $^\circ$

SUPERSEDES DATA OF AUGUST 1987

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).

QUICK REFERENCE DATA

RF performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common-emitter class-A circuit

mode of operation	f GHz	V _{CC} V	I _C mA	P _{L1} W	G _{po} dB
CW; class-A	2.1	16	150	typ. 1.0	typ. 8.5

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 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

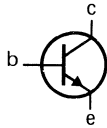
Dimensions in mm

Fig.1 FO-41B.

Emitter and metallic cap are connected to the seating plane.

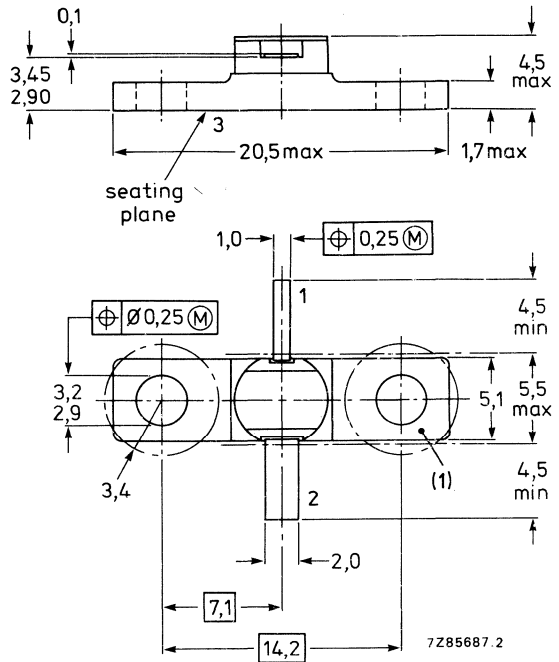
Pinning:

- 1 = collector
- 2 = base
- 3 = emitter



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

→ **Marking code:**
435 = LTE21009R

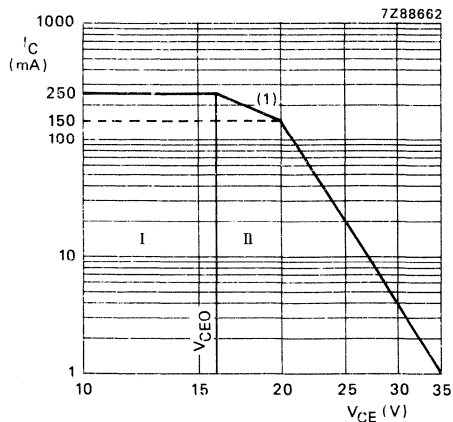


(1) Flatness of this area ensures full thermal contact with bold head.

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 $R_{BE} = 100 \Omega$ open base	V_{CER} V_{CEO}	max. max.	35 V 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 $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	4.0 W
Storage temperature range	T_{stg}		-65 to + 200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.3 mm from case; $t_{std} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$



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

Fig.2 DC SOAR at $T_{mb} \leq 75 \text{ }^\circ\text{C}$.

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

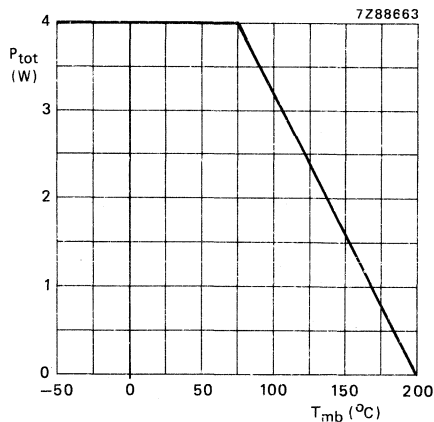


Fig.3 Power derating curve.

THERMAL RESISTANCE ($T_{mb} = 25 \text{ }^\circ\text{C}$)

From junction to mounting base
 From mounting base to heatsink

$R_{th \text{ j-mb}}$	max.	30 K/W
$R_{th \text{ mb-h}}$	max.	0.7 K/W

CHARACTERISTICS

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

Collector cut-off current

$I_E = 0; V_{CB} = 20 \text{ V}$
 $I_E = 0; V_{CB} = 40 \text{ V}$

I_{CBO}	max.	50 μA
I_{CBO}	max.	0.4 mA

Emitter cut-off current

$I_C = 0; V_{EB} = 1.5 \text{ V}$
 $I_C = 0; V_{EB} = 3.5 \text{ V}$

I_{EBO}	max.	200 nA
I_{EBO}	max.	0.1 mA

DC current gain

$I_C = 150 \text{ mA}; V_{CE} = 5 \text{ V}$

h_{FE}	min.	15
	max.	150

s-parameters (common emitter)

$V_{CE} = 16\text{ V}$
 $I_C = 150\text{ mA}$ } regulated; $T_{mb} = 25\text{ }^\circ\text{C}$; $Z_O = 50\ \Omega$; 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.

Philips Components

Data sheet	
status	Product specification
date of issue	June 1990

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 base connected to flange. It is mounted in common-emitter configuration, and specified in class A.

QUICK REFERENCE DATA

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

MODE OF OPERATION	f (GHz)	V _{CE} (V)	I _C (mA)	P _{L1} (mW)	G _{po} (dB)	z _i / Z _L (Ω)
class A	2	16	250	≥ 1.5	> 8.5	see Figs 6 and 7

WARNING

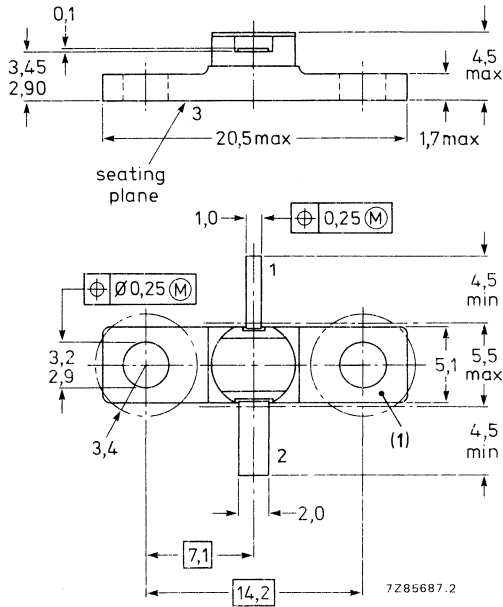
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.
After use, dispose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

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

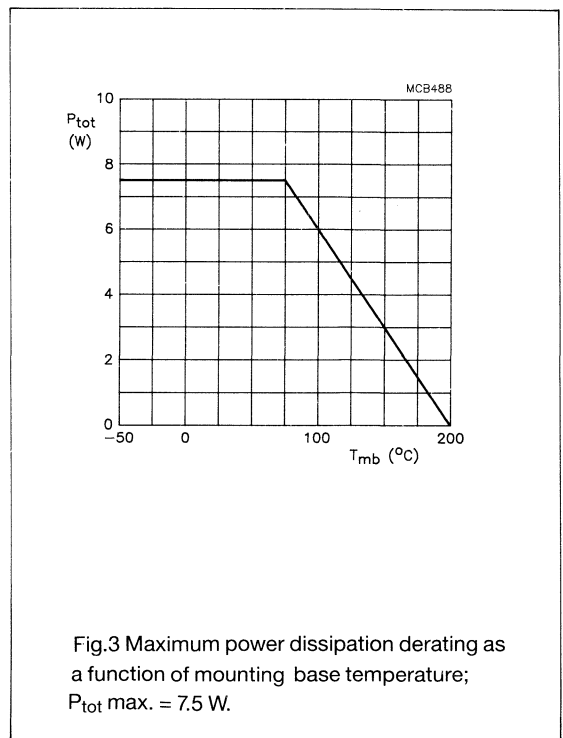
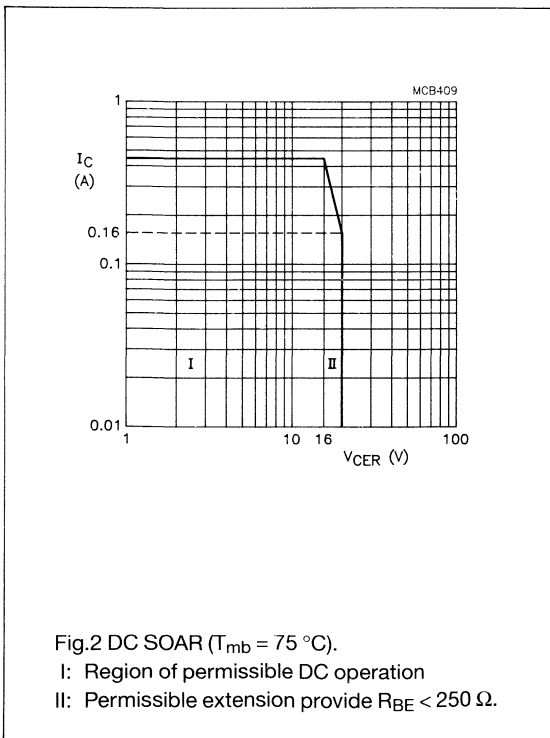
LIMITING VALUES

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 Ω	-	20	V
V _{CEO}	collector-emitter voltage	open base	-	16	V
V _{EBO}	emitter-base voltage	open collector	-	3.5	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 _{slid}	soldering temperature	t ≤ 10 s; up to 0.2 mm from ceramic	-	235	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
R _{th j-mb}	from junction to mounting base	T _j = 70 °C	12	K/W
R _{th mb-h}	from mounting base to heatsink		0.7	K/W



NPN silicon planar epitaxial microwave power transistor

LTE21015R

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 20\text{ V}; I_E = 0$	-	150	μA
I_{CBO}	collector cut-off current	$V_{CB} = 40\text{ V}; I_E = 0$	-	1	mA
I_{CER}	collector cut-off current	$V_{CE} = 20\text{ V}; R_{BE} = 270\ \Omega$	-	0.5	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	-	1.5	μA
I_{EBO}	emitter cut-off current	$V_{EB} = 3.5\text{ V}; I_C = 0$	-	200	μA
h_{FE}	DC current gain	$V_{CE} = 5\text{ V}; I_C = 250\text{ mA}$	15	150	

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ °C}$ 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} (mW) 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

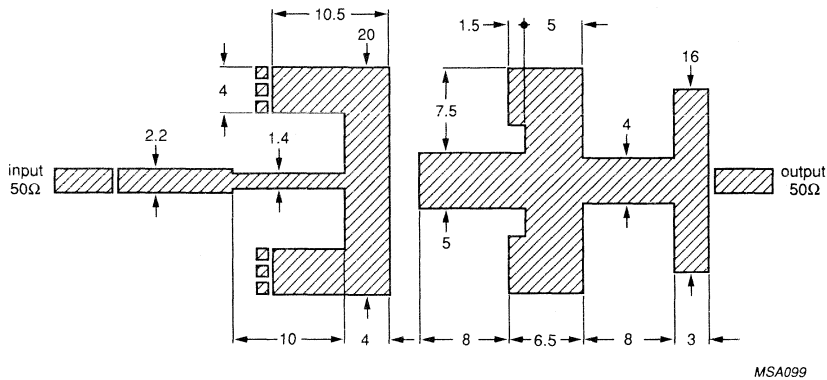
Notes

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
 $\epsilon = 2.55$
 thickness = 0.8 mm

Fig.4 Narrowband test circuit

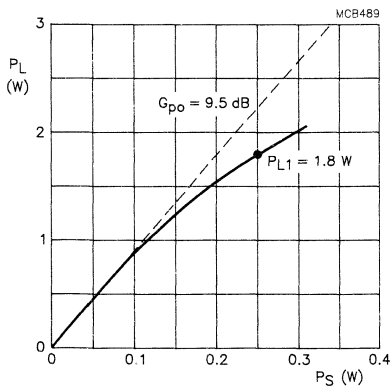


Fig.5 Load power P_L as a function of source power P_S ;
 $V_{CE} = 16$ V; $I_C = 250$ mA (regulated);
 (In narrowband test circuit as shown in Fig.4).

NPN silicon planar epitaxial microwave power transistor

LTE21015R

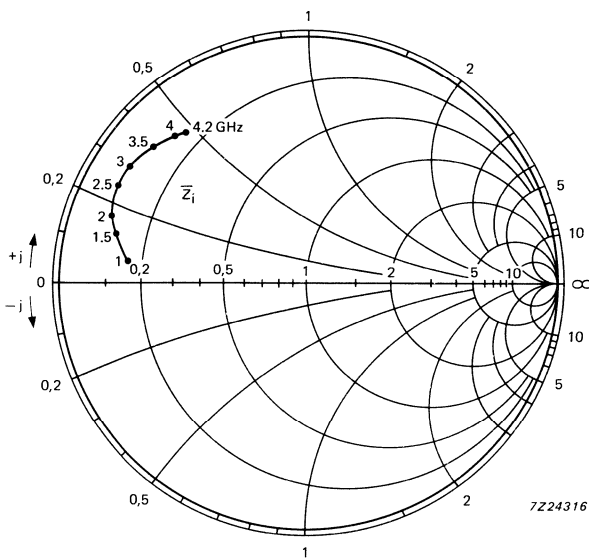


Fig.6 Input impedance as a function of frequency for P_{L1} ; associated with optimum load impedance; $V_{CE} = 16$ V; $I_C = 250$ mA; $Z_o = 50 \Omega$.

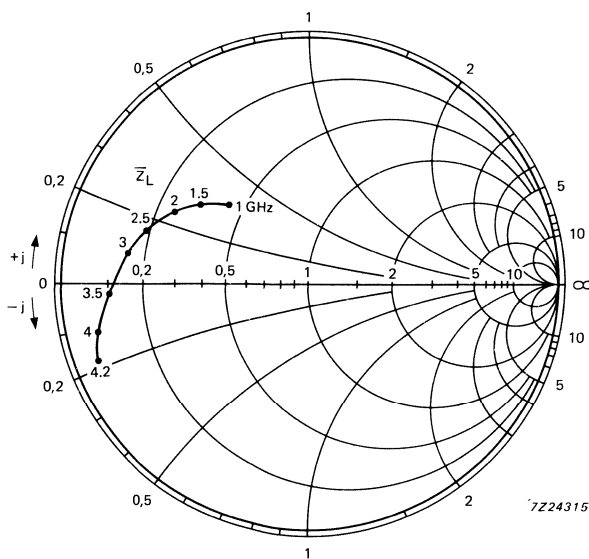


Fig.7 Optimum load impedance as a function of frequency for P_{L1} ; associated with input impedance; $V_{CE} = 16$ V; $I_C = 250$ mA; $Z_o = 50 \Omega$.

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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common-emitter class-A circuit

Mode of operation	f GHz	V _{CC} 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

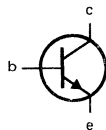
Dimensions in mm

Fig. 1 FO-41B.

Emitter and metallic cap are connected to the seating plane.

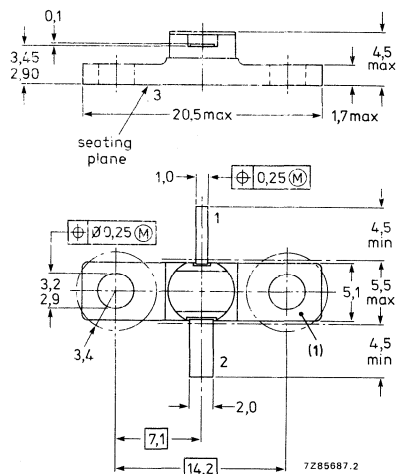
Pinning:

- 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 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.

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 $R_{BE} = 70 \Omega$ open base	V_{CER} V_{CEO}	max.	20 V 16 V
Emitter-base voltage open collector	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	800 mA
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	8.0 W
Storage temperature range	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.3 mm from case; $t_{std} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

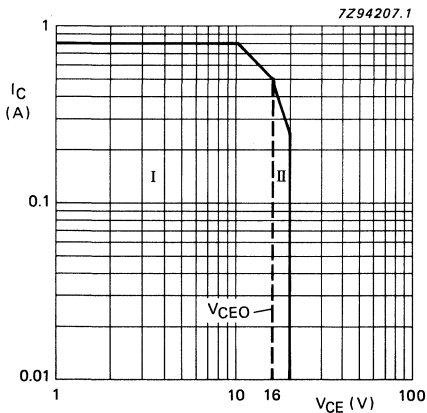


Fig. 2 DC SOAR at $T_{mb} \leq 75 \text{ }^\circ\text{C}$.
 I Region of permissible DC operation.
 II Permissible extension provided $R_{BE} \leq 70 \Omega$.

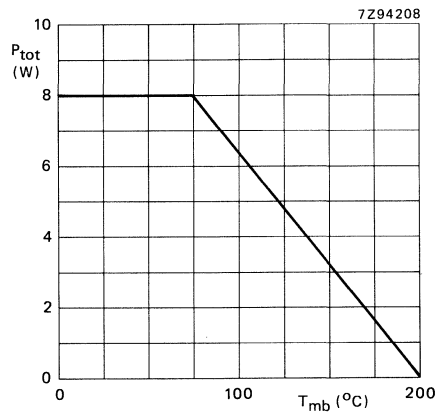


Fig. 3 Power derating curve.

THERMAL RESISTANCE ($T_j = 75\text{ }^\circ\text{C}$)

From junction to mounting base

 $R_{th\ j-mb}$ max. 10 K/W ←

From mounting base to heatsink

 $R_{th\ mb-h}$ max. 0.7 K/W ←**CHARACTERISTICS** $T_{mb} = 25\text{ }^\circ\text{C}$ unless otherwise specified

Collector cut-off current

 $I_E = 0; V_{CB} = 20\text{ V}$ I_{CBO} max. 225 μA $I_E = 0; V_{CB} = 40\text{ V}$ I_{CBO} max. 1.5 mA

Emitter cut-off current

 $I_C = 0; V_{EB} = 1.5\text{ V}$ I_{EBO} max. 600 nA $I_C = 0; V_{EB} = 3.5\text{ V}$ I_{EBO} max. 0.3 mA

DC current gain

 $I_C = 400\text{ mA}; V_{CE} = 5\text{ V}$ h_{FE} min. 15
max. 150Collector-base capacitance at $f = 1\text{ MHz}$ $I_E = I_C = 0; V_{CB} = 16\text{ V}; V_{EB} = 1.5\text{ V}$ C_{cb} typ. 3 pF ←Collector-emitter capacitance at $f = 1\text{ MHz}$ $I_C = I_E = 0; V_{CE} = 16\text{ V}; V_{EB} = 1.5\text{ V}$ C_{ce} typ. 1.5 pF ←Emitter-base capacitance at $f = 1\text{ MHz}$ $I_C = I_E = 0; V_{EB} = 1\text{ V}; V_{CB} = 10\text{ V}$ C_{eb} typ. 28 pF ←

s-parameters (common-emitter)

Typical values; $V_{CE} = 16\text{ V}$; $I_C = 400\text{ mA}$; $Z_0 = 50\ \Omega$; $T_{mb} = 25\text{ }^\circ\text{C}$.

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.

SUPERSEDES DATA OF JULY 1988

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

Fig.1 FO-41B.

Emitter and metallic cap are connected to the seating plane.

Pinning

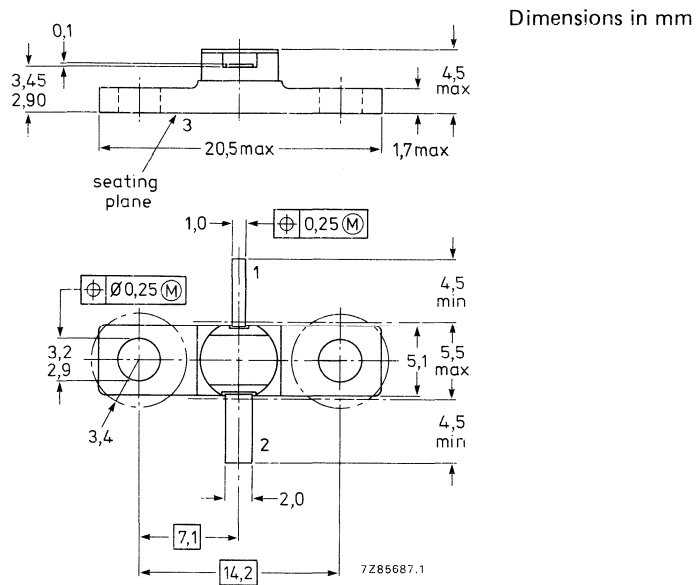
- 1 = collector
- 2 = base
- 3 = emitter

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 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.

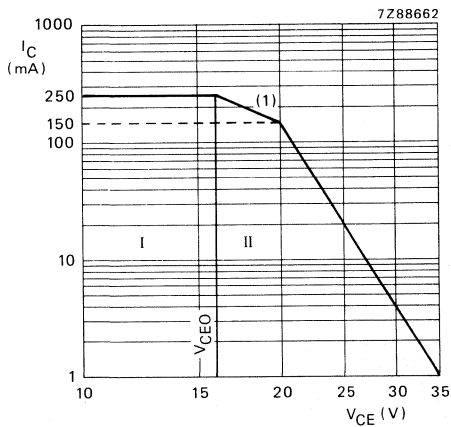
RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	40 V
Collector-emitter voltage $R_{BE} = 100 \Omega$ (open base)	V_{CER} V_{CEO}	max.	35 V 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 $T_{mb} = 75^\circ C$	P_{tot}	max.	4 W
Storage temperature range	T_{stg}		-65 to $+200^\circ C$
Junction temperature	T_j	max.	$200^\circ C$
Lead soldering temperature at 0.3 mm from the case; $t_{sld} = 10$ s	T_{sld}	max.	$235^\circ C$

THERMAL RESISTANCE (at $T_j = 75^\circ C$)

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



(1) Second breakdown limit (independent of temperature).
 Fig.2 DC SOAR at $T_{mb} \leq 75^\circ C$.
 I Region of permissible DC operation.
 II Permissible extension provided $R_{BE} \leq 100 \Omega$.

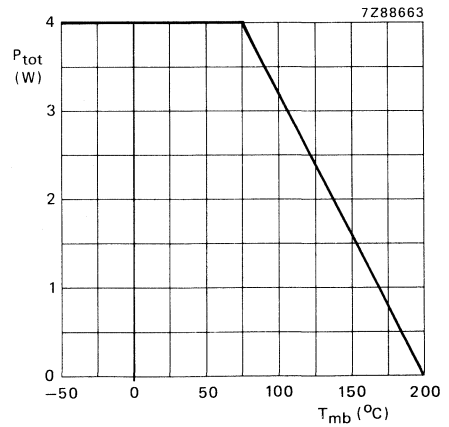


Fig.3 Power derating curve as a function of mounting base temperature.

* K/W is SI unit for $^\circ C/W$.

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

Collector cut-off current

 $I_E = 0; V_{CB} = 20\text{ V}$ I_{CBO} max. 0.1 μA $I_E = 0; V_{CB} = 40\text{ V}$ I_{CBO} max. 0.25 mA $V_{CE} = 35\text{ V}; R_{BE} = 100\ \Omega$ I_{CER} max. 1 mA

Emitter cut-off current

 $I_C = 0; V_{EB} = 1.5\text{ V}$ I_{EBO} max. 200 nA $I_C = 0; V_{EB} = 3.5\text{ V}$ I_{EBO} max. 50 μA

DC current gain

 $I_C = 110\text{ mA}; V_{CE} = 5\text{ V}$ h_{FE} min. 15
max. 150Collector-base capacitance at $f = 1\text{ MHz}$ $I_E = I_C = 0; V_{CB} = 20\text{ V}; V_{EB} = 1.5\text{ V}$ C_{cb} typ. 0.5 pFCollector-emitter capacitance at $f = 1\text{ MHz}$ $I_C = I_E = 0; V_{CE} = 20\text{ V}; V_{EB} = 1.5\text{ V}$ C_{ce} typ. 1.5 pFEmitter-base capacitance at $f = 1\text{ MHz}$ $I_C = I_E = 0; V_{EB} = 1\text{ V}; V_{CB} = 10\text{ V}$ C_{eb} typ. 6.5 pF

s-parameters (common-emitter)

$V_{CE} = 18\text{ V}$
 $I_C = 110\text{ mA}$ } regulated; $T_{mb} = 25\text{ }^\circ\text{C}$; $Z_O = 50\text{ }\Omega$; 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common-emitter class-A circuit*

f GHz	V_{CE} (1) V	I_C (1) mA	P_{L1} (2) mW (dBm)	G_{p0} (3) dB	z_i Ω	Z_L Ω
4.2	18	110	\geq 450(26.5) typ. 550(27.4)	\geq 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} .

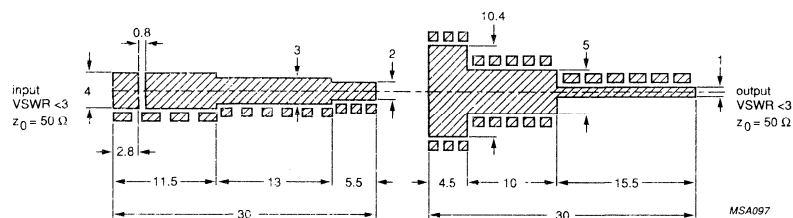


Fig.4 Prematching test circuit board for 4.2 GHz. (Dimensions in mm.)

Input striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric ($\epsilon_r = 2.54$); thickness 1.6 mm.

Output striplines on a double Cu-clad Rexolite printed-circuit board with dielectric ($\epsilon_r = 2.4$); thickness 0.25 mm.

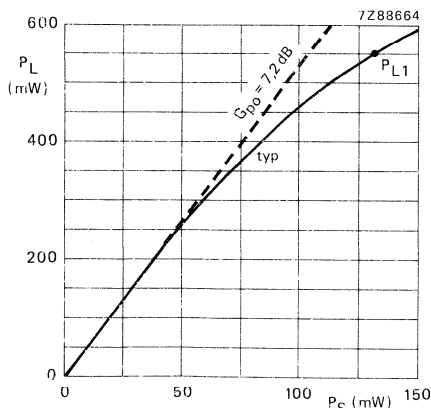


Fig.5 Load power as a function of source power. $f = 4.2\text{ GHz}$; $T_{mb} = 25\text{ }^{\circ}\text{C}$;
 $V_{CE} = 18\text{ V}$
 $I_C = 110\text{ mA}$ } regulated

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

SUPERSEDES DATA OF JULY 1988

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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common-emitter class-A circuit.

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} mW	G_{D0} dB	z_i Ω	Z_L Ω
CW linear ampl.	4.2	18	250	≥ 800	> 7	$7.5 + j23.5$	$2.5 - j9$

MECHANICAL DATA

Fig.1 FO-41B.

Emitter and metallic cap are connected to the seating plane.

Pinning

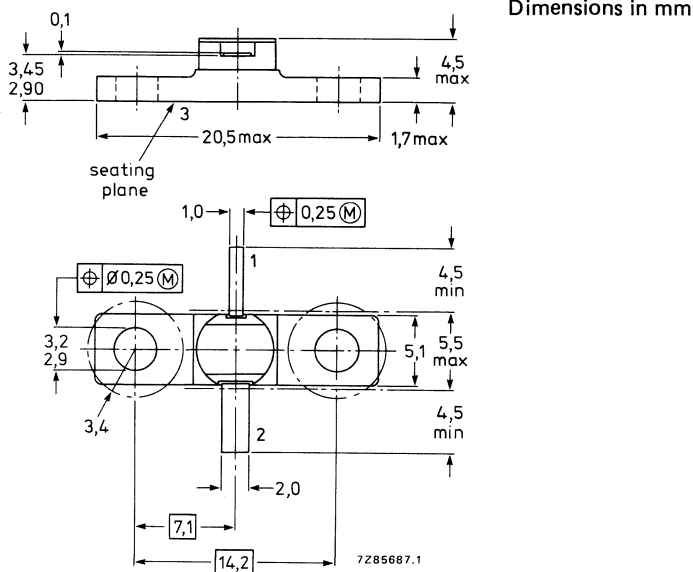
- 1 = collector
- 2 = base
- 3 = emitter

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 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.

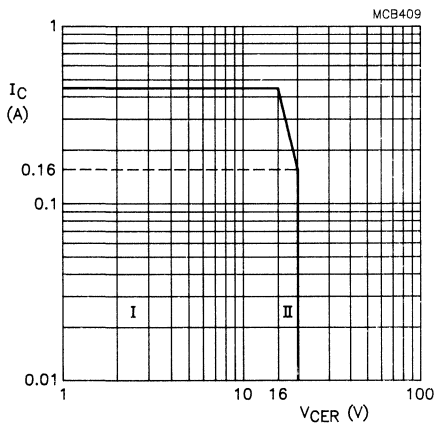
RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	40 V
Collector-emitter voltage $R_{BE} = 250 \Omega$ (open base)	V_{CER} V_{CEO}	max.	20 V 16 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	450 mA
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	7.5 W
Storage temperature range	T_{stg}		-65 to + 200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.2 mm from the case; $t_{sld} = 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 70 \text{ }^\circ\text{C}$)

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



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

Fig.2 DC SOAR at $T_{mb} \leq 75 \text{ }^\circ\text{C}$.

- I Region of permissible DC operation.
- II Permissible extension provided $R_{BE} \leq 250 \Omega$.

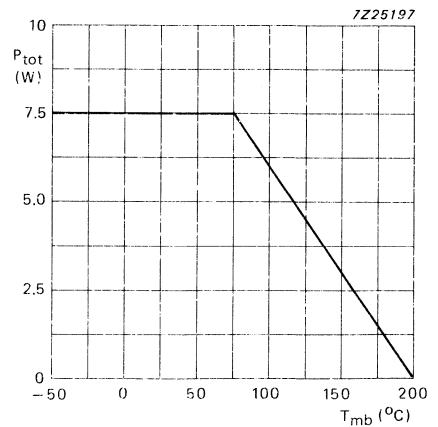


Fig.3 Power derating curve as a function of mounting base temperature.

* K/W is SI unit for $^\circ\text{C}/\text{W}$.

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

Collector cut-off current

 $I_E = 0; V_{CB} = 20\text{ V}$ I_{CBO} max. 150 μA $I_E = 0; V_{CB} = 40\text{ V}$ I_{CBO} max. 1 mA $V_{CE} = 20\text{ V}; R_{BE} = 250\ \Omega$ I_{CER} max. 0.5 mA

Emitter cut-off current

 $I_C = 0; V_{EB} = 1.5\text{ V}$ I_{EBO} max. 400 nA $I_C = 0; V_{EB} = 3.5\text{ V}$ I_{EBO} max. 200 μA

DC current gain

 $I_C = 250\text{ mA}; V_{CE} = 5\text{ V}$ h_{FE} min. 15
max. 150Collector-base capacitance at $f = 1\text{ MHz}$ $I_E = I_C = 0; V_{CB} = 16\text{ V}; V_{EB} = 1.5\text{ V}$ C_{cb} typ. 2 pFCollector-emitter capacitance at $f = 1\text{ MHz}$ $I_C = I_E = 0; V_{CE} = 16\text{ V}; V_{EB} = 1.5\text{ V}$ C_{ce} typ. 1.5 pFEmitter-base capacitance at $f = 1\text{ MHz}$ $I_C = I_E = 0; V_{EB} = 1\text{ V}; V_{CB} = 10\text{ V}$ C_{eb} typ. 20 pF

s-parameters (common-emitter)

$V_{CE} = 16\text{ V}$
 $I_C = 250\text{ mA}$ } regulated; $T_{mb} = 25\text{ }^\circ\text{C}$; $Z_0 = 50\ \Omega$; 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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} .

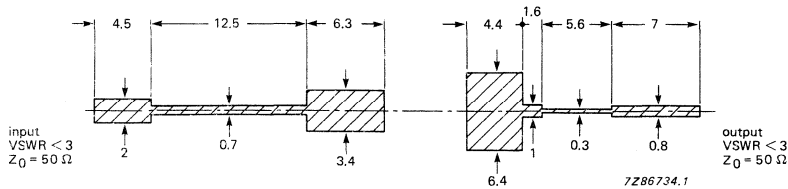


Fig.4 Prematching test circuit board for 4.2 GHz. (Dimensions in mm.)

Input striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric ($\epsilon_r = 2.54$); thickness 1.6 mm.

Output striplines on a double Cu-clad Rexolite printed-circuit board with dielectric ($\epsilon_r = 2.4$); thickness 0.25 mm.

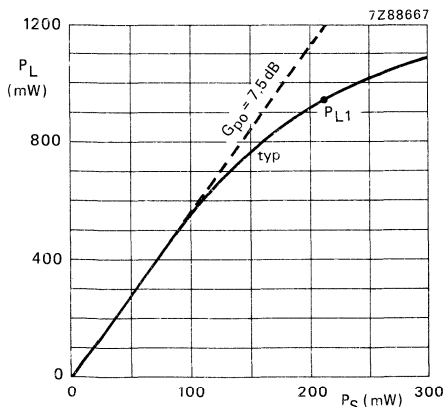


Fig.5 Load power as a function of source power. $f = 4.2\text{ GHz}$; $T_{mb} = 25\text{ }^{\circ}\text{C}$;
 $V_{CE} = 16\text{ V}$
 $I_C = 250\text{ mA}$ } regulated

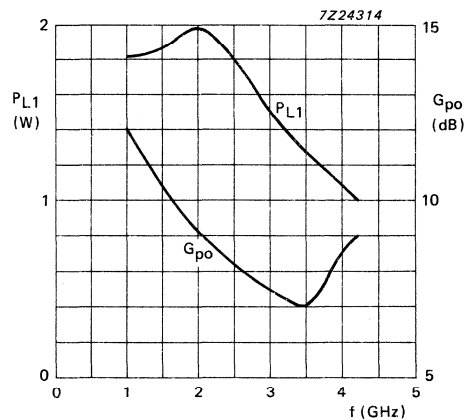


Fig.6 Load power and power gain, associated with 1 dB compressed power gain, as a function of frequency.

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

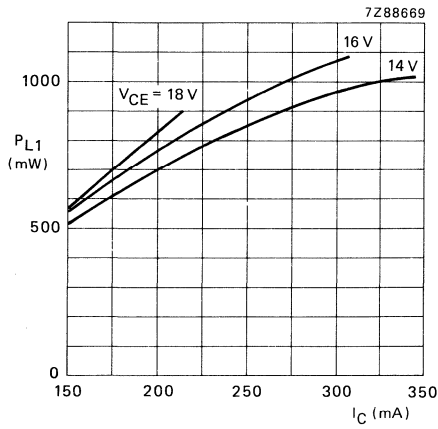


Fig.7 Load power associated with 1 dB compressed power gain, as a function of collector current.

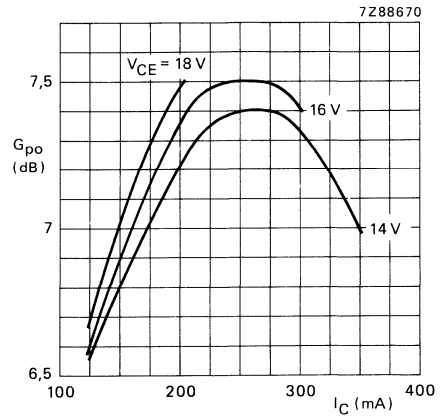


Fig.8 Low-level power gain associated with P_{L1} as a function of collector current.

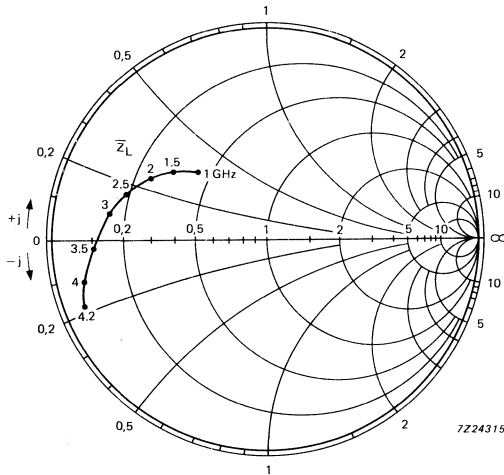


Fig.9 Optimum load impedance as a function of frequency for P_{L1} .

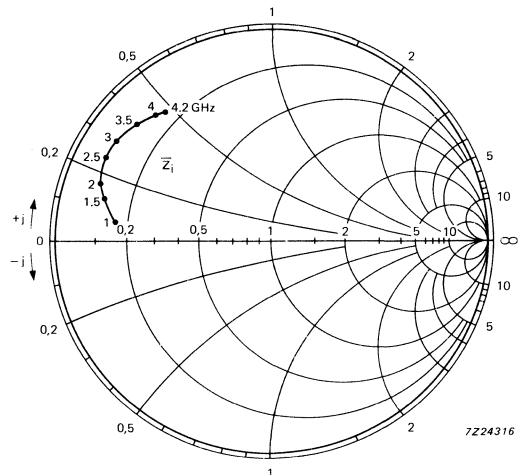


Fig.10 Input impedance as a function of frequency for P_{L1} .

Conditions for Figs 7 and 8:

V_{CE} and I_C regulated; typical values; $T_{mb} = 25^\circ C$.

Conditions for Figs 9 and 10:

$V_{CE} = 16V$
 $I_C = 250mA$ } regulated; typical values; $Z_o = 50\Omega$; $T_{mb} = 25^\circ C$.

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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 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-41B.

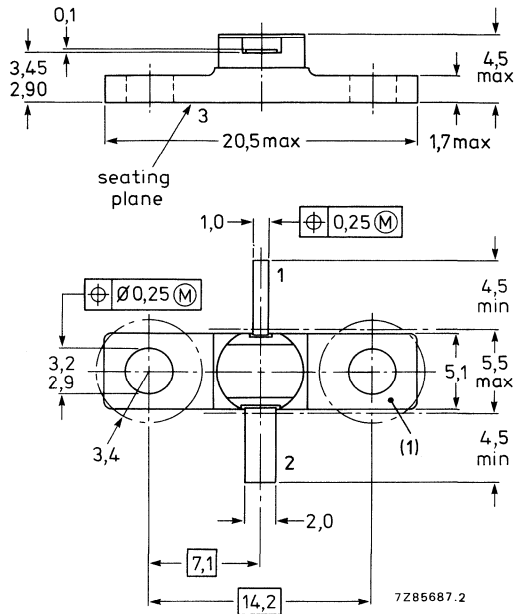
Emitter and metallic cap connected to flange.

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
Emitter-base voltage, open collector	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	800 mA
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	8 W
Storage temperature	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature at 0.1 mm from ceramic; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

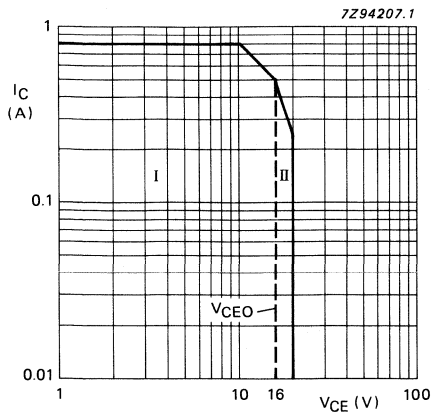


Fig.2 DC SOAR; $T_{mb} \leq 75^\circ\text{C}$.

I Region of permissible DC operation.
 II Permissible extension provided
 $R_{BE} \leq 70 \Omega$.

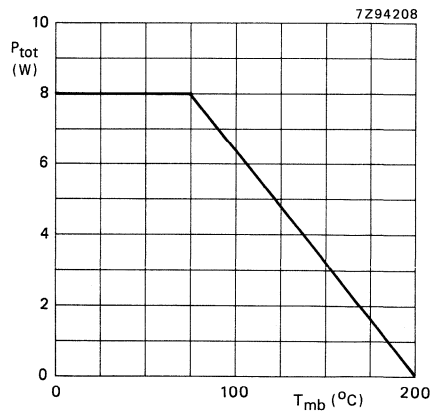


Fig.3 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75^\circ\text{C}$)

From junction to mounting base

$R_{th\ j-mb}$ max. 10 K/W ←

From mounting base to heatsink

$R_{th\ mb-h}$ max. 0.7 K/W ←

CHARACTERISTICS

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

Collector cut-off current

$I_E = 0; V_{CB} = 20\text{ V}$

I_{CBO} max. 200 μA

Emitter cut-off current

$I_C = 0; V_{EB} = 1.5\text{ V}$

I_{EBO} max. 600 nA

DC current gain

$I_C = 400\text{ mA}; V_{CE} = 5\text{ V}$

$h_{FE} = 15\text{ to }100$

Collector-base capacitance at $f = 1\text{ MHz}$

$I_E = I_C = 0; V_{CB} = 16\text{ V}; V_{EB} = 1.5\text{ V}$

C_{cb} typ. 3 pF

Collector-emitter capacitance at $f = 1\text{ MHz}$

$I_C = I_E = 0; V_{CE} = 16\text{ V}; V_{EB} = 1.5\text{ V}$

C_{ce} typ. 1.5 pF ←

Emitter-base capacitance at $f = 1\text{ MHz}$

$I_C = I_E = 0; V_{EB} = 1\text{ V}; V_{CB} = 10\text{ V}$

C_{eb} typ. 28 pF ←

s-parameters (common-emitter)

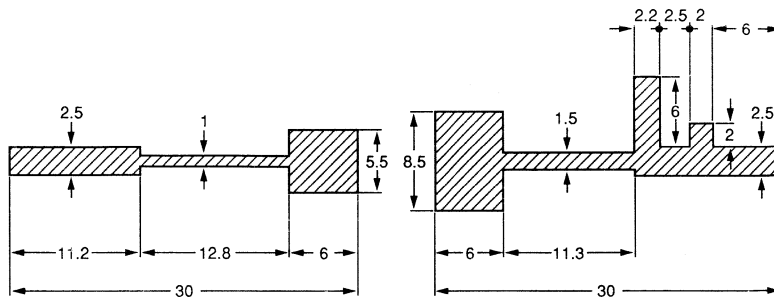
Typical values; $V_{CE} = 16\text{ V}$; $I_C = 400\text{ mA}$; $Z_O = 50\ \Omega$; $T_{mb} = 25\ ^\circ\text{C}$.

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

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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



MSA102

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 ($\epsilon_r = 2.54$); thickness 0.8 mm.

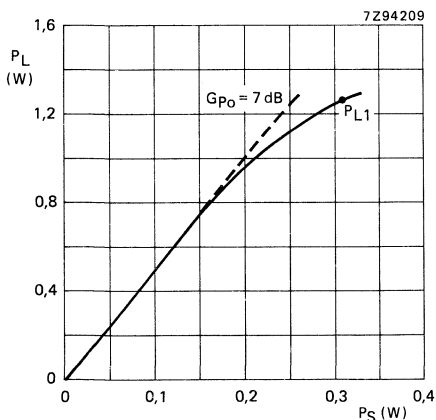


Fig. 5 Load power as a function of input power; $f = 4.2\text{ GHz}$; $V_{CE} = 16\text{ V}$; $I_C = 400\text{ mA}$ regulated.

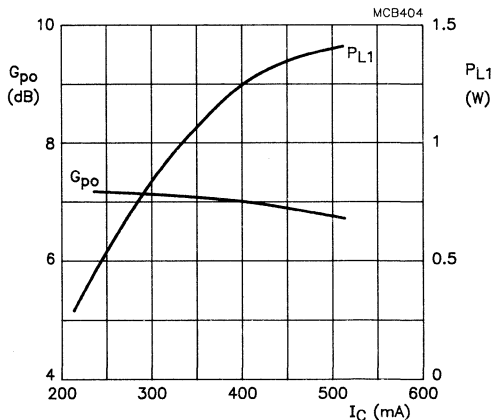


Fig.6 Low level power gain associated with P_{L1} as a function of collector current; $f = 4.2\text{ GHz}$; $V_{CE} = 16\text{ V}$; $I_C = X\text{ mA}$ regulated.

* 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common-emitter class-A circuit

type number	mode of operation	f GHz	V _{CC} V	I _C mA	P _{L1} mW	G _{po} dB
LUE2003S	CW class-A	2.0	18	30	typ. 250	typ. 11
LUE2009S	CW class-A	2.0	18	110	typ. 900	typ. 9.8

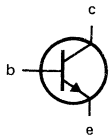
MECHANICAL DATA

Dimensions in mm

Fig.1 FO-163.

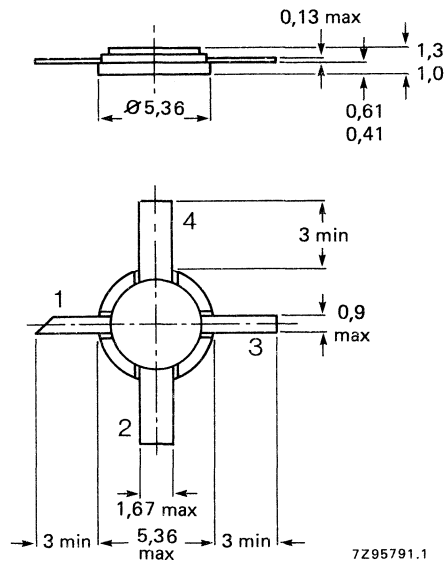
Pinning:

- 1 = collector
- 2 = emitter
- 3 = base



Marking codes:

- 400 = LUE2003S
- 401 = LUE2009S



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.

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 $R_{BE} = 100 \Omega$	V_{CER}	max.	—	35	V
$R_{BE} = 220 \Omega$ open base	V_{CER}	max.	35	—	V
	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 $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	1.4	3.5	W
Storage temperature range	T_{stg}		-65 to + 200		$^\circ\text{C}$
Junction temperature	T_j	max.	200		$^\circ\text{C}$
Lead soldering temperature at 0.3 mm from case; $t_{std} \leq 10 \text{ s}$	T_{sld}	max.	235		$^\circ\text{C}$

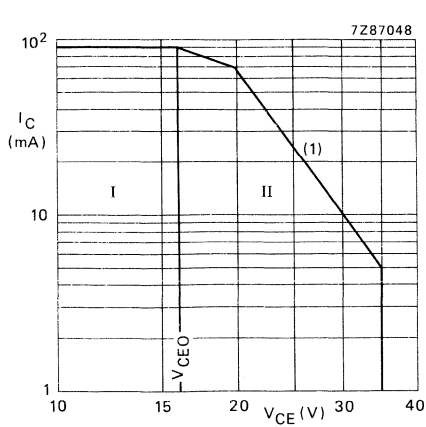


Fig. 2 DC SOAR at $T_{mb} \leq 75^\circ\text{C}$.

- (1) Second breakdown limit (independent of temperature)
- I Region of permissible DC operation.
- II Permissible extension provided $R_{BE} \leq 220 \Omega$.

LUE2003S

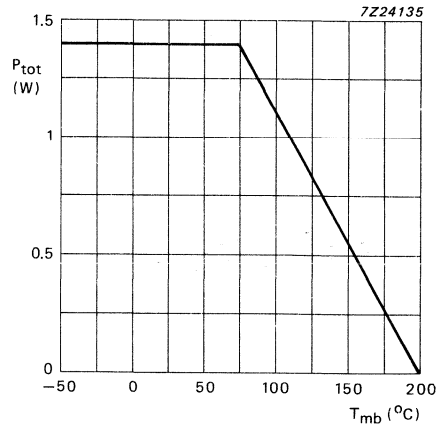


Fig. 3 Power derating curve as a function of base temperature.

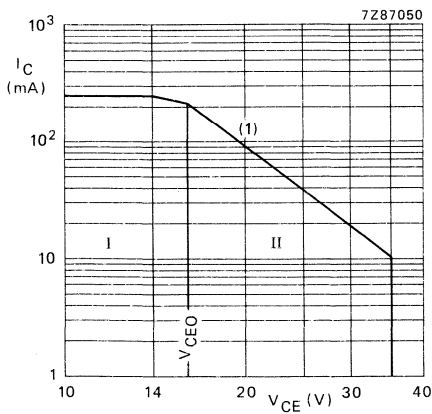


Fig. 4 DC SOAR at $T_{mb} \leq 75^\circ\text{C}$.

- (1) Second breakdown limit (independent of temperature)
- I Region of permissible DC operation.
- II Permissible extension provided $R_{BE} \leq 100 \Omega$.

LUE2009S

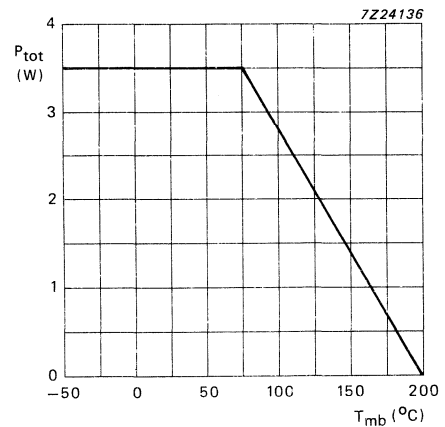


Fig. 5 Power derating curve as a function of base temperature.

THERMAL RESISTANCE (at $T_j = 75\text{ }^\circ\text{C}$)

		LUE2003S	LUE2009S	
From junction to mounting base	$R_{th\ j-mb}$	= 65	36	K/W
From mounting base to heatsink	$R_{th\ mb-h}$	= 1.5	1.5	K/W

CHARACTERISTICS

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

		LUE2003S	LUE2009S	
Collector cut-off current				
$I_E = 0; V_{CB} = 20\text{ V}$	I_{CBO}	< 0.1	0.1	μA
$I_E = 0; V_{CB} = 40\text{ V}$	I_{CBO}	< 150	250	μA
$V_{CB} = 35\text{ V}; R_{BE} = 220\ \Omega$	I_{CER}	< 500	—	μA
$V_{CB} = 35\text{ V}; R_{BE} = 100\ \Omega$	I_{CER}	< —	1000	μA
Emitter cut-off current				
$I_C = 0; V_{EB} = 1.5\text{ V}$	I_{EBO}	< 0.05	0.2	μA
$I_C = 0; V_{EB} = 3.0\text{ V}$	I_{EBO}	< 25	50	μA
DC current gain				
$I_C = 30\text{ mA}; V_{CE} = 5\text{ V}$	h_{FE}	> 15	—	
	h_{FE}	< 150	—	
$I_C = 110\text{ mA}; V_{CE} = 5\text{ V}$	h_{FE}	> —	15	
	h_{FE}	< —	150	
Collector-base capacitance at $f = 1\text{ MHz}; I_E = I_C = 0;$ $V_{CB} = 18\text{ V}; V_{EB} = 1.5\text{ V}$	C_{cb}	typ. 0.3	0.6	pF
Collector-emitter capacitance at $f = 1\text{ MHz}; I_E = I_C = 0;$ $V_{CE} = 18\text{ V}; V_{EB} = 1.5\text{ V}$	C_{ce}	typ. 0.45	0.6	pF
Emitter-base capacitance at $f = 1\text{ MHz}; I_E = I_C = 0;$ $V_{EB} = 18\text{ V}; V_{CB} = 10\text{ V}$	C_{eb}	typ. 1.7	3.3	pF

LUE2003S

s-parameters (common-emitter)

 $V_{CE} = 18 \text{ V}$; $I_C = 30 \text{ mA}$; $T_{mb} = 25 \text{ }^\circ\text{C}$; $Z_O = 50 \text{ } \Omega$; typical values.

f GHz	S_{ie}	S_{re}	S_{fe}	S_{oe}
0,5	0,56/-146 $^\circ$	0,029(-30,8)/52 $^\circ$	8,98(19,1)/99 $^\circ$	0,61/-37 $^\circ$
0,6	0,55/-152 $^\circ$	0,031(-30,1)/55 $^\circ$	7,64(17,7)/93 $^\circ$	0,60/-40 $^\circ$
0,7	0,54/-156 $^\circ$	0,034(-29,4)/58 $^\circ$	6,64(16,4)/88 $^\circ$	0,60/-41 $^\circ$
0,8	0,53/-162 $^\circ$	0,037(-28,7)/60 $^\circ$	5,91(15,4)/84 $^\circ$	0,61/-44 $^\circ$
0,9	0,52/-166 $^\circ$	0,040(-28,1)/62 $^\circ$	5,34(14,6)/80 $^\circ$	0,61/-46 $^\circ$
1,0	0,51/-170 $^\circ$	0,043(-27,4)/64 $^\circ$	4,87(13,8)/77 $^\circ$	0,61/-48 $^\circ$
1,1	0,50/-174 $^\circ$	0,046(-26,8)/66 $^\circ$	4,48(13,0)/73 $^\circ$	0,62/-51 $^\circ$
1,2	0,49/-179 $^\circ$	0,049(-26,1)/67 $^\circ$	4,16(12,4)/70 $^\circ$	0,62/-54 $^\circ$
1,3	0,48/-177 $^\circ$	0,054(-25,4)/69 $^\circ$	3,88(11,8)/67 $^\circ$	0,63/-56 $^\circ$
1,4	0,47/-172 $^\circ$	0,058(-24,7)/70 $^\circ$	3,65(11,2)/65 $^\circ$	0,63/-59 $^\circ$
1,5	0,47/-167 $^\circ$	0,063(-24,0)/71 $^\circ$	3,45(10,8)/62 $^\circ$	0,64/-61 $^\circ$
1,6	0,48/-161 $^\circ$	0,068(-23,4)/72 $^\circ$	3,27(10,3)/59 $^\circ$	0,64/-65 $^\circ$
1,7	0,48/-156 $^\circ$	0,073(-22,8)/73 $^\circ$	3,10(9,8)/56 $^\circ$	0,64/-68 $^\circ$
1,8	0,48/-152 $^\circ$	0,078(-22,2)/73 $^\circ$	2,93(9,4)/52 $^\circ$	0,65/-72 $^\circ$
1,9	0,49/-147 $^\circ$	0,082(-21,7)/73 $^\circ$	2,79(8,9)/49 $^\circ$	0,65/-75 $^\circ$
2,0	0,50/-143 $^\circ$	0,086(-21,3)/73 $^\circ$	2,65(8,5)/46 $^\circ$	0,65/-79 $^\circ$

LUE2009S

s-parameters (common-emitter)

 $V_{CE} = 18 \text{ V}$; $I_C = 110 \text{ mA}$; $T_{mb} = 25 \text{ }^\circ\text{C}$; $Z_O = 50 \text{ } \Omega$; typical values.

f GHz	S_{ie}	S_{re}	S_{fe}	S_{oe}
0,5	0,69/-170 $^\circ$	0,031(-30,2)/54 $^\circ$	6,61(16,4)/85 $^\circ$	0,43/-48 $^\circ$
0,6	0,69/-173 $^\circ$	0,035(-29,1)/57 $^\circ$	5,57(14,9)/80 $^\circ$	0,44/-51 $^\circ$
0,7	0,69/-177 $^\circ$	0,039(-28,2)/60 $^\circ$	4,81(13,6)/77 $^\circ$	0,45/-54 $^\circ$
0,8	0,68/-180 $^\circ$	0,043(-27,3)/62 $^\circ$	4,26(12,6)/73 $^\circ$	0,46/-57 $^\circ$
0,9	0,68/-177 $^\circ$	0,047(-26,5)/63 $^\circ$	3,84(11,7)/69 $^\circ$	0,47/-61 $^\circ$
1,0	0,67/-174 $^\circ$	0,052(-25,7)/65 $^\circ$	3,50(10,9)/65 $^\circ$	0,49/-64 $^\circ$
1,1	0,66/-170 $^\circ$	0,056(-25,0)/66 $^\circ$	3,22(10,2)/62 $^\circ$	0,50/-67 $^\circ$
1,2	0,66/-166 $^\circ$	0,062(-24,2)/67 $^\circ$	2,98(9,5)/59 $^\circ$	0,51/-70 $^\circ$
1,3	0,66/-162 $^\circ$	0,068(-23,4)/68 $^\circ$	2,77(8,9)/55 $^\circ$	0,52/-73 $^\circ$
1,4	0,65/-158 $^\circ$	0,074(-22,6)/68 $^\circ$	2,60(8,3)/52 $^\circ$	0,53/-76 $^\circ$
1,5	0,65/-153 $^\circ$	0,080(-21,9)/68 $^\circ$	2,45(7,8)/49 $^\circ$	0,54/-80 $^\circ$
1,6	0,65/-149 $^\circ$	0,087(-21,2)/68 $^\circ$	2,32(7,3)/45 $^\circ$	0,54/-84 $^\circ$
1,7	0,66/-145 $^\circ$	0,093(-20,6)/68 $^\circ$	2,18(6,8)/41 $^\circ$	0,55/-88 $^\circ$
1,8	0,66/-141 $^\circ$	0,100(-20,0)/67 $^\circ$	2,06(6,3)/38 $^\circ$	0,56/-92 $^\circ$
1,9	0,67/-137 $^\circ$	0,105(-19,5)/67 $^\circ$	1,94(5,8)/34 $^\circ$	0,56/-96 $^\circ$
2,0	0,68/-134 $^\circ$	0,110(-19,2)/66 $^\circ$	1,84(5,3)/32 $^\circ$	0,57/-100 $^\circ$

The figures given between brackets are values in dB.

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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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_1 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

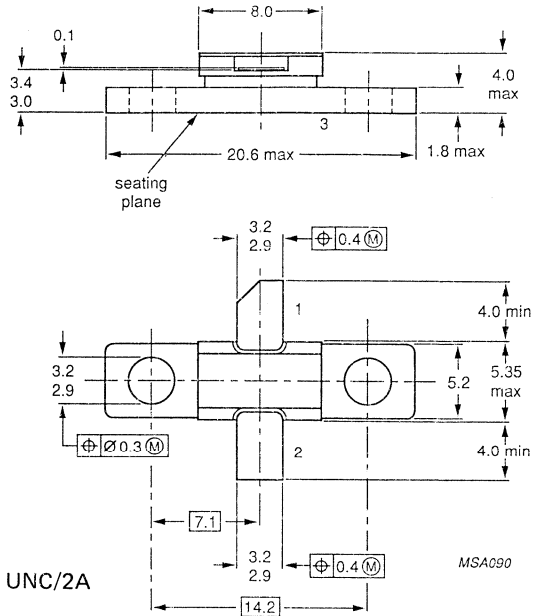
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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-83.

Dimensions in mm



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.	3.5 V
Collector current (DC)	I_C	max.	2 A
Total power dissipation up to $T_{mb} = 75^\circ C$	P_{tot}	max.	18 W
Storage temperature	T_{stg}		-65 to + 200 °C
Junction temperature	T_j	max.	200 °C
Soldering temperature at 0.1 mm from case; $t_{sld} \leq 10$ s	T_{sld}	max.	235 °C

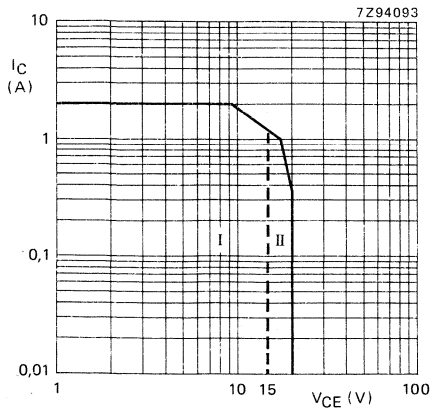


Fig. 2 DC SOAR; $T_{mb} \leq 75$ °C.

- I Region of permissible DC operation.
- II Permissible extension provided $R_{BE} \leq 47 \Omega$.

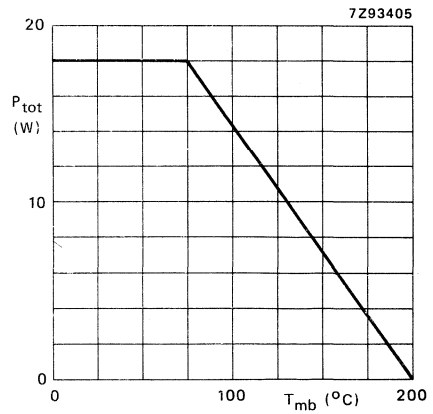


Fig.3 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75$ °C)

From junction to mounting base
 From mounting base to heatsink

$R_{th\ j-mb}$	max. 4 K/W	←
$R_{th\ mb-h}$	max. 0.7 K/W	←

CHARACTERISTICS

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

Collector cut-off currents

- $I_E = 0; V_{CB} = 20$ V
- $I_E = 0; V_{CB} = 40$ V
- $V_{CE} = 20$ V; $R_{BE} = 47 \Omega$
- $V_{CE} = 15$ V; $I_B = 0$

I_{CBO}	max. 0.5 mA
I_{CER}	max. 2.5 mA
I_{CEO}	max. 2 mA

Emitter cut-off current

- $I_C = 0; V_{EB} = 1.5$ V
- $I_C = 0; V_{EB} = 3.5$ V

I_{EBO}	max. 100 μ A
	max. 500 μ A

DC current gain

- $I_C = 1$ A; $V_{CE} = 3$ V

h_{FE}	15 to 100
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APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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	

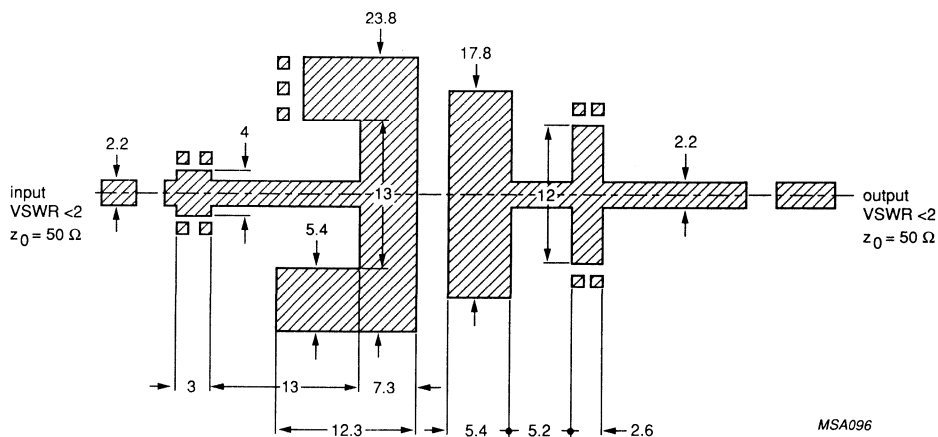


Fig. 4 Wideband test circuit board for 1.7 to 2.1 GHz, CW, class-A application (Dimensions in mm).

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

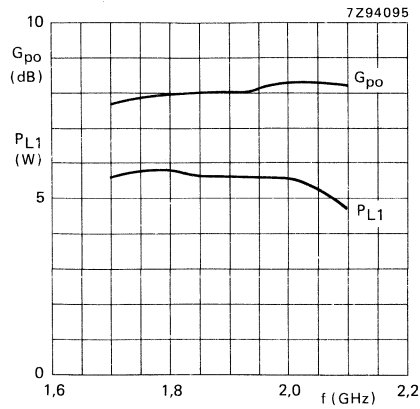


Fig. 5 Load power and power gain as a function of frequency; $V_{CE} = 16 \text{ V}$; $I_C = 1.1 \text{ A}$; V_{CE} and I_C regulated.

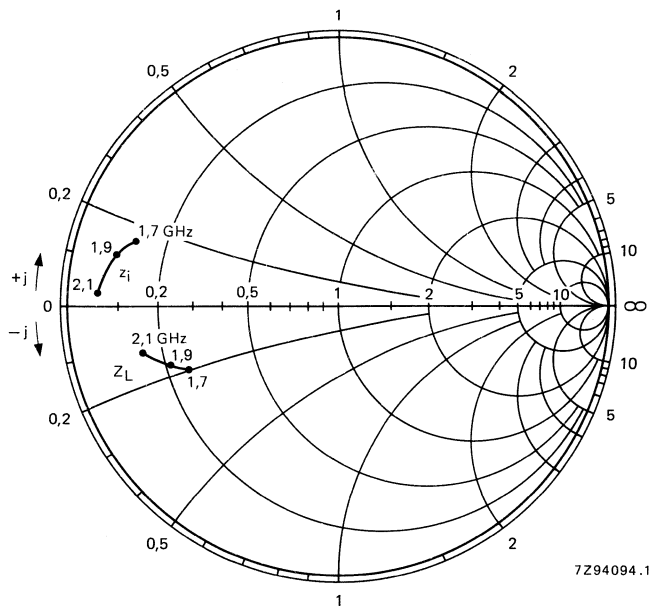


Fig. 6 Input and optimum load impedances as a function of frequency; $P_{L1} = 5.5 \text{ W}$; $Z_0 = 50 \Omega$; typical values.

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

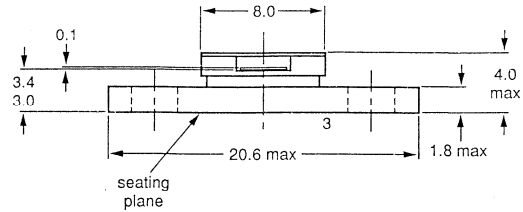
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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-83.

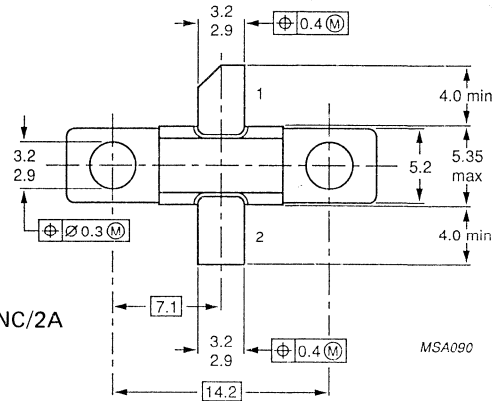


Pinning:

- 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	V_{CEO}	max.	15 V
open base	V_{CER}	max.	20 V
$R_{BE} = 47 \Omega$	V_{EBO}	max.	3.5 V
Emitter-base voltage, open collector	I_C	max.	2 A
Collector current (DC)	P_{tot}	max.	18 W
Total power dissipation	T_{stg}	-65 to + 200 °C	
up to $T_{mb} = 75 \text{ °C}$	T_j	max.	200 °C
Storage temperature	T_{slid}	max.	235 °C
Junction temperature			
Soldering temperature			
at 0.1 mm from case; $t_{slid} \leq 10 \text{ s}$			

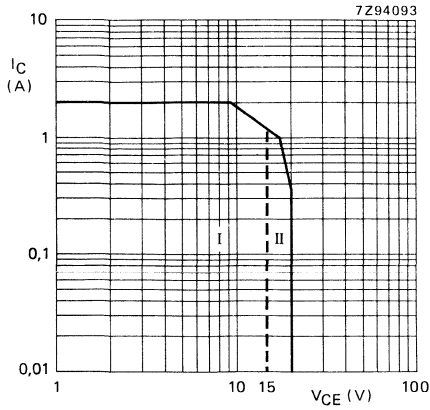


Fig. 2 DC SOAR; $T_{mb} \leq 75^\circ\text{C}$.
 I Region of permissible DC operation.
 II Permissible extension provided
 $R_{BE} \leq 47 \Omega$.

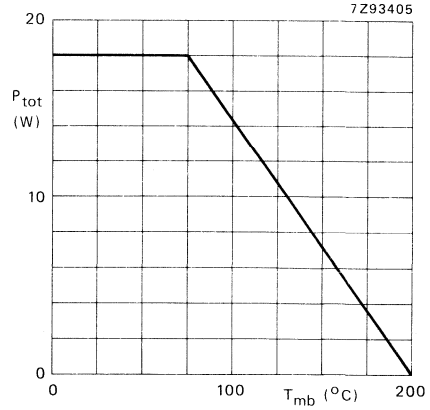


Fig.3 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75^\circ\text{C}$)

From junction to mounting base
 From mounting base to heatsink

$R_{th\ j-mb}$ max. 4 K/W ←
 $R_{th\ mb-h}$ max. 0.7 K/W ←

CHARACTERISTICS

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

Collector cut-off currents

$I_E = 0; V_{CB} = 20\text{ V}$
 $I_E = 0; V_{CB} = 40\text{ V}$
 $V_{CE} = 20\text{ V}; R_{BE} = 47 \Omega$
 $V_{CE} = 15\text{ V}; I_B = 0$

I_{CBO} max. 0.5 mA
 max. 2.5 mA
 I_{CER} max. 25 mA
 I_{CEO} max. 2 mA

Emitter cut-off current

$I_C = 0; V_{EB} = 1.5\text{ V}$
 $I_C = 0; V_{EB} = 3.5\text{ V}$

I_{EBO} max. 100 μA
 max. 500 μA

DC current gain

$I_C = 1\text{ A}; V_{CE} = 3\text{ V}$

h_{FE} 15 to 100

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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	

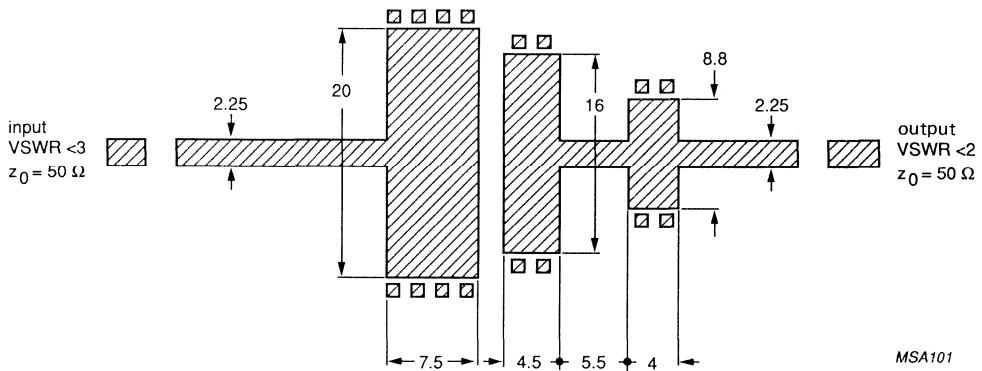


Fig. 4 Wideband test circuit board, class-A application. (Dimensions in mm).

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

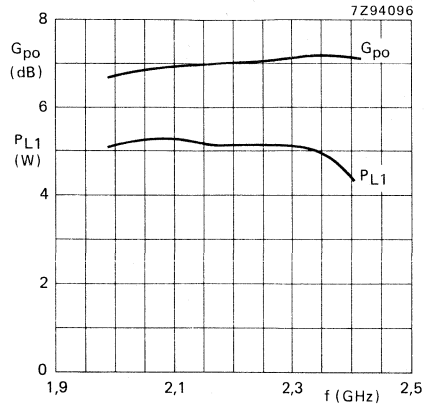


Fig. 5 Load power and power gain as a function of frequency; $V_{CE} = 16$ V; $I_C = 1.1$ A; V_{CE} and I_C regulated.

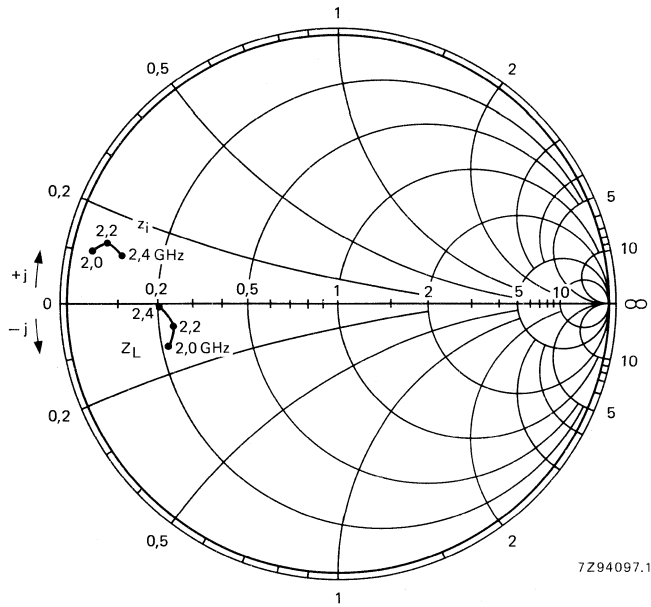


Fig. 6 Input and optimum load impedance as a function of frequency; $Z_O = 50 \Omega$; typical values.

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 $T_{\text{case}} = 25\text{ }^{\circ}\text{C}$ 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-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 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-83.

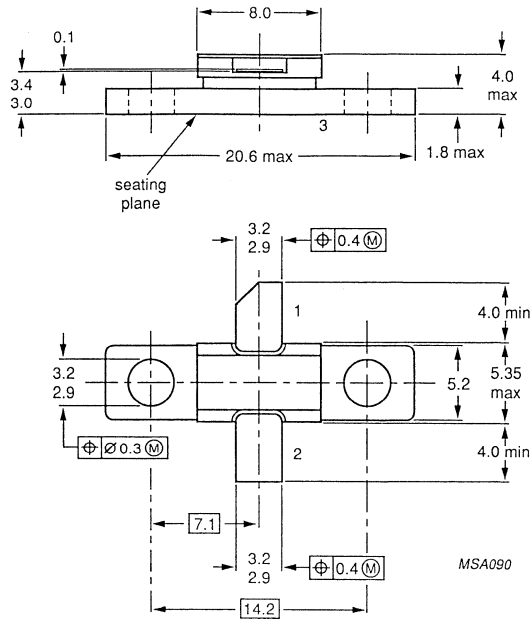
Metallic cap is connected to the flange

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

Marking code:

- 2327E40R = LV2327E40R

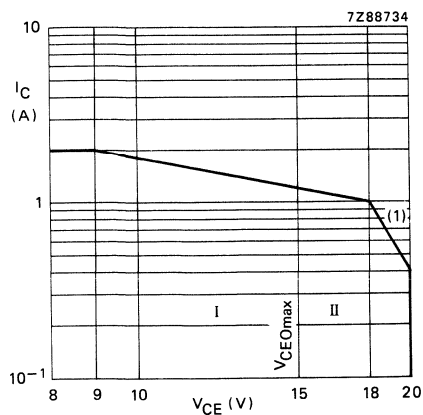
Dimensions in mm



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	V_{CER}	max.	20 V
$R_{BE} = 47 \Omega$ open base	V_{CEO}	max.	15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	2 A
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	18 W
Storage temperature	T_{stg}		-65 to + 200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.3 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$



(1) Second breakdown limit (independent of temperature)

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

- I Region of permissible DC operation.
- II Permissible extension provided $R_{BE} \leq 47 \Omega$.

THERMAL RESISTANCE (at $T_j = 75$ °C)

From junction to mounting base

From mounting base to heatsink

$R_{th\ j-mb}$	max.	4 K/W	←
$R_{th\ mb-h}$	max.	0.7 K/W	←

CHARACTERISTICS

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

Collector cut-off currents

- $V_{CB} = 20$ V; $I_E = 0$
- $V_{CB} = 40$ V; $I_E = 0$
- $V_{CE} = 20$ V; $R_{BE} = 47 \Omega$
- $V_{CE} = 15$ V; $I_B = 0$

I_{CBO}	max.	0.5 mA
I_{CBO}	max.	2.5 mA
I_{CER}	max.	25 mA
I_{CEO}	max.	2 mA

Emitter cut-off current

- $V_{EB} = 1.5$ V; $I_C = 0$
- $V_{EB} = 3.5$ V; $I_C = 0$

I_{EBO}	max.	100 μ A
I_{EBO}	max.	500 μ A

DC current gain

- $V_{CE} = 3$ V; $I_C = 1$ A

h_{FE}	min.	15
	max.	100

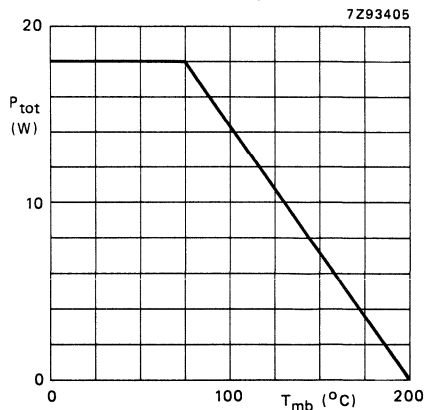


Fig.3 Power derating curve as a function of mounting base temperature.

APPLICATION INFORMATION

RF performance in CW operation up to $T_{case} = 25\text{ }^{\circ}\text{C}$ in a wideband common-emitter class-A circuit

mode of operation	f GHz	$V_{CE(1)}$ V	$I_{C(1)}$ mA	$P_{L1(2)}$ mW	$G_{po(3)}$ dB	\bar{z}_i Ω	\bar{z}_L Ω
CW class-A	2.3 to 2.7	16	1000	≥ 4 typ. 5	≥ 7 typ. 8	typ. $11 + j3$	typ. $7.5 - j9$

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} .

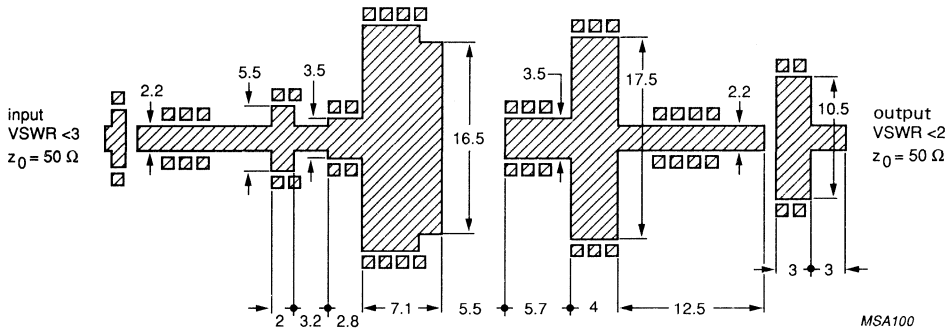


Fig.4 Wideband test circuit board for 2.3 to 2.7 GHz. (Dimensions in mm).

Striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric ($\epsilon_r = 2.55$); thickness 0.8 mm.

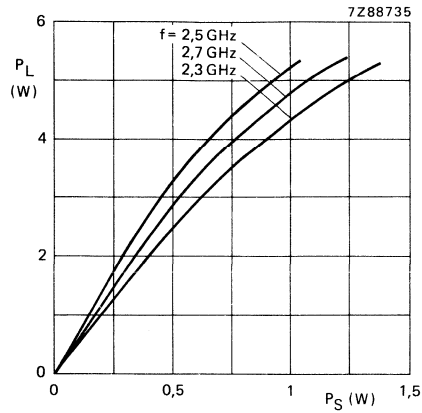


Fig. 5 Load power as a function of source power.

Conditions for Fig. 5:

$$\left. \begin{matrix} V_{CE} = 16 \text{ V} \\ I_C = 1 \text{ A} \end{matrix} \right\} \text{regulated; typical values; } T_{\text{case}} = 25 \text{ }^\circ\text{C}.$$

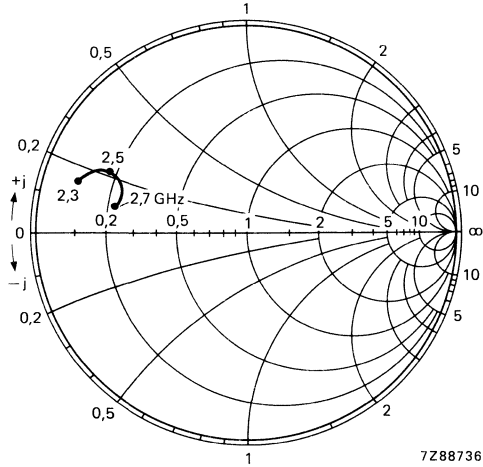


Fig. 6 Input impedance as a function of frequency for P_{L1} .

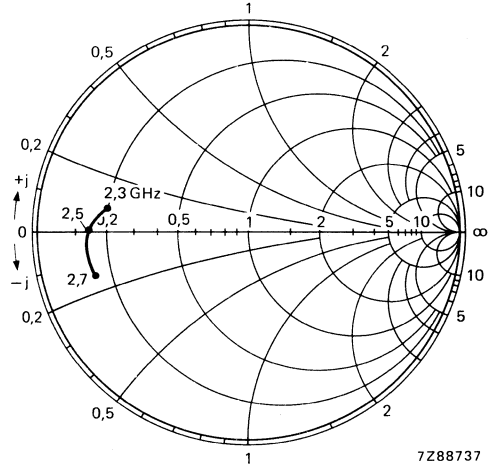


Fig. 7 Optimum load impedance as a function of frequency for P_{L1} .

Conditions for Figs 6 and 7:

$$\left. \begin{matrix} V_{CE} = 16 \text{ V} \\ I_C = 1 \text{ A} \end{matrix} \right\} \text{regulated; typical values; } Z_0 = 50 \text{ } \Omega; T_{\text{case}} = 25 \text{ }^\circ\text{C}.$$

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon planar microwave power transistor intended for use in common-emitter class-A broadband linear power amplifiers, in the 2.9 to 3.1 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
- Input and output matching cells; for an easier design of broadband circuits

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

QUICK REFERENCE DATA

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

mode of operation	f GHz	V_{CE} V	I_C A	P_{L1} W	G_{po} dB	$z_i; Z_L$
class-A CW	2.9 to 3.1	18	1.0	≥ 4.5	≥ 6	see Fig. 6

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 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.

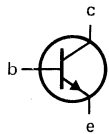
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

MECHANICAL DATA

Fig. 1 FO-83B.

Pinning:

- 1 = collector
- 2 = base
- 3 = emitter

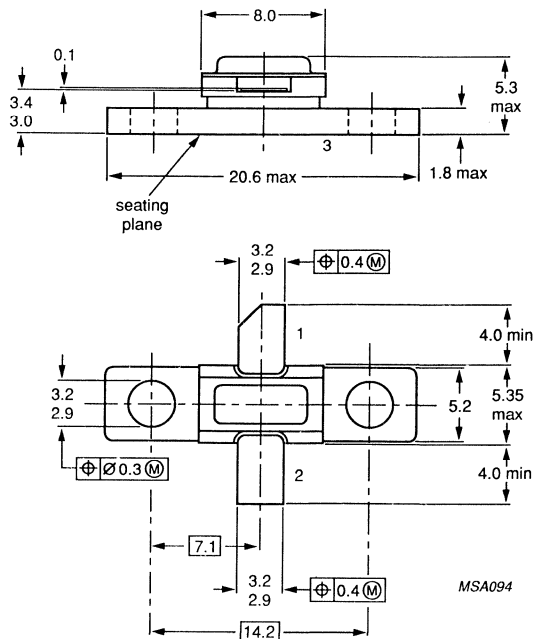


Emitter is connected to the seating plane

Marking code
430 = LV2931E50S

Torque on screw: max. 0.4 Nm
Recommended screw: M2.5 or 4-40 UNC/2A

Dimensions in mm



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, $R_{BE} = 100 \Omega$ open base	V_{CER} V_{CEO}	max.	20 V 15 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	1.6 A
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	20 W
Storage temperature range	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature at 0.3 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base	$R_{th \text{ j-mb}}$	max.	6 K/W
From mounting base to heat sink	$R_{th \text{ mb-h}}$	max.	0.7 K/W

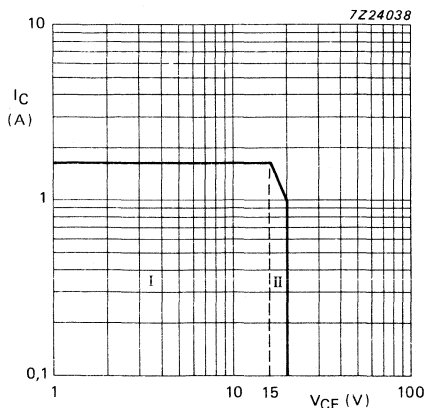


Fig. 2 DC SOAR at $T_{mb} = 75\text{ }^{\circ}\text{C}$

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

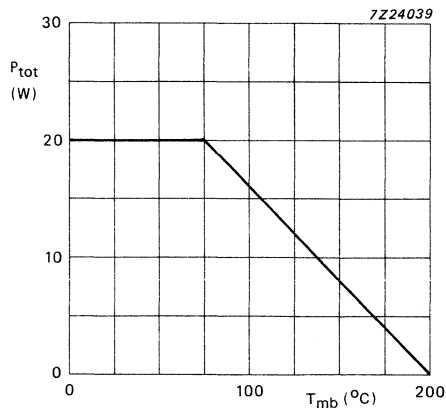


Fig. 3 Power derating curve.

CHARACTERISTICS

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

Collector cut-off currents

$V_{CB} = 40\text{ V}; I_E = 0$

$V_{CB} = 30\text{ V}; I_E = 0$

$V_{CE} = 20\text{ V}; R_{BE} = 100\ \Omega$

$V_{CE} = 15\text{ V}; I_B = 0$

I_{CBO}	max.	6.0 mA
I_{CBO}	max.	60 μA
I_{CER}	max.	100 μA
I_{CEO}	max.	600 μA

Emitter cut-off currents

$V_{EB} = 1.5\text{ V}; I_C = 0$

$V_{EB} = 3.5\text{ V}; I_C = 0$

I_{EBO}	max.	6 μA
I_{EBO}	max.	60 μA

DC current gain

$V_{CE} = 5\text{ V}; I_C = 1\text{ A}$

h_{FE}	min.	15
	max.	150

APPLICATION INFORMATION

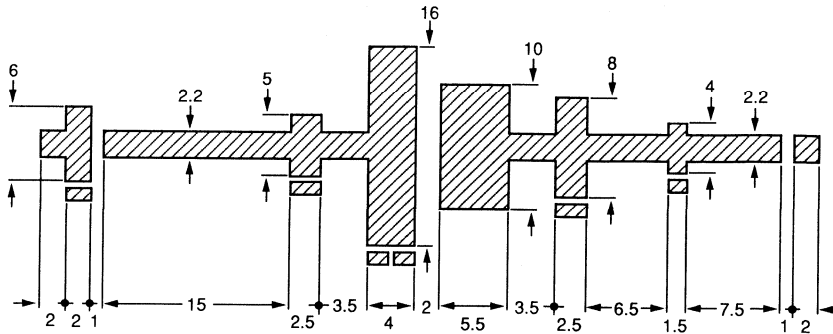
Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common-emitter class-A broadband amplifier.

mode of operation	f GHz	$V_{CE}(1)$ V	$I_C(1)$ mA	$P_{L1}(2)$ W	$G_{p0}(3)$ dB
class-A ; CW	2.9 to 3.1	18	1000	≥ 4.5 typ. 5.0	≥ 6.0 typ. 6.5

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}

APPLICATION INFORMATION (continued)



MSA098

Fig. 4 Broadband test circuit for 2.9 to 3.1 GHz (dimensions in mm).
 Double Cu clad p.c. board with PTFE fibreglass dielectric,
 thickness 0.8 mm, $\epsilon_r = 2.54$.

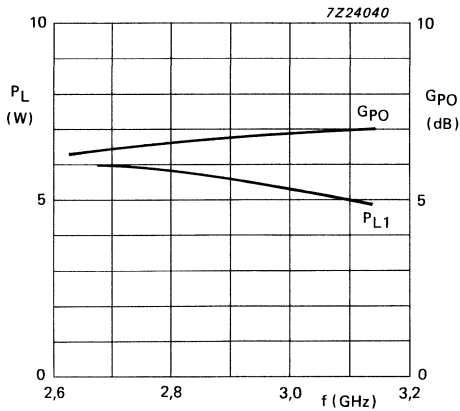


Fig. 5 Load power and power gain as a function of frequency.

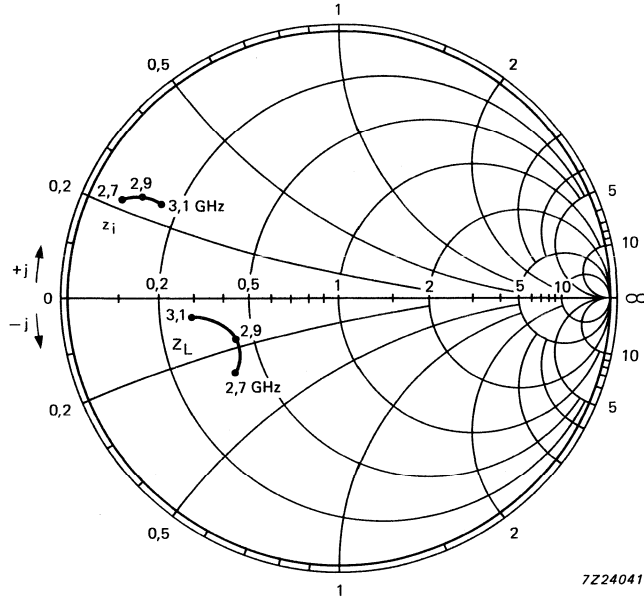


Fig. 6 Input and optimum load impedances as a function of frequency;
 $P_{L1} = 5 \text{ W}$; $Z_O = 50 \Omega$.

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

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

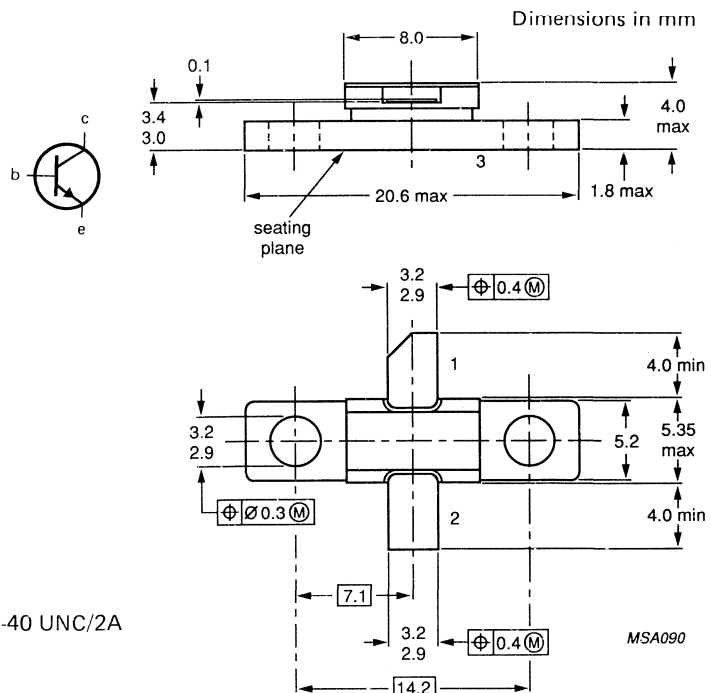
Recommended screw: M2.5 or 4-40 UNC/2A

WARNING

Product and environmental safety – toxic materials

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



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 $R_{BE} = 47 \Omega$ open base	V_{CER} V_{CEO}	max.	20 V 16 V
Emitter-base voltage open collector	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	2 A
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	18 W
Storage temperature range	T_{stg}		-65 to + 200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0,3 mm from case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

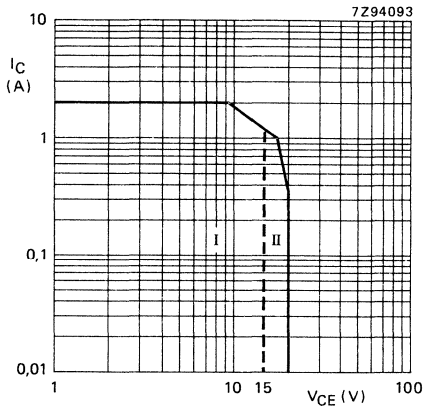


Fig. 2 DC SOAR at $T_{mb} \leq 75 \text{ }^\circ\text{C}$.

- I Region of permissible DC operation.
- II Permissible extension provided $R_{BE} \leq 47 \Omega$.

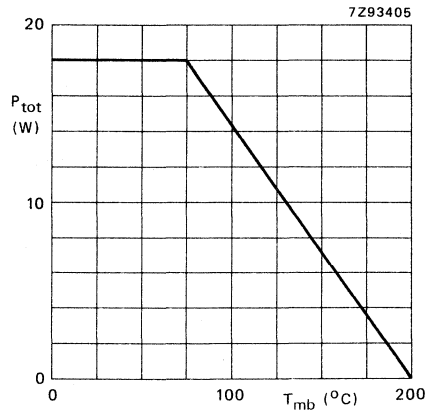


Fig. 3 Power derating curve.

THERMAL RESISTANCE ($T_j = 75\text{ }^\circ\text{C}$)

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

CHARACTERISTICS

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

Collector cut-off currents

$I_E = 0; V_{CB} = 20\text{ V}$	I_{CBO}	max. 0.5 mA	
$I_E = 0; V_{CB} = 40\text{ V}$		max. 2.5 mA	←
$V_{CE} = 20\text{ V}; R_{BE} = 47\ \Omega$	I_{CER}	max. 25 mA	←
$V_{CE} = 15\text{ V}; I_B = 0$	I_{CEO}	max. 2 mA	←

Emitter cut-off current

$I_C = 0; V_{EB} = 1.5\text{ V}$	I_{EBO}	max. 100 μA	←
$I_C = 0; V_{EB} = 3.5\text{ V}$		max. 500 μA	

DC current gain

$I_C = 1\text{ A}; V_{CE} = 3\text{ V}$	h_{FE}	15 to 100	←
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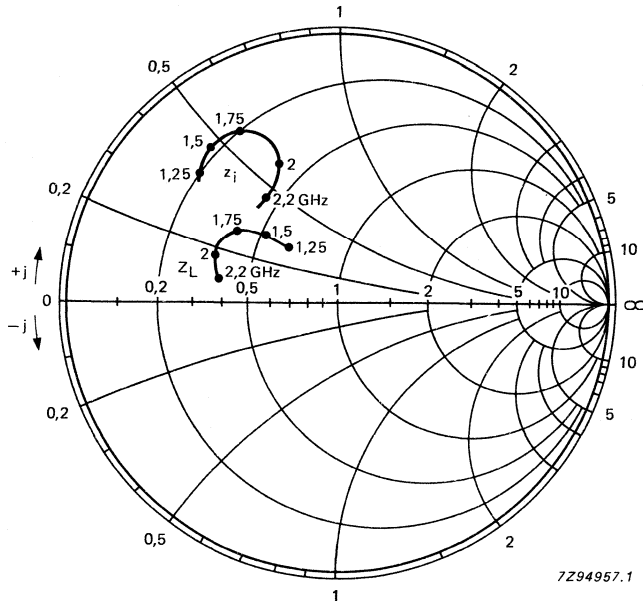


Fig. 4 Input and optimum load impedance as a function of frequency; $Z_0 = 10\ \Omega$; typical values.

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
- New 5 GHz technology

The transistor is housed in a metal ceramic studless envelope (FO-93).

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

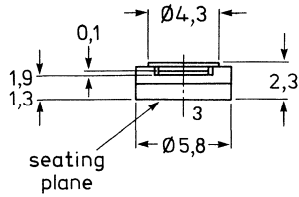
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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.

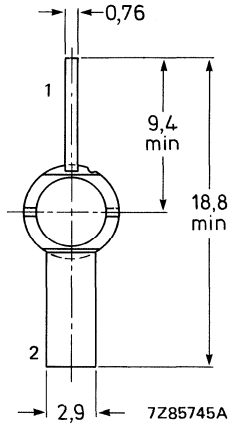


Pinning:

- 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.	3.5 V
Collector current (DC)	I_C	max.	450 mA
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	6 W
Storage temperature	T_{stg}		-65 to + 200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature at 0.1 mm from case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

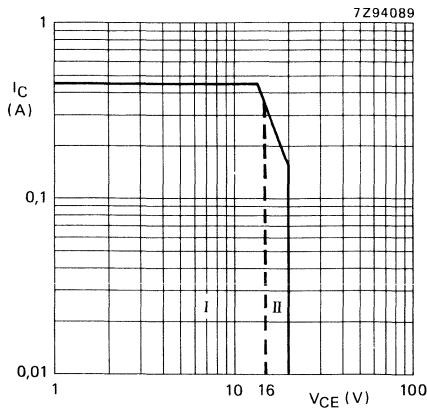


Fig. 2 DC SOAR; $T_{mb} \leq 75 \text{ }^\circ\text{C}$.

- I Region of permissible DC operation
- II Permissible extension at $R_{BE} \leq 70 \text{ } \Omega$.

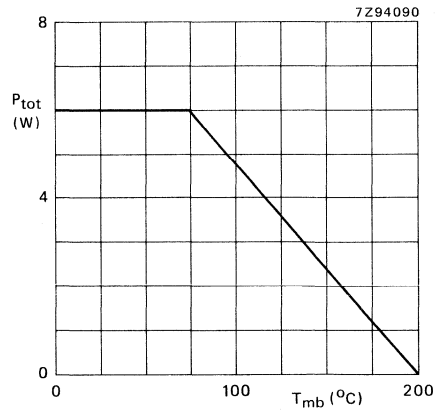


Fig. 3 Power derating curve versus mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base

$R_{th\ j-mb}$ max. 12 K/W ←

CHARACTERISTICS

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

Collector cut-off current

$I_E = 0; V_{CB} = 25 \text{ V}$

$I_E = 0; V_{CB} = 35 \text{ V}$

$I_{CBO} \leq 10 \text{ } \mu\text{A}$
 $\leq 500 \text{ } \mu\text{A}$

Emitter cut-off current

$I_C = 0; V_{EB} = 1.5 \text{ V}$

$I_C = 0; V_{EB} = 3.5 \text{ V}$

$I_{EBO} \leq 10 \text{ } \mu\text{A}$
 $\leq 100 \text{ } \mu\text{A}$

DC current gain

$I_C = 230 \text{ mA}; V_{CE} = 5 \text{ V}$

h_{FE} typ. 40

Collector-base capacitance at $f = 1 \text{ MHz}$

$I_E = I_C = 0; V_{CB} = 16 \text{ V}; V_{EB} = 1.5 \text{ V}$

C_{cb} typ. 2 pF ←

Collector-emitter capacitance at $f = 1 \text{ MHz}$

$I_E = I_C = 0; V_{CE} = 16 \text{ V}; V_{EB} = 1.5 \text{ V}$

C_{ce} typ. 2 pF ←

Emitter-base capacitance at $f = 1 \text{ MHz}$

$I_E = I_C = 0; V_{CB} = 10 \text{ V}; V_{EB} = 1 \text{ V}$

C_{eb} typ. 15 pF ←

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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	$3.5 + j11$	$6.4 + j2$

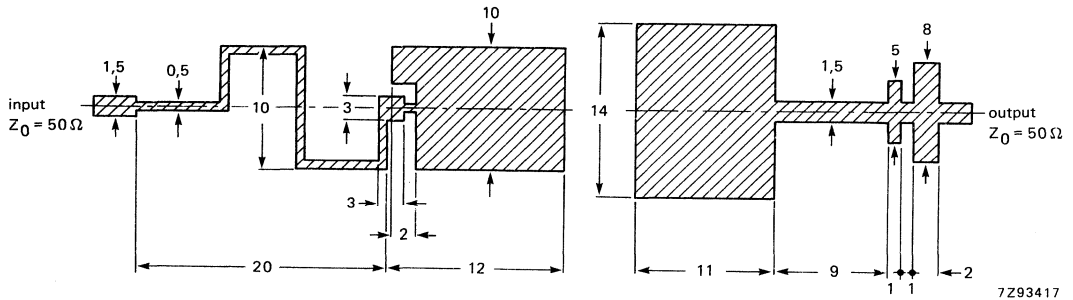


Fig. 4 Prematching test circuit board with PTFE fibre-glass dielectric ($\epsilon_r = 2.54$), thickness 0.8 mm.

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

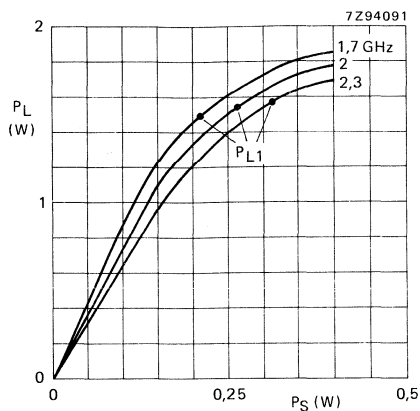


Fig. 5 Output power versus source power.

Conditions for Figs 5 and 6:

$V_{CE} = 16 \text{ V}$ } regulated; typical values.
 $I_C = 250 \text{ mA}$ }

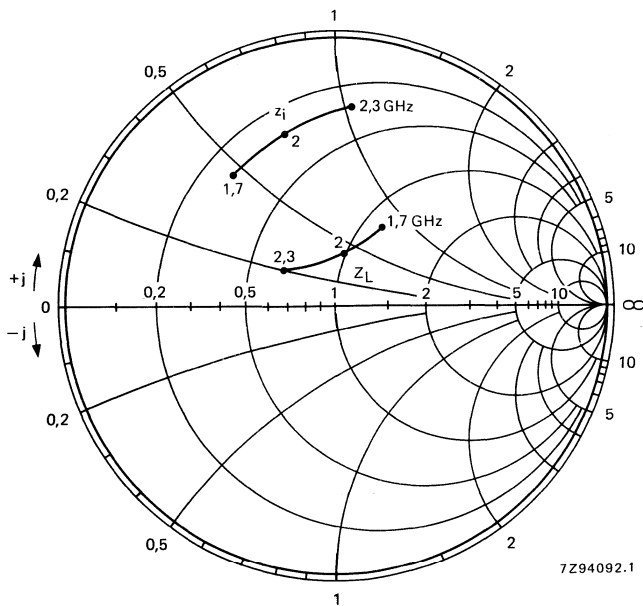


Fig. 6 Input and optimum load impedances versus frequency;
 $Z_0 = 10 \Omega$; $P_{L1} = 1.6 \text{ W}$; $T_{mb} = 25 \text{ }^\circ\text{C}$.

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
- New 5 GHz technology

The transistor is housed in a metal ceramic studless envelope (FO-93).

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

FO-93 (see Fig. 1).

Dimensions in mm

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.

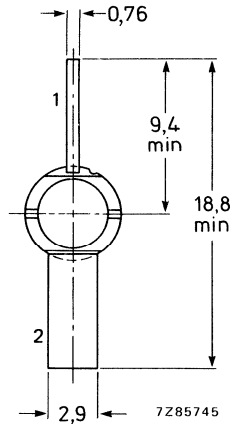
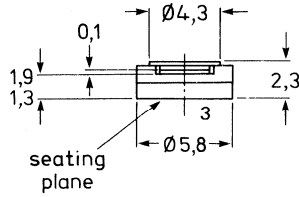
MECHANICAL DATA

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
$R_{BE} = 70 \Omega$	V_{CER}	max.	20 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	800 mA
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	8 W
Storage temperature	T_{stg}		$-65 \text{ to } +200 \text{ }^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature at 0.1 mm from case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

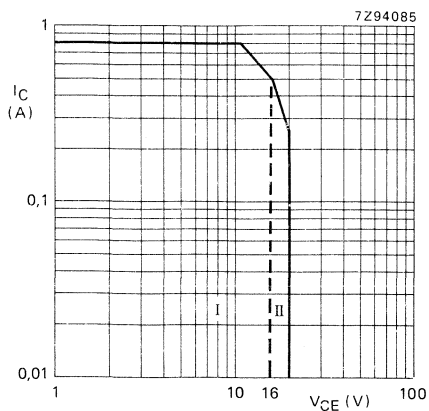


Fig. 2 DC SOAR; $T_{mb} \leq 75^\circ\text{C}$.

I Region of permissible DC operation

II Permissible extension provided

$R_{BE} \leq 70 \Omega$.

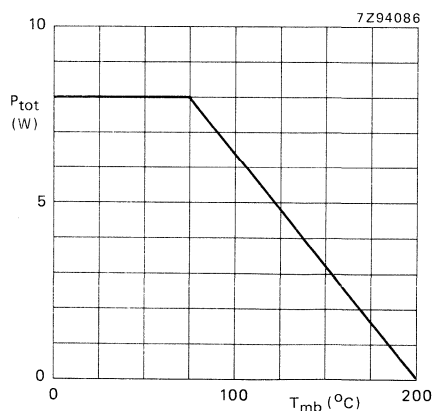


Fig. 3 Power derating curve versus mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75^\circ\text{C}$)

From junction to mounting base

$R_{th\ j-mb}$ max. 8 K/W ←

CHARACTERISTICS

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

Collector cut-off current

$I_E = 0; V_{CB} = 25\text{ V}$

$I_E = 0; V_{CB} = 35\text{ V}$

$I_{CBO} \leq 15\ \mu\text{A}$
 $\leq 700\ \mu\text{A}$

Emitter cut-off current

$I_C = 0; V_{EB} = 1.5\text{ V}$

$I_C = 0; V_{EB} = 3.5\text{ V}$

$I_{EBO} \leq 15\ \mu\text{A}$
 $\leq 150\ \mu\text{A}$

DC current gain

$I_C = 400\text{ mA}; V_{CE} = 5\text{ V}$

h_{FE} typ. 40 ←

Collector-base capacitance at $f = 1\text{ MHz}$

$I_E = I_C = 0; V_{CB} = 16\text{ V}; V_{EB} = 1.5\text{ V}$

C_{cb} typ. 3 pF ←

Collector-emitter capacitance at $f = 1\text{ MHz}$

$I_E = I_C = 0; V_{CE} = 16\text{ V}; V_{EB} = 1.5\text{ V}$

C_{ce} typ. 2.2 pF ←

Emitter-base capacitance at $f = 1\text{ MHz}$

$I_E = I_C = 0; V_{CB} = 10\text{ V}; V_{EB} = 1\text{ V}$

C_{eb} typ. 83 pF ←

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 typ. 2.8	≥ 7 typ. 7.8	2 + j8	5.5 - j1.8

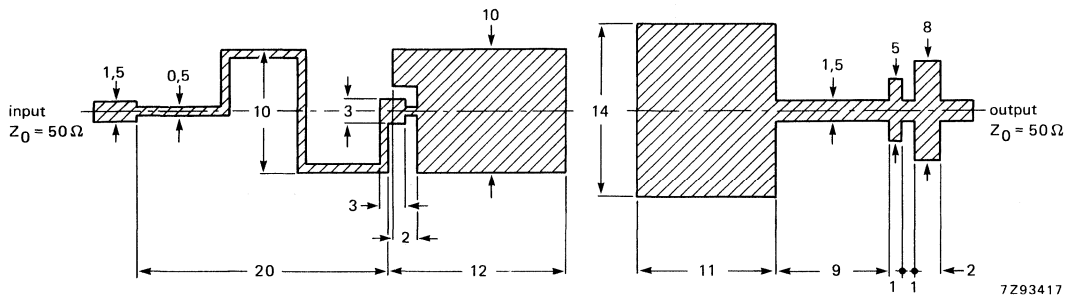


Fig. 4 Prematching test circuit board with PTFE fibre-glass dielectric ($\epsilon_r = 2.54$), thickness 0.8 mm.

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

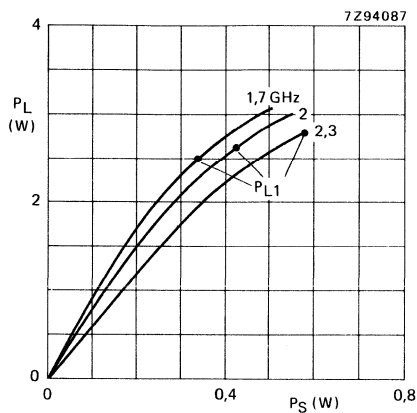


Fig. 5 Output power versus source power.

Conditions for Figs 5 and 6:

$V_{CE} = 16 \text{ V}$ } regulated; typical values.
 $I_C = 400 \text{ mA}$ }

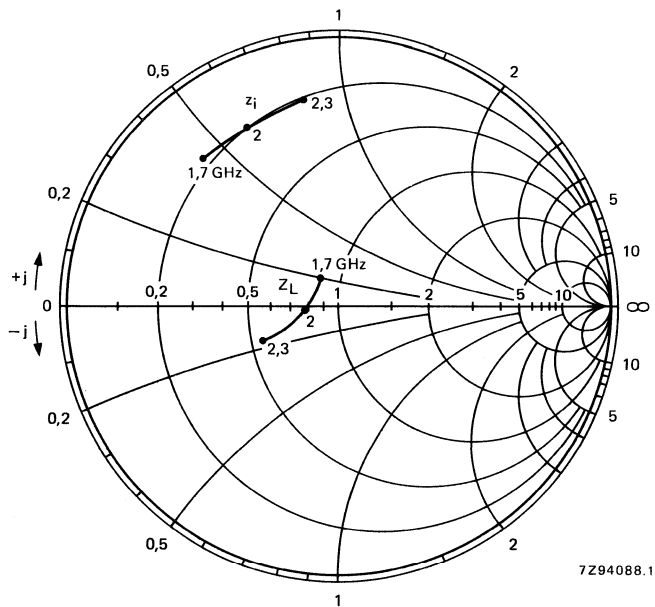


Fig. 6 Input and optimum load impedance versus frequency;
 $Z_0 = 10 \Omega$; $T_{mb} = 25 \text{ }^\circ\text{C}$.

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

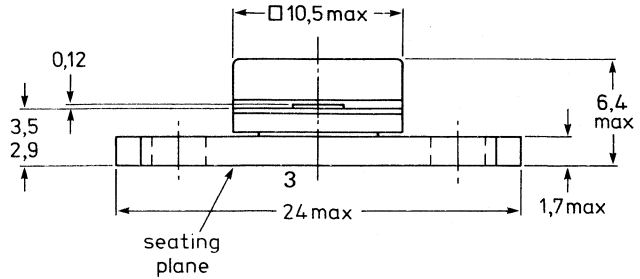
MECHANICAL DATA

Fig. 1 FO-57C.

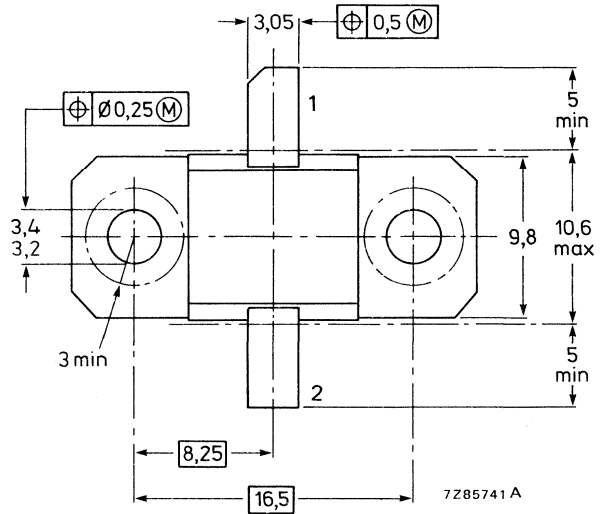
Dimensions in mm

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
→ $R_{BE} = 220 \Omega$	V_{CER}	max.	30 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	4 A
Total power dissipation			
→ up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	45 W
Storage temperature	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature			
→ at 0.2 mm from flange; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

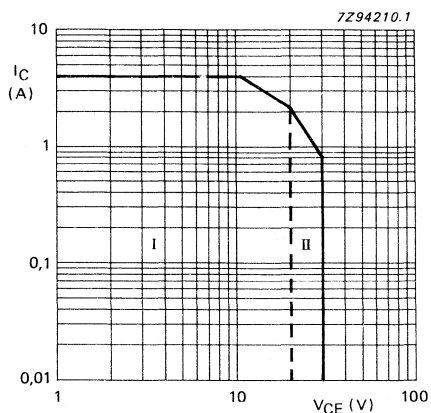


Fig. 2 DC SOAR; $T_{mb} \leq 75^\circ\text{C}$.
 I Region of permissible DC operation
 II Permissible extension provided
 $R_{BE} \leq 220 \Omega$

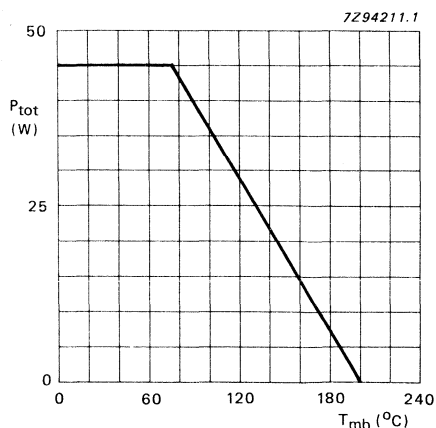


Fig. 3 Power derating curve versus mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75^\circ\text{C}$)

From junction to mounting base
 From mounting base to heatsink

$R_{th\ j-mb}$	max.	2.2 K/W	
$R_{th\ mb-h}$	max.	0.2 K/W	←

CHARACTERISTICS

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

Collector cut-off current

$I_E = 0; V_{CB} = 20\text{ V}$

$I_E = 0; V_{CB} = 40\text{ V}$

$V_{CE} = 30\text{ V}; R_{BE} = 220 \Omega$

$V_{CE} = 20\text{ V}; I_B = 0$

I_{CBO}	max.	2 mA	←
	max.	20 mA	←
I_{CER}	max.	20 mA	←
I_{CEO}	max.	20 mA	←

Emitter cut-off current

$I_C = 0; V_{EB} = 1.5\text{ V}$

$I_C = 0; V_{EB} = 3.5\text{ V}$

I_{EBO}	max.	200 μA	
	max.	2.5 mA	←

DC current gain

$I_C = 2\text{ A}; V_{CE} = 3\text{ V}$

h_{FE}	15 to 100	
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APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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	

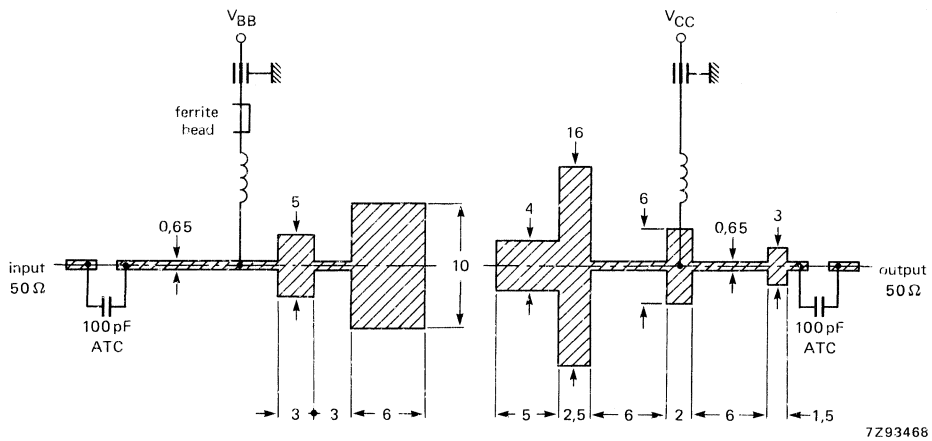


Fig. 4 Wideband test circuit board for 1.4 to 1.8 GHz, CW, class-A application (dimensions in mm). Epsilam p.c. board, thickness 0.635 mm, $\epsilon_r = 10$.

* Amplifier consists of test circuit board without any additional tuning.

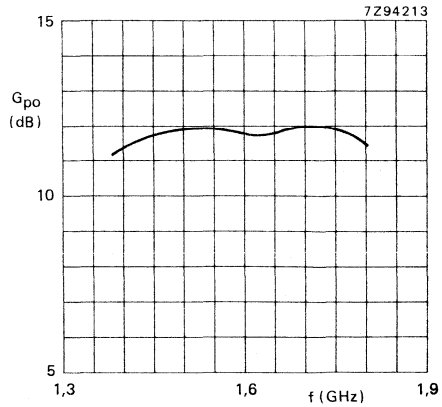
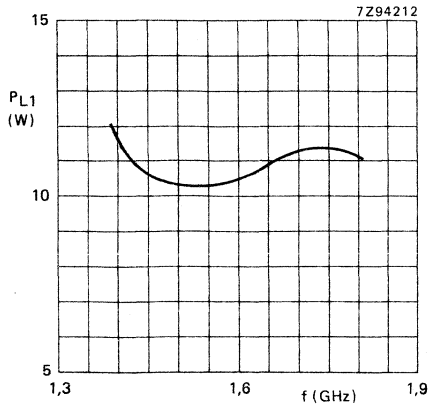


Fig. 5 Load power as a function of frequency.

Fig.6 Linear power gain as a function of frequency.

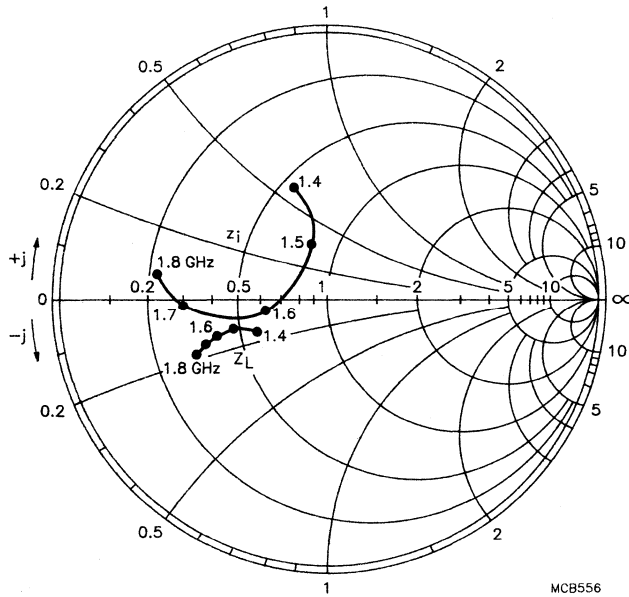


Fig. 7 Input and load impedances as a function of frequency;
Z₀ = 10 Ω; typical values.

Conditions for Figs 5 to 7:

V_{CE} = 16 V } regulated; T_{mb} = 25 °C; typical values.
I_C = 2 A }

Philips Components

Data sheet	
status	Preliminary specification
date of Issue	June 1990

LZE18100R

NPN silicon microwave power transistor

FEATURES

- Interdigitated structure giving a 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.
- Internal input prematching ensures good stability and allows an easier design of wideband circuits.

DESCRIPTION

NPN silicon power transistor intended for use in common emitter class A amplifier from 1.4 GHz to 1.8 GHz in CW conditions in military and professional applications. The transistor has a FO-57C metal ceramic package, with emitter connected to flange.

QUICK REFERENCE DATA

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

MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_C (mA)	P_{L1} (mW)	G_{po} (dB)
CW; class A	1.8	16	2	typ. 10	typ. 11

WARNING

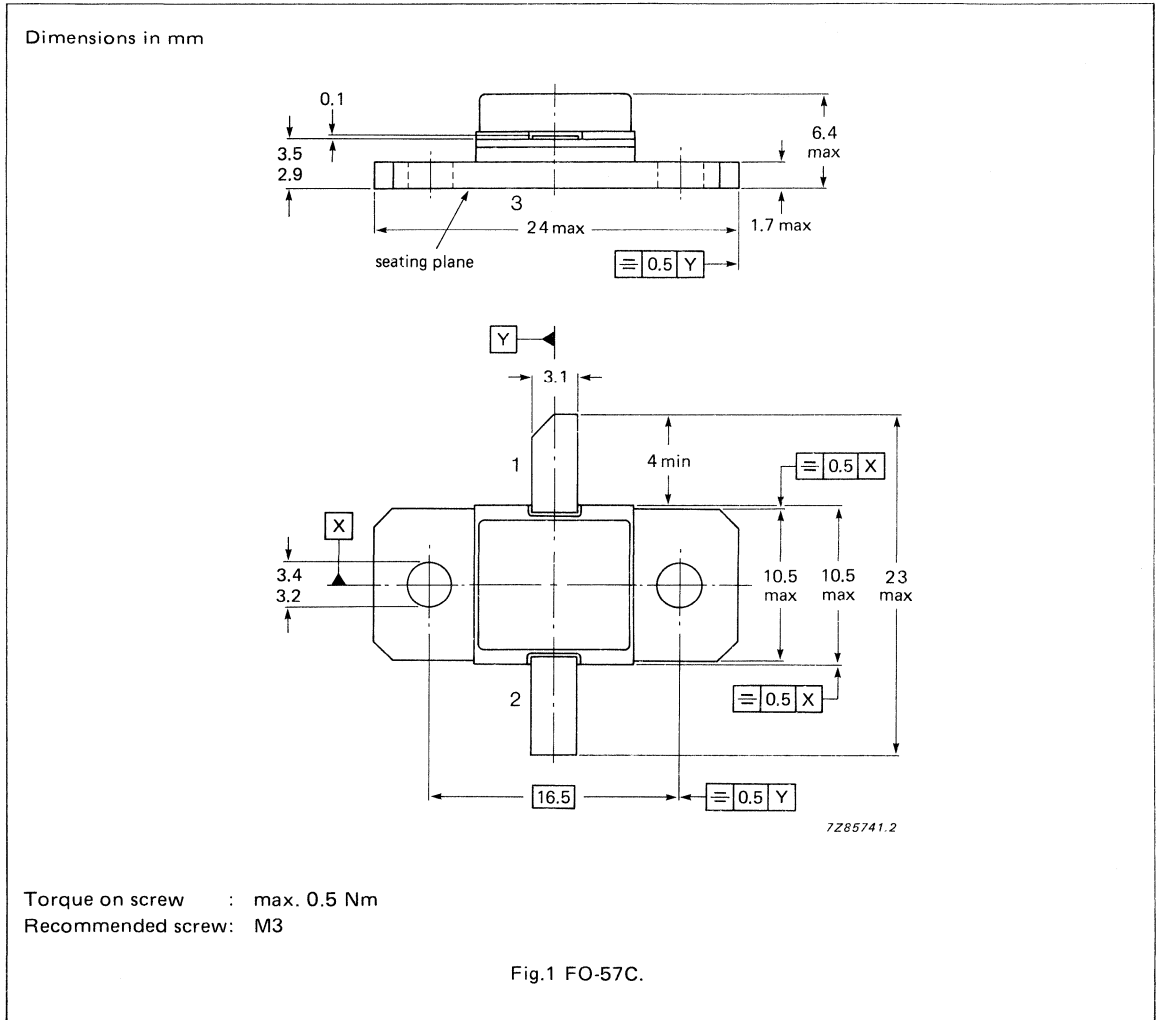
Product and environmental safety – toxic materials

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 industrial or domestic waste.

NPN silicon microwave power transistor

LZE18100R

MECHANICAL DATA



PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter

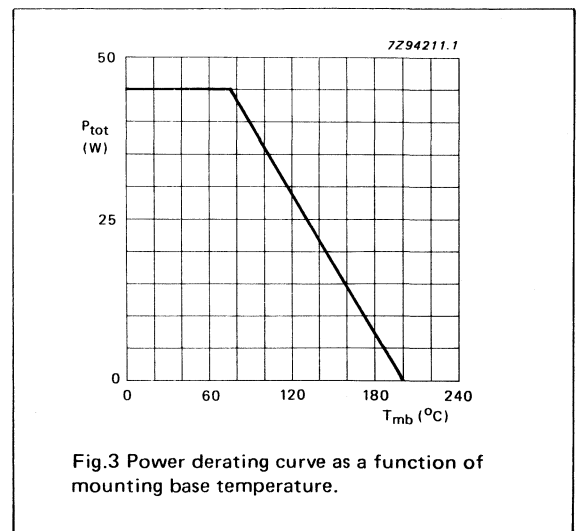
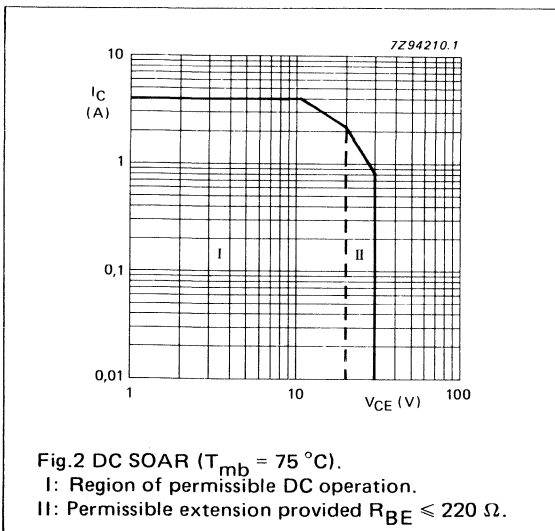
NPN silicon microwave power transistor

LZE18100R

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_{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	—	3.5	V
I_C	collector current (DC)		—	4	A
P_{tot}	total power dissipation	$T_{mb} = 75^\circ\text{C}$	—	45	W
T_{stg}	storage temperature range		-65	200	$^\circ\text{C}$
T_j	operating junction temperature		—	200	$^\circ\text{C}$
T_{sld}	soldering temperature	$t_{sld} \leq 10 \text{ s};$ up to 0.2 mm from flange	—	235	$^\circ\text{C}$



THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th j-mb}$	from junction to mounting base	$T_j = 75^\circ\text{C}$	2.2	K/W
$R_{th mb-h}$	from mounting base to heatsink	$T_j = 75^\circ\text{C}$	0.2	K/W

NPN silicon microwave power transistor**LZE18100R****CHARACTERISTICS** $T_{mb} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 20\text{ V}; I_E = 0$	—	2	mA
I_{CBO}	collector cut-off current	$V_{CB} = 40\text{ V}; I_E = 0$	—	20	mA
I_{CER}	collector cut-off current	$V_{CE} = 30\text{ V}; R_{BE} = 220\ \Omega$	—	20	mA
I_{CEO}	collector cut-off current	$V_{CE} = 20\text{ V}; I_B = 0$	—	20	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	—	200	μA
I_{EBO}	emitter cut-off current	$V_{EB} = 3.5\text{ V}; I_C = 0$	—	2.5	mA
h_{FE}	DC current gain	$V_{CE} = 3\text{ V}; I_C = 2\text{ A}$	15	100	

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon power transistor intended for use in military and professional applications. It operates only in pulsed conditions and is recommended for IFF applications at 1.09 GHz.

It offers the following technological advantages:

- Interdigitated structure giving a 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 thermal resistance

The transistor has an FO-67 metal ceramic flange package.

It is mounted in a common-base configuration, specified in class-C and operates in pulsed conditions. An input matching cell improves the input impedance and allows an easier design of wideband circuits.

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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
pulsed: $t_p = 10\ \mu\text{s}$ $\delta = 1\%$	1.09	50	> 175	> 7.5	> 35	see Figs 3 and 4	

MECHANICAL DATA

FO-67 (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.

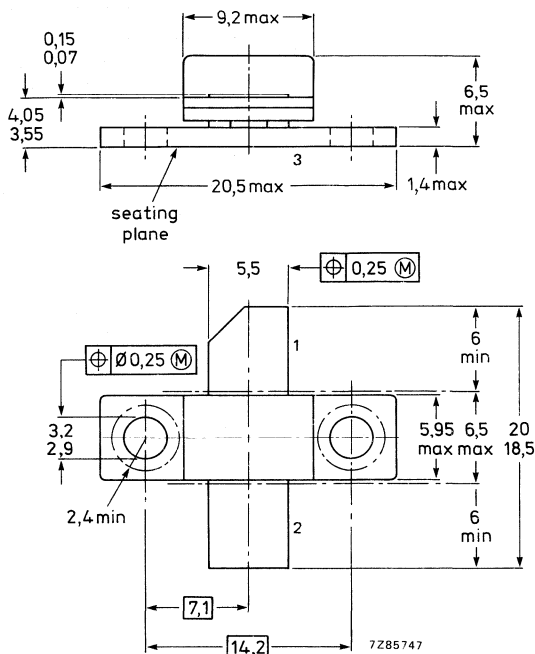
MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-67.

Pinning:

- 1 = collector
- 2 = emitter
- 3 = base



Marking code

11175Y

Torque on screw: max. 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.	65 V
Collector-emitter voltage	V_{CES}	max.	65 V
$R_{BE} = 0$	V_{CEO}	max.	25 V
open base			
Emitter-base voltage, open collector	V_{EBO}	max.	3.5 V
Collector current	I_C	max.	12.5 A
$t_p \leq 10 \mu s, \delta \leq 1\%$			
Total power dissipation	P_{tot}	max.	500 W
$t_p \leq 10 \mu s, \delta \leq 1\%; T_{mb} \leq 75 \text{ }^\circ\text{C}$			
Storage temperature	T_{stg}		-65 to 150 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature	T_{sld}	max.	235 $^\circ\text{C}$
at 0.1 mm from case; $t_{sld} \leq 10 \text{ s}$			

THERMAL RESISTANCE (at $T_j=75 \text{ }^\circ\text{C}$)

From junction to mounting base under pulsed conditions:

$t_p \leq 10 \mu s, \delta \leq 1\%$	$R_{th \text{ j-mb}}$	max.	0.08 K/W
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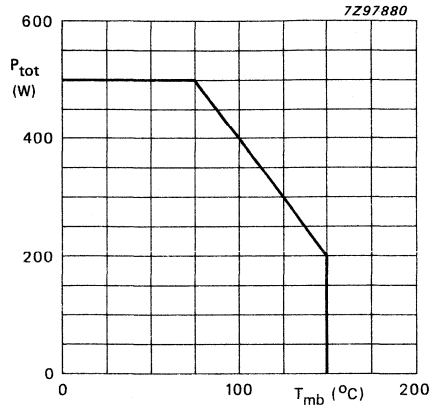


Fig.2 Power derating curve as a function of mounting base temperature in pulsed condition.

CHARACTERISTICS

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

Breakdown voltages

$I_C = 40\text{ mA}; I_E = 0$

$I_C = 40\text{ mA}; R_{BE} = 0$

$I_C = 0; I_E = 25\text{ mA}$

$V_{(BR)CBO}$	min.	65 V	
$V_{(BR)CES}$	min.	65 V	←
$V_{(BR)EBO}$	min.	3.5 V	←

Collector cut-off current

$I_E = 0; V_{CB} = 50\text{ V}$

I_{CBO}	max.	15 mA	←
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Emitter cut-off current

$I_C = 0; V_{EB} = 1.5\text{ V}$

I_{EBO}	max.	1.5 mA	←
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Collector-base capacitance

$I_E = I_C = 0; V_{CB} = 50\text{ V}$

C_{cb}	typ.	45 pF	
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APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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
pulsed: t _p = 10 μ s δ = 1%	1.09	50	≥ 175 typ. 200	≥ 7.5 typ. 8.5	≥ 35 typ. 40	see Figs 3 and 4	

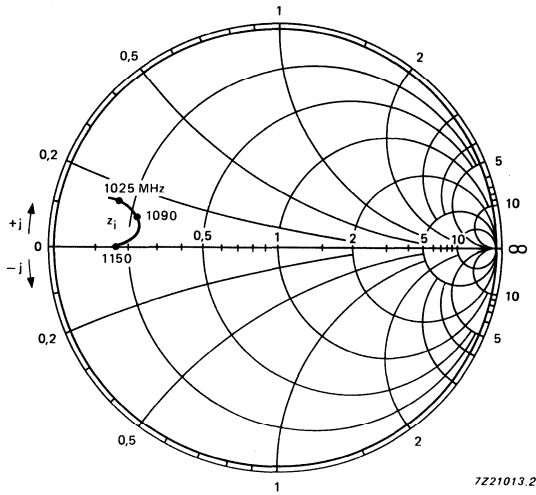


Fig.3 Input impedance as a function of frequency; $Z_0 = 50\ \Omega$; typical values.

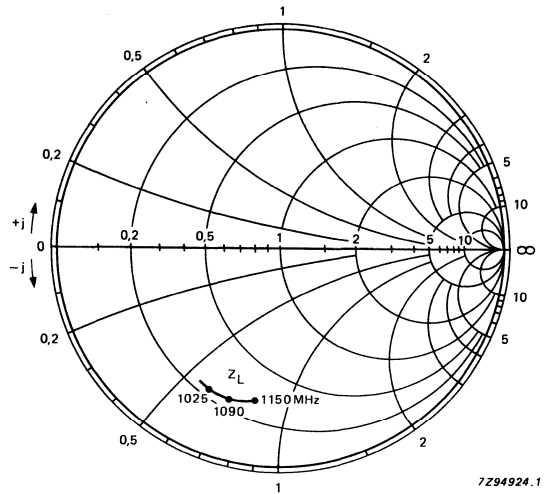


Fig.4 Optimum load impedance as a function of frequency; $Z_0 = 5\ \Omega$; typical values.

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon power transistor intended for use in military and professional applications. It operates only in pulsed conditions and is recommended for IFF applications at 1.09 GHz.

It offers the following technological advantages:

- Interdigitated structure giving a 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 thermal resistance

The transistor has an FO-67 metal ceramic flange package.

It is mounted in a common-base configuration, specified in class-C and operates in pulsed conditions. An input matching cell improves the input impedance and allows an easier design of wideband circuits.

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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
pulsed: t _p = 10 μ s δ = 1%	1.09	50	≥ 350	≥ 7	≥ 30	see Fig.3	

MECHANICAL DATA

FO-67 (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.

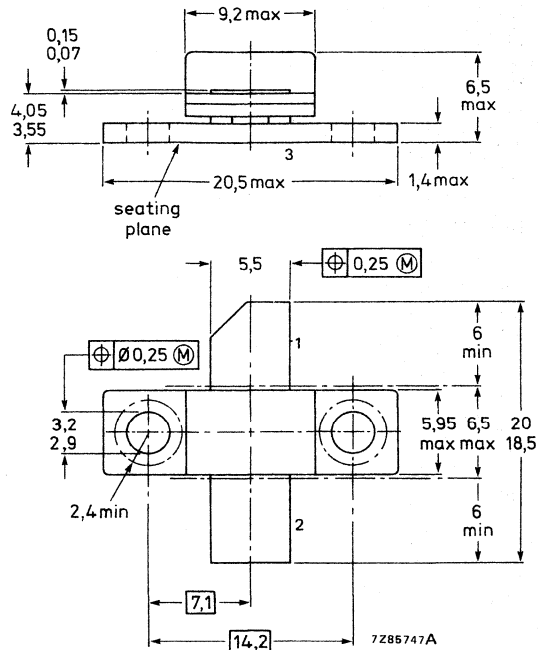
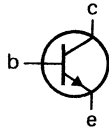
MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-67.

Pinning:

- 1 = collector
- 2 = emitter
- 3 = base



Marking code

11350Y

Torque on screw: max. 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.	65 V
Collector-emitter voltage	V_{CES}	max.	65 V
→ $R_{BE} = 0$ open base	V_{CEO}	max.	25 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.5 V
Collector current	I_C	max.	25 A
$t_p \leq 10 \mu s, \delta \leq 1\%$			
Total power dissipation	P_{tot}	max.	1000 W
$t_p \leq 10 \mu s, \delta \leq 1\%; T_{mb} \leq 75 \text{ }^\circ\text{C}$			
Storage temperature	T_{stg}		-65 to 150 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature	T_{sld}	max.	235 $^\circ\text{C}$
at 0.1 mm from case; $t_{sld} \leq 10 \text{ s}$			

THERMAL RESISTANCE (at $T_j=75 \text{ }^\circ\text{C}$)

From junction to mounting base under pulsed conditions:

$t_p \leq 10 \mu s, \delta \leq 1\%$	$R_{th \text{ j-mb}}$	max.	0.04 K/W
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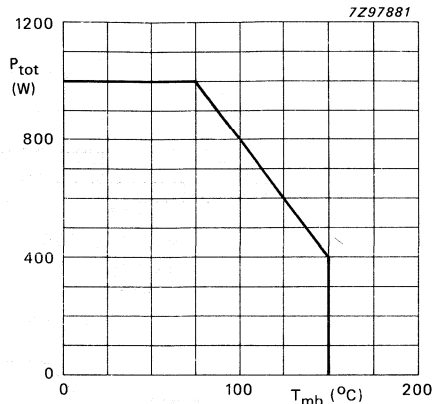


Fig. 2 Power derating curve as a function of mounting base temperature; pulsed condition.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Breakdown voltages

I_C = 80 mA; I_E = 0

V(BR)CBO min. 65 V

I_C = 80 mA; R_{BE} = 0

V(BR)CES min. 65 V ←

I_C = 0; I_E = 50 mA

V(BR)EBO min. 3.5 V

Collector cut-off current

I_E = 0; V_{CB} = 50 V

I_{CBO} max. 30 mA ←

Emitter cut-off current

I_C = 0; V_{EB} = 1.5 V

I_{EBO} max. 2.5 mA ←

Collector-base capacitance

I_E = I_C = 0; V_{CB} = 50 V

C_{cb} typ. 90 pF

APPLICATION INFORMATION

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

mode of operation	f GHz	V _{CC} V	PL W	G _p dB	η _c %	z _i Ω	Z _L Ω
pulsed: t _p = 10 μs δ = 1%	1.09	50	≥ 350 typ. 400	≥ 7 typ. 8	≥ 30 typ. 35	see Fig. 3 ←	

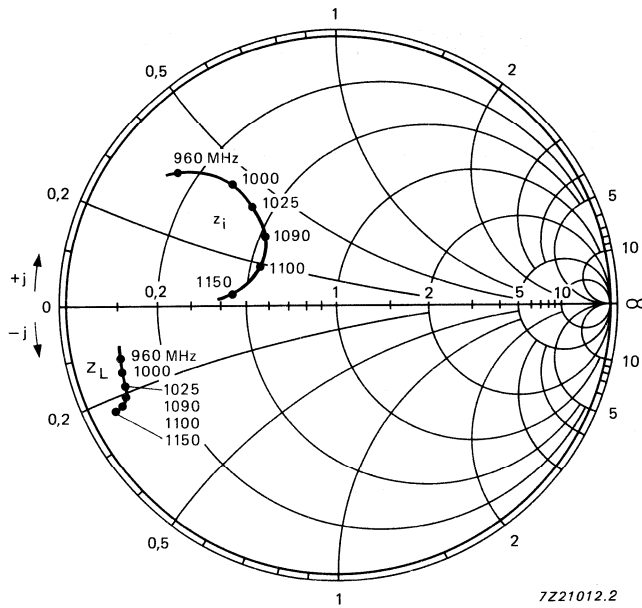


Fig. 3 Optimal load impedance and input impedance in large signal conditions; $Z_O = 10 \Omega$; typical values.

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon power transistor (two transistor sections) intended for use in military and professional applications. It operates only in pulsed conditions and is recommended for IFF applications at 1.09 MHz.

It offers the following technological advantages:

- Interdigitated structure giving a 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 thermal resistance

The transistor has an FO-96 metal-ceramic flange package.

It is mounted in a common-base configuration, specified in class-C and operates in pulsed conditions. An input matching cell improves the input impedance and allows an easier design of wideband circuits.

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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
pulsed: t _p = 10 μ s δ = 1%	1.09	50	≥ 800	≥ 7	> 30	see Fig. 3	

MECHANICAL DATA

FO-96 (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.

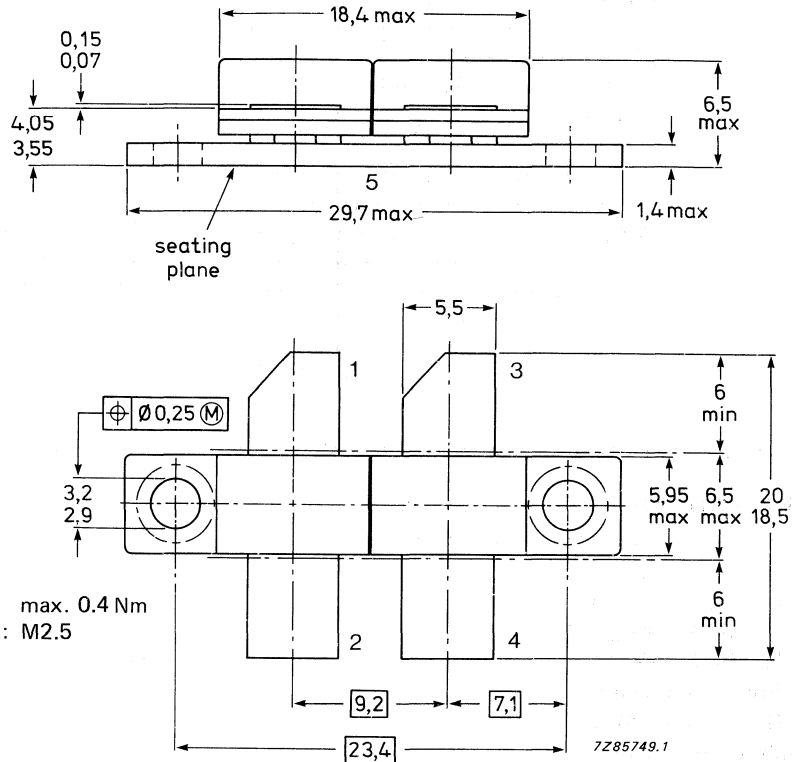
MECHANICAL DATA

Fig. 1 FO-96.

Dimensions in mm

Pinning:

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



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

RATINGS

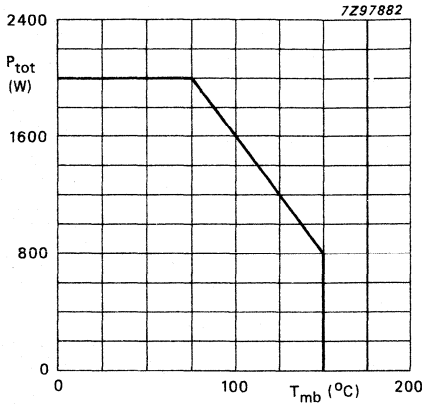
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage, open emitter	V_{CBO}	max.	65 V
Collector-emitter voltage	V_{CES}	max.	65 V
→ $R_{BE} = 0$ open base	V_{CEO}	max.	25 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.5 V
Collector current, per transistor section	I_C	max.	30 A
→ $t_p \leq 10 \mu s, \delta \leq 1\%$			
Total power dissipation	P_{tot}	max.	2x1000 W
$t_p \leq 10 \mu s, \delta \leq 1\%; T_{mb} \leq 75 \text{ }^\circ\text{C}$			
Storage temperature	T_{stg}		-65 to 150 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature at 0.1 mm from case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE* (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base under pulsed conditions:			
→ $t_p \leq 10 \mu s, \delta \leq 1\%$	$R_{th\ j-mb}$	max.	0.02 K/W

* Dissipation of either transistor section shall not exceed half rated power.



*Dissipation of either transistor section shall not exceed half rated power.

Fig. 2 Power derating curve as a function of mounting base temperature; pulsed condition.*

CHARACTERISTICS, per transistor section

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

Breakdown voltages

$I_C = 80\text{ mA}; I_E = 0$

$I_C = 80\text{ mA}; R_{BE} = 0$

$I_C = 0; I_E = 50\text{ mA}$

$V(BR)CBO$	min.	65 V	
$V(BR)CES$	min.	65 V	←
$V(BR)EBO$	min.	3.5 V	←

Collector cut-off current

$I_E = 0; V_{CB} = 50\text{ V}$

I_{CBO}	max.	10 mA	←
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Emitter cut-off current

$I_C = 0; V_{EB} = 1.5\text{ V}$

I_{EBO}	max.	2.5 mA	←
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Collector-base capacitance

$I_E = I_C = 0; V_{CB} = 50\text{ V}$

C_{cb}	typ.	90 pF	←
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APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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
pulsed: $t_p = 10\text{ }\mu\text{s}$ $\delta = 1\%$	1.09	50	≥ 800 typ. 850	≥ 7 typ. 7.5	≥ 30 typ. 35	see Fig. 3 ←	

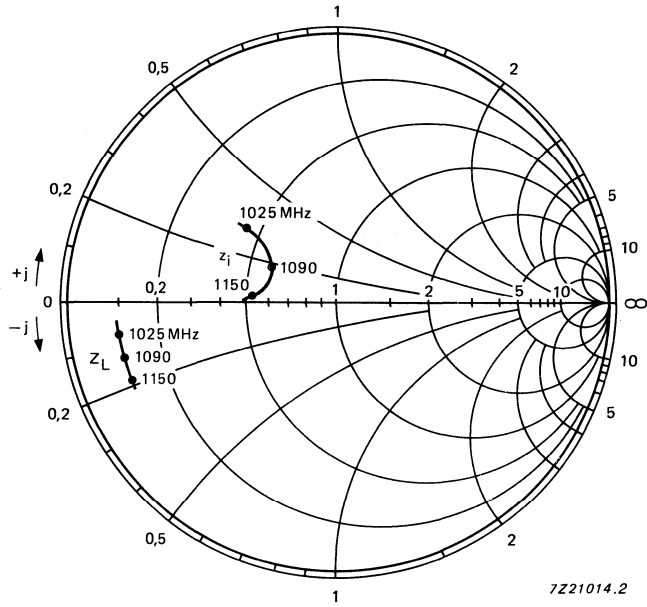


Fig. 3 Input and optimum load impedance in large signal conditions;
 $Z_o = 10 \Omega$; typical values.

Data sheet	
status	Preliminary specification
date of issue	April 1990

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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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	> 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 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 industrial or domestic waste.

NPN silicon planar epitaxial microwave power transistor

MZ0912B50Y

MECHANICAL DATA

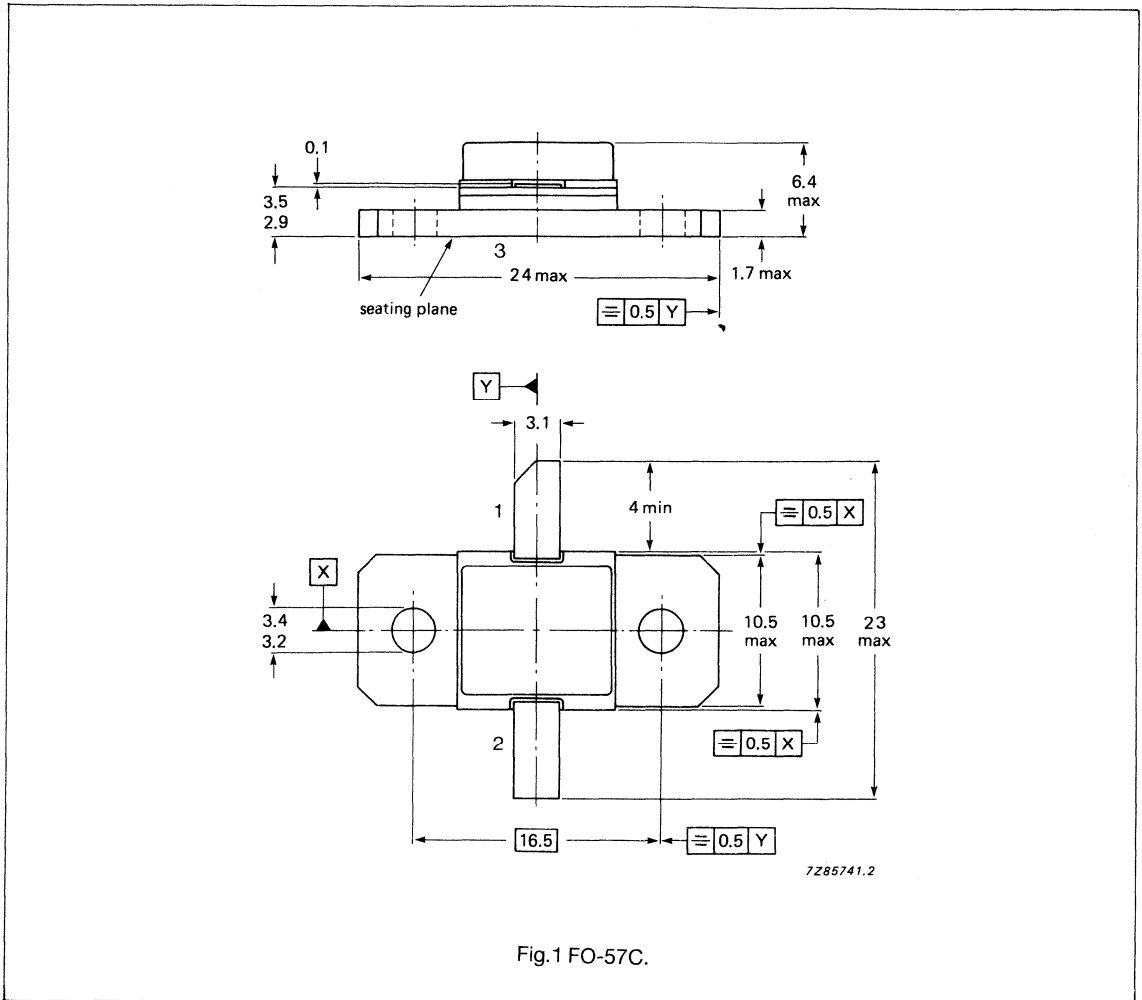


Fig.1 FO-57C.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
	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 (average)	$t_p \leq 10 \mu s; \delta \leq 10\%$	-	3	A
P_{tot}	total power dissipation	peak power; $T_{mb} = 75^\circ C$; $t_p \leq 10 \mu s; \delta \leq 10\%$	-	150	W
T_{stg}	storage temperature range		-65	200	$^\circ C$
T_j	operating junction temperature		-	200	$^\circ C$
T_{sld}	soldering temperature	$t \leq 10 s$ up to 0.2 mm from ceramic	-	235	$^\circ C$

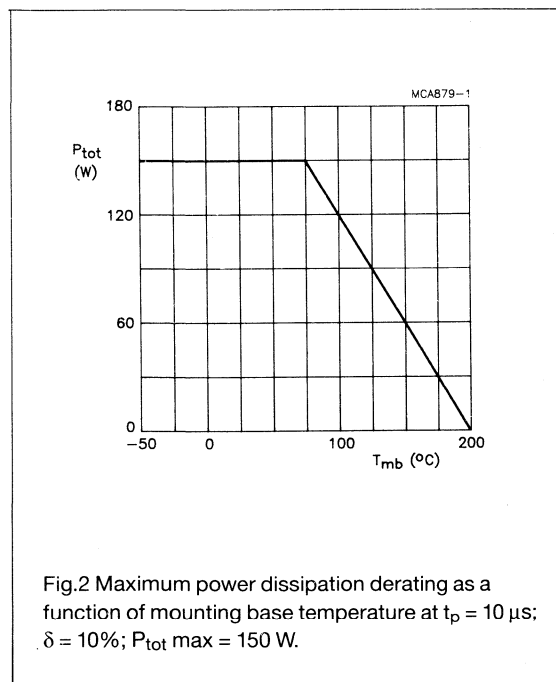


Fig.2 Maximum power dissipation derating as a function of mounting base temperature at $t_p = 10 \mu s$; $\delta = 10\%$; P_{tot} max = 150 W.

NPN silicon planar epitaxial microwave power transistor

MZ0912B50Y

THERMAL CHARACTERISTICS

$T_j = 125\text{ }^\circ\text{C}$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j-mb}$	thermal resistance from junction to mounting base	CW	4.9	K/W
$R_{th\ mb-h}$	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 ($t_p = 10\ \mu\text{s}$ and $\delta = 10\%$).

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 65\text{ V}; I_E = 0$	20	mA
I_{CBO}	collector cut-off current	$V_{CB} = 50\text{ V}; I_E = 0$	2	mA
I_{CES}	collector cut-off current	$V_{CE} = 60\text{ V}; R_{BE} = 0$	20	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	200	μA

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^\circ\text{C}$ 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 $t_p = 10\ \mu\text{s}; \delta = 10\%$	0.960 to 1.215	50	> 50 typ. 60	> 7 typ. 70	> 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 $\varnothing = 0.65\text{ mm}$, total length = 12 mm, height of loop = 9 mm

L3 = Cu wire $\varnothing = 0.65\text{ mm}$, internal diameter 3 mm, 4 turns, L = 5 mm

C1 = DC block, 100 pF (ATC, ref. 100A101KP50X)

C2 = tantalum capacitor 10 $\mu\text{F}/50\text{ V}$

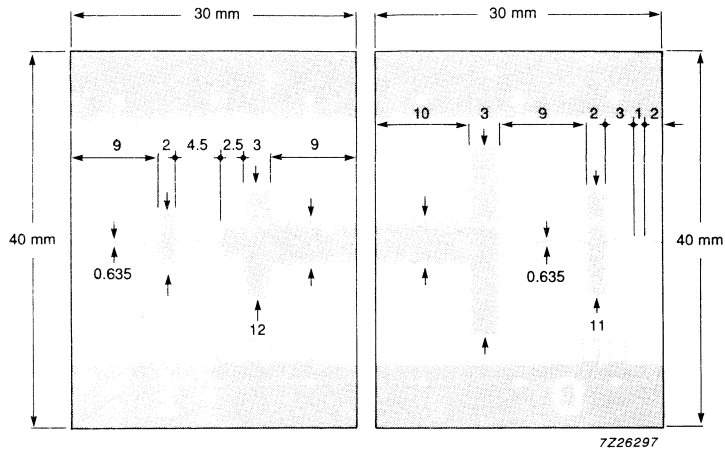
C3 = electrolytic capacitor 470 $\mu\text{F}/63\text{ V}$

C4 = feedthru bypass capacitor (Erie, ref. 1250-003)

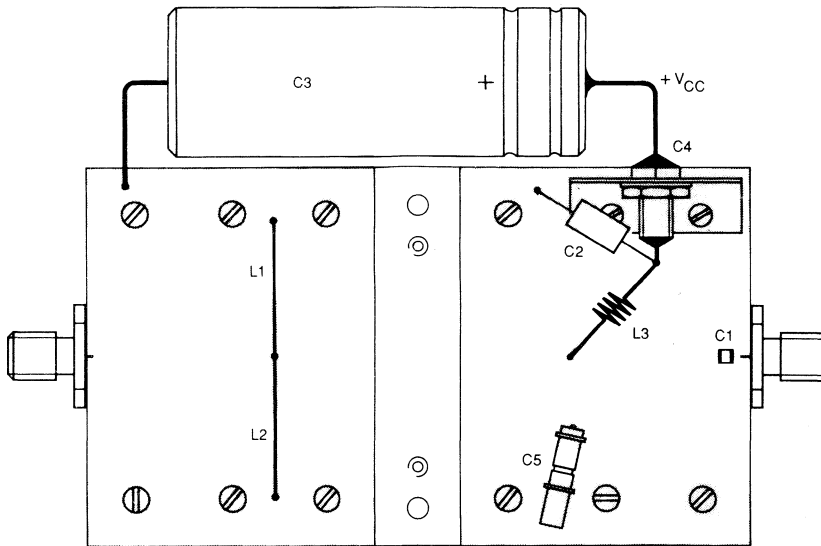
C5 = C6 = Variable gigatrim capacitor 0.6 - 4.5 pF, (Tekelec, ref. 727.1)

NPN silicon planar epitaxial microwave power transistor

MZ0912B50Y



7Z26297



7Z26296

Substrate: Epsilam 10
 Thickness: 0.635 mm
 $\epsilon_r = 10$
 All dimensions in mm.

Fig.3 Broadband test circuit.

NPN silicon planar epitaxial microwave power transistor

MZ0912B50Y

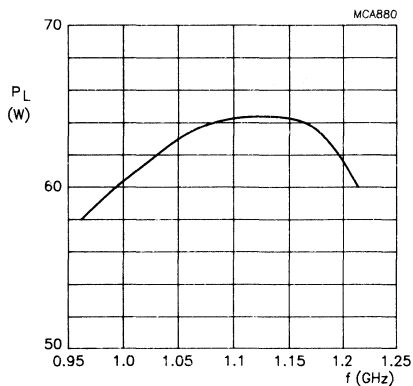


Fig.4 Load power P_L as a function of frequency; $V_{CC} = 50\text{ V}$; $t_p = 10\ \mu\text{s}$; $\delta = 10\%$. (In broadband test circuit as shown in Fig.3).

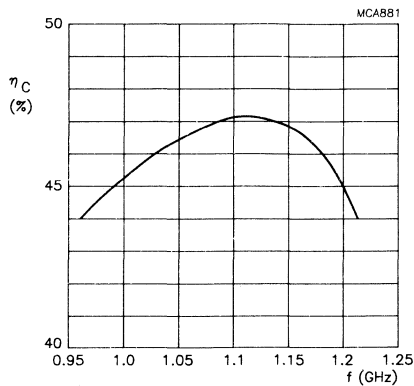


Fig.5 Collector efficiency as a function of frequency. (In broadband test circuit as shown in Fig.3).

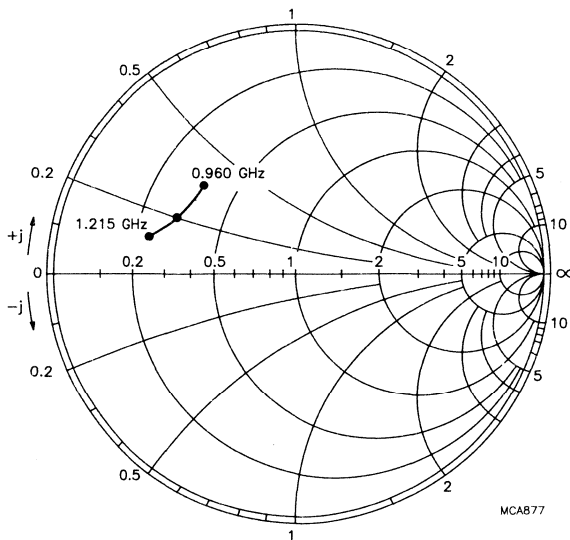


Fig.6 Input impedance as a function of frequency for $P_L = 50\text{ W}$; associated with optimum load impedance; $V_{CC} = 50\text{ V}$; $Z_0 = 10\ \Omega$.

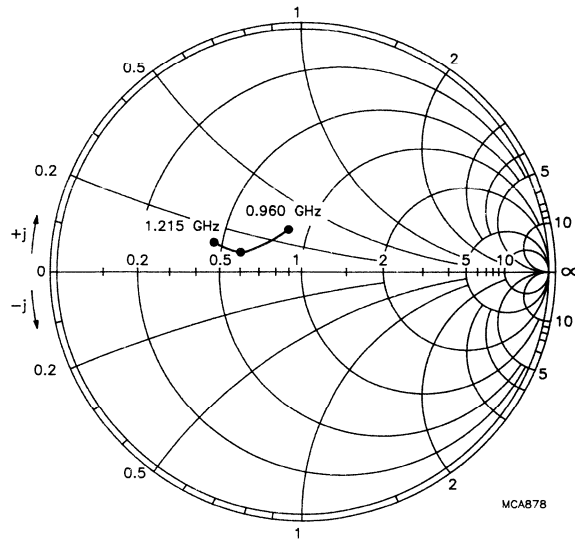
**NPN silicon planar epitaxial microwave
power transistor****MZ0912B50Y**

Fig.7 Optimum load impedance as a function of frequency for $P_L = 50$ W; associated with input impedance; $V_{CC} = 50$ V; $Z_0 = 10 \Omega$.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	April 1990

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.

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QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

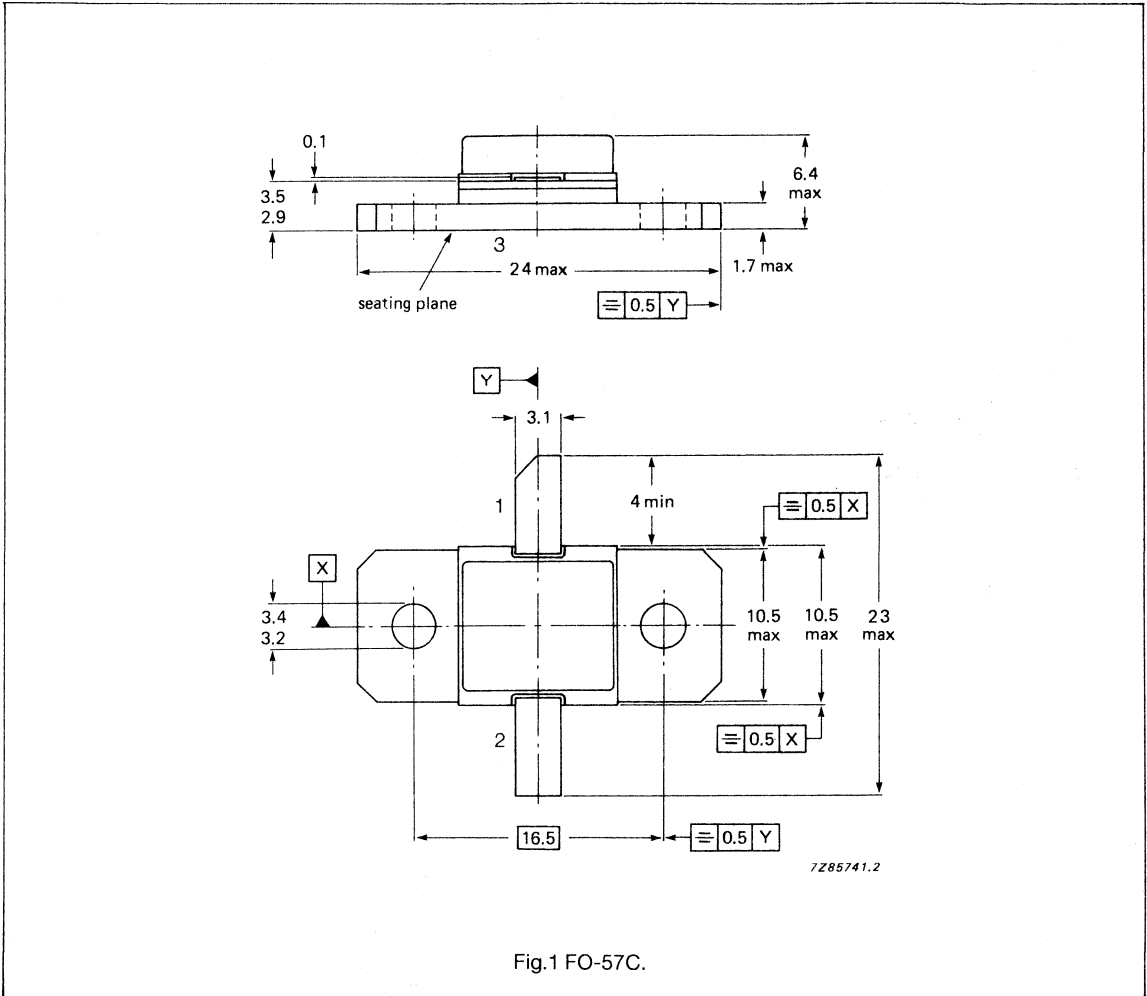
WARNING

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**NPN silicon planar epitaxial microwave
power transistor**

MZ0912B100Y

MECHANICAL DATA



PINNING

PIN	DESCRIPTION
1	collector
2	emitter
	base connected to flange

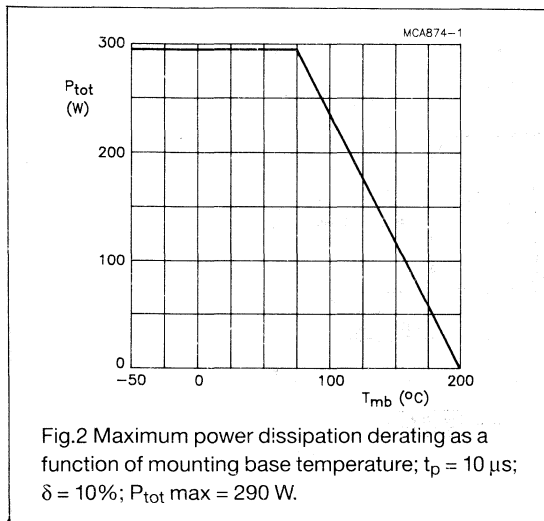
NPN silicon planar epitaxial microwave power transistor

MZ0912B100Y

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 (average)	$t_p \leq 10 \mu\text{s}; \delta \leq 10\%$	-	6	A
P_{tot}	total power dissipation	peak power; $T_{mb} = 75^\circ\text{C};$ $t_p \leq 10 \mu\text{s}; \delta \leq 10\%$	-	290	W
T_{stg}	storage temperature range		-65	200	$^\circ\text{C}$
T_j	operating junction temperature		-	200	$^\circ\text{C}$
T_{sld}	soldering temperature	$t \leq 10 \text{ s}$ up to 0.2 mm from ceramic	-	235	$^\circ\text{C}$



THERMAL CHARACTERISTICS

$T_j = 125^\circ\text{C}$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th \text{ j-mb}}$	thermal resistance from junction to mounting base	CW	3.2	K/W
$R_{th \text{ mb-h}}$	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

- Equivalent thermal impedance under nominal pulse microwave operating conditions; $t_p = 10 \mu\text{s}$; $\delta = 10\%$.

NPN silicon planar epitaxial microwave power transistor

MZ0912B100Y

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 65\text{ V}; I_E = 0$	40	mA
I_{CBO}	collector cut-off current	$V_{CB} = 50\text{ V}; I_E = 0$	4	mA
I_{CES}	collector cut-off current	$V_{CE} = 60\text{ V}; R_{BE} = 0$	40	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	400	μA

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 $t_p = 10\text{ }\mu\text{s}; \delta = 10\%$	0.960 to 1.215	50	≥ 100 typ. 115	≥ 7 typ. 7.6	≥ 42 typ. 44	see Figs 7 and 8
$t_p = 300\text{ }\mu\text{s}; \delta = 10\%$	1.03 to 1.09	50	typ. 125	typ. 8	typ. 50	see Fig.3

Notes

- V_{CC} during pulse.
- Operating conditions and performance for other pulse formats can be made available on request.

List of components

- L1 = Cu wire $\varnothing = 0.65\text{ mm}$, total length = 12 mm, height of loop = 12 mm
 L2 = Cu wire $\varnothing = 0.65\text{ mm}$, internal diameter 3 mm, 4 turns, L = 5 mm
 C1 = DC block, 100 pF (ATC, ref. 100A101KP50X)
 C2 = tantalum capacitor 10 $\mu\text{F}/50\text{ V}$
 C3 = electrolytic capacitor 470 $\mu\text{F}/63\text{ V}$
 C4 = feedthru bypass capacitor (Erie, ref. 1250-003)
 C5 = C6 = Variable gigatrim capacitor 0.6 - 4.5 pF, (Tekelec, ref. 727.1)

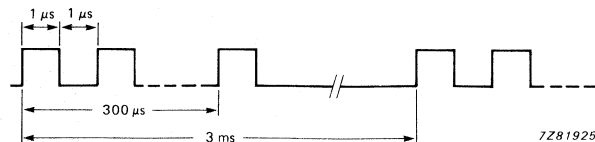
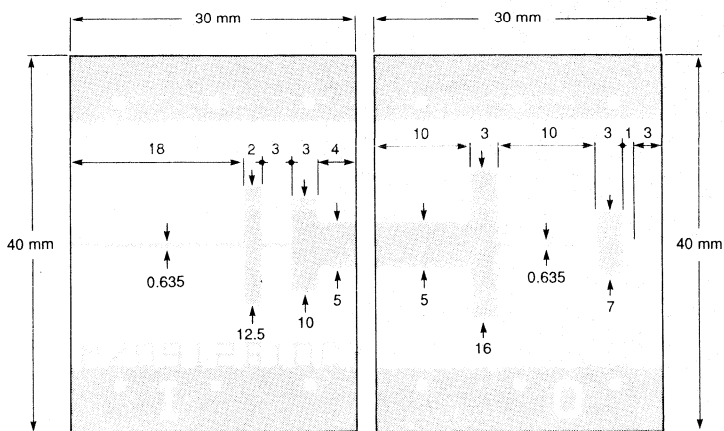


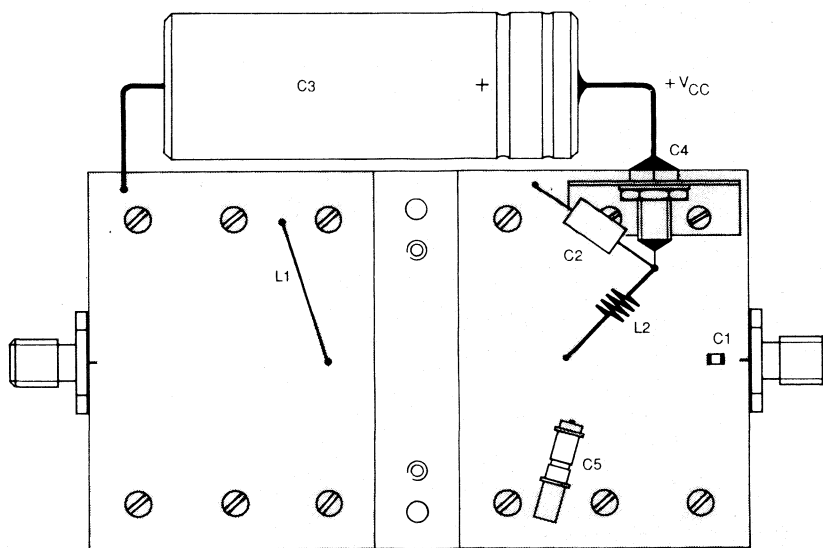
Fig.3 Pulse definition.

NPN silicon planar epitaxial microwave power transistor

MZ0912B100Y



7Z26293



7Z26292

Substrate: Epsilam 10
 Thickness: 0.635 mm
 $\epsilon_r = 10$
 All dimensions in mm.

Fig.4 Broadband test circuit.

NPN silicon planar epitaxial microwave power transistor

MZ0912B100Y

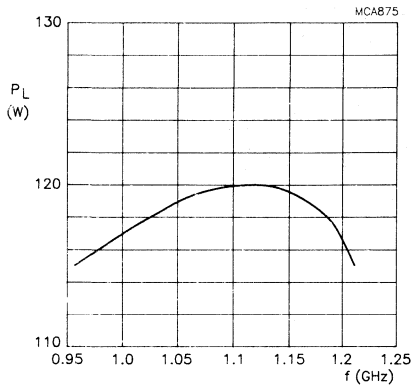


Fig.5 Load power P_L as a function of frequency; $V_{CC} = 50$ V; $t_p = 10 \mu\text{s}$; $\delta = 10\%$. (In broadband test circuit as shown in Fig.4).

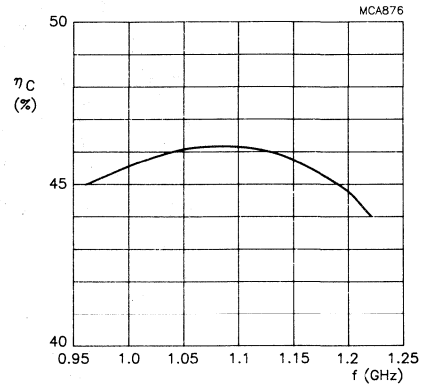


Fig.6 Collector efficiency as a function of frequency. (In broadband test circuit as shown in Fig.4).

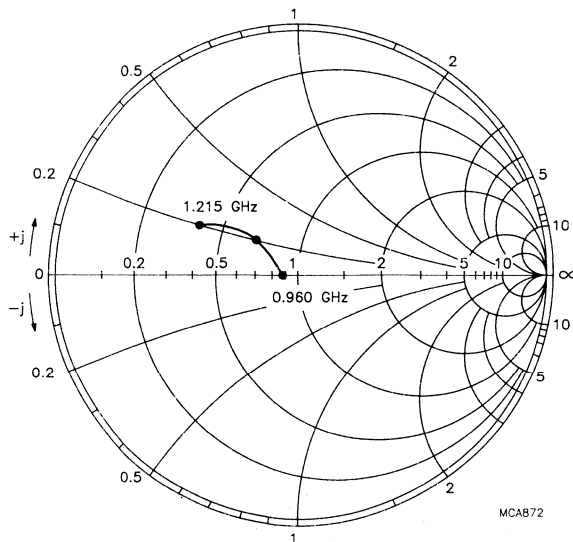


Fig.7 Input impedance as a function of frequency for $P_L = 100$ W; associated with optimum load impedance; $V_{CC} = 50$ V; $Z_0 = 10 \Omega$.

**NPN silicon planar epitaxial microwave
power transistor**

MZ0912B100Y

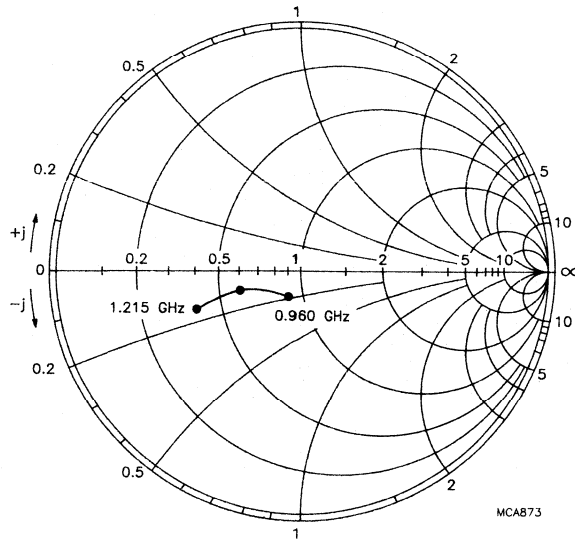


Fig.8 Optimum load impedance as a function of frequency for $P_L = 100 \text{ W}$; associated with input impedance; $V_{CC} = 50 \text{ V}$; $Z_0 = 10 \Omega$.

Data sheet	
status	Preliminary specification
date of issue	June 1990

MX0912B250Y

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.

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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	> 235	> 7	> 42	see Figs 6 and 7

WARNING

<p>Product and environmental safety - toxic materials</p> <p>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.</p> <p>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.</p>
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**NPN silicon planar epitaxial microwave
power transistor**

MX0912B250Y

MECHANICAL DATA

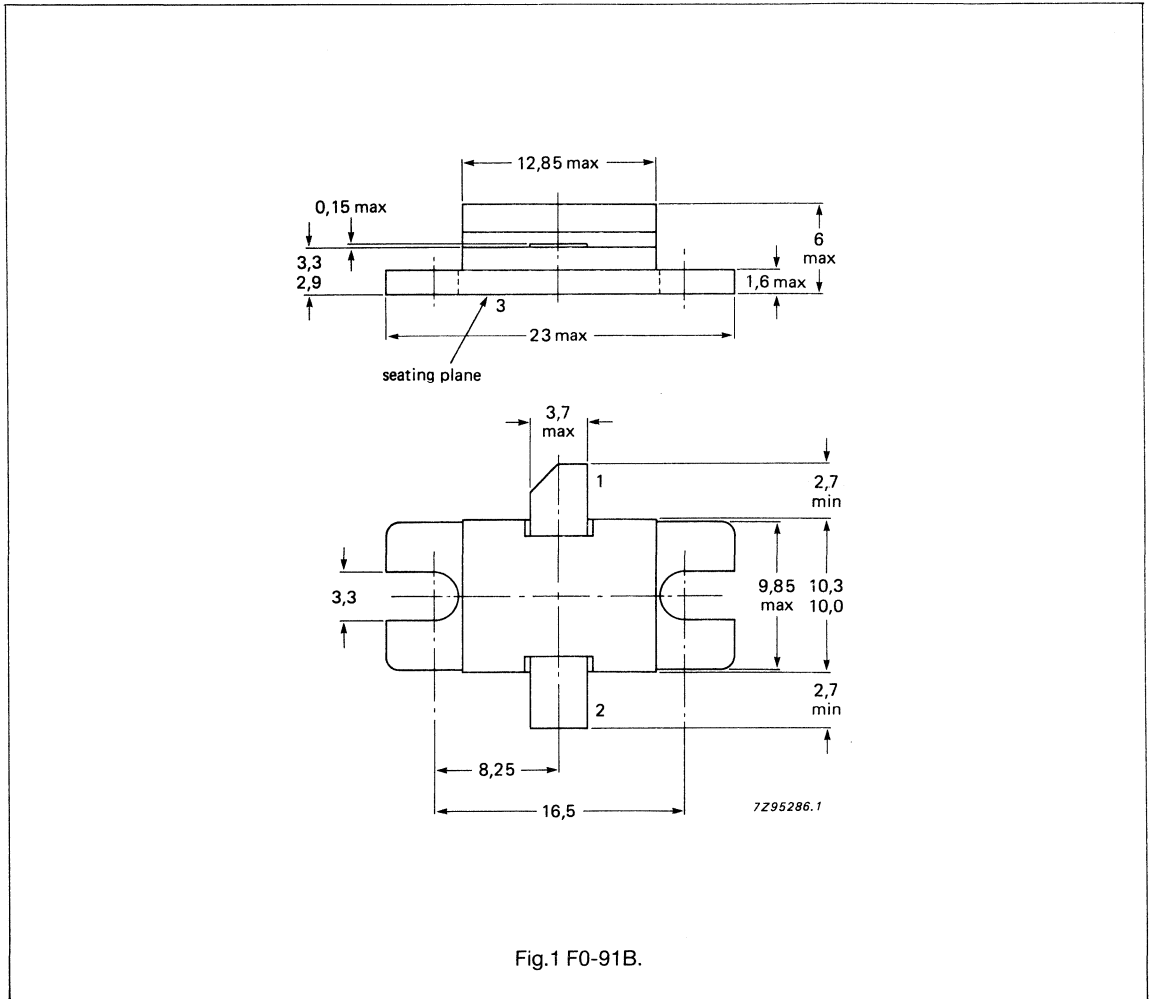


Fig.1 F0-91B.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
	base connected to flange

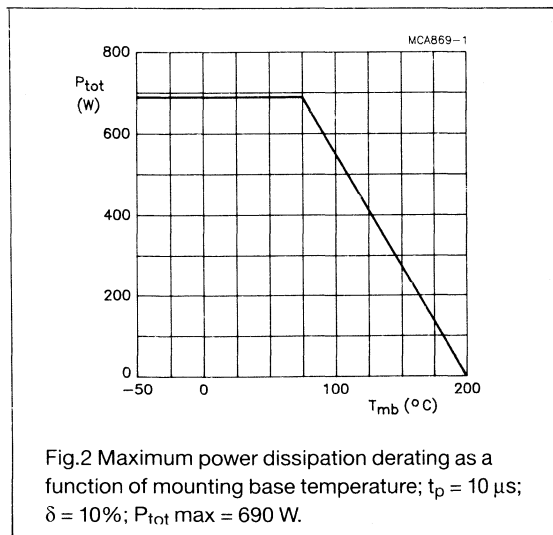
NPN silicon planar epitaxial microwave power transistor

MX0912B250Y

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 Ω	-	60	V
V _{CEO}	collector-emitter voltage	open base	-	20	V
V _{EBO}	emitter-base voltage	open collector	-	3	V
I _C	collector current (average)	t _p ≤ 10 μs; δ ≤ 10%	-	15	A
P _{tot}	total power dissipation	peak power T _{mb} = 75 °C; t _p ≤ 10 μs; δ ≤ 10%	-	690	W
T _{stg}	storage temperature range		-65	200	°C
T _j	operating junction temperature		-	200	°C
T _{slid}	soldering temperature	t ≤ 10 s up to 0.2 mm from ceramic	-	235	°C



THERMAL CHARACTERISTICS

T_j = 125 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
R _{th j-mb}	thermal resistance from junction to mounting base	CW	1.9	K/W
R _{th mb-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 μs; δ = 10%).

NPN silicon planar epitaxial microwave power transistor

MX0912B250Y

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 65\text{ V}; I_E = 0$	100	mA
I_{CBO}	collector cut-off current	$V_{CB} = 50\text{ V}; I_E = 0$	10	mA
I_{CES}	collector cut-off current	$V_{CE} = 60\text{ V}; R_{BE} = 0$	100	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	1	mA

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 $t_p = 10\text{ }\mu\text{s}; \delta = 10\%$	0.960 to 1.215	50	> 235 typ. 275	> 7 typ. 7.4	> 42 typ. 47	see Figs 6 and 7
$t_p = 300\text{ }\mu\text{s}; \delta = 10\%$	1.03 to 1.09	50	typ. 280	typ. 8	typ. 48	see Fig.3

Notes

- V_{CC} during pulse.
- Operating conditions and performance for other pulse formats can be made available on request.

List of components

- L1 = L2 = Cu wire $\varnothing = 0.65\text{ mm}$, total length = 12 mm, height of loop = 9 mm
- L3 = Cu wire $\varnothing = 0.65\text{ mm}$, internal diameter 3 mm, 4 turns, L = 5 mm
- C1 = DC block, 100 pF (ATC, ref. 100A101KP50X)
- C2 = tantalum capacitor 10 $\mu\text{F}/50\text{ V}$
- C3 = electrolytic capacitor 470 $\mu\text{F}/63\text{ V}$
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- C5 = C6 = Variable gigatrim capacitor 0.8 - 8 pF, (Tekelec, ref. 729.1)

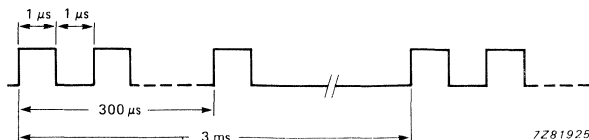
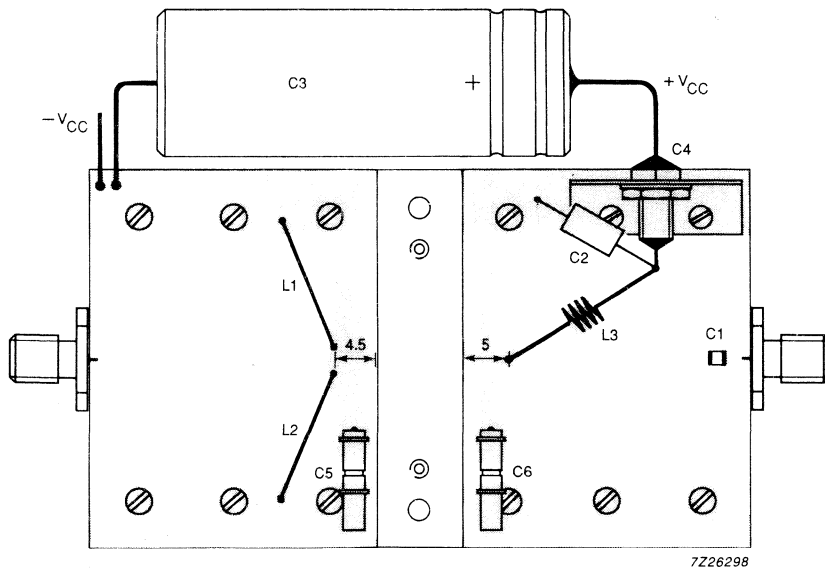
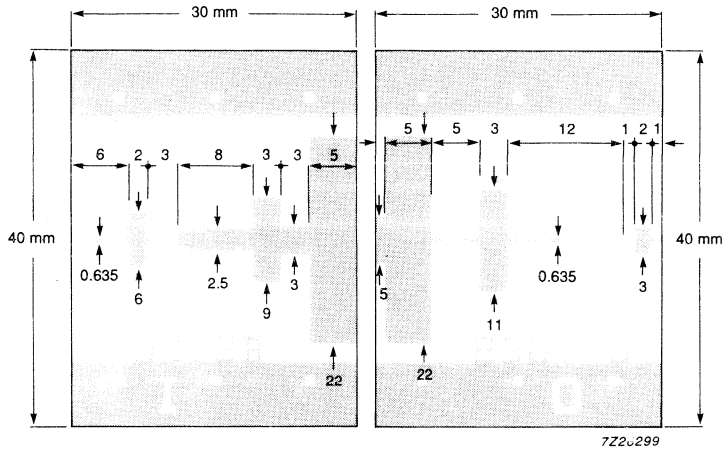


Fig.3 Pulse definition.

NPN silicon planar epitaxial microwave power transistor

MX0912B250Y

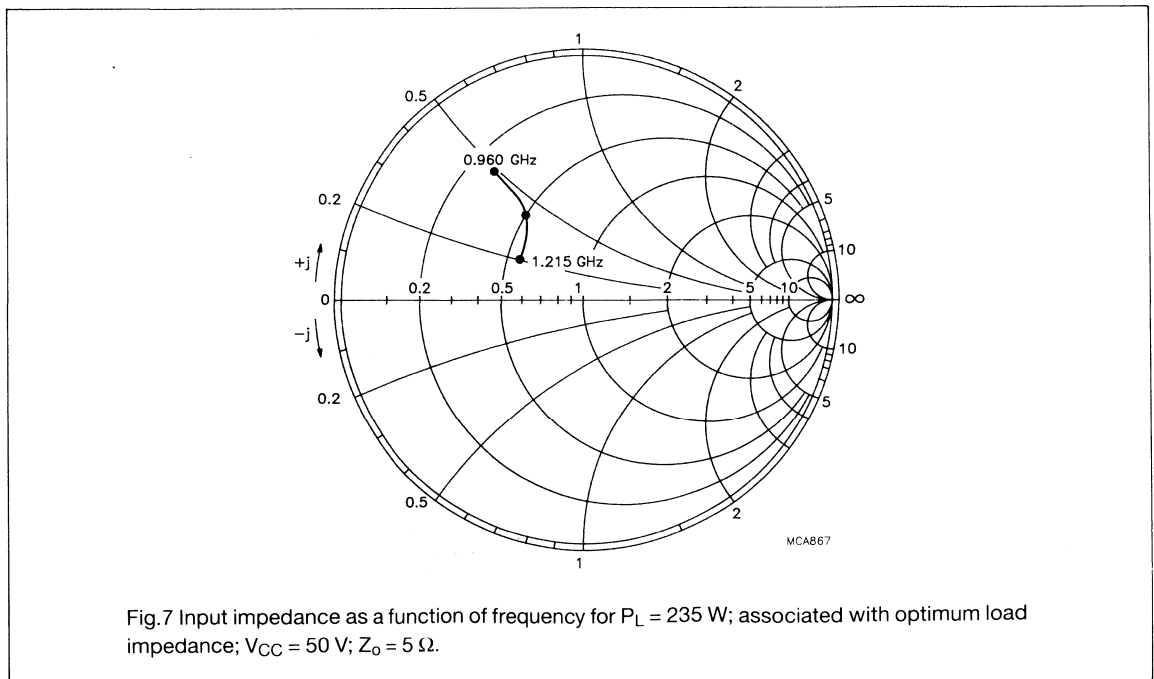
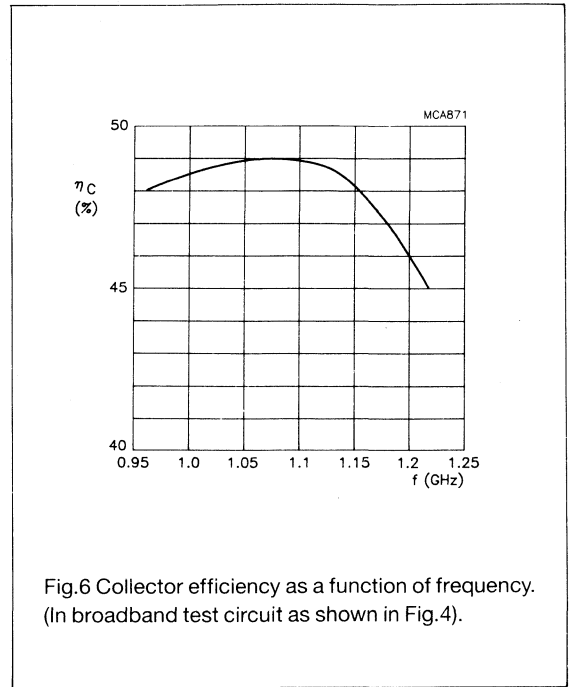
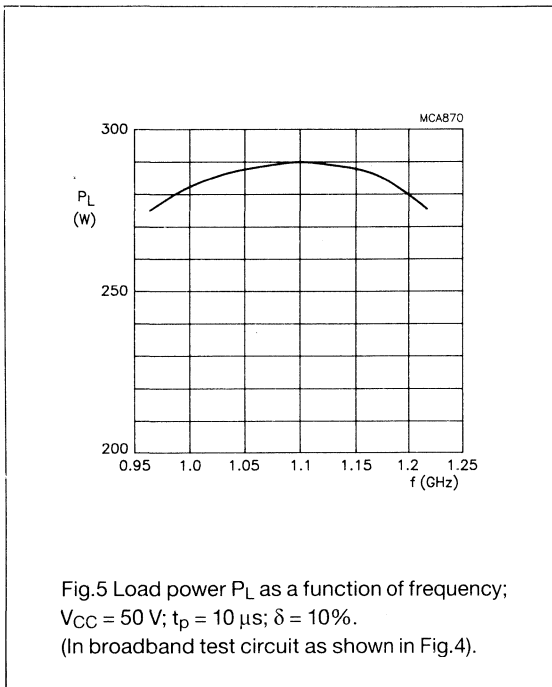


Substrate: Epsilam 10
 Thickness: 0.635 mm
 $\epsilon_r = 10$
 All dimensions in mm.

Fig.4 Broadband test circuit.

NPN silicon planar epitaxial microwave power transistor

MX0912B250Y



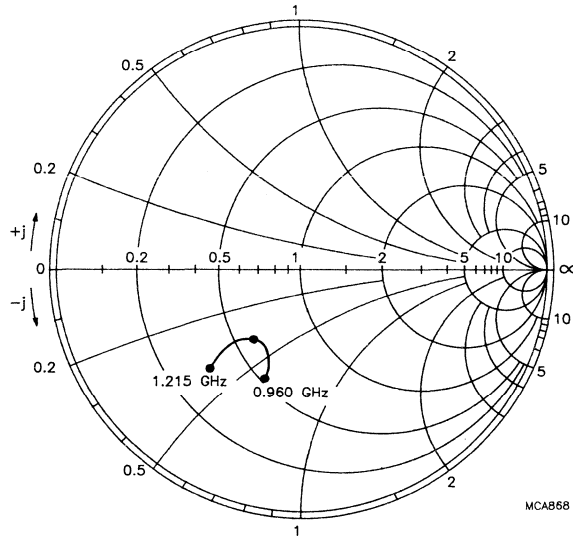
**NPN silicon planar epitaxial microwave
power transistor****MX0912B250Y**

Fig.8 Optimum load impedance as a function of frequency for $P_L = 235 \text{ W}$; associated with input impedance; $V_{CC} = 50 \text{ V}$; $Z_o = 5 \Omega$.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	June 1990

MX0912B350Y

NPN silicon planar epitaxial microwave power transistor

FEATURES

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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.

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ °C}$ 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 $t_p = 10\ \mu\text{s}$; $\delta = 10\%$	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 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 industrial or domestic waste.

NPN silicon planar epitaxial microwave power transistor

MX0912B350Y

MECHANICAL DATA

Dimensions in mm.

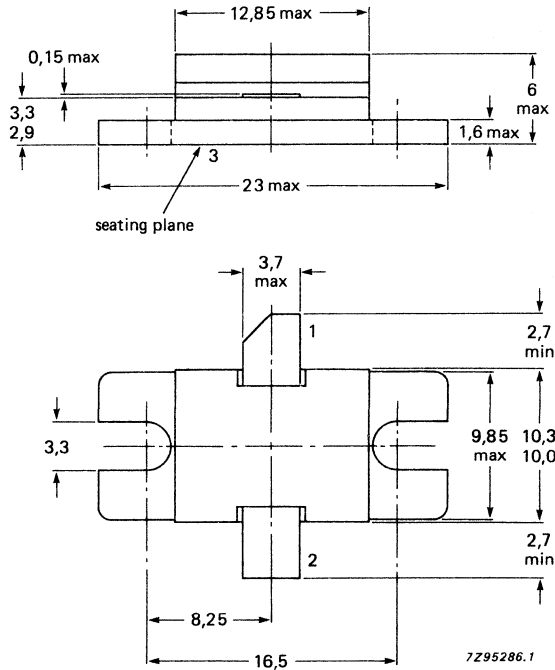


Fig.1 F0-91B.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base

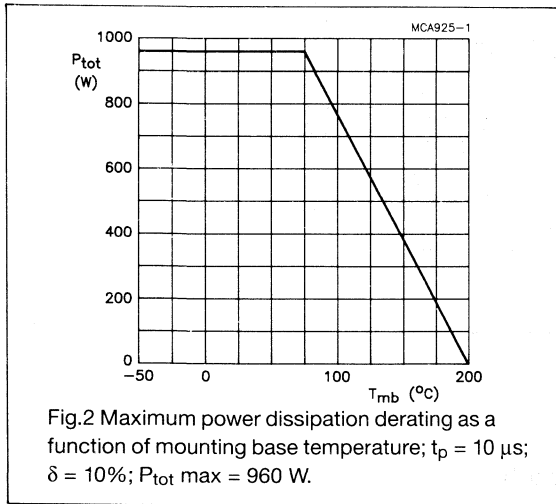
NPN silicon planar epitaxial microwave power transistor

MX0912B350Y

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V _{CB0}	collector-base voltage	open emitter	-	65	V
V _{CE5}	collector-emitter voltage	R _{BE} = 0 Ω	-	60	V
V _{CEO}	collector-emitter voltage	open base	-	20	V
V _{EB0}	emitter-base voltage	open collector	-	3	V
I _C	collector current (average)	t _p ≤ 10 μs; δ ≤ 10%	-	21	A
P _{tot}	total power dissipation	peak power; T _{mb} = 75 °C; t _p ≤ 10 μs; δ ≤ 10%	-	960	W
T _{stg}	storage temperature range		-65	200	°C
T _j	operating junction temperature		-	200	°C
T _{sld}	soldering temperature	t ≤ 10 s; up to 0.2 mm from ceramic	-	235	°C



THERMAL CHARACTERISTICS

T_j = 125 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
R _{th j-mb}	thermal resistance from junction to mounting base	CW	1.7	K/W
R _{th mb-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 μs; δ = 10%).

NPN silicon planar epitaxial microwave power transistor

MX0912B350Y

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 65\text{ V}; I_E = 0$	140	mA
I_{CBO}	collector cut-off current	$V_{CB} = 50\text{ V}; I_E = 0$	14	mA
I_{CES}	collector cut-off current	$V_{CE} = 60\text{ V}; R_{BE} = 0\ \Omega$	140	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	1.4	mA

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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)	η_C	z_i/Z_L (Ω)
class C $t_p = 10\ \mu\text{s} = 10\%$	0.960 to 1.215	50	> 325 typ. 375	> 7 typ. 7.6	> 40 typ. 47	see Figs 7 and 8
$t_p = 300\ \mu\text{s}; \delta = 10\%$	1.03 to 1.09	50	typ. 350	typ. 8	typ. 48	see Fig.3

Notes

- V_{CC} during pulse.
- Operating conditions and performances for other pulse formats can be made available on request.

List of components

- L1 = Cu wire $\varnothing = 0.65\text{ mm}$, total length = 12 mm, height of loop = 9 mm
- L2 = Cu wire $\varnothing = 0.65\text{ mm}$, internal diameter 3 mm, 4 turns, L = 5 mm
- C1 = DC block, 100 pF (ATC, ref. 100A101KP50X)
- C2 = tantalum capacitor 10 $\mu\text{F}/50\text{ V}$
- C3 = electrolytic capacitor 470 $\mu\text{F}/63\text{ V}$
- C4 = feedthru bypass capacitor (Erie, ref. 1250-003)
- C5 = C6 = Variable gigatrim capacitor 0.8 - 8 pF, (Tekelec, ref. 729.1)

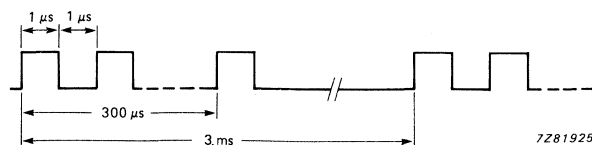
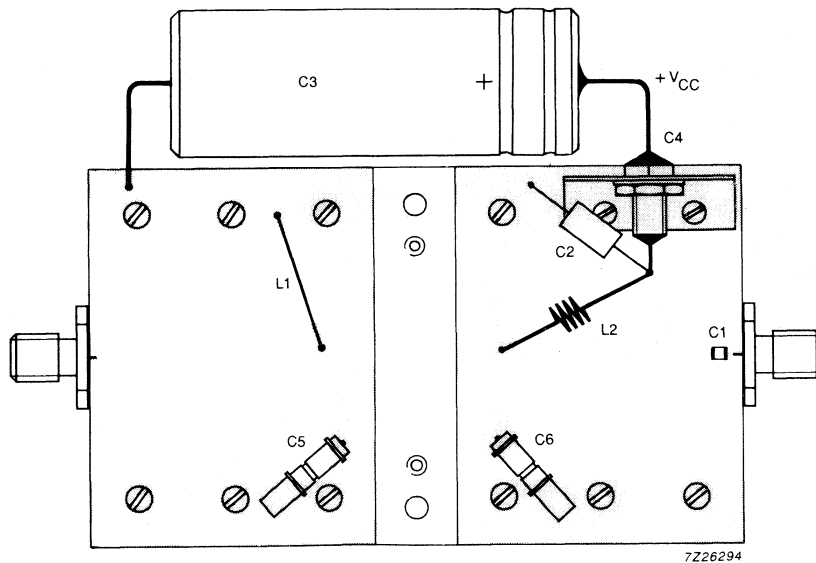
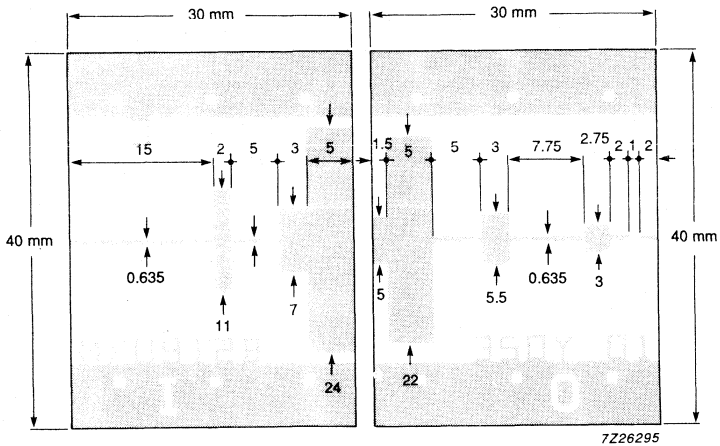


Fig.3 Pulse definition.

**NPN silicon planar epitaxial microwave
power transistor**

MX0912B350Y



Substrate: Epsilam 10
 Thickness: 0.635 mm
 $\epsilon_r = 10$
 All dimensions in mm.

Fig.4 Broadband test circuit.

NPN silicon planar epitaxial microwave power transistor

MX0912B350Y

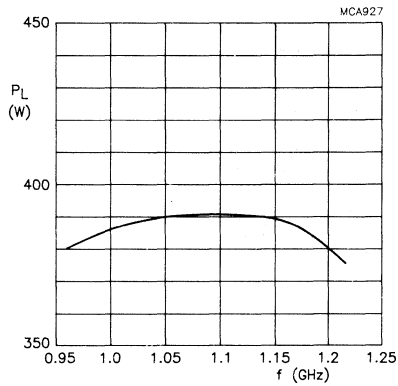


Fig.5 Load power P_L as a function of frequency;
 $V_{CC} = 50$ V; $t_p = 10$ μ s; $\delta = 10\%$.
 (In broadband test circuit as shown in Fig.4).

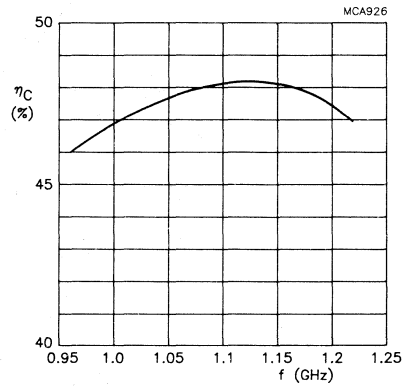


Fig.6 Collector efficiency as a function of frequency;
 (In broadband test circuit as shown in Fig.4).

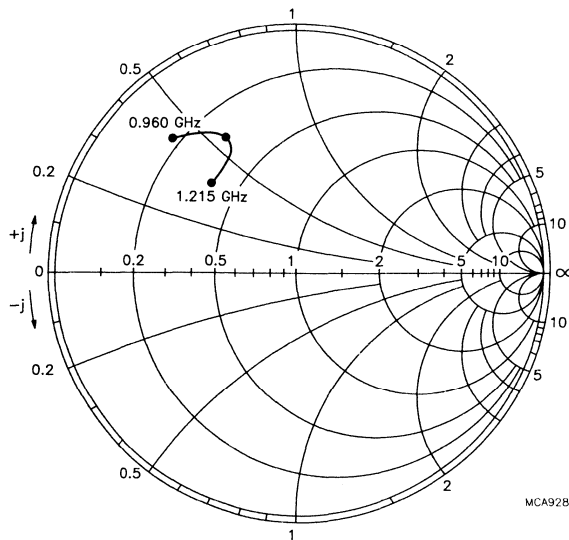


Fig.7 Input impedance as a function of frequency for $P_L = 275$ W; associated with optimum load impedance;
 $V_{CC} = 50$ V; $Z_o = 5$ Ω .

NPN silicon planar epitaxial microwave power transistor

MX0912B350Y

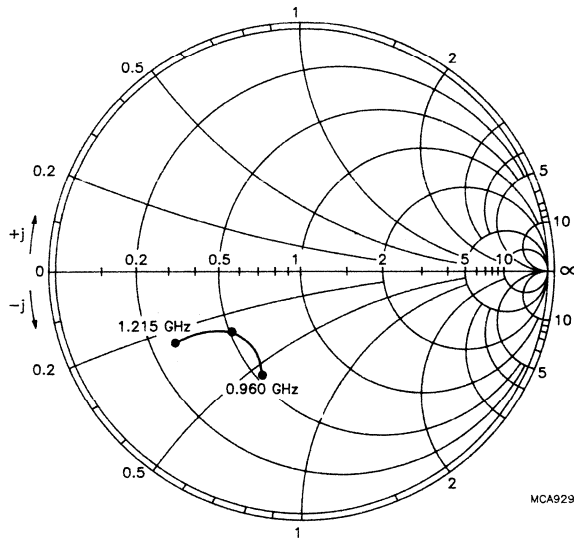


Fig.8 Optimum load impedance as a function of frequency for $P_L = 275 \text{ W}$; associated with input impedance; $V_{CC} = 50 \text{ V}$; $Z_o = 5 \Omega$.

C.W. AND PULSED MICROWAVE POWER TRANSISTOR

NPN silicon transistor intended for use in military and professional applications. It operates in c.w. and pulsed conditions and is recommended for NAVAID applications (IFF, DME, TACAN) in common-base class-B amplifier up to 1.3 GHz.

It offers the following technological advantages:

- 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

The transistor has an FO-53 metal ceramic flange package.

It is mounted in a common-base configuration, specified in class-B and operates in pulsed and c.w. conditions.

Internal input prematching ensures a good stability and easy broadband usage.

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in an unneutralized common-base class-B broadband amplifier.

Typical values

mode of operation	f GHz	V _{CC} V	P _L W	G _p dB	η_c %	z _i Ω	Z _L Ω
pulsed t _p = 10 μ s δ = 10%	0.960 to 1.215	28	5	9	45	7 + 5.5 (at f = 1.09 GHz)	8 + j13
CW	1.2	28	6.5	10.5	45	—	—

MECHANICAL DATA

FO-53 (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.

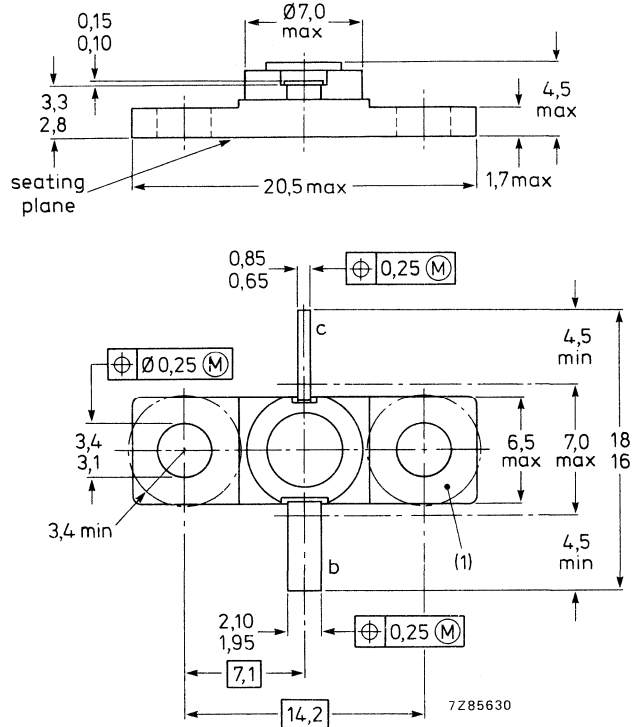
MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-53.

Marking code:

RTC1005M



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 ($R_{BE} = 10 \Omega$)	V_{CER}	max.	40 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3 V
Collector current ($t_p \leq 10 \mu s, \delta \leq 10\%$)	I_C	max.	1.2 A
Total power dissipation ($t_p \leq 10 \mu s, \delta \leq 10\%, T_{mb} \leq 75 \text{ }^\circ\text{C}$)	P_{tot}	max.	17.5 W
Storage temperature	T_{stg}		-65 to 200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature at 0.1 mm from case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to mounting base	$R_{th \text{ j-mb}}$	7,5 K/W
--------------------------------	-----------------------	---------

MICROWAVE POWER TRANSISTOR

NPN silicon transistor for use in space, military and professional applications.

It offers the following technological advantages:

- 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 lifetime.
- Multicell geometry gives good balance of dissipated power and low thermal resistance.

QUICK REFERENCE DATA

RF performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in an unneutralized common-base class-C circuit

mode of operation	f GHz	V _{CE} V	P _L W	G _p dB	η_c %	Z _i Ω	Z _L Ω
CW	1	28	typ. 25	typ. 11	typ. 58	2 + j6.5	5 + j1
CW	2	28	typ. 10	typ. 6	typ. 42	7 + j6.75	1.5 - j7

MECHANICAL DATA

Fig. 1 FO-53.

Base connected to flange

Pinning

- 1 = collector
- 2 = emitter
- 3 = base

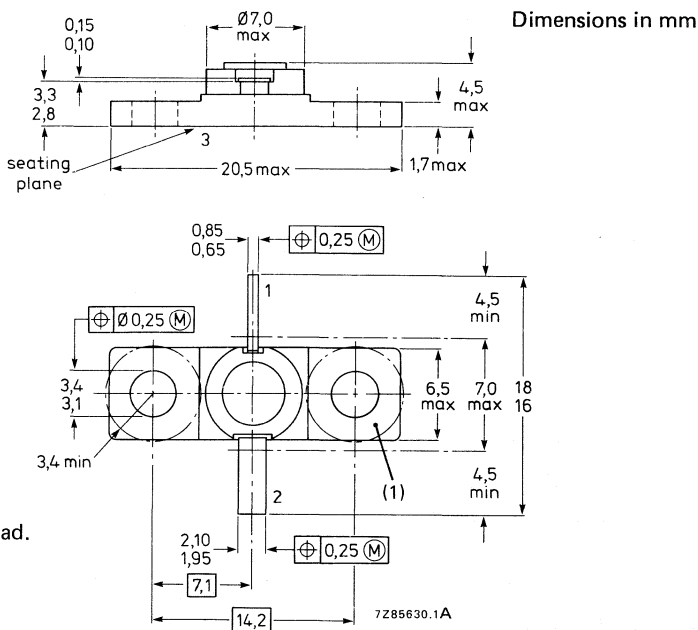
Torque on nut: max. 0.5 Nm

Recommended screw: M3

Marking code

RTC2010M = PKB20010U

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



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.

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	V_{CER}	max.	40 V
$R_{BE} \leq 10 \Omega$	V_{CEO}	max.	22 V
open base	V_{EBO}	max.	3 V
Emitter-base voltage (open collector)	I_C	max.	2 A
Collector current (DC)	P_{tot}	max.	25 W
Total power dissipation up to $T_{mb} = 75^\circ C$	T_{stg}	-65 to + 200	$^\circ C$
Storage temperature range	T_j	max.	200 $^\circ C$
Junction temperature	T_{sld}	max.	235 $^\circ C$
Lead soldering temperature			
at 0.3 mm from the case; $t_{sld} \leq 10$ s			

THERMAL RESISTANCE

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

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 8 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
- New 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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-B; CW	5	20	200	450

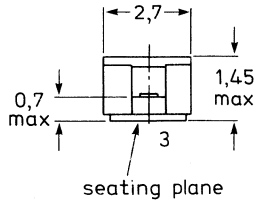
MECHANICAL DATA

PPC5001T FO-102 (see Fig. 1a)

PQC5001T FO-85 (see Fig. 1b).

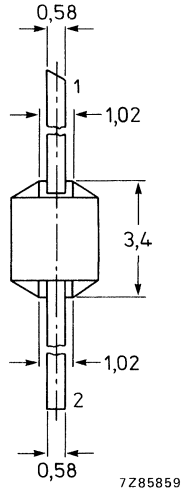
MECHANICAL DATA

Fig. 1a FO-102.
PPC5001T



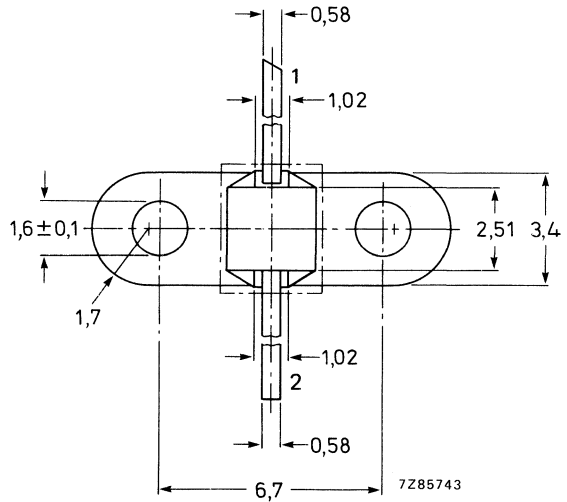
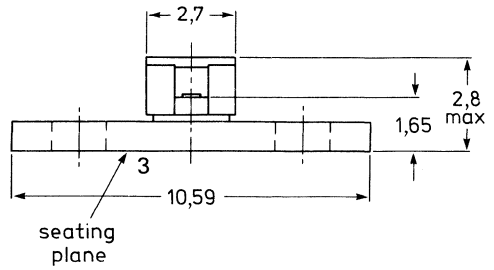
Pinning:

- 1 = base
- 2 = emitter
- 3 = collector



Dimensions in mm

Fig. 1b FO-85.
PQC5001T



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, $R_{BE} = 70 \Omega$ open emitter	V_{CER} V_{CEO}	max.	35 V 16 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.5 V
Collector current, DC	I_C	max.	0.25 A
Total power dissipation up to $T_{amb} = 75^\circ C$	P_{tot}	max.	4 W
Storage temperature	T_{stg}		-65 to +200 °C
Junction temperature	T_j	max.	200 °C
Soldering temperature at 0.1 mm from the case, $t_{sld} \leq 10$ s	T_{sld}	max.	235 °C

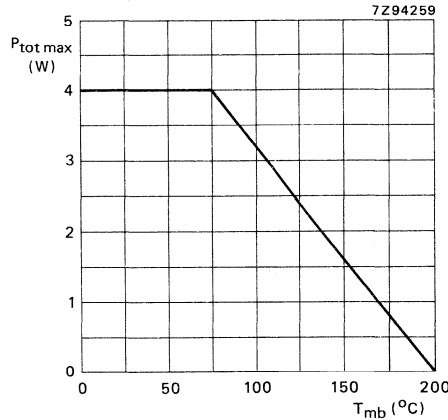


Fig.2 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at $T_j=75^\circ C$)

From junction to mounting base $R_{th\ j-mb} = 24\ K/W$

CHARACTERISTICS

$T_{mb} = 25^\circ C$ 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
$I_C = 0; I_E = 100\ \mu A$	$V_{(BR)EBO}$	min.	3.5 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 $f = 1 \text{ MHz}$

$I_E = I_C = 0$; $V_{EB} = 1 \text{ V}$; $V_{CB} = 10 \text{ V}$

C_{eb} typ. 5.5 pF

Collector-emitter capacitance at $f = 1 \text{ MHz}$

$I_E = I_C = 0$; $V_{CE} = 18 \text{ V}$; $V_{EB} = 1.5 \text{ V}$

C_{ce} typ. 0.9 pF

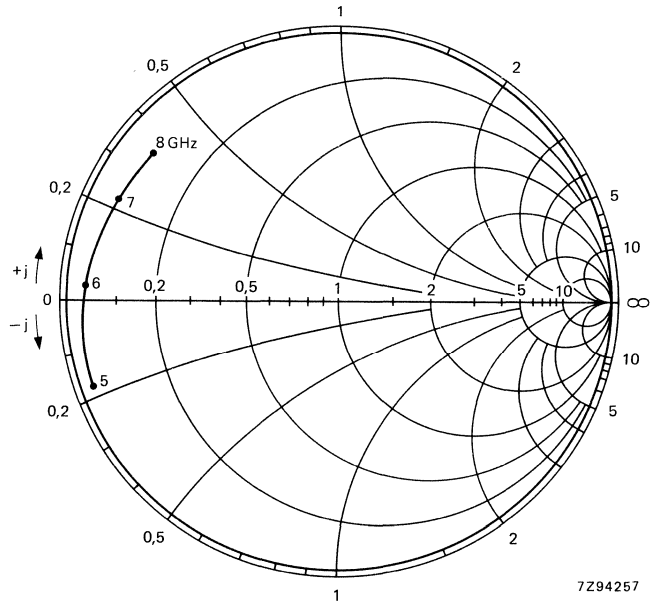


Fig. 3 Emitter reflection coefficient.

Conditions for Figs 3 and 4:

$V_{CE} = 20 \text{ V}$; $I_C = 200 \text{ mA}$;

$Z_0 = 50 \Omega$

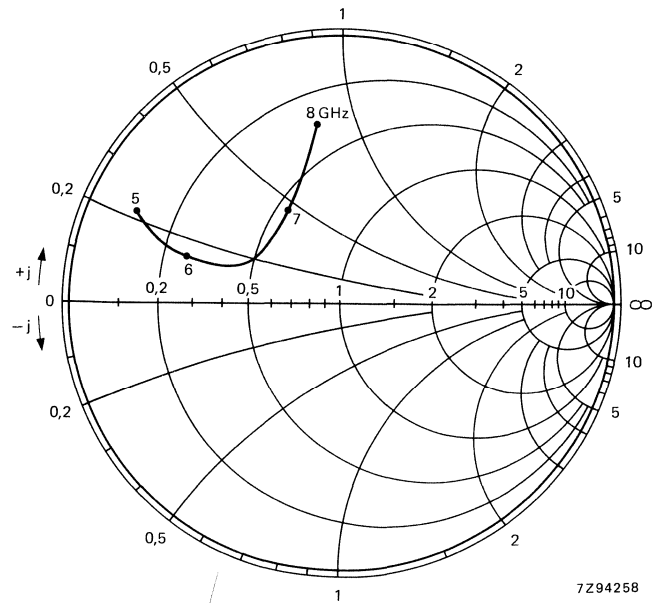


Fig. 4 Base reflection coefficient.

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.

QUICK REFERENCE DATA

RF performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 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-41B.

Dimensions in mm

Base and metallic cap
 connected to flange.

Torque on screw: max. 0.5 Nm

Recommended screw: M2.5

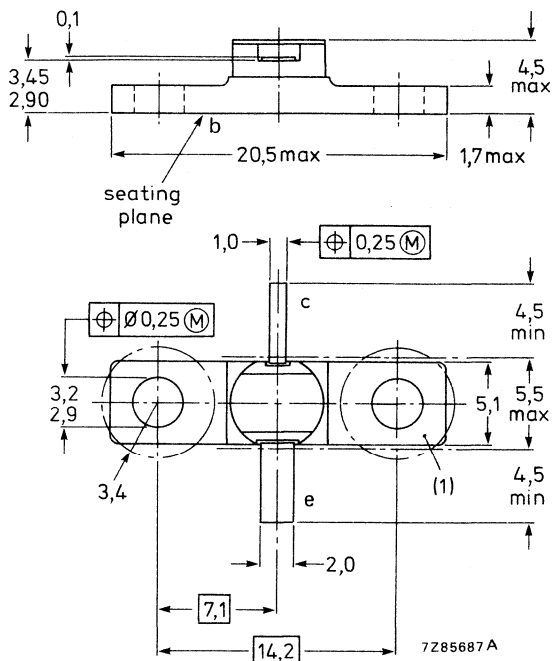
Marking code:

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 $R_{BE} = 10 \Omega$ open base	V_{CER} max. V_{CEO} max.	40 15	40 15	40 V 15 V
Emitter-base voltage open collector	V_{EBO} max.	3.5	3.5	3.5 V
Collector current (DC)	I_C max.	0.25	0.5	0.75 A
Total power dissipation ($f > 1$ MHz) up to $T_{mb} = 75^\circ C$	P_{tot} max.	5.5	10	14.5 W
Storage temperature range	T_{stg}	-65 to + 200		
Junction temperature	T_j max.	200		
Lead soldering temperature at 0.3 mm from ceramic; $t_{sld} \leq 10$ s	T_{sld} max.	235 °C		

THERMAL RESISTANCE (at $T_j = 75\text{ }^\circ\text{C}$)

		PTB23001X	23003X	23005X
From junction to mounting base	$R_{th\ j-mb}$ max.	22	12	8.5 K/W
From mounting base to heatsink	$R_{th\ mb-h}$ max.	0.7	0.7	0.7 K/W

PTB23001X

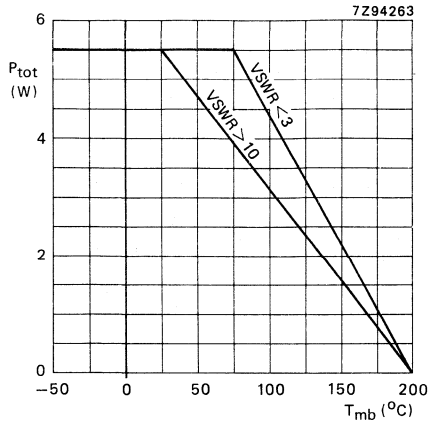


Fig. 2 Maximum permissible RF power dissipation as a function of mounting base temperature; $f > 1\text{ MHz}$.

PTB23003X

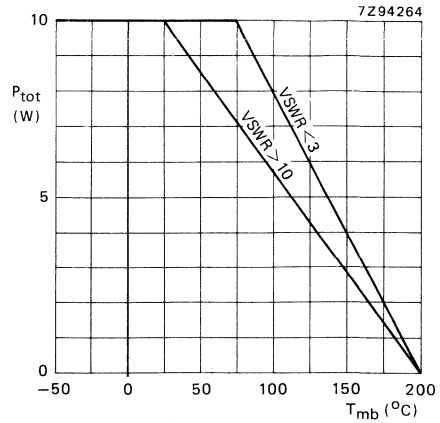
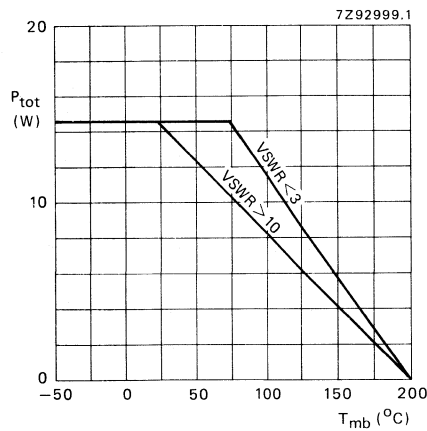


Fig. 3 Maximum permissible RF power dissipation as a function of mounting base temperature; $f > 1\text{ MHz}$.



PTB23005X

Fig. 4 Maximum permissible RF power dissipation as a function of mounting base temperature; $f > 1\text{ MHz}$.

CHARACTERISTICS

			PTB23001X	23003X	23005X
Collector-base breakdown voltage open emitter; $I_C = 1$ mA		min.	40	—	— V
	V(BR)CBO	min.	—	40	— V
		min.	—	—	40 V
Collector-emitter breakdown voltage $R_{BE} = 10 \Omega$; $I_C = 10$ mA	V(BR)CER	min.	40	40	40 V
Emitter-base breakdown voltage open collector; $I_E = 0.5$ mA		min.	3.5	—	— V
	V(BR)EBO	min.	—	3.5	— V
		min.	—	—	3.5 V
Collector cut-off current $I_E = 0$; $V_{CB} = 24$ V	I_{CBO}	max.	10	20	30 μ A
Emitter cut-off current $I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	0.2	0.4	0.6 μ A
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		2	24	> 3 typ. 4	> 8.75 typ. 10	> 45 typ. 50
→ PTB23005X		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.

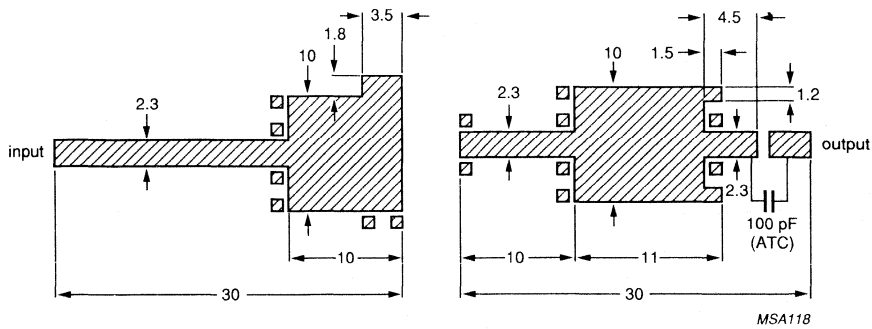


Fig. 5 Prematching test circuit board for PTB23001X.

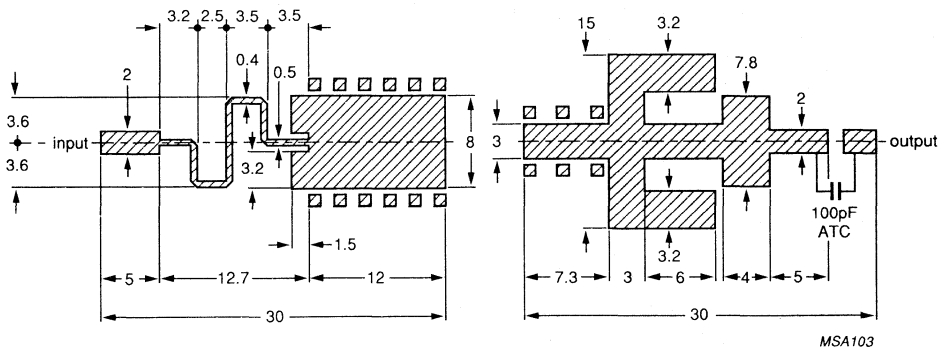


Fig. 6 Prematching test circuit board for PTB23003X.

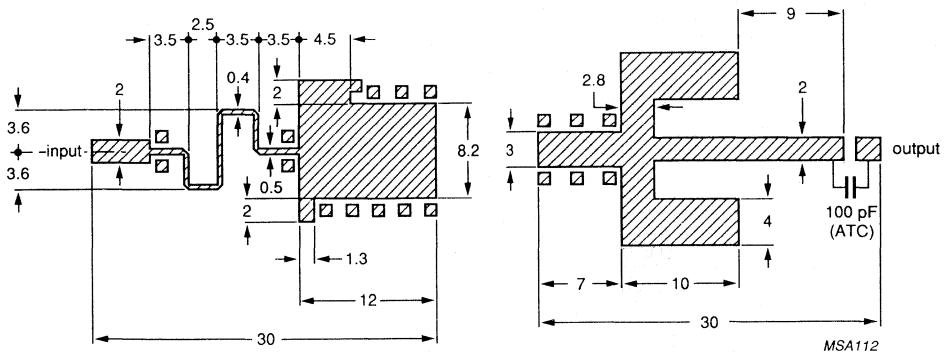


Fig. 7 Prematching test circuit board for PTB23005X.

Circuits on a double Cu-clad printed-circuit board Teflon fibre-glass dielectric ($\epsilon_r = 2.55$) 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

Fig.1 FO-41B.

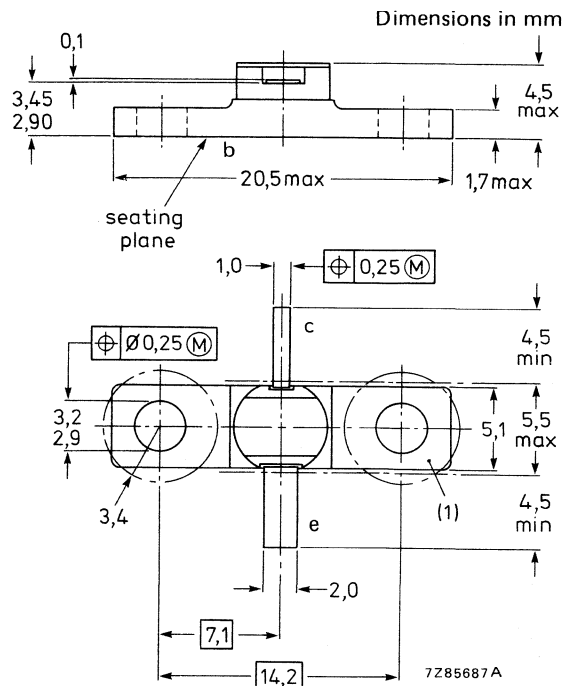
Base and metallic cap connected to flange.

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 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.

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 $R_{BE} = 10 \Omega$ open base	V_{CER}	max.	40	40	40 V
	V_{CEO}	max.	15	15	15 V
Emitter-base voltage open collector	V_{EBO}	max.	3.5	3.5	3.5 V
Collector current (DC)	I_C	max.	0.25	0.5	0.75 A
Total power dissipation ($f > 1$ MHz) up to $T_{mb} = 75^\circ C$	P_{tot}	max.	5.5	10	14.5 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 $T_j = 75^\circ C$)

			PTB32001X	32003X	32005X
From junction to mounting base	$R_{th\ j-mb}$	max.	22	12	8.5 K/W
From mounting base to heatsink	$R_{th\ mb-h}$	max.	0.7	0.7	0.7 K/W

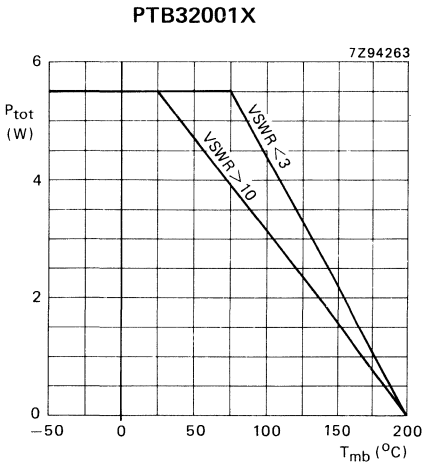


Fig. 2 Maximum permissible RF power dissipation as a function of mounting base temperature. $f > 1$ MHz.

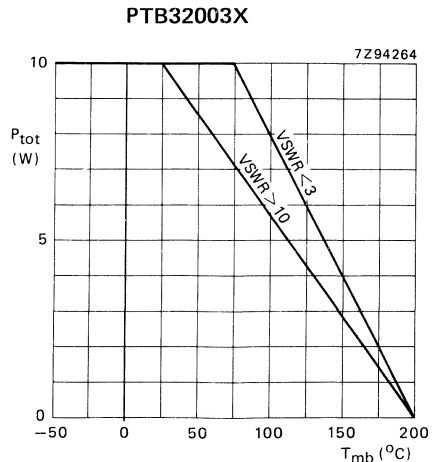
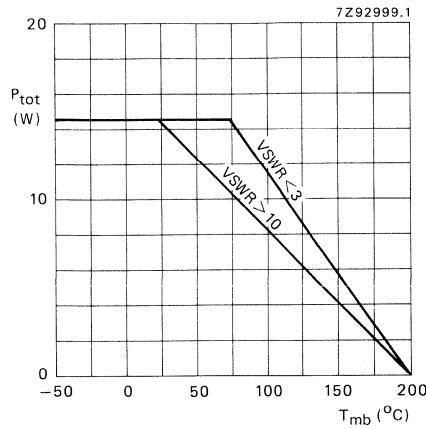


Fig. 3 Maximum permissible RF power dissipation as a function of mounting base temperature. $f > 1$ MHz.



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					
$R_{BE} = 10 \Omega$; $I_C = 10$ mA	$V_{(BR)CER}$	min.	40	40	40 V
Emitter-base breakdown voltage					
open collector; $I_E = 0.5$ mA		min.	3.5	—	— V
open collector; $I_E = 1.0$ mA	$V_{(BR)EBO}$	min.	—	3.5	— V
open collector; $I_E = 1.5$ mA		min.	—	—	3.5 V
Collector cut-off current					
$I_E = 0$; $V_{CB} = 24$ V	I_{CBO}	max.	10	20	30 μ A
Emitter cut-off current					
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	0.2	0.4	0.6 μ A
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	> 45 typ. 5.5	> 8 typ. 9.5	> 35 typ. 45	←

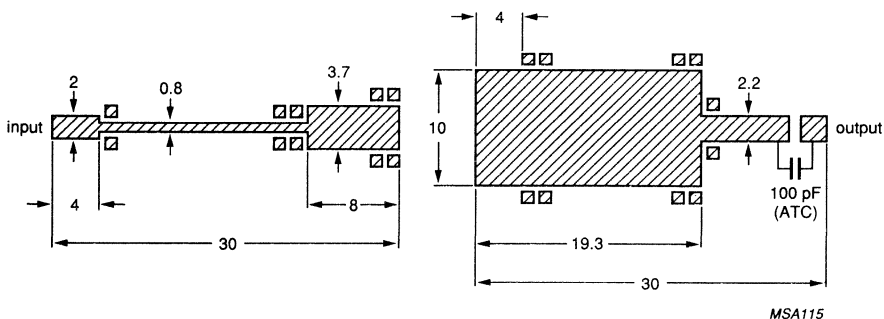


Fig. 5 Prematching test circuit board for PTB32001X.

Circuit on a double Cu-clad printed-circuit board Teflon fibre-glass dielectric ($\epsilon_r = 2.55$); thickness 0.8 mm.

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

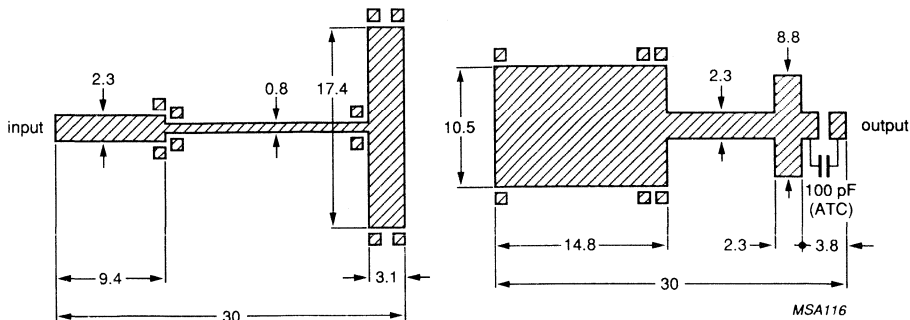


Fig. 6 Prematching test circuit board for PTB32003X.

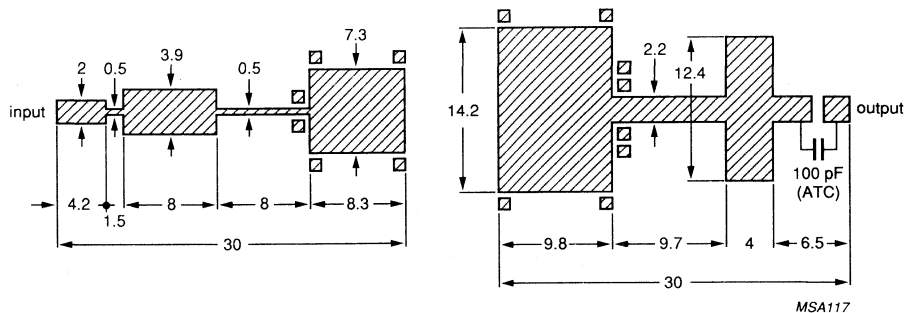


Fig. 7 Prematching test circuit board for PTB32005X.

Circuits on a double Cu-clad printed-circuit board Teflon fibre-glass dielectric ($\epsilon_r = 2.55$); 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

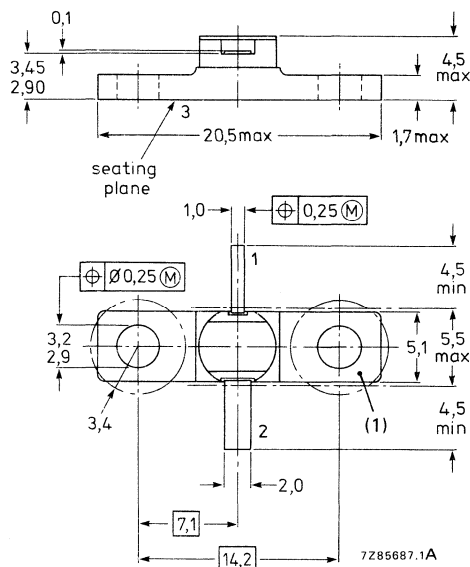
Torque on screw: max. 0.4 Nm

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 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.

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 $R_{BE} = 10 \Omega$ open base	V_{CER}	max.	40	40	V
Emitter-base voltage open collector	V_{CEO}	max.	15	15	V
Collector current (DC)	I_C	max.	0.25	0.5	A
RF power dissipation ($f > 1$ MHz) up to $T_{mb} = 75^\circ\text{C}$	P_{tot}	max.	5,5	10	W
Storage temperature range	T_{stg}		-65 to +200		$^\circ\text{C}$
Junction temperature	T_j	max.		200	$^\circ\text{C}$
Lead soldering temperature at 0.3 mm from ceramic; $t_{sld} \leq 10$ s	T_{sld}	max.		235	$^\circ\text{C}$

PTB42001X

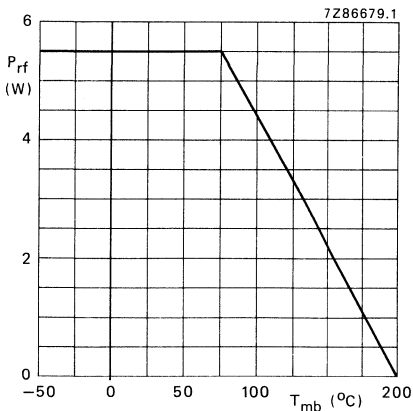


Fig. 2 Maximum permissible RF power dissipation as a function of mounting base temperature; $f > 1$ MHz.

PTB42002X

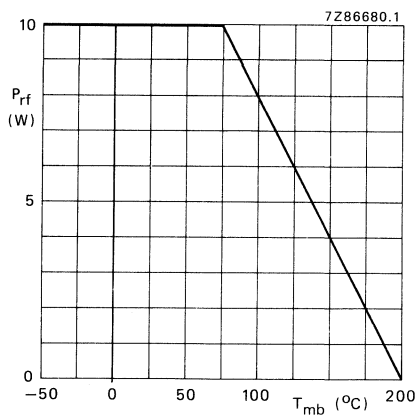


Fig. 3 Maximum permissible RF power dissipation as a function of mounting base temperature; $f > 1$ MHz.

THERMAL RESISTANCE (at $T_j = 75^\circ\text{C}$)

From junction to mounting base
From mounting base to heatsink

			PTB42001X	42002X	
$R_{th\ j-mb}$	max.		22	12	K/W
$R_{th\ mb-h}$	max.		0.7	0.7	K/W

CHARACTERISTICS

Collector-base breakdown voltage

open emitter; $I_C = 1 \text{ mA}$

open emitter; $I_C = 2 \text{ mA}$

Collector-emitter breakdown voltage

$R_{BE} = 10 \Omega$; $I_C = 10 \text{ mA}$

Emitter-base breakdown voltage

open collector; $I_E = 0.5 \text{ mA}$

open collector; $I_E = 1.0 \text{ mA}$

Collector cut-off current

$I_E = 0$; $V_{CB} = 24 \text{ V}$

Emitter cut-off current

$I_C = 0$; $V_{EB} = 1.5 \text{ V}$

Collector-base capacitance at $f = 1 \text{ MHz}$

$I_E = I_C = 0$; $V_{CB} = 24 \text{ V}$; $V_{EB} = 1.5 \text{ V}$

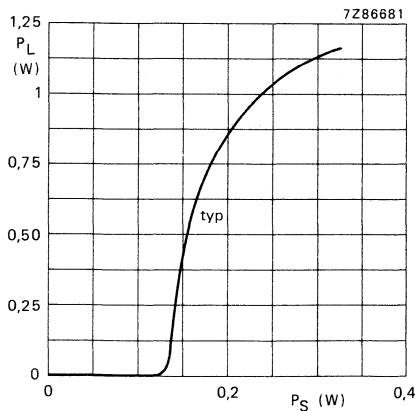
Collector-emitter capacitance at $f = 1 \text{ MHz}$

$I_E = I_C = 0$; $V_{CB} = 24 \text{ V}$; $V_{EB} = 1.5 \text{ V}$

		PTB42001X	42002X	
$V_{(BR)CBO}$	min.	40	—	V
$V_{(BR)CBO}$	min.	—	40	V
$V_{(BR)CER}$	min.	40	40	V
$V_{(BR)EBO}$	min.	3.5	—	V
$V_{(BR)EBO}$	min.	—	3.5	V
I_{CBO}	max.	10	20	μA
I_{EBO}	max.	0.2	0.4	μA
C_{cb}	typ.	2.2	3	pF
C_{ce}	typ.	0.3	0.6	pF

APPLICATION INFORMATION (see also next page)

PTB42001X



PTB42002X

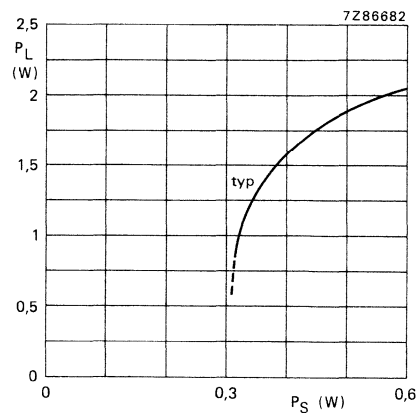


Fig. 4 Load power as a function of source power.

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

Conditions for Figs 4 and 5:

Class-B operation; $V_{CE} = 24 \text{ V}$; $f = 4.2 \text{ GHz}$; $T_{mb} = 25 \text{ }^\circ\text{C}$.

APPLICATION INFORMATION (see also previous page)

RF performance up to $T_{mb} = 25\text{ }^\circ\text{C}$ 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 typ. 1.0	> 5 typ. 6	> 28 typ. 33	235 + j0	3.3 - j5.8
PTB42002X	CW	4.2	24	> 1.6 typ. 2.0	> 5 typ. 6	> 28 typ. 35	44.5 + j85	2.4 - j15.5

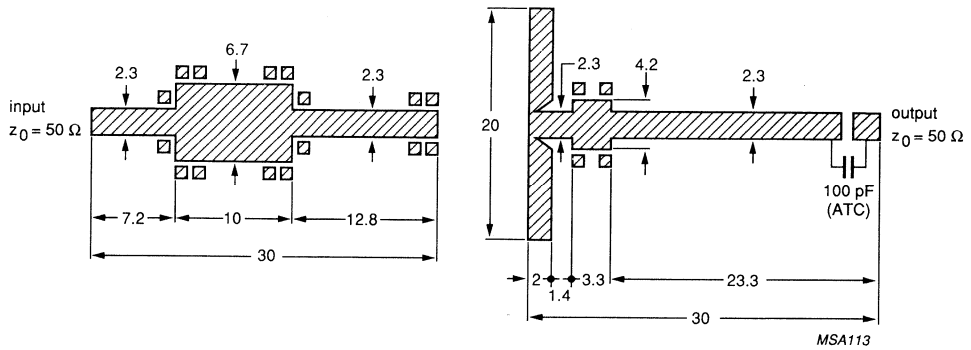


Fig. 6 Prematching test circuit boards for the PTB42001X at 4.2 GHz (Dimensions in mm.)

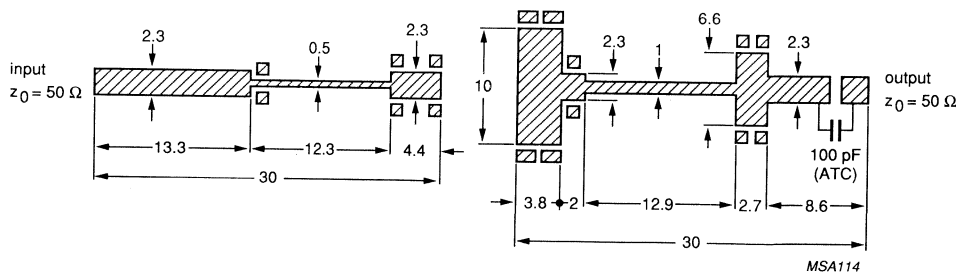


Fig. 7 Prematching test circuit boards for the PTB42002X at 4.2 GHz. (Dimensions in mm.)

Circuits on a double Cu-clad printed-circuit board PTFE fibre-glass dielectric ($\epsilon_r = 2.55$); thickness 0.8 mm.

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

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

FO-41B (see Fig.1).

Dimensions in mm

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-41-B.

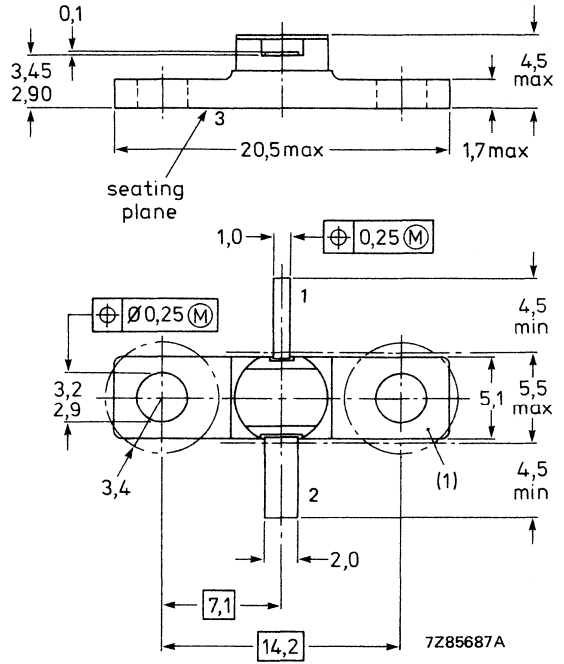
Base and metallic cap
connected to flange

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.

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
$R_{BE} = 10 \Omega$	V_{CER}	max.	40 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	0.75 A
Total power dissipation	P_{tot}	max.	14.5 W
Storage temperature	T_{stg}		-65 to + 200 °C
Junction temperature	T_j	max.	200 °C
Soldering temperature at 0.1 mm from ceramic; $t_{sld} \leq 10$ s	T_{sld}	max.	235 °C

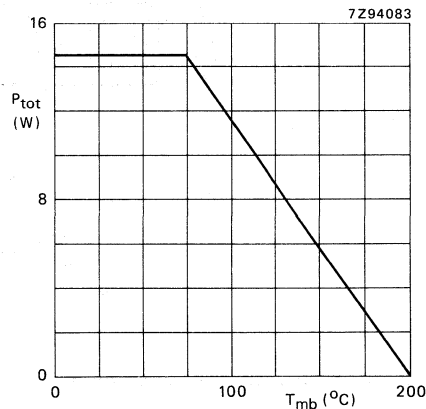


Fig.2 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75$ °C)

From junction to mounting base	$R_{th j-mb}$	max.	8.5 K/W
From mounting base to heatsink	$R_{th mb-h}$	max.	0.7 K/W

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

Breakdown voltages

 $I_C = 3$ mA; $I_E = 0$ $I_C = 10$ mA; $R_{BE} = 10 \Omega$ $I_C = 0$; $I_E = 1$ mA

$V_{(BR)CBO}$	min.	40 V
$V_{(BR)CER}$	min.	40 V
$V_{(BR)EBO}$	min.	3.5 V

Collector cut-off current

 $I_E = 0$; $V_{CB} = 24$ V

I_{CBO}	max.	30 μ A
-----------	------	------------

Emitter cut-off current

 $I_C = 0$; $V_{EB} = 1.5$ V

I_{EBO}	max.	0.6 μ A
-----------	------	-------------

Collector-base capacitance

 $I_E = I_C = 0$; $V_{CB} = 24$ V

C_{cb}	typ.	3.8 pF
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APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 typ. 3	≥ 5 typ. 6	≥ 28 typ. 33	12 + j35	2.5 - j10

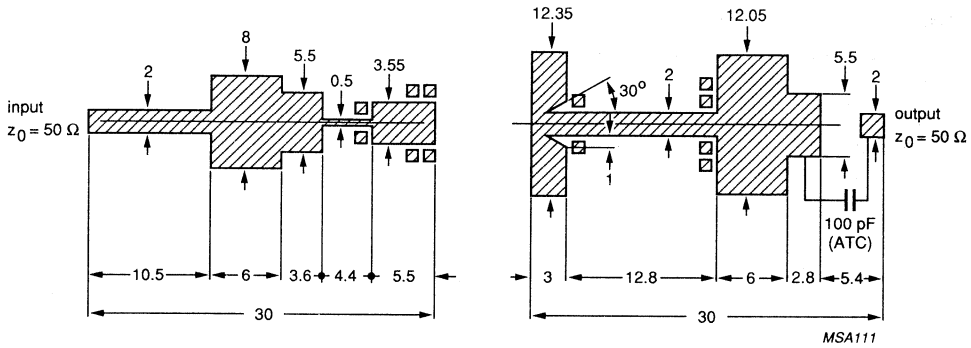


Fig.3 Prematching test circuit board for 4.2 GHz. (Dimensions in mm).

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

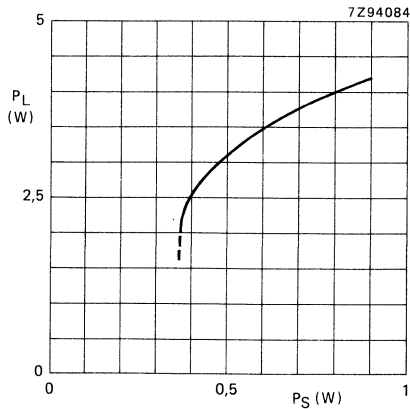


Fig.4 Load power as a function of source power.

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

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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 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-83.

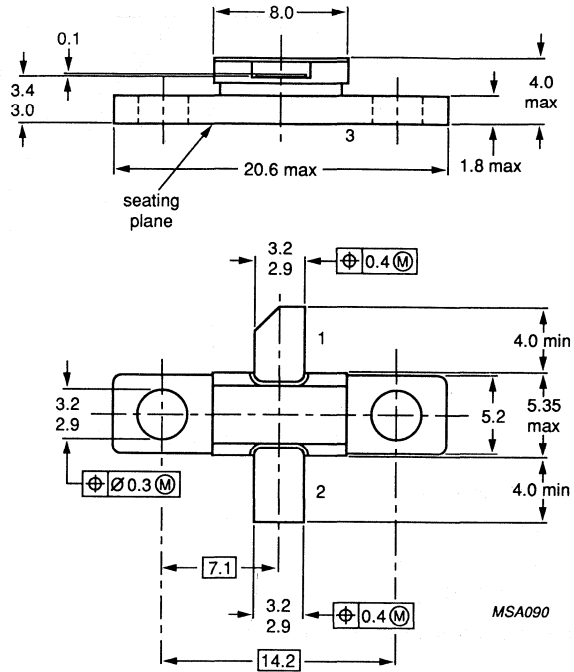
Base connected to flange.

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_{CB0}	max.	40 V
Collector-emitter voltage open base $R_{BE} = 10 \Omega$	V_{CEO} V_{CER}	max.	15 V 40 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	1 A
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	18 W
Storage temperature	T_{stg}		-65 to 200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.1 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

→ From junction to mounting base	$R_{th \text{ j-mb}}$	max.	6.5 K/W
→ From mounting base to heatsink	$R_{th \text{ mb-h}}$	max.	0.7 K/W

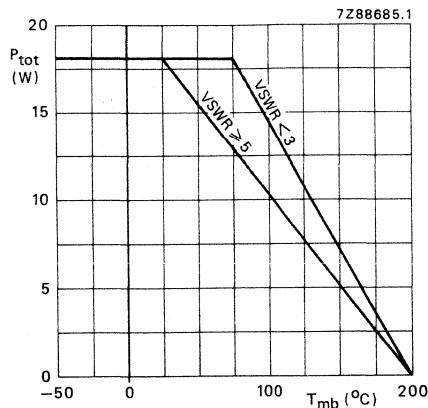


Fig. 2 Power derating curve as a function of mounting base temperature; $V_{CE} = 24$ V; $f > 1$ MHz.

CHARACTERISTICS

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

Collector-emitter breakdown voltage

$I_C = 30$ mA; $R_{BE} = 10 \Omega$

$V_{(BR)CER}$ min. 40 V

Emitter-base breakdown voltage

$I_C = 0$; $I_E = 0.5$ mA

$V_{(BR)EBO}$ min. 3.5 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	\bar{z}_i Ω	\bar{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

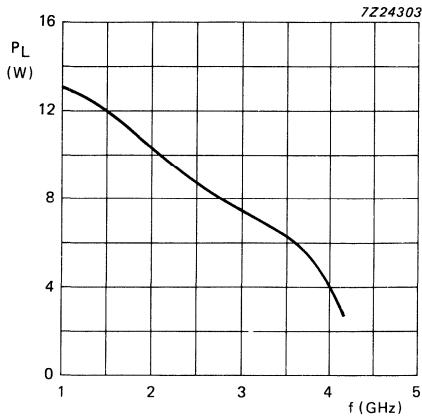


Fig. 3 Load power as a function of frequency. $V_{CC} = 24\text{ V}$; $P_S = 1\text{ W}$.

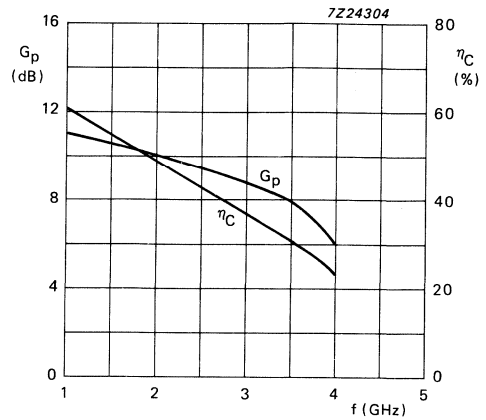


Fig. 4 Power gain and efficiency as a function of frequency. $V_{CC} = 24\text{ V}$; $P_S = 1\text{ W}$.

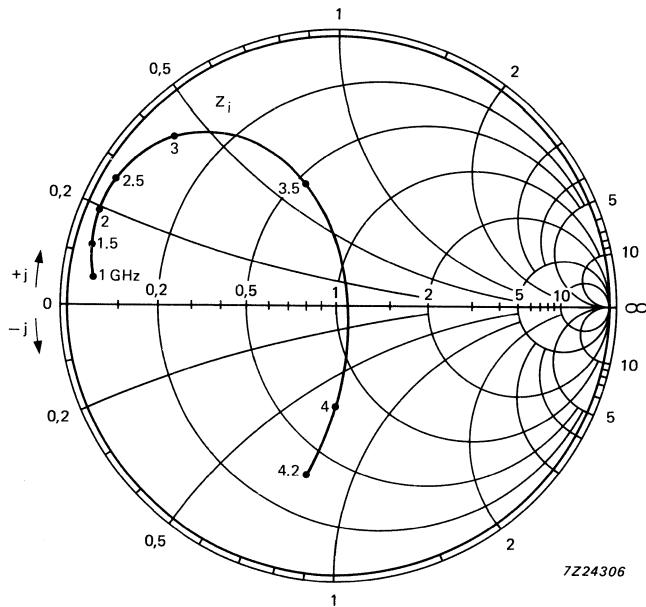


Fig. 5 Input impedance as a function of frequency. $V_{CC} = 24\text{ V}$; $P_S = 1\text{ W}$; $Z_0 = 50\ \Omega$.

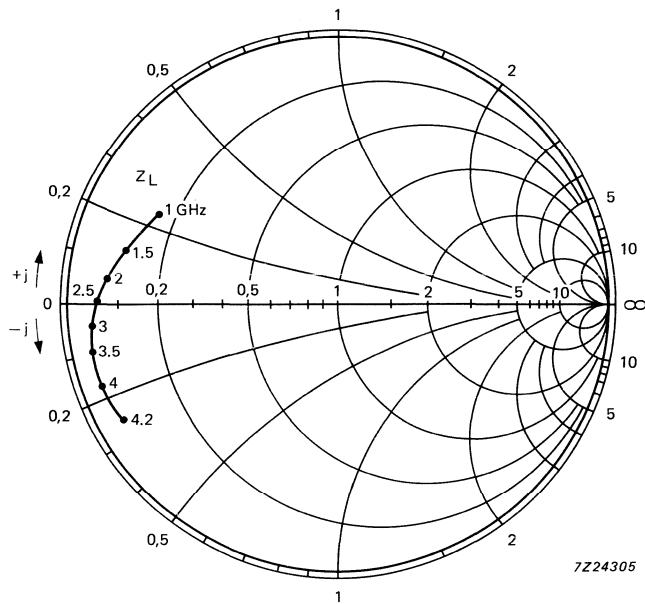


Fig. 6 Output impedance as a function of frequency.
 $V_{CC} = 24 \text{ V}$; $P_S = 1 \text{ W}$; $Z_0 = 50 \Omega$.



Philips Components

Data sheet	
status	Product specification
date of issue	June 1990

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

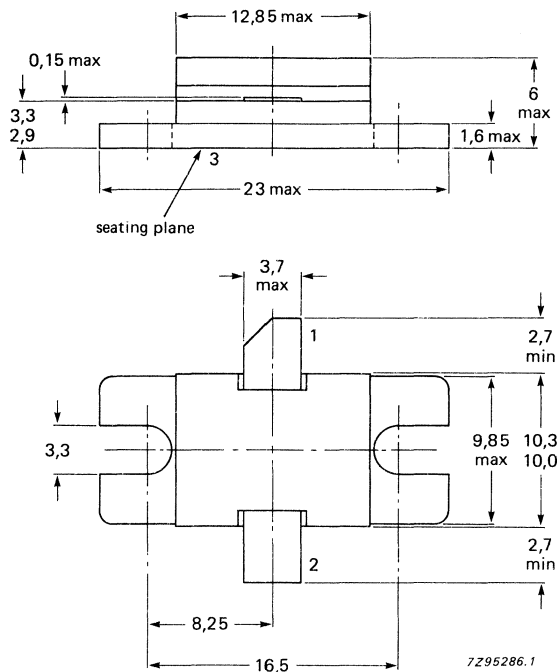
PXB16050U

MECHANICAL DATA

Dimensions in mm

Torque on screws: max. 0.5 Nm

Recommended screw: M 3



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 _{CB0}	collector-base voltage	open emitter	–	45	V
V _{CES}	collector-emitter voltage	R _{BE} = 0 Ω	–	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 _{slid}	soldering temperature	t ≤ 10 s up to 0.2 mm from ceramic	–	235	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
R _{th j-mb}	from junction to mounting base	T _j = 100 °C	1.5	K/W
R _{th mb-h}	from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I _{CB0}	collector cut-off current	V _{CB} = 40 V I _E = 0	3	mA
I _{CB0}	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 Ω	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.

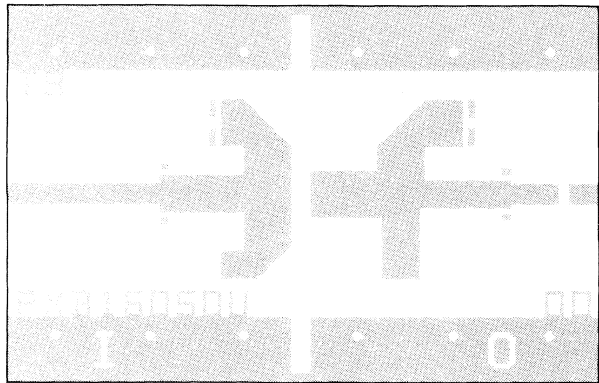
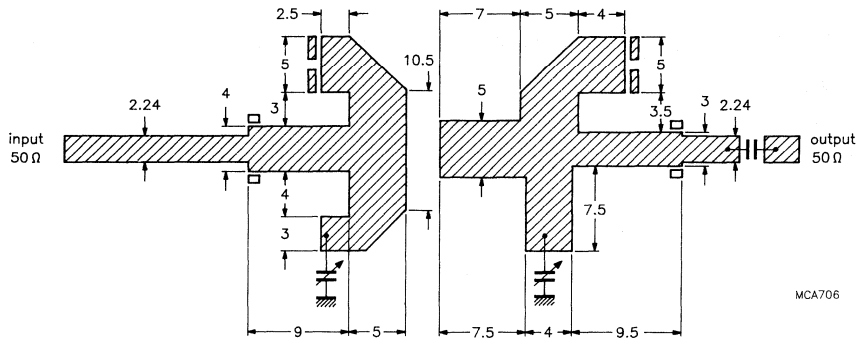
MODE OF OPERATION	f (GHz)	V _{CC} (V)	P _L (W)	G _p (dB)	η _c (%)	z _i / Z _L (Ω)
class C (CW) see note 1	1.65	28	≥ 45 typ. 50	≥ 8.5 typ. 9.5	≥ 45 typ. 52	see Figs 5 and 6

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



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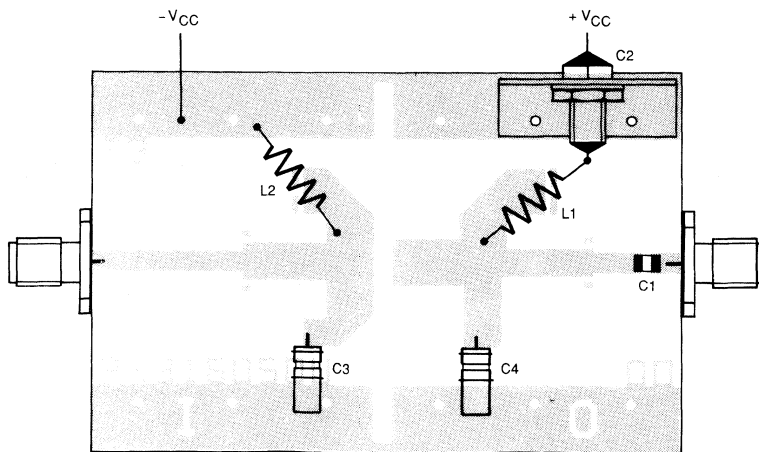


Fig.2 Narrowband test circuit, see note 1.

NPN silicon planar epitaxial microwave power transistor

PXB16050U

Note

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

Substrate : Teflon fibre glass; $\epsilon = 2.55$; 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 $\varnothing = 0.5$ mm; \varnothing internal = 2 mm, 4 turns

L2 Cu wire $\varnothing = 0.5$ mm; \varnothing internal = 2 mm, 5 turns

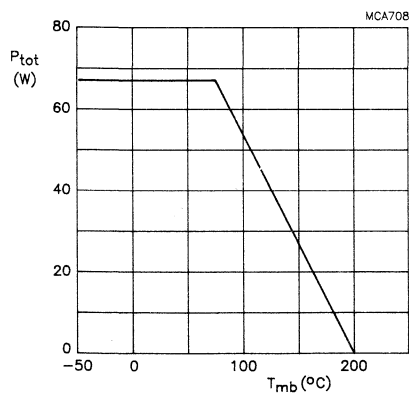


Fig.3 Maximum power dissipation as a function of mounting base temperature; P_{tot} max = 67 W.

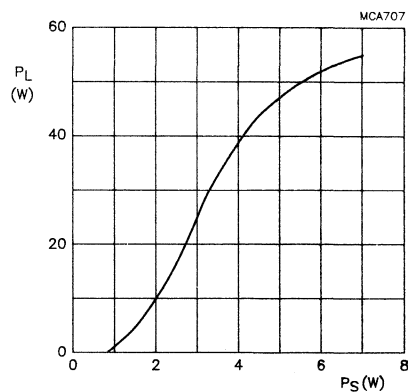


Fig.4 Load power P_L as a function of source power P_S ; $V_C = 28$ V; $f = 1.65$ GHz.
See narrowband test circuit as shown in Fig.2.

NPN silicon planar epitaxial microwave power transistor

PXB16050U

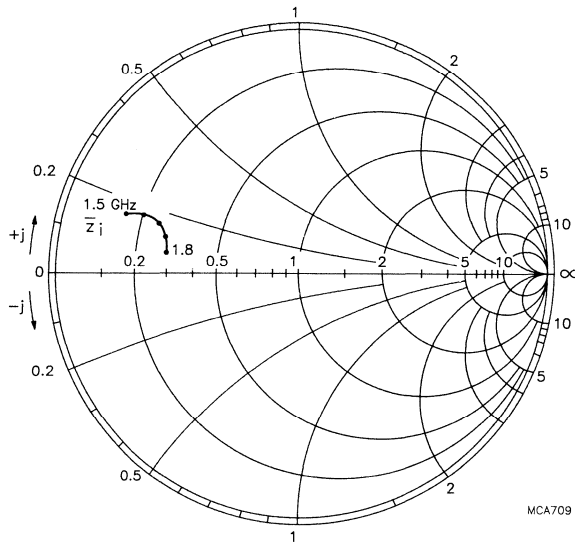


Fig.5 Input impedance as a function of frequency;
 $Z_o = 10 \Omega$; $V_{CC} = 28 \text{ V}$; typical values.

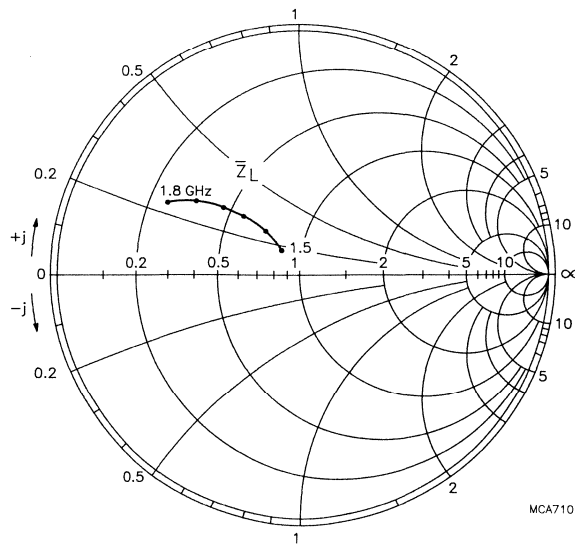


Fig.6 Optimum load impedance as a function of frequency;
 $Z_o = 10 \Omega$; $V_{CC} = 28 \text{ V}$; typical values.

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
- New 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

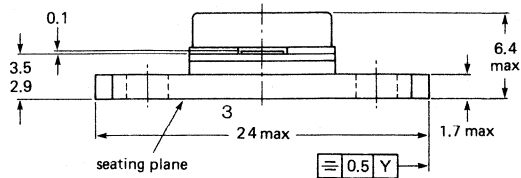
Product and environmental safety – toxic materials

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

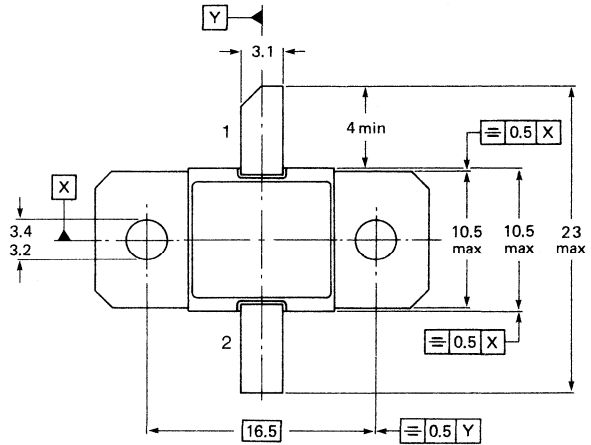
Fig. 1 FO-57C.

Torque on screw: max. 0,5 Nm
Recommended screw: M3



→ **Pinning**

- 1 = collector
- 2 = emitter
- 3 = base



7285741.2

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
 $R_{BE} = 10 \Omega$
open base

V_{CER} max. 35 V

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 $T_{mb} = 75 \text{ }^\circ\text{C}$

P_{tot} max. 27 W

Storage temperature

T_{stg} -65 to $+200 \text{ }^\circ\text{C}$

Junction temperature

T_j max. $+200 \text{ }^\circ\text{C}$

Lead soldering temperature

T_{sld} max. $+235 \text{ }^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base

R_{thj-mb} max. 4 K/W

→ From mounting base to heatsink

R_{thmb-h} max. 0.2 K/W

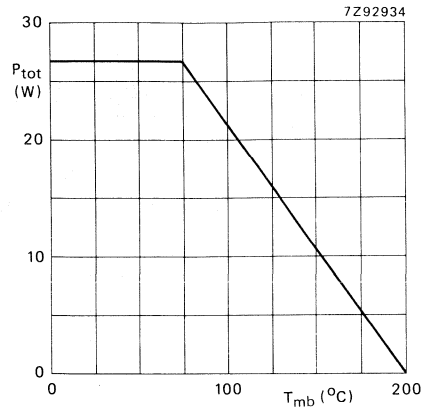


Fig. 2 Power derating curve as a function of mounting base temperature.

CHARACTERISTICS

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

Collector cut-off current

$I_E = 0; V_{CB} = 30\text{ V}$

$I_E = 0; V_{CB} = 40\text{ V}$

$R_{BE} = 10\text{ }\Omega; V_{CE} = 35\text{ V}$

Emitter cut-off current

$I_C = 0; V_{EB} = 1.5\text{ V}$

$I_C = 0; V_{EB} = 3\text{ V}$

I_{CBO} max. 2.5 mA

I_{CBO} max. 5 mA

I_{CER} max. 25 mA

I_{EBO} max. 100 μA

I_{EBO} max. 0.5 mA

APPLICATION INFORMATION (type PZ1418B15U)

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

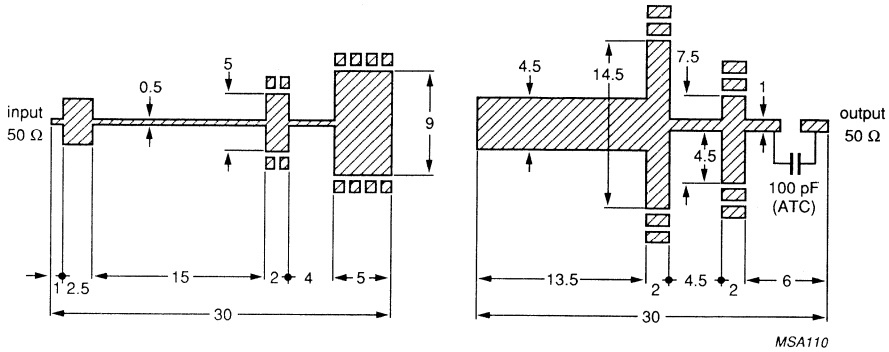


Fig. 3 Wideband test circuit boards for 1.4 to 1.8 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; $\epsilon_r = 10$.

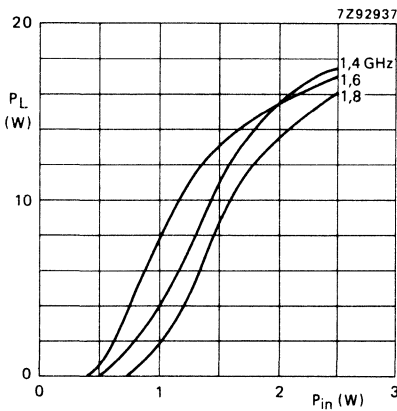


Fig. 4 Load power as a function of input power; typical values.

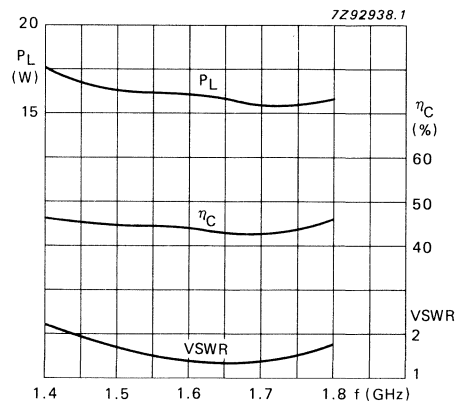


Fig. 5 Load power, efficiency and VSWR as a function of frequency; typical values; $P_{in} = 2.5\text{ W}$.

Conditions for Figs 4 and 5:

$V_{CC} = 28\text{ V}$; class-B operation; $T_{mb} = 25\text{ }^{\circ}\text{C}$.

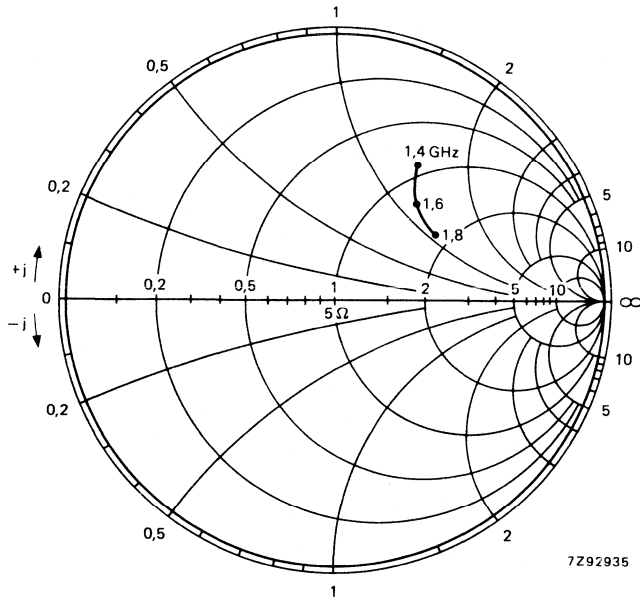


Fig. 6 Input impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.

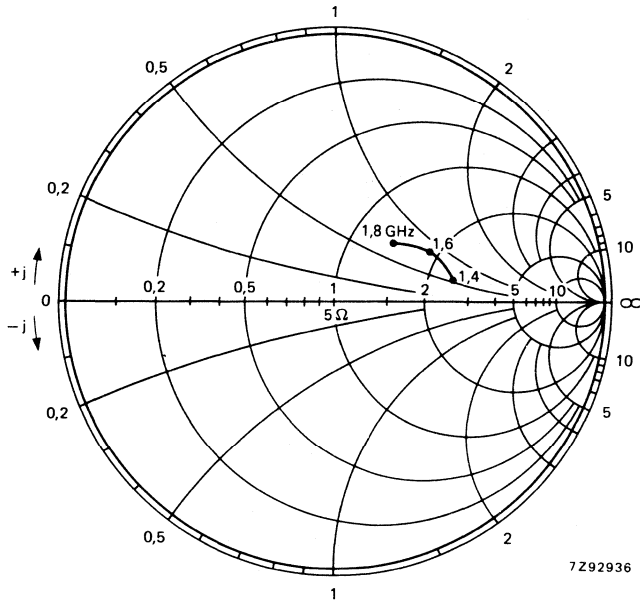


Fig. 7 Optimum load impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.

APPLICATION INFORMATION (type PZ1721B12U)

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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
→ PZ1721B12U	1.7 to 2.1	28	≥ 12 typ. 16	≥ 6.8 typ. 8	≥ 35 typ. 45	see Fig.11	see Fig.12

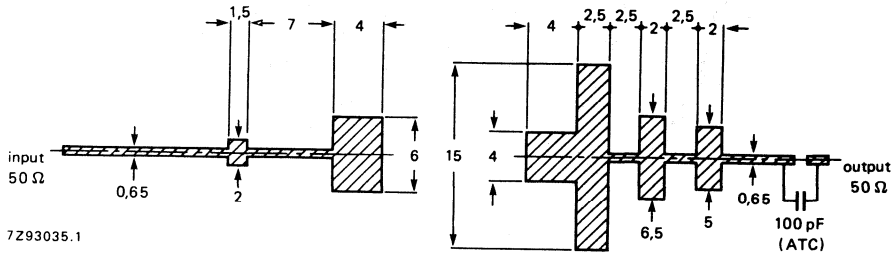


Fig. 8 Wideband test circuit boards for 1.7 to 2.1 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; $\epsilon_r = 10$.

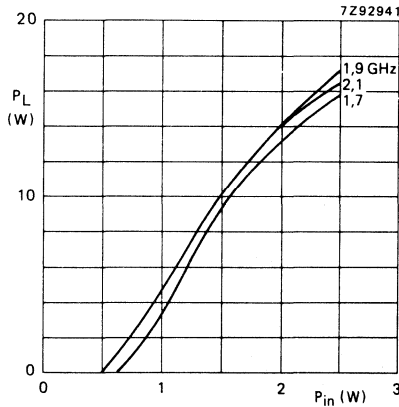


Fig. 9 Load power as a function of input power; typical values.

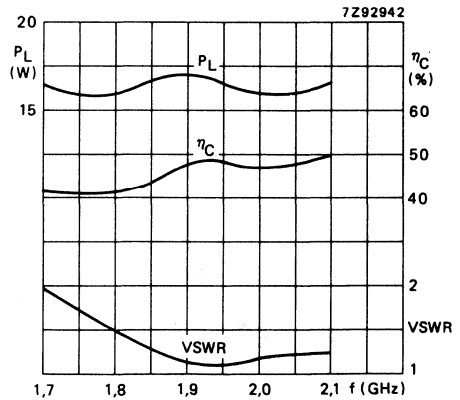


Fig. 10 Load power, efficiency and VSWR as a function of frequency; typical values; $P_{in} = 2.5\text{ W}$.

Conditions for Figs 9 and 10:

V_{CC} = 28 V; class-B operation; $T_{mb} = 25\text{ }^{\circ}\text{C}$.

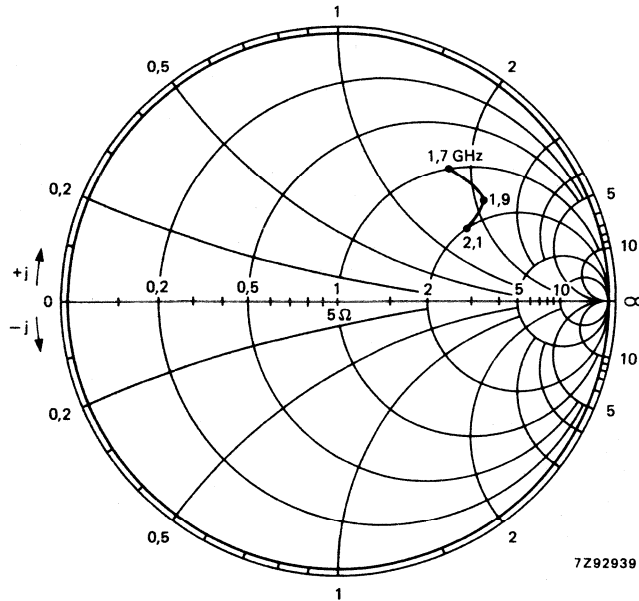


Fig. 11 Input impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.

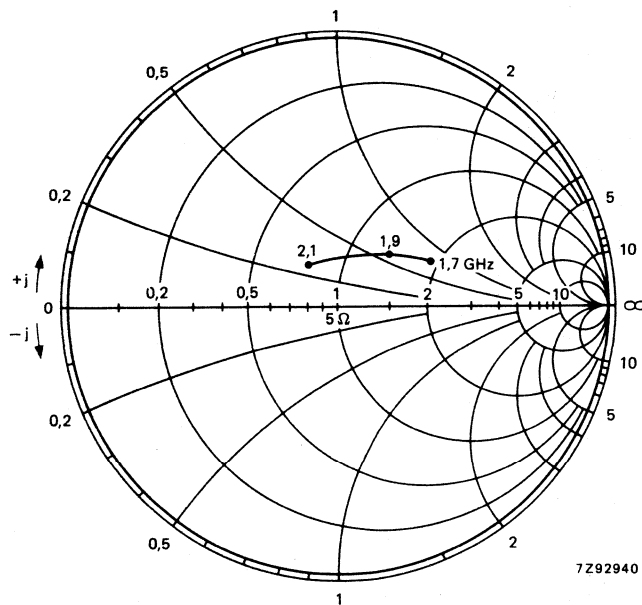


Fig. 12 Optimum load impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.

APPLICATION INFORMATION (type PZ2024B10U)

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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
→ PZ2024B10U	2.0 to 2.4	28	≥ 9 typ. 12	≥ 5.6 typ. 6.8	≥ 30 typ. 45	see Fig.16	see Fig.17

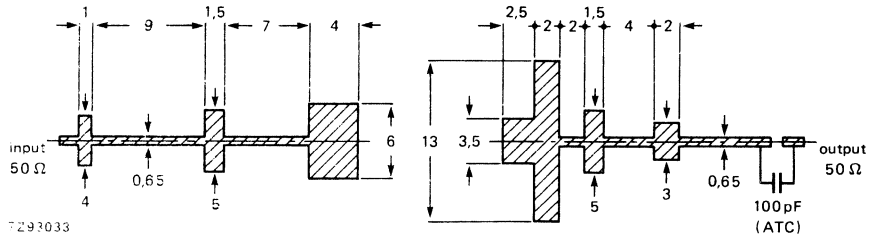


Fig. 13 Wideband test circuit boards for 2.0 to 2.4 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; $\epsilon_r = 10$.

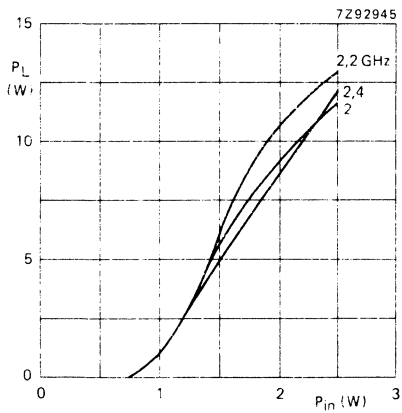


Fig. 14 Load power as a function of input power; typical values.

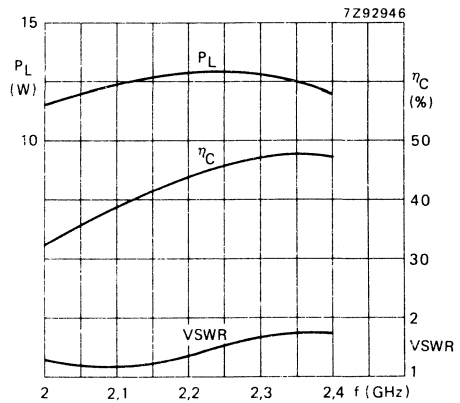


Fig. 15 Load power, efficiency and VSWR as a function of frequency; typical values; $P_{in} = 2.5\text{ W}$.

Conditions for Figs 14 and 15:

V_{CC} = 28 V; class-B operation; $T_{mb} = 25\text{ }^{\circ}\text{C}$.

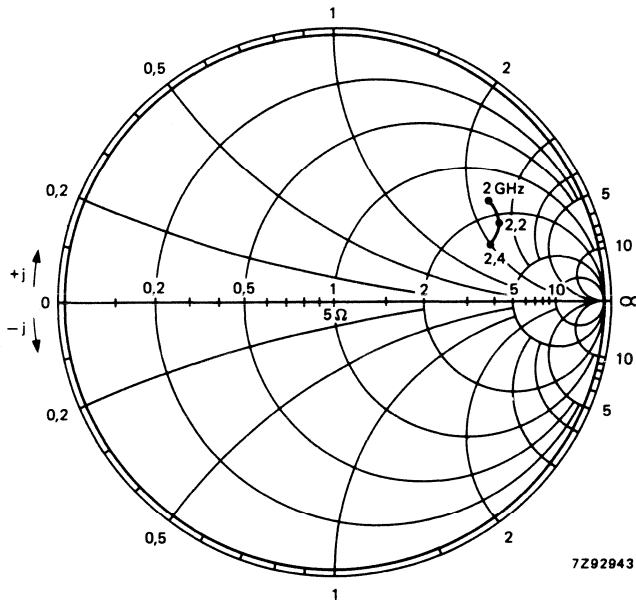


Fig. 16 Input impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.

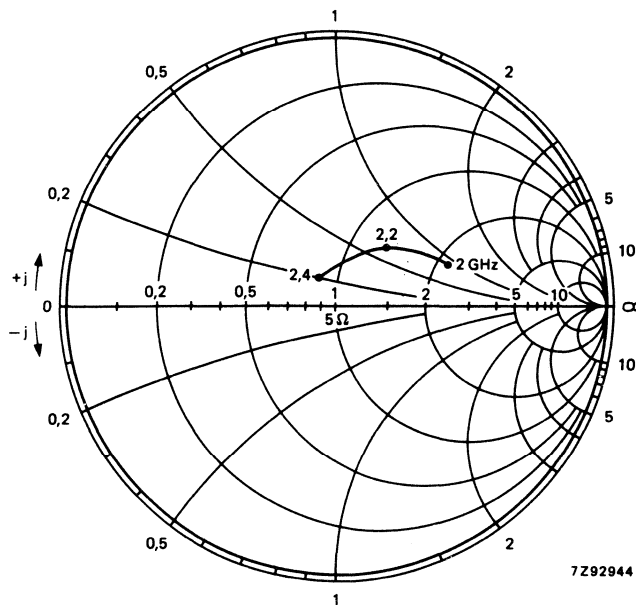


Fig. 17 Optimum load impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.

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
- New 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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	≥ 27	≥ 7.3	≥ 38	see Fig. 6	see Fig. 7
PZ1721B25U	1.7 to 2.1	28	≥ 25	≥ 7	≥ 35	see Fig. 11	see Fig. 12
PZ2024B20U	2.0 to 2.4	28	≥ 20	≥ 6	≥ 35	see Fig. 16	see Fig. 17

MECHANICAL DATA

Dimensions in mm

FO-57C (see Fig. 1)

WARNING

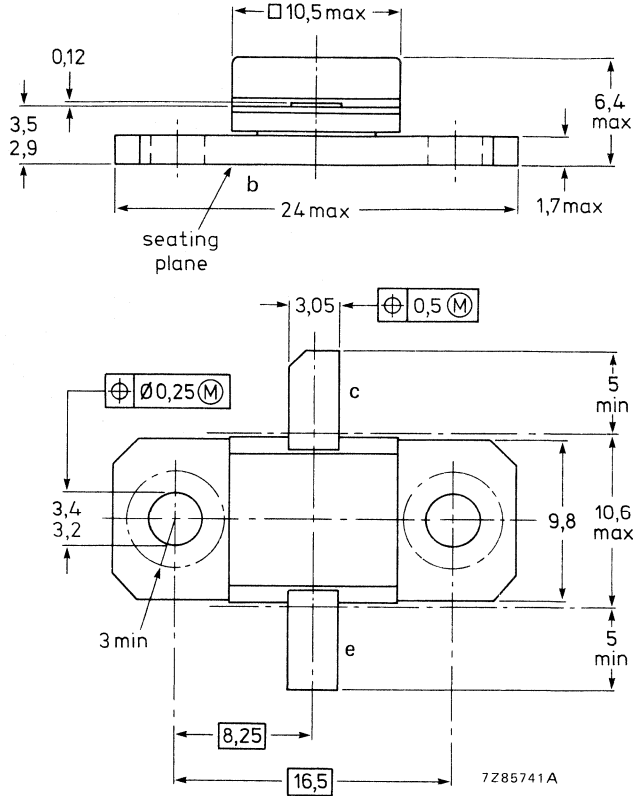
Product and environmental safety – toxic materials

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

Fig. 1 FO-57C.

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.	40 V
Collector-emitter voltage $R_{BE} = 10 \Omega$ open base	V_{CER}	max.	35 V
	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 $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	45 W
Storage temperature	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	+200 $^\circ\text{C}$
Lead soldering temperature	T_{slid}	max.	+235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base	$R_{th \text{ j-mb}}$	max.	2.2 K/W
→ From mounting base to heatsink	$R_{th \text{ mb-h}}$	max.	0.2 K/W

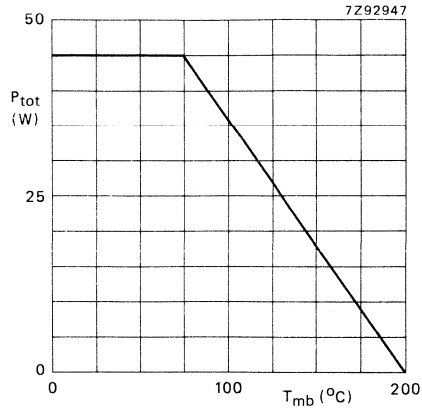


Fig.2 Power derating curve as a function of mounting base temperature.

CHARACTERISTICS

T_{mb} = 25 °C

Collector cut-off current

I_E = 0; V_{CB} = 30 V

I_E = 0; V_{CB} = 40 V

R_{BE} = 10 Ω; V_{CE} = 35 V

Emitter cut-off current

I_C = 0; V_{EB} = 1.5 V

I_C = 0; V_{EB} = 3 V

I_{CBO} max. 5 mA

I_{CBO} max. 10 mA

I_{CER} max. 50 mA

I_{EBO} max. 200 μA

I_{EBO} max. 1 mA

APPLICATION INFORMATION (type PZ1418B30U)

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

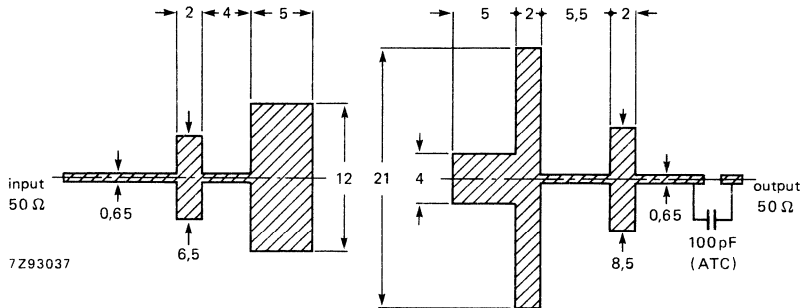


Fig. 3 Wideband test circuit boards for 1.4 to 1.8 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; $\epsilon_r = 10$.

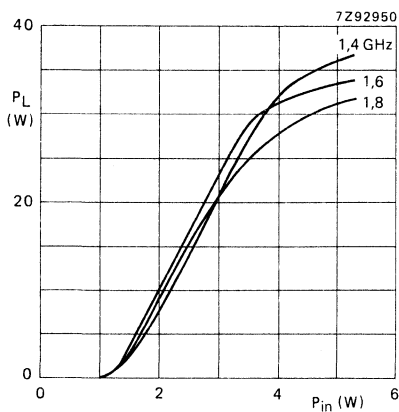


Fig. 4 Load power as a function of input power; typical values.

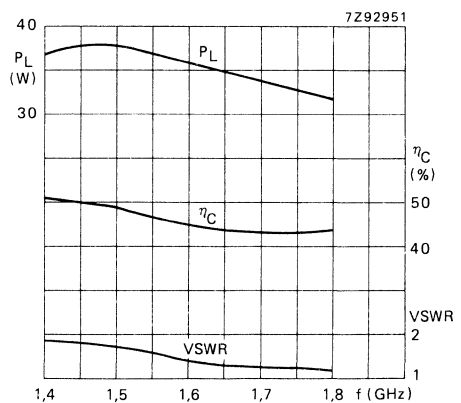
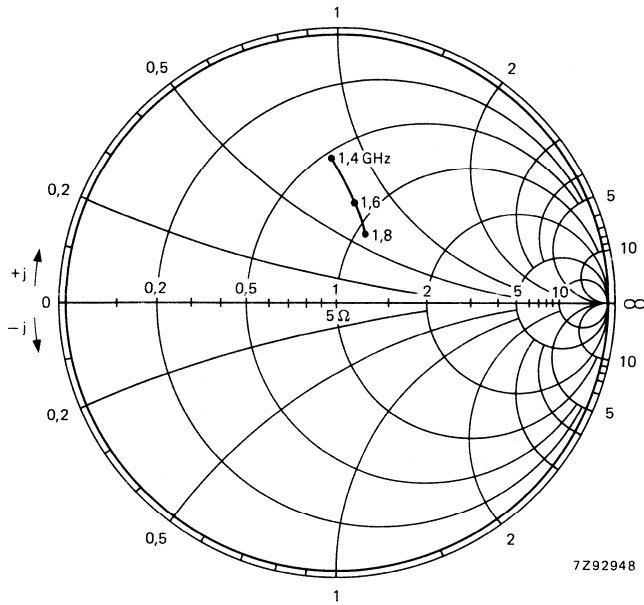


Fig.5 Load power, efficiency and VSWR as a function of frequency; typical values; $P_{in} = 5\text{ W}$.

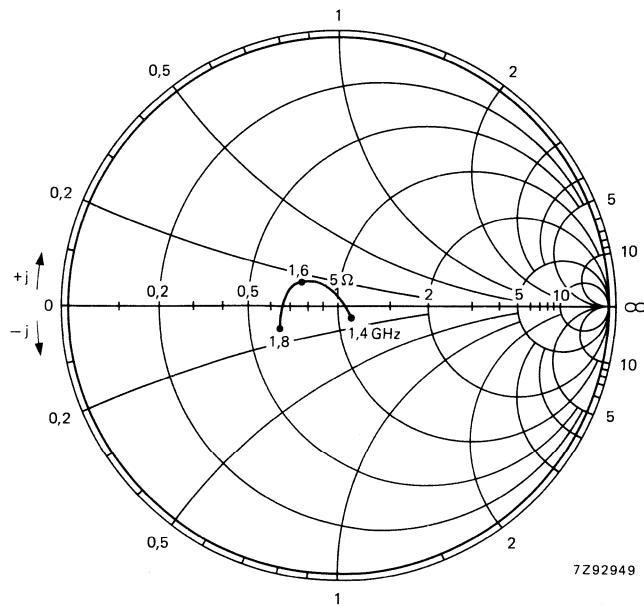
Conditions for Figs 4 and 5:

V_{CC} = 28 V; class-B operation; $T_{mb} = 25\text{ }^{\circ}\text{C}$.



7Z92948

Fig. 6 Input impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.



7Z92949

Fig. 7 Optimum load impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.

APPLICATION INFORMATION (type PZ1721B25U)

Microwave performance up to $T_{mb} = 25\text{ }^\circ\text{C}$ 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

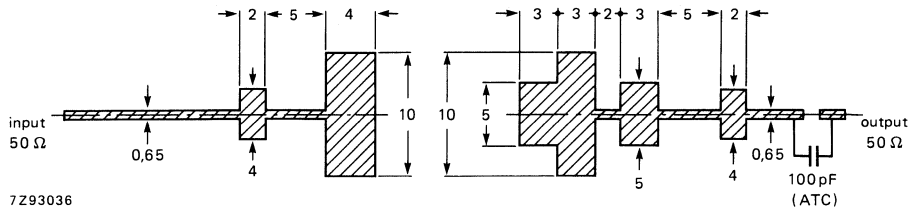


Fig. 8 Wideband test circuit boards for 1.7 to 2.1 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; ε_r = 10.

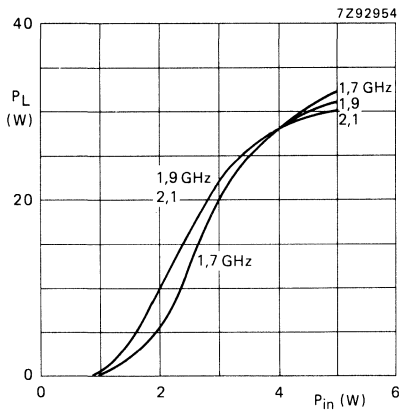


Fig. 9 Load power as a function of input power; typical values.

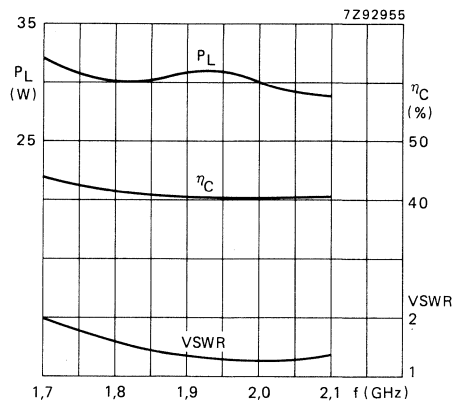


Fig. 10 Load power, efficiency and VSWR as a function of frequency; typical values; P_{in} = 5 W.

Conditions for Figs 9 and 10:

V_{CC} = 28 V; class-B operation; T_{mb} = 25 °C.

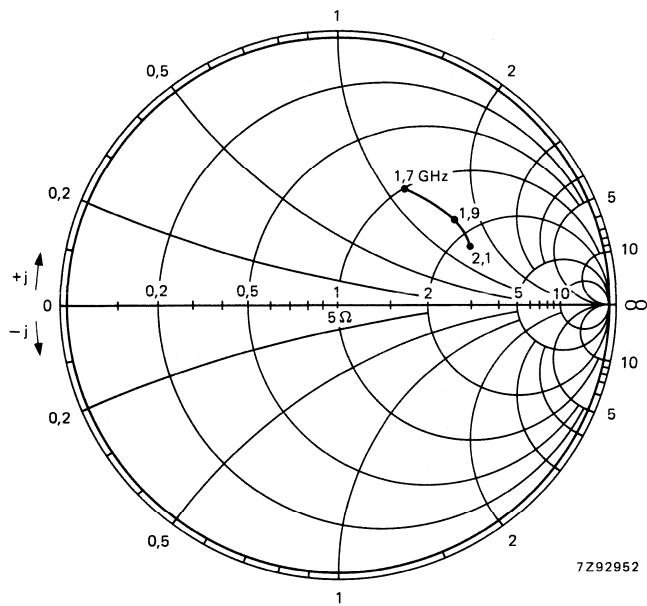


Fig. 11 Input impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.

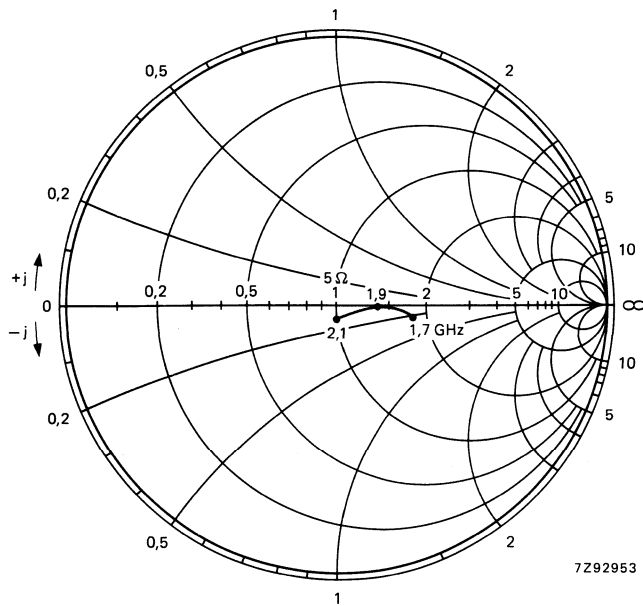


Fig. 12 Optimum load impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.

APPLICATION INFORMATION (type PZ2024B20U)

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

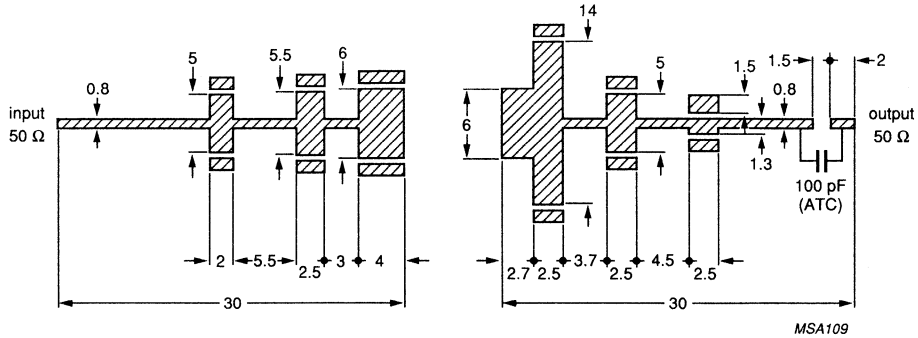


Fig. 13 Wideband test circuit boards for 2.0 to 2.4 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; $\epsilon_r = 10$.

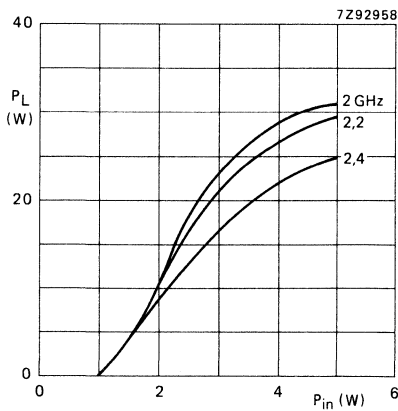


Fig. 14 Load power as a function of input power; typical values.

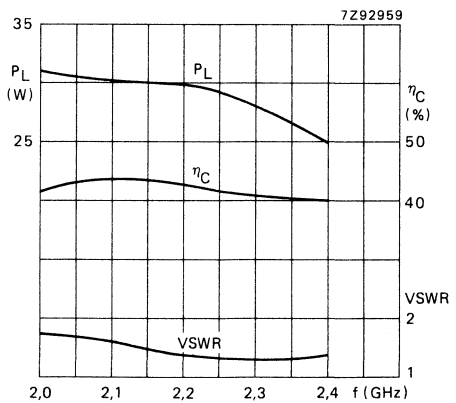


Fig. 15 Load power, efficiency and VSWR as a function of frequency; typical values; $P_{in} = 5\text{ W}$.

Conditions for Figs 14 and 15:

$V_{CC} = 28\text{ V}$; class-B operation; $T_{mb} = 25\text{ }^{\circ}\text{C}$.

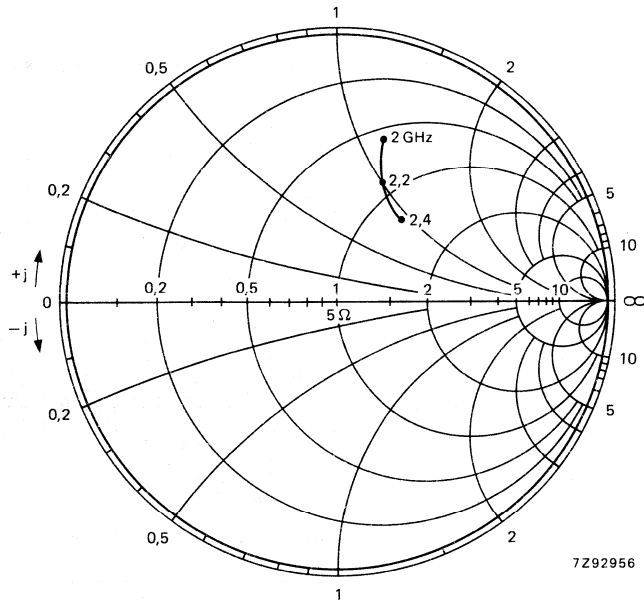


Fig. 16 Input impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.

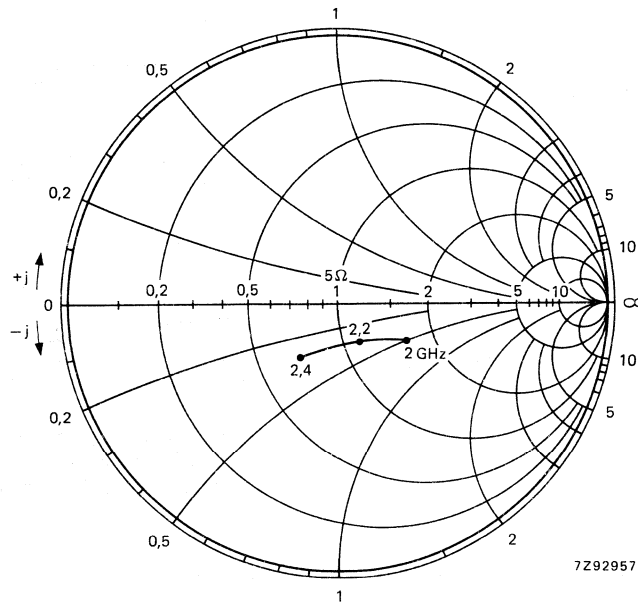


Fig. 17 Optimum load impedance as a function of frequency; typical values; $Z_0 = 5 \Omega$.

DEVELOPMENT DATA

This data sheet contains advance information and specifications are subject to change without notice.

PZ2327B15U

MICROWAVE POWER TRANSISTOR

NPN silicon epitaxial microwave power transistor, intended for use in a common-base, class-C broadband 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

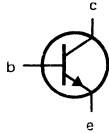
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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.

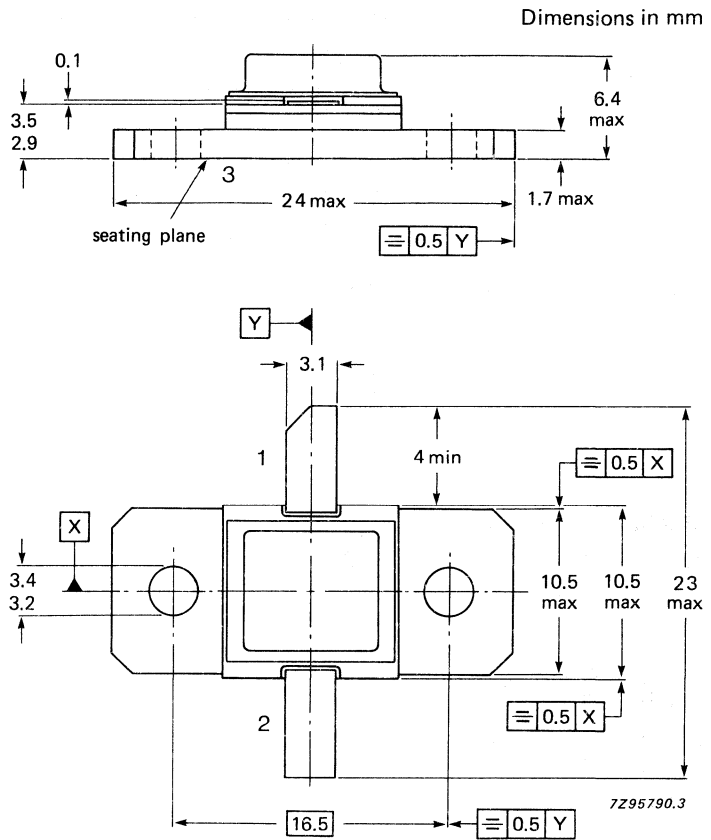
MECHANICAL DATA

Fig. 1 FO-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_{CB0}	max.	40 V
Collector-emitter voltage; $R_{BE} = 10 \Omega$	V_{CER}	max.	30 V
Collector-emitter voltage; open base	V_{CEO}	max.	15 V
Emitter-base voltage; open collector	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	2.1 A
Total power dissipation at $T_{mb} \leq 75 \text{ }^\circ\text{C}$	P_{tot}	max.	32 W
Storage temperature range	T_{stg}		-65 to +200 $^\circ\text{C}$
Operating junction temperature	T_j	max.	200 $^\circ\text{C}$
→ Soldering temperature at 0.2 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

→ From junction to mounting base	R_{thj-mb}	max.	4 K/W
→ From mounting base to heatsink	R_{thmb-h}	max.	0.2 K/W

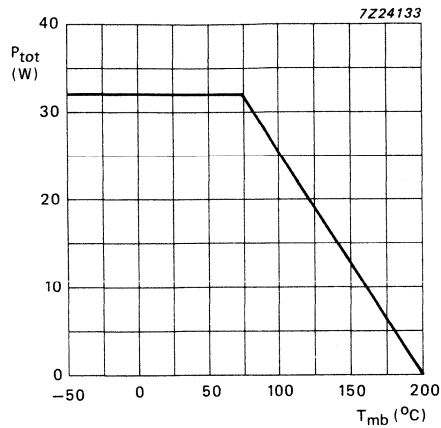


Fig. 2 Power derating curve.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current

V_{CB} = 40 V; I_E = 0

V_{CB} = 30 V; I_E = 0

V_{CE} = 30 V; R_{BE} = 10 Ω

V_{CE} = 40 V; I_B = 0

I_{CBO} max. 8 mA

I_{CBO} max. 80 μA

I_{CER} max. 130 μA

I_{CEO} max. 1 mA

Emitter cut-off current

V_{EB} = 1.5 V; I_C = 0

V_{EB} = 3.5 V; I_C = 0

I_{EBO} max. 100 μA

I_{EBO} max. 1 mA

APPLICATION INFORMATION

Microwave performance at T_{mb} = 25 °C measured in a common-base broadband 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	2.3 to 2.7	28	≥ 15 typ. 16	≥ 7 typ. 8	≥ 40 typ. 45	see Figs 6 and 7

DEVELOPMENT DATA



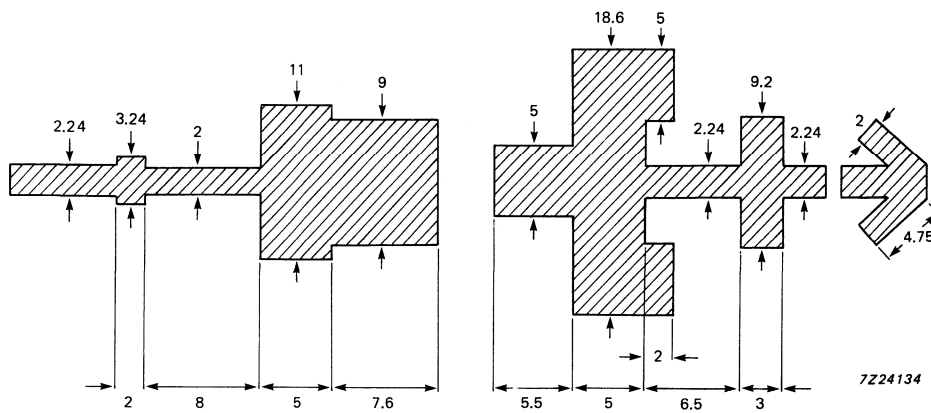


Fig. 3 Broadband test circuit for 2.3 to 2.7 GHz; class-C; CW application
 Teflon fibreglass; $\epsilon_r = 2.55$; thickness 0.8 mm (dimensions in mm).

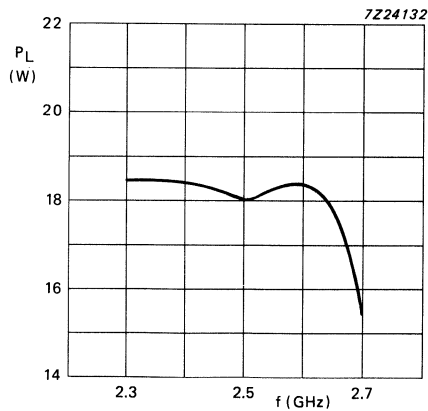


Fig. 4 Load power as a function of frequency;
 $P_{in} = 2.5$ W; typical values.

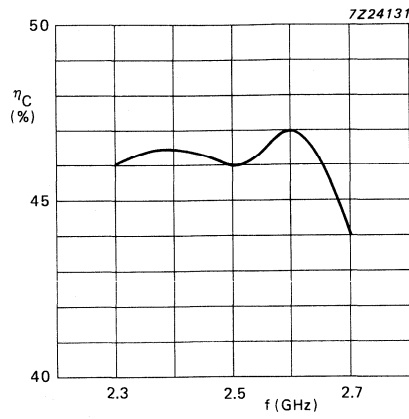


Fig. 5 Power gain as a function of frequency; typical values.

DEVELOPMENT DATA

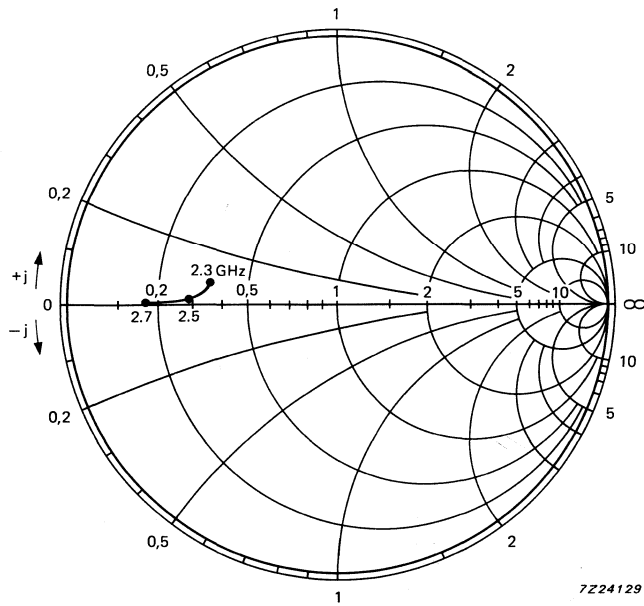


Fig. 6 Input impedance as a function of frequency;
 $V_{CC} = 28 \text{ V}$; $P_L = 16 \text{ W}$; $Z_0 = 50 \Omega$.

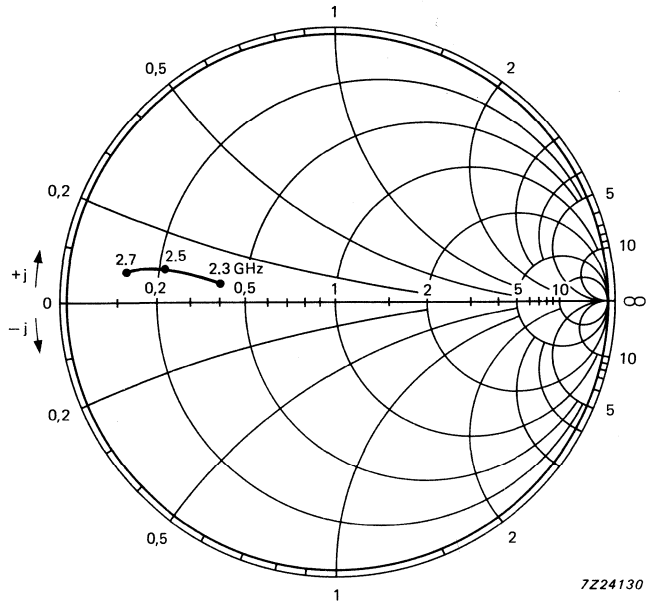


Fig. 7 Optimum load impedance as a function of frequency;
 $V_{CC} = 28 \text{ V}; P_L = 16 \text{ W}; Z_O = 50 \Omega$.

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
- New 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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

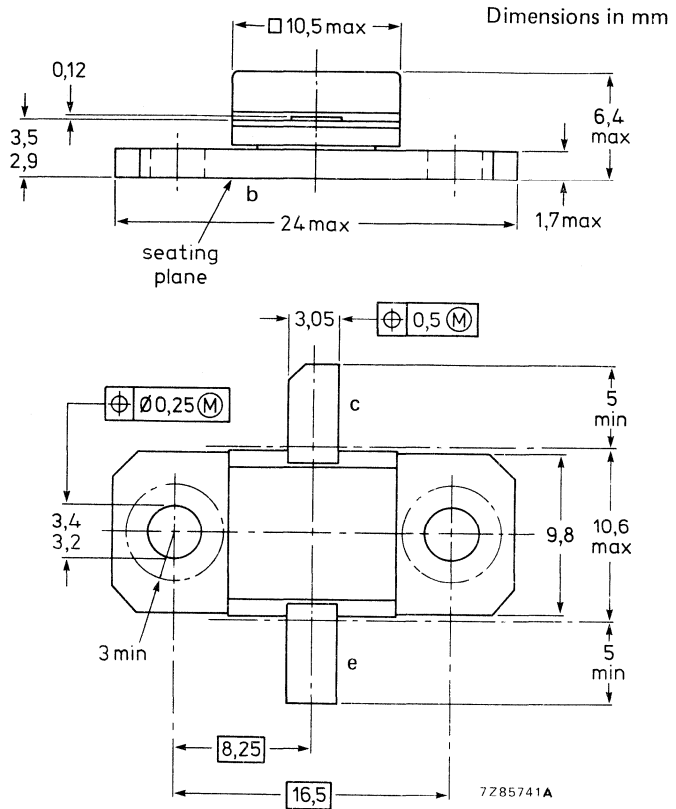
Product and environmental safety – toxic materials

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

Fig. 1 FO-57C.

Torque on nut: 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.	40 V
Collector-emitter voltage $R_{BE} = 10 \Omega$ open base	V_{CER}	max.	35 V
	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 $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	45 W
Storage temperature	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	+200 $^\circ\text{C}$
Lead soldering temperature → > 0.2 mm from flange; $t_{sld} < 10 \text{ s}$	T_{sld}	max.	+235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base	$R_{th \text{ j-mb}}$	max.	2.2 K/W
→ From mounting base to heatsink	$R_{th \text{ mb-h}}$	max.	0.2 K/W

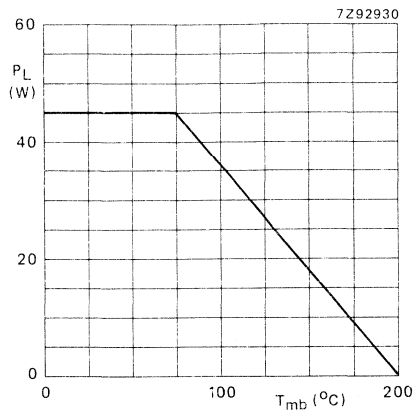


Fig.2 Power derating curve as a function of mounting base temperature.

CHARACTERISTICS

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

Collector cut-off currents

$V_{CB} = 40\text{ V}; I_E = 0$

$V_{CB} = 30\text{ V}; I_E = 0$

$V_{CER} = 35\text{ V}; R_{BE} = 10\ \Omega$

I_{CBO} max. 10 mA

I_{CBO} max. 5 mA

I_{CER} max. 50 mA

Emitter cut-off currents

$V_{EB} = 3\text{ V}; I_C = 0$

$V_{EB} = 1.5\text{ V}; I_C = 0$

I_{EBO} max. 1 mA

I_{EBO} max. 200 μA

Collector-base capacitance

$I_E = I_C = 0; V_{CB} = 28\text{ V}$

C_{cb} typ. 17 pF

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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. 5	2 + j4.5 typ. value	1,5 + j0 typ. value

* Amplifier consists of pre-matching test circuit with complementary input and output slug tuners.

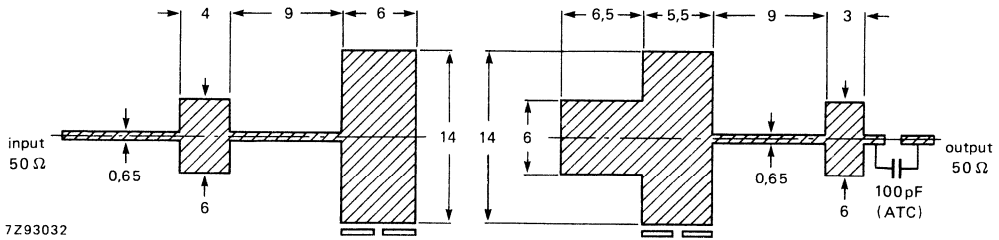


Fig. 3 Prematching test circuit boards, CW, class-B at 1.55 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.65 mm; ε_r = 10.

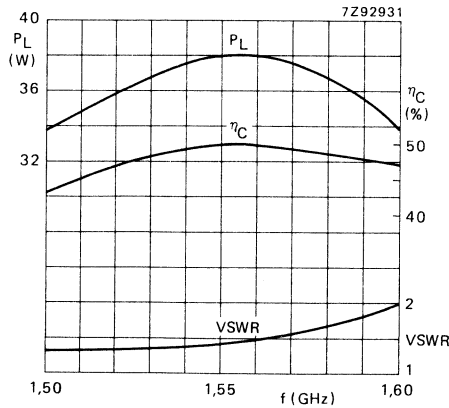


Fig. 4 Load power, efficiency and VSWR as a function of frequency; V_{CE} = 28 V; T_{mb} = 25 °C; class-B operation; typical values.

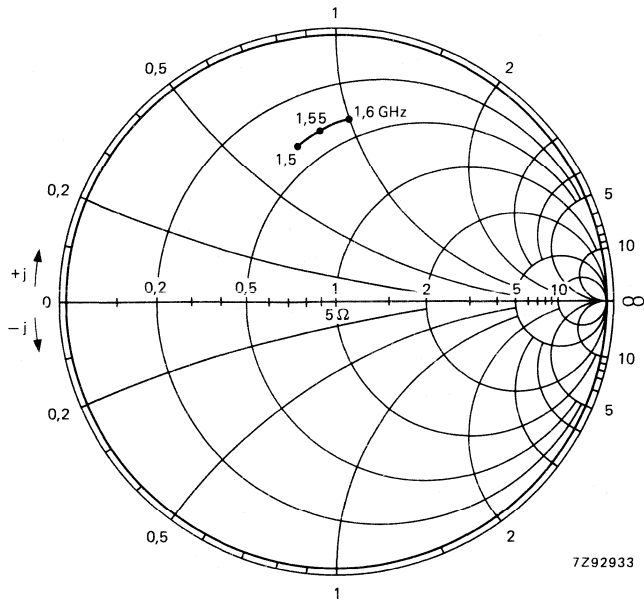


Fig. 5 Input impedance as a function of frequency;
 $P_L = 38 \text{ W}$; $Z_0 = 5 \Omega$; typical values.

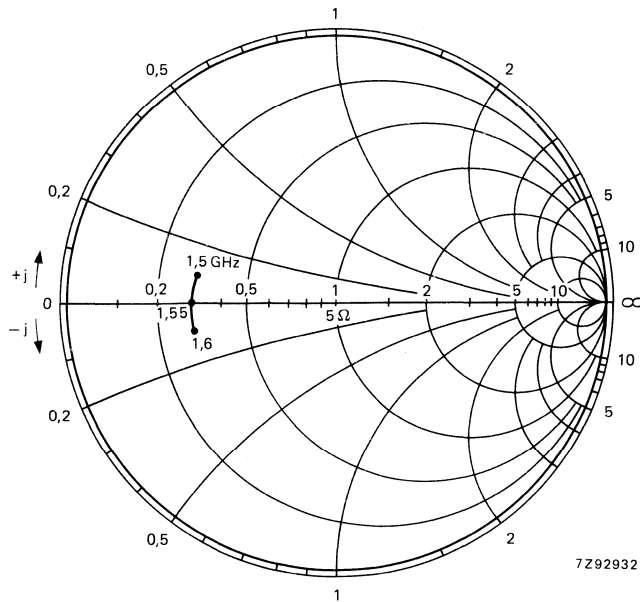


Fig. 6 Optimum load impedance as a function of frequency;
 $P_L = 38 \text{ W}$; $Z_0 = 5 \Omega$; typical values.

MICROWAVE POWER TRANSISTOR

NPN silicon planar epitaxial microwave power transistor, intended for use in a common-base class-C narrowband power amplifier, operating at a frequency of 1.64 GHz.

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 matching cell; simplifying circuit design

The transistor is housed in a metal ceramic flange envelope (FO-57D).

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in an unneutralized common-base class-C narrowband amplifier; typical values.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	$z_i; Z_L$ Ω
class-C; CW	1.64	28	45	9	45	see Fig. 5

MECHANICAL DATA

Dimensions in mm

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 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.

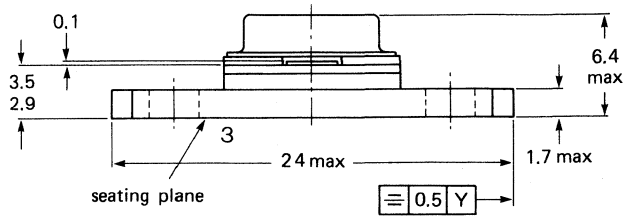
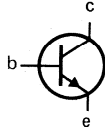
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

MECHANICAL DATA

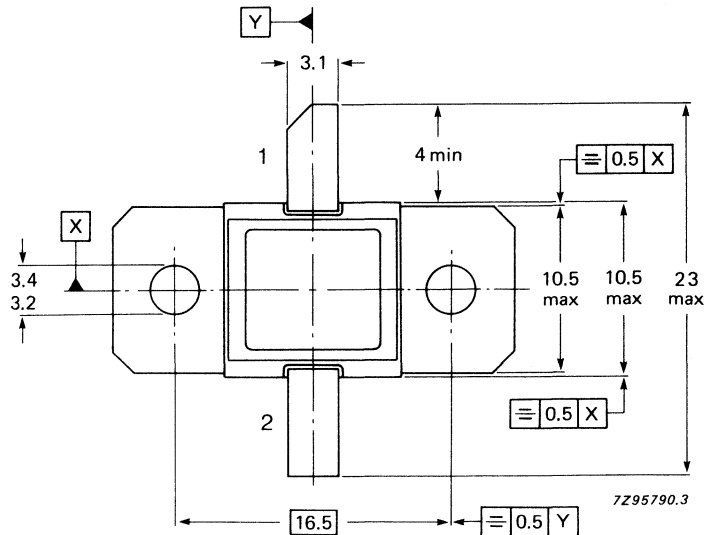
Fig. 1 FO-57D.

Dimensions in mm

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; $R_{BE} = 10 \Omega$	V_{CER}	max.	35 V
Collector-emitter voltage; open base	V_{CEO}	max.	15 V
Emitter-base voltage; open collector	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	6 A
Total power dissipation at $T_{mb} \leq 75 \text{ }^\circ\text{C}$	P_{tot}	max.	67.5 W
Storage temperature range	T_{stg}		-65 to 200 $^\circ\text{C}$
Operating junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature at 0.3 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 200 \text{ }^\circ\text{C}$)

From junction to mounting base	$R_{th-j-mb}$	max.	2.5 K/W
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MICROWAVE POWER TRANSISTOR

NPN silicon power transistor for use in a common-base, class-B amplifier up to a frequency of 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
- New 5 GHz technology

The transistor is housed in a metal ceramic flange envelope (FO-57C).

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in an unneutralized common-base class-B selective amplifier.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	$z_i; Z_L$ Ω
CW; class-B	1	28	typ. 70	typ. 10	typ. 62	see Fig. 6
	2	28	typ. 40	typ. 7.8	typ. 48	
	3	28	typ. 22	typ. 5	typ. 25	

MECHANICAL DATA

FO-57C (see Fig. 1)

Dimensions in mm

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.

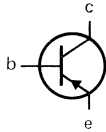
MECHANICAL DATA

Fig. 1 FO-57C.

Dimensions in mm

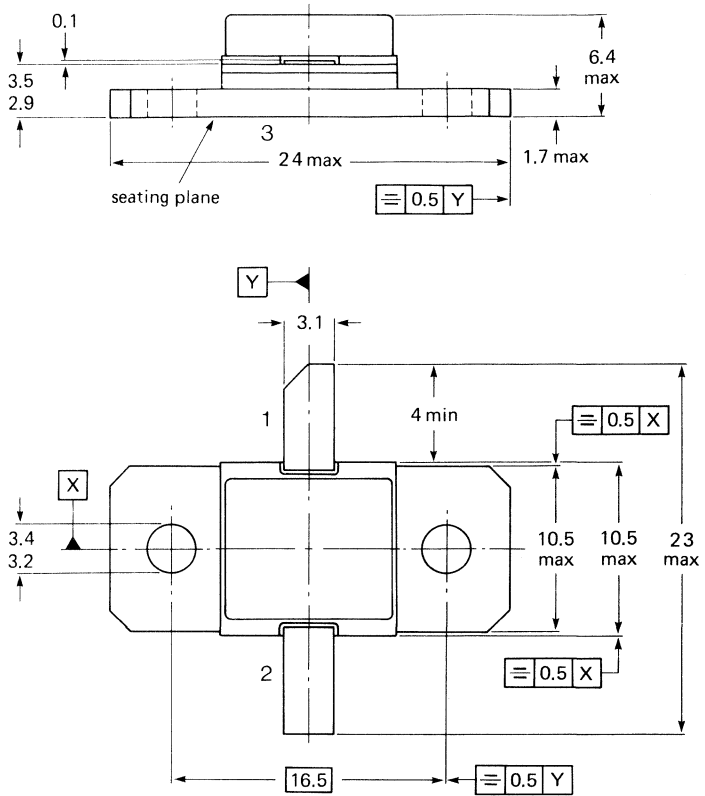
Pinning:

- 1 = collector
- 2 = emitter
- 3 = base



Torque on screw: max. 0.5 Nm

Recommended screw: M3



7285741.2

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
$R_{BE} = 10 \Omega$	V_{CER}	max.	35 V
Emitter-base voltage, open collector	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	6 A
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$	P_{tot}	max.	67.5 W
Storage temperature	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature at 0.1 mm from case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

PULSED POWER TRANSISTOR FOR S-BAND RADAR

NPN transistor for use in common-base pulsed power amplifiers for S-band radar (3.1 to 3.5 GHz).

Diffused emitter ballasting resistors, interdigitated structure, multicell geometry and gold sandwich metallization ensure an optimum temperature profile and reliability. Owing to the entirely ion-implanted, self-aligning process an excellent wideband performance is obtained.

Internal input and output prematching ensures good stability and easy broadband use.

QUICK REFERENCE DATA

RF performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a wideband common-base class-B circuit under pulse conditions

mode of operation	f GHz	V_{CC} V	t_p μs	δ %	P_L W	G_p dB	η_C %
class-B	3.1 to 3.5	24	100	10	≥ 4	≥ 4.3	≥ 30

MECHANICAL DATA

Fig. 1 FO-83.

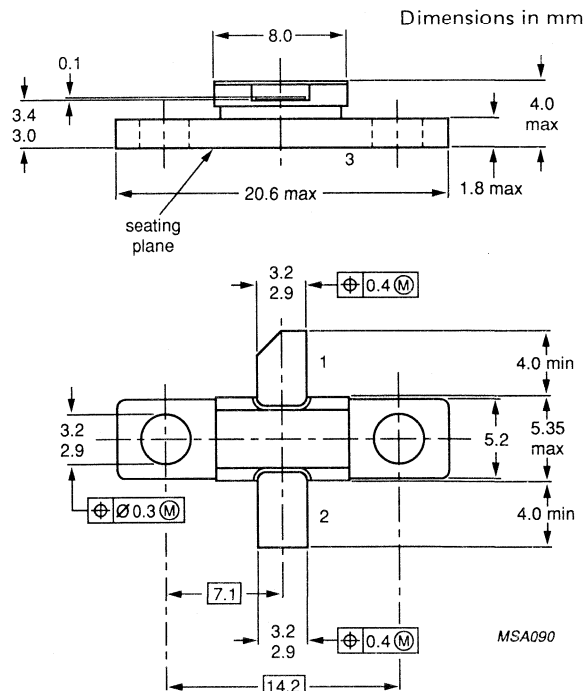
Base connected to flange

Torque on nut: max. 0.4 Nm

Recommended screw: M2.5

Marking code

3135B5X = RV3135B5X



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.

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 ($R_{BE} = 0$) (open base)	V_{CES} V_{CEO}	max. max.	35 V 15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3 V
Collector current (DC) ($t_p = 100 \mu s$; $\delta = 10\%$)	I_C	max.	1 A
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$ ($t_p = 100 \mu s$; $\delta = 10\%$)	P_{tot}	max.	25 W
Storage temperature range	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.3 mm from the case $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base	$R_{th \text{ j-mb}}$	max.	6.5 K/W
From mounting base to heatsink	$R_{th \text{ mb-h}}$	max.	0.6 K/W

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

Collector-base breakdown voltage $I_C = 3 \text{ mA}$; open emitter	$V_{(BR)CBO}$	min.	35 V
Collector-emitter breakdown voltage ($R_{BE} = 0$; $I_C = 3 \text{ mA}$)	$V_{(BR)CES}$	min.	35 V
Emitter-base breakdown voltage $I_E = 0.5 \text{ mA}$; open collector	$V_{(BR)EBO}$	min.	3 V
Collector cut-off current $I_E = 0$; $V_{CB} = 24 \text{ V}$	I_{CBO}	max.	0.1 mA
Emitter cut-off current $I_C = 0$; $V_{EB} = 1.5 \text{ V}$	I_{EBO}	max.	10 μA

APPLICATION INFORMATION

RF performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in an unneutralized wideband common-base class-B circuit under pulse conditions.

type number	f GHz	V _{CC} V	t _p μs	δ %	P _L W	G _p dB	η _C %
RV3135B5X	3.1 to 3.5	24	100	10	> 4 typ. 5.6	> 4.3 typ. 5.7	> 30 typ. 47

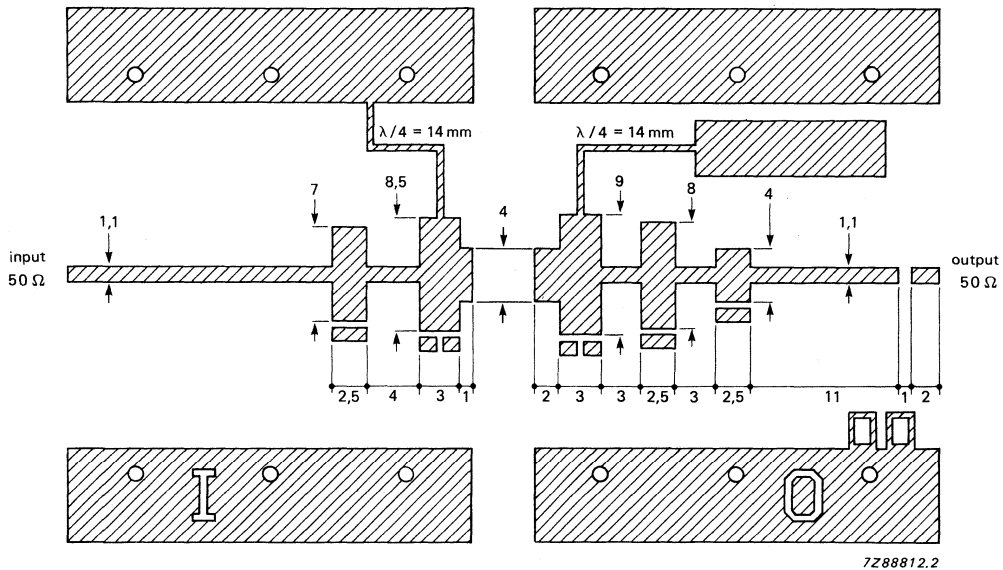


Fig. 2 Wideband test circuit boards for 3.1 to 3.5 GHz (dimensions in mm); striplines on a double CU-clad p.c. board with PTFE fibre-glass dielectric ($\epsilon_r = 2,54$); thickness 0.4 mm.

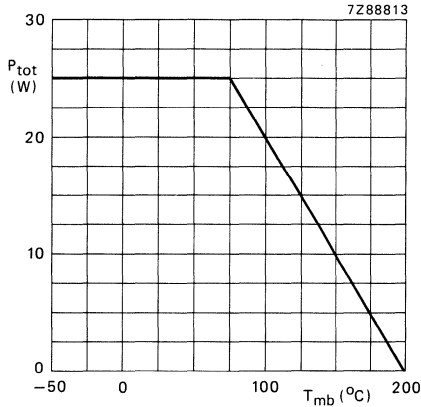


Fig. 3

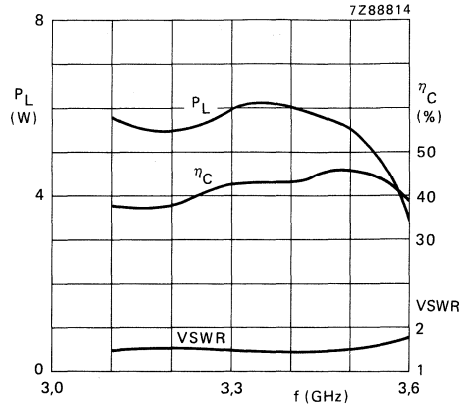


Fig. 4.

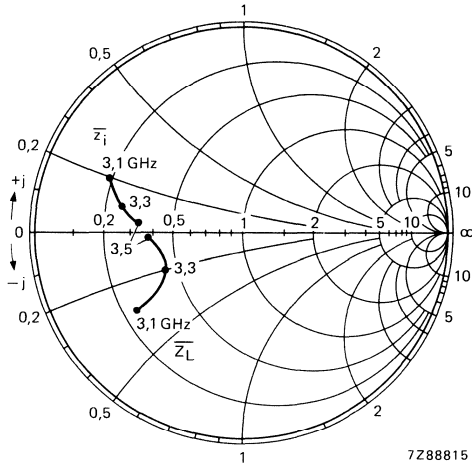


Fig. 5.

Fig. 3 Power derating curve as a function of mounting base temperature; $t_p = 100 \mu s$; $\delta = 10\%$.

Fig. 4 Load power, collector efficiency and VSWR as a function of frequency; $P_{in} = 1.5 W$.

Fig. 5 Input and optimum load impedance as a function of frequency; typical values; $Z_o = 50 \Omega$; $T_{mb} = 25 \text{ }^\circ\text{C}$.

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon planar epitaxial microwave power transistor intended for use in common-base, class-C broadband pulse power amplifiers operating in the 1.03 to 1.09 GHz range.

It is recommended for IFF long pulse 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
- 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common-base class-C broadband amplifier.

mode of operation	f GHz	V_{CE} V	P_L W	G_p dB	η_C %
class-C $t_p = 300\text{ }\mu\text{s}$ $\delta = 10\%$ (see Fig. 2)	1.03 to 1.09	50	≥ 300	≥ 7	≥ 38

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 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.

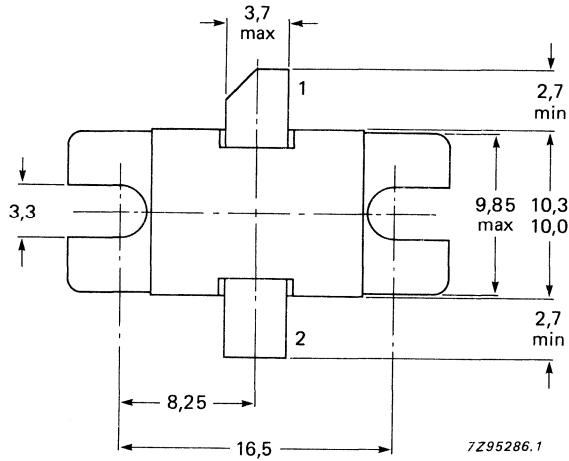
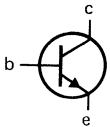
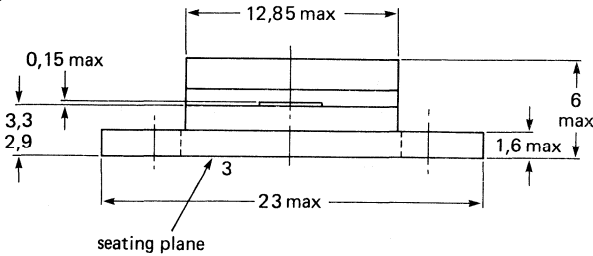
MECHANICAL DATA

Fig. 1 FO-91.

Dimensions in mm

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_{CB0}	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 (peak)*	I_C	max.	21 A
→ Total power dissipation at $T_{mb} \leq 75\text{ °C}^*$	P_{tot}	max.	830 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; $t_{sld} \leq 10\text{ s}$	T_{sld}	max.	235 °C

THERMAL RESISTANCE (at $T_j = 100\text{ °C}$)

→ From junction to mounting base in CW	$R_{th\ j-mb}$	max.	0.8 K/W
From mounting base to heatsink in CW	$R_{th\ mb-h}$	max.	0.2 K/W
→ From junction to heatsink	Z_{th}	max.	0.15 K/W

* Maximum value under nominal pulsed microwave operating conditions.

** Equivalent thermal impedance under nominal pulsed microwave operating conditions (see Fig. 2).

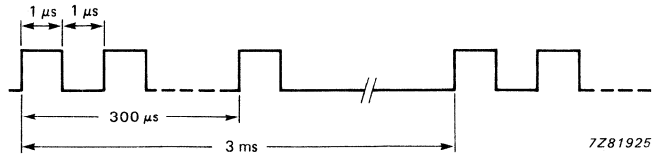


Fig. 2 Pulse definition.

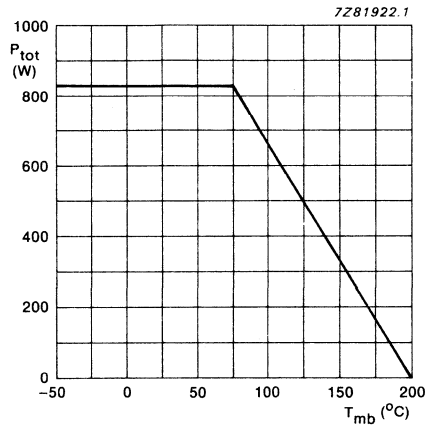


Fig. 3 Power derating curve.
 $t_p = 300 \mu\text{s}$; $\delta = 10\%$ (see Fig. 2).

CHARACTERISTICS

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

Collector cut-off current

$V_{\text{CB}} = 50 \text{ V}$; $I_{\text{E}} = 0$

$V_{\text{CB}} = 60 \text{ V}$; $I_{\text{E}} = 0$

$V_{\text{CE}} = 50 \text{ V}$; $R_{\text{BE}} = 0$

Emitter cut-off current

$V_{\text{EB}} = 1.5 \text{ V}$; $I_{\text{B}} = 0$

I_{CBO} max. 14 mA ←

I_{CBO} max. 140 mA ←

I_{CES} max. 140 mA ←

I_{EBO} max. 1.4 mA ←

APPLICATION INFORMATION

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

mode of operation	f GHz	V _{CC} V	P _L W	G _p dB	η_C %
pulsed t _p = 300 μ s δ = 10% (see Fig. 2)	1.03 to 1.09	50	\geq 300 typ. 350	\geq 7 typ. 7.5	\geq 38 typ. 40

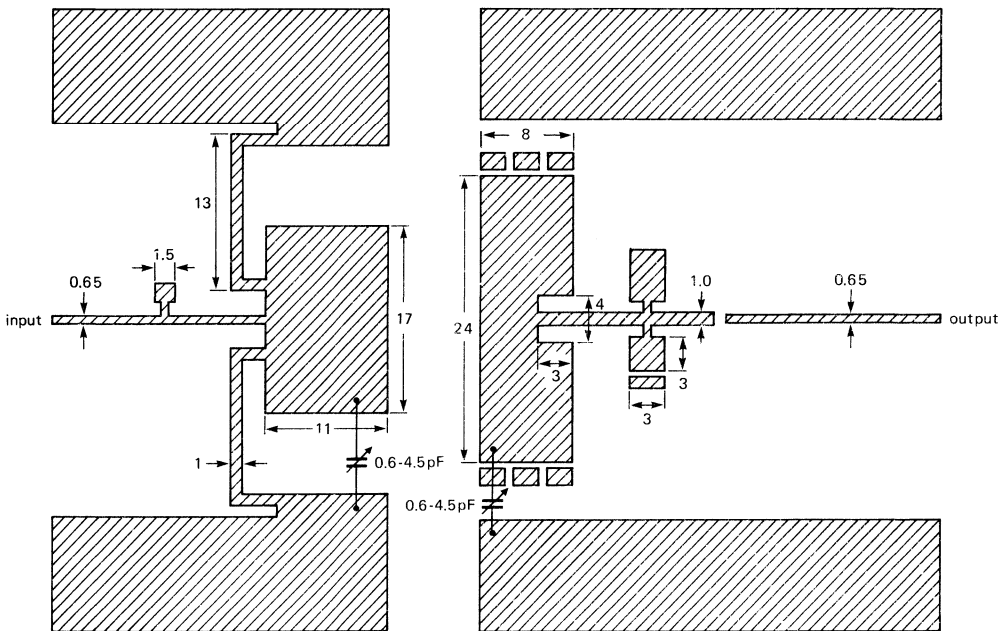


Fig. 4 Broadband test circuit for 1.03 to 1.09 GHz; class-C; pulse application. Epsilam printed circuit board thickness 0.635 mm; $\epsilon_r = 10$ (dimensions in mm).

SUPERSEDES HANDBOOK DATA OF APRIL 1988

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 $T_{mb} = 25^{\circ}\text{C}$ 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
$t_p = 1 \text{ ms};$ $\delta = 10\%$	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 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.

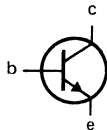
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

MECHANICAL DATA

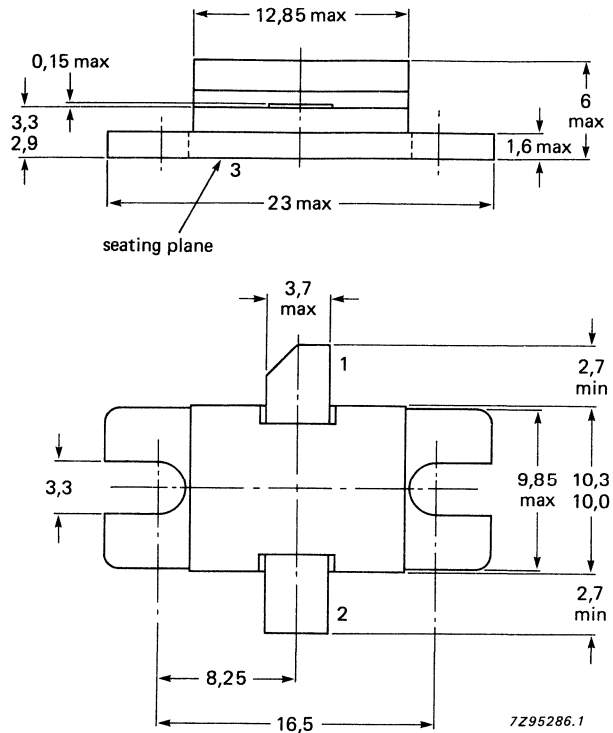
Fig. 1 FO-91.

Pinning:
 1 = collector
 2 = emitter
 3 = base

Base is connected to the seating plane.



Dimensions in mm



RATINGS

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

Collector-base voltage; open emitter	V_{CB0}	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 $T_{mb} \leq 75\text{ }^\circ\text{C}^*$	P_{tot}	max.	355 W
Storage temperature range	T_{stg}		-65 to +200 $^\circ\text{C}$
Operating junction temperature	T_j	max.	200 $^\circ\text{C}$
Soldering temperature at 0.2 mm from the case; $t_{sld} \leq 10\text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 75\text{ }^\circ\text{C}$)

From junction to mounting base (CW)	R_{thj-mb}	max.	1 K/W
From junction to heatsink**	Z_{th}	max.	0.35 K/W
From mounting base to heatsink (CW)	R_{thmb-h}	max.	0.2 K/W

* Maximum values under nominal pulsed microwave operating conditions ($t_p = 1\text{ ms}$; $\delta = 10\%$).

** Equivalent thermal impedance under nominal pulsed microwave operating conditions ($t_p = 1\text{ ms}$; $\delta = 10\%$).

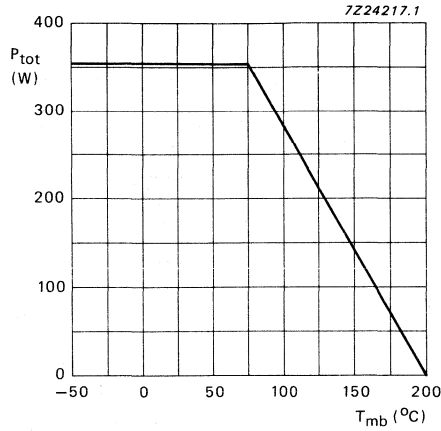


Fig. 2 Power derating curve $t_p = 1$ ms; $\delta = 10\%$.

CHARACTERISTICS

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

Breakdown voltages

$I_C = 100$ mA; $I_E = 0$

$I_C = 100$ mA; $R_{BE} = 0$

$V_{(BR)CBO}$ min. 65 V

$V_{(BR)CES}$ min. 60 V

Collector cut-off current

$I_E = 0$; $V_{CB} = 50$ V

I_{CBO} max. 10 mA

Emitter cut-off current

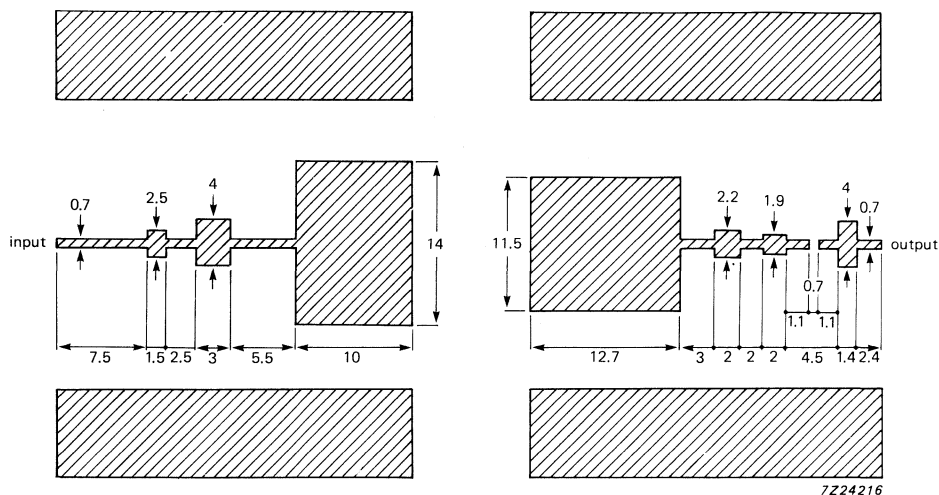
$V_{EB} = 1.5$ V; $I_C = 0$

I_{EBO} max. 1 mA

APPLICATION INFORMATION

Microwave performance at $T_{mb} = 25$ °C measured in a common-base broadband test circuit as shown in Fig. 3.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	$z_i; Z_L$
class-C; $t_p = 1$ ms; $\delta = 10\%$	1.2 to 1.4	40	≥ 135 typ. 150	≥ 6.5 typ. 7	≥ 35 typ. 42	see Fig. 6
$t_p = 150$ μ s $\delta = 5\%$	1.2 to 1.4	50	typ. 220	typ. 8	typ. 45	see Fig. 6



7Z24216

Fig. 3 Broadband test circuit for 1.2 to 1.4 GHz; class-C; pulse applications (dimensions in mm). Epsilon printed circuit board; thickness 0.635 mm; $\epsilon_r = 10$.

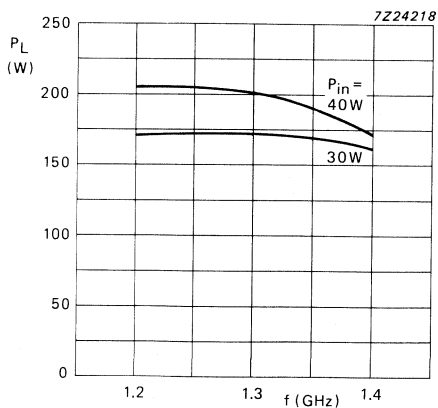


Fig. 4 Load power as a function of frequency; $V_{CC} = 40V$; $t_p = 1ms$; $\delta = 10\%$; typical values.

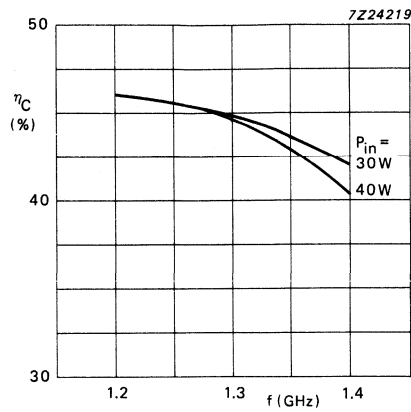


Fig. 5 Efficiency as a function of frequency; $t_p = 1 \text{ ms}$; $\delta = 10\%$; typical values.

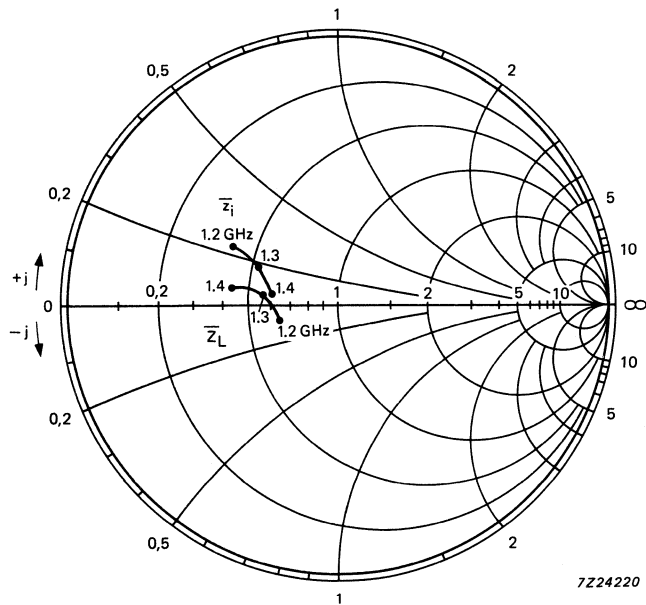


Fig. 6 Input and optimum load impedance as a function of frequency; $V_{CC} = 40 \text{ V}$; $Z_0 = 5 \Omega$.

SUPERSEDES HANDBOOK DATA OF FEBRUARY 1988

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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 μ s; δ = 5%	1.2 to 1.4	50	≥ 250	≥ 7	≥ 35	see Fig. 6

MECHANICAL DATA

FO-91 (see Fig. 1).

Dimensions in mm

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.

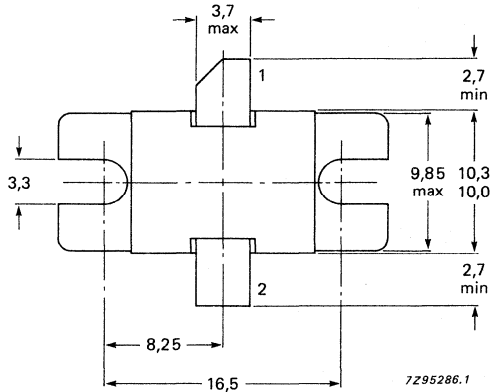
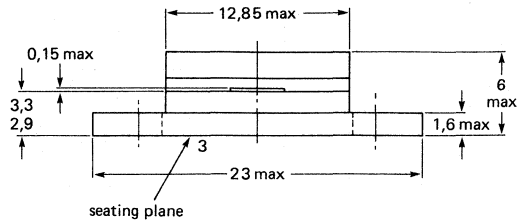
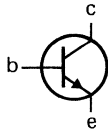
MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-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) $t_p \leq 150 \mu s; \delta \leq 5\%$	I_C	max.	21 A
Total power dissipation up to $T_{mb} = 75^\circ C$ $t_p \leq 150 \mu s; \delta \leq 5\%$	P_{tot}	max.	570 W
Storage temperature range	T_{stg}		-65 to 200 °C
Junction temperature	T_j	max.	200 °C
Lead soldering temperature at 0.2 mm from the case; $t_{sld} \leq 10 s$	T_{sld}	max.	235 °C

THERMAL RESISTANCE (at $T_j = 100^\circ C$)

From junction to mounting base	$R_{th j-mb}$	max.	0.8 K/W
From mounting base to heatsink	$R_{th mb-h}$	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

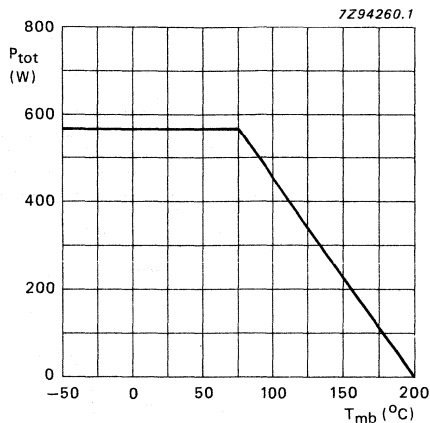


Fig. 2 Power derating curve; pulsed conditions; $t_p = 150 \mu s$; $\delta = 5\%$.

CHARACTERISTICS

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

Collector-base breakdown voltage

$I_C = 140 \text{ mA}$; $I_E = 0$

$V_{(BR)CBO}$ min. 65 V

Collector-emitter breakdown voltage

$I_C = 140 \text{ mA}$; $R_{BE} = 0$

$V_{(BR)CES}$ min. 50 V

Emitter-base breakdown voltage

$I_C = 0$; $I_E = 20 \text{ mA}$

$V_{(BR)EBO}$ min. 3 V

Collector cut-off current

$I_E = 0$; $V_{CB} = 50 \text{ V}$

I_{CBO} max. 14 mA

Emitter cut-off current

$I_C = 0$; $V_{EB} = 1.5 \text{ V}$

I_{EBO} max. 1.4 mA

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25 \text{ }^\circ\text{C}$ 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; $t_p = 150 \mu s$; $\delta = 5\%$	1.2 to 1.4	50	≥ 250 typ. 320	≥ 7 typ. 8	≥ 35 typ. 40	see Fig. 6
$t_p = 300 \mu s$; $\delta = 10\%$	1.2 to 1.4	50	typ. 300	typ. 7.5	typ. 35	see Fig. 6

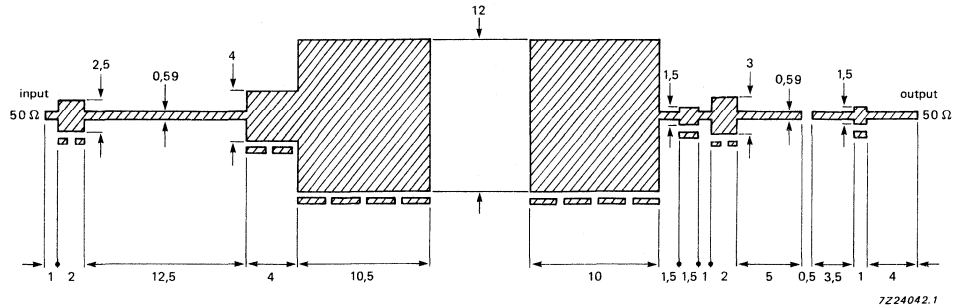


Fig. 3 Wideband test circuit for 1.2 to 1.4 GHz (dimensions in mm).
Epsilon printed circuit board; thickness 0.635 mm; $\epsilon_r = 10$.

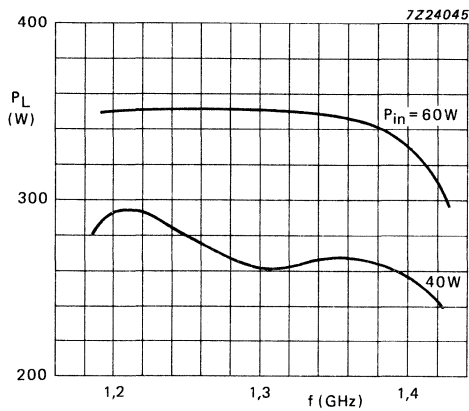


Fig. 4 Load power as a function of frequency; typical values;
 $t_p = 150 \mu s$; $\delta = 5\%$.

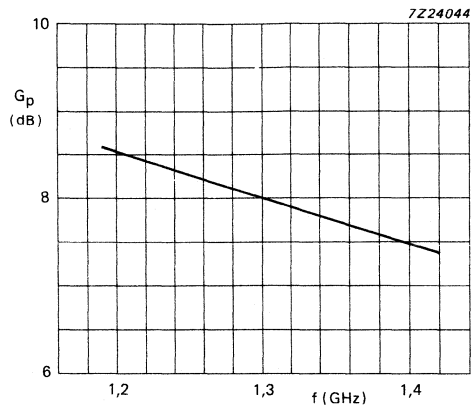


Fig. 5 Power gain as a function of frequency; $t_p = 150 \mu s$; $\delta = 5\%$.

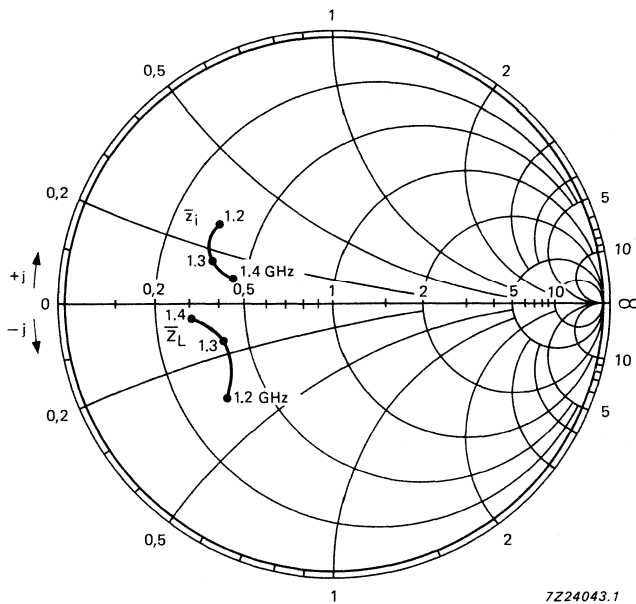


Fig. 6 Input and optimum load impedance as a function of frequency; $V_{CC} = 50 V$; $P_L = 250 W$; $t_p = 150 \mu s$; $\delta = 5\%$; class-C operation; $Z_O = 5 \Omega$; typical values.

DEVELOPMENT DATA

This data sheet contains advance information and specifications are subject to change without notice.

RX2731B90W

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon planar epitaxial microwave power transistor, intended for use in a common-base class-C broadband pulse power amplifier with a frequency range of 2.7 to 3.1 GHz.

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
- Input and output matching cells; simplifying circuit design.

The transistor is housed in a metal-ceramic flange envelope (FO-125A).

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 $t_p = 100\ \mu\text{s}$; $\delta = 10\%$	2.7 to 3.1	40	≥ 90	≥ 6	≥ 35	see Fig. 5

MECHANICAL DATA

FO-125A (see Fig. 1).

Dimensions in mm

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

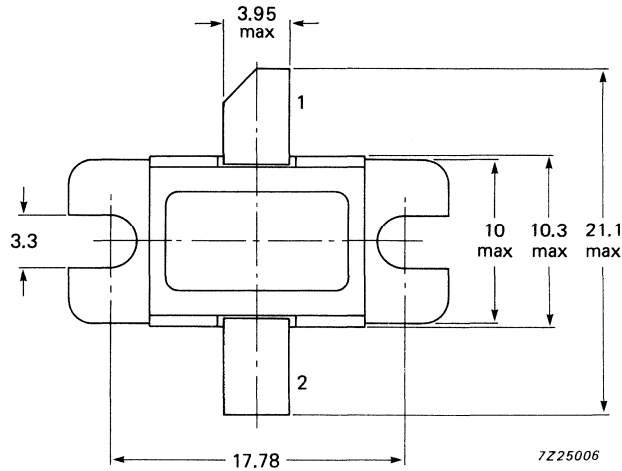
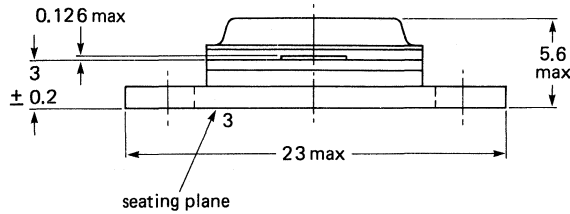
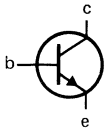
Dimensions in mm

Fig. 1 FO-125A.

Base is connected to the seating plane

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_{CB0}	max.	50 V
Collector-emitter voltage, → $R_{BE} = 0$ open base	V_{CES}	max.	50 V
	V_{CEO}	max.	15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3.5 V
Collector current (peak)*	I_C	max.	8.5 A
Total power dissipation up to $T_{mb} = 75\text{ °C}$ *	P_{tot}	max.	185 W
Storage temperature range	T_{stg}		-65 to +200 °C
Junction temperature	T_j	max.	200 °C
→ Soldering temperature up to 0.2 mm from the case; $t_{slid} \leq 10\text{ s}$	T_{slid}	max.	235 °C
THERMAL RESISTANCE (at $T_j = 100\text{ °C}$)			
→ From junction to mounting base	$R_{th\ j-mb}$	max.	1.7 K/W
From mounting base to heatsink	$R_{th\ mb-h}$	max.	0.3 K/W
Equivalent thermal impedance under pulse microwave conditions $t_p = 100\ \mu\text{s}$; $\delta = 10\%$	$Z_{th\ j-mb}$	max.	0.55 K/W
→ * Maximum value under nominal pulsed microwave operating conditions ($t_p = 100\ \mu\text{s}$; $\delta = 10\%$).			

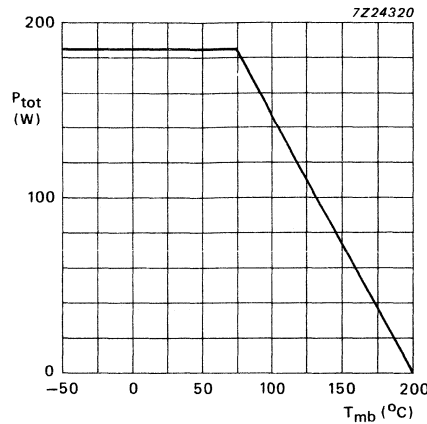


Fig. 2 Power derating curve; $t_p = 100 \mu s$; $\delta = 10\%$.

DEVELOPMENT DATA

CHARACTERISTICS

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

Collector cut-off current

$V_{CB} = 50 \text{ V}; I_E = 0$

$V_{CB} = 30 \text{ V}; I_E = 0$

$V_{CB} = 50 \text{ V}; R_{BE} = 0$

I_{CBO} max. 30 mA
 I_{CBO} max. 150 μA
 I_{CES} max. 30 mA

Emitter cut-off current

$V_{EB} = 1.5 \text{ V}; I_C = 0$

$V_{EB} = 3.5 \text{ V}; I_C = 0$

I_{EBO} max. 150 μA
 I_{EBO} max. 7 mA

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25 \text{ }^\circ\text{C}$ in a class-C broadband amplifier under pulsed conditions.

mode of operation	f GHz	V _{CC} * V	P _L W	G _p dB	η_C %	$z_i; Z_L$ Ω
class-C $t_p = 100 \mu s$; $\delta = 10\%$	2.7 to 3.1	40	≥ 90 typ. 100	≥ 6 typ. 6.5	≥ 35 typ. 40	see Fig. 5

* During pulse.

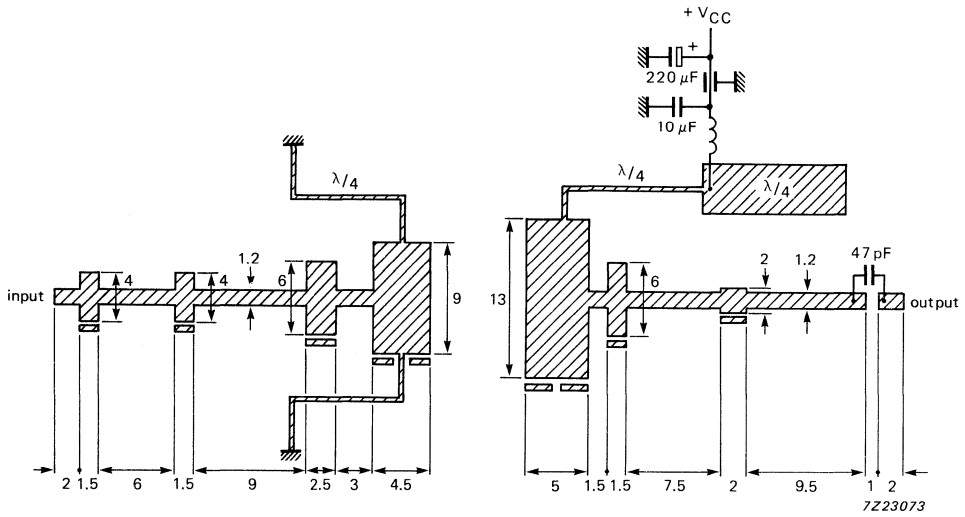


Fig. 3 Broadband test circuit for 3.0 to 3.4 GHz. (dimensions in mm).
PTFE fiberglass printed circuit board; $\epsilon_r = 2.55$; thickness 0.4 mm.

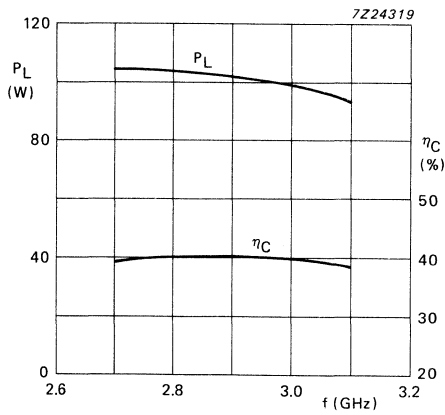


Fig. 4 Load power and collector efficiency as a function of frequency*;
 $V_{CC} = 40 \text{ V}$; $t_p = 100 \mu\text{s}$; $\delta = 10\%$; typical values.

* In a broadband test circuit as shown in Fig. 3.

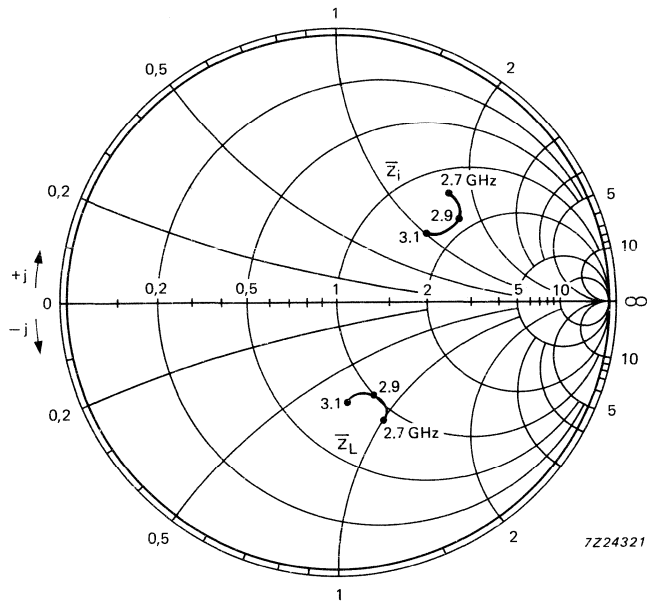


Fig. 5 Input and optimum load impedance as a function of frequency;
 $Z_0 = 5 \Omega$; $V_{CC} = 40 \text{ V}$; typical values.

DEVELOPMENT DATA

PULSED MICROWAVE POWER TRANSISTORS

NPN silicon planar epitaxial microwave power transistor, intended for use in a common-base class-C broadband pulse power amplifier with a frequency range of 3.0 to 3.4 GHz.

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
- Input and output matching cells; simplifying circuit design.

The transistor is housed in a metal-ceramic flange envelope (FO-125A).

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 = 100 μ s; δ = 10%	3.0 to 3.4	40	≥ 70	≥ 5.4	≥ 30	see Fig. 5

MECHANICAL DATA

FO-125A (see Fig. 1).

Dimensions in mm

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

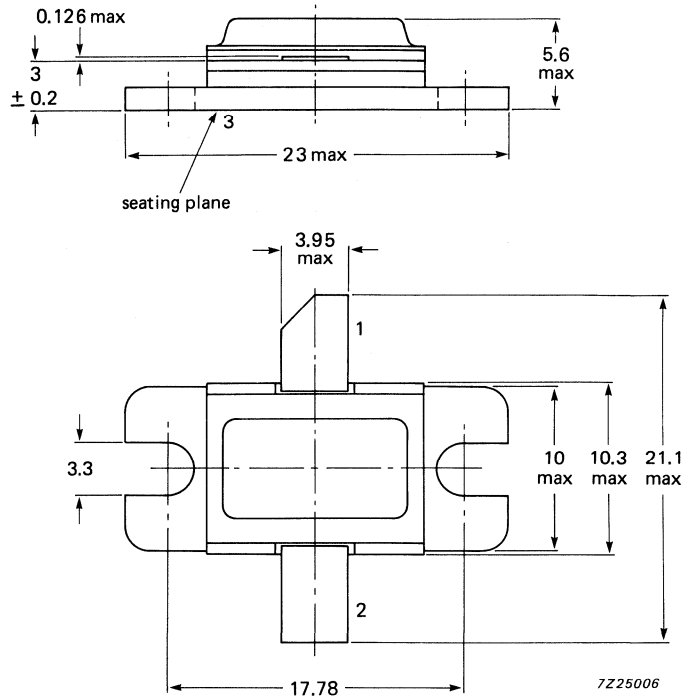
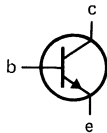
Fig. 1 FO-125A.

Dimensions in mm

Base is connected to the seating plane

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.	50 V
Collector-emitter voltage, → $R_{BE} = 0$ open base	V_{CES}	max.	50 V
	V_{CEO}	max.	15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3.5 V
Collector current (peak)*	I_C	max.	8.5 A
Total power dissipation up to $T_{mb} = 75\text{ °C}^*$	P_{tot}	max.	185 W
Storage temperature range	T_{stg}		-65 to +200 °C
Junction temperature	T_j	max.	200 °C
→ Soldering temperature up to 0.2 mm from the case; $t_{sld} \leq 10\text{ s}$	T_{sld}	max.	235 °C
THERMAL RESISTANCE (at $T_j = 100\text{ °C}$)			
From junction to mounting base	$R_{th\ j-mb}$	max.	1.7 K/W
→ From mounting base to heatsink	$R_{th\ mb-h}$	max.	0.3 K/W
Equivalent thermal impedance under pulse microwave conditions $t_p = 100\ \mu\text{s}$; $\delta = 10\%$	$Z_{th\ j-mb}$	max.	0.55 K/W
→ * Maximum value under nominal pulsed microwave operating conditions ($t_p = 100\ \mu\text{s}$; $\delta = 10\%$).			

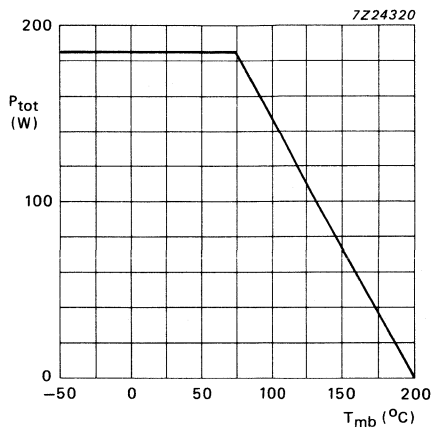


Fig. 2 Power derating curve; $t_p = 100 \mu s$; $\delta = 10\%$.

DEVELOPMENT DATA

CHARACTERISTICS

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

Collector cut-off current

$V_{CB} = 50 \text{ V}; I_E = 0$

I_{CBO} max. 30 mA

$V_{CB} = 30 \text{ V}; I_E = 0$

I_{CBO} max. 150 μA

$V_{CB} = 50 \text{ V}; R_{BE} = 0$

I_{CES} max. 30 mA ←

Emitter cut-off current

$V_{EB} = 1.5 \text{ V}; I_C = 0$

I_{EBO} max. 150 μA

$V_{EB} = 3.5 \text{ V}; I_C = 0$

I_{EBO} max. 7 mA ←

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25 \text{ }^\circ\text{C}$ in a class-C broadband amplifier under pulsed conditions.

mode of operation	f GHz	V_{CC}^* V	P_L W	G_p dB	η_C %	z_i, Z_L Ω
class-C $t_p = 100 \mu s$; $\delta = 10\%$	3.0 to 3.4	40	≥ 70 typ. 80	≥ 5.4 typ. 6	≥ 30 typ. 35	see Fig. 5 ←

* During pulse.

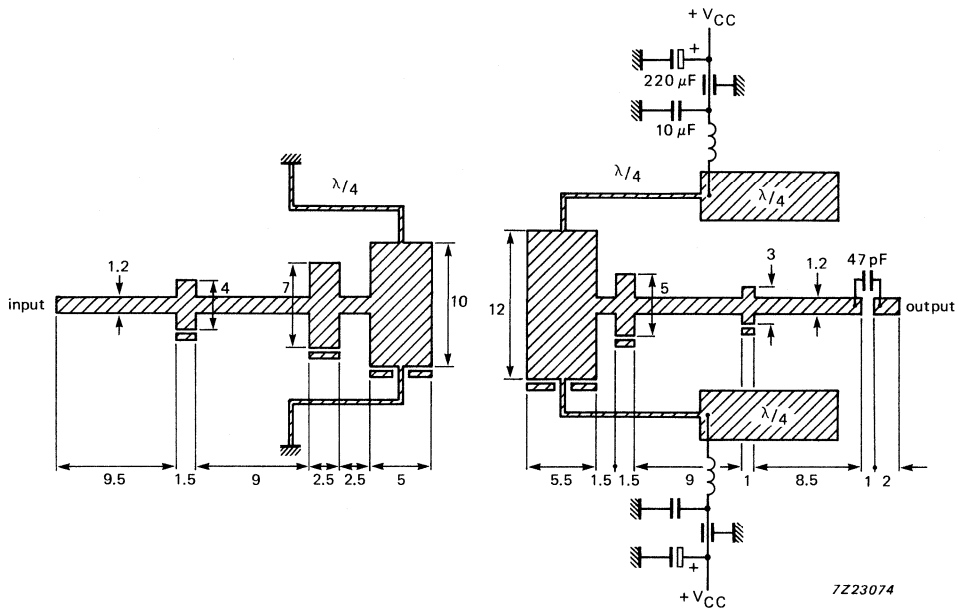


Fig. 3 Broadband test circuit for 3.0 to 3.4 GHz. (dimensions in mm).
PTFE fibreglass printed circuit board; $\epsilon_r = 2.55$; thickness 0.4 mm.

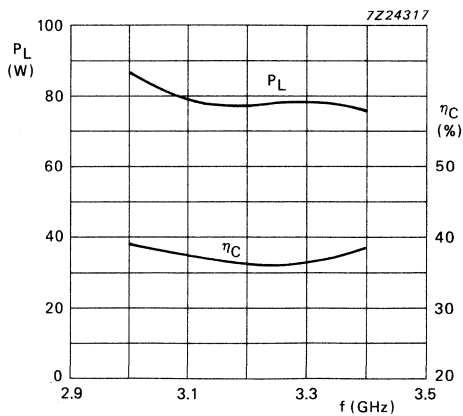


Fig. 4 Load power and collector efficiency as a function of frequency*;
 $V_{CC} = 40 \text{ V}$, $t_p = 100 \mu\text{s}$; $\delta = 10\%$; typical values.

* In a broadband test circuit as shown in Fig. 3.

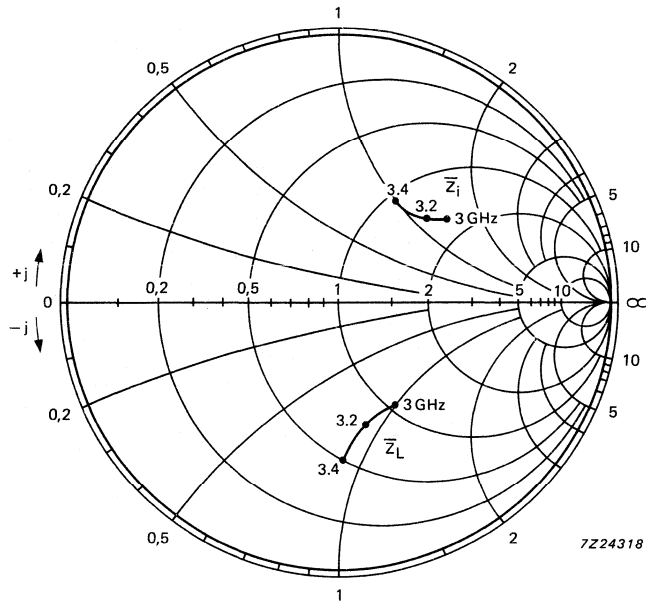


Fig. 5 Input and optimum load impedance as a function of frequency;
 $Z_0 = 5 \Omega$; $V_{CC} = 40 \text{ V}$; typical values.

DEVELOPMENT DATA

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon power transistor for use in a common-base, class-C narrowband amplifier in avionics applications.

It operates in pulsed conditions only and is recommended for IFF applications.

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

The transistor is housed in a metal ceramic flange envelope (FO-91).

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 Ω	Z _L
class-B t _p = 100 μs, δ = 10%	1.09	50	≥ 300	≥ 7	≥ 30	see table	

MECHANICAL DATA

Dimensions in mm

FO-91 (see Fig. 1)

WARNING

Product and environmental safety – toxic materials

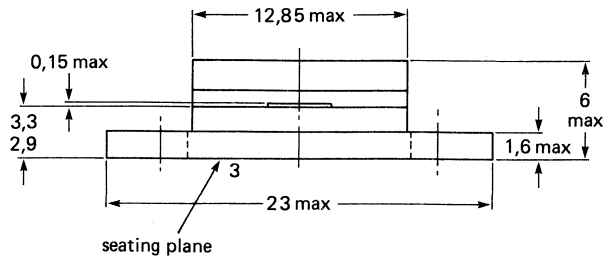
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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-91.

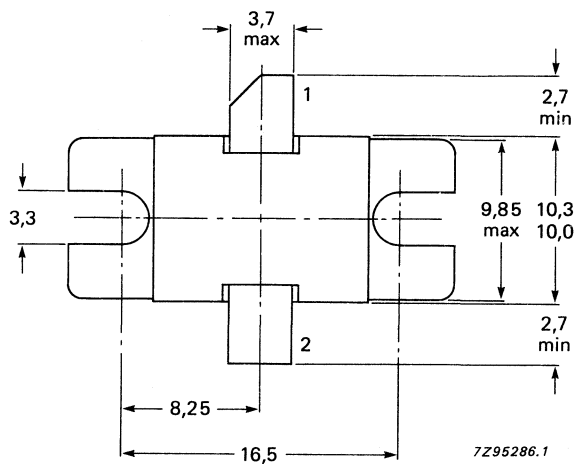


Pinning:

- 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_{CB0}	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) $t_p = 100 \mu s, \delta \leq 10\%$	I_C	max.	21 A	
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$ $t_p = 100 \mu s, \delta \leq 10\%$	P_{tot}	max.	570 W	←
Storage temperature	T_{stg}		-65 to +200 $^\circ\text{C}$	
Junction temperature	T_j	max.	200 $^\circ\text{C}$	
Soldering temperature at 0.2 mm from the case, $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$	←

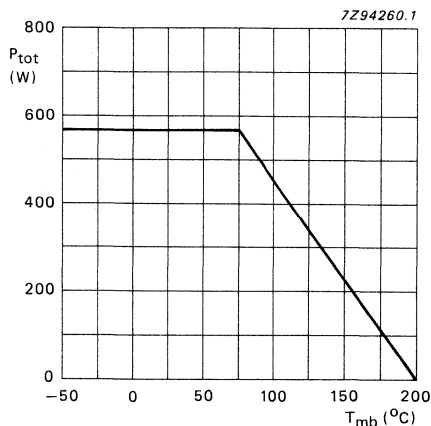


Fig. 2 Power derating curve as a function of mounting base temperature; $t_p = 100 \mu s, \delta = 10\%$.

THERMAL RESISTANCE (at $T_j = 100 \text{ }^\circ\text{C}$)

From junction to mounting base	$R_{th j-mb}$	max.	0.8 K/W	
From mounting base to heatsink	$R_{th mb-h}$	max.	0.2 K/W	←
Equivalent thermal impedance $t_p = 100 \mu s; \delta = 10\%$	Z_{th}	max.	0.22 K/W	←

CHARACTERISTICS

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

Breakdown voltages

$I_C = 140 \text{ mA}; I_E = 0$	$V_{(BR)CBO}$	min.	65 V	←
$I_C = 140 \text{ mA}; R_{BE} = 0$	$V_{(BR)CES}$	min.	60 V	←
$I_C = 0; I_E = 20 \text{ mA}$	$V_{(BR)EBO}$	min.	3 V	←

Collector cut-off current

$I_E = 0; V_{CB} = 50 \text{ V}$	I_{CBO}	max.	14 mA	←
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IMPEDANCES

frequency GHz	input (z_i) Ω	load (Z_L) Ω
1.03	$1.45 + j3.71$	$0.72 - j1.09$
1.09	$1.7 + j3.93$	$0.68 - j1.13$

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a class-C narrowband amplifier under pulsed conditions and measured in the test circuit shown in Fig. 3.

mode of operation	f GHz	V _{CC} V	P _L W	G _p dB	η_C %
→ class-C $t_p = 100\text{ }\mu\text{s}$; $\delta = 10\%$	1,09	50	≥ 300 typ. 350	≥ 7 typ. 7.8	≥ 30 typ. 38

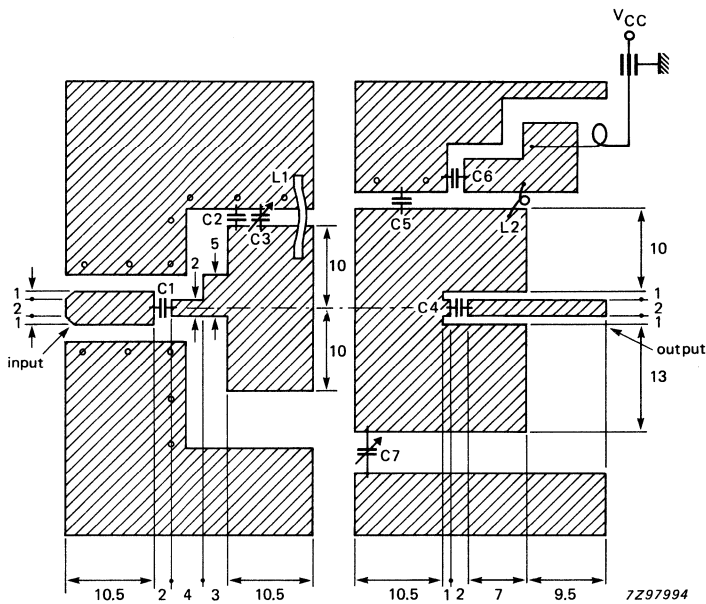


Fig. 3 Narrowband test circuit for 1.09 GHz (dimensions in mm).
PTFE printed circuit board; thickness 0.8 mm; $\epsilon_r = 2.55$.

List of components

- C1 = C4 = 100 pF ATC capacitor
- C2 = C5 = 2.2 pF ATC capacitor
- C3 = 0.8 - 12.3 pF Gigatrim capacitor
- C6 = 47 pF ATC capacitor
- C7 = 0.6 - 8 pF Gigatrim capacitor
- L1 = Rectangular loop 10 x 5.5 mm of 3 mm copper strip
- L2 = One turn diameter 6 mm; wire diameter 0.8 mm

SUPERSEDES HANDBOOK DATA OF SEPTEMBER 1987

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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 μ s 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**

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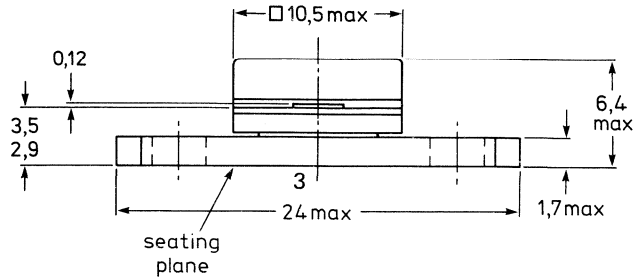
MECHANICAL DATA

Dimensions in mm

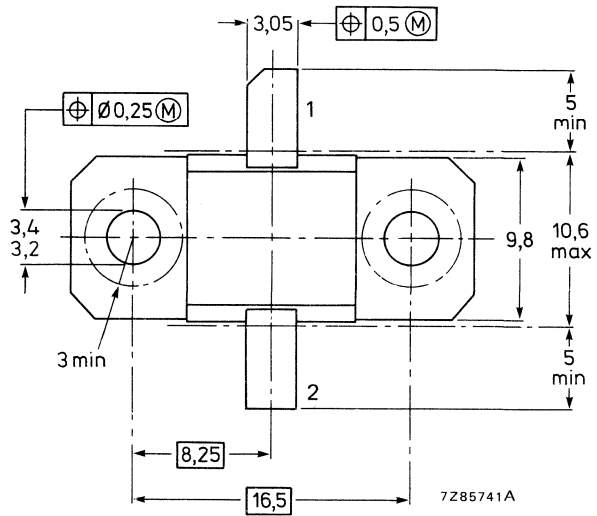
Fig. 1 FO-57C.

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
Emitter-base voltage, open collector	V_{EBO}	max.	3 V
Collector current (DC) $t_p \leq 150 \mu s; \delta \leq 5\%$	I_C	max.	3 A
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$ $t_p \leq 150 \mu s; \delta \leq 5\%$	P_{tot}	max.	125 W
Storage temperature range	T_{stg}		-65 to 200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.2 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base	$R_{th j-mb}$	max.	5.0 K/W
From mounting base to heatsink	$R_{th mb-h}$	max.	0.2 K/W
Equivalent thermal impedance under pulsed microwave conditions $t_p = 100 \mu s; \delta = 10\%$	Z_{th}	max.	1.0 K/W

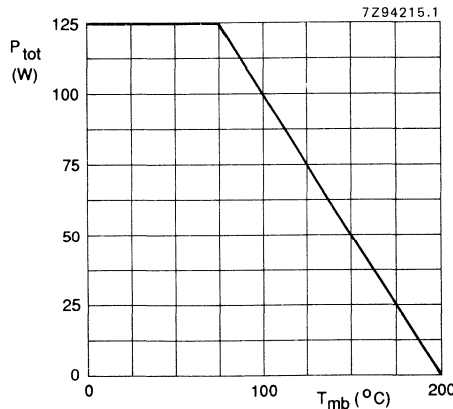


Fig. 2 Power derating curve as a function of mounting base temperature (under pulsed conditions: $t_p = 150 \mu s, \delta = 5\%$).

CHARACTERISTICS

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

Collector-base breakdown voltage $I_C = 20 \text{ mA}; I_E = 0$	$V_{(BR)CBO}$	min.	65 V
Collector-emitter breakdown voltage $I_C = 20 \text{ mA}; R_{BE} = 0$	$V_{(BR)CES}$	min.	60 V
Emitter-base breakdown voltage $I_C = 0; I_E = 3 \text{ mA}$	$V_{(BR)EBO}$	min.	3 V
Collector cut-off current $I_E = 0; V_{CB} = 50 \text{ V}$	I_{CBO}	max.	2 mA
Emitter cut-off current $I_C = 0; V_{EB} = 1.5 \text{ V}$	I_{EBO}	max.	200 μA

PRODUCT TEST

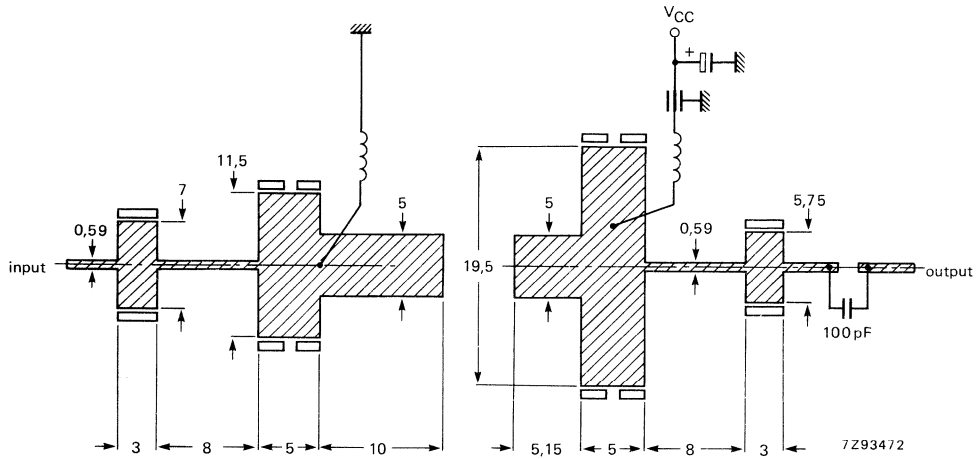


Fig. 3 Wideband test circuit for 1.2 to 1.4 GHz (dimensions in mm).
Epsilam p.c. board, thickness 0.635 mm, $\epsilon_r = 10$.

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 μ s δ = 5%	1.2 to 1.4	50	typ. 40 > 35	typ. 7.8 > 7	typ. 35 > 35		see Fig. 6
t _p = 300 μ s δ = 10%	1.2 to 1.4	50	typ. 40	typ. 7	typ. 35		

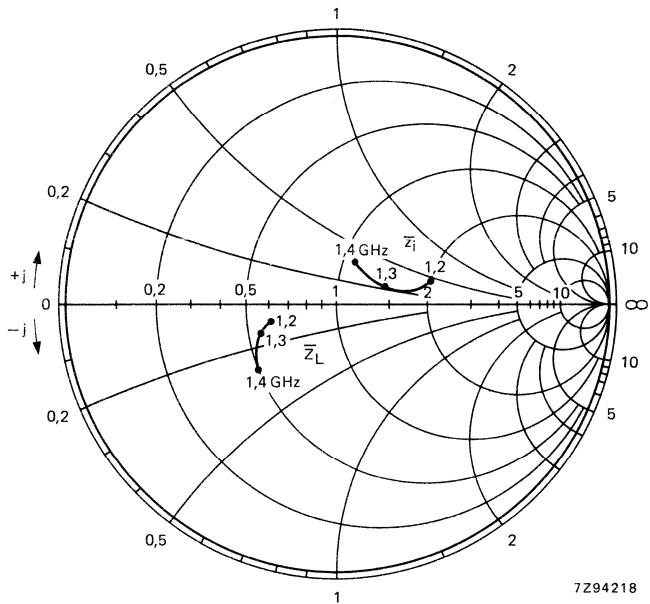


Fig. 4 Input and optimum load impedances as a function of frequency; $Z_0 = 5 \Omega$.

Conditions for Fig. 4:

$V_{CE} = 50 \text{ V}$; $P_L = 35 \text{ W}$; $t_p = 150 \mu\text{s}$; $\delta = 5\%$; class-C operation.

SUPERSEDES HANDBOOK DATA OF SEPTEMBER 1987

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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 μ s; 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

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.

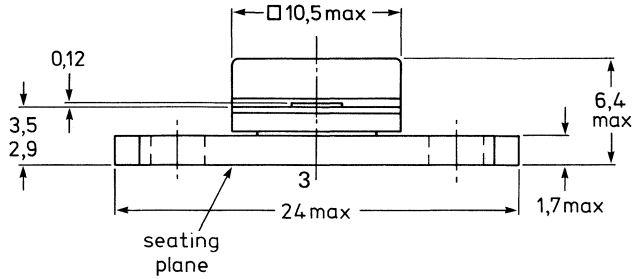
MECHANICAL DATA

Dimensions in mm

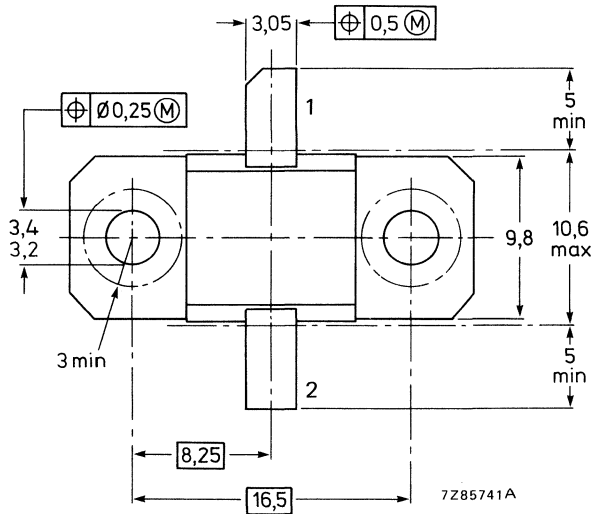
Fig. 1 FO-57C.

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
Emitter-base voltage, open collector	V_{EBO}	max.	3 V
Collector current (DC) $t_p \leq 150 \mu s; \delta \leq 5\%$	I_C	max.	6 A
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$ $t_p \leq 150 \mu s; \delta \leq 5\%$	P_{tot}	max.	225 W
Storage temperature range	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
Lead soldering temperature at 0.2 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base	$R_{th \text{ j-mb}}$	max.	2.5 K/W
From mounting base to heatsink	$R_{th \text{ mb-h}}$	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

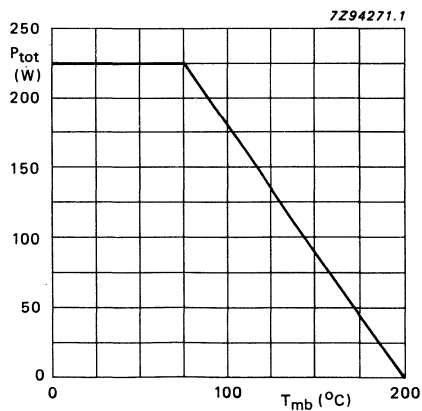


Fig.2 Power derating curve as a function of mounting base temperature (under pulsed conditions: $t_p = 150 \mu s, \delta = 5\%$).

CHARACTERISTICS

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

Collector-base breakdown voltage

$I_C = 40\text{ mA}; I_E = 0$

$V_{(BR)CBO}$ min. 65 V

Collector-emitter breakdown voltage

$I_C = 40\text{ mA}; R_{BE} = 0$

$V_{(BR)CES}$ min. 60 V

Emitter-base breakdown voltage

$I_C = 0; I_E = 6\text{ mA}$

$V_{(BR)EBO}$ min. 3 V

Collector cut-off current

$I_E = 0; V_{CB} = 50\text{ V}$

I_{CBO} max. 4 mA

Emitter cut-off current

$I_C = 0; V_{EB} = 1.5\text{ V}$

I_{EBO} max. 400 μA

PRODUCT TEST

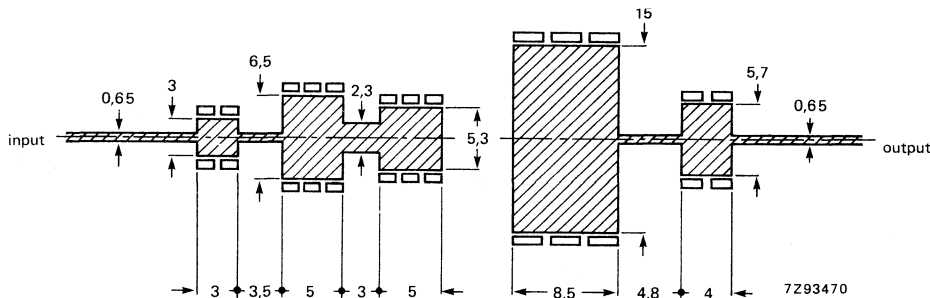


Fig.3 Wideband test circuit for 1.2 to 1.4 GHz (dimensions in mm).
Epsilam p.c. board, thickness 0.635 mm, $\epsilon_r = 10$.

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 %	\bar{z}_i Ω	\bar{z}_L Ω
class-C; $t_p = 150\text{ }\mu\text{s}$; $\delta = 5\%$	1.2 to 1.4	50	> 70 typ. 80	> 7 typ. 7.8	> 35 typ. 40	see Fig.6	
$t_p = 300\text{ }\mu\text{s}$; $\delta = 10\%$	1.2 to 1.4	50	typ. 80	typ. 7	typ. 30		

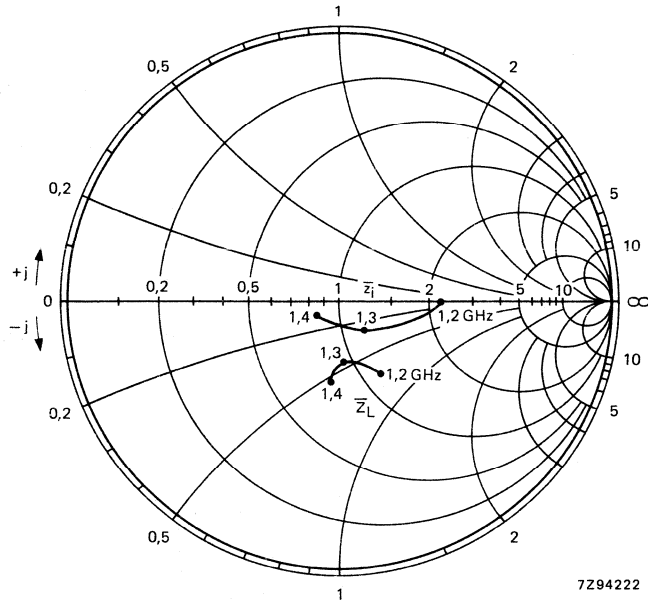


Fig.4 Input and optimum load impedance as a function of frequency; $Z_0 = 5 \Omega$.

Conditions for Fig. 4:

$V_{CE} = 50 \text{ V}$; $P_L = 65 \text{ W}$; $t_p = 150 \mu\text{s}$; $\delta = 5\%$; class-C operation.

Data sheet	
status	Product specification
date of issue	June 1990

RZ2731B16W

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 amplifiers in the frequency range 2.7 to 3.1 GHz for radar application.

DESCRIPTION

NPN transistor in a FO-57D 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ in an unneutralized common base class C broadband amplifier.

MODE OF OPERATION	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	> 15	> 6	> 32

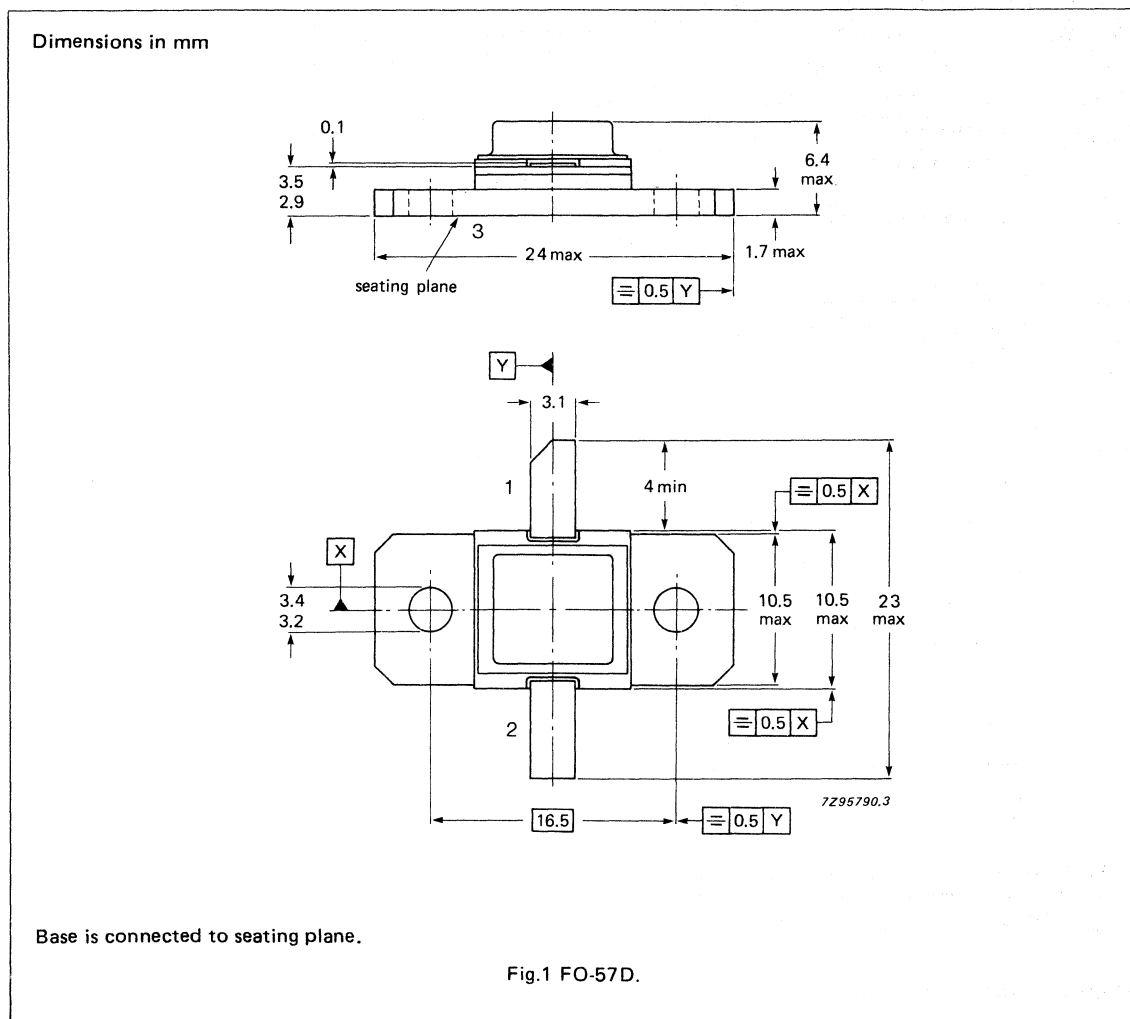
WARNING

<p>Product and environmental safety – toxic materials</p> <p>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.</p> <p>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.</p>
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NPN silicon planar epitaxial microwave power transistor

RZ2731B16W

MECHANICAL DATA



PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base

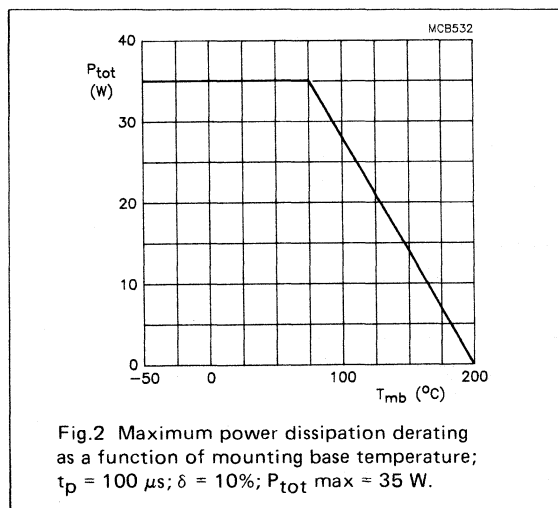
NPN silicon planar epitaxial microwave power transistor

RZ2731B16W

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	—	50	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0 \Omega$	—	50	V
V_{EBO}	emitter-base voltage	open collector	—	3.5	V
I_C	collector current	$t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	1.4	A
P_{tot}	total power dissipation	$T_{mb} = 75^\circ C$; $t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	35	W
T_{stg}	storage temperature range		-65	200	$^\circ C$
T_j	operating junction temperature		—	200	$^\circ C$
T_{sld}	soldering temperature	$t \leq 10 s$; up to 0.2 mm from ceramic	—	235	$^\circ C$



THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th j-mb}$	thermal resistance from junction to mounting base	CW	6.5	K/W
$R_{th mb-h}$	thermal resistance from mounting base to heatsink	CW	0.3	K/W
Z_{th}	thermal impedance from junction to heatsink	note 2	3.2	K/W

Notes

- Maximum values under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).
- Equivalent thermal impedance under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).

NPN silicon planar epitaxial microwave power transistor

RZ2731B16W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 40\text{ V}; I_E = 0$	300	μA
I_{CES}	collector cut-off current	$V_{CE} = 40\text{ V}; R_{BE} = 0\ \Omega$	1	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	25	μA

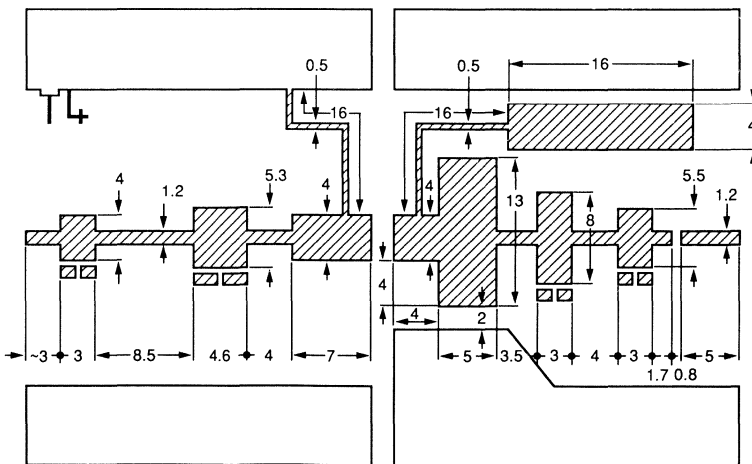
APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^\circ\text{C}$ measured in the test jig as shown in Fig.3 and working in class C broadband mode in pulse ($t_p = 100\ \mu\text{s}; \delta = 10\%$).

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; $t_p = 100\ \mu\text{s};$ $\delta = 10\%$	2.7 to 3.1	40	> 15 typ. 16	> 6 typ. 6.3	> 32 typ. 38	see Figs 6 and 7

Notes

- V_{CC} during pulse.



MSA105

Substrate: Teflon fibre glass
 Thickness: 0.4 mm
 $\epsilon_r = 2.54$
 Dimensions in mm

Fig.3 Broadband test circuit.

NPN silicon planar epitaxial microwave power transistor

RZ2731B16W

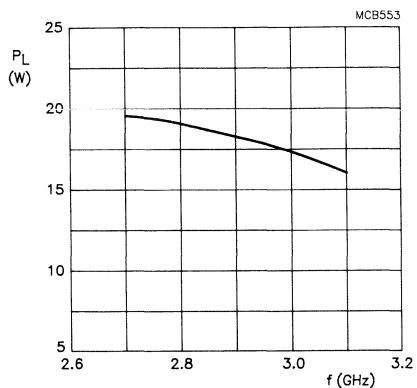


Fig.4 Load power P_L as a function of frequency; $V_{CC} = 40$ V; $t_p = 100$ μ s; $\delta = 10\%$.
(In broadband test circuit as shown in Fig.3).

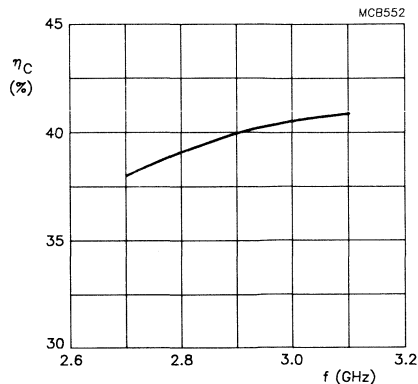


Fig.5 Collector efficiency as a function of frequency.
(In broadband test circuit as shown in Fig.3).

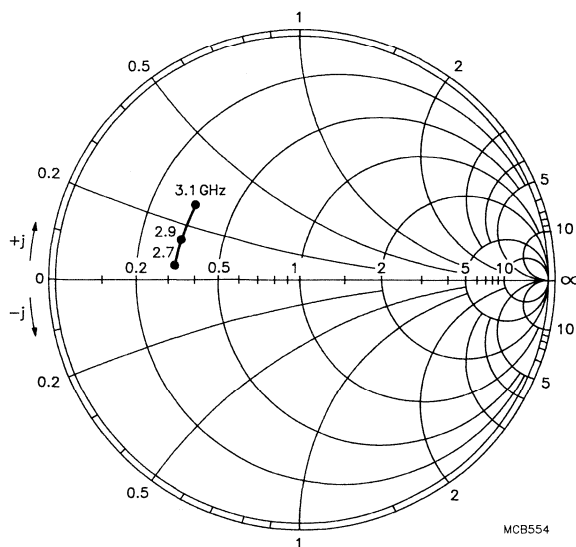


Fig.6 Input impedance as a function of frequency for $P_L = 16$ W; associated with optimum load impedance; $V_{CC} = 40$ V; $Z_o = 50$ Ω .

NPN silicon planar epitaxial microwave power transistor

RZ2731B16W

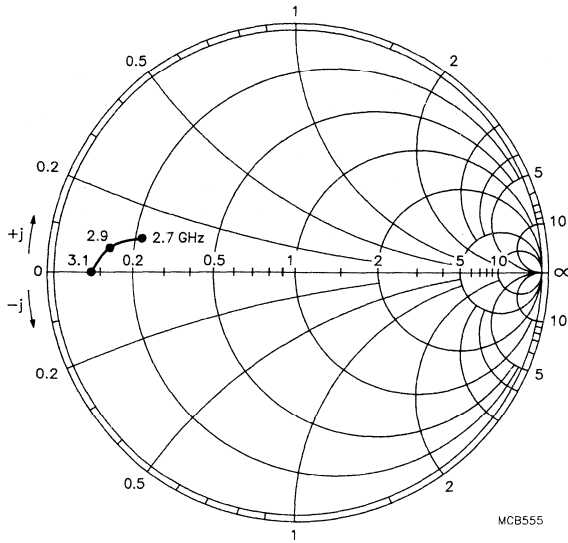


Fig.7 Optimum load impedance as a function of frequency for $P_L = 16 \text{ W}$; associated with input impedance; $V_{CC} = 40 \text{ V}$; $Z_0 = 50 \Omega$.

Philips Components

Data sheet	
status	Product specification
date of issue	June 1990

RZ2731B32W

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 amplifiers in the frequency range 2.7 to 3.1 GHz for radar application.

DESCRIPTION

NPN transistor in a FO-57D 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 $T_{mb} = 25^{\circ}\text{C}$ in a common base class C broadband amplifier.

MODE OF OPERATION	f (GHz)	V _{CC} (V)	P _L (W)	G _p (dB)	η_C (%)
class C; $t_p = 100 \mu\text{s}$; $\delta = 10\%$	2.7 to 3.1	40	> 30	> 6	> 32

WARNING

Product and environmental safety — toxic materials

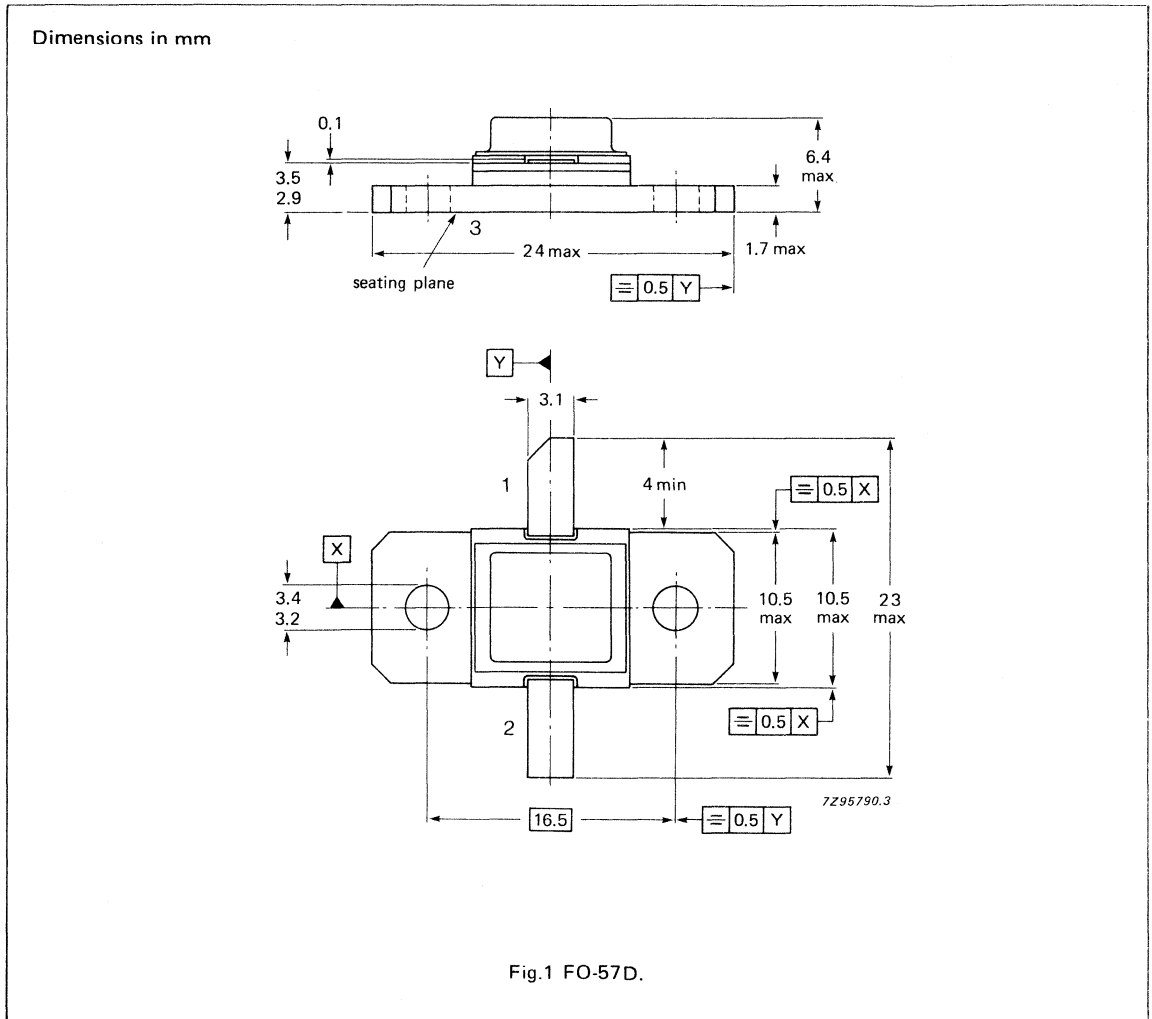
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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 industrial or domestic waste.

NPN silicon planar epitaxial microwave power transistor

RZ2731B32W

MECHANICAL DATA



PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base

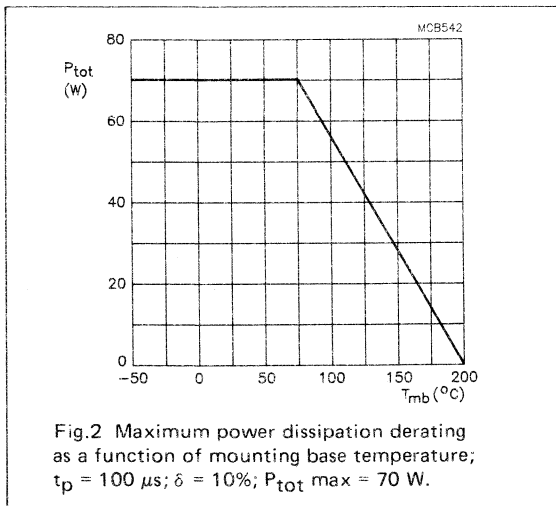
NPN silicon planar epitaxial microwave power transistor

RZ2731B32W

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	—	50	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0 \Omega$	—	50	V
V_{EBO}	emitter-base voltage	open collector	—	3.5	V
I_C	collector current	$t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	2.8	A
P_{tot}	total power dissipation	$T_{mb} = 75^\circ C$; $t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	70	W
T_{stg}	storage temperature range		-65	200	$^\circ C$
T_j	operating junction temperature		—	200	$^\circ C$
T_{sld}	soldering temperature	$t \leq 10 s$; up to 0.2 mm from ceramic	—	235	$^\circ C$



THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th j-mb}$	thermal resistance from junction to mounting base	CW	3.8	K/W
$R_{th mb-h}$	thermal resistance from mounting base to heatsink	CW	0.3	K/W
Z_{th}	thermal impedance from junction to heatsink	note 2	1.6	K/W

Notes

- Maximum values under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).
- Equivalent thermal impedance under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).

NPN silicon planar epitaxial microwave power transistor

RZ2731B32W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 40\text{ V}; I_E = 0$	600	μA
I_{CES}	collector cut-off current	$V_{CE} = 40\text{ V}; R_{BE} = 0\ \Omega$	2	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	50	μA

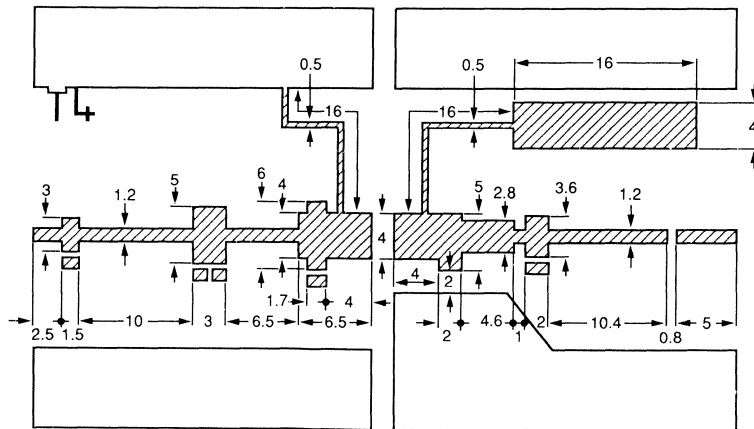
APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^\circ\text{C}$ measured in the test jig as shown in Fig.3 and working in class C broadband mode in pulse ($t_p = 100\ \mu\text{s}; \delta = 10\%$).

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; $t_p = 100\ \mu\text{s};$ $\delta = 10\%$	2.7 to 3.1	40	> 30 typ. 32	> 6 typ. 6.3	> 32 typ. 38	see Figs 6 and 7

Notes

- V_{CC} during pulse.



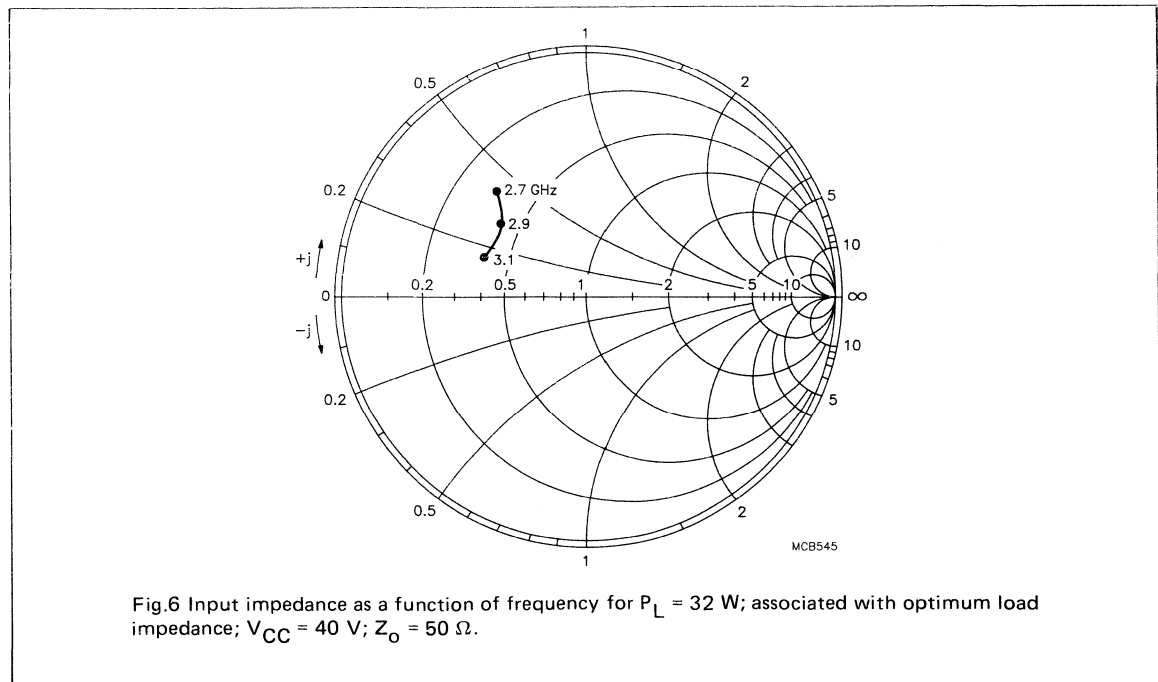
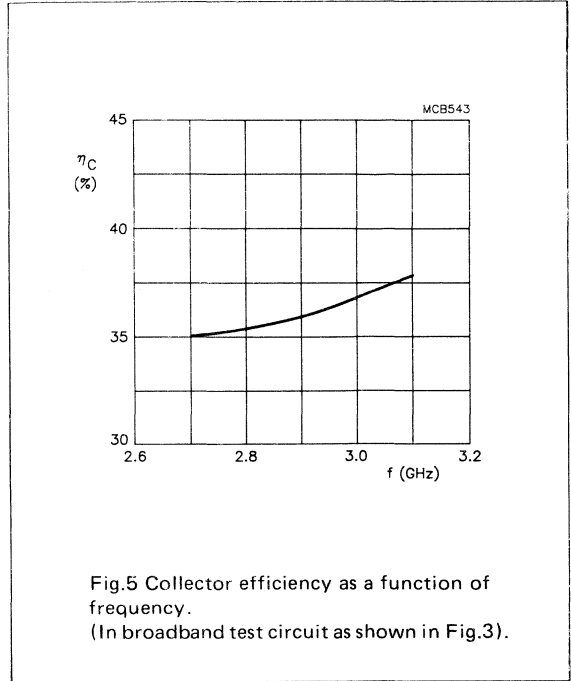
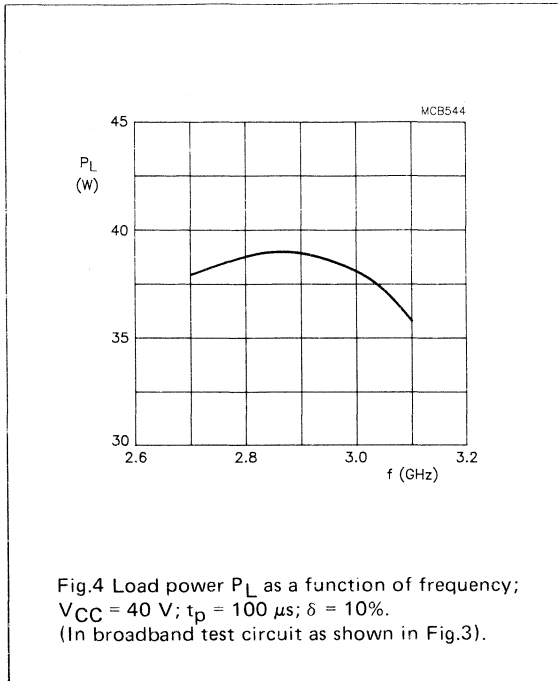
MSA106

Substrate: Teflon fibre glass
 Thickness: 0.4 mm
 $\epsilon_r = 2.54$
 Dimensions in mm

Fig.3 Broadband test circuit.

NPN silicon planar epitaxial microwave power transistor

RZ2731B32W



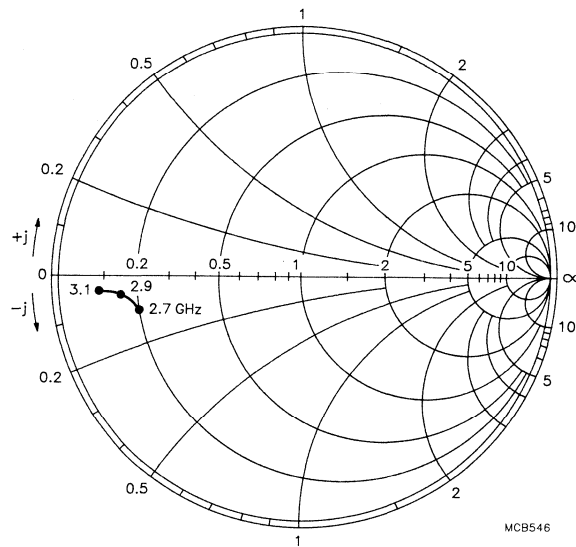
**NPN silicon planar epitaxial microwave
power transistor****RZ2731B32W**

Fig.7 Optimum load impedance as a function of frequency for $P_L = 32 \text{ W}$; associated with input impedance; $V_{CC} = 40 \text{ V}$; $Z_o = 50 \Omega$.

Philips Components

Data sheet	
status	Product specification
date of issue	June 1990

RZ2731B48W

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 amplifiers in the frequency range 2.7 to 3.1 GHz for radar application.

DESCRIPTION

NPN transistor in a FO-57D 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ in an unneutralized common base class C broadband amplifier.

MODE OF OPERATION	f (GHz)	V _{CC} (V)	P _L (W)	G _p (dB)	η_C (%)
class C; $t_p = 100\ \mu\text{s}$; $\delta = 10\%$	2.7 to 3.1	40	> 45	> 6	> 32

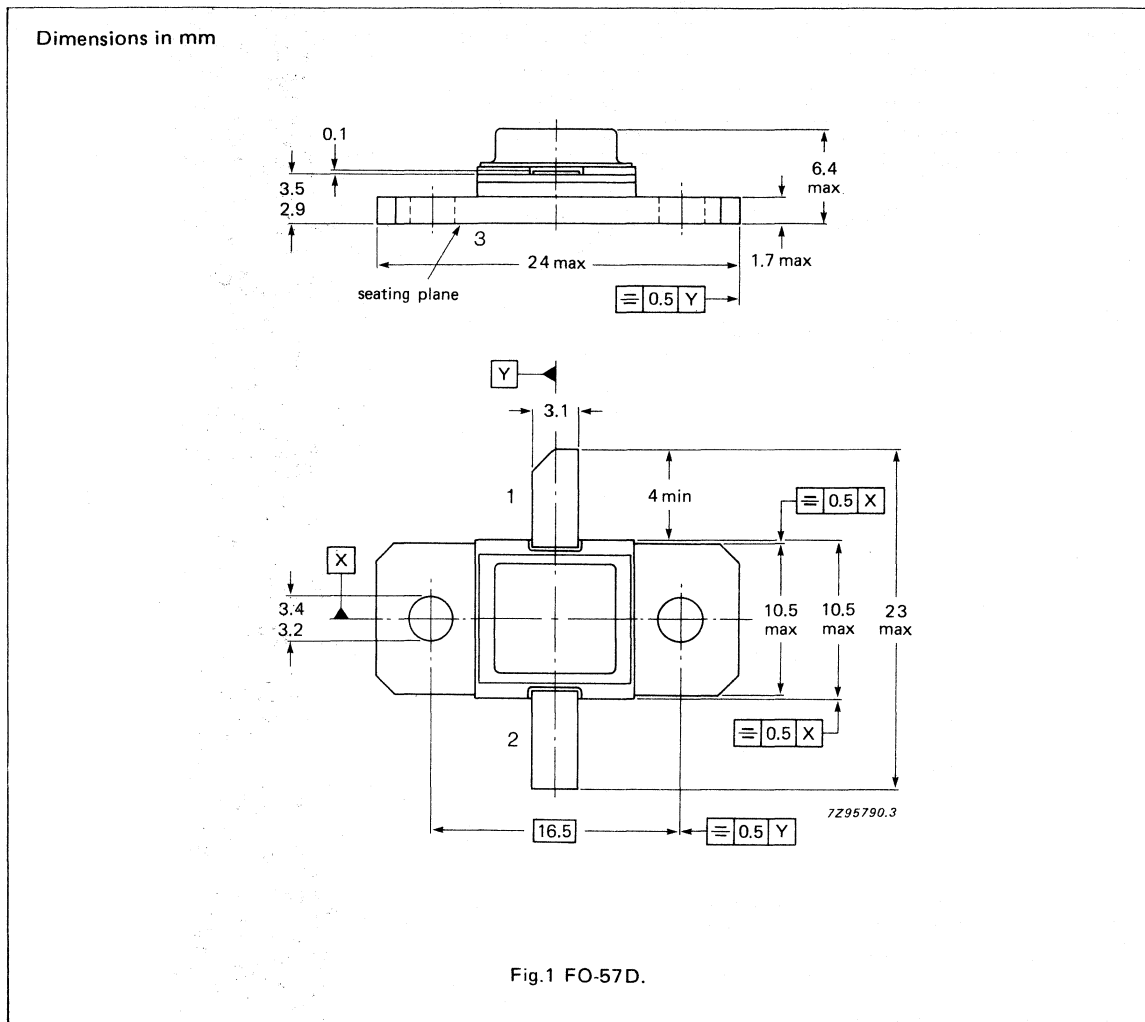
WARNING

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 industrial or domestic waste.

NPN silicon planar epitaxial microwave power transistor

RZ2731B48W

MECHANICAL DATA



PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base

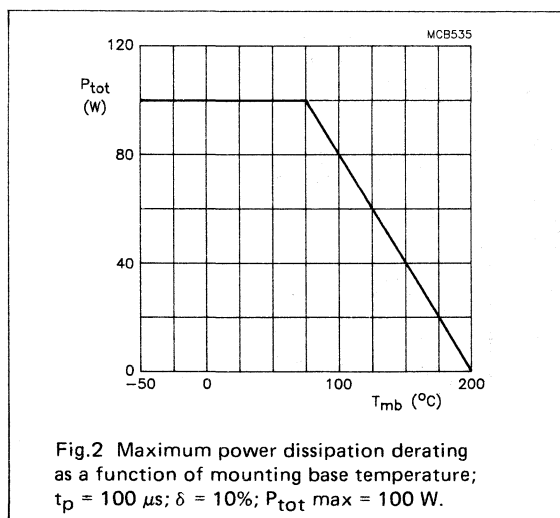
NPN silicon planar epitaxial microwave power transistor

RZ2731B48W

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	—	50	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0 \Omega$	—	50	V
V_{EBO}	emitter-base voltage	open collector	—	3.5	V
I_C	collector current	$t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	4.2	A
P_{tot}	total power dissipation	$T_{mb} = 75^\circ C$; $t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	100	W
T_{stg}	storage temperature range		-65	200	$^\circ C$
T_j	operating junction temperature		—	200	$^\circ C$
T_{sld}	soldering temperature	$t \leq 10 s$; up to 0.2 mm from ceramic	—	235	$^\circ C$



THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th j-mb}$	thermal resistance from junction to mounting base	CW	2.8	K/W
$R_{th mb-h}$	thermal resistance from mounting base to heatsink	CW	0.3	K/W
Z_{th}	thermal impedance from junction to heatsink	note 2	1.05	K/W

Notes

1. Maximum values under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).
2. Equivalent thermal impedance under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).

NPN silicon planar epitaxial microwave power transistor

RZ2731B48W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 40\text{ V}; I_E = 0$	900	μA
I_{CES}	collector cut-off current	$V_{CE} = 40\text{ V}; R_{BE} = 0\ \Omega$	3	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	75	μA

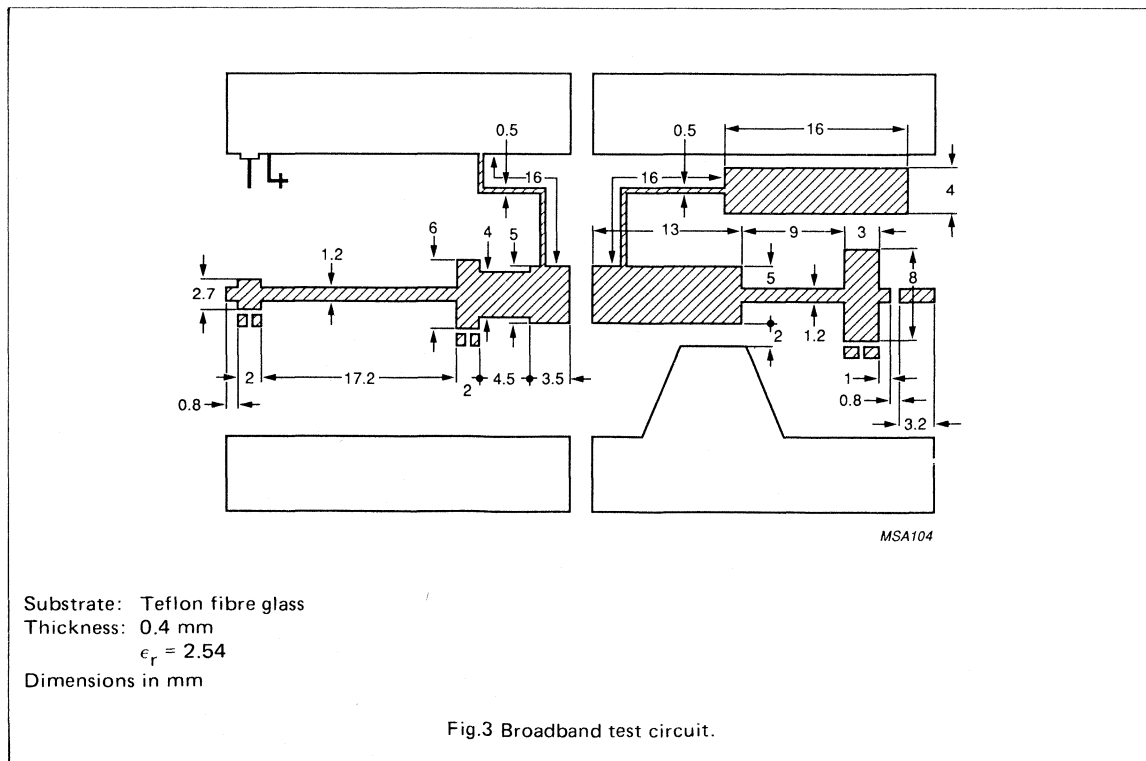
APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^\circ\text{C}$ measured in the test jig as shown in Fig.3 and working in class C broadband mode in pulse ($t_p = 100\ \mu\text{s}; \delta = 10\%$).

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; $t_p = 100\ \mu\text{s};$ $\delta = 10\%$	2.7 to 3.1	40	> 45 typ. 48	> 6 typ. 6.3	> 32 typ. 38	see Figs 6 and 7

Notes

- V_{CC} during pulse.



NPN silicon planar epitaxial microwave power transistor

RZ2731B48W

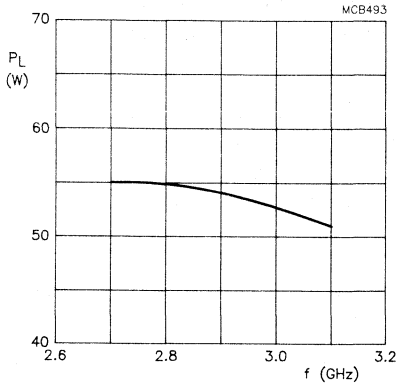


Fig.4 Load power P_L as a function of frequency; $V_{CC} = 40$ V; $t_p = 100 \mu s$; $\delta = 10\%$. (In broadband test circuit as shown in Fig.3).

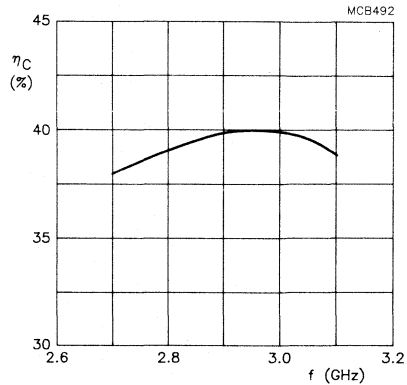


Fig.5 Collector efficiency as a function of frequency. (In broadband test circuit as shown in Fig.3).

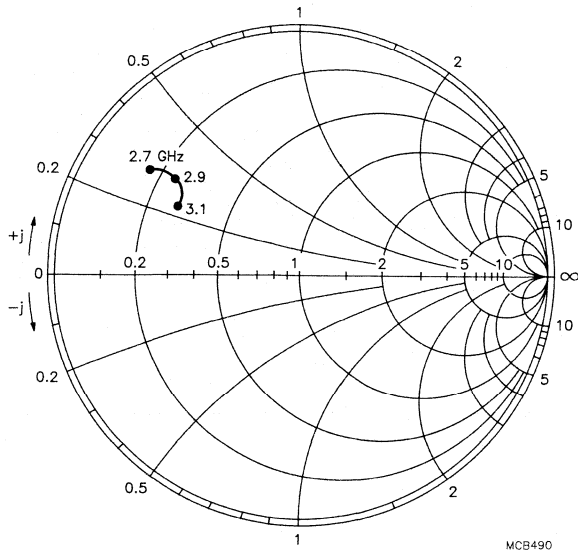


Fig.6 Input impedance as a function of frequency for $P_L = 48$ W; associated with optimum load impedance; $V_{CC} = 40$ V; $Z_o = 50 \Omega$.

NPN silicon planar epitaxial microwave power transistor

RZ2731B48W

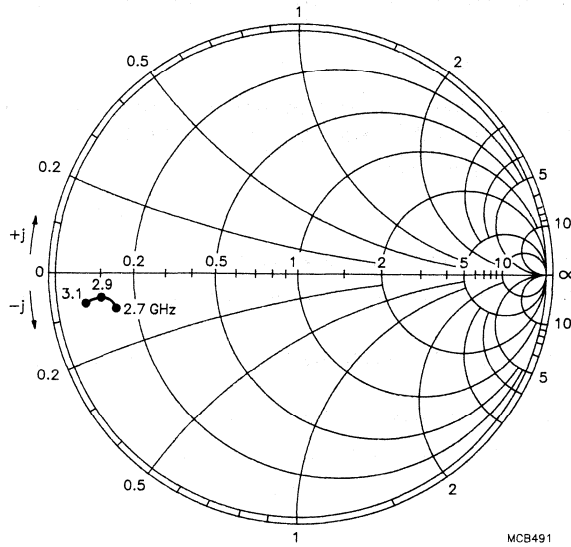


Fig.7 Optimum load impedance as a function of frequency for $P_L = 48 \text{ W}$; associated with input impedance; $V_{CC} = 40 \text{ V}$; $Z_o = 50 \Omega$.

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon planar epitaxial microwave power transistor, intended for use in a common-base class-C broadband pulse power amplifier with a frequency range of 2.7 to 3.1 GHz.

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
- 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common-base class-C broadband amplifier

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	$\bar{z}_i; \bar{Z}_L$ Ω
class-C $t_p = 100\text{ }\mu\text{s}$ $\delta = 10\%$	2.7 to 3.1	40	≥ 60	≥ 6	≥ 35	see Fig. 6

MECHANICAL DATA

FO-57D (see Fig. 1).

Dimensions in mm

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.

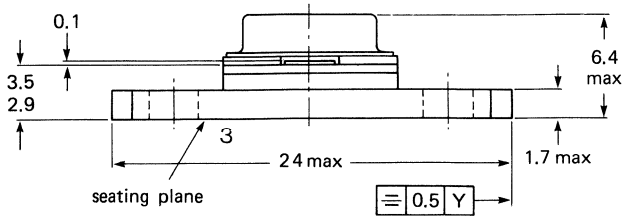
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

MECHANICAL DATA

Fig. 1 FO-57D.

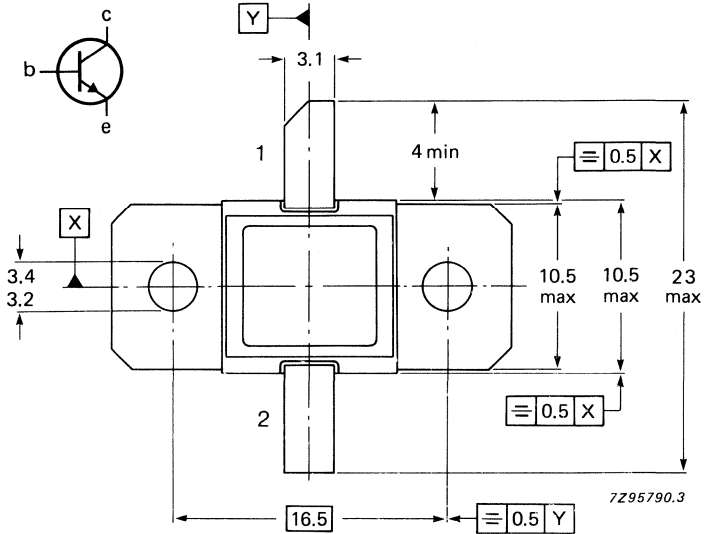
Dimensions in mm

Base is connected to the seating plane



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.	50 V
Collector-emitter voltage	V_{CES}	max.	50 V
→ $R_{BE} = 0$ open base	V_{CEO}	max.	15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3.5 V
Collector current (peak)*	I_C	max.	5.7 A
Total power dissipation at $T_{mb} \leq 75\text{ °C}^*$	P_{tot}	max.	125 W
Storage temperature range	T_{stg}		-65 to +200 °C
Junction temperature	T_j	max.	200 °C
→ Soldering temperature up to 0.2 mm from the case; $t_{sld} \leq 10\text{ s}$	T_{sld}	max.	235 °C

* Maximum value under normal pulsed microwave operating conditions.

THERMAL RESISTANCE (at $T_j = 100\text{ }^\circ\text{C}$)

From junction to mounting base (CW)

$R_{th\ j-mb}$ max. 2.5 K/W

Equivalent thermal impedance under pulsed microwave conditions

$t_p = 100\ \mu\text{s}; \delta = 10\%$

$Z_{th\ j-mb}$ max. 0.8 K/W ←

From mounting base to heatsink

$R_{th\ mb-h}$ max. 0.3 K/W ←

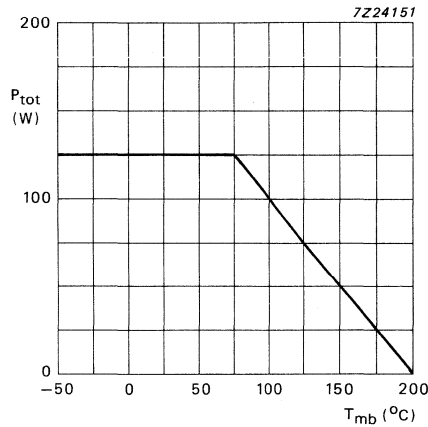


Fig. 2 Power derating curve; $t_p = 100\ \mu\text{s}; \delta = 10\%$.

CHARACTERISTICS

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

Collector cut-off current

$V_{CB} = 50\text{ V}; I_E = 0$

I_{CBO} max. 24 mA ←

$V_{CB} = 30\text{ V}; I_E = 0$

I_{CBO} max. 80 μA ←

$V_{CB} = 50\text{ V}; R_{BE} = 0$

I_{CES} max. 24 mA ←

Emitter cut-off current

$V_{EB} = 3.5\text{ V}; I_C = 0$

I_{EBO} max. 5 mA

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^\circ\text{C}$ in a class-C broadband amplifier under pulsed conditions.

mode of operation	f GHz	V_{CC}^* V	P_L W	G_p dB	η_C %	$z_i; Z_L$ Ω
class-C $t_p = 100\ \mu\text{s}$ $\delta = 10\%$	2.7 to 3.1	40	≥ 60 typ. 65	≥ 6.0 typ. 6.3	≥ 35 typ. 40	see Fig. 6 ←

* During pulse.

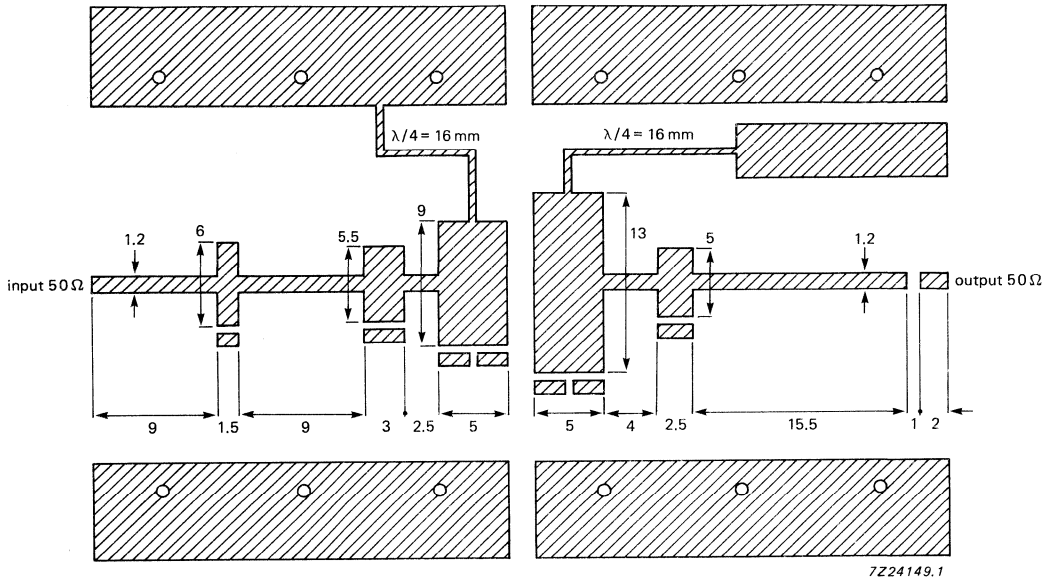


Fig. 3 Broadband test circuit for 2.7 to 3.1 GHz. (dimensions in mm).
PTFE fiberglass printed circuit board, thickness 0.4 mm; $\epsilon_r = 2.54$.

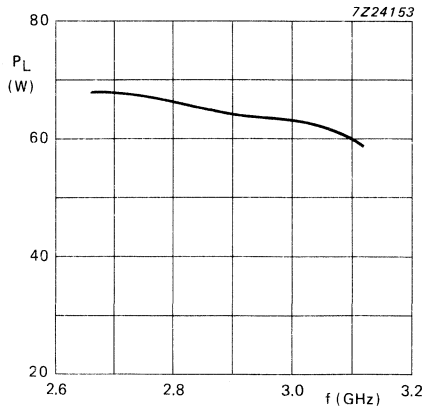


Fig. 4 Load power as a function of frequency*; $V_{CC} = 40$ V;
 $P_{in} = 15$ W; $t_p = 100 \mu s$; $\delta = 10\%$; typical values.

* In a broadband test circuit as shown in Fig. 3.

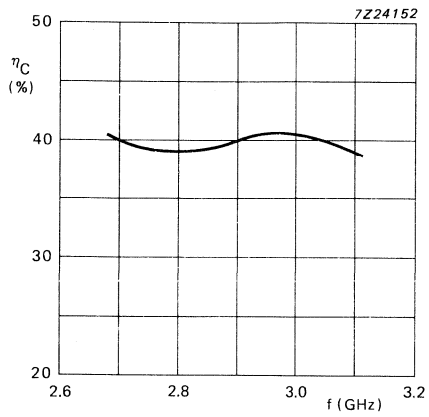


Fig. 5 Collector efficiency as a function of frequency* ;
 $V_{CC} = 40 \text{ V}$; $P_{in} = 15 \text{ W}$; $t_p = 100 \mu\text{s}$; $\delta = 10\%$;
 typical values.

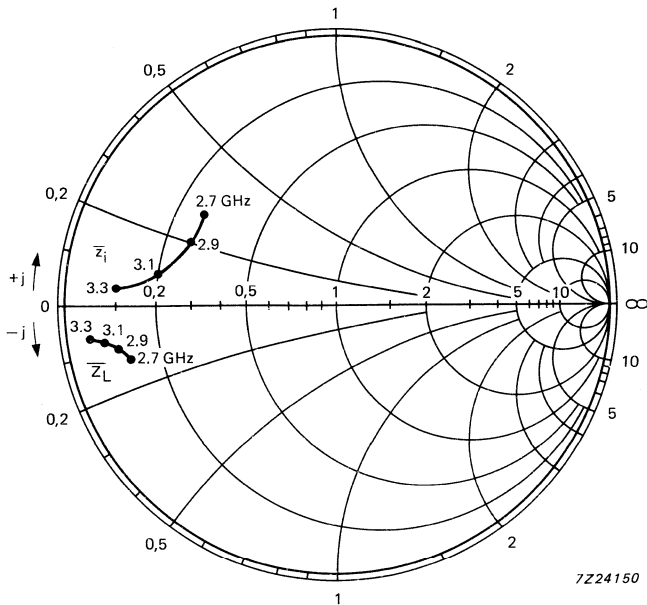


Fig. 6 Input and optimum load impedance as a function of frequency;
 $Z_0 = 50 \Omega$; $V_{CC} = 40 \text{ V}$; typical values.

* In a broadband test circuit as shown in Fig. 3.

Data sheet	
status	Preliminary specification
date of issue	June 1990

RZ3135B14W

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 amplifiers in the frequency range 3.1 to 3.5 GHz for radar application.

DESCRIPTION

NPN transistor in a FO-57D 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common base class C broadband amplifier.

MODE OF OPERATION	f (GHz)	V _{CC} (V)	P _L (W)	G _p (dB)	η_C (%)
class C; $t_p = 100\text{ }\mu\text{s}$; $\delta = 10\%$	3.1 to 3.5	40	≥ 13	≥ 5.5	≥ 30

WARNING

Product and environmental safety – toxic materials

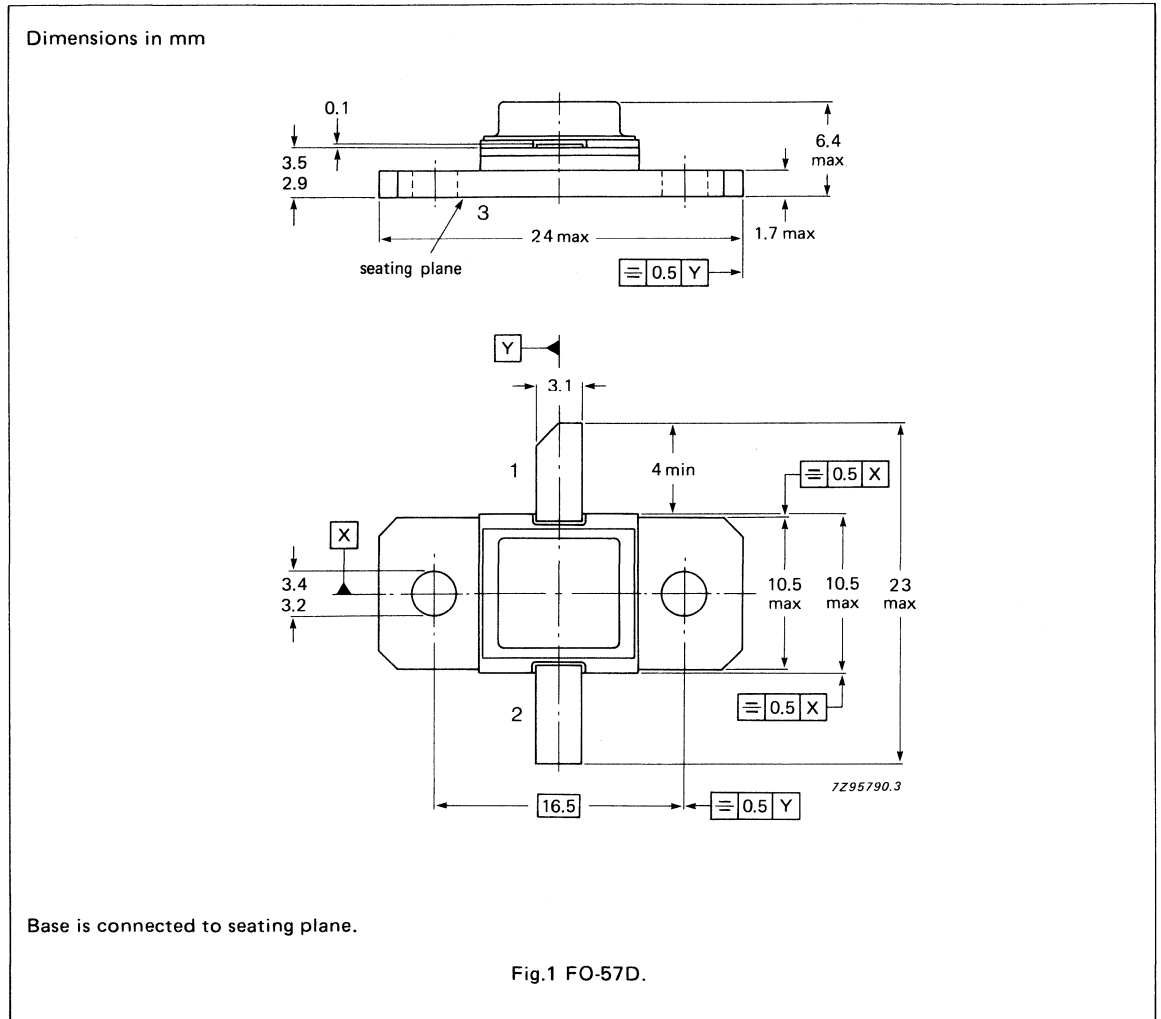
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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 industrial or domestic waste.

NPN silicon planar epitaxial microwave power transistor

RZ3135B14W

MECHANICAL DATA



PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base

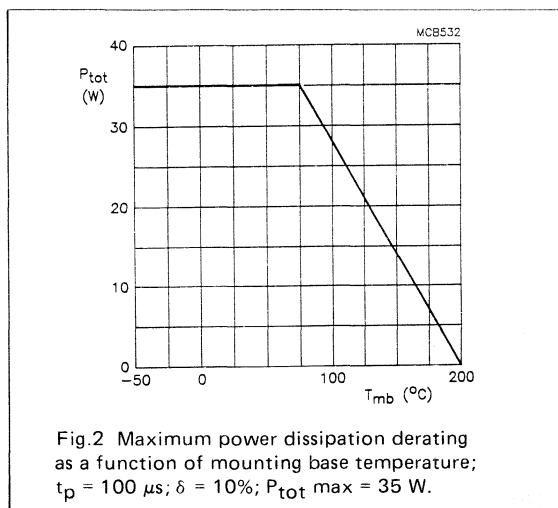
NPN silicon planar epitaxial microwave power transistor

RZ3135B14W

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	—	50	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0 \Omega$	—	50	V
V_{CEO}	collector-emitter voltage	open base	—	15	V
V_{EBO}	emitter-base voltage	open collector	—	3.5	V
I_C	collector current	$t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	1.4	A
P_{tot}	total power dissipation	$T_{mb} = 75^\circ C$; $t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	35	W
T_{stg}	storage temperature range		-65	200	$^\circ C$
T_j	operating junction temperature		—	200	$^\circ C$
T_{sld}	soldering temperature	$t \leq 10 s$; up to 0.2 mm from ceramic	—	235	$^\circ C$



THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th j-mb}$	thermal resistance from junction to mounting base	CW	6.5	K/W
$R_{th mb-h}$	thermal resistance from mounting base to heatsink	CW	0.3	K/W
Z_{th}	thermal impedance from junction to heatsink	note 2	3.2	K/W

Notes

1. Maximum values under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).
2. Equivalent thermal impedance under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).

NPN silicon planar epitaxial microwave power transistor

RZ3135B14W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 40\text{ V}; I_E = 0$	300	μA
I_{CES}	collector cut-off current	$V_{CE} = 40\text{ V}; R_{BE} = 0\ \Omega$	1	mA
I_{CEO}	collector cut-off current	$V_{CE} = 15\text{ V}; I_B = 0$	1	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	25	μA

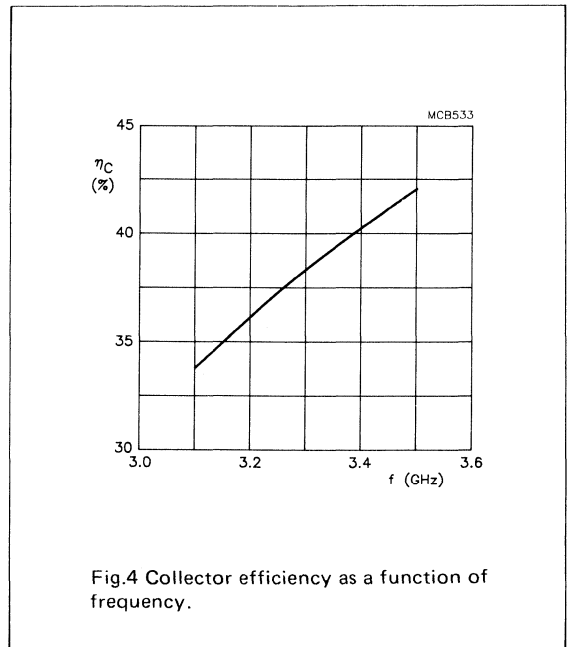
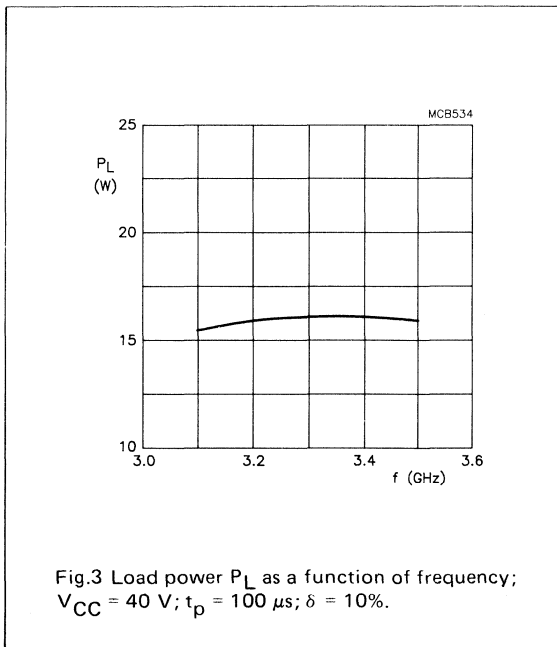
APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^\circ\text{C}$; working in class C broadband mode in pulse ($t_p = 100\ \mu\text{s}; \delta = 10\%$).

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; $t_p = 100\ \mu\text{s};$ $\delta = 10\%$	3.1 to 3.5	40	> 13 typ. 14	> 5.5 typ. 5.7	> 30 typ. 34	see Figs 5 and 6

Notes

- V_{CC} during pulse.



NPN silicon planar epitaxial microwave power transistor

RZ3135B14W

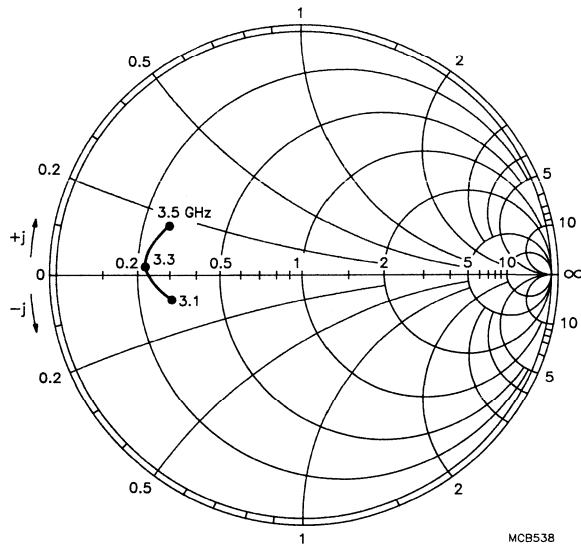


Fig.5 Input impedance as a function of frequency for $P_L = 14$ W; associated with optimum load impedance; $V_{CC} = 40$ V; $Z_O = 50 \Omega$.

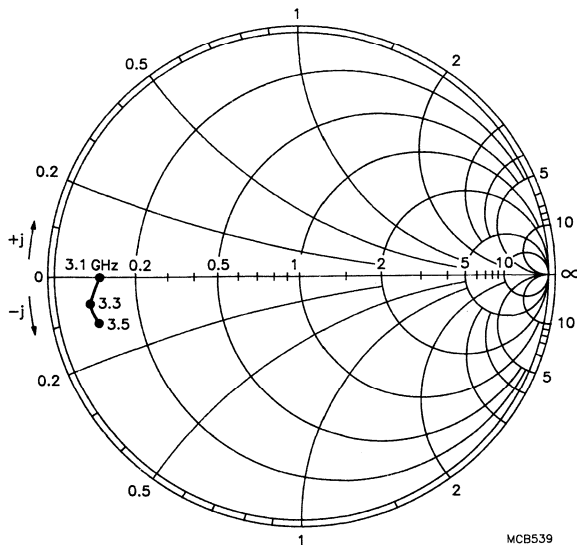


Fig.6 Optimum load impedance as a function of frequency for $P_L = 14$ W; associated with input impedance; $V_{CC} = 40$ V; $Z_O = 50 \Omega$.

Data sheet	
status	Product specification
date of issue	June 1990

RZ3135B28W

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 amplifiers in the frequency range 3.1 to 3.5 GHz for radar application.

DESCRIPTION

NPN transistor in a FO-57D 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common base class C broadband amplifier.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
class C; $t_p = 100\text{ }\mu\text{s}$; $\delta = 10\%$	3.1 to 3.5	40	> 27	> 5.5	> 30

WARNING

Product and environmental safety – toxic materials

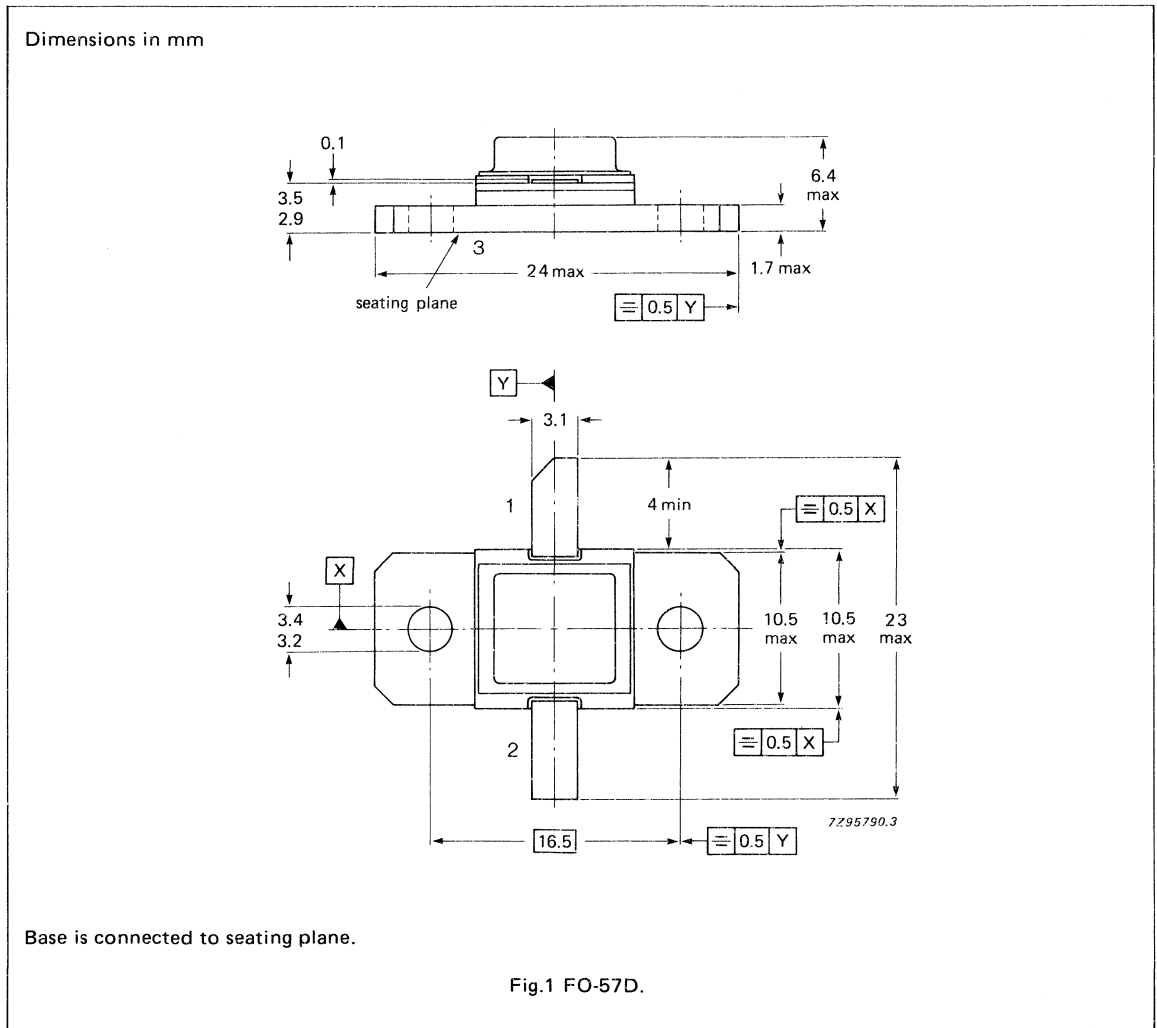
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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 industrial or domestic waste.

NPN silicon planar epitaxial microwave power transistor

RZ3135B28W

MECHANICAL DATA



PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base

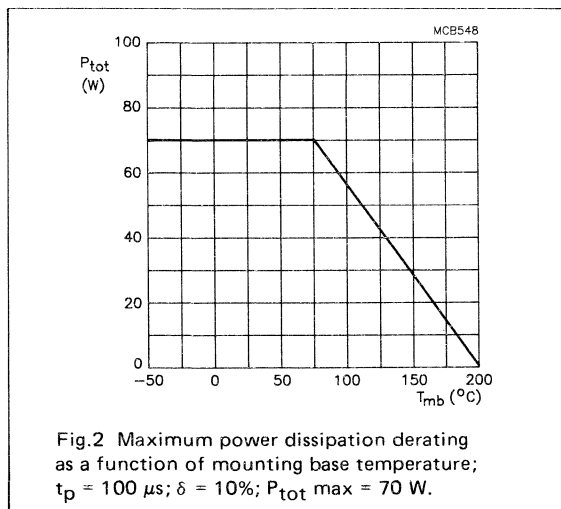
NPN silicon planar epitaxial microwave power transistor

RZ3135B28W

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	—	50	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0 \Omega$	—	50	V
V_{CEO}	collector-emitter voltage	open base	—	15	V
V_{EBO}	emitter-base voltage	open collector	—	3.5	V
I_C	collector current	$t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	2.8	A
P_{tot}	total power dissipation	$T_{mb} = 75^\circ C$; $t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	70	W
T_{stg}	storage temperature range		-65	200	$^\circ C$
T_j	operating junction temperature		—	200	$^\circ C$
T_{sld}	soldering temperature	$t \leq 10 s$; up to 0.2 mm from ceramic	—	235	$^\circ C$



THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th j-mb}$	thermal resistance from junction to mounting base	CW	3,8	K/W
$R_{th mb-h}$	thermal resistance from mounting base to heatsink	CW	0,3	K/W
Z_{th}	thermal impedance from junction to heatsink	note 2	1,6	K/W

Notes

1. Maximum values under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).
2. Equivalent thermal impedance under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).

NPN silicon planar epitaxial microwave power transistor

RZ3135B28W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 40\text{ V}; I_E = 0$	600	μA
I_{CES}	collector cut-off current	$V_{CE} = 40\text{ V}; R_{BE} = 0\ \Omega$	2	mA
I_{CEO}	collector cut-off current	$V_{CE} = 15\text{ V}; I_B = 0$	2	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	50	μA

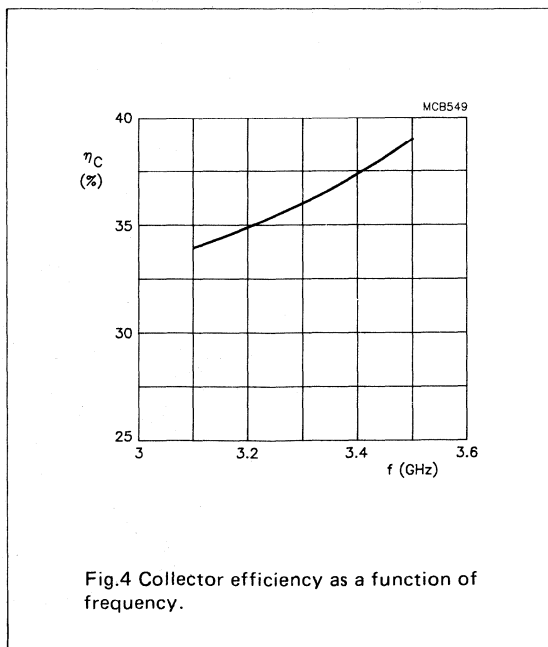
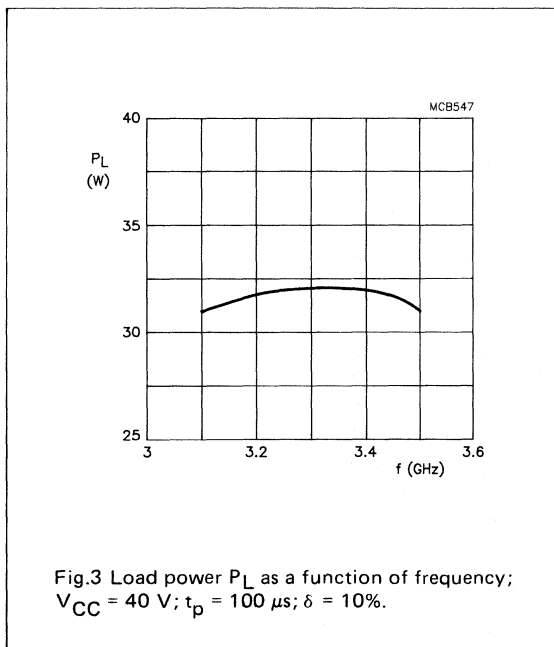
APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$; working in class C broadband mode in pulse ($t_p = 100\ \mu\text{s}$; $\delta = 10\%$).

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; $t_p = 100\ \mu\text{s}$; $\delta = 10\%$	3.1 to 3.5	40	> 27 typ. 28	> 5.5 typ. 5.7	> 30 typ. 34	see Figs 5 and 6

Notes

- V_{CC} during pulse.



NPN silicon planar epitaxial microwave power transistor

RZ3135B28W

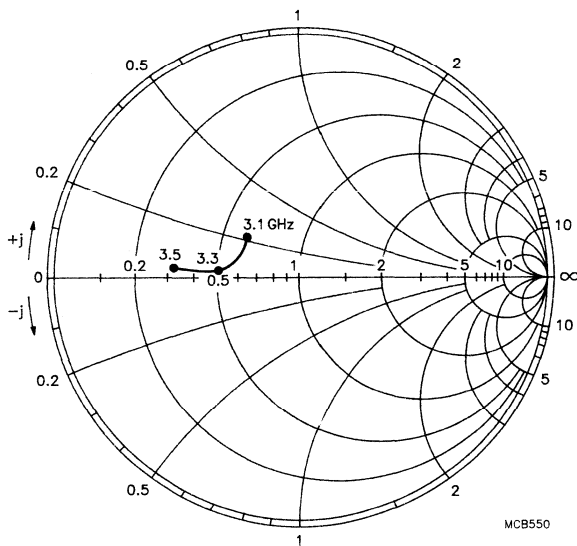


Fig.5 Input impedance as a function of frequency for $P_L = 28 \text{ W}$; associated with optimum load impedance; $V_{CC} = 40 \text{ V}$; $Z_o = 50 \Omega$.

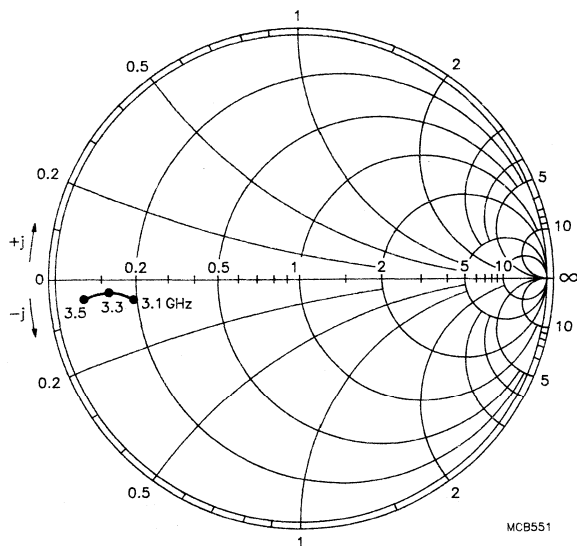


Fig.6 Optimum load impedance as a function of frequency for $P_L = 28 \text{ W}$; associated with input impedance; $V_{CC} = 40 \text{ V}$; $Z_o = 50 \Omega$.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	June 1990

RZ3135B42W

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 amplifiers in the frequency range 3.1 to 3.5 GHz for radar application.

DESCRIPTION

NPN transistor in a FO-57D 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 $T_{mb} = 25^\circ\text{C}$ in a common base class C broadband amplifier.

MODE OF OPERATION	f (GHz)	V _{CC} (V)	P _L (W)	G _p (dB)	η_C (%)
class C; $t_p = 100 \mu\text{s}$; $\delta = 10\%$	3.1 to 3.5	40	≥ 40	≥ 5.5	≥ 30

WARNING

Product and environmental safety – toxic materials

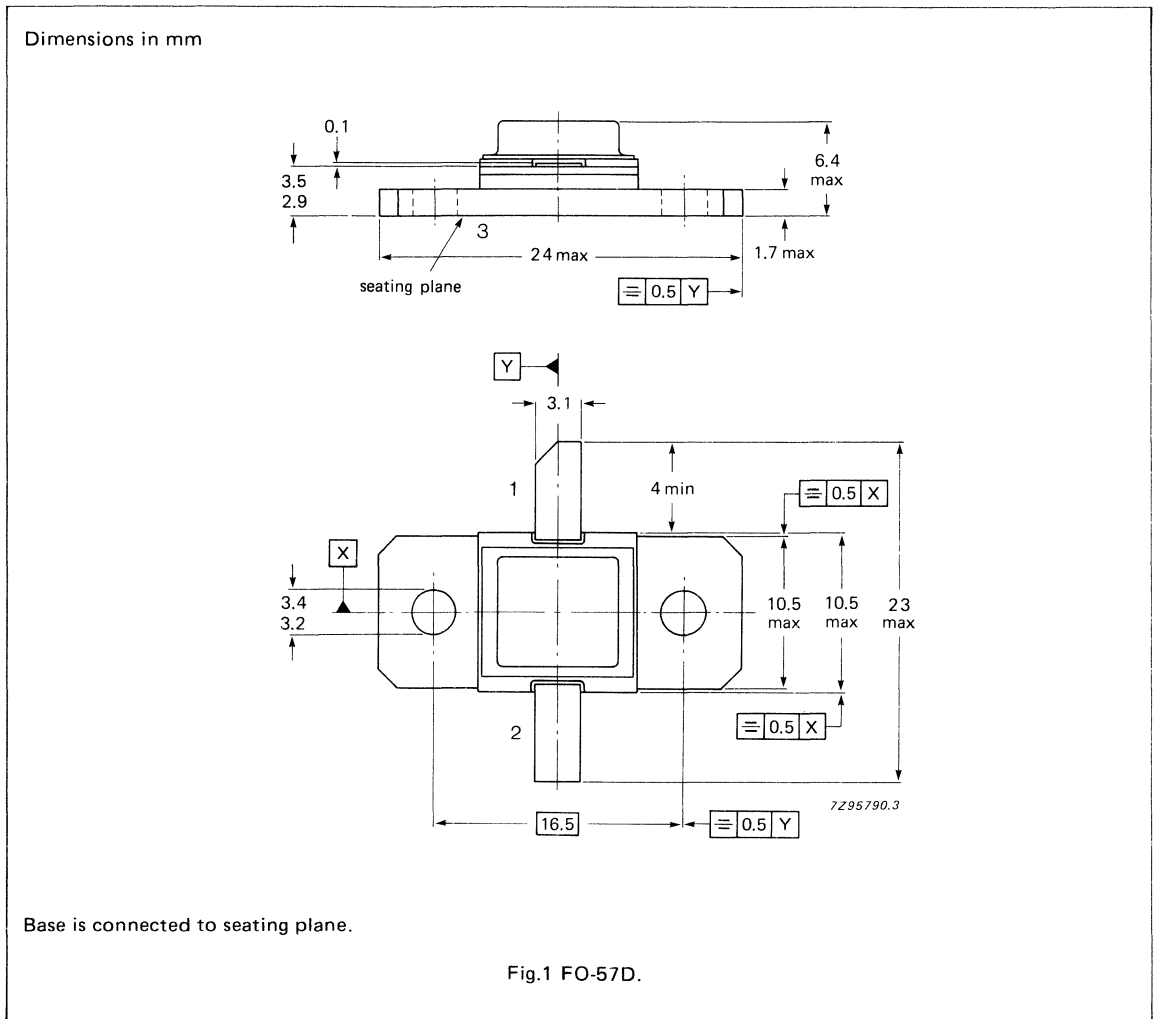
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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 industrial or domestic waste.

NPN silicon planar epitaxial microwave power transistor

RZ3135B42W

MECHANICAL DATA



PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base

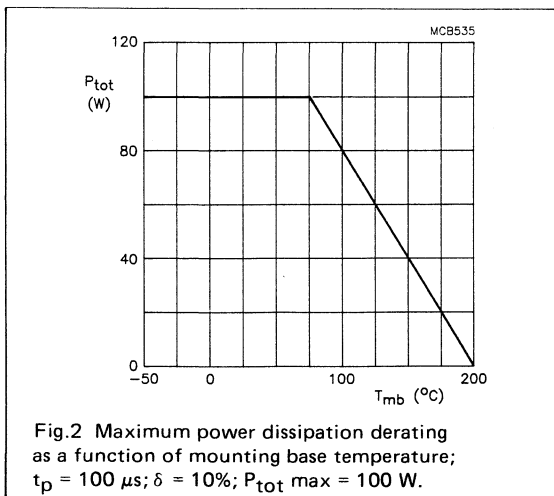
NPN silicon planar epitaxial microwave power transistor

RZ3135B42W

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	—	50	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0 \Omega$	—	50	V
V_{CEO}	collector-emitter voltage	open base	—	15	V
V_{EBO}	emitter-base voltage	open collector	—	3.5	V
I_C	collector current	$t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	4.2	A
P_{tot}	total power dissipation	$T_{mb} = 75^\circ C$; $t_p = 100 \mu s$; $\delta = 10\%$; note 1	—	100	W
T_{stg}	storage temperature range		-65	200	$^\circ C$
T_j	operating junction temperature		—	200	$^\circ C$
T_{sld}	soldering temperature	$t \leq 10 s$; up to 0.2 mm from ceramic	—	235	$^\circ C$



THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th j-mb}$	thermal resistance from junction to mounting base	CW	2.8	K/W
$R_{th mb-h}$	thermal resistance from mounting base to heatsink	CW	0.3	K/W
Z_{th}	thermal impedance from junction to heatsink	note 2	1.05	K/W

Notes

1. Maximum values under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).
2. Equivalent thermal impedance under nominal pulse microwave operating conditions ($t_p = 100 \mu s$; $\delta = 10\%$).

NPN silicon planar epitaxial microwave power transistor

RZ3135B42W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 40\text{ V}; I_E = 0$	900	μA
I_{CES}	collector cut-off current	$V_{CE} = 40\text{ V}; R_{BE} = 0\ \Omega$	3	mA
I_{CEO}	collector cut-off current	$V_{CE} = 15\text{ V}; I_B = 0$	3	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5\text{ V}; I_C = 0$	75	μA

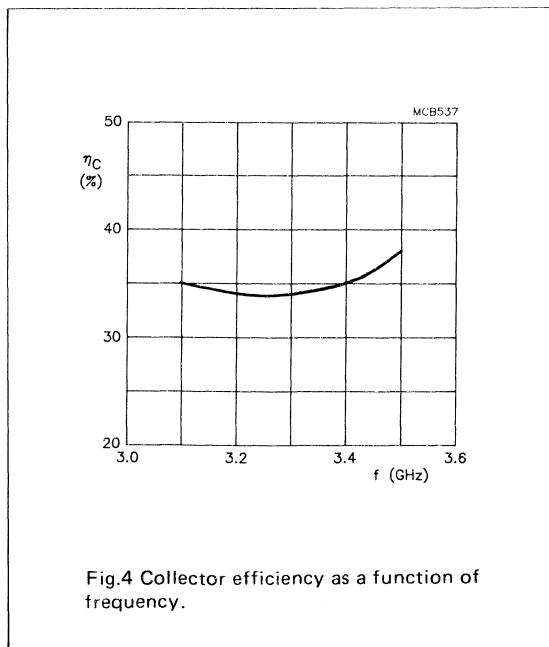
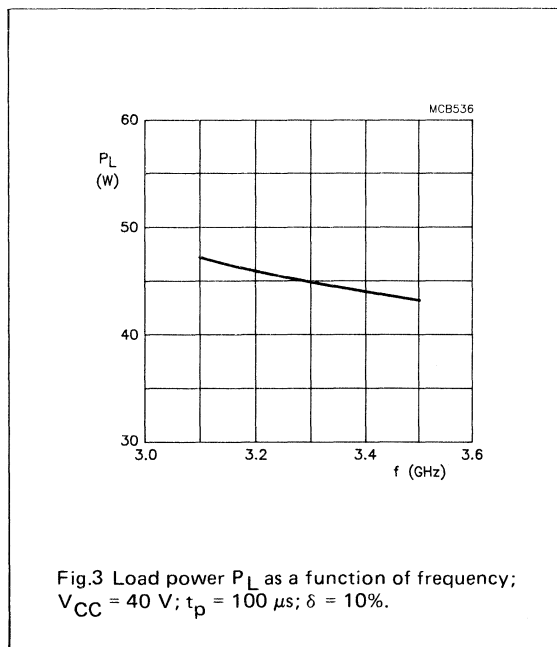
APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^\circ\text{C}$; working in class C broadband mode in pulse ($t_p = 100\ \mu\text{s}; \delta = 10\%$).

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; $t_p = 100\ \mu\text{s};$ $\delta = 10\%$	3.1 to 3.5	40	40 typ. 42	5.5 typ. 5.7	30 typ. 34	see Figs 5 and 6

Notes

- V_{CC} during pulse.



NPN silicon planar epitaxial microwave power transistor

RZ3135B42W

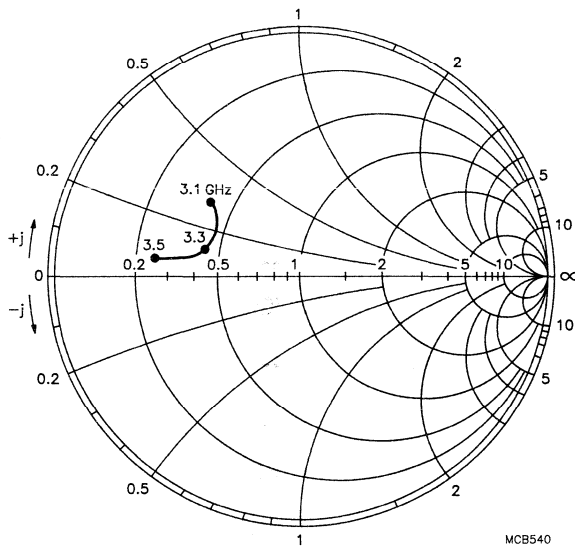


Fig.5 Input impedance as a function of frequency for $P_L = 42\text{ W}$; associated with optimum load impedance; $V_{CC} = 40\text{ V}$; $Z_o = 50\ \Omega$.

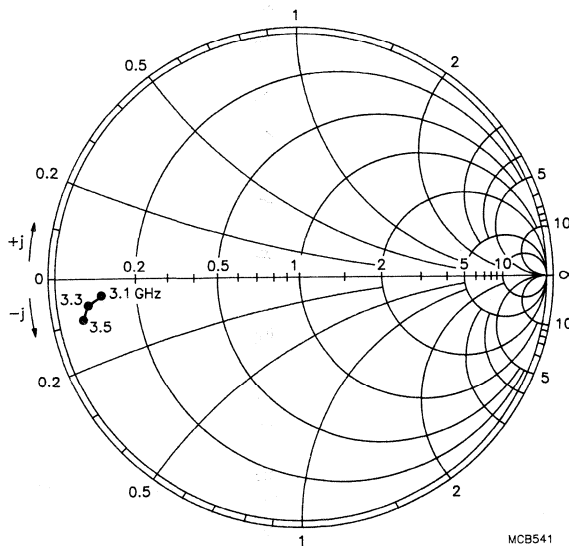


Fig.6 Optimum load impedance as a function of frequency for $P_L = 42\text{ W}$; associated with input impedance; $V_{CC} = 40\text{ V}$; $Z_o = 50\ \Omega$.

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon planar epitaxial microwave power transistor, intended for use in a common-base class-C broadband pulse power amplifier with a frequency range of 3.1 to 3.5 GHz.

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
- 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 $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 $t_p = 100\ \mu\text{s}$ $\delta = 10\%$	3.1 to 3.5	40	≥ 50	≥ 5.2	> 30	see Fig. 6

MECHANICAL DATA

Dimensions in mm

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 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.

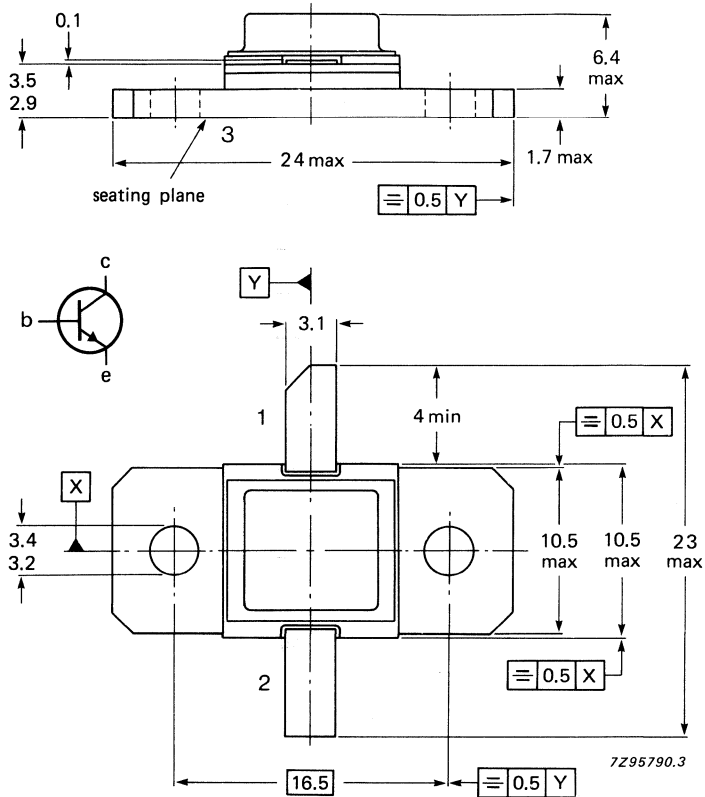
MECHANICAL DATA

Fig. 1 FO-57D.

Dimensions in mm

Base is connected to the seating plane

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_{CB0}	max.	50 V
Collector-emitter voltage	V_{CES}	max.	50 V
→ $R_{BE} = 0$ open base	V_{CEO}	max.	15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3.5 V
Collector current (peak)*	I_C	max.	5.7 A
Total power dissipation at $T_{mb} \leq 75\text{ °C}$ *	P_{tot}	max.	125 W
Storage temperature range	T_{stg}		-65 to +200 °C
Junction temperature	T_j	max.	200 °C
→ Soldering temperature up to 0.2 mm from the case; $t_{sld} \leq 10\text{ s}$	T_{sld}	max.	235 °C

* Maximum value under normal pulsed microwave operating conditions.

THERMAL RESISTANCE (at $T_j = 100\text{ }^\circ\text{C}$)

From junction to mounting base (CW)

$R_{th\ j-mb}$ max. 2.5 K/W

Equivalent thermal impedance under pulsed microwave conditions

$t_p = 100\ \mu\text{s}; \delta = 10\%$

$Z_{th\ j-mb}$ max. 0.8 K/W

From mounting base to heatsink

$R_{th\ mb-h}$ max. 0.3 K/W

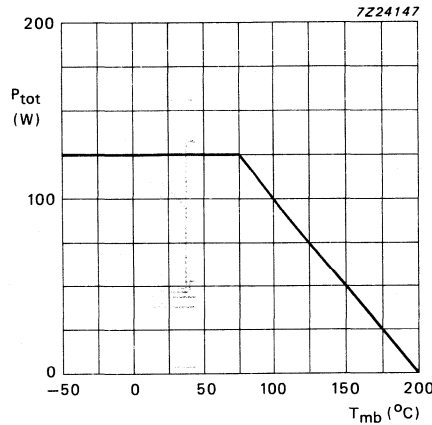


Fig. 2 Power derating curve; $t_p = 100\ \mu\text{s}; \delta = 10\%$.

CHARACTERISTICS

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

Collector cut-off current

$V_{CB} = 50\text{ V}; I_E = 0$

I_{CBO} max. 24 mA

$V_{CB} = 30\text{ V}; I_E = 0$

I_{CBO} max. 80 μA

$V_{CB} = 50\text{ V}; R_{BE} = 0$

I_{CES} max. 24 mA

Emitter cut-off current

$V_{EB} = 3.5\text{ V}; I_C = 0$

I_{EBO} max. 5 mA

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^\circ\text{C}$ in a class-C broadband amplifier under pulsed conditions.

mode of operation	f GHz	V_{CC}^* V	P_L W	G_p dB	η_C %	$z_i; Z_L$ Ω
class-C $t_p = 100\ \mu\text{s}$ $\delta = 10\%$	3,1 to 3,5	40	≥ 50 typ. 55	≥ 5.2 typ. 5.6	≥ 30 typ. 35	see Fig. 6

* During pulse.

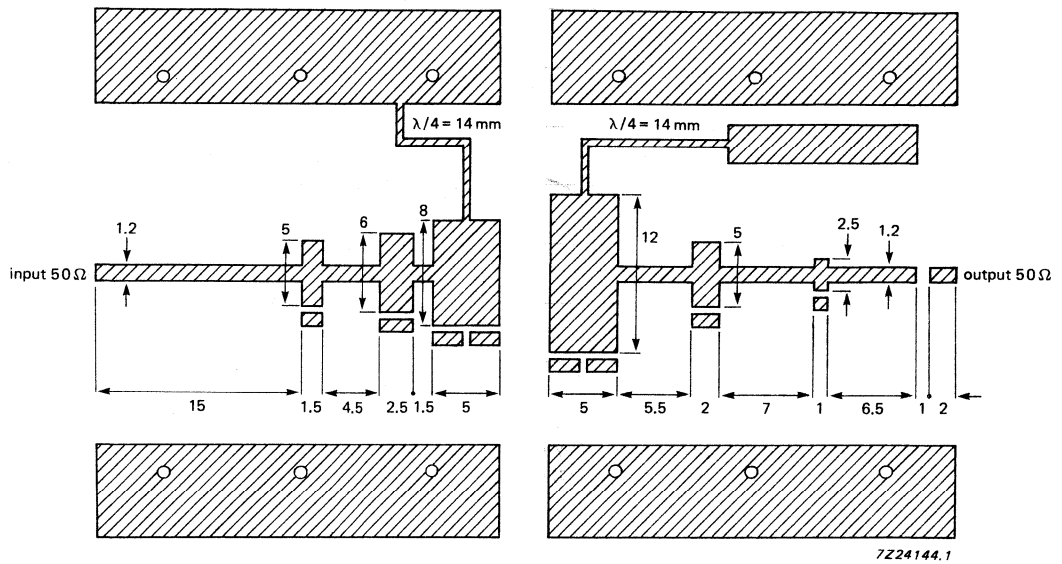


Fig. 3 Broadband test circuit for 3.1 to 3.5 GHz. (dimensions in mm).
 PTFE fibreglass printed circuit board, thickness 0.4 mm; $\epsilon_r = 2.54$.

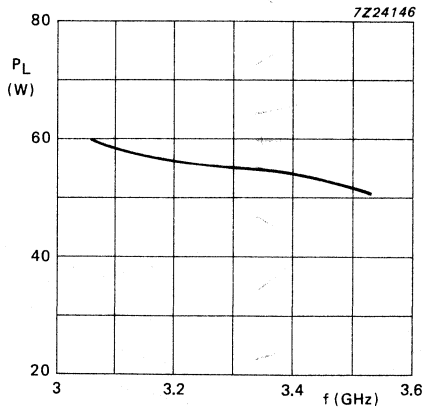


Fig. 4 Load power as a function of frequency*; $V_{CC} = 40 \text{ V}$;
 $P_{in} = 15 \text{ W}$; $t_p = 100 \mu\text{s}$; $\delta = 10\%$; typical values.

* In a broadband test circuit as shown in Fig. 3.

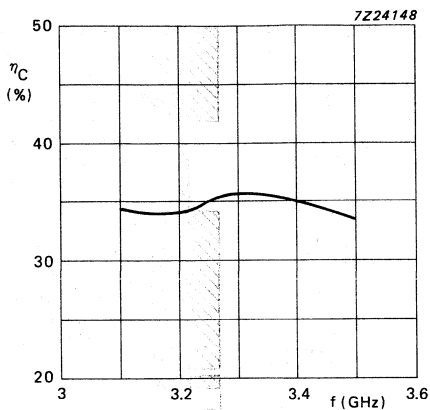


Fig. 5 Collector efficiency as a function of frequency*; $V_{CC} = 40\text{ V}$; $t_p = 100\ \mu\text{s}$; $\delta = 10\%$; typical values.

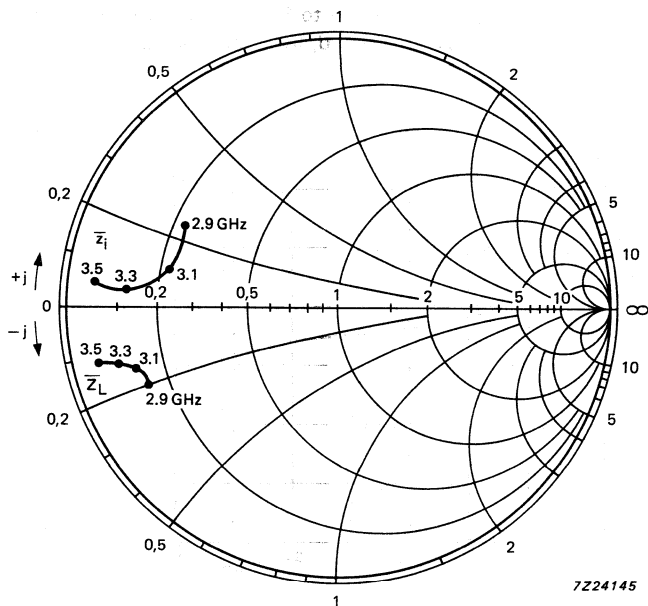


Fig. 6 Input and optimum load impedance as a function of frequency; $Z_0 = 50\ \Omega$; $V_{CC} = 40\text{ V}$; typical values.

* In a broadband test circuit as shown in Fig. 3.

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon microwave power transistor intended for use in a common-base, class-C narrowband amplifier operating under pulsed conditions.

It is recommended for IFF 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

The transistor is housed in a metal-ceramic flange envelope (FO-57C).

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a common-base class-C narrowband amplifier

mode of operation	f GHz	V _{CC} V	PL W	G _p dB	η_C %
$t_p = 100\ \mu\text{s}; \delta = 10\%$	1.09	50	≥ 35	≥ 7	≥ 30

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 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.

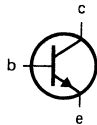
MECHANICAL DATA

Fig. 1 FO-57C.

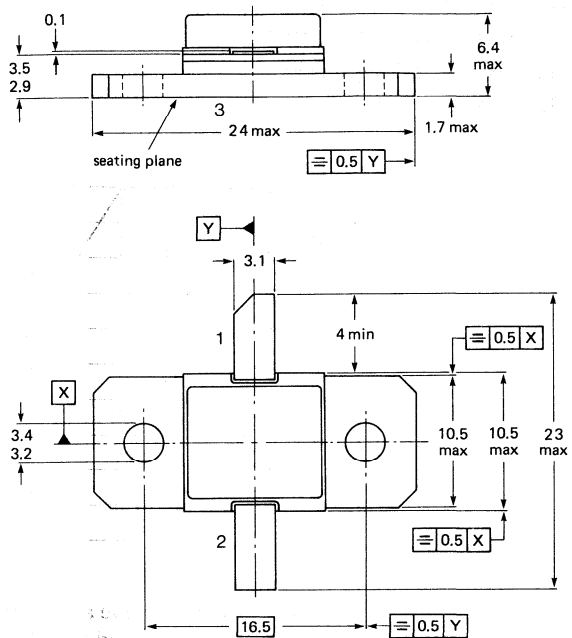
Dimensions in mm

Base is connected to the seating plane

Pinning;
 1 = collector
 2 = emitter
 3 = base



Torque on screw: max. 0.5 Nm
 Recommended screw: M3



7Z85741.2

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)	I_C	max.	3 A
→ $t_p = 100 \mu s; \delta \leq 10\%$			
Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$;	P_{tot}	max.	125 W
→ $t_p = 100 \mu s; \delta \leq 10\%$			
Storage temperature range	T_{stg}		-65 to +200 $^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$
→ Soldering temperature up to 0.2 mm from the case; $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 $^\circ\text{C}$

THERMAL RESISTANCE (at $T_j = 75\text{ }^\circ\text{C}$)

From junction to mounting base

$R_{th\ j-mb}$ max. 5.0 K/W

From mounting base to heatsink

$R_{th\ mb-h}$ max. 0.2 K/W ←

Equivalent thermal impedance

$t_p = 100\ \mu\text{s}; \delta = 10\%$

Z_{th} max. 1.0 K/W ←

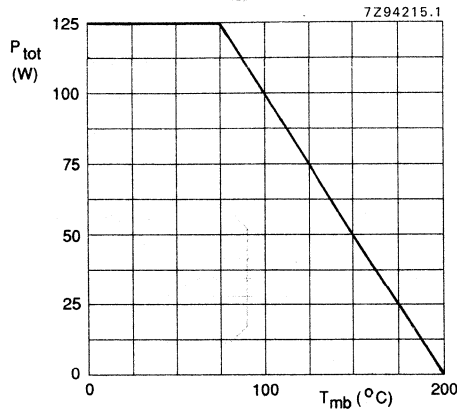


Fig. 2 Power derating curve as a function of base temperature; $t_p = 100\ \mu\text{s}; \delta = 10\%$; pulsed conditions.

CHARACTERISTICS

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

Collector-base breakdown voltage

$I_C = 20\text{ mA}; I_E = 0$

$V_{(BR)CBO}$ min. 65 V ←

Collector-emitter breakdown voltage

$I_C = 20\text{ mA}; R_{BE} = 0$

$V_{(BR)CES}$ min. 60 V ←

Emitter-base breakdown voltage

$I_C = 0; I_E = 3\text{ mA}$

$V_{(BR)EBO}$ min. 3 V ←

Collector cut-off current

$I_E = 0; V_{CB} = 50\text{ V}$

I_{CBO} max. 2 mA ←

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a class-C narrowband amplifier under pulsed conditions (measured in the test circuit shown in Fig. 4).

mode of operation	f GHz	V _{CC} V	P _L W	G _p dB	η_C %
class-C $t_p = 100\ \mu\text{s}$; $\delta = 10\%$	1.09	50	≥ 35 typ. 50	≥ 7 typ. 10	≥ 30 typ. 45

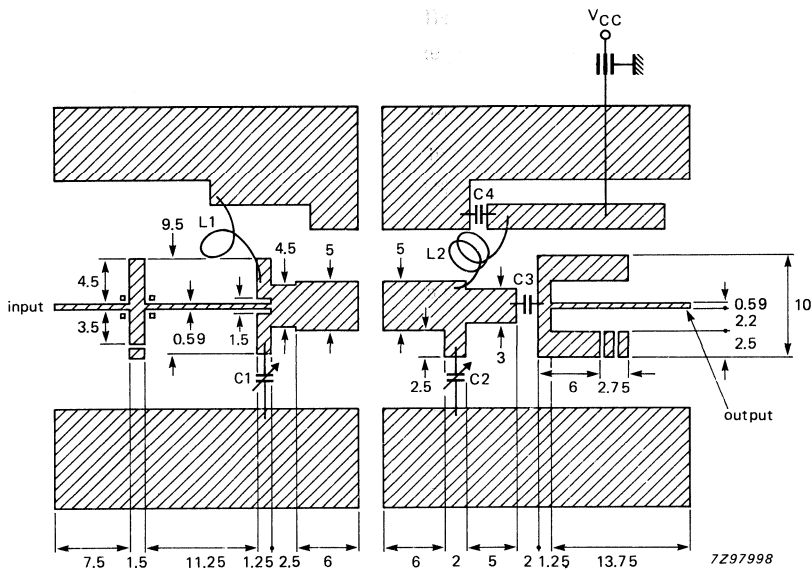


Fig. 3 Narrowband test circuit for 1.09 GHz. (dimensions in mm).
Epsilam printed circuit board; thickness = 0.635 mm; $\epsilon_r = 10$.

List of components

- C1 = C2 0.6 to 8 pF Gigatrim capacitor
- C3 100 pF ATC capacitor (small size)
- C4 1000 pF (approximately) decoupling capacitor
- L1 One turn diameter 4 mm; wire diameter 0.5 mm
- L2 Two turns diameter 4.5 mm; wire diameter 0.5 mm

IMPEDANCE DATA

Frequency GHz	z_i Ω	Z_L Ω
1.1	$9.0 + j3.8$	$4.3 + j1.3$
1.0	$7.2 + j3.7$	$3.9 + j1.1$
0.9	$5.5 + j1.9$	$3.8 + j0$

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon power transistor for use in a common-base, class-C narrowband amplifier in avionics applications.

It operates in pulsed conditions only and is recommended for IFF applications.

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

The transistor is housed in a metal ceramic flange envelope (FO-57C).

QUICK REFERENCE DATA

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

mode of operation	f GHz	V_{CC} V	PL W	G_p dB	η_C %	z_i Z_L Ω
class-C $t_p = 100\text{ }\mu\text{s}$, $\delta = 10\%$	1.09	50	≥ 80	≥ 7	≥ 30	see table

MECHANICAL DATA

FO-57C (see Fig.1)

WARNING

Product and environmental safety – toxic materials

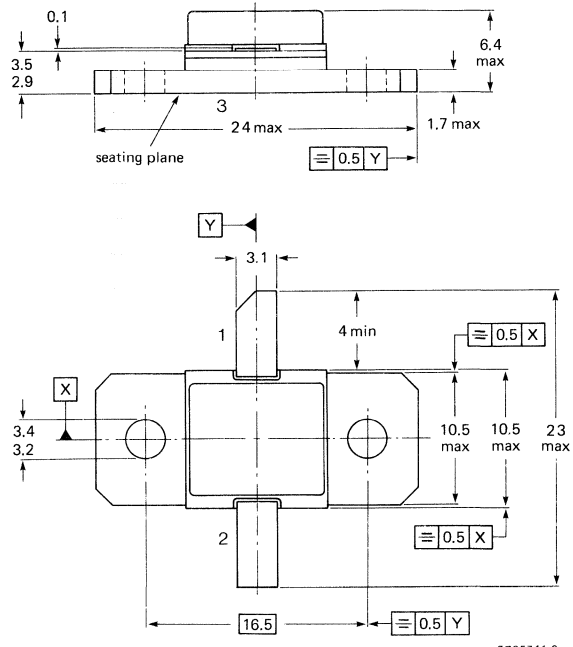
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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-57C.



Pinning:

- 1 = collector
- 2 = emitter
- 3 = base

Torque on screw: max. 0.5 Nm
 Recommended screw: M3

7285741.2

RATINGS

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

→ Collector-base voltage, open emitter	V_{CB0}	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) $t_p = 100 \mu s, \delta \leq 10\%$	I_C	max.	6 A
→ Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$ $t_p = 100 \mu s, \delta \leq 10\%$	P_{tot}	max.	225 W
Storage temperature	T_{stg}		-65 to +200 °C
Junction temperature	T_j	max.	200 °C
Soldering temperature at 0.2 mm from the case, $t_{sld} \leq 10 \text{ s}$	T_{sld}	max.	235 °C

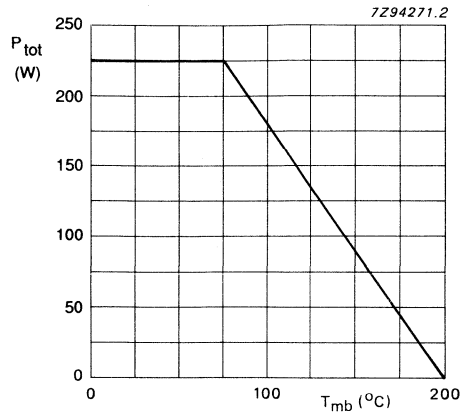


Fig.2 Power derating curve as a function of mounting base temperature;
 $t_p = 100 \mu s$, $\delta = 10\%$.

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base

$R_{th \text{ j-mb}}$ max. 2.5 K/W

From mounting base to heatsink

$R_{th \text{ mb-h}}$ max. 0.2 K/W ←

Equivalent thermal impedance;

$t_p = 100 \mu s$; $\delta = 10\%$

Z_{th} max. 0.55 K/W ←

CHARACTERISTICS

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

Breakdown voltages

$I_C = 40 \text{ mA}$; $I_E = 0$

$V_{(BR)CBO}$ min. 65 V ←

$I_C = 40 \text{ mA}$; $R_{BE} = 0$

$V_{(BR)CES}$ min. 60 V ←

$I_C = 0$; $I_E = 6 \text{ mA}$

$V_{(BR)EBO}$ min. 3 V ←

Collector cut-off current

$I_E = 0$; $V_{CB} = 50 \text{ V}$

I_{CBO} max. 4 mA ←

IMPEDANCES

frequency GHz	input (\bar{z}_i) Ω	load (\bar{Z}_L) Ω
1.03	$3.5 + j4.5$	$2.6 + j1.75$
1.09	$4.2 + j4.5$	$1.9 - j0.9$

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a class-C narrowband amplifier under pulsed conditions (measured in the test circuit shown in Fig. 4).

mode of operation	f GHz	V _{CC} V	P _L W	G _p dB	η _C %
class-C t _p = 100 μs; δ = 10%	1.09	50	≥ 80 typ. 100	≥ 7 typ. 10	≥ 30 typ. 45

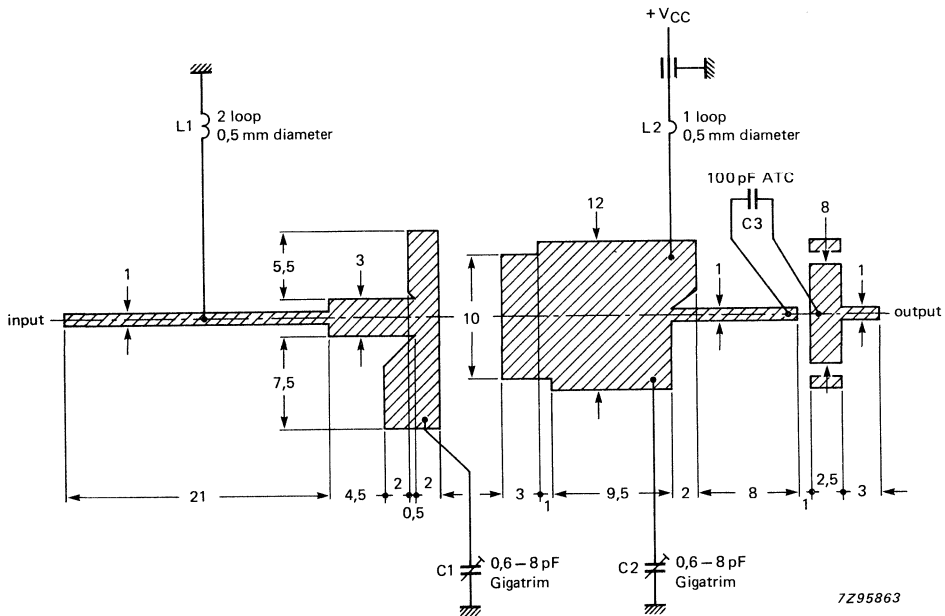


Fig.3 Narrowband test circuit for 1.09 GHz (dimensions in mm).
Epsilon printed-circuit board; thickness 0.635 mm; ε_r = 10.

List of components

- C1 = C2 0.6 to 8 pF Gigatrim capacitor
- C3 = 100 pF ATC capacitor (small size)
- L1 = Two open turns; wire diameter 0.5 mm
- L2 = One turn diameter 4 mm; wire diameter 0.5 mm

PULSED MICROWAVE POWER TRANSISTOR

NPN silicon power transistor for use in a common-base, class-C narrowband amplifier in avionics applications.

It operates in pulsed conditions only and is recommended for IFF applications.

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

The transistor is housed in a metal ceramic flange envelope (FO-57C).

QUICK REFERENCE DATA

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ 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 Ω	Z _L
class-C t _p = 100 μs, δ = 10%	1.09	50	≥ 200	≥ 7	≥ 30	see table	

MECHANICAL DATA

FO-57C (see Fig. 1)

Dimensions in mm

WARNING

Product and environmental safety – toxic materials

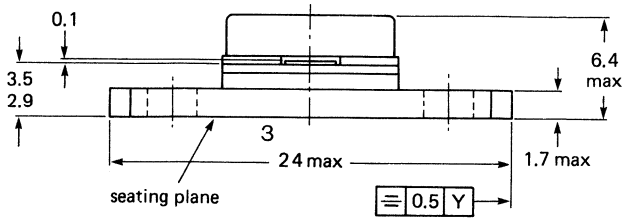
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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-57C.

Dimensions in mm

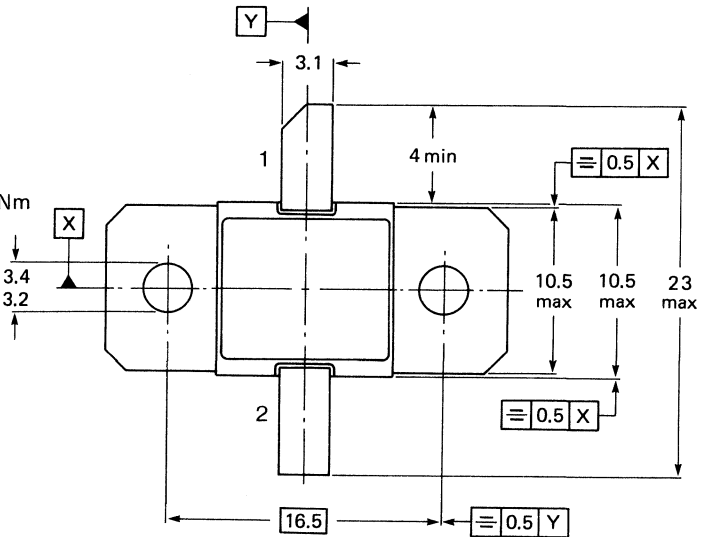


Pinning:

- 1 = collector
- 2 = emitter
- 3 = base

Torque on screw: max. 0.5 Nm

Recommended screw: M3



7Z85741.2

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)

$t_p = 100 \mu s, \delta \leq 10\%$

I_C max. 15 A

Total power dissipation up to $T_{mb} = 75 \text{ }^\circ\text{C}$

$t_p = 100 \mu s, \delta \leq 10\%$

P_{tot} max. 450 W

Storage temperature range

T_{stg} -65 to +200 $^\circ\text{C}$

Junction temperature

T_j max. 200 $^\circ\text{C}$

Soldering temperature

at 0.2 mm from the case. $t_{sld} \leq 10 \text{ s}$

T_{sld} max. 235 $^\circ\text{C}$ ←

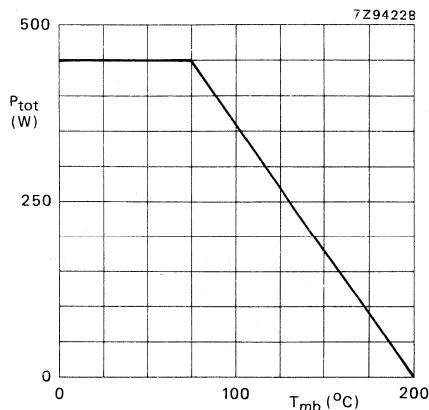


Fig. 2 Power derating curve as a function of mounting base temperature; $t_p = 100 \mu s, \delta = 10\%$.

THERMAL RESISTANCE (at $T_j = 75 \text{ }^\circ\text{C}$)

From junction to mounting base

$R_{th j-mb}$ max. 1.1 K/W

From mounting base to heatsink

$R_{th mb-h}$ max. 0.2 K/W ←

Equivalent thermal impedance; $t_p = 100 \mu s; \delta = 10\%$

Z_{th} max. 0.28 K/W ←

CHARACTERISTICS

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

Breakdown voltages

$I_C = 100 \text{ mA}; I_E = 0$

$V_{(BR)CBO}$ min. 65 V ←

$I_C = 100 \text{ mA}; R_{BE} = 0$

$V_{(BR)CES}$ min. 60 V ←

$I_C = 0; I_E = 15 \text{ mA}$

$V_{(BR)EBO}$ min. 3 V ←

Collector cut-off current

$I_E = 0; V_{CB} = 50 \text{ V}$

I_{CBO} max. 10 mA ←

IMPEDANCES

frequency GHz	input (z_i) Ω	load (Z_L) Ω
1.03	1.9 + j4	1.3 - j1
1.09	2.3 + j4.5	1.1 - j1.8

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25\text{ }^{\circ}\text{C}$ in a class-C narrowband amplifier under pulsed conditions (measured in the test circuit shown in Fig. 4).

mode of operation	f GHz	V _{CC} V	P _L W	G _p dB	η_C %
class-C t _p = 100 μ s; δ = 10%	1.09	50	≥ 200 typ. 250	≥ 7 typ. 7.5	≥ 30 typ. 35

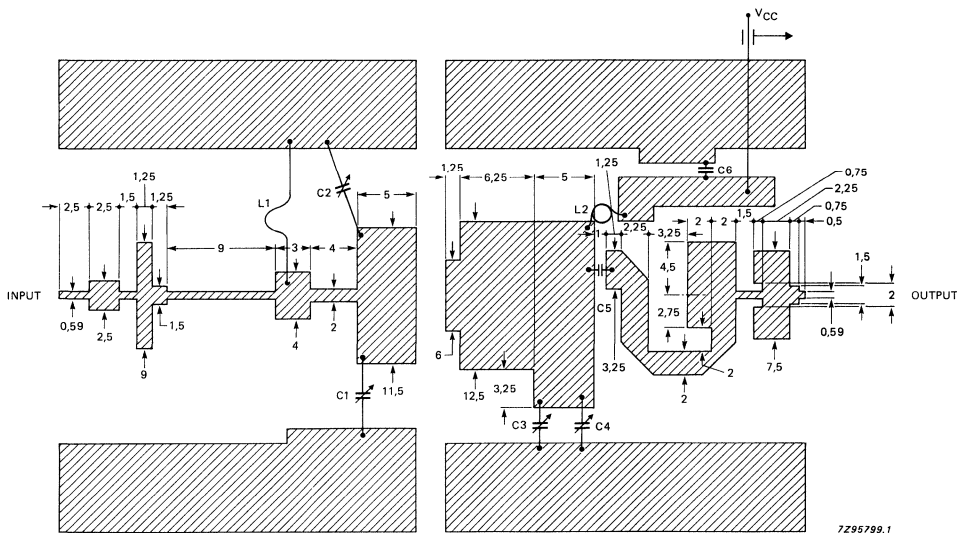


Fig. 3 Narrowband test circuit for 1.09 GHz (dimensions in mm).
Epsilon printed circuit board; thickness 0.635 mm; $\epsilon_r = 10$.

List of components:

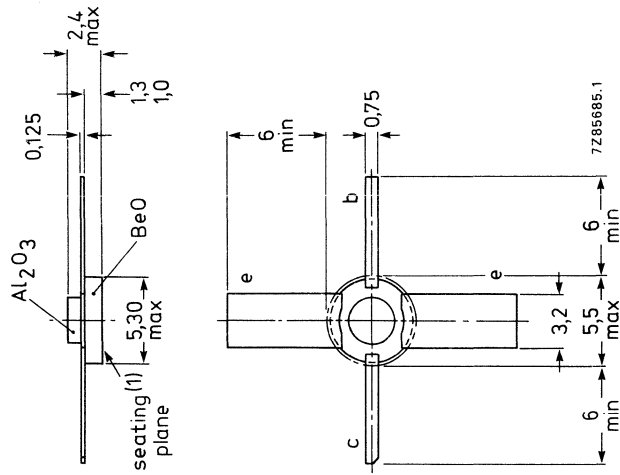
- C1 = C3 0.6 - 8 pF Gigatrim capacitor
- C2 0.8 - 12.3 pF Gigatrim capacitor
- C4 10 pF capacitor
- C5 100 pF ATC capacitor
- C6 1000 pF decoupling capacitor
- L1 Square loop 6 x 6 mm; wire diameter 0.8 mm
- L2 One turn diameter 5 mm; wire diameter 0.5 mm

ENVELOPES

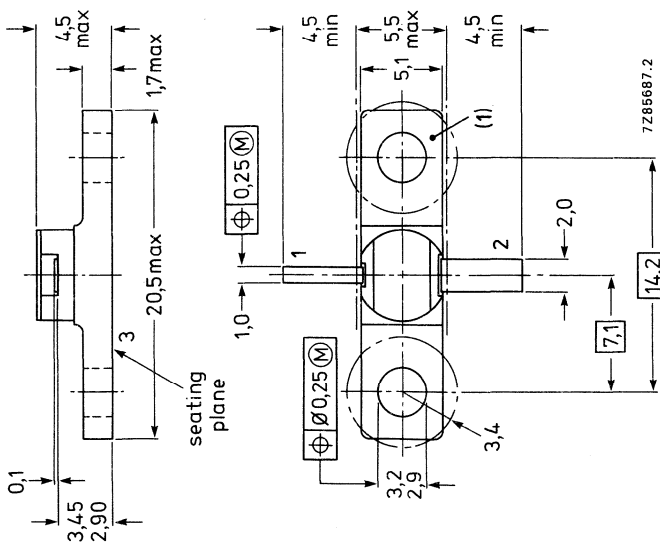
MECHANICAL DATA

Dimensions in mm

FO-45.



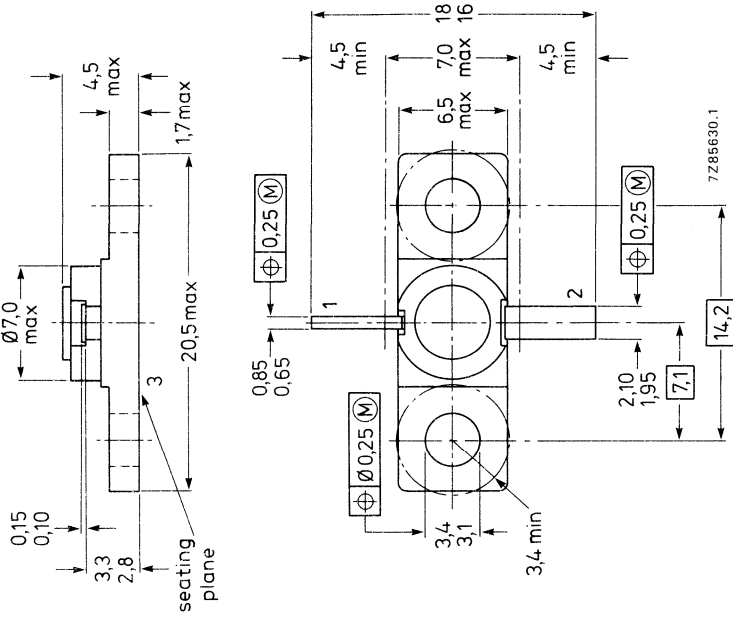
FO-41B.



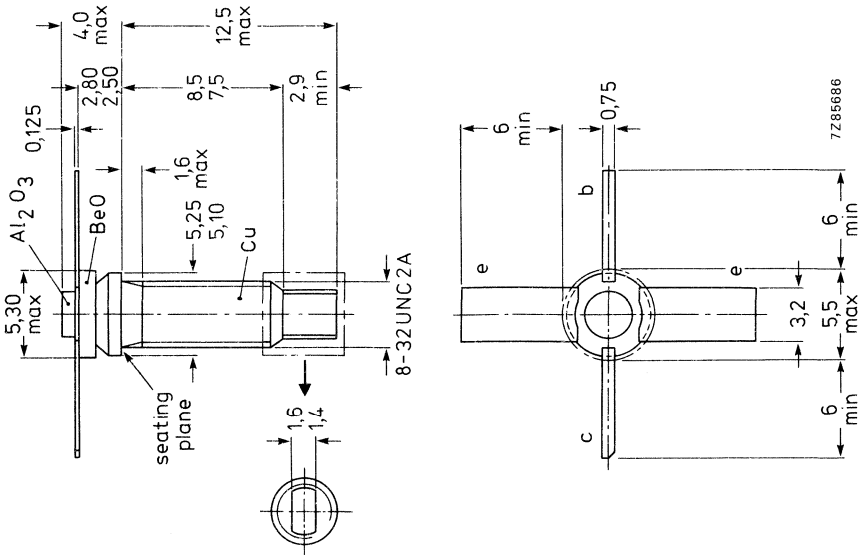
MECHANICAL DATA

Dimensions in mm

FO-53.

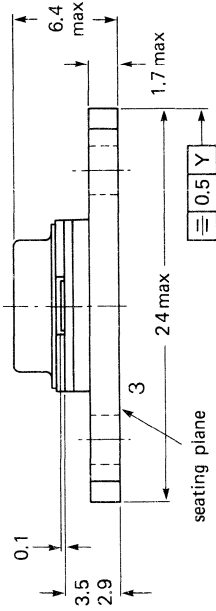


FO-46.

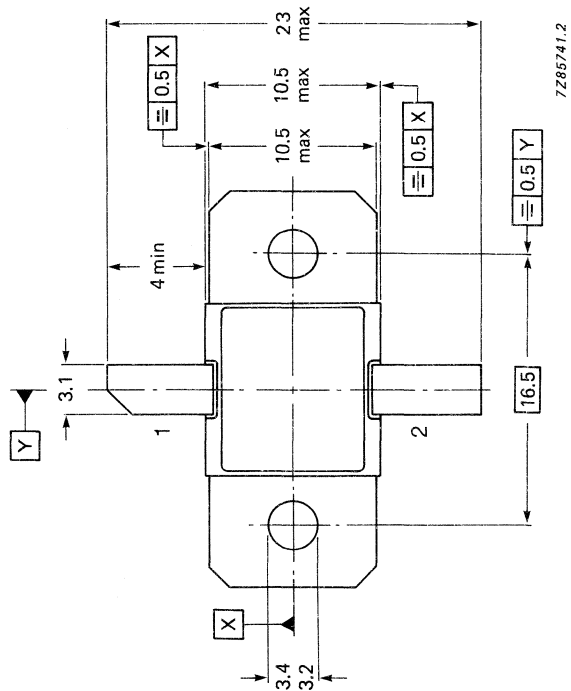
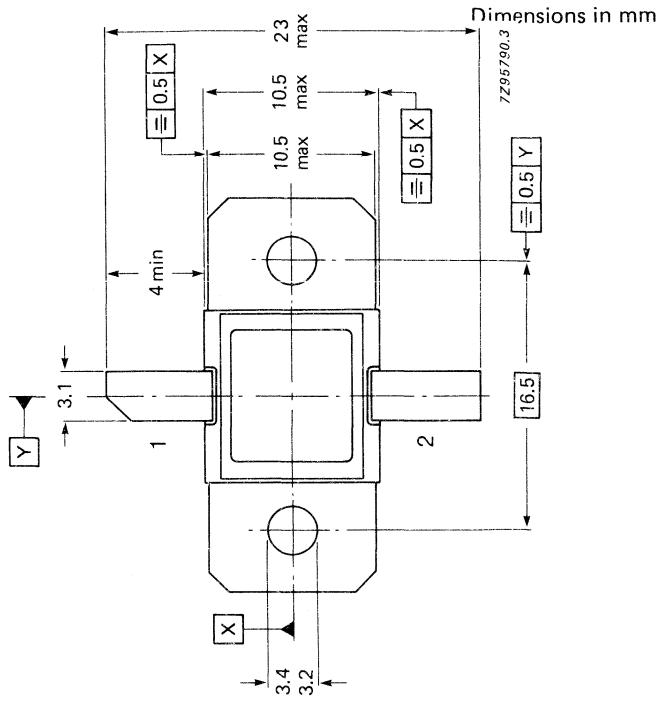
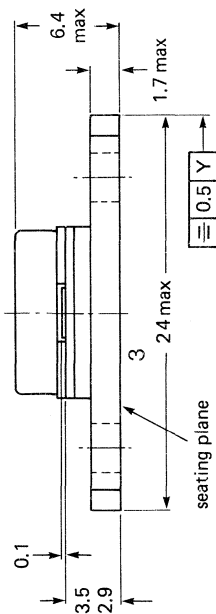


MECHANICAL DATA

FO-57D.



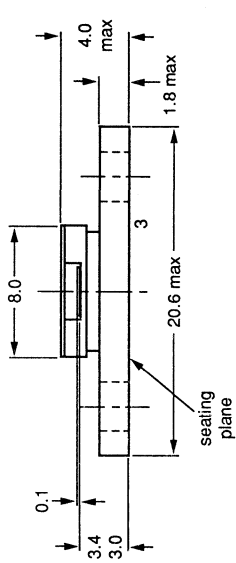
FO-57C.



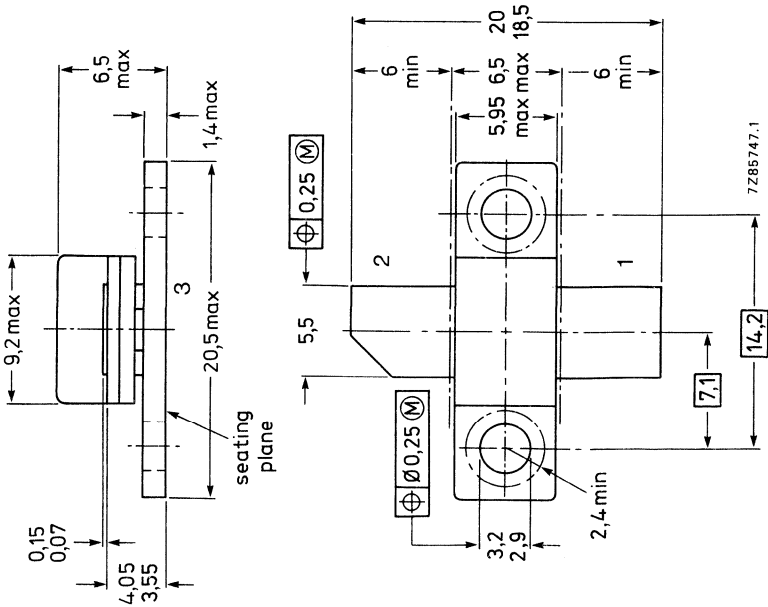
MECHANICAL DATA

Dimensions in mm

FO-83A.



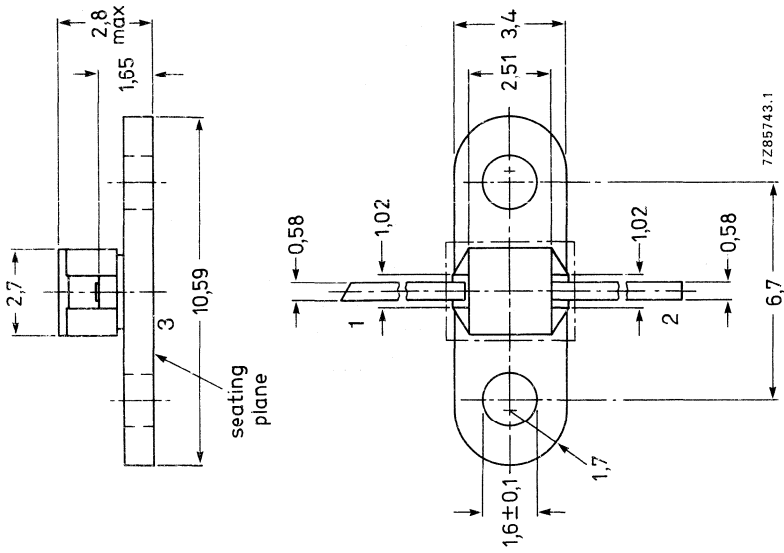
FO-67.



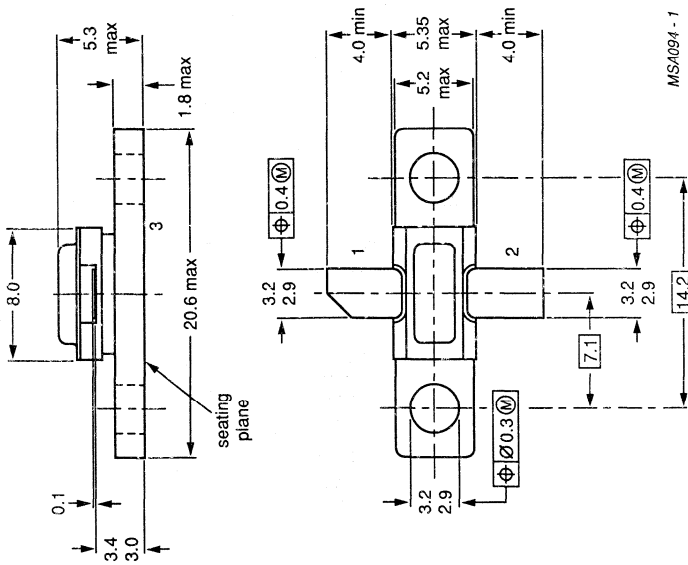
MECHANICAL DATA

Dimensions in mm

FO-85.



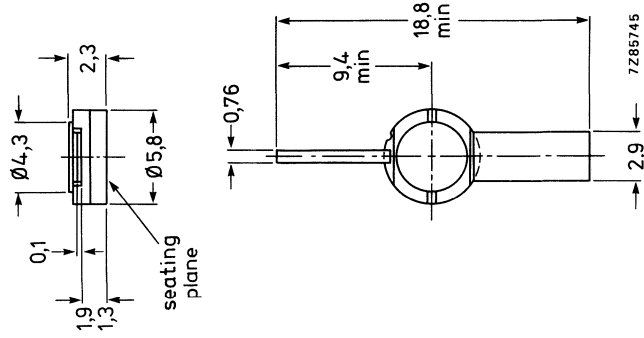
FO-83B.



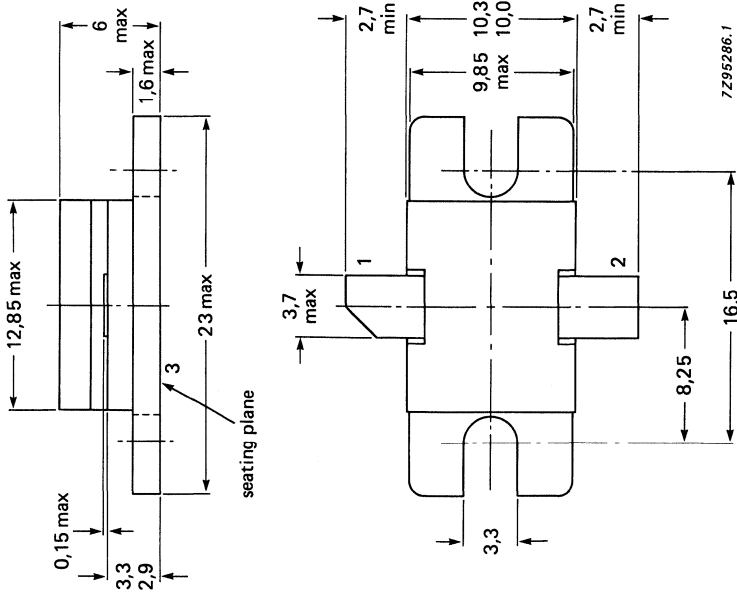
MECHANICAL DATA

Dimensions in mm

FO-93.



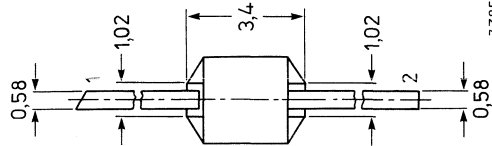
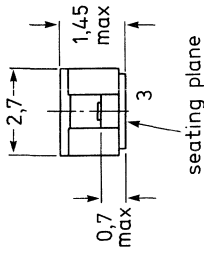
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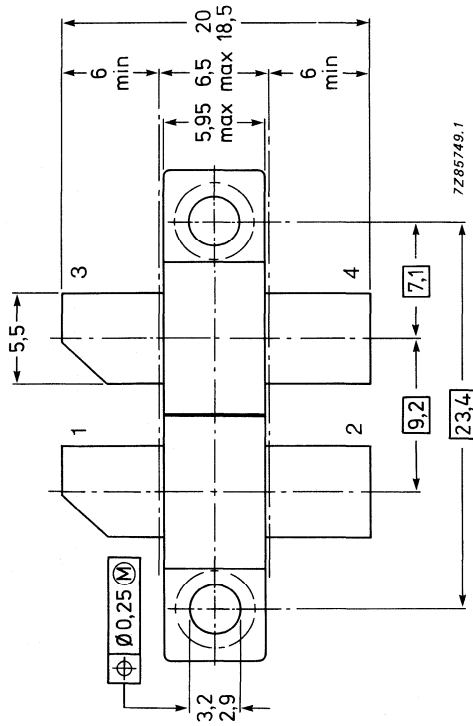
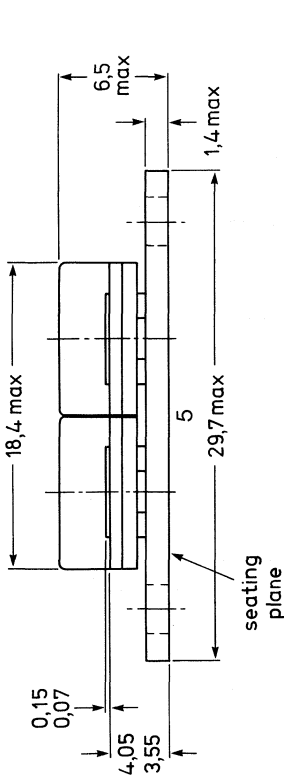
MECHANICAL DATA

Dimensions in mm

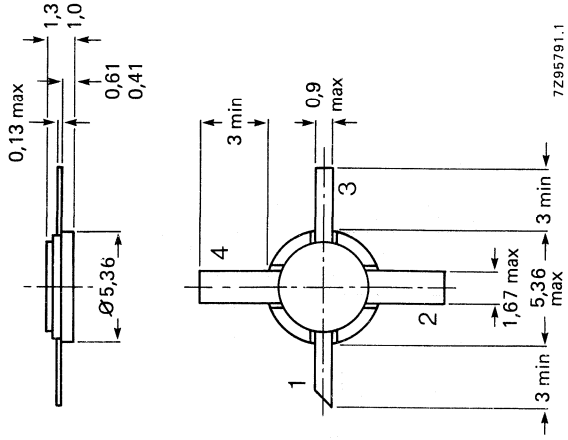
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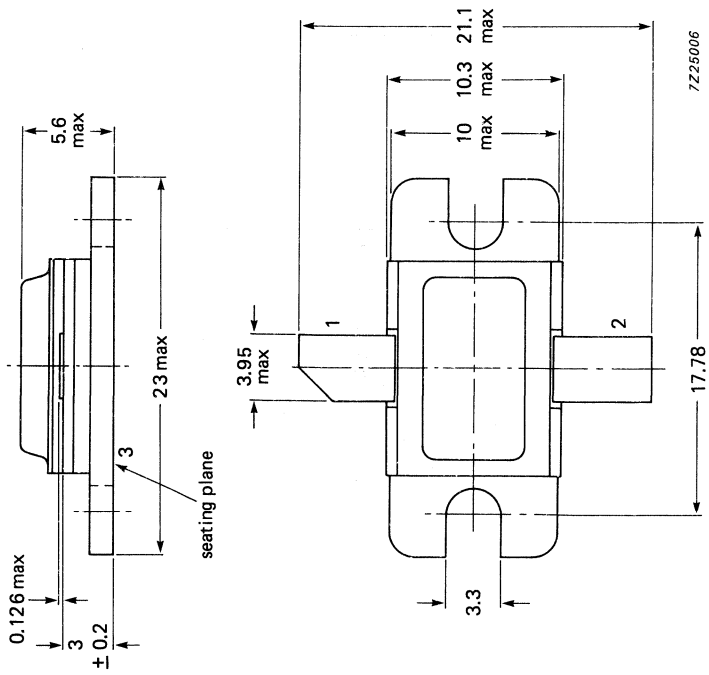
FO-96.



FO-163.



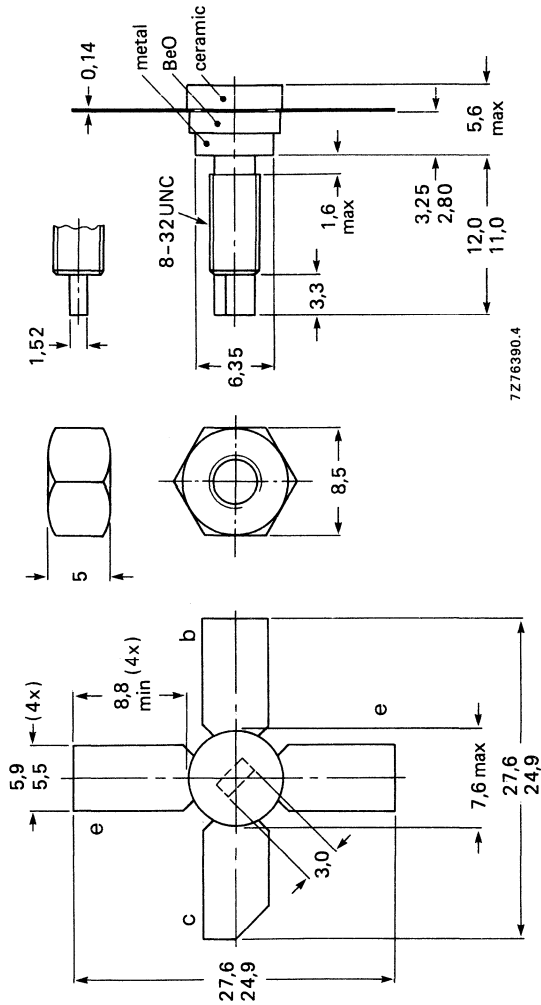
FO-125A.



MECHANICAL DATA

Dimensions in mm

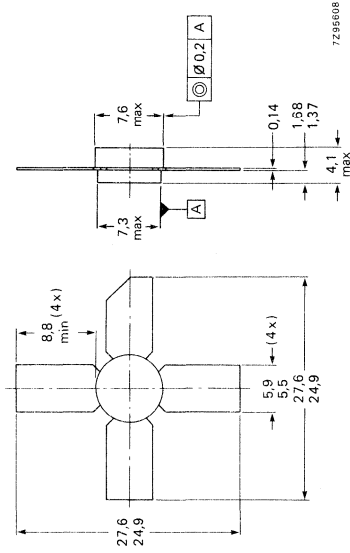
SOT122.



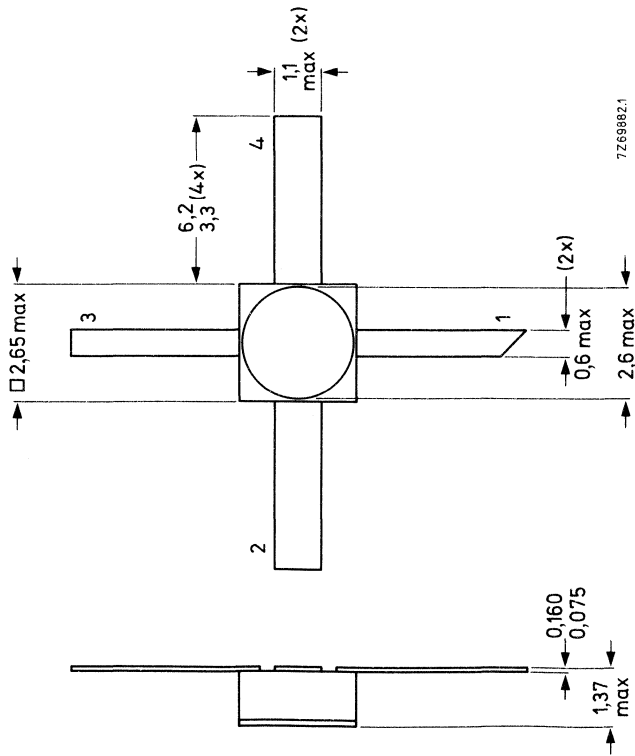
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SOT-100.



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BA223	SC01	T	BAS31	SC01/10	SD/Mm	BAV74	SC01	SD
BA281	SC01	SD	BAS32	SC01/10	SD/Mm	BAV99	SC01/10	SD/Mm
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Key to handbook sections

A = Accessories
 FET = Field-effect transistors
 I = Infrared devices
 LED = Light-emitting diodes
 LCD = Liquid crystal displays
 Mm = Surface-mounted devices
 M = Microwave transistors
 P = Low-frequency power transistors and modules
 PDT = Photodiodes or transistors
 Ph = Photoconductive devices
 PhC = Photocouplers
 PM = Power MOS transistors
 R = Rectifier diodes
 RFP = RF power transistors and modules
 RT = Triplers

Sen = Semiconductor sensors
 SD = Small-signal diodes
 Sm = Small-signal transistors
 Sp = Special diodes
 SP = Low-frequency switching power diodes
 St = Rectifier stacks
 T = Tuner diodes
 Th = Thyristors
 Tri = Triacs
 TS = Transient suppressor diodes
 Vrf = Voltage reference diodes
 Vrg = Voltage regulator diodes
 WBT = Wideband hybrid IC transistors
 WBM = Wideband hybrid IC modules

* series.

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BB809	SC01	T	BC560	SC04	Sm	BCV28	SC10	Mm
BB909A	SC01	T	BC635	SC04	Sm	BCV29	SC10	Mm
BB909B	SC01	T	BC636	SC04	Sm	BCV46	SC10	Mm
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BB911	SC01	T	BC638	SC04	Sm	BCV48	SC10	Mm
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BC141	SC04	Sm	BC849	SC10	Mm	BCV72R	SC10	Mm
BC160	SC04	Sm	BC850	SC10	Mm	BCW29	SC10	Mm
BC161	SC04	Sm	BC856	SC10	Mm	BCW29R	SC10	Mm
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BC338	SC04	Sm	BCF33	SC10	Mm	BCW70	SC10	Mm
BC368	SC04	Sm	BCF33R	SC10	Mm	BCW70R	SC10	Mm
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BCY87	SC04	Sm	BD242B	SC05	P	BD652F	SC05	P
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BD944	SC05	P	BDT31AF	SC05	P	BDT61C	SC05	P
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BDT63AF	SC05	P	BDT95	SC05	P	BDX64B	SC05	P
BDT63B	SC05	P	BDT95F	SC05	P	BDX64C	SC05	P
BDT63BF	SC05	P	BDT96	SC05	P	BDX65	SC05	P
BDT63C	SC05	P	BDT96F	SC05	P	BDX65A	SC05	P
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BDT64AF	SC05	P	BDV65	SC05	P	BDX66B	SC05	P
BDT64B	SC05	P	BDV65A	SC05	P	BDX66C	SC05	P
BDT64BF	SC05	P	BDV65B	SC05	P	BDX67	SC05	P
BDT64C	SC05	P	BDV65C	SC05	P	BDX67A	SC05	P
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BDT65C	SC05	P	BDV67D	SC05	P	BDX69A	SC05	P
BDT65CF	SC05	P	BDV91	SC05	P	BDX69B	SC05	P
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BF247C	SC07	FET	BF822	SC10	Mm	BFG195	SC14	WBT
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BF256B	SC07	FET	BF824	SC10	Mm	BFP90A	SC14	WBT
BF256C	SC07	FET	BF840	SC10	Mm	BFP91A	SC14	WBT
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BF410B	SC07	FET	BF939	SC04	Sm	BFQ12	SC07	FET
BF410C	SC07	FET	BF960	SC07	FET	BFQ13	SC07	FET
BF410D	SC07	FET	BF964S	SC07	FET	BFQ14	SC07	FET
BF420	SC04	Sm	BF965	SC07	FET	BFQ15	SC07	FET
BF421	SC04	Sm	BF966S	SC07	FET	BFQ16	SC07	FET
BF422	SC04	Sm	BF967	SC04	Sm	BFQ17	SC14/10	WBT/Mm
BF423	SC04	Sm	BF970	SC04	Sm	BFQ18A	SC14/10	WBT/Mm
BF450	SC04	Sm	BF970A	SC04	Sm	BFQ19	SC14/10	WBT/Mm
BF451	SC04	Sm	BF979	SC04	Sm	BFQ22S	SC14	WBT
BF483	SC04	Sm	BF980	SC07	FET	BFQ23	SC14	WBT
BF485	SC04	Sm	BF980A	SC07	FET	BFQ23C	SC14	WBT
BF487	SC04	Sm	BF981	SC07	FET	BFQ24	SC14	WBT
BF494	SC04	Sm	BF982	SC07	FET	BFQ32	SC14	WBT
BF495	SC04	Sm	BF989	SC07/10	FET/Mm	BFQ32C	SC14	WBT
BF496	SC04	Sm	BF990A	SC07/10	FET/Mm	BFQ32M	SC14	WBT
BF510	SC07/10	FET/Mm	BF990AR	SC07/10	FET/Mm	BFQ32S	SC14	WBT
BF511	SC07/10	FET/Mm	BF991	SC07/10	FET/Mm	BFQ33	SC14	WBT
BF512	SC07/10	FET/Mm	BF992	SC07/10	FET/Mm	BFQ33C	SC14	WBT
BF513	SC07/10	FET/Mm	BF992R	SC07/10	FET/Mm	BFQ34	SC14	WBT
BF550	SC10	Mm	BF994S	SC07/10	FET/Mm	BFQ34T	SC14	WBT
BF550R	SC10	Mm	BF994SR	SC07/10	FET/Mm	BFQ42	SC08	RFP
BF569	SC10	Mm	BF996S	SC07/10	FET/Mm	BFQ43	SC08	RFP
BF570	SC10	Mm	BF996SR	SC07/10	FET/Mm	BFQ43S	SC08	RFP
BF579	SC10	Mm	BF997	SC07/10	FET/Mm	BFQ51	SC14	WBT
BF620	SC10	Mm	BFG23	SC14	WBT	BFQ51C	SC14	WBT
BF621	SC10	Mm	BFG32	SC14	WBT	BFQ52	SC14	WBT
BF622	SC10	Mm	BFG34	SC14	WBT	BFQ53	SC14	WBT
BF623	SC10	Mm	BFG35	SC14/10	WBT/Mm	BFQ63	SC14	WBT
BF660	SC10	Mm	BFG51	SC14	WBT	BFQ65	SC14	WBT
BF660R	SC10	Mm	BFG65	SC14	WBT	BFQ66	SC14	WBT
BF689K	SC14	WBT	BFG67	SC14/10	WBT/Mm	BFQ67	SC14/10	WBT/Mm
BF720	SC10	Mm	BFG90A	SC14	WBT	BFQ68	SC14	WBT
BF721	SC10	Mm	BFG91A	SC14	WBT	BFQ136	SC14	WBT
BF722	SC10	Mm	BFG92A	SC14	WBT	BFR29	SC07	FET
BF723	SC10	Mm	BFG93A	SC14	WBT	BFR30	SC07/10	FET/Mm
BF763	SC14	WBT	BFG96	SC14	WBT	BFR31	SC07/10	FET/Mm

Type no.	book	section	Type no.	book	section	Type no.	book	section
BFR49	SC14	WBT	BFW30	SC14	WBT	BGY49B	SC09	RFP
BFR53	SC14/10	WBT/Mm	BFW61	SC07	FET	BGY50	SC14	WBM
BFR54	SC04	Sm	BFW92	SC14	WBT	BGY51	SC14	WBM
BFR64	SC14	WBT	BFW92A	SC14	WBT	BGY52	SC14	WBM
BFR65	SC14	WBT	BFW93	SC14	WBT	BGY53	SC14	WBM
BFR84	SC07	FET	BFX34	SC04	Sm	BGY54	SC14	WBM
BFR90	SC14	WBT	BFX89	SC14	WBT	BGY55	SC14	WBM
BFR90A	SC14	WBT	BFY50	SC04	Sm	BGY56	SC14	WBM
BFR91	SC14	WBT	BFY51	SC04	Sm	BGY57	SC14	WBM
BFR91A	SC14	WBT	BFY52	SC04	Sm	BGY58	SC14	WBM
BFR92	SC14/10	WBT/Mm	BFY55	SC04	Sm	BGY58A	SC14	WBM
BFR92A	SC14/10	WBT/Mm	BFY90	SC14	WBT	BGY59	SC14	WBM
BFR93	SC14/10	WBT/Mm	BG2000	SC01	RT	BGY60	SC14	WBM
BFR93A	SC14/10	WBT/Mm	BG2097	SC01	RT	BGY61	SC14	WBM
BFR94	SC14	WBT	BGD102	SC14	WBM	BGY65	SC14	WBM
BFR95	SC14	WBT	BGD102E	SC14	WBM	BGY67	SC14	WBM
BFR96	SC14	WBT	BGD104	SC14	WBM	BGY67A	SC14	WBM
BFR96S	SC14	WBT	BGD104E	SC14	WBM	BGY70	SC14	WBM
BFR101A	SC07/10	FET/Mm	BGD502	SC14	WBM	BGY71	SC14	WBM
BFR101B	SC07/10	FET/Mm	BGD504	SC14	WBM	BGY74	SC14	WBM
BFS17	SC14/10	WBT	BGX885	SC14	WBM	BGY75	SC14	WBM
BFS17A	SC14	WBT	BGY22	SC09	RFP	BGY78	SC14	WBM
BFS18	SC10	Mm	BGY22A	SC09	RFP	BGY84	SC14	WBM
BFS18R	SC10	Mm	BGY23	SC09	RFP	BGY84A	SC14	WBM
BFS19	SC10	Mm	BGY23A	SC09	RFP	BGY85	SC14	WBM
BFS19R	SC10	Mm	BGY32	SC09	RFP	BGY85A	SC14	WBM
BFS20	SC10	Mm	BGY33	SC09	RFP	BGY86	SC14	WBM
BFS20R	SC10	Mm	BGY35	SC09	RFP	BGY87	SC14	WBM
BFS21	SC07	FET	BGY36	SC09	RFP	BGY88	SC14	WBM
BFS21A	SC07	FET	BGY40A	SC09	RFP	BGY90A	SC09	RFP
BFS22A	SC08	RFP	BGY40B	SC09	RFP	BGY90B	SC09	RFP
BFS23A	SC08	RFP	BGY41A	SC09	RFP	BGY91A	SC09	RFP
BFT24	SC14	WBT	BGY41B	SC09	RFP	BGY91B	SC09	RFP
BFT25	SC14/10	WBT/Mm	BGY43	SC09	RFP	BGY93A	SC09	RFP
BFT44	SC04	Sm	BGY45A	SC09	RFP	BGY93B	SC09	RFP
BFT45	SC04	Sm	BGY45B	SC09	RFP	BGY93C	SC09	RFP
BFT46	SC07/10	FET/Mm	BGY45C	SC09	RFP	BGY94A	SC09	RFP
BFT92	SC14/10	WBT/Mm	BGY46A	SC09	RFP	BGY94B	SC09	RFP
BFT93	SC14/10	WBT/Mm	BGY46B	SC09	RFP	BGY94C	SC09	RFP
BFW10	SC07	FET	BGY47A	SC09	RFP	BGY95A	SC09	RFP
BFW11	SC07	FET	BGY47F	SC09	RFP	BGY95B	SC09	RFP
BFW12	SC07	FET	BGY48A	SC09	RFP	BGY96A	SC09	RFP
BFW13	SC07	FET	BGY48B	SC09	RFP	BGY96B	SC09	RFP
BFW16A	SC14	WBT	BGY48C	SC09	RFP	BGY110A	SC09	RFP
BFW17A	SC14	WBT	BGY49A	SC09	RFP	BGY110B	SC09	RFP

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BGY584A	SC14	WBM	BLV25	SC08	RFP	BLW89	SC08	RFP
BGY585A	SC14	WBM	BLV30	SC08	RFP	BLW90	SC08	RFP
BGY586	SC14	WBM	BLV30/12	SC08	RFP	BLW91	SC08	RFP
BGY587	SC14	WBM	BLV31	SC08	RFP	BLW95	SC08	RFP
BLF145	SC08	RFP/FET	BLV32F	SC08	RFP	BLW96	SC08	RFP
BLF147	SC08	RFP/FET	BLV33	SC08	RFP	BLW97	SC08	RFP
BLF175	SC08	RFP/FET	BLV33F	SC08	RFP	BLW98	SC08	RFP
BLF177	SC08	RFP/FET	BLV36	SC08	RFP	BLW99	SC08	RFP
BLF221	SC08	RFP/FET	BLV37	SC08	RFP	BLX13	SC08	RFP
BLF241	SC08	RFP/FET	BLV38	SC08	RFP	BLX13C	SC08	RFP
BLF242	SC08	RFP/FET	BLV45/12	SC08	RFP	BLX14	SC08	RFP
BLF244	SC08	RFP/FET	BLV57	SC08	RFP	BLX15	SC08	RFP
BLF245	SC08	RFP/FET	BLV59	SC08	RFP	BLX39	SC08	RFP
BLF246	SC08	RFP/FET	BLV75/12	SC08	RFP	BLX65	SC08	RFP
BLF278	SC08	RFP/FET	BLV80/28	SC08	RFP	BLX65E	SC08	RFP
BLF368	SC08	RFP/FET	BLV90	SC08	RFP	BLX65ES	SC08	RFP
BLF378	SC08	RFP/FET	BLV90/SL	SC08	RFP	BLX67	SC08	RFP
BLF521	SC08	RFP/FET	BLV91	SC08	RFP	BLX68	SC08	RFP
BLF522	SC08	RFP/FET	BLV91/SL	SC08	RFP	BLX69A	SC08	RFP
BLF543	SC08	RFP/FET	BLV92	SC08	RFP	BLX91A	SC08	RFP
BLF544	SC08	RFP/FET	BLV93	SC08	RFP	BLX91CB	SC08	RFP
BLF545	SC08	RFP/FET	BLV94	SC08	RFP	BLX92A	SC08	RFP
BLF547	SC08	RFP/FET	BLV95	SC08	RFP	BLX93A	SC08	RFP
BLF548	SC08	RFP/FET	BLV97	SC08	RFP	BLX94A	SC08	RFP
BLT90/SL	SC08	RFP	BLV98	SC08	RFP	BLX94C	SC08	RFP
BLT91/SL	SC08	RFP	BLV99	SC08	RFP	BLX95	SC08	RFP
BLT92/SL	SC08	RFP	BLW29	SC08	RFP	BLX96	SC08	RFP
BLT93/SL	SC08	RFP	BLW31	SC08	RFP	BLX97	SC08	RFP
BLU20/12	SC08	RFP	BLW32	SC08	RFP	BLX98	SC08	RFP
BLU30/12	SC08	RFP	BLW33	SC08	RFP	BLY87A	SC08	RFP
BLU30/28	SC08	RFP	BLW34	SC08	RFP	BLY87C	SC08	RFP
BLU45/12	SC08	RFP	BLW50F	SC08	RFP	BLY88A	SC08	RFP
BLU50	SC08	RFP	BLW60	SC08	RFP	BLY88C	SC08	RFP
BLU51	SC08	RFP	BLW60C	SC08	RFP	BLY89A	SC08	RFP
BLU52	SC08	RFP	BLW76	SC08	RFP	BLY89C	SC08	RFP
BLU53	SC08	RFP	BLW77	SC08	RFP	BLY90	SC08	RFP
BLU60/12	SC08	RFP	BLW78	SC08	RFP	BLY91A	SC08	RFP
BLU60/28	SC08	RFP	BLW79	SC08	RFP	BLY91C	SC08	RFP
BLU97	SC08	RFP	BLW80	SC08	RFP	BLY92A	SC08	RFP
BLU98	SC08	RFP	BLW81	SC08	RFP	BLY92C	SC08	RFP
BLU99	SC08	RFP	BLW83	SC08	RFP	BLY93A	SC08	RFP
BLV10	SC08	RFP	BLW84	SC08	RFP	BLY93C	SC08	RFP
BLV11	SC08	RFP	BLW85	SC08	RFP	BLY94	SC08	RFP
BLV20	SC08	RFP	BLW86	SC08	RFP	BR100/03	SC03	Th
BLV21	SC08	RFP	BLW87	SC08	RFP	BR101	SC04	Sm

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BR210*	SC02	R	BSP51	SC10	Mm	BSR62	SC04	Sm
BR211*	SC02	R	BSP52	SC10	Mm	BSR111	SC07/10	FET/Mm
BR213*	SC02	R	BSP60	SC10	Mm	BSR112	SC07/10	FET/Mm
BR216*	SC02	R	BSP61	SC10	Mm	BSR113	SC07/10	FET/Mm
BR220*	SC02	R	BSP62	SC10	Mm	BSR174	SC07/10	FET/Mm
BRY39	SC04	Sm	BSP204	SC07	FET	BSR175	SC07/10	FET/Mm
BRY56	SC04	Sm	BSP204A	SC07	FET	BSR176	SC07/10	FET/Mm
BRY61	SC10	Mm	BSR12	SC10	Mm	BSR177	SC07/10	FET/Mm
BRY62	SC10	Mm	BSR12R	SC10	Mm	BSS38	SC04	Sm
BS107	SC07	FET	BSR13	SC10	Mm	BSS50	SC04	Sm
BS107A	SC07	FET	BSR13R	SC10	Mm	BSS51	SC04	Sm
BS170	SC07	FET	BSR14	SC10	Mm	BSS52	SC04	Sm
BS250	SC07	FET	BSR14R	SC10	Mm	BSS60	SC04	Sm
BSD10	SC07	FET	BSR15	SC10	Mm	BSS61	SC04	Sm
BSD12	SC07	FET	BSR15R	SC10	Mm	BSS62	SC04	Sm
BSD20	SC07/10	FET/m	BSR16	SC10	Mm	BSS63	SC10	Mm
BSD22	SC07/10	FET/M	BSR16R	SC10	Mm	BSS63R	SC10	Mm
BSD212	SC07	FET	BSR17	SC10	Mm	BSS64	SC10	Mm
BSD213	SC07	FET	BSR17R	SC10	Mm	BSS64R	SC10	Mm
BSD214	SC07	FET	BSR17A	SC10	Mm	BSS68	SC04	Sm
BSD215	SC07	FET	BSR17AR	SC10	Mm	BSS83	SC07/10	FET/Mm
BSJ111	SC07	FET	BSR18	SC10	Mm	BSS87	SC07	FET
BSJ112	SC07	FET	BSR18R	SC10	Mm	BSS89	SC07	FET
BSJ113	SC07	FET	BSR18A	SC10	Mm	BSS91	SC07	FET
BSJ174	SC07	FET	BSR18AR	SC10	Mm	BSS92	SC07	FET
BSJ175	SC07	FET	BSR19	SC10	Mm	BST15	SC10	Mm
BSJ176	SC07	FET	BSR19A	SC10	Mm	BST16	SC10	Mm
BSJ177	SC07	FET	BSR20	SC10	Mm	BST39	SC10	Mm
BSN205	SC07	FET	BSR20A	SC10	Mm	BST40	SC10	Mm
BSN205A	SC07	FET	BSR30	SC10	Mm	BST50	SC10	Mm
BSN254	SC07	FET	BSR31	SC10	Mm	BST51	SC10	Mm
BSN254A	SC07	FET	BSR32	SC10	Mm	BST52	SC10	Mm
BSP15	SC10	Mm	BSR33	SC10	Mm	BST60	SC10	Mm
BSP16	SC10	Mm	BSR40	SC10	Mm	BST61	SC10	Mm
BSP19	SC10	Mm	BSR41	SC10	Mm	BST62	SC10	Mm
BSP20	SC10	Mm	BSR42	SC10	Mm	BST70A	SC07	FET
BSP30	SC10	Mm	BSR43	SC10	Mm	BST72A	SC07	FET
BSP31	SC10	Mm	BSR50	SC04	Sm	BST74A	SC07	FET
BSP32	SC10	Mm	BSR51	SC04	Sm	BST76A	SC07	FET
BSP33	SC10	Mm	BSR52	SC04	Sm	BST78	SC07	FET
BSP40	SC10	Mm	BSR56	SC07/10	FET/Mm	BST80	SC07/10	FET/Mm
BSP41	SC10	Mm	BSR57	SC07/10	FET/Mm	BST82	SC07/10	FET/Mm
BSP42	SC10	Mm	BSR58	SC07/10	FET/Mm	BST84	SC07/10	FET/Mm
BSP43	SC10	Mm	BSR60	SC04	Sm	BST86	SC07/10	FET/Mm
BSP50	SC10	Mm	BSR61	SC04	Sm	BST95	SC07	FET

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BST97	SC07	FET	BT169*	SC03	Th	BUS133*	SC06	SP
BST100	SC07	FET	BT169W*	SC03	Th	BUT11	SC06	SP
BST110	SC07	FET	BTA140*	SC03	Tri	BUT11A	SC06	SP
BST120	SC07/10	FET/Mm	BTR59*	SC03	Tri	BUT11F	SC06	SP
BST122	SC07/10	FET/Mm	BTS59*	SC03	Tri	BUT11AF	SC06	SP
BSV15	SC04	Sm	BTW58*	SC03	Th	BUT12	SC06	SP
BSV16	SC04	Sm	BTW38*	SC03	Th	BUT12A	SC06	SP
BSV17	SC04	Sm	BTW40*	SC03	Th	BUT12F	SC06	SP
BSV52	SC10	Mm	BTW42*	SC03	Th	BUT12AF	SC06	SP
BSV52R	SC10	Mm	BTW43*	SC03	Tri	BUT18	SC06	SP
BSV64	SC04	Sm	BTW45*	SC03	Th	BUT18A	SC06	SP
BSV78	SC07	FET	BTW58*	SC03	Th	BUT18F	SC06	SP
BSV79	SC07	FET	BTY79*	SC03	Th	BUT18AF	SC06	SP
BSV80	SC07	FET	BTY91*	SC03	Th	BUT21B	SC06	SP
BSV81	SC07	FET	BU306	SC06	SP	BUT21C	SC06	SP
BSW66A	SC04	Sm	BU306F	SC06	SP	BUT21BF	SC06	SP
BSW67A	SC04	Sm	BU505	SC06	SP	BUT21CF	SC06	SP
BSW68A	SC04	Sm	BU506	SC06	SP	BUT22B	SC06	SP
BSX19	SC04	Sm	BU506D	SC06	SP	BUT22C	SC06	SP
BSX20	SC04	Sm	BU508A	SC06	SP	BUT22BF	SC06	SP
BSX32	SC04	Sm	BU508D	SC06	SP	BUT22CF	SC06	SP
BSX45	SC04	Sm	BU705	SC06	SP	BUT131	SC06	SP
BSX46	SC04	Sm	BU706	SC06	SP	BUV26	SC06	SP
BSX47	SC04	Sm	BU706D	SC06	SP	BUV26A	SC06	SP
BSX59	SC04	Sm	BU806	SC06	SP	BUV26F	SC06	SP
BSX60	SC04	Sm	BU807	SC06	SP	BUV26AF	SC06	SP
BSX61	SC04	Sm	BU808	SC06	SP	BUV27	SC06	SP
BT134*	SC03	Tri	BU824	SC06	SP	BUV27A	SC06	SP
BT134W*	SC03	Tri	BU826	SC06	SP	BUV27F	SC06	SP
BT136*	SC03	Tri	BUP22*	SC06	SP	BUV27AF	SC06	SP
BT136F*	SC03	Tri	BUP23*	SC06	SP	BUV28	SC06	SP
BT137*	SC03	Tri	BUS11	SC06	SP	BUV28A	SC06	SP
BT137F*	SC03	Tri	BUS11A	SC06	SP	BUV28F	SC06	SP
BT138*	SC03	Tri	BUS12	SC06	SP	BUV28AF	SC06	SP
BT138F*	SC03	Tri	BUS12A	SC06	SP	BUV47	SC06	SP
BT139*	SC03	Tri	BUS13	SC06	SP	BUV47A	SC06	SP
BT139F*	SC03	Tri	BUS13A	SC06	SP	BUV48	SC06	SP
BT145*	SC03	Tri	BUS14	SC06	SP	BUV48A	SC06	SP
BT148*	SC03	Th	BUS14A	SC06	SP	BUV82	SC06	SP
BT149*	SC03	Th	BUS21*	SC06	SP	BUV83	SC06	SP
BT150	SC03	Th	BUS22*	SC06	SP	BUV89	SC06	SP
BT151*	SC03	Th	BUS23*	SC06	SP	BUV90	SC06	SP
BT151F*	SC03	Th	BUS24*	SC06	SP	BUV90F	SC06	SP
BT152*	SC03	Th	BUS131*	SC06	SP	BUV98(V)	SC06	SP
BT153	SC03	Th	BUS132*	SC06	SP	BUV98A	SC06	SP

Type no.	book	section	Type no.	book	section	Type no.	book	section
BUV298(V)	SC06	SP	BUZ24	S9	PM	BUZ311	S9	PM
BUV298A	SC06	SP	BUZ25	S9	PM	BUZ326	S9	PM
BUW11	SC06	SP	BUZ31	S9	PM	BUZ330	S9	PM
BUW11A	SC06	SP	BUZ32	S9	PM	BUZ331	S9	PM
BUW12	SC06	SP	BUZ34	S9	PM	BUZ347	S9	PM
BUW12A	SC06	SP	BUZ35	S9	PM	BUZ348	S9	PM
BUW12F	SC06	SP	BUZ36	S9	PM	BUZ349	S9	PM
BUW12AF	SC06	SP	BUZ41A	S9	PM	BUZ350	S9	PM
BUW13	SC06	SP	BUZ42	S9	PM	BUZ351	S9	PM
BUW13A	SC06	SP	BUZ45	S9	PM	BUZ355	S9	PM
BUW13F	SC06	SP	BUZ45A	S9	PM	BUZ356	S9	PM
BUW13AF	SC06	SP	BUZ45B	S9	PM	BUZ357	S9	PM
BUW84	SC06	SP	BUZ50A	S9	PM	BUZ358	S9	PM
BUW85	SC06	SP	BUZ50B	S9	PM	BUZ384	S9	PM
BUW86	SC06	SP	BUZ50C	S9	PM	BUZ385	S9	PM
BUW87	SC06	SP	BUZ53A	S9	PM	BY228	SC01	R
BUW87A	SC06	SP	BUZ54	S9	PM	BY229*	SC02	R
BUW131*	SC06	SP	BUZ54A	S9	PM	BY229F*	SC02	R
BUW132*	SC06	SP	BUZ60	S9	PM	BY249*	SC02	R
BUW133*	SC06	SP	BUZ63	S9	PM	BY249F*	SC02	R
BUX46	SC06	SP	BUZ64	S9	PM	BY260*	SC02	R
BUX46A	SC06	SP	BUZ71	S9	PM	BY328	SC01	SD
BUX47	SC06	SP	BUZ71A	S9	PM	BY329*	SC02	R
BUX47A	SC06	SP	BUZ72	S9	PM	BY359*	SC02	R
BUX48	SC06	SP	BUZ72A	S9	PM	BY359F	SC02	R
BUX48A	SC06	SP	BUZ73	S9	PM	BY438	SC01	R
BUX84	SC06	SP	BUZ73A	S9	PM	BY448	SC01	R
BUX84F	SC06	SP	BUZ74	S9	PM	BY458	SC01	R
BUX85	SC06	SP	BUZ74A	S9	PM	BY505	SC01	R
BUX85F	SC06	SP	BUZ76	S9	PM	BY509	SC01	R
BUX86	SC06	SP	BUZ76A	S9	PM	BY527	SC01	R
BUX87	SC06	SP	BUZ78	S9	PM	BY584	SC01	R
BUX88	SC06	SP	BUZ80	S9	PM	BY588	SC01	R
BUX98	SC06	SP	BUZ80A	S9	PM	BY609	SC01	R
BUX98A	SC06	SP	BUZ83	S9	PM	BY610	SC01	R
BUX99	SC06	SP	BUZ83A	S9	PM	BY614	SC01	R
BUY89	SC06	SP	BUZ84	S9	PM	BY619	SC01	R
BUZ10	S9	PM	BUZ84A	S9	PM	BY620	SC01	R
BUZ11	S9	PM	BUZ90	S9	PM	BY627	SC01	R
BUZ11A	S9	PM	BUZ90A	S9	PM	BY705	SC01	R
BUZ14	S9	PM	BUZ94	S9	PM	BY706	SC01	R
BUZ15	S9	PM	BUZ211	S9	PM	BY707	SC01	R
BUZ20	S9	PM	BUZ307	S9	PM	BY708	SC01	R
BUZ21	S9	PM	BUZ308	S9	PM	BY709	SC01	R
BUZ23	S9	PM	BUZ310	S9	PM	BY710	SC01	R

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BY711	SC01	R	BYV26*	SC01	R	BYW95C	SC01	R
BY712	SC01	R	BYV27*	SC01	R	BYW96D	SC01	R
BY713	SC01	R	BYV28*	SC01	R	BYW96E	SC01	R
BY714	SC01	R	BYV29*	SC02	R	BYX10G	SC01	R
BY715	SC01	R	BYV29F*	SC02	R	BYX25*	SC02	R
BY716	SC01	R	BYV30*	SC02	R	BYX30*	SC02	R
BY717	SC01	R	BYV31*	SC02	R	BYX38*	SC02	R
BY718	SC01	R	BYV32*	SC02	R	BYX39*	SC02	R
BY719	SC01	R	BYV32F*	SC02	R	BYX42*	SC02	R
BY720	SC01	R	BYV34*	SC02	R	BYX46*	SC02	R
BY721	SC01	R	BYV36*	SC01	R	BYX52*	SC02	R
BY722	SC01	R	BYV42*	SC02	R	BYX56*	SC02	R
BY723	SC01	R	BYV44*	SC02	R	BYX90G	SC01	R
BY724	SC01	R	BYV54V	SC02	R	BYX96*	SC02	R
BYD11*	SC01	R	BYV72*	SC02	R	BYX97*	SC02	R
BYD13*	SC01	R	BYV72F*	SC02	R	BYX98*	SC02	R
BYD14*	SC01	R	BYV74*	SC02	R	BYX99*	SC02	R
BYD17*	SC01/10	R/Mm	BYV74F*	SC02	R	BZD23	SC01	Vrg
BYD31*	SC01	R	BYV79*	SC02	R	BZD27	SC01/10	Vrg/Mm
BYD33*	SC01	R	BYV92*	SC02	R	BZT03	SC01	Vrg
BYD34*	SC01	R	BYV95A	SC01	R	BZV10	SC01	Vrf
BYD37*	SC01/10	R/Mm	BYV95B	SC01	R	BZV11	SC01	Vrf
BYD73*	SC01	R	BYV95C	SC01	R	BZV12	SC01	Vrf
BYD74*	SC01	R	BYV96D	SC01	R	BZV13	SC01	Vrf
BYD77*	SC01	R	BYV96E	SC01	R	BZV14	SC01	Vrf
BYM26*	SC01	R	BYV118*	SC02	R	BZV37	SC01	Vrf
BYM36*	SC01	R	BYV118F*	SC02	R	BZV49*	SC01/10	Vrg/Mm
BYM56*	SC01	R	BYV120*	SC02	R	BZV55*	SC10	Mm
BYP20*	SC02	R	BYV121*	SC02	R	BZV60	SC01	Vrg
BYP21*	SC02	R	BYV133*	SC02	R	BZV80	SC01	Vrf
BYP22*	SC02	R	BYV133F*	SC02	R	BZV81	SC01	Vrf
BYQ27*	SC01	R	BYV143*	SC02	R	BZV85*	SC01	Vrg
BYQ28*	SC02	R	BYV143F*	SC02	R	BZV86	SC01	SD
BYQ28F*	SC02	R	BYW25*	SC02	R	BZW03*	SC01	Vrg
BYR28*	SC02	R	BYW29*	SC02	R	BZW14	SC01	Vrg
BYR29*	SC02	R	BYW29F*	SC02	R	BZW86*	SC02	TS
BYR29F*	SC02	R	BYW30*	SC02	R	BZX55*	SC01	Vrg
BYR30*	SC02	R	BYW31*	SC02	R	BZX70*	SC02	Vrg
BYR34*	SC02	R	BYW54	SC01	R	BZX75*	SC01	Vrg
BYR79*	SC02	R	BYW55	SC01	R	BZX79*	SC01	Vrg
BYT28*	SC02	R	BYW56	SC01	R	BZX84*	SC01/10	Vrg/Mm
BYT79*	SC02	R	BYW92*	SC02	R	BZY91*	SC02	Vrg
BYT230PIV	SC02	R	BYW93*	SC02	R	BZY93*	SC02	Vrg
BYV10*	SC01	R	BYW95A	SC01	R	CNG35	SC12	PhC
BYV24*	SC02	R	BYW95B	SC01	R	CNG36	SC12	PhC

Type no.	book	section	Type no.	book	section	Type no.	book	section
CNG40	SC12	PhC	H11A4	SC12	PhC	LTE42005S	SC15	M
CNG82	SC12	PhC	H11A5	SC12	PhC	LTE42008R	SC15	M
CNG83	SC12	PhC	H11B1	SC12	PhC	LTE42012R	SC15	M
CNR36	SC12	PhC	H11B2	SC12	PhC	LUE2003S	SC15	M
CNS35	SC12	PhC	H11B3	SC12	PhC	LUE2009S	SC15	M
CNW82	SC12	PhC	H11B255	SC12	PhC	LV1721E50R	SC15	M
CNW83	SC12	PhC	KGZ10	SC17	SEN	LV2024E45R	SC15	M
CNX21	SC12	PhC	KGZ20	SC17	SEN	LV2327E40R	SC15	M
CNX35	SC12	PhC	KGZ21	SC17	SEN	LV2931E50S	SC15	M
CNX35U	SC12	PhC	KMZ10A	SC17	SEN	LVE21050R	SC15	M
CNX36	SC12	PhC	KMZ10A1	SC17	SEN	LWE2015R	SC15	M
CNX36U	SC12	PhC	KMZ10B	SC17	SEN	LWE2025R	SC15	M
CNX38	SC12	PhC	KMZ10C	SC17	SEN	LZ1418E100R	SC15	M
CNX38U	SC12	PhC	KP100A	SC17	SEN	LZE18100R	SC15	M
CNX39	SC12	PhC	KP100A1	SC17	SEN	MCA230	SC12	PhC
CNX39U	SC12	PhC	KP101A	SC17	SEN	MCA231	SC12	PhC
CNX48	SC12	PhC	KP130AE	SC17	SEN	MCA255	SC12	PhC
CNX48U	SC12	PhC	KP131AE	SC17	SEN	MCT2	SC12	PhC
CNX62	SC12	PhC	KPZ20G	SC17	SEN	MCT26	SC12	PhC
CNX62A	SC12	PhC	KPZ21G	SC17	SEN	MJE13004	SC06	SP
CNX71	SC12	PhC	KPZ21GE	SC17	SEN	MJE13005	SC06	SP
CNX72A	SC12	PhC	KRX10	SC17	SEN	MJE13006	SC06	SP
CNX82A	SC12	PhC	KRX11	SC17	SEN	MJE13007	SC06	SP
CNX83A	SC12	PhC	KTY81-100*	SC17	SEN	MJE13008	SC06	SP
CNY17-1	SC12	PhC	KTY81-200*	SC17	SEN	MJE13009	SC06	SP
CNY17-2	SC12	PhC	KTY83-100*	SC17	SEN	MPS6513	SC04	Sm
CNY17-3	SC12	PhC	KTY84-100*	SC17	SEN	MPS6514	SC04	Sm
CNY17-4	SC12	PhC	KTY85-100*	SC10/17	SEN	MPS6515	SC04	Sm
CQW58A	S8a	I	KTY86-205	SC17	SEN	MPS6517	SC04	Sm
CQW89A	S8a	I	KTY87-205	SC17	SEN	MPS6518	SC04	Sm
CQW89B	S8a	I	LAE4001R	SC15	M	MPS6519	SC04	Sm
CQY58A	S8a	I	LAE4002S	SC15	M	MPS6520	SC04	Sm
CQY89A	S8a	I	LAE6000Q	SC15	M	MPS6521	SC04	Sm
CQY89F	S8a	I	LBE2003S	SC15	M	MPS6522	SC04	Sm
ESM3045A(V)	SC06	SP	LBE2009S	SC15	M	MPS6523	SC04	Sm
ESM3045D(V)	SC06	SP	LCE2003S	SC15	M	MPSA05	SC04	Sm
ESM4045A(V)	SC06	SP	LCE2009S	SC15	M	MPSA06	SC04	Sm
ESM4045D(V)	SC06	SP	LJE42002T	SC15	M	MPSA13	SC04	Sm
ESM5045D(V)	SC06	SP	LKE21004R	SC15	M	MPSA14	SC04	Sm
ESM6045A(V)	SC06	SP	LKE21015T	SC15	M	MPSA42	SC04	Sm
ESM6045D(V)	SC06	SP	LKE21050T	SC15	M	MPSA43	SC04	Sm
Fresnel-lens	SC12	A	LTE21009R	SC15	M	MPSA55	SC04	Sm
H11A1	SC12	PhC	LTE21015R	SC15	M	MPSA56	SC04	Sm
H11A2	SC12	PhC	LTE21025R	SC15	M	MPSA63	SC04	Sm
H11A3	SC12	PhC	LTE4002S	SC15	M	MPSA64	SC04	Sm

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MPSA92	SC04	Sm	PBYR735/40/45	SC02	R	PLED-H313A	S8a	LED
MPSA93	SC04	Sm	PBYR735/40/45F	SC02	R	PLED-H314A	S8a	LED
MRB11175Y	SC15	M	PBYR1035/40/45	SC02	R	PLED-H511C	S8a	LED
MRB11350Y	SC15	M	PBYR1035/40/45F	SC02	R	PLED-H514B	S8a	LED
MSB11900Y	SC15	M	PBYR1535/40/45CT	SC02	R	PLED-H544KL	S8a	LED
MX0912B250Y	SC15	M	PBYR1535/40/45CTF	SC02	R	PLED-H544LL	S8a	LED
MX0912B350Y	SC15	M	PBYR1635/40/45	SC02	R	PLED-HR14E	S8a	LED
MZ0912B50Y	SC15	M	PBYR1635/40/45F	SC02	R	PLED-HR14F	S8a	LED
MZ0912B100Y	SC15	M	PBYR2035/40/45CT	SC02	R	PLED-HR14G	S8a	LED
OM286	SC17	SEN	PBYR2035/40/45CTF	SC02	R	PLED-HR44DL	S8a	LED
OM286M	SC17	SEN	PBYR2535/40/45CT	SC02	R	PLED-0313N	S8a	LED
OM287	SC17	SEN	PBYR2535/40/45CTF	SC02	R	PLED-0314N	S8a	LED
OM287M	SC17	SEN	PBYR3035/40/45PT	SC02	R	PLED-0513M	S8a	LED
OM320	SC14	WBM	PBYR12035/40/45TV	SC02	R	PLED-0514M	S8a	LED
OM321	SC14	WBM	PBYR16035/40/45TV	SC02	R	PLED-P313N	S8a	LED
OM322	SC14	WBM	PBYR30035/40/45CT	SC02	R	PLED-P314N	S8a	LED
OM323	SC14	WBM	PBYR40035/40/45CT	SC02	R	PLED-P513M	S8a	LED
OM323A	SC14	WBM	PH2222/A	SC04	Sm	PLED-P514M	S8a	LED
OM335	SC14	WBM	PH2369	SC04	Sm	PLED-T512B	S8a	LED
OM336	SC14	WBM	PH2907	SC04	Sm	PLED-TR12E	S8a	LED
OM337	SC14	WBM	PH2907A	SC04	Sm	PLED-TR12F	S8a	LED
OM337A	SC14	WBM	PH5415	SC04	Sm	PLED-TR12G	S8a	LED
OM339	SC14	WBM	PH5416	SC04	Sm	PLED-TR42DL	S8a	LED
OM345	SC14	WBM	PH6659	SC07	FET	PLED-Y313A	S8a	LED
OM350	SC14	WBM	PH6660	SC07	FET	PLED-Y313N	S8a	LED
OM360	SC14	WBM	PH6661	SC07	FET	PLED-Y314A	S8a	LED
OM361	SC14	WBM	PH13002	SC06	SP	PLED-Y314N	S8a	LED
OM370	SC14	WBM	PH13003	SC06	SP	PLED-Y511C	S8a	LED
OM386B	SC17	SEN	PKB12005U	SC15	M	PLED-Y513C	S8a	LED
OM386M	SC17	SEN	PKB20010U	SC15	M	PLED-Y513M	S8a	LED
OM387B	SC17	SEN	PLED-G313A	S8a	LED	PLED-Y514B	S8a	LED
OM387M	SC17	SEN	PLED-G313N	S8a	LED	PLED-Y514M	S8a	LED
OM388B	SC17	SEN	PLED-G314A	S8a	LED	PLED-Y544KL	S8a	LED
OM389B	SC17	SEN	PLED-G314N	S8a	LED	PLED-Y544LL	S8a	LED
OM390	SC17	SEN	PLED-G511C	S8a	LED	PLED-YR14E	S8a	LED
OM391	SC17	SEN	PLED-G513C	S8a	LED	PLED-YR14F	S8a	LED
OM931	SC05	P	PLED-G513M	S8a	LED	PLED-YR14G	S8a	LED
OM961	SC05	P	PLED-G514B	S8a	LED	PLED-YR44DL	S8a	LED
OM2860	SC17	SEN	PLED-G514M	S8a	LED	PMBD914	SC01	SD
OM2870	SC17	SEN	PLED-G544KL	S8a	LED	PMBD2835	SC01	SD
OSB/M/S9115*	SC02	St	PLED-G544LL	S8a	LED	PMBD2836	SC01	SD
OSB/M/S9215*	SC02	St	PLED-GR14E	S8a	LED	PMBD2837	SC01	SD
OSB/M/S9415*	SC02	St	PLED-GR14F	S8a	LED	PMBD2838	SC01	SD
OSM9510-12	SC02	St	PLED-GR14G	S8a	LED	PMBD6050	SC01	SD
PBYR635/40/45CT	SC02	R	PLED-GR44DL	S8a	LED	PMBD6100	SC01	SD

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PMBD7000	SC01	SD	PMLL5267B	SC01/10	SD/Mm	PZ2024B20U	SC15	M
PMBF170	SC07/10	FET/Mm	PN2222	SC04	Sm	PZ2327B15U	SC15	M
PMBF4391	SC07/10	FET/Mm	PN2222A	SC04	Sm	PZB16035U	SC15	M
PMBF4392	SC07/10	FET/Mm	PN2369	SC04	Sm	PZB16040U	SC15	M
PMBF4393	SC07/10	FET/Mm	PN2907	SC04	Sm	PZB27020U	SC15	M
PMBFJ174	SC07/10	FET/Mm	PN2907A	SC04	Sm	PZT2222	SC10	Mm
PMBJF175	SC07/10	FET/Mm	PN3439	SC04	Sm	PZT2222A	SC10	Mm
PMBJF176	SC07/10	FET/Mm	PN3440	SC04	Sm	PZT2907	SC10	Mm
PMBJF177	SC07/10	FET/Mm	PN4391	SC07	FET	PZT2907A	SC10	Mm
PMBT2222	SC10	Mm	PN4392	SC07	FET	PZT3904	SC10	Mm
PMBT2222A	SC10	Mm	PN4393	SC07	FET	PZT3906	SC10	Mm
PMBT2369	SC10	Mm	PN5415	SC04	Sm	PZTA13	SC10	Mm
PMBT2907	SC10	Mm	PN5416	SC04	Sm	PZTA14	SC10	Mm
PMBT2907A	SC10	Mm	PO44	SC12	PhC	PZTA42	SC10	Mm
PMBT3903	SC10	Mm	PO44A	SC12	PhC	PZTA43	SC10	Mm
PMBT3904	SC10	Mm	PPC5001T	SC15	M	PZTA63	SC10	Mm
PMBT3906	SC10	Mm	PQC5001T	SC15	M	PZTA64	SC10	Mm
PMBT4401	SC10	Mm	PTB23001X	SC15	M	PZTA92	SC10	Mm
PMBT4403	SC10	Mm	PTB23003X	SC15	M	PZTA93	SC10	Mm
PMBT5088	SC10	Mm	PTB23005X	SC15	M	RPW100	SC17	SEN
PMBT5401	SC10	Mm	PTB32001X	SC15	M	RPW101	SC17	SEN
PMBT5550	SC10	Mm	PTB32003X	SC15	M	RPW102	SC17	SEN
PMBT5551	SC10	Mm	PTB32005X	SC15	M	RPY98A	SC17	SEN
PMBT6428	SC10	Mm	PTB42001X	SC15	M	RPY98C	SC17	SEN
PMBT6429	SC10	Mm	PTB42002X	SC15	M	RPY98F	SC17	SEN
PMBTA05	SC10	Mm	PTB42003X	SC15	M	RPY98G	SC17	SEN
PMBTA06	SC10	Mm	PVB42004X	SC15	M	RPY98S	SC17	SEN
PMBTA13	SC10	Mm	PXB16050U	SC15	M	RPY99A	SC17	SEN
PMBTA14	SC10	Mm	PXT2222	SC10	Mm	RPY99C	SC17	SEN
PMBTA42	SC10	Mm	PXT2222A	SC10	Mm	RPY99D	SC17	SEN
PMBTA43	SC10	Mm	PXT2907	SC10	Mm	RPY99F	SC17	SEN
PMBTA55	SC10	Mm	PXT2907A	SC10	Mm	RPY99G	SC17	SEN
PMBTA56	SC10	Mm	PXT3904	SC10	Mm	RPY99S	SC17	SEN
PMBTA63	SC10	Mm	PXT3906	SC10	Mm	RPY99P/P5206	SC17	SEN
PMBTA64	SC10	Mm	PXT4401	SC10	Mm	RPY100	SC17	SEN
PMBTA92	SC10	Mm	PXT4403	SC10	Mm	RPY102	SC17	SEN
PMBTA93	SC10	Mm	PXTA14	SC10	Mm	RPY104A	SC17	SEN
PMBZ5226	SC01	SD	PXTA27	SC10	Mm	RPY104C	SC17	SEN
PMLL4148	SC01/10	SD/Mm	PXTA64	SC10	Mm	RPY104D	SC17	SEN
PMLL4150	SC10/10	SD/Mm	PXTA77	SC10	Mm	RPY104F	SC17	SEN
PMLL4151	SC10/10	SD/Mm	PZ1418B15U	SC15	M	RPY104G	SC17	SEN
PMLL4153	SC10/10	SD/Mm	PZ1418B30U	SC15	M	RPY104S	SC17	SEN
PMLL4446	SC10/10	SD/Mm	PZ1721B12U	SC15	M	RPY105P/P5206	SC17	SEN
PMLL4448	SC10/10	SD/Mm	PZ1721B25U	SC15	M	RPY107	SC17	SEN
PMLL5225B to	SC10/10	SD/Mm	PZ2024B10U	SC15	M	RPY108P/P5211	SC17	SEN

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RPY109	SC17	SEN	TIP117	SC05	P	1N4004G	SC01	R
RPY109B/P2105	SC17	SEN	TIP120	SC05	P	1N4005G	SC01	R
RPY222	SC17	SEN	TIP121	SC05	P	1N4006G	SC01	R
RV3135B5X	SC15	M	TIP122	SC05	P	1N4007G	SC01	R
RX1011B350Y	SC15	M	TIP125	SC05	P	1N4148	SC01	SD
RX1214B150Y	SC15	M	TIP126	SC05	P	1N4150	SC01	SD
RX1214B300Y	SC15	M	TIP127	SC05	P	1N4151	SC01	SD
RX2731B90W	SC15	M	TIP130	SC05	P	1N4153	SC01	SD
RX3034B70W	SC15	M	TIP131	SC05	P	1N4446	SC01	SD
RXB12350Y	SC15	M	TIP132	SC05	P	1N4448	SC01	SD
RZ1214B35Y	SC15	M	TIP135	SC05	P	1N4531	SC01	SD
RZ1214B65Y	SC15	M	TIP136	SC05	P	1N4532	SC01	SD
RZ2731B16W	SC15	M	TIP137	SC05	P	1N4933	SC01	R
RZ2731B32W	SC15	M	TIP140	SC05	P	1N5059	SC01	R
RZ2731B48W	SC15	M	TIP141	SC05	P	1N5060	SC01	R
RZ2731B60W	SC15	M	TIP142	SC05	P	1N5061	SC01	R
RZ3135B14W	SC15	M	TIP145	SC05	P	1N5062	SC01	R
RZ3135B28W	SC15	M	TIP146	SC05	P	1N5225 to	SC01	R
RZ3135B42W	SC15	M	TIP147	SC05	P	1N5267B	SC01	R
RZ3135B50W	SC15	M	TIP2955	SC05	P	2N918	SC14	WBT
RZB12050Y	SC15	M	TIP2955T	SC05	P	2N930	SC04	Sm
RZB12100Y	SC15	M	TIP3055	SC05	P	2N1613	SC04	Sm
RZB12250Y	SC15	M	TIP3055T	SC05	P	2N1711	SC04	Sm
SL5500	SC12	PhC	1N821	SC01	Vrf	2N1893	SC04	Sm
SL5501	SC12	PhC	1N821A	SC01	Vrf	2N2219	SC04	Sm
SL5504	SC12	PhC	1N823	SC01	Vrf	2N2219A	SC04	Sm
SL5505S	SC12	PhC	1N823A	SC01	Vrf	2N2222	SC04	Sm
SL5511	SC12	PhC	1N825	SC01	Vrf	2N2222A	SC04	Sm
TIP29*	SC05	P	1N825A	SC01	Vrf	2N2297	SC04	Sm
TIP30*	SC05	P	1N827	SC01	Vrf	2N2369	SC04	Sm
TIP31*	SC05	P	1N827A	SC01	Vrf	2N2369A	SC04	Sm
TIP32*	SC05	P	1N829	SC01	Vrf	2N2483	SC04	Sm
TIP33*	SC05	P	1N829A	SC01	Vrf	2N2484	SC04	Sm
TIP34*	SC05	P	1N914	SC01	SD	2N2904	SC04	Sm
TIP41*	SC05	P	1N916	SC01	SD	2N2904A	SC04	Sm
TIP42*	SC05	P	1N4001D	SC01	R	2N2905	SC04	Sm
TIP47	SC06	P	1N4002D	SC01	R	2N2905A	SC04	Sm
TIP48	SC06	P	1N4003D	SC01	R	2N2906	SC04	Sm
TIP49	SC06	P	1N4004D	SC01	R	2N2906A	SC04	Sm
TIP50	SC06	P	1N4005D	SC01	R	2N2907	SC04	Sm
TIP110	SC05	P	1N4006D	SC01	R	2N2907A	SC04	Sm
TIP111	SC05	P	1N4007D	SC01	R	2N3019	SC04	Sm
TIP112	SC05	P	1N4001G	SC01	R	2N3020	SC04	Sm
TIP115	SC05	P	1N4002G	SC01	R	2N3053	SC04	Sm
TIP116	SC05	P	1N4003G	SC01	R	2N3375	SC08	RFP

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2N3553	SC08	RFP	2N5415	SC04	Sm	56360a	SC02/03	A
2N3632	SC08	RFP	2N5416	SC04	Sm	56363	SC02/03	A
2N3822	SC07	FET	2N5550	SC04	Sm	56364	SC02/03	A
2N3823	SC07	FET	2N5551	SC04	Sm	56367	SC02/03	A
2N3866	SC08	RFP	2N6659	SC07	FET	56368b	SC02/03	A
2N3903	SC04	Sm	2N6660	SC07	FET	56368c	SC02/03	A
2N3904	SC04	Sm	2N6661	SC07	FET	56369	SC02/03	A
2N3905	SC04	Sm	4N25	SC12	PhC	56378	SC02/03	A
2N3906	SC04	Sm	4N25A	SC12	PhC	56379	SC02/03	A
2N3924	SC08	RFP	4N26	SC12	PhC	56387a	SC06	A
2N3926	SC08	RFP	4N27	SC12	PhC	56387b	SC06	A
2N3927	SC08	RFP	4N28	SC12	PhC	56397	SC01	A
2N3966	SC07	FET	4N29	SC12	PhC			
2N4030	SC04	Sm	4N30	SC12	PhC			
2N4031	SC04	Sm	4N31	SC12	PhC			
2N4032	SC04	Sm	4N32	SC12	PhC			
2N4033	SC04	Sm	4N33	SC12	PhC			
2N4091	SC07	FET	4N35	SC12	PhC			
2N4092	SC07	FET	4N36	SC12	PhC			
2N4093	SC07	FET	4N37	SC12	PhC			
2N4123	SC04	Sm	4N38	SC12	PhC			
2N4124	SC04	Sm	4N38A	SC12	PhC			
2N4125	SC04	Sm	4N46	SC12	PhC			
2N4126	SC04	Sm	6N135	SC12	PhC			
2N4391	SC07	FET	6N136	SC12	PhC			
2N4392	SC07	FET	56201d	SC06	A			
2N4393	SC07	FET	56201j	SC06	A			
2N4400	SC04	Sm	56245	SC04/14	A			
2N4401	SC04	Sm	56246	SC04/14	A			
2N4402	SC04	Sm	56261a	SC06	A			
2N4403	SC04	Sm	56264	SC03	A			
2N4427	SC08	RFP	56264a	SC02/03	A			
2N4856	SC07	FET	56264b	SC02/03	A			
2N4857	SC07	FET	56295	SC03	A			
2N4858	SC07	FET	56295a	SC02/03	A			
2N4859	SC07	FET	56295b	SC02/03	A			
2N4860	SC07	FET	56295c	SC02/03	A			
2N4861	SC07	FET	56326	SC06	A			
2N5064	SC03	Tri	56339	SC06	A			
2N5086	SC04	Sm	56352	SC06	A			
2N5087	SC04	Sm	56353	SC06/03	A			
2N5088	SC04	Sm	56354	SC06/03	A			
2N5089	SC04	Sm	56359b	SC02/03	A			
2N5400	SC04	Sm	56359c	SC02/03	A			
2N5401	SC04	Sm	56359d	SC02/03	A			

NOTES

DATA HANDBOOK SYSTEM

DATA HANDBOOK SYSTEM

Our Data Handbook System comprises more than 60 books with specifications on electronic components, subassemblies and materials. It is made up of six series of handbooks:

INTEGRATED CIRCUITS

DISCRETE SEMICONDUCTORS

DISPLAY COMPONENTS

PASSIVE COMPONENTS*

PROFESSIONAL COMPONENTS**

MATERIALS*

The contents of each series are listed on pages iii to viii.

The data handbooks contain all pertinent data available at the time of publication, and each is revised and reissued periodically.

When ratings or specifications differ from those published in the preceding edition they are indicated with arrows in the page margin. Where application is given it is advisory and does not form part of the product specification.

Condensed data on the preferred products of Philips Components is given in our Preferred Type Range catalogue (issued annually).

Information on current Data Handbooks and how to obtain a subscription for future issues is available from any of the Organizations listed on the back cover.

Product specialists are at your service and enquiries will be answered promptly.

* Will replace the Components and materials (green) series of handbooks.

** Will replace the Electron tubes (blue) series of handbooks.

INTEGRATED CIRCUITS

This series of handbooks comprises:

code	handbook title
IC01	Radio, audio and associated systems Bipolar, MOS
IC02a/b	Video and associated systems Bipolar, MOS
IC03	ICs for Telecom Bipolar, MOS Subscriber sets, Cordless Telephones
IC04	HE4000B logic family CMOS
IC05	Advanced Low-power Schottky (ALS) Logic Series
IC06	High-speed CMOS; PC74HC/HCT/HCU Logic family
IC07	Advanced CMOS logic (ACL)
IC08	ECL 10K and 100K logic families
IC09	TTL logic series
IC10	Memories MOS, TTL, ECL
IC11	Linear Products
IC12	I²C-bus compatible ICs
IC13	Semi-custom Programmable Logic Devices (PLD)
IC14	Microcontrollers NMOS, CMOS
IC15	FAST TTL logic series
IC16	CMOS integrated circuits for clocks and watches
IC17	ICs for Telecom Bipolar, MOS Radio pagers Mobile telephones ISDN
IC18	Microprocessors and peripherals
IC19	Data communication products

DISCRETE SEMICONDUCTORS

This series of data handbooks comprises:

current code	new code	handbook title
S1	SC01	Diodes High-voltage tripler units
S2a	SC02	Power diodes
S2b	SC03	Thyristors and triacs
S3	SC04	Small-signal transistors
S4a	SC05	Low-frequency power transistors and hybrid IC power modules
S4b	SC06	High-voltage and switching power transistors
S5	SC07	Small-signal field-effect transistors
S6	SC08	RF power transistors
	SC09	RF power modules
S7	SC10	Surface mounted semiconductors
S8a	SC11*	Light emitting diodes
S8b	SC12	Optocouplers
S9	SC13*	PowerMOS transistors
S10	SC14	Wideband transistors and wideband hybrid IC modules
S11	SC15	Microwave transistors
S15**	SC16	Laser diodes
S13	SC17	Semiconductor sensors
S14	SC18*	Liquid crystal displays and driver ICs for LCDs

* Not yet issued with the new code in this series of handbooks.

** New handbook in this series; will be issued shortly.

DISPLAY COMPONENTS

This series of data handbooks comprises:

current code	new code	handbook title
T8	DC01	Colour display components
T16	DC02	Monochrome monitor tubes and deflection units
C2	DC03	Television tuners, coaxial aerial input assemblies
C3	DC04	Loudspeakers
C20	DC05	Flyback transformers, mains transformers and general-purpose FXC assemblies

* These handbooks are currently issued in another series; they are not yet issued in the Display Components series of handbooks.

PASSIVE COMPONENTS

This series of data handbooks comprises:

current code	new code	handbook title
C14	PA01	Electrolytic capacitors; solid and non-solid
C11	PA02	Varistors, thermistors and sensors
C12	PA03	Potentiometers and switches
C7	PA04	Variable capacitors
C22	PA05*	Film capacitors
C15	PA06*	Ceramic capacitors
C9	PA07*	Piezoelectric quartz devices
C13	PA08	Fixed resistors

* Not yet issued with the new code in this series of handbooks.

PROFESSIONAL COMPONENTS

This series of data handbooks comprises:

current code	new code	handbook title
T1	*	Power tubes for RF heating and communications
T2a	*	Transmitting tubes for communications, glass types
T2b	*	Transmitting tubes for communications, ceramic types
T3	PC01	High-power klystrons and accessories
T4	*	Magnetrons for microwave heating
T5	PC02**	Cathode-ray tubes
T6	PC03**	Geiger-Müller tubes
T9	PC04	Photo multipliers
T10	PC05	Plumbicon camera tubes and accessories
T11	PC06	Circulators and Isolators
T12	PC07	Vidicon and Newvicon camera tubes and deflection units
T13	PC08	Image intensifiers
T15	PC09	Dry-reed switches
C8	PC10	Variable mains transformers; annular fixed transformers
	PC11	Solid state image sensors and peripheral integrated circuits
T9	PC12**	Electron multipliers

* These handbooks will not be reissued.

** Not yet issued with the new code in this series of handbooks.

MATERIALS

This series of data handbooks comprises:

current code	new code	handbook title
C4 } C5 }	MA01*	Soft Ferrites
C16	MA02**	Permanent magnet materials
C19	MA03**	Piezoelectric ceramics

* Handbooks C4 and C5 will be reissued as one handbook having the new code MA01.

** Not yet issued with the new code in this series of handbooks.

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Printed in The Netherlands

9398 164 20011

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